YAMAHA

F50F
FT50G
F60C
FT60D

SERVICE MANUAL

290551

6C1-28197-3G-11

NOTICE

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

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

Important information

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

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

⚠ WARNING

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

CAUTION:

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

NOTE:

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

F50F, FT50G, F60C, FT60D
SERVICE MANUAL
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How to use this manual

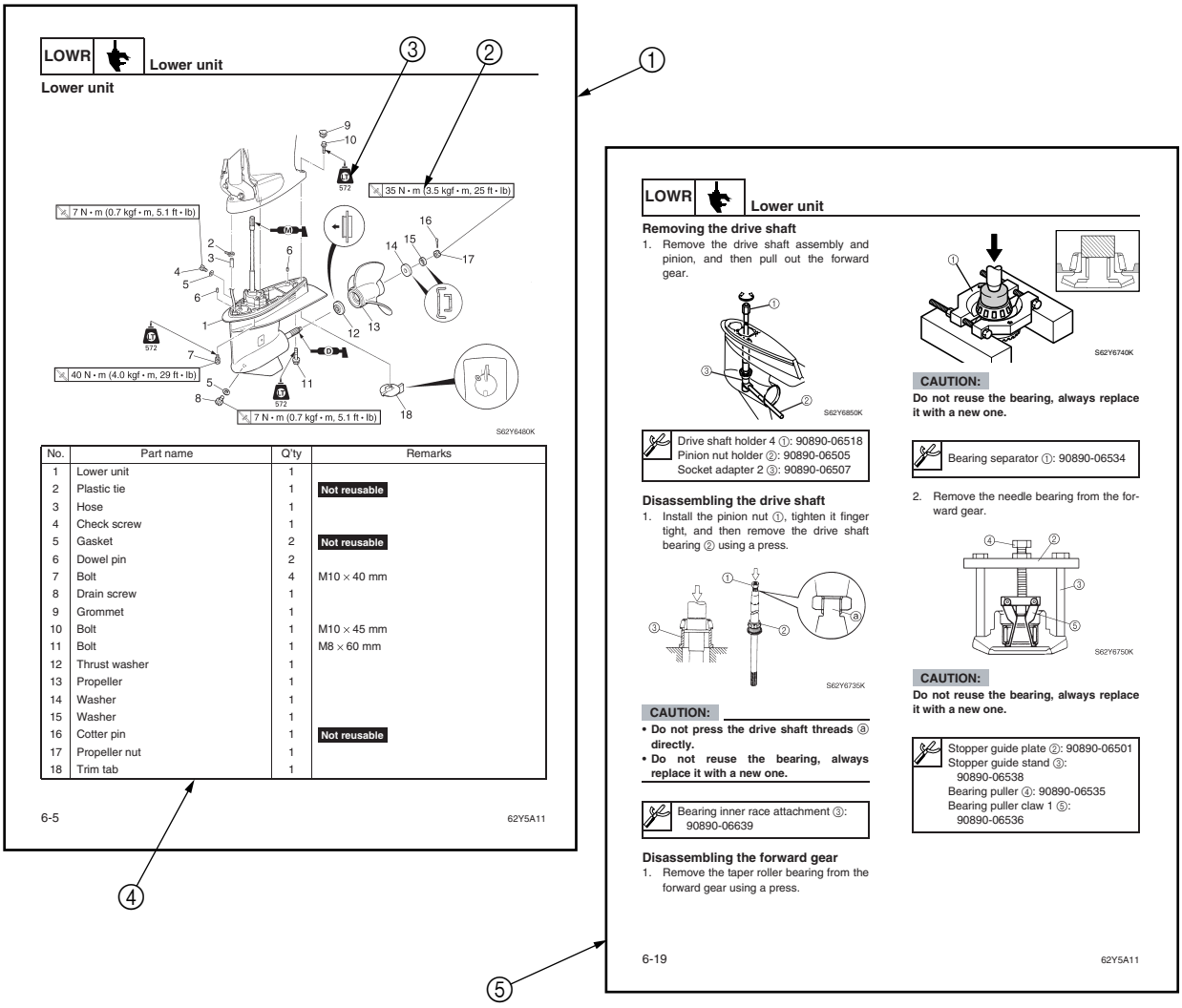
Manual format

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 consists of part names and part quantities, as well as bolt and screw dimensions.
⑤ Service points regarding removal, checking, and installation are shown in individual illustrations to explain the relevant procedure.

NOTE:

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

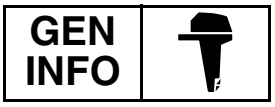


No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plastic tie	1	Not reusable
3	Hose	1	
4	Check screw	1	
5	Gasket	2	Not reusable
6	Dowel pin	2	
7	Bolt	4	M10 × 40 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 × 45 mm
11	Bolt	1	M8 × 60 mm
12	Thrust washer	1	
13	Propeller	1	
14	Washer	1	
15	Washer	1	
16	Cotter pin	1	Not reusable
17	Propeller nut	1	
18	Trim tab	1	

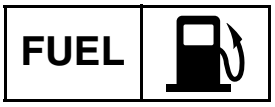
Symbols

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

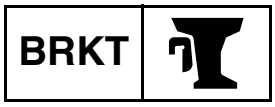
General information



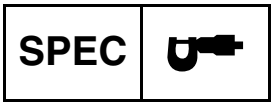
Fuel system



Bracket unit



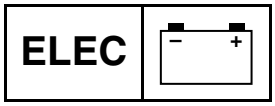
Specifications



Power unit



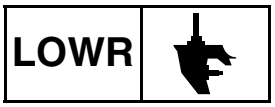
Electrical systems



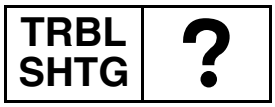
Periodic checks and adjustments



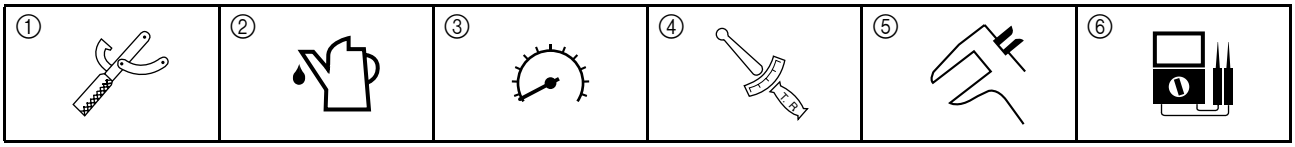
Lower unit



Troubleshooting

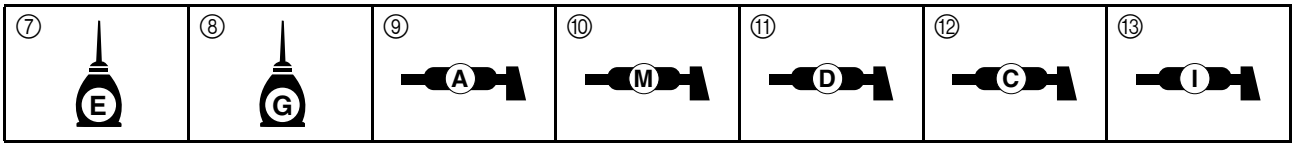


Symbols ① to ⑥ indicate specific data.



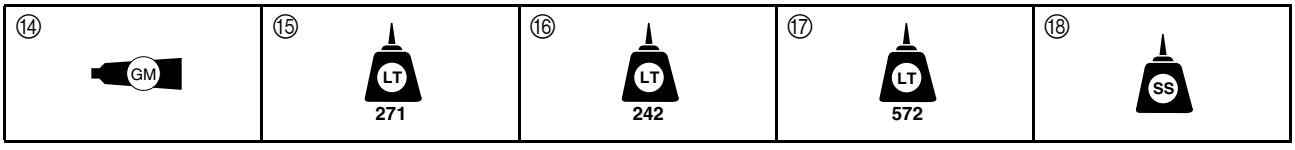
① Special tool
② Specified oil or fluid
③ Specified engine speed
④ Specified tightening torque
⑤ Specified measurement
⑥ Specified electrical value (resistance, voltage, electric current)

Symbols ⑦ to ⑬ in an exploded diagram indicate the grade of lubricant and the lubrication point.



⑦ Apply Yamaha 4-stroke motor oil
⑧ Apply gear oil
⑨ Apply water resistant grease (Yamaha grease A)
⑩ Apply molybdenum disulfide grease
⑪ Apply corrosion resistant grease (Yamaha grease D)
⑫ Apply low temperature resistant grease (Yamaha grease C)
⑬ Apply injector grease

Symbols ⑭ to ⑱ in an exploded diagram indicate the type of sealant or locking agent and the application point.



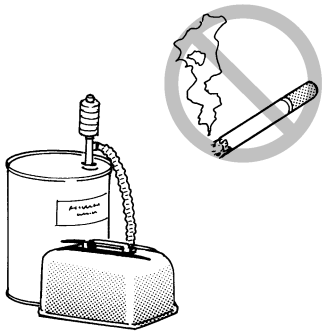
⑭ Apply Gasket Maker
⑮ Apply LOCTITE 271 (red)
⑯ Apply LOCTITE 242 (blue)
⑰ Apply LOCTITE 572
⑱ Apply silicon sealant

Safety while working

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

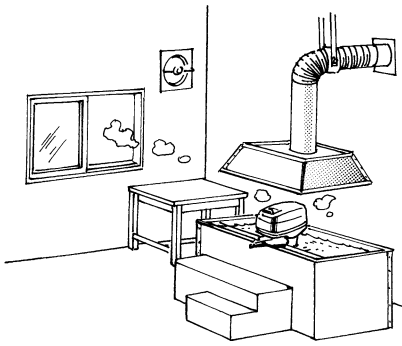
Fire prevention

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


S69J1010

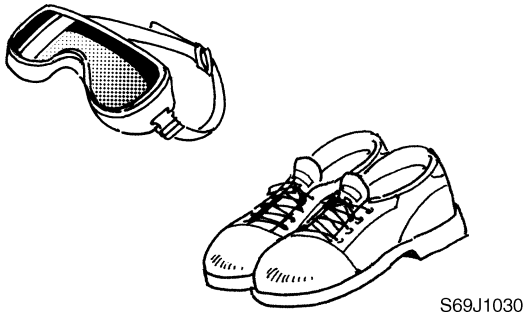
Ventilation

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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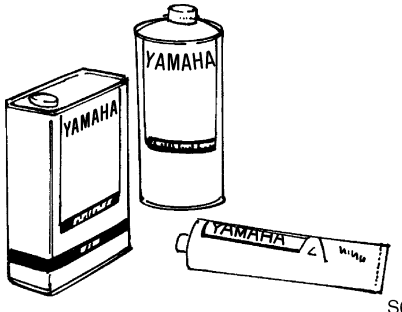
Self-protection

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.


S69J1030

Parts, lubricants, and sealants

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



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

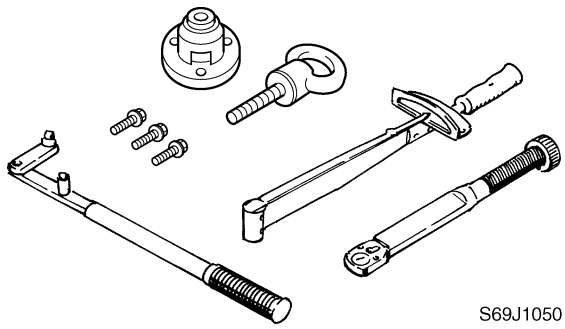
1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water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

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

Good working practices

Special service tools

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



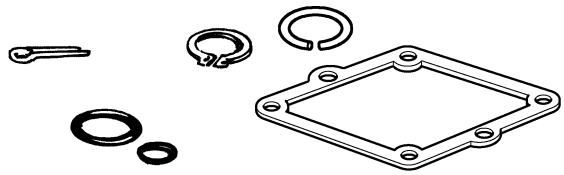
S69J1050

Tightening torques

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

Non-reusable parts

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

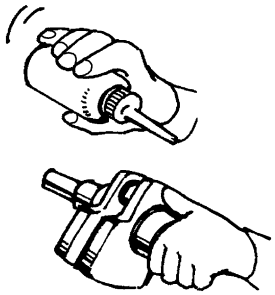


S69J1060

Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.

2. Apply engine oil to the contact surfaces of moving parts before assembly.



S69J1070

3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.

4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.

5. Check that moving parts operate normally after assembly.

Identification

Applicable models

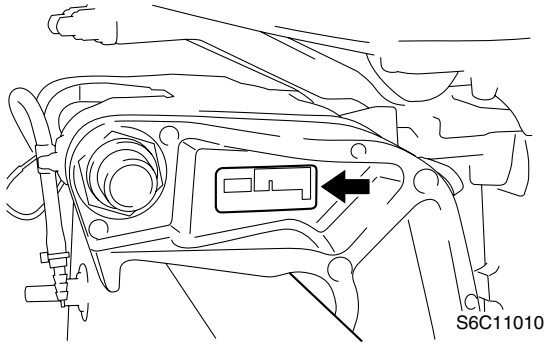
This manual covers the following models.

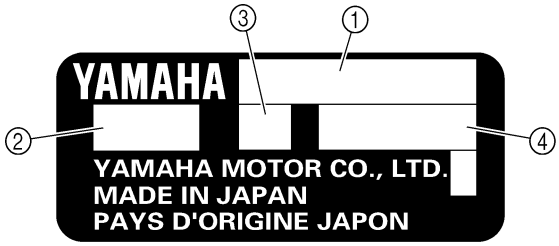
Applicable models
F50FED, F50FEHT, F50FET, FT50GET, F60CEHT, F60CET, FT60DET

(*) Hydro tilt model (For Europe)
(*) Tiller handle model (For Oceania)

Serial number

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





S69J1090N

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

Model name	Approved model code	Starting serial No.
F50FED	6C1	1000001–
F50FEHT		
F50FET		
FT50GET	6C2	1000001–
F60CEHT	6C5	1000001–
F60CET		
FT60DET	6C6	1000001–

(*) Hydro tilt model (For Europe)
(*) Tiller handle model (For Oceania)

Outline of features

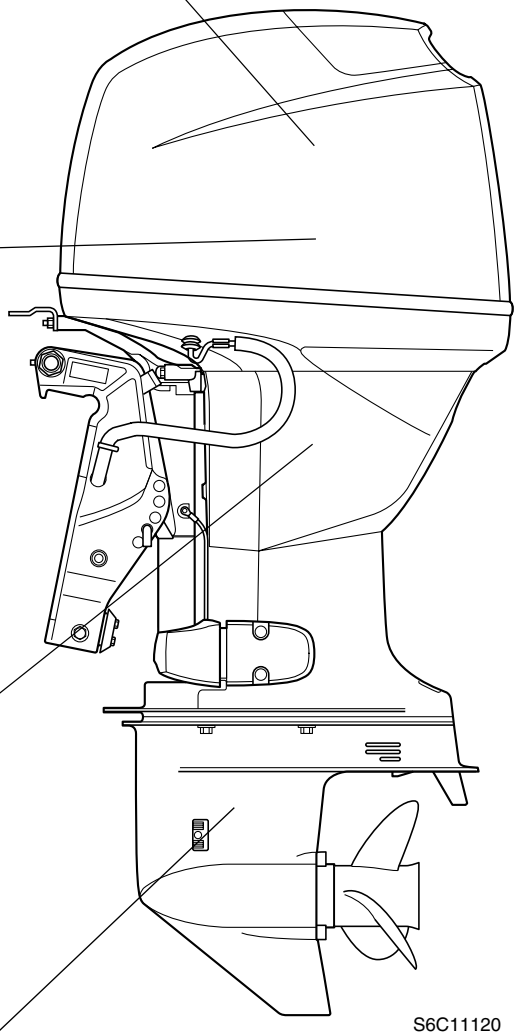
New electronic fuel injected F50 and F60 outboard motors have a mainly redesigned fuel and intake system based on the carbureted F60 outboard motor.

Power unit
- Single throttle body, single throttle valve
- Multi-point injection system, group injection (#1/#4 and #2/#3)
- Group ignition system (#1/#4 and #2/#3)
- Large plastic intake manifold
- Compact plastic fuel rail
- Modularized intake system components
- Vapor separator with built-in pressure regulator
- Solenoid valve
- Fuel cooler
- Aluminum rocker arm

Electrical
- Compact electronic fuel injection system
- Self-diagnosis system and Yamaha Diagnostic System
- Variable trolling RPM switch (optional for tiller handle model)
- Throttle position sensor with learning function (adjustment free)
- Compact charging system at low rpm
- Compact fuel injectors
- Fuel filter with water separator

Clamp bracket/upper case
- 2-piece upper case
- Upper portion case with oil sump
- Big capacity water wall structure around muffler
- Idle exhaust labyrinth structure
- Exclusive clamp bracket for permanent mounting

Lower unit
- Same lower drive unit as carbureted F60 model

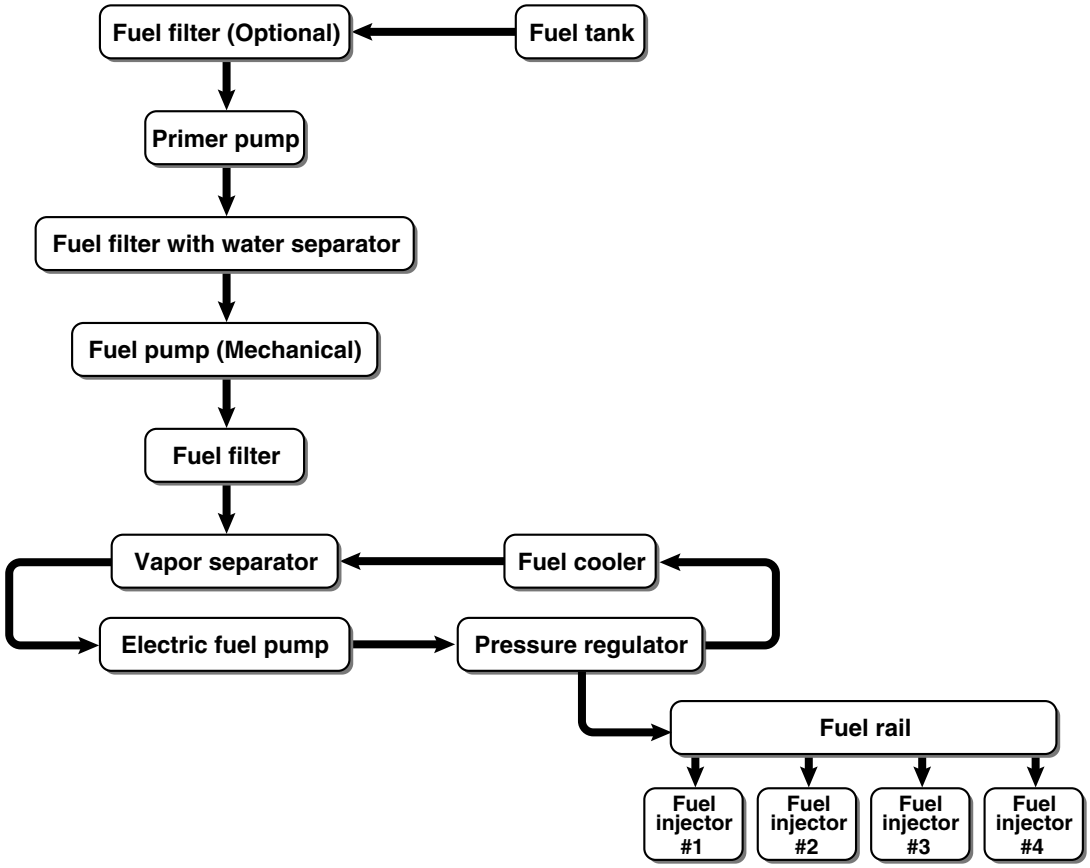


S6C11120

Features and benefits

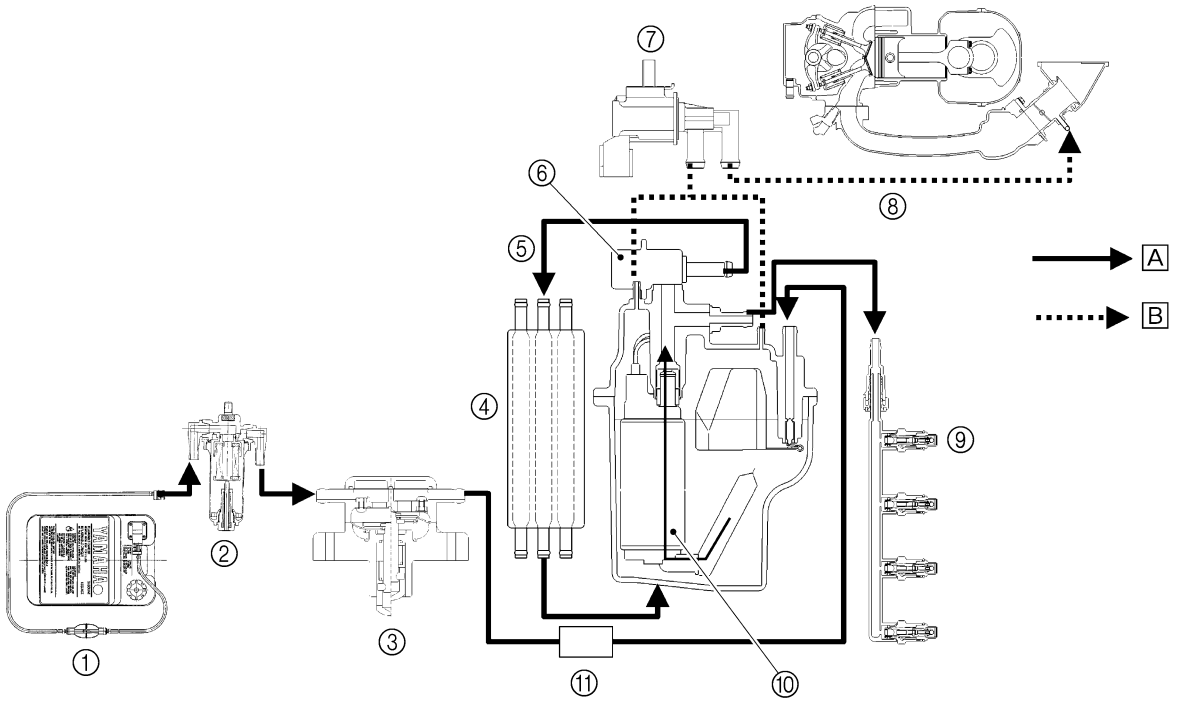
Fuel system

A pressure regulator is built into the vapor separator to obtain compact and simple fuel delivery structure.
A plastic fuel rail is used to prevent it from corrosion and for light weight.
Fuel discharged from the pressure regulator returns to the vapor separator after cooling down through the fuel cooler.
The fuel joint is used on the high pressure fuel hose to remove and/or install the intake unit easily.



Solenoid valve

Just after the engine is stopped, the cooling water supply is also stopped and the heat is conducted to the vapor separator from the engine, causing birth of many fuel vapor gases.
The vapor gases are fed into the intake silencer to reburn them.
However, many vapor gases are sucked into the combustion chambers, causing a rich air and fuel mixture, which is difficult to restart the engine.
So the solenoid valve has been used for better restarting engine while the engine is warm.
The solenoid valve stops the vapor gases not to return into the intake silencer.



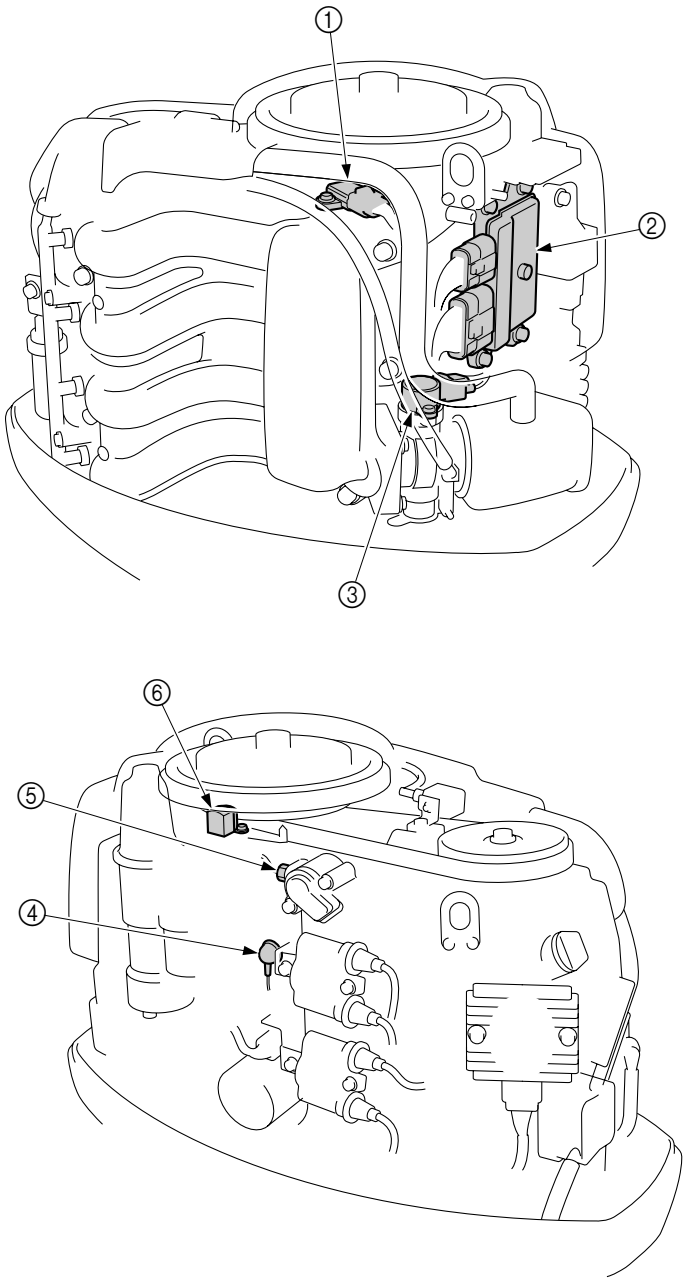
S6C11140

① Fuel tank
② Fuel filter
③ Fuel pump
④ Fuel cooler
⑤ Return fuel hose
⑥ Pressure regulator
⑦ Solenoid valve
⑧ To throttle body
⑨ Fuel injector
⑩ Electric fuel pump
⑪ Fuel filter

A Fuel
B Vapor gas

Electronic control system

The electronic control system is built up by the sensors and the ECM (Electric control Module).
The ECM receives signals from the sensors and determines the air and fuel mixture (A/F), and ignition timing.
Under various condition, the ECM gives the best-suitable engine operation.
In addition, warning control, fail-safe control, a self-diagnosis function, etc., are equipped to increase reliability.



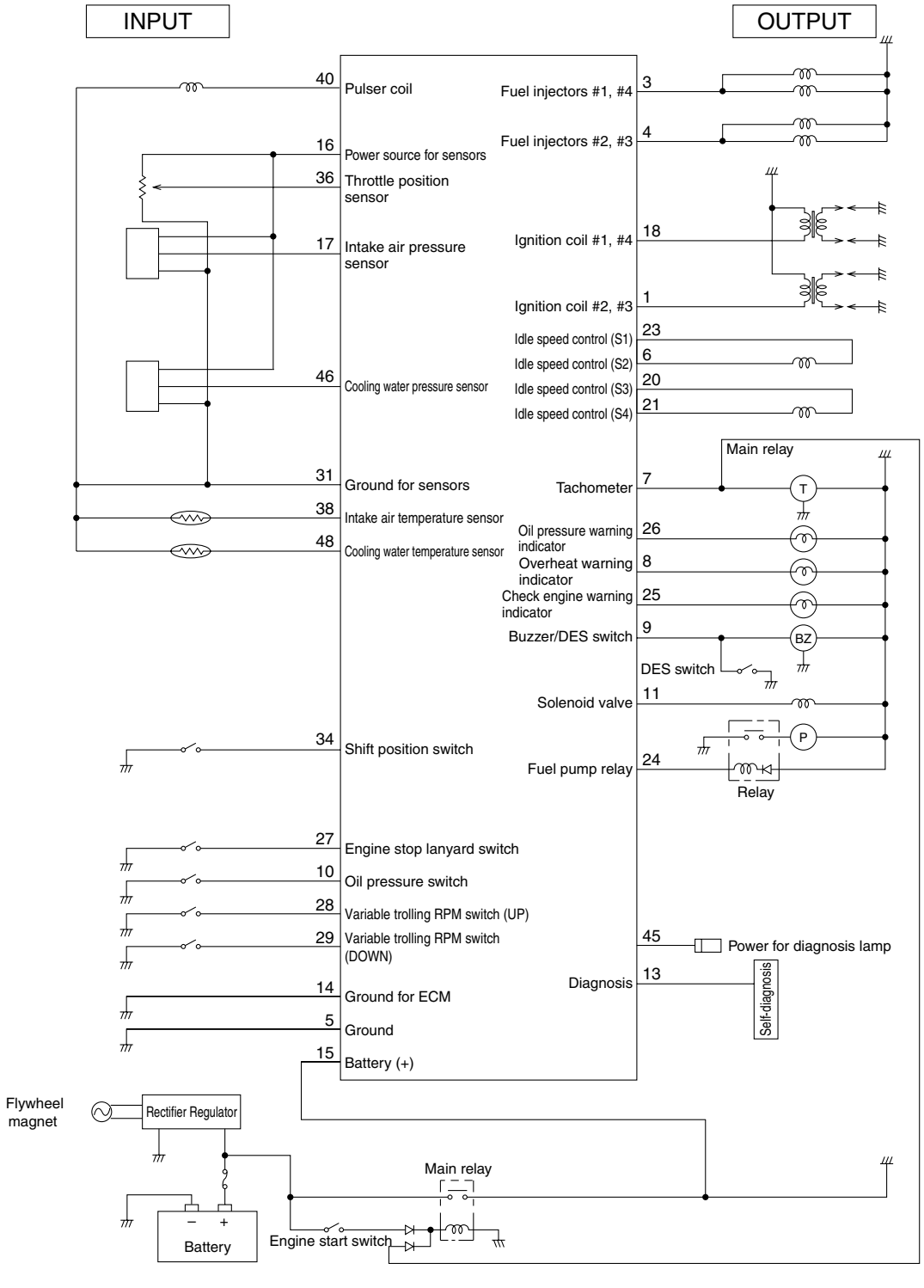
S6C11150

① Sensor assembly (intake air temperature and intake air pressure)
② ECM
③ Throttle position sensor
④ Oil pressure switch
⑤ Cooling water temperature sensor
⑥ Pulser coil

ECM (Electric Control Module)

This engine is controlled by the ECM to obtain precision combustion under various operations, and can realize high power output, low fuel consumption, and low emission.
The ECM controls the ignition timing, fuel injection timing, and the fuel injection volume, and ensures that the optimum ignition timing and air and fuel ratio can be achieved in all operating conditions such as engine starting, normal operation, and quick acceleration.

The self-diagnosis function is incorporated into the ECM and can be easily found a malfunction point by a personal computer with the optional software installed.



S6C11160

Variable trolling RPM switch (optional)

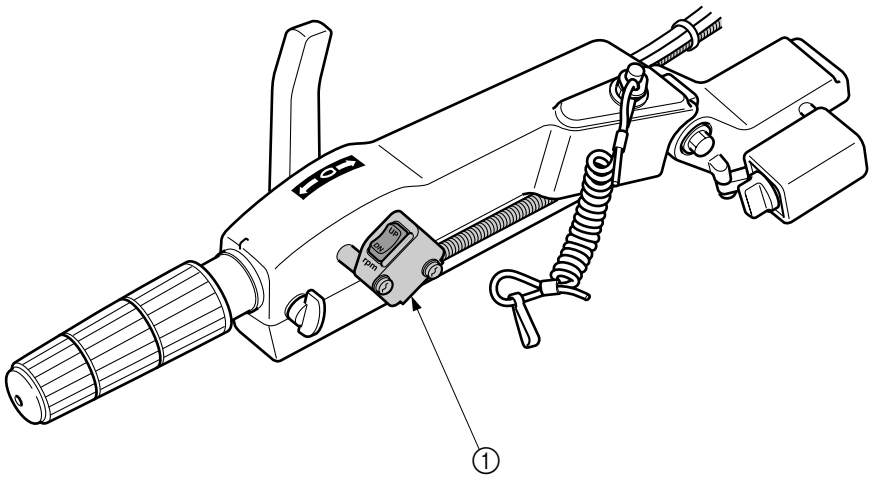
This device is an optional equipment for tiller handle model.
The idling and/or trolling rpm can be controlled in the range of 620 through 900 r/min with 50 r/min interval.
Especially for 620 through 700 r/min, the engine rpm is controlled with 40 r/min interval.
Pushing and holding the switch changes rpm continuously at 50 r/min interval.
If engine rpm reaches to the ends of specified range, the rpm is no longer changed.

CAUTION:

Do not modify the variable trolling RPM switch.
Modification such as wire extension, disassembly, etc., can malfunction for the system and/or damage the electrical components.

NOTE:

Variable trolling RPM switch kit P/N: 6C5-W8186-00



S6C11170

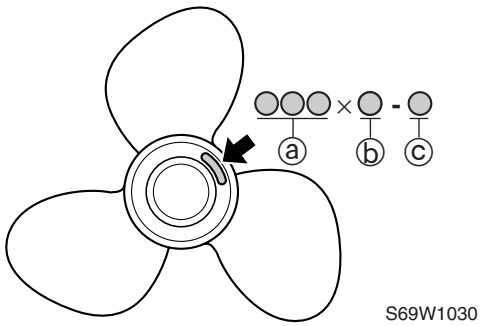
① Variable trolling RPM switch (optional)

Propeller selection

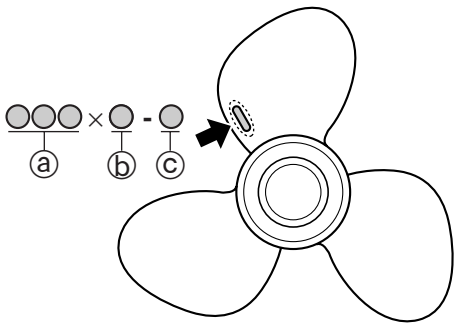
The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and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

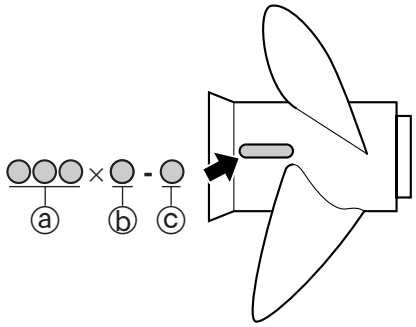
The size of the propeller is indicated on a propeller blade, on the propeller boss end.



S69W1030



S69W1040



S69W1050

ⓐ 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.

F50, F60

Propeller size (in)	Material
10 × 15 - G	Aluminum
10 1/4 × 14 - G	
10 3/8 × 13 - G	
10 5/8 × 12 - G	
10 3/4 × 16 - G	
10 3/4 × 17 - G	
11 × 15 - G	
11 1/8 × 13 - G	
11 1/4 × 14 - G	
11 3/8 × 12 - G	
11 5/8 × 11 - G	
12 1/4 × 9 - G	
10 1/4 × 14 - G	Stainless
10 1/4 × 15 - G	
10 1/4 × 16 - G	
10 5/8 × 13 - G	
11 1/4 × 14 - G	
11 1/2 × 13 - G	
11 3/4 × 12 - G	
12 × 11 - G	

FT50, FT60

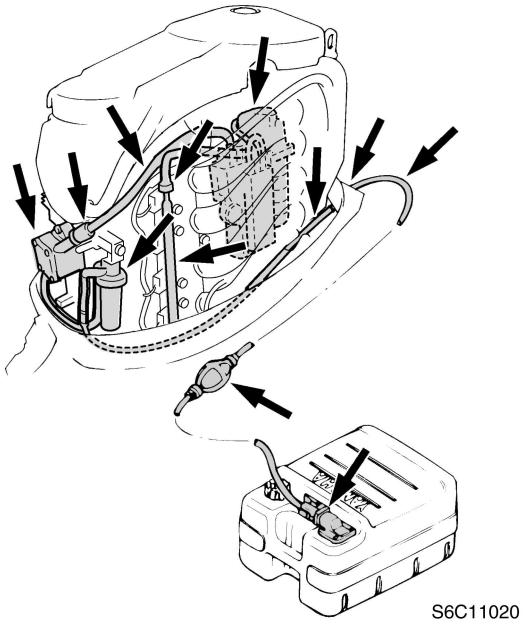
Propeller size (in)	Material
14 × 11 - K	Aluminum

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.

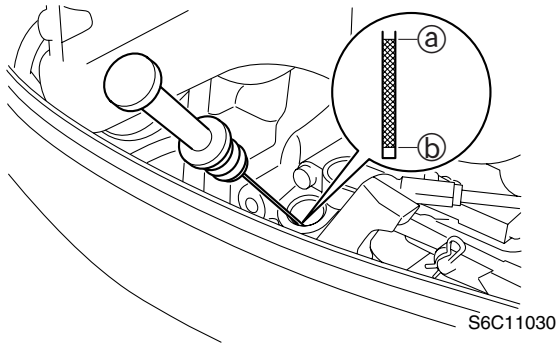

S6C11020

CAUTION:

This is a 4-stroke engine. Never use premixed fuel.

Checking the engine oil level

1. Check the engine oil level.



S6C11030

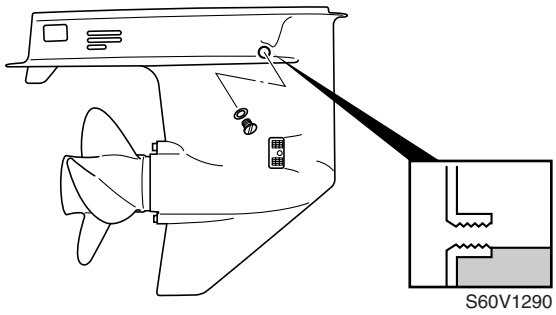
NOTE:

If the engine oil is below the minimum level mark ⓑ, add sufficient oil until the level is between ⓐ and ⓑ.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter replacement:
2.5 L (2.64 US qt, 2.20 Imp qt)

Checking the gear oil level

1. Check the gear oil level.


S60V1290

Checking the battery

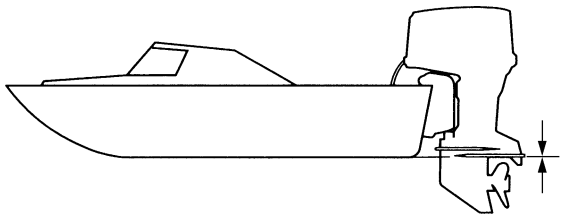
1. Check the capacity, electrolyte level, and specified gravity of the battery.

Recommended battery capacity:
CCA/EN: 430 A
20HR/IEC: 70 Ah
Electrolyte specified gravity:
1.280 at 20 °C (68 °F)

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

Checking the outboard motor mounting height

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



S69J1160

NOTE:

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

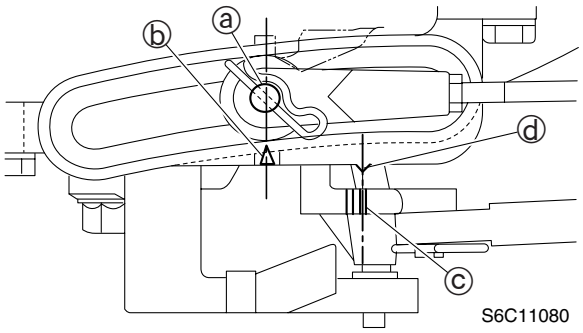
2. Check that the clamp brackets are secured with the clamp bolts.

Checking the remote control cables

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

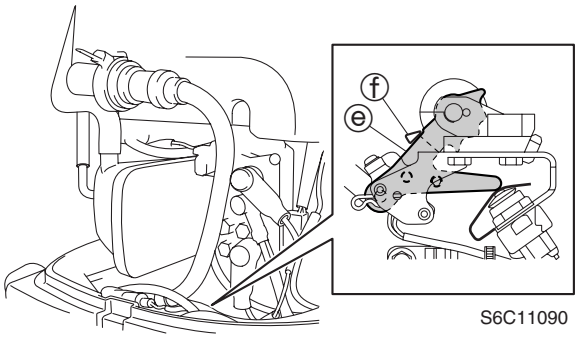
2. Check that the set pin ⓐ is aligned with the alignment mark ⓑ.

3. Check that the alignment mark ⓒ is aligned with the mark ⓓ.

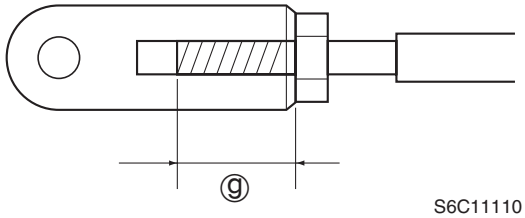


S6C11080

4. Check that the edge of a shift rod ⓔ is aligned with the alignment mark ⓕ on the bottom cowling.



S6C11090



S6C11110

⚠ WARNING

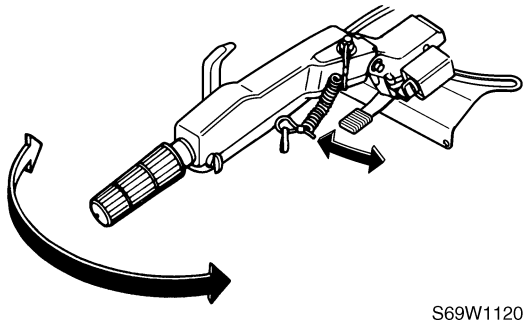
The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓖ.

Checking the steering system

1. Check the steering friction for proper adjustment.

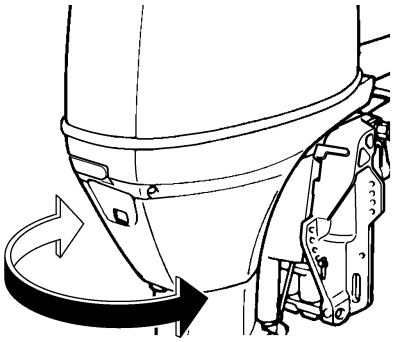
2. Check that the steering operates smoothly.

A



S69W1120

B



S68S1040

A Tiller handle model
B Remote control model

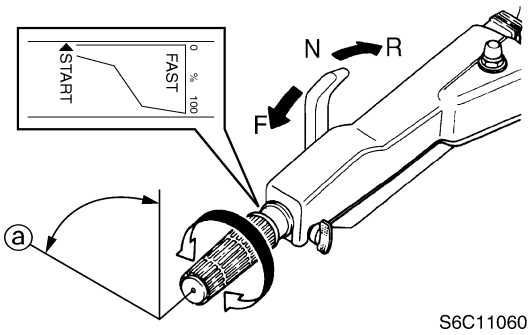
3. Check that there is no interference with wires or hoses when the outboard motor is steered.

Checking the gear shift and throttle operation

1. Check that the gear shift operates smoothly when the remote control lever or shift lever is shifted from neutral to forward or reverse.

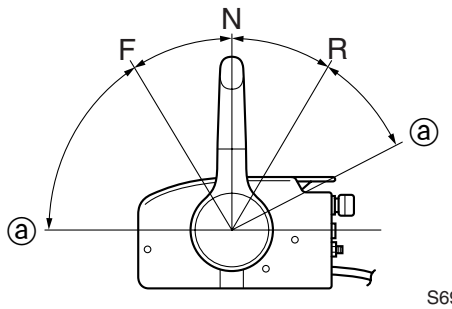
2. Check that the throttle operates smoothly when the throttle grip (tiller handle model) is turned from the fully closed position to the fully open position ⓐ. Check that the throttle operates smoothly when the remote control lever (remote control model) is shifted from forward or reverse to the fully open position ⓐ.

A



S6C11060

B



S69J1210

A Tiller handle model
B Remote control model

Checking the power trim and tilt system

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

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

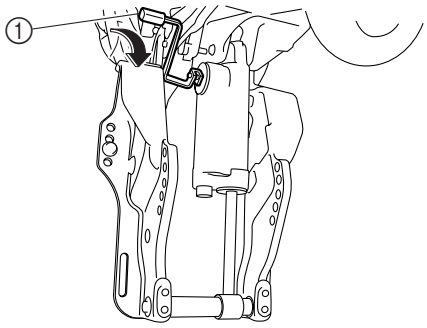
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.

4. Check that the trim meter points down when the outboard motor is tilted all the way down.

Checking the hydro tilt system

1. Check that the outboard motor tilts up and down smoothly.

2. Fully tilt the outboard motor up, and then lock the tilt stop lever ① to check the lock mechanism of the hydro tilt. Replace the hydro tilt unit if necessary.



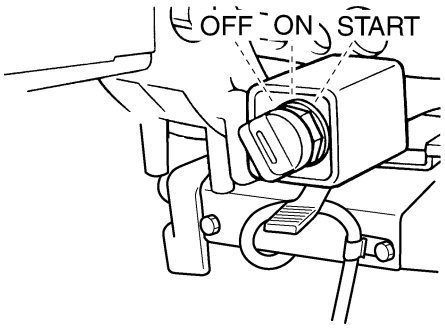
S6C11100

Checking the engine start switch and engine stop lanyard switch

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

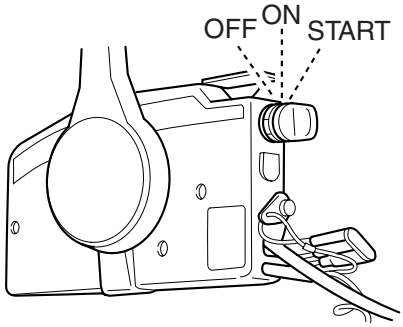
2. Check that the engine turns off when the engine start switch is turned to OFF.

A



S6C11040

B

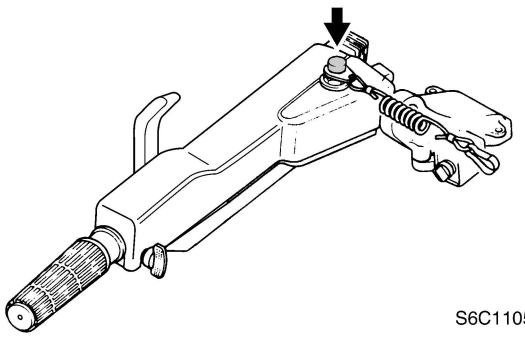


S60V1070

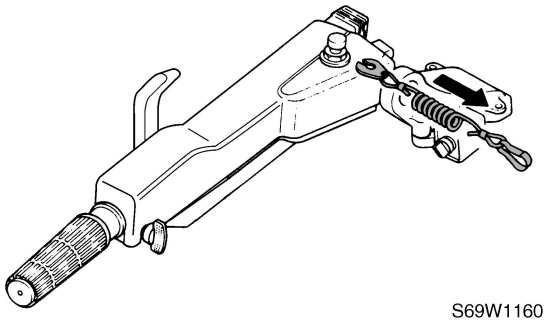
A Tiller handle model
B Remote control model

3. Check that the engine turns off when the engine stop lanyard switch is pushed or engine stop lanyard is pulled from the engine stop lanyard switch.

A

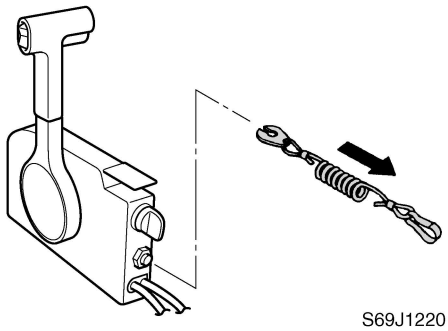


S6C11050



S69W1160

B

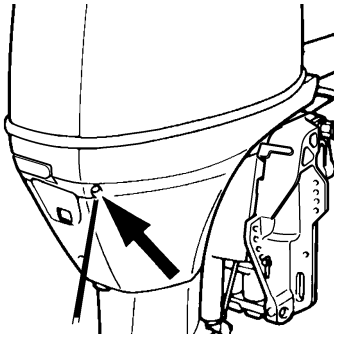


S69J1220

A Tiller handle model
B Remote control model

Checking the cooling water pilot hole

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



S68S1050

Test run

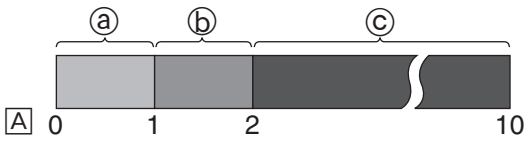
1. Start the engine, and then check that the gear shift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for 1 hour at 2,000 r/min or at half throttle, then for another hour at 3,000 r/min or at 3/4 throttle.
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 ⓐ at 2,000 r/min or at approximately half throttle
2. One hour ⓑ at 3,000 r/min or 3/4 throttle and 1 minute out of every 10 at full throttle
3. Eight hours ⓒ at any speed, however, avoid running at full speed for more than 5 minutes



S69J1240

A Hour

After test run

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

Specifications

General specifications 2-1

Maintenance specification 2-5
Power unit 2-5
Lower unit 2-8
Electrical 2-9
Power unit 2-11
Lower unit 2-14
Electrical 2-15
Dimensions 2-17

Tightening torques 2-21
Specified torques 2-21
General torques 2-24

General specifications

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Dimension					
Overall length	mm (in)	706 (27.8)	1,339 (52.7)	706 (27.8)	
Overall width	mm (in)	384 (15.1)			
Overall height					
(L)	mm (in)	1,415 (55.7)			1,455 (57.3)
(X)(*1)	mm (in)	—			1,569 (61.8)
Boat transom height					
(L)	mm (in)	508 (20.0)			
(X)(*1)	mm (in)	—			635 (25.0)
Weight					
(with aluminium propeller)					
(L)	kg (lb)	107.0 (236)	114.0 (251)	110.0 (243)	115.0 (254)
(X)(*1)	kg (lb)	—			119.0 (262)
Performance					
Maximum output	kW (hp)	36.8 (50.0) at 5,500 r/min			
Full throttle operating range	r/min	5,000–6,000			
Maximum fuel consumption	L (US gal, lmp gal)/hr	18.5 (4.89, 4.07) at 6,000 r/min			
Engine idle speed	r/min	700–800			
Power unit					
Type		In-line, 4-stroke, SOHC, 8 valves			
Cylinder quantity		4			
Total displacement	cm^3 (cu. in)	996 (60.8)			
Bore × stroke	mm (in)	65.0 × 75.0 (2.56 × 2.95)			
Compression ratio		9.50			
Control system		Remote control	Tiller handle	Remote control	
Starting system		Electric			
Fuel system		Fuel injection			
Ignition system		TCI			
Advance system		Micro computer			
Maximum generator output	V, A	12, 16			
Spark plug		DPR6EB-9 (NGK)			
Cooling system		Water			
Exhaust system		Propeller boss			
Lubrication system		Wet sump			

(*1) For Oceania

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Fuel and oil					
Fuel type		Regular unleaded gasoline			
Fuel minimum rating	RON(*1)	90			
	PON	86			
Engine oil		4-stroke motor oil			
Engine oil grade	API	SE, SF, SG, SH, or SJ			
	SAE	10W-30 or 10W-40			
Engine oil quantity					
(without oil filter replacement)	L (US qt, Imp qt)	2.5 (2.64, 2.20)			
(with oil filter replacement)	L (US qt, Imp qt)	2.7 (2.85, 2.38)			
Gear oil type		Hypoid gear oil			
Gear oil grade(*2)	API	GL-4			
	SAE	90			
Gear oil quantity	cm^3 (US oz, Imp oz)	430 (14.5, 15.2)			670 (22.7, 23.6)
Bracket unit					
Trim angle (at 12° boat transom)	Degree	–4 to 20			
Tilt-up angle	Degree	67	69		
Steering angle	Degree	40 + 40			
Drive unit					
Gear shift positions		F-N-R			
Gear ratio		1.85 (13/24)			2.31 (13/30)
Reduction gear type		Spiral bevel gear			
Clutch type		Dog clutch			
Propeller shaft type		Spline			
Propeller direction (rear view)		Clockwise			
Propeller identification mark		G			K
Electrical					
Battery minimum capacity(*3)					
CCA/EN	A	430			
20HR/IEC	Ah	70			

(*1) RON: Research Octane Number
PON: Pump Octane Number = (RON + Motor Octane Number)/2
(*2) Meeting both API and SAE requirements
(*3) CCA: Cold Cranking Ampere
EN: European Norm (European standard)
IEC: International Electrotechnical Commission

Specifications

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Dimension				
Overall length	mm (in)	1,339 (52.7)	706 (27.8)	
Overall width	mm (in)	384 (15.1)		
Overall height				
(L)	mm (in)	1,415 (55.7)		1,455 (57.3)
(X)(*1)	mm (in)	—		1,569 (61.8)
Boat transom height				
(L)	mm (in)	508 (20.0)		
(X)(*1)	mm (in)	—		635 (25.0)
Weight				
(with aluminium propeller)				
(L)	kg (lb)	114.0 (251)	110.0 (243)	115.0 (254)
(X)(*1)	kg (lb)	—		119.0 (262)
Performance				
Maximum output	kW (hp)	44.1 (60.0) at 5,500 r/min		
Full throttle operating range	r/min	5,000–6,000		
Maximum fuel consumption	L (US gal, lmp gal)/hr	20.0 (5.28, 4.40) at 6,000 r/min		
Engine idle speed	r/min	700–800		
Power unit				
Type		In-line, 4-stroke, SOHC, 8 valves		
Cylinder quantity		4		
Total displacement	cm^3 (cu. in)	996 (60.8)		
Bore × stroke	mm (in)	65.0 × 75.0 (2.56 × 2.95)		
Compression ratio		9.50		
Control system		Tiller handle	Remote control	
Starting system		Electric		
Fuel system		Fuel injection		
Ignition system		TCI		
Advance system		Micro computer		
Maximum generator output	V, A	12, 16		
Spark plug		DPR6EB-9 (NGK)		
Cooling system		Water		
Exhaust system		Propeller boss		
Lubrication system		Wet sump		

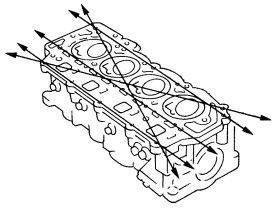
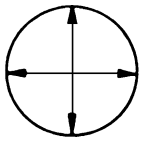
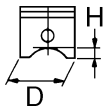
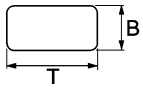
(*1) For Oceania

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Fuel and oil				
Fuel type		Regular unleaded gasoline		
Fuel minimum rating	RON(*1)	90		
	PON	86		
Engine oil		4-stroke motor oil		
Engine oil grade	API	SE, SF, SG, SH, or SJ		
	SAE	10W-30 or 10W-40		
Engine oil quantity				
(without oil filter replacement)	L (US qt, Imp qt)	2.5 (2.64, 2.20)		
(with oil filter replacement)	L (US qt, Imp qt)	2.7 (2.85, 2.38)		
Gear oil type		Hypoid gear oil		
Gear oil grade(*2)	API	GL-4		
	SAE	90		
Gear oil quantity	cm^3 (US oz, Imp oz)	430 (14.5, 15.2)		670 (22.7, 23.6)
Bracket unit				
Trim angle (at 12° boat transom)	Degree	–4 to 20		
Tilt-up angle	Degree	69		
Steering angle	Degree	40 + 40		
Drive unit				
Gear shift positions		F-N-R		
Gear ratio		1.85 (13/24)		2.31 (13/30)
Reduction gear type		Spiral bevel gear		
Clutch type		Dog clutch		
Propeller shaft type		Spline		
Propeller direction (rear view)		Clockwise		
Propeller identification mark		G		K
Electrical				
Battery minimum capacity(*3)				
CCA/EN	A	430		
20HR/IEC	Ah	70		

(*1) RON: Research Octane Number
PON: Pump Octane Number = (RON + Motor Octane Number)/2
(*2) Meeting both API and SAE requirements
(*3) CCA: Cold Cranking Ampere
EN: European Norm (European standard)
IEC: International Electrotechnical Commission

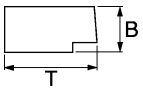
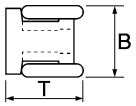
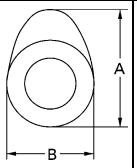
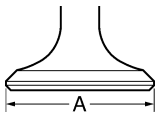
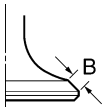
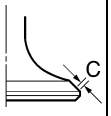
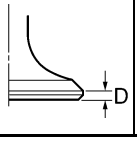
Maintenance specification

Power unit

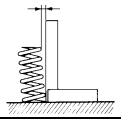
Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Power unit					
Minimum compression pressure(*1)	kPa (kgf/cm², psi)	960 (9.6, 139.2)			
Oil pressure(*2)	kPa (kgf/cm², psi)	125 (1.25, 18.1) at engine idle speed			
Cylinder head					
Warpage limit	mm (in)	0.10 (0.0039)			
 (lines indicate straightedge position)					
Journal inside diameter	mm (in)	37.000–37.025 (1.4567–1.4577)			
Cylinders					
 Bore size	mm (in)	65.000–65.015 (2.5591–2.5596)			
Taper limit	mm (in)	0.08 (0.0032)			
Out-of-round limit	mm (in)	0.05 (0.0020)			
Pistons					
 Piston diameter (D)	mm (in)	64.950–64.965 (2.5571–2.5577)			
Measuring point (H)	mm (in)	5.0 (0.20)			
Piston clearance	mm (in)	0.035–0.065 (0.0014–0.0026)			
Piston pin boss bore	mm (in)	15.974–15.985 (0.6289–0.6293)			
Oversize piston diameter					
1st	mm (in)	65.200–65.215 (2.5669–2.5675)			
2nd	mm (in)	65.450–65.465 (2.5768–2.5774)			
Piston pins					
Outside diameter	mm (in)	15.965–15.970 (0.6285–0.6287)			
Piston rings					
Top ring					
 Dimension B	mm (in)	1.17–1.19 (0.0461–0.0469)			
Dimension T	mm (in)	2.30–2.50 (0.0905–0.0984)			
End gap	mm (in)	0.15–0.30 (0.0059–0.0118)			
Side clearance	mm (in)	0.02–0.06 (0.0008–0.0024)			

(*1) Measure conditions:
Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.
The figures are for reference only.

(*2) The figures are for reference only.

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
2nd piston ring					
Dimension B 	mm (in)	1.47–1.49 (0.0579–0.0587)			
Dimension T	mm (in)	2.60–2.80 (0.1024–0.1102)			
End gap	mm (in)	0.30–0.50 (0.0118–0.0197)			
Side clearance	mm (in)	0.02–0.06 (0.0008–0.0024)			
Oil ring					
Dimension B 	mm (in)	2.36–2.48 (0.0929–0.0976)			
Dimension T(*1)	mm (in)	2.75 (0.1083)			
End gap	mm (in)	0.20–0.70 (0.0079–0.0276)			
Side clearance	mm (in)	0.04–0.18 (0.0016–0.0071)			
Camshaft					
Intake (A) 	mm (in)	30.888–30.988 (1.2161–1.2200)			
Exhaust (A)	mm (in)	30.824–30.924 (1.2135–1.2175)			
Intake and exhaust (B)	mm (in)	25.950–26.050 (1.0216–1.0256)			
Camshaft journal diameter #1	mm (in)	36.925–36.945 (1.4537–1.4545)			
Camshaft journal diameter #2, #3, #4	mm (in)	36.935–36.955 (1.4541–1.4549)			
Camshaft journal oil clearance	mm (in)	0.045–0.090 (0.0018–0.0035)			
Camshaft runout limit	mm (in)	0.03 (0.0012)			
Rocker arm shaft					
Rocker arm shaft outside diameter	mm (in)	15.971–15.991 (0.6288–0.6296)			
Rocker arms					
Rocker arm inside diameter	mm (in)	16.000–16.018 (0.6299–0.6306)			
Valves					
Valve clearance (cold)					
Intake	mm (in)	0.20 ± 0.05 (0.008 ± 0.002)			
Exhaust	mm (in)	0.30 ± 0.05 (0.012 ± 0.002)			
Head diameter (A)					
Intake 	mm (in)	31.90–32.10 (1.256–1.264)			
Exhaust	mm (in)	26.60–26.80 (1.047–1.055)			
Face width (B)					
Intake 	mm (in)	1.98–2.40 (0.078–0.094)			
Exhaust	mm (in)	2.16–2.79 (0.085–0.110)			
Seat contact width (C)					
Intake and exhaust 	mm (in)	1.3–1.5 (0.051–0.059)			
Margin thickness (D)					
Intake	mm (in)	0.8–1.2 (0.031–0.047)			
Exhaust 	mm (in)	1.0–1.4 (0.039–0.055)			

(*1) The figures are for reference only.

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Stem diameter					
Intake	mm (in)	5.475–5.490 (0.2156–0.2161)			
Exhaust	mm (in)	5.460–5.475 (0.2150–0.2156)			
Guide inside diameter					
Intake and exhaust	mm (in)	5.500–5.512 (0.2165–0.2170)			
Stem-to-guide clearance					
Intake and exhaust	mm (in)	0.025–0.052 (0.0010–0.0020)			
Stem runout limit					
Intake	mm (in)	0.05 (0.0020)			
Exhaust	mm (in)	0.03 (0.0012)			
Valve springs					
Free length 	mm (in)	39.85 (1.5689)			
Tilt limit	mm (in)	1.7 (0.07)			
Connecting rods					
Small end inside diameter	mm (in)	15.985–15.998 (0.6293–0.6298)			
Big end inside diameter	mm (in)	36.000–36.024 (1.4173–1.4183)			
Connecting rod big end side clearance	mm (in)	0.05–0.22 (0.0020–0.0087)			
Crankpin oil clearance	mm (in)	0.016–0.040 (0.0006–0.0016)			
Big end bearing thickness					
Yellow	mm (in)	1.500–1.504 (0.0591–0.0592)			
Red	mm (in)	1.496–1.500 (0.0589–0.0591)			
Pink	mm (in)	1.492–1.496 (0.0587–0.0589)			
Green	mm (in)	1.488–1.492 (0.0586–0.0587)			
Crankshaft					
Crankshaft journal diameter	mm (in)	42.984–43.000 (1.6923–1.6929)			
Crankpin diameter	mm (in)	32.984–33.000 (1.2986–1.2992)			
Crankpin width	mm (in)	21.000–21.070 (0.8268–0.8295)			
Runout limit	mm (in)	0.03 (0.0012)			
Crankcase					
Crankshaft main journal oil clearance	mm (in)	0.012–0.036 (0.0005–0.0014)			
Crankcase main journal bearing thickness					
Yellow	mm (in)	1.502–1.506 (0.0591–0.0592)			
Red	mm (in)	1.498–1.502 (0.0590–0.0591)			
Pink	mm (in)	1.494–1.498 (0.0588–0.0590)			
Green	mm (in)	1.490–1.494 (0.0587–0.0588)			

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Oil pump					
Type		Trochoid			
Outer rotor-to-housing clearance	mm (in)	0.09–0.15 (0.0035–0.0059)			
Outer rotor-to-inner rotor clearance limit	mm (in)	0.12 (0.0047)			
Rotor-to-cover clearance	mm (in)	0.03–0.08 (0.0012–0.0031)			
Relief valve operating pressure	kPa (kgf/cm^2, psi)	350–450 (3.5–4.5, 50.8–62.3)			
Thermostat					
Opening temperature	°C (°F)	58–62 (136–144)			
Fully open temperature	°C (°F)	70 (158)			
Valve open lower limit	mm (in)	3.0 (0.12)			

Lower unit

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Gear backlash					
Pinion-to-forward gear	mm (in)	0.35–0.81 (0.0138–0.0319)			0.09–0.62 (0.0035–0.0244)
Pinion-to-reverse gear	mm (in)	0.89–1.34 (0.0350–0.0528)			—
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			—

Electrical

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Ignition and ignition control system					
Ignition timing range(*1)	Degree	ATDC 10-BTDC 25			
Spark plug gap	mm (in)	0.8–0.9 (0.031–0.035)			
Ignition coil resistance					
Primary coil (R – B/W)					
at 20 °C (68 °F)	Ω	1.53–2.07			
Secondary coil					
at 20 °C (68 °F)	kΩ	12.50–16.91			
Spark plug wire resistance	kΩ	1.9–5.0			
ECM output peak voltage (B/R, B/W – ground)					
at cranking (loaded)	V	240			
at 1,500 r/min (loaded)	V	290			
at 3,500 r/min (loaded)	V	300			
Pulser coil output peak voltage (W/R – W/B)					
at cranking (unloaded)	V	7.9			
at cranking (loaded)	V	7.2			
at 1,500 r/min (loaded)	V	20.7			
at 3,500 r/min (loaded)	V	32.0			
Pulser coil resistance(*2) (W/B – W/R)	Ω	396–594			
Pulser coil air gap	mm (in)	0.75 ± 0.25 (0.030 ± 0.010)			
Throttle position sensor					
Output voltage (P – B)	V	0.8–1.2 at engine idle speed			
Sensor assembly resistance(*2)					
at 20 °C (68 °F)	kΩ	5.4–6.6			
at 80 °C (176 °F)	kΩ	0.282–0.382			
Cooling water temperature sensor resistance(*2) (B/Y – B)					
at 20 °C (68 °F)	kΩ	2.439			
at 60 °C (140 °F)	kΩ	0.589			
at 100 °C (212 °F)	kΩ	0.193			
Fuel control system					
Fuel injector resistance(*2)					
at 21 °C (70 °F)	Ω	12.0			
Solenoid valve resistance(*2)					
at 20 °C (68 °F)	Ω	30.0–34.0			

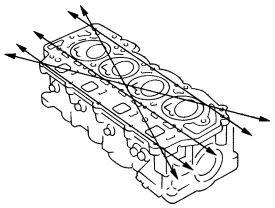
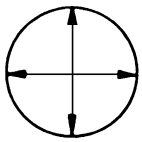
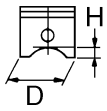
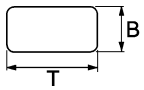
(*1) The actual ignition timing may vary according to environmental conditions.
The figures are for reference only and do not represent the ignition timing figures from the fully closed position to the fully open position of the throttle valve.

(*2) The figures are for reference only.

Item	Unit	Model			
		F50FED	F50FEHT	F50FET	FT50GET
Starter motor					
Type		Sliding gear			
Output	kW	1.4			
Cranking time limit	Second	30			
Brushes					
Standard length	mm (in)	15.5 (0.61)			
Wear limit	mm (in)	9.5 (0.37)			
Commutator					
Standard diameter	mm (in)	29.0 (1.14)			
Wear limit	mm (in)	28.0 (1.10)			
Mica					
Standard undercut	mm (in)	0.8 (0.03)			
Wear limit	mm (in)	0.2 (0.01)			
Charging system					
Fuse	A	20, 30			
Stator coil output peak voltage (W – W)					
at cranking (unloaded)	V	13.2			
at 1,500 r/min (unloaded)	V	42.2			
at 3,500 r/min (unloaded)	V	96.6			
Stator coil resistance(*1)					
at 20 °C (68 °F) (W – W)	Ω	0.52–0.63			
Rectifier Regulator output peak voltage (R – B)					
at 1,500 r/min (unloaded)	V	13.0			
at 3,500 r/min (unloaded)	V	13.0			
Power trim and tilt system					
Trim sensor					
Setting resistance (P – B)	Ω	9–11			
Resistance (P – B)	Ω	9–288.3			
Fluid type		ATF Dexron II			
Brushes					
Standard limit	mm (in)	11.0 (0.43)			
Wear limit	mm (in)	4.5 (0.18)			
Commutator					
Standard limit	mm (in)	19.0 (0.75)			
Wear limit	mm (in)	18.0 (0.71)			
Mica					
Standard undercut	mm (in)	1.5 (0.06)			

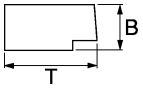
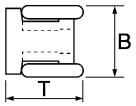
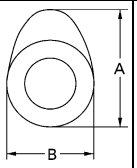
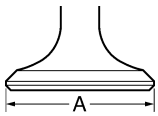
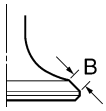
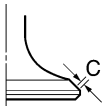
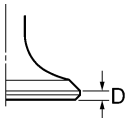
(*1) The figures are for reference only.

Power unit

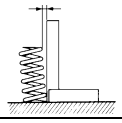
Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Power unit				
Minimum compression pressure(*1)	kPa (kgf/cm², psi)	960 (9.6, 139.2)		
Oil pressure(*2)	kPa (kgf/cm², psi)	125 (1.25, 18.1) at engine idle speed		
Cylinder head				
Warpage limit	mm (in)	0.10 (0.0039)		
 (lines indicate straightedge position)				
Journal inside diameter	mm (in)	37.000–37.025 (1.4567–1.4577)		
Cylinders 				
Bore size	mm (in)	65.000–65.015 (2.5591–2.5596)		
Taper limit	mm (in)	0.08 (0.0032)		
Out-of-round limit	mm (in)	0.05 (0.0020)		
Pistons 				
Piston diameter (D)	mm (in)	64.950–64.965 (2.5571–2.5577)		
Measuring point (H)	mm (in)	5.0 (0.20)		
Piston clearance	mm (in)	0.035–0.065 (0.0014–0.0026)		
Piston pin boss bore	mm (in)	15.974–15.985 (0.6289–0.6293)		
Oversize piston diameter				
1st	mm (in)	65.200–65.215 (2.5669–2.5675)		
2nd	mm (in)	65.450–65.465 (2.5768–2.5774)		
Piston pins				
Outside diameter	mm (in)	15.965–15.970 (0.6285–0.6287)		
Piston rings				
Top ring				
Dimension B 	mm (in)	1.17–1.19 (0.0461–0.0469)		
Dimension T	mm (in)	2.30–2.50 (0.0905–0.0984)		
End gap	mm (in)	0.15–0.30 (0.0059–0.0118)		
Side clearance	mm (in)	0.02–0.06 (0.0008–0.0024)		

(*1) Measure conditions:
Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.
The figures are for reference only.

(*2) The figures are for reference only.

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
2nd piston ring				
Dimension B 	mm (in)	1.47–1.49 (0.0579–0.0587)		
Dimension T	mm (in)	2.60–2.80 (0.1024–0.1102)		
End gap	mm (in)	0.30–0.50 (0.0118–0.0197)		
Side clearance	mm (in)	0.02–0.06 (0.0008–0.0024)		
Oil ring				
Dimension B 	mm (in)	2.36–2.48 (0.0929–0.0976)		
Dimension T(*1)	mm (in)	2.75 (0.1083)		
End gap	mm (in)	0.20–0.70 (0.0079–0.0276)		
Side clearance	mm (in)	0.04–0.18 (0.0016–0.0071)		
Camshaft				
Intake (A) 	mm (in)	30.888–30.988 (1.2161–1.2200)		
Exhaust (A)	mm (in)	30.824–30.924 (1.2135–1.2175)		
Intake and exhaust (B)	mm (in)	25.950–26.050 (1.0216–1.0256)		
Camshaft journal diameter #1	mm (in)	36.925–36.945 (1.4537–1.4545)		
Camshaft journal diameter #2, #3, #4	mm (in)	36.935–36.955 (1.4541–1.4549)		
Camshaft journal oil clearance	mm (in)	0.045–0.090 (0.0018–0.0035)		
Camshaft runout limit	mm (in)	0.03 (0.0012)		
Rocker arm shaft				
Rocker arm shaft outside diameter	mm (in)	15.971–15.991 (0.6288–0.6296)		
Rocker arms				
Rocker arm inside diameter	mm (in)	16.000–16.018 (0.6299–0.6306)		
Valves				
Valve clearance (cold)				
Intake	mm (in)	0.20 ± 0.05 (0.008 ± 0.002)		
Exhaust	mm (in)	0.30 ± 0.05 (0.012 ± 0.002)		
Head diameter (A)				
Intake 	mm (in)	31.90–32.10 (1.256–1.264)		
Exhaust	mm (in)	26.60–26.80 (1.047–1.055)		
Face width (B)				
Intake 	mm (in)	1.98–2.40 (0.078–0.094)		
Exhaust	mm (in)	2.16–2.79 (0.085–0.110)		
Seat contact width (C)				
Intake and exhaust 	mm (in)	1.3–1.5 (0.051–0.059)		
Margin thickness (D)				
Intake 	mm (in)	0.8–1.2 (0.031–0.047)		
Exhaust	mm (in)	1.0–1.4 (0.039–0.055)		

(*1) The figures are for reference only.

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Stem diameter				
Intake	mm (in)	5.475–5.490 (0.2156–0.2161)		
Exhaust	mm (in)	5.460–5.475 (0.2150–0.2156)		
Guide inside diameter				
Intake and exhaust	mm (in)	5.500–5.512 (0.2165–0.2170)		
Stem-to-guide clearance				
Intake and exhaust	mm (in)	0.025–0.052 (0.0010–0.0020)		
Stem runout limit				
Intake	mm (in)	0.05 (0.0020)		
Exhaust	mm (in)	0.03 (0.0012)		
Valve springs				
Free length 	mm (in)	39.85 (1.5689)		
Tilt limit	mm (in)	1.7 (0.07)		
Connecting rods				
Small end inside diameter	mm (in)	15.985–15.998 (0.6293–0.6298)		
Big end inside diameter	mm (in)	36.000–36.024 (1.4173–1.4183)		
Connecting rod big end side clearance	mm (in)	0.05–0.22 (0.0020–0.0087)		
Crankpin oil clearance	mm (in)	0.016–0.040 (0.0006–0.0016)		
Big end bearing thickness				
Yellow	mm (in)	1.500–1.504 (0.0591–0.0592)		
Red	mm (in)	1.496–1.500 (0.0589–0.0591)		
Pink	mm (in)	1.492–1.496 (0.0587–0.0589)		
Green	mm (in)	1.488–1.492 (0.0586–0.0587)		
Crankshaft				
Crankshaft journal diameter	mm (in)	42.984–43.000 (1.6923–1.6929)		
Crankpin diameter	mm (in)	32.984–33.000 (1.2986–1.2992)		
Crankpin width	mm (in)	21.000–21.070 (0.8268–0.8295)		
Runout limit	mm (in)	0.03 (0.0012)		
Crankcase				
Crankshaft main journal oil clearance	mm (in)	0.012–0.036 (0.0005–0.0014)		
Crankcase main journal bearing thickness				
Yellow	mm (in)	1.502–1.506 (0.0591–0.0592)		
Red	mm (in)	1.498–1.502 (0.0590–0.0591)		
Pink	mm (in)	1.494–1.498 (0.0588–0.0590)		
Green	mm (in)	1.490–1.494 (0.0587–0.0588)		

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Oil pump				
Type		Trochoid		
Outer rotor-to-housing clearance	mm (in)	0.09–0.15 (0.0035–0.0059)		
Outer rotor-to-inner rotor clearance limit	mm (in)	0.12 (0.0047)		
Rotor-to-cover clearance	mm (in)	0.03–0.08 (0.0012–0.0031)		
Relief valve operating pressure	kPa (kgf/cm^2, psi)	350–450 (3.5–4.5, 50.8–62.3)		
Thermostat				
Opening temperature	°C (°F)	58–62 (136–144)		
Fully open temperature	°C (°F)	70 (158)		
Valve open lower limit	mm (in)	3.0 (0.12)		

Lower unit

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Gear backlash				
Pinion-to-forward gear	mm (in)	0.35–0.81 (0.0138–0.0319)		0.09–0.62 (0.0035–0.0244)
Pinion-to-reverse gear	mm (in)	0.89–1.34 (0.0350–0.0528)		—
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		—

Electrical

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Ignition and ignition control system				
Ignition timing range(*1)	Degree	ATDC 10-BTDC 24		
Spark plug gap	mm (in)	0.8–0.9 (0.031–0.035)		
Ignition coil resistance				
Primary coil (R – B/W)				
at 20 °C (68 °F)	Ω	1.53–2.07		
Secondary coil				
at 20 °C (68 °F)	kΩ	12.50–16.91		
Spark plug wire resistance	kΩ	1.9–5.0		
ECM output peak voltage (B/R, B/W – ground)				
at cranking (loaded)	V	240		
at 1,500 r/min (loaded)	V	290		
at 3,500 r/min (loaded)	V	300		
Pulser coil output peak voltage (W/B – W/R)				
at cranking (unloaded)	V	7.9		
at cranking (loaded)	V	7.2		
at 1,500 r/min (loaded)	V	20.7		
at 3,500 r/min (loaded)	V	32.0		
Pulser coil resistance(*2) (W/B – W/R)	Ω	396–594		
Pulser coil air gap	mm (in)	0.75 ± 0.25 (0.030 ± 0.010)		
Throttle position sensor				
Output voltage (P – B)	V	0.8–1.2 at engine idle speed		
Sensor assembly resistance(*2)				
at 20 °C (68 °F)	kΩ	5.4–6.6		
at 80 °C (176 °F)	kΩ	0.282–0.382		
Cooling water temperature sensor resistance(*2) (B/Y – B)				
at 20 °C (68 °F)	kΩ	2.439		
at 60 °C (140 °F)	kΩ	0.589		
at 100 °C (212 °F)	kΩ	0.193		
Fuel control system				
Fuel injector resistance(*2)				
at 21 °C (70 °F)	Ω	12.0		
Solenoid valve resistance(*2)				
at 20 °C (68 °F)	Ω	30.0–34.0		

(*1) The actual ignition timing may vary according to environmental conditions.
The figures are for reference only and do not represent the ignition timing figures from the fully closed position to the fully open position of the throttle valve.

(*2) The figures are for reference only.

Item	Unit	Model		
		F60CEHT	F60CET	FT60DET
Starter motor				
Type		Sliding gear		
Output	kW	1.4		
Cranking time limit	Second	30		
Brushes				
Standard length	mm (in)	15.5 (0.61)		
Wear limit	mm (in)	9.5 (0.37)		
Commutator				
Standard diameter	mm (in)	29.0 (1.14)		
Wear limit	mm (in)	28.0 (1.10)		
Mica				
Standard undercut	mm (in)	0.8 (0.03)		
Wear limit	mm (in)	0.2 (0.01)		
Charging system				
Fuse	A	20, 30		
Stator coil output peak voltage (W – W)				
at cranking (unloaded)	V	13.2		
at 1,500 r/min (unloaded)	V	42.2		
at 3,500 r/min (unloaded)	V	96.6		
Stator coil resistance(*1)				
at 20 °C (68 °F) (W – W)	Ω	0.52–0.63		
Rectifier Regulator output peak voltage (R – B)				
at 1,500 r/min (unloaded)	V	13.0		
at 3,500 r/min (unloaded)	V	13.0		
Power trim and tilt system				
Trim sensor				
Setting resistance (P – B)	Ω	9–11		
Resistance (P – B)	Ω	9–288.3		
Fluid type		ATF Dexron II		
Brushes				
Standard limit	mm (in)	11.0 (0.43)		
Wear limit	mm (in)	4.5 (0.18)		
Commutator				
Standard limit	mm (in)	19.0 (0.75)		
Wear limit	mm (in)	18.0 (0.71)		
Mica				
Standard undercut	mm (in)	1.5 (0.06)		

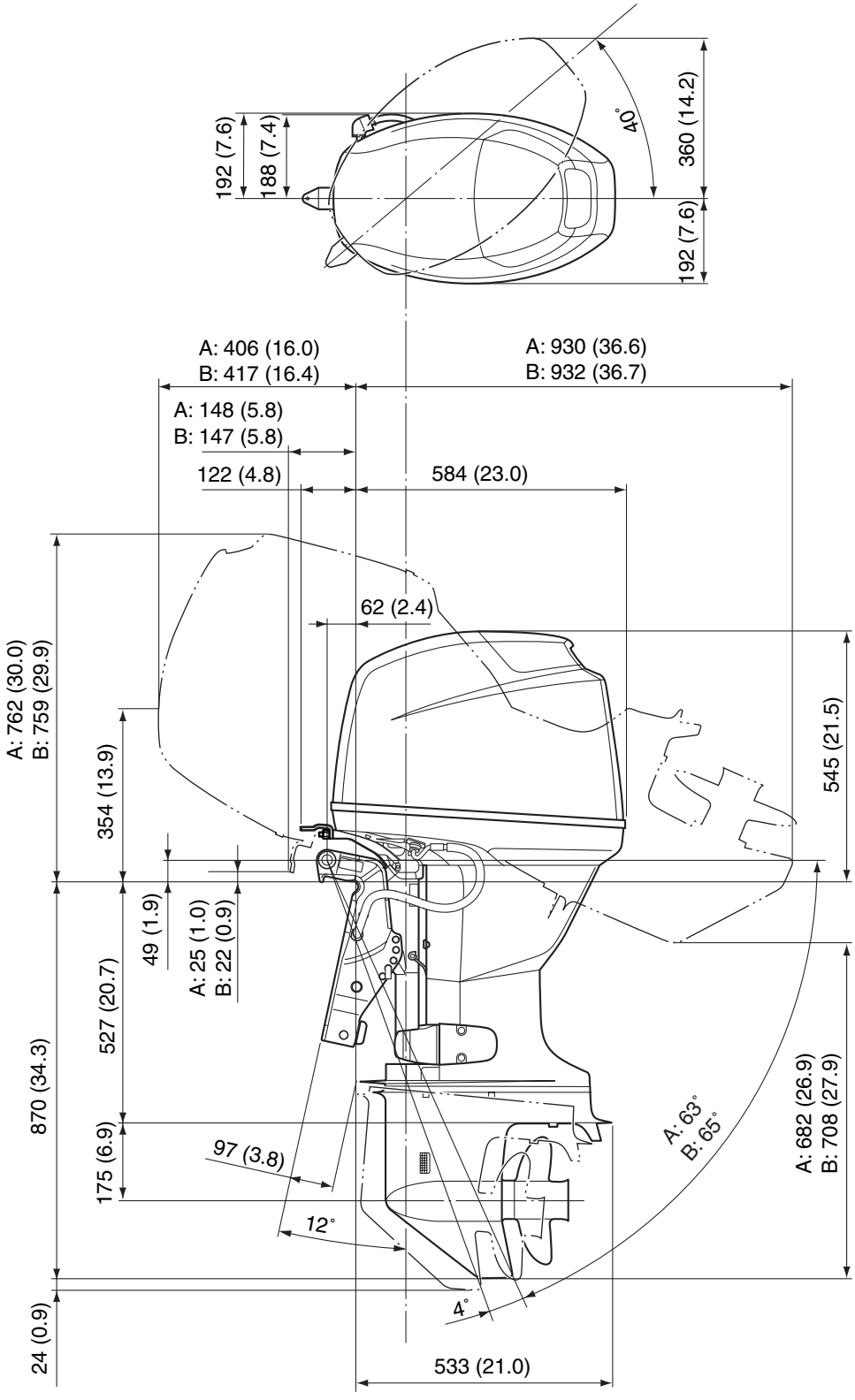
(*1) The figures are for reference only.

Dimensions

Exterior

F50, F60 (Remote control model)

mm (in)

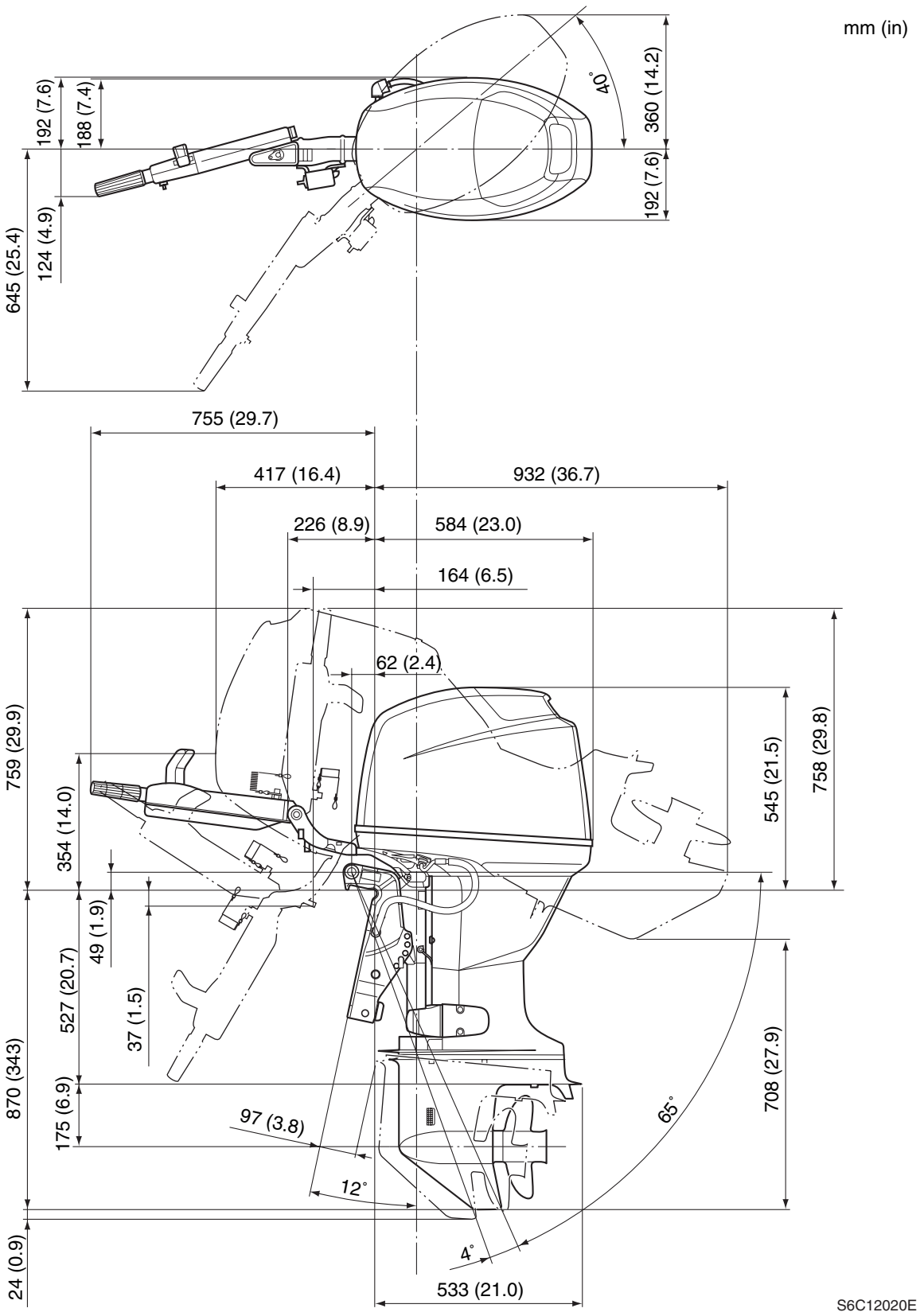


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A: Hydro tilt model (For Europe)
B: Power trim and tilt model

F50, F60 (Tiller handle model)(*1)

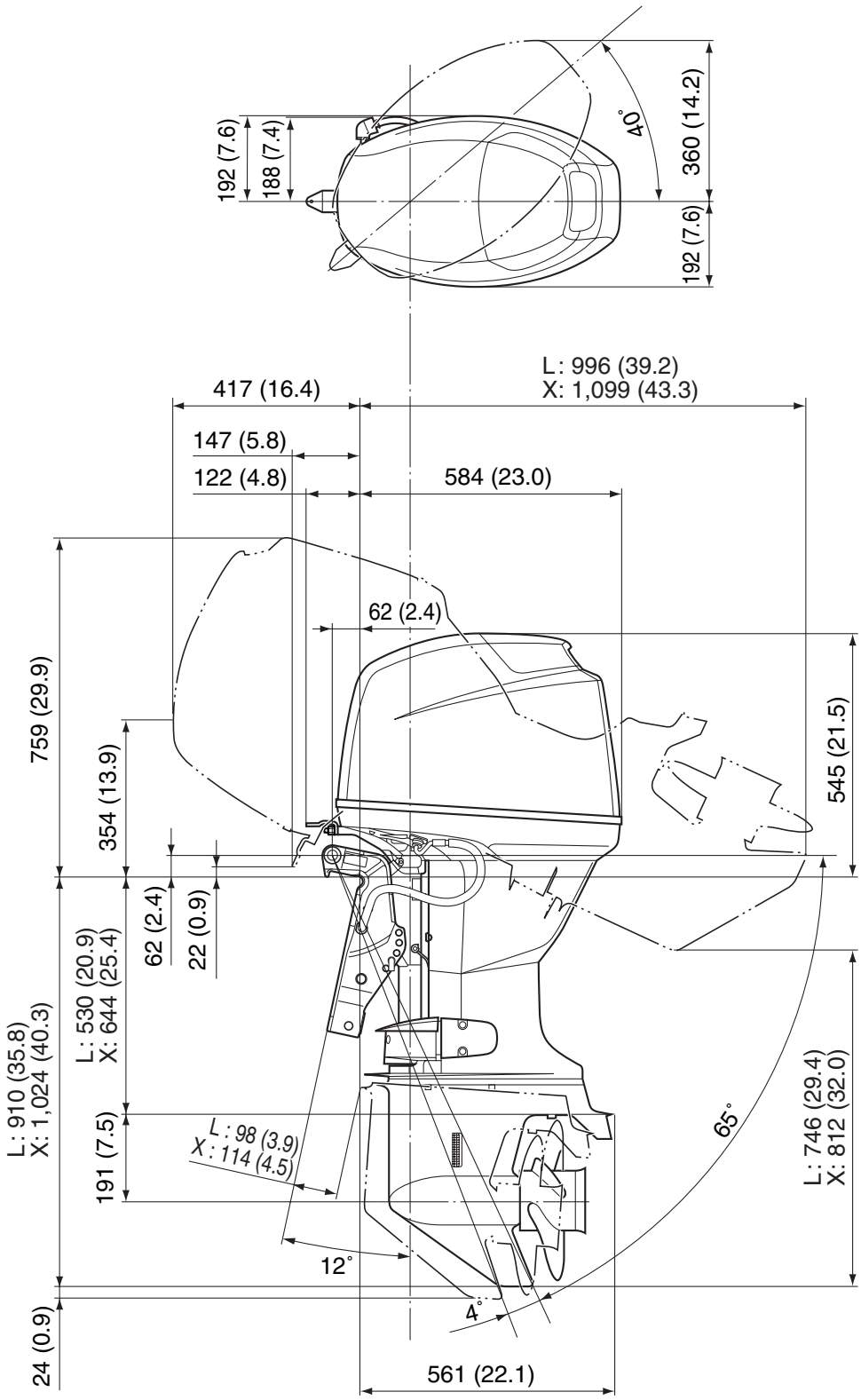
mm (in)



Power trim and tilt model
(*1) For Oceania

FT50, FT60

mm (in)

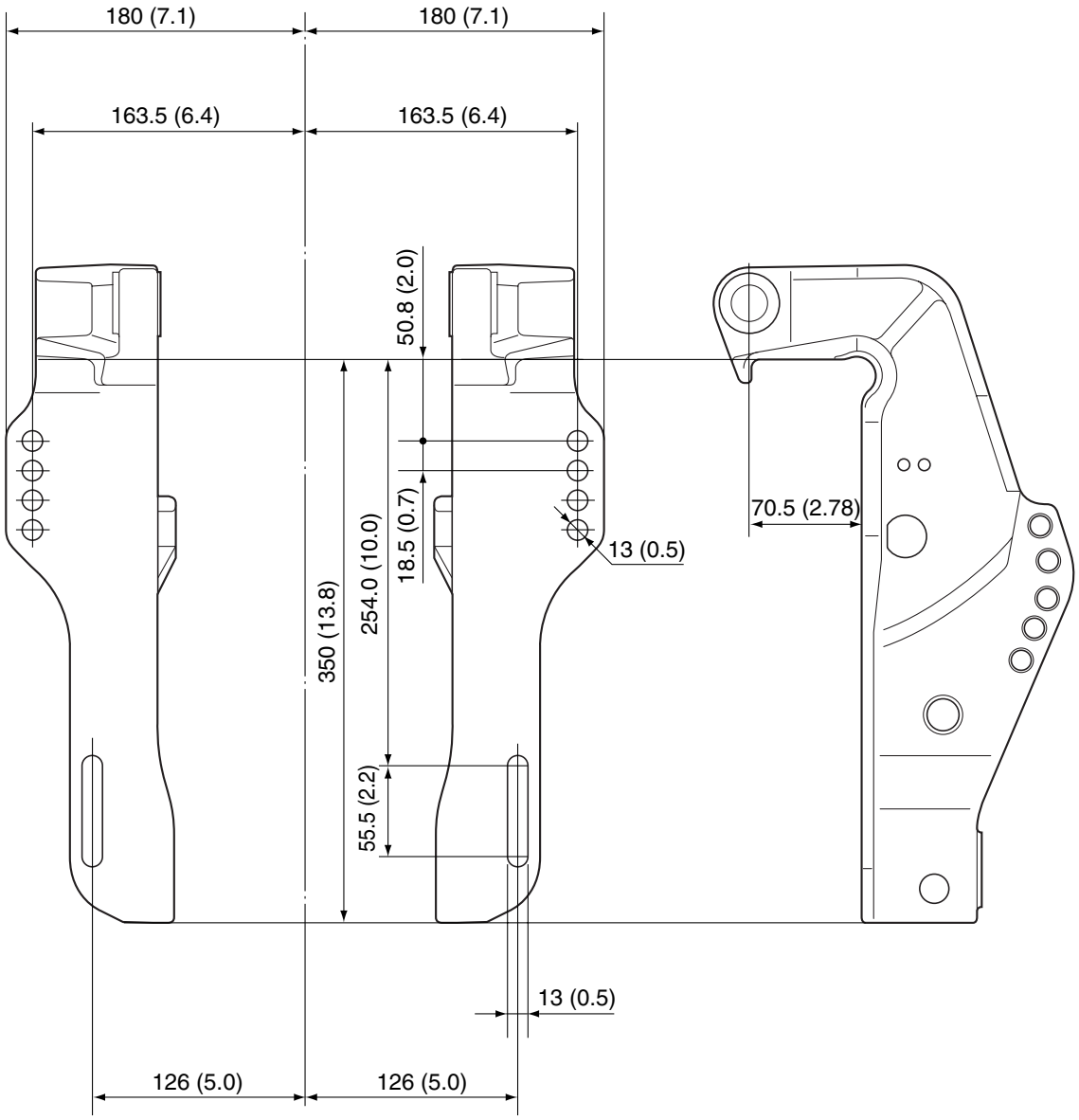


S6C12010

X: For Oceania

Clamp bracket

mm (in)



S6C12070

Tightening torques

Specified torques

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Fuel system				
Fuel filter cup	—	3	0.3	2.2
Fuel pump screw	M5	3	0.3	2.2
Fuel pump valve screw	M3	0.5	0.05	0.36
Idle speed control screw	M5	4	0.4	3.0
Sensor assembly screw	M5	4	0.4	3.0
Fuel cooler screw	M6	3	0.3	2.2
Fuel rail mounting bolt	M6	9	0.9	6.6
Throttle body mounting bolt	M6	9	0.9	6.6
Pressure regulator bolt	M6	5	0.5	3.7
Drain screw	—	1.5	0.15	1.1
Joint screw	—	4	0.4	3.0
Vapor separator cover screw	M5	3	0.3	2.2
Plate screw	M4	2	0.2	1.5
Power unit				
Power unit mounting bolt	M8	27	2.7	20.0
Shift position switch screw	M4	2	0.2	1.5
Stator coil bracket bolt	M6	4	0.4	3.0
Pulser coil bolt	M5	4	0.4	3.0
Flywheel magnet nut	M20	157	15.7	115.8
Starter motor bolt	M8	29	2.9	21.4
Starter motor terminal nut	M8	9	0.9	6.6
Starter relay lead bolt	M6	4	0.4	3.0
Starter motor lead screw	M4	2	0.2	1.5
Starter relay holder screw	M6	3	0.3	2.2
Main and fuel pump relay screw	M6	3	0.3	2.2
ECM cover screw	M6	3	0.3	2.2
Self diagnosis connector screw	M6	3	0.3	2.2
Ignition coil bolt	M6	7	0.7	5.2
Oil filter	—	18	1.8	13.3
PTT relay nut	M6	4	0.4	3.0
PTT motor lead bolt	M6	4	0.4	3.0
Positive battery lead nut	M8	9	0.9	6.6
Drive sprocket nut	M41	140	14.0	103.3
Driven sprocket bolt	M10	38	3.8	28.0
Rocker arm lock nut	M10	14	1.4	10.3
Rocker arm shaft bolt	M8	18	1.8	13.3

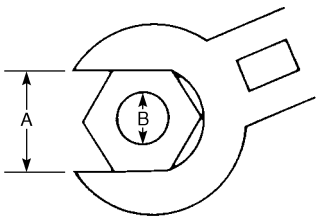
Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Cylinder head bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
	1st	M9	12	1.2	8.9
	2nd		23	2.3	17.0
	3rd		90°		
Spark plug		—	17	1.7	12.5
Cooling water temperature sensor		—	23	2.3	17.0
Oil pressure switch		—	8	0.8	5.9
Oil pressure switch lead bolt		M4	2	0.2	1.5
Exhaust cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Exhaust cover plug		M14	23	2.3	17.0
		M18	55	5.5	40.6
Oil filter union bolt		—	40	4.0	29.5
Oil pump screw		M6	4	0.4	3.0
Crankcase bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
	1st	M8	15	1.5	11.1
	2nd		30	3.0	22.1
Connecting rod cap bolt	1st	—	6	0.6	4.4
	2nd		17	1.7	12.5
Lower unit (F50, F60)					
Gear oil drain screw		—	9	0.9	6.6
Gear oil check screw		—	9	0.9	6.6
Lower case mounting bolt		M10	39	3.9	28.8
Propeller nut		M16	34	3.4	25.1
Ring nut		—	103	10.3	76.0
Cooling water inlet cover screw		—	4	0.4	3.0
Pinion nut		M16	74	7.4	54.6
Propeller shaft housing bolt		M8	16	1.6	11.8
Lower unit (FT50, FT60)					
Gear oil drain screw		—	9	0.9	6.6
Gear oil check screw		—	9	0.9	6.6
Lower case mounting bolt (nut)		M10	39	3.9	28.8
Propeller nut		M16	34	3.4	25.1
Ring nut		—	103	10.3	76.0
Cooling water inlet cover screw		—	4	0.4	3.0
Pinion nut		M16	93	9.3	68.6
Propeller shaft housing bolt		M8	16	1.6	11.8

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Bracket unit				
Retaining plate bolt	M6	10	1.0	7.4
Tiller handle nut	—	37	3.7	27.3
Self-locking nut	—	4	0.4	3.0
Engine stop lanyard switch nut	—	2	0.2	1.5
Tiller handle bracket nut	—	37	3.7	27.3
Tiller handle bracket bolt	M12	37	3.7	27.3
Engine start switch nut	—	4	0.4	3.0
Shift rod detent bolt	—	18	1.8	13.3
PTT switch bracket bolt	M6	10	1.0	7.4
Flushing hose adapter screw	M6	2	0.2	1.5
Engine oil drain bolt	M14	17	1.7	12.5
Muffler bolt	M6	10	1.0	7.4
Exhaust manifold bolt	M6	10	1.0	7.4
Oil pan bolt	M8	27	2.7	20.0
Oil strainer bolt	M6	10	1.0	7.4
Upper mounting nut	M8	24	2.4	17.7
Self-locking nut	—	22	2.2	16.2
Grease nipple	—	3	0.3	2.2
Power trim and tilt unit				
PTT motor bolt	M5	4	0.4	3.0
Reservoir cap	—	7	0.7	5.2
Manual valve	—	2	0.2	1.5
Gear pump bolt	M5	5	0.5	3.7
Lever bolt	M3	3	0.3	2.2
Relief valve seat cap bolt	M4	4	0.4	3.0
	M5	5	0.5	3.7
Gear pump housing bolt	M5	5	0.5	3.7
Gear pump bracket bolt	M3	3	0.3	2.2
	M5	4	0.4	3.0
Tilt cylinder end screw	—	110	11.0	81.1
Trim cylinder end screw	—	80	8.0	59.0
Tilt piston bolt	M12	61	6.1	45.0

General torques

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

Nut (A)	Bolt (B)	General torque specifications		
		N·m	kgf·m	ft·lb
8 mm	M5	5	0.5	3.6
10 mm	M6	8	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	25
17 mm	M12	43	4.3	31



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Periodic checks and adjustments

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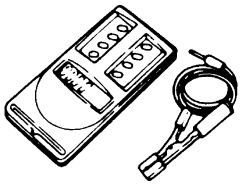
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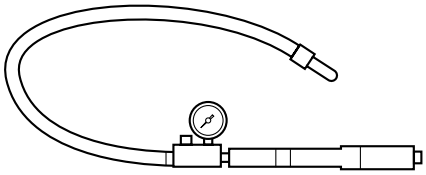
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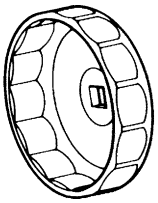
Special service tools



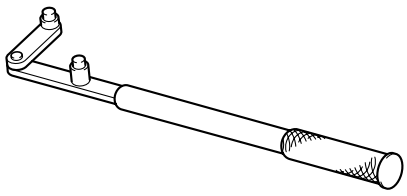
Digital tachometer
90890-06760



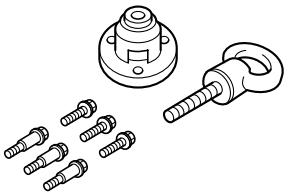
Leakage tester
90890-06840



Oil filter wrench
90890-01426



Flywheel holder
90890-06522



Flywheel puller
90890-06521

Maintenance interval chart

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

Item	Remarks	Initial		Every		Refer to page
		10 hours (1 month)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Anodes (external)	Check/replace		○	○		3-16
Anodes (internal)	Check/replace				○	3-16
Battery	Check/charge	○				3-17
Cooling water passages	Clean		○	○		3-10
Top cowling	Check				○	3-3
Fuel filter (can be disassembled)	Check/replace	○	○	○		3-3
Fuel system	Check	○	○	○		3-3
Fuel tank (Yamaha portable tank)	Check/clean				○	—
Gear oil	Change	○		○		3-14
Lubrication points	Lubricate			○		3-18
Engine idle speed (EFI models)	Check/adjust				○	3-10
Power trim and tilt unit	Check				○	3-13
Propeller and cotter pin	Check/replace		○	○		3-16
Shift link/shift cable	Check/adjust				○	3-12
Thermostat	Check				○	3-9
Throttle link/throttle cable/ throttle pick-up timing	Check/adjust				○	3-10
Water pump	Check				○	6-7, 6-32
Engine oil	Check/change	○		○		3-3
Oil filter	Change				○	3-5
Spark plugs	Clean/adjust/ replace	○			○	3-8
Timing belt	Check/replace			○	○	3-6
Valve clearance (OHC)	Check/adjust	○		○		5-4

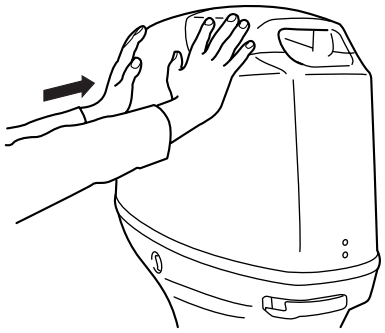
NOTE:
When operating in salt water, turbid or muddy water, the engine should be flushed with clean water after each use.

Item	Remarks	Every		Refer to page
		500 hours (2.5 years)	1,000 hours (5 years)	
Timing belt	Replace		○	3-6

Top cowling

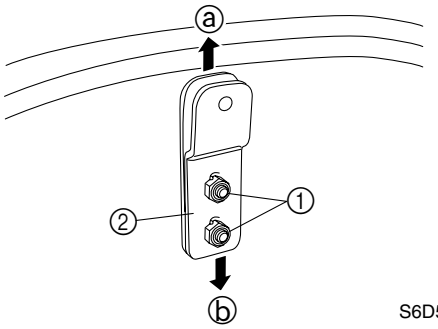
Checking the top cowling

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


S6C13010

2. Loosen the nuts ①.

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



S6D53020

NOTE:
- To loosen the fitting, move the hook in direction ⓐ.
- To tighten the fitting, move the hook in direction ⓑ.

4. Tighten the nuts.

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

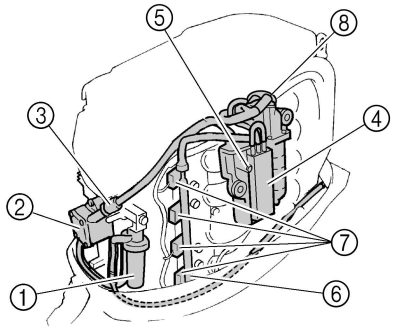
Fuel system

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

1. Remove the flywheel magnet cover.

2. Check the low-pressure fuel hose connections and fuel joint for leaks. Replace if necessary. Also, check the fuel filter ①, fuel pump ②, strainer ③, and fuel cooler ④ for leaks or deterioration. Replace if necessary.

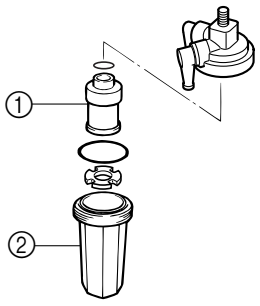
3. Check the high-pressure fuel hose connections for leaks. Replace if necessary. Also, check the vapor separator ⑤, fuel rail ⑥, fuel injectors ⑦, and pressure regulator ⑧ for leaks or deterioration. Replace if necessary.



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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 the cup with straight gasoline and replace the element if necessary.



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

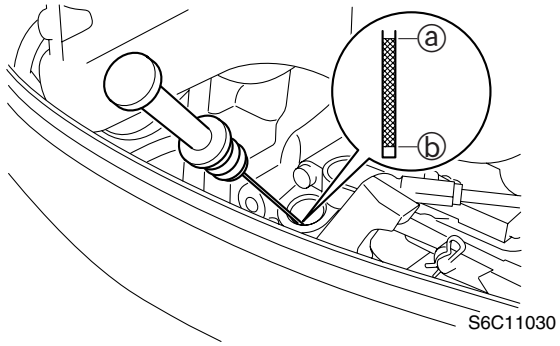
Power unit

Checking the engine oil level

1. Place the outboard motor in an upright position.

2. Remove the oil dipstick, wipe it clean, and then insert it back into the dipstick hole.

3. Remove the oil dipstick again to check the oil level and to check the oil for discoloration and its viscosity.

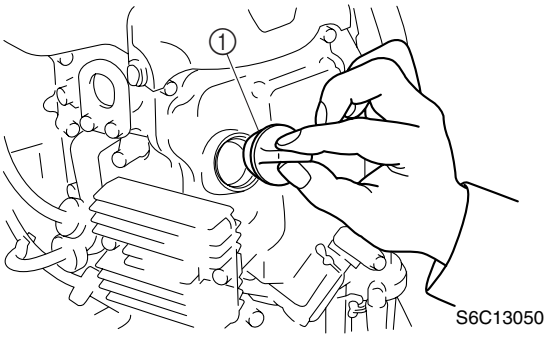


NOTE:
- Change the oil if it appears milky or dirty.
- If the engine oil is below the minimum level mark ⓑ, add sufficient oil until the level is between ⓐ and ⓑ.

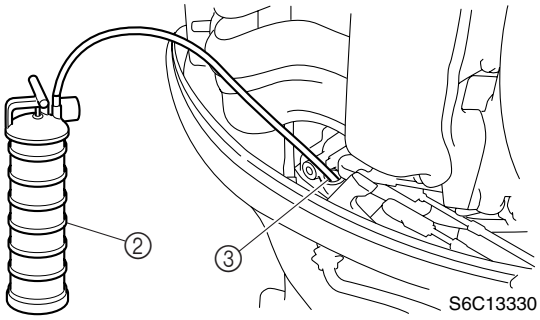
Changing the engine oil using an oil changer

1. Start the engine, warm it up, and then turn it off.

2. Remove the oil dipstick and oil filler cap ①.



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



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, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter replacement:
2.5 L (2.64 US qt, 2.20 Imp qt)

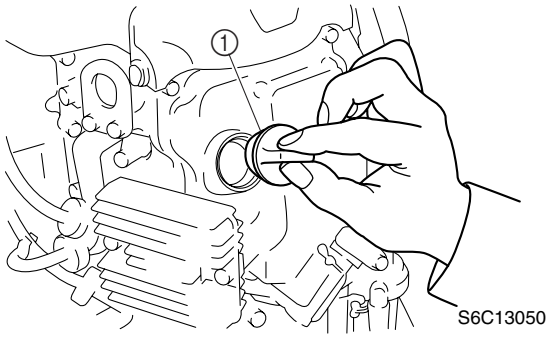
6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

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

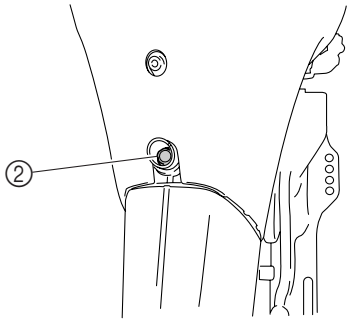
Changing the engine oil by draining it

1. Start the engine, warm it up, and then turn it off.

2. Remove the oil dipstick and oil filler cap ①.



3. Place a drain pan under the drain hole, and then remove the drain bolt ② and gasket and let the oil drain completely.



NOTE:
Be sure to clean up any oil spills.

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

Engine oil drain bolt:
17 N·m (1.7 kgf·m, 12.5 ft·lb)

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, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter replacement:
2.5 L (2.64 US qt, 2.20 Imp qt)

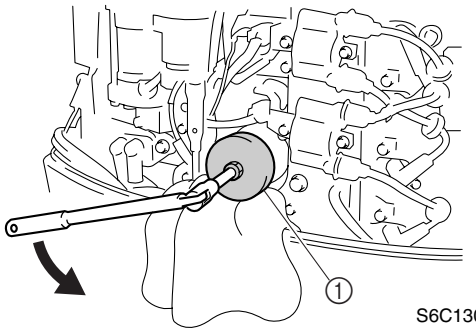
6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

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

Replacing the oil filter

1. Extract the engine oil with an oil changer or drain it.

2. Place a rag under the oil filter, and then remove the oil filter using the oil filter wrench ①.

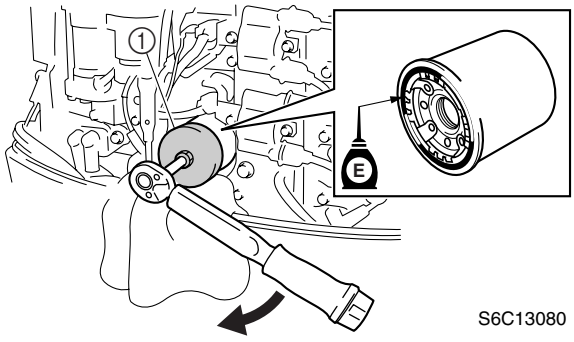


NOTE:
- Wait more than 5 minutes after turning the engine off to replace the oil filter.
- Be sure to clean up any oil spills.

Oil filter wrench ①: 90890-01426

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

4. Install the oil filter, and then tighten it to the specified torque using the oil filter wrench ①.



Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

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, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
With oil filter replacement:
2.7 L (2.85 US qt, 2.38 Imp qt)

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

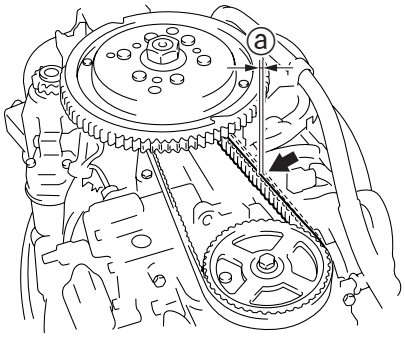
7. Turn the engine off, and then check the oil level and correct it if necessary.

Checking the timing belt

CAUTION:

Do not turn the flywheel magnet counterclockwise, otherwise the valve system may be damaged.

1. Remove the flywheel magnet cover.
2. Remove the solenoid valve.
3. While turning the flywheel magnet clockwise, check the interior and the exterior of the timing belt for cracks, damage, or wear. Replace if necessary.
4. Turn the flywheel magnet clockwise to transfer the slack of the timing belt from port to starboard, and then lightly hold the flywheel magnet in place.
5. Slightly push the timing belt with your finger between the drive gear and driven gear, and then measure the belt slack. Replace the timing belt if above specification.



S6C13090

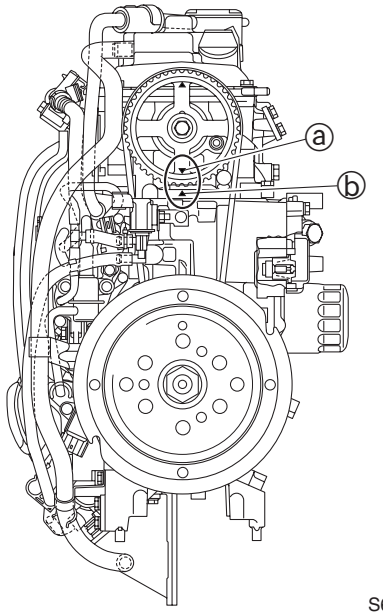
Timing belt slack ⓐ:
Within 14 mm (0.55 in)

Replacing the timing belt

CAUTION:

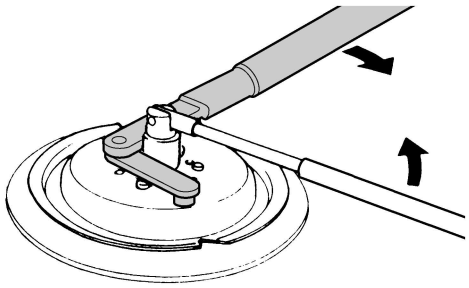
Do not turn the flywheel magnet counterclockwise, otherwise the valve system may be damaged.

1. Remove the flywheel magnet cover.
2. Turn the flywheel magnet clockwise and align the "▲1" mark ⓐ on the driven sprocket with the "▲" mark ⓑ on the cylinder head.



S6C15850

3. Loosen the flywheel magnet nut.



S6D55B30

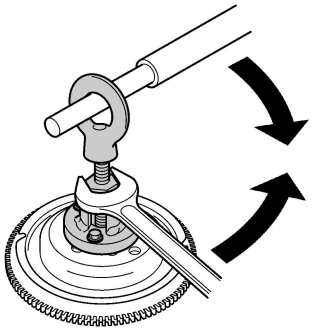
CAUTION:

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

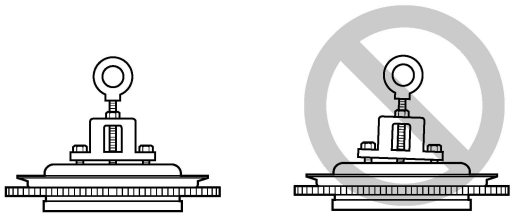


Flywheel holder: 90890-06522

4. Remove the flywheel magnet, then the Woodruff key.



S63P5280



S63P5290

CAUTION:

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

NOTE:

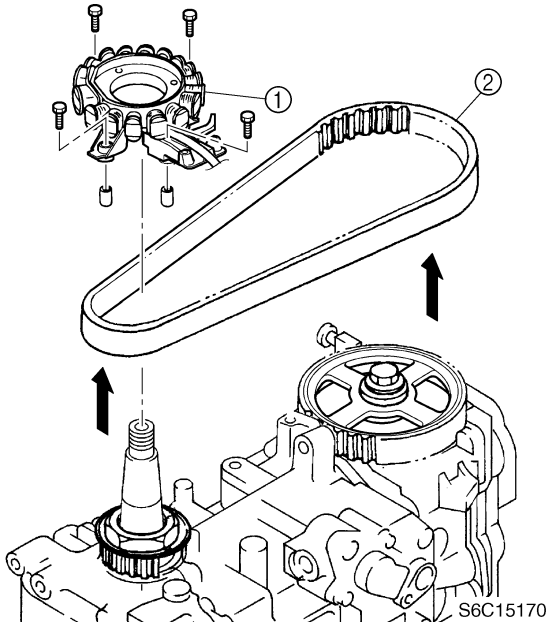
Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.



Flywheel puller: 90890-06521

5. Disconnect the stator coil coupler and pulser coil coupler, and remove the stator coil assembly ①.

6. Remove the solenoid valve, and then remove the timing belt ② from the driven sprocket, then from the drive sprocket.

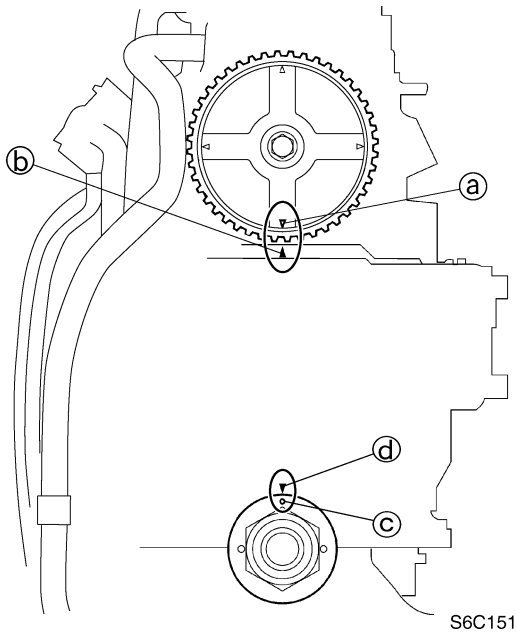


S6C15170

CAUTION:

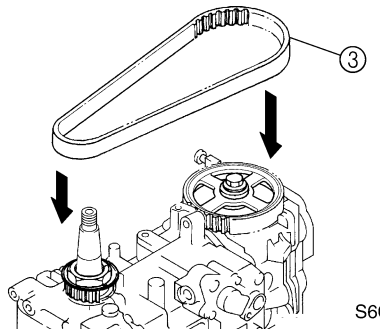
Do not turn the drive sprocket or the driven sprocket when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.

7. Check that the "▲1" mark ⓐ on the driven sprocket is aligned with the "▲" mark ⓑ on the cylinder head, and that the "●" mark ⓒ on the retaining plate is aligned with the "▲" mark ⓓ on the crankcase.



S6C15180

8. Install a new timing belt ③ onto the drive sprocket, then onto the driven sprocket with its part number in the upright position.



S6C15190

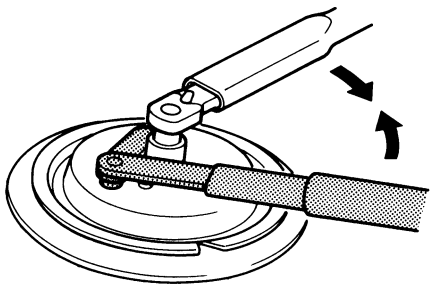
CAUTION:

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

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

10. Install the solenoid valve and stator coil assembly, and connect the stator coil coupler and pulser coil coupler.

11. Install the Woodruff key, then the flywheel magnet.

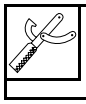

S63P5370

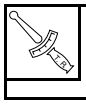
CAUTION:

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: 157 N·m (15.7 kgf·m, 115.8 ft·lb)

12. Adjust the pulser coil air gap.

NOTE:

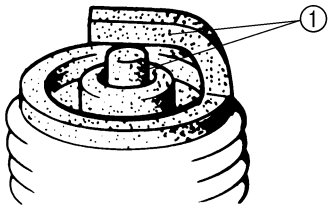
For adjustment procedures, see Chapter 8, “Checking the pulser coil air gap.”

13. Install the flywheel magnet cover.

Checking the spark plugs

1. Disconnect the spark plug wires, and then remove the spark plugs.

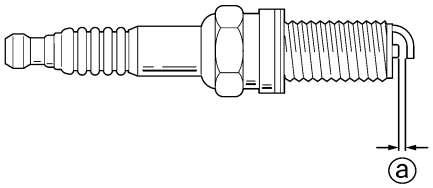
2. Clean the electrodes ① with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



S69J3190

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

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



S69J3200

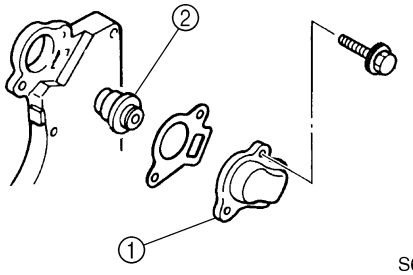
Specified spark plug:
DPR6EB-9 (NGK)
Spark plug gap ⓐ:
0.8–0.9 mm (0.031–0.035 in)

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

Spark plug:
17 N·m (1.7 kgf·m, 12.5 ft·lb)

Checking the thermostat

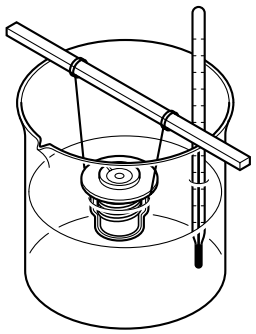
1. Remove the cover ①, gasket, and thermostat ②.



S6D53120

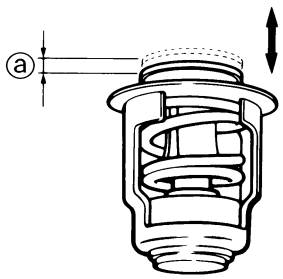
2. Suspend the thermostat in a container of water.

3. Place a thermometer in the water and slowly heat the water.



S69J5E40

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



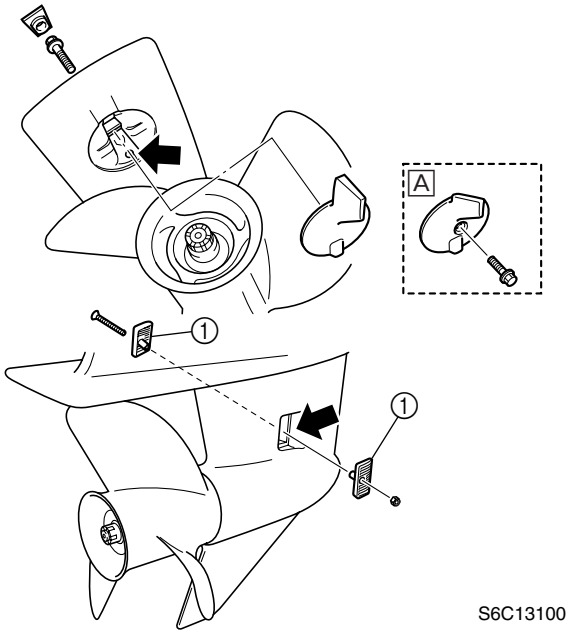
S69J5E50

Water temperature	Valve lift ⓐ
58–62 °C (136–144 °F)	0.05 mm (0.0020 in) (valve begins to lift)
above 70 °C (158 °F)	more than 3.0 mm (0.12 in)

5. Install the thermostat, gasket, and cover.

Checking the cooling water passage

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

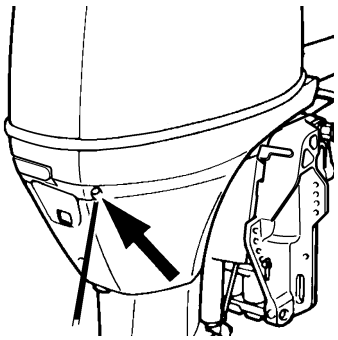


S6C13100

A F50, F60

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.

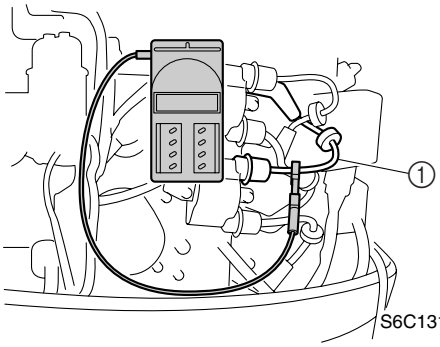

S68S1050

Control system

Checking the engine idle speed

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

2. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed.



S6C13110

Digital tachometer: 90890-06760

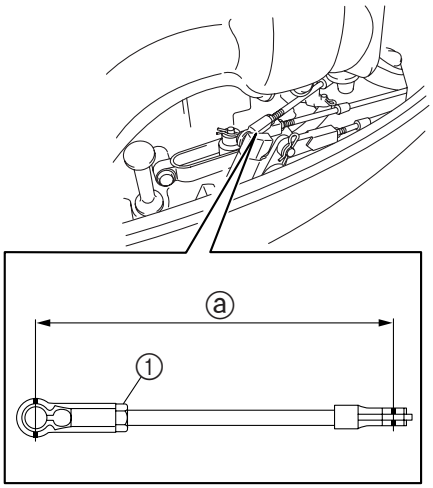
Engine idle speed: 700–800 r/min

Adjusting the throttle link and throttle cable

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

2. Disconnect the throttle link rod from the throttle body and the throttle link.

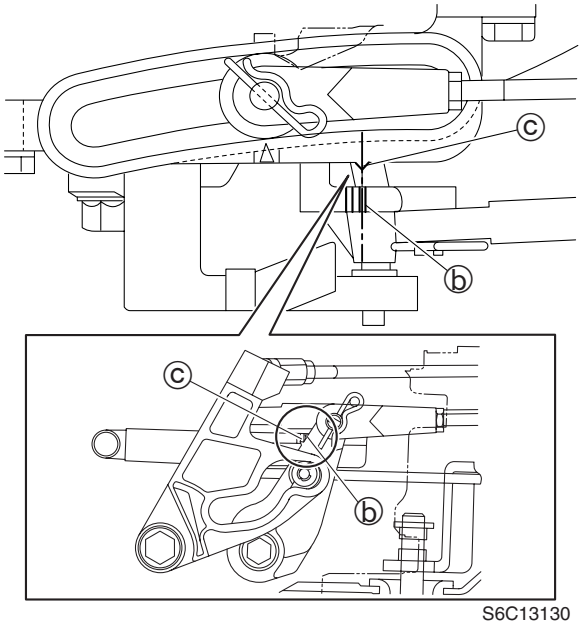
3. Loosen the locknut ①, and then adjust the throttle link rod length ⓐ.



S6C13120

Throttle link rod length ⓐ:
121 mm (4.76 in)

4. Align the alignment mark ⓑ on the throttle control lever with the alignment mark ⓒ on the bracket.

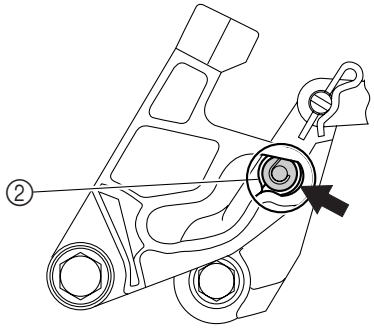


S6C13130

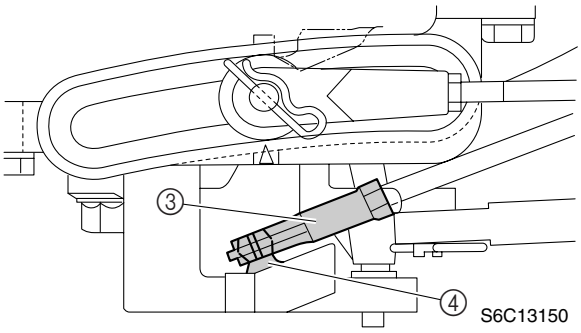
5. Connect the throttle link rod to the throttle body.

NOTE:
Connect the end of the throttle link rod that does not have a locknut to the throttle body.

6. Contact the cam roller ② on the throttle control lever to the throttle cam as shown, and then adjust the position of the throttle link rod until the joint ③ of the throttle link rod is aligned with the joint ④ of the control lever.



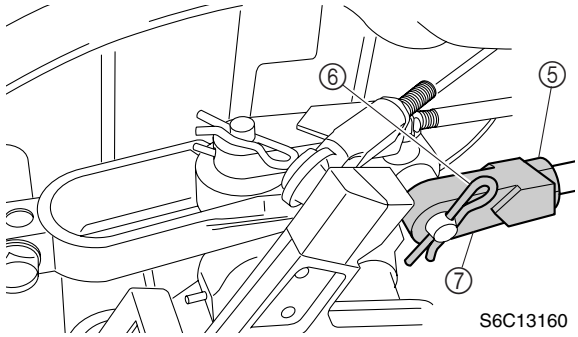
S6C13140



S6C13150

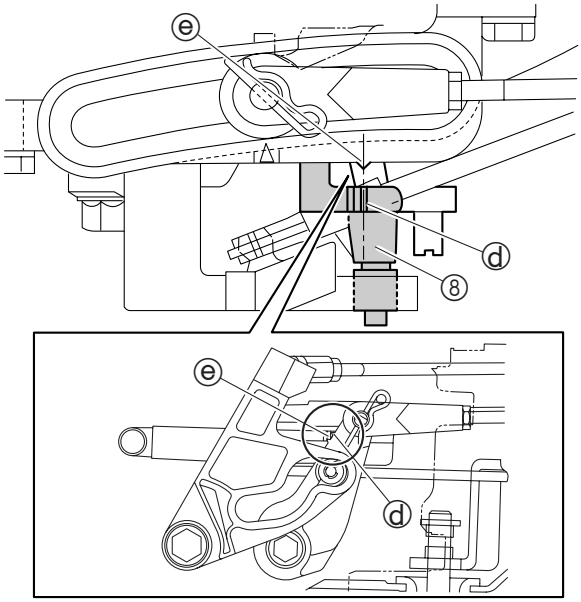
7. Connect the throttle link rod to the throttle link, and then tighten the locknut.

8. Loosen the locknut ⑤, remove the clip ⑥, and then disconnect the throttle cable joint ⑦.



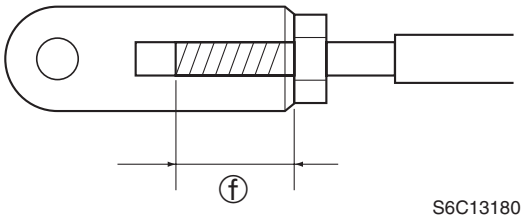
S6C13160

9. Adjust the throttle cam ⑧ until the alignment mark ⓓ on the throttle cam is aligned with the alignment mark ⓔ on the bracket.



S6C13170

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



S6C13180

NOTE:
Pull the throttle cable towards the set pin to remove any free play in the cable before adjusting the position of the throttle cable joint.

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

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

12. Operate the throttle to check that the throttle valves fully close and fully open, and check that the throttle cam contacts the fully closed stopper when the throttle is in the fully closed position.

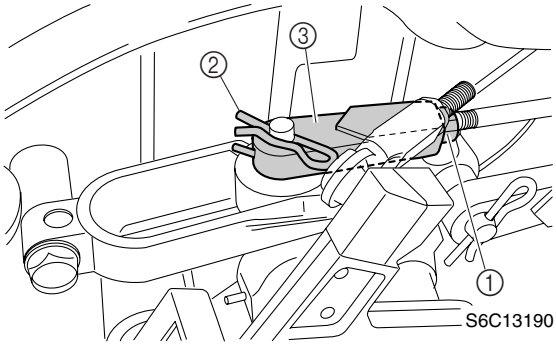
13. Check the throttle cable for smooth operation and, if necessary, repeat steps 1–12.

Checking the gear shift operation

1. Check that the gear shift operates smoothly when shifting it from neutral to forward or reverse. Adjust the shift cable length if necessary.

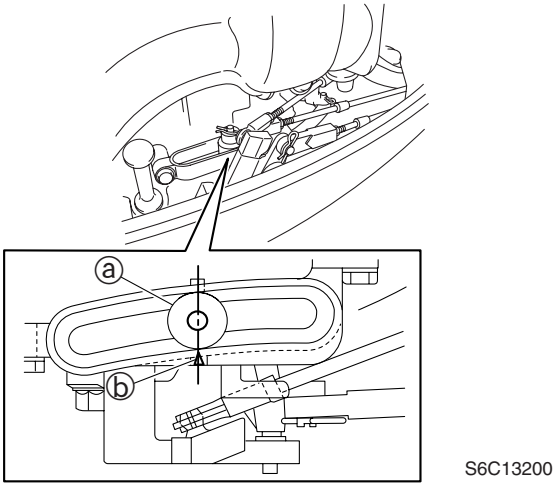
2. Set the gear shift to the neutral position.

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



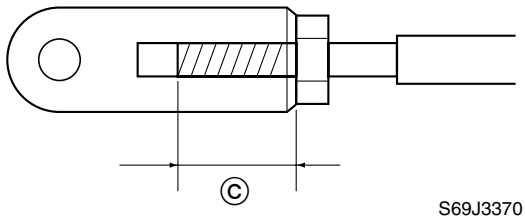
S6C13190

4. Align the center of the set pin ⓐ with the alignment mark ⓑ on the bracket.



S6C13200

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



S69J3370

⚠ WARNING

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

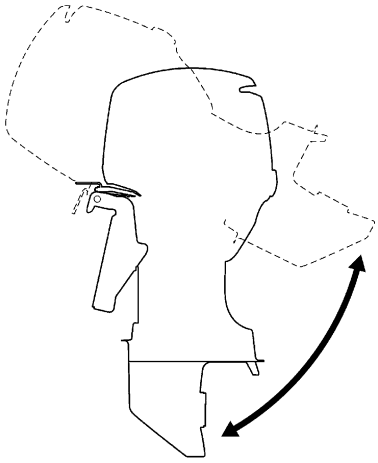
6. Connect the cable joint, install the clip, and then tighten the locknut.

7. Check the gear shift for smooth operation and, if necessary, repeat steps 3–6.

Bracket unit

Checking the power trim and tilt operation

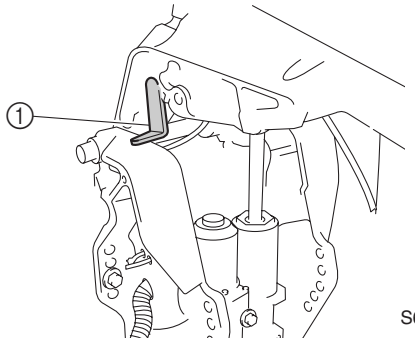
1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the power trim and tilt fluid level if necessary.


S6C13220

NOTE:

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

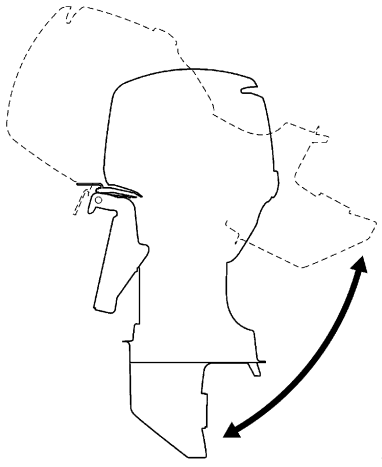
2. Fully tilt the outboard motor up, and then support it with the tilt stop lever ① to check the lock mechanism of the lever.



S6C13300

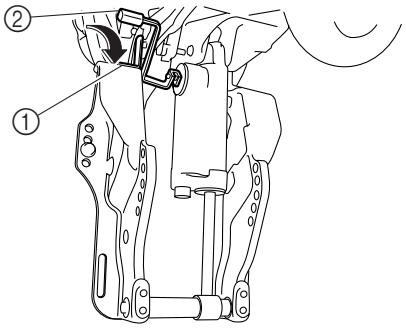
Checking the hydro tilt unit operation

1. Fully tilt the outboard motor up and down a few times and check the entire tilt range for smooth operation. Replace the hydro tilt unit if necessary.


S6C13220

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.

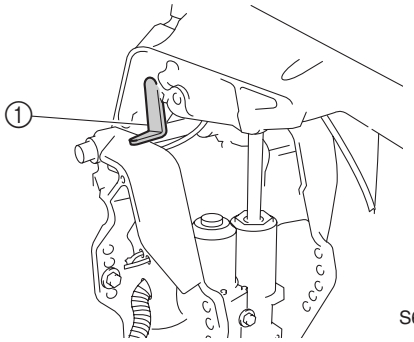
3. Fully tilt the outboard motor up, and then lock the tilt stop lever ② to check the lock mechanism of the hydro tilt unit. Replace the hydro tilt unit if necessary.



S6C13360

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.

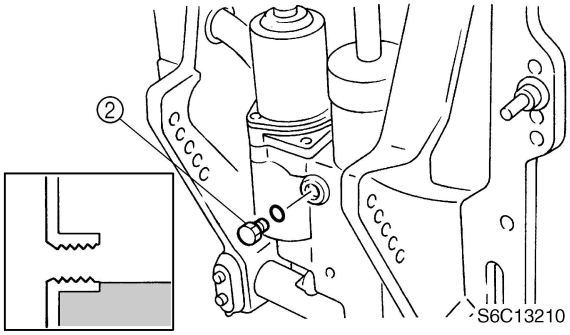


S6C13300

⚠ 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.



S6C13210

NOTE:

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

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

Recommended power trim and tilt fluid:
ATF Dexron II

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

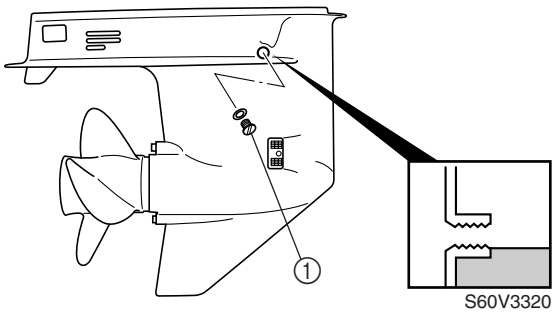
Reservoir cap:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

Lower unit

Checking the gear oil level

1. Fully tilt the outboard motor down.

2. Remove the check screw ①, and then check the gear oil level in the lower case.



S60V3320

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
API: GL-4
SAE: 90

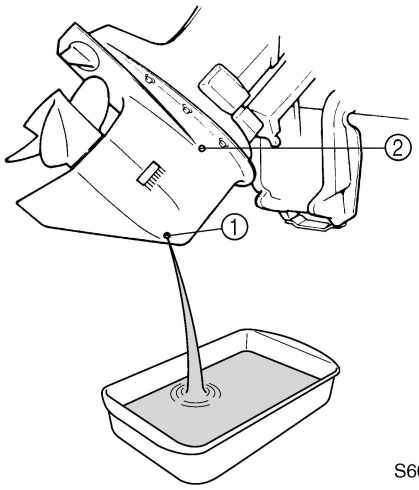
4. Install the check screw, and then tighten it to the specified torque.

Gear oil check screw:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Changing the gear oil

1. Tilt the outboard motor up slightly.

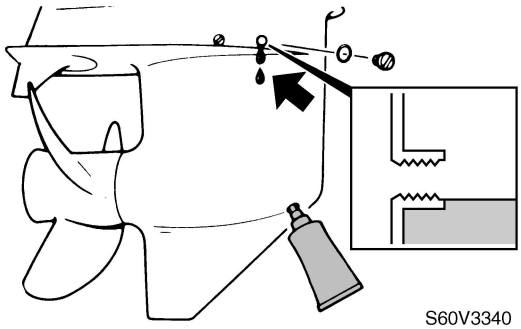
2. Place a drain pan under the drain screw ①, remove the drain screw, then the check screw ② and let the oil drain completely.

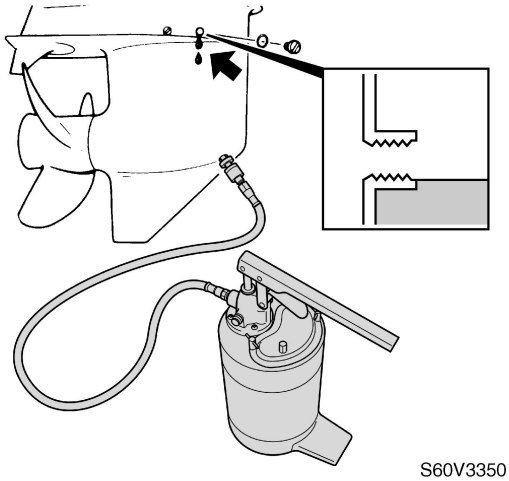


S60V3330

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

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


S60V3340


S60V3350

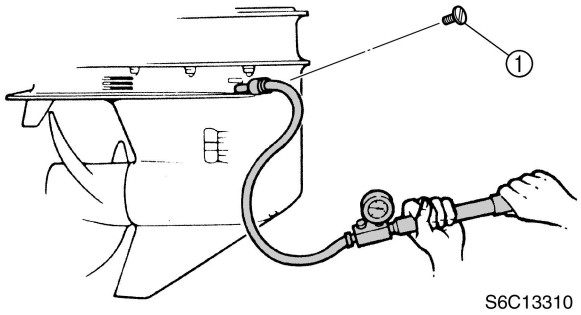
Recommended gear oil:
Hypoid gear oil
API: GL-4
SAE: 90
Gear oil quantity:
F50, F60:
430 cm^3
(14.5 US oz, 15.2 Imp oz)
FT50, FT60:
670 cm^3
(22.7 US oz, 23.6 Imp oz)

5. Install the check screw and quickly install the drain screw, and then tighten them to the specified torque.

Gear oil check screw and drain screw:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Checking the lower unit for air leakage

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



S6C13310

Leakage tester: 90890-06840

2. Apply the specified pressure to check that the pressure is maintained in the lower unit for at least 10 seconds.

CAUTION:

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

NOTE:

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

Lower unit holding pressure:
100 kPa (1.0 kgf/cm^2, 14.5 psi)

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

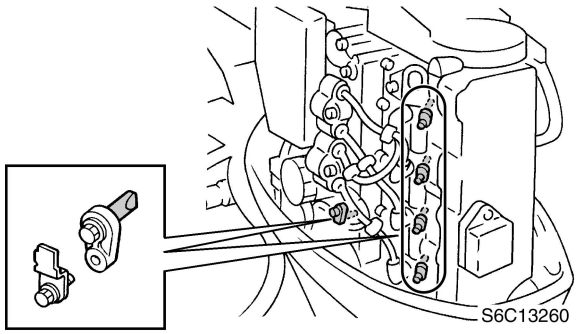
Checking the propeller

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

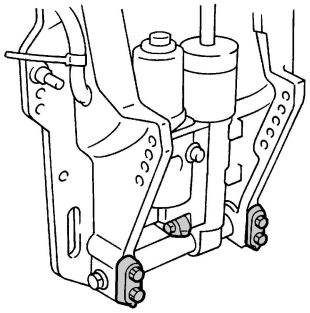
General

Checking the anodes

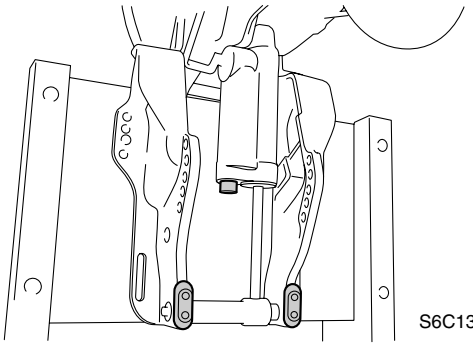
1. Check the anodes and trim tab for scales, grease, or oil. Clean if necessary.


S6C13260

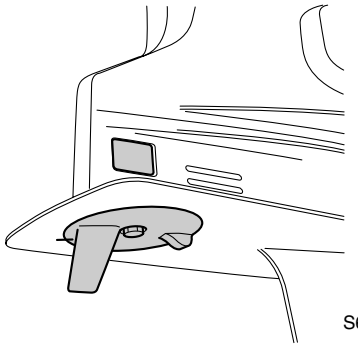
A


S6C13230

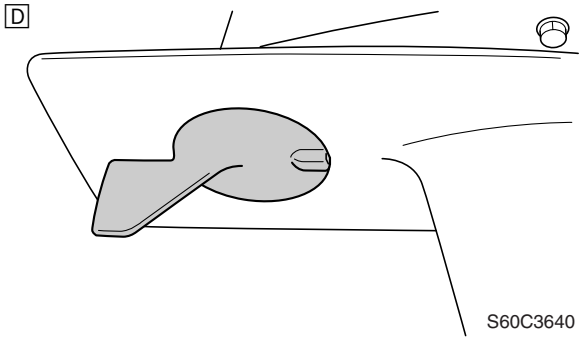
B


S6C13240

C


S6C13250

3



A Power trim and tilt model
B Hydro tilt model
C F50, F60
D FT50, FT60

CAUTION:

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

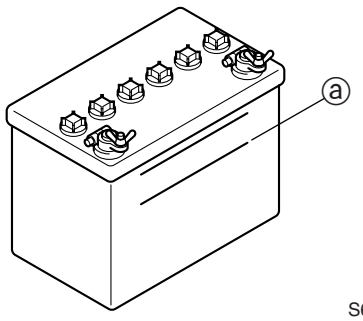
NOTE:

If it is necessary to disassemble the outboard motor to check an anode, refer to the applicable disassembly procedure in this manual.

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

Checking the battery

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



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

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.
Always follow these preventive measures:
- **Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.**
- **Wear protective eye gear when handling or working near batteries.**

Antidote (EXTERNAL):
- **SKIN – Wash with water.**
- **EYES – Flush with water for 15 minutes and get immediate medical attention.**

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

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:
- **Charge batteries in a well-ventilated area.**
- **Keep batteries away from fire, sparks or open flames (e.g., welding equipment, lighted cigarettes).**
- **DO NOT SMOKE when charging or handling batteries.**

KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

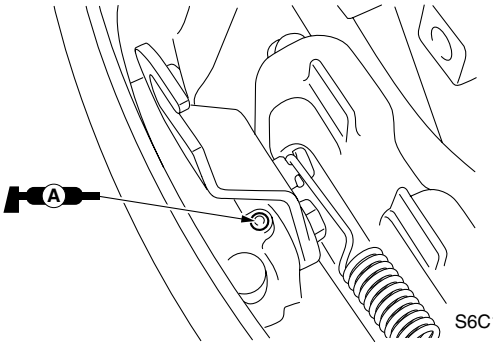
NOTE:

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

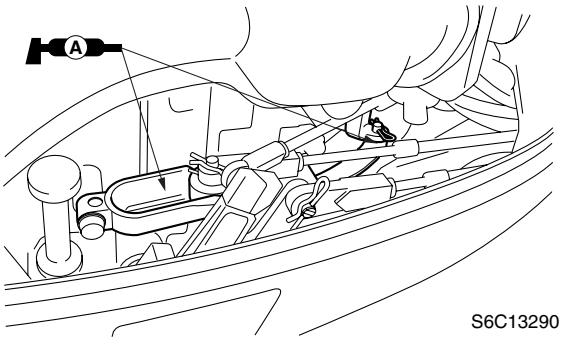
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Lubricating the outboard motor

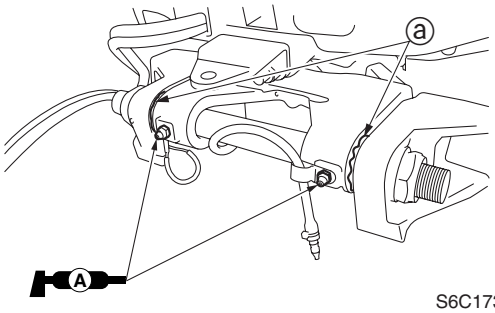
1. Apply water resistant grease to the areas shown.



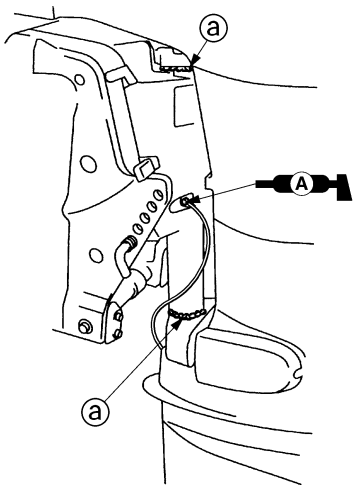
S6C13270



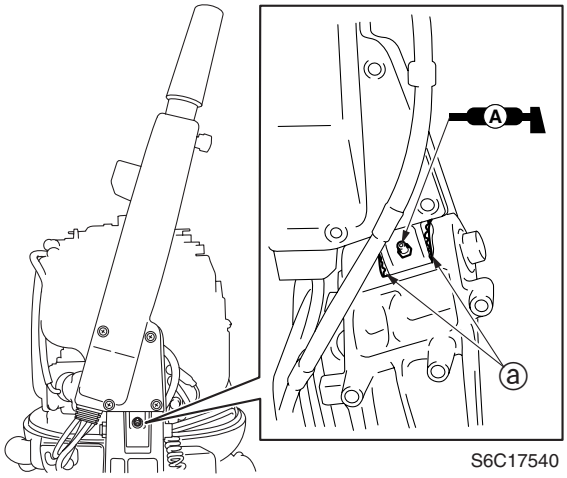
S6C13290



S6C17360



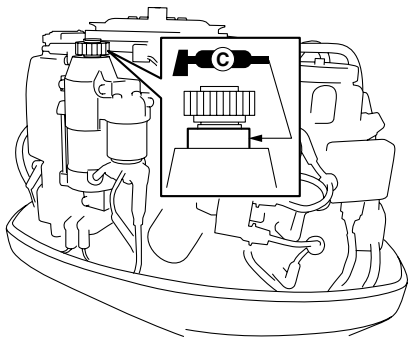
S6C13320



S6C17540

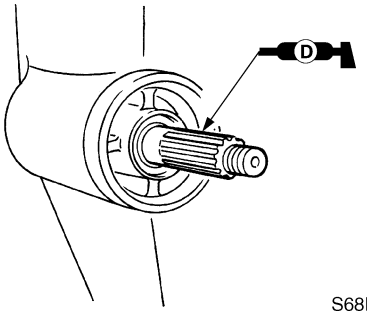
NOTE:
Apply grease to the grease nipple until it flows from the bushings ⓐ.

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



S6C13280

3. Apply corrosion resistant grease to the area shown.



S68F3190C

Fuel system

Special service tools 4-1

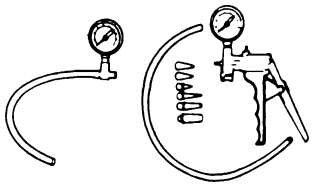
Hose routing 4-2
Fuel and blowby hoses 4-2
Cooling water pilot hoses 4-3

Fuel filter and fuel pump 4-4
Checking the fuel pump 4-6
Disassembling the fuel pump 4-6
Checking the diaphragm and valves 4-7
Assembling the fuel pump 4-7
Checking the fuel joint 4-7

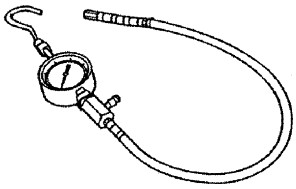
Intake manifold 4-8
Checking the throttle position sensor 4-11
Installing the throttle position sensor 4-11
Checking the idle speed control 4-11

Vapor separator 4-12
Disconnecting the quick connector 4-16
Measuring the fuel pressure 4-16
Checking the pressure regulator 4-17
Draining the fuel 4-18
Disassembling the vapor separator 4-18
Checking the vapor separator 4-19
Adjusting the float 4-19
Assembling the vapor separator 4-20

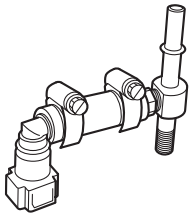
Special service tools



Vacuum/pressure pump gauge set
90890-06756

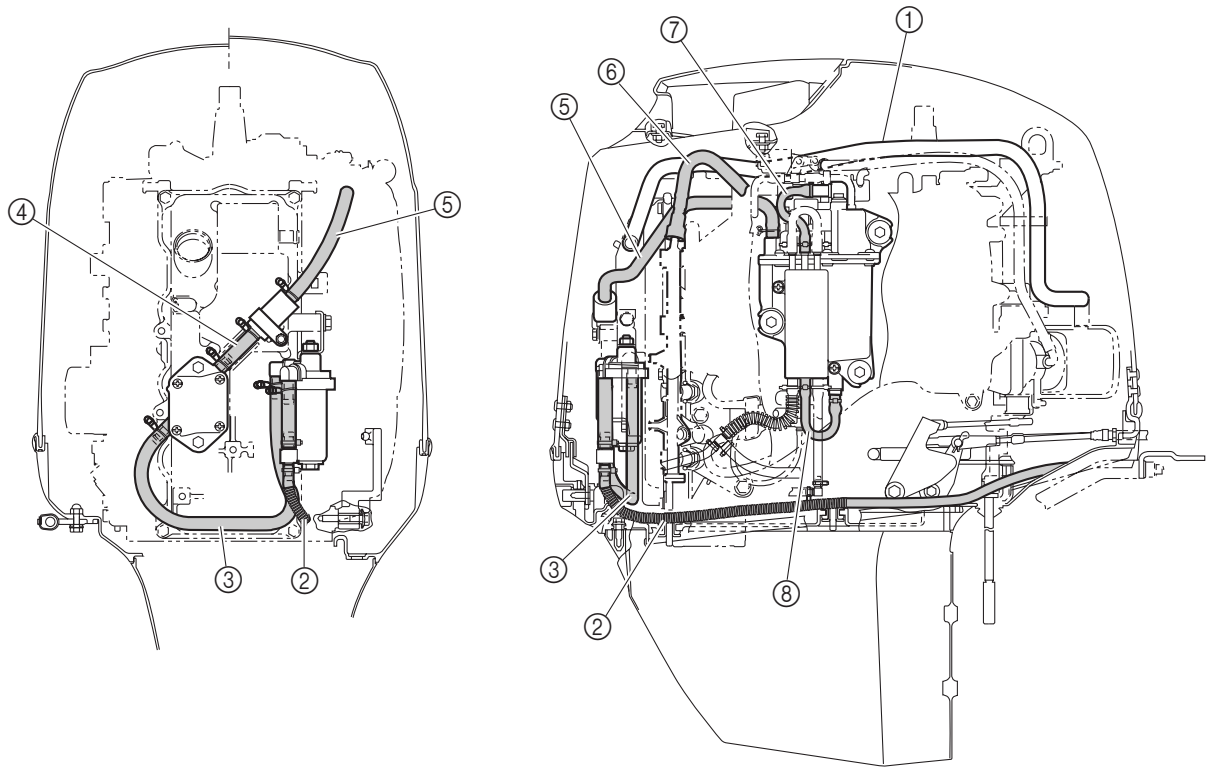


Fuel pressure gauge
90890-06786



Fuel pressure gauge adapter B
90890-06942

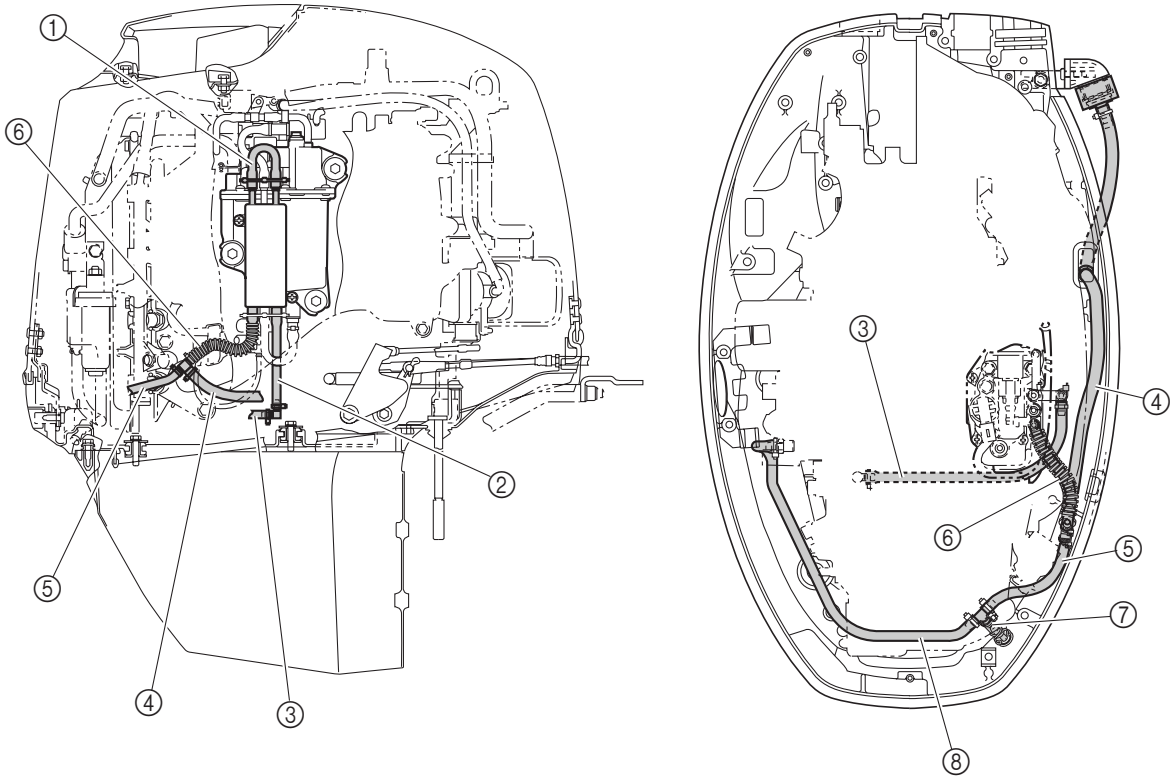
Hose routing
Fuel and blowby hoses



S6C14010

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-strainer)
⑤ Fuel hose (strainer-to-vapor separator)
⑥ High-pressure fuel hose (vapor separator-to-fuel rail)
⑦ Fuel hose (pressure regulator-to-fuel cooler)
⑧ Fuel hose (fuel cooler-to-vapor separator)

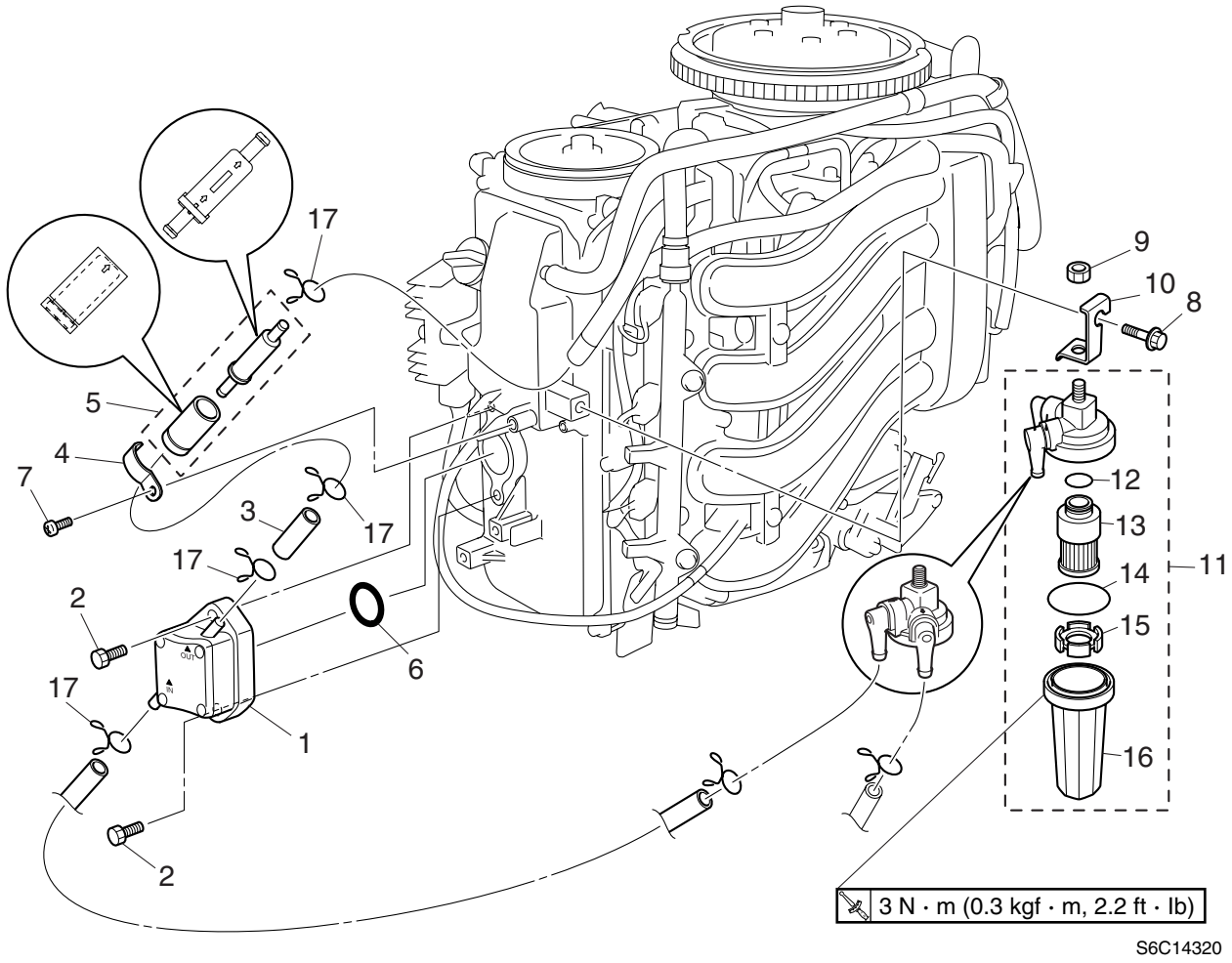
Cooling water pilot hoses



S6C14340

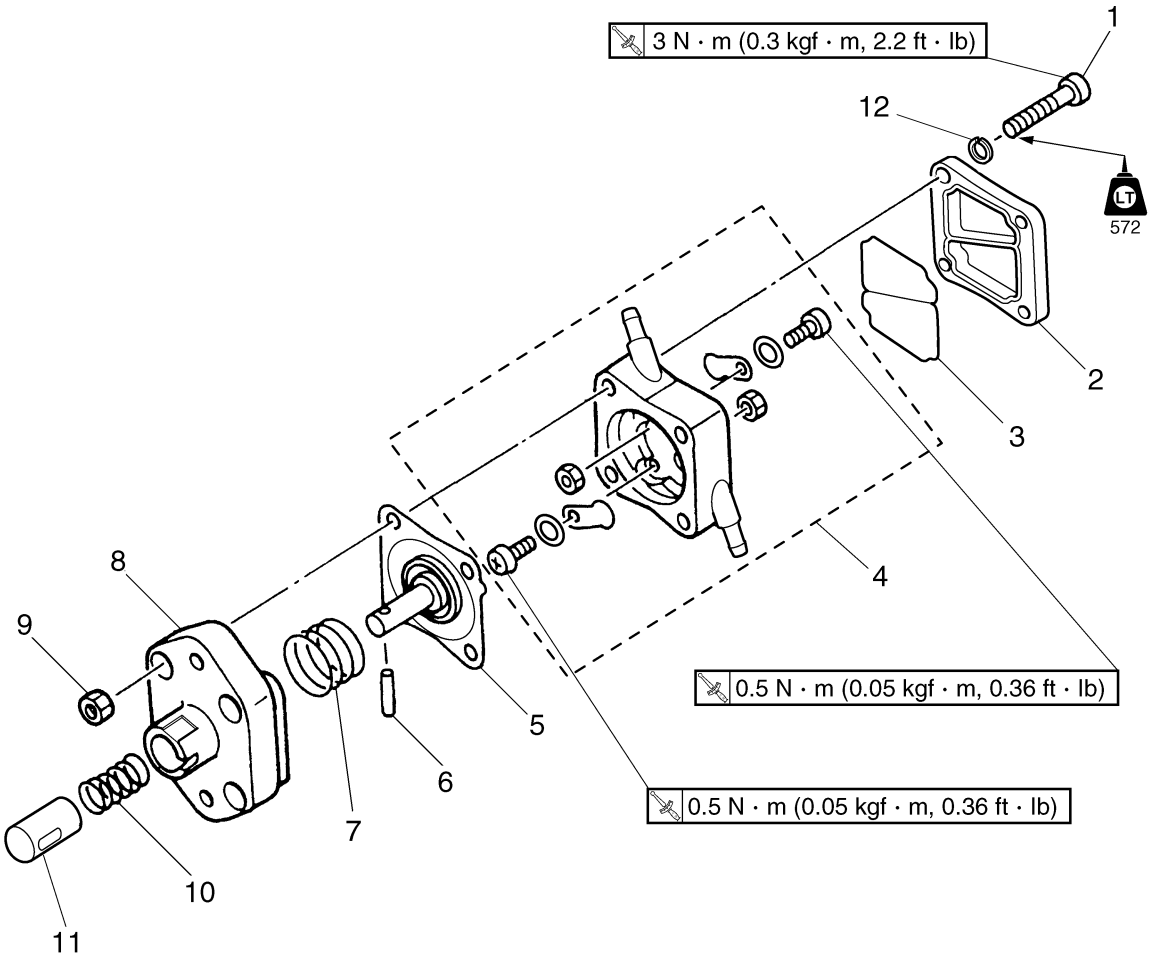
① Cooling water pilot hose (fuel cooler to fuel cooler)
② Cooling water pilot hose (fuel cooler to fuel joint)
③ Cooling water pilot hose (fuel joint to upper case)
④ Flushing hose (hose joint to fuel joint)
⑤ Cooling water pilot hose (fuel joint to water outlet joint)
⑥ Cooling water pilot hose (fuel cooler to fuel joint)
⑦ Cooling water pilot hose (water outlet joint to water outlet)
⑧ Cooling water pilot hose (water outlet joint to exhaust cover)

Fuel filter and fuel pump



S6C14320

No.	Part name	Q'ty	Remarks
1	Fuel pump assembly	1	
2	Bolt	2	M6 × 30 mm
3	Fuel hose	1	
4	Holder	1	
5	Strainer	1	
6	O-ring	1	**Not reusable**
7	Screw	1	ø6 × 14 mm
8	Bolt	1	M8 × 16 mm
9	Nut	1	
10	Bracket	1	
11	Fuel filter assembly	1	
12	O-ring	1	**Not reusable**
13	Fuel filter element	1	
14	O-ring	1	**Not reusable**
15	Float	1	
16	Cup	1	
17	Clamp	4	

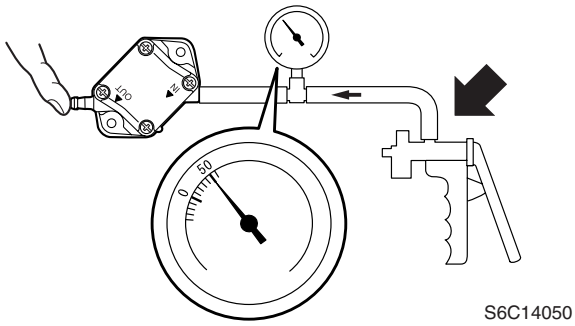


S6C14040

No.	Part name	Q'ty	Remarks
1	Screw	4	ø5 × 43 mm
2	Cover	1	
3	Seal	1	**Not reusable**
4	Fuel pump body 2 assembly	1	
5	Diaphragm	1	
6	Pin	1	
7	Spring	1	
8	Fuel pump body 1	1	
9	Nut	4	
10	Spring	1	
11	Plunger	1	
12	Spring washer	4	

Checking the fuel pump

1. Disconnect the fuel hoses from the fuel pump.
2. Connect the special service tool to the fuel pump inlet.
3. Cover the fuel pump outlet with a finger, and then apply the specified positive pressure. Check that there is no air leakage.

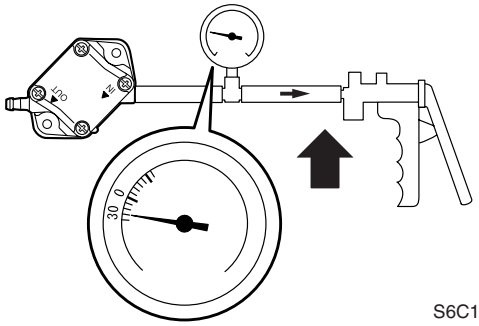


S6C14050

Vacuum/pressure pump gauge set:
90890-06756

Specified pressure:
50 kPa (0.5 kgf/cm^2, 7.3 psi)

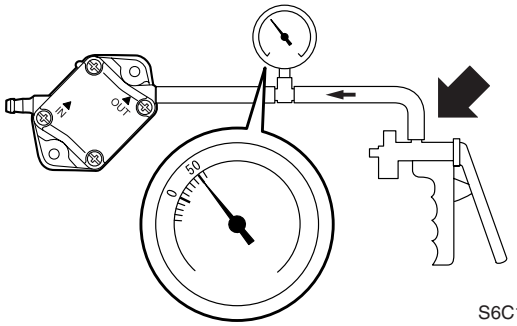
4. Apply the specified negative pressure and check that there is no air leakage.



S6C14060

Specified pressure:
30 kPa (0.3 kgf/cm^2, 4.4 psi)

5. Connect the special service tool to the fuel pump outlet.
6. Apply the specified positive pressure and check that there is no air leakage. Disassemble the fuel pump if necessary.



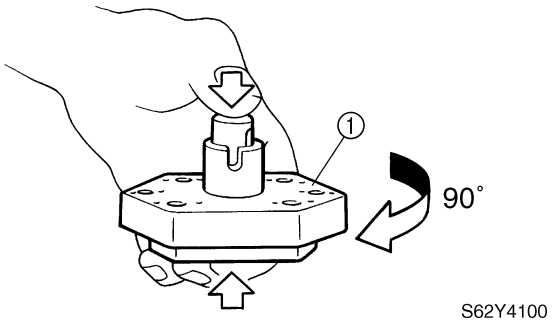
S6C14070

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

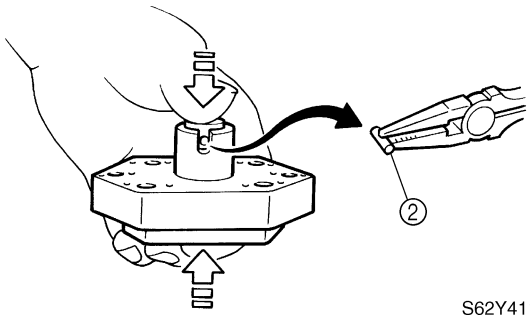
Specified pressure:
50 kPa (0.5 kgf/cm^2, 7.3 psi)

Disassembling the fuel pump

1. Disassemble the fuel pump.
2. Push down on the plunger and the diaphragm, turn fuel pump body 1 ① approximately 90° to a position where the pin ② can be removed easily, and then remove the pin.



S62Y4100



S62Y4110

3. Slowly let up on the plunger and diaphragm, and then remove them.

Checking the diaphragm and valves

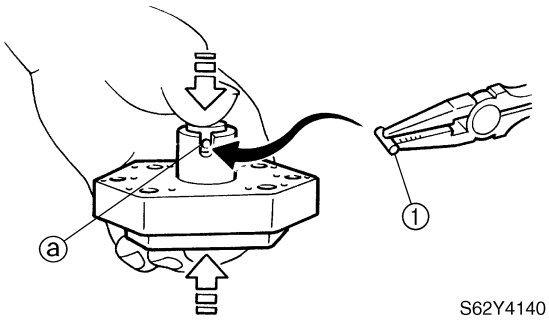
1. Check the diaphragm for tears and the valves for cracks. Replace if necessary.

Assembling the fuel pump

NOTE:
Clean the parts and soak the valves and the diaphragm in gasoline before assembly to obtain prompt operation of the fuel pump when starting the engine.

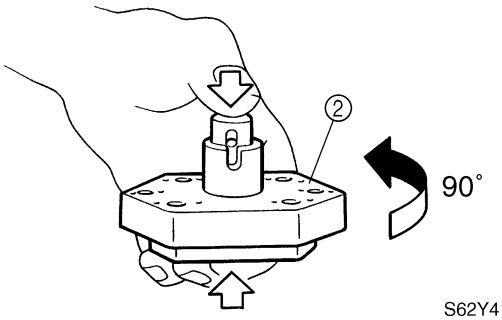
1. Align the plunger and diaphragm installation holes ⓐ, and then install the plunger into the diaphragm.

2. Push down on the plunger and the diaphragm, and then install the pin ①.



S62Y4140

3. Turn fuel pump body 1 ② approximately 90°, and then push down on the plunger several times to make sure that the pin does not come out.



S62Y4150

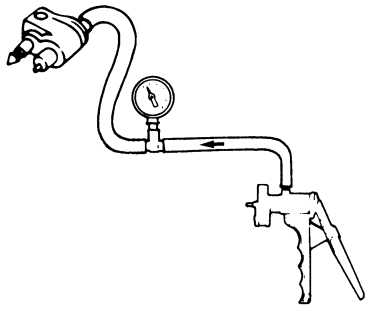
NOTE:
Make sure that the gasket and diaphragm are kept in place through the assembly process.

Checking the fuel joint

1. Check the fuel hose connector for cracks or damage.

2. Connect the special service tool to the fuel hose connector outlet.

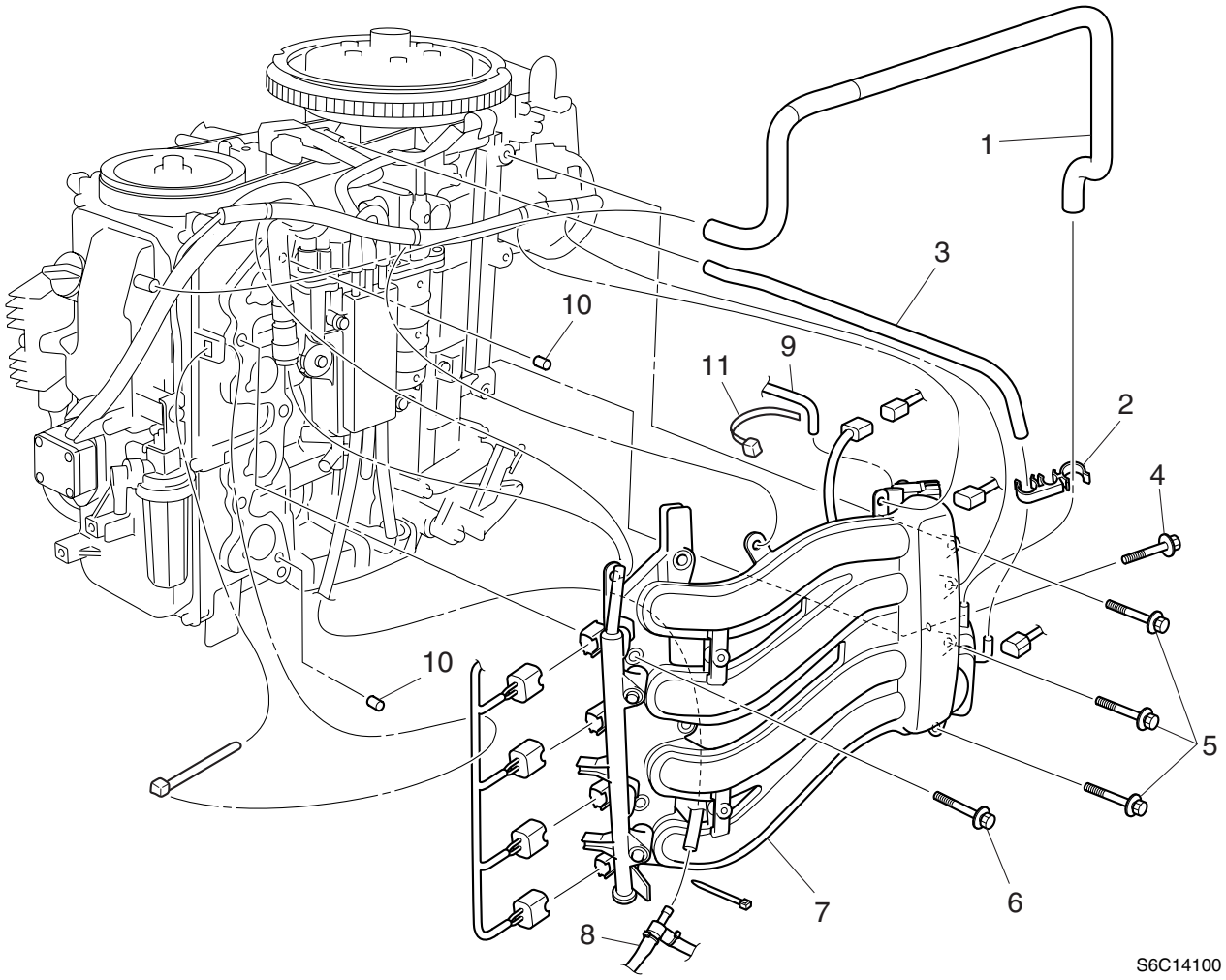
3. Apply the specified pressure to check that the pressure is maintained for 10 seconds. Replace the fuel hose connector if necessary.


S6C14330

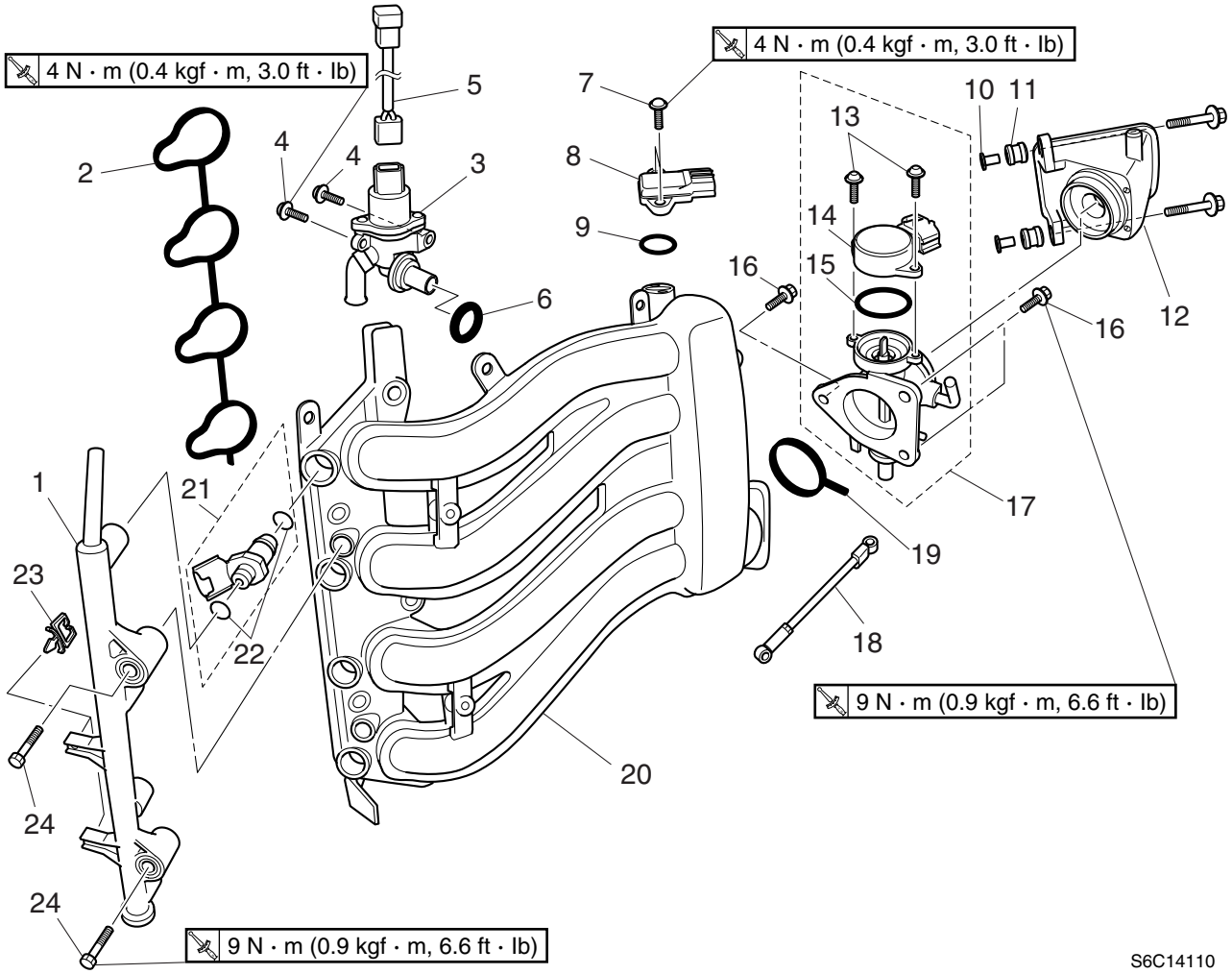
	Vacuum/pressure pump gauge set: 90890-06756

	Fuel hose connector holding pressure: 50 kPa (0.5 kgf/cm^2, 7.3 psi)

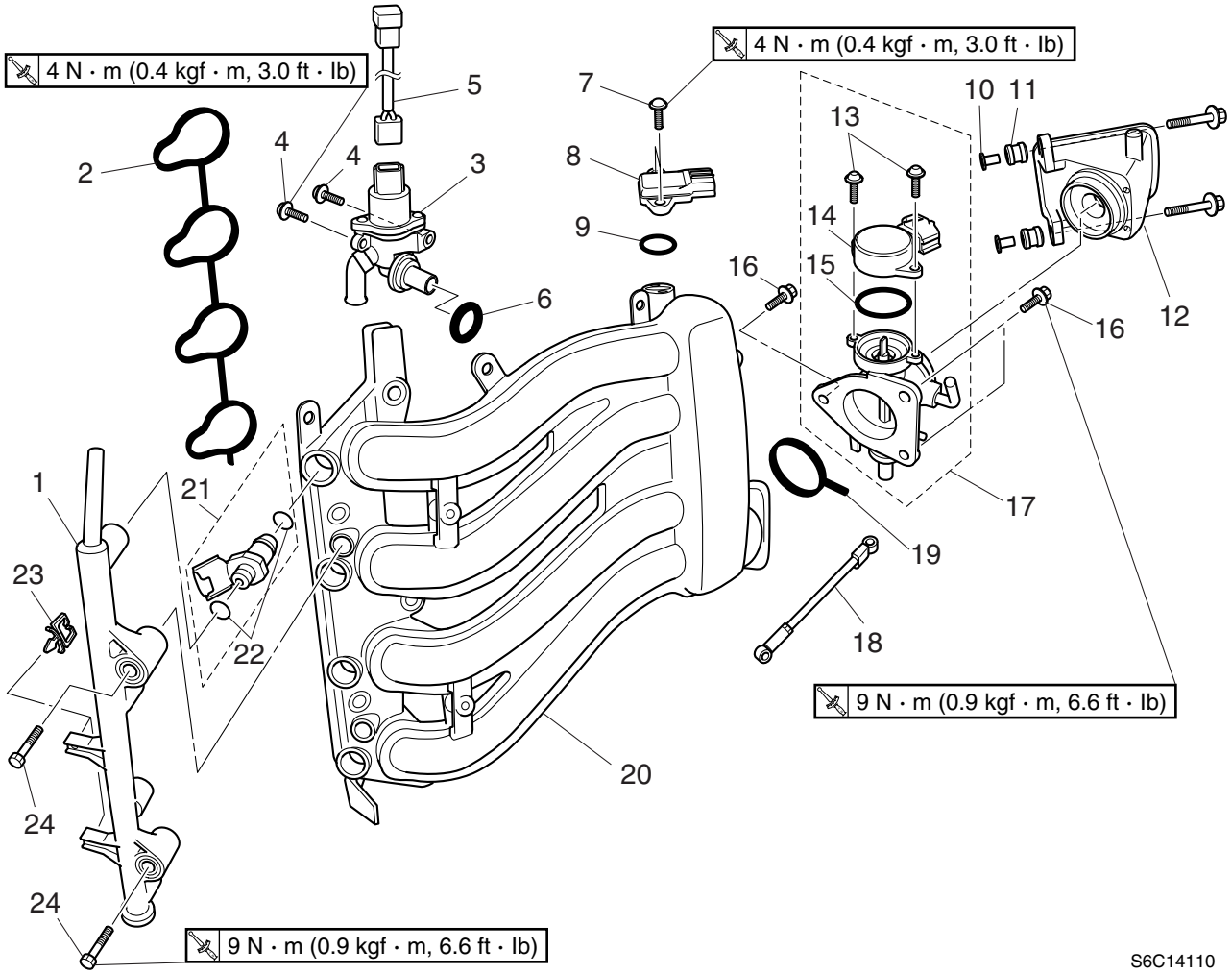
Intake manifold



No.	Part name	Q'ty	Remarks
1	Blowby hose	1	
2	Holder	1	
3	Hose	1	
4	Bolt	2	M6 × 35 mm
5	Bolt	3	M6 × 45 mm
6	Bolt	5	M8 × 40 mm
7	Intake manifold assembly	1	
8	Cooling water pilot hose	1	
9	Pressure regulator hose	1	
10	Dowel	2	
11	Plastic tie	1	**Not reusable**



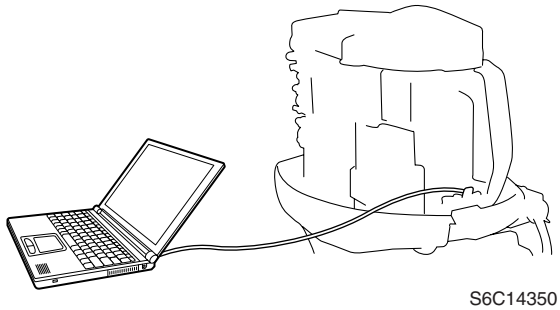
No.	Part name	Q'ty	Remarks
1	Fuel rail	1	
2	Gasket	1	**Not reusable**
3	Idle speed control	1	
4	Screw	2	ø5 × 13 mm
5	Wiring harness	1	
6	O-ring	1	**Not reusable**
7	Screw	2	ø5 × 13 mm
8	Sensor assembly	1	
9	O-ring	1	**Not reusable**
10	Collar	2	
11	Grommet	2	
12	Intake silencer	1	
13	Screw	2	
14	Throttle position sensor	1	
15	O-ring	1	**Not reusable**
16	Bolt	3	M6 × 16 mm
17	Throttle body assembly	1	



No.	Part name	Q'ty	Remarks
18	Link rod	1	
19	Gasket	1	**Not reusable**
20	Intake manifold	1	
21	Fuel injector	4	
22	O-ring set	4	**Not reusable**
23	Clip	2	
24	Bolt	2	M6 × 38 mm

Checking the throttle position sensor

1. Check the throttle position sensor output voltage using the Yamaha Diagnostic System. If the output voltage is out of specification, replace the throttle position sensor.

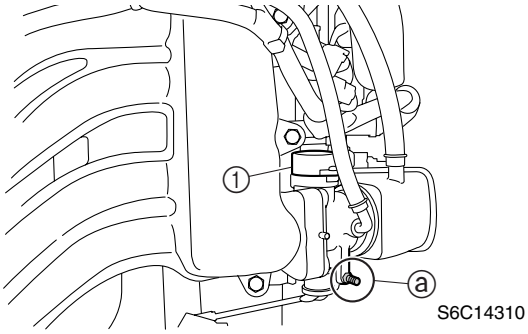


S6C14350

Throttle position sensor output voltage at engine idle speed:
0.8–1.2 V

Installing the throttle position sensor

1. Install the throttle position sensor ① in a position where the output voltage is within specification.



S6C14310

Throttle position sensor output voltage at engine idle speed:
0.8–1.2 V

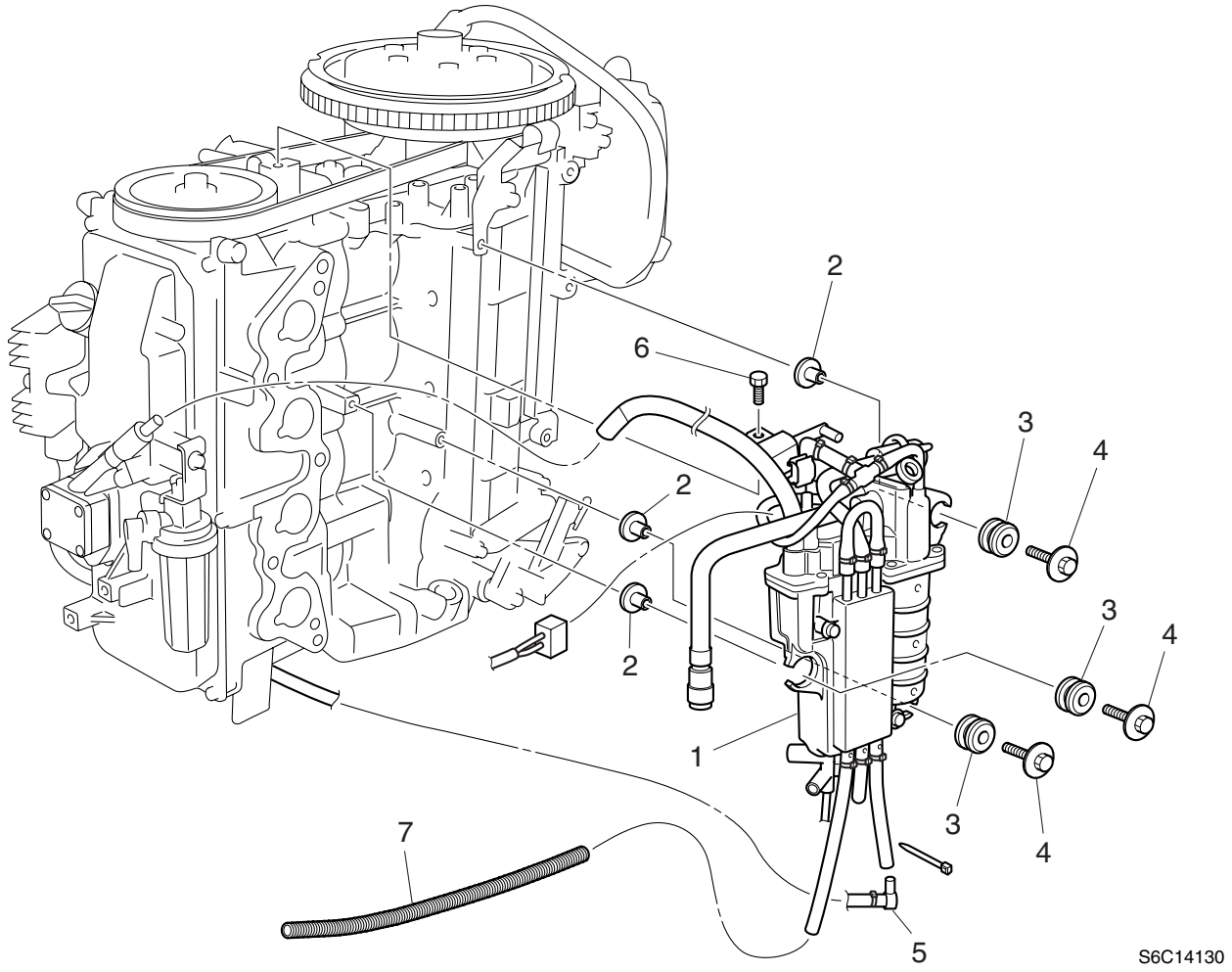
NOTE:

- If the throttle position sensor output voltage is out of specification, reinstall the throttle position sensor.
- Measure the throttle position sensor output voltage using the Yamaha Diagnostic System.
- Do not turn the throttle stop screw ⓐ.

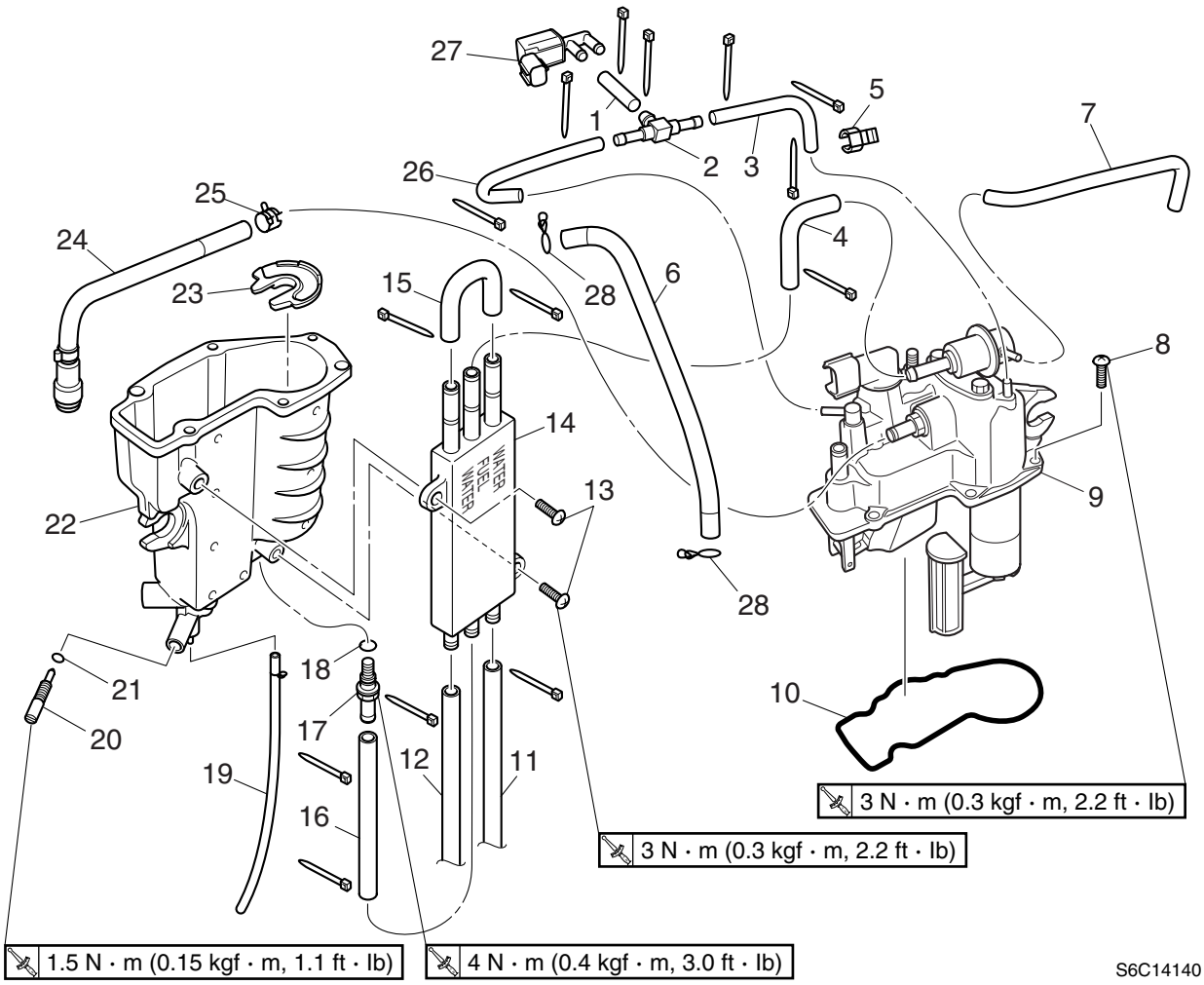
Checking the idle speed control

1. Check the operation of the idle speed control using the Yamaha Diagnostic System.

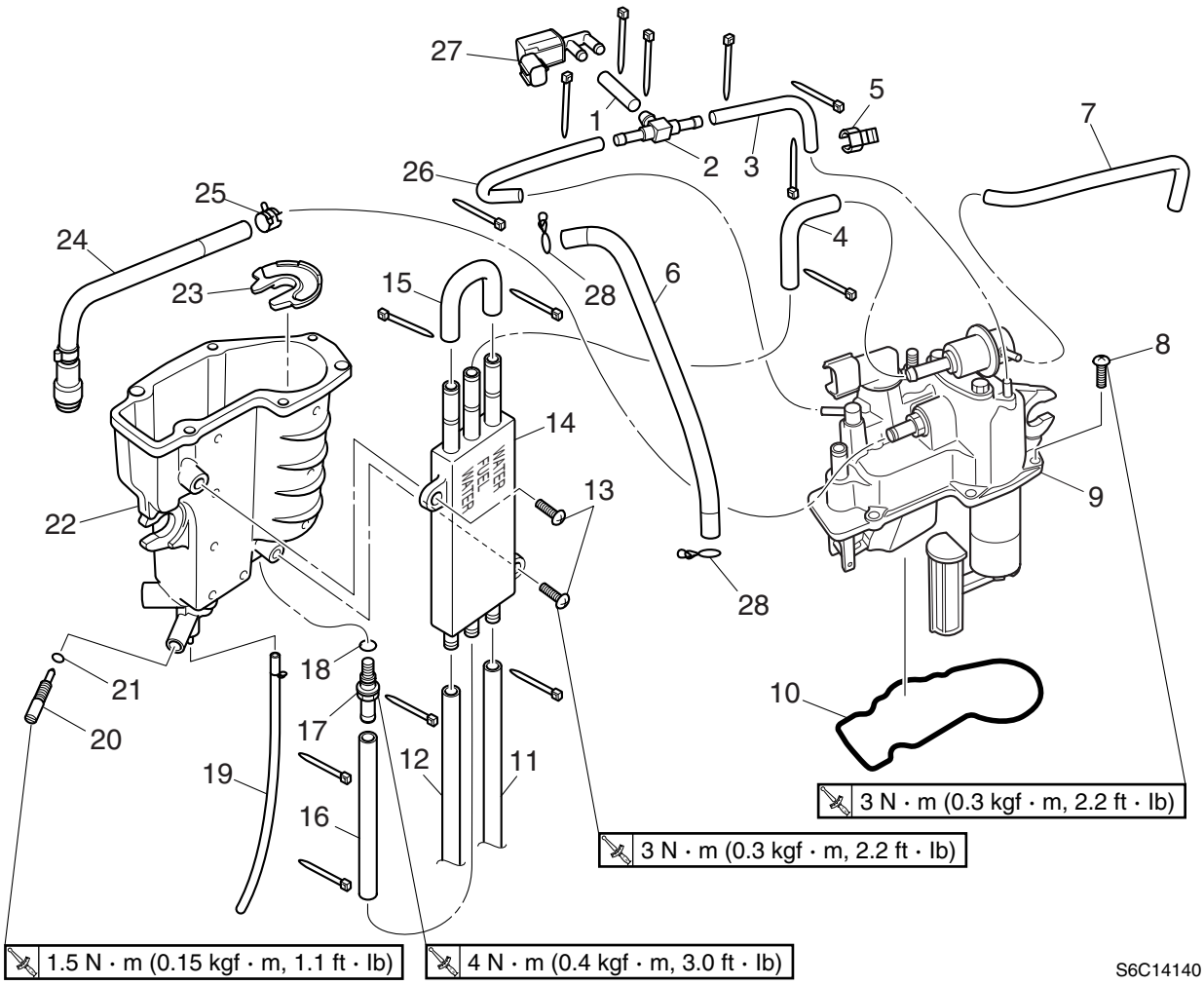
Vapor separator



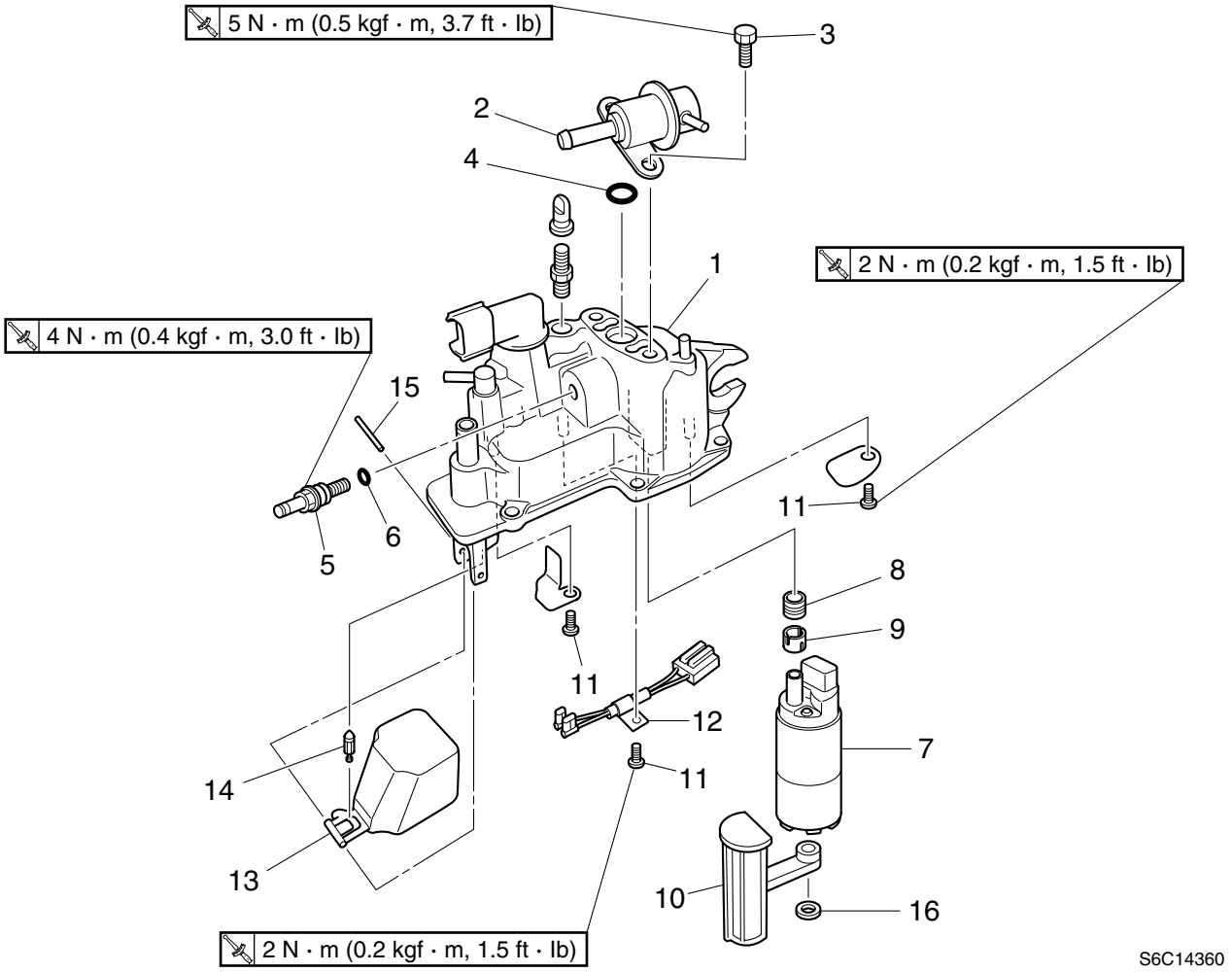
No.	Part name	Q'ty	Remarks
1	Vapor separator	1	
2	Collar	3	
3	Grommet	3	
4	Bolt	3	M6 × 30 mm
5	Cooling water pilot hose	1	
6	Bolt	1	M6 × 15 mm
7	Corrugated tube	1	



No.	Part name	Q'ty	Remarks
1	Hose	1	
2	Joint	1	
3	Hose	1	
4	Fuel hose	1	
5	Holder	1	
6	Fuel hose	1	
7	Hose	1	
8	Screw	6	ø5 × 14 mm
9	Cover assembly	1	
10	Gasket	1	**Not reusable**
11	Hose	1	
12	Hose	1	
13	Screw	2	ø6 × 14 mm
14	Fuel cooler	1	
15	Hose	1	
16	Fuel hose	1	
17	Joint screw	1	



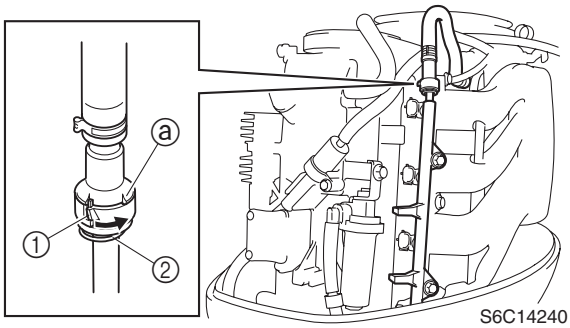
No.	Part name	Q'ty	Remarks
18	O-ring	1	**Not reusable**
19	Drain hose	1	
20	Drain screw	1	
21	O-ring	1	**Not reusable**
22	Float chamber	1	
23	Fuel pump damper	1	
24	High-pressure fuel hose	1	
25	Clamp	1	
26	Hose	1	
27	Solenoid valve	1	
28	Clamp	2	



No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Pressure regulator	1	
3	Bolt	2	M6 × 12 mm
4	O-ring	1	**Not reusable**
5	Joint screw	1	
6	O-ring	1	**Not reusable**
7	Electric fuel pump	1	
8	Grommet	1	
9	Collar	1	
10	Filter	1	
11	Screw	2	ø4 × 6 mm
12	Wiring harness	1	
13	Float	1	
14	Needle valve	1	
15	Pin	1	**Not reusable**
16	Clip	1	**Not reusable**

Disconnecting the quick connector

1. Wrap the quick connector with a rag, and then rotate the quick connector tab ① to the stopper position ⓐ.



S6C14240

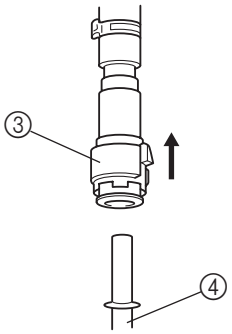
⚠ WARNING

If the quick connector is removed suddenly, pressurized fuel could spray out. To gradually release the fuel pressure, be sure to remove the quick connector slowly.

CAUTION:

- **Do not rotate the quick connector tab ① past the stopper position ⓐ, otherwise it could be damaged.**
- **When the fuel hoses are disconnected, quickly remove the retainer ② from the quick connector, otherwise the retainer can be lost.**

2. Disconnect the quick connector ③ from the fuel rail ④ directly.



S6C14250

⚠ WARNING

Always reduce the fuel pressure in the fuel line before servicing the line or the fuel pipe. If the fuel pressure is not released, pressurized fuel could spray out.

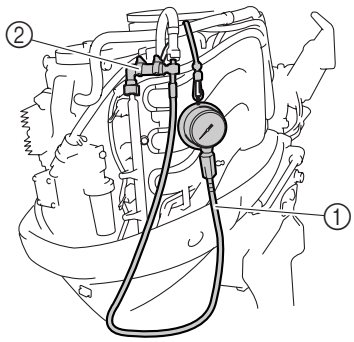
Measuring the fuel pressure

1. Disconnect the quick connector from the fuel rail.

NOTE:

Before disconnecting the quick connector, release the fuel pressure.

2. Connect the special service tools as shown.



S6C14260

⚠ WARNING

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



Fuel pressure gauge ①:
90890-06786
Fuel pressure gauge adapter B ②:
90890-06942

4

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

⚠ WARNING

Before measuring the fuel pressure, make sure that the drain screw is tightened securely.

NOTE:
The fuel pressure decreases 3 seconds after the engine start switch is turned to ON.

Fuel pressure (reference data):
290 kPa (2.9 kgf/cm^2, 41.2 psi)

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

⚠ WARNING

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

Fuel pressure (reference data):
230 kPa (2.3 kgf/cm^2, 32.7 psi)

Checking the pressure regulator

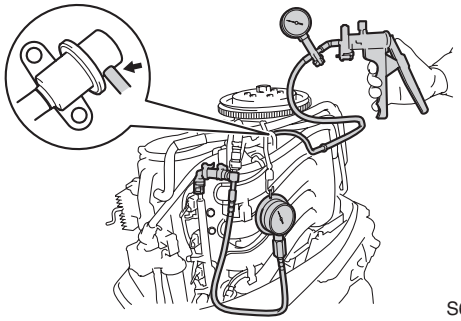
1. Remove the cap.

2. Disconnect the quick connector from the fuel rail.

NOTE:
Before disconnecting the quick connector, release the fuel pressure.

3. Connect the special service tools as shown.

4. Disconnect the pressure regulator hose, and then connect the special service tools to the pressure regulator.



S6C14160

⚠ WARNING

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

Fuel pressure gauge: 90890-06786
Vacuum/pressure pump gauge set:
90890-06756
Fuel pressure gauge adapter B:
90890-06942

5. Start the engine and let it idle.

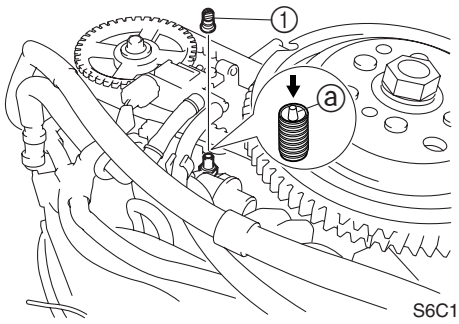
6. Check that the fuel pressure reduces when vacuum pressure is applied to the pressure regulator. If the fuel pressure does not reduce, replace the pressure regulator.

⚠ WARNING

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

Draining the fuel

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

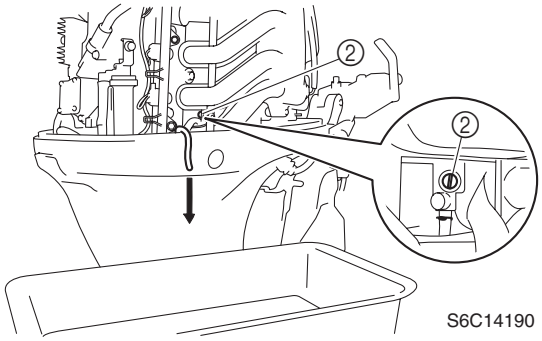


S6C14180

⚠ 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.

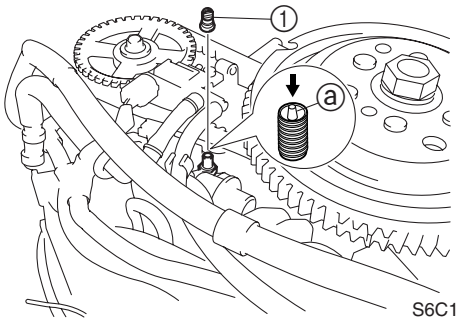
3. Place a container under the vapor separator drain hose, and then loosen the drain screw ②.
4. Drain the fuel from the vapor separator drain hose by pressing the valve using a thin screwdriver.



S6C14190

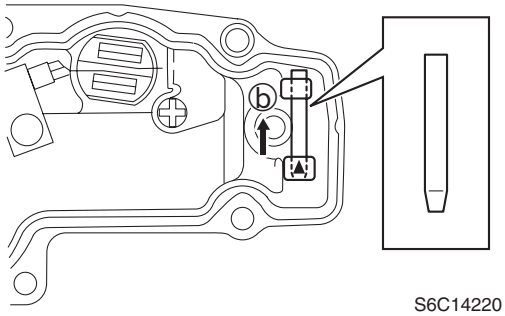
Disassembling the vapor separator

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



S6C14180

3. Remove the float chamber.
4. Remove the float pin and float.



S6C14220

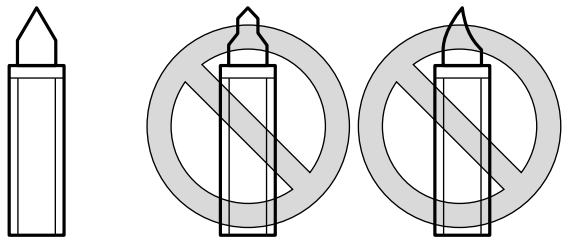
NOTE:

Remove the float pin in the direction of the arrow ⓑ shown.

5. Remove the needle valve and other components.

Checking the vapor separator

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

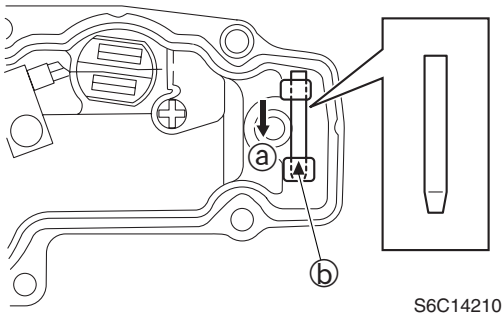


S6D54200

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

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

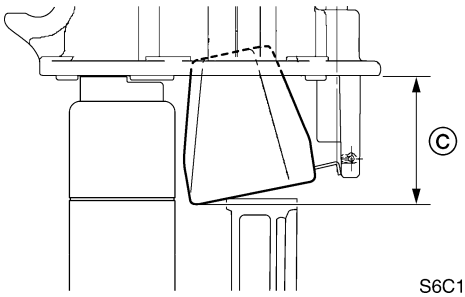
4. Install the needle valve, float, and float pin, and then check the float for smooth operation.



S6C14210

NOTE:
- Do not reuse the float pin, always replace it with a new one.
- Install the float pin in the direction of the arrow ⓐ shown.
- Install the float pin with its tapered end towards the punch mark ⓑ on the vapor separator cover.

5. Check the float height ⓒ as shown. Adjust the float height if out of specification.



S6C14280

Float height ⓒ:
46.6 ± 1.0 mm (1.83 ± 0.04 in)

6. Check the float height ⓓ as shown. Adjust the float height if out of specification.



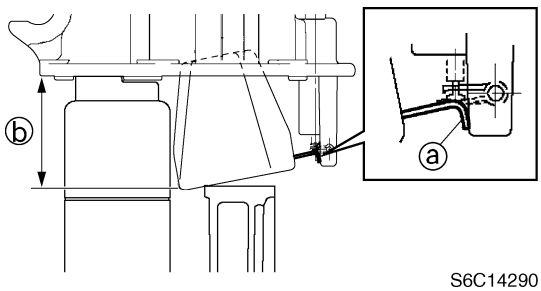
S6C14200

NOTE:
The float should be resting on the needle valve, but not compressing it.

Float height ⓓ:
35.0 ± 1.0 mm (1.38 ± 0.04 in)

Adjusting the float

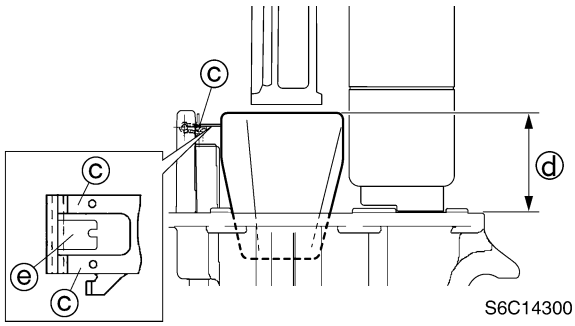
1. Adjust the stopper ⓐ of the float by bending it until the float height ⓑ is within specification.



S6C14290

Float height ⓑ:
46.6 ± 1.0 mm (1.83 ± 0.04 in)

2. Adjust the lever ⓒ of the float by bending it until the float height ⓓ is within specification.



NOTE:
When adjusting the float height, do not bend the lever ⓔ.

Float height ⓓ:
35.0 ± 1.0 mm (1.38 ± 0.04 in)

Assembling the vapor separator

1. Install the float chamber.

2. Install all parts removed during dissassembly.

NOTE:
Be sure to connect and route the hoses correctly.

Power unit

Special service tools 5-1

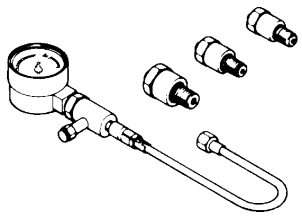
Power unit 5-3
Checking the compression pressure 5-3
Checking the oil pressure 5-3
Checking the valve clearance 5-4
Removing the power unit 5-14
Removing the timing belt and sprockets 5-15
Checking the timing belt and sprockets 5-16
Installing the timing belt and sprockets 5-17

Cylinder head 5-19
Removing the cylinder head 5-23
Checking the valve springs 5-24
Checking the valves 5-24
Checking the valve guides 5-25
Replacing the valve guides 5-25
Checking the valve seat 5-26
Refacing the valve seat 5-27
Checking the rocker arms and rocker arm shaft 5-29
Checking the camshaft 5-29
Checking the cylinder head 5-30
Checking the oil pump 5-31
Installing the valves 5-31
Installing the camshaft 5-32
Installing the rocker arm shaft assembly 5-32
Installing the oil pump 5-33
Installing the cylinder head 5-34

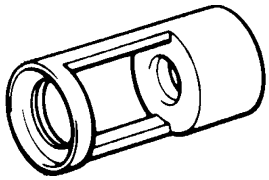
Exhaust cover 5-35

Cylinder block 5-37
Disassembling the cylinder block 5-38
Checking the piston diameter 5-39
Checking the cylinder bore 5-39
Checking the piston clearance 5-39
Checking the piston rings 5-39
Checking the piston ring grooves 5-40
Checking the piston ring side clearance 5-41
Checking the piston pin boss bore 5-41
Checking the piston pin 5-41
Checking the connecting rod small end inside diameter 5-41
Checking the connecting rod big end side clearance 5-41
Checking the crankshaft 5-42
Checking the crankpin oil clearance 5-42
Selecting the connecting rod bearing 5-43
Checking the crankshaft journal oil clearance 5-44
Selecting the main bearings 5-45
Assembling the power unit 5-46
Installing the power unit 5-49

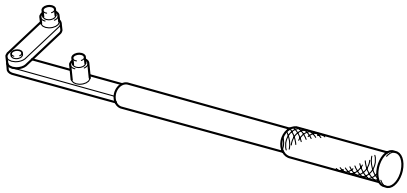
Special service tools



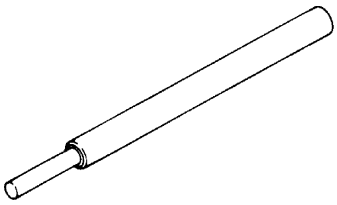
Compression gauge
90890-03160



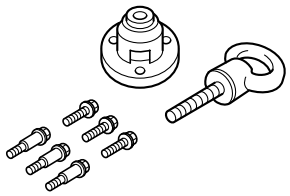
Valve spring compressor attachment
90890-06320



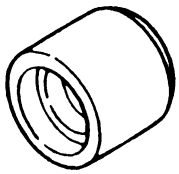
Flywheel holder
90890-06522



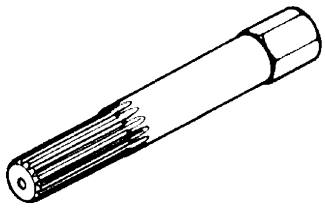
Valve guide remover/installer
90890-06801



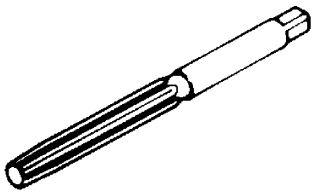
Flywheel puller
90890-06521



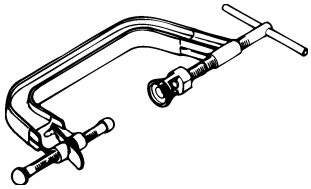
Valve guide installer
90890-06810



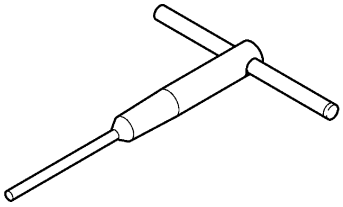
Crankshaft holder 18
90890-06562



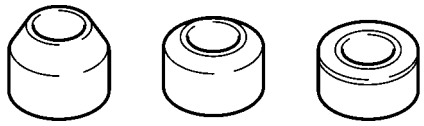
Valve guide reamer
90890-06804



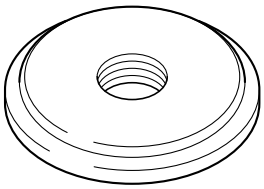
Valve spring compressor
90890-04019



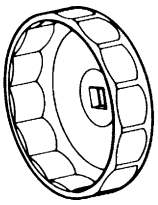
Valve seat cutter holder
90890-06316



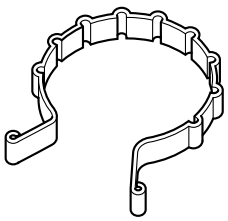
Valve seat cutter
90890-06312, 90890-06315, 90890-06323,
90890-06327, 90890-06328, 90890-06555



Bearing outer race attachment
90890-06626



Oil filter wrench
90890-01426

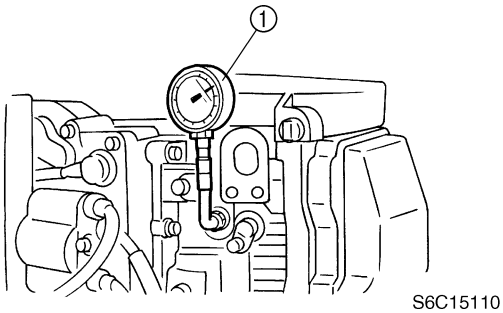


Piston slider
90890-06529

Power unit

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 stop lanyard switch.
3. Remove the spark plug caps and all spark plugs, and then install the special service tools into a 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

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):
960 kPa (9.6 kgf/cm^2, 139.2 psi)

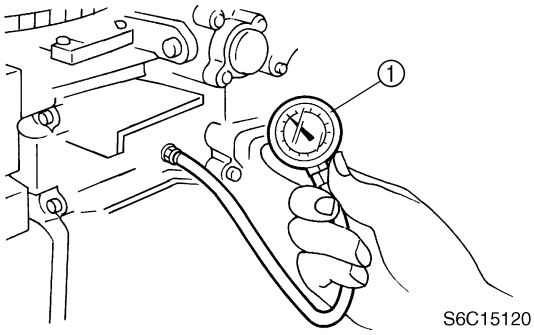
5. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then check the pressure again.

NOTE:

- If the compression pressure increases, check the pistons and piston rings for wear. Replace if necessary.
- If the compression pressure does not increase, check the valve clearance, valves, 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 switch.
2. Remove the oil pressure switch, and then install an oil pressure gauge ① into the oil pressure switch installation hole.



NOTE:

Use a general pressure gauge.

3. Start the engine and warm it up for 5 minutes.
4. Check the oil pressure. Check the oil pump and oil strainer and check for oil leakage if below specification.

Oil pressure (reference data):
125 kPa (1.25 kgf/cm^2, 18.1 psi)
at engine idle speed

5. Increase the engine speed, and then check the relief valve opening pressure.

NOTE:

The relief valve is installed in the oil pump.

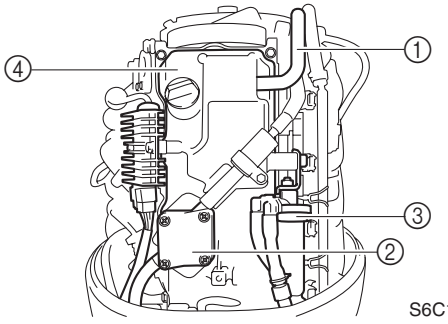
Relief valve opening pressure (reference data):
350–450 kPa
(3.5–4.5 kgf/cm^2, 50.8–62.3 psi)

Checking the valve clearance

CAUTION:

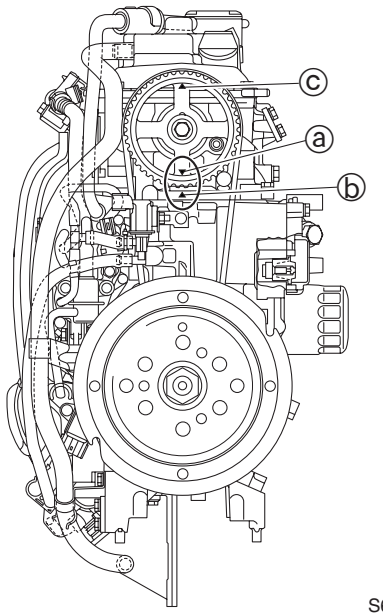
Do not turn the flywheel magnet counterclockwise, otherwise the valve system may be damaged.

1. Remove the flywheel magnet cover, and then remove the blowby hose ①.
2. Remove the fuel pump ② and fuel filter ③.
3. Disconnect the spark plug caps and remove the spark plugs and cylinder head cover ④.



S6C15130

4. Turn the flywheel magnet clockwise and align the "▲1" mark ⓐ on the driven sprocket with the "▲" mark ⓑ on the cylinder head.

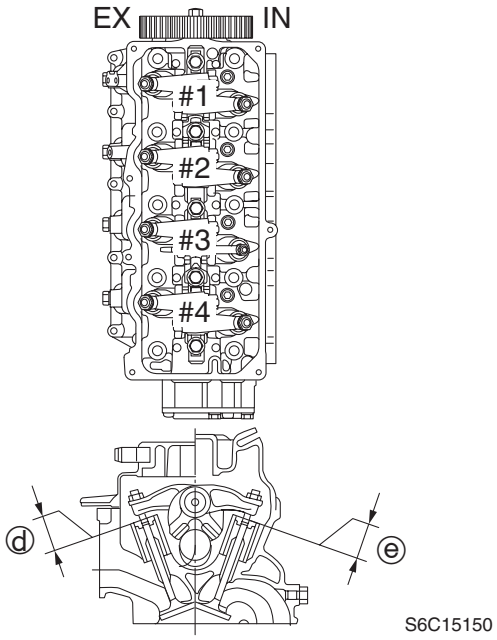


S6C15140

5. Check the intake valve clearance for cylinders #1 and #2, and the exhaust valve clearance for cylinders #1 and #3. Adjust if out of specification.
6. Turn the flywheel magnet clockwise and align the "▲4" mark ⓒ on the driven sprocket with the "▲" mark ⓑ on the cylinder head.

5

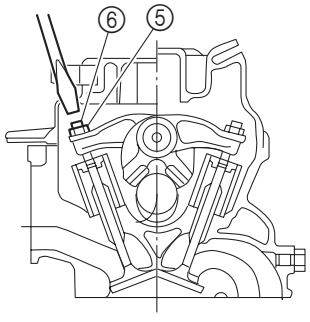
7. Check the intake valve clearance for cylinders #3 and #4, and the exhaust valve clearance for cylinders #2 and #4. Adjust if out of specification.



NOTE:
Check the valve clearance when the engine is cold.

Valve clearance (cold):
Intake ⓓ:
0.20 ± 0.05 mm
(0.008 ± 0.002 in)
Exhaust ⓔ:
0.30 ± 0.05 mm
(0.012 ± 0.002 in)

8. Loosen the rocker arm locknut ⑤, and then turn the adjusting screw ⑥ until the specified valve clearance is obtained.

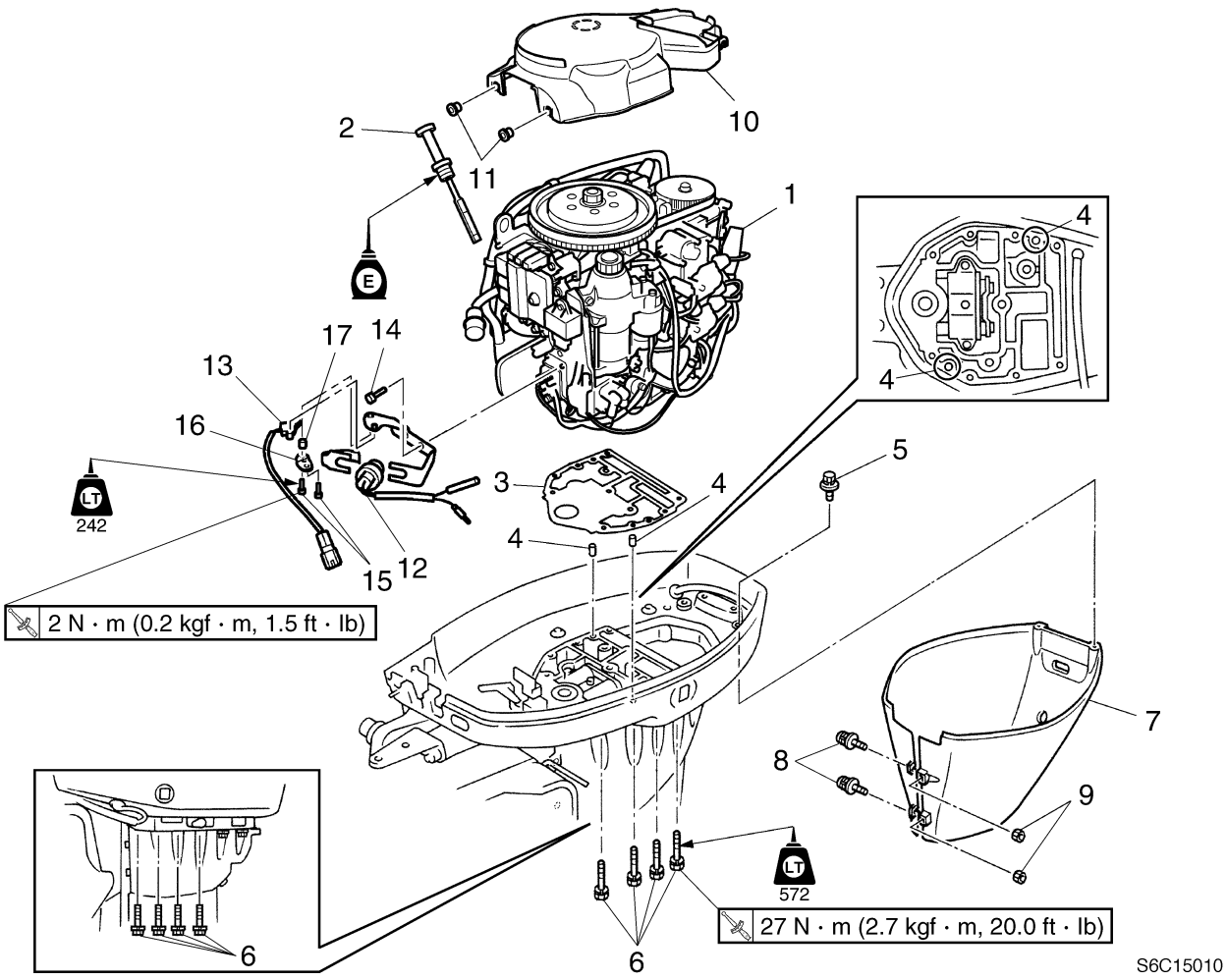


NOTE:
- To decrease the valve clearance, turn the adjusting screw clockwise.
- To increase the valve clearance, turn the adjusting screw counterclockwise.

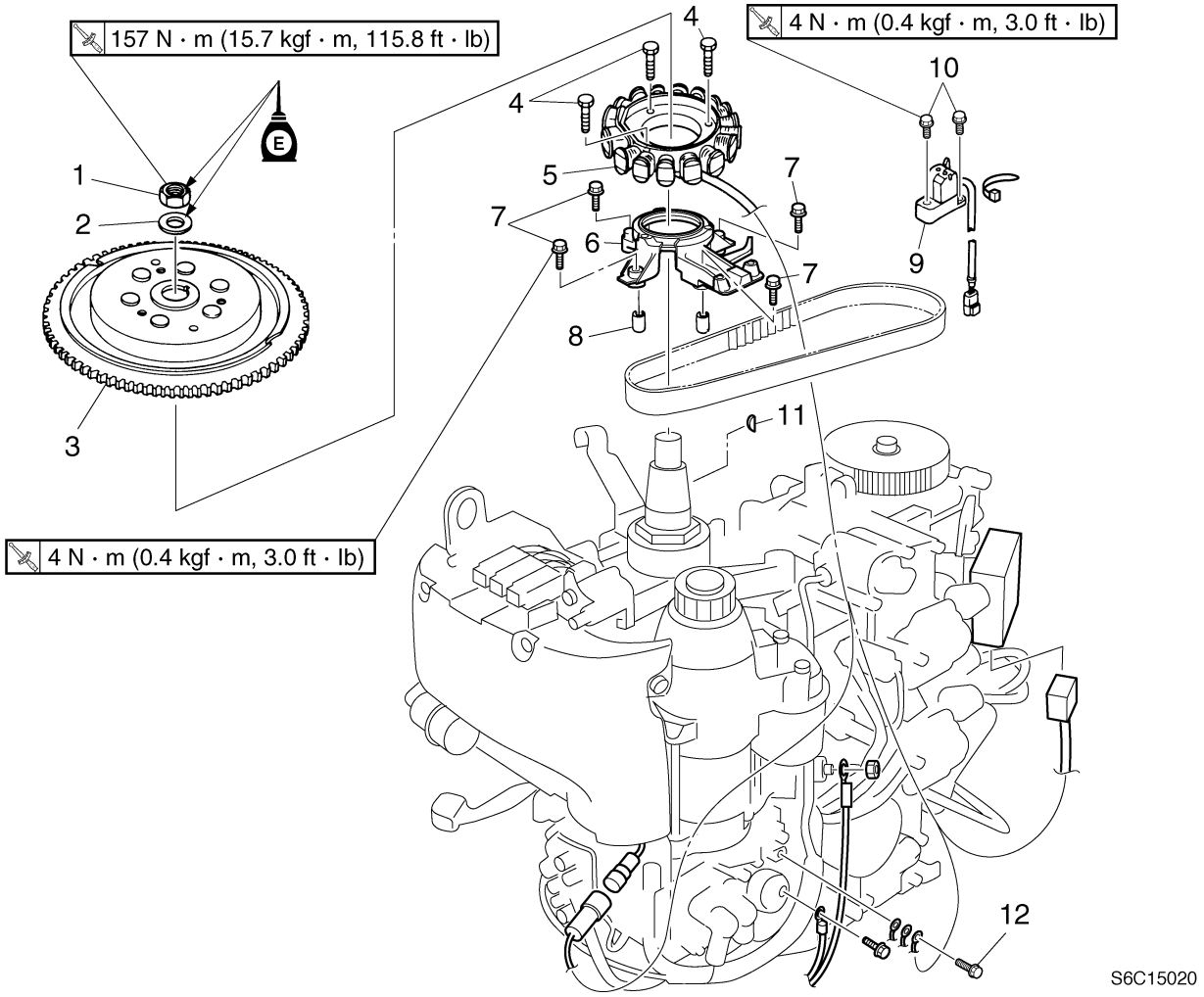
9. Tighten the rocker arm locknut to the specified torque, and then check the valve clearance again. Adjust if necessary.

Rocker arm locknut ⑤:
14 N·m (1.4 kgf·m, 10.3 ft·lb)

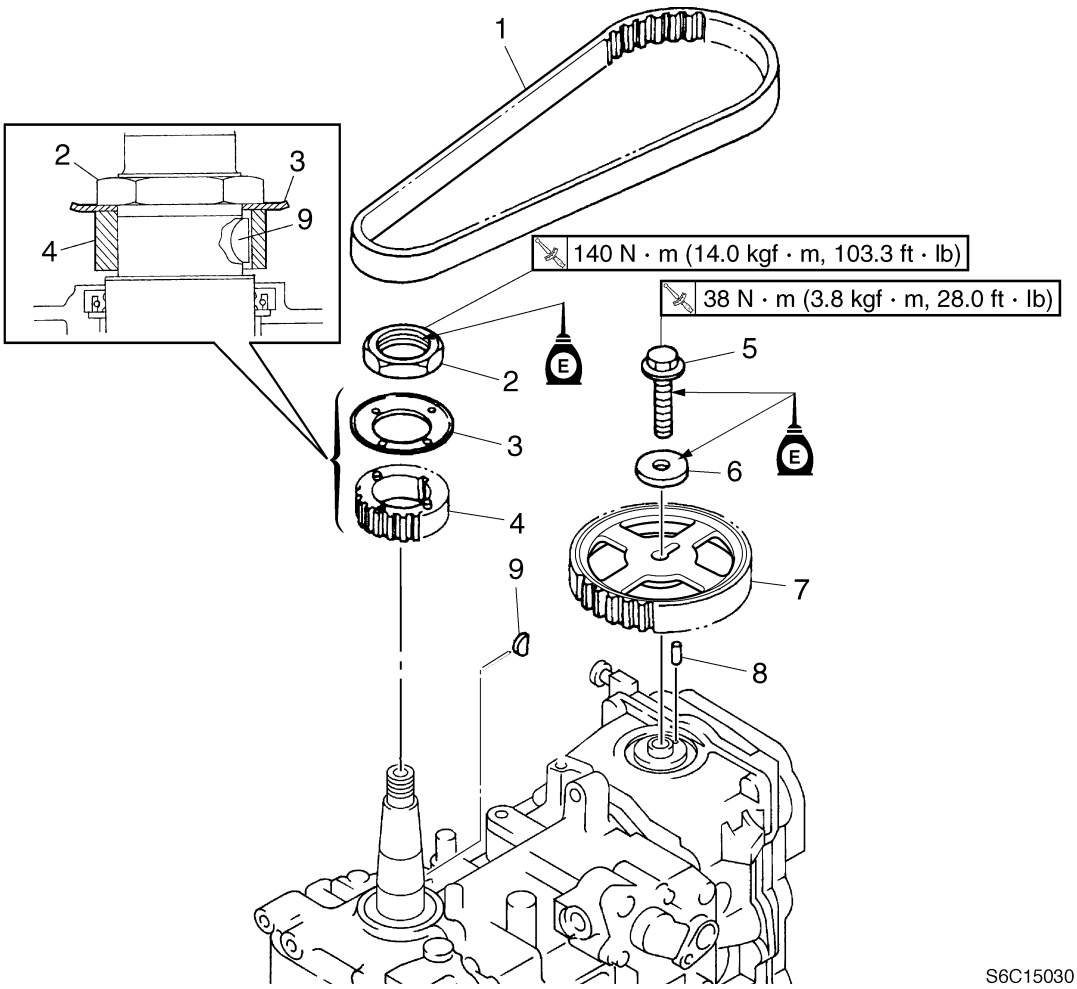
10. Install the cylinder head cover, fuel pump, fuel filter, spark plugs, spark plug caps, blowby hose, and flywheel magnet cover.



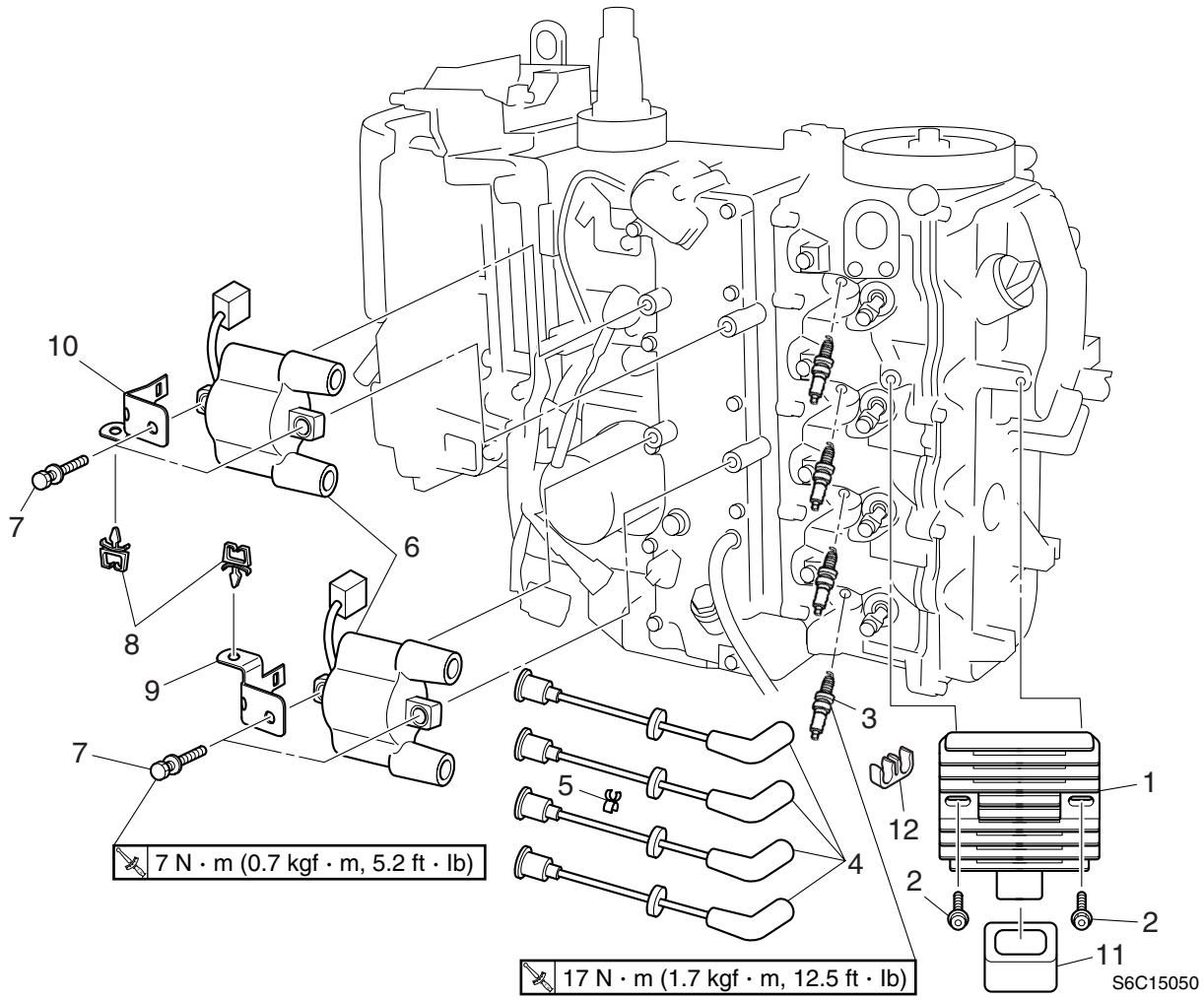
No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Oil dipstick	1	
3	Gasket	1	**Not reusable**
4	Dowel	2	
5	Bolt	2	M6 × 16 mm
6	Bolt	8	M8 × 80 mm
7	Apron	1	
8	Screw	2	ø6 × 24 mm
9	Nut	2	
10	Flywheel magnet cover	1	
11	Grommet	2	
12	Neutral switch	1	Tiller handle model
13	Shift position switch	1	
14	Bolt	2	M6 × 20 mm
15	Screw	2	ø4 × 16 mm
16	Plate	1	
17	Collar	1	



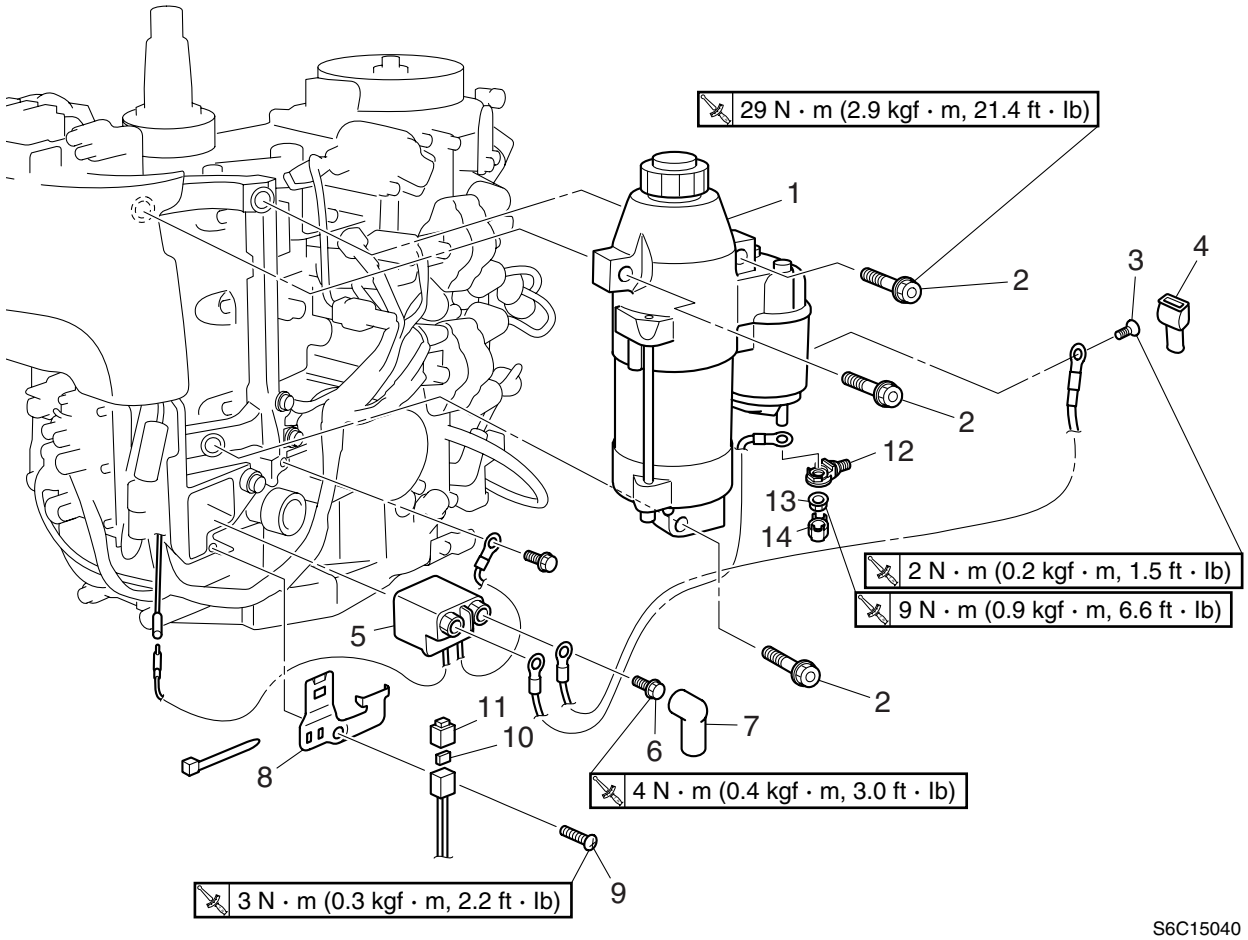
No.	Part name	Q'ty	Remarks
1	Nut	1	
2	Washer	1	
3	Flywheel magnet	1	
4	Bolt	3	M6 × 30 mm
5	Stator coil	1	
6	Stator coil bracket	1	
7	Bolt	4	M6 × 30 mm
8	Collar	2	
9	Pulser coil	1	
10	Bolt	2	M5 × 12 mm
11	Woodruff key	1	
12	Bolt	1	M6 × 20 mm



No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Nut	1	Width across flats: 41 mm (1.6 in)
3	Retaining plate	1	
4	Drive sprocket	1	
5	Bolt	1	M10 × 35 mm
6	Washer	1	
7	Driven sprocket	1	
8	Dowel	1	
9	Woodruff key	1	

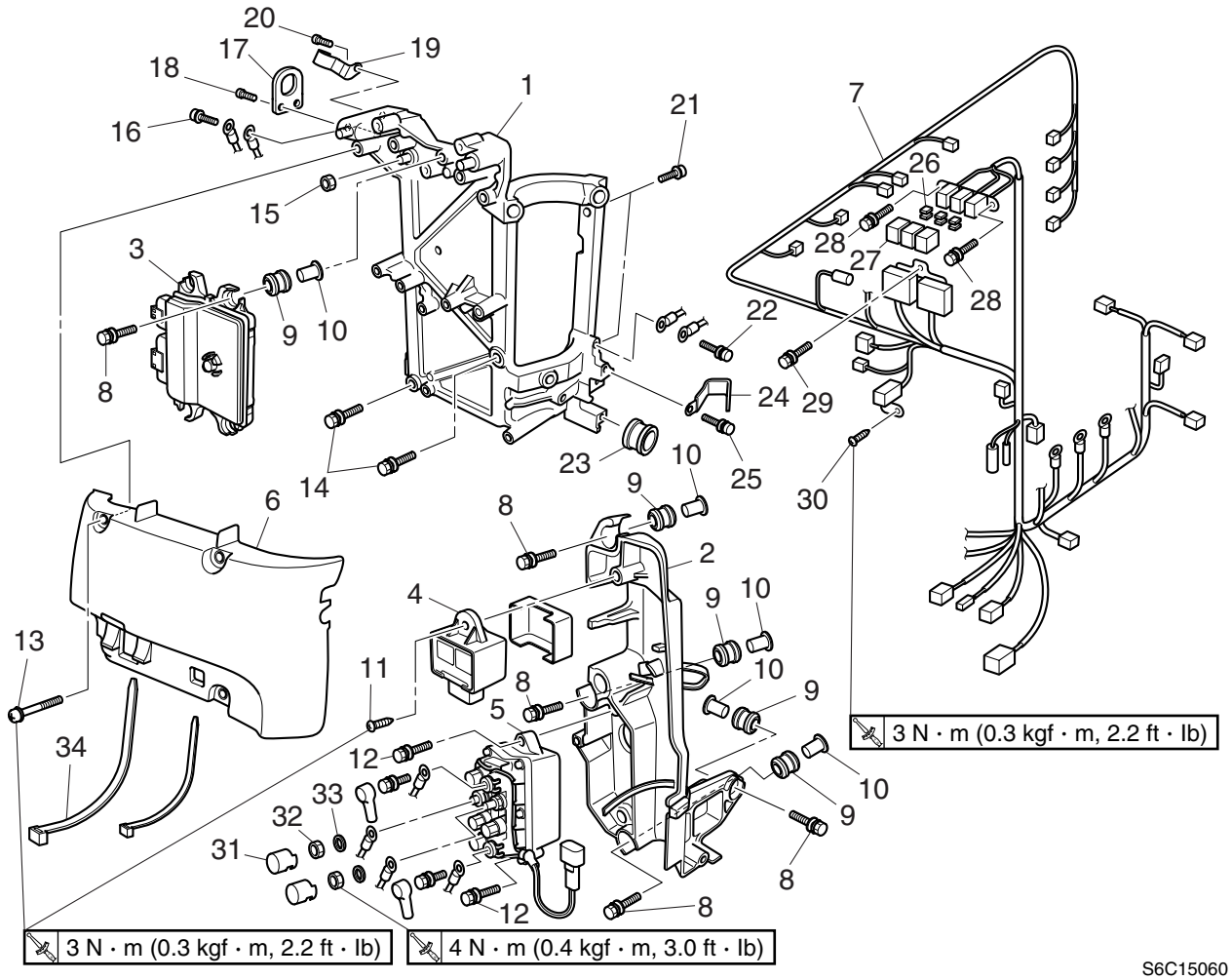


No.	Part name	Q'ty	Remarks
1	Rectifier Regulator	1	
2	Bolt	2	M6 × 25 mm
3	Spark plug	4	
4	Spark plug wire	4	
5	Holder	1	
6	Ignition coil	2	
7	Bolt	4	M6 × 30 mm
8	Holder	2	
9	Bracket	1	
10	Bracket	1	
11	Cover	1	
12	Holder	1	

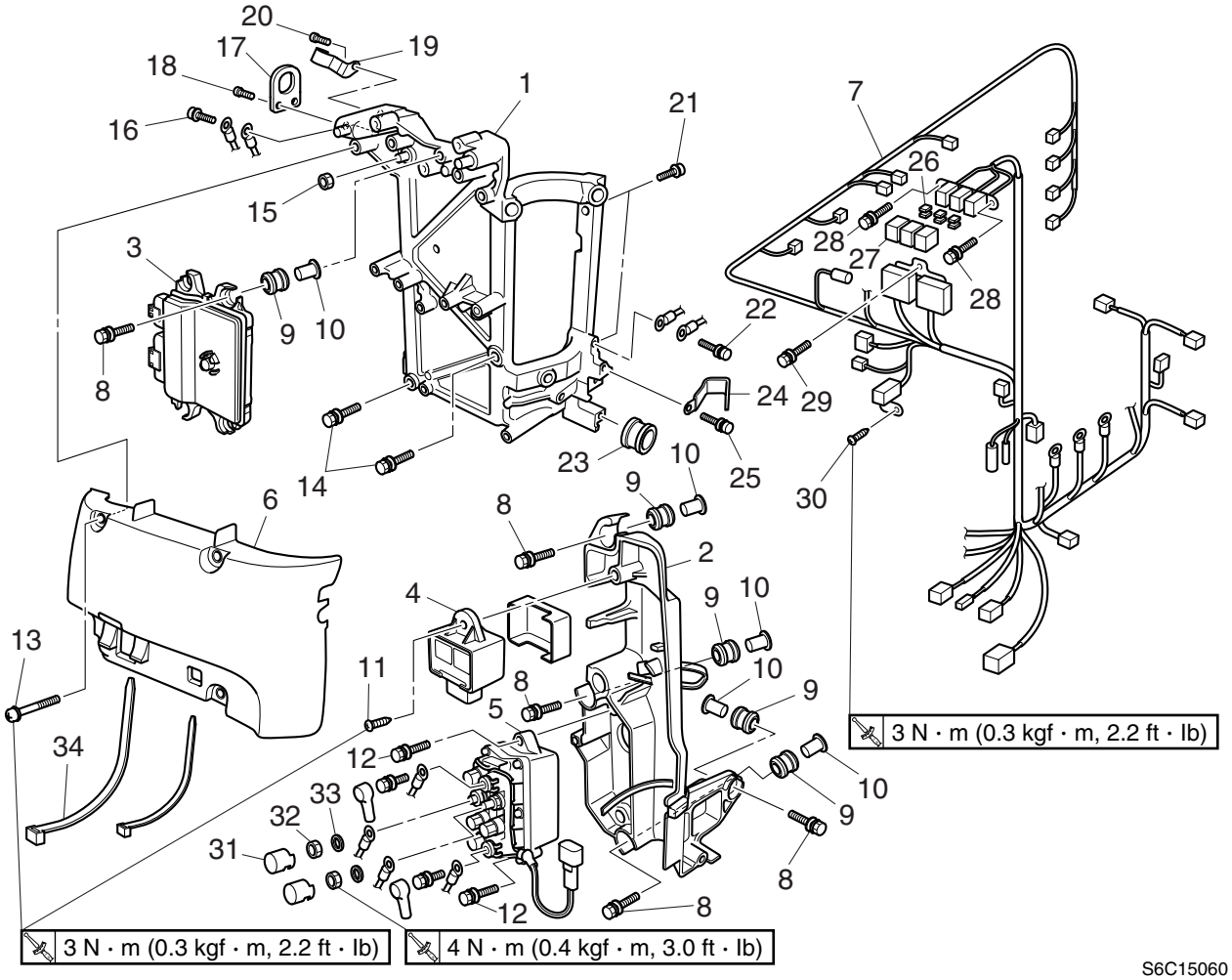


S6C15040

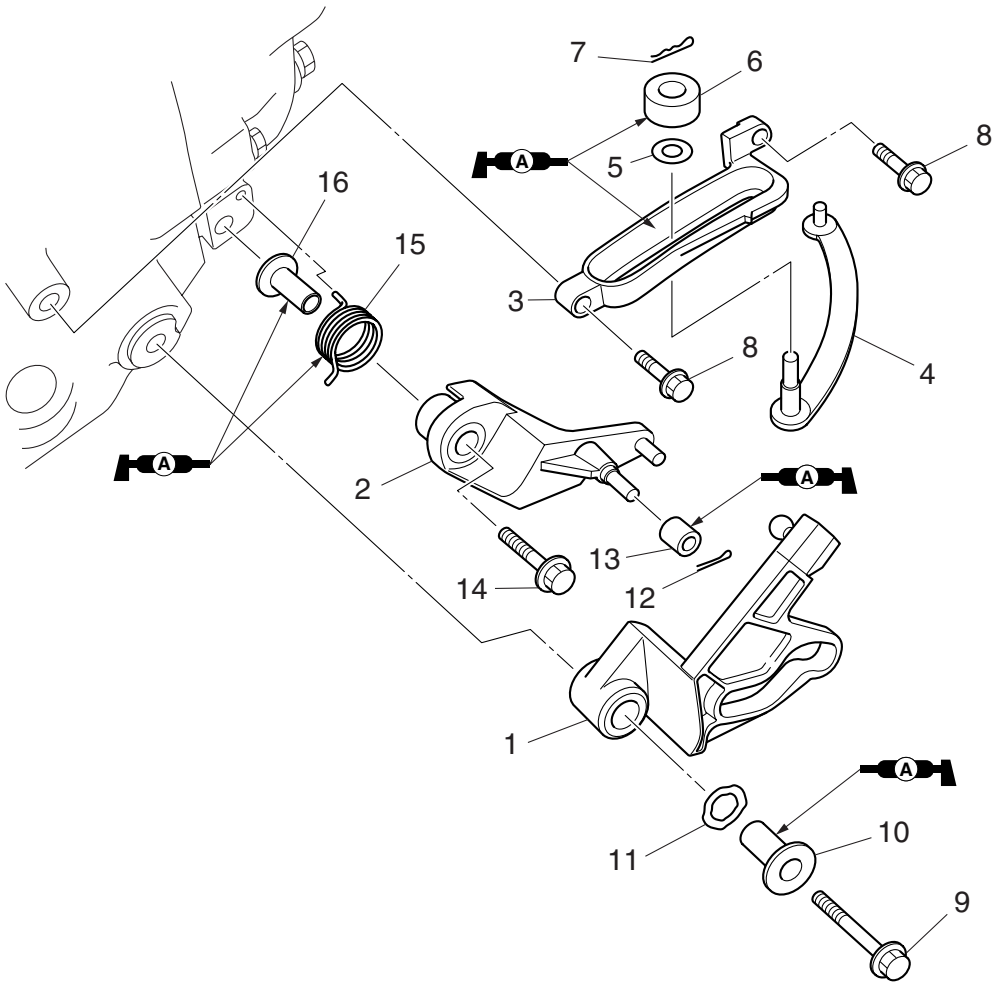
No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Bolt	3	M8 × 45 mm
3	Screw	1	ø4 × 5 mm
4	Cap	1	
5	Starter relay	1	
6	Bolt	2	M6 × 10 mm
7	Cap	2	
8	Holder	1	
9	Screw	1	ø6 × 19 mm
10	Fuse	1	30 A
11	Cap	1	
12	Terminal	1	
13	Nut	1	
14	Cap	1	



No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Junction box	1	
3	ECM	1	
4	Main and fuel pump relay	1	
5	Power trim and tilt relay	1	
6	Cover	1	
7	Wiring harness	1	
8	Bolt	8	M6 × 28 mm
9	Grommet	8	
10	Collar	8	
11	Screw	1	ø6 × 19 mm
12	Bolt	2	M6 × 20 mm
13	Screw	4	ø6 × 55 mm
14	Bolt	2	M8 × 35 mm
15	Nut	1	
16	Bolt	1	M6 × 20 mm
17	Engine hanger	1	



No.	Part name	Q'ty	Remarks
18	Bolt	2	M6 × 20 mm
19	Holder	1	
20	Bolt	1	M6 × 14 mm
21	Bolt	2	M8 × 25 mm
22	Bolt	1	M6 × 20 mm
23	Grommet	1	
24	Holder	1	
25	Bolt	1	M6 × 20 mm
26	Fuse	3	20 A
27	Cap	3	
28	Bolt	2	M6 × 14 mm
29	Bolt	1	M6 × 14 mm
30	Screw	1	ø6 × 19 mm
31	Cap	2	
32	Nut	2	
33	Washer	2	
34	Plastic tie	1	**Not reusable**



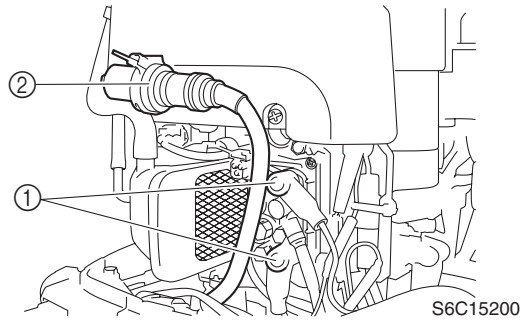
S6C15070

No.	Part name	Q'ty	Remarks
1	Throttle cam	1	
2	Throttle control lever	1	
3	Bracket	1	
4	Lever	1	
5	Washer	1	
6	Bushing	1	
7	Clip	1	
8	Bolt	2	M6 × 25 mm
9	Bolt	1	M6 × 35 mm
10	Collar	1	
11	Wave washer	1	
12	Cotter pin	1	**Not reusable**
13	Throttle cam roller	1	
14	Bolt	1	M6 × 35 mm
15	Spring	1	
16	Collar	1	

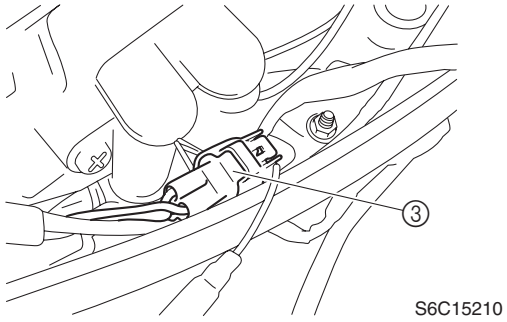
Removing the power unit

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

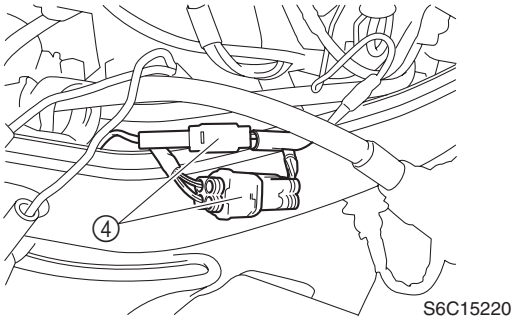
1. Remove the flywheel magnet cover.
2. Disconnect the battery leads, PTT motor leads ①, and main switch coupler ②.



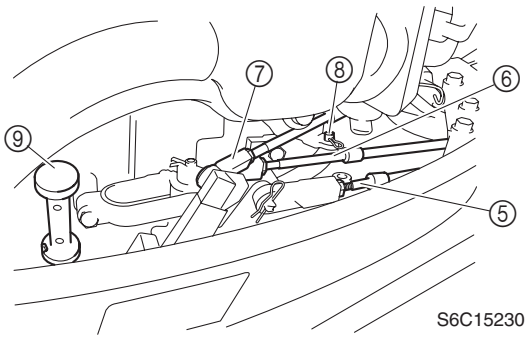
3. Disconnect the PTT switch coupler ③.



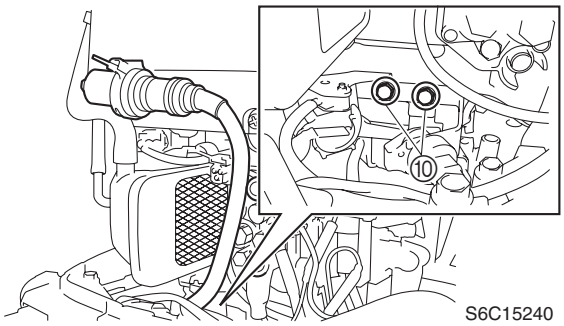
4. Disconnect the warning indicator couplers ④ (tiller handle model).



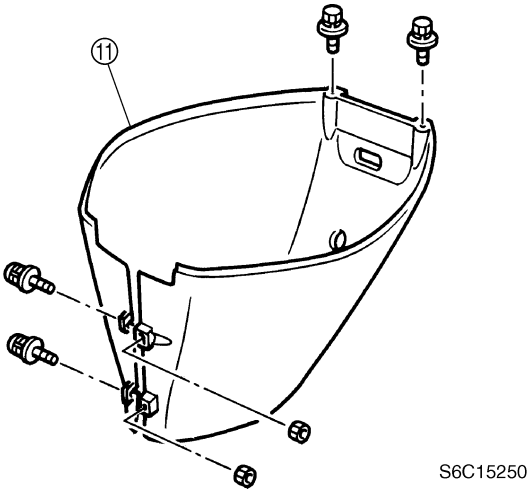
5. Disconnect the throttle cable ⑤, shift cable ⑥, throttle link rod ⑦, and shift lever ⑧.
6. Remove the oil dipstick ⑨.



7. Remove the shift rod bolts ⑩.

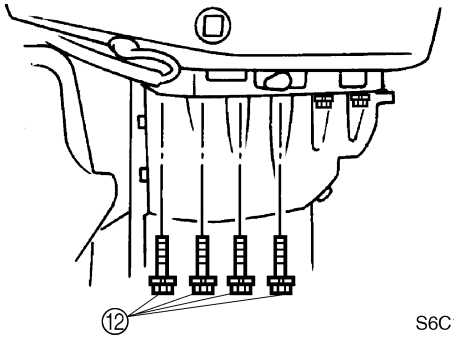


8. Disconnect the cooling water pilot hose, flushing hose, and fuel hose.
9. Remove the apron ⑪.



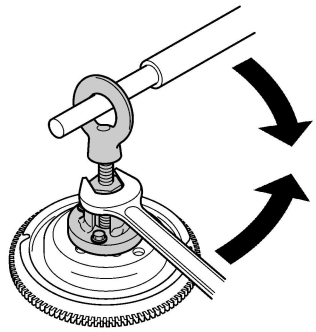
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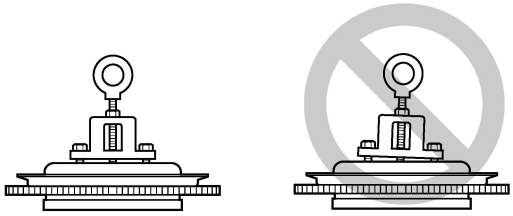
10. Remove the power unit by removing the bolts ⑫.



S6C15260

11. Remove the flywheel magnet, then the Woodruff key.


S63P5280


S63P5290

CAUTION:

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

NOTE:

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

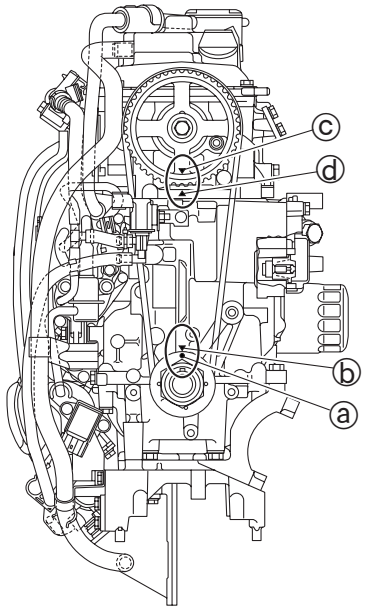
	Flywheel puller: 90890-06521

Removing the timing belt and sprockets

CAUTION:

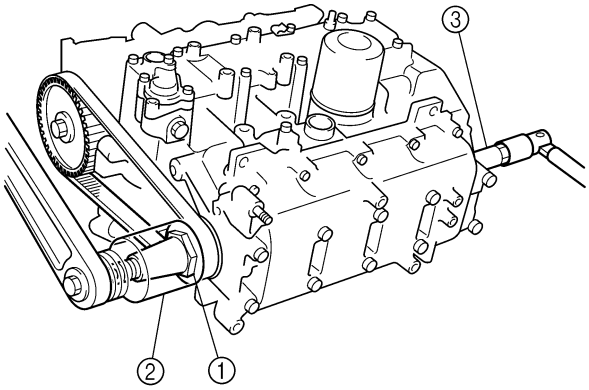
Do not turn the drive sprocket counterclockwise, otherwise the valve system may be damaged.

1. Turn the drive sprocket clockwise and align the "●" mark ⓐ on the retaining plate with the "▲" mark ⓑ on the cylinder block, and check that the "▲1" mark ⓒ on the driven sprocket is aligned with the "▲" mark ⓓ on the cylinder head.



S6C15270

2. Loosen the drive sprocket nut ①.

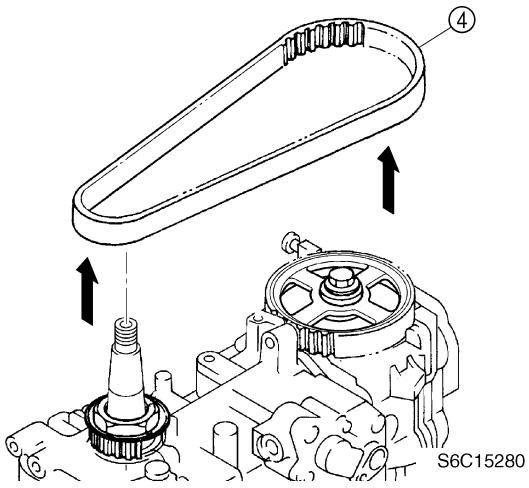


S6C15860

NOTE:
- Use a deep socket ② for this procedure.
- Make sure that the camshaft does not turn when loosening the drive sprocket nut.

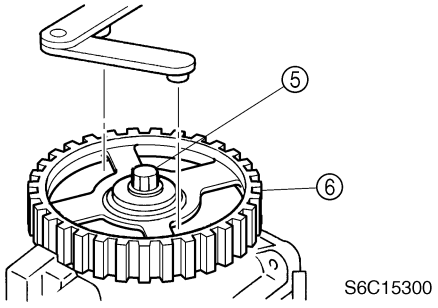
	Crankshaft holder 18 ③: 90890-06562

3. Remove the timing belt ④ from the driven sprocket, then from the drive sprocket.



CAUTION:
Do not turn the drive sprocket or the driven sprocket when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.

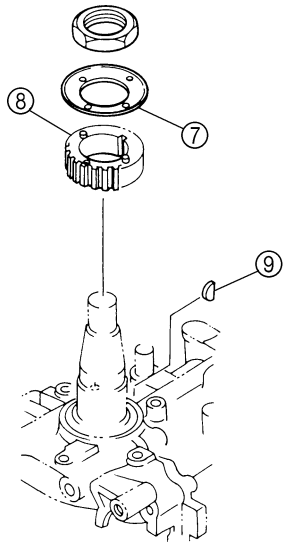
4. Loosen the driven sprocket bolt ⑤ and remove the driven sprocket ⑥.



NOTE:
Make sure that the camshaft does not crank when loosening the driven sprocket bolt.

	Flywheel holder: 90890-06522

5. Remove the nut, retaining plate ⑦, drive sprocket ⑧, and Woodruff key ⑨.



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 and driven sprocket for cracks, damage, or wear. Replace if necessary.

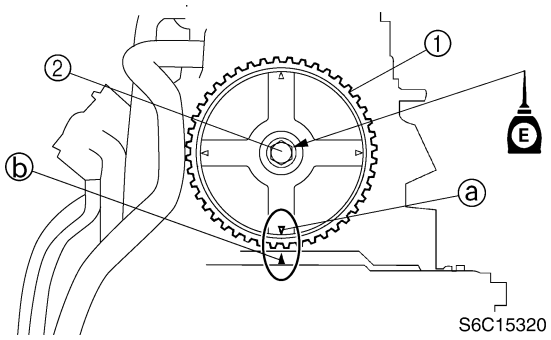
5

Installing the timing belt and sprockets

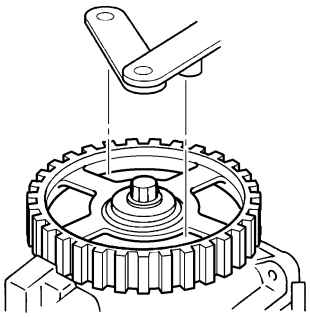
CAUTION:

Do not turn the drive sprocket or the driven sprocket when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.

1. Install the driven sprocket, and then check that the "▲1" mark ⓐ on the driven sprocket ① is aligned with the "▲" mark ⓑ on the cylinder head, and then tighten the bolt ② to the specified torque.



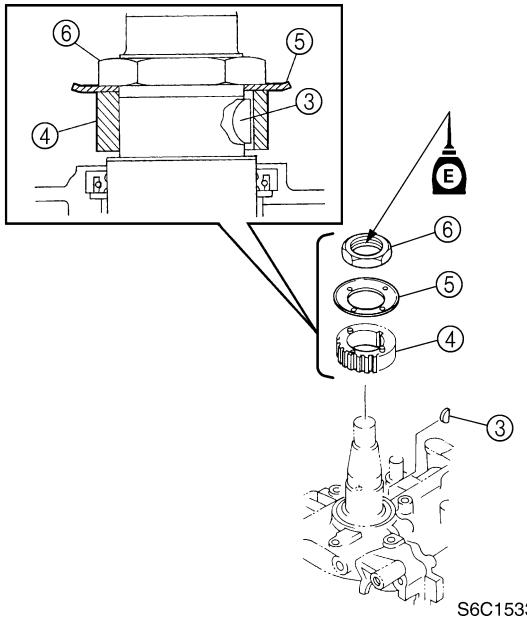
S6C15320


S6C15370

Flywheel holder: 90890-06522

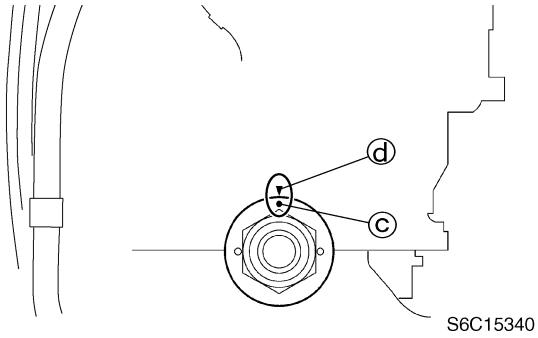
Driven sprocket bolt:
38 N·m (3.8 kgf·m, 28.0 ft·lb)

2. Install the Woodruff key ③, drive sprocket ④, retaining plate ⑤, and nut ⑥, and then tighten the nut.



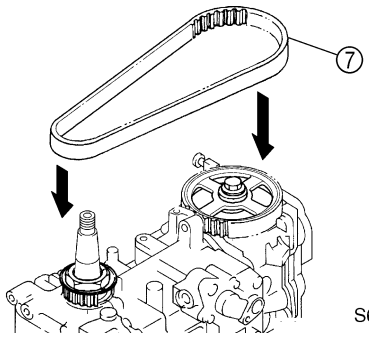
S6C15330

3. Check that the "●" mark ⓒ on the retaining plate is aligned with the "▲" mark ⓓ on the cylinder block.



S6C15340

4. Install the timing belt ⑦ to the drive sprocket, then onto the driven sprocket with its part number in the upright position.



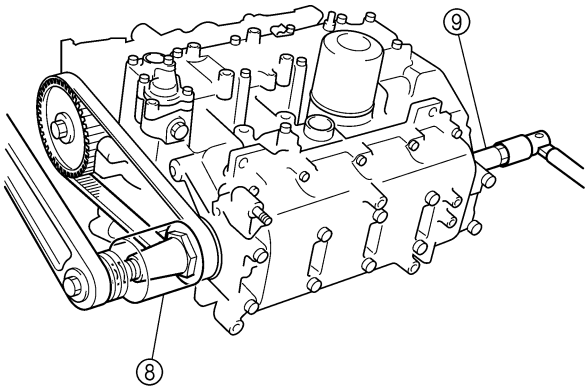
S6C15350

CAUTION:

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

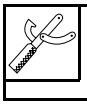
5. Turn the drive sprocket clockwise two turns, and then check that the alignment marks are aligned.

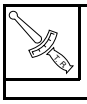
6. Tighten the drive sprocket nut to the specified torque.



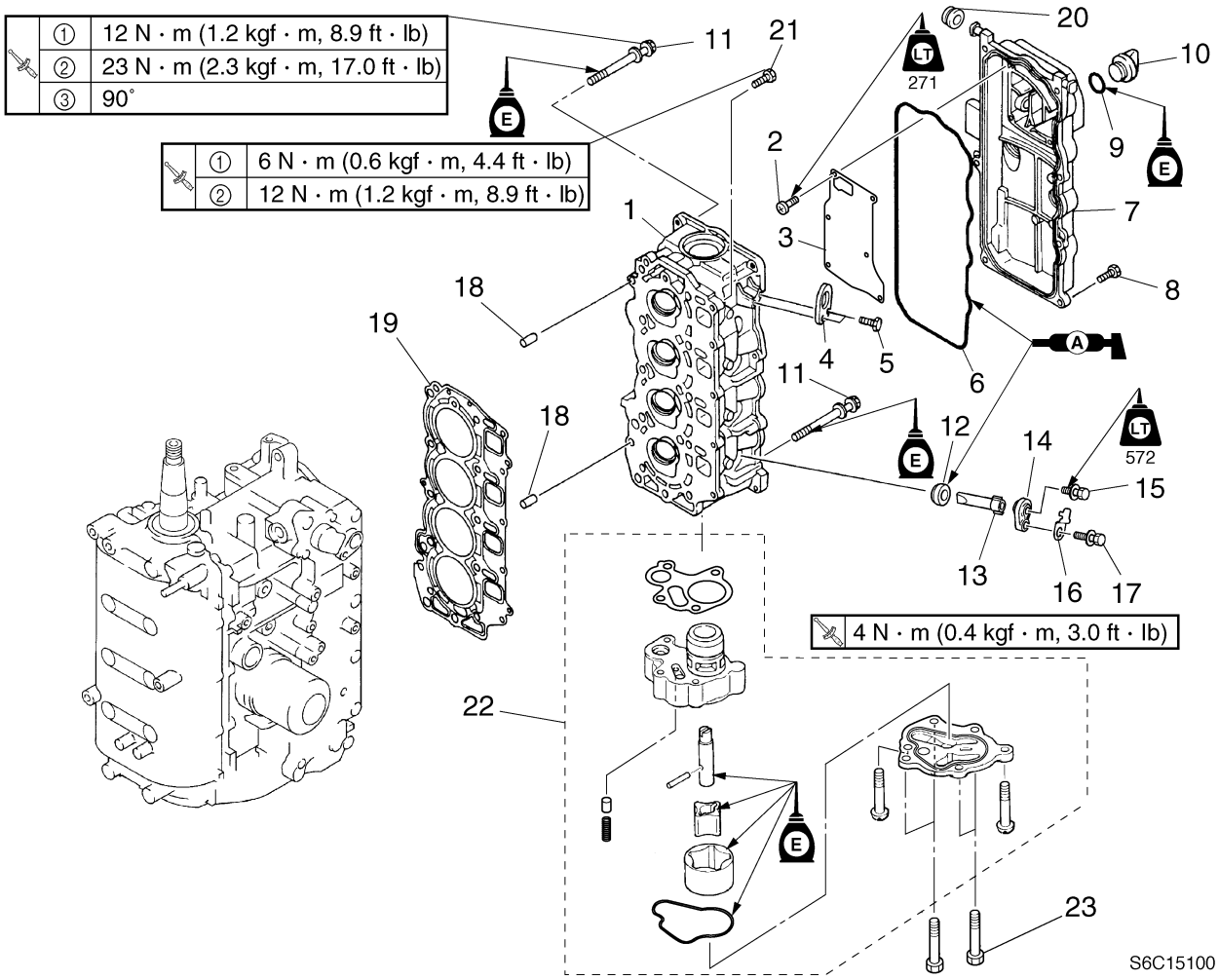
S6C15380

NOTE:
Use a deep socket ⑧ for this procedure.

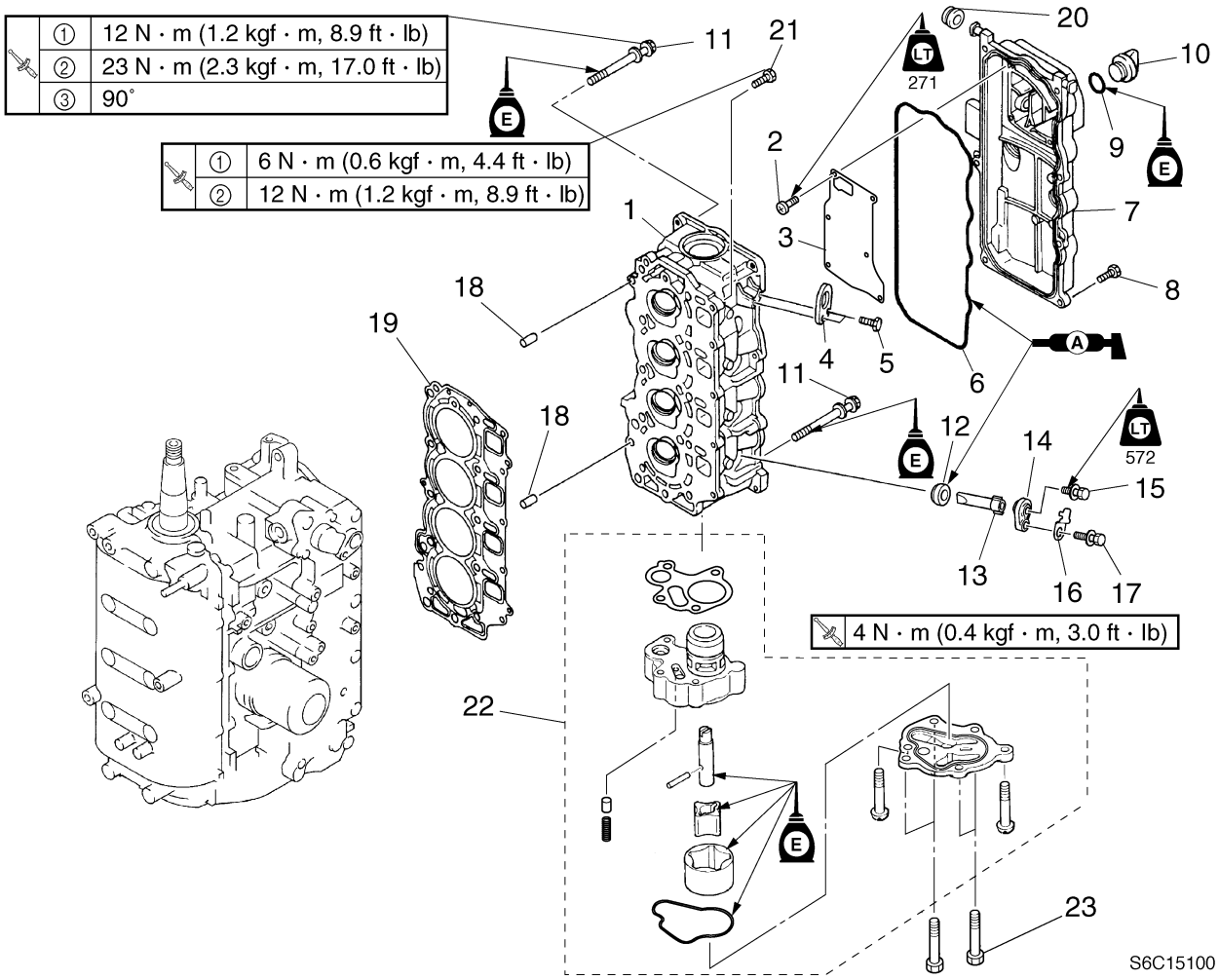
	Crankshaft holder 18 ⑨: 90890-06562

	Drive sprocket nut: 140 N·m (14.0 kgf·m, 103.3 ft·lb)

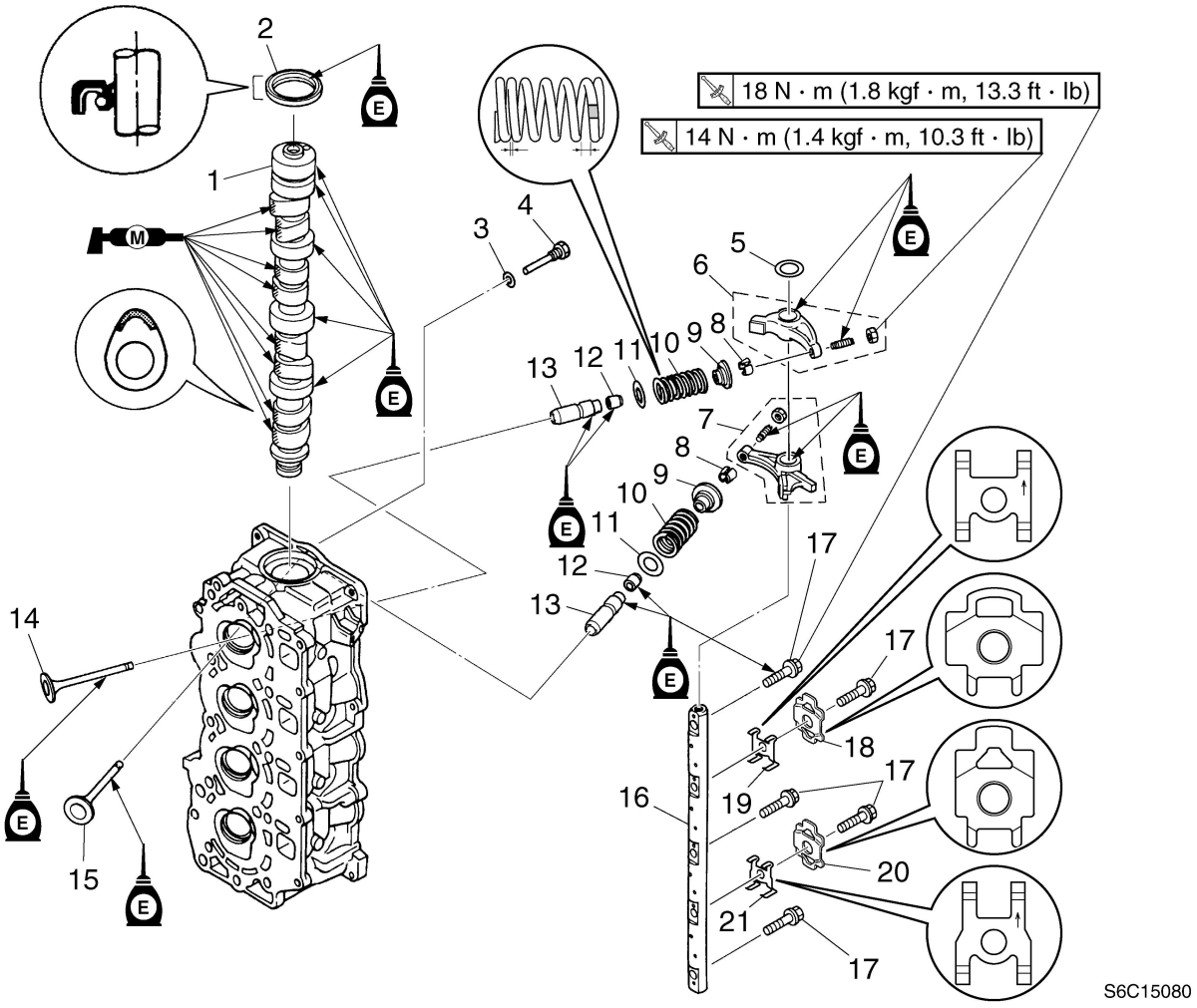
Cylinder head



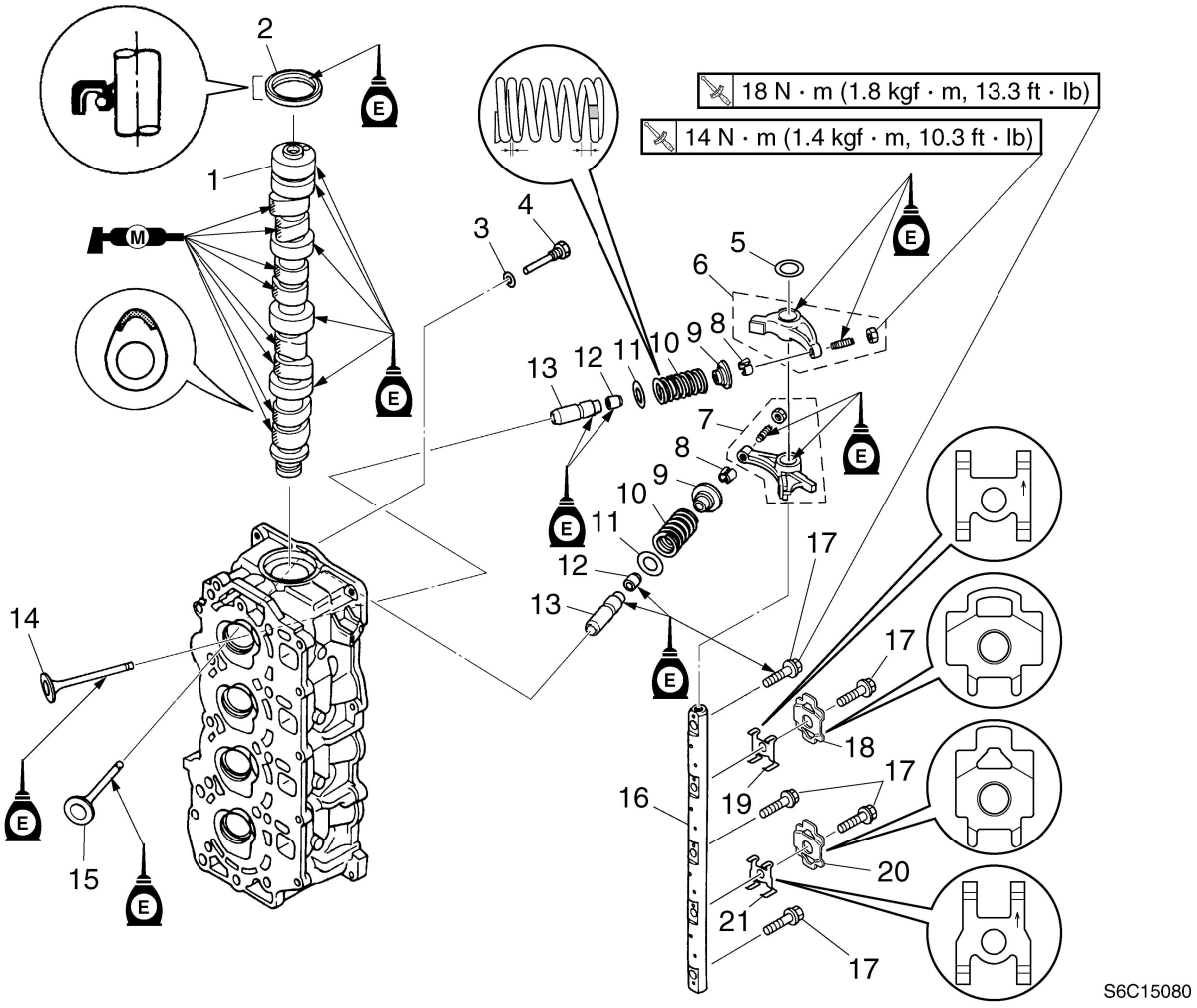
No.	Part name	Q'ty	Remarks
1	Cylinder head	1	
2	Screw	6	ø4 × 20 mm
3	Plate	1	
4	Engine hanger	1	
5	Bolt	2	M6 × 20 mm
6	Gasket	1	**Not reusable**
7	Cylinder head cover	1	
8	Bolt	7	M6 × 20 mm
9	O-ring	1	
10	Oil filler cap	1	
11	Bolt	10	M9 × 93 mm
12	Grommet	4	
13	Anode	4	
14	Cover	4	
15	Bolt	4	M5 × 12 mm
16	Plate	4	
17	Bolt	4	M6 × 20 mm



No.	Part name	Q'ty	Remarks
18	Dowel	2	
19	Gasket	1	**Not reusable**
20	Grommet	2	
21	Bolt	5	M6 × 25 mm
22	Oil pump assembly	1	
23	Bolt	4	M6 × 45 mm



No.	Part name	Q'ty	Remarks
1	Camshaft	1	
2	Oil seal	1	**Not reusable**
3	Gasket	1	**Not reusable**
4	Retaining bolt	1	
5	Washer	7	
6	Rocker arm assembly	7	
7	Rocker arm assembly	1	
8	Valve cotter	16	
9	Valve spring retainer	8	
10	Valve spring	8	
11	Valve spring seat	8	
12	Valve seal	8	**Not reusable**
13	Valve guide	8	
14	Exhaust valve	4	
15	Intake valve	4	
16	Rocker arm shaft	1	
17	Bolt	5	M8 × 22 mm

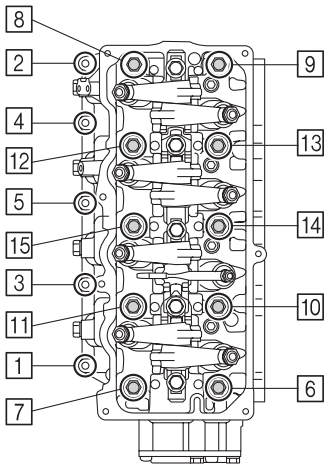


No.	Part name	Q'ty	Remarks
18	Stopper guide	1	
19	Tensioner	1	
20	Stopper guide	1	
21	Tensioner	1	

Removing the cylinder head

1. Remove the cylinder head cover.

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

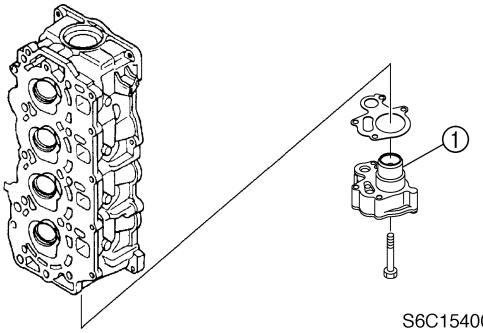


S6C15390

CAUTION:

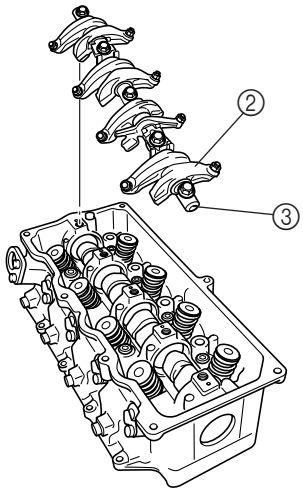
Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.

3. Remove the oil pump assembly ①.



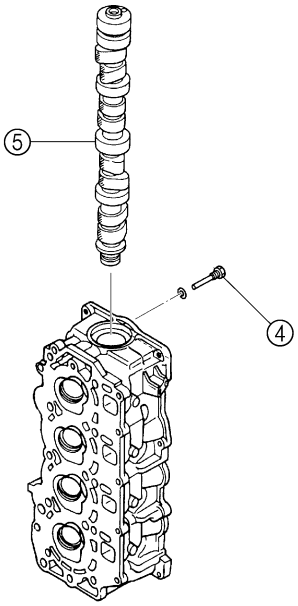
S6C15400

4. Remove the rocker arm assembly ② and rocker arm shaft ③.



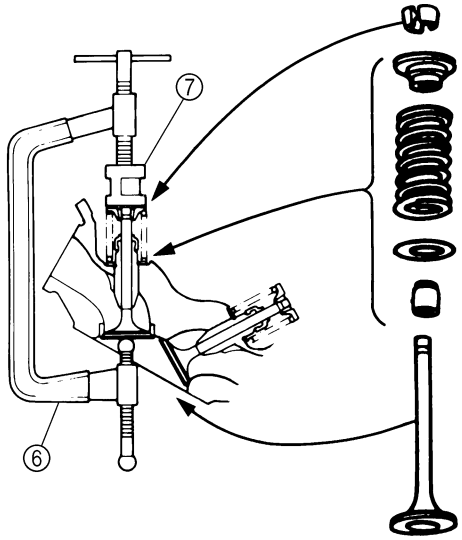
S6C15410

5. Remove the retaining bolt ④, then the camshaft ⑤.



S6C15420

6. Remove the intake and exhaust valves.



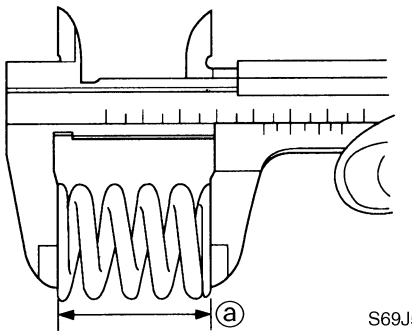
S62Y5290

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

Valve spring compressor ⑥:
90890-04019
Valve spring compressor attachment ⑦:
90890-06320

Checking the valve springs

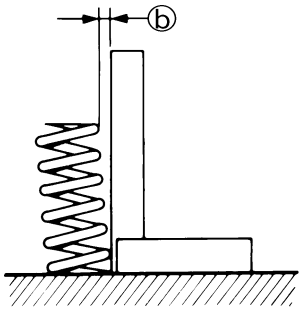
1. Measure the valve spring free length ⓐ. Replace if below specification.



S69J5720

Valve spring free length ⓐ:
39.85 mm (1.5689 in)

2. Measure the valve spring tilt ⓑ. Replace if above specification.



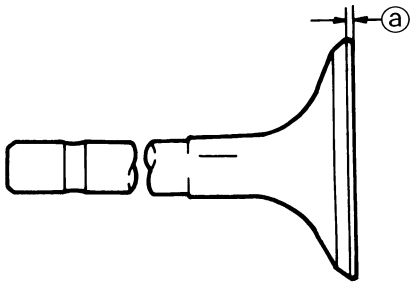
S69J5730

Valve spring tilt limit ⓑ:
1.7 mm (0.07 in)

Checking the valves

1. Check the valve face for pitting or wear. Replace if necessary.

2. Measure the valve margin thickness ⓐ. Replace if below specification.

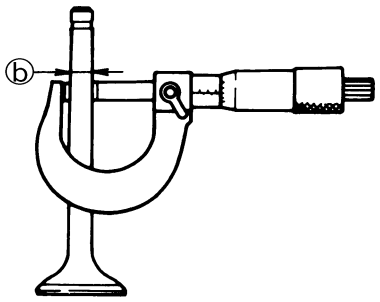


S69J5740

Valve margin thickness ⓐ:
Intake:
0.8–1.2 mm (0.031–0.047 in)
Exhaust:
1.0–1.4 mm (0.039–0.055 in)

5

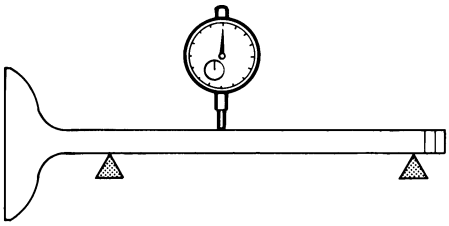
3. Measure the valve stem diameter ⓑ. Replace if out of specification.



S69J5750

Valve stem diameter ⓑ:
Intake:
5.475–5.490 mm
(0.2156–0.2161 in)
Exhaust:
5.460–5.475 mm
(0.2150–0.2156 in)

4. Measure the valve stem runout. Replace if above specification.



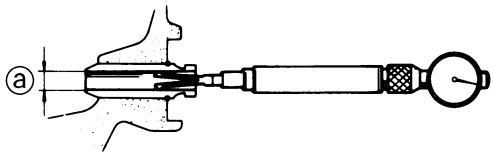
S69J5760

Valve stem runout limit:
Intake: 0.05 mm (0.0020 in)
Exhaust: 0.03 mm (0.0012 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 ⓐ.



S6D55490

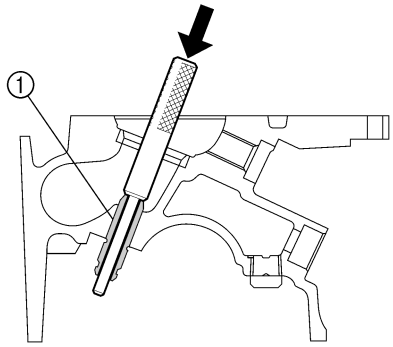
Valve guide inside diameter ⓐ:
Intake and exhaust:
5.500–5.512 mm
(0.2165–0.2170 in)

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 and exhaust:
0.025–0.052 mm
(0.0010–0.0020 in)

Replacing the valve guides

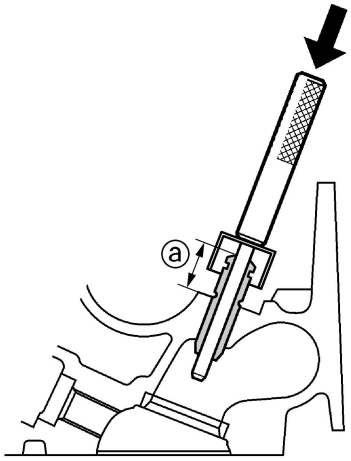
1. Remove the valve guide ① by striking the special service tool from the combustion chamber end.



S6C15430

Valve guide remover/installer:
90890-06801

2. Install a new valve guide by striking the special service tool from the camshaft end.



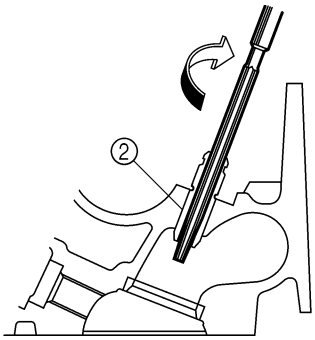
S6C15440

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

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

Valve guide position ⓐ:
16.5 ± 0.2 mm (0.650 ± 0.008 in)

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



S6C15450

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

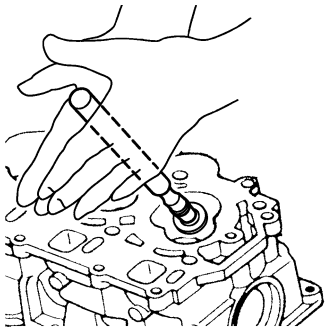
Valve guide reamer: 90890-06804

4. Measure the valve guide inside diameter.

Valve guide inside diameter:
Intake and exhaust:
5.500–5.512 mm
(0.2165–0.2170 in)

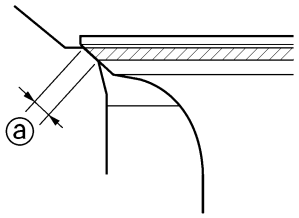
Checking the valve seat

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 available) as shown.

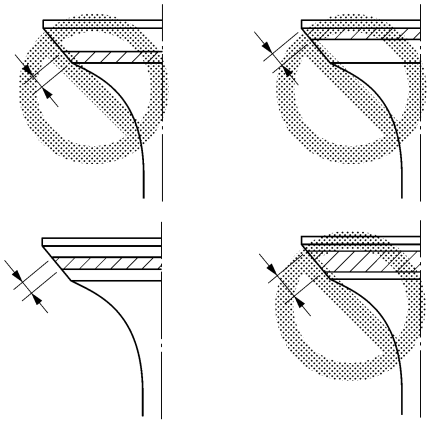

S6C15460

5

4. Measure the valve seat contact width ⓐ 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

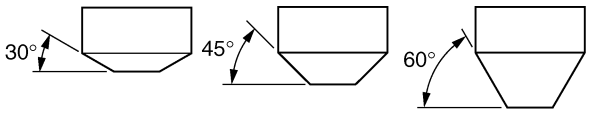


S69J5840

Valve seat contact width ⓐ:
Intake and exhaust:
1.3–1.5 mm (0.051–0.059 in)

Refacing the valve seat

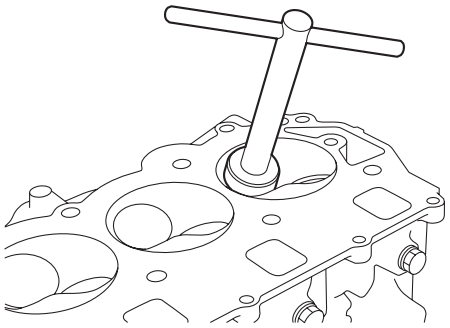
1. Reface the valve seat with the valve seat cutters.



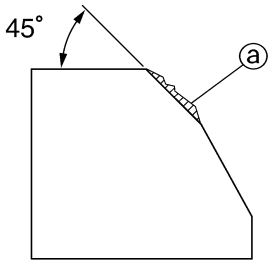
S69J5850

Valve seat cutter holder:
90890-06316
Valve seat cutter:
30° (intake): 90890-06327
30° (exhaust): 90890-06328
45° (intake): 90890-06555
45° (exhaust): 90890-06312
60° (intake): 90890-06323
60° (exhaust): 90890-06315

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.



S6C15480



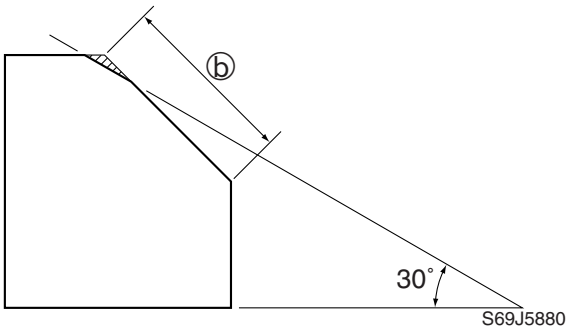
S69J5870

ⓐ Slag or rough surface

CAUTION:

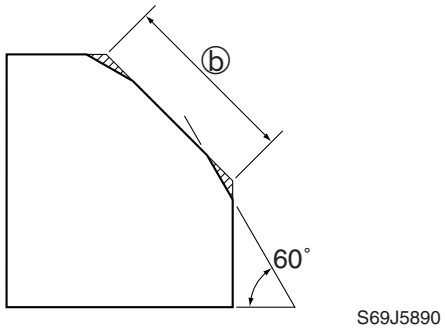
Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.

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



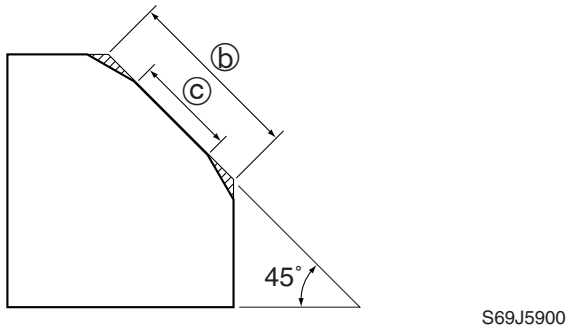
ⓑ Previous contact width

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



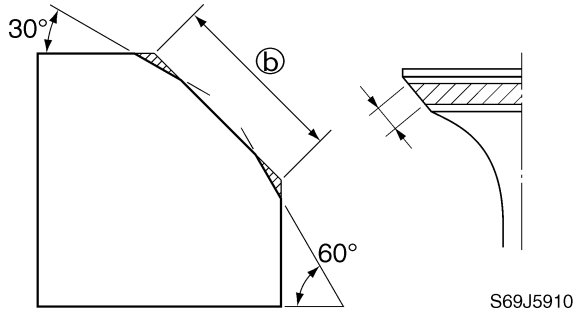
ⓑ Previous contact width

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



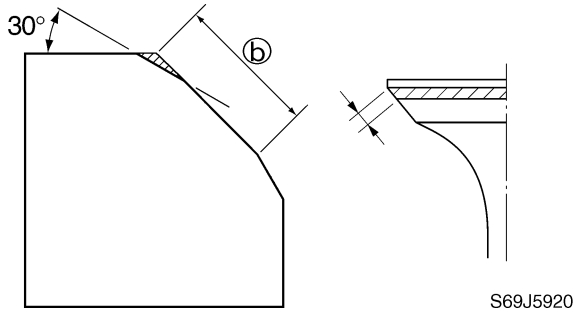
ⓑ Previous contact width
ⓒ Specified contact width

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 and a 60° cutter to cut the bottom edge to center the area and set its width.



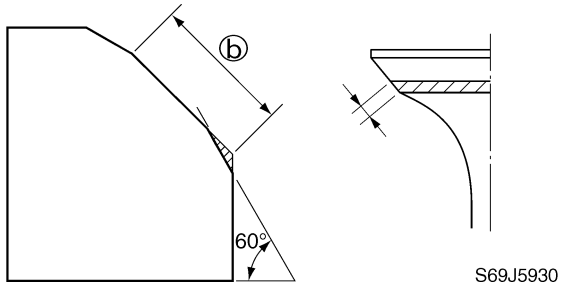
ⓑ Previous contact width

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.



ⓑ Previous contact width

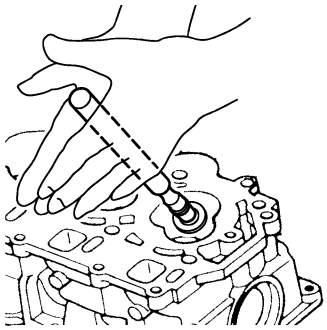
8. If the valve seat contact area is too narrow and situated near the bottom edge of the valve face, use a 60° cutter to cut the bottom edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



ⓑ Previous contact width

5

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


S6C15460

CAUTION:

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

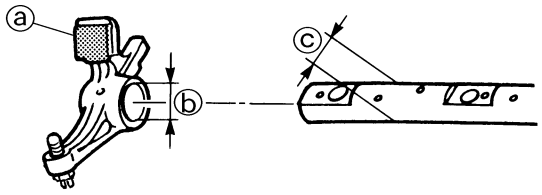
10. After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder head and the valve.

11. Check the valve seat contact area of the valve again.

Checking the rocker arms and rocker arm shaft

1. Check the rocker arms, rocker arm shaft, and rocker arm contact surface ⓐ for wear. Replace if necessary.

2. Measure the rocker arm inside diameter ⓑ and rocker arm shaft outside diameter ⓒ. Replace if out of specification.

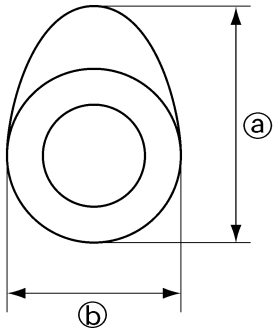


S62Y5510

Rocker arm inside diameter ⓑ:
16.000–16.018 mm
(0.6299–0.6306 in)
Rocker arm shaft outside diameter ⓒ:
15.971–15.991 mm
(0.6288–0.6296 in)

Checking the camshaft

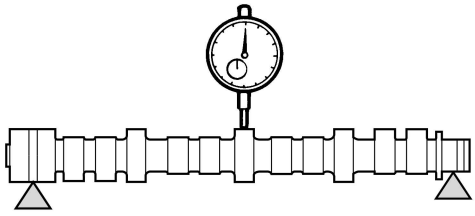
1. Measure the cam lobe. Replace if out of specification.



S69J5950

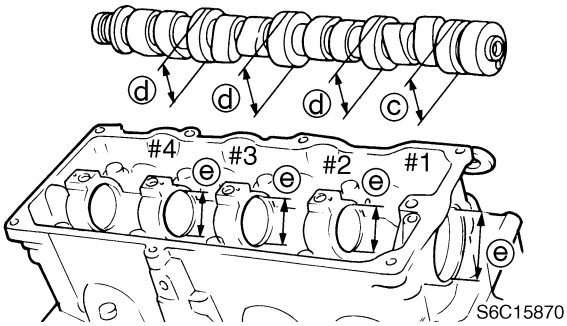
Cam lobe ⓐ:
Intake:
30.888–30.988 mm
(1.2161–1.2200 in)
Exhaust:
30.824–30.924 mm
(1.2135–1.2175 in)
Cam lobe ⓑ:
Intake and exhaust:
25.950–26.050 mm
(1.0216–1.0256 in)

2. Measure the camshaft runout. Replace if above specification.


S6C15490

Camshaft runout limit:
0.03 mm (0.0012 in)

3. Measure the camshaft journal diameters ⓒ and ⓓ, and cylinder head journal inside diameter ⓔ. Replace the camshaft and cylinder head if out of specification.

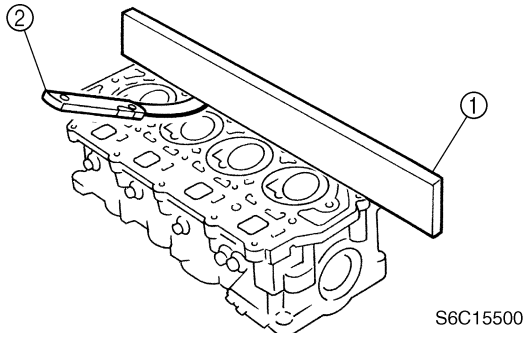


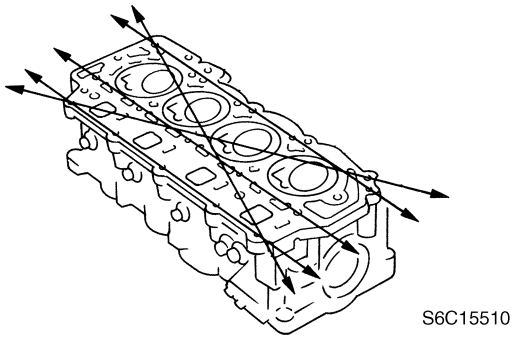
Camshaft journal diameter ⓒ:
36.925–36.945 mm
(1.4537–1.4545 in)
Camshaft journal diameter ⓓ:
36.935–36.955 mm
(1.4541–1.4549 in)
Cylinder head journal inside diameter ⓔ:
37.000–37.025 mm
(1.4567–1.4577 in)

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 the directions shown. Replace if above specification.



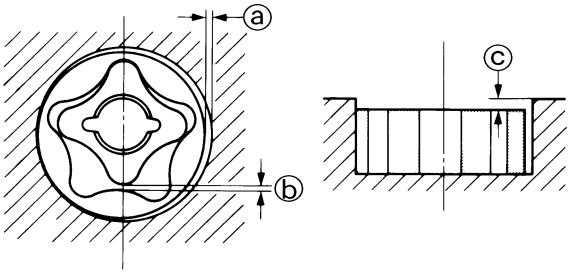


Cylinder head warpage limit:
0.10 mm (0.0039 in)

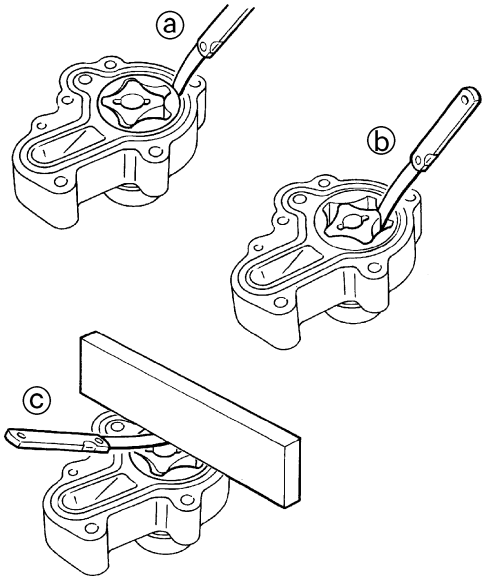
5

Checking the oil pump

1. Measure the oil pump rotor clearances as shown. Replace if out of specification.



S6D55580

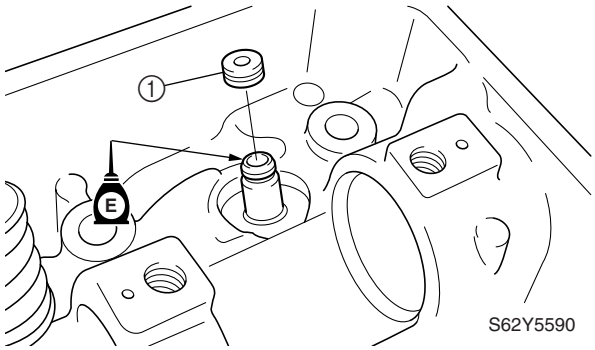


S6D55590

Clearance ⓐ:
0.09–0.15 mm (0.0035–0.0059 in)
Clearance ⓑ:
Within 0.12 mm (0.0047 in)
Clearance ⓒ:
0.03–0.08 mm (0.0012–0.0031 in)

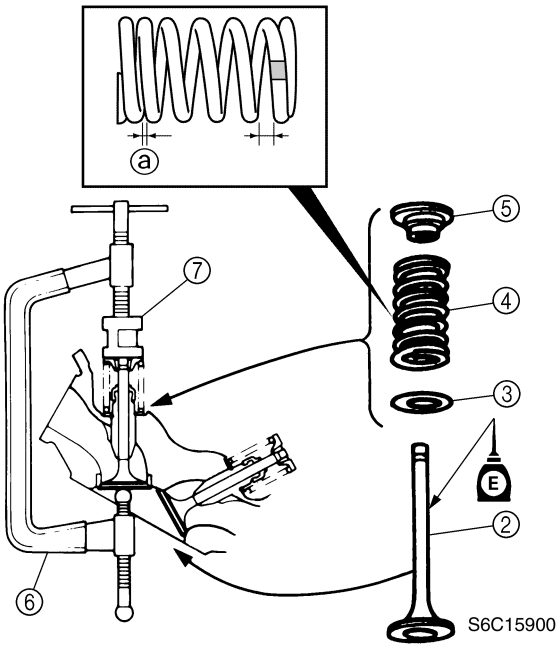
Installing the valves

1. Install a new valve seal ① onto the valve guide.



S62Y5590

2. Install the valve ②, valve spring seat ③, valve spring ④, and valve spring retainer ⑤ in the sequence shown, and then attach the special service tools.

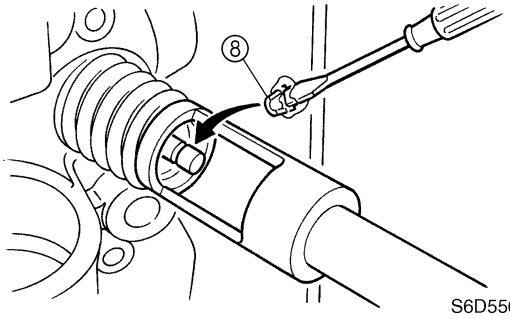


S6C15900

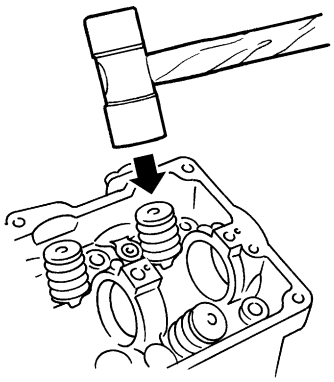
NOTE:
Face the fine pitch side ⓐ of the valve spring toward the spring seat.

Valve spring compressor ⑥:
90890-04019
Valve spring compressor attachment ⑦:
90890-06320

3. Compress the valve spring, and then install the valve cotter ⑧ using a thin screwdriver with a small amount of grease applied to it.

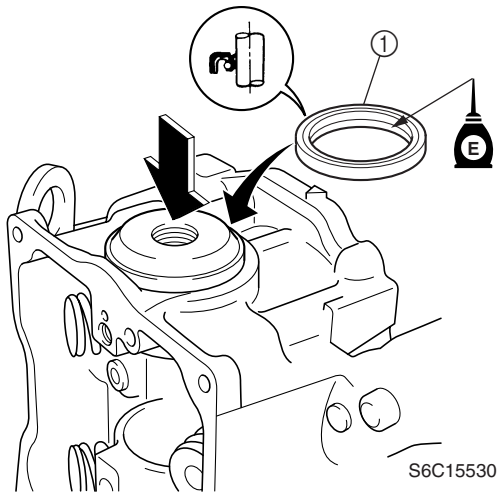


4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotter securely.



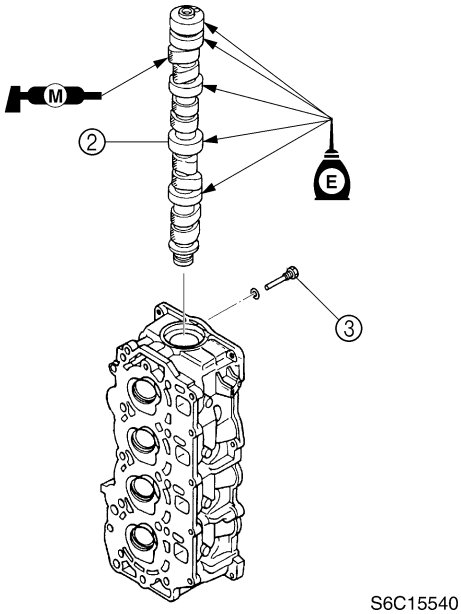
Installing the camshaft

1. Install a new oil seal ①.



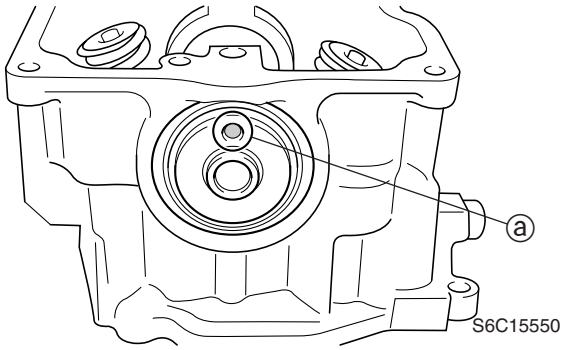
	Bearing outer race attachment: 90890-06626

2. Install the camshaft ② in the direction shown, then the retaining bolt ③.



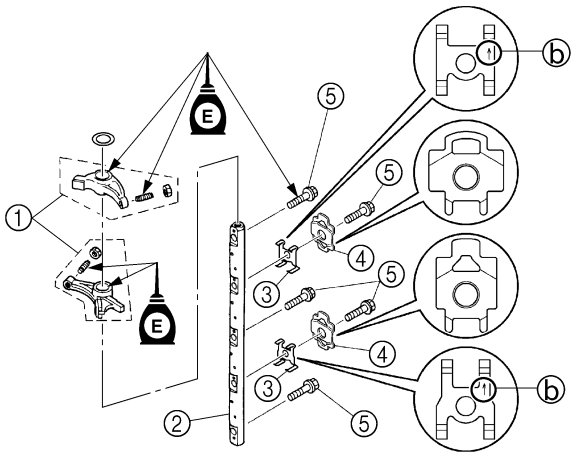
Installing the rocker arm shaft assembly

1. Check that the camshaft dowel hole ⓐ is in the position shown in the illustration. Adjust if necessary.



5

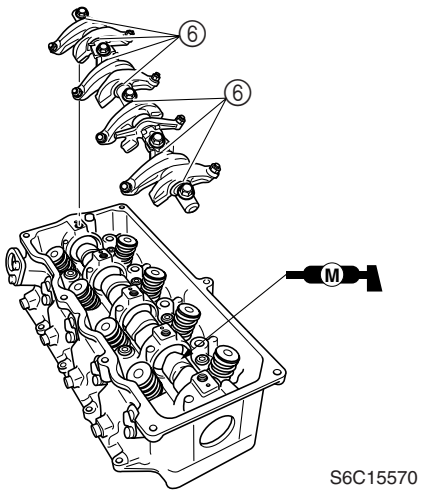
2. Assemble the rocker arm assemblies ① and rocker arm shaft ②, and then install the tensioners ③ and stopper guides ④ to the rocker arm shaft by installing the bolts ⑤.



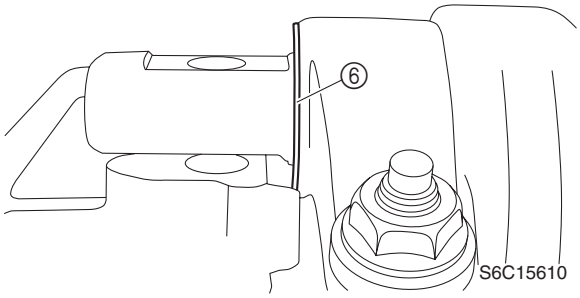
S6C15560

NOTE:
Make sure that the arrow marks ⓑ on the tensioners are facing up.

3. Install the rocker arm shaft assembly to the cylinder head by installing the bolts, and then tighten them to the specified torque.



S6C15570



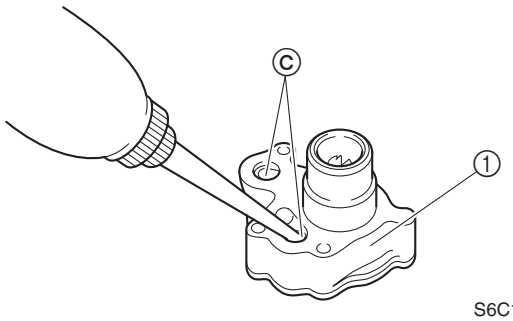
S6C15610

CAUTION:
Be sure not to damage the washers ⑥ when installing the rocker arm shaft assembly to the cylinder head.

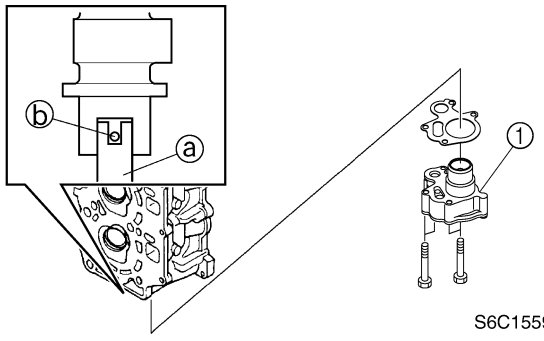
Rocker arm shaft bolt:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

Installing the oil pump

1. Install the oil pump ① by aligning the oil pump drive shaft ⓐ with the camshaft pin ⓑ.



S6C15580

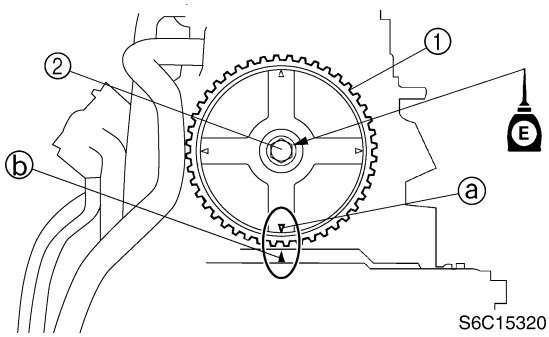


S6C15590

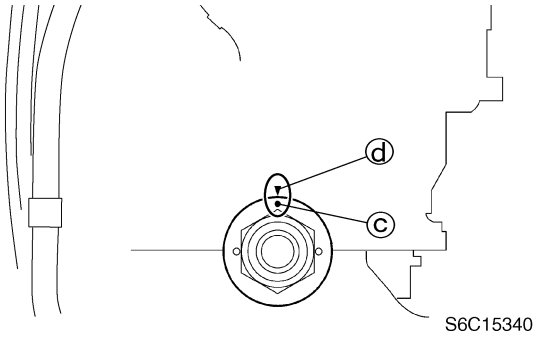
NOTE:
Before installing the oil pump, be sure to fill it with a small amount of engine oil through the oil passages ⓒ.

Installing the cylinder head

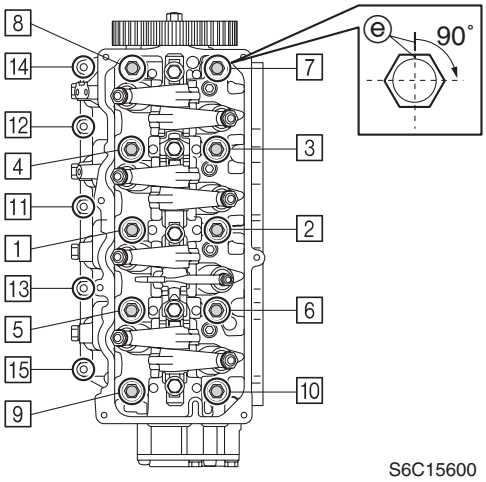
1. Install the driven sprocket, and then check that the "▲1" mark ⓐ on the driven sprocket ① is aligned with the "▲" mark ⓑ on the cylinder head, and then tighten the bolt ②.



2. Check that the "●" mark ⓒ on the retaining plate is aligned with the "▲" mark ⓓ on the cylinder block.



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



CAUTION:

- **Do not reuse the cylinder head gasket, always replace it with a new one.**
- **Do not turn the drive sprocket or the driven sprocket when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.**

NOTE:

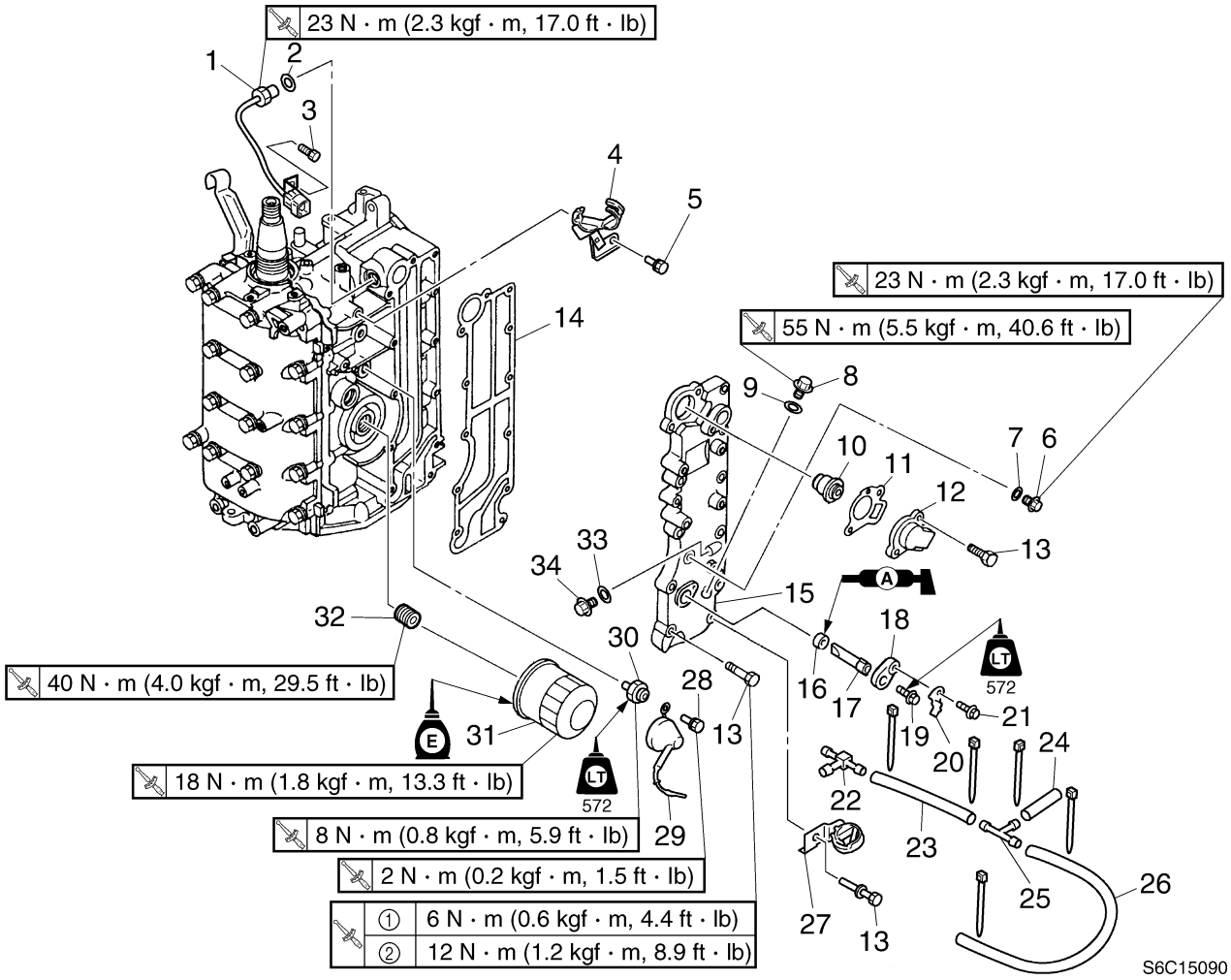
- Apply engine oil to the cylinder head bolts before installation.
- Tighten the M9 bolts to the specified torques in two stages first, and then make a mark ⓔ on the M9 bolts and the cylinder head, and then tighten the bolts 90° from the mark.
- Tighten the M6 bolts to the specified torques in two stages.
- After installing the cylinder head, install the timing belt and check the valve clearances. See the applicable procedures in this manual.

Cylinder head bolt (M9):
1st: 12 N·m (1.2 kgf·m, 8.9 ft·lb)
2nd: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
3rd: 90°
Cylinder head bolt (M6):
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

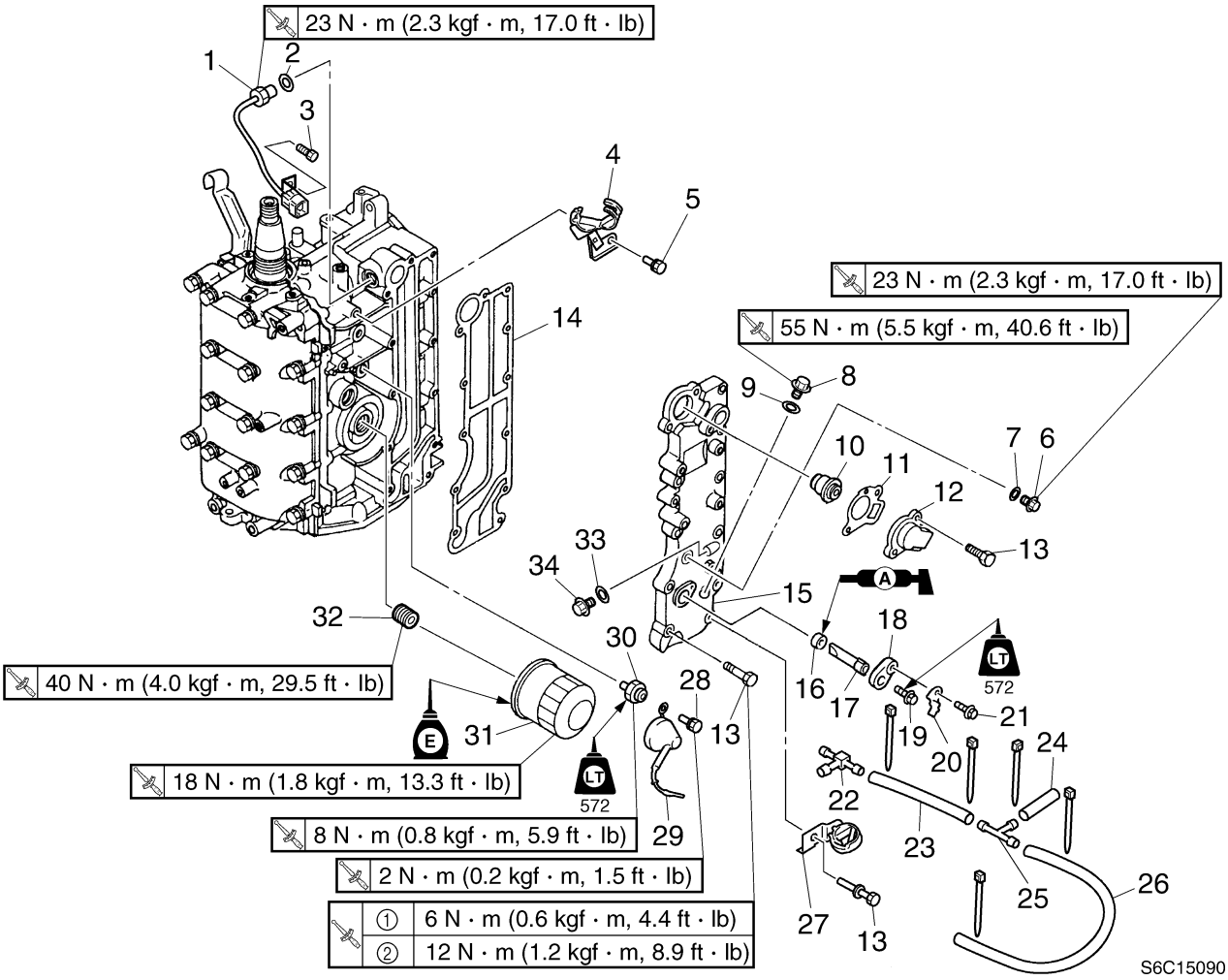
4. Install the cylinder head cover, and then tighten the bolts.

5

Exhaust cover

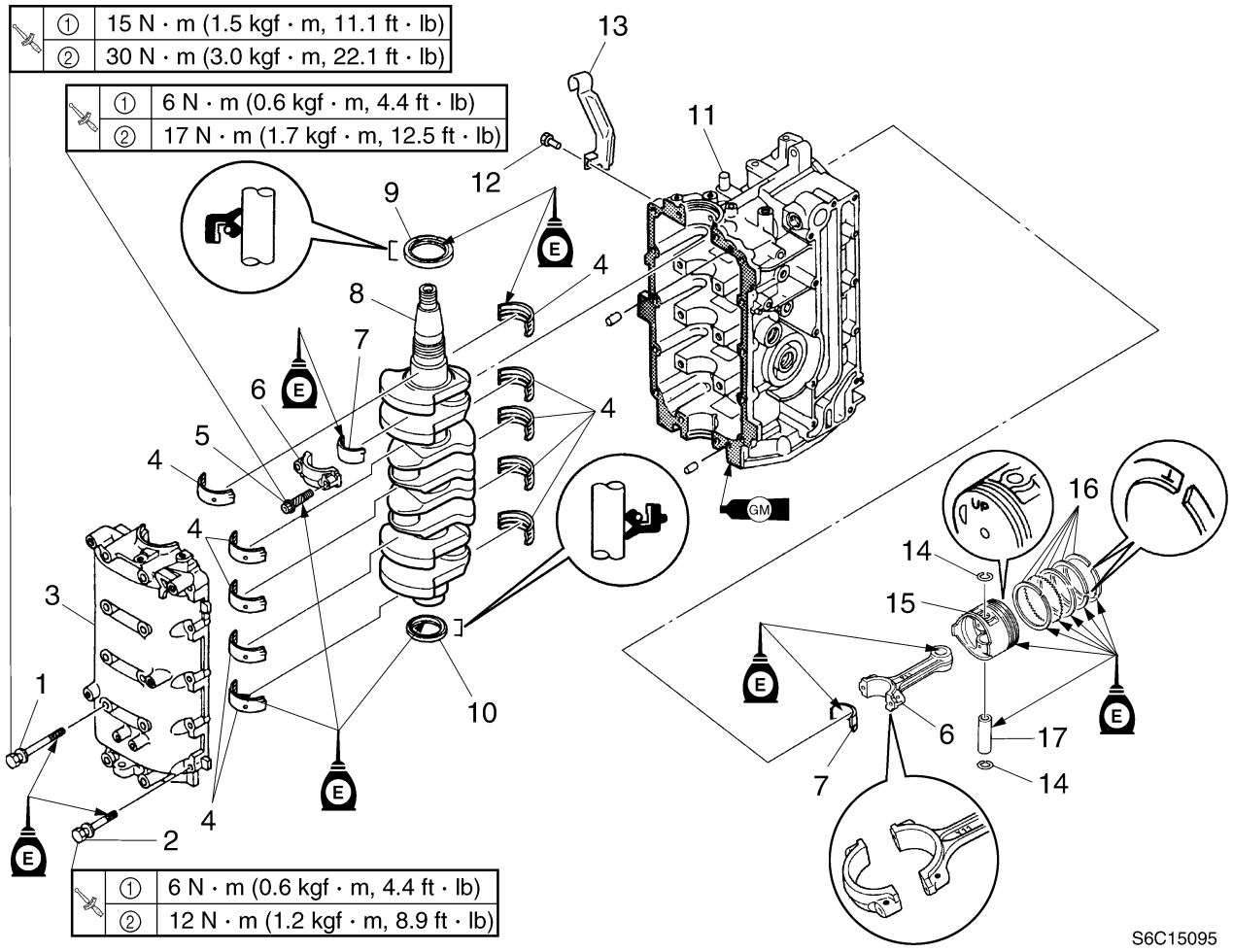


No.	Part name	Q'ty	Remarks
1	Cooling water temperature sensor	1	
2	Gasket	1	**Not reusable**
3	Bolt	1	M6 × 14 mm
4	Holder	1	
5	Bolt	1	M6 × 14 mm
6	Plug	1	M14 × 12 mm
7	Gasket	1	**Not reusable**
8	Plug	1	M8 × 17 mm
9	Gasket	1	**Not reusable**
10	Thermostat	1	
11	Gasket	1	**Not reusable**
12	Thermostat cover	1	
13	Bolt	12	M6 × 35 mm
14	Gasket	1	**Not reusable**
15	Exhaust cover	1	
16	Grommet	1	
17	Anode	1	



No.	Part name	Q'ty	Remarks
18	Cover	1	
19	Bolt	1	M5 × 12 mm
20	Plate	1	
21	Bolt	1	M6 × 20 mm
22	Joint	1	
23	Hose	1	
24	Hose	1	
25	Joint	1	
26	Hose	1	
27	Holder	1	
28	Bolt	1	M4 × 8 mm
29	Oil pressure switch lead	1	
30	Oil pressure switch	1	
31	Oil filter	1	
32	Joint	1	
33	Gasket	1	**Not reusable**
34	Plug	1	M14 × 12mm

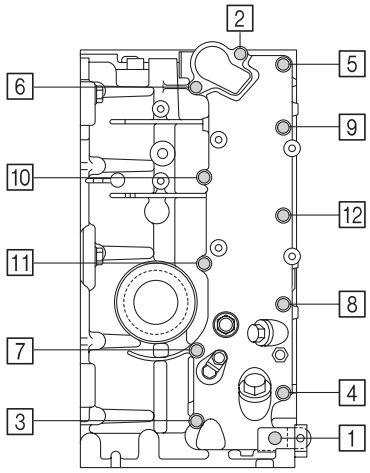
Cylinder block



No.	Part name	Q'ty	Remarks
1	Bolt	10	M8 × 82 mm
2	Bolt	10	M6 × 35 mm
3	Crankcase	1	
4	Main bearing	10	
5	Bolt	8	M6 × 30 mm
6	Connecting rod assembly	4	
7	Connecting rod bearing	8	
8	Crankshaft	1	
9	Oil seal	1	**Not reusable**
10	Oil seal	1	**Not reusable**
11	Cylinder block	1	
12	Bolt	1	M6 × 14 mm
13	Holder	1	
14	Clip	8	
15	Piston	4	
16	Piston ring assembly	4	
17	Piston pin	4	

Disassembling the cylinder block

1. Remove the thermostat cover and exhaust cover by removing the bolts in the sequence shown.



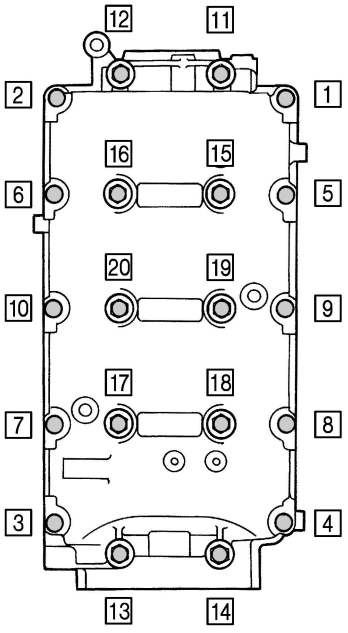
S6C15620

2. Remove the oil filter.

NOTE:
Be sure to clean up any oil spills.

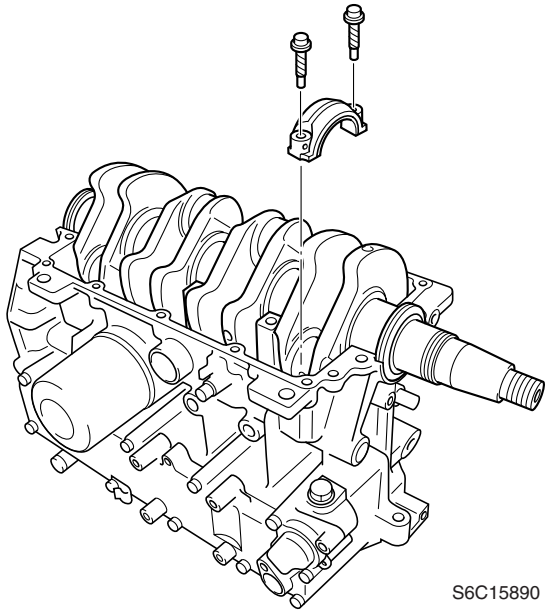
	Oil filter wrench: 90890-01426

3. Remove the crankcase bolts in the sequence shown.



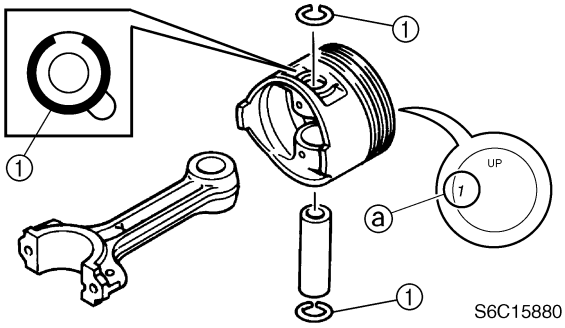
S6C15630

4. Remove the connecting rod bolts and the connecting rod caps, and then remove the crankshaft and oil seals.


S6C15890

5. Remove the connecting rod and piston assemblies.

6. Remove the piston pin clips ① and piston pin, and then remove the piston.



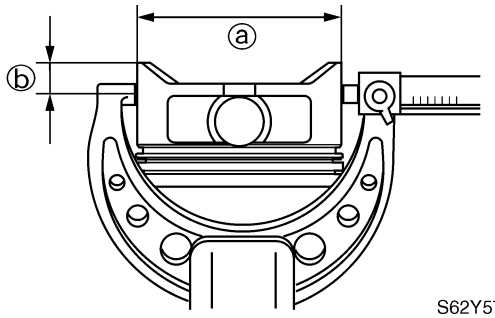
S6C15880

NOTE:
- Be sure to keep the bearings in the order as they were removed.
- Mark each piston with an identification number ⓐ of the corresponding cylinder.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

5

Checking the piston diameter

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

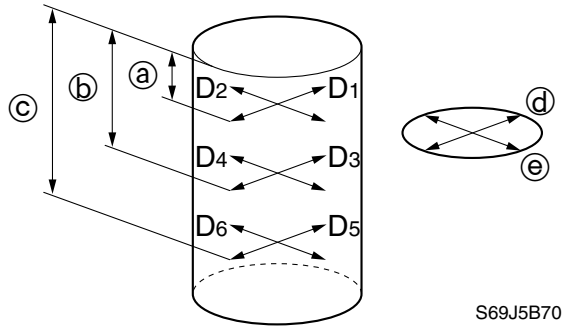


S62Y5750

Piston diameter ⓐ:
64.950–64.965 mm
(2.5571–2.5577 in)
Measuring point ⓑ:
5.0 mm (0.20 in) up from the bottom of the piston skirt
Oversize piston diameter:
Oversize 1st:
65.200–65.215 mm
(2.5669–2.5675 in)
Oversize 2nd:
65.450–65.465 mm
(2.5768–2.5774 in)

Checking the cylinder bore

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



S69J5B70

ⓐ 20 mm (0.8 in)
ⓑ 40 mm (1.6 in)
ⓒ 70 mm (2.8 in)

Cylinder bore (D_1–D_6):
65.000–65.015 mm
(2.5591–2.5596 in)

2. Calculate the taper limit. Replace the cylinder block if above specification.

Taper limit:
D_1–D_5 (direction ⓓ)
D_2–D_6 (direction ⓔ)
0.08 mm (0.0032 in)

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

Out-of-round limit:
D_2–D_1 (measuring point ⓐ)
D_6–D_5 (measuring point ⓒ)
0.05 mm (0.0020 in)

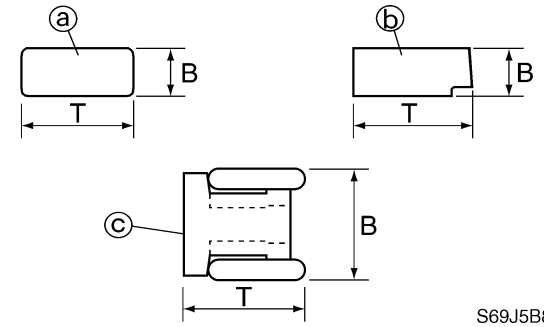
Checking the piston clearance

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

Piston clearance:
0.035–0.065 mm
(0.0014–0.0026 in)

Checking the piston rings

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

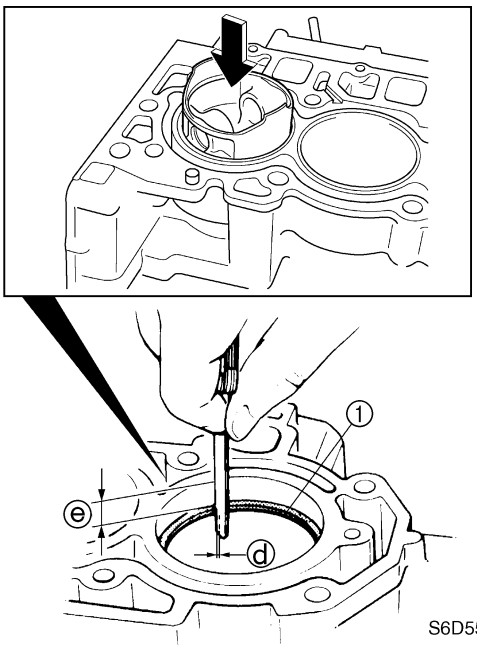


S69J5B80

Piston ring dimensions:
Top ring ⓐ:
B: 1.17–1.19 mm
(0.0461–0.0469 in)
T: 2.30–2.50 mm
(0.0905–0.0984 in)
2nd ring ⓑ:
B: 1.47–1.49 mm
(0.0579–0.0587 in)
T: 2.60–2.80 mm
(0.1024–0.1102 in)
Oil ring ⓒ:
B: 2.36–2.48 mm
(0.0929–0.0976 in)
T: (reference data)
2.75 mm (0.1083 in)

2. Level the piston ring ① in the cylinder with a piston crown.

3. Check the piston ring end gap ⓓ at the specified measuring point. Replace if out of specification.

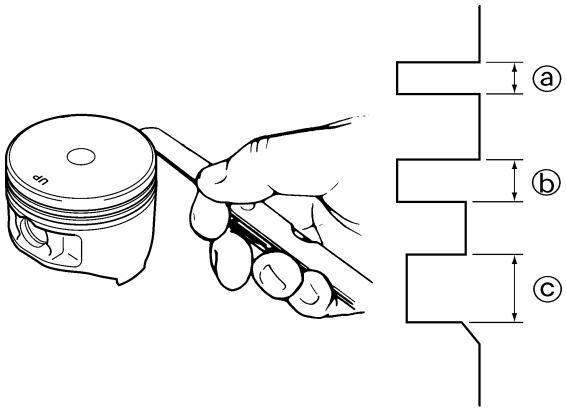


S6D55780

Piston ring end gap ⓓ:
Top ring:
0.15–0.30 mm
(0.0059–0.0118 in)
2nd ring:
0.30–0.50 mm
(0.0118–0.0197 in)
Oil ring:
0.20–0.70 mm
(0.0079–0.0276 in)
Measuring point ⓔ: 20 mm (0.8 in)

Checking the piston ring grooves

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



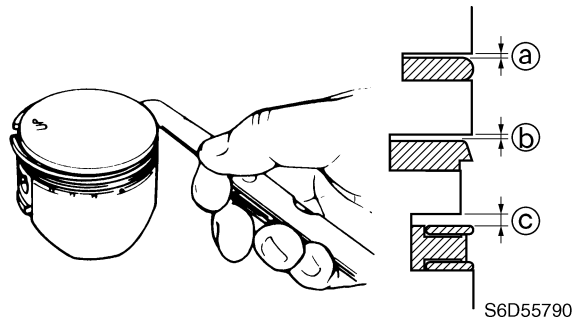
S6C15640

Piston ring groove:
Top ring ⓐ:
1.21–1.23 mm
(0.0476–0.0484 in)
2nd ring ⓑ:
1.51–1.53 mm
(0.0594–0.0602 in)
Oil ring ⓒ:
2.52–2.54 mm
(0.0992–0.1000 in)

5

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.

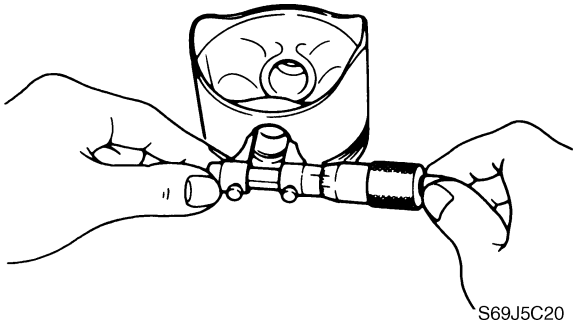


S6D55790

Piston ring side clearance:
Top ring ⓐ:
0.02–0.06 mm
(0.0008–0.0024 in)
2nd ring ⓑ:
0.02–0.06 mm
(0.0008–0.0024 in)
Oil ring ⓒ:
0.04–0.18 mm
(0.0016–0.0071 in)

Checking the piston pin boss bore

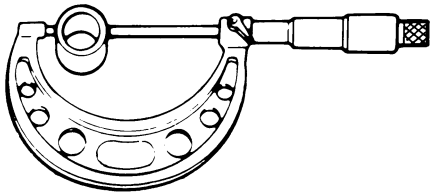
1. Measure the piston pin boss bore. Replace the piston if out of specification.


S69J5C20

Piston pin boss bore:
15.974–15.985 mm
(0.6289–0.6293 in)

Checking the piston pin

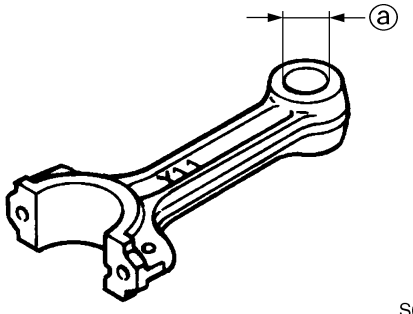
1. Measure the piston pin diameter. Replace if out of specification.


S69J5C30

Piston pin outside diameter:
15.965–15.970 mm
(0.6285–0.6287 in)

Checking the connecting rod small end inside diameter

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

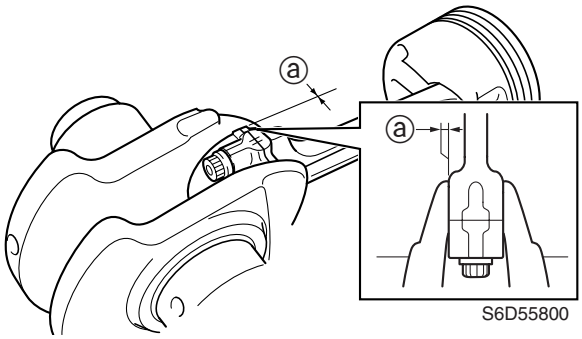


S62Y5830

Connecting rod small end inside diameter ⓐ:
15.985–15.998 mm
(0.6293–0.6298 in)

Checking the connecting rod big end side clearance

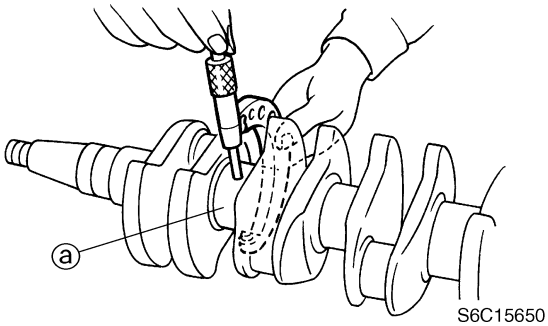
1. Measure the connecting rod big end side clearance ⓐ. Replace the connecting rod or crankshaft, or both if out of specification.

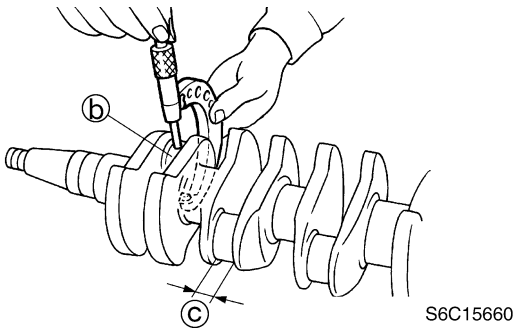


Connecting rod big end side clearance ⓐ:
0.05–0.22 mm (0.0020–0.0087 in)

Checking the crankshaft

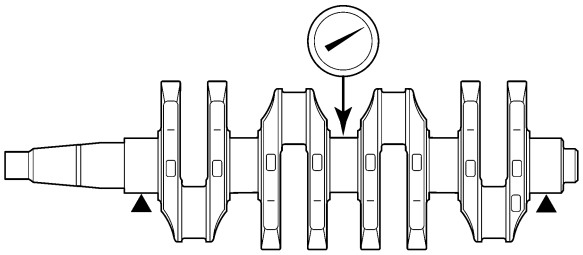
1. Measure the crankshaft journal diameter ⓐ, crankpin diameter ⓑ, and crankpin width ⓒ. Replace the crankshaft if out of specification.





Crankshaft journal diameter ⓐ:
42.984–43.000 mm
(1.6923–1.6929 in)
Crankpin diameter ⓑ:
32.984–33.000 mm
(1.2986–1.2992 in)
Crankpin width ⓒ:
21.000–21.070 mm
(0.8268–0.8295 in)

2. Measure the crankshaft runout. Replace the crankshaft if above specification.

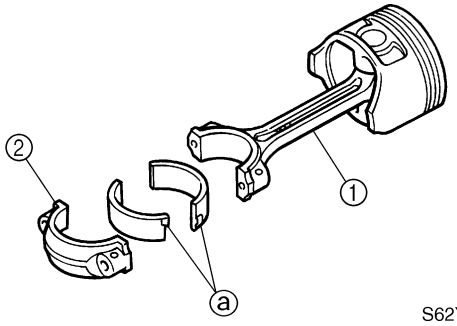


Crankshaft runout limit:
0.03 mm (0.0012 in)

Checking the crankpin oil clearance

1. Clean the bearings and the connecting rod.

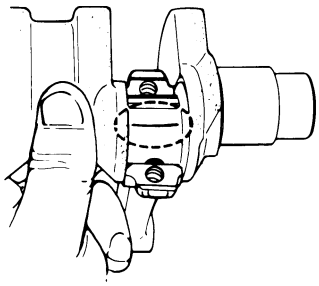
2. Install the upper bearing into the connecting rod ① and the lower bearing into the connecting rod cap ②.



NOTE:
- Install the connecting rod bearings in their original positions.
- Insert the projection ⓐ of each bearing into the slots in the connecting rod cap and connecting rod.

5

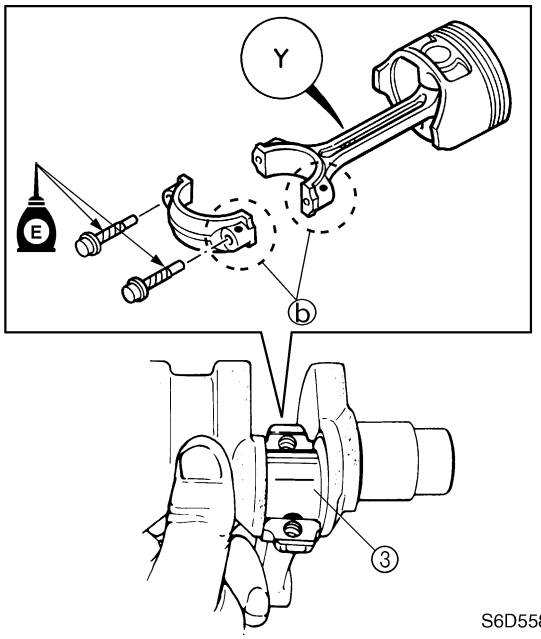
3. Put a piece of Plastigauge (PG-1) onto the crankpin, parallel to the crankshaft.



S69J5D00

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

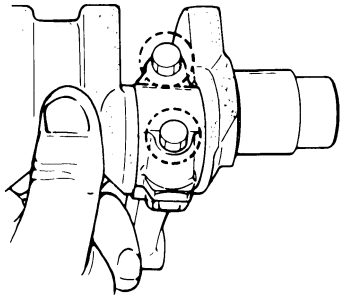
4. Install the connecting rod onto the crankpin ③.



S6D55840

NOTE:
Make sure that the marks ⓑ of the connecting rod face toward the flywheel magnet end of the crankshaft.

5. Tighten the connecting rod bolts to the specified torques in two stages.

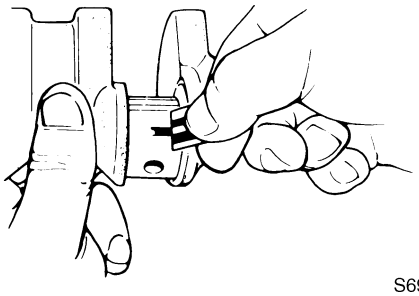


S62Y5980

NOTE:
Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.

Connecting rod cap bolt:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

6. 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.



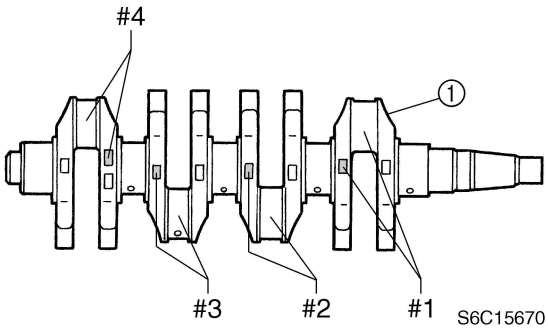
S69J5D30

Crankpin oil clearance:
0.016–0.040 mm
(0.0006–0.0016 in)

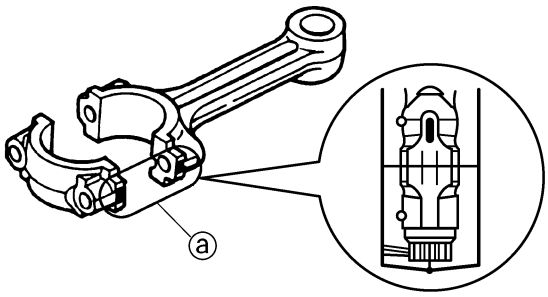
Selecting the connecting rod bearing

1. When replacing the connecting rod bearing, select the suitable bearing as follows.

2. Check the crankpin mark on the crankshaft ① and the connecting rod mark or painted color ⓐ on the connecting rod.

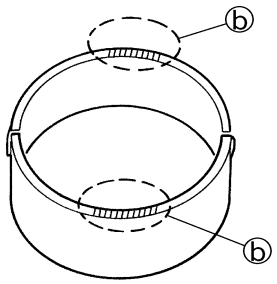


S6C15670



S6C15680

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

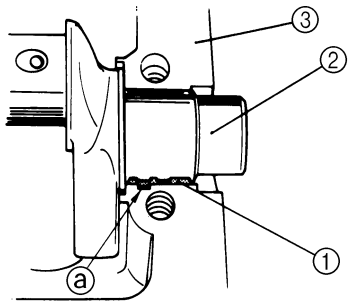


S69J5D50

Connecting rod mark/color	Crankpin mark	Bearing color
I/Red	A	Yellow
I/Red	B	Red
II/Blue	A	
II/Blue	B	Pink
III/Yellow	A	
III/Yellow	B	Green

Checking the crankshaft journal oil clearance

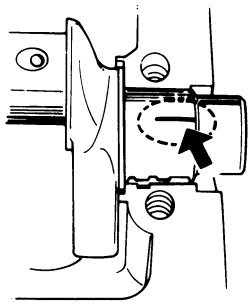
1. Clean the bearings, crankshaft journals, and bearing portions of the crankcase and cylinder block.
2. Place the cylinder block upside down on a bench.
3. Install half of the bearings ① and the crankshaft ② into the cylinder block ③.



S6D55860

NOTE:
- Install the main bearings in their original positions.
- Insert the projection ⓐ of each bearing into the slots in the cylinder block.

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


S6D55870

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

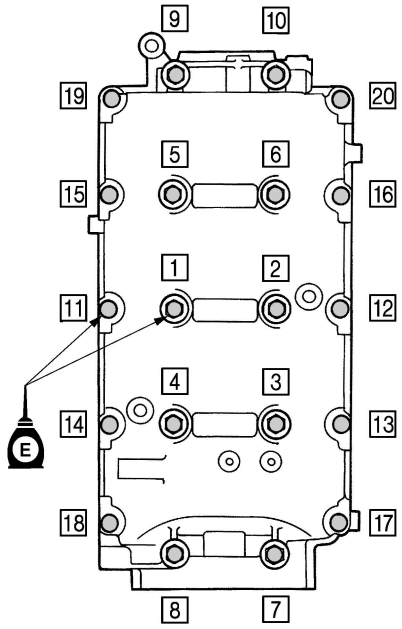
5. Install the remaining half of the bearings into the crankcase.

NOTE:
- Install the main bearings in their original positions.
- Insert the projection of each bearing into the slots in the crankcase.

5

6. Install the crankcase onto the cylinder block.

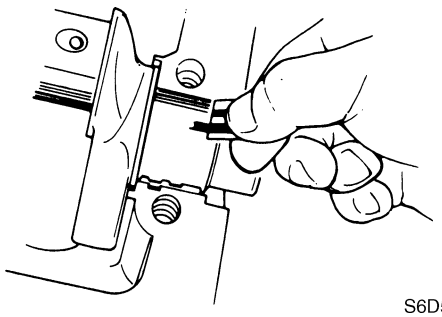
7. Apply engine oil to the threads of the crankcase bolts, and then tighten them to the specified torques in two stages and in the sequence shown.



S6C15690

Crankcase bolt (M8):
1st: 15 N·m (1.5 kgf·m, 11.1 ft·lb)
2nd: 30 N·m (3.0 kgf·m, 22.1 ft·lb)
Crankcase bolt (M6):
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

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

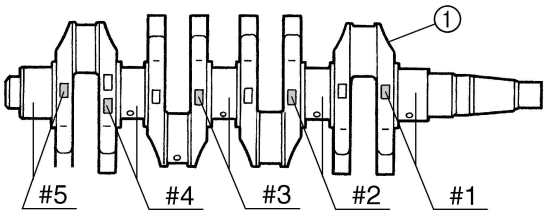

S6D55880

Crankshaft main journal oil clearance:
0.012–0.036 mm
(0.0005–0.0014 in)

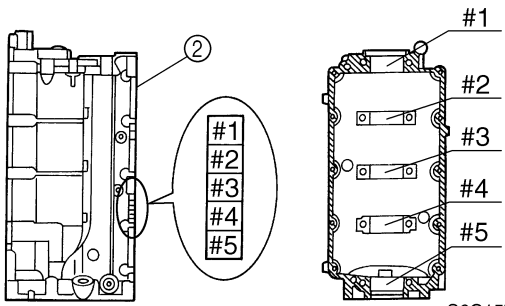
Selecting the main bearings

1. When replacing the main bearing, select the suitable bearing as follows.

2. Check the crankshaft journal mark on the crankshaft ① and the cylinder block mark on the cylinder block ②.

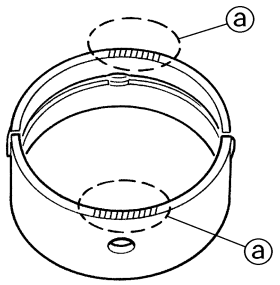


S6C15700



S6C15710

3. Select the suitable color ⓐ for the main bearing from the table.

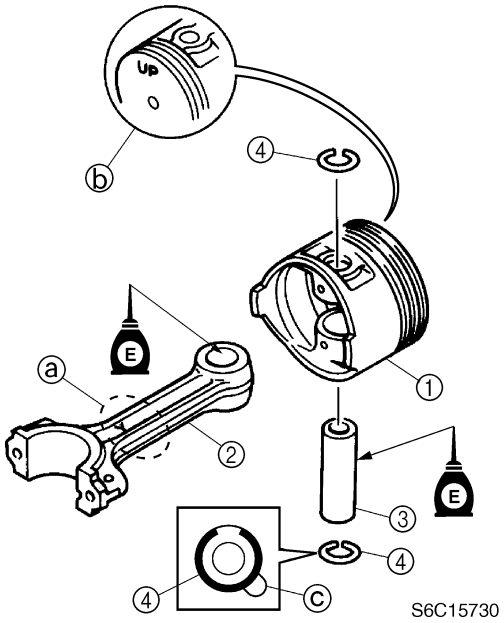


S6C15720

Cylinder body mark	Crankshaft journal mark	Bearing color
A	A	Yellow
A	B	Red
B	A	
B	B	Pink
C	A	
C	B	Green

Assembling the power unit

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

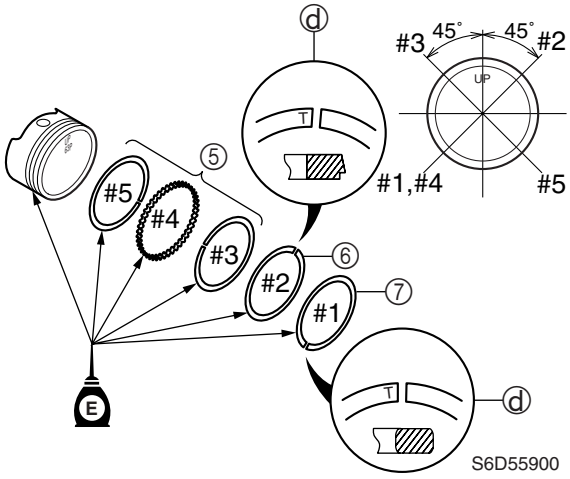


S6C15730

NOTE:
- Face the embossed "Y" mark ⓐ on the connecting rod in the same direction as the "UP" mark ⓑ on the piston.
- Always use new piston pin clips, and do not allow the piston pin clip end to align with the piston pin slot ⓒ.

2. Install the oil ring ⑤, second ring ⑥, and top ring ⑦ onto each piston with the "T" marks ⓓ of the second ring and the top ring facing upward.

3. Offset the piston ring end gaps as shown.



S6D55900

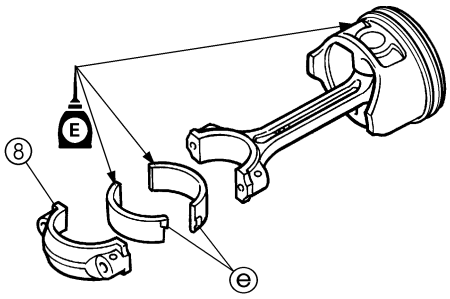
CAUTION:

Do not scratch the pistons or break the piston rings.

NOTE:

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

4. Install the upper bearing into the connecting rod and the lower bearing into the connecting rod cap ⑧.

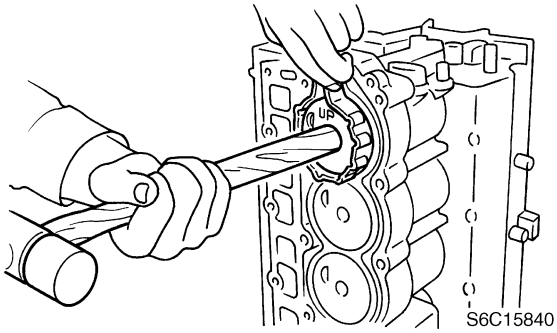


S6D55910

NOTE:
- Install the connecting rod bearings in their original positions.
- Insert the projection ⓔ of each bearing into the slots in the connecting rod cap and connecting rod.

5

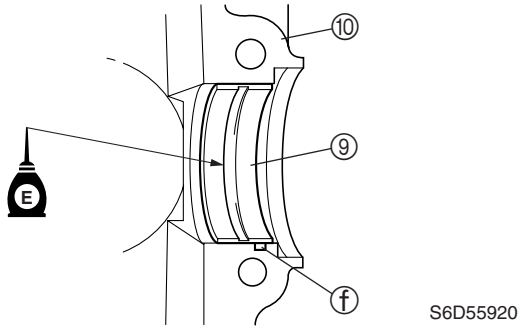
5. Install the piston with the “UP” mark on the piston crown facing towards the fly-wheel magnet.



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

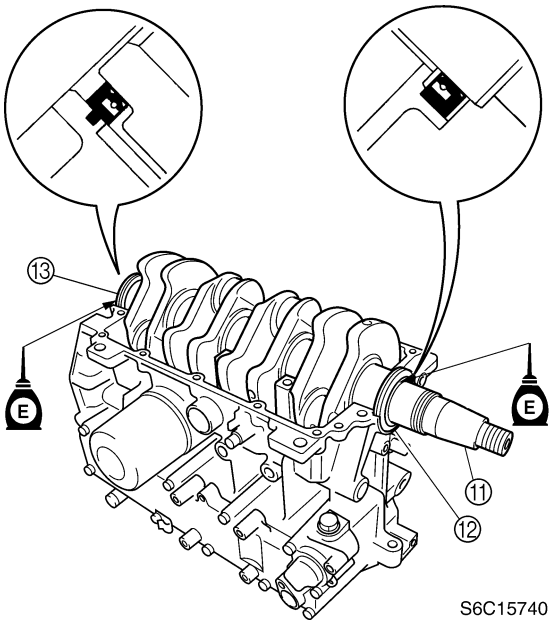
Piston slider: 90890-06529

6. Install half of the main bearings ⑨ into the cylinder block ⑩.



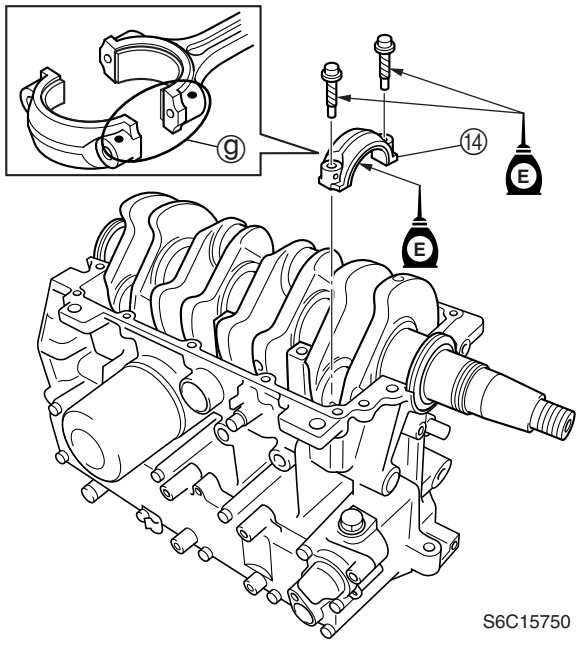
NOTE:
- Install the main bearings in their original positions.
- Insert the projection ⓕ of each bearing into the slots in the cylinder block.

7. Set the crankshaft ⑪ and oil seals ⑫ and ⑬ into the cylinder block as shown.



NOTE:
Apply engine oil to the inner oil seals before installation.

8. Install the connecting rod caps ⑭ to the connecting rods, and then tighten the connecting rod bolts to the specified torques in two stages.



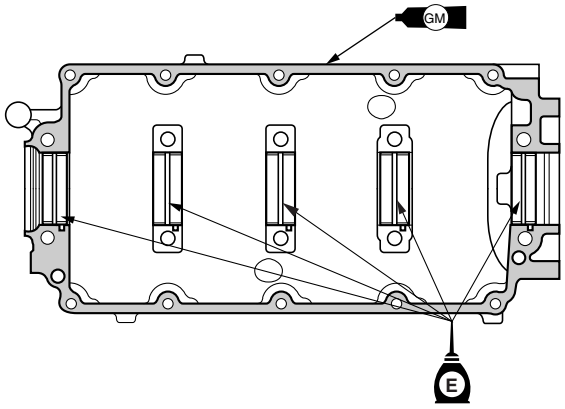
NOTE:
- Align the alignment marks ⓖ on the connecting rod cap and connecting rod.
- Apply engine oil to the connecting rod bolts before installation.

Connecting rod cap bolt:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

9. Install half of the bearings into the crankcase.

NOTE:
- Install the main bearings in their original positions.
- Insert the projection of each bearing into the slots in the crankcase.

10. Apply sealant to the mating surface of the crankcase.

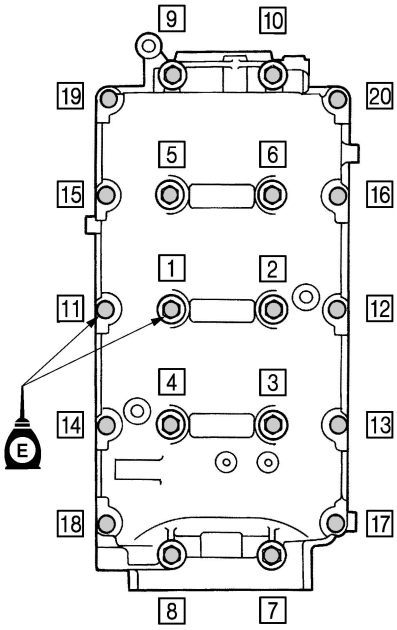


S6C15760

NOTE:
Do not get any sealant on the main bearings.

11. Install the crankcase onto the cylinder block.

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

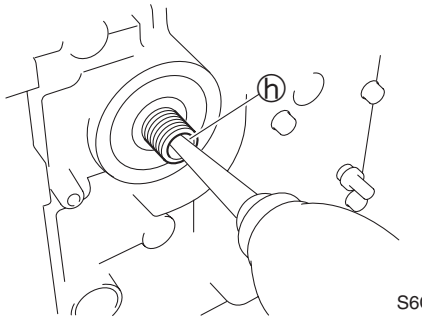


S6C15690

NOTE:
Apply engine oil to the crankcase bolts before installation.

1–10 Crankcase bolt (M8):
1st: 15 N·m (1.5 kgf·m, 11.1 ft·lb)
2nd: 30 N·m (3.0 kgf·m, 22.1 ft·lb)
11–20 Crankcase bolt (M6):
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

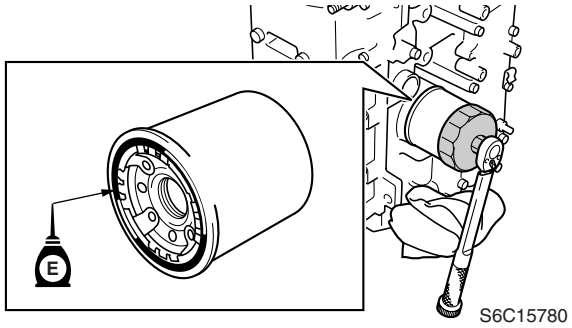
13. Before installing the oil filter, be sure to supply engine oil to the oil passage ⓗ.



S6C15770

5

14. Install the oil filter, and then tighten it to the specified torque using the oil filter wrench.



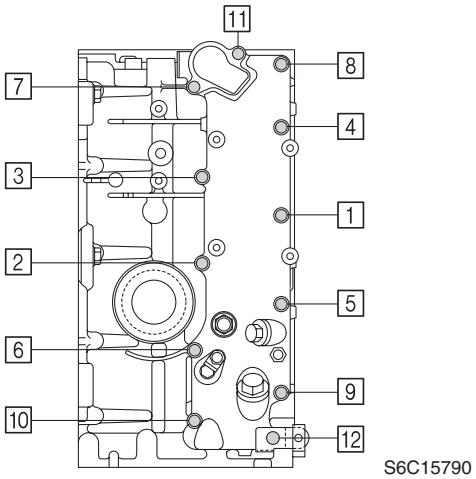
NOTE:
Apply a thin coat of engine oil to the O-ring of the new oil filter before installation.

Oil filter wrench: 90890-01426

Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

15. Install a new gasket and the exhaust cover.

16. Install the thermostat and thermostat cover, and then tighten the bolts to the specified torques in two stages and in the sequence shown.



Exhaust cover bolt:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

17. Install the cylinder head.

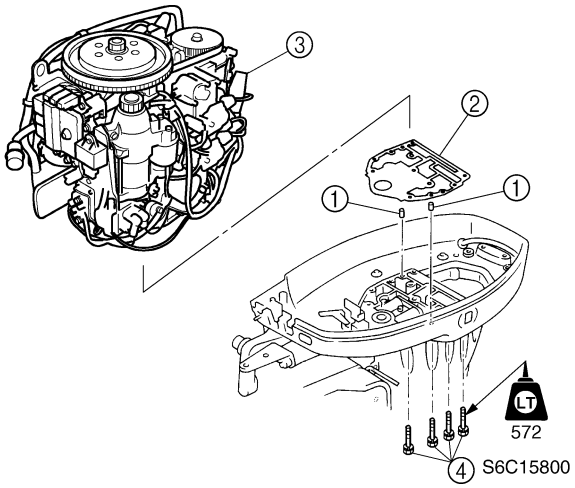
NOTE:
For installation procedure, see “Installing the cylinder head.”

Installing the power unit

1. Clean the power unit mating surface, and install the dowels ① and a new gasket ②.

2. Install the power unit ③ by installing the bolts ④, then tightening them to the specified torque.

3. Install the apron.

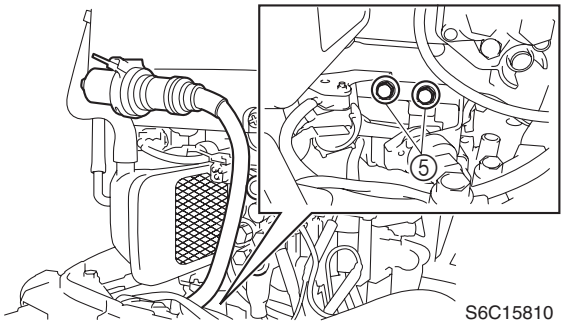


Power unit mounting bolt ④:
27 N·m (2.7 kgf·m, 20.0 ft·lb)

4. Connect the flushing hose, cooling water pilot hose, and fuel hose.

5. Install the oil dipstick.

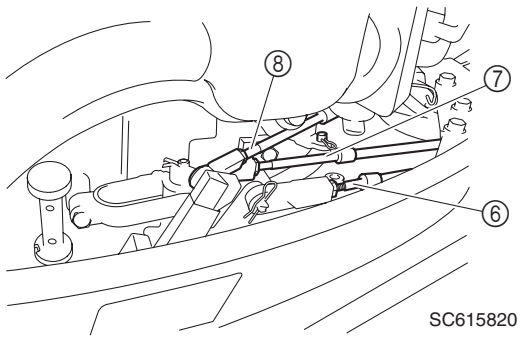
6. Install the shift rod bolts ⑤.



7. Install the PTT switch coupler, PTT motor leads, and battery leads.

Positive battery lead nut:
9 N·m (0.9 kgf·m, 6.6 ft·lb)
PTT motor lead bolt:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

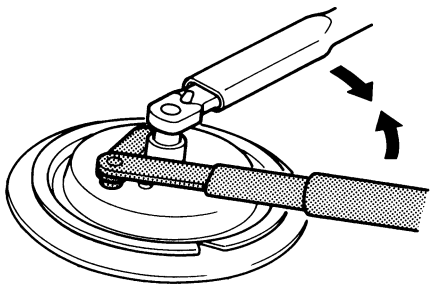
8. Connect the throttle cable ⑥, shift cable ⑦, and throttle link rod ⑧, and then adjust their lengths. For adjustment procedures, see Chapter 3, "Adjusting the throttle link and throttle cable" and "Checking the gear shift operation."



SC615820

9. Connect the warning indicator couplers and main switch coupler (tiller handle model).

10. Install the Woodruff key, then the flywheel magnet.


S63P5370

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:
157 N·m (15.7 kgf·m, 115.8 ft·lb)

11. Install all parts removed during disassembly.

12. Adjust the pulser coil air gap.

NOTE:
For adjustment procedures, see Chapter 8 "Checking the pulser coil air gap."

13. Fill the engine with the specified amount of the recommended engine oil.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter element:
2.5 L (2.64 US qt, 2.20 Imp qt)
With oil filter element:
2.7 L (2.85 US qt, 2.38 Imp qt)

5

Lower unit

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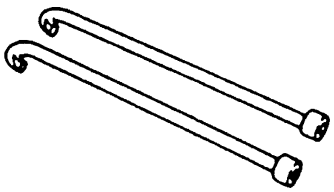
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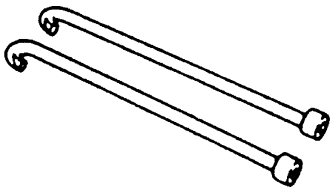
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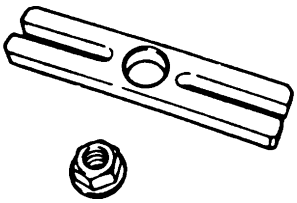
Special service tools



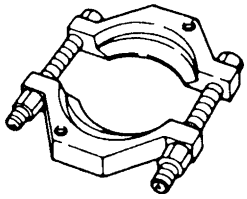
Bearing housing puller claw L
90890-06502



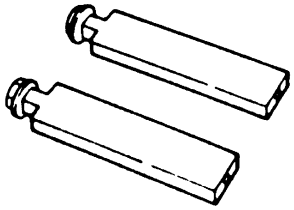
Bearing housing puller claw S
90890-06564



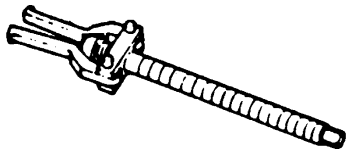
Stopper guide plate
90890-06501



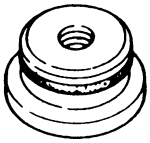
Bearing separator
90890-06534



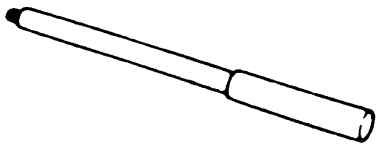
Stopper guide stand
90890-06538



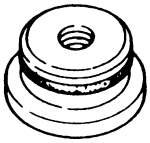
Bearing puller assembly
90890-06535



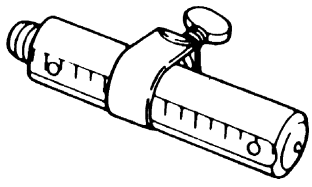
Needle bearing attachment
90890-06607, 90890-06608, 90890-06610, 90890-06611, 90890-06612, 90890-06614, 90890-06653



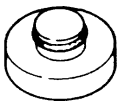
Driver rod L3
90890-06652



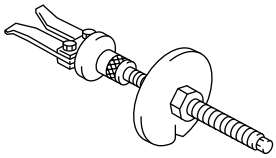
Ball bearing attachment
90890-06637



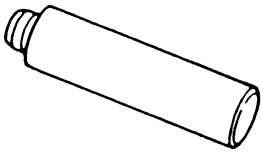
Driver rod SS
90890-06604



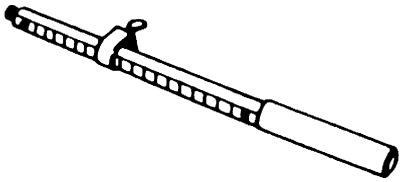
Ball bearing attachment
90890-06655



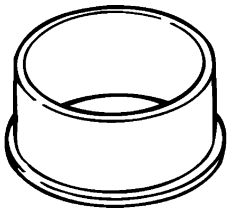
Bearing outer race puller assembly
90890-06523



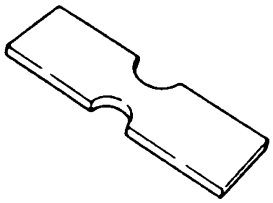
Driver rod LS
90890-06606



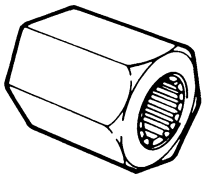
Driver rod SL
90890-06602



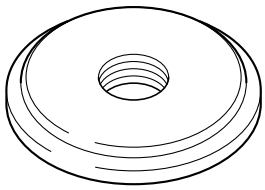
Bearing inner race attachment
90890-06639, 90890-06641, 90890-06643, 90890-06644, 90890-06661



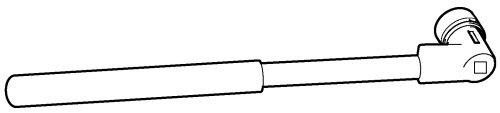
Bearing depth plate
90890-06603



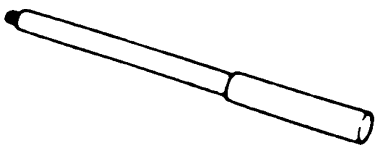
Drive shaft holder 4
90890-06518



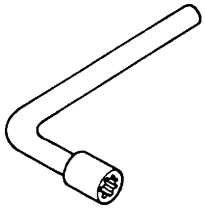
Bearing outer race attachment
90890-06621, 90890-06622, 90890-06626, 90890-06627



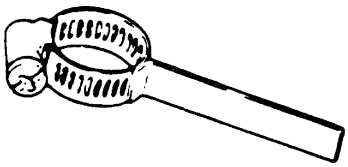
Pinion nut holder
New: 90890-06715
Current: 90890-06505



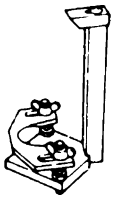
Driver rod LL
90890-06605



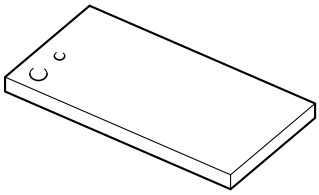
Shift rod push arm
90890-06052



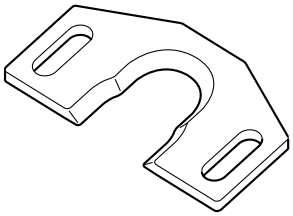
Backlash indicator
90890-06706



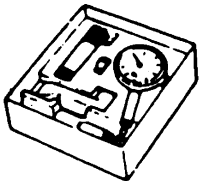
Pinion height gauge
90890-06710



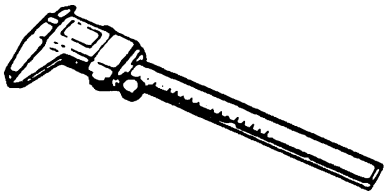
Magnet base plate
90890-07003



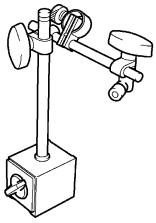
Pinion height gauge plate B
90890-06712



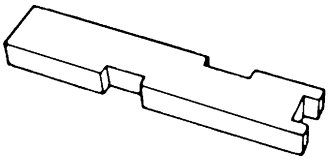
Dial gauge set
90890-01252



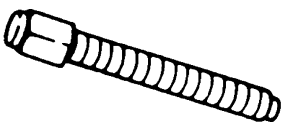
Digital caliper
90890-06704



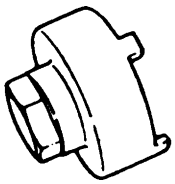
Magnet base B
90890-06844



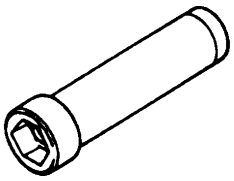
Shimming plate
90890-06701



Center bolt
90890-06504

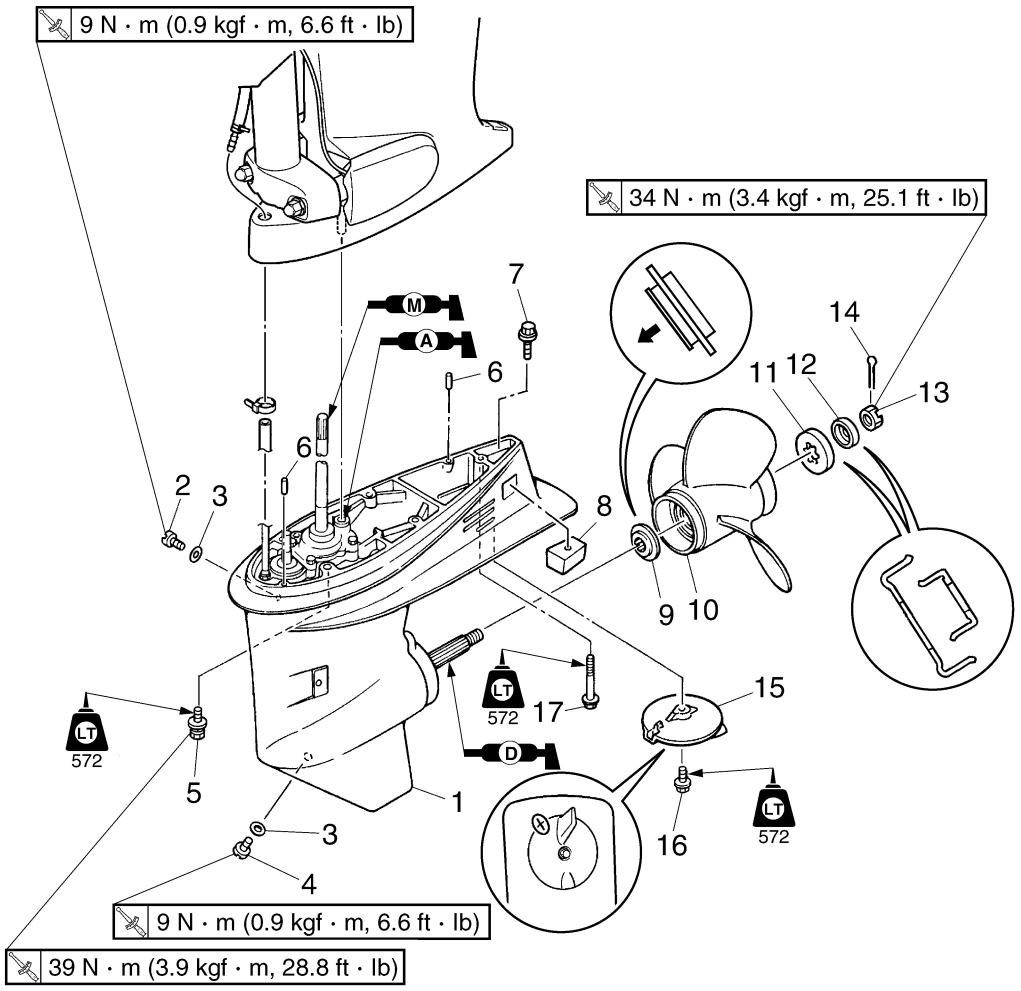


Ring nut wrench 3
90890-06511

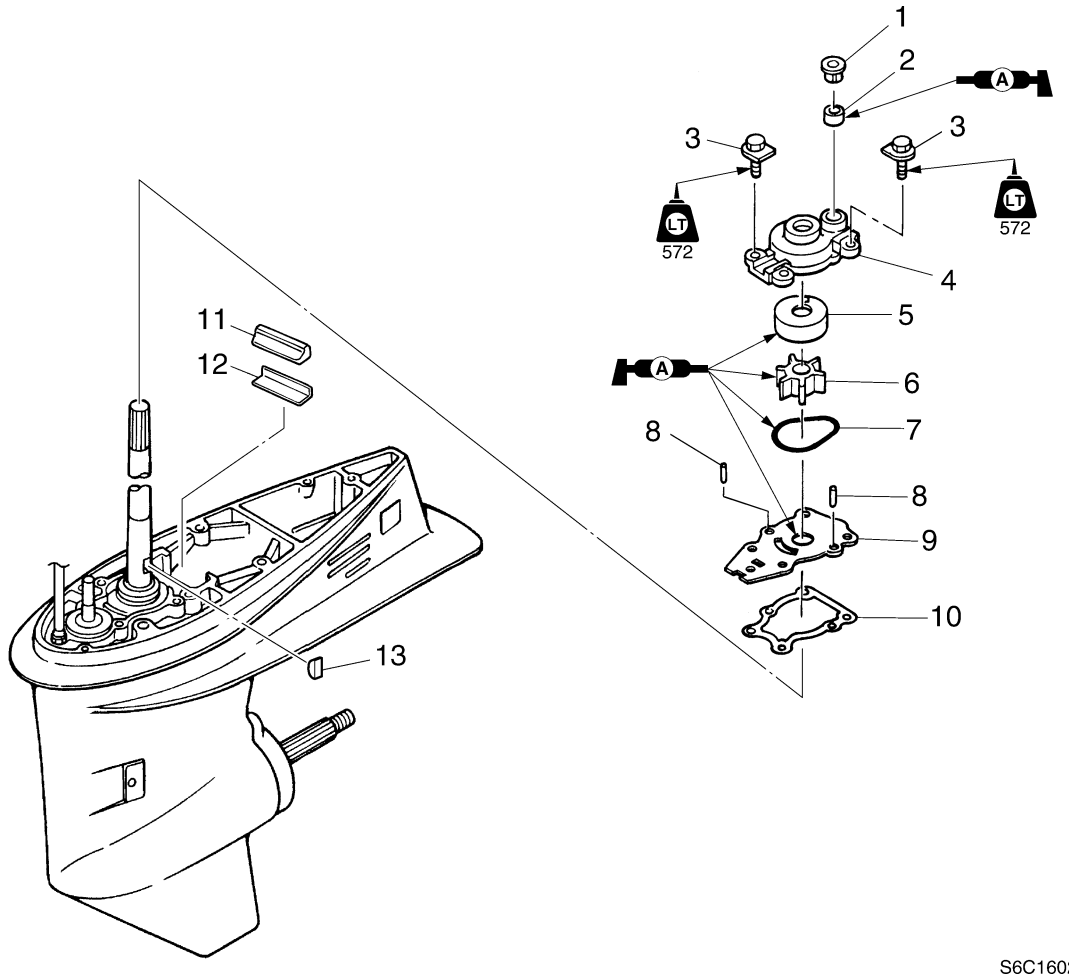


Ring nut wrench extension
90890-06513

Lower unit (F50, F60)



No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Check screw	1	
3	Gasket	2	**Not reusable**
4	Drain screw	1	
5	Bolt	4	M10 × 40 mm
6	Dowel	2	
7	Bolt	1	M8 × 35 mm
8	Anode	1	
9	Spacer	1	
10	Propeller	1	
11	Washer	1	
12	Washer	1	
13	Propeller nut	1	
14	Cotter pin	1	**Not reusable**
15	Trim tab	1	
16	Bolt	1	M8 × 25 mm
17	Bolt	1	M8 × 60 mm

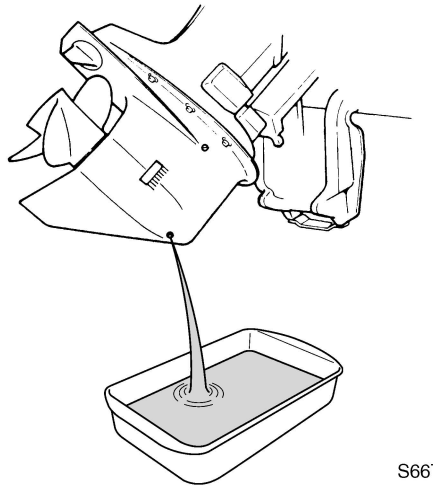


S6C16020

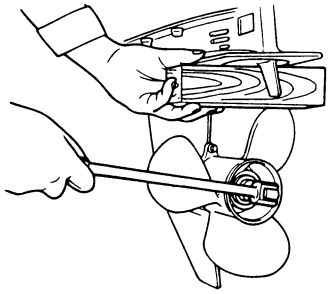
No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Seal	1	
3	Bolt	4	M8 × 30 mm
4	Water pump housing	1	
5	Insert cartridge	1	
6	Impeller	1	
7	O-ring	1	**Not reusable**
8	Dowel	2	
9	Outer plate cartridge	1	
10	Gasket	1	**Not reusable**
11	Seal	1	
12	Plate	1	
13	Woodruff key	1	

Removing the lower unit

1. Drain the gear oil.


S66T6370

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.


S69J6015

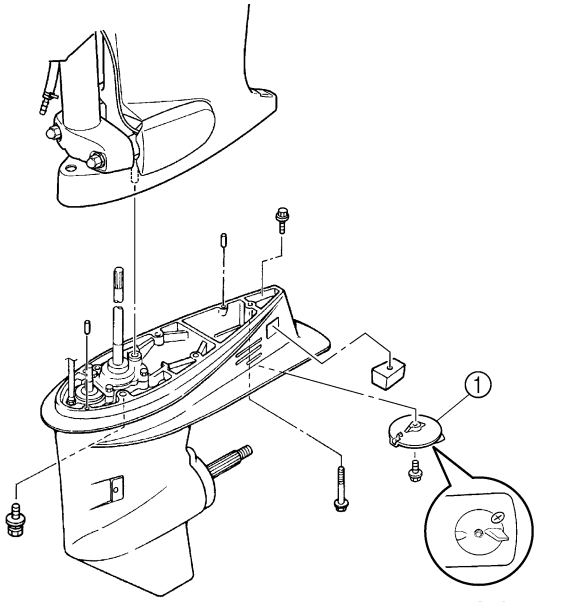
⚠ WARNING

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

3. Disconnect the speedometer hose.

4. Mark the trim tab ① at the area shown, and then remove it.

5. Loosen the bolts, and then remove the lower unit from the upper case.



S6C16030

Removing the water pump

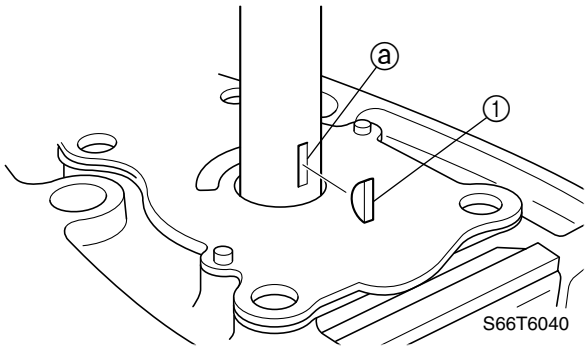
1. Remove the water pump assembly.

Checking the water pump

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

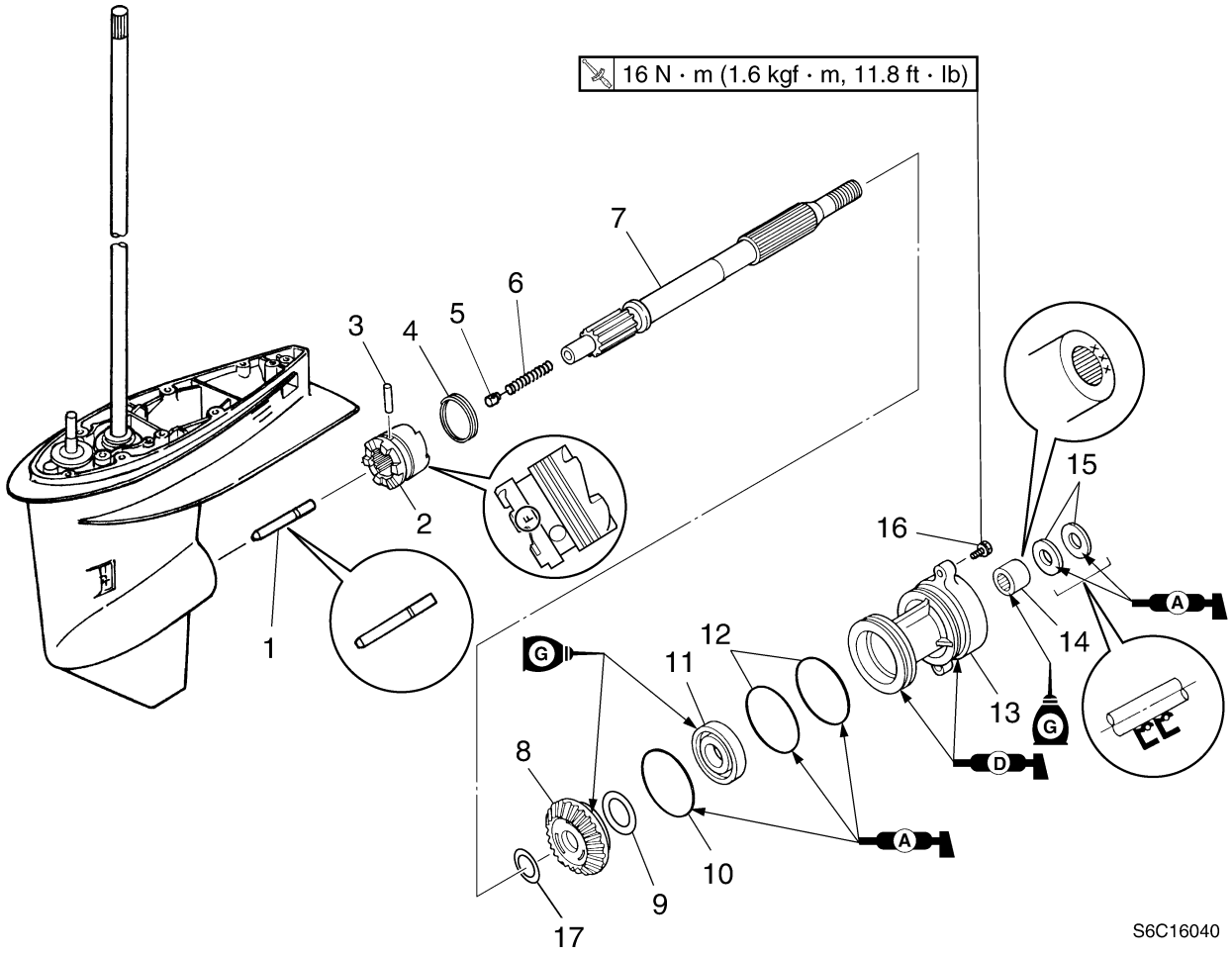
2. Check the impeller and insert cartridge for cracks or wear. Replace if necessary.

3. Check the Woodruff key ① and the keyway ⓐ in the drive shaft for wear. Replace if necessary.



S66T6040

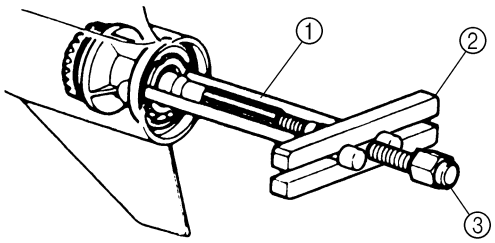
Propeller shaft housing (F50, F60)



No.	Part name	Q'ty	Remarks
1	Shift plunger	1	
2	Dog clutch	1	
3	Cross pin	1	
4	Spring	1	
5	Shift slider	1	
6	Spring	1	
7	Propeller shaft	1	
8	Reverse gear	1	
9	Reverse gear shim	—	
10	O-ring	1	**Not reusable**
11	Ball bearing	1	**Not reusable**
12	O-ring	2	**Not reusable**
13	Propeller shaft housing	1	
14	Needle bearing	1	
15	Oil seal	2	**Not reusable**
16	Bolt	2	M8 × 25 mm
17	Washer	1	

Removing the propeller shaft housing assembly

1. Remove the bolts, and then pull out the propeller shaft housing assembly.



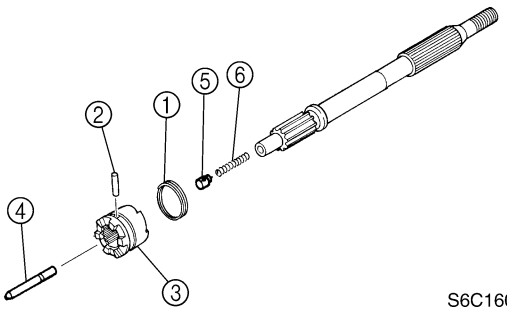
S6D56070

Bearing housing puller claw S ①: 90890-06564
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

2. Remove the propeller shaft assembly.

Disassembling the propeller shaft assembly

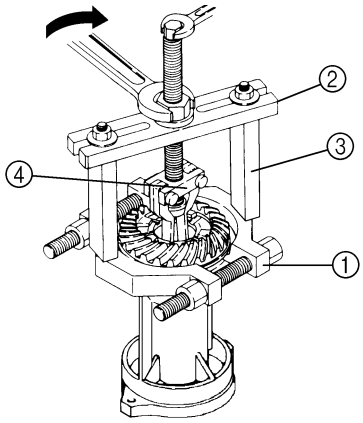
1. Remove the spring ①, then the cross pin ②, dog clutch ③, shift plunger ④, shift slider ⑤, and spring ⑥.



S6C16060

Disassembling the propeller shaft housing

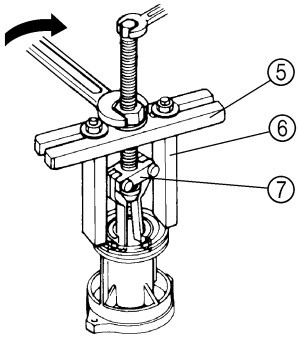
1. Remove the reverse gear and reverse gear shim(s).



S6D56470

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

2. Remove the ball bearing.



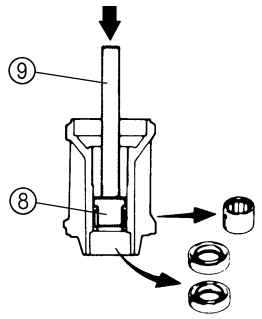
S6D56480

CAUTION:

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

Stopper guide plate ⑤: 90890-06501
Stopper guide stand ⑥: 90890-06538
Bearing puller assembly ⑦: 90890-06535

3. Remove the oil seals and needle bearing.



S68S6350

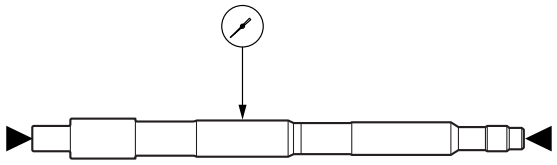
Needle bearing attachment ⑧: 90890-06614
Driver rod L3 ⑨: 90890-06652

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.
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. Measure the propeller shaft runout.

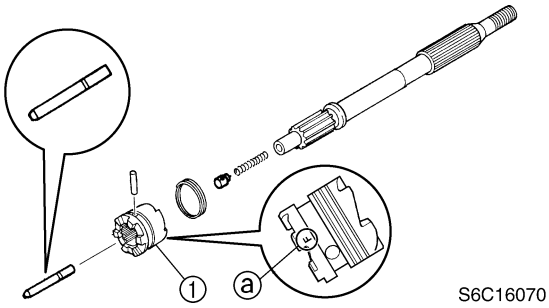

S6D56510

Runout limit: 0.02 mm (0.0008 in)

3. Check the dog clutch, shift slider, and shift plunger for cracks or wear. Replace if necessary.

Assembling the propeller shaft assembly

1. Install the dog clutch as shown.

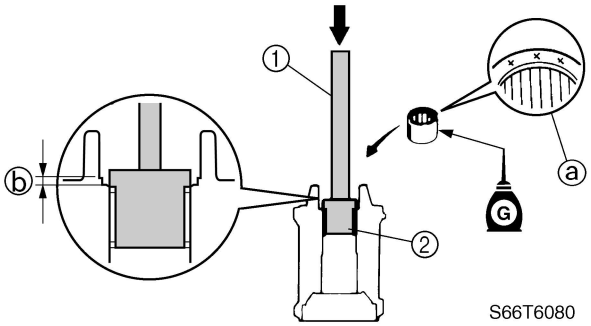


S6C16070

NOTE:
Install the dog clutch ① with the "F" mark ⓐ facing toward the shift plunger.

Assembling the propeller shaft housing

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



S66T6080

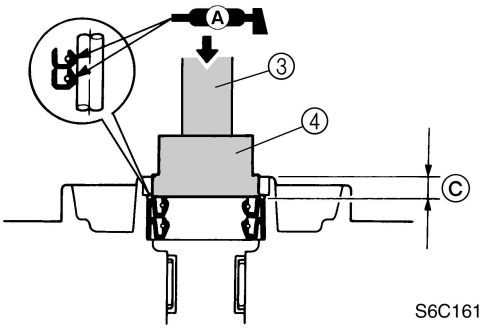
NOTE:
Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).

Driver rod L3 ①: 90890-06652
Needle bearing attachment ②: 90890-06614

Depth ⓑ: 3.25 ± 0.25 mm (0.128 ± 0.010 in)

6

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



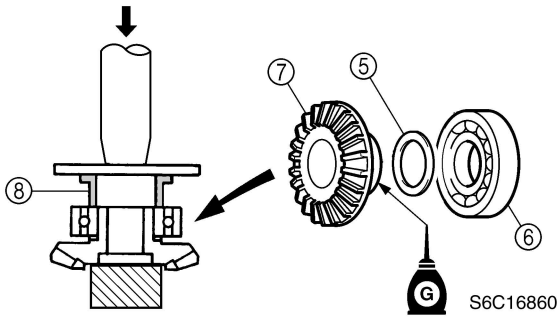
S6C16100

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

Driver rod LS ③: 90890-06606
Ball bearing attachment ④:
90890-06637

Depth Ⓒ:
4.25 ± 0.25 mm (0.167 ± 0.010 in)

3. Install the original shim(s) ⑤ and new ball bearing ⑥ onto the reverse gear ⑦ using a press.

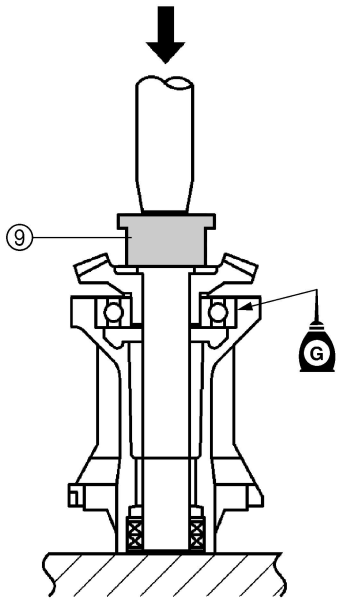


S6C16860

CAUTION:
Add or remove shim(s), if necessary, if replacing the reverse gear, propeller shaft housing, or lower case.

Bearing inner race attachment ⑧:
90890-06639

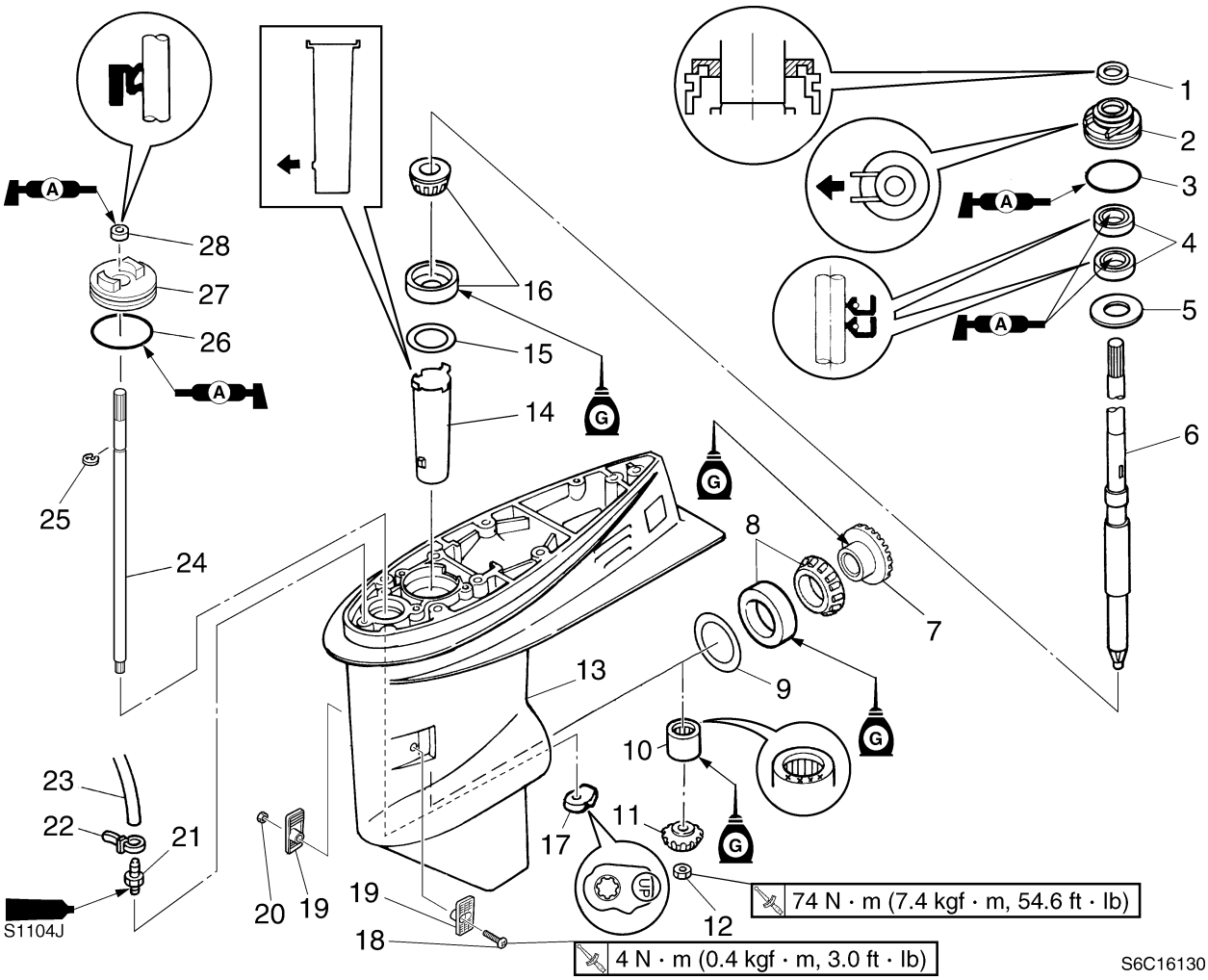
4. Install the reverse gear assembly into the propeller shaft housing using a press.



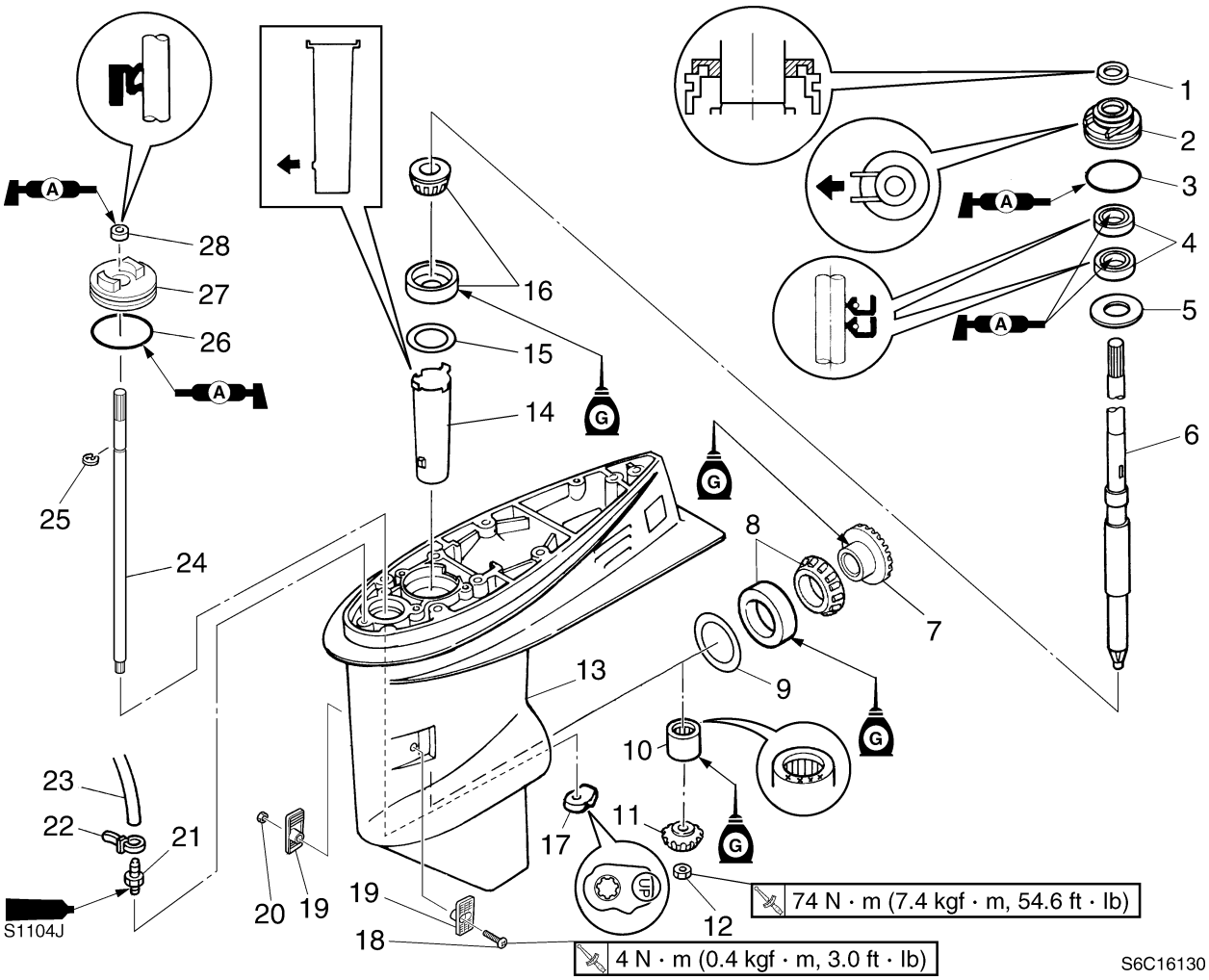
S66T6110

Needle bearing attachment ⑨:
90890-06608

Drive shaft and lower case (F50, F60)



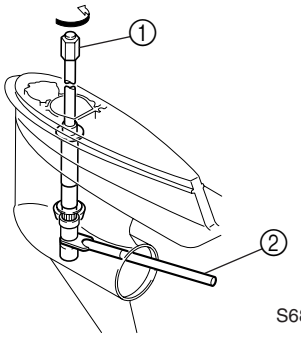
No.	Part name	Q'ty	Remarks
1	Seal	1	
2	Oil seal housing	1	
3	O-ring	1	**Not reusable**
4	Oil seal	2	**Not reusable**
5	Washer	1	
6	Drive shaft	1	
7	Forward gear	1	
8	Taper roller bearing assembly	1	**Not reusable**
9	Forward gear shim	—	
10	Needle bearing	1	
11	Pinion	1	
12	Nut	1	
13	Lower case	1	
14	Sleeve	1	
15	Pinion gear shim	—	
16	Taper roller bearing assembly	1	**Not reusable**
17	Shift cam	1	



No.	Part name	Q'ty	Remarks
18	Screw	1	ø5 × 28 mm
19	Cooling water inlet cover	2	
20	Nut	1	
21	Joint	1	
22	Plastic tie	1	**Not reusable**
23	Hose	1	
24	Shift rod	1	
25	Circlip	1	
26	O-ring	1	**Not reusable**
27	Shift rod housing	1	
28	Oil seal	1	**Not reusable**

Removing the drive shaft

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

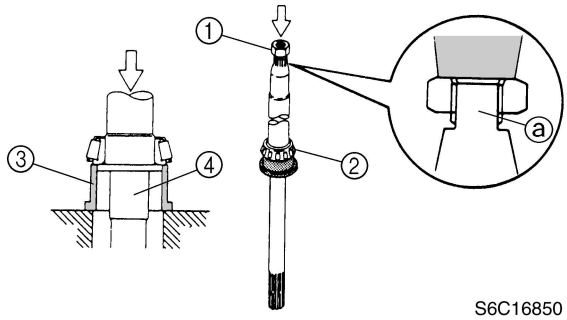


S68S6360J

Drive shaft holder 4 ①: 90890-06518
Pinion nut holder ②:
New: 90890-06715
Current: 90890-06505

Disassembling the drive shaft

1. Install the pinion nut ①, tighten it finger tight, and then remove the drive shaft bearing ② using a press.



S6C16850

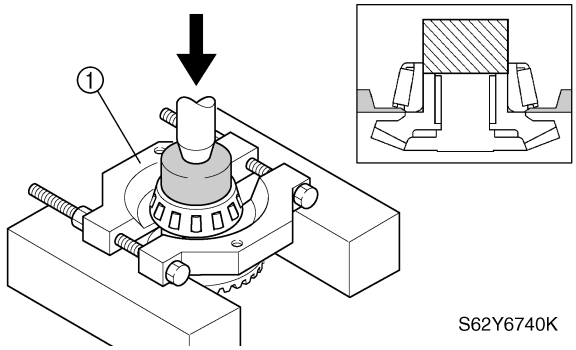
CAUTION:

- **Do not press the drive shaft threads ⓐ directly.**
- **When removing the drive shaft bearing, do not damage the drive shaft collar ④.**
- **Do not reuse the bearing, always replace it with a new one.**

Bearing inner race attachment ③:
90890-06641

Disassembling the forward gear

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



S62Y6740K

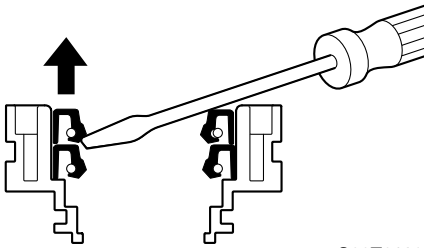
CAUTION:

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

Bearing separator ①: 90890-06534

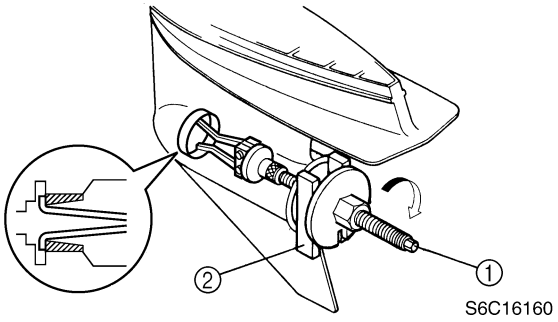
Disassembling the oil seal housing

1. Remove the oil seals using a flat head screwdriver.


S66T6130

Disassembling the lower case

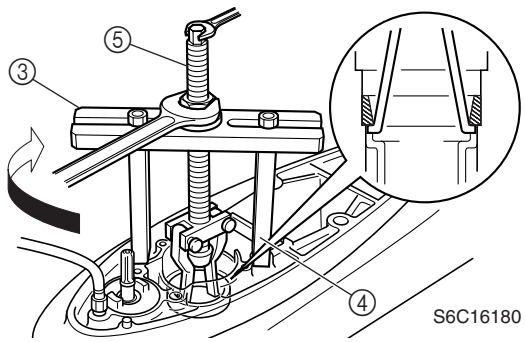
1. Remove the taper roller bearing outer race and shim(s).



NOTE:
Install the claws as shown.

Bearing outer race puller assembly ①:
90890-06523
Stopper guide stand ②:
90890-06538

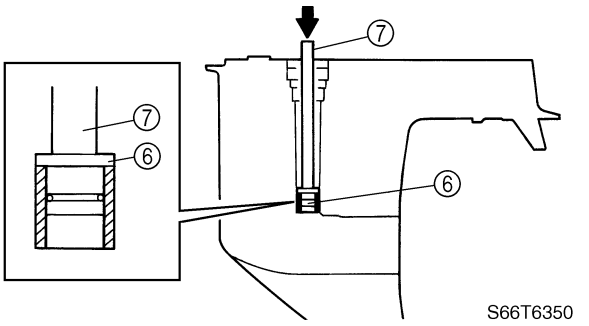
2. Remove the drive shaft bearing outer race, shim(s), and drive shaft sleeve.



NOTE:
Install the claws as shown.

Stopper guide plate ③: 90890-06501
Stopper guide stand ④:
90890-06538
Bearing puller assembly ⑤:
90890-06535

3. Remove the needle bearing.



Needle bearing attachment ⑥:
90890-06614
Driver rod L3 ⑦: 90890-06652

Checking the shift rod and shift cam

1. Check the shift rod and shift cam for cracks or wear. Replace if necessary.

Checking the pinion and forward gear

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

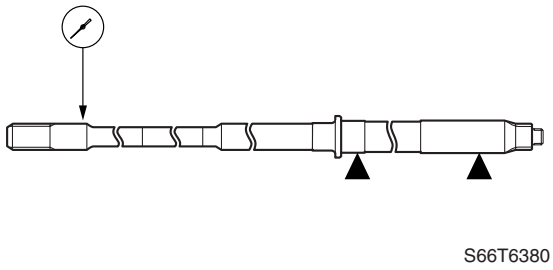
Checking the bearings

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

Checking the drive shaft

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

2. Measure the drive shaft runout.



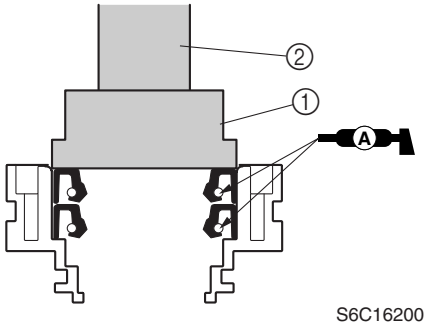
Runout limit: 0.5 mm (0.020 in)

Checking the lower case

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

Assembling the oil seal housing

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

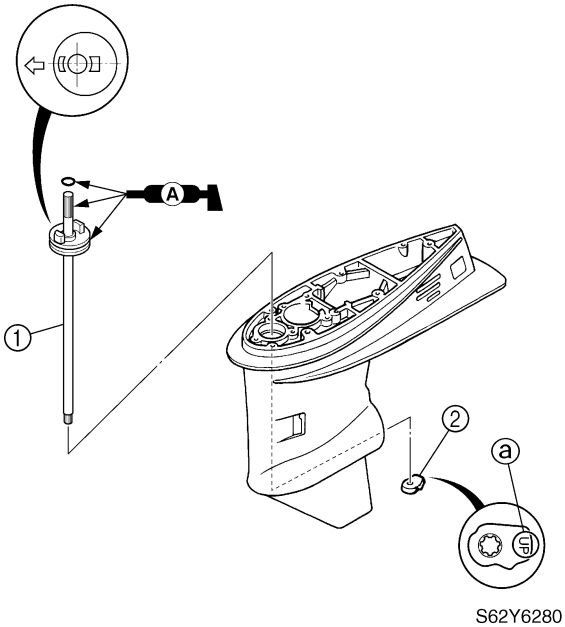


S6C16200

Needle bearing attachment ①: 90890-06653
Driver rod L3 ②: 90890-06652

Assembling the lower case

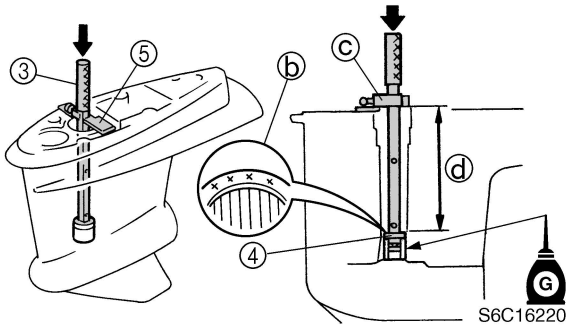
1. Install the shift rod assembly ① and shift cam ② as shown.



S62Y6280

NOTE:
Install the shift cam with the "UP" mark ⓐ facing upward.

2. Install the needle bearing into the lower case to the specified depth.



S6C16220

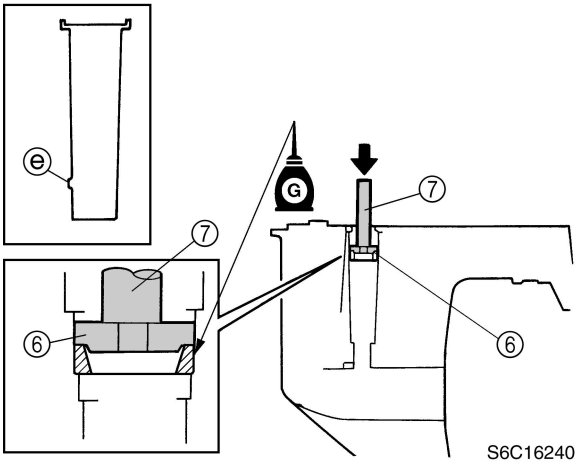
NOTE:
- Install the needle bearing with the manufacture identification mark ⓑ facing up.
- When using the driver rod, do not strike the special service tool in a manner that will force the stopper ⓒ out of place.

Driver rod SL ③: 90890-06602
Needle bearing attachment ④: 90890-06614
Bearing depth plate ⑤: 90890-06603

Depth ⓓ:
182.75 ± 0.25 mm
(7.195 ± 0.010 in)

6

3. Install the sleeve, original shim(s), and taper roller bearing outer race.



CAUTION:

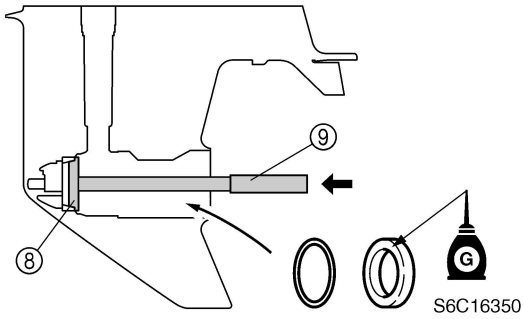
Add or remove shim(s), if necessary, if replacing the taper roller bearing or lower case.

NOTE:

- Apply gear oil to the inside and outside of the sleeve before installation.
- Install the sleeve with the projection ⓔ facing forward.

Bearing outer race attachment ⑥: 90890-06627
Driver rod LS ⑦: 90890-06606

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



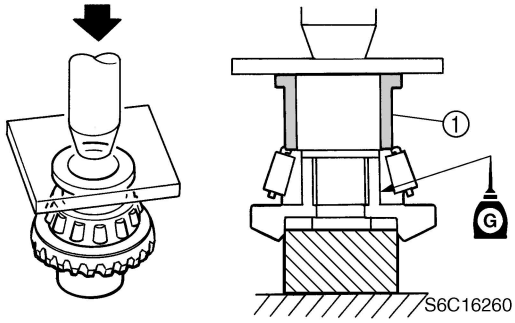
CAUTION:

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

Bearing outer race attachment ⑧: 90890-06622
Driver rod LL ⑨: 90890-06605

Assembling the forward gear

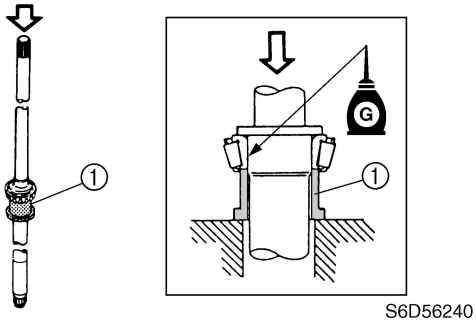
1. Install a new taper roller bearing into the forward gear using a press.



Bearing inner race attachment ①: 90890-06639

Assembling the drive shaft

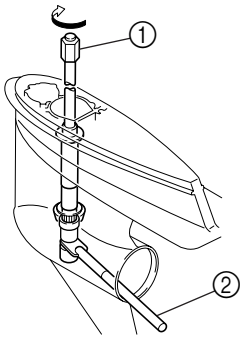
1. Install a new drive shaft bearing onto the drive shaft using a press.



Bearing inner race attachment ①: 90890-06644

Installing the pinion

1. Install the forward gear, then the drive shaft assembly, pinion, and pinion nut, and then tighten the nut to the specified torque.



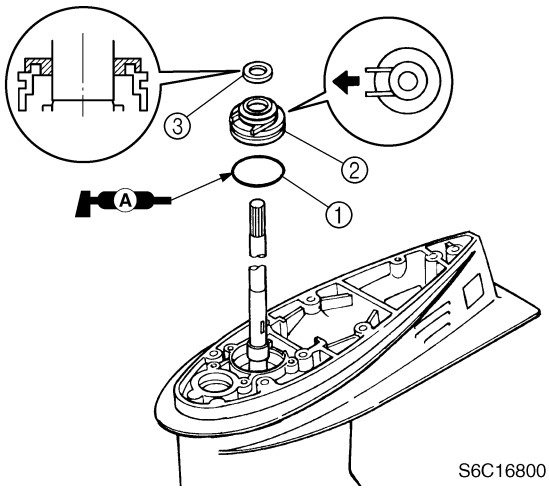
S68S6400

Drive shaft holder 4 ①: 90890-06518
Pinion nut holder ②:
New: 90890-06715
Current: 90890-06505

Pinion nut:
74 N·m (7.4 kgf·m, 54.6 ft·lb)

Installing the oil seal housing

1. Install a new O-ring ①, the oil seal housing ②, and the seal ③.

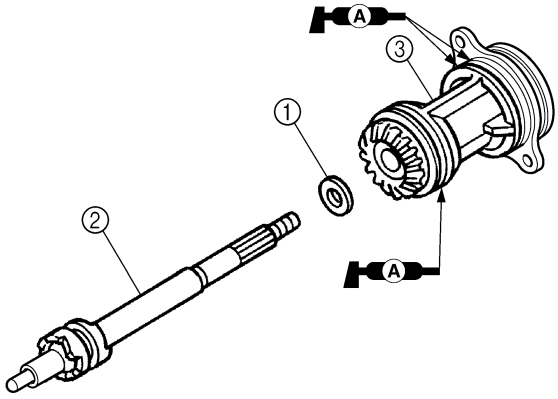


S6C16800

Installing the propeller shaft housing

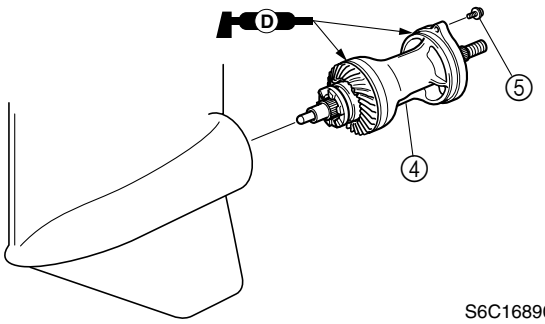
1. Install the washer ① and propeller shaft assembly ② into the propeller shaft housing assembly ③.

2. Apply grease to a new O-rings.



S6C16880

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



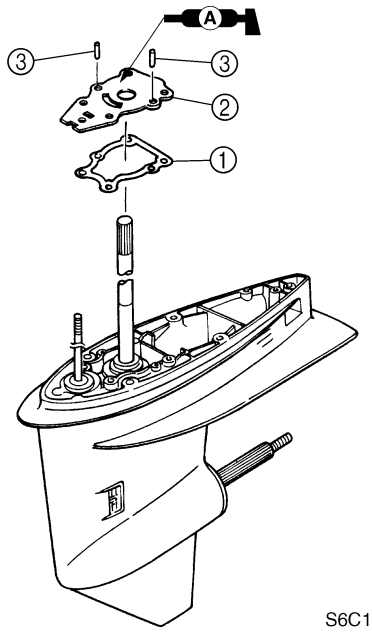
S6C16890

Propeller shaft housing bolt ⑤:
16 N·m (1.6 kgf·m, 11.8 ft·lb)

6

Installing the water pump

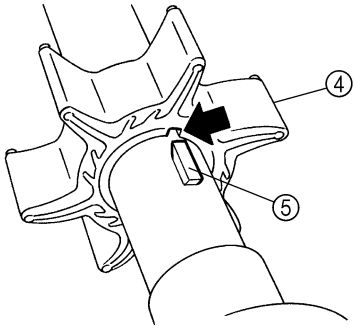
1. Install a new gasket ①, the outer plate cartridge ②, and dowels ③.



S6C16360

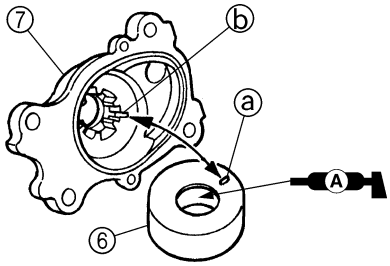
2. Install the Woodruff key into the drive shaft.

3. Align the groove in the impeller ④ with the Woodruff key ⑤, and then install the impeller onto the drive shaft.



S6C16280

4. Install the insert cartridge ⑥ into the pump housing ⑦, and then apply grease to the inside of the insert cartridge.

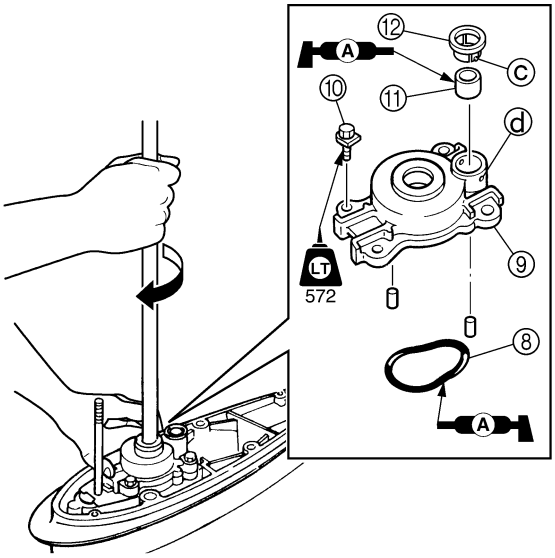


S6C16290

NOTE:

Align the insert cartridge projection ⓐ with the hole ⓑ in the pump housing.

5. Install the new O-ring ⑧ and pump housing assembly ⑨ into the lower case, tighten the bolts ⑩, and then install the seal ⑪ and cover ⑫.



S6C16300

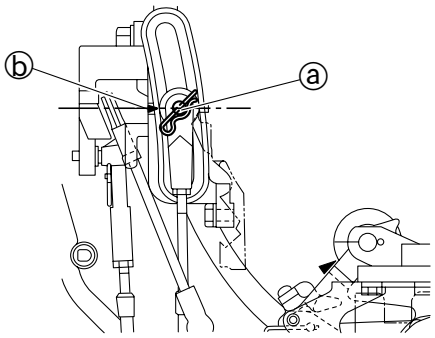
NOTE:

- 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 ⓒ with the hole ⓓ in the pump housing.

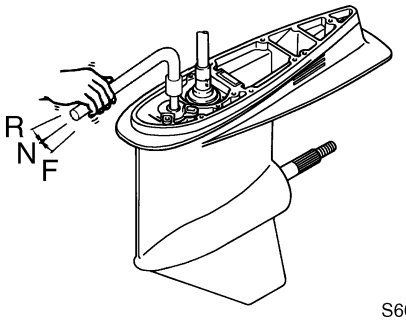
Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.

2. Align the center of the set pin ⓐ with the alignment mark ⓑ on the bracket.



S6C16310



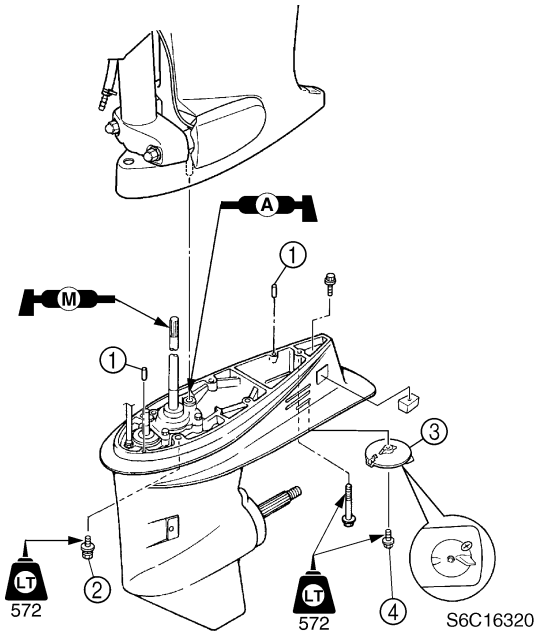
S60V6330

Shift rod push arm: 90890-06052

3. Install the two dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts ② to the specified torque.

5. Install the trim tab ③ to its original position, and then tighten the trim tab bolt ④.

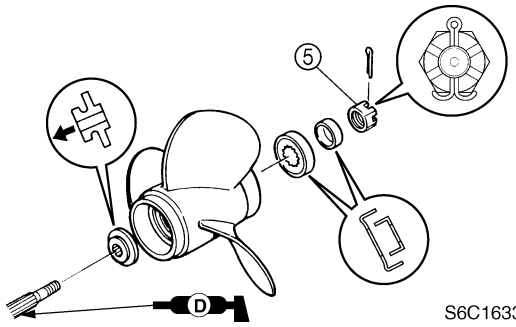


S6C16320

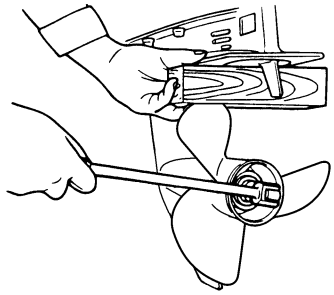
Lower case mounting bolt ②:
39 N·m (3.9 kgf·m, 28.8 ft·lb)

6

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



S6C16330


S69J6340

⚠ WARNING

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

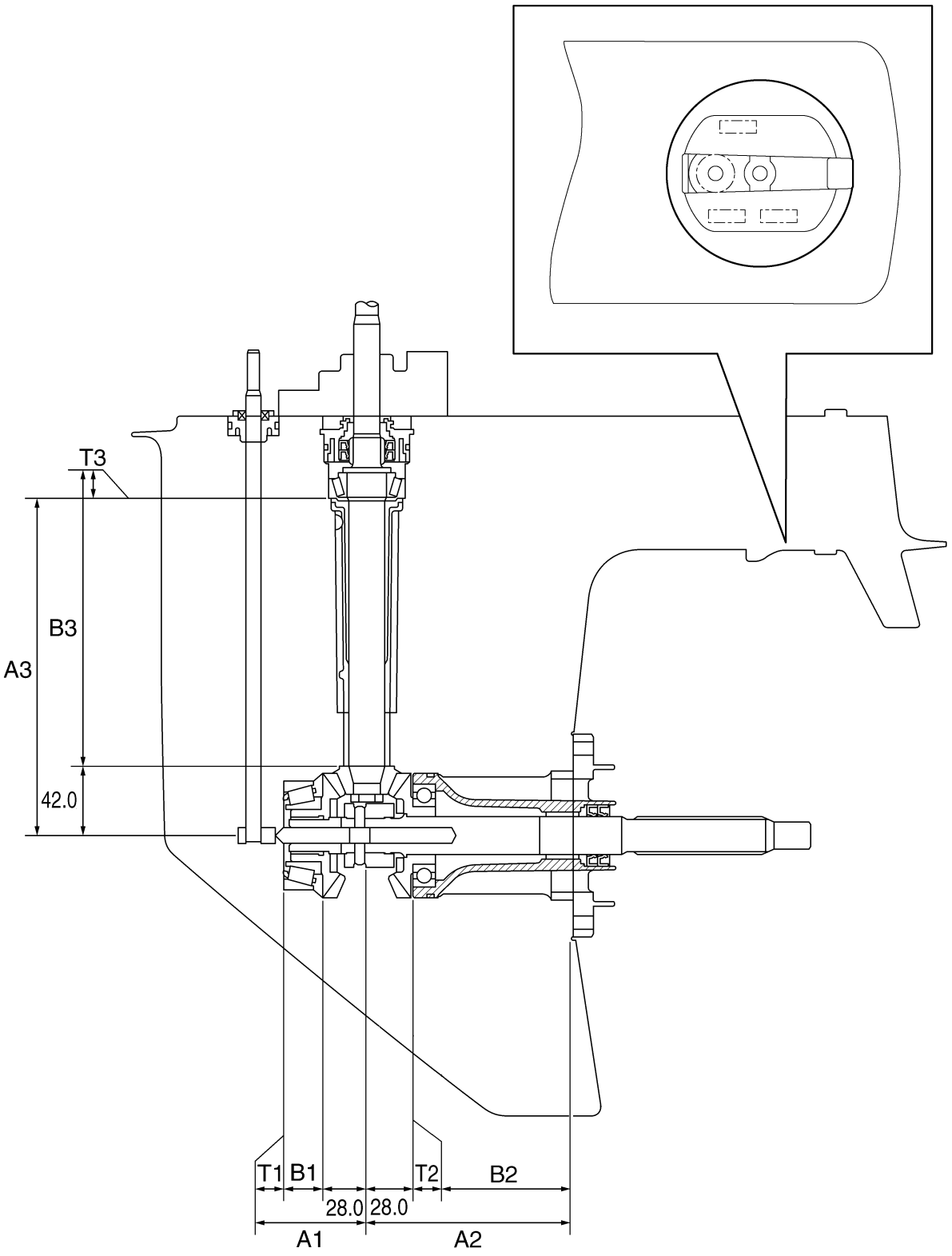
NOTE:

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: 34 N·m (3.4 kgf·m, 25.1 ft·lb)

7. Fill the gear oil to the correct level.

Shimming (F50, F60)



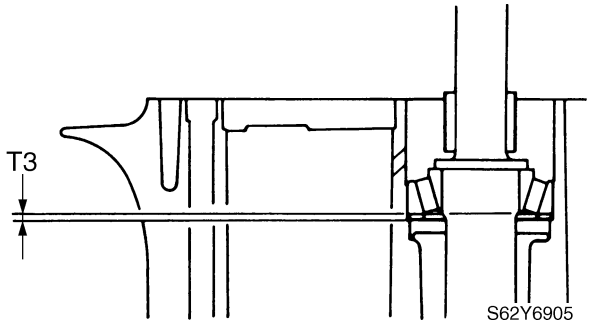
S6C16340

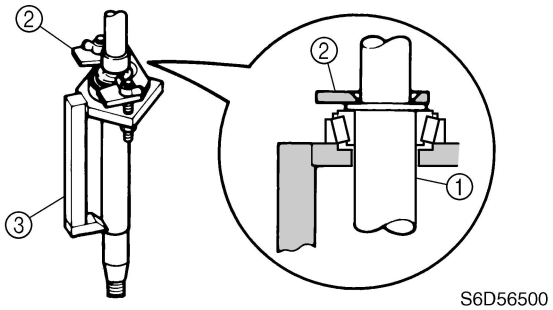
Shimming

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

Selecting the pinion shims

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





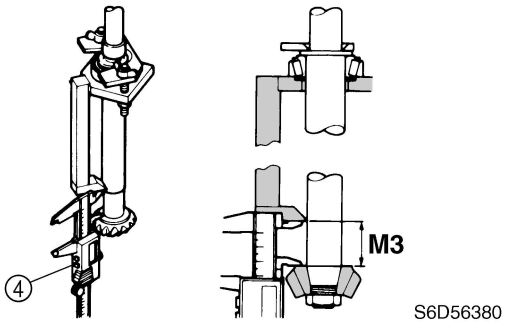
NOTE:
- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the special service tools onto the drive shaft so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the plate ②.

Pinion height gauge plate B ②: 90890-06712
Pinion height gauge ③: 90890-06710

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

Pinion nut: 74 N·m (7.4 kgf·m, 54.6 ft·lb)

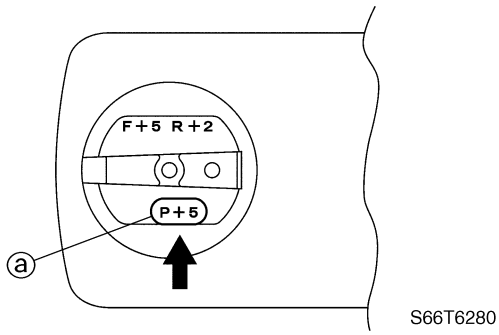
3. Measure the distance (M3) between the special service tool and the pinion as shown.



NOTE:
Measure the pinion at three points to find the distance average.

Digital caliper ④: 90890-06704

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



NOTE:
"P" is the deviation of the lower case dimension from standard. The "P" mark ⓐ 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:
Pinion shim thickness (T3) =
M3 – 11.30 – P/100

Example:
If “M3” is 11.70 mm and “P” is (+5), then
T3 = 11.70 – 11.30 – (+5)/100 mm
= 0.40 – 0.05 mm
= 0.35 mm

5. Select the pinion shim(s) (T3) as follows.

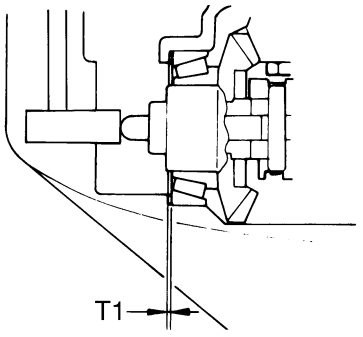
Calculated numeral at 1/100 place	Rounded numeral
1, 2	2
3, 4, 5	5
6, 7, 8	8
9, 10	10

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

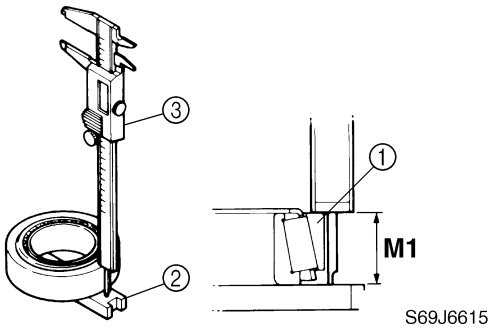
Example:
If “T3” is 0.35 mm, then the pinion shim is 0.35 mm.
If “T3” is 0.46 mm, then the pinion shim is 0.48 mm.

Selecting the forward gear shims

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



S62Y6375



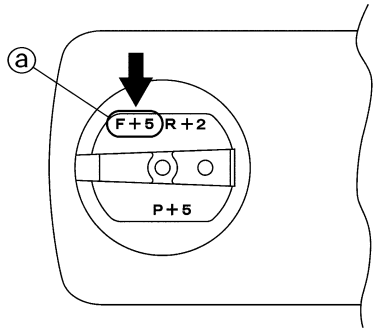
S69J6615

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

6

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



S66T6290

NOTE:
"F" is the deviation of the lower case dimension from standard. The "F" mark ⓐ 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:
Forward gear shim thickness (T1) =
26.50 + F/100 – M1

Example:
If "M1" is 26.00 mm and "F" is (–1), then
T1 = 26.50 + (–1)/100 – 26.00 mm
= 26.50 – 0.01 – 26.00 mm
= 0.49 mm

3. Select the forward gear shim(s) (T1) as follows.

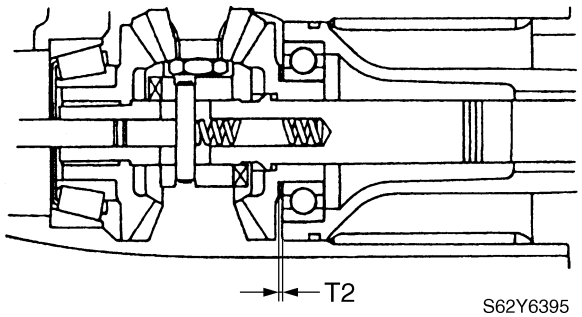
Calculated numeral at 1/100 place	Rounded numeral
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

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

Example:
If "T1" is 0.49 mm, then the forward gear shim is 0.48 mm.
If "T1" is 0.58 mm, then the forward gear shim is 0.55 mm.

Selecting the reverse gear shims

1. Measure the backlash to find the necessary shim thickness (T2). Add or remove shim(s) if out of specification. For measuring procedure, see "Measuring the forward and reverse gear backlash."



S62Y6395

NOTE:
Measure the backlash with the original shim(s). If the original shim(s) is unavailable, start with a 0.50 mm shim.

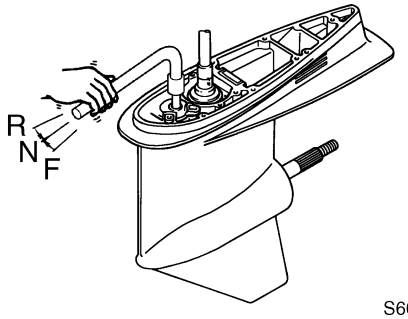
Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Backlash (F50, F60)

Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.

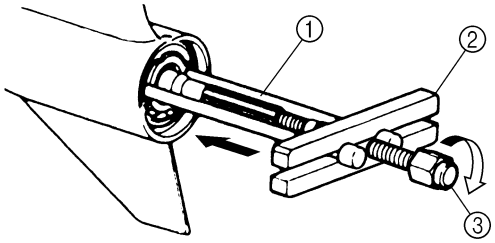
2. Set the gear shift to the neutral position at the lower unit.



S60V6330

Shift rod push arm: 90890-06052

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

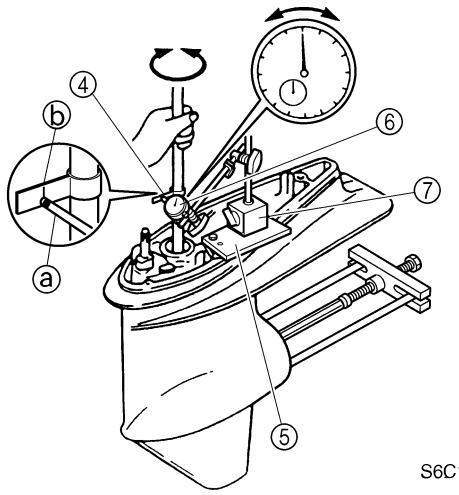


S60X6370

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

Bearing housing puller claw S ①: 90890-06564
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

4. Install the backlash indicator onto the drive shaft (18.0 mm [0.71 in] in diameter), then the dial gauge onto the lower unit.



S6C16760

NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator.

Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

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

Forward gear backlash:
0.35–0.81 mm (0.0138–0.0319 in)

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

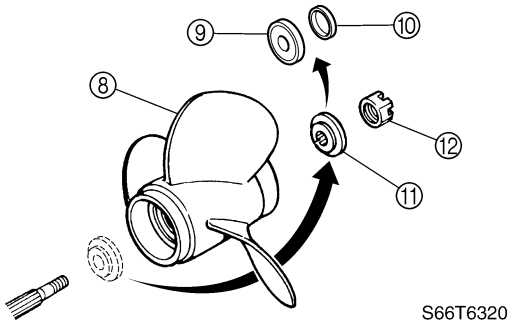
Forward gear backlash	Shim thickness
Less than 0.35 mm (0.0138 in)	To be decreased by (0.58 – M) × 0.56
More than 0.81 mm (0.0319 in)	To be increased by (M – 0.58) × 0.56

M: Measurement

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

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

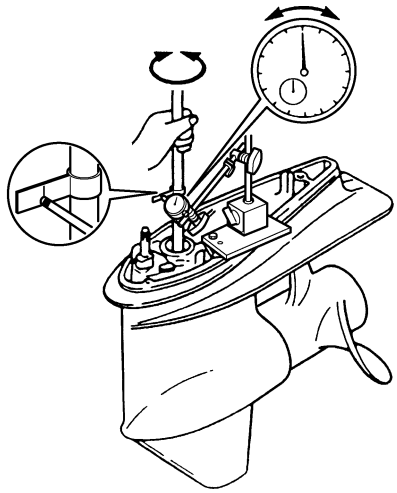
8. Apply a load to the reverse gear by installing the propeller ⑧ (without the washer ⑨ and ⑩), then the spacer ⑪ as shown.



S66T6320

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

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


S6C16770

Reverse gear backlash:
0.89–1.34 mm (0.0350–0.0528 in)

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

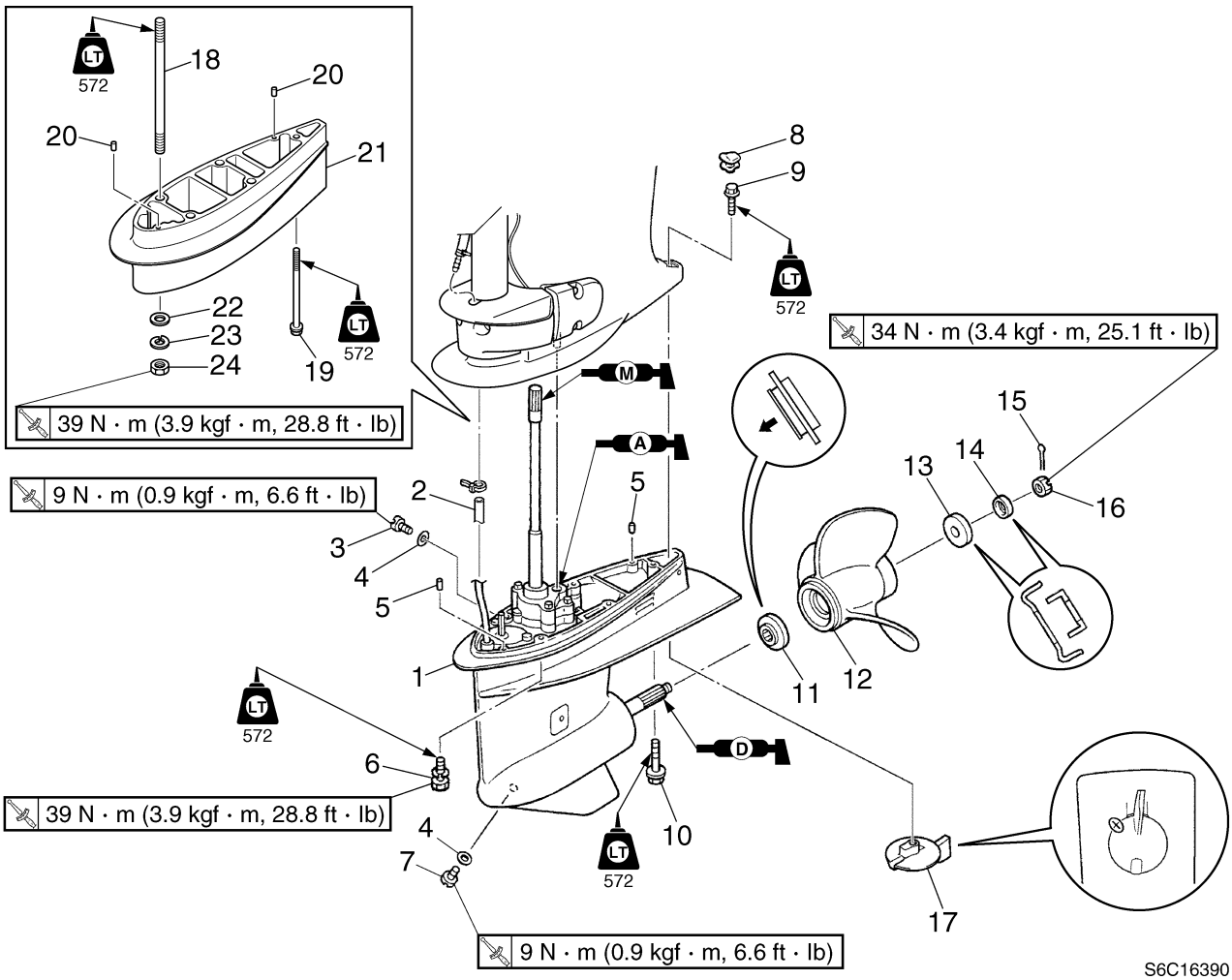
Reverse gear backlash	Shim thickness
Less than 0.89 mm (0.0350 in)	To be decreased by (1.12 – M) × 0.56
More than 1.34 mm (0.0528 in)	To be increased by (M – 1.12) × 0.56

M: Measurement

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

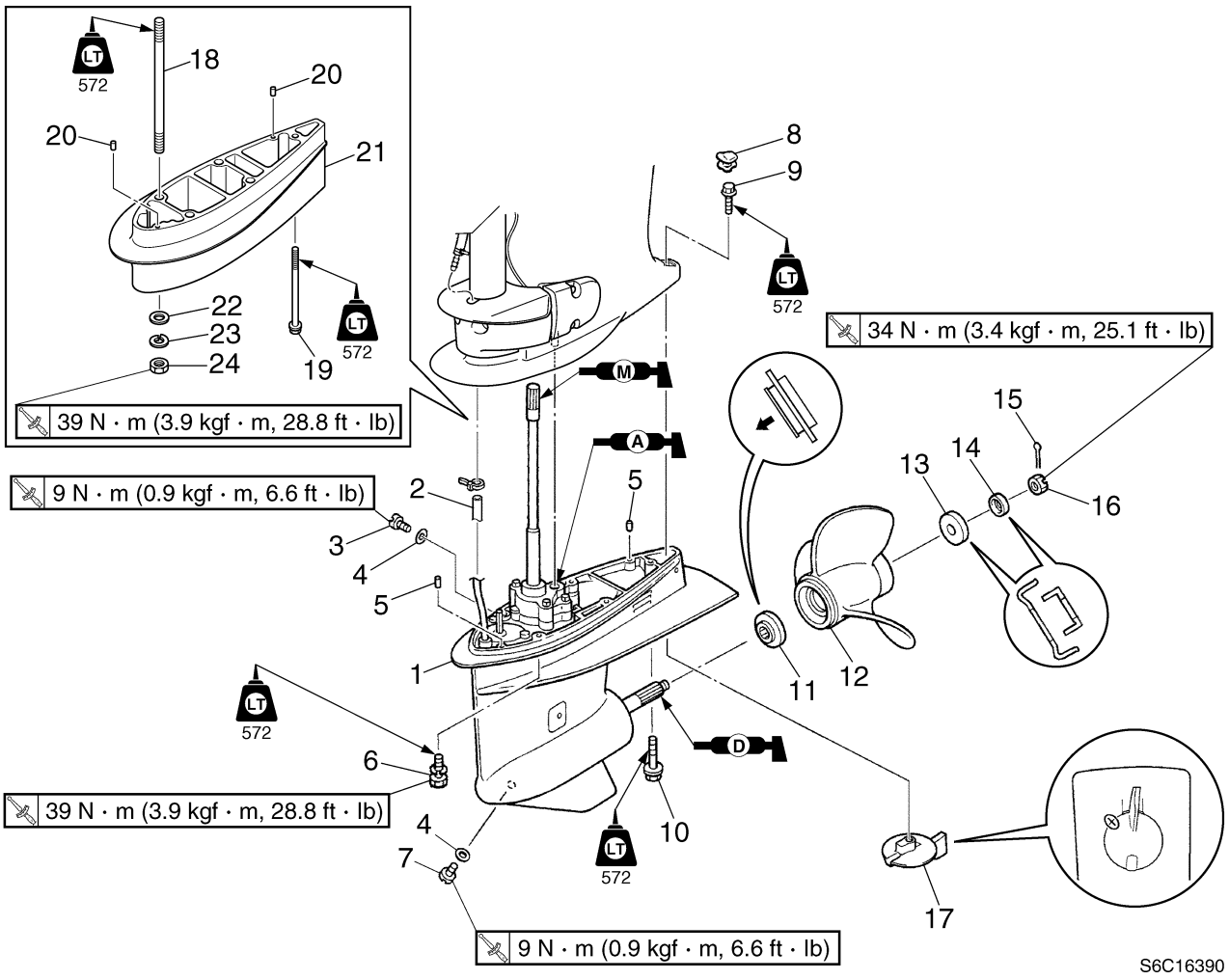
11. Remove the special service tools, and then install the water pump assembly.

Lower unit (FT50, FT60)

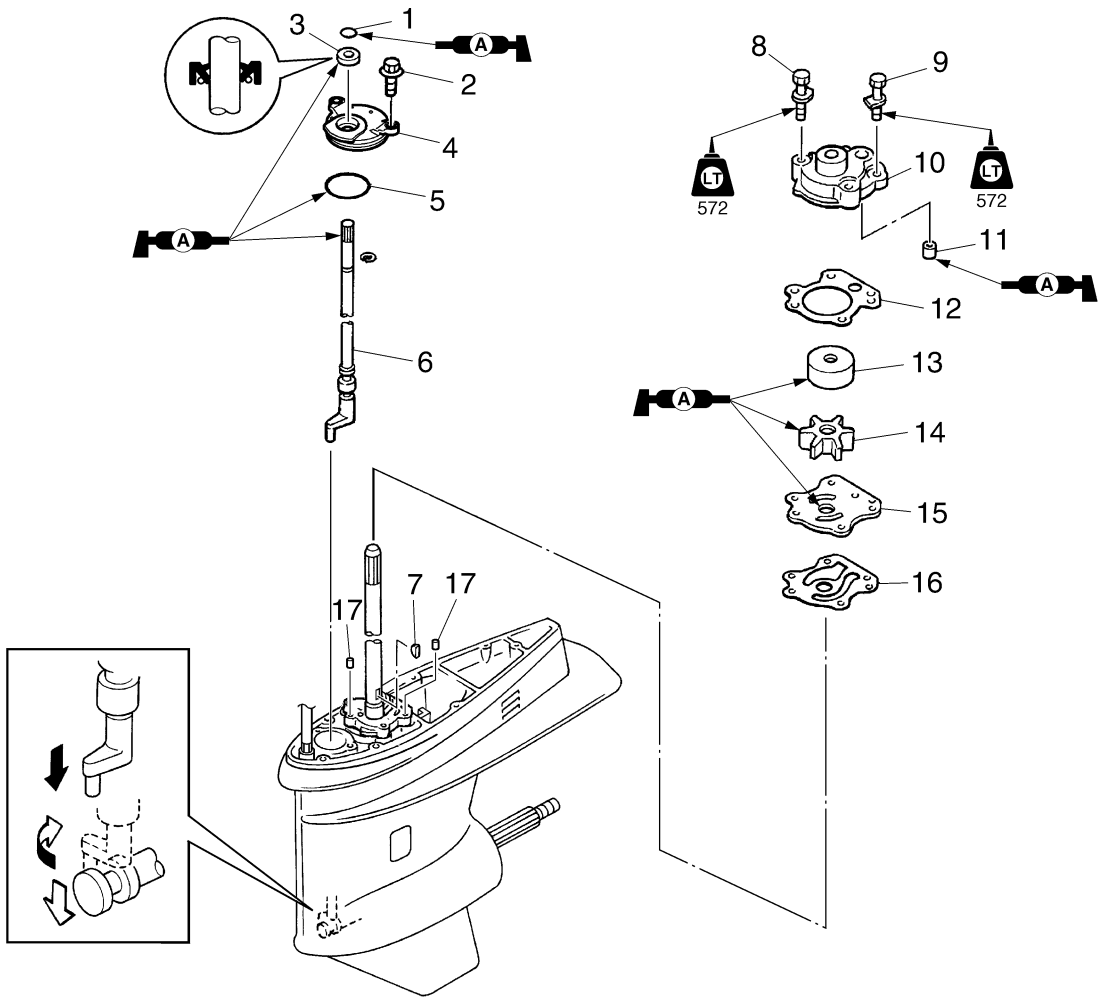


No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Hose	1	
3	Check screw	1	
4	Gasket	2	**Not reusable**
5	Dowel	2	
6	Bolt	4	M10 × 40 mm/L-transom model
7	Drain screw	1	
8	Grommet	1	
9	Bolt	1	M10 × 45 mm
10	Bolt	1	M8 × 60 mm/L-transom model
11	Spacer	1	
12	Propeller	1	
13	Washer	1	
14	Washer	1	
15	Cotter pin	1	**Not reusable**
16	Nut	1	
17	Trim tab	1	

6



No.	Part name	Q'ty	Remarks
18	Stud bolt	4	X-transom model
19	Bolt	1	M8 × 185 mm/X-transom model
20	Dowel	2	X-transom model
21	Extension	1	X-transom model
22	Washer	4	X-transom model
23	Spring washer	4	X-transom model
24	Nut	4	X-transom model

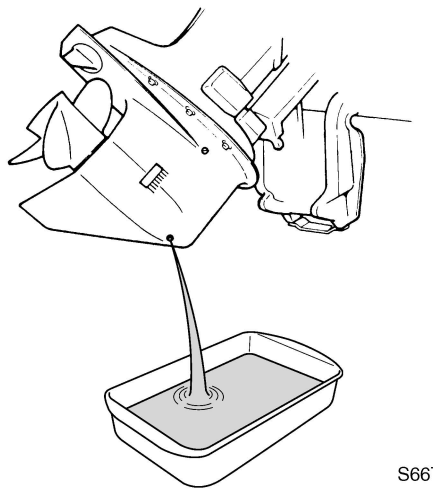


S6C16410

No.	Part name	Q'ty	Remarks
1	O-ring	1	**Not reusable**
2	Bolt	2	M6 × 16 mm
3	Oil seal	1	**Not reusable**
4	Oil seal housing	1	
5	O-ring	1	**Not reusable**
6	Shift rod	1	
7	Woodruff key	1	
8	Bolt	2	M8 × 55 mm
9	Bolt	2	M8 × 45 mm
10	Water pump housing	1	
11	Seal	1	
12	Gasket	1	**Not reusable**
13	Insert cartridge	1	
14	Impeller	1	
15	Outer plate cartridge	1	
16	Gasket	1	**Not reusable**
17	Dowel	2	

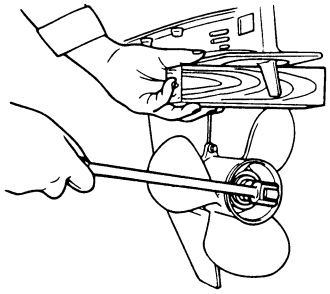
Removing the lower unit

1. Drain the gear oil.



S66T6370

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



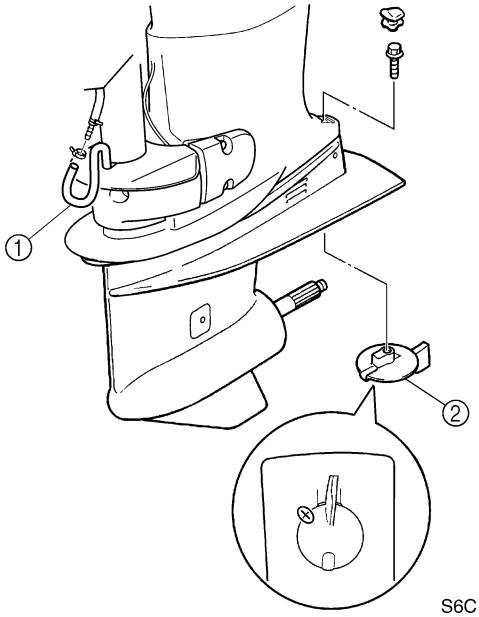
S62Y6485

⚠ WARNING

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

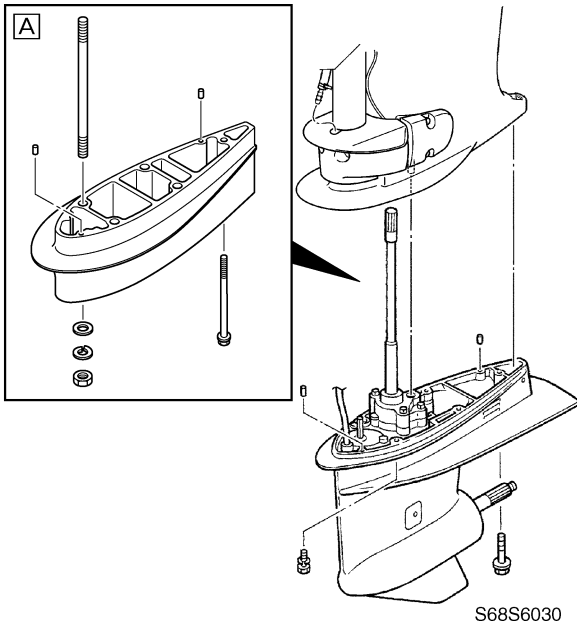
3. Disconnect the speedometer hose ①.

4. Mark the trim tab ② at the area shown, and then remove it.



S6C16400

5. Loosen the bolts (nuts), and then remove the lower unit from the upper case.

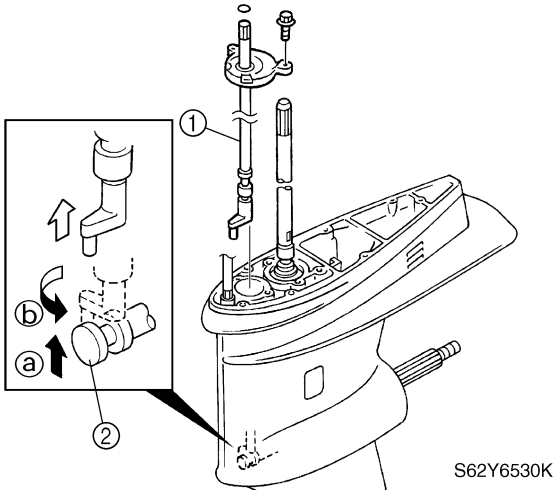


S68S6030

A X-transom model

Removing the water pump and shift rod

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



NOTE:
Pull up the shift rod assembly a little ⓐ to disconnect it from the shift slider ②, turn it counterclockwise 90° ⓑ, and then remove it.

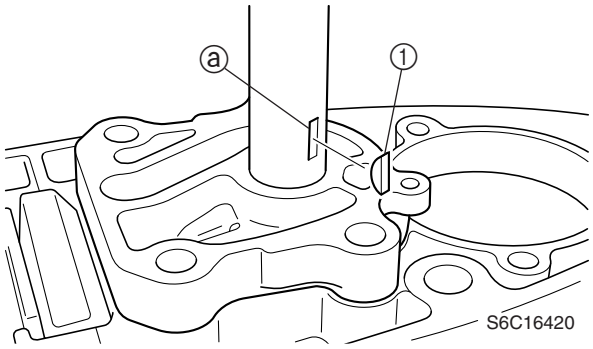
2. Remove the Woodruff key, and then remove the outer plate cartridge.

Checking the water pump and shift rod

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

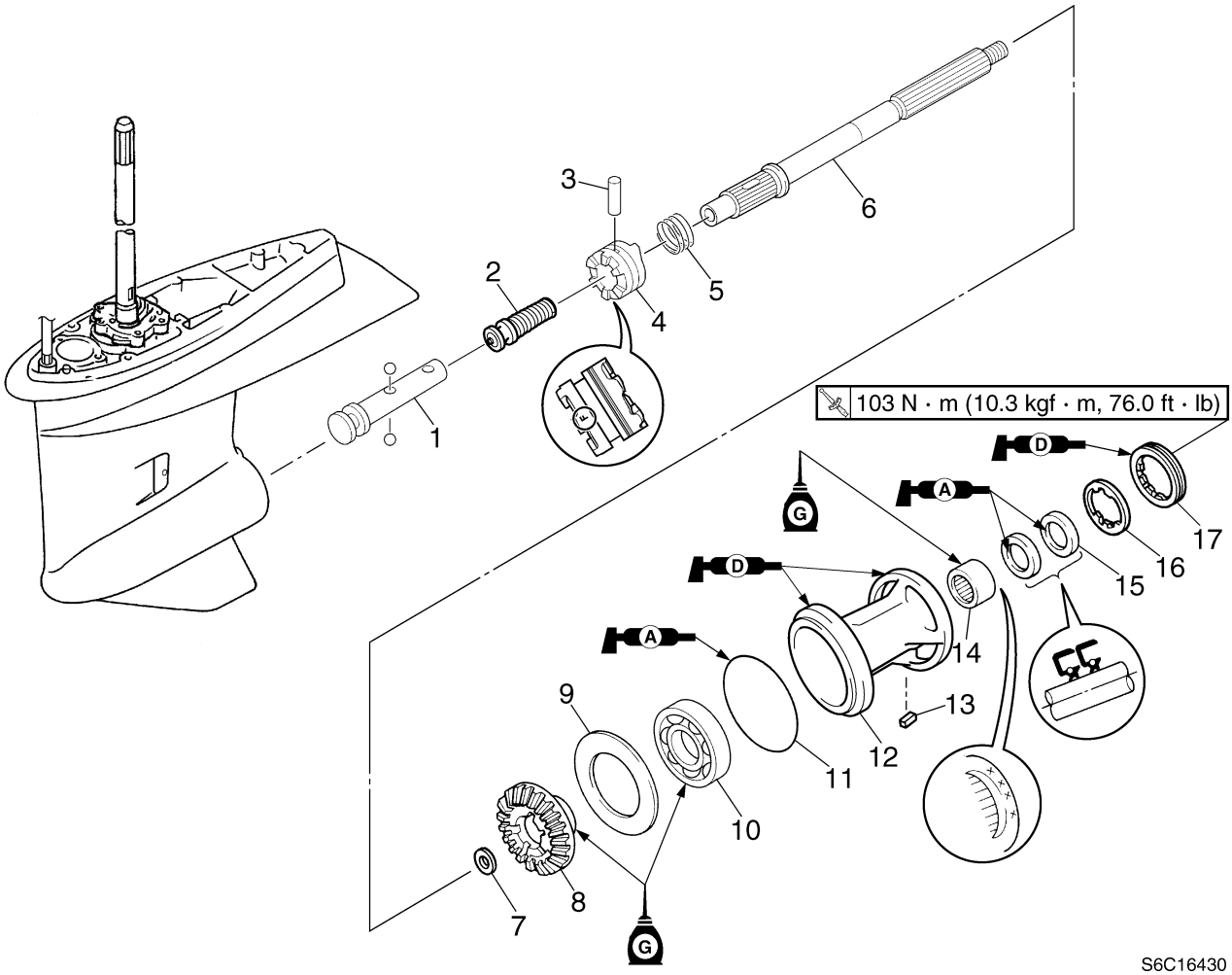
2. Check the impeller and insert cartridge for cracks or wear. Replace if necessary.

3. Check the Woodruff key ① and the keyway ⓐ in the drive shaft for wear. Replace if necessary.



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

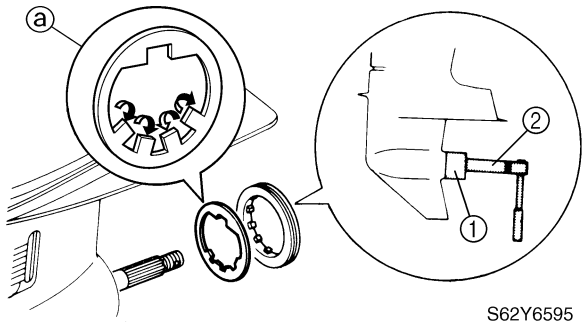
Propeller shaft housing (FT50, FT60)



No.	Part name	Q'ty	Remarks
1	Slider	1	
2	Shift plunger	1	
3	Cross pin	1	
4	Dog clutch	1	
5	Spring	1	
6	Propeller shaft	1	
7	Washer	1	
8	Reverse gear	1	
9	Thrust washer	1	
10	Ball bearing	1	Not reusable
11	O-ring	1	Not reusable
12	Propeller shaft housing	1	
13	Straight key	1	
14	Needle bearing	1	
15	Oil seal	2	Not reusable
16	Claw washer	1	
17	Ring nut	1	

Removing the propeller shaft housing assembly

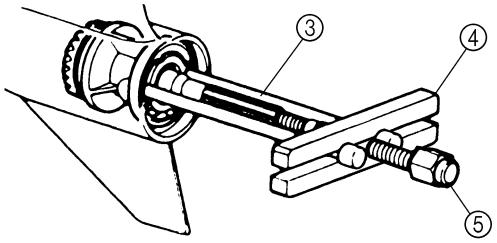
1. Straighten the claw washer tabs ⓐ, and then remove the ring nut and claw washer.



S62Y6595

Ring nut wrench 3 ①: 90890-06511
Ring nut wrench extension ②: 90890-06513

2. Pull out the propeller shaft housing assembly.



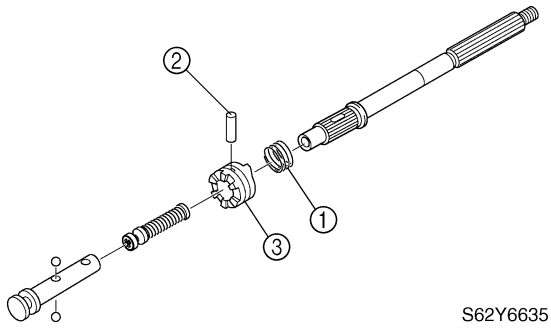
S68S6310

Bearing housing puller claw L ③: 90890-06502
Stopper guide plate ④: 90890-06501
Center bolt ⑤: 90890-06504

3. Remove the propeller shaft assembly.

Disassembling the propeller shaft assembly

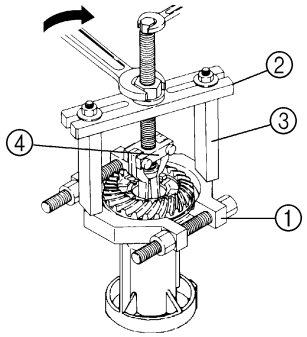
1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, slider, and shift plunger.



S62Y6635

Disassembling the propeller shaft housing

1. Remove the reverse gear and thrust washer.

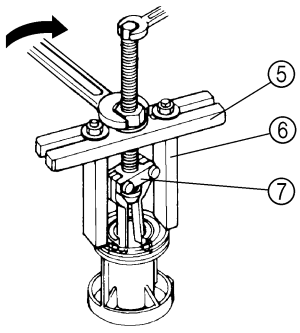


S6C16440

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

6

2. Remove the ball bearing.



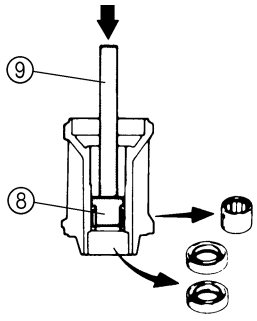
S6C16450

CAUTION:

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

Stopper guide plate ⑤: 90890-06501
Stopper guide stand ⑥: 90890-06538
Bearing puller assembly ⑦: 90890-06535

3. Remove the oil seals and needle bearing.



S68S6350

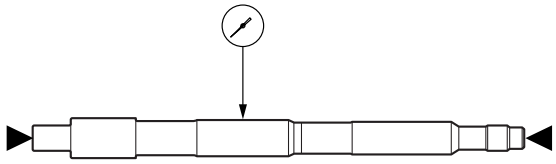
Needle bearing attachment ⑧: 90890-06612
Driver rod L3 ⑨: 90890-06652

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.
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. Measure the propeller shaft runout.

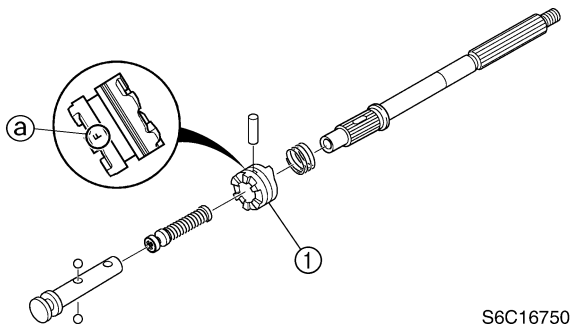

S6D56510

Runout limit: 0.02 mm (0.0008 in)

3. Check the dog clutch and slider for cracks or wear. Replace if necessary.

Assembling the propeller shaft assembly

1. Install the dog clutch as shown.



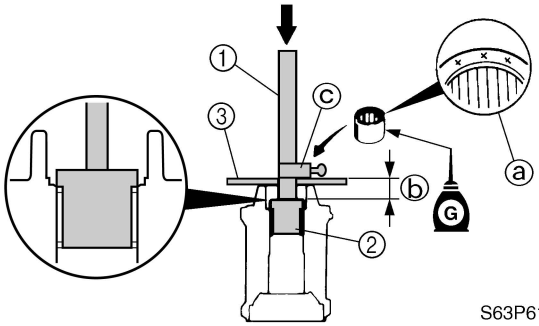
S6C16750

NOTE:

Install the dog clutch ① with the "F" mark ⓐ facing toward the slider.

Assembling the propeller shaft housing

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

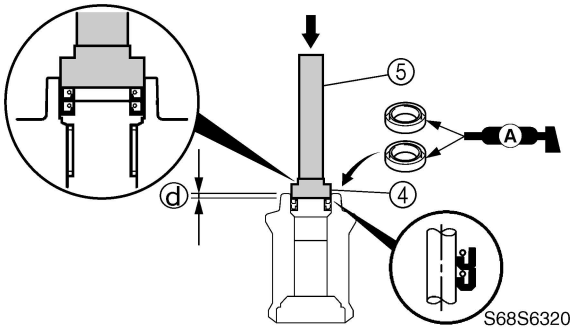


NOTE:
- Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special tool in a manner that will force the stopper ⓒ out of place.

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

Depth ⓑ:
25.25 ± 0.25 mm (0.990 ± 0.010 in)

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

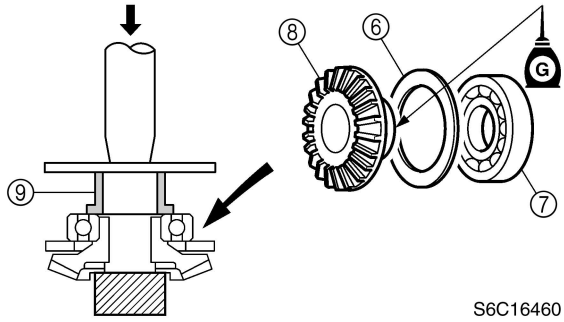


NOTE:
Install an oil seal halfway into the propeller shaft housing, then the other oil seal.

Ball bearing attachment ④:
90890-06655
Driver rod LS ⑤: 90890-06606

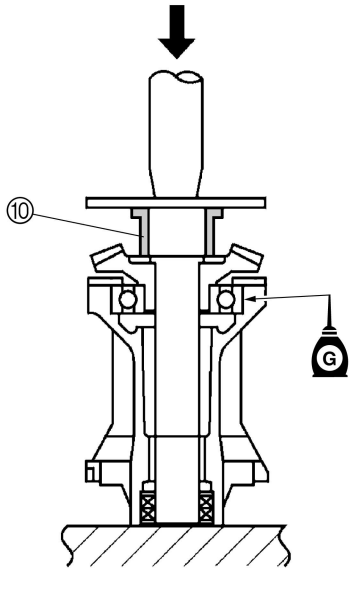
Depth ⓓ:
5.0 ± 0.5 mm (0.200 ± 0.020 in)

3. Install the thrust washer ⑥ and new ball bearing ⑦ to the reverse gear ⑧ using a press.



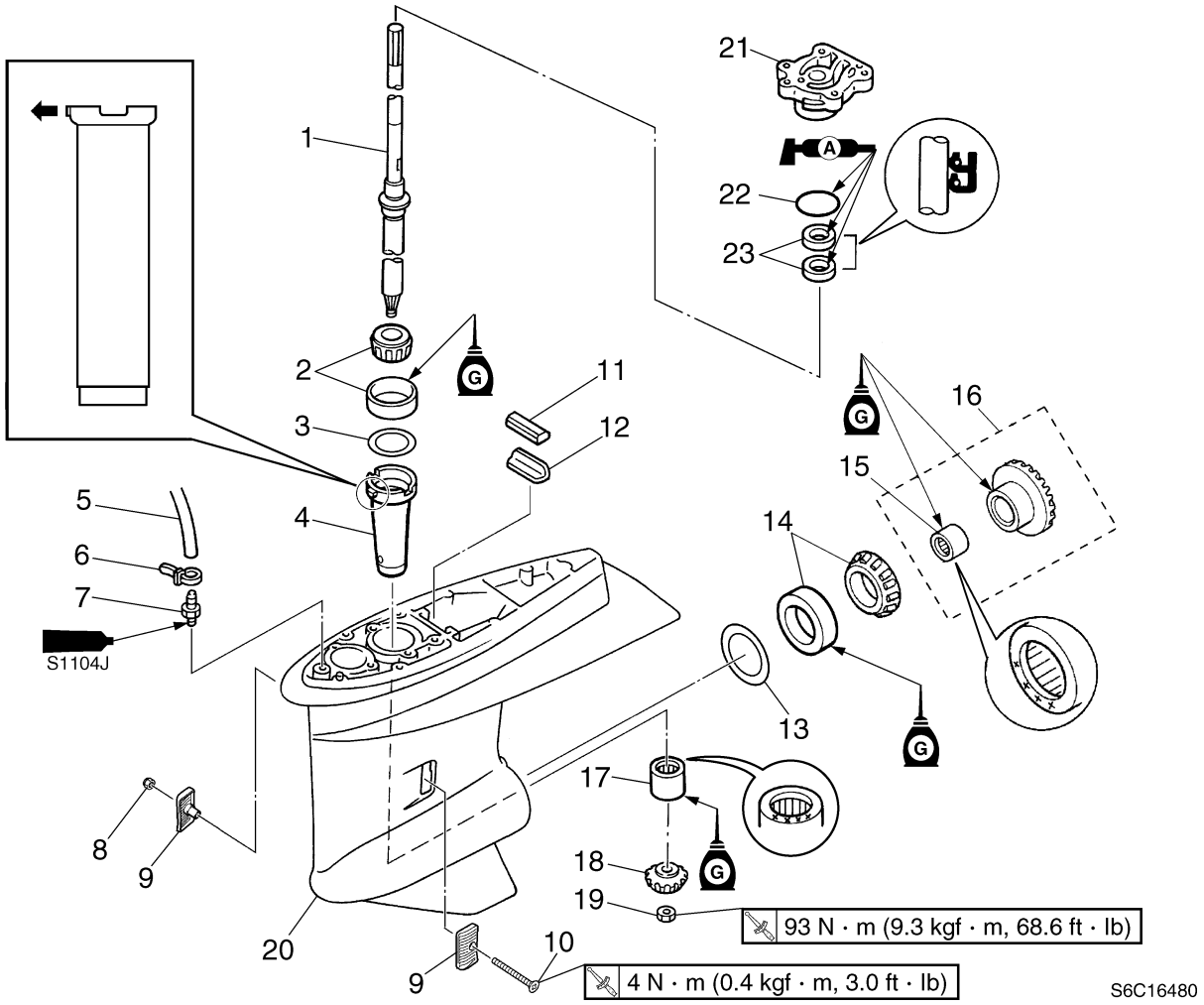
Bearing inner race attachment ⑨:
90890-06639

4. Install the reverse gear assembly into the propeller shaft housing using a press.

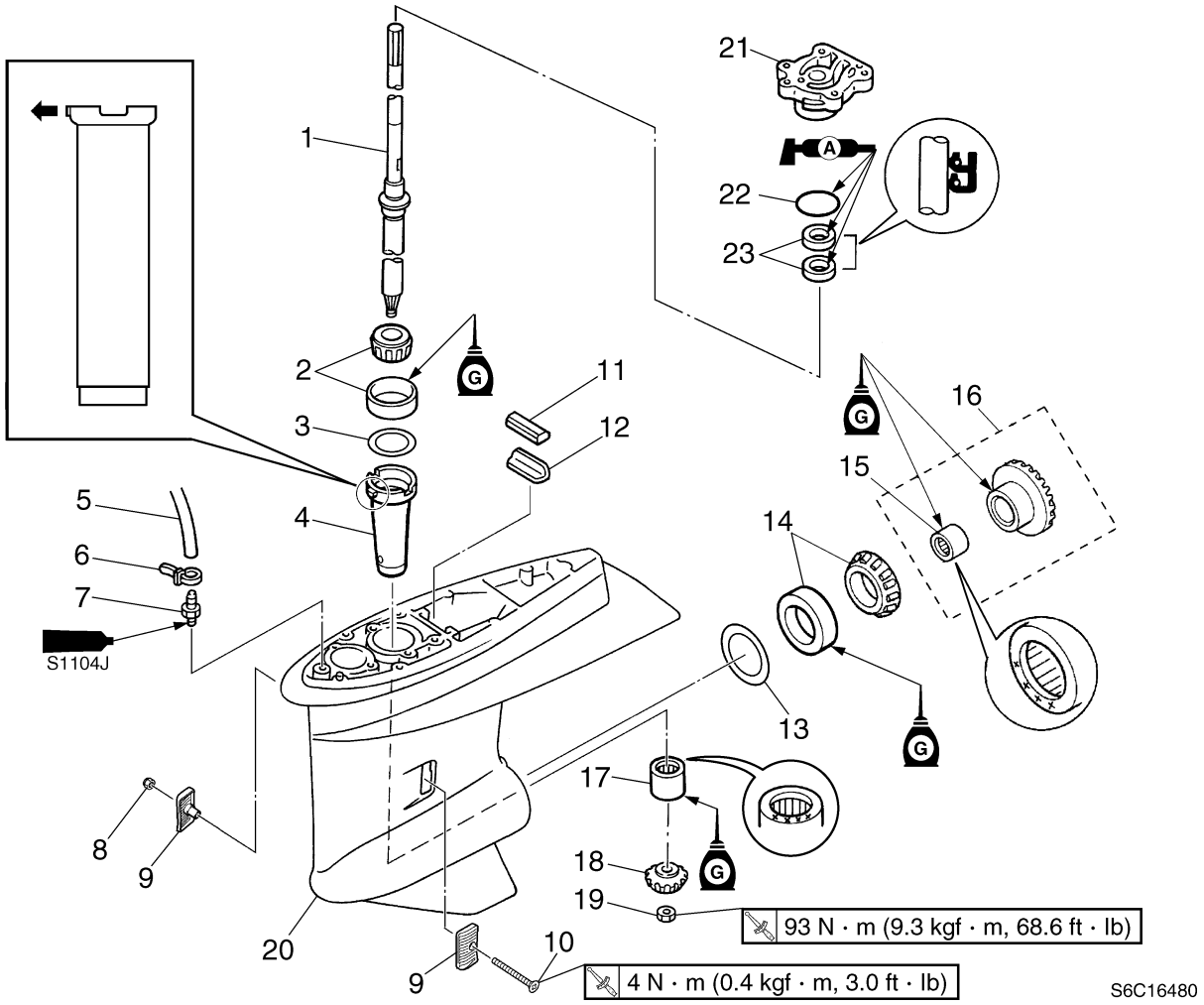


Bearing inner race attachment ⑩:
90890-06661

Drive shaft and lower case (FT50, FT60)



No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Taper roller bearing	1	**Not reusable**
3	Pinion shim	—	
4	Sleeve	1	
5	Hose	1	
6	Plastic tie	1	**Not reusable**
7	Joint	1	
8	Nut	1	
9	Cooling water inlet cover	2	
10	Screw	1	ø5 × 41 mm
11	Seal	1	
12	Plate	1	
13	Forward gear shim	—	
14	Taper roller bearing	1	**Not reusable**
15	Needle bearing	1	**Not reusable**
16	Forward gear assembly	1	
17	Needle bearing	1	

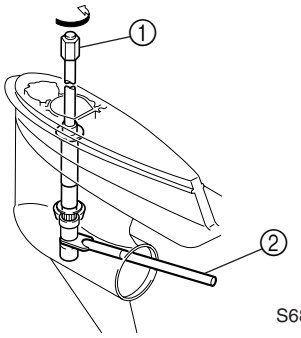


No.	Part name	Q'ty	Remarks
18	Pinion	1	
19	Nut	1	
20	Lower case	1	
21	Oil seal housing	1	
22	O-ring	1	**Not reusable**
23	Oil seal	1	**Not reusable**

6

Removing the drive shaft

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

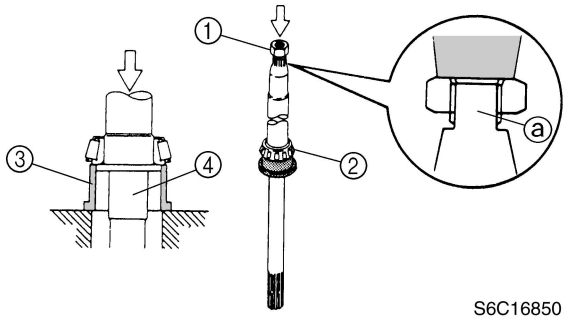


S68S6360J

Drive shaft holder 4 ①: 90890-06518
Pinion nut holder ②:
New: 90890-06715
Current: 90890-06505

Disassembling the drive shaft

1. Install the pinion nut ①, tighten it finger tight, and then remove the drive shaft bearing ② using a press.



S6C16850

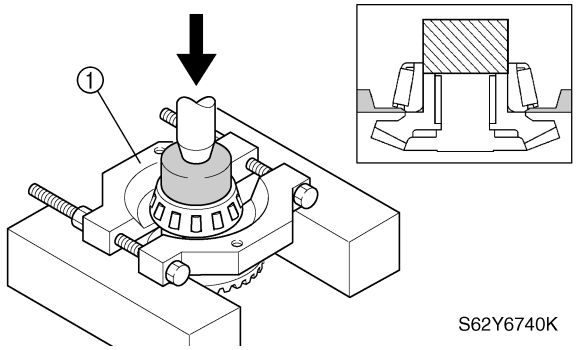
CAUTION:

- **Do not press the drive shaft threads ⓐ directly.**
- **When removing the drive shaft bearing, do not damage the drive shaft collar ④.**
- **Do not reuse the bearing, always replace it with a new one.**

Bearing inner race attachment ③:
90890-06639

Disassembling the forward gear

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



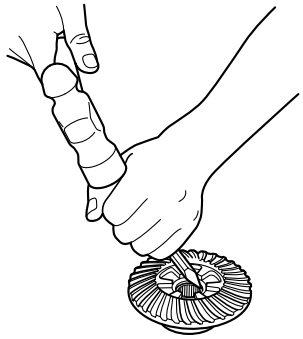
S62Y6740K

CAUTION:

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

Bearing separator ①: 90890-06534

2. Remove the needle bearing from the forward gear.

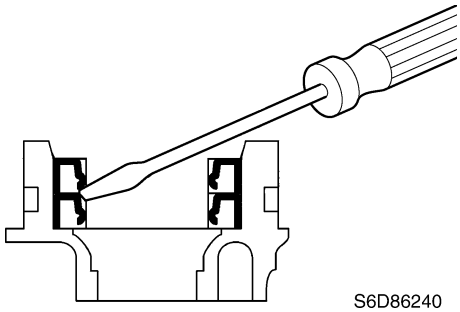

S68S6160

CAUTION:

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

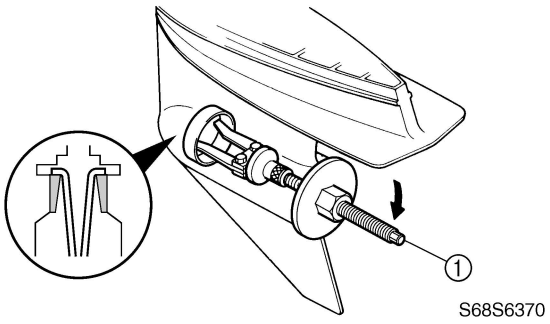
Disassembling the oil seal housing

1. Remove the oil seals using a flat head screwdriver.


S6D86240

Disassembling the lower case

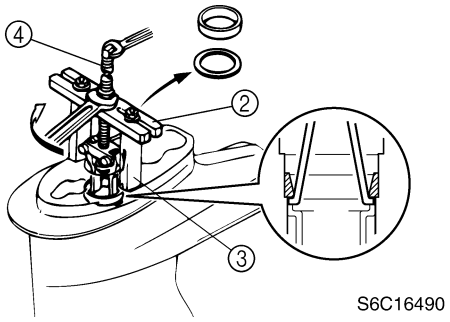
1. Remove the taper roller bearing outer race and shim(s).



NOTE:
Install the claws as shown.

Bearing outer race puller assembly ①:
90890-06523

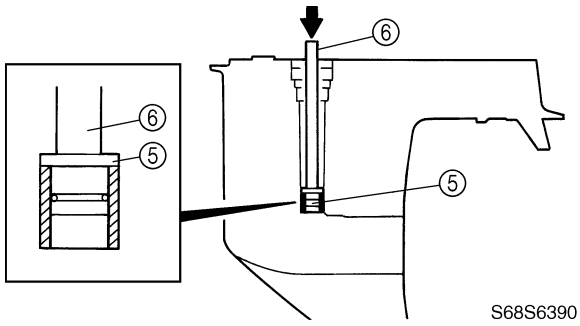
2. Remove the drive shaft bearing outer race, shim(s), and drive shaft sleeve.



NOTE:
Install the claws as shown.

Stopper guide plate ②: 90890-06501
Stopper guide stand ③:
90890-06538
Bearing puller assembly ④:
90890-06535

3. Remove the needle bearing.



Needle bearing attachment ⑤:
90890-06611
Driver rod L3 ⑥: 90890-06652

Checking the pinion and forward gear

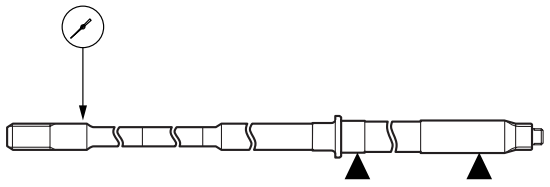
1. Check the teeth of the pinion, and the teeth and dogs of the forward gear for cracks or wear. Replace if necessary.

Checking the bearings

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

Checking the drive shaft

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



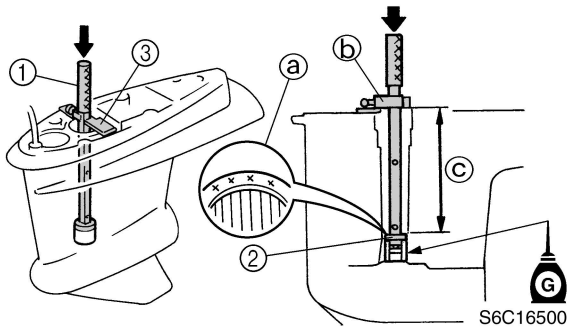
Runout limit: 0.5 mm (0.020 in)

Checking the lower case

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

Assembling the lower case

1. Install the needle bearing into the lower case to the specified depth.



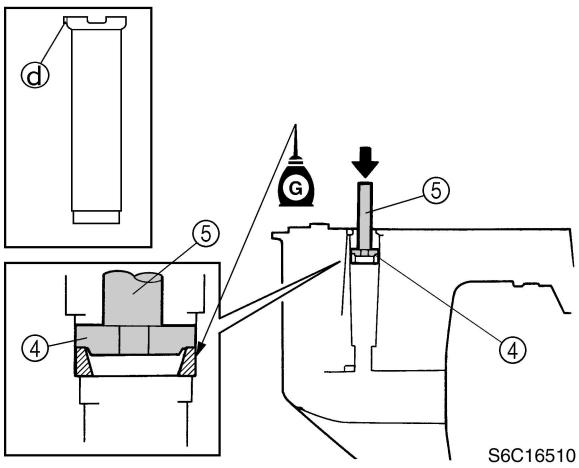
NOTE:

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

Driver rod SL ①: 90890-06602
Needle bearing attachment ②: 90890-06611
Bearing depth plate ③: 90890-06603

Depth ⓒ:
188.1 ± 0.5 mm (7.405 ± 0.020 in)

2. Install the sleeve, original shim(s), and taper roller bearing outer race.



CAUTION:

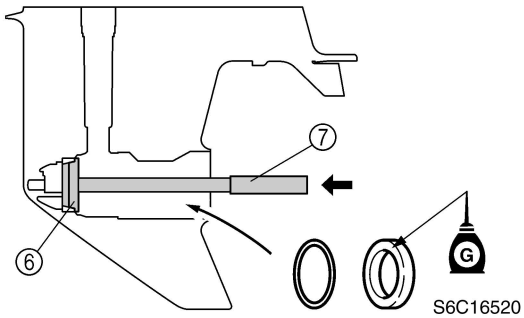
Add or remove shim(s), if necessary, if replacing the taper roller bearing or lower case.

NOTE:

- Apply the gear oil to the inside and outside of the sleeve before installation.
- Install the sleeve by facing the projection ⓓ forward.

Bearing outer race attachment ④: 90890-06626
Driver rod LS ⑤: 90890-06606

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



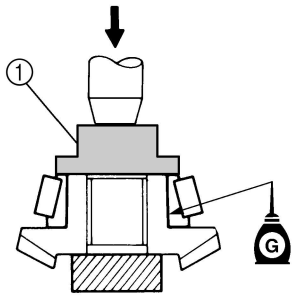
CAUTION:

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

Bearing outer race attachment ⑥: 90890-06621
Driver rod LL ⑦: 90890-06605

Assembling the forward gear

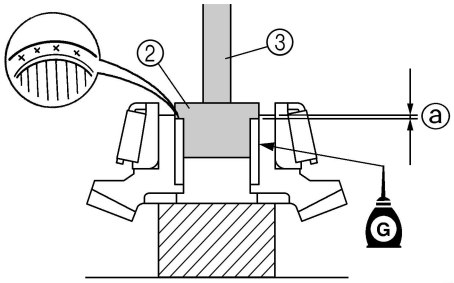
1. Install a new taper roller bearing into the forward gear using a press.



S6C16530

Needle bearing attachment ①:
90890-06607

2. Install the new needle bearing into the forward gear to the specified depth.



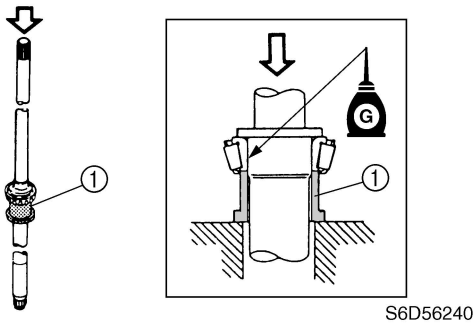
S6C16540

Needle bearing attachment ②:
90890-06614
Driver rod L3 ③: 90890-06652

Depth ⓐ:
0.95–1.45 mm (0.04–0.06 in)

Assembling the drive shaft

1. Install a new drive shaft bearing into the drive shaft using a press.

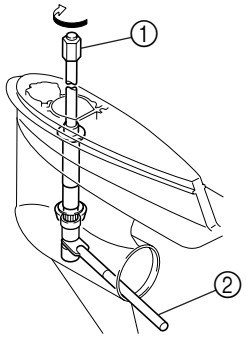


S6D56240

Bearing inner race attachment ①:
90890-06643

Installing the pinion

1. Install the forward gear, then the drive shaft assembly, pinion, and pinion nut, and then tighten the nut to the specified torque.



S68S6400

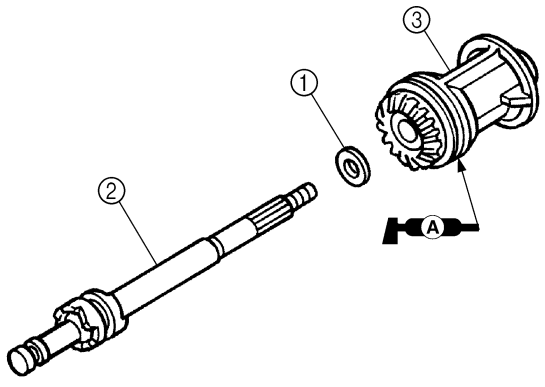
Drive shaft holder 4 ①: 90890-06518
Pinion nut holder ②:
New: 90890-06715
Current: 90890-06505

Pinion nut:
93 N·m (9.3 kgf·m, 68.6 ft·lb)

Installing the propeller shaft housing

1. Install the washer ① and propeller shaft assembly ② into the propeller shaft housing assembly ③.

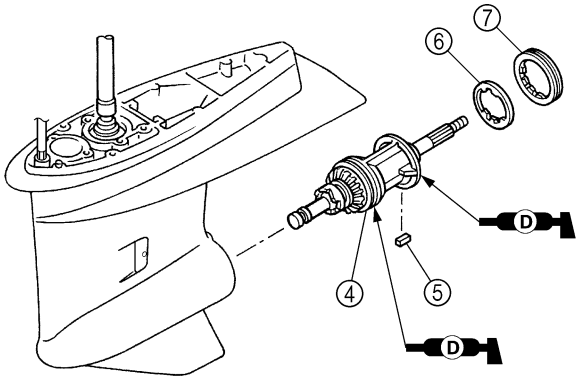
2. Apply grease to a new O-ring.



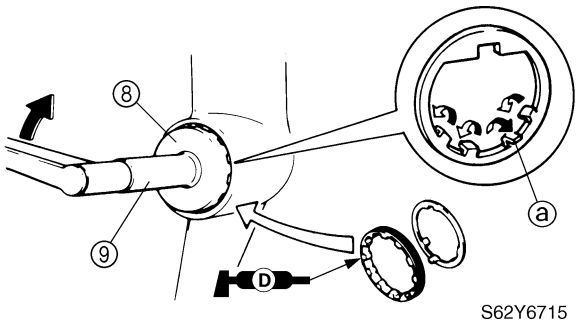
S6C16900

3. Install the propeller shaft housing assembly ④ into the lower case, and then install the straight key ⑤, claw washer ⑥, and ring nut ⑦.

4. Tighten the ring nut to the specified torque.



S62Y6710



S62Y6715

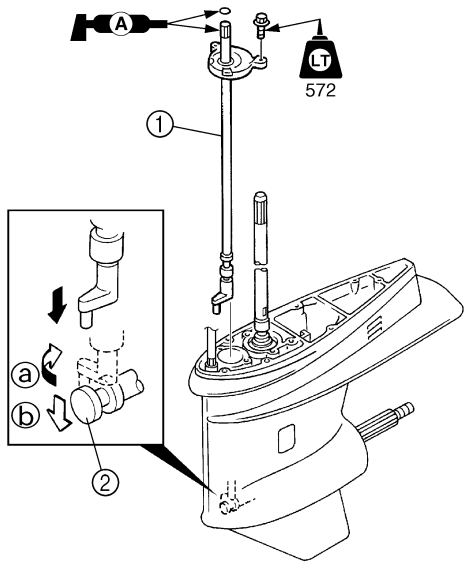
NOTE:
- To secure the ring nut, bend one tab ⓐ of the claw washer into a slot in the ring nut.
- Bend all other tabs toward the propeller shaft housing assembly.

Ring nut wrench 3 ⑧: 90890-06511
Ring nut wrench extension ⑨: 90890-06513

Ring nut ⑦:
103 N·m (10.3 kgf·m, 76.0 ft·lb)

Installing the water pump and shift rod

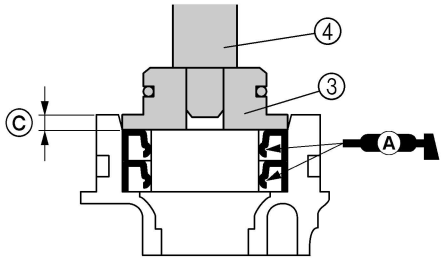
1. Install the shift rod assembly ①.



S62Y6555

NOTE:
Install the shift rod assembly into the lower case, turn it clockwise 90° ⓐ, and then push it down ⓑ to connect it to the shift slider ②.

2. Install new oil seals into the oil seal housing as shown.



S6C16560

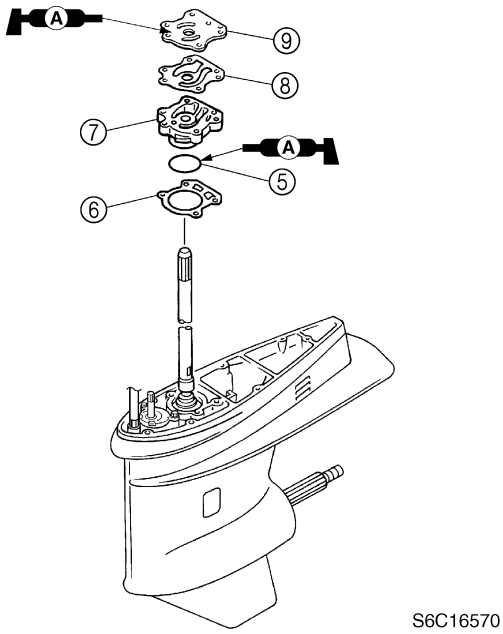
NOTE:
Install an oil seal halfway into the oil seal housing, then the other oil seal.

Needle bearing attachment ③: 90890-06610
Driver rod L3 ④: 90890-06652

Depth ⓒ:
3.5–4.5 mm (0.14–0.18 in)

3. Install a new O-ring ⑤, onto the oil seal housing ⑦.

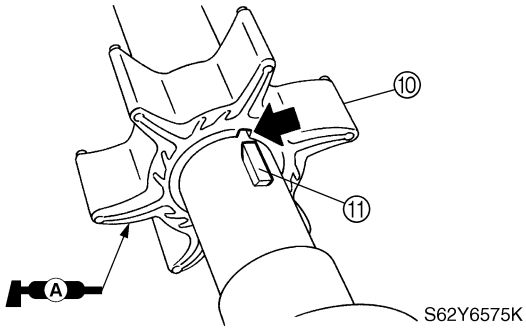
4. Install a new gasket ⑥, the oil seal housing ⑦, a new gasket ⑧, and the outer plate cartridge ⑨.



S6C16570

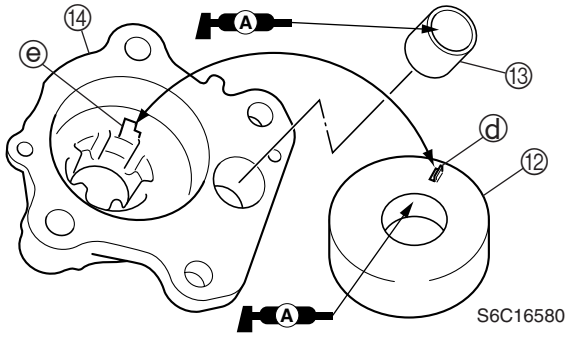
5. Install the Woodruff key into the drive shaft.

6. Align the groove on the impeller ⑩ with the Woodruff key ⑪, and then install the impeller onto the drive shaft.



S62Y6575K

7. Install the insert cartridge ⑫ and grommet ⑬ into the water pump housing ⑭.

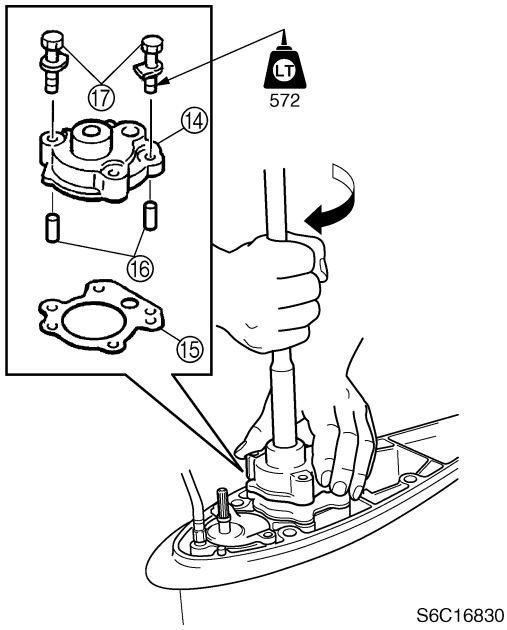


S6C16580

NOTE:
Align the insert cartridge projection ⓓ with the hole ⓔ in the water pump housing.

8. Install a new gasket ⑮, the water pump housing ⑭, and the dowels ⑯ onto the lower case.

9. Install and tighten the bolts ⑰.



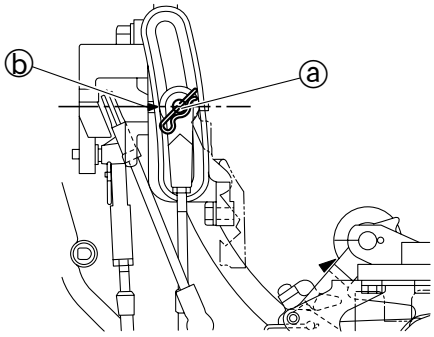
S6C16830

NOTE:
- Apply grease to the inside of the water pump housing before installation.
- To install the water pump housing, push down on the pump housing, and then turn the drive shaft clockwise.

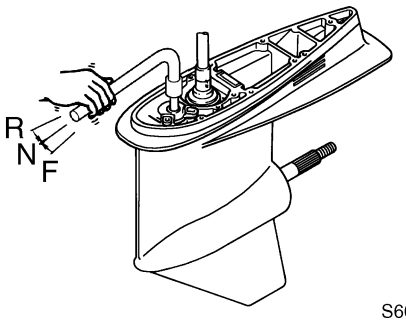
Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.

2. Align the alignment mark ⓐ on the bushing with the alignment mark ⓑ on the bracket.



S6C16310

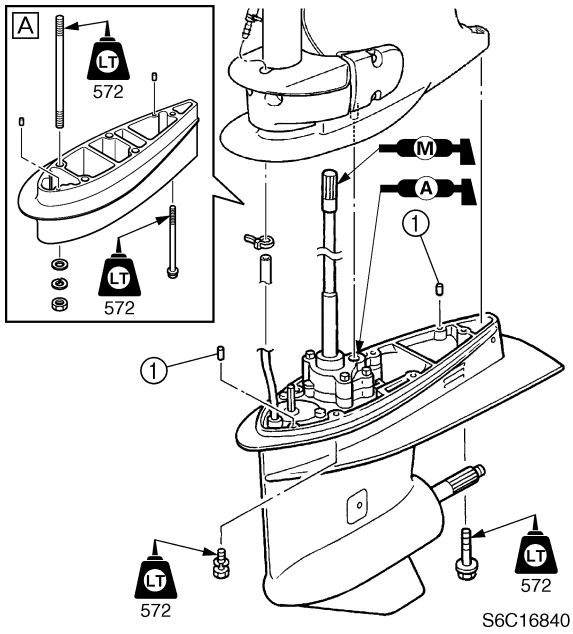


S60V6330

Shift rod push arm: 90890-06052

3. Install the dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts (nuts) to the specified torque.

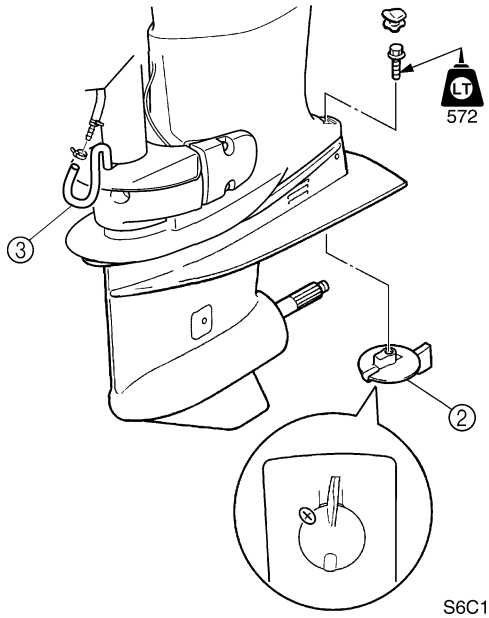


S6C16840

A X-transom model

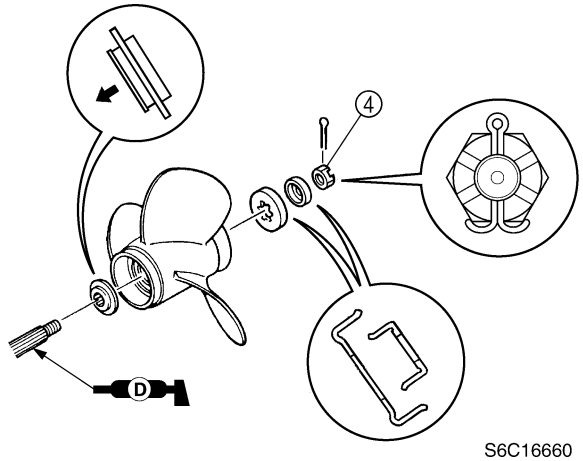
Lower case mounting bolt (nut):
39 N·m (3.9 kgf·m, 28.8 ft·lb)

5. Install the trim tab ② to its original position, and then connect the speedometer hose ③.

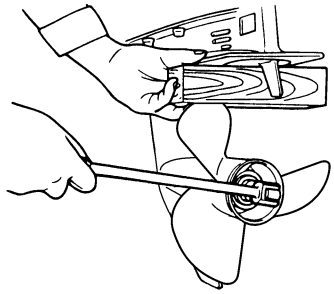


S6C16600

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



S6C16660



S69J6340

⚠ WARNING

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

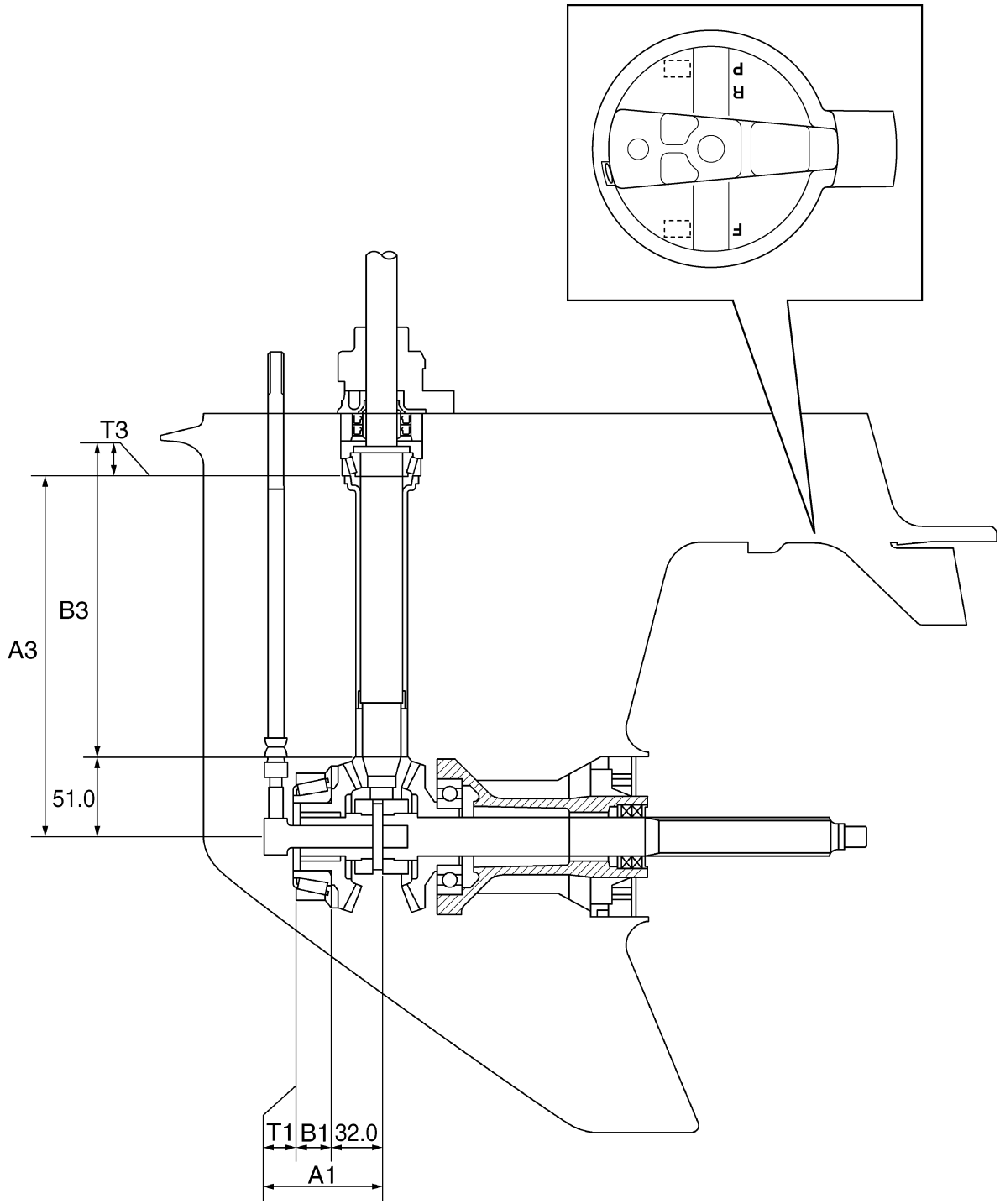
NOTE:

If the grooves in the propeller nut ④ do not align with the cotter pin hole, tighten the nut until they are aligned.

	Propeller nut ④: 34 N·m (3.4 kgf·m, 25.1 ft·lb)

7. Fill the gear oil to the correct level.

Shimming (FT50, FT60)



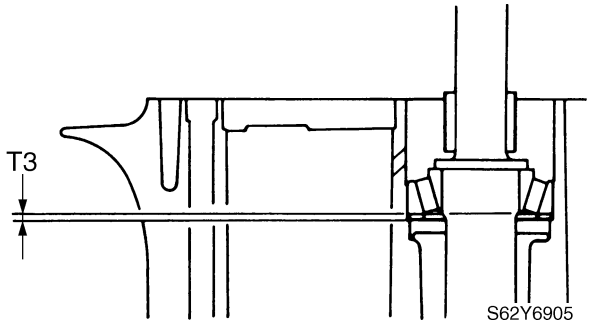
S6C16670

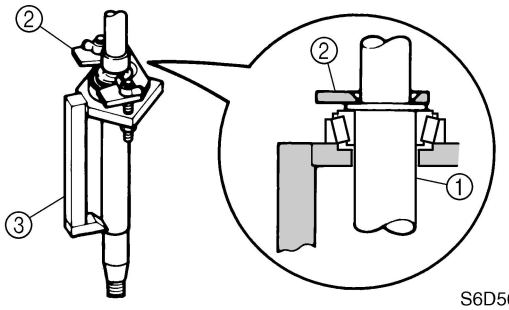
Shimming

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

Selecting the pinion shims

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





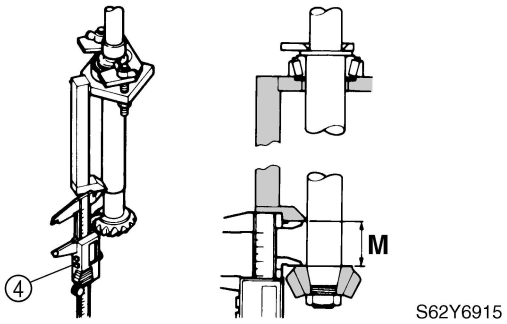
NOTE:
- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the special service tools to the drive shaft so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the plate ②.

Pinion height gauge plate B ②:
90890-06712
Pinion height gauge ③:
90890-06710

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

Pinion nut:
93 N·m (9.3 kgf·m, 68.6 ft·lb)

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

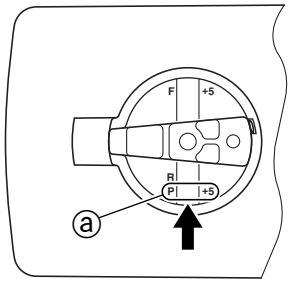


NOTE:
Measure the pinion at three points to find the distance average.

Digital caliper ④: 90890-06704

6

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



S68S6250

NOTE:

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

Calculation formula:
Pinion shim thickness (T3) =
M – 31.50 mm – P/100

Example:
If "M" is "32.10 mm" and "P" is "+5", then
T3 = 32.10 – 31.50 – (+5)/100 mm
= 0.60 – 0.05 mm = 0.55 mm
If "M" is "32.10 mm" and "P" is "–5", then
T3 = 32.10 – 31.50 – (–5)/100 mm
= 0.60 + 0.05 mm = 0.65 mm

5. Select the pinion shim(s) (T3) as follows.

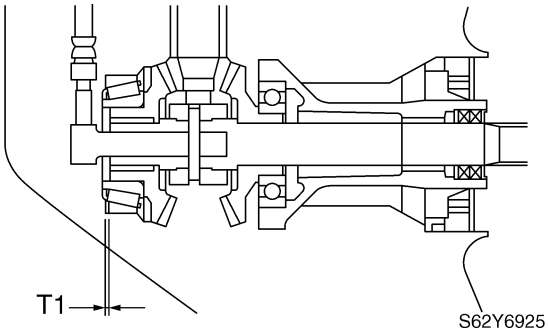
Calculated numeral at 1/100 place	Rounded numeral
0, 1	2
2, 3, 4	5
5, 6, 7	8
8, 9	10

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

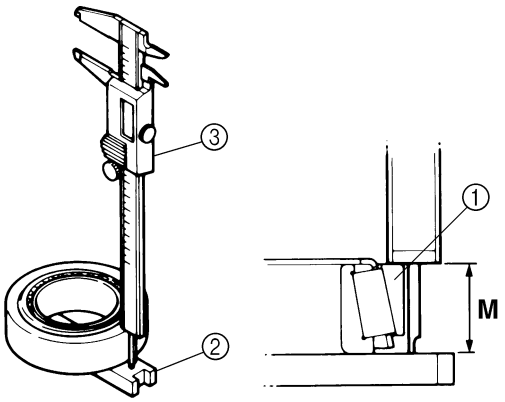
Example:
If "T3" is "0.55 mm", then the pinion shim is 0.58 mm.
If "T3" is "0.64 mm", then the pinion shim is 0.65 mm.

Selecting the forward gear shims

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



S62Y6925



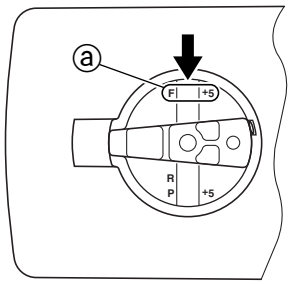
S62Y6930

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

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



S68S6260

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

Calculation formula:
Forward gear shim thickness (T1) =
24.50 + F/100 – M

Example:
If "M" is "24.00 mm" and "F" is "+5", then
T1 = 24.50 + (+5)/100 – 24.00 mm
= 0.50 + 0.05 mm = 0.55 mm
If "M" is "24.00 mm" and "F" is "–5", then
T1 = 24.50 + (–5)/100 – 24.00 mm
= 0.50 – 0.05 mm = 0.45 mm

3. 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 "0.55 mm", then the forward gear shim is 0.52 mm.

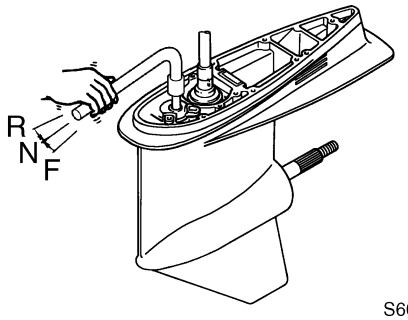
If "T1" is "0.50 mm", then the forward gear shim is 0.48 mm.

Backlash (FT50, FT60)

Measuring the forward gear backlash

1. Remove the water pump assembly.

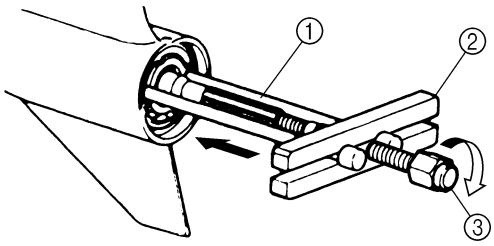
2. Set the gear shift to the neutral position at the lower unit.



S60V6330

Shift rod push arm: 90890-06052

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



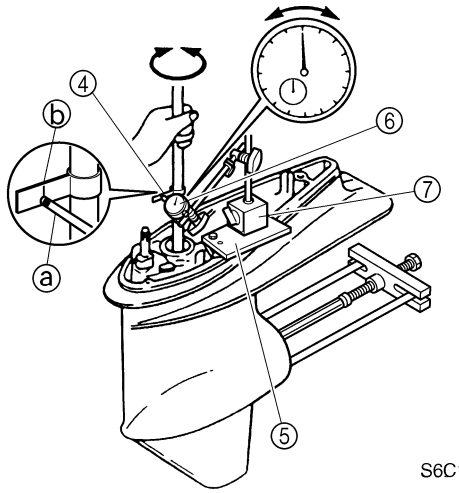
S60X6370

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

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

6

4. Install the backlash indicator onto the drive shaft (18 mm [0.71 in] in diameter), then the dial gauge onto the lower unit.



NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator.

Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

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

Forward gear backlash:
0.09–0.62 mm (0.0035–0.0244 in)

6. Add or remove shims if out of specification.

Forward gear backlash	Shim thickness
Less than 0.09 mm (0.0035 in)	To be decreased by (0.36 – M) × 0.53
More than 0.62 mm (0.0244 in)	To be increased by (M – 0.36) × 0.53

M: Measurement

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

7. Remove the special service tools from the propeller shaft, and then install the water pump assembly.

— MEMO —

Bracket unit

Special service tools 7-1

Tiller handle 7-2
Checking the throttle cable and shift cable 7-8
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Adjusting the friction plate 7-8

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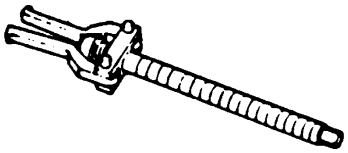
Gear pump 7-35
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Checking the gear pump 7-38
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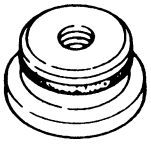
Power trim and tilt electrical system 7-48
Checking the fuse 7-48
Checking the power trim and tilt relay 7-48
Checking the power trim and tilt switch 7-49
Checking the trim sensor 7-50

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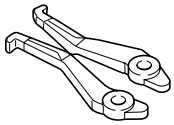
Special service tools



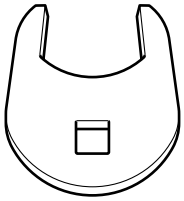
Bearing puller assembly
90890-06535



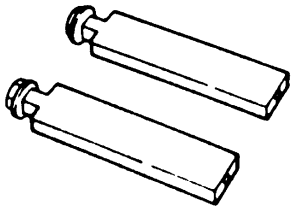
Ball bearing attachment
90890-06637



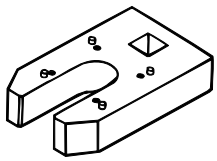
Bearing puller claw 1
90890-06536



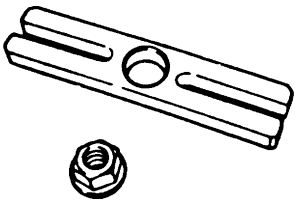
Cylinder-end screw wrench
90890-06588



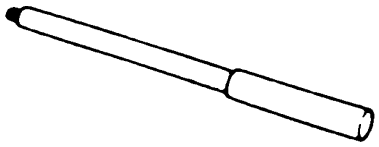
Stopper guide stand
90890-06538



Cylinder-end screw wrench
New: 90890-06568
Current: 90890-06544

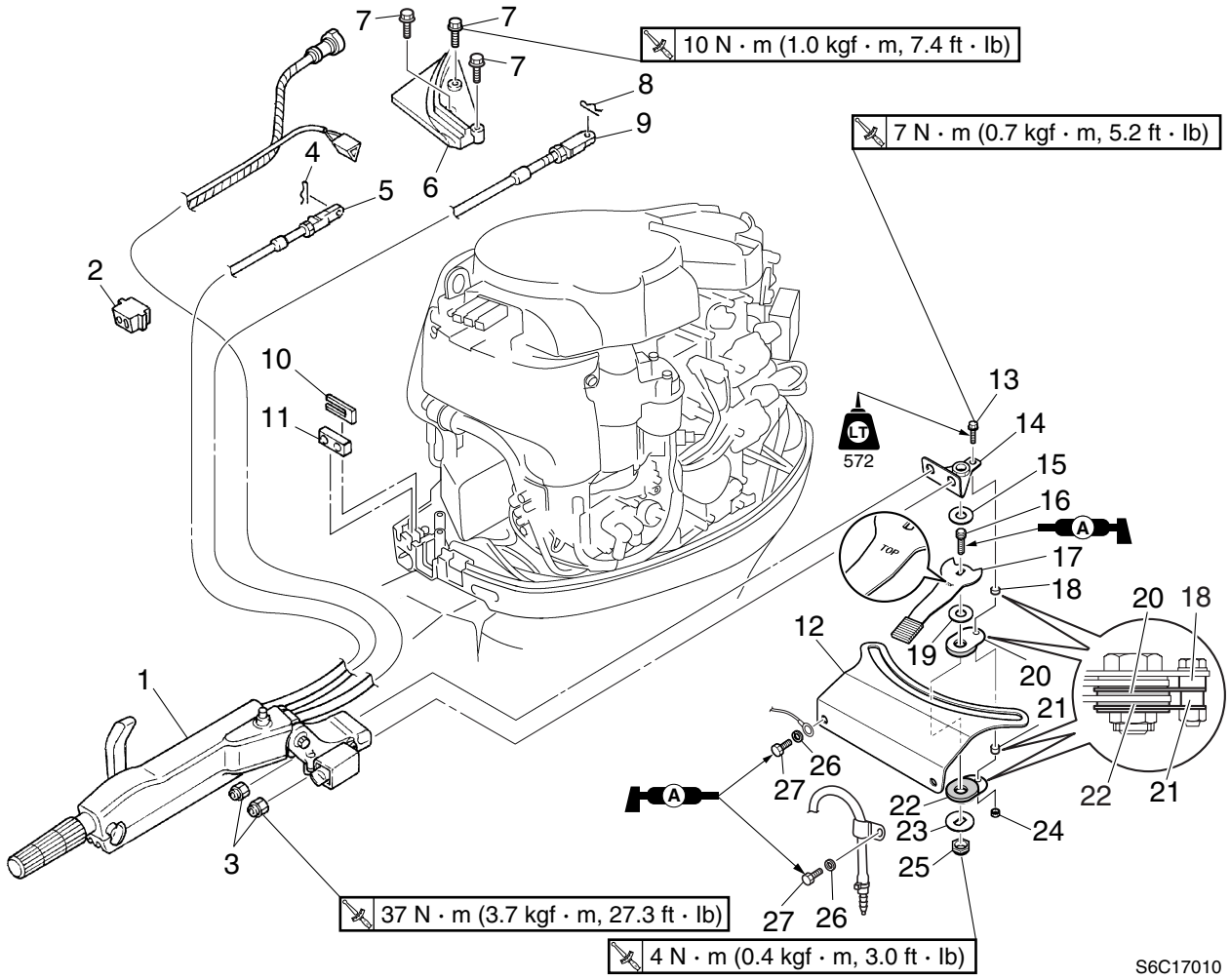


Stopper guide plate
90890-06501

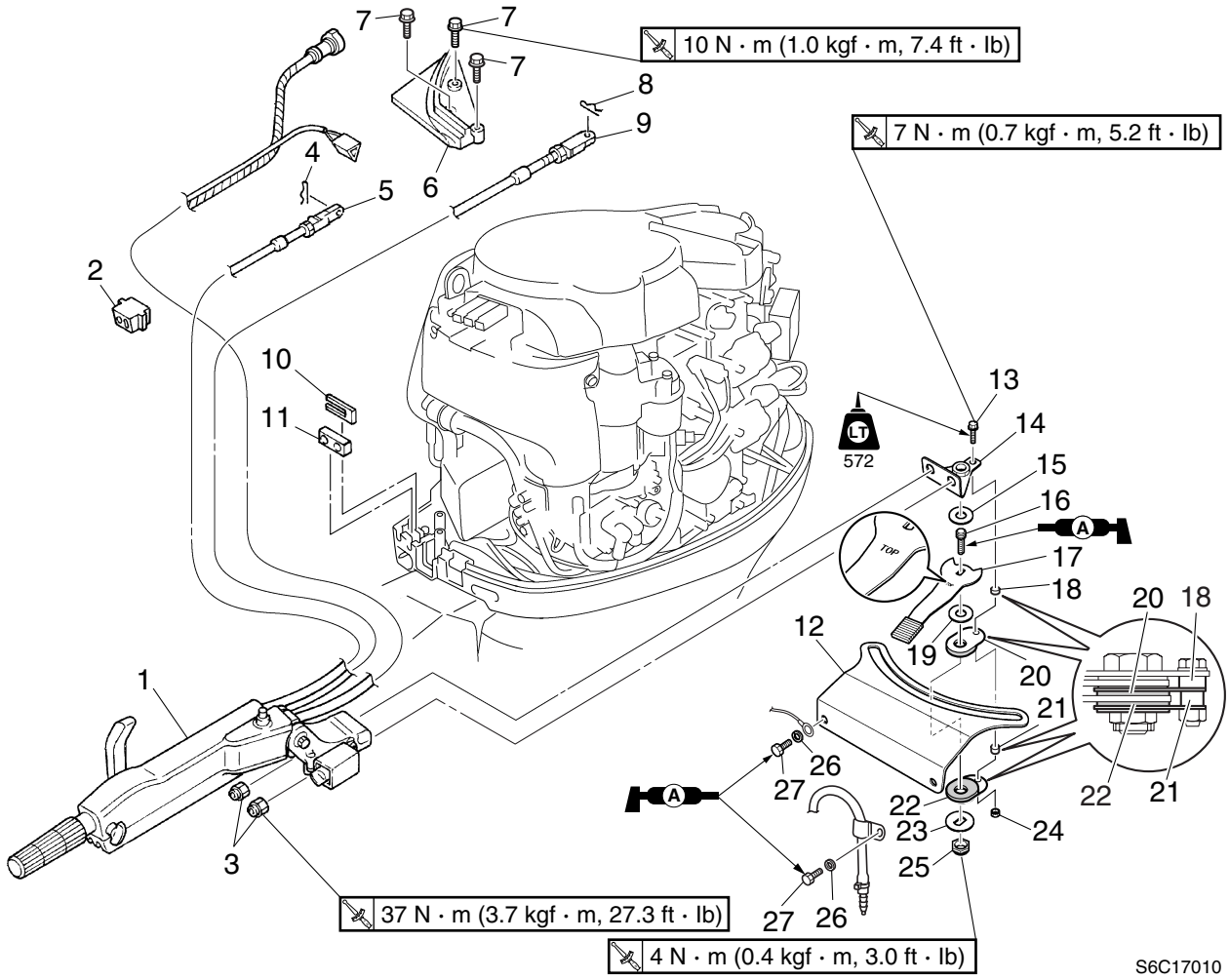


Driver rod LS
90890-06605

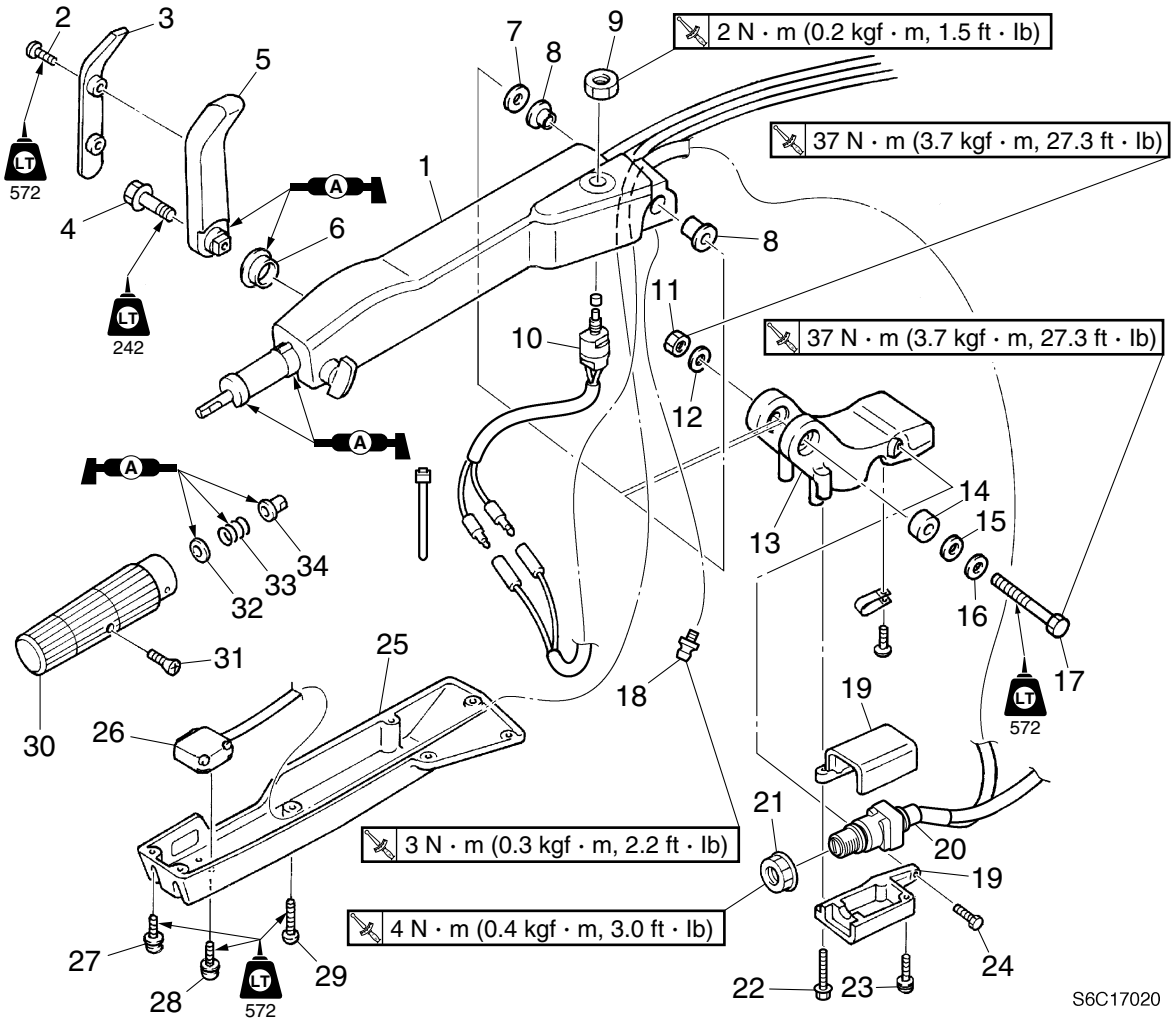
Tiller handle



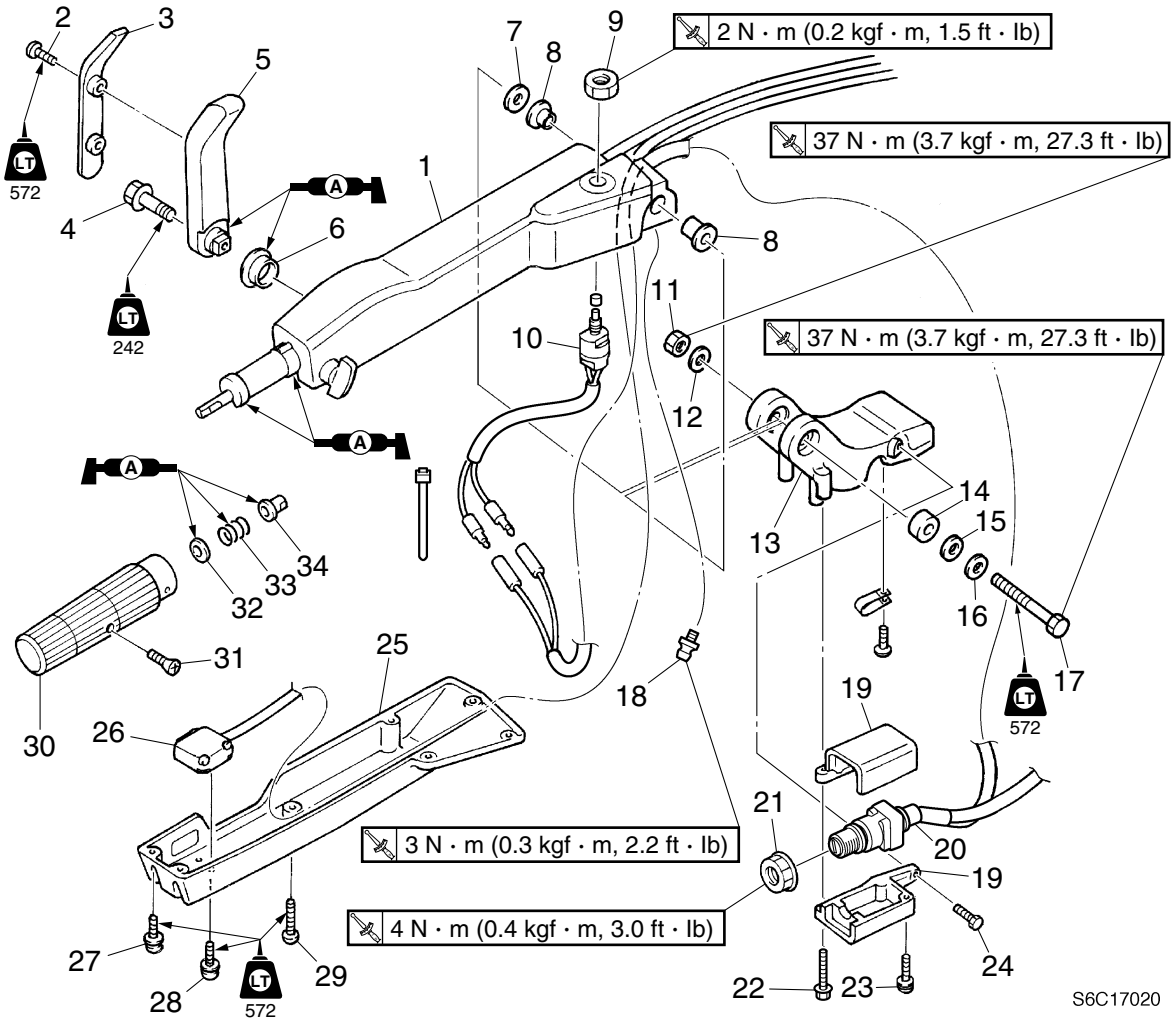
No.	Part name	Q'ty	Remarks
1	Tiller handle assembly	1	
2	Grommet	1	
3	Nut	2	
4	Clip	1	
5	Throttle cable	1	
6	Retaining plate	1	
7	Bolt	3	M6 × 15 mm
8	Clip	1	
9	Shift cable	1	
10	Cable guide	1	
11	Grommet	1	
12	Friction plate	1	
13	Bolt	1	M5 × 20 mm
14	Bracket	1	
15	Washer	1	
16	Steering lock shaft	1	
17	Steering lock lever	1	



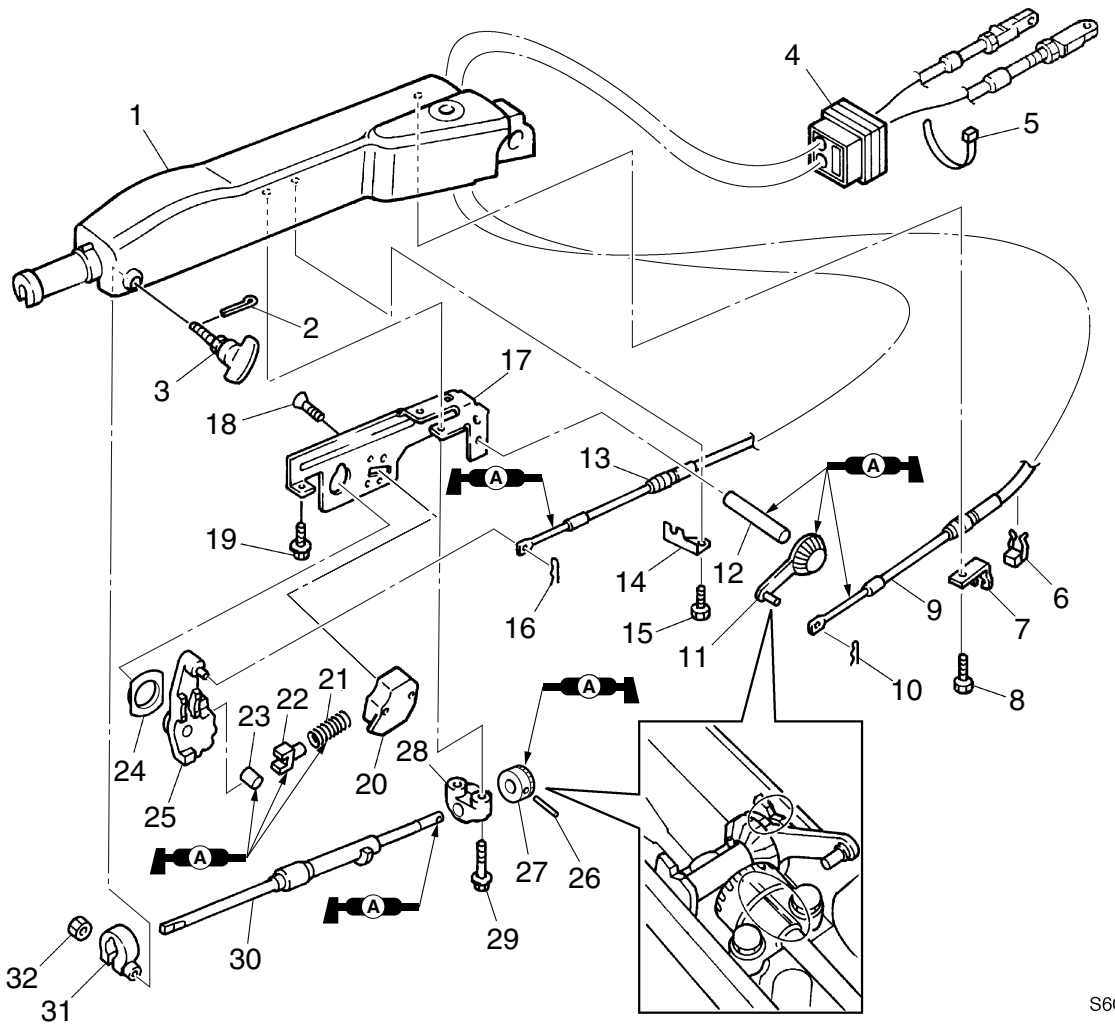
No.	Part name	Q'ty	Remarks
18	Collar	1	Short
19	Washer	1	
20	Friction piece	1	
21	Collar	1	Long
22	Friction piece	1	
23	Steering lock washer	1	
24	Nut	1	
25	Self-locking nut	1	
26	Washer	2	
27	Bolt	2	



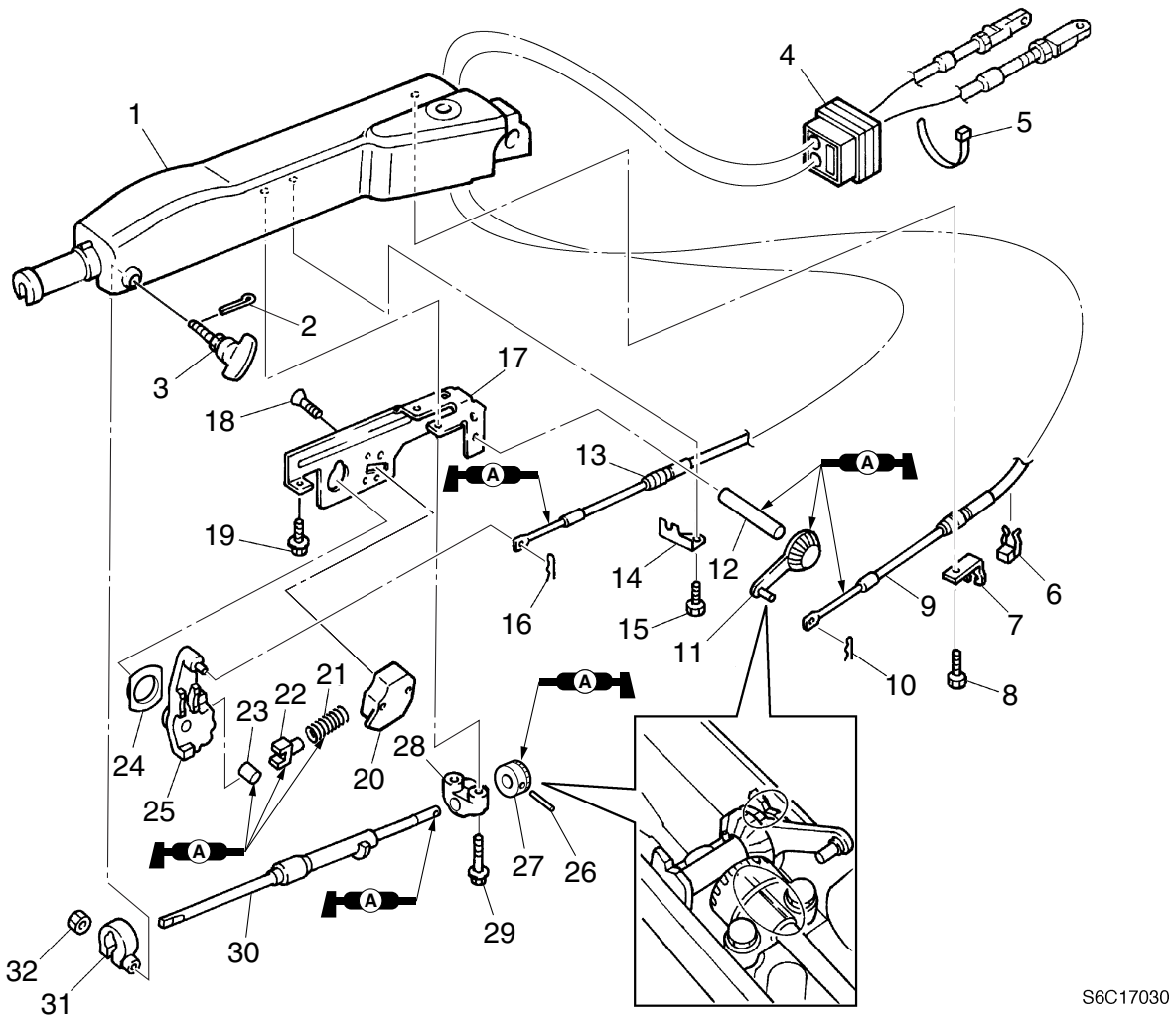
No.	Part name	Q'ty	Remarks
1	Tiller handle sub assembly	1	
2	Screw	2	ø6 × 10 mm
3	Shift lever cover	1	
4	Bolt	1	M8 × 40 mm
5	Shift lever	1	
6	Bushing	1	
7	Washer	1	
8	Bushing	2	
9	Nut	1	
10	Engine stop lanyard switch	1	
11	Nut	1	
12	Washer	1	
13	Bracket	1	
14	Collar	1	
15	Wave washer	1	
16	Washer	1	
17	Bolt	1	M12 × 80 mm



No.	Part name	Q'ty	Remarks
18	Grease nipple	1	
19	Engine start switch housing	1	
20	Engine start switch	1	
21	Nut	1	
22	Bolt	1	M6 × 25 mm
23	Screw	1	ø6 × 24 mm
24	Bolt	1	M6 × 20 mm
25	Cover	1	
26	Power trim and tilt switch	1	
27	Screw	5	ø6 × 15 mm
28	Screw	2	ø6 × 15 mm
29	Screw	2	ø6 × 40 mm
30	Throttle grip	1	
31	Screw	1	ø6 × 21 mm
32	Washer	1	
33	Spring	1	
34	Bushing	1	



No.	Part name	Q'ty	Remarks
1	Tiller handle	1	
2	Cotter pin	1	**Not reusable**
3	Friction adjusting knob	1	
4	Grommet	1	
5	Plastic tie	1	**Not reusable**
6	Cable clamp	1	
7	Stay	1	
8	Bolt	1	M6 × 14 mm
9	Throttle cable	1	Short
10	Clip	1	
11	Throttle arm	1	
12	Throttle arm shaft	1	
13	Shift cable	1	Long
14	Shift cable bracket	1	
15	Bolt	1	M6 × 14 mm
16	Clip	1	
17	Frame	1	



No.	Part name	Q'ty	Remarks
18	Screw	2	ø5 × 10 mm
19	Bolt	1	M6 × 14 mm
20	Spring housing	1	
21	Spring	1	
22	Actuator	1	
23	Roller	1	
24	Bushing	1	
25	Shift arm	1	
26	Pin	1	
27	Gear	1	
28	Holder	1	
29	Bolt	2	M6 × 30 mm
30	Throttle shaft	1	
31	Friction piece	1	
32	Nut	1	

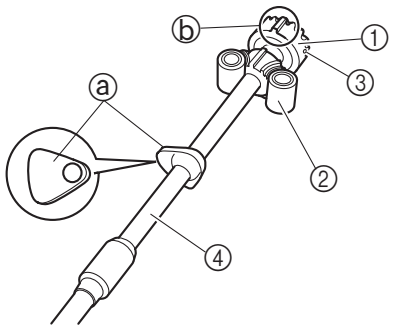
Checking the throttle cable and shift cable

1. Check the operation of the throttle cable and shift cable.

2. Check the inner wire and outer wire of both cables for bends or damage, and the rubber seals for damage. Replace if necessary.

Assembling the tiller handle

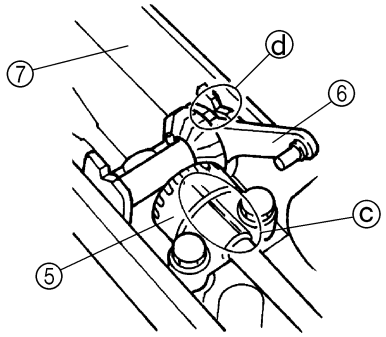
1. Install the gear ①, holder ②, pin ③, and throttle shaft ④.



S6C17050

NOTE:
Make sure that the cam ⓐ on the throttle shaft is facing toward the left when the mark ⓑ on the gear is facing upward.

2. Install the throttle shaft ⑤ and throttle arm ⑥ into the frame ⑦. Align the mark ⓒ of the fully closed position of the throttle shaft to the shaft holder. Align the mark ⓓ of the fully closed position of the throttle arm to the indent of the frame.

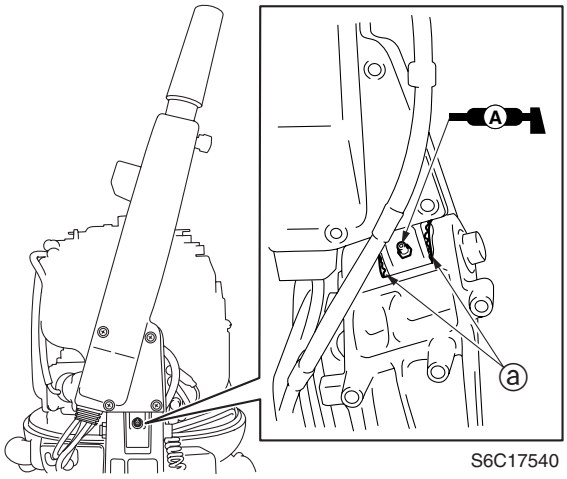


S6C17860

NOTE:
Make sure that the throttle grip is fully closed when installing the throttle cable.

Lubricating the tiller handle bracket

1. Inject grease into the grease nipple until grease comes out from the bushing ⓐ.



S6C17540

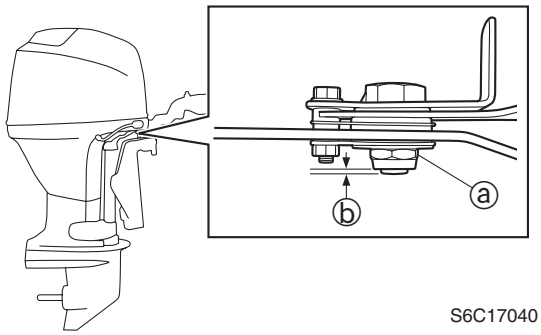
Adjusting the friction plate

1. Install the friction plate and tiller handle.

2. Slide the steering lock lever to its locked position.

3. Tighten the self-locking nut ⓐ until the outboard motor cannot rotate.

4. Slide the steering lock lever to its released position and check that the outboard motor rotates smoothly. If the outboard motor does not rotate smoothly, repeat steps 2–4.

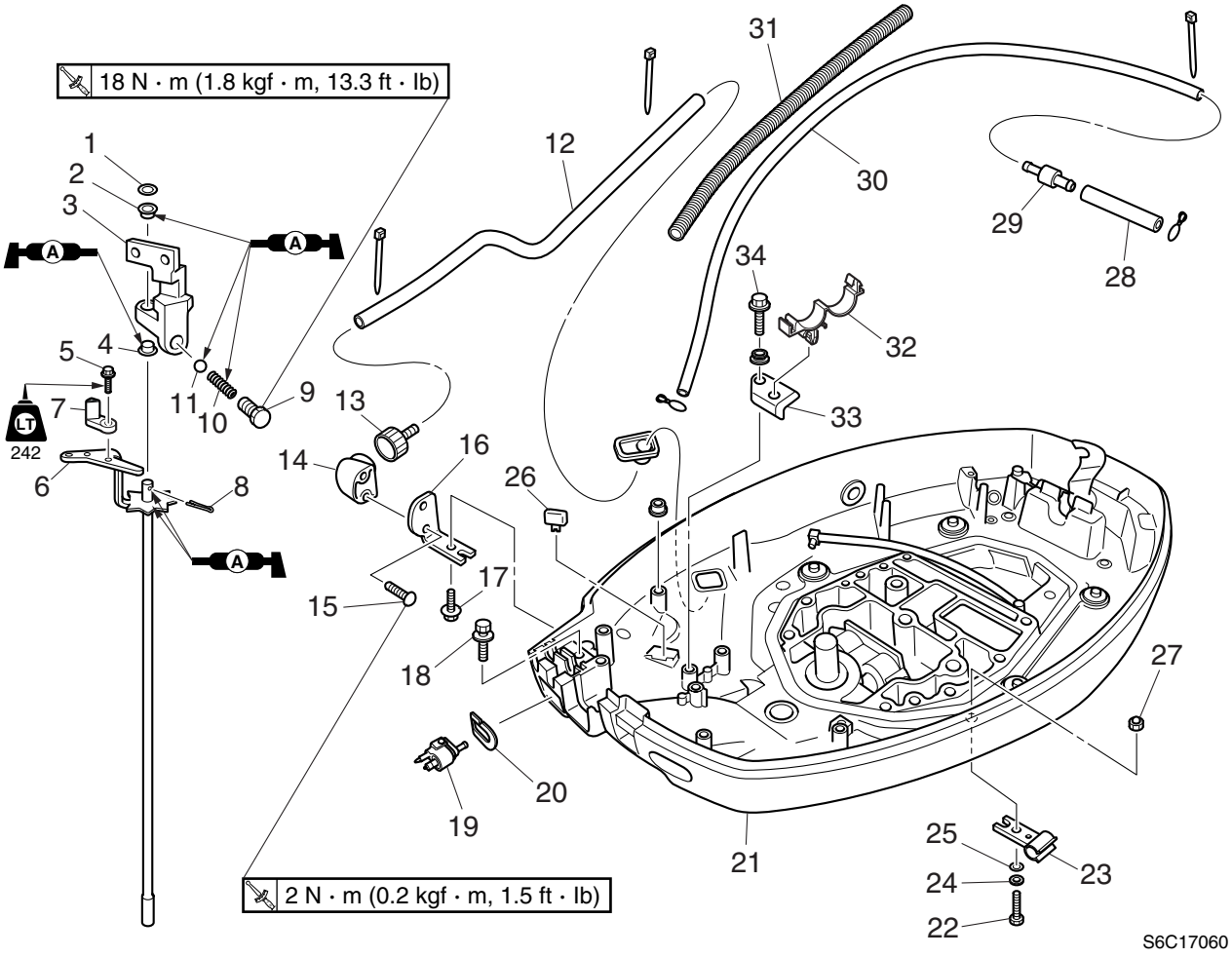


S6C17040

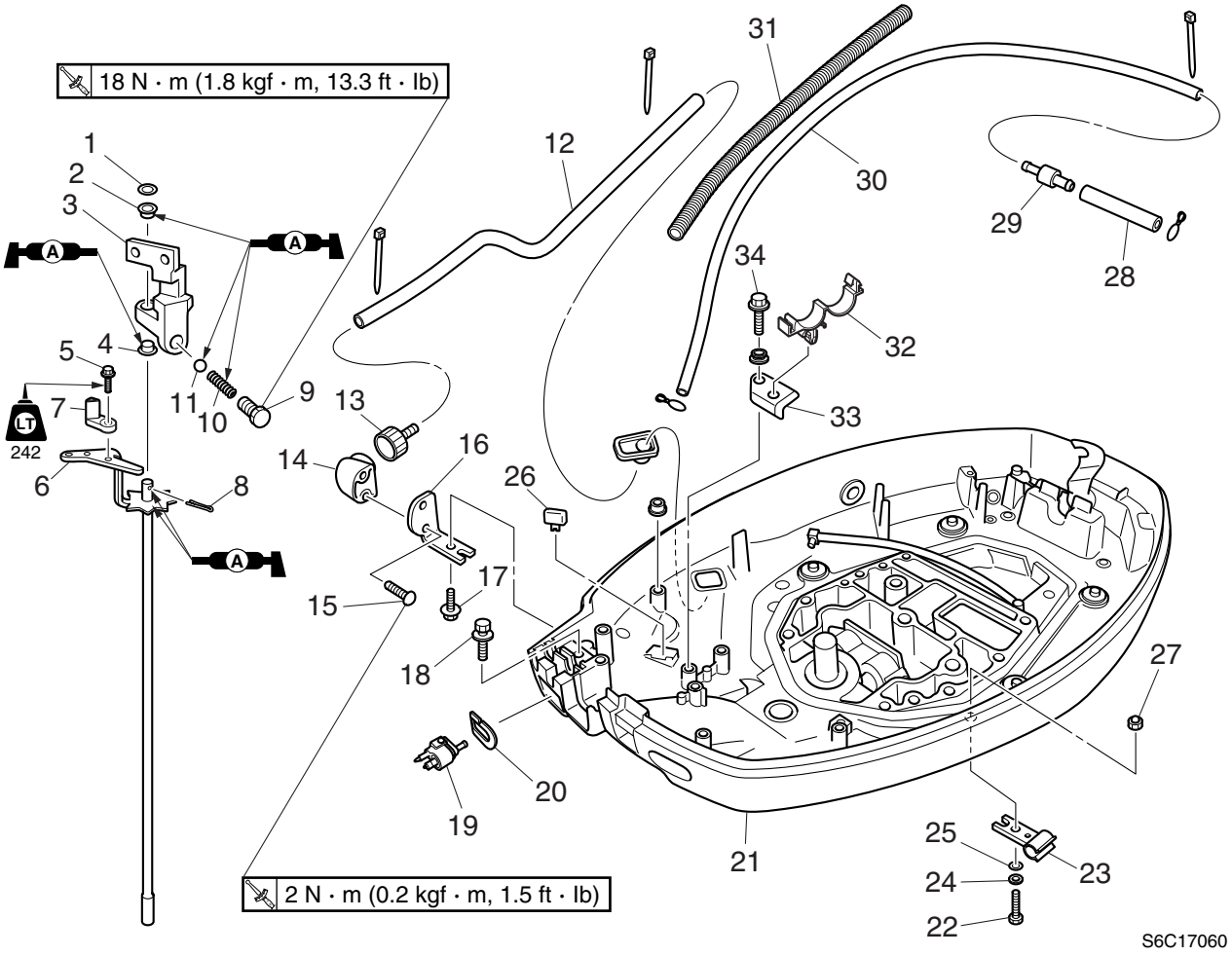
NOTE:
To prevent the self-locking nut from falling off, tighten the nut until at least one ridge ⓑ of the bolt thread is visible past the end of the nut.

7

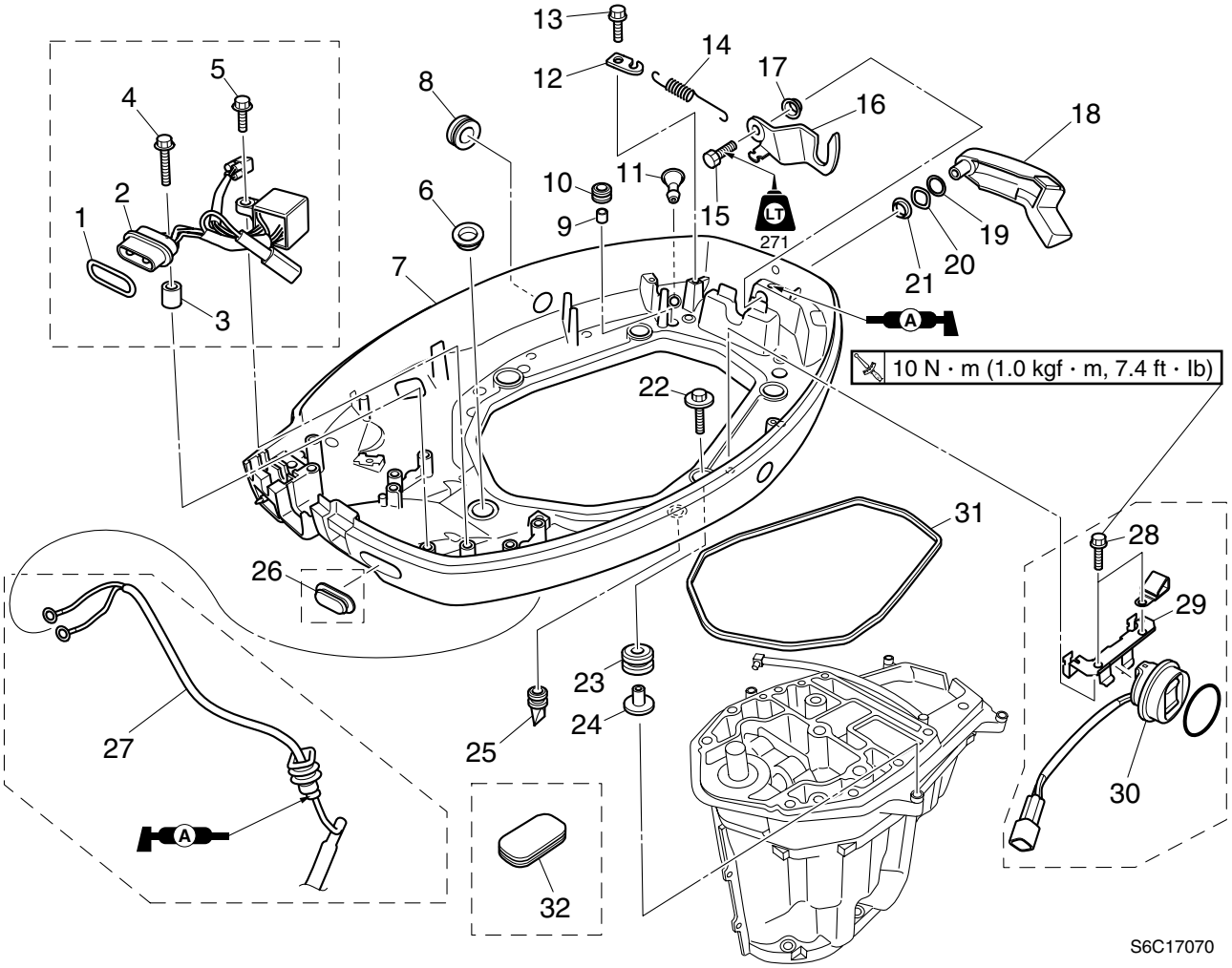
Bottom cowling



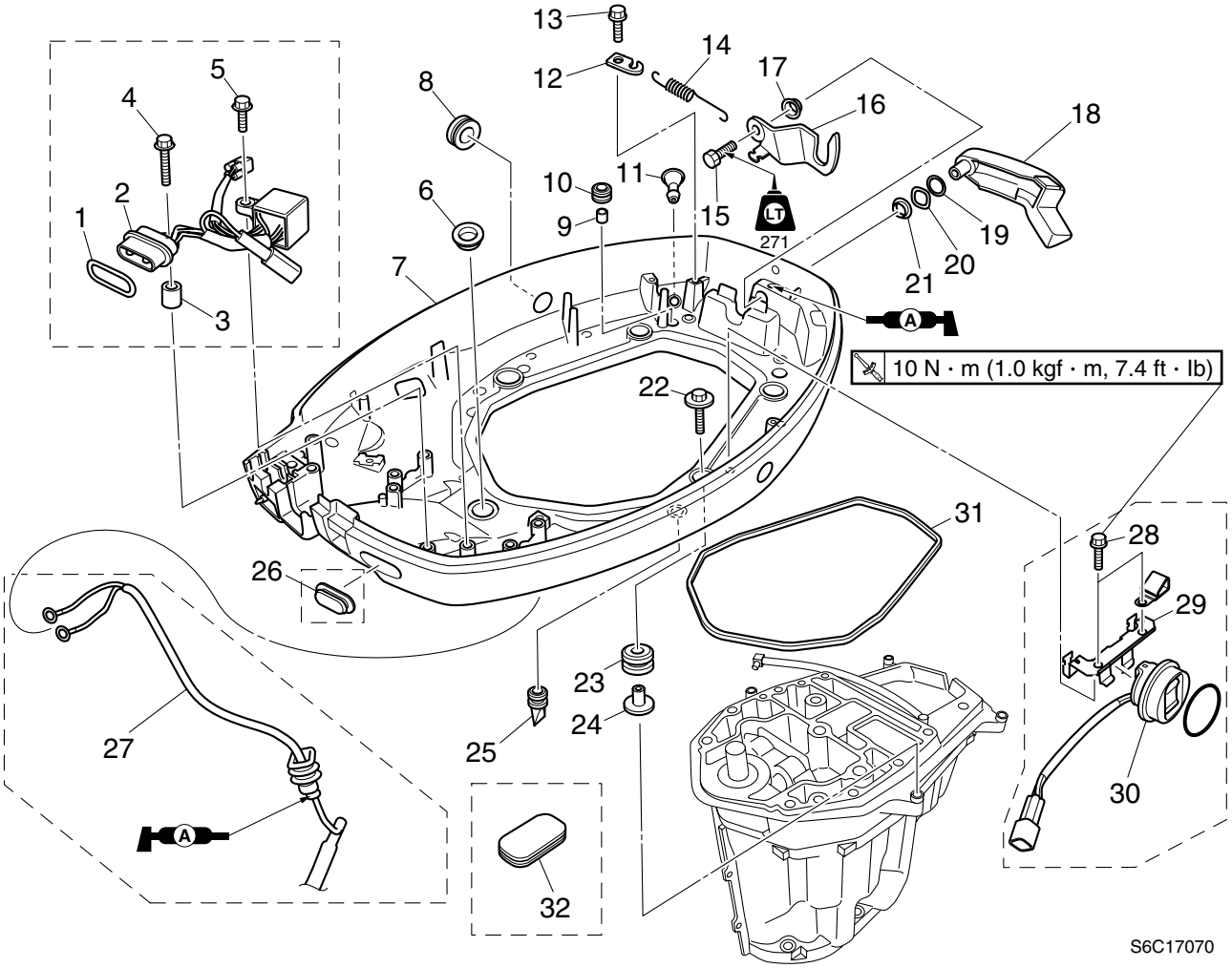
No.	Part name	Q'ty	Remarks
1	Washer	1	
2	Bushing	1	
3	Bracket	1	
4	Bushing	1	
5	Bolt	1	M5 × 14 mm
6	Shift rod	1	
7	Bushing	1	
8	Cotter pin	1	**Not reusable**
9	Bolt	1	
10	Spring	1	
11	Ball	1	
12	Flushing hose	1	
13	Hose joint	1	
14	Adapter	1	
15	Screw	2	ø6 × 19 mm
16	Stay	1	
17	Bolt	1	M6 × 15 mm



No.	Part name	Q'ty	Remarks
18	Bolt	1	M6 × 25 mm
19	Fuel joint	1	
20	Seal	1	
21	Bottom cowling assembly	1	
22	Bolt	1	M6 × 20 mm
23	Holder	1	
24	Washer	1	
25	Washer	1	
26	Holder	1	
27	Nut	1	
28	Fuel hose	1	
29	Joint	1	
30	Fuel hose	1	
31	Corrugated tube	1	
32	Holder	1	
33	Bracket	1	
34	Bolt	1	M6 × 15 mm

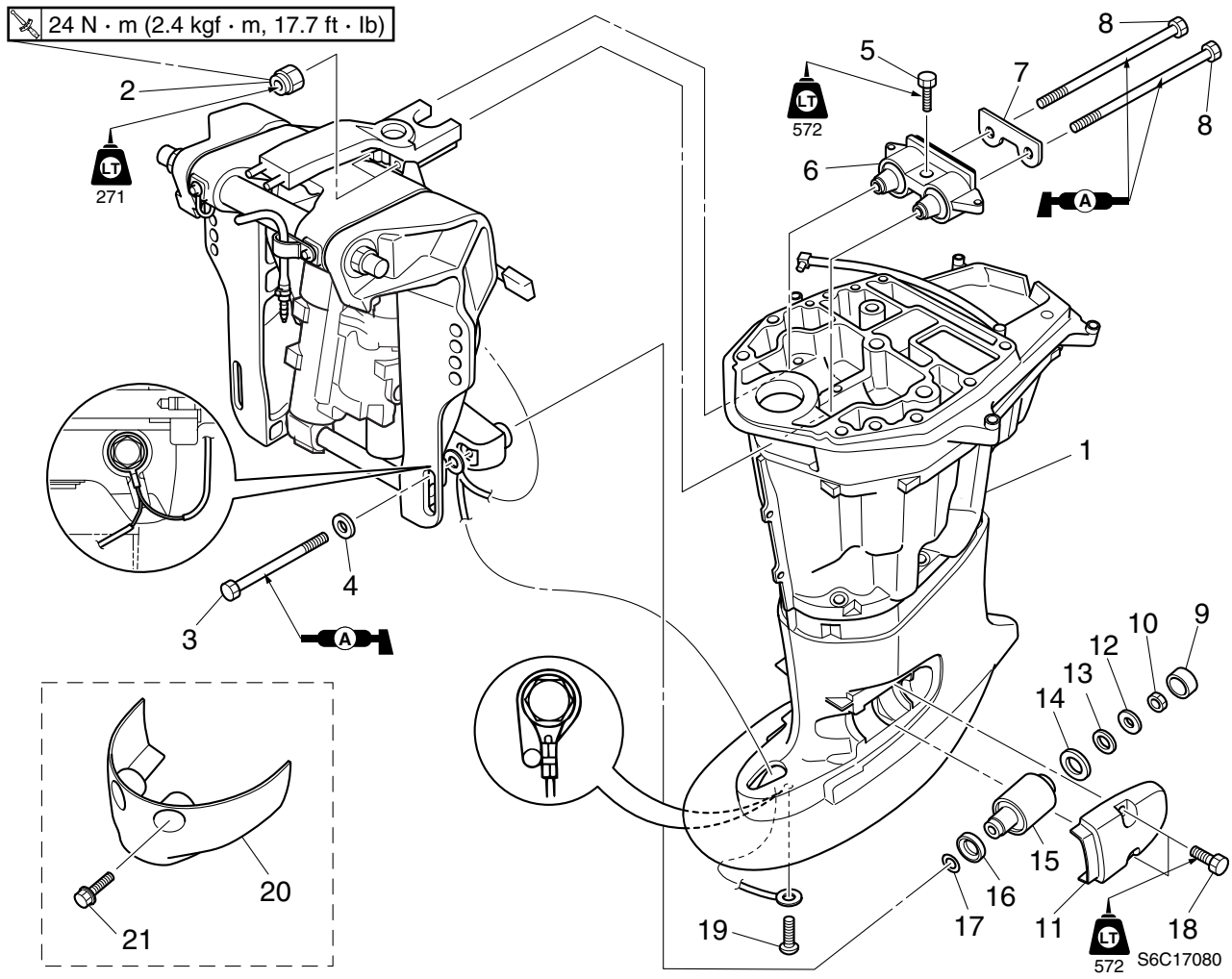


No.	Part name	Q'ty	Remarks
1	Seal	1	Tiller handle model
2	Warning indicator	1	Tiller handle model
3	Collar	1	Tiller handle model
4	Bolt	1	M6 × 35 mm, Tiller handle model
5	Bolt	1	M6 × 20 mm, Tiller handle model
6	Grommet	1	
7	Bottom cowling	1	
8	Grommet	1	
9	Collar	2	
10	Grommet	2	
11	Water outlet	1	
12	Hook	1	
13	Bolt	1	M6 × 20 mm
14	Spring	1	
15	Bolt	1	M6 × 14 mm
16	Lever	1	
17	Bushing	1	

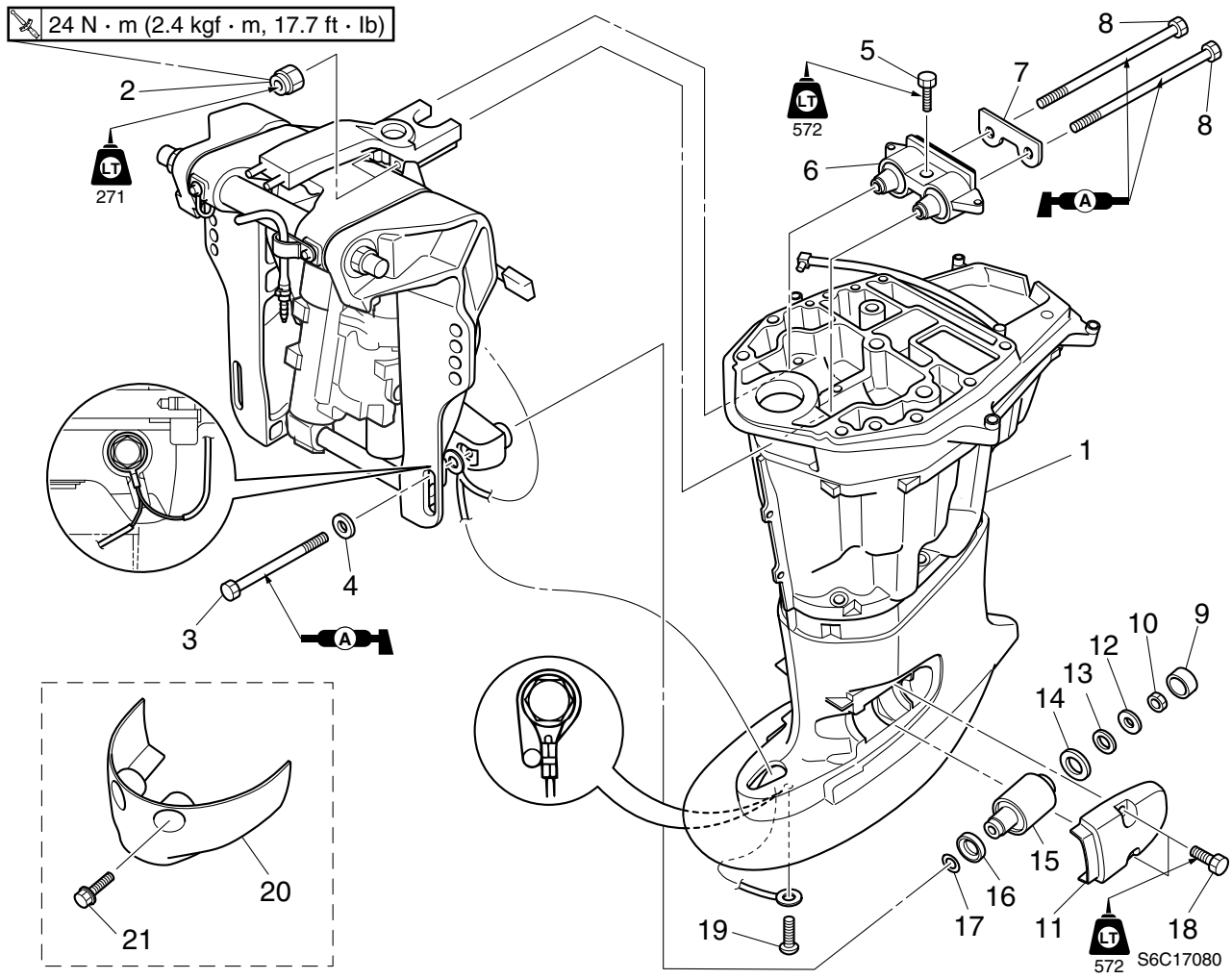


No.	Part name	Q'ty	Remarks
18	Cowling lock lever	1	
19	Washer	1	
20	Wave washer	1	
21	Bushing	1	
22	Bolt	4	M6 × 30 mm
23	Grommet	4	
24	Collar	4	
25	Grommet	4	
26	Grommet	1	Remote control model
27	PTT motor lead	1	Power trim and tilt model
28	Bolt	2	M6 × 20 mm
29	Stay	1	
30	Power trim and tilt switch	1	Power trim and tilt model
31	Rubber seal	1	
32	Grommet	1	Hydro tilt model

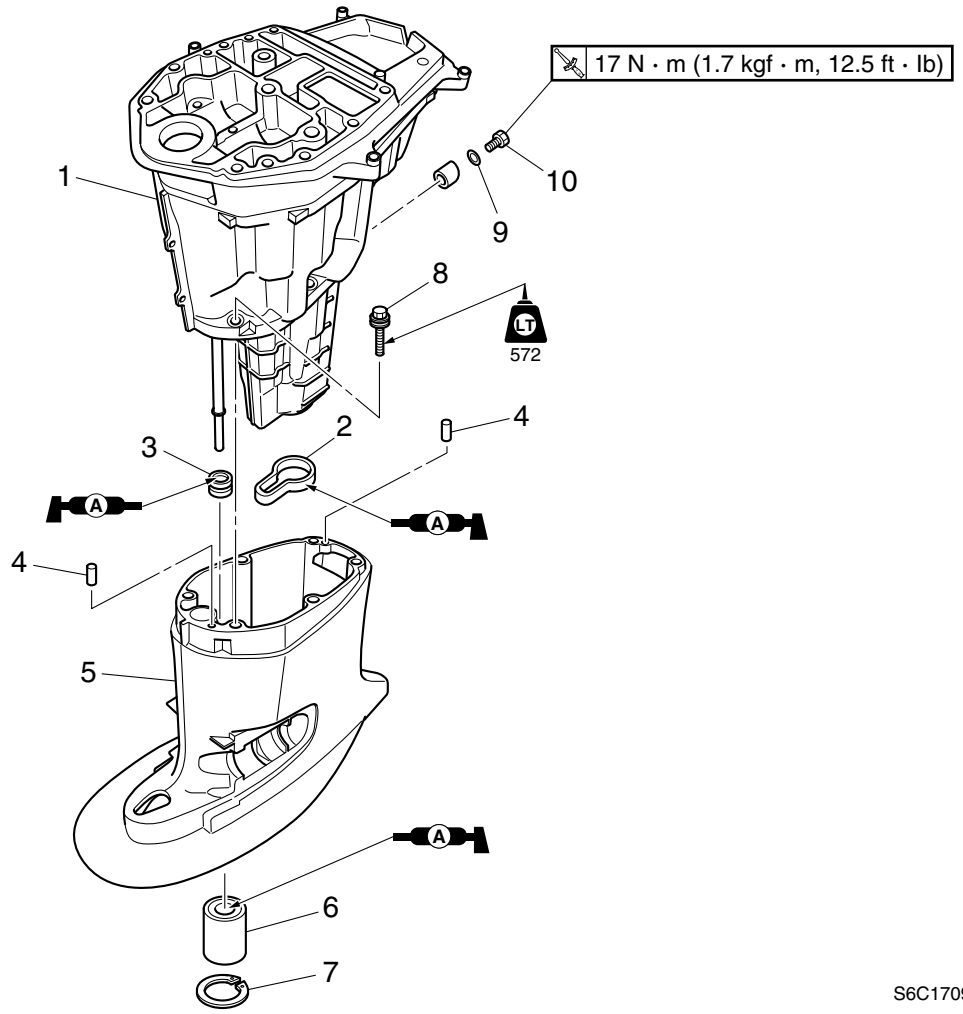
Upper case



No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Nut	2	
3	Bolt	2	M12 × 170 mm
4	Washer	2	
5	Bolt	3	M8 × 30 mm
6	Upper mount	1	
7	Plate	1	
8	Bolt	2	M8 × 175 mm
9	Cap	2	
10	Nut	2	
11	Mount cover	2	
12	Washer	2	
13	Rubber washer	2	
14	Washer	2	
15	Lower mount	2	
16	Grommet	2	
17	Washer	2	

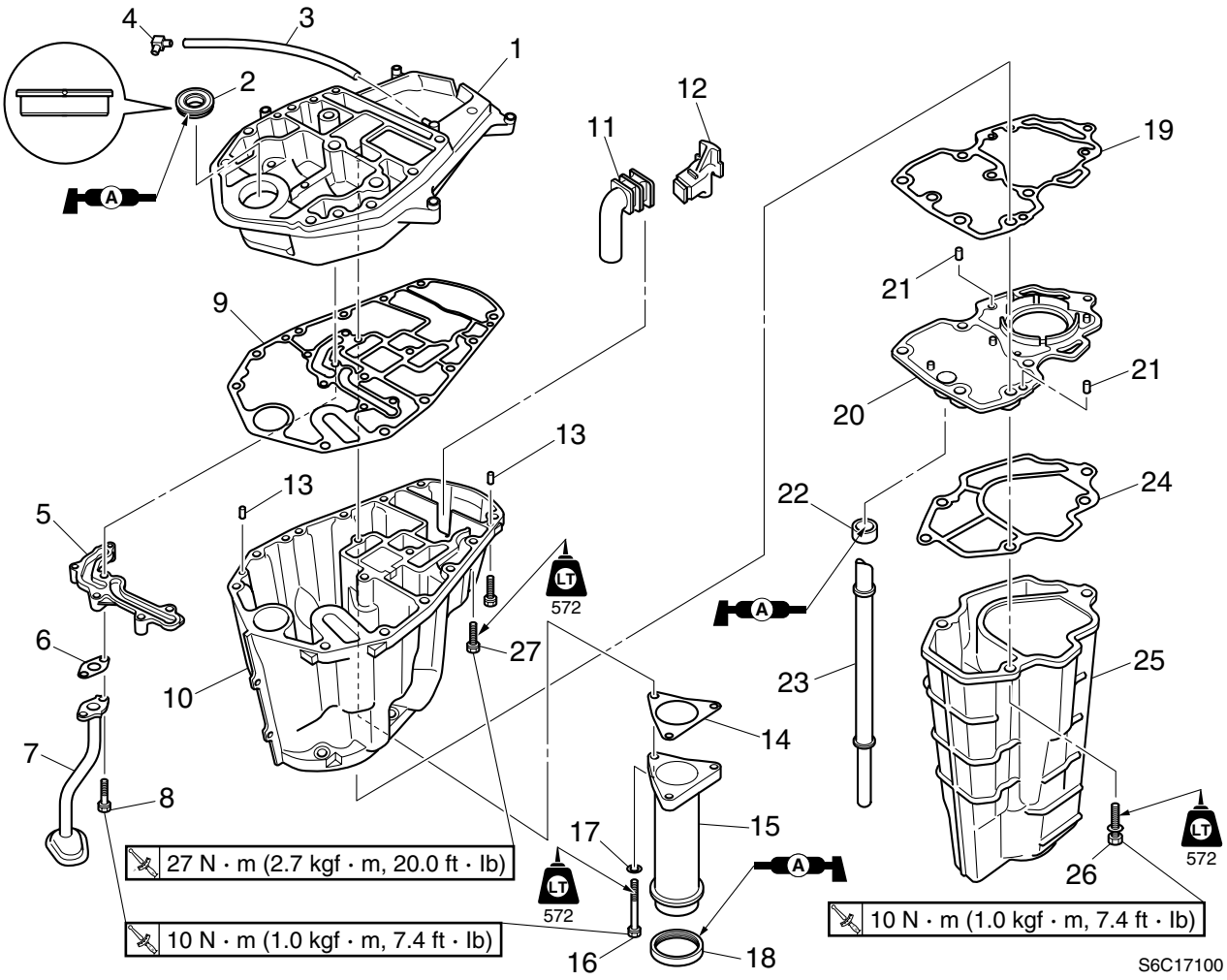


No.	Part name	Q'ty	Remarks
18	Bolt	4	M8 × 30 mm
19	Screw	1	ø6 × 7 mm
20	Cover	1	High thrust model
21	Bolt	2	M8 × 20 mm, High thrust model

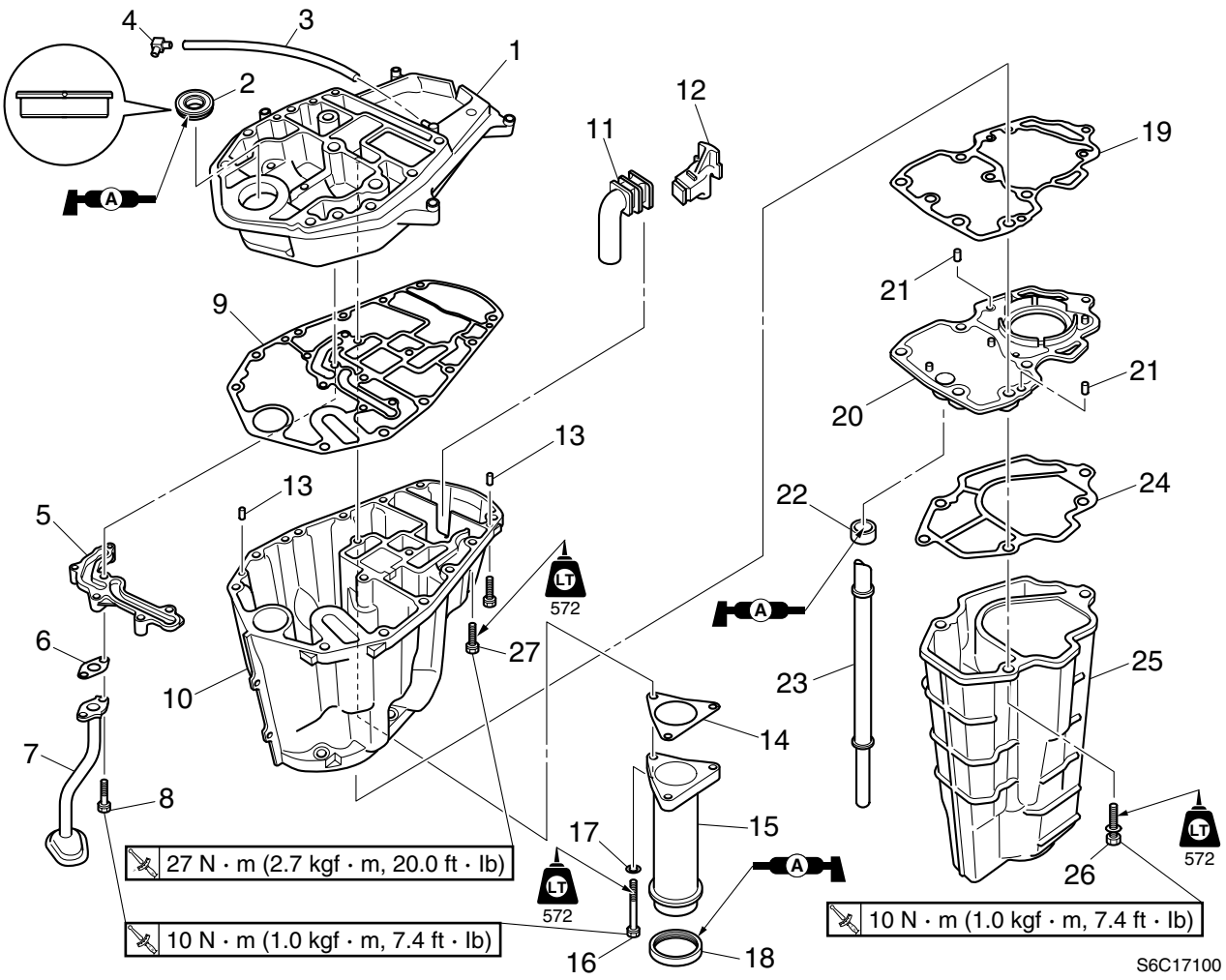


S6C17090

No.	Part name	Q'ty	Remarks
1	Muffler assembly	1	
2	Rubber seal	1	
3	Grommet	1	
4	Dowel	2	
5	Upper case	1	
6	Drive shaft bushing	1	
7	Circlip	1	
8	Bolt	6	M10 × 45 mm
9	Gasket	1	**Not reusable**
10	Drain bolt	1	M14 × 12 mm



No.	Part name	Q'ty	Remarks
1	Exhaust guide	1	
2	Oil seal	1	**Not reusable**
3	Hose	1	
4	Joint	1	
5	Housing	1	
6	Gasket	1	**Not reusable**
7	Oil strainer	1	
8	Bolt	6	M6 × 30 mm
9	Gasket	1	**Not reusable**
10	Oil pan	1	
11	Pipe 1	1	
12	Pipe 2	1	
13	Dowel	2	
14	Gasket	1	**Not reusable**
15	Exhaust manifold	1	
16	Bolt	3	M6 × 60 mm
17	Washer	3	



No.	Part name	Q'ty	Remarks
18	Rubber seal	1	
19	Gasket	1	**Not reusable**
20	Plate	1	
21	Dowel	2	
22	Grommet	1	
23	Pipe	1	
24	Gasket	1	**Not reusable**
25	Muffler	1	
26	Bolt	6	M6 × 24 mm
27	Bolt	4	M8 × 30 mm

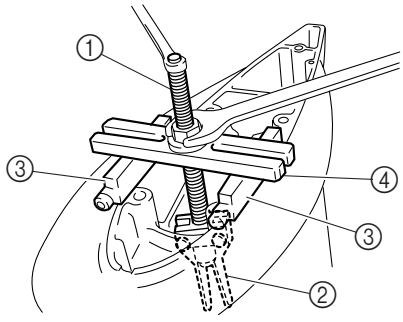
Removing the upper case

1. Place a drain pan under the drain hole, and then remove the drain bolt and let the oil drain completely.
2. Remove the bolts, and then remove the covers.
3. Remove the upper mounting nuts and lower mounting bolts, and then remove the upper case.

NOTE:
To remove or install the upper case without removing the power unit, suspend the outboard motor so that there is no load on the upper mount bolts.

Disassembling the upper case

1. Remove the muffler assembly from the upper case.
2. Remove the circlip.
3. Remove the drive shaft bushing.



S6C17220

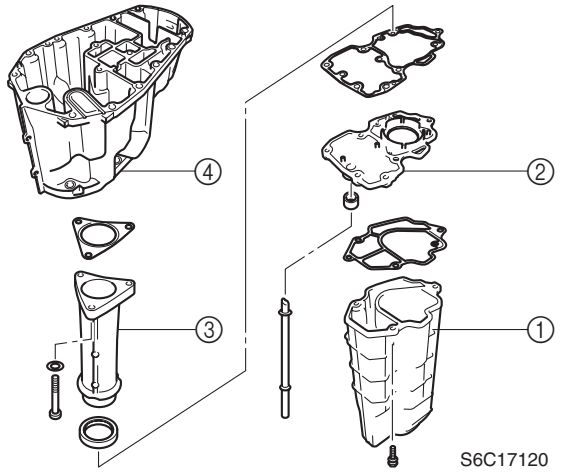
Bearing puller assembly ①: 90890-06535
Bearing puller claw 1 ②: 90890-06536
Stopper guide stand ③: 90890-06538
Stopper guide plate ④: 90890-06501

Checking the drive shaft bushing

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

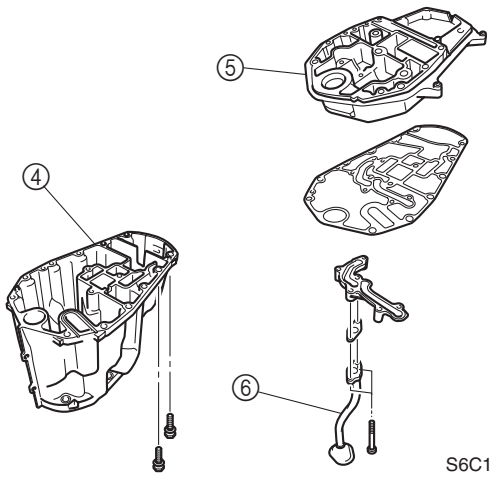
Disassembling the oil pan

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



S6C17120

2. Remove the oil pan ④ from the exhaust guide ⑤.
3. Remove the oil strainer ⑥ from the exhaust guide ⑤.



S6C17130

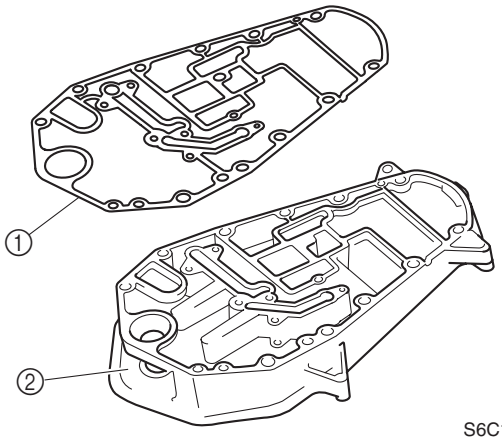
Checking the oil strainer

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

7

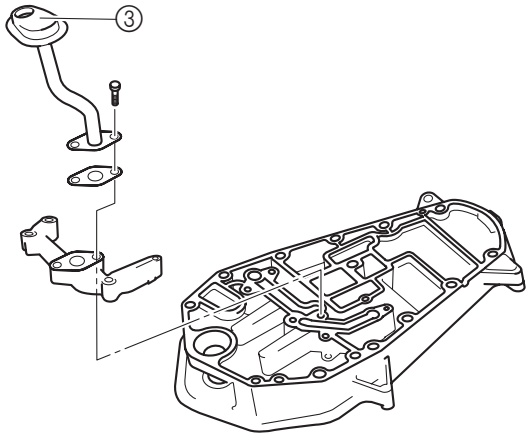
Assembling the oil pan

1. Install a new gasket ① onto the exhaust guide ②.

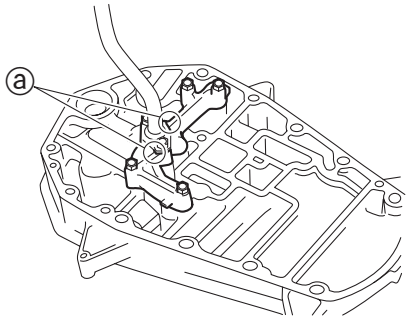


S6C17140

2. Install the oil strainer ③, a new gasket, and the housing onto the exhaust guide, and then tighten the bolts to the specified torque.



S6C17150



S6C17160

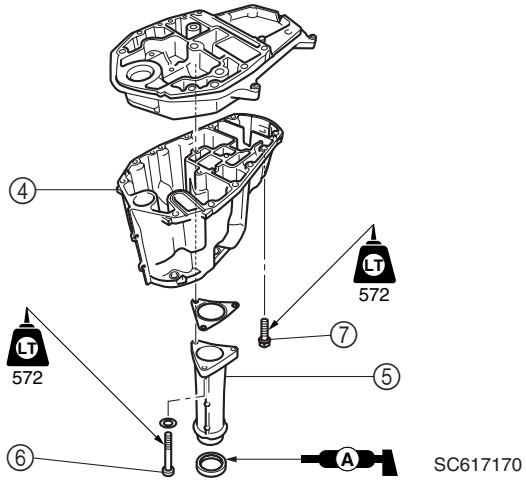
NOTE:
Align the projection ⓐ of the oil strainer with the rib of the housing.

	Oil strainer bolt: 10 N·m (1.0 kgf·m, 7.4 ft·lb)

3. Install the oil pan ④, and then tighten the bolts finger tight.

4. Install a new gasket, the exhaust manifold ⑤, and the bolts, and then tighten the bolts finger tight.

5. Tighten the exhaust manifold bolts ⑥, then the oil pan bolts ⑦, and then tighten them to the specified torques.

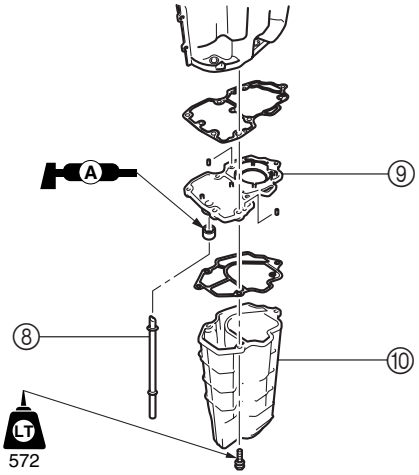


SC617170

	Exhaust manifold bolt ⑥: 10 N·m (1.0 kgf·m, 7.4 ft·lb) Oil pan bolt ⑦: 27 N·m (2.7 kgf·m, 20.0 ft·lb)

6. Install the cooling water pipe ⑧ into the plate ⑨.

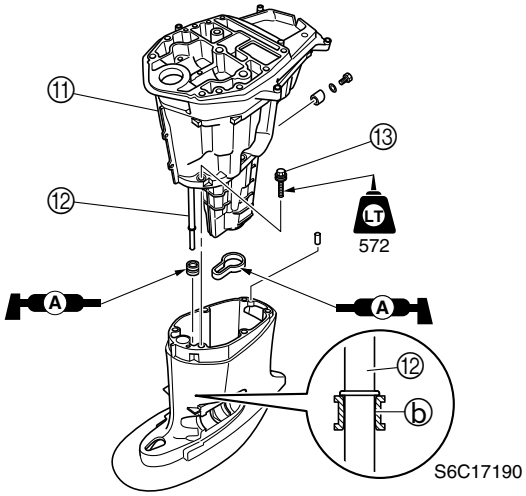
7. Install a new gasket, the plate ⑨, a new gasket, the muffler ⑩, and the bolts into the oil pan, and then tighten the bolts to the specified torque.



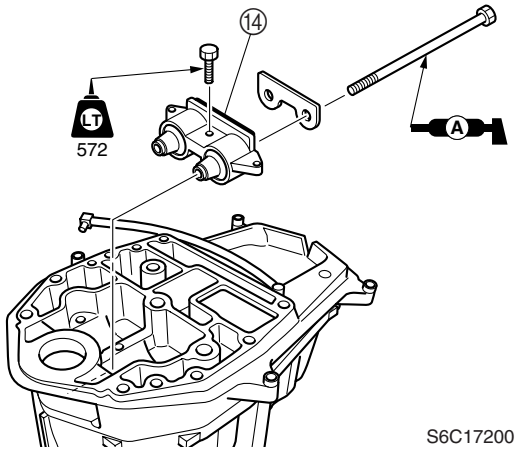
Muffler bolt:
10 N·m (1.0 kgf·m, 7.4 ft·lb)

8. Install the muffler assembly ⑪ by inserting the tip of the cooling water pipe ⑫ into the joint hole ⓑ of the upper case.

9. Install the muffler assembly bolts ⑬, and then tighten them.

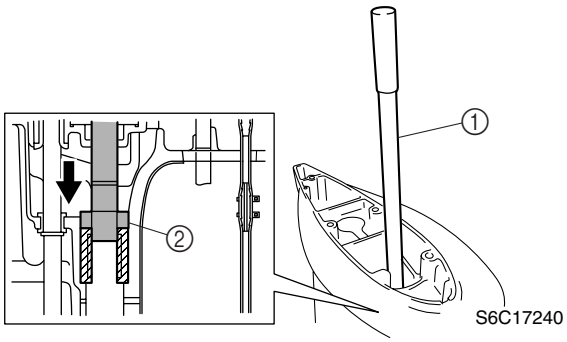


10. Install the upper mount ⑭ and bolts into the upper case, and then tighten the bolts.



Assembling the upper case

1. Install the drive shaft bushing into the upper case.



Driver rod LS ①: 90890-06605
Ball bearing attachment ②:
90890-06637

7

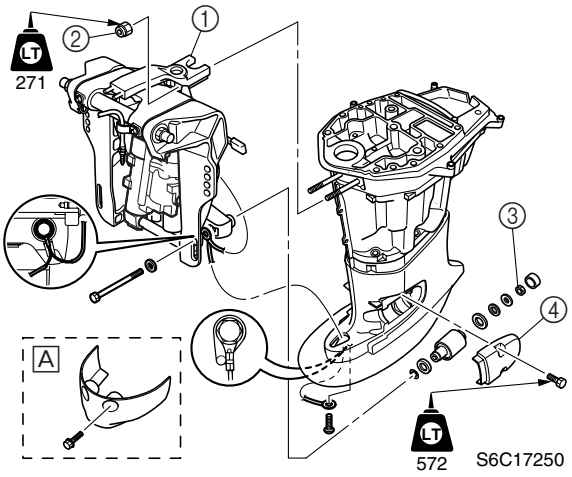
Installing the upper case

1. Install the upper and lower mounting bolts into the swivel bracket ① simultaneously.

2. Install the upper mounting nuts ②, and then tighten the nuts to the specified torque.

3. Install and tighten the lower mounting nuts ③.

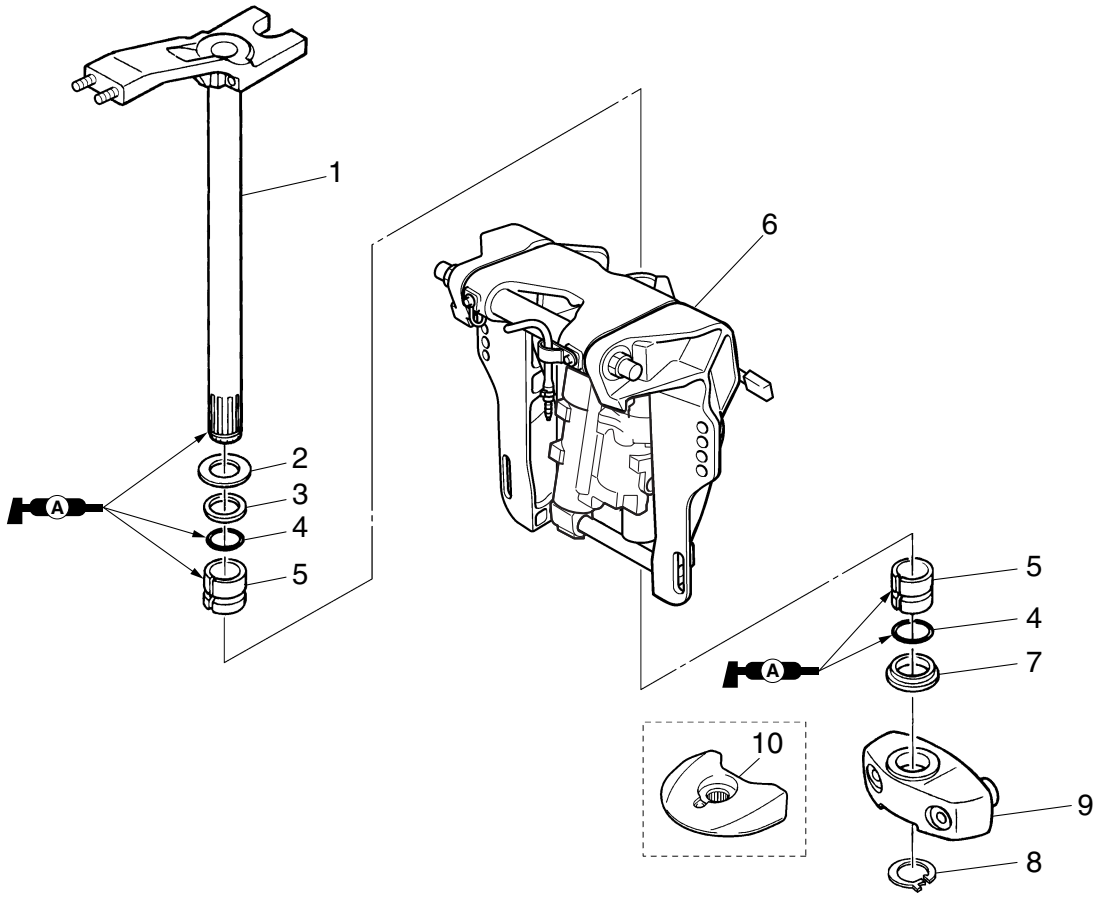
4. Install the covers ④, and then tighten the bolts.



A High thrust model

	Upper mounting nut ②: 24 N·m (2.4 kgf·m, 17.7 ft·lb)

Steering arm



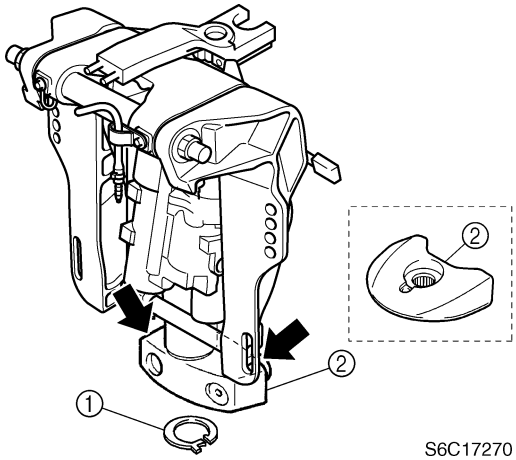
S6C17260

No.	Part name	Q'ty	Remarks
1	Steering arm	1	
2	Washer	1	
3	Bushing	1	
4	O-ring	2	**Not reusable**
5	Bushing	2	
6	Swivel bracket assembly	1	
7	Bushing	1	
8	Circlip	1	
9	Steering yoke	1	
10	Steering yoke	1	High thrust model

Removing the steering arm

1. Remove the circlip ①.

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



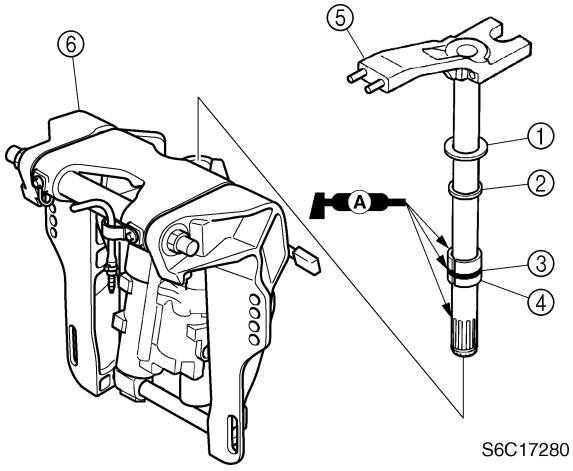
S6C17270

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

Installing the steering arm

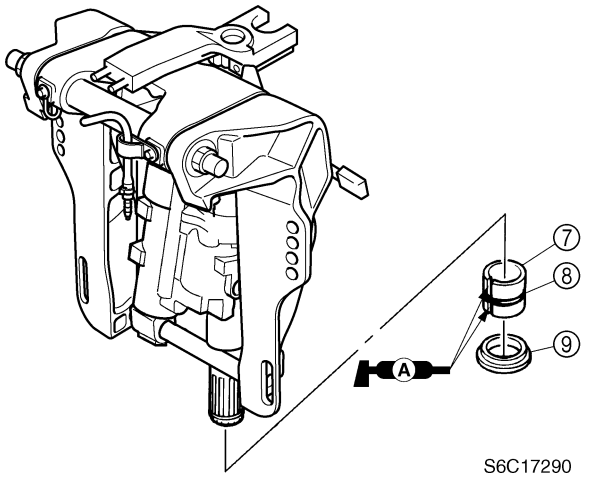
1. Install the washer ①, bushing ②, new O-ring ③, and bushing ④ onto the steering arm ⑤.

2. Place the swivel bracket ⑥ in an upright position, and then install the steering arm onto the swivel bracket assembly.



S6C17280

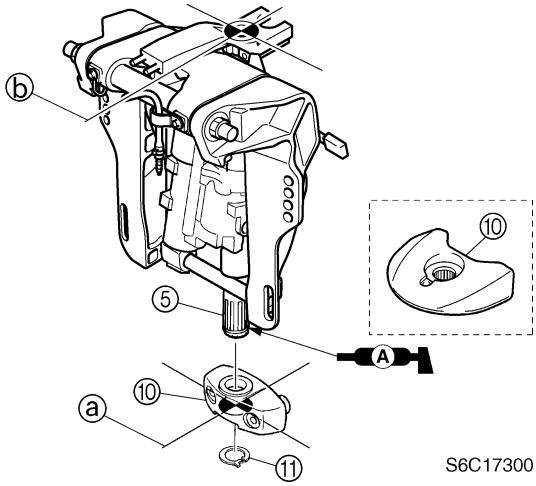
3. Install the bushing ⑦, new O-ring ⑧, and bushing ⑨ onto the swivel bracket assembly.



S6C17290

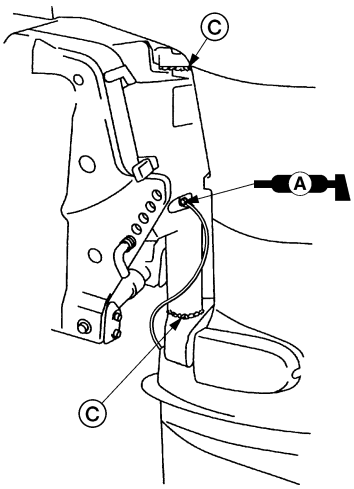
4. Install the steering yoke ⑩ onto the steering arm ⑤ by aligning the center ⓐ of the yoke with the center ⓑ of the steering arm.

5. Install the circlip ⑪.



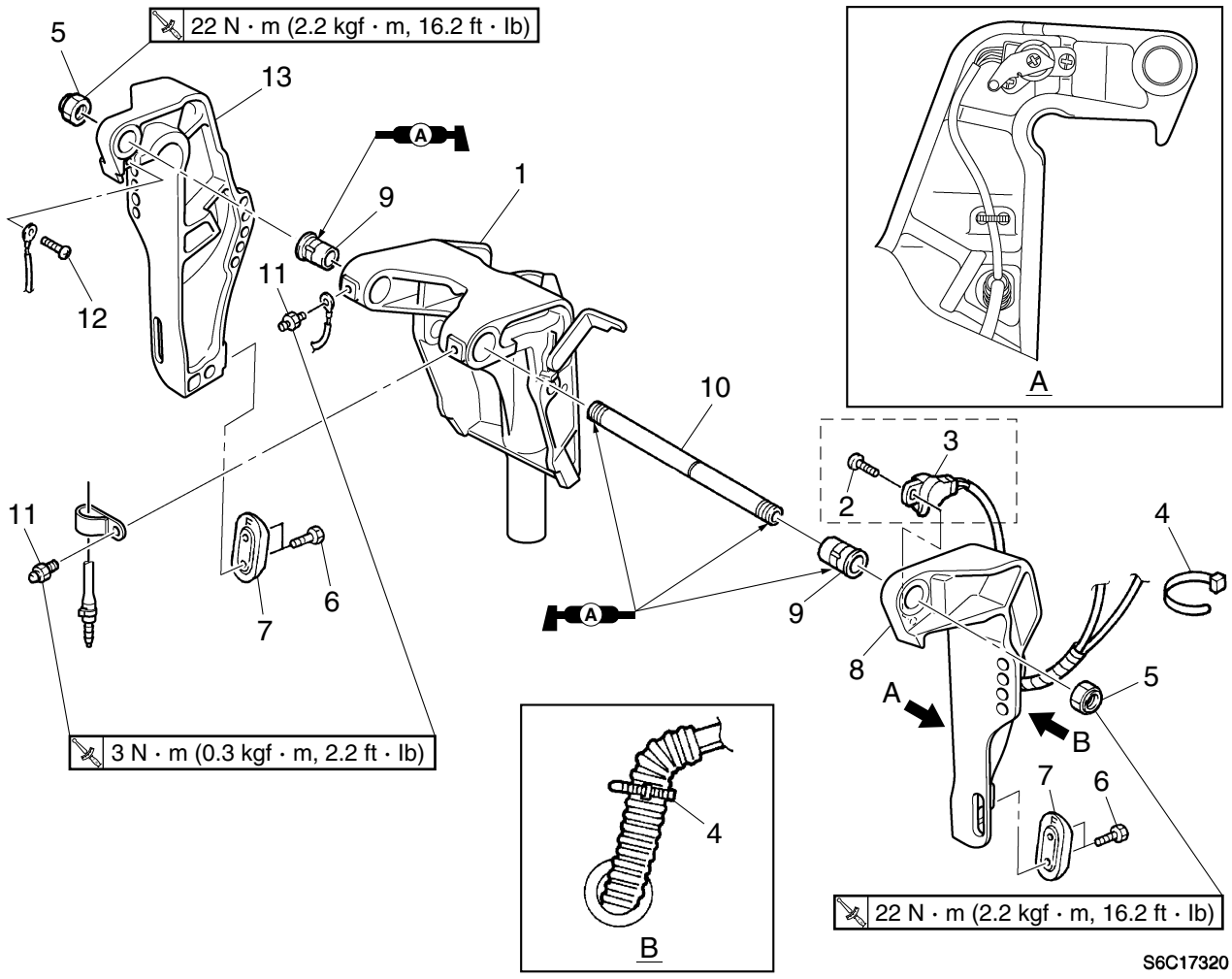
S6C17300

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

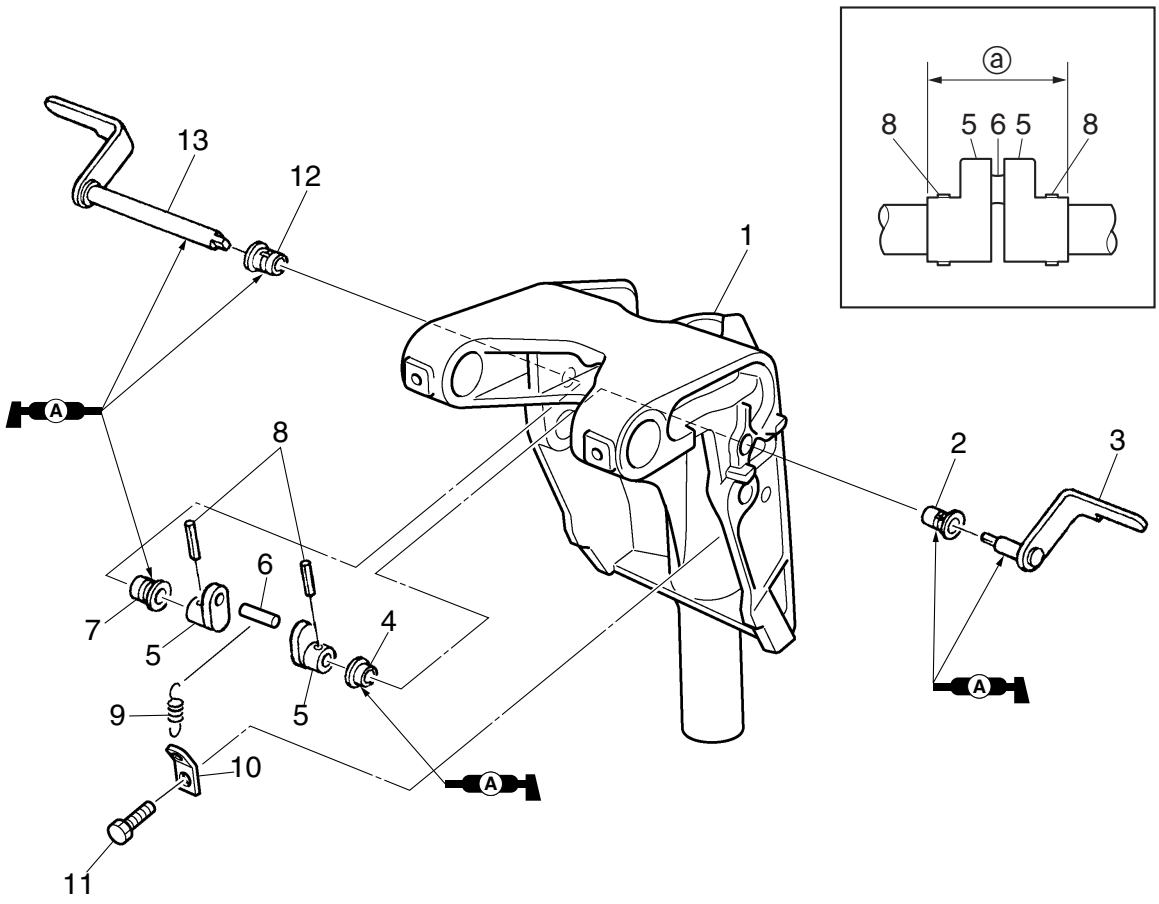


S6C17310

Clamp brackets and swivel bracket



No.	Part name	Q'ty	Remarks
1	Swivel bracket assembly	1	
2	Screw	2	ø6 × 16 mm/Power trim and tilt model
3	Trim sensor	1	Power trim and tilt model
4	Plastic tie	1	**Not reusable** Power trim and tilt model
5	Self-locking nut	2	
6	Bolt	4	M6 × 25 mm
7	Anode	2	
8	Clamp bracket	1	
9	Bushing	1	
10	Through tube	1	
11	Grease nipple	2	
12	Screw	1	ø6 × 8 mm
13	Clamp bracket	1	



S6C17390

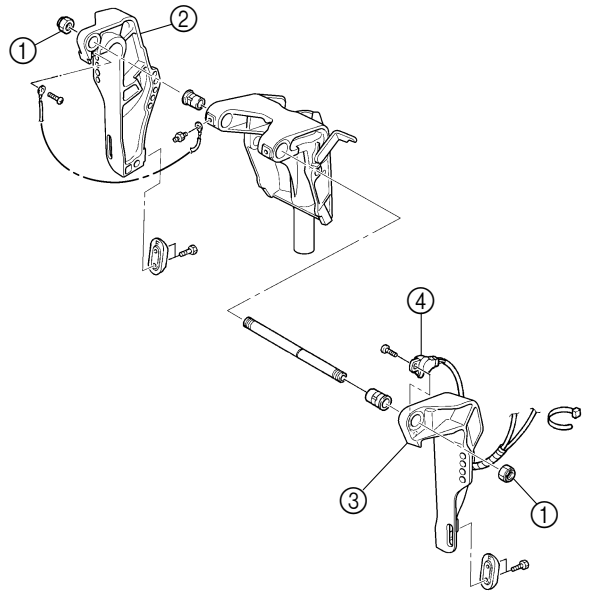
No.	Part name	Q'ty	Remarks
1	Swivel bracket	1	
2	Bushing	1	
3	Tilt stop lever	1	
4	Bushing	1	
5	Collar	2	Distance ⓐ: 30.3–30.4 mm (1.19–1.20 in)
6	Pin	1	
7	Bushing	1	
8	Pin	2	
9	Spring	1	
10	Spring holder	1	
11	Bolt	1	M6 × 10 mm
12	Bushing	1	
13	Tilt stop lever	1	

Removing the clamp brackets

1. Remove the power trim and tilt or hydro tilt. For removal procedure, see “Removing the power trim and tilt unit/hydro tilt unit.”

2. Loosen the self-locking nuts ①, and then remove clamp brackets ② and ③.

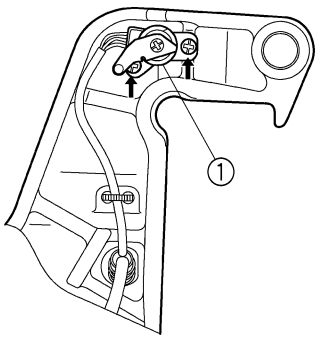
3. Remove the trim sensor ④.



S6C17330

Installing the clamp brackets

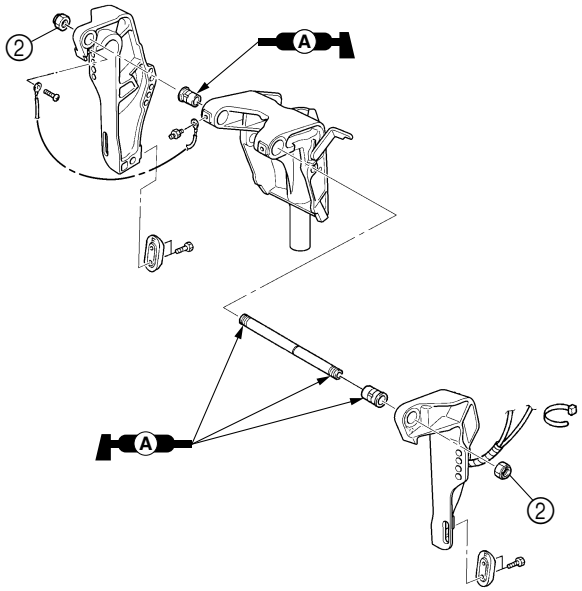
1. Install the trim sensor ① onto the port clamp bracket.



S6C17340

NOTE:
Adjust the trim sensor after installing the power trim and tilt.

2. Assemble the clamp brackets and the swivel bracket by installing the self-locking nuts ②, then tightening them to the specified torque.

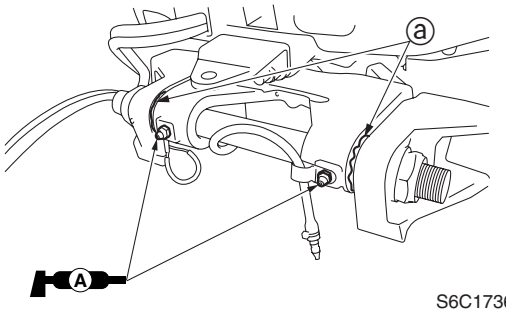


S6C17350

	Self-locking nut ②: 22 N·m (2.2 kgf·m, 16.2 ft·lb)

3. Install the power trim and tilt or hydro tilt. For installation procedure, see “Installing the power trim and tilt unit/hydro unit.”

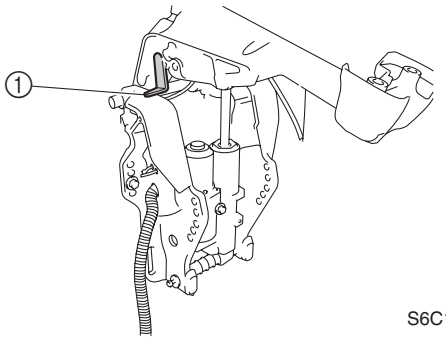
4. Inject grease into both grease nipples until grease comes out from the bushings ⓐ.



S6C17360

Adjusting the trim sensor

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

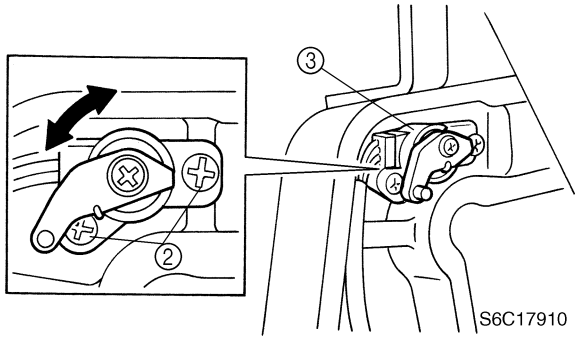


⚠ WARNING

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.

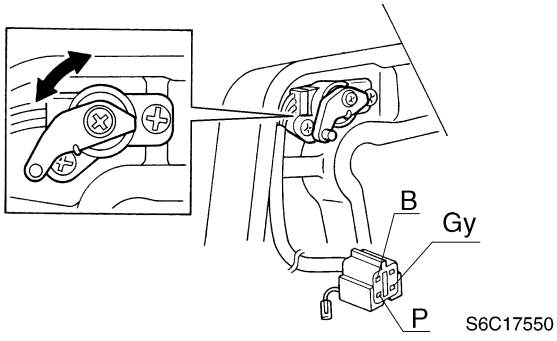
2. Loosen the cam screws ②.

3. Adjust the position of the trim sensor ③, 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 setting resistance:
Pink (P) – Black (B)
9–11 Ω at 20 °C (68 °F)

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

⚠ WARNING

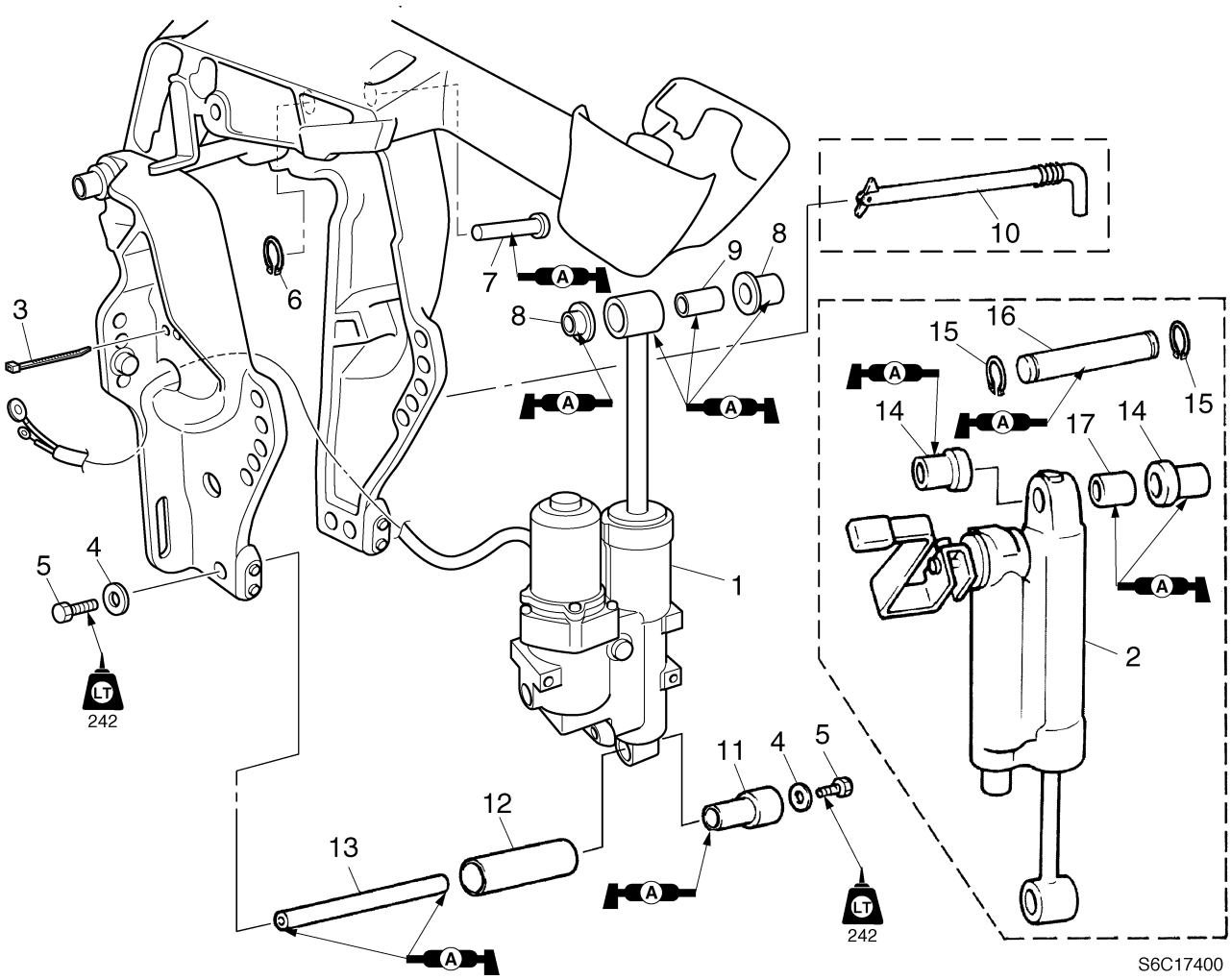
After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

7. Tighten the cam screws ②.

8. Fully tilt the outboard motor down.

7

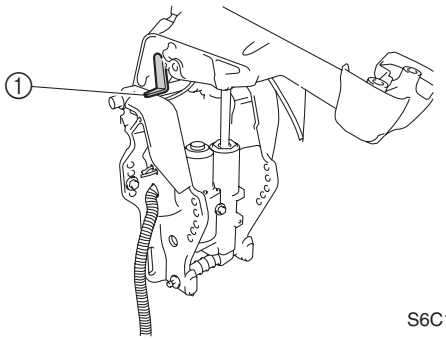
Power trim and tilt unit



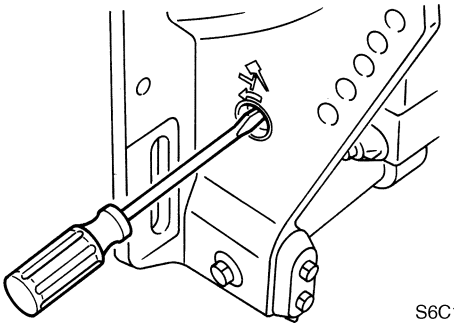
No.	Part name	Q'ty	Remarks
1	Power trim and tilt unit	1	Power trim and tilt model
2	Hydro tilt unit	1	Hydro tilt model
3	Plastic tie	1	**Not reusable** Power trim and tilt model
4	Washer	2	
5	Bolt	2	M8 × 19 mm
6	Circlip	1	Power trim and tilt model
7	Shaft	1	Power trim and tilt model
8	Bushing	2	Power trim and tilt model
9	Collar	1	Power trim and tilt model
10	Tilt pin	1	Hydro tilt model
11	Collar	1	
12	Collar	1	
13	Shaft	1	
14	Bushing	1	Hydro tilt model
15	Circlip	2	Hydro tilt model
16	Shaft	1	Hydro tilt model
17	Collar	1	Hydro tilt model

Removing the power trim and tilt unit/hydro tilt unit

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



S6C17370



S6C17880

⚠ 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.
- If the manual valve is loosened, be sure to tighten it to the specified torque after tilting the outboard motor up.

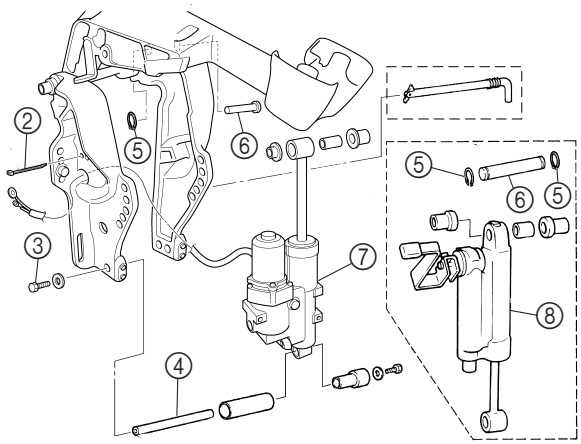
	Manual valve: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

2. Remove the bolt and disconnect the ground lead at the bottom of the power trim and tilt unit.
3. Remove the plastic tie ②, and then pull out the PTT motor leads.
4. Remove the bolts ③, then the lower mounting shaft ④.
5. Remove the circlip(s) ⑤, then the upper mounting shaft ⑥.

NOTE:

Hold the power trim and tilt unit or hydro tilt unit with one hand, and pull the upper mount shaft out at a downward angle with the other.

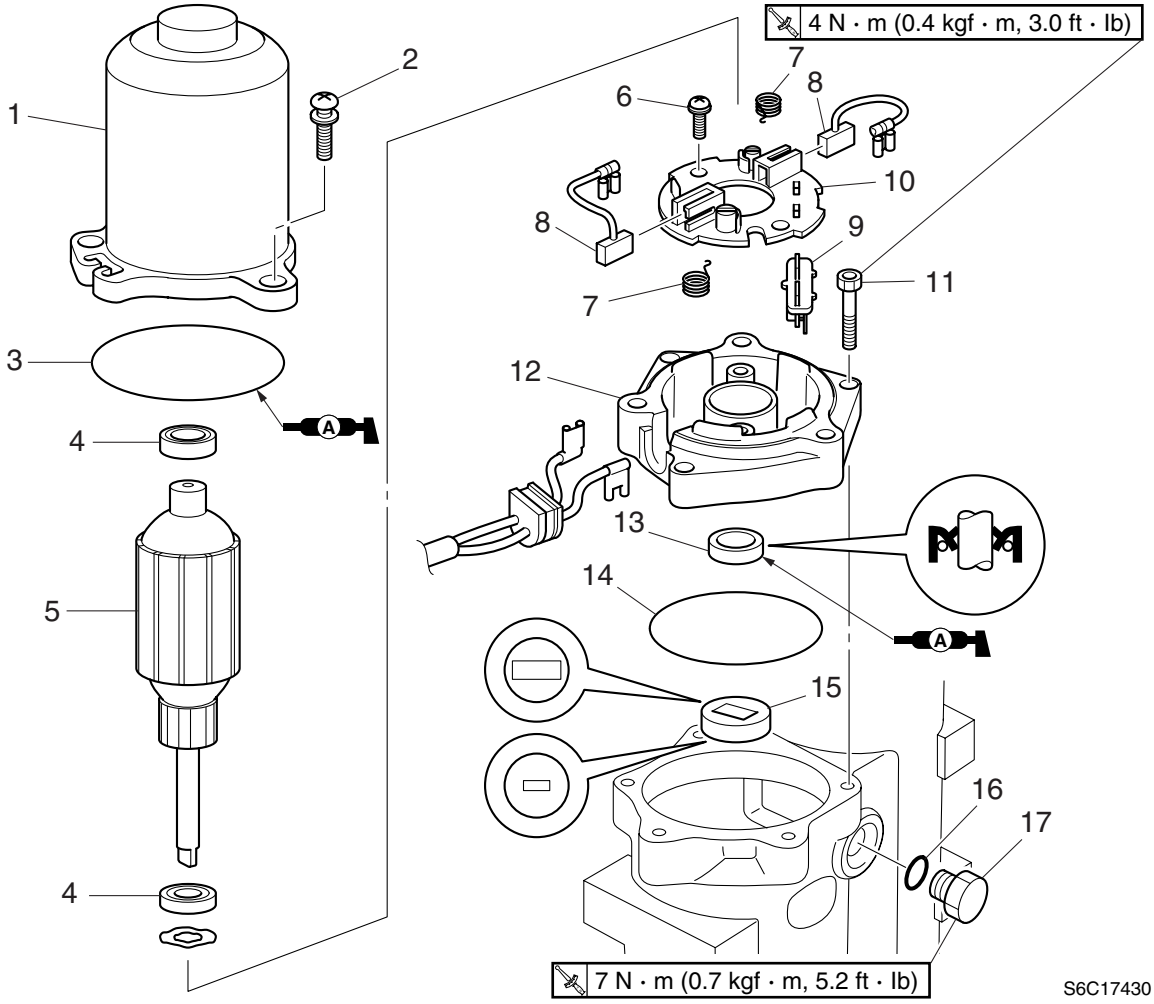
6. Remove the collars.
7. Remove the power trim and tilt unit ⑦ or hydro tilt unit ⑧.



S6C17420

7

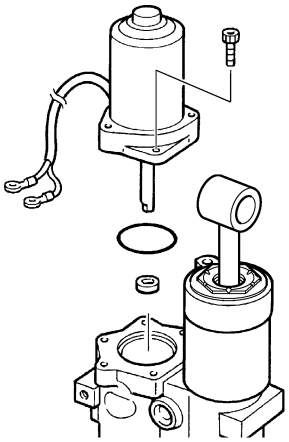
Power trim and tilt motor



No.	Part name	Q'ty	Remarks
1	Stator	1	
2	Screw	3	ø5 × 20 mm
3	O-ring	1	**Not reusable**
4	Bearing	2	**Not reusable**
5	Armature	1	
6	Screw	2	ø4 × 10 mm
7	Spring	2	
8	Brush	2	
9	Circuit breaker	1	
10	Brush holder	1	
11	Bolt	3	M5 × 20 mm
12	PTT motor base	1	
13	Oil seal	1	**Not reusable**
14	O-ring	1	**Not reusable**
15	Joint	1	
16	O-ring	1	**Not reusable**
17	Reservoir cap	1	

Disassembling the power trim and tilt motor

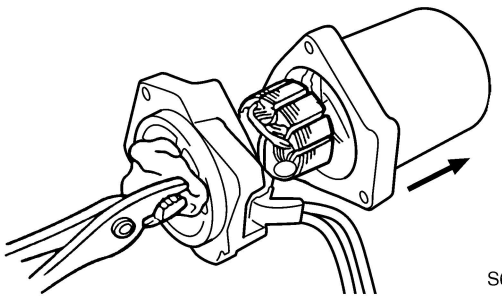
1. Remove the power trim and tilt motor, O-ring, and joint from the power trim and tilt unit.


S6C17470

CAUTION:

- **Make sure that the tilt ram is fully extended when removing the power trim and tilt motor, otherwise fluid can spurt out from the unit due to internal pressure.**
- **Do not push the tilt ram down while the power trim and tilt motor is removed from the power trim and tilt unit, otherwise fluid can spurt out.**

2. Remove the stator.


S6C17480

NOTE:

Place a clean cloth over the end of the armature shaft, hold it with a pair of pliers, and then carefully slide the stator off of the armature.

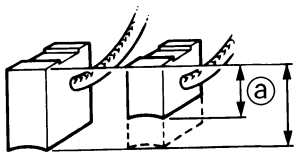
3. Remove the armature from the PTT motor base.

CAUTION:

Do not allow grease or oil to contact the commutator.

Checking the power trim and tilt motor

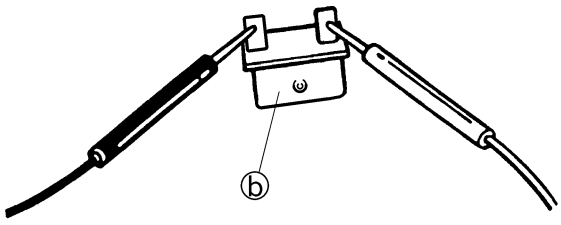
1. Measure the length of the brushes. Replace if below specification.



S60X7260

Brush length wear limit ⓐ:
4.5 mm (0.18 in)

2. Check the circuit breaker for continuity. Replace if there is no continuity.



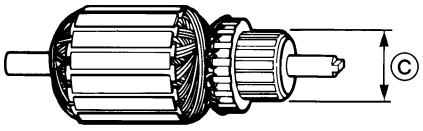
S6C17490

CAUTION:

Do not touch the bimetal ⓑ, otherwise the operation of the circuit breaker can be affected.

7

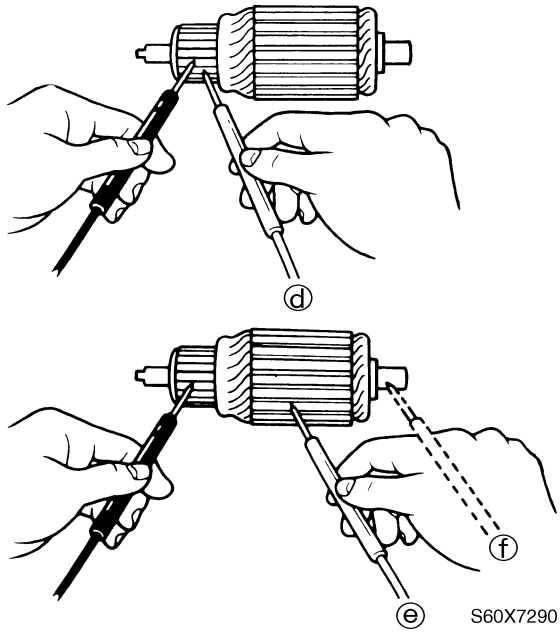
3. Measure the commutator diameter. Replace if below specification.



S60X7280

Commutator diameter wear limit ⓒ:
18.0 mm (0.71 in)

4. Check the armature for continuity. Replace if out of specifications.



S60X7290

Armature continuity

Commutator segments ⓓ	Continuity
Segment ⓓ – Armature core ⓔ	No continuity
Segment ⓓ – Armature shaft ⓕ	No continuity

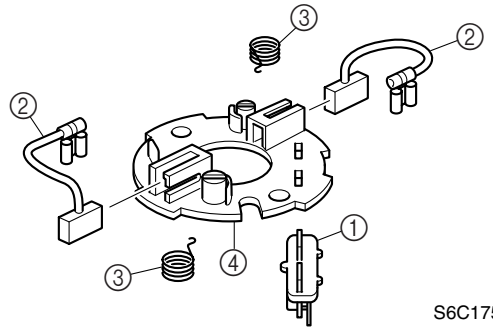
5. Check the base for cracks or damage. Replace if necessary.

6. Check the bearings and oil seal for damage or wear. Replace if necessary.

NOTE:
If the bearings and oil seal are removed, always replace them with new ones.

Assembling the power trim and tilt motor

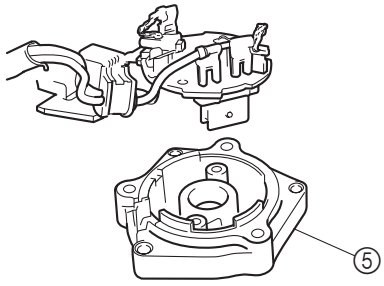
1. Install the circuit breaker ①, brushes ②, and springs ③ onto the brush holder ④.



S6C17500

2. Connect the PTT motor leads to the brush holder.

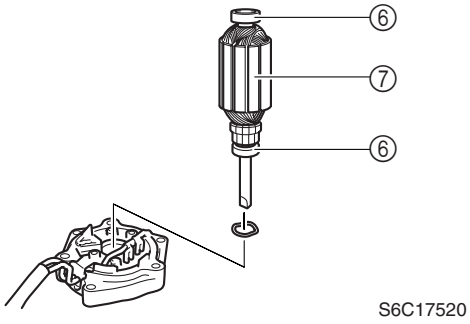
3. Install the brush holder assembly to the motor base ⑤.



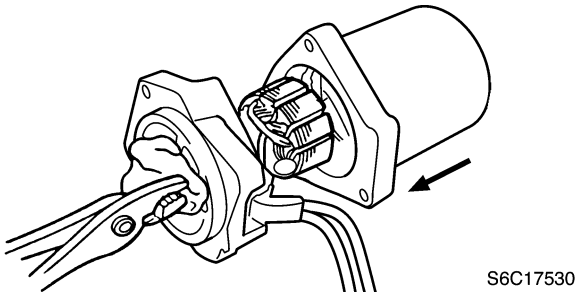
S6C17510

4. Install the bearings ⑥ onto the armature ⑦.

5. Push the brushes into the holders, and then install the armature.

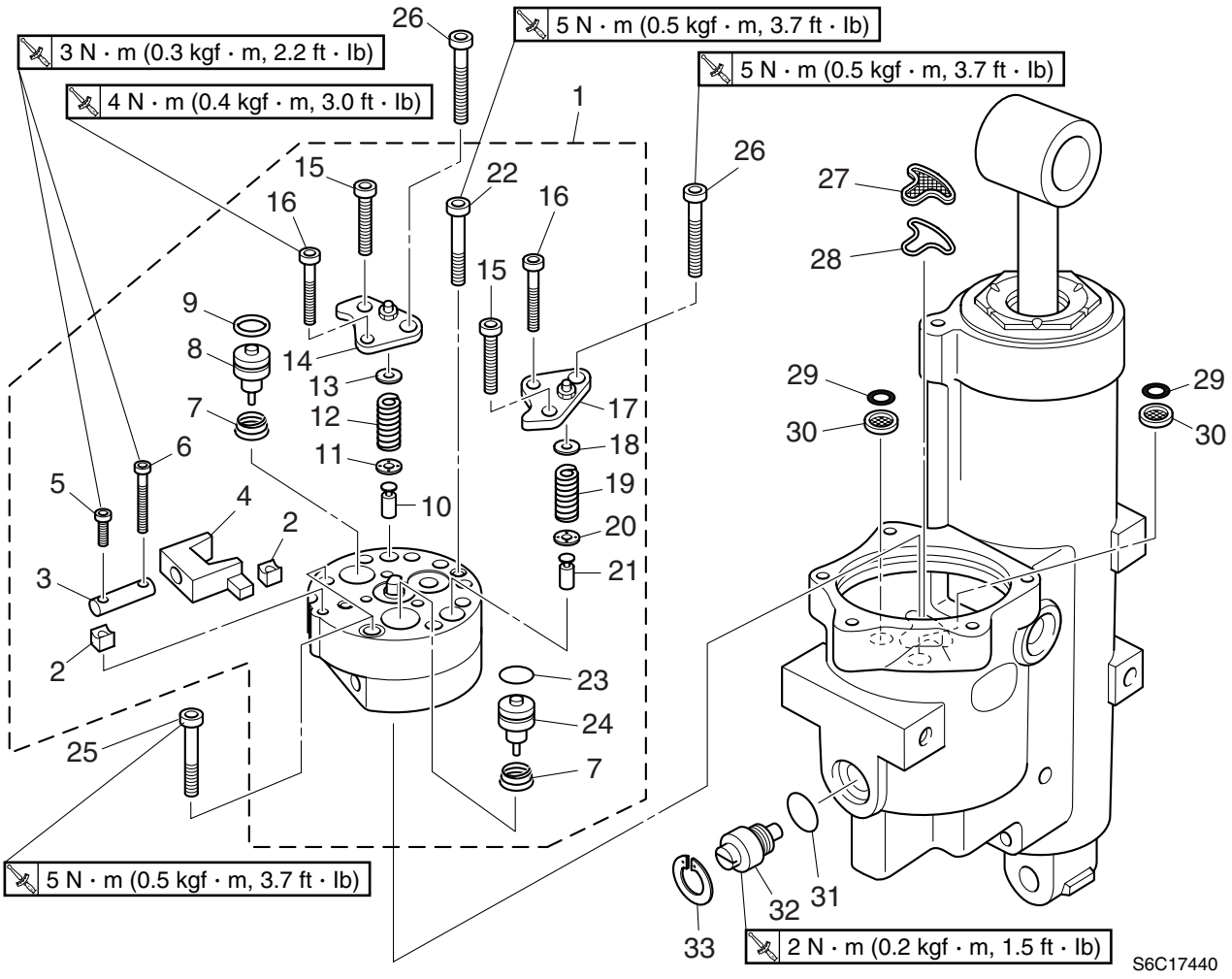


6. Install the stator onto the motor base.

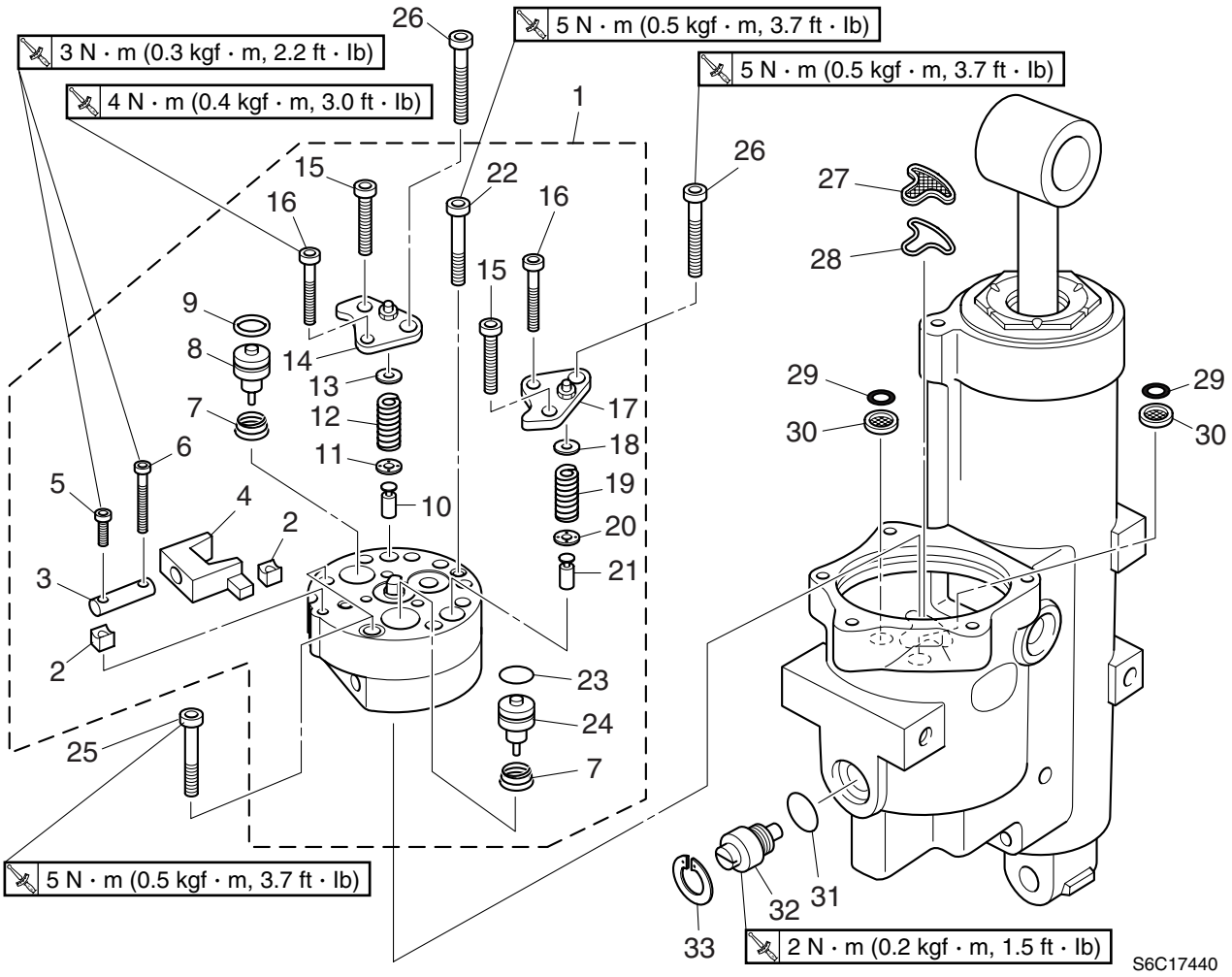


NOTE:
Place a clean cloth over the end of the armature shaft, hold it with a pair of pliers, and then carefully slide the stator over the armature.

Gear pump

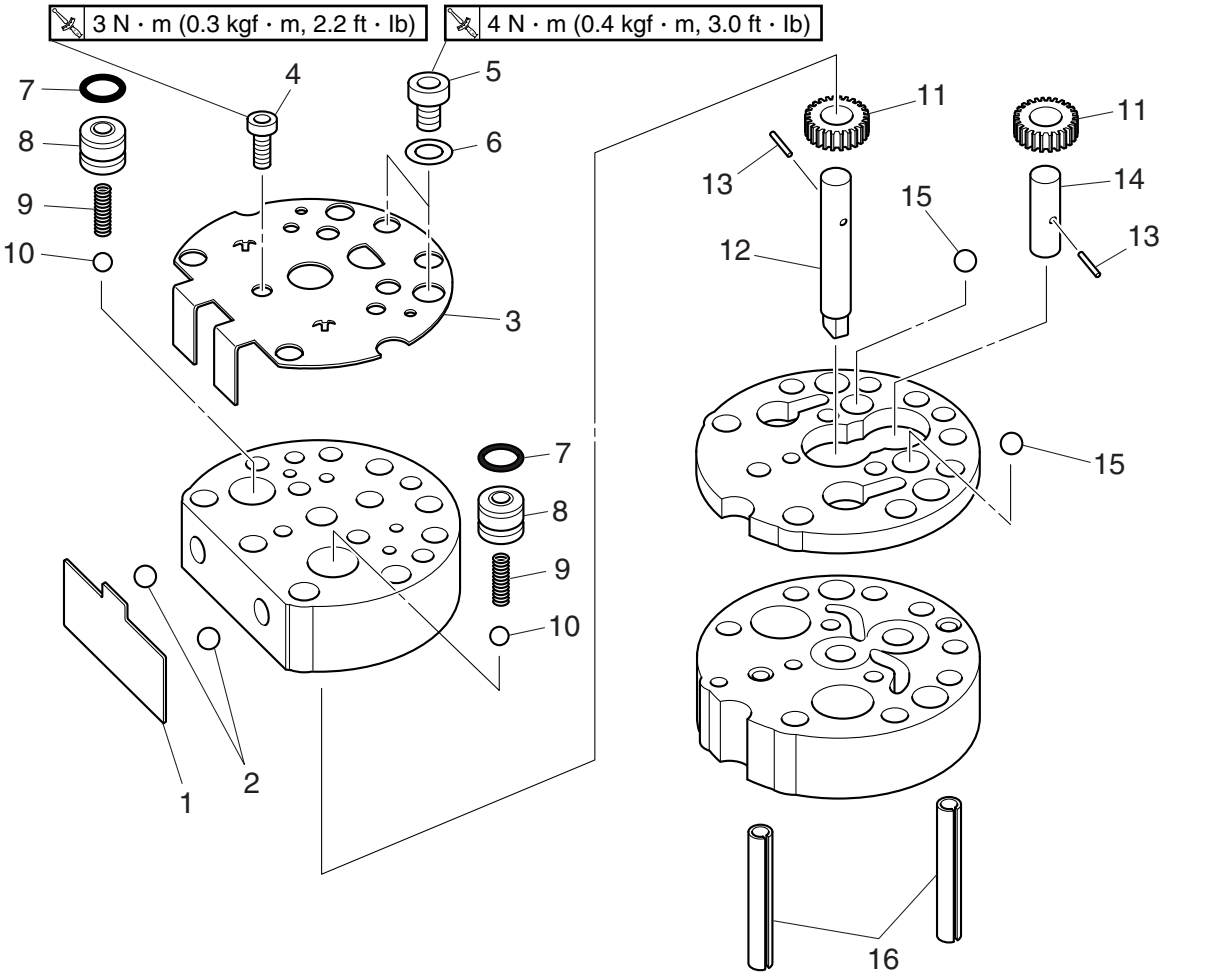


No.	Part name	Q'ty	Remarks
1	Gear pump assembly	1	
2	Spacer	2	
3	Pin	1	
4	Lever	1	
5	Bolt	1	M3 × 16 mm
6	Bolt	1	M3 × 35 mm
7	Spring	2	
8	Shuttle piston	1	
9	Backup ring	1	
10	Down-relief valve seat	1	
11	Washer	1	
12	Spring	1	
13	Washer	1	
14	Cap	1	
15	Bolt	2	M5 × 30 mm
16	Bolt	2	M4 × 30 mm
17	Cap	1	



No.	Part name	Q'ty	Remarks
18	Washer	1	
19	Spring	1	
20	Washer	1	
21	Up-relief valve seat	1	
22	Bolt	2	M5 × 25 mm
23	O-ring	1	**Not reusable**
24	Shuttle piston	1	
25	Bolt	2	M5 × 45 mm
26	Bolt	2	M5 × 50 mm
27	Filter	1	
28	Plate	1	
29	O-ring	2	**Not reusable**
30	Filter	2	
31	O-ring	1	**Not reusable**
32	Manual valve	1	
33	Circlip	1	

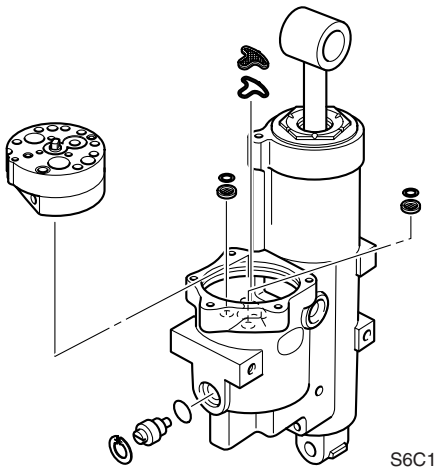
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No.	Part name	Q'ty	Remarks
1	Manual release spring	1	
2	Ball	2	
3	Bracket	1	
4	Bolt	1	M3 × 5 mm
5	Bolt	2	M5 × 6 mm
6	Washer	2	
7	O-ring	2	**Not reusable**
8	Adapter	2	
9	Spring	2	
10	Ball	2	
11	Gear	2	
12	Drive shaft	1	
13	Pin	2	
14	Driven shaft	1	
15	Ball	2	
16	Pin	2	

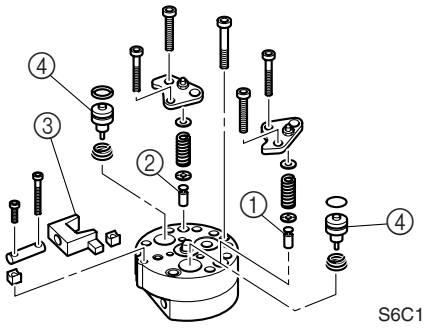
Disassembling the gear pump

1. Remove the manual valve, then the gear pump and filters.


S6C17580

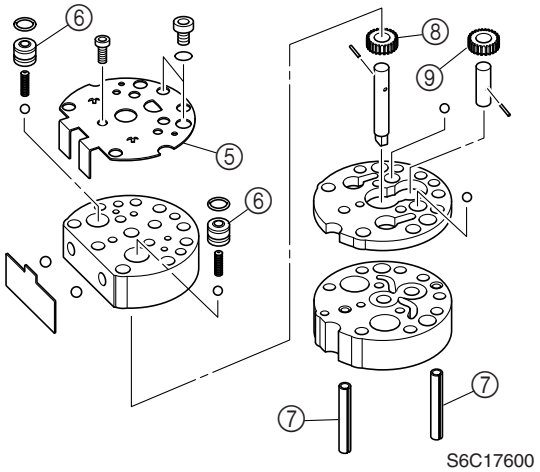
2. Remove the relief valve seat caps, then the up-relief valve seat ① and down-relief valve seat ②.

3. Remove the lever ③, then the shuttle pistons ④.


S6C17590

4. Remove the gear pump bracket ⑤, then the adapters ⑥.

5. Remove the pins ⑦, then the drive gear ⑧ and driven gear ⑨.


S6C17600

Checking the gear pump

1. Clean all the pistons and balls, and then check them for damage or wear. Replace if necessary.

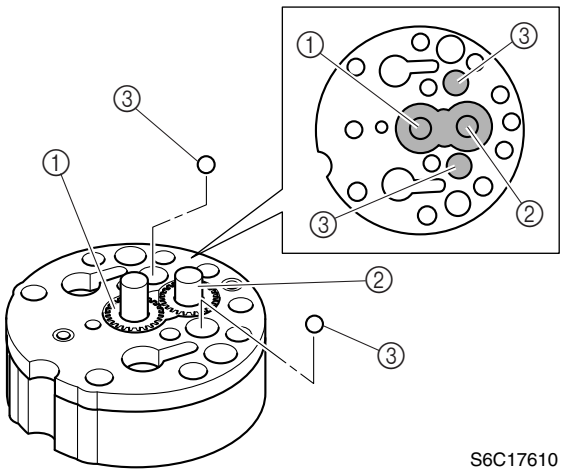
2. Check the filters for damage or clogs. Replace if necessary.

3. Check the drive gear and driven gear for damage or wear. Replace the gear pump assembly if necessary.

Assembling the gear pump

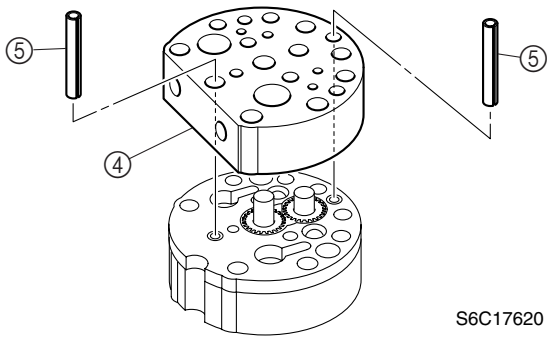
1. Install the drive gear ① and driven gear ② into the gear pump housing.

2. Install the balls ③ into the gear pump housing.


S6C17610

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3. Install the gear pump cover ④, then the pins ⑤.

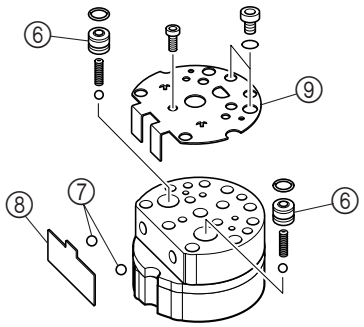


S6C17620

4. Install the adapters ⑥ into the gear pump cover.

5. Install the balls ⑦ into the gear pump cover with the manual release spring ⑧.

6. Install the gear pump bracket ⑨ by installing the bolts, and then tighten them to the specified torques.

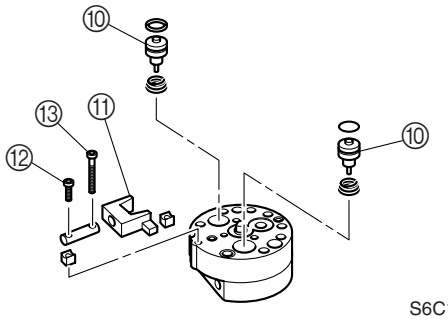


S6C17630

Gear pump bracket bolt (M3):
3 N·m (0.3 kgf·m, 2.2 ft·lb)
Gear pump bracket bolt (M5):
4 N·m (0.4 kgf·m, 3.0 ft·lb)

7. Install the shuttle pistons ⑩, then the lever ⑪.

8. Tighten bolts ⑫ and ⑬ to the specified torque.



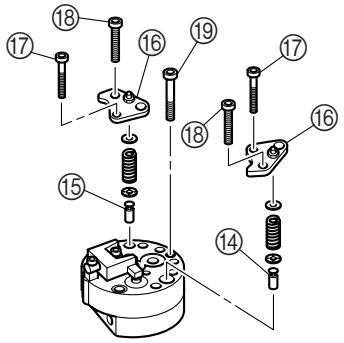
S6C17640

Lever bolt (M3) ⑫, ⑬:
3 N·m (0.3 kgf·m, 2.2 ft·lb)

9. Install the up-relief valve seat ⑭ and down-relief valve seat ⑮.

10. Install the relief valve seat caps ⑯ by installing bolts ⑰ and ⑱, then tightening them to the specified torques.

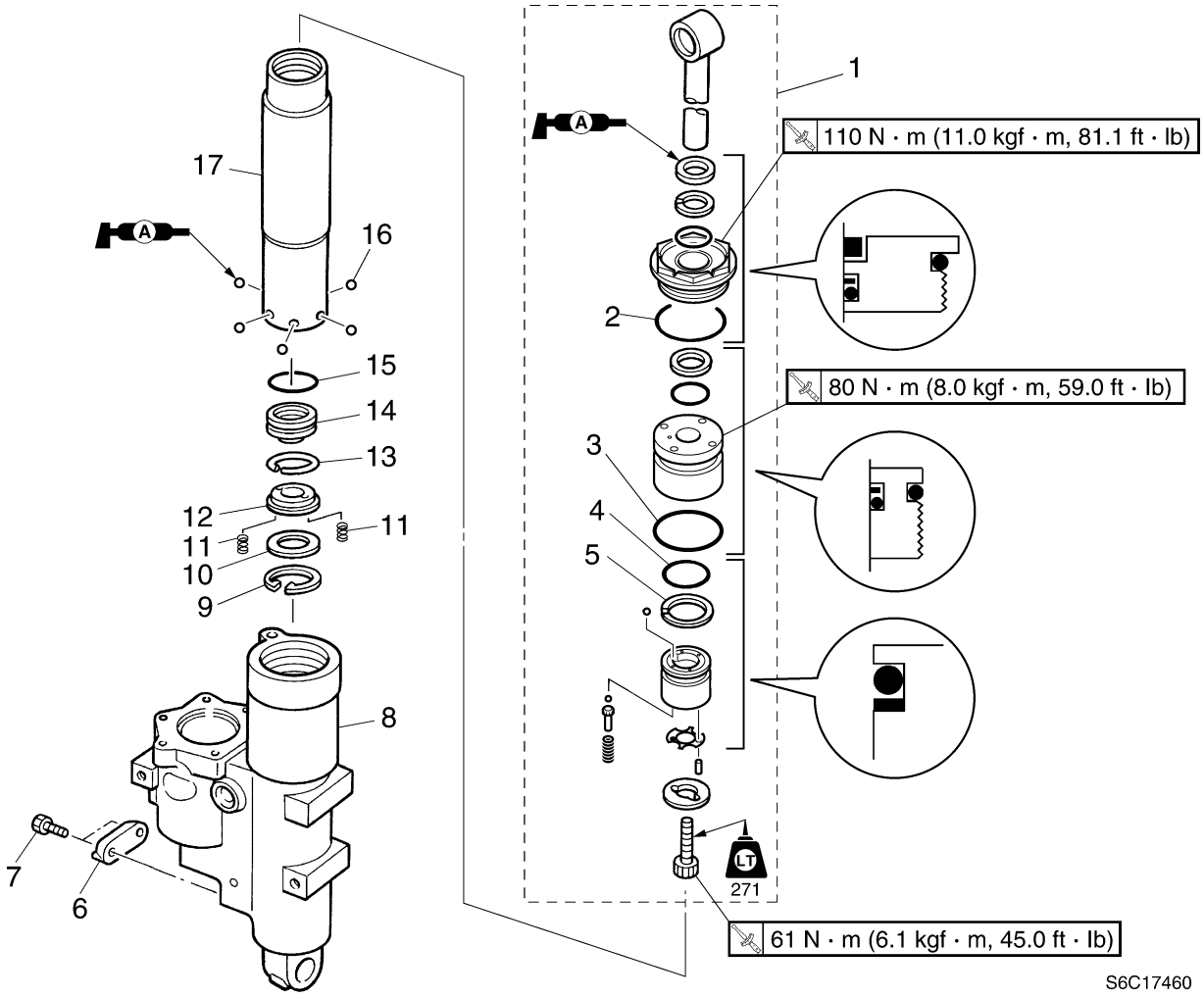
11. Tighten the bolts ⑲ to the specified torque.



S6C17650

Relief valve seat cap bolt (M4) ⑰:
4 N·m (0.4 kgf·m, 3.0 ft·lb)
Relief valve seat cap bolt (M5) ⑱:
5 N·m (0.5 kgf·m, 3.7 ft·lb)
Gear pump housing bolt ⑲:
5 N·m (0.5 kgf·m, 3.7 ft·lb)

Tilt cylinder and trim cylinder

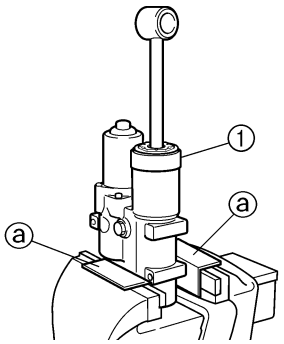


No.	Part name	Q'ty	Remarks
1	Tilt piston assembly	1	
2	O-ring	1	**Not reusable**
3	O-ring	1	**Not reusable**
4	O-ring	1	**Not reusable**
5	Backup ring	1	
6	Anode	1	
7	Bolt	1	M6 × 25 mm
8	Trim cylinder	1	
9	Circlip	1	
10	Plate	1	
11	Spring	2	
12	Cylinder base	1	
13	Circlip	1	
14	Free piston	1	
15	O-ring	1	**Not reusable**
16	Ball	6	
17	Tilt cylinder	1	

7

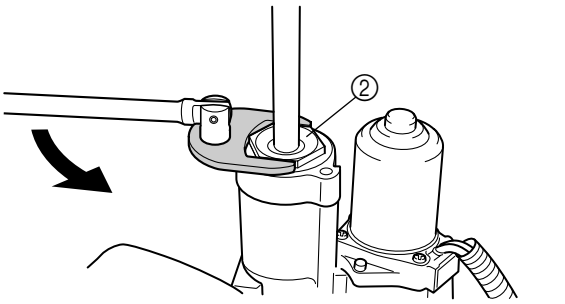
Disassembling the trim cylinder

1. Hold the power trim and tilt unit ① in a vise using aluminum plates ⓐ on both sides.



S68S7030

2. Loosen the trim cylinder end screw ②, and then remove it.



S68S7040

⚠ WARNING

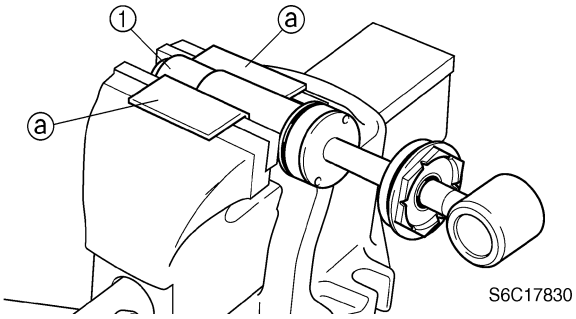
Make sure that the ram is fully extended before removing the end screw.

Cylinder-end screw wrench:
90890-06588

3. Drain the power trim and tilt fluid.

Disassembling the tilt cylinder

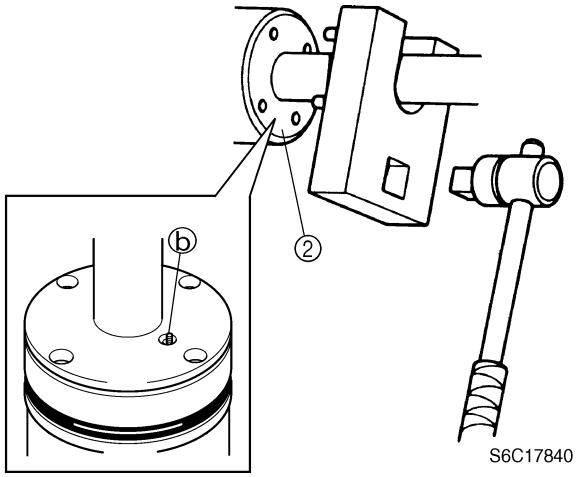
1. Hold the tilt cylinder ① in a vise using aluminum plates ⓐ on both sides.



S6C17830

NOTE:
Place the tilt cylinder in the vise horizontally.

2. Loosen the tilt cylinder end screw ②, and then remove it.



S6C17840

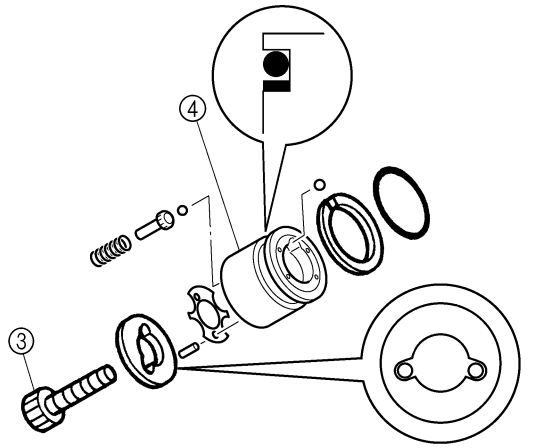
CAUTION:

Do not damage the check valve ⓑ when loosening the end screw.

Cylinder-end screw wrench:
New: 90890-06568
Current: 90890-06544

3. Hold the tilt ram end in a vise using aluminum plates on both sides.

4. Remove the bolt ③, then the tilt piston ④.



S6C17660

Checking the tilt cylinder and trim cylinder

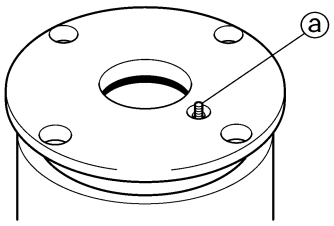
1. Check the inner walls of the trim cylinder and tilt cylinder for scratches. Replace if necessary.

2. Check the outer surface of the tilt piston and free piston for scratches. Replace if necessary.

3. Check the tilt ram for bends or excessive corrosion. Polish with 400- to 600-grit sandpaper if there is light rust or replace if necessary.

Checking the valves

1. Check the operation of the check valve ⓐ of the tilt cylinder end screw and check the valve for dirt or residue. Clean if necessary.



S6C17670

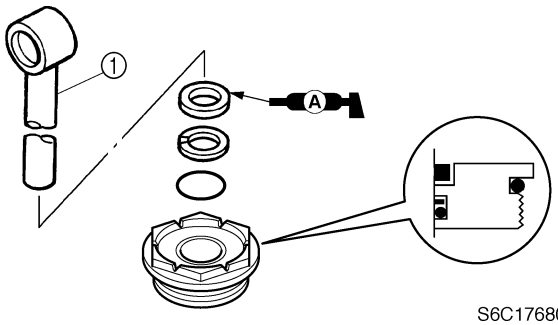
2. Check the operation of the absorber valve and check the valve for dirt or residue. Clean if necessary.

Assembling the tilt cylinder

1. Install new O-rings into the trim cylinder end screw.

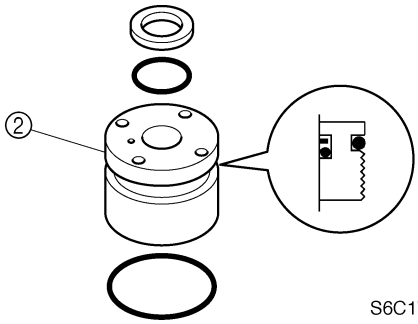
2. Install a new dust seal into the trim cylinder end screw.

3. Install the tilt ram ① into the trim cylinder end screw.



S6C17680

4. Install the backup ring and new O-rings into the tilt cylinder end screw ②.



S6C17690

5. Install the tilt cylinder end screw onto the tilt ram.

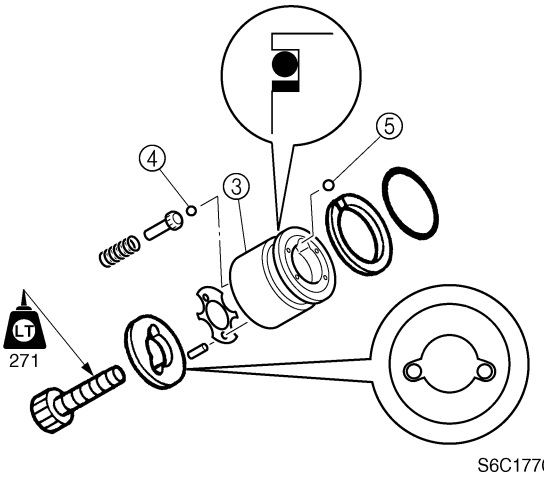
7

6. Install the backup ring and new O-ring into the tilt piston ③.

7. Install balls ④ and ⑤, absorber valve pin, spring, pins, plate, and washer into the tilt piston.

8. Hold the tilt ram end in a vise using aluminum plates on both sides.

9. Install the tilt piston to the tilt ram by installing the bolt, then tightening it to the specified torque.



S6C17700

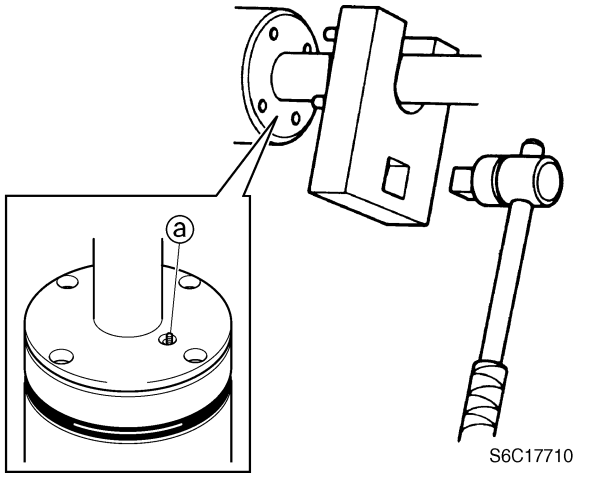
	Tilt piston bolt: 61 N·m (6.1 kgf·m, 45.0 ft·lb)

10. Install the tilt ram into the tilt cylinder.

11. Hold the tilt cylinder in a vise using aluminum plates on both sides.

NOTE:
Place the tilt cylinder in the vise horizontally.

12. Install the tilt cylinder end screw, and then tighten it to the specified torque.



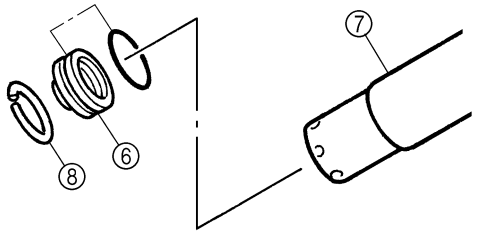
S6C17710

CAUTION:
Do not damage the check valve ⓐ when tightening the end screw.

	Cylinder-end screw wrench: New: 90890-06568 Current: 90890-06544

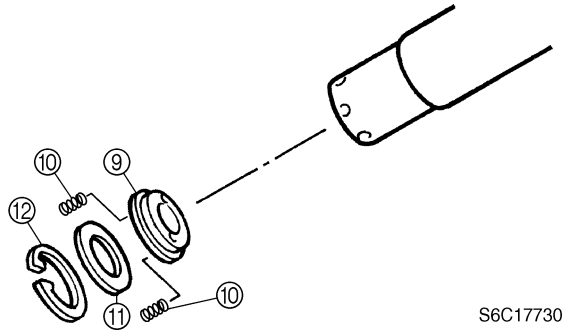
	Tilt cylinder end screw: 80 N·m (8.0 kgf·m, 59.0 ft·lb)

13. Install the free piston ⑥ into the tilt cylinder ⑦ with the circlip ⑧.



S6C17720

14. Install the cylinder base ⑨, springs ⑩, and plate ⑪ into the tilt cylinder with the circlip ⑫.



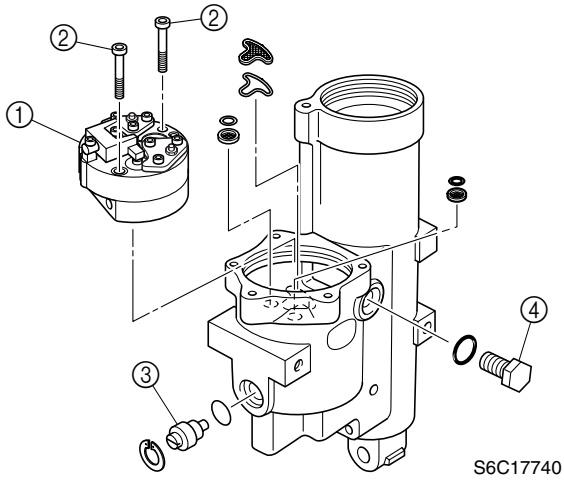
S6C17730

Assembling the power trim and tilt unit

1. Hold the trim cylinder in a vise using aluminum plates on both sides.

2. Install the filters and gear pump assembly ① by installing the bolts ②, then tightening them to the specified torque.

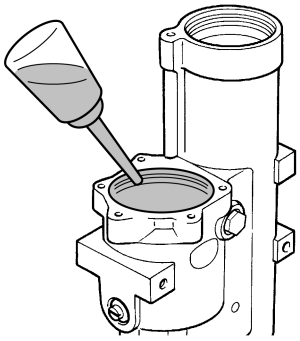
3. Install the manual valve ③ and reservoir cap ④.



S6C17740

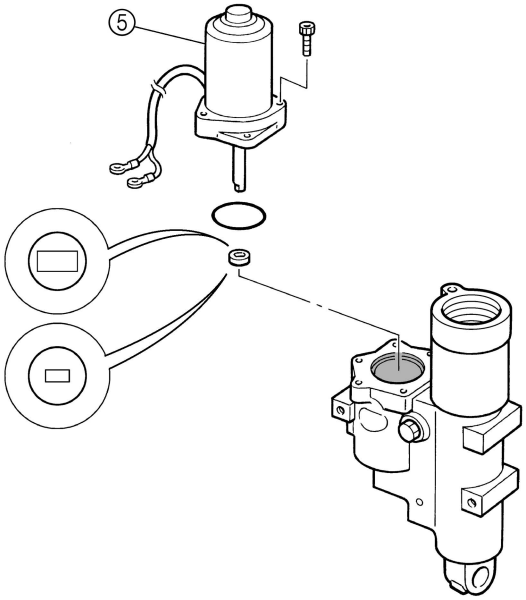
Gear pump bolt ②:
5 N·m (0.5 kgf·m, 3.7 ft·lb)
Reservoir cap ④:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

4. Fill the reservoir with the recommended fluid to the correct level as shown.


S62Y7700

Recommended power trim and tilt fluid:
ATF Dexron II

5. Install the new O-ring, joint, and power trim and tilt motor ⑤ by installing the bolts, then tightening them to the specified torque.

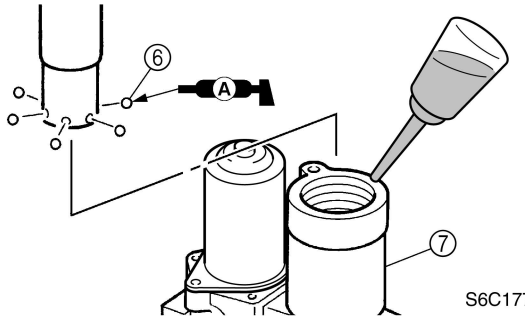


S6C17750

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

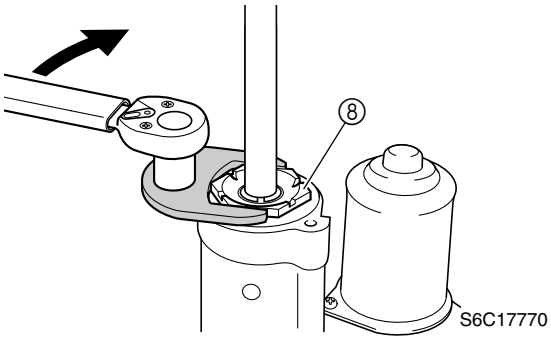
6. Add fluid of the recommended type to the first level at the bottom of the trim cylinder.

7. Install the balls ⑥ into the tilt cylinder, and then insert the tilt cylinder into the trim cylinder ⑦.



NOTE:
Apply grease to the balls to prevent them from falling off.

8. Install the trim cylinder end screw ⑧, and then tighten it to the specified torque.

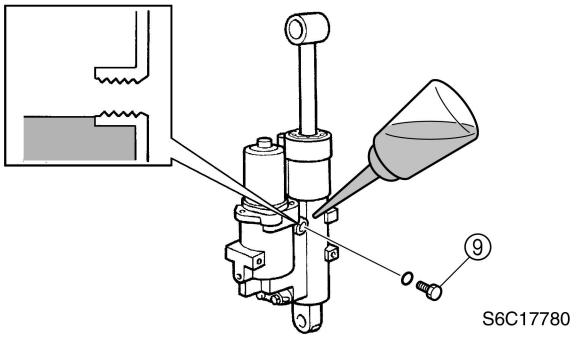


	Cylinder-end screw wrench: 90890-06588

	Trim cylinder end screw ⑧: 110 N·m (11.0 kgf·m, 81.1 ft·lb)

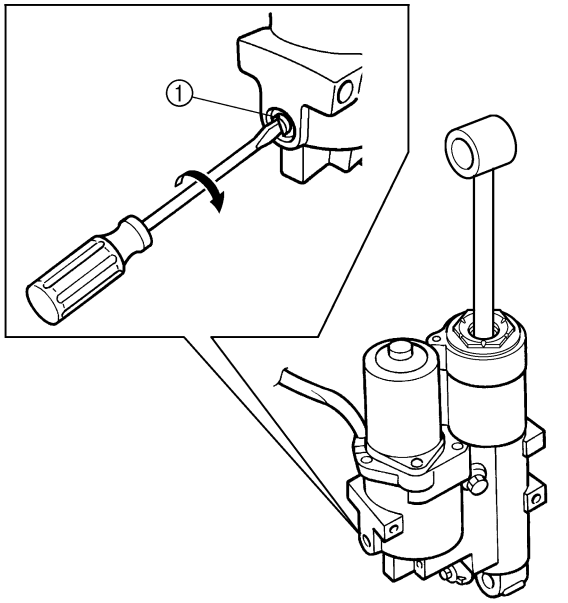
9. Fully extend the tilt rod, and then add sufficient fluid of the recommended type to the correct level.

10. Install the reservoir cap ⑨.



Bleeding the power trim and tilt unit

1. Tighten the manual valve ① by turning it clockwise.



	Manual valve ①: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

2. Place the power trim and tilt unit in an upright position.

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

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

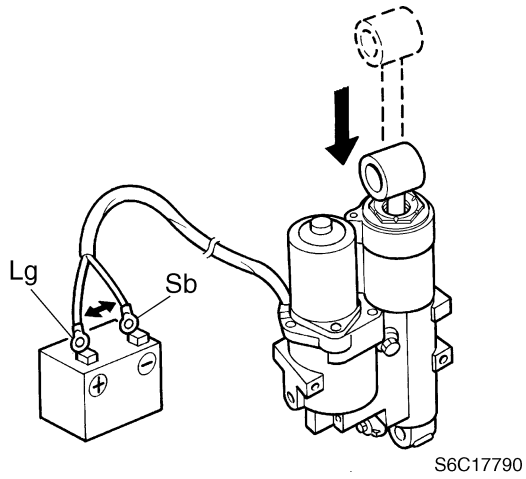
4. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

	Recommended power trim and tilt fluid: ATF Dexron II

5. Install the reservoir cap, and then tighten it to the specified torque.

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

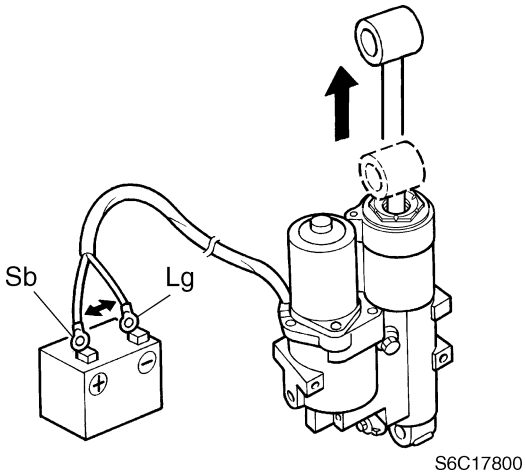
6. Connect the PTT motor leads to the battery terminals to fully retract the tilt ram.



S6C17790

Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

7. Reverse the PTT motor leads between the battery terminals to fully extend the tilt ram.



S6C17800

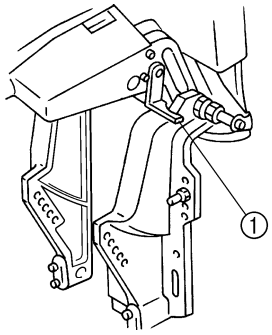
Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

NOTE:
- Repeat this procedure so that the tilt ram goes up and down four or five time (be sure to wait a few seconds before switching the leads).
- If the ram does not move up and down easily, push and pull on the ram to assist operation.

8. Check the fluid level when the tilt ram is fully extended. Add sufficient fluid if necessary.

Installing the power trim and tilt unit/hydro unit

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



S62Y7990

CAUTION:
After tilting the outboard motor up, be sure to support it with the tilt stop lever.

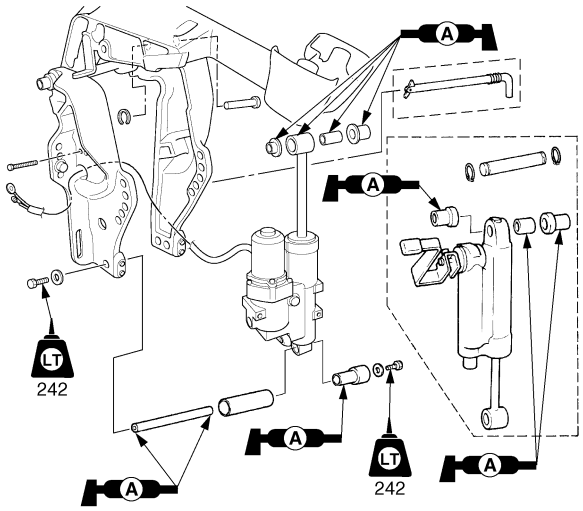
2. Install the collars.
3. Lift the power trim and tilt unit or hydro tilt unit up, and then install the upper mounting shaft.
4. Install the circlip.
5. Install the lower mounting shaft, and then tighten the bolts.

7

6. Route the PTT motor leads through the hole, and then install the plastic tie.

7. Connect the ground lead to the bottom of the power trim and tilt unit, and then tighten the bolt.

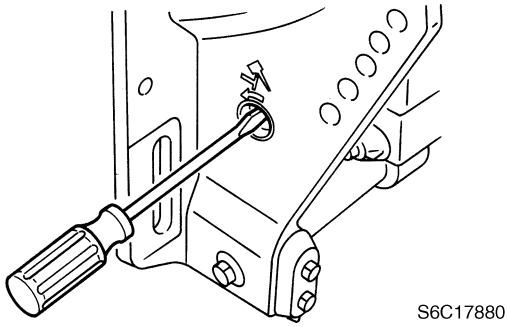
8. Install the tilt pin (hydro tilt model).



S6C17850

Bleeding the power trim and tilt unit (built-in)

1. Fully turn the manual valve counterclockwise.



S6C17880

2. Fully tilt the outboard motor up, and then release it to let it lower by its own weight four to five times.

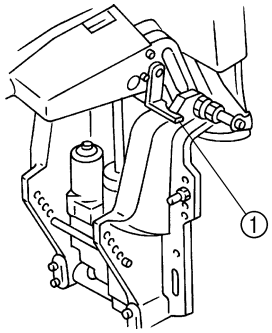
3. Tighten the manual valve by turning it clockwise.

Manual valve:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

4. Let the fluid settle for 5 minutes.

5. Push and hold the power trim and tilt switch in the up position to check that the outboard motor is fully tilted up.

6. Support the outboard motor with the tilt stop lever ①.

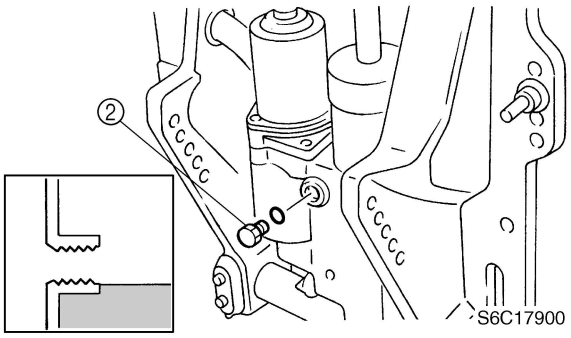


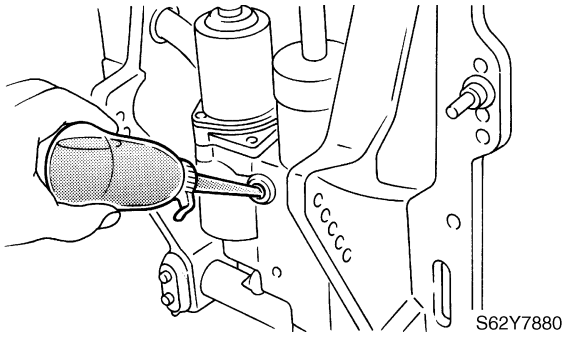
S62Y3530

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





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

8. If necessary, add sufficient fluid of the recommended type to the correct level.

Recommended power trim and tilt fluid:
ATF Dexron II

9. Install the reservoir cap, and then tighten it to the specified torque.

NOTE:
Repeat this procedure until the fluid remains at the correct level.

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

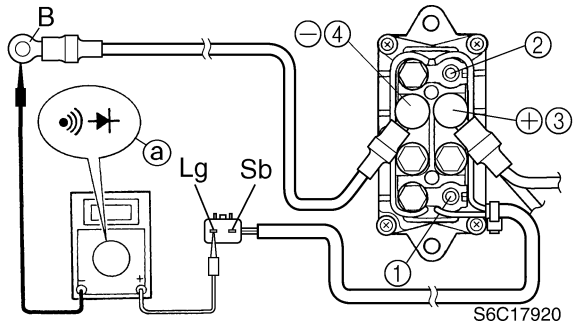
Power trim and tilt electrical system

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 ⓐ shown in the illustration when checking for continuity.

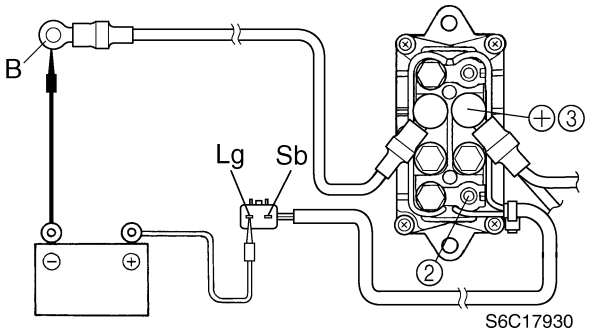
Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B) Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ④ Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③ Terminal ② – Terminal ③	No continuity

7

2. Connect the digital circuit tester between power trim and tilt relay terminals ② 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 ② and ③. Replace if there is no continuity.

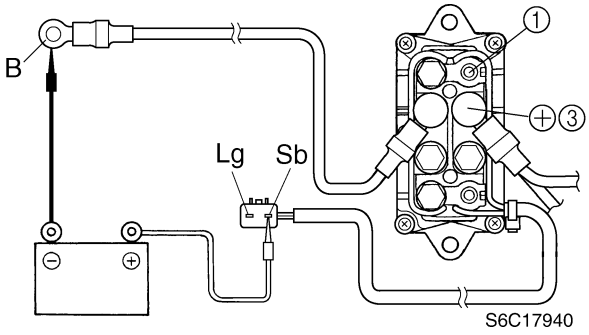


S6C17930

5. Connect the digital circuit tester between power trim and tilt relay terminals ① 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.

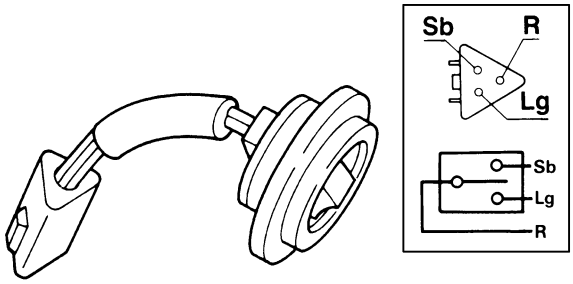
7. Check for continuity between terminals ① and ③. Replace if there is no continuity.



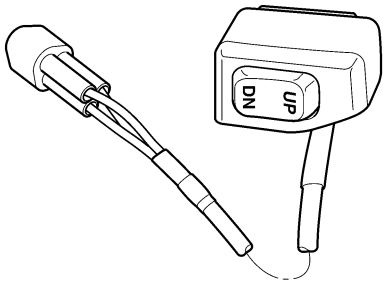
S6C17940

Checking the power trim and tilt switch

1. Check the power trim and tilt switch for continuity. Replace if out of specification.



S62Y7A70

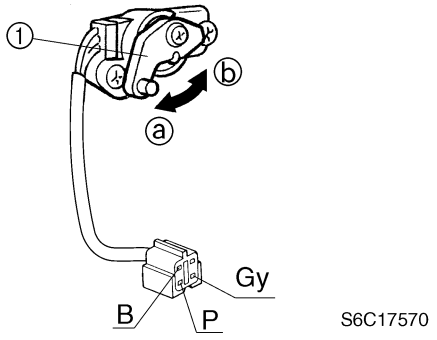


S62Y7A80

	Lead color		
Switch position	Sky blue (Sb)	Red (R)	Light green (Lg)
Up	○——	——○	
Free			
Down		○——	——○

Checking the trim sensor

1. Measure the trim sensor resistance. Replace if out of specification.



NOTE:
Turn the lever ① and measure the resistance as it gradually changes.

Trim sensor resistance:
Pink (P) – Black (B)
168.3–288.3 Ω at 20 °C (68 °F) ⓐ
9–11 Ω at 20 °C (68 °F) ⓑ

Electrical systems

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Measuring the peak voltage 8-2
Measuring the lower resistance 8-2

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Checking the engine stop lanyard switch (tiller handle model) 8-12
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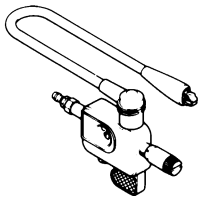
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Checking the main and fuel pump relay (fuel control) 8-14
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Checking the starter relay 8-15

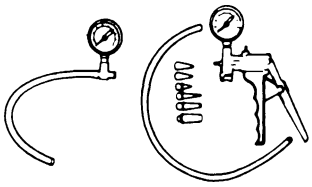
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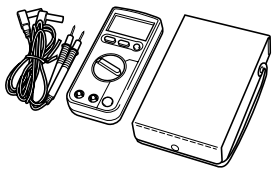
Special service tools



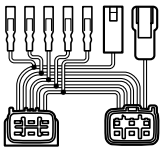
Ignition tester
90890-06754



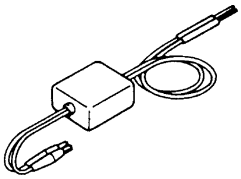
Vacuum/pressure pump gauge set
90890-06756



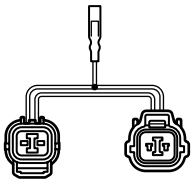
Digital circuit tester
90890-03174



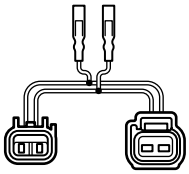
Test harness (6 pins)
90890-06848



Peak voltage adapter B
90890-03172



Test harness (2 pins)
90890-06792



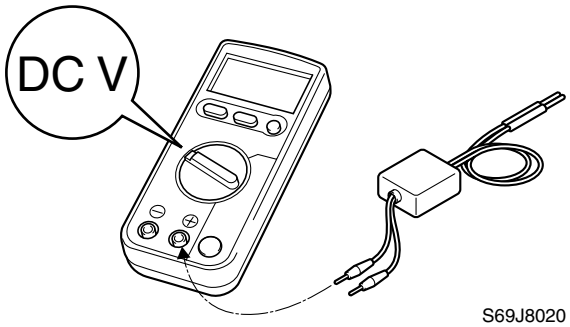
Test harness (2 pins)
New: 90890-06867
Current: 90890-06767

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.



S69J8020

⚠ WARNING

When checking the peak voltage, do not touch any of the connections of the digital tester leads.

NOTE:
- Use the peak voltage adapter 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 adapter 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 due to the internal resistance of the tester. To obtain the correct value, subtract the internal resistance from the displayed measurement.

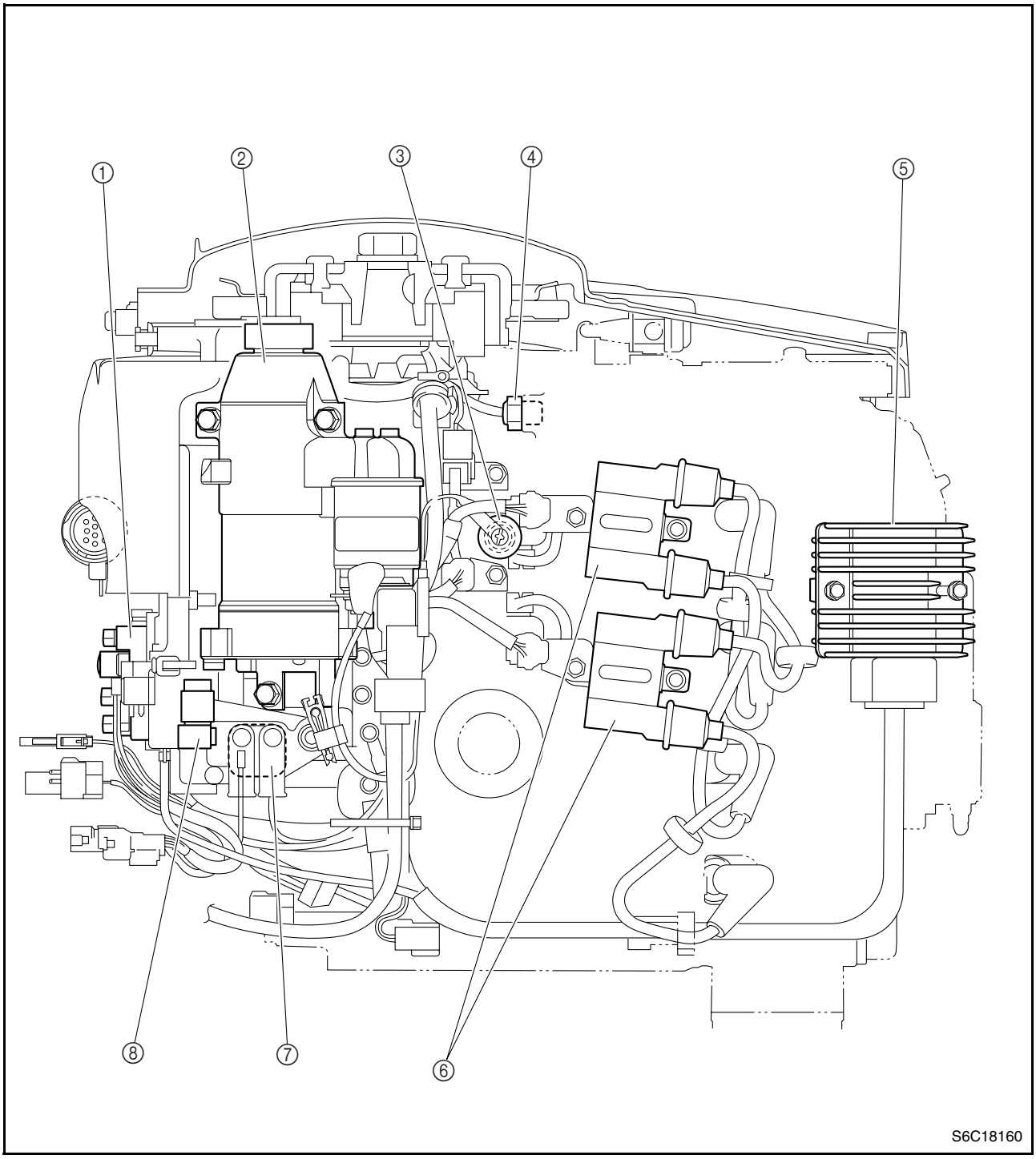
NOTE:
To obtain the internal resistance of the digital circuit tester, connect both of its probes and check the display.

Correct value =
displayed measurement – internal resistance

8

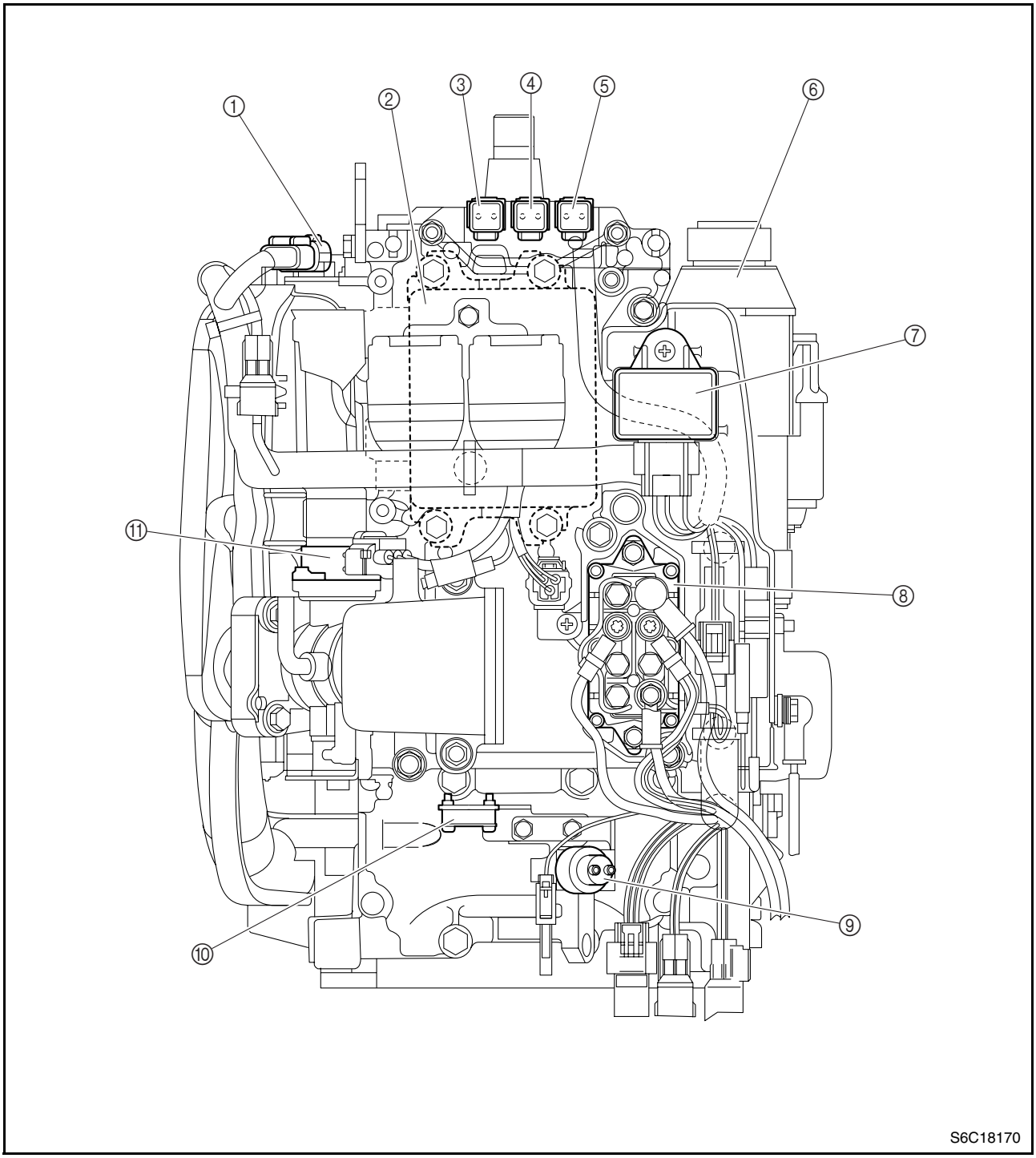
Electrical components

Port view



① Power trim and tilt relay
② Starter motor
③ Oil pressure switch
④ Cooling water temperature sensor
⑤ Rectifier Regulator
⑥ Ignition coil
⑦ Starter relay
⑧ Fuse (30 A) (starter relay)

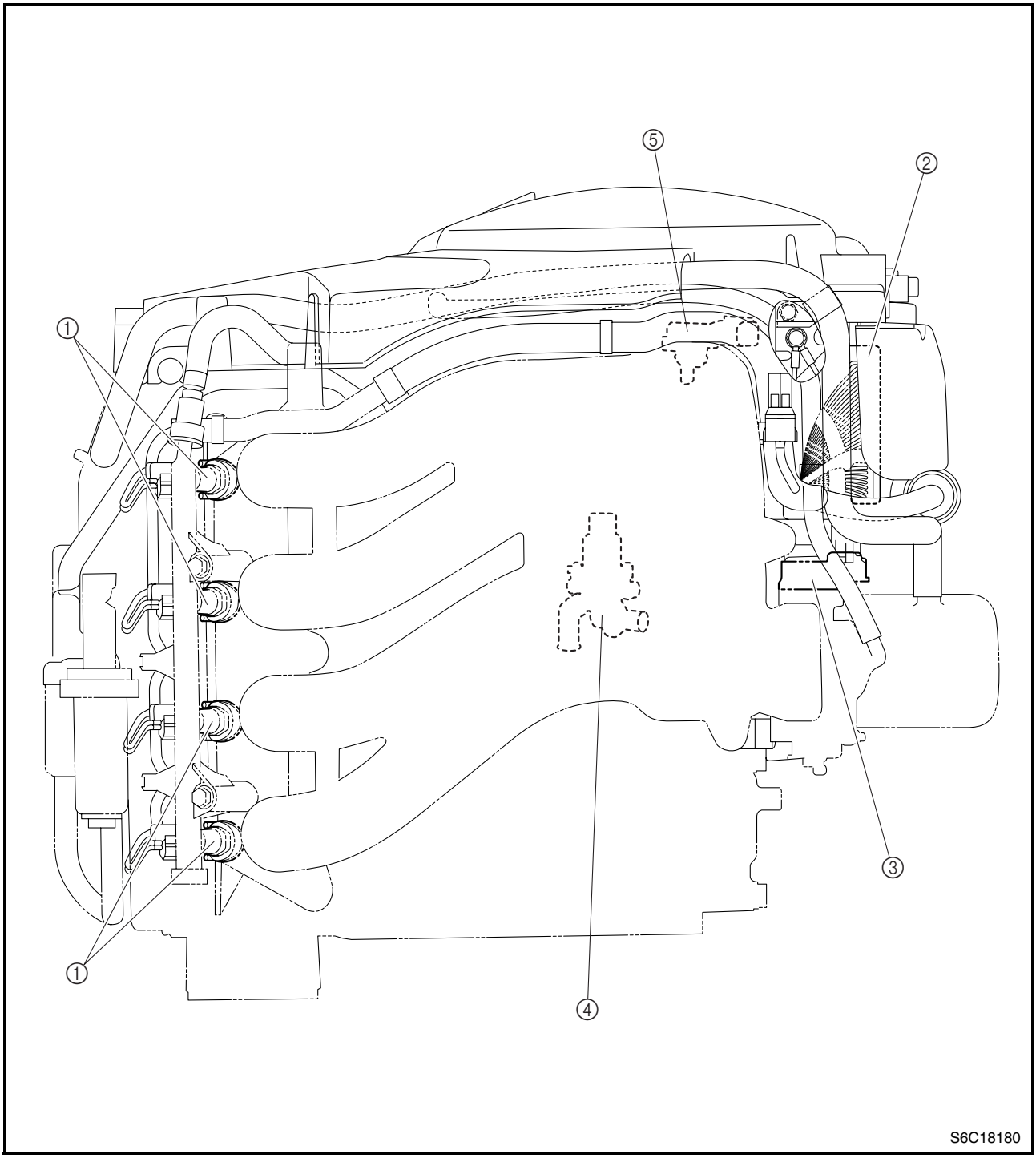
Bow view



① Sensor assembly (intake air temperature and intake air pressure)
② ECM
③ Fuse (20 A) (ECM, ignition coil, electric fuel pump, fuel injector, idle speed control, and vapor separator)
④ Fuse (20 A) (main switch and power trim and tilt switch)
⑤ Fuse (20 A) (Rectifier Regulator)
⑥ Starter motor
⑦ Main and fuel pump relay
⑧ Power trim and tilt relay
⑨ Neutral switch (tiller handle model)
⑩ Shift position switch
⑪ Throttle position sensor

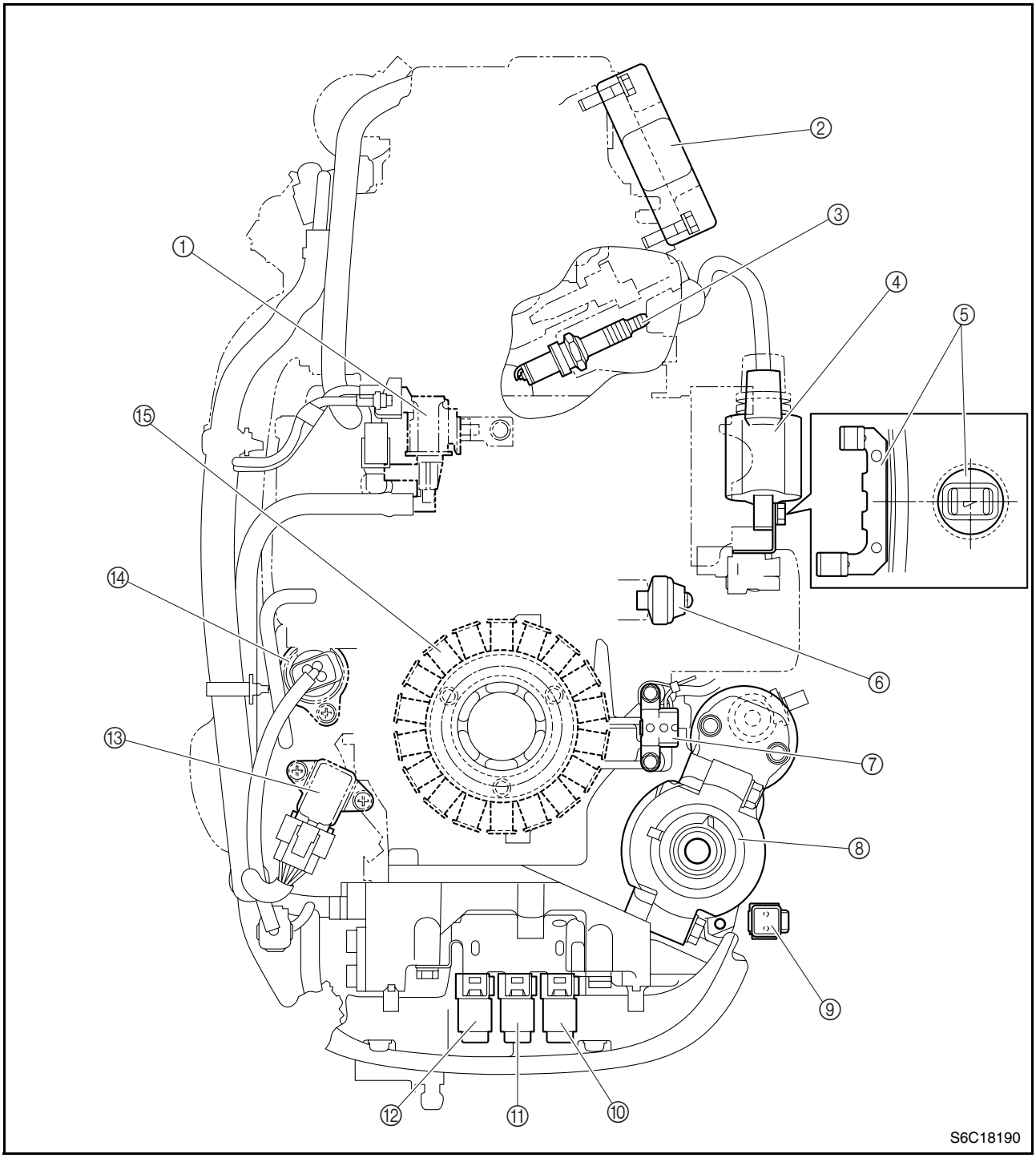
8

Starboard view



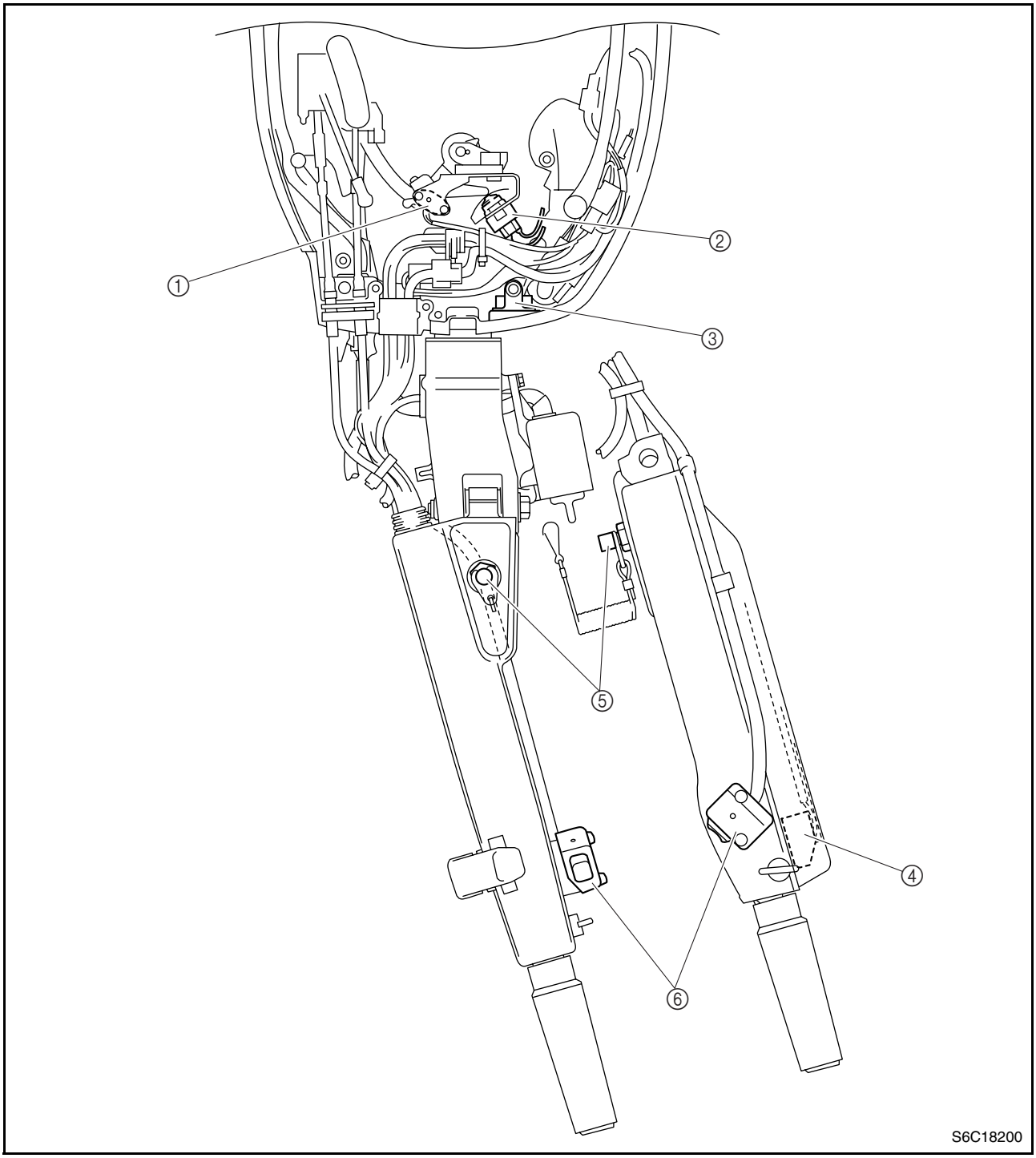
① Fuel injector
② ECM
③ Throttle position sensor
④ Idle speed control
⑤ Sensor assembly (intake air temperature and intake air pressure)

Top view



① Solenoid valve
② Rectifier Regulator
③ Spark plug
④ Ignition coil
⑤ Power trim and tilt switch (remote control model)
⑥ Oil pressure switch
⑦ Pulser coil
⑧ Starter motor
⑨ Fuse (30 A) (starter relay)
⑩ Fuse (20 A) (Rectifier Regulator)
⑪ Fuse (20 A) (main switch and power trim and tilt switch)
⑫ Fuse (20 A) (ECM, ignition coil, electric fuel pump, fuel injection, idle speed control, and vapor separator)
⑬ Sensor assembly (intake air temperature and intake air pressure)
⑭ Idle speed control
⑮ Stator coil

Tiller handle model



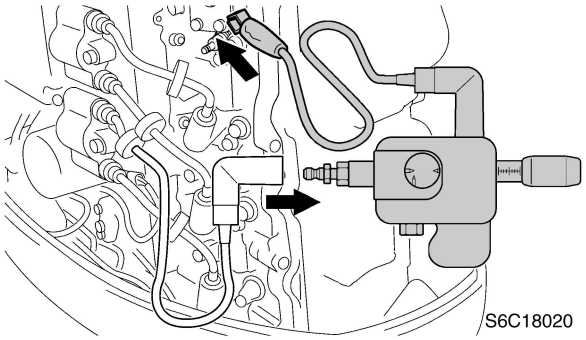
① Shift position switch
② Neutral switch (tiller handle model)
③ Warning indicator (tiller handle model)
④ Power trim and tilt switch
⑤ Engine stop lanyard switch
⑥ Variable trolling RPM switch (optional)

Ignition and ignition control system

Checking the ignition spark

1. Disconnect the spark plug caps from the spark plugs.

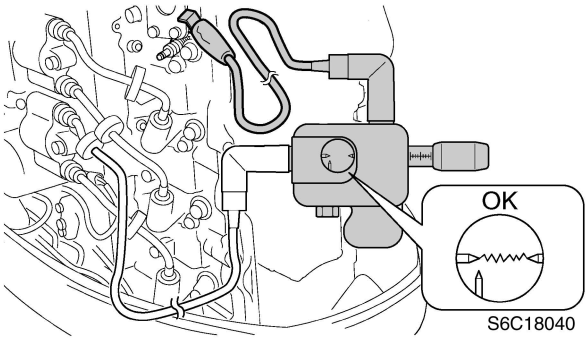
2. Connect a spark plug cap to the special service tool.





Ignition tester: 90890-06754

3. Crank the engine and observe the spark through the discharge window of the special service tool. Check the ignition system if the spark is weak.



⚠ WARNING

- **Do not touch any of the connections of the ignition 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.**

NOTE:

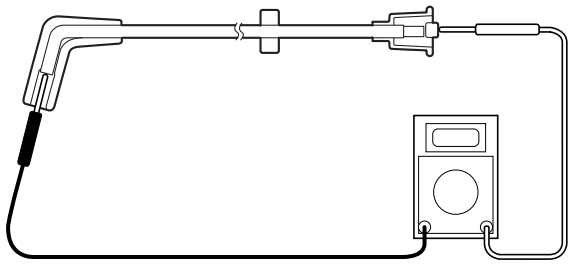
The ignition spark can also be checked using the “Stationary test” of the Yamaha Diagnostic System.

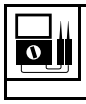
Checking the spark plug wires

1. Remove the spark plug wires from the spark plugs.

2. Remove the spark plug wires from the ignition coils.

3. Measure the spark plug wire resistance. Replace if out of specification.





Spark plug wire resistance:
1.9–5.0 kΩ

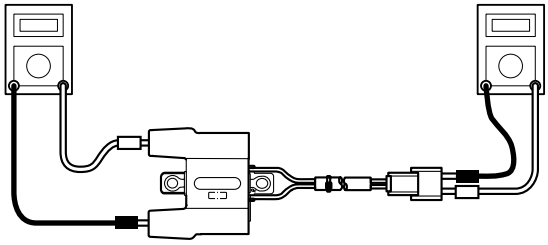
Checking the ignition coils

1. Remove the spark plug wires from the ignition coils.

2. Disconnect the ignition coil coupler.

8

3. Measure the ignition coil resistance. Replace if out of specification.



S63P8100

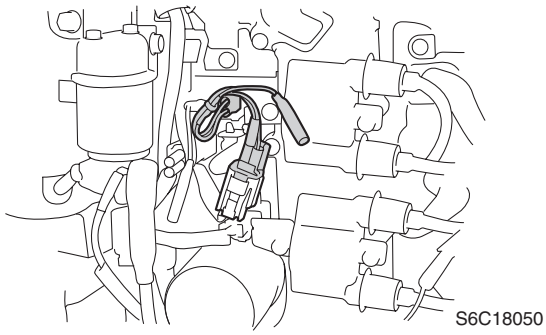
Ignition coil resistance:
Primary coil:
Red (R) – Black/white (B/W)
1.53–2.07 Ω at 20 °C (68 °F)
Secondary coil:
12.50–16.91 kΩ at 20 °C (68 °F)

Checking the ECM

1. Disconnect an 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.



S6C18050

Digital circuit tester: 90890-03174
Peak voltage adapter B:
90890-03172
Test harness (2 pins): 90890-06792

ECM output peak voltage:
Black/red (B/R) – Ground
Black/white (B/W) – Ground

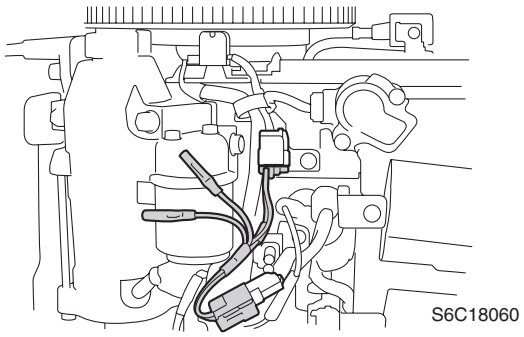
r/min	Loaded		
	Cranking	1,500	3,500
DC V	240	290	300

Checking the pulser coil

1. Remove the flywheel magnet cover and disconnect the pulser coil coupler.

2. Connect the test harness (2 pins) to the pulser coil.

3. Measure the pulser coil output peak voltage. Replace the pulser coil if below specification.



S6C18060

Digital circuit tester: 90890-03174
Peak voltage adapter B:
90890-03172
Test harness (2 pins):
New: 90890-06867
Current: 90890-06767

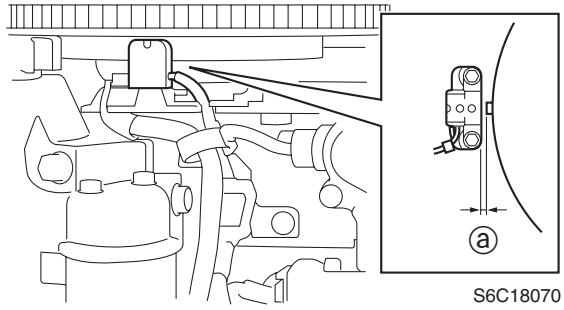
Pulser coil output peak voltage:
White/red (W/R) –
White/black (W/B)

r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	7.9	7.2	20.7	32.0

Pulser coil resistance
(reference data):
396–594 Ω

Checking the pulser coil air gap

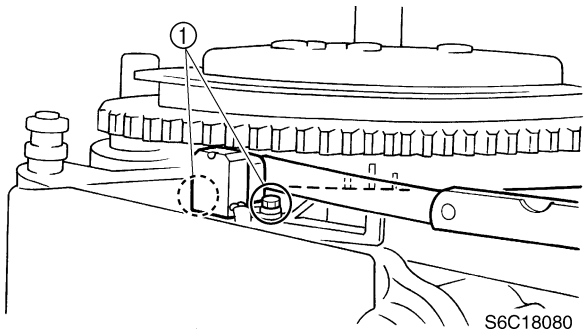
1. Remove the flywheel magnet cover.
2. Turn the flywheel magnet clockwise to align the projection of the flywheel magnet with the pulser coil projection.
3. Measure the pulser coil air gap ⓐ. Adjust if out of specification.



S6C18070

Pulser coil air gap:
0.75 ± 0.25 mm (0.030 ± 0.010 in)

4. Loosen the bolts ① and adjust the pulser coil air gap.



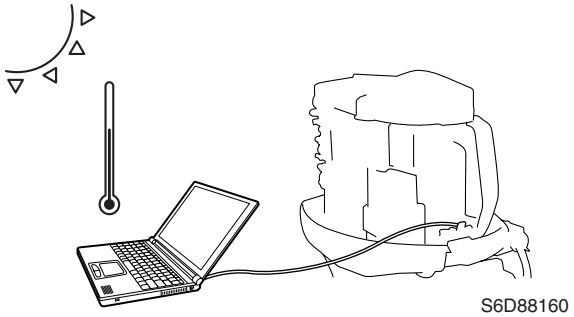
S6C18080

5. Tighten the bolts, and then check the pulser coil air gap again. Adjust if necessary.

Pulser coil bolt:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

Checking the sensor assembly

1. Measure the ambient temperature.
2. Connect a computer to the outboard motor and use the Yamaha Diagnostic System to display the intake air temperature.

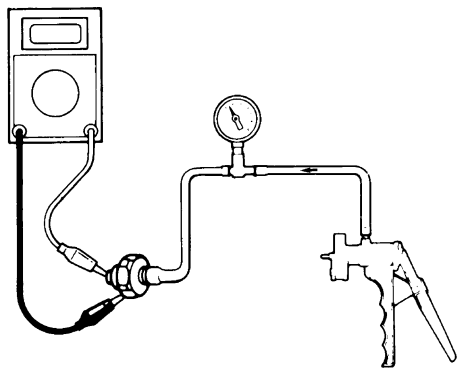

S6D88160

3. If the ambient temperature and the displayed intake air temperature differ by more than ± 5 °C (± 9 °F), replace the sensor assembly.

NOTE:
Check the sensor assembly when the engine is cold.

Checking the oil pressure switch

1. Check the oil pressure switch for continuity. Replace if there is no continuity.
2. Connect the special service tool to the oil pressure switch.
3. Slowly operate the special service tool.


S6C18220

8

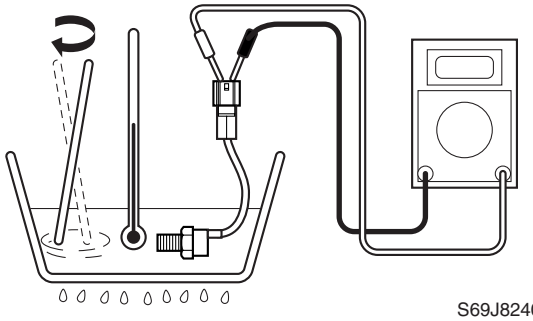
4. Check the switch for no continuity at the specified pressure. Replace if there is continuity.

Vacuum/pressure pump gauge set:
90890-06756

Specified oil pressure:
29.4–58.8 kPa
(0.29–0.59 kgf/cm^2, 4.26–8.53 psi)

Checking the cooling water temperature sensor

1. Place the cooling water temperature sensor in a container of water and slowly heat the water.



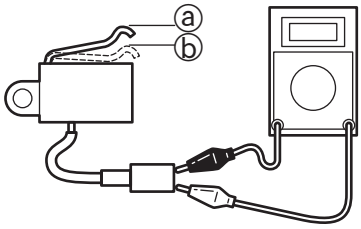
S69J8240

2. Measure the cooling water temperature sensor resistance. Replace if out of specification.

Cooling water temperature sensor resistance:
Black/yellow (B/Y) – Black (B)
at 20 °C (68 °F): 2.439 kΩ
at 60 °C (140 °F): 0.589 kΩ
at 100 °C (212 °F): 0.193 kΩ

Checking the shift position switch

1. Check the shift position switch for continuity. Replace if there is no continuity.

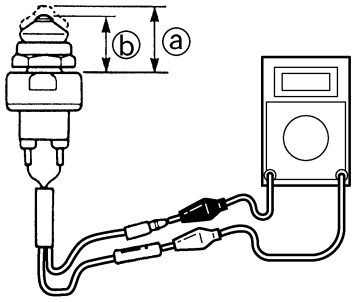


S69J8270

Switch position	Lead color	
	Blue/green (L/G)	Black (B)
Free ⓐ		
Push ⓑ	○	○

Checking the neutral switch (tiller handle model)

1. Check the neutral switch for continuity. Replace if there is no continuity.

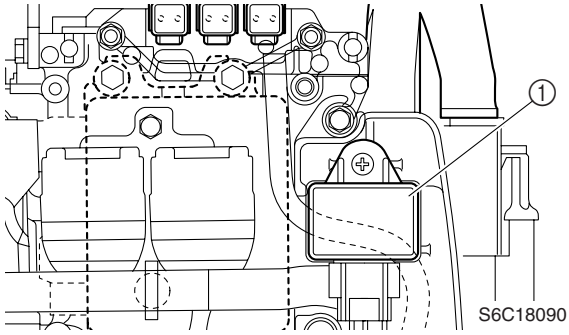


S66T8250

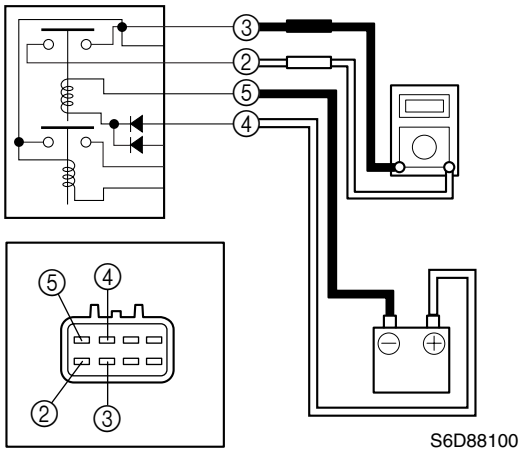
Switch position	Lead color	
	Brown (Br)	Brown (Br)
Free ⓐ		
Push ⓑ	○	○

Checking the main and fuel pump relay (main control)

1. Remove the main and fuel pump relay ①.

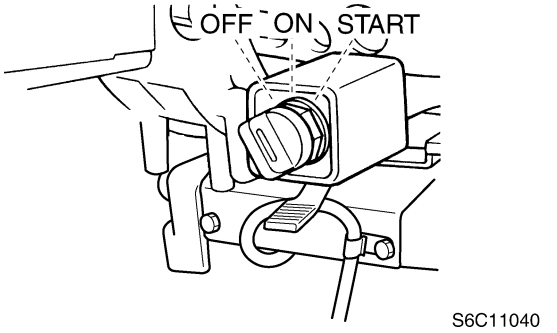


2. Connect the digital circuit tester leads to the relay terminals ② and ③.
3. Connect the positive battery terminal to the main and fuel pump relay terminal ④.
4. Connect the negative battery terminal to the main and fuel pump relay terminal ⑤.
5. Check for continuity between the relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals after disconnecting a battery terminal from the relay terminal ④ or ⑤. Replace if there is continuity.



Checking the engine start switch (tiller handle model)

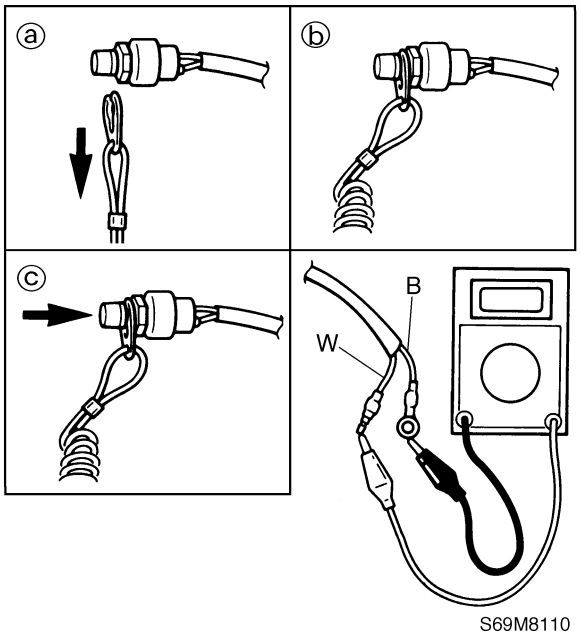
1. Check the engine start switch for continuity. Replace if there is no continuity.



Switch position	Lead color				
	White (W)	Black (B)	Red (R)	Pink (P)	Brown (Br)
Off	○—○				
On			○—○		
Start			○—○	○—○	

Checking the engine stop lanyard switch (tiller handle model)

1. Check the engine stop lanyard switch for continuity. Replace if out of specification.

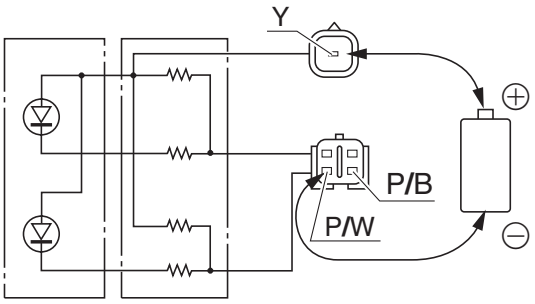


Switch position	Lead color	
	White (W)	Black (B)
Clip removed ⓐ	○—○	
Clip installed ⓑ		
Engine stop button pushed ⓒ	○—○	

8

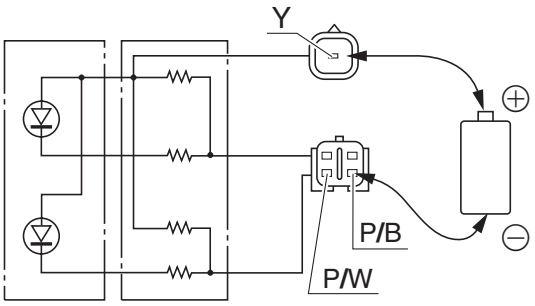
Checking the warning indicators (tiller handle model)

1. Connect a positive penlight battery terminal (1.5 V) to the yellow (Y) lead.
2. Connect a negative penlight battery terminal (1.5 V) to the pink and white (P/W) lead.
3. Check that the low oil pressure warning indicator (LED) comes on. Replace if it does not come on.



S6C18100

4. Connect a positive penlight battery terminal (1.5 V) to the yellow (Y) lead.
5. Connect a negative penlight battery terminal (1.5 V) to the pink and black (P/B) lead.
6. Check that the overheat warning indicator (LED) comes on. Replace if it does not come on.



S6C18110

CAUTION:

Only use a penlight battery (1.5 V) when checking the LEDs. Other batteries (e.g., alkaline batteries or high-voltage batteries) will damage the diodes.

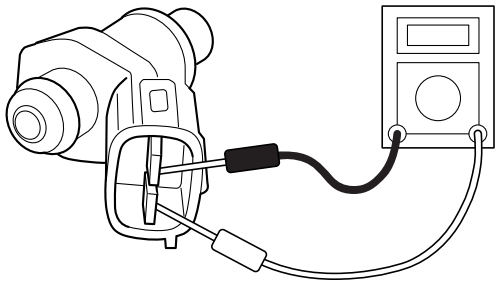
NOTE:

- Do not apply more than 1.7 V to the leads when checking the LEDs.
- The LEDs only allow current to flow in one direction. Therefore, if the LEDs do not come on, reverse the connection.

Fuel control system

Checking the injectors

1. Measure the resistance of the fuel injectors.


S6C14170

NOTE:

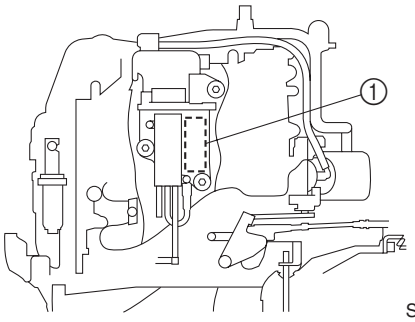
Check the operation of the fuel injectors using the “Stationary test” of the Yamaha Diagnostic System.

Digital circuit tester: 90890-03174

Fuel injector resistance (reference data):
12.0 Ω at 21 °C (70 °F)

Checking the electric fuel pump

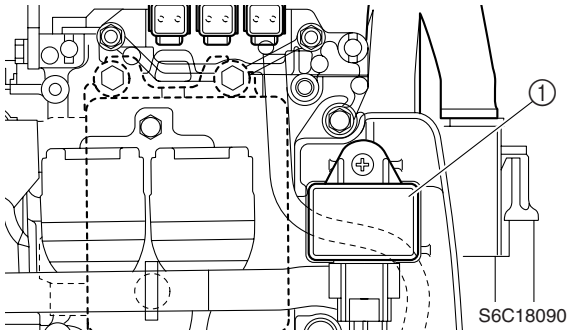
1. Turn the engine start switch to ON.
2. Listen for the operating sound of the electric fuel pump ①. Check the fuel system if there is no sound.



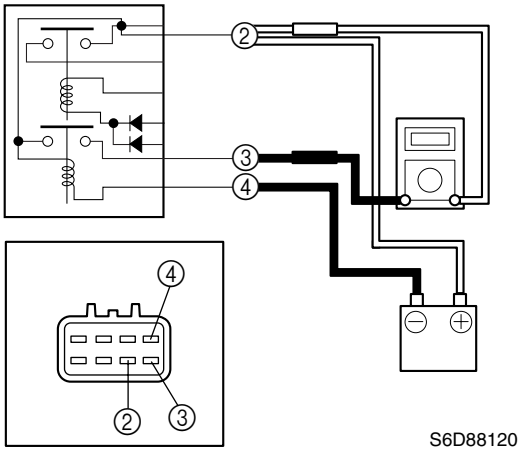
NOTE:
After the engine start switch is turned to ON, the electric fuel pump will operate for 3 seconds.

Checking the main and fuel pump relay (fuel control)

1. Remove the main and fuel pump relay ①.



2. Connect the digital circuit tester leads to the relay terminals ② and ③.
3. Connect the positive battery terminal to the relay terminal ②.
4. Connect the negative battery terminal to the relay terminal ④.
5. Check for continuity between the relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals after disconnecting a battery terminal from the relay terminal ② or ④. Replace if there is continuity.



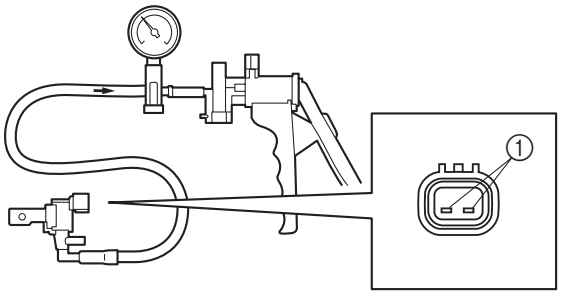
Checking the solenoid valve

1. Connect the special service tool to the solenoid valve.
2. Apply the specified negative pressure to the solenoid valve.

	Vacuum/pressure pump gauge set: 90890-06756

	Specified negative pressure: 67 kPa (0.7 kgf/cm^2, 9.7 psi)

3. Check that the solenoid valve opens and the negative pressure is released when the battery voltage is applied to the solenoid valve terminals ①.



	Solenoid valve resistance (reference data): 30.0–34.0 Ω at 20 °C (68 °F)

8

Starting system

Checking the fuses

1. Check the fuses for continuity. Replace if there is no continuity.

Checking the starter relay

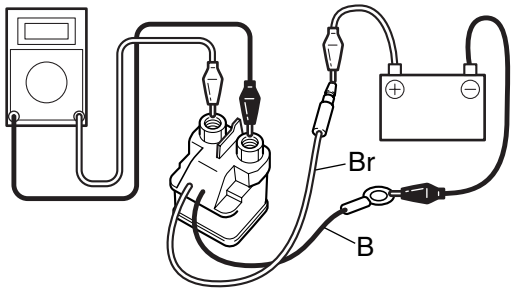
1. Connect the digital circuit tester leads to the starter relay terminals.

2. Connect the positive battery terminal to the brown (Br) lead.

3. Connect the negative battery terminal to the black (B) lead.

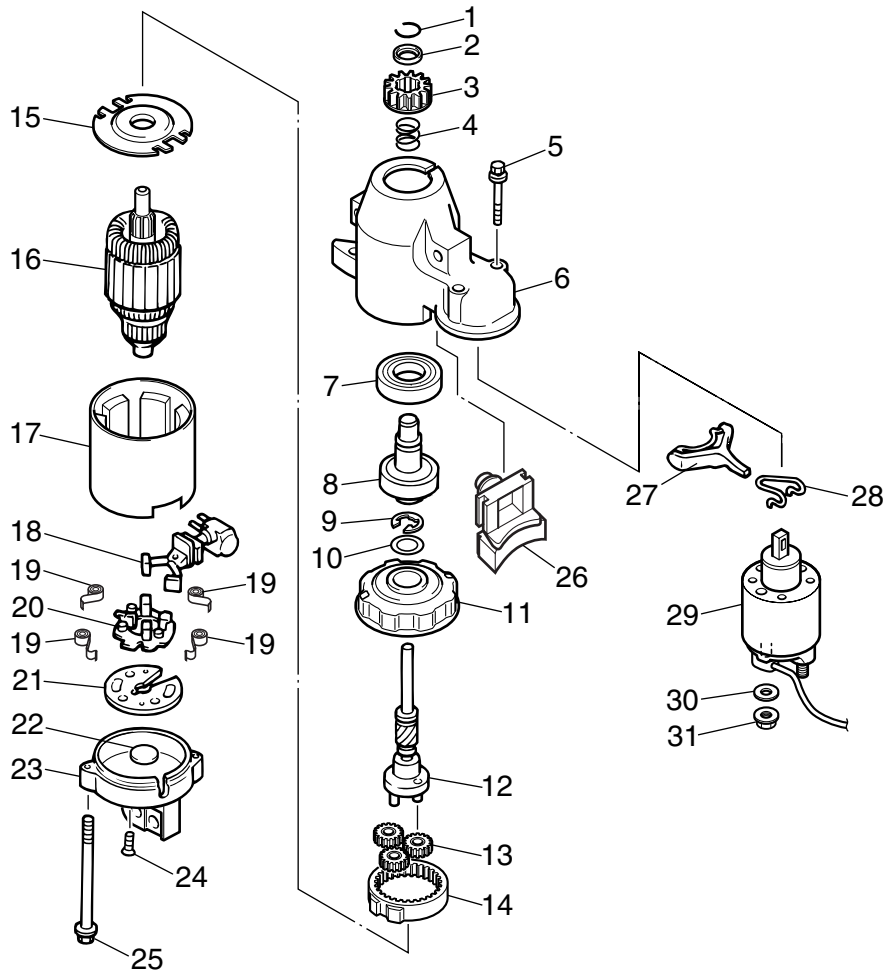
4. Check for continuity between the starter relay terminals. Replace if there is no continuity.

5. Check that there is no continuity between the starter relay terminals after disconnecting a battery terminal from the brown (Br) or black (B) lead. Replace if there is continuity.



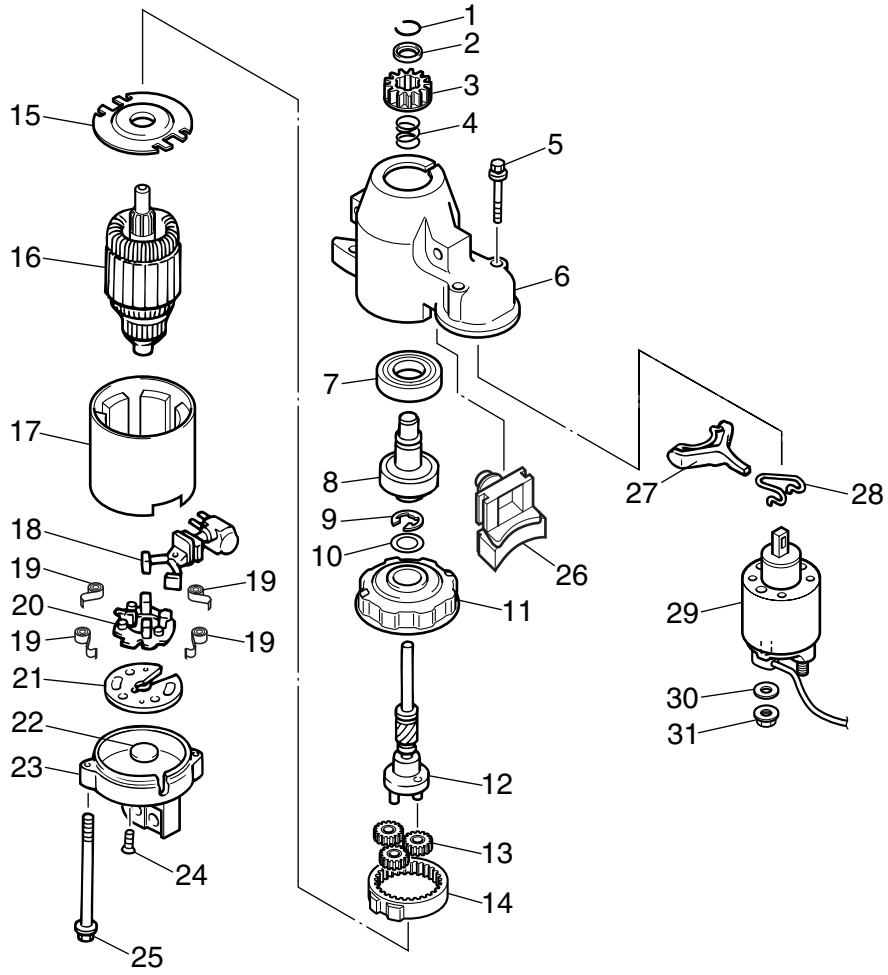
S60V8265

Starter motor



S63P8050

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	Bearing	1	
8	Clutch assembly	1	
9	E-clip	1	**Not reusable**
10	Washer	1	
11	Bracket	1	
12	Pinion shaft	1	
13	Planetary gear	3	
14	Outer gear	1	
15	Plate	1	
16	Armature	1	
17	Stator	1	

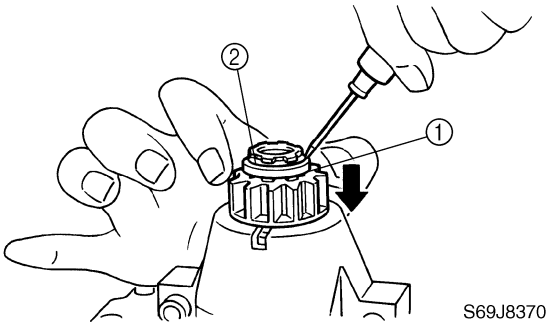


S63P8050

No.	Part name	Q'ty	Remarks
18	Brush assembly	1	
19	Brush spring	4	
20	Brush holder	1	
21	Plate	1	
22	Washer	1	
23	Bracket	1	
24	Screw	2	ø4 × 15 mm
25	Bolt	2	M6 × 120 mm
26	Rubber seal	1	
27	Shift lever	1	
28	Spring	1	
29	Magnet switch assembly	1	
30	Washer	1	
31	Nut	1	

Disassembling the starter motor

1. Slide the pinion stopper ① down as shown, and then remove the clip ②.



S69J8370

NOTE:
Remove the clip with a thin screwdriver.

2. Remove the bolt, and then disassemble the starter motor.

Checking the starter motor pinion

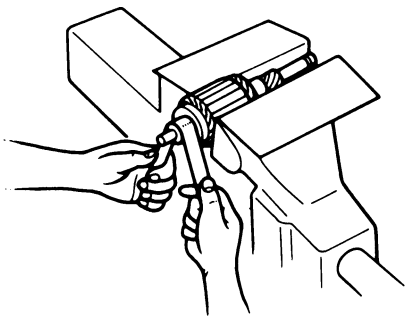
1. Check the teeth of the pinion for cracks or wear. Replace if necessary.

2. Check for smooth operation. Replace if necessary.

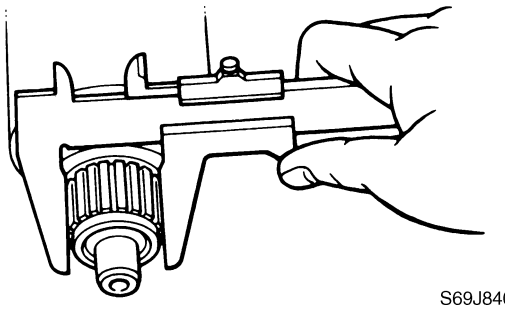
NOTE:
Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

Checking the armature

1. Check the commutator for dirt. Clean with 600–grit sandpaper and compressed air if necessary.

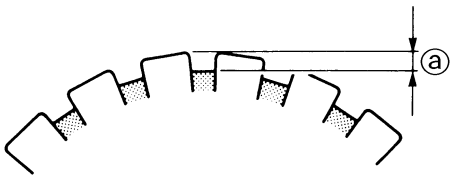

S69J8390

2. Measure the commutator diameter. Replace the armature if below specification.


S69J8400

Commutator diameter limit:
28.0 mm (1.10 in)

3. Measure the commutator undercut ⓐ. Replace the armature if below specification.

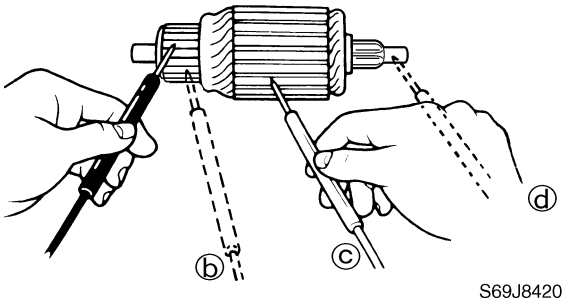


S69J8410

Commutator undercut wear limit ⓐ:
0.2 mm (0.01 in)

8

4. Check the armature for continuity. Replace if out of specifications.

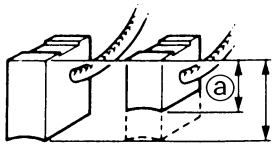


S69J8420

Armature continuity	
Commutator segments ⓑ	Continuity
Segment – Armature core ⓒ	No continuity
Segment – Armature shaft ⓓ	No continuity

Checking the brushes

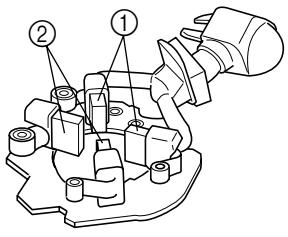
1. Measure the brush length. Replace the brush assembly if below specification.



S69J8430

Brush length wear limit ⓐ:
9.5 mm (0.37 in)

2. Check the brush holder assembly for continuity. Replace if out of specification.

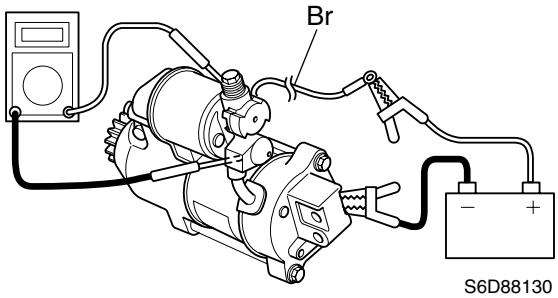


S69J8440

Brush continuity	
Brush ① – Brush ②	No continuity

Checking the magnet switch

1. Connect the tester leads between the magnet switch terminals as shown.
2. Connect the positive battery lead to the brown (Br) lead.
3. Connect the negative battery lead to the starter motor body.



S6D88130

CAUTION:

Do not connect the battery for more than one second, otherwise the magnet switch can be damaged.

4. Check that there is continuity between the magnet switch terminals. Replace if there is no continuity.
5. Check that there is no continuity after the negative battery terminal is removed. Replace if there is continuity.

NOTE:

The starter motor pinion should be pushed out while the magnet switch is on.

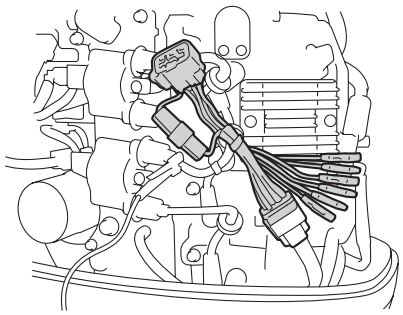
Checking the starter motor operation

1. Check the operation of the starter motor after installing it onto the power unit.

Charging system

Checking the stator coil

1. Disconnect the stator coil coupler.
2. Connect the test harness (6 pins) to the stator coil coupler.
3. Measure the stator coil output peak voltage. Replace the stator coil if below specification.


S6C18150

Digital circuit tester: 90890-03174
Peak voltage adapter B: 90890-03172
Test harness (6 pins): 90890-06848

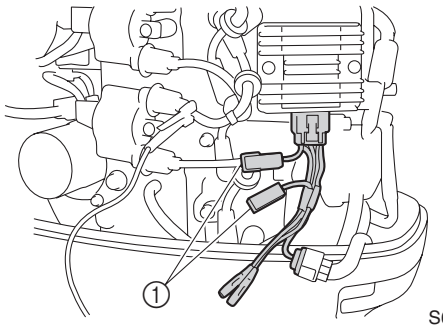
Stator coil output peak voltage:
White (W) – White (W)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	13.2	42.2	96.6

Stator coil resistance (reference data):
White (W) – White (W)
0.52–0.63 Ω at 20 °C (68 °F)

Checking the Rectifier Regulator

1. Disconnect the stator coil coupler.
2. Connect the test harness (6 pins) between the Rectifier Regulator and stator coil coupler.
3. Disconnect the test harness coupler ①, and then measure the Rectifier Regulator output peak voltage at the coupler. 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.



S6C18140

Digital circuit tester: 90890-03174
Test harness (6 pins): 90890-06848

Rectifier Regulator output peak voltage:
Red (R) – Black (B)

r/min	Unloaded	
	1,500	3,500
DC V	13.0	13.0

8

— MEMO —

TRBL SHTG ?

Troubleshooting

Special service tools 9-1

Yamaha Diagnostic System 9-2
Introduction 9-2

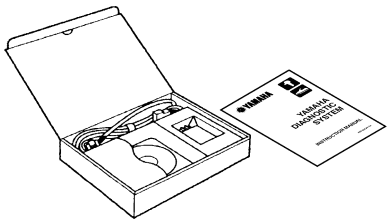
Self-diagnosis 9-5
Diagnosing the electronic control system 9-5

Power unit 9-7

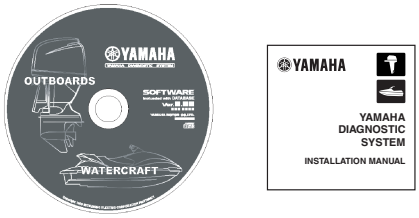
Power trim and tilt unit 9-22

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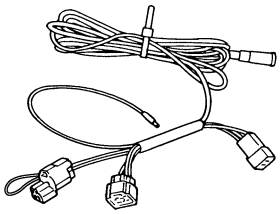
Special service tools



Yamaha Diagnostic System
60V-85300-02



Yamaha Diagnostic System
60V-WS853-02



Diagnostic flash indicator B
90890-06865

Yamaha Diagnostic System

Introduction

Features

The newly developed Yamaha Diagnostic System provides quicker detection and analysis of engine malfunctions for quicker troubleshooting procedures than traditional methods.
By connecting your computer to the ECM (Electronic Control Module) of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the ECM on a computer's monitor.
If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, Windows 2000, or Windows XP the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.
In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, and Data logger) can be saved on a disk or printed out.

Functions

1. **Diagnosis:** With the engine main switch ON, each sensor's status and each ECM diagnosis code or item is displayed. This enables you to find malfunctioning parts and controls quickly.

2. **Diagnosis record:** Sensors that had been activated and ECM diagnostic codes that have been recorded are displayed. This allows you to check the outboard motor's record of malfunctions.

3. **Engine monitor:** Each sensor status and the ECM data are displayed while the engine is running. This enables you to find malfunctioning parts quickly.

4. **Stationary test:** With the engine off, the ignition, fuel injection, electric fuel pump, and idle speed control valve are checked. These tests can be performed quickly.

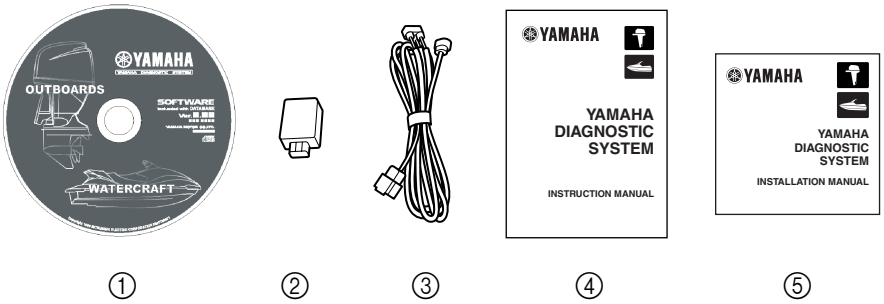
5. **Active test:** With the engine running, each firing cylinder has dropped and the engine speed is checked for changes to determine whether the cylinder is malfunctioning, and the idle speed control valve is checked as well. These tests can be performed quickly.

6. **Data logger:** Displays 13 minutes of recorded data for two or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine.

7. **Some files:** Lets you select and run other applications while continuing to run the diagnostic program.

Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)



① ② ③ ④ ⑤

9

Hardware requirements

Make sure that your computer meets the following requirements before using this software.

Computer:	IBM-compatible computer
Operating system:	Microsoft Windows 95, Windows 98, Windows Me, Windows 2000, or Windows XP (English version)
CPU:	
Windows 95/98:	i486X, 100 MHz or higher (Pentium 100 MHz or higher recommended)
Windows Me/2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 95/98:	16 MB or more (32 MB or more recommended)
Windows Me:	32 MB or more (64 MB or more recommended)
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels), (SVGA [800 × 600 pixels] or more recommended) 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

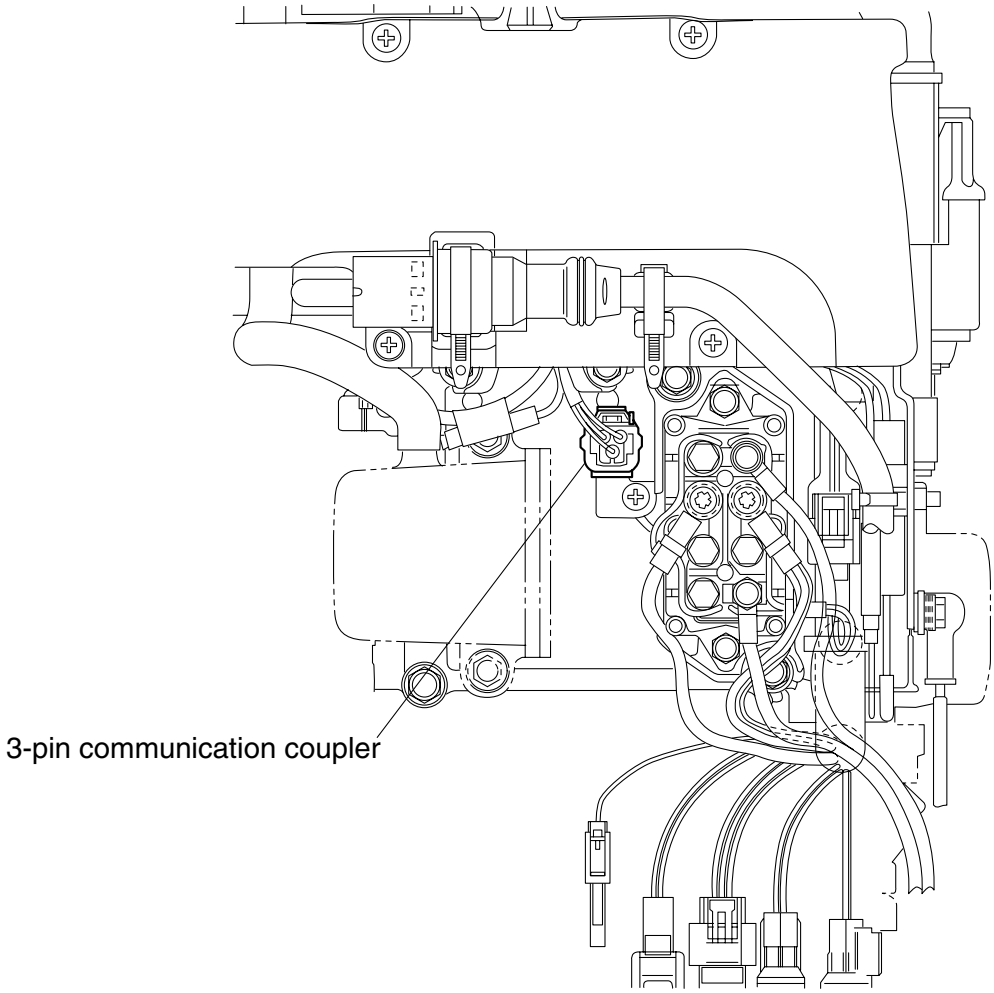
NOTE:

- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
- Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
- This software will not run properly on some computers.
- When starting up this program, do not start other software applications.
- Do not use the screen saver function or the energy saving feature when using this program.
- If the ECM is changed, restart the program.
- Windows XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.
- The USB adapter cannot be used with Windows 95.

For operating instructions of the Yamaha Diagnostic System, refer to the “Yamaha Diagnostic System Instruction Manual.”

Connecting the communication cable to the outboard motor

Bow view

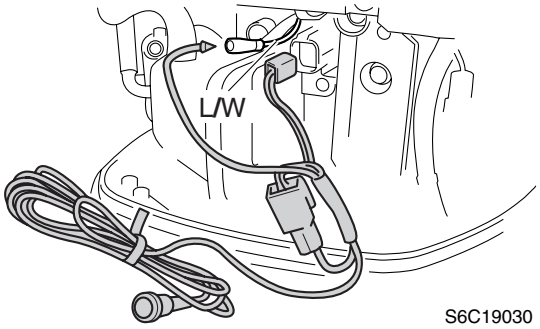


S6C19010

Self-diagnosis

Diagnosing the electronic control system

1. Connect the special service tool to the outboard motor as shown.



S6C19030

NOTE:
When performing this diagnosis, all of the electrical wires must be properly connected.

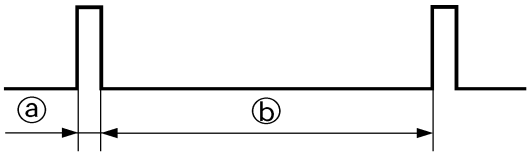

Diagnostic flash indicator B:
90890-06865

2. Start the engine and let it idle.

3. Check the flash pattern of the special service tool to determine if there are any malfunctions.

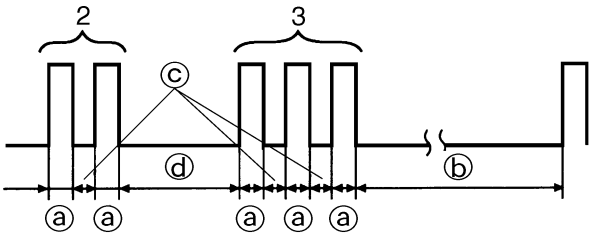
   - Normal condition
     (no defective part or irregular processing is found)

   - Single flash is given every 4.95 seconds.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds



S69J9020

   - Trouble code indication
     Example: The illustration indicates code number 23.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds
     ⓒ: Light off, 0.33 second
     ⓓ: Light off, 1.65 seconds



S69J9030

4. If a flash pattern listed in the diagnostic code chart is displayed, check the malfunctioning part according to the flash pattern.

NOTE:
When more than one problem is detected, the light of the special service tool 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.

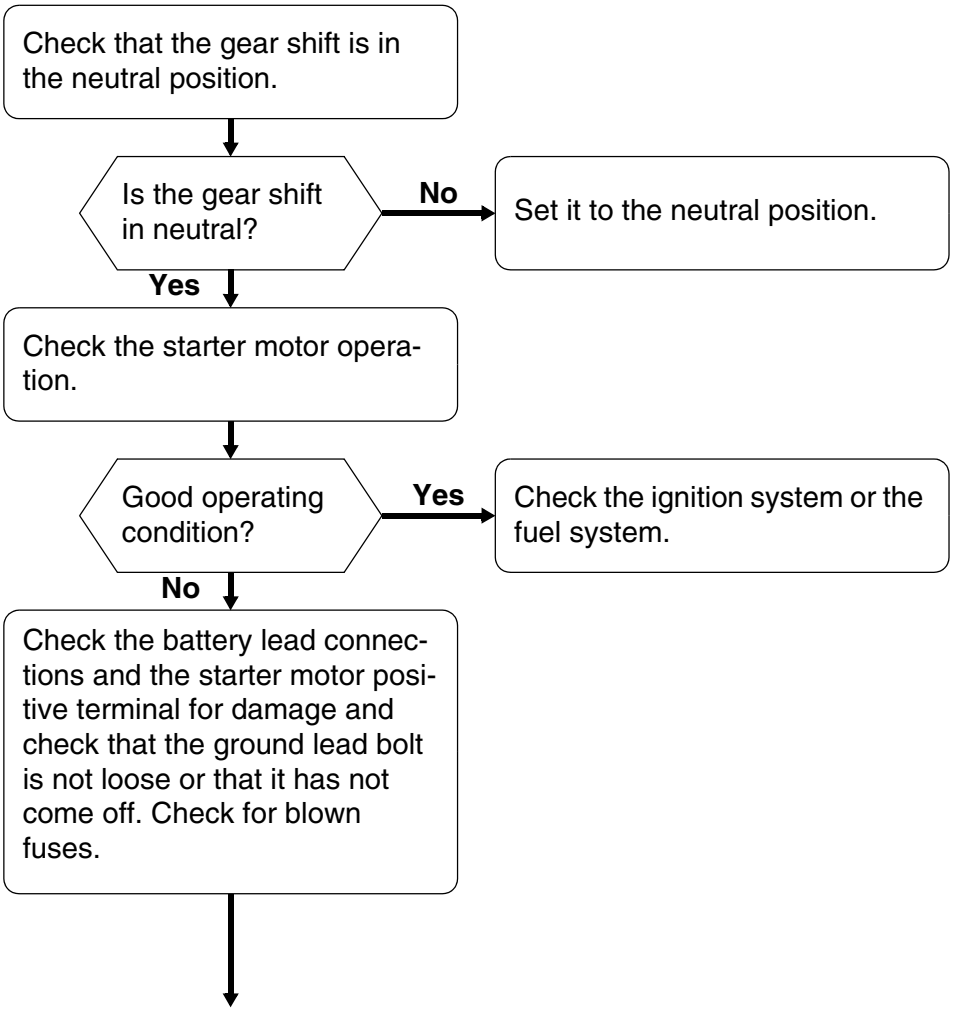
Code	Symptom
1	Normal
15	Incorrect cooling water temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
23	Incorrect sensor assembly (intake air temperature sensor) signal
28	Incorrect neutral switch signal
29	Incorrect sensor assembly (intake air pressure sensor) signal
37	Incorrect idle speed control signal
44	Incorrect engine stop lanyard switch signal
49	Over cool signal
59	Incorrect memory data signal

NOTE:
- Before troubleshooting the outboard motor, check the mounting and rigging of the outboard motor. Also, make sure that the specified fuel has been used and that the battery is fully charged.
- To diagnose a mechanical malfunction, use the troubleshooting charts for each trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 3–8 for safe maintenance procedures.
- To diagnose a sensor or switch malfunction, use the diagnostic flash indicator to determine the cause.

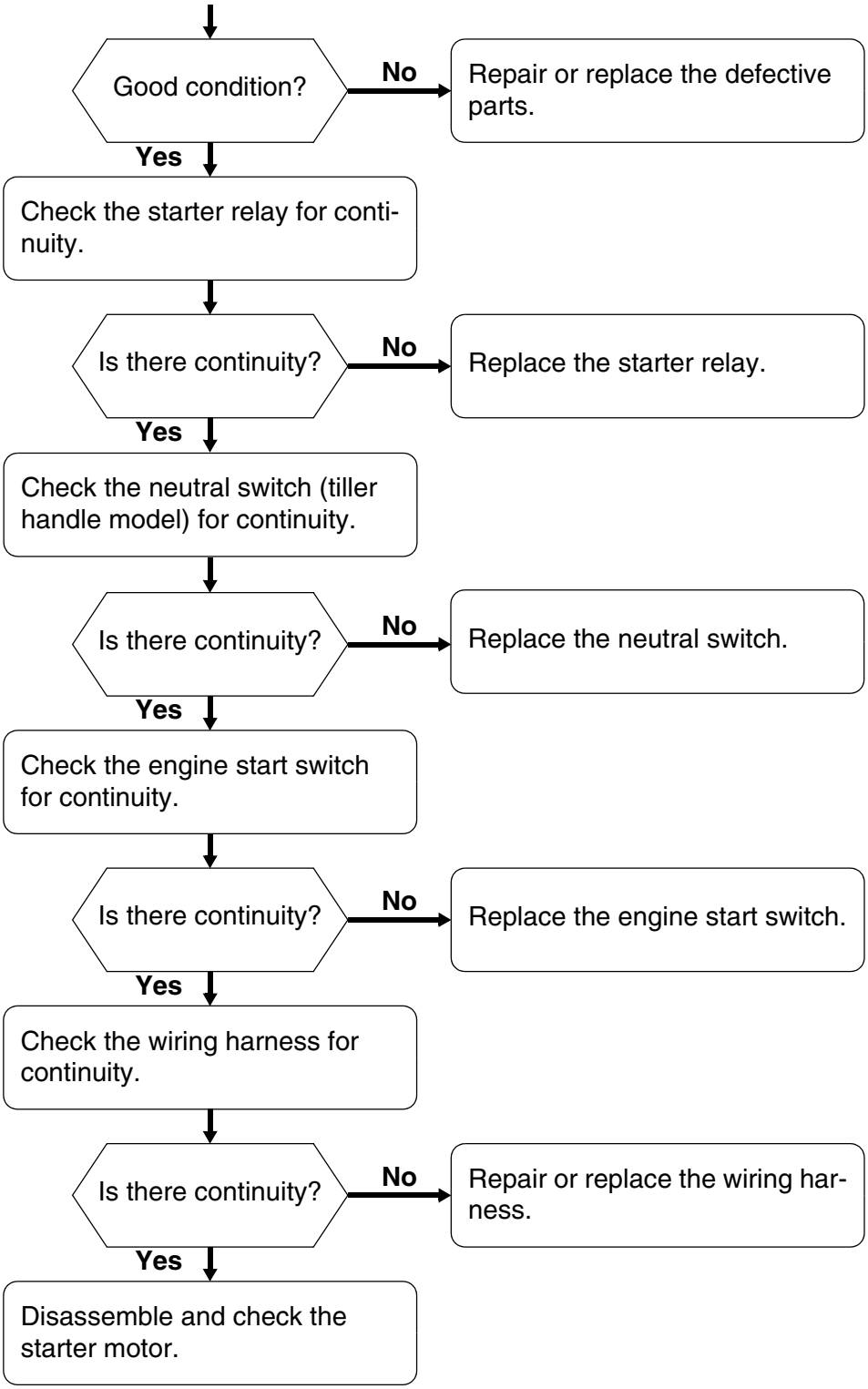
Power unit

Symptom 1: Engine does not start or starting the engine is difficult.

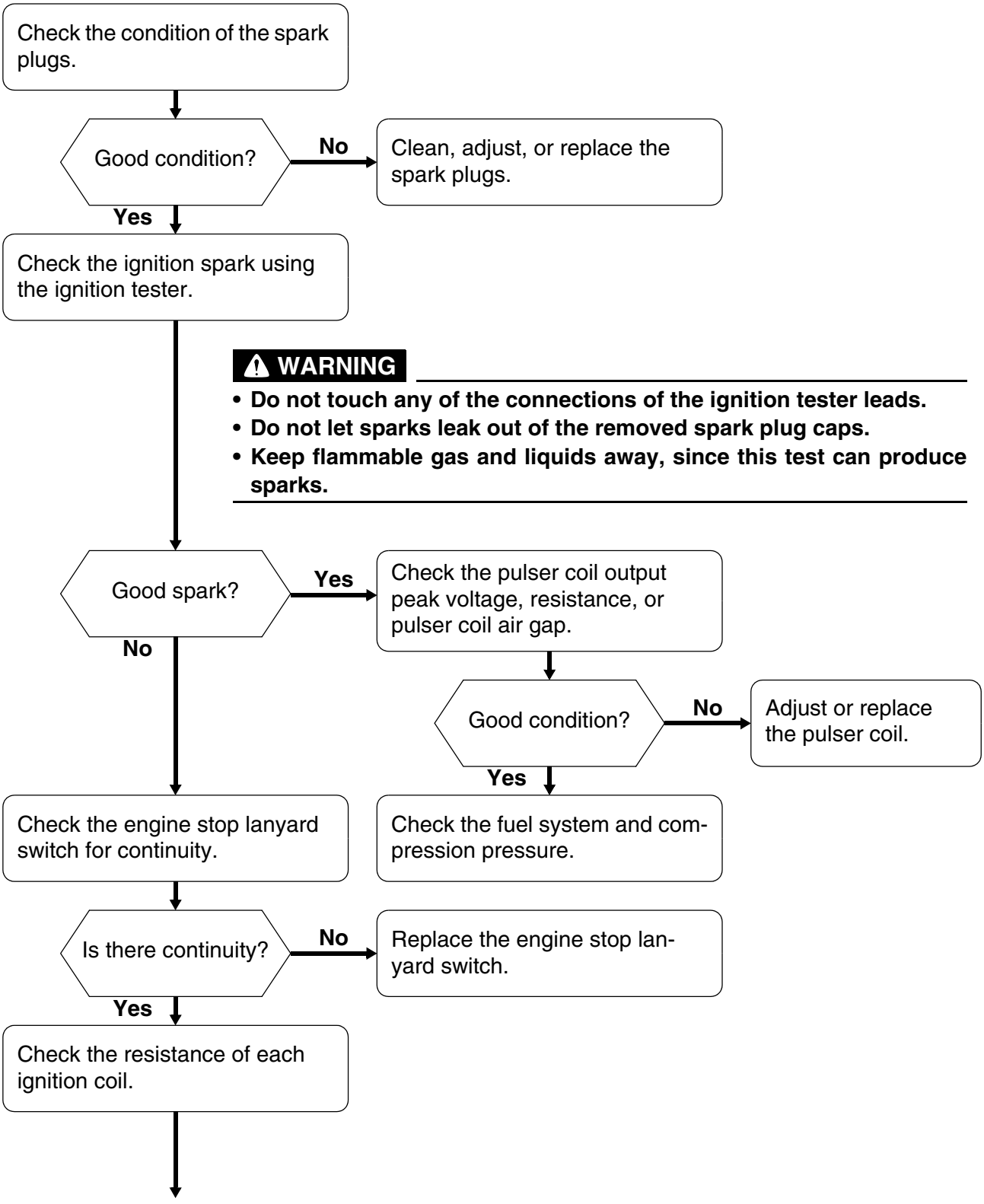
Starting system



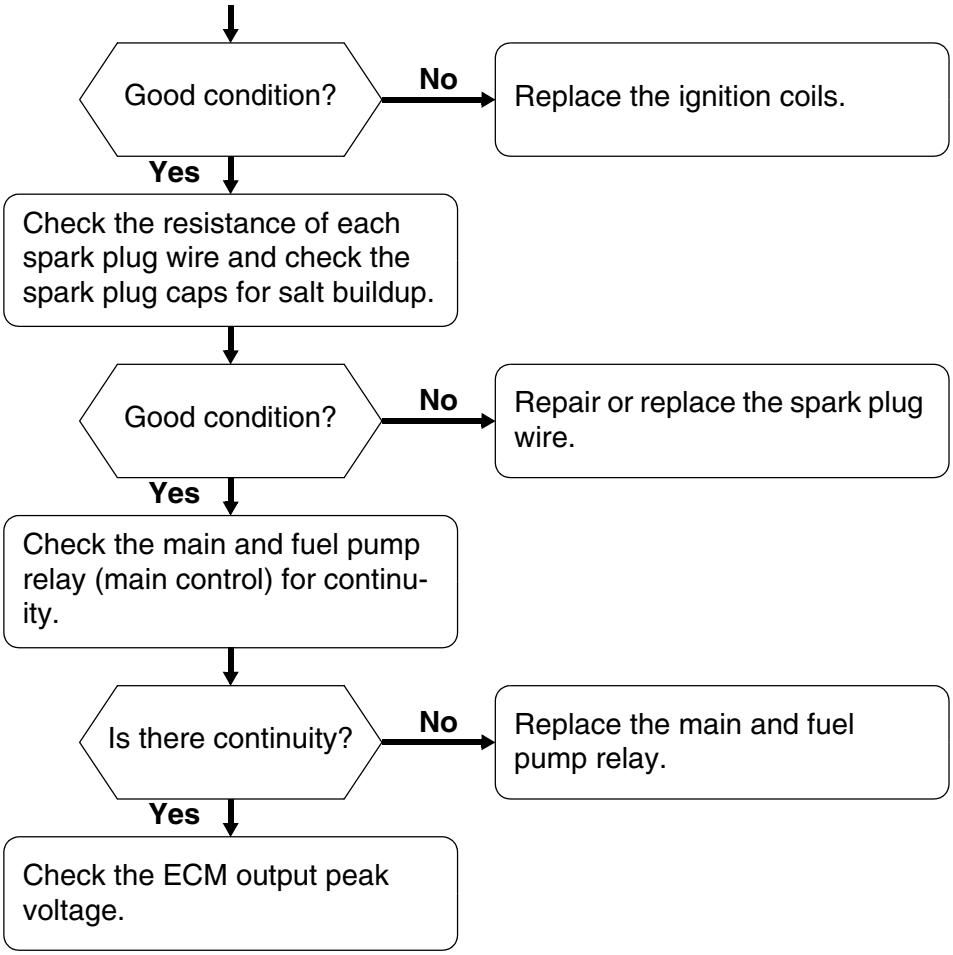
Continued on next page.


Good condition?
No
Repair or replace the defective parts.
Yes
Check the starter relay for continuity.
Is there continuity?
No
Replace the starter relay.
Yes
Check the neutral switch (tiller handle model) for continuity.
Is there continuity?
No
Replace the neutral switch.
Yes
Check the engine start switch for continuity.
Is there continuity?
No
Replace the engine start switch.
Yes
Check the wiring harness for continuity.
Is there continuity?
No
Repair or replace the wiring harness.
Yes
Disassemble and check the starter motor.

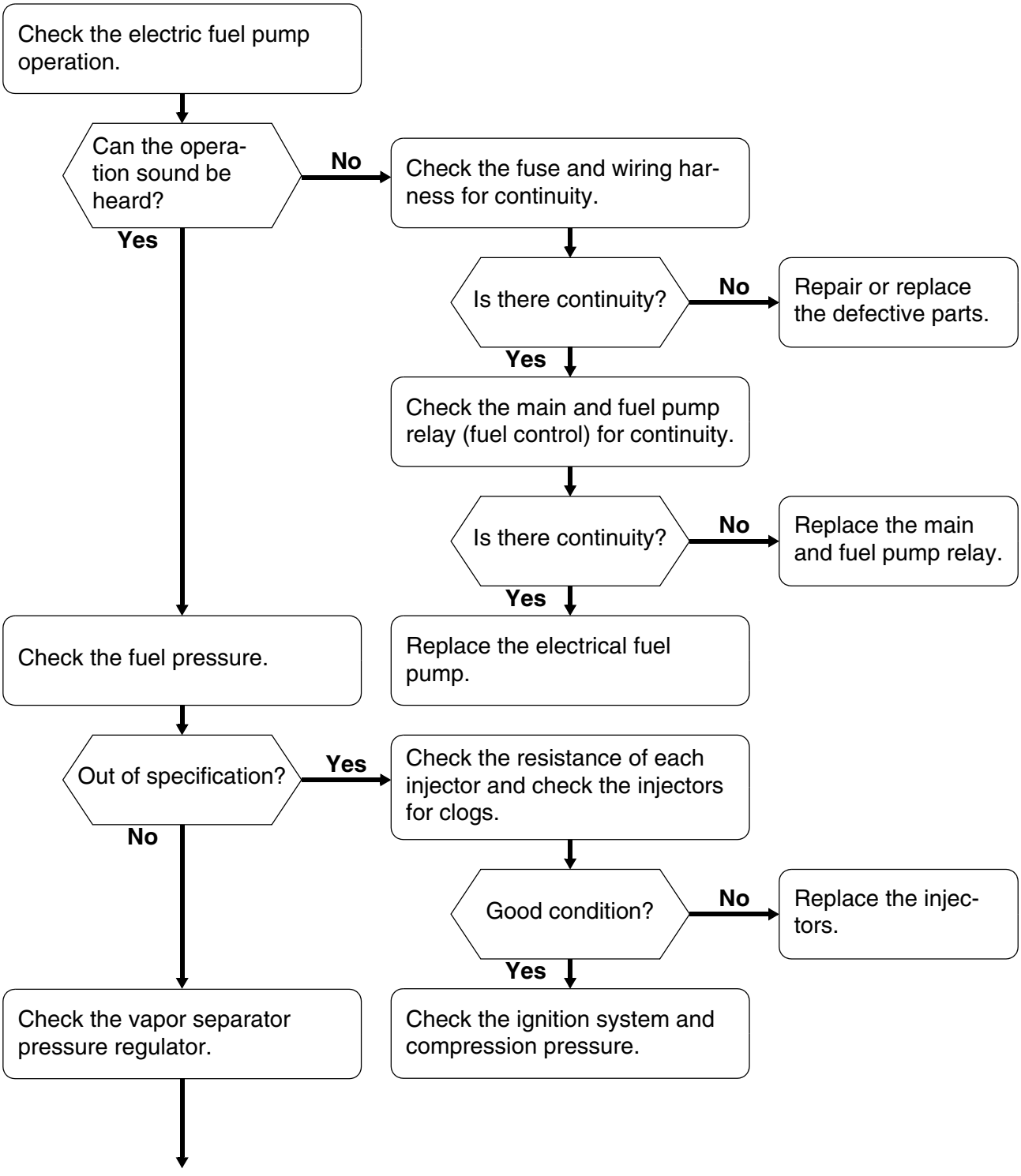
Ignition system



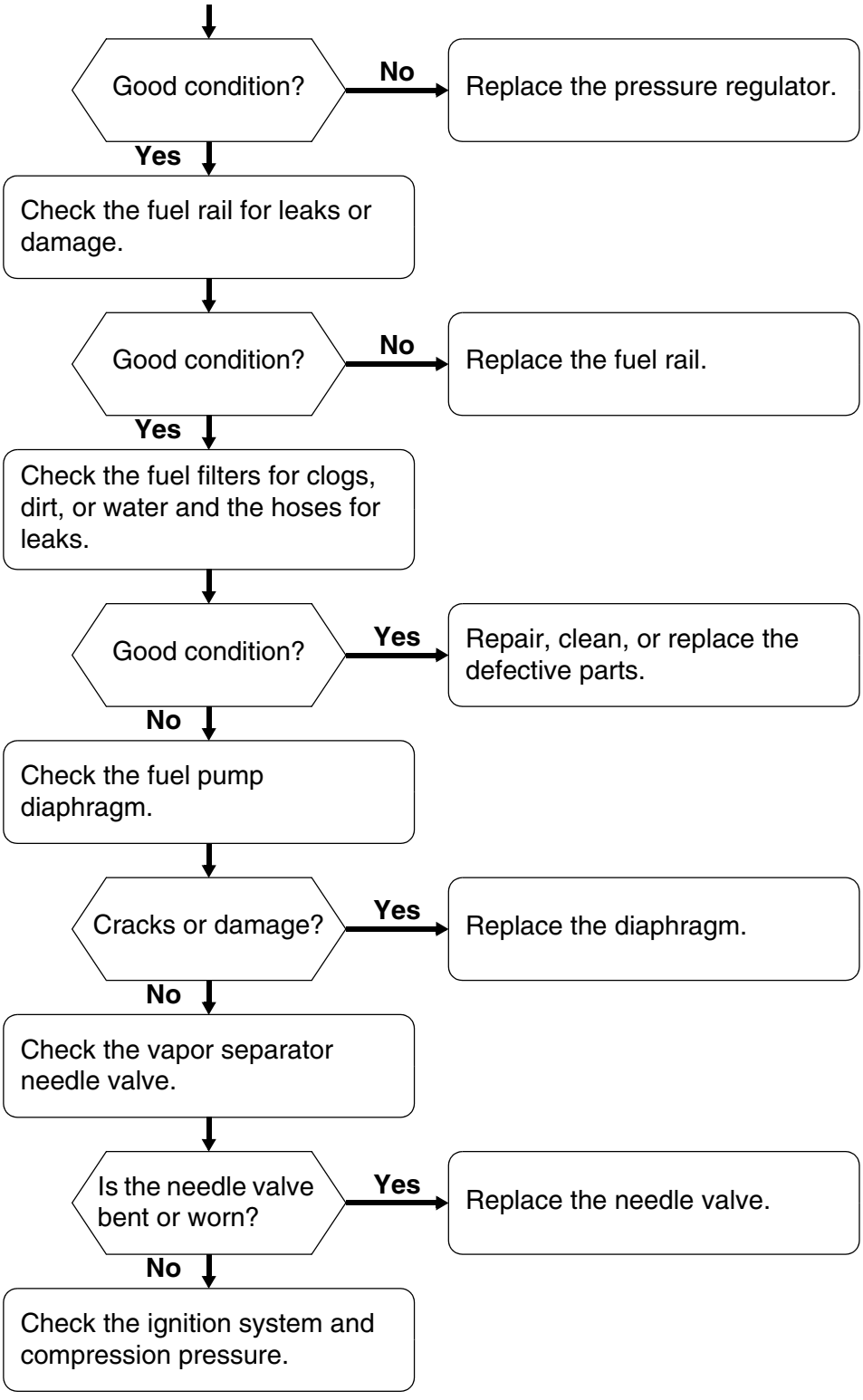
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Good condition?
No
Replace the ignition coils.
Yes
Check the resistance of each spark plug wire and check the spark plug caps for salt buildup.
Good condition?
No
Repair or replace the spark plug wire.
Yes
Check the main and fuel pump relay (main control) for continuity.
Is there continuity?
No
Replace the main and fuel pump relay.
Yes
Check the ECM output peak voltage.

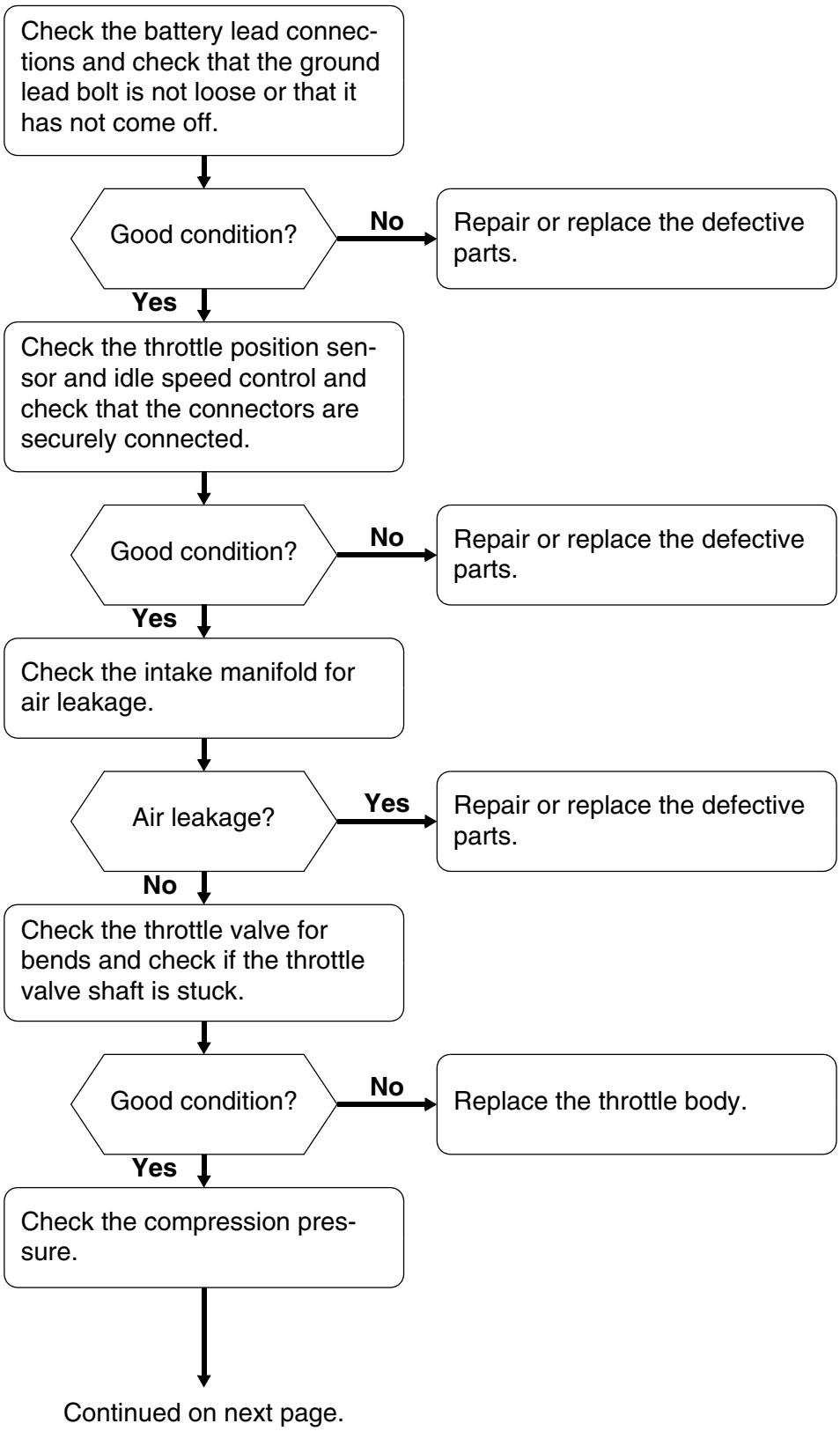
Fuel system



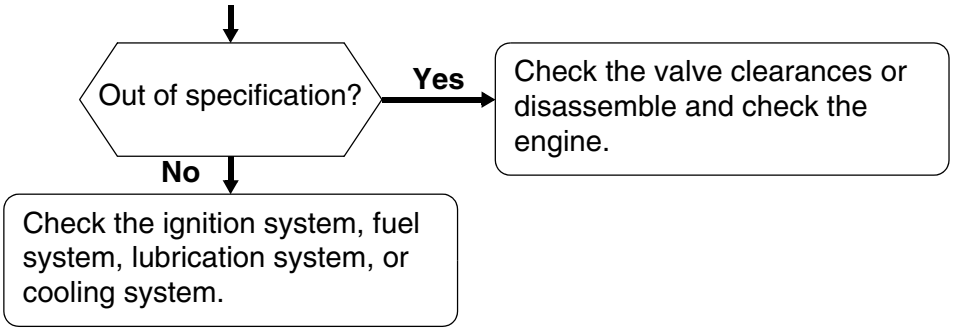
Continued on next page.


Good condition?
No
Replace the pressure regulator.
Yes
Check the fuel rail for leaks or damage.
Good condition?
No
Replace the fuel rail.
Yes
Check the fuel filters for clogs, dirt, or water and the hoses for leaks.
Good condition?
Yes
Repair, clean, or replace the defective parts.
No
Check the fuel pump diaphragm.
Cracks or damage?
Yes
Replace the diaphragm.
No
Check the vapor separator needle valve.
Is the needle valve bent or worn?
Yes
Replace the needle valve.
No
Check the ignition system and compression pressure.

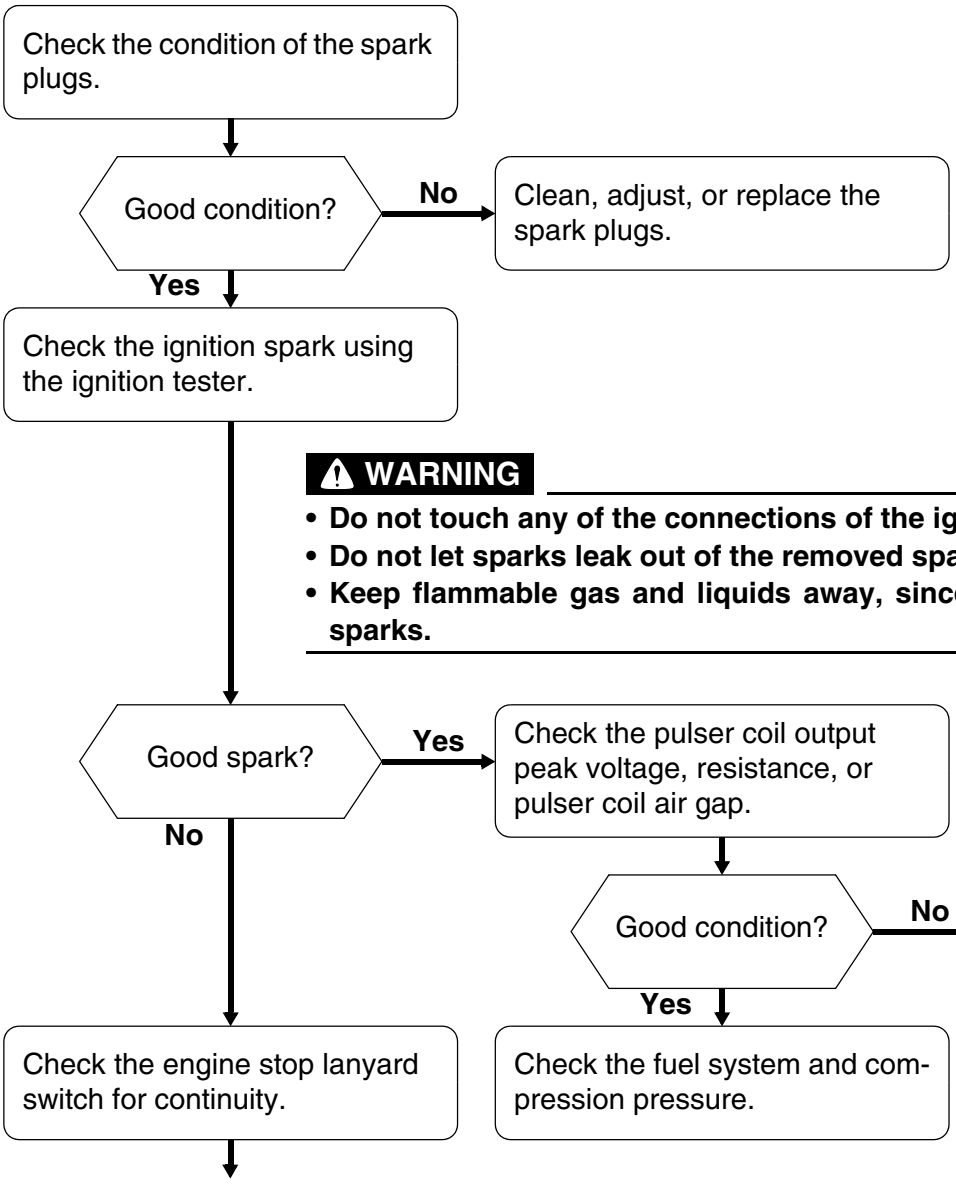
Symptom 2: Engine speed at wide open throttle is low, engine speed decreases, or engine stalls (poor acceleration or poor deceleration).



Continued on next page.



Ignition system

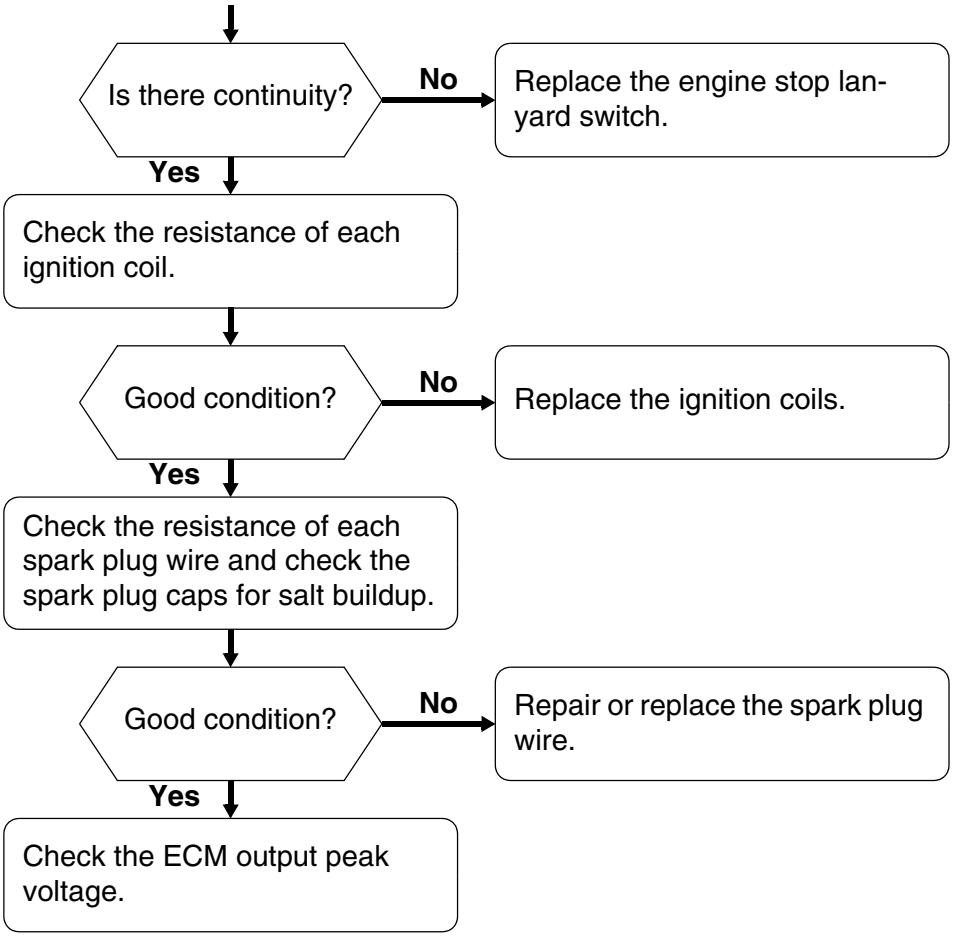


⚠ WARNING

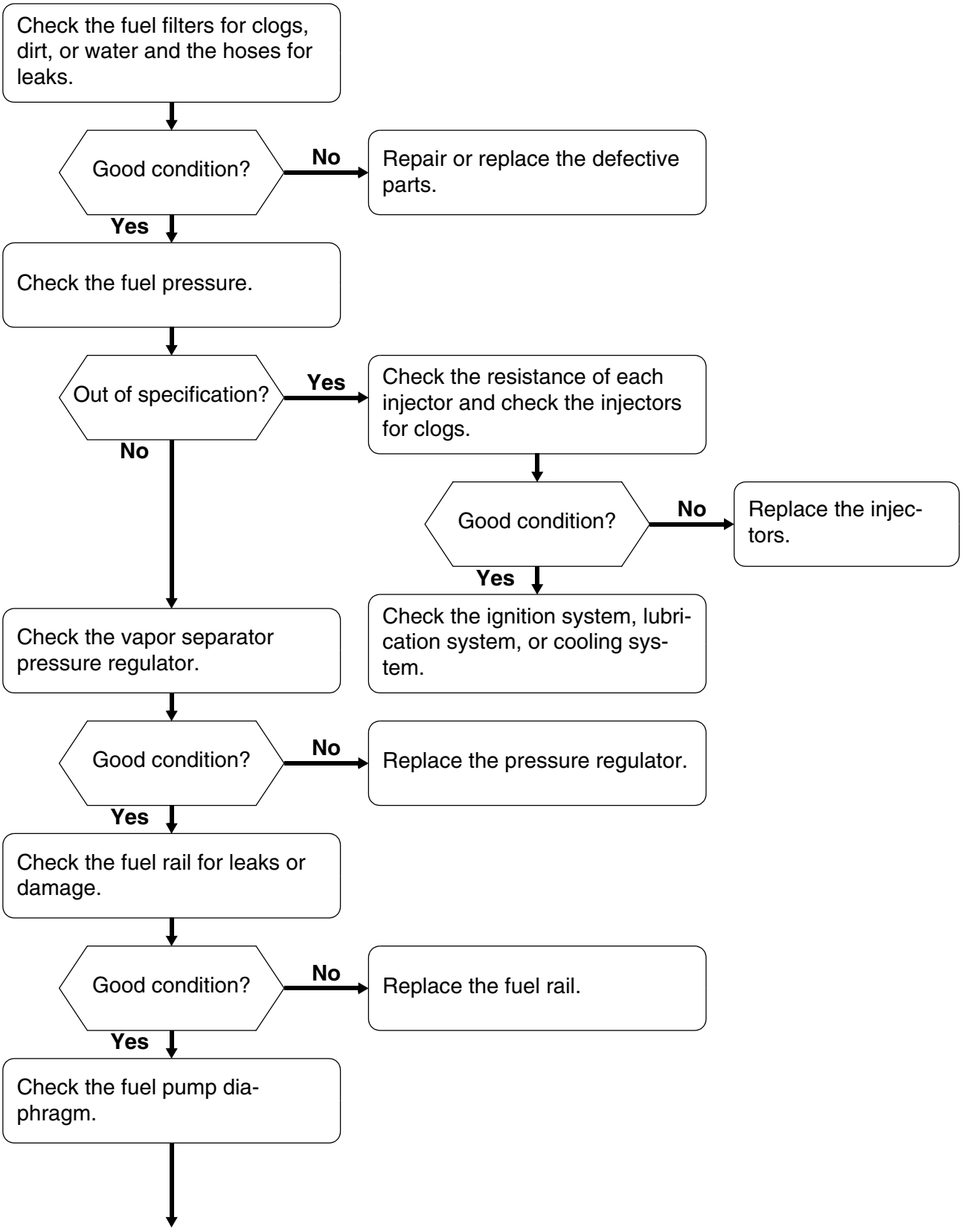
- **Do not touch any of the connections of the ignition tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas and liquids away, since this test can produce sparks.**

Continued on next page.

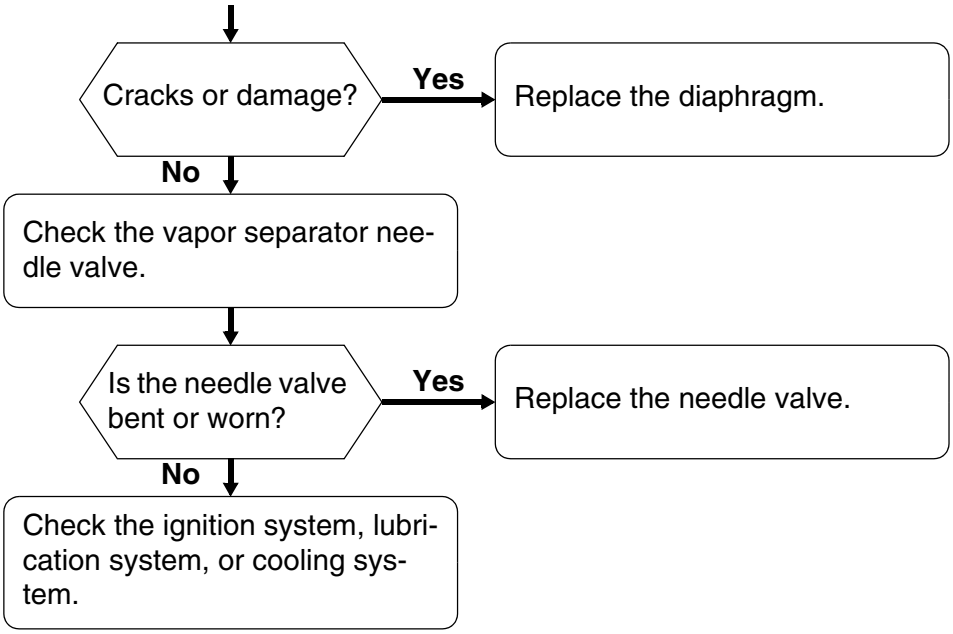
9


Is there continuity?
No
Replace the engine stop lanyard switch.
Yes
Check the resistance of each ignition coil.
Good condition?
No
Replace the ignition coils.
Yes
Check the resistance of each spark plug wire and check the spark plug caps for salt buildup.
Good condition?
No
Repair or replace the spark plug wire.
Yes
Check the ECM output peak voltage.

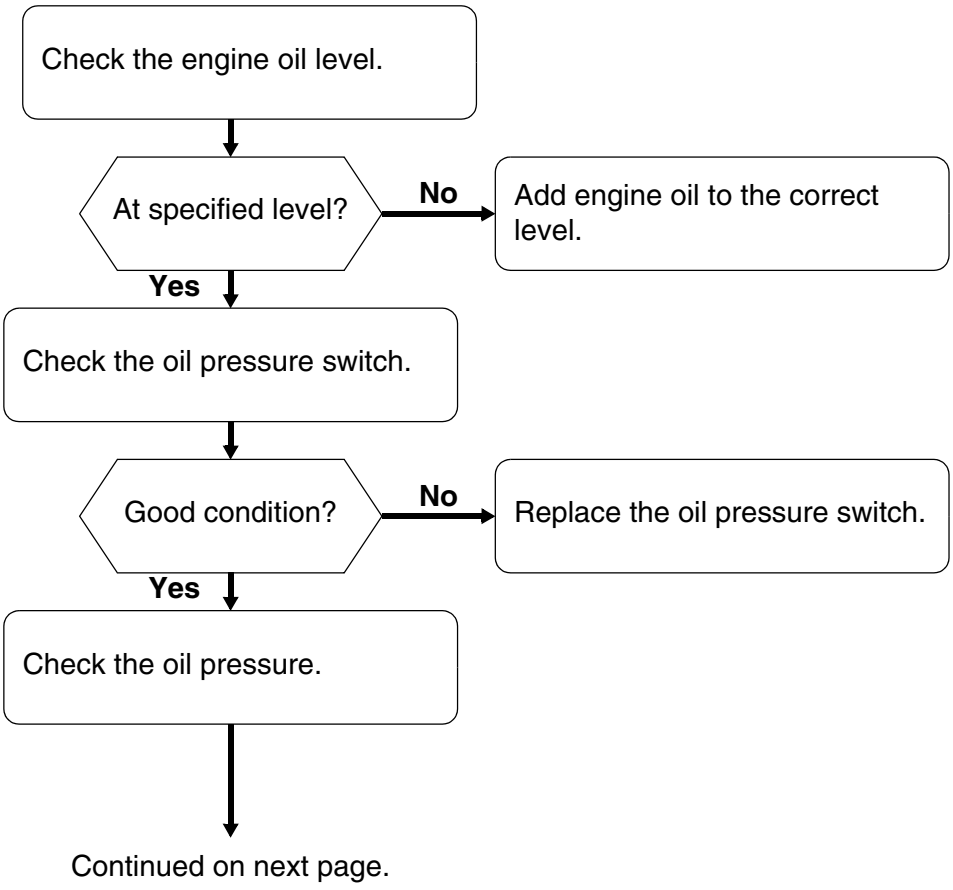
Fuel system



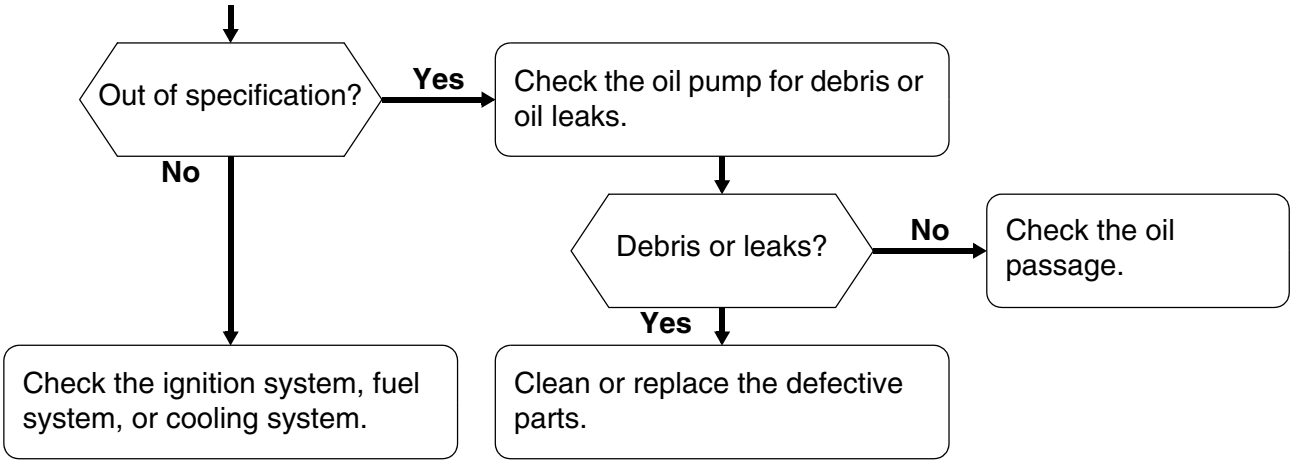
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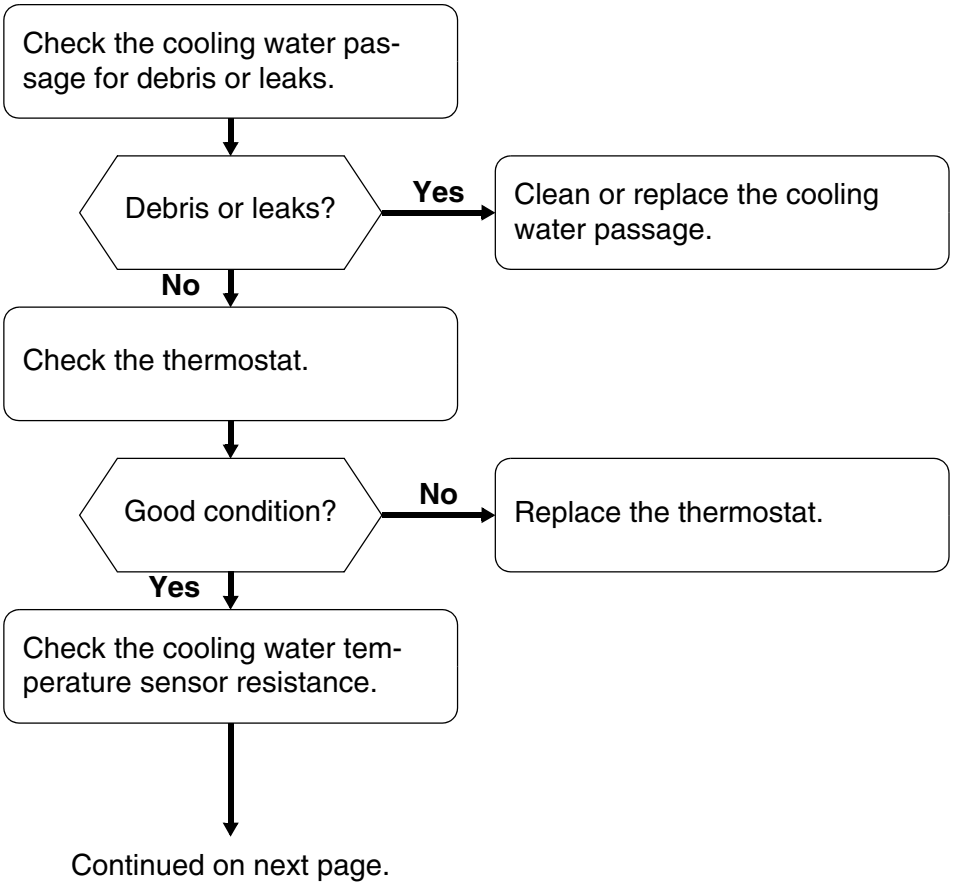
Lubrication system



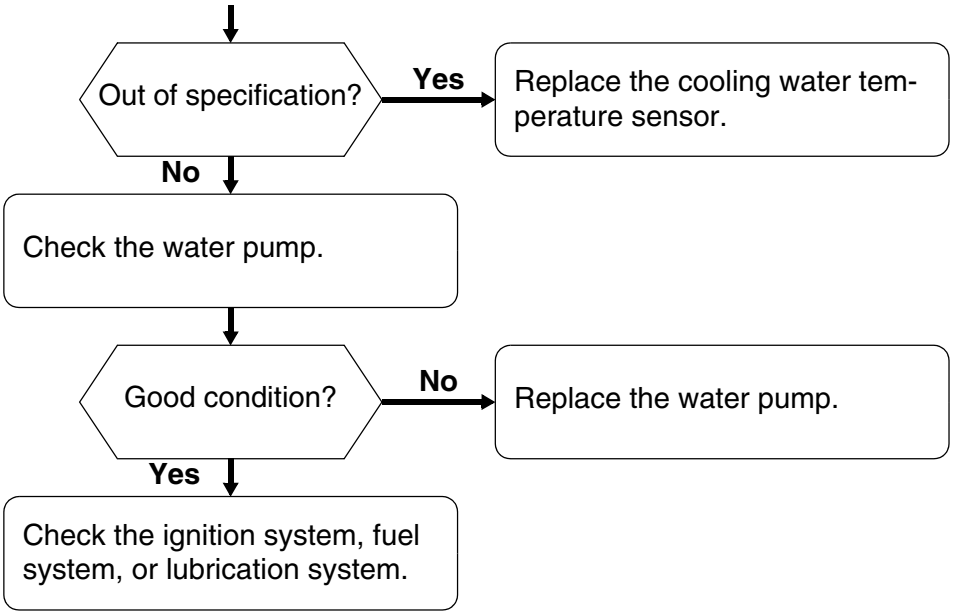
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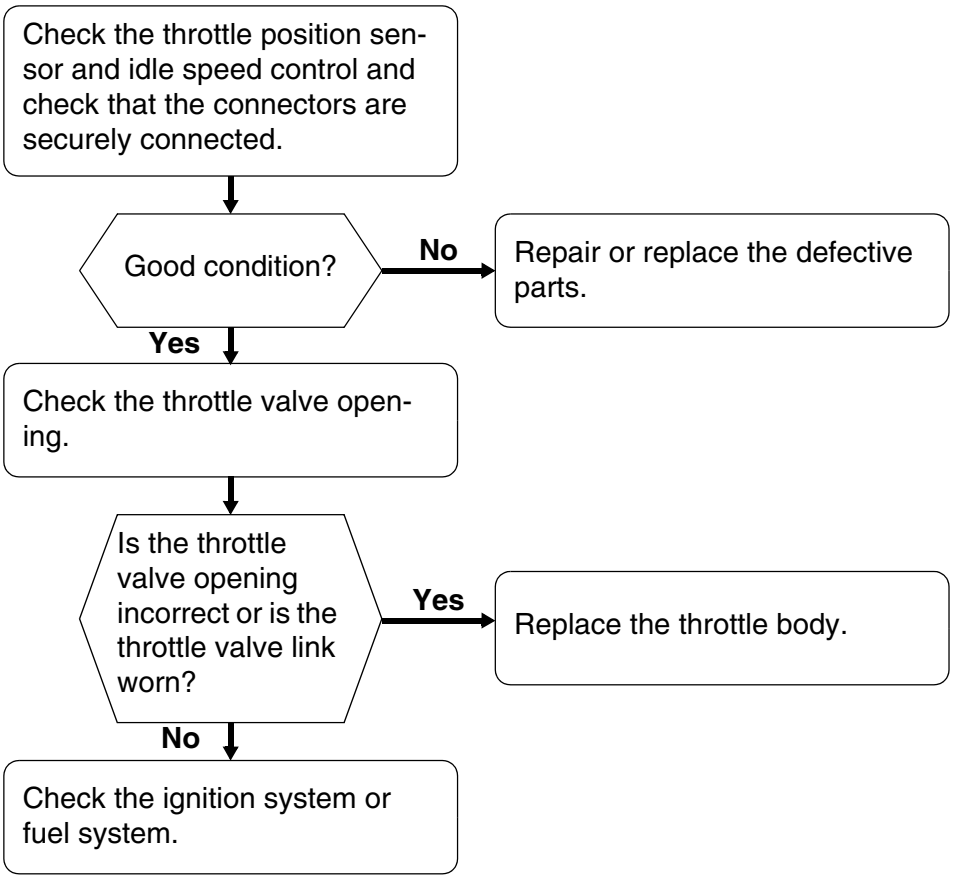
Cooling system



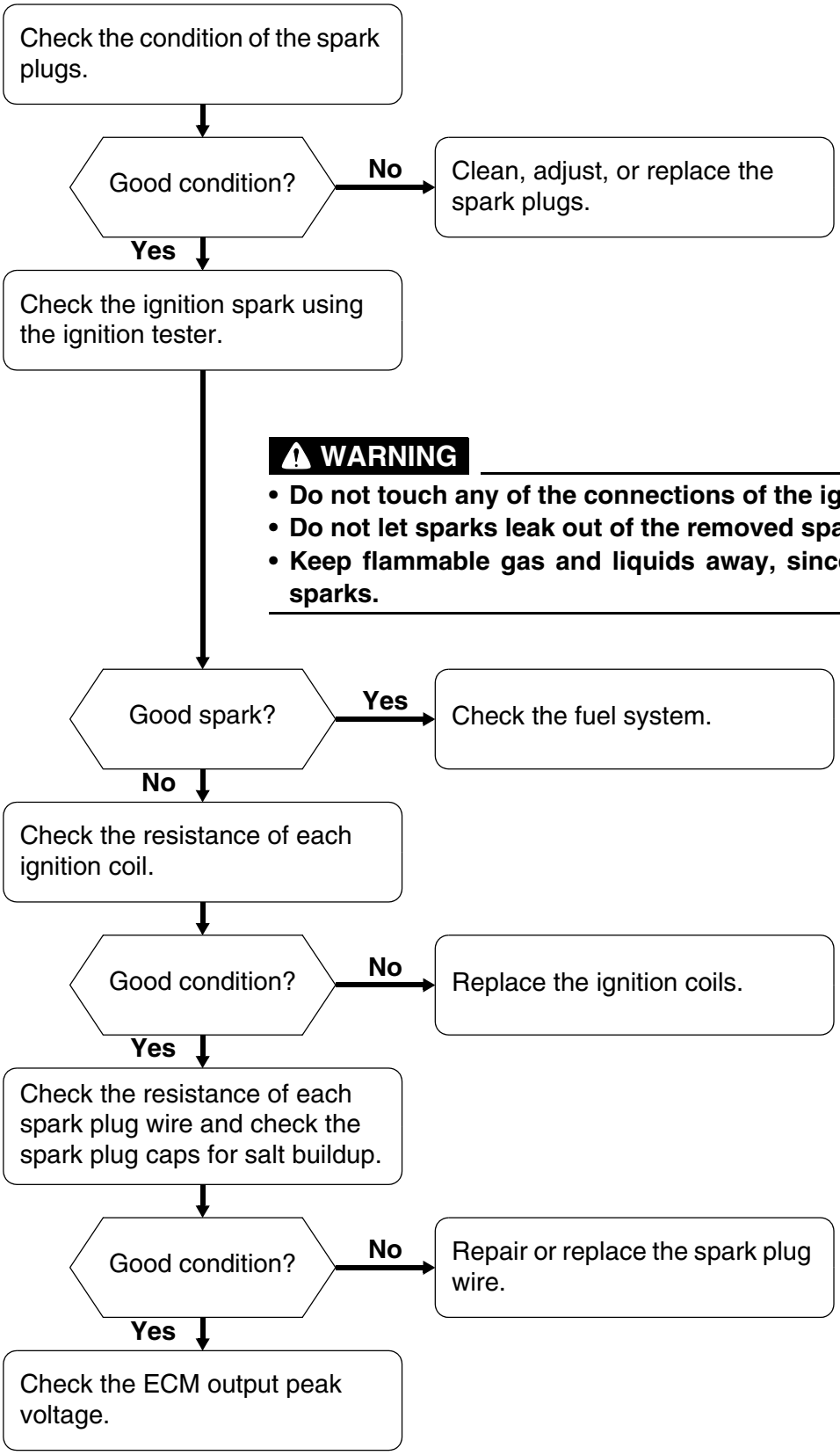
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Symptom 3: Engine speed not stable at low speeds or hunting occurs.



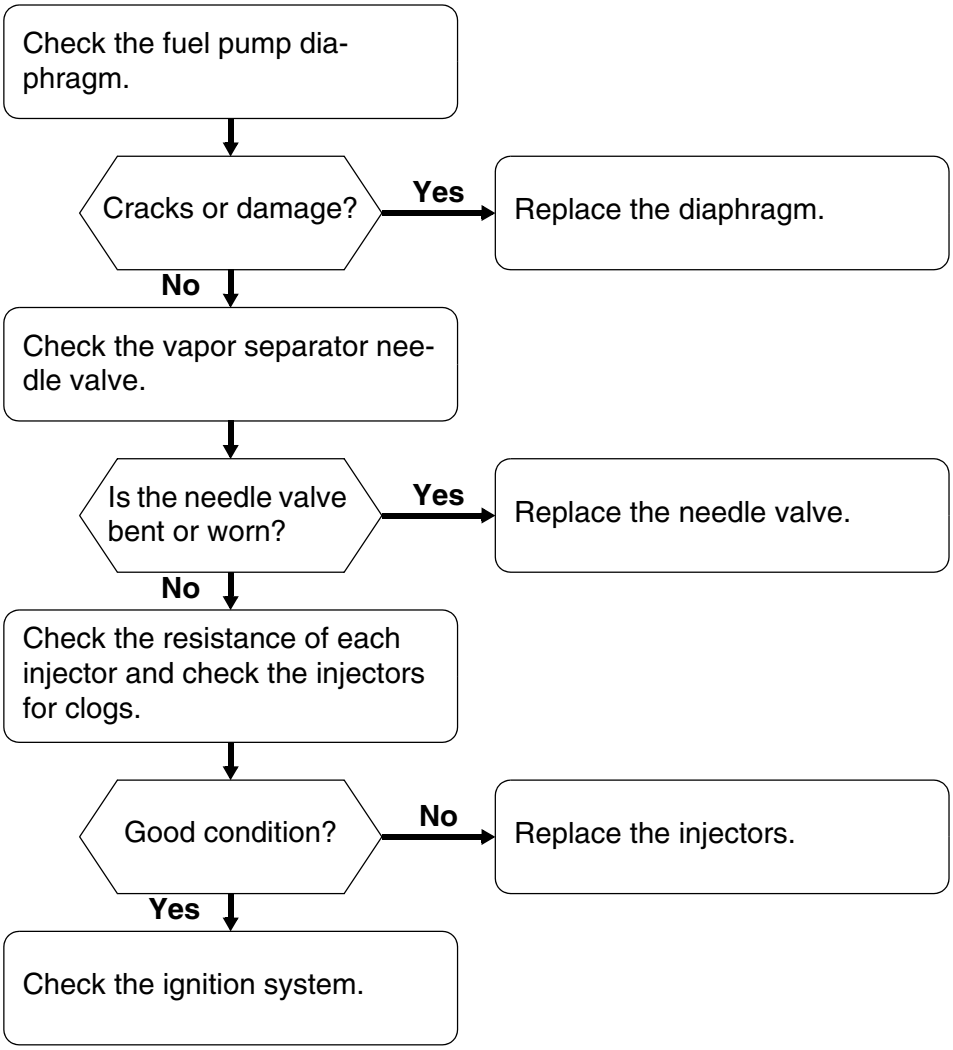
Ignition system



⚠ WARNING

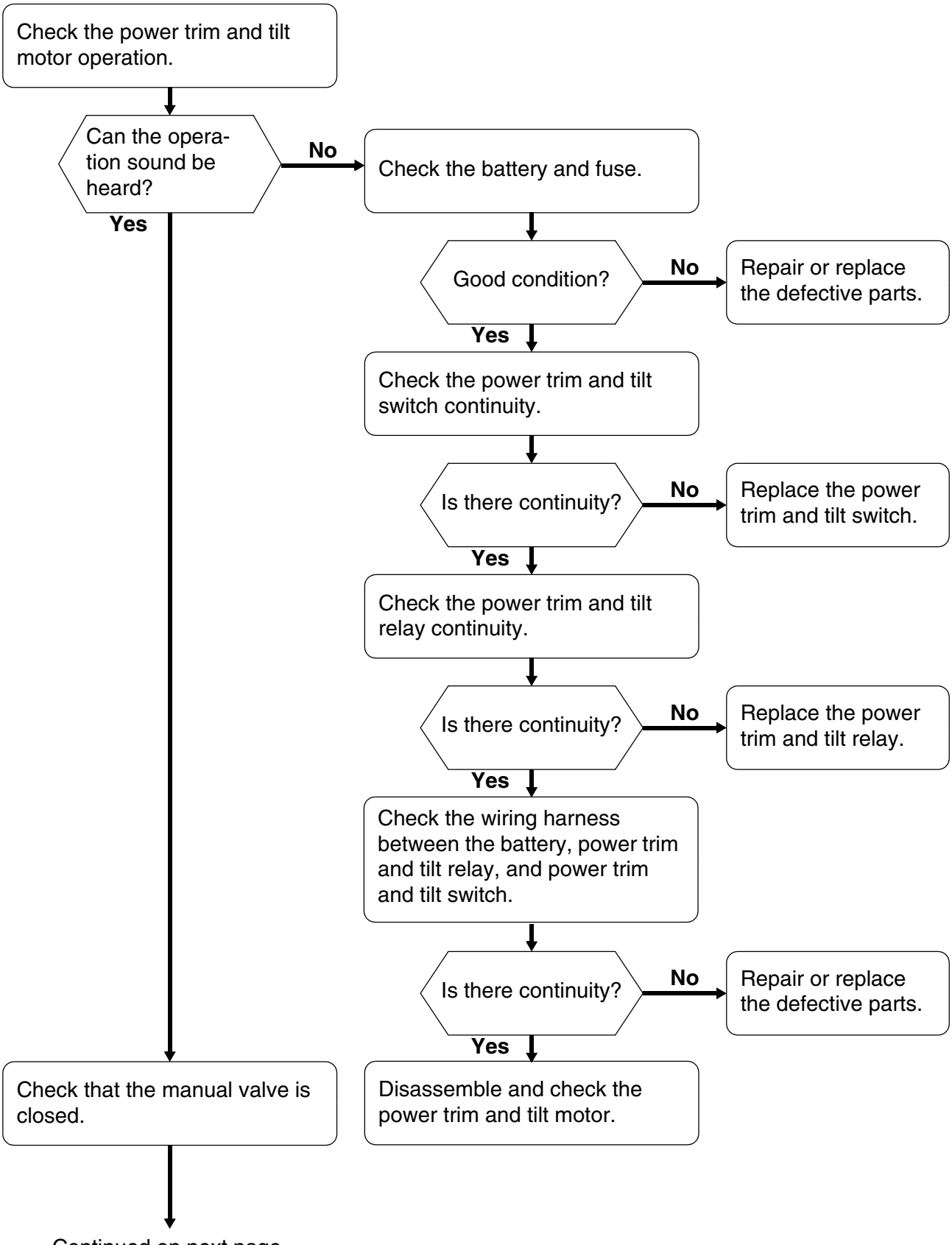
- **Do not touch any of the connections of the ignition tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas and liquids away, since this test can produce sparks.**

Fuel system

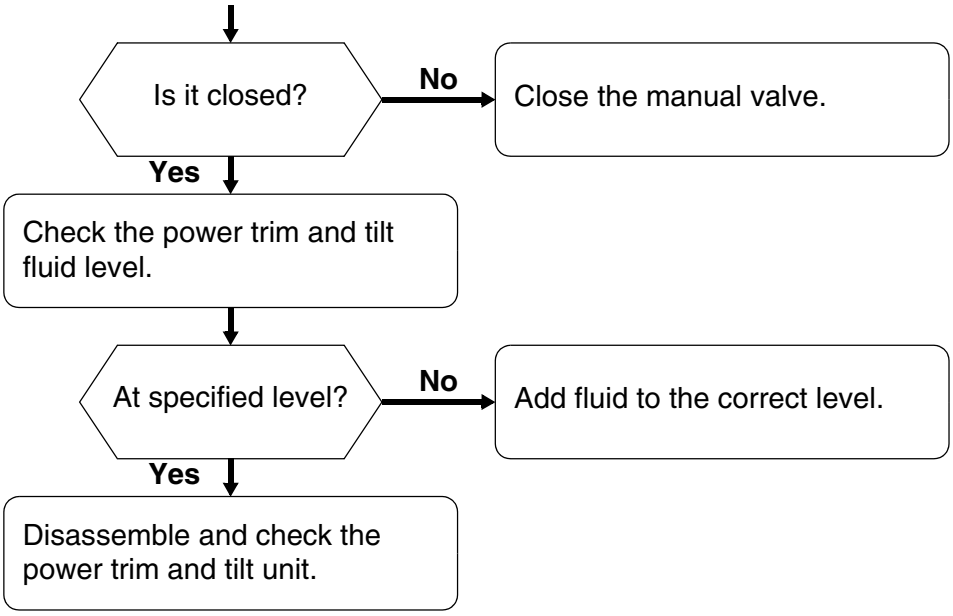

Check the fuel pump diaphragm.
Cracks or damage?
Yes
Replace the diaphragm.
No
Check the vapor separator needle valve.
Is the needle valve bent or worn?
Yes
Replace the needle valve.
No
Check the resistance of each injector and check the injectors for clogs.
Good condition?
No
Replace the injectors.
Yes
Check the ignition system.

Power trim and tilt unit

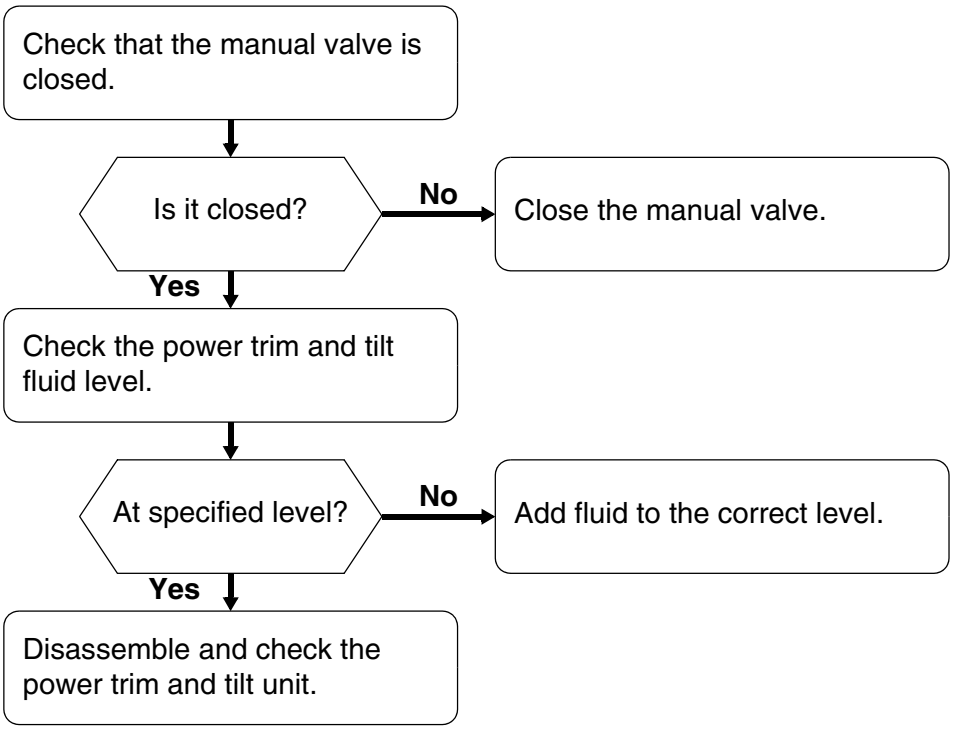
Symptom 1: Power trim and tilt unit does not operate.



Continued on next page.



Symptom 2: Power trim and tilt unit does not hold the outboard motor up.



A.

Adjusting the float 4-19
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— MEMO —

Wiring diagram
F50FED, F50FEHT, F50FET, FT50GET, F60CEHT, F60CET, FT60DET

① Ignition coil
② Spark plug
③ Power trim and tilt switch (tiller handle)
④ Power trim and tilt switch (bottom cowling)
⑤ Battery
⑥ Cooling water temperature sensor
⑦ Starter motor
⑧ Fuse (30 A)
⑨ Fuse (20 A)
⑩ Neutral switch (tiller handle model)
⑪ Starter relay
⑫ Power trim and tilt relay
⑬ Trim sensor
⑭ Power trim and tilt motor
⑮ Fuel pump
⑯ Main and fuel pump relay
⑰ Diode
⑱ Oil pressure switch
⑲ Pulser coil
⑳ Stator coil
㉑ Rectifier Regulator
㉒ ECM
㉓ Throttle position sensor
㉔ Shift position switch
㉕ Sensor assembly
㉖ Fuel injector
㉗ Solenoid valve
㉘ Idle speed control
㉙ Variable trolling RPM switch (optional)
㉚ Warning indicator (tiller handle model)
㉛ Engine stop lanyard switch (tiller handle model)
㉜ Engine start switch (tiller handle model)

Ⓐ To warning indicator (tiller handle model)
Ⓑ To remote control or tiller handle
Ⓒ To diagnostic flash indicator or Yamaha Diagnostic System
Ⓓ To diagnostic flash indicator (special service tool)
Ⓔ To variable trolling RPM switch (optional)
Ⓕ To trim meter
Ⓖ To wiring harness main coupler

Color code

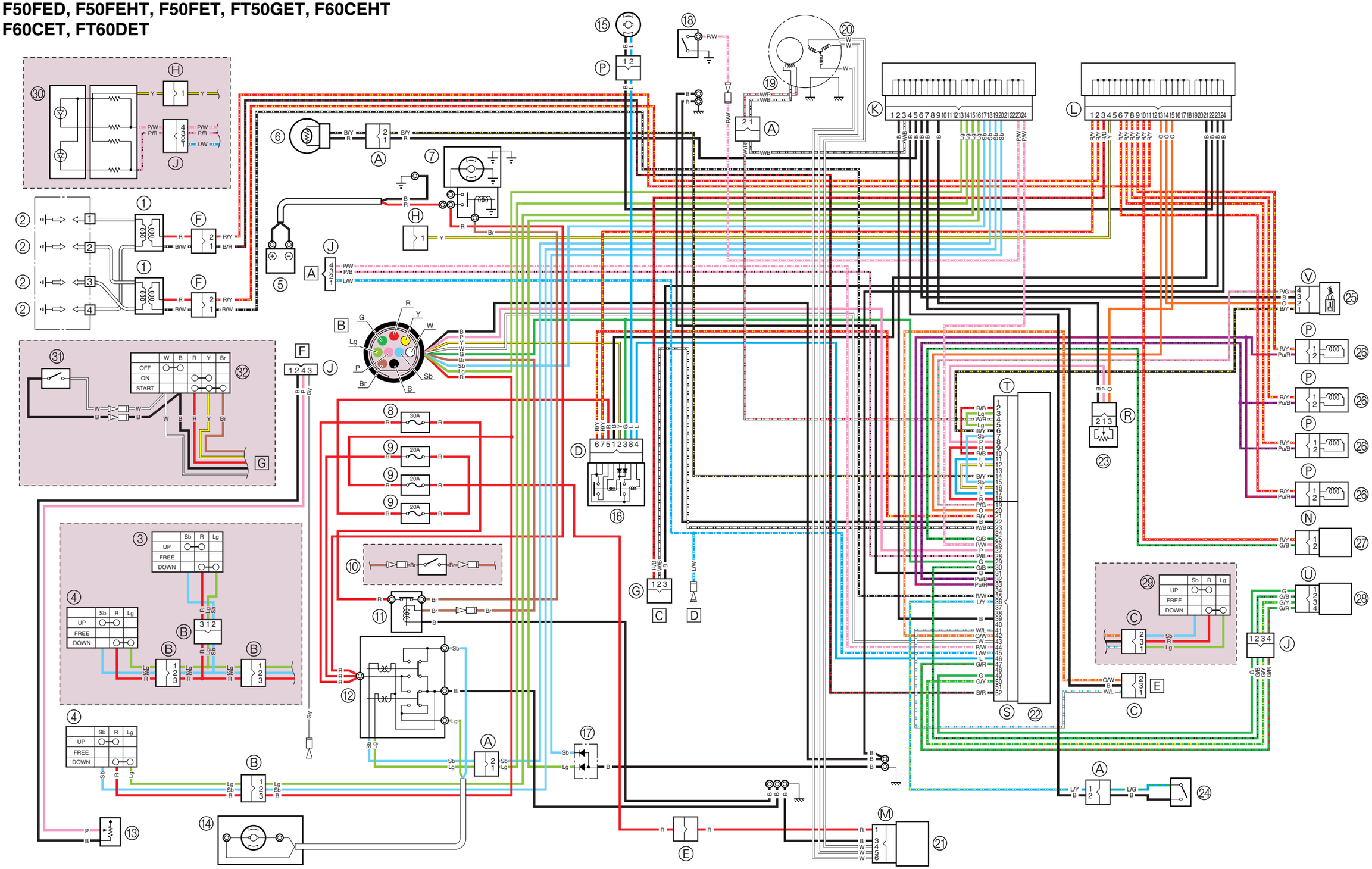
B : Black
Br : Brown
G : Green
Gy : Gray
L : Blue
Lg : Light green
O : Orange
P : Pink
R : Red
Sb : Sky blue
W : White
Y : Yellow
B/O : Black/orange
B/R : Black/red
B/W : Black/white
B/Y : Black/yellow
Br/W : Brown/white
G/B : Green/black
G/R : Green/red
G/Y : Green/yellow
L/G : Blue/green
L/W : Blue/white
L/Y : Blue/yellow
O/W : Orange/white
P/B : Pink/black
P/G : Pink/green
P/W : Pink/white
Pu/B : Purple/black
Pu/G : Purple/green
Pu/R : Purple/red
Pu/Y : Purple/yellow
R/B : Red/black
R/Y : Red/yellow
W/B : White/black
W/L : White/blue
W/R : White/red
Y/G : Yellow/green



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F50FED, F50FEHT, F50FET, FT50GET, F60CEHT
F60CET, FT60DET



	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ	Ⓙ	Ⓚ, Ⓛ
⬠	①②	①②③	①②③	①②③④ ⑤⑥⑦⑧	①	①②	①② ③	①	①② ③④	
⬡	②①	②①③	③②①	④③②① ⑧⑦⑥⑤	①	②①	②① ③	①	②① ④③	⑫⑪⑩⑨⑧⑦⑥⑤④③②① ㉔㉓㉒㉑⑳⑲⑱⑰⑯⑮⑭⑬

	Ⓜ	Ⓝ	Ⓟ	Ⓡ	Ⓢ	Ⓣ	Ⓤ	Ⓥ
⬡	③②① ⑥⑤④	②①	① ②	③②①	㉟㉞㉝㉜㉛㉚㉙㉘㉗㉖㉕㉔㉓㉒㉑⑳⑲ ㊷㊶㊵㊴㊳㊲㊱㊵㊹㊸㊷㊶㊵㊴㊳㊲㊱	⑨⑧⑦⑥⑤④③②① ⑱⑰⑯⑮⑭⑬⑫⑪⑩	②① ④③	④③②①