



YAMAHA

Z250

LZ250

HPDI / TWO STROKE

Service Manual



LIT-18616-02-78



NOTICE

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

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

Important information

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

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

WARNING

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

CAUTION:

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

NOTE:

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

CAUTION:

USE UNLEADED STRAIGHT GASOLINE ONLY

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

YAMALUBE 2-STROKE OUTBOARD OIL IS RECOMMENDED.

Z250C, LZ250C SERVICE MANUAL

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How to use this manual

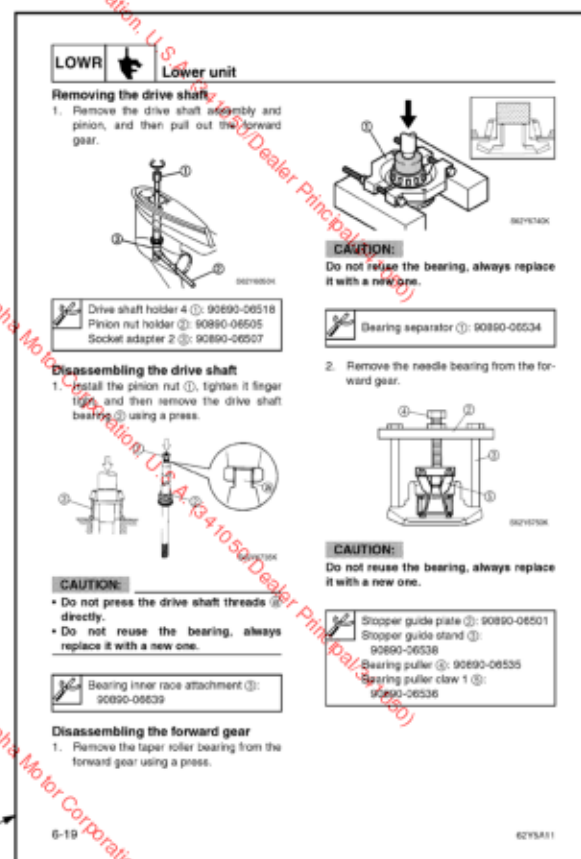
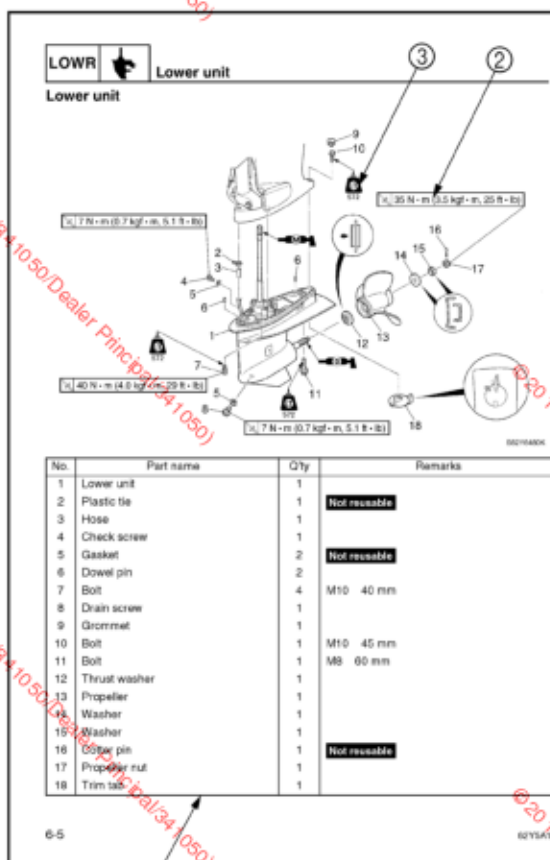
Manual format

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:

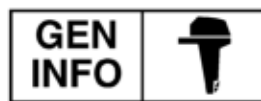
For troubleshooting procedures, see Chapter 9, "Troubleshooting."



Symbols

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

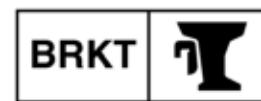
General information



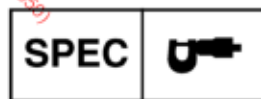
Fuel system



Bracket unit



Specifications



Power unit



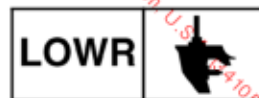
Electrical systems



Periodic checks and adjustments



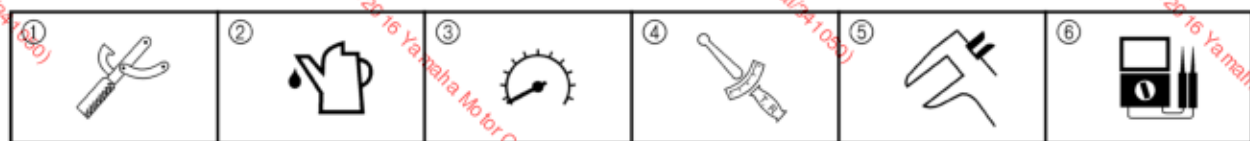
Lower unit



Troubleshooting

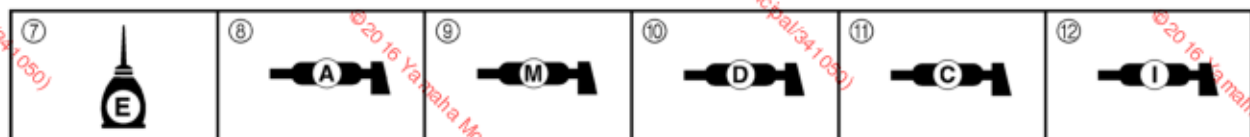


Symbols ① to ⑥ indicate specific data.



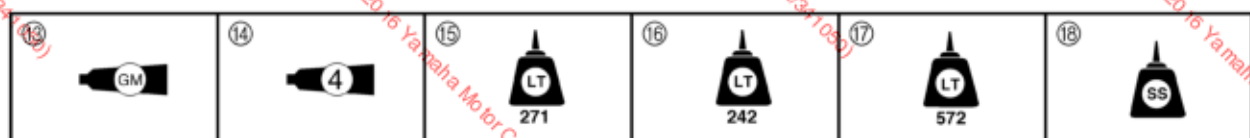
- ① Special tool
- ② Specified oil or fluid
- ③ Specified engine speed
- ④ Specified tightening torque
- ⑤ Specified measurement
- ⑥ Specified electrical value (resistance, voltage, electric current)

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



- ⑦ Apply 2-stroke outboard motor oil
- ⑧ Apply water resistant grease (Yamaha grease A)
- ⑨ Apply molybdenum disulfide grease
- ⑩ Apply corrosion resistant grease (Yamaha grease D)
- ⑪ Apply low temperature resistant grease (Yamaha grease C)
- ⑫ Apply injector grease

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



- ⑬ Apply Gasket Maker
- ⑭ Apply Yamabond No. 4
- ⑮ Apply LOCTITE 271 (red)
- ⑯ Apply LOCTITE 242 (blue)
- ⑰ Apply LOCTITE 572
- ⑱ Apply silicon sealant



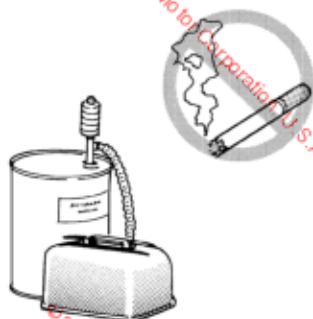
Safety while working

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

Fire prevention

Gasoline is highly flammable.

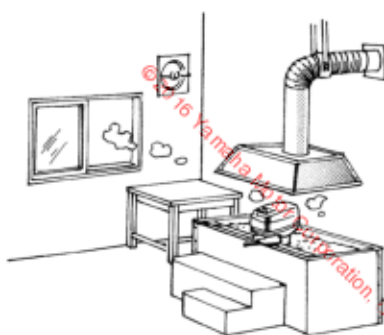
Keep gasoline and all flammable products away from heat, sparks, and open flames.



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.



S69J1020

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.



S69J1040

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

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

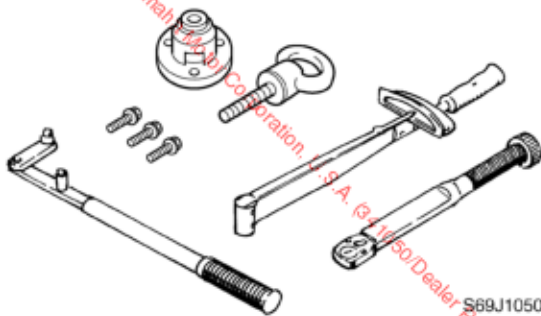
Safety while working

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

Good working practices

Special service tools

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

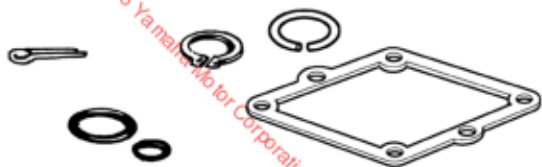


Tightening torques

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.

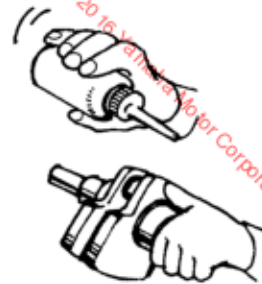
Non-reusable parts

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



Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.
2. Apply engine oil to the contact surfaces of moving parts before assembly.



3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.
4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.
5. Check that moving parts operate normally after assembly.

1



Identification

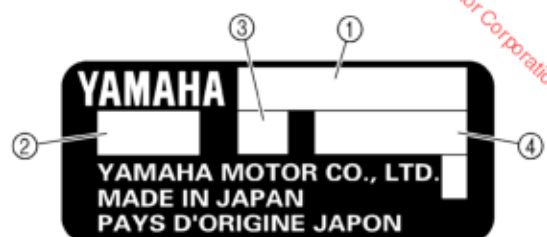
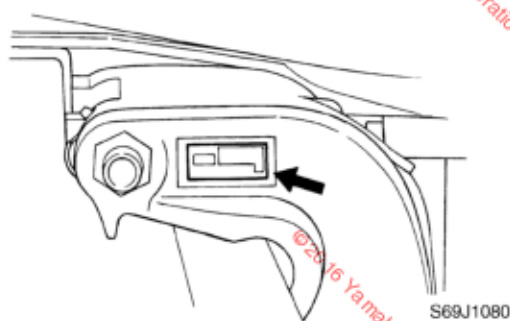
Applicable models

This manual covers the following models.

Applicable models
Z250TR, LZ250TR

Serial number

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



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

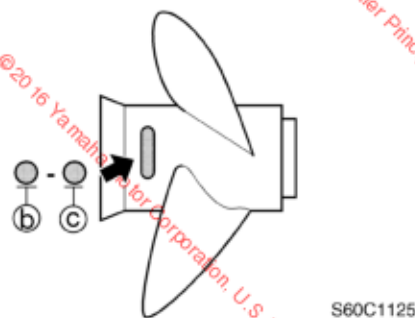
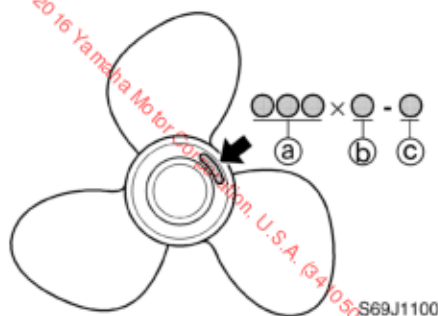
Model name	Approved model code	Starting serial No.
Z250TR	60V	1002362–
LZ250TR	60W	1001037–

Propeller selection

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

Propeller size

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



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

Selection

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

Regular rotation model

Propeller size (in)	Material
13 3/8 × 23 - M	Stainless
13 3/8 × 25 - M	
13 3/4 × 17 - M2	
13 3/4 × 19 - M2	
13 3/4 × 21 - M	
14 1/2 × 19 - T	
14 1/2 × 21 - T	
14 1/2 × 23 - M	
14 3/4 × 25 - T	
14 7/8 × 21 - M	
15 × 17 - T	
15 1/8 × 27 - T	
15 1/4 × 15 - M	
15 1/4 × 17 - M	
15 1/4 × 19 - M	
15 3/4 × 13 - M	

Counter rotation model

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

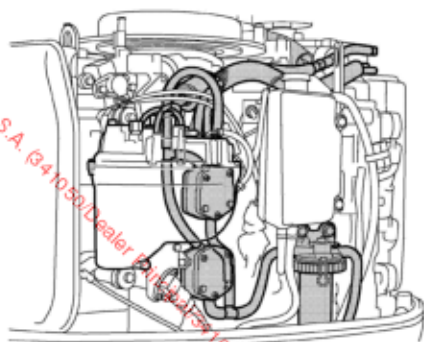


Predelivery checks

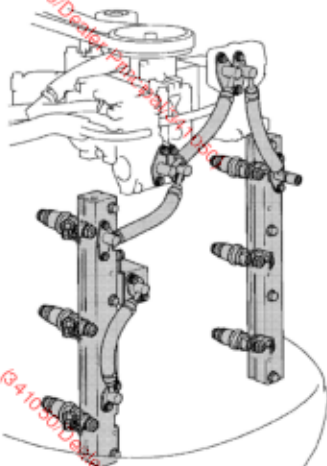
To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the fuel system

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



S6D01010



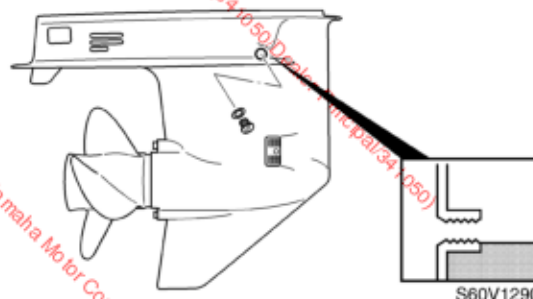
S60V1020

CAUTION:

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

Checking the gear oil level

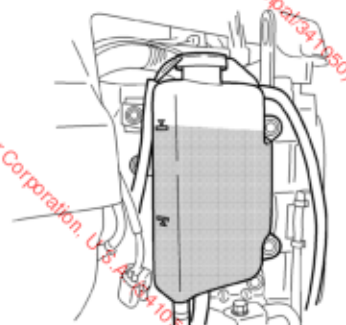
1. Check the gear oil level.



S60V1290

Checking the engine oil level

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




S60V3260



Recommended engine oil:
YAMALUBE 2-stroke outboard
motor oil

Checking the battery

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

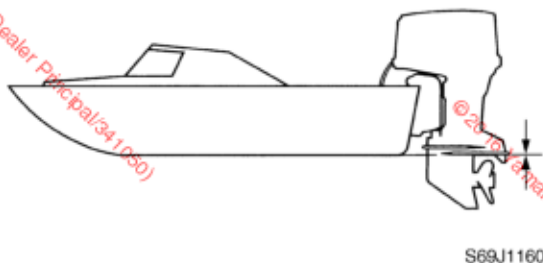


Recommended battery capacity:
 CCA/SAE: 512 A
 MCA/ABYC: 675 A
 RC/SAE: 182 Minute
 Electrolyte specified gravity:
 1.280 at 20 °C (68 °F)

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.



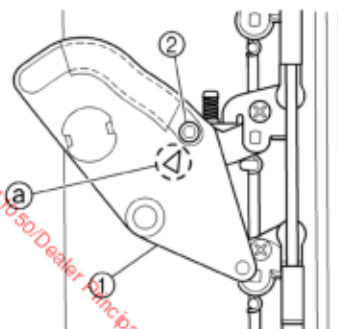
NOTE:

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

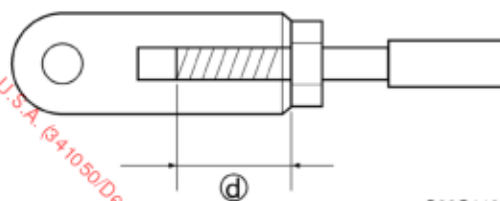
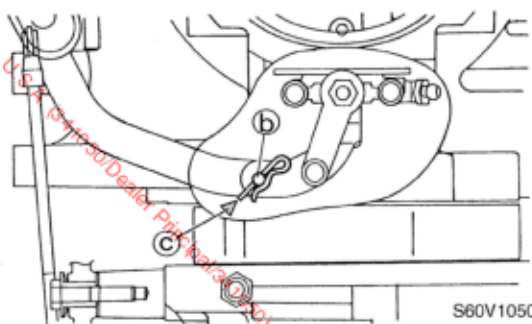
2. Check that the clamp brackets are secured with the clamp bolts.

Checking the remote control cables

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



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



CAUTION:

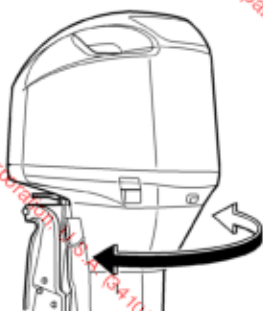
The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in)

④.



Checking the steering system

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

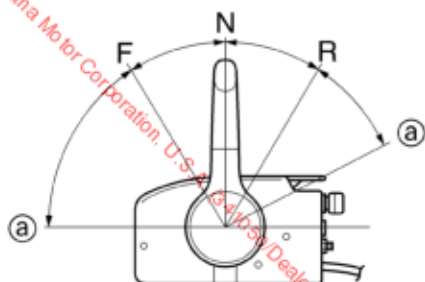


S60V1060

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

Checking the gear shift and throttle operation

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



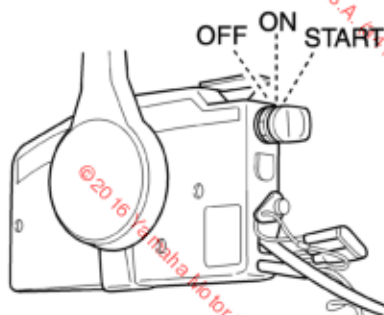
S69J1210

Checking the power trim and tilt system

1. Check that the outboard motor tilts up and down smoothly when operating the power trim and tilt unit.
2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.
4. Check that the trim meter points down when the outboard motor is tilted all the way down.

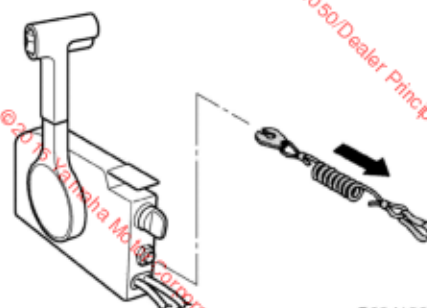
Checking the engine start switch and engine stop lanyard switch

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.



S60V1070

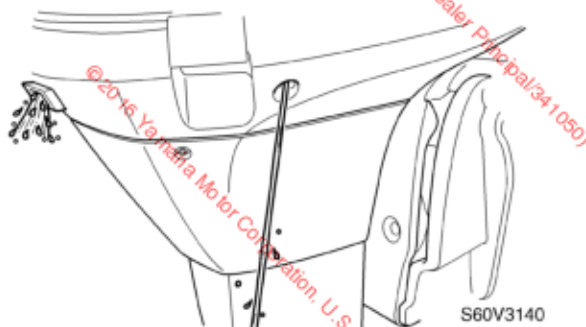
3. Check that the engine turns off when the engine stop lanyard is pulled from the engine stop lanyard switch.



S69J1220

Checking the cooling water pilot hole

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



Test run

1. Start the engine, and then check that the gear shift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for 1 hour at 3,000 r/min or at half throttle, then for another hour at 4,000 r/min or at 3/4 throttle.
5. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.

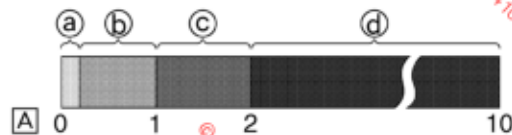
NOTE:

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

Break-in

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

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

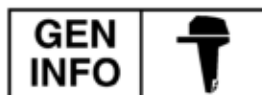


S60V1120

A Hour

After test run

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



General information

— MEMO —



Specifications

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General specifications

Item	Unit	Model	
		Z250TR	LZ250TR
Dimension			
Overall length	mm (in)	868 (34.2)	
Overall width	mm (in)	568 (22.4)	
Overall height			
(X)	mm (in)	1,830 (72.0)	
(U)	mm (in)	1,957 (77.0)	
Boat transom height			
(X)	mm (in)	635 (25.0)	
(U)	mm (in)	762 (30.0)	
Weight			
(without propeller)			
(X)	kg (lb)	247 (545)	
(U)	kg (lb)	252 (556)	
Performance			
Maximum output	kW (hp)	183.9 (250) at 5,000 r/min	
Full throttle operating range	r/min	4,500 to 5,500	
Maximum fuel consumption	L (US gal, Imp gal)/hr	74 (19.6, 16.3) at 5,500 r/min	
Idle speed	r/min	670–730	
Power unit			
Type		2-stroke, 76°, V6, HPDI	
Total displacement	cm ³ (cu. in)	3,342 (203.9)	
Bore × stroke	mm (in)	93 (3.66) × 82 (3.23)	
Compression ratio		6.2	
Control system		Remote control	
Starting system		Electric starter	
Enrichment system		Fuel injection	
Ignition control system		TCI	
Maximum generator output	V, A	12, 50	
Spark plug		BKR6EKG (NGK)	
Cooling system		Water	
Exhaust system		Propeller boss	
Lubrication system		Oil injection	

General specifications

Item	Unit	Model	
		Z250TR	LZ250TR
Fuel and oil			
Fuel type		Regular unleaded gasoline	
Fuel minimum rating	RON ^(*) PON	90 86	
Engine oil ^(*)		YAMALUBE 2-stroke outboard motor oil	
Engine oil tank capacity			
Oil tank	L (US gal, Imp gal)	1.2 (0.32, 0.26)	
Remote oil tank	L (US gal, Imp gal)	10.5 (2.77, 2.31)	
Gear oil type		GEAR CASE LUBE	
Gear oil grade	SAE	90	
Gear oil quantity	cm ³ (US oz, Imp oz)	1,150 (38.9, 40.5)	1,000 (33.8, 35.2)
Bracket unit			
Trim angle	Degree	-3 to 16	
(at 12° boat transom)			
Tilt-up angle	Degree	70	
Steering angle	Degree	30 + 30	
Drive unit			
Gear shift positions		F-N-R	
Gear ratio		1.81 (29/16)	
Reduction gear type		Spiral bevel gear	
Clutch type		Dog clutch	
Propeller shaft type		Spline	
Propeller direction (rear view)		Clockwise	Counterclockwise
Propeller ID mark		T, M	TL, ML
Electrical			
Battery minimum capacity ^(*)			
CCA/SAE	A	512	
MCA/ABYC	A	675	
RC/SAE	Minute	182	

(*) RON: Research Octane Number

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

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

(*) CCA: Cold Cranking Ampere

MCA: Marine Cranking Ampere

ABYC: American Boat and Yacht Council

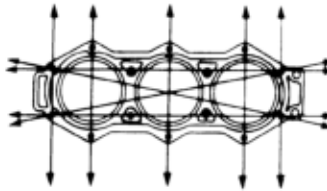

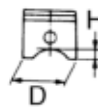
SAE: Society of Automotive Engineers

RC: Reserve Capacity



Maintenance specifications

Power unit

Item	Unit	Model	
		Z250TR	LZ250TR
Power unit Minimum compression pressure*	kPa (kgf/cm ² , psi)	560 (5.6, 81)	
Cylinder heads Warpage limit  (lines indicate straightedge position)	mm (in)	0.1 (0.004)	
Cylinders Bore size Bore size limit Taper limit Out-of-round limit 	mm (in) mm (in) mm (in) mm (in)	93.000–93.020 (3.6614–3.6622) 93.100 (3.6654) 0.08 (0.0031) 0.05 (0.0020)	
Pistons Piston diameter (D) Measuring point (H) Piston-to-cylinder clearance Piston pin boss bore Oversize piston 1st 2nd Oversize piston diameter 1st 2nd 	mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in)	92.830–92.850 (3.6547–3.6555) 10 (0.39) 0.165–0.171 (0.0065–0.0067) 26.004–26.015 (1.0238–1.0242) 0.25 (0.010) 0.50 (0.020) 93.080–93.100 (3.6646–3.6653) 93.330–93.350 (3.6744–3.6752)	
Piston pins Outside diameter	mm (in)	25.995–26.000 (1.0234–1.0236)	

* Measuring conditions:

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

The figures are for reference only.

Maintenance specifications

Item	Unit	Model	
		Z250TR	LZ250TR
Piston rings			
Top ring			
Dimension B	mm (in)	2.05 (0.0807)	
Dimension T	mm (in)	3.00–3.20 (0.118–0.126)	
End gap	mm (in)	0.30–0.50 (0.0118–0.0197)	
Side clearance	mm (in)	0.02–0.06 (0.0008–0.0024)	
2nd piston ring			
Dimension B	mm (in)	2.05 (0.0807)	
Dimension T	mm (in)	2.70–2.90 (0.106–0.114)	
End gap	mm (in)	0.30–0.45 (0.0118–0.0177)	
Side clearance	mm (in)	0.02–0.06 (0.0008–0.0024)	
Connecting rods			
Small end inside diameter	mm (in)	31.000–31.012 (1.2205–1.2209)	
Big end side clearance	mm (in)	0.12–0.26 (0.0047–0.0102)	
Small end axial play limit	mm (in)	2.0 (0.08)	
Crankshaft			
Crankshaft journal diameter	mm (in)	58.975–58.991 (2.3219–2.3225)	
Crankpin diameter	mm (in)	40.485–40.500 (1.5939–1.5945)	
Runout limit	mm (in)	0.02 (0.0008)	
Thermostats			
Opening temperature	°C (°F)	48–52 (118–126)	
Fully open temperature	°C (°F)	60 (140)	
Valve open lower limit	mm (in)	4.3 (0.17)	
Oil pump			
ID mark		60V11	
Bleeding		Screw type	
Reed valves			
Valve stopper height limit	mm (in)	8 (0.31)	
Valve bending limit	mm (in)	0.2 (0.008)	

Lower unit

Item	Unit	Model	
		Z250TR	LZ250TR
Gear backlash			
Pinion-to-forward gear	mm (in)	0.13–0.42 (0.0051–0.0165)	0.32–0.64 (0.0126–0.0252)
Pinion-to-reverse gear	mm (in)	0.64–0.93 (0.0252–0.0366)	
Pinion shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Forward gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Reverse gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Propeller shaft shims	mm	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Propeller shaft			
End play	mm (in)	—	0.25–0.35 (0.0098–0.0138)



Electrical

Item	Unit	Model	
		Z250TR	LZ250TR
Ignition and ignition control system			
Ignition timing			
Cylinder #1			
at engine idle speed	Degree	ATDC 9	
at 5,500 r/min	Degree	BTDC 19	
Spark plug gap	mm (in)	1.5–1.6 (0.059–0.063)	
Ignition coil resistance			
Primary coil (R – B/W)			
at 20 °C (68 °F)	Ω	1.36–1.84	
Secondary coil			
(B/W – spark plug wire)			
at 20 °C (68 °F)	kΩ	7.31–9.89	
ECM output peak voltage			
(R – B/W)			
at cranking (loaded)	V	160	
at 1,500 r/min (loaded)	V	260	
at 3,500 r/min (loaded)	V	260	
Pulser coil output peak voltage			
(W/R, W/B, W/Y, W/G, W/L, W/Br – B)			
at cranking (unloaded)	V	3.5	
at cranking (loaded)	V	3.5	
at 1,500 r/min (loaded)	V	20.0	
at 3,500 r/min (loaded)	V	30.0	
Pulser coil resistance ^(*)	Ω	294–398	
(W/R, W/B, W/Y, W/G, W/L, W/Br – B)			
Throttle position sensor			
Input voltage (O – R)	V	5	
Output voltage (P – O)			
at engine idle speed	V	0.58–0.62	
Crank position sensor output peak voltage			
(G/L – G/W)			
at cranking (unloaded)	V	1.5	
at cranking (loaded)	V	1.5	
at 1,500 r/min (loaded)	V	8.0	
at 3,500 r/min (loaded)	V	10.0	

^(*) The figures are for reference only.

Maintenance specifications

Item	Unit	Model	
		Z250TR	LZ250TR
Crank position sensor resistance ^(*) (G/L – G/W)	Ω	178.5–241.5	
Crank position sensor air gap	mm (in)	0.5–1.5 (0.02–0.06)	
Intake air temperature sensor resistance			
at 0 °C (32 °F)	kΩ	5.4–6.6	
at 80 °C (176 °F)	kΩ	0.3–0.4	
Engine temperature sensor resistance (B/Y – B/Y)			
at 20 °C (68 °F)	kΩ	54.2–69.0	
at 100 °C (212 °F)	kΩ	3.12–3.48	
Fuel control system			
Injector driver output peak voltage ^(*) (Pu/R – O/R, Pu/B – O/B, Pu/Y – O/Y, Pu/G – O/G, Pu/L – O/L, Pu/W – O/W)			
at cranking (loaded)	V	70	
at 1,500 r/min (loaded)	V	80	
at 3,500 r/min (loaded)	V	80	
Fuel injector resistance ^(*) at 20 °C (68 °F)	Ω	0.9–1.1	
Fuel pressure sensor output voltage (engine idle speed) ^(*) (O – P)	V	3.2	
Starter motor			
Type		Sliding gear	
Output	kW	1.4	
Cranking time limit	Second	30	
Brushes			
Standard length	mm (in)	15.5 (0.61)	
Wear limit	mm (in)	9.5 (0.37)	
Commutator			
Standard diameter	mm (in)	29.0 (1.14)	
Wear limit	mm (in)	28.0 (1.10)	
Mica			
Standard undercut	mm (in)	0.5–0.8 (0.02–0.03)	
Wear limit	mm (in)	0.2 (0.01)	

^(*) The figures are for reference only.

SPEC



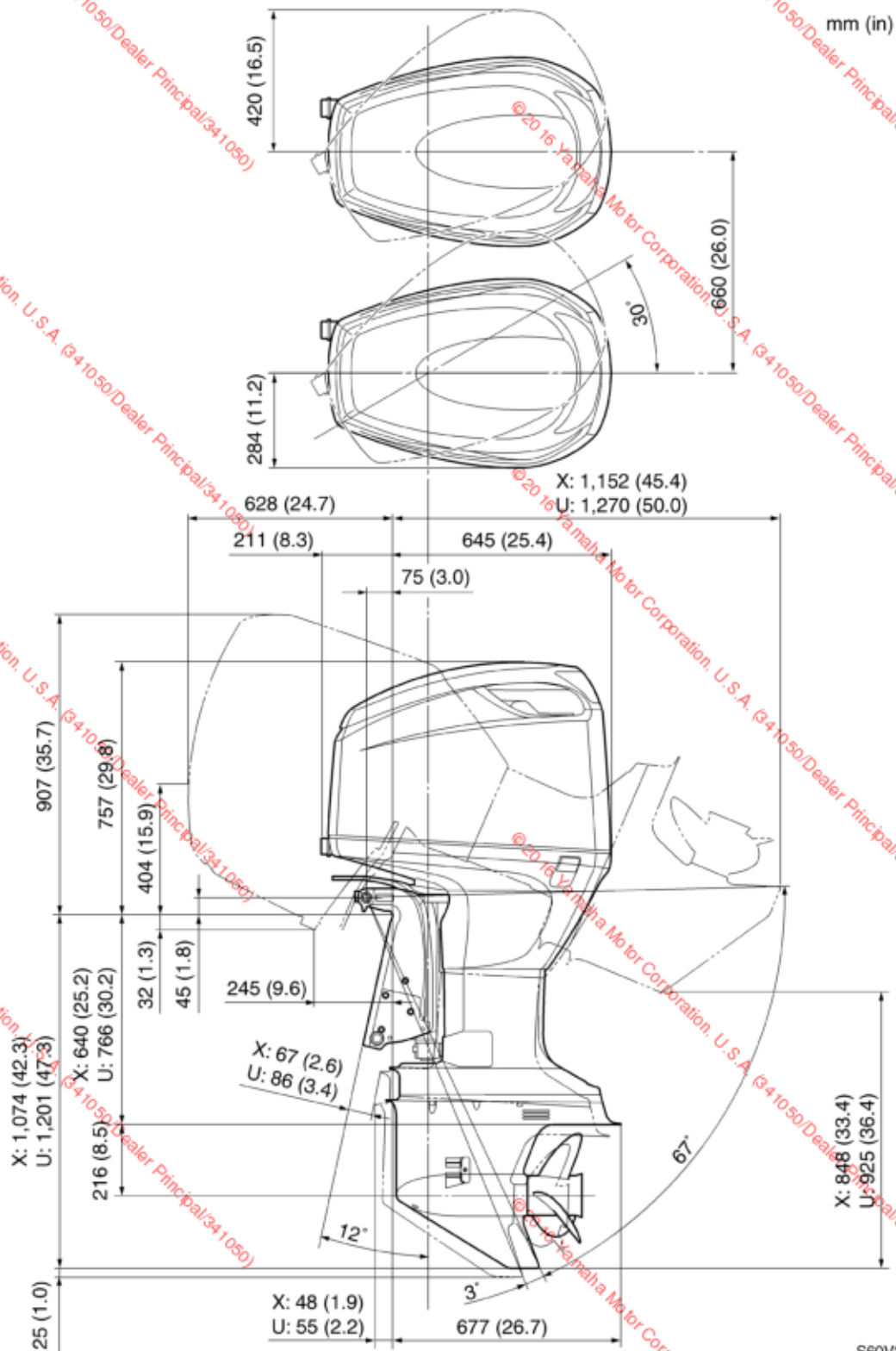
Specifications

Item	Unit	Model	
		Z250TR	LZ250TR
Charging system			
Fuse	A	20, 30, 100	
Stator coil output peak voltage (G – G)			
at cranking (unloaded)	V	5.5	
at 1,500 r/min (unloaded)	V	40	
at 3,500 r/min (unloaded)	V	90	
Stator coil resistance ^(*) at 20 °C (68 °F) (G – G)	Ω	0.11–0.17	
Rectifier Regulator output peak voltage (R – ground)			
at 1,500 r/min (unloaded)	V	14.5	
at 3,500 r/min (unloaded)	V	14.5	
Power trim and tilt system			
Trim sensor			
Setting resistance	Ω	9–11	
Resistance (P – B)	Ω	9–387.6	
Fluid type		ATF Dexron II	

(*) The figures are for reference only.

Dimensions

Exterior

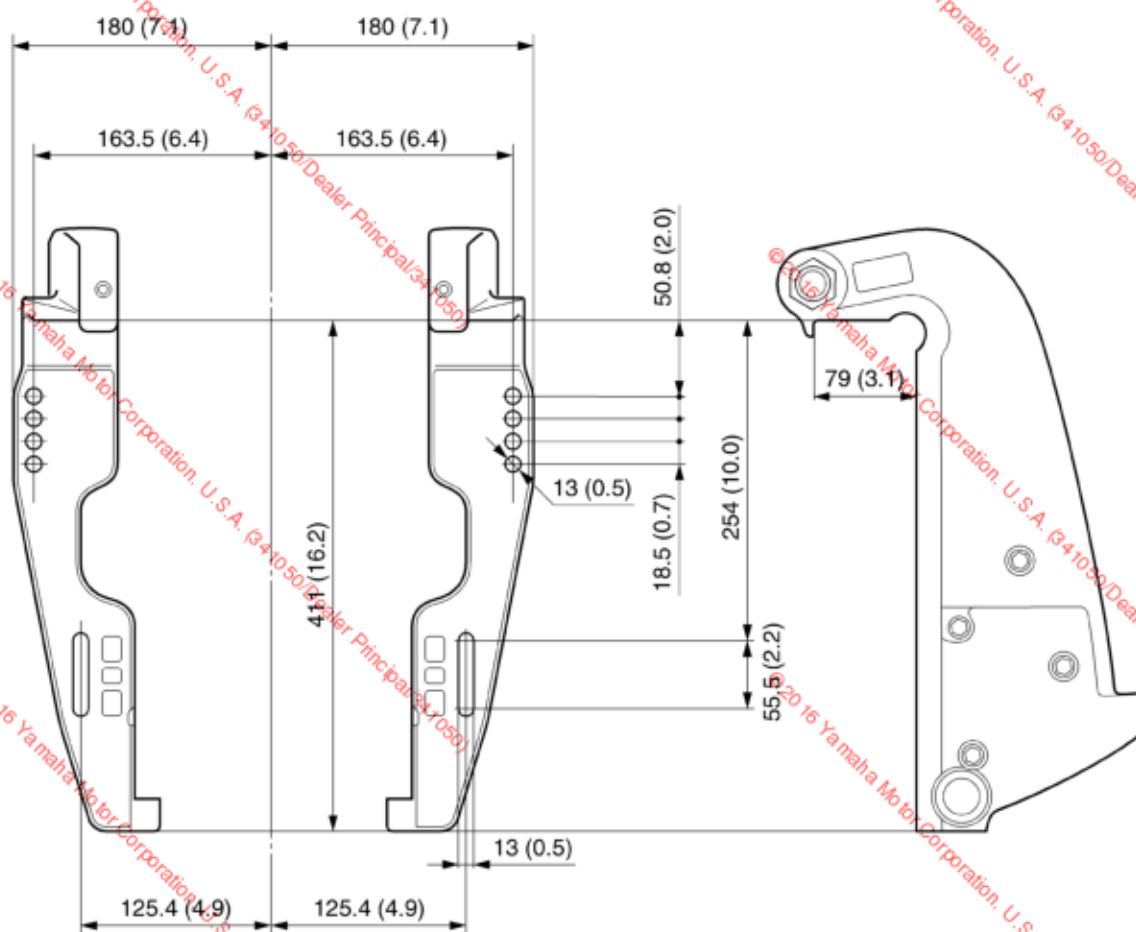


S60V2010



Clamp bracket

mm (in)



S60V2020

Maintenance specifications / Tightening torques

Tightening torques

Specified torques

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Fuel system					
Fuel pump screw		M5	3	0.3	2.2
Emergency switch		—	4	0.4	3.0
High-pressure fuel pump bolt		M8	26	2.6	19.2
Power unit					
Negative battery terminal nut		M8	12	1.2	8.9
Drive belt tensioner bolt		M10	39	3.9	28.8
Starter motor bolt		M8	29	2.9	21.4
Intake air temperature sensor		—	8	0.8	5.9
Rectifier Regulator bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
PTT motor lead bolt		M6	4	0.4	3.0
Shift position switch screw		M4	3	0.3	2.2
Control lever stopper screw		—	2	0.2	1.5
Connecting rod cap	1st	M9	28	2.8	20.7
	2nd		45	4.5	33.2
	3rd		Loosen completely		
	4th		28	2.8	20.7
	5th		45	4.5	33.2
Crankshaft balancer nut		M32	100	10.0	73.8
Crankcase bolt	1st	M10	17	1.7	12.5
	2nd		34	3.4	25.1
	1st	M6	4	0.4	3.0
	2nd		9	0.9	6.6
Cylinder head bolt	1st	M8	15	1.5	11.1
	2nd		29	2.9	21.4
Cylinder head cover bolt	1st	M6	5	0.5	3.7
	2nd		11	1.1	8.1
Exhaust outer cover bolt	1st	M6	5	0.5	3.7
	2nd		11	1.1	8.1
Flywheel nut		M24	190	19.0	140
Fuel rail mounting bolt		M8	23	2.3	17.0
Fuel filter cup holder mounting bolt		M6	8	0.8	5.9
Injector holder bolt		M8	26	2.6	19.2
Intake silencer mounting screw		M6	3	0.3	2.2
Reed valve mounting screw		M5	3	0.3	2.2
Intake manifold bolt		M6	13	1.3	9.6
Oil pump mounting bolt		M6	7	0.7	5.2
Pressure control valve cover bolt	1st	M6	5	0.5	3.7
	2nd		11	1.1	8.1
Shift cut switch mounting screw		M4	3	0.3	2.2

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SPEC



Specifications

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

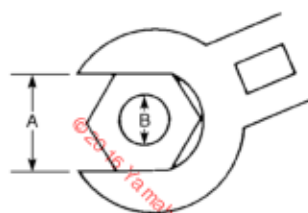
Tightening torques

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

General torques

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

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



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SPEC



Specifications

— MEMO —

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Periodic checks and adjustments

Special service tools



Inductive self-powered tachometer
YU-08036-B



Battery powered timing light
YM-33277-A



Pressure/vacuum tester
YB-35956-A

Special service tools / Maintenance interval chart

Maintenance interval chart

Use the following chart as a guideline for general maintenance.

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

Item	Remarks	Initial		Every		Refer to page
		10 hours (1 month)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Top cowling						
Top cowling fit	Check/adjust				○	3-4
Fuel system						
Fuel system	Check	○	○	○		3-4
Fuel filter (water separator)	Clean/replace	○	○	○		3-5
Fuel tank	Clean				○	—
High-pressure fuel pump oil ^(*)	Check				○	3-5
Power unit						
Drive belt ^(*)	Check				○	3-6
Spark plugs	Clean/adjust/replace	○	○	○		3-6
Cooling water passages ^(*)	Clean		○	○		3-8
Oil tank water drain	Check/clean	○	○	○		—
Outboard motor exterior	Check	○	○	○		—
Control system						
Idle speed	Check/adjust	○		○		3-8
Throttle position sensor	Check/adjust				○	4-26
Throttle link	Check/adjust				○	4-24
Throttle pick-up timing	Check/adjust				○	4-24
Power trim and tilt unit						
Power trim and tilt unit	Check				○	3-11
Power trim and tilt operation	Check	○	○	○		3-11
Lower unit						
Gear oil	Change	○		○		3-12
Propeller	Check	○	○	○		3-13
General						
Anodes	Check/replace		○	○		3-14
Battery	Check/charge	○ (every month)				3-14
Bolts and nuts	Tighten	○				—
Lubrication points	Lubricate			○		3-15
Exhaust leakage	Check	○	○	○		—
Water leakage	Check	○	○	○		—
Wiring and connectors	Check/reconnect	○	○	○		—

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ADJ



Periodic checks and adjustments

NOTE:

(*1) Be sure to change the high-pressure fuel pump oil every 1,000 hours of operation or every 5 years.

(*2) Be sure to replace the drive belt every 1,000 hours of operation or every 5 years.

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

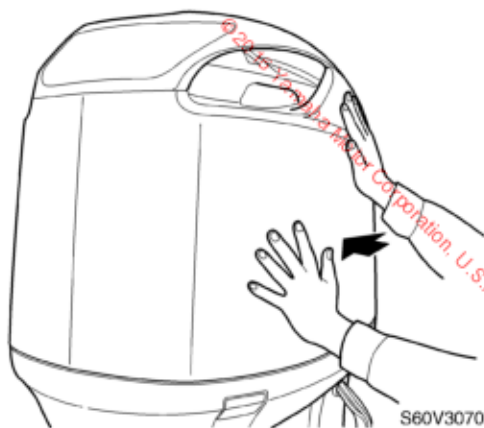
CAUTION:

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

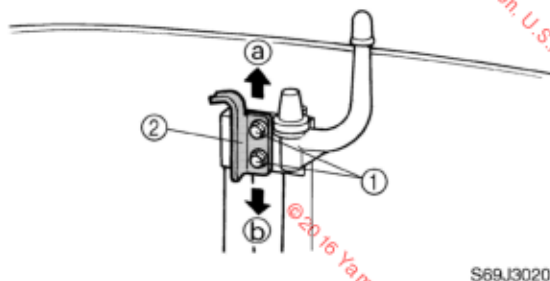
Top cowling

Checking the top cowling

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



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



NOTE:

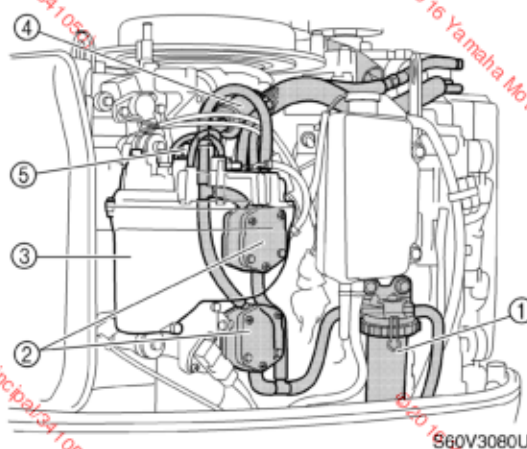
- To loosen the fitting, move the hook in direction ①.
- To tighten the fitting, move the hook in direction ②.

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

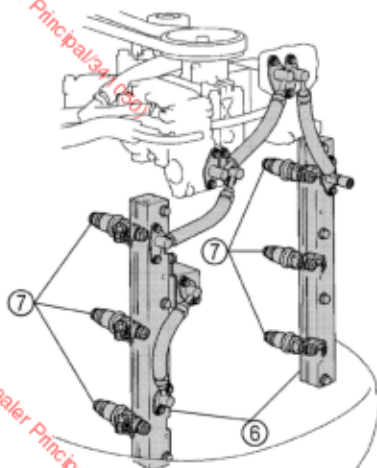
Fuel system

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

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



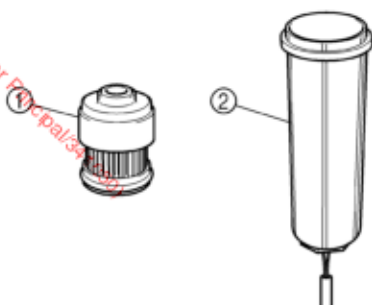
4. Check the high-pressure fuel hose connections for leaks. Replace if necessary. Also, check the fuel rails ⑥ and fuel injectors ⑦ for leaks or damage. Replace if necessary.



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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.



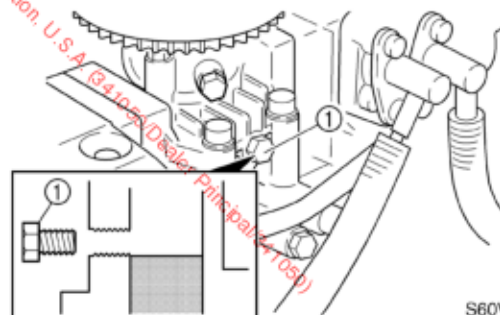
S60V3100

NOTE:

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

Checking the high-pressure fuel pump gear oil level

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

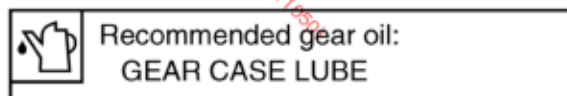


S60V3230

NOTE:

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

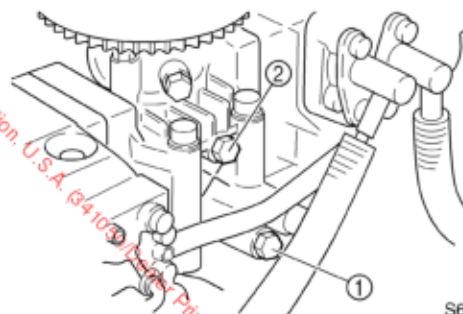
3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.



4. Install the check bolt.

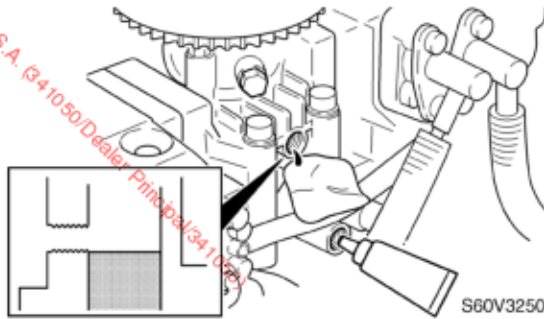
Changing the high-pressure fuel pump gear oil

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



S60V3240

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



S60V3250



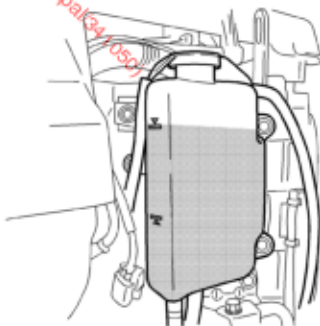
Recommended gear oil:
GEAR CASE LUBE
Oil quantity:
45 cm³ (1.5 US oz, 1.6 Imp oz)

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

Power unit

Checking the engine oil level

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



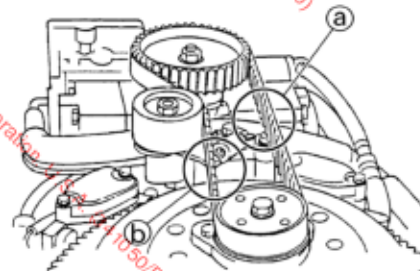
S60V3260



Recommended engine oil:
YAMALUBE 2-stroke outboard motor oil

Checking the drive belt

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



S60V3110

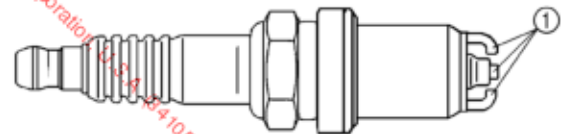
Replacing the drive belt

NOTE:

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

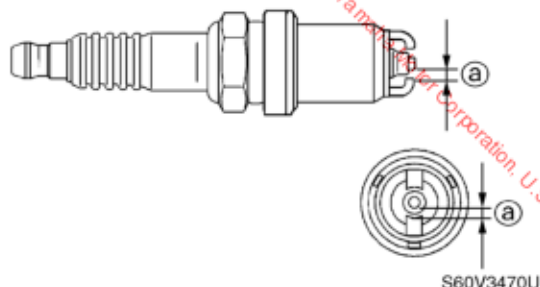
Checking the spark plugs

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



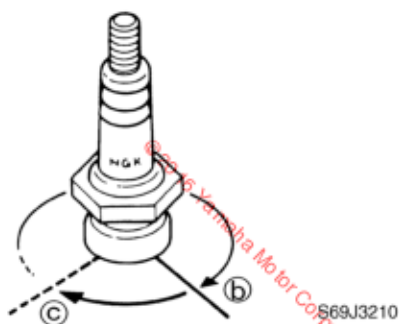
S60V3460

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



Specified spark plug:
BKR6EKU (NGK)
Spark plug gap (a):
1.5–1.6 mm (0.059–0.063 in)

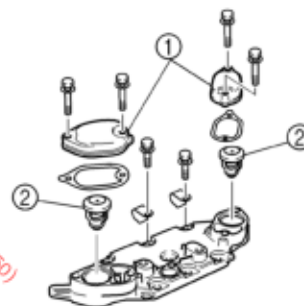
5. Install the spark plugs, tighten them finger tight (b), then to the specified torque with a spark plug wrench (c).



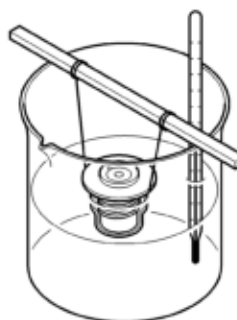
Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

Checking the thermostats

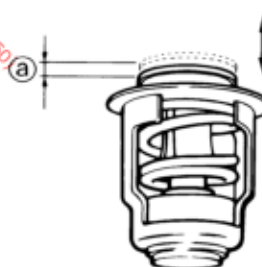
1. Remove the flywheel magnet cover.
2. Remove the covers (1) and thermostats (2).



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



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



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

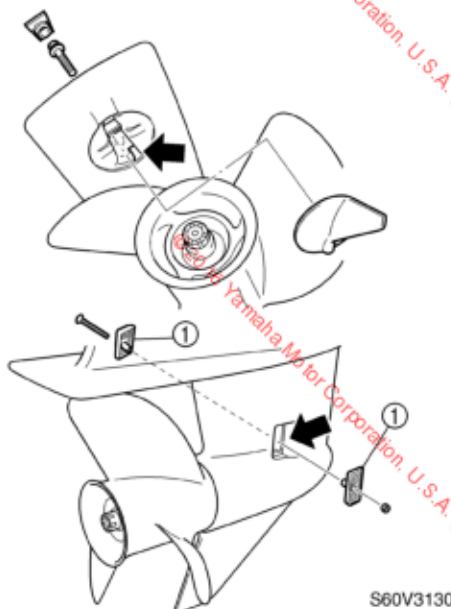
6. Install the thermostats and covers, and then tighten the cover bolts to the specified torque.



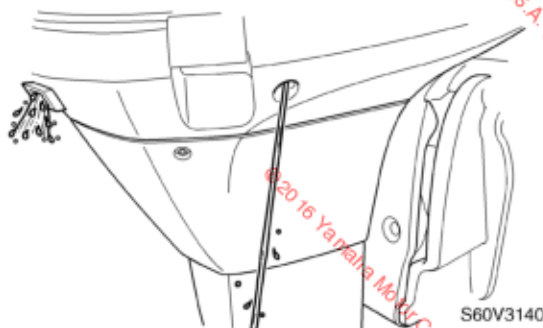
Thermostat cover bolt:
11 N·m (1.1 kgf·m, 8.1 ft·lb)

Checking the cooling water passage

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



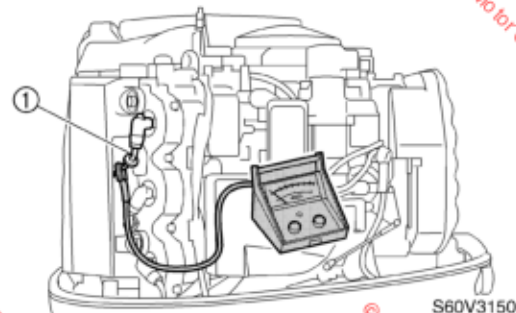
2. Place the lower unit in water, and then start the engine.
3. Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the out-board motor.



Control system

Checking the engine idle speed

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

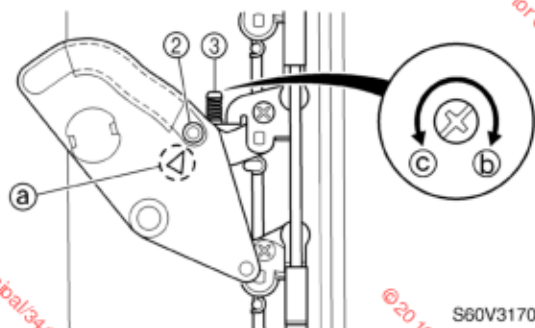


Inductive self-powered tachometer:
YU-08036-B



Engine idle speed: 670–730 r/min

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



NOTE:

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

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

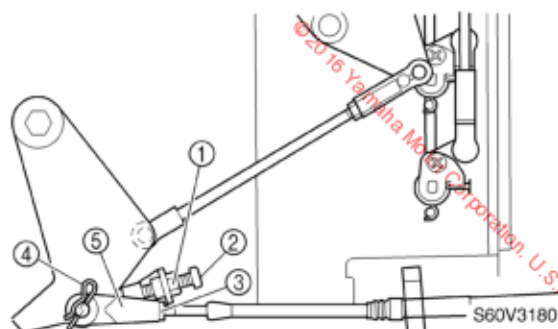
7. Adjust the position of the throttle cable joint until its hole is aligned with the set pin on the throttle lever.

Adjusting the throttle cable

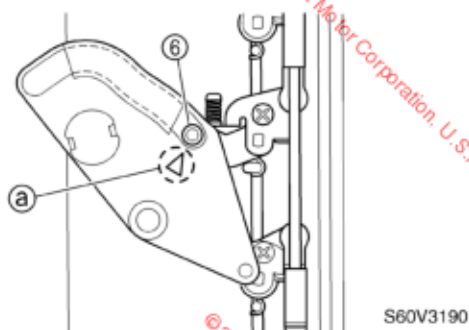
NOTE:

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

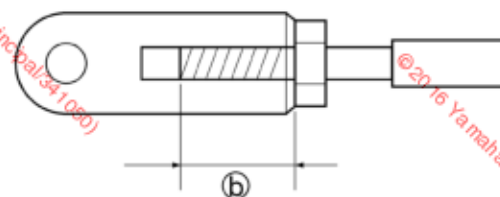
1. Loosen the locknut ① and stopper screw ②.
2. Loosen the locknut ③, remove the clip ④, and then disconnect the throttle cable joint ⑤.



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



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



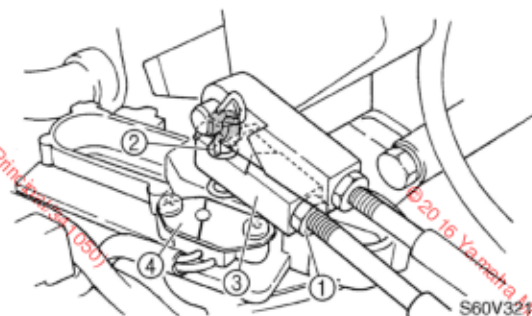
CAUTION:

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

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

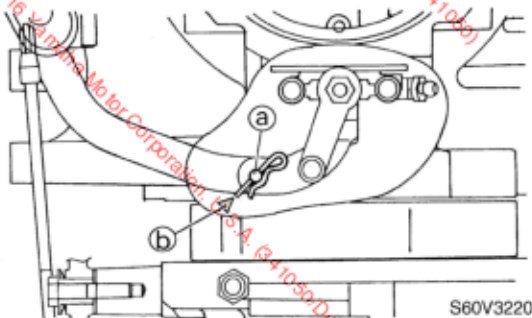
Checking the gear shift operation

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

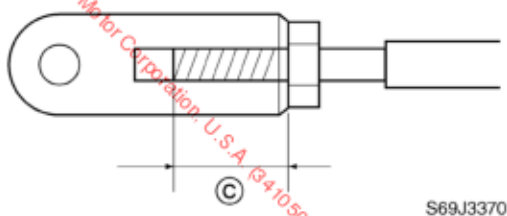


- Adjust the position of the shift lever until the pin on the lever is aligned with the line on the shift position switch plate ④.

- Align the center of the set pin ① with the alignment mark ② on the bottom cowl.



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

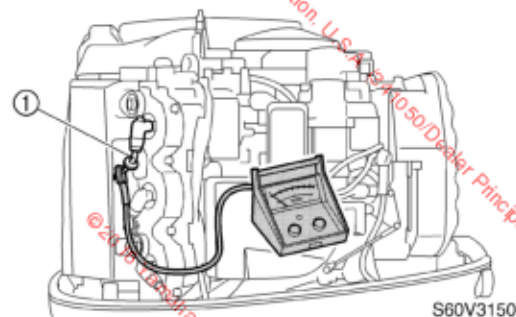
**CAUTION:**

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

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

Checking the ignition timing

- Start the engine and warm it up for 5 minutes.
- Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed.



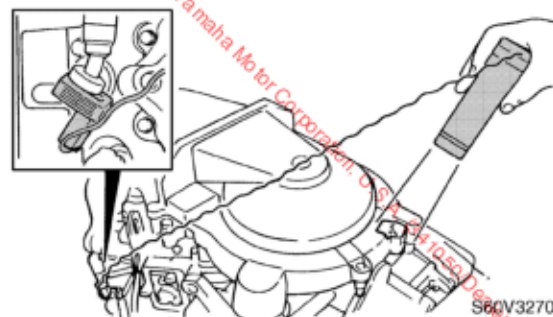
Inductive self-powered tachometer:
YU-08036-B



Engine idle speed: 670–730 r/min

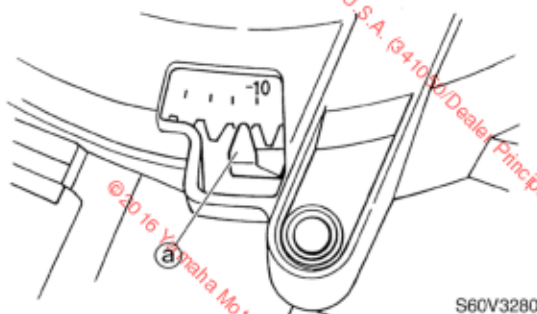
3

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



Battery powered timing light:
YM-33277-A

- Check that the pointer ① is within the specified ignition timing range on the flywheel magnet.



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

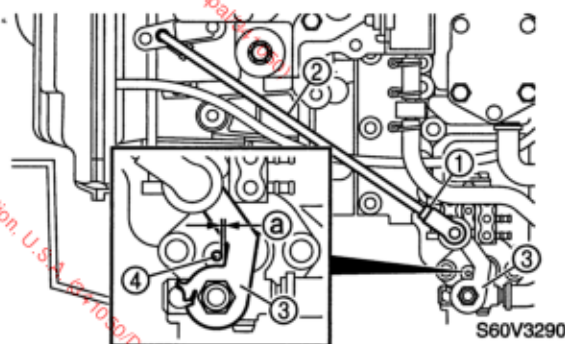
Oil injection system

Adjusting the oil pump link rod

1. Loosen the locknut ①, then disconnect the oil pump link rod ②.

NOTE: Review "Synchronizing the throttle valves" (page 4-24 of the Service Manual) and "Adjusting the throttle position sensor" (page 4-26 of the Service Manual) before proceeding.

2. Loosen the throttle stop screw until it no longer contacts the idle stopper. Check that all throttle plates are fully closed.
3. Adjust the oil pump link rod so the gap ③ between the oil pump lever ③ (in the fully closed position) and the stopper (roll pin) ④ is less than 0.5mm (0.02 in), but not touching the roll pin.



4. Connect the link rod and tighten locknut ①.
5. Turn the throttle stop screw in until the throttle sensor voltage is within specification (see "Adjusting the throttle position sensor" (page 4-26 of the Service Manual)).

Power trim and tilt unit

Checking the power trim and tilt operation

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

NOTE:

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

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



Checking the power trim and tilt fluid level

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

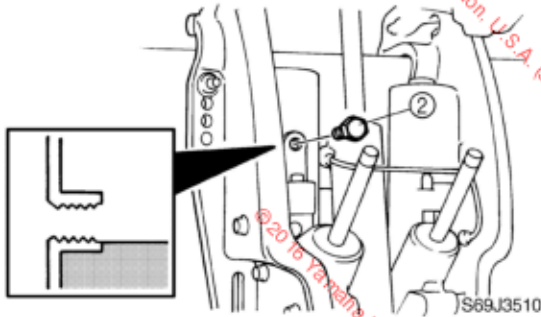


⚠ WARNING

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

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

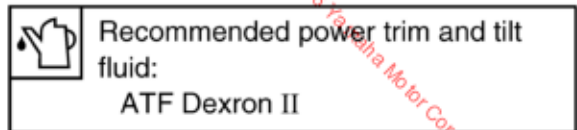
Oil injection system / Power trim and tilt unit / Lower unit



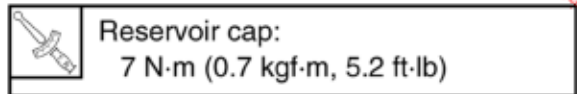
NOTE:

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.



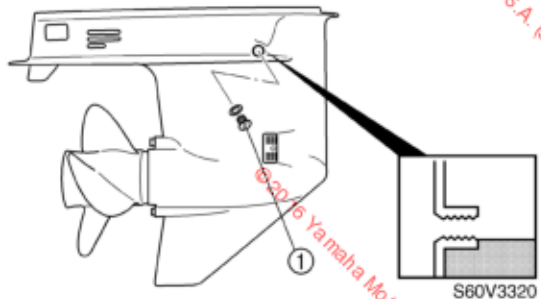
4. Install the reservoir cap, and then tighten it to the specified torque.



Lower unit

Checking the gear oil level

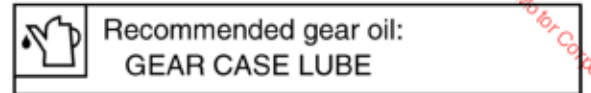
1. Fully tilt the outboard motor down.
2. Remove the check screw (1), and then check the gear oil level in the lower case.



NOTE:

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

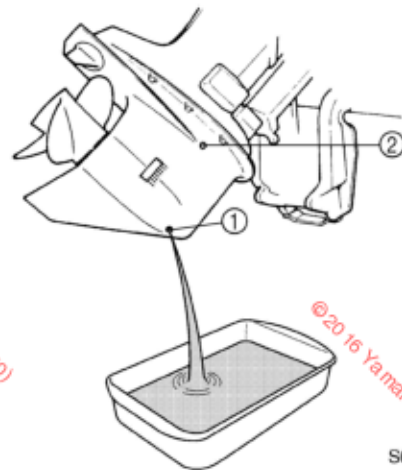
3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.



4. Install the check screw.

Changing the gear oil

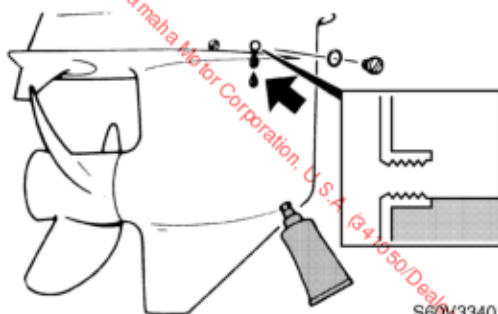
1. Tilt the outboard motor up slightly.
2. Place a drain pan under the drain screw (1), remove the drain screw, then the check screw (2) to drain the oil.



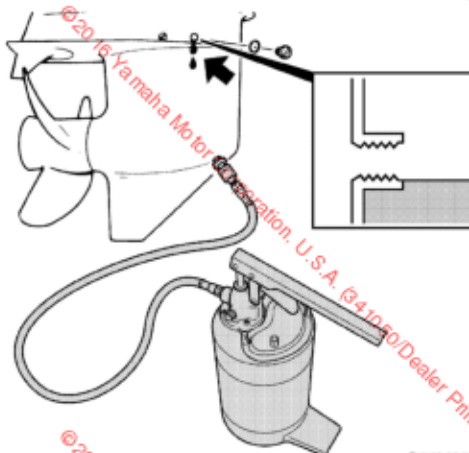
S60V3330

3

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



S60V3340



S60V3350



Recommended gear oil:
GEAR CASE LUBE

Oil quantity:

Regular rotation model:

1,150 cm³
(38.9 US oz, 40.5 Imp oz)

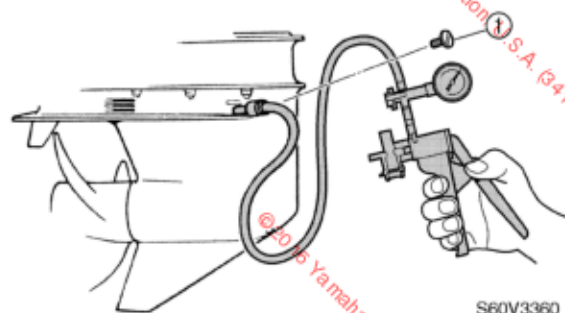
Counter rotation model:

1,000 cm³
(33.8 US oz, 35.2 Imp oz)

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

Checking the lower unit for air leakage

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



S60V3360



Pressure/vacuum tester:
YB-35956-A

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

CAUTION:

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

NOTE:

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

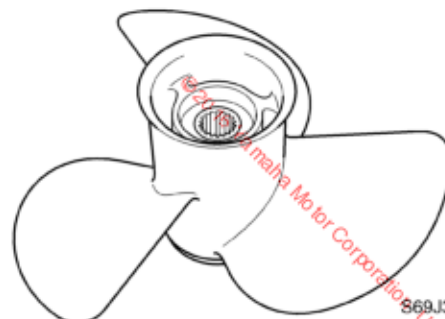


Lower unit holding pressure:
70 kPa (0.7 kgf/cm², 10 psi)

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.

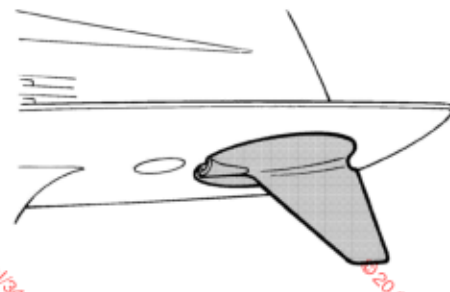
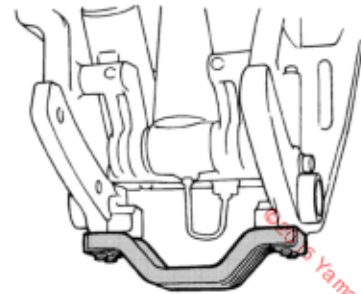
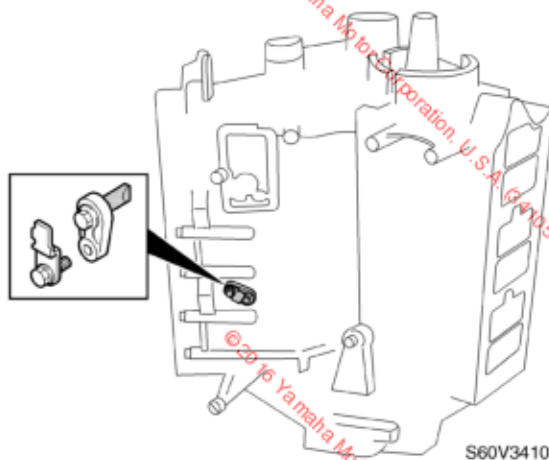
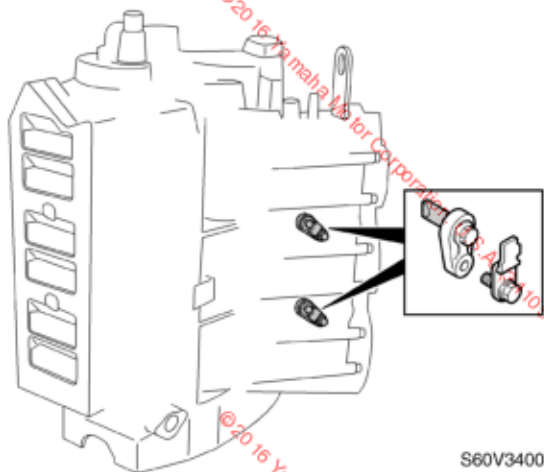
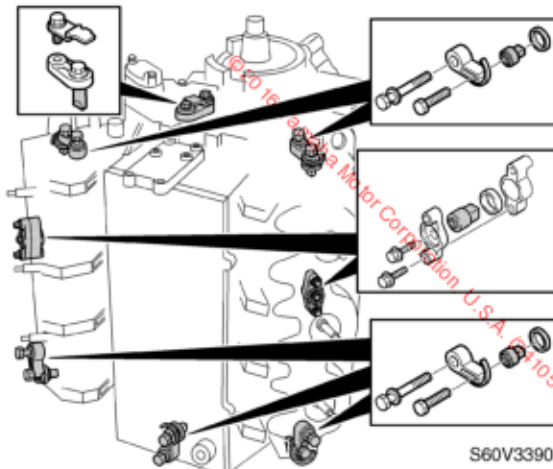


S60J3580

General

Checking the anodes

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



3

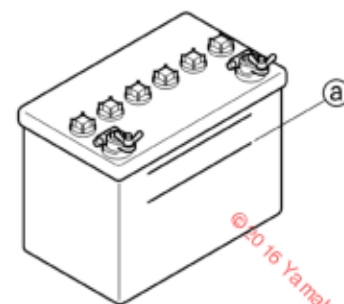
CAUTION:

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

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

Checking the battery

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



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

⚠ WARNING

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

Always follow these preventive measures:

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

Antidote (EXTERNAL):

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

Antidote (INTERNAL):

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

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

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

KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:

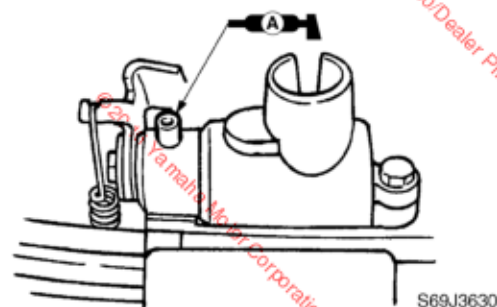
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the negative battery lead first, then the positive battery lead.



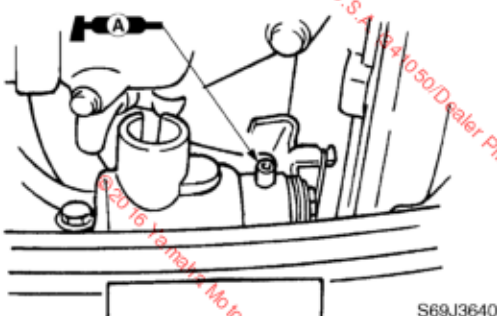
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Lubricating the outboard motor

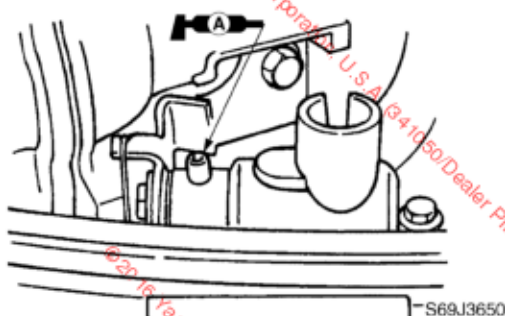
1. Apply water resistant grease to the areas shown.



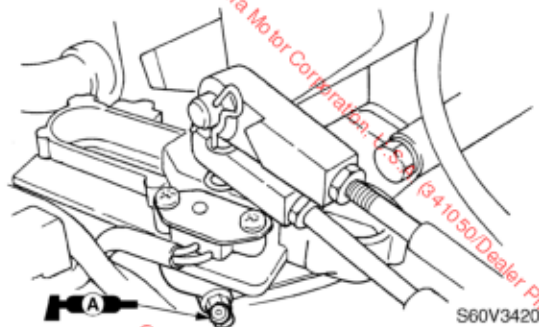
S69J3630



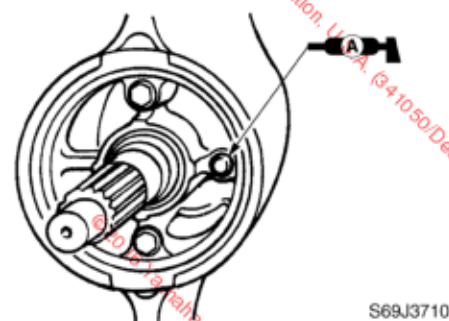
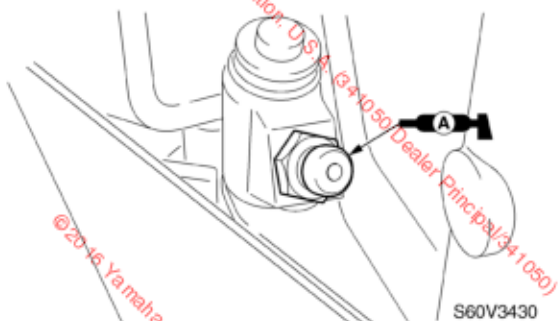
S69J3640



S69J3650

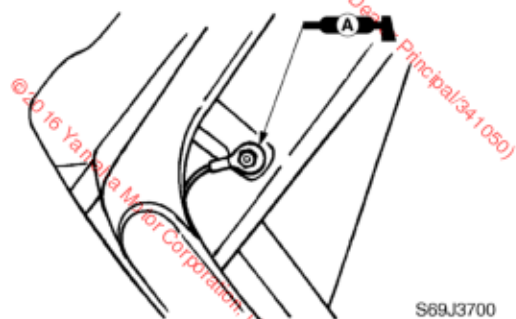
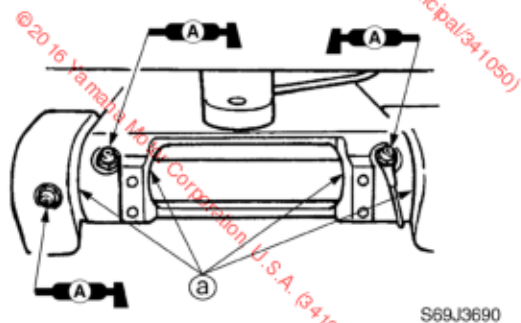
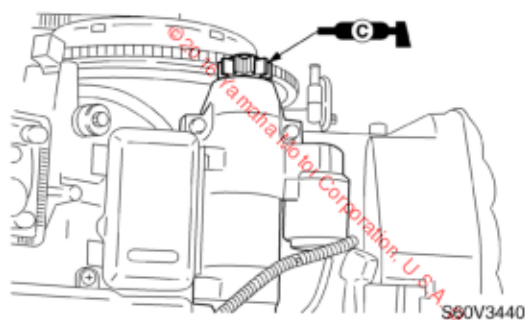
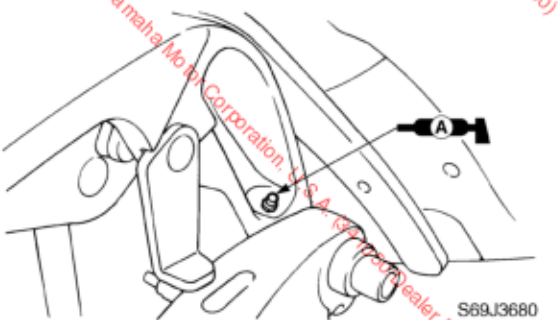
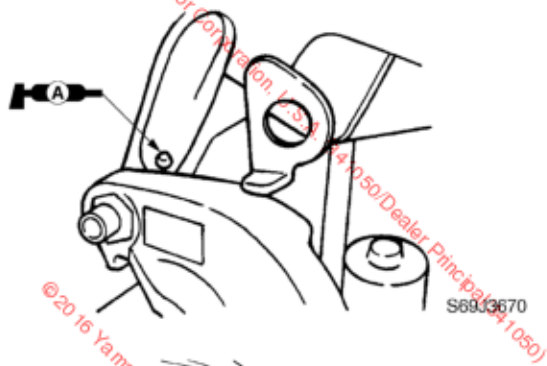


S60V3420

**NOTE:**

Apply grease to the grease nipple until it flows from the bushings (a).

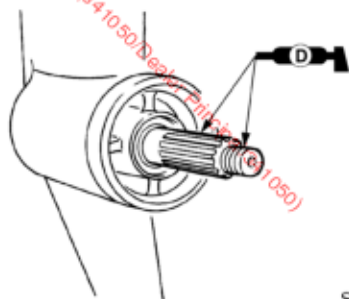
2. Apply low temperature resistant grease to the areas shown.





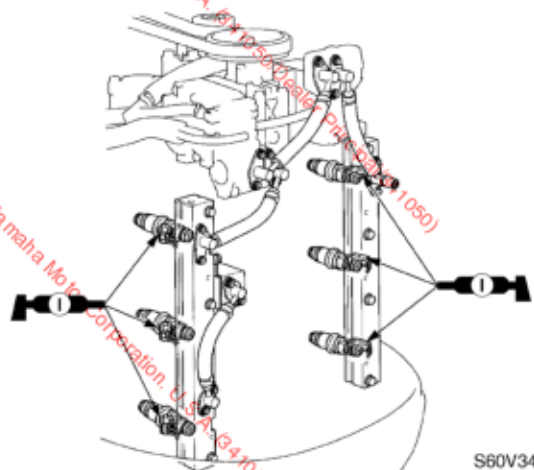
Periodic checks and adjustments

3. Apply corrosion resistant grease to the areas shown.



S69J3720

4. Apply injector grease to the areas shown.



S60V3450



Fuel system

Special service tools	4-1
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FUEL

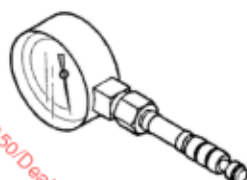


Fuel system

Special service tools



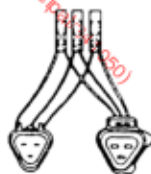
Pressure/vacuum tester
YB-35956-A



Fuel pressure gauge
YB-06766



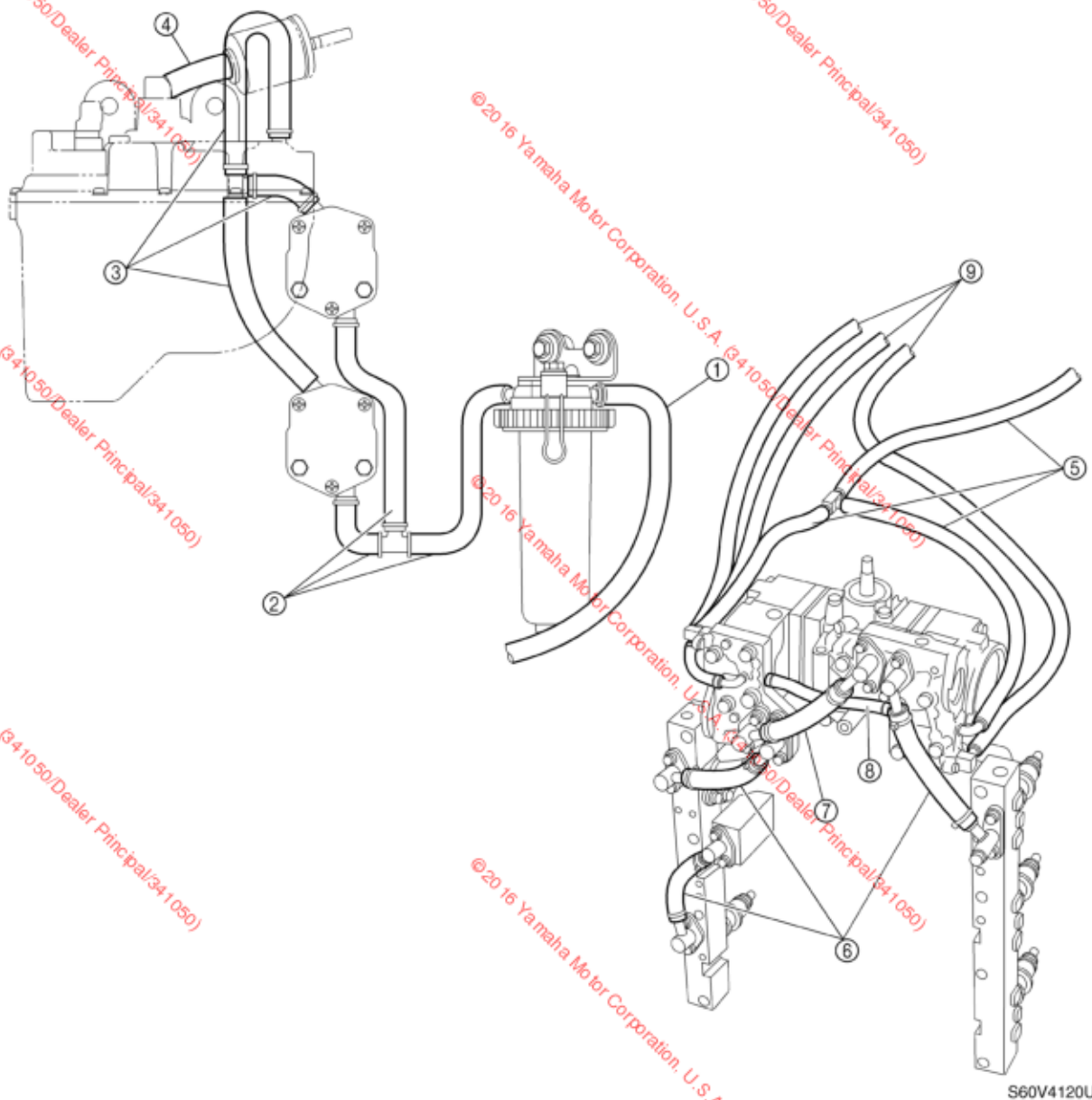
Digital multimeter
YU-34899-A



Test harness (3 pins)
YB-06757

Hose routing

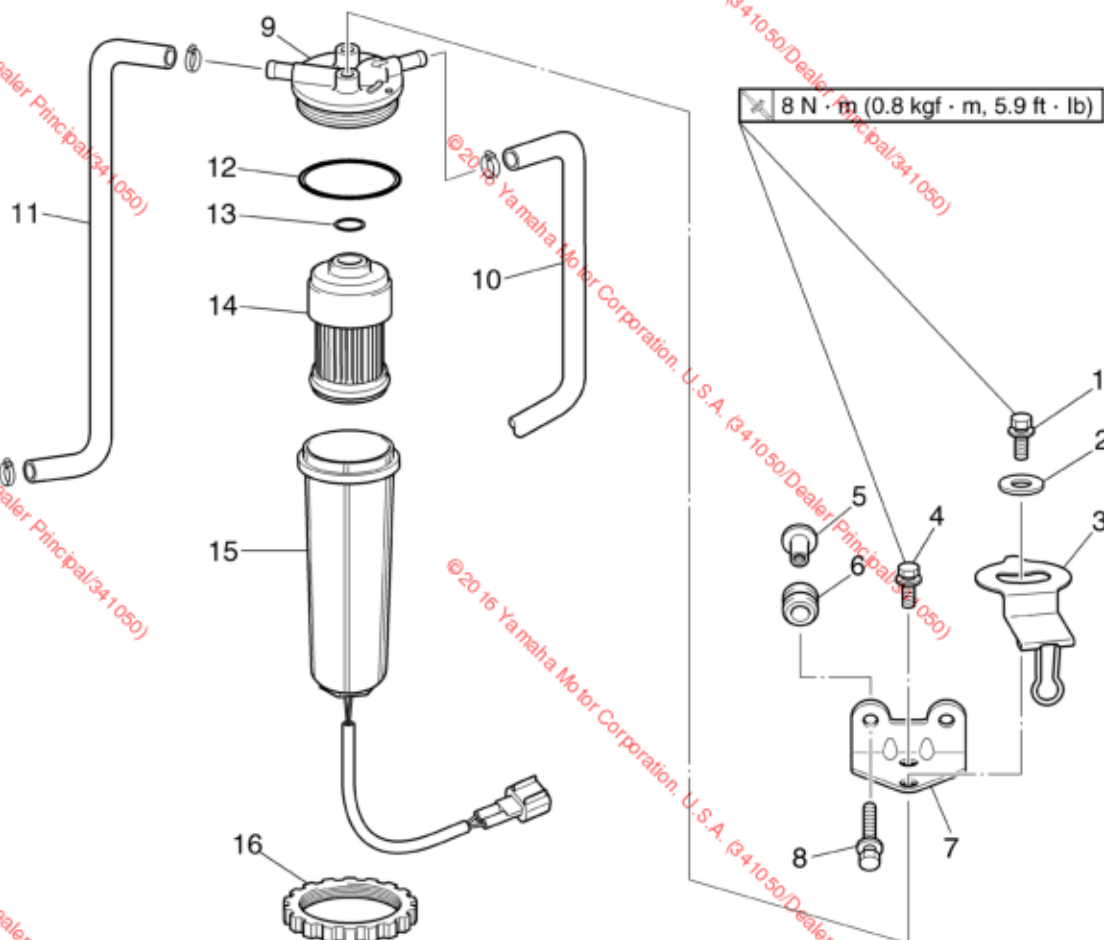
Fuel hoses and fuel pipes



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



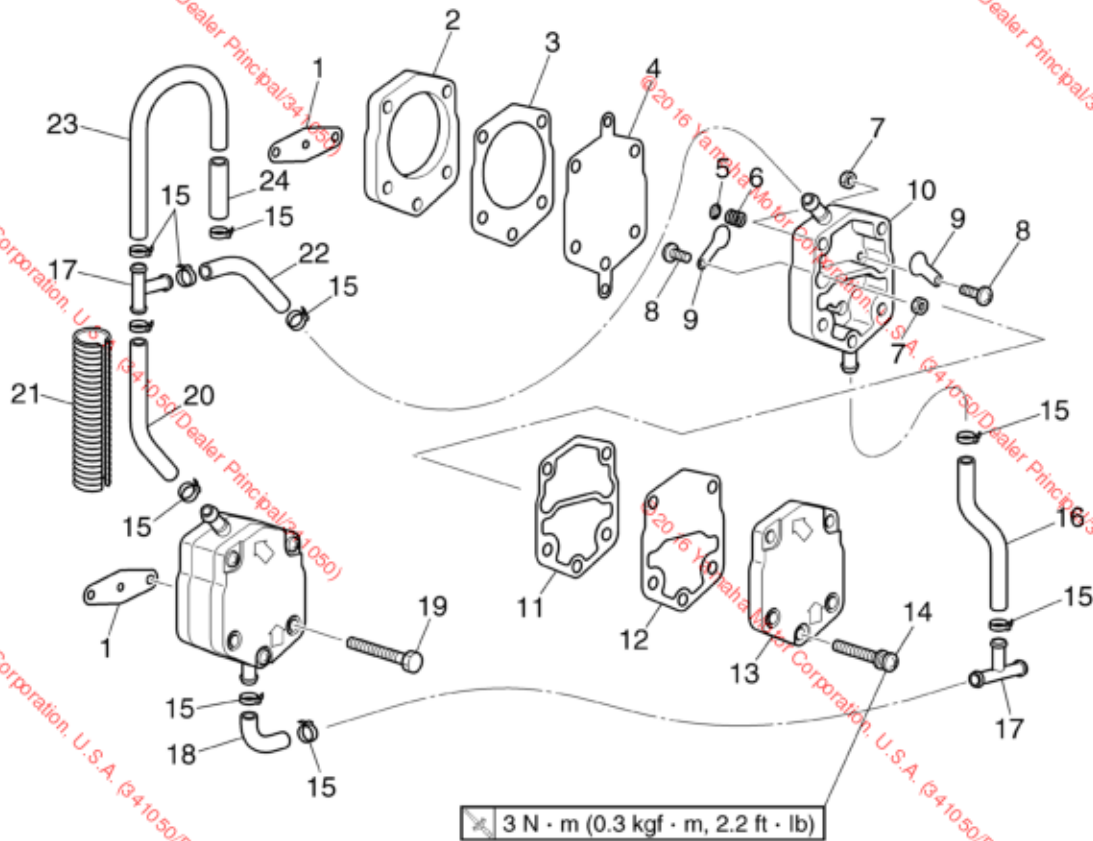
Fuel filter



S6D04010

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

Fuel pump



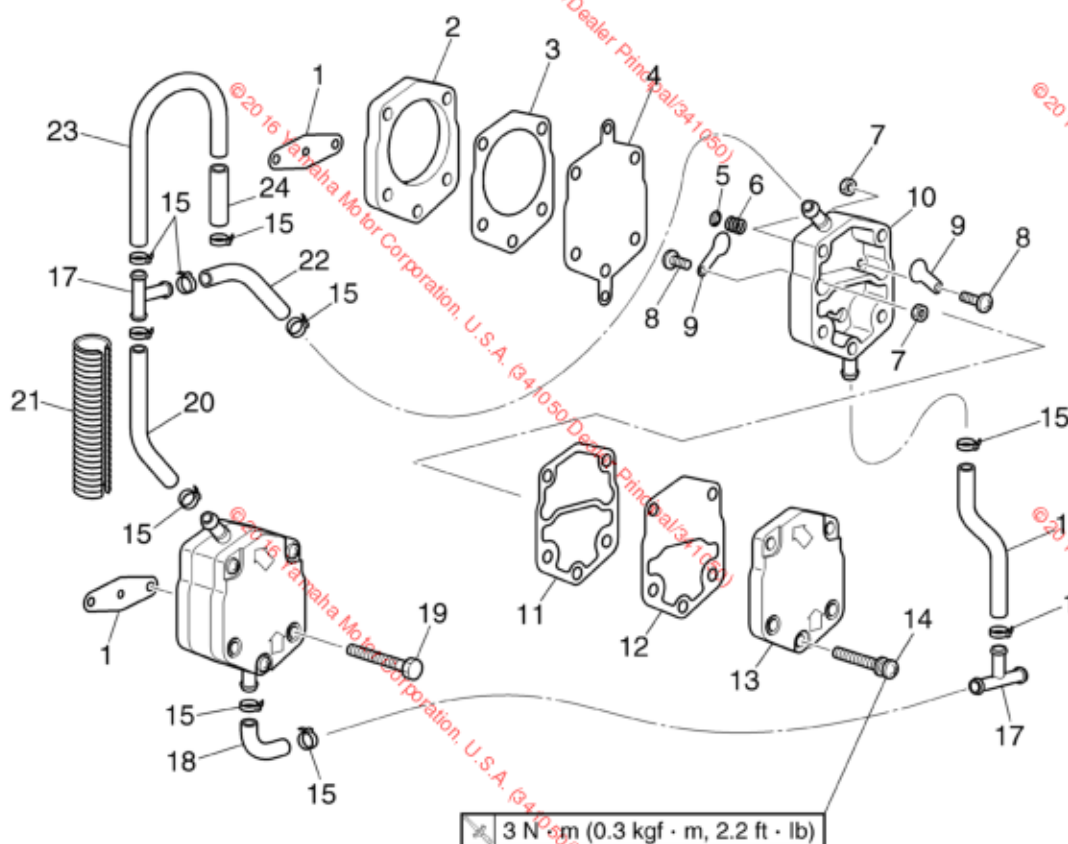
S60V4100

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

FUEL



Fuel system



3 N · m (0.3 kgf · m, 2.2 ft · lb)

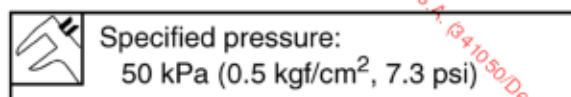
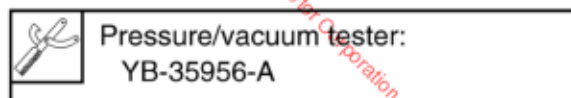
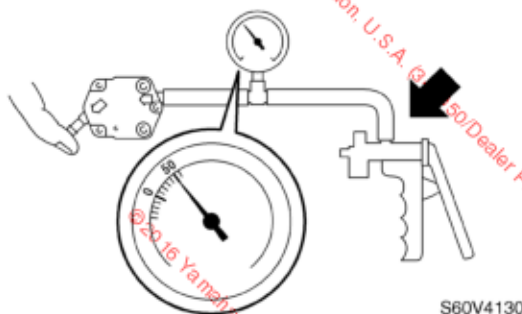
S60V4100

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

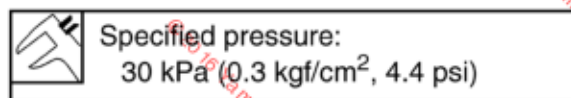
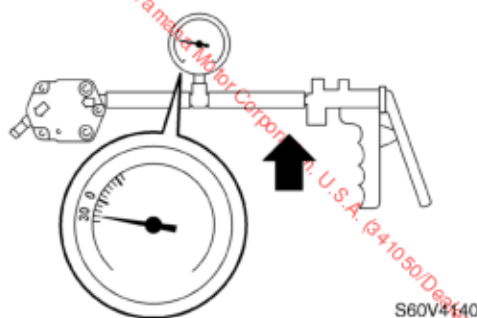
Fuel pump

Checking the fuel pumps

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

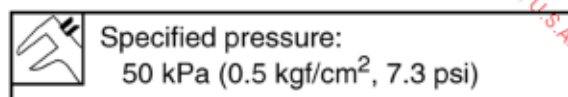
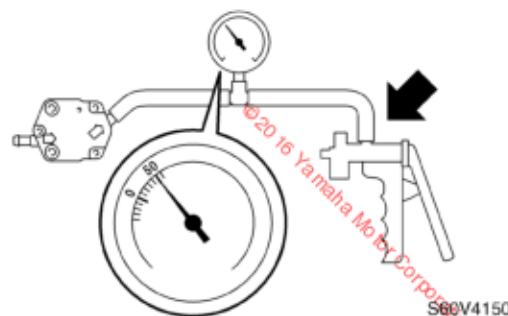


4. Apply the specified negative pressure and check that there is no air leakage.



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.

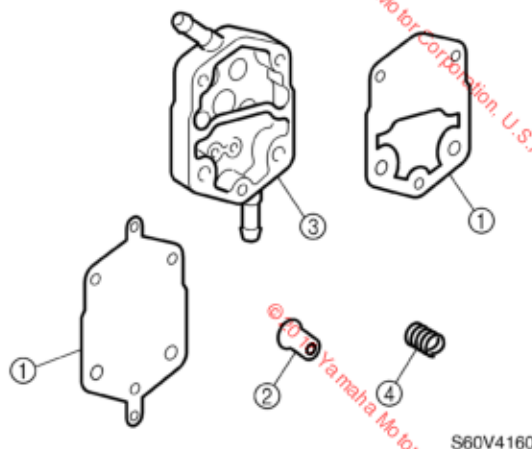


NOTE:

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

Disassembling the fuel pumps

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



4. Clean the fuel pump bodies.

FUEL



Fuel system

Assembling the fuel pumps

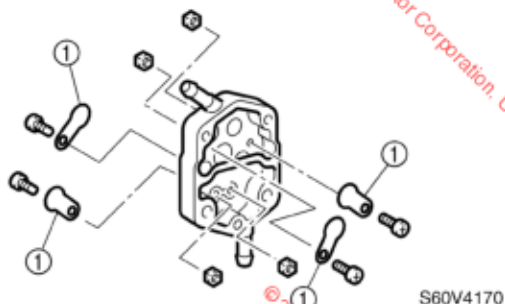
NOTE:

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

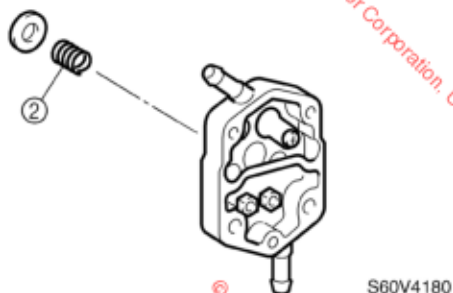
NOTE:

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

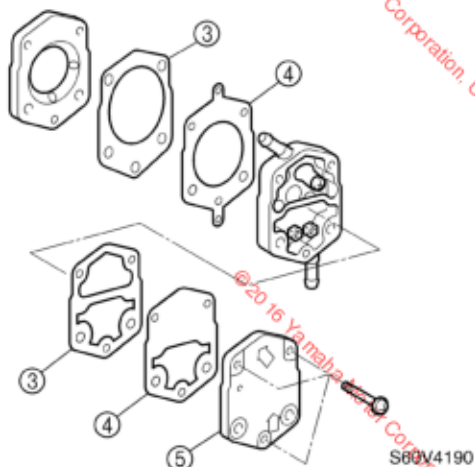
1. Install the valves ① onto the fuel pump body.



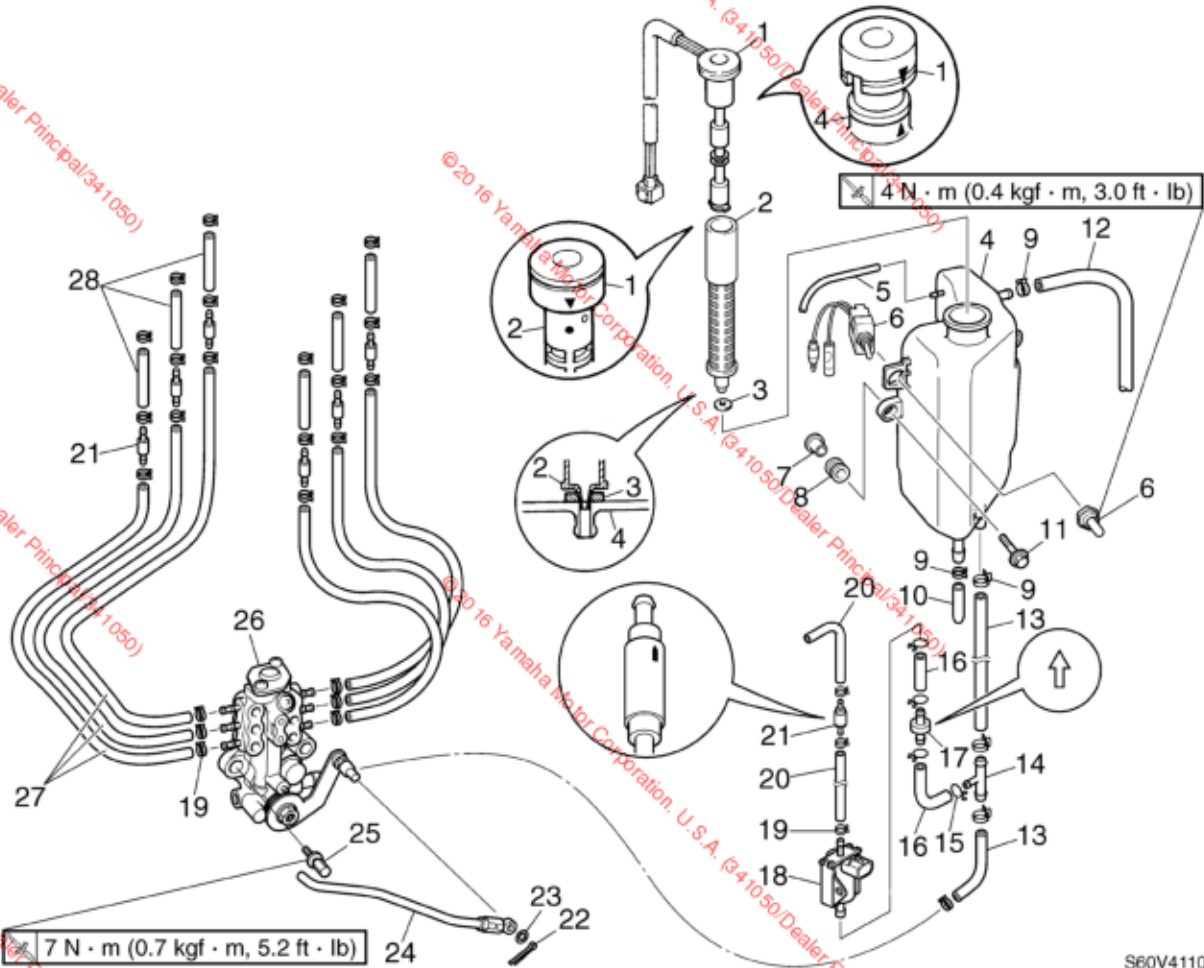
2. Install the spring ②.



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



Oil injection system



S60V4110

No.	Part name	Q'ty	Remarks
1	Oil level sensor	1	
2	Oil filter	1	
3	Washer	1	
4	Oil tank	1	
5	Air vent hose	1	
6	Emergency switch	1	
7	Collar	3	
8	Grommet	3	
9	Plastic tie	6	
10	Cap	1	
11	Bolt	3	
12	Oil hose	1	
13	Oil hose	2	
14	Joint	1	
15	Clip	1	
16	Oil hose	2	
17	Check valve	1	

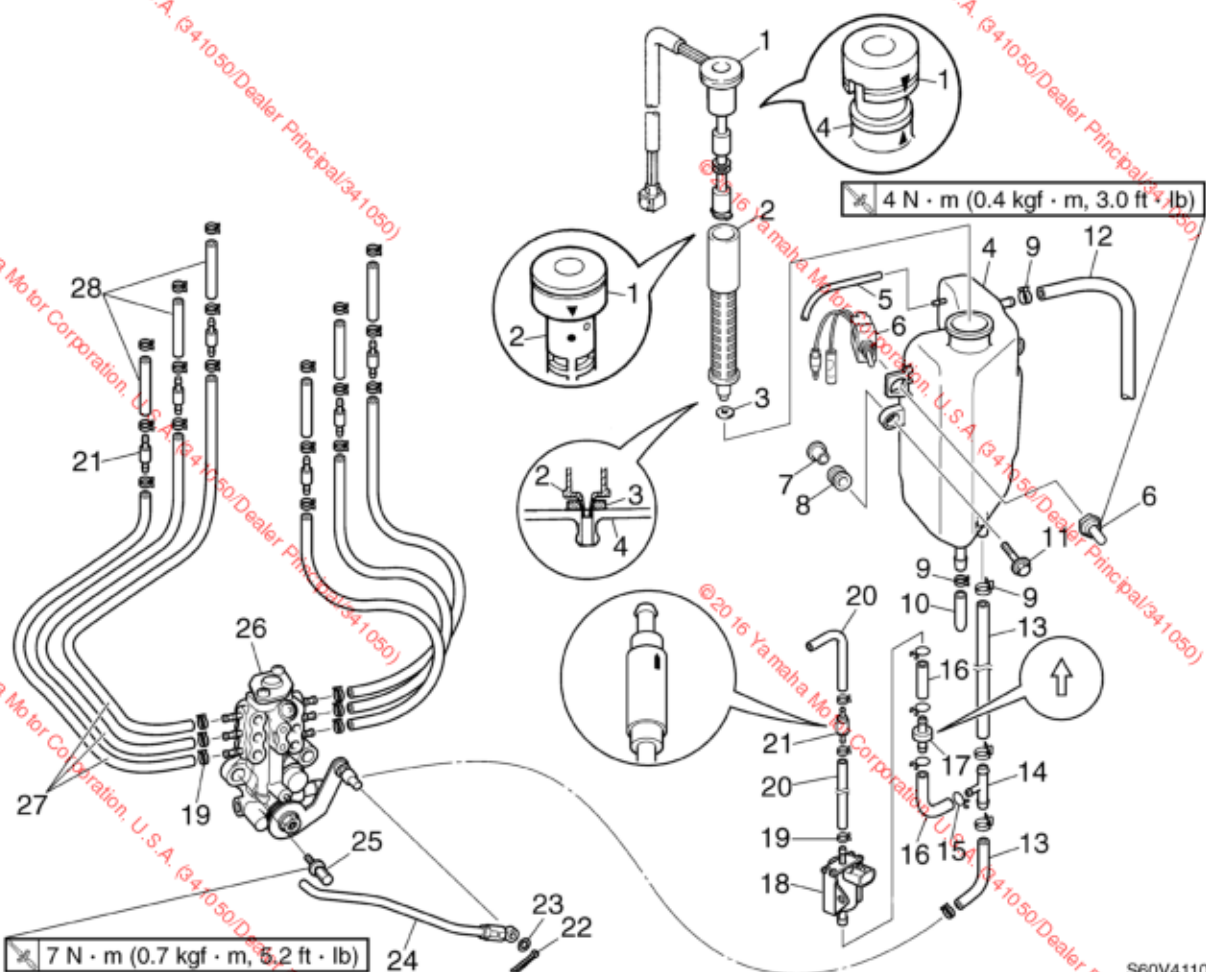
Not reusable

M6 × 30 mm

FUEL



Fuel system

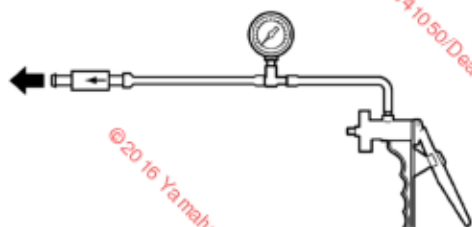
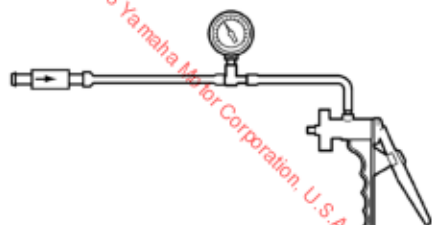


S60V4110

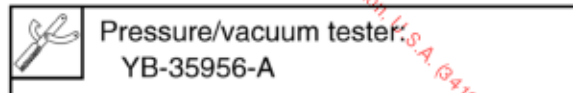
No.	Part name	Q'ty	Remarks
18	Electric oil pump	1	
19	Clamp	27	
20	Oil hose	2	
21	Check valve	7	
22	Pin	1	
23	Washer	1	
24	Oil pump link rod	1	
25	Bolt	2	M6 × 20 mm
26	Oil pump	1	
27	Oil hose	6	
28	Oil hose	6	

Checking the check valve

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



S60V4200

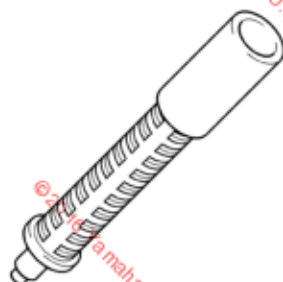


NOTE:

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

Checking the oil filter

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



S60V4210

Checking the oil tank

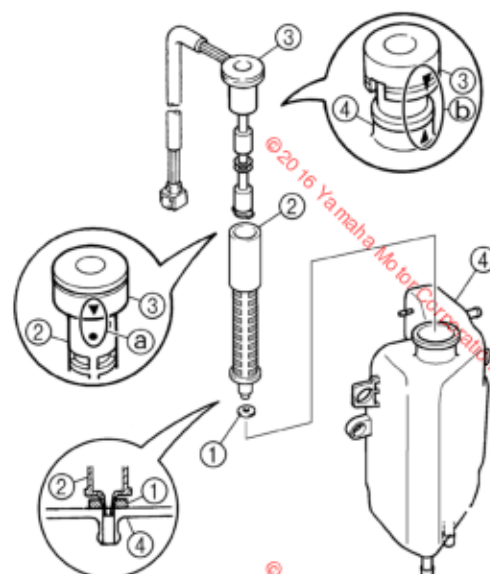
1. Check the oil tank for cracks, leaks, or damage. Replace if necessary.



S60V4220

Assembling the oil tank

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



S60V4230

NOTE:

- Align the alignment marks ④ on the oil filter ② and oil level sensor ③.
- Align the alignment marks ⑥ on the oil level sensor ③ and oil tank ④.

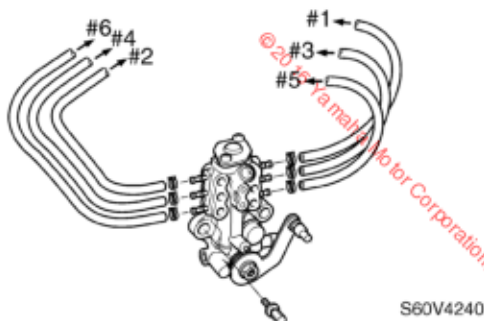
FUEL



Fuel system

Installing the oil pump

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



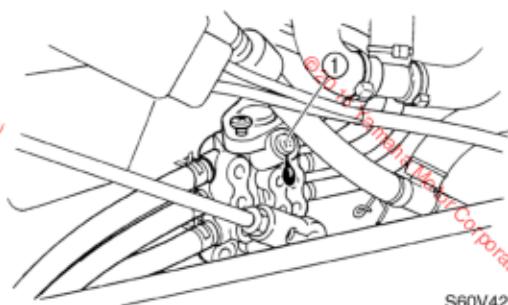
Oil pump bolt:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

Bleeding the oil injection system

CAUTION:

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

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



2. Fill the oil tank with engine oil.



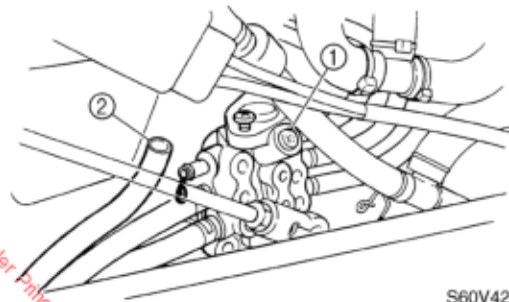
Recommended engine oil:
YAMALUBE 2-stroke outboard
motor oil

3. Disconnect the oil pump link rod joint from the oil pump lever.
4. Start the engine and let it idle.

5. Loosen the air bleed screw ① and make sure that both the oil and air bubbles flow out.

6. When there are no air bubbles left, tighten the air bleed screw.

7. Disconnect an oil pump feed hose ② from the oil pump.

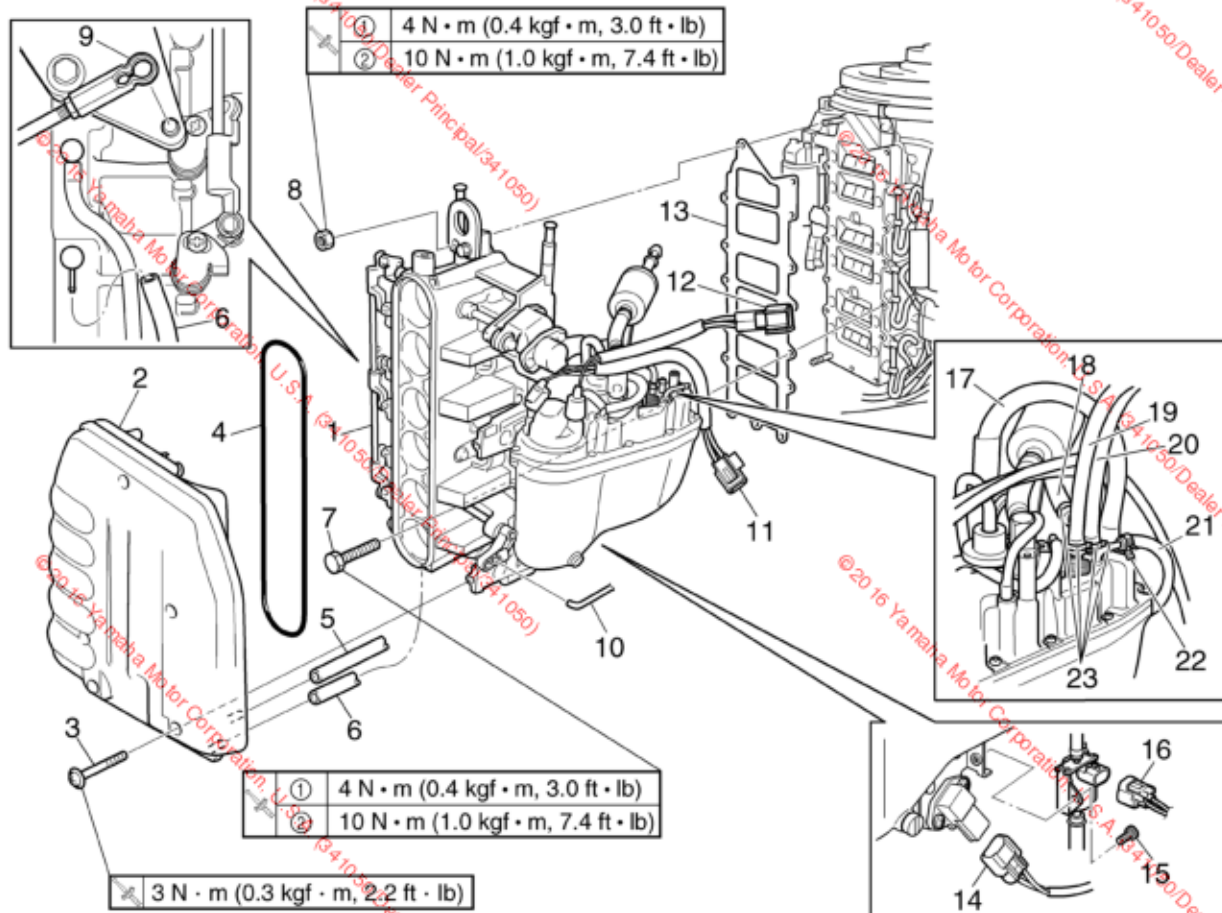


8. Check that oil flows from the oil pump.

9. Connect the oil pump feed hose.

10. Connect the oil pump link rod joint to the oil pump lever.

Throttle body assembly and vapor separator



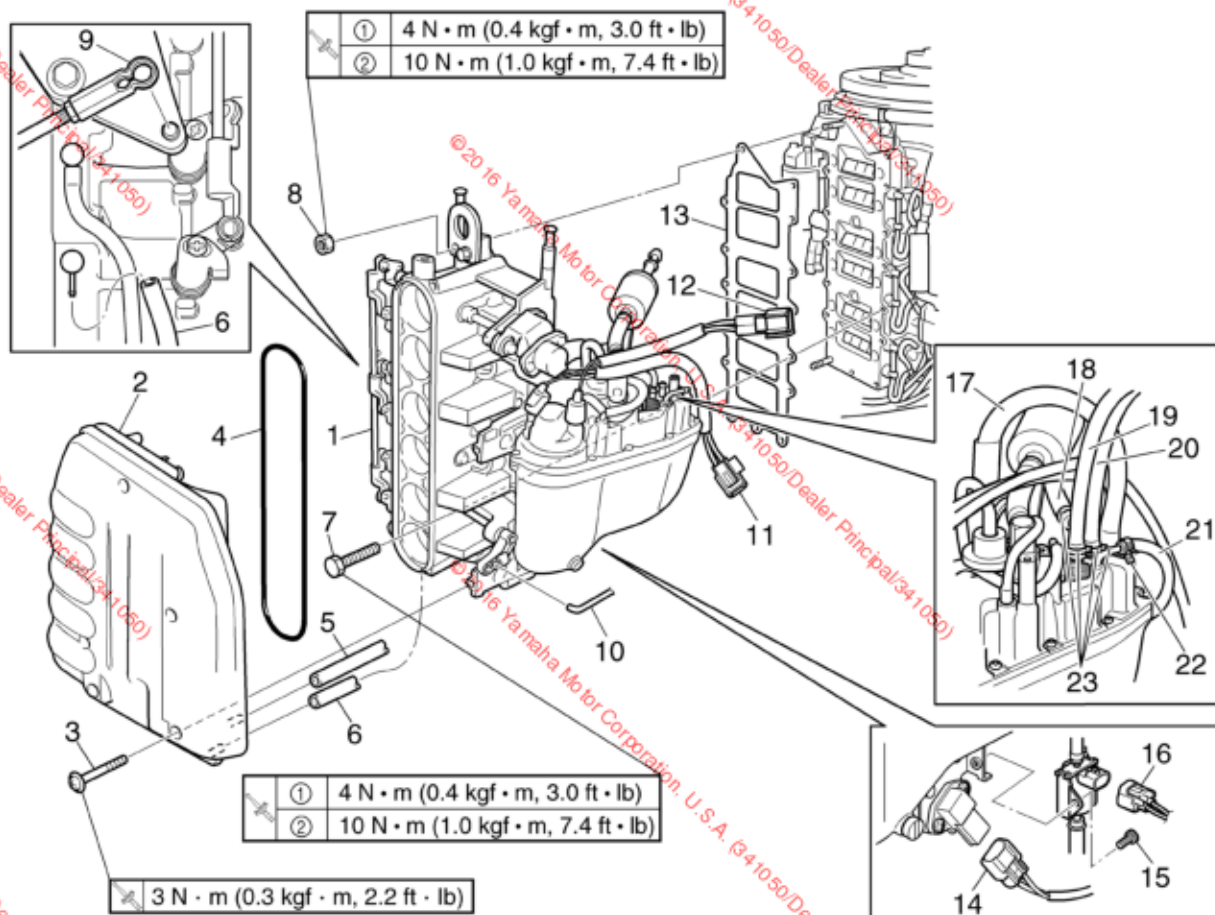
4

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

FUEL

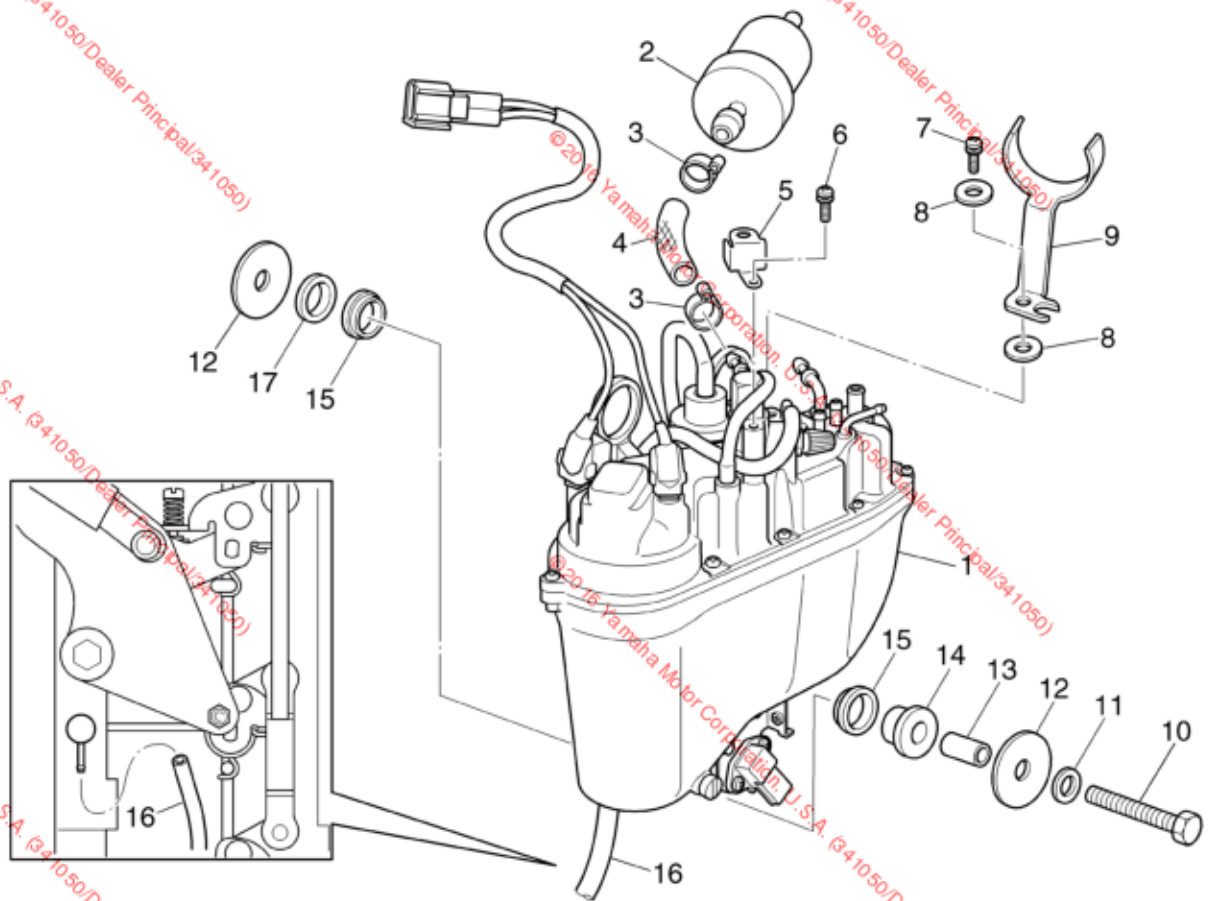


Fuel system



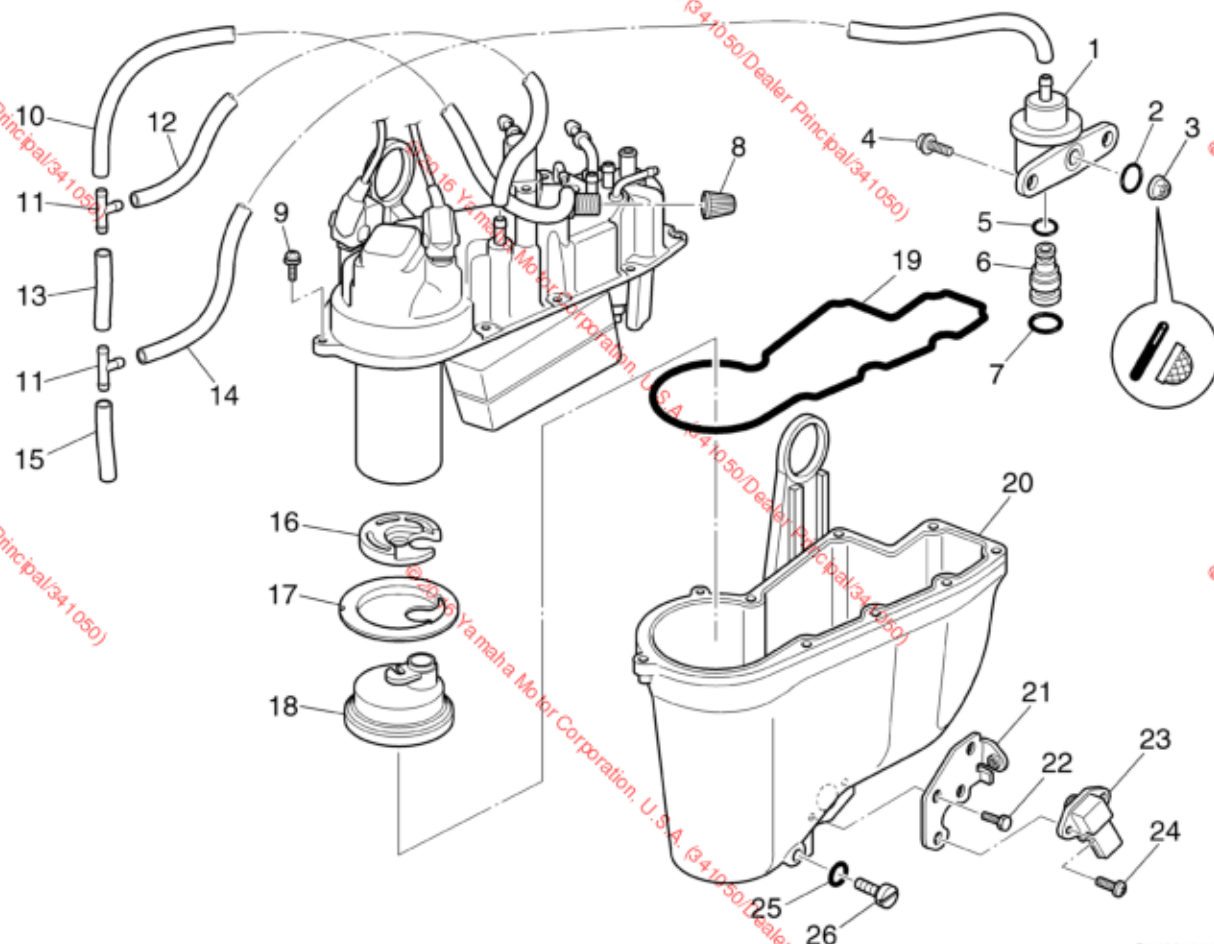
No.	Part name	Q'ty	Remarks
18	Fuel hose	1	
19	Fuel hose	1	
20	Fuel hose	1	
21	Oil hose	1	
22	Clamp	1	
23	Plastic tie	4	Not reusable

Throttle body assembly and vapor separator



S60V4020

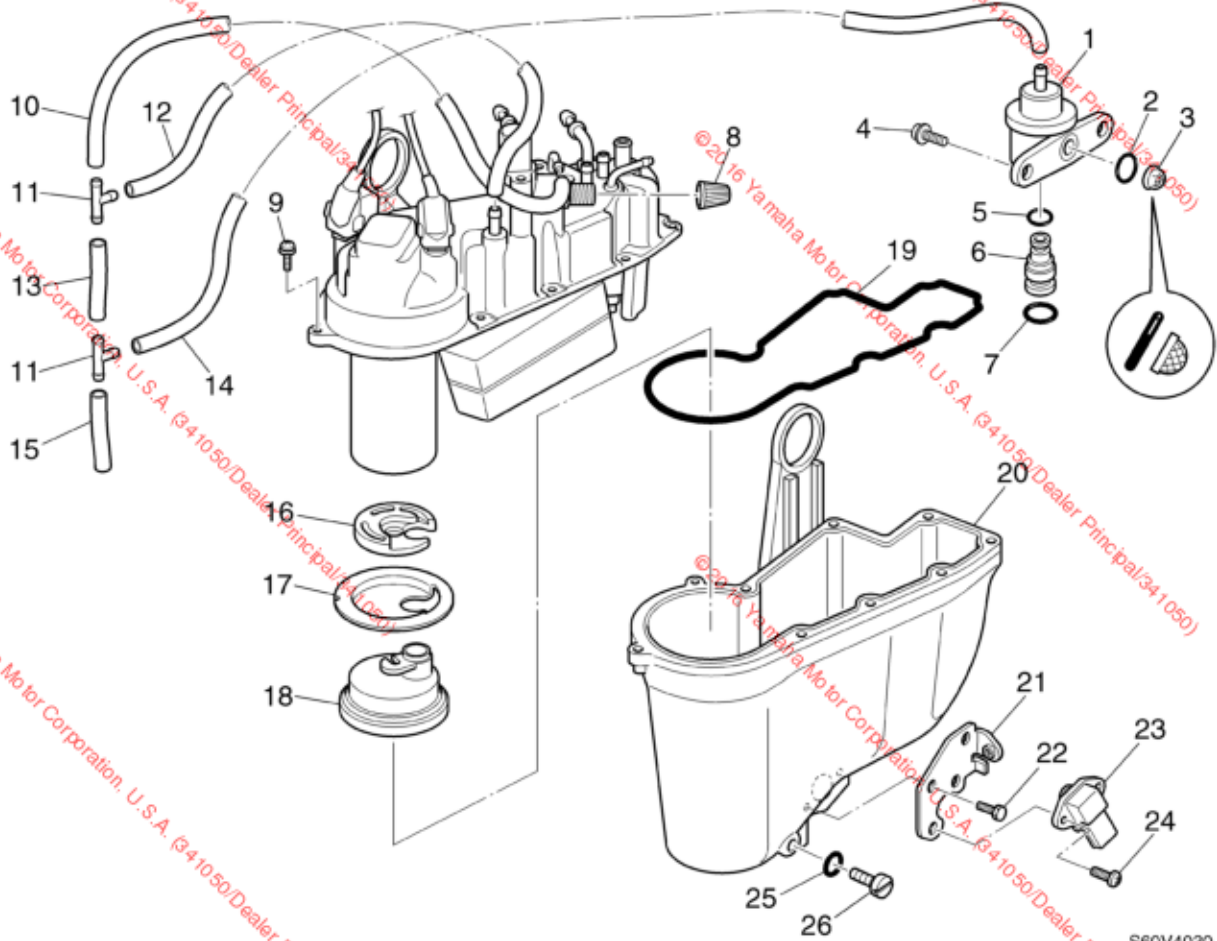
No.	Part name	Q'ty	Remarks
1	Vapor separator	1	
2	Fuel filter	1	
3	Clamp	2	Not reusable
4	Fuel hose	1	
5	Holder	1	
6	Screw	1	ø4 × 10 mm
7	Screw	1	ø4 × 15 mm
8	Washer	2	
9	Holder	1	
10	Bolt	3	M6 × 35 mm
11	Washer	3	
12	Washer	6	
13	Collar	3	
14	Grommet	3	
15	Collar	6	
16	Hose	1	
17	Grommet	3	



S60V4030

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

Throttle body assembly and vapor separator



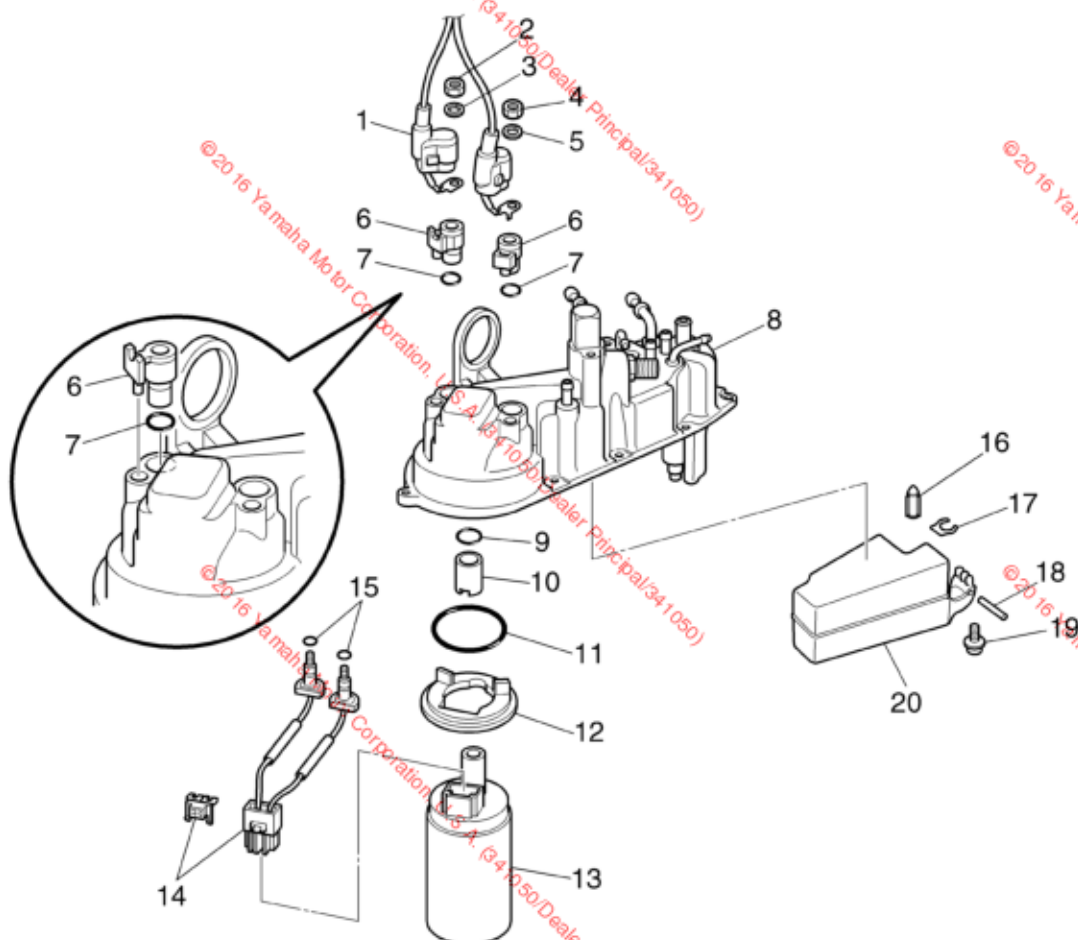
4

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

FUEL



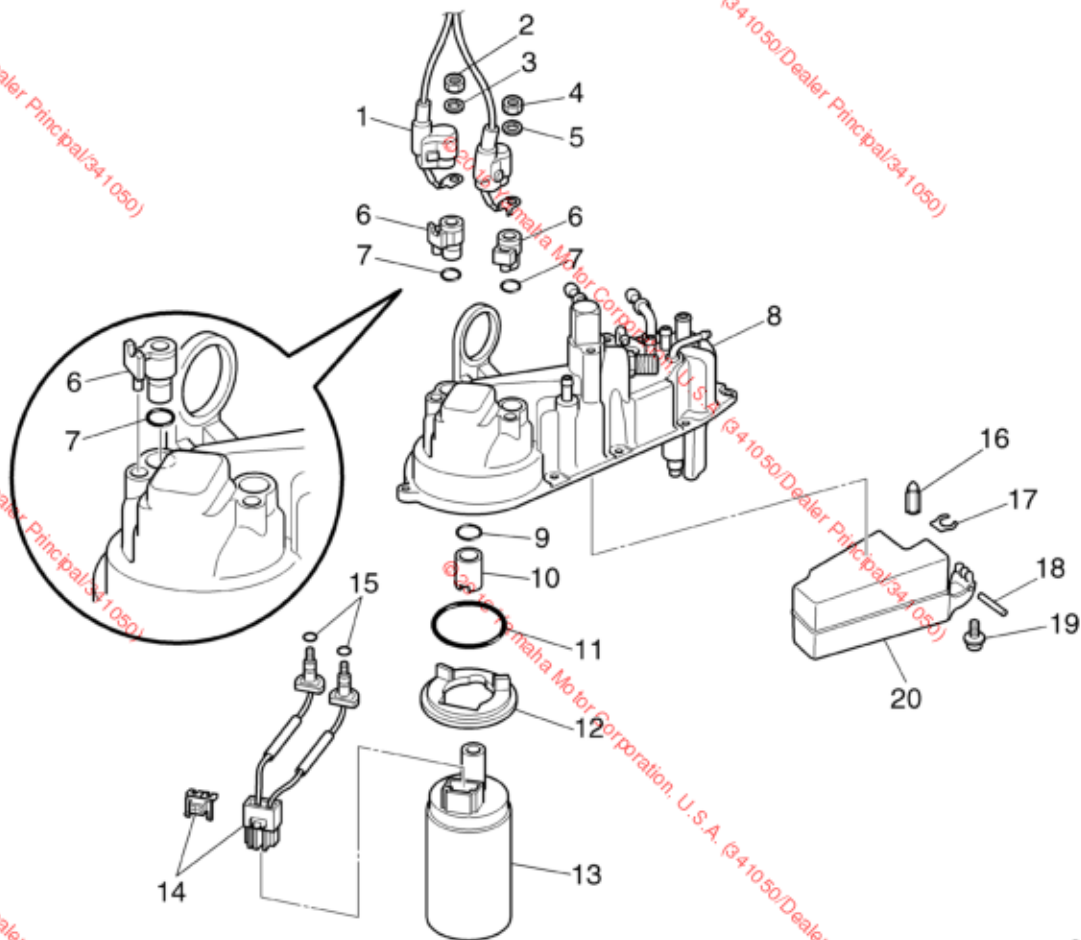
Fuel system



S60V4040

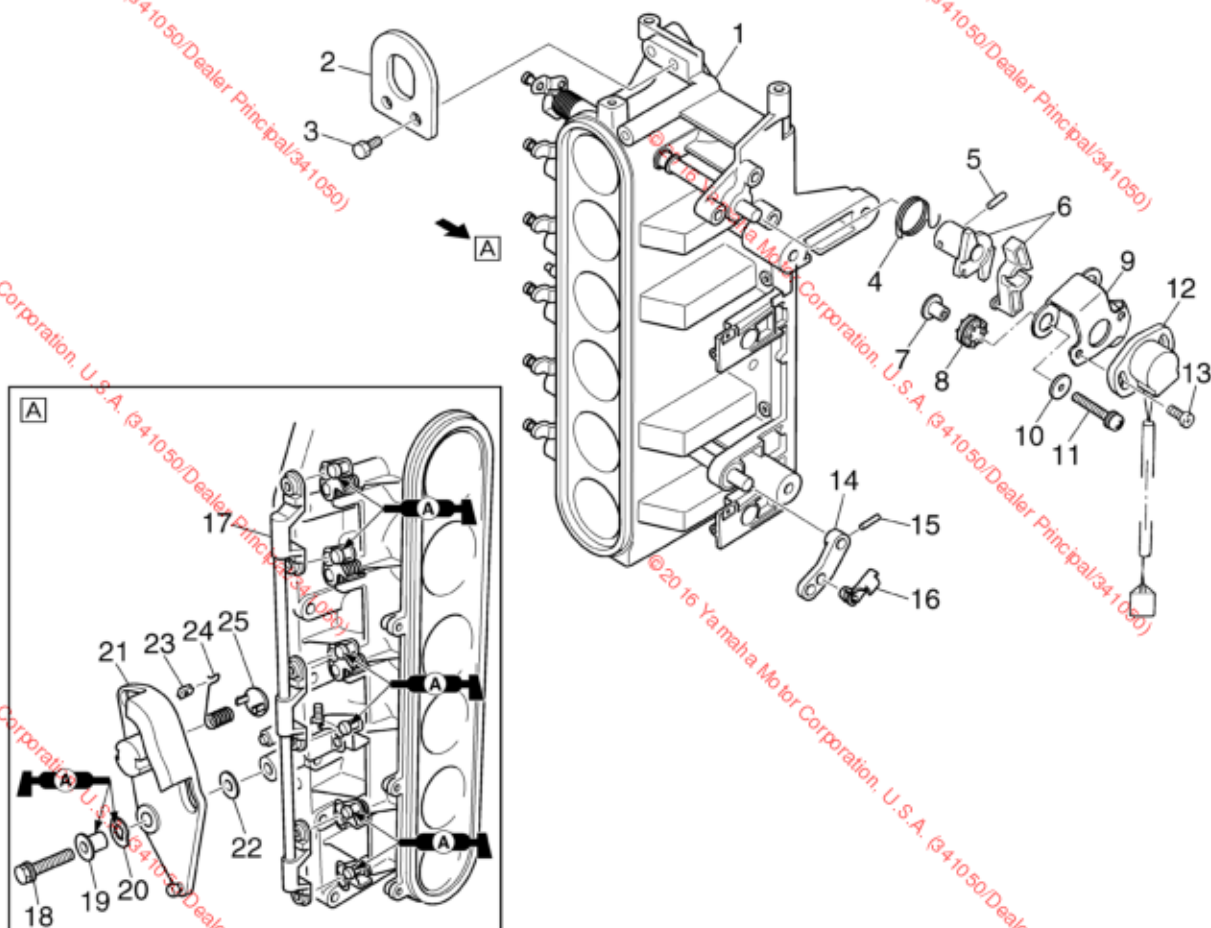
No.	Part name	Q'ty	Remarks
1	Electric fuel pump lead	1	
2	Nut	1	ø4 mm
3	Washer	1	
4	Nut	1	ø5 mm
5	Washer	1	
6	Insulator	2	
7	O-ring	2	Not reusable
8	Cover	1	
9	O-ring	1	Not reusable
10	Collar	1	
11	O-ring	1	Not reusable
12	Plate	1	
13	Electric fuel pump	1	
14	Terminal	1	
15	O-ring	2	Not reusable
16	Needle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

Throttle body assembly and vapor separator



S60V4040

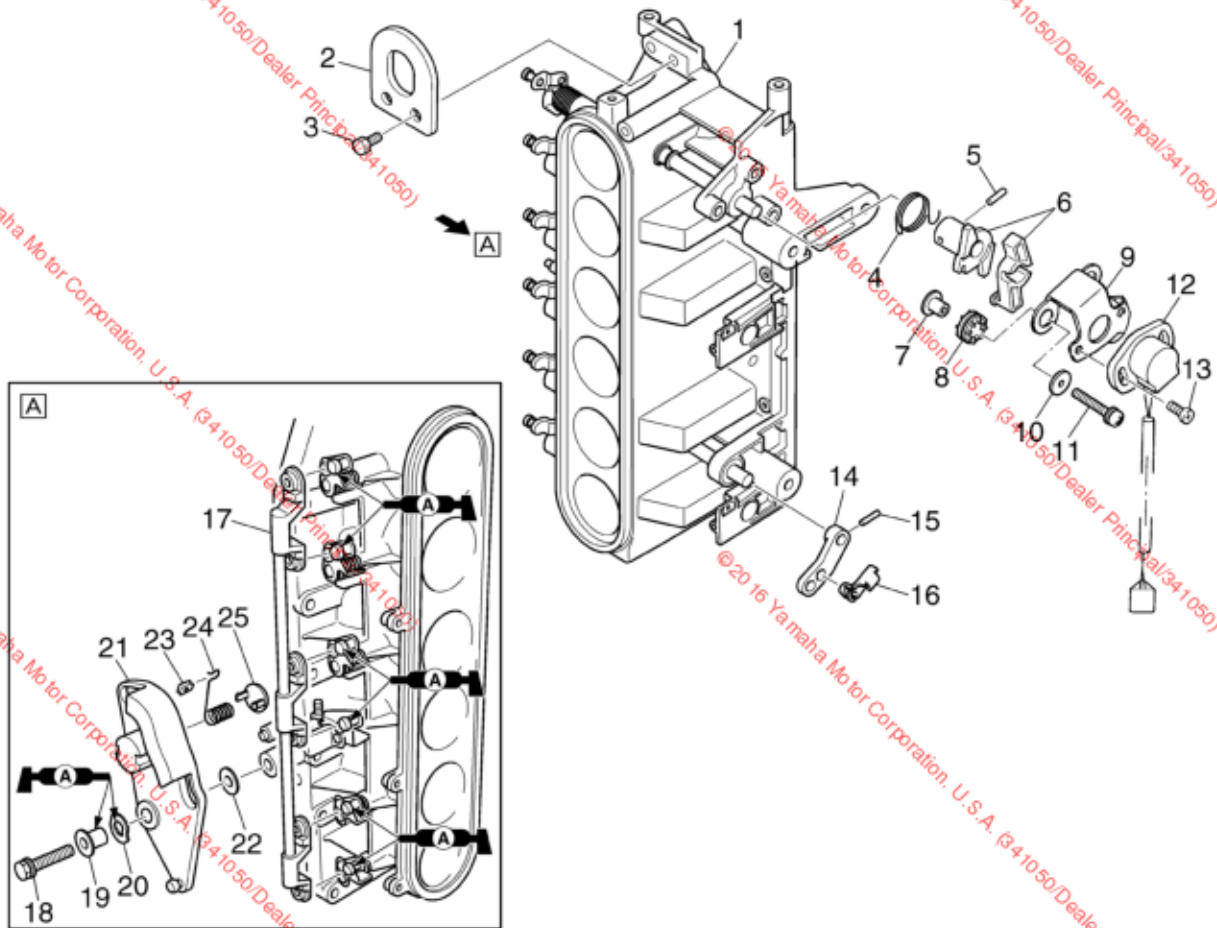
No.	Part name	Q'ty	Remarks
18	Pin	1	ø4 × 7 mm
19	Screw	1	
20	Float	1	



S60V4050

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

Throttle body assembly and vapor separator



S60V4050

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

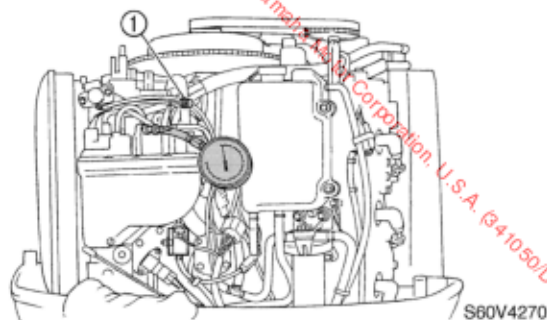
FUEL



Fuel system

Measuring the fuel pressure (medium-pressure fuel line)

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



Fuel pressure gauge: YB-06766

⚠ WARNING

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

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

NOTE:

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



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

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



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

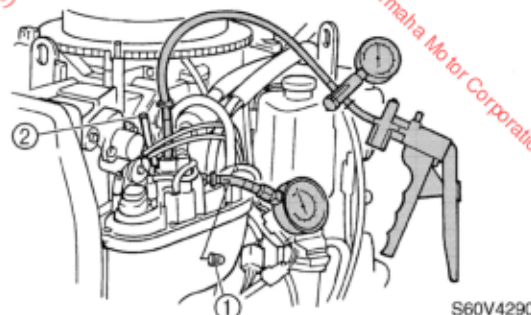
6. Start the engine, warm it up for 5 minutes, and then measure the fuel pressure. If below specification, check the medium-pressure fuel line and the vapor separator.



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

Checking the pressure regulator

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



Fuel pressure gauge: YB-06766
Pressure/vacuum tester:
YB-35956-A

⚠ WARNING

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

5. Start the engine and let it idle.

Throttle body assembly and vapor separator

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.

NOTE:

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

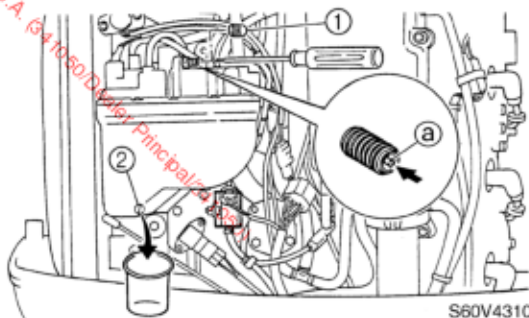
Reducing the fuel pressure (medium-pressure fuel line)

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

⚠ WARNING

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

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

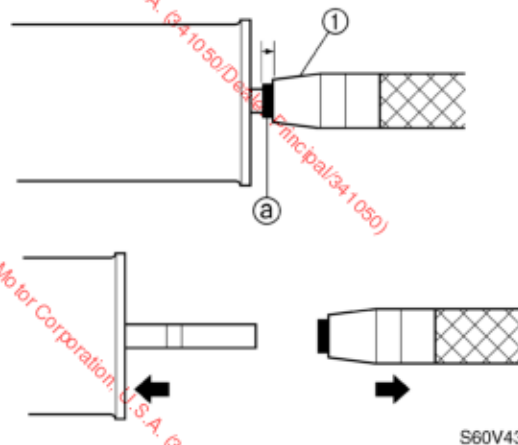


⚠ WARNING

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

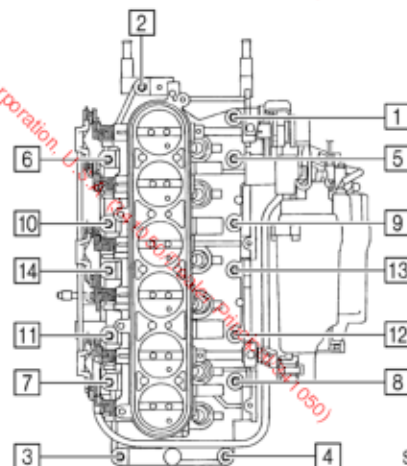
Disconnecting the medium-pressure fuel hose joint

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



Removing the throttle body assembly

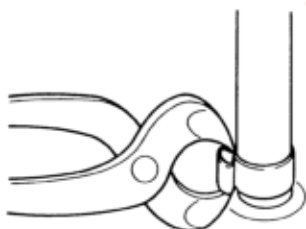
1. Remove the throttle body assembly bolts and nuts in the sequence shown.





Removing the medium-pressure fuel hose clamps

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



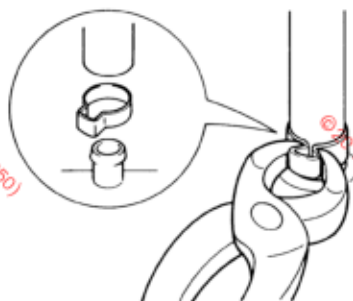
S69J4030

CAUTION:

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

Installing the medium-pressure fuel hose clamps

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



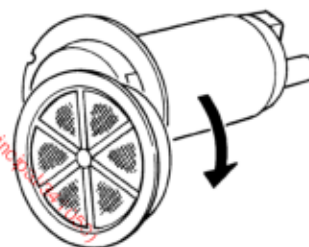
S69J4040

WARNING

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

Removing the electric fuel pump filter

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



S60V4335

NOTE:

To remove the filter, turn it clockwise.

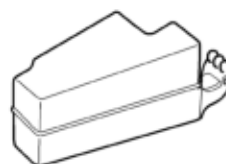
Checking the vapor separator

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



S69J4080

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



S60V4340

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

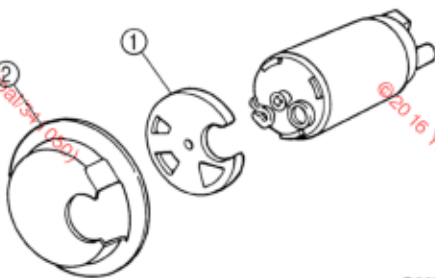
Throttle body assembly and vapor separator



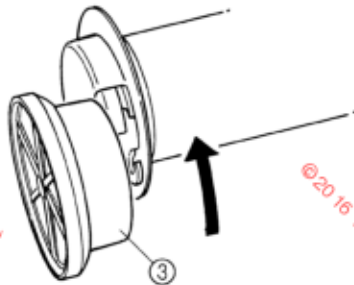
S60V4350

Installing the electric fuel pump filter

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



S60V4360



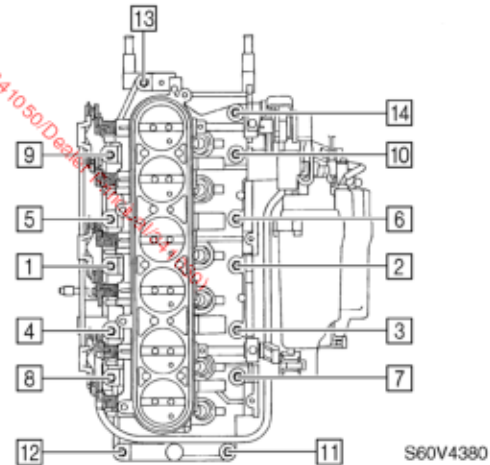
S60V4370

NOTE:

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

Installing the throttle body assembly

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



S60V4380



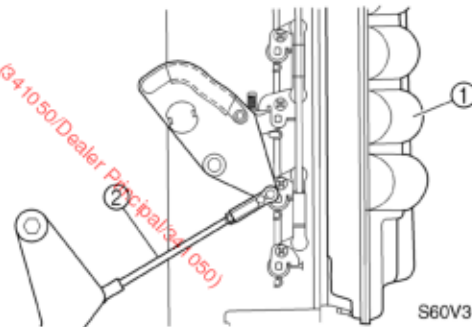
Throttle body bolt and nut:

1st: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

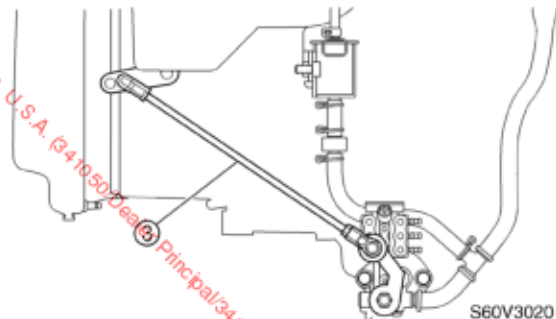
2nd: 10 N·m (1.0 kgf·m, 7.4 ft·lb)

Synchronizing the throttle valves

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



S60V3010

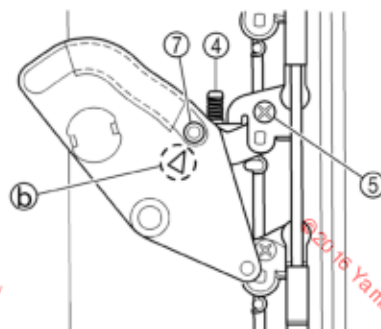


S60V3020

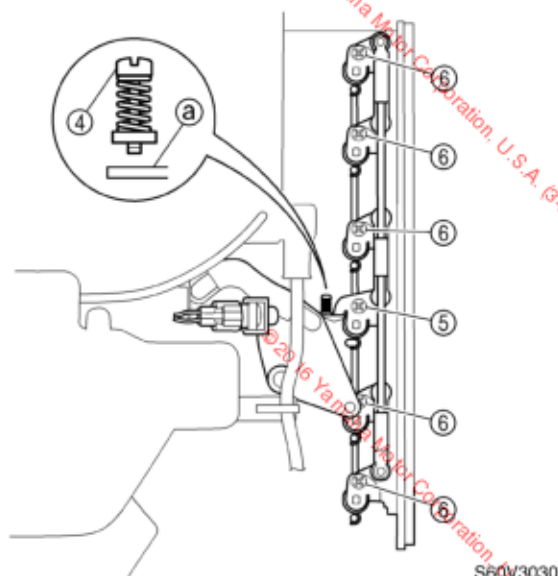
4

FUEL**Fuel system**

3. Loosen the throttle stop screw ④ until it no longer contacts the stopper ①.
4. Loosen throttle adjusting screw #4 ⑤ by turning it clockwise.
5. Check that all the throttle valves are fully closed.



S60V3040



S60V3030

NOTE:

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

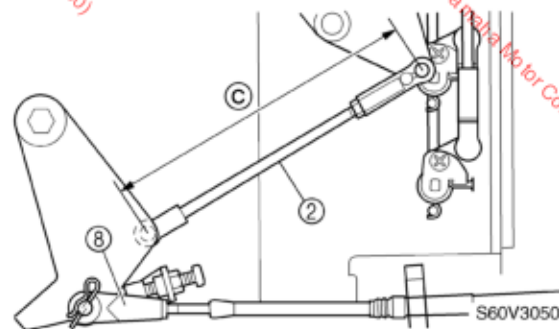
6. Connect the oil pump link rod.
7. Align the center of the throttle cam roller ⑦ with the alignment mark ①, and then turn throttle adjusting screw #4 ⑤ counterclockwise.
8. Turn the throttle stop screw ④ in until the throttle valves start to open.
9. Connect the test harness (3 pins) to the throttle position sensor.
10. Turn the engine start switch to ON, and then turn the throttle stop screw in until the throttle position sensor output voltage is within specification.



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

11. Disconnect the throttle cable joint ⑧.

12. Adjust the throttle link rod length ③, and then connect the throttle link rod ②.



S60V3050



Throttle link rod length ③
151.5 mm (6.0 in)

13. Install the intake silencer.

14. Adjust the throttle cable length.

NOTE:

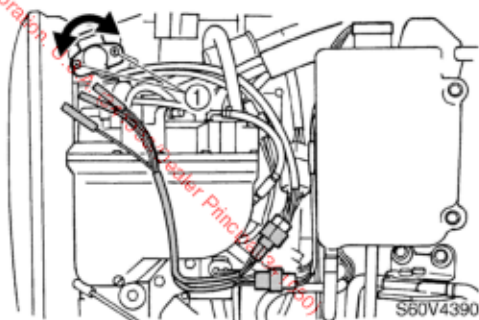
For adjustment procedures, see Chapter 3, "Adjusting the throttle cable."

Adjusting the throttle position sensor

NOTE:

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

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



Test harness (3 pins): YB-06757
Digital multimeter: YU-34899-A

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

7. Tighten the throttle position sensor screws.
8. Turn the throttle stop screw in until the throttle valves start to open.

Throttle body assembly and vapor separator

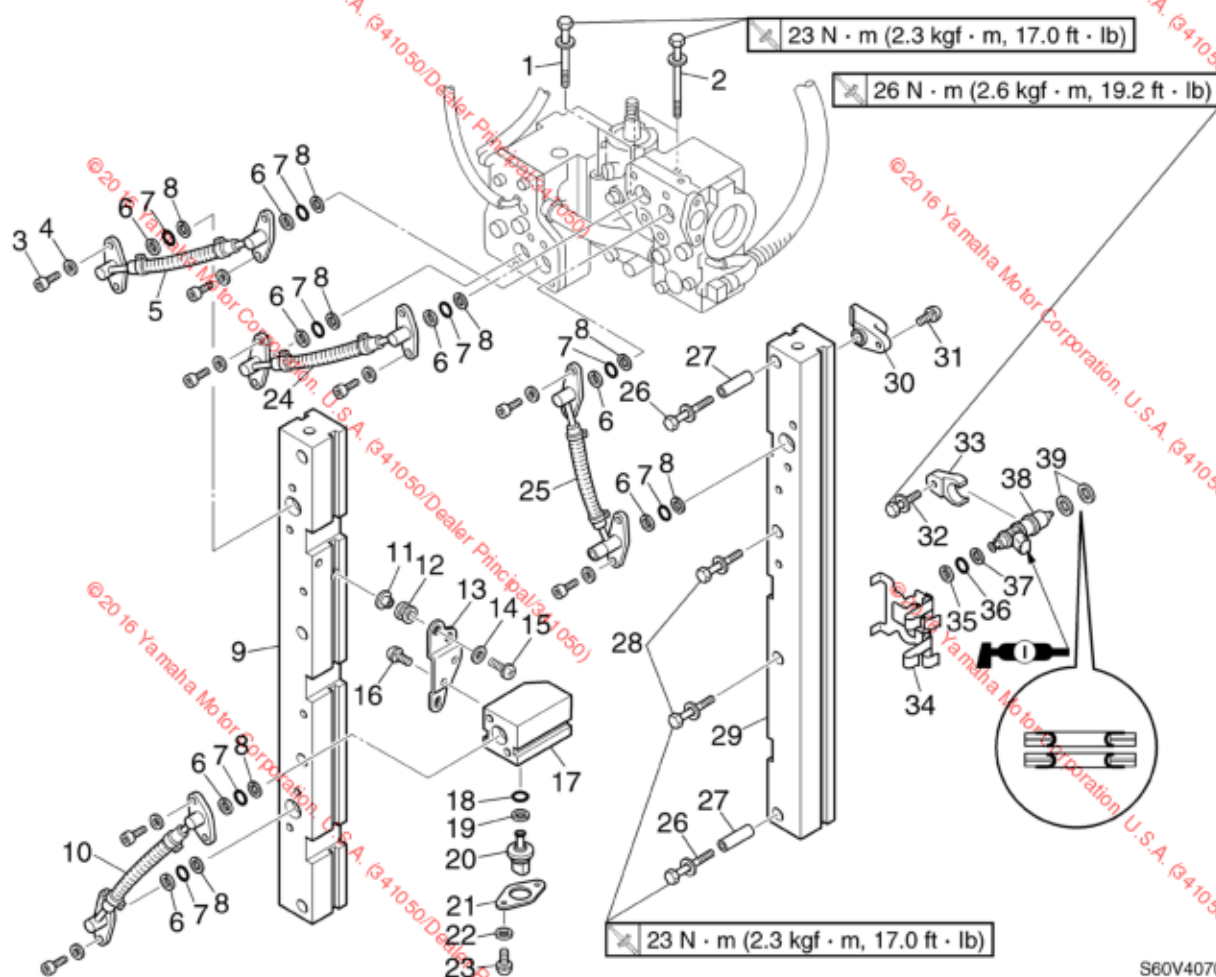
9. Turn the throttle stop screw in until the throttle position sensor output voltage is within specification.

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

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



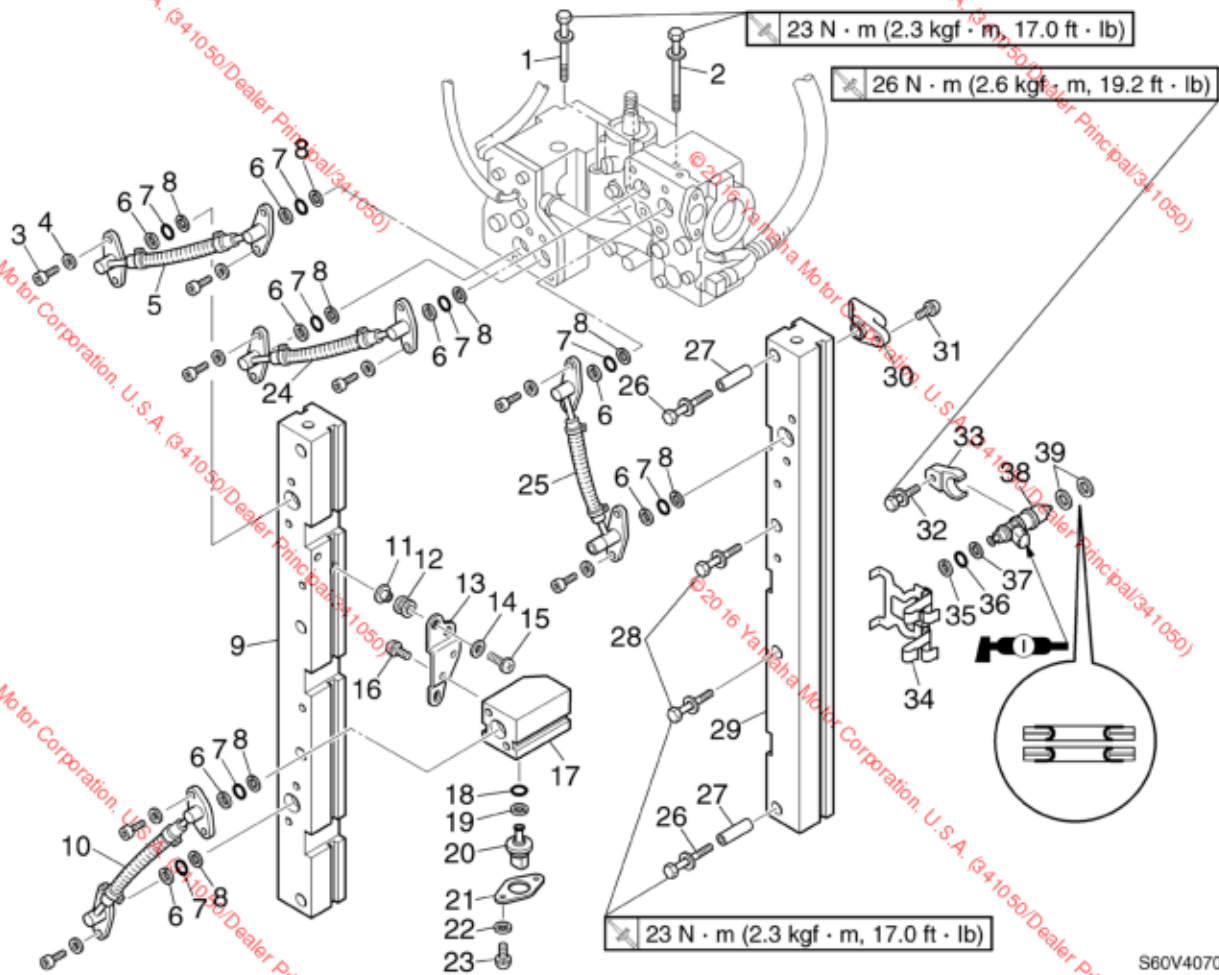
High-pressure fuel line



S60V4070

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

High-pressure fuel line



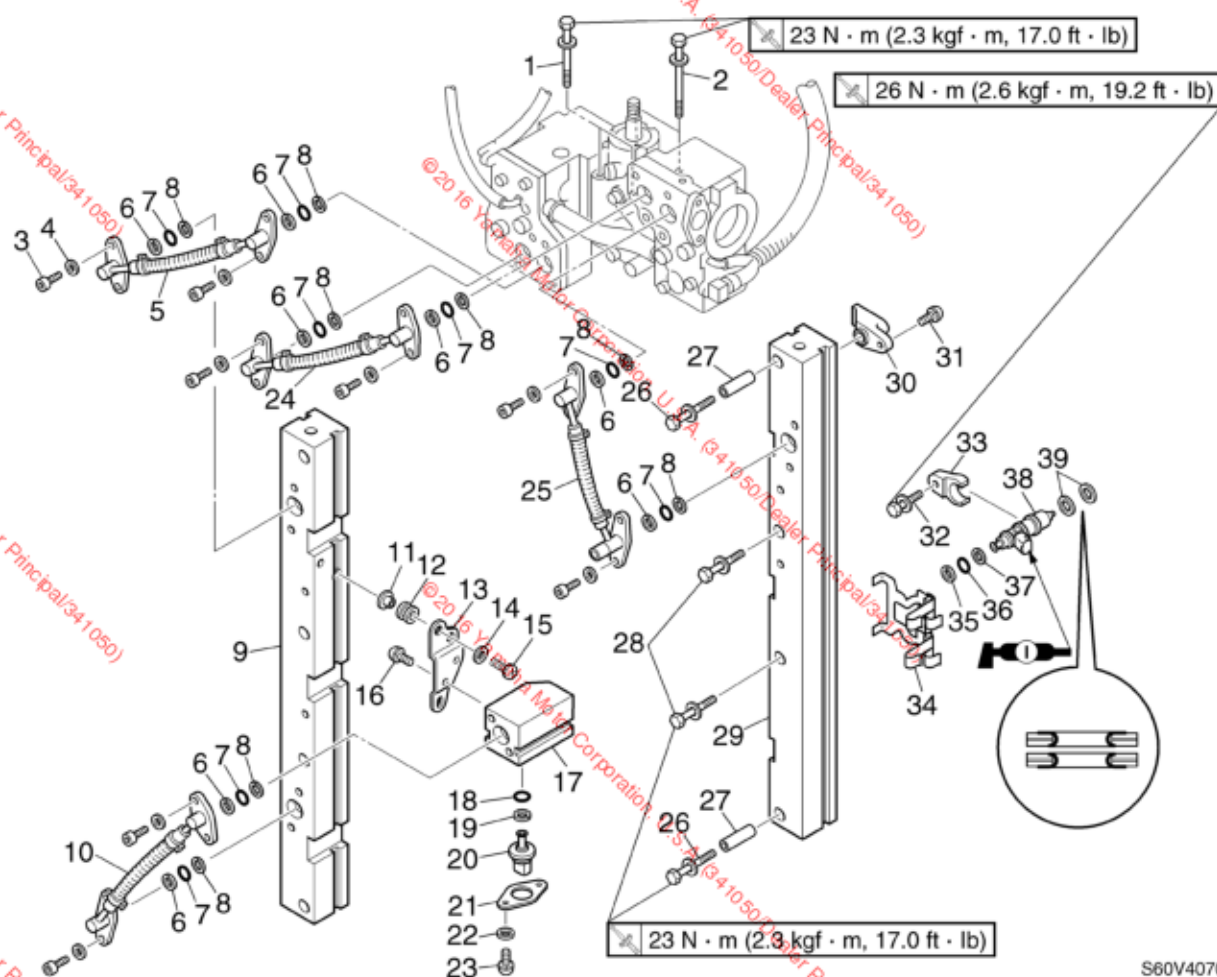
S60V4070

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

FUEL



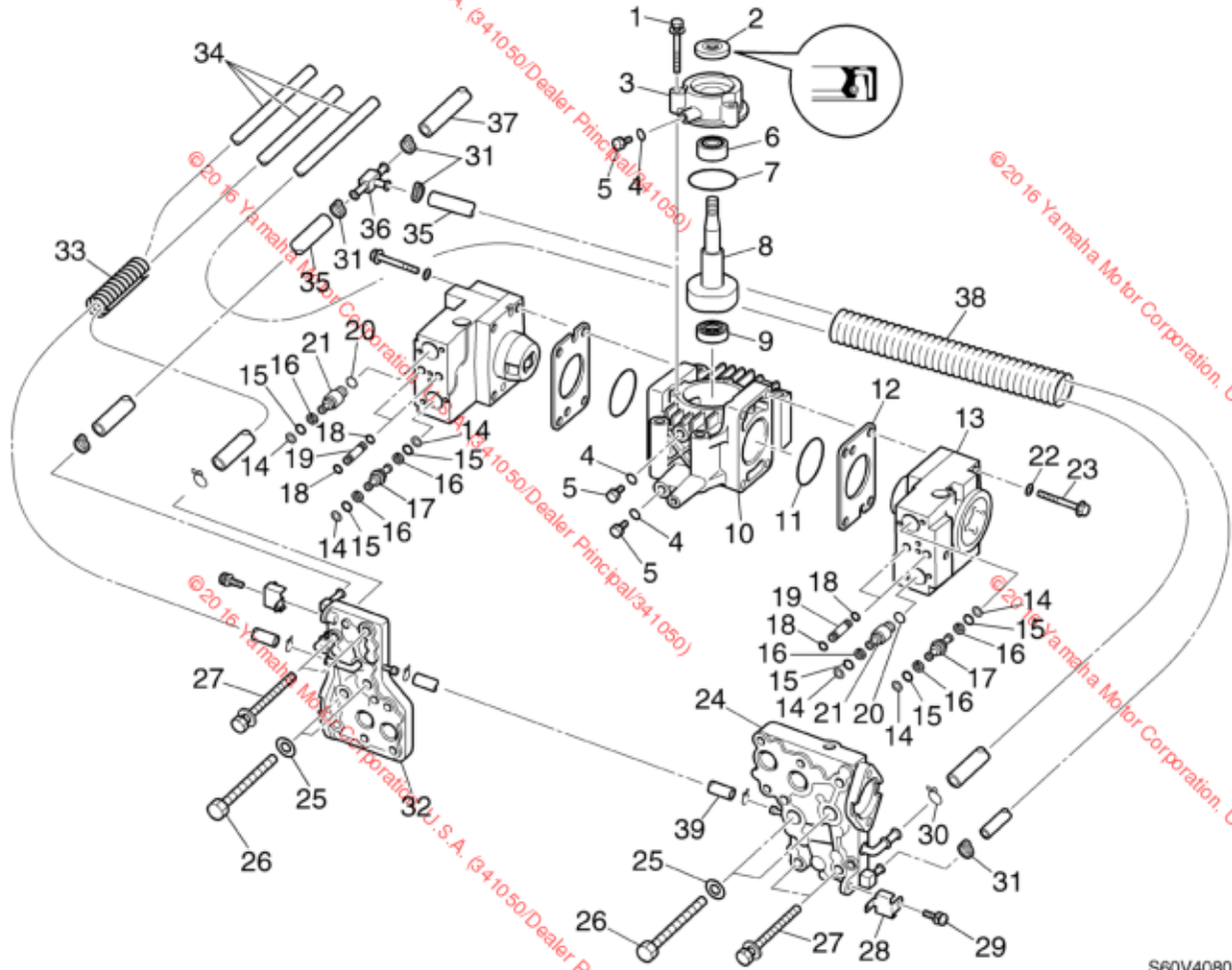
Fuel system



S60V4070

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

High-pressure fuel pump



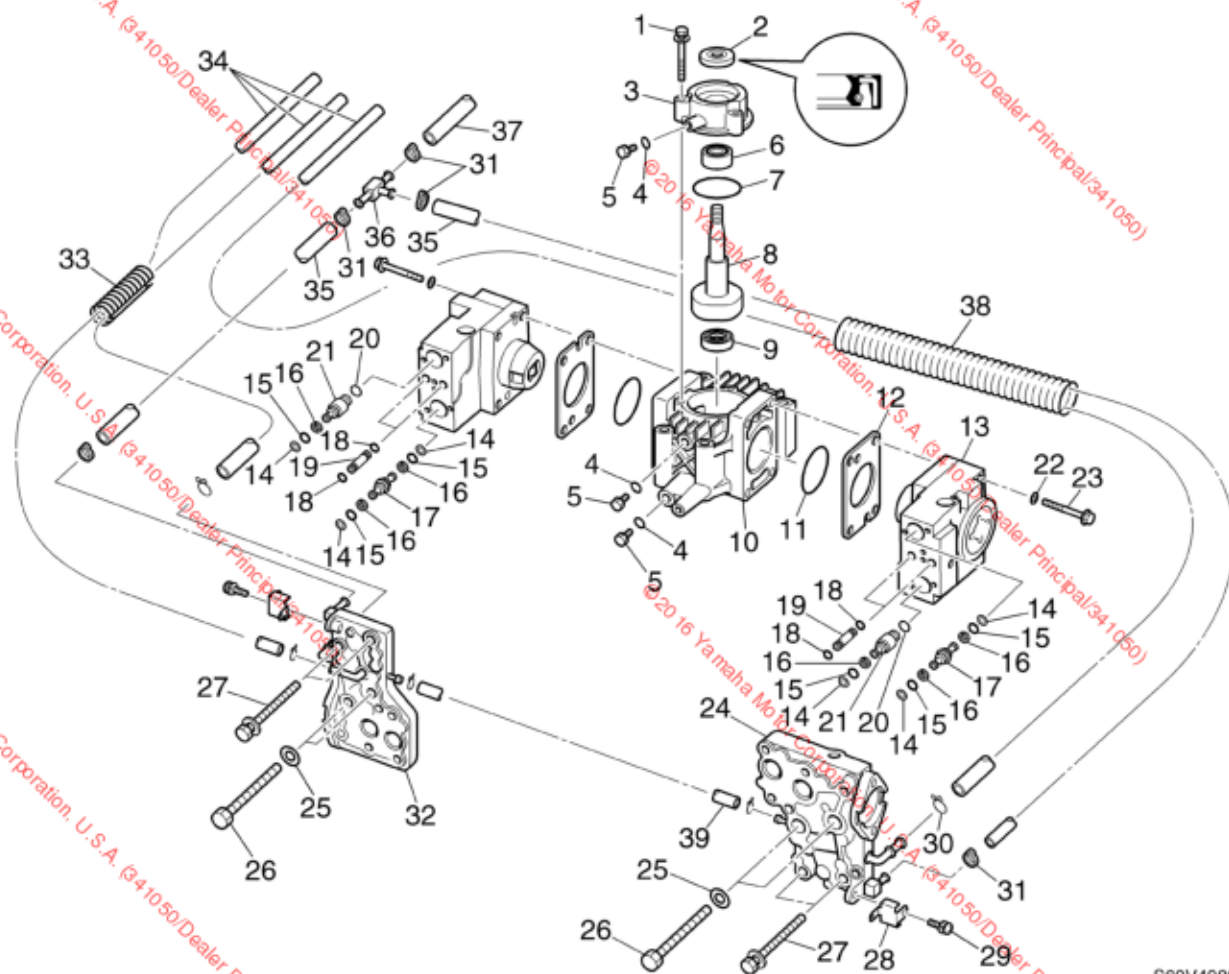
S60V4080

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

FUEL



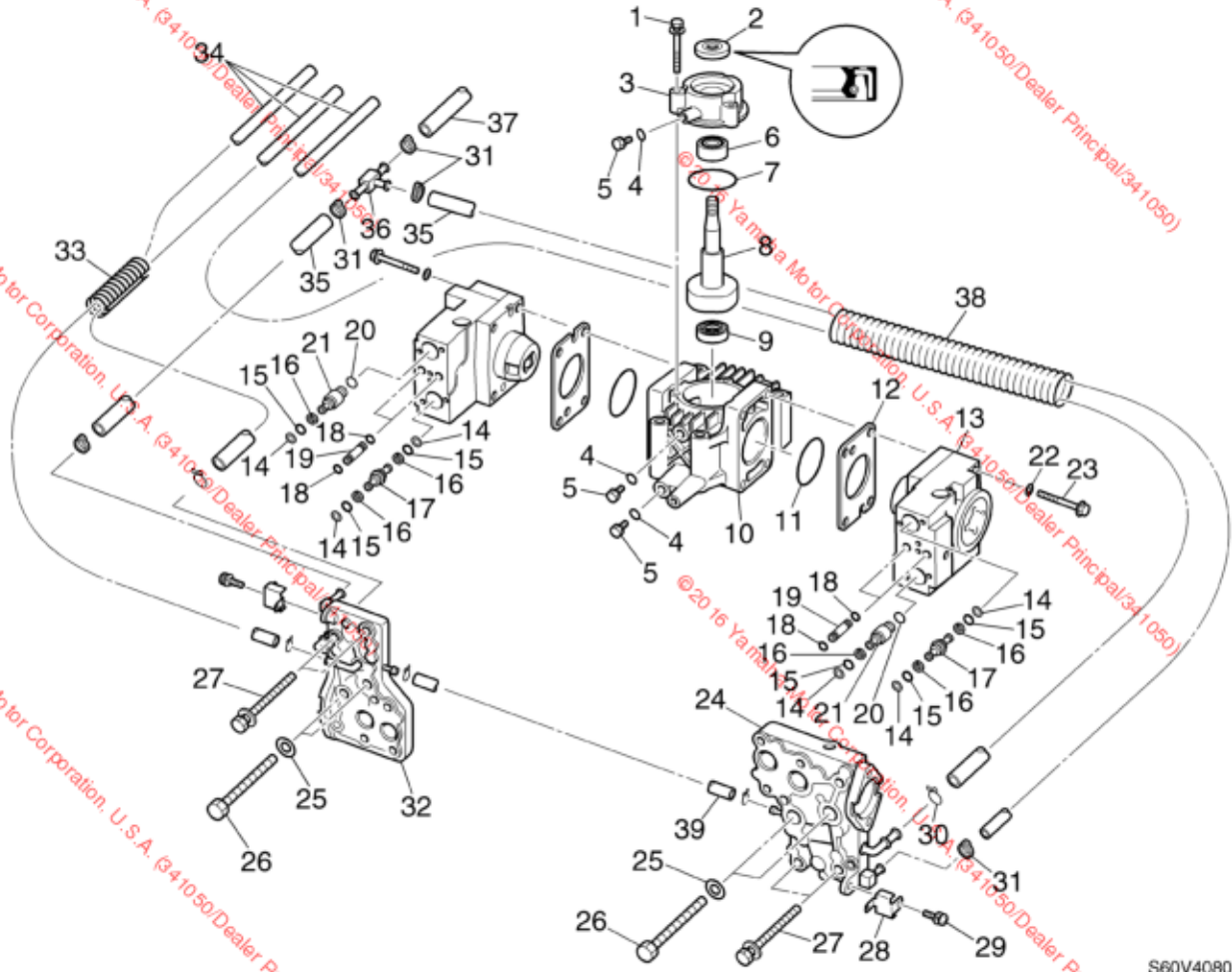
Fuel system



S60V4080

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

High-pressure fuel pump



S60V4080

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

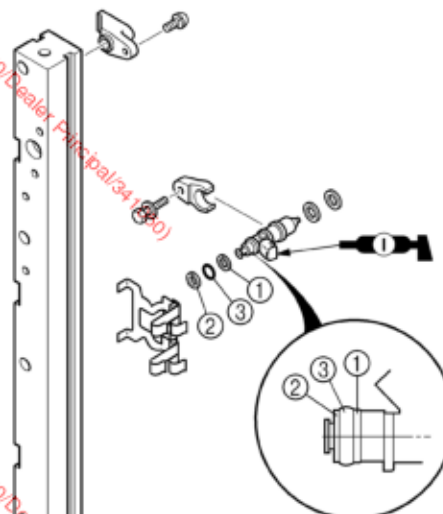
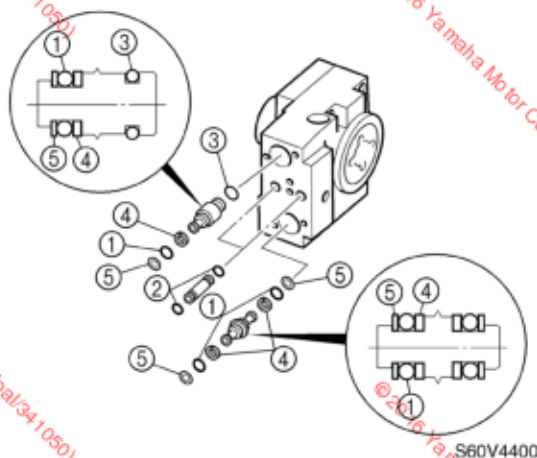
FUEL



Fuel system

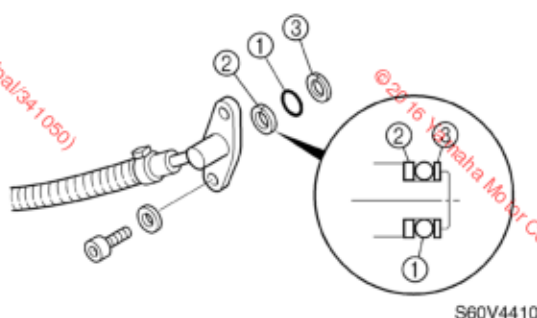
Installing the joints

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



Installing the fuel pipes

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



Installing the fuel injectors

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

— MEMO —



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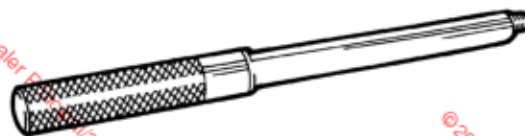


Power unit

Special service tools



Compression gauge
YU-33223-1



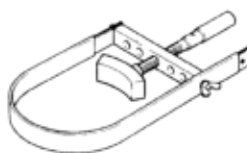
Driver handle
YB-06071



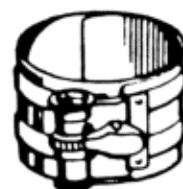
Universal magnet and rotor holder
YU-01235



Crank upper and lower seal installer
YB-06244



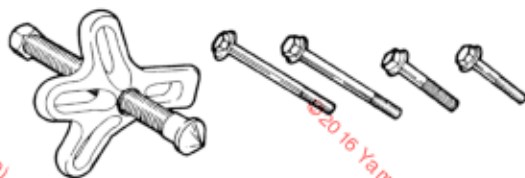
Primary sheave holder
YS-01880



Piston ring compressor
YM-08037



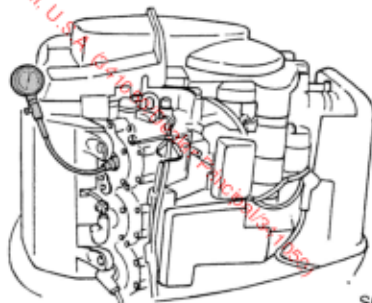
Flywheel magnet holder
YB-06139



Universal puller
YB-06117

Power unit**Checking the compression pressure**

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



S60V5160

CAUTION:

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



Compression gauge: YU-33223-1

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

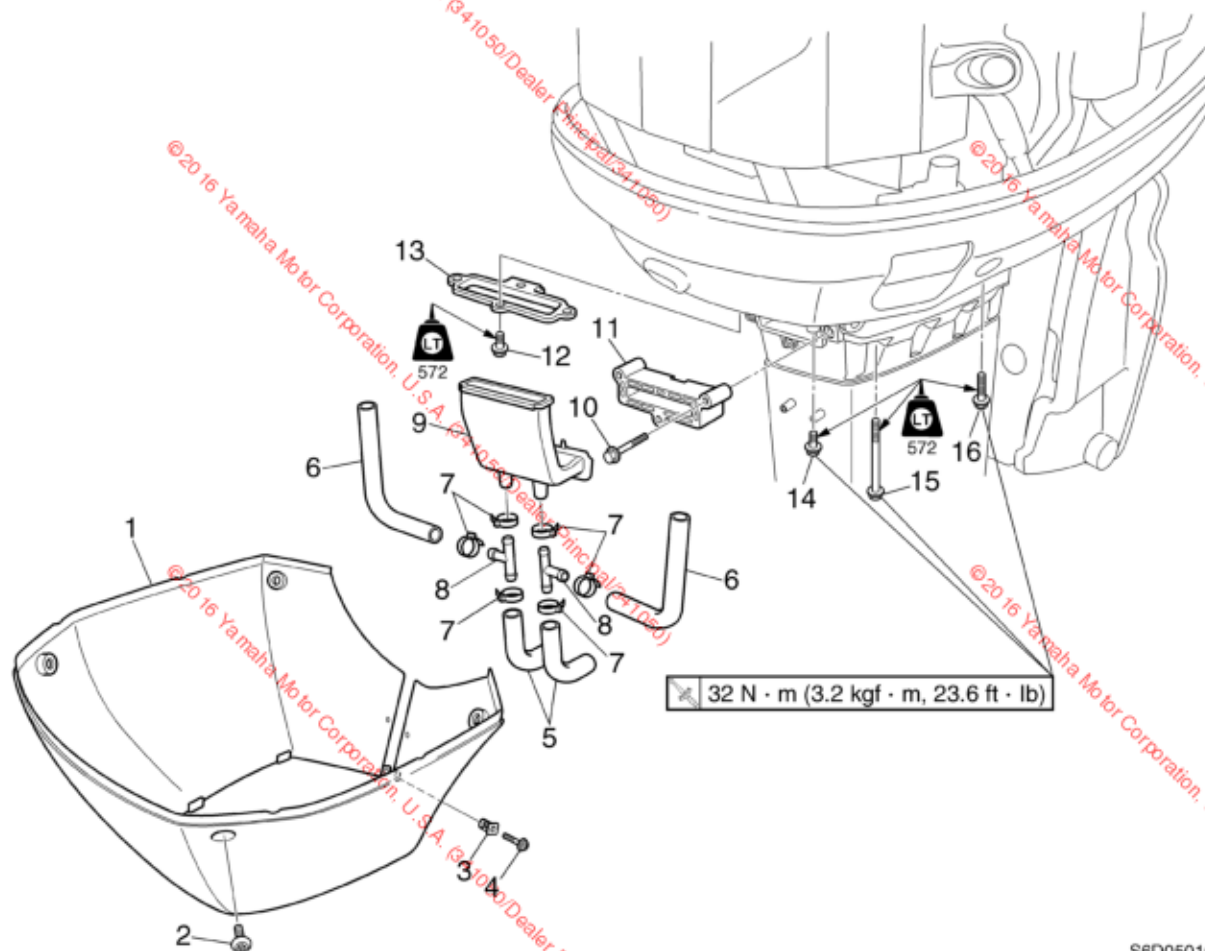


Minimum compression pressure
(reference data):
560 kPa (5.6 kgf/cm², 81 psi)

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

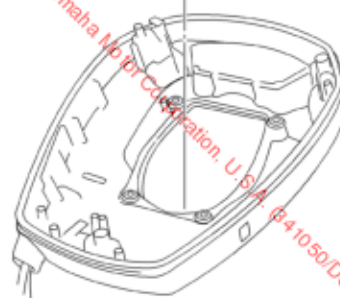
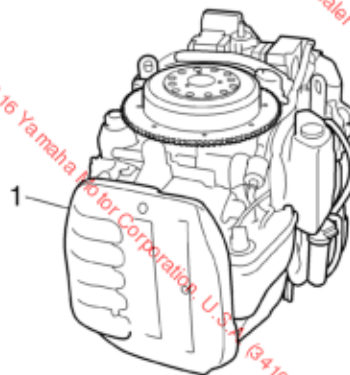
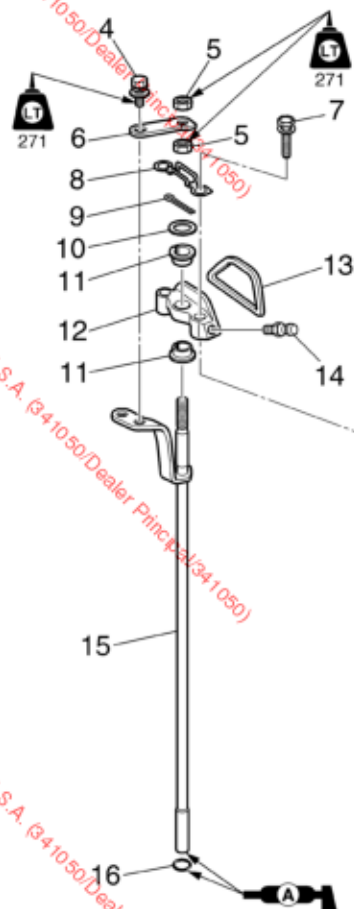
NOTE:

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



S6D05010

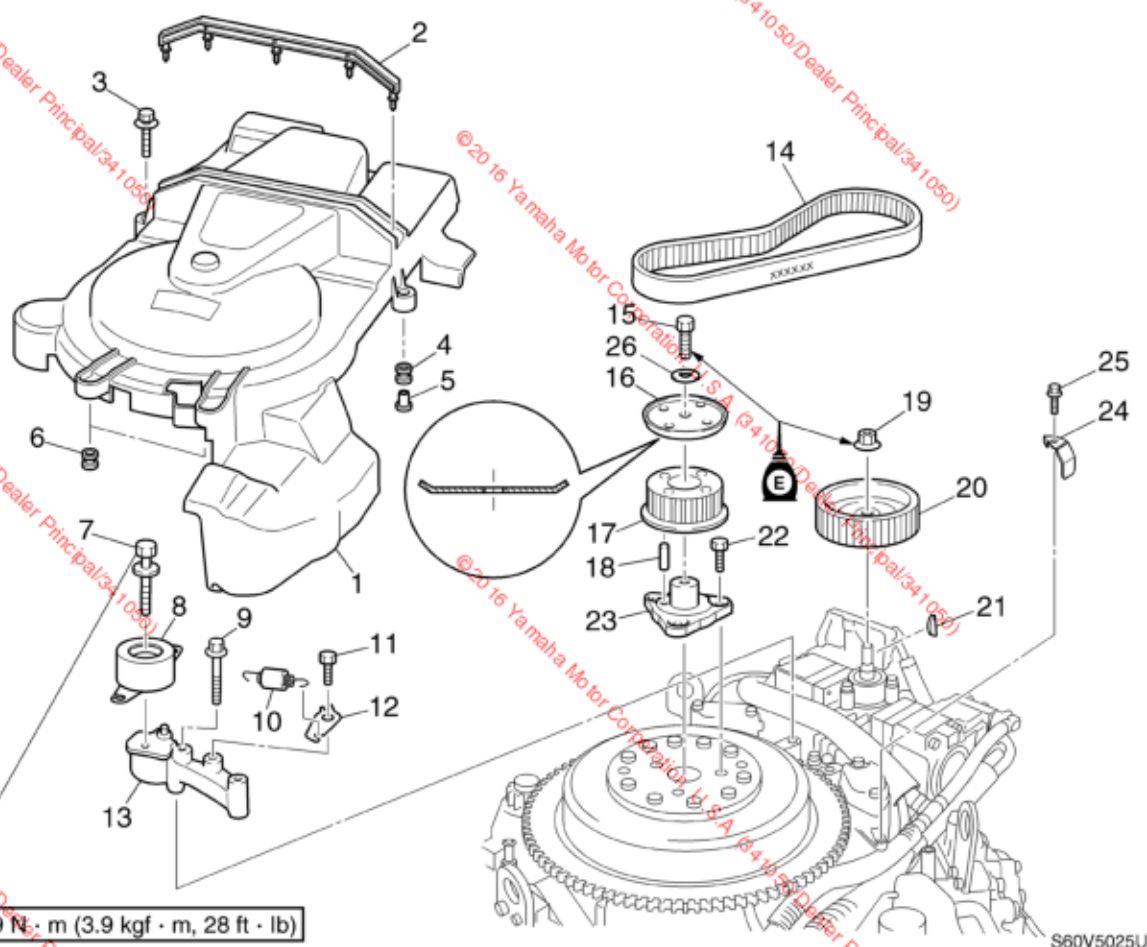
No.	Part name	Q'ty	Remarks
1	Apron	1	
2	Bolt	4	M6 × 16 mm
3	Clamp	1	
4	Screw	1	ø4 × 16 mm
5	Hose	2	
6	Hose	2	
7	Plastic tie	6	Not reusable
8	Joint	2	
9	Joint	1	
10	Bolt	3	M8 × 55 mm
11	Bracket	1	
12	Bolt	4	M6 × 20 mm
13	Plate	1	
14	Bolt	2	M8 × 30 mm
15	Bolt	8	M8 × 135 mm
16	Bolt	4	M8 × 45 mm



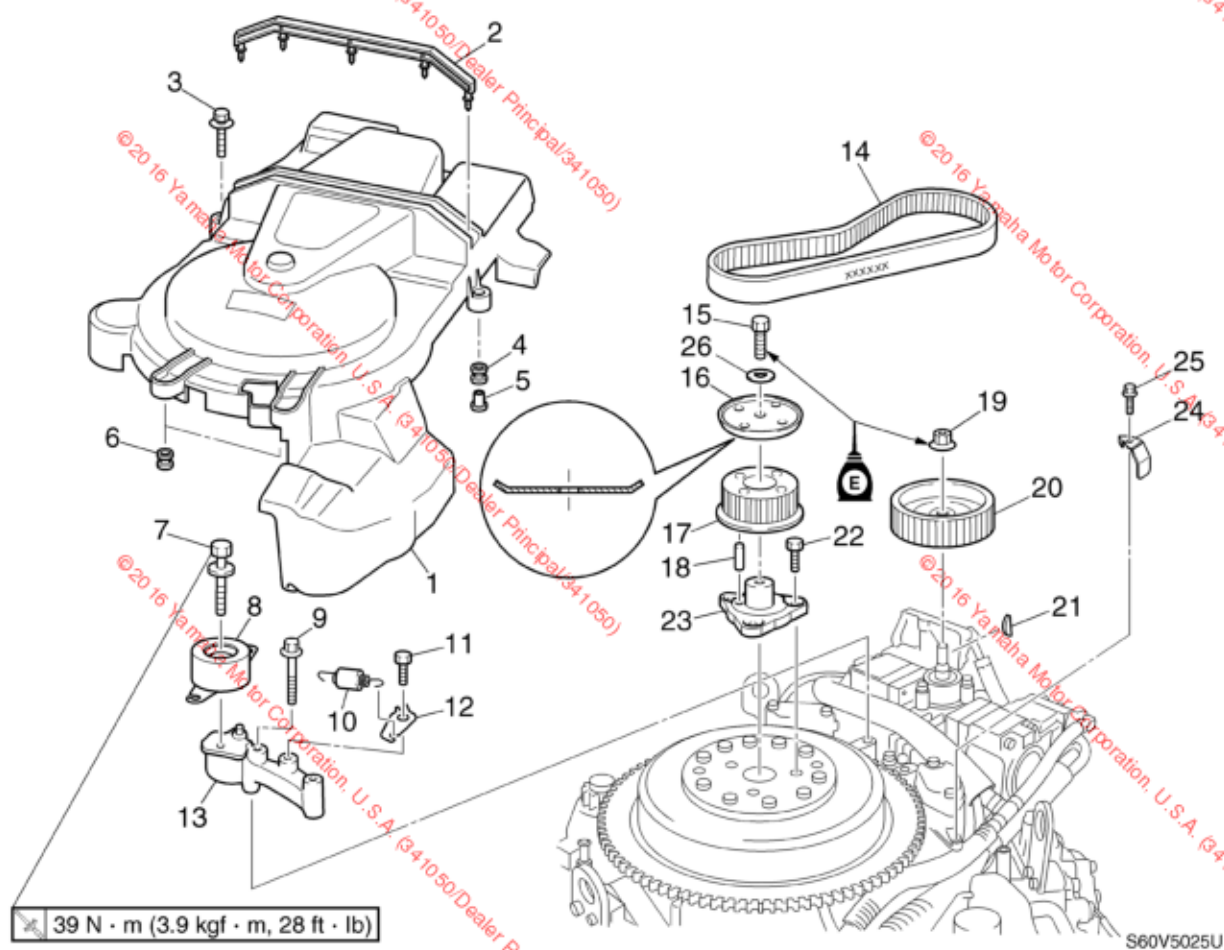
S60V5020

5

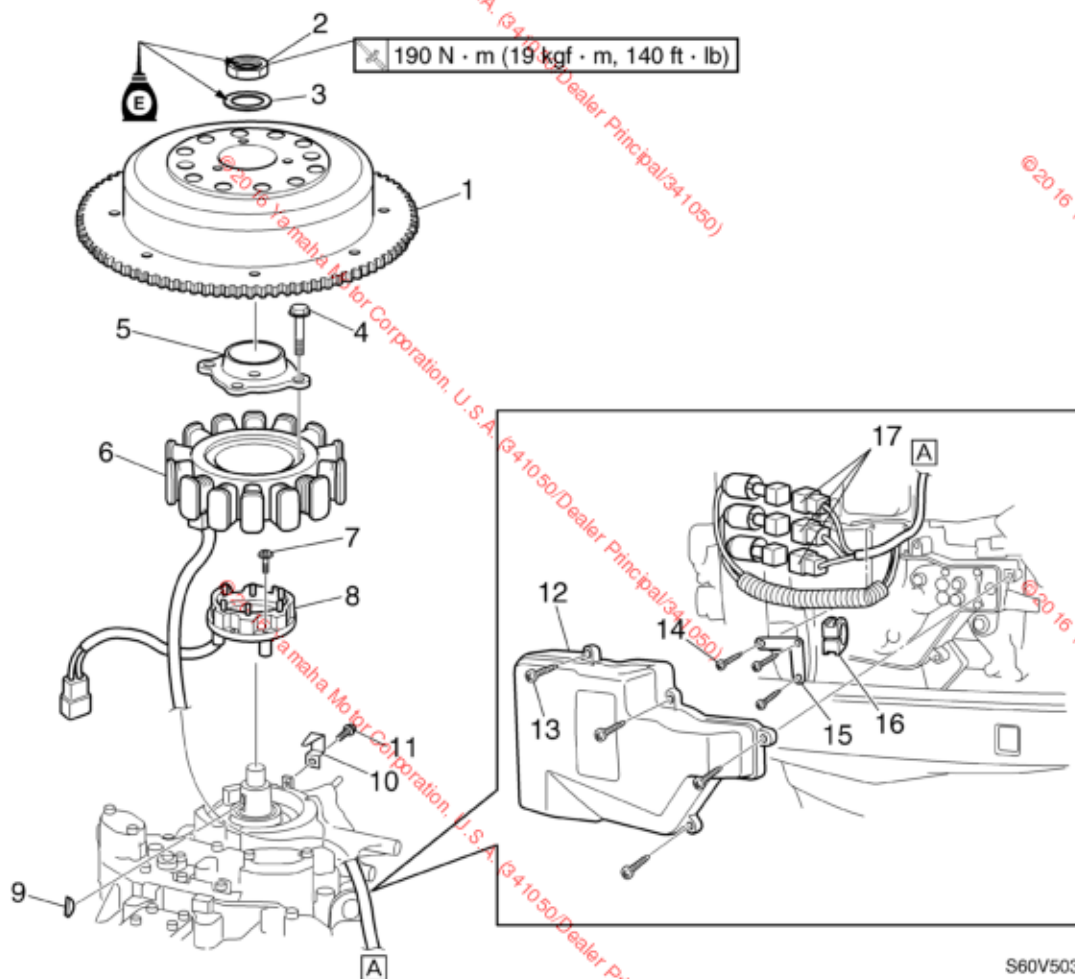
No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Dowel	2	Not reusable
3	Gasket	1	Not reusable
4	Bolt	1	M6 × 12 mm
5	Nut	2	
6	Plate	1	
7	Bolt	2	M6 × 30 mm
8	Spring plate	1	
9	Pin	1	Not reusable
10	Washer	1	
11	Bushing	2	
12	Bracket	1	
13	Grommet	1	
14	Grease nipple	1	
15	Shift rod	1	
16	O-ring	1	Not reusable



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

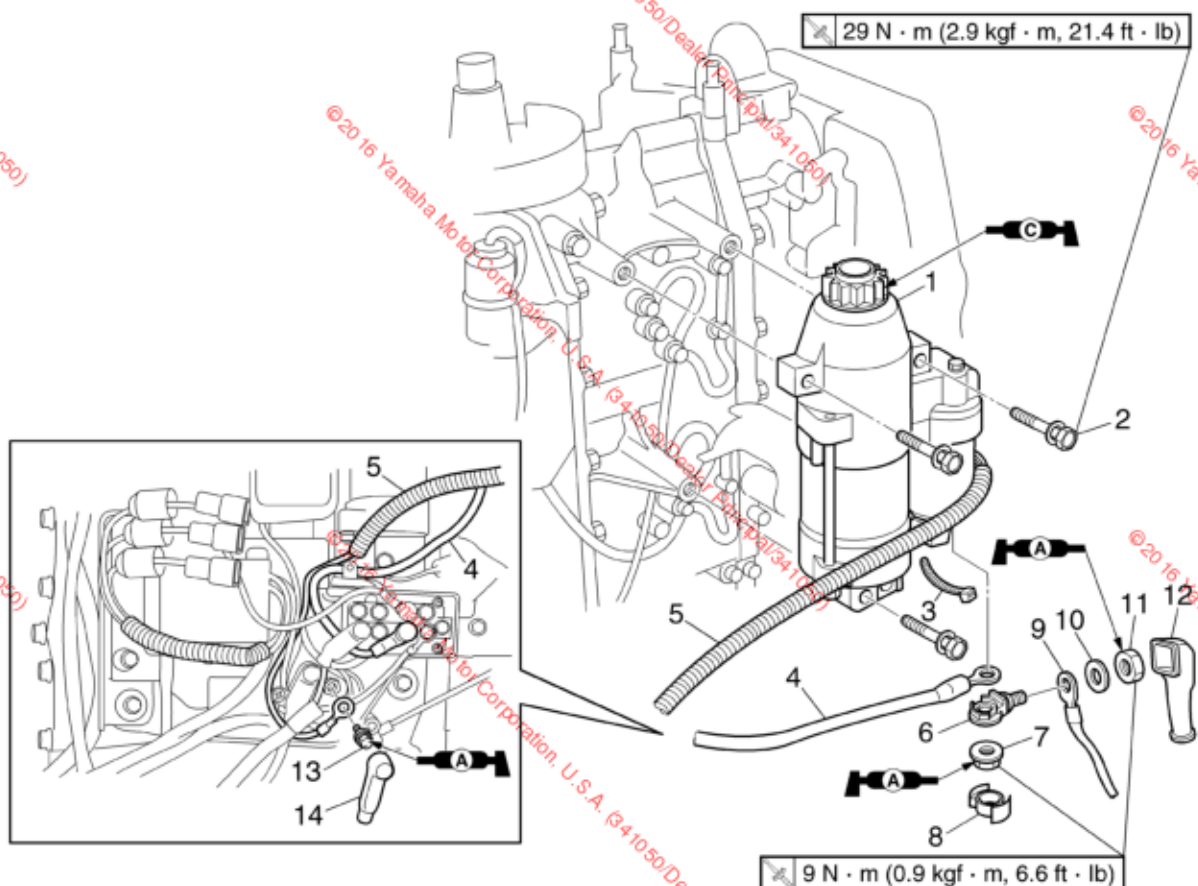


No.	Part name	Q'ty	Remarks
18	Dowel	1	
19	Nut	1	
20	Driven sprocket	1	
21	Woodruff key	1	
22	Bolt	3	M8 × 12 mm
23	Bracket	1	
24	Clamp	1	
25	Bolt	1	M5 × 12 mm
26	Washer	1	



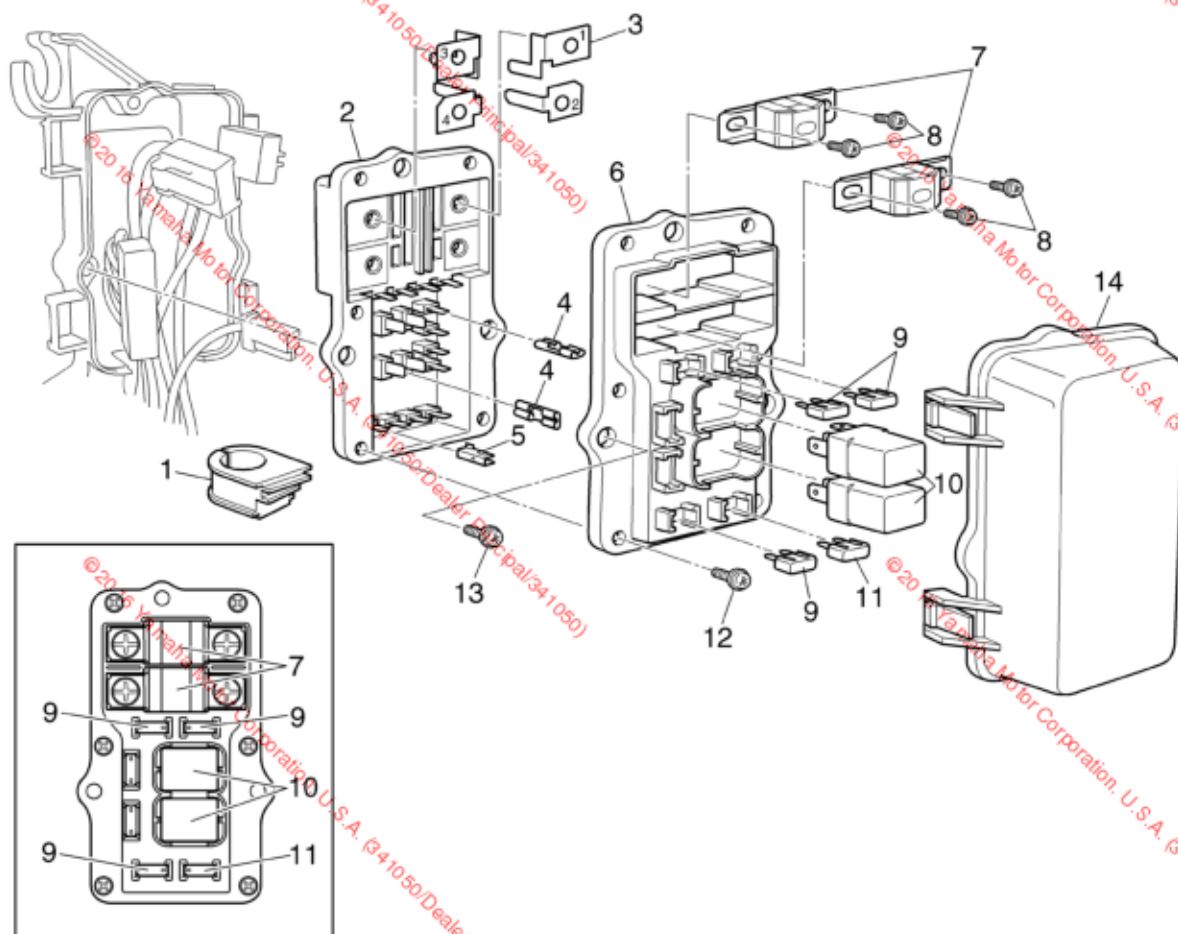
S60V5030

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



S60V5040

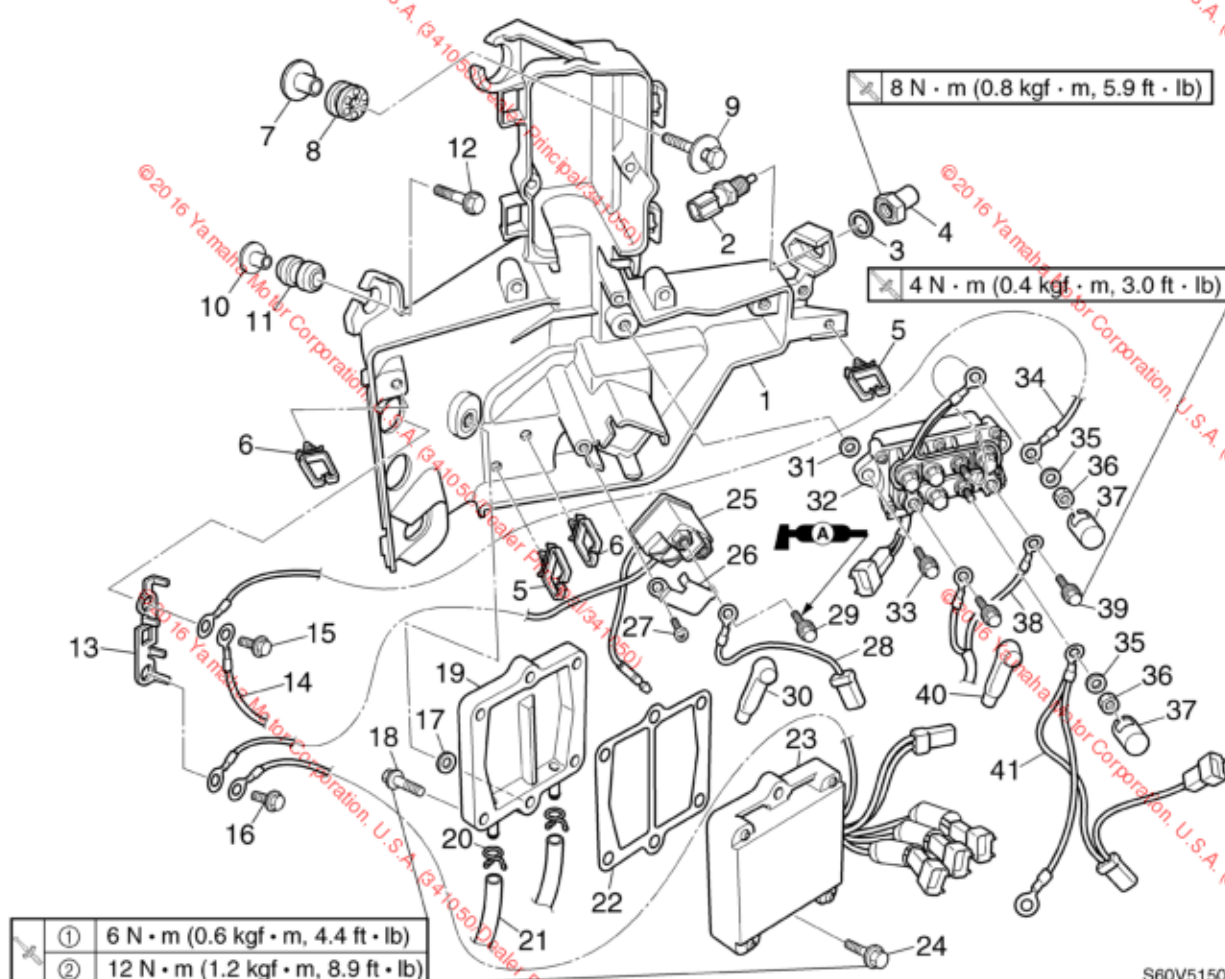
No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Bolt	3	M8 × 45 mm
3	Plastic tie	1	Not reusable
4	PTT relay lead	1	
5	Starter relay lead	1	
6	Terminal	1	
7	Nut	1	
8	Cap	1	
9	Positive battery lead	1	
10	Washer	1	
11	Nut	1	
12	Cap	1	
13	Bolt	1	M6 × 10 mm
14	Cap	1	



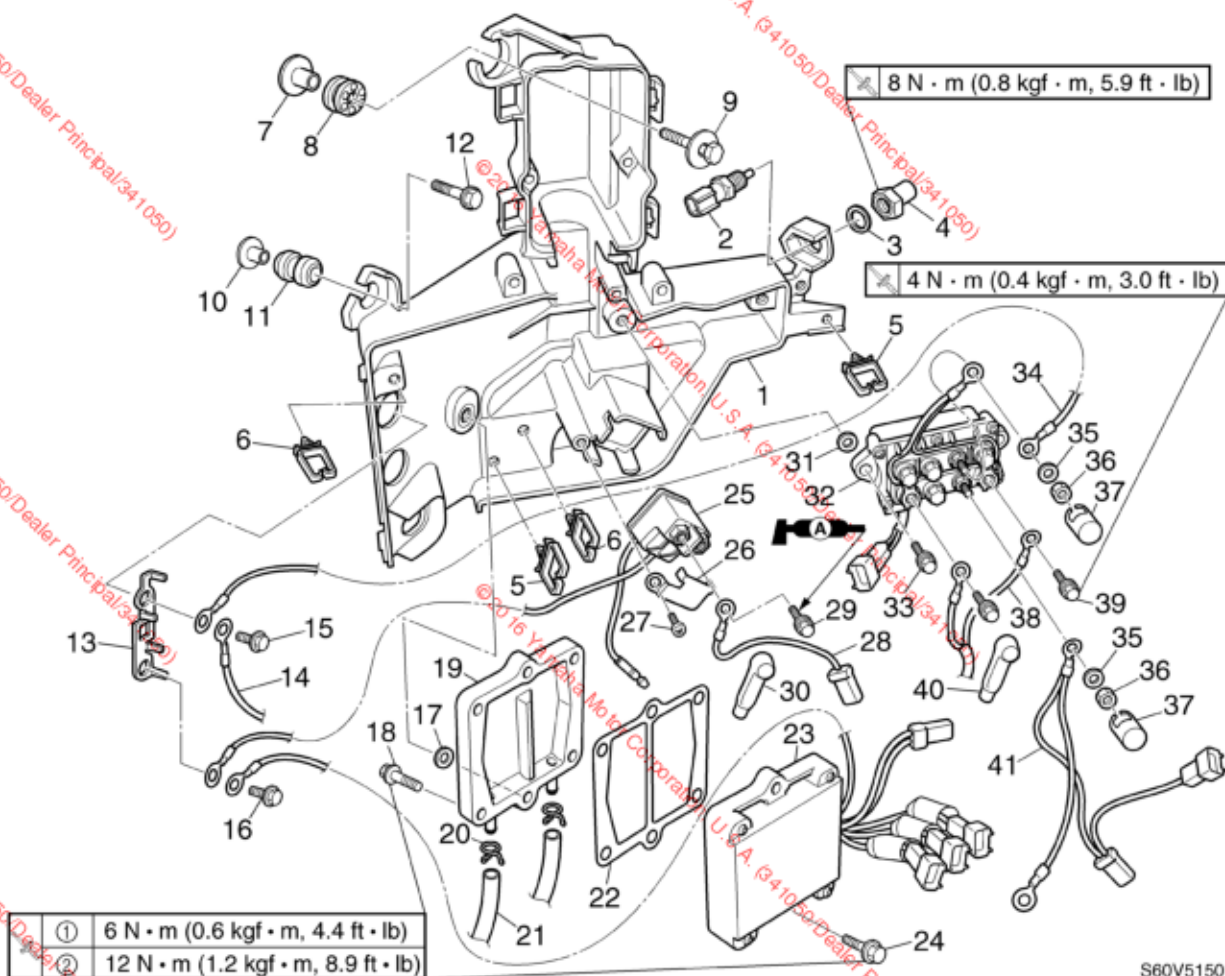
S60V5140

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

Power unit

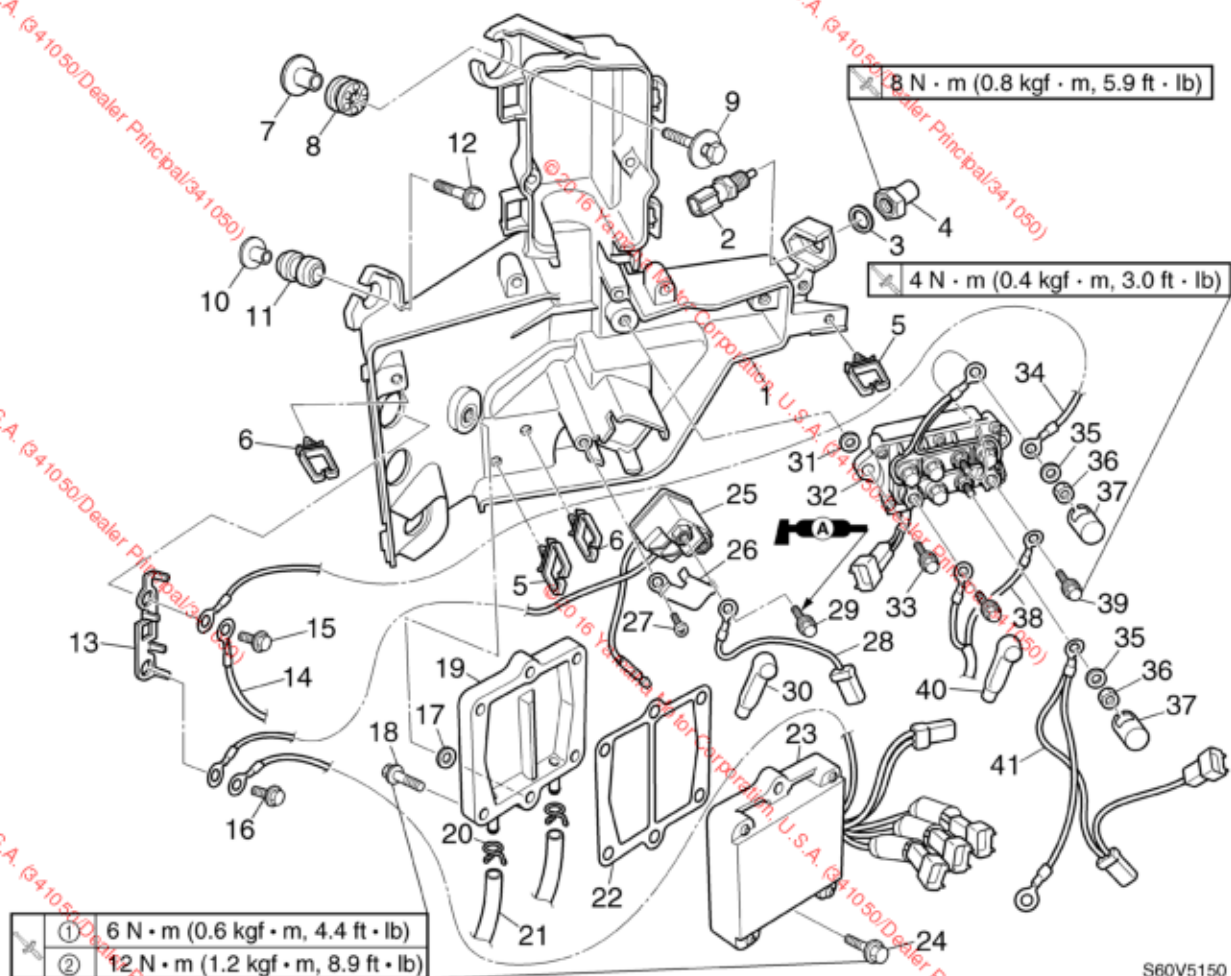


No.	Part name	Q'ty	Remarks
1	Junction box	1	
2	Intake air temperature sensor	1	
3	Washer	1	
4	Nut	1	
5	Holder	2	
6	Holder	2	
7	Collar	3	
8	Grommet	3	
9	Bolt	3	M6 × 35 mm
10	Collar	1	
11	Grommet	1	
12	Bolt	1	M6 × 25 mm
13	Connector	1	
14	Ground lead	1	
15	Bolt	1	M6 × 12 mm
16	Bolt	1	M6 × 12 mm
17	Washer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



S60V5150

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



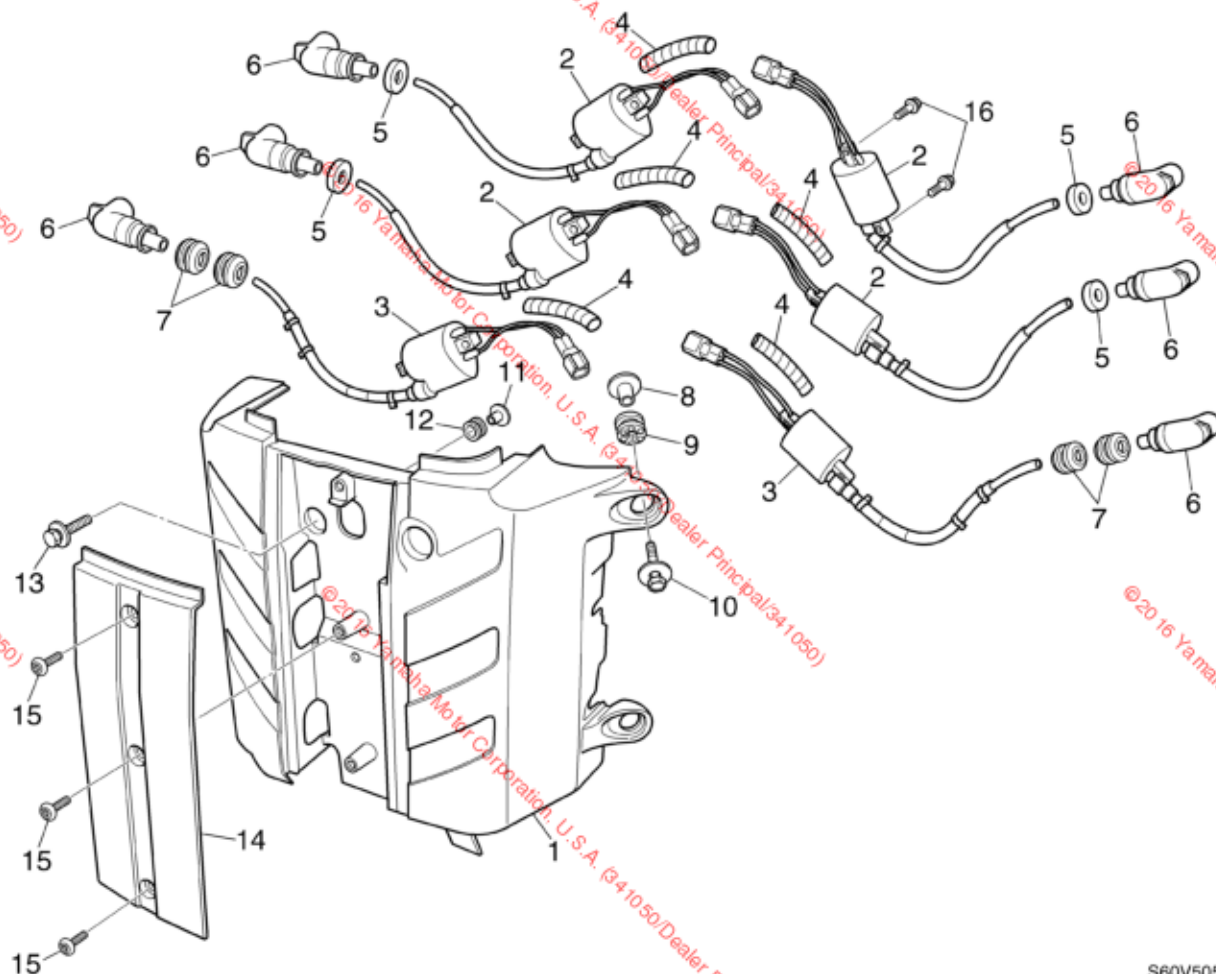
S60V5150

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

POWR



Power unit



S60V5050

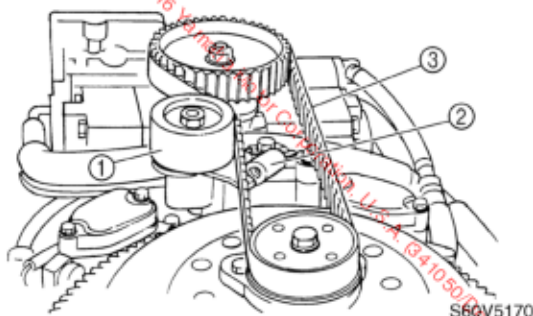
No.	Part name	Q'ty	Remarks
1	Ignition coil cover	1	
2	Ignition coil	4	Cylinders #1, #2, #3, and #4
3	Ignition coil	2	Cylinders #5 and #6
4	Hose	5	
5	Grommet	4	
6	Spark plug cap	6	
7	Grommet	4	
8	Collar	4	
9	Grommet	4	
10	Bolt	4	M6 × 35 mm
11	Collar	4	
12	Grommet	4	
13	Bolt	4	M6 × 30 mm
14	Cover	1	
15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

60V1E11

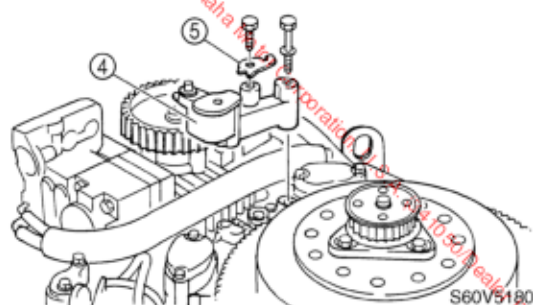


Removing the drive belt and sprockets

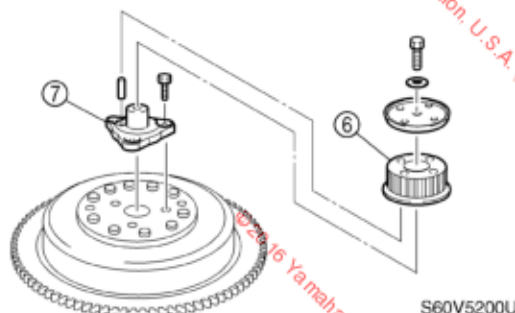
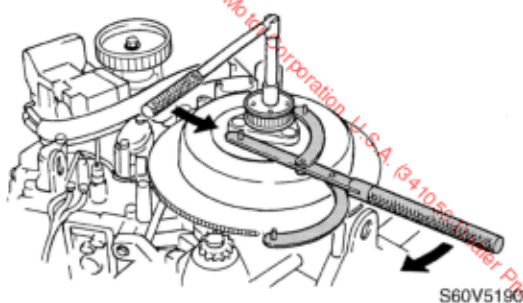
1. Remove the flywheel magnet cover.
2. Remove the drive belt tensioner ① and the tensioner spring ②, and then remove the drive belt ③.



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

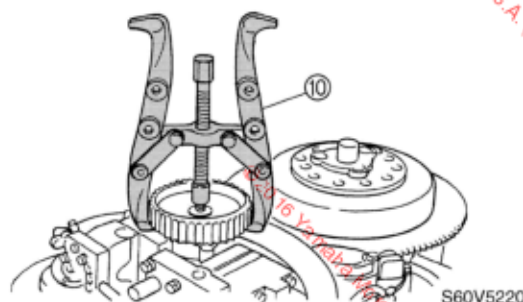
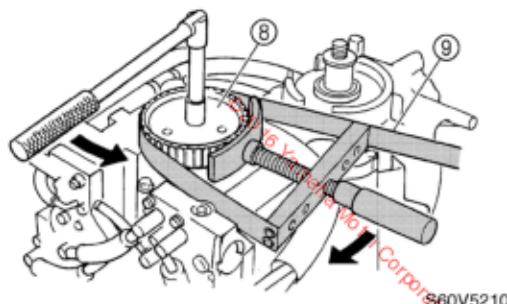


4. Remove the drive sprocket ⑥ and the drive sprocket bracket ⑦.



Universal magnet and rotor holder:
YU-01235

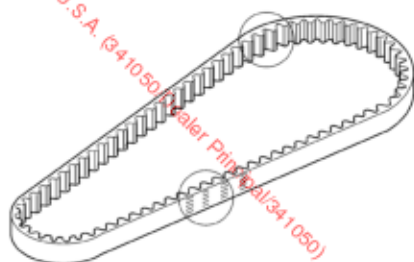
5. Remove the driven sprocket ⑧.



Primary sheave holder ⑨: YS-01880
Universal puller ⑩:
(commercially available)

Checking the drive belt and sprockets

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



S69J5570

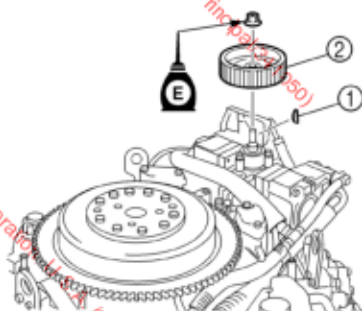
2. Check the drive sprocket ① and driven sprockets ② for cracks, damage, or wear. Replace if necessary.



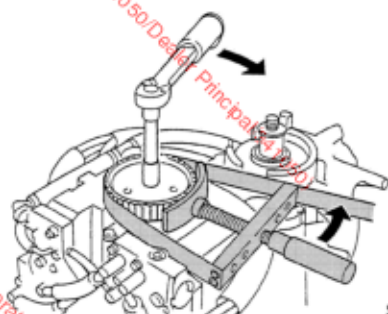
S60V5230

Installing the sprockets and drive belt

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



S60V5240

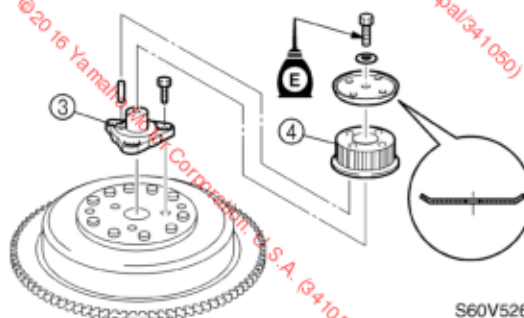


S60V5250

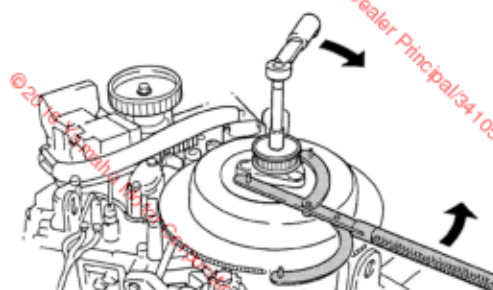


Primary sheave holder: YS-01880

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



S60V5260U

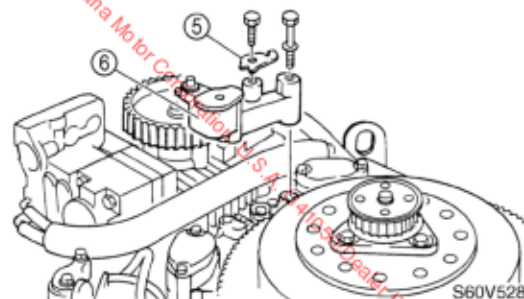


S60V5270



Universal magnet and rotor holder: YU-01235

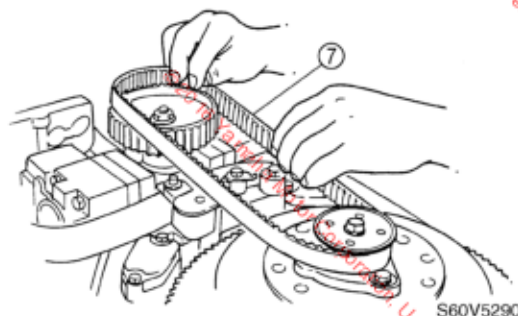
3. Install the spring holder ⑤ and tensioner bracket ⑥.



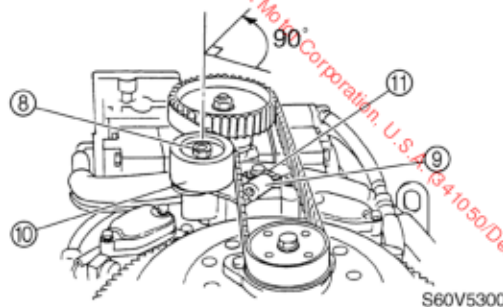
S60V5280



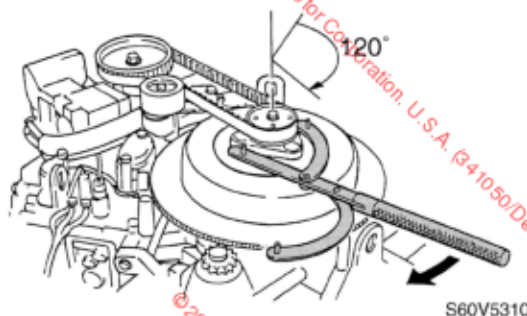
4. Install the drive belt ⑦ from the drive sprocket side with its part number in the upright position, and then turn the belt a half turn counterclockwise to align it.



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



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



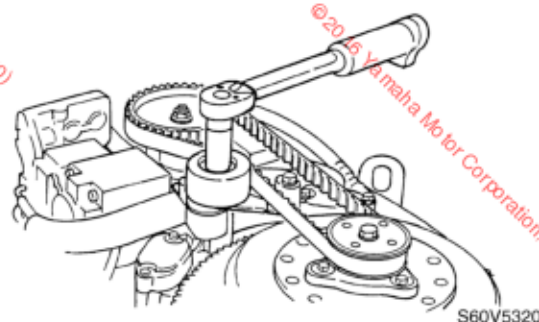
NOTE:

Do not turn the flywheel magnet counterclockwise.



Universal magnet and rotor holder:
YU-01235

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



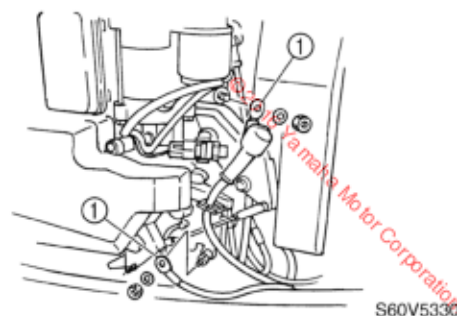
Drive belt tensioner bolt:
39 N·m (3.9 kgf·m, 28.8 ft·lb)

Removing the power unit

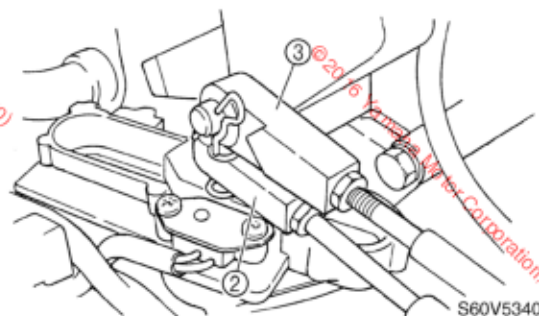
NOTE:

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

1. Disconnect the battery leads ①.



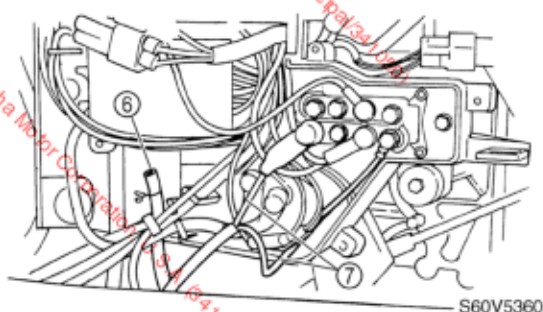
2. Disconnect the shift cable ② and the throttle cable ③.



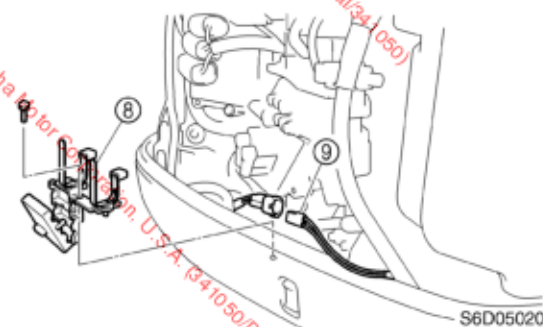
3. Disconnect the fuel hose ④ and the oil hose ⑤.



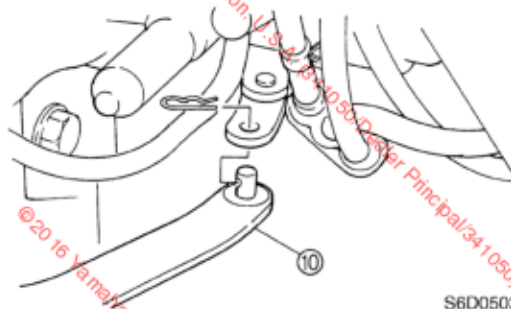
4. Remove the flywheel magnet cover.
5. Remove the junction box cover, and then disconnect the cooling water hose ⑥ and the PTT motor leads ⑦.



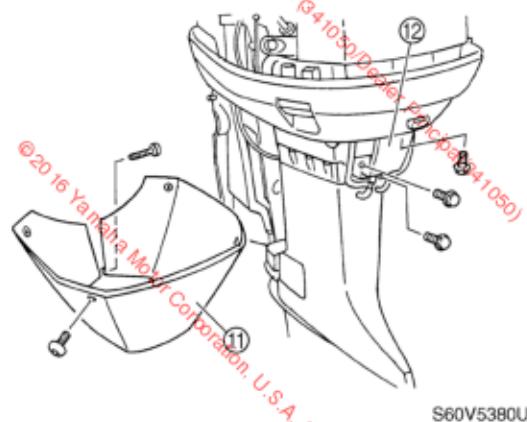
6. Remove the bracket ⑧ and disconnect the trim sensor coupler ⑨.



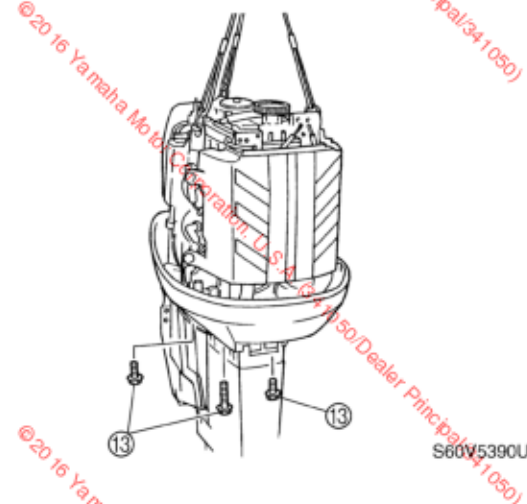
7. Disconnect the PTT switch coupler and the shift lever ⑩.



8. Remove the apron ⑪ and the hose joint assembly ⑫.

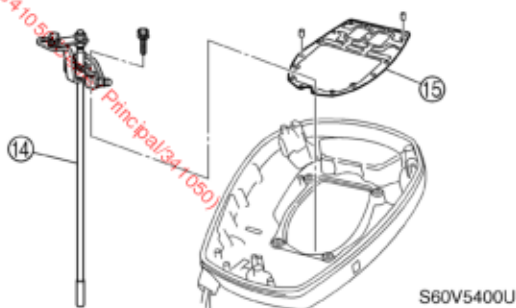


9. Remove the bolts ⑬, then the power unit.



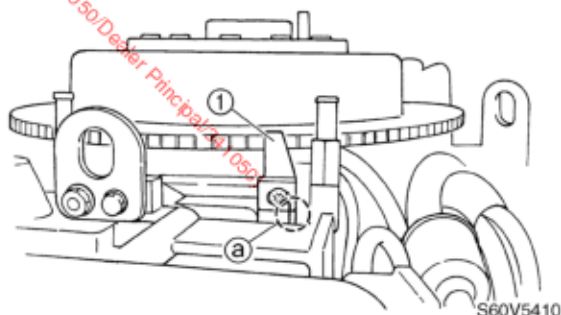
POWR**Power unit**

10. Remove the shift rod assembly ⑭ and gasket ⑮.



Removing the flywheel magnet

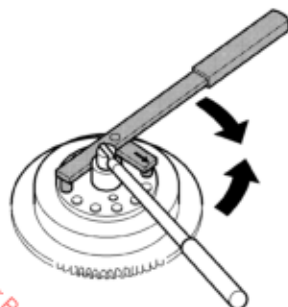
1. Remove the pointer ①.



NOTE:

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

2. Loosen the flywheel magnet nut.



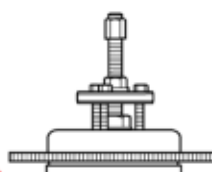
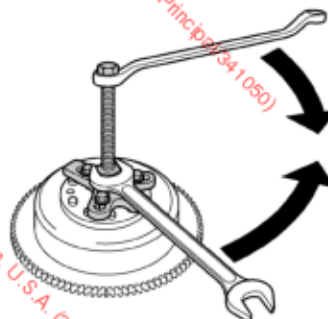
CAUTION:

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



Flywheel magnet holder: YB-06139

3. Remove the flywheel magnet.



S60V5450

CAUTION:

To prevent damage to the engine or tools, screw in the universal puller set bolts evenly and completely so that the universal puller 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.

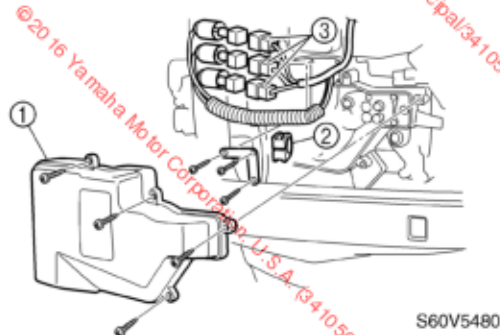


Universal puller: YB-06117

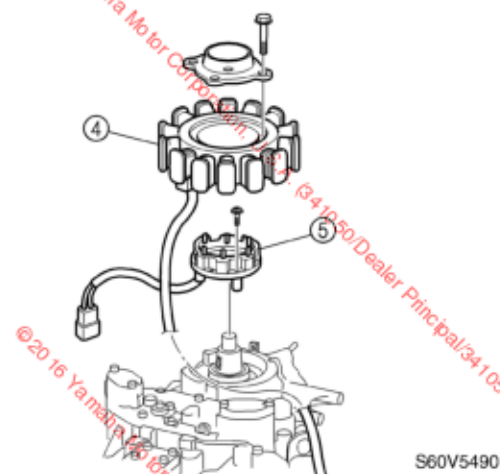
4. Remove the Woodruff key.

Removing the stator coil and pulser coil

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

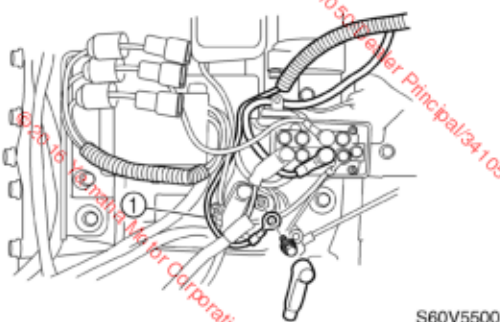


3. Disconnect the pulser coil coupler.
4. Remove the stator coil ④ and pulser coil ⑤.

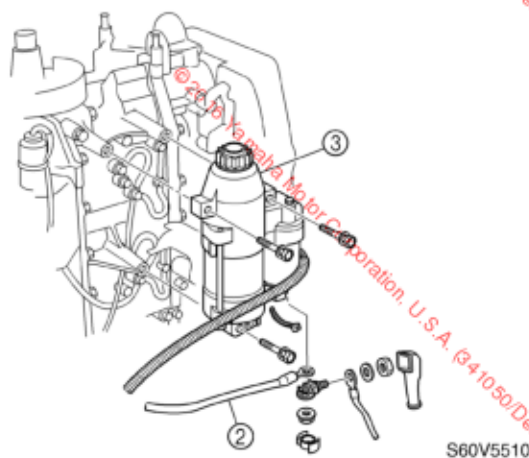


Removing the starter motor

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



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

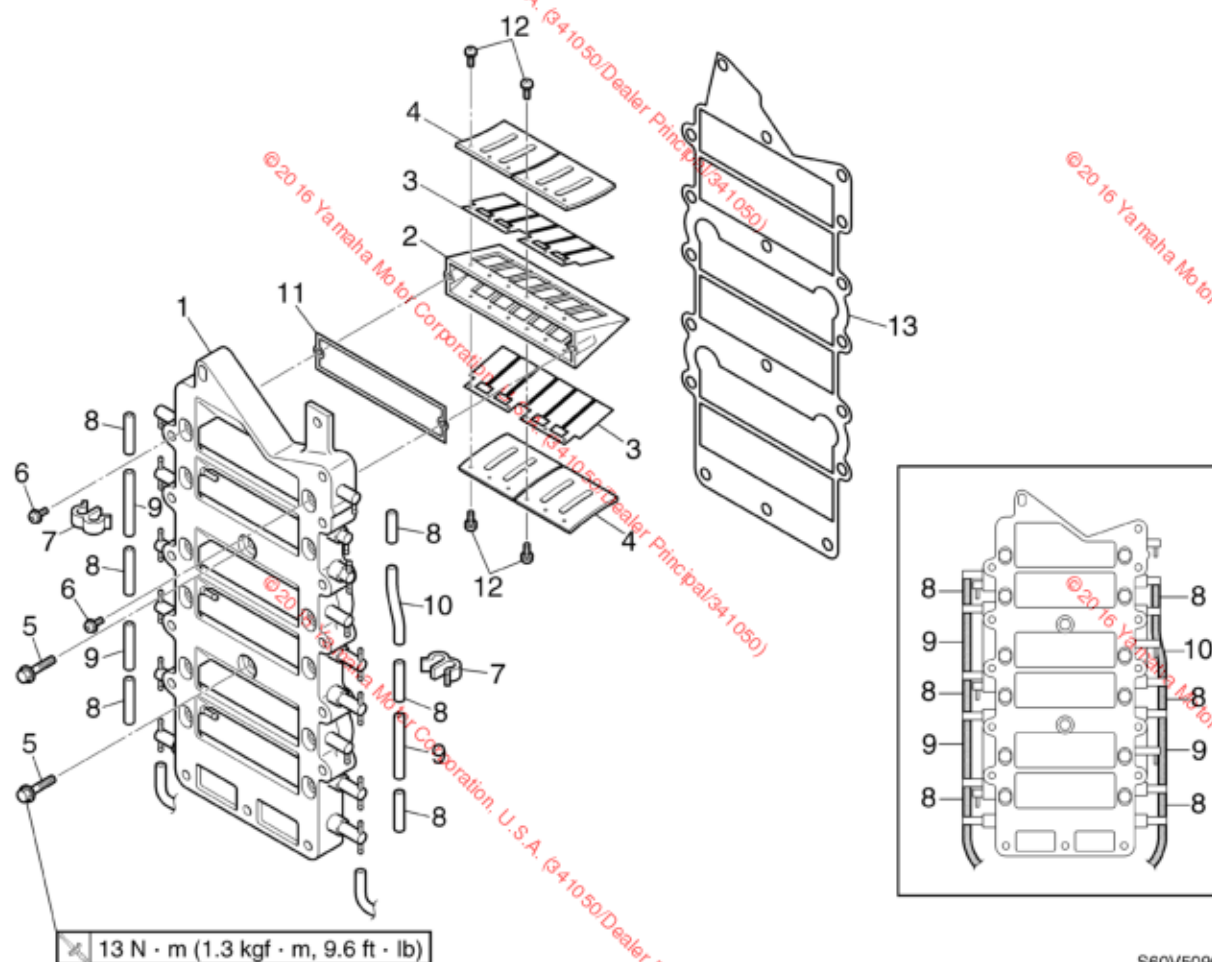


POWR



Power unit

Intake manifold



S60V5090

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

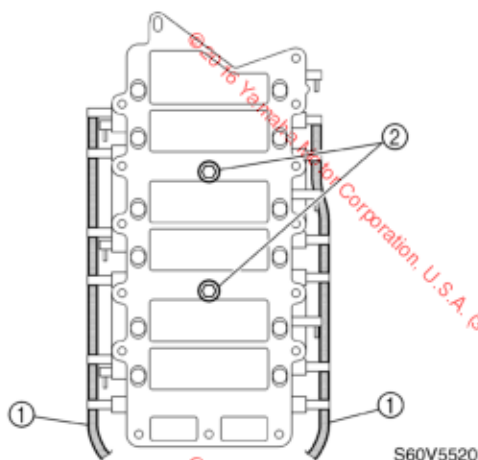
Intake manifold

Removing the intake manifold

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

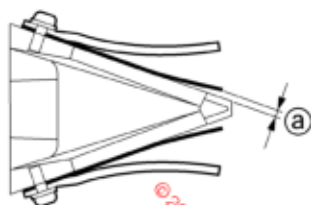


Valve stopper height ⑥:
8 mm (0.31 in)



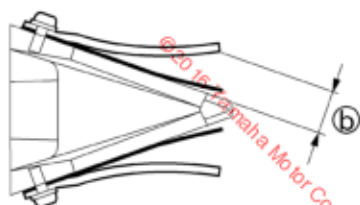
Checking the reed valve

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



Valve bend limit ③:
0.2 mm (0.008 in)

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



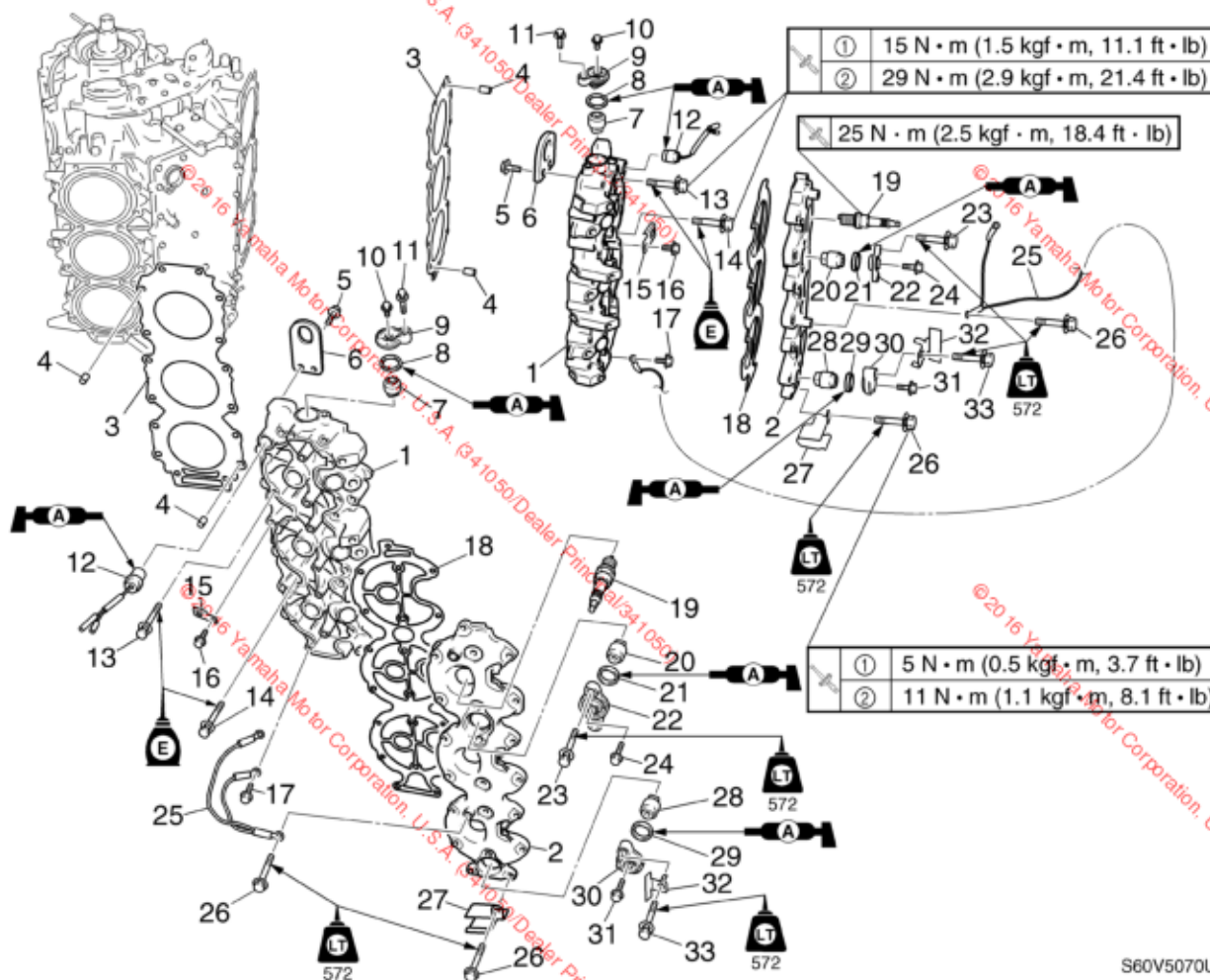
5

POWR



Power unit

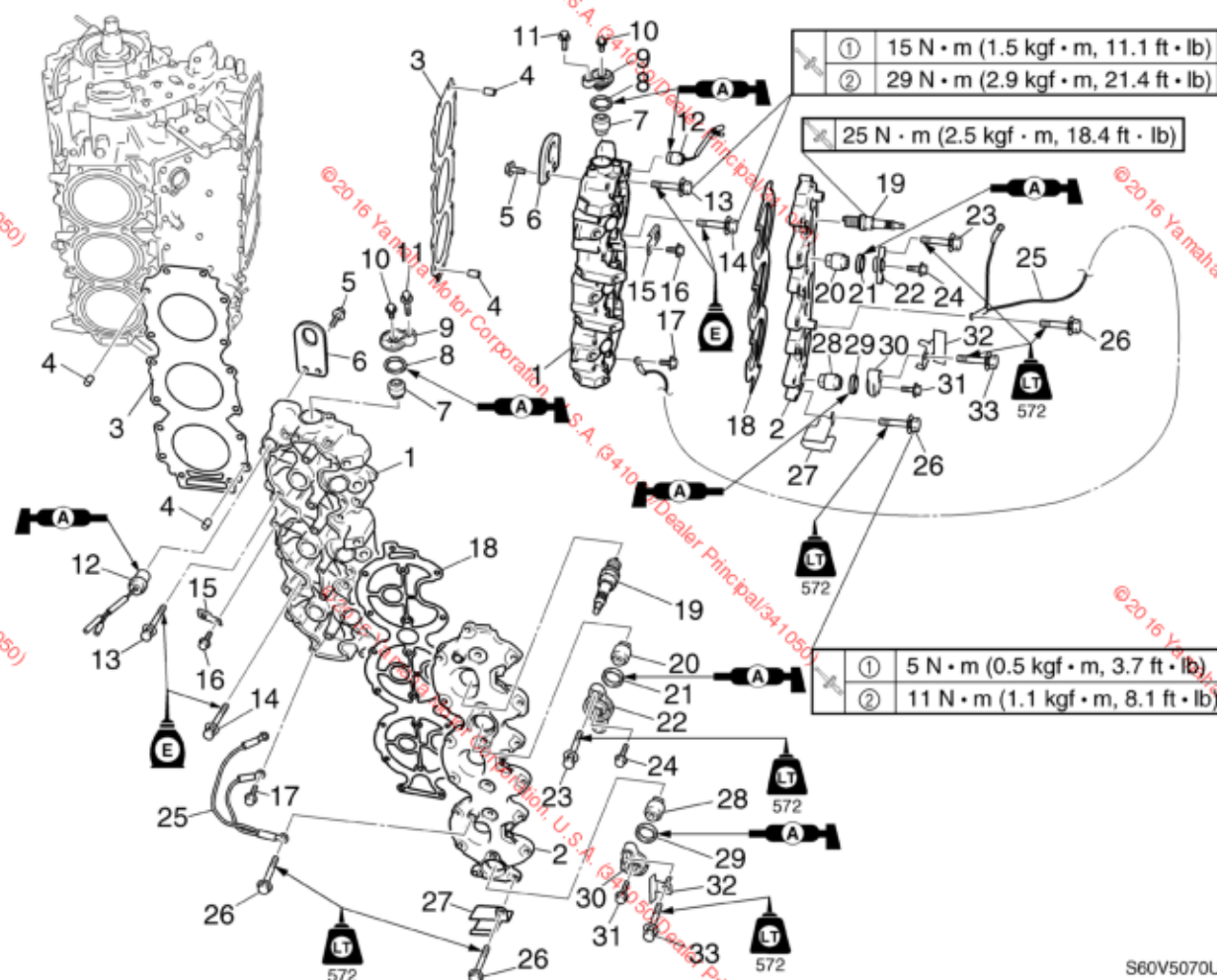
Cylinder head



S60V5070U

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

Cylinder head



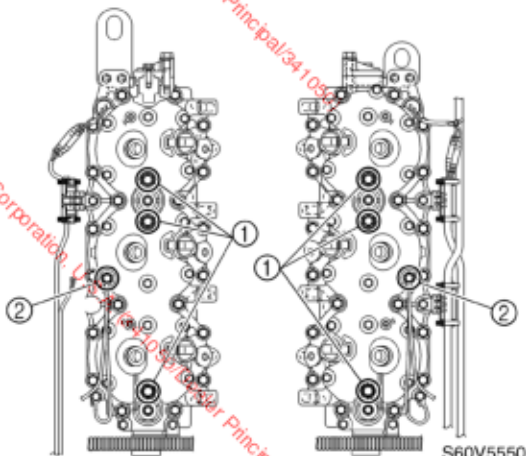
S60V5070U

No.	Part name	Q'ty	Remarks
18	Gasket	2	Not reusable
19	Spark plug	6	
20	Anode	2	
21	Grommet	2	
22	Cover	2	
23	Bolt	4	M8 × 50 mm
24	Bolt	2	M6 × 20 mm
25	Ground lead	2	
26	Bolt	36	M6 × 30 mm
27	Holder	2	
28	Anode	2	
29	Grommet	2	
30	Cover	2	
31	Bolt	2	M6 × 20 mm
32	Plate	2	
33	Bolt	2	M8 × 50 mm

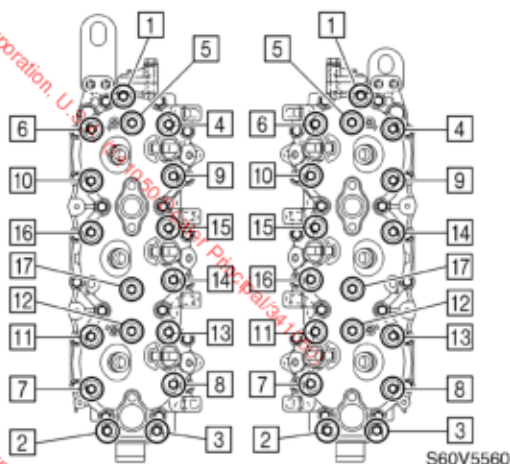


Removing the cylinder head

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



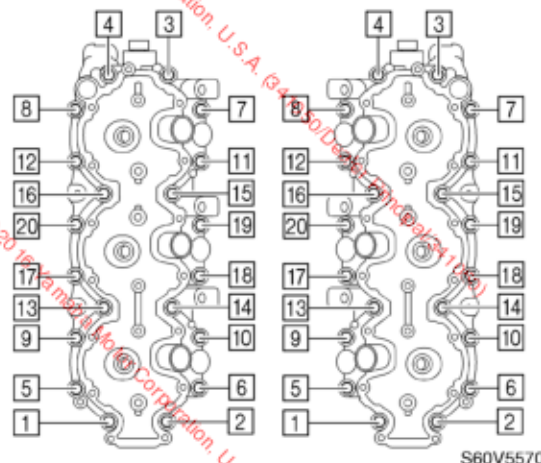
3. Remove the cylinder head cover bolts in the sequence shown.



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

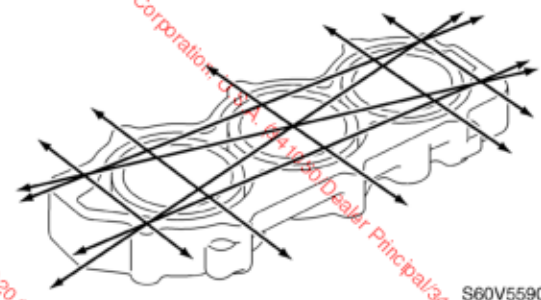
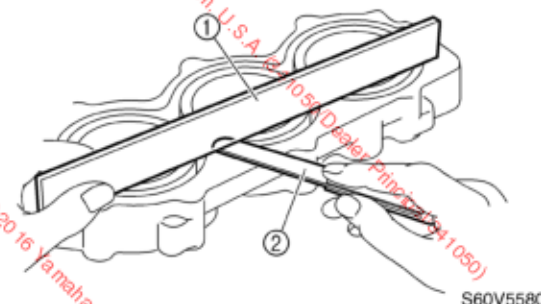
CAUTION:

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



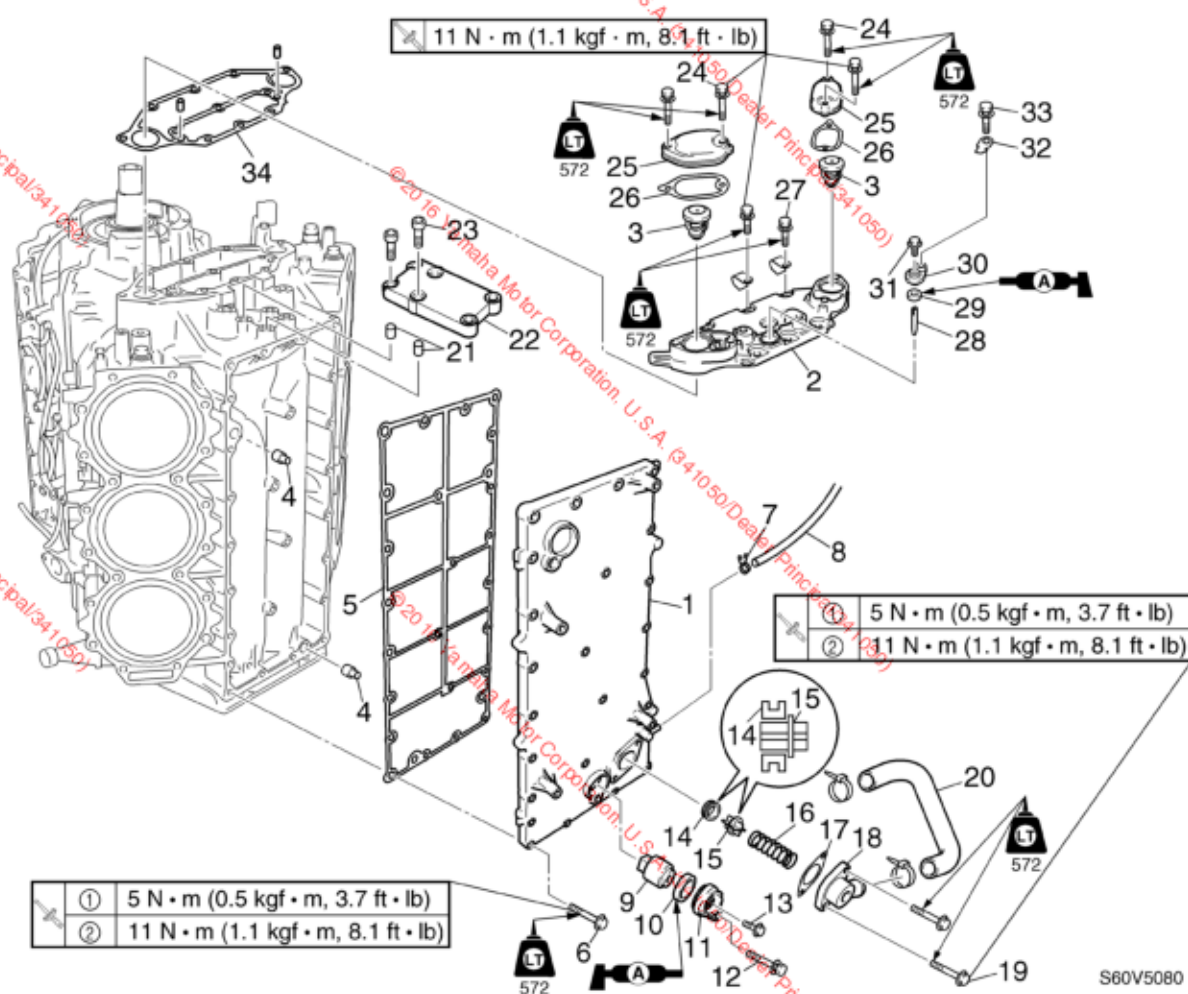
Checking the cylinder head

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

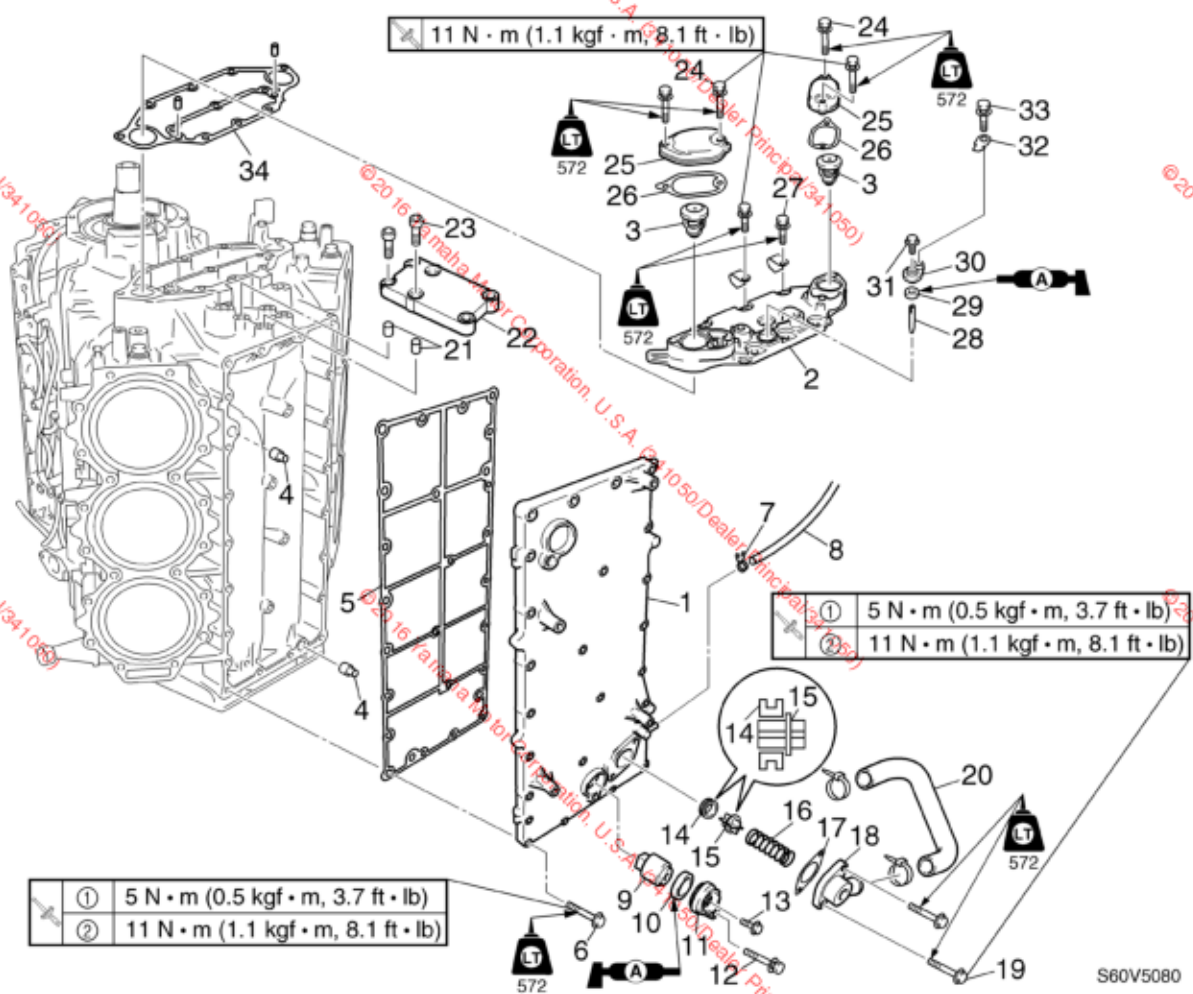


Cylinder head warpage limit:
0.1 mm (0.004 in)

Exhaust and cylinder cover



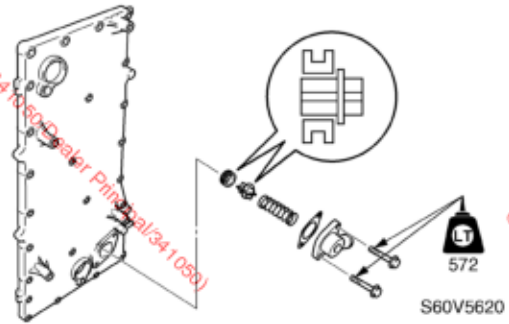
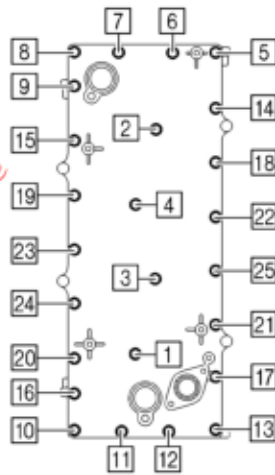
No.	Part name	Q'ty	Remarks
1	Exhaust outer cover	1	
2	Cover	1	
3	Thermostat	2	
4	Collar	2	
5	Gasket	1	Not reusable
6	Bolt	25	M6 × 25 mm
7	Clamp	1	
8	Hose	1	
9	Anode	1	
10	Grommet	1	
11	Cover	1	
12	Bolt	1	M8 × 30 mm
13	Bolt	1	M6 × 20 mm
14	Grommet	1	
15	Pressure control valve	1	
16	Spring	1	
17	Gasket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



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

Removing the exhaust cover

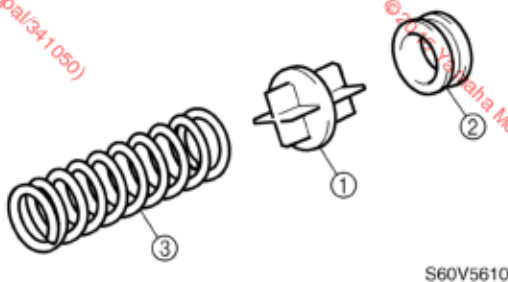
1. Remove the exhaust cover bolts in the sequence shown.



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

Checking the pressure control valve

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

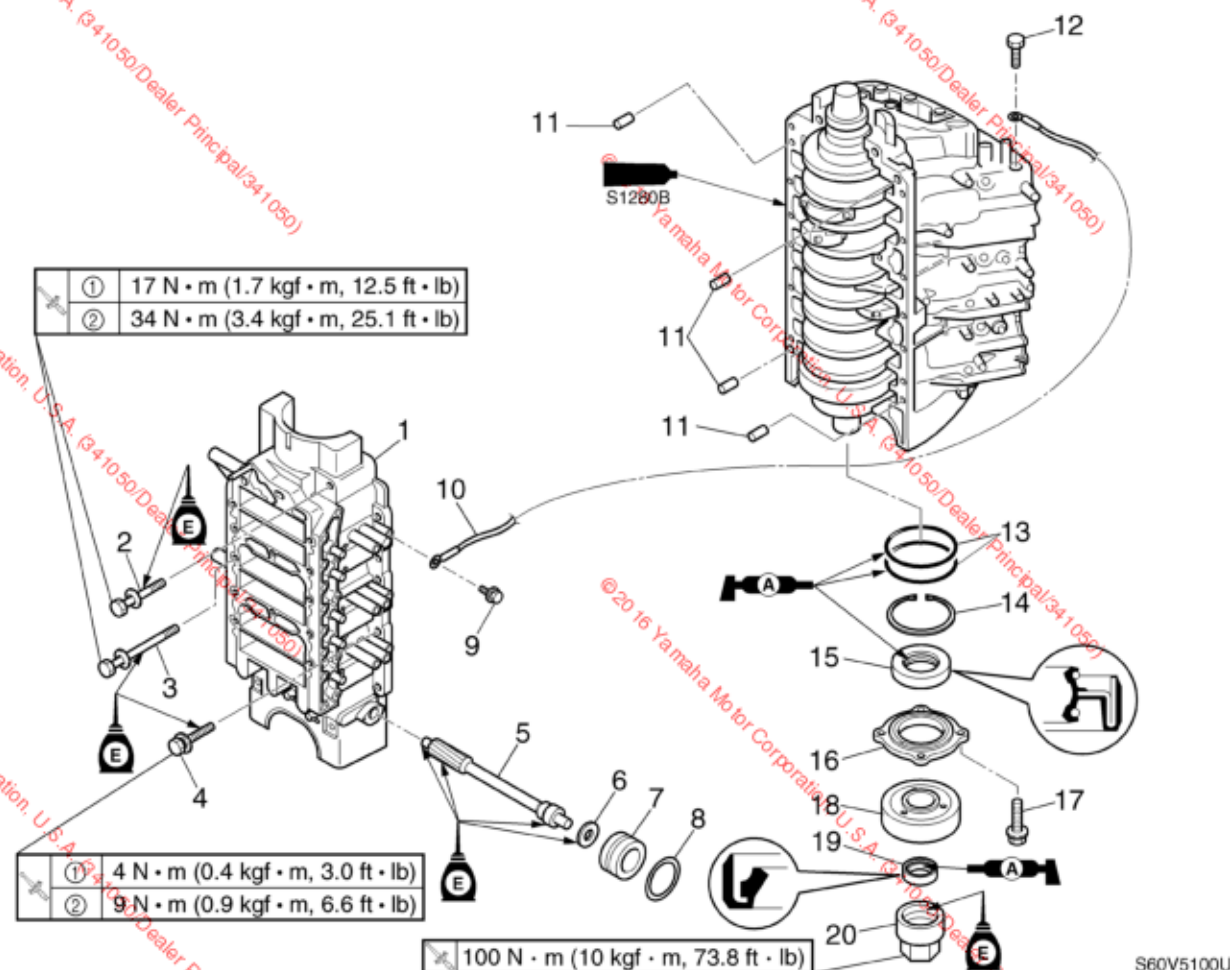


Installing the pressure control valve

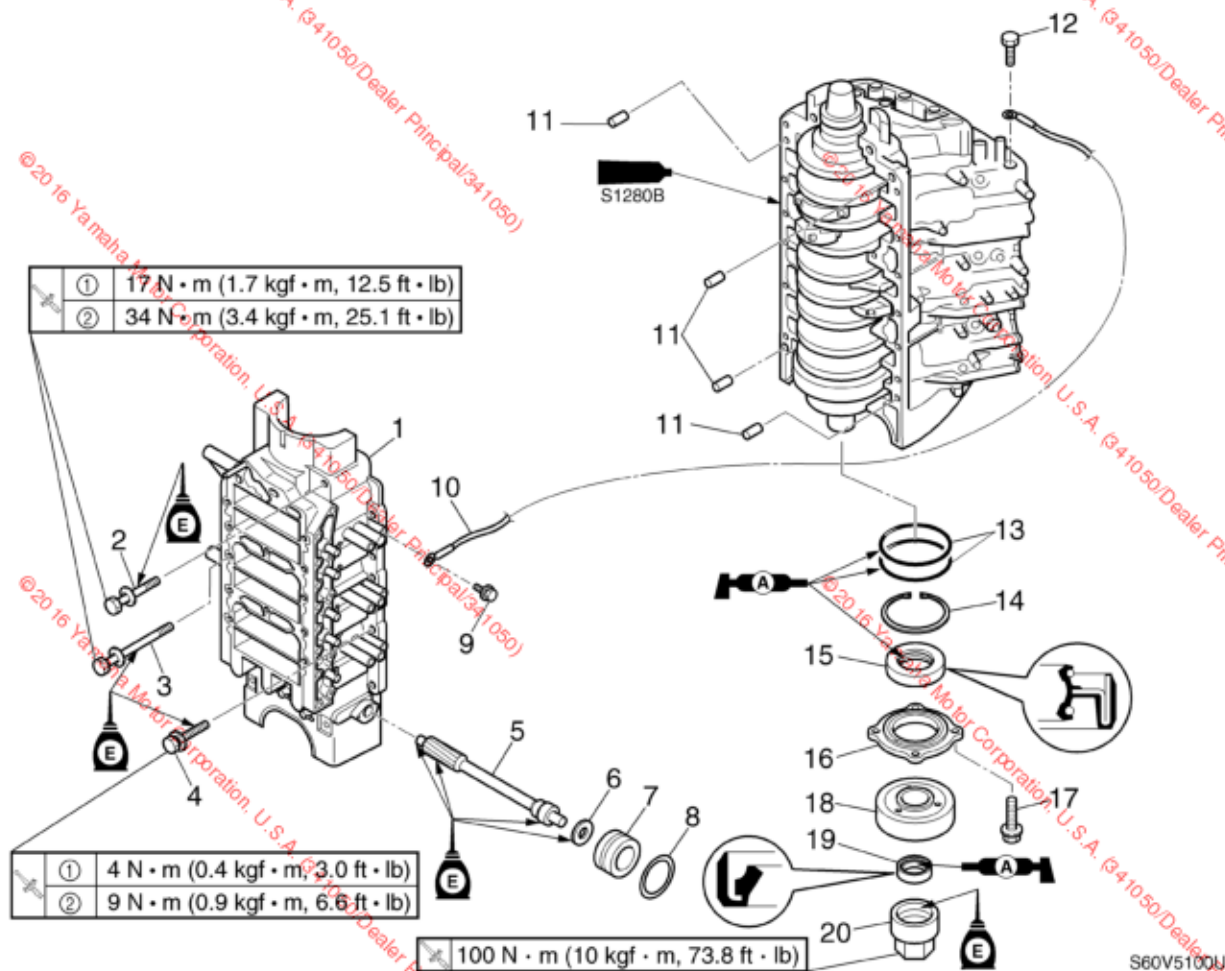
1. Install a new gasket and the pressure control valve, and then tighten the bolts to the specified torques in two stages.



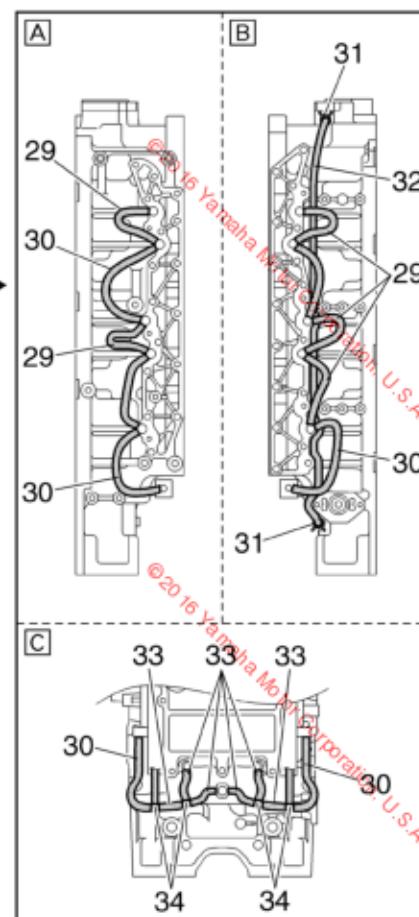
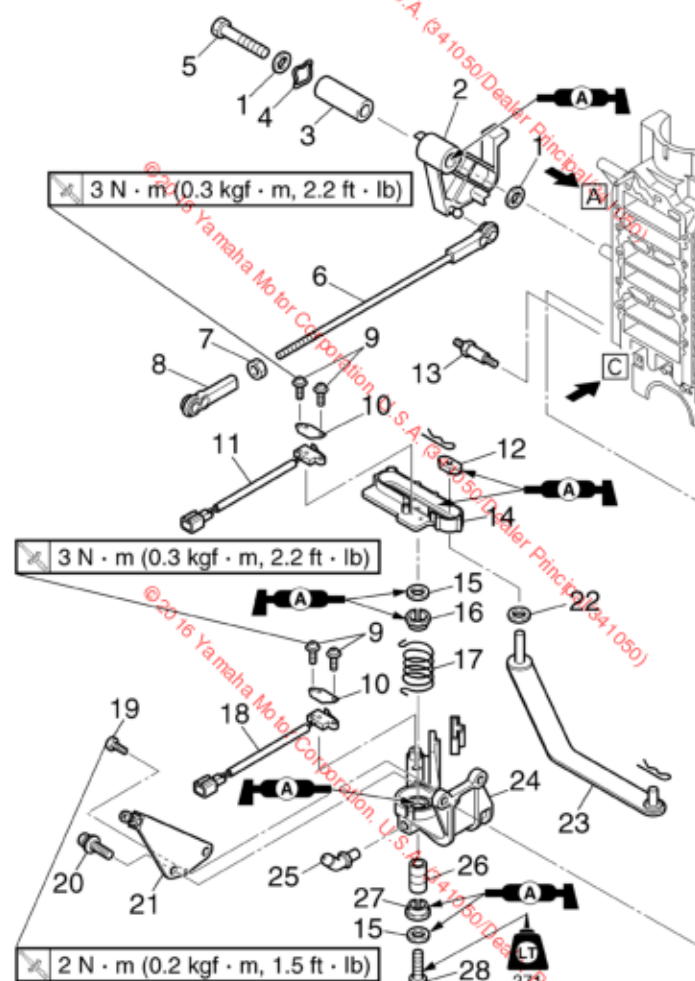
Crankcase



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

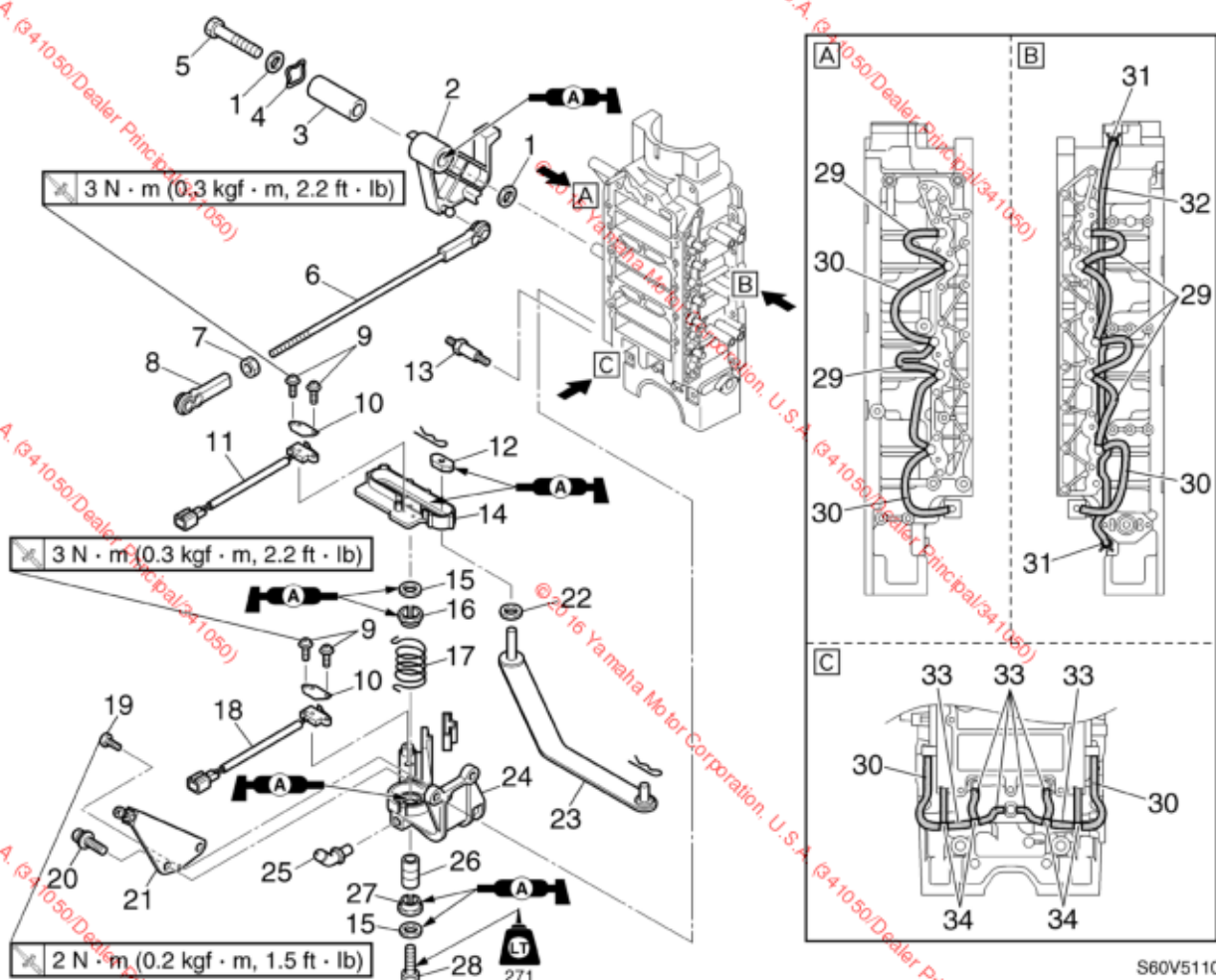


No.	Part name	Q'ty	Remarks
18	Crankshaft balancer	1	Not reusable
19	Oil seal	1	
20	Nut	1	



S60V5110

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



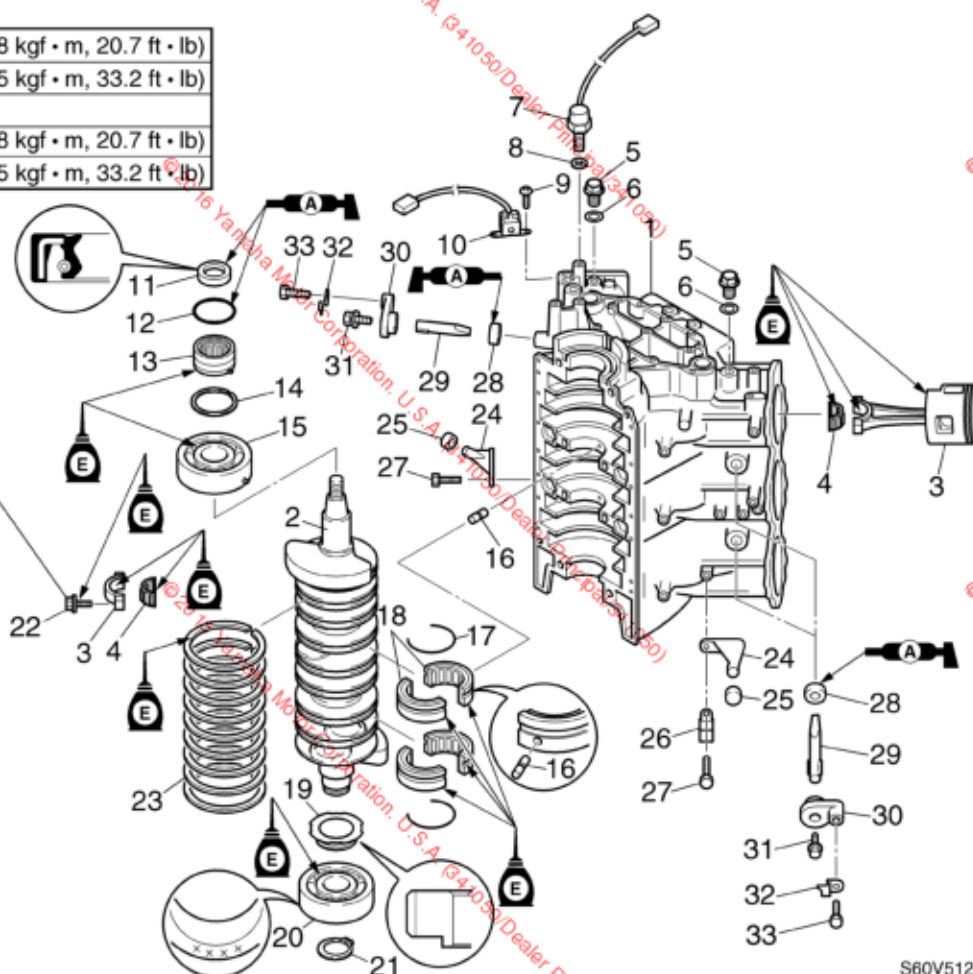
S60V5110

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



Cylinder block

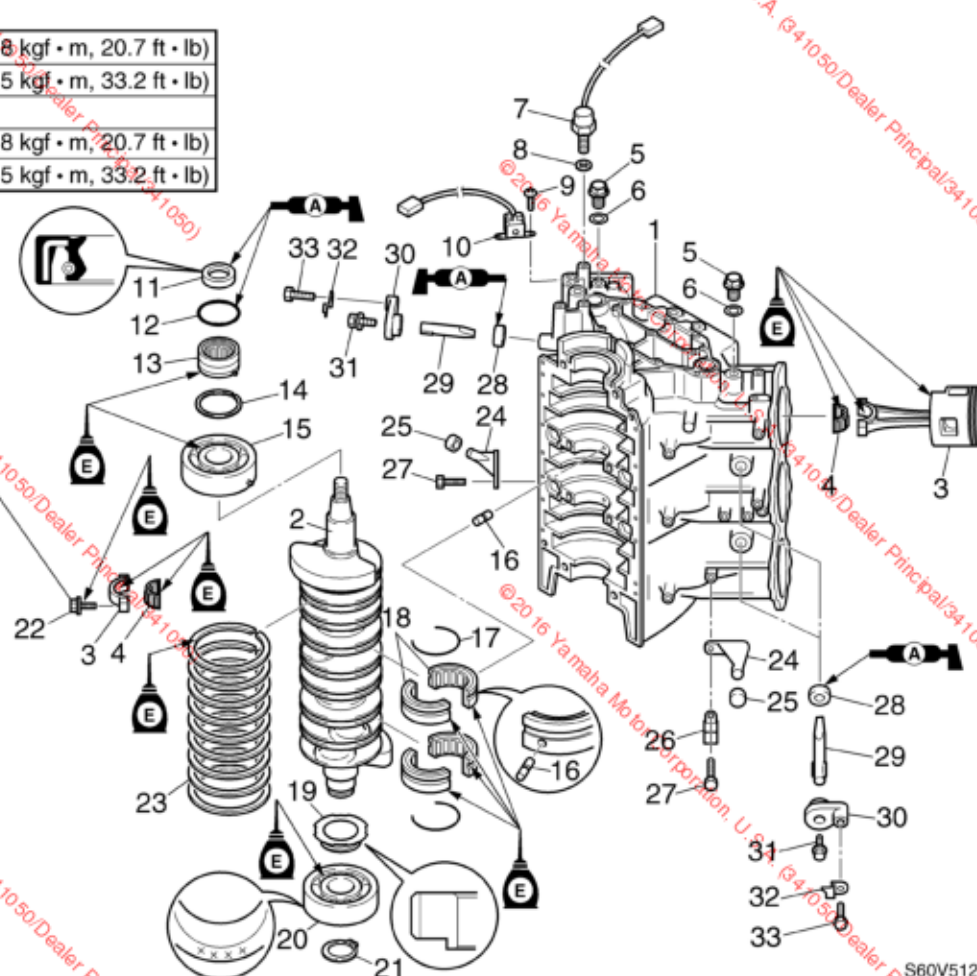
①	28 N · m (2.8 kgf · m, 20.7 ft · lb)
②	45 N · m (4.5 kgf · m, 33.2 ft · lb)
③	*
④	28 N · m (2.8 kgf · m, 20.7 ft · lb)
⑤	45 N · m (4.5 kgf · m, 33.2 ft · lb)



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

*: Loosen completely

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



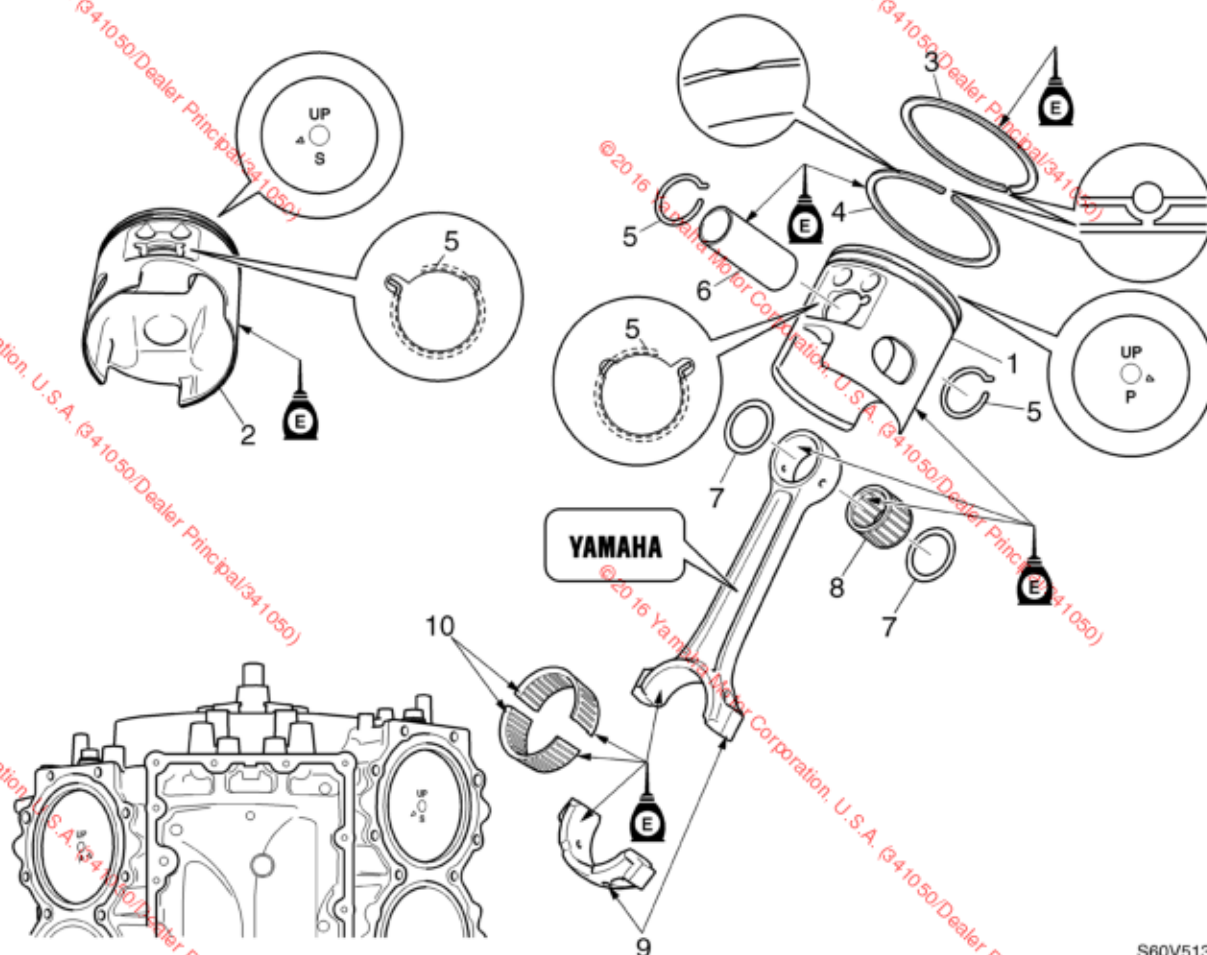
5

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

POWR



Power unit

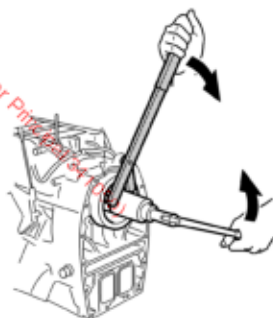


S60V5130

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

Removing the crankcase

1. Remove the crankshaft balancer nut.



S60V5630

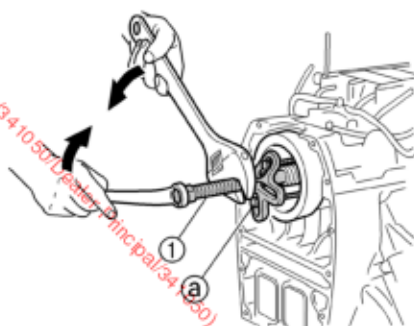
CAUTION:

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

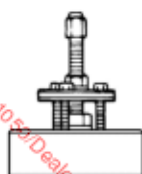


Flywheel magnet holder: YB-06139

2. Remove the crankshaft balancer.



S60V5650



S60V5660

CAUTION:

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

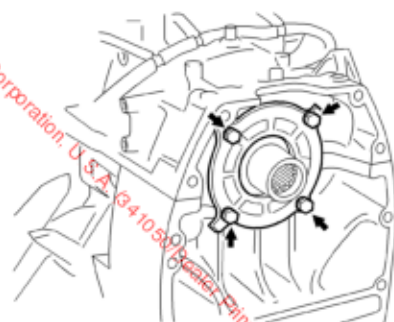
NOTE:

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



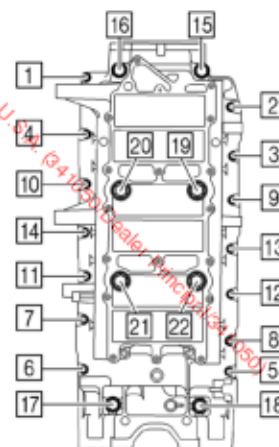
Universal puller (1): YB-06117
Specified bolts (a): M8 × 80 mm

3. Remove the oil seal housing.



S60V5690

4. Remove the crankcase bolts in the sequence shown.

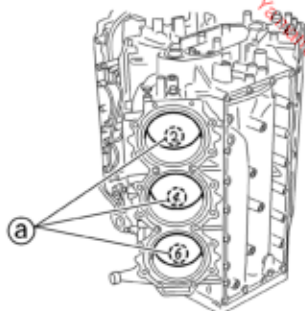


S60V5700

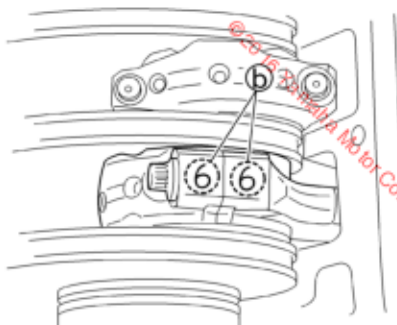


Removing the piston and connecting rod assemblies and crankshaft assembly

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



S60V5710

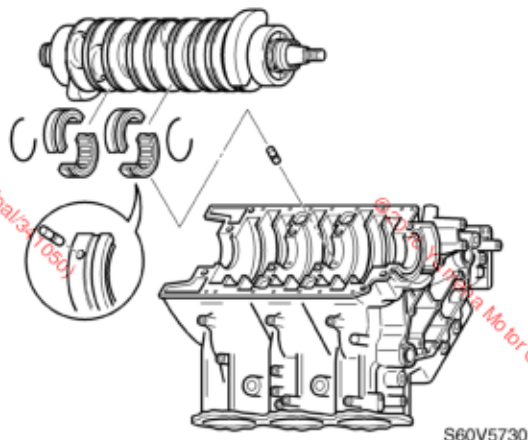


S60V5720

NOTE:

- Be sure to keep the bearings in the order as they were removed.
- Mark each piston with the identification number ① of the corresponding cylinder. Also, mark each connecting rod and connecting rod cap with an identification number ② as shown.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

2. Remove the crankshaft assembly.



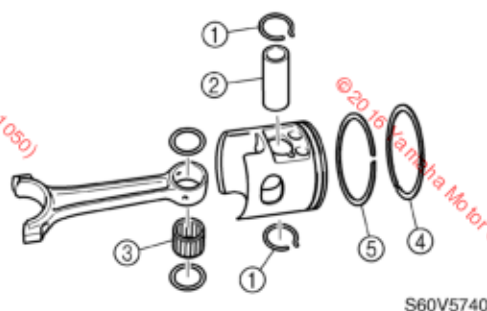
S60V5730

NOTE:

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

Disassembling the piston and connecting rod assemblies

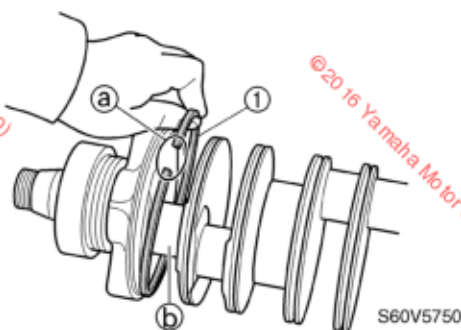
1. Remove the clips ① with pliers, and then remove the piston pin ② and needle bearing ③.
2. Remove the top ring ④ and 2nd piston ring ⑤.



S60V5740

Disassembling the crankshaft

1. Remove the seal rings ①.

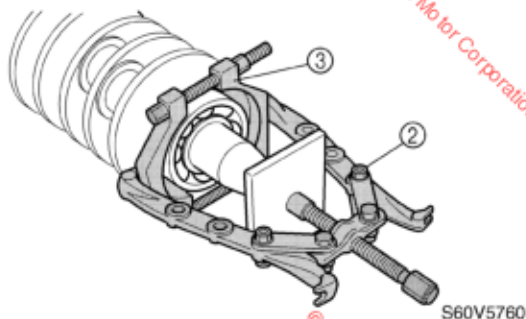


S60V5750

NOTE:

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

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

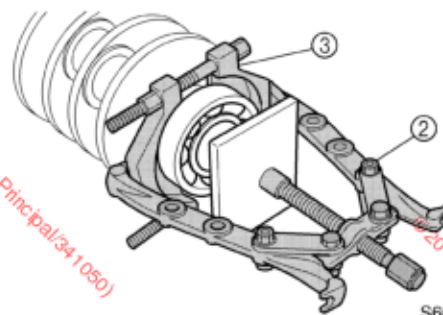
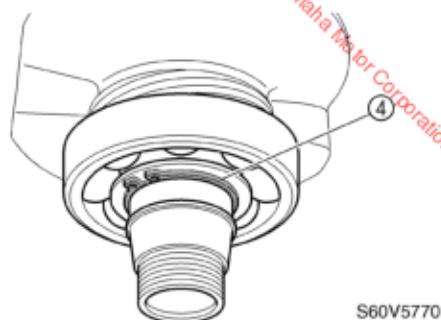
**CAUTION:**

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



Universal puller ②:
(commercially available)
Bearing separator ③:
(commercially available)

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

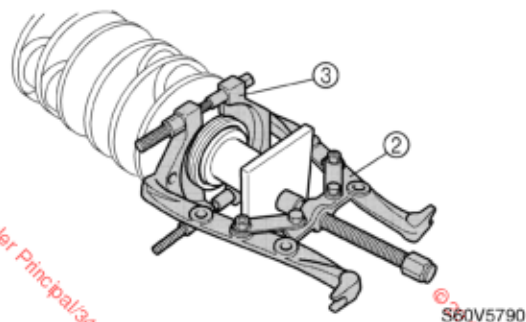
**CAUTION:**

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



Universal puller ②:
(commercially available)
Bearing separator ③:
(commercially available)

5. Remove the oil pump drive gear.

**WARNING**

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



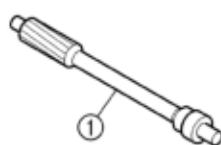
Universal puller ②:
(commercially available)
Bearing separator ③:
(commercially available)

5



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

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



S60V5800

Checking the bearings

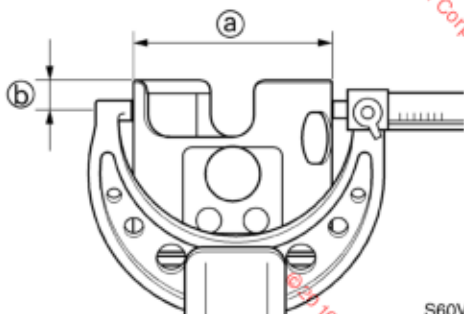
1. Check the bearings for pitting or rumbling. Replace if necessary.



S60V5810

Checking the piston diameter

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



S60V5820



Piston diameter (a):

92.830–92.850 mm
(3.6547–3.6555 in)

Measuring point (b):

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

Oversize piston diameter:

1st:

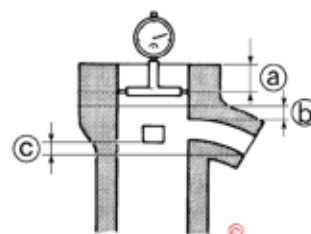
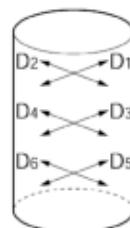
93.080–93.100 mm
(3.6646–3.6653 in)

2nd:

93.330–93.350 mm
(3.6744–3.6752 in)

Checking the cylinder bore

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



S60V5830

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

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

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



Cylinder bore (D_1 – D_6):

93.000–93.020 mm
(3.6614–3.6622 in)

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

Cylinder block



Taper limit:

$D_1 - D_5$ (direction ㉔)
 $D_2 - D_6$ (direction ㉔)
 0.08 mm (0.0031 in)

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



Out-of-round limit:

$D_2 - D_1$ (measuring point ㉔)
 $D_6 - D_5$ (measuring point ㉔)
 0.05 mm (0.0020 in)

Checking the piston clearance

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

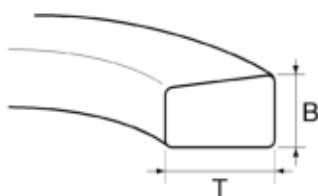


Piston clearance:

Cylinder bore – piston diameter
 0.165–0.171 mm
 (0.0065–0.0067 in)

Checking the piston rings

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



S60V5840

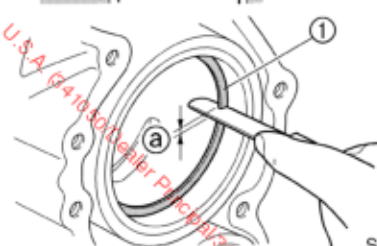
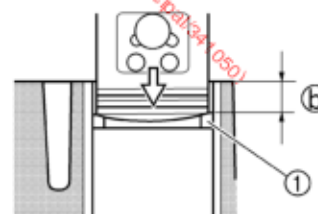


Piston ring dimensions:

Top ring:
 B: 2.05 mm (0.0807 in)
 T: 3.00–3.20 mm (0.118–0.126 in)
 2nd piston ring:
 B: 2.05 mm (0.0807 in)
 T: 2.70–2.90 mm (0.106–0.114 in)

- Level the piston rings ① in a cylinder with a piston crown.

- Check the piston ring end gap ㉔ at the specified measuring point. Replace if out of specification.



S60V5850

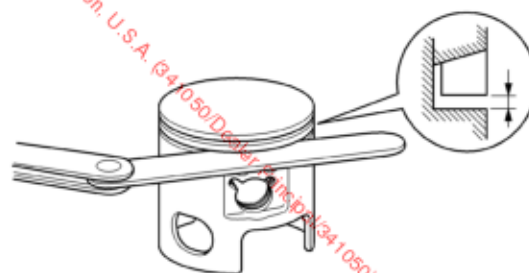


Piston ring end gap ㉔:

Top ring:
 0.30–0.50 mm
 (0.0118–0.0197 in)
 2nd piston ring:
 0.30–0.45 mm
 (0.0118–0.0177 in)
 Measuring point ㉔: 20 mm (0.8 in)

Checking the piston ring side clearance

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



S60V5860



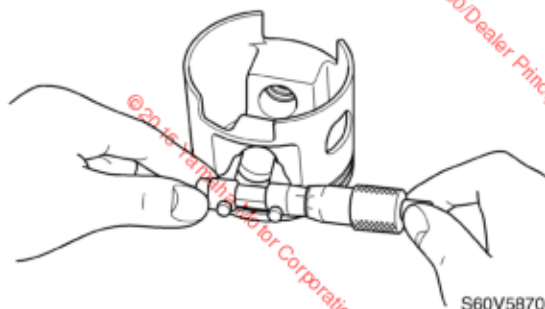
Piston ring side clearance:

Top ring and 2nd piston ring:
 0.02–0.06 mm
 (0.0008–0.0024 in)



Checking the piston pin boss bore

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

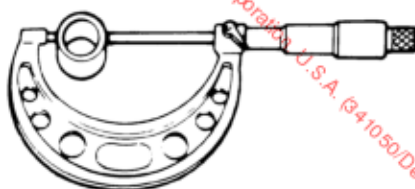


S60V5870

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

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

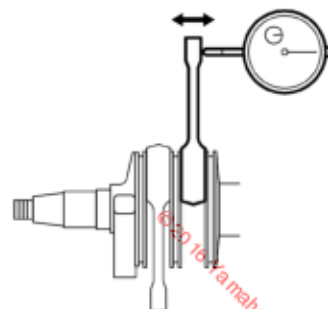


S69J5C30

	Piston pin diameter: 25.995–26.000 mm (1.0234–1.0236 in)
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Checking the connecting rod small end axial play

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



S60V5880

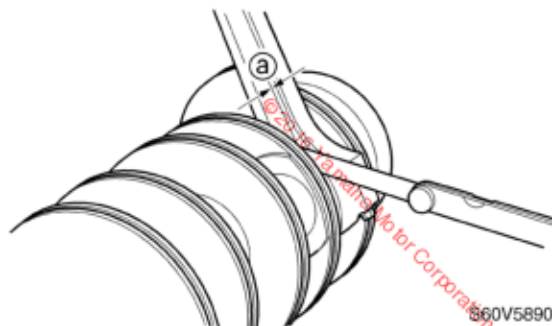
	Connecting rod small end axial play limit: 2.0 mm (0.079 in)
--	---

NOTE:

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

Checking the connecting rod big end side clearance

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

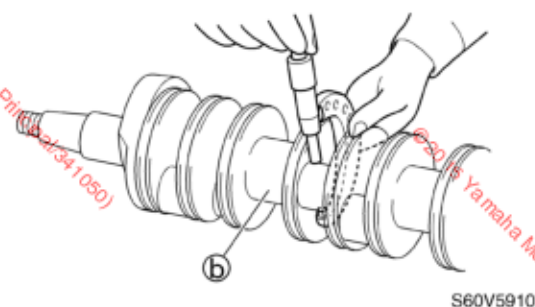
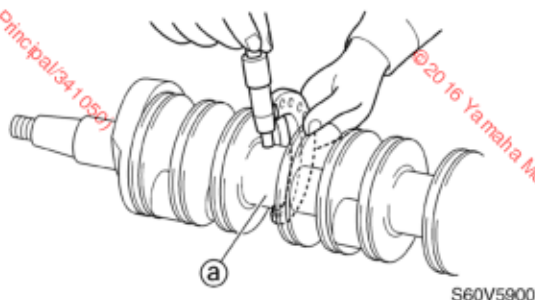


S60V5890

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

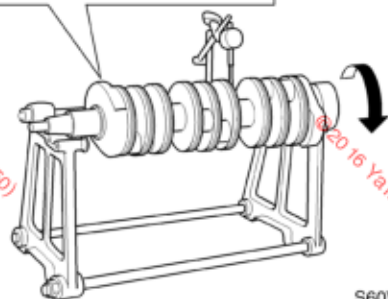
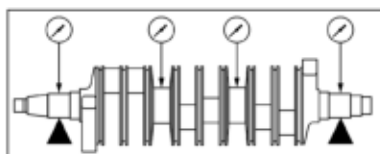
Checking the crankshaft

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



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

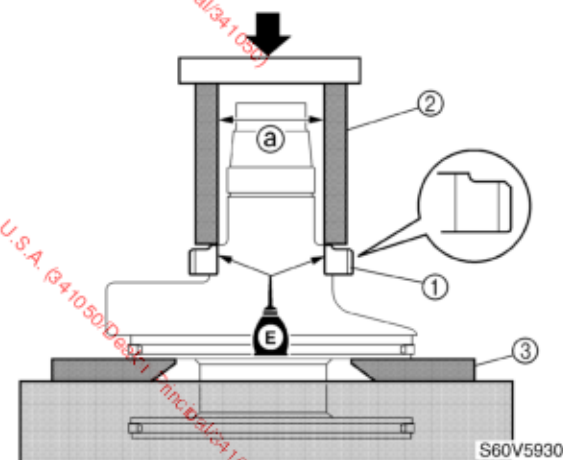
2. Measure the crankshaft runout. Replace the crankshaft if out of specification.



Crankshaft runout limit:
0.02 mm (0.0008 in)

Assembling the crankshaft

1. Install the oil pump drive gear **1**.

**CAUTION:**

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



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

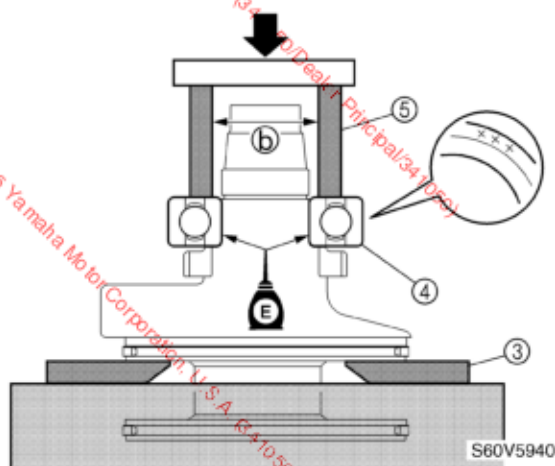
5

POWER



Power unit

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



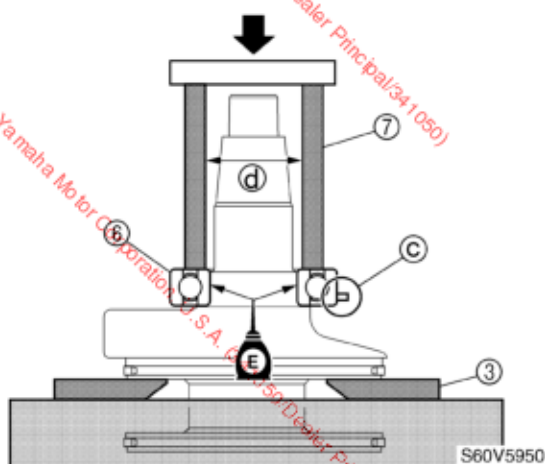
CAUTION:

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



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

3. Install the upper ball bearing ⑥.



CAUTION:

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

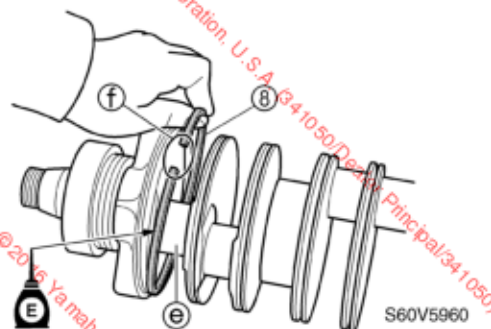
NOTE:

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



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

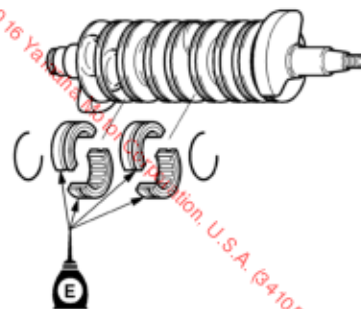
4. Install the seal rings ⑧.



NOTE:

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

5. Install the main bearings onto the crankshaft.

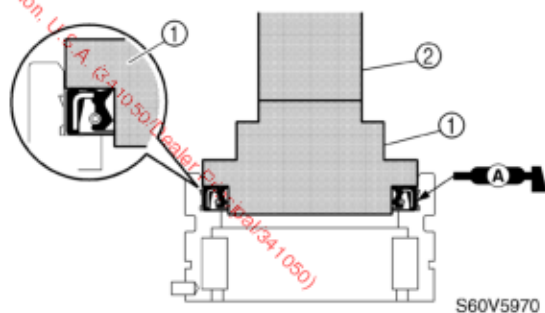



NOTE:

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

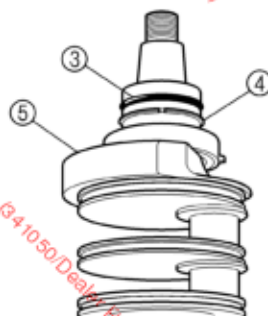
Assembling the crankshaft roller bearings

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



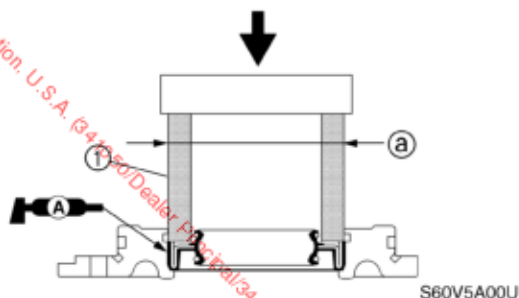
 Crank upper and lower seal installer ①:
YB-06244
Driver handle ②: YB-06071


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



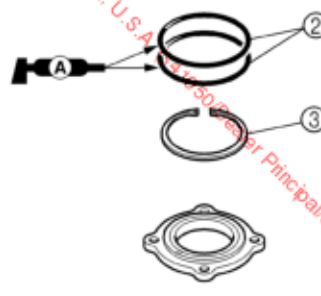
Assembling the oil seal housing

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



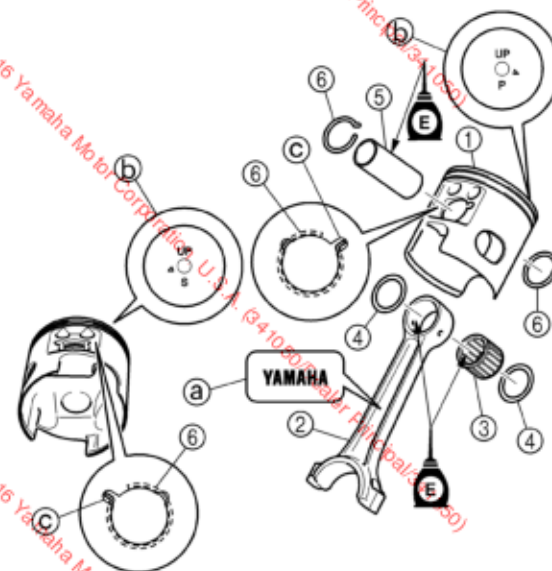
 General pipe ①:
① = 58 mm (2.28 in)

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



Assembling the piston and connecting rod assemblies

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

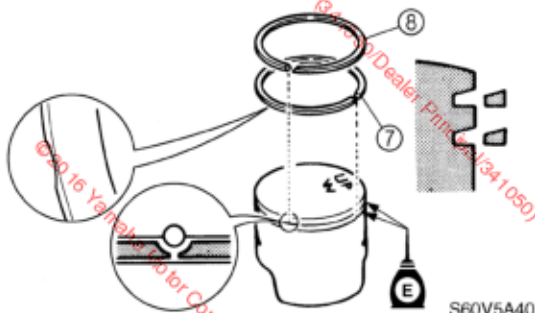


NOTE:

- Face the embossed "YAMAHA" mark (a) on the connecting rod in the same direction as the "UP" mark (b) on the piston.
- Always use new piston pin clips.
- Be sure to align the piston pin clip end with the piston pin slot (c).



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



CAUTION:

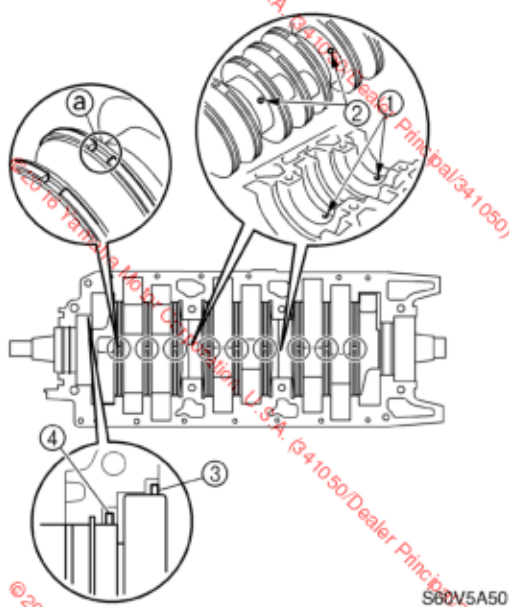
Do not scratch the pistons or break the piston rings.

NOTE:

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

Assembling the power unit

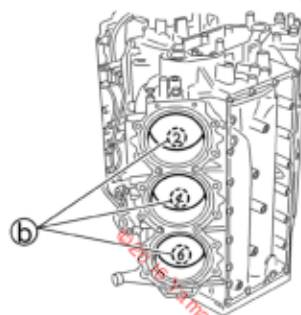
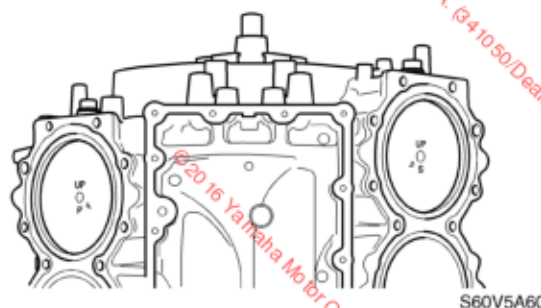
1. Set the crankshaft in the cylinder block.

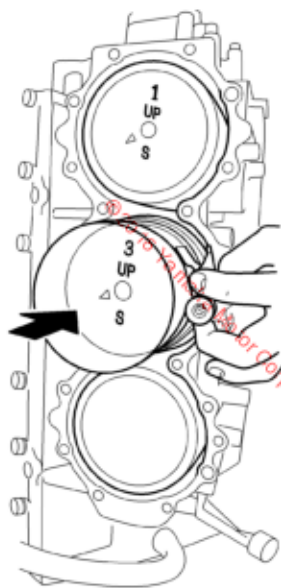


NOTE:

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

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





S60V5A80

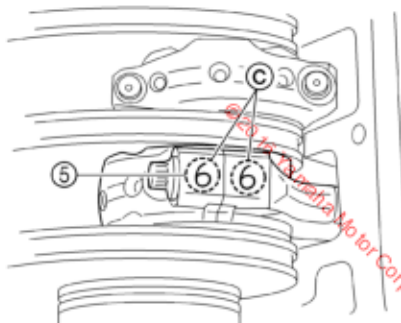
NOTE:

- Apply engine oil to the pistons and piston rings before installation.
- Be sure to install the piston and connecting rod assemblies into the corresponding cylinders according to the marks ① made during disassembly. Also, be sure to install the assemblies with an "S" mark on the starboard side, and the assemblies with a "P" mark on the port side.



Piston ring compressor: YM-08037

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



S60V5A90

NOTE:

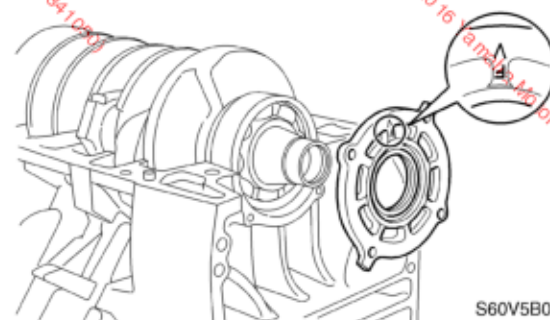
- Align the identification numbers ③ on the connecting rod caps and connecting rods, which you made during disassembly.
- Apply engine oil to the connecting rod bearings, connecting rod caps, and connecting rod bolts before installation.



Connecting rod bolt ⑤:

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

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

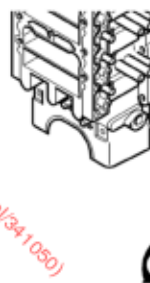


S60V5B00

NOTE:

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

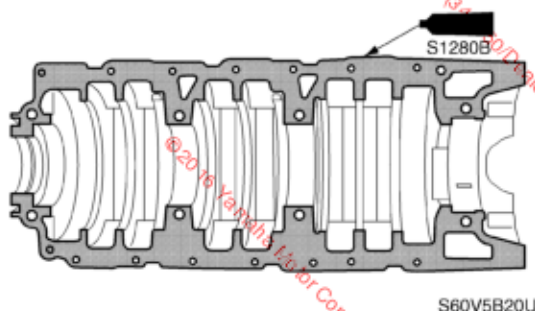
5. Install the oil pump driven gear onto the crankcase.



S60V5B10

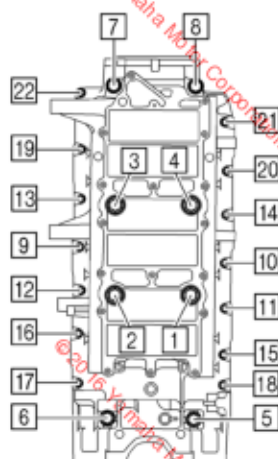
POWR**Power unit**

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

**NOTE:**

Do not get any sealant on the journals.

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

**NOTE:**

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

	1–8 Crankcase bolt (M10):
	1st: 17 N·m (1.7 kgf·m, 12.5 ft·lb)
	2nd: 34 N·m (3.4 kgf·m, 25.1 ft·lb)
	9–22 Crankcase bolt (M8):
	1st: 4 N·m (0.4 kgf·m, 3.0 ft·lb)
	2nd: 9 N·m (0.9 kgf·m, 6.6 ft·lb)



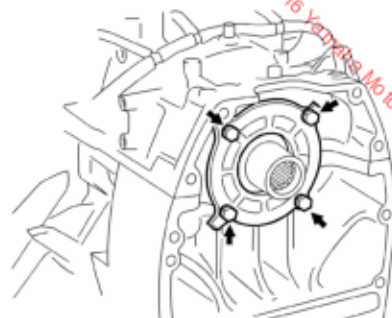
1–4 Crankcase bolt:

M10 × 130 mm

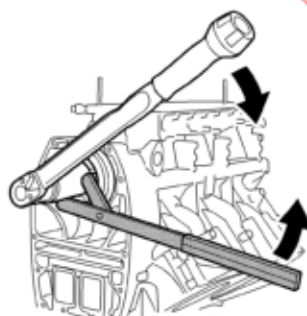
5–8 Crankcase bolt:

M10 × 90 mm

8. Tighten the oil seal housing bolts.



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

**CAUTION:**

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

NOTE:

Apply engine oil to the crankshaft and the crankshaft balancer nut before installation.



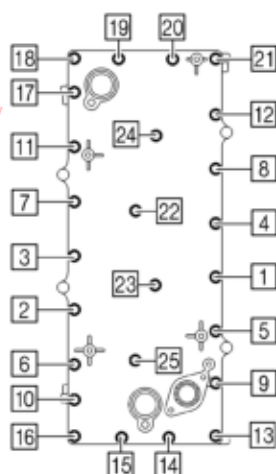
Flywheel magnet holder: YB-06139



Crankshaft balancer nut:

100 N·m (10 kgf·m, 73.8 ft·lb)

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



S60V5B60

NOTE:

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

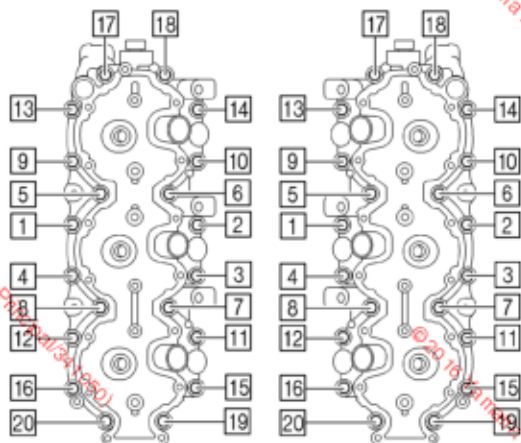


Exhaust outer cover bolt:

1st: 5 N·m (0.5 kgf·m, 3.7 ft·lb)

2nd: 11 N·m (1.1 kgf·m, 8.1 ft·lb)

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



S60V5B70

NOTE:

Apply engine oil to the cylinder head bolts before installation.



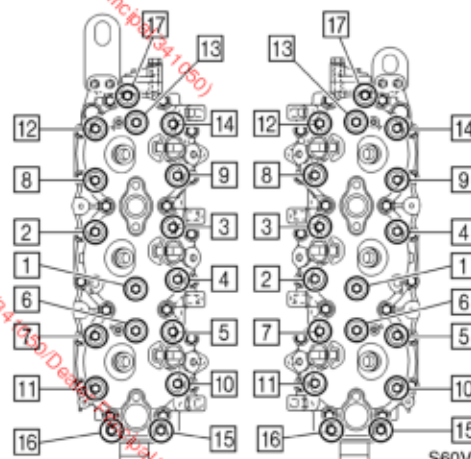
Cylinder head bolt:

1st: 15 N·m (1.5 kgf·m, 11.1 ft·lb)

2nd: 29 N·m (2.9 kgf·m, 21.4 ft·lb)

12. Install the thermostats onto the cylinder head.

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



S60V5B80

NOTE:

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



Cylinder head cover bolt:

1st: 5 N·m (0.5 kgf·m, 3.7 ft·lb)

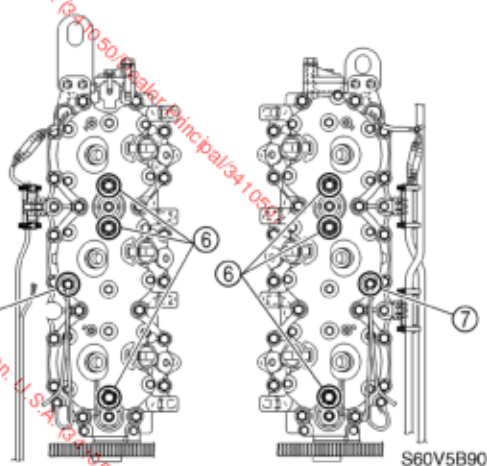
2nd: 11 N·m (1.1 kgf·m, 8.1 ft·lb)

POWR



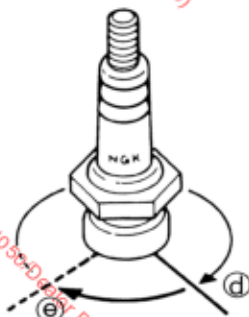
Power unit

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




S60V5B90

15. Install the spark plugs, tighten them finger tight ①, then to the specified torque with a spark plug wrench ②.

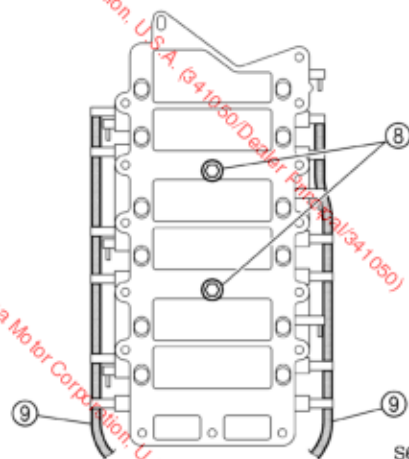


S60V5C00


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

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

17. Connect the hoses ⑨.



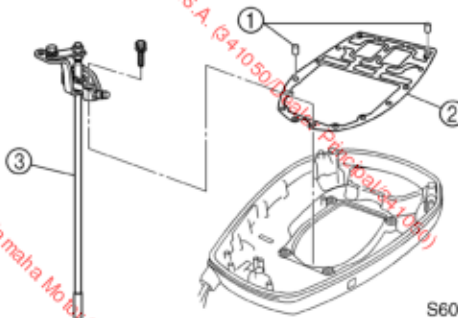
S60V5C10

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

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

Installing the power unit

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



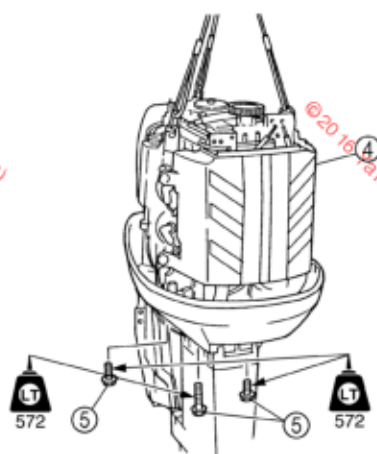
S60V5C20

CAUTION:

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

Cylinder block

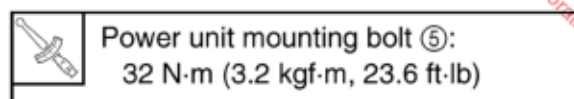
2. Install the power unit ④, and then tighten the power unit mounting bolts ⑤ to the specified torque.



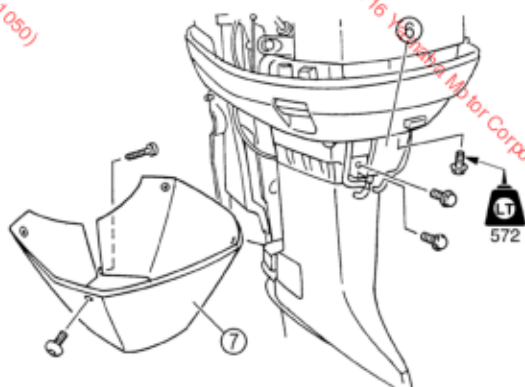
S6D05105

NOTE:

Replace or reuse the power unit mounting bolts. If reusing the power unit mounting bolts, be sure to completely remove any LOCTITE remaining on the bolts.

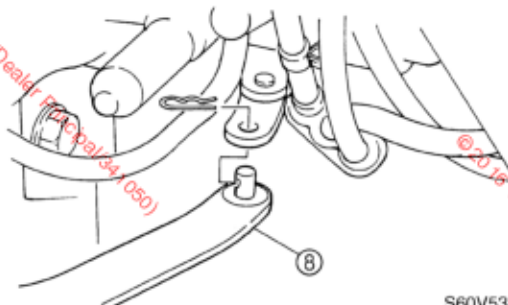


3. Install the hose joint assembly ⑥ and the apron ⑦.



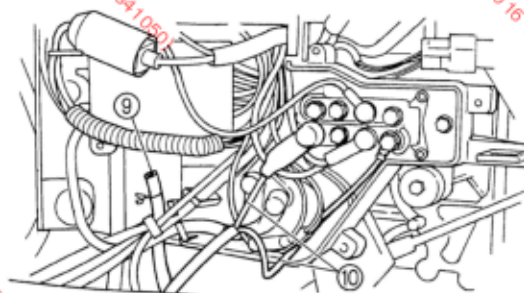
S6D05170

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

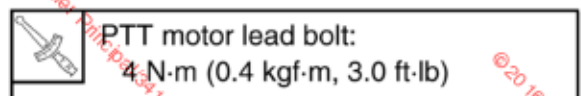


S60V5370

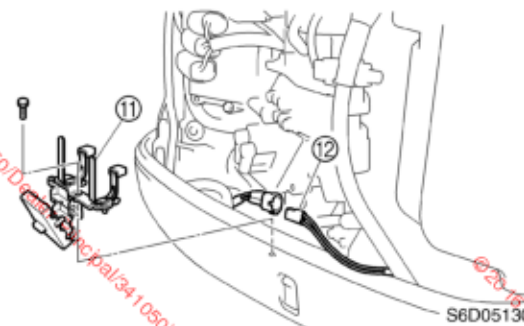
5. Connect the cooling water hose ⑨ to the Rectifier Regulator.
6. Connect the PTT motor leads ⑩, and then tighten the PTT motor lead bolts to the specified torque.



S60V5C50



7. Install the bracket ⑪ and connect the trim sensor coupler ⑫.



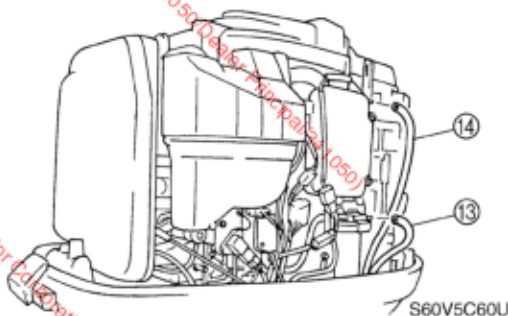
S6D05130U

5

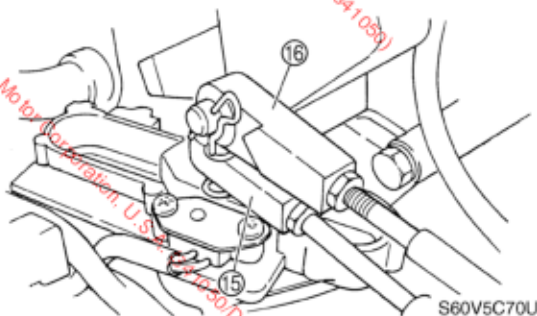


Power unit

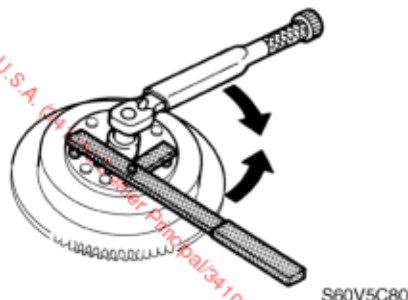
8. Install the junction box cover.
9. Connect the fuel hose ⑬ and oil hose ⑭.



10. Connect the shift cable ⑮ and throttle cable ⑯, and then adjust their lengths. For adjustment procedures, see Chapter 3, "Adjusting the throttle cable," and "Checking the gear shift operation."



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



CAUTION:

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

NOTE:

Apply engine oil to the flywheel magnet nut before installation.

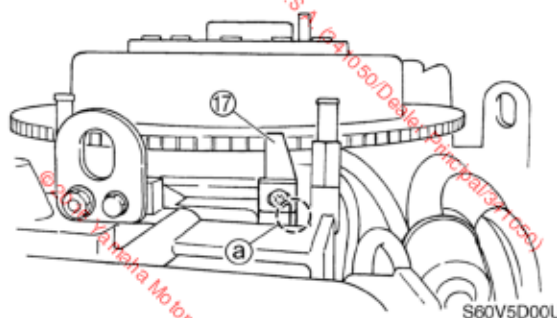


Flywheel magnet holder: YB-06139



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

13. Install the pointer ⑰.



NOTE:

Align the marks ② on the pointer ⑰, which you made during disassembly.

14. Install all removed parts.

— MEMO —



Lower unit

Special service tools 6-1

Lower unit (regular rotation model) 6-4

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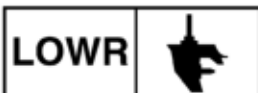
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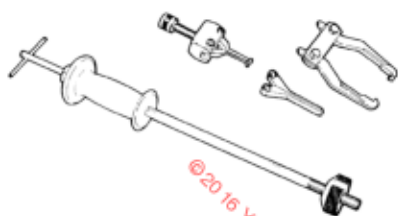
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Measuring the forward and reverse gear backlash	6-56



Lower unit

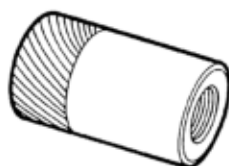
Special service tools



Slide hammer and adapters
YB-06096



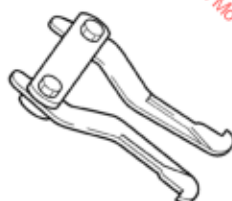
Drive shaft needle bearing remover and
installer
YB-06196



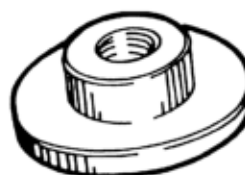
Propeller shaft and bearing housing
remover
YB-06335



Outer race installer-forward gear
YB-06085



Puller claw
YB-06523



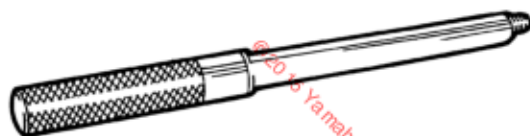
Forward bearing installer
YB-06430



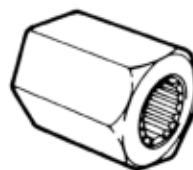
Oil seal installer
YB-06168



Bearing outer race attachment
YB-06109

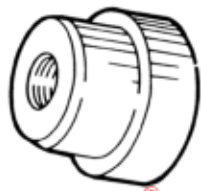


Driver handle
YB-06071

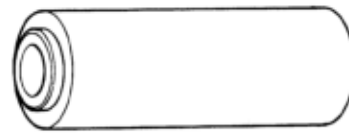


Drive shaft holder
YB-06201

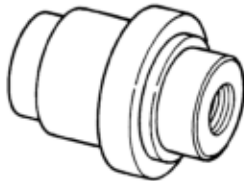
Special service tools



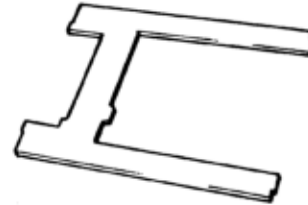
Roller bearing installer/remover
YB-06432



Pinion shimming gauge III
YB-06441



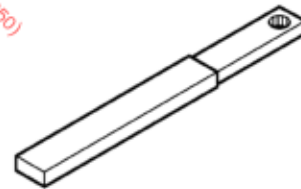
Needle bearing installer
YB-06435



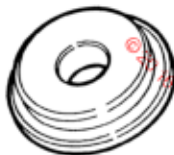
Shimming gauge I
YB-06439



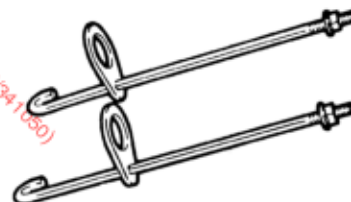
Pinion gear bushing installer
YB-06029-4



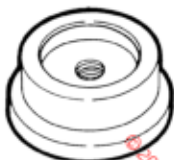
Shift rod push arm
YB-06052



Needle bearing remover and installer
YB-06213



Bearing housing puller
YB-06207

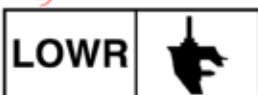


Taper roller bearing installer
YB-06431
Forward gear bearing cup installer
YB-06276-B



Universal puller
YB-06117

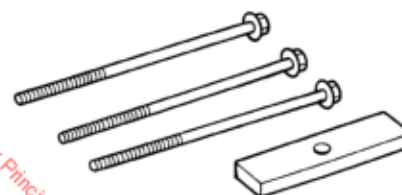
6



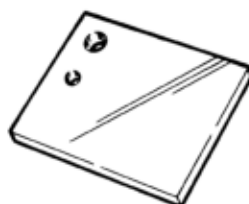
Lower unit



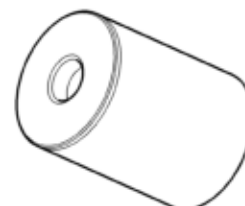
Backlash indicator gauge
YB-06265



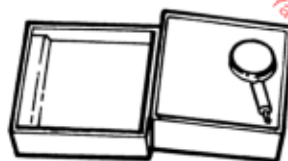
Puller bolt
YB-41707



Magnetic plate
YB-07003



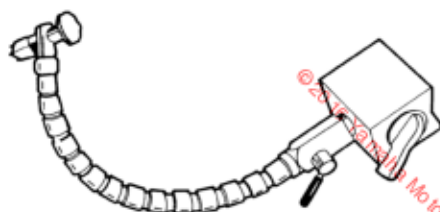
Shimming gauge
YB-06440-A



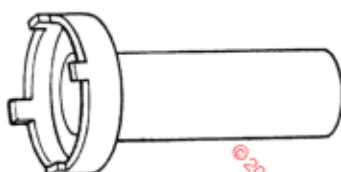
Dial gauge
YU-03097



Needle bearing installer
YB-06434

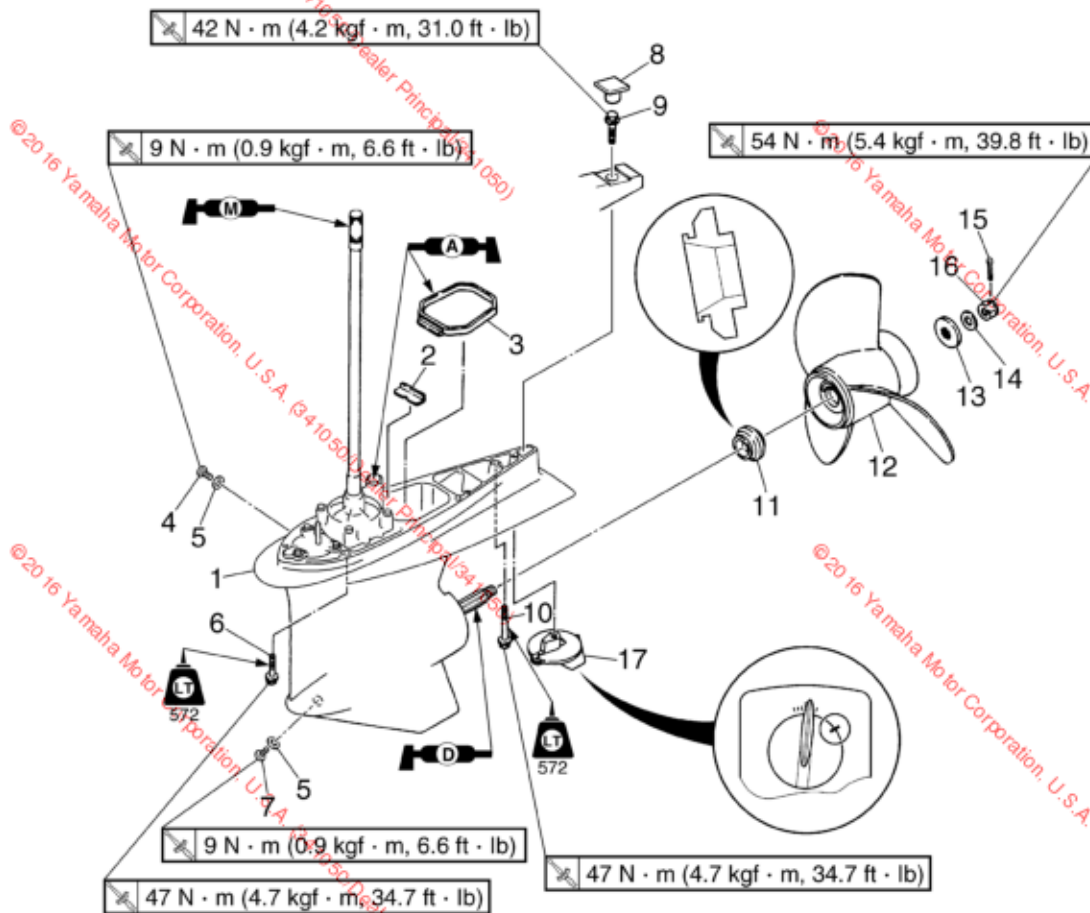


Magnetic flexible stand
YU-34481



Ring nut wrench
YB-06578

Lower unit (regular rotation model)



S60V6010

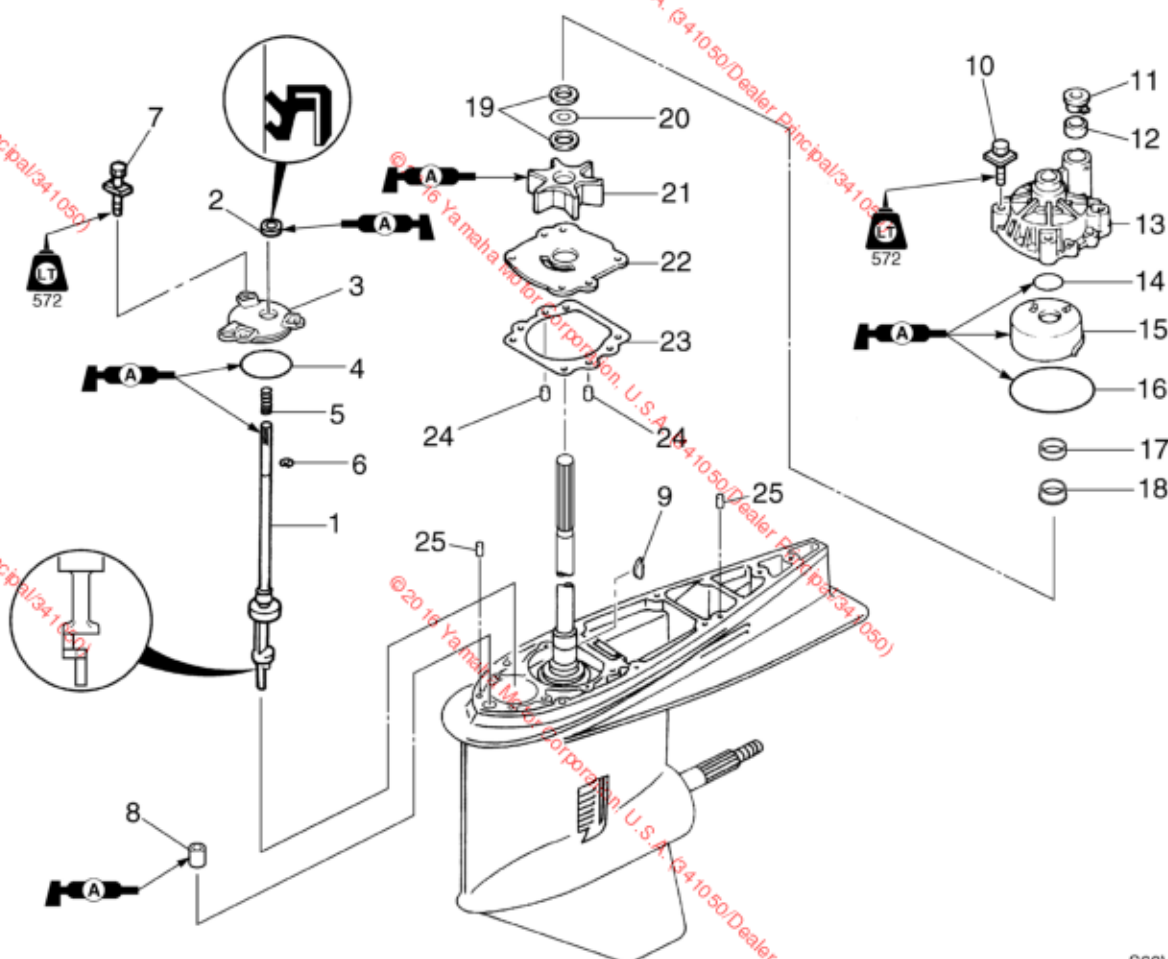
6

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

LOWR



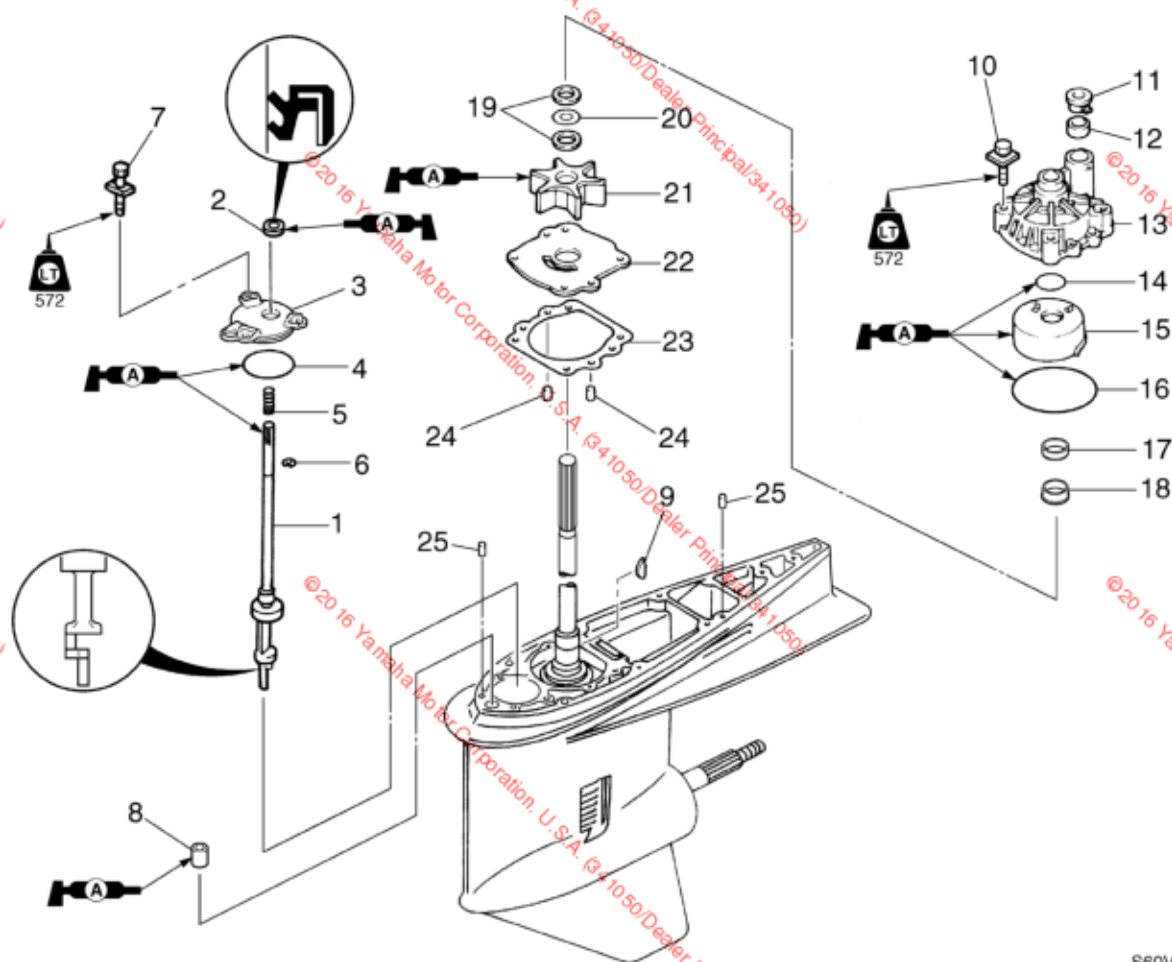
Lower unit



S60V6020

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

Lower unit (regular rotation model)



S60V6020

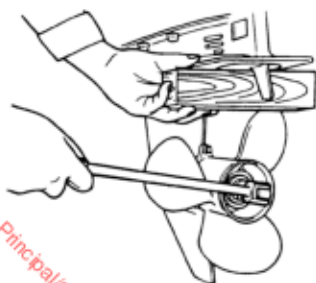
6

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



Removing the lower unit

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

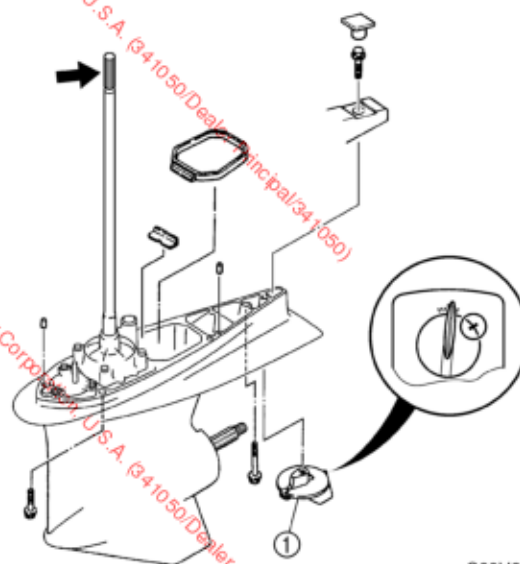


S69J6015

⚠ WARNING

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

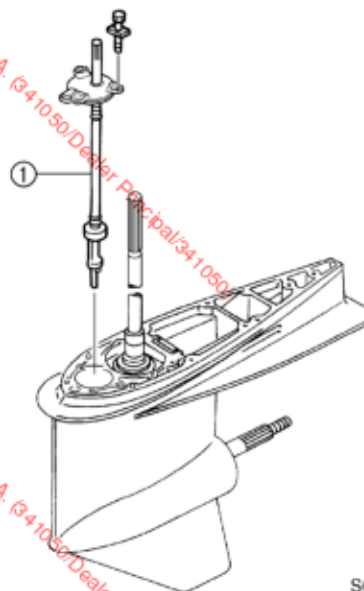
3. Mark the trim tab ① at the area shown, and then remove it.
4. Loosen the bolts, and then remove the lower unit from the upper case.



S60V6025

Removing the water pump and shift rod

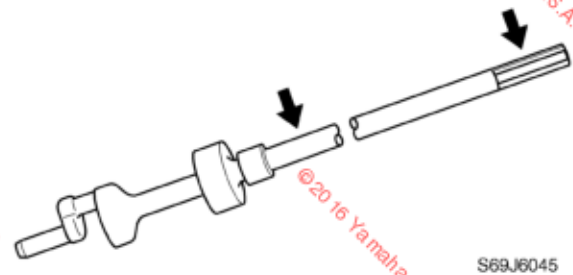
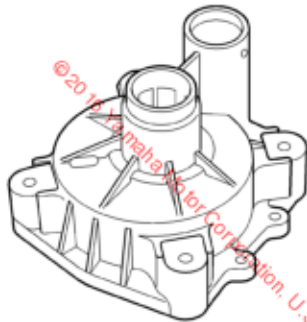
1. Remove the water pump assembly and shift rod assembly ①.



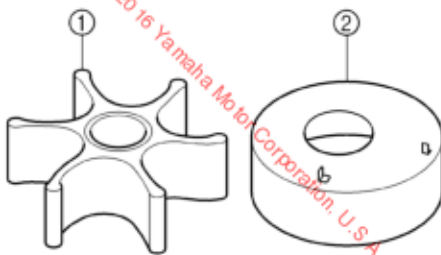
S60V6030

Checking the water pump and shift rod

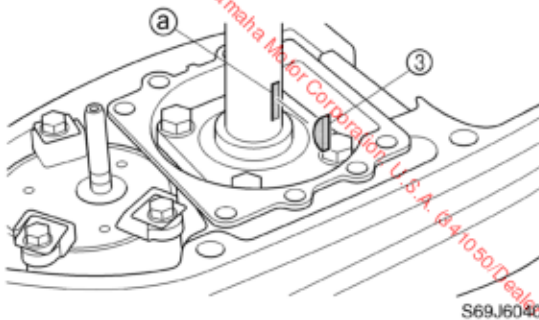
1. Check the water pump housing for deformation. Replace if necessary.



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



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



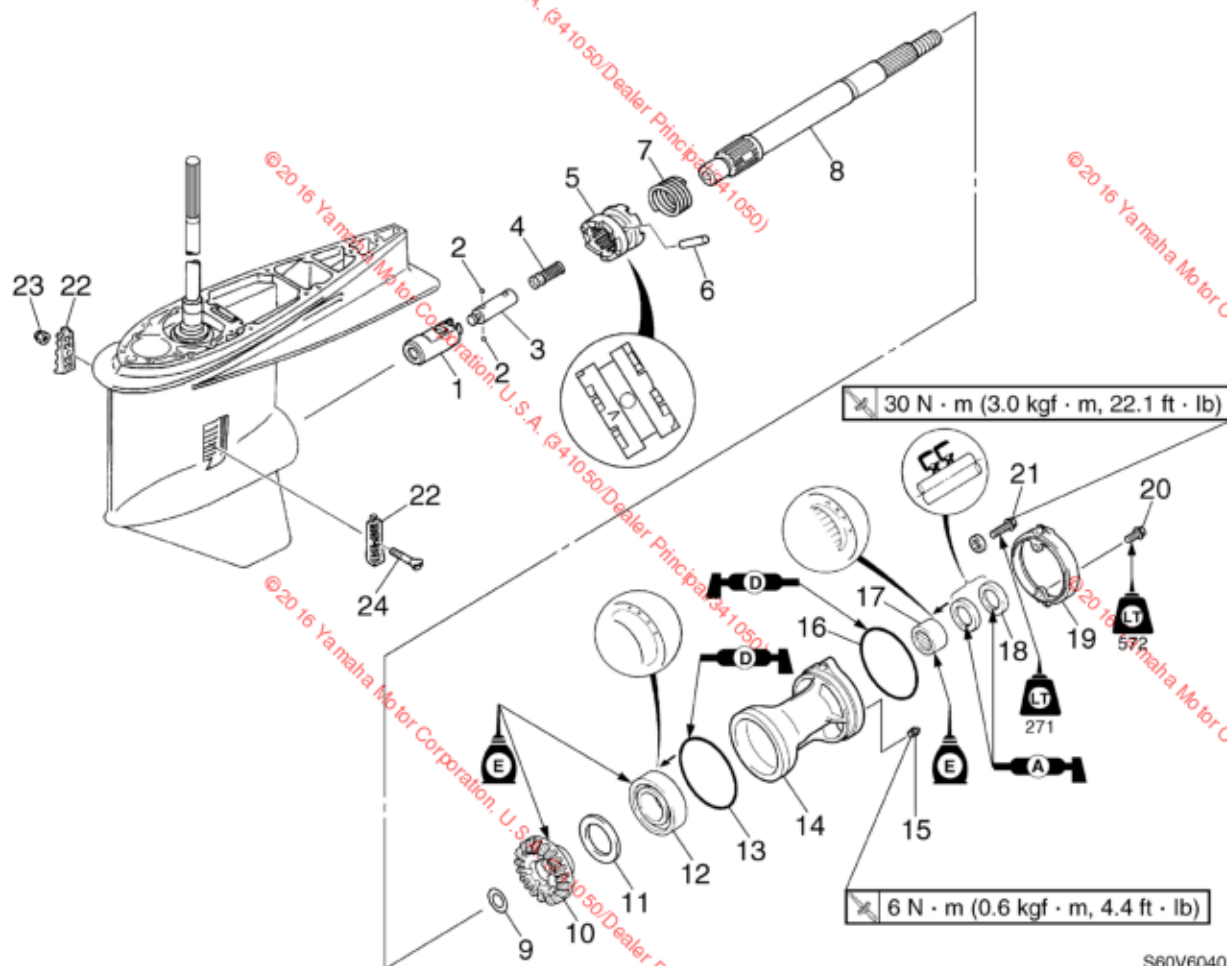
4. Check the shift rod for cracks or wear. Replace if necessary.

LOWR



Lower unit

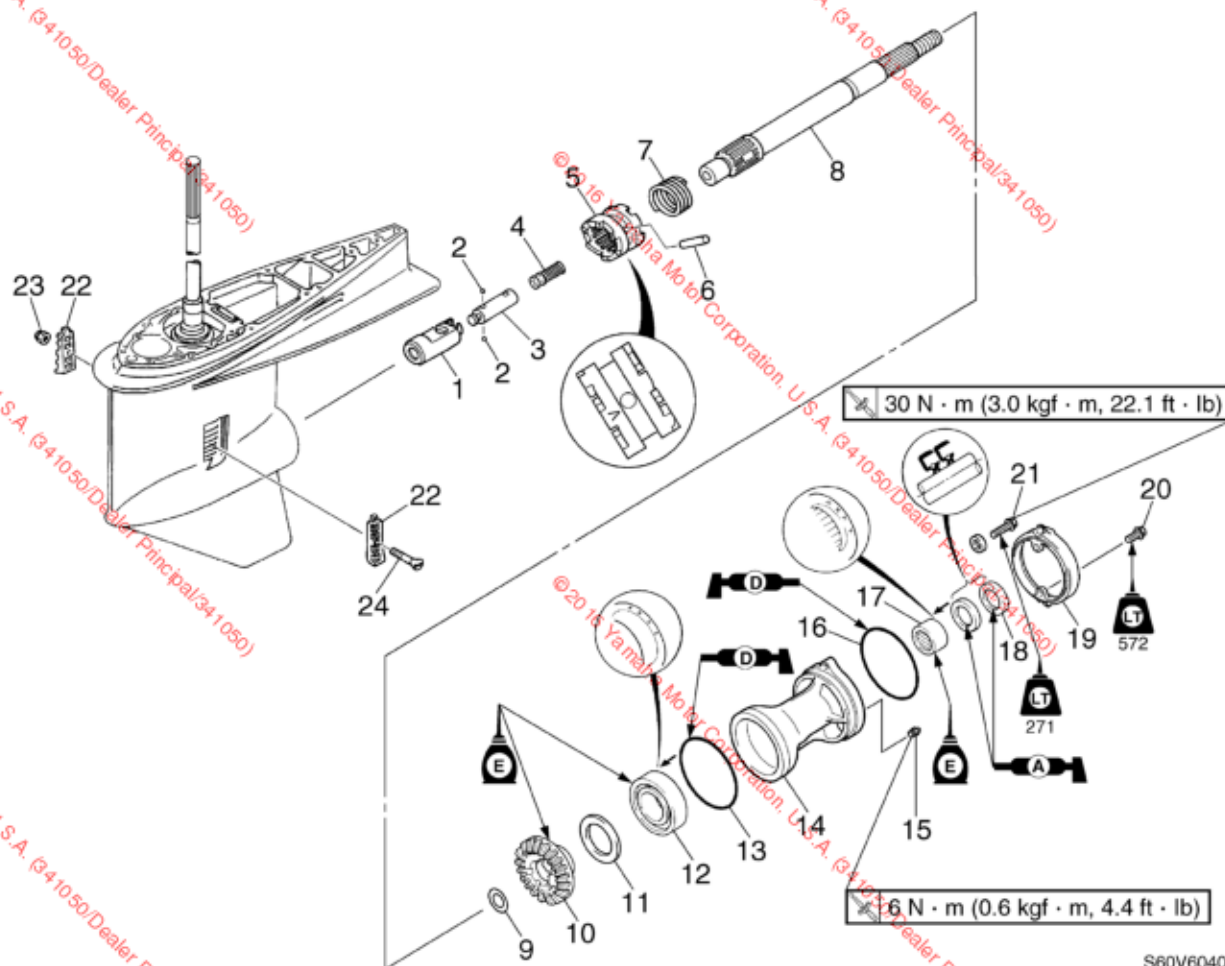
Propeller shaft housing (regular rotation model)



S60V6040

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

Propeller shaft housing (regular rotation model)



S60V6040

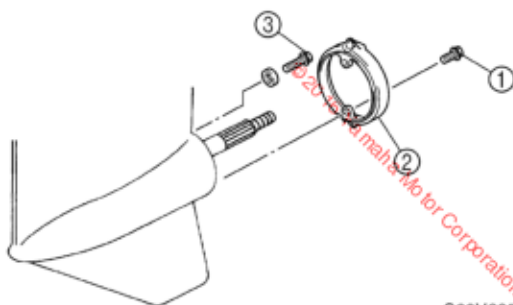
No.	Part name	Q'ty	Remarks
18	Oil seal	2	Not reusable
19	Ring	1	
20	Bolt	2	M8 × 20 mm
21	Bolt	2	M8 × 33 mm
22	Cooling water inlet cover	2	
23	Nut	1	
24	Screw	1	

6

LOWR**Lower unit**

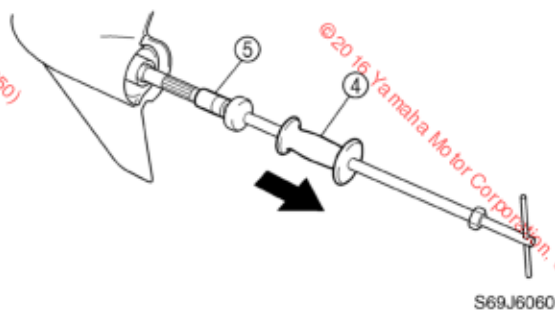
Removing the propeller shaft housing assembly

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



S60V6050

2. Pull out the propeller shaft housing assembly.



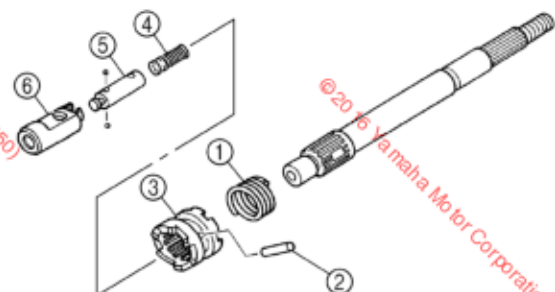
S69J6060



Slide hammer and adapters ④:
YB-06096
Propeller shaft and bearing housing
remover ⑤:
YB-06335

Disassembling the propeller shaft assembly

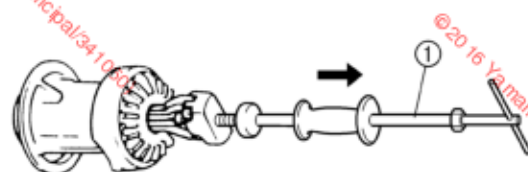
1. Remove the spring ①, then the cross pin ②, dog clutch ③, shift plunger ④, slider ⑤, and shift rod joint ⑥.



S69J6100

Disassembling the propeller shaft housing

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

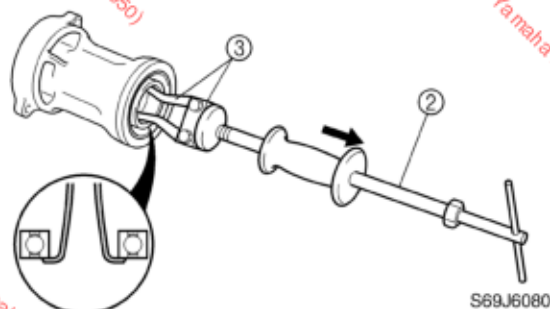


S69J6070



Slide hammer and adapters ①:
YB-06096

2. Remove the ball bearing.



S69J6080

CAUTION:

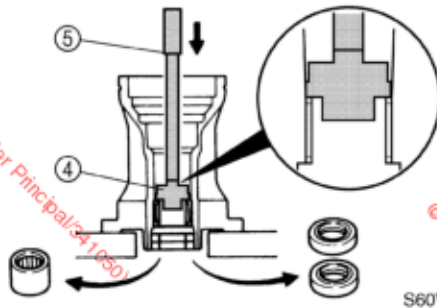
Do not reuse the bearing, always replace it with a new one.



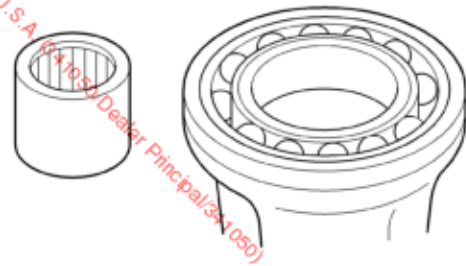
Slide hammer and adapters ②:
YB-06096
Puller claw ③: YB-06523

3. Remove the oil seals and needle bearing.

Propeller shaft housing (regular rotation model)



S60V6100



S69J6115



Oil seal installer ④: YB-06168

Driver handle ⑤: YB-06071

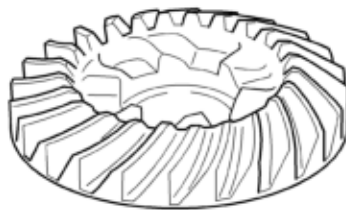
Checking the propeller shaft housing

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



S69J6105

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

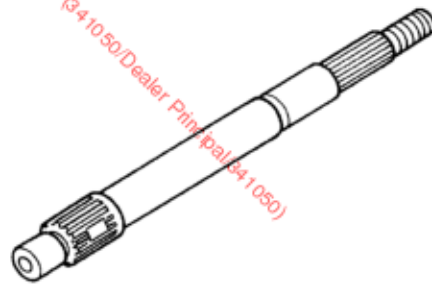


S69J6110

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

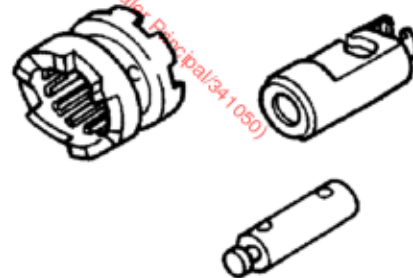
Checking the propeller shaft

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



S69J6120

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



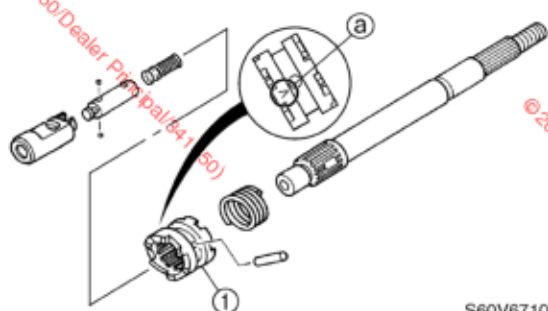
S69J6125

6

LOWR**Lower unit**

Assembling the propeller shaft assembly

1. Install the dog clutch ① as shown.



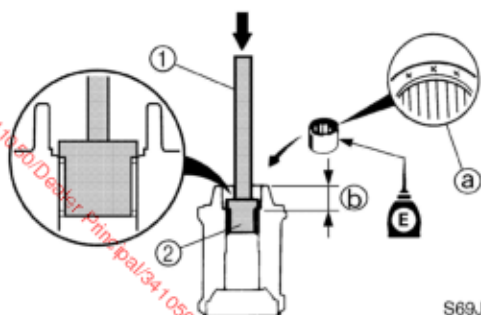
S60V6710

NOTE:

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

Assembling the propeller shaft housing

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



S69J6135

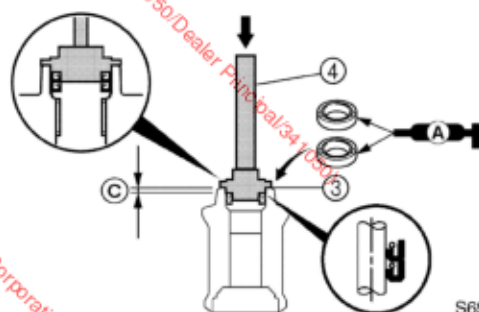
NOTE:

Install the needle bearing with the manufacture identification mark ② facing toward the oil seal (propeller side).

Driver handle ①: YB-06071
Drive shaft needle bearing remover and installer ②: YB06196

Depth ③: 25.05–25.55 mm (0.986–1.006 in)

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



S69J6145

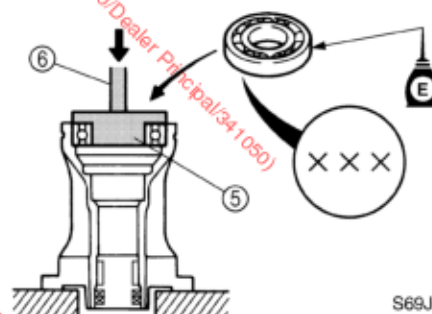
NOTE:

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

Oil seal installer ③: YB-06085
Driver handle ④: YB-06071

Depth ③: 4.75–5.25 mm (0.187–0.207 in)

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



S69J6155

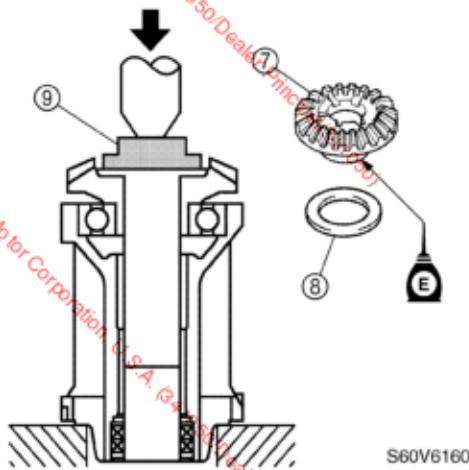
NOTE:

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

Forward bearing installer ⑤: YB-06430
Driver handle ⑥: YB-06071

Propeller shaft housing (regular rotation model)

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

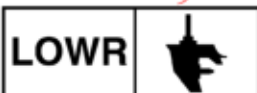


CAUTION:

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

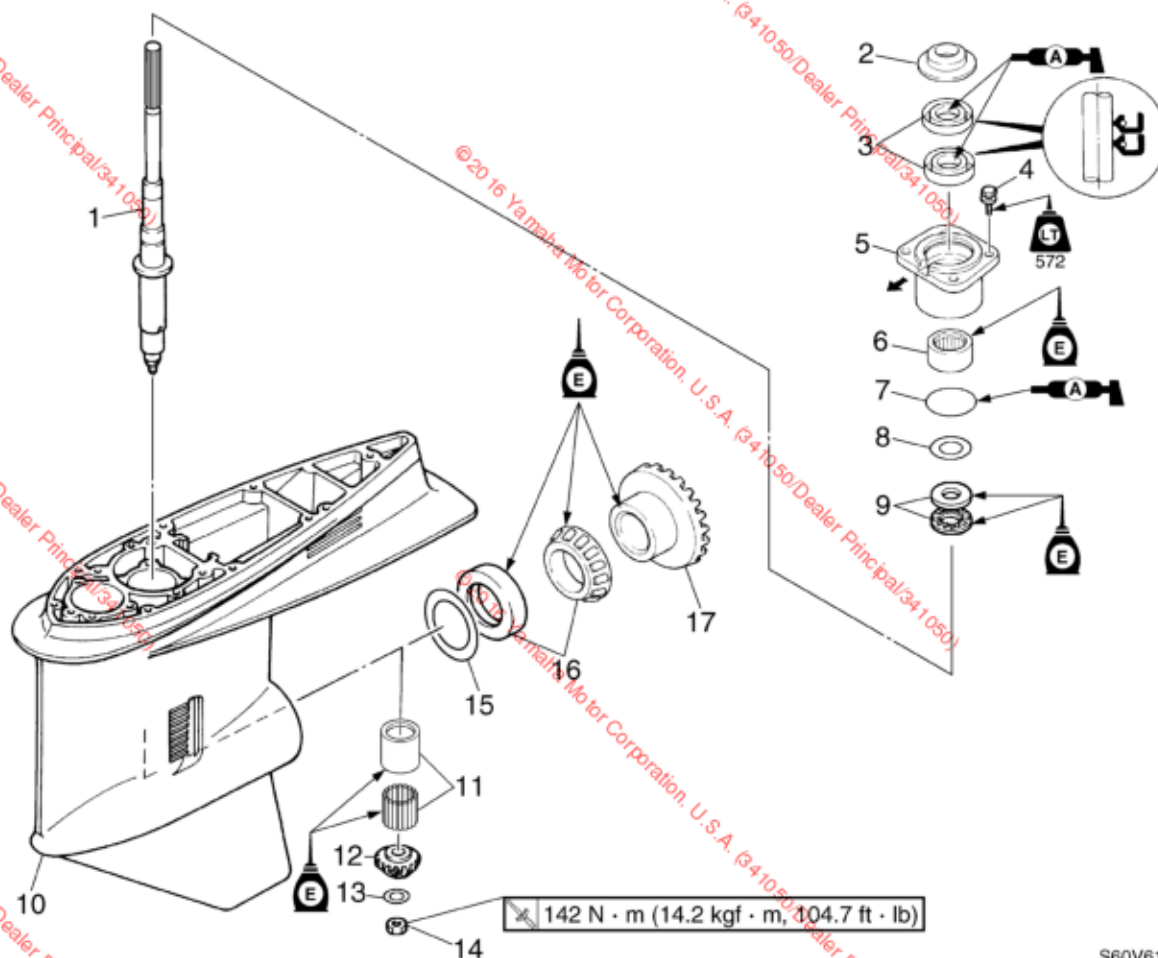


Bearing outer race attachment ⑨:
YB-06109



Lower unit

Drive shaft and lower case (regular rotation model)



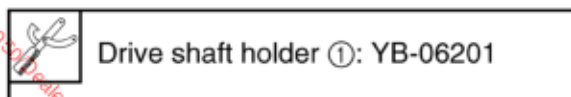
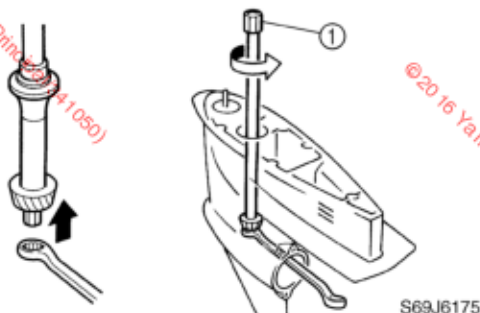
S60V6180U

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

Drive shaft and lower case (regular rotation model)

Removing the drive shaft

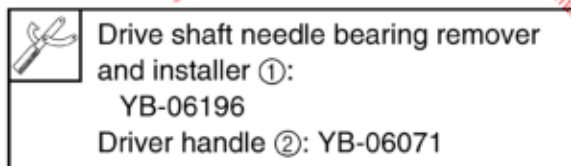
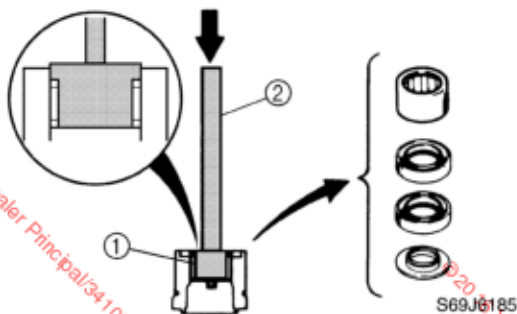
1. Remove the drive shaft, drive shaft housing, and pinion, and then pull out the forward gear.



Drive shaft holder ①: YB-06201

Disassembling the drive shaft housing

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



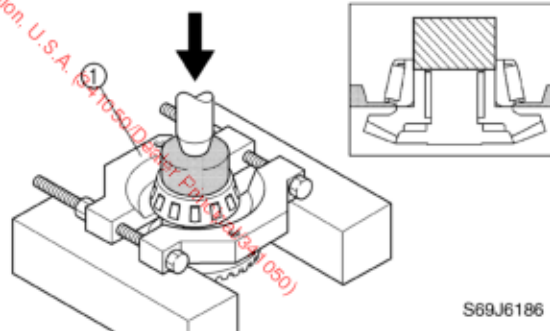
Drive shaft needle bearing remover and installer ①:

YB-06196

Driver handle ②: YB-06071

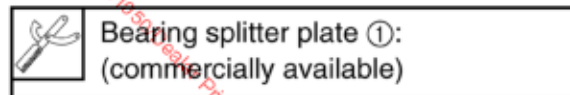
Disassembling the forward gear

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



CAUTION:

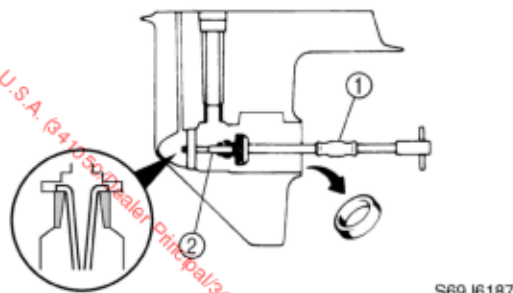
Do not reuse the bearing, always replace it with a new one.



Bearing splitter plate ①:
(commercially available)

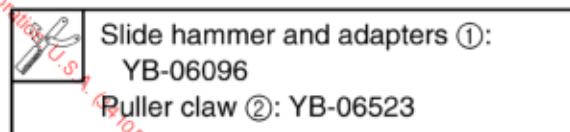
Disassembling the lower case

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



NOTE:

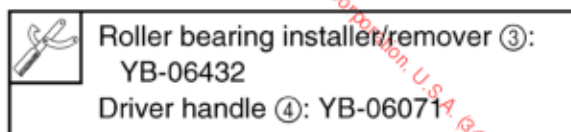
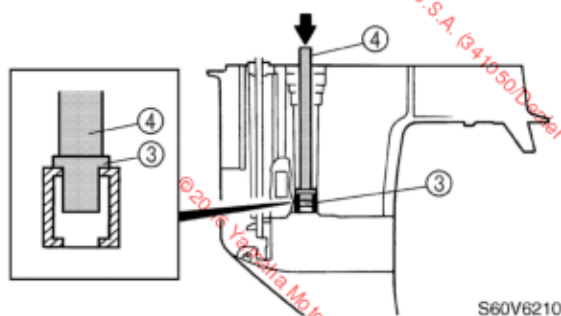
Install the claws as shown.



Slide hammer and adapters ①:
YB-06096
Puller claw ②: YB-06523

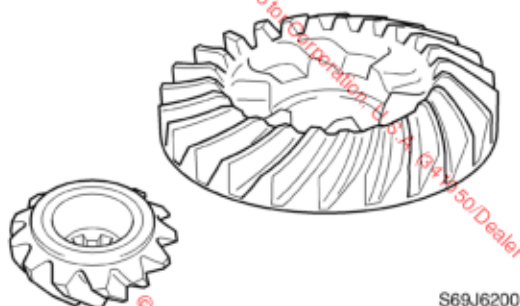
LOWR**Lower unit**

2. Remove the needle bearing.



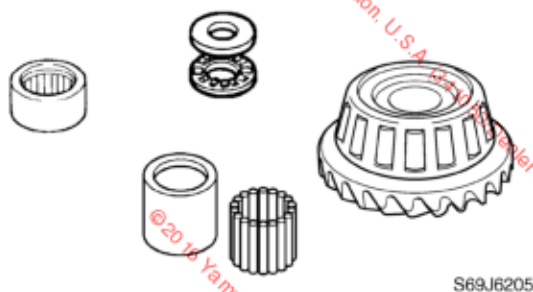
Checking the pinion and forward gear

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



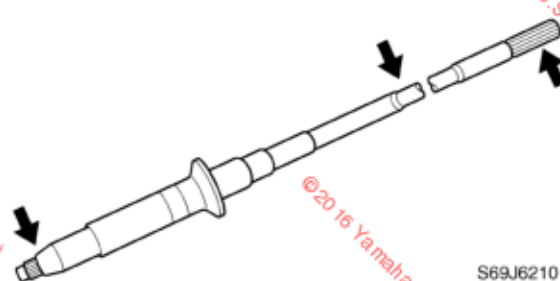
Checking the bearings

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



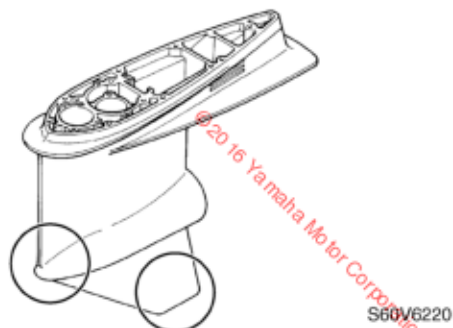
Checking the drive shaft

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



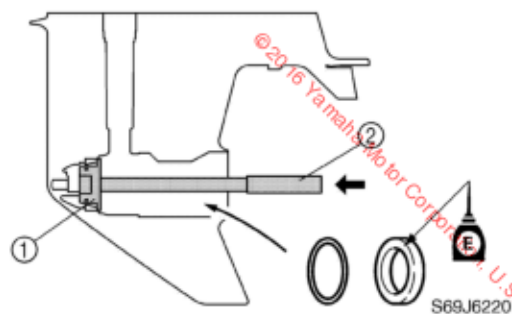
Checking the lower case

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



Assembling the lower case

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



CAUTION:

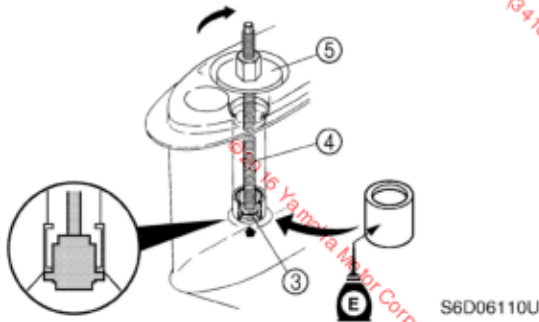
Add or remove shim(s), if necessary, if replacing the forward gear or lower case.



Taper roller bearing installer (1):
YB-06431
Driver handle (2): YB-06071

Drive shaft and lower case (regular rotation model)

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



NOTE:

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



Needle bearing installer ③:
YB-06435
Pinion gear bushing installer ④:
YB-06029-4
Needle bearing remover and
installer ⑤:
YB-06213

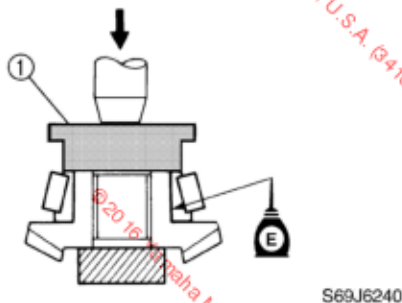
3. Install the needle bearing into the needle bearing outer case.

NOTE:

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

Assembling the forward gear

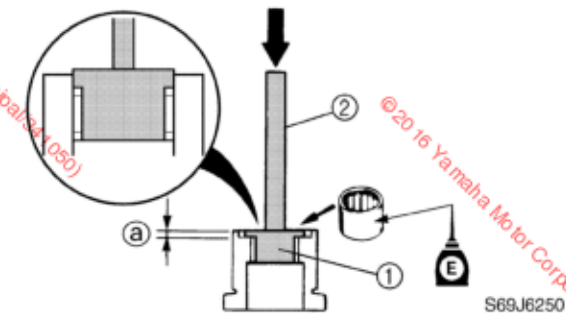
1. Install a new taper roller bearing into the forward gear using a press.



Forward gear bearing cup
installer ①:
YB-06276-B

Assembling the drive shaft housing

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

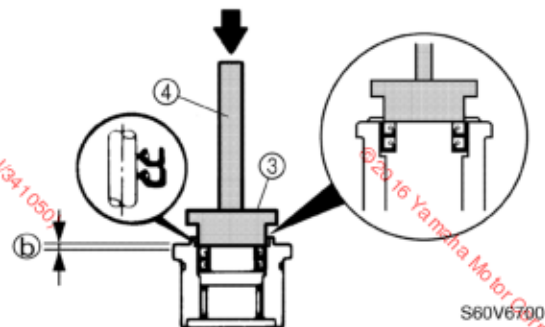


Drive shaft needle bearing remover
and installer ①:
YB-06196
Driver handle ②: YB-06071



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

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



NOTE:

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



Oil seal installer ③: YB-06085
Driver handle ④: YB-06071

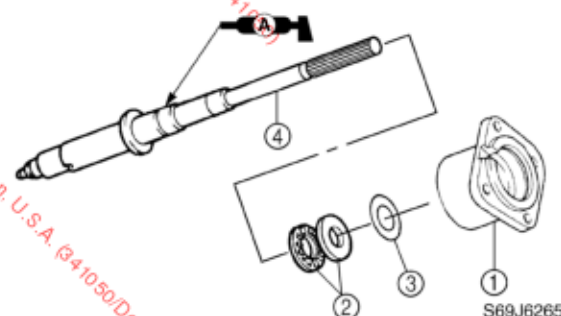


Depth ②:
0.25–0.75 mm (0.01–0.03 in)

LOWR**Lower unit**

Installing the drive shaft

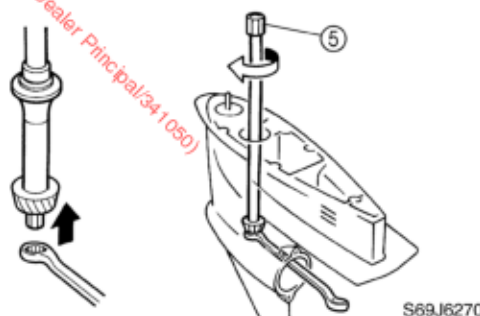
1. Install the forward gear into the lower case.
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ onto the drive shaft ④.



CAUTION:

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

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



NOTE:

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



Drive shaft holder ⑤: YB-06201

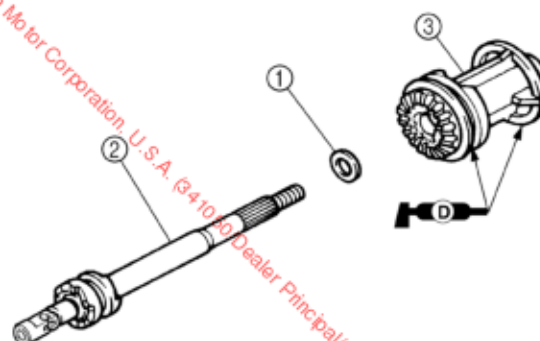


Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

4. Tighten the drive shaft housing bolts.

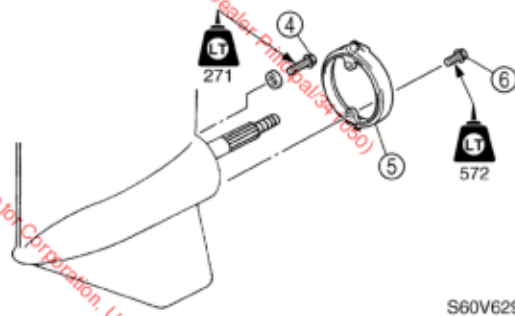
Installing the propeller shaft housing

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



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

4. Install the ring ⑤ and bolts ⑥.

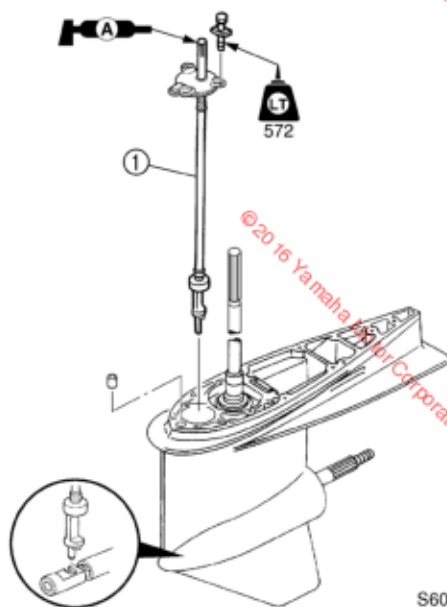


Propeller shaft housing bolt ④:
30 N·m (3.0 kgf·m, 22.1 ft·lb)

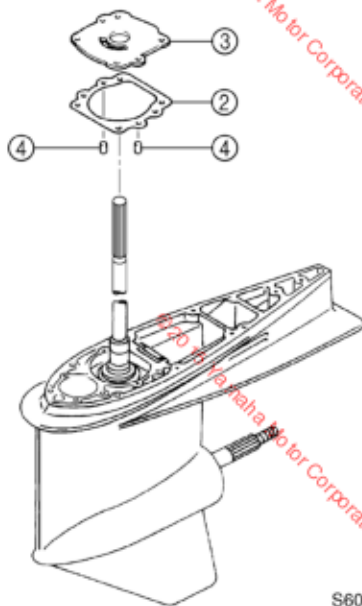
Installing the water pump and shift rod

1. Install the shift rod assembly ①.

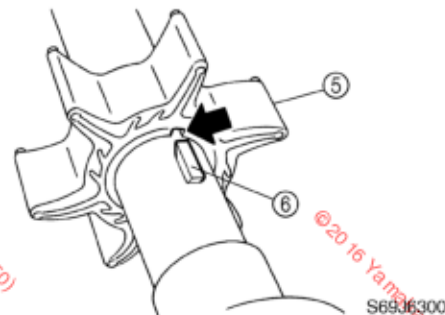
Drive shaft and lower case (regular rotation model)



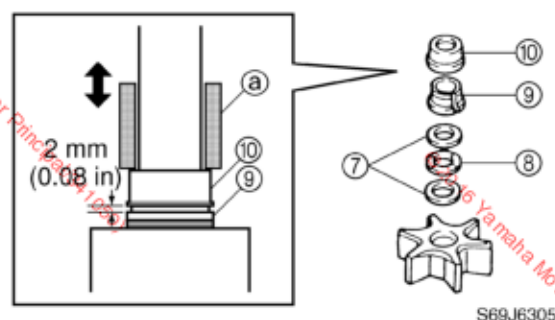
2. Install a new gasket (2), the outer plate cartridge (3), and dowels (4).



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



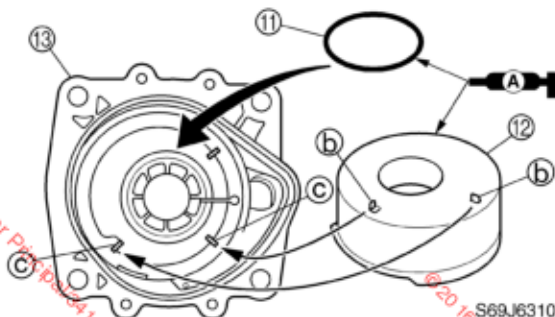
5. Install the washers (7), wave washer (8), spacer (9), and collar (10) onto the drive shaft.



NOTE:

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

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

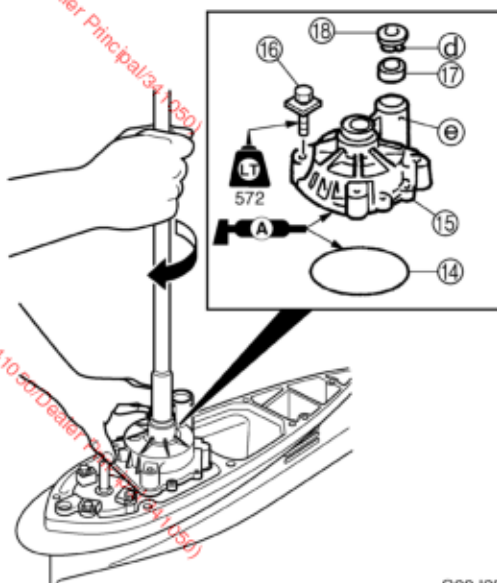


NOTE:

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

LOWR**Lower unit**

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



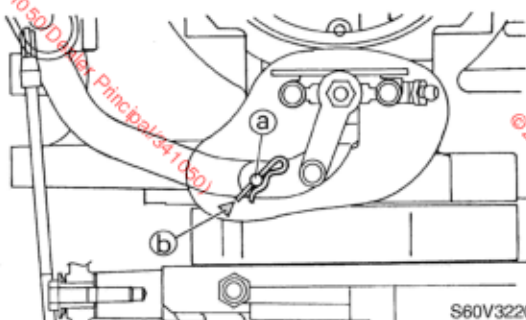
S69J6315

NOTE:

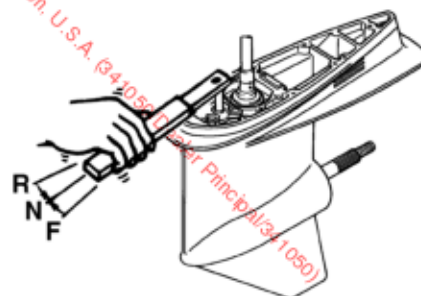
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ④ with the hole ⑤ in the pump housing.

Installing the lower unit

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



S60V3220

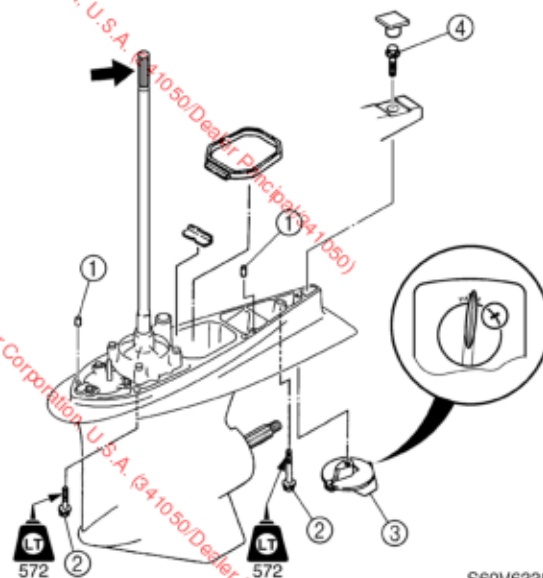


S60V6320



Shift rod push arm: YB-06052

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



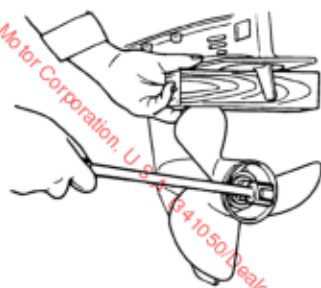
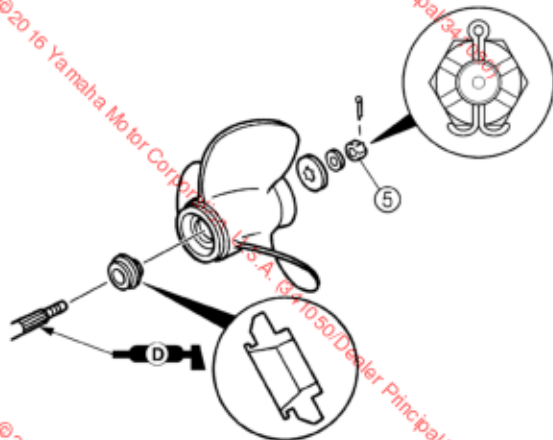
S60V6335



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

Drive shaft and lower case (regular rotation model)

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.



⚠ WARNING

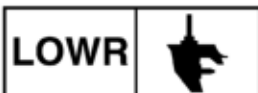
- Do not hold the propeller with your hands when loosening or tightening it.
- Be sure to disconnect the battery leads from the battery and the clip from the engine stop lanyard switch.
- Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.

NOTE:

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

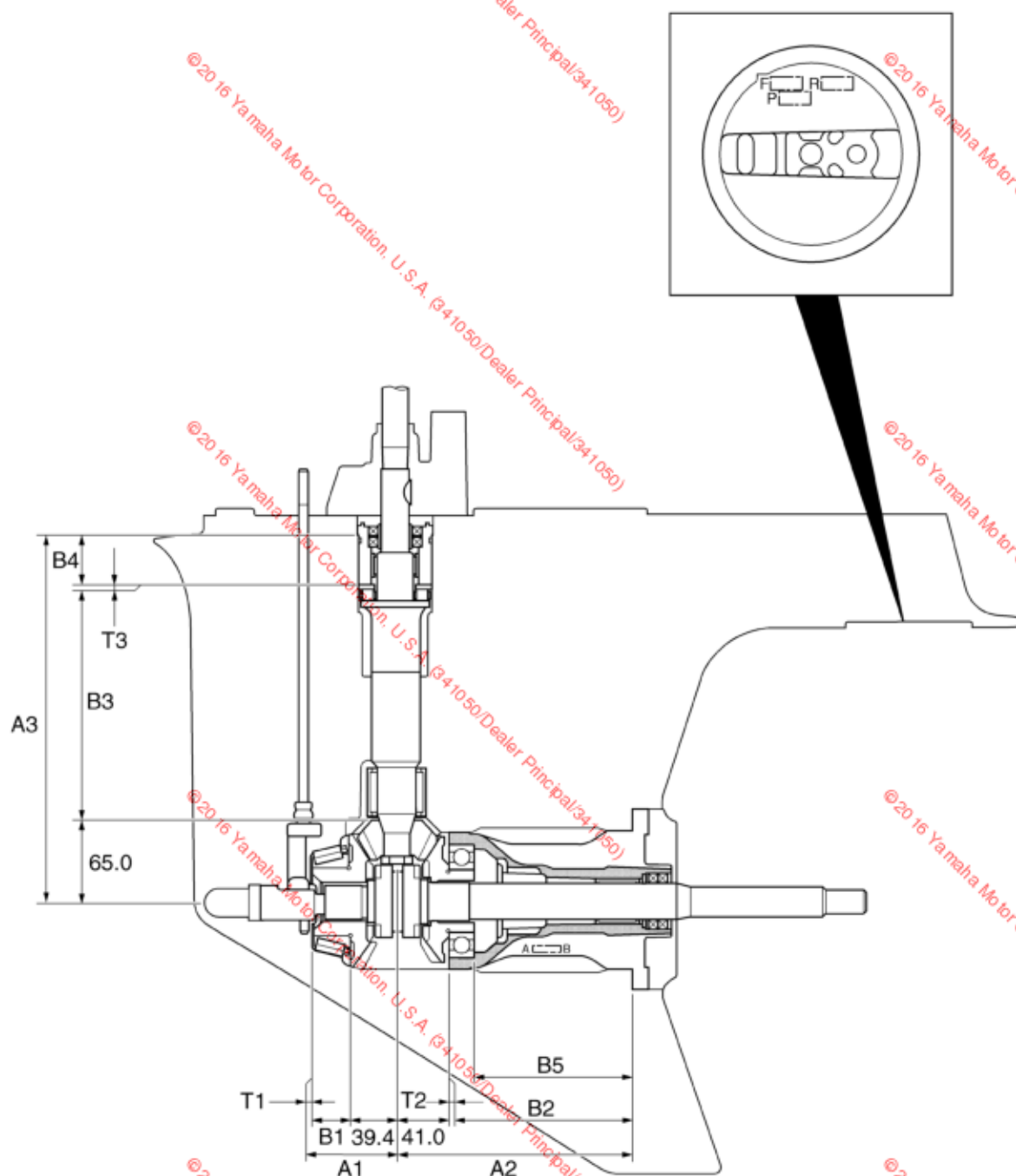


Propeller nut (5):
54 N·m (5.4 kgf·m, 39.8 ft·lb)



Lower unit

Shimming (regular rotation model)



S6D06020

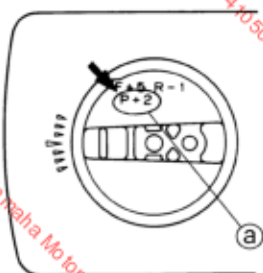
Shimming

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. Calculate the specified value (M0) as shown in the examples below.



S69J6555

NOTE:

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

Calculation formula:

$$\text{Specified value (M0)} = 1.00 + P/100 \text{ mm}$$

Example:

If "P" is (+5), then

$$\begin{aligned} M0 &= 1.00 + (+5)/100 \text{ mm} = 1.00 + 0.05 \text{ mm} \\ &= 1.05 \text{ mm} \end{aligned}$$

If "P" is (-3), then

$$\begin{aligned} M0 &= 1.00 + (-3)/100 \text{ mm} = 1.00 - 0.03 \text{ mm} \\ &= 0.97 \text{ mm} \end{aligned}$$

2. Install the drive shaft ①, thrust bearing ②, and drive shaft housing ③ onto the special service tool.

Shimming (regular rotation model)

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

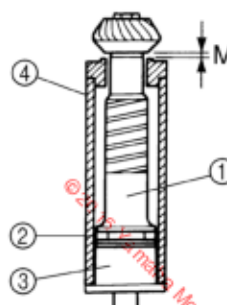


Pinion shimming gauge III ④:
YB-06441



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

4. Measure the clearance (M) between the special service tool and the pinion as shown.



S69J6560

NOTE:

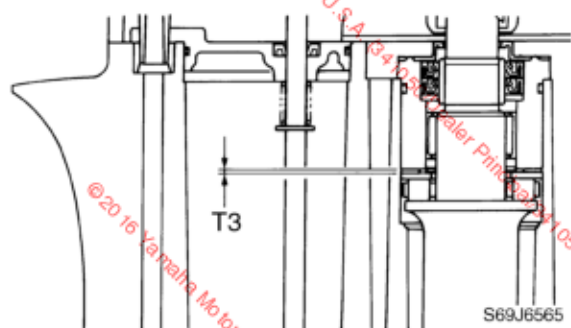
Measure the pinion at three points to find the clearance average.

LOWR



Lower unit

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



NOTE:

The sum of T3 and M should not be more than M0.

Calculation formula:

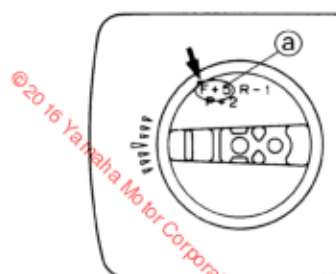
$$\text{Pinion shim thickness (T3)} = M0 - M$$

Available shim thicknesses:

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

Selecting the forward gear shims

1. Calculate the specified value (M0) as shown in the examples below.



NOTE:

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

Calculation formula:

$$\text{Specified value (M0)} = 0.50 - F/100 \text{ mm}$$

Example:

If "F" is (+5), then

$$M0 = 0.50 - (+5)/100 \text{ mm} = 0.50 - 0.05 \text{ mm} = 0.45 \text{ mm}$$

If "F" is (-3), then

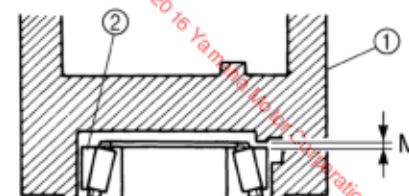
$$M0 = 0.50 - (-3)/100 \text{ mm} = 0.50 + 0.03 \text{ mm} = 0.53 \text{ mm}$$

2. Set the special service tool on the taper roller bearing.



Shimming gauge I ①: YB-06439

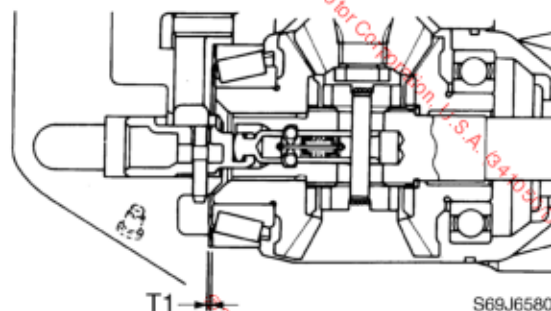
3. Measure the clearance (M) between the special service tool and the bearing outer race ② as shown.



NOTE:

Measure the taper roller bearing at three points to find the clearance average.

4. Select the forward gear shim(s) (T1).



NOTE:

The sum of T1 and M0 should not be more than M.

Shimming (regular rotation model)

Calculation formula:

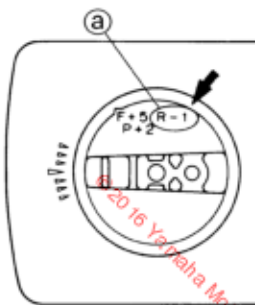
$$\text{Forward gear shim thickness (T1)} = M - M0$$

Available shim thicknesses:

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

Selecting the reverse gear shims

1. Calculate the specified value (M0) as shown in the examples below.



S69J6585

NOTE:

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

Calculation formula:

$$\text{Specified value (M0)} = 0.50 - R/100 \text{ mm}$$

Example:

If "R" is (+5), then

$$M0 = 0.50 - (+5)/100 \text{ mm} = 0.50 - 0.05 \text{ mm} = 0.45 \text{ mm}$$

If "R" is (-3), then

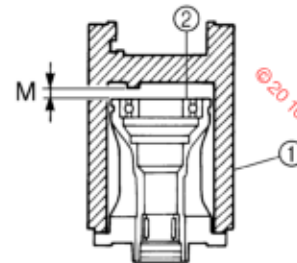
$$M0 = 0.50 - (-3)/100 \text{ mm} = 0.50 + 0.03 \text{ mm} = 0.53 \text{ mm}$$

2. Set the special service tool on the ball bearing.



Shimming gauge I (1): YB-06439

3. Measure the clearance (M) between the special service tool and the ball bearing (2) as shown.

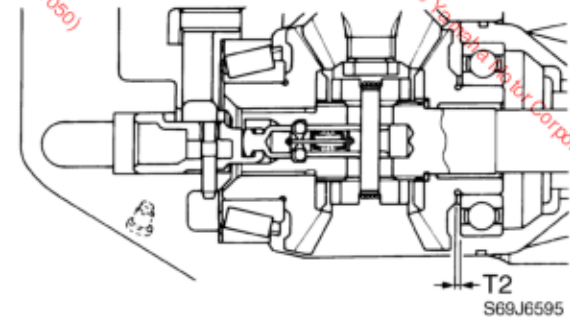


S69J6590

NOTE:

Measure the ball bearing at three points to find the clearance average.

4. Select the reverse gear shim(s) (T2).



S69J6595

NOTE:

The sum of T2 and M0 should not be more than M.

Calculation formula:

$$\text{Reverse gear shim thickness (T2)} = M - M0$$

Available shim thicknesses:

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

LOWR



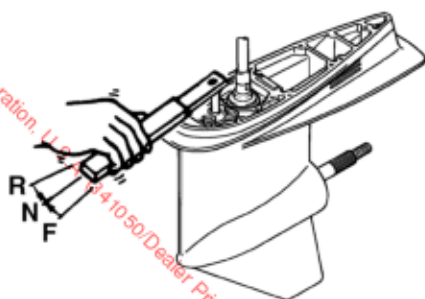
Lower unit

Backlash

(regular rotation model)

Measuring the forward and reverse gear backlash

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

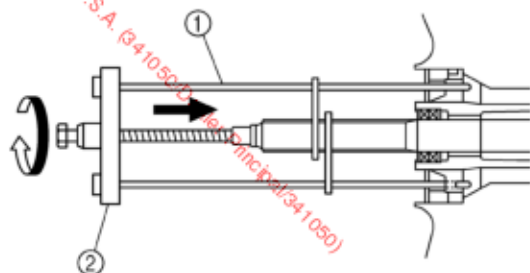


S60V6320



Shift rod push arm: YB-06052

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



S69J6640

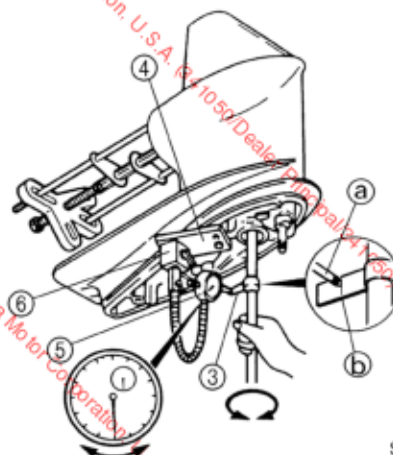
NOTE:

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



Bearing housing puller ①: YB-06207
Universal puller ②: YB-06117

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



S60V6530

NOTE:

Install the dial gauge so that the plunger (a) contacts the mark (b) on the backlash indicator.



Backlash indicator gauge ③:

YB-06265

Magnetic plate ④: YB-07003

Dial gauge ⑤: YU-03097

Magnetic flexible stand ⑥:

YU-34481

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



Forward gear backlash:

0.13–0.42 mm (0.0051–0.0165 in)

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

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

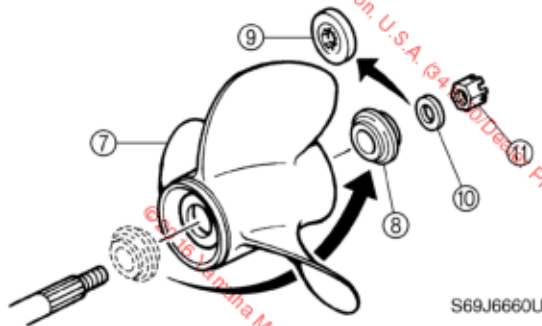
M: Measurement

Backlash (regular rotation model)

Available shim thicknesses:

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

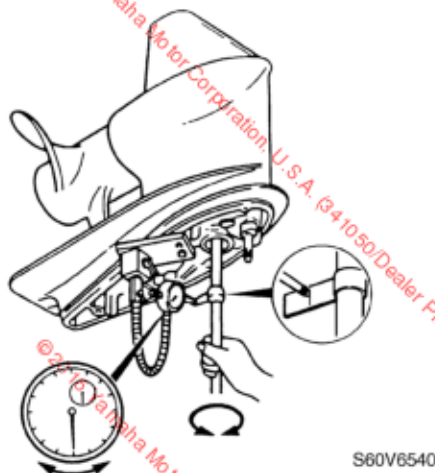
8. Remove the special service tools from the propeller shaft.
9. Apply a load to the reverse gear by installing the propeller ⑦, the spacer ⑧ (without the washer ⑨), then the washer ⑩ as shown.



NOTE:

Tighten the propeller nut ⑪ while turning the drive shaft until the drive shaft can no longer be turned.

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



Reverse gear backlash:

0.64–0.93 mm (0.0252–0.0366 in)

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

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

M: Measurement

Available shim thicknesses:

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

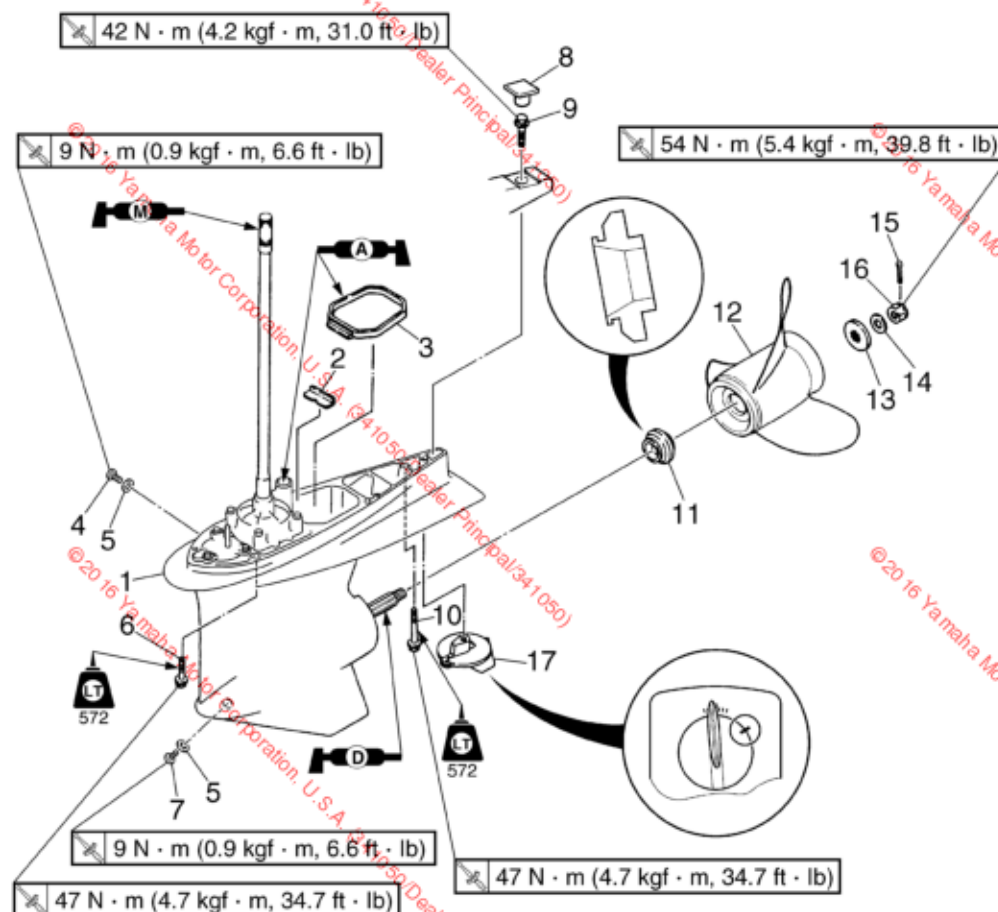
12. Remove the special service tools, and then install the water pump assembly.

LOWR



Lower unit

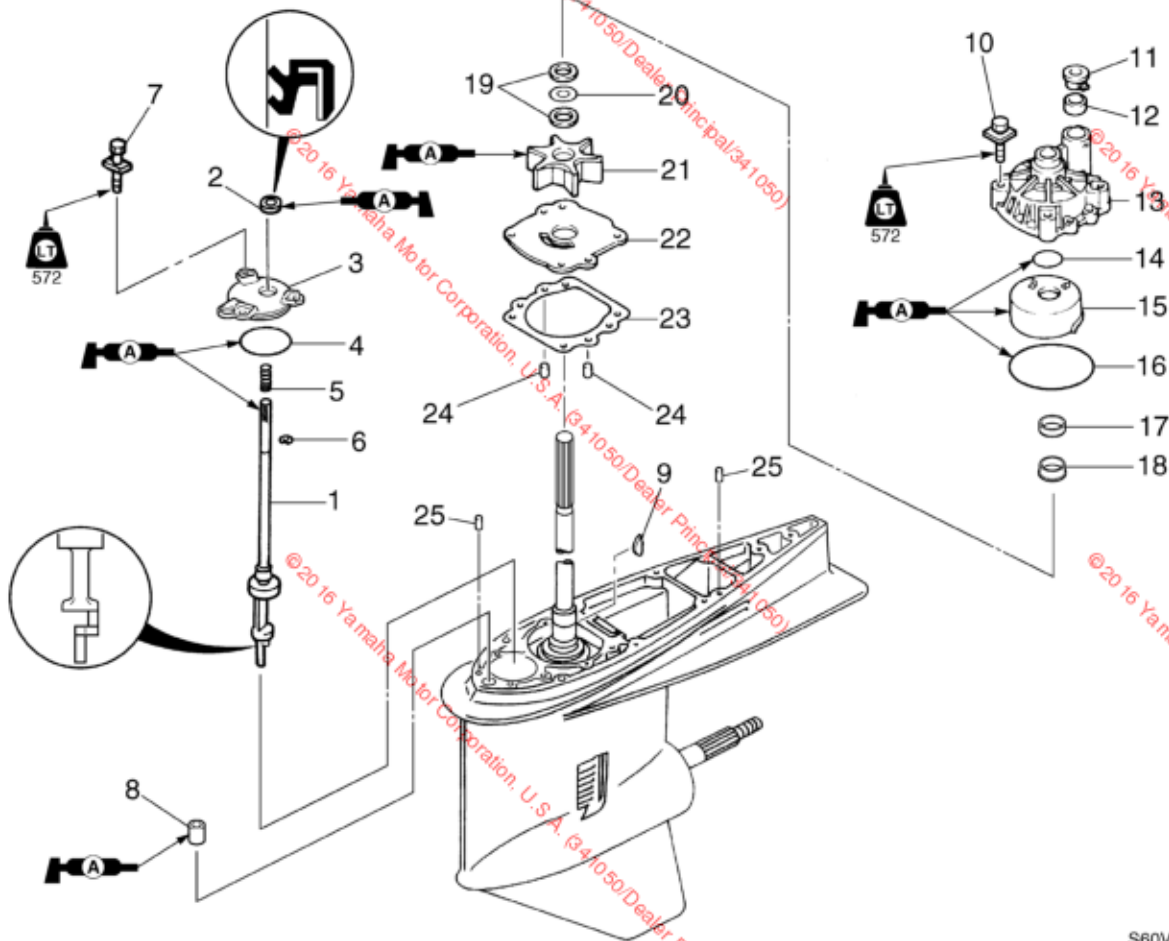
Lower unit (counter rotation model)



S60V6340

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

Lower unit (counter rotation model)



S60V6350

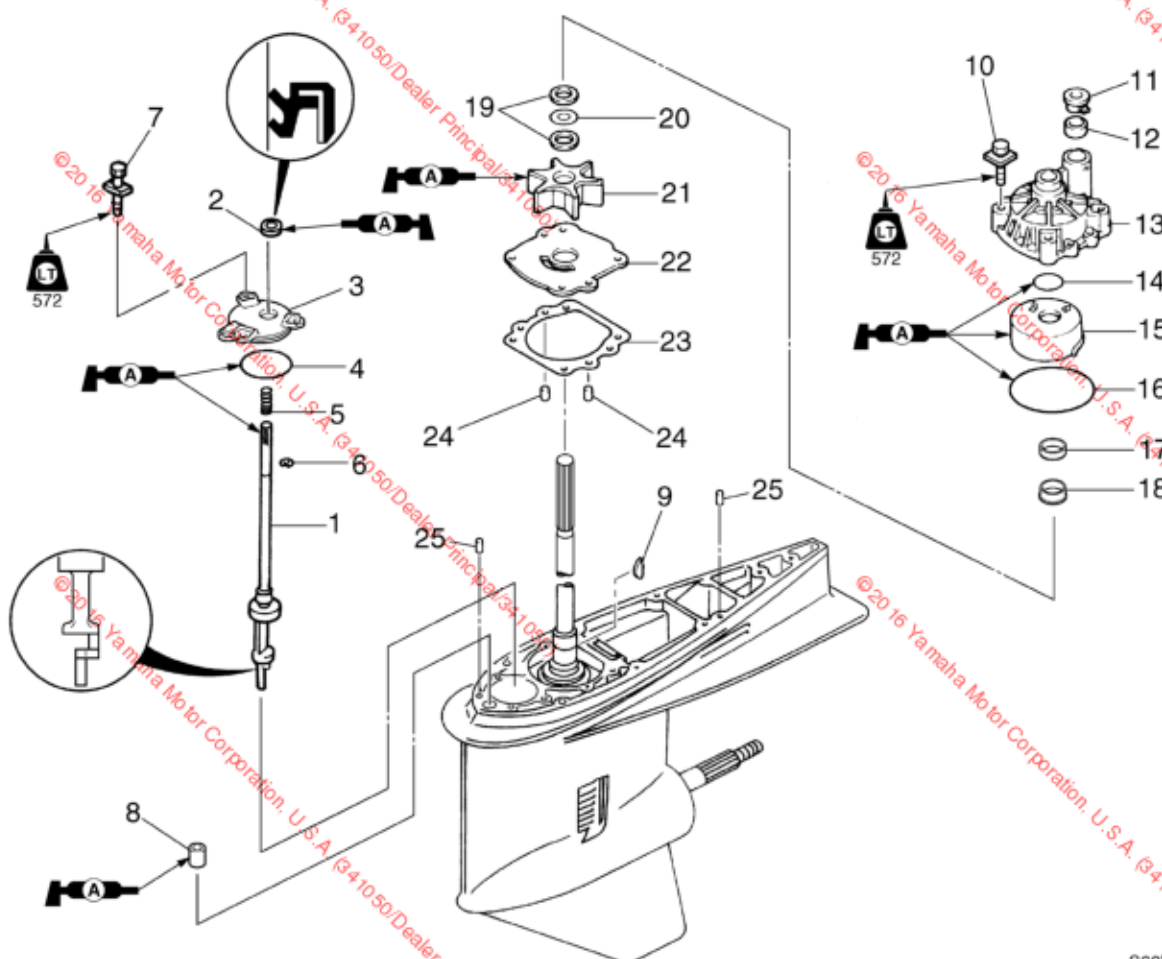
6

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

LOWR



Lower unit



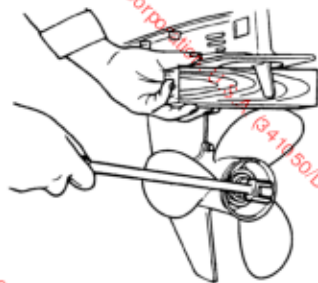
S60V6350

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

Lower unit (counter rotation model)

Removing the lower unit

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

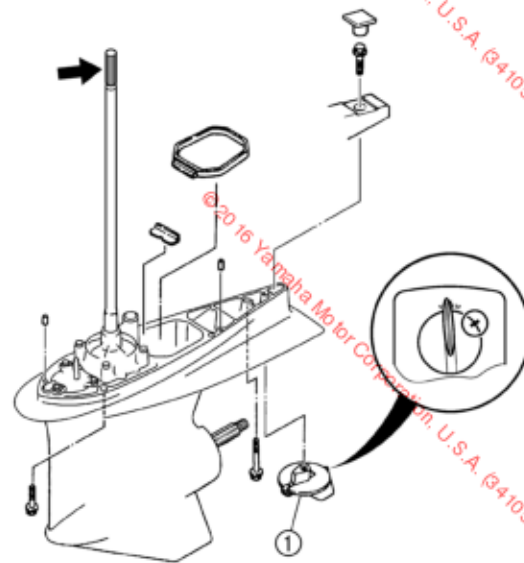


S69J6545

⚠ WARNING

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

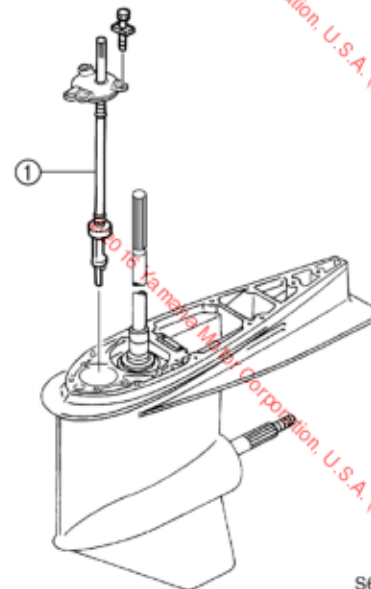
3. Mark the trim tab ① at the area shown, and then remove it.
4. Loosen the bolts, and then remove the lower unit from the upper case.



S60V6355

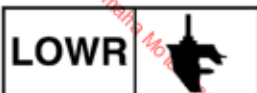
Removing the water pump and shift rod

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



S60V6030

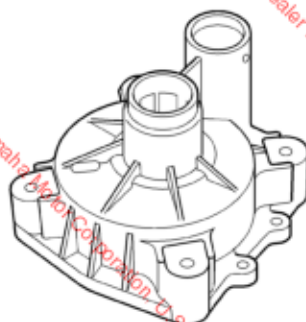
6



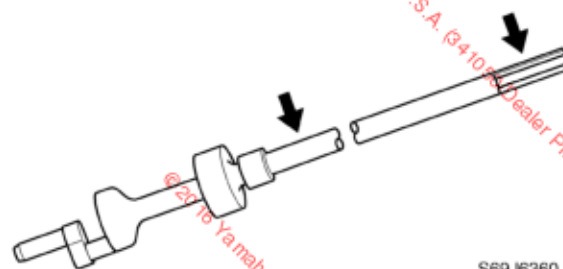
Lower unit

Checking the water pump and shift rod

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

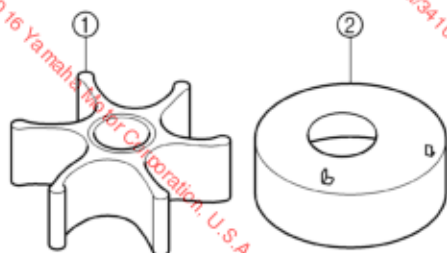


S69J6030



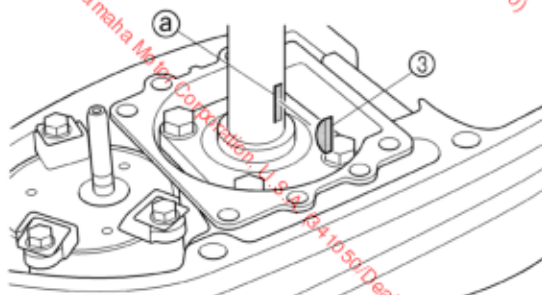
S69J6360

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



S69J6035

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

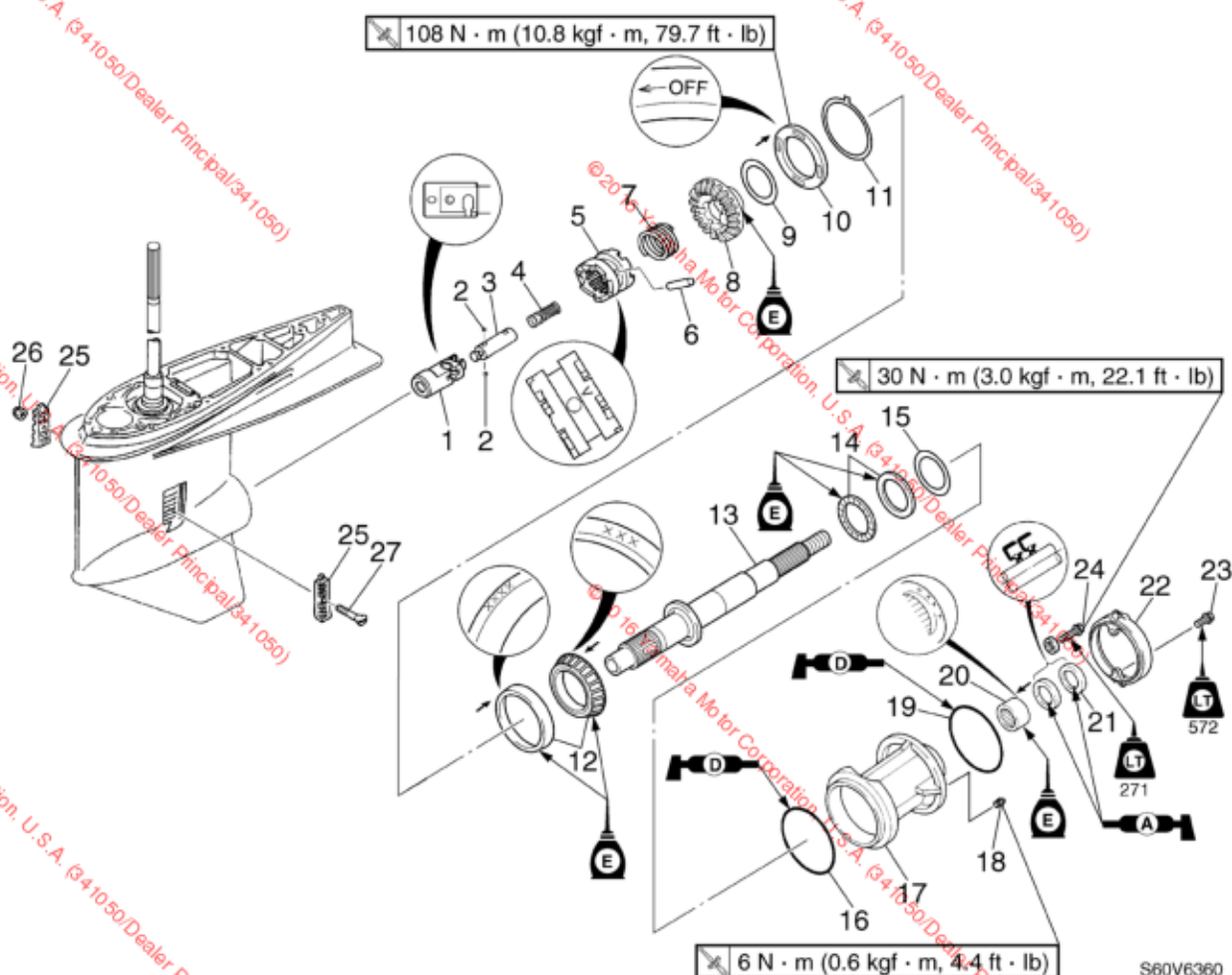


S69J6040

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

Lower unit (counter rotation model) / Propeller shaft housing (counter rotation model)

Propeller shaft housing (counter rotation model)

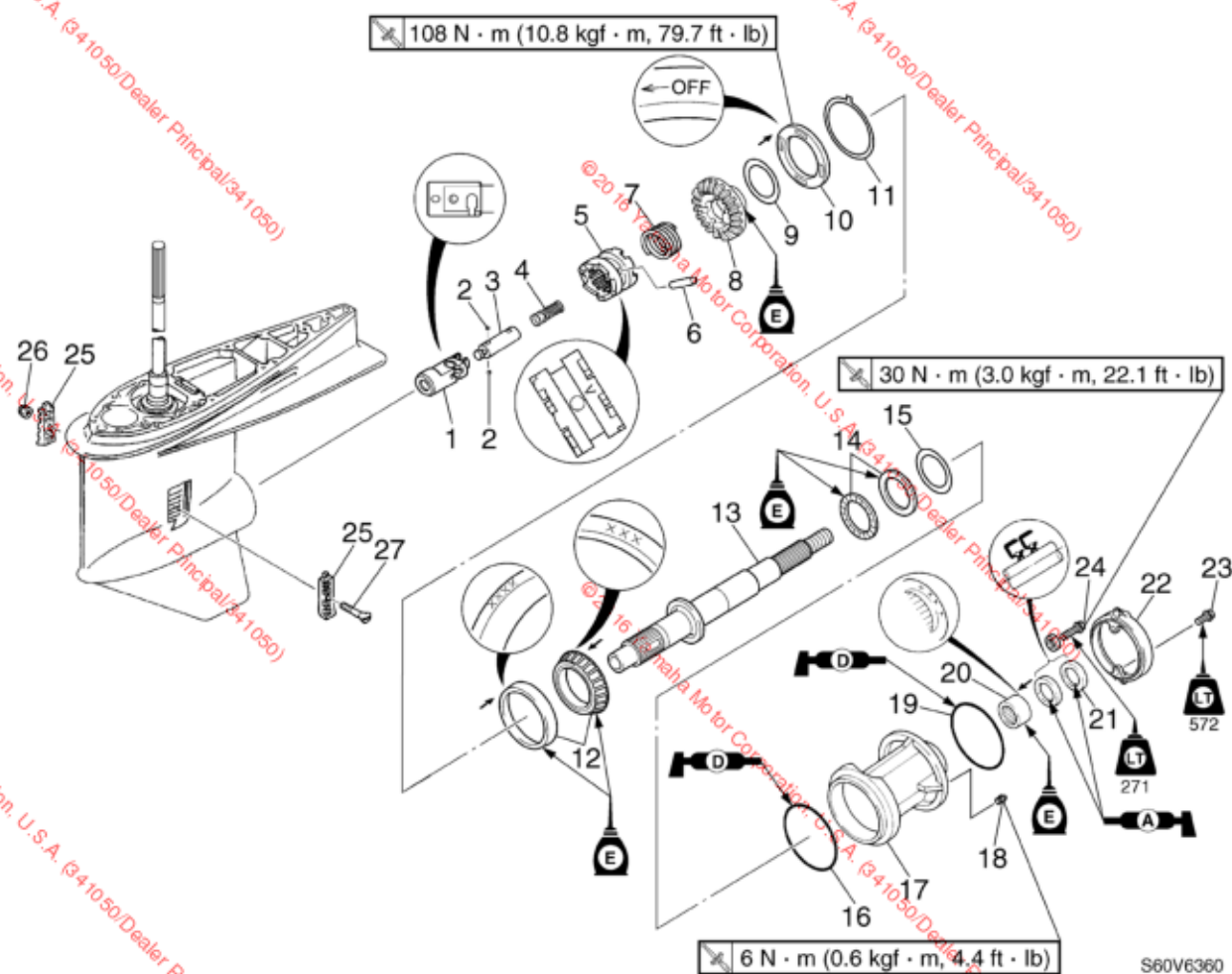


No.	Part name	Qty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Slider	1	
4	Shift plunger	1	
5	Dog clutch	1	
6	Cross pin	1	
7	Spring	1	
8	Forward gear	1	
9	Forward gear shim	—	As required
10	Ring nut	1	
11	Claw washer	1	
12	Taper roller bearing assembly	1	Not reusable
13	Propeller shaft	1	
14	Thrust bearing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

LOWR



Lower unit

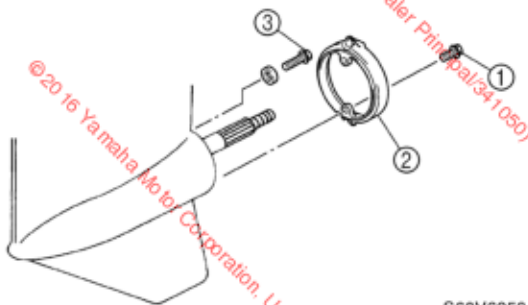


No.	Part name	Qty	Remarks
18	Grease nipple	1	
19	O-ring	1	Not reusable
20	Needle bearing	1	
21	Oil seal	2	Not reusable
22	Ring	1	
23	Bolt	2	M8 × 20 mm
24	Bolt	2	M8 × 33 mm
25	Cooling water inlet cover	2	
26	Nut	1	
27	Screw	1	

Propeller shaft housing (counter rotation model)

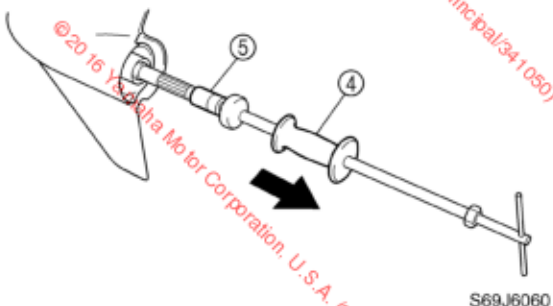
Removing the propeller shaft housing assembly

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



S60V6050

2. Pull out the propeller shaft housing assembly.



S69J6060



Slide hammer and adapters ④:

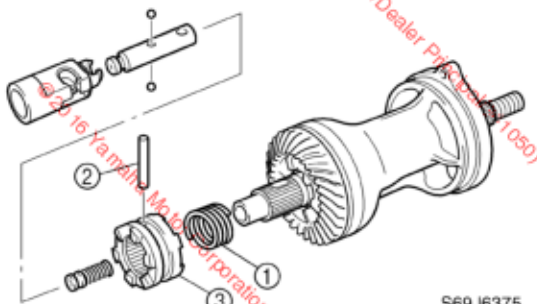
YB-06096

Propeller shaft and bearing housing remover ⑤:

YB-06335

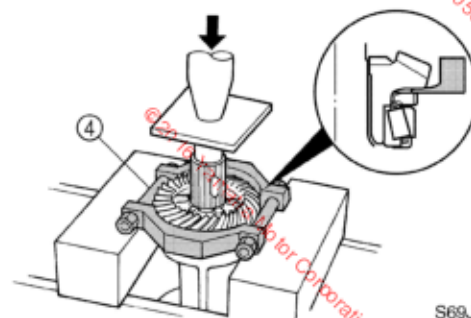
Disassembling the propeller shaft housing

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



S69J6375

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

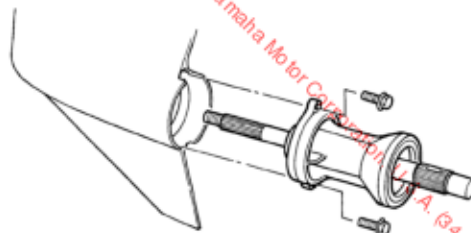


S69J6380



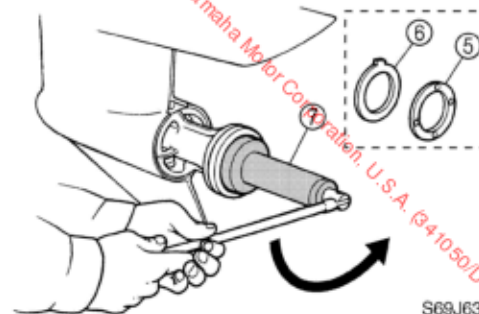
Bearing splitter plate ④:
(commercially available)

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



S69J6385

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



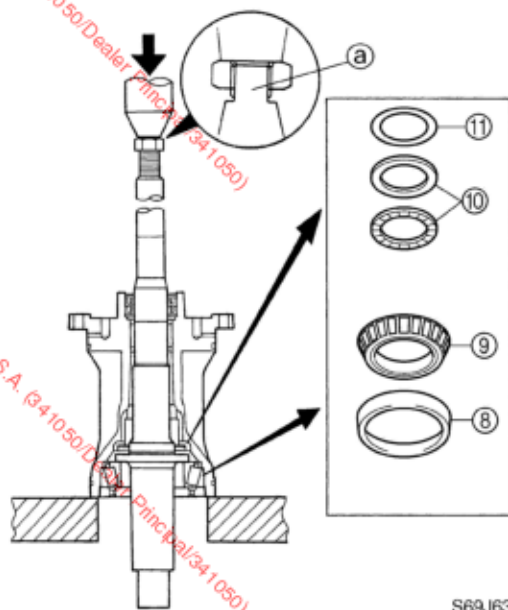
S69J6390



Ring nut wrench ⑦: YB-06578

LOWR**Lower unit**

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

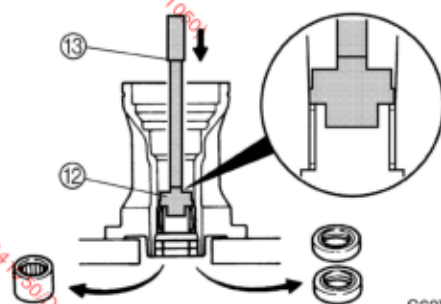


S69J6395

CAUTION:

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

6. Remove the oil seals and needle bearing.



S60V6630



Oil seal installer ⑫: YB-06168
Driver handle ⑬: YB-06071

Checking the propeller shaft housing

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



S69J6105

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



S69J6110

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

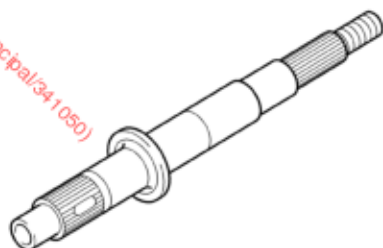


S69J6410

Propeller shaft housing (counter rotation model)

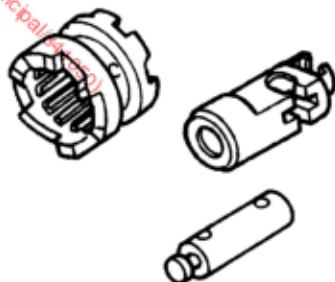
Checking the propeller shaft

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



S69J6415

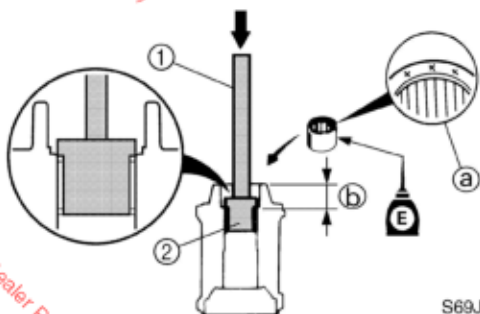
2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



S69J6420

Assembling the propeller shaft housing

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



S69J6135

NOTE:

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

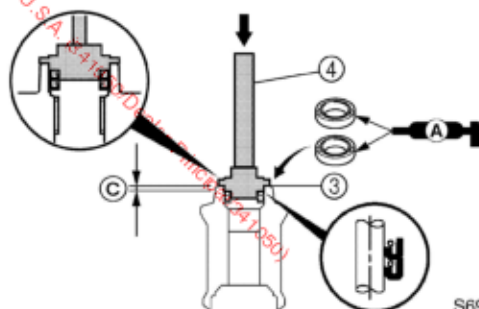


Driver handle ①: YB-06071
Drive shaft needle bearing remover and installer ②:
YB-06196



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

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



S69J6145

NOTE:

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



Oil seal installer ③: YB-06085
Driver handle ④: YB-06071

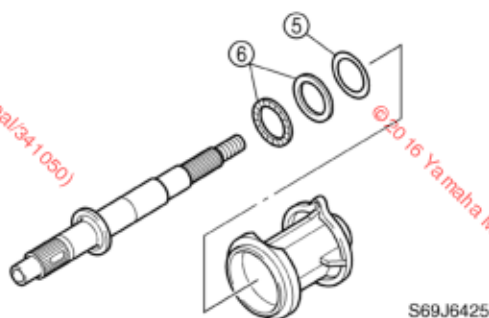


Depth **c**:
4.75–5.25 mm (0.187–0.207 in)

6

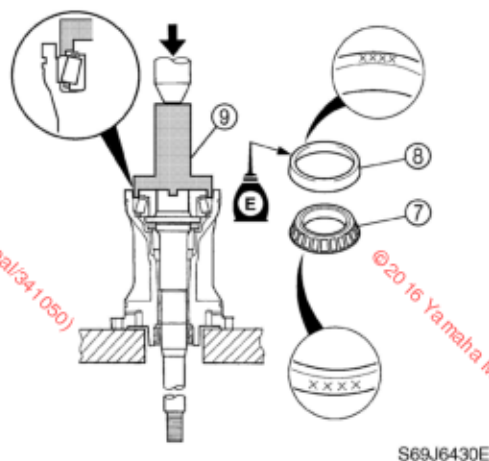
LOWR**Lower unit**

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

**CAUTION:**

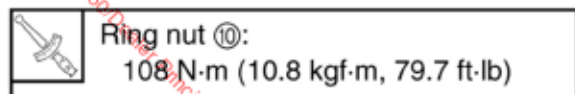
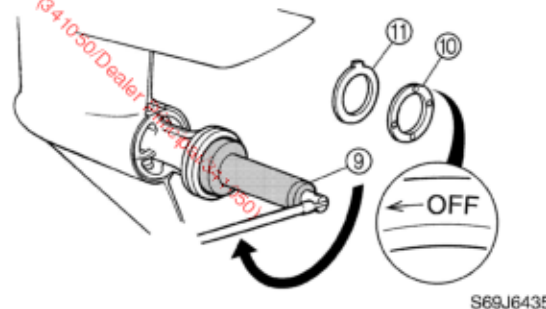
Add or remove shim(s), if necessary, if replacing the propeller shaft, the thrust bearing, or the propeller shaft housing.

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

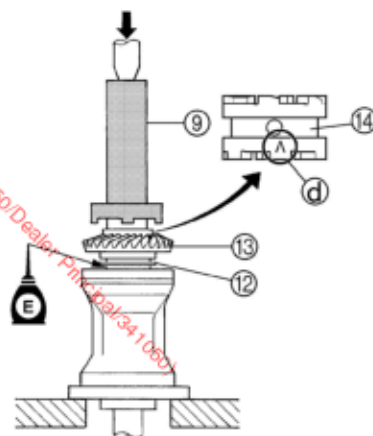


5. Install the propeller shaft assembly in the reverse direction into the lower case.

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



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



Propeller shaft housing (counter rotation model)

CAUTION:

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

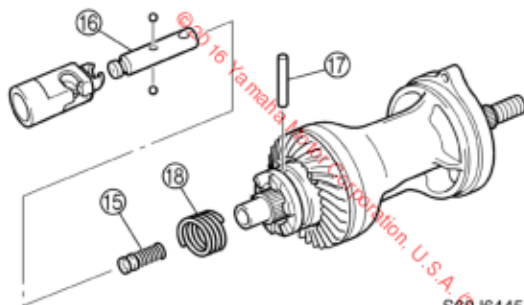
NOTE:

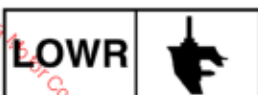
Install the dog clutch ⑭ with the "V" mark ㊦ facing toward the forward gear.



Ring nut wrench ⑨: YB-06578

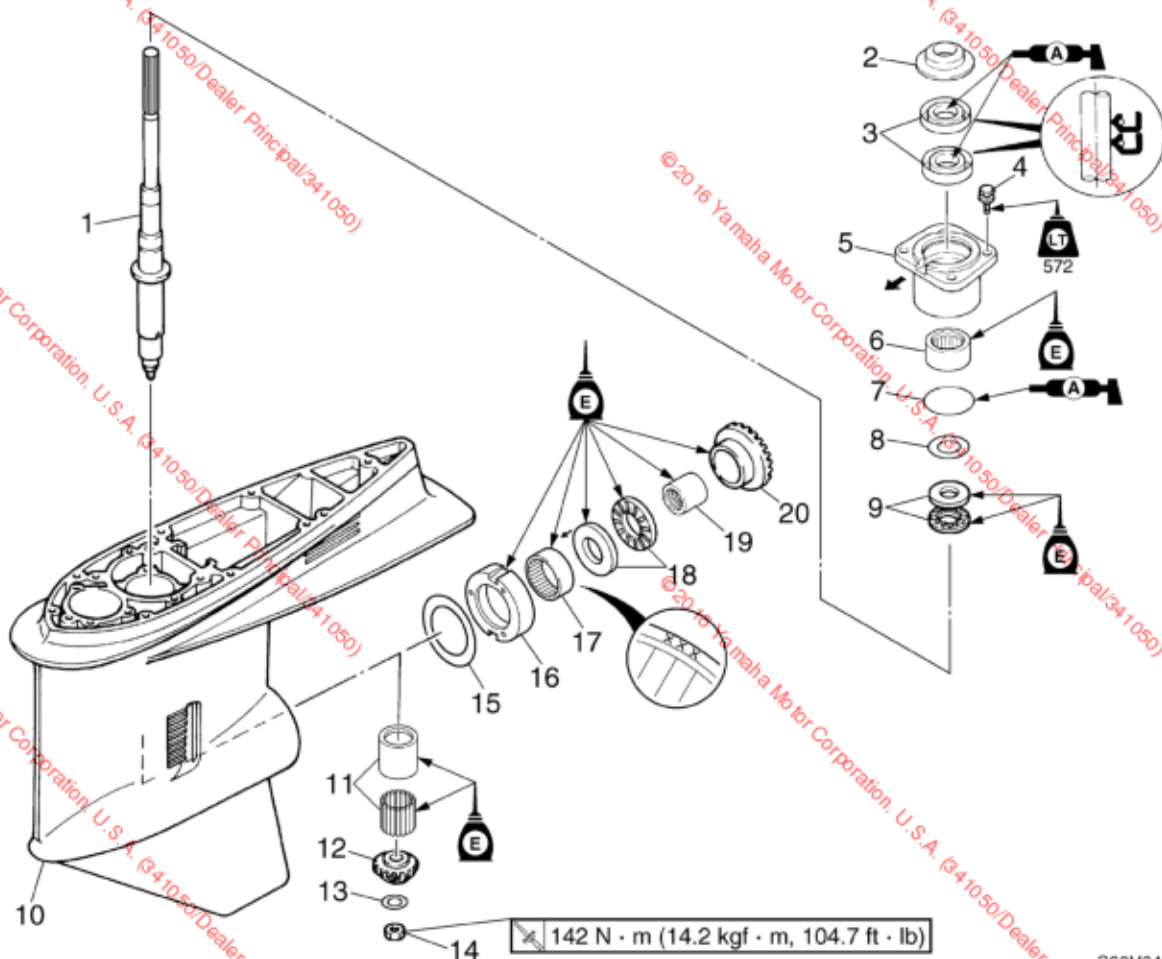
8. Install the shift plunger ⑮ and slider ⑯ into the propeller shaft, and then install the cross pin ⑰ and spring ⑱.





Lower unit

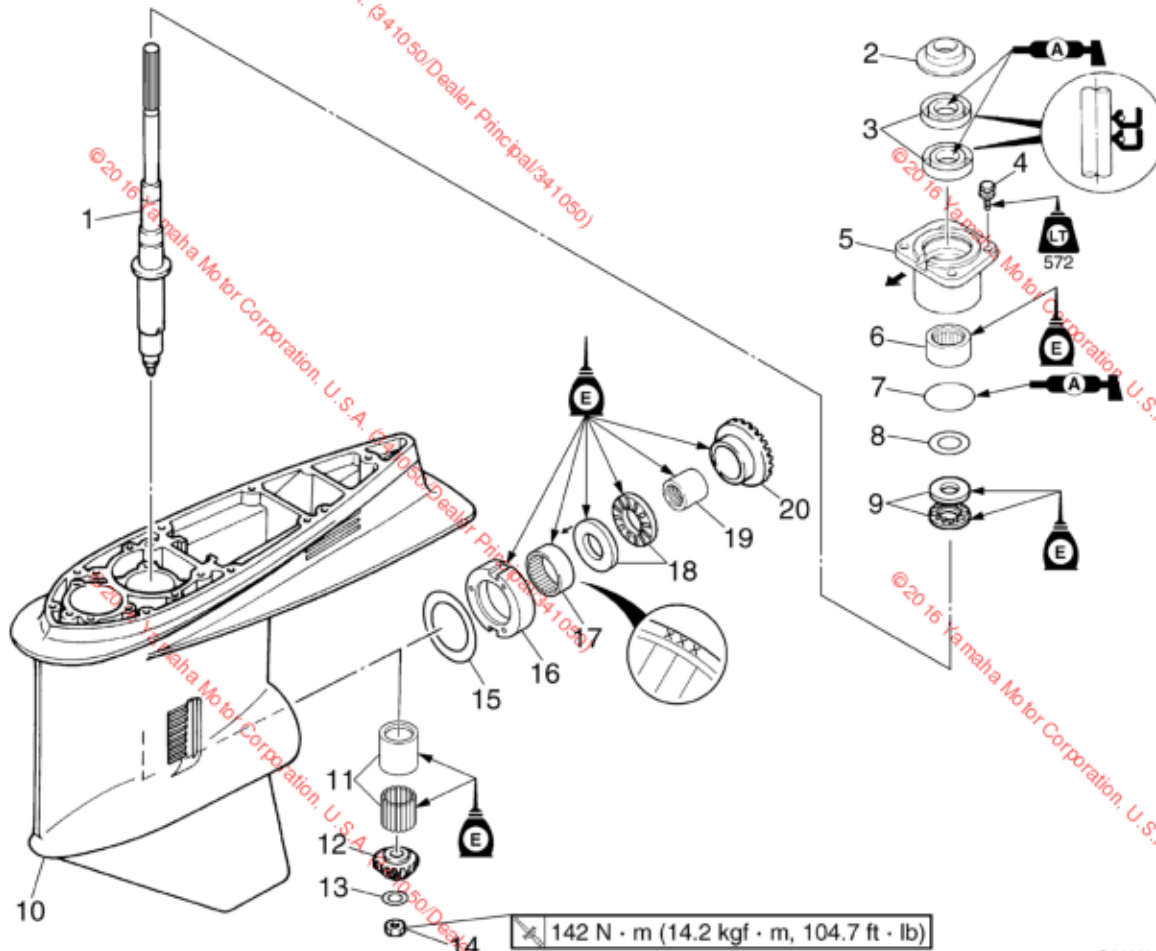
Drive shaft and lower case (counter rotation model)



S60V6420U

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

Drive shaft and lower case (counter rotation model)

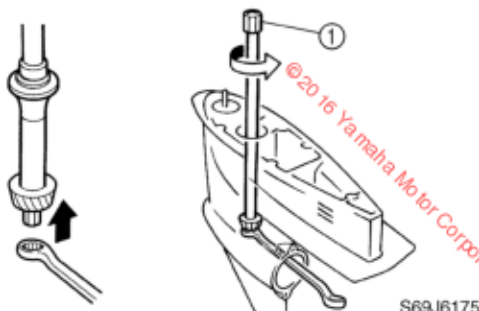


S60V6420U

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

LOWR**Lower unit****Removing the drive shaft**

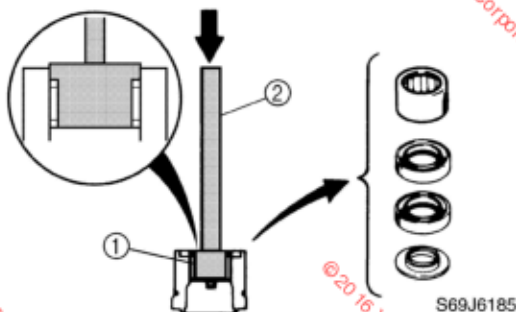
1. Remove the drive shaft assembly and pinion, and then pull out the reverse gear and thrust bearing.



Drive shaft holder ①: YB-06201

Disassembling the drive shaft housing

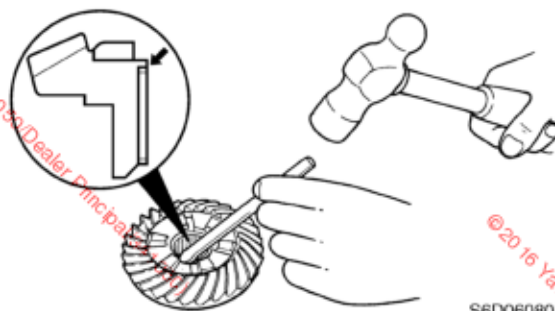
1. Remove the cover, oil seals, and needle bearing.



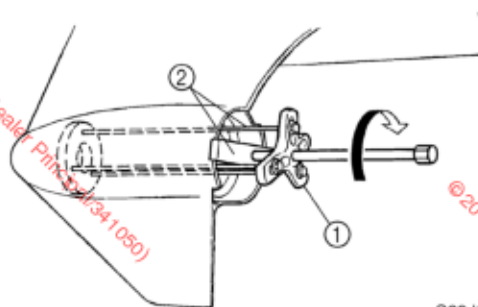
Drive shaft needle bearing remover and installer ①:
YB-06196
Driver handle ②: YB-06071

Disassembling the reverse gear

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

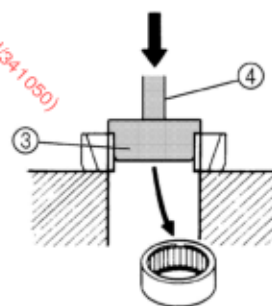
**Disassembling the lower case**

1. Remove the retainer and shim(s).



Universal puller ①: YB-06117
Puller bolt ②: YB-41707

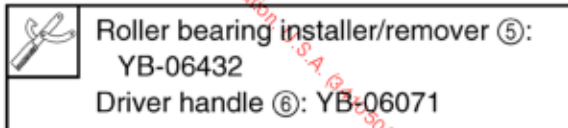
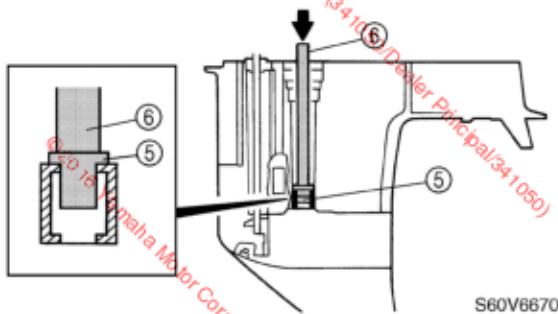
2. Remove the needle bearing from the retainer.



Needle bearing installer ③:
YB-06434
Driver handle ④: YB-06071

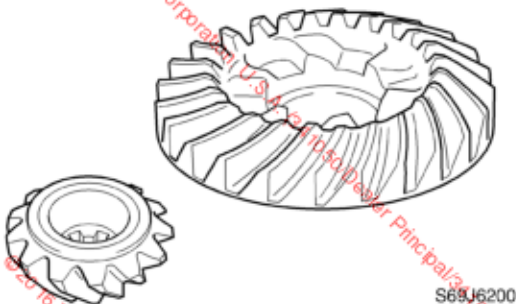
Drive shaft and lower case (counter rotation model)

- Remove the needle bearing from the lower case.



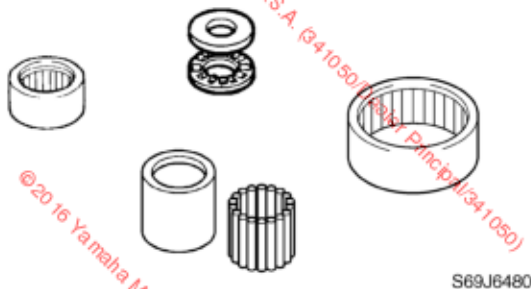
Checking the pinion and reverse gear

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



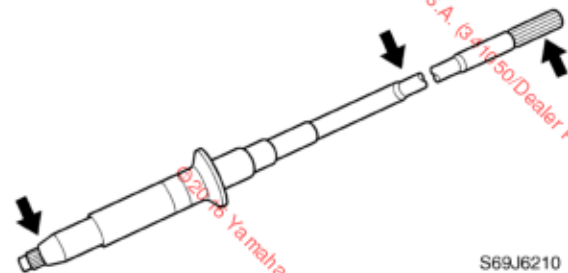
Checking the bearings

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



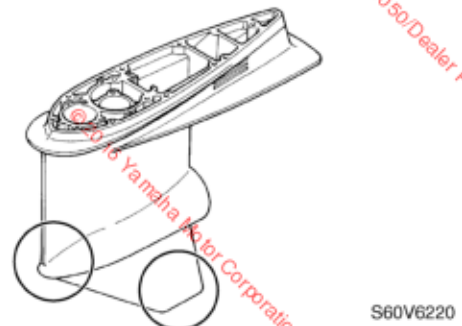
Checking the drive shaft

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



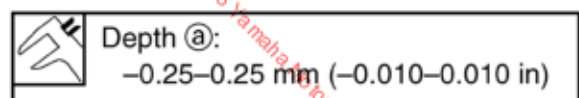
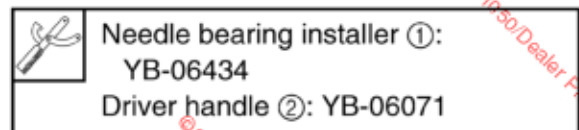
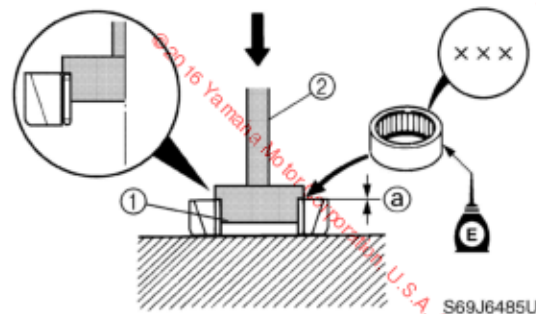
Checking the lower case

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



Assembling the lower case

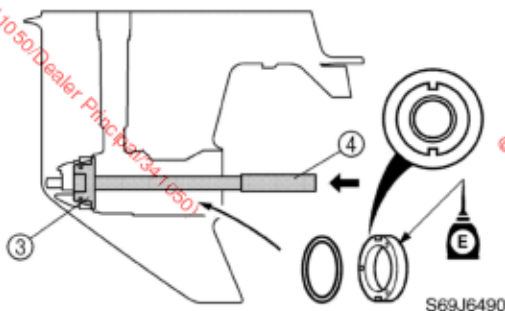
- Install the needle bearing into the retainer to the specified depth.



6

LOWR**Lower unit**

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

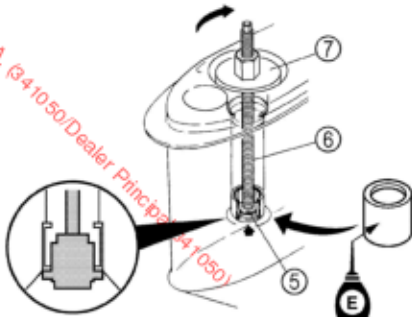
**CAUTION:**

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



Forward bearing installer ③:
YB-06430
Driver handle ④: YB-06071

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

**NOTE:**

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



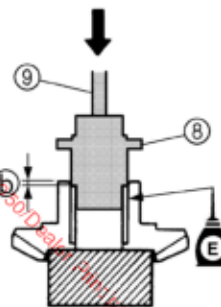
Needle bearing installer ⑤:
YB-06435
Pinion gear bushing installer ⑥:
YB-06029-4
Needle bearing remover and
installer ⑦:
YB-06213

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

NOTE:

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

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



Needle bearing installer ⑧:
YB-06435
Driver handle ⑨: YB-06071



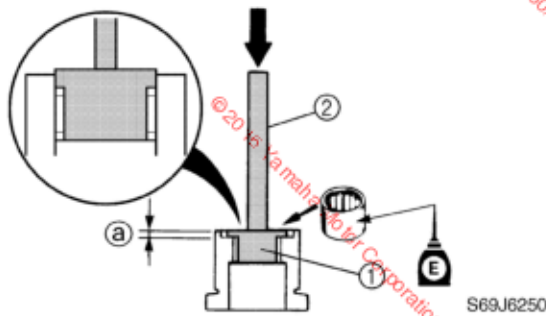
Depth ⑩:
6.75–7.25 mm (0.266–0.285 in)

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

Drive shaft and lower case (counter rotation model)

Assembling the drive shaft housing

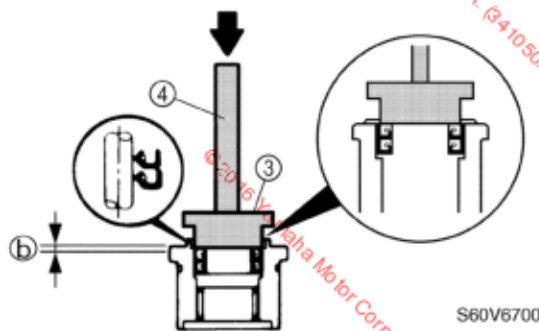
1. Install the needle bearing into the drive shaft housing to the specified depth.



Drive shaft needle bearing remover and installer ①:
YB-06196
Driver handle ②: YB-06071

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

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



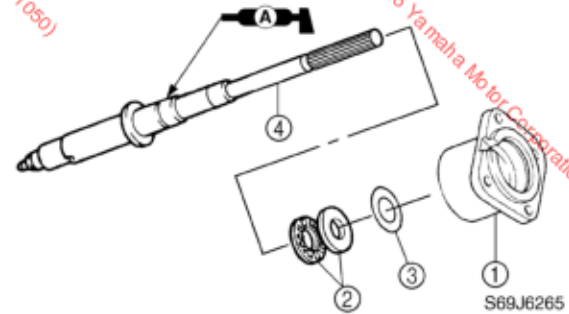
NOTE:
Install an oil seal halfway into the drive shaft housing, then the other oil seal.

Oil seal installer ③: YB-06085
Driver handle ④: YB-06071

Depth ②:
0.25–0.75 mm (0.01–0.03 in)

Installing the drive shaft

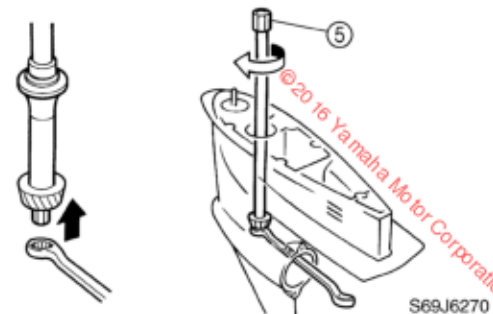
1. Install the reverse gear into the lower case.
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ onto the drive shaft ④.



CAUTION:

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

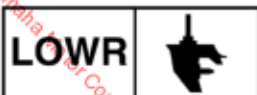
3. Install the drive shaft and drive shaft housing into the lower case, then the pinion and pinion nut, and then tighten the nut to the specified torque.



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

Drive shaft holder ⑤: YB-06201

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

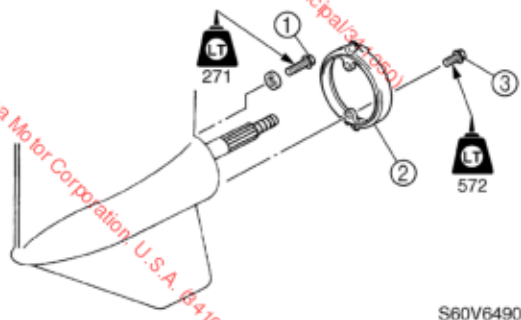
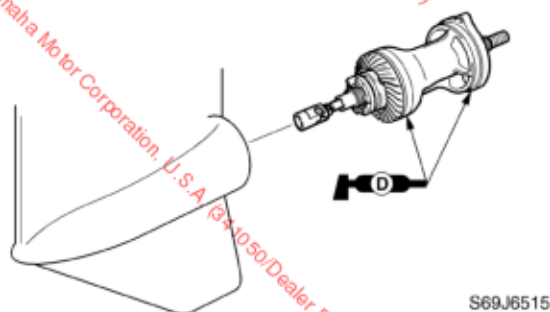


Lower unit

4. Tighten the housing bolts.

Installing the propeller shaft housing

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



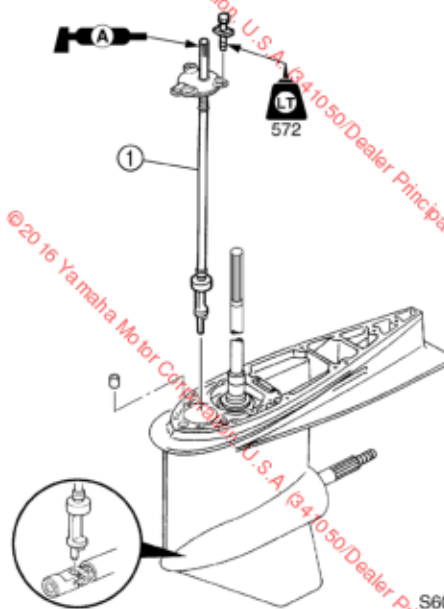
NOTE:

Apply grease to the new O-rings before installation.

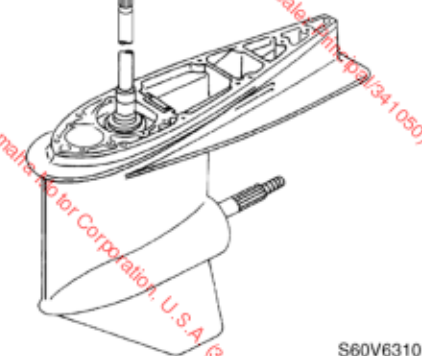
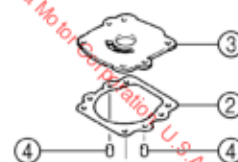
	Propeller shaft housing bolt ①: 30 N·m (3.0 kgf·m, 22.1 ft·lb)
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Installing the water pump and shift rod

1. Install the shift rod assembly ①.



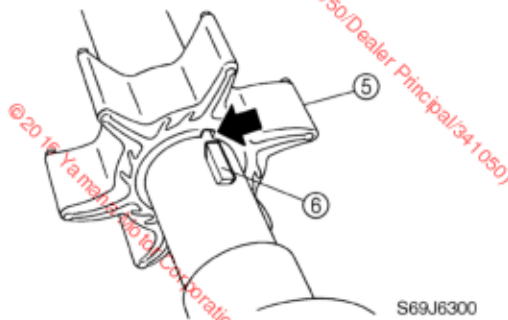
2. Install a new gasket ②, the outer plate cartridge ③, and dowel pins ④.



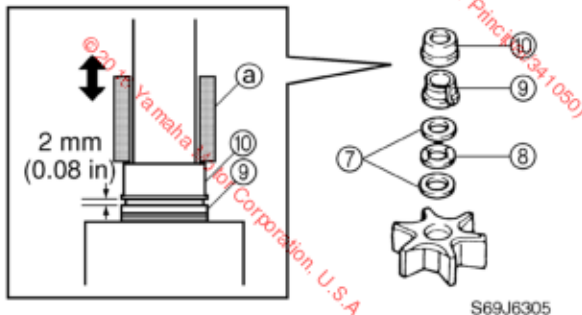
3. Install the Woodruff key into the drive shaft.

Drive shaft and lower case (counter rotation model)

- Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.



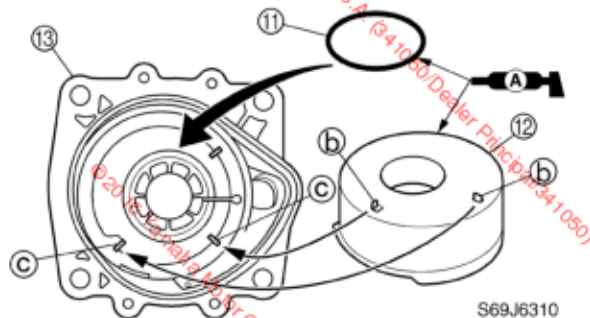
- Install the washers ⑦, wave washer ⑧, spacer ⑨, and collar ⑩ onto the drive shaft.



NOTE:

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

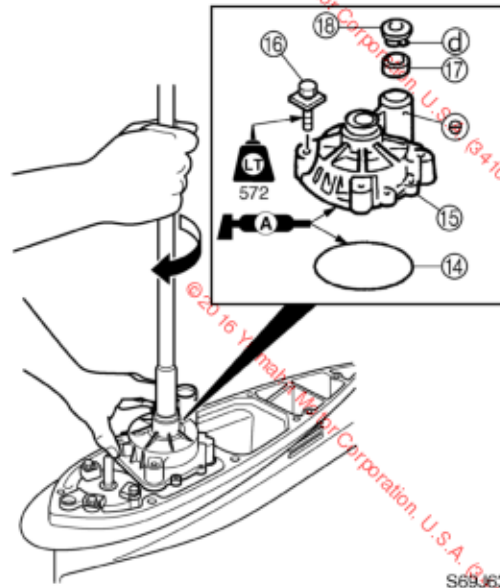
- Install the O-ring ⑪ and insert cartridge ⑫ into the pump housing ⑬.



NOTE:

Align the insert cartridge projections ⑬ with the holes ⑭ in the pump housing.

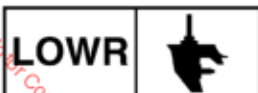
- Install the O-ring ⑭ and pump housing assembly ⑮ into the lower case, tighten the bolts ⑯, and then install the seal ⑰ and cover ⑱.



NOTE:

- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⑱ with the hole ⑲ in the pump housing.

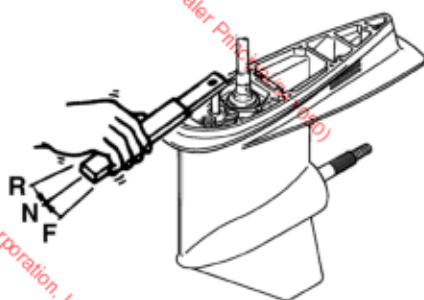
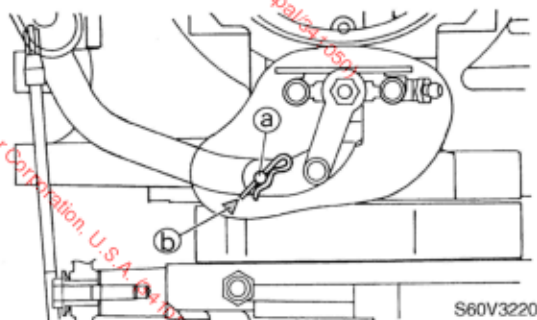
6



Lower unit

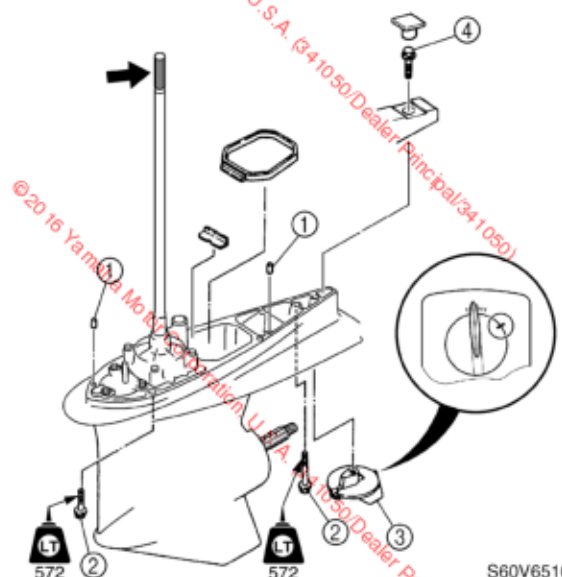
Installing the lower unit

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



Shift rod push arm: YB-06052

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

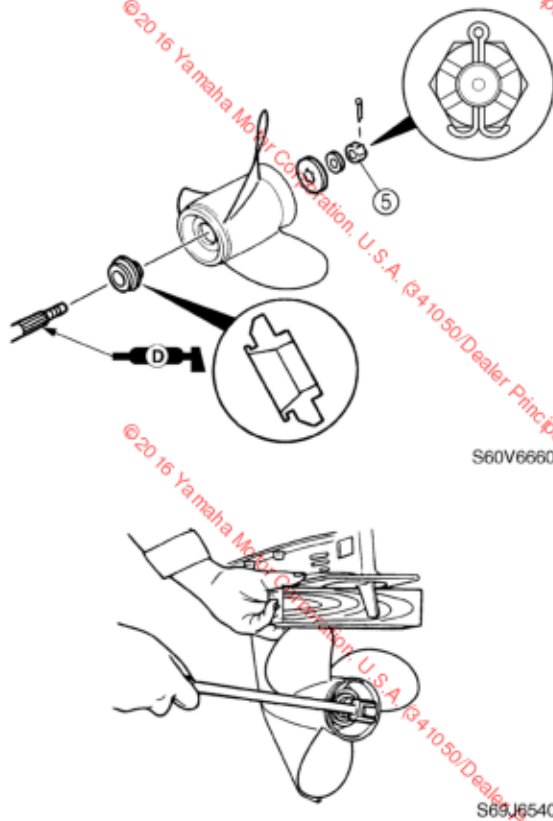


Lower case mounting bolt (2):
47 N·m (4.7 kgf·m, 34.7 ft·lb)

Trim tab bolt (4):
42 N·m (4.2 kgf·m, 31.0 ft·lb)

Drive shaft and lower case (counter rotation model)

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.



⚠ 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:

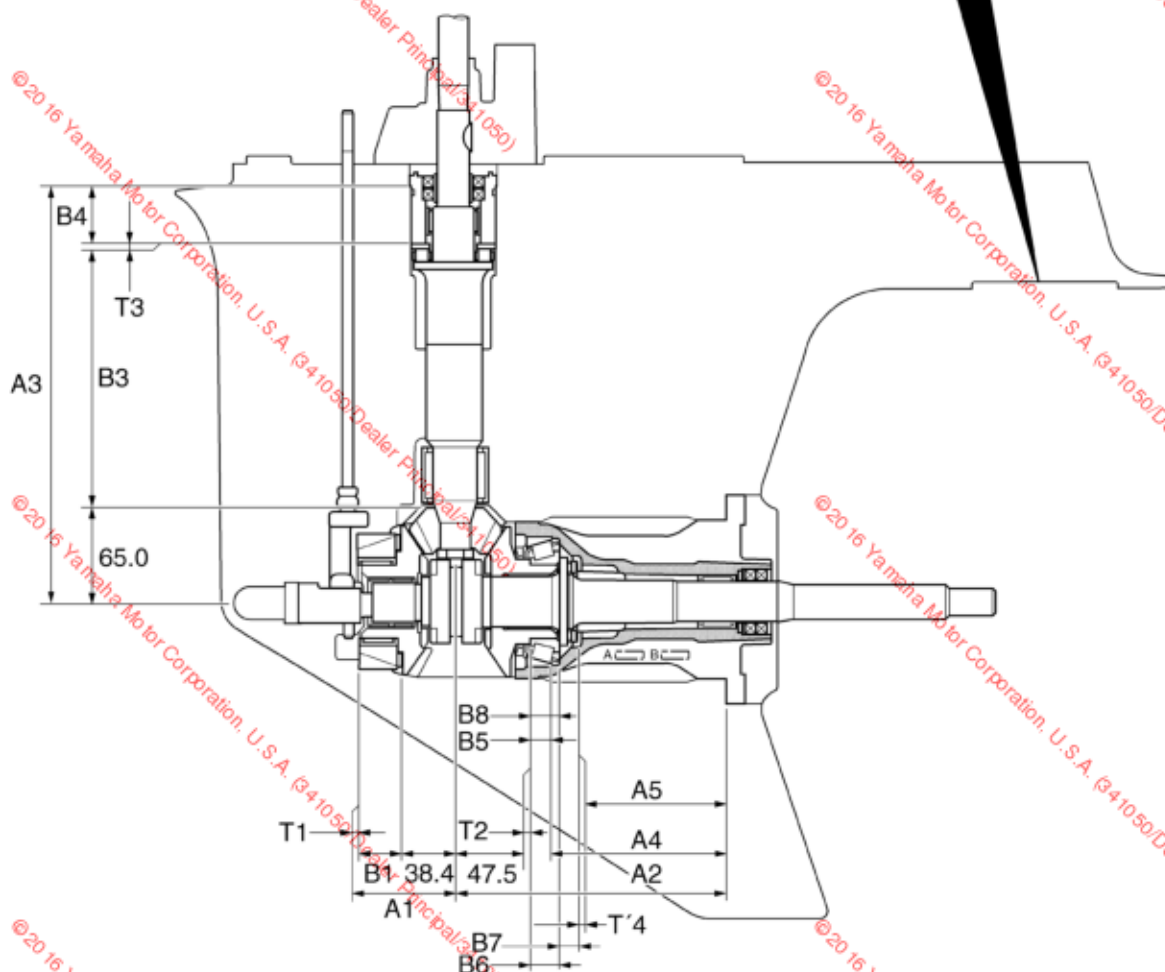
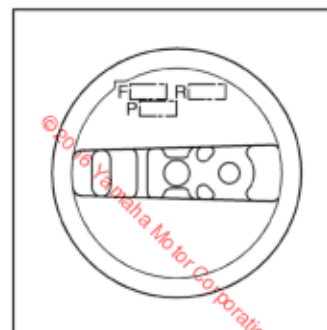
If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.



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



Shimming (counter rotation model)



S6D06150

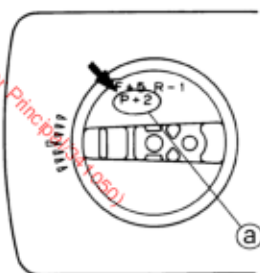
Shimming

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. Calculate the specified value (M0) as shown in the examples below.



S69J6555

NOTE:

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

Calculation formula:

$$\text{Specified value (M0)} = 1.00 + P/100 \text{ mm}$$

Example:

If "P" is (+5), then

$$M0 = 1.00 + (+5)/100 \text{ mm} = 1.00 + 0.05 \text{ mm} = 1.05 \text{ mm}$$

If "P" is (-3), then

$$M0 = 1.00 + (-3)/100 \text{ mm} = 1.00 - 0.03 \text{ mm} = 0.97 \text{ mm}$$

2. Install the drive shaft (1), thrust bearing (2), and drive shaft housing (3) onto the special service tool.

Shimming (counter rotation model)

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

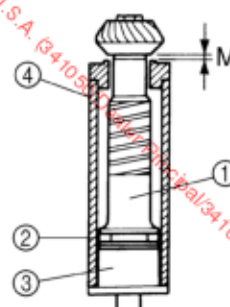


Pinion shimming gauge III (4):
YB-06441



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

4. Measure the clearance (M) between the special service tool and the pinion as shown.

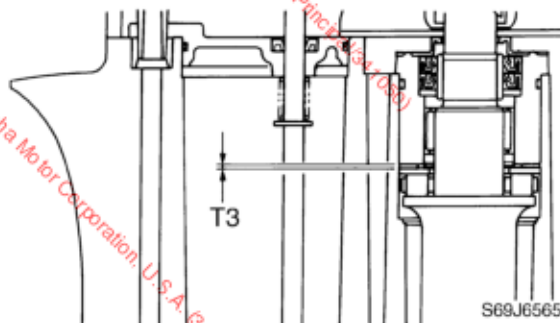


S69J6560

NOTE:

Measure the pinion at three points to find the clearance average.

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



S69J6565

NOTE:

The sum of T3 and M should not be more than M0.

Calculation formula:

$$\text{Pinion shim thickness (T3)} = M0 - M$$

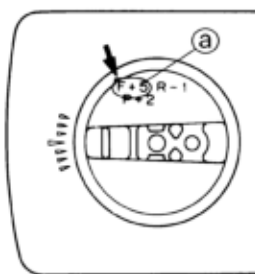
6

LOWR**Lower unit**

Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and
0.50 mm**Selecting the reverse gear shims**

1. Calculate the specified value (M0) as shown in the examples below.



S69J6570

NOTE:

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

Calculation formula:

Specified value (M0) = $30.60 + F/100$ mm

Example:

If "F" is (+5), then

$$M0 = 30.60 + (+5)/100 \text{ mm} = 30.60 + 0.05 \text{ mm}$$

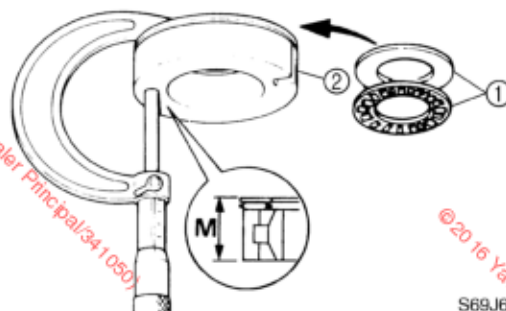
$$= 30.65 \text{ mm}$$

If "F" is (-3), then

$$M0 = 30.60 + (-3)/100 \text{ mm} = 30.60 - 0.03 \text{ mm}$$

$$= 30.57 \text{ mm}$$

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

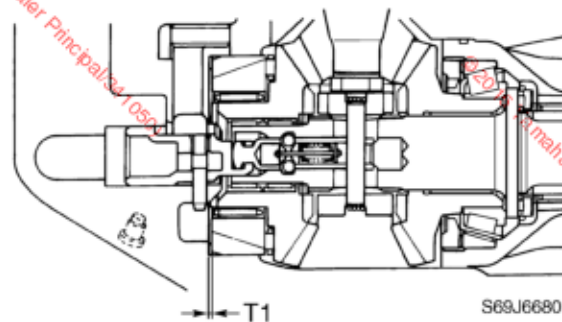


S69J6675

NOTE:

Measure the bearing retainer at three points to find the clearance average.

4. Select the reverse gear shim(s) (T1).



S69J6680

NOTE:

The sum of T1 and M should not be more than M0.

Calculation formula:

Reverse gear shim thickness (T1) =
 $M0 - M$

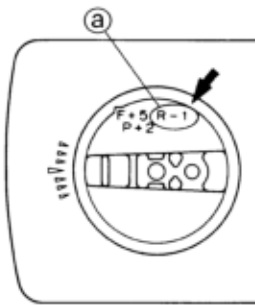
Available shim thicknesses:

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

Shimming (counter rotation model)

Selecting the forward gear shims

1. Calculate the specified value (M0) as shown in the examples below.



S69J6585

NOTE:

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

Calculation formula:

$$\text{Specified value (M0)} = 2.50 + R/100 \text{ mm}$$

Example:

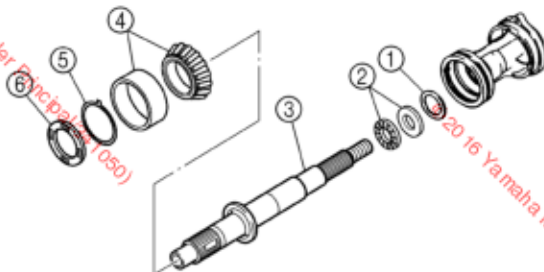
If "R" is (+5), then

$$M0 = 2.50 + (+5)/100 \text{ mm} = 2.50 + 0.05 \text{ mm} = 2.55 \text{ mm}$$

If "R" is (-3), then

$$M0 = 2.50 + (-3)/100 \text{ mm} = 2.50 - 0.03 \text{ mm} = 2.47 \text{ mm}$$

2. Install the shim(s) ①, thrust bearing ②, propeller shaft ③, taper roller bearing ④, and claw washer ⑤, and then tighten the ring nut ⑥ to the specified torque.



S60V6610



Ring nut wrench: YB-06578



Ring nut ⑥:

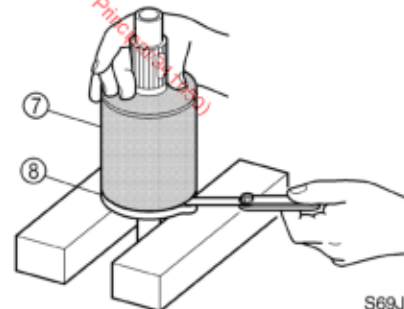
108 N·m (10.8 kgf·m, 79.7 ft·lb)

3. Set the special service tool on the taper roller bearing inner race.

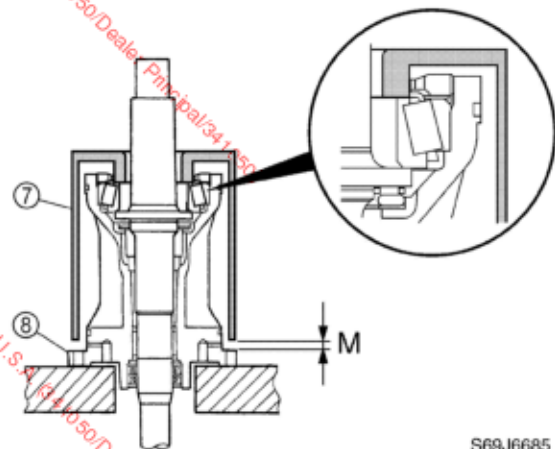


Shimming gauge ⑦: YB-06440-A

4. Measure the clearance (M) between the special service tool and the propeller shaft housing ⑧ as shown.



S69J6684



S69J6685

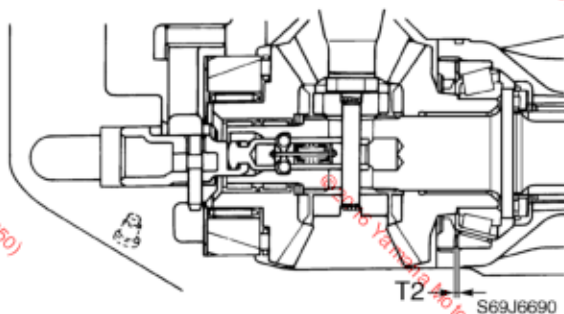
NOTE:

Measure the clearance at four points to find the clearance average.

6

LOWR**Lower unit**

5. Select the forward gear shim(s) (T2).

**NOTE:**

The sum of T2 and M should not be more than M0.

Calculation formula:

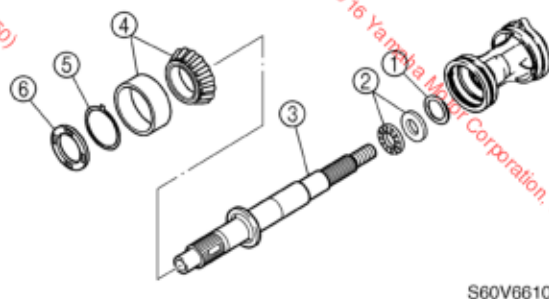
Forward gear shim thickness (T2) =
M0 - M

Available shim thicknesses:

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

Selecting the propeller shaft shims

1. Install the shim(s) ①, thrust bearing ②, propeller shaft ③, taper roller bearing ④, and claw washer ⑤, and then tighten the ring nut ⑥ to the specified torque.

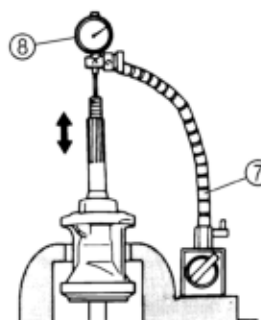


Ring nut wrench: YB-06578



Ring nut ⑥:
108 N·m (10.8 kgf·m, 79.7 ft·lb)

2. Measure the propeller shaft free play as shown.



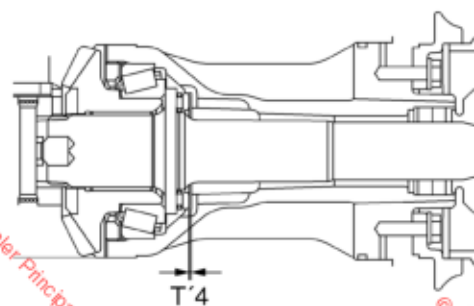
Propeller shaft free play:
0.25–0.35 mm (0.0098–0.0138 in)



Magnetic flexible stand ⑦:
YU-34481

Dial gauge ⑧: YU-03097

3. Select the propeller shaft shim(s) (T'4).

**NOTE:**

Add or remove shim(s) if the free play is out of specification.

Available shim thicknesses:

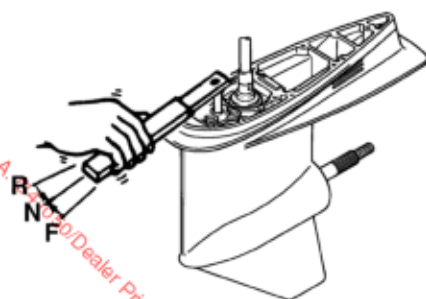
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and
0.50 mm

Backlash

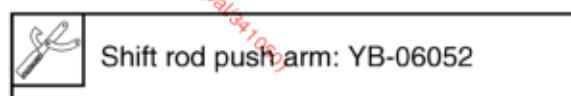
(counter rotation model)

Measuring the forward and reverse gear backlash

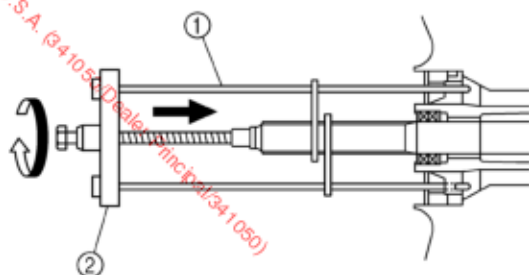
1. Remove the water pump assembly.
2. Set the gear shift to the neutral position at the lower unit.



S60V6320



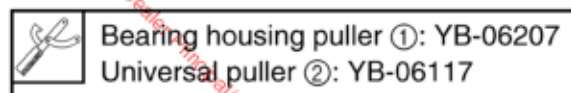
3. Install the special service tool so that it pushes against the propeller shaft.



S69J6640

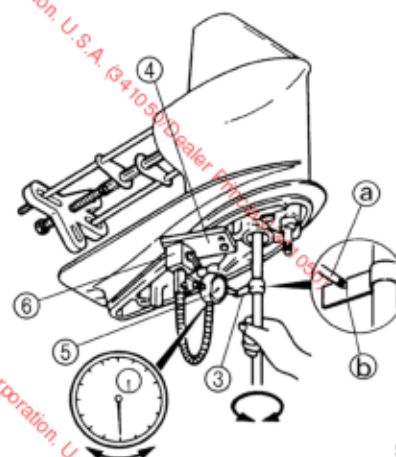
NOTE:

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



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

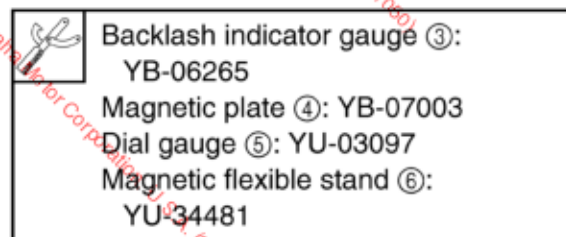
5. Set the lower unit upside down.



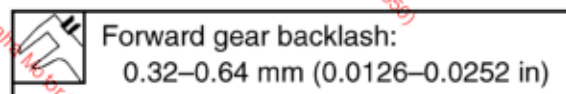
S60V6530

NOTE:

Install the dial gauge so that the plunger (a) contacts the mark (b) on the backlash indicator.



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



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

Forward gear backlash	Shim thickness
Less than 0.32 mm (0.0126 in)	To be decreased by $(0.48 - M) \times 0.78$
More than 0.64 mm (0.0252 in)	To be increased by $(M - 0.48) \times 0.78$

M: Measurement

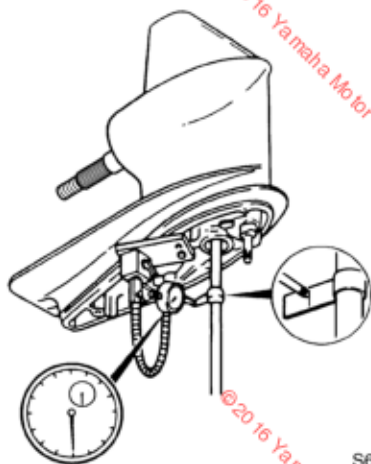
6

LOWR**Lower unit**

Available shim thicknesses:

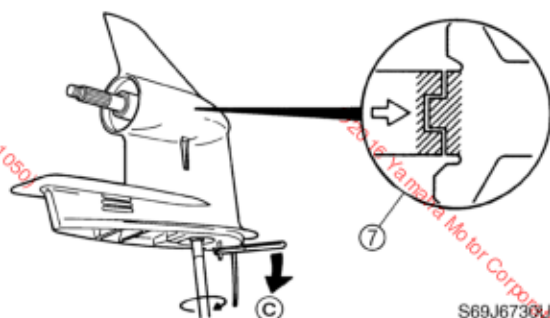
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and
0.50 mm

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



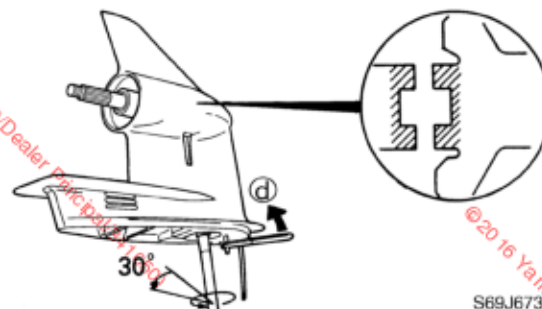
9. Turn the shift rod into the reverse position © with the shift rod push arm.

10. Turn the drive shaft clockwise until the dog clutch ⑦ is fully engaged.



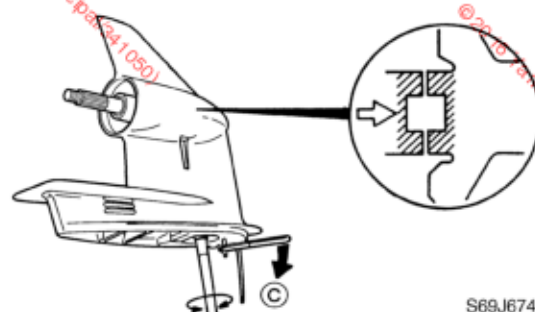
11. Turn the shift rod to the neutral position ④ with the shift rod push arm.

12. Turn the drive shaft counterclockwise approximately 30°.



13. Turn the shift rod to the reverse position © with the shift rod push arm.

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

**NOTE:**

When measuring the reverse gear backlash, turn the shift rod push arm towards the reverse position © with force.



Reverse gear backlash:

0.64–0.93 mm (0.0252–0.0366 in)

Backlash (counter rotation model)

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

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

M: Measurement

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

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



Bracket unit

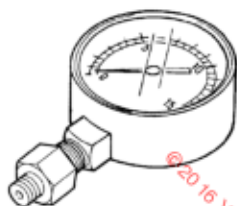
Special service tools	7-1
Bottom cowling	7-2
Upper case, steering arm, swivel bracket, and clamp brackets	7-6
Disassembling the upper case	7-13
Checking the upper case	7-13
Assembling the upper case	7-14
Removing the steering arm	7-15
Installing the steering arm	7-16
Installing the upper case	7-17
Removing the power trim and tilt unit	7-17
Removing the clamp brackets	7-18
Installing the clamp brackets	7-18
Installing the power trim and tilt unit	7-18
Adjusting the trim sensor	7-19
Power trim and tilt unit	7-21
Disassembling the power trim and tilt motor	7-28
Checking the power trim and tilt motor	7-28
Assembling the power trim and tilt motor	7-29
Checking the hydraulic pressure	7-30
Disassembling the gear pump	7-32
Disassembling the relief valve	7-33
Disassembling the tilt cylinder and trim cylinders	7-33
Checking the reservoir	7-35
Checking the tilt cylinder and trim cylinders	7-35
Checking the valves	7-36
Checking the filters	7-36
Checking the gear pump	7-37
Assembling the relief valve	7-37
Assembling the gear pump	7-37
Assembling the tilt ram	7-38
Assembling the trim rams	7-39
Installing the tilt cylinder	7-40
Installing the trim rams	7-40
Installing the power trim and tilt motor	7-41
Installing the reservoir	7-42
Installing the tilt ram	7-42
Bleeding the power trim and tilt unit	7-43
Not installed	7-43
Built-in	7-44

Power trim and tilt electrical system.....	7-45
Checking the fuse.....	7-46
Checking the power trim and tilt relay	7-46
Checking the power trim and tilt switch	7-47
Checking the trim sensor	7-47

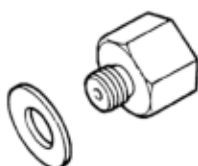


Bracket unit

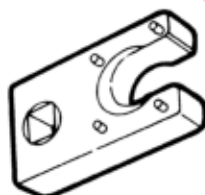
Special service tools



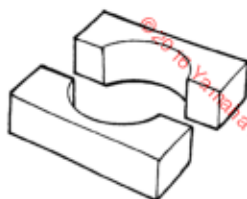
PTT oil pressure gauge assembly
YB-06580



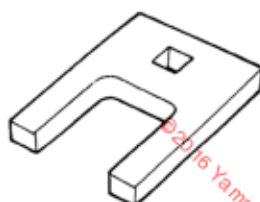
PTT oil pressure gauge adapter
YB-06581



Trim and tilt cylinder wrench
YB-06175-2B

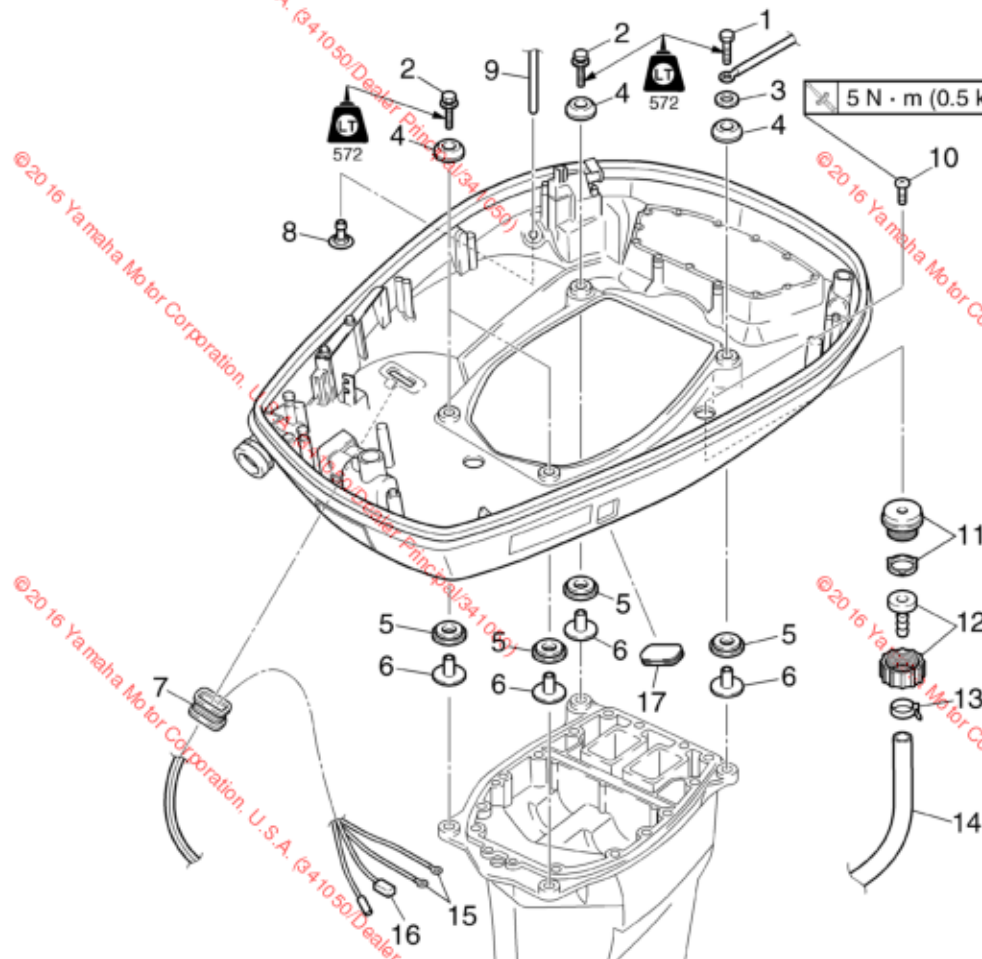


PTT piston vice attachment
YB-06572



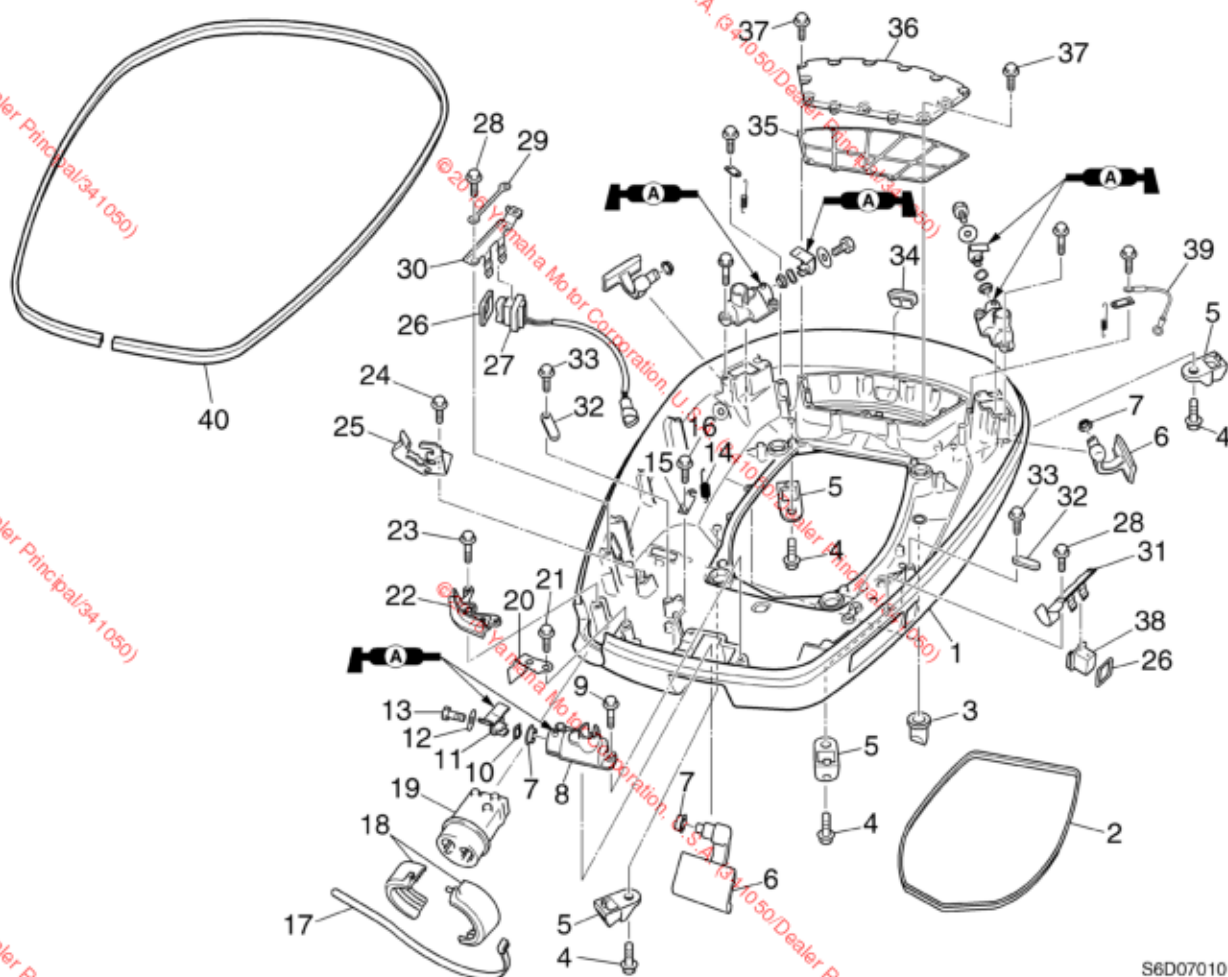
Tilt rod wrench
YB-06569

Bottom cowling



S60V7010

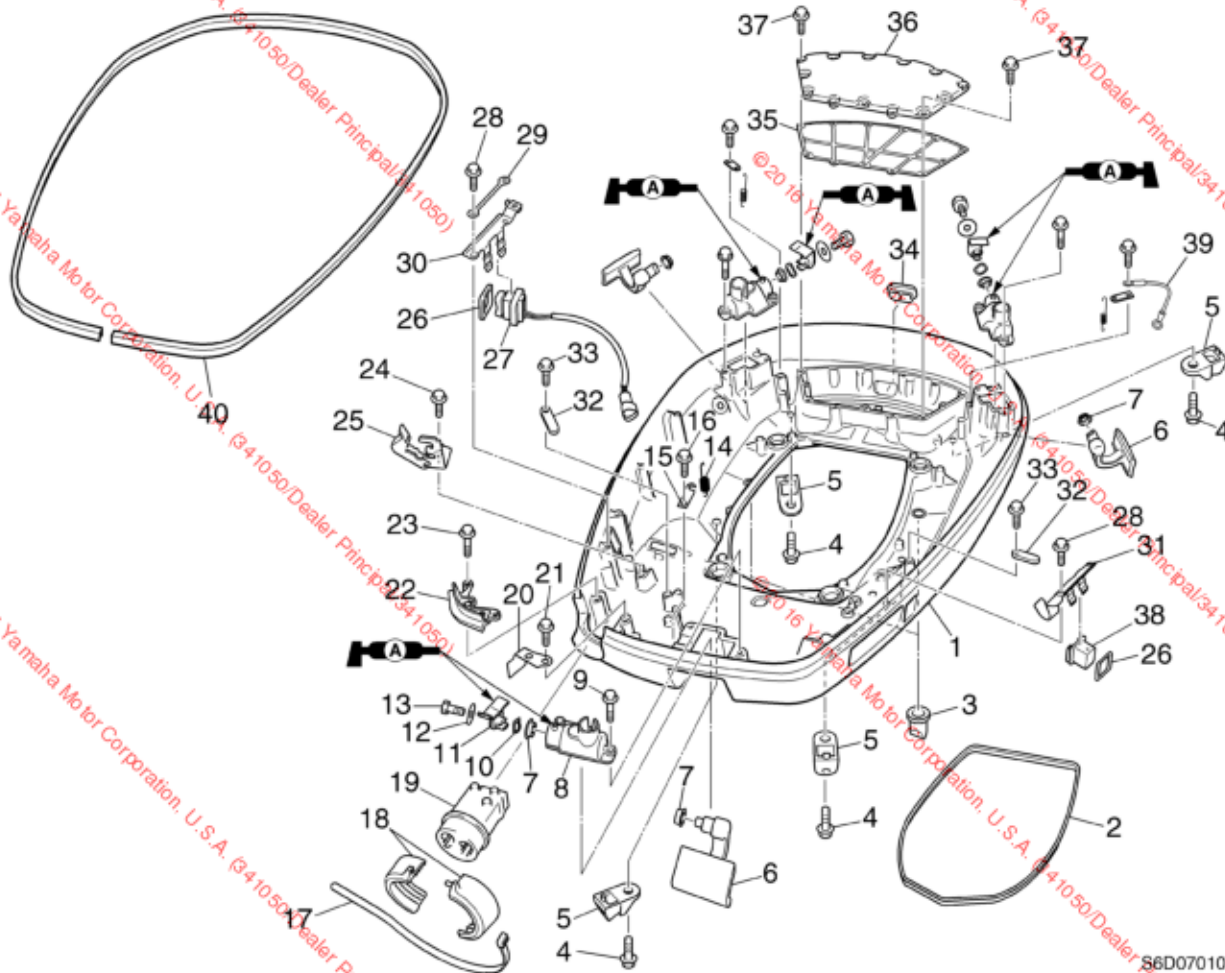
No.	Part name	Q'ty	Remarks
1	Bolt	1	M8 × 35 mm
2	Bolt	3	M8 × 35 mm
3	Washer	1	
4	Grommet	4	
5	Grommet	4	
6	Collar	4	
7	Grommet	1	
8	Cooling water pilot hole	1	
9	Pilot water hose	1	
10	Screw	1	M5 × 20 mm
11	Adapter	1	
12	Hose joint	1	
13	Plastic tie	1	Not reusable
14	Flushing hose	1	
15	PTT motor lead	1	
16	Trim sensor coupler	1	
17	Grommet	1	



S6D07010

No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Grommet	2	
4	Bolt	4	M6 × 16 mm
5	Bracket	4	
6	Cowling lock lever	3	
7	Bushing	6	
8	Plate	3	
9	Bolt	6	M6 × 30 mm
10	Wave washer	3	
11	Lever	3	
12	Washer	3	
13	Bolt	3	M6 × 16 mm
14	Spring	3	
15	Hook	3	
16	Bolt	3	M6 × 16 mm
17	Plastic tie	1	

Bottom cowling

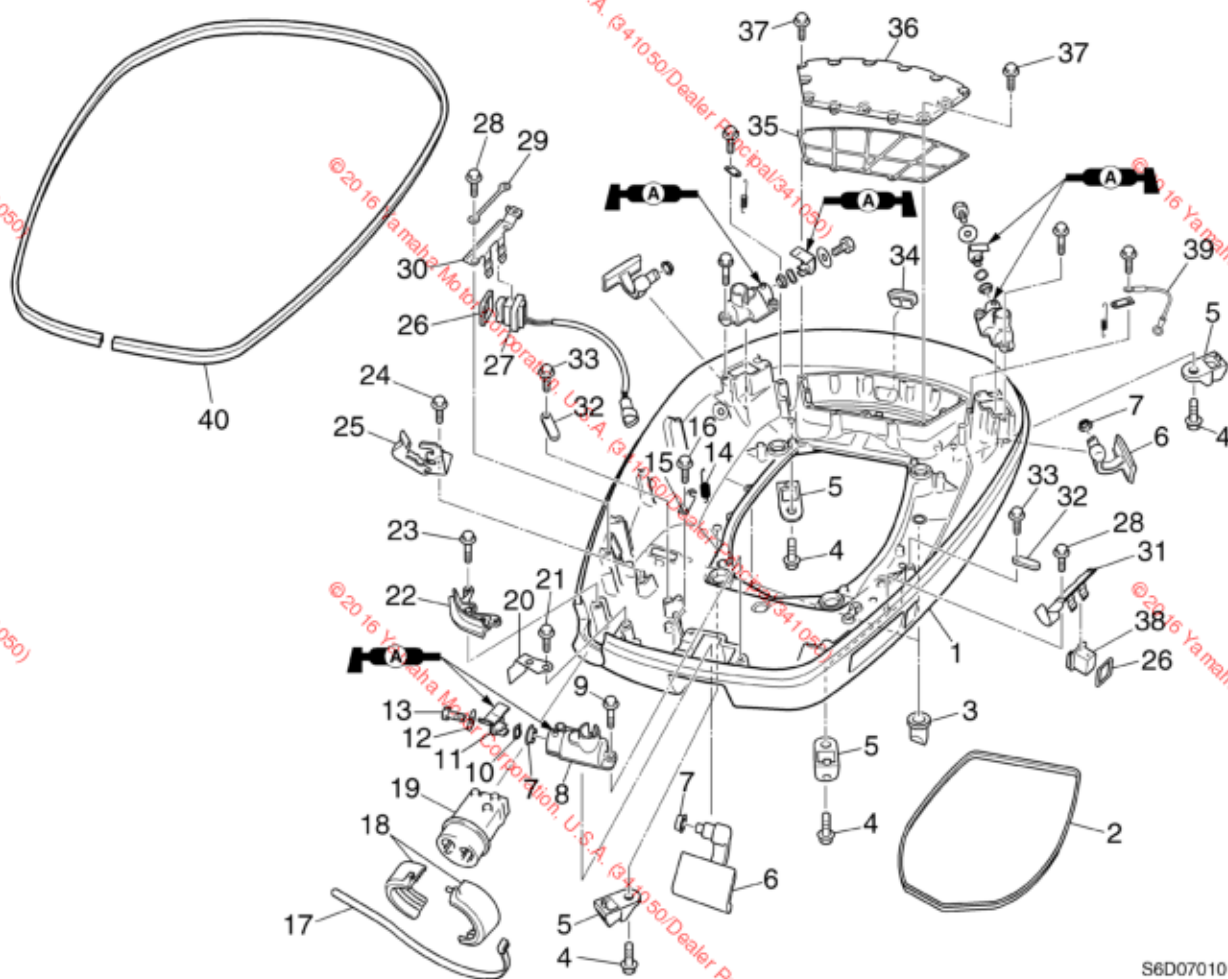


No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Grommet	1	
20	Holder	1	
21	Bolt	1	M6 × 25 mm
22	Retaining plate	1	
23	Bolt	2	M6 × 25 mm
24	Bolt	1	M6 × 16 mm
25	Cable holder	1	
26	Grommet	2	
27	Power trim and tilt switch	1	
28	Bolt	4	M6 × 20 mm
29	Bracket	1	
30	Bracket	1	
31	Bracket	1	
32	Plate	2	
33	Bolt	2	M6 × 20 mm
34	Grommet	1	

BRKT



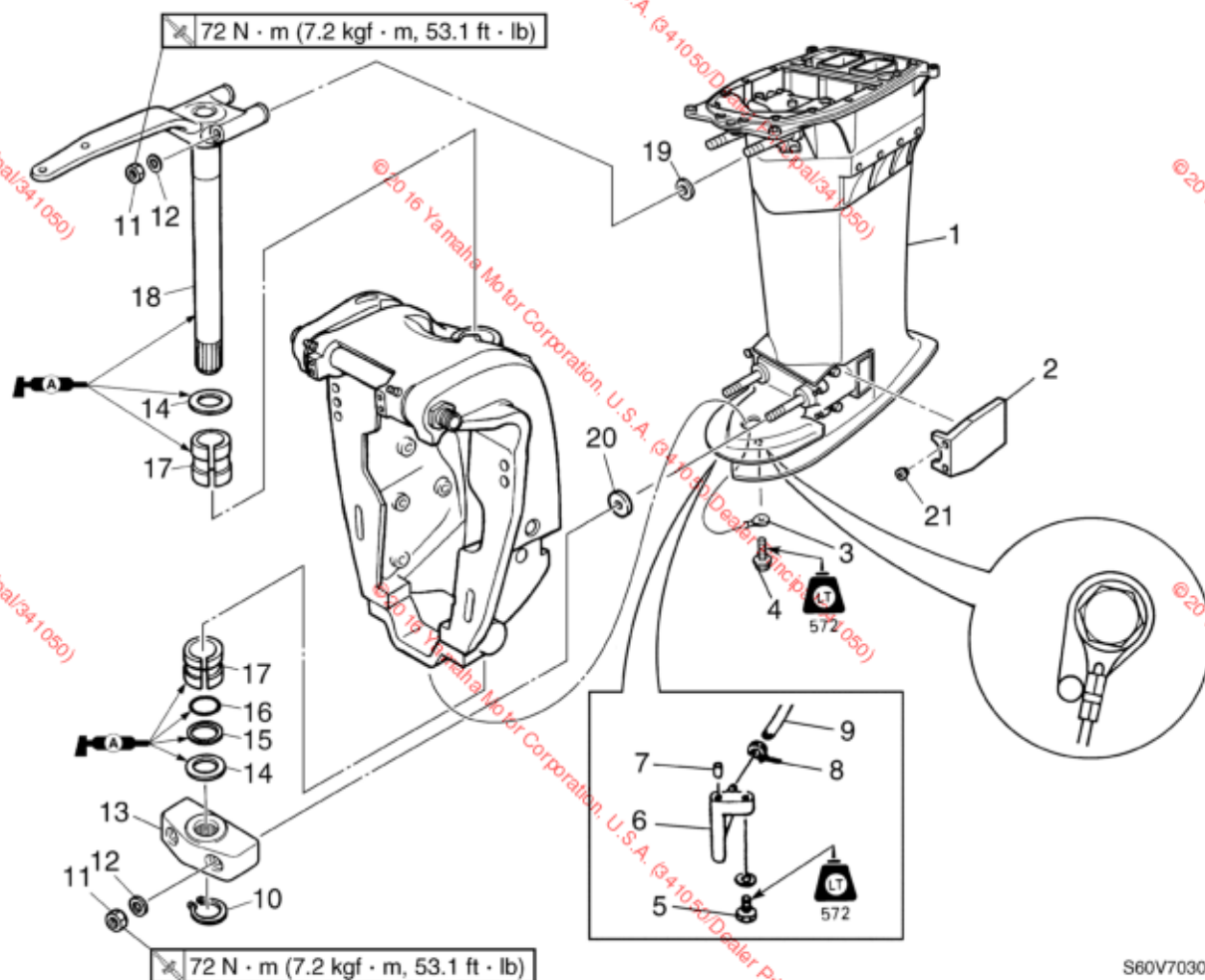
Bracket unit



S6D07010

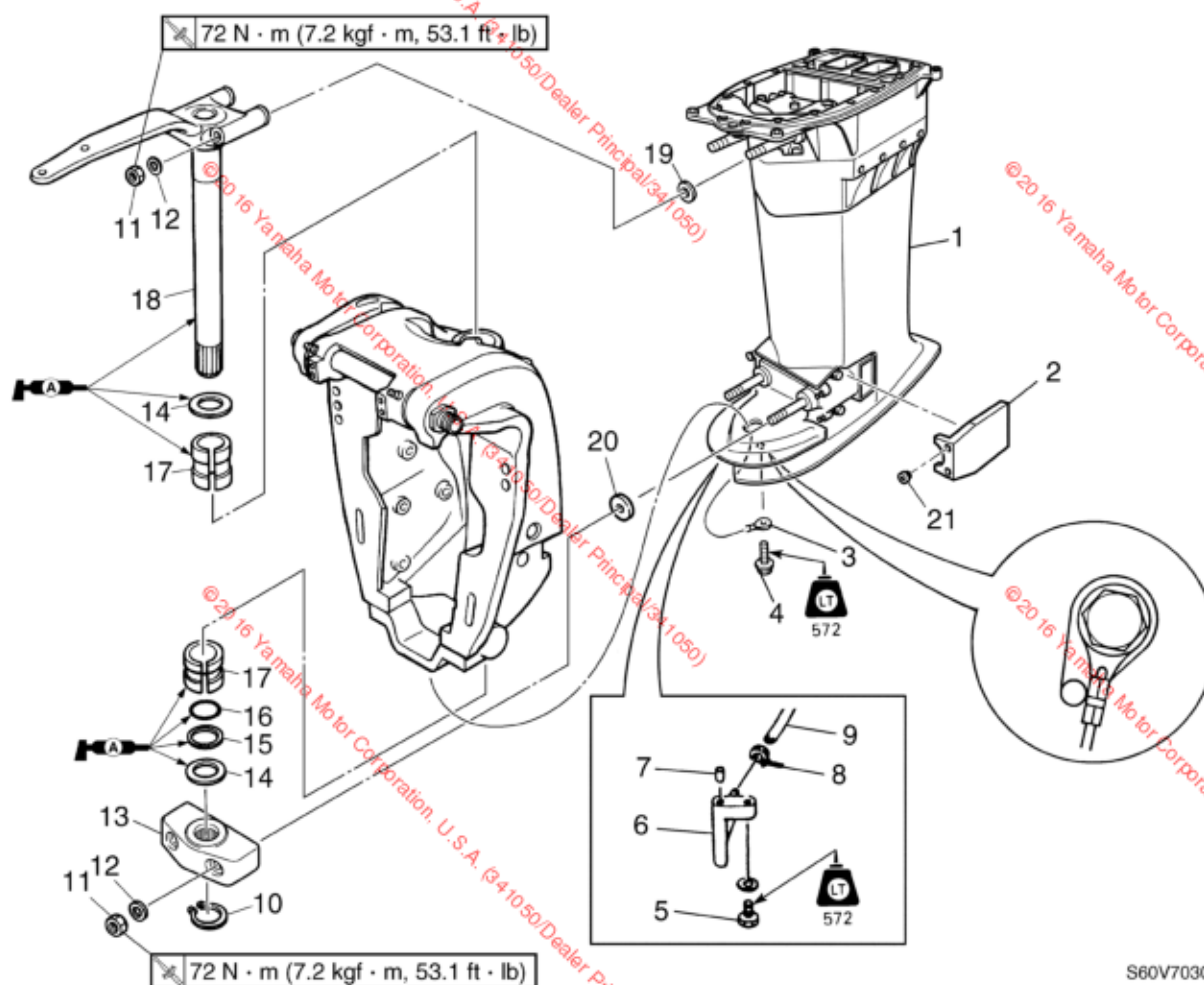
No.	Part name	Q'ty	Remarks
35	Gasket	1	Not reusable
36	Cover	1	
37	Bolt	13	M6 × 20 mm
38	Cover	1	
39	Ground lead	1	
40	Rubber trim	1	

Bottom cowling / Upper case, steering arm, swivel bracket, and clamp brackets Upper case, steering arm, swivel bracket, and clamp brackets



S60V7030

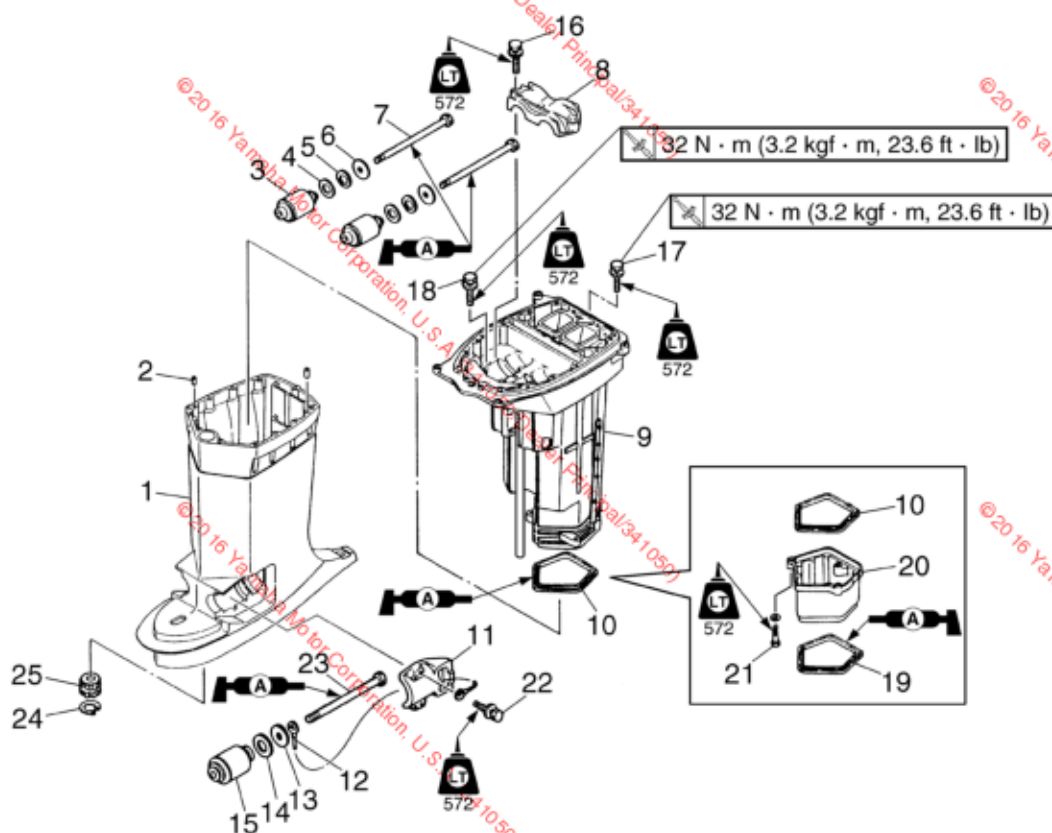
No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Cover	2	
3	Ground lead	1	
4	Bolt	1	M6 × 10 mm
5	Bolt	1	M6 × 17 mm
6	Adapter	1	
7	Dowel	1	
8	Plastic tie	1	Not reusable
9	Hose	1	
10	Circlip	1	
11	Nut	4	
12	Washer	4	
13	Steering yoke	1	
14	Washer	2	
15	Bushing	1	
16	O-ring	1	Not reusable
17	Bushing	2	



S60V7030

No.	Part name	Q'ty	Remarks
18	Steering arm	1	
19	Washer	2	
20	Washer	2	
21	Grommet	4	

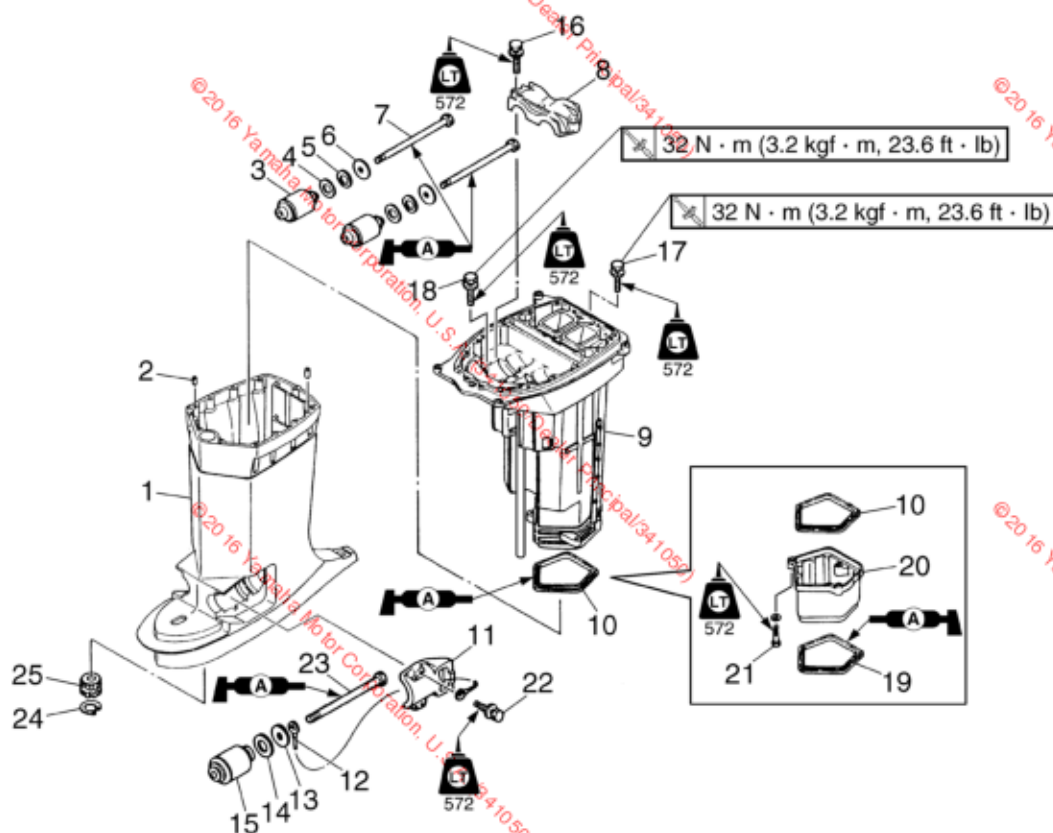
Upper case, steering arm, swivel bracket, and clamp brackets



S60V7040

No.	Part name	Q'ty	Remarks
1	Upper case	1	
2	Dowel	2	
3	Upper mount	2	
4	Washer	2	
5	Washer	2	
6	Washer	2	
7	Bolt	2	M14 × 190 mm
8	Bracket	1	
9	Muffler assembly	1	
10	Gasket	1	Not reusable
11	Mount housing	2	
12	Ground lead	1	
13	Washer	2	
14	Washer	2	
15	Lower mount	2	
16	Bolt	3	M10 × 45 mm
17	Bolt	1	M8 × 45 mm

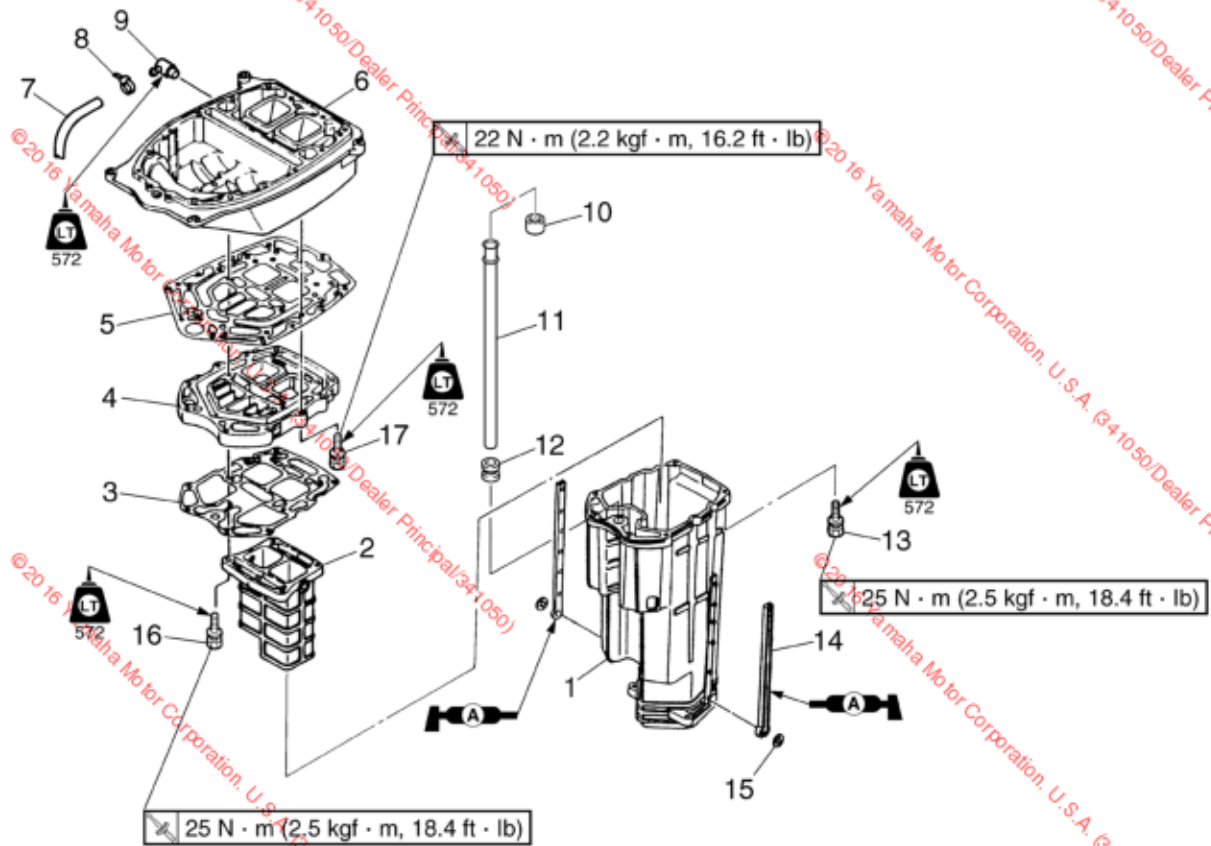
7



S60V7040

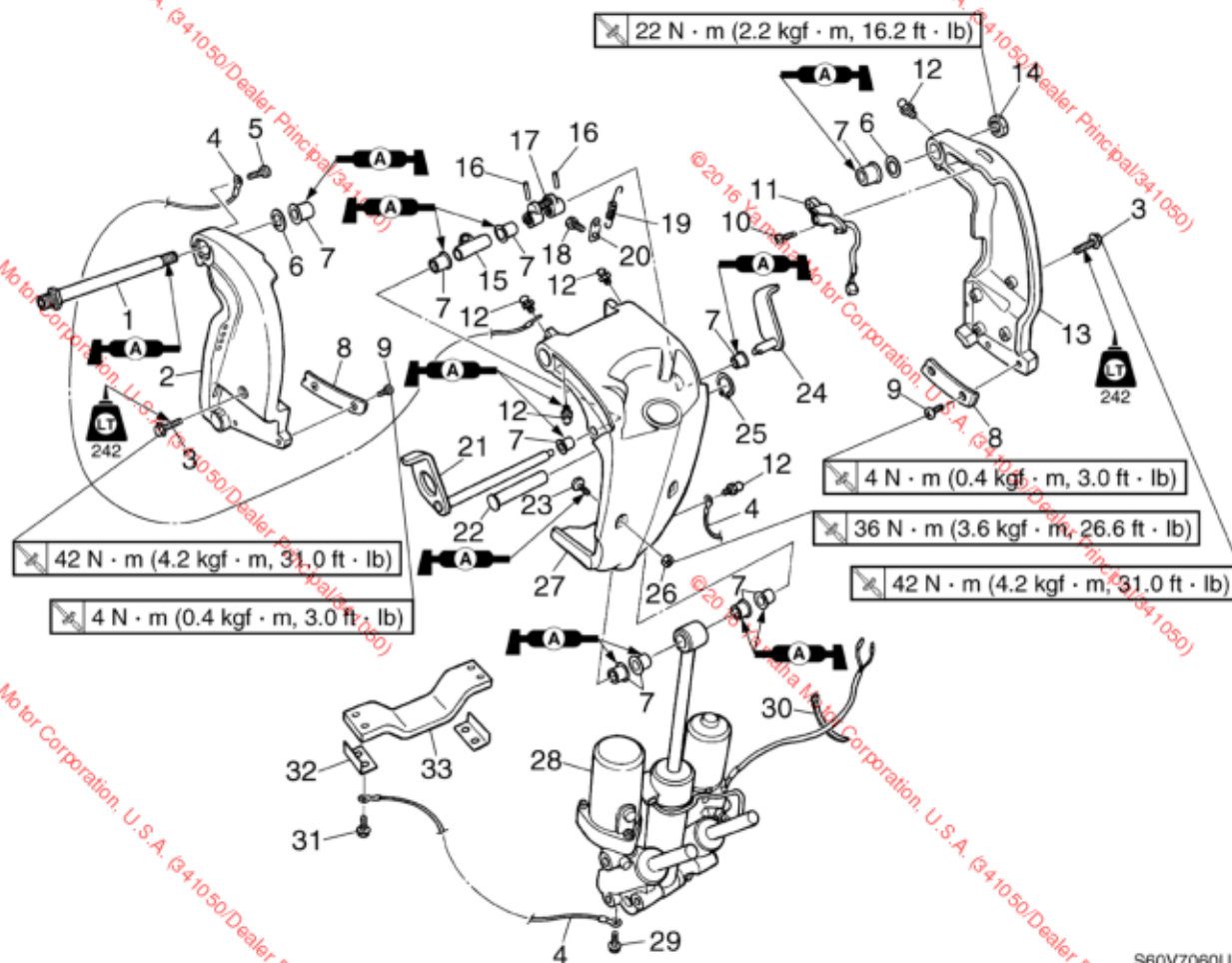
No.	Part name	Q'ty	Remarks
18	Bolt	2	M8 × 30 mm
19	Gasket	1	U-transom model Not reusable
20	Muffler	1	U-transom model
21	Bolt	2	M6 × 35 mm / U-transom model
22	Bolt	4	M10 × 45 mm
23	Bolt	2	M14 × 205 mm
24	Circlip		
25	Bushing	1	

Upper case, steering arm, swivel bracket, and clamp brackets



S60V7050

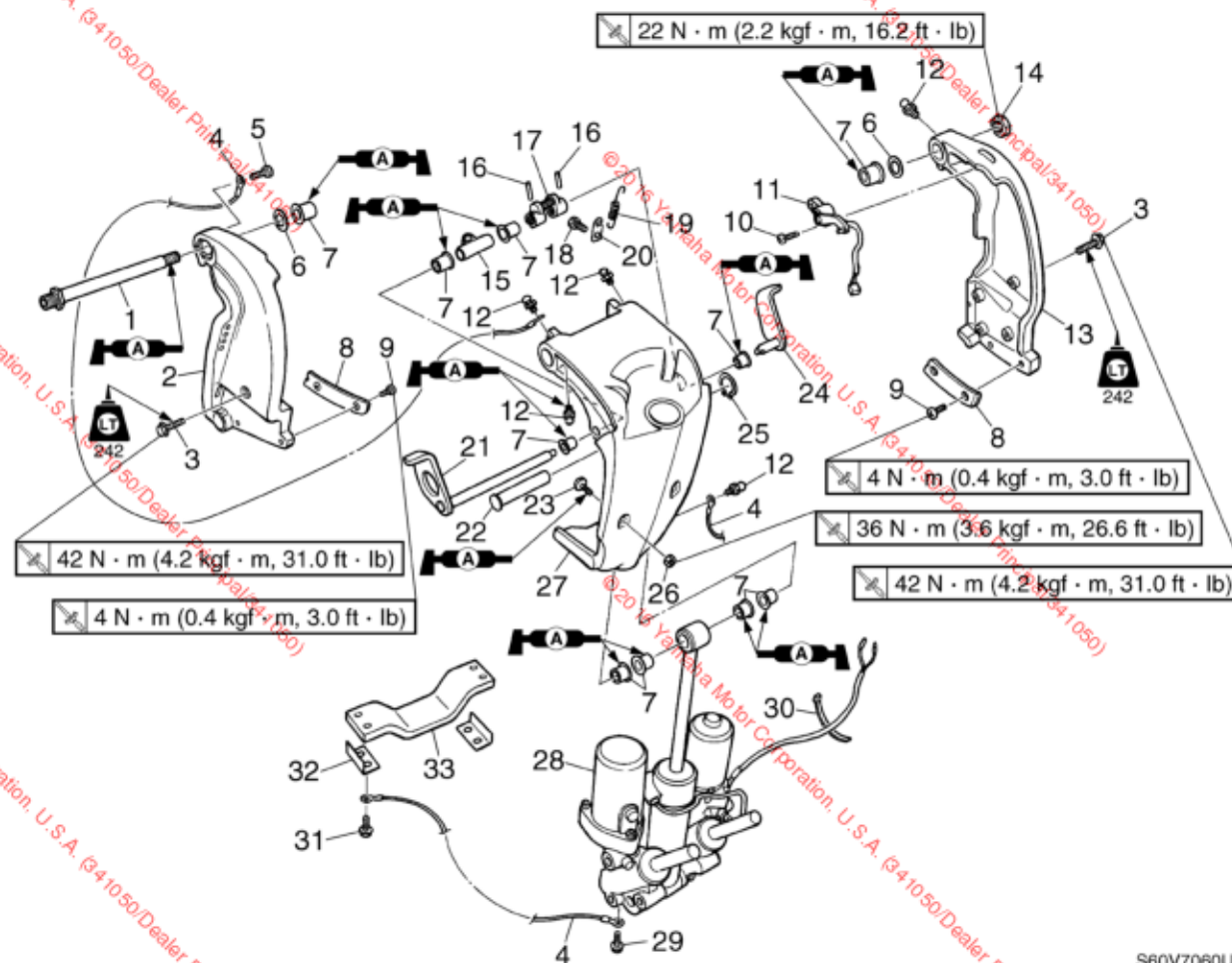
No.	Part name	Q'ty	Remarks
1	Muffler	1	
2	Exhaust manifold	1	
3	Gasket	1	Not reusable
4	Lower exhaust guide	1	
5	Gasket	1	Not reusable
6	Upper exhaust guide	1	
7	Flushing hose	1	
8	Plastic tie	1	Not reusable
9	Joint	1	
10	Rubber seal	1	
11	Pipe	1	
12	Rubber seal	1	
13	Bolt	6	M8 × 50 mm
14	Rubber damper	2	
15	Clip	2	
16	Bolt	4	M8 × 50 mm
17	Bolt	4	M8 × 35 mm



S60V7060U

No.	Part name	Q'ty	Remarks
1	Through tube	1	
2	Port clamp bracket	1	
3	Bolt	8	M10 × 45 mm
4	Ground lead	3	
5	Screw	1	ø6 × 10 mm
6	Washer	2	
7	Bushing	10	
8	Friction plate	2	
9	Screw	4	ø6 × 10 mm
10	Screw	2	ø6 × 15 mm
11	Trim sensor	1	
12	Grease nipple	6	
13	Starboard clamp bracket	1	
14	Self-locking nut	1	
15	Collar	1	
16	Pin	2	
17	Tilt lever joint	1	

Upper case, steering arm, swivel bracket, and clamp brackets



S60V7060U

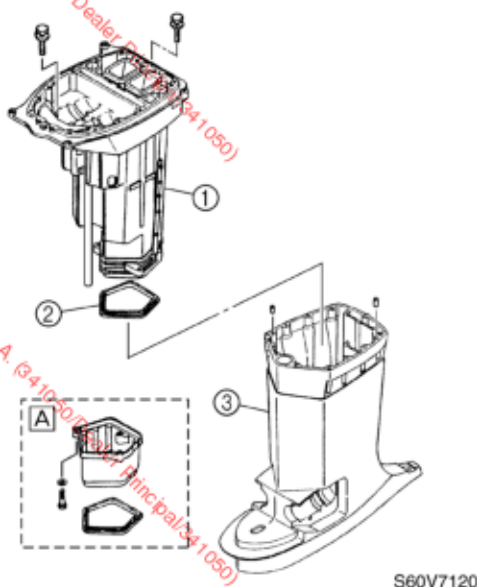
No.	Part name	Qty	Remarks
18	Bolt	1	M6 × 10 mm
19	Spring	1	
20	Spring holder	1	
21	Port tilt stop lever	1	
22	Shaft	1	
23	Trim stopper	2	
24	Starboard tilt stop lever	1	
25	Circlip	1	
26	Nut	2	
27	Swivel bracket	1	
28	Power trim and tilt unit	1	
29	Bolt	1	M6 × 10 mm
30	Plastic tie	4	
31	Bolt	4	M6 × 25 mm
32	Bracket	2	
33	Anode	1	

7



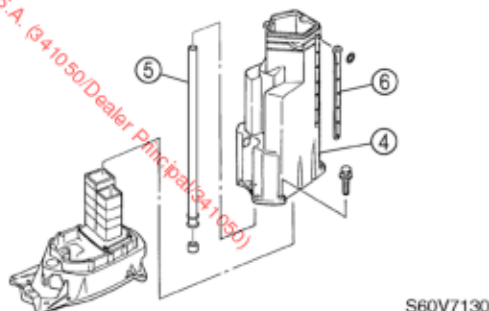
Disassembling the upper case

1. Remove the muffler assembly ① and gasket ② from the upper case ③.

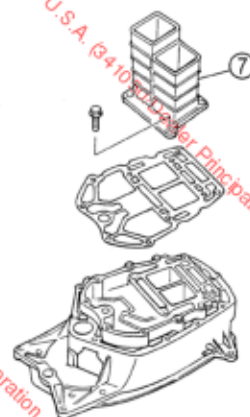


A U-transom model

2. Remove the muffler ④, cooling water pipe ⑤, and rubber damper ⑥.

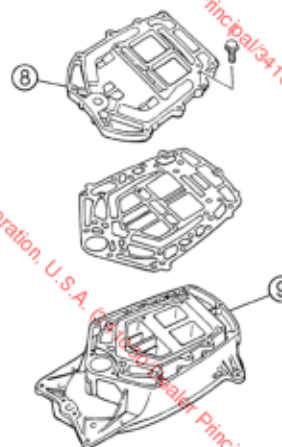


3. Remove the exhaust manifold ⑦.



S60V7140

4. Remove the lower exhaust guide ⑧ from the upper exhaust guide ⑨.



S60V7150

Checking the upper case

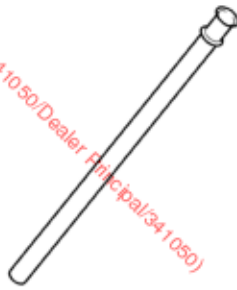
1. Check the rubber damper for deterioration. Replace if necessary.



S60V7160

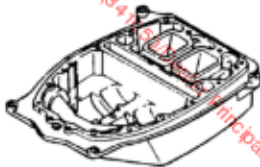
2. Check the cooling water pipe for deformation or corrosion. Replace if necessary.

Upper case, steering arm, swivel bracket, and clamp brackets

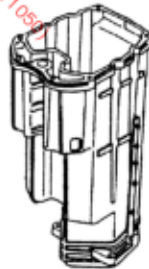


S60V7170

3. Check the exhaust guide, exhaust manifold, and muffler for damage or corrosion. Replace if necessary.



S60V7180

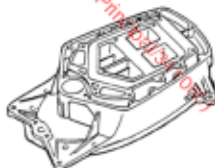


Assembling the upper case

1. Install a new gasket ①, the lower exhaust guide ②, and bolts, and then tighten the bolts to the specified torque.



572

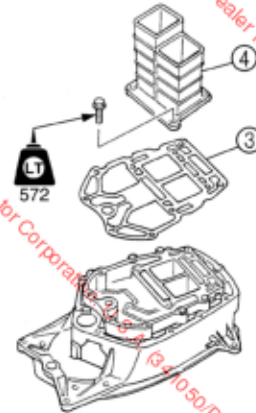


S60V7190



Lower exhaust guide bolt:
22 N·m (2.2 kgf·m, 16.2 ft·lb)

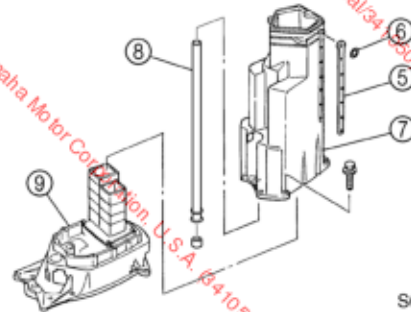
2. Install a new gasket ③, the exhaust manifold ④, and bolts, and then tighten the bolts to the specified torque.



S60V7200

Exhaust manifold bolts:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

3. Install the rubber damper ⑤ and clip ⑥ onto the muffler ⑦.
4. Install the cooling water pipe ⑧ onto the muffler ⑦.
5. Install the muffler ⑦ onto the exhaust guide ⑨, and then tighten the bolts to the specified torque.



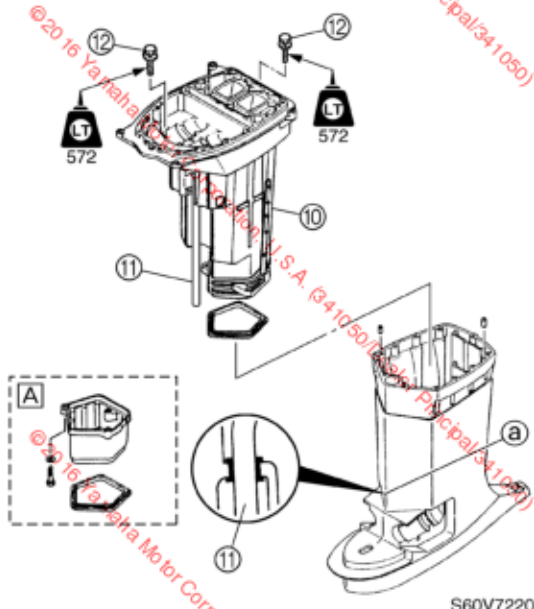
S60V7210



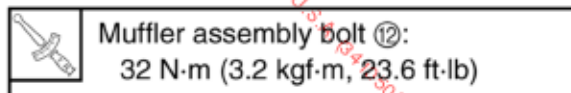
Muffler bolt:
25 N·m (2.5 kgf·m, 18.4 ft·lb)



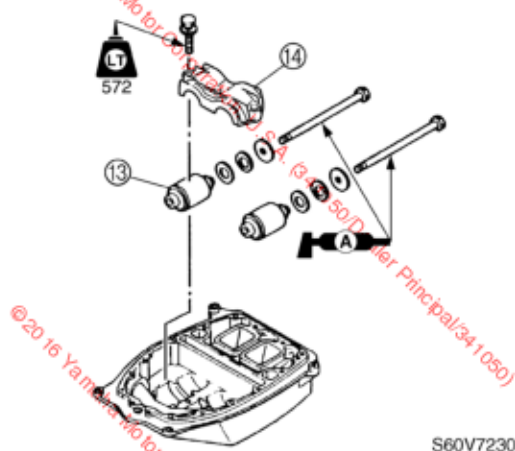
6. Install the muffler assembly ⑩ by inserting the tip of the cooling water pipe ⑪ into the joint hole ③ of the upper case.
7. Tighten the muffler assembly bolts ⑫ to the specified torque.



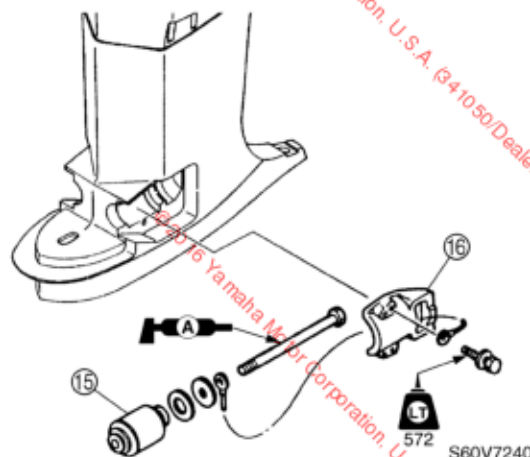
A U-transom model



8. Install the upper mounts ⑬ and bolts into the upper case.
9. Install the bracket ⑭ and bolts.

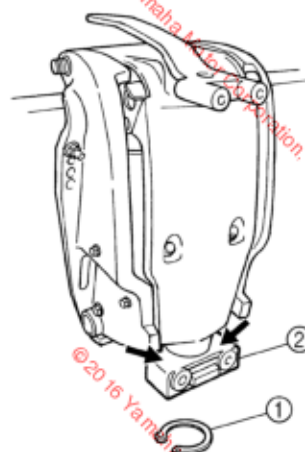


10. Install the lower mounts ⑮ and mount housings ⑯.



Removing the steering arm

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

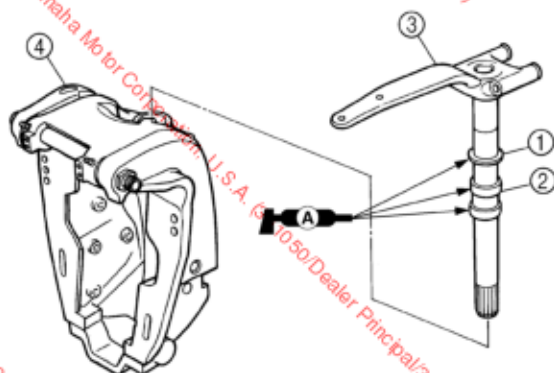


3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

Upper case, steering arm, swivel bracket, and clamp brackets

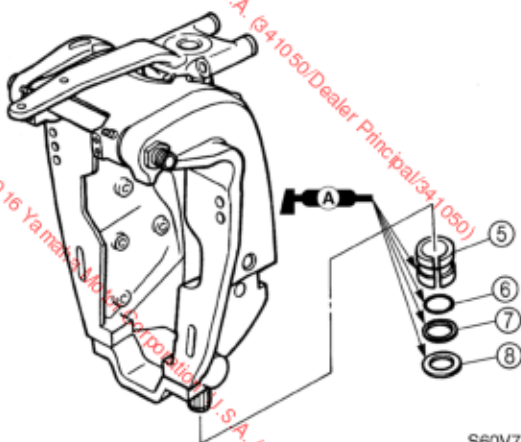
Installing the steering arm

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



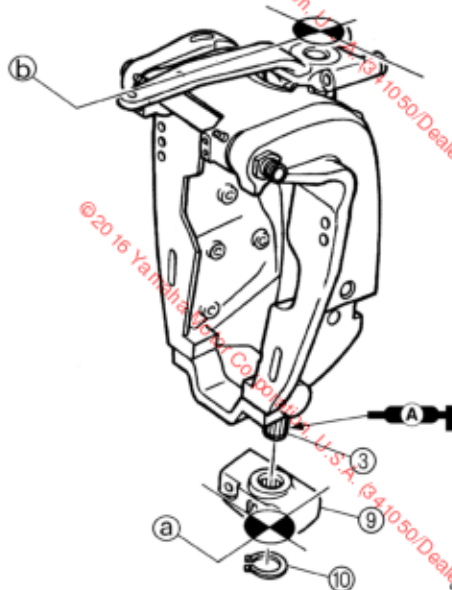
S69J7080

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



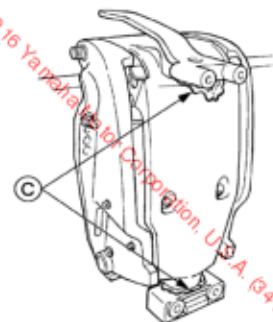
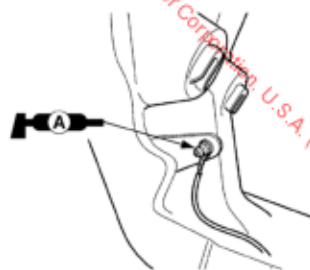
S60V7700

4. Install the steering arm ③ into the steering yoke ⑨ by aligning the center ③ of the yoke with the center ④ of the steering arm.
5. Install the circlip ⑩.



S69J7090

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



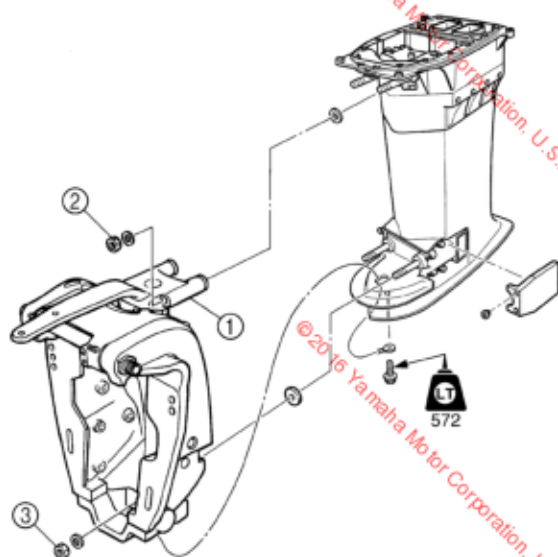
S69J7095

7

BRKT**Bracket unit**

Installing the upper case

1. Install the upper and lower mounting bolts into the swivel bracket ① simultaneously.
2. Install the upper mounting nut ② and lower mounting nut ③, and then tighten them to the specified torques.



S60V7250



Upper mounting nut ②:

72 N·m (7.2 kgf·m, 53.1 ft·lb)

Lower mounting nut ③:

72 N·m (7.2 kgf·m, 53.1 ft·lb)

Removing the power trim and tilt unit

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



S60V3310

⚠ WARNING

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

NOTE:

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

2. Remove the anode ② and bolts ③.

3. Loosen the self-locking nut ④, and then move the clamp brackets slightly in the direction of the arrows.

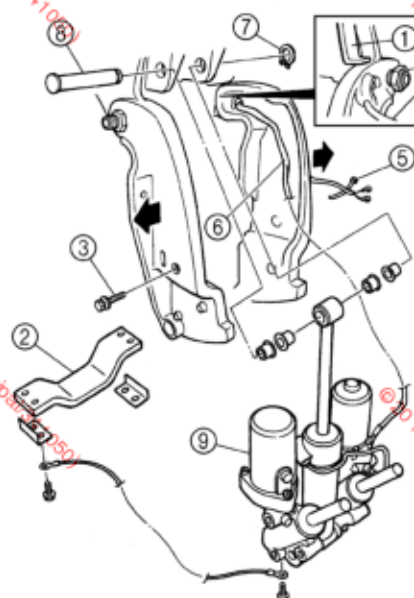
⚠ WARNING

Do not remove the tilt stop lever ① from the clamp brackets.

4. Remove the plastic ties ⑤, and then pull out the PTT motor lead ⑥.

5. Remove the circlip ⑦, then the shaft ⑧.

6. Remove the power trim and tilt unit ⑨.

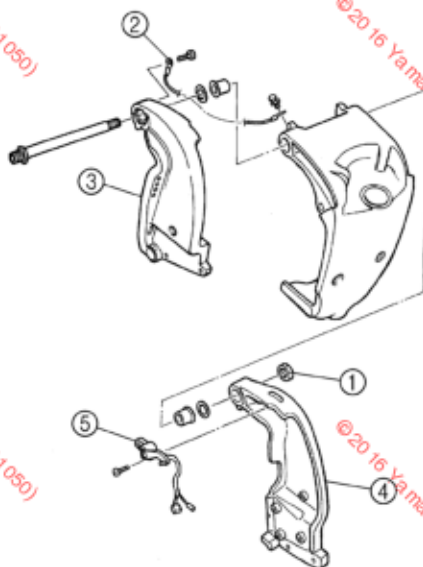


S60V7260

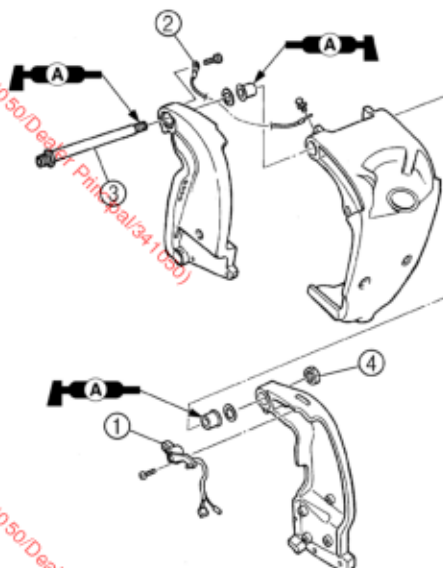
Upper case, steering arm, swivel bracket, and clamp brackets

Removing the clamp brackets

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



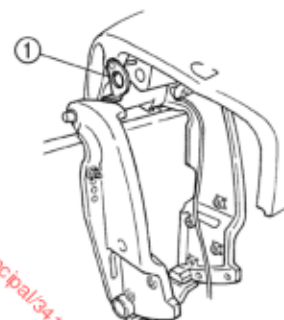
S69J7120



S69J7130

Installing the power trim and tilt unit

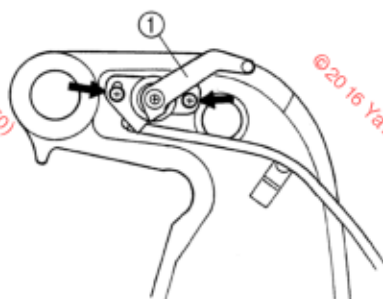
1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S60V7270

Installing the clamp brackets

1. Install the trim sensor ① onto the starboard clamp bracket.



S69J7125

NOTE:

Adjust the trim sensor ① after installing the power trim and tilt unit.

2. Assemble the clamp brackets and the swivel bracket by connecting the ground lead ②, installing the through tube ③, then tightening the self-locking nut ④ finger tight.

NOTE:

After tilting up the outboard motor, be sure to support it with the tilt stop lever ①.

7

BRKT**Bracket unit**

2. Install the PTT unit mounting bolts ② onto both clamp brackets together with the power trim and tilt unit ③, and then tighten them to the specified torque.



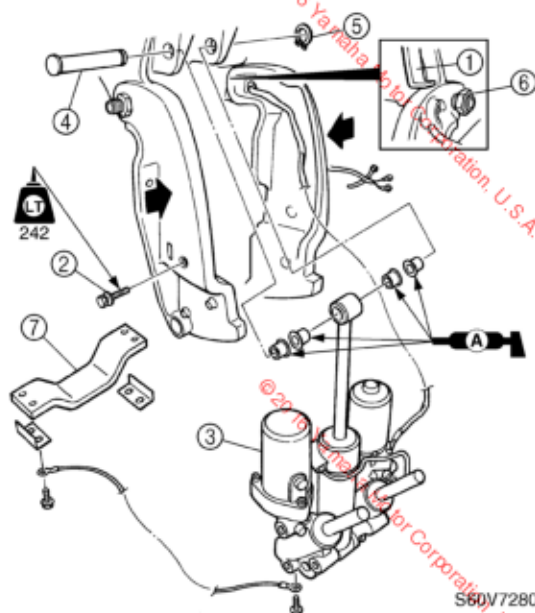
PTT unit mounting bolt ②:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

3. Install the tilt ram upper end into the swivel bracket with the shaft ④ and circlip ⑤.
4. Tighten the through tube nut ⑥ to the specified torque.

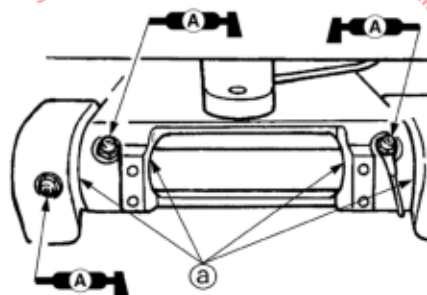
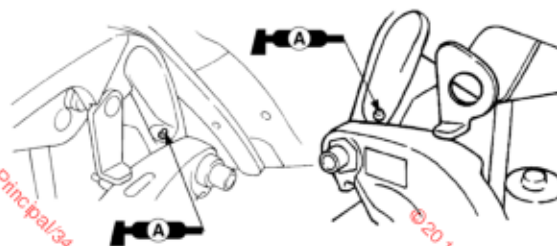


Through tube nut ⑥:
22 N·m (2.2 kgf·m, 16.2 ft·lb)

5. Install the anode ⑦.



6. Inject grease into all grease nipples until grease comes out from the bushings ①.



S69J7145

Adjusting the trim sensor

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



S60V3310

⚠ WARNING

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

2. Loosen the cam screws ②.
3. Adjust the position of the trim sensor, and then tighten the screws ② finger tight.
4. Fully tilt the outboard motor down.

Upper case, steering arm, swivel bracket, and clamp brackets

5. Measure the trim sensor setting resistance. Repeat steps 1–5 if out of specification.

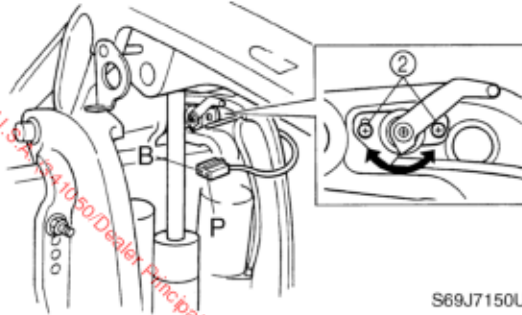


Trim sensor setting resistance:

Pink (P) – Black (B)

9–11 Ω at 20 °C (68 °F)

6. Tighten the screws ②.



S69J7150U

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

⚠ WARNING

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

8. Measure the trim sensor resistance. Check the trim sensor if out of specification.

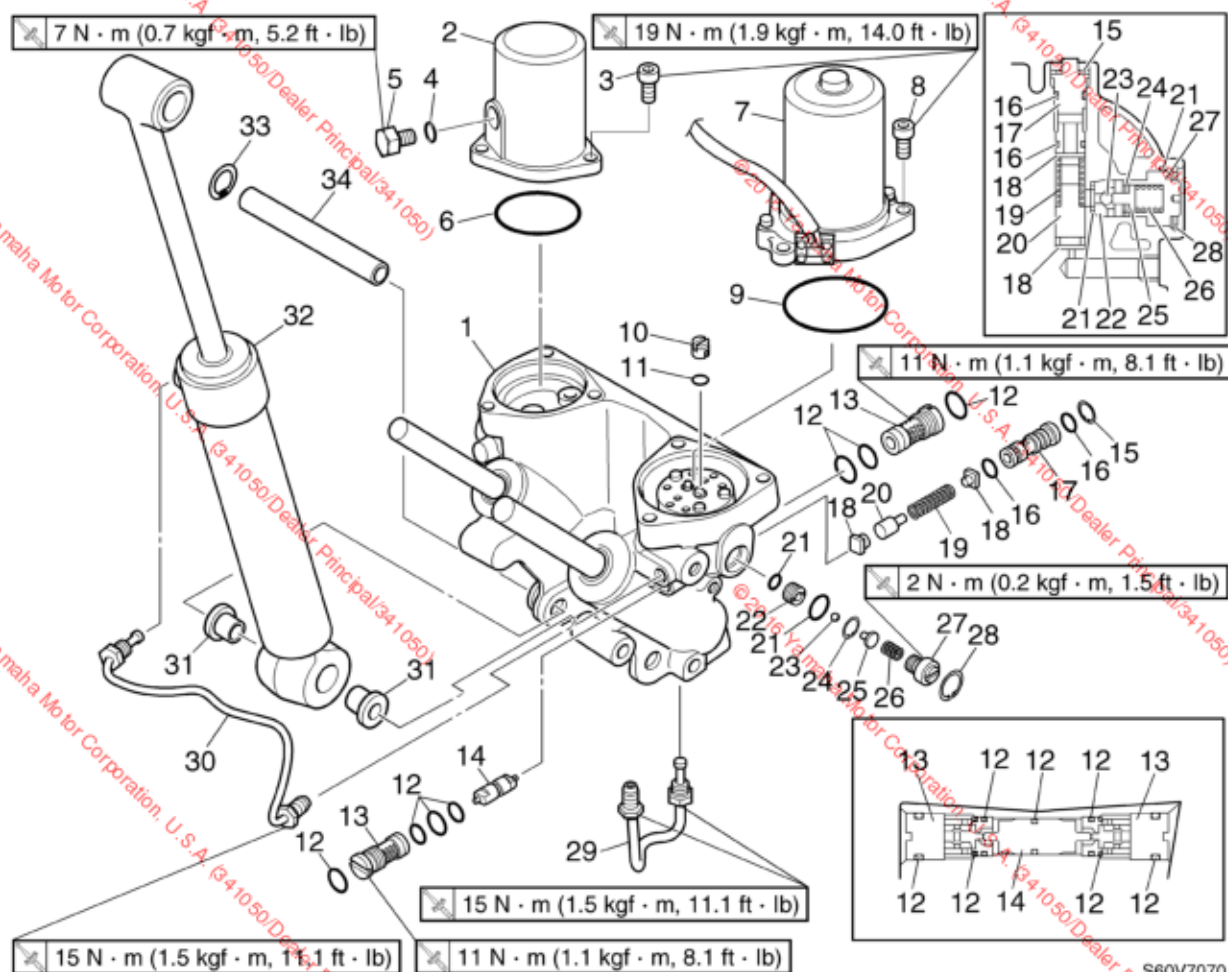


Trim sensor resistance:

Pink (P) – Black (B)

247.6–387.6 Ω at 20 °C (68 °F)

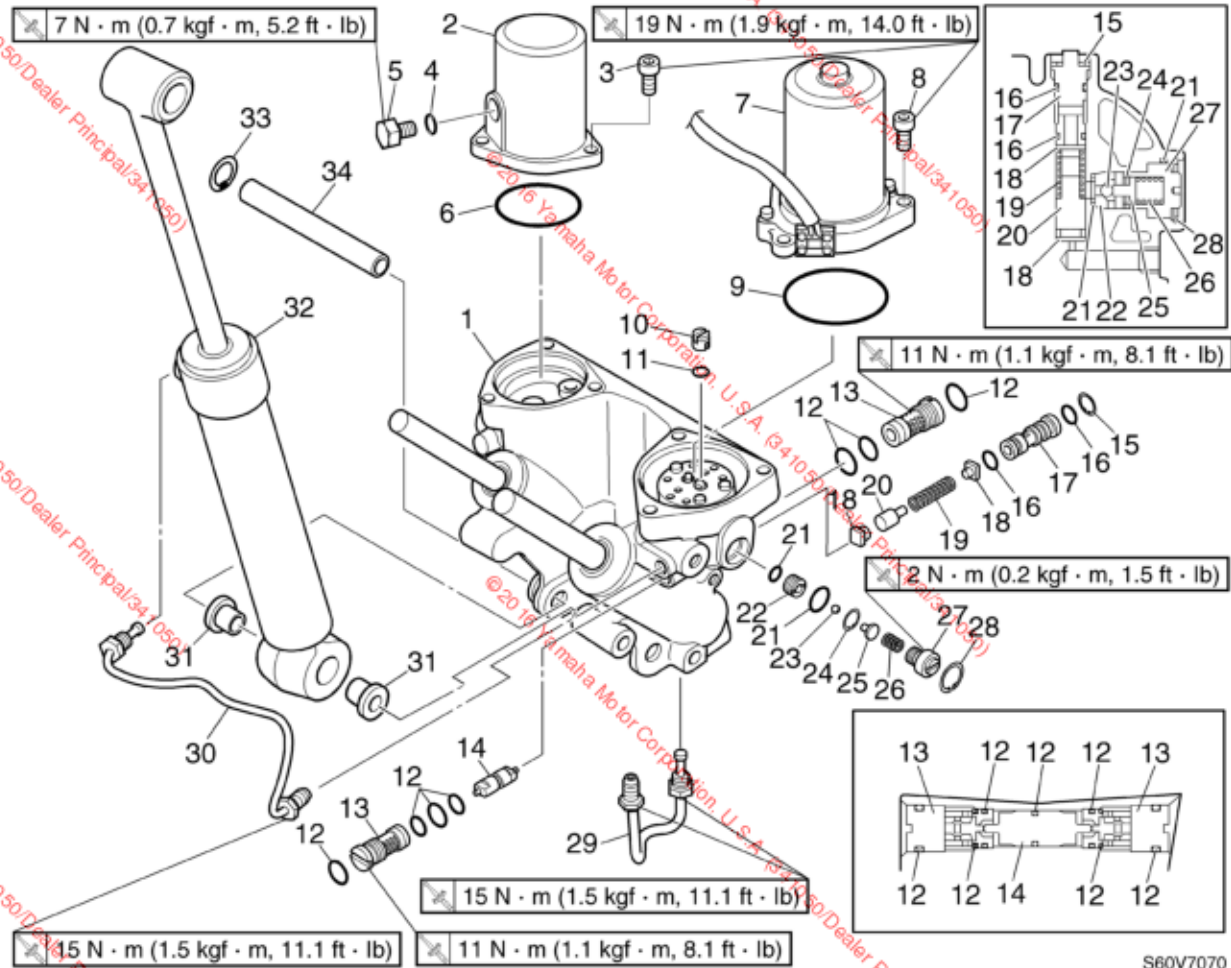
Power trim and tilt unit



S60V7070

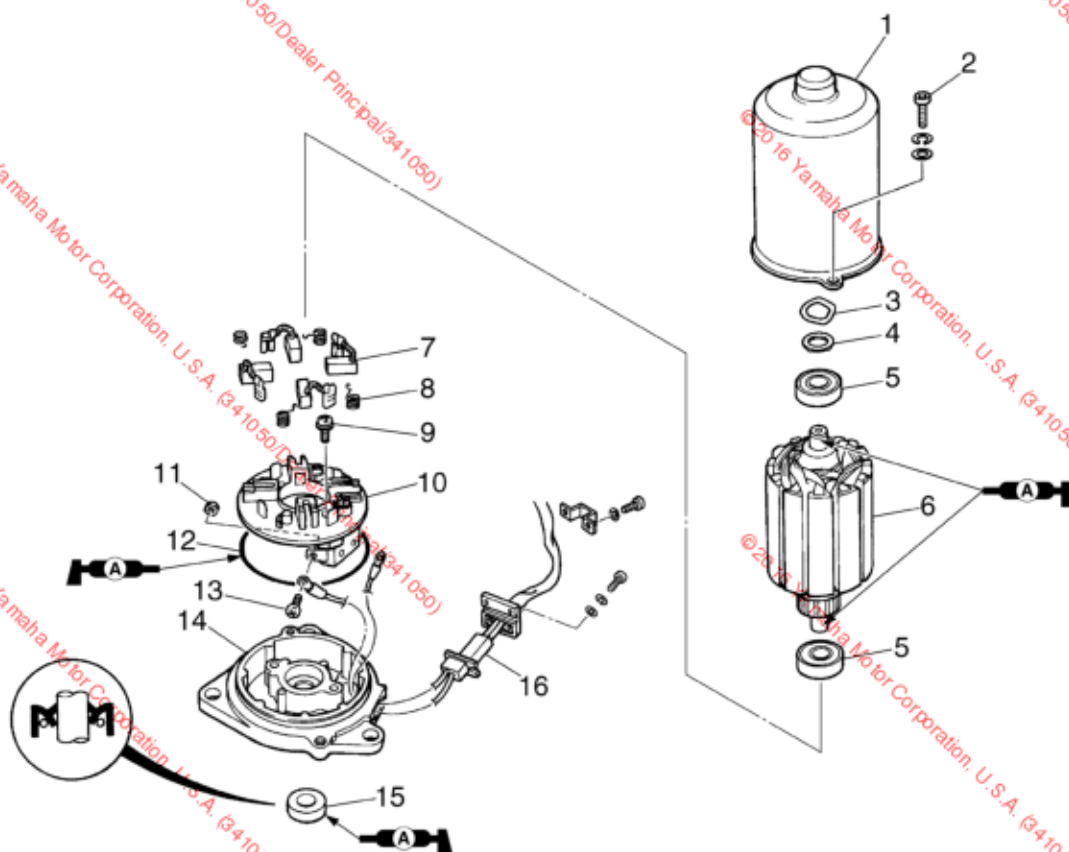
No.	Part name	Q'ty	Remarks
1	Cylinder block	1	
2	Reservoir	1	
3	Bolt	3	M8 × 20 mm
4	O-ring	1	Not reusable
5	Reservoir cap	1	
6	O-ring	1	Not reusable
7	Power trim and tilt motor	1	
8	Bolt	3	M8 × 20 mm
9	O-ring	1	Not reusable
10	Joint	1	
11	O-ring	1	Not reusable
12	O-ring	7	Not reusable
13	Main valve	2	
14	Piston	1	
15	Circlip	1	
16	O-ring	2	Not reusable
17	Retainer	1	

Power trim and tilt unit



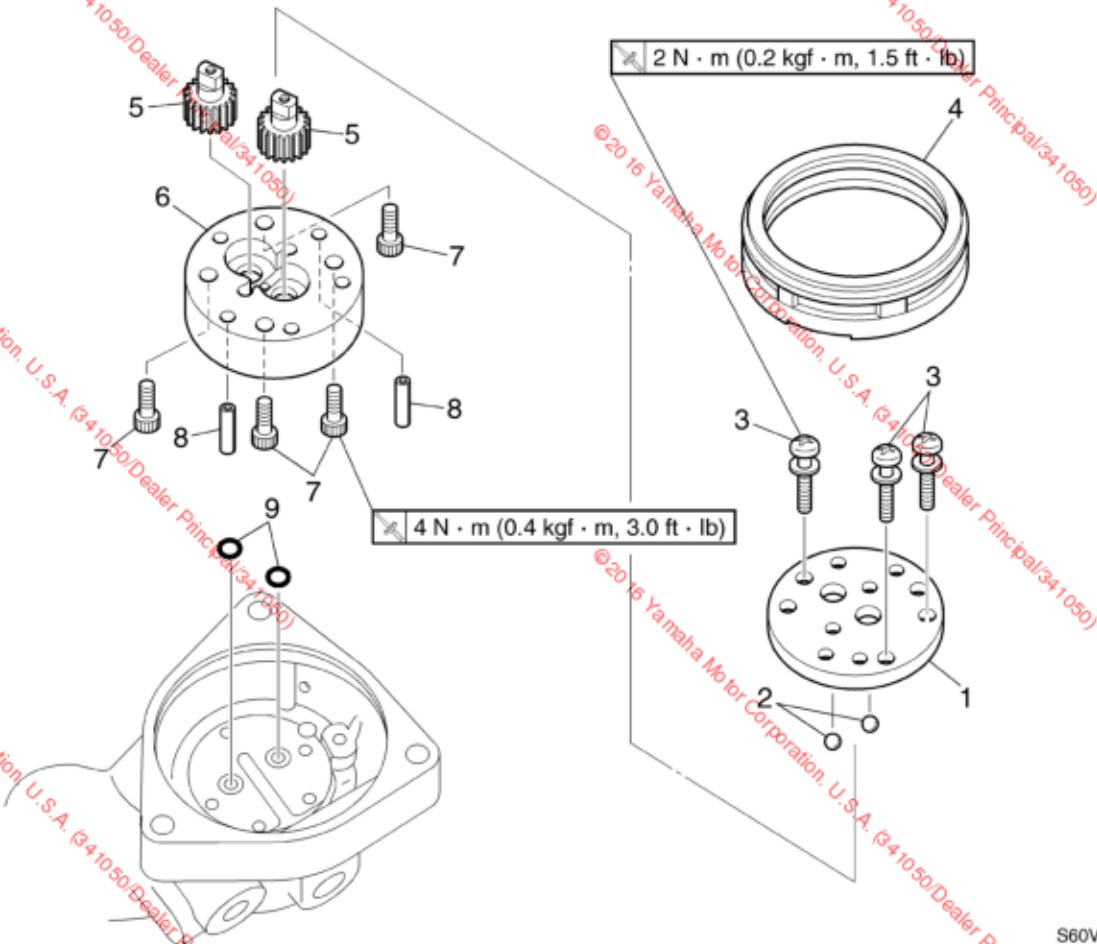
S60V7070

No.	Part name	Q'ty	Remarks
18	Valve seal	2	
19	Spring	1	
20	Spring seat	1	
21	O-ring	2	Not reusable
22	Valve seat	1	
23	Ball	1	
24	Circlip	1	
25	Actuator pin	1	
26	Spring	1	
27	Manual valve	1	
28	Circlip	1	
29	Pipe	1	
30	Pipe	1	
31	Bushing	1	
32	Tilt cylinder assembly	1	
33	Circlip	1	
34	Shaft	1	



S60V7080

No.	Part name	Q'ty	Remarks
1	Yoke	1	
2	Bolt	2	M5 × 12 mm
3	Wave washer	1	
4	Washer	1	
5	Bearing	2	
6	Armature	1	
7	Brush	4	
8	Spring	4	
9	Screw	2	ø4 × 12 mm
10	Brush holder	1	
11	Nut	2	
12	O-ring	1	Not reusable
13	Screw	2	ø4 × 6 mm
14	PTT motor base	1	
15	Oil seal	1	Not reusable
16	PTT motor lead	1	



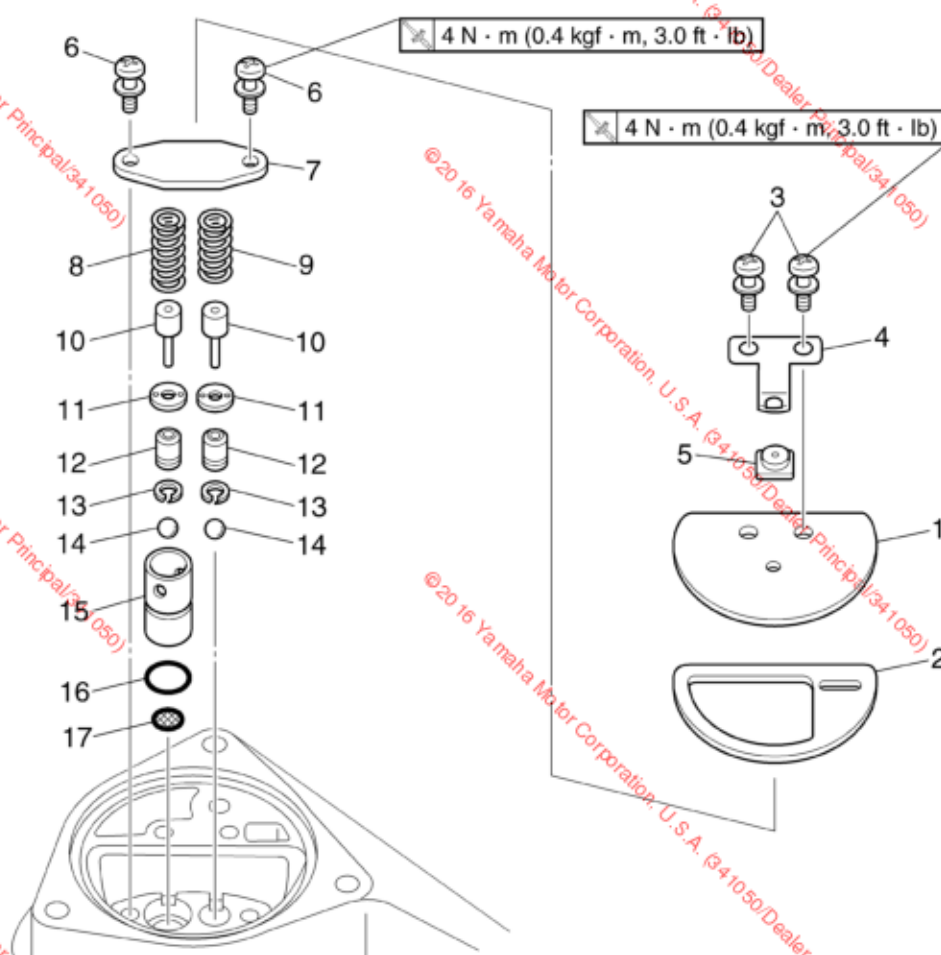
S60V7100

No.	Part name	Q'ty	Remarks
1	Gear housing 1	1	
2	Ball	2	
3	Screw	3	ø4 × 30 mm
4	Gear pump filter	1	
5	Drive gear	2	
6	Gear housing 2	1	
7	Bolt	4	M5 × 12 mm
8	Pin	2	
9	O-ring	2	Not reusable

BRKT



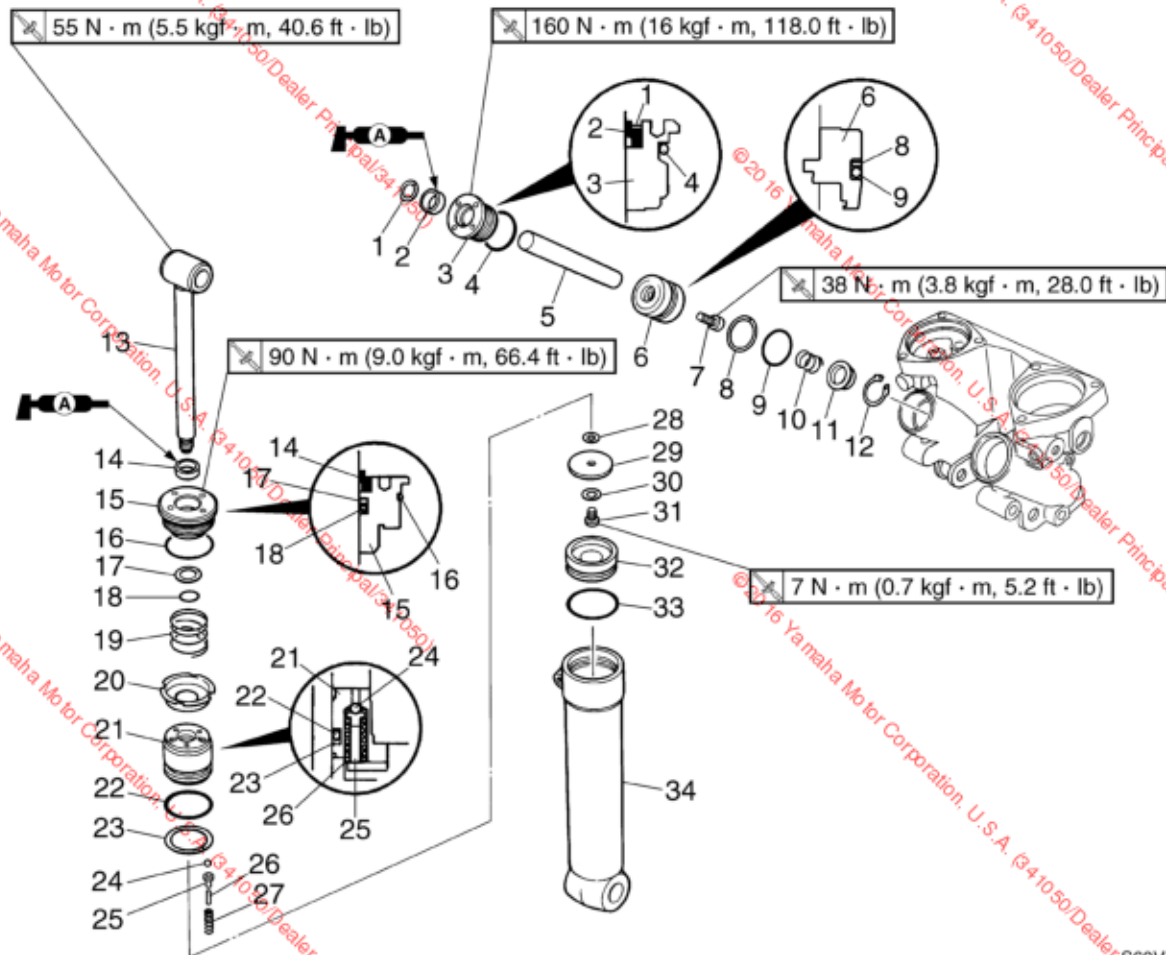
Bracket unit



S60V7110

No.	Part name	Qty	Remarks
1	Trim down plate	1	
2	Seal	1	
3	Screw	2	ø5 × 10 mm
4	Trim down spring	1	
5	Valve seal	1	
6	Screw	2	ø5 × 10 mm
7	Relief valve plate	1	
8	Up-relief valve spring	1	
9	Down-relief valve spring	1	
10	Pin	2	
11	Washer	2	
12	Valve seat	2	
13	Valve seal	2	
14	Ball	2	
15	Relief valve	1	
16	O-ring	1	Not reusable
17	Relief valve filter	1	

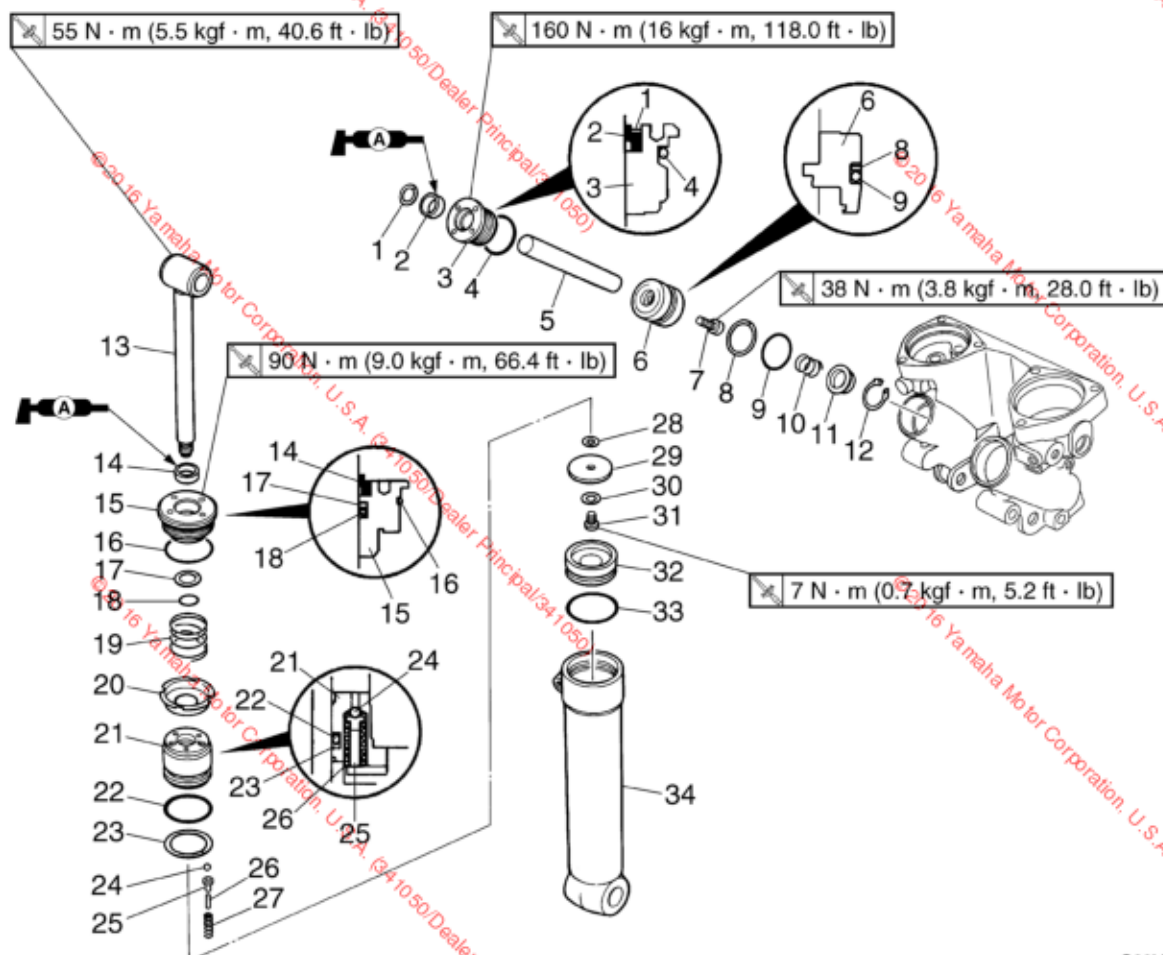
Power trim and tilt unit



S60V7080

No.	Part name	Q'ty	Remarks
1	Circlip	2	
2	Dust seal	2	Not reusable
3	Trim cylinder end screw	2	
4	O-ring	2	Not reusable
5	Trim ram	2	
6	Trim piston	2	
7	Bolt	2	M8 × 20 mm
8	Backup ring	2	
9	O-ring	2	Not reusable
10	Spring	2	
11	Adapter	2	
12	Circlip	2	
13	Tilt ram	1	
14	Dust seal	1	Not reusable
15	Tilt cylinder end screw	1	
16	O-ring	1	Not reusable
17	Backup ring	1	

7

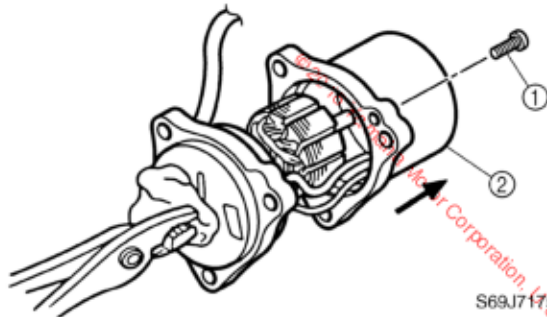


S60V7080

No.	Part name	Q'ty	Remarks
18	O-ring	1	Not reusable
19	Spring	1	
20	Adapter	1	
21	Tilt piston	1	
22	O-ring	1	Not reusable
23	Backup ring	1	
24	Ball	5	
25	Pin	5	
26	Pin	5	
27	Spring	5	
28	Washer	1	
29	Plate	1	
30	Washer	1	
31	Bolt	1	M6 × 10 mm
32	Free piston	1	
33	O-ring	1	Not reusable
34	Tilt cylinder	1	

Disassembling the power trim and tilt motor

1. Remove the PTT motor screws ①, then the yoke ②.



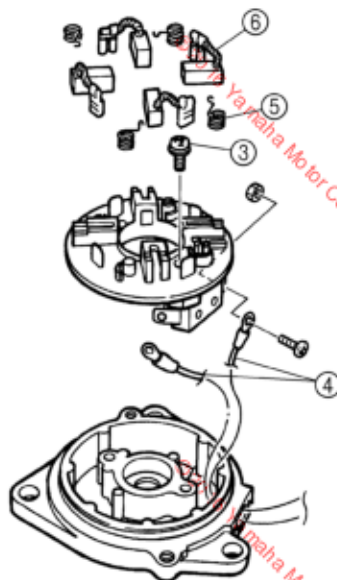
CAUTION:

Do not allow grease or oil to contact the commutator.

NOTE:

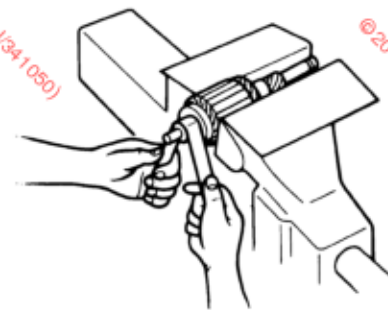
Place a clean cloth over the end of the armature shaft and carefully pull the armature from the yoke with pliers as shown.

2. Remove the screws ③, disconnect the PTT motor leads ④, and then remove the springs ⑤ and brushes ⑥.

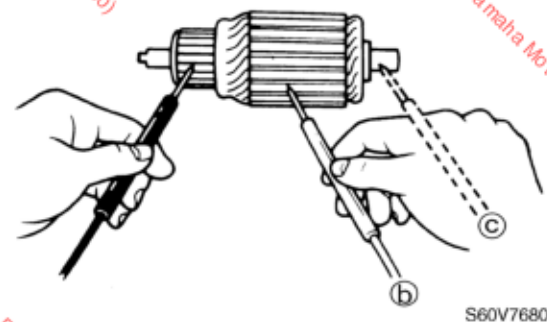
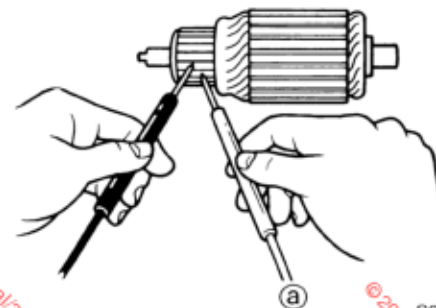


Checking the power trim and tilt motor

1. Check the commutator for dirt or foreign substances. Clean with #600 grit sandpaper if necessary.



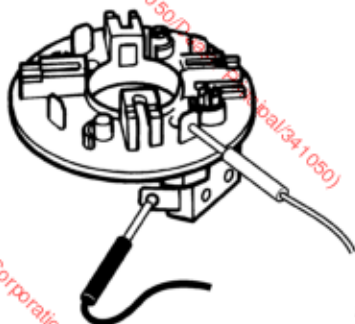
2. Check the commutator undercut for dirt or foreign substances. Clean with compressed air if necessary.
3. Check the armature coil for continuity. Replace if out of specification.



Armature coil continuity	
Commutator segments ①	Continuity
Segment-laminations ②	No continuity
Segment-shaft ③	No continuity

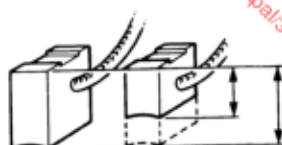


4. Check the circuit breaker for continuity. Replace the brush holder if there is no continuity.



S69J7205

5. Check the brush for wear. Replace if necessary.

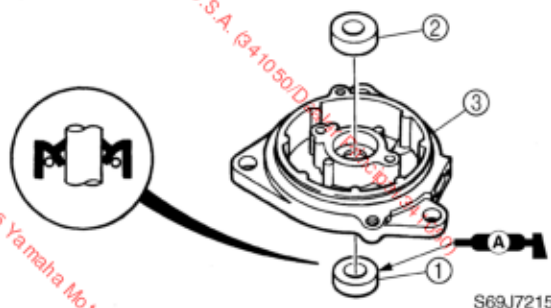


S60V7290

6. Check the base for corrosion or damage. Replace if necessary.
7. Check the bearing for damage or wear. Replace if necessary.

Assembling the power trim and tilt motor

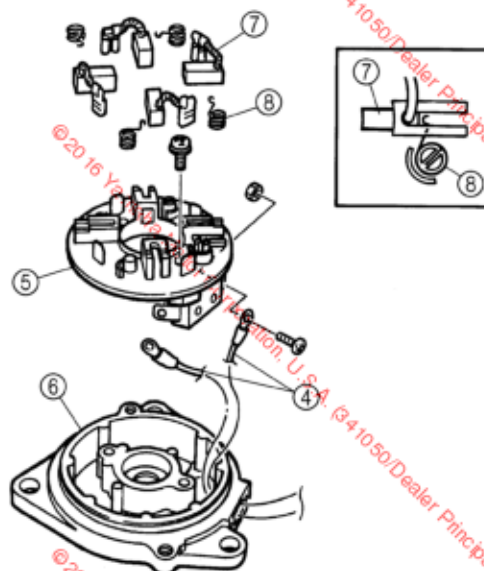
1. Install a new oil seal ① and the bearing ② into the motor base ③ as shown.



S69J7215

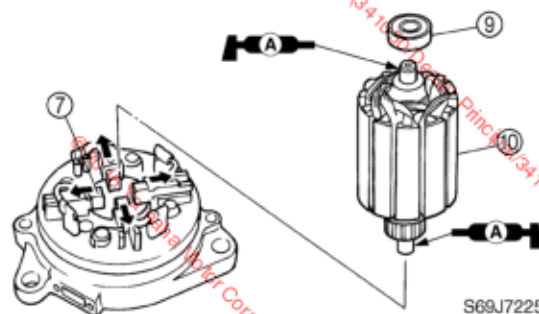
2. Connect the PTT motor leads ④ to the brush holder ⑤, and then install the brush holder ⑤ to the motor base ⑥.

3. Install the brushes ⑦ and springs ⑧ onto the brush holder as shown.



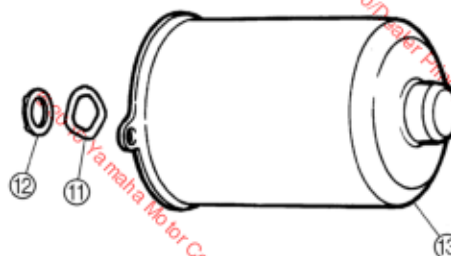
S69J7220

4. Install the bearing ⑨ onto the armature ⑩.
5. Push the brushes ⑦ into the holders, and then install the armature ⑩.



S69J7225

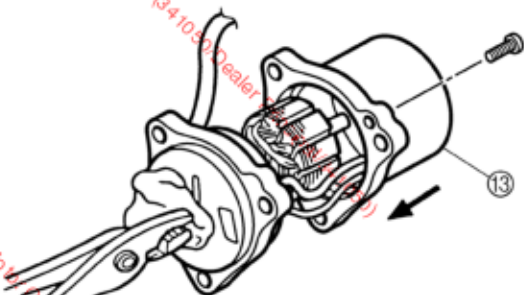
6. Install the wave washer ⑪ and washer ⑫ into the yoke ⑬.



S69J7230

Power trim and tilt unit

- Install a new O-ring and the yoke ⑬ into the motor base.



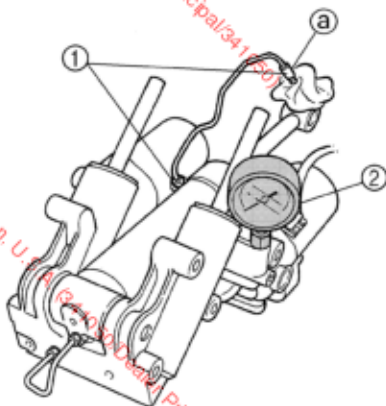
S69J7235

NOTE:

Place a clean cloth over the end of the armature shaft and carefully push the armature from the yoke with a pair of pliers as shown.

Checking the hydraulic pressure

- Check the hydraulic pressure. Check the internal parts if out of specification.
- Fully extend the power trim and tilt rams.
- Loosen the pipe joints ①, and then remove the pipe joint ②.
- Install the PTT oil pressure gauge assembly ③.



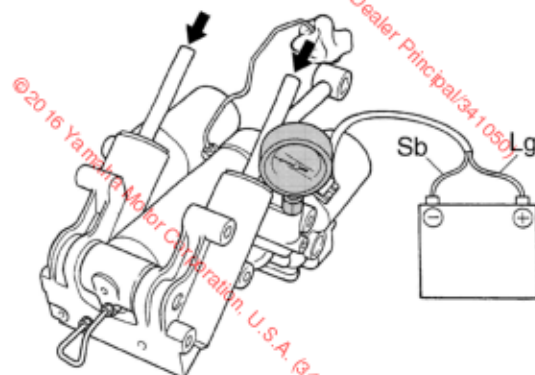
S6D07050

NOTE:

Wrap the removed pipe joint ② in a rag.

PTT oil pressure gauge assembly:
YB-06580

- Connect the PTT motor leads to the battery terminals to retract the trim ram, and then measure the hydraulic pressure.

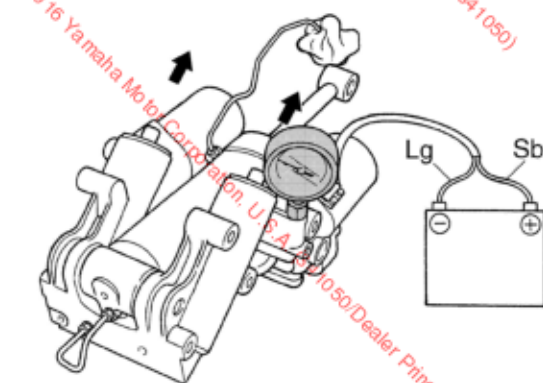


S6D07060

Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

Hydraulic pressure (down):
4.7–6.7 MPa (47–67 kgf/cm²)

- Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.




S6D07070

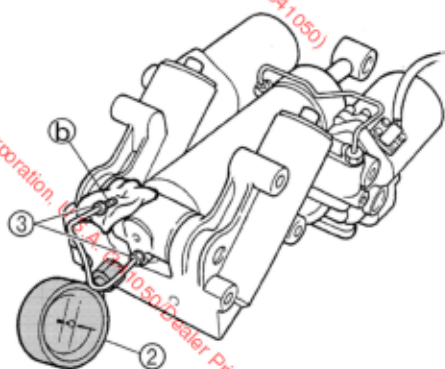
Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

BRKT**Bracket unit**

7. Remove the PTT oil pressure gauge assembly ②.
8. Install the pipe joint ①, and then tighten the pipe joints to the specified torque.

 **Pipe joint ①:**
15 N·m (1.5 kgf·m, 11.1 ft·lb)


9. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams.
10. Loosen the pipe joints ③, and then remove the pipe joint ④.
11. Install the PTT oil pressure gauge assembly ②.



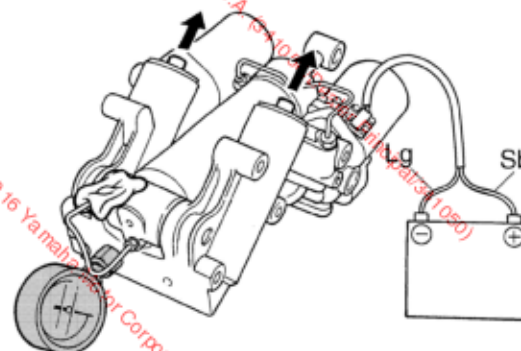
S6D07080

NOTE:


Wrap the removed pipe joint ④ in a rag.

 **PTT oil pressure gauge assembly:**
YB-06580

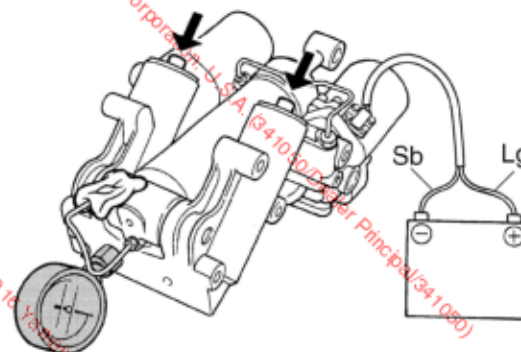
12. Connect the PTT motor leads to the battery terminals to extend the trim ram, and then measure the hydraulic pressure.



S6D07090


 **Hydraulic pressure (up):**
11.3–13.3 MPa (113–133 kgf/cm²)

13. Reverse the PTT motor leads between the battery terminals to fully retract the trim and tilt rams.

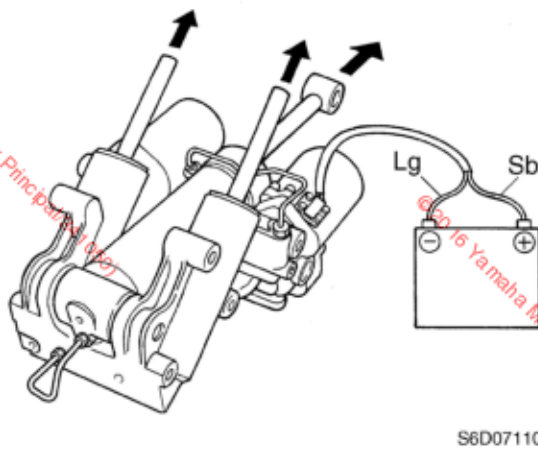


S6D07100

14. Remove the PTT oil pressure gauge assembly ②.
15. Install the pipe joint ④, and then tighten the pipe joints to the specified torque.

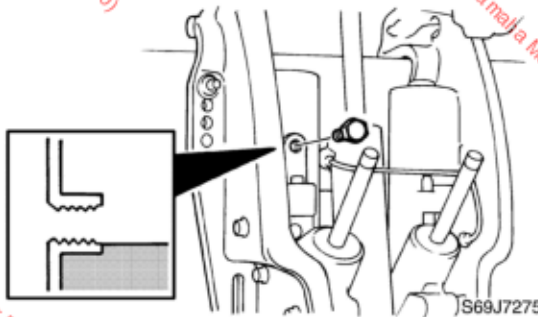
 **Pipe joint ③:**
15 N·m (1.5 kgf·m, 11.1 ft·lb)

16. After measuring the hydraulic pressure, connect the PTT motor leads to the battery terminals to fully extend the trim and tilt rams.



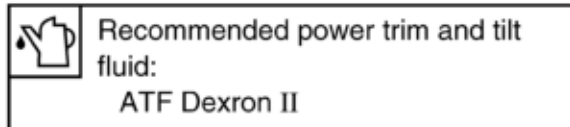
17. Remove the reservoir cap, and then check the fluid level in the reservoir.

18. If necessary, add fluid of the recommended type to the correct level.

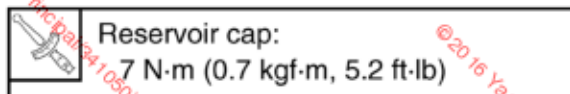


NOTE:

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

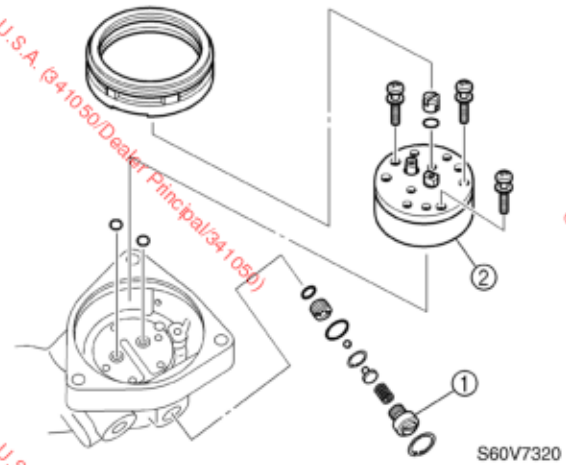


19. Install the reservoir cap.

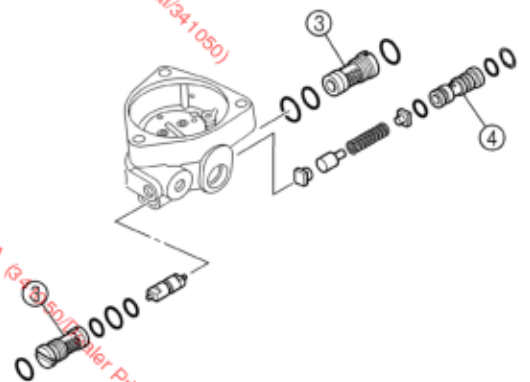


Disassembling the gear pump

1. Remove the manual valve ① and gear pump ②.

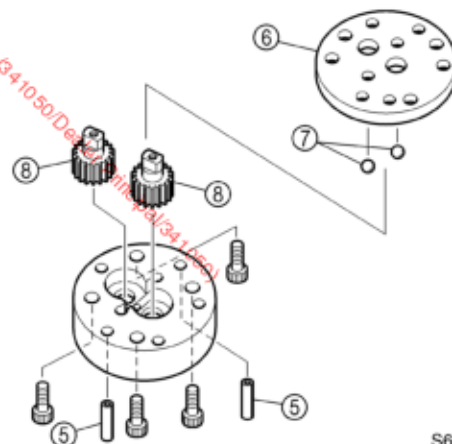


2. Remove the main valves ③ and retainer ④.



3. Remove the pins ⑤.

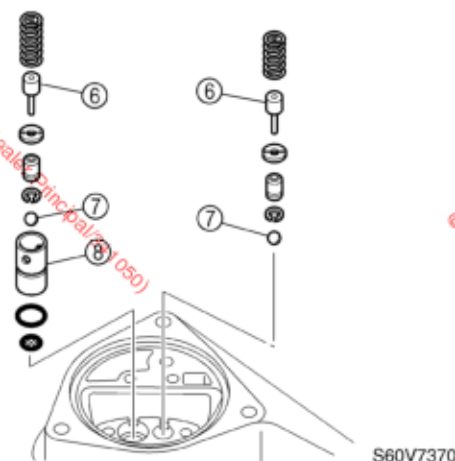
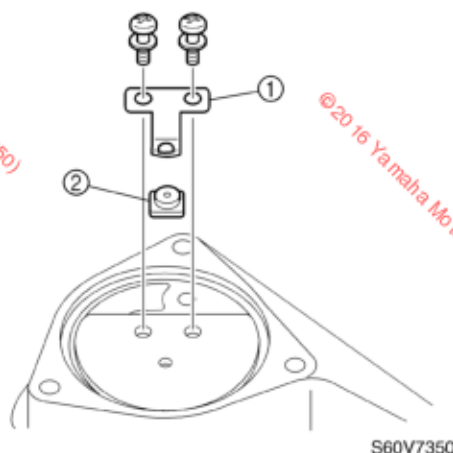
4. Remove gear housing 1 ⑥, then the balls ⑦ and drive gears ⑧.





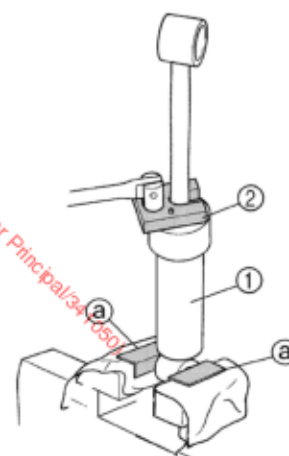
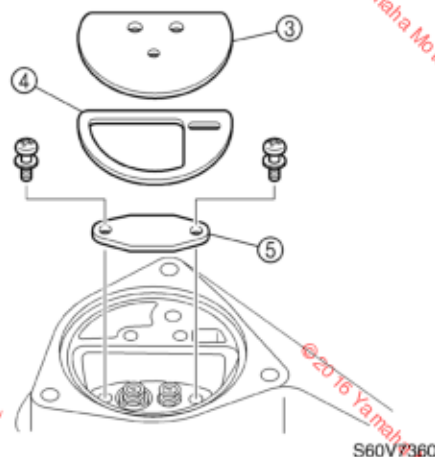
Disassembling the relief valve

1. Remove the trim down spring ① and valve seal ②.



Disassembling the tilt cylinder and trim cylinders

1. Hold the tilt cylinder ① in a vise using aluminum plates ③ on both sides.
2. Loosen the tilt cylinder end screw ②, and then remove the tilt piston assembly.



3. Remove the pins ⑥, balls ⑦, and relief valve ⑧.

⚠ WARNING

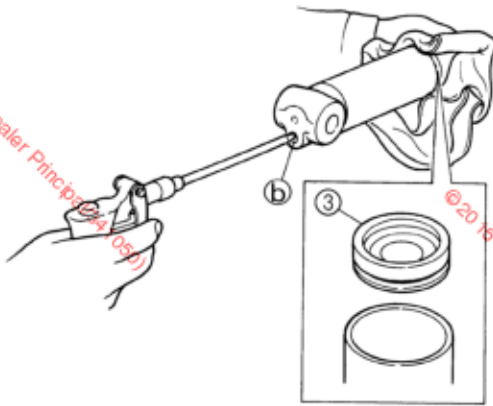
Make sure that the rams are fully extended before removing the end screw.



Trim and tilt cylinder wrench:
YB-06175-2B

3. Drain the power trim and tilt fluid.
4. Blow compressed air through the hole ⑥ to remove the free piston ③.

Power trim and tilt unit



S69J7305

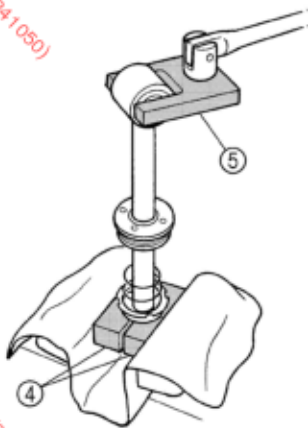
⚠ WARNING

Never look into the tilt cylinder opening when removing the free piston. The free piston and power trim and tilt fluid can be forcefully expelled out.

NOTE:

Be sure to cover the opposite end of the tilt cylinder with a rag.

5. Hold the tilt piston in a vise using the special service tool (4) on both sides.
6. Remove the tilt ram.

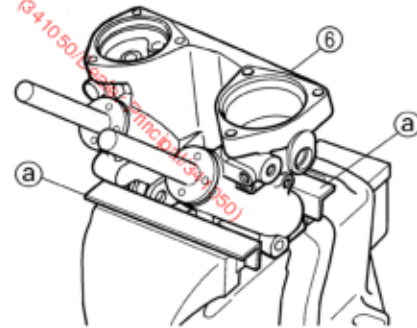


S69J7310



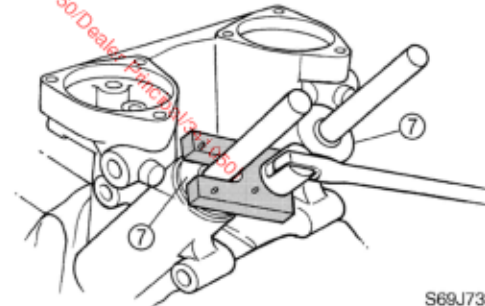
PTT piston vice attachment (4):
YB-06752
Tilt rod wrench (5): YB-06569

7. Hold the cylinder block (6) in a vise using aluminum plates (a) on both sides.



S60V7380

8. Loosen the trim cylinder end screws (7), and then remove them.

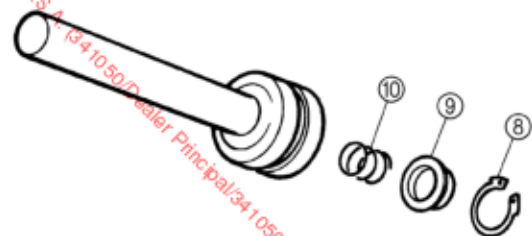


S69J7320



Trim and tilt cylinder wrench:
YB-06175-2B

9. Remove the trim piston assemblies.
10. Drain the power trim and tilt fluid.
11. Remove the circlip (8), adapter (9), and spring (10) from the trim piston assemblies.



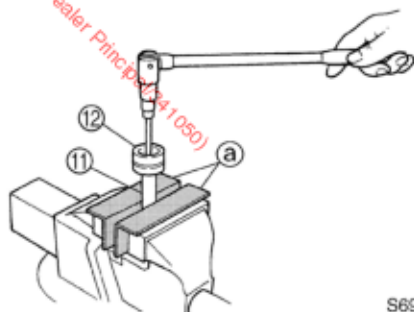
S69J7325

7



12. Hold the trim ram ⑪ in a vise using aluminum plates ③ on both sides.

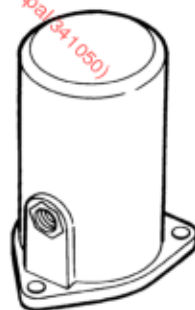
13. Remove the trim piston ⑫.



S69J7330

Checking the reservoir

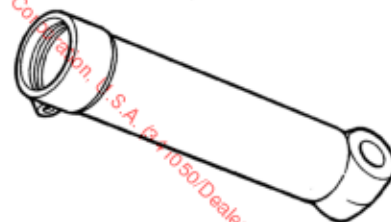
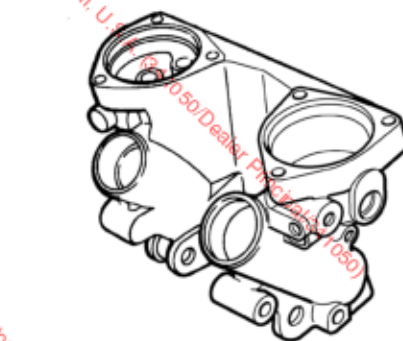
1. Check the reservoir for cracks or corrosion. Replace if necessary.



S69J7335

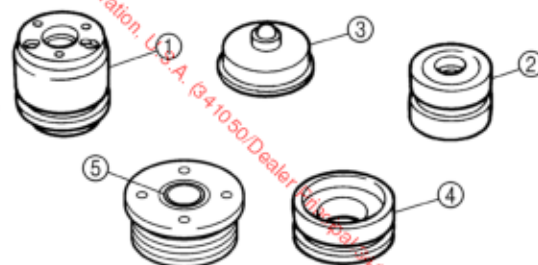
Checking the tilt cylinder and trim cylinders

1. Check the power trim and tilt unit for cracks or corrosion. Replace if necessary.
2. Check the inner walls of the cylinder block and tilt cylinder for scratches. Replace if necessary.



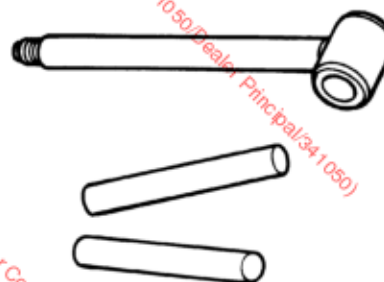
S60V7390

3. Check the outer surface of the tilt piston ①, trim piston ②, adapter ③, free piston ④, and oil seal of end screw ⑤ for scratches. Replace if necessary.



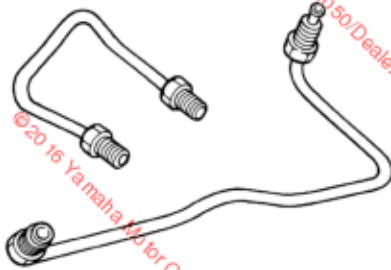
S69J7345

4. Check the trim and tilt rams for bends or excessive corrosion. Polish with #400–600 grit sandpaper if there is light rust or replace if necessary.



S69J7350

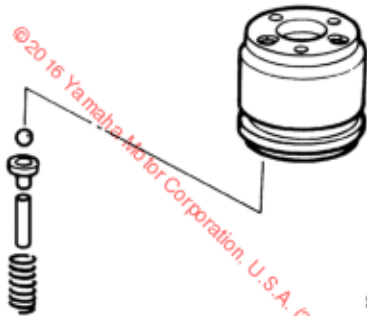
5. Check the pipes for cracks or corrosion. Replace if necessary.



S69J7355

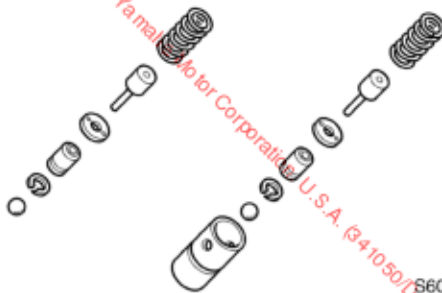
Checking the valves

1. Check the operation of the tilt piston absorber valves and the valves for dirt or residue. Clean if necessary.



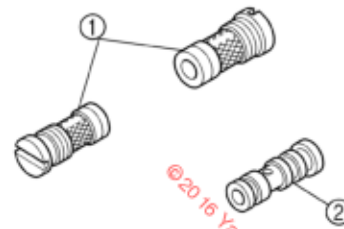
S60V7400

2. Check the up-relief valve and down-relief valve for dirt or residue. Clean if necessary.



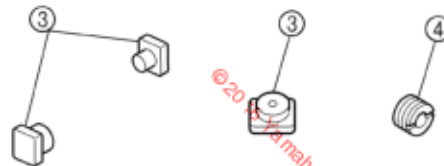
S60V7410

3. Check the main valve ① and retainer ② for dirt or residue. Replace if necessary.



S60V7420

4. Check the valve seal ③ and valve seat ④ for dirt or residue. Replace if necessary.



S60V7430

Checking the filters

1. Check gear pump filter ① and relief valve filter ② for dirt or residue. Clean if necessary.

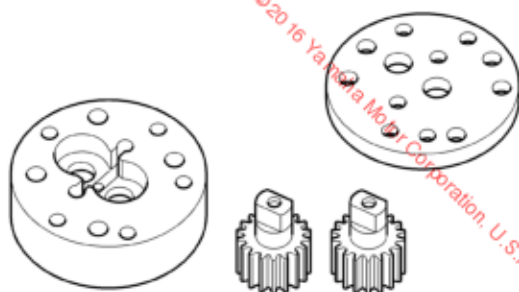


S60V7440

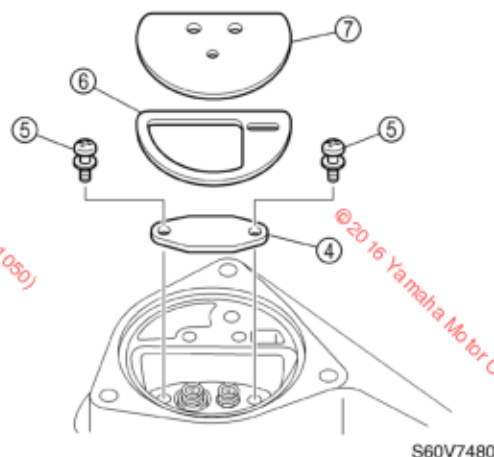


Checking the gear pump

1. Check the drive gear for damage or excessive wear. Replace if necessary.
2. Check the gear pump housing for scratches. Replace if necessary.



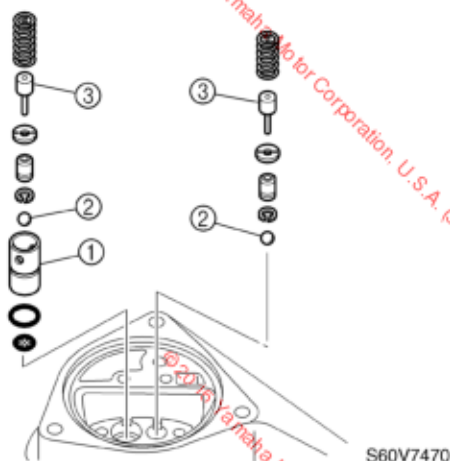
S60V7460



S60V7480

Assembling the relief valve

1. Install the relief valve (1), balls (2), and pins (3).

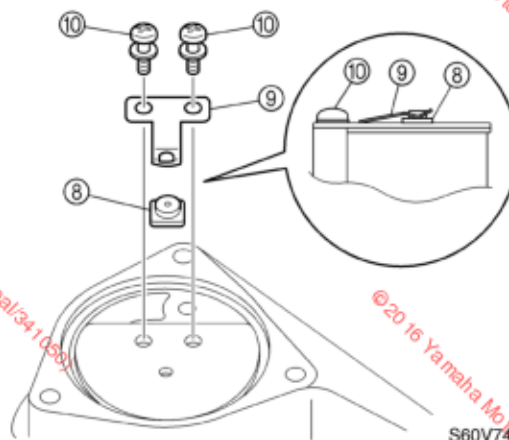


S60V7470



Relief valve plate screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

4. Install the valve seal (8) and trim down spring (9), and then tighten the screws (10) to the specified torque.



S60V7490

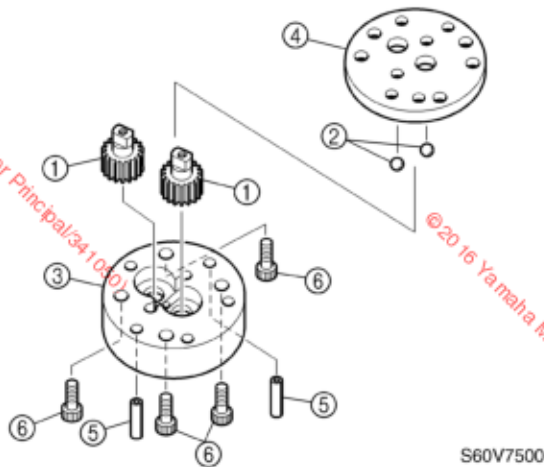


Trim down spring screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

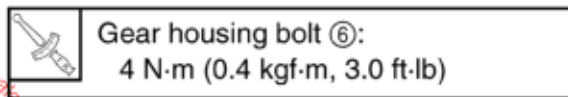
2. Install the relief valve plate (4) by installing the screws (5), then tighten them to the specified torque.
3. Install the seal (6) and tilt down plate (7).

Assembling the gear pump

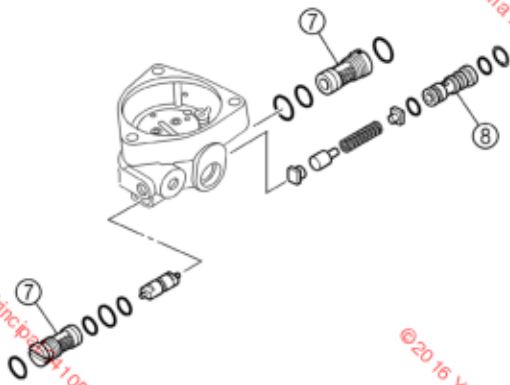
1. Install the drive gears (1) and balls (2) into gear housing 2 (3).
2. Install gear housing 1 (4), then the pins (5).
3. Tighten the bolts (6) to the specified torque.



S60V7500

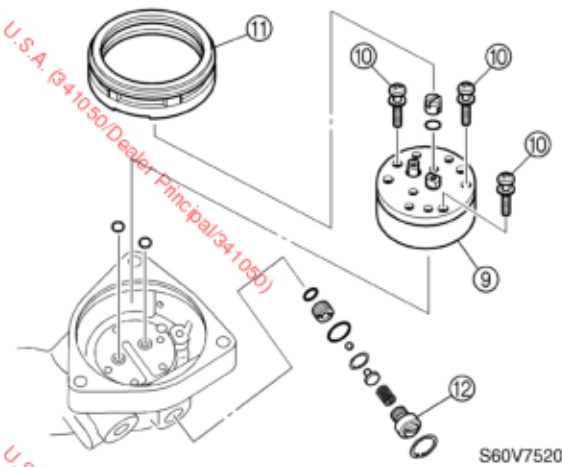


4. Install the main valves (7) and retainer (8).

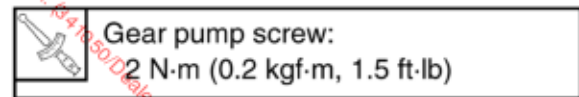


S60V7510

5. Install the gear pump (9) by installing the screws (10), then tightening them to the specified torque.
6. Install the gear pump filter (11).
7. Install the manual valve (12).

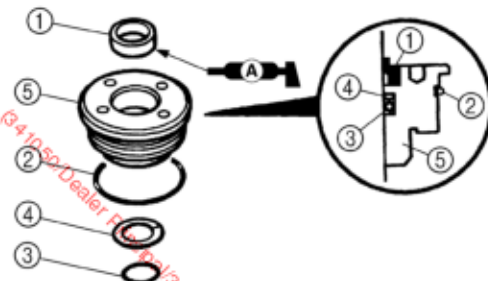


S60V7520



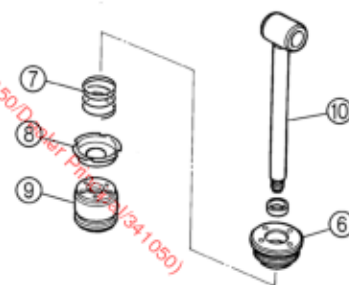
Assembling the tilt ram

1. Install a new dust seal (1), O-rings (2) and (3), and the backup ring (4) into the tilt cylinder end screw (5).



S69J7410

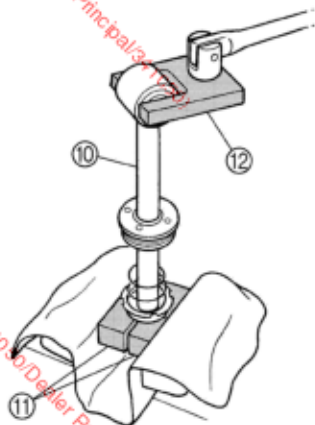
2. Install the tilt cylinder end screw assembly (6), spring (7), adapter (8), and tilt piston (9) onto the tilt ram (10).



S60V7690



3. Hold the tilt piston in a vise using the special service tool ⑪ on both sides.
4. Tighten the tilt ram ⑩ to the specified torque.



S69J7420

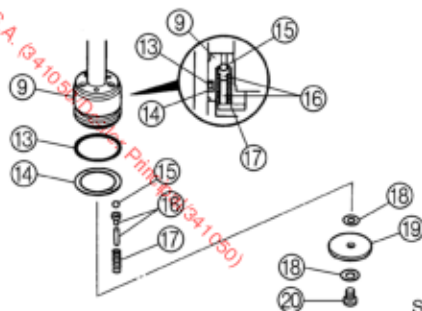


PTT piston vice attachment ⑪:
YB-06752
Tilt rod wrench ⑫: YB-06569



Tilt ram ⑩:
55 N·m (5.5 kgf·m, 40.6 ft·lb)

5. Install a new O-ring ⑬ and the backup ring ⑭ into the tilt piston ⑨.
6. Install the balls ⑮, pins ⑯, and springs ⑰ as shown.
7. Install the washers ⑱, plate ⑲, and bolt ⑳ into the tilt piston ⑨, and then tighten the bolt to the specified torque.



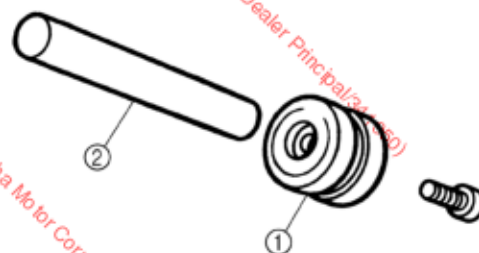
S60V7530



Tilt piston bolt ⑳:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

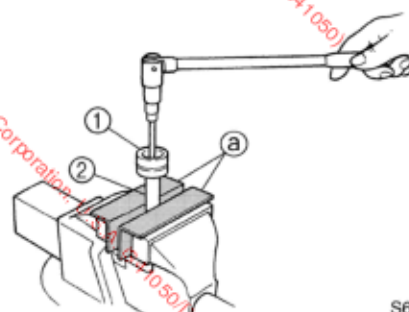
Assembling the trim rams

1. Install the trim piston ① onto the trim ram ②.



S60V7540

2. Hold the trim ram ② in a vise using aluminum plates ③ on both sides.
3. Tighten the trim piston bolt to the specified torque.

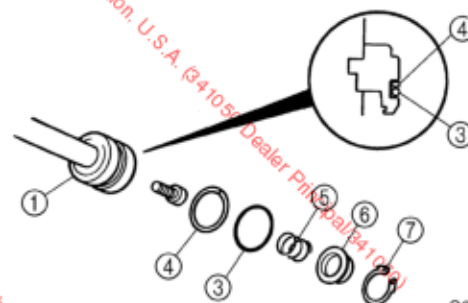


S69J7435



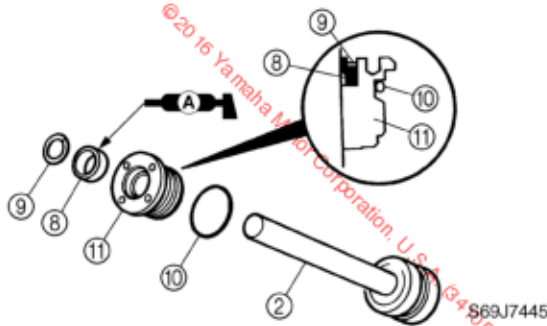
Trim piston bolt:
38 N·m (3.8 kgf·m, 28.0 ft·lb)

4. Install a new O-ring ③, the backup ring ④, spring ⑤, adapter ⑥, and circlip ⑦ into the trim piston ①.



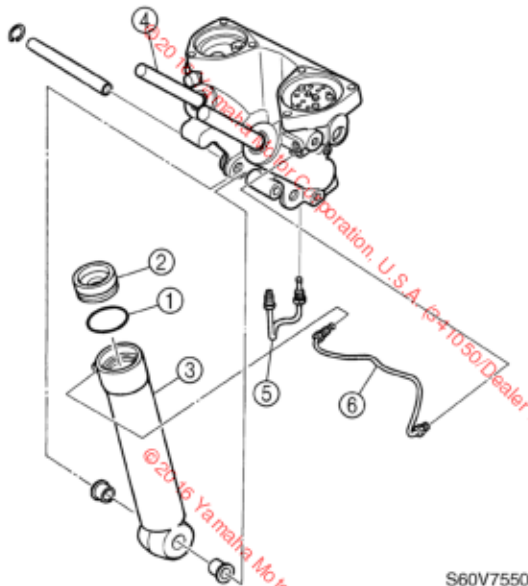
S60V7545


5. Install a new oil seal ⑧, the circlip ⑨, and a new O-ring ⑩ into the trim cylinder end screw ⑪.
6. Install the trim cylinder end screw ⑪ onto the trim ram ②.



Installing the tilt cylinder

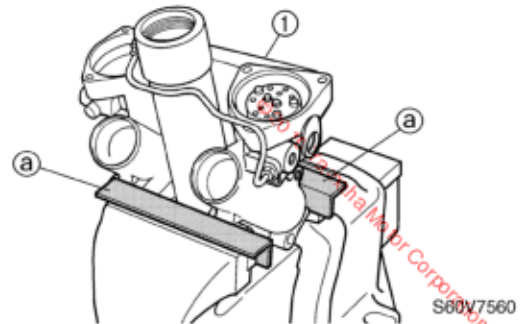
1. Install a new O-ring ① onto the free piston ②.
2. Push the free piston ② into the tilt cylinder ③ until it bottoms out.
3. Install the tilt cylinder ③ onto the cylinder block ④.
4. Install pipes ⑤ and ⑥, and then tighten the pipe joints to the specified torque.



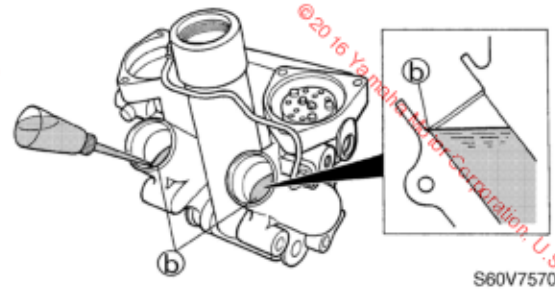
 Pipe joint ⑤ and ⑥:
15 N·m (1.5 kgf·m, 11.1 ft·lb)


Installing the trim rams

1. Hold the cylinder block ① in a vise using aluminum plates ③ on both sides.



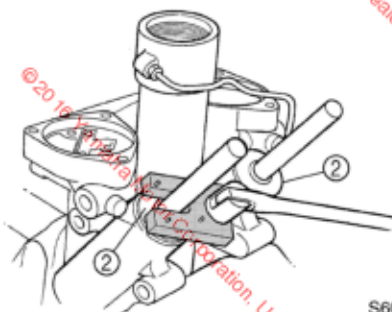
2. Fill the trim cylinders with the recommended fluid to the correct level ④ as shown.



 Recommended power trim and tilt fluid:
ATF Dexron II



3. Install the trim piston assembly into the trim cylinder, and then tighten the trim cylinder end screw ② to the specified torque.



⚠ WARNING

Do not push the trim rams down while installing them into the trim cylinders. Otherwise, the power trim and tilt fluid may spurt out from the unit.



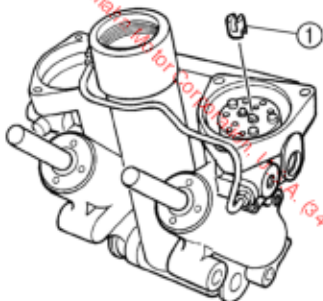
Trim and tilt cylinder wrench:
YB-06175-2B



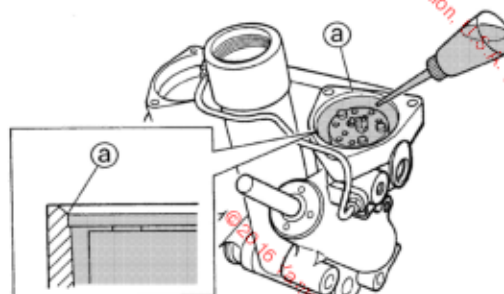
Trim cylinder end screw ②:
160 N·m (16.0 kgf·m, 118 ft·lb)

Installing the power trim and tilt motor

1. Install the joint ① into the pump housing.



2. Fill the pump housing with the recommended fluid to the correct level ③ as shown.



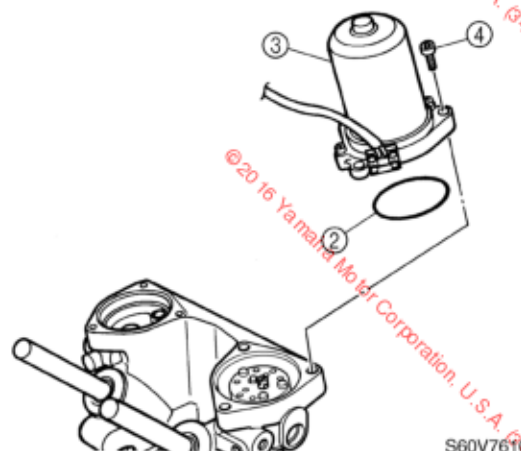
Recommended power trim and tilt
fluid:
ATF Dexron II

3. Remove all of the air bubbles with a syringe or suitable tool.

NOTE:

Turn the joint with a screwdriver, and then remove any air between the pump gear teeth.

4. Install a new O-ring ② and the power trim and tilt motor ③, and then tighten the bolts ④ to the specified torque.



NOTE:

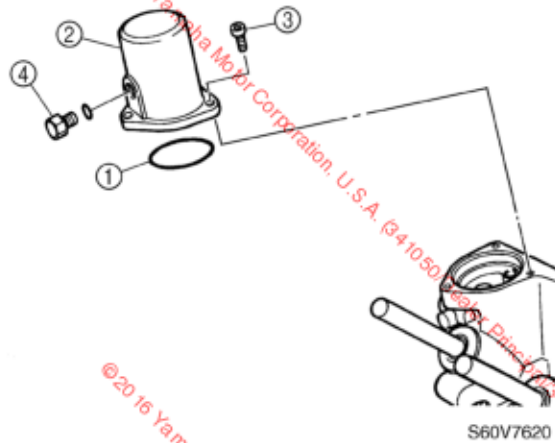
Align the armature shaft with the recess in the joint.



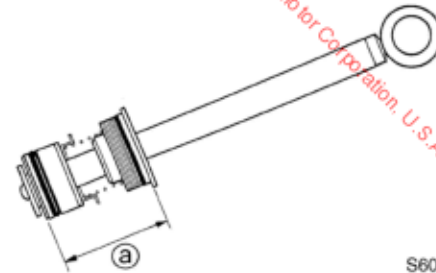
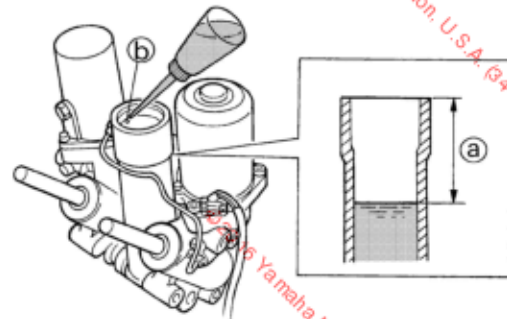
PTT motor bolt ④:
19 N·m (1.9 kgf·m, 14.0 ft·lb)

Installing the reservoir

1. Install a new O-ring ① and the reservoir ②, and then tighten the bolts ③ to the specified torque.
2. Install the reservoir cap ④, and then tighten it to the specified torque.



	Reservoir bolt ③: 19 N·m (1.9 kgf·m, 14.0 ft·lb) Reservoir cap ④: 7 N·m (0.7 kgf·m, 5.2 ft·lb)
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S60V7710



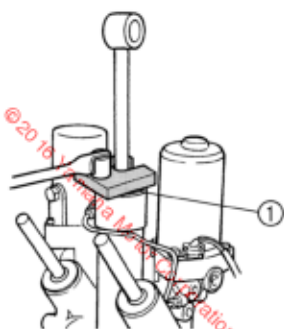
Recommended power trim and tilt
fluid:
ATF Dexron II

Installing the tilt ram

1. Fill the tilt cylinder with the recommended fluid to the correct level (a) as shown.
2. Add a small amount of the recommended fluid through the cylinder block hole (b) as shown.

BRKT**Bracket unit**

3. Install the tilt piston assembly into the tilt cylinder, and then tighten the tilt cylinder end screw ① to the specified torque.



S69J7495

WARNING

To prevent the power trim and tilt fluid from spurting out due to internal pressure, the tilt ram should be kept at full length.

NOTE:

Place the tilt cylinder end screw at the bottom of the tilt ram and install the tilt piston assembly into the tilt cylinder.



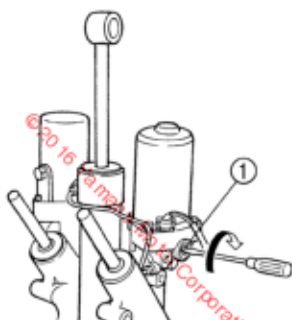
Trim and tilt cylinder wrench:
YB-06175-2B



Tilt cylinder end screw:
90 N·m (9.0 kgf·m, 66.4 ft·lb)

Bleeding the power trim and tilt unit**Not installed**

1. Tighten the manual valve ① by turning it clockwise.



S69J7500

2. Place the power trim and tilt unit in an upright position.
3. Check the fluid level in the reservoir.

NOTE:

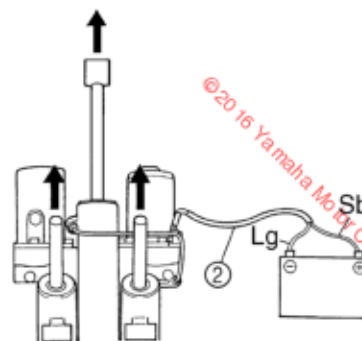
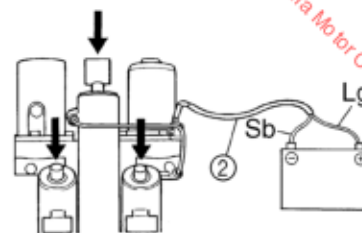
The fluid level should be at the brim of the filler hole.

4. If necessary, add sufficient fluid of the recommended type to the correct level.



Recommended power trim and tilt fluid:
ATF Dexron II

5. Install the reservoir cap.
6. Connect the PTT motor leads ② to the battery terminals.



S69J7505

Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

Power trim and tilt unit / Bleeding the power trim and tilt unit

- Reverse the PTT motor leads between the battery terminals to fully extend the tilt ram and trim rams, and then reverse them again to fully retract the rams.

NOTE:

- Repeat this procedure so that the rams go up and down four to five times (be sure to wait a few seconds before switching the leads).
- The sound of the power trim and tilt motor will change when the rams are fully extended.
- If the rams do not move up and down easily, push and pull on the rams to assist operation.

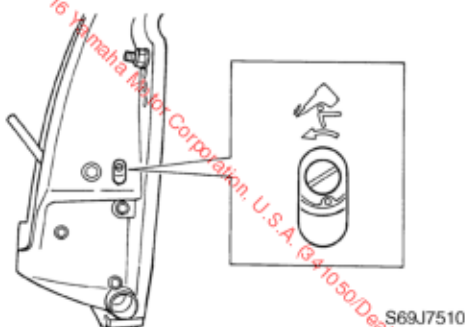
- Check the fluid level again when the rams are fully extended. Add sufficient fluid, if necessary, and then repeat step 7.

NOTE:

Repeat this procedure until the fluid remains at the correct level.

Built-in

- Loosen the manual valve by turning it counterclockwise until it cannot be turned further.



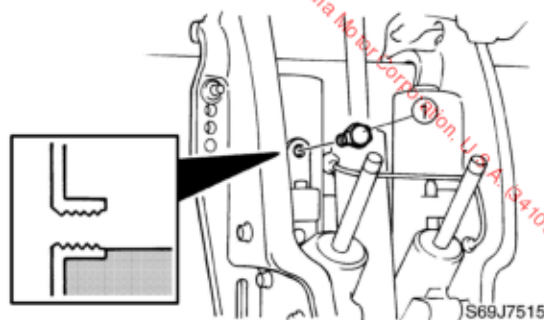
- Fully tilt the outboard motor up, and then release it and let it lower by its own weight four to five times.
- Tighten the manual valve by turning it clockwise.
- Let the fluid settle for 5 minutes.

- Push and hold the power trim and tilt switch in the up position until the outboard motor is fully tilted up.
- Support the outboard motor with the tilt stop lever, and then let the fluid settle for 5 minutes.

⚠ WARNING

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

- Remove the reservoir cap ①, and then check the fluid level in the reservoir.
- If necessary, add sufficient fluid of the recommended type to the correct level.



NOTE:

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



Recommended power trim and tilt fluid:
ATF Dexron II

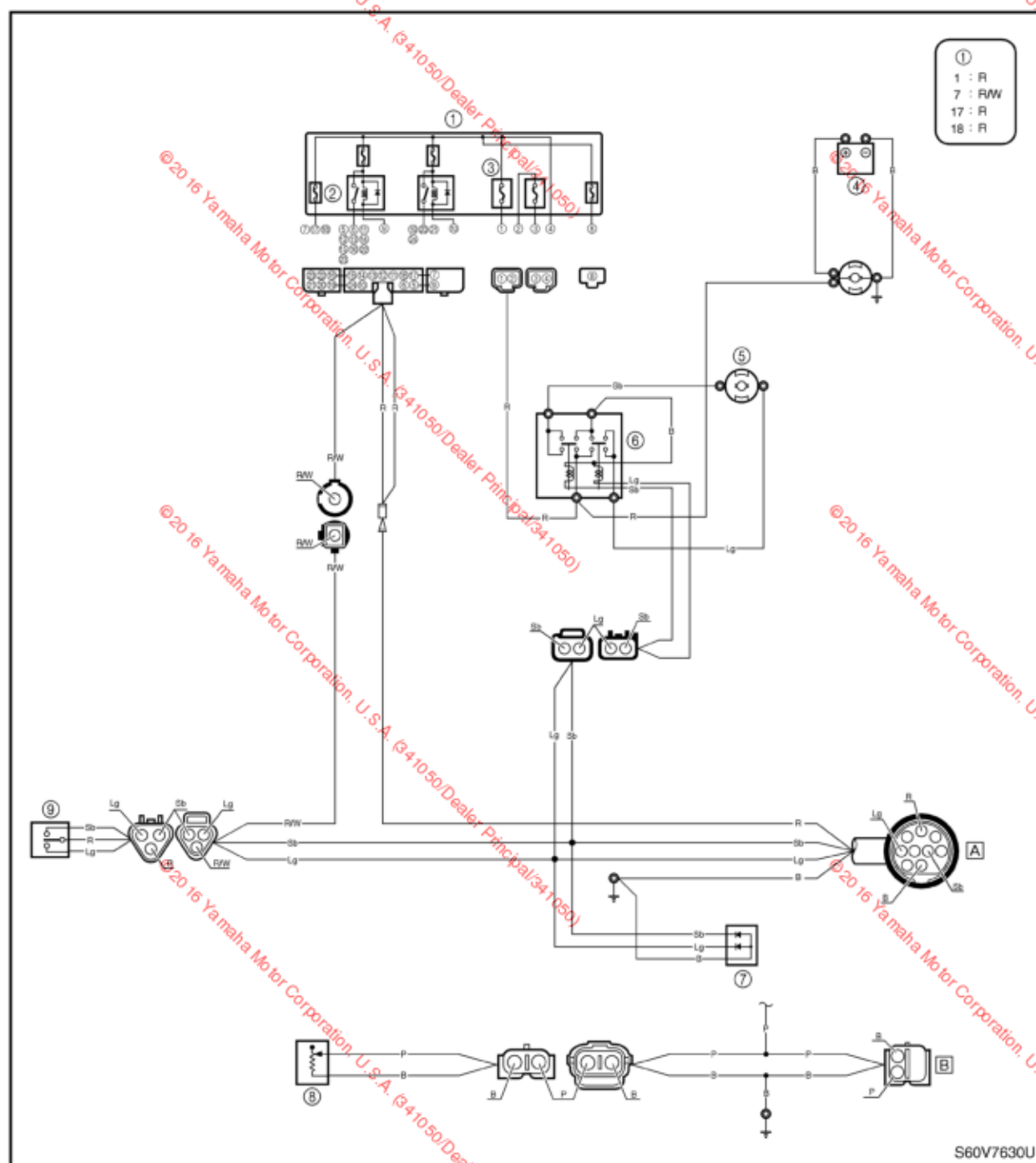
- Install the reservoir cap.

NOTE:

Repeat this procedure until the fluid remains at the correct level.

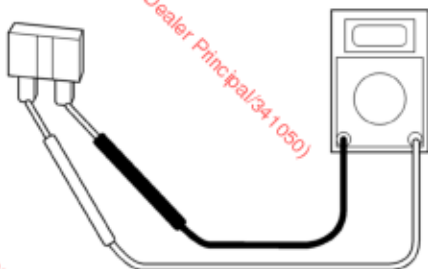


Power trim and tilt electrical system



Checking the fuse

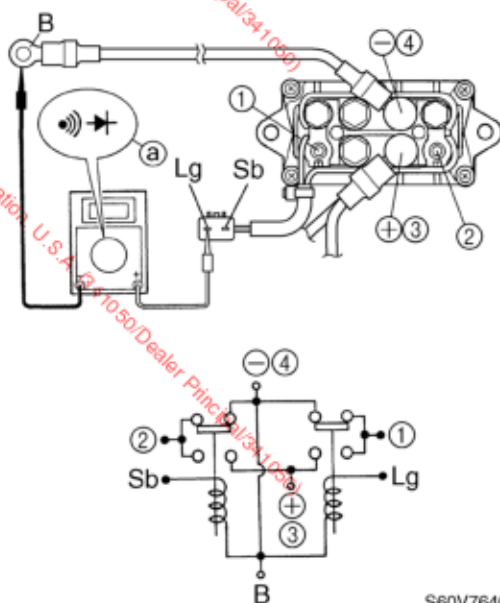
1. Check the fuse for continuity. Replace if there is no continuity.



S69J7525

Checking the power trim and tilt relay

1. Check the power trim and tilt relay for continuity. Replace if out of specification.



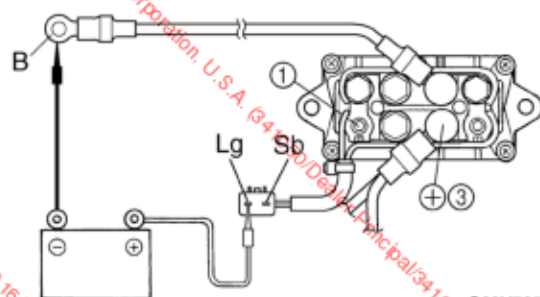
S60V7640

NOTE:

Be sure to set the measurement range ① shown in the illustration when checking for continuity.

Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B)	Continuity
Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ④	Continuity
Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③	No continuity
Terminal ② – Terminal ③	No continuity

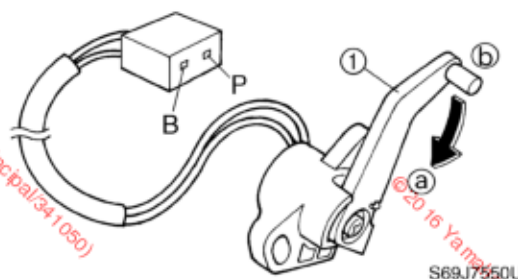
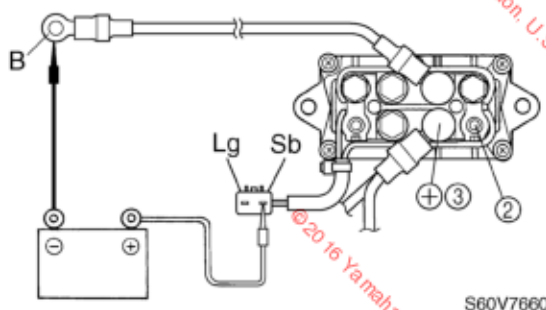
2. Connect the digital circuit tester between power trim and tilt relay terminals ① and ③.
3. Connect the light green (Lg) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
4. Check for continuity between terminals ① and ③. Replace if there is no continuity.



S60V7650

BRKT**Bracket unit**

- Connect the digital circuit tester between power trim and tilt relay terminals ② and ③.
- Connect the sky blue (Sb) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
- Check for continuity between terminals ② and ③. Replace if there is no continuity.

**NOTE:**

Turn the lever ① and measure the resistance as it gradually changes.



Trim sensor resistance:

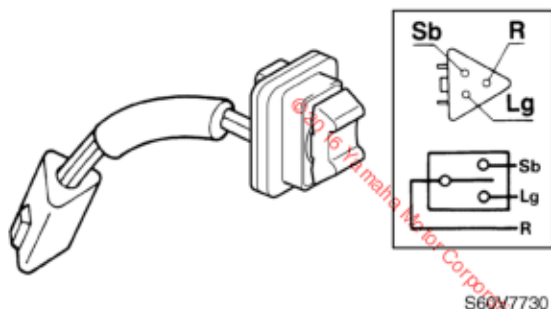
Pink (P) – Black (B)

9–11 Ω at 20 °C (68 °F) ①

247.6–387.6 Ω at 20 °C (68 °F) ②

Checking the power trim and tilt switch

- Check the power trim and tilt switch for continuity. Replace if out of specification.



	Lead color		
Switch position	Sky blue (Sb)	Red (R)	Lightgreen (Lg)
Up	○	○	
Free			
Down		○	○

Checking the trim sensor

- Measure the trim sensor resistance. Replace if out of specification.

— MEMO —



Electrical systems

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Special service tools



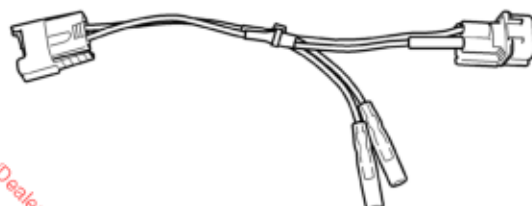
Dynamic spark tester
YM-34487



Test harness (3 pins)
YB-06757



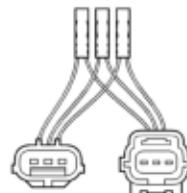
Digital multimeter
YU-34899-A



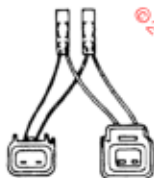
Test harness (2 pins)
YB-06861



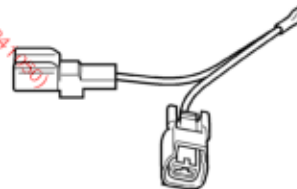
Peak voltage adaptor
YU-39991



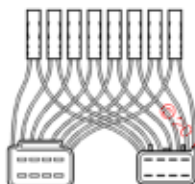
Test harness (3 pins)
YB-06769



Test harness (2 pins)
YB-06767



Test harness (1 pin)
YB-06788



Test harness (8 pins)
YB-06779

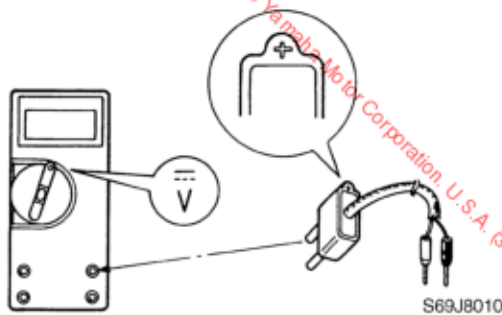
Checking the electrical components

Measuring the peak voltage

NOTE:

Before troubleshooting the peak voltage, check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.

The condition of the ignition system can be determined by measuring the peak voltage. Cranking speed is effected by many factors, such as fouled or weak spark plugs, or a weak battery. If one of these factors is present, the peak voltage will be lower than specification. In addition, if the peak voltage is lower than specification the engine will not operate properly.



⚠ WARNING

When checking the peak voltage, do not touch any of the connections of the digital tester leads.

NOTE:

- Use the peak voltage adaptor with the digital circuit tester.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode**.
- Connect the positive pin on the peak voltage adaptor to the positive terminal of the digital circuit tester.

Measuring the lower resistance

When measuring a resistance of 10 Ω or less with the digital circuit tester, the correct measurement cannot be obtained because of the internal resistance of the tester. To obtain the correct value, subtract the internal resistance from the displayed measurement.

NOTE:

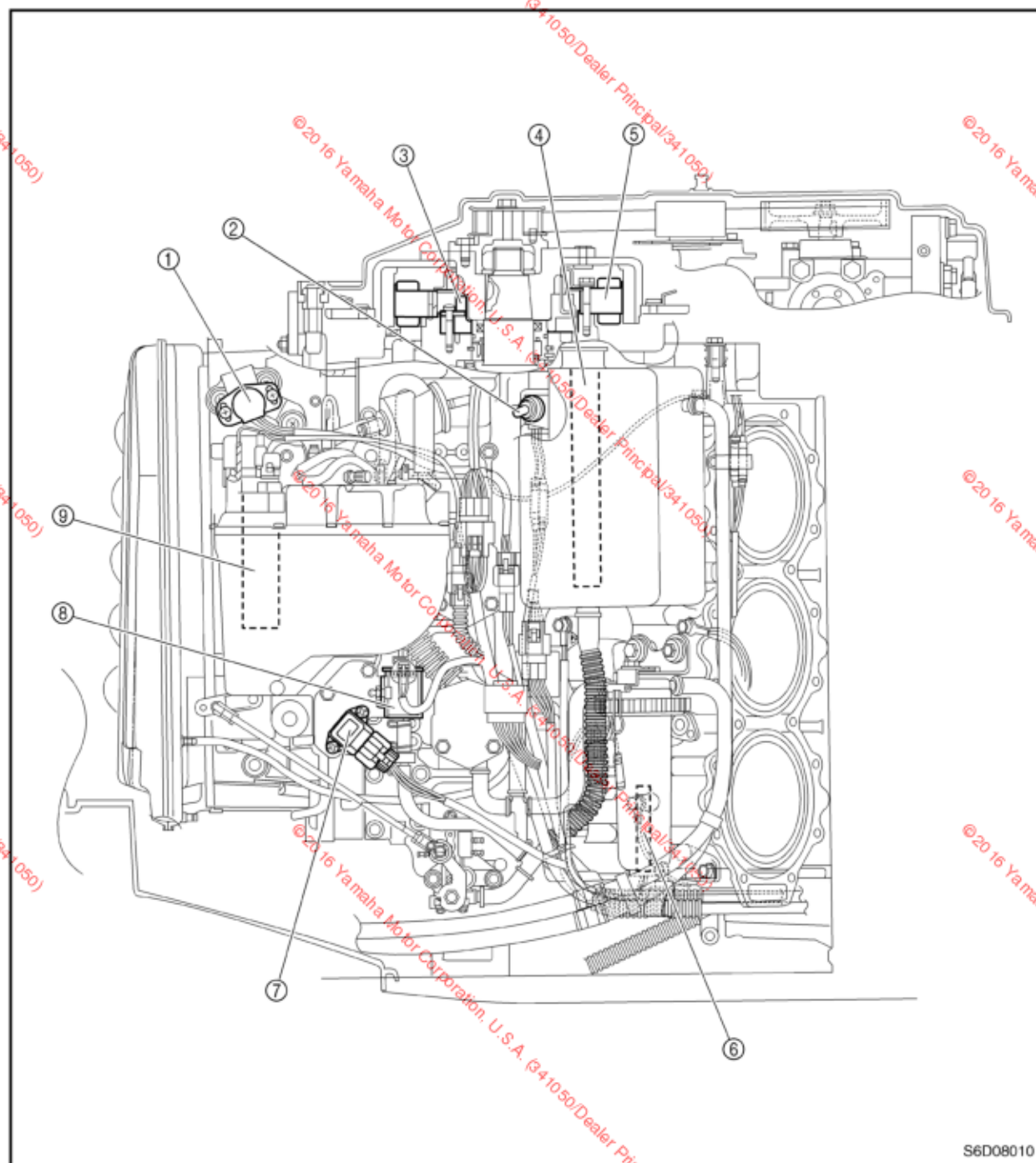
Obtain the internal resistance of the digital circuit tester by connecting both of its probes and checking the display.

Correct value =
displayed measurement – internal
resistance



Electrical components

Port view

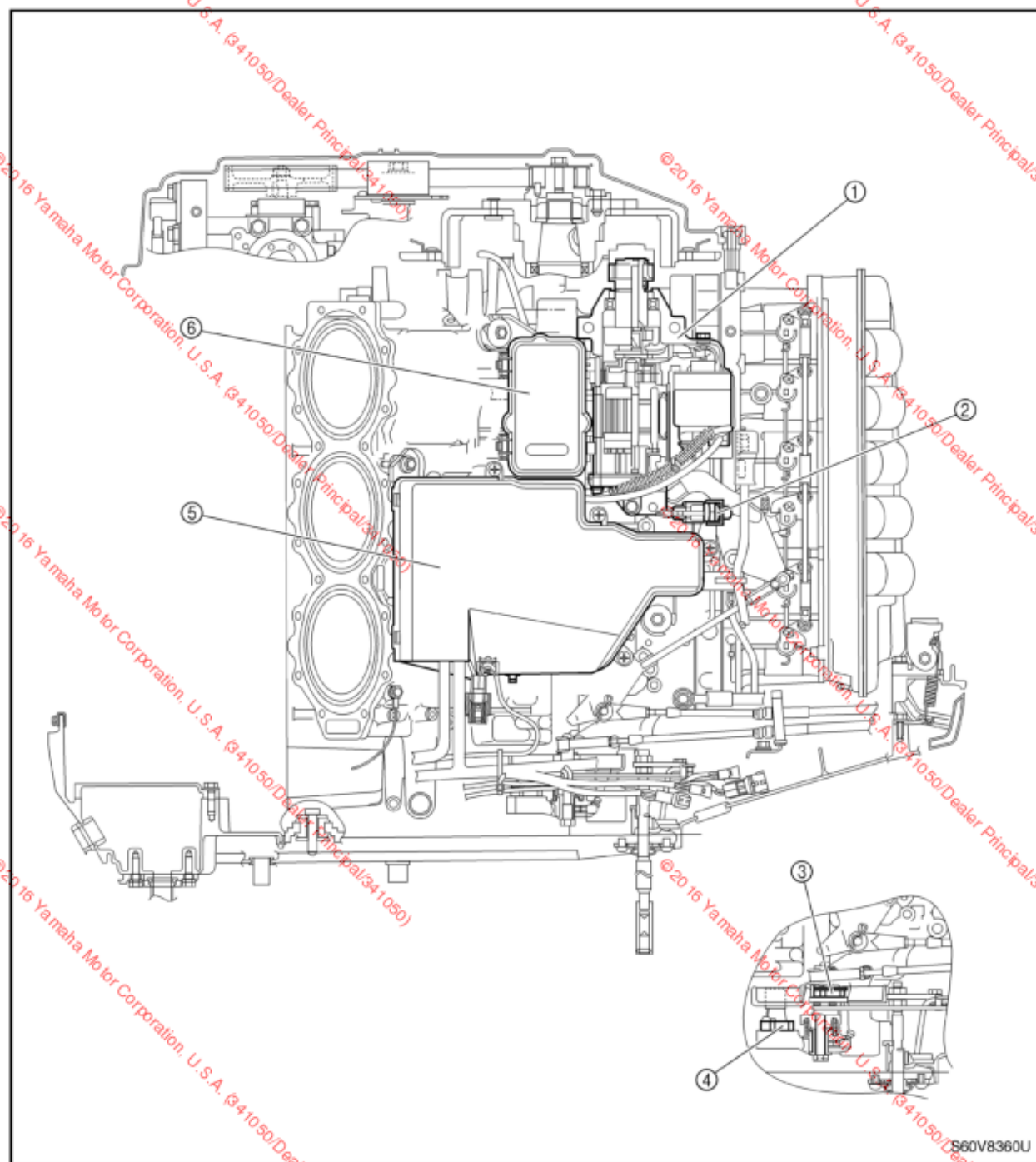


- ① Throttle position sensor
- ② Emergency switch
- ③ Pulser coil
- ④ Oil level sensor
- ⑤ Stator coil
- ⑥ Water detection switch
- ⑦ Atmospheric pressure sensor
- ⑧ Electric oil pump

- ⑨ Electric fuel pump

S6D08010

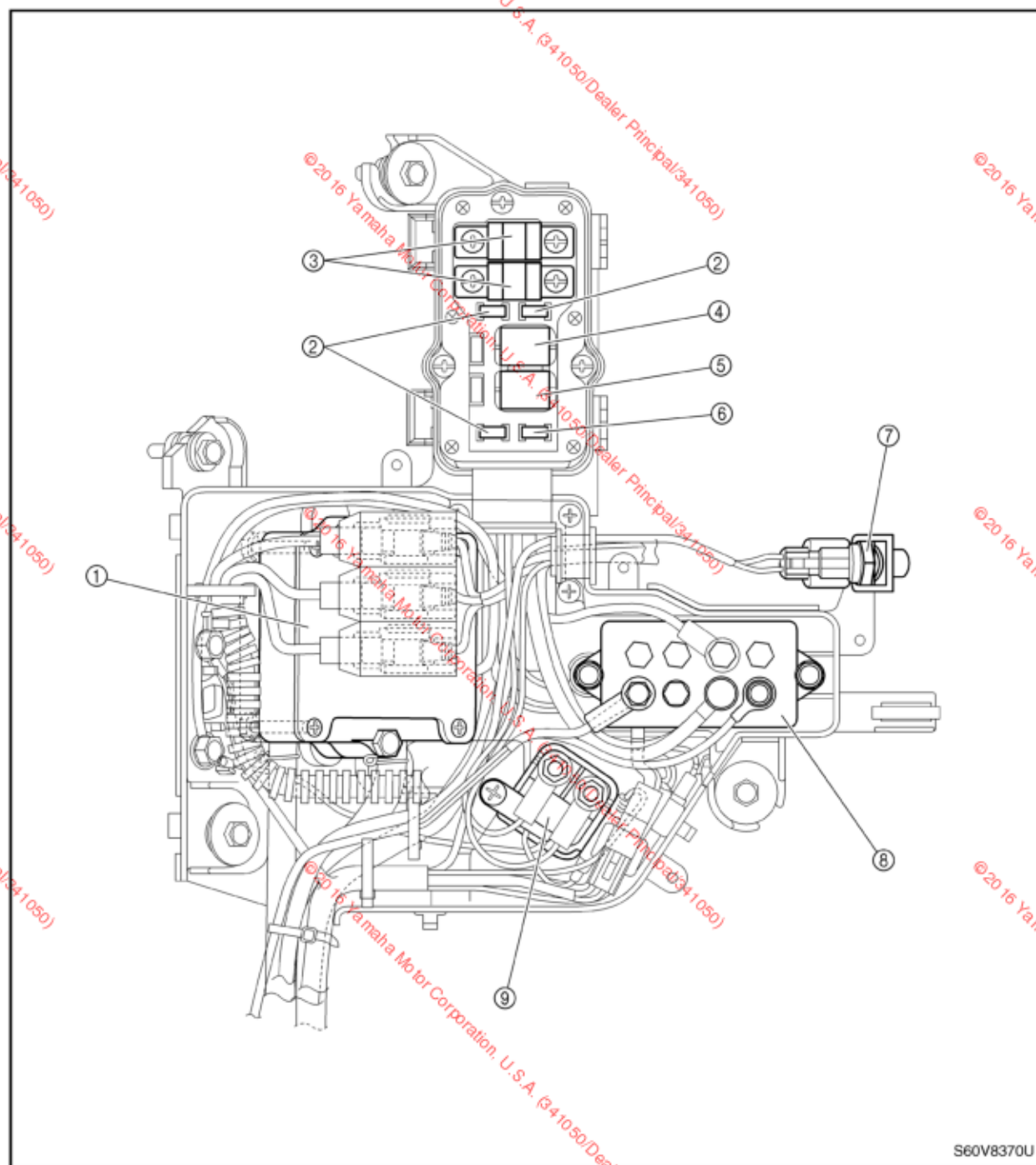
Starboard view



- ① Starter motor
- ② Intake air temperature sensor
- ③ Shift position switch
- ④ Shift cut switch
- ⑤ Junction box
- ⑥ Fuse holder

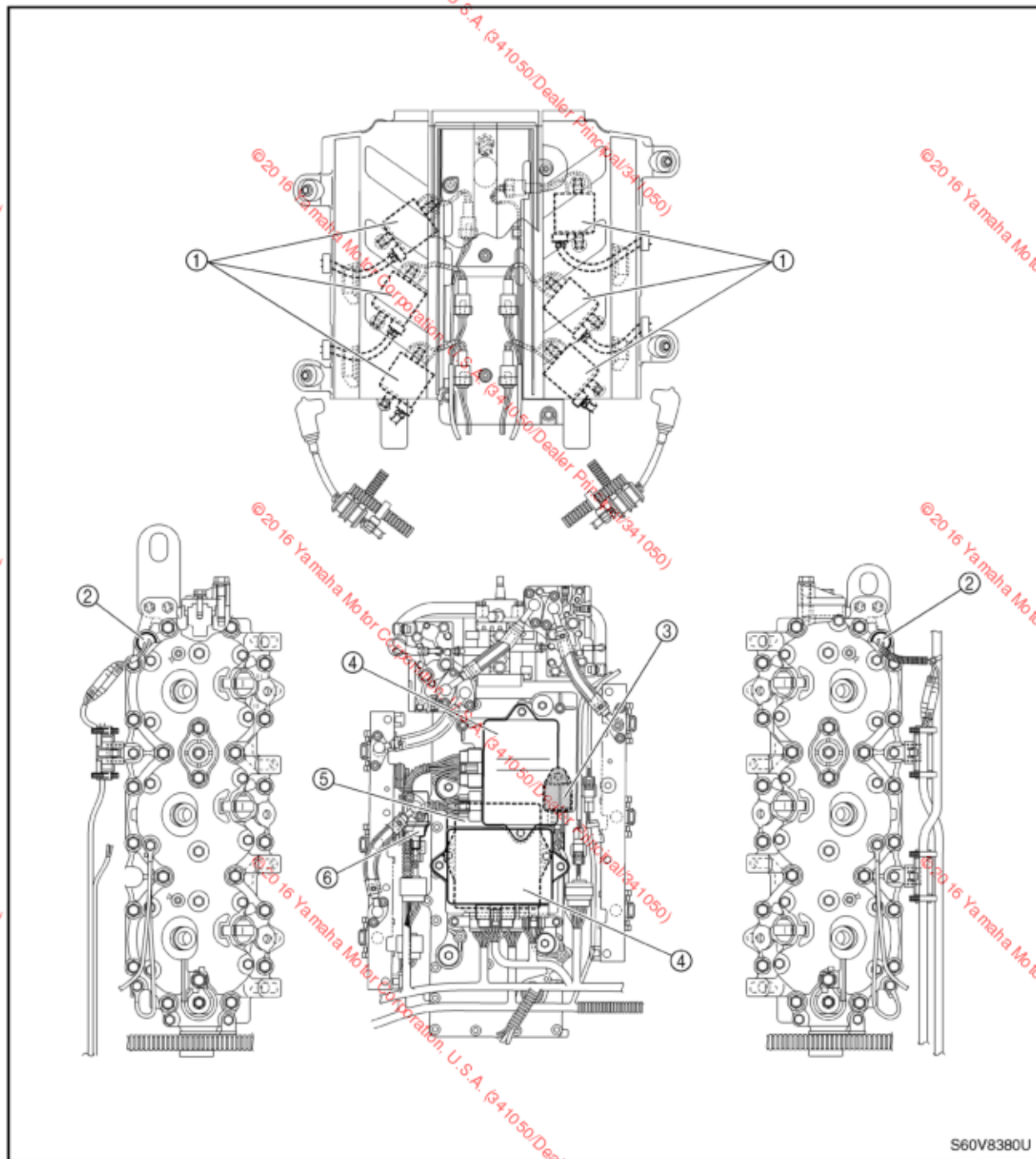


Junction box assembly



- ① Rectifier Regulator
- ② Fuse (20 A)
- ③ Fuse (100 A)
- ④ Main relay
- ⑤ Driver relay
- ⑥ Fuse (30 A)
- ⑦ Intake air temperature sensor
- ⑧ Power trim and tilt relay
- ⑨ Starter relay

Aft view

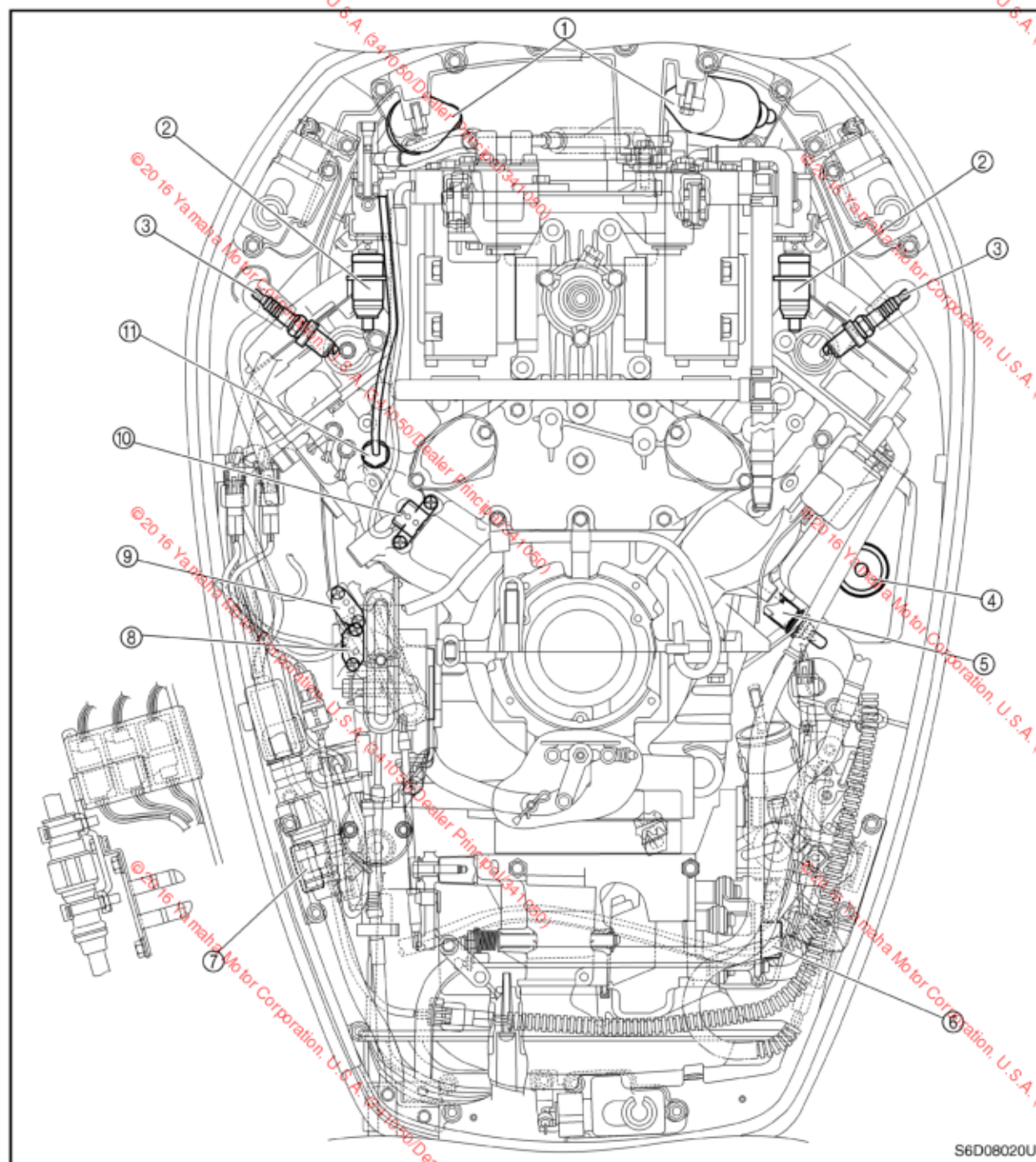


S60V8380U

- ① Ignition coil
- ② Thermoswitch
- ③ Fuel pump relay
- ④ Injector drivers
- ⑤ ECM
- ⑥ Fuel pressure sensor

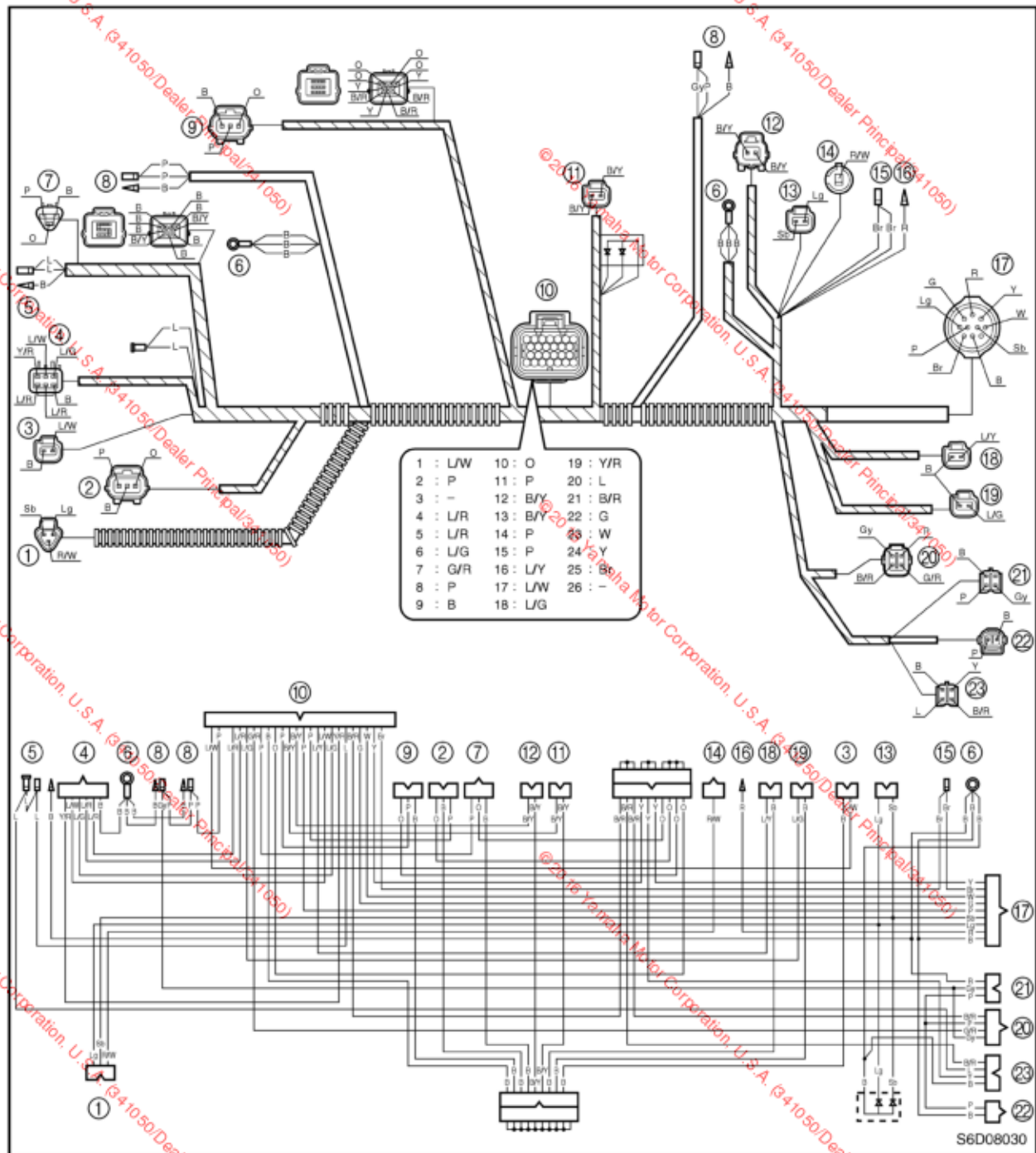


Top view



- ① Ignition coil
- ② Fuel injector
- ③ Spark plug
- ④ Oil level sensor
- ⑤ Emergency switch
- ⑥ Throttle position sensor
- ⑦ Power trim and tilt switch
- ⑧ Shift position switch
- ⑨ Shift cut switch
- ⑩ Crank position sensor
- ⑪ Engine temperature sensor

Wiring harness

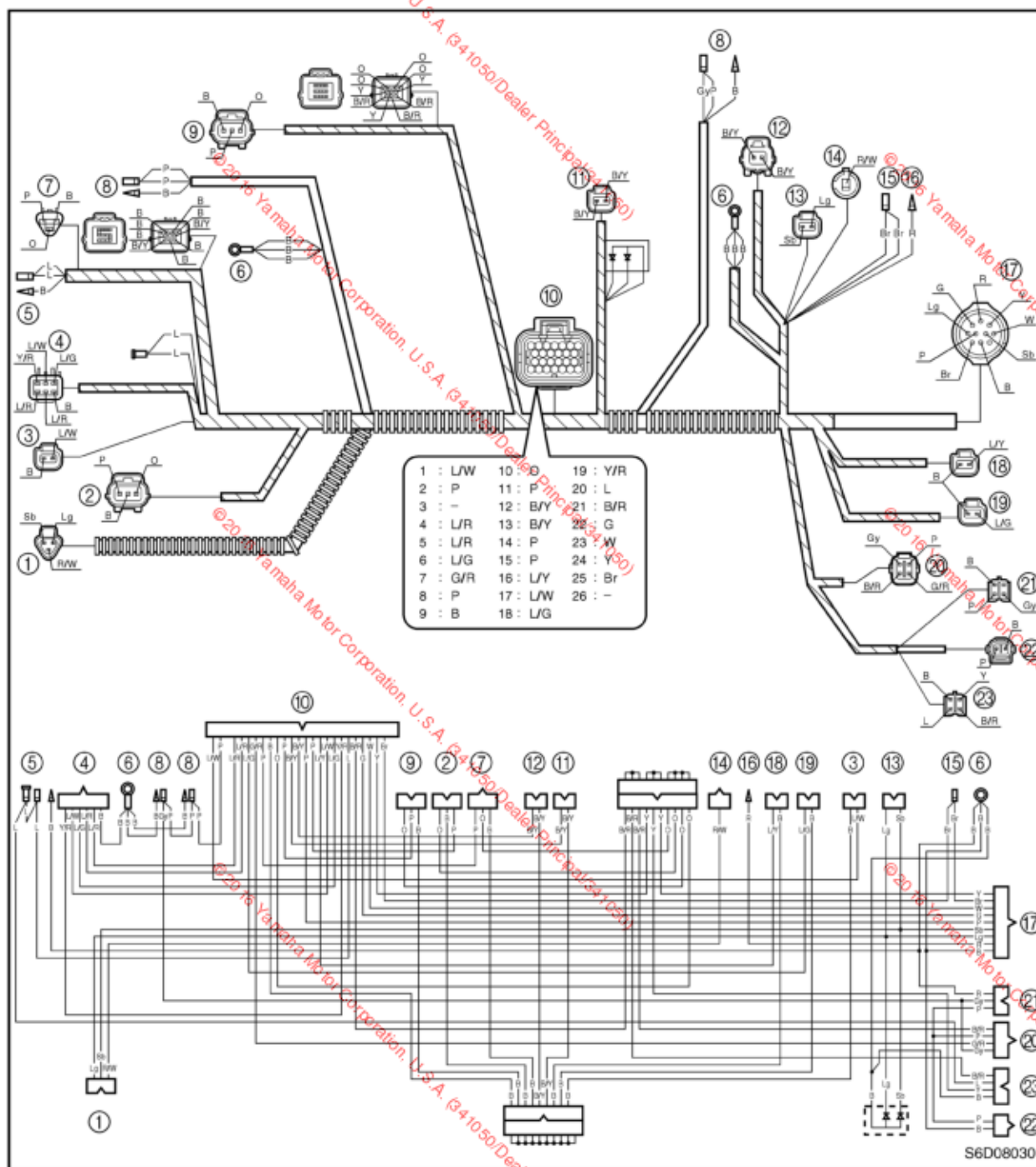


Connect to:

- ① Power trim and tilt switch
- ② Atmospheric pressure sensor
- ③ Water detection switch
- ④ Oil level sensor
- ⑤ Emergency switch
- ⑥ Ground
- ⑦ Throttle position sensor
- ⑧ Thermoswitch

- ⑨ Fuel pressure sensor
- ⑩ ECM
- ⑪ Engine temperature sensor
- ⑫ Intake air temperature sensor
- ⑬ Power trim and tilt relay
- ⑭ Fuse holder
- ⑮ Starter relay
- ⑯ Fuse holder
- ⑰ Remote control
- ⑱ Shift cut switch

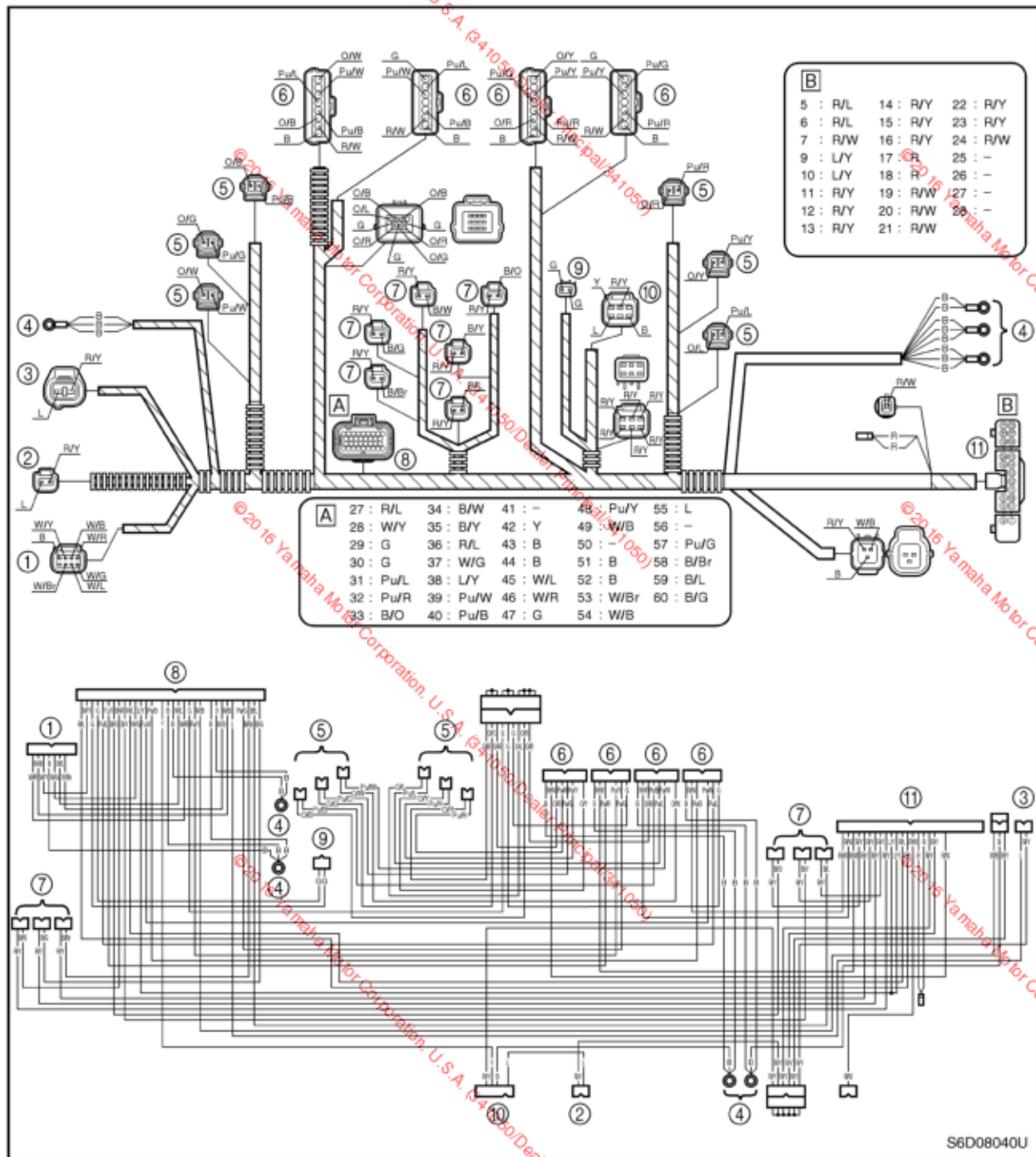
- ⑲ Shift position switch
- ⑳ Oil level warning indicator
- ㉑ Trim meter
- ㉒ Trim sensor
- ㉓ Remote oil tank



B : Black
 Br : Brown
 G : Green
 Gy : Gray
 L : Blue
 Lg : Light green
 O : Orange
 P : Pink
 R : Red
 Sb : Sky blue

W : White
 Y : Yellow
 B/R : Black/red
 B/Y : Black/yellow
 G/R : Green/red
 L/G : Blue/green
 L/R : Blue/red
 L/W : Blue/white
 L/Y : Blue/yellow
 R/W : Red/white

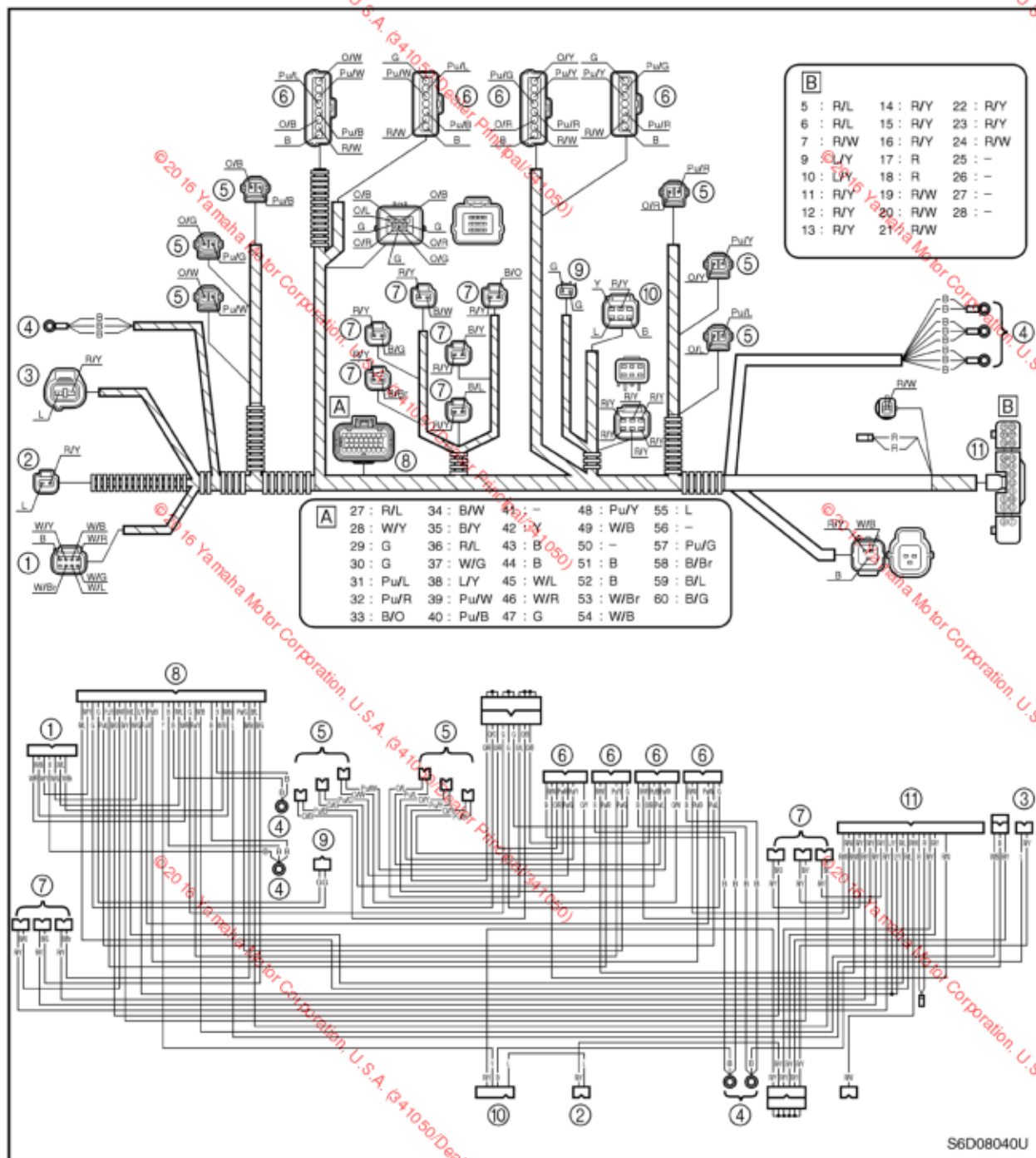
Y/R : Yellow/red



Connect to:

- ① Pulser coil
- ② Electric fuel pump
- ③ Electric oil pump
- ④ Ground
- ⑤ Fuel injector
- ⑥ Injector drivers
- ⑦ Ignition coil
- ⑧ ECM

- ⑨ Crank position sensor
- ⑩ Fuel pump relay
- ⑪ Fuse holder



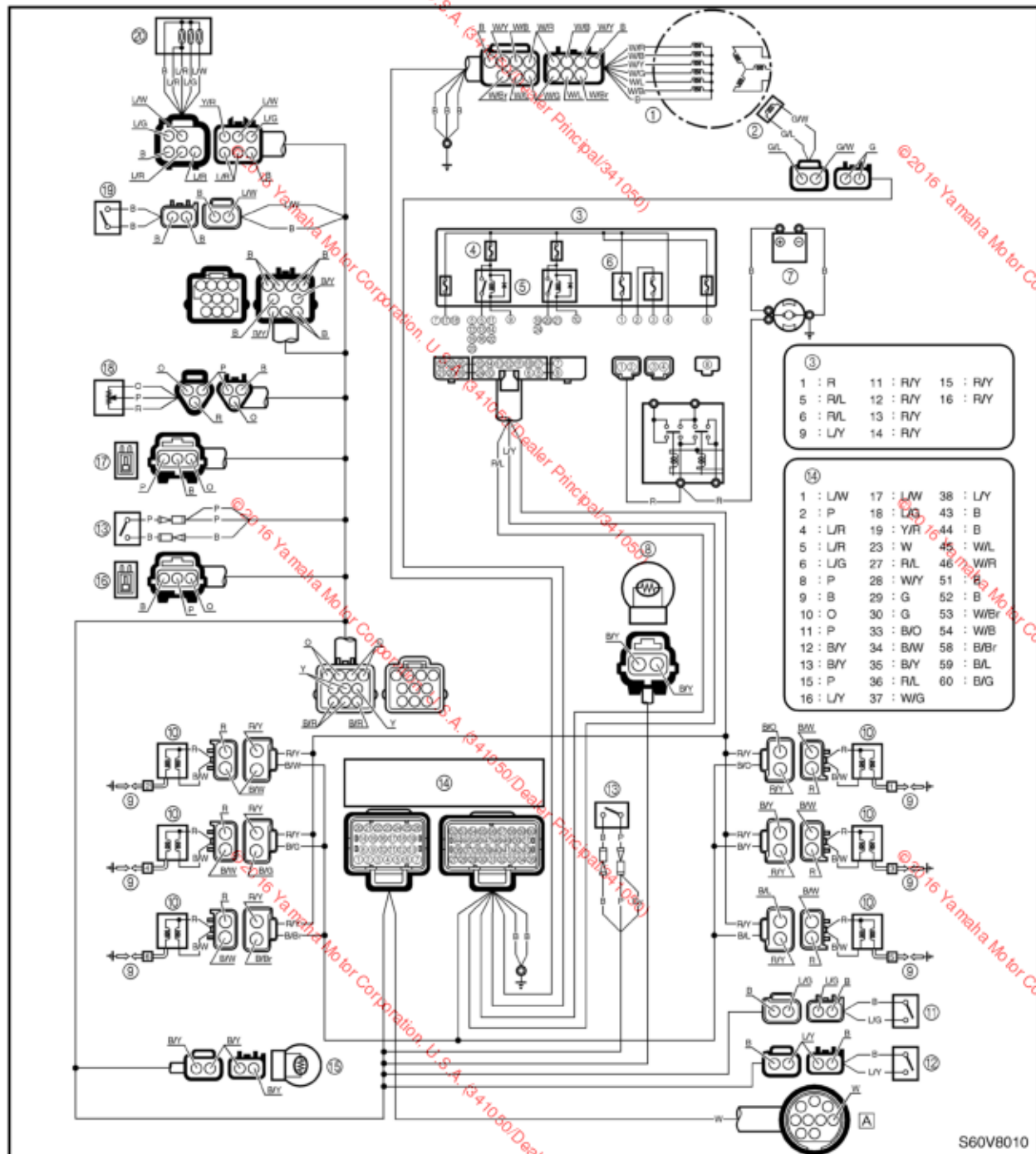
B : Black
 G : Green
 L : Blue
 R : Red
 Y : Yellow
 B/Br : Black/brown
 B/G : Black/green
 B/L : Black/blue
 B/W : Black/white
 B/Y : Black/yellow

L/Y : Blue/yellow
 O/B : Orange/black
 O/G : Orange/green
 O/L : Orange/blue
 O/R : Orange/red
 O/W : Orange/white
 O/Y : Orange/yellow
 Pu/B : Purple/black
 Pu/G : Purple/green
 Pu/L : Purple/blue

Pu/R : Purple/red
 Pu/W : Purple/white
 Pu/Y : Purple/yellow
 R/L : Red/blue
 R/W : Red/white
 R/Y : Red/yellow
 W/B : White/black
 W/Br : White/brown
 W/G : White/green
 W/L : White/blue

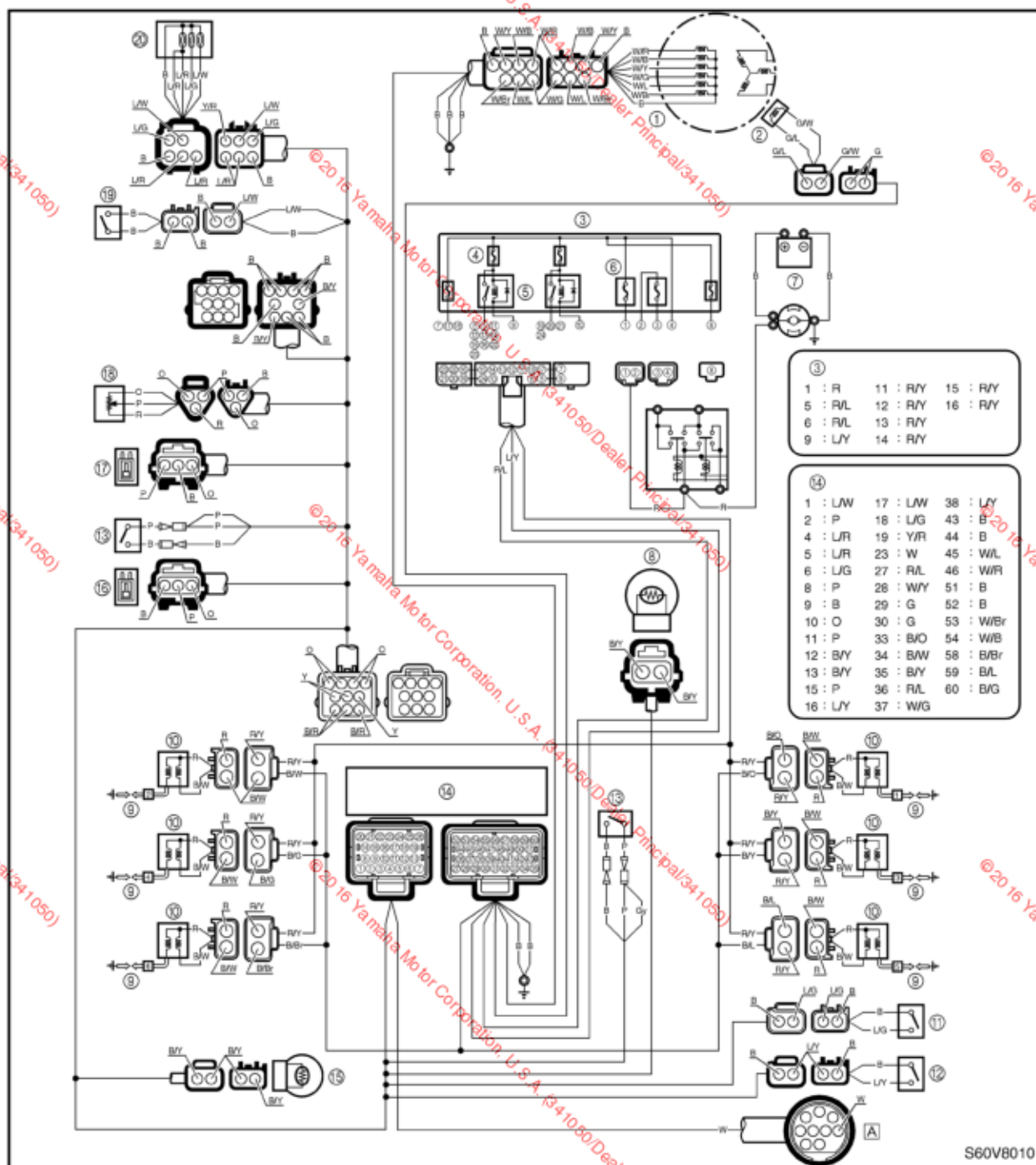
W/R : White/red
 W/Y : White/yellow

Ignition and ignition control system



- ① Pulser coil
- ② Crank position sensor
- ③ Fuse holder
- ④ Fuse (20 A)
- ⑤ ECM main relay
- ⑥ Fuse (100 A)
- ⑦ Battery
- ⑧ Intake air temperature sensor
- ⑨ Spark plug
- ⑩ Ignition coil
- ⑪ Shift position switch
- ⑫ Shift cut switch
- ⑬ Thermoswitch
- ⑭ ECM
- ⑮ Engine temperature sensor
- ⑯ Fuel pressure sensor
- ⑰ Atmospheric pressure sensor
- ⑱ Throttle position sensor
- ⑲ Water detection switch
- ⑳ Oil level sensor

Ⓐ To remote control box/switch panel



B : Black
G : Green
O : Orange
P : Pink
R : Red
W : White
Y : Yellow
B/Br : Black/brown
B/G : Black/green
B/L : Black/blue

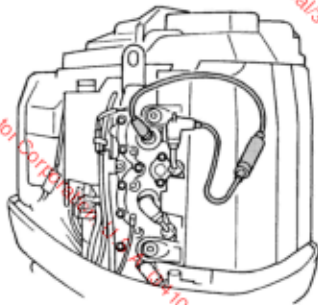
B/O : Black/orange
B/R : Black/red
B/W : Black/white
B/Y : Black/yellow
G/L : Green/blue
G/W : Green/white
L/G : Blue/green
L/R : Blue/red
L/W : Blue/white
L/Y : Blue/yellow

R/L : Red/blue
R/Y : Red/yellow
W/B : White/black
W/Br : White/brown
W/G : White/green
W/L : White/blue
W/R : White/red
W/Y : White/yellow
Y/R : Yellow/red

Ignition and ignition control system

Checking the ignition spark gap

1. Disconnect the spark plug caps from the spark plugs.
2. Connect a spark plug cap to the special service tool.

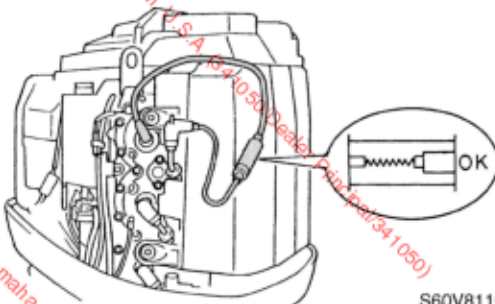


S60V8090



Dynamic spark tester: YM-34487

3. Crank the engine and observe the spark through the discharge window of the spark gap tester. Check the ignition system if the spark is weak.



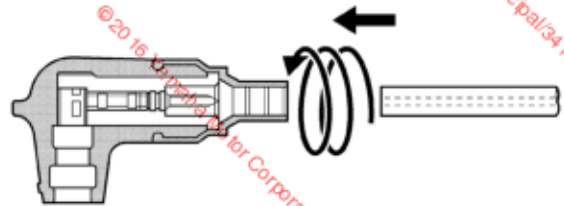
S60V8110U

⚠ WARNING

- Do not touch any of the connections of the spark gap tester leads.
- Do not let sparks leak out of the removed spark plug caps.
- Keep flammable gas or liquids away, since this test can produce sparks.

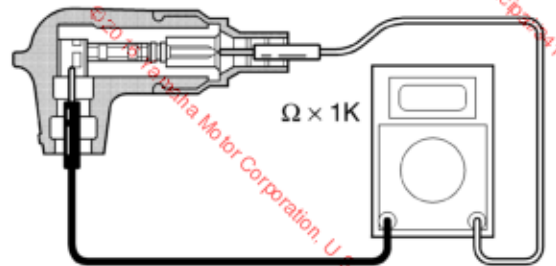
Checking the spark plug caps

1. Remove the spark plug caps from the spark plug wires by turning the caps counterclockwise.



S60V8130

2. Measure the spark plug cap resistance. Replace if out of specification.



S60V8140



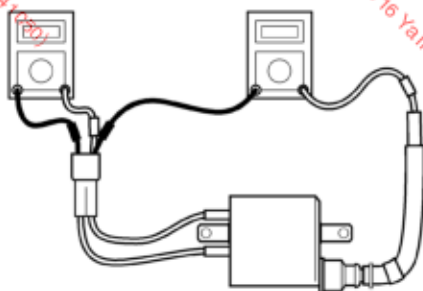
Spark plug cap resistance:
4–6 k Ω

Checking the ignition coils

1. Remove the spark plug wires from the spark plugs.
2. Remove the harness cover and disconnect the ignition coil coupler.



- Remove the ignition coil cover.
- Remove the spark plug caps from the spark plug wires.
- Measure the ignition coil resistance. Replace if out of specification.



S60V8150



Ignition coil resistance:

Primary coil:

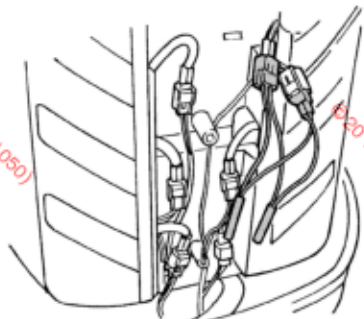
Red (R) – Black/white (B/W)
1.36–1.84 Ω at 20 °C (68 °F)

Secondary coil:

Black/white (B/W) – Spark plug wire
7.31–9.89 k Ω at 20 °C (68 °F)

Checking the ECM

- Remove the harness cover and disconnect a ignition coil coupler.
- Connect the test harness (2 pins) to the ignition coil.
- Measure the ECM output peak voltage. If below specification, measure the pulser coil output peak voltage. Replace the ECM if the output peak voltage of the pulser coil is above specification.



S60V8160



Digital multimeter: YU-34899-A
Peak voltage adaptor: YU-39991
Test harness (2 pins): YB-06767

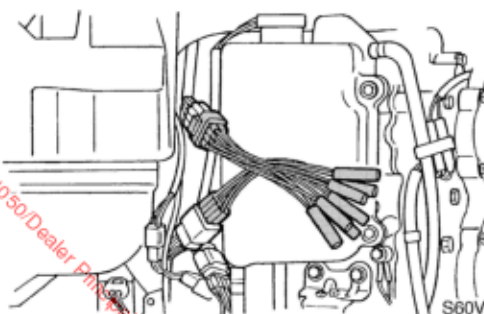


ECM output peak voltage:
Red (R) – Black/white (B/W)

r/min	Loaded		
	Cranking	1,500	3,500
DC V	160	260	260

Checking the pulser coil

- Disconnect the pulser coil coupler.
- Connect the test harness (8 pins) to the pulser coil.
- Measure the pulser coil output peak voltage. Replace the pulser coil if below specification.



S60V8170



Digital multimeter: YU-34899-A
Peak voltage adaptor: YU-39991
Test harness (8 pins): YB-06779



Pulser coil output peak voltage:
White/red (W/R) – Black (B)
White/black (W/B) – Black (B)
White/yellow (W/Y) – Black (B)
White/green (W/G) – Black (B)
White/blue (W/L) – Black (B)
White/brown (W/Br) – Black (B)

r/min	Unloaded		Loaded	
	Cranking		1,500	3,500
DC V	3.5	3.5	20.0	30.0

Ignition and ignition control system



Pulser coil resistance
(use as reference):
294–398 Ω

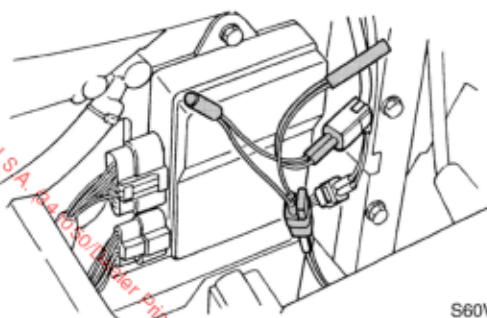
Checking the crank position sensor

1. Remove the harness cover bolts, and then pull back the ignition coil cover.

NOTE:

The ignition coils are connected to the ignition coil cover. Do not remove the ignition coil cover.

2. Connect the test harness (2 pins) to the crank position sensor.
3. Measure the crank position sensor output peak voltage. Replace the crank position sensor if below specification.



S60V8180



Digital multimeter: YU-34899-A
Peak voltage adaptor: YU-39991
Test harness (2 pins): YB-06767




Crank position sensor output peak voltage:
Green/blue (G/L) –
Green/white (G/W)

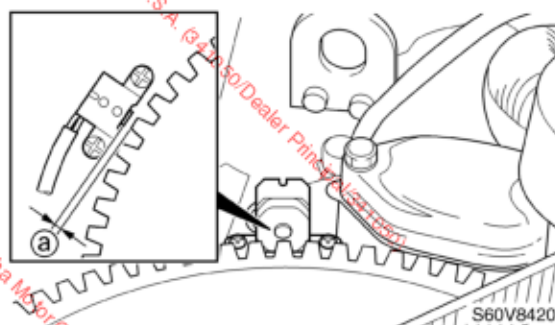
r/min	Unloaded		Loaded	
	Cranking		1,500	3,500
DC V	1.5	1.5	8.0	10.0



Crank position sensor resistance
(use as reference):
Green/blue (G/L) –
Green/white (G/W)
178.5–241.5 Ω

Checking the crank position sensor air gap


1. Remove the flywheel magnet cover.
2. Measure the crank position sensor air gap . Adjust if out of specification.

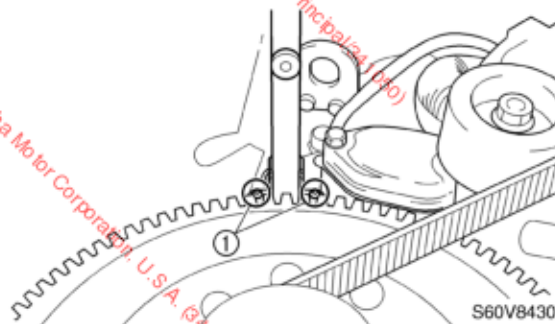


S60V8420



Crank position sensor air gap:
0.5–1.5 mm (0.02–0.06 in)

3. Loosen the screws  and adjust the crank position sensor air gap.



S60V8430

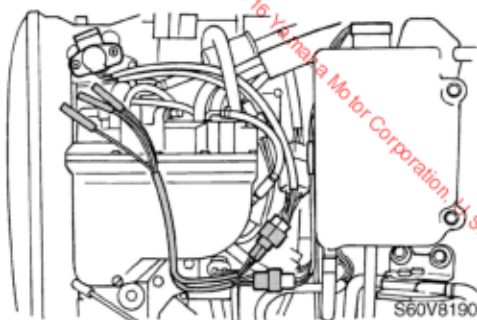
4. Tighten the screws, and then check the crank position sensor air gap. Adjust if necessary.

Checking the throttle position sensor

1. Connect the test harness (3 pins) to the throttle position sensor.
2. Turn the engine start switch to ON.

ELEC**Electrical systems**

3. Measure the throttle position sensor input voltage. Replace the ECM if out of specification.
4. Measure the throttle position sensor output voltage. Adjust the throttle position sensor if out of specification.



Test harness (3 pins): YB-06757



Throttle position sensor input voltage:

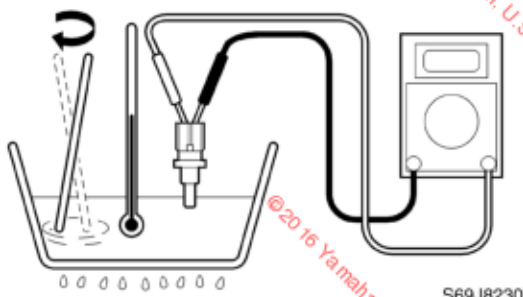
Orange (O) – Red (R)
5 V

Throttle position sensor output voltage:

Pink (P) – Orange (O)
0.58–0.62 V

Checking the intake air temperature sensor

1. Place the intake air temperature sensor in a container of water and slowly heat the water.



2. Measure the intake air temperature sensor resistance. Replace if out of specification.



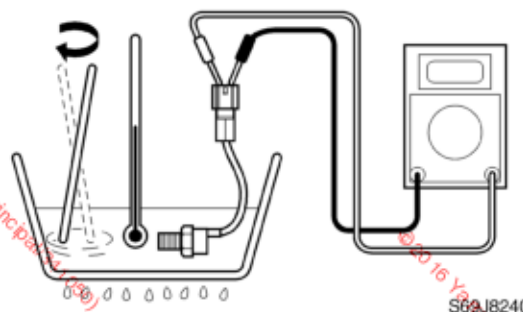
Intake air temperature sensor resistance:

at 0 °C (32 °F): 5.4–6.6 k Ω

at 80 °C (176 °F): 0.3–0.4 k Ω

Checking the engine temperature sensor

1. Place the engine temperature sensor in a container of water and slowly heat the water.



2. Measure the engine temperature sensor resistance. Replace if out of specification.



Engine temperature sensor resistance:

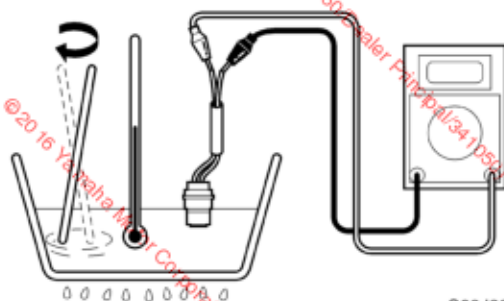
Black/yellow (B/Y) –
Black/yellow (B/Y)

at 20 °C (68 °F): 54.2–69.0 k Ω

at 100 °C (212 °F): 3.12–3.48 k Ω

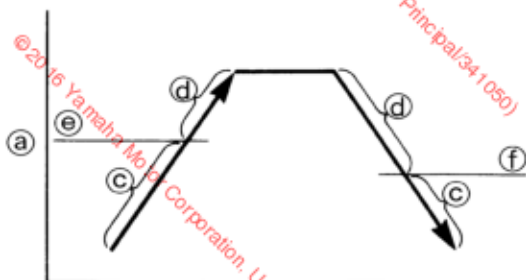
Checking the thermostwitches

1. Place the thermostwitches in a container of water and slowly heat the water.



S69J8250

2. Check the switches for continuity at the specified temperatures. Replace if out of specification.



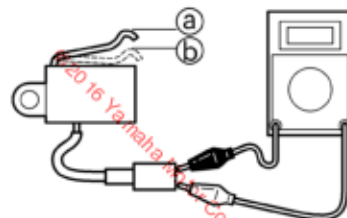
S69J8260

- (a) Temperature
- (b) Time
- (c) No continuity
- (d) Continuity

Thermostwitch continuity temperature:
Pink (P) – Black (B)
(e): 84–90 °C (183–194 °F)
(f): 60–74 °C (140–165 °F)

Checking the shift cut switch

1. Check the shift cut switch for continuity. Replace if there is no continuity.

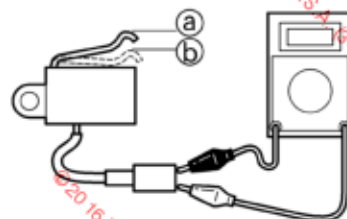


S69J8270

Switch position	Lead color	
	Blue/yellow (L/Y)	Black (B)
Free (a)		
Push (b)		

Checking the shift position switch

1. Check the shift position switch for continuity. Replace if there is no continuity.



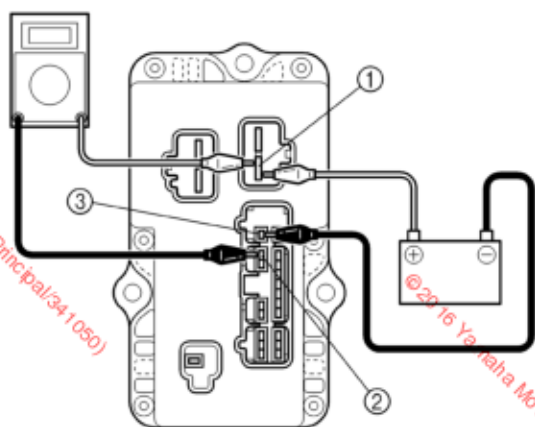
S69J8270

Switch position	Lead color	
	Blue/green (L/G)	Black (B)
Free (a)		
Push (b)		



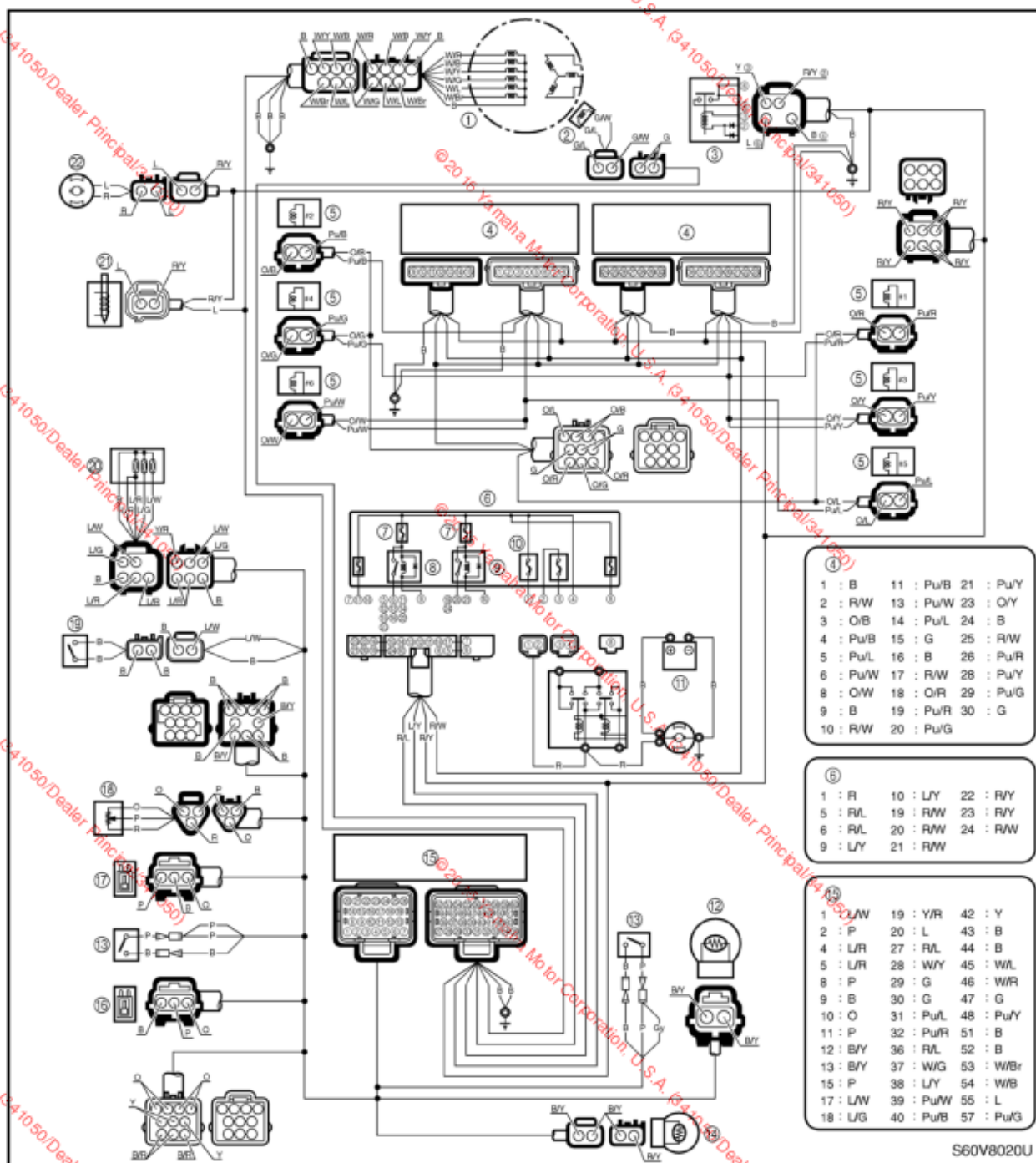
Checking the ECM main relay

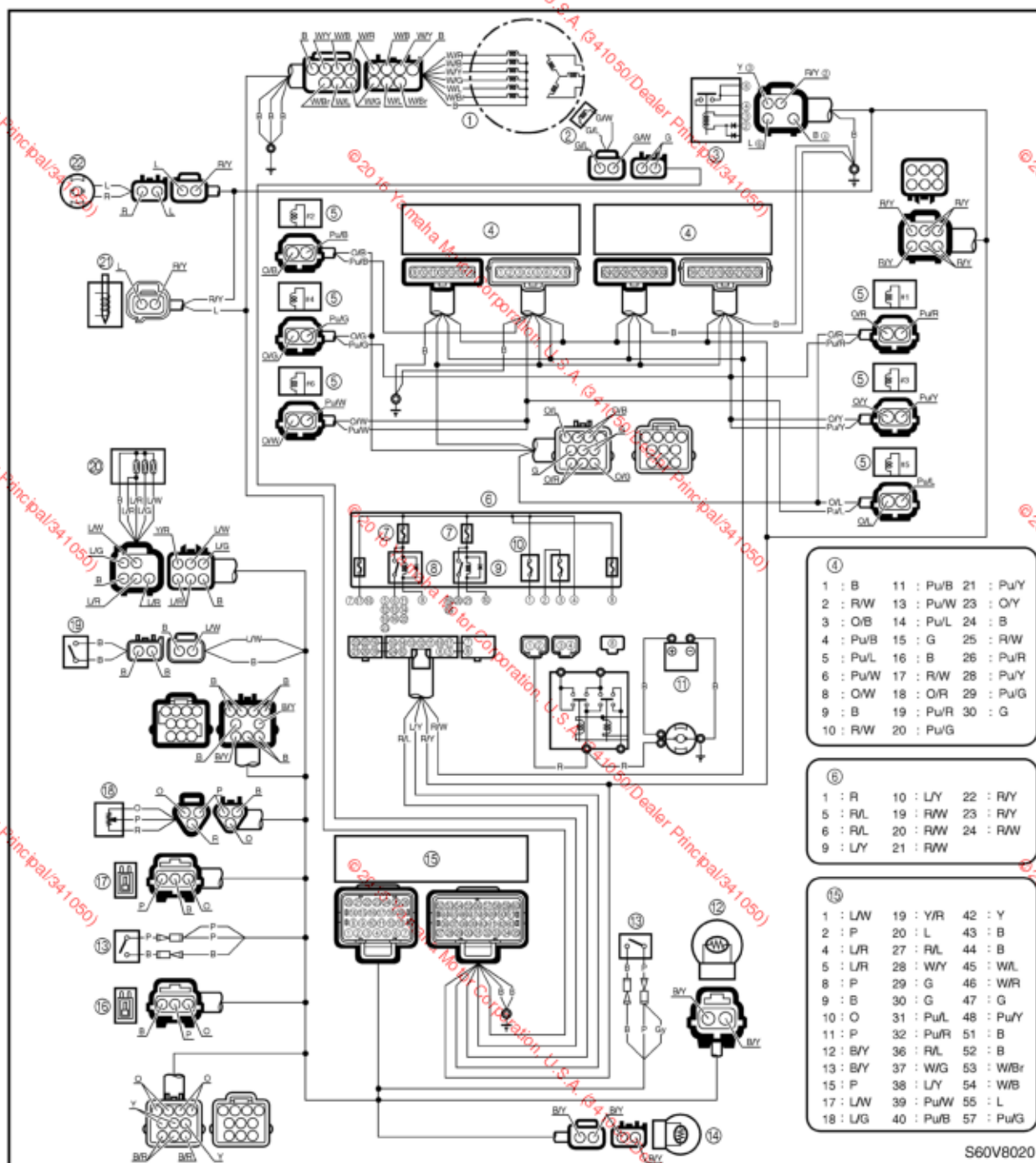
1. Remove the fuse holder cover, and then remove the fuse holder.
2. Connect the digital circuit tester leads to ECM main relay terminals ① and ②.
3. Connect positive battery terminal to the ECM main relay terminal ①.
4. Connect the negative battery terminal to the ECM main relay terminal ③.
5. Check for continuity between the ECM main relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals after disconnecting a battery terminal from ECM main relay terminal ① or ③. Replace if there is continuity.



S60V8450

Fuel control system





S60V8020

B : Black
 G : Green
 Gy : Gray
 L : Blue
 O : Orange
 P : Pink
 R : Red
 Y : Yellow
 B/R : Black/red
 B/Y : Black/yellow

G/L : Green/blue
 G/W : Green/white
 L/G : Blue/green
 L/R : Blue/red
 L/W : Blue/white
 L/Y : Blue/yellow
 O/B : Orange/black
 O/G : Orange/green
 O/L : Orange/blue
 O/R : Orange/red

O/W : Orange/white
 O/Y : Orange/yellow
 Pu/B : Purple/black
 Pu/G : Purple/green
 Pu/L : Purple/blue
 Pu/R : Purple/red
 Pu/W : Purple/white
 Pu/Y : Purple/yellow
 R/L : Red/blue
 R/W : Red/white

R/Y : Red/yellow
 W/B : White/black
 W/Br : White/brown
 W/G : White/green
 W/L : White/blue
 W/R : White/red
 W/Y : White/yellow
 Y/R : Yellow/red

Fuel control system

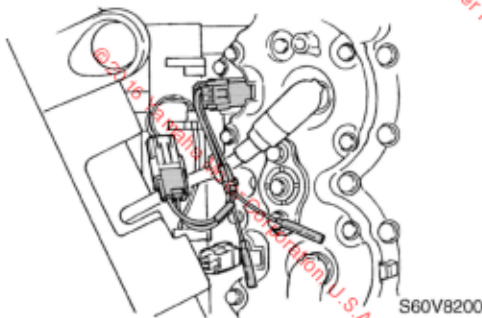
Checking the injector drivers

1. Remove the harness cover bolts, and then pull back the ignition coil cover ①.

NOTE:

The ignition coils are connected to the ignition coil cover. Do not remove the ignition coil cover.

2. Connect the test harness (2 pins) to the fuel injector.
3. Measure the injector driver output peak voltage. If below specification, measure the fuel injector resistance or replace the injector drivers.



Digital multimeter: YU-34899-A
Peak voltage adaptor: YU-39991
Test harness (2 pins): YB-06861

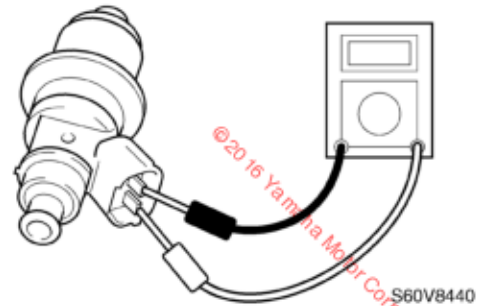


Injector driver output peak voltage
(use as reference):

Purple/red (Pu/R) –
Orange/red (O/R) –
Purple/black (Pu/B) –
Orange/black (O/B) –
Purple/yellow (Pu/Y) –
Orange/yellow (O/Y) –
Purple/green (Pu/G) –
Orange/green (O/G) –
Purple/blue (Pu/L) –
Orange/blue (O/L) –
Purple/white (Pu/W) –
Orange/white (O/W)

r/min	Loaded		
	Cranking	1,500	3,500
DC V	70	80	80

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



Digital multimeter: YU-34899-A



Fuel injector resistance
(use as reference):
0.9–1.1 Ω at 20 °C (68 °F)

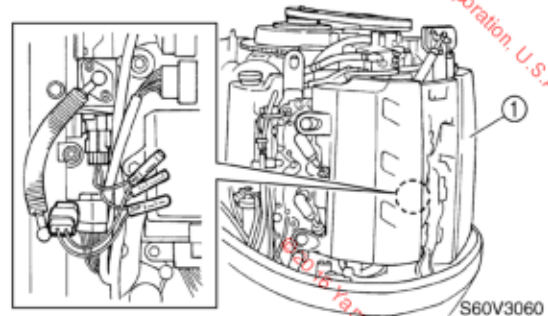
Checking the fuel pressure sensor

1. Remove the flywheel magnet cover.
2. Remove the harness cover bolts, and then pull back the ignition coil cover ①.

NOTE:

The ignition coils are connected to the ignition coil cover. Do not remove the ignition coil cover.

3. Connect the test harness (3 pins) between the fuel pressure sensor and the wiring harness as shown.



Test harness (3 pins): YB-06769

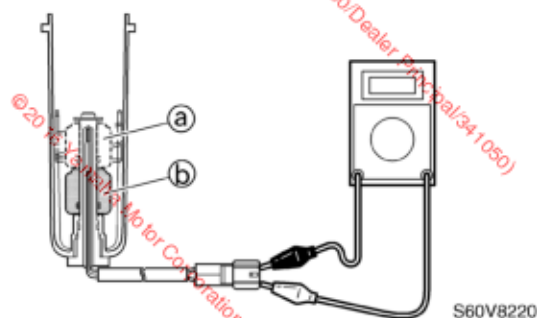


- Start the engine and warm it up for 5 minutes, and then measure the fuel pressure sensor output voltage. If out of specification, check the high-pressure fuel line and the mechanical fuel pump or replace the fuel pressure sensor.

	Fuel pressure sensor output voltage (use as reference):
	Orange (O) – Pink (P)
	3.2 V at 670–730 r/min

Checking the water detection switch

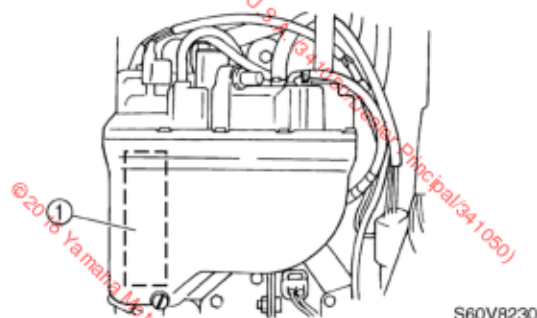
- Check the water detection switch for continuity. Replace if there is no continuity.



Float position	Lead color	
	Black (B)	Black (B)
On (a)	○ — ○	○ — ○
Off (b)		

Checking the electric fuel pump

- Turn the engine start switch to ON.
- Listen for the operating sound of the electric fuel pump (1).

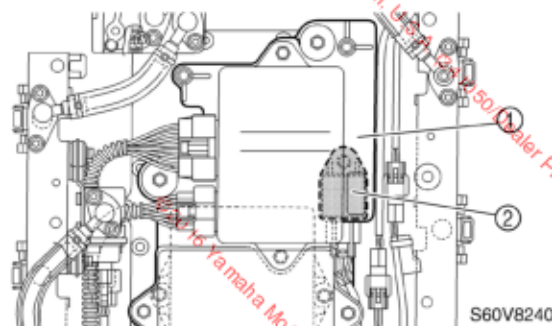


NOTE:

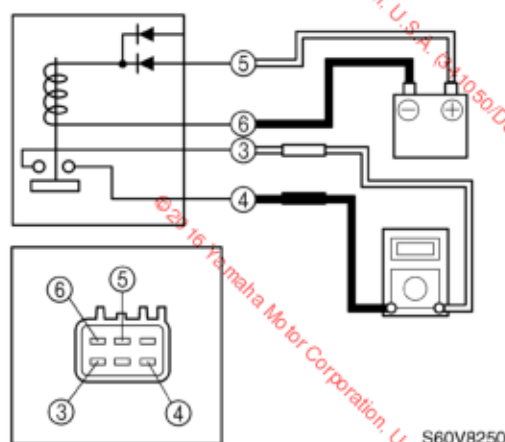
After the engine start switch is turned to ON, the electric fuel pump will operate for 5 seconds.

Checking the electric fuel pump relay

- Remove the ignition coil cover.
- Remove the bracket (1), then the electric fuel pump relay (2).



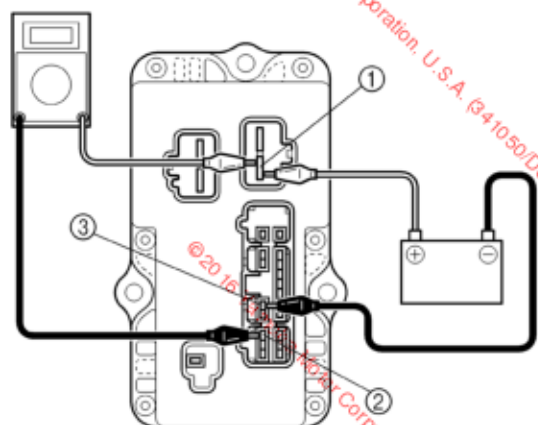
- Connect the digital circuit tester leads to electric fuel pump relay terminals (3) and (4).
- Connect the positive battery terminal to the electric fuel pump relay terminal (5).
- Connect the negative battery terminal to the electric fuel pump relay terminal (6).
- Check for continuity between the electric fuel pump relay terminals. Replace if there is no continuity.
- Check that there is no continuity between the relay terminals after disconnecting a battery terminal from electric fuel pump relay terminal (5) or (6). Replace if there is continuity.



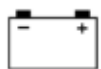
S60V8250

Checking the injector driver relay

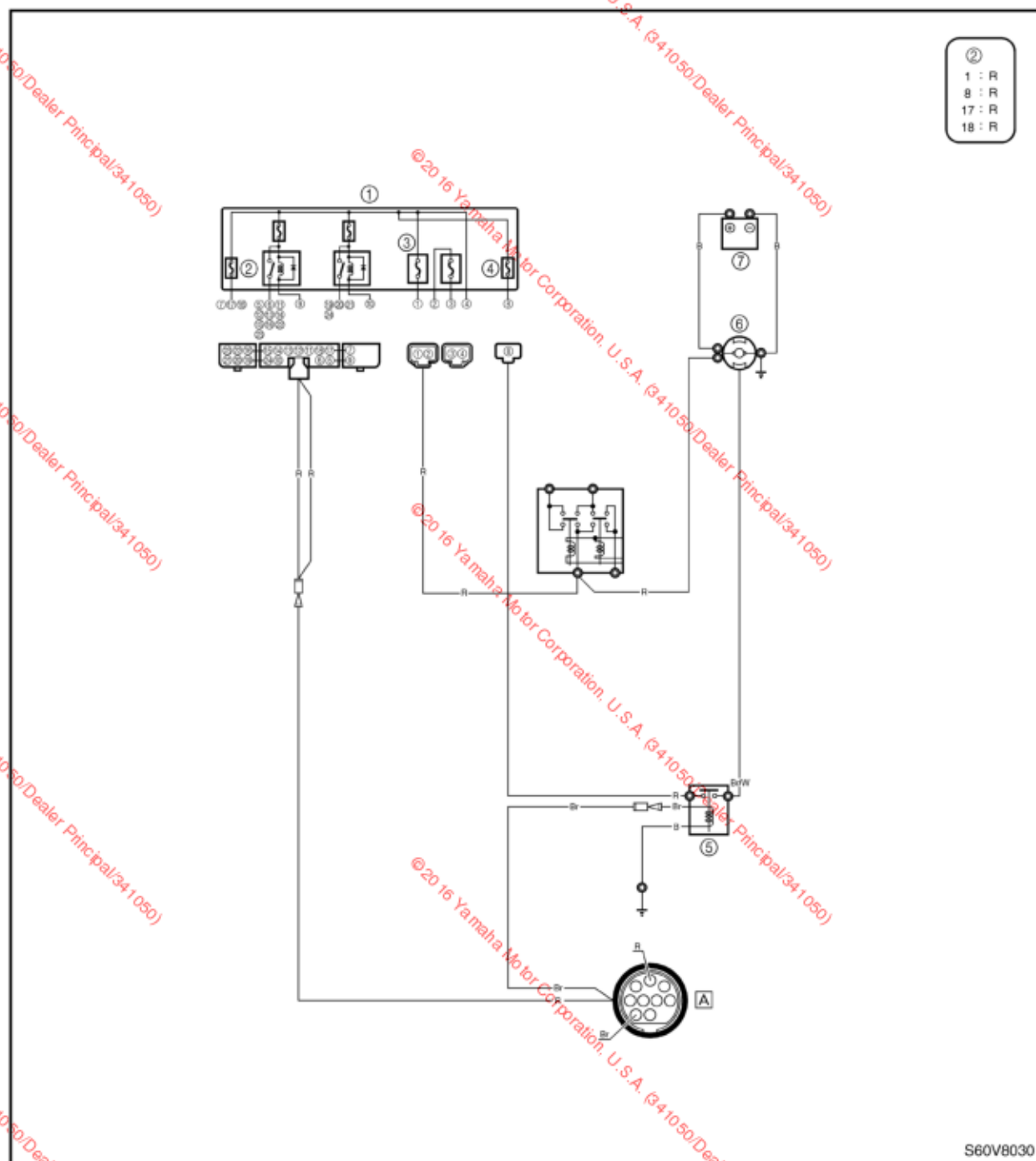
1. Remove the fuse holder cover, then the fuse holder.
2. Connect the digital circuit tester leads to terminals ① and ②.
3. Connect the terminal ① to the positive battery terminal.
4. Connect the terminal ③ to the negative battery terminal.
5. Check for continuity between the injector driver relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the terminals after disconnecting terminal ① or ③. Replace if there is continuity.



S60V8460



Starting system



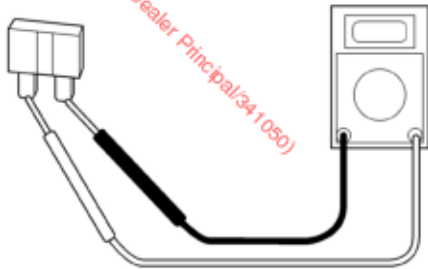
- ① Fuse holder
- ② Fuse (20 A)
- ③ Fuse (100 A)
- ④ Fuse (30 A)
- ⑤ Starter relay
- ⑥ Starter motor
- ⑦ Battery

A To remote control box/switch panel

B : Black
Br : Brown
R : Red
Br/W : Brown/white

Checking the fuses

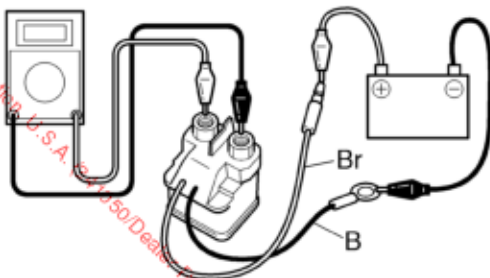
1. Check the fuses for continuity. Replace if there is no continuity.



S69J8340

Checking the starter relay

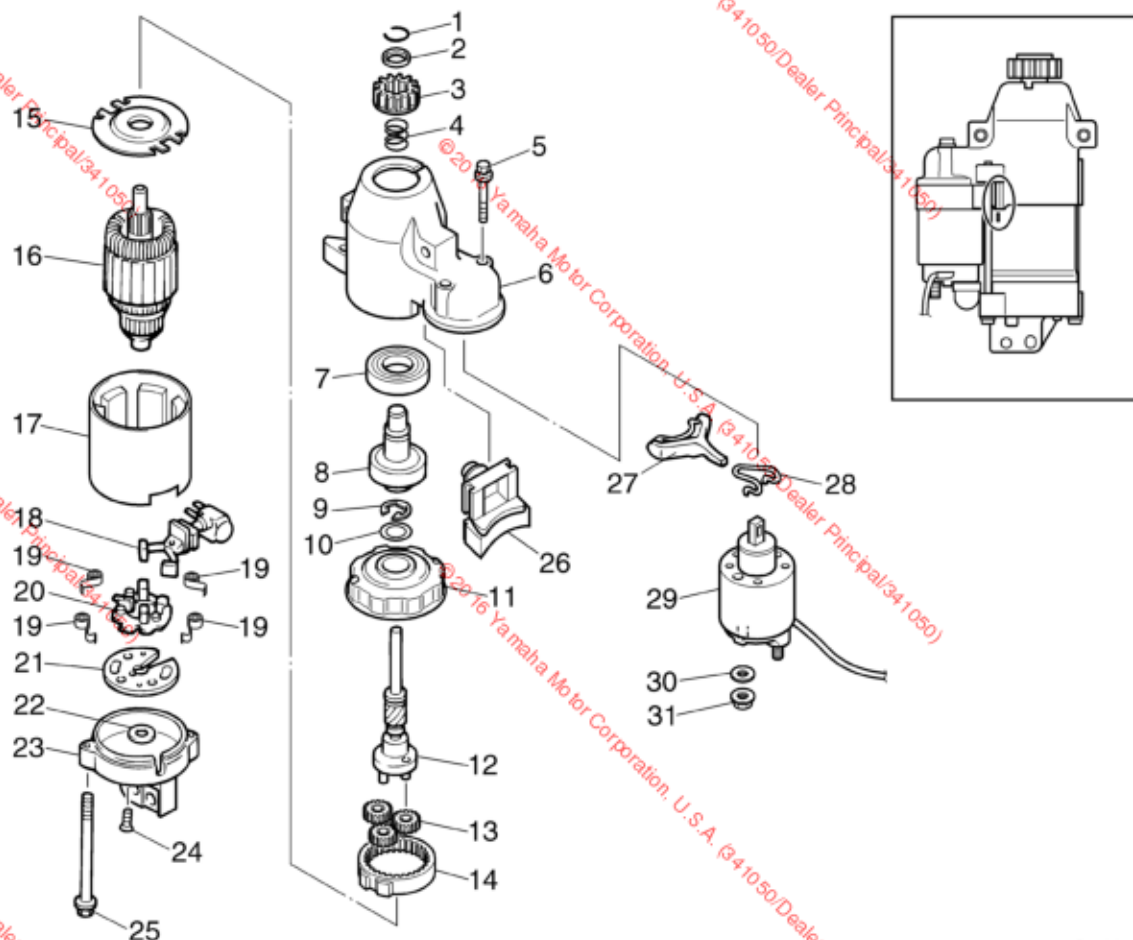
1. Connect the digital circuit tester leads to the starter relay terminals.
2. Connect the positive battery terminal to the brown (Br) lead.
3. Connect the negative battery terminal to the black (B) lead.
4. Check for continuity between the starter relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the starter relay terminals after disconnecting a battery terminal from the brown or black lead. Replace if there is continuity.



S60V8265



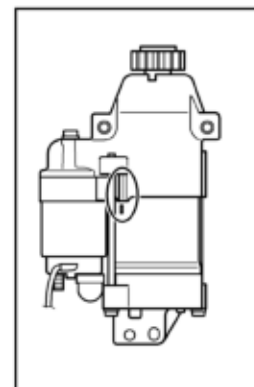
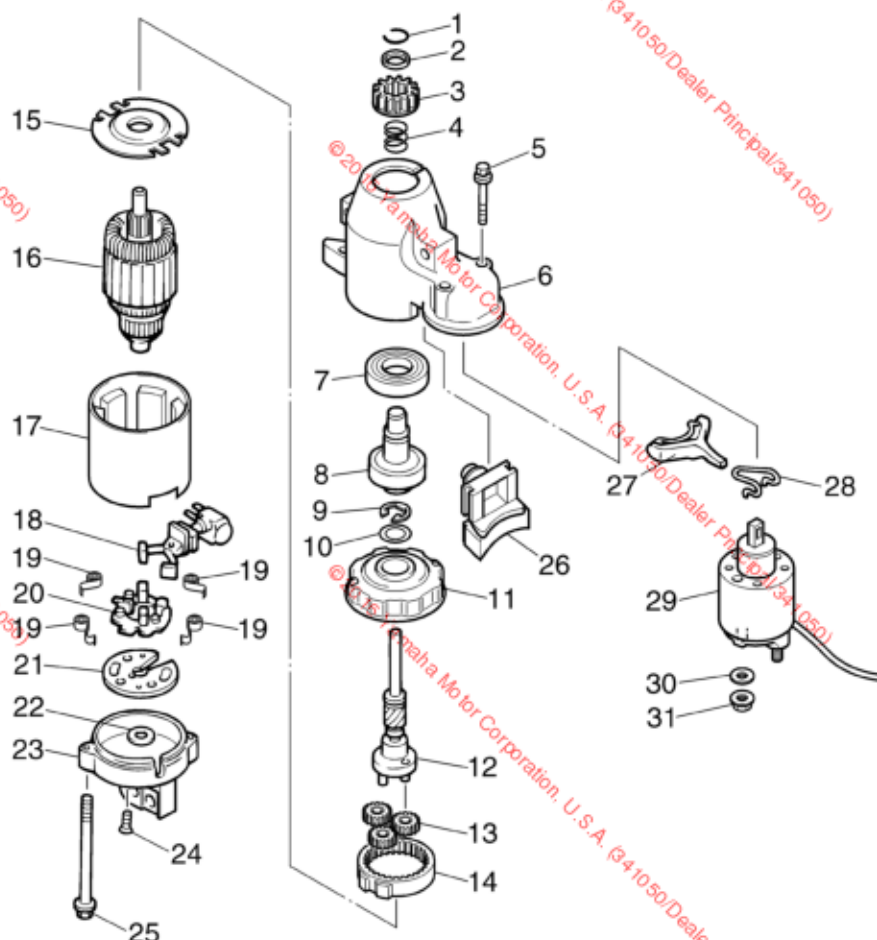
Starter motor



S60V8270

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 x 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	

Starter motor



S60V8270

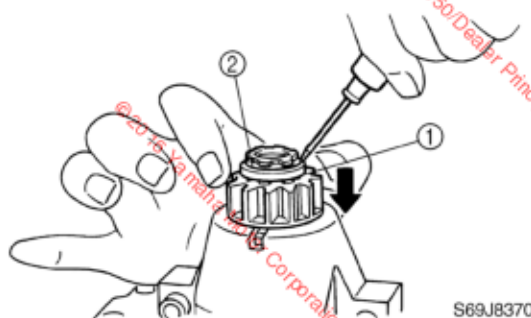
No.	Part name	Q'ty	Remarks
18	Brush assembly	1	
19	Brush spring	4	
20	Brush holder	1	
21	Plate	1	
22	Washer	1	
23	Bracket	1	
24	Screw	2	4 × 15 mm
25	Bolt	2	M6 × 120 mm
26	Rubber seal	1	
27	Shift lever	1	
28	Spring	1	
29	Magnet switch assembly	1	
30	Washer	1	
31	Nut	1	

8



Removing the starter motor pinion

1. Slide the pinion stopper ① down as shown, and then remove the clip ②.



S69J8370

NOTE:

Remove the clip with a thin screwdriver.

Checking the starter motor pinion

1. Check the teeth of the pinion for cracks or wear. Replace if necessary.



S69J8380

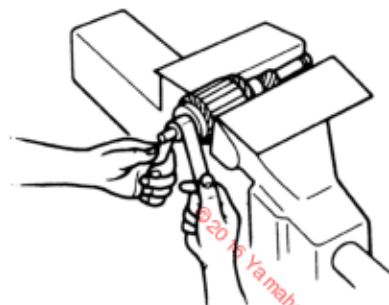
2. Check for smooth operation. Replace if necessary.

NOTE:

Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

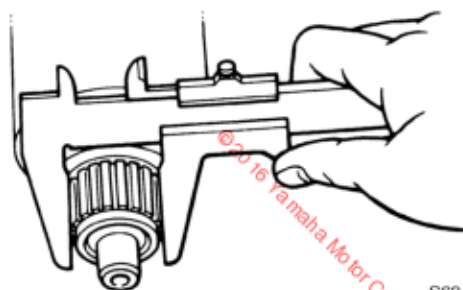
Checking the armature

1. Check the commutator for dirt. Clean with #600 grid sandpaper and compressed air if necessary.



S69J8390

2. Measure the commutator diameter. Replace the armature if out of specification.



S69J8400



Commutator diameter limit:
28.0 mm (1.10 in)

3. Measure the commutator undercut ①. Replace the armature if out of specification.

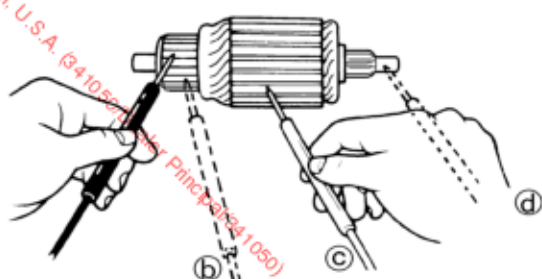


S69J8410



Commutator undercut limit ①:
0.2 mm (0.01 in)

4. Check the armature for continuity. Replace if out of specifications.



S69J8420

Armature continuity	
Commutator segments (b)	Continuity
Segment – Armature core (c)	No continuity
Segment – Armature shaft (d)	No continuity

Checking the brushes

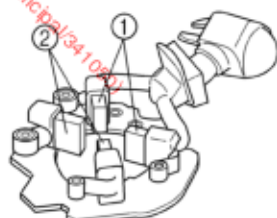
1. Measure the brush length. Replace the brush assembly if out of specification.



S69J8430

	Brush length limit (a): 9.5 mm (0.37 in)
--	---

2. Check the brush holder assembly for continuity. Replace if out of specifications.

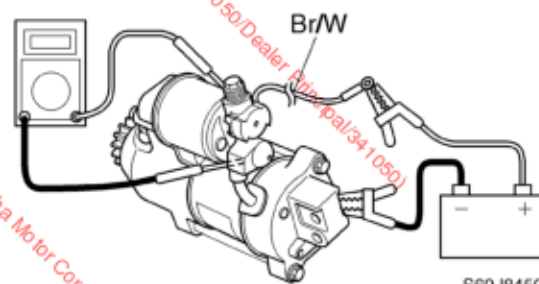


S69J8440

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 and white (Br/W) lead.
3. Connect the negative battery lead to the starter motor body.



S69J8450

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:

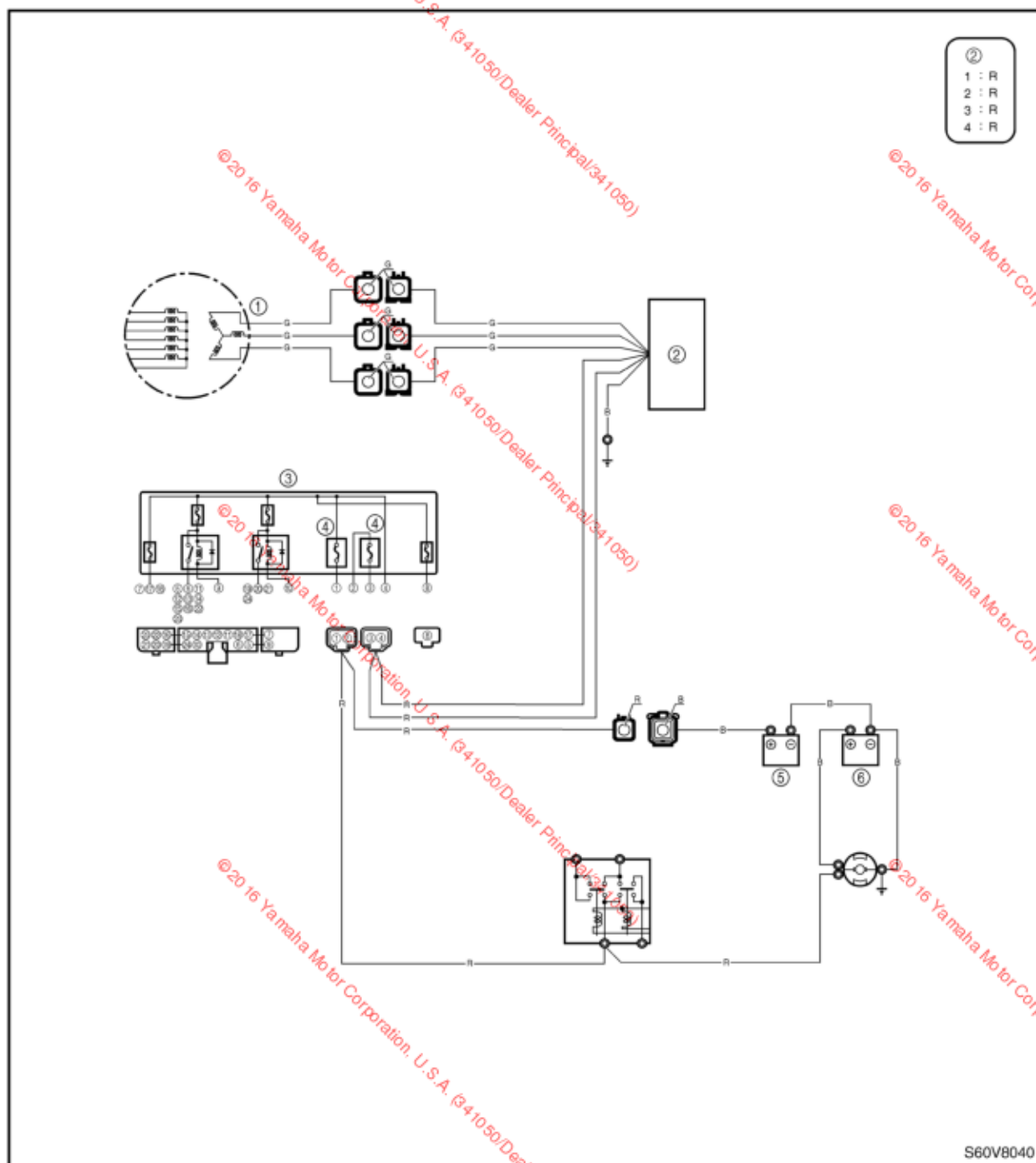
The starter motor pinion should be pushed out while the magnet switch is on.

Checking the starter motor operation

1. Check the operation of the starter motor after installing it onto the power unit.



Charging system

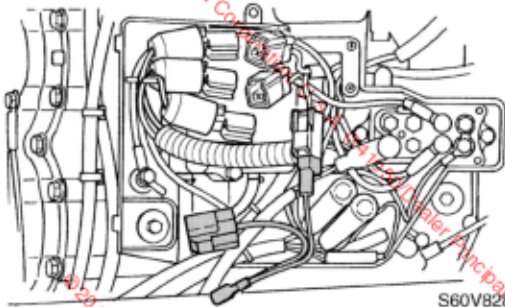



- ① Stator coil
- ② Rectifier Regulator
- ③ Fuse holder
- ④ Fuse (100 A)
- ⑤ Accessory battery
- ⑥ Battery


B : Black
G : Green
R : Red


Checking the stator coil

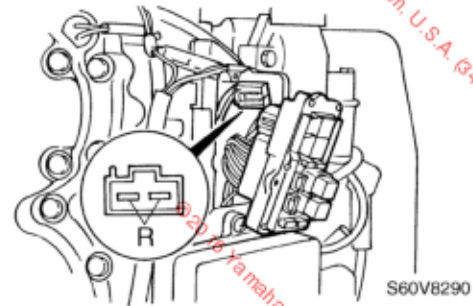
1. Remove the junction box cover and disconnect the stator coil coupler.
2. Connect the test harness (1 pin) to the stator coil.
3. Measure the stator coil output peak voltage. Replace the stator coil if below specification.






 Digital multimeter: YU-34899-A
 Peak voltage adaptor: YU-39991
 Test harness (1 pin): YB-06788

 Stator coil output peak voltage: Green (G) – Green (G)			
r/min	Unloaded		
	Cranking	1,500	3,500
DC V	5.5	40	90


 Stator coil resistance
 (use as reference):
 Green (G) – Green (G)
 0.11–0.17 Ω at 20 °C (68 °F)




 Digital multimeter: YU-34899-A
 Peak voltage adaptor: YU-39991

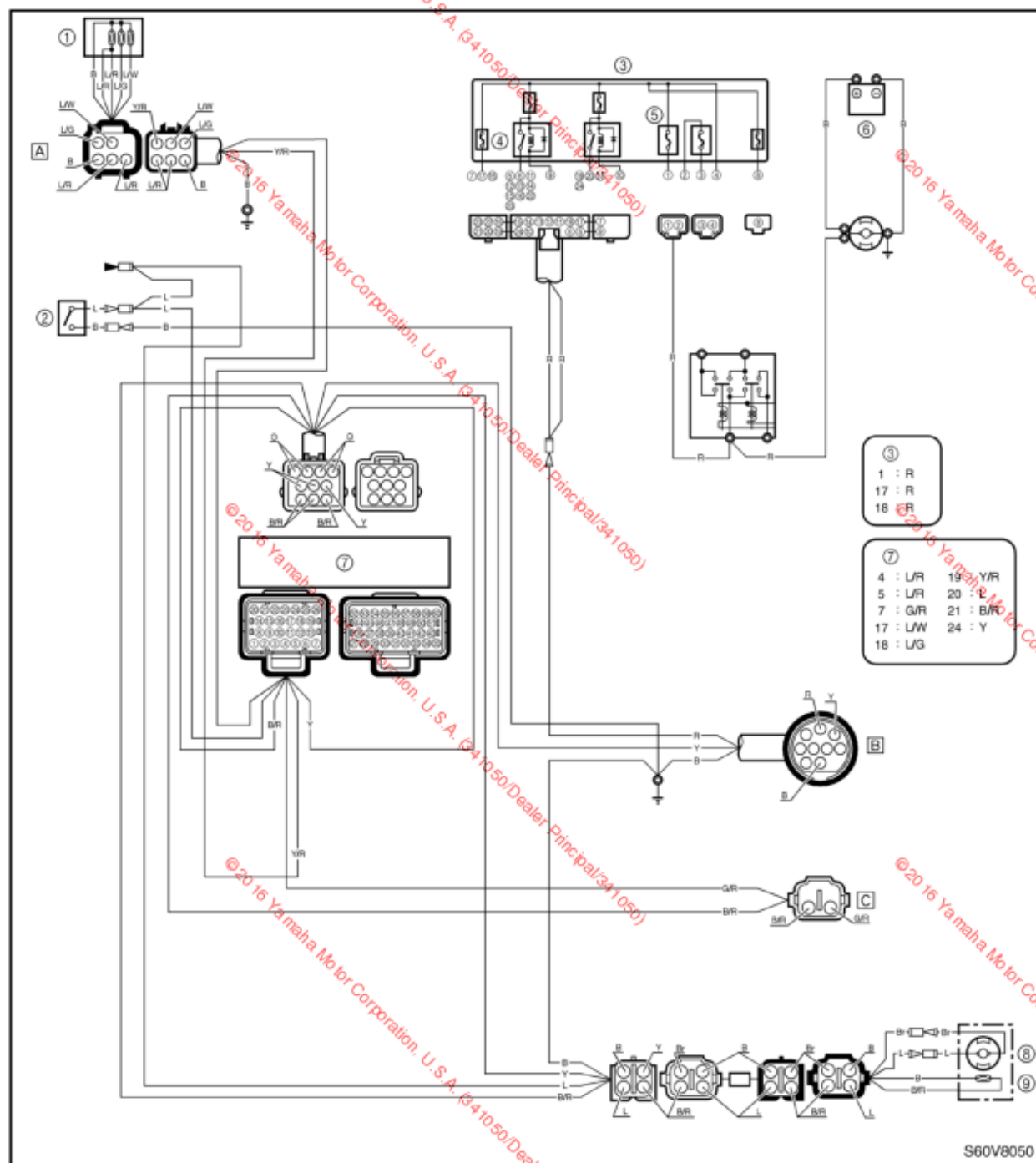
 Rectifier Regulator output peak voltage: Red (R) – Ground		
r/min	Unloaded	
	1,500	3,500
DC V	14.5	14.5

Checking the Rectifier Regulator

1. Remove the fuse holder and disconnect the Rectifier Regulator coupler (blue).
2. Measure the Rectifier Regulator output peak voltage. If below specification, measure the stator coil output voltage. Replace the Rectifier Regulator if the output peak voltage of the stator coil is above specification.



Oil feed pump control system



- ① Oil level sensor
- ② Emergency switch
- ③ Fuse holder
- ④ Fuse (20 A)
- ⑤ Fuse (100 A)
- ⑥ Battery
- ⑦ ECM
- ⑧ Oil pump (remote oil tank)

- ⑨ Oil level sensor (remote oil tank)
- A To diagnostic indicator (special service tool)
- B To remote control box/switch panel
- C To oil level warning indicator

B : Black
 Br : Brown
 L : Blue
 O : Orange
 R : Red
 Y : Yellow
 B/R : Black/red
 G/R : Green/red
 L/G : Blue/green
 L/R : Blue/red

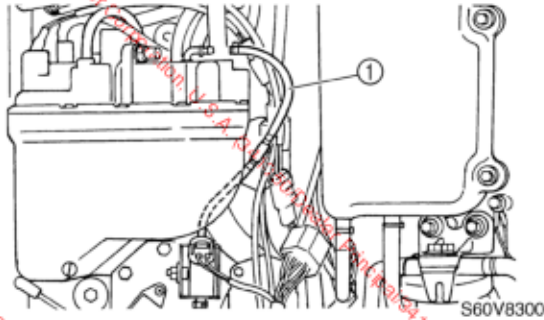
L/W : Blue/white
 R/Y : Red/yellow
 W/B : White/black
 W/R : White/red
 Y/R : Yellow/red

Checking the electric oil pump

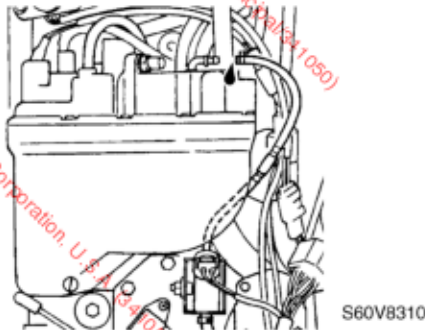
CAUTION:

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

1. Remove the flywheel magnet cover and disconnect the electric oil pump hose ① from the vapor separator.



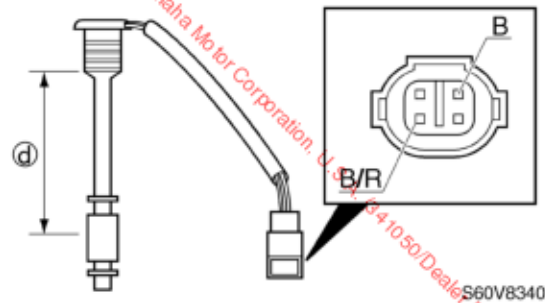
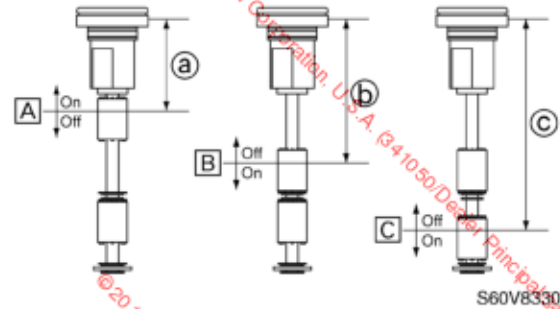
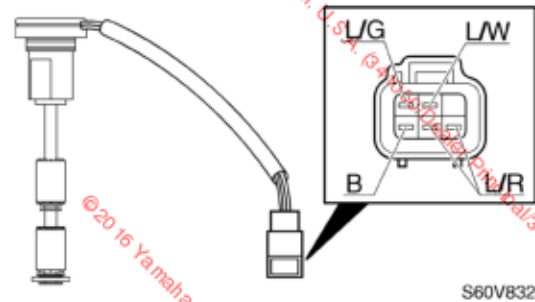
2. Wrap the end of the electric oil pump hose with a rag.
3. Start the engine and let it idle.
4. Check that the oil flows from the electric oil pump hose end. If no oil flows from the hose end, replace the electric oil pump.



5. Connect the electric oil pump hose.

Checking the oil level sensor

1. Check the oil level sensor for continuity. Replace if there is no continuity.

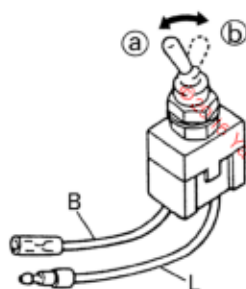


Float position	Lead color			
	Black (B)	Blue/white (L/W)	Blue/green (L/G)	Blue/red (L/R)
A On	○	○		
A Off				
B On	○		○	
B Off				
C On	○			○
C Off				
Float distance: a: 53–57 mm (2.09–2.24 in) b: 83–87 mm (3.27–3.43 in) c: 126.5–130.5 mm (4.98–5.14 in) d: 150–153 mm (5.91–6.02 in)				



Checking the emergency switch

1. Check the emergency switch for continuity. Replace if there is no continuity.



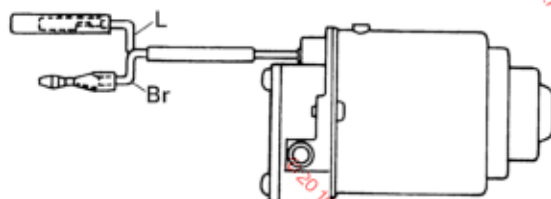
S60V8400

Switch position	Lead color	
	Blue (L)	Black (B)
Home (a)		
On (b)		

2. Check that the emergency switch returns automatically to the home position from the on position when released. Replace if necessary.

Checking the oil pump (remote oil tank)

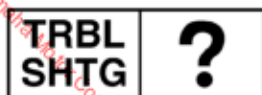
1. Connect the positive battery terminal to the blue (L) lead.
2. Connect the negative battery terminal to the brown (Br) lead.
3. Listen for the operating sound of the oil pump (remote oil tank). Replace if there is no sound.



S60V8410

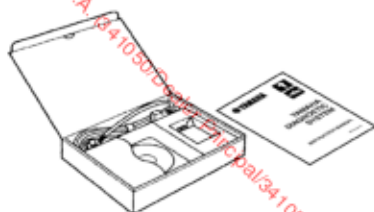
Troubleshooting

Special service tools	9-1
Yamaha Diagnostic System	9-2
Introduction	9-2
Power unit.....	9-5
Self-diagnosis.....	9-22
Diagnosing the electronic control system	9-22



Troubleshooting

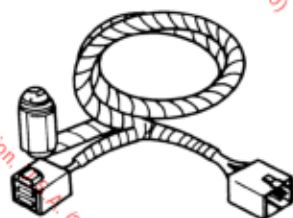
Special service tools



Yamaha Diagnostic System
60V-85300-02



Yamaha Diagnostic System
60V-WS853-02



Diagnostic flash indicator
YB-06444

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 electric oil pump 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.
6. **Data logger:** Displays 20 minutes of recorded data for two or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine.
7. **Some files:** Lets you select and run other applications while continuing to run the diagnostic program.

Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)



①



②



③



④



⑤

Hardware requirements

Make sure that your computer meets the following requirements before using this software.

Computer:	IBM-compatible computer
Operating system:	Microsoft (Windows 95,) Windows 98, Windows Me, Windows 2000, or Windows XP (English version)
CPU:	
Windows 95/98:	i486X, 100 MHz or higher (Pentium 100 MHz or higher recommended)
Windows Me/2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 95/98:	16 MB or more (32 MB or more recommended)
Windows Me:	32 MB or more (64 MB or more recommended)
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels), (SVGA [800 × 600 pixels] or more recommended) 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

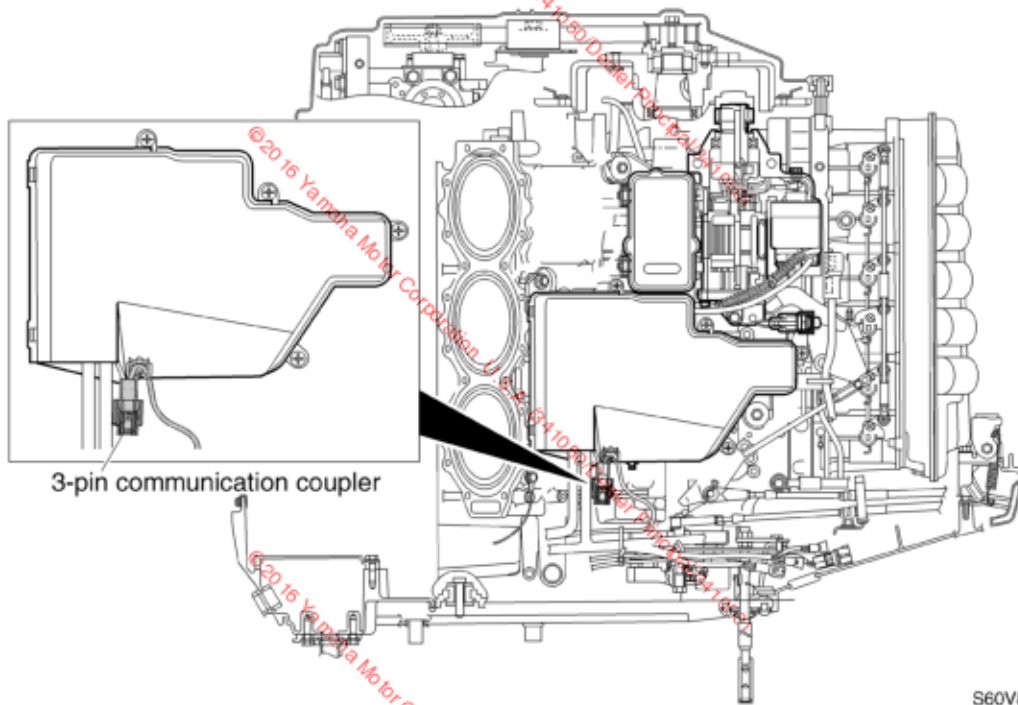
NOTE:

- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
- Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
- This software will not run properly on some computers.
- When starting up this program, do not start other software applications.
- Do not use the screen saver function or the energy saving feature when using this program.
- If the ECM is changed, restart the program.
- Window XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.
- The USB adapter cannot be used with Windows 95.

For operating instructions of the Yamaha Diagnostic System, refer to the "Yamaha Diagnostic System Instruction Manual."

Connecting the communication cable to the outboard motor

Models: HPDI series 3.3L



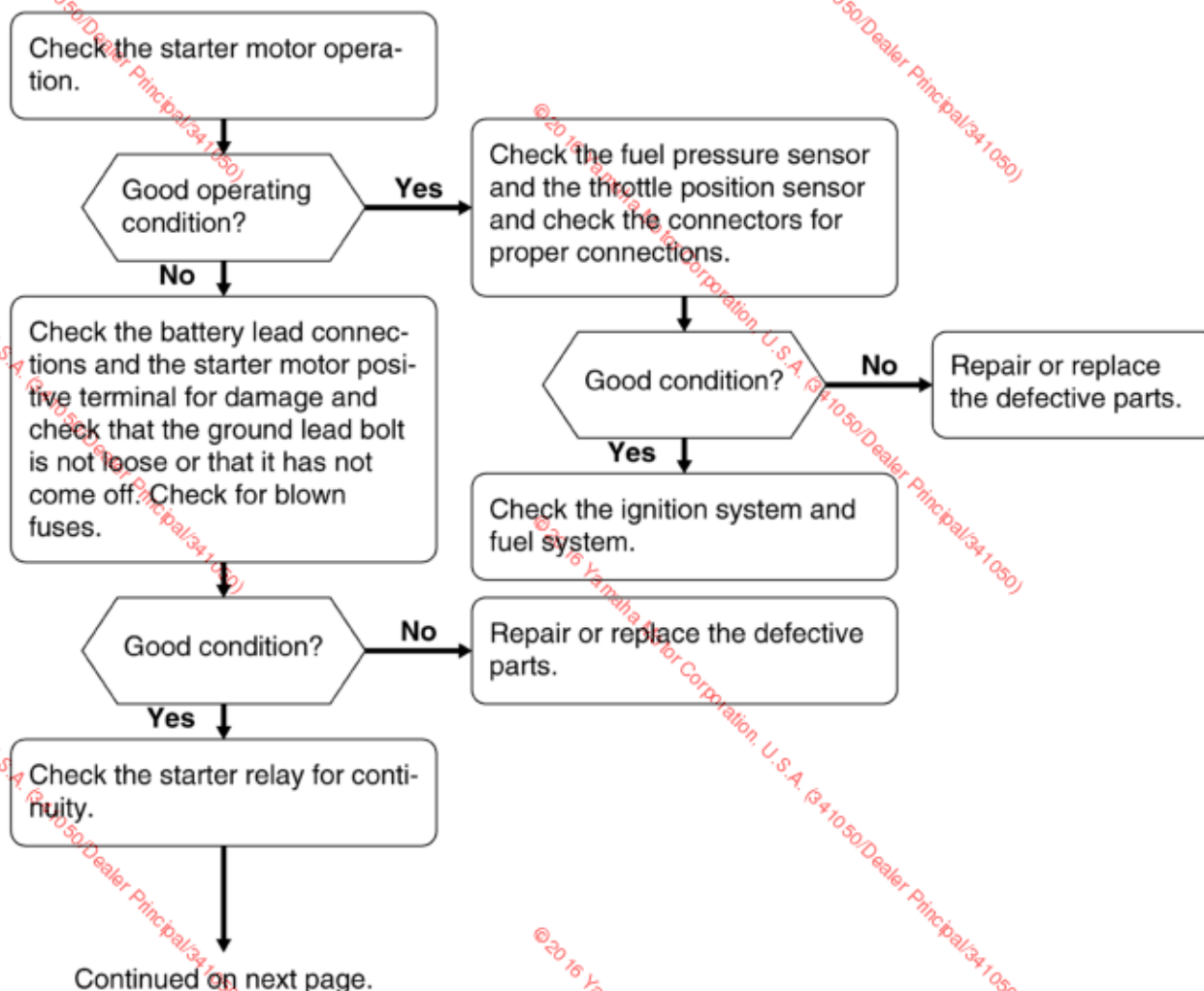
NOTE:

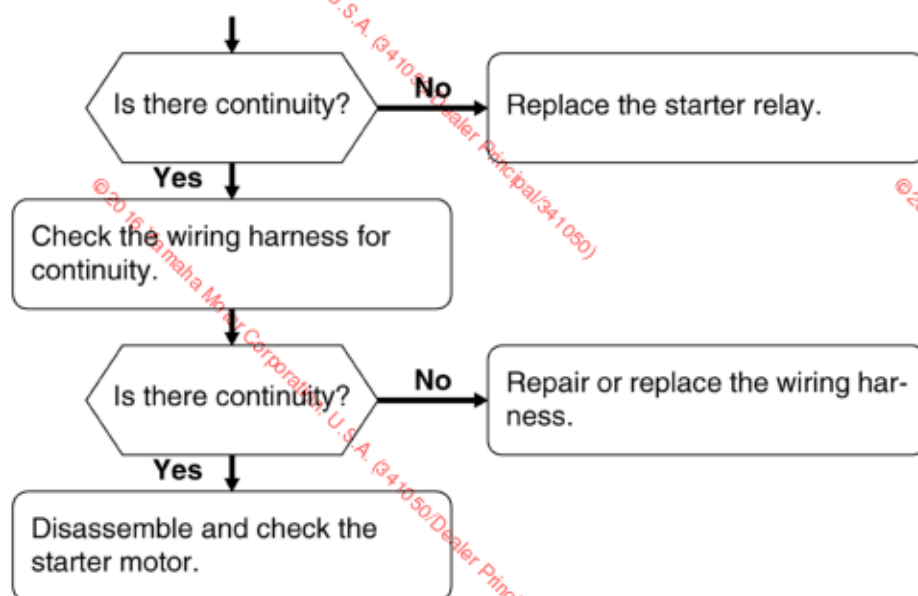
- Before troubleshooting the outboard motor, check the compression pressure, the mounting and rigging of the outboard motor, and the operation of the engine start switch. Also, make sure that specified fuel has been used and that the battery is fully charged.
- To diagnose a mechanical malfunction, use the troubleshooting charts for each trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 3–8 for safe maintenance procedures.
- To diagnose a malfunctioning sensor or switch, use the diagnostic flash indicator to determine the cause.

Power unit

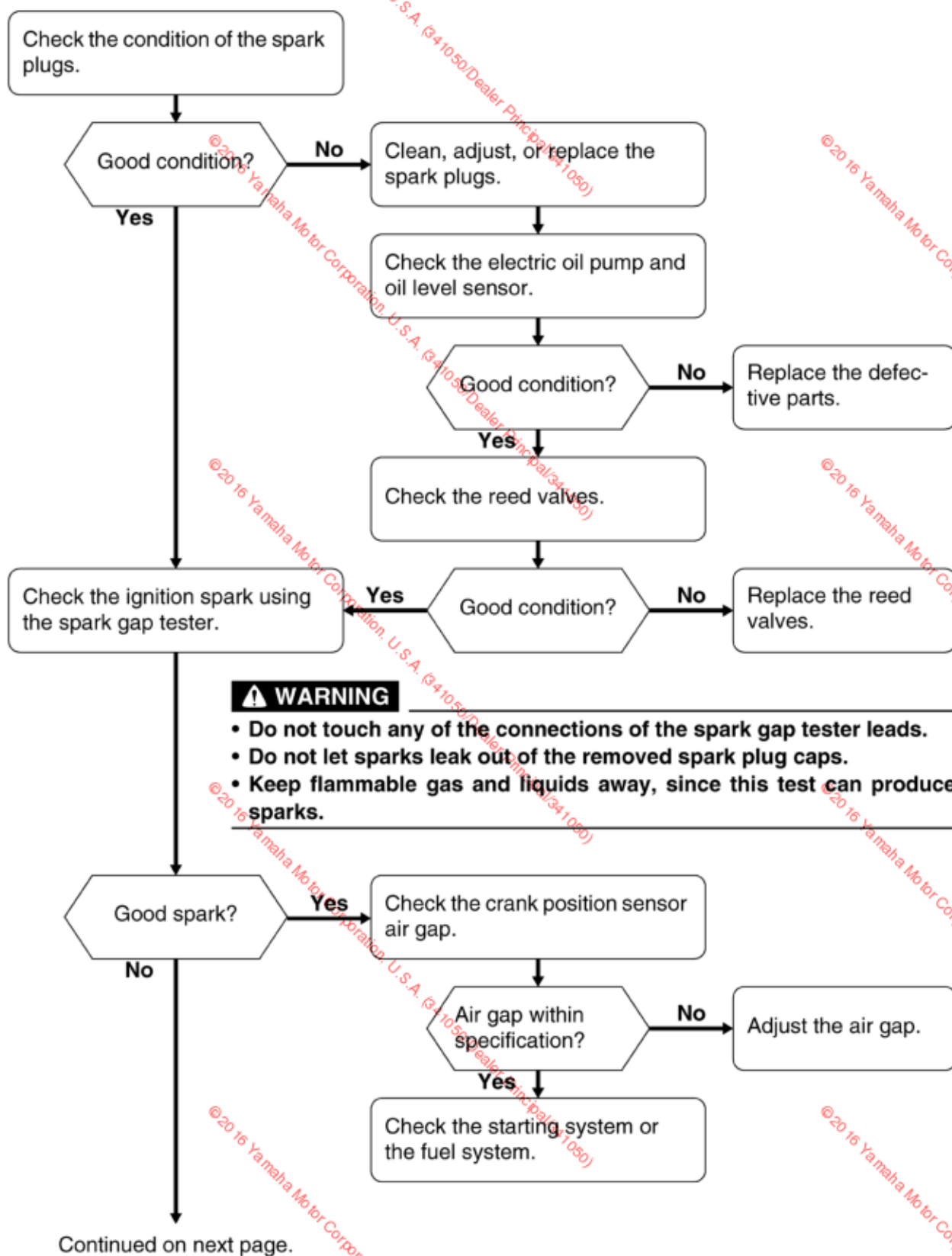
Symptom 1: Engine does not start, or starting the engine is difficult.

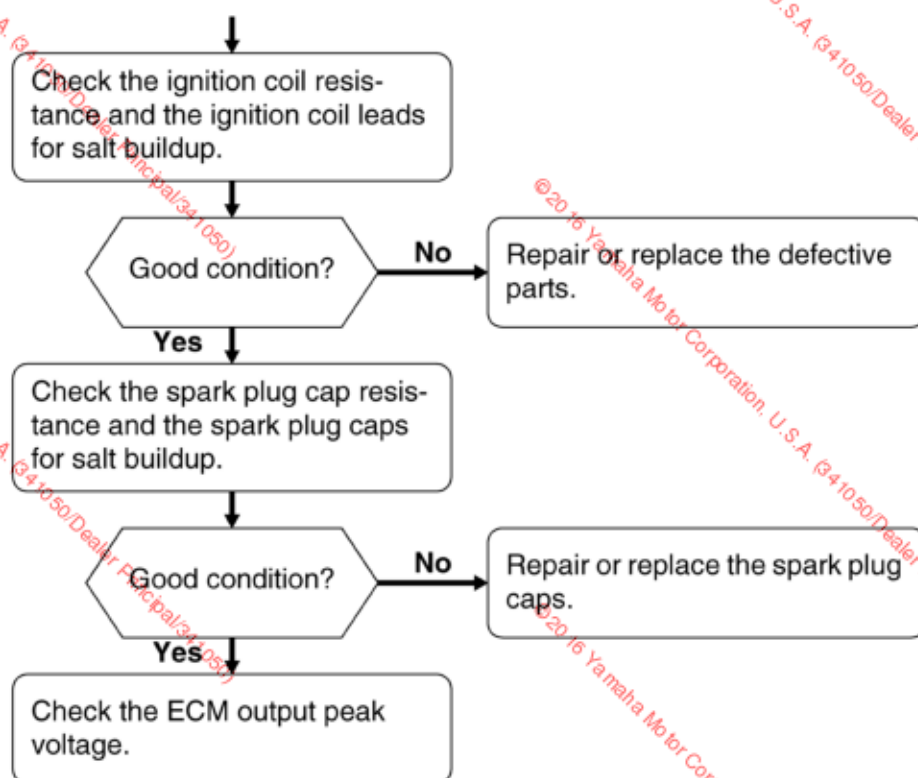
Starting system



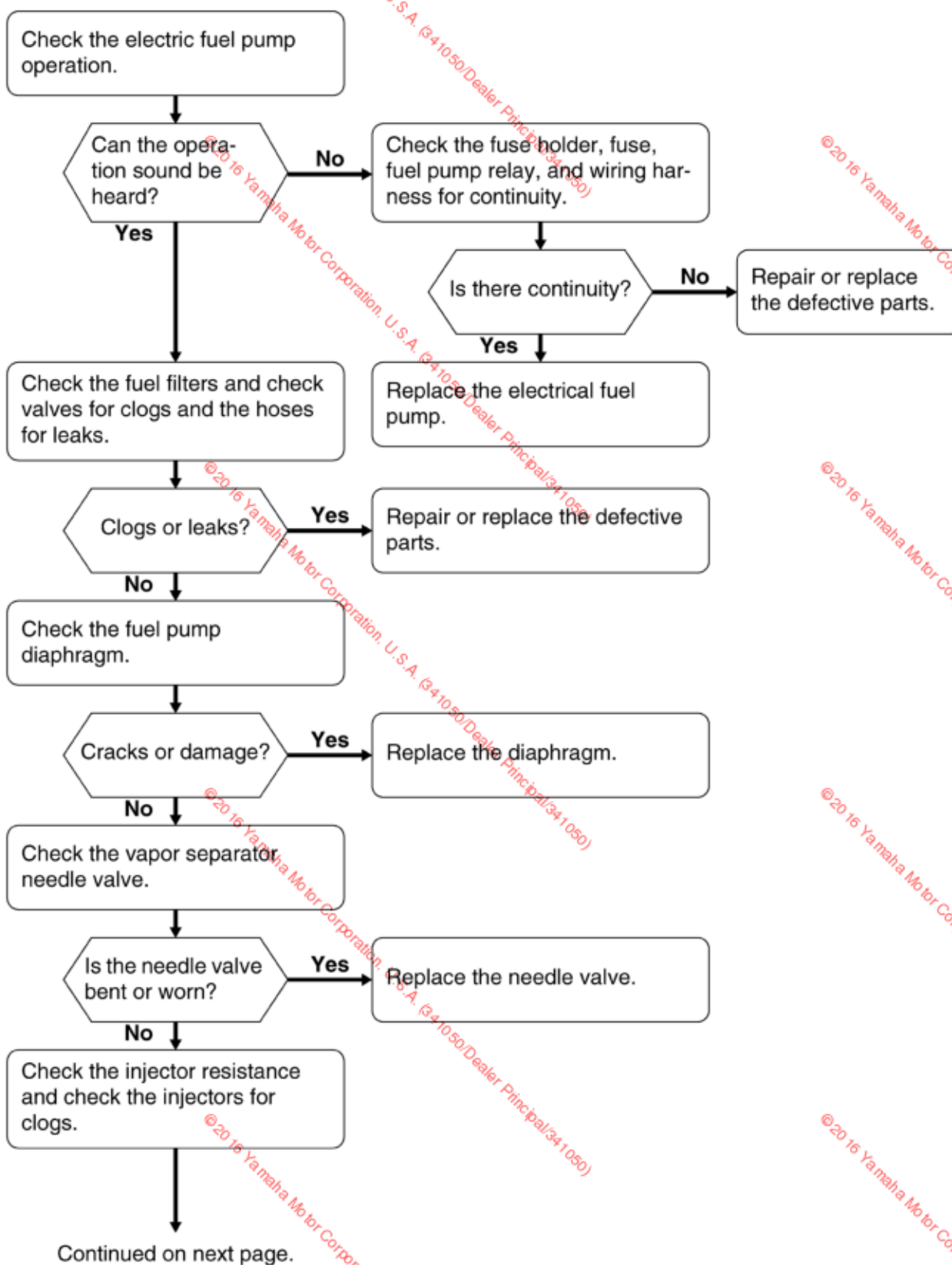


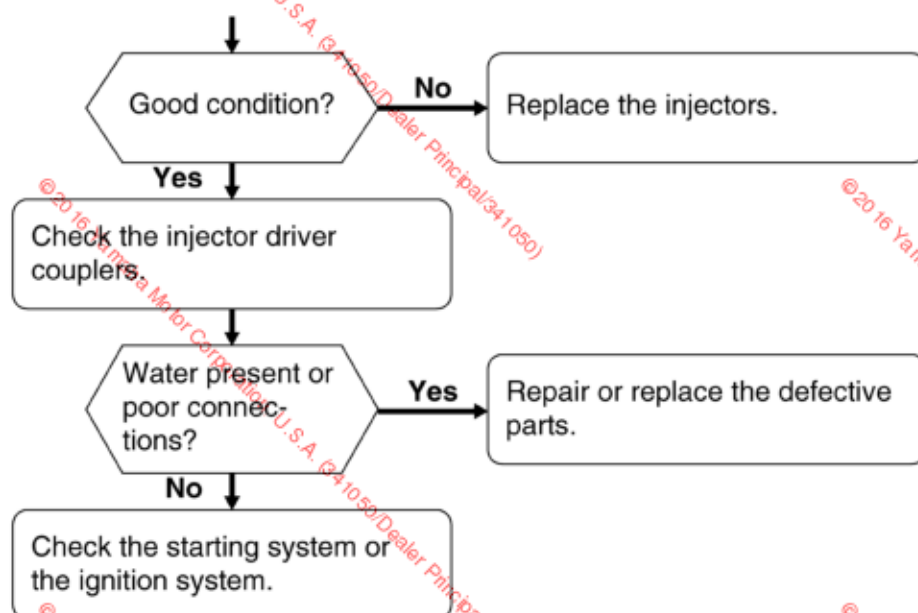
Ignition system



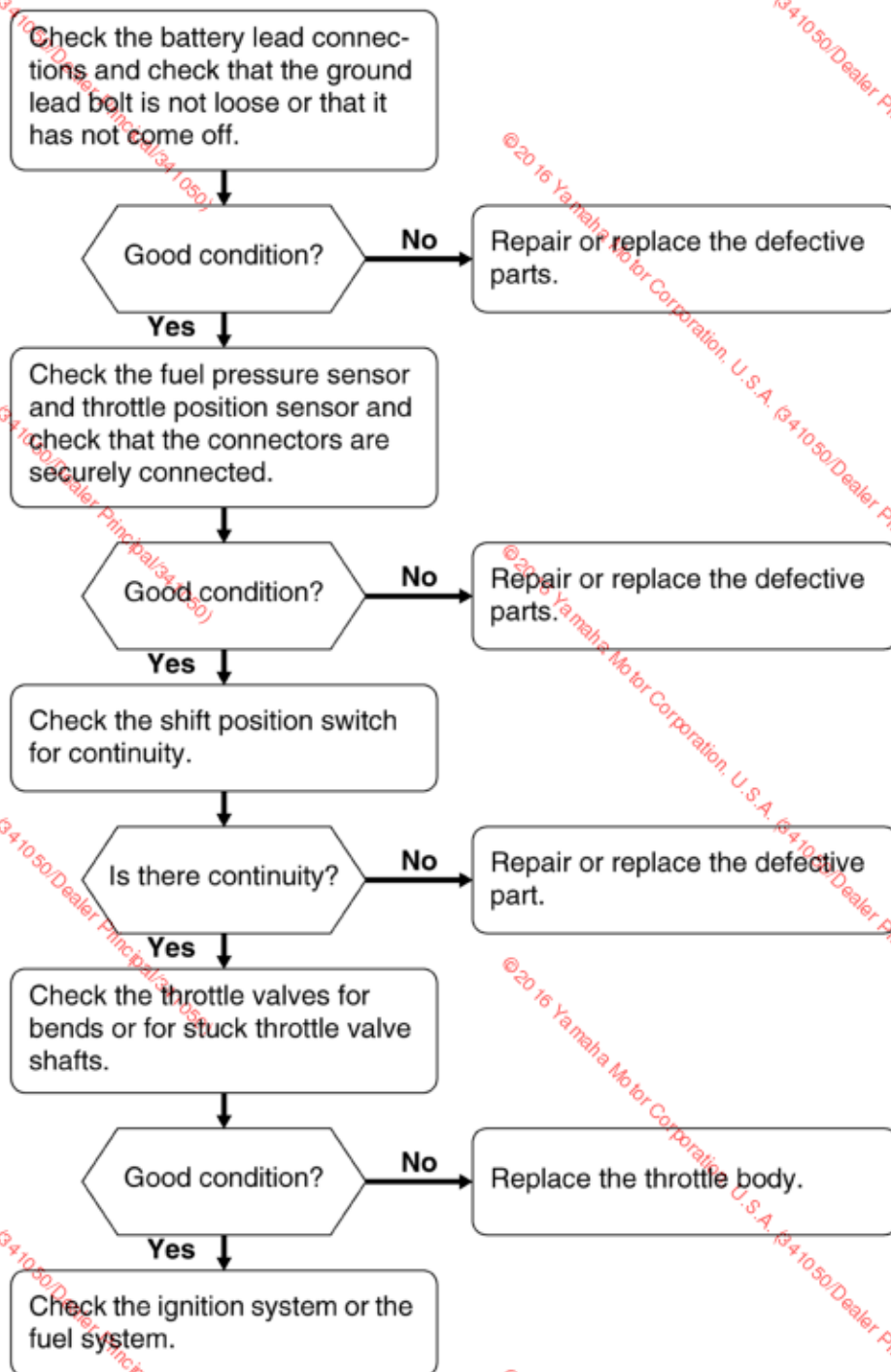


Fuel system

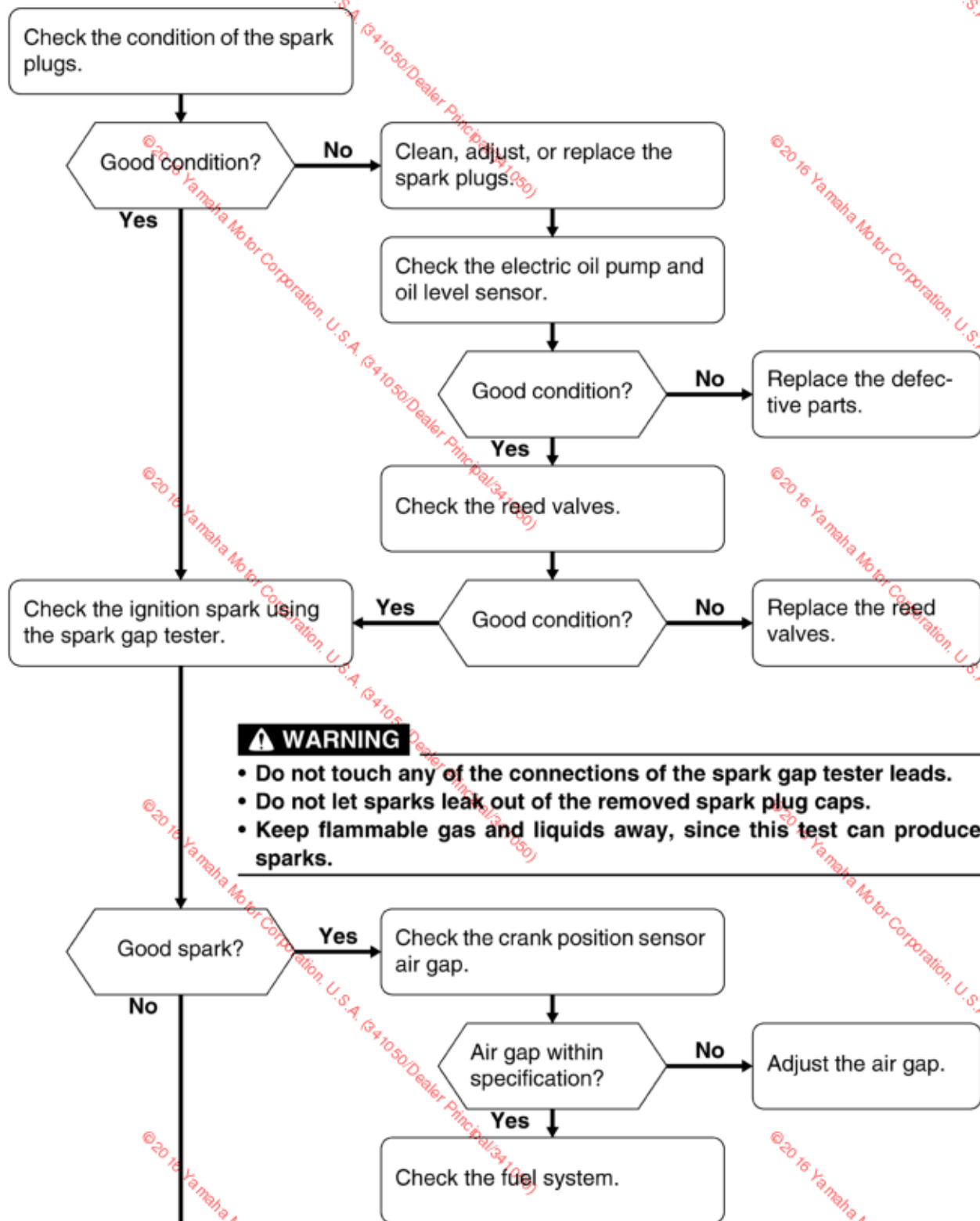




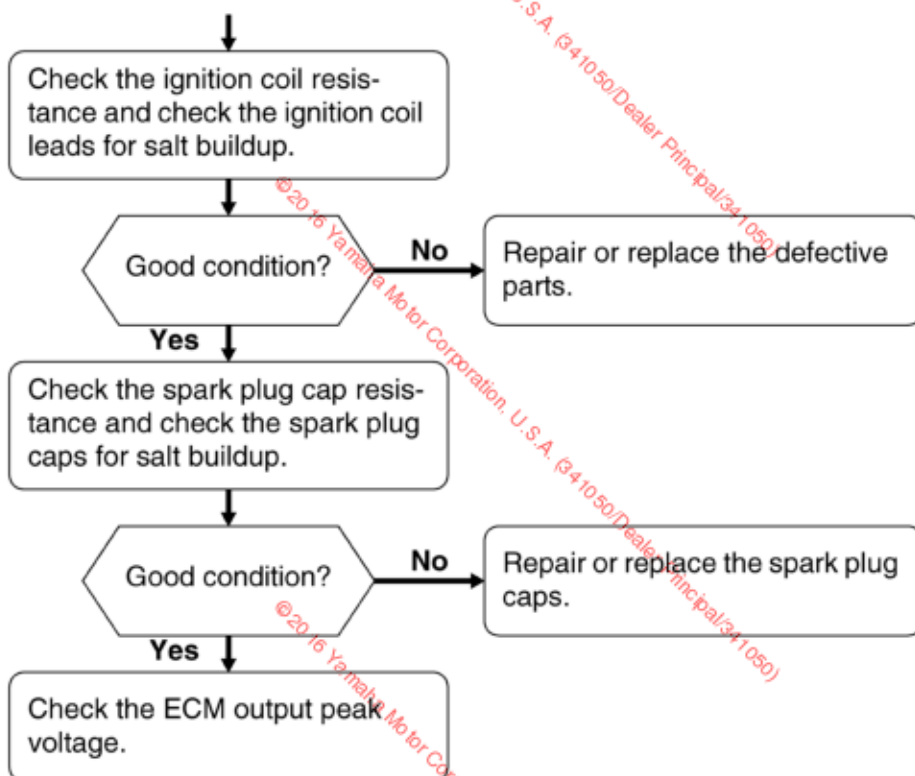
Symptom 2: Engine speed at wide open throttle is low, engine speed decreases, or engine stalls (poor acceleration or poor deceleration).



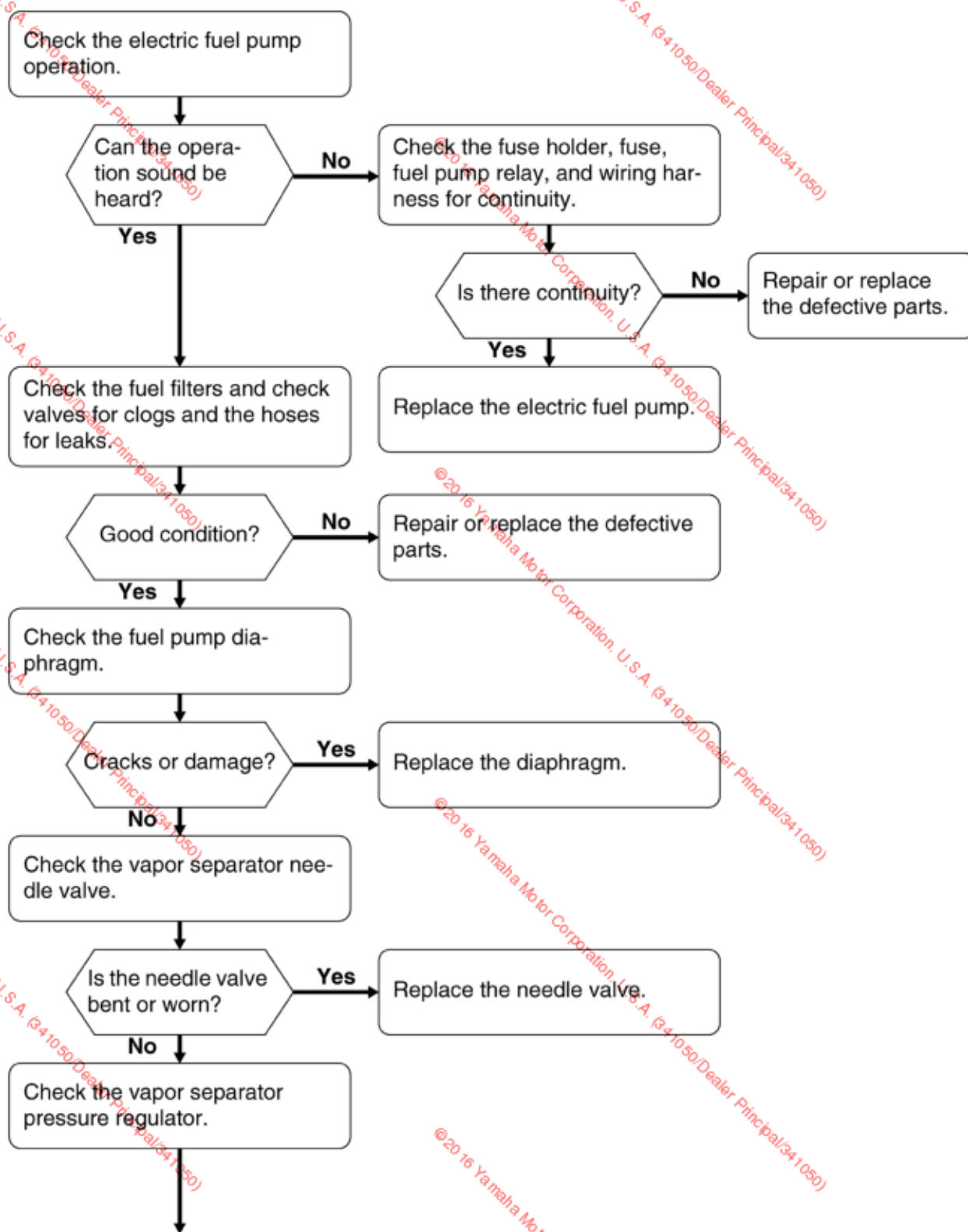
Ignition system

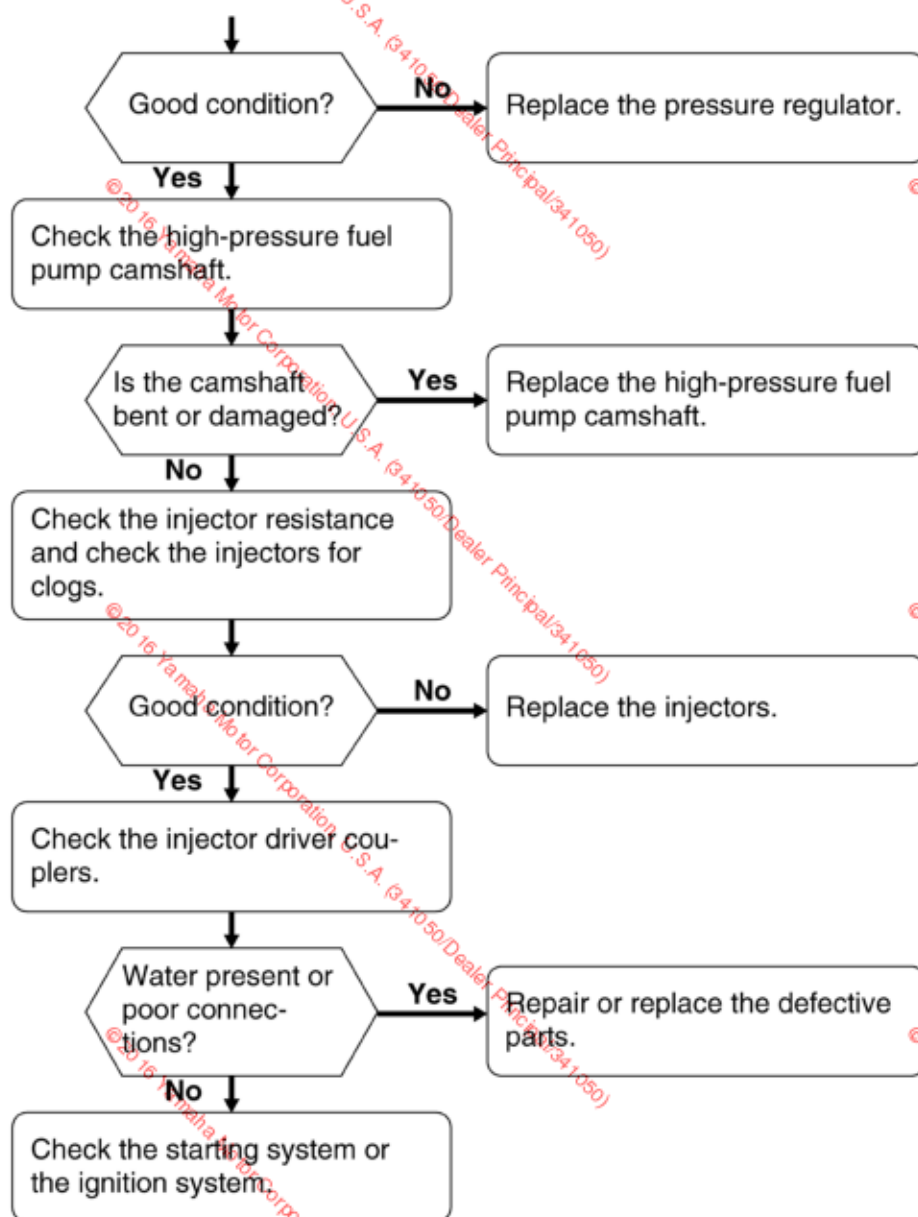


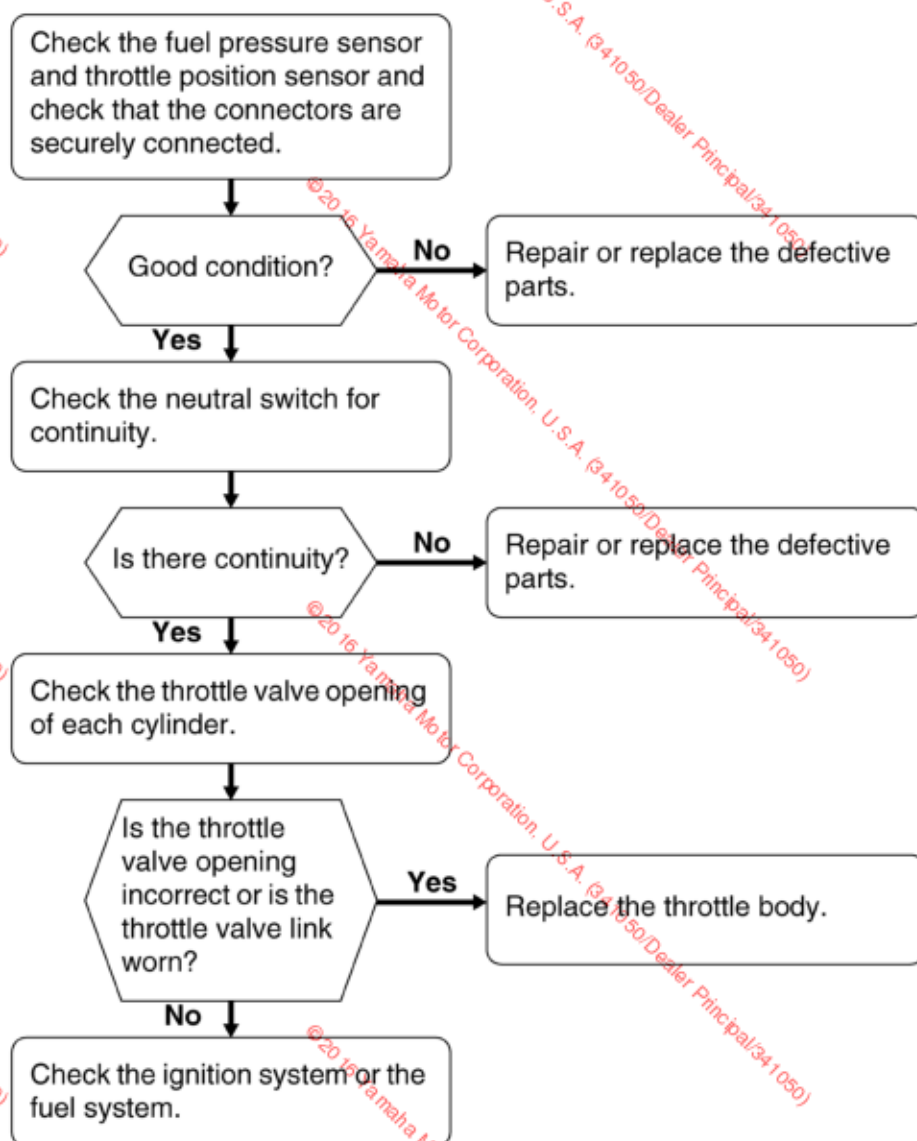
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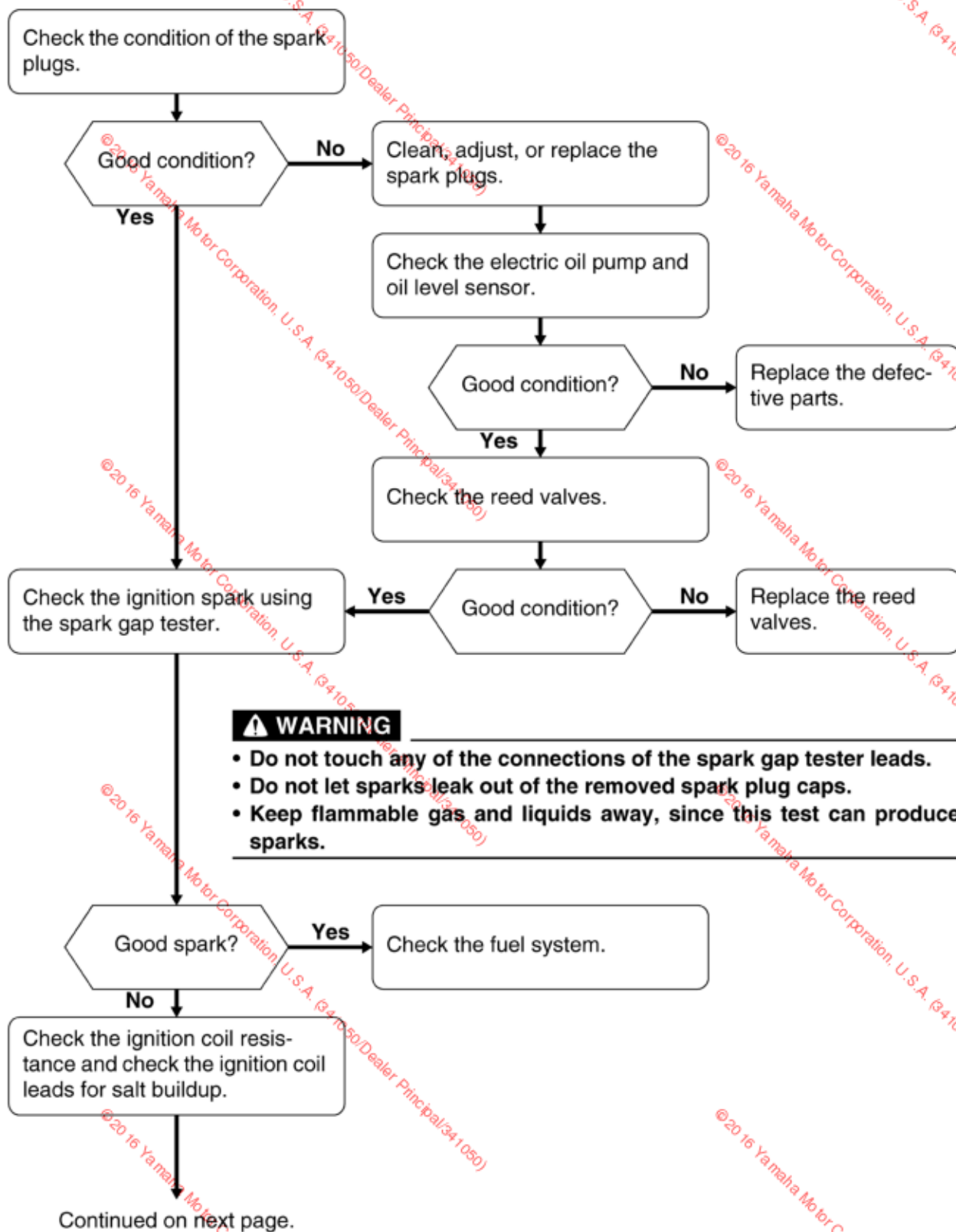
Fuel system

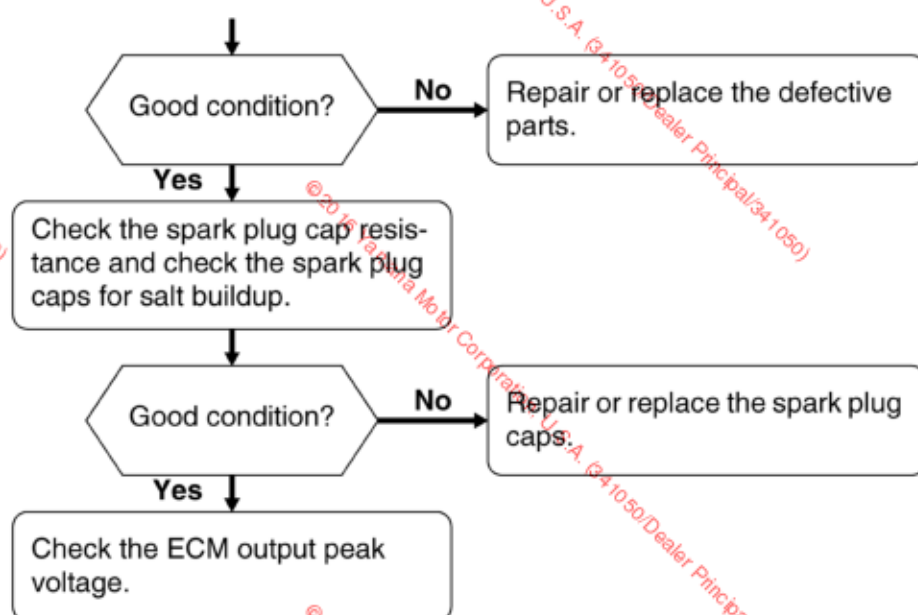




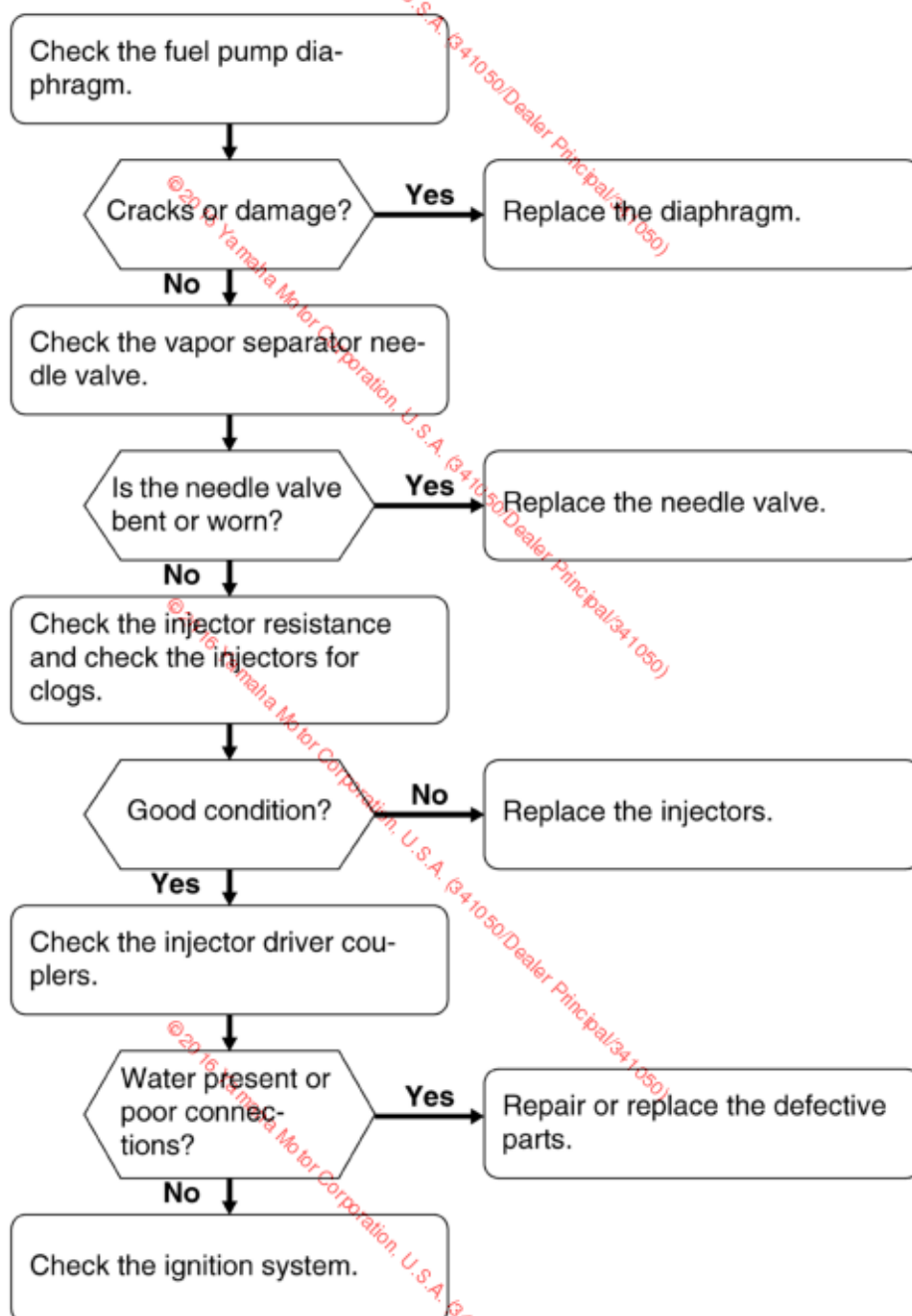
Symptom 3: Engine speed not stable at low speeds.

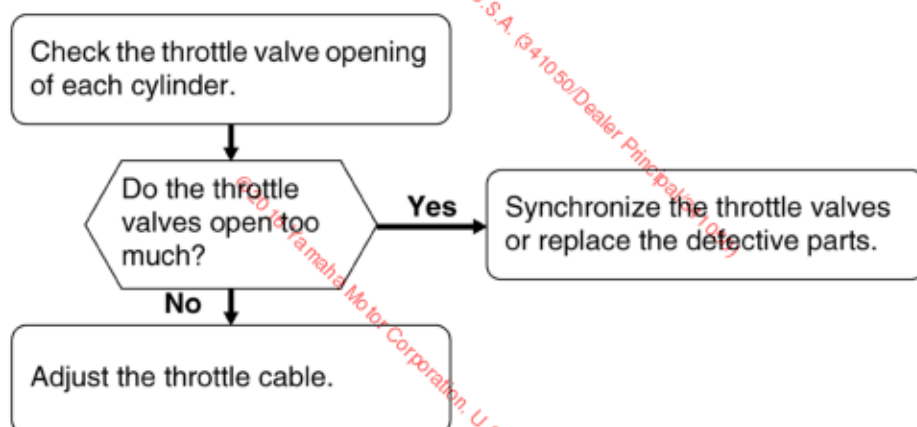
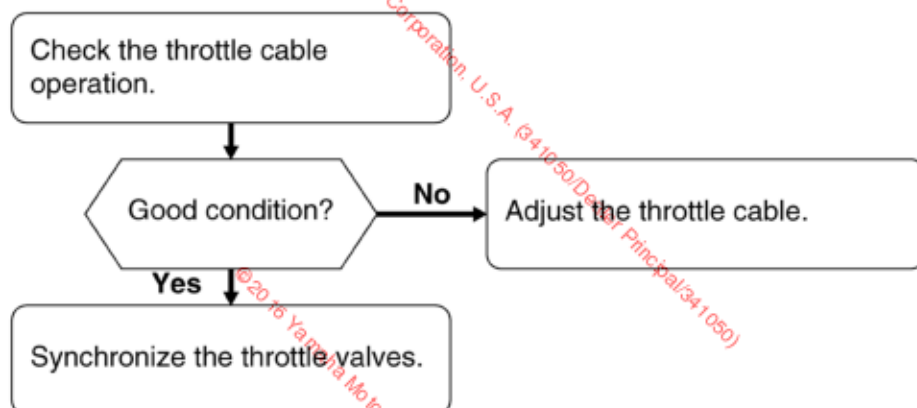
Ignition system

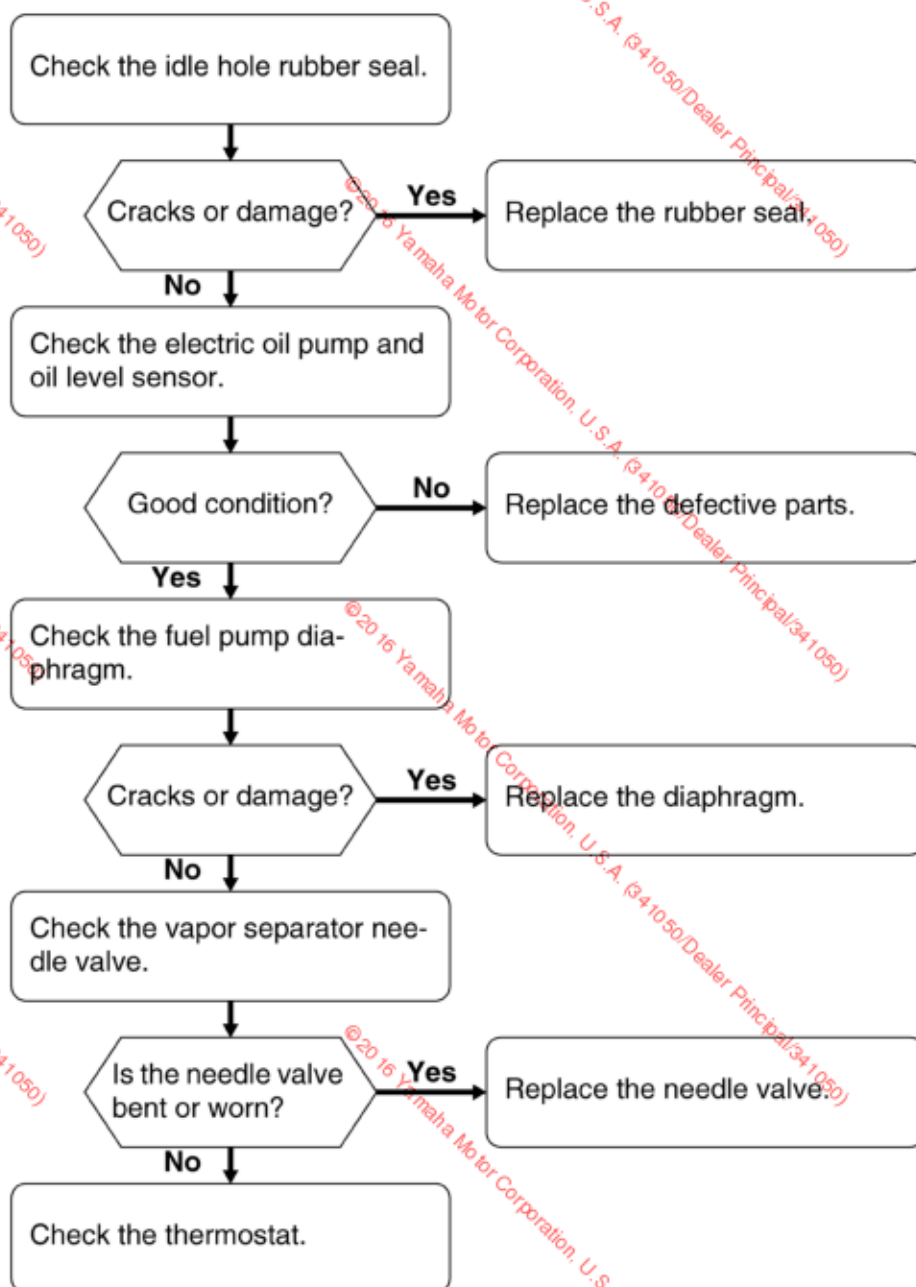




Fuel system



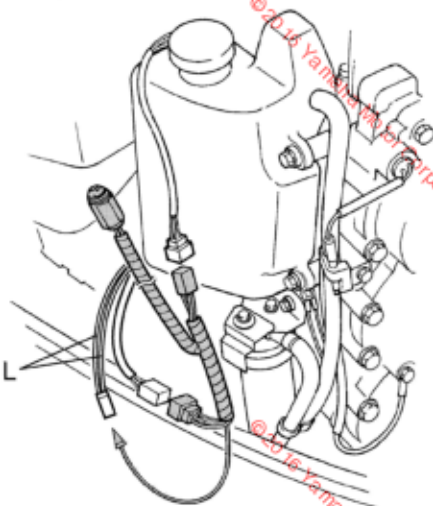
Symptom 4: Hunting occurs.**Symptom 5: Engine speed rises even when the throttle position is fixed.**

Symptom 6: Excessive white exhaust smoke.

Self-diagnosis

Diagnosing the electronic control system

1. Connect the special service tool to the outboard motor as shown.



S60V9020

NOTE:

When performing this diagnosis, all of the electrical wires must be properly connected.



Diagnostic flash indicator: YB-06444

2. Start the engine and let it idle.
3. Check the flash pattern of the diagnostic flash indicator to determine if there are any malfunctions.

- Normal condition
(no defective part or irregular processing is found)
- Single flash is given every 4.95 seconds.
 - Ⓐ: Light on, 0.33 second
 - Ⓑ: Light off, 4.95 seconds

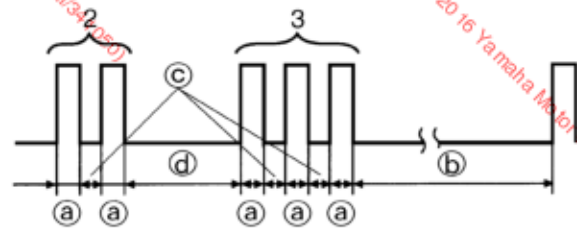


S69J9020

- Trouble code indication

Example: The illustration indicates code number 23.

- Ⓐ: Light on, 0.33 second
- Ⓑ: Light off, 4.95 seconds
- Ⓒ: Light off, 0.33 second
- Ⓓ: Light off, 1.65 seconds



S69J9030

4. If a flash pattern listed in the diagnostic code chart is displayed, check the malfunctioning part according to the flash pattern.

NOTE:

When more than one problem is detected, the light of the diagnostic flash indicator flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.

Code	Symptom
1	Normal
13	Incorrect pulser coil signal
14	Incorrect crank position sensor signal
15	Incorrect engine temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
22	Incorrect atmospheric pressure sensor signal
23	Incorrect intake air temperature sensor signal
25	Incorrect fuel pressure signal
26	Incorrect injector signal
27	Incorrect water in fuel signal
28	Incorrect shift position switch signal
44	Incorrect engine stop lanyard switch signal
62	Low fuel pressure warning

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— MEMO —

Wiring diagram

Z250TR, LZ250TR

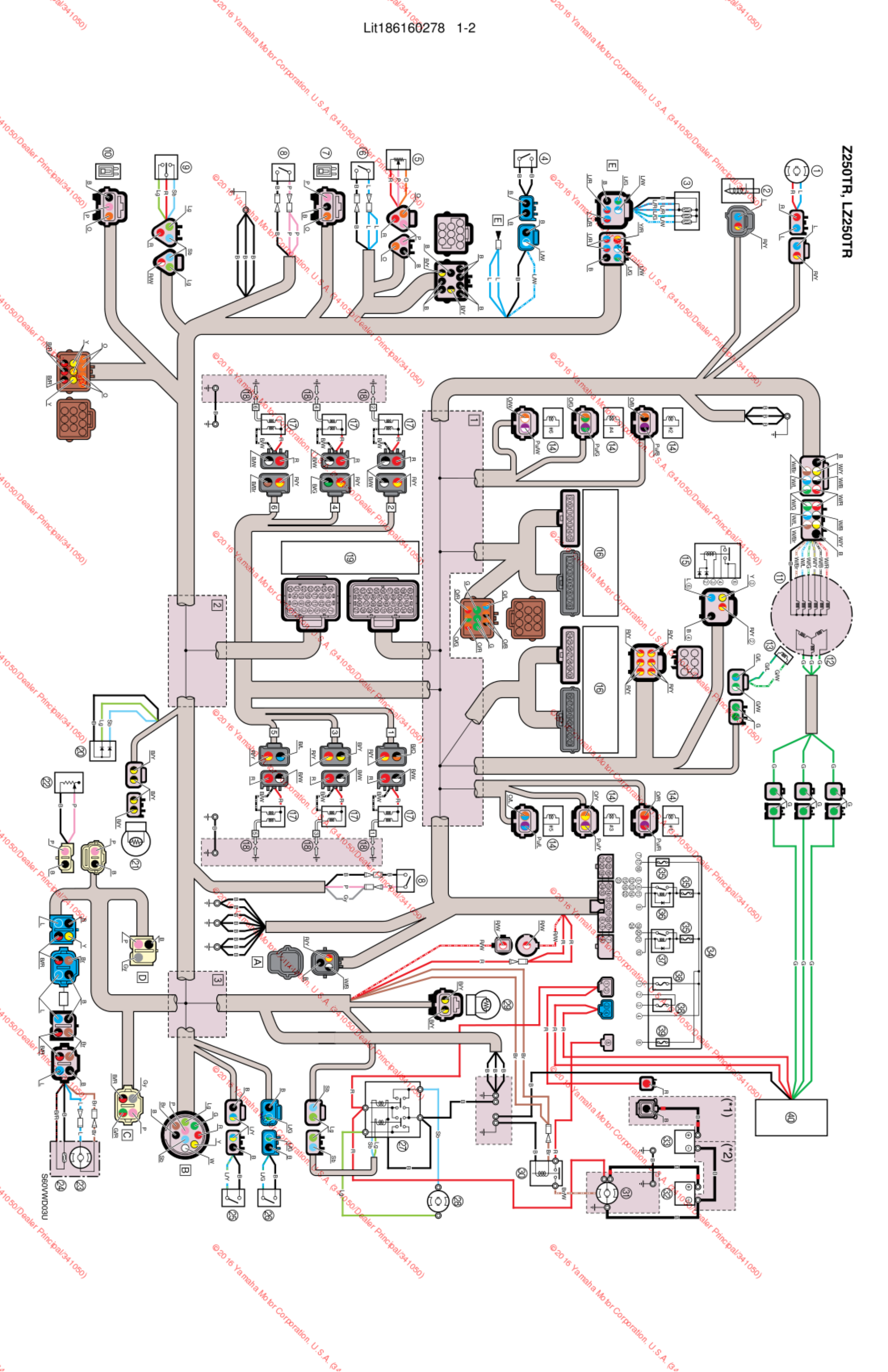
- ① Electric fuel pump
- ② Electric oil pump
- ③ Oil level sensor
- ④ Water detection switch
- ⑤ Throttle position sensor
- ⑥ Emergency switch
- ⑦ Atmospheric pressure sensor
- ⑧ Thermoswitch
- ⑨ Power trim and tilt switch
- ⑩ Fuel pressure sensor
- ⑪ Pulser coil
- ⑫ Stator coil
- ⑬ Crank position sensor
- ⑭ Fuel injector
- ⑮ Fuel pump relay
- ⑯ Injector driver
- ⑰ Ignition coil
- ⑱ Spark plug
- ⑲ ECM
- ⑳ Diode
- ㉑ Engine temperature sensor
- ㉒ Trim sensor
- ㉓ Oil pump (remote oil tank)
- ㉔ Oil level sensor (remote oil tank)
- ㉕ Shift cut switch
- ㉖ Shift position switch
- ㉗ Power trim and tilt relay
- ㉘ Power trim and tilt motor
- ㉙ Intake air temperature sensor
- ㉚ Starter relay
- ㉛ Starter motor
- ㉜ Starting battery
- ㉝ Accessory battery
- ㉞ Fuse holder
- ㉟ Fuse (20 A)
- ㊱ ECM main relay
- ㊲ Injector driver relay
- ㊳ Fuse (100 A)
- ㊴ Fuse (30 A)
- ㊵ Rectifier Regulator

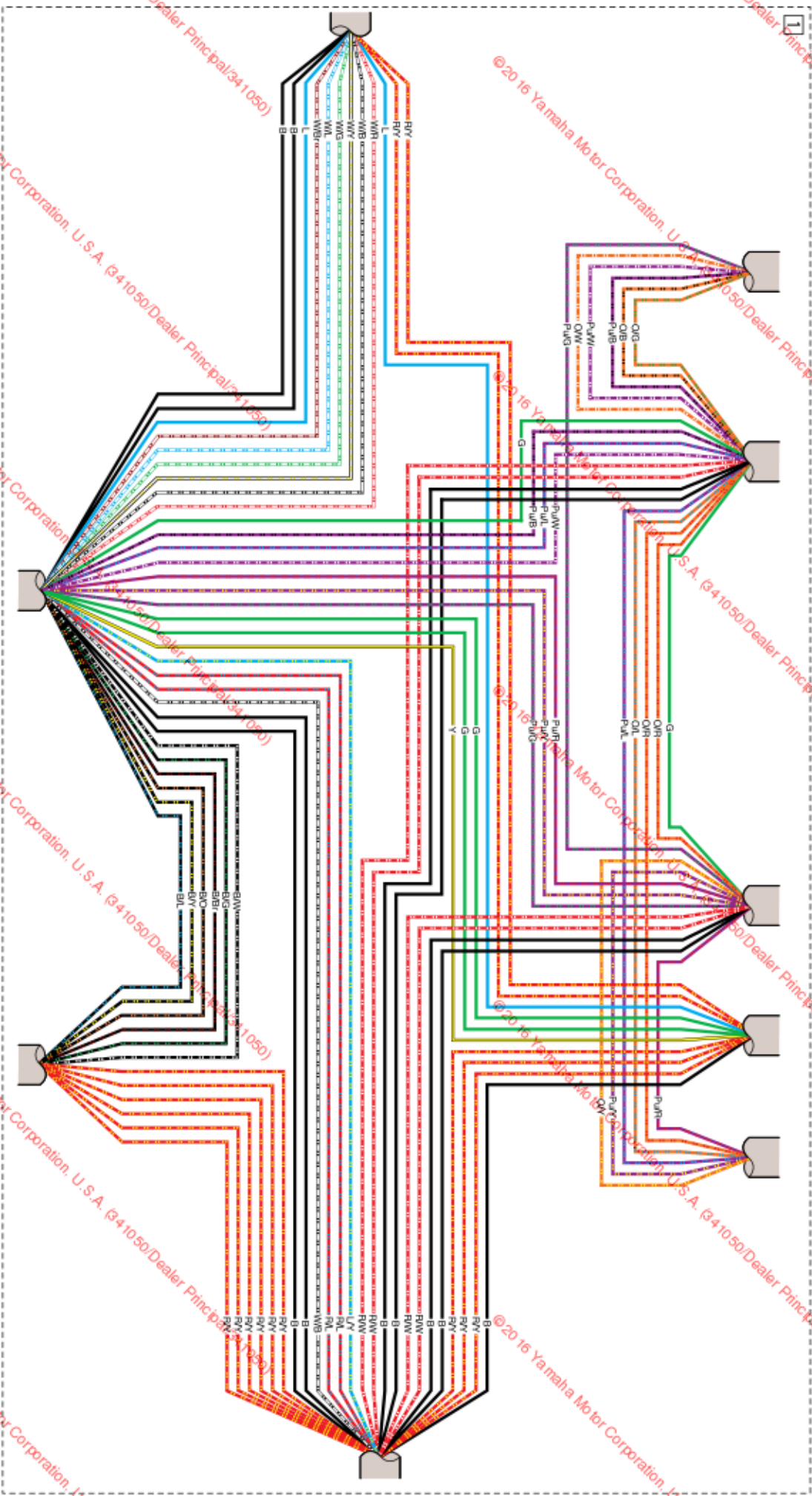
- A** To personal computer for diagnosis
B To remote control box/switch panel
C To oil level warning indicator
D To trim meter
E To diagnostic flash indicator
 (special service tool)

- (*1) Isolator cable (optional)
 (*2) Negative cable (commercially available)

Color code

B	: Black
Br	: Brown
G	: Green
Gy	: Gray
L	: Blue
Lg	: Light green
O	: Orange
P	: Pink
R	: Red
Sb	: Sky blue
W	: White
Y	: Yellow
B/Br	: Black/brown
B/G	: Black/green
B/L	: Black/blue
B/O	: Black/orange
B/R	: Black/red
B/W	: Black/white
B/Y	: Black/yellow
G/L	: Green/blue
G/R	: Green/red
G/W	: Green/white
L/G	: Blue/green
L/R	: Blue/red
L/W	: Blue/white
L/Y	: Blue/yellow
O/B	: Orange/black
O/G	: Orange/green
O/L	: Orange/blue
O/R	: Orange/red
O/W	: Orange/white
O/Y	: Orange/yellow
Pu/B	: Purple/black
Pu/G	: Purple/green
Pu/L	: Purple/blue
Pu/R	: Purple/red
Pu/W	: Purple/white
Pu/Y	: Purple/yellow
R/L	: Red/blue
R/W	: Red/white
R/Y	: Red/yellow
W/B	: White/black
W/Br	: White/brown
W/G	: White/green
W/L	: White/blue
W/R	: White/red
W/Y	: White/yellow
Y/R	: Yellow/red





1 : B	11 : Pu/B	21 : Pu/Y
2 : R/W	12 : —	22 : —
3 : O/B	13 : Pu/W	23 : B
4 : Pu/B	14 : Pu/L	24 : B
5 : Pu/L	15 : G	25 : R/W
6 : Pu/W	16 : B	26 : Pu/R
7 : —	17 : R/W	27 : —
8 : O/W	18 : O/R	28 : Pu/Y
9 : B	19 : Pu/R	29 : Pu/G
10 : R/W	20 : Pu/G	30 : G

1 : LW	21 : B/R	41 : —
2 : P	22 : G	42 : Y
3 : —	23 : W	43 : B
4 : L/R	24 : Y	44 : B
5 : L/R	25 : B/r	45 : W/L
6 : L/G	26 : —	46 : W/R
7 : G/R	27 : R/L	47 : G
8 : P	28 : W/Y	48 : Pu/Y
9 : B	29 : G	49 : W/B
10 : O	30 : G	50 : —
11 : P	31 : Pu/L	51 : B
12 : B/Y	32 : Pu/R	52 : B
13 : B/O	33 : B/O	53 : W/B
14 : P	34 : B/W	54 : W/B
15 : P	35 : B/Y	55 : L
16 : L/Y	36 : R/L	56 : —
17 : L/W	37 : W/G	57 : Pu/G
18 : L/G	38 : L/Y	58 : B/B
19 : Y/R	39 : Pu/W	59 : B/L
20 : L	40 : Pu/B	60 : B/G

1 : R	9 : L/Y	17 : R
2 : R	10 : L/Y	18 : R
3 : R	11 : R/Y	19 : R/W
4 : R	12 : R/Y	20 : R/W
5 : R/L	13 : R/Y	21 : R/W
6 : R/L	14 : R/Y	22 : R/W
7 : R/W	15 : R/Y	23 : R/Y
8 : R	16 : R/Y	24 : R/W

