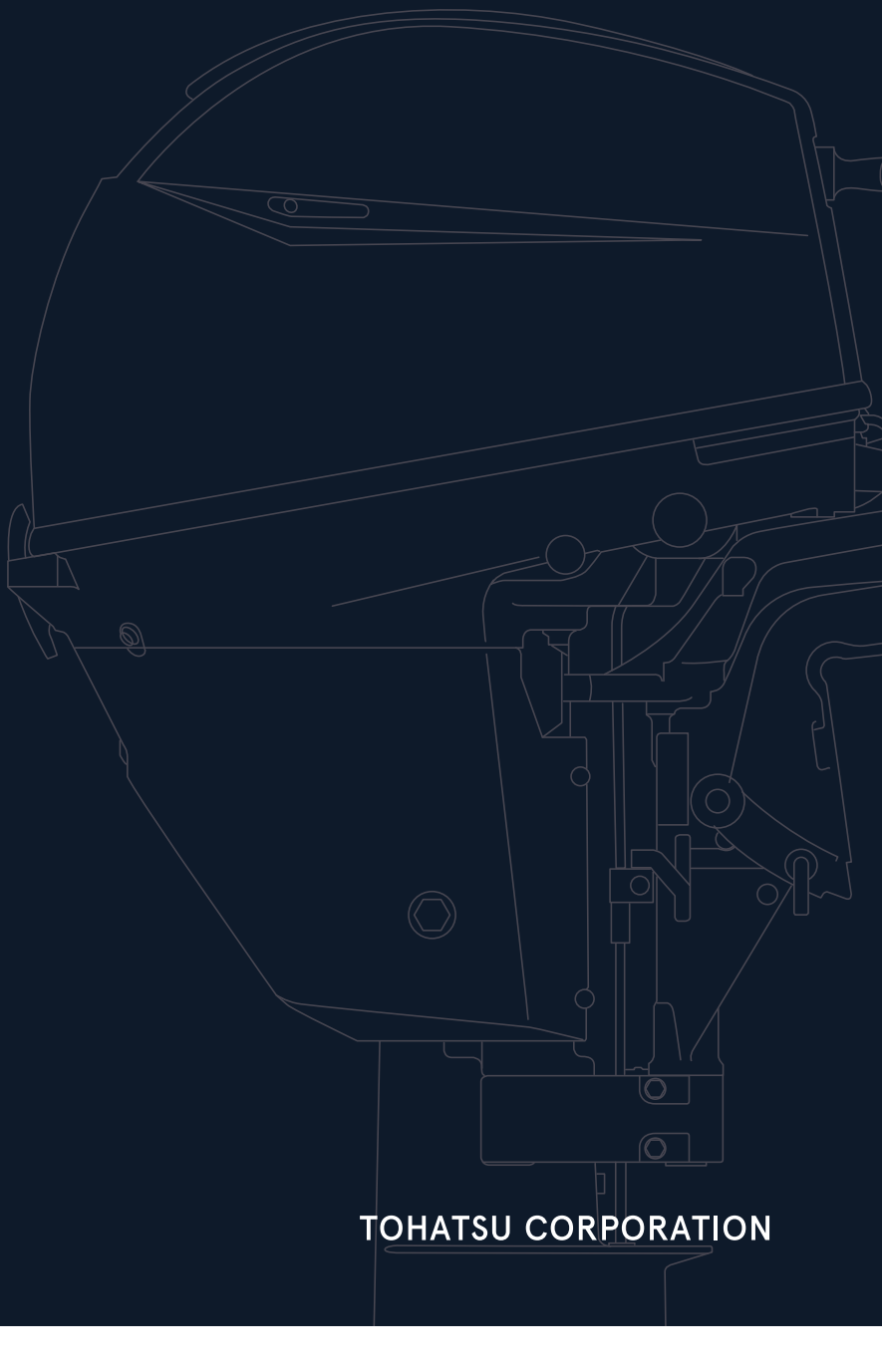
SERVICE MANUAL

TOHATSU
Feel the Wind™

4 STROKE
MFS 6CZ
MFS 8C
MFS 9.8C
MFS 9.9CY
Models

OB No.003-21079-0BD1 | 04-24 NB



BACKS YOU UP™

TOHATSU CORPORATION

Introduction

Before reading this manual

This service manual provides information that is needed for inspection, service and repair of applicable outboard motors. For information about operation of the products that are not described in this document, refer to the owners manual. For our customers' safe and dependable use of the product for long term, it is essential to maintain the performance and quality of the outboard. To ensure this, the maintenance and service have to be done properly by service technicians with fundamental knowledge and skills. This manual is utilized so that our customers can always use their outboard motor with full satisfaction.

Safety Information

Safety Statements

The following safety statements are found throughout this manual and indicate information which, if ignored, could result in fatal safety hazards or property damage:

⚠ DANGER

Indicates the presence of a hazard which, if ignored, will result in severe injury or death.

⚠ WARNING

Indicates the presence of a hazard or an unsafe activity which, if ignored, could result in severe injury or death.

⚠ CAUTION

Indicates the presence of a hazard or an unsafe activity which, if ignored, could result in minor personal injury or damage to the products or facilities.

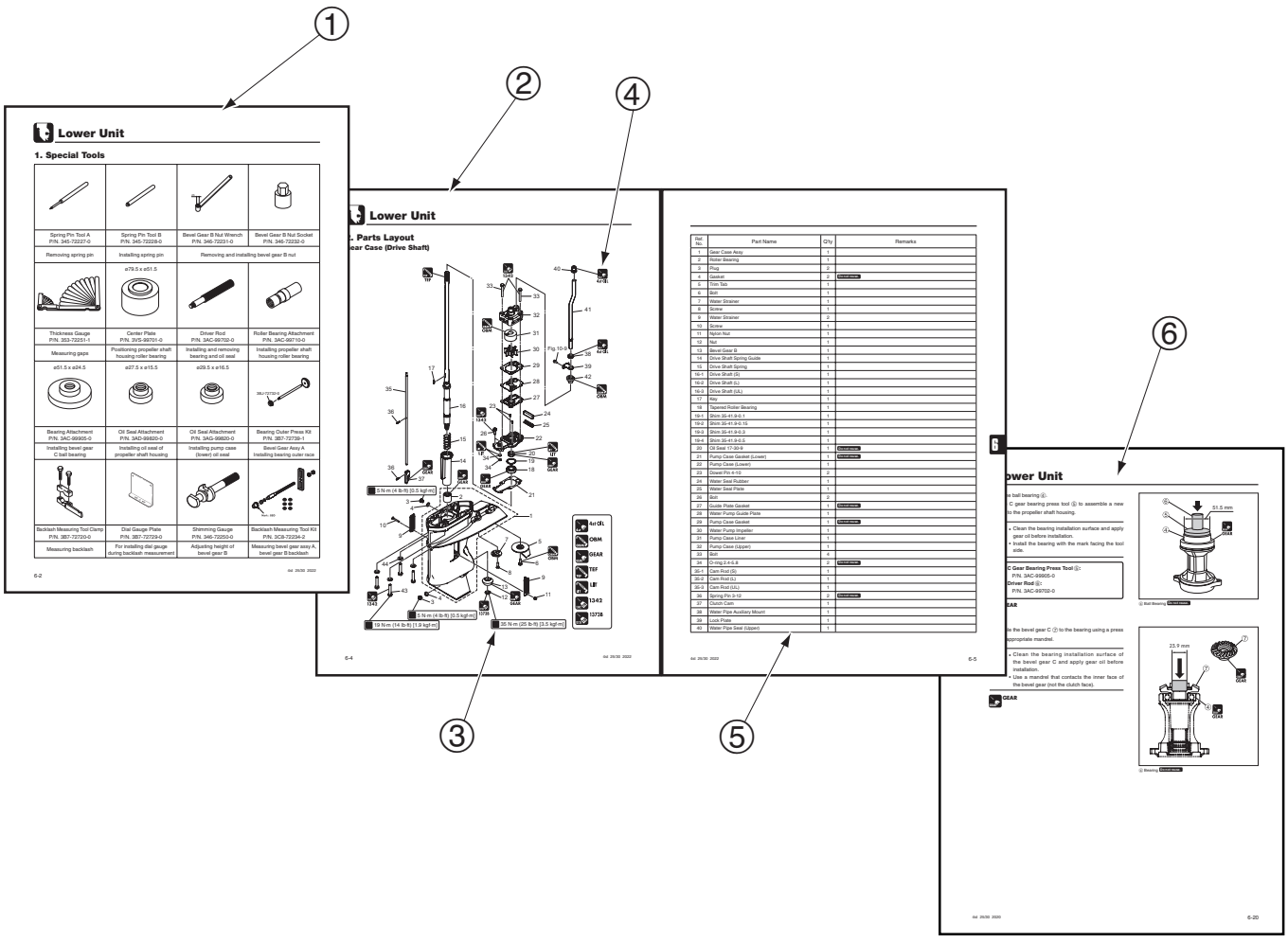
Attention:

About this manual

Composition and use of this manual

This service manual is designed so that service persons are able to perform repairs correctly.
Understand the following matters well for efficient service and repair.

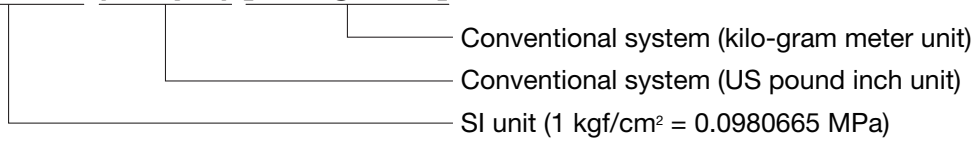
①Each chapter begins with the introduction of special tools that are used for the work described.
②Parts that are serviced in each chapter and their details are presented by using a component composition diagram.
③Fastening torques are described in the component composition diagram. In the body text are critical points of the applicable work.
④Pictograms indicate that there is an important work instruction for the relevant parts. It also shows the type of lubricant and its application point(s).
⑤The component composition diagrams describe the names of the parts, the number of pieces of the parts used, size of fasteners and special notes.
⑥Specific works are described in detail by using illustrations and adding advice on the work.



This manual uses SI unit system (International System of Units) for pressure, force (load), torque and stress. This manual newly adopts the international unit construction system (SI unit system) followed by the conventional imperial and metric systems enclosed by ( ) and [ ] as described below.

Example : <Pressure>

0.90 MPa (128 psi) [9.0 kgf/cm²]



* Measurements are shown using SI unit followed by conventional units (US unit) and [Japanese domestic unit].

Example : <Torque>

18 N·m (13 lb·ft) [1.8 kgf·m]

*

* The conventional unit for measurement of force uses "kgf (kilogram force)" to discriminate it from "kg (mass kilogram)" of SI unit system.

Example : <Volume>

900 cm³ (30.4 fl.oz)

Example : <Length>

10 mm (0.39 in)

<Reference>

What is the SI unit system?

Although the measurement unit is standardized mostly with metric system in the world, the metric system includes different kinds of unit systems.

Though the metric system was established expecting that a single unit system would be used in the world, various physical units were established later, resulting in branching the metric system in different unit systems.

The new unit system is called "International System of Units" because it was established for the purpose of unifying the different unit systems.

Since the metric system was initially established in France, and International Bureau of Weights and Measures (IBWM) is located in Paris, General Conference of Weights and Measures (GCWM) passed a resolution of the international unit system as "Systéme International d'Unités (French)" that is abbreviated as "SI unit".

For example, conventional metric system uses the unit of mass (kg) and unit of force (kg or kgf) without discriminating them, but the SI unit system uses, for example, "kg" as the unit of mass, and "N" as the unit of force, aiming to apply a kind of unit for a kind of physical quantity.

Description of Pictograph

The following symbols represent the contents of individual chapters.

Service Information 	Service Data 	Inspections and Adjustments 	Fuel System (Fuel Injection) 
Power Unit 	Lower Unit 	Bracket 	Electrical System 
Troubleshooting 	Wiring Diagrams 		

The following symbols indicate items needed for the service.

Special Tool 	Lubrication Oil 	Engine RPM 	Tightening Torque 
Specified Electrical Value 	Specified Measurement Value 	Use Limit 	Test Run Adjustment 
Specified Part 			

The following symbols indicate a point to which lubrication oil, sealing agent or screw-locking agent is to be applied.

4 stroke engine oil 	Gear oil 	ATF DEXRON III 	OBM Grease 
Teflon® Grease TEFLON 	Low Temperature Lithium Grease LITHIUM 	Silicone Grease Oil Compound [Shinetsu Silicone] S.O.C 	Temporary Rubber Assembly Lubricant (Insertion Aiding Agent) 
Screw Locking Agent [Loctite®] • 263 (271) 	Screw Locking Agent [Three Bond®] • 1327 	Screw Locking Agent [Three Bond®] • 1342 	Screw Locking Agent [Three Bond®] • 1373B 
Sealant [Loctite®] • 5910 	Instant Adhesive [Three Bond®] • 7781 	Adhesive [Three Bond®] • 1521 	Adhesive [Three Bond®] • 1530D 

1. Service Information

2. Service Data

3. Maintenance

4. Fuel System (Fuel Injection)

5. Power Unit

6. Lower Unit

7. Bracket

8. Electrical System

9. Troubleshooting

10. Wiring Diagram

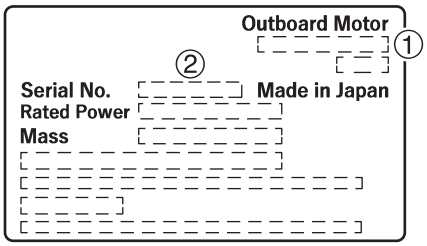
INDEX

1
Service Information

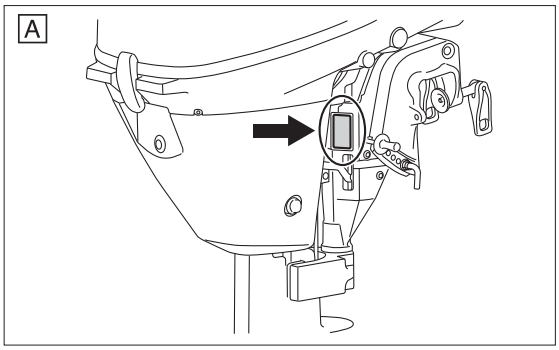
1. Identification (Engine Serial Number)

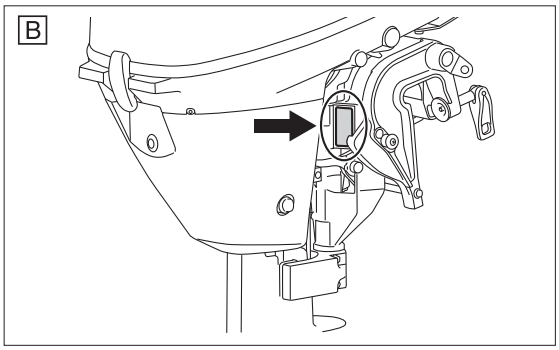
The engine serial number is stamped on the swivel bracket of the outboard motor body.

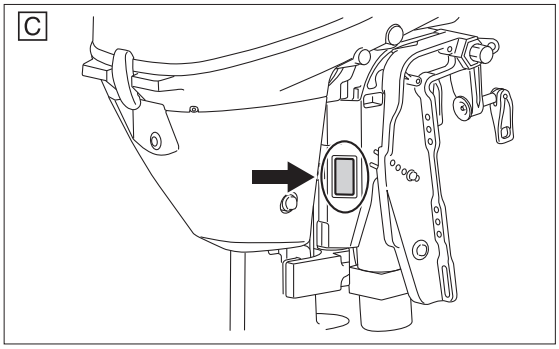
① Model Name
② Serial Number



A Tiller Handle Model
B Remote Control Model
C Power Tilt Model



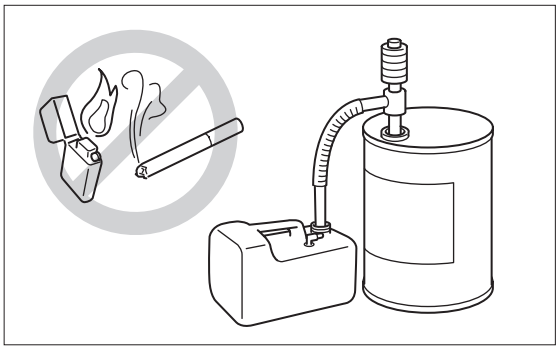




2. Ensuring Work Safety

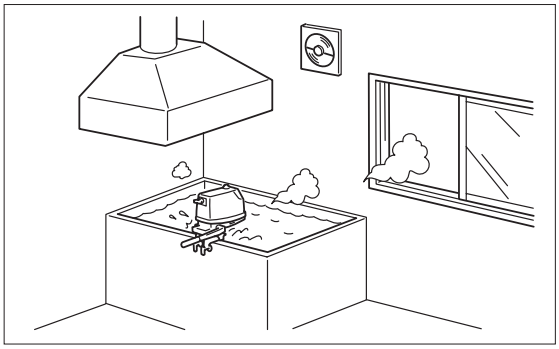
1) Fire Prevention

Gasoline is a hazardous material and very flammable. Do not handle gasoline near ignition source such as sparks or static electricity.



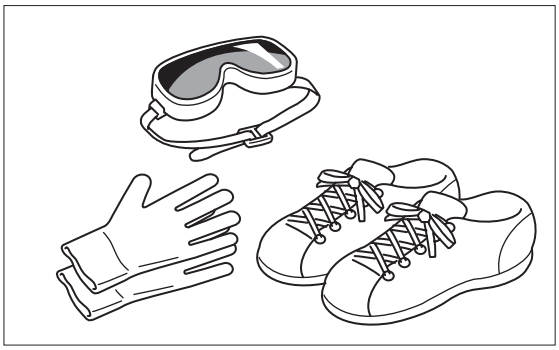
2) Ventilation

Exhaust gas or gasoline vapor is hazardous for human health. Be sure to ventilate well when working indoors.



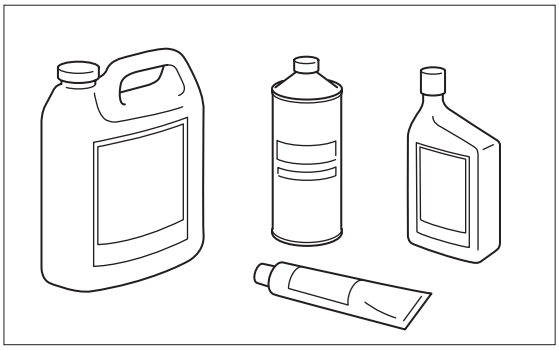
3) Protection

Wear a pair of goggles, working gloves and safety shoes to protect human body from chemicals and oils and eyes from particles generated by grinding or polishing works.



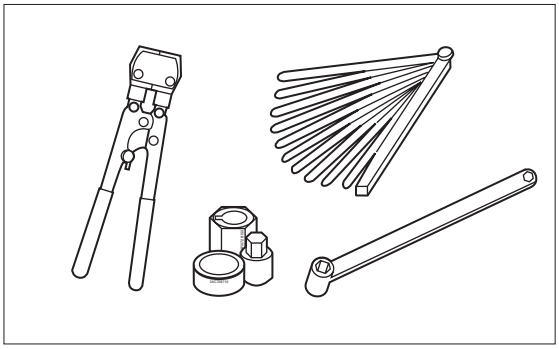
4) Genuine Parts

Use parts and/or chemicals that are genuine or recommended. Be careful not to allow oil, grease or sealing agent to adhere to the skin. In case of exposure to such substances, wash away with soap or warm water immediately.



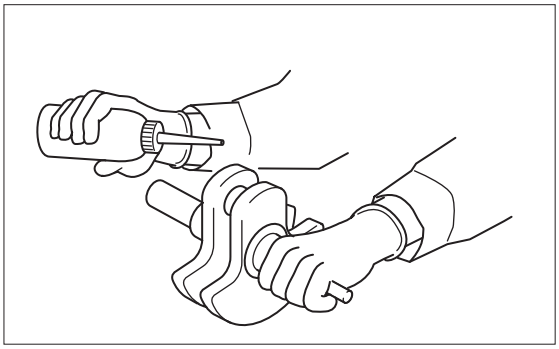
5) Tools

Use specified special tools to avoid damaging parts and to perform the work safely and reliably. Be sure to follow the installation procedures described in this manual and use the tightening torque specified.



6) Recommendations on service

Clean and remove foreign substances and dirt from the outboard motor body and individual parts. Apply the recommended oil or grease on rotating areas and sliding surfaces. After carrying out each work, always conduct a check to ensure smooth movement and sealing.



7) Cautions in disassembling and assembling components

(1) Install the outboard motor securely to a dedicated stand.

(2) Take special care not to scratch the painted surfaces or mating surfaces of the cylinder block and crankcase.

(3) Replace parts that cannot be reused such as packings, gaskets, O-rings, oil seals, spring pins or split pins with new ones after disassembly. Replace deformed snap rings with new ones.

(4) When replacing parts, be sure to use genuine parts. For fluids such as gear oil, use genuine product.

(5) Be sure to use special tools that are specified, and perform the works properly.

(6) When reassembling parts, use their mating marks. For parts without mating marks, simple marking makes reassembling easier. Refer to the parts catalog too.

(7) Clean individual parts that have been removed, and check their conditions.

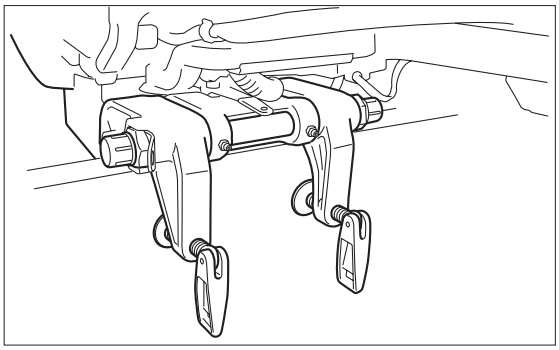
(8) When reassembling parts, pay extra attention to details such as the fitting of each part, repair limits, air tightness, clogging of oil holes for lubrication and greasing, packings, wiring, piping and so on. For components which use a lot of bolts and nuts for assembly, such as the cylinder head and crankcase, tighten all the fasteners uniformly to their specified torques clockwise in two or three stages, starting with the inner ones first followed by the outer ones. (Reverse the order when disassembling.)

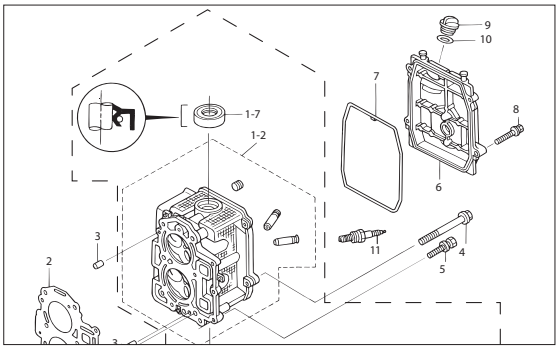
(9) When installing bearings, the flat (numbered) side should be the side in contact with the special assembly tool.

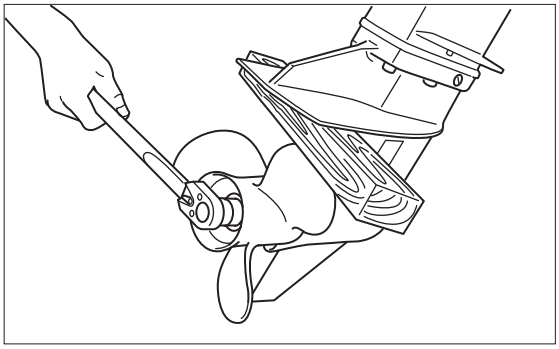
(10) When installing oil seals, be careful not to scratch the surface of the lip that contacts the shaft, and install them in the correct direction. Apply the recommended grease on the lip before installation.

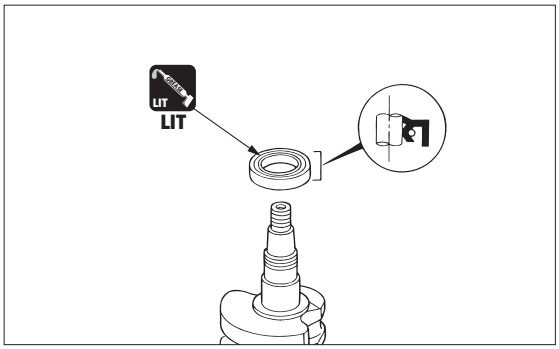
(11) When applying liquid packing, be extra careful of the thickness and quantity. Excess liquid may ooze out if too much liquid is applied, adversely affecting the interior of the crankcase. Use adhesive after thoroughly reading the instructions.

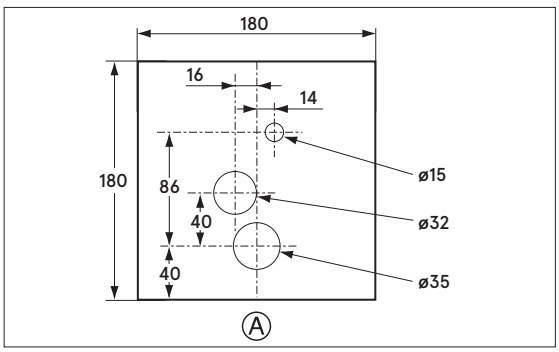
(12) When servicing the power unit, use of a work board (made of wood, etc.) such as shown on the right makes the work easier.









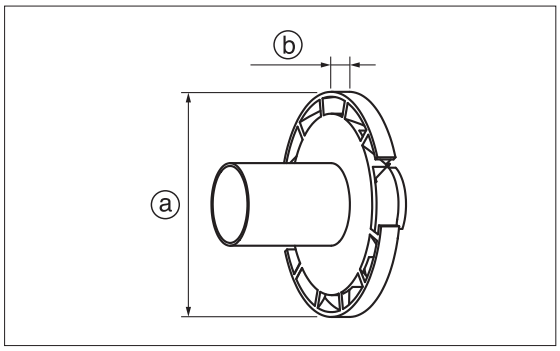


Ⓐ Thickness: 30 mm or more, Material: wood, Unit: mm

3. Tools and Instruments

1) Test Propeller

	MFS6CZ	MFS8C	MFS9.8C
Part No.	3B2-64110-1	3B2-64110-1	3B2-64110-1
Outer Diameter ⓐ	164 mm (6.46 in)	164 mm (6.46 in)	164 mm (6.46 in)
Width ⓑ	12 mm (0.47 in)	12 mm (0.47 in)	12 mm (0.47 in)
Fully Open Revolution Speed	4500 to 5000 min^{-1} (rpm)	5000 to 5500 min^{-1} (rpm)	5600 to 6100 min^{-1} (rpm)



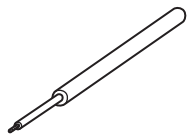
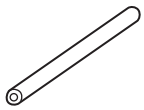
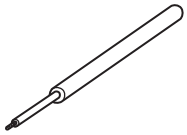
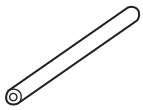
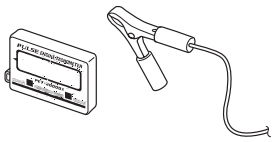
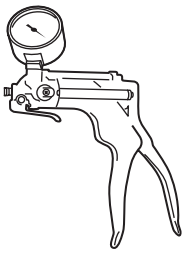
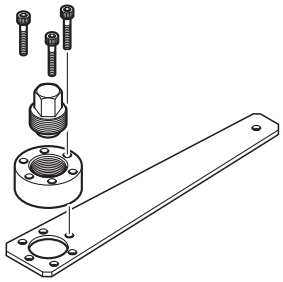
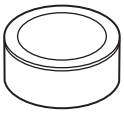
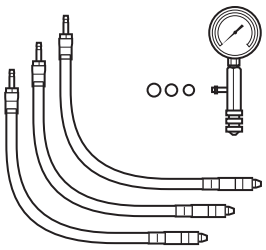
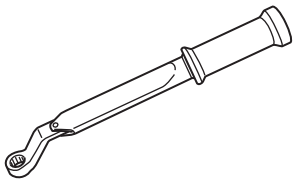
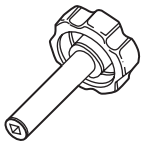
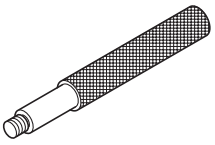
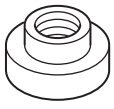
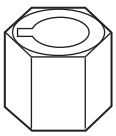
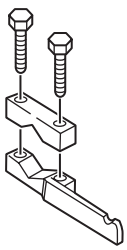
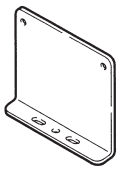
2) Measuring instruments

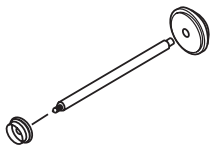
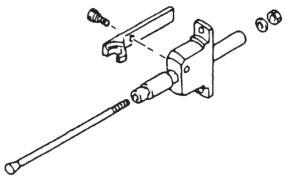
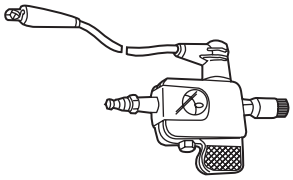
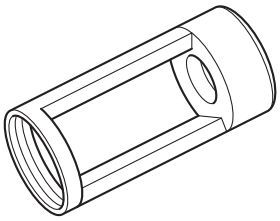
For the following measuring instruments, use commercially available ones.

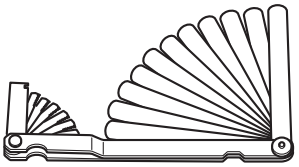
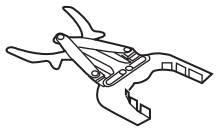
Circuit tester	(HIOKI 3000 Series: Resistance: 1 Ω, 10 Ω, 10 kΩ, AC voltage: 30 to 300 V, DC voltage: 30 V)
Vernier calipers	(M1 type, 300 mm)
Micrometer	(JIS B 7502; minimum graduation of 0.01, outer, 0 to 25 mm, 25 to 50 mm, 50 to 75 mm)
Cylinder gauge	(4 to 6 mm, 10 to 25 mm, 25 to 30 mm, 50 to 75 mm)
Ring gauge	(JIS B 7420; ø5.5, ø17, ø42, ø70)
Dial gauge	(JIS B 7503; minimum graduation of 0.01)
Thickness gauge	(JIS B 7524; 0.03 to 0.3 mm)
V block	(JIS B 7540)
Surface plate	(JIS B 7513; 500×500)

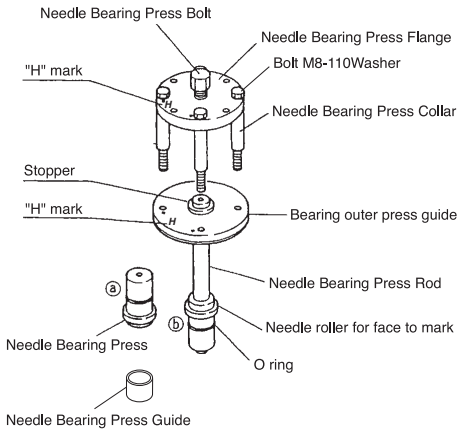
Dial gauge magnet base or dial gauge stand

3) Special Tools

			
Spring Pin Tool A (ø3.0) P/N. 345-72227-0	Spring Pin Tool B (ø3.0) P/N. 345-72228-0	Spring Pin Tool A (ø3.5) P/N. 369-72227-0	Spring Pin Tool B (ø3.5) P/N. 369-72228-0
Removing spring pin	Installing spring pin	Removing spring pin	Installing spring pin
			
Tachometer P/N. 3AC-99010-0	Vacuum/Pressure Gauge P/N. 3AC-99020-1	Flywheel Puller Kit P/N. 3V1-72211-1	Piston Slider P/N. 3V1-72871-0
Measuring engine revolution speed	Inspecting pressure	Removing and installing flywheel	Installing piston
			
Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0	Valve Clearance Driver P/N. 3AC-99071-0	Driver Rod P/N. 3AC-99702-0
Measuring compression pressure	Adjusting valve clearance	Adjusting valve clearance	Installing oil seal
ø34.5 x ø17.5 			
Oil Seal Attachment P/N. 3AC-99820-0	Crank Shaft Holder P/N. 31H-72815-0	Backlash Measuring Tool Clamp P/N. 3B7-72720-0	Dial Gauge Plate P/N. 3B7-72729-0
Installing cam shaft oil seal	Holding crankshaft	Measuring backlash	For installing dial gauge during backlash measurement

			
Bearing Outer Press Kit P/N. 3B7-72739-1	Backlash Measuring Tool Kit P/N. 369-72740-0	Spark Tester P/N. 3F3-72540-0	Valve Spring Compressor Attachment P/N. 3AB-99076-0
Bevel Gear Assy A Installing bearing outer race	Measuring between bevel gear assy A and bevel gear B	Inspecting ignition	Installing and removing valve spring

	
Thickness Gauge P/N. 353-72251-1	Piston Ring Tool P/N. 353-72249-0
Measuring gaps	Removal/installation of piston rings



Roller Bearing Press Kit P/N. 3AC-72900-3
Installing and removing drive shaft roller bearing

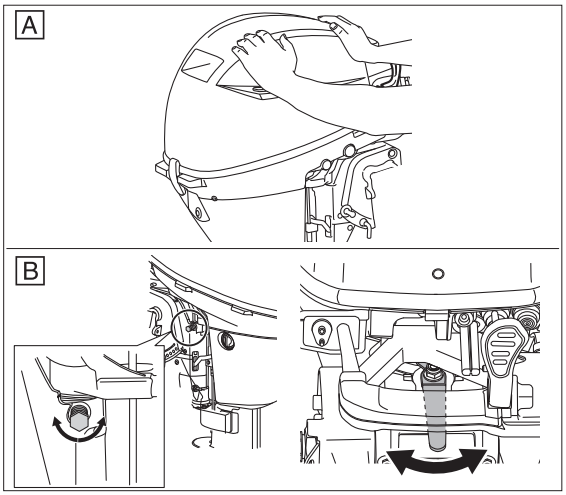
4. Pre-delivery Inspection

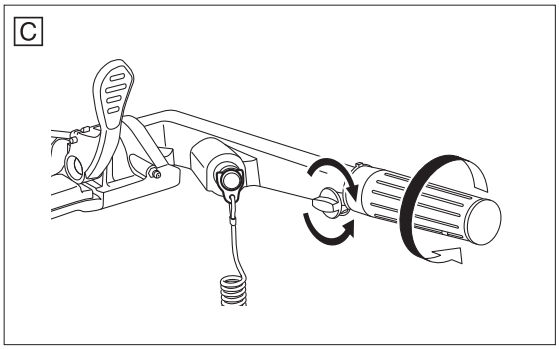
1) Steering Handle

A Check installations for clattering and play →

B Adjust steering friction →

C Check throttle grip for movement (full open/full close) →
Adjust throttle friction →



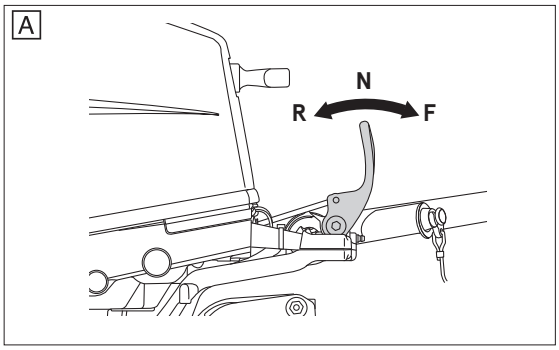


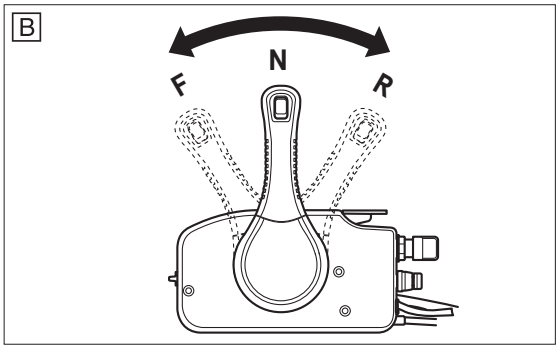
2) Gear Shift

Check that gear shifts from neutral (N) to forward (F) and reverse (R) smoothly.

A Tiller Handle Model

B Remote Control Model





3) Engine Oil

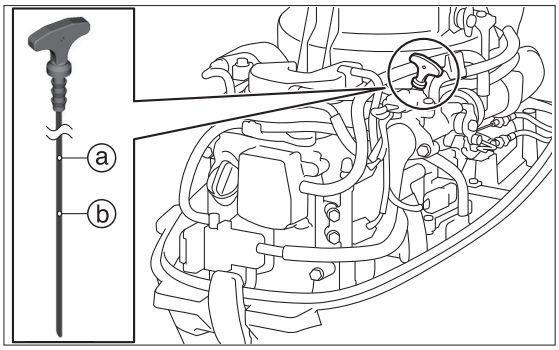
⚠ CAUTION

Engine oil is removed before shipment to prevent leakage.

Fill the engine with engine oil.

4 Stroke Engine Oil:
800 mL (0.8 US qt.)

Use oil level gauge to check oil quantity.



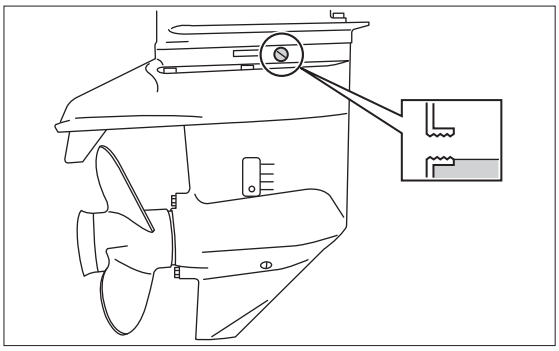
ⓐ Upper Limit
ⓑ Lower Limit

4) Gear Oil

Check the quantity of gear oil.

Gear Oil:
320 mL (11 US fl.oz.)

Fill with gear oil until some of the oil spills out of the plug hole when the upper oil plug is removed.

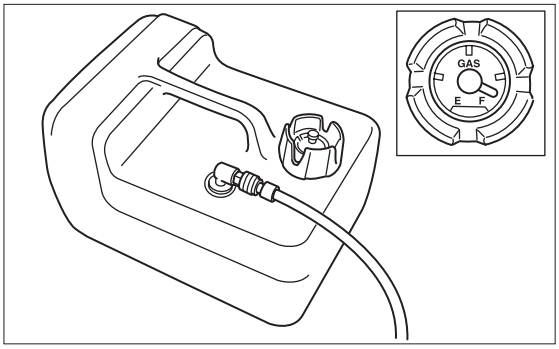


5) Fuel Line

⚠ CAUTION

Since this is a 4-stroke engine model, do not use fuel mixed with engine oil. Use of fuel mixed with engine oil will cause engine trouble.

Check that the fuel tank contains a sufficient amount of gasoline and check the connection of the fuel line to see if there are any leaks.

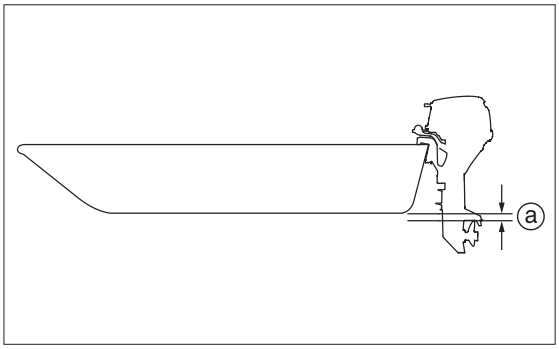


6) Rigging

Check that the clamp bracket is fixed securely to the hull. Check the location of the anti-ventilation plate relative to the boat's bottom, and, if necessary, adjust it to prevent engine overheating and a decrease in the propulsion force.

Conduct a test run to determine the best installation height.

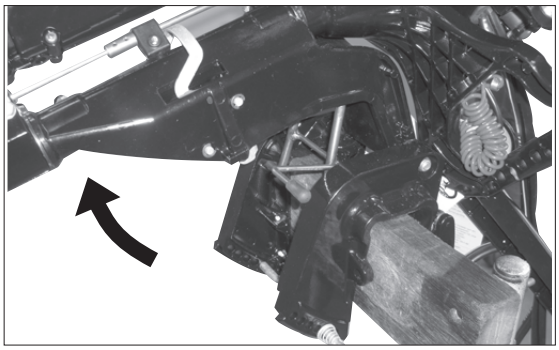
Anti-Ventilation Plate Position Standard Value ⓐ:
Located 5 to 25 mm (0.2 to 1.0 in) below boat's bottom



7) Inspection of Manual Tilt (MF, EF, EP)

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

2. Fully tilt up the outboard motor to check that the tilt limit mechanism engages automatically.



8) Inspection of PT unit (EFT, EPT)

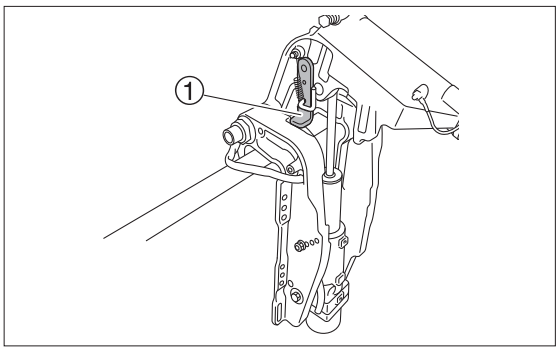
1. Operate the PT switch to check that the outboard motor tilts up/down smoothly.

2. Operate the PT switch to check that no abnormal noise is made when tilting the outboard motor up/down.

3. Tilt the outboard motor up and steer fully to the right and left to check that the cables and hoses do not interfere with each other and with any part of the hull.

4. Check that the needle of the trim meter is pointing at the bottommost position when the outboard motor is fully tilted down.

5. Fully tilt up the outboard motor, lock with tilt stopper (1), and check that tilt stopper's lock mechanism functions normally.

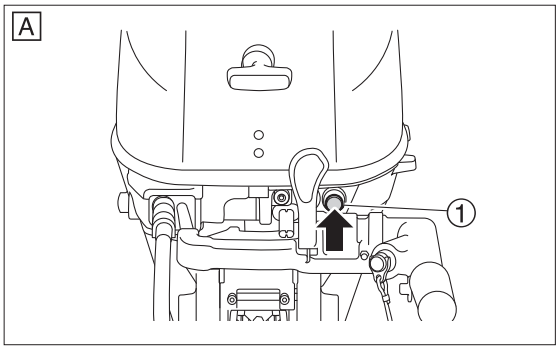


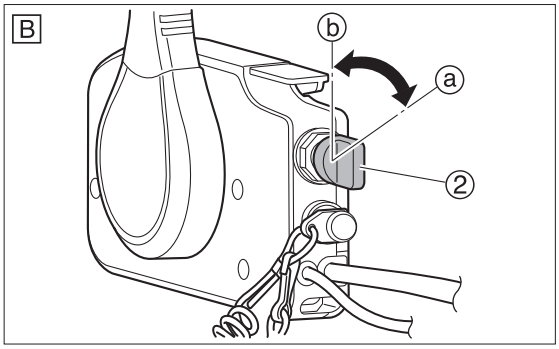
9)Inspection of Starting Switch and Stop Switch

1. Press start switch ① or turn main switch key ② to the START position ⓐ to check that the engine starts.

2. Turn the main switch key to the OFF position ⓑ to check that the engine stops.

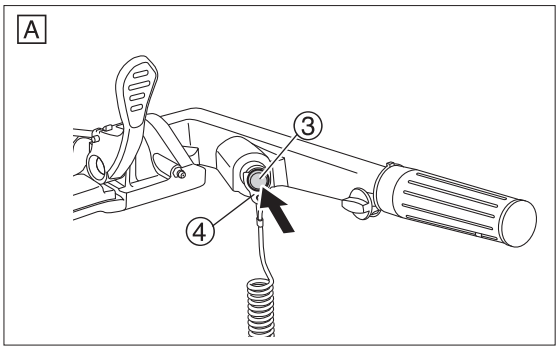
Ⓐ Tiller Handle Model
Ⓑ Remote Control Model

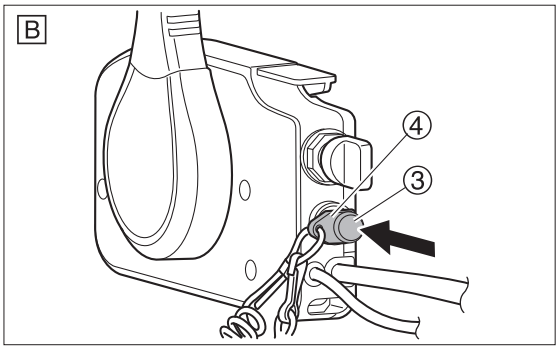




3. Press the stop switch ③ hard or pull out the lock ④ from the stop switch to check that the engine stops.

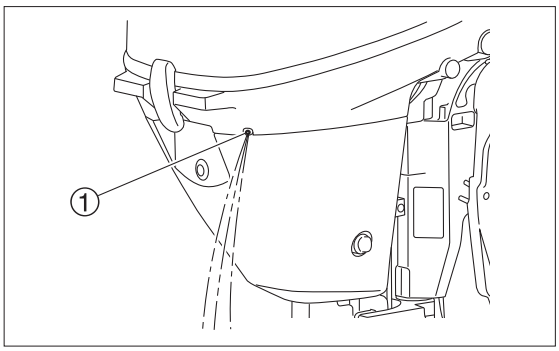
A Tiller Handle Model
B Remote Control Model





10) Cooling Water Check Port

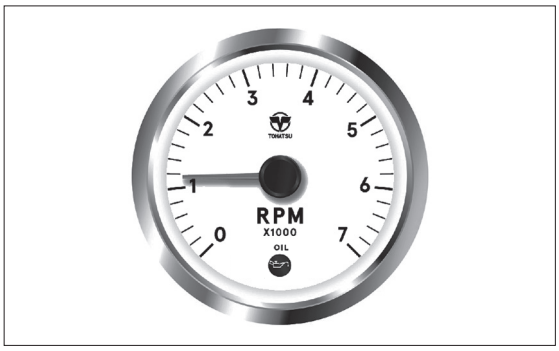
Check that water is discharged from the cooling water check port ①.



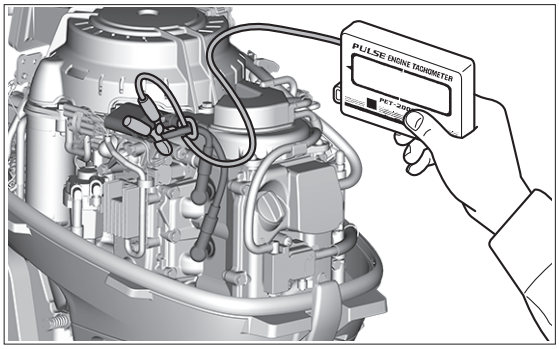
11) Idling

After the engine has warmed up, use a tachometer to check that the idle revolution speed is as specified.

Idle Revolution Speed:
900 min^{-1} (rpm)



Tachometer:
P/N. 3AC-99010-0



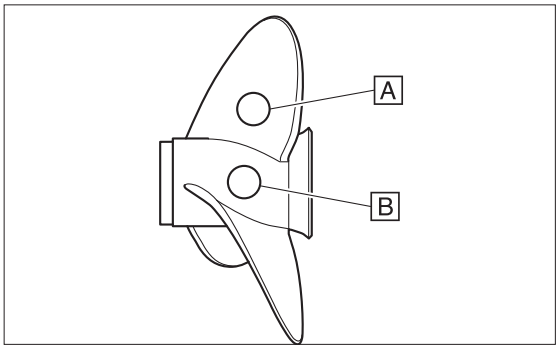
12) Propeller Selection

⚠ CAUTION

Selecting a wrong propeller may cause adverse effects on the engine life, fuel consumption, etc. as well as the performance.

Select a propeller that is best-suited to type of boat and application.

Fully Open Operating RPM Range:
6CZ: 5000 to 6000 min^{-1} (rpm)
8C/9.8C/9.9CY: 5300 to 6200 min^{-1} (rpm)



Propeller Mark

A 3-blade propeller

B 4-blade propeller

Propeller List

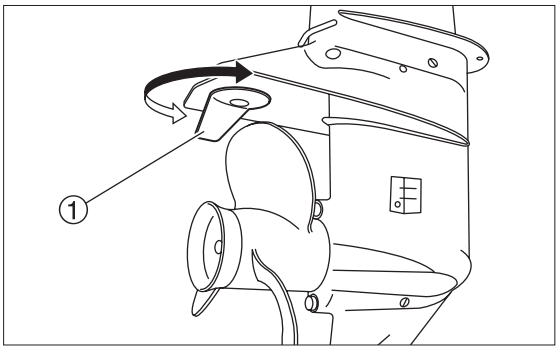
Propeller Mark	(No. of Blades x Pitch x Diameter)		Part No.
	in	mm	
5.0	4×5.0×8.7	4×127×221	3V1B64510-1
7.0	4×7.0×8.7	4×178×226	3V1B64514-1
6.5	3×6.5×8.5	3×165×216	3B2B64513-1
F7	3×7.0×8.9	3×178×226	3B2B64514-1
7.5	3×7.5×8.5	3×190×216	3B2B64515-1
F8.5	3×8.3×8.9	3×211×226	3B2B64517-1
F9.5	3×10×8.9	3×255×226	3B2B64519-1

13) Trim Tab

Trim Tab Angle Adjustment

After installing the outboard motor on your boat, make sure the weight of the left and right steering handle is evenly distributed at the trim angle and engine speed that you normally or frequently use. For this purpose, loosen the bolt of the trim tab, adjust it with the angle of the trim tab ①, and tighten it to the specified torque.

Trim Tab Bolt:
6 N · m (5 lb · ft) [0.6 kgf · m]

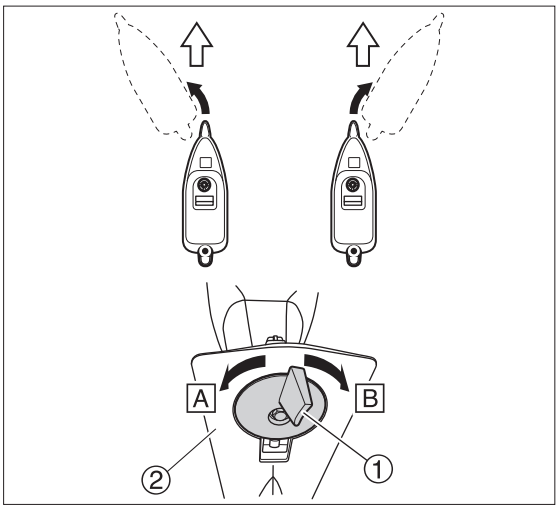


Specific Example

A If the weight of the steering handle is lighter on the left side, or if it tends to turn towards the left side, turn the trim tab in the direction of A as shown in the diagram.

B If the weight of the steering handle is lighter on the right side, or if it tends to turn towards the right side, turn the trim tab in the direction of B as shown in the diagram.

Move the trim tab a little bit at a time and determine the best position by repeating the test several times.



①Trim Tab
②Anti-Ventilation Plate

5. Break-in Operation

Break-in operation is needed for the purpose of smoothening the sliding surfaces between components such as pistons and cylinder, piston rings, piston pins, crankshaft, connecting rods, and intake and exhaust valves.

- In order to apply an appropriate load on each part during the break-in operation, run the test with the propeller mounted.
- During the break-in operation, change the revolution speed while keeping it equal to or below the specified revolution speed.

Break-in Operation...10 hours

	0 to 10 minutes	10 minutes to 2 hours	2 to 3 hours	3 to 10 hours	10 hours or longer
Throttle Position	Idling or Low-Speed Running	1/2 of WOT or less	3/4 of WOT or less	3/4 of WOT	Regular Operation
Engine Rotation	Running at the slowest possible speed	Approx. 3,000 min^{-1} (rpm)	Approx. 4,000 min^{-1} (rpm) Can be operated fully open for about 1 minute every 10 minutes	Approx. 4,000 min^{-1} (rpm) Can be operated fully open for about 2 minutes every 10 minutes	

It is best to fluctuate the engine RPM (Target RPM or less) every 15-30 mins at each stage during the break in procedure to allow for complete break in of outboard engine.

Running the outboard at for prolonged periods such as idling or one specific RPM is detrimental to the outboard and could affect engine reliability and performance.

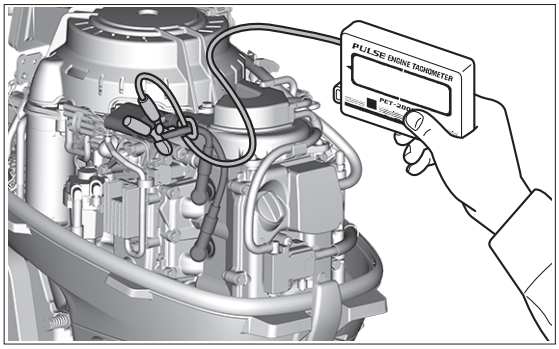
6. Test Run

1. Start the engine and check if the gear can be shifted smoothly.

2. After completing the warm-up operation, check the idle revolution speed.

Idle Revolution Speed:
900 min^{-1} (rpm)

Tachometer:
P/N. 3AC-99010-0



3. Shift the gear to the Forward (F) position and run at the dead slow speed. (About 10 minutes)

Dead Slow Revolution Speed:
900 min^{-1} (rpm)

4. Run at 3,000 min^{-1} (rpm) or half of the WOT for an initial 2 hours, then at 4,000 min^{-1} (rpm) or 3/4 of the WOT for 1 hour.

5. Check that the outboard motor is not tilted up and that water does not infiltrate the boat when the gear is shifted to the Reverse (R) position.

Conduct a test run during the break-in operation.

7. Checks After Test Run

1. Check that no water is present in the gear oil.

2. Check if fuel is leaking inside the cowl.

3. Check if oil or water is leaking inside the cowl and if the engine oil is contaminated by water.

4. After the test run, use a hose joint to wash the cooling water path inside the engine with fresh water.

⚠ WARNING

- **Be sure that the engine is stopped, at the cooling water path flushing. If not, the water pump may be damaged.**
- **Remove the stop switch lock to prevent the engine from starting.**

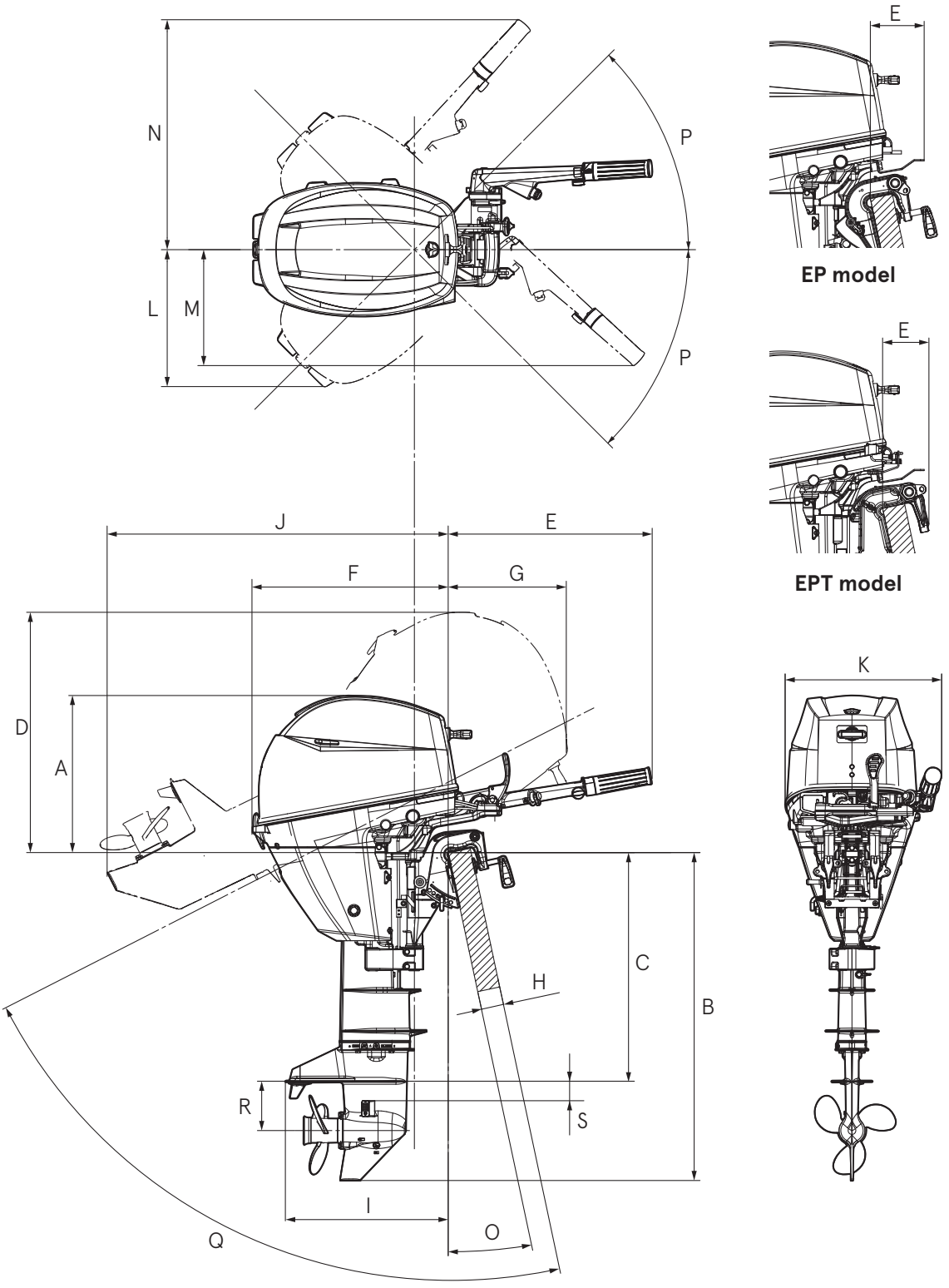
2

Service Data

1. Outline Dimensions

1) Engine Dimensions

Basic Tiller Handle Model



EP model

EPT model

MF/EF/EFT

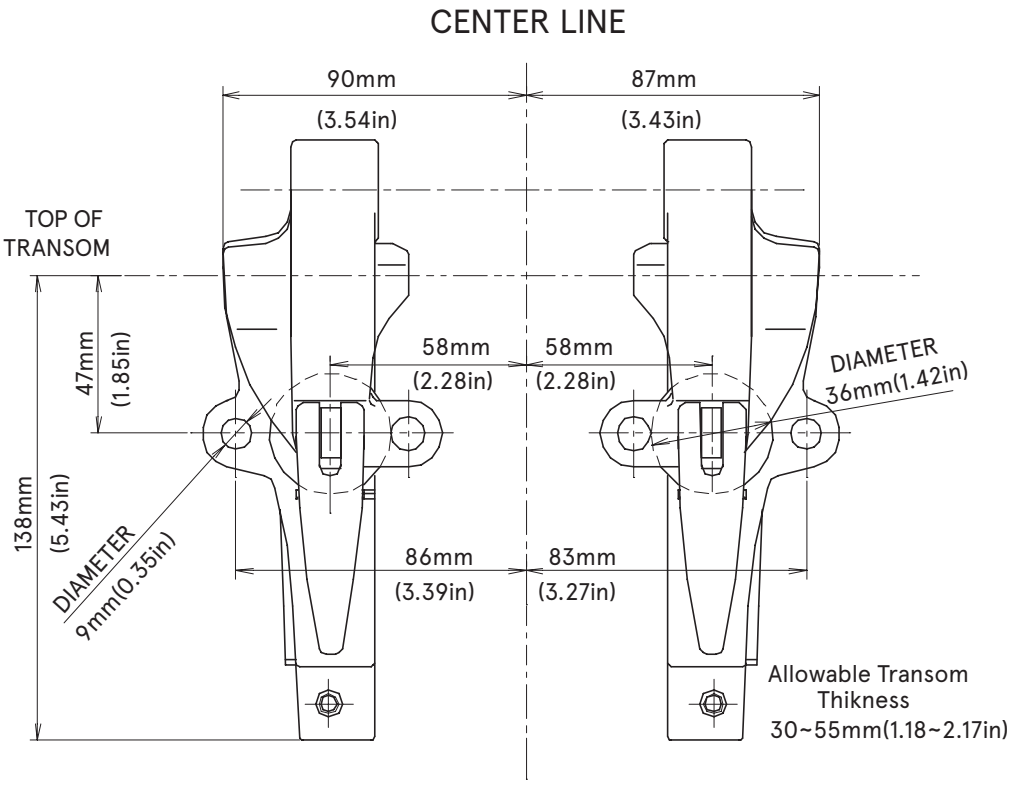
Item	Type		Unit	MFS6/8/9.8/9.9C	
				mm	in
A			mm/in	385	15.15
B	S		mm/in	676	26.60
	L		mm/in	803	31.60
	UL		mm/in	930	36.60
C	S		mm/in	433	17.05
	L		mm/in	560	22.05
	UL		mm/in	687	27.05
D	MF/EF		mm/in	588	23.15
	EFT		mm/in	603	23.75
E	MF/EF		mm/in	499	19.65
	EFT		mm/in	483	19.00
F	MF/EF		mm/in	478	18.80
	EFT		mm/in	494	19.45
G	MF/EF		mm/in	282	11.10
	EFT		mm/in	285	11.20
H	MF/EF		mm/in	30-55	1.20-2.10
	EFT		mm/in	30-70	1.20-2.75
I	MF/EF		mm/in	399	15.70
	EFT		mm/in	415	16.35
J	S	MF/EF	mm/in	703	27.65
		EFT	mm/in	710	27.95
	L	MF/EF	mm/in	835	32.85
		EFT	mm/in	843	33.20
	UL	MF/EF	mm/in	967	38.05
		EFT	mm/in	976	38.40
K			mm/in	383	15.10
L			mm/in	366	14.40
M			mm/in	284	11.20
N			mm/in	563	22.15
O			deg.	12°	
P			deg.	45°	
Q			deg.	75°	
R			mm/in	121	4.75
S			mm/in	46	1.80
Trim Angle (Position)	MF/EF		deg.	4-24 (6)	
	EFT		deg.	4-20	

EP/EPT

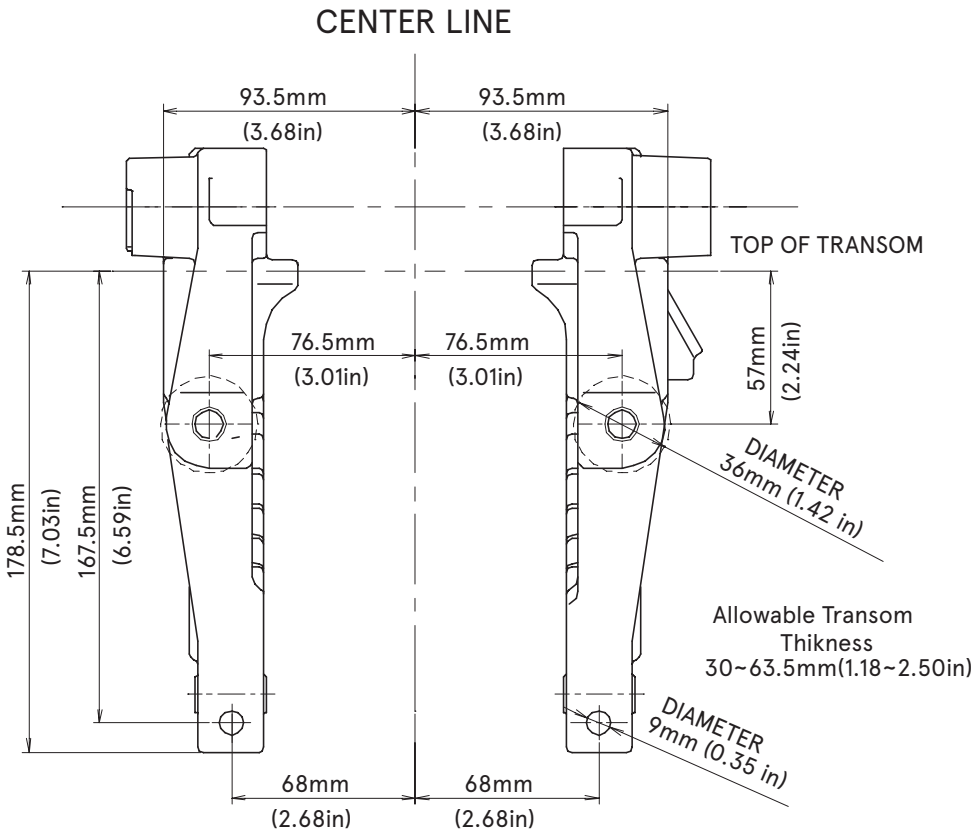
Item	Type		Unit	MFS6/8/9.8/9.9C	
				mm	in
A			mm/in	385	15.15
B	S		mm/in	676	26.60
	L		mm/in	803	31.60
	UL		mm/in	930	36.60
C	S		mm/in	433	17.05
	L		mm/in	560	22.05
	UL		mm/in	687	27.05
D	EP		mm/in	570	22.45
	EPT		mm/in	603	23.75
E	EP		mm/in	132	5.20
	EPT		mm/in	113	4.45
F	EP		mm/in	464	18.25
	EPT		mm/in	494	19.45
G	EP		mm/in	295	11.60
	EPT		mm/in	285	11.20
H	EP		mm/in	30-63.5	1.20-2.50
	EPT		mm/in	30-70	1.20-2.75
I	EP		mm/in	385	15.15
	EPT		mm/in	415	16.35
J	S	EP	mm/in	695	27.35
		EPT	mm/in	710	27.95
	L	EP	mm/in	825	32.50
		EPT	mm/in	843	33.20
	UL	EP	mm/in	955	37.60
		EPT	mm/in	976	38.40
K			mm/in	337	13.25
L	EP		mm/in	336	13.25
	EPT		mm/in	336	13.25
O	EP		deg.	12°	
	EPT		deg.	12°	
P	EP		deg.	45°	
	EPT		deg.	45°	
Q	EP		deg.	73°	
	EPT			75°	
R			mm/in	121	4.75
S			mm/in	46	1.80
Trim Angle (Position)	EP		deg.	7-18 (3)	
	EPT		deg.	4-20	

2) Transom Bolts

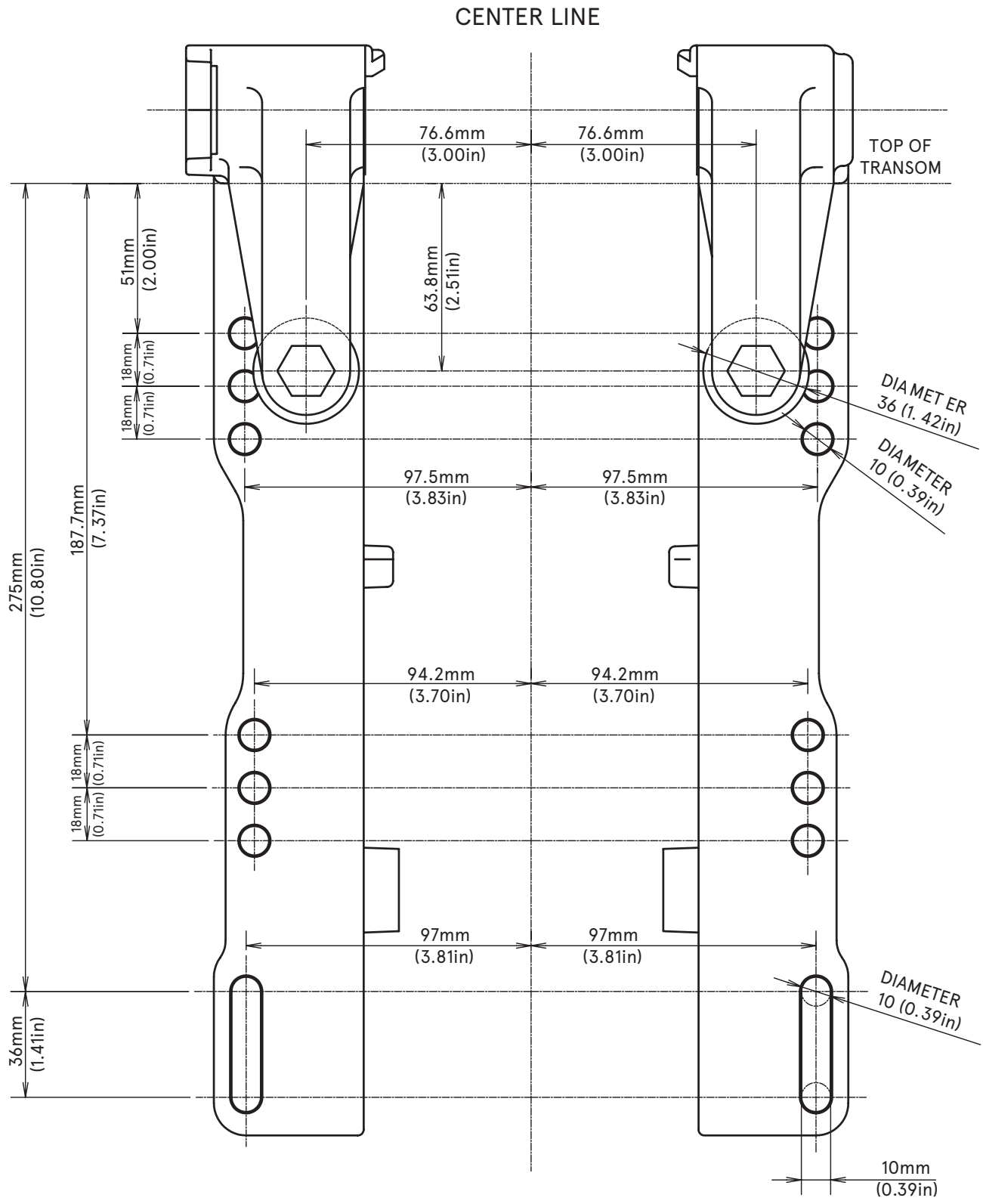
Manual Tilt Model (MF/EF)



Manual Tilt Model (EP)



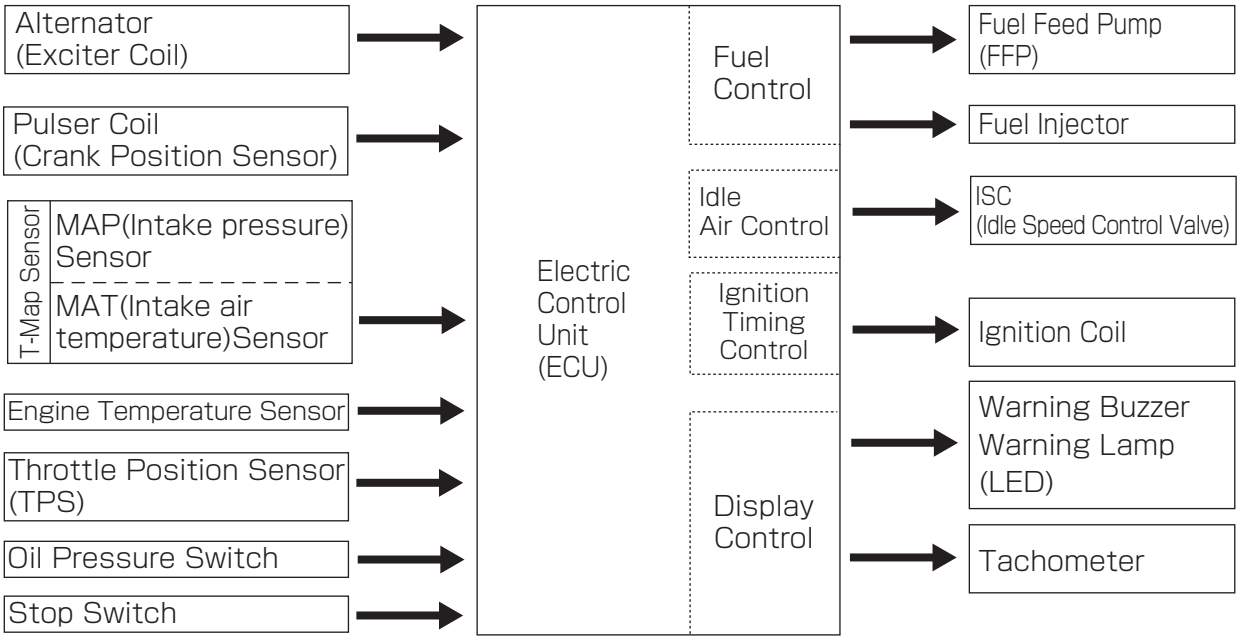
Power Tilt Model (EFT/EPT)

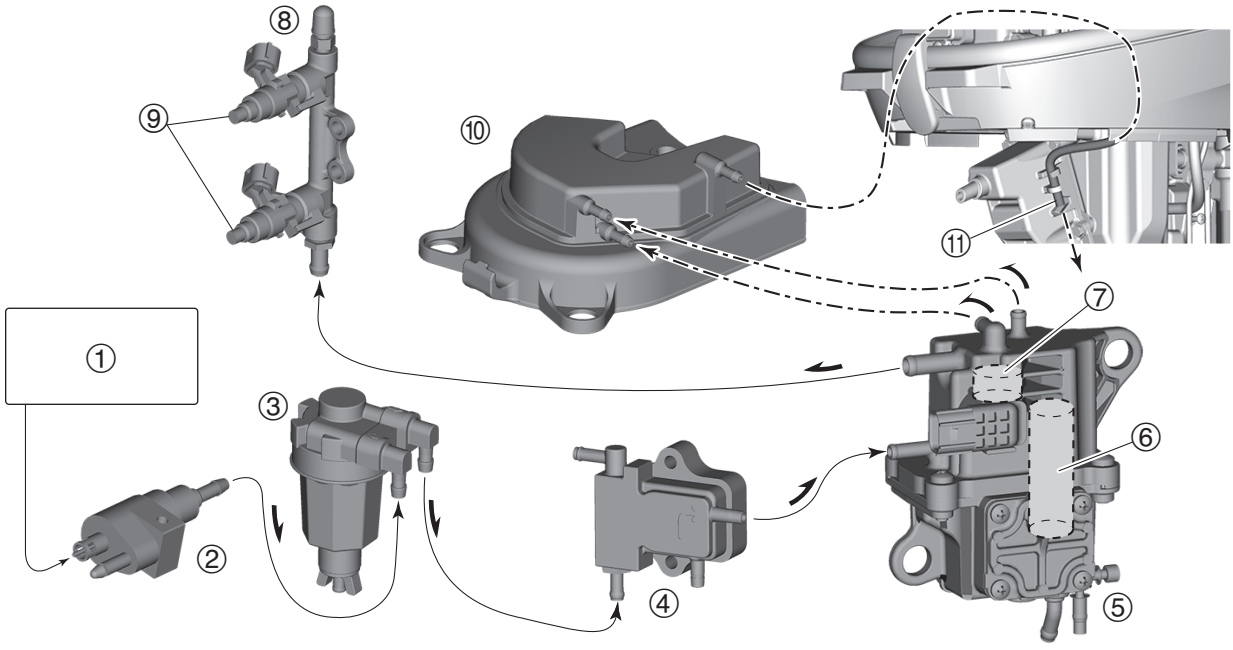


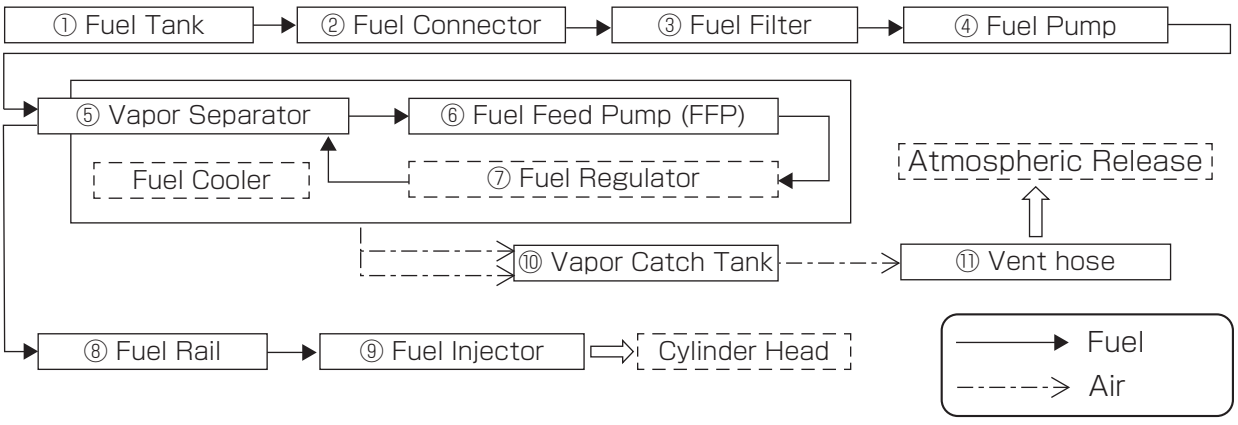
2. Fuel Injection System

1) ECU Fuel Feed System

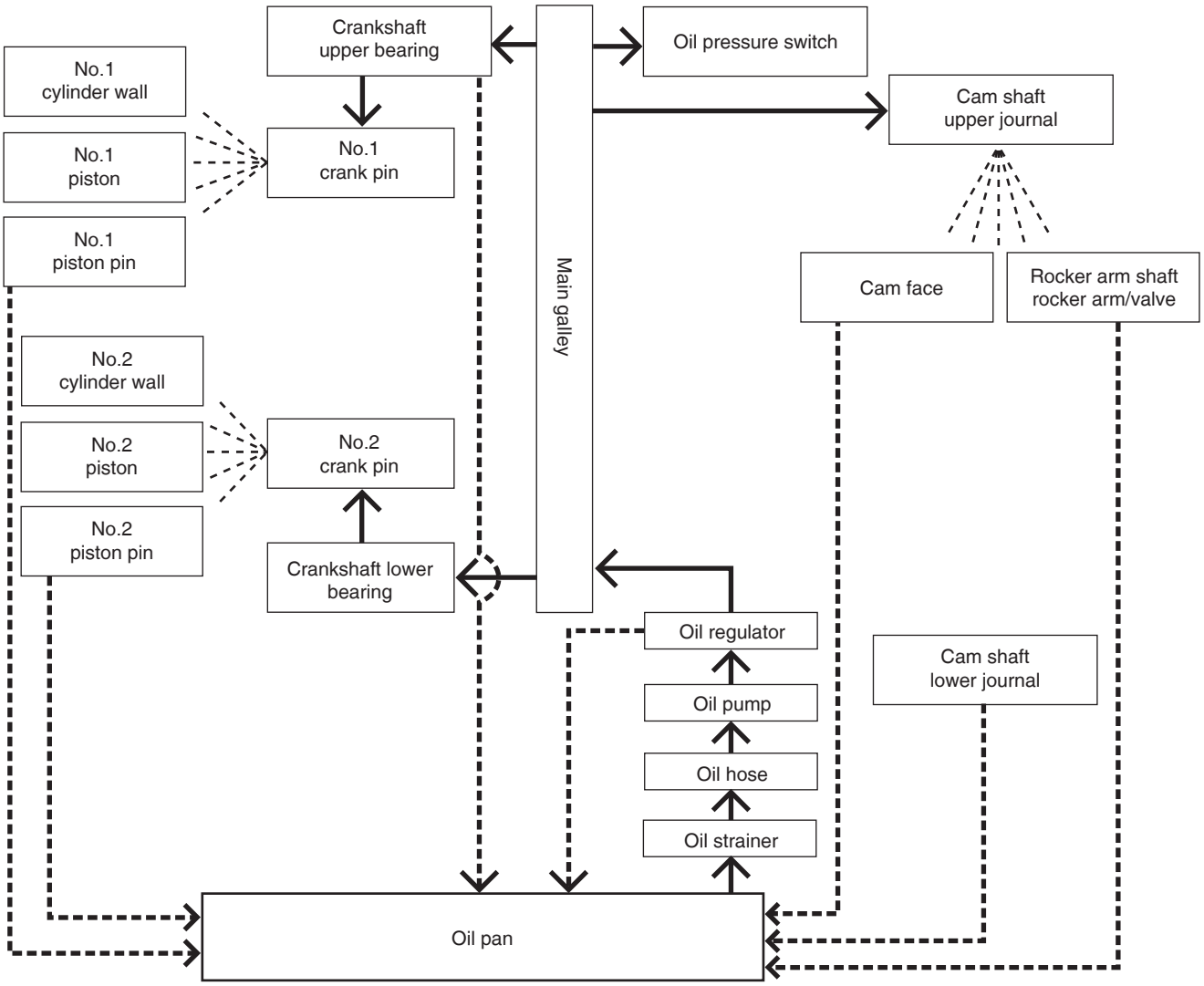
The ECU uses various sensors to precisely control the injected fuel amount (time) and ignition timing.



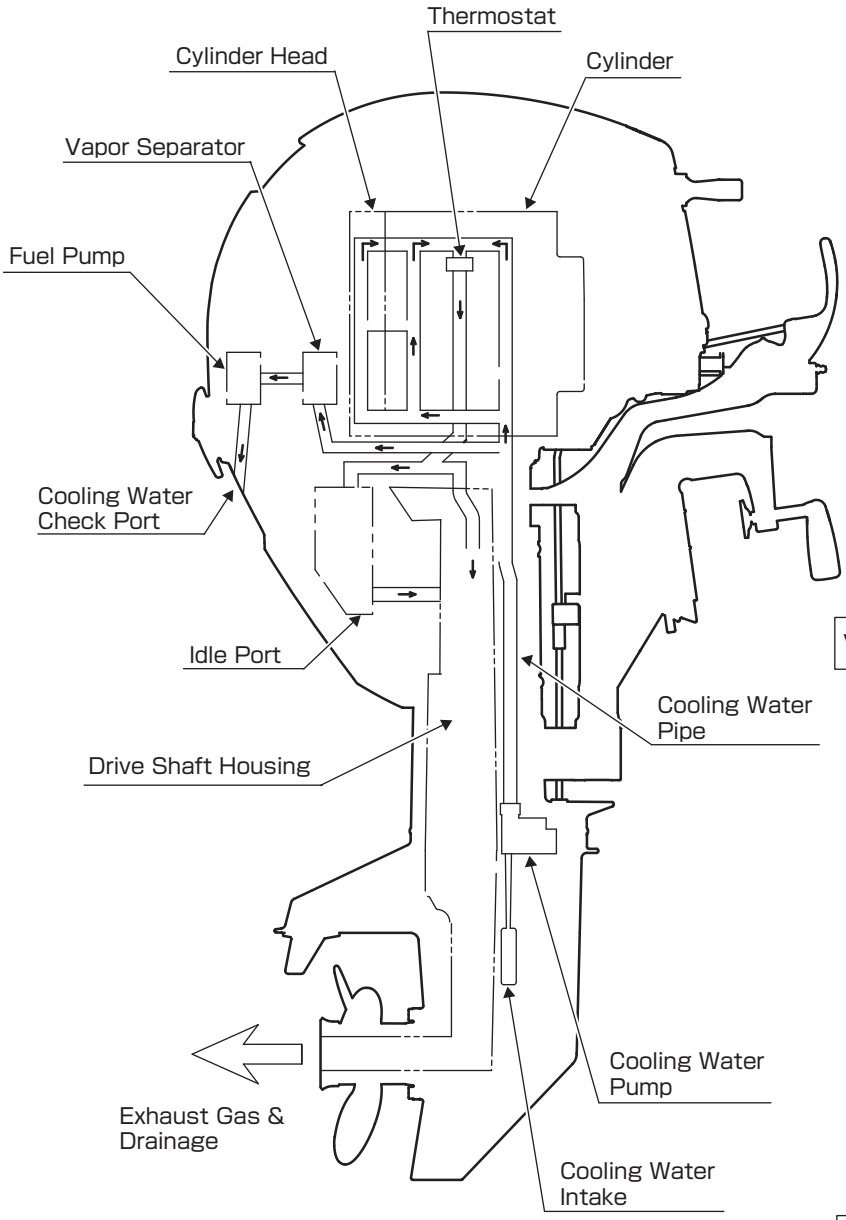


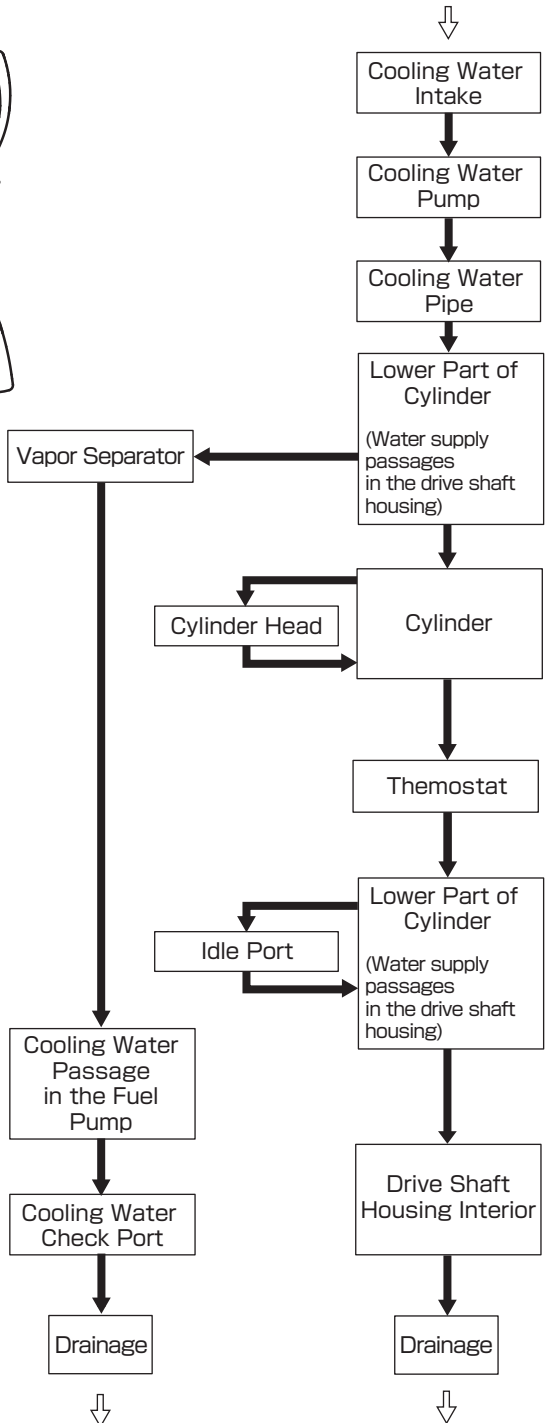


3. Engine Lubrication System Diagram



4. Cooling Water System Diagram





5. Specifications

Item		Unit	Model				
			MF	EF	EFT	EP	EPT
Dimensions							
Overall Length		mm (in)	977 (38.45)			596 (23.45)	607 (23.90)
Overall Width		mm (in)	383 (15.05)			337 (13.25)	
Overall Height	S	mm (in)	1061 (41.75)				
	L	mm (in)	1188 (46.75)				
	UL	mm (in)	1315 (51.75)				
Transom Height	S	mm (in)	433 (17.05)				
	L	mm (in)	560 (22.05)				
	UL	mm (in)	687 (27.05)				
Weight							
	S	kg (lbs)	38.5 (85)	41.0 (90)	47.5 (105)	41.0 (90)	46.5 (102)
	L	kg (lbs)	39.5 (87)	42.0 (93)	48.5 (107)	42.0 (93)	47.5 (105)
	UL	kg (lbs)	-	43.0 (95)	49.5 (109)	-	48.0 (106)
Performance							
Maximum Output		kW (ps)	6CZ: 4.4 (6) 8C: 5.9 (8) 9.8C: 7.2 (9.8) 9.9CY: 7.3 (9.9)				
Full-throttle Fuel Consumption		L (gal.)/hr	6CZ: 3.1 (0.80) 8C: 3.4(0.90) 9.8C/9.9CY: 3.9 (1.05)				
Fully Open Operating RPM Range		min^{-1} (rpm)	6CZ: 5000 - 6000 8C/9.8C/9.9CY: 5300 - 6200				
Idling (Neutral [N])		min^{-1} (rpm)	900				
Dead Slow (Forward [F])		min^{-1} (rpm)	900				

Item	Unit	Model				
		MF	EF	EFT	EP	EPT

Power Unit

Engine type		4-stroke		
No. of Cylinders		2		
Piston Displacement	ml (cu. in)	209 (12.7)		
Valve System		OHC Crossflow		
Bore x Stroke	mm (in)	55×44 (2.15×1.75)		
Compression Ratio		8.7		
Shift Operation System		Manual system		Remote Control System
Starting System		Recoil	Electric & Recoil	
Lubrication System		Pressurized Feeding Type (Wet Sump)		
Cooling System		Forced Water Cooling		
Exhaust System		Through-the-prop Exhaust		
Ignition System		Flywheel Magneto CD Ignition		
Ignition Timing		MFS 6CZ: TDC0° - BTDC22° MFS 8C: TDC0° - BTDC32° MFS 9.8C/9.9CY: TDC0° - BTDC30°		
Spark Plug		Equivalent to NGK DCPR6E		
Alternator Output		12 V–7.0 A		
Fuel Feed System		Fuel Injection		

Fuel & Oil

Type of Fuel			Unleaded Regular Gasoline (Research octane number 91 or higher)	
Fuel Tank Capacity		L (US gal.)	12 (3.2)	
Fuel Priming System			ECU (Electronic Control Unit)	
Fuel Pumping System			Diaphragm pump (Plunger Type), Electric Fuel Pump	
Engine Oil	Type		4 Stroke Engine (Motor) Oil	
	Grade	API	SH, SJ, SL	
		SAE	10W-30, 10W-40	
	Oil Quantity (when oil filter is not replaced)	ml (US qt)	800 (0.8)	
Gear Oil	Type		Tohatsu Gear Oil	
	Grade *1	API	GL-5	
	Grade *1	SAE	80-90	
	Oil Capacity	ml (US fl.oz.)	320 (11)	

*1 Both API and SAE requirements shall be met.

Lower Unit

Gear Shift		F-N-R
Gear Ratio		27:13 (2.08)
Type of Gears		Spiral Bevel Gear
Clutch Model Type		Dog Clutch
Propeller Shaft Driving		Spiral
Propeller Rotation (Direction)		Clockwise at forward (F) shift as viewed from rear

Item		Unit	Model				
			MF	EF	EFT	EP	EPT

Bracket

		Steps	6	5	3	5
Trim Angle (Transom 12°)	*2	Degrees °	-8 – 12°	-8 – 8°	-5 – 6°	-8 – 8°
Shallow Water Drive Angle (Transom 12°)	*2	Degrees °	32.5°	Adjustable	24 – 40°	Adjustable
Max. Tilt Angle	*2	Degrees °	63°	63°	61°	63°
Steering Angle	*3	Degrees °	90°	90°	90°	90°
Max. Allowable Transom Thickness		mm (in)	30 – 55 (1.20 – 2.15)	30 – 70 (1.20 – 2.75)	30 – 63.5 (1.20 – 2.50)	30 – 70 (1.20 – 2.75)

* 2: Trim angle to horizontal when transom angle is 12°.
*3 Full Steering Angle Range to Starboard and Port

Warning System

Over-Revolution Protection			Engine speed exceeds maximum allowable RPM Engine speed is controlled at 6400min-1(rpm) or less for MFS 8C, 9.8C and 9.9CY and 6200 min-1 (rpm) or less (High Speed ESG) for MFS 6CZ. Warning lamp is lit, and warning buzzer sound continuously.
Engine Oil Pressure Low	*4		Engine speed is controlled at 2800 min^{-1} (rpm) or less (Low Speed ESG). Warning lamp is lit.
Warning System Operation Check			Only lamp operates (5 seconds) at every start.

*4 Stop the engine once to cancel the warning.

6. Maintenance Data

	Description	Item	Standard Value
Engine Parts	**Engine**	Compression pressure (reference value) Note) After warming up, remove all the spark plugs and injector connectors, then take measurements with the throttle fully opened.	0.88 MPa
	Valve (IN/EX)	Valve Clearance	IN: 0.10 – 0.15 mm (0.0040 – 0.0060 in)
			EX: 0.20 – 0.24 mm (0.0080 – 0.0095 in)
		Valve Stem Outer Diameter	IN: ø5.48 mm (0.2157 in)
			EX: ø5.46 mm (0.2150 in)
		Valve Stem Runout	-
			-
		Valve Guide Inner Diameter	IN: ø5.51 mm (0.2169 in)
			EX: ø5.51 mm (0.2169 in)
		Clearance Between Valve Stem and Guide	IN: 0.008 – 0.040 mm (0.0003 – 0.0016 in)
			EX: 0.025 – 0.057 mm (0.001 – 0.0022 in)
		Valve Seat Contact Width	IN: 1.0 mm (0.0394 in)
			EX: 1.0 mm (0.0394 in)
	Valve Spring	Free Spring Length	IN: 38.3 mm (1.5078 in)
			EX: 38.3 mm (1.5078 in)
	Rocker Arm	Rocker Arm Inner Diameter	ø13.01 mm (0.5122 in)
		Rocker Arm Shaft Outer Diameter (Arm Sliding Part)	ø12.99 mm (0.5114 in)
		Clearance Between Rocker Arm and Shaft	0.006 – 0.035 mm (0.0002 – 0.0014 in)
	Piston	Maximum outer diameter Outer diameter at 7 mm above the lower end of the piston skirt At right angle to the piston pin	ø54.960 mm (2.1638 in)
		Clearance Between Piston Diameter and Cylinder Inner Diameter	0.020 – 0.055 mm (0.0008 – 0.0022 in)
		Adhesion of Carbon on Piston Crown and Ring Groove	-
		Clearance Between Piston Ring and Ring Groove	Top Ring: 0.04 – 0.08 mm (0.0016 – 0.0031 in)
			Second Ring: 0.03 – 0.07 mm (0.0012 – 0.0028 in)
			Oil Ring: 0.05 – 0.15 mm (0.0020 – 0.0059 in)
		Piston Pin Hole Inner Diameter	ø14.002 – 14.008 mm (0.5513 – 0.5515 in)
	Piston Pin	Pin Outer Diameter	ø14.000 mm (0.5512 in)
		Clearance Between Piston Pin and Pin Hole	0.002 – 0.012 mm (0.0001 – 0.0047 in)
	Piston Ring	Ring End Gap Note) Measure the Ring End Gap at the bottom of the cylinder bore where there is little wear if you do not have a ring gauge.	Top Ring: 0.15 – 0.30 mm (0.0059 – 0.0098 in)
			Second Ring: 0.30 – 0.45 mm (0.0118 – 0.0177 in)
			Oil Ring: 0.20 – 0.70 mm (0.0079 – 0.0276 in)
	Cylinder Head	Cam Bearing Inner Diameter	Upper part: ø18.010 – 18.025 mm (0.7091 – 0.0276 in)
		Distortion or Damage on Mating Surface	Distortion: 0.05 mm (0.0020 in) or less
		Carbon Adhesion in Combustion Chamber	-
		Cooling Water Passage Clogged	-

Functional Limit	Correction Method
-	Check if rotating parts, sliding parts and sealing parts cause compression leakage.
-	Adjust to specified range
-	
IN: ø5.46 mm (0.2150 in)	Replace if less than specified limit
EX: ø5.44 mm (0.2142 in)	
IN: 0.05 mm (0.0002 in)	Replace if more than specified limit
EX: 0.03 mm (0.0012 in)	
IN: ø5.55 mm (0.2185 in)	Replace if more than specified limit
EX: ø5.57 mm (0.2193 in)	
IN: 0.070 mm (0.0028 in)	Replace if more than specified limit
EX: 0.100 mm (0.0039 in)	
IN: 2.0 mm (0.0787 in)	Correct or replace if more than specified limit
EX: 2.0 mm (0.0787 in)	
IN: 36.8 mm (1.4488 in)	Replace if less than specified limit
EX: 36.8 mm (1.4488 in)	
ø13.05 mm (0.5138 in)	Replace if more than specified limit
ø12.94 mm (0.5094 in)	Replace if less than specified limit
0.060 mm (0.0024 in)	Replace if more than specified limit
ø54.900 mm (2.1614 in)	Replace if less than specified limit
0.15 mm (0.0059 in)	Replace if more than specified limit
-	Clean to remove. Replace with a new one if the stains cannot be fully removed even after cleaning.
0.10 mm (0.0039 in)	Replace if the gap is over the specified limit Replace the oil ring at the same time when replacing the top or second ring.
0.09 mm (0.0035 in)	
0.18 mm (0.0071 in)	
ø14.040 mm (0.5528 in)	Replace if more than specified limit
ø13.970 mm (0.5500 in)	Replace if less than specified limit
0.040 mm (0.0016 in)	Replace if more than specified limit
0.50 mm (0.0197 in)	Replace if more than specified limit Replace the oil ring when the top ring or second ring is replaced.
0.70 mm (0.0278 in)	
Upper part: ø18.050 mm (0.7206 in)	Replace if more than specified limit
Distortion: 0.1 mm (0.0039 in) or when the sealing performance may be affected.	Resurface by laying a #240 - 400 waterproof abrasive paper on the surface plate. Use #600 for finish.
-	Clean to remove
-	Clean to remove

	Description	Item	Standard Value
Engine Parts	Cylinder Block	Cylinder Liner Inner Diameter Use a cylinder gauge etc. to measure the inner diameter	ø54.990 – 55.005 mm (2.1650 – 2.1656 in)
		Seizure, Cylinder Liner Damage or Wear	-
		Distortion or Damage on Mating Surface	Distortion: 0.05 mm (0.0020 in) or less
		Deposition in Water Jacket	-
	Connecting Rod	Small End Inner Diameter	ø14.010 – 14.021 mm (0.5516 – 0.5520 in)
		Big End Oil Clearance	0.015 – 0.041 mm (0.0006 – 0.0016 in)
		Big End Side Clearance	0.10 – 0.25 mm (0.0039 – 0.0098 in)
	Crankshaft	Center Deflection (measure with support of journal at both ends)	Both sides must be less than 0.03 mm (0.0012 in).
		Main Journal Outer Diameter	ø29.988 – 29.996 mm (1.1806 – 1.1809 in)
		Crank pin outer diameter	ø26.972 – 26.985 mm (1.0619 – 1.0624 in)
		Main Journal Oil Clearance	0.012 – 0.044 mm (0.0005 – 0.0017 in)
		Main Journal Thrust Clearance	0.10 – 0.20 mm (0.0039 – 0.0079 in)
	Cam Shaft	Cam Height	IN: 23.43 mm (0.9224 in)
			EX: 23.46 mm (0.9236 in)
		Bearing Outer Diameter	Pulley Side 17.975 - 17.990 mm (0.7078 - 0.7083 in)
			Oil Pump Side 15.965 - 15.980 mm (0.6285 - 0.6291 in)
		Cam Shaft Runout	-
	Timing Belt	External Appearance	-
	Oil Pump	1. Pump Body Inner Diameter	-
		2. Clearance between Outer Rotor and Body	-
		3. Height of Outer Rotor	-
		4. Clearance between sides of rotor and body	-
		5. Clearance between outer and inner rotors	-
Fuel-Related Parts	Fuel Rail	O-ring Wear and Damage	-
	Fuel Regulator	Fuel Pressure	250 kPa
	Vapor Separator	Sealing Ring Wear and Damage	-
		Float	-

Functional Limit	Correction Method
ø55.06 mm (2.1677 in)	Replace if more than specified limit
Difference of 0.05 mm (0.0020 in) or less between the most worn out area and least worn out area of the liner inner diameter	If the difference between the most worn out area and least worn out area of the liner inner diameter exceeds the specified value, the inner diameter should be bored to ø55.5 ± 0.01 mm (2.1850 ± 0.0004 in), and the piston and piston ring should be replaced with oversized ones.
Distortion: 0.1 mm (0.0039 in) or when the sealing performance may be affected.	Resurface by laying a #240 - 400 waterproof abrasive paper on the surface plate. Use #600 for finish.
	Clean to remove
ø14.040 mm (0.5528 in)	Replace if more than specified limit
0.060 mm (0.0024 in)	Replace if more than specified limit
0.60 mm (0.0236 in)	Replace if more than specified limit
0.05 mm (0.0020 in)	Replace if more than specified limit
ø29.97 mm (1.1799 in)	Replace if less than specified limit
ø26.95 mm (1.0610 in)	Replace if less than specified limit
0.060 mm (0.0024 in)	Replace if more than specified limit
0.55 mm (0.0217 in)	Replace if more than specified limit
IN: 23.3 mm (0.9173 in)	Replace if less than specified limit
EX: 23.3 mm (0.9173 in)	Replace if less than specified limit
Pulley Side 17.95 mm (0.7070 in)	Replace if less than specified limit
Oil Pump Side 15.95 mm (0.6280 in)	Replace if less than specified limit
0.05 mm (0.0020 in)	Replace if more than specified limit
Wear, Damage, Elongation	Replace depending on the condition.
29.04 mm (1.1433 in)	Replace if out of specified range
0.36 mm (0.0142 in)	Replace if out of specified range
9.96 mm (0.3921 in)	Replace if out of specified range
0.11 mm (0.0043 in) (including wear of oil pump cover)	Replace if out of specified range
0.16 mm (0.0063 in)	Replace if out of specified range
Parts that are worn out or damaged	Replace with new part
-	Replace if out of standard value
Parts that are worn out or damaged	Replace with new part
Parts that have deteriorated and parts where fuel has gotten inside	Replace with new part

	Description	Item	Standard Value
Electrical Parts	Spark Plug	Plug Type	DCPR6E (NGK)
		Spark Gap	0.8 – 0.9 mm (0.0315 – 00354 in)
	Ignition Coil	Primary Coil Resistance	0.30 Ω ± 15% (20°C)
		Secondary Coil Resistance	8.5 kΩ ± 20% (20°C)
	Magneto (Alternator)	Alternator (MAX)	12 V–84 W
		Power Generation Performance	1000 r/min, 14 V, 2 A or more
			5500 r/min, 14 V, 6 A or more
		Charge Coil Resistance (Between W-W-W Lines)	0.57 Ω ± 20% (20°C)
	Fuel Injector	Measuring the Resistance Between Terminals	11.50 - 12.5 Ω (20°C)
		Operating Check	-
	F.F.P.	Wear and damage of seals and grommets	-
		Operating Check	-
	Crank Position Sensor	Clearance with Encoder Ring (Flywheel)	0.8 mm (0.0315 in) ± 0.2 mm (0.0079 in)
		Pulser Coil Resistance (Between Terminals)	148 – 222 Ω
	T.P.S	Measuring the Resistance Between Terminals * Terminal layout diagram attached	5 kΩ ± 30%
	ISC Valve	Measuring the Resistance Between Terminals * Terminal layout diagram attached	24 ± 3 Ω (20°C)
	Engine Temperature Sensor	Measuring the Resistance Between Terminals * Terminal layout diagram attached	4.24 – 4.86 kΩ (4 – 6°C)
			1.90 – 2.10 kΩ (24 – 26°C)
	T- MAP Sensor	Measuring the Resistance Between Terminals * Terminal layout diagram attached	6.0 ± 0.6 kΩ (0°C)
			0.282 – 0.388 kΩ (80°C)
	Rectifier	Measuring the Resistance Between Terminals * Terminal layout diagram attached	Refer to the tester check table
	Starter Motor	Output	12 V 0.5 kW
		Brush Length	6.9 – 7.1 mm (0.272 – 0.280 in)
		Commutator Undercut	1.1 mm (0.043 in)
		Commutator Outer Diameter	19.9 – 20 mm (0.783 – 0.787 in)
	Starter Solenoid	Rated Voltage	12 V (DC)
		Excitation Current	4 A or less
		Exciter Coil Resistance	4.4 Ω ± 10% (20°C)
	Fuse	Capacity	20 A x 1
Cooling System Parts	Thermostat	Valve Operation Starting Temperature (Submerged)	60±2°C
		Valve Full Open Temperature (Submerged)	75°C
		Valve Full Open Lift (Submerged)	3 mm (0.1181 in) or more
	Pump Impeller	Wear, Crack	-
	Pump Case Liner	Wear	-
	Guide Plate	Wear	-
Lower Parts	Propeller Shaft	Bearing Wear and Damage	-
		Oil Seal Wear and Damage	-
		Center Deflection	-
	Bevel Gear	Forward Gear - Pinion Backlash (between A and B Gears)	0.05 – 0.15 mm (0.0020 – 0.0060 in)
		Dial Gauge Read Value	0.14 – 0.42 mm (0.0055 – 0.0165 in)
		Reverse Gear (C Gear) Washer Thickness	1.90 mm (0.0748 in)
	Drive Shaft	Spline (Upper) Base Tangent Length, 2 Gears	5.108 – 5.140 mm (0.2011 – 0.2024 in)
		Bearing Wear and Damage	-
		Oil Seal Wear and Damage	-
		Center Deflection	0.2 mm (0.0079 in)
	Propeller	Wear, Bend, Crack, Break	-

Functional Limit	Action To Be Taken
-	Clean and remove the carbon stains or damage Replace if the electrode is worn out significantly
Spark gap 1.2 mm (0.0472 in)	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	-
-	-
-	-
-	Replace if out of standard value
-	Replace with new part
Parts that do not make a "clicking" sound when a voltage of 12 V is applied on the terminals	
Parts that are worn out or damaged	Replace with new part
Checking the operation sound or the valve in the fuel rail section	
-	Re-adjust if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	Replace if out of standard value
-	-
4.5 mm (0.177 in)	Replace if less than specified limit
-	Replace if out of standard value
19.8 mm (0.780 in)	Replace if less than specified limit
-	Replace if out of standard value
-	
-	
Burn out	Replace with new part after eliminating the cause of the disconnection
Any opening under ambient temperature	Replace if out of specified range
Less than 3 mm (0.1181 in)	Replace if less than specified limit
Wear, crack or damage on tips and upper and lower surface lips	Replace pump case liner and guide plate as a set.
-	Replace if severely worn
-	Replace if severely worn
-	Replace depending on the condition.
-	Replace depending on the condition.
0.05 mm (0.0020 in)	Replace if more than specified limit
0.30 mm (0.0118 in)	Adjust to specified range
0.84 mm (0.0331 in)	Adjust to specified range
1.75 mm (0.0689 in)	Replace if less than specified limit
4.680 mm (0.1843 in) or less	Replace depending on the condition.
-	Replace depending on the condition.
-	Replace depending on the condition.
0.21 mm (0.0083 in)	Replace if more than specified limit
-	Replace depending on the condition.

	Description	Item	Standard Value
Other	**Oil Seal Parts**	Wear, Damage	-
	Anodes	Wear Exhaust cover: 1 piece Gear case (trim tab): 1 piece Gear case: 1 piece (MFS9.9CX only) Lower mount bracket: 1 piece (MFS9.9CX only) Clamp bracket: 2 pieces (PTT model only)	-

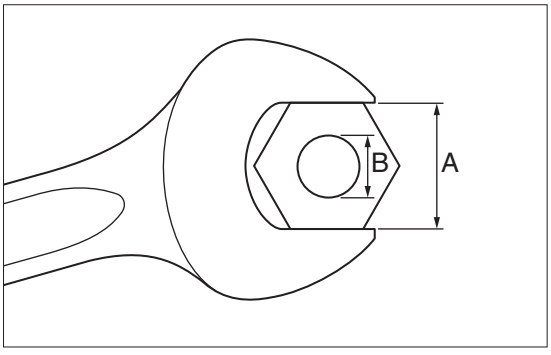
Functional Limit	Action To Be Taken
When the lips are deteriorated, degraded or damaged, or when the tightening margin is reduced to 0.5 mm (0.0197 in) due to wear	Replace with new part
-	Replace if severely worn out

7. Tightening Torque Data

	Fastened Components	Wrench A	Screw B x Pitch	Type of Fastener	Tightening Torque		
					N·m	lb·ft	kgf·m
Engine	Cylinder Head Installation Bolt (Cylinder Block and Cylinder Head)	12	M8x1.25	Bolt	First Tightening Torque		
					10	7	1.0
					Second Tightening Torque		
					30	22	3.0
		10	M6x1.0	Bolt	First Tightening Torque		
					6	4.4	0.6
					Second Tightening Torque		
					10	7	1.0
	Crankcase Mounting Bolt (Cylinder Block to Crankcase)	12	M8x1.25	Bolt	First Tightening Torque		
					10	7	1.0
					Second Tightening Torque		
					23.5	17	2.35
	Anode Plug	10	M16x1.5	Special	18	13	1.8
	Connecting Rod Bolt	10	M6x1.0	Bolt	First Tightening Torque		
					6	4.4	0.6
					Second Tightening Torque		
					12	9	1.2
	Tappet Adjustment Nut	10	M6x0.75	Nut	7	5	0.7
	Flywheel Nut	18	M12x1.25	Nut	58	43	5.8
	Drive (Timing) Pulley	46	M30×1.5	Nut	64	47	6.5
	Driven (Camshaft) Pulley	10	M6x1.0	Pre-coated Bolt	11	8	1.1
	Oil Pump	10	M6x1.0	Bolt	6	4.4	0.6
	Engine TEMP Sensor		M8x1.25	Bolt	4	3	0.4
	Oil Pressure Switch	-	PT 1/8	-	8	6	0.8
	Plunger Assembly	24	M16x1.5	-	30	22	3.0
	Spark Plug	18	M12x1.25	-	18	13	1.8
	Power Unit Installation Bolt	12	M8x1.25	Bolt	First Tightening Torque		
					15	11	1.5
					Second Tightening Torque		
					30	22	3.0
Bottom Cowl	Main Switch	22	M16x1.5	Nut	3.5	2.5	0.35
	Lanyard Stop Switch	22	M16x1.5	Nylon Nut	3.5	2.5	0.35
	Neutral Switch	19	M12x1.25	Nut	2.7	2	0.27
Bracket Drive Shaft Housing	Bracket Bolt Nut (MF/EF)	13	M8x1.25	Nylon Nut	14	10	1.4
	Bracket Bolt Nut (EP/EFT/EPT)	-	7/8-14UNF	Nylon Nut	25	18	2.5
	Mount Rubber (Upper) Installation Bolt	10	M6x1.0	Bolt	9	7	0.9
	Steering Bracket	-	M8x1.25	Studs Bolt	14	10	1.4
	Tiller Handle Mounting Nut	10	M6x1.0	Nut	8	6	0.8
	Damper (Upper) Mounting Nut	13	M8x1.25	Nut	13	10	1.3
	Grease Nipple (Swivel Bracket)	10	M6x1.0	-	3	2.2	0.3
	Engine Oil Drain Bolt	16	M14-1.5	Bolt	23.5	17	2.4

	Fastened Components	Wrench A	Screw B x Pitch	Type of Fastener	Tightening Torque		
					N·m	lb·ft	kgf·m
PT Unit	Tilt Cylinder Pin (Upper) Mounting Bolt	10	M6x1.0	Bolt	13	10	1.3
	Tilt Cylinder (Lower) Mounting Bolt	13	M8x1.25	Bolt	13	10	1.3
	Retaining Screw	13	M8x1.25	Bolt	13	10	1.3
	Pump Mounting Screw	-	-	Bolt	5	3.7	0.5
	Motor Assy Mounting Bolt	-	-	Bolt	5	3.7	0.5
	Reserve Tank Cap	17	-	Bolt	2	1.5	0.2
	Manual Valve	-	-	-	2	1.5	0.2
Lower Unit	Gear Case Bolt	10	M6x1.0	Bolt	11.5	8.5	1.2
	Extension Housing Mounting Bolt	10	M6x1.0	Bolt	11.5	8.5	1.2
	Propeller Nut	17	M10x1.25	Nut	12	9	1.2
	Oil Plug	-	M8x1.25	Cross-head screw	4	3	0.4
	Water Plug	-	M8x1.25	Cross-head screw	4	3	0.4

	Fastened Components	Wrench A	Screw B x Pitch	Type of Fastener	Tightening Torque		
					N·m	lb·ft	kgf·m
Standard Tightening Torque	M4	-	M4x0.7	Bolt, Nut	1.5	1.1	0.15
	M5	8	M5x0.8	Bolt, Nut	3	2.2	0.3
	M6	10	M6x1.0	Bolt, Nut	6	4.4	0.6
	M8	13	M8x1.25	Bolt, Nut	13	10	1.3
	M10	17	M10x1.25	Bolt, Nut	27	20	2.7
	M4	-	M4x0.7	Screw	1.5	1.1	0.15
	M5	-	M5x0.8	Screw	2.5	1.8	0.25
	M6	-	M6x1.0	Screw	3.5	2.5	0.35
	M8	-	M8x1.25	Screw	4.5	3.3	0.5



8. Sealant Application Locations

Location of Use		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Gasket sealing agent	Instant Glue	Bond	
		Loctite	ThreeBond			Loctite	ThreeBond		
		263	1342	1327	1373B	5910	7781	1521	1530D
Cylinder Head	Cam Shaft								
	Oil Seal (Cam Shaft)								
	Rocker Arm								
	Rocker Arm Shaft								
	Rocker Arm Spring								
	Washer (Rocker Arm)								
	Valve (IN, EX)								
	Valve Spring								
	Valve Spring Seat								
	Retainer · Cotter								
	Valve Stem Seal (IN, EX)								
	Tappet Adjustment Screw								
	Oil Pump								
	Head Bolt								
	Washer (Under Head Bolt)								
Cylinder Head Cover	Screw (Breather Chamber Cover)		●						
	Fuel Pump								
	O-Ring (Fuel Pump)								
	O-Ring (Filler Cap)								
Cylinder Block Crankcase	Cylinder Liner								
	Piston								
	Piston Ring								
	Piston Pin								
	Connecting Rod								
	Connecting Rod Bolt								
	Crankshaft								
	Crankshaft Metal Bearing								
	Oil Seal (Crankshaft Upper, Lower)								
	Cylinder Block, Crankcase Mating Surface					●			
	Plunger Assembly								
	O-ring (Oil Level Gauge Guide)								
Exhaust Cover	O-Ring (Anode Plug)								
	Screw (Anode Plug)		●						
Fuel Rail	Nipple	●							
	Valve Assy	●							
	Seal Ring								

Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicon Grease		4 st Engine Oil	Tohatsu Genuine Gear Oil	Automatic transmission fluid	Hose insertion lubricant	Remarks
			Shinetsu Silicone	KS-64			DEXRON-III		
					●				Bearing, Cam Unit
●									Lip
					●				Outer Surface, Press Fit
					●				Bearing, Slipper Face
					●				Outer Face
					●				Entire Surface
					●				Entire Surface
					●				Shaft, Stem Head
					●				Entire Surface
					●				Entire Surface
					●				Entire Surface
					●				Lip and Inside
					●				Entire Surface
					●				Approx. 2 cc from bearing & intake port (cannot be disassembled)
					●				Thread, Seat Surface
					●				Both Faces
									Thread
					●				Plunger Tip
					●				Entire Surface
					●				Entire Surface
					●				Inner Wall
					●				Ring Grooves, Outer Face
					●				Entire Surface
					●				Outer Face
					●				Big and Small End Inner Diameter
					●				Thread, Seat Surface
					●				Sliding Surface
					●				Both Faces
●									Lip
									Mating Surface
					●				Internal (approx. 1cc injection, cannot be disassembled)
					●				
	●								Entire Surface
									Thread
									Thread
									Thread
					●				Entire Surface

Location of Use		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Gasket sealing agent	Instant Glue	Bond	
		Loctite	ThreeBond			Loctite	ThreeBond		
		263	1342	1327	1373B	5910	7781	1521	1530D
Fuel Rail	O-ring (Fuel Injector Assy)								
	Bolt (Fuel Rail Installation)		●						
	High-Pressure Fuel Hose								
Intake Silencer	Hose (to ISC valve)								
	Breather Hose (to Cylinder Head Cover)								
VST Front Assembly	Rubber Mount								
	Collar								
Recoil Starter	Starter Case								
	Starter Spring								
	Ratchet								
	Friction Plate								
	Reel								
	Starter Seal							●	
Electrical Parts	Oil Pressure Switch			●					
Shift Throttle	Collar (Steering Shaft Arm)								
	Washer (Steering Shaft Arm)								
	Wave Washer (Steering Shaft Arm)								
	Shift Lever Shaft (Bottom Cowl)								
	Shift Arm (Remote Control Model)								
	Shift Lever (Remote Control Model)								
	Pivot (Shift Arm)								
	Hook Lever Bushing (Pivot)								
	Shift Rod Lever (Shift Lever Shaft)								
	Lever (Shift Lever Shaft)								
	Screw (Shift Lever Shaft)		●						
	Grommet (Shift Lever Rod Mounting Area)								
	Collar (Throttle Drum Assy)								
Engine Short Block	Bolt (Power Unit Mounting)								
Drive Shaft Housing	Oil Seal								
Drive Shaft Housing	Oil Seal								
	Drive Shaft Guide								
	Water Pipe Seal (Upper)								
	Sealing Plug 8-4		●						
	Bolt (Idle Port Cover)		●						
	Nipple (Cooling Water Inlet)	●							

Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicon Grease	4 st Engine Oil	Tohatsu Genuine Gear Oil	Automatic transmission fluid	Hose insertion lubricant	Remarks
			Shinetsu Silicone KS-64			DEXRON-III		
				●				Entire Surface
								Thread
							●	Can be applied to the end of the hose when inserting into the nipple
							●	Can be applied to the end of the hose when inserting into the silencer
							●	Can be applied to the end of the hose when inserting into the silencer
	●							Concaved part
	●							Outer Tube
●								Sliding Face
●								Entire Surface
●								Sliding Face
●								Sliding Face
●								Sliding Face
								During application
								Threaded Section
			●					Terminals
●								Outer Face
●								Entire Surface
●								Entire Surface
●								Inner Circumference of Resin Part
●								Cylindrical Section
●								Cylindrical Section (Shift Lever Rod Mounting Area)
●								Tip Cylindrical Section
●								Inner Face/Outer Face
●								Sliding Part, Teeth Shaped Part
●								Sliding Part, Side Protrusion (only for models using neutral switch)
								Thread
	●							Lip
●								Outer Face
	●							Thread
		●						After lip & drive shaft assembly, 3 g on oil seal
				●				Outer Surface, Press Fit
				●				Outer Surface, Press Fit
				●				Outer Face
								Cooling Water Passage (2 locations)
								Thread
								Outer Surface, Press Fit

Location of Use		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Gasket sealing agent	Instant Glue	Bond	
		Loctite	ThreeBond			Loctite	ThreeBond		
		263	1342	1327	1373B	5910	7781	1521	1530D
Drive Shaft	Drive Shaft (Spline)								
	Ball Bearing								
	Needle Bearing Inner								
Gear Case	Oil Seal (Lower Pump Case)								
	Pump Case Liner								
	Water Pipe Seal (Lower)								
	O-Ring (Cam Rod Bushing Inner Side)								
	O-Ring (Cam Rod Bushing Outer Side)								
	Bolt (Pump Case)								
	Ball Bearing								
	Needle Bearing								
Propeller Shaft	Propeller Shaft								
	Push Rod								
	Spring Retainer								
Propeller Shaft Housing	Bolt (Propeller Shaft Housing)		●						
	O-ring								
	Oil Seal								
	Ball Bearing								
Bracket	Upper Mount Rubber Installation Bolt		●						
	Clamp Screw								
	Swivel Bracket (Steering Shaft)								
	Swivel Bracket (Bracket Bolt)								
	Swivel Bracket (Tilt Stopper Mounting Area)								
	O-Ring (Steering Shaft)								
	Bushing (Steering Shaft)								
	Friction Piece Adjustment Bolt								
	Co-Pilot Bolt								
	Bolt/PT (Co-Pilot Plate)	●							
	Clamp Bracket								
	Nut 7/8 (Bracket Bolt)		●						
	Swivel Bracket Shaft (Carrying Handle)								
	Bolt (Steering Plate)		●						
	Cylinder Pin/PT (Upper, Lower)								
	Bushing/PT (Cylinder Pin Upper, Lower)								
	Tilt Stopper Grip/MF/EF/PT								●
	Tilt Stopper/PT								

Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicon Grease	4 st Engine Oil	Tohatsu Genuine Gear Oil	Automatic transmission fluid	Hose insertion lubricant	Remarks
			Shinetsu Silicone KS-64			DEXRON-III		
		●						Crankshaft Side Spline
					●			At press fitting
					●			At press fitting
●								Lip
					●			Outer Surface, Press Fit
	●							Impeller Sliding Area
	●							Inner Face
	●							Entire Surface
					●			Entire Surface
	●							Thread
					●			At press fitting
					●			At press fitting
	●							Spline Section
	●							Entire Surface
	●							Entire Surface
								Thread
					●			Entire Surface
								Lip
					●			Outer Surface, Press Fit
					●			At press fitting
								Thread
	●							Thread
	●							Apply Grease to Inside
	●							Sliding Face
	●							Sliding Face
	●							At Assembly
	●							Sliding Face
	●							Thread
	●							Embedded Side
								Thread
	●							Washer Mounting Surface, Sliding Face
								Locking Side Nut
	●							Sliding Face
								For Bolt Reuse
	●							
	●							
								Grip Mounting Area
	●							Sliding Surface (Shaft Section)

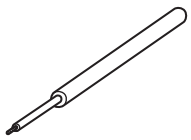
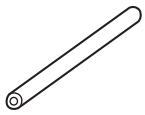
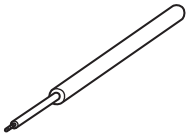
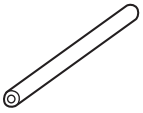
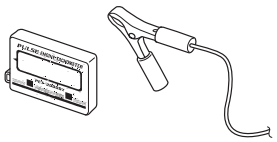
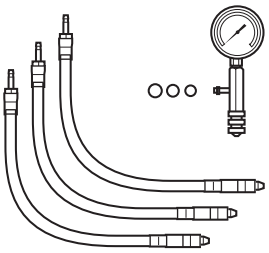
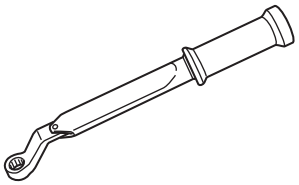
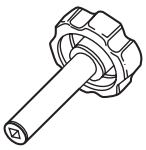
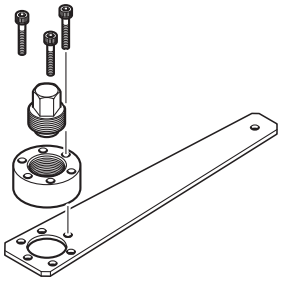
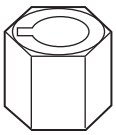
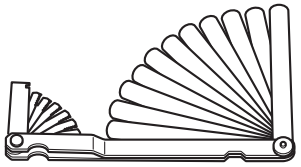
Location of Use		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Gasket sealing agent	Instant Glue	Bond	
		Loctite	ThreeBond			Loctite	ThreeBond		
		263	1342	1327	1373B	5910	7781	1521	1530D
Tiller Handle & Steering Shaft Assy	Throttle Shaft								
	Throttle Wire								
	Throttle Shaft Supporter		●						
	Stud				●				
			●						
	Steering Shaft				●				
	Tiller Handle								
	Bushing (tiller handle side)								
	Washer (tiller handle side)								
	Bushing (steering shaft arm side)								
	Grease Fitting								
Top Cowl	Top Cowl Seal						●		
Bottom Cowl	Bolt (Fuel Connector)		●						
	Bolt (fuel connector stay)		●						
	Grommet (for Tohatsu tiller model)								
Other	Nipples, Sealing Plugs		●						
	Reuse Pre-coated Bolts		●						
	PT Unit								

Cold-Resistant Lithium Grease	Water-Resistant Grease	Teflon Grease	Silicon Grease	4 st Engine Oil	Tohatsu Genuine Gear Oil	Automatic transmission fluid	Hose insertion lubricant	Remarks
			Shinetsu Silicone KS-64			DEXRON-III		
	●							Sliding Face (except slide adjustment section)
	●							Wire Section
								Thread
								Thread (tiller handle embedded side)
								Thread (nut mounting side)
								Press Fit
	●							Sliding Face
	●							Entire Surface
	●							Entire Surface
	●							Entire Surface
	●							Grease injection after completing the bracket assembly
								Rear Side Latch
								Thread
								Thread
	●							Inner Lip
								Press Fit
								Thread
						●		

3

Maintenance

1. Special Tools

			
Spring Pin Tool A (ø3.0) P/N. 345-72227-0	Spring Pin Tool B (ø3.0) P/N. 345-72228-0	Spring Pin Tool A (ø3.5) P/N. 369-72227-0	Spring Pin Tool B (ø3.5) P/N. 369-72228-0
Removing spring pin	Installing spring pin	Removing spring pin	Installing spring pin
			
Tachometer P/N. 3AC-99010-0	Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0	Valve Clearance Driver P/N. 3AC-99071-0
Measuring engine revolution speed	Measuring compression pressure	Adjusting valve clearance	Adjusting valve clearance
			
Flywheel Puller Kit P/N. 3V1-72211-1	Crank Shaft Holder P/N. 31H-72815-0	Thickness Gauge P/N. 353-72251-1	
Removing/installing flywheel	Holding crankshaft	Measuring gaps	

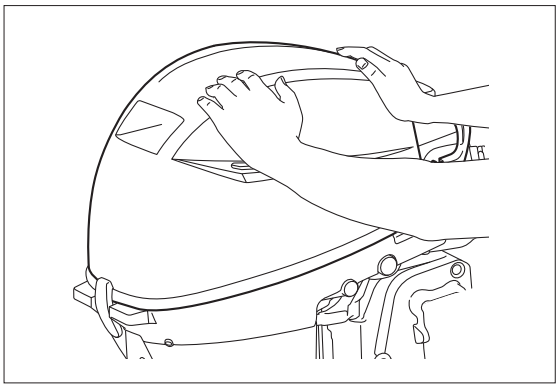
2. Inspection Schedule

	Inspection item	Inspection interval					Inspection procedure	Remarks
		First 20 hours or 1 month	Every 50 hours or 3 months	Every 100 hours or 6 months	Every 200 hours or 1 year	Every 400 hours or 2 years		
Fuel System	Fuel Filter			○			Check and Clean/ Replace if Necessary	
	Fuel Filter (Vapor Separator)					○	Check/Replace if Necessary	
	Fuel Hose	○	○				Check/Replace if Necessary	
	Fuel Tank	○	○				Check and Clean	
	Fuel Tank Cap	○	○				Check/Replace if Necessary	
	Fuel Pump					○	Check/Replace if Necessary	
	Fuel Pressure				○		Check	
	Hose	○	○				Check/Replace if Necessary	
Ignition System	Spark Plug			○			Check and Clean	Gap (0.8-0.9 mm)
	Spark Plug Cap/High Tension Cord	○		○			Check and Clean/ Replace if Necessary	
Starting System	Starter Rope	○	○				Wear/Replace if Necessary	
	Starter Motor				○		Inspect (Pinion)	
	Battery & Cable Connections	○	○				Check Battery Electrolyte Level/ Check Battery Terminal Connections	
Engine	Engine Oil	Replace		Replace			Replace	0.8 L
	Valve Clearance				○		Check/Adjust	
	Timing Belt				○		Check/Replace if Necessary	
	Thermostat				○		Check/Replace if Necessary	
Lower Unit	Propeller	○	○				Check/Replace if Necessary	
	Split Pin	○	○				Check/Replace if Necessary	
	Gear Oil	Replace	○	Replace			Check/Replace	Approx. 320 mL
	Water Strainer	○	○				Check and Clean	
	Water Pump Impeller		○		Replace		Check/Replace if Necessary	
	Water Pump Housing					○	Check/Replace if Necessary	
Shift Throttle	Throttle Cable			○			Check/Replace if Necessary	
	Shift Cable		○				Check/Replace if Necessary	
	Shift Link	○	○				Check/Adjust	
Power Tilt		○		○			Check /Replenish	
Warning System			○				Check	
Stop Switch		○	○				Check	
Meters		○	○				Check	
Bolt, Nut		○	○				Retighten	
Sliding Part/Rotation Part		○	○				Apply Grease	
Grease Nipple		○	○				Pump in Grease	
External Appearance		○	○				Check	
Anode (Engine)				○			Check/Replace if Necessary	
Anode (Lower/Bracket)			○				Check/Replace if Necessary	
Top Cowl/Latch					○		Check and Adjustment	

3. Inspection Items

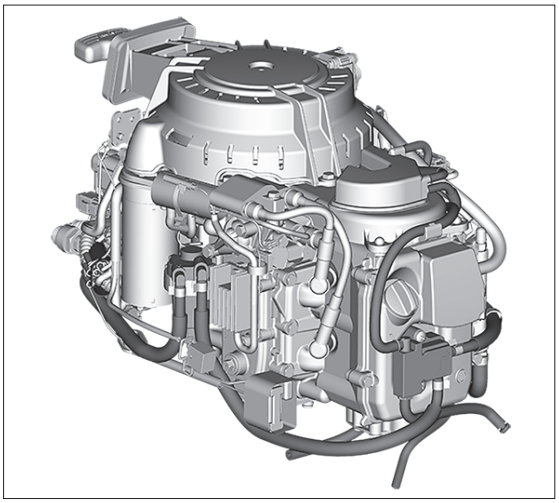
1) Inspection of Top Cowl

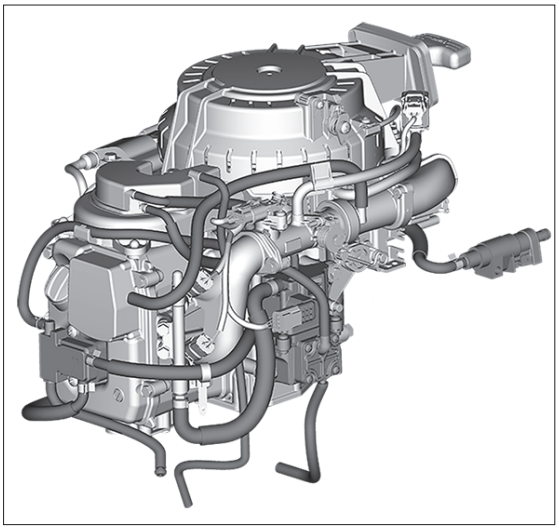
Push the top cowl with both hands to check the rattling and tightening condition.



2) Inspection of Fuel System Piping

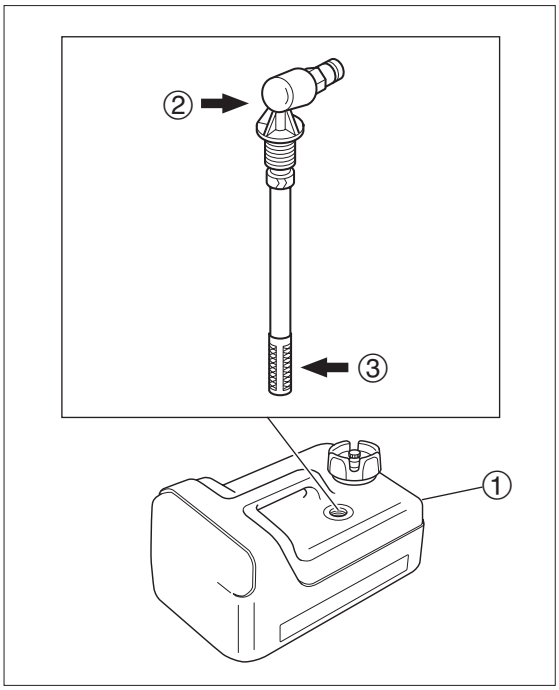
Check the fuel system piping for fuel leak, dirt, deterioration and damage, and replace or repair parts if necessary.





3) Inspection of Fuel Tank

Turn the fuel pickup elbow ② of the fuel tank ① to the left and remove it, and clean the filter ③. Remove dirt and water from the fuel tank if any.

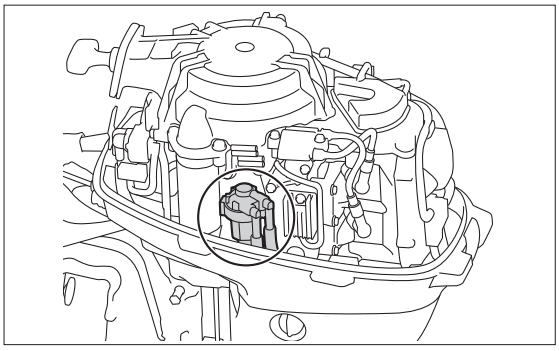


② Fuel Pickup Elbow
③ Filter

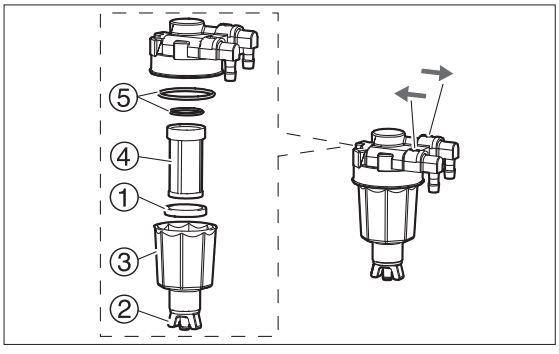
4) Inspection of Fuel Filter

⚠ CAUTION

- **If the red float ① in the fuel filter is floating, water has entered. Loosen the drain valve ② and grip the primer valve several times to drain the water.**
- **Be careful not to spill fuel when removing the cup ③.**



Check the filter ④ for any dirt or buildup of fuel varnish or debris, and the cup for any cracks or contamination by foreign matter. Wash the cup, and replace the filter if necessary.

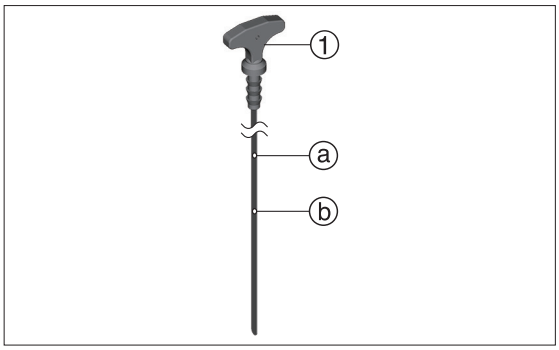


⑤ O-ring **Do not reuse.**

5) Replacement of Engine Oil

1. Oil Level

	Quantity of Oil for Full Replacement
Upper Limit	800 ml (0.8 US qt.)
Lower Limit	600 ml (0.6 US qt.)

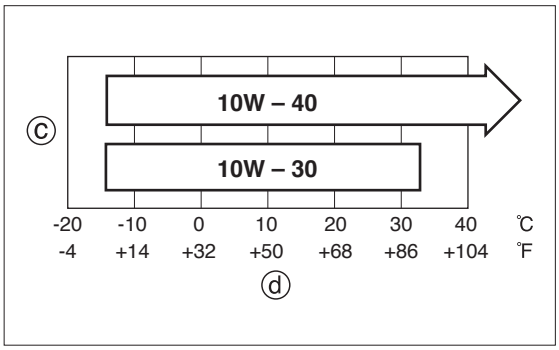


① Oil Level Gauge
ⓐ Upper Limit
ⓑ Lower Limit

2. Oil Specification

Recommended Engine Oil:
Tohatsu 4-Stroke Engine Oil
Recommended Engine Oil Grade:
API: SH, SJ, SL
SAE: 10W-30, 10W-40
Quantity of Engine Oil:
800 ml (0.8 US qt.)

Use oil with a viscosity that is suitable for the ambient air temperature of the operating region.



ⓒ Engine Oil
ⓓ Outside Air Temperature

3. Oil Replacement Procedure

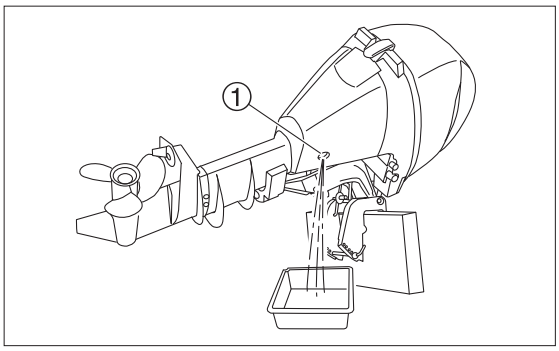
⚠ CAUTION

The engine and engine oil are hot immediately after the engine stops. Work after the engine has sufficiently cooled down.

Engine oil that is contaminated by dirt or water can significantly shorten the lives of the rotating and sliding parts of the engine.

Replacement of Engine Oil:

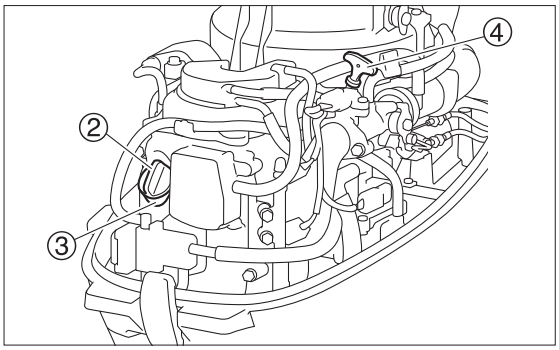
1. Stop the engine and leave it in the upright condition for 5 or more minutes.
2. Tilt up the outboard motor a little as shown.
3. Place drain oil pan below drain bolt ①.
4. Remove the engine oil drain bolt to drain away the oil.
5. Install the engine oil drain bolt and gasket.



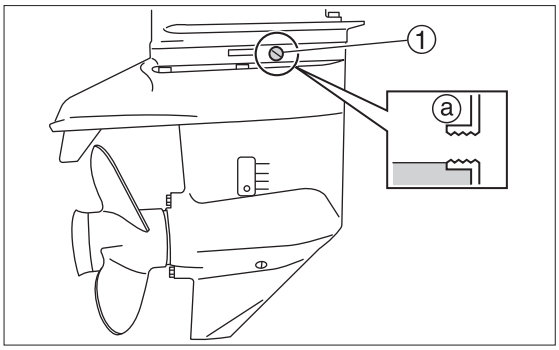
- Apply engine oil on the sealing areas of the engine oil drain bolt.
- Use a new gasket.

Engine Oil Drain Bolt:
24 N·m (18 lb·ft) [2.4 kgf·m]

6. Tilt down the outboard motor to make it vertical.
7. Pull the bottom of the cowl latch to release the lock, and lift the top cowl to remove it.
8. Remove the oil filler cap 2 and pour new engine oil into the oil inlet 3 until the oil level reaches a point somewhere between the upper and lower limit marks while checking the oil level gauge 4.
9. Tighten the oil filler cap.
10. Leave the outboard motor alone for 5 minutes before checking the oil level again.
11. Adjust the oil quantity where necessary. Return the oil level gauge to its original position and install the top cowl.
12. Start the engine and run it at idle for approx. 5 minutes, and check that there are no oil leaks or warning displays.



6) Inspection of Gear Oil Quantity



1. Tilt down the outboard motor to make it vertical.

2. Remove the upper oil plug ① and check the level of the gear oil in the gear case.

Fill with gear oil until some of the oil spills out of the plug hole ⓐ when the oil plug is removed.

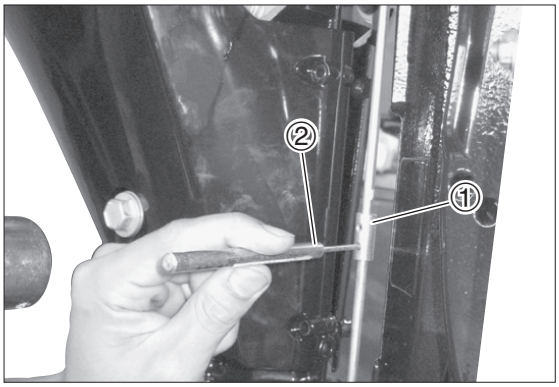
3. Replenish the gear oil to the specified level if it is insufficient.

Recommended Gear Oil:
Tohatsu Gear Oil
Recommended Gear Oil Grade:
API: GL-5 SAE: #80-90

If the shortage is large, replenish through the lower oil plug hole.

4. Install the upper oil plug.

7) Inspection of Water Pump



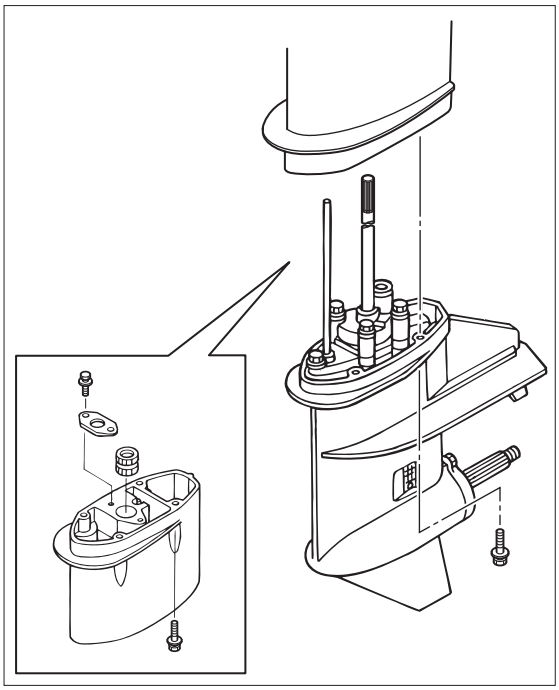
Inspection of water pump does not require removal of power unit from outboard motor body.

1. Remove the spring pin and disconnect the shift rod.
(Disconnect the shift rod at the lower side of shift rod joint ①.)

- Disconnect the shift rod at the lower side of the shift rod joint.
- Use spring pin tool A 2 to remove the spring pin.
- The spring pin cannot be reused once it is removed.

Spring Pin Tool A② (ø3.0):
P/N. 345-72227-0

2. Remove the lower unit installation bolts, and pull the lower unit downward to remove it.



3. Remove the pump upper case ③.

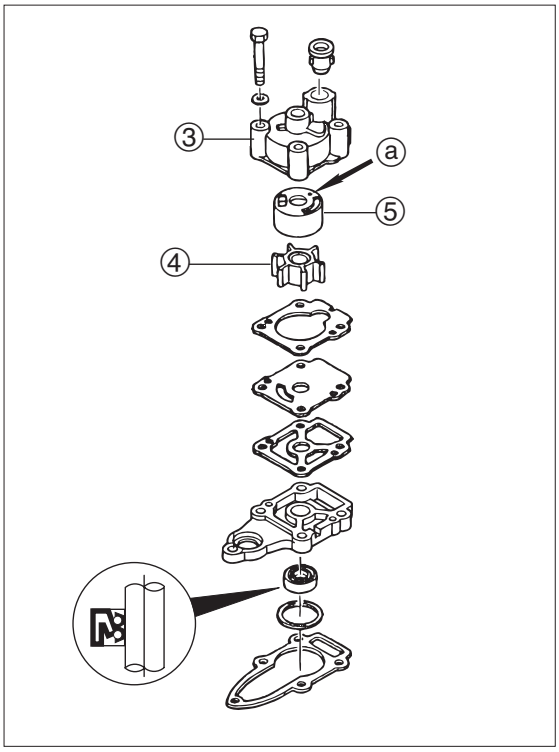
4. Remove the impeller ④ and check it.

5. Check the pump case (upper) to see if there is any deformation. Replace if necessary.

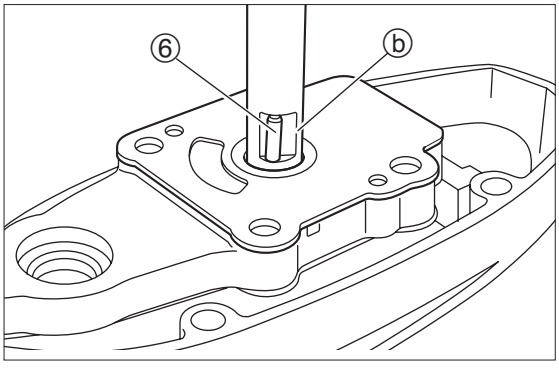
6. Check the impeller and pump case liner 5 for any cracks and wear. Replace if necessary.

7. Check the pin ⑥ and drive shaft groove ⓑ for any wear. Replace if necessary.

8. Reinstall the removed component. Refer to Chapter 6 for details.



ⓐ Hole



8) Replacement of Gear Oil

1. Tilt up the outboard motor a little as shown.

2. Place the drain oil pan below the lower oil plug ①, then first loosen the upper oil plug ② to release the internal pressure, and then tighten it again. Next, remove the lower oil plug, and then remove the upper oil plug to drain the oil.

Remove the lower oil plug first when draining.

3. Check the viscosity and the gear oil to see if there are any metal particles or discoloration (clouding). Check the lower unit internal components if necessary.

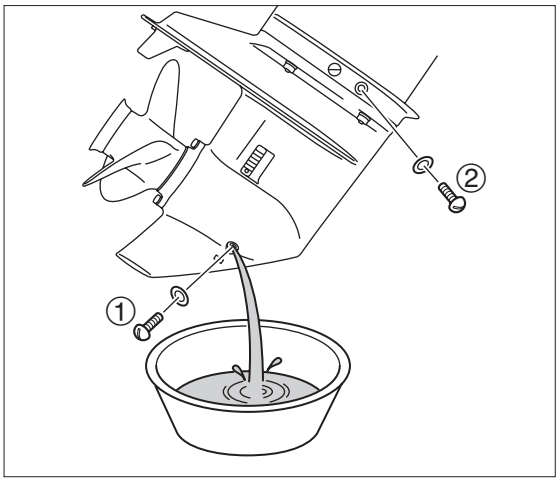
4. Tilt down the outboard motor to the vertical position, and fill with gear oil (via an oil tube or pump) through the lower plug hole ⓐ until gear oil starts to spill out from the upper oil plug hole ⓑ and no air bubbles remain.

Recommended Gear Oil:
Tohatsu Gear Oil
Recommended Gear Oil Grade:
API: GL-5 SAE: #80-90
Quantity of Gear Oil:
320 ml (11 US fl.oz)

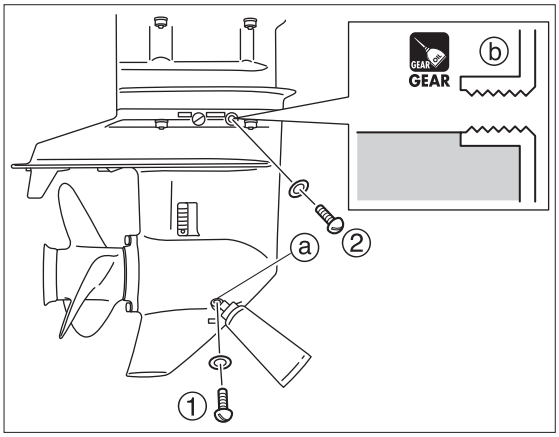
- Use the lower plug hole when filling with gear oil. The upper hole cannot be used because air cannot be purged and oil cannot be supplied.
- Be sure to tilt the outboard motor to the vertical position or otherwise the specified quantity cannot be filled.

5. Install a new gasket and upper oil plug, then install a new gasket and the lower oil plug immediately.

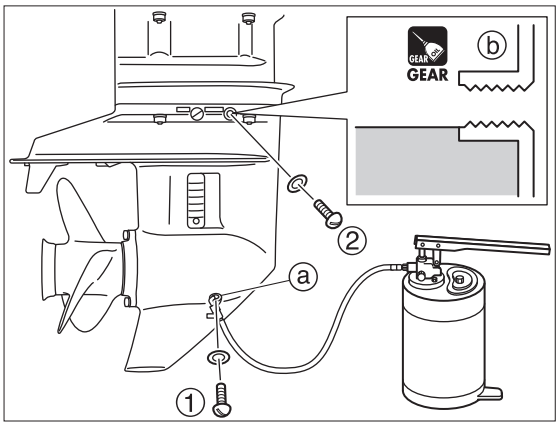
Install the upper oil plug first when refueling ends.



Gasket **Do not reuse.**



Gasket **Do not reuse.**

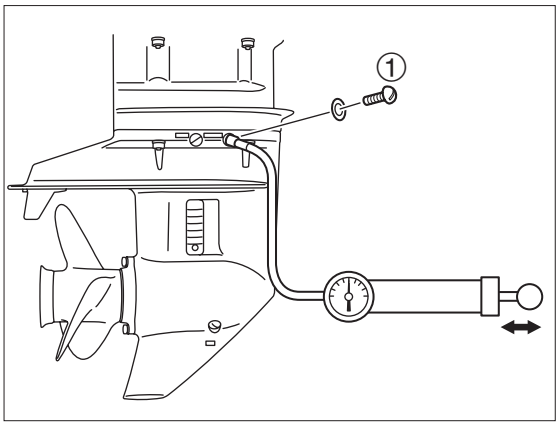


Gasket **Do not reuse.**

9) Inspection of Gear Case (for leakage)

1. Drain the gear oil.

2. Remove the upper oil plug ① and connect a commercially available leakage tester to the hole.



3. Apply the specified pressure to the gear case, and check if the pressure is maintained for 10 seconds.

⚠ CAUTION

Do not apply pressure to the gear case over the specified value.
Doing so can cause damage to the oil seal.

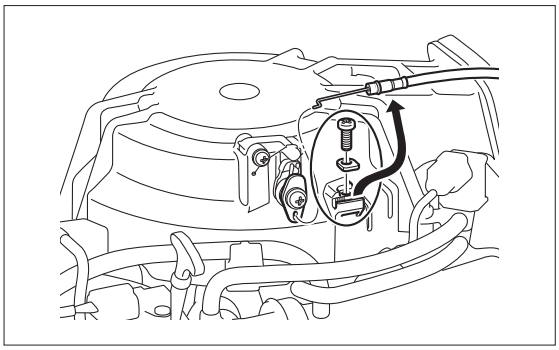
Specified Gear Case Maintained Pressure:
0.05 MPa (7 psi) [0.5 kgf/cm²]

- When the propeller shaft is rotated while maintaining the pressure, or a test is performed with the gear oil drained, it is easier to detect air leaks due to wear of the lip of the oil seal.
- Depressurize the gear case and cover the oil plug area with a piece of rag before disconnecting the leakage tester.

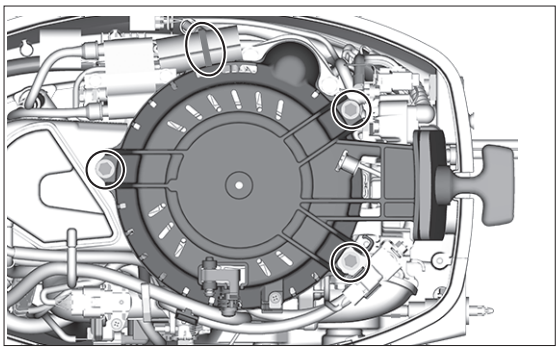
4. If the specified pressure cannot be maintained, check the oil seals of the drive shaft and propeller shaft and the O-ring of the shift shaft for any damage.

10) Inspection of Timing Belt

1. Loosen the screw and disconnect the upper starter lock cable.

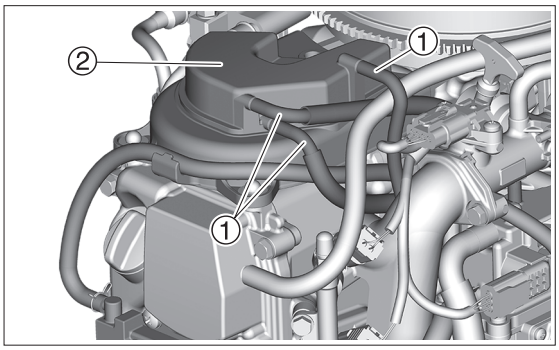


2. Remove the band and bolts (3 locations), and remove the recoil starter.



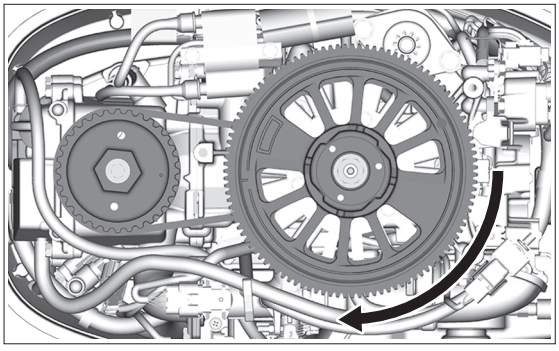
3. Disconnect the vent hose ① and remove the belt cover ②.

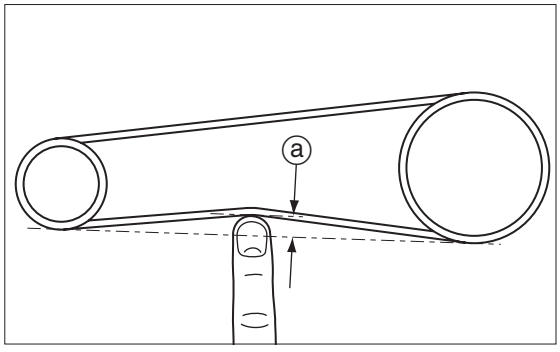
> Before removing the vent hose, mark the hose and nipple with a white pen so that the hose installation position can be identified.



4. Check the timing belt inner and outer surfaces for cracks, damage, and wear while rotating the flywheel clockwise with your hands. Replace if necessary.

Bend limit ⓐ:
Replace if timing belt deflects more than 10 mm (0.394 in).



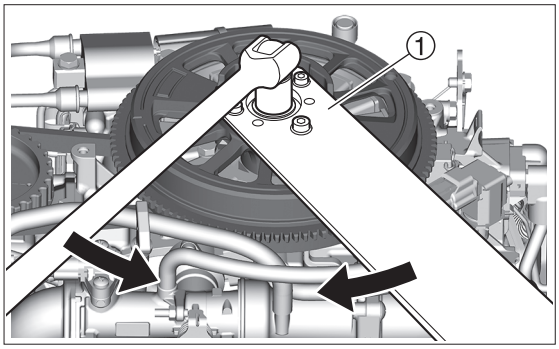


11) Replacement of Timing Belt

1. Remove the recoil starter and belt cover.

2. Using the flywheel puller kit ①, loosen the flywheel nut and remove it.

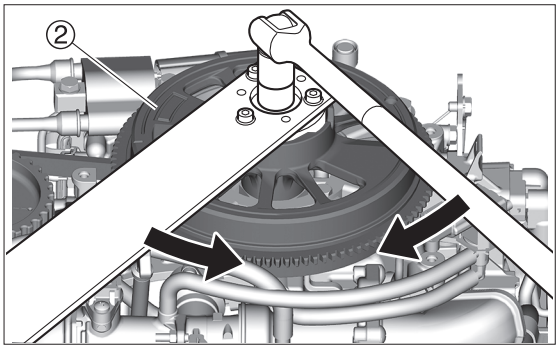
Flywheel Puller Kit :
P/N. 3V1-72211-1



3. Use the flywheel puller kit to remove the flywheel ② and key.

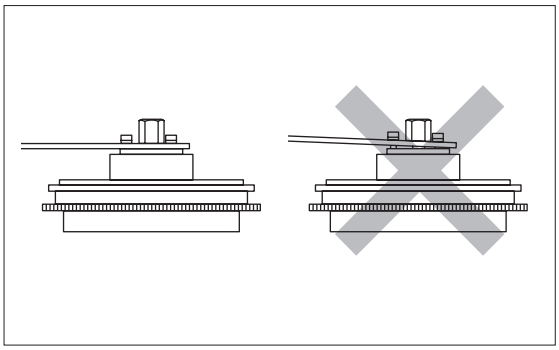
Flywheel Puller Kit :
P/N. 3V1-72211-1

Turn the puller into the end of the crankshaft until the flywheel comes out of the taper of the crankshaft.

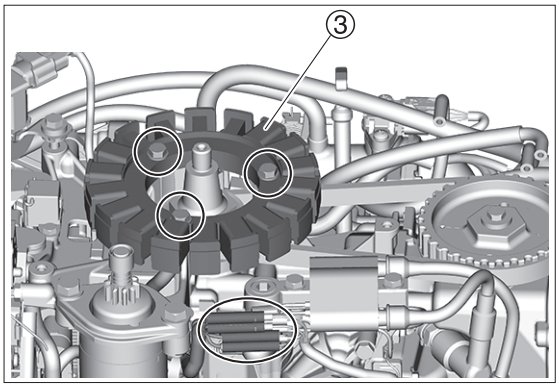


⚠ CAUTION

To prevent damages to engine and special tools, tighten flywheel puller set bolts evenly and keep flywheel puller parallel to flywheel while working.

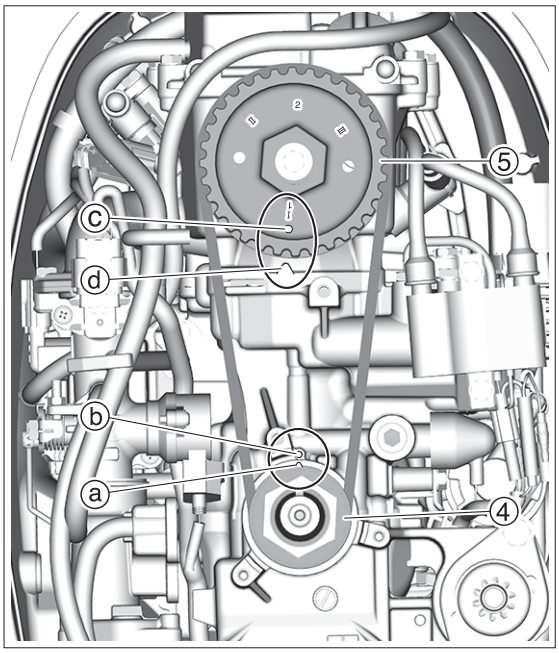


4. Disconnect the alternator connector and remove the alternator ③.



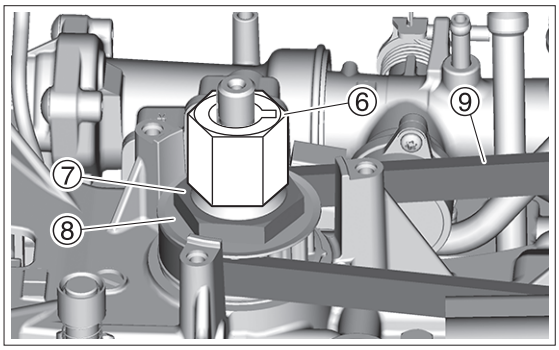
5. Turn the drive pulley④ in the clockwise direction, and align the " ● " mark ⓐ of the drive pulley with the " ▲ " mark ⓑ of the cylinder block. Check that the " ● I" mark ⓒ of the driven pulley ⑤ and the " ▲ " mark ⓓ of the cylinder head are aligned.

The No.1 cylinder should be at the top dead center of the compression stroke.



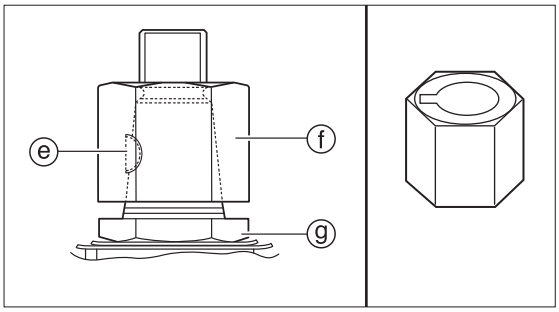
6. Install and secure the crankshaft holder ⑥ on the crankshaft.

7. Loosen drive pulley nut ⑦ and remove it.
Remove belt guide ⑧.



- Use a 32-mm socket wrench and 36-mm ring wrench for this step.
- When loosening the nut of drive pulley ⑦, be careful not to turn the driven pulley ⑤.
- Keep timing belt ⑨ engaged as a means of precaution.

Crankshaft Holder ⑥:
P/N. 31H-72815-0

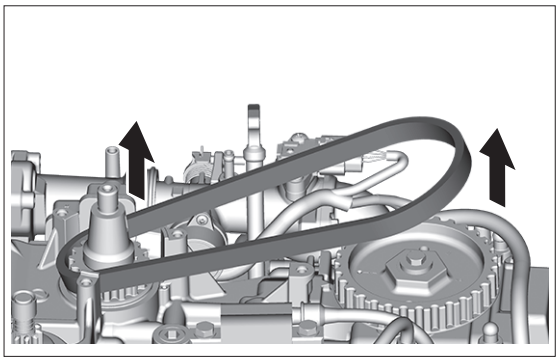


ⓔ Flywheel Key
ⓕ Crankshaft Holder
ⓖ Drive Pulley Nut

8. Remove the timing belt.

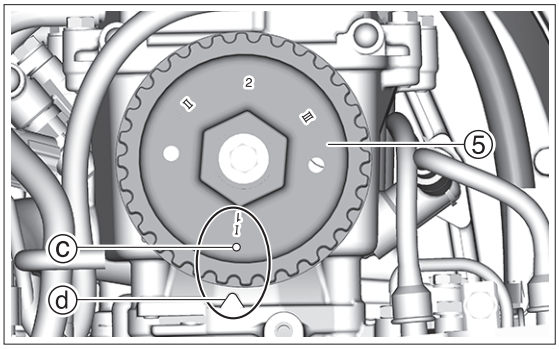
⚠ CAUTION

Do not turn the drive pulley (crank shaft) or driven pulley with the timing belt removed. Doing so can make the pistons and valves interfere with each other, possibly resulting in damage to these parts.



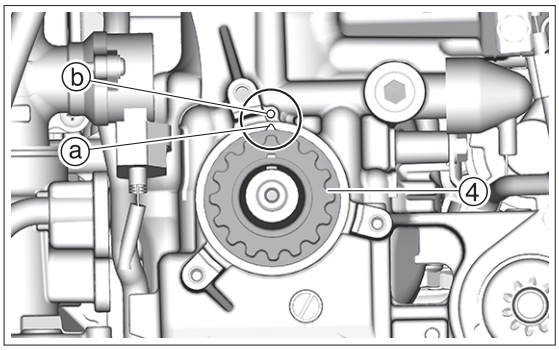
Remove the timing belt from the driven pulley side, and then remove it from the drive pulley side.

9. Check that the " ● I" mark ⓒ of the driven pulley is aligned with the " ▲ " mark ⓓ of the cylinder head.



10. Make sure that the " ▲ " mark ⓐ of the drive pulley is aligned with the " ● " mark ⓑ of the cylinder block.

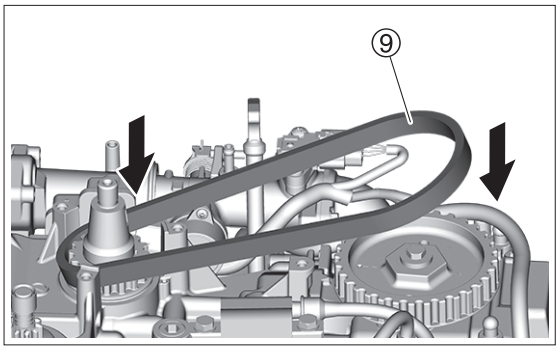
> The No.1 cylinder should be at the top dead center of the compression stroke.



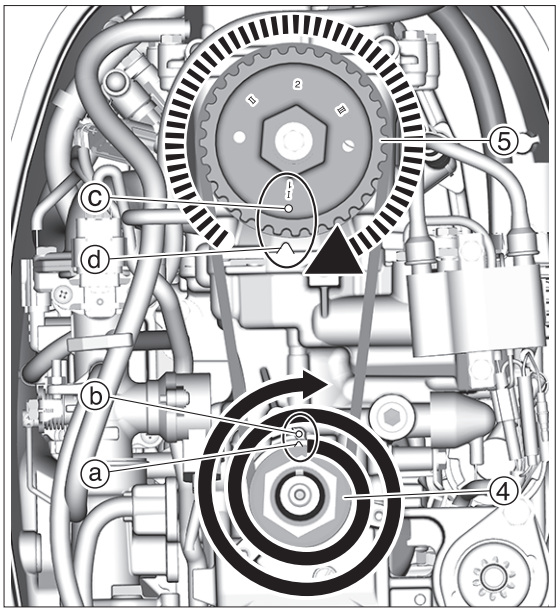
11. Attach new timing belt ⑨ to timing pulley with its part number side facing upward, and then to cam shaft pulley.

⚠ CAUTION

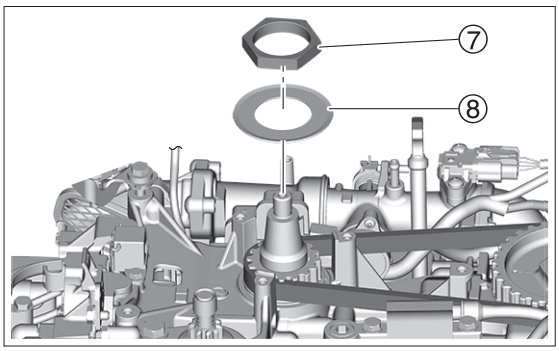
- **Be careful not to damage the timing belt when installing.**
- **Do not twist the timing belt, turn it inside out, or bend it sharply as it may be damaged.**
- **Be careful not to allow oil or grease to stain the timing belt.**



12. Rotate the driven pulley clockwise twice to seat the belt, and check that the crankshaft rotates smoothly and that the alignment marks ⓐⓑ and ⓒⓓ on each pulley match.



13. Attach belt guide ⑧ and temporarily tighten nut ⑦.

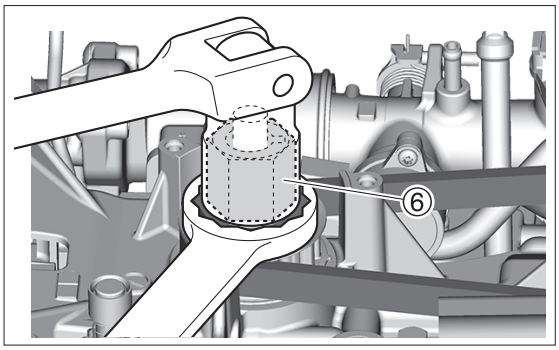


14. Tighten timing pulley nut to specified torque.

- Put pulley nut with chamfered face down.
- Use a 32-mm socket wrench and 36-mm ring wrench for this step.

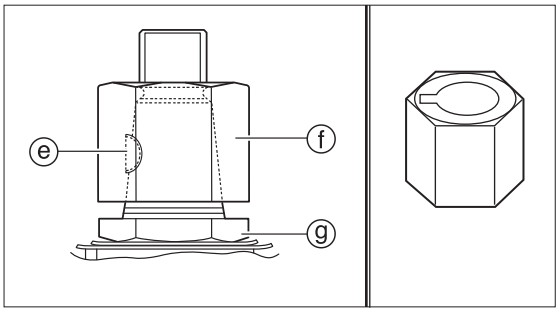
Crankshaft Holder ⑥:
P/N. 31H-72815-0

Drive Pulley Nut:
64 N·m (47 lb·ft) [6.4 kgf·m]



⑥ Crankshaft Holder

15. Install the alternator.



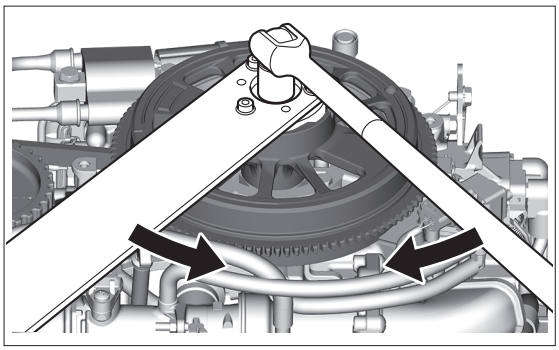
ⓔ Flywheel Key
ⓕ Crankshaft Holder
ⓖ Drive Pulley Nut

16. Secure align key slot of flywheel and crankshaft, and then install flywheel.

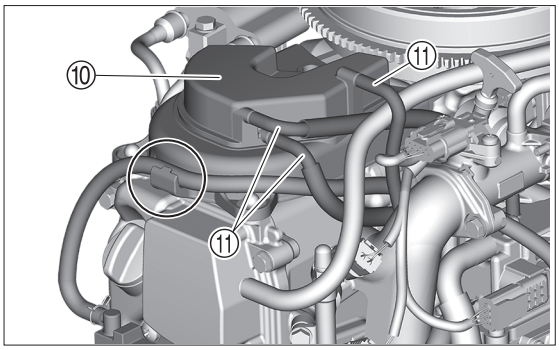
17. Tighten flywheel nut to specified torque.

Flywheel Puller Kit :
P/N. 3V1-72211-1

Flywheel Nut:
58 N · m (43 lb · ft) [5.8 kgf · m]

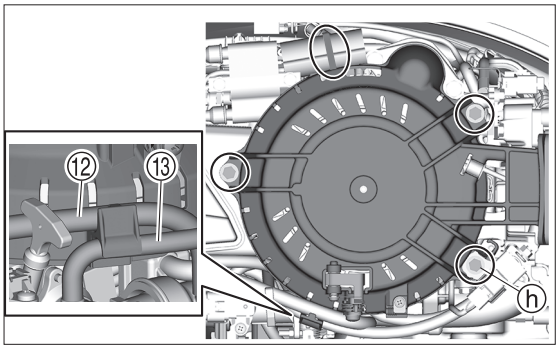


18. Install the belt cover ⑩, and connect the vent hoses ⑪.



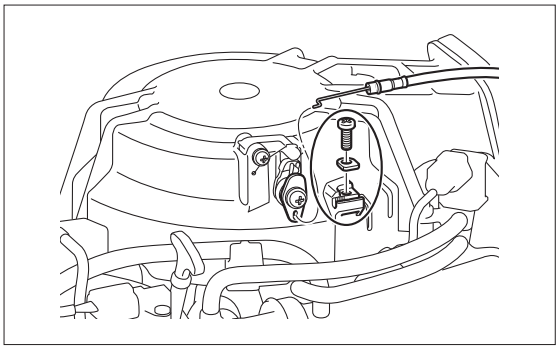
> Install the vent hoses in their original location on the belt cover.

19. Install the recoil starter, then install the bolts (3 locations) and the band.



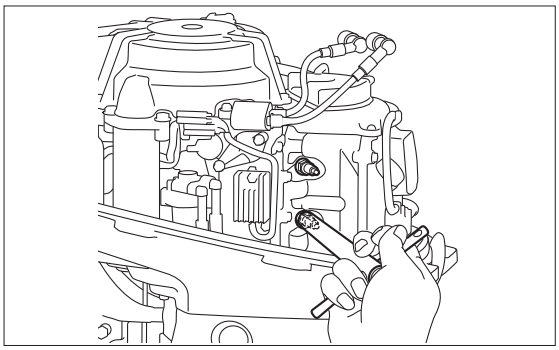
> ·At partⓗ, secure the ISC valve bracket and recoil starter with bolts.
> ·Secure the recoil starter and protector with a band.
> ·Attach breather hose ⑫ and ISC valve hose ⑬.

20. Connect the starter lock cable and tighten the screw.

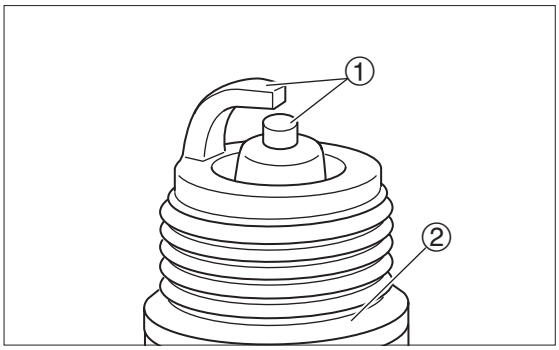


12) Inspection of Spark Plugs

1. Remove plug cap and then spark plugs.



2. Use a spark plug cleaner or wire brush to clean the spark plug electrodes ①. Replace if necessary.

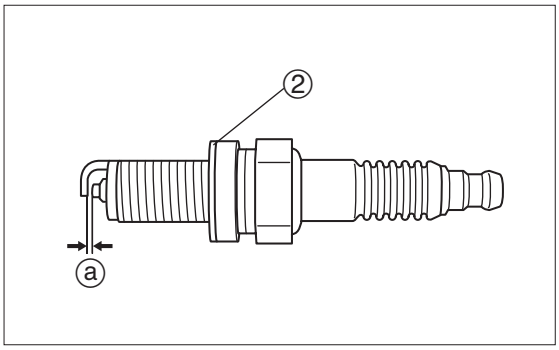


3. Check the electrode for any corrosion or excessive buildup of carbon, and the washer ② for any damage. Replace if necessary.

4. Check the gap ⓐ of the spark plug. Replace if greater than the specified value. Adjust the gap if it is less than specified value.

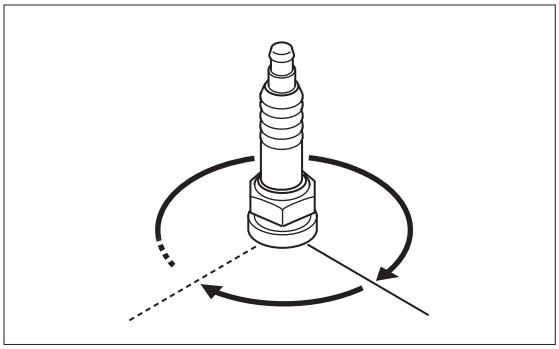
Spark Plug Gap ⓐ: Standard value
0.8 to 0.9 mm (0.031 to 0.035 in)

Functional Limit:
1.2 mm (0.047 in)



Specified Spark Plug:
DCPR6E [NGK]

5. Install the spark plug, tighten it fully by hand, then use a plug wrench to further tighten it to the specified torque.



Spark Plug:
18 N·m (13 lb·ft) [1.8 kgf·m]

13) Inspection of Compression Pressure

1. Start the engine to warm up for 5 minutes, then stop the engine.

2. Shift the gear into neutral (N).

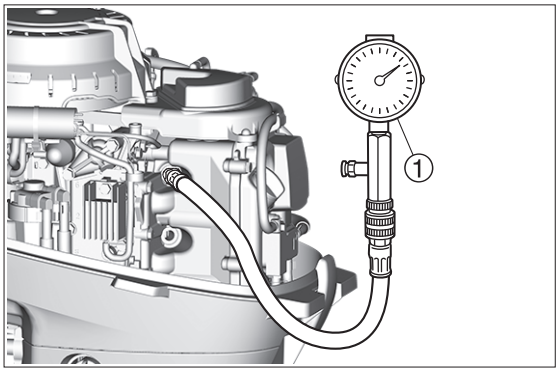
3. Remove lock plate (stop switch lanyard) from stop switch.

⚠ CAUTION
Remove lock plate (stop switch lanyard) from stop switch before measuring compression pressure. This will prevent engine malfunction.

4. Remove all plug caps and then all spark plugs.

⚠ CAUTION
Clean the areas around the spark plugs on the cylinder before removing the spark plugs to prevent dirt from entering the cylinder.

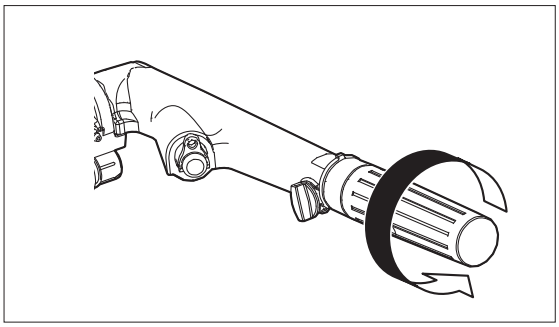
5. Install compression gauge to plug hole.



Compression Gauge ①:
P/N. 3AC-99030-0

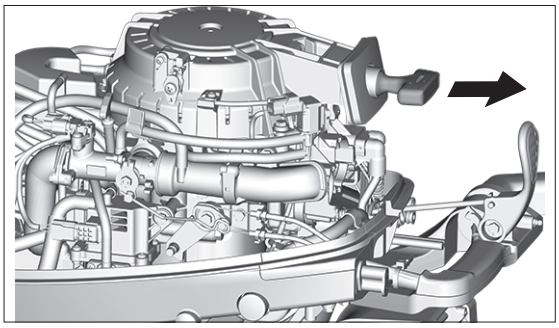
6. Fully open the throttle and crank the engine until the compression gauge indication stabilizes, then measure the compression pressure.

Compression Pressure (reference value): 500 min^{-1} (rpm)
0.88 MPa (128 psi) [9.0 kgf/cm^2]



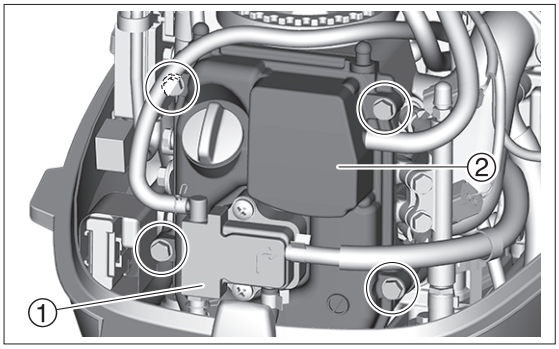
Compression pressure is affected by the cranking speed, and normally varies by about 10% to 20%.

7. If the compression pressure is below the specified value or varies among the cylinders, pour a small amount of engine oil into the cylinders and perform the compression test again.



- If the compression pressure increases after the above measure, check the pistons and piston rings of that cylinder for wear. Replace if necessary.
- If the compression pressure does not increase after the above measure, check the valve clearances, valves, valve seats, cylinder sleeves, cylinder head gasket and cylinder head. Adjust or replace if necessary.

14) Inspection and Adjustment of Valve Clearance



Perform adjustment of valve clearances when the engine is cold.

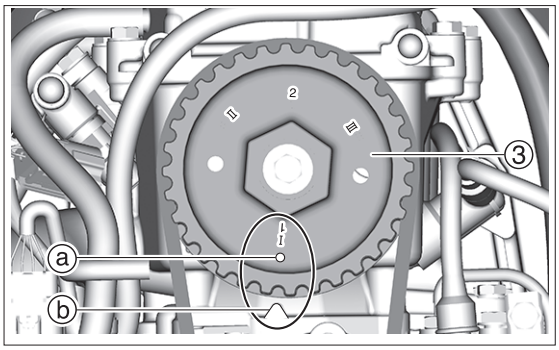
1. Disconnect the starter lock cable (top), and remove the recoil starter and belt cover.

2. Remove fuel pump ①.

3. Disconnect all plug caps and then remove all spark plugs and cylinder head cover ②.

When removing and installing the cylinder head cover, use a 10 mm ring wrench with a large offset angle (bend).

4. Turn the recoil starter slowly to align the " ● 1" mark ⓐ on driven pulley ③ with " ▲ " mark ⓑ on the cylinder head.

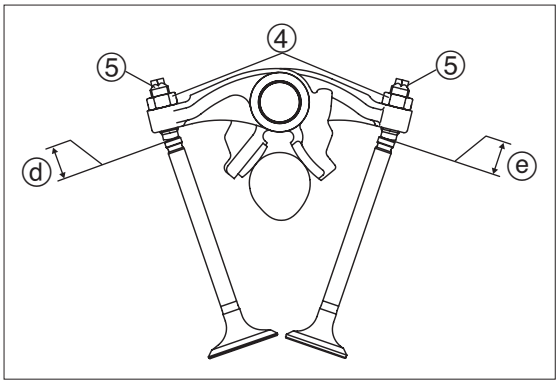


> The No.1 cylinder should be at the top dead center of the compression stroke.

5. Check No. 1 cylinder's intake and exhaust valve clearances. Adjust the gap if it is less than specified value.

Valve Clearance (when engine is cold):
0.10 – 0.15 mm (0.004 – 0.006 in)
0.20 – 0.24 mm (0.008 – 0.0095 in)

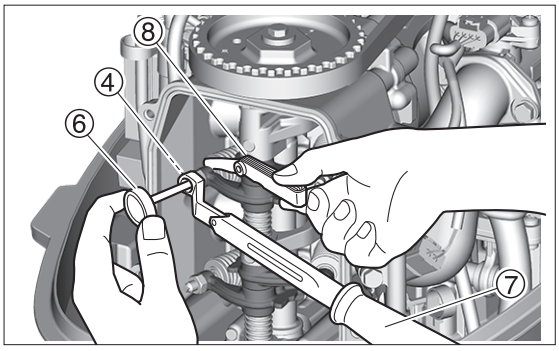
6. Loosen rocker arm lock nut ④, and turn adjustment screws ⑤ until the valve clearance is at the specified value.



- Turning the adjustment screw clockwise decreases the valve clearance.
- Turning the adjustment screws counterclockwise increases the valve clearance.

Valve Clearance Driver ⑥ :
P/N. 3AC-99071-0
Torque Wrench ⑦ :
P/N. 3AC-99070-0
Thickness Gauge ⑧ :
P/N. 353-72251-1

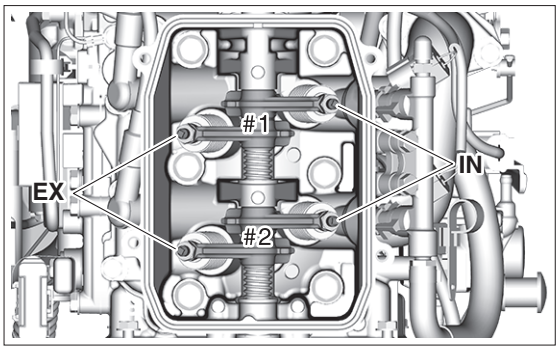
7. Tighten the lock nut on the rocker arm to the specified torque and check the valve clearance again. Perform adjustment again if necessary.



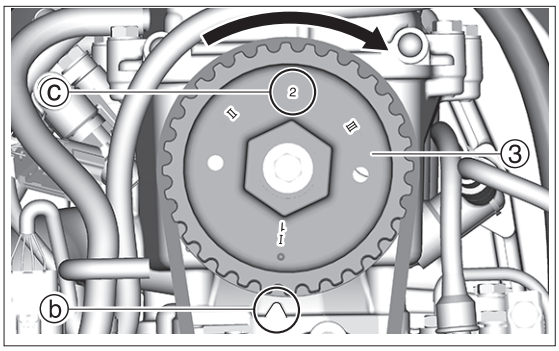
Lock Nut ④:
7 N · m (5 lb · ft) [0.7 kgf · m]

Valve Clearance (when engine is cold):
0.10 – 0.15 mm (0.004 – 0.006 in)
0.20 – 0.24 mm (0.008 – 0.0095 in)

8. Turn the flywheel in the clockwise direction to align the "2" mark ⓒof the driven pulley ③ with the " ▲ " mark ⓑ of the cylinder head.



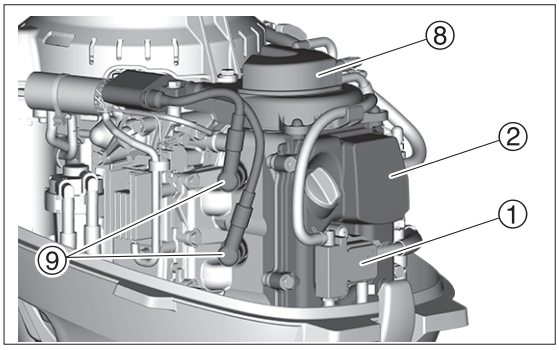
9. Check No. 2 cylinder's intake and exhaust valve clearances. Adjust the gap if it is less than specified value.



10. Connect the upper starter lock cable.

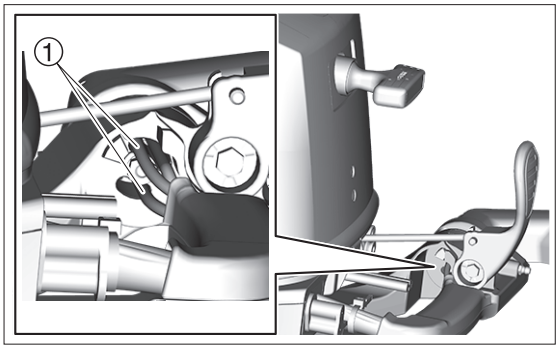
11 Install the new O-ring, cylinder head cover ②, fuel pump ①, all spark plugs and recoil starters, and belt cover ⑧.

12. Connect the plug caps ⑨.

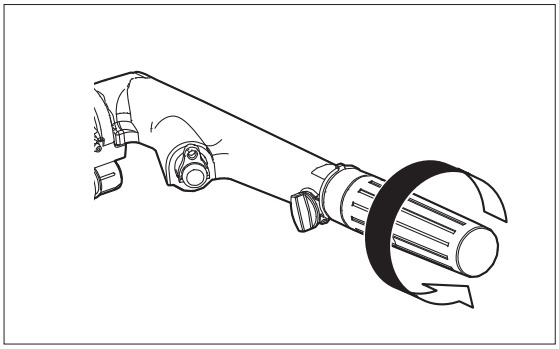


15) Adjustment of Throttle Cable (Tiller handle model)

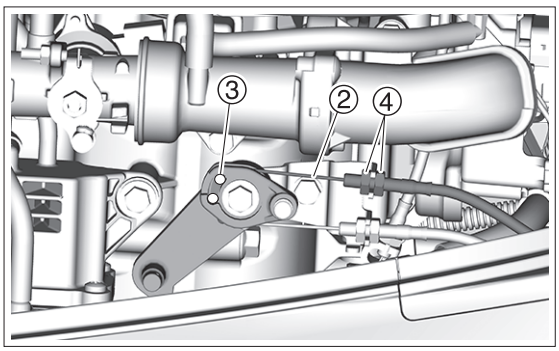
1. Firmly push outer ① of the throttle cable into the tiller handle.



2. Set the throttle grip to the fully opened position.

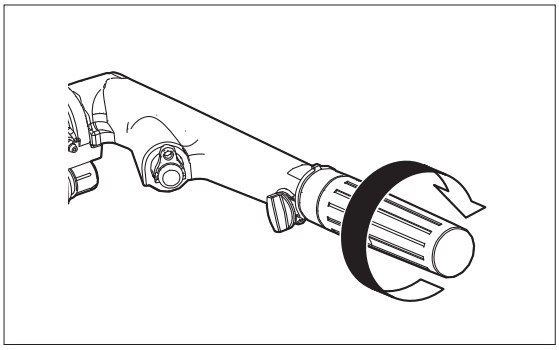


3. Insert throttle cable ②, which has a larger inner protrusion, into recess ③ on the top of the throttle drum, and secure temporarily with nut ④.

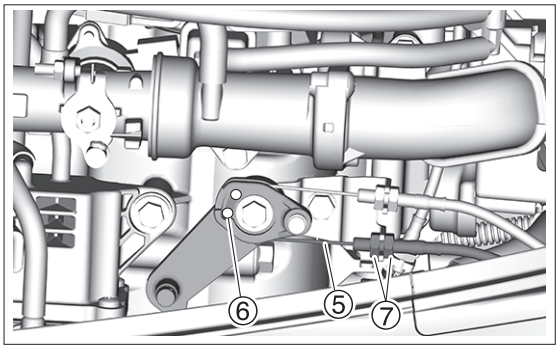


Position it at the center of the threaded section.

4. Set the throttle grip to the fully closed position.

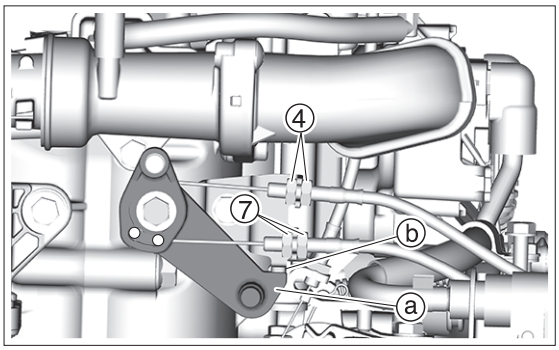


5. In the same way as in step 3., insert the other throttle cable ⑤ into recess ⑥ on the bottom of the throttle drum and secure temporarily with nut ⑦.

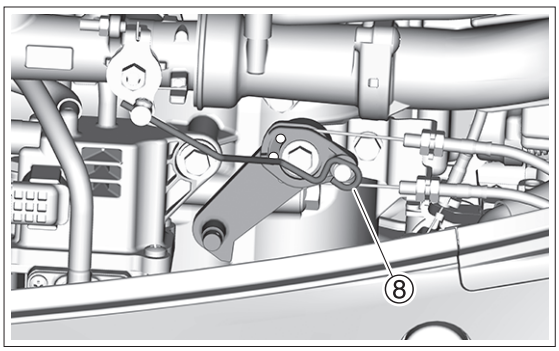


Position it at the center of the threaded section.

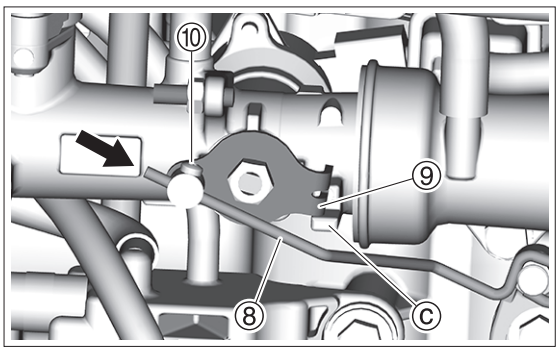
6. Adjust both throttle wires so that throttle drum arm ⓐ touches stopper ⓑ of the throttle wire bracket when the throttle is fully opened, and then tighten nut ④⑦.



7. Install throttle rod ⑧.

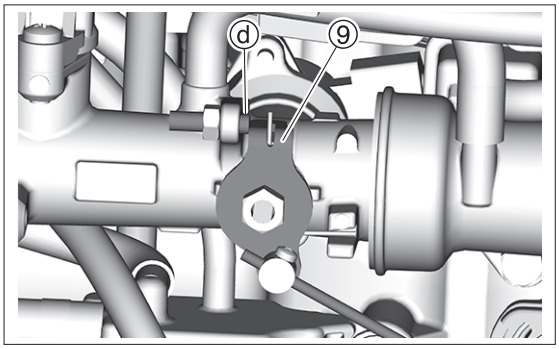


8. Fully open the throttle grip until throttle lever ⑨ on the throttle body touches fully open stopper ⓒ, then tighten screw ⑩ while pushing the end of throttle rod ⑧ in the direction of the arrow.



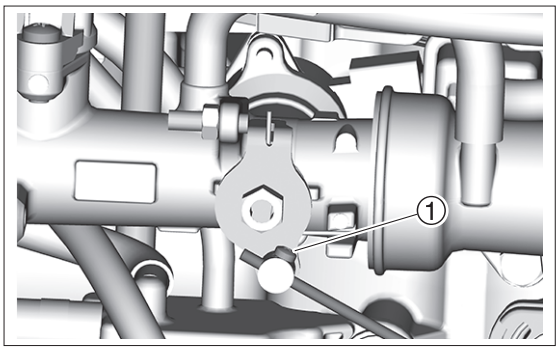
9. Set the throttle grip to the fully closed position and check that the throttle lever on the throttle body touches fully closed stopper ⓓ.

10. Alternately set the throttle grip to its fully open and fully closed positions several times to check.

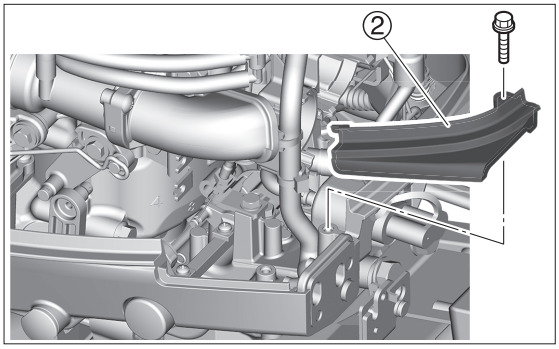


16) Adjustment of Shift/Throttle Cable (Remote Control Model)

1. Loosen stop screw ① on the throttle rod.

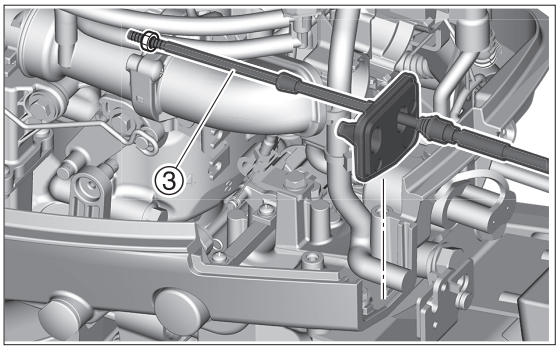


2. Remove remote control cable stay cover ②.

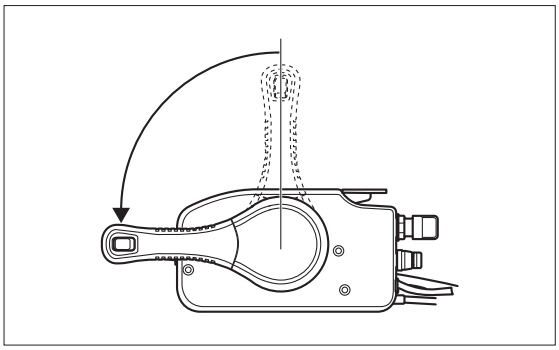


3. Run remote control cable ③ (throttle side) through the grommet.

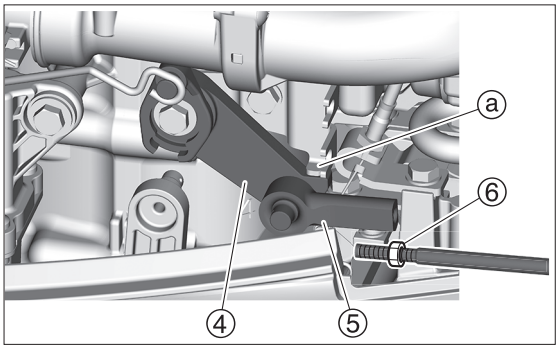
Applying a small amount of grease to the grommet will make it easier to work with.



4. Set the control lever on the remote control box to the fully open position.



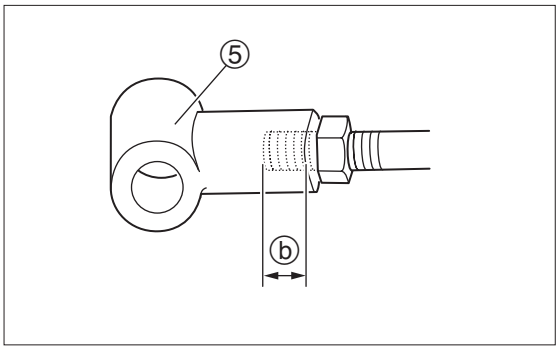
5. Place throttle drum ④ against the fully open stopper ⓐ, and align nut ⑥ at the end of the remote control cable with the position of cable joint ⑤.



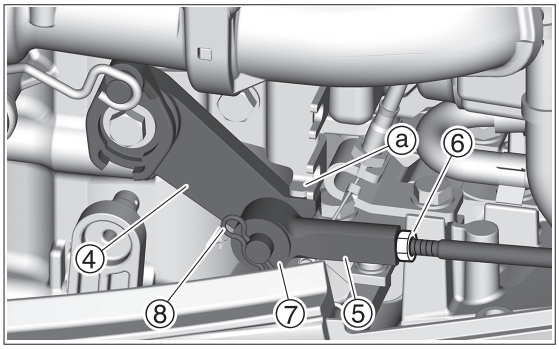
6. Screw on cable joint ⑤ to the position of the remote control cable nut.

⚠ CAUTION

Cable joint ③ should be screwed in at least 10 mm. If this is insufficient, adjust the remote control box side.



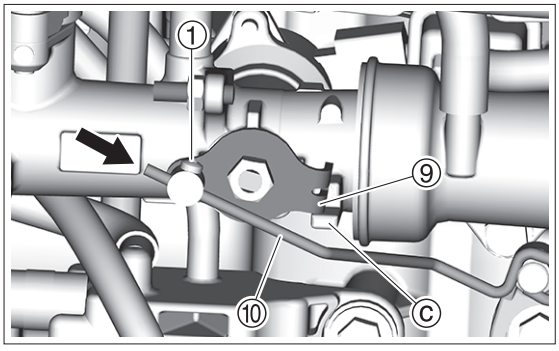
7. Fit the cable joint onto the throttle drum, and check that the throttle drum touches fully open stopper ⓐ when the control lever on the remote control box is fully opened. Tighten the cable joint nut and secure it with washer ⑦ and snap pin ⑧.



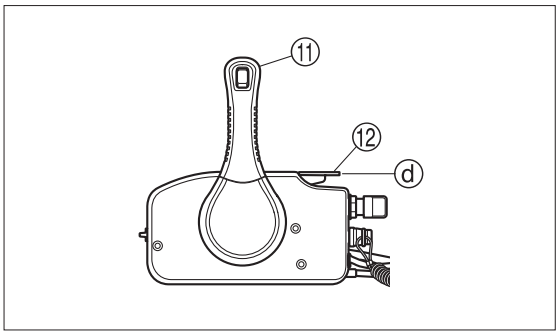
8. While pressing throttle lever ⑨ of the throttle body against the fully open stopper ⓒ, press throttle rod ⑩ toward the throttle drum and fix it with screw ①.

⚠ CAUTION

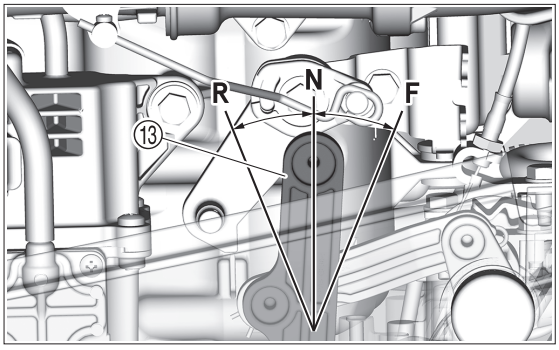
When pressing the throttle rod against the throttle drum, be careful not to push it too hard and cause the drum to move from the fully open position.



9. Set control lever ⑪ to neutral (N) and free accelerator lever ⑫ to fully closed position ⓓ.

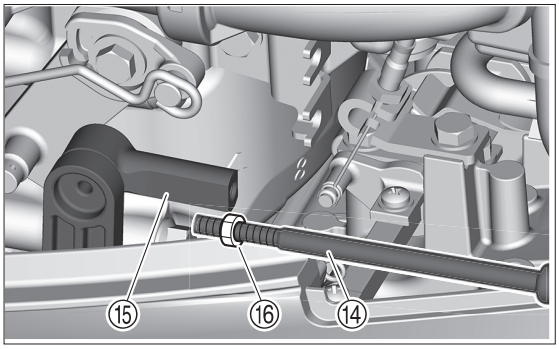


10. Set shift arm ⑬ to the forward (F), neutral (N), and reverse (R) positions, and then set it to the neutral (N) position.



11. Run remote control cable ⑭ (shift side) through the grommet, and align the nut ⑯ of the cable with the joint ⑮ position in the same way as for the throttle cable.

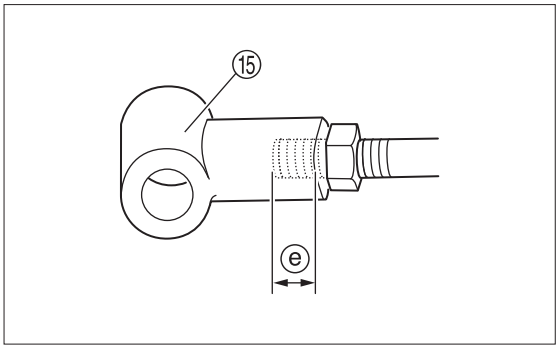
When adjusting the position of the cable joint, push in the remote control cable to remove any play.



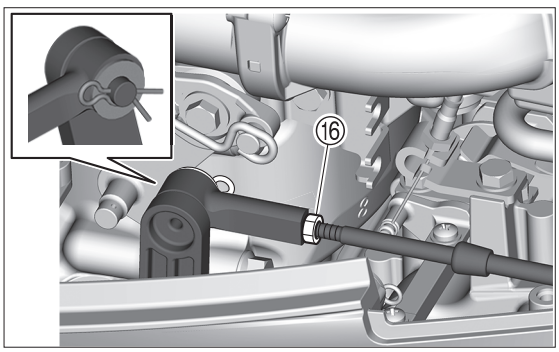
12. Screw on the cable joint to the position of the remote control cable nut.

⚠ CAUTION

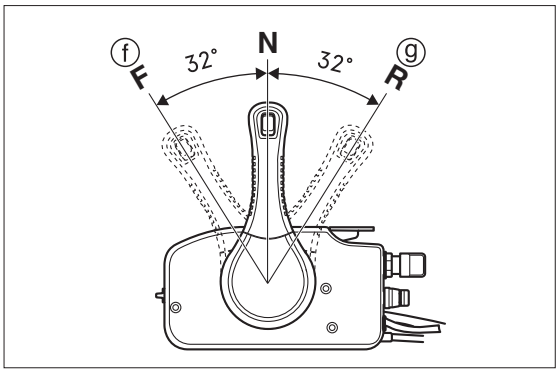
The cable joint should be screwed in at least 10 mm ⓔ. If this is insufficient, adjust the remote control box side.



13. Tighten the cable joint nut and secure it with a washer and snap pin.

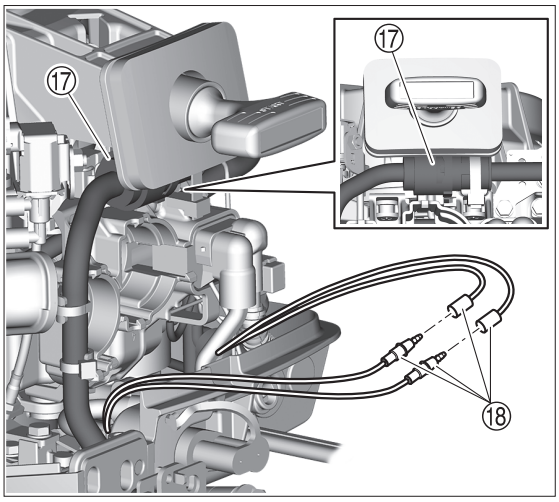


14. Check that the outboard motor shifts in when the control lever is lowered to the Forward (F) side ⓕ or reverse (R) side ⓖ until it stops (approximately 32°), and that the throttle is activated and fully opened when the control lever is lowered further.

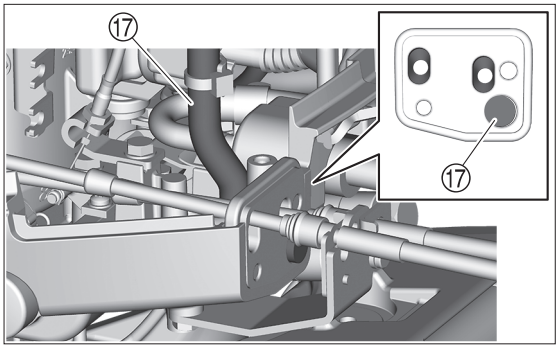


15. Check if the throttle valve operates smoothly, and repeat Steps 1 to 14 where necessary.

16. Connect connector ⑰ and connector ⑱ (power tilt model only) of the cord assy.



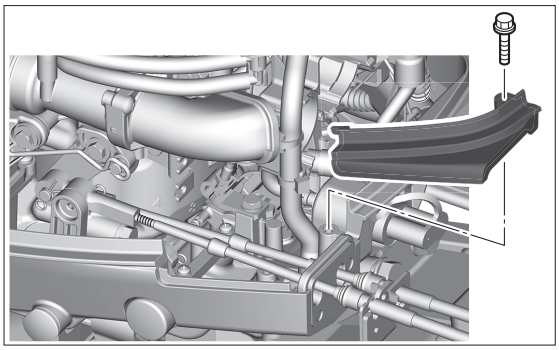
17. Run the cord assy through the grommet.



18. Fit the grommet into the bottom cowl, and fix the remote control cables by fitting the grooves on the cable clip.

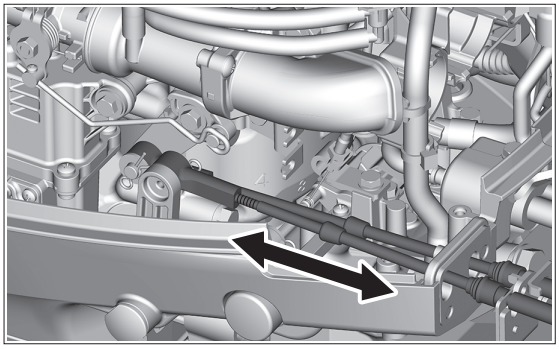
19. Install the remote control cable stay cover.

> **⚠ CAUTION**
>
> **Be careful not to nip the PT switch cord with the cover and bottom cowl. (EPT Model)**

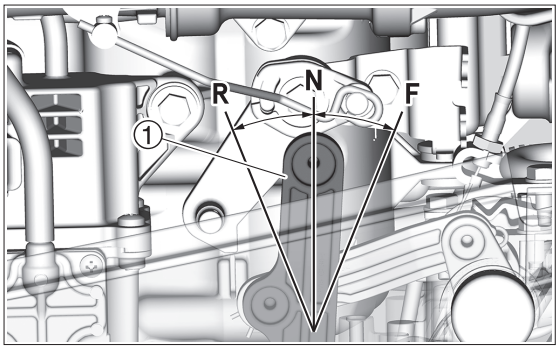


17) Inspection of Shift Lever Gear Operations

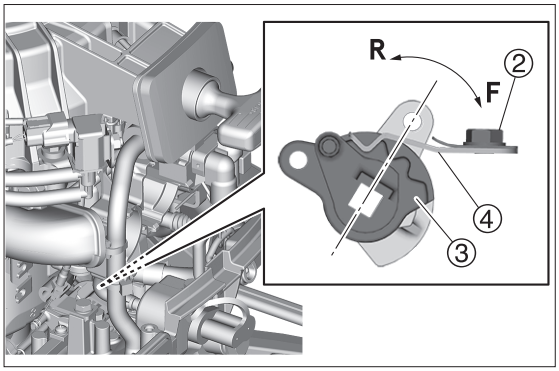
Check that the gear shift operates smoothly when shifting from neutral (N) to forward (F) or reverse (R). Adjust the shift cable position as necessary.



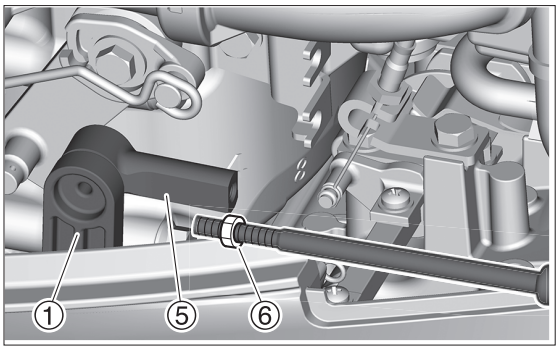
1. Set the control lever on the remote control box and shift arm ① to the neutral (N) position.



2. Perform shift adjustment after assembling the lower unit. Loosen shift lever stopper bolt ②. Push shift lever shaft assy ③ all the way forward, adjust the position of shift lever stopper ④, and then tighten the shift lever stopper bolt. Operate the shift lever to check that operation from neutral (N) to forward (F) and operation from neutral (N) to reverse (R) are normal and that forward and reverse movements trace the same course.

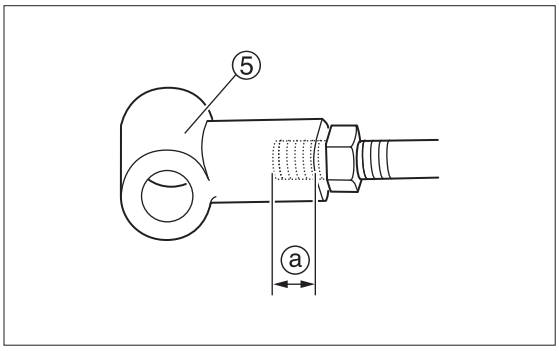


3. Fit cable joint ⑤ onto shift arm ①, and align nut ⑥ of the remote control cable with the cable joint.



When adjusting the position of the cable joint, push in the remote control cable to remove any play.

4. Screw on the cable joint to the position of the remote control cable nut.

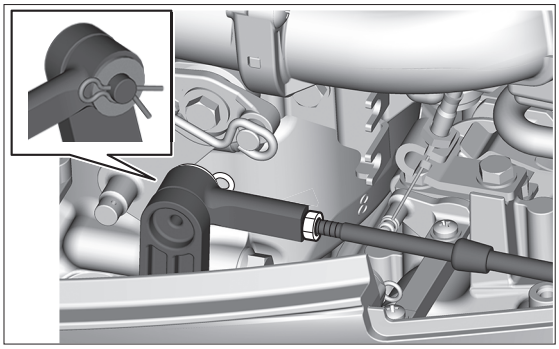


⚠ CAUTION

The cable joint should be screwed in at least 10 mm ⓐ. If this is insufficient, adjust the remote control box side.

5. Tighten the cable joint nut and secure it with a washer and snap pin.

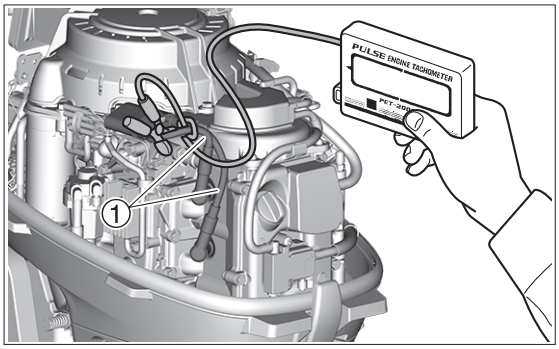
6. Check if gear shifts smoothly, and repeat steps 2. to 8. as necessary.



18) Inspection of Idle Speed

1. Start the engine and run for 5 minutes to warm up.

2. Connect a tachometer to the high-tension cord ① and check the idle rotation speed.



Accuracy and stability can be improved by connecting the tachometer lead wire between the high-tension cords of each cylinder.

Tachometer:
P/N. 3AC-99010-0

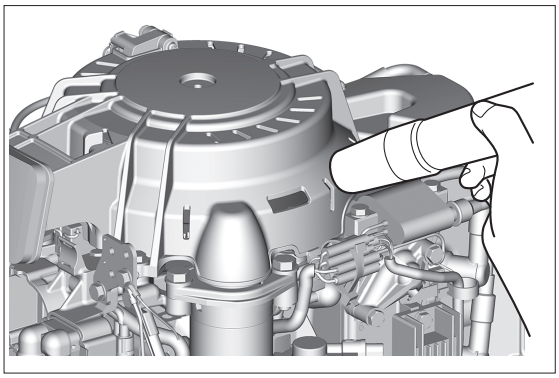
Idle Revolution Speed:
900 min^{-1} (rpm)

19) Inspection of Ignition Timing

Adjustment method: Automatic control. No adjustment required.

Run the engine and use a timing light to check the ignition timing.

11 timing marks are found on the side of the flywheel (TDC0°, ATDC5°, 10°, BTDC5°, 10°, 15°, 20°, 25°, 30°, 35°, 40°), so the ignition timing is read from the mark in the center of the starter case window.



Model	Range of Ignition Angle	Engine Starting	Idling
MFS6CZ	TDC0° – BTDC22°	BTDC5°	TDC0°±5°
MFS8C	TDC0°– BTDC32°	BTDC5°	TDC0°±5°
MFS9.8C/9.9CY	TDC0°– BTDC30°	BTDC5°	TDC0°±5°

20) Inspection of Anodes

⚠ CAUTION

Do not coat the anode or trim tab with oil, grease or paint, or their anti-galvanic corrosion function will not work normally.

When it is necessary to disassemble the outboard motor to inspect the anode, refer to the disassembly procedure described in this manual.

Inspection of Exterior

1. Check the anode and trim tab for buildup of scale and staining by grease and oil. Clean or replace if necessary.

2. Replace the anode and/or trim tab if they are corroded excessively.

Inspection of Conductivity

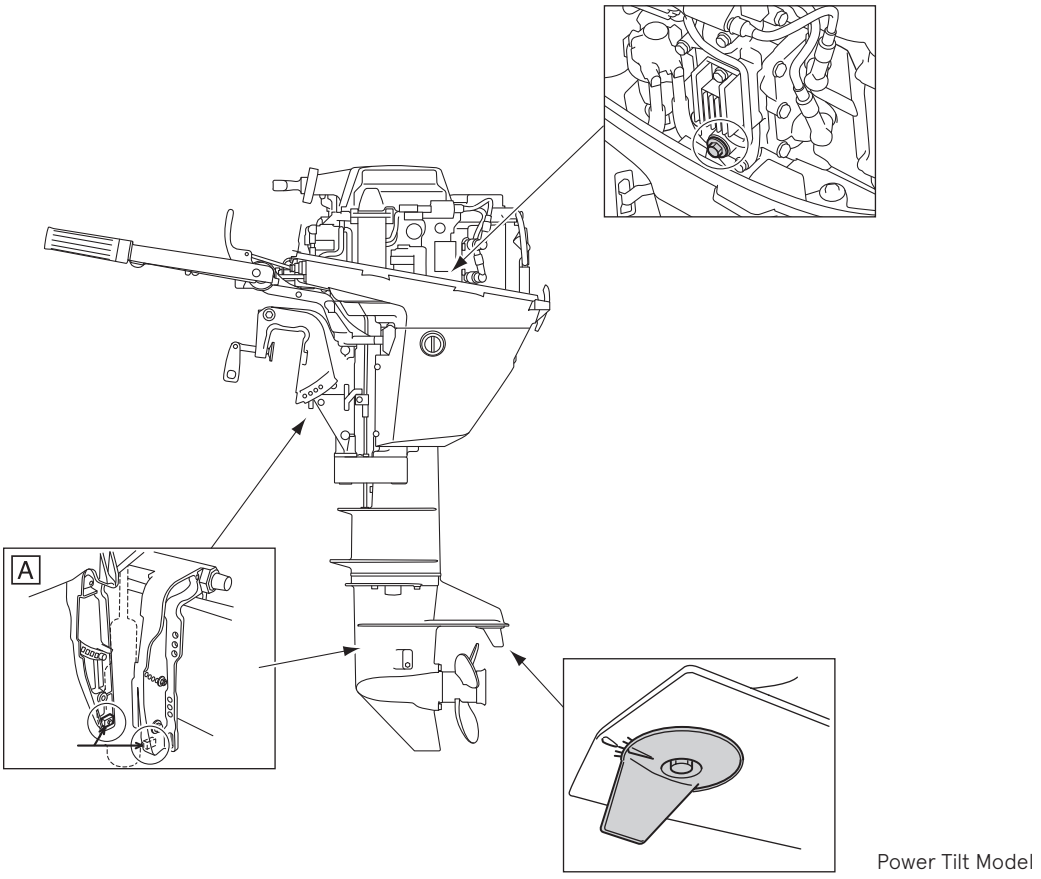
If the anode is not getting smaller, there is a possibility that conductivity is not being maintained correctly.

Follow the procedure below to check the anode.

1. Check the grounding of the outboard motor and conductivity of the anode surface with a tester.

2. If the resistance is very small or none at all, it means that the anode is installed correctly.
   If the resistance is large, remove the mounting bolts and after cleaning the screw thread and screw hole, install and inspect the anode again.

For the cooling water passage anode (cylindrical shape), check the conductivity between the ground of the outboard motor and anode bracket.



Power Tilt Model

21) Replacement of Anodes

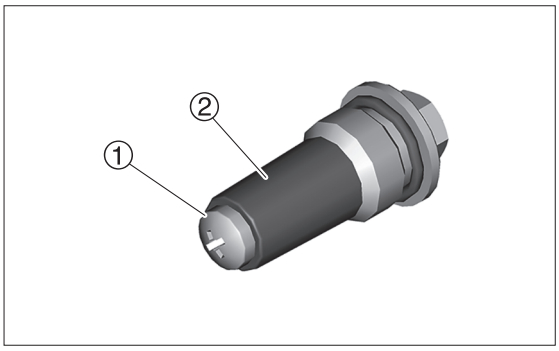
Anodes protect the outboard motor from galvanic corrosion (corrosion of metal due to very weak electric current).

Anodes are used in the gear case and power unit.

Replace an anode if the size is reduced to 2/3 that of a new one.

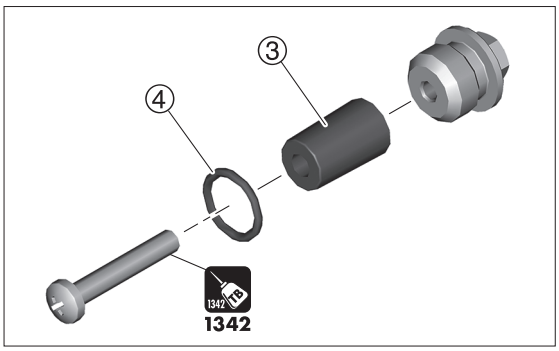
- Do not coat the anodes with oil or paint.
- Since the area around the anode installation bolts will be corroded more than the other areas, be sure to retighten the bolts at every inspection.

22) Replacement of Cooling Water Passage Anode (Cylindrical Shape)



1. Remove the screw ① from the anode plug, then remove the anode ②.

2. Clean the screw locking agent remaining on the screw thread of the screw tip and clean each contact surface of the anode plug.



④ O-ring [redacted]

3. Install a new anode ③ in the anode plug and tighten the screw to the specified torque.

- Install the anode with the smaller diameter end facing the screw.
- Apply a screw locking agent (ThreeBond 1342) to the screw.

Anode Screw:
2.5 N · m (1.84 lb · ft) [0.25 kgf · m]

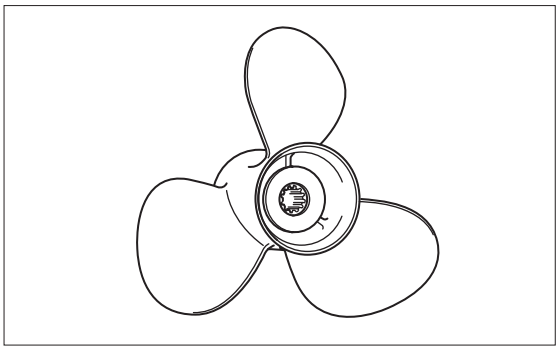
4. Install a new O-ring ④ and install the anode plug on the outboard motor.

Apply a thin coat of water-resistant grease on the O-ring.

Anode Plug:
18 N · m (13 lb · ft) [1.8 kgf · m]

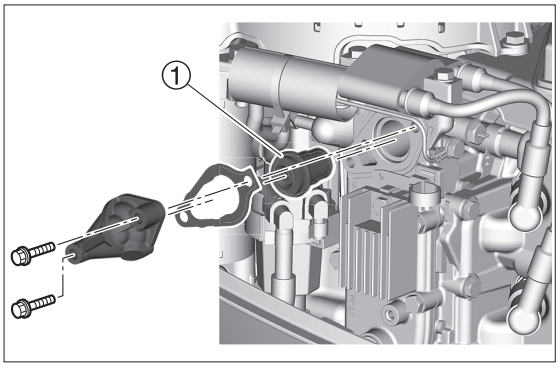
23) Inspection of Propeller

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



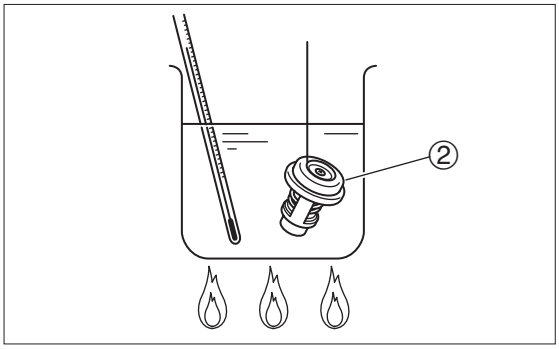
24) Inspection of Thermostat

1. Loosen the nut on the thermostat cover and remove thermostat ①.



2. Hang thermostat ② in a vessel containing water.

3. Put thermometer in the water, and warm up water to measure valve opening temperature.

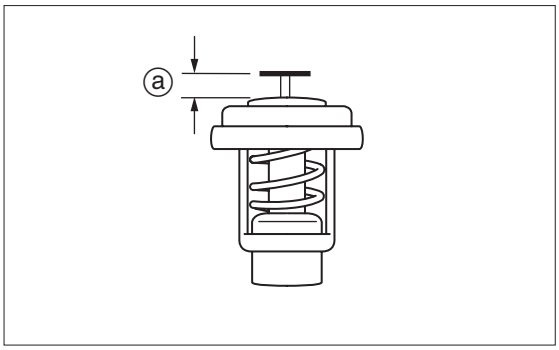


Put a piece of thread in the closed valve gap and hang it in the water. Valve opening moment can be known when thermostat is released to drop due to opening with rise of temperature.

Valve Opening Temperature:
60±1.5C° (140±3°F) (The valve starts to open.)

4. Measure valve lift of thermostat when prescribed temperature has been reached. Replace if less than the specified value.

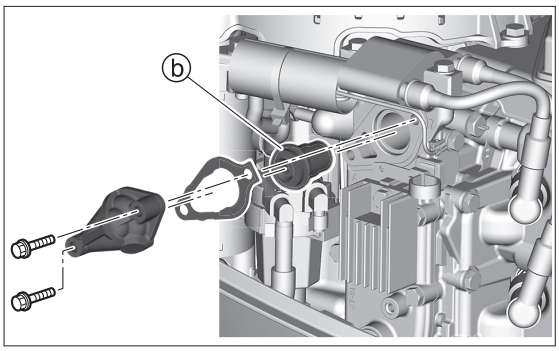
Water Temperature	Valve Lift ⓐ
75±1.5°C (167±3°F)	3.0 mm (0.12 in) or more



5. Install thermostat, new gasket and cover.

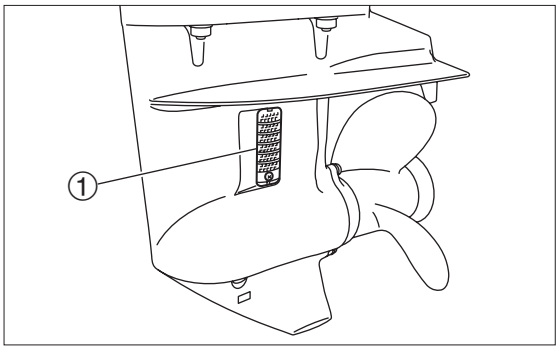
Install the thermostat with the air bleeding valve recess ⓑ facing upward.

Thermostat Cover Bolt :
6 N·m (4 lb·ft) [0.6 kgf·m]



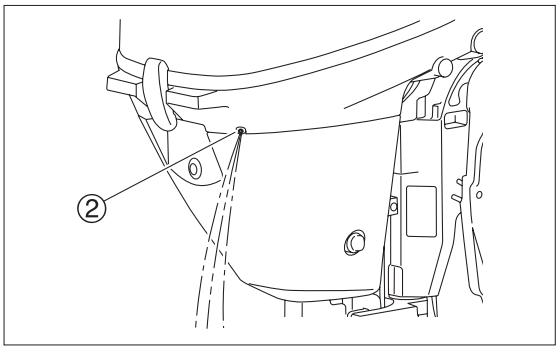
25) Inspection of Cooling Water Passage

1. Check water strainer ① for clogging. Clean if necessary.



2. Place the outboard motor in the water and start the engine.

3. Check that cooling water is discharged from the cooling water check port ②. If not, check the water pump and cooling water passage in the engine.



26) Flushing with Water

⚠ WARNING

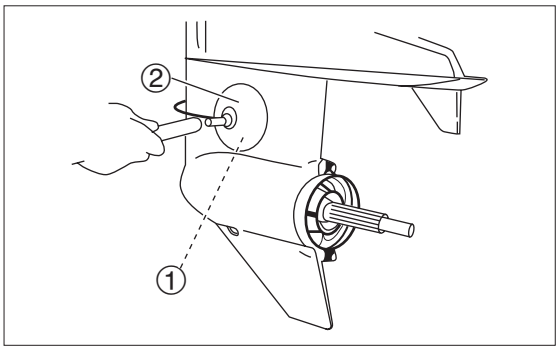
Exhaust gas contains carbon monoxide, which may result in gas poisoning. Do not start the engine with the outboard motor placed in an enclosed area such as a boat house etc.

⚠ CAUTION

Touching a rotating propeller may lead to injury.
Be sure to remove the propeller before running the engine on land.

Flushing with water using the drive cleaner②

1. Remove the propeller and thrust holder.
2. Attach the drive cleaner to the water strainer ① area.
3. Insert the water hose into the drive cleaner and turn on the water supply.
4. Set the gear shift to neutral (N) and start the engine.
5. Check that the cooling water check port discharges water, and run engine for 3 to 5 minutes at idle speed.
6. Stop the engine and water supply, then remove the drive cleaner and install the propeller.

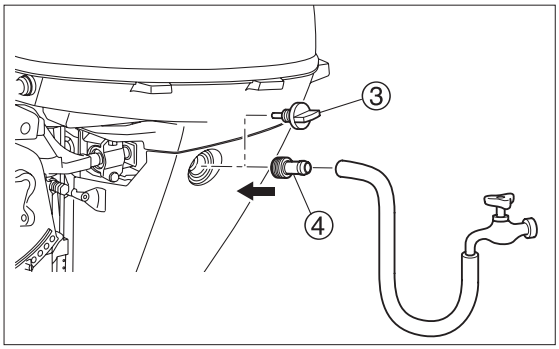


Flushing with water using a hose joint ④

1. Tilt down the outboard motor to make it vertical.
2. Remove flushing connector cap ③ and install the hose joint.
3. Connect a water hose to the hose joint. Turn on the water and adjust the flow. Continue flushing the outboard motor for 3 to 5 minutes.

⚠ CAUTION

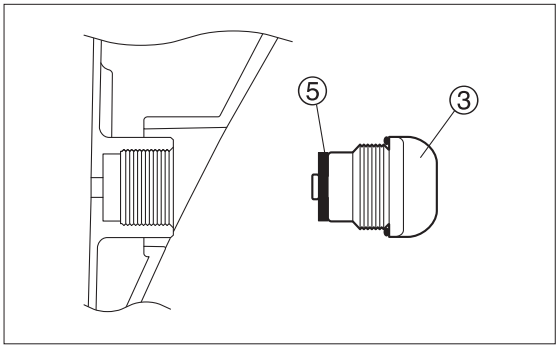
Do not operate the engine.



4. Remove hose joint.
5. Check for cracks and other damage in seal ring ⑤, then install the flushing connector cap.

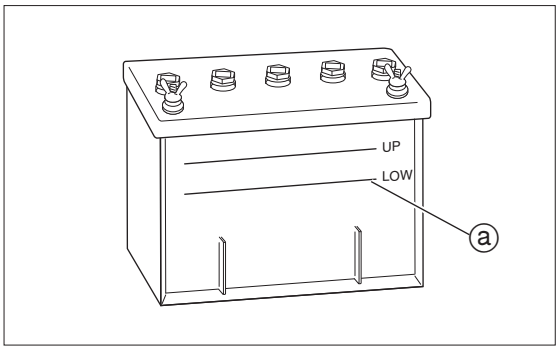
⚠ CAUTION

Cooling water leaks may lead to the engine overheating.
Be sure to reattach the flushing connector cap.

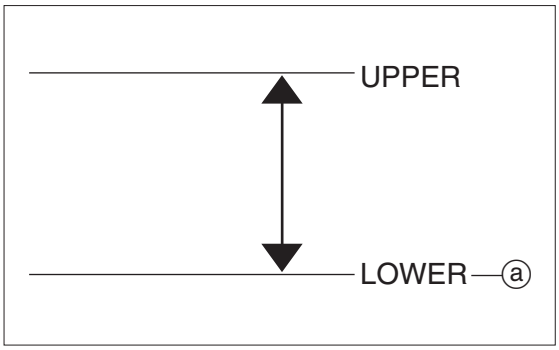


27) Inspection of Battery

1. Inspect the electrolyte level. If it is lower than the "LOW" mark ⓐ, add distilled water until the level is between the "UP" and "LOW" marks.



2. Measure the specific gravity of the electrolyte. Fully charge the battery if the specific gravity is less than the specified value.



⚠ WARNING

Battery fluid is dangerous because it contains sulfuric acid, which is toxic and highly corrosive. Always take the following precautions to prevent accidents:
• Battery fluid can cause severe burns or blindness. Handle with care to avoid contact with your body.
• Wear protective goggle when working near the battery or handling the battery.
First Aid (if battery fluid gets on your body):
• If it gets on the skin - Rinse thoroughly with running water.
• If it gets in the eyes - Rinse thoroughly with water for 15 minutes and seek immediate medical attention from an ophthalmologist.
First Aid (if swallowed):
•Drink plenty of water, or magnesium hydroxide solution (commonly known as milk of magnesia), raw eggs, or salad oil, and seek immediate medical attention.
Batteries generate highly flammable hydrogen gas. Always take the following precautions to prevent accidents:
• Charge batteries in well-ventilated areas.
• Keep batteries away from sources of fire, sparks, and flames. (for example, cigarette flames or welding equipment)
• Do not smoke while handling or charging batteries.
Keep batteries and battery fluid out of reach of children.

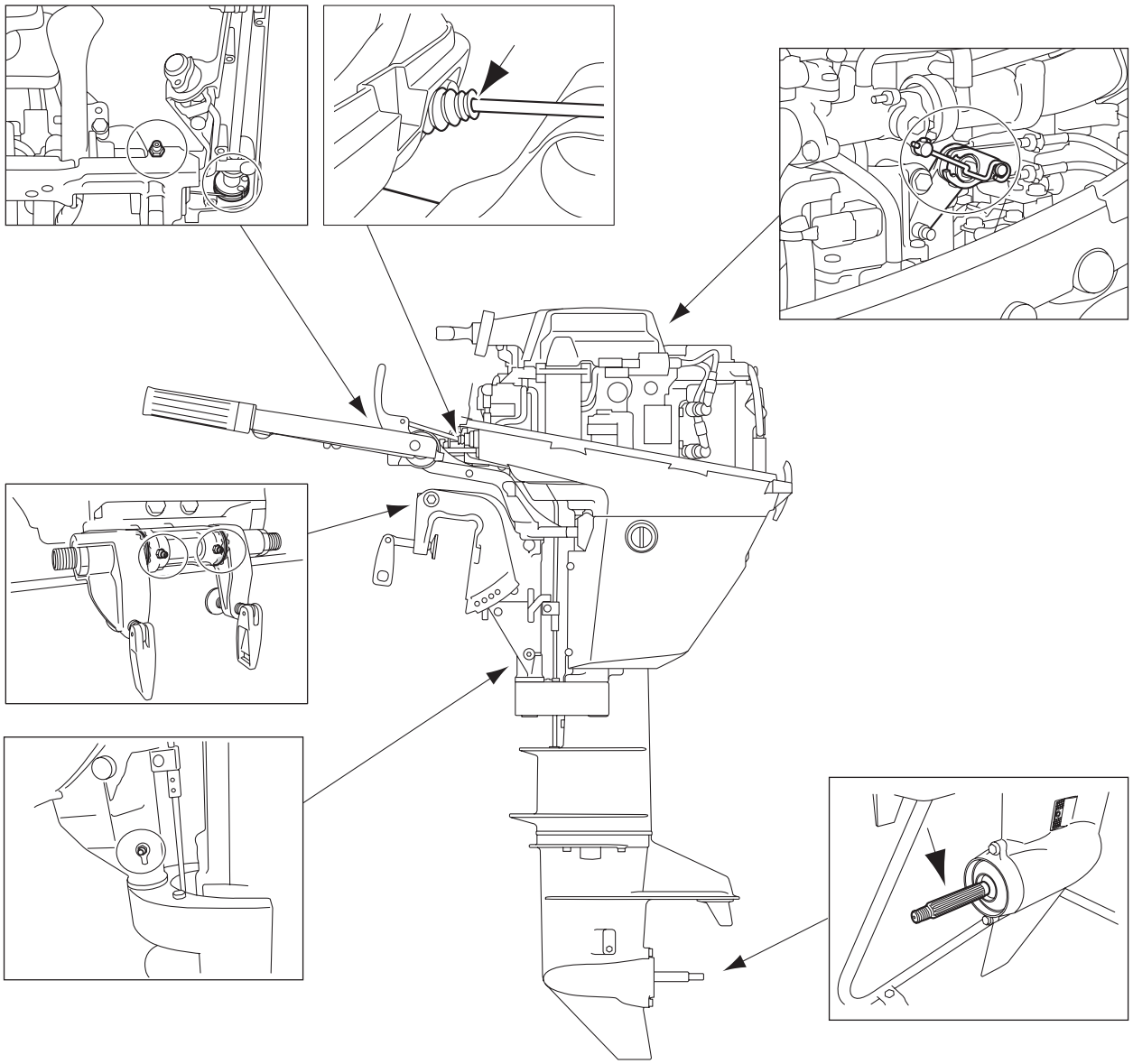
· Batteries come in many types and differ by manufacturer. Refer to the manual that comes with the battery.
· When removing the battery, disconnect the negative lead first followed by the positive lead.

Recommended Minimum Battery Capacity:
36Ah/5HR (40Ah/20HR, 330CCA)

Specific Gravity of Electrolyte:
1.280 (at 20°C)

28) Grease points

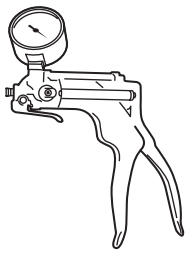
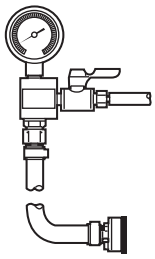
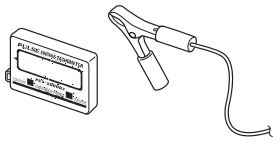
Apply water proof grease to the parts shown below or pour it via grease nipples.



4

Fuel System (Fuel Injection)

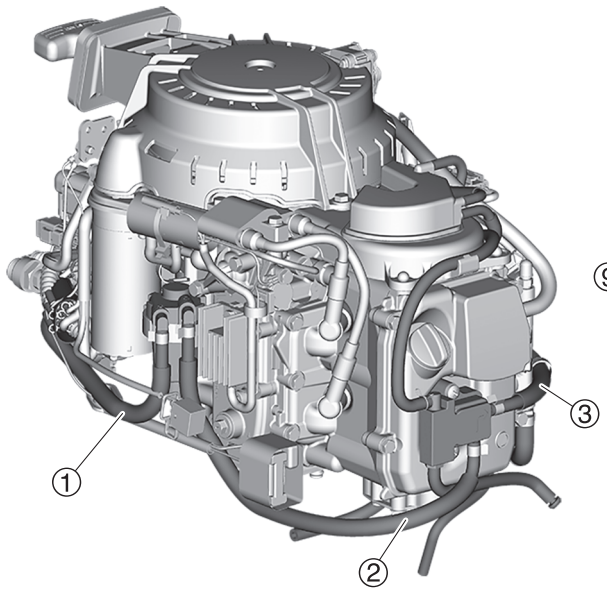
1. Special Tools

		
Vacuum/Pressure Gauge P/N. 3AC-99020-1	Pressure Gauge Assembly P/N. 3T5-72880-0	Tachometer P/N. 3AC-99010-0
Inspecting pressure	Measurement of fuel pressure	Measuring engine revolution speed

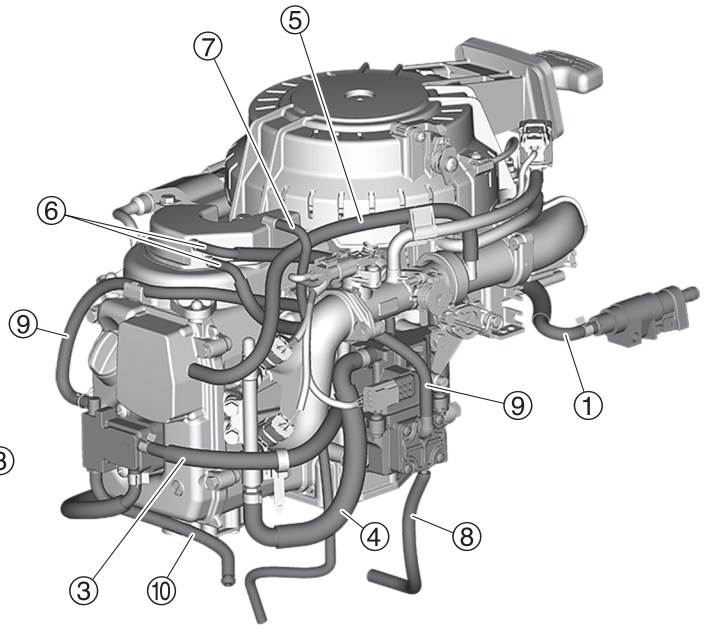
2.Piping Arrangement Diagram

Fuel Hose, Vent Hose, Breather Hose, Cooling Water Hose

Port Side



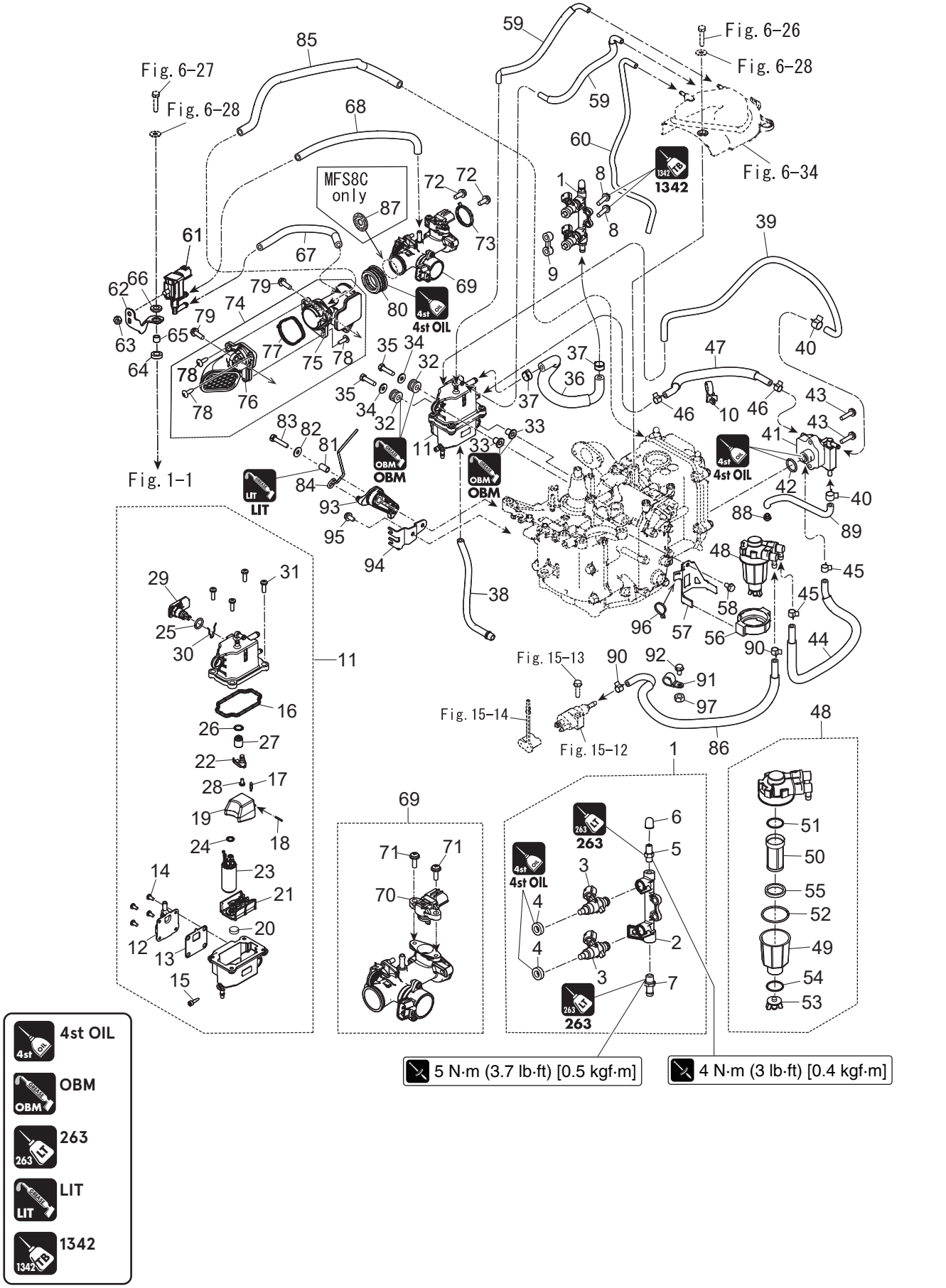
Starboard Side



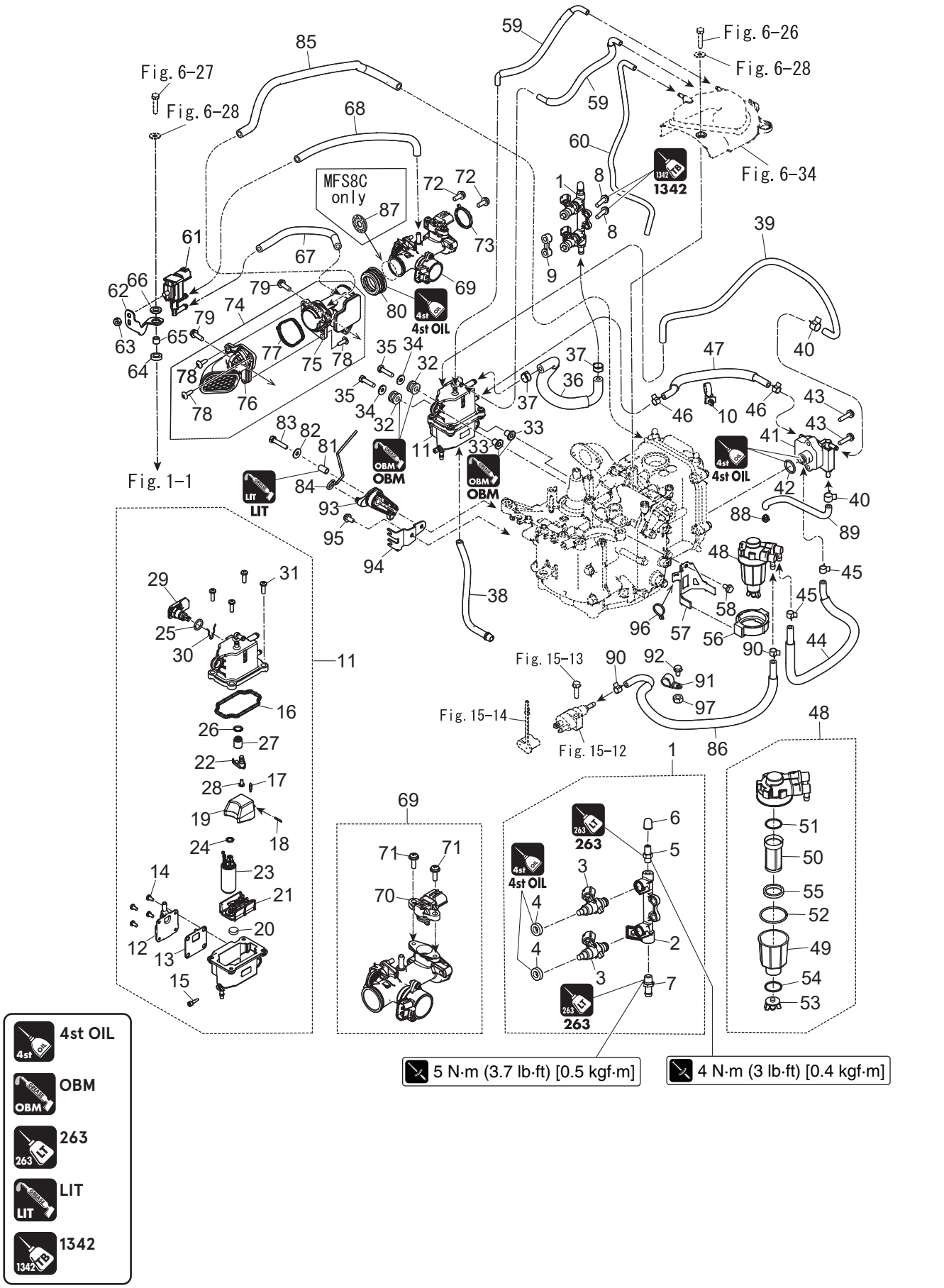
Ref. No.	Part Name
①	Fuel Hose (Fuel Connector → Fuel Filter)
②	Fuel Hose (Fuel Filter → Fuel Pump)
③	Fuel Hose (Fuel Pump → Vapor Separator)
④	High Pressure Fuel Hose (Vapor Separator → Fuel Rail)
⑤	Breather Hose (Cylinder Head to Throttle Body)
⑥	Vent Hose (Vapor Separator → Vapor Catch Tank)
⑦	Vent Hose (Vapor Catch Tank → Atmospheric Release)
⑧	Cooling Water Hose (Drive Shaft Housing → Fuel Cooler)
⑨	Cooling Water Hose (Fuel Cooler → Fuel Pump)
⑩	Cooling Water Hose (Fuel Pump → Cooling Water Check Port)

3.Parts Layout

Intake Manifold & Fuel Pump



Ref. No.	Part Name	Q'ty	Remarks
1	Fuel Rail Assy	1	
2	* Fuel Rail	1	
3	* Fuel Injector Assy	2	
4	* Seal Ring	2	Do not reuse.
5	* Valve Assy (Pressure Check)	1	
6	* Valve Cap	1	
7	* Nipple	1	
8	Bolt	2	
9	Insulator	1	
10	Band	1	Do not reuse.
11	Vapor Separator Assy	1	
12	* Cover	1	
13	* Seal	1	Do not reuse.
14	* Screw	4	
15	* Drain Screw	1	
16	* Gasket	1	
17	* Float Valve Assy	1	Do not reuse.
18	* Float Arm Pin	1	
19	* Float	1	
20	* Grommet	1	
21	* Filter (Inlet)	1	
22	* Holder	1	
23	* Fuel Feed Pump	1	
24	* O-ring	1	Do not reuse.
25	* O-ring	1	Do not reuse.
26	* O-ring	1	Do not reuse.
27	* Fuel Regulator	1	
28	* Screw	1	
29	* VST Connector	1	
30	* Clip	1	
31	* Screw	4	
32	Rubber Mount	2	
33	Collar	2	
34	Washer 6-16-1.5	2	
35	Bolt	2	
36	Fuel Hose W/Protector	1	
37	Clamp	2	
38	Hose	1	
39	Water Hose	1	
40	Clip ø9.4	2	


MFS8C only
Fig. 6-26
Fig. 6-27
Fig. 6-28
Fig. 6-34
Fig. 1-1
Fig. 15-12
Fig. 15-13
Fig. 15-14
4st OIL
OBM
LIT
1342
263
5 N·m (3.7 lb·ft) [0.5 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]

Ref. No.	Part Name	Q'ty	Remarks
41	Fuel Pump Assy	1	
42	O-ring	1	Do not reuse.
43	Screw	2	
44	Hose	1	
45	Clip ø9.4	2	
46	Clip ø9.4	2	
47	Hose	1	
48	Fuel Filter Assy	1	
49	* Cup	1	
50	* Filter	1	
51	* O-ring	1	Do not reuse.
52	* O-ring	1	Do not reuse.
53	* Drain Valve	1	
54	* Seal	1	Do not reuse.
55	* Float	1	
56	Fuel Filter Holder	1	
57	Fuel Filter Bracket	1	
58	Bolt	1	
59	Vent Hose W/Protector	2	
60	Fuel Hose	1	
61	ISC Valve	1	
62	ISC Valve Stay	1	
63	Nut	1	
64	Rubber Mount 9-16-4.3	1	
65	Collar 6.2-9-7.4	1	
66	Rubber Mount 8.5-12-2	1	
67	Hose	1	
68	Hose	1	
69	Throttle Body Assy	1	
70	* MAP Sensor	1	
71	* Screw	2	
72	Bolt	2	
73	Gasket	1	Do not reuse.
74	Intake Silencer Assy	1	
75	* Intake Silencer Sub-Assy	1	
76	* Intake Silencer Sub-Assy	1	
77	* Gasket	1	Do not reuse.
78	* Tapping Screw	3	
79	Bolt	2	
80	Gasket	1	Do not reuse.

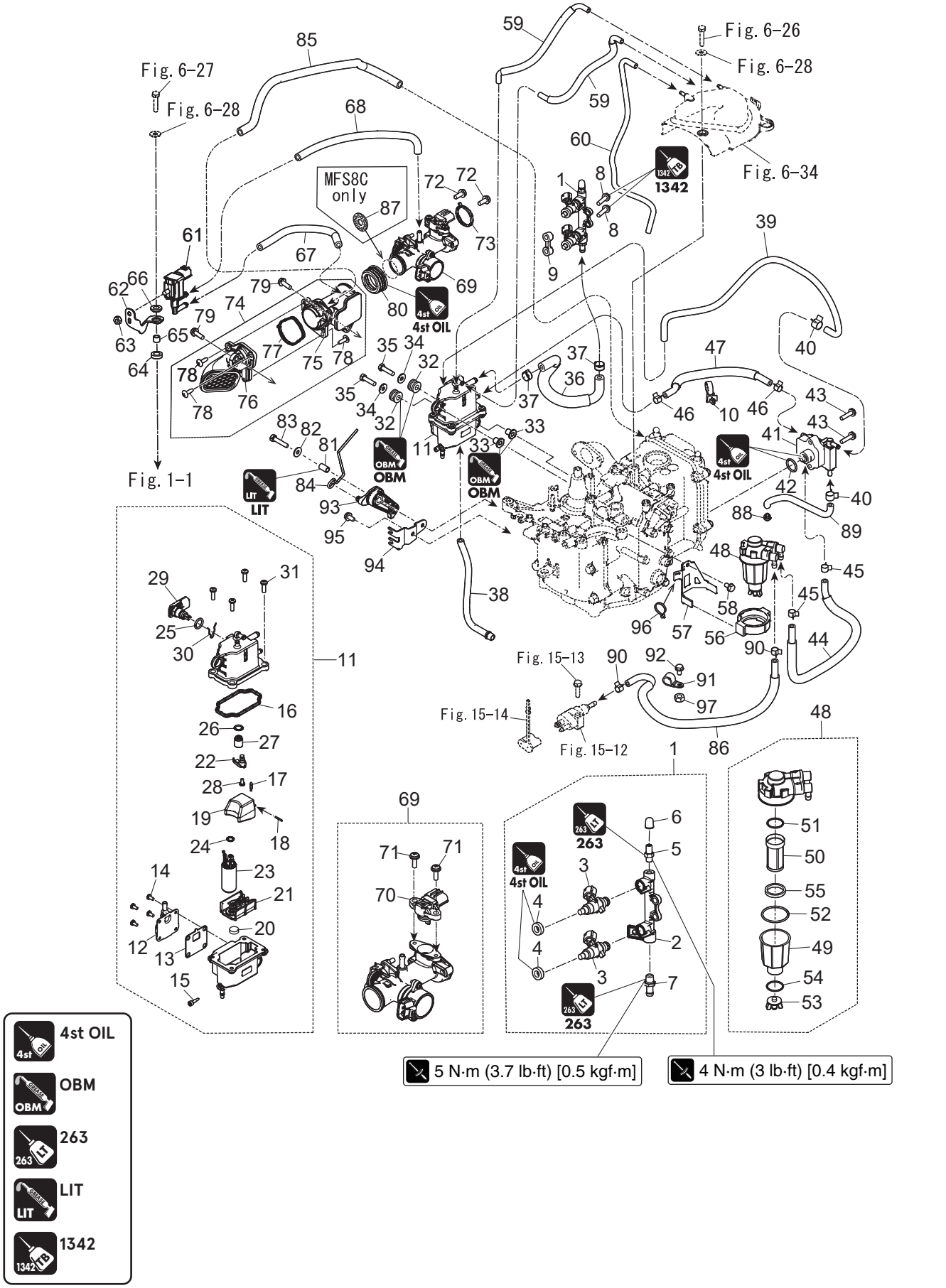
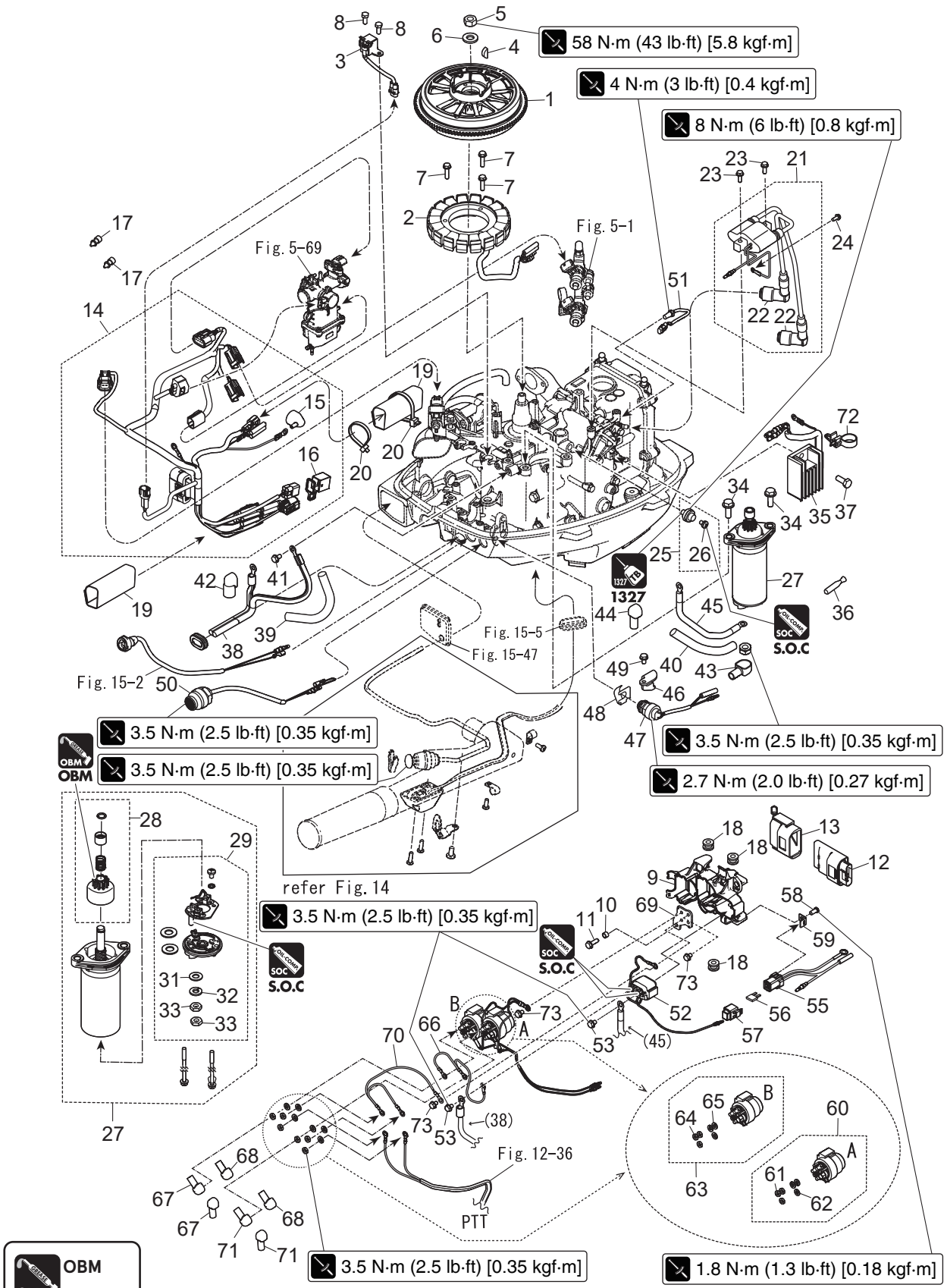


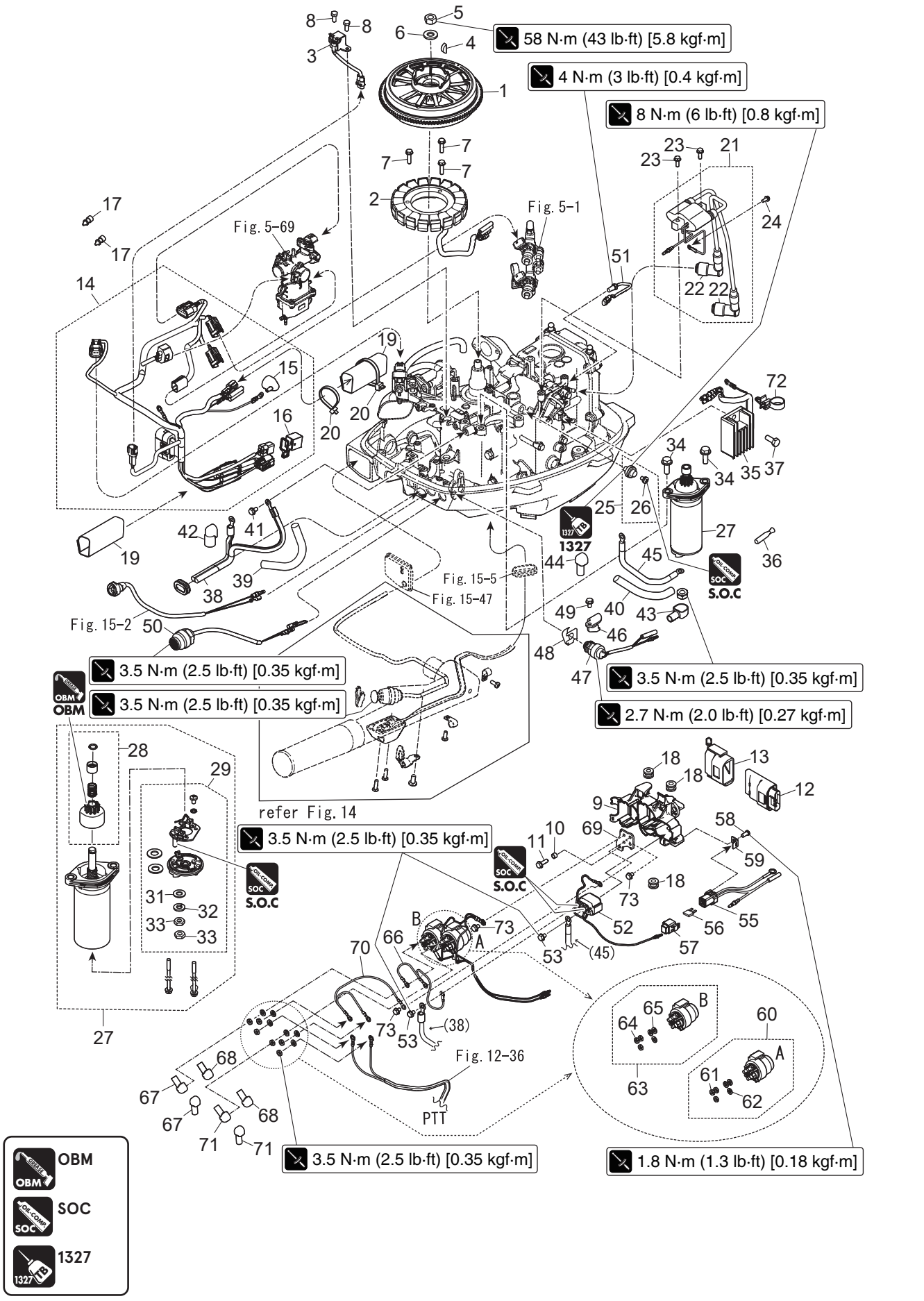
Fig. 6-27
Fig. 6-28
Fig. 6-26
Fig. 6-34
Fig. 1-1
Fig. 15-13
Fig. 15-14
Fig. 15-12
MFS8C only
4st OIL
OBM
LIT
1342
263
5 N·m (3.7 lb·ft) [0.5 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]

Ref. No.	Part Name	Q'ty	Remarks
81	Collar	1	
82	Washer 6-16-1.5	1	
83	Bolt	1	
84	Throttle Rod	1	
85	Breather Hose	1	
86	Fuel Hose W/Protector	1	
87	Restrictor	1	
88	Water Nipple	1	
89	Hose	1	
90	Clip ø9.4	2	
91	Clamp 6.5-14L	1	
92	Bolt	1	
93	Throttle Drum Assy	1	
94	Throttle Wire Bracket	1	
95	Bolt	1	
96	Band	1	Do not reuse.
97	Nut	1	MF EF EFT

Magneto & Electric Parts

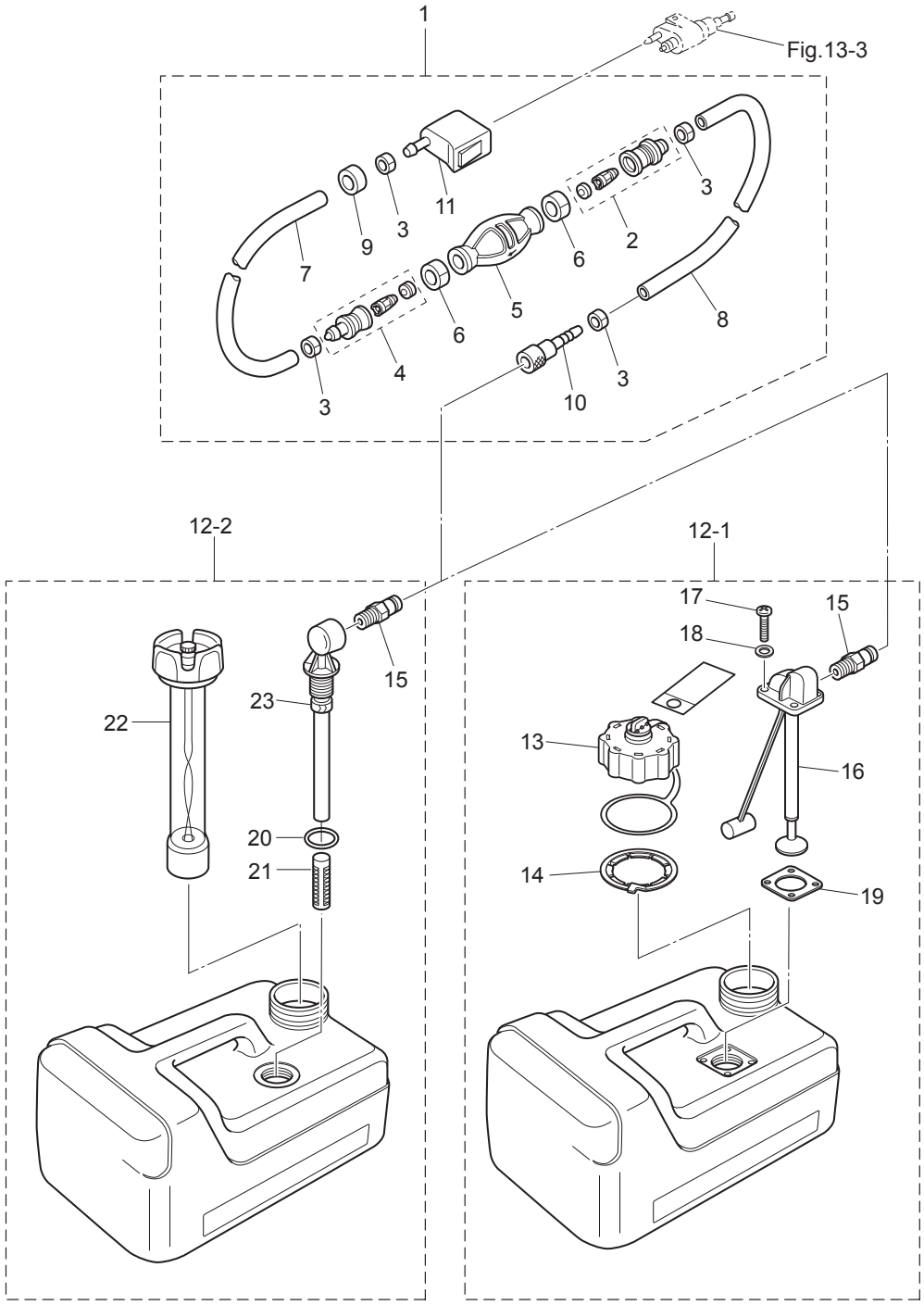


Ref. No.	Part Name	Q'ty	Remarks
1	Flywheel Assy	1	
2	Alternator Assy	1	
3	Pulser Coil	1	
4	Key 13.4-5-4	1	
5	Nut 12-P1.25	1	
6	Washer	1	
7	Bolt	3	
8	Bolt	2	
9	Electrical Bracket	1	
10	Collar	1	
11	Bolt	1	
12	ECU Assy (9.8)	1	
13	ECU Holder	1	
14	Cord Assy	1	
15	Grommet Oil Pressure Switch	1	
16	Cable Terminal Plug	1	Diagnostic Connector Cap
17	Cable Terminal Plug	2	MF
18	Rubber Mount	3	
19	Protector	2	
20	Band	2	Do not reuse.
21	Ignition Coil W/R-cap	1	
22	* Plug Cap W/Resistance	2	
23	Bolt	2	
24	Bolt	1	
25	Oil Pressure Switch	1	
26	* Screw	1	
27	Starter Motor Assy	1	EP EPT EF EFT
28	* Pinion Assy	1	EP EPT EF EFT
29	* Brush Holder Assy	1	EP EPT EF EFT
31	** Washer	1	EP EPT EF EFT
32	** Spring Washer	1	EP EPT EF EFT
33	** Nut	2	EP EPT EF EFT
34	Bolt	2	EP EPT EF EFT
35	Rectifier Complete	1	EP EPT EF EFT
36	Plug	1	
37	Bolt	1	EF EFT EP EPT
38	Battery Cable L=2500	1	EF EFT EP EPT
39	Protector	1	EF EFT EP EPT
40	Protector	1	EF EFT EP EPT


58 N·m (43 lb·ft) [5.8 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]
8 N·m (6 lb·ft) [0.8 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
2.7 N·m (2.0 lb·ft) [0.27 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
1.8 N·m (1.3 lb·ft) [0.18 kgf·m]
Fig. 5-1
Fig. 5-69
Fig. 15-5
Fig. 15-47
Fig. 15-2
Fig. 12-36
refer Fig. 14
1327
S.O.C
OBM
PTT
OBM
SOC
1327

Ref. No.	Part Name	Q'ty	Remarks
41	Bolt	1	EF EFT EP EPT
42	Terminal Cap	1	EF EFT EP EPT
43	Terminal Cap	1	EF EFT EP EPT
44	Terminal Cap	1	EF EFT EP EPT
45	Starter Cable L=200	1	EF EFT EP EPT
46	Neutral Switch Bracket	1	EF EFT EP EPT
47	Neutral Switch	1	EF EFT EP EPT
48	Neutral Switch Actuator	1	EF EFT EP EPT
49	Bolt	1	EF EFT EP EPT
50	Main Switch Assy	1	EF EFT
51	Engine TEMP Sensor	1	
52	Starter Solenoid	1	EF EFT EP EPT
53	Bolt	2	EF EFT EP EPT
55	Fuse Wire Assy	1	EF EFT EP EPT
56	Fuse 20A	2	EF EFT EP EPT
57	Fuse Box Cap (Y)	1	EF EFT EP EPT
58	Tapping Screw 5-12	1	EF EFT EP EPT
59	Fuse Holder Bracket	1	EF EFT EP EPT
60	PTT Solenoid Switch (A)	1	EFT EPT
61	* Nut	3	EFT EPT
62	* Spring Washer	3	EFT EPT
63	PTT Solenoid Switch (B)	1	EFT EPT
64	* Nut	3	EFT EPT
65	* Spring Washer	3	EFT EPT
66	Solenoid Switch Cord (A)	1	EFT EPT
67	Terminal Cap	2	EFT EPT
68	Starter Terminal Cap	2	EFT EPT
69	Bracket	1	EF EFT EP EPT
70	Solenoid Switch Cord (B)	1	EFT EPT
71	Terminal Cap	2	EFT EPT
72	Band	1	EF EFT EP EPT Do not reuse.
73-1	Bolt	1	EF EP
73-2	Bolt	3	EFT EPT
74-1	Washer	1	EF EP
74-2	Washer	3	EFT EPT

Fuel Tank



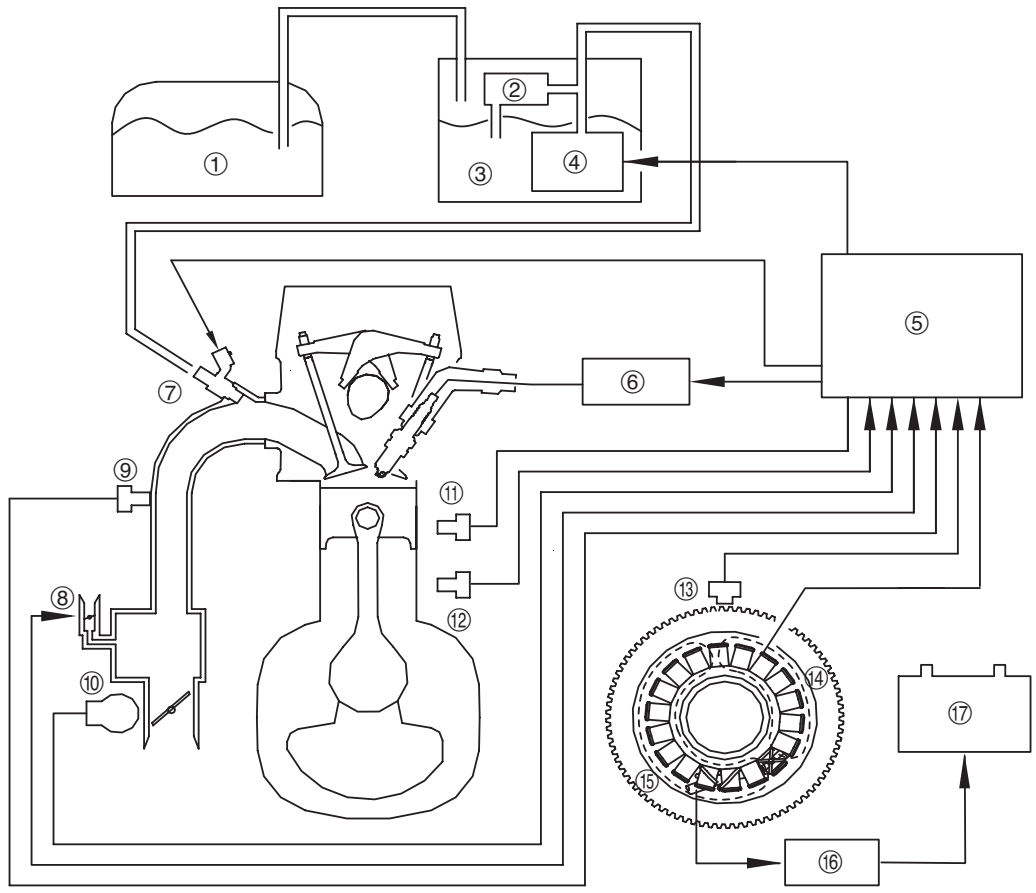
Ref. No.	Part Name	Q'ty	Remarks
1	Primer Bulb Assy	1	
2	Joint Assy (Inlet)	1	
3	Clamp	4	
4	Joint Assy (Outlet)	1	
5-1	Primer Bulb	1	for USA Model
5-2	Primer Bulb	1	
6	Clamp	2	
7	Low Permeation Hose L=700	1	for USA Model
	Hose	1	
8	Low Permeation Hose L=1600	1	for USA Model
	Hose	1	
9	Fuel Connector Mark	1	for USA Model
10	Fuel Connector	1	
11	Fuel Connector	1	

Ref. No.	Part Name	Q'ty	Remarks
12-1	Fuel Tank Assy 12L	1	for USA Model
12-2	Fuel Tank Assy 12L	1	
13	Fuel Tank Cap Assy	1	for USA Model
14	Retaining Ring	1	for USA Model
15	Quick-connector (Male)	1	
16	Fuel Pick-up Assy W/Gauge	1	for USA Model
17	Screw	4	for USA Model
18	Washer	4	for USA Model
19	Gasket	1	for USA Model Do not reuse.
20	O-ring	1	Do not reuse.
21	Filter	1	
22	Fuel Gauge Vent Cap Assy (12L)	1	
23	Pick-up Elbow Assy (12L)	1	

4. ECU System

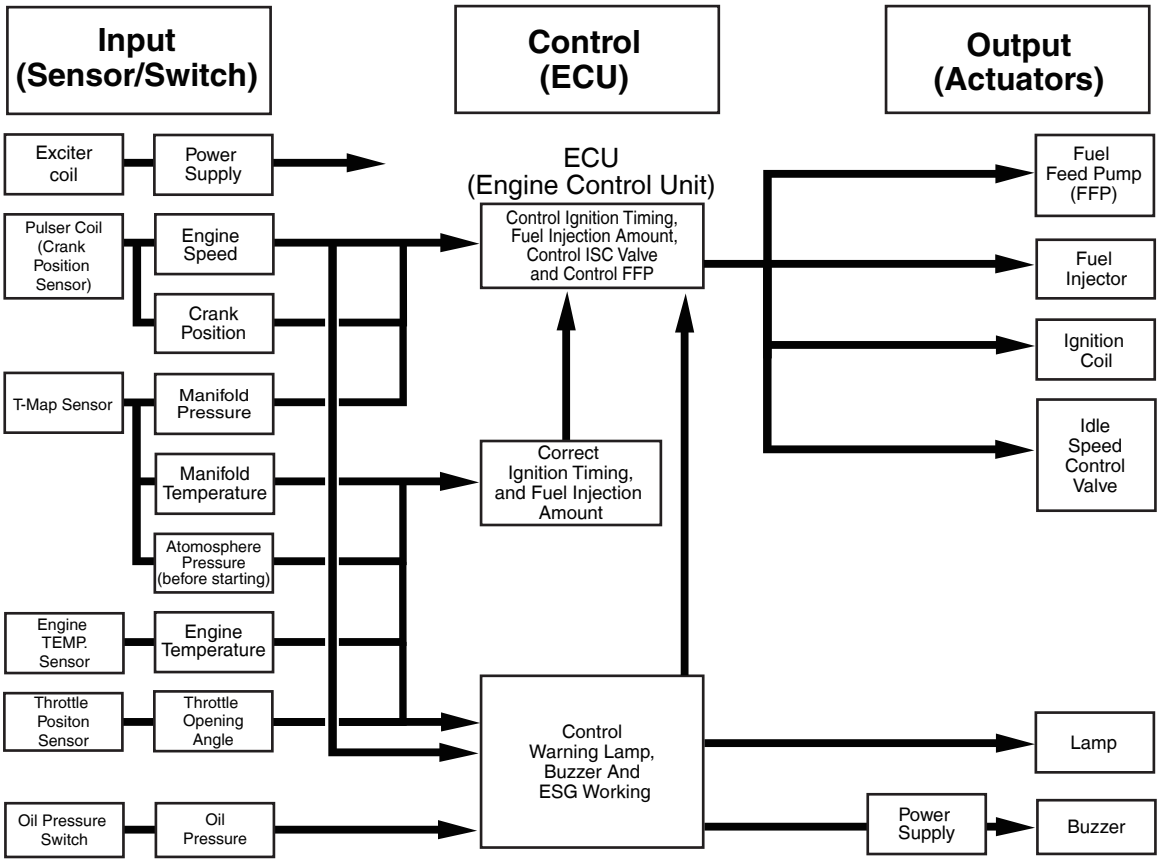
(1) Configuration of ECU System

The ECU uses various sensors to precisely control the injected fuel amount and ignition timing.



① Fuel Tank
② Fuel Regulator
③ Vapor Separator
④ Fuel Feed Pump (FFP)
⑤ ECU
⑥ Ignition Coil
⑦ Fuel Injector
⑧ ISC Valve
⑨ T-MAP Sensor
⑩ TPS
⑪ Engine Temperature Sensor
⑫ Oil Pressure Switch
⑬ Pulser Coil
⑭ Exciter Coil
⑮ Charge Coil
⑯ Rectifier Regulator
⑰ Battery

* ⑮ , ⑯ , ⑰ : For electric starter models only



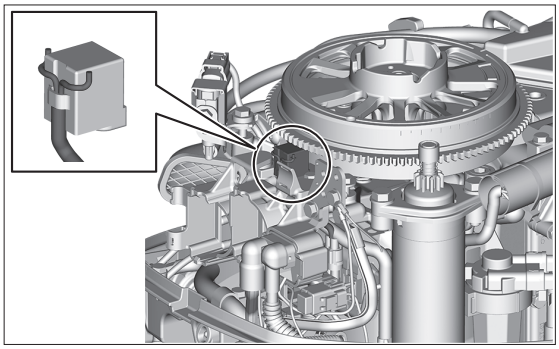
1) Sensors

Individual sensors detect the engine operating conditions and sends signals regarding the information to the ECU.

1. Pulser Coil [Crank Position Sensor]

Pulser coils function as crank position sensors. As the flywheel rotates, the pulser coil sends a crank position signal to the ECU.

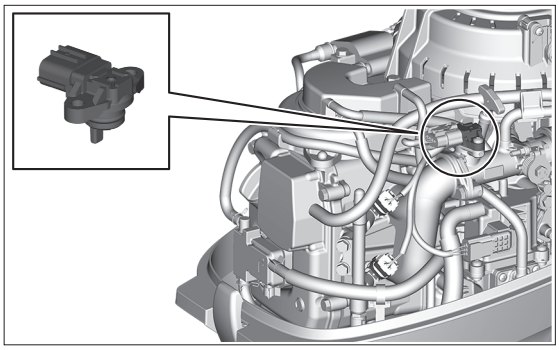
The ECU uses this signal to confirm the fuel injection timing and ignition timing.



2. T-MAP (Manifold Pressure and Temperature) Sensor

The T-MAP sensor is installed on top of the throttle body. It measures the pressure inside the throttle body (intake air vacuum pressure) and intake air temperature, and sends a signal to the ECU.

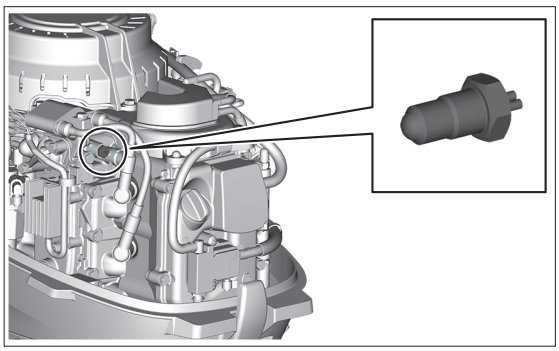
The ECU uses this signal to confirm the fuel injection amount and ignition timing.



3. Engine Temperature Sensor

The engine temperature sensor located in the upper part of the engine cylinder measures the wall temperature of the cooling water passage passing through the engine which is controlled by a thermostat, and sends a signal to the ECU.

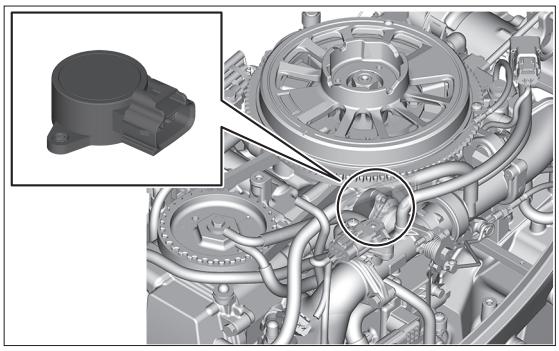
The ECU uses this information to correct the fuel injection.



4. Throttle Position Sensor (TPS)

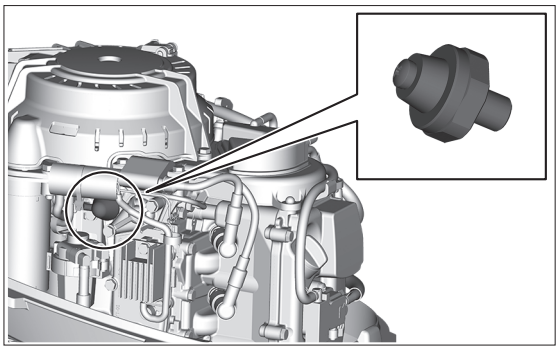
The throttle position sensor is located on the side of the throttle body, and it is connected to the throttle shaft. The throttle position sensor sends throttle opening angle information to the ECU.

The ECU uses this information for fuel injection compensation, ignition timing compensation, idling control and ISC control.



5. Oil Pressure Switch

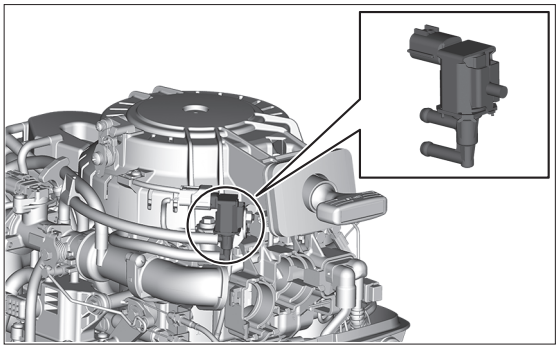
The oil pressure switch is located on the port side of the engine block, protruding into the oil passage. The oil pressure switch sends an oil pressure low signal to the ECU. The ECU activates the low speed ESG and warning lamp based on this information.



2) Actuators

The actuator receives signals from the ECU to control the air/fuel ratio, ignition advance angle and idle revolution speed.

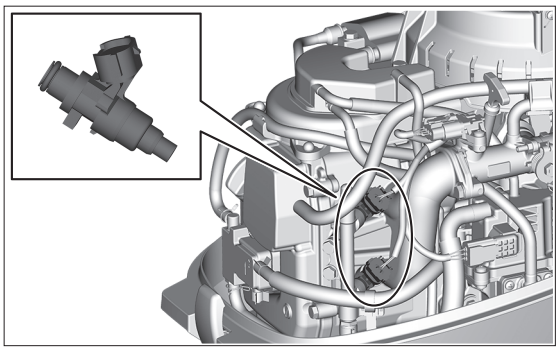
1. ISC (Idle Speed Control) Valve



ISC is also referred to as IAC (Idle Air Control). The ISC valve is a solenoid valve with a built-in spring that is operated electrically to control the air intake quantity that bypasses the closed throttle valve. The opening of the ISC valve varies between 0% to 100% to control the following three functions according to signals from the ECU.

1. Increase the idle revolution speed during engine warm-up by increasing the air intake when starting the engine.
2. Control the idle revolution speed according to varying engine load and operating conditions.
3. Prevent the engine from stalling by increasing the air intake (bypass) to function as a dash pot when the throttle is closed quickly e.g. during sudden deceleration etc.

2. Fuel Injector



The fuel injector is a solenoid valve with a built-in spring that is operated electrically to feed fuel into the intake manifold passage. Electricity is supplied from the ECU to the injector, and high pressure fuel is injected by the ECU closing the ground circuit and lifting the solenoid. The fuel injector closes to stop injecting fuel when the ECU opens the ground circuit.

3. Fuel Feed Pump (FFP)

Refer to the description of the vapor separator in Chapter 4.

3) Control System (ECU)

If the ECU (Engine Control Unit) fails, the engine stops.

The ECU provides the following functions.

1. Calculates the most suitable fuel injection amount and ignition timing based on the engine revolution speed, throttle position, intake vacuum, intake air temperature and engine temperature.
2. Controls the fuel injectors, ignition coils and ISC (Idle Speed Control) valve.
3. Controls the warning lamp (LED).
4. Controls the engine low speed ESG function.
5. Controls the engine high speed ESG function.
   Memorizes engine operation information.

Monitoring and failure diagnosis can be carried out using a PC on which TOHATSU DIAGNOSTICS (software) is installed and diagnostics harness.

(2) Control System

The ECU (Electronic Control Unit) is installed in the crankcase via a bracket. Data received from sensors such as pulser coil, T-MAP (Manifold Pressure, Manifold Temperature) sensor and engine temperature sensor are processed in a computer to drive the actuators (fuel injectors, ISC valves, etc.) and control the fuel injection amount and ignition timing according to the operating conditions then.

The principal control items are as follows.

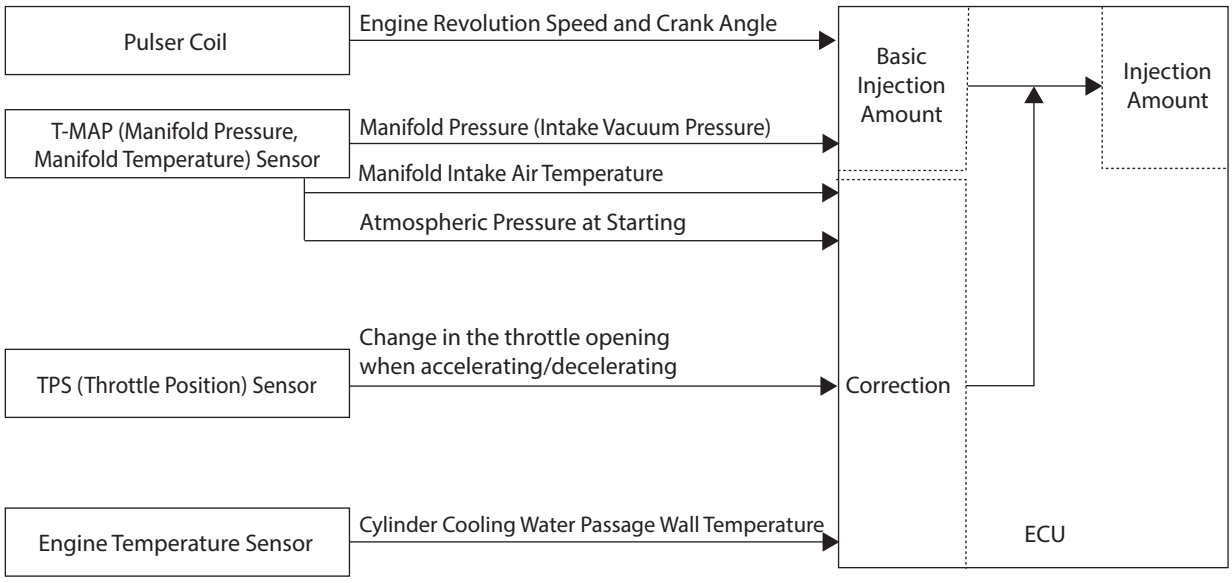
Control Item	Control Description
Ignition Timing	Sets the most suitable ignition timing according to the current operating conditions.
Fuel Injection Amount	Sets the most suitable fuel injection amount according to the current operating conditions.
ISC (Idle Speed Control)	Stabilizes the engine revolution speed during idling or low speed running by actuating the ISC valve to control the air flow in the bypass passage.
Fuel Feed Pump	Controls the actuation of the fuel feed pump (FFP).
Tachometer	Outputs the tachometer actuation pulses. Per Crankshaft Rotation (6 Pulses) (12 Poles)
Warning Buzzer*1	Emits a warning sound when an error is detected. · Only for 0.5 seconds after starting: Indicates that system operation is normal and there is no problem. · Continuous sound: When engine high speed ESG is "ON" When the engine temperature is abnormally high (95°C or higher) When engine oil pressure is abnormally low · Intermittent sound: When water temperature sensor or T-Map (Manifold Pressure) sensor is defective or sensor circuit is disconnected.
Warning Lamp (LED) (The tachometer warning lamp synchronizes and lights or flashes accordingly.)	The lamp lights or flashes when an error is detected. ·Lit only for 5 seconds after starting: Indicates that system operation is normal and there is no problem. ·Lit: When engine high speed ESG is "ON" When the engine temperature is abnormally high (95°C or higher) When engine oil pressure is abnormally low ·Flashing: Failure of the engine temperature sensor or T-MAP (manifold pressure, intake air temperature) sensor is defective or circuit disconnection
Memorizing operational data	Manages the following engine operation information: · Engine operating hours · Maximum water temperature record (Maximum water temperature and time of occurrence) · Engine high speed ESG operation record · Engine low speed ESG operation record · Malfunction records

*1: Only for Remote Control Models

(3) Fuel Injection Control

The ECU calculates the intake air quantity based on the engine revolution speed and intake manifold pressure (intake vacuum pressure) to determine the fuel injection amount.

During engine startup, warm-up, acceleration/deceleration, and idling, the ECU performs correction control based on information from the sensors.



1) Start Up Fuel Mapping

When the engine is started (cranked), the amount of fuel injected by each cylinder is increased from the normal quantity to improve the starting performance.

In addition to this basic correction, information including cooling water temperature, atmospheric pressure and intake air temperature in the manifold from individual sensors are used to correct the engine operation to the best operating conditions.

2) Acceleration Fuel Mapping

When the change in the throttle opening (TPS output) exceeds a threshold value, the ECU determines that the engine revolution speed is being increased and so it increases the fuel injection amount.

3) Deceleration Fuel Mapping

When pressure in the intake manifold is increased over a threshold value, the ECU determines that the engine revolution speed is being decreased and so it decreases the fuel injection amount.

4) Correction Based On Intake Air Temperature

The ECU adjusts and corrects the fuel injection amount relative to the manifold intake air temperature, which differs greatly depending on the outboard motor operating conditions and whether the engine is cold or warm.

5) Engine Temperature Correction

ECU adjusts fuel injection amount for correction according to cylinder cooling water temperature when engine is rotating at low speed or high speed.

ECU increases the amount when engine is cold, and resumes standard basic amount as engine warms up.

(4) Control of Fuel Feed Pump (FFP)

During normal operation: ECU performs on/off control for fuel feed pump (FFP) by using output signal from its pump control circuit.

At starting: Pump control circuit outputs a signal to the pump (FFP), and power is supplied to the DC motor to drive the pump (FFP).

When stopped: Power supply to the motor is shut off and the pump (FFP) stops.

(5) Control of Tachometer

ECU performs on/off control for tachometer by using pulse input signal (On-off signal).

Pulse output rate is 4 pulses per crank revolution (18 poles).

When using accessory tachometer, set selector switch to 12 P (poles).

(6) Warning Buzzer and Lamp (LED), and Control of Engine Revolution Speed

Warning System

When an abnormality occurs on the engine, warning buzzer sounds and warning lamp (LED) is lit or blinks.

In such case, engine speed is controlled but engine is not stopped.

1) Location of Warning Buzzer and Lamp (LED)

- Warning buzzer: In the remote control box for remote control model. (only for remote control model)
- Warning lamp (LED): In the tachometer or on the tiller handle.

  Remarks: The lamp of the tachometer (option) with warning lamp operates synchronously with the lamp (LED) of the engine side.

2) Waring Notification, Abnormality and Action to be taken

Warning Indicators				Description of faults or notice	Remedy
Buzzer	Lamp (LED)	Low speed ESG	High speed ESG		
0.5 second only	ON: 5 Sec.			Normal operating check of the system at the starting (*1)	
Continuous sound (*2)	ON (*2)	ON (*2)		Engine temp. abnormally high	(1)
				Engine Oil Pressure Low	(2)
Continuous sound	ON		ON	Engine speed exceeds maximum allowable rpm	(3)
Beep (*2)	Flashing (*2)	ON (*2)		Engine temp sensor or T-MAP (manifold pressure, intake air temperature) sensor is defective or short-circuited.	(4)

Remarks: *1: When oil pressure switch is ON.

*2: To cancel the warning display, stop the engine once.

*3: A warning buzzer is provided only for the remote control model, and it operates at shift-in. (The US model has a different remote control, so it works even when in neutral (N).)

Note: When engine low speed ESG goes on, the engine speed is controlled at 2,800 min^{-1} (rpm) or lower. Continuous operation in this state should be avoided.

High speed ESG activates above 6200 min^{-1} (rpm) (MFS6CZ), 6400min^{-1} (rpm) (MFS8C, 9.8C, 9.9CY). It cuts fuel injection and ignition to keep the engine speed below 6200 min^{-1} (rpm). Continuous operation in this state should be avoided.

Action to be taken (1): Move promptly to a safe location, set the throttle speed to low, set the shift to the Neutral (N) position, check that cooling water is discharged from the cooling water check port, and stop the engine. Remove any dirt, plastic sheets, etc. stuck around the lower unit. If no cooling water is discharged from the cooling water check port, check each part of the outboard motor.

(2): Move immediately to a safe location and stop the engine. Check the engine oil level and replenish the oil if the engine oil level is below the specified level. If the engine oil level is within the specified range, check each part.

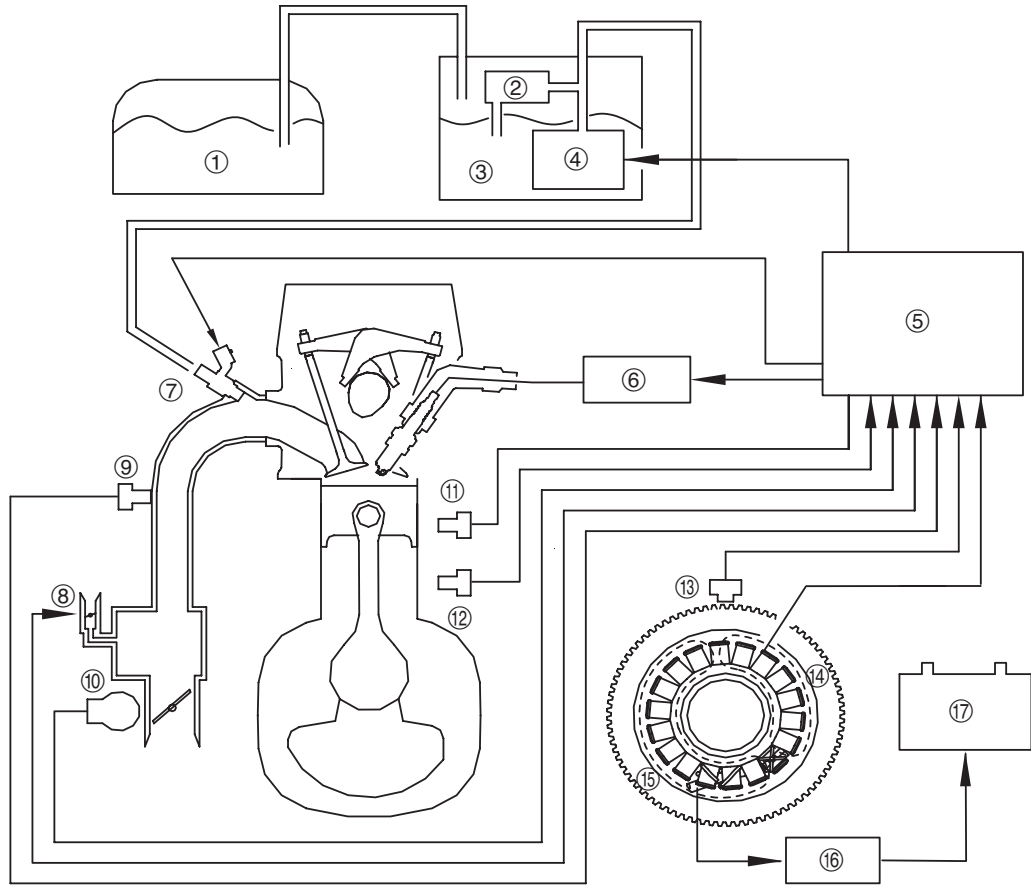
(3): Return the throttle to medium speed or lower, move promptly to a safe location, and stop the engine. Check the propeller blades to see if they are bent or damaged. Check each part if the condition does not improve even after the propeller is replaced with a new one.

(4): Go to the nearest port immediately and check each part after stopping the engine.

5. Ignition System

For ignition system, CD ignition system is adopted, and ECU's electronic ignition timing control system controls the timing to the most suitable state according to current operating conditions.

As engine is started, electric current is generated in the exciter coil of alternator. Which is input to ECU's regulator to feed power needed for operations of ignition coil, fuel injector and fuel feed pump (FFP).



① Fuel Tank
② Fuel Regulator
③ Vapor Separator
④ Fuel Feed Pump (FFP)
⑤ ECU
⑥ Ignition Coil
⑦ Fuel Injector
⑧ ISC Valve
⑨ T-MAP Sensor
⑩ TPS
⑪ Engine Temperature Sensor
⑫ Oil Pressure Switch
⑬ Pulser Coil
⑭ Exciter Coil
⑮ Charge Coil
⑯ Rectifier Regulator
⑰ Battery
* ⑮ , ⑯ , ⑰ : For electric starter models only

(1) Configuration of Ignition System

The ignition system consists of mainly the following components.

(1) Sensors and switches that transmit the engine operating status to the ECU

(2) ECU that electronically controls some parts based on input from sensors

(3) Ignition coils, spark plugs, etc., that operate in accordance with outputs from the ECU

The following 6 components are included in the sensors and switches in (1).

· Pulser coil	Crank position [Crank Position Sensor]
· Throttle Position Sensor (TPS)	Throttle opening angle
· Engine Temperature Sensor	Temperature of Cooling Water (Crankcase)
· T-MAP (Manifold Pressure) Sensor	Intake air vacuum pressure and temperature
· Oil Pressure Switch	Reduction of hydraulic pressure

(2) Ignition Control

The ECU's microcomputer is pre-programmed with optimal ignition timings according to the condition of the engine. The ECU obtains information about the engine operating status such as the revolution speed, throttle opening, manifold pressure (air intake vacuum pressure), cooling water temperature etc. based on the signals from the above-mentioned sensors to ignite the fuel at the optimal ignition timing.

1) Ignition Timing Control

Ignition timing control is classified into two types, the first type by correcting the ignition timing during normal operation, and the second type by fixing the ignition advance angle (at engine startup or when an error occurs). In either case, ECU corrects ignition time or fixes it to the base.

- The basic ignition timing is determined by the engine revolution speed and manifold pressure (intake air vacuum pressure).
- Signals that are used for correction of ignition timing includes cooling water temperature, manifold intake air temperature, change of pressure at acceleration/deceleration under atmospheric pressure, and engine revolution speed.
- Ignition timing is fixed to the base at acceleration, deceleration, when high speed ESG is on, low speed ESG is on, or when hydraulic pressure is reduced.

2) Ignition and Combustion Order

No. of Ignitions: Once per revolution of each cylinder (around the end of the compression and exhaust strokes)
Ignition Order: Simultaneous ignition
Combustion Order : #1 → #2 → #1 (every 360 degrees of crank angle)

3) Ignition Timing

The ignition timing is set as described below.

Model	Range of Ignition Angle	Engine Starting	Idling
MFS8C	TDC 0° - BTDC 32°	BTDC 5°	TDC 0°±5°
MFS9.8C	TDC 0° - BTDC 32°	BTDC 5°	TDC 0°±5°

4) Operations

- At Engine Starting and During Warm-up
  Ignition timing is fixed at BTDC5° at engine startup.
  The input signal and the engine temperature, manifold intake air temperature, engine speed and atmospheric pressure, on the basis of the programs stored in the ECU, the microcomputer determines the ignition timing after starting.

- During idling and low speed running
  When the ECU receives the manifold pressure (intake air vacuum pressure) signal and input signal from the pulser coil (engine revolution speed signal), it controls the ignition timing so that the idling and low speed revolution speeds stabilize.

- During normal operation
  Microcomputer determines ignition timing in accordance with ECU's program by using cooling water temperature, manifold intake air temperature, atmospheric pressure and engine revolution speed as input signals. The maximum timing during normal operation is BTDC 32°.

- High speed ESG
  When the engine revolution speed exceeds the maximum allowable value (6,200 min^{-1} (rpm) (MFS6CZ), 6,400min^{-1} (rpm) (MFS8C, 9.8C, 9.9CY)), the ECU cuts fuel injection and ignition to control revolution based on pulser coil signals.

- Low speed ESG
  When any of the following state has been detected, engine revolution speed is controlled to 2,800r/min^{-1} (rpm) to prevent or reduce engine damage.
  - Engine is overheating.: The engine temperature sensor detects 95°C or higher.
  - Engine hydraulic pressure is low: Oil pressure switch is ON (24.5 KPa (3.6 psi) [0.25 kg/cm^2] or less) is detected.
  - Sensor defective: Engine temperature sensor or T-Map sensor is defective, or the sensor circuit is disconnected.

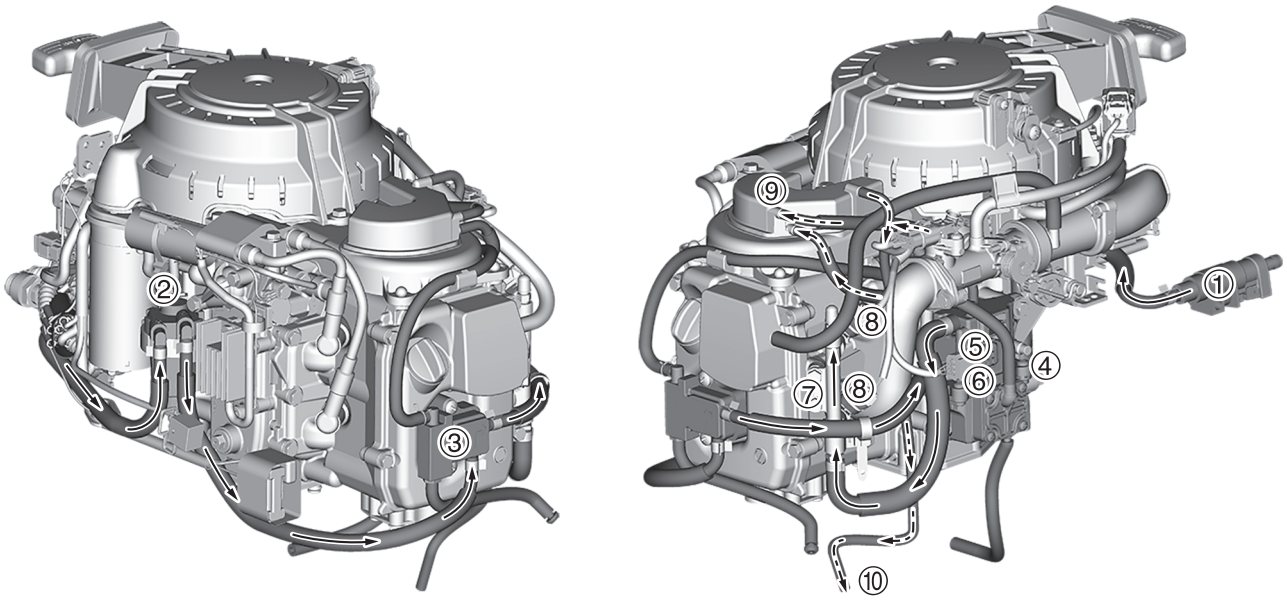
(3) Fuel Feed System

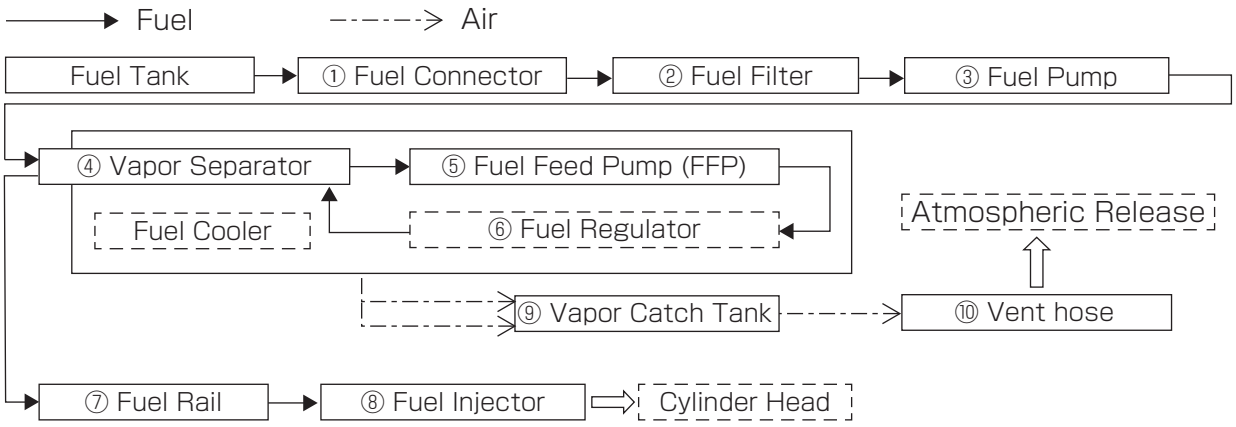
The fuel pump ③ [low-pressure mechanical] draws fuel from the fuel tank and supplies it to the fuel feed pump ⑤ (FFP) [high-pressure electric] inside the vapor separator ④ through the fuel connector ① and fuel filter ②.

Highly pressurized fuel is fed into the fuel rail ⑦ and fuel injector, and is then injected into the intake manifold.

Excessive fuel that is not used by fuel injector passes through the fuel regulator ⑥, and circulated in the vapor separator ④ to keep fuel pressure constant.

Stabilization of fuel pressure is performed by the fuel regulator built into the vapor separator.



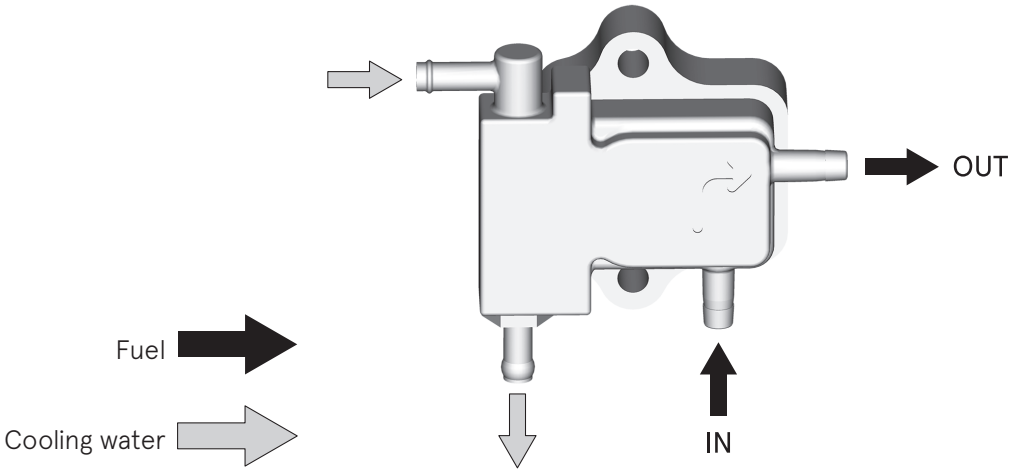


6. Components of Fuel Feed System

1) Fuel Pump [Low Pressure Mechanical Pump]

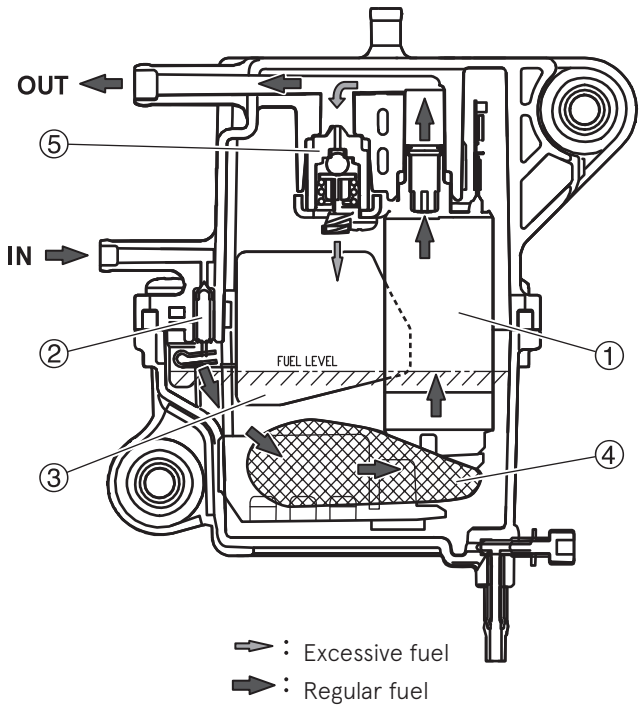
The fuel pump is a diaphragm pump that is operated mechanically by the camshaft.

Due to the cooling system, cooling water enters from the vapor separator, cools the fuel, and then discharges to the cooling water check port.



2) Vapor Separator

The vapor separator feeds only liquid fuel for internal fuel feed pump (FFP) ① (electrical high pressure pump). Fuel that is fed from fuel pump (low pressure mechanical pump) is sent to the vapor separator, where it is controlled with needle valve ②/float ③ assy. When the fuel passes through the Fuel Feed Pump (FFP), debris is removed by the fuel filter (suction side) ④. High pressure fuel from the fuel feed pump (FFP) is fed to the fuel injector through the fuel rail. Excessive fuel is returned to the chamber by a fuel regulator ⑤ that is built into the vapor separator. In addition, a fuel cooler is mounted in the vapor separator to suppress an increase in the fuel temperature.

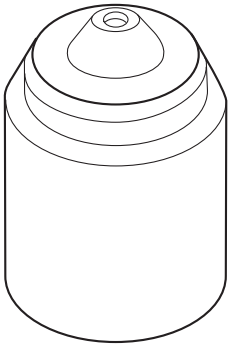


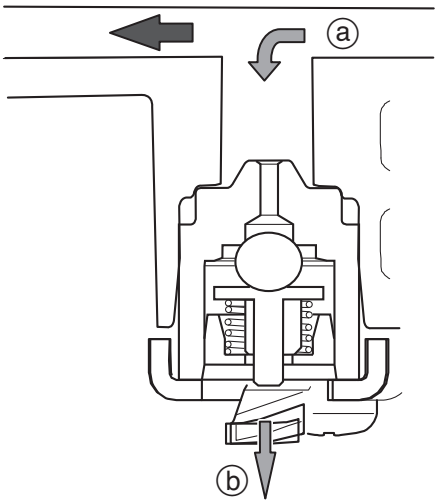
① Fuel Feed Pump
② Needle Valve
③ Float
④ Fuel Filter (suction side)
⑤ Fuel Regulator

3) Fuel Regulator

The fuel regulator located inside the vapor separator serves to keep the fuel pressure constant.

The fuel regulator is located in the passage connecting the high-pressure side and the chamber (low-pressure side), with a spring inside that pushes a ball to seal it (valve closed). When the pressure in the high-pressure passage exceeds a certain level, the spring is compressed, the valve opens, and fuel is returned to the chamber, maintaining constant fuel pressure on the high-pressure side.



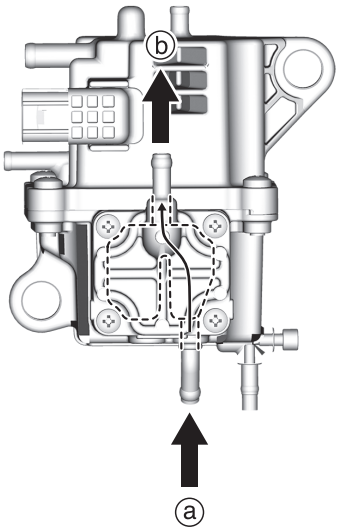


ⓐ High-Pressure Fuel Passage (discharge side of FFP)

ⓑ When the pressure exceeds a certain level, fuel is returned to the chamber (suction side of FFP)

4) Fuel Cooler

The vapor separator and fuel cooler are integrated into a single structure. Engine cooling water flows right next to the chamber where the fuel accumulates, cooling the fuel. The water passage branches to the drive shaft housing, passing through the vapor separator and the [low-pressure mechanical] fuel pump, and is discharged from the cooling water check port.



ⓐ Cooling Water Inlet

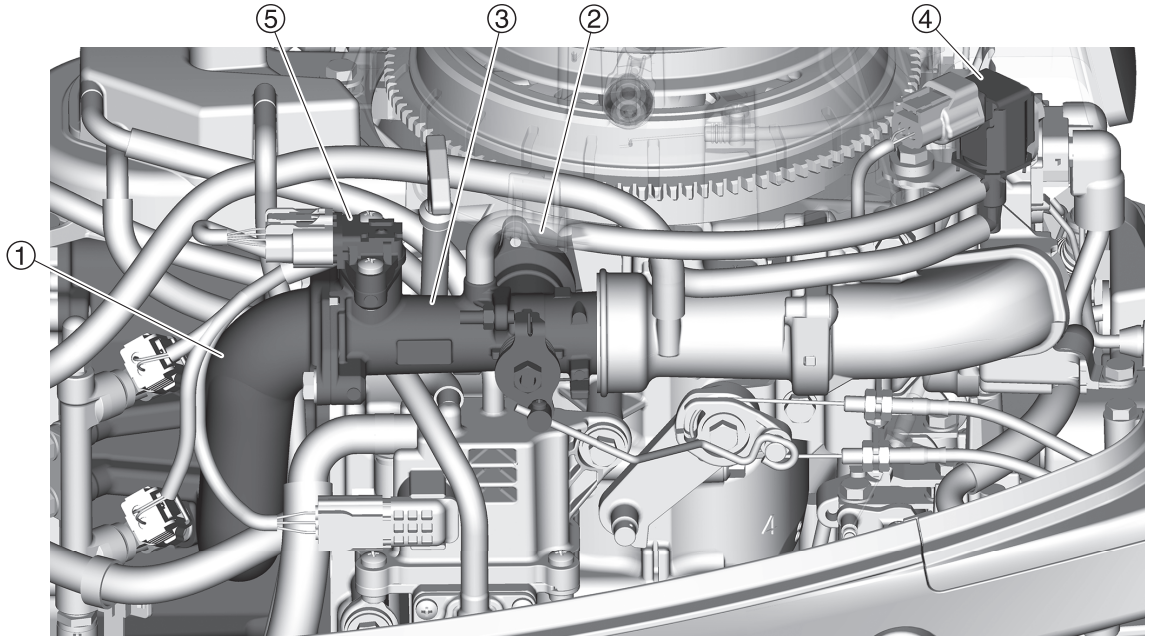
ⓑ Cooling Water Outlet

7. Outline of Fuel Injection System

1) Air Intake System

The air intake system consists of intake manifold ①, throttle position sensor ②, throttle body ③, ISC (idle speed control) valve ④, and T-MAP (manifold pressure and temperature) sensor ⑤.

The fuel rail and fuel injector are installed in the intake manifold ①.

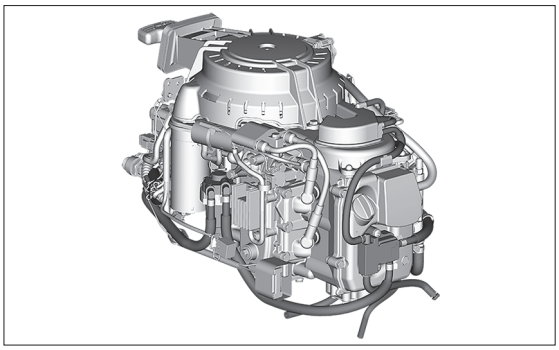


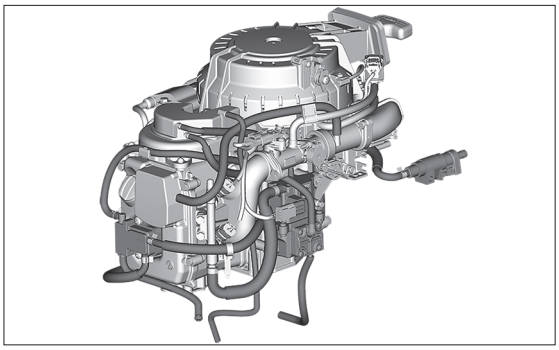
① Intake Manifold
② Throttle Position Sensor
③ Throttle Body
④ ISC (Idle Speed Control) Valve
⑤ T-MAP (Manifold Pressure and Temperature) Sensor

8. Inspection Items

1) Inspection of Fuel Supply System

Check the fuel system piping for fuel leak, dirt, deterioration and damage, and replace or repair parts if necessary.

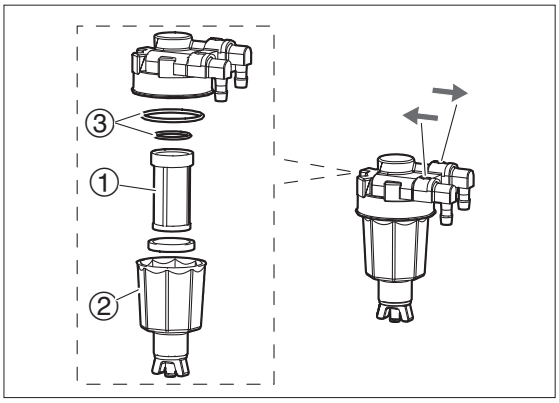




2) Inspection of Filter

1. Check if there is any dirt in fuel filter ①, or if there is any fuel varnish, debris, deposits and contamination by foreign matter or water in the fuel filter cup ②, or if there are any cracks. Wash the fuel filter cup ② with gasoline, and replace the filter ① where necessary.

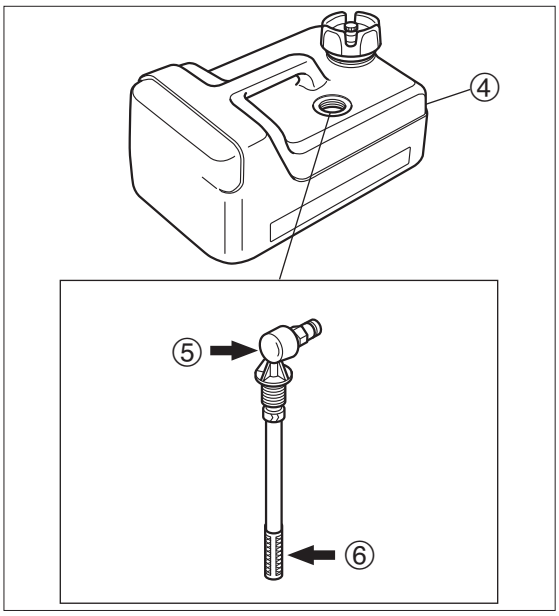
When removing the fuel filter cup, use a rag or container to catch any fuel so there is no spillage.



③ O-ring **Do not reuse.**

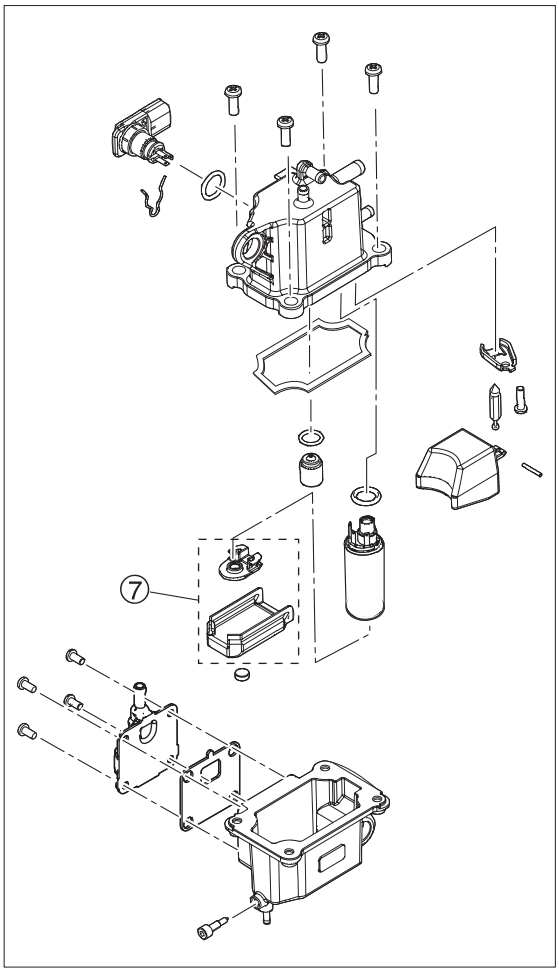
2. Cleaning of Fuel Tank Filter
   Remove the fuel pick up elbow ⑤ of the fuel tank ④ counterclockwise to remove the part, and clean the filter ⑥.

3. Cleaning of Fuel Tank ④
   Clean the fuel tank ④ if there is any dirt or water.

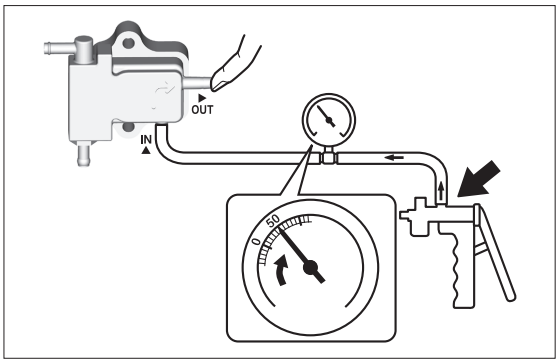


④ Fuel Tank ⑤ Fuel Pick Up Elbow
⑥ Filter

4. Remove and inspect the fuel filter (suction side) from the fuel feed pump (FFP) in the vapor separator. Replace it if it is dirty.



3) Inspection of Fuel Pump



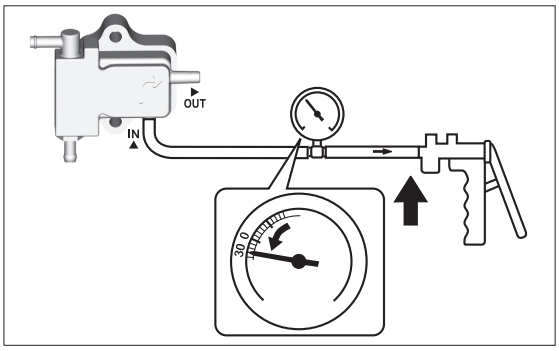
1. Remove the fuel hoses (2 pcs.) from the fuel pump.

2. Connect the vacuum/pressure gauge to the inlet of the fuel pump.

3. Close the fuel pump outlet with your finger and apply the specified pressure. Make sure there are no air leaks.

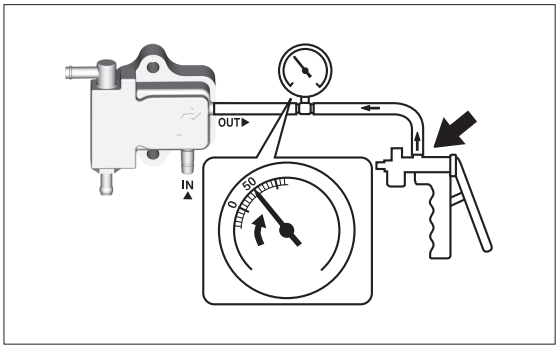
Vacuum/Pressure Gauge:
P/N. 3AC-99020-1

Specified Pressure:
50 KPa (7 psi) [0.5 kgf/cm²]



4. With the outlet closed, apply the specified vacuum pressure to check that there are no air leaks.

Specified vacuum pressure:
−30 kPa (−4 psi) [−0.3 kgf/cm²]



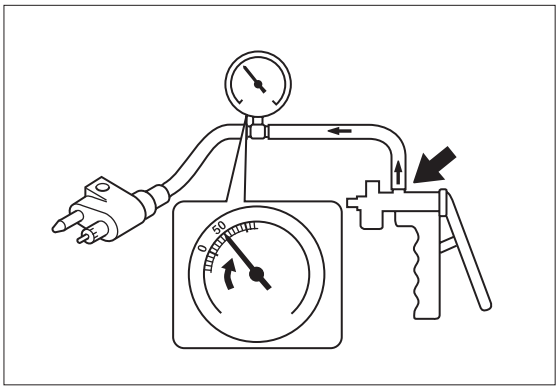
5. Connect the vacuum/pressure gauge to the outlet of the fuel pump.

6. Apply the specified pressure to make sure that there are no air leaks. Replace if necessary.

The air-tightness of the fuel pump can be increased by wetting the inside of the fuel pump with gasoline.

Specified Pressure:
50 KPa (7 psi) [0.5 kgf/cm²]

4) Inspection of Fuel Connector



1. Check fuel connector for crack and damage.

2. Connect vacuum/pressure gauge to outlet of fuel connector.

3. Apply the specified pressure, and check if the pressure is maintained for 10 seconds. Replace if necessary.

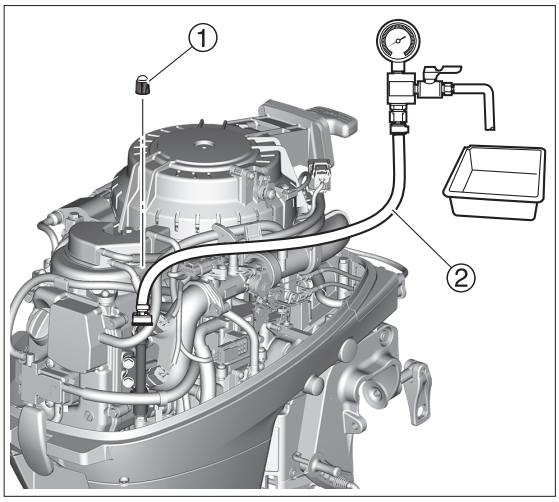
Vacuum/Pressure Gauge:
P/N. 3AC-99020-1

Specified Pressure:
30kPa (4 psi) [0.3 kgf/cm²]

5) Measurement of Fuel Pressure

1. Remove the cap .

2. Connect the pressure gauge as shown in the figure.



⚠ WARNING

- **Before measurement, check that pressure relief valve is fully closed.**
- **Before connecting pressure gauge, cover connection between pressure gauge and valve with clean and dry cloth to prevent fuel from releasing.**
- **Connect the pressure gauge securely.**

Pressure Gauge Assembly:
P/N. 3T5-72880-0

3. Start the engine, run it for 5 minutes to warm up, and then measure the fuel pressure. If the pressure is below specified value, check high pressure fuel passage and vapor separator.

⚠ WARNING

- **Before measurement, be sure to check that the pressure relief valve is fully closed.**
- **Do not open the pressure relief valve during measurement. Opening the valve allows fuel to spew out, possibly causing fire.**
- **After measurement, cover hose tip with rag, and open pressure relief valve to drain fuel from discharge hose and the instrument.**
- **Before storing pressure gauge, fully close pressure relief valve.**

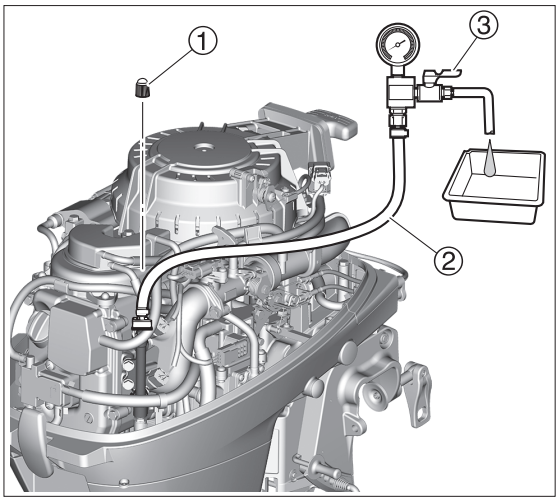
Fuel Pressure (Reference value):
250± 5 kPa
(35.5 ±0.724 psi) [2.5 ±0.05 kg/cm²] (at 10 L/h)

To measure the fuel pressure without operating the engine, remove lock plate of engine stop switch and pull recoil starter 4 to 5 times to measure the fuel pressure.

6) Draining Fuel

1. Remove the cap ①.

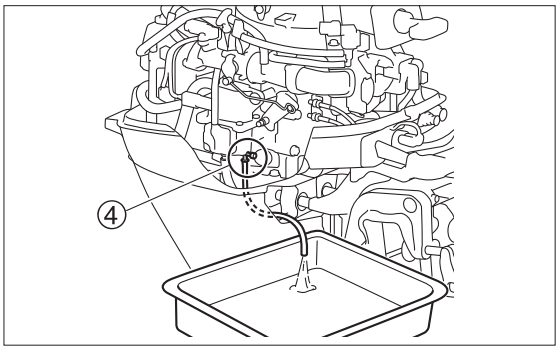
2. Connect the pressure gauge assembly ② as shown in the figure, place a vessel below the pressure relief hose, and open the pressure relief valve ③ to release the fuel pressure.



⚠ WARNING

Be sure to reduce the fuel pressure in the high pressure fuel passage before servicing the fuel passage and/or vapor separator. Performing the service without releasing the pressure causes compressed fuel to be injected, possibly causing a hazard.

3. Place a vessel below vapor separator drain hose, and loosen drain screw ④ to drain fuel from vapor separator drain hose.

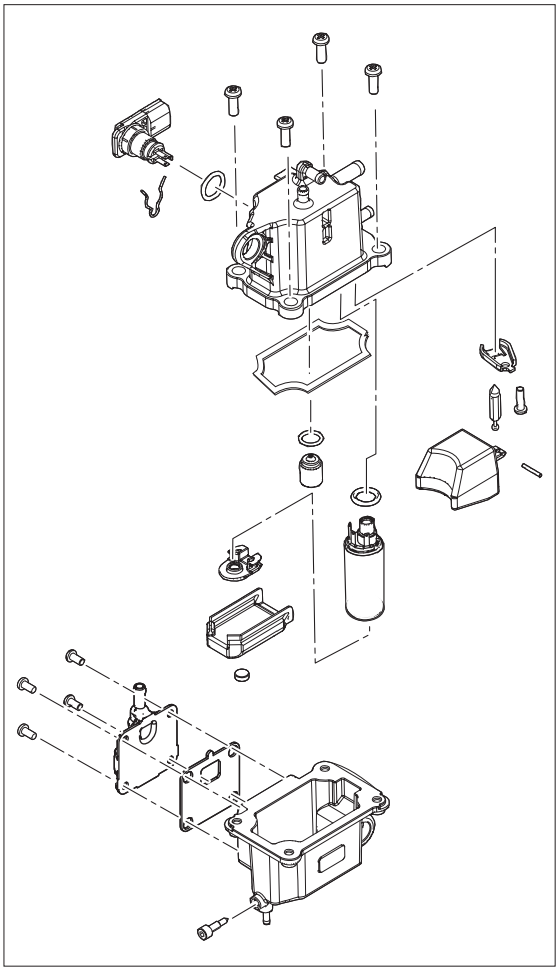


7) Disassembly of Vapor Separator

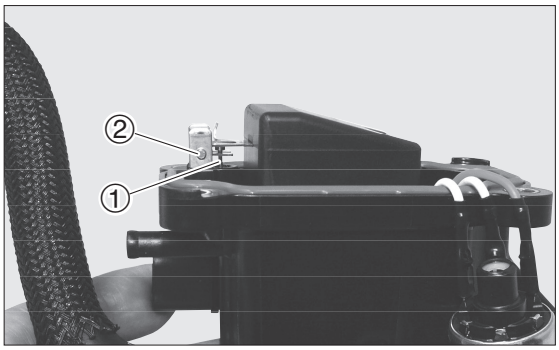
⚠ WARNING

Be sure to reduce the fuel pressure in the high pressure fuel passage before servicing the fuel passage and/or vapor separator. Performing the service without releasing the pressure causes compressed fuel to be injected, possibly causing a hazard.

1. Remove the float chamber of the vapor separator.

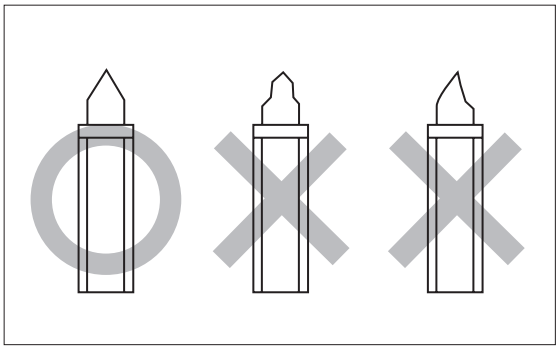


2. Remove the needle valve ①, float pin ②, and float.



8) Inspection of Vapor Separator

1. Check the needle valve for bend and wear. Replace if necessary.



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

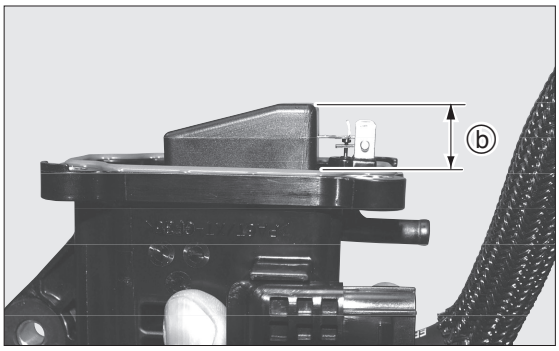
3.Check the filter for dirt and clogging. Clean if necessary.

4.Reinstall the needle valve, float and float pin, and check that the parts moves smoothly.

5.Check the float height ⓑ as shown. Replace the float or needle valve if the height is out of the specified range.

Do not press the needle valve with the float.

Float Height ⓑ:
15.2 mm (0.598 in)

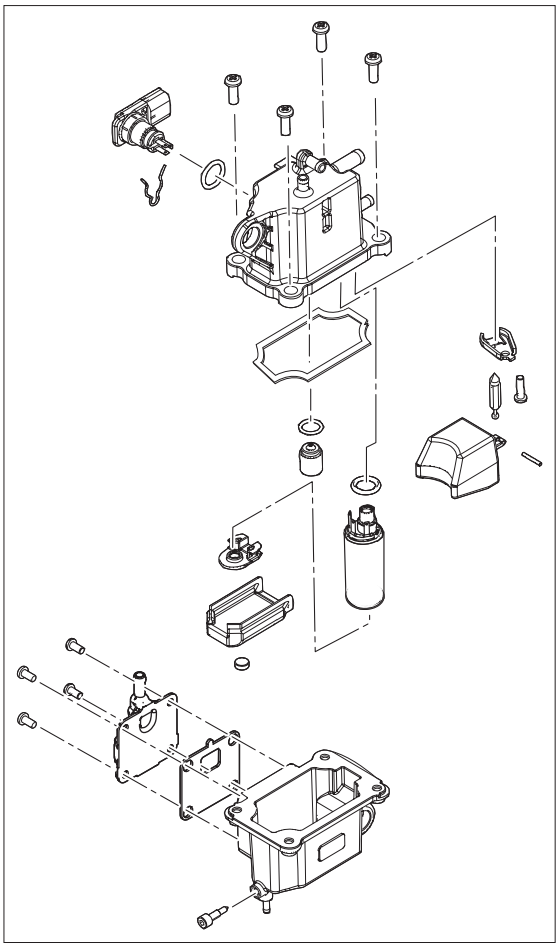


9) Reassembly of Vapor Separator

1. Attach the float chamber to the vapor separator.

2. Reassemble all parts that were removed.

Check that the hose is reconnected correctly.

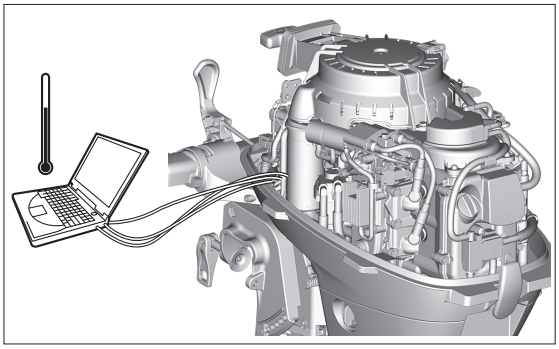


10) Inspection of ISC (Idle Speed Control)

1. Use the diagnosis system to check operation of the ISC (Idle Speed Control) valve. The value may be significantly higher than the reference value when there is abnormality in the engine.

ISC Duty Ratio:
30 to 50% (at idling speed)

2. Disconnect hose at intake silencer side of ISC valve, close the hole from which the hose was disconnected with a finger to check if engine speed is reduced. Replace the ISC valve if not.



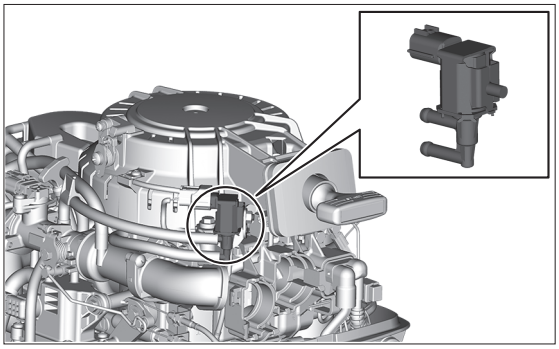
11) Inspection of Idle Speed

1. Start the engine and run for 5 minutes to warm up.

2. Check the idle speed.

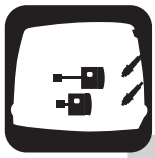
Tachometer:
P/N. 3AC-99010-0

Idle Revolution Speed:
950 min^{-1} (rpm)

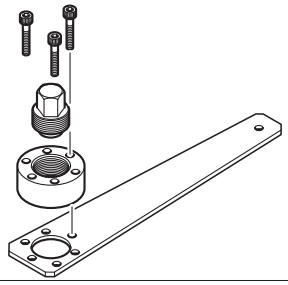
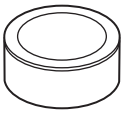
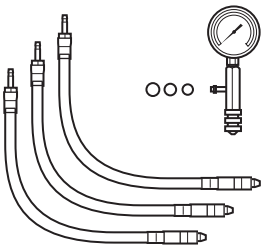
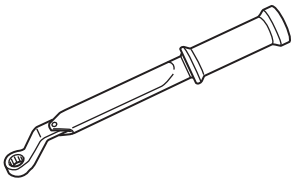
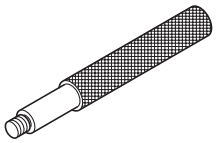
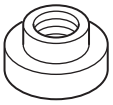
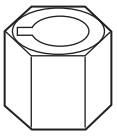
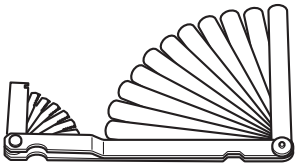
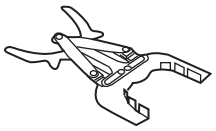


5

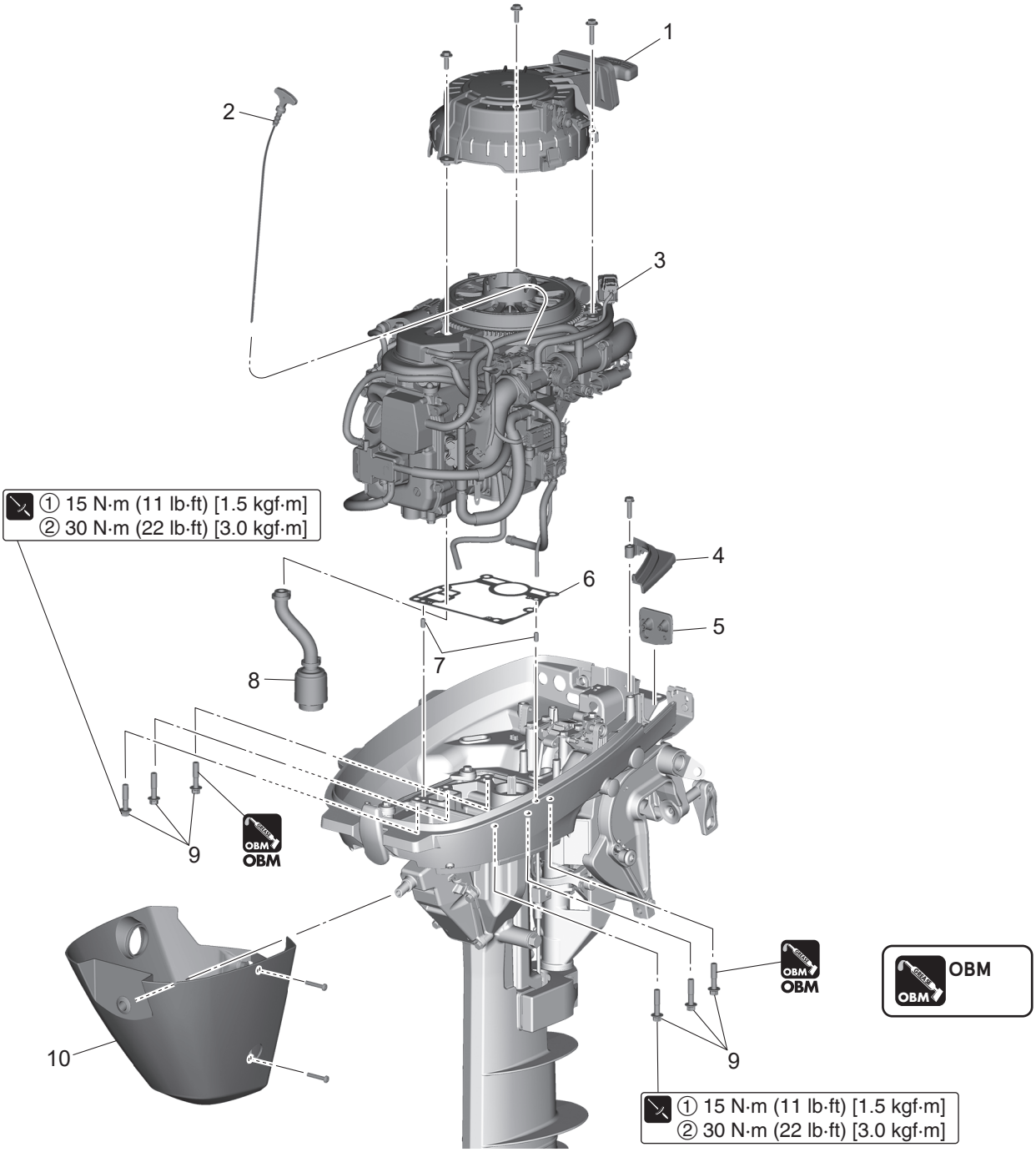
Power Unit



1. Special Tools

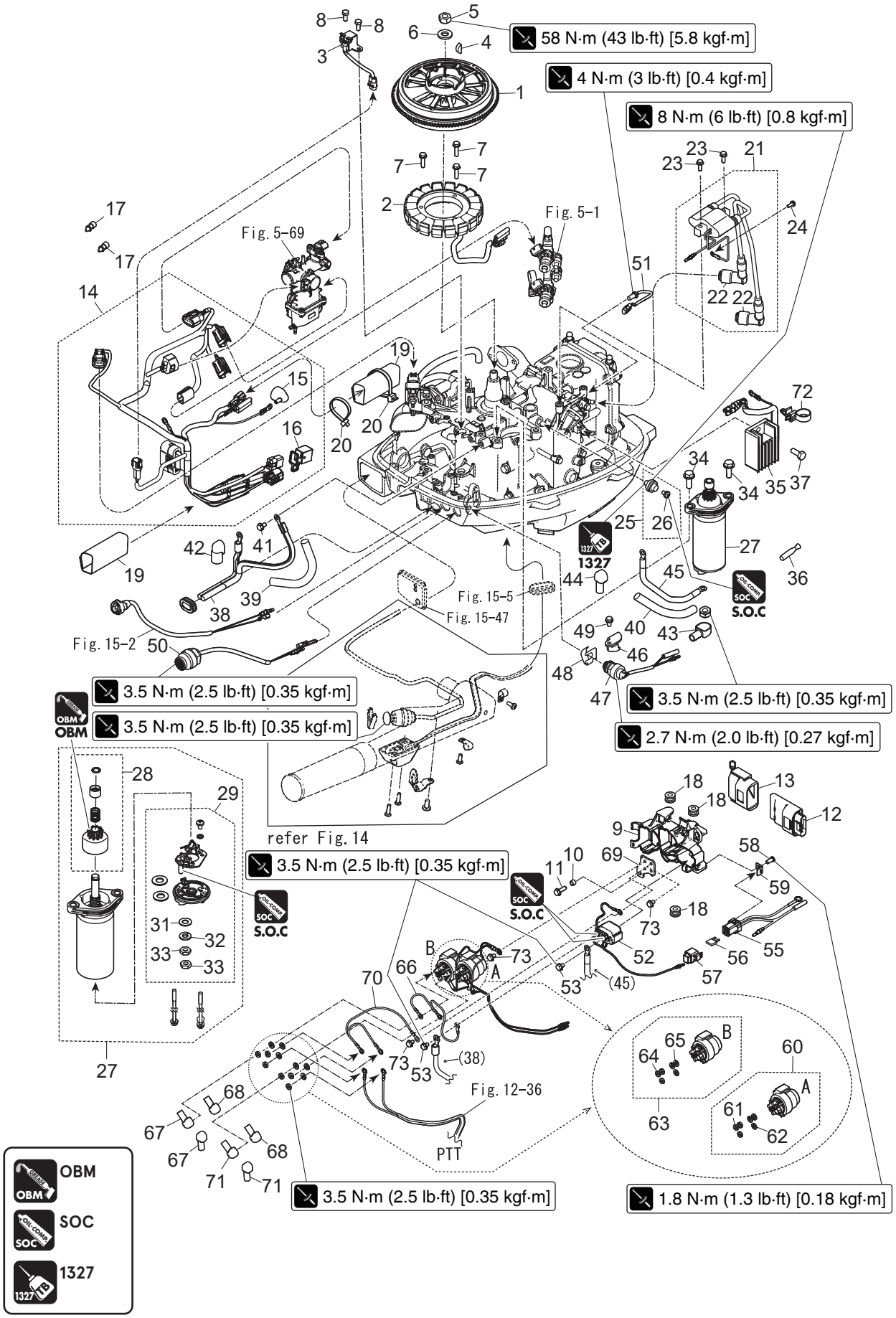
			
Flywheel Puller Kit P/N. 3V1-72211-1	Piston Slider P/N. 3V1-72871-0	Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0
Removing and installing flywheel	Installing piston	Measuring compression pressure	Adjusting valve clearance
		ø34.5 x ø17.5 	
Valve Clearance Driver P/N. 3AC-99071-0	Driver Rod P/N. 3AC-99702-0	Oil Seal Attachment P/N. 3AC-99820-0	Crank Shaft Holder P/N. 31H-72815-0
Adjusting valve clearance	Installing oil seal	Installing cam shaft oil seal oil seal	Holding crankshaft
			
Thickness Gauge P/N. 353-72251-1	Piston Ring Tool P/N. 353-72249-0		
Measuring gaps	Removal/installation of piston rings		

2.Parts Layout
Engine

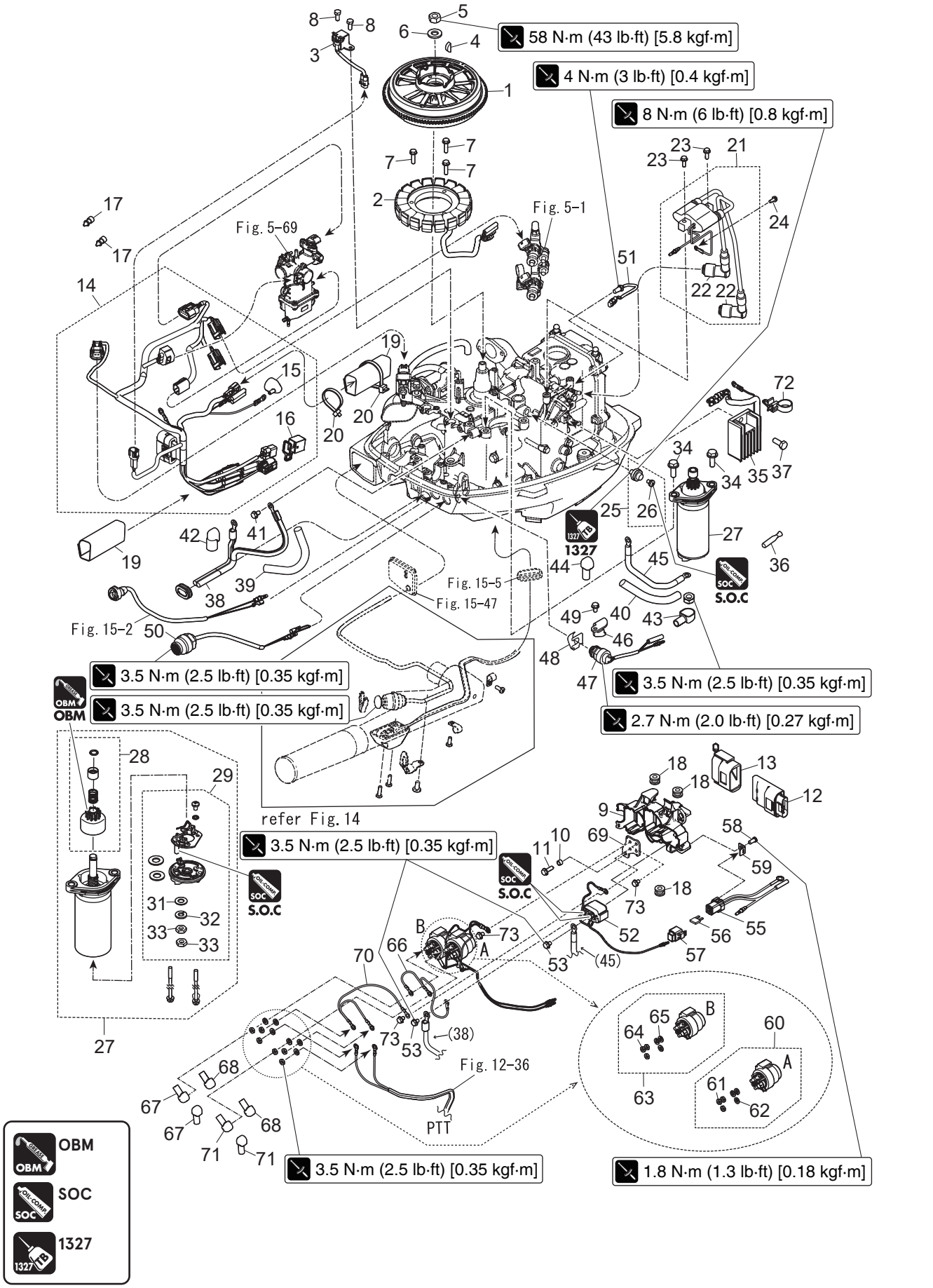


Ref. No.	Part Name	Q'ty	Remarks
1	Recoil Starter	1	
2	Oil Level Gauge	1	
3	Power Unit	1	
4	Stay Cover	1	
5	Grommet	1	
6	Engine Base Gasket	1	Do not reuse.
7	Dowel Pin	2	
8	Oil Strainer	1	
9	Bolt	6	
10	Drive Shaft Housing Cover	1	

Magneto & Electric Parts

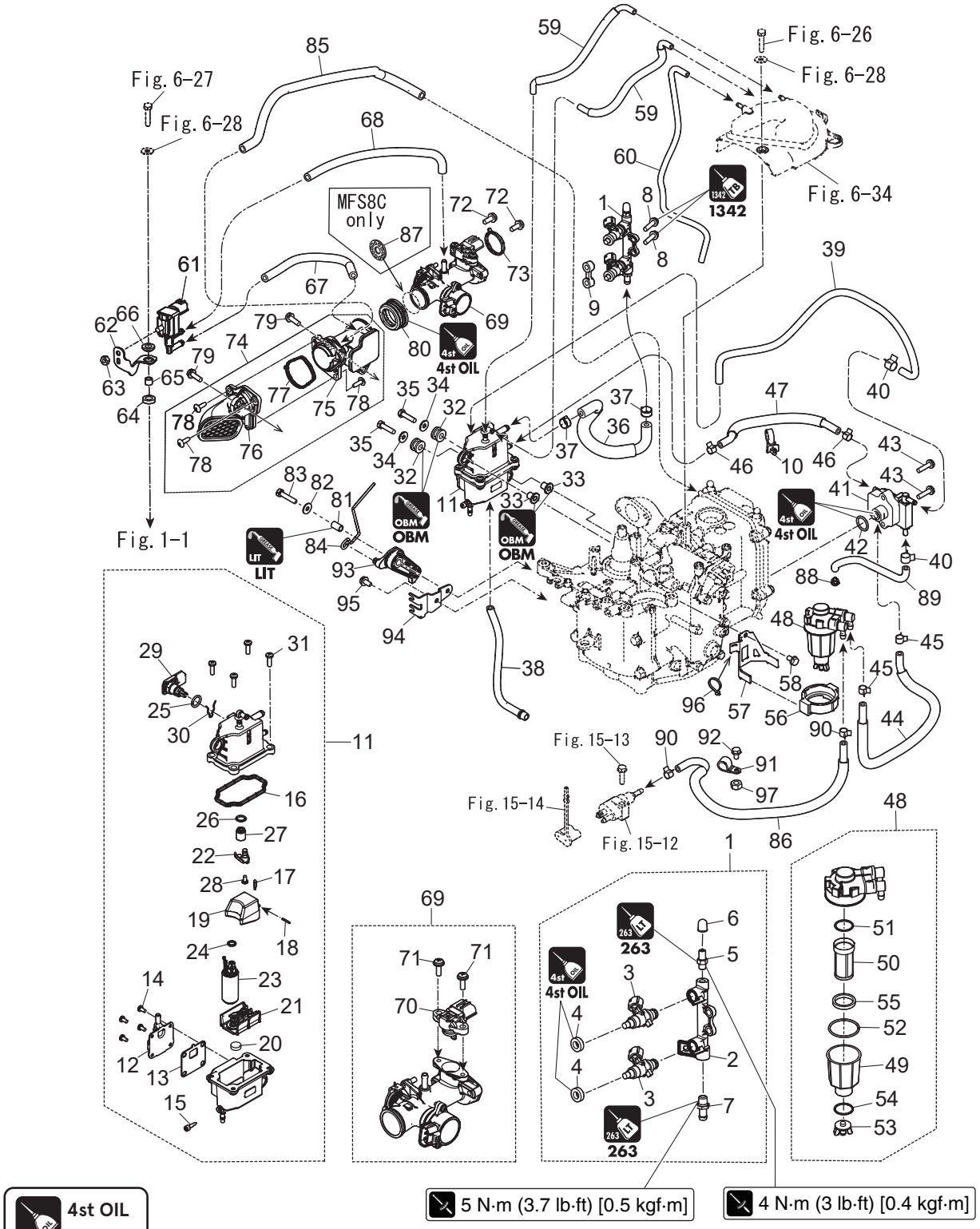


Ref. No.	Part Name	Q'ty	Remarks
1	Flywheel Assy	1	
2	Alternator Assy	1	
3	Pulser Coil	1	
4	Key 13.4-5-4	1	
5	Nut 12-P1.25	1	
6	Washer	1	
7	Bolt	3	
8	Bolt	2	
9	Electrical Bracket	1	
10	Collar	1	
11	Bolt	1	
12	ECU Assy (9.8)	1	
13	ECU Holder	1	
14	Cord Assy	1	
15	Grommet Oil Pressure Switch	1	
16	Cable Terminal Plug	1	Diagnostic Connector Cap
17	Cable Terminal Plug	2	MF
18	Rubber Mount	3	
19	Protector	2	
20	Band	2	Do not reuse.
21	Ignition Coil W/R-cap	1	
22	* Plug Cap W/Resistance	2	
23	Bolt	2	
24	Bolt	1	
25	Oil Pressure Switch	1	
26	* Screw	1	
27	Starter Motor Assy	1	EP EPT EF EFT
28	* Pinion Assy	1	EP EPT EF EFT
29	* Brush Holder Assy	1	EP EPT EF EFT
31	** Washer	1	EP EPT EF EFT
32	** Spring Washer	1	EP EPT EF EFT
33	** Nut	2	EP EPT EF EFT
34	Bolt	2	EP EPT EF EFT
35	Rectifier Complete	1	EP EPT EF EFT
36	Plug	1	
37	Bolt	1	EF EFT EP EPT
38	Battery Cable L=2500	1	EF EFT EP EPT
39	Protector	1	EF EFT EP EPT
40	Protector	1	EF EFT EP EPT

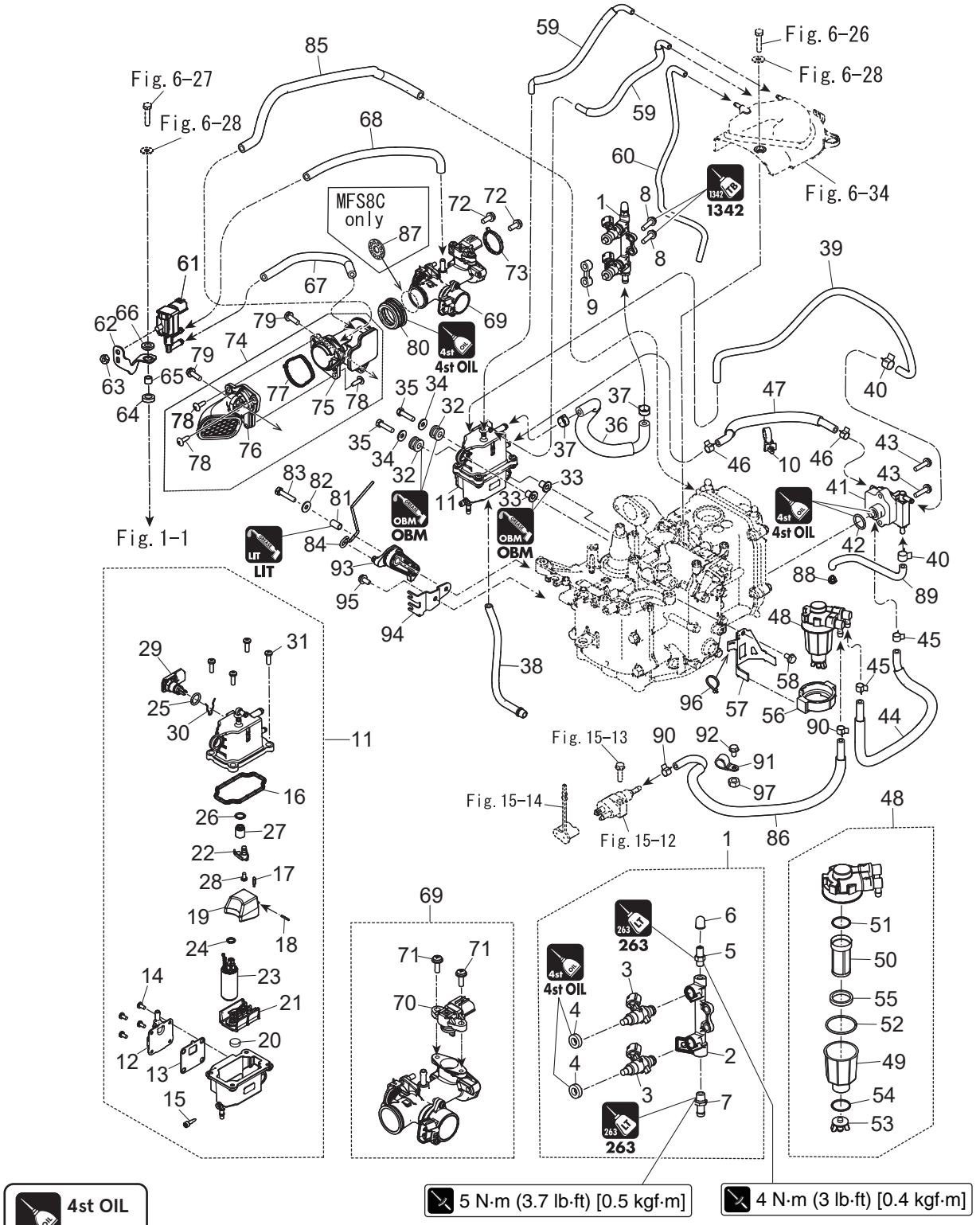

58 N·m (43 lb·ft) [5.8 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]
8 N·m (6 lb·ft) [0.8 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
2.7 N·m (2.0 lb·ft) [0.27 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
1.8 N·m (1.3 lb·ft) [0.18 kgf·m]
Fig. 5-1
Fig. 5-69
Fig. 15-5
Fig. 15-47
Fig. 15-2
Fig. 12-36
refer Fig. 14
1327
S.O.C
OBM
PTT
OBM
SOC
1327

Ref. No.	Part Name	Q'ty	Remarks
41	Bolt	1	EF EFT EP EPT
42	Terminal Cap	1	EF EFT EP EPT
43	Terminal Cap	1	EF EFT EP EPT
44	Terminal Cap	1	EF EFT EP EPT
45	Starter Cable L=200	1	EF EFT EP EPT
46	Neutral Switch Bracket	1	EF EFT EP EPT
47	Neutral Switch	1	EF EFT EP EPT
48	Neutral Switch Actuator	1	EF EFT EP EPT
49	Bolt	1	EF EFT EP EPT
50	Main Switch Assy	1	EF EFT
51	Engine TEMP Sensor	1	
52	Starter Solenoid	1	EF EFT EP EPT
53	Bolt	2	EF EFT EP EPT
55	Fuse Wire Assy	1	EF EFT EP EPT
56	Fuse 20A	2	EF EFT EP EPT
57	Fuse Box Cap (Y)	1	EF EFT EP EPT
58	Tapping Screw 5-12	1	EF EFT EP EPT
59	Fuse Holder Bracket	1	EF EFT EP EPT
60	PTT Solenoid Switch (A)	1	EFT EPT
61	* Nut	3	EFT EPT
62	* Spring Washer	3	EFT EPT
63	PTT Solenoid Switch (B)	1	EFT EPT
64	* Nut	3	EFT EPT
65	* Spring Washer	3	EFT EPT
66	Solenoid Switch Cord (A)	1	EFT EPT
67	Terminal Cap	2	EFT EPT
68	Starter Terminal Cap	2	EFT EPT
69	Bracket	1	EF EFT EP EPT
70	Solenoid Switch Cord (B)	1	EFT EPT
71	Terminal Cap	2	EFT EPT
72	Band	1	EF EFT EP EPT Do not reuse.
73-1	Bolt	1	EF EP
73-2	Bolt	3	EFT EPT
74-1	Washer	1	EF EP
74-2	Washer	3	EFT EPT

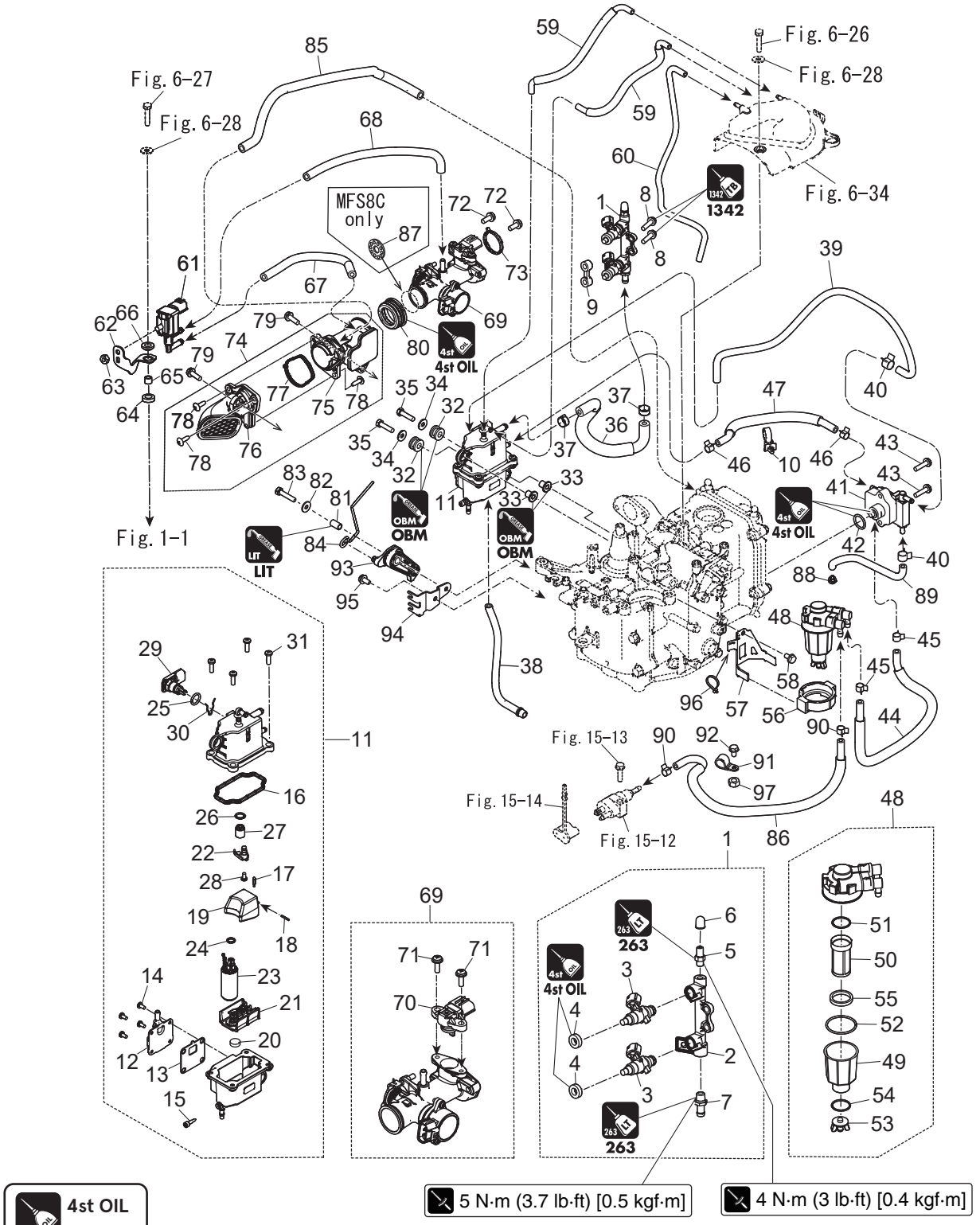
Intake Manifold & Fuel Pump



Ref. No.	Part Name	Q'ty	Remarks
1	Fuel Rail Assy	1	
2	* Fuel Rail	1	
3	* Fuel Injector Assy	2	
4	* Seal Ring	2	Do not reuse.
5	* Valve Assy (Pressure Check)	1	
6	* Valve Cap	1	
7	* Nipple	1	
8	Bolt	2	
9	Insulator	1	
10	Band	1	Do not reuse.
11	Vapor Separator Assy	1	
12	* Cover	1	
13	* Seal	1	Do not reuse.
14	* Screw	4	
15	* Drain Screw	1	
16	* Gasket	1	
17	* Float Valve Assy	1	Do not reuse.
18	* Float Arm Pin	1	
19	* Float	1	
20	* Grommet	1	
21	* Filter (Inlet)	1	
22	* Holder	1	
23	* Fuel Feed Pump	1	
24	* O-ring	1	Do not reuse.
25	* O-ring	1	Do not reuse.
26	* O-ring	1	Do not reuse.
27	* Fuel Regulator	1	
28	* Screw	1	
29	* VST Connector	1	
30	* Clip	1	
31	* Screw	4	
32	Rubber Mount	2	
33	Collar	2	
34	Washer 6-16-1.5	2	
35	Bolt	2	
36	Fuel Hose W/Protector	1	
37	Clamp	2	
38	Hose	1	
39	Water Hose	1	
40	Clip ø9.4	2	

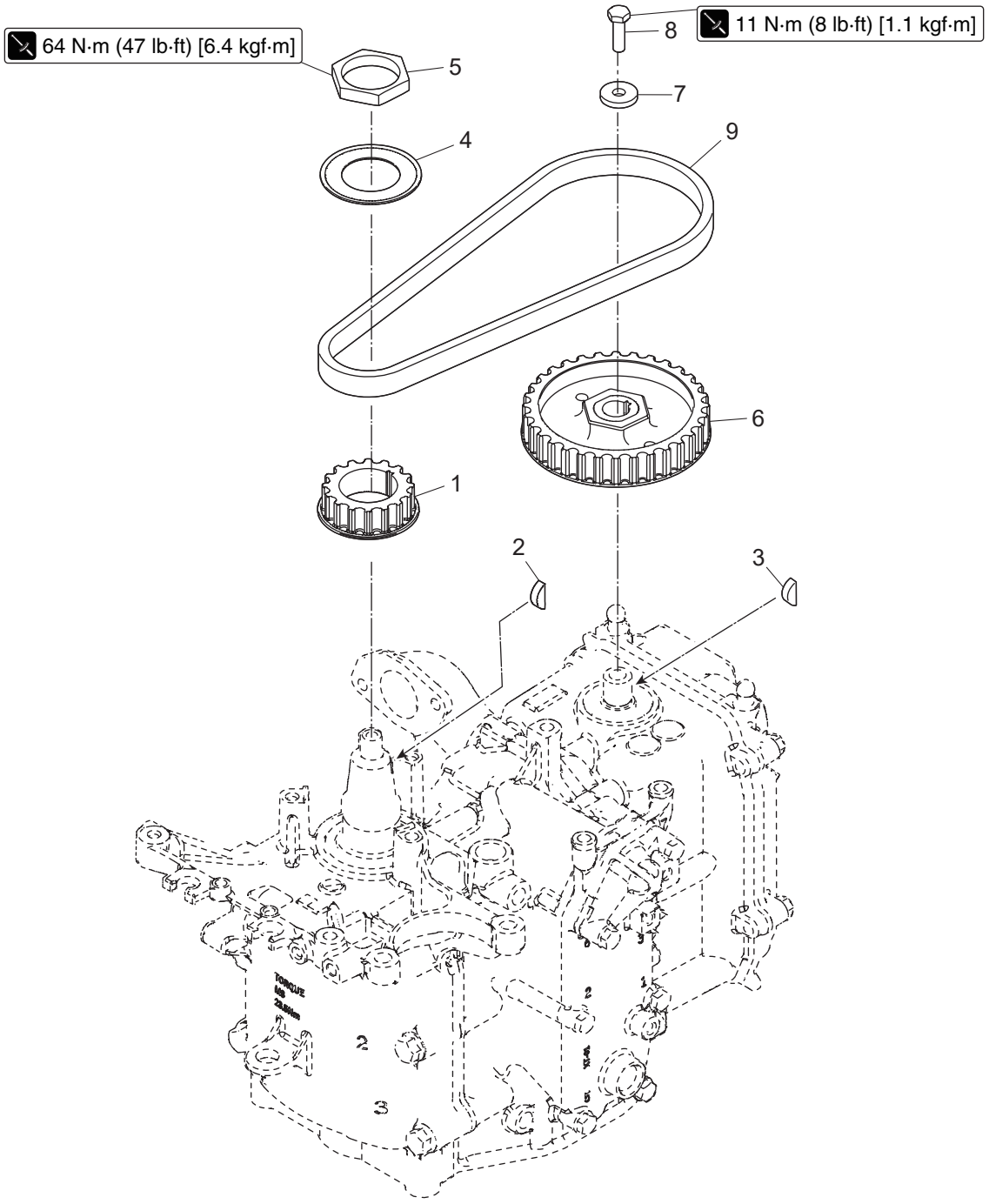

MFS8C only
Fig. 6-26
Fig. 6-27
Fig. 6-28
Fig. 6-34
Fig. 1-1
Fig. 15-12
Fig. 15-13
Fig. 15-14
4st OIL
OBM
LIT
263
1342
5 N·m (3.7 lb·ft) [0.5 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]

Ref. No.	Part Name	Q'ty	Remarks
41	Fuel Pump Assy	1	
42	O-ring	1	Do not reuse.
43	Screw	2	
44	Hose	1	
45	Clip ø9.4	2	
46	Clip ø9.4	2	
47	Hose	1	
48	Fuel Filter Assy	1	
49	* Cup	1	
50	* Filter	1	
51	* O-ring	1	Do not reuse.
52	* O-ring	1	Do not reuse.
53	* Drain Valve	1	
54	* Seal	1	Do not reuse.
55	* Float	1	
56	Fuel Filter Holder	1	
57	Fuel Filter Bracket	1	
58	Bolt	1	
59	Vent Hose W/Protector	2	
60	Fuel Hose	1	
61	ISC Valve	1	
62	ISC Valve Stay	1	
63	Nut	1	
64	Rubber Mount 9-16-4.3	1	
65	Collar 6.2-9-7.4	1	
66	Rubber Mount 8.5-12-2	1	
67	Hose	1	
68	Hose	1	
69	Throttle Body Assy	1	
70	* MAP Sensor	1	
71	* Screw	2	
72	Bolt	2	
73	Gasket	1	Do not reuse.
74	Intake Silencer Assy	1	
75	* Intake Silencer Sub-Assy	1	
76	* Intake Silencer Sub-Assy	1	
77	* Gasket	1	Do not reuse.
78	* Tapping Screw	3	
79	Bolt	2	
80	Gasket	1	Do not reuse.


MFS8C only
Fig. 6-26
Fig. 6-27
Fig. 6-28
Fig. 6-34
Fig. 1-1
Fig. 15-13
Fig. 15-14
Fig. 15-12
4st OIL
OBM
263
LIT
1342
5 N·m (3.7 lb·ft) [0.5 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]

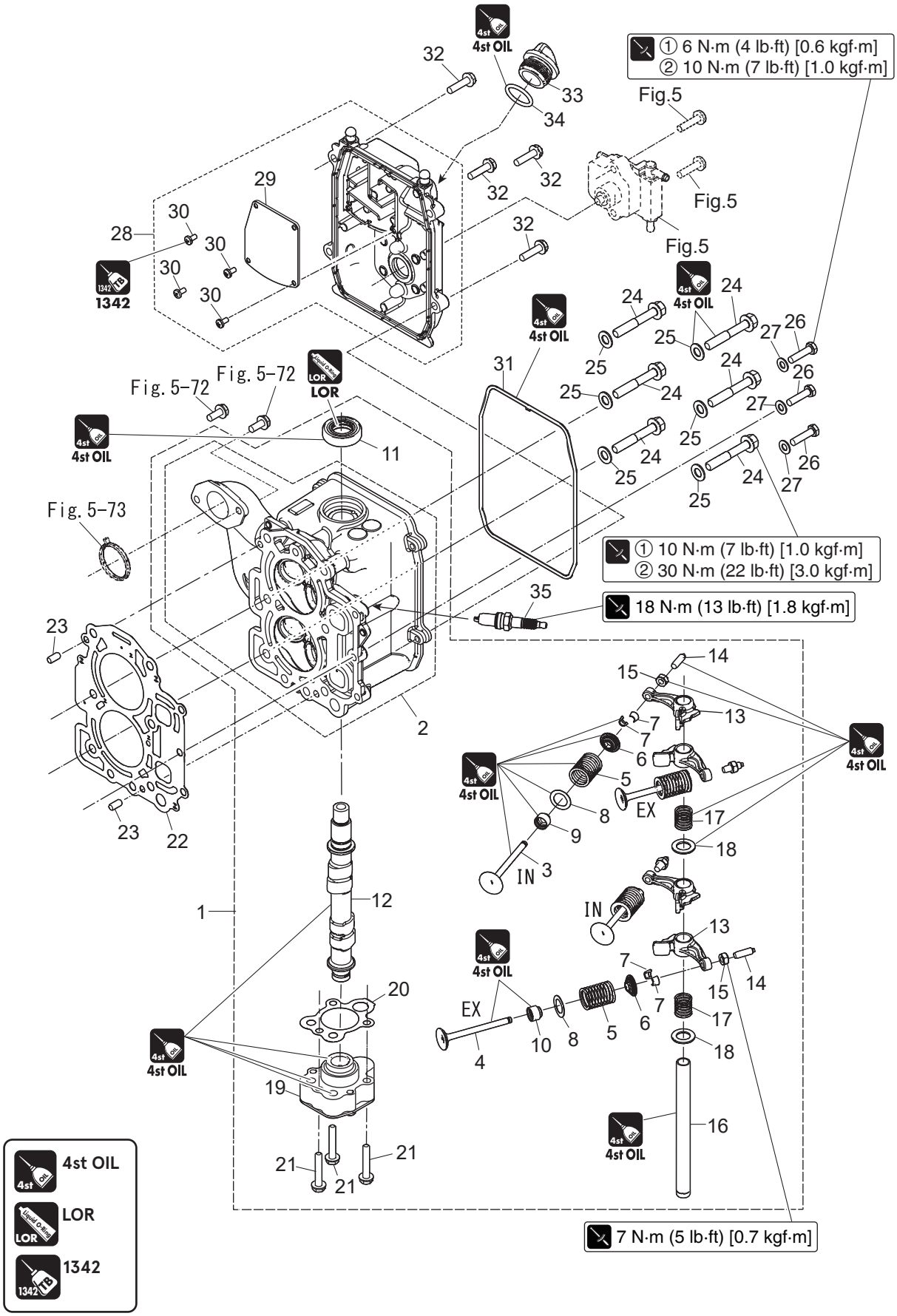
Ref. No.	Part Name	Q'ty	Remarks
81	Collar	1	
82	Washer 6-16-1.5	1	
83	Bolt	1	
84	Throttle Rod	1	
85	Breather Hose	1	
86	Fuel Hose W/Protector	1	
87	Restrictor	1	
88	Water Nipple	1	
89	Hose	1	
90	Clip ø9.4	2	
91	Clamp 6.5-14L	1	
92	Bolt	1	
93	Throttle Drum Assy	1	
94	Throttle Wire Bracket	1	
95	Bolt	1	
96	Band	1	Do not reuse.
97	Nut	1	MF EF EFT

Pulley & Timing Belt



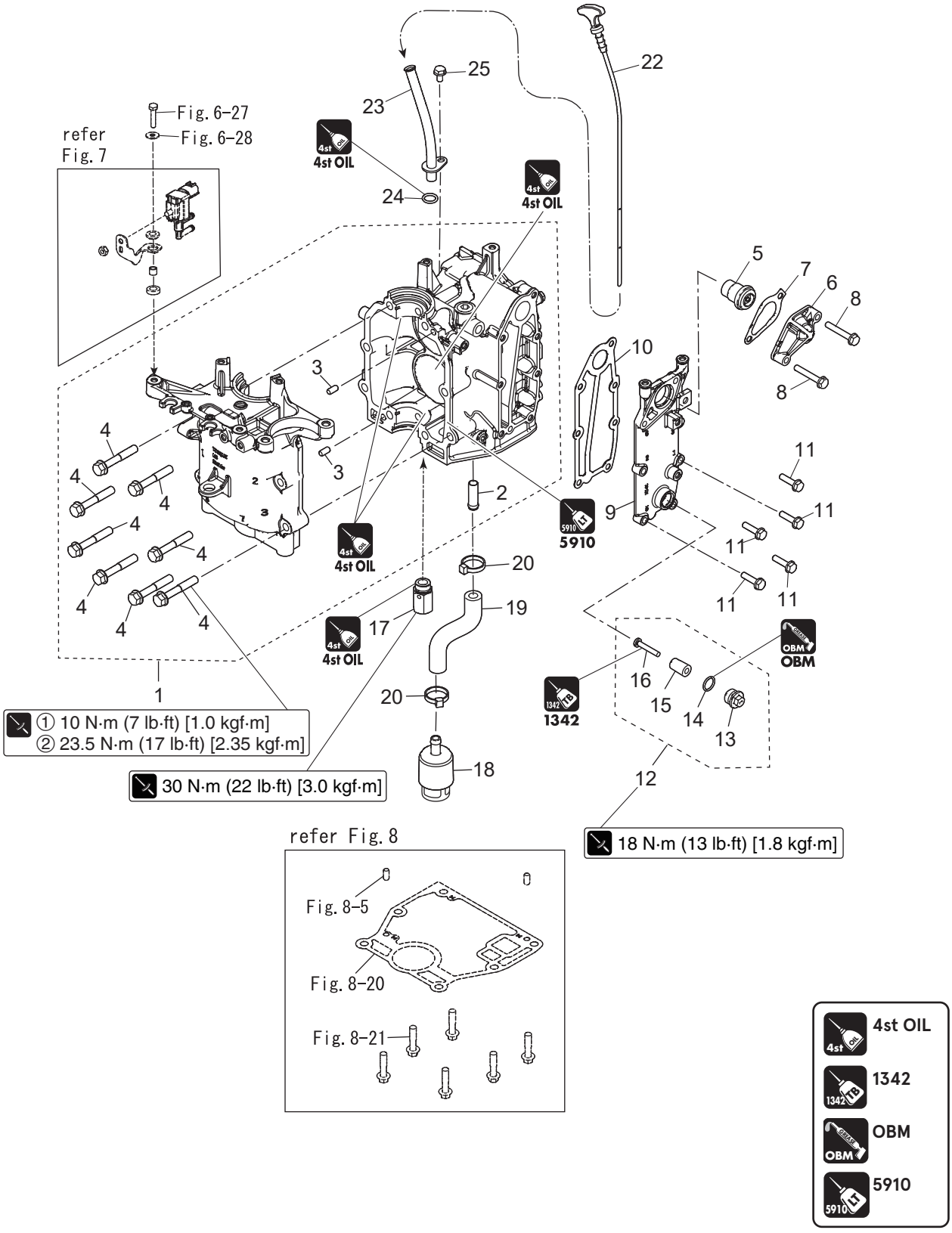
Ref. No.	Part Name	Q'ty	Remarks
1	Drive Pulley	1	
2	Key 10-3.7-3	1	
3	Key 10-3.7-3	1	
4	Belt Guide	1	
5	Nut Pulley	1	
6	Driven Pulley	1	
7	Washer	1	
8	Pre-Coated Bolt	1	
9	Timing Belt	1	

Cylinder Head & Oil Pump



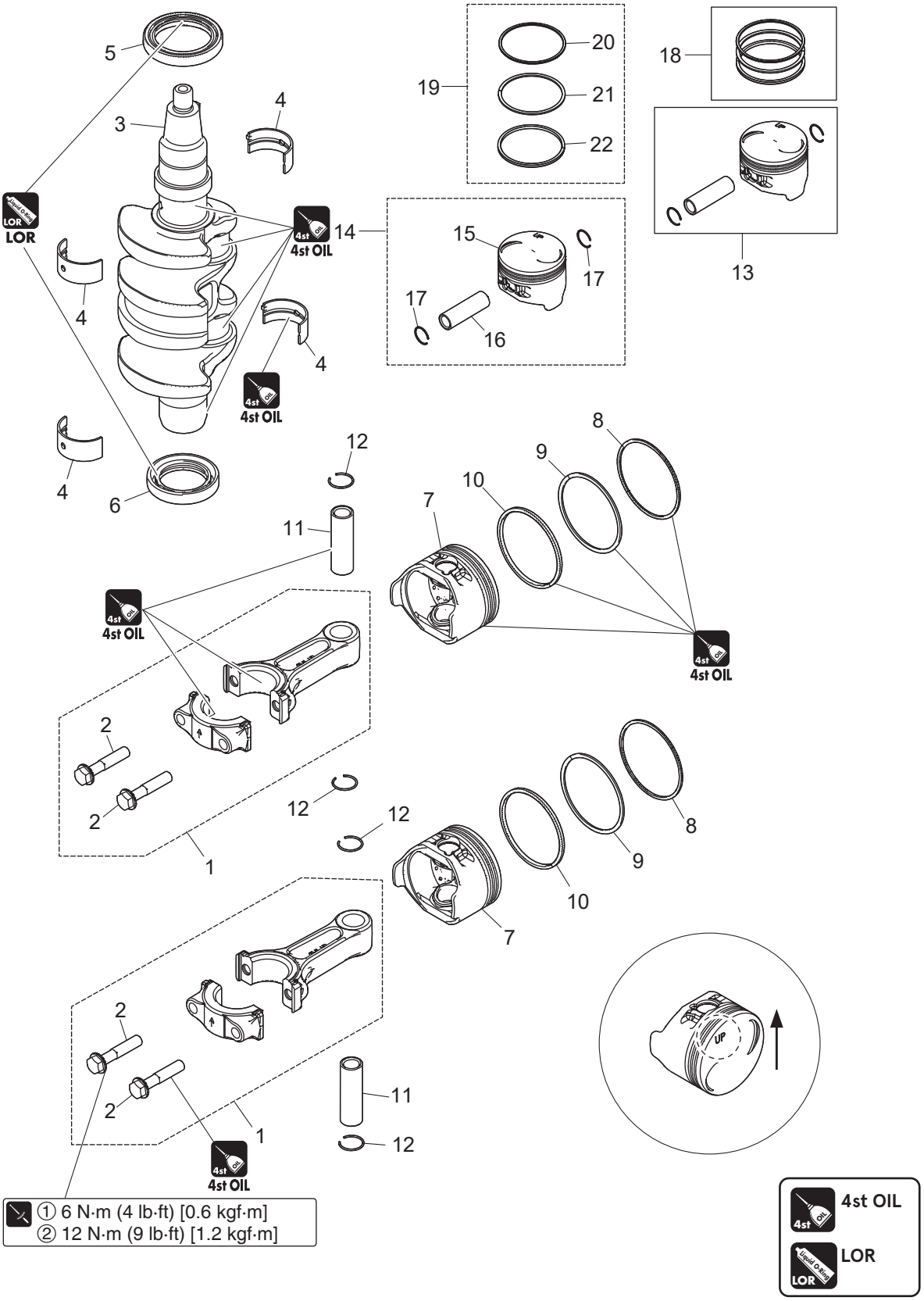
Ref. No.	Part Name	Q'ty	Remarks
1	Cylinder Head Complete	1	
2	* Cylinder Head Assy	1	
3	* Intake Valve	2	
4	* Exhaust Valve	2	
5	* Valve Spring L=38.3	4	
6	* Retainer	4	
7	* Cotter	8	
8	* Valve Spring Seat	4	
9	* Intake Valve Stem Seal	2	Do not reuse.
10	* Exhaust Valve Stem Seal	2	Do not reuse.
11	* Oil Seal 18-35-8	1	Do not reuse.
12	* Camshaft Assy	1	
13	* Rocker Arm	4	
14	* Adjusting Screw	4	
15	* Adjusting Nut	4	
16	* Rocker Arm Shaft	1	
17	* Rocker Shaft Spring L=25	2	
18	* Washer 13.2-21.8-2	2	
19	* Oil Pump Assy	1	
20	* Oil Pump Gasket	1	Do not reuse.
21	* Bolt	3	
22	Cylinder Head Gasket	1	Do not reuse.
23	Dowel Pin 6-12	2	
24	Cylinder Head Bolt	6	
25	Washer	6	
26	Bolt 25mm	3	
27	Washer	3	
28	Cylinder Head Cover Assy	1	
29	* Breather Chamber Cover	1	
30	* Screw	4	
31	Cylinder Head Cover Gasket	1	Do not reuse.
32	Bolt	4	
33	Oil Filler Cap	1	
34	O-ring 3.1-24.4	1	
35	Spark Plug (DCPR6E)	2	

Cylinder & Crankcase



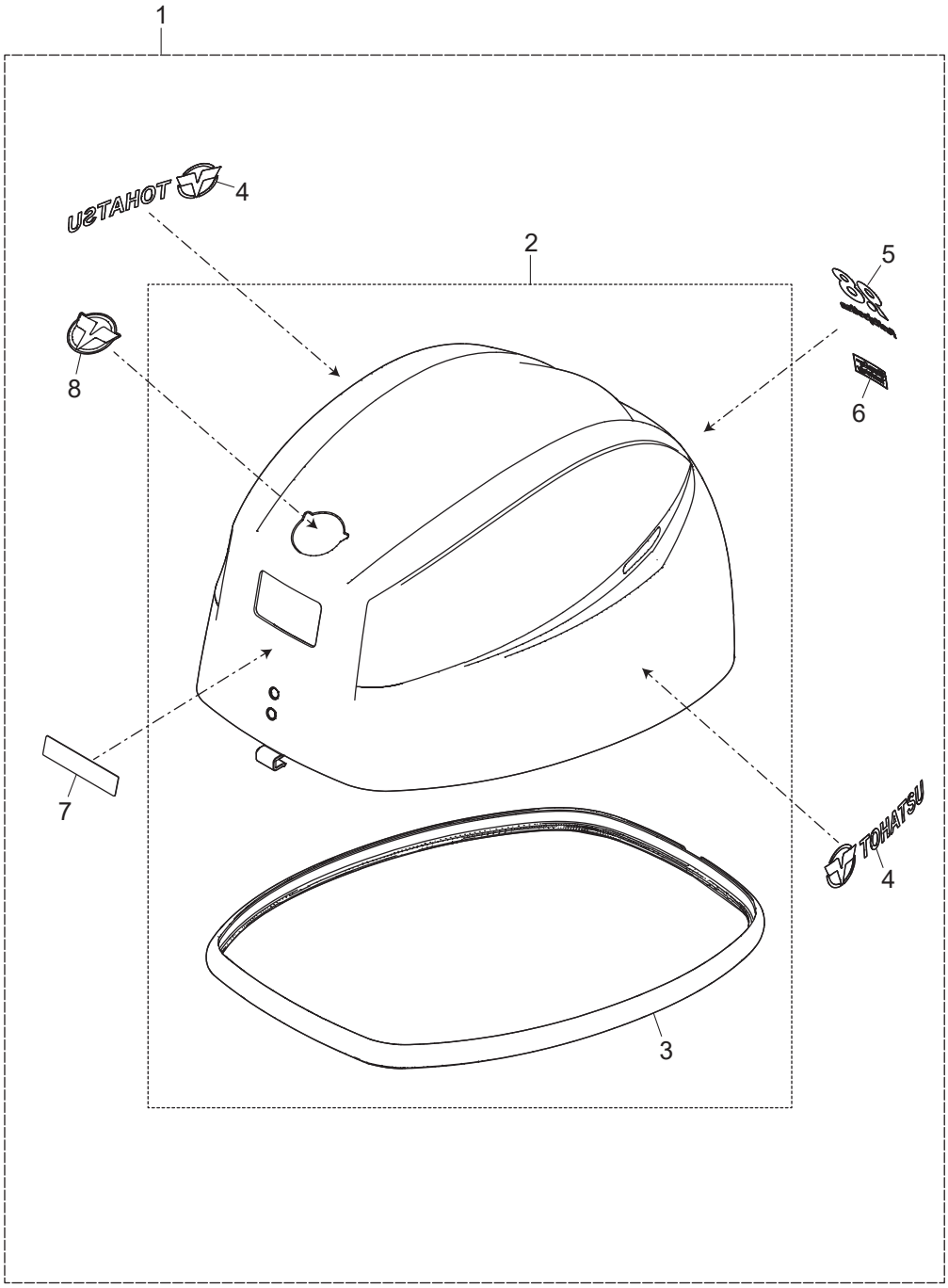
Ref. No.	Part Name	Q'ty	Remarks
1	**Cylinder Block & Crankcase Assy**	1	
2	* Nipple	1	
3	* Dowel Pin 6-12	2	
4	* Bolt	8	
5	Thermostat	1	
6	Thermostat Cap	1	
7	Thermostat Cap Gasket	1	Do not reuse.
8	Bolt	2	
9	Exhaust Cover (Outer)	1	
10	Exhaust Cover Gasket	1	Do not reuse.
11	Bolt	5	
12	Anode Plug Assy	1	
13	* Anode Plug	1	
14	* O-ring 1.9-13	1	Do not reuse.
15	* Anode	1	
16	* Screw	1	
17	Plunger Assy	1	
18	Oil Strainer Assy	1	
19	Pipe	1	
20	Band	2	Do not reuse.
22	Oil Level Gauge	1	
23	Oil Level Gauge Guide	1	
24	O-ring	1	Do not reuse.
25	Bolt	1	

Piston & Crankshaft



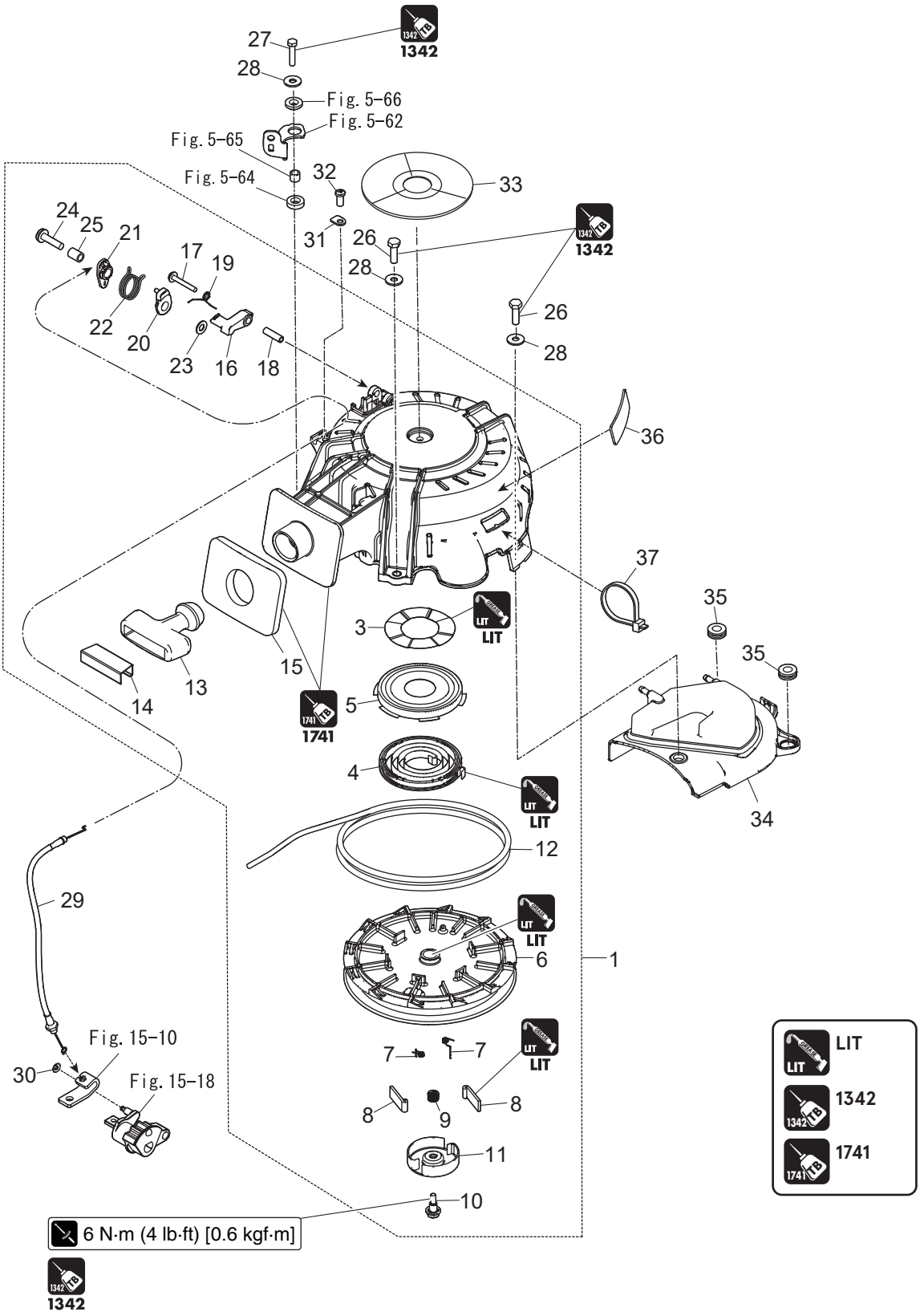
Ref. No.	Part Name	Q'ty	Remarks
1	Connecting Rod Assy	2	
2	* Connecting Rod Assy	2	
3	Crankshaft Assy	1	
4	Plain Shaft Bearing (Brown)	4	
5	Oil Seal 36-50-7	1	Do not reuse.
6	Oil Seal 30-45-8	1	Do not reuse.
7	Piston	2	
8	Piston Ring	2	
9	Piston Ring	2	
10	Piston Ring (Oil)	2	
11	Piston Pin	2	
12	Piston Pin Clip	4	Do not reuse.
13	Piston Repair Kit	2	No.7×1, No.11×1, No.12×2
14	Piston Repair Kit (0.5 O/S)	2	
15	* Piston (0.5 O/S)	1	
16	* Piston Pin	1	
17	* Piston Pin Clip	2	Do not reuse.
18	Piston Ring Set	2	No.8×1, No.9×1, No.10×1
19	Piston Ring Set (0.5 O/S)	2	
20	* Piston Ring (0.5 O/S)	1	
21	* Piston Ring (0.5 O/S) 2nd	1	
22	* Piston Ring (Oil) (0.5 O/S)	1	

Top Cowl



Ref. No.	Part Name	Q'ty	Remarks
1	Top Cowl Assy	1	
2	* Top Cowl Sub-assy	1	
3	** Top Cowl Seal	1	
4	* Side Decal	1	
5	* Rear Decal (6)	1	
6	* Simpliq Decal	1	
7	* Fuel Injection Decal	1	
8	* Logo Decal	1	

Recoil Starter



Ref. No.	Part Name	Q'ty	Remarks
1	Recoil Starter Assy	1	
3	* Wave Washer	1	
4	* Starter Spring	1	
5	* Starter Spring Case	1	
6	* Reel 140	1	
7	* Return Spring	2	
8	* Ratchet	2	
9	* Friction Spring	1	
10	* Bolt Starter Shaft	1	
11	* Friction Plate	1	
12	* Starter Rope 4.5-1600	1	
13	* Starter Handle	1	
14	* Rope Anchor	1	
15	* Starter Seal	1	
16	* Starter Lock	1	
17	* Screw	1	
18	* Collar 4-6-21	1	
19	* Starter Lock Spring	1	
20	* Starter Lock Cam	1	
21	* Starter Lock Lever	1	
22	* Starter Lock Cam Spring	1	
23	* Washer	1	
24	* Screw	1	
25	* Collar 6.2-9-12.3	1	
26	Pre-coated Bolt 6-20	2	
27	Pre-Coated Bolt	1	
28	Washer 6-16-1.5	3	
29	Starter Lock Wire	1	
30	O-ring 1.5-2.5	1	Do not reuse.
31	Stopper Cam Rod Bushing	1	
32	Tapping Screw 5-12	1	
33	Caution Decal (B)	1	
34	Belt Cover	1	
35	Grommet 13-2	2	
36	Caution Decal	1	US

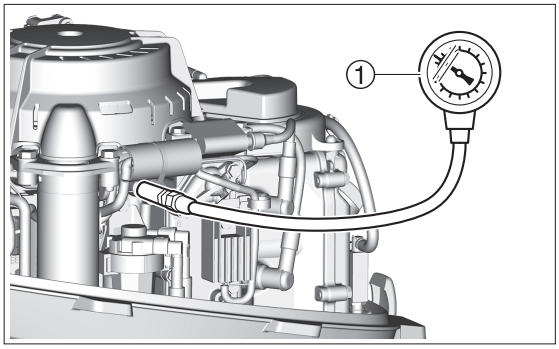
3. Inspection Items

1) Inspection of Compression Pressure

1. Refer to "Inspection of Compression Pressure" in chapter 3.

Compression Pressure (Reference value): At 500 min^{-1} (rpm)
0.88 MPa (128 psi) [8.9 kgf/cm^2]

2) Inspection of Oil Pressure



1. Place a rag below the oil pressure switch.

2. Disconnect the switch and connect oil pressure gauge ① (sold commercially) to the switch hole.

Use a commercially available oil pressure gauge. Use the instrument applicable to 1 Mpa (142 psi) [10 kgf/cm^2].

3. Start and run the engine for 5 minutes to warm up the engine at the idling revolution speed.

4. Measure hydraulic pressure. If the pressure is below specified value, check oil pump for oil leak, and oil strainer and plunger.

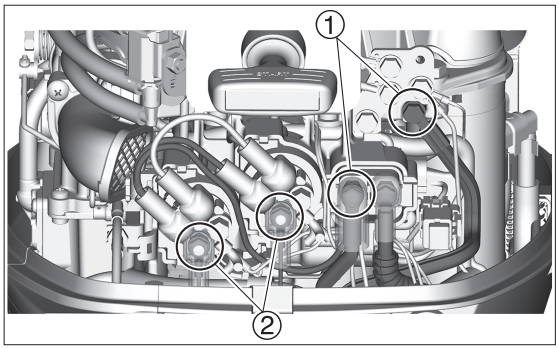
Hydraulic Pressure (Reference value):
950 min^{-1} (rpm): 0.22 MPa (31.2 psi) [2.2 kgf/cm^2]
4000 min^{-1} (rpm): 0.38 MPa (55.1 psi) [3.9 kgf/cm^2]

3) Inspection of Valve Clearance

1. Refer to "Inspection of Valve Clearance" in chapter 3.

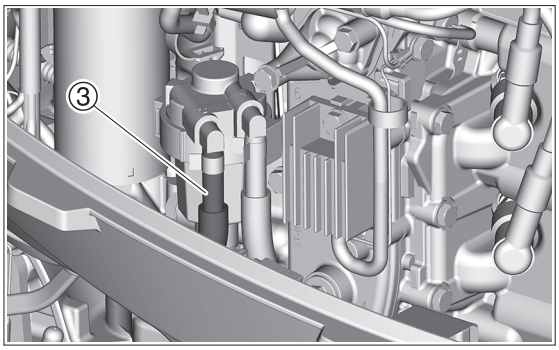
Valve Clearance (when engine is cold):
(IN) Intake Side ⓓ: 0.10-0.15 mm (0.004-0.006 in)
(EX) Exhaust Side ⓔ: 0.20-0.24 mm (0.008-0.0095 in)

4) Removal of Power Unit

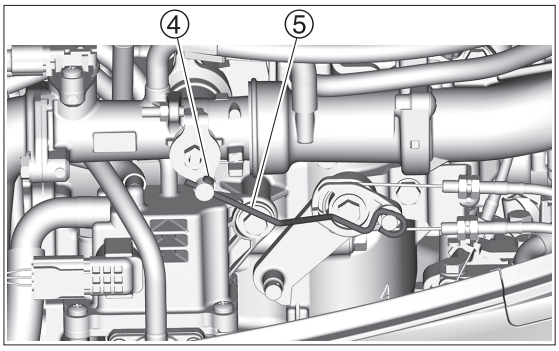


1. Remove battery cable ① (electric start model) and PT solenoid lead wire ② (power tilt model).

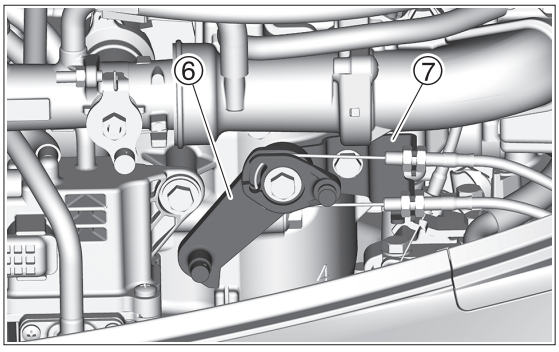
2. Remove the fuel hose (IN) ③.



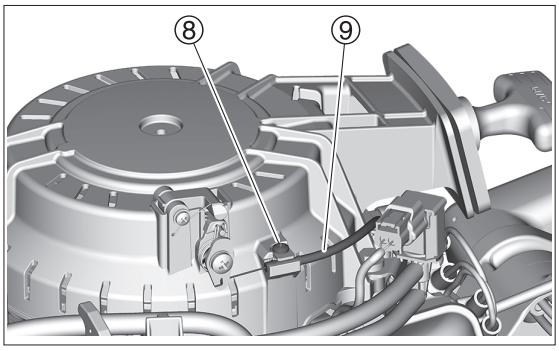
3. Loosen screw ④ and remove link ⑤.



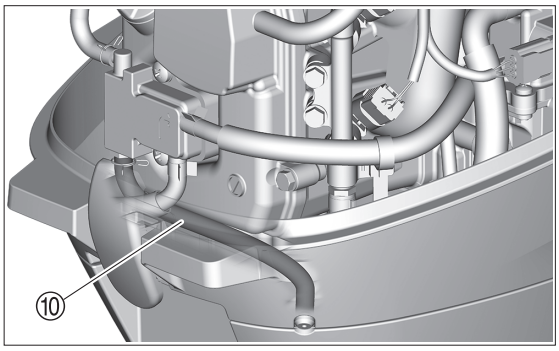
4. Remove throttle drum ⑥ and bracket ⑦.



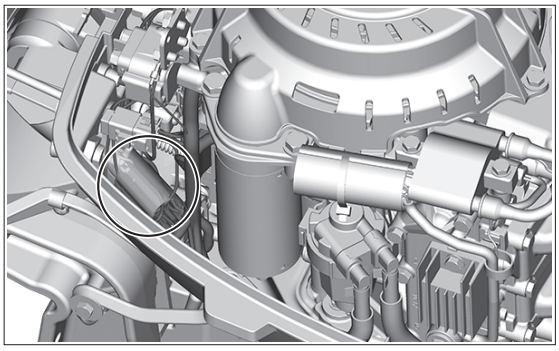
5. Loosen screw ⑧ and remove starter lock cable ⑨.



6. Remove cooling water hose ⑩.

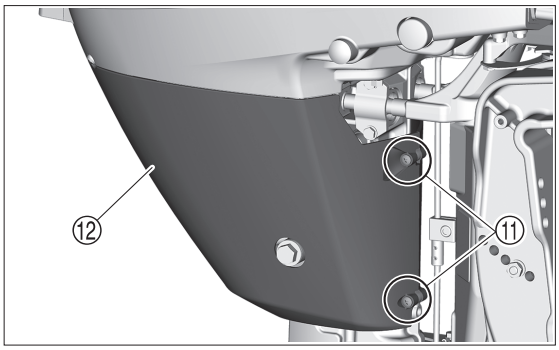


7. Disconnect the connectors for the indicator lamp, stop switch, neutral switch, start switch, fuse, and PT switch.

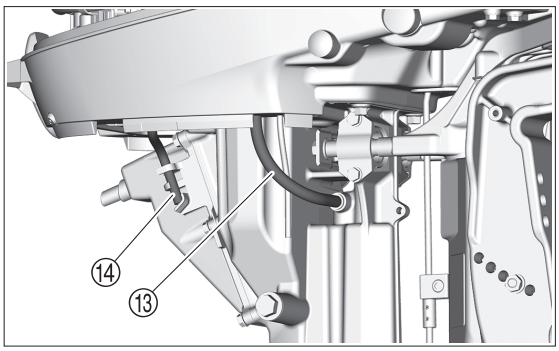


- Disconnect the start switch and fuse connectors for the electric start model only.
- Disconnect the PT switch connector for the power tilt model only.

8. Remove screw ⑪ and then remove drive shaft housing cover ⑫.

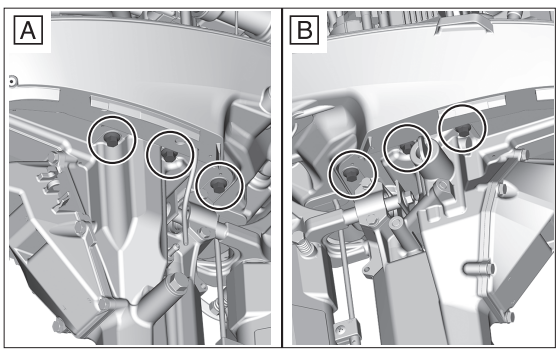


9. Remove cooling water hose ⑬ and vent hose ⑭.



10. Remove the power unit installation bolts.

11. Lift the engine.

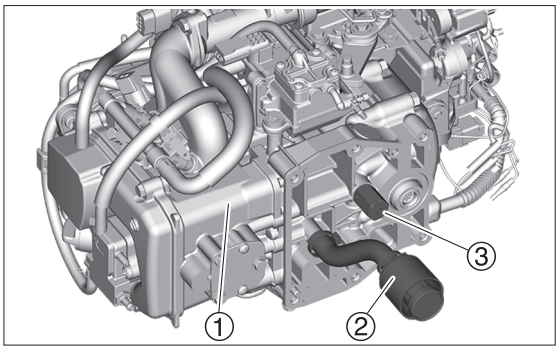


A Starboard
B Port

5) Removing Oil Strainer

1. Remove the power unit. (Refer to the section on removing the power unit) Place removed power unit assembly ① on a stand with the port side (left side) facing down.

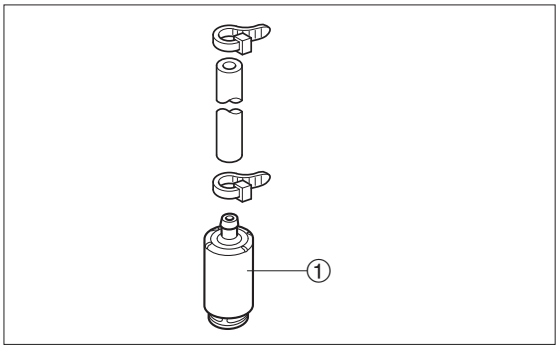
2. Remove oil strainer ② and plunger ③ from power unit ass'y ①.



Before removing the oil strainer hose, note the arrangement of the hose.

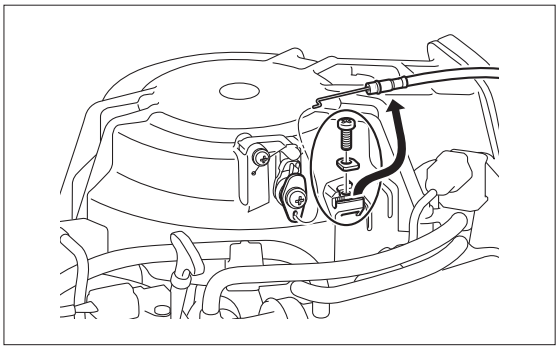
6) Inspection of Oil Strainer

1. Check oil strainer ① for dirt and clogging. Clean or replace if necessary.

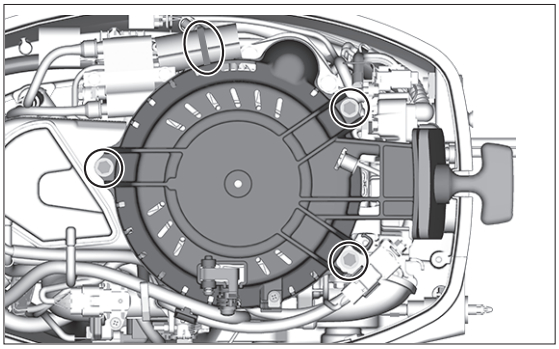


7) Removing Timing Belt and Pulley

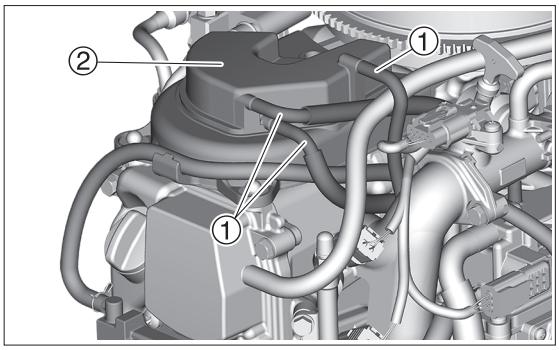
1. Loosen the screw and disconnect the upper starter lock cable.



2. Remove the band and bolts (3 locations), and remove the recoil starter.

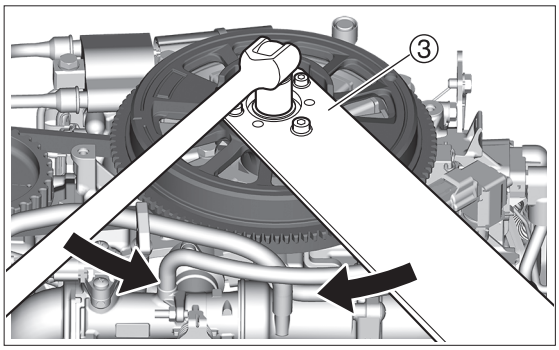


3. Disconnect the vent hose ① and remove the belt cover ②.



4. Using the flywheel puller kit ③, loosen the flywheel nut and remove it.

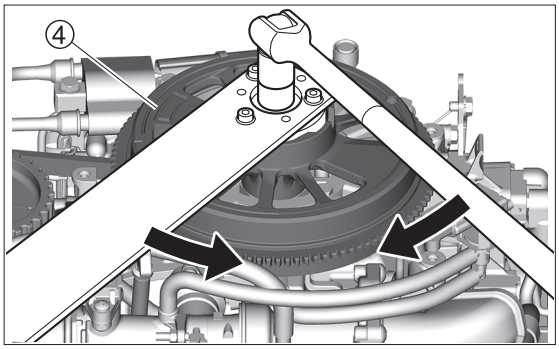
Flywheel Puller Kit :
P/N. 3V1-72211-1



5. Use the flywheel puller kit to remove the flywheel ④ and key.

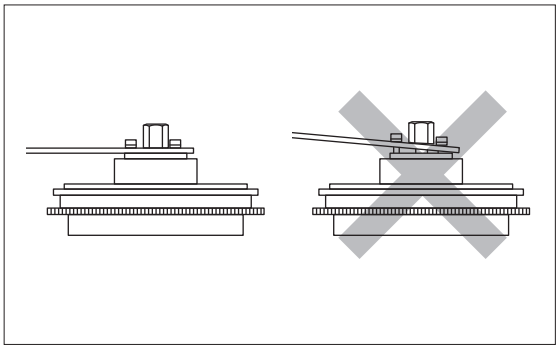
Flywheel Puller Kit :
P/N. 3V1-72211-1

Turn the puller into the end of the crankshaft until the flywheel comes out of the taper of the crankshaft.

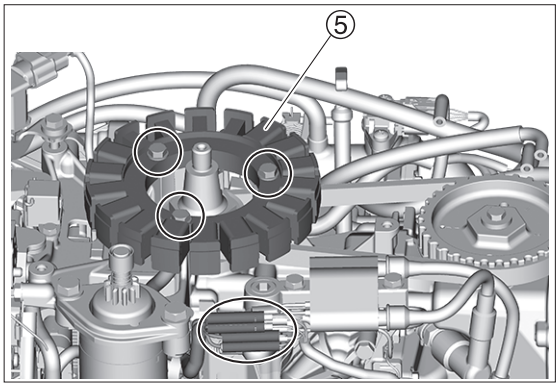


⚠ CAUTION

To prevent damages to engine and special tools, tighten flywheel puller set bolts evenly and keep flywheel puller parallel to flywheel while working.

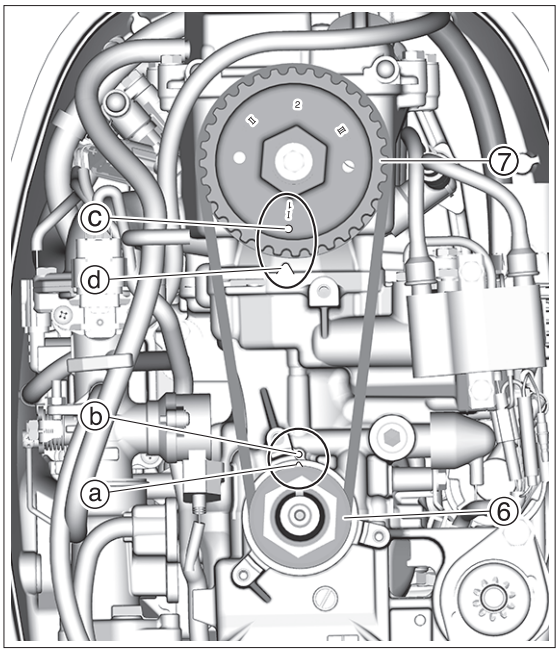


6. Disconnect the alternator connector and remove the alternator ⑤.



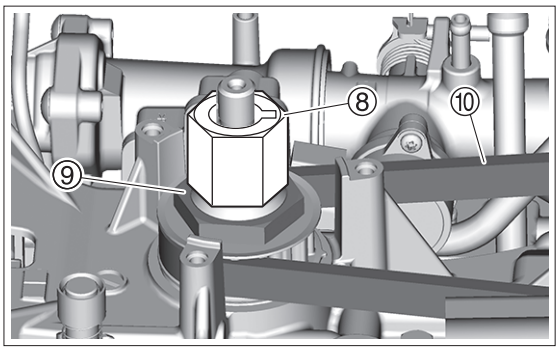
7. Turn the drive pulley ⑥ in the clockwise direction, and align the " ▲ " mark ⓐ of the drive pulley with the " ● " mark ⓑ of the cylinder block. Check that the " ● 1" mark ⓒ of the driven pulley ⑦ and the " ▲ " mark ⓓ of the cylinder head are aligned.

The No.1 cylinder should be at the top dead center of the compression stroke.



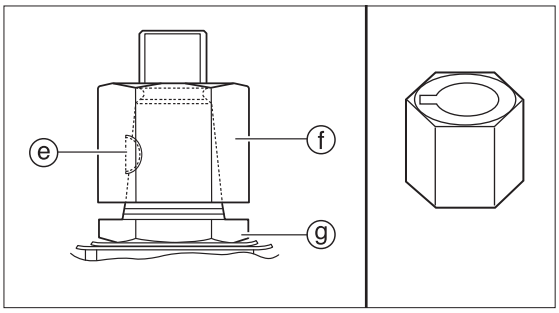
8. Install and secure the crankshaft holder ⑧ on the crankshaft.

9. Loosen drive pulley nut ⑨.



- Use a 32-mm socket wrench and 36-mm ring wrench for this step.
- When loosening the nut of drive pulley ⑨, be careful not to turn the driven pulley ⑦.
- Keep timing belt ⑩ engaged as a means of precaution.

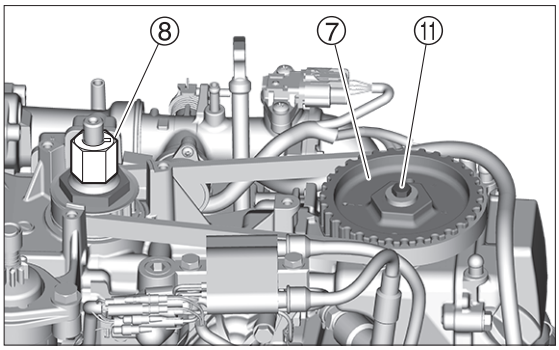
Crankshaft Holder ⑧:
P/N. 31H-72815-0



ⓔ Flywheel Key
ⓕ Crankshaft Holder
ⓖ Drive Pulley Nut

10. While securing the crankshaft holder ⑧, remove the bolt ⑪ from the driven pulley ⑦.

When loosening the driven pulley bolt, be careful not to turn the driven pulley.

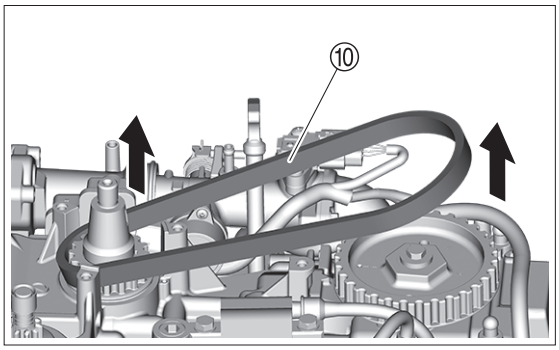


11. Remove the timing belt ⑩.

⚠ CAUTION

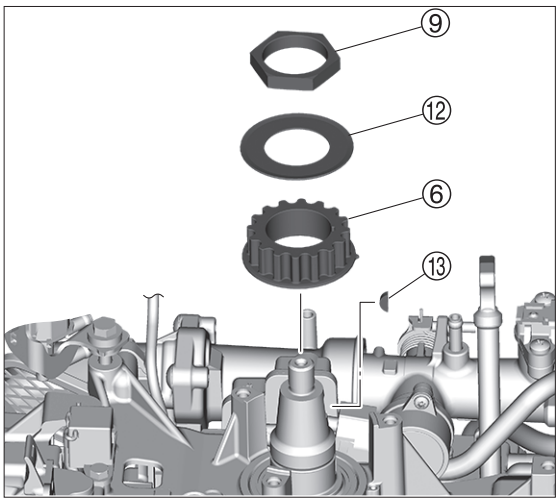
Do not turn the drive pulley (crank shaft) or driven pulley with the timing belt removed. Doing so can make the pistons and valves interfere with each other, possibly resulting in damage to these parts.

Remove the timing belt from the driven pulley side ⑦, and then remove it from the drive pulley side.



12. Remove the driven pulley ⑦.

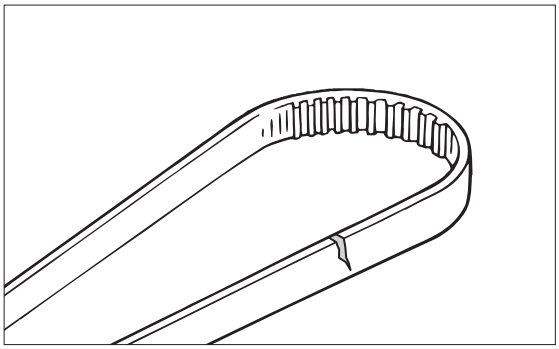
13. Remove the nut ⑨ of the drive pulley, the belt guide ⑫, the drive pulley ⑥, and the key ⑬.



8) Inspection of Timing Belt

1. Check the timing belt for cracks, damage, and wear on both faces. Replace if necessary.

2. Check the drive pulley and the driven pulley for cracks, damage, and wear. Replace if necessary.

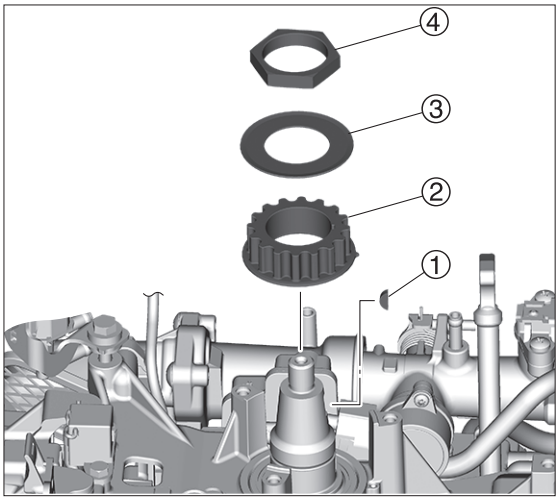


9) Installation of Pulley and Timing Belt

⚠ CAUTION

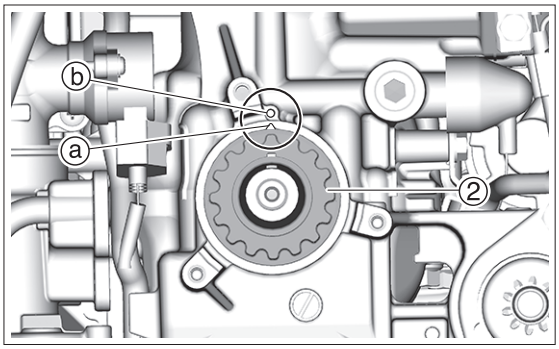
Do not turn the drive pulley or the driven pulley with the timing belt removed. Doing so can make pistons and valves interfere with each other, possibly resulting in damages to these parts.

1. Install the key ①, the drive pulley ②, the belt guide ③, and the nut ④ of the drive pulley. Tightening to the specified torque is performed later.



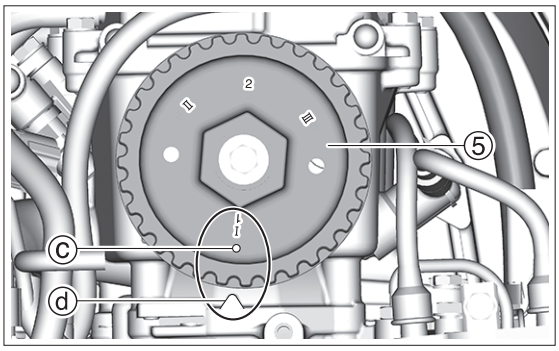
- Degrease the drive pulley mounting area of the crankshaft and the inner side of the drive pulley.
- Align the positions of the key and key groove of the drive pulley to install the drive pulley.

2. Make sure that the " ▲ " mark ⓐ of the drive pulley is aligned with the " ● " mark ⓑ of the cylinder block.



This position is the compression top dead center of the No. 1 cylinder.

3. Install the driven pulley ⑤ and check that the " ● 1" mark ⓒ of the driven pulley is aligned with the " ▲ " mark ⓓ of the cylinder head.



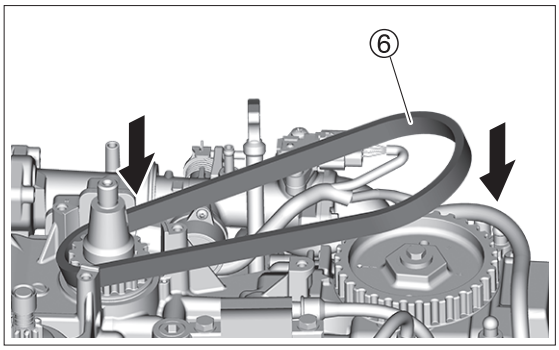
Align the positions of the key and key groove of the driven pulley to install the driven pulley.

4. Install the timing belt ⑥.

⚠ CAUTION

- **Be careful not to damage the timing belt during installation.**
- **Do not twist, turn inside out, or sharply bend the timing belt. Doing so may cause damage.**
- **Be careful not to allow oil or grease to adhere to the timing belt.**

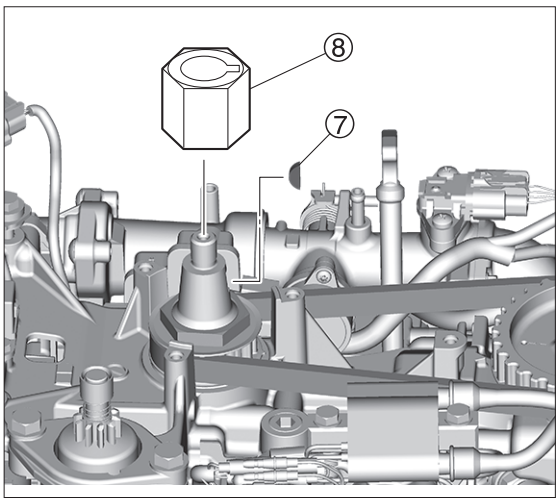
- Install the timing belt oriented so that the part number can be read.
- Install the timing belt to the drive pulley and then to the driven pulley.



5. Install the key ⑦ of the flywheel and the crankshaft holder ⑧ in the crankshaft.

When installing the crankshaft holder, align the groove of the crankshaft holder with the key.

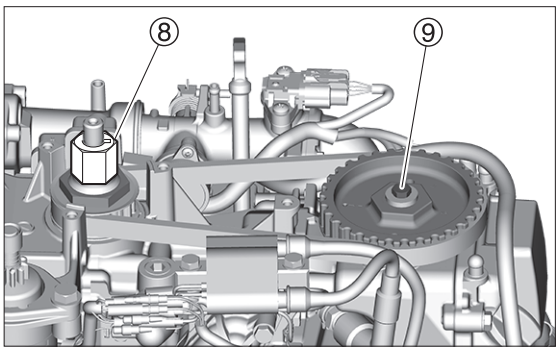
Crankshaft Holder ⑧:
P/N. 31H-72815-0



6. Tighten the bolt ⑨ of the driven pulley to the specified torque while immobilizing the crankshaft holder.

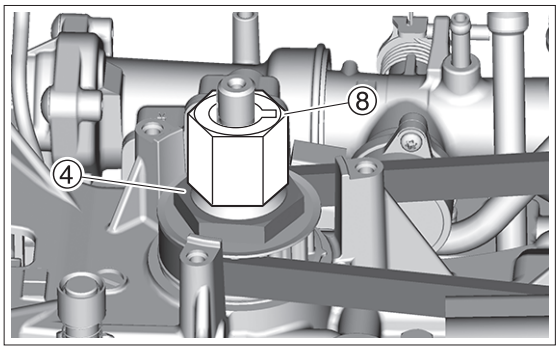
When tightening driven pulley bolt, be careful not to turn driven pulley.

Driven Pulley Bolt ⑨:
11 N·m (8 lb·ft) [1.1 kgf·m]



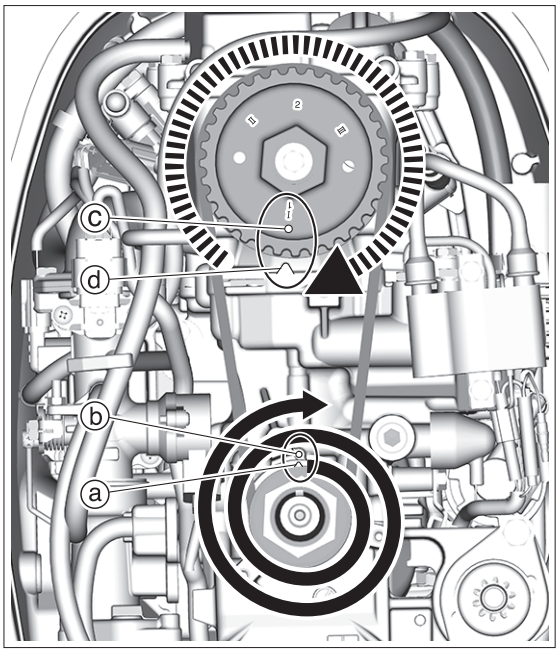
7. Tighten the nut ④ of the drive pulley to the specified torque while immobilizing the crankshaft holder.

Drive Pulley Nut ④:
64 N·m (47 lb·ft) [6.4 kgf·m]



8. Turn the crankshaft two full rotations in the clockwise direction, and check that the alignment marks of the pulleys are aligned.

- Check that the crankshaft turns smoothly.
- Make sure the " ▲ " mark ⓐ of the drive pulley is aligned with the " ● " mark ⓑ of the cylinder block.
- Check that the " ● 1" mark ⓒ of the driven pulley is aligned with the " ▲ " mark ⓓ of the cylinder head.



5

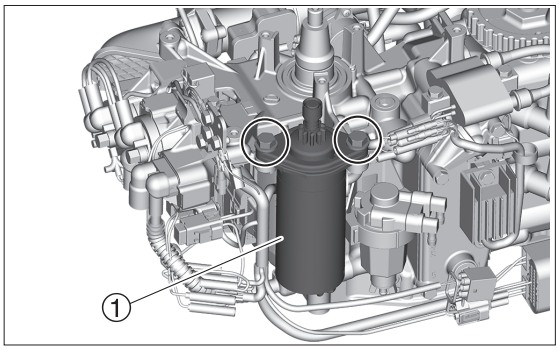
10) Removal of Cylinder Head

- No.1 piston is to be at top dead center of compression stroke (make sure both valves are closed).(Refer to the section on the replacement of the timing belt.)
- Removal or installation of parts can be made easier when some of them are assembled together.

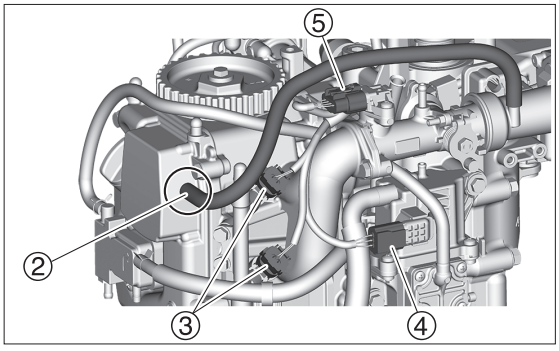
1.Remove the power unit, and then remove the components of the fuel system and electrical system. (Refer to the section for removing power unit.)

2. Remove the pulley and the timing belt. (Refer to the section on the removal of the pulley and timing belt.)

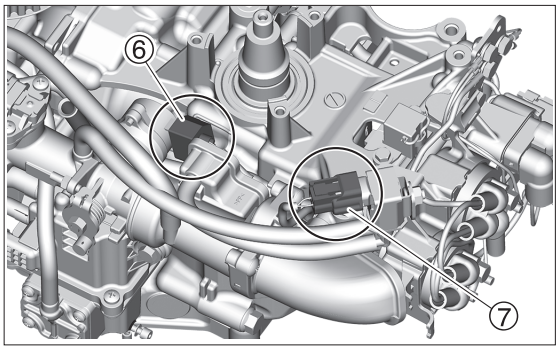
3. Remove the starter motor ①.



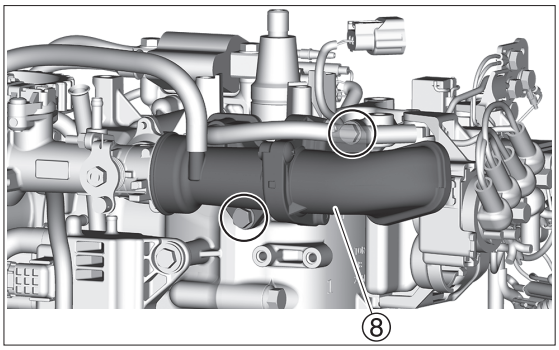
4. Disconnect the breather hose ②, fuel injector coupler ③, vapor separator coupler ④, and T-MAP sensor coupler ⑤.



5. Disconnect the TPS coupler ⑥ and ISC coupler ⑦.

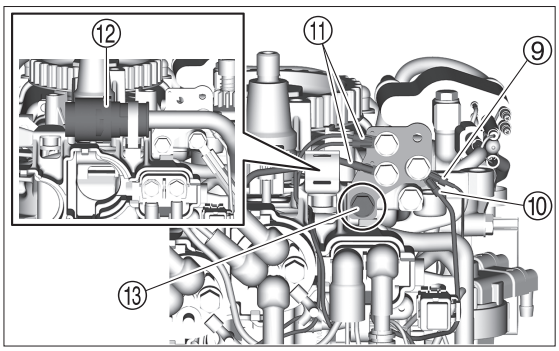


6. Remove the intake silencer ⑧.



Remove the ground wires (main harness ⑨, starter solenoid ⑩, PT solenoid ⑪) and the main harness connector ⑫.

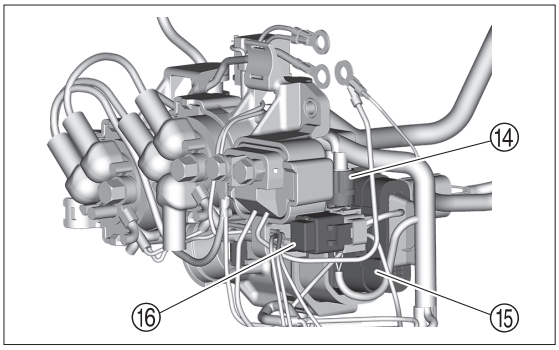
·Power tilt model only: PT solenoid ground wire ⑪
·Remote control model only: Main harness connector ⑫



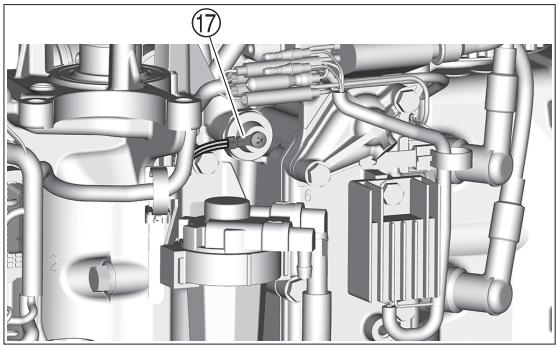
8. Remove the electrical bracket bolt ⑬ and then remove the electrical bracket.

9. Disconnect the crank position sensor coupler ⑭.

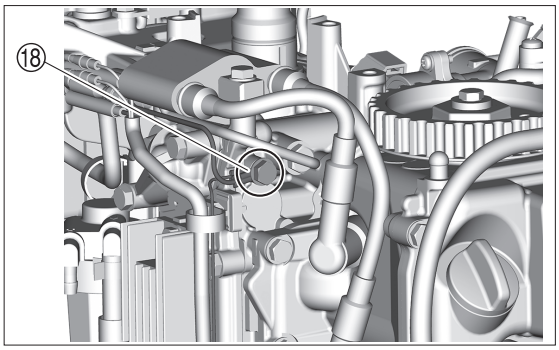
10. Remove the ECU ⑮ and the fuse ⑯.



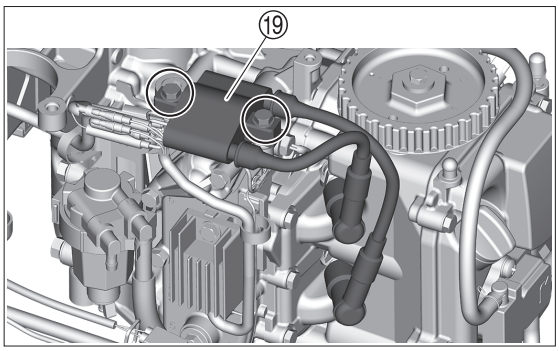
11. Remove the oil pressure switch lead wire ⑰.



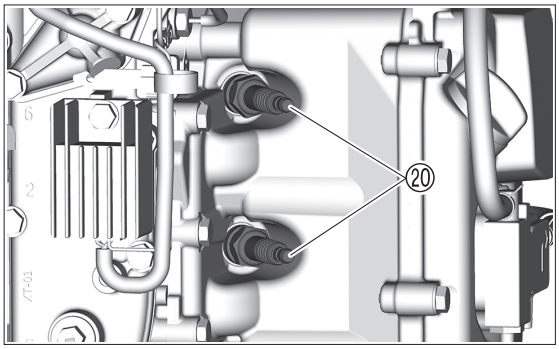
Remove the ground wire ⑱ (rectifier, ignition coil).



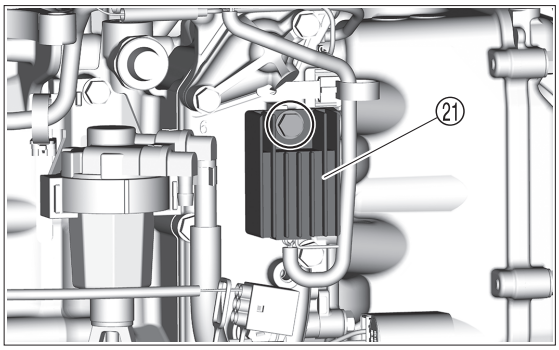
13. Remove the ignition coil ⑲.



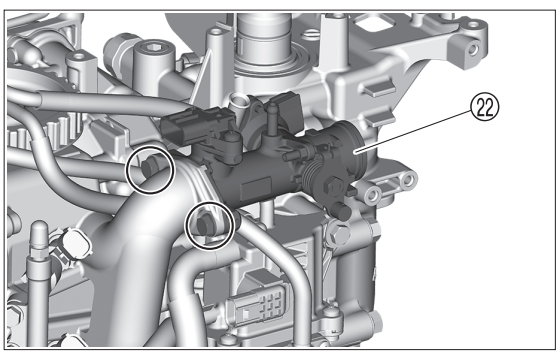
14. Remove the spark plugs ⑳.



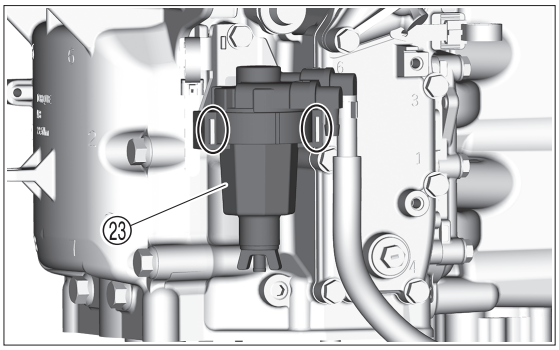
15. Remove the rectifier ㉑.



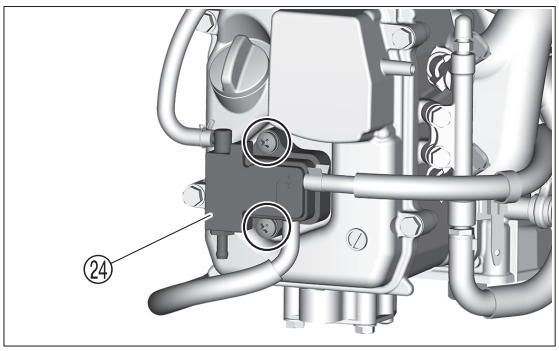
16. Remove the throttle body ㉒.



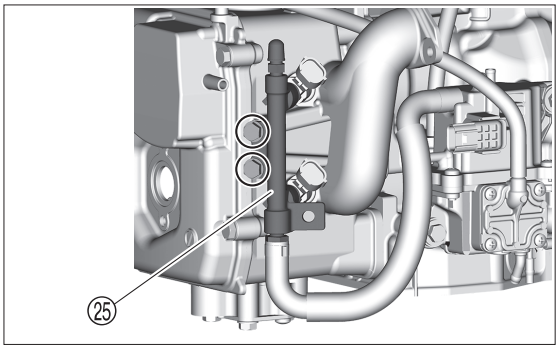
17. Remove the fuel filter ㉓.



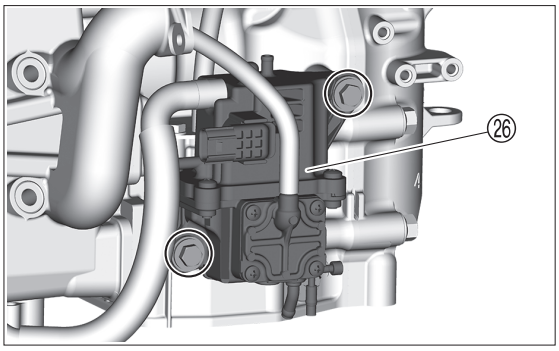
18. Remove fuel pump ㉔.



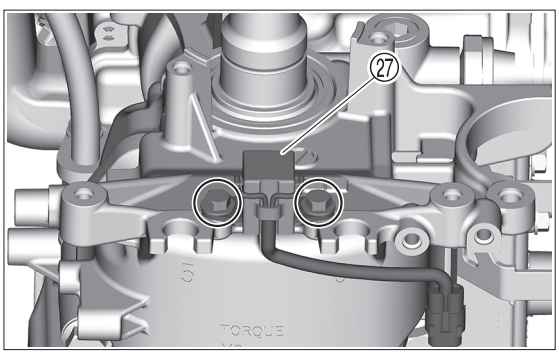
19. Remove the fuel rail ㉕.



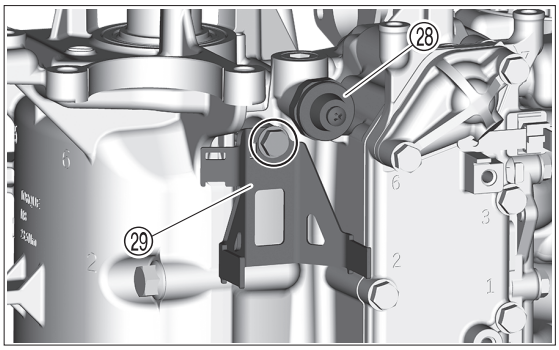
20. Remove the vapor separator ㉖.



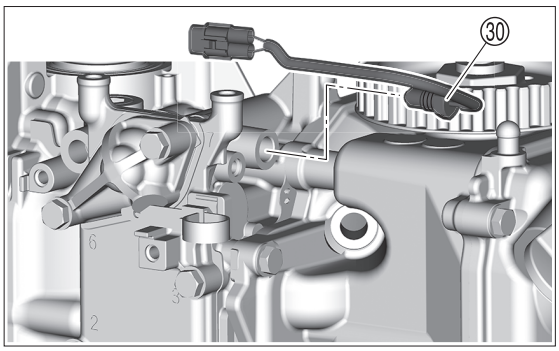
21. Remove the crank position sensor ㉗.



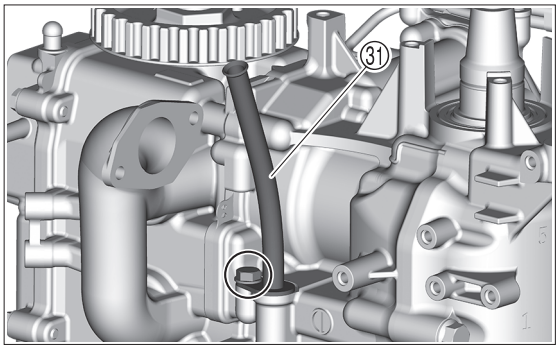
22. Remove the oil pressure switch ㉘ and the fuel filter bracket ㉙.



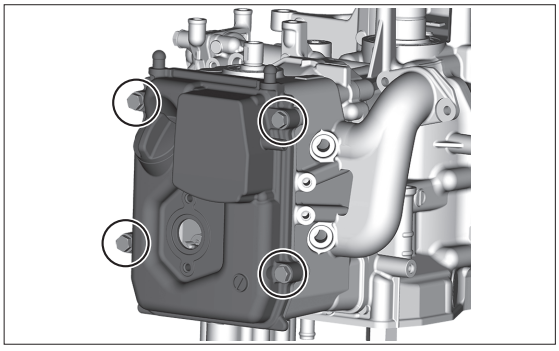
23. Remove the engine temperature sensor ㉚.



24. Remove the oil level gauge guide ㉛.



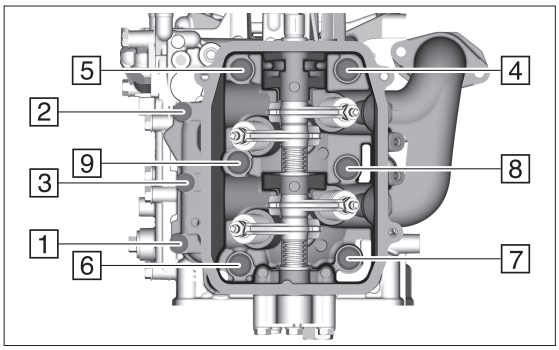
25. Remove the cylinder head cover.



26. Remove the cylinder head bolts in the order shown in the diagram, then remove the cylinder head.

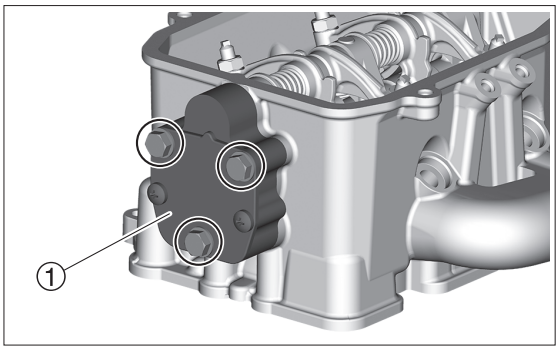
⚠ CAUTION

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



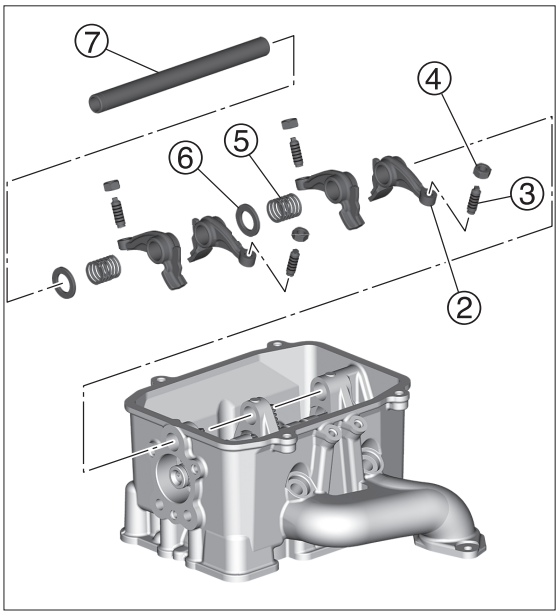
27. Loosen the adjusting nut ④ of the rocker arm and fully loosen the adjusting screw ③.

28. Remove the oil pump ①.



28. Remove the rocker arm ②, adjusting screw ③, adjusting nut ④, spring ⑤, washer ⑥, and rocker arm shaft ⑦.

- Use a flat-blade screwdriver as a guide tool and slowly pull out rocker arm shaft.
- When pulling out work while holding each part by hand.

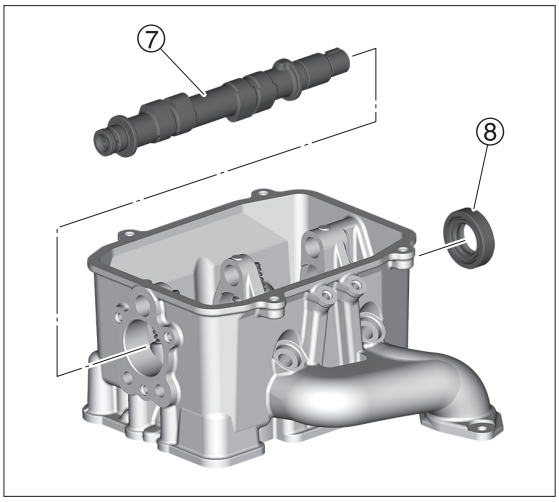


30. Remove the camshaft ⑦.

⚠ CAUTION

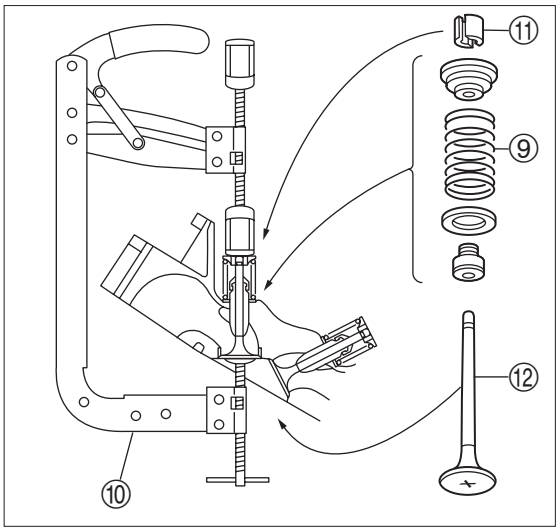
Pull out slowly so as not to hit the journals.

31. Remove the oil seal ⑧.



5

32. Compress the valve spring ⑨ by using the compressor ⑩, remove the cotter ⑪, and then remove the valve spring and valve ㉞.

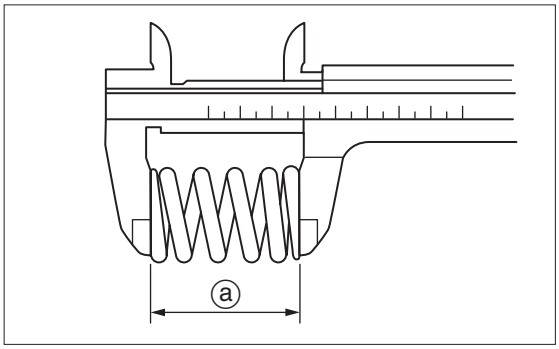


- Valves, springs and other power unit related parts should be arranged in the order they are removed.
- Use an attachment that fits retainer outer diameter of 20 mm.

Valve Spring Compressor :
Commercially available item

11) Inspection of Valve Spring

1. Measure the free length ⓐ of the valve spring. Replace if less than the specified value.



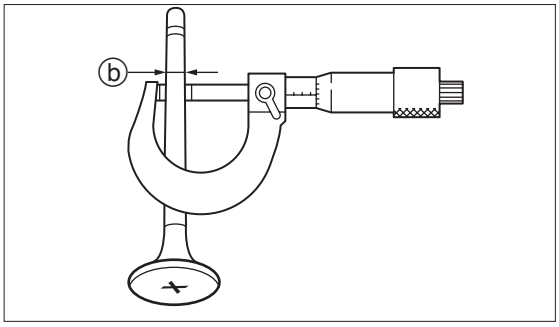
Valve Spring Free Length ⓐ: Standard Value
38.3 mm (1.51 in)

Functional Limit:
36.8 mm (1.45 in)

12) Inspection of Valve

1. Check the valve for dents and wear on the face. Replace if necessary.

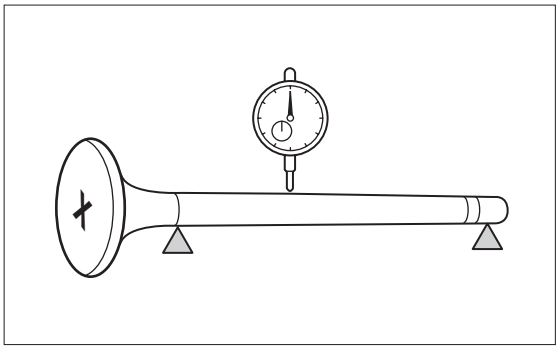
2. Measure the valve stem outer diameter ⓑ. Replace if less than the specified value.



Valve Stem Outer Diameter ⓑ: Standard Value
Intake Side: 5.48 mm (0.2157 in)
Exhaust Side: 5.46 mm (0.2150 in)

Functional Limit:
Intake Side: 5.46 mm (0.2150 in)
Exhaust Side: 5.44 mm (0.2142 in)

3. Measure the valve stem runout. Replace if greater than the specified value.



Valve Stem Runout Limit:
Intake Side: 0.05 mm (0.0020 in)
Exhaust Side: 0.03 mm (0.0012 in)

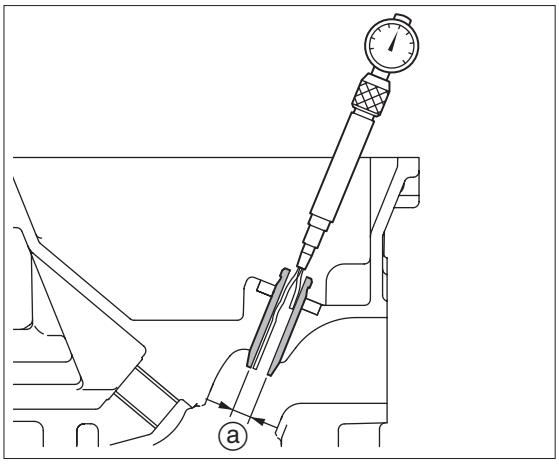
13) Inspection of Valve Guide

Before inspecting the valve guide, check that the valve stem outer diameter is within the specified limit.

1. Measure the valve guide inner diameter ⓐ. Replace the cylinder head if greater than the specified value.

Valve Guide Inner Diameter ⓐ: Standard Value
Intake/Exhaust Side: 5.51 mm (0.2169 in)

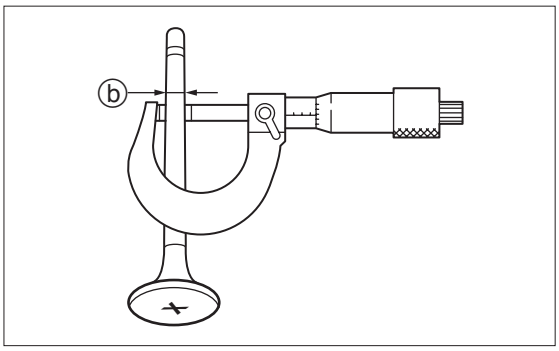
Functional Limit:
Intake Side: 5.55 mm (0.02185 in)
Exhaust Side: 5.57 mm (0.02193 in)



2. Calculate the clearance between the valve guide and valve stem as described below. Replace the cylinder head and/or valve if greater than the specified value.

Clearance between valve guide and valve stem = Valve Guide Inner Diameter ⓐ – Valve Stem Outer Diameter ⓑ:
Intake Side: 0.008 – 0.040 mm (0.00031 – 0.00157 in)
Exhaust Side: 0.025 – 0.057 mm (0.00098 – 0.00224 in)

Functional Limit
Intake Side: 0.070 mm (0.00276 in)
Exhaust Side: 0.100 mm (0.00394 in)



14) Inspection of Valve Seat

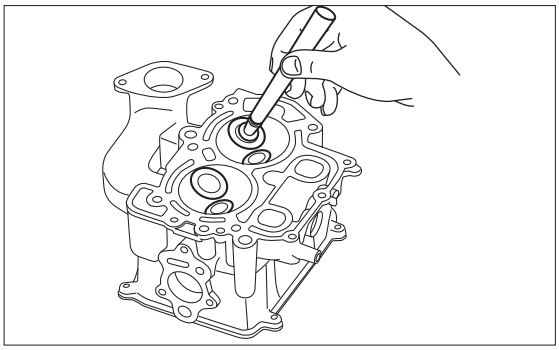
1. Remove the carbon built up on the valve.

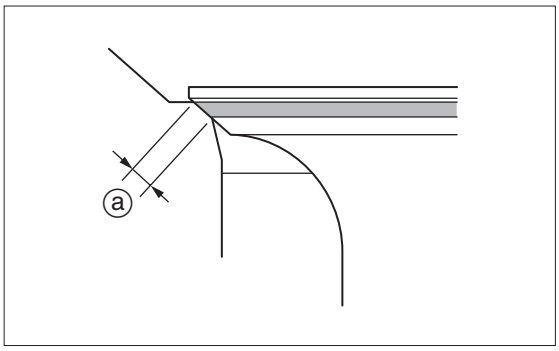
2. Evenly apply a thin coat of red lead to the valve seat.

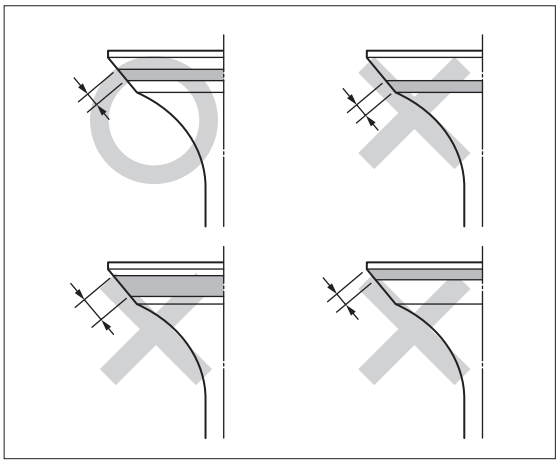
3. Use a valve lapper (commercially available) to push the valve onto the valve seat lightly as shown in the diagram.

4. Measure the valve seat contact width ⓐ of the valve face stained with red lead. Correct the valve seat if the contact area is above or below the center or the contact area of the valve seat is greater than the specified limit.

Valve Seat Contact Width ⓐ: Standard Value Intake/Exhaust Side : 1.0 mm (0.04 in)
Functional Limit: Intake/Exhaust Side: 2.0 mm (0.08 in)

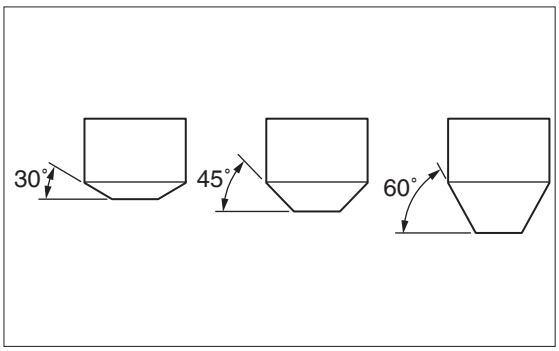






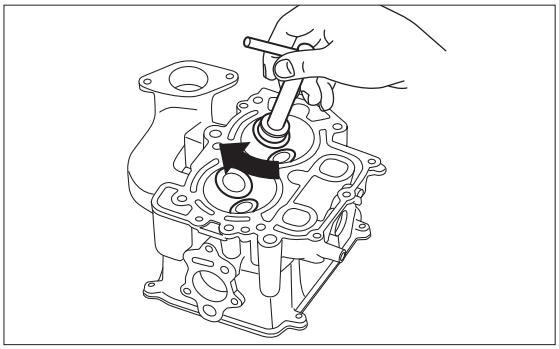
15) Correction of Valve Seat

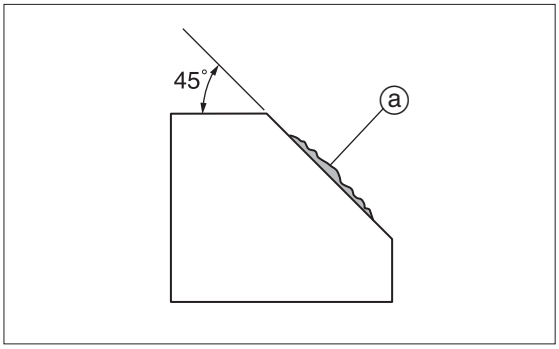
1. Use valve seat cutter (commercially available item) to correct valve seat.



2. Use a 45° seat cutter to grind the valve seat surface until it becomes smooth while rotating the cutter in the clockwise direction.

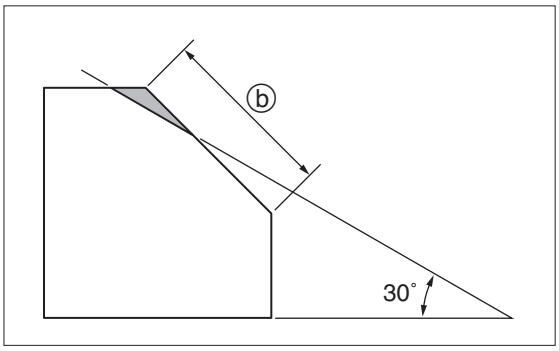
> Be careful not to over-grind the valve seat. Rotate the valve seat cutter while pressing it down evenly.





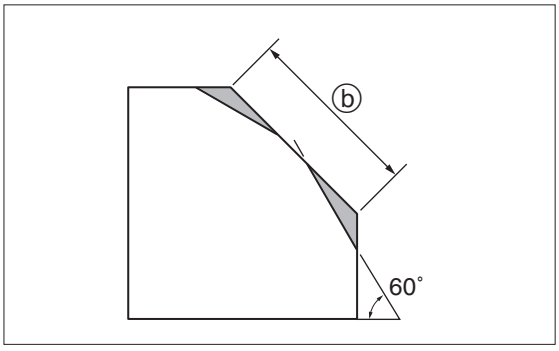
ⓐ Carbon build-up or uneven surface

3. Use a 30° seat cutter to adjust the contact position at the upper end of the valve seat.



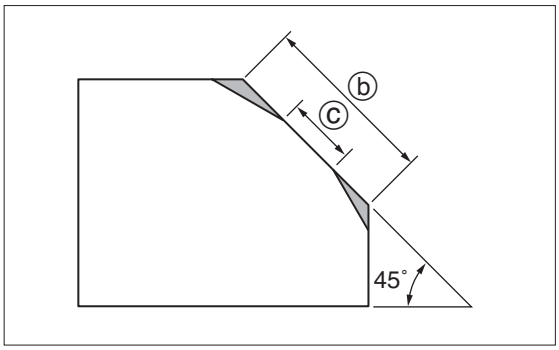
ⓑ Width before correction

4. Use a 60° seat cutter to adjust the contact position at the lower end of the valve seat.



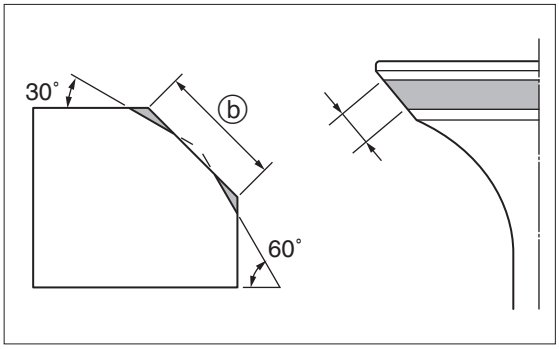
ⓑ Width before correction

5. Use a 45˚ seat cutter to adjust the contact width ⓒ of the valve seat to the specified value.



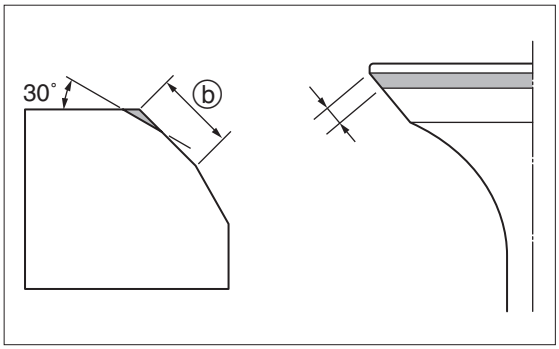
ⓑ Width before correction
ⓒ Specified width

6. If the valve seat contact area is located in the center and the area is too wide, adjust the contact width to the specified value by cutting the upper and lower ends using 30° and 60° seat cutters respectively.



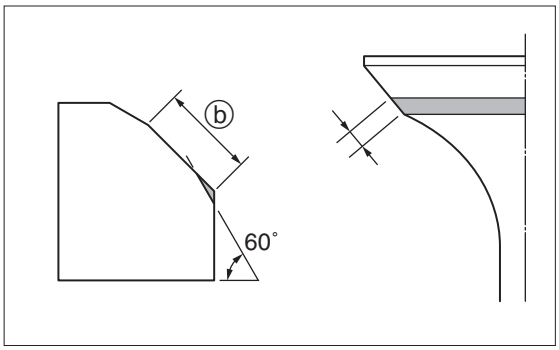
ⓑ Width before correction

7. If the valve seat contact area is too narrow and located nearer to the valve face upper end, use a 30° seat cutter to cut the upper end. If necessary, use a 45° seat cutter to adjust the contact width of the valve seat to the specified value.



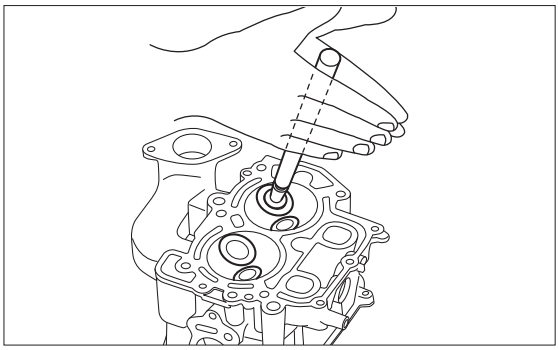
ⓑ Width before correction

8. If the valve seat contact area is too narrow and located nearer to the valve face lower end, use a 60° seat cutter to cut the lower end. If necessary, use a 45° seat cutter to adjust the contact width of the valve seat to the specified value.



ⓑ Width before correction

9. Apply a thin coat of an abrasive compound to the entire valve seat contact area, and rub and polish the valve seat while knocking and turning the valve with a valve lapper (commercially available).



⚠ CAUTION

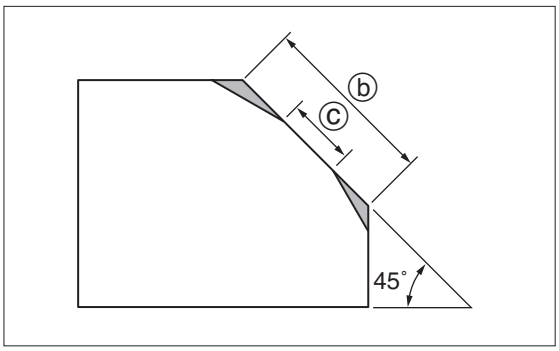
Perform the work by taking care not to allow the abrasive compound to adhere to the valve stem and valve guide.

- Use a finer abrasive compound to finish.
- When changing abrasive compound to finer one, remove present one completely.
- After completion of lapping, wipe off the compound and then clean.

10. After the work, remove the compound completely from the cylinder head and valve.

11. Check the valve seat contact width ⓒ.

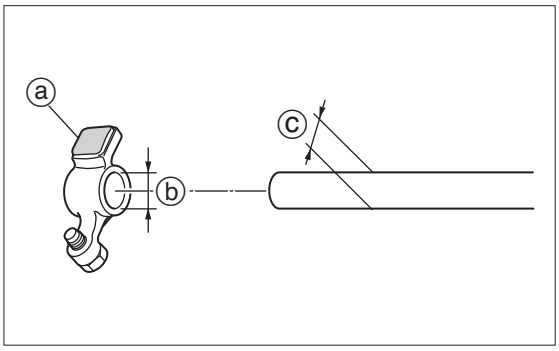
Valve Seat Contact Width ⓒ: Standard Value
1.0 mm (0.04 in)



16) Inspection of Rocker Arm and Rocker Arm Shaft

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

2. Measure the rocker arm inner diameter ⓑ and rocker arm shaft outer diameter ⓒ. Calculate the oil clearance ⓓ (ⓓ = ⓑ − ⓒ). Replace if other than the specified value.



Ⓓⓑ − ⓒ

Rocker Arm Inner Diameter ⓑ: Standard Value
13.01 mm (0.5129 in)
Rocker Arm Shaft Outer Diameter ⓒ: Standard Value
12.99 mm (0.5114 in)
Oil Clearance Between Rocker Arm Hole and Shaft ⓓ: ⓑ − ⓒ
0.006 – 0.035 mm (0.00024 – 0.00138 in)

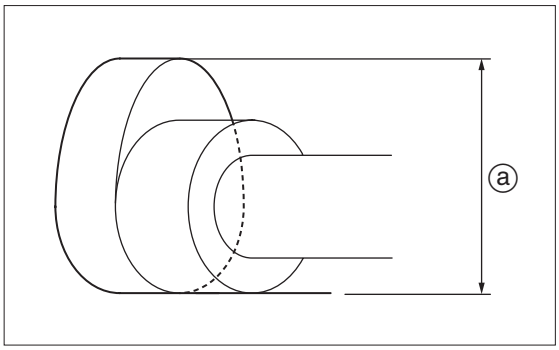
Functional Limit:
Replace if ⓑ is 13.05 mm (0.5138 in) or greater
Replace if ⓒ is 12.99 mm (0.5094 in) or less
Replace if ⓓ is 0.060 mm (0.00236 in) or greater

17) Inspection of Camshaft

1. Measure the cam height. Replace if less than the specified value.

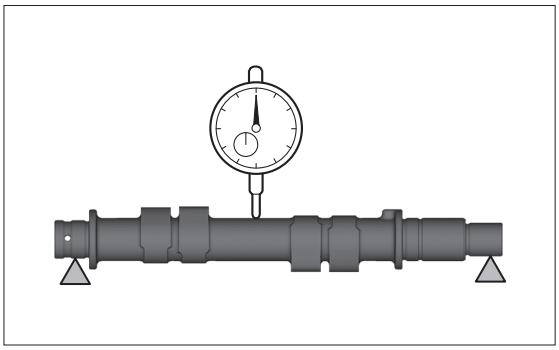
Cam Height ⓐ: Standard Value
Intake Side: 23.43 mm (0.9224 in)
Exhaust Side: 23.46 mm (0.9236 in)

Functional Limit: Cam Height ⓐ
Intake Side: 23.3 mm (0.9173 in)
Exhaust Side: 23.3 mm (0.9173 in)



2. Measure the camshaft runout. Replace if greater than the specified value.

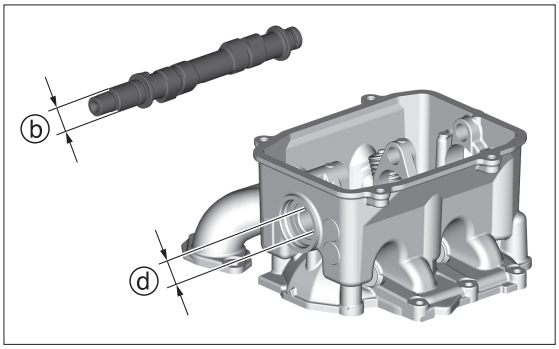
Camshaft Runout Limit:
0.05 mm (0.0020 in)



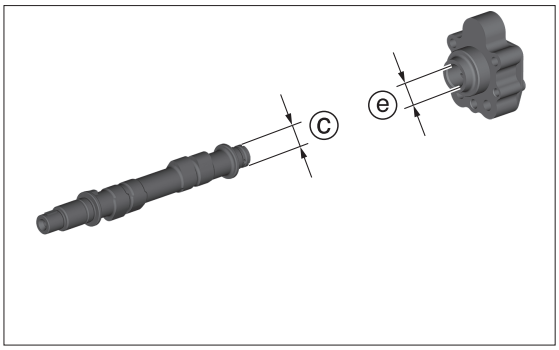
3. Measure the camshaft journal outer diameters ⓑ and ⓒ. Replace the camshaft if less than the specified value.

Camshaft Outer Diameter (pulley side bearing) ⓑ: Standard Value
17.975 – 17.990 mm (0.7077 – 0.7083 in)
Camshaft Outer Diameter (oil pump side and center bearing) ⓒ: Standard Value
15.965 – 15.980 mm (0.6285 – 0.6291 in)

Functional Limit
ⓑ 17.95 mm (0.7067 in)
ⓒ 15.95 mm (0.6280 in)



4. Measure the cylinder head journal inner diameter ⓓ and oil pump journal inner diameter ⓔ. Calculate the oil clearances. The values are ⓓ – ⓑ and ⓔ – ⓒ. Replace the camshaft, cylinder head, or oil pump if greater than the specified value.



Cylinder Head Journal Inner Diameter ⓓ (Upper): Standard Value
18.010 – 18.025 mm (0.7091 – 0.7096 in)

Functional Limit
18.050 mm (0.7106 in)

Oil Clearance: Standard Value
0.02 – 0.05 mm (0.0008 – 0.0020 in)

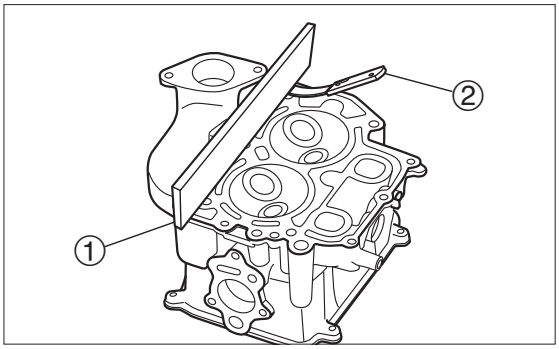
Functional Limit:
0.09 mm (0.0035 in)

If the oil clearance exceeds the functional limit, replace the cylinder head, camshaft, or oil pump, or all of them as a set, and check that the clearance is within the specified range.

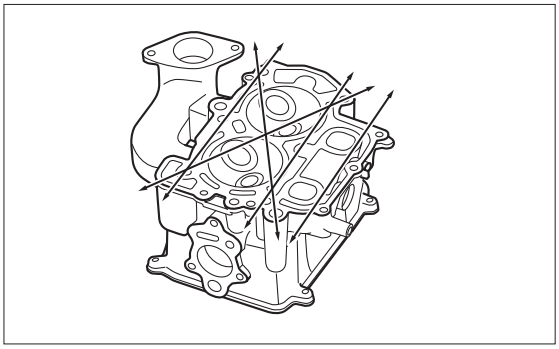
18) Inspection of Cylinder Head

1. Remove the carbon build-up of the combustion chamber, and check for deterioration, corrosion of mating surfaces, etc.

2. Use a straight edge ① and thickness gauge ② to check the distortion of the cylinder head in the directions shown in the diagram. Replace if greater than the specified value.



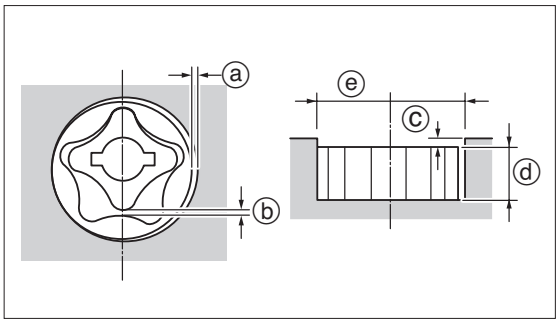
Cylinder Head Distortion Limit:
0.1 mm (0.004 in)

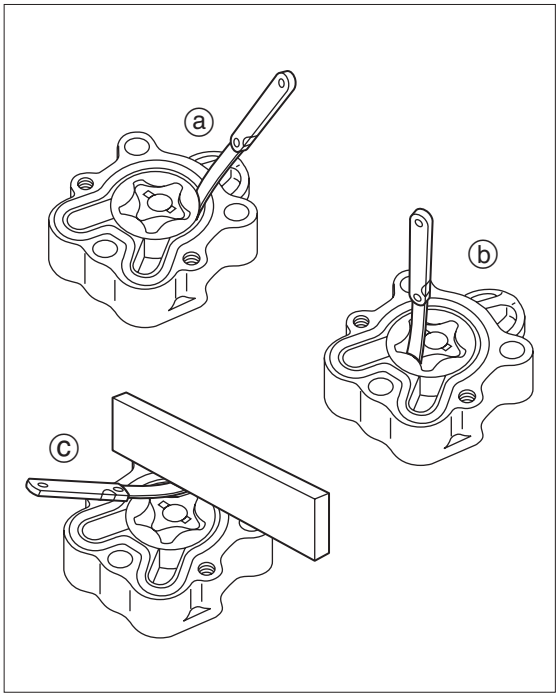


19) Inspection of Oil Pump

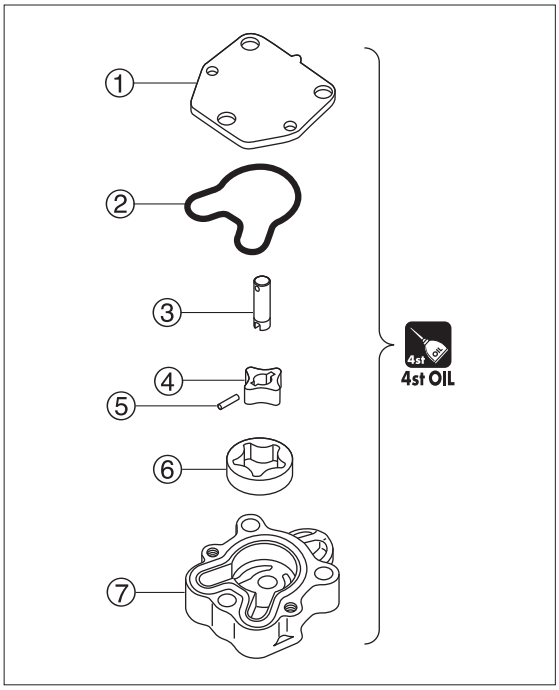
1. Use a micrometer, cylinder gauge, depth gauge, and thickness gauge to measure the dimensions shown below. Replace the oil pump if other than the specified value.

Functional Limit
Clearance between outer rotor and body ⓐ:
0.36 mm (0.0142 in)
Clearance between outer and inner rotors ⓑ:
0.16 mm (0.0063 in)
Clearance between sides of rotor and body ⓒ:
0.11 mm (0.0043 in) (including wear of oil pump cover)
Height of Outer Rotor ⓓ:
9.96 mm (0.3921 in)
Pump Body Inner Diameter ⓔ:
29.04 mm (1.1433 in)





① Oil Pump Cover
② Gasket
③ Shaft
④ Inner Rotor
⑤ Pin
⑥ Outer Rotor
⑦ Pump Body

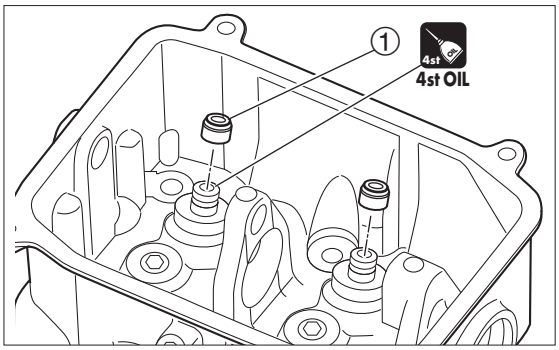


20) Installation of Valves

1. Apply oil to valve guide and attach new valve stem seal.

Intake Side: Gray
Exhaust Side: Green

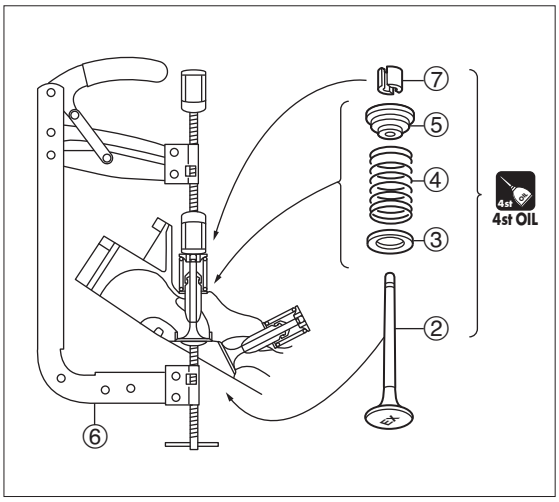
4st OIL



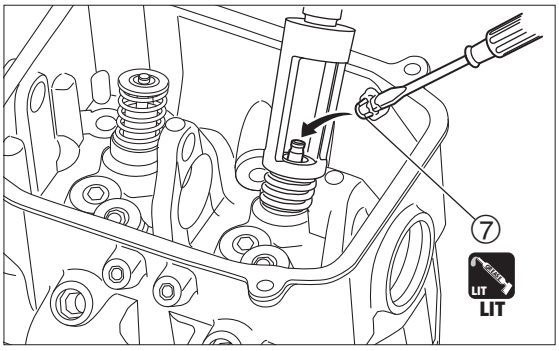
2. Install the valve ②, valve spring seat ③, valve spring ④, and retainer ⑤ in the order shown in the diagram, then install the valve spring compressor ⑥.

Valve Spring Compressor ⑥:
Commercially available item

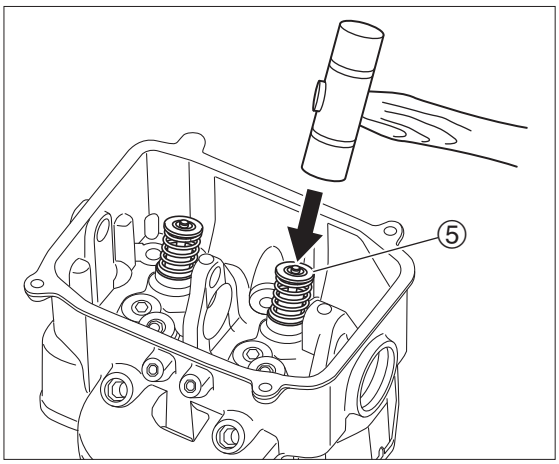
- Valves, springs and other power unit related parts should be arranged in the order they are removed.
- Use an attachment that fits retainer outer diameter of 20 mm.
- If a valve spring compressor is not used, put the cylinder head on a folded rag to prevent the valves from being damaged.
- Install the valve spring ④ with the roughly wound section (painted section) facing the retainer side.
- Install the valve ② without getting oil on the valve head.



3. With the valve spring ④ compressed, use a narrow flathead screwdriver with a small amount of grease at the tip to install the cotter ⑦.



4. Tap the retainer lightly with a plastic hammer to fasten the cotter securely.



5

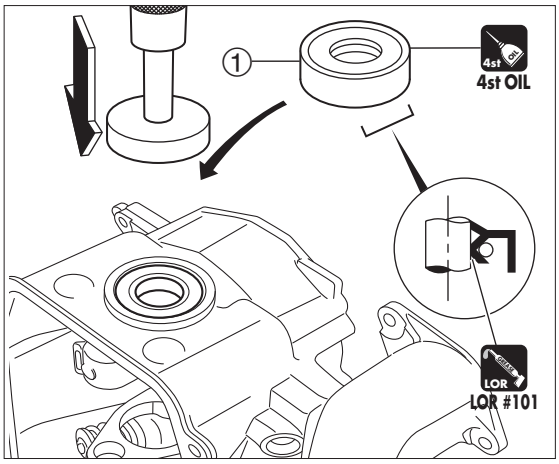
21) Installation of Camshaft

1. Apply 4-stroke engine oil on the outer circumference of the new oil seal ① and install the camshaft.

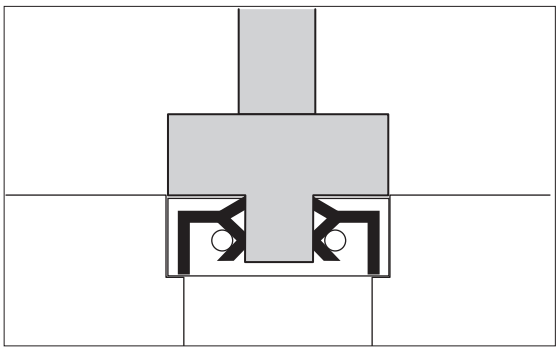
Oil Seal Attachment:
Commercially available item

Apply seal grease to lip of oil seal before installing it.

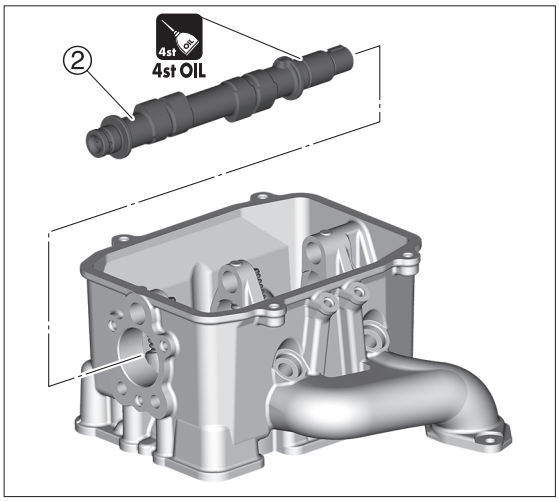
LOR



Oil Seal

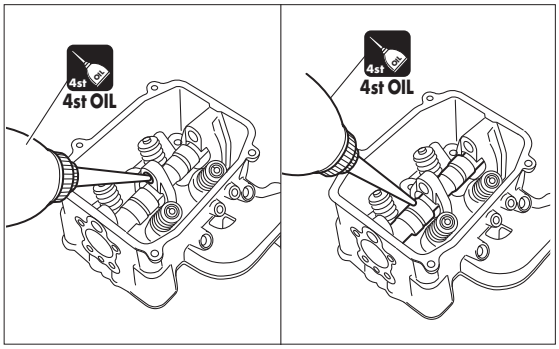


2. Apply oil and install the camshaft ② from the direction shown in the diagram.

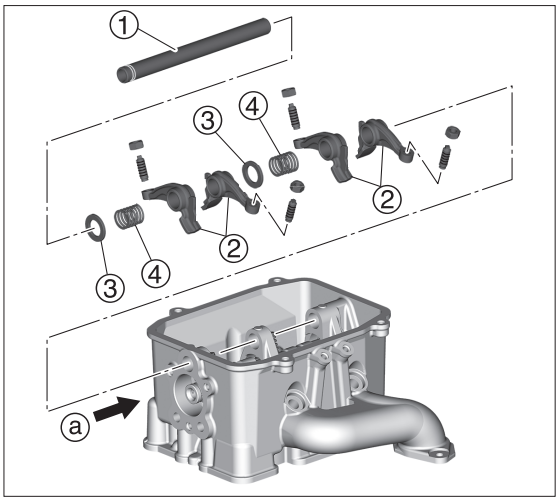


22)Installation of Rocker Arm Shaft

1. Apply sufficient amount oil to cam surface of cam shaft and journal of rocker arm shaft.



2. Install the rocker arms ②, washers ③, and springs ④ while inserting the rocker arm shaft ① from the lower side of cylinder head .

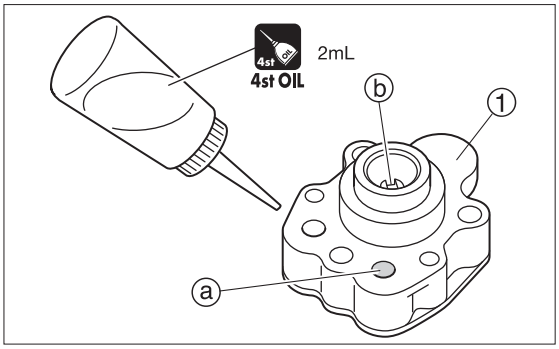


· Apply sufficient amount of engine oil to rocker arm and adjust screw after installing rocker arm.
· Install the rocker arm shaft with the groove facing the oil pump side.

4st OIL

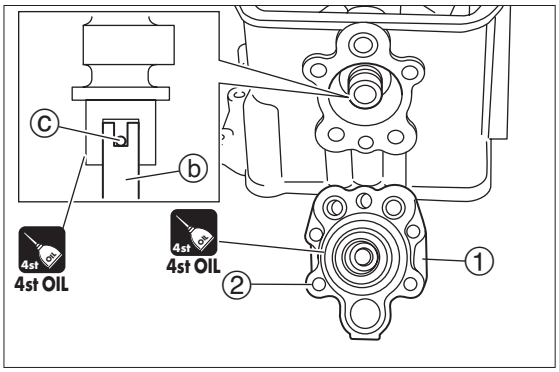
23) Installation of Oil Pump

Before installing the oil pump, pour approximately 2 mL of engine oil into the oil passage ⓐ (IN side) and rotate the oil pump drive shaft ⓑ clockwise twice.



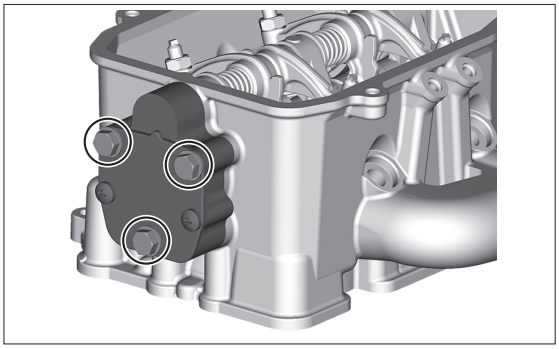
4st OIL

1. Install the oil pump ①, aligning the notch on the oil pump drive shaft ⓑ with the camshaft pin ⓒ.



Use new gasket ②.

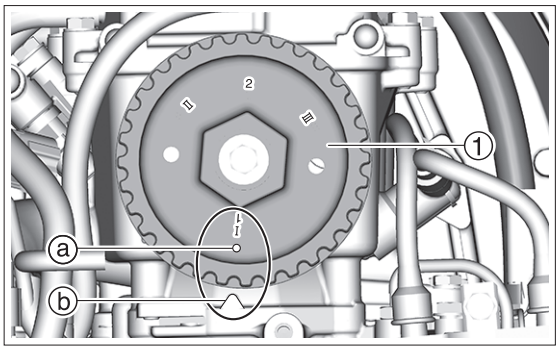
2. Install the oil pump.



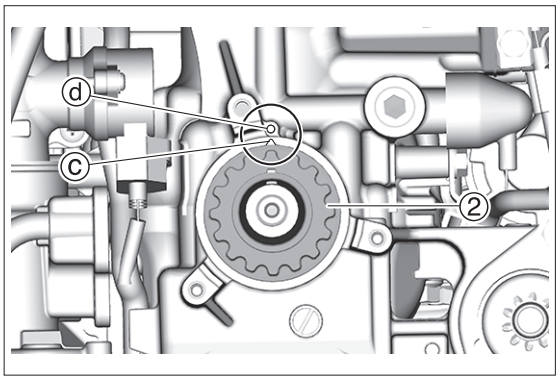
24) Installation of Cylinder Head

The No.1 cylinder should be at the top dead center of the compression stroke.

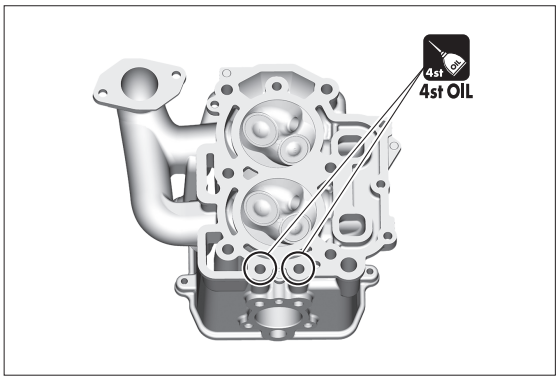
1. After temporarily assembling the driven pulley, align the "1" mark ⓐ of the pulley ① to the " ▲ " mark ⓑ of the cylinder head.



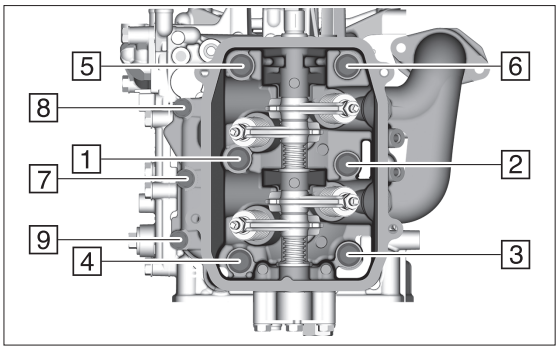
2. Check that the " ▲ " mark ⓒ of the drive pulley ② is aligned with the " ● " mark ⓓ of the cylinder block.



3. Supply approximately 1 mL of engine oil to the oil passage.



4. Install cylinder head with new gasket, and tighten bolts in the order shown in two steps to specified torque.



⚠ CAUTION

- **Do not reuse the cylinder head gasket. Be sure to replace it with a new one.**
- **Do not turn the timing pulley or camshaft pulley with the timing belt removed. Doing so can make the pistons and valves interfere with each other, possibly resulting in damage to these parts.**

- First, tighten the M8 bolts to the specified torque in two steps. Then, tighten the M6 bolts to the specified torque in two steps.
- After installing cylinder head, install timing belt and check valve clearance. For the procedure, refer to the corresponding section.
- Apply engine oil to the threaded areas and seats of the M8 bolts.

Install the washers so that the chamfer side of the washer faces the bolt head.

First Tightening Torque:

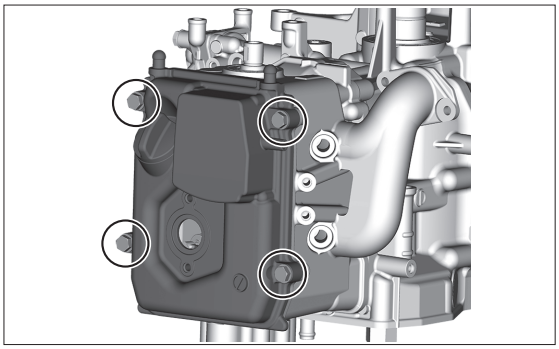
Cylinder Head Bolts (M8) 1 to 6
10 N·m (7 lb·ft) [1.0 kgf·m]

Cylinder Head Bolts (M6) 7 to 9
6 N·m (4 lb·ft) [0.6 kgf·m]

Second Tightening Torque:

Cylinder Head Bolts (M8) 1 to 6
30 N·m (22 lb·ft) [3 kgf·m]

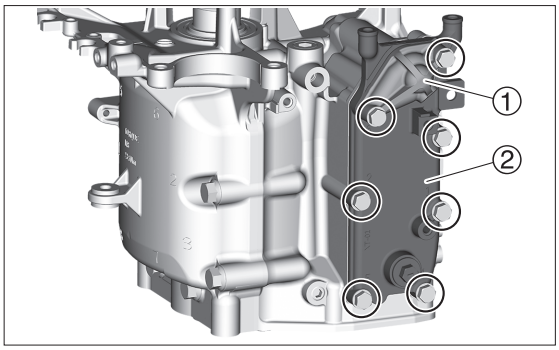
Cylinder Head Bolts (M6) 7 to 9
10 N·m (7 lb·ft) [1.0 kgf·m]



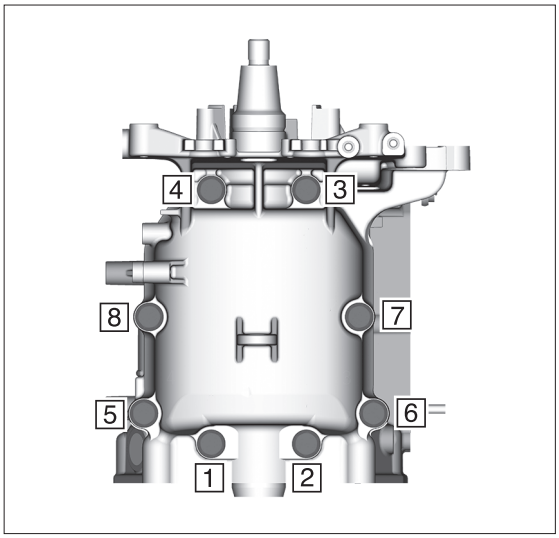
5. Install cylinder head cover, and tighten them.

25) Disassembly of Cylinder Block

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



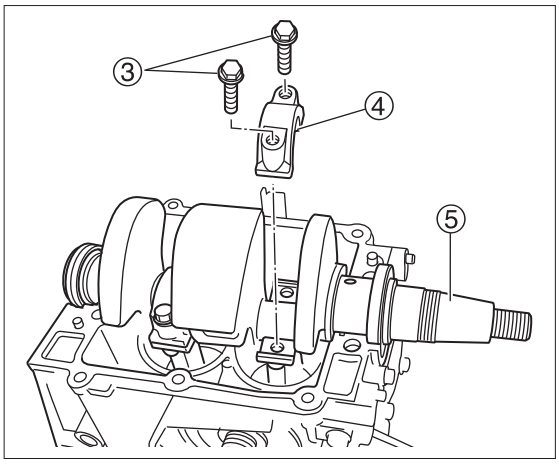
2. Loosen the crankcase bolts in several steps in the order shown in the diagram and remove the crankcase. 1 - 8



3. Remove the connecting rod bolts ③ and connecting rod cap ④, and then remove the crankshaft ⑤ and oil seals.

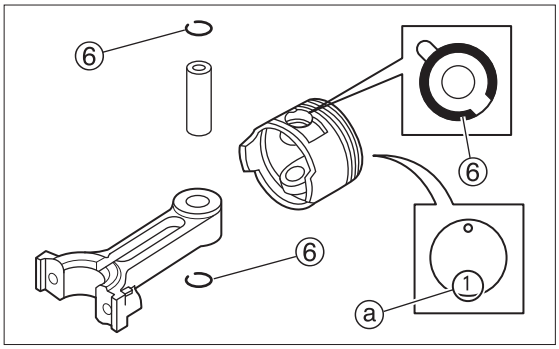
4. Remove the metal bearings from the cylinder block and crankcase.

5. Remove the connecting rods and piston assemblies from the cylinder block.



- Removed bearings should be arranged in the order they are removed.
- Mark individual pistons with the number ⓐ corresponding to their cylinders.
- Connecting rods and caps should be arranged as pairs in the order they are removed. Removed parts should be arranged so that they can be reassembled in their original positions and orientations.
- Do not reuse piston pin clips. Be sure to replace with new ones.

6. Remove the piston pin clip ⑥ and piston pin, and then remove the piston.



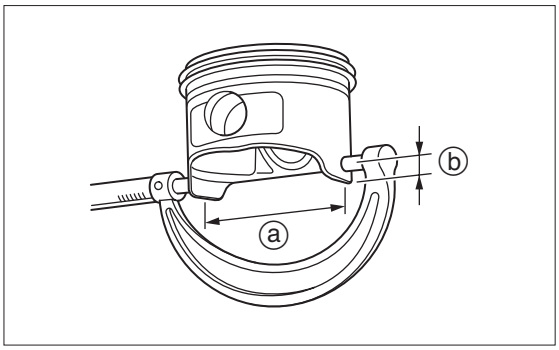
⑥ Do not reuse.

26) Inspection of Piston Outer Diameter

1. Measure the piston outer diameter between the specified points. Replace if less than the specified value.

Piston Outer Diameter ⓐ: Standard Value
54.96 mm (2.1638 in)
Measurement Point ⓑ:
7 mm (0.28 in) above piston skirt bottom

Functional Limit:
54.90 mm (2.1614 in)



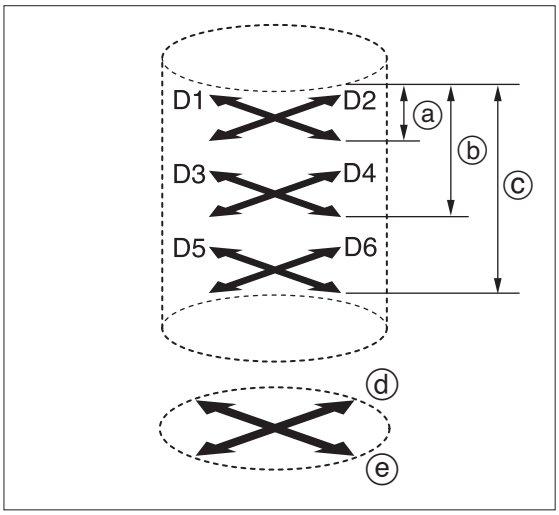
27) Inspection of Cylinder Inner Diameter

1. Measure the cylinder inner diameters (D1 to D6) at measurement points ⓐ, ⓑ and ⓒ, taking measurements of D1, D3, and D5 ⓓ in the direction of the crankshaft and taking measurements of D2, D4, and D6 ⓔ in the direction of the crank web.

Cylinder Inner Diameters (D1 to D6): Standard Value
55.00 mm (2.1654 in)

Functional Limit:
55.06 mm (2.1677 in)
If the values exceed the specifications, perform replacement or boring and honing, and use oversized pistons and piston rings.

Note : Measure at the maximum wear points.



ⓐ 15 mm (0.6 in)
ⓑ 35 mm (1.4 in)
ⓒ 55 mm (2.2 in)
ⓓ Crankshaft direction
ⓔ Crank web direction

2. Calculate the taper limit as shown below. Replace the cylinder block if greater than the specified value.

Taper Limit:
D1–D5 (Direction ⓓ)
D2–D6 (Direction ⓔ)

Functional Limit:
0.08 mm (0.0031 in)

3. Calculate the out-of-roundness limit as described below. Replace the cylinder block if greater than the specified value.

Out-of-roundness limit:
D2–D1 (Measurement Point ⓐ)
D6–D5 (Measurement Point ⓒ)

Functional Limit:
0.06 mm (0.0024 in)

5

28) Inspection of Piston Clearance

1. If the piston clearance is greater than the specified limit, replace the cylinder block, or replace the piston and piston rings as a set, or replace all of them.

Piston Clearance (Cylinder inner diameter – Piston outer diameter):
0.020 – 0.055 mm (0.00079 – 0.00217 in)

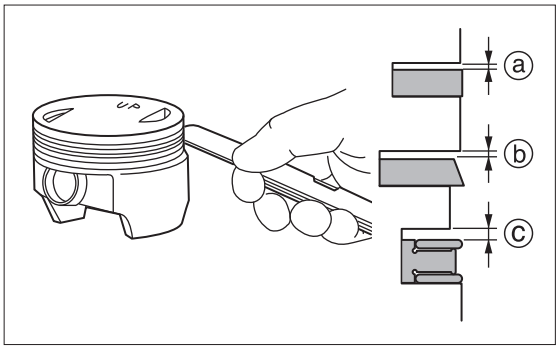
Functional Limit:
0.150 mm (0.00591 in)

29) Inspection of Piston Ring Side Clearance

1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if greater than the specified value.

Piston Ring Side Clearance:
Top Ring ⓐ: 0.04 to 0.08 mm (0.0016 to 0.0031 in)
Second Ring ⓑ: 0.03 to 0.07 mm (0.0012 to 0.0028 in)
Oil Ring ⓒ: 0.05 to 0.15 mm (0.0019 to 0.0059 in)

Functional Limit
Top Ring ⓐ: 0.10 mm (0.0039 in)
Second Ring ⓑ: 0.09 mm (0.0035 in)
Oil Ring ⓒ: 0.18 mm (0.0059 in)



30) Inspection of Piston Ring

1. Push the piston ring ① into the ring gauge parallel to the top edge. Measure the cylinder bore at the top or bottom sections where there is little wear.

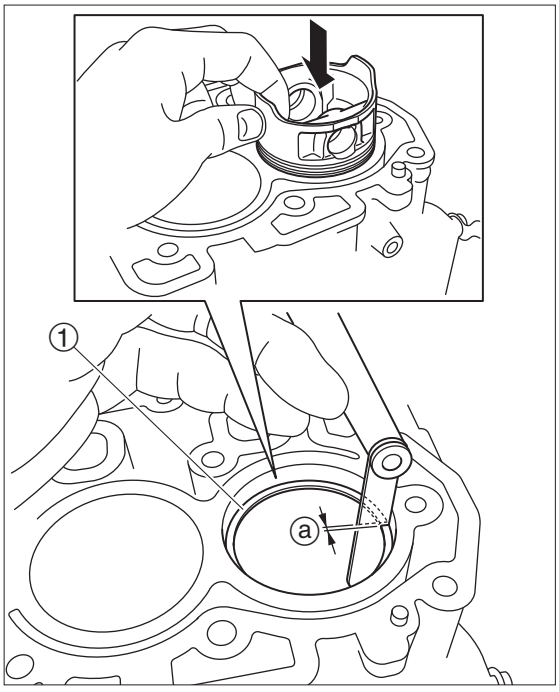
2. If a ring gauge is not available, push the piston ring into the cylinder with the piston crown in a parallel manner.

3. Measure the piston ring end gap ⓐ. Replace if greater than the specified value.

Piston Ring End Gap ⓐ:
Top Ring: 0.15 – 0.30 mm (0.0059 – 0.0118 in)
Second Ring: 0.35 – 0.50 mm (0.0138 – 0.0197 in)
Oil Ring: 0.20 – 0.70 mm (0.0079 – 0.0276 in)

Functional Limit:
Top ring: 0.50 mm (0.01975 in)
Second Ring: 0.70 mm (0.0276 in)
Oil Ring: 0.90 mm (0.0354 in)

Replace the oil ring when the top ring or second ring is replaced.

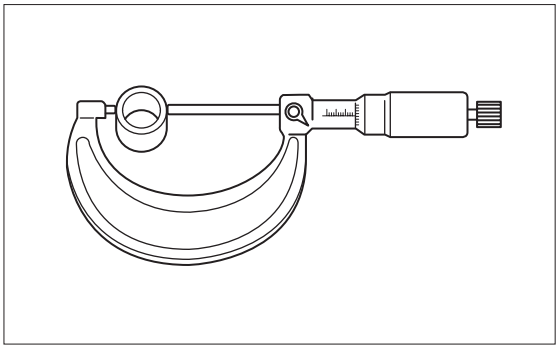


31) Inspection of Piston Pin

1. Measure the piston pin outer diameter. Replace the piston pin if less than the specified value.

Piston Pin Outer Diameter: Standard Value
14.00 mm (0.6612 in)

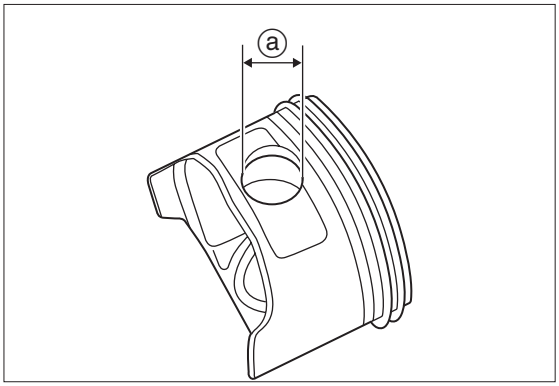
Functional Limit:
13.97 mm (0.5500 in)



2. Measure the piston pin hole inner diameter ⓐ. Replace the piston if greater than the specified value.

Piston Pin Hole ⓐ Inner Diameter: Standard Value
14.002 – 14.008 mm (0.5512 – 0.5514 in)

Functional Limit:
14.040 mm (0.5528 in)



3. Calculate the clearance between the piston pin and pin hole. Replace the piston pin or piston if greater than the specified value.

Clearance Between Piston Pin and Pin Hole (Piston pin hole inner diameter - Piston pin outer diameter):
0.002 – 0.012 mm (0.00008 – 0.00047 in)

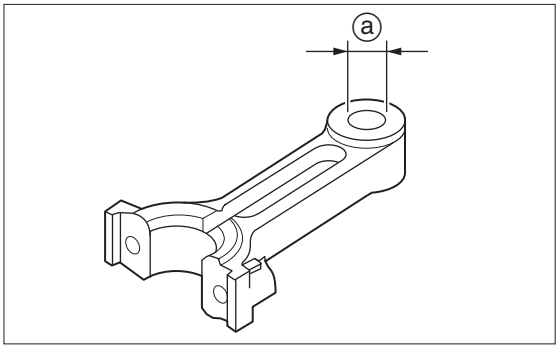
Functional Limit:
0.040 mm (0.00157 in)

32) Inspection of Connecting Rod Small End Inner Diameter

1. Measure the connecting rod small end inner diameter ⓐ. Replace the connecting rod if greater than the specified value.

Connecting Rod Small End Inner Diameter ⓐ: Standard Value
14.01 mm (0.5516 in)

Functional Limit:
14.04 mm (0.5526 in)

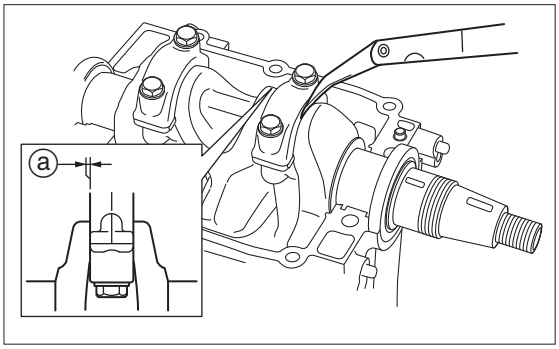


33) Inspection of Connecting Rod Big End Side Clearance

1. Measure the connecting rod big end side clearance ⓐ. Replace the connecting rod or crankshaft or both if greater than the specified value.

Connecting Rod Big End Side Clearance ⓐ:
0.10 – 0.25 mm (0.0039 – 0.0098 in)

Functional Limit:
0.60 mm (0.0236 in)

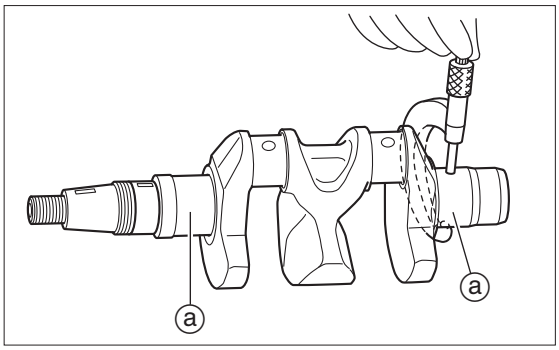


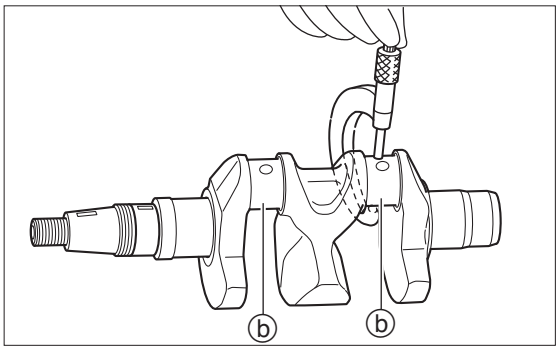
34) Inspection of Crankshaft

1. Measure the crankshaft journal outer diameters ⓐ and crank pin outer diameters ⓑ. Replace the crankshaft if less than the specified limit.

Crankshaft Journal Outer Diameter ⓐ: Standard Value
29.988 – 29.996 mm (1.1806 – 1.1809 in)
Crank Pin Outer Diameter ⓑ: Standard Value
26.972 – 26.985 mm (1.0618 – 1.0624 in)

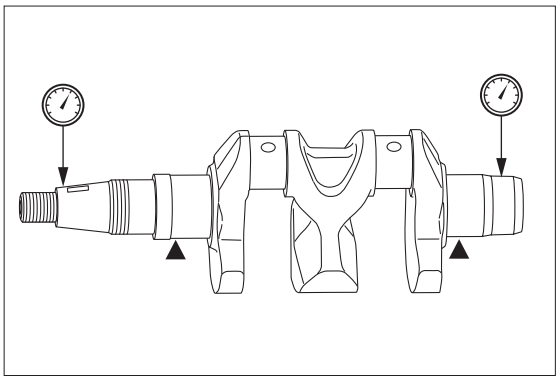
Functional Limit
Crankshaft Journal Outer Diameter ⓐ:
Replace if 29.97 mm (1.1799 in) or less
Crank Pin Outer Diameter ⓑ:
Replace if 26.95 mm (1.0610 in) or less





2. Measure the crankshaft runout. Replace the crankshaft if greater than the specified value.

Crankshaft Runout Limit:
0.05 mm (0.0020 in)



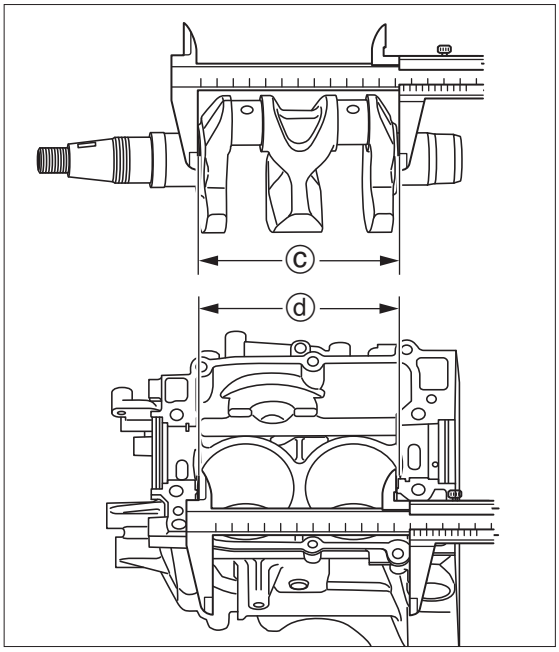
3. Side Clearance

Side Clearance:
0.1 – 0.2 mm (0.0039 – 0.0079 in)

Functional Limit:
0.55 mm (0.0217 in)

If the side clearance is out of the specified range, measure the crankcase (cylinder side) width ⓓ and crankshaft width ⓒ, and replace the part whose width is out of the specified range.

Crankshaft Width ⓒ: Standard Value
126.90 – 126.95 mm (4.9961 – 4.9980 in)
Crankcase Width ⓓ: Standard Value
127.05 – 127.10 mm (5.0020 – 5.0039 in)



35) Inspection of Crank Pin Oil Clearance

1. Clean the connecting rod and metal bearings. Re-install the metal bearings.

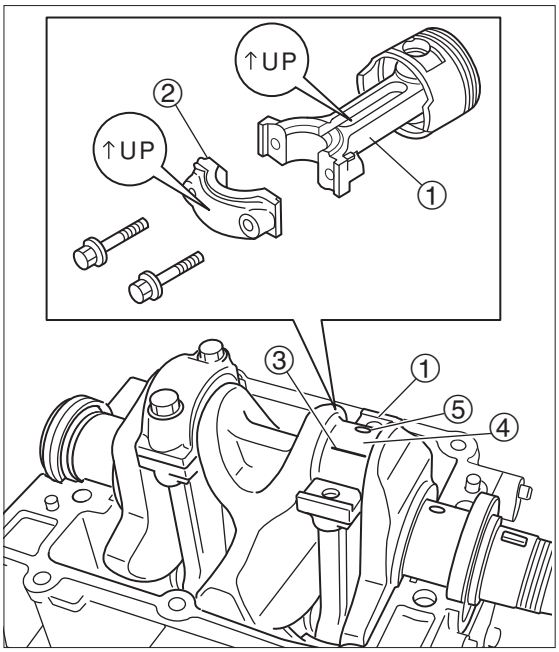
2. Place cylinder block upside down on the work bench. Install the piston to the connecting rod ① and install this assembly to the cylinder block.

> Do not attach piston rings.

3. Install the crankshaft in the cylinder block

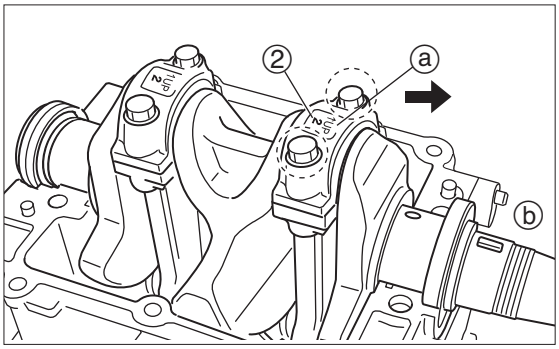
4. Place the Plastigauge ③ in each crank pin ④ so that it is parallel to the crankshaft.

> Do not place the Plastigauge ③ on the oil hole 5 of the crank pin ④.



5. Install the connecting rod and the cap ② to the crank pin ④.

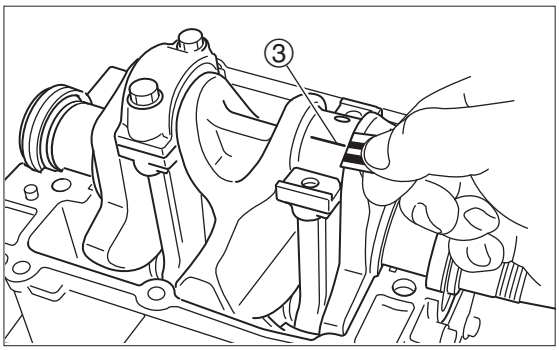
> ·Be sure that individual cap is installed to their original connecting rod.
> ·Check that the UP mark ⓐ on the connecting rod cap is facing the crankshaft flywheel side ⓑ.



6. Tighten the connecting rod bolts in two steps to the specified torque.

> ·Do not move the connecting rod and crankshaft until the oil clearance measurement is completed.
> ·Apply engine oil to the threaded areas and seats of the bolts.

Connecting Rod Bolts:
First Tightening Torque: 6 N·m (4 lb·ft) [0.6 kgf·m]
Second Tightening Torque: 12 N·m (9 lb·ft) [1.2 kgf·m]

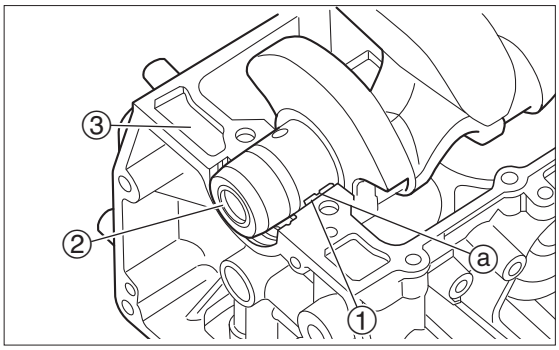


7. Remove the connecting rod cap and measure the crushed width of the Plastigauge on each crank pin. Replace connecting rod or crankshaft if the width is over specified value.

Crank Pin Oil Clearance:
0.015 – 0.041 mm (0.00059 – 0.00161 in)

Functional Limit:
0.060 mm (0.00236 in)

36) Inspection of Crankshaft Main Journal Oil Clearance

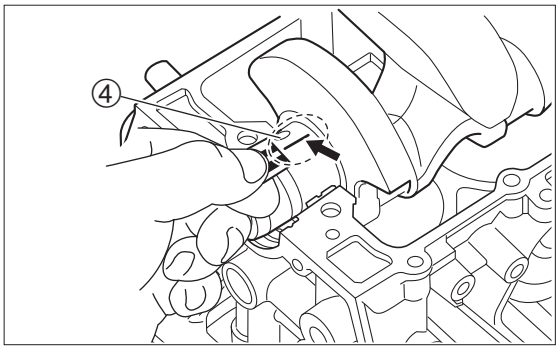


1. Clean the bearings, crankshaft main journals, and bearing mounting surfaces of the crankcase and cylinder block.

2. Place the cylinder block on a workbench with the cylinder head side facing downward.

3. Install the bearings ① and crankshaft ② in the cylinder block ③.

·Be sure to install the individual bearings at their original locations.
·Align the protrusion ⓐ on the bearings to the groove on the cylinder block to install them.



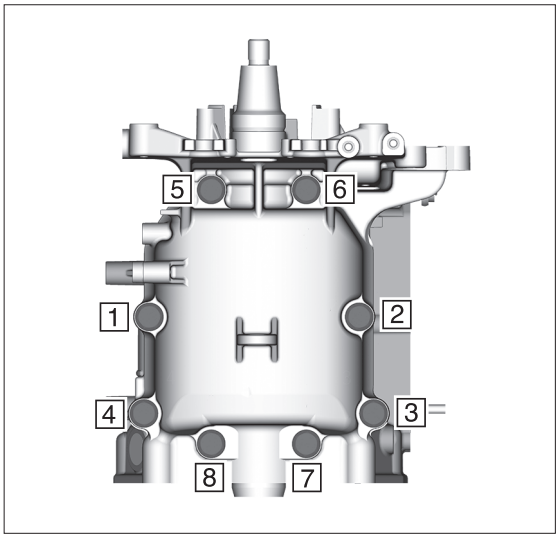
4. Place a Plastigauge ④ in each crankshaft main journal so that it is parallel with the crankshaft.

Do not place the Plastigauge on the oil hole of the crankshaft main journal.

5. Install the bearings in the crankcase.

·Be sure to install the individual bearings at their original locations.
·Install the bearings with their protrusions fitted into the crankcase grooves.

6. Install the crankcase in the cylinder block.



7. Tighten the crankcase bolts in two steps to the specified torque in the order shown in the diagram.

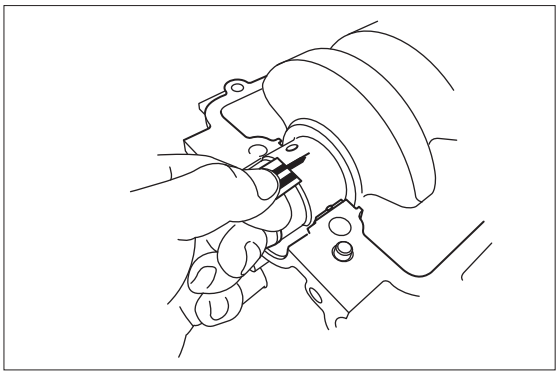
Crankcase Bolts: 1 – 8
First Tightening Torque: 10 N·m (7 lb·ft) [1.0 kgf·m]
Second Tightening Torque: 23.5 N·m (17 lb·ft) [2.4 kgf·m]

8. Loosen bolts in reverse order in several steps. Remove the crankcase and measure the width of the crushed Plastigauge on each main journal. Replace the bearings if greater than the specified limit.

Crankshaft Main Journal Oil Clearance:
0.012 – 0.044 mm (0.00047 – 0.00173 in)

Functional Limit:
0.060 mm (0.00236 in)

If the clearance is less than the specified value, check that the inner diameter codes are as shown below.

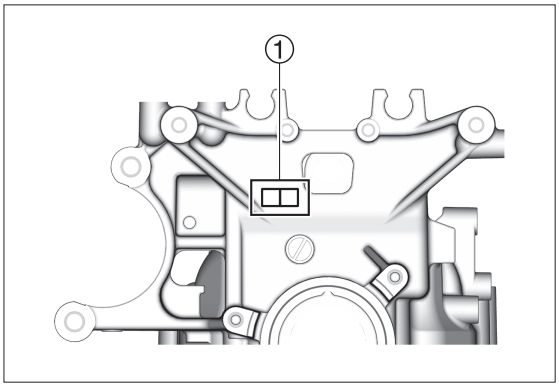


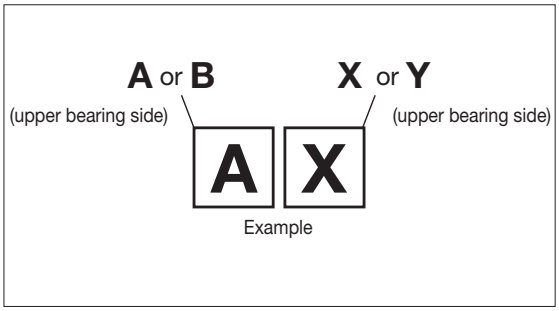
37) Inner Diameter of Cylinder/Crankcase Bearing Holder (Inner Diameter Codes)

The top part of the cylinder is marked with the inner diameter codes ① to indicate the inner diameters of each bearing holder. The inner diameter codes indicate the following two types of bearings. Check the code and select the bearing accordingly.

Inner diameter code ①	Standard value	Bearing color
A or X	37.000 – 37.008 mm	Brown
B or Y	33.008 – 33.016 mm	Black

Inner diameter codes A and B or X and Y represent size of each bearing section.

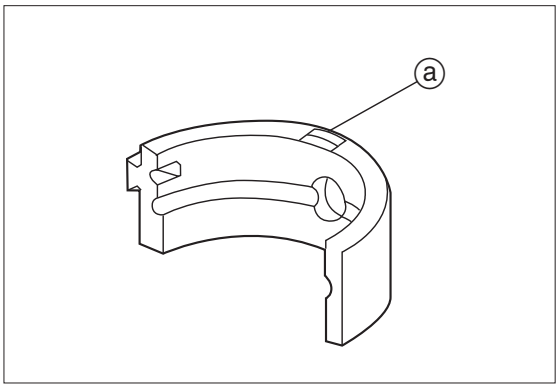




38) Thickness of Metal Bearing (Color of Inner Diameter Code)

The bearings are painted in a color ⓐ that indicates their thickness. The colors indicate the following two types of bearings. Use the proper bearings.

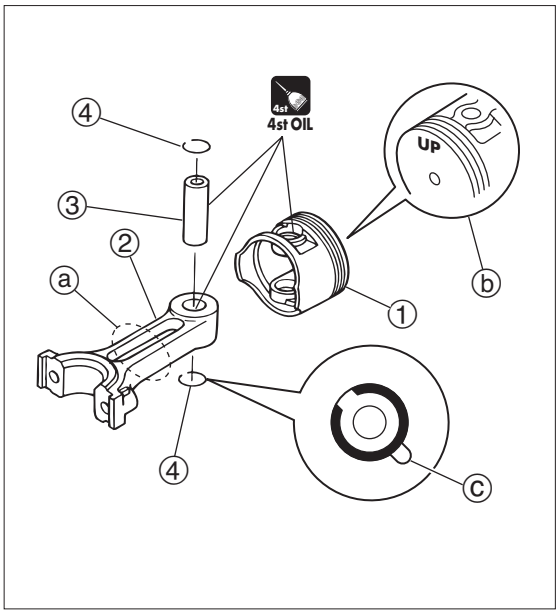
[Color (Inner Diameter Code)]	Thickness
Brown	1.488 – 1.494 mm (0.05858 to 0.05882 in)
Black	1.494 – 1.500 mm (0.05882 to 0.05906 in)



39) Installation of Piston and Connecting Rod

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

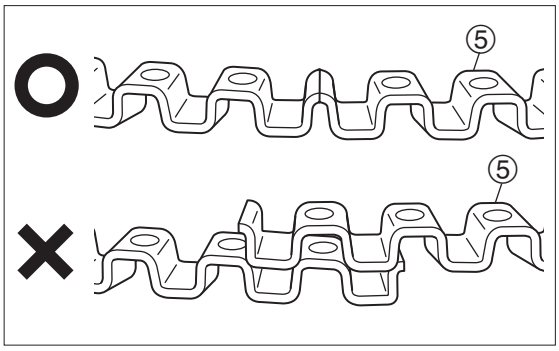
- Point "3V1-UP" mark ⓐ on the connecting rod and "UP" mark ⓑ on the piston in the same direction.
- Be sure to use new piston pin clip, and place clip gap away from piston pin groove ⓒ as shown in the diagram.
- Be sure to install each connecting rod cap to its original connecting rod.



④ Do not reuse.

2. Place the expander ⑤ (#4) into the oil ring groove and check that the ring ends meet each other correctly as shown in the diagram.

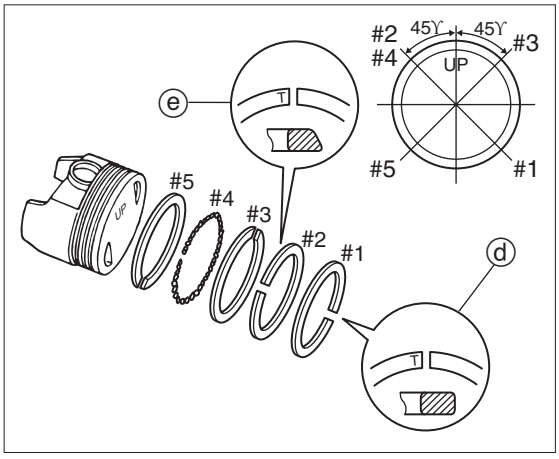
3. Install by sliding the end of the upper side rail (#3) to the left by 90° from the gap in the expander ⑤ (#4) while pressing down on the expander ⑤ (#4) gap with your thumb.



4. Similarly, place the lower side rail (#5) into the groove by shifting it 90° to the right from the gap.

5. Install the second ring (#2 taper) and top ring (#1) in the piston. Install the top ring (#1) and second ring (#2) so that the respective manufacturer marks ⓓⓔ (T) are on top.

6. Install the piston rings so that their gaps are away from each other as shown in the diagram on the right.

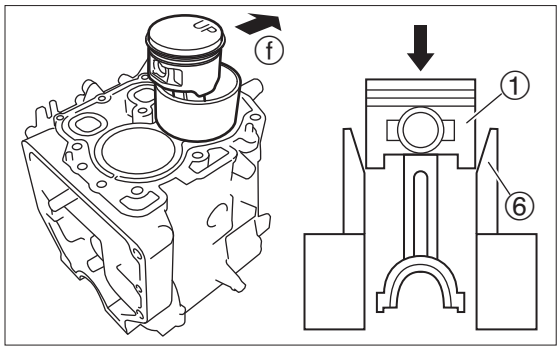


⚠ CAUTION

Be careful not to scratch the piston surface and damage the rings.

- ·Install the piston rings so that their gaps are away from the thrust direction of the piston and the direction of the piston pin too.
- ·After installing the piston rings, check that they move smoothly.

7. Set the piston① into the piston slider ⑥ with the "UP" mark on the piston on the flywheel side ⓕ, and install it in the cylinder.

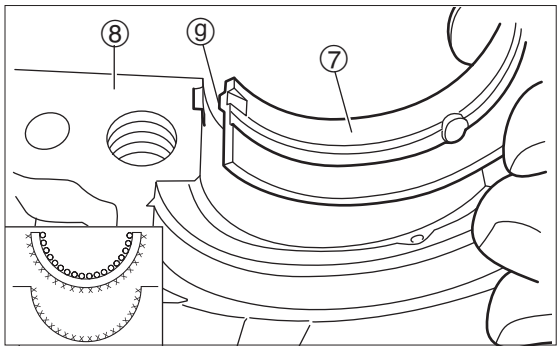


- Before installing, apply engine oil to piston peripheral surfaces, piston rings and piston sliders.
- Clean the the piston to remove any carbon deposits.

Piston Slider ⑥:
P/N. 3V1-72871-0

8. Clean and remove grease on the bearing holder of the crankcase (X).

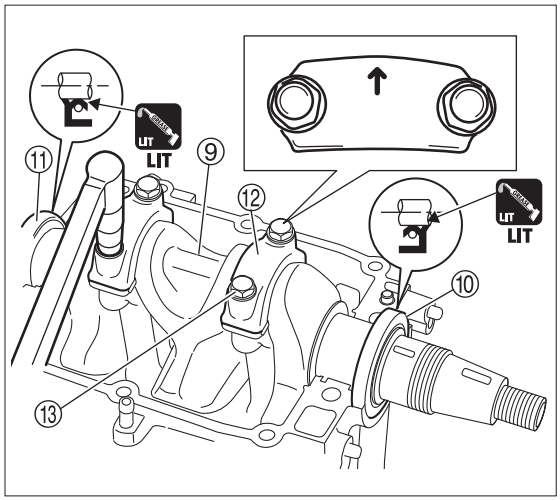
9. Install one side of the bearing ⑦ in the cylinder block ⑧ and connecting rod.



- Be sure to install individual bearings at their original locations.
- Align the protrusion ⑨ on the bearings to the groove on the cylinder block to install them.

10. Apply engine oil on the bearings and crankshaft (○).

11. Install the crankshaft ⑨ and oil seals ⑩ and ⑪ in the cylinder block as shown in the diagram.



- Apply grease on the lip of the oil seal before installing it.
- Be sure to install each connecting rod cap to its original connecting rod.

12. Install the connecting rod cap ⑫ in the connecting rod, and tighten the connecting rod bolts ⑬ to the specified torque in 2 steps.

Connecting Rod Bolts ⑬:
First Tightening Torque: 6 N·m (4 lb·ft) [0.6 kgf·m]
Second Tightening Torque: 12 N·m (9 lb·ft) [1.2 kgf·m]

Apply engine oil to the threaded areas and seats of the bolts.

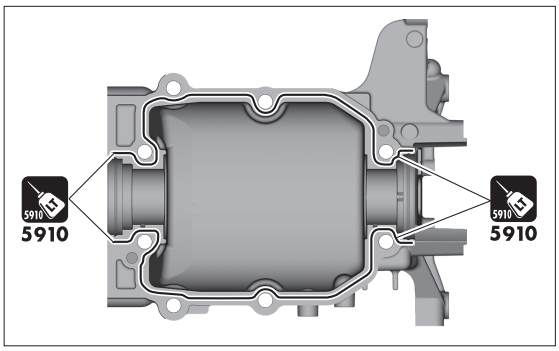
13. Degrease the bearing holder surface of the crankcase and the bearing contact surface, and install one side of the bearing in the crankcase.

- ·Be sure to install the individual bearings at their original locations.
- ·Install the bearings with their protrusions fitted into the crankcase grooves.
- ·Degrease the bearing holder surface of the crankcase journal bearing and the contact surface of the bearings.

14. Apply engine oil to the bearings.

15. Apply a sealing agent to the mating surface (one side) of the crankcase.

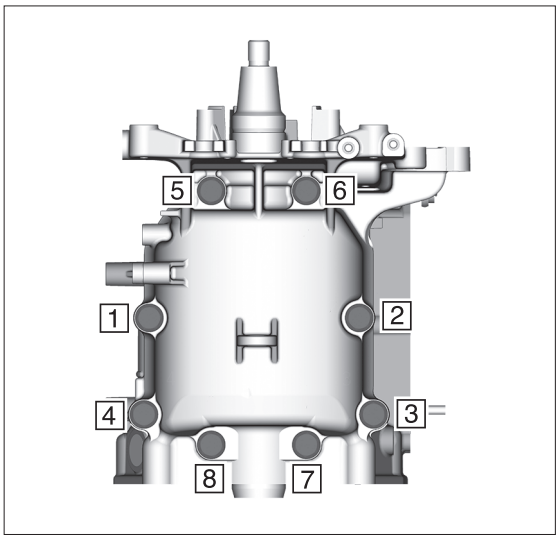
- · Degrease the mating surfaces of the cylinder and crankcase.
- · Be careful not to allow the sealing agent to adhere to the bearings.
- · Apply Loctite 5910 to mating surfaces of crankcase halves, taking care that no excessive agent protrudes.
- · Be sure apply Loctite 5910 constantly and to be approximately 2 mm width.



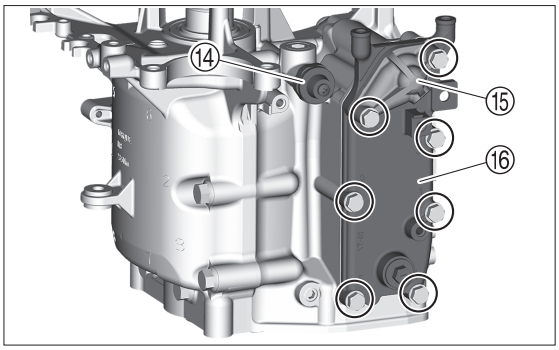
16. Install the crankcase in the cylinder block.

17. Tighten the crankcase bolts, first the M8 bolts and then the M6 bolts, to about half of the specified torque in the order shown.
Then tighten to the specified torque in the order of M8 bolts and M6 bolts.

Crankcase Bolts: 1 – 8
First Tightening Torque: 10 N·m (7 lb·ft) [1.0 kgf·m]
Second Tightening Torque: 23.5 N·m (17 lb·ft) [2.4 kgf·m]



18. Install the oil pressure switch lead wire ⑭.

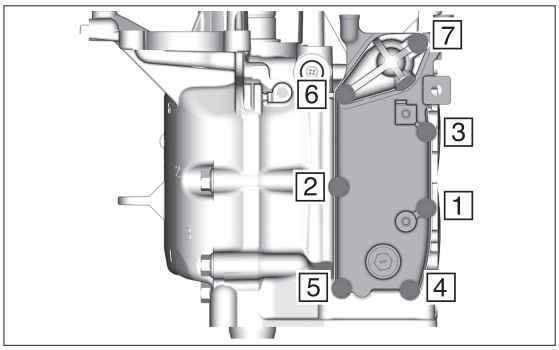


- Apply ThreeBond 1327 on to thread of oil pressure switch, before installation.
- Use 24 mm Socket wrench.

Oil Pressure Switch:
8 N · m (6 lb · ft) [0.8 kgf · m]

19. Install the thermostat, new gasket, thermostat cover⑮, and exhaust cover ⑯.

Tighten the exhaust cover bolts in the order shown in the diagram.



20. Install the cylinder head.

For the installation procedure, refer to "Installation of Cylinder Head."

21. Install the pulley and timing belt.

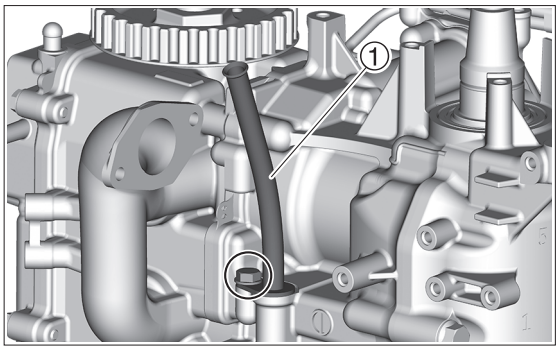
For the installation procedure, refer to "Installation of Pulley and Timing Belt."

5

40) Assembling Electrical System and Fuel system Parts

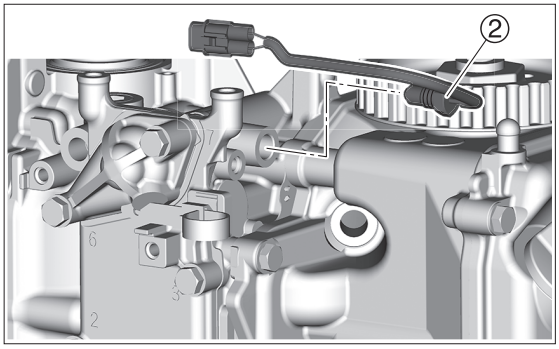
1. Install the oil level gauge guide ①.

·The O-ring cannot be reused.
·Apply 4-stroke engine oil on the O-ring.

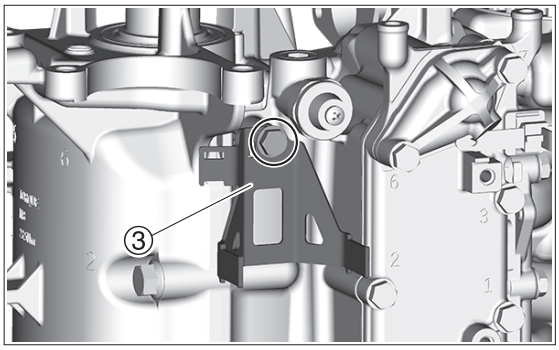


2. Remove the engine temperature sensor ②.

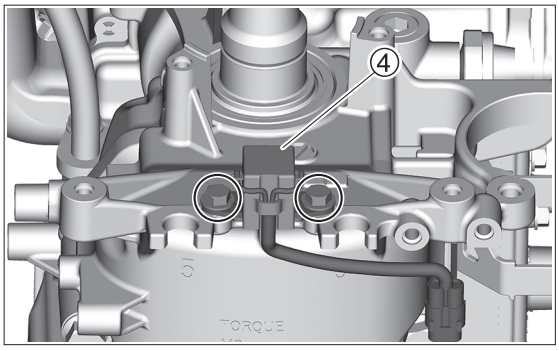
Engine temperature Sensor:
4 N · m (3 lb · ft) [0.4 kgf · m]



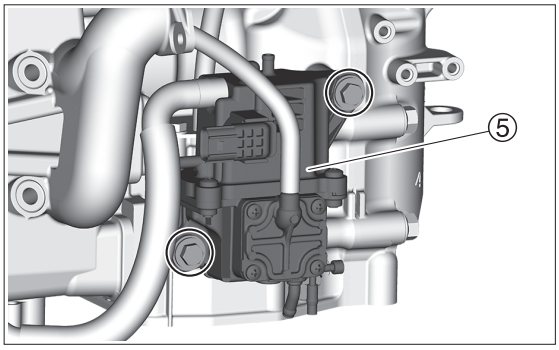
3. Install the fuel filter motor stay ③.



4. Install the crank position sensor ④.

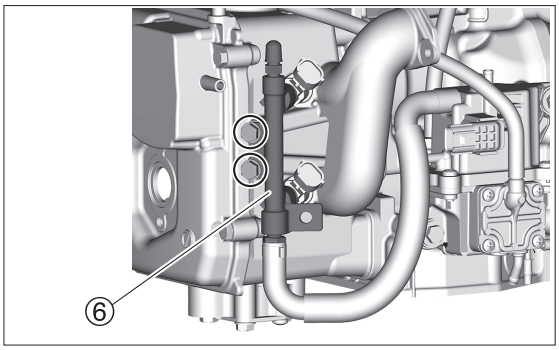


5. Install the vapor separator ⑤.



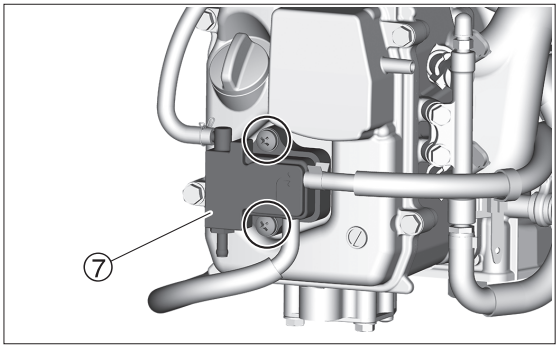
6. Install the fuel rail ⑥.

Apply a screw locking agent (ThreeBond 1342) to the thread area of the bolt.
· Apply 4-stroke engine oil on the seal ring.

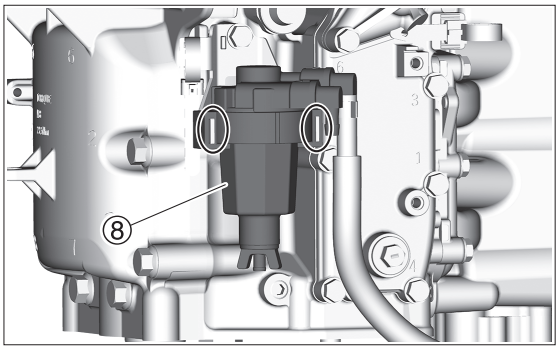


7. Install the fuel pump ⑦.

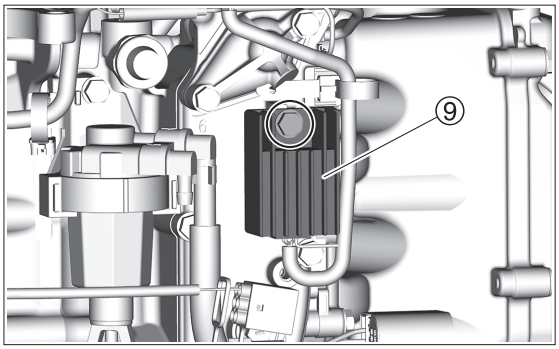
Apply 4-stroke engine oil to the cam unit and O-ring of the fuel pump.



8. Install the fuel filter ⑧.

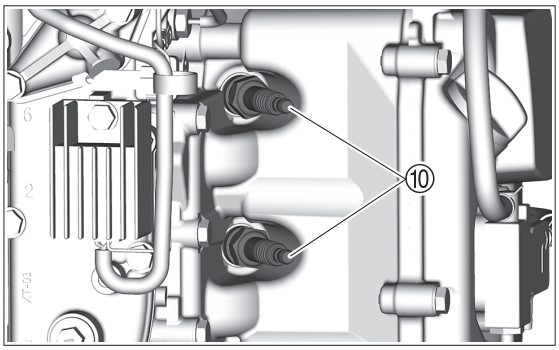


9. Install the rectifier ⑨.



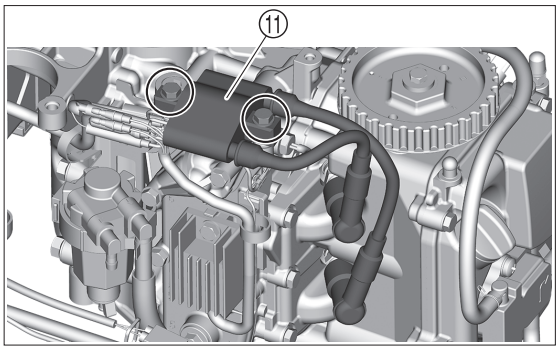
10. Install the spark plugs ⑩.

Spark Plug:
18 N · m (13 lb · ft) [1.8 kgf · m]



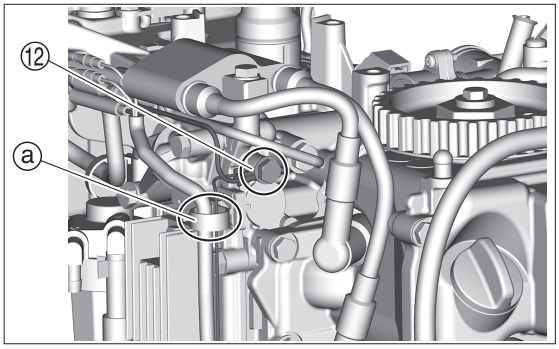
5

11. Install the ignition coil ⑪ and attach the plug caps to the spark plugs.

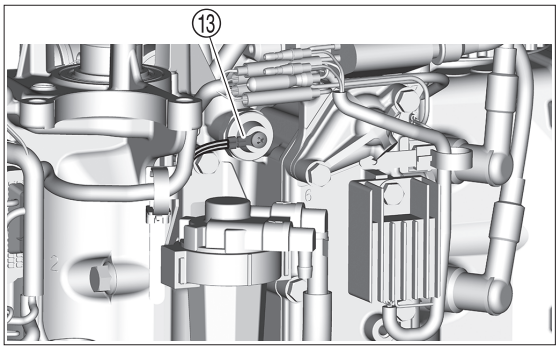


12. Install the ground wire ⑫ (rectifier, ignition coil).

- Secure the rectifier lead wire and rectifier ground wire with clamp ⓐ.
- Route the engine temperature sensor lead wire along the ignition coil ground wire.

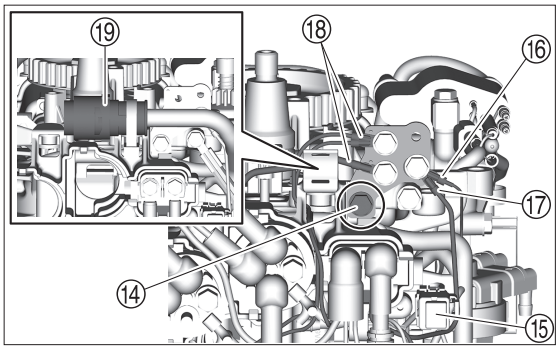


13. Install the oil pressure switch lead wire ⑬.



14. Install the electrical bracket bolt and secure it with the electrical bracket bolt ⑭.

Route the crank position sensor lead wire and main harness behind the electrical bracket.

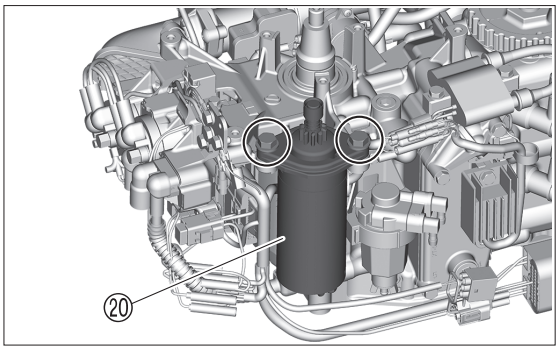


15. Install the fuse ⑮, ground wires (main harness ⑯, starter solenoid ⑰, PT solenoid ⑱), and main harness connector ⑲.

- Power tilt model only: PT solenoid ground wire ⑱
- Remote control model only: Main harness connector ⑲

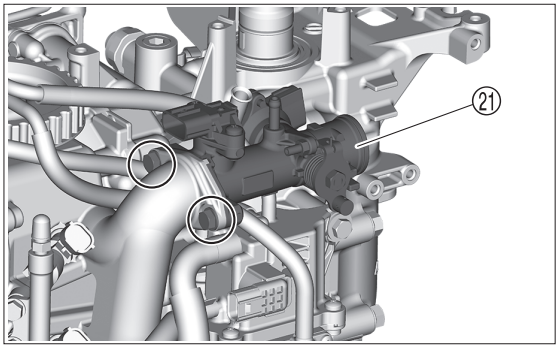
16. Install the starter motor ⑳.

Route the fuse lead wire and main harness behind the starter motor.

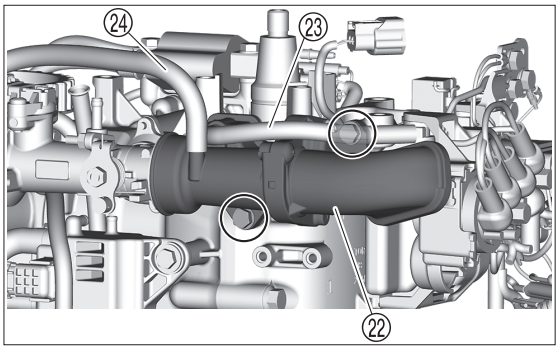


17. Install the throttle body ㉑.

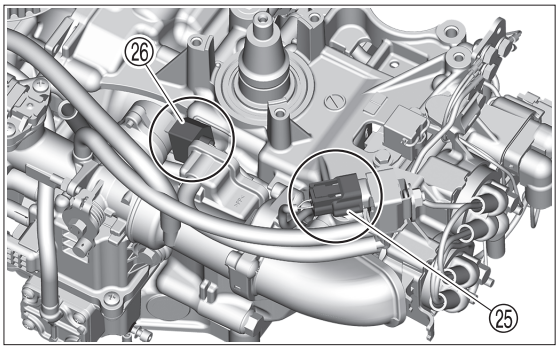
Arrange the main harness, TPS coupler, and ISC coupler behind the throttle body.



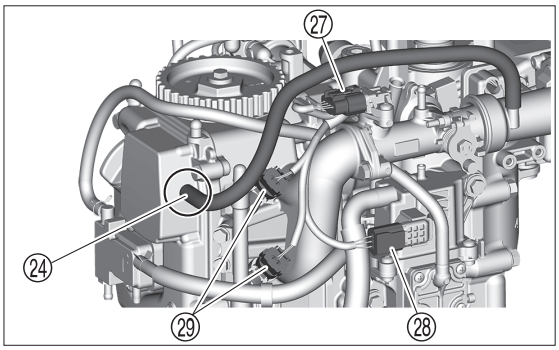
18. Install the intake silencer ㉒, ISC valve hose ㉓, and breather hose ㉔.



19. Connect the ISC coupler ㉕ and TPS coupler ㉖.

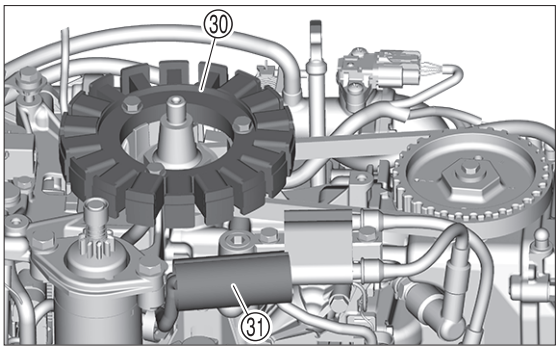


20. Connect the T-MAP sensor coupler ㉗, vapor separator coupler ㉘, fuel injector coupler ㉙, and breather hose ㉔.



21. Install the alternator ㉚.

Route the alternator lead wire through the hole behind the starter motor.

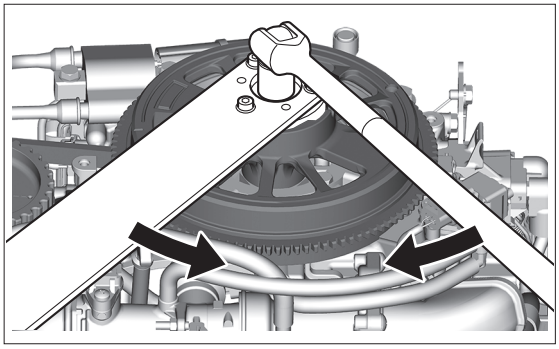


22. Connect the alternator connector to the main harness and rectifier lead wire, then install the protector ㉛.

23. Install the flywheel.

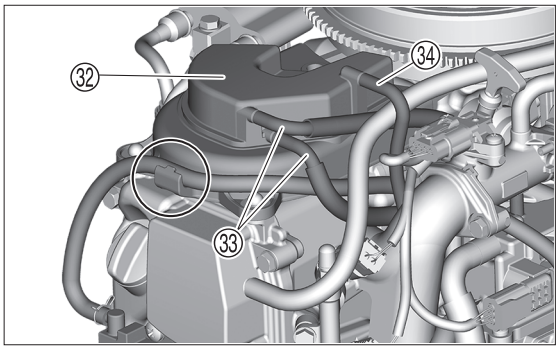
Flywheel Nut:
58 N · m (43 lb · ft) [5.8 kgf · m]

Flywheel Puller Kit :
P/N. 3V1-72211-1



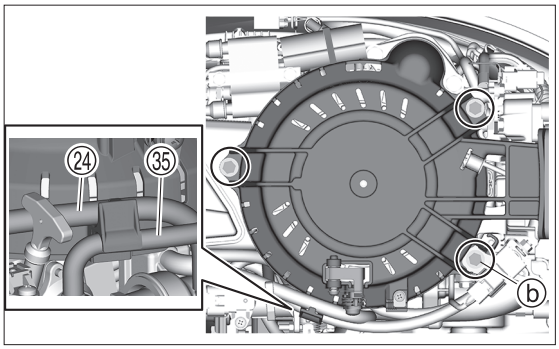
24. Install the belt cover ㉜, and connect the vent hose ㉝ and vent hose ㉞.

- Route the upper part of vent hose ㉞ between the intake manifold and vent hose ㉝, and the lower part along the left side of the vapor separator.
- Attach the cooling hose (fuel cooler → fuel pump) to the belt cover.

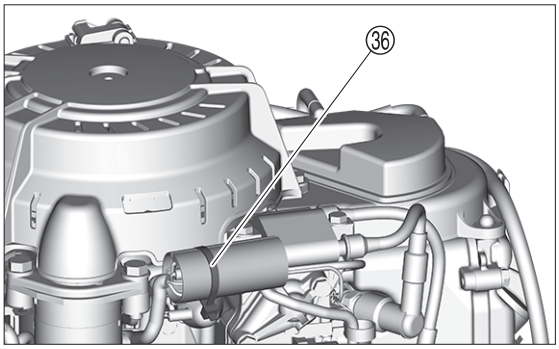


25. Install the recoil starter.

- At part ⓑ, secure the ISC valve bracket and recoil starter with bolts.
- Attach breather hose ㉔ and ISC valve hose ㉟.



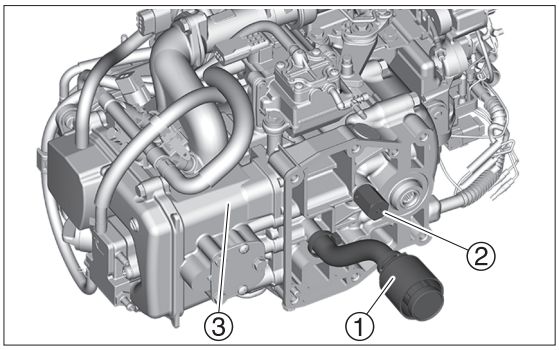
26. Secure the recoil starter and protector with a band ㊱.



41) Installation of Oil Strainer

1. Install the oil strainer ① and the plunger ②.

Tightening Torque:
Plunger 30 N·m (22 lb·ft) [3.0 kgf·m]



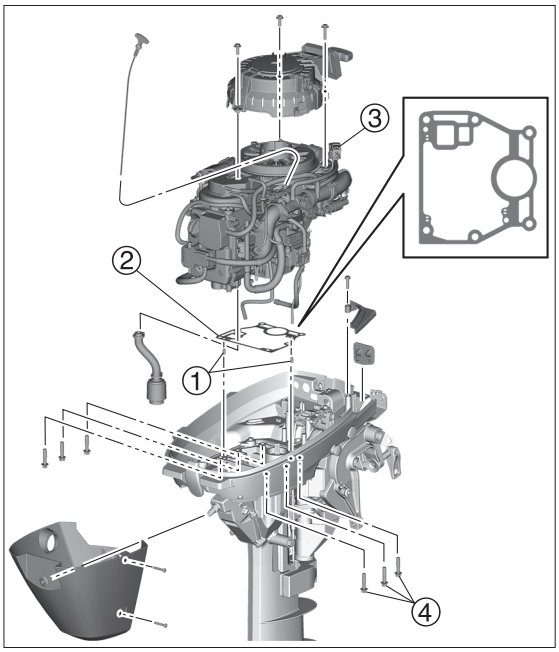
- ·Place the power unit ass'y ③ on the work bench with the port side down and install the oil strainer ①.
- · Complete this work in a short period. Doing this work for long time can cause engine oil to flow from breather pipe.
- · Apply 1 cc of engine oil to the plunger.

42) Installation of Power Unit

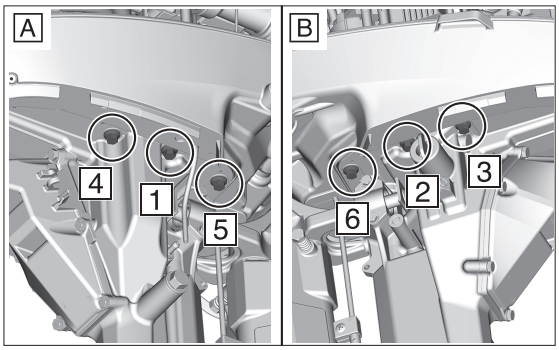
1. Clean the mating surface of the power unit and install the dowel pin ① and a new gasket ②.

2. Install the power unit ③ and tighten the bolts ④ to the specified torque in the order shown in the diagram, in 2 or 3 steps.

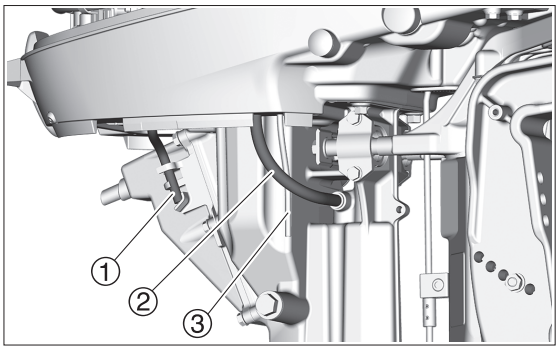
Power Unit Installation Bolt:
First Tightening Torque: 15 N·m (11 lb·ft) [1.5 kgf·m]
Second Tightening Torque: 30 N·m (22 lb·ft) [3.0 kgf·m]



A Starboard
B Port

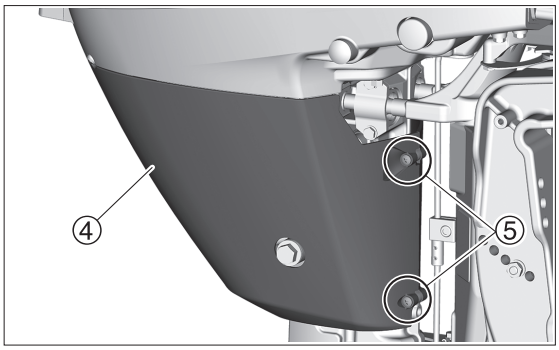


3. Install the vent hose ①, cooling water hose ②, and vapor separator drain hose ③.

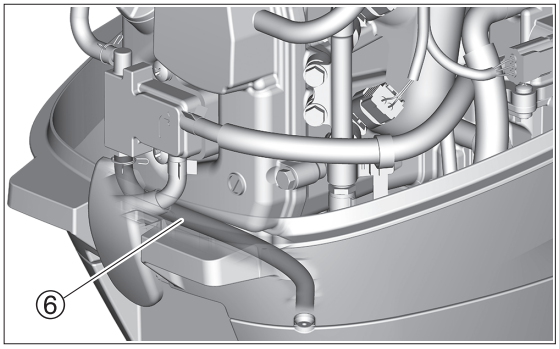


5

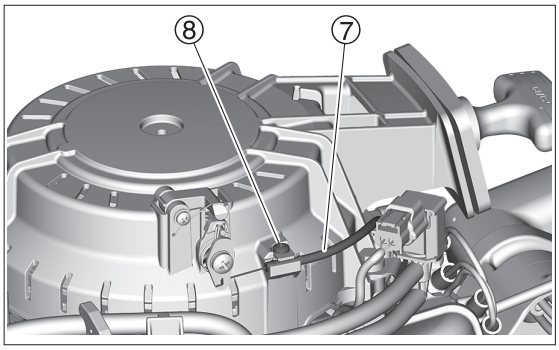
4. Install the drive shaft housing cover ④ and screws ⑤.



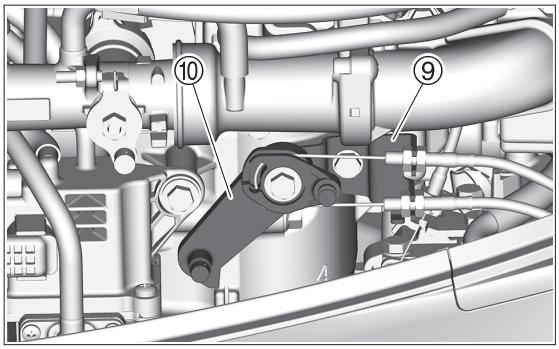
5. Install the cooling water hose ⑥.



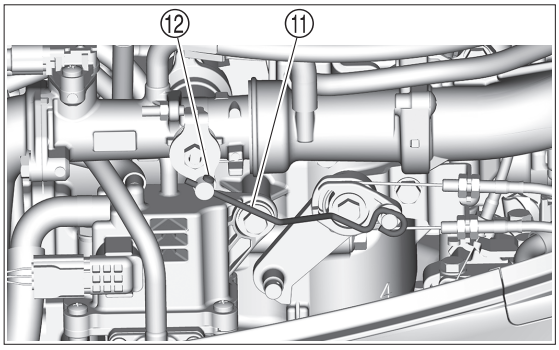
6. Install the starter lock cable ⑦ and tighten the screw ⑧.



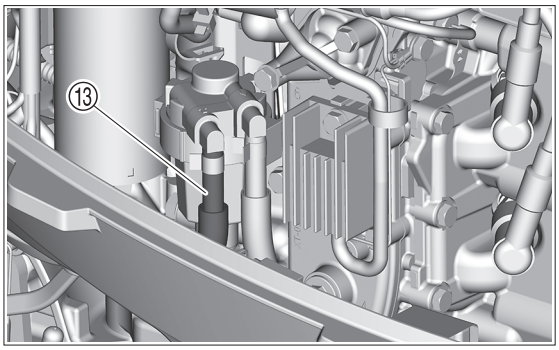
7. Install the bracket ⑨ and throttle drum ⑩.



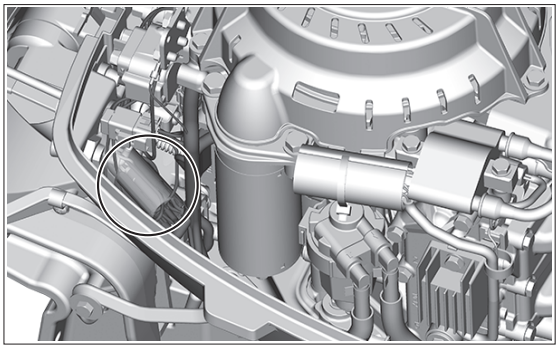
8. Install the link ⑪ and tighten the screw ⑫.



9. Install the fuel hose (IN) ⑬.

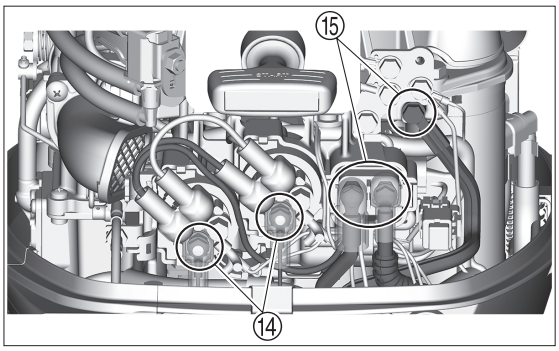


10. Connect the connectors for the indicator lamp, stop switch, neutral switch, start switch, fuse, and PT switch.



·Connect the start switch and fuse connectors for the electric start model only.
·Connect the PT switch connector for the power tilt model only.

11. Install the PT solenoid lead wire ⑭ (power tilt model) and the battery cable ⑮ (electric start model).

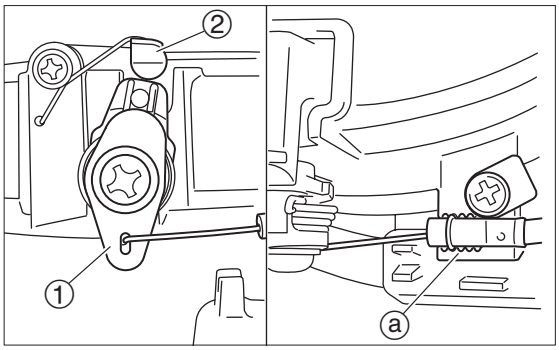


Starter Cable:
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]

12. Fill with the specified amount of engine oil.

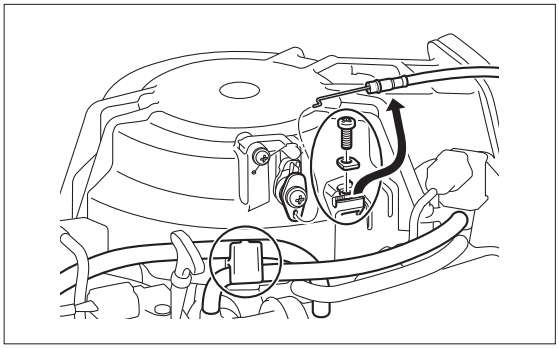
Recommended Engine Oil:
4-Stroke Engine Oil
API: SH, SJ, SL
SAE: 10W-30, 10W-40
Quantity of Engine Oil:
800 ml (0.8 US qt.)

43) Adjustment of Starter Lock Cable

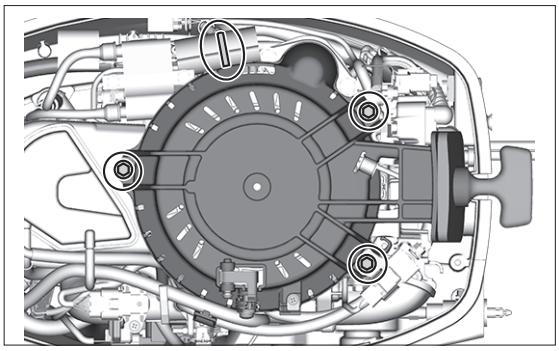


1. Shift the gear into neutral (N).
2. Check that the starter lock lever ① is pushing up the starter lock ②.
3. If the state described in 2. does not exist, perform adjustment using the starter lock wire adjusting groove ⓐ.
4. Perform a shift operation to check that the recoil starter is locked in a position other than neutral (N).

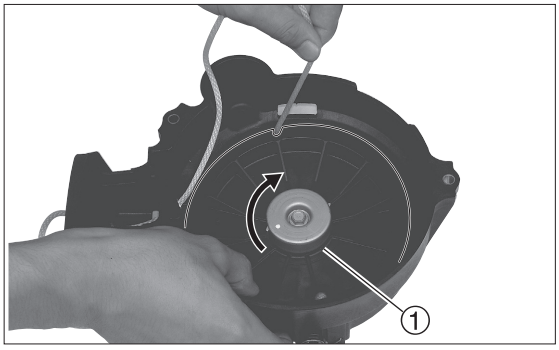
44) Disassembly of Recoil Starter



1. Loosen the screw, disconnect the upper starter lock cable, and remove the breather hose from the guide.



2. Remove the band securing the connectors and recoil starter.
3. Remove the bolts, and then the recoil starter.

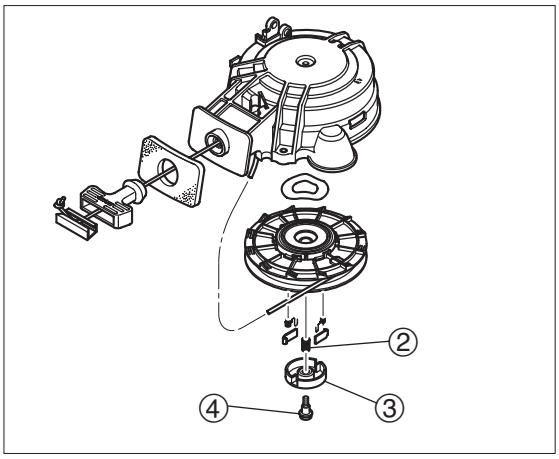


4. Place the rope into the groove of the reel ① and gently turn the reel ① clockwise to release the tension of the starter spring.

① Reel

5. Remove the starter shaft bolt ④, friction plate ③, friction spring ②, ratchet, and return spring.

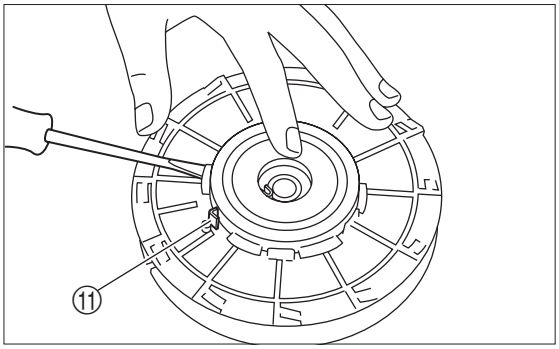
6. Take out the reel carefully.



② Friction Spring
③ Friction Plate
④ Starter Shaft Bolt

7. Remove the starter spring ⑪.
   Insert a flathead screwdriver or similar tool and slowly remove the starter spring along with it.

> It is not necessary to remove the starter spring from the starter case if replacement is not necessary. The starter spring can be inspected without removal from the starter case.



⑪ Starter Spring

45) Inspection of Recoil Starter

1. Check the ratchet, starter lock, and all springs. Replace if any deformation, wear, or damage is found.

2. Check the reel and starter case. Replace if any crack or damage is found.

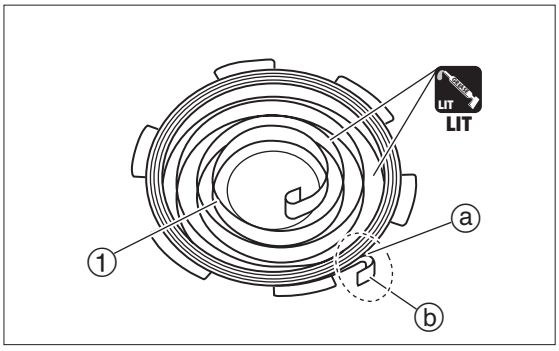
3. Check the starter rope. Replace if any wear, unraveling, or damage is found.

46) Installation of Recoil Starter

Assembly is performed in the reverse order of disassembly, but the following points should be noted.

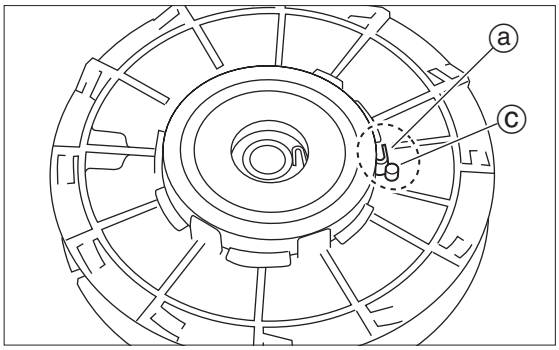
When setting the starter spring ① into the starter case, face the starter spring outer edge hook ⓐ to the right and set it into the peripheral cut ⓑ of the starter case.

The new starter spring is secured by a wire. Cut the wire to release the tension while keeping the outer hook set in the case.



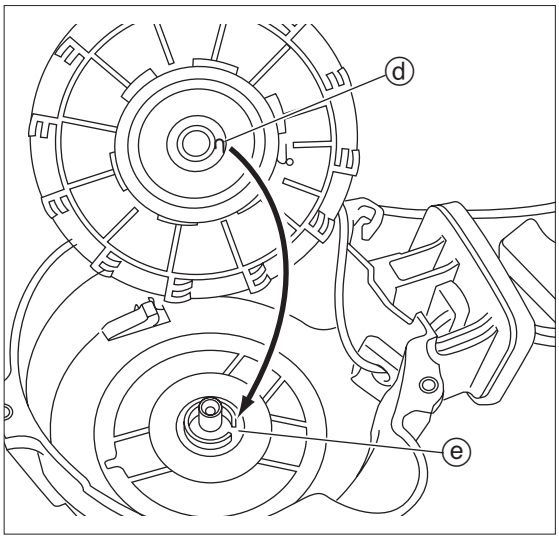
● When installing the starter spring and case onto the starter reel, align the outer hook ⓐ of the starter spring with the round protrusion ⓒ on the starter reel.

● Pass the starter rope through the rope guide.



● When installing the reel into the starter case, ensure that the inner hook ⓐ of the starter spring engages with the notch ⓔ in the bearing part of the starter case.

● Parts to which cold-resistant lithium grease is applied
- · Starter Spring
- · Reel Center Hole
- · Ratchet
- · Starter Lock
- · Friction Plate

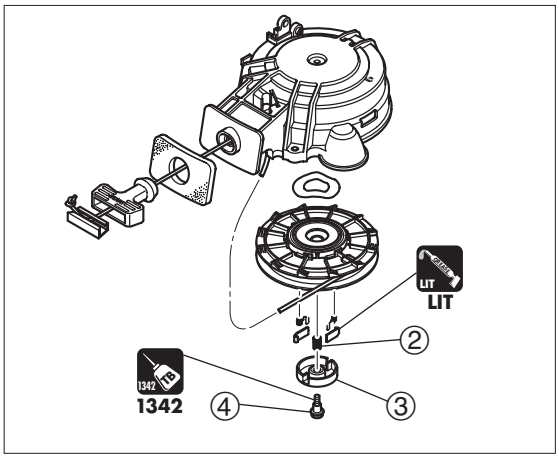


● Apply "ThreeBond 1342" to the starter shaft bolt, and tighten the screw to the specified torque.

Starter Shaft Bolt:
6 N · m (4 lb · ft) [0.6 kgf · m]

1342

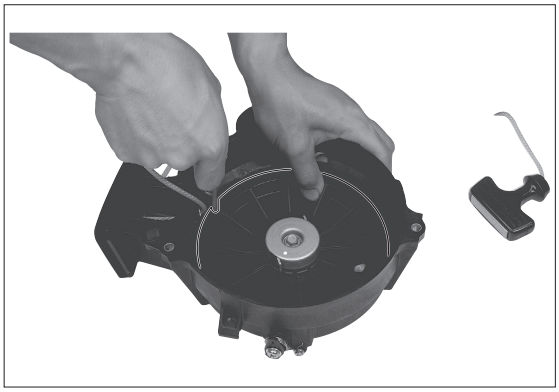
LIT



② Friction Spring
③ Friction Plate
④ Starter Shaft Bolt

● When winding the starter spring, turn the reel 4 to 5 times in the direction in which the reel rotates when pulling out the rope (left rotation). Then, set it so that the reel can rotate an additional 1/4 to 1-1/4 turns when the rope is fully extended. (Approximately 5 to 6 turns in total)

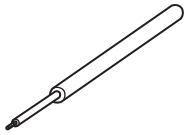
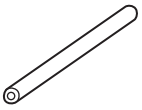
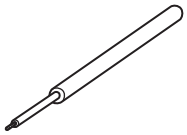
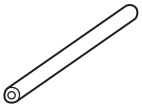
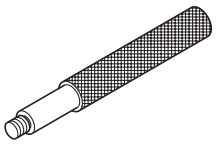
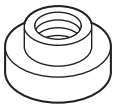
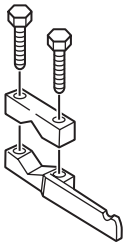
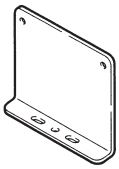
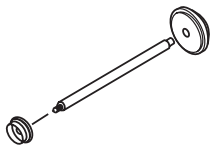
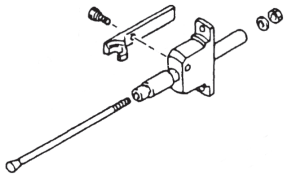
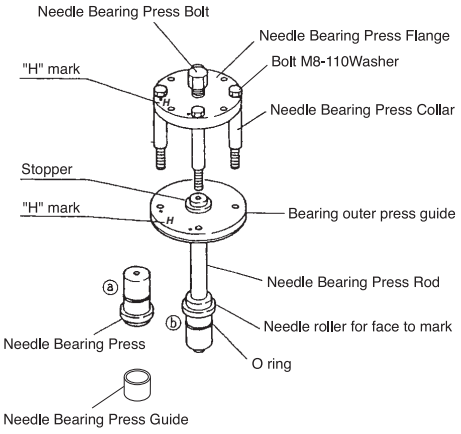
● After installing the recoil starter to the outboard motor, perform a shift operation to check that the starter is locked in a position other than neutral (N).



6

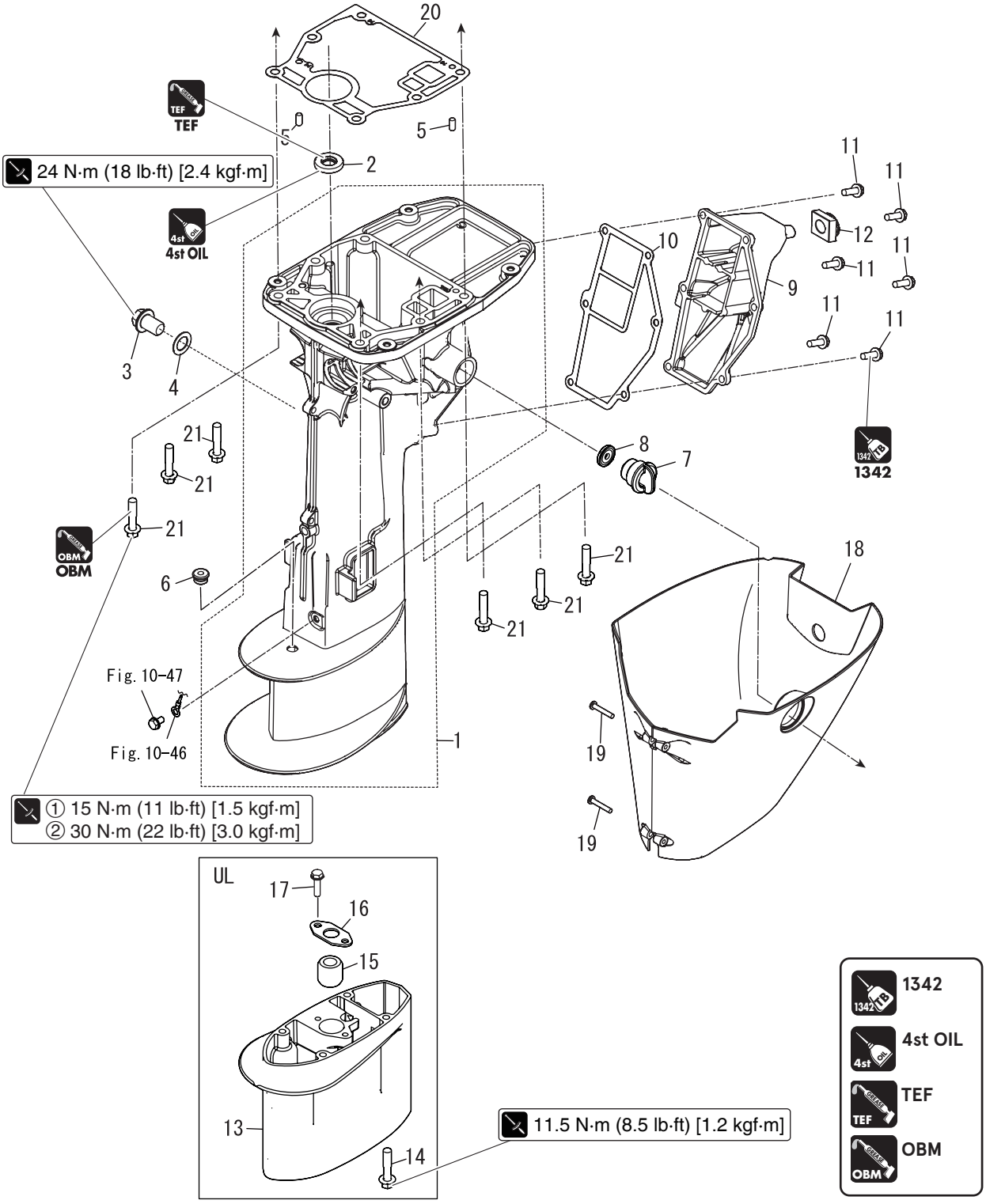
Lower Unit

1. Special Tools

			
Spring Pin Tool A (ø3.0) P/N. 345-72227-0	Spring Pin Tool B (ø3.0) P/N. 345-72228-0	Spring Pin Tool A (ø3.5) P/N. 369-72227-0	Spring Pin Tool B (ø3.5) P/N. 369-72228-0
Removing spring pin	Installing spring pin	Removing spring pin	Installing spring pin
	ø27.5 x ø15.5 		
Driver Rod P/N. 3AC-99702-0	Oil Seal Attachment 2 P/N. 3AD-99820-0	Backlash Measuring Tool Clamp P/N. 3B7-72720-0	Dial Gauge Plate P/N. 3B7-72729-0
Installing oil seal	Installing oil seal of propeller shaft housing	Measuring backlash	For installing dial gauge during backlash measurement
		
Bearing Outer Press Kit P/N. 3B7-72739-1	Backlash Measuring Tool Kit P/N. 369-72740-0	Roller Bearing Press Assy P/N. 3AC-72900-3	
Forward (A) Gear Installing bearing outer race	Forward Pinion (A, B) Measuring between gears	Installing and removing drive shaft roller bearing	

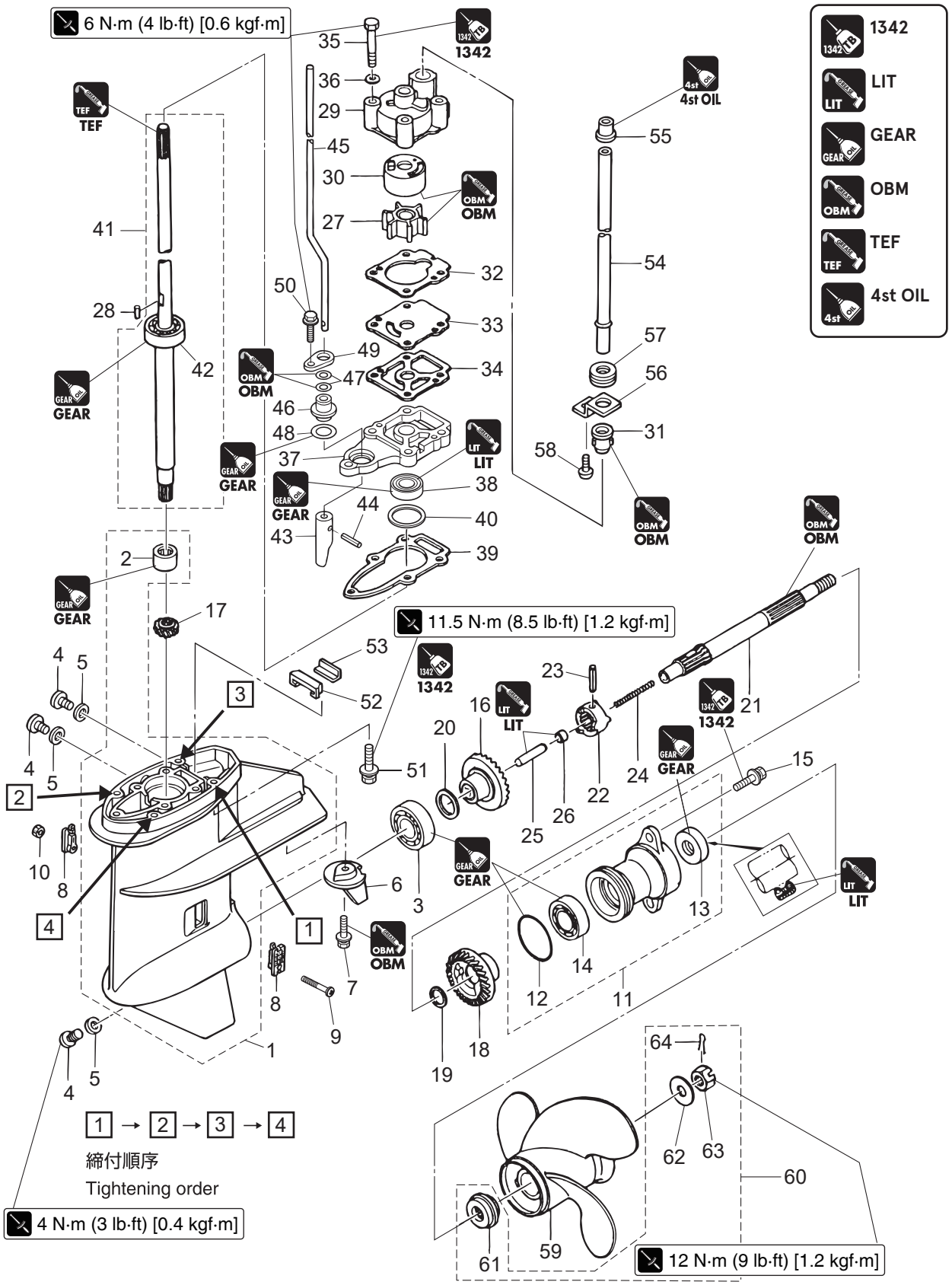
2.Parts Layout

Drive Shaft Housing

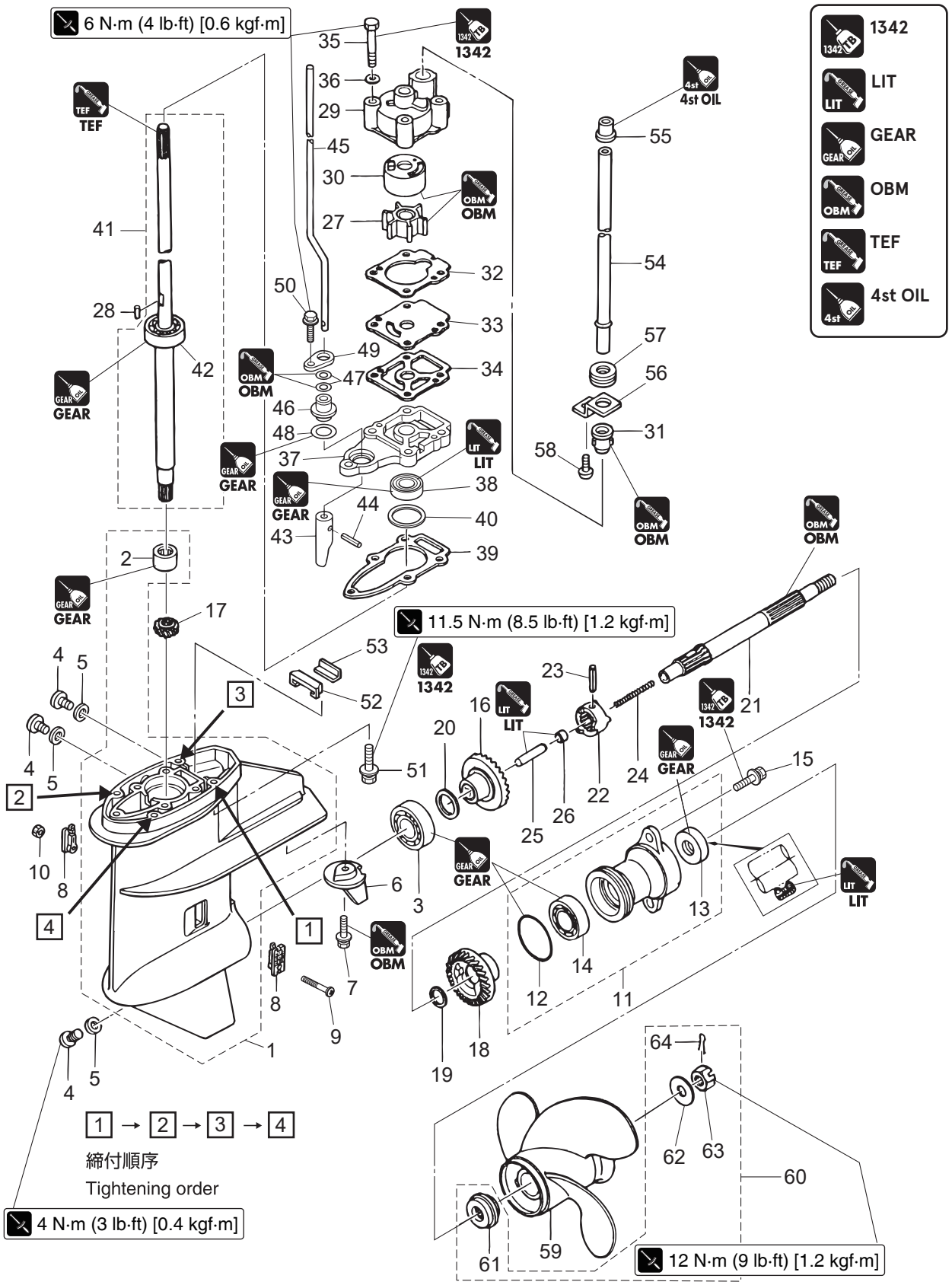


Ref. No.	Part Name	Q'ty	Remarks
1-1	Drive Shaft Housing Assy (S)	1	
1-2	Drive Shaft Housing Assy (L)	1	
2	Oil Seal 12-28-5	1	Do not reuse.
3	Drain Bolt	1	
4	Washer 14.5-24-1	1	
5	Dowel Pin 6-12	2	
6	Grommet	1	
7	Flushing Connector Cap	1	
8	Seal Ring	1	Do not reuse.
9	Idle Exhaust Port Cover	1	
10	Idle Exhaust Port Gasket	1	Do not reuse.
11	Bolt	6	
12	Idle Port Grommet	1	
13	Extension Housing	1	UL
14	Bolt 6-35	4	UL
15	Drive Shaft Housing (UL)	1	UL
16	Stopper Bushing	1	UL
17	Bolt	2	UL
18	Apron	1	
19	Tapping Screw 5-30	2	
20	Engine Base Gasket	1	Do not reuse.
21	Bolt	6	

Gear Case


6 N·m (4 lb·ft) [0.6 kgf·m]
11.5 N·m (8.5 lb·ft) [1.2 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]
12 N·m (9 lb·ft) [1.2 kgf·m]
1342
LIT
GEAR
OBM
TEF
4st OIL
1 → 2 → 3 → 4
締付順序
Tightening order

Ref. No.	Part Name	Q'ty	Remarks
1	Gear Case Assy	1	
2	Roller Bearing 15-21-16	1	
3	Ball Bearing 6204	1	Do not reuse.
4	Plug 8-8	3	
5	Gasket 8.1-15-1	3	Do not reuse.
6	Trim Tab	1	
7	Bolt	1	
8	Water Strainer W = 17	2	Mark A
9	Screw	1	
10	Nylon Nut 4-P0.7	1	
11	Propeller Shaft Housing Assy	1	
12	O-ring 3.2-47	1	Do not reuse.
13	Oil Seal 15-28-10	1	Do not reuse.
14	Ball Bearing 6004	1	
15	Bolt	2	
16	Bevel Gear Assy (A)	1	
17	Bevel Gear B	1	
18	Bevel Gear C	1	
19	Washer 15.2-19-1.9	1	
20	Shim 21-28-0.1	A	Select as necessary.
	Shim 21-28-0.15	A	
21	Propeller Shaft	1	
22	Clutch	1	
23	Pin 3.5-28	1	
24	Spring	1	
25	Push Rod Clutch	1	
26	Spring Retainer Clutch	1	
27	Water Pump Impeller	1	
28	Key Pump Impeller φ3-11	1	Pump Impeller
29	Pump Case (Upper)	1	
30	Pump Case Liner	1	
31	Water Pipe Seal (Lower)	1	
32	Pump Case Gasket	1	Do not reuse.
33	Water Pump Guide Plate	1	
34	Guide Plate Gasket	1	Do not reuse.
35	Bolt	4	
36	Washer	4	
37	Pump Case (Lower)	1	
38	Oil Seal 12-24-8	1	
39	Pump Case Gasket (Lower)	1	
40	Shim 28-36.8-0.1	A	Select as necessary.
	Shim 28-36.8-0.15	A	
	Shim 28-36.8-0.3	A	
41	Drive Shaft Assy (S)	1	Transom S
	Drive Shaft Assy (L)	1	Transom L
	Drive Shaft Assy (UL)	1	Transom UL
42	Ball Bearing 6301	1	Do not reuse.
43	Clutch Cam	1	
44	Spring Pin 3-10	1	Do not reuse.
45	Cam Rod (S)	1	Transom S
	Cam Rod (L)	1	Transom L
	Cam Rod (UL)	1	Transom UL

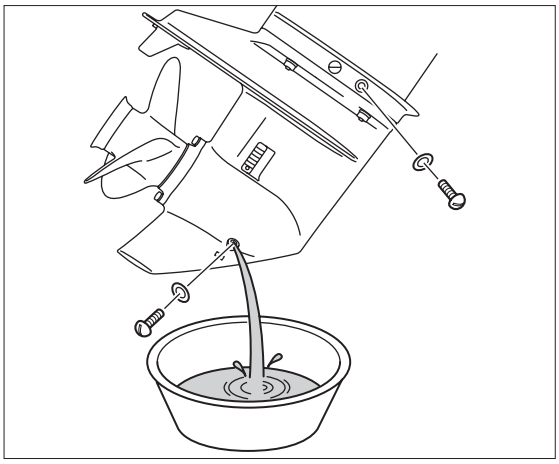

6 N·m (4 lb·ft) [0.6 kgf·m]
11.5 N·m (8.5 lb·ft) [1.2 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]
12 N·m (9 lb·ft) [1.2 kgf·m]
1342
LIT
GEAR
OBM
TEF
4st OIL
1 → 2 → 3 → 4
締付順序
Tightening order

Ref. No.	Part Name	Q'ty	Remarks
46	Cam Rod Bushing	1	
47	O-ring A 2.5-4.9	2	Do not reuse.
48	O-ring 2.4-15.4	1	Do not reuse.
49	Stopper Cam Rod Bushing	1	
50	Bolt	1	
51	Bolt 6-35	4	
52	Water Seal Rubber	1	
53	Water Seal Plate	1	
54	Water Pipe (S)	1	Transom S
	Water Pipe (L)	1	Transom L
	Water Pipe (UL)	1	Transom UL
55	Water Pipe Seal (Upper)	1	
56	Lock Plate	1	
57	Water Pipe Auxiliary Mount 13-2.5	1	
58	Screw	1	
59	Propeller Assy (6.5)	1	6: L 3 x 216 x 165
	Propeller Assy (7)	1	(USA: 8 ps S/L, 9.8 ps L) STD 3 x 226 x 178
	Propeller Assy (7.5)	1	8: S/L/UL, 9.8: L/UL 3 x 216 x 190
	Propeller Assy (8.5)	1	9.8: S 3 x 226 x 211
	Propeller Assy (9.5)	1	OPT 3 x 226 x 255
	Propeller Assy (5) 4 Blades	1	(USA: 9.8 UL) 4 x 221 x 127
	Propeller Assy (7) 4 Blades	1	(USA: 9.8: EFTL/EPTL) 4 x 216 x 178
60	Propeller Hardware Kit	1	
61	Thrust Holder	1	
62	Washer 10.5-28-2	1	
63	Propeller Nut	1	
64	Split Pin 3-18	1	Do not reuse.

3. Inspection Items

1) Draining Gear Oil

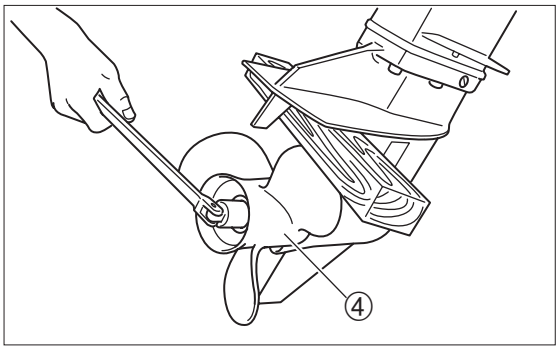
1. Drain the gear oil. Refer to "Replacement of Gear Oil" in Chapter 3



2) Removal of Propeller

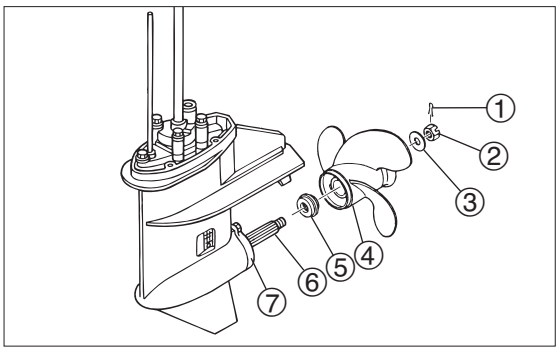
⚠ WARNING

- **Before removing or installing the propeller, be sure to disconnect the battery cables from the battery and remove the stop switch lock plate.**
- **When removing or installing the propeller, do not handle the propeller with your bare hands.**
- **Put a wooden block or the like between the cavitation plate and propeller and then remove or install the propeller.**



1.Shift the gear into neutral (N).

2.Put a wood block or the like between the cavitation plate and propeller ④ to prevent the propeller ④ from accidental rotation, and remove the propeller nut ② and propeller ④.

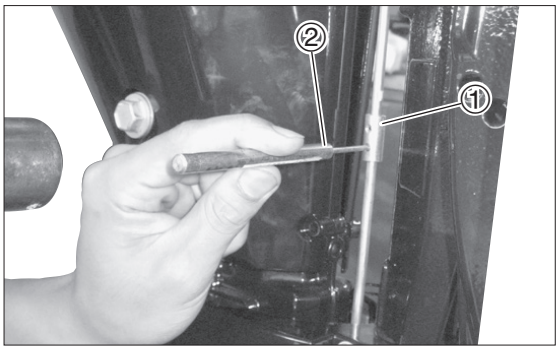


① Split pin
② Propeller Nut
③ Washer
④ Propeller
⑤ Thrust Holder
⑥ Propeller Shaft
⑦ Propeller Shaft Housing

3) Removal of Lower Unit

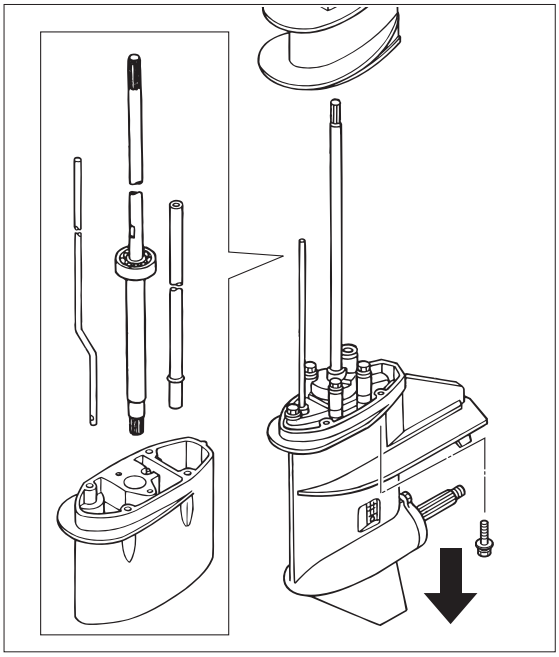
⚠ WARNING

When working with the outboard motor in the tilt-up position, be sure to lock it with the tilt stopper.



- Removal of the lower unit does not require the power unit to be removed from the outboard motor.
- When removing the lower unit from the outboard motor, tilt up the engine to make the work easier.

1. Remove the spring pin and disconnect the shift rod.

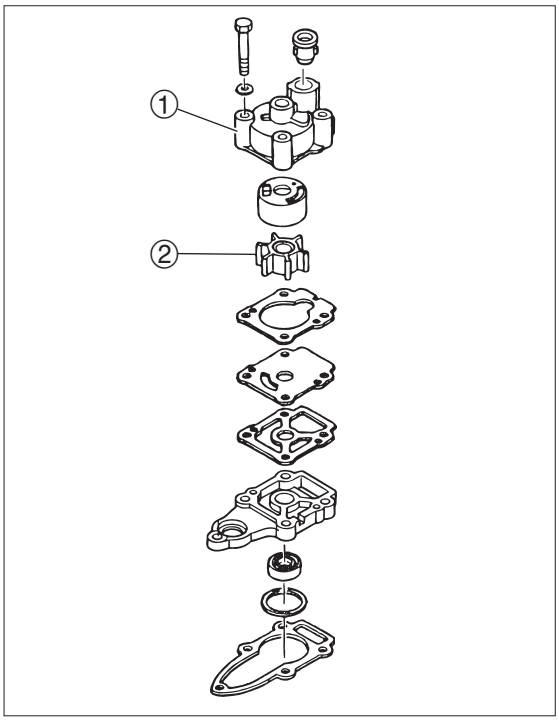


- Disconnect the shift rod on the lower side of the shift rod joint ①.
- Use the spring pin tool A ② to remove it.
- The spring pin cannot be reused once it is removed.
- Leave the spring pin tool inserted until lower unit removal in order to hold the lower unit.

Spring Pin Tool A ② (ø3.0):
P/N.345-72227-0

2.Remove the lower unit installation bolts, and pull the lower unit assy downward to remove.

4) Disassembly of Water Pump

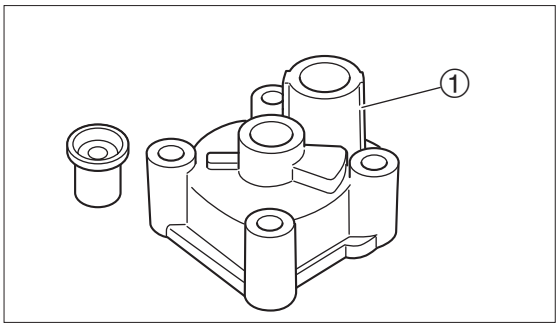


1. Remove the pump upper case ①.

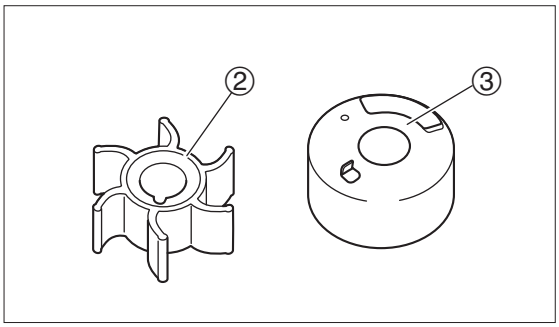
2. Remove the impeller ②.

5) Inspection of Water Pump

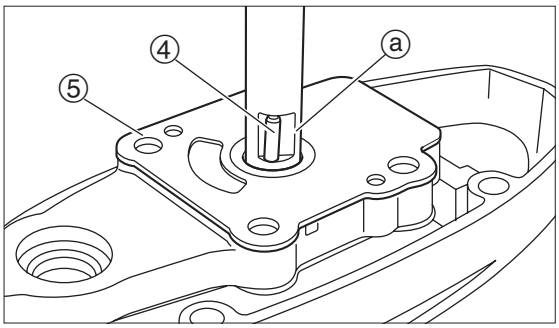
1. Check the pump case (upper) ① for deformation. Replace if necessary.



2. Check the impeller ② and pump case liner ③ for any cracks and wear. Replace if necessary.

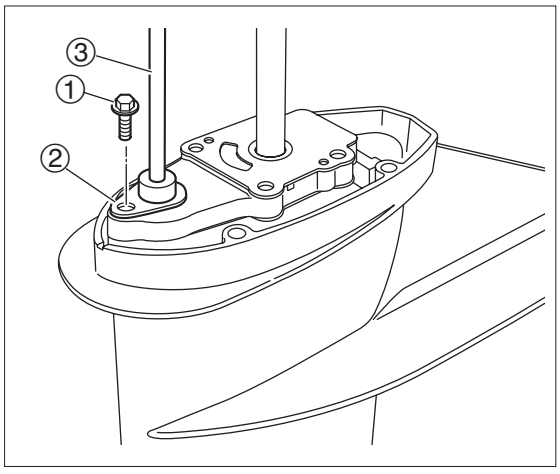


3. Check the pin ④, water pump guide plate ⑤, and drive shaft recess ⓐ for wear. Replace if necessary.



6) Removal of Clutch Cam and Cam Rod

1. Remove the cam rod bushing bolt ① and blade ②, and pull the cam rod assy ③ upward to remove it.

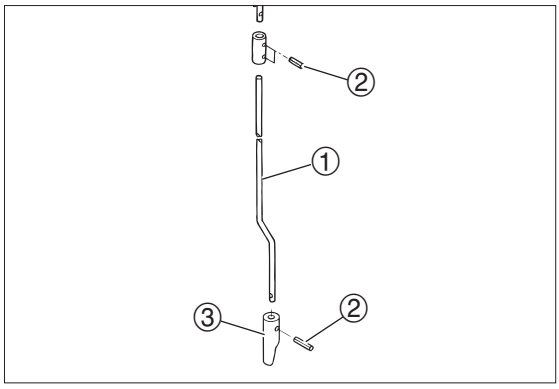


7) Disassembly of Clutch Cam and Cam Rod

1.Remove the spring pins ② from the cam rod ①, and remove the clutch cam ③ and cam rod bushing.

·Use the spring pin tool A to remove the spring pins.
·The spring pin cannot be reused once it is removed.

Spring Pin Tool A (ø3.0):
P/N. 345-72227-0



8) Inspection of Cam Rod and Clutch Cam

1.Check the cam rod ① and clutch cam ② for cracks and wear. Replace if necessary.

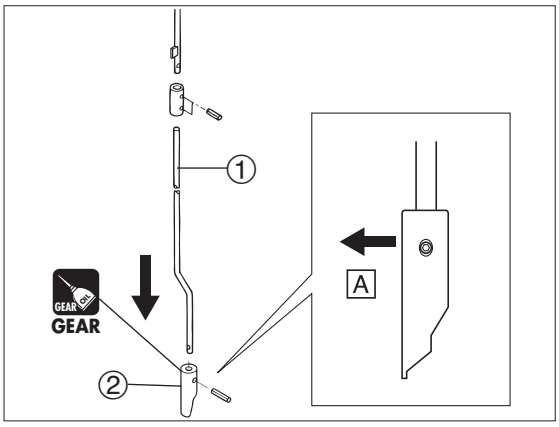
9) Assembly of Clutch Cam and Cam Rod

1. Reinstall the removed components.

Pay attention to the orientation of the cam rod.

·Use the spring pin tool B to install the spring pin.
·The spring pin cannot be reused once it is removed.

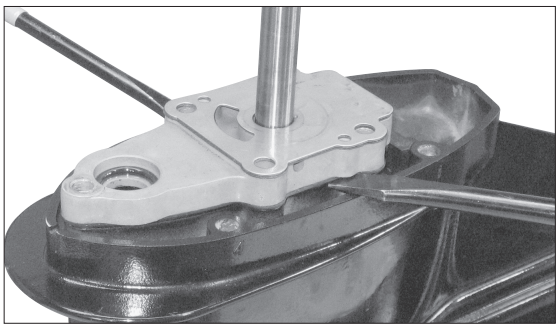
Spring Pin Tool B (ø3.0):
P/N. 345-72228-0



A Forward direction

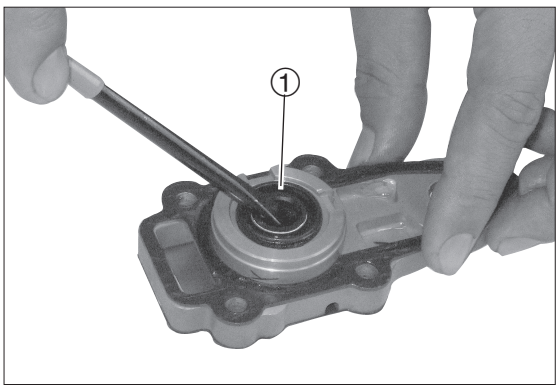
10) Removal of Pump Case (Lower)

1. Remove the pump case (lower).



11) Disassembly of Pump Case (Lower)

1.Use a flathead screwdriver to remove the oil seal ①.



① Oil Seal Do not reuse.

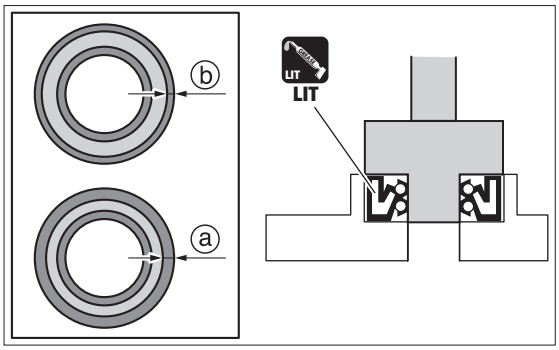
12) Assembly of Pump Case (Lower)

1.Apply gear oil to the oil seal attachment surface and press-fit until abutted using an appropriate mandrel.

2.Apply lithium grease to the lip of the oil seal.

LIT

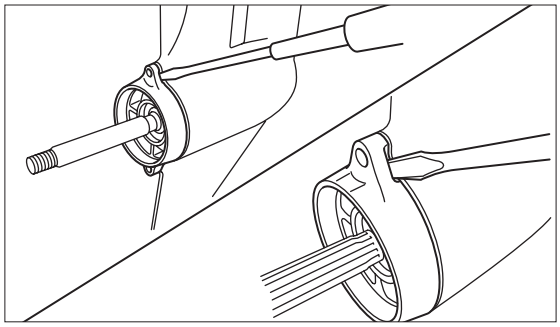
With reference to the illustration, install the oil seal with the side ⓐ having a wide outer circumference facing the coolant side and the side ⓑ having a narrow outer circumference facing the lubricating oil side.



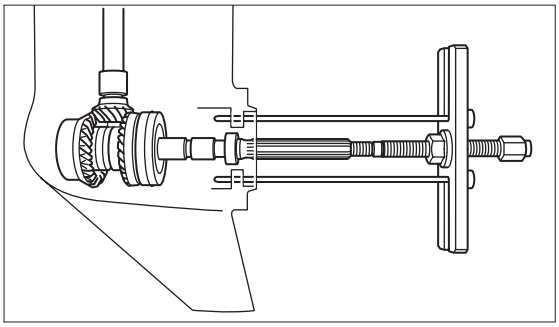
13) Removal of Propeller Shaft Housing Assy

1. Remove the propeller shaft assy.

Use a plastic hammer to remove the part if it cannot be removed by inserting a bladed screw driver.



2. Use a commercially available puller to remove as illustrated.

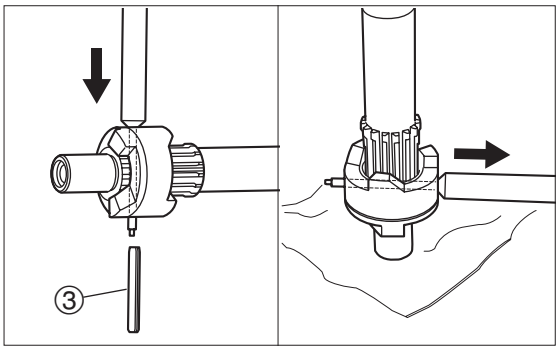


14) Disassembly of Propeller Shaft Assy

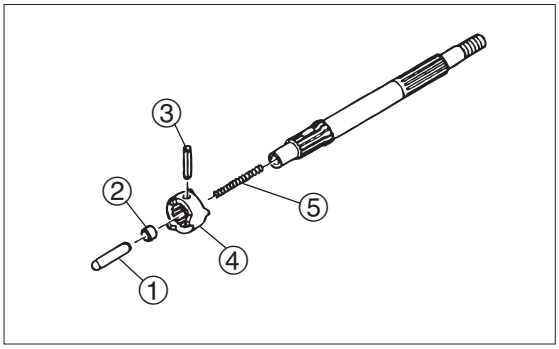
1. Fix the propeller shaft with a vise, remove the push rod ① and spring retainer ② first, then punch out the spring pin ③ and remove the clutch ④ and spring ⑤.

·Work with care to prevent the spring from flying off the propeller shaft.
·Use the spring pin tool A.
·The spring pin cannot be reused once it is removed.

Spring Pin Tool A (ø3.5):
P/N. 369-72227-0



2. Check the clutch ④, spring retainer ②, and push rod ① for cracks or wear. Replace if necessary.

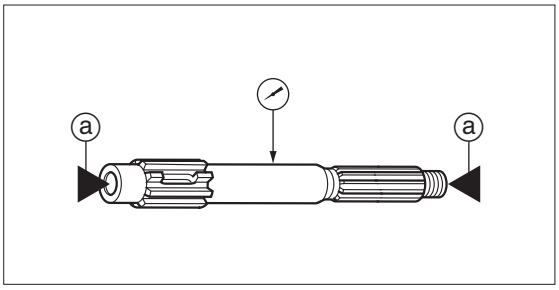


15) Inspection of Propeller Shaft

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

2. Measure the propeller shaft runout.

Runout Limit:
0.05 mm (0.0020 in)

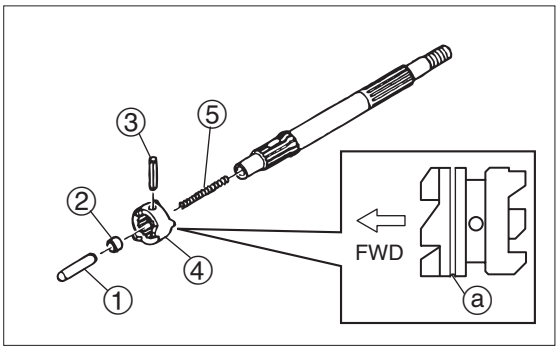


ⓐ Support points

16) Assembly of Propeller Shaft Assy

1.Fix the propeller shaft with a vice, and install the spring ⑤ and clutch ④.

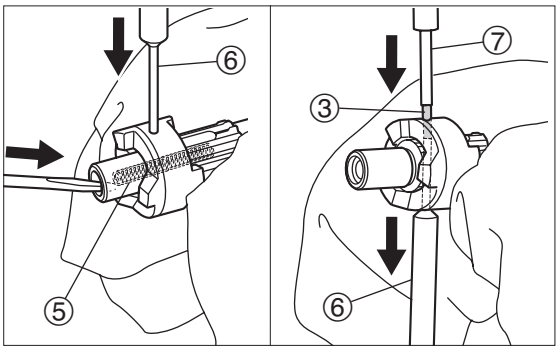
- ·Install the clutch with the groove ⓐ facing the push rod side.
- ·Orient the groove of the spring pin 90° sideways with respect to the axial direction of the propeller shaft.
- · Apply gear oil before the assembly.



2.Using a flathead screwdriver, compress the spring ⑤, and insert the spring pin tool A⑥ into the hole in the clutch ④ to secure the spring while referring to the illustration. Apply a new spring pin ③ from the opposite side to the spring pin tool A and press-fit it gradually with the spring pin tool B⑦.

⚠ CAUTION

The spring pin cannot be reused once it is removed.

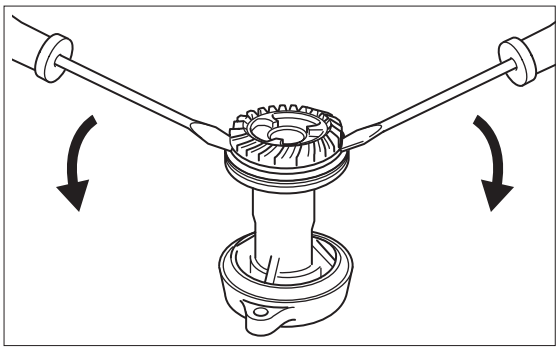


- ·Drive the spring pin in about 0.5 mm from the clutch face.
- ·After driving in the spring pin, check the operation of the clutch.

Spring Pin Tool A (ø3.5):
P/N. 369-72227-0
Spring Pin Tool B (ø3.5):
P/N. 369-72228-0

17) Disassembly of Propeller Shaft Housing

1.Remove the bevel gear C by inserting two flathead screwdrivers into the gap and prying.

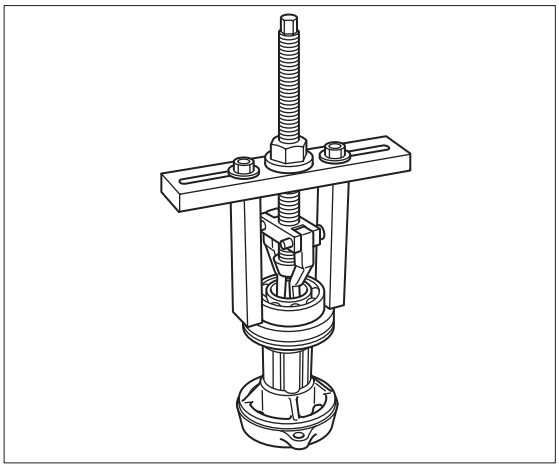


2. Use a commercially available universal puller plate to remove the ball bearing.

Before removal, check the bearing for play or deflection. Replace if necessary.

⚠ CAUTION

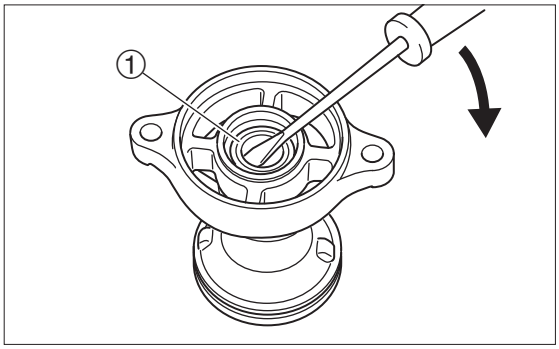
Do not reuse a removed bearing.



3.To remove the oil seal only, use a flathead screwdriver or similar tool.

⚠ CAUTION

The oil seal cannot be reused once it is removed.



① Oil Seal **Do not reuse.**

18) Inspection of Propeller Shaft Housing

1.Clean the propeller shaft housing with oil wash and a cleaning brush and check for cracks or damage. Replace if necessary.

2.Check the Bevel Gear C teeth and clutch for cracks or damage. Replace if necessary.

3.If the bearing is to be reused without removal, check the bearing for rattling or runout. Replace if necessary.

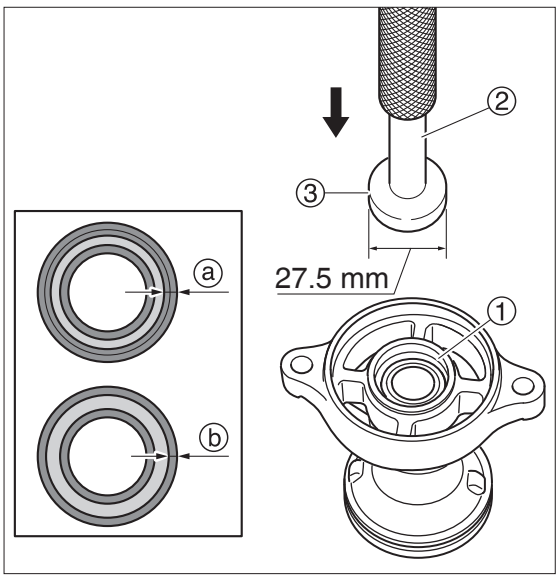
19) Assembly of Propeller Shaft Housing

1.Apply gear oil to the attachment surface ① and press-fit the oil seal until abutted.
Apply lithium grease to the lip of the oil seal after installation.

LIT

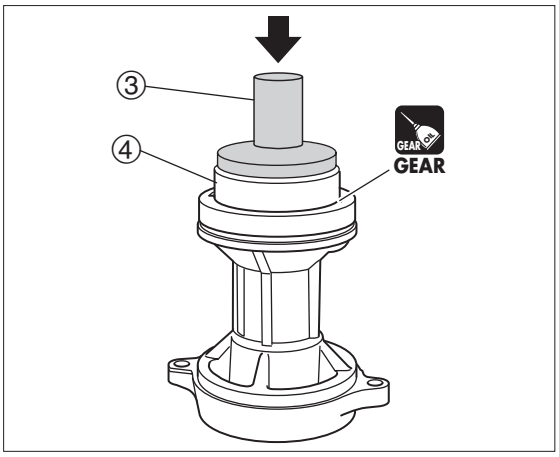
Driver Rod ②:
P/N. 3AC-99702-0
Oil Seal Attachment ③:
P/N. 3AD-99820-0

With reference to the illustration, install the oil seal with the side ⓐ having a wide outer circumference on the outer side and the side ⓑ having a narrow circumference facing the lubricating oil side.



2.Apply gear oil to the attachment surface of the bearing and press-fit using an appropriate mandrel ③ until abutted.

Install the ball bearing ④ with the manufacturer's marking facing the forward side.

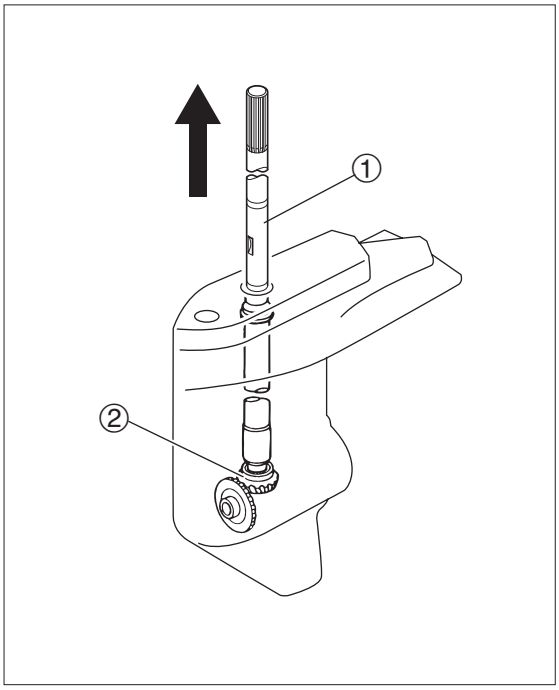


3. Install the reverse (C) gear assy into the propeller shaft housing.

20) Removal of Drive Shaft

1. Pull up the drive shaft assy ①, remove the pinion (B) gear ②, and pull out the forward (A) gear.

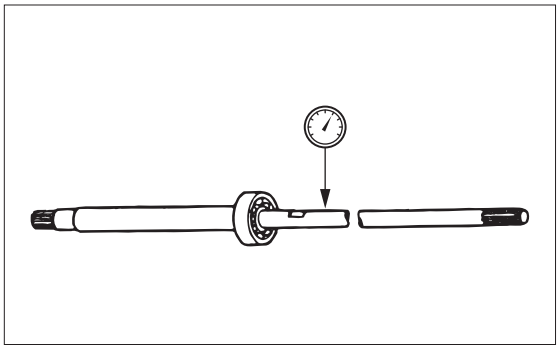
·When removing the drive shaft, be careful not to damage or lose the shim on the ball bearing. The shim can be reused.
·Replace the shim with a new one having the same thickness if any deformation or damage is found.



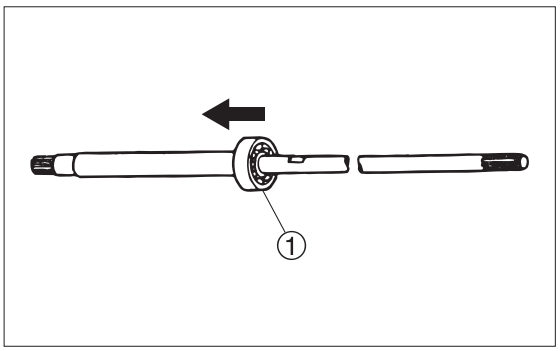
21) Inspection, Disassembly, and Assembly of Drive Shaft

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

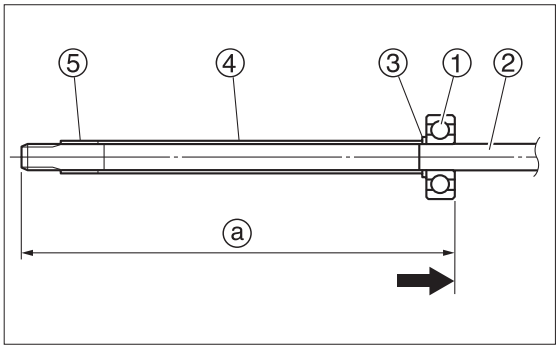
Runout Limit:
0.2 mm (0.008 in)



2.Using a press, remove the ball bearing ① in the direction of the bevel gear B along with the spacers and the like.



3.Attach the ball bearing ① to the drive shaft ② by press-fitting using a press until dimension ⓐ is reached.
Attach the ball bearing ①, washer ③, spacer ④, and roller bearing inner ring ⑤, in this order.



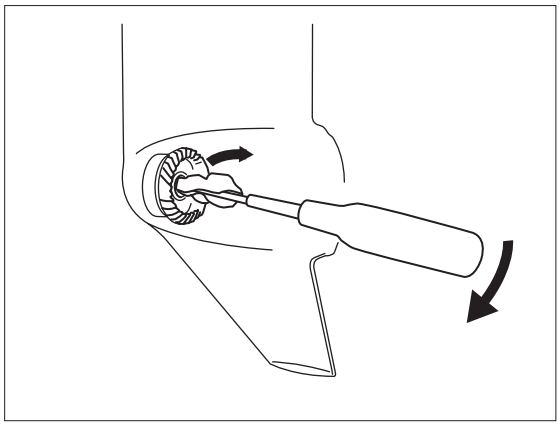
·Assemble the ball bearing ① with the manufacturer's marking facing the engine side.
·Press-fit the ball bearing ① from the bezel gear B side to the engine side.
·Attach the roller bearing inner ring ⑤ so that the washer ③ and spacer ④ are fixed.
·When press-fitting, use a cylindrical object having an inside diameter of ø12.5 mm (0.49 in).

Installation depth ⓐ
187.85 – 188.15 mm (7.39 – 7.407 in)

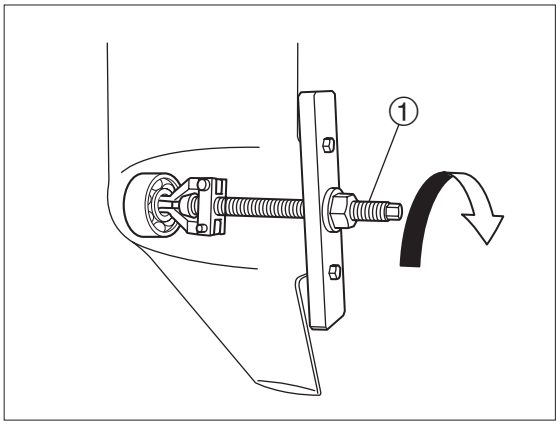
22) Removal of Bevel Gear Assy A and Bearing

1. Apply a rag to a flathead screwdriver or similar object and press against the bushing inner surface of the bevel gear assy A to pull it out.

·When removing the bevel gear assy A, be careful not to damage or lose the shim between the gear and ball bearing.
·Replace the shim with a new one having the same thickness if any deformation or damage is found.



2. Using a commercially available bearing puller ① or the like, remove the bearing from the gear case.

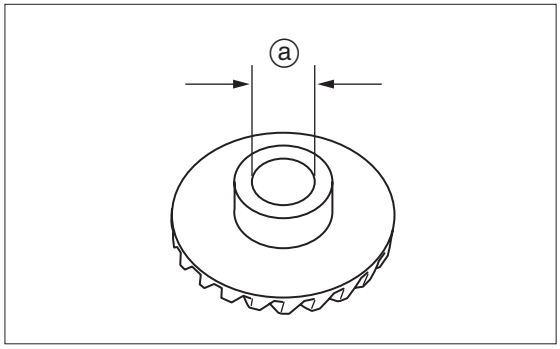


23) Inspection of Bevel Gear Assy A and Bevel Gear B

1. Check the bevel gear assy A teeth, bevel gear assy B teeth, and clutch for cracks and wear. Replace if necessary.

2. Measure the bushing inner diameter ⓐ of the bevel gear assy A gear. If wear is excessive, replace the gear as necessary.

Bushing inner diameter ⓐ of bevel gear assy A: standard value
16.013 – 16.077 mm (0.6304 – 0.6332 in)



3.When replacing the shim between the bevel gear assy A and bearing, measure the thickness of the originally installed shim and install a shim having the same thickness.

Sizes of Adjusting Shims:
Bevel Gear Assy A: 0.1, 0.15 mm
The shim is for machining error adjustment. Be sure to use a shim having the same thickness as the original shim.

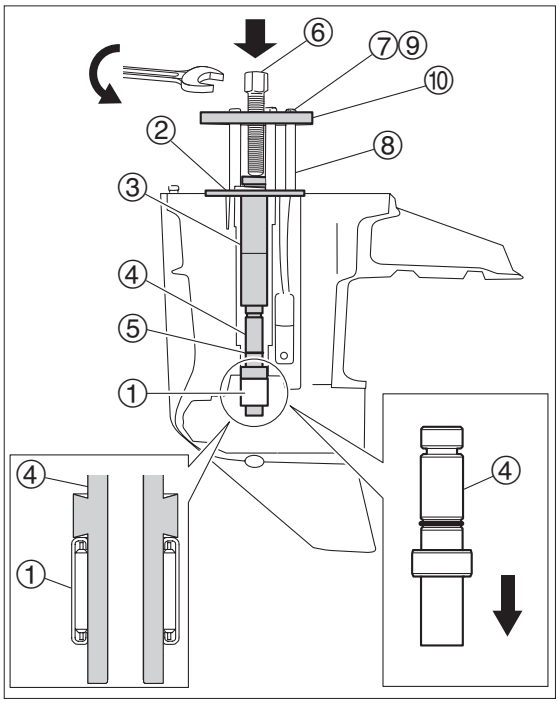
24) Disassembly of Gear Case

1. Use the tools below to remove the roller bearing ①.

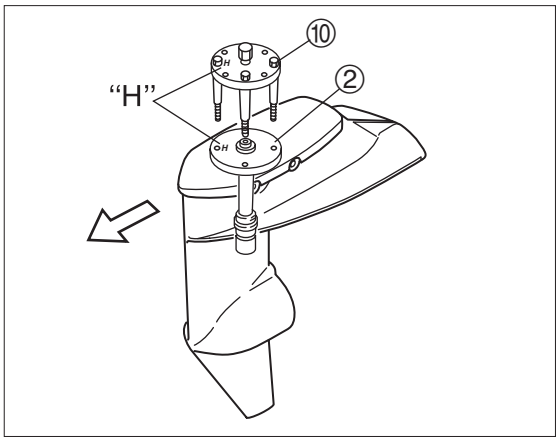
Roller Bearing Press Kit:
P/N. 3AC-72900-3
Bearing Outer Press Guide ②:
Roller Bearing Press Rod ③:
Roller Bearing Press ④:
O-Ring ⑤:
Roller Bearing Press Bolt ⑥:
Bolt M8-110 ⑦:
Collar ⑧:
Washer ⑨:
Roller Bearing Press Flange ⑩:

⚠ CAUTION

When attaching the guide ② and flange ⑩, be sure that the bolt hole marked "H" is aligned with the gear case screw hole on the right front in the forward direction.

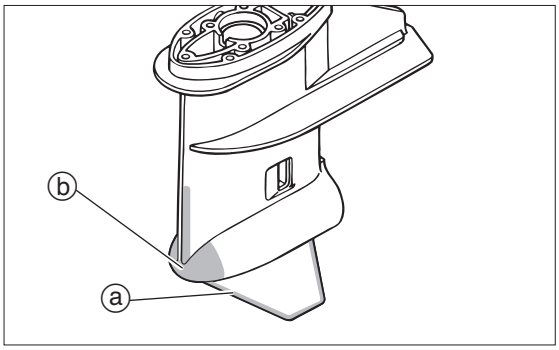


① Roller Bearing



25) Inspection of Gear Case

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



26) Assembly of Gear Case

When replacing a ball bearing, gear, drive shaft, propeller shaft, or gear case , make shim adjustments.

1. Install the roller bearing ① using the tools below.

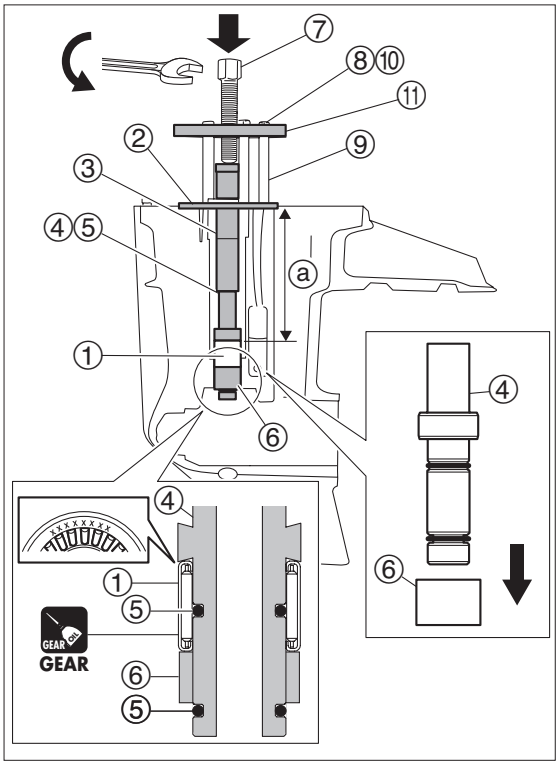
Roller Bearing Press Kit:
P/N. 3AC-72900-3
Bearing Outer Press Guide ②:
Roller Bearing Press Rod ③:
Roller Bearing Press ④:
O-Ring ⑤:
Roller Bearing Press Guide ⑥:
Roller Bearing Press Bolt ⑦:
Bolt M8-110 ⑧:
Collar ⑨:
Washer ⑩:
Roller Bearing Press Flange ⑪:

⚠ CAUTION

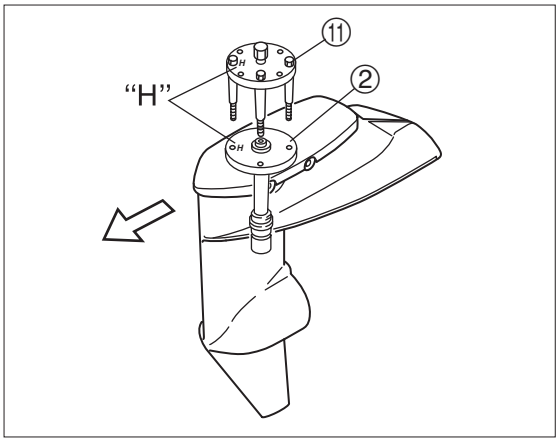
- **When attaching the guide ② and the flange ⑪, be sure the the bolt hole marked "H" is aligned with the gear case screw hole on the right front in the forward direction.**
- **Install the bearing with the marked side facing upward.**

·When attaching the roller bearing, clean the attachment surface of the bearing and apply gear oil before insertion.
· Do not reuse the roller bearing. Use a new bearing.

Installation depth ⓐ (Reference value):
189.75 ± 0.3 mm (7.4705 ± 0.0118 in)



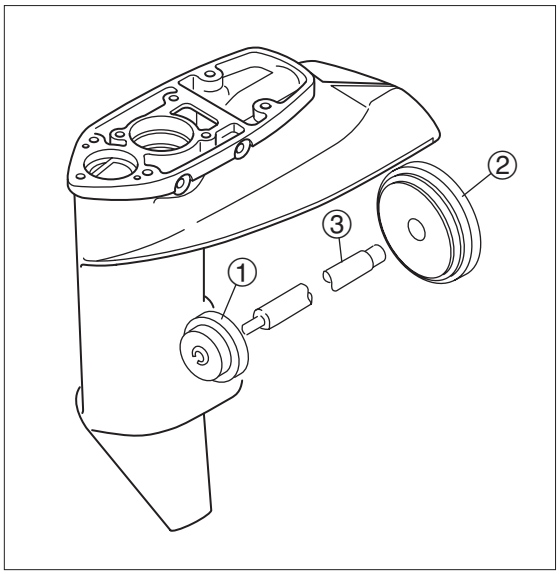
① Roller Bearing Do not reuse.



6

2. Use the tools below to install the ball bearing.

Bearing Outer Press Kit:
P/N. 3B7-72739-1
Bearing Outer Press Plate ①:
Bearing Outer Press Guide ②:
Bearing Outer Press Rod ③:

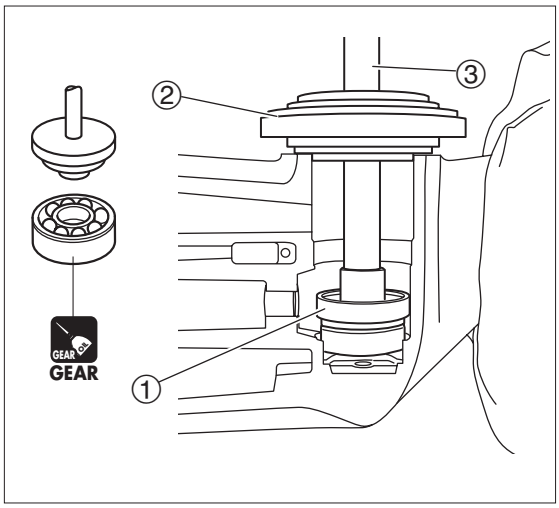


3. Fix the gear case horizontally in a vice or other holder with its propeller shaft opening facing upward.

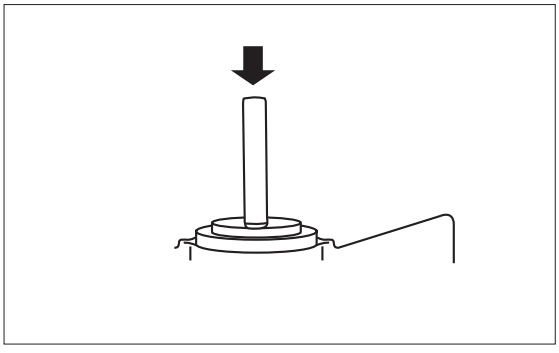
4. Clean the outer race installation face in the gear case and apply gear oil.

GEAR

5. Apply gear oil to the external face of the outer race, and position the outer race in the center of the housing with the marked face of the race facing the inside of the housing.

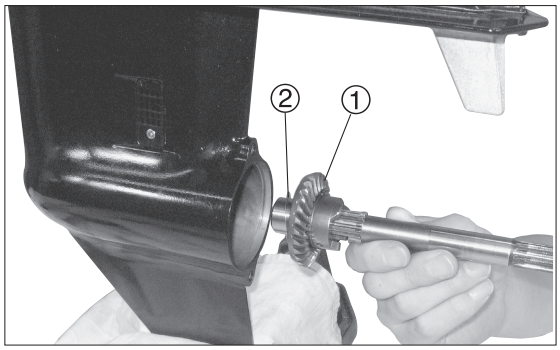


6. Firmly press-fit the ball bearing in the housing using a press.



27) Installation of Bevel Gear Assy A

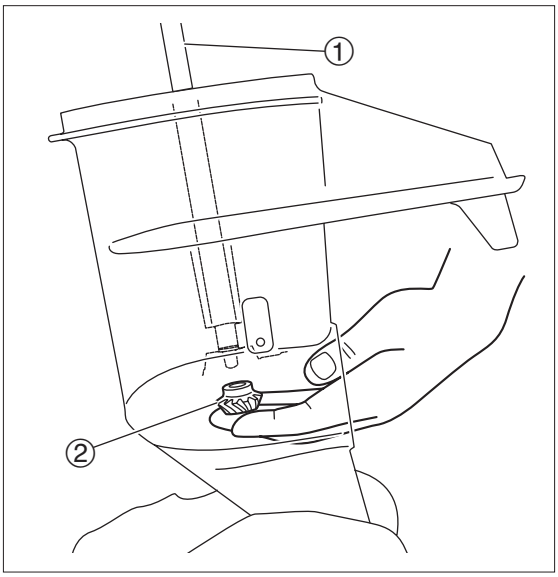
1.In the gear case, install the bezel gear assy A ① and the shim ② to the ball bearing using the propeller shaft.



28) Installation of Bevel Gear B

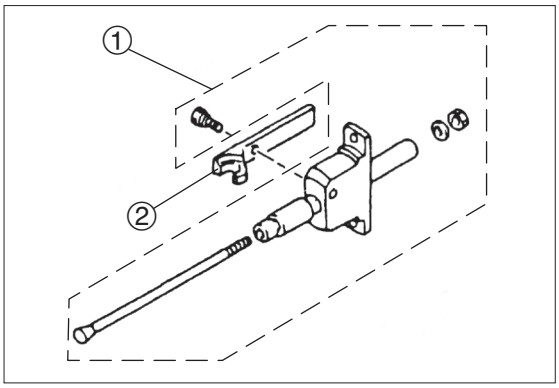
1. Lift the drive shaft assy 1 slightly upward and install the bezel gear B②.

To make bezel gear B installation easier, slightly incline the gear case.



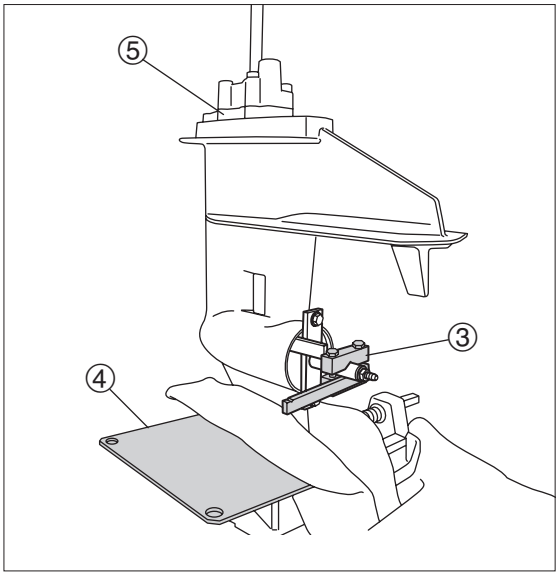
29) Backlash Measurement and Shim Selection

Backlash Measuring Tool Kit:
P/N. 369-72740-0
Backlash Measuring Tool Assy①:
Measuring Tool Set Piece ②:
Backlash Measuring Tool
Clamp A③:
P/N. 3B7-72720-0
Dial Gauge Plate ④:
P/N. 3B7-72729-0

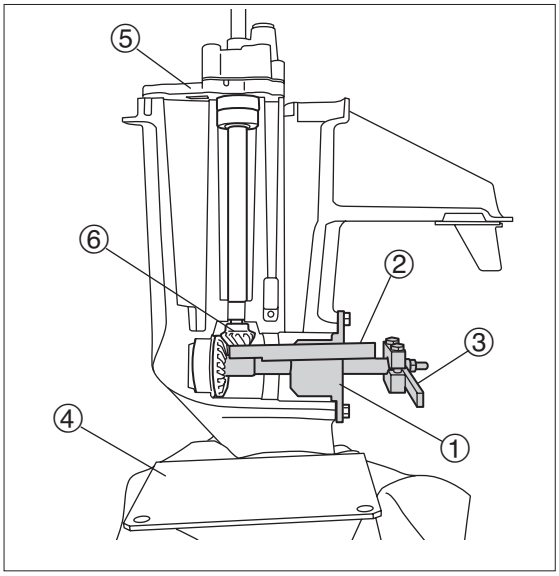


⑤ Pump Case (Lower)
⑥ Bevel Gear B

1.Install the pump case to the gear case and assemble the backlash measuring tool as in the illustration.



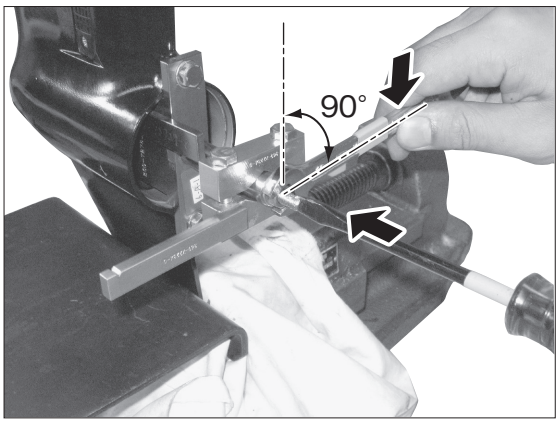
- Fix the gear case using a vice.
- Before installation, clean the drive shaft using a new rag.
- Install all parts of the pump case except the impeller and key, and tighten to the specified torque.
- Measure the backlash between the bevel gear assy A and the bevel gear B with the propeller shaft housing, propeller shaft, and reverse (C) gear removed from the gear case.



2.First, pull up the drive shaft by hand.

Fix the shaft B with a flathead screwdriver and tighten the nut while pressing. Be careful not to over-tighten the shaft B at this time, otherwise the shaft B will not move.

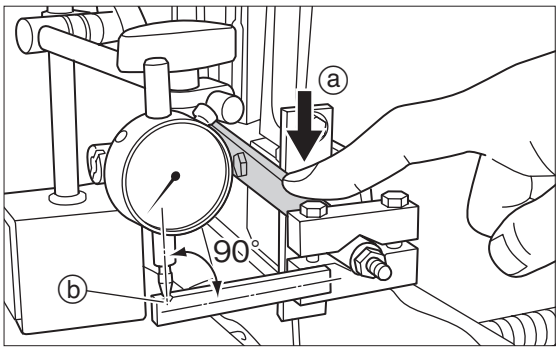
Tighten the nut with your finger, and then further tighten it with a wrench to about 90° from the point where it stops. In the meantime, use a flathead screwdriver to secure the shaft B.



3. Secure the clamps A and B to the shaft B with bolts. Move the clamp A with the arm pressed in the direction ⓐ and use a dial gauge to read the runout at the notched groove ⓑ position.

Proper Backlash Obtained from Gauge Reading:
0.14 - 0.42 mm (0.0055 - 0.0165 in)

Sizes of Adjusting Shims:
For Bevel Gear B Side 0.1, 0.15, 0.3 mm

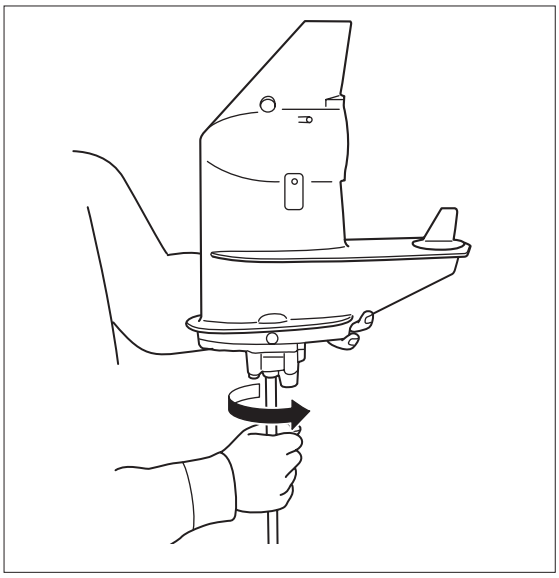


4. Make bevel gear B side shim adjustments as necessary based on the gauge value measured. The table shows the relation between dial gauge readings and shim adjustments.

1. Values in this table indicate dial gauge readings obtained when using the special tool.
2. Change the gear engagement position and measure the backlash again.

Dial Gauge Reading mm	Shim thickness to increase / decrease mm
0.00-0.02	-0.15
0.03-0.13	-0.10
0.14-0.42	0
0.43-0.47	+0.25
0.48-0.52	+0.30
0.53-0.58	+0.35
0.59-0.64	+0.40
0.65-0.69	+0.45
0.70-0.75	+0.50

5. After adjustment, remove the backlash measuring tool, invert the gear case, and turn the drive shaft slowly to see if it turns smoothly.
   If not, reduce the shim thickness by 0.05 mm and adjust the backlash again.

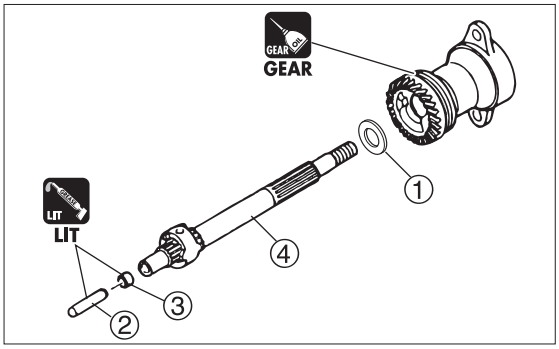


- Remove the backlash measuring tool from the bearing of the bevel gear assy A by loosening the nut and lightly tapping the shaft with a plastic hammer.
- If the engagement of the bevel gear assy A and bevel gear B is imperfect, an abnormal noise may occur when turning the drive shaft. In such a case, reduce the shim thickness by 0.05 mm.

30) Installation of Propeller Shaft Housing

1. Check that lithium grease is applied to the oil seal of the housing assy.

2. Install the washer ① and propeller assy to the propeller shaft housing assy.



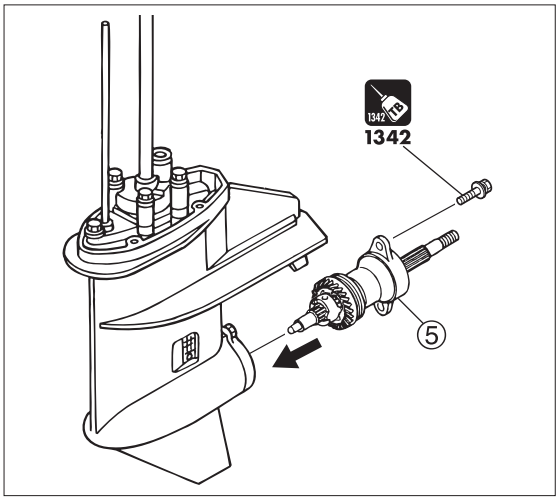
3. Apply gear oil to the new O-ring.

GEAR

4. Apply lithium grease to the push rod ② and the retainer ③ and install the propeller shaft ④.

LIT

5. Install the propeller shaft housing assy ⑤ in the gear case.



- ·Apply grease to the push rod and retainer to prevent them from falling off during installation.
- ·When installing the housing assy to the gear case, tighten the upper and lower bolts evenly 2 to 3 times.

1342

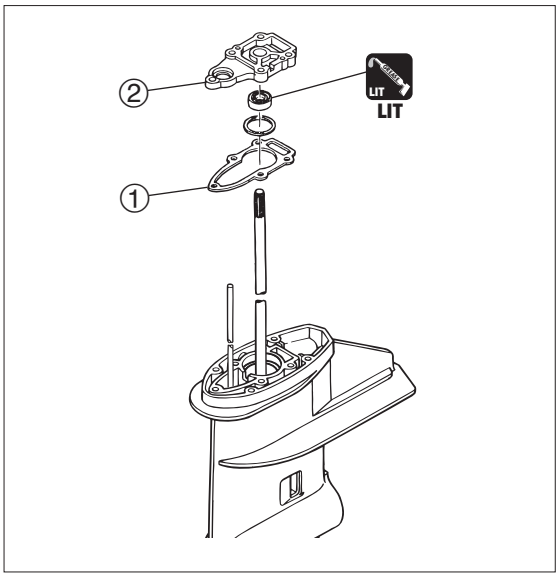
31) Installation of Pump Case

1.Remove the pump case (lower) and (upper) and apply lithium grease to the lip of the oil seal.

LIT

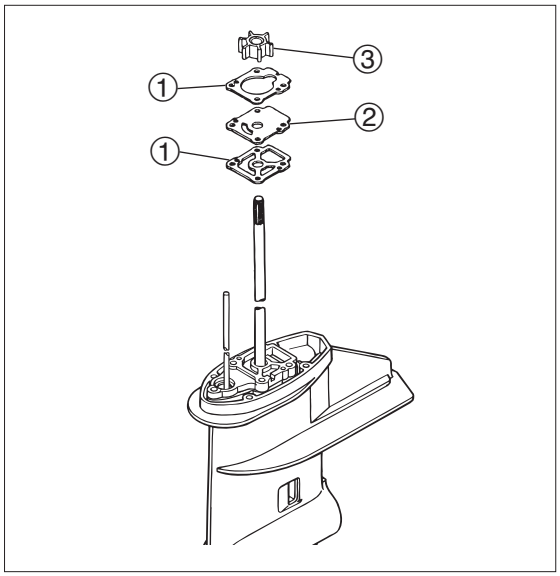
2. Install a new gasket ① and the pump case (lower) ②.

Before installation, clean the drive shaft using a new rag.



32) Installation of Water Pump

1. Install new gaskets ① and the water pump guide plate ②.

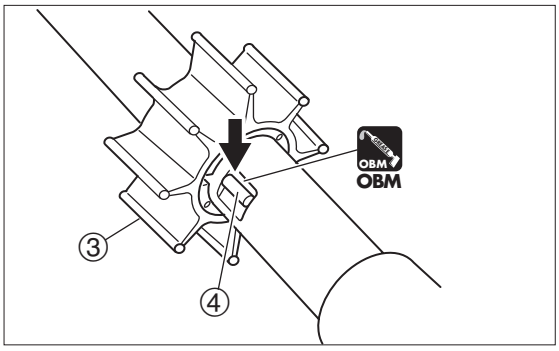


2. Apply a small amount of OBM grease to the recessed portion of the drive shaft, and temporarily position the pin.

OBM

3. Align the groove of the impeller ③ and the pin ④ and install to the drive shaft.

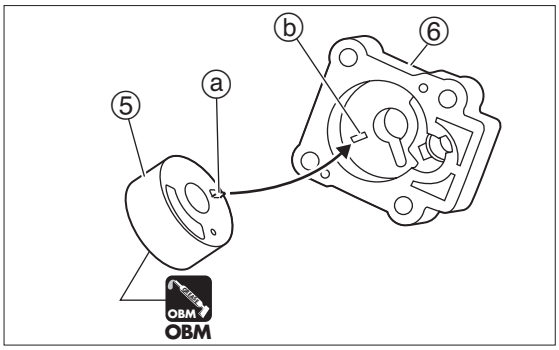
When reusing the impeller, install it in the same direction of rotation as the original.



4. Install the pump case liner ⑤ to the pump case (upper) ⑥ and apply OBM grease to the inside of the pump case liner ⑤.

Align the protruding portion ⓐ of the pump case liner with the groove ⓑ of the pump case (upper).

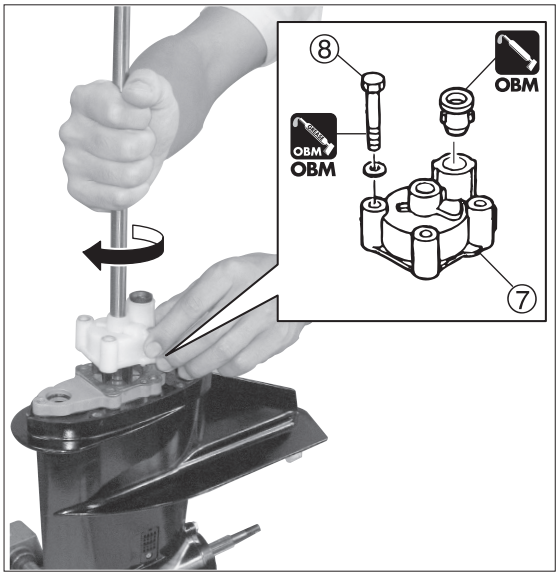
OBM



5.Install the pump case (upper) assy ⑦ to the gear case, and tighten the bolt ⑧ 2 to 3 times to the specified torque.

Apply grease to the inside of the pump case liner and install by pressing down the pump case (upper) by hand while turning the drive shaft clockwise.

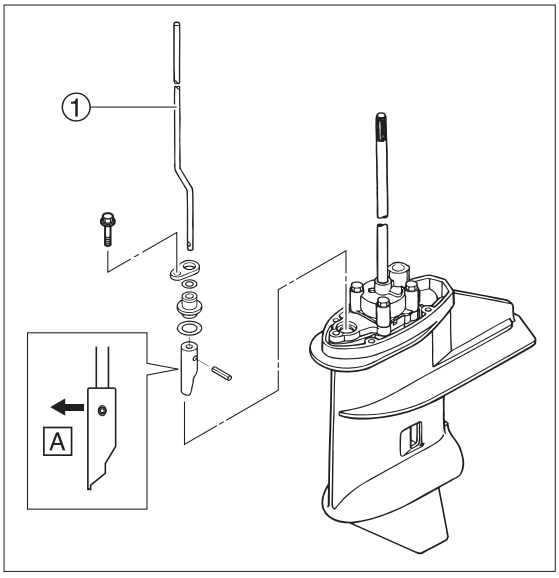
Pump Case (Upper) Bolt ⑧:
6 N·m (4 lb·ft) [0.6 kgf·m]



6.Install the cam rod assy ① as illustrated.

Cam Rod Bushing Bolt:
6 N · m (4 lb · ft) [0.6 kgf · m]

Pay attention to the orientation of the cam rod.

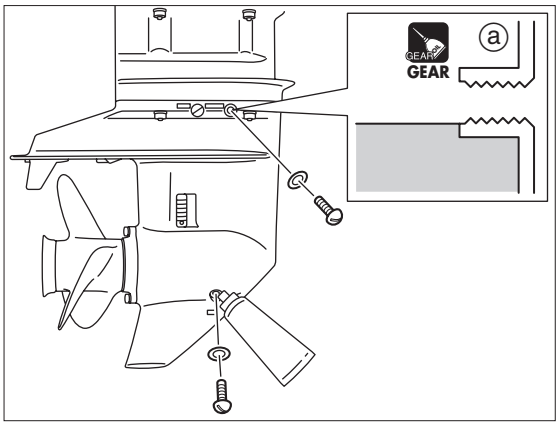


A Forward direction

6.Fill with the specified amount ⓐ of gear oil. Refer to Chapter 3.

Carry out the task "Inspection of Gear Case (for leakage)" in Chapter 3 as necessary.

Gear OIL

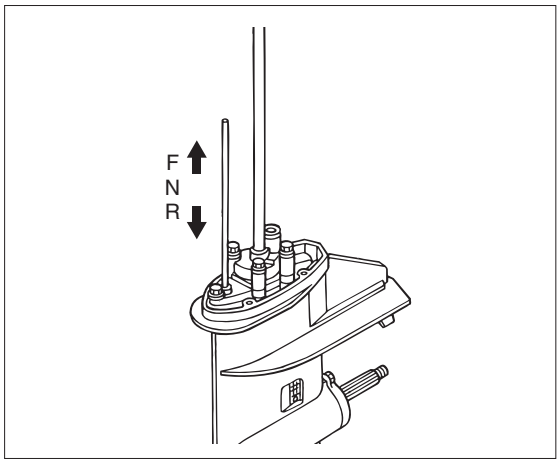


33) Installation of Lower Unit

⚠ WARNING

When working with the outboard motor in the tilt-up position, be sure to lock it with the tilt stopper.

Securely connect the water pipe. To align the splines, move the flywheel slightly or shift the gear shift to forward (F), install the propeller, and turn the propeller shaft clockwise.

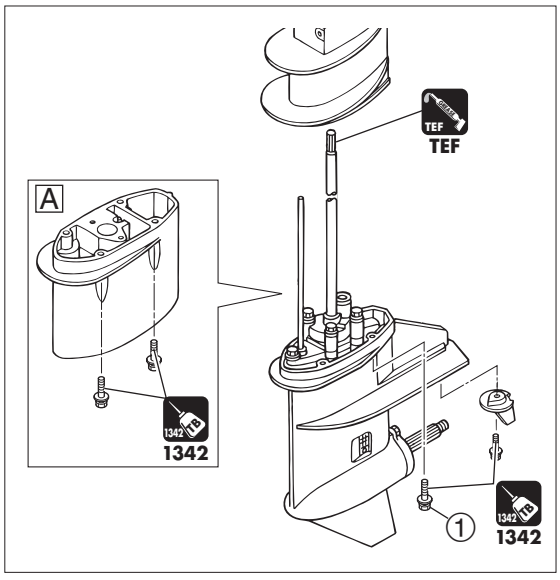


1. Install the lower unit assy to the drive shaft housing, and tighten the lower unit installation bolt (nut) ① to the specified torque.

Gear Case Installation Bolt (Nut) ①:
11.5 N·m (8.5 lb·ft) [1.2 kgf·m]

TEF

1342



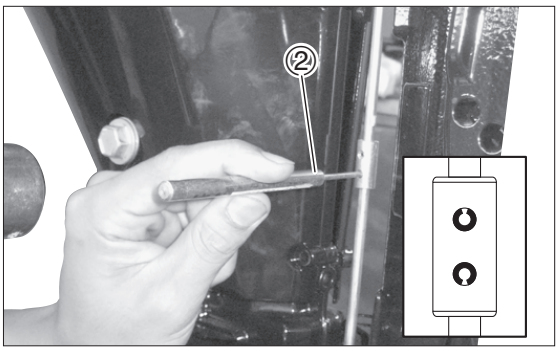
A UL - Transom Model

2.Shift the gear on the engine side and on the gear case side into neutral (N).

3.Connect the shift rod and cam rod using a new spring pin.

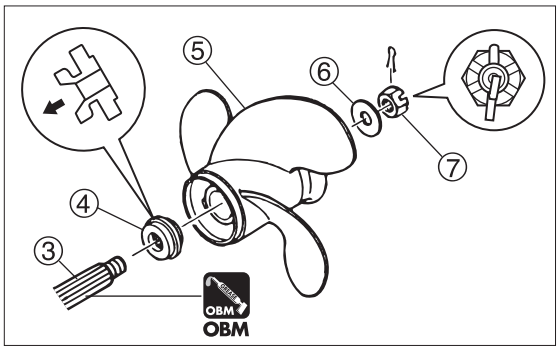
Spring Pin Tool B (ø3.0) ②:
P/N. 345-72228-0

Install the spring pin so that the abutment opening is vertically oriented.



4. Apply OBM grease to the propeller shaft ③.

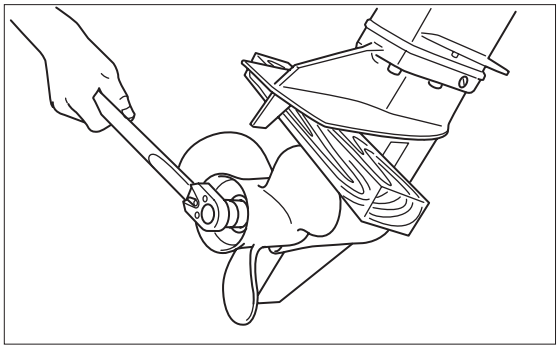
OBM



5. Install the thrust holder ④, propeller ⑤, washer ⑥, and propeller shaft ⑦. Put a wood block or the like between the cavitation plate and propeller to prevent propeller accidental rotation, and tighten the propeller nut to the specified torque.

⚠ WARNING

- **Before removing or installing the propeller, be sure to remove the stop switch lock plate.**
- **When removing or installing the propeller, do not handle the propeller with your bare hands.**
- **Put a wooden block or the like between the cavitation plate and propeller and then remove or install the propeller.**



If the groove in the propeller nut does not line up with the hole in the propeller shaft, temporarily loosen the propeller nut and then retighten it to align the groove and hole.

Propeller Nut ⑦:
12 N·m (9 lb·ft) [1.2 kgf·m]

6. Check the gear oil amount. Refer to Chapter 3.

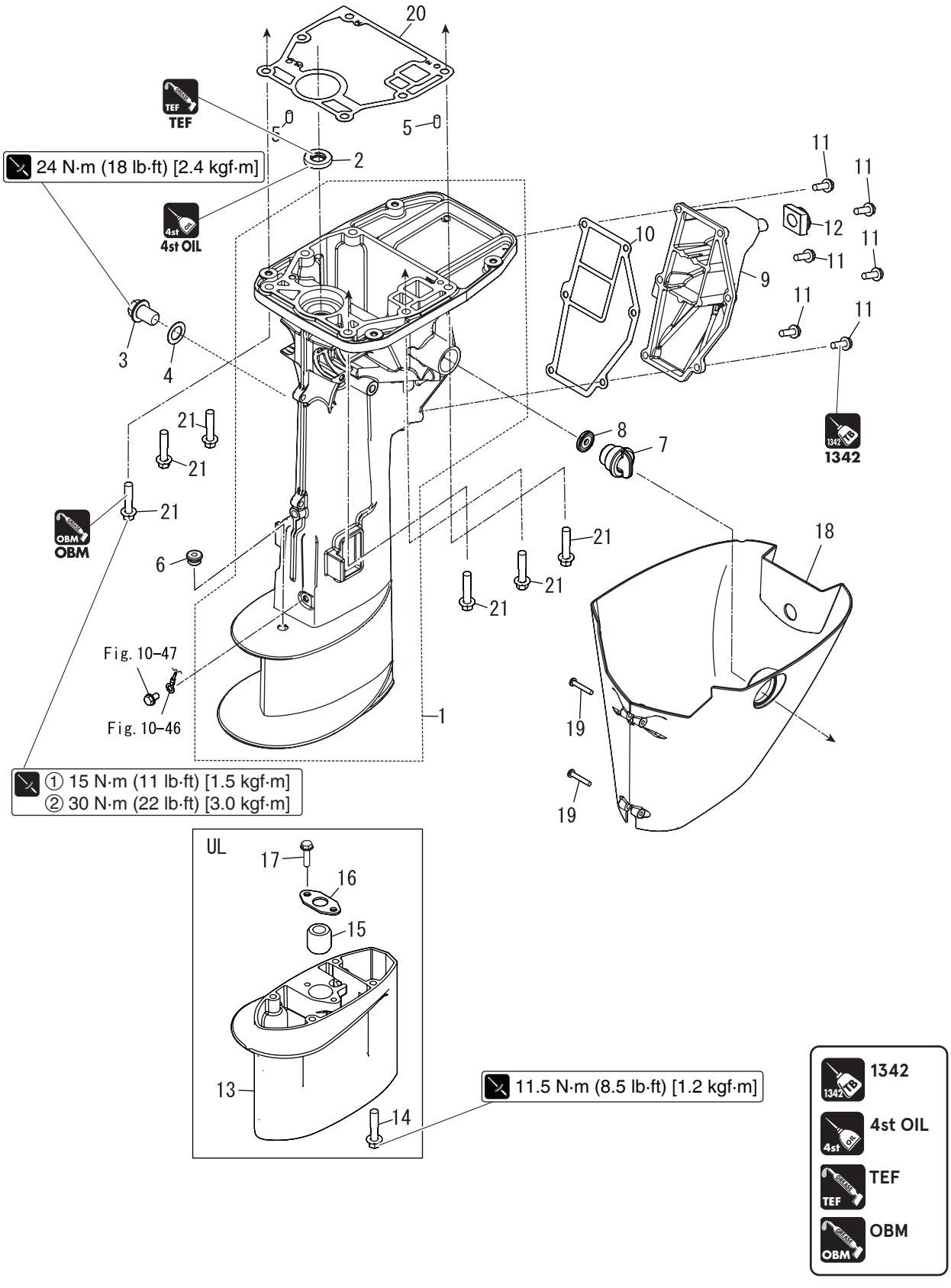
Carry out the task "Inspection of Lower Unit (for leakage)" in Chapter 3, as necessary.

7

Bracket

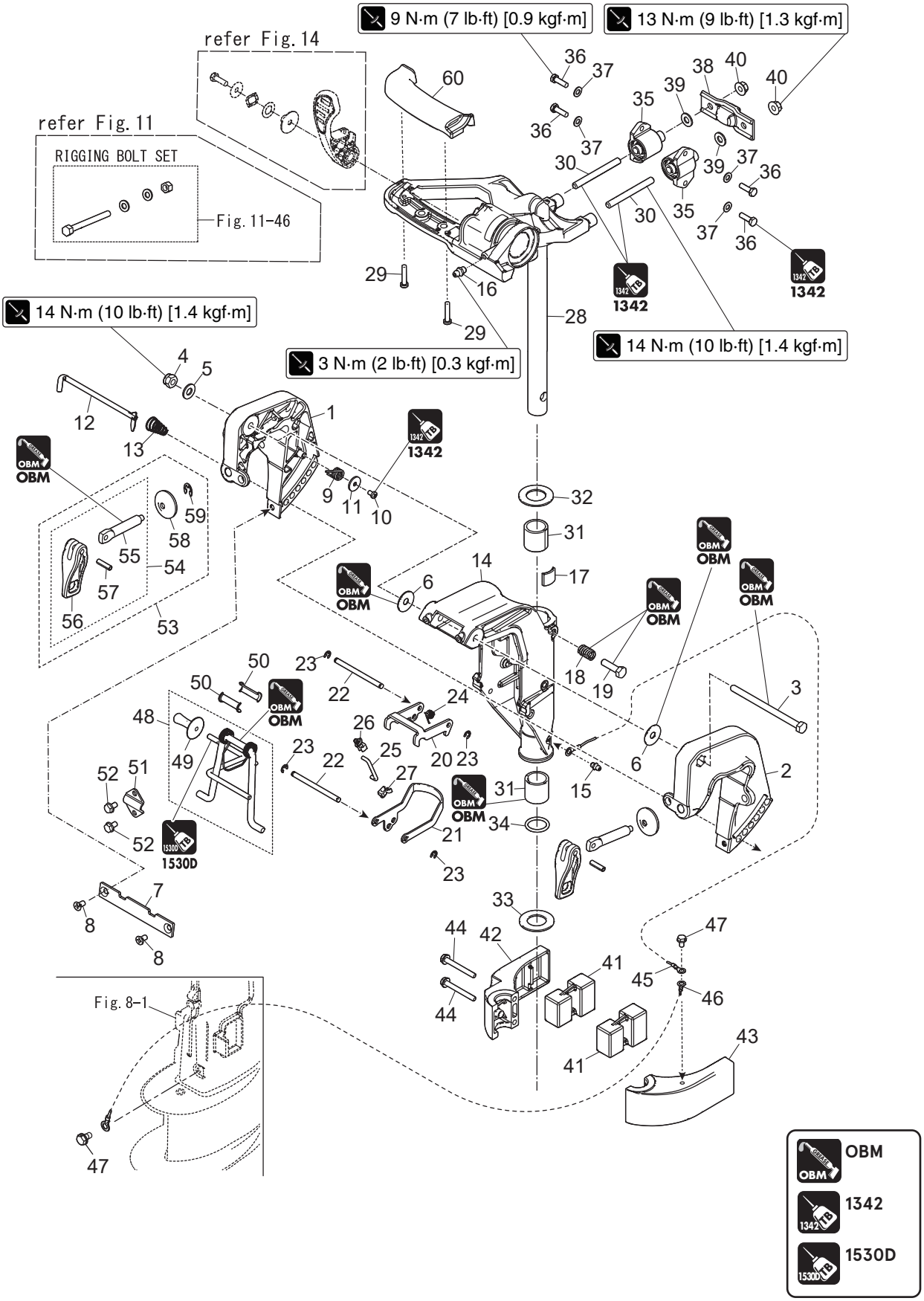
1. Parts Layout

Drive Shaft Housing

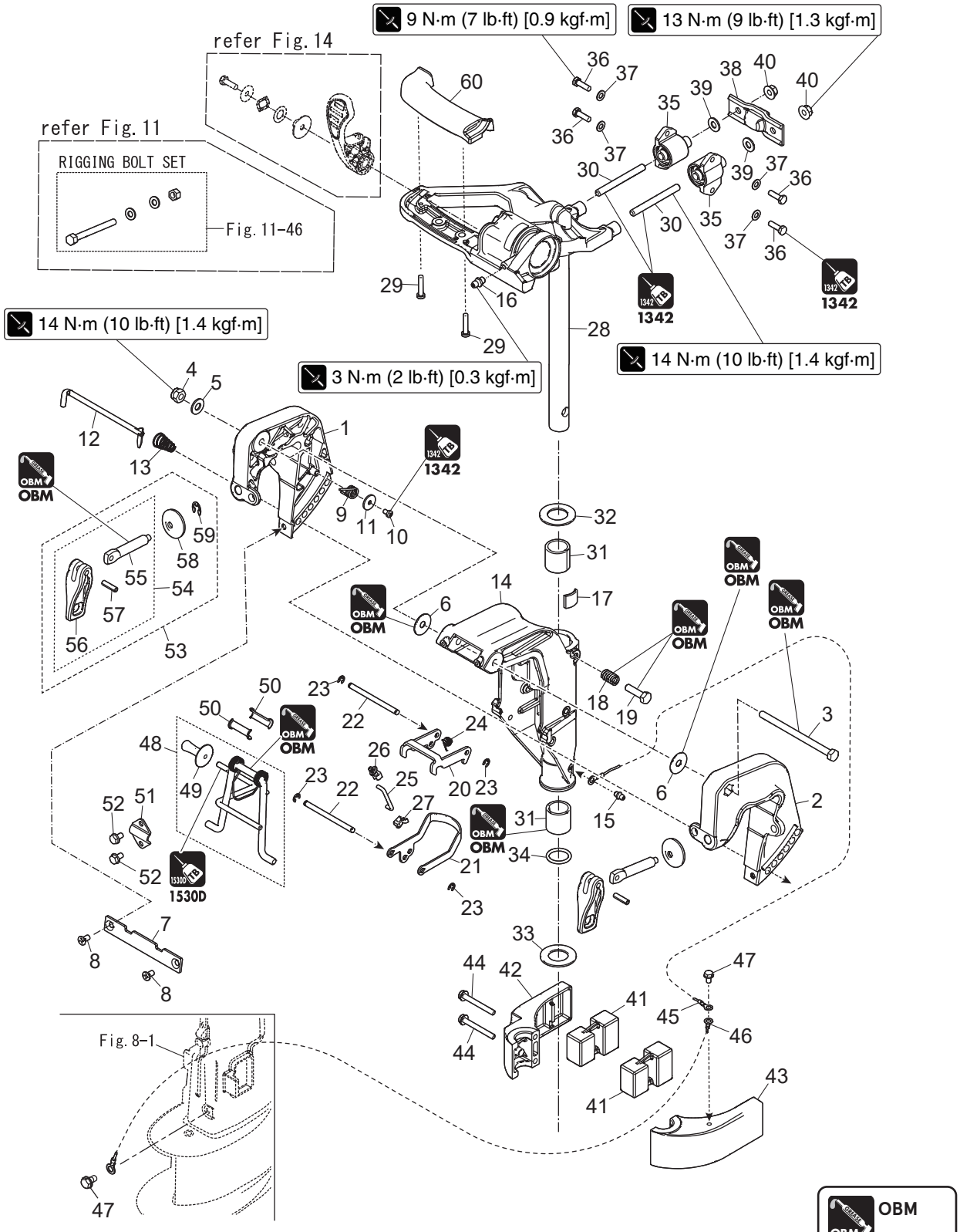


Ref. No.	Part Name	Q'ty	Remarks
1-1	Drive Shaft Housing Assy (S)	1	
1-2	Drive Shaft Housing Assy (L)	1	
2	Oil Seal 12-28-5	1	Do not reuse.
3	Drain Bolt	1	
4	Washer 14.5-24-1	1	
5	Dowel Pin 6-12	2	
6	Grommet	1	
7	Flushing Connector Cap	1	
8	Seal Ring	1	Do not reuse.
9	Idle Exhaust Port Cover	1	
10	Idle Exhaust Port Gasket	1	Do not reuse.
11	Bolt	6	
12	Idle Port Grommet	1	
13	Extension Housing	1	UL
14	Bolt 6-35	4	UL
15	Drive Shaft Housing (UL)	1	UL
16	Bushing Stopper	1	UL
17	Bolt	2	UL
18	Apron	1	
19	Tapping Screw 5-30	2	
20	Engine Base Gasket	1	Do not reuse.
21	Bolt	6	

Clamp Bracket (MF & EF models)

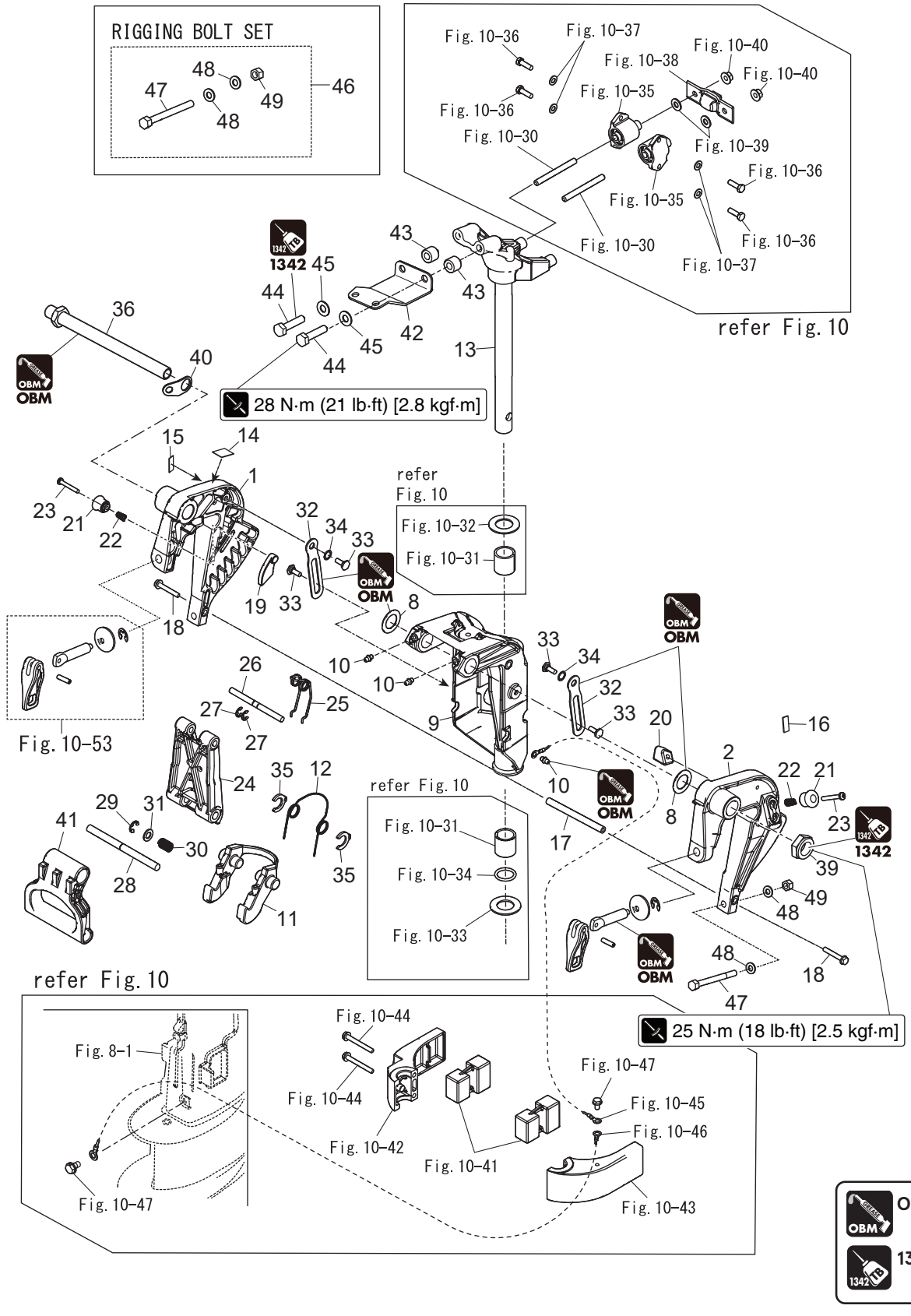


Ref. No.	Part Name	Q'ty	Remarks
1	Clamp Bracket (R)	1	MF EF
2	Clamp Bracket (L)	1	MF EF
3	Bolt 8-122	1	MF EF
4	Nylon Nut 8-P1.25	1	MF EF
5	Washer	1	MF EF
6	Washer 8.5-28-1	2	MF EF
7	Bracket Distance Plate	1	MF EF
8	Screw	2	MF EF
9	Stern Bracket Spring	1	MF EF
10	Screw	1	MF EF
11	Washer 4.3-16-1.5	1	MF EF
12	Thrust Rod	1	MF EF
13	Thrust Rod Spring	1	MF EF
14	Swivel Bracket	1	MF EF
15	Grease Fitting	1	MF EF
16	Grease Fitting	1	MF EF EFT
17	Friction Piece	1	MF EF
18	Friction Spring	1	MF EF EFT EPT
19	Bolt	1	MF EF EFT EPT
20	Reverse Lock	1	MF EF
21	Reverse Lock Arm	1	MF EF
22	Reverse Lock Rod	2	MF EF
23	E-Ring d=5	4	MF EF **Do not reuse.**
24	Reverse Lock Spring	1	MF EF
25	Reverse Lock Link	1	MF EF
26	Rod Snap 5-3	1	MF EF
27	Rod Snap 4-2	1	MF EF
28	Steering Shaft Assy	1	MF EF EFT
29	Tapping Screw 4-20	2	MF EF EFT
30	Stud	2	
31	Bushing 24-30-30	2	MF EF EP
32	Thrust Plate (Upper)	1	
33	Thrust Plate (Upper)	1	
34	O-ring 3.5-22	1	
35	Rubber Mount (Upper)	2	
36	Bolt	4	
37	Washer	4	
38	Damper (Upper)	1	
39	Washer	2	
40	Nut (W/Flange)	2	

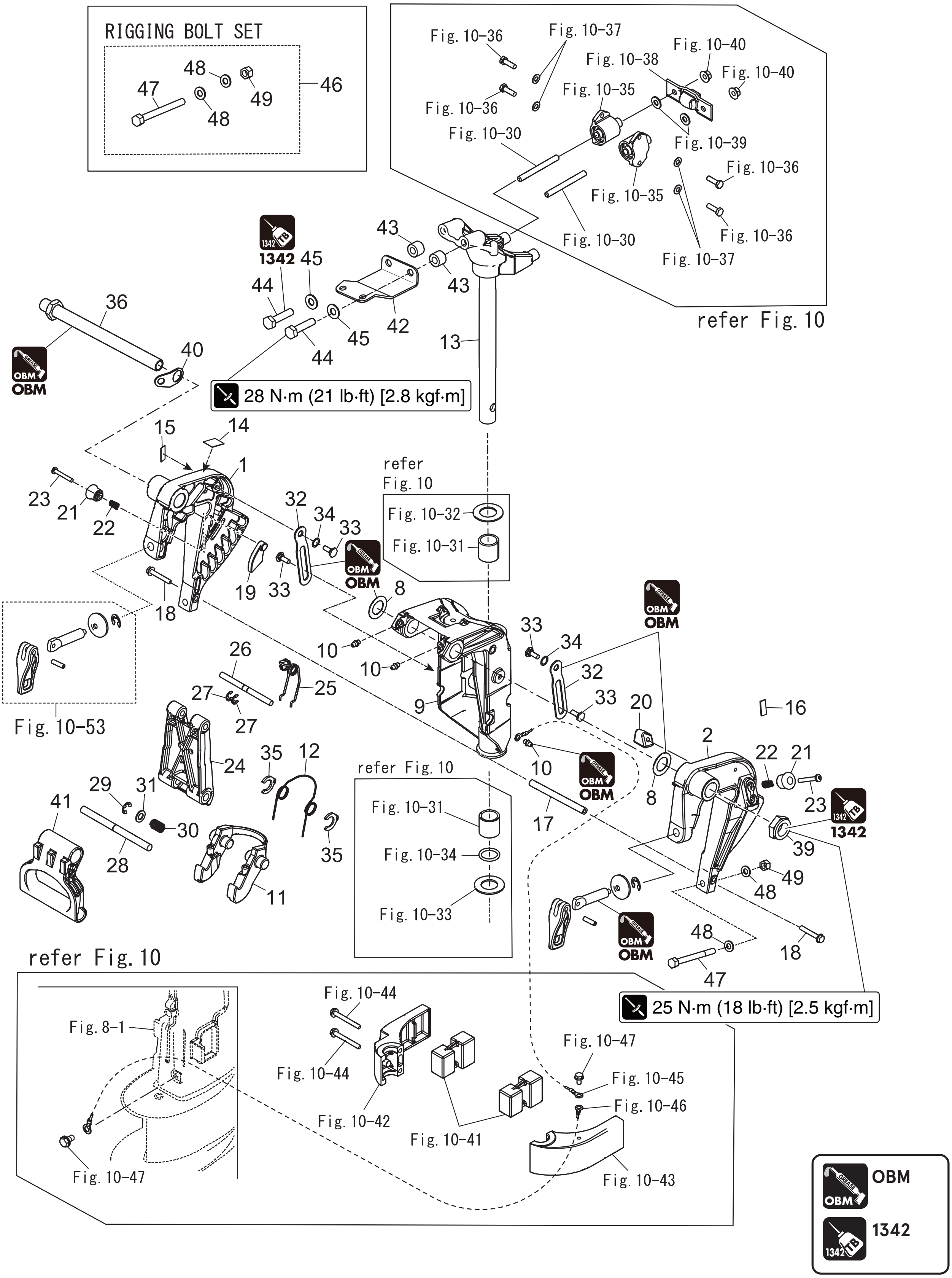

9 N·m (7 lb·ft) [0.9 kgf·m]
13 N·m (9 lb·ft) [1.3 kgf·m]
refer Fig. 14
refer Fig. 11
RIGGING BOLT SET
Fig. 11-46
14 N·m (10 lb·ft) [1.4 kgf·m]
3 N·m (2 lb·ft) [0.3 kgf·m]
14 N·m (10 lb·ft) [1.4 kgf·m]
1342
1530D
OBM
Fig. 8-1
OBM
1342
1530D

Ref. No.	Part Name	Q'ty	Remarks
41	Rubber Mount (Lower)	2	
42	Mount Bracket (R)	1	
43	Mount Bracket (L)	1	
44	Bolt	2	
45	Ground L = 110	1	
46	Ground L = 110	1	
47	Bolt	2	
48	Tilt Stopper Assy	1	MF EF
49	*Tilt Stopper Grip	1	MF EF
50	Tilt Stopper Bushing	2	MF EF
51	Tilt Stopper Setting Plate	1	MF EF
52	Bolt	2	MF EF
53	Clamp Screw Kit	2	
54	*Clamp Screw Assy	1	
55	**Clamp Screw	1	
56	**Clamp Screw Handle	1	
57	**Spring Pin	1	Do not reuse.
58	*Clamp Screw Pad	1	
59	*Ring d=5	1	
60	Cord Holder	1	MF EF EFT

Clamp Bracket (EP model)

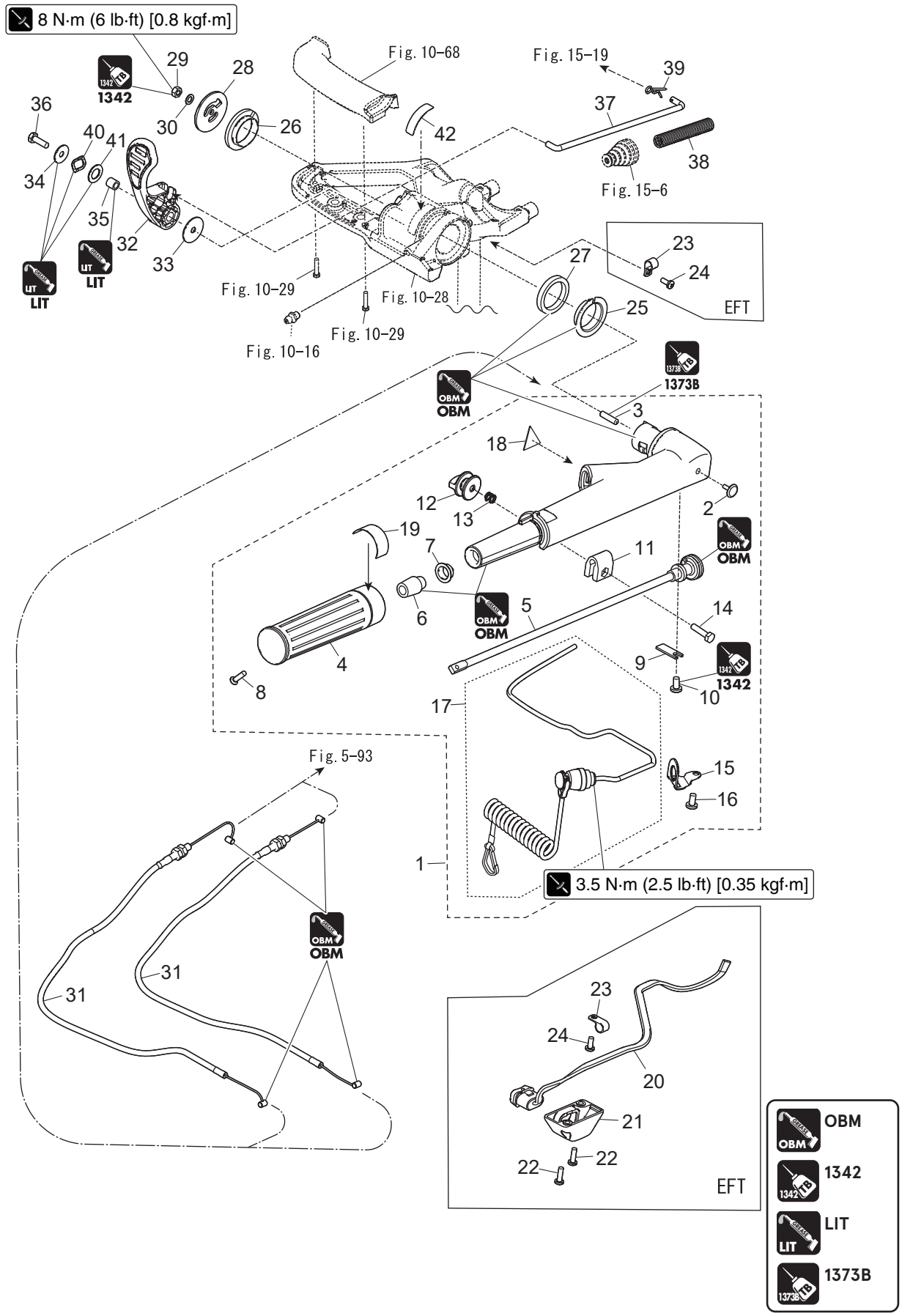


Ref. No.	Part Name	Q'ty	Remarks
1	Clamp Bracket (R)	1	EP
2	Clamp Bracket (L)	1	EP
8	Washer 22-36-1	2	EFT EP EPT
9	Swivel Bracket	1	EP
10	Grease Fitting	3	EFT EP EPT
11	Reverse Lock	1	EP
12	Reverse Lock Spring	1	EP
13	Steering Shaft Assy	1	EP EPT
14	Trim Position Decal	1	EP
15	Lower Tilt Limit Decal	1	EP
16	Tilt Lock Decal	1	EP
17	Distance Piece	1	EP
18	Bolt	2	EP
19	Trim Setting Plate	1	EP
20	Tilt Lock Piece	1	EP
21	Knob	2	EP
22	Tilt Lock Knob Spring	2	EP
23	Screw	2	EP
24	Tilt Stopper Body	1	EP
25	Spring	1	EP
26	Tilt Stopper Shaft (Upper)	1	EP
27	E-ring d=6	2	EP Do not reuse.
28	Tilt Stopper Shaft (Lower)	1	EP
29	E-ring d=9	1	EP Do not reuse.
30	Spring	1	EP
31	Washer 10.5-18-1.5	1	EP
32	Tilt Stopper (L)	2	EP
33	Bolt	4	EP
34	Wave Washer d = 10	2	EP
35	Reverse Lock Clip	2	EP
36	Swivel Bracket Shaft Assy	1	EFT EP EPT
39	Nylon Nut 7/8-14	1	EFT EP EPT
40	Plate	1	EFT EP EPT

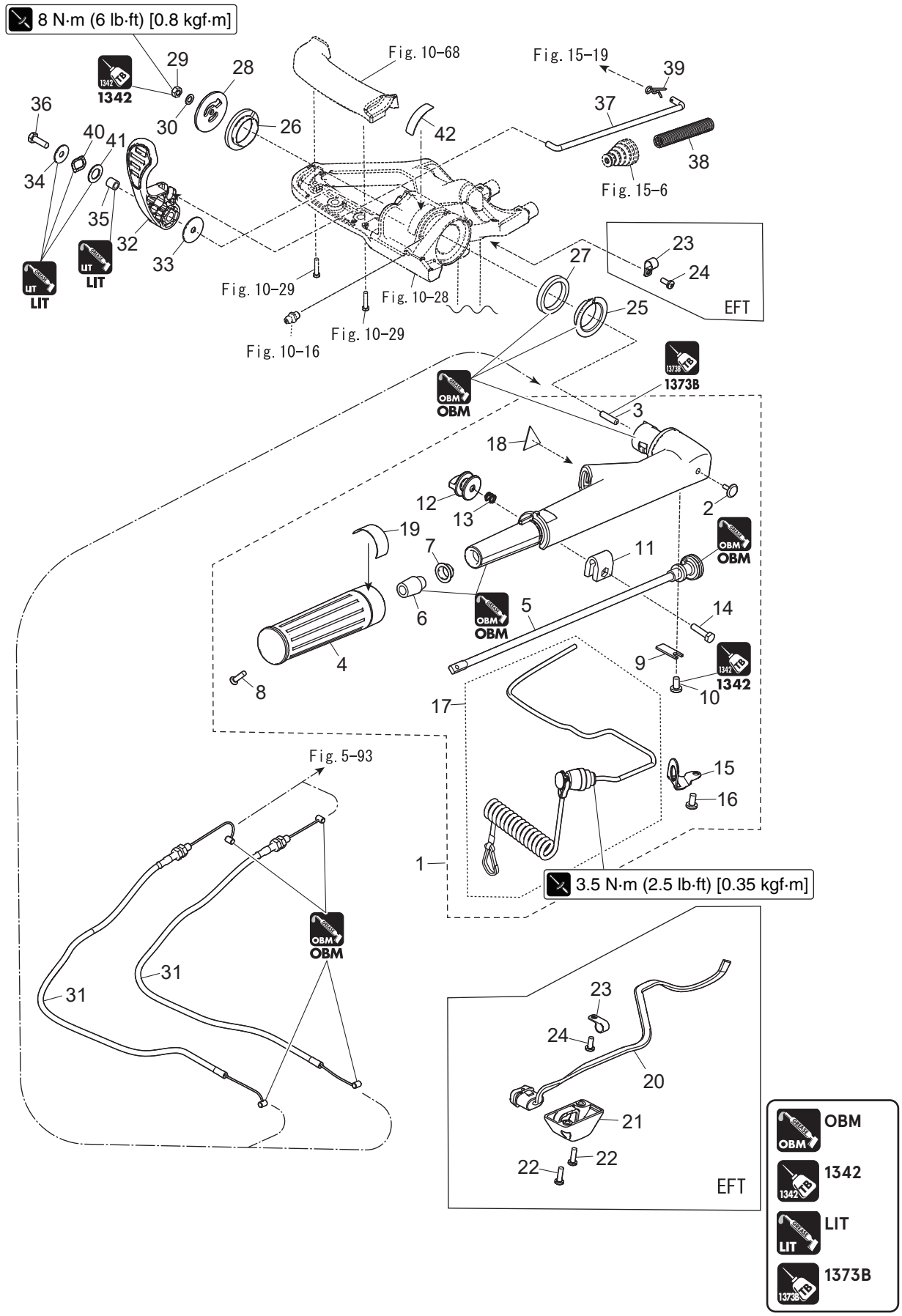

RIGGING BOLT SET
refer Fig. 10
28 N·m (21 lb·ft) [2.8 kgf·m]
25 N·m (18 lb·ft) [2.5 kgf·m]
Fig. 10-30
Fig. 10-31
Fig. 10-32
Fig. 10-33
Fig. 10-34
Fig. 10-35
Fig. 10-36
Fig. 10-37
Fig. 10-38
Fig. 10-39
Fig. 10-40
Fig. 10-41
Fig. 10-42
Fig. 10-43
Fig. 10-44
Fig. 10-45
Fig. 10-46
Fig. 10-47
Fig. 10-53
Fig. 8-1
OBM
1342

Ref. No.	Part Name	Q'ty	Remarks
41	Carrying Handle	1	EP EPT
42	Steering Hook Plate	1	EP EPT
43	Collar 10.1-20-15	2	EP EPT
44	Bolt	2	EP EPT
45	Washer	2	EP EPT
46	Rigging Bolt Set	1	EP EFT EPT
47-1	*Bolt	2	EF EFT
47-2	*Bolt	4	EPT
48-1	*Washer	4	EF EFT
48-2	*Washer	8	EPT
49-1	*Nylon Nut 8-P1.25	2	EF EFT
49-2	*Nylon Nut 8-P1.25	4	EPT

Tiller Handle & Shift Lever

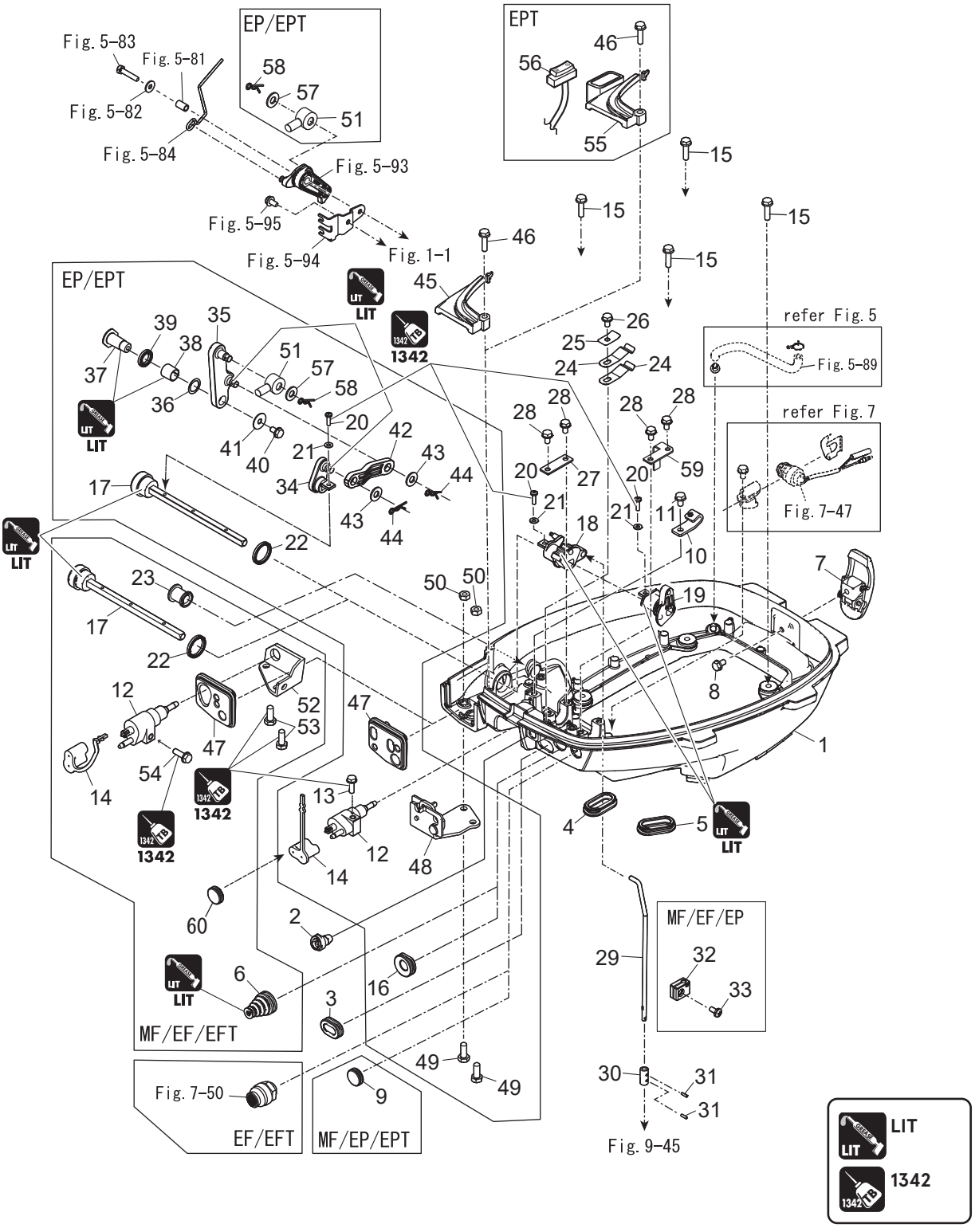


Ref. No.	Part Name	Q'ty	Remarks
1	Tiller Handle Assy	1	MF EF
2	*Plastic Rivet 6.5	1	MF EF EFT
3	*Stud	1	MF EF EFT
4	*Grip	1	MF EF EFT
5	*Throttle Shaft	1	MF EF EFT
6	*Throttle Shaft Damper	1	MF EF EFT
7	*Bushing 14-15.8-7	1	MF EF EFT
8	*Screw	1	MF EF EFT
9	*Throttle Shaft Support	1	MF EF EFT
10	*Screw	1	MF EF EFT
11	*Friction Piece	1	MF EF EFT
12	*Adjusting Nut	1	MF EF EFT
13	*Spring	1	MF EF EFT
14	*Bolt	1	MF EF EFT
15	*Bracket	1	MF EF EFT
16	*Screw	1	MF EF EFT
17	*Stop Switch Assy	1	MF EF EFT
18	*Stop Switch Decal	1	MF EF EFT
19	*Throttle Decal	1	MF EF EFT
20	PTT Switch Assy	1	EFT
21	Switch Box	1	EFT
22	Screw	2	EFT
23	Clamp 6-9.5L	2	EFT
24	Screw	2	EFT
25	Handle Bushing	1	MF EF EFT
26	Bushing	1	MF EF EFT
27	Washer	1	MF EF EFT
28	Cover	1	MF EF EFT
29	Nut	1	MF EF EFT
30	Washer	1	MF EF EFT
31	Throttle Wire	2	MF EF EFT
32	Shift Lever	1	MF EF EFT
33	Washer	1	MF EF EFT
34	Washer 6.5-21-1	1	MF EF EFT
35	Bracket Collar 6.5-10.5-10	1	MF EF EFT
36	Bolt	1	MF EF EFT
37	Shift Lever Rod	1	MF EF EFT
38	Protector	1	MF EF EFT
39	Snap Pin d = 6	1	MF EF EFT
40	Wave Washer	1	MF EF EFT

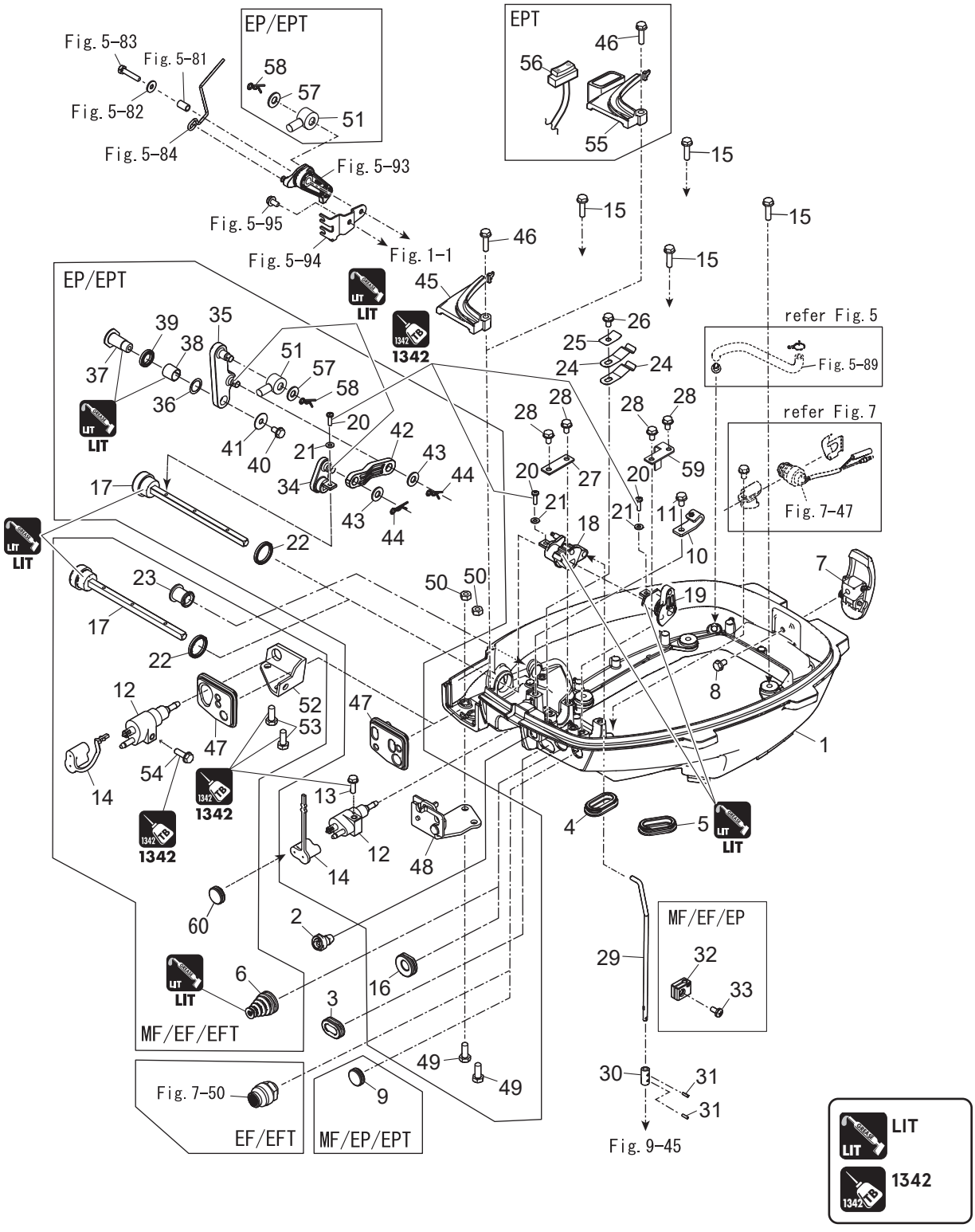

8 N·m (6 lb·ft) [0.8 kgf·m]
1342
LIT
OBM
1373B
EFT
Fig. 10-68
Fig. 15-19
Fig. 15-6
Fig. 10-29
Fig. 10-28
Fig. 10-16
Fig. 5-93
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42

Ref. No.	Part Name	Q'ty	Remarks
41	Washer	1	MF EF EFT
42	Shift Decal	1	MF EF EFT

Bottom Cowl & Shift

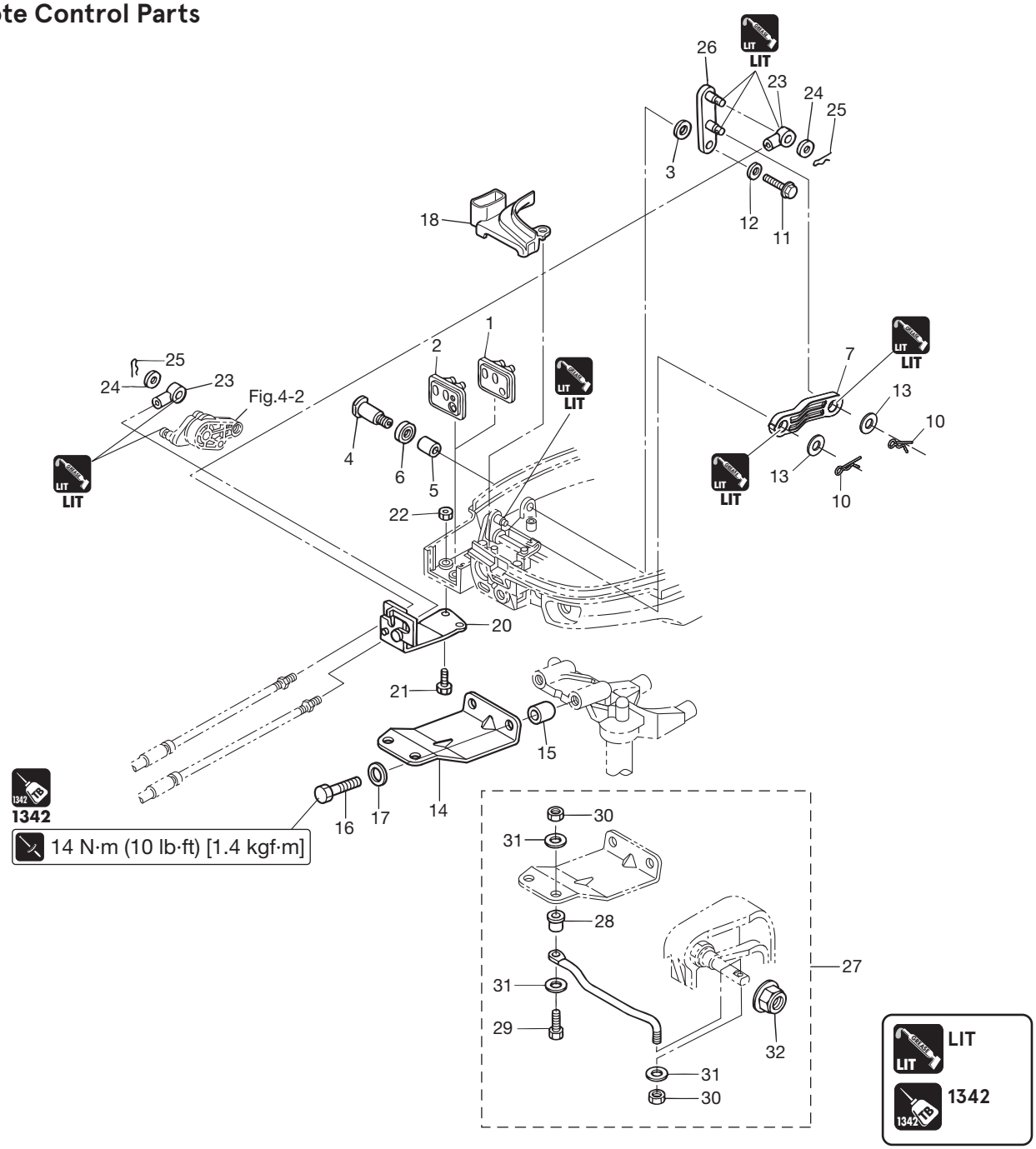


Ref. No.	Part Name	Q'ty	Remarks
1	Bottom Cowl	1	
2	Pilot Lamp Assy	1	
3	Battery Cable Grommet	1	
4	Shift Rod Grommet	1	
5	Shift Rod Grommet	1	
6	Grommet	1	MF EF EFT
7	Cowl Latch Assy	1	
8	Bolt	1	
9	Grommet 17-2.7	1	MF EP EPT
10	Starter Lock Cable Bracket	1	
11	Bolt	1	
12	Fuel Connector (Male)	1	
13	Bolt		EP EPT
14	Fuel Connector Protector	1	
15	Bolt	4	
16	Grommet 22-3		EP EPT
17	Shift Lever Shaft	1	
18	Shift Rod Lever	1	
19	Lever	1	
20-1	Screw	2	MF EF EFT
20-2	Screw	3	EP EPT
21-1	Washer	2	MF EF EFT
21-2	Washer	3	EP EPT
22	Seal Ring 23-29-3.7	1	Do not reuse.
23	Grommet	1	MF EF EFT
24	Shift Detent Spring	2	
25	Shift Detent Support	1	
26	Bolt	1	
27	Shift Lever Shaft Holder	1	
28	Bolt	4	
29	Shift Rod	1	
30	Shift Rod Joint	1	
31	Spring Pin 3-10	2	Do not reuse.
32	Reverse Lock Link Joint	1	MF EF EP
33	Screw	1	MF EF EP
34	Shift Lever (Remote Control)	1	EP EPT
35	Shift Arm (Remote Control)	1	EP EPT
36	Wave Washer d = 14	1	EP EPT
37	Pivot (EP)	1	EP EPT
38	Hook Lever Bushing	1	EP EPT
39	Seal Ring 13.8-22-3.7	1	EP EPT Do not reuse.
40	Bolt	1	EP EPT


EP/EPT
EPT
MF/EF/EP
MF/EF/EFT
EF/EFT
MF/EP/EPT
refer Fig. 5
refer Fig. 7
Fig. 5-83
Fig. 5-81
Fig. 5-82
Fig. 5-84
Fig. 5-93
Fig. 5-95
Fig. 5-94
Fig. 1-1
Fig. 5-89
Fig. 7-47
Fig. 7-50
Fig. 9-45
LIT
1342

Ref. No.	Part Name	Q'ty	Remarks
41	Washer 6.5-21-1	1	EP EPT
42	Shift Lever Rod	1	EP EPT
43	Washer 8.5-18-1.6	2	EP EPT
44	Snap Pin d = 8	2	EP EPT
45	Shift Lever Bracket Cover	1	MF EF EFT EP
46	Bolt	1	
47	Grommet	1	MF EF EFT
48	Cable Clip Assy	1	EP EPT
49	Bolt	2	EP EPT
50	Nut	2	EP EPT
51	Cable Joint	2	EP EPT
52	Fuel Connector Stay	1	MF EF EFT
53	Bolt	2	MF EF EFT
54	Bolt	1	MF EF EFT
55	Remote Control Cable Stay Cover	1	EPT
56	PTT Switch Assy	1	EPT
57	Washer 8.5-18-1.6	2	EP EPT
58	Snap Pin d = 8	2	EP EPT
59	Holder	1	
60	Grommet 17-2.7	1	MF EF EFT

Remote Control Parts



Ref. No.	Part Name	Q'ty	Remarks
1	Grommet	1	for EP
2	Grommet	1	for EPT
3	Wave Washer d = 14	1	
4	Pivot (EP)	1	
5	Hook Lever Bushing	1	
6	Seal Ring 13.8-22-3.7	1	
7	Shift Lever Rod (EP)	1	
10	Snap Pin d = 8	2	Rod End
11	Bolt	1	
12	Washer 6.5-21-1	1	
13	Washer 8.5-18-1.6	2	Rod End
14	Steering Hook Plate	1	
15	Collar 10.1-20-15	2	
16	Bolt	2	
17	Washer	2	

Ref. No.	Part Name	Q'ty	Remarks
18	Remote Control Cable Stay Cover	1	
19	PTT Switch Assy	1	
20	Cable Clip Assy	1	
21	Bolt	2	
22	Nut	2	
23	Cable Joint	2	Cable End
24	Washer 8.5-18-1.6	2	Cable End
25	Snap Pin d = 8	2	Cable End
26	Shift Arm (Remote Control)	1	Mark 3V2
27	Drag Link Assy J	1	for EP
28	Spacer 9.6-19-13	1	
29	Bolt 3/8-35	1	
30	Nylon Nut 3/8-24UNF	2	
31	Washer 9.6-18-2	3	
32	Seal Ring	1	

2. Inspection Items

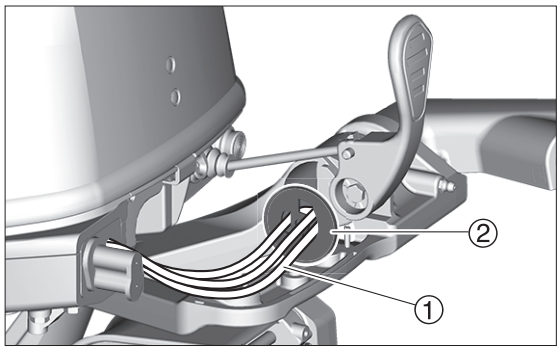
1) Inspection of Throttle Cable

1. Check the operation of the throttle cable.

2. Check the throttle cable inner wire and outer wire for bending or damage. Replace if necessary.

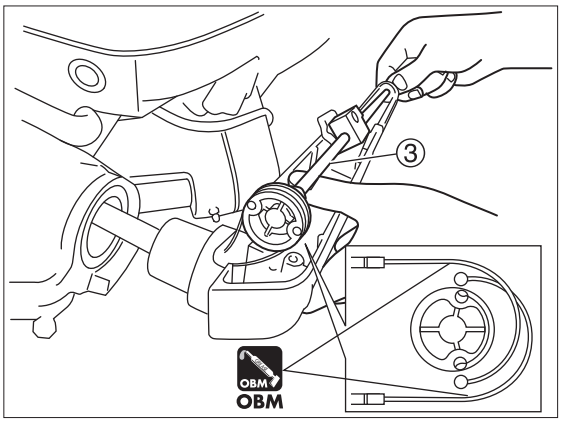
2) Installation of Tiller Handle

1. Install the stop switch lead wire ① and throttle wire to the cover ② first.



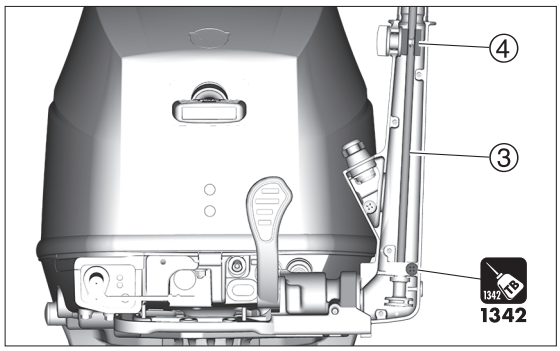
2. Install the cables to the throttle shaft ③ as illustrated.

OBM



3. Install the throttle shaft ③ with the cable attached to the tiller handle. Pay attention to the installation position of the throttle friction ④.

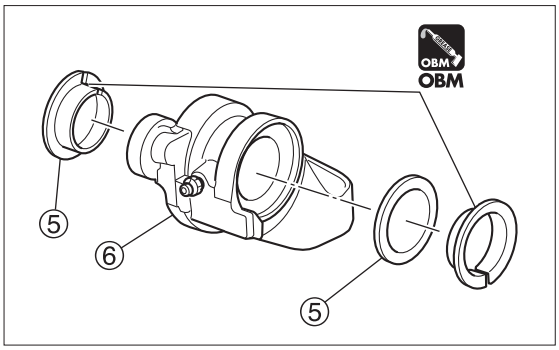
1342



7

4. Install the bushings ⑤ to the steering bracket ⑥.

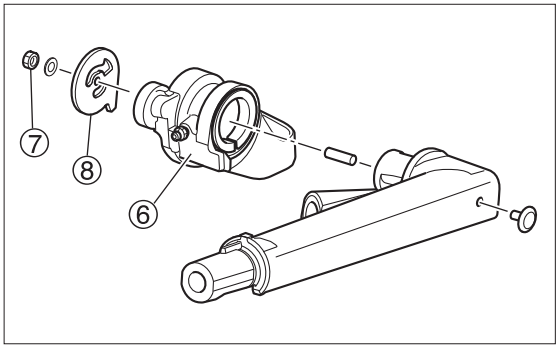
OBM



5. Install the tiller handle assy to the steering bracket ⑥ and tighten the nut ⑦ to the specified torque.

The tiller handle has a positioning bump. Attach the handle by aligning the bump with the cutout portion of the cover ⑧.

1342

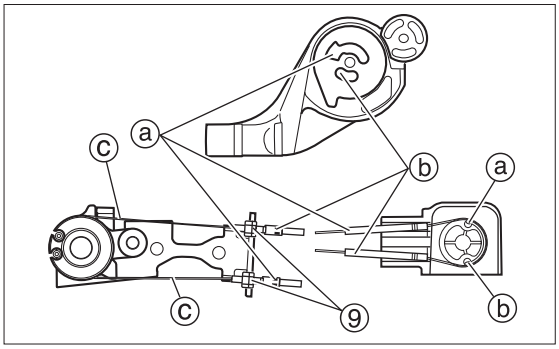


6. Install the cable ⓑ of the inner wire that stretches when the acceleration grip is set to the fully closed position.

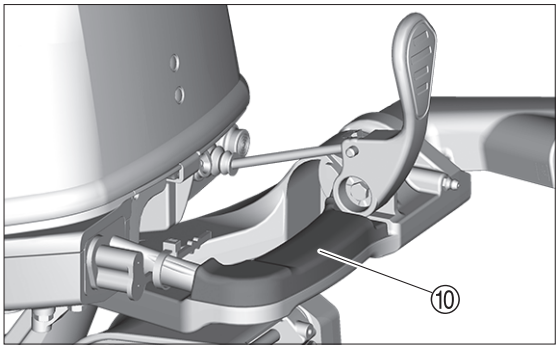
7.Next, install the other cable ⓐ (of the inner wire that stretches when the acceleration grip is set to the fully open position).

8.Adjust the positions of the lock nuts ⑨ of the throttle cable so that the throttle grip can reach the fully open and fully closed positions.

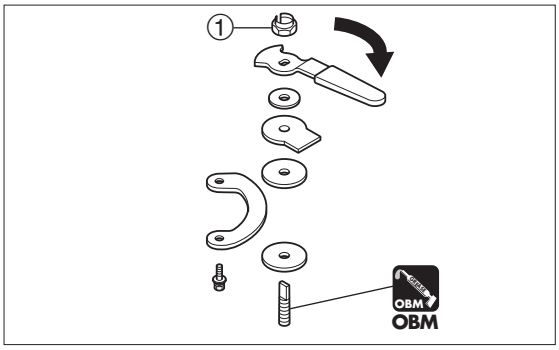
Adjust the cable tension so that the cable moves approximately 1 mm when pushed lightly with a finger.



9. Attach the cover ⑩ so that the cables pass through the cable holder without getting caught, and tighten with a screw.



3) Adjustment of Co-pilot Plate (EFT model only)

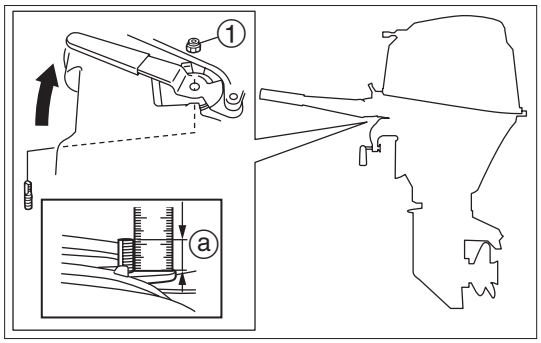


1. Install the co-pilot plate and tiller handle assy.

OBM

2.Move the co-pilot handle to the left and slide it to the tightening position.

3.Tighten the nylon nut ① until the outboard motor is tightened and heavy.



Tighten the nylon nut ① to approximately 6 N·m (4 lb·ft) [0.6 kgf·m] and check the steering load.

4.Move the co-pilot handle to the right to slide it to the release position and check that the outboard motor can be moved smoothly. If not, repeat steps 2 to 4 to make fine adjustments.

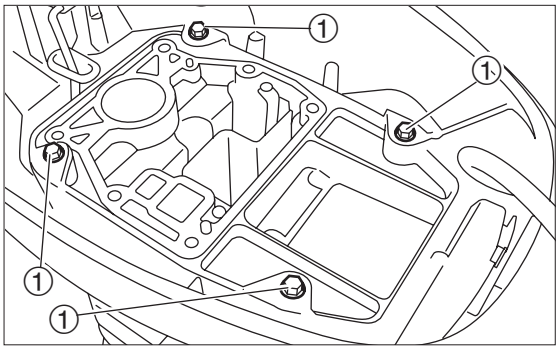
To prevent the nylon nut from falling, tighten the stud bolt until it is roughly ⓐ 12 to 13 mm from the plate upper surface.

7

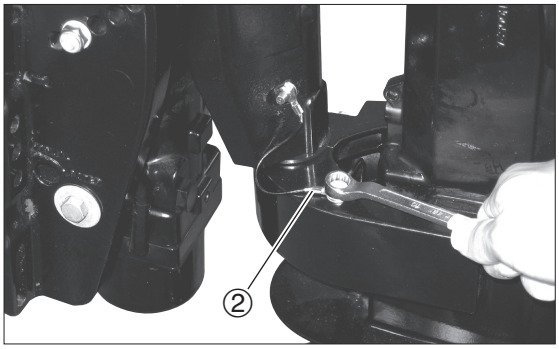
4) Removal of Drive Shaft Housing

1. With reference to Chapter 5 "Removal of Power Unit," drain the engine oil completely and remove the power unit.

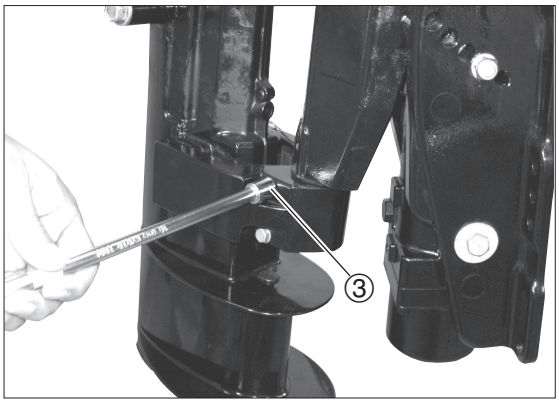
2. Loosen the the four bolts ① and remove the bottom cowl from the drive shaft housing.



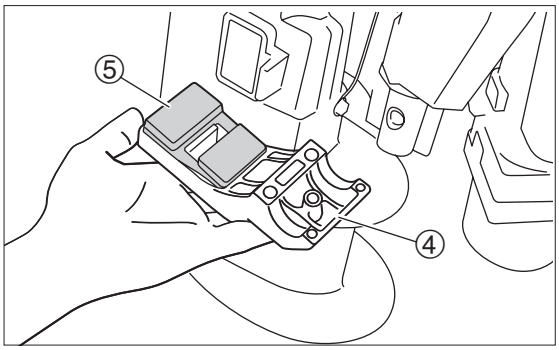
3. Remove the ground wire ② from each unit.



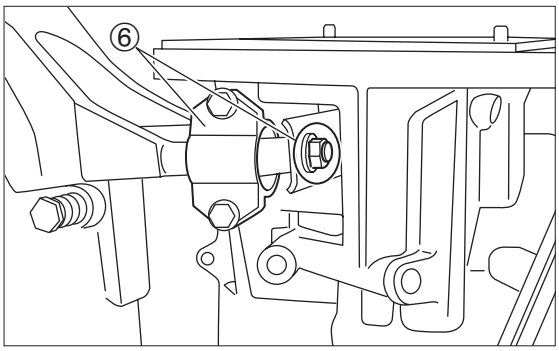
4. Remove the bolt ③ of the lower mount bracket.



5. Check that there are no abnormalities with the lower mount bracket ④ and rubber mount ⑤. Replace if abnormal.

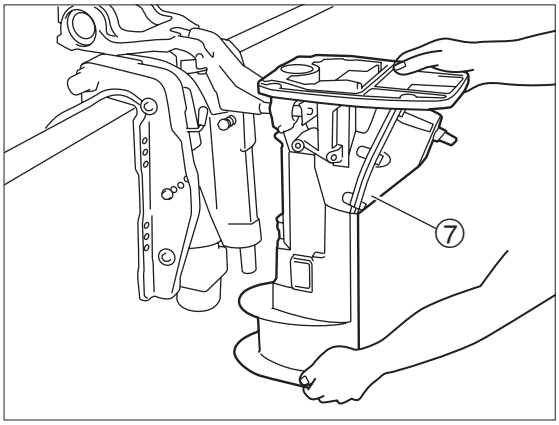


6. Remove the nut of the upper rubber mount ⑥.



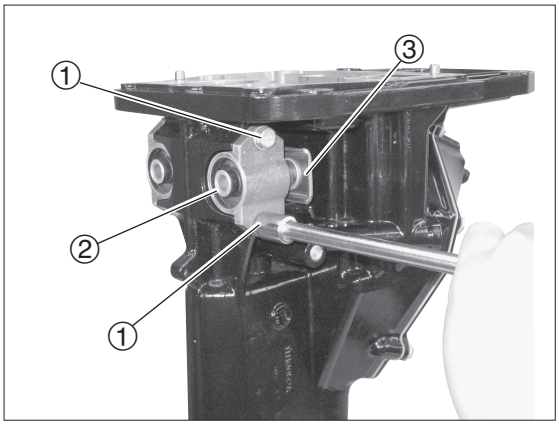
7. Remove the drive shaft housing ⑦ from the clamp bracket assy.

> Be careful not to drop the drive shaft housing during removal from the clamp bracket.

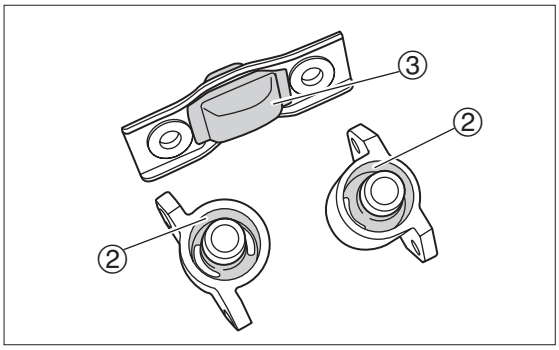


5) Disassembly of Drive Shaft Housing

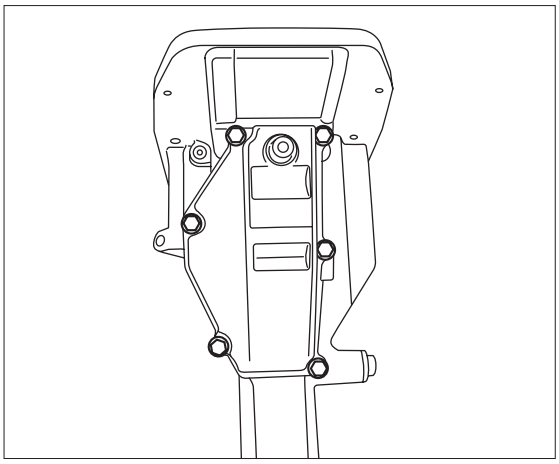
1. Remove the upper rubber mount installation bolts ① and remove the rubber mounts ② and the dampers ③ from the drive shaft housing.

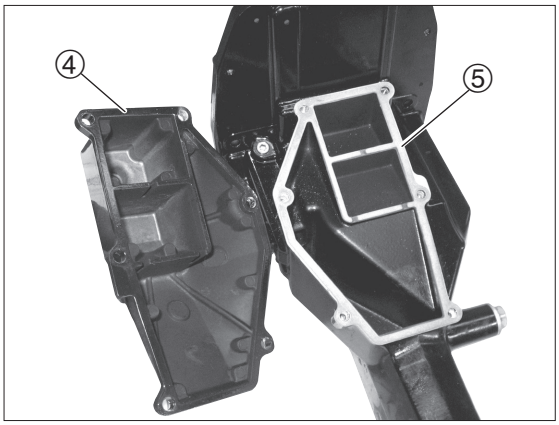


2. Check the rubber mounts ② and damper ③ for abnormalities such as cracks and fissures. Replace if any abnormality is found.

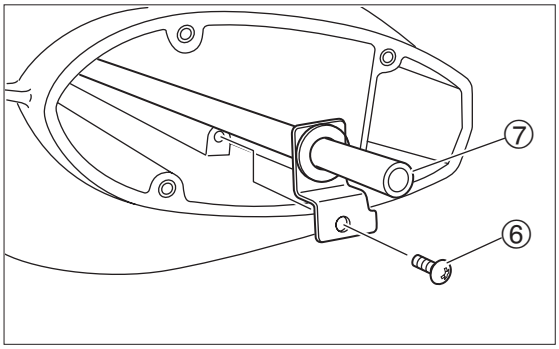


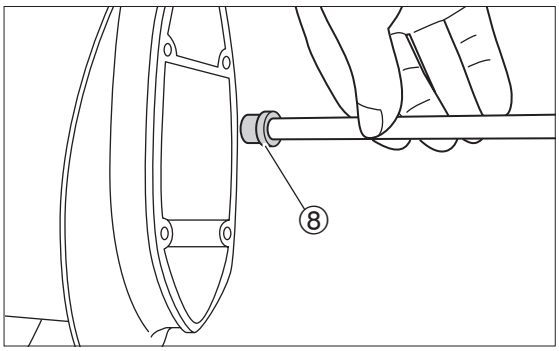
3. Remove the idol exhaust cover ④ and gasket ⑤, and check the cover and the interior for sludge, cracks, fissures, and other abnormalities.





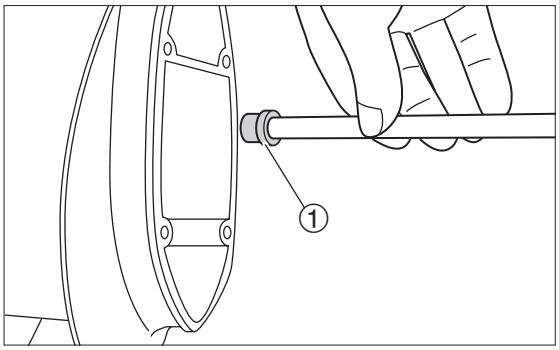
4. Remove the screw ⑥ and then remove the water pipe ⑦ from the drive shaft housing. Check the water pipe auxiliary mount ⑧ for abnormalities such as fissures and cracks.

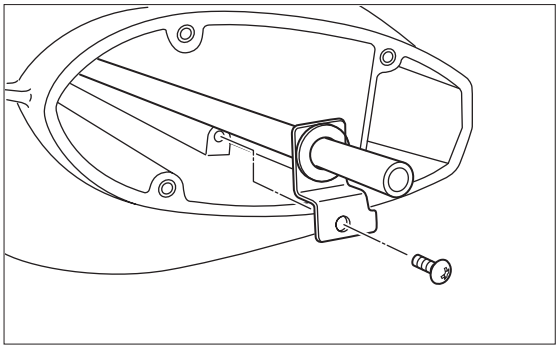




6) Assembly of Drive Shaft Housing

1. Install the water pipe ① into the drive shaft housing.

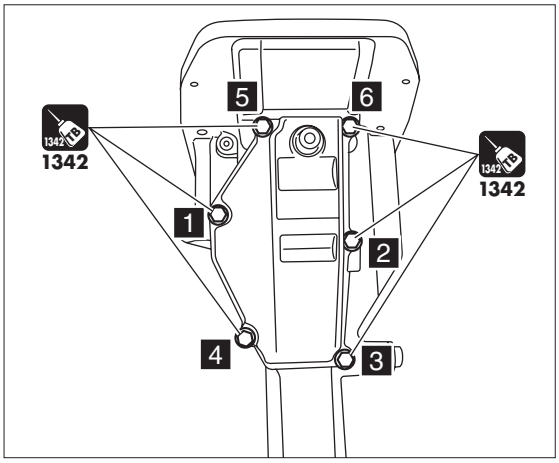




2. Install a new gasket and tighten the idle exhaust cover installation bolts in the order illustrated to the specified torque.

Idle Exhaust Installation Bolt :
6 N·m (4 lb·ft) [0.6 kgf·m]

1342

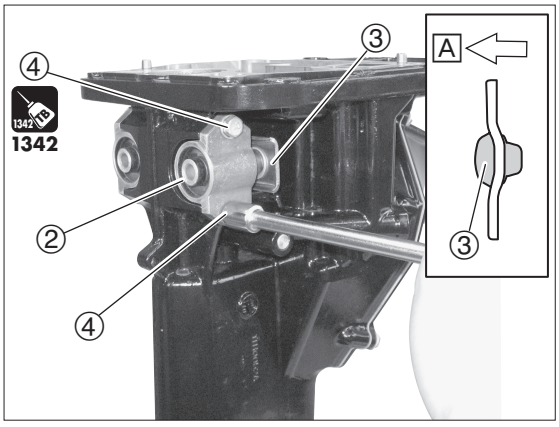


3. Attach the upper rubber mount ② and damper ③ onto the drive shaft housing and tighten the bolts ④.

Install the damper in the illustrated orientation A.

Mount Rubber (Upper) Installation Bolt :
9 N·m (7 lb·ft) [0.9 kgf·m]

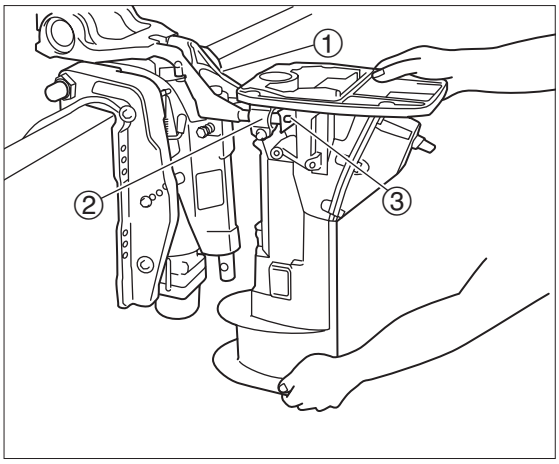
1342



7

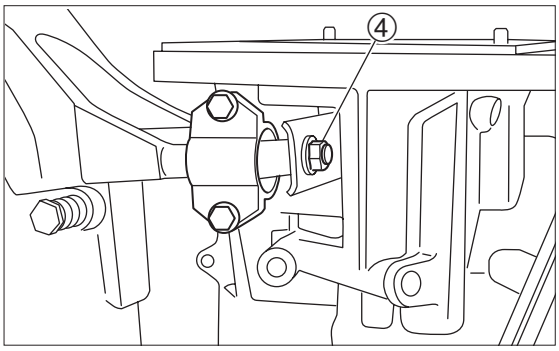
7) Installation of Drive Shaft Housing Assy

1. Insert the drive shaft housing assy into the stud bolt ③ of the upper rubber mount ② of the swivel bracket ①.



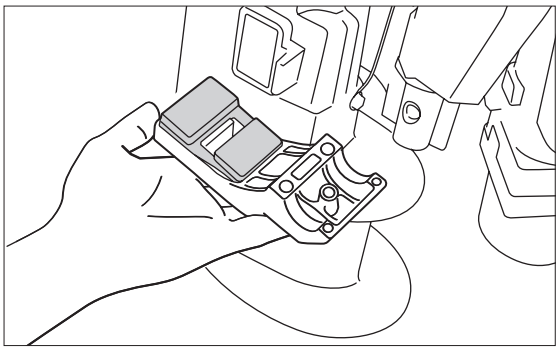
Correctly align the bolt hole position of the damper when installing.

2. Install the rubber mount and lower damper and mount bracket to the drive shaft housing. Tighten the bolt ⑤ and nut ④ to the specified torque.

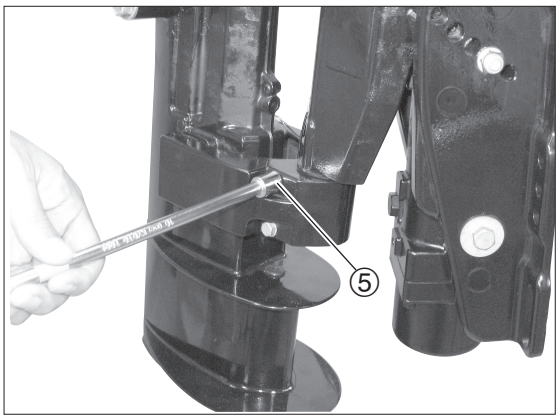


Steering Bracket Nut ④:
M8 13 N· m (9 lb·ft) [1.3 kgf·m]

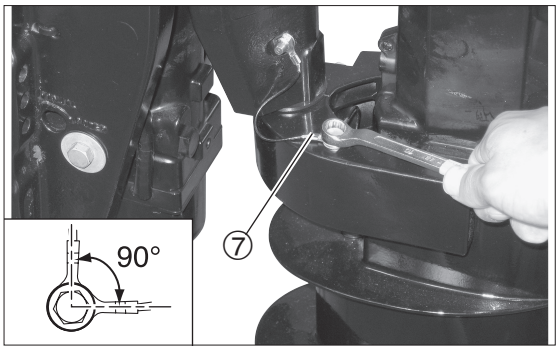
Lower Mount Bolt ⑤:
M6 6 N· m (4 lb·ft) [0.6 kgf·m]



- When installing the lower rubber mount, be careful that the ground lead is not caught by the part.
- The steering shaft has a flange for attachment to the mount bracket. Look for the flange during installation.
- Tighten the lower rubber mount bolts in several steps to 6 N·m.



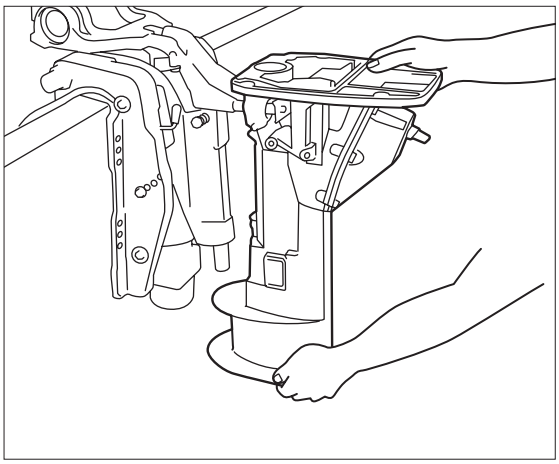
3. Attach the ground wire ⑦.



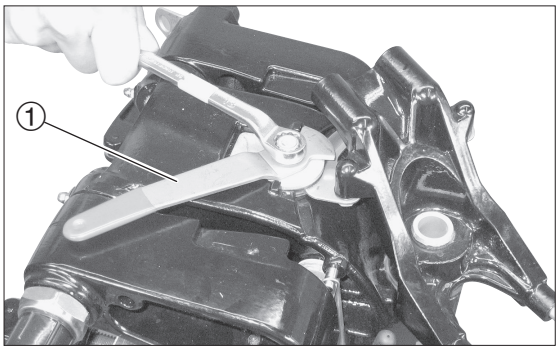
- Be careful not to coat the ground wire attachment surface. Doing so eliminates the anti-corrosion effect.
- If there are two ground wires, separate them by 90° as illustrated.

8) Removal of Steering Shaft

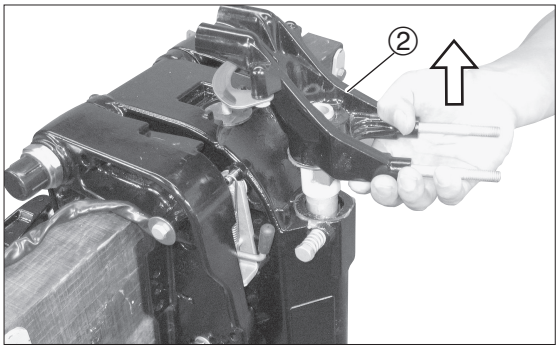
1. Remove the drive shaft housing assy by referring to Chapter 7, "Removal of Drive Shaft Housing."



2. Loosen the co-pilot handle nut, and remove the handle ①. (EFT model)



3. Pull out the steering shaft ② from the swivel bracket assy to remove it.

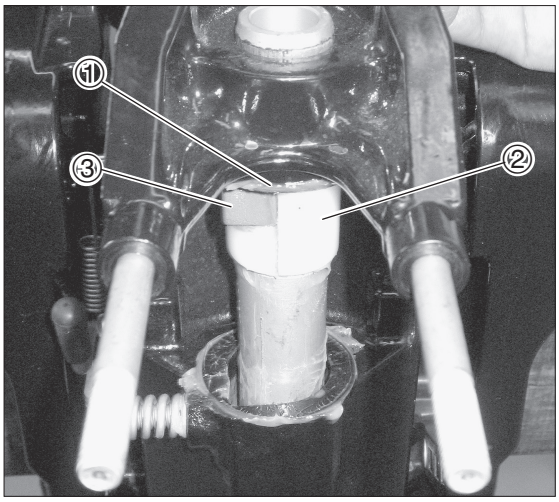


- Loosen the friction bolt.
- Remove the washer and then remove the O-ring and collar from the steering bracket.
- When lifting up the steering shaft, be careful not to lose the friction piece.

4. Check the individual parts.

9) Installation of Steering Shaft

1. Install the thrust plate ①, bushing ②, and friction piece ③ to the steering shaft.

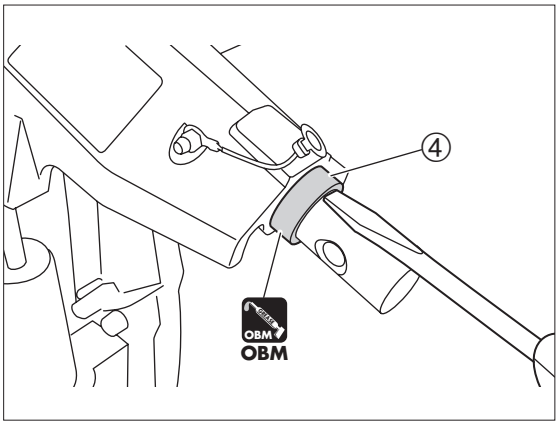


2. Stand the swivel bracket assy vertically, and insert the steering shaft into the swivel bracket assy.

3. Install the bushing ④, new O-ring ⑤, and thrust plate ⑥ to the swivel bracket.

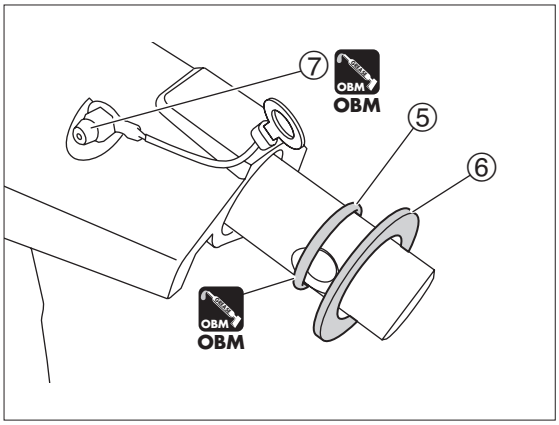
- Push the bushing using a flathead screw driver until it stops.
- Insert the O-ring until it contacts the bushing.

OBM



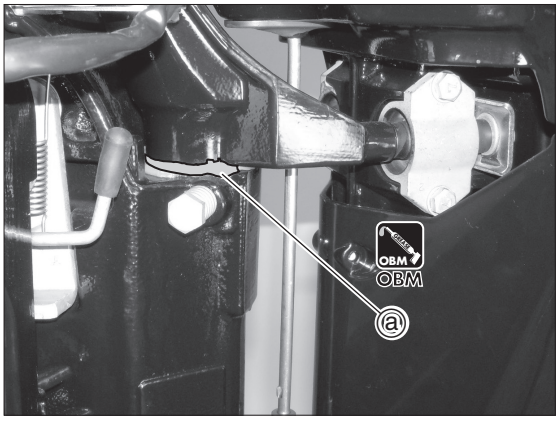
4. Securely insert the bushing and O-ring into the swivel bracket.

OBM

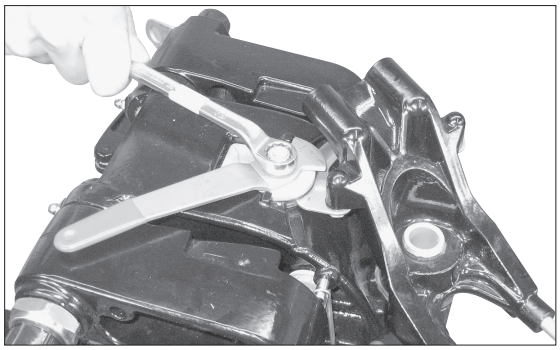


5. Pour OBM grease into the bushing ⓐ through the grease nipple ⑦ until it overflows.

OBM

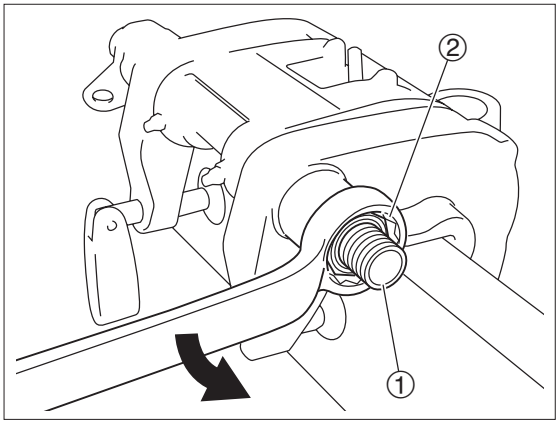


6. Install the co-pilot handle and adjust the co-pilot. (EFT model)

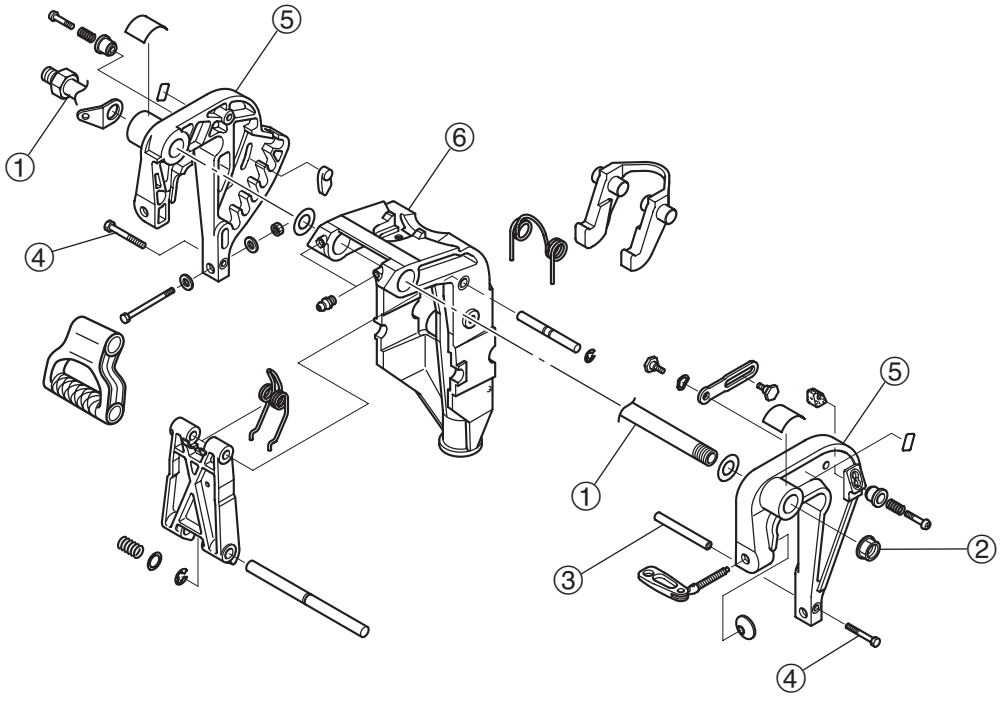


10) Disassembly of Clamp Bracket (EP model)

1. Remove the drive shaft housing, steering shaft, and co-pilot.
2. Loosen the swivel bracket shaft ① and nut ②. Loosen the bolt ④ of the distance piece ③, and remove the bolt ④. Pull out the swivel bracket shaft and remove the clamp brackets ⑤ from the swivel bracket ⑥.



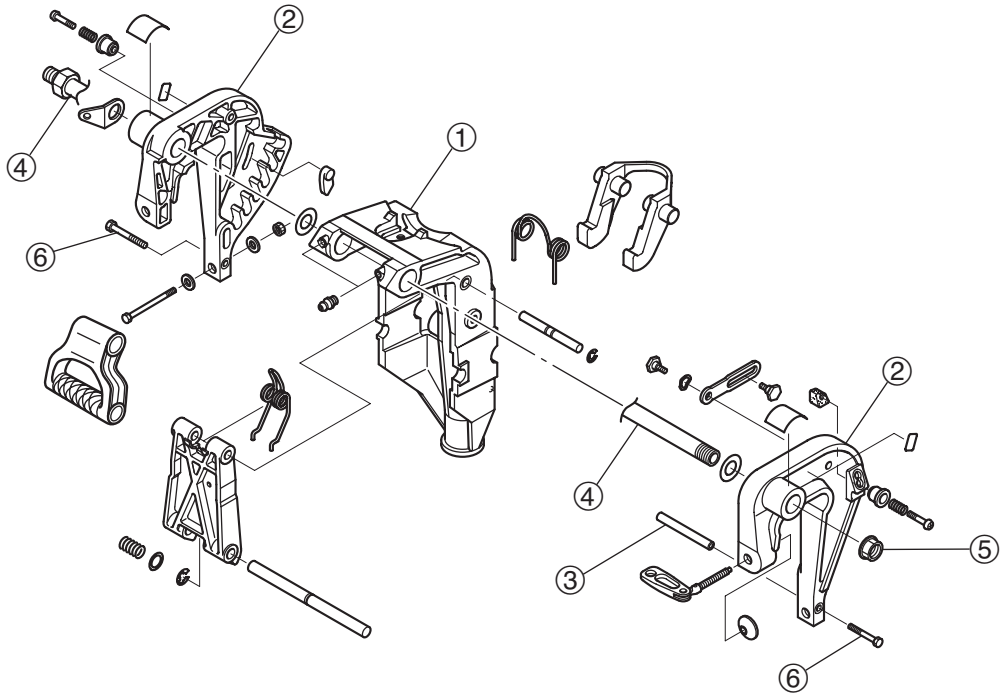
3. Check the swivel bracket shaft and other parts for abnormality, and replace if necessary.



7

11) Installation of Clamp Bracket (EP model)

1.Return the area around the swivel bracket ① to its original state, and insert and install the distance piece ③ into the clamp bracket ②.



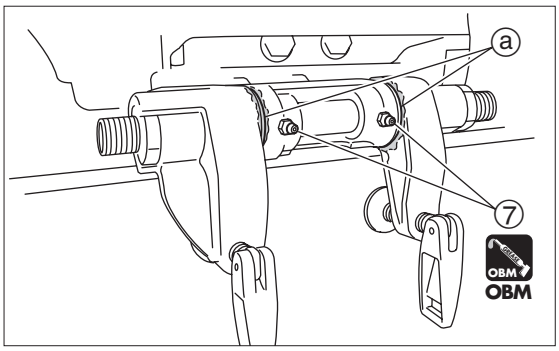
2. Install the clamp brackets onto the swivel bracket, insert the swivel bracket shaft ④, and tighten the nylon nut ⑤ and bolts ⑥ to the specified torque.

Nylon Nut ⑤:
25 N·m (18 lb·ft) [2.5 kgf·m]

Bolt ⑥:
6.0 N·m (4 lb·ft) [0.6 kgf·m]

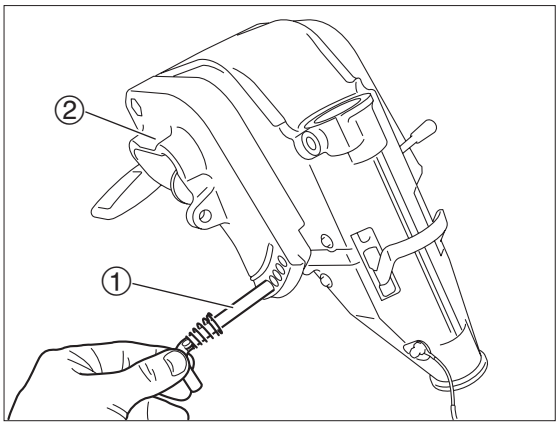
3. Pour grease into the bushings ⓐ through the grease nipples ⑦ until it overflows.

OBM

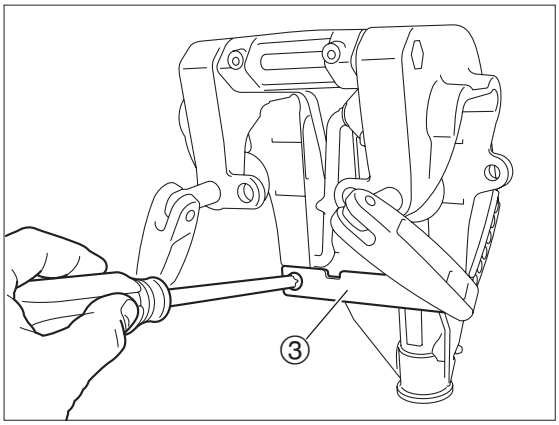


12) Disassembly of Clamp Bracket (MF & EF models)

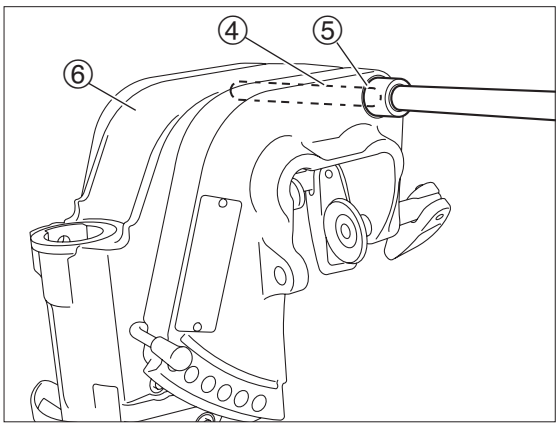
1. Remove the thrust rod ① from the clamp bracket ②.



2. Remove the distance plate ③.

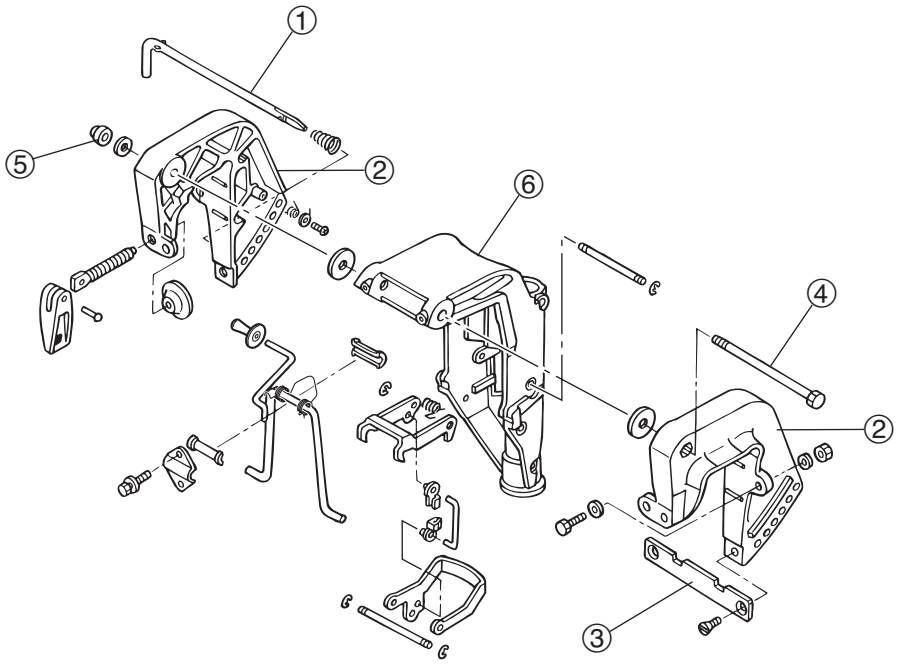


3. Loosen and remove the nut ⑤ of the swivel bracket shaft ④.
   Pull out the swivel bracket shaft and remove the clamp bracket from the swivel bracket ⑥.



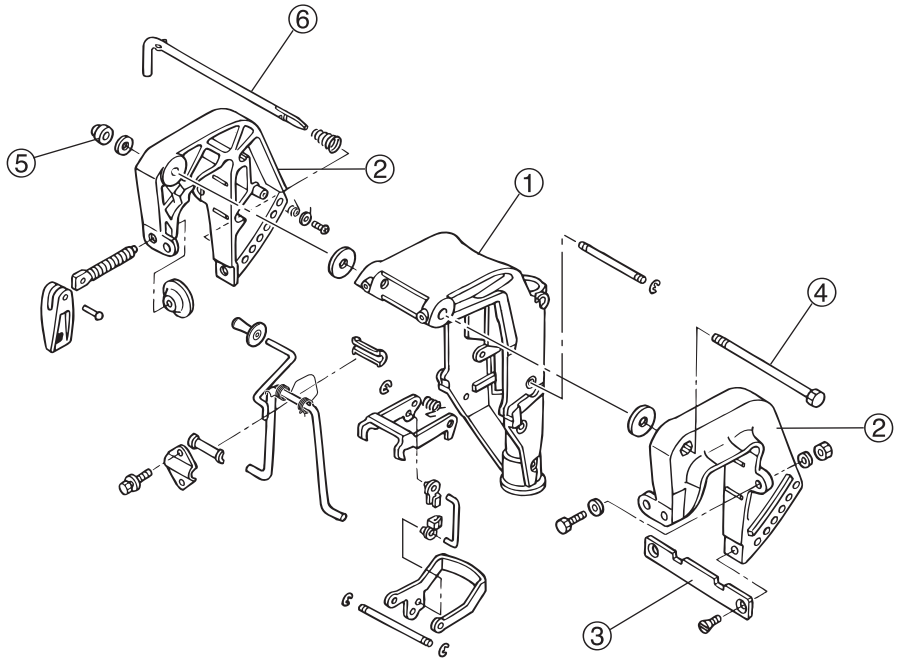
7

4. Check the swivel bracket shaft and other parts for abnormality, and replace if necessary.



13) Installation of Clamp Bracket (MF & EF models)

1.Return the area around the swivel bracket ① to its original state, and install the distance plate ③ in the clamp bracket ②.

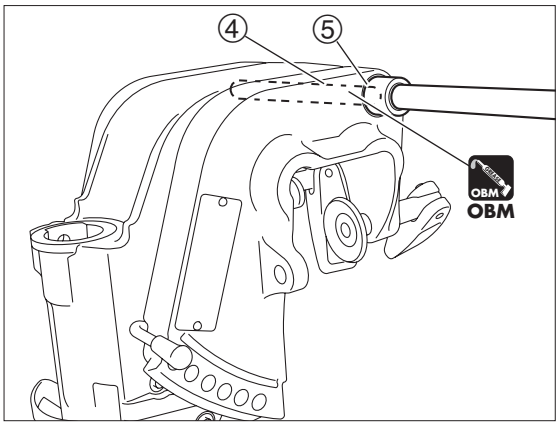


2. Install the clamp brackets onto the swivel bracket, insert the swivel bracket shaft ④, and tighten the nylon nut ⑤ to the specified torque.

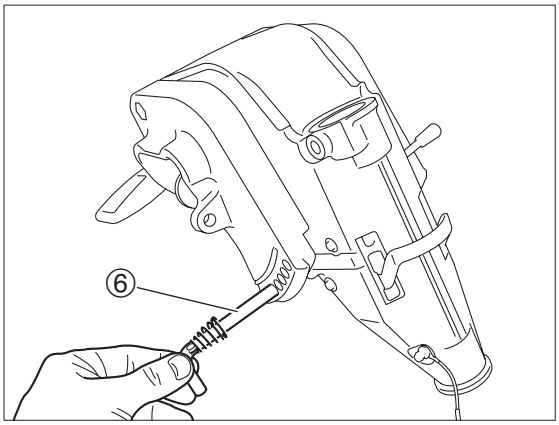
Nylon Nut ⑤:
14 N·m (10 lb·ft) [1.4 kgf·m]

Apply sufficient OBM grease to the swivel bracket shaft.

OBM



3. Install the thrust rod ⑥.

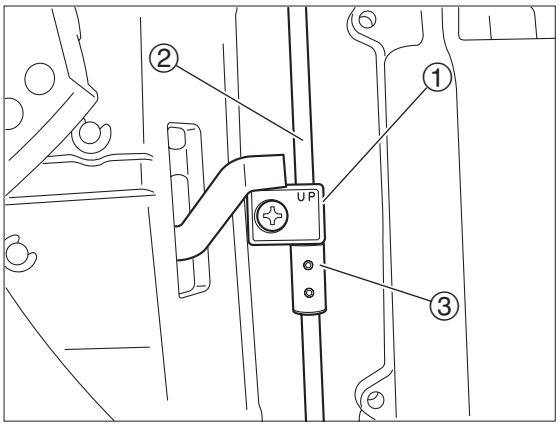


14) Inspection of Reverse Lock (MF & EF & EP models)

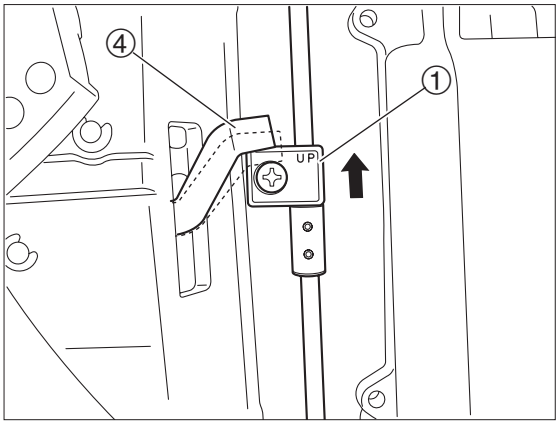
1. Inspect the reverse lock when disassembling and assembling the bracket.

2. Insert the reverse lock link joint ① into the shift rod ② with the UP mark oriented on the upper side.

Secure the reverse lock joint against the shift rod joint ③.

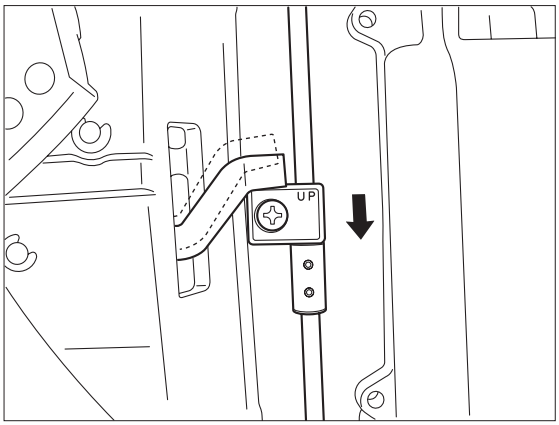


3. Check that the reverse lock link joint ① can push the reverse lock ④ and tilt-up can occur when the shift is in forward (F).



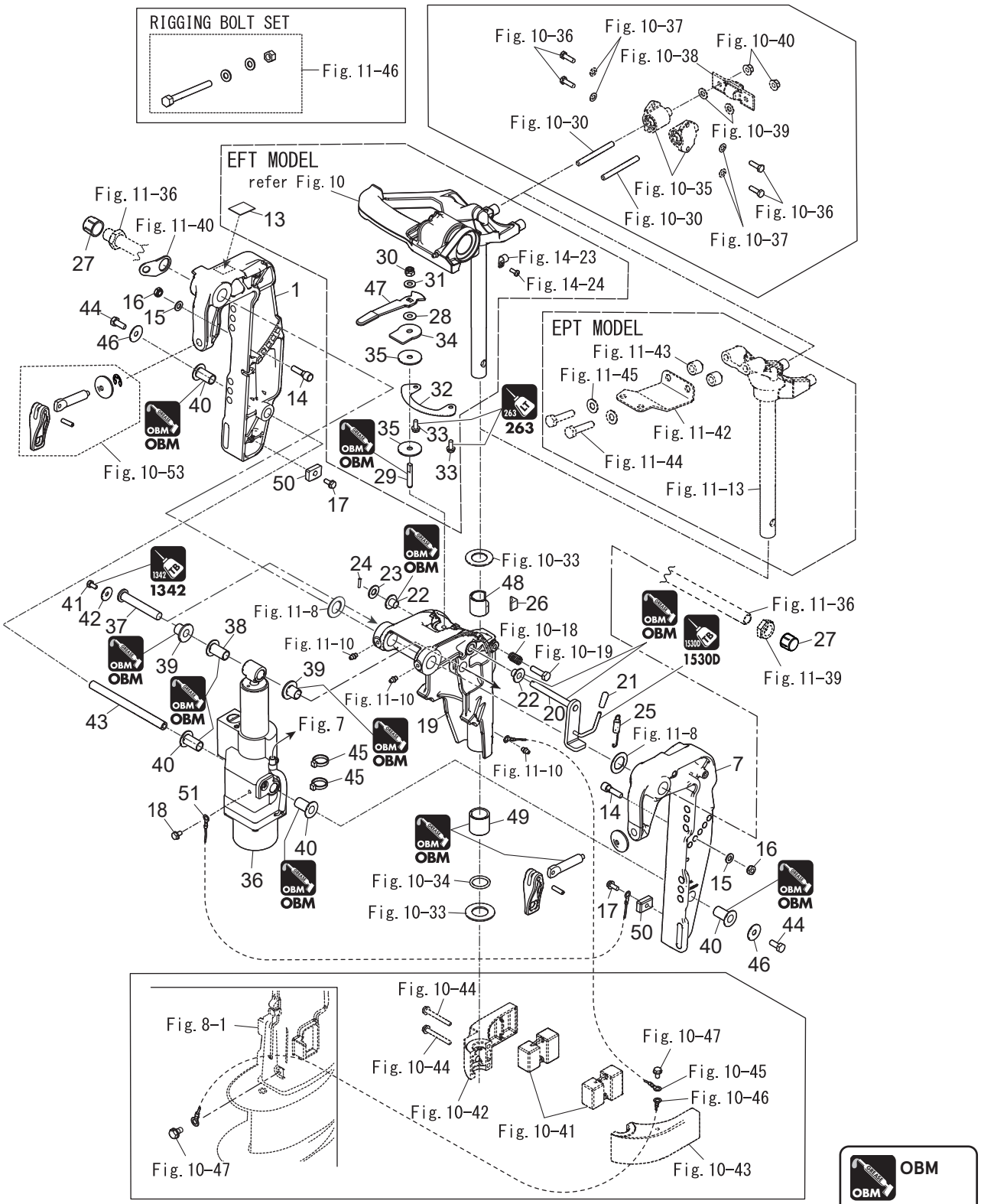
7

4. Check that the reverse lock lowers and tilt-up cannot occur when the shift is in neutral (N) and reverse (R).



3. Parts Layout (PT model)

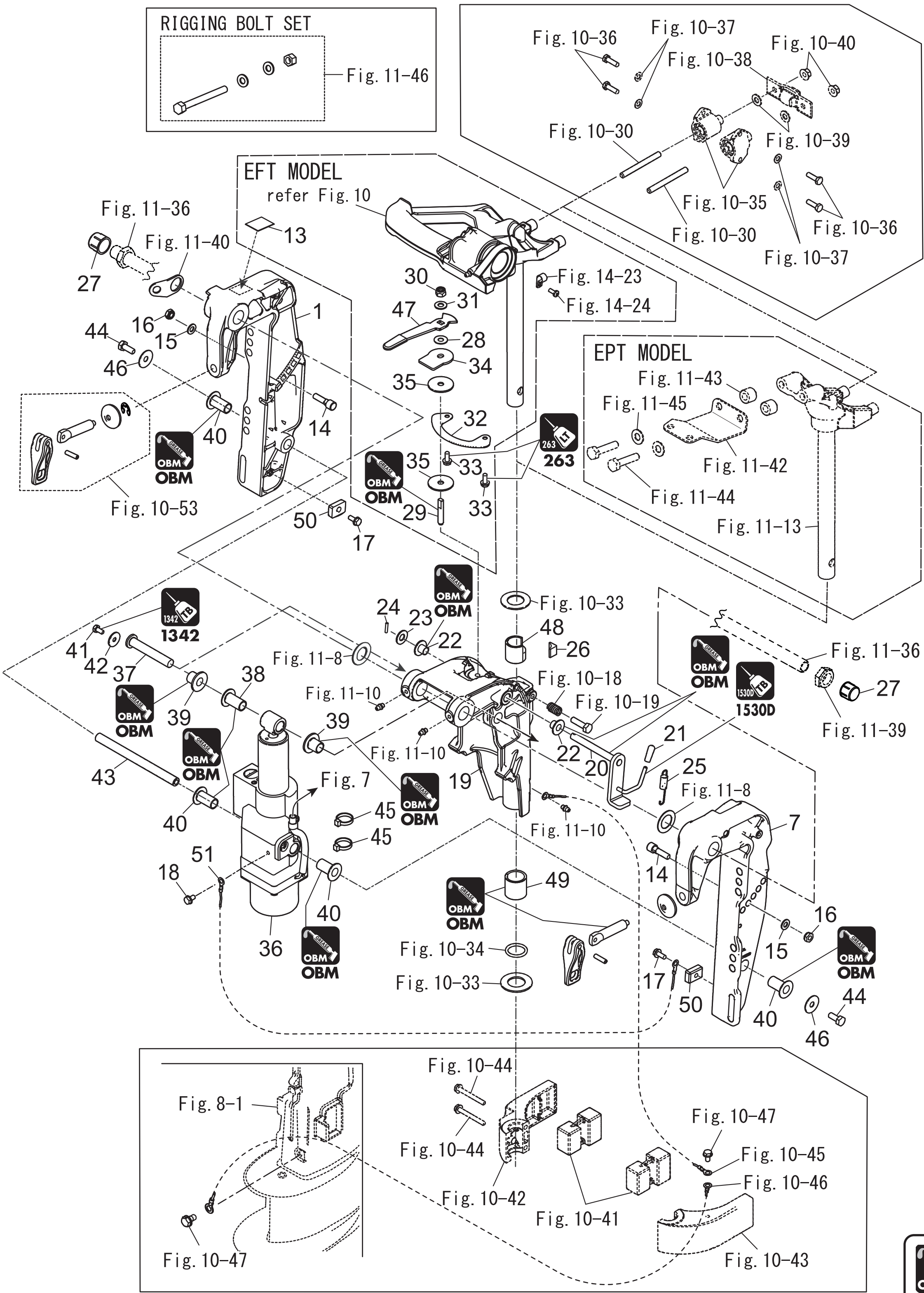
Bracket (EFT & EPT models)



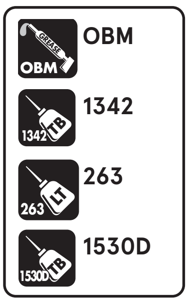
OBM
1342
263
1530D

Ref. No.	Part Name	Q'ty	Remarks
1	Clamp Bracket (PTT-R)	1	EFT EPT
7	Clamp Bracket (PTT-L)	1	EFT EPT
13	Co-Pilot Decal	1	EFT
14	Trim Lock Pin	2	EFT EPT
15	Washer 8.1-16-1.5	2	EFT EPT
16	Nylon Nut 8-P1.25	2	EFT EPT
17	Bolt	2	EFT EPT
18	Bolt	1	EFT EPT
19	Swivel Bracket Assy	1	EFT EPT
20	Tilt Stopper (PTT)	1	EFT EPT
21	Tilt Stopper Grip	1	EFT EPT
22	Collar 10.2-12	2	EFT EPT
23	Washer	1	EFT EPT
24	Spring Pin 3.5-16	1	EFT EPT Do not reuse.
25	Tilt Stopper Spring	1	EFT EPT
26	Friction Piece	1	EFT EPT
27	Bracket Bolt Cap Nut	2	EFT
28	Washer 8.1-20-0.8	1	EFT
29	Co-pilot Bolt	1	EFT
30	Nylon Nut 8-P1.25	1	EFT
31	Washer	1	EFT
32	Co-pilot Plate	1	EFT
33	Bolt	2	EFT
34	Co-pilot Washer	1	EFT
35	Co-pilot Disc 8.5-38-2	2	EFT
36	PT Assy	1	EFT EPT
37	Cylinder Pin (Upper)	1	EFT EPT
38	Bushing 13-16-31	1	EFT EPT
39	Bushing	2	EFT EPT
40	Bushing 13-16-31	4	EFT EPT

Bracket



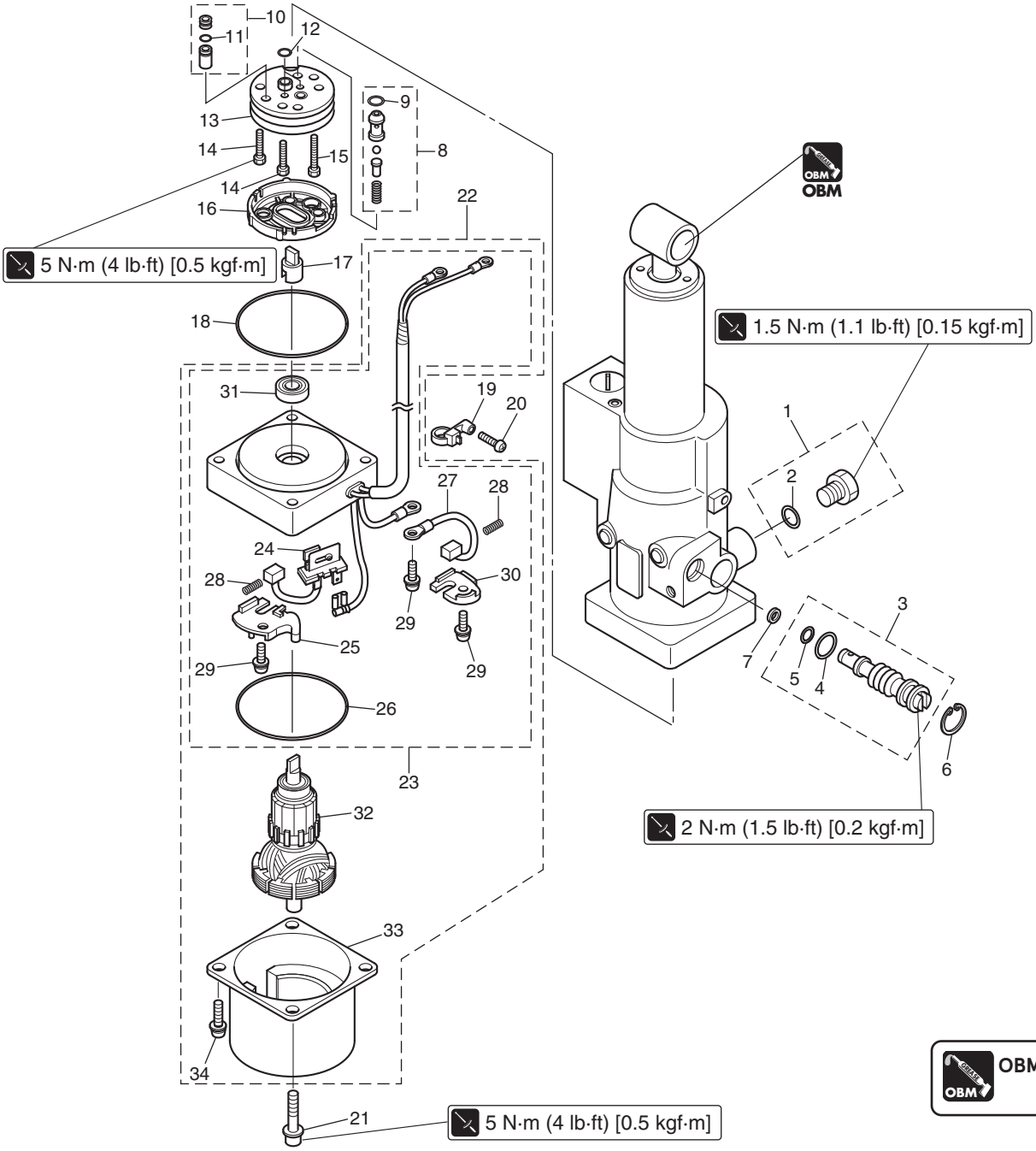
RIGGING BOLT SET
Fig. 11-46
Fig. 10-36
Fig. 10-37
Fig. 10-38
Fig. 10-40
Fig. 10-30
Fig. 10-39
Fig. 10-35
Fig. 10-30
Fig. 10-36
Fig. 10-37
EFT MODEL
refer Fig. 10
Fig. 11-36
Fig. 11-40
13
27
30
31
Fig. 14-23
Fig. 14-24
47
1
28
44
16
15
34
46
35
EPT MODEL
Fig. 11-43
Fig. 11-45
32
14
40
263
35
33
Fig. 11-42
OBM
Fig. 11-44
Fig. 10-53
29
33
50
Fig. 11-13
17
Fig. 10-33
24
23
22
48
26
1342
41
42
37
Fig. 11-8
Fig. 10-18
Fig. 11-36
38
Fig. 11-10
Fig. 10-19
27
1530D
39
39
Fig. 11-39
21
Fig. 11-10
22
43
20
25
Fig. 7
19
Fig. 11-8
45
40
45
Fig. 11-10
7
51
14
18
49
16
40
15
36
Fig. 10-34
Fig. 10-33
17
50
44
40
46
Fig. 10-44
Fig. 8-1
Fig. 10-47
Fig. 10-44
Fig. 10-45
Fig. 10-46
Fig. 10-42
Fig. 10-41
Fig. 10-47
Fig. 10-43



OBM
1342
263
1530D

Ref. No.	Part Name	Q'ty	Remarks
41	Bolt	1	EFT EPT
42	Washer 6.5-23-1.5	1	EFT EPT
43	Cylinder Pin (Lower)	1	EFT EPT
44	Bolt	2	EFT EPT
45	Lead Wire Band 203	2	EFT EPT Do not reuse.
46	Washer 8.5-28-1	2	EFT EPT
47	Friction Lever	1	EFT
48	Bushing 24-30-30	1	EFT EPT
49	Bushing 24-30-30	1	EFT EPT
50	Anode	2	EFT EPT
51	Ground L = 130	1	EFT EPT

Power Tilt Assy



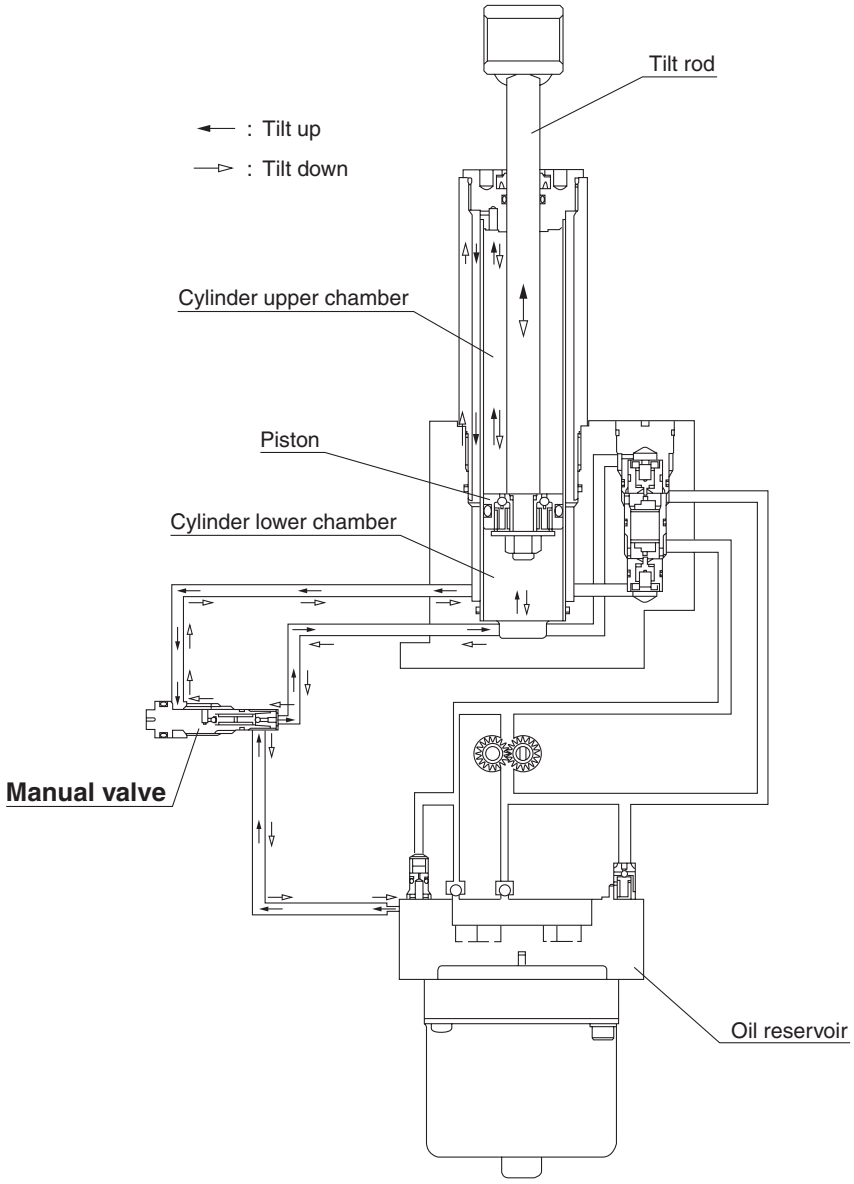
Ref. No.	Part Name	Q'ty	Remarks
1	Cap Assy	1	
2	O-ring	1	Do not reuse.
3	Manual Valve Assy	1	
4	O-ring 2.4-9.8	1	Do not reuse.
5	O-ring	1	Do not reuse.
6	C-ring	1	
7	Seal Washer	1	
8	Relief Valve Assy	1	
9	O-ring	1	Do not reuse.
10	Valve Assy	1	
11	O-ring 1.5-3.5	1	Do not reuse.
12	O-ring	2	Do not reuse.
13	Pump	1	
14	Bolt	2	
15	Bolt	1	
16	Filter	1	
17	Pump Coupling	1	

Ref. No.	Part Name	Q'ty	Remarks
18	O-ring 2-62.5	1	Do not reuse.
19	Band	1	
20	Pre-coated Screw	1	
21	Bolt	2	
22	Motor Assy	1	
23	Motor Bracket Assy	1	
24	Breaker	1	
25	Breaker Holder	1	
26	O-ring	1	Do not reuse.
27	Brush	1	
28	Brush Spring	2	
29	Screw	3	
30	Brush Holder	1	
31	Oil Seal	1	
32	Armature Assy	1	
33	Yoke Assy	1	
34	Screw	2	

4. Power Tilt Functions

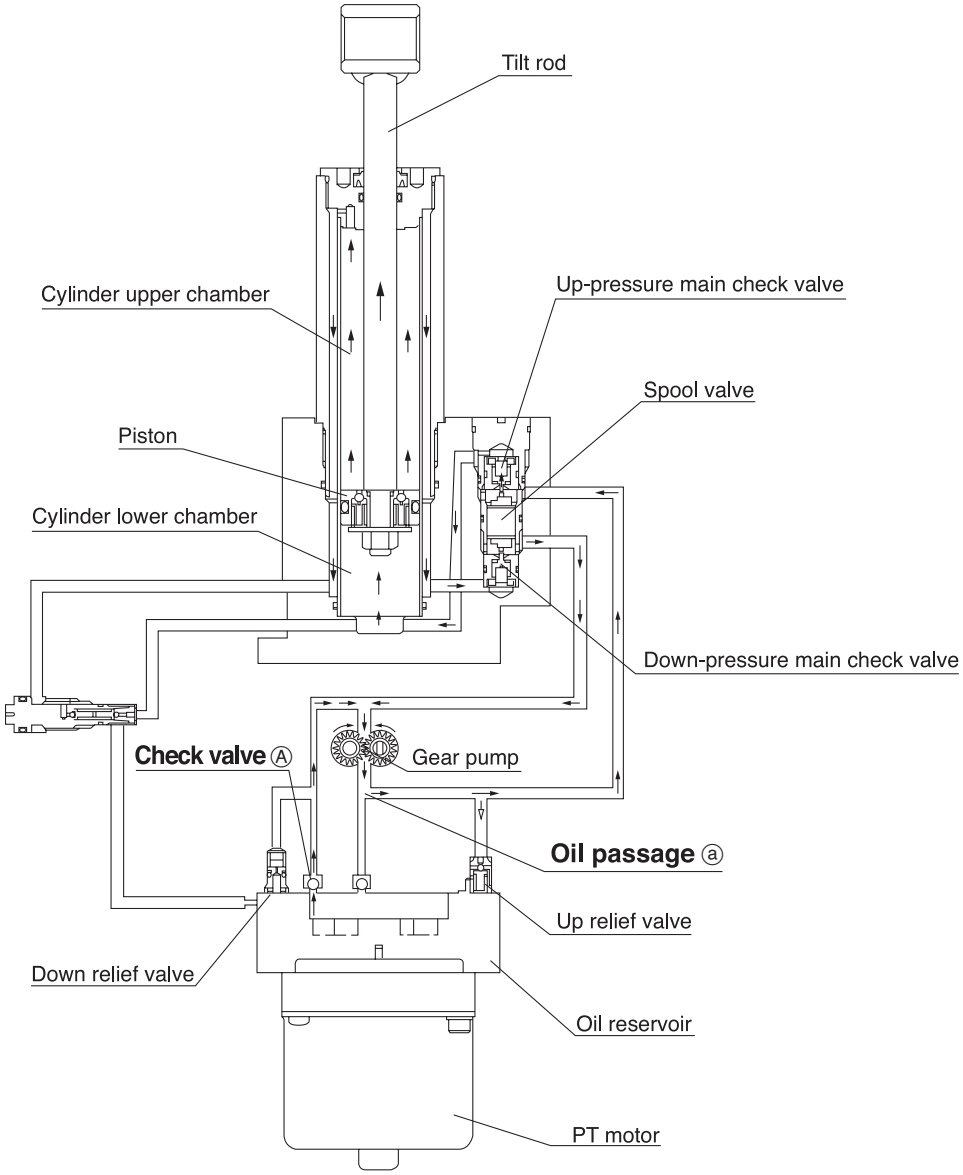
- The power tilt system has an electric motor built into the system that drives the hydraulic pump to feed pressurized oil into the tilt cylinder.
- The power tilt switch located on the tiller handle or remote control box is used to tilt up or down the outboard motor.

5. Operations of Hydraulic Circuit



Manual Tilt Operation

Turning the manual valve counterclockwise 2 to 3 times opens the manual operation circuit.
The outboard motor can now be tilted up or down easily by hand.
When the manual operation circuit is fully closed by turning the manual valve clockwise before the outboard motor reaches the fully tilted up or down position, the outboard motor holds the tilt position at that time.



Tilt Up Operation

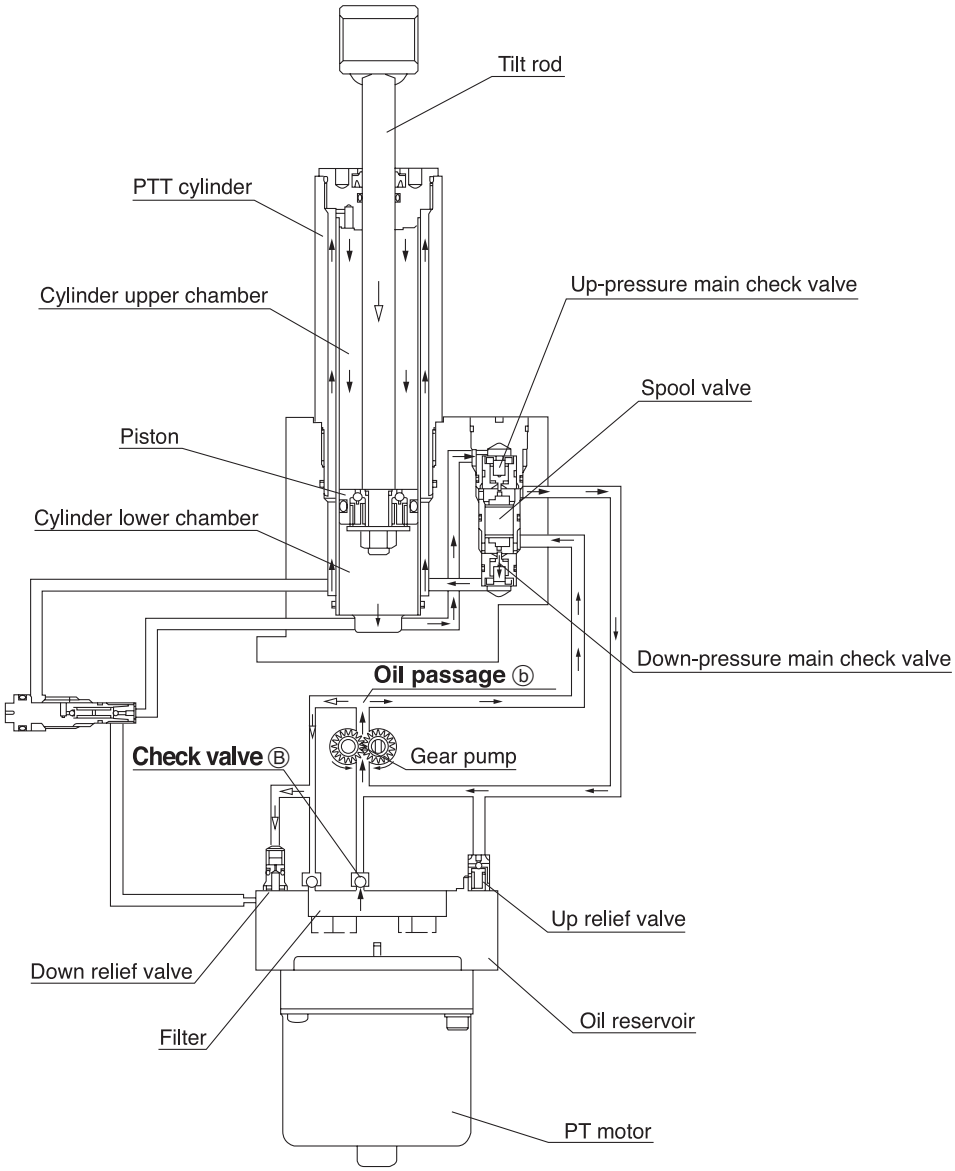
Pressing the "UP" side of the PT switch rotates the motor (gear of gear pump) rightward.

The check valve A opens, and oil flows from the reservoir toward the gear pump and spool valve. This oil flow shifts the spool valve downward, opening the down-pressure main check valve. The oil in the cylinder upper chamber returns to the gear pump, and the oil pressure of the oil passage a further increases, opening the up-pressure main check valve. The oil then flows into the cylinder lower chamber. As a result, the piston rod is pushed up, tilting up the outboard motor. The oil in the cylinder upper chamber returns to the gear pump through the down-pressure main check valve.

Due to the difference in capacity between the upper and lower chambers of the cylinder (the piston rod is on the upper chamber side), oil flows from the reservoir through the check valve A and to the pump to make up for the shortage of oil.

When the motor stops, the down/up-pressure main check valve closes, and the spool valve moves to the center. As a result, the piston rod is held at any desired position.

When the tilt rod fully extends, the hydraulic pressure in the cylinder lower chamber further rises, but the up relief valve opens, releasing pressure into the reservoir, protecting the PT unit.



Tilt Down Operation

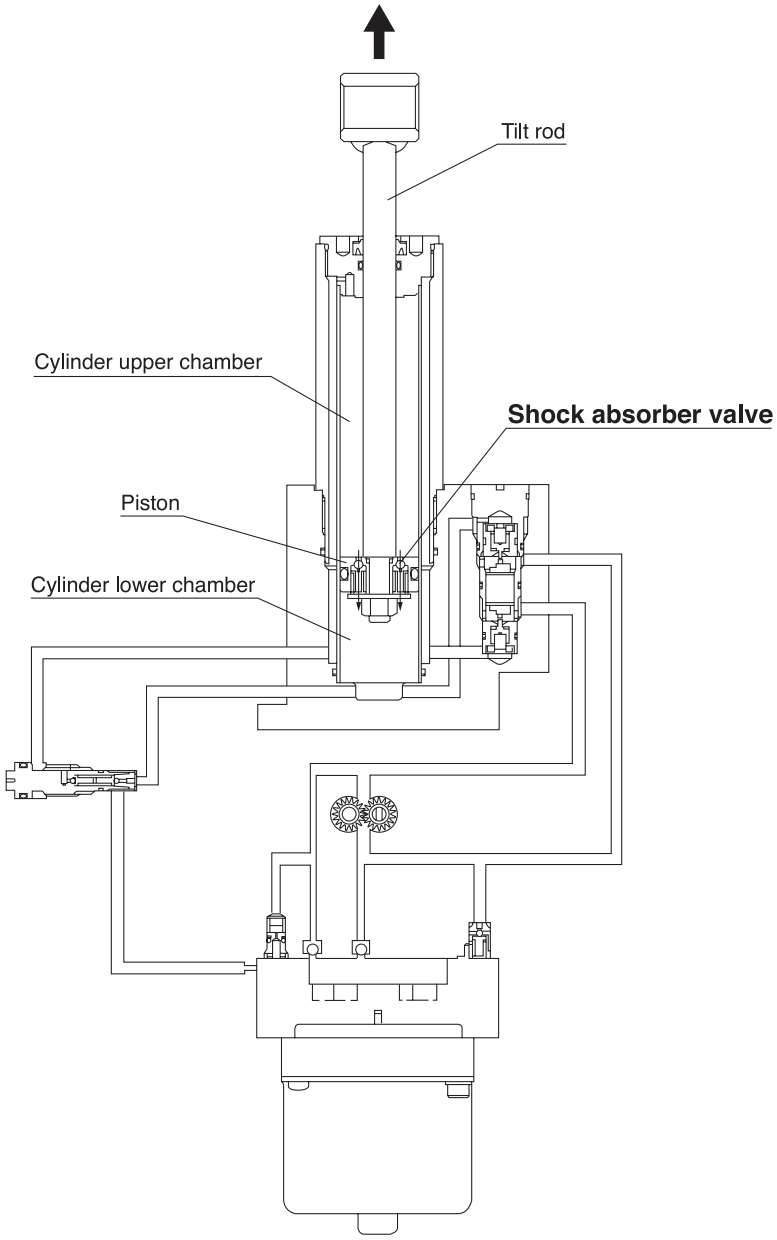
Pressing the "DOWN" side of the PT switch rotates the motor (gear pump) leftward.

The check valve B opens, and oil flows from the reservoir toward the gear pump and spool valve. This oil flow shifts the spool valve upward to open the up-pressure main check valve. The oil in the cylinder lower chamber returns to the gear pump, and the oil pressure of the oil passage b further increases, opening the down-pressure main check valve. The oil then flows into the cylinder upper chamber. As a result, the piston rod is pushed down, tilting down the outboard motor.

The oil in the cylinder lower chamber returns to the gear pump through the up-pressure main check valve.

Because of the capacity difference between the cylinder upper chamber and lower chamber, the amount of oil exceeding that required by the upper chamber returns to the gear pump, and the excess oil flows into the reservoir through the down relief valve.

When the piston rod is fully drawn inward, all of the oil discharged from the pump returns from the down relief valve to the reservoir.

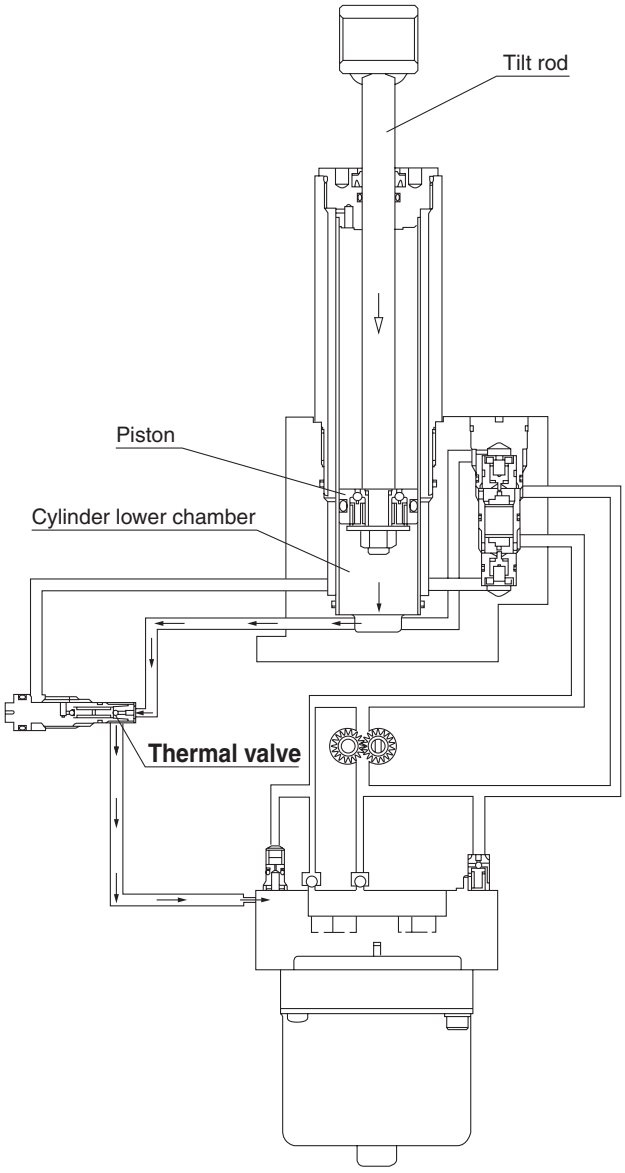


Shock Absorber Valve

The PT unit is provided with a shock absorber that protects the drive unit from impact in the event the drive unit hits an underwater obstacle during cruising.

When the drive unit hits an underwater obstacle, the hydraulic pressure in the cylinder upper chamber is abruptly increased. This high pressure opens the shock valve of the piston.

When the shock valve opens, oil in the cylinder upper chamber flows into the cylinder lower chamber, extending the tilt rod upward to absorb the shock.



Thermal Valve

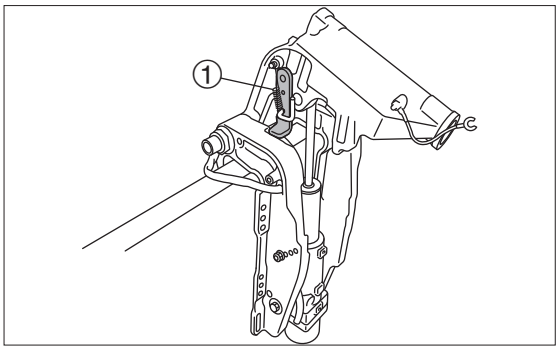
The thermal valve protects the drive unit from excessive force that attempts to push down the tilt rod when the outboard motor is in the full tilt-up position.

When excessive force is applied, the piston rod is pressed into the cylinder, increasing the hydraulic pressure in the cylinder lower chamber over a rated value.

This increased hydraulic pressure reaches the thermal valve, opening the valve, and is thus dissipated.

6. Removal of PT Unit

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

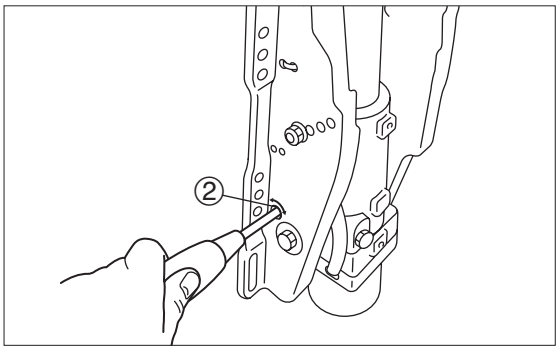


⚠ WARNING

- **As the hydraulic pressure of the PT unit lowers, the outboard motor may suddenly fall, which is dangerous. Be sure to support the outboard motor with a stopper when tilting the motor up.**
- **When removing and installing the PT unit without removing the power unit, suspend and support the outboard motor with a hoist. Failure to do so may result in the outboard motor falling, which is dangerous.**

⚠ CAUTION

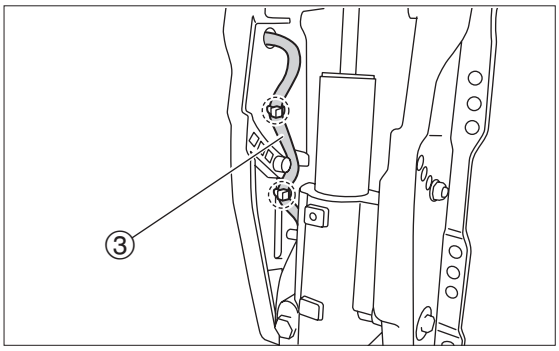
Do not tighten the manual valve with the outboard motor tilted up in the middle position. The manual valve may be damaged.

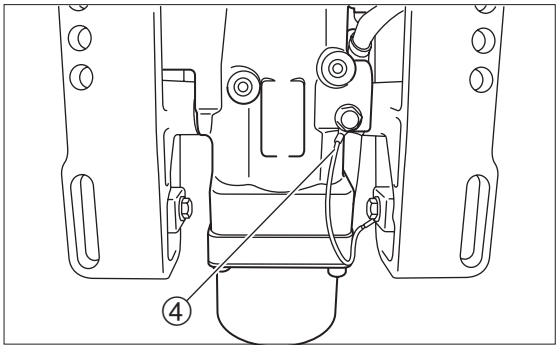


If the PT unit will not operate, open the manual valve and lift up the outboard motor by hand. When the manual valve is loose, tighten it to the specified torque after tilting up the outboard motor.

Manual Valve ②:
2 N·m (1.5 lb·ft) [0.2 kgf·m]

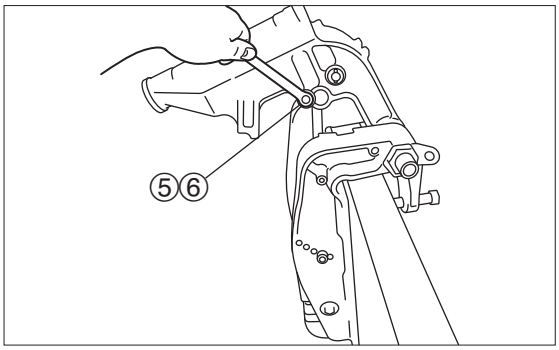
2. Remove the PT cable ③ from the PT solenoid, and remove the ground cord ④ from the PT.

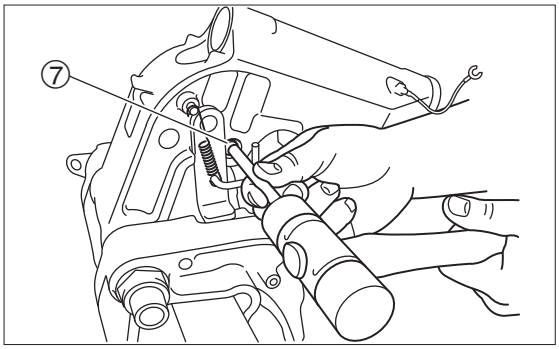




3. Remove the bolt ⑤ and washer ⑥ on the starboard side, and remove the upper cylinder pin ⑦.

The upper cylinder pin can be removed easily when the tilt rod is retracted a little by performing the tilt down operation.

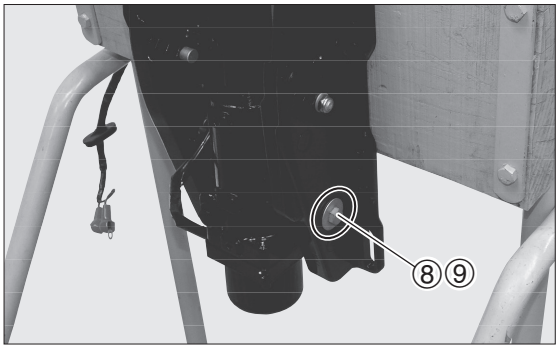


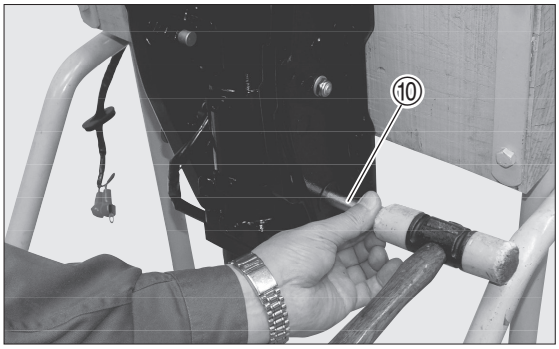


4. Remove the cap, loosen the port side bracket nylon nut and clamp screw, and create bracket clearance.

5. Remove the bolt ⑧ and washer ⑨ and remove the the lower cylinder pin using an appropriate pin punch ⑩.

- Be careful not to drop the PT assembly.
- Expand the port side clamp slowly, by pressing with a plastic hammer handle or the like, until enough clearance is formed for easy PT assembly removal.

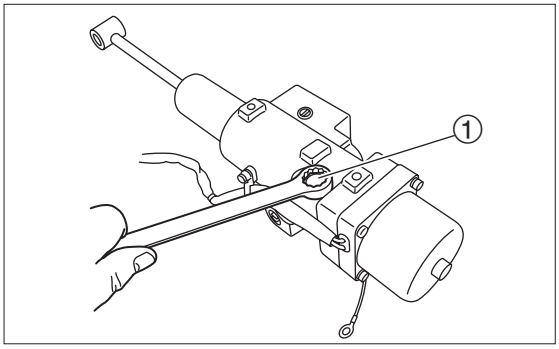




7

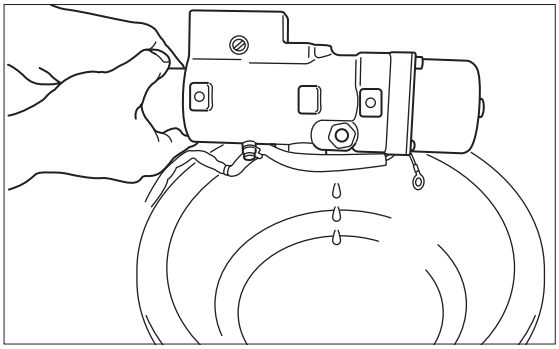
7. Removal and Inspection of Manual Valve

1. Slowly loosen and remove the PT fill cap ①.

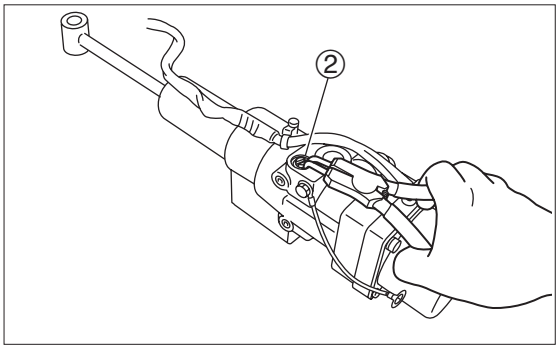


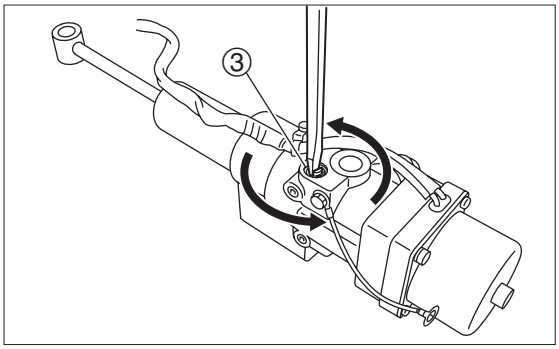
> Fully extend the tilt rod before removing the fill cap.

2. Drain the PT fluid from the filler cap outlet.



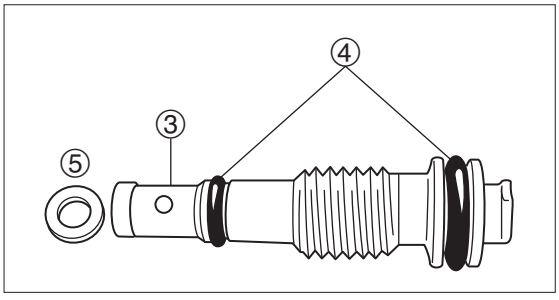
3. Remove the manual valve C-clip ②, and turn the manual valve ③ counterclockwise for removal.





4. Remove the O-rings (two locations) ④ from the manual valve ③, and check the O-rings for damage and deterioration. If necessary, replace the O-rings with new ones.

5. Remove the seal washer ⑤ and, if necessary, replace with a new one.

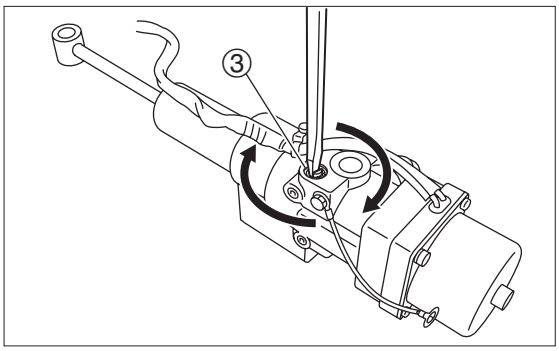


③ Manual Valve
④ O-ring
⑤ Seal Washer

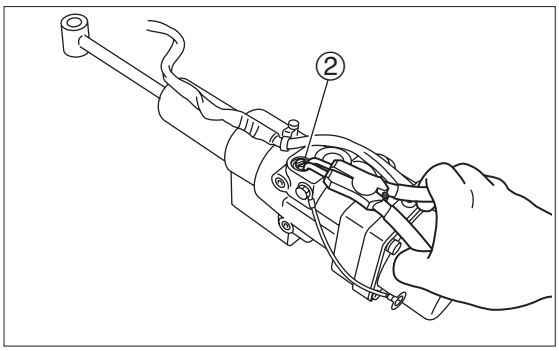
> When installing a new O-ring to the PT assembly, apply new PT fluid prior to installation.

6. Install two O-rings (two locations) ④ in the manual valve.

7. Install the manual valve ③ in the PT assy.



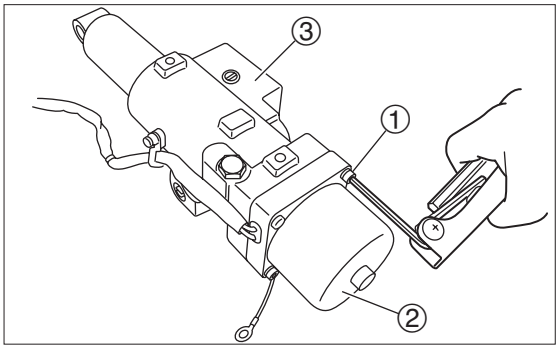
8. Install the C-ring ②.



8. PT Motor

1) Removal, Inspection, and Repair of PT Motor

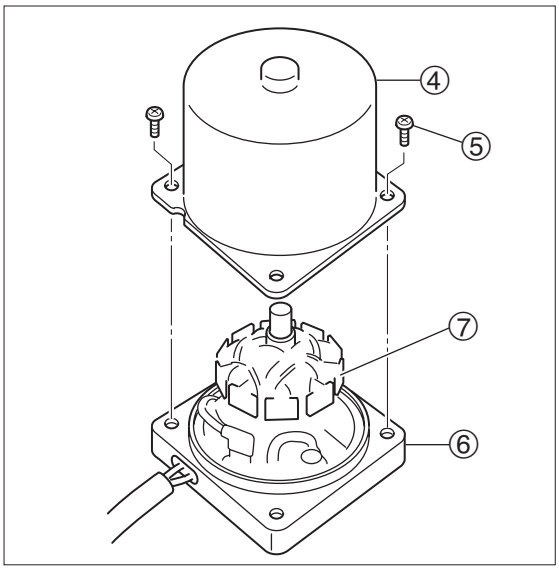
1. Remove two inner hex bolts ①, and remove the motor assy ② from the PT pump and cylinder assy ②.



Before disassembling the PT motor, drain the PT fluid. <Refer to section 7.>

2. Remove the two screws ⑤, and remove the yoke assy ④ from the motor bracket assy ④.

3. Remove the armature assy ⑦ from the yoke assy ④.



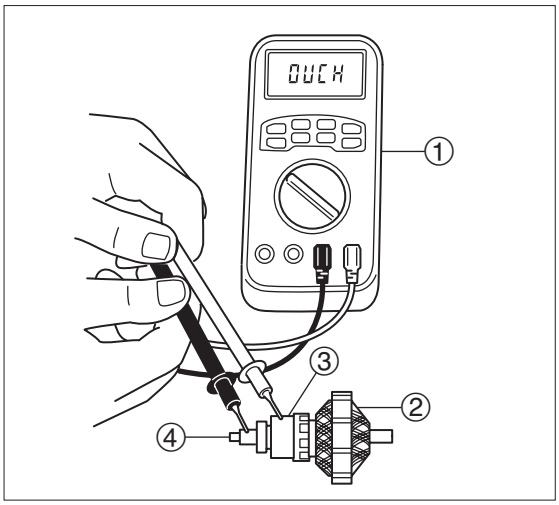
④ Yoke Assy
⑤ Screw
⑥ Motor Bracket
④ Armature Assy

7

2) Continuity Test

1. Check the conductivity of the armature ②. Replace the armature assy if the conductivity is other than the specification.

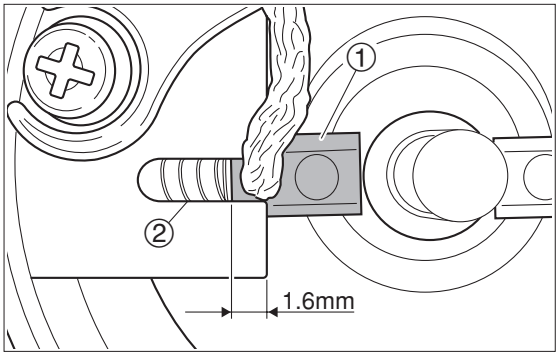
Armature Conductivity: ③ Commutator ④ Armature shaft	Non-conductive



① Meter
② Armature
③ Commutator
④ Armature Assy

3) Inspection of Motor

1. Replace the brush ① if the brush is damaged or if the distance to the brush end portion is 1.6 mm or less in the groove of the brush holder ②.

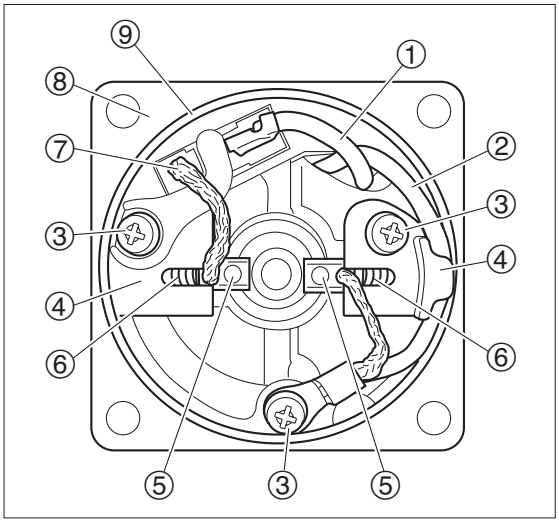


4) Replacement of Motor

1. Remove the three screws ③, and remove the brush ⑤ and the breaker ⑦ from the motor bracket ⑧.

2. Remove the breaker ⑦.

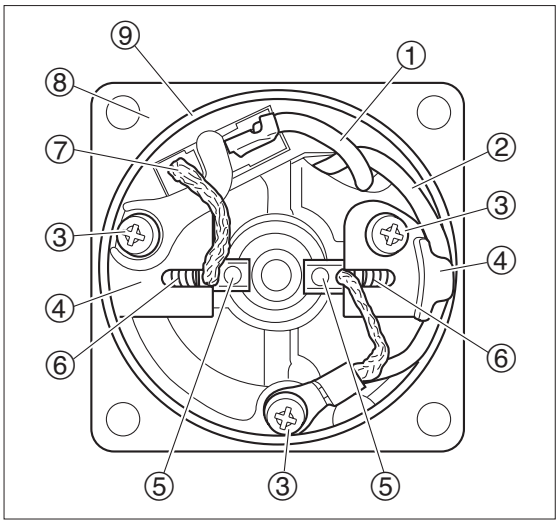
3. Remove the brush holder ④ and the brush ⑤.



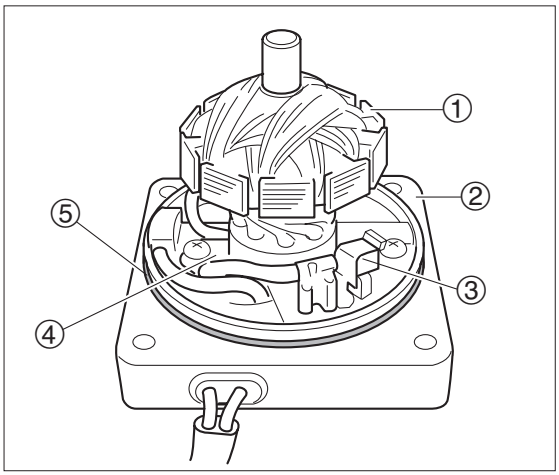
① Wire (blue)
② Wire (green)
③ Screw
④ Brush Holder
⑤ Brush
⑥ Spring
⑦ Breaker
⑧ Motor Bracket
⑨ O-ring

5) Assembly of PT Motor

1. Attach the breaker ⑦ to the motor bracket ⑧.
2. Attach the circuit breaker holder securely using screws.
3. Attach the blue wire ① to the terminal post of the breaker ⑦.
4. Arrange the green wire ② along the inner diameter area of the bracket.
5. Attach the brush holder ④ securely using the screws ③.
6. Attach the green wire ② and the end portion of the brush wire securely to the motor bracket ⑧ using the screw ③.
7. Attach the two springs ⑥ in the brush.
8. Attach the breaker ⑦ and the brush ⑤ in the groove.
9. While attaching the armature ① to the motor bracket ②, attach the armature ① while holding the brush ③ in the groove.
10. Attach the O-ring ⑤ to the motor bracket ②.



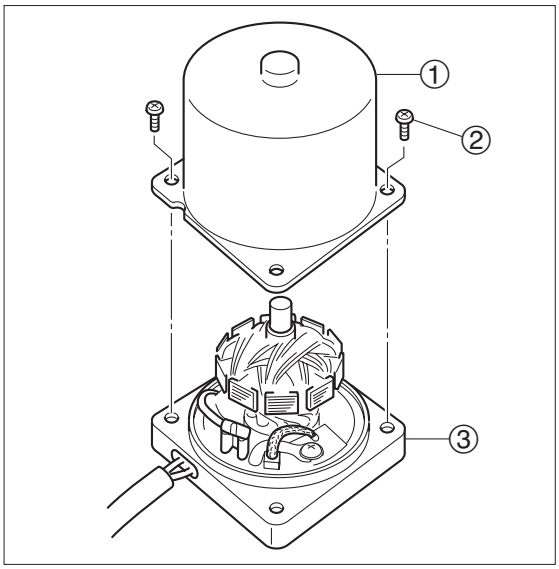
① Wire (blue)
② Wire (green)
③ Screw
④ Brush Holder
⑤ Brush
⑥ Spring
⑦ Breaker
⑧ Motor Bracket
⑨ O-ring



① Armature
② Motor Bracket
③ Brush
④ Brush
⑤ O-ring

7

11. Attach the yoke assy ① securely using the the two screws ②.



① Yoke Assy
② Screw (2)
③ Motor Bracket

9. PT Pump

1) Disassembly of PT Pump

⚠ WARNING

Contamination of the hydraulic system can result in damage to the components and circuits, possibly resulting in serious damage to the product.
Do not use rags or the like for inspecting and servicing parts.
Doing so may cause the hydraulic circuit to be clogged.
Remove the oil feed plug before beginning the work.
Keep the parts individually in plastic bags during disassembly.

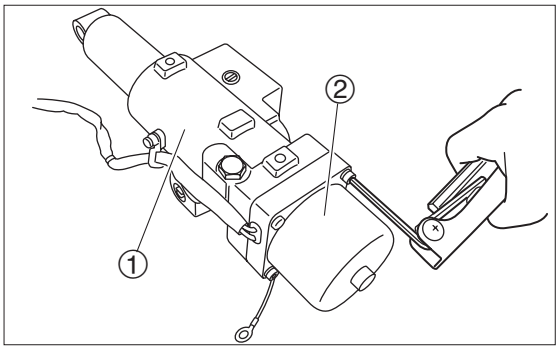
1. Remove PT ass'y from outboard motor.

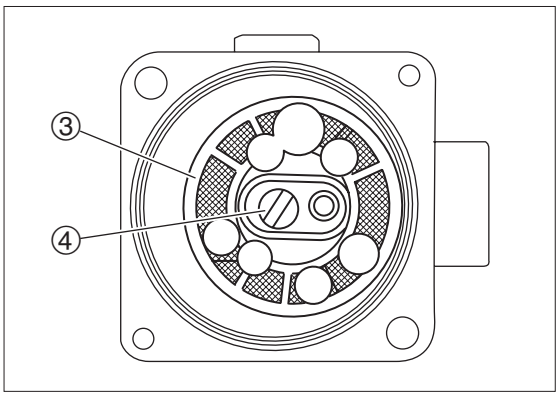
2. Remove the PT motor assy ② from the PT assy ①.

3. Remove the pump coupling ④.

4. Remove the filter ③ from the PT assy.

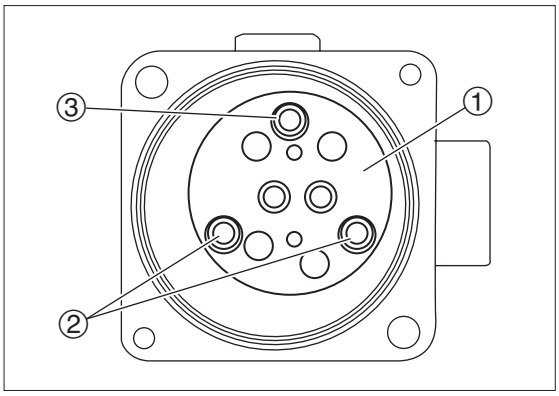
The relief valve assy is located in the PT pump. When removing the pump, be careful not to lose its parts.





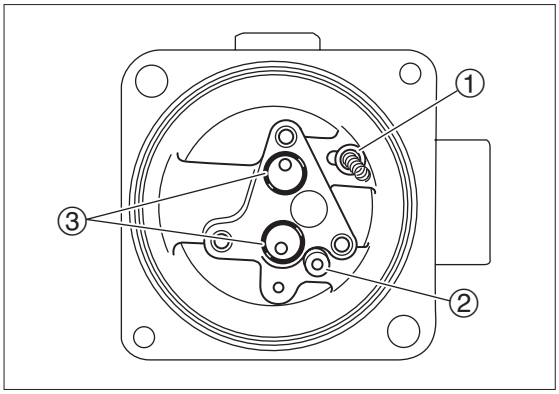
③ Filter
④ Pump/Motor Coupling

5. Remove the three screws ② and ③ holding the PT pump ① and the assembly together.



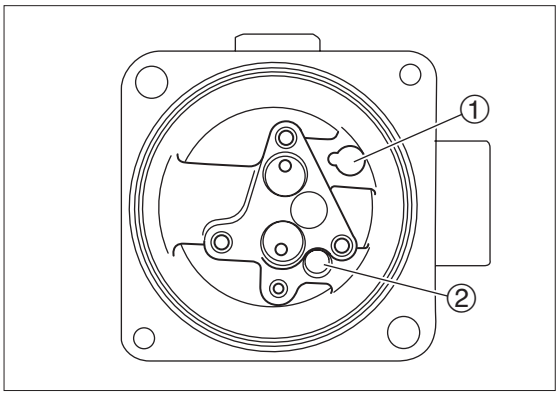
① PT Pump
② Internal Hex Screw (5 mm × 20)
③ Internal Hex Screw (5 mm × 25)

6. Remove the up-side relief valve ①, down-side relief orifice ②, and then the O-ring ③ from the PT housing.



① Up Relief Valve Component
② Down Relief Orifice
③ O-ring

7. Inspect the down-side orifice screen ② and up-side relief valve seat surface ①. Replace parts if necessary.



① Up Relief Valve Seat
② Down Orifice Screen

2) Assembly of PT Pump

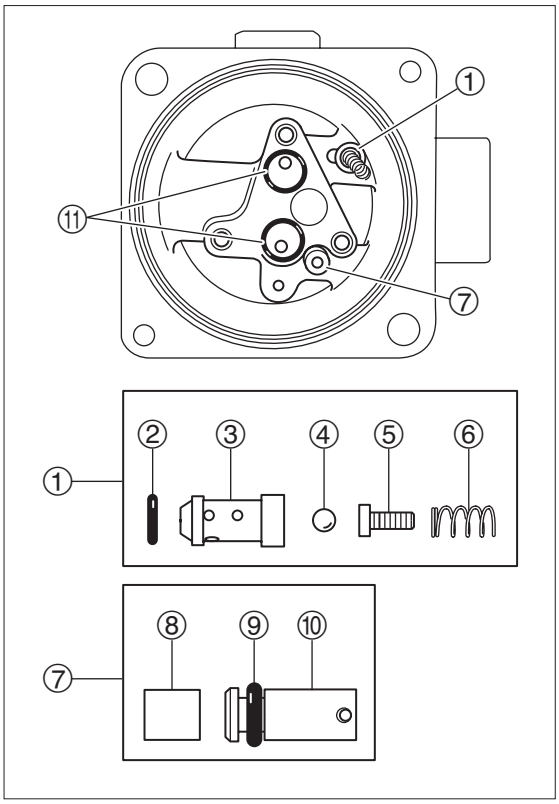
1. Apply oil to the new O-rings (two locations) ⑪ and attach them in the PT housing.

2. Apply oil to the new O-ring ⑨ and install it in the orifice ⑩.

3. Attach the filter ⑧ and the orifice ⑩.

4. Attach the up-side relief valve ① to the PT pump.

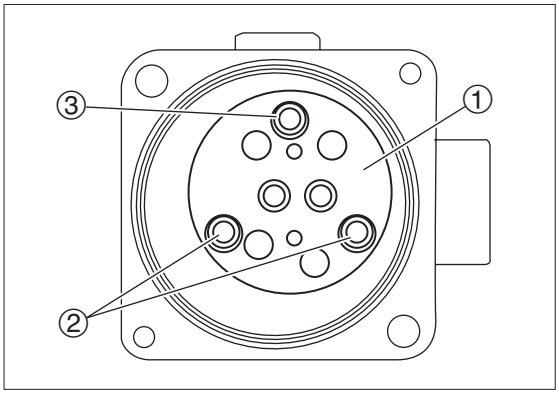
Recommended PT Fluid:
ATF DEXRON III



① Up Relief Valve Assy
② O-ring
③ Valve Seat
④ Ball
⑤ Spring Guide
⑥ Spring
⑦ Down Orifice Assy
⑧ Filter
⑨ O-ring
⑩ Orifice
⑤1 O-ring

5. Install the pump using the screws ② and ③.
Tighten the screws to the specified torque.

Pump mounting screw :
5 N·m (4 lb·ft) [0.5 kgf·m]



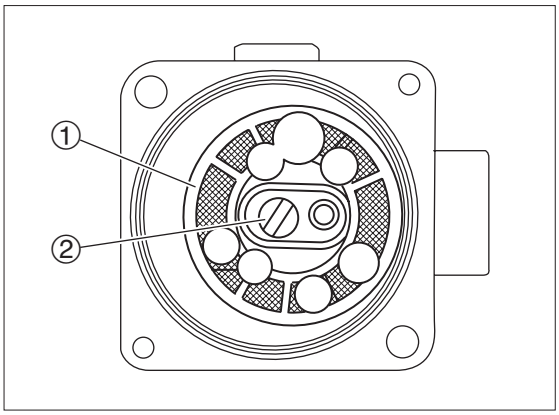
① PT Pump
② Internal Hex Screw (5 mm × 20)
③ Internal Hex Screw (5 mm × 25)

6. Attach the cleaned screen ①.

7. Attach the pump coupling ② to the pump.

8. Install the motor assy to the PT pump and cylinder assy.

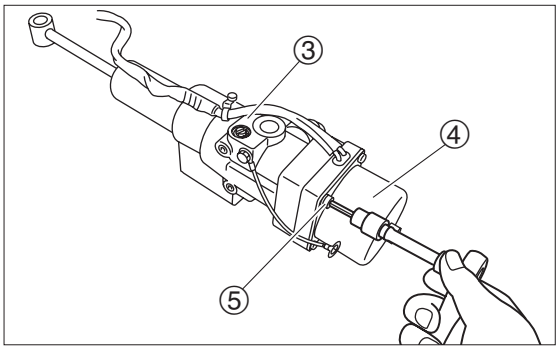
9. Attach the wire harness mounting screws.



① Pump Filter
② Pump/Motor Coupler

10. Install the motor assy ④ to the cylinder assy and PT pump ③ using the screw ⑤ and tighten to the specified torque.

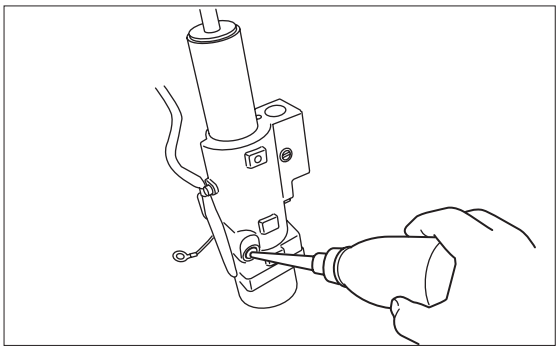
Motor assy installation screws:
5 N·m (4 lb·ft) [0.5 kgf·m]



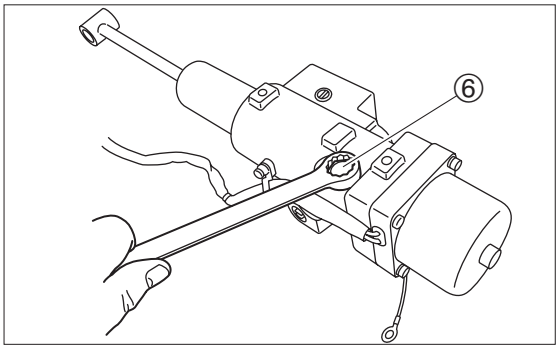
11. Fill power tilt system with PT fluid.

Recommended PT Fluid :
ATF DEXRON III

Extend the tilt rod and set the PT unit vertically. Pour fluid until it overflows from inlet.

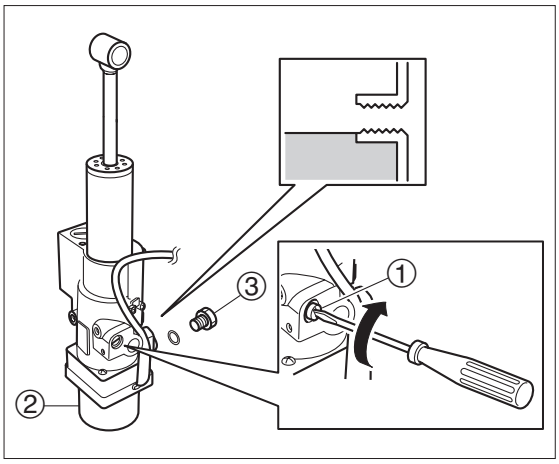


12. Attach the cap ⑥.



7

3) Air-Purging PT Unit (Separated from Outboard Motor)



1. Turn the manual valve ① clockwise (to the right) until it no longer turns.

2. Set the PT unit ② vertically, remove the cap ③, and check the fluid level in the reserve.

⚠ WARNING

Check the fluid level with the tilt rod fully extended. Removing the reserve tank cap with the tilt rod at the halfway position can cause the PT fluid to blast out, which is dangerous, and results in inaccurate fluid level reading.

3. Add the recommended PT fluid to the specified level if it is lacking.

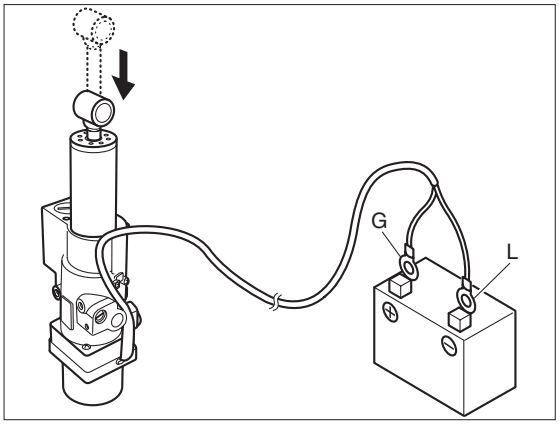
Recommended PT Fluid :
ATF DEXRON III

4. Install the cap ③ and tighten to the specified torque.

Reserve Tank Cap:
1.5 N·m (1.1 lb·ft) [1.5 kgf·m]

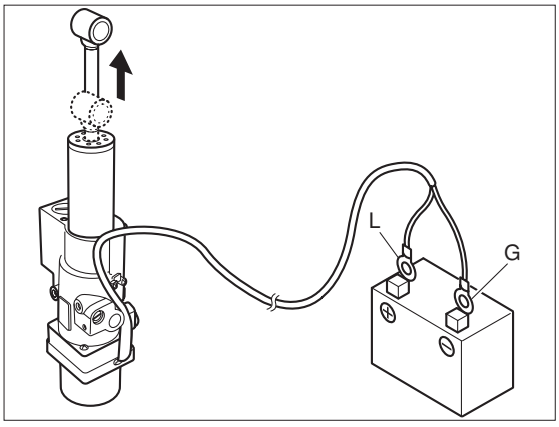
5. Reconnect the PT motor lead wires to the battery terminals to fully retract the tilt rod.

Tilt Rod	PT Motor Lead Wires	Battery Terminals
DOWN	Green (G)	+ : Positive Terminal
	Blue (L)	− : Negative Terminal



6. Reconnect PT motor lead wires to battery terminals to fully extend tilt rod.

Tilt Rod	PT Motor Lead Wires	Battery Terminals
UP	Blue (L)	+ : Positive Terminal
	Green (G)	− : Negative Terminal



Repeat the above steps four to five times to move the tilt rod up and down. (When reversing the motor lead wire connection, keep the connection open for two to three seconds.)

7. Check the fluid level with the tilt rod fully extended. Add the recommended PT fluid to the specified level if it is low.

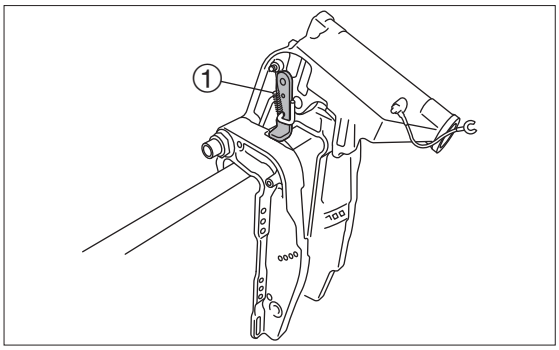
Recommended PT Fluid :
ATF DEXRON II

8. Repeat steps 2 to 7 until the fluid reaches the specified level.

9. Reattach the cap.

4) Installation of PT Assy

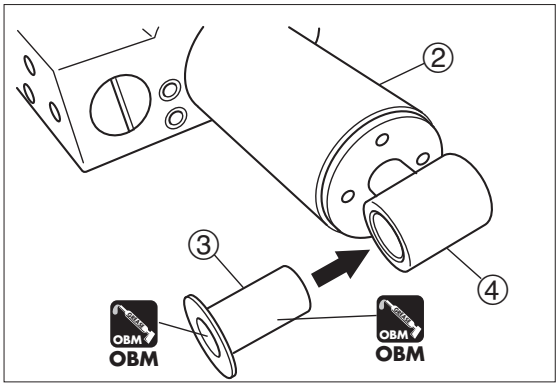
1. Fully tilt up the outboard motor and support it with the tilt stopper ①.



⚠ WARNING

- **Be sure to lock the outboard motor with the tilt stopper after tilting it up. Leaving the outboard motor up without locking may lead to accidental descent due to the reduction of PT unit hydraulic pressure, which is dangerous.**
- **When attaching or detaching the PT unit without removing the power unit, suspend and support the outboard motor with a hoist etc. The outboard motor may fall, which is dangerous.**

2. Install the bushing ③ to the tilt cylinder rod ④.

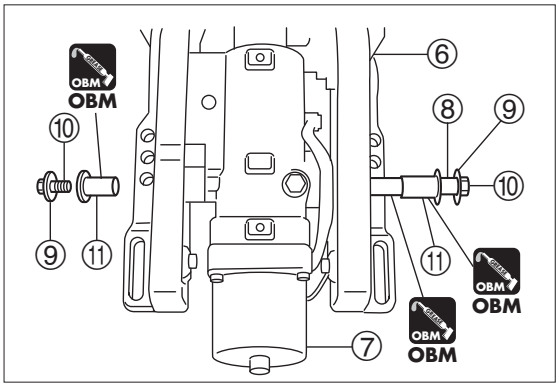


② PT Cylinder
③ Bushing
④ Cylinder Rod Eye

3.Attach the pivot pin bushings (two locations) ⑤ to the clamp bracket ⑥.

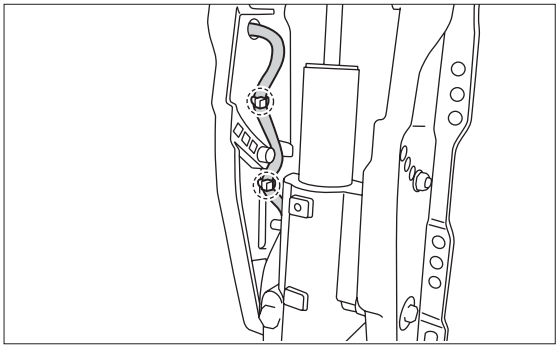
4. Slightly widen the clamp bracket on the port side, and position the PT assy ⑦ in the clamp bracket ⑥.

5. Pass the tilt cylinder pivot pin (lower) ⑨ through the clamp bracket ⑥ and attach the PT assy ⑦.



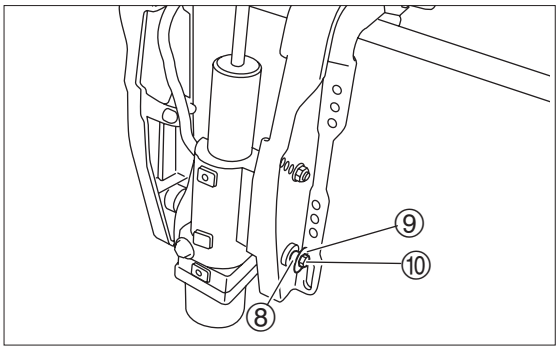
⑥ Clamp Bracket
⑦ PT Assy
⑧ Pivot Pin
⑨ Washer (2)
⑩ Bolt
⑪ Pivot Pin Bushing (2)

6. Route the PT cable as illustrated and fix it with a lock tie.



7. Attach the washer ⑨ and bolt ⑩ to the pin (lower) ⑧ and tighten to the specified torque.

Retaining bolt :
13 N·m (1.9 lb·ft) [1.3 kgf·m]

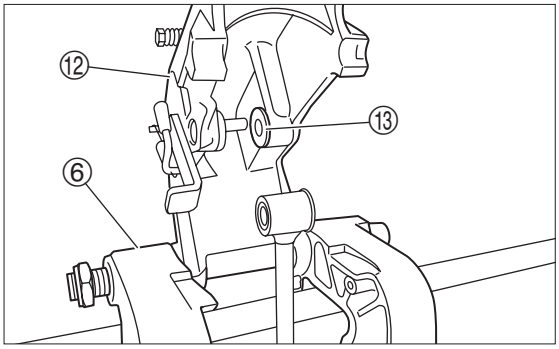


8. Install the bushings (2 locations) ⑬ to the swivel bracket ⑫.

9. Extend the power tilt cylinder rod to align the tilt cylinder rod and swivel bracket.

10. Fit the tilt cylinder rod by using the cylinder pin (upper).

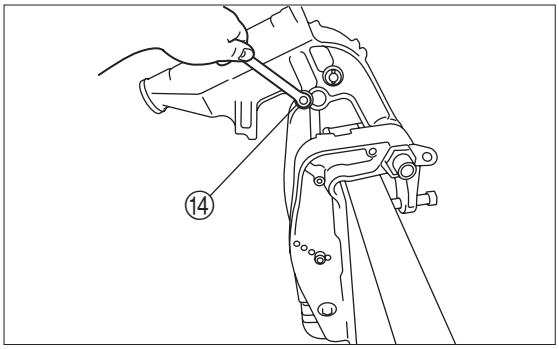
Apply OBM grease to the cylinder pin (upper) sliding surface then install the PT unit assy.



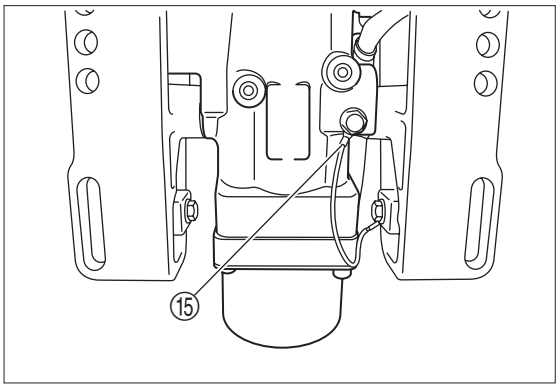
⑥ Clamp Bracket
⑬ Bushing (2)
⑫ Swivel Bracket

11. Attach the tilt cylinder pin (upper) bolt ⑭ and washer, and tighten to the specified torque.

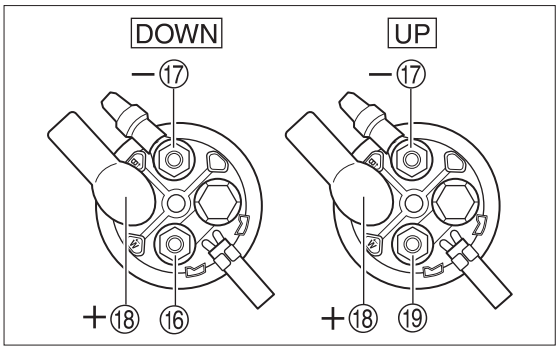
Tilt the cylinder pin (upper) installation bolt :
13 N·m (9 lb·ft) [1.2 kgf·m]



12.Attach the ground cord ⑮ securely using a bolt.



13. Attach the PT electrical cord to the PT solenoid terminals ⑯ and ⑲.



⑯ Down Relay Terminal (Green)
⑰ － Electrode Terminal (Black)
⑱ ＋ Electrode Terminal (Red)
⑲ Up Relay Terminal (Blue)

14. Unlock the tilt stopper, and repeat tilting the outboard motor up and down to bleed air from the hydraulic circuit.
< Refer to 3) Air-Purging PT Unit >

15. Check the power tilt fluid level, and replenish if necessary.

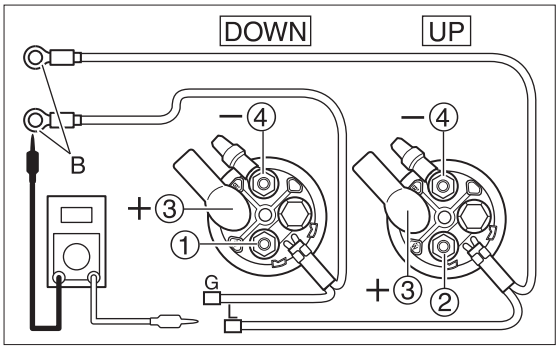
5) Inspection of PT Solenoid

This test can be conducted without removing the part.

1. Disconnect terminal ③ (+) R and terminal ④ (-) of the battery cable from the battery.

2. Disconnect the PT lead wire from terminals ① and ②.

3. Check the PT solenoid wires in accordance with the following table.
Replace if other than specified value.



Conductivity of PT Solenoid

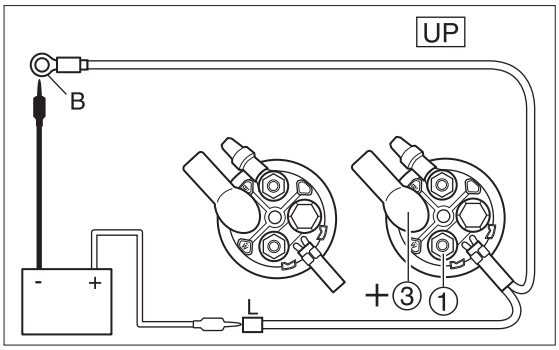
Green (G) - Black (B) Blue (L) - Black (B)	Conductive
Terminal ① -Terminal ④ (-) Terminal ② -Terminal ④ (-)	Conductive
Terminal ① -Terminal ③ (+) Terminal ② -Terminal ③ (+)	Non-conductive

7

Inspection of UP side solenoid

4. As shown in the figure, connect the blue (L) terminal in the coupler to the battery positive terminal and the black (B) terminal (B) to the negative terminal, then connect the circuit tester leads to the PT solenoid terminals ① and ③.

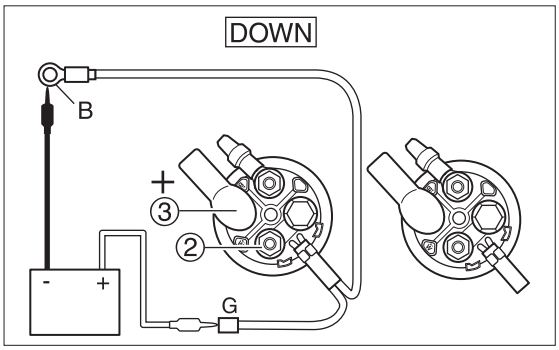
5. Check the electrical conductivity between terminals ① and ③..
   Replace the solenoid if it is non-conductive.



Inspection of Down side relay

6. As shown in the figure, connect the green (G) terminal in the coupler to the battery positive terminal and the black (B) terminal to the negative terminal, then connect the circuit tester leads to the PT solenoid terminals ② and ③.

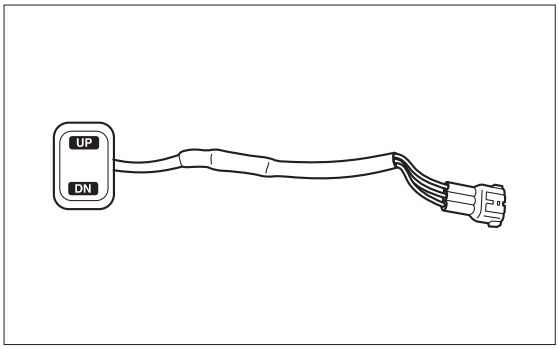
7. Check the conductivity between terminals ② and ③.
   Replace the solenoid if it is non-conductive.



6) Inspection of PT Switch

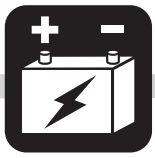
1. Check the electrical conductivity of the PT switch. Replace if other than the specified value.

Lead Wires			
Switch Position	Sky Blue (Sb)	Red (R)	Pink (P)
UP (Tilt Up)	○	○	
Free			
DOWN (Tilt Down)		○	○

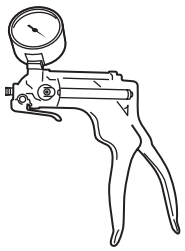
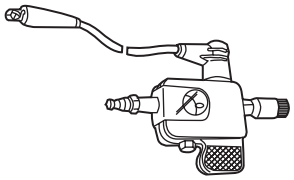


8

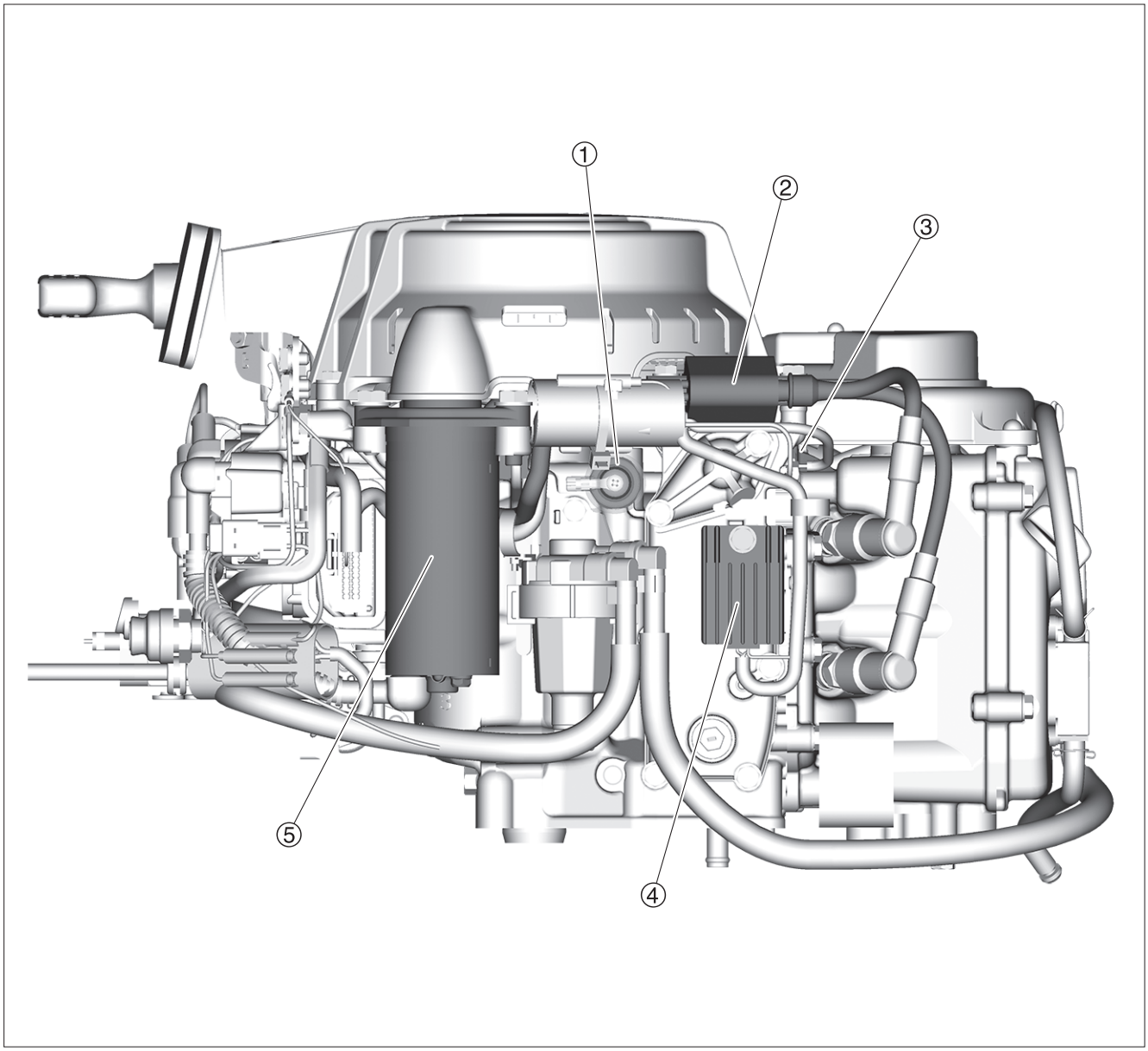
Electrical System



1. Special Tools

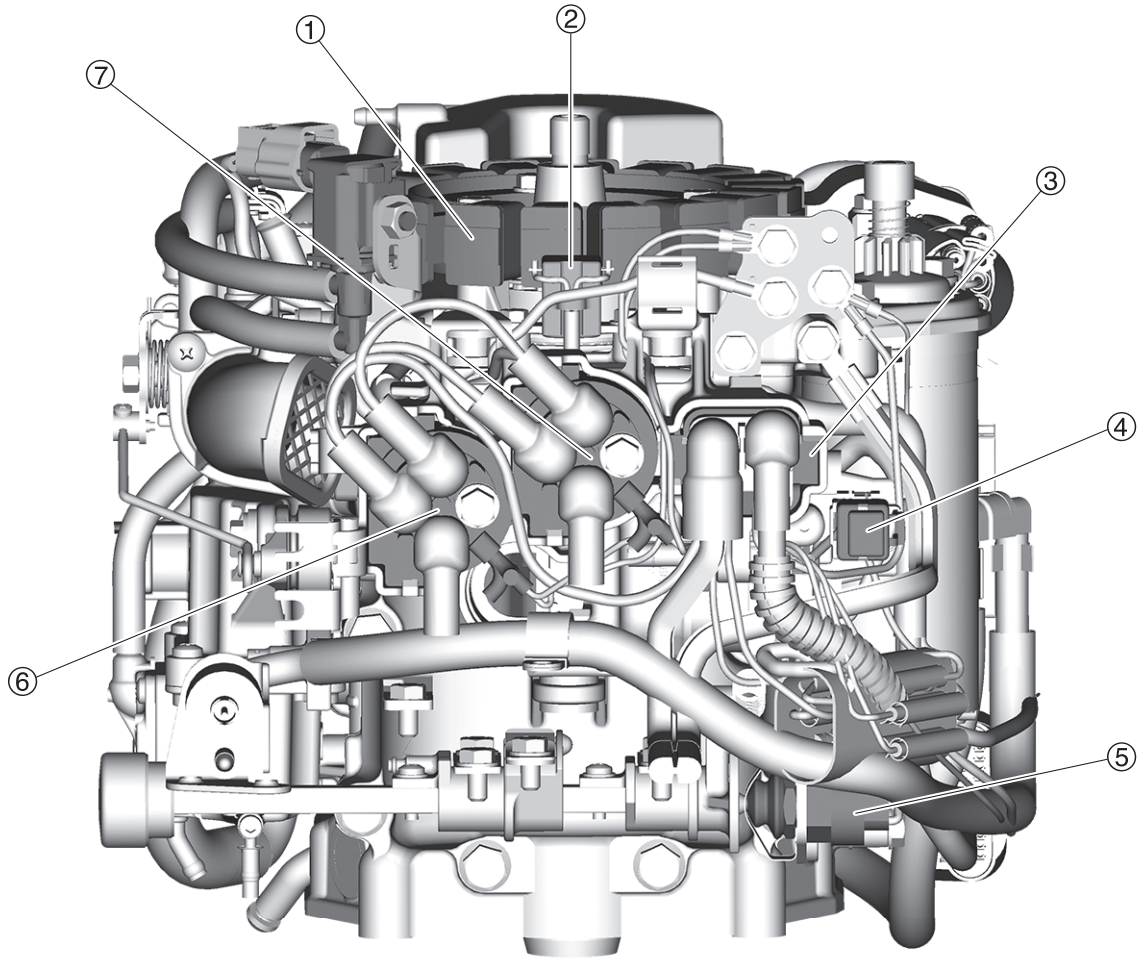
	
Vacuum/Pressure Gauge P/N. 3AC-99020-1	Spark Tester P/N. 3F3-72540-0
Inspecting pressure	Inspecting ignition

2. Electrical Component Layout
Port Side View



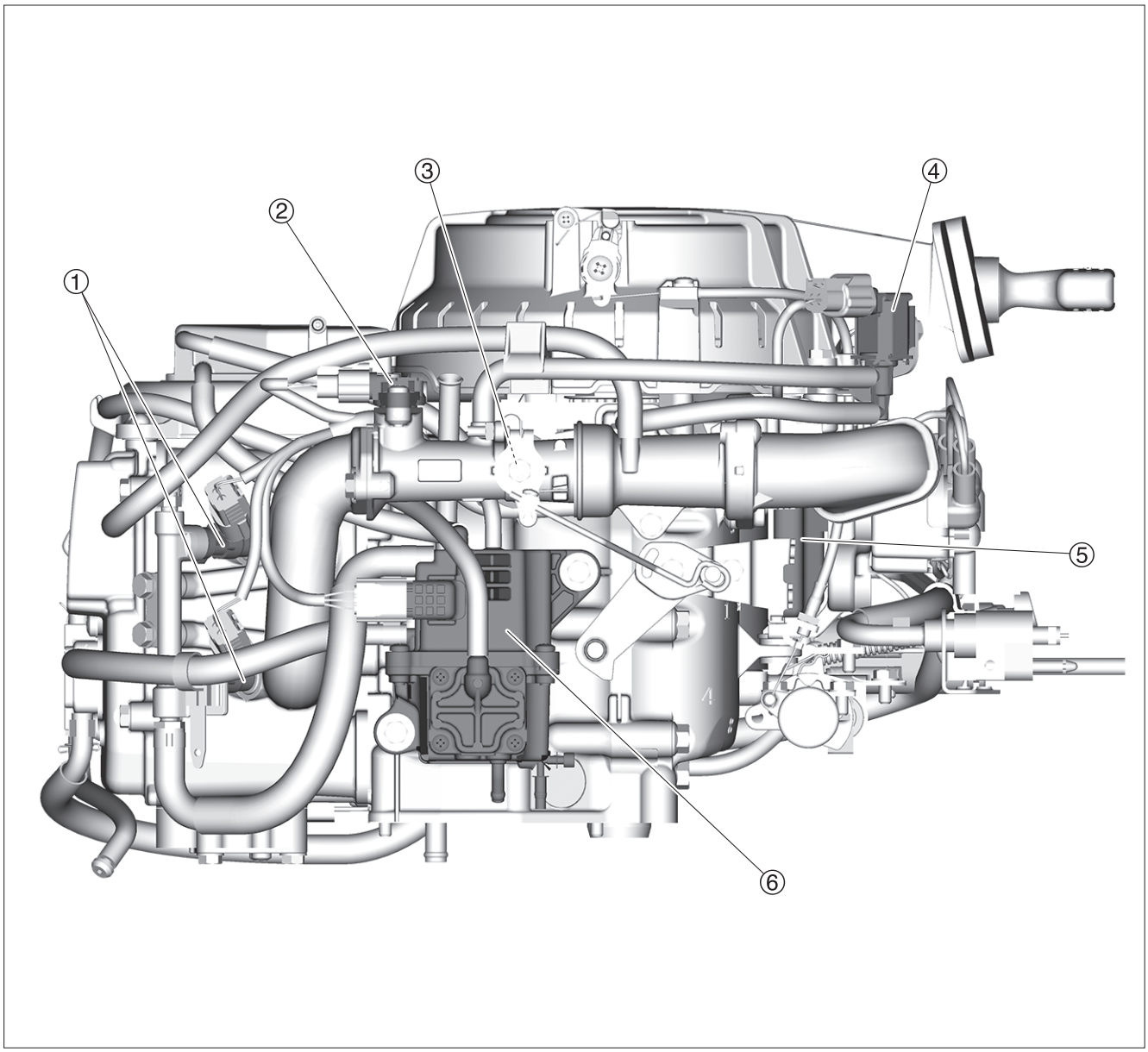
① Oil Pressure Switch
② Ignition Coil
③ Engine TEMP Sensor
④ Rectifier Complete (except for MF model)
⑤ Starter Motor Assy (except for MF model)

Bow Side View



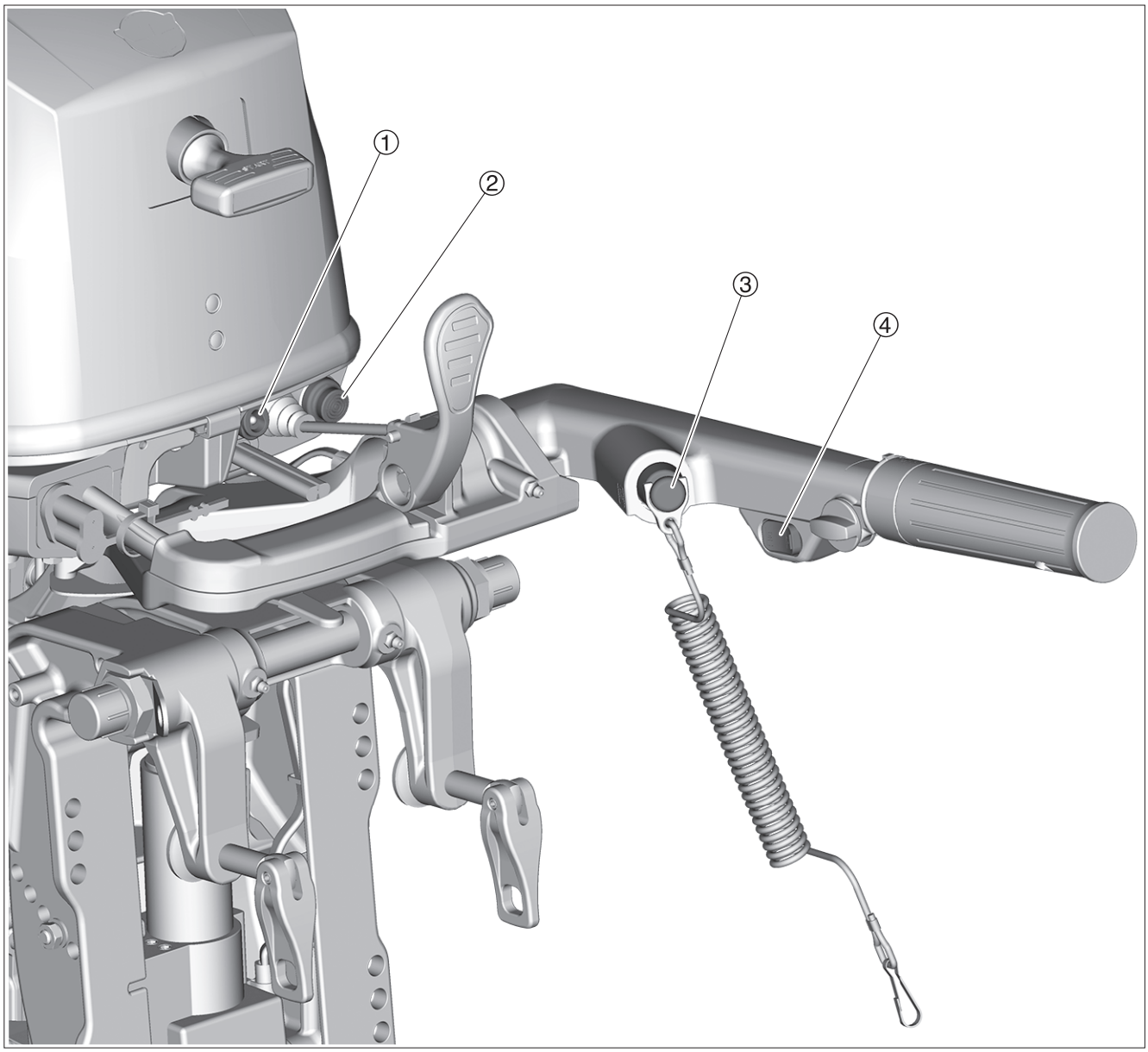
① ECU/charge coil (charge coil except for MF model)
② Pulser Coil
③ Starter Solenoid Switch (except for MF model)
④ Fuse (20A) (except for MF model)
⑤ Neutral Switch (except for MF model)
⑥ PTT Solenoid Switch (B) (DOWN side) (EFT, EPT models)
⑦ PTT Solenoid Switch (A) (UP Side) (EFT, EPT models)

Starboard Side View



① Fuel injector
② T- MAP Sensor
③ Throttle Position Sensor
④ ISC Valve
⑤ ECU Assy
⑥ Vapor Separator Assy

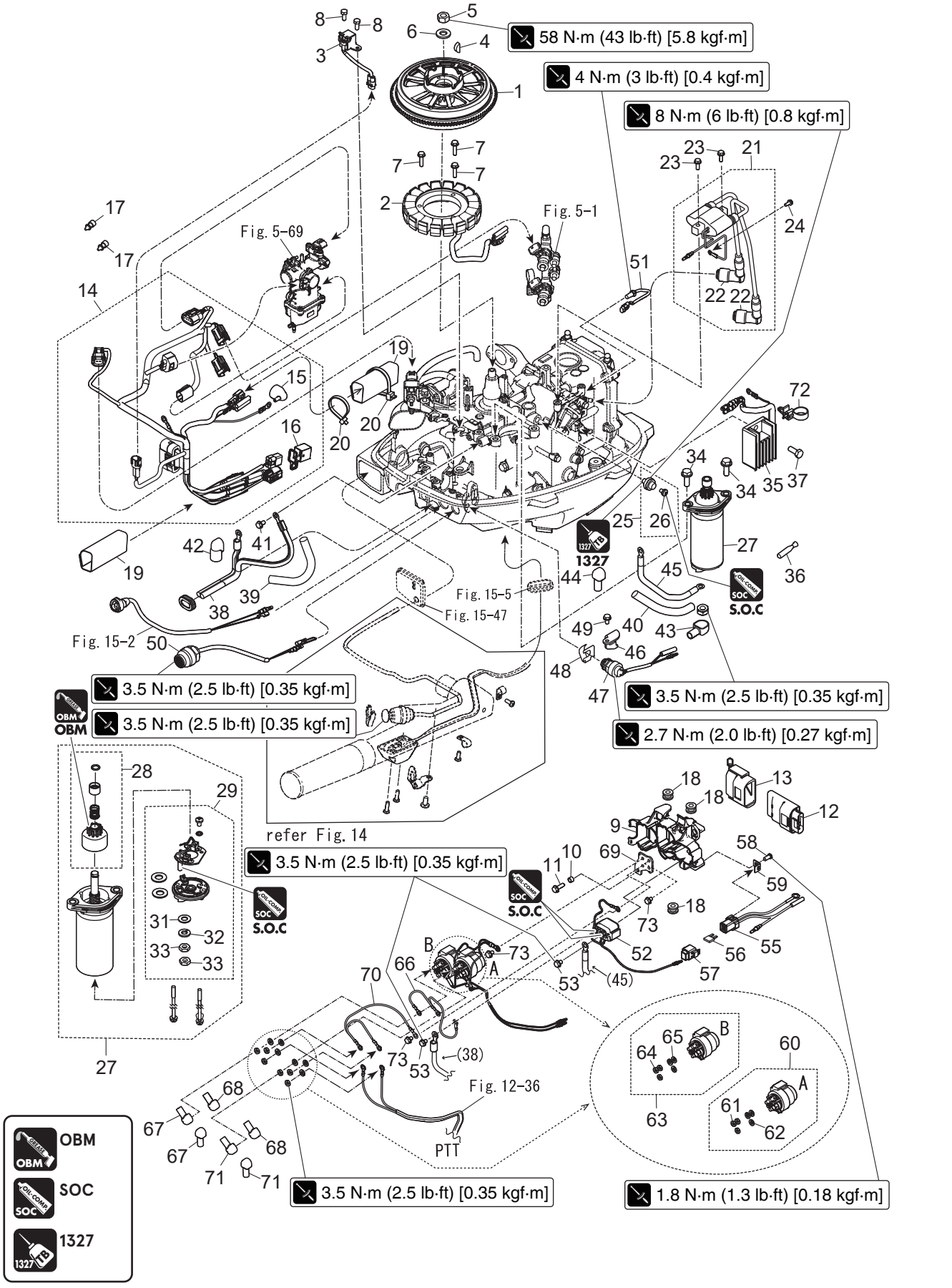
Housing Cover (Front)



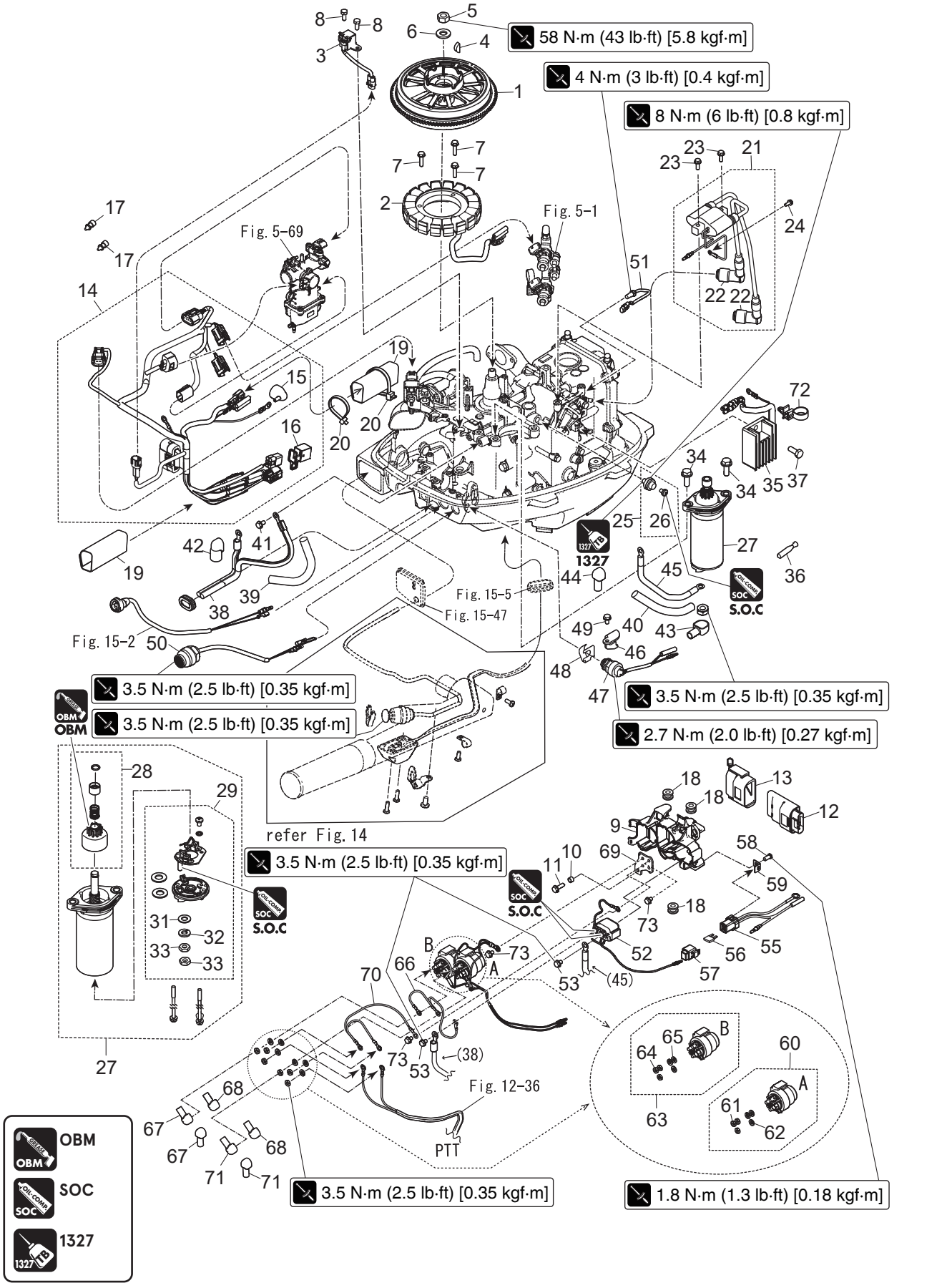
① Pilot Lamp Assy
② Main Switch Assy (EF, EFT models)
③ Stop Switch Assy
④ PT Switch (EFT model)

3.Parts Layout

Magneto & Electric Parts

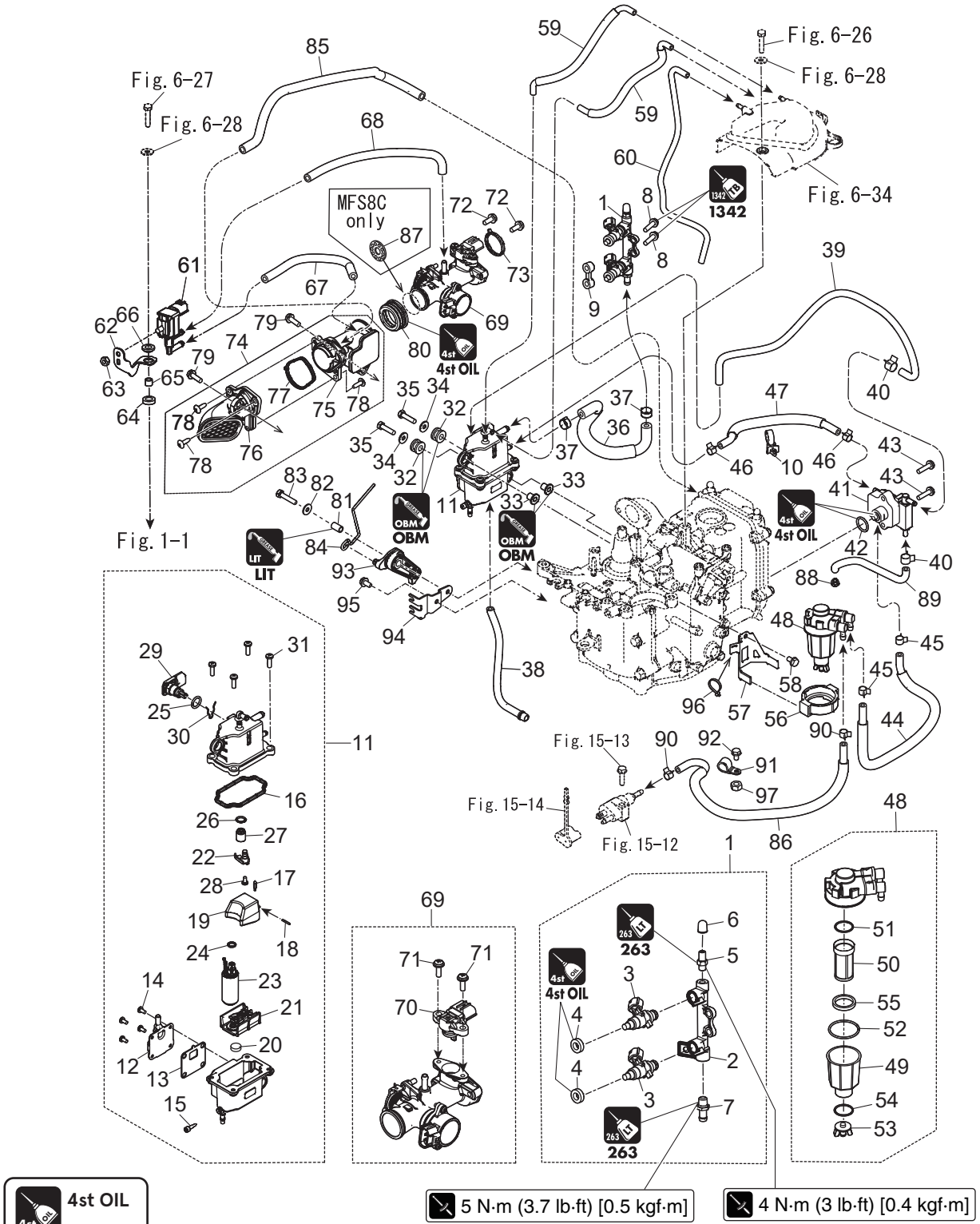


Ref. No.	Part Name	Q'ty	Remarks
1	Flywheel Assy	1	
2	Alternator Assy	1	
3	Pulser Coil	1	
4	Key 13.4-5-4	1	
5	Nut 12-P1.25	1	
6	Washer	1	
7	Bolt	3	
8	Bolt	2	
9	Electrical Bracket	1	
10	Collar	1	
11	Bolt	1	
12	ECU Assy (9.8)	1	
13	ECU Holder	1	
14	Cord Assy	1	
15	Grommet Oil Pressure Switch	1	
16	Cable Terminal Plug	1	Diagnostic Connector Cap
17	Cable Terminal Plug	2	MF
18	Rubber Mount	3	
19	Protector	2	
20	Band	2	Do not reuse.
21	Ignition Coil W/R-cap	1	
22	* Plug Cap W/Resistance	2	
23	Bolt	2	
24	Bolt	1	
25	Oil Pressure Switch	1	
26	* Screw	1	
27	Starter Motor Assy	1	EP EPT EF EFT
28	* Pinion Assy	1	EP EPT EF EFT
29	* Brush Holder Assy	1	EP EPT EF EFT
31	** Washer	1	EP EPT EF EFT
32	** Spring Washer	1	EP EPT EF EFT
33	** Nut	2	EP EPT EF EFT
34	Bolt	2	EP EPT EF EFT
35	Rectifier Complete	1	EP EPT EF EFT
36	Plug	1	
37	Bolt	1	EF EFT EP EPT
38	Battery Cable L = 2500	1	EF EFT EP EPT
39	Protector	1	EF EFT EP EPT
40	Protector	1	EF EFT EP EPT

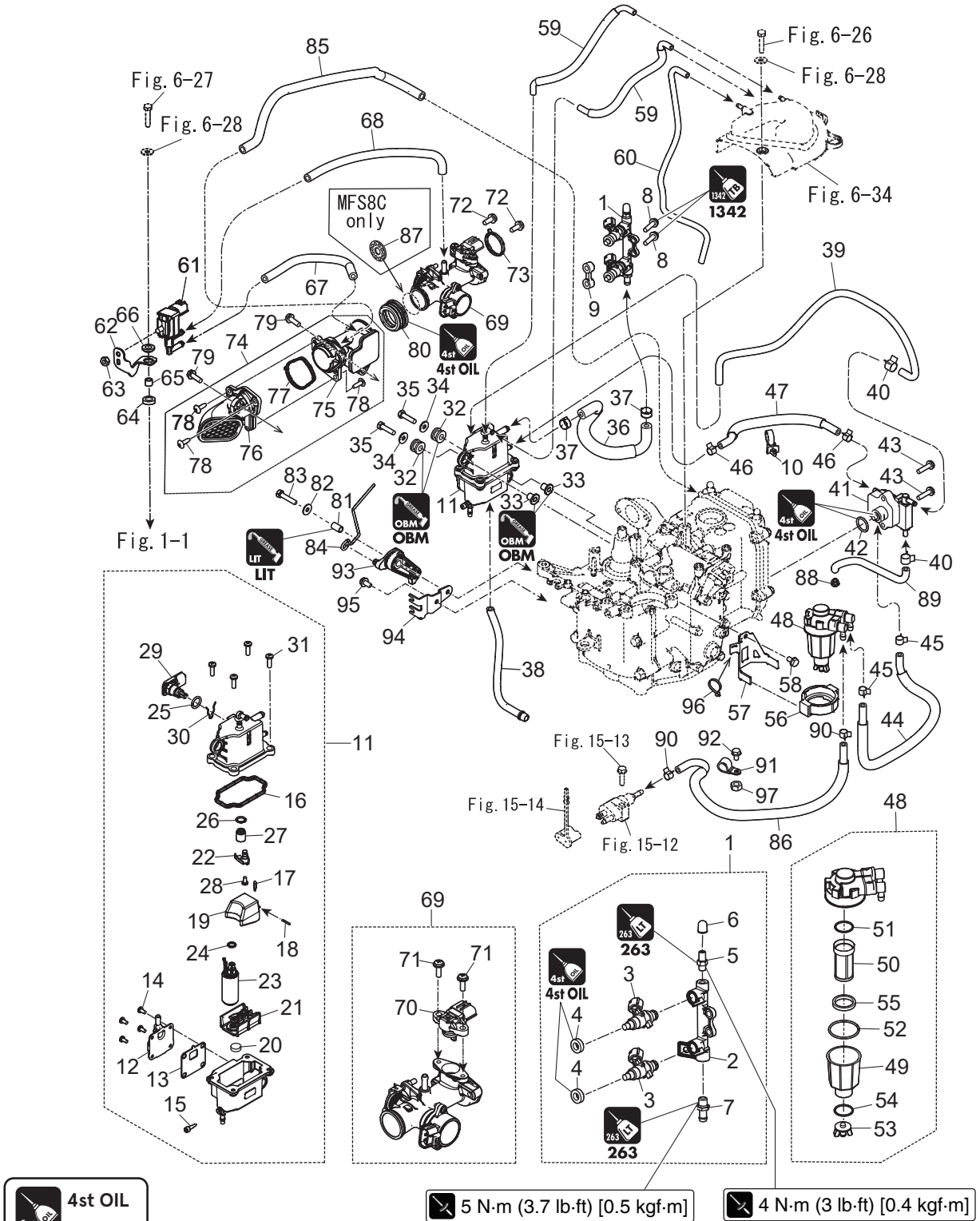

58 N·m (43 lb·ft) [5.8 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]
8 N·m (6 lb·ft) [0.8 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
2.7 N·m (2.0 lb·ft) [0.27 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
3.5 N·m (2.5 lb·ft) [0.35 kgf·m]
1.8 N·m (1.3 lb·ft) [0.18 kgf·m]
Fig. 5-1
Fig. 5-69
Fig. 15-5
Fig. 15-47
Fig. 15-2
Fig. 12-36
refer Fig. 14
1327
S.O.C
OBM
PTT
OBM
SOC
1327

Ref. No.	Part Name	Q'ty	Remarks
41	Bolt	1	EF EFT EP EPT
42	Terminal Cap	1	EF EFT EP EPT
43	Terminal Cap	1	EF EFT EP EPT
44	Terminal Cap	1	EF EFT EP EPT
45	Starter Cable L = 200	1	EF EFT EP EPT
46	Neutral Switch Bracket	1	EF EFT EP EPT
47	Neutral Switch	1	EF EFT EP EPT
48	Neutral Switch Actuator	1	EF EFT EP EPT
49	Bolt	1	EF EFT EP EPT
50	Main Switch Assy	1	EF EFT
51	Engine TEMP Sensor	1	
52	Starter Solenoid	1	EF EFT EP EPT
53	Bolt	2	EF EFT EP EPT
55	Fuse Wire Assy	1	EF EFT EP EPT
56	Fuse 20A	2	EF EFT EP EPT
57	Fuse Box Cap (Y)	1	EF EFT EP EPT
58	Tapping Screw 5-12	1	EF EFT EP EPT
59	Fuse Holder Bracket	1	EF EFT EP EPT
60	PTT Solenoid Switch (A)	1	EFT EPT
61	* Nut	3	EFT EPT
62	* Spring Washer	3	EFT EPT
63	PTT Solenoid Switch (B)	1	EFT EPT
64	* Nut	3	EFT EPT
65	* Spring Washer	3	EFT EPT
66	Solenoid Switch Cord (A)	1	EFT EPT
67	Terminal Cap	2	EFT EPT
68	Starter Terminal Cap	2	EFT EPT
69	Bracket	1	EF EFT EP EPT
70	Solenoid Switch Cord (B)	1	EFT EPT
71	Terminal Cap	2	EFT EPT
72	Band	1	EF EFT EP EPT Do not reuse.
73-1	Bolt	1	EF EP
73-2	Bolt	3	EFT EPT
74-1	Washer	1	EF EP
74-2	Washer	3	EFT EPT

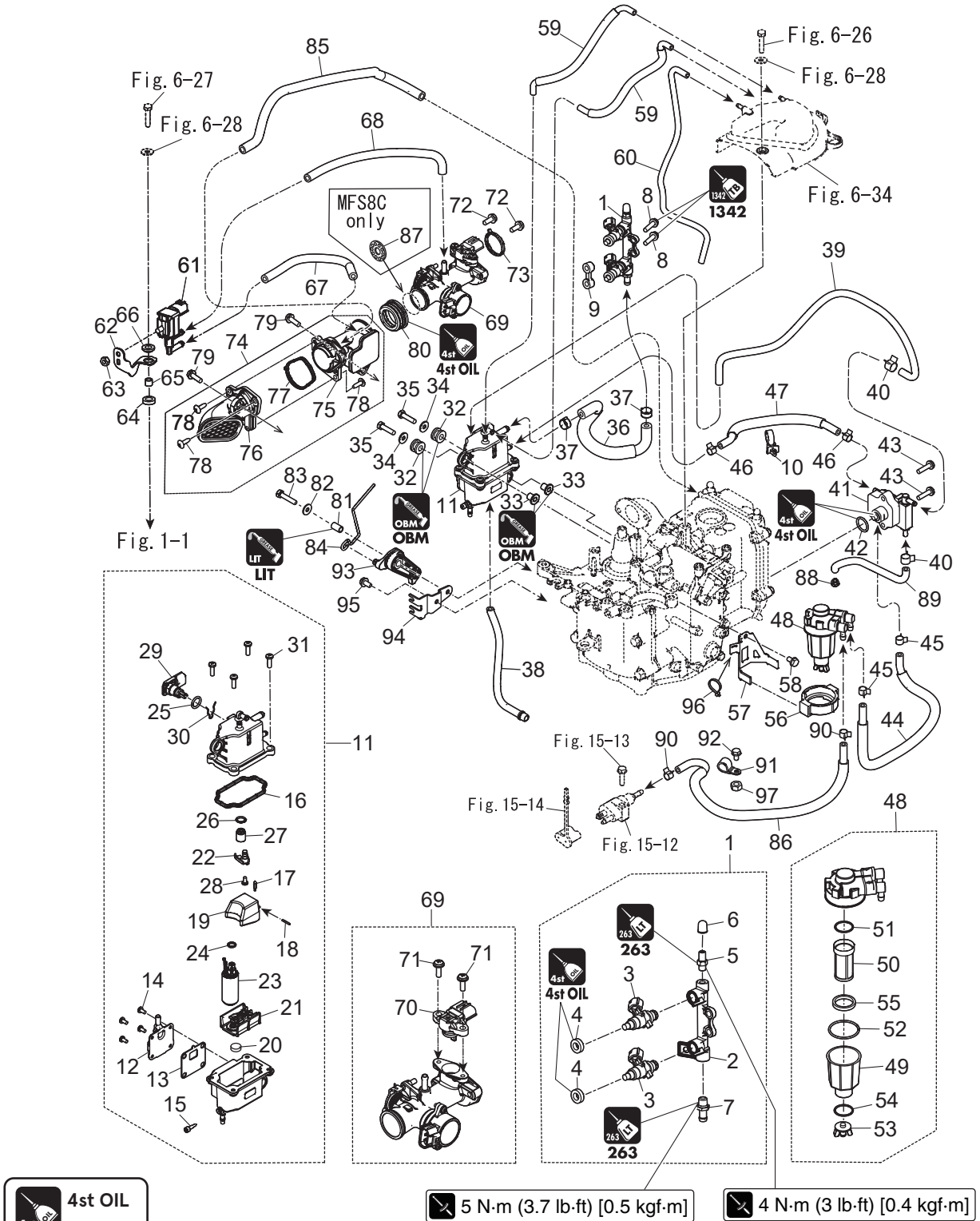
Intake Manifold & Fuel Pump



Ref. No.	Part Name	Q'ty	Remarks
1	Fuel Rail Assy	1	
2	* Fuel Rail	1	
3	* Fuel Injector Assy	2	
4	* Seal Ring	2	Do not reuse.
5	* Valve Assy (Pressure Check)	1	
6	* Valve Cap	1	
7	* Nipple	1	
8	Bolt	2	
9	Insulator	1	
10	Band	1	Do not reuse.
11	Vapor Separator Assy	1	
12	* Cover	1	
13	* Seal	1	Do not reuse.
14	* Screw	4	
15	* Drain Screw	1	
16	* Gasket	1	
17	* Float Valve Assy	1	Do not reuse.
18	* Float Arm Pin	1	
19	* Float	1	
20	* Grommet	1	
21	* Filter (Inlet)	1	
22	* Holder	1	
23	* Fuel Feed Pump	1	
24	* O-ring	1	Do not reuse.
25	* O-ring	1	Do not reuse.
26	* O-ring	1	Do not reuse.
27	* Fuel Regulator	1	
28	* Screw	1	
29	* VST Connector	1	
30	* Clip	1	
31	* Screw	4	
32	Rubber Mount	2	
33	Collar	2	
34	Washer 6-16-1.5	2	
35	Bolt	2	
36	Fuel Hose W/Protector	1	
37	Clamp	2	
38	Hose	1	
39	Water Hose	1	
40	Clip ø9.4	2	


MFS8C only
Fig. 6-26
Fig. 6-28
Fig. 6-27
Fig. 6-34
Fig. 1-1
Fig. 15-13
Fig. 15-14
Fig. 15-12
4st OIL
OBM
LIT
1342
263
5 N·m (3.7 lb·ft) [0.5 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]

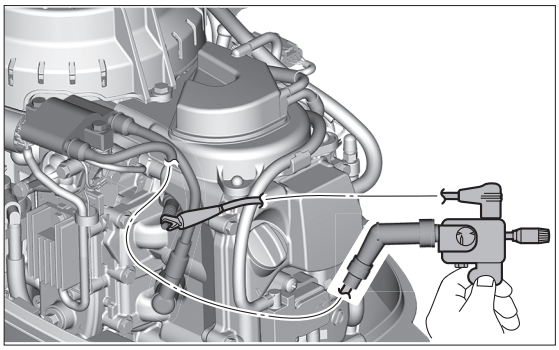
Ref. No.	Part Name	Q'ty	Remarks
41	Fuel Pump Assy	1	
42	O-ring	1	Do not reuse.
43	Screw	2	
44	Hose	1	
45	Clip ø9.4	2	
46	Clip ø9.4	2	
47	Hose	1	
48	Fuel Filter Assy	1	
49	* Cup	1	
50	* Filter	1	
51	* O-ring	1	Do not reuse.
52	* O-ring	1	Do not reuse.
53	* Drain Valve	1	
54	* Seal	1	Do not reuse.
55	* Float	1	
56	Fuel Filter Holder	1	
57	Fuel Filter Bracket	1	
58	Bolt	1	
59	Vent Hose W/Protector	2	
60	Fuel Hose	1	
61	ISC Valve	1	
62	ISC Valve Stay	1	
63	Nut	1	
64	Rubber Mount 9-16-4.3	1	
65	Collar 6.2-9-7.4	1	
66	Rubber Mount 8.5-12-2	1	
67	Hose	1	
68	Hose	1	
69	Throttle Body Assy	1	
70	* MAP Sensor	1	
71	* Screw	2	
72	Bolt	2	
73	Gasket	1	Do not reuse.
74	Intake Silencer Assy	1	
75	* Intake Silencer Sub-Assy	1	
76	*Intake Silencer Sub-Assy	1	
77	* Gasket	1	Do not reuse.
78	* Tapping Screw	3	
79	Bolt	2	
80	Gasket	1	Do not reuse.


MFS8C only
Fig. 6-26
Fig. 6-28
Fig. 6-27
Fig. 6-34
Fig. 1-1
Fig. 15-13
Fig. 15-14
Fig. 15-12
4st OIL
OBM
LIT
1342
263
5 N·m (3.7 lb·ft) [0.5 kgf·m]
4 N·m (3 lb·ft) [0.4 kgf·m]

Ref. No.	Part Name	Q'ty	Remarks
81	Collar	1	
82	Washer 6-16-1.5	1	
83	Bolt	1	
84	Throttle Rod	1	
85	Breather Hose	1	
86	Fuel Hose W/Protector	1	
87	Restrictor	1	
88	Water Nipple	1	
89	Hose	1	
90	Clip ø9.4	2	
91	Clamp 6.5-14L	1	
92	Bolt	1	
93	Throttle Drum Assy	1	
94	Throttle Wire Bracket	1	
95	Bolt	1	
96	Band	1	Do not reuse.
97	Nut	1	MF EF EFT

4. The Ignition System and the Ignition Control System

1) Inspection of the Ignition Spark



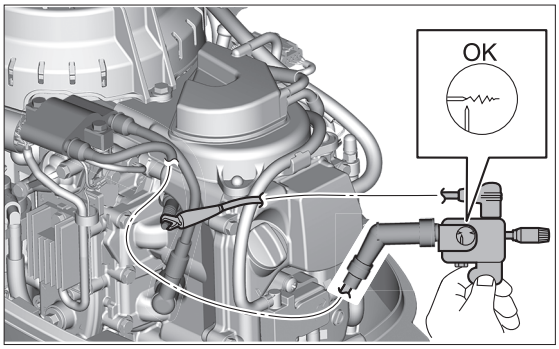
⚠ WARNING

- **When testing, install the electrode cap properly so as to prevent leaks and contact with the wiring of the spark tester, and perform the test carefully.**
- **Keep flammable gas, fuel, and oils away, because testing generates sparks.**

1. Disconnect the plug cap from the spark plug.
2. Connect the plug cap to a spark tester.
3. Connect the spark tester clip to the spark plug tip electrode.

Spark Tester:
P/N. 3F3-72540-0

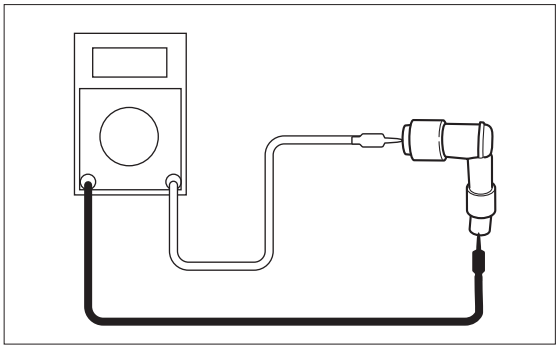
Spark Performance:
10 mm (0.4 in) or greater



4. Start the engine and check the spark. Check the ignition system if the sparks are weak.

- This test can be conducted without removing the part.
- The ignition coil operation test can be conducted using the "Running (Drop) Test" of the diagnosis system.

2) Inspection of the Plug Cap



Remove the part to test it as a separate unit.

1. Disconnect the plug cap from the spark plug.
2. Remove the plug cap from the high tension cable.
3. Measure the plug cap resistance. Replace if other than the specified value.

Plug Cap Resistance:
3.0 to 7.0 kΩ

3) Inspection of the Ignition Coil

1. Disconnect the ignition coil.

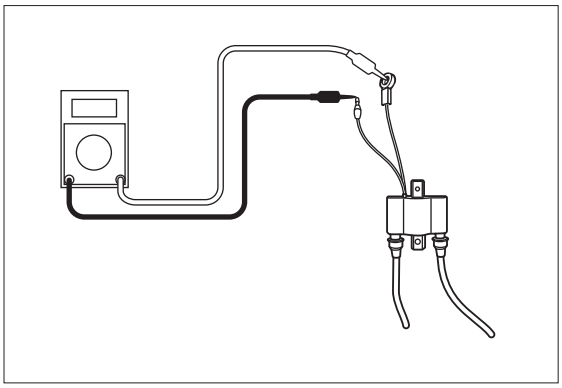
2. Measure the ignition coil resistance. Replace if other than the specified value.

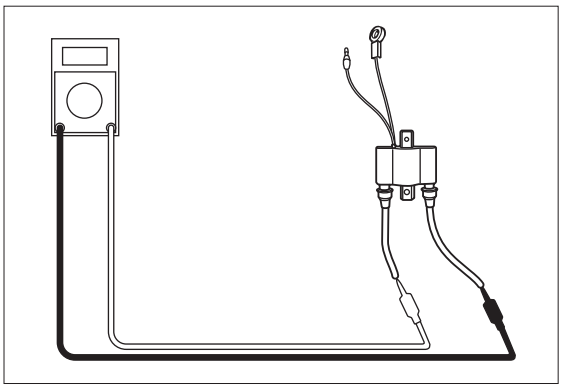
This test can be conducted without removing the part.

Ignition Coil Resistance:
Primary Coil : Between Black (B) - Orange (Or)
0.26 - 0.35 kΩ (at 20°C)
Secondary coil: Between high tension cable and high tension cable
6.8 to -10.2 kΩ (at 20°C)

3. Install the plug cap on the high tension cable by turning it clockwise.

4. Connect the plug cap to the spark plug.





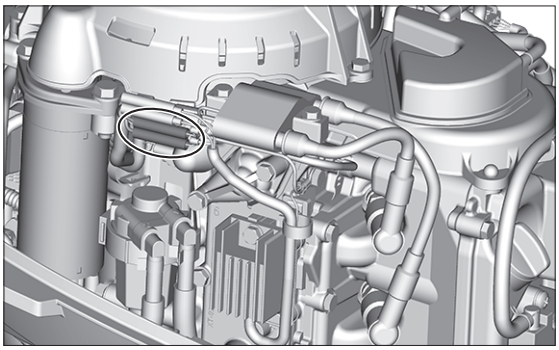
4) Inspection of the ECU Coil (Exciter Coil)

1. Disconnect the ECU coil connector (2 pin connector).

2. Measure the resistance of the ECU coil. Replace if other than the specified value.

This test can be conducted without removing the part.

ECU Coil (Exciter Coil) Resistance:
Between Red/Black (R/B) - Blue (L)
1.04 - 1.56 Ω (at 20°C)

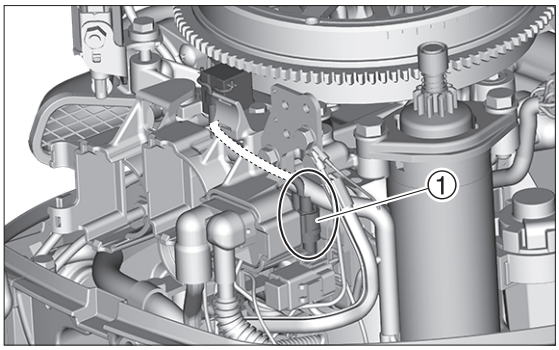


8

5) Inspection of the Pulser Coil

1. Disconnect the coupler ① of the pulser coil.

2. Measure the resistance of the pulser coil. Replace if other than the specified value.

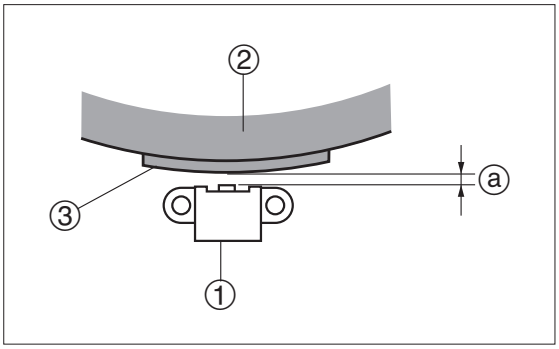


This test can be conducted without removing the part.

Pulser Coil Resistance (Reference Value): #1
Between Red/White (R/W) - Black (B) terminals
148 to 222 Ω (at 20°C)

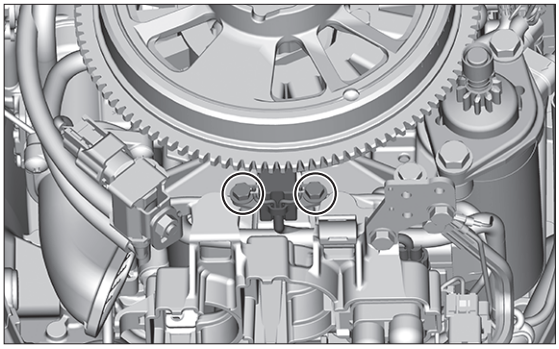
6) Adjustment of the Pulser Coil Air Gap

1. Loosen the mounting screws of the pulser coil ① and insert the thickness gauge into the gap ⓐ between the pulser coil and the encoder ring ③ on the flywheel ②.



Pulser Coil Air Gap: ⓐ
0.6 - 1.0 mm (0.024 - 0.039 in)

2. Tighten the mounting screws of the pulser coil.



The gap between the encoder ring and the pulser coil can be kept even by tightening the screws while pushing the pulser coil lightly toward the flywheel.

7) Inspection of the Oil Pressure Switch

Remove the part to test it as a separate unit.

1. Remove the oil pressure switch ①.

2. Check the conductivity of the oil pressure switch. Replace it if it is not conductive.

3. Connect the vacuum/pressure gauge to the oil pressure switch.

Vacuum/Pressure Gauge:
P/N. 3AC-99020-1

4. Apply pressure slowly with the vacuum/pressure gauge.

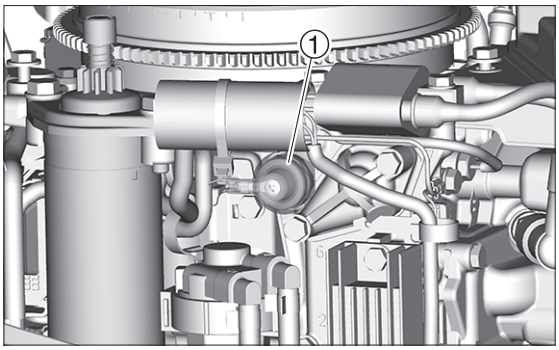
5. Check that the oil pressure switch is not conductive at the specified pressure. Replace it if it is conductive.

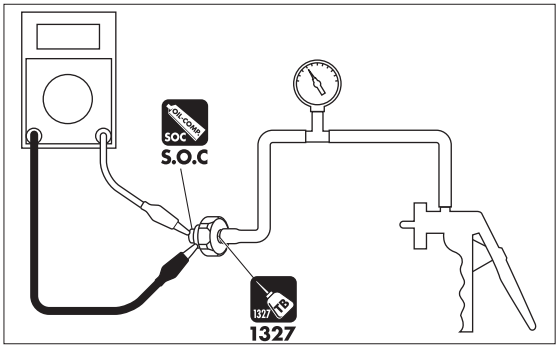
Oil Pressure Switch Pressure:
0.020 - 0.003 MPa (2.8 - 4.0 psi)
[0.2 - 0.3 kgf/cm^2]

6. Reinstall the oil pressure switch and tighten to the specified torque.

Apply a screw locking agent (ThreeBond 1327) to the threaded area of the oil pressure switch, and apply silicon grease to the threaded area of the lead wire installation screw.

Oil Pressure Switch:
8 N·m (6 lb·ft) [0.8 kgf·m]

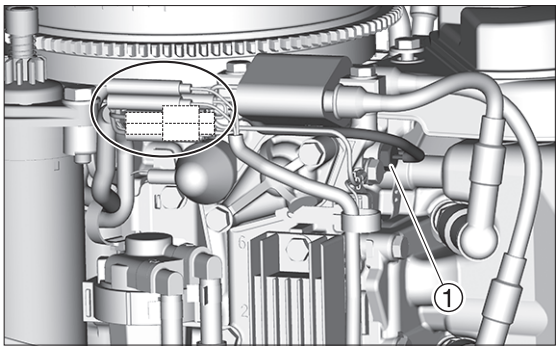




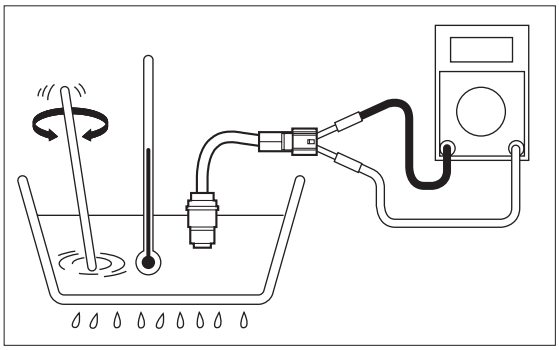
8) Inspection of the Engine Temperature Sensor

Remove the part to test it as a separate unit.

1. Remove the engine temperature sensor ① from the engine.



2. Place the engine temperature sensor in a vessel containing water and slowly heat the water. To measure the resistance at low temperatures, place the sensor in ice water, refrigerator, etc. to cool the sensor.



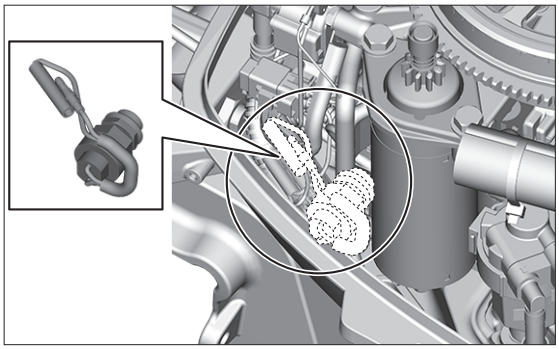
3. Measure the engine temperature sensor resistance. Replace if other than the specified value.

Engine Temperature Resistance (Reference Value):
Between terminals
At about 5°C: 4.24 to 4.86 kΩ
At about 25°C: 1.90 to 2.10 kΩ
At about 100°C:0.17 to 0.20 kΩ

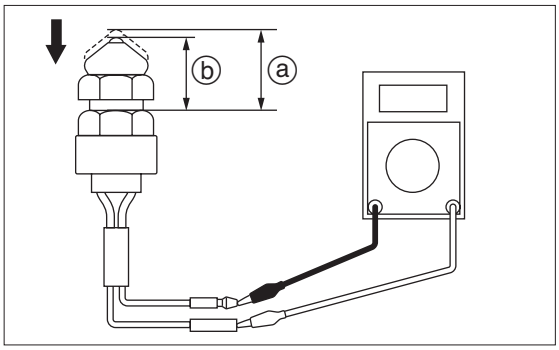
9) Inspection of the Neutral Switch (Except for MF)

This test can be conducted without removing the part.

1. Check the conductivity of the neutral switch. Replace it if it is not conductive.



Switch Position	Lead Wire Color	
	Green (G)	Green (G)
Free ⓐ		
Pushed (shift in) ⓑ	○———	———○

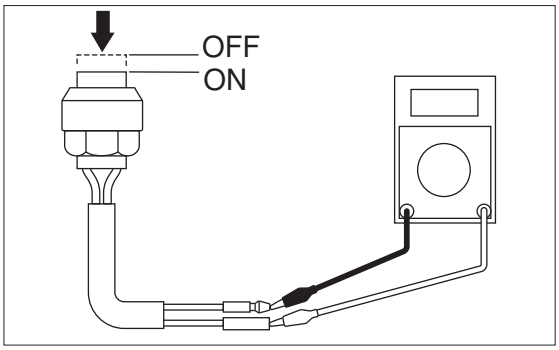


10) Inspection of the Main Switch Assy (EF, EFT)

1. Check the conductivity of the main switch assy and replace it if it is not conductive.

This test can be conducted without removing the part.

Switch Position	Lead Wire Color	
	Green (G)	Red (R)
Free: OFF		
Pushed: ON	○———	———○

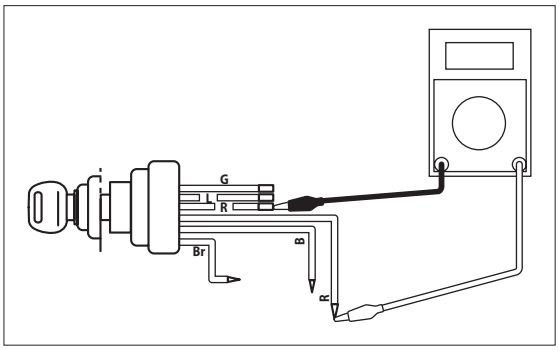


11) Inspection of the Main Switch Assy (Key)

1. Remove the main switch ass'y from the tiller handle or remote controller.

2. Check the conductivity of the key switch and replace it if it is not conductive.

Remove the part to test it as a separate unit.



Remote Control Model:

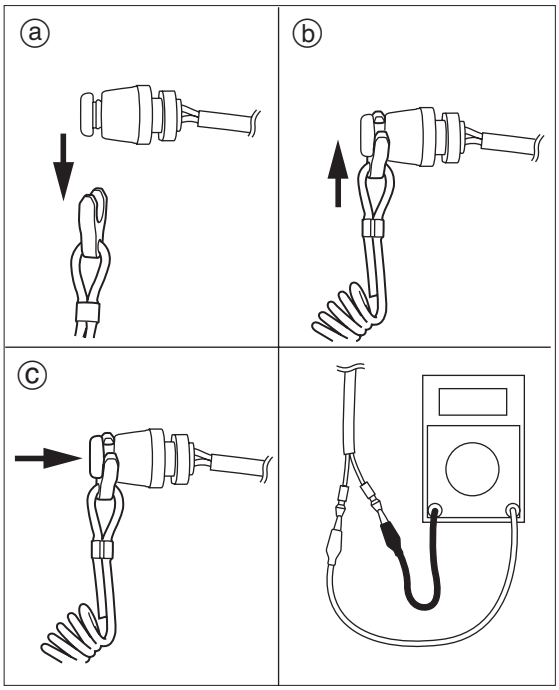
	Switch Position	Lead Wire Color						
		B	Br	R	R	G	L	
	OFF	○—○						
	ON			○—○				
	START			○—○—○				
PUSH	ON			○—○			○	Variable Idle

8

12) Inspection of the Stop Switch Assy

1. Check the conductivity of the stop switch assy and replace it if it is not conductive.

Switch Position	Lead Wire Color	
	Brown (Br)	Black (B)
Remove lock ⓐ	○———	———○
Install lock ⓑ		
Press switch ⓒ	○———	———○



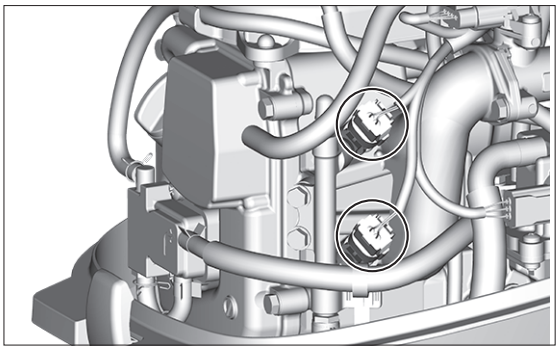
5. The Fuel Control System

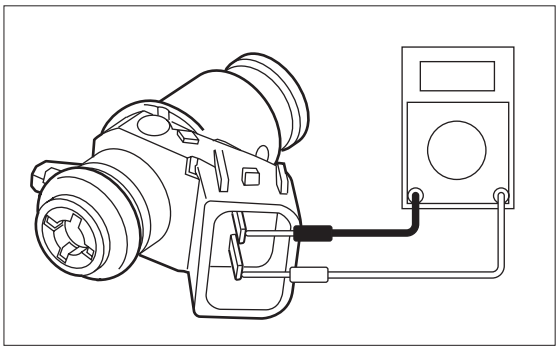
1) Inspection of the Injector

1. Measure the injector resistance.

- This test can be conducted without removing the part.
- The injector operation test can be conducted using the "Engine Shut-down Test" or "Engine Running Test" of the diagnosis system.

Injector Resistance (Reference Value): (at 25°C)
11.50 to 12.50 Ω



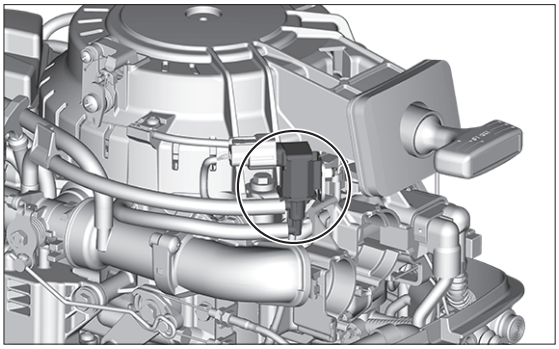


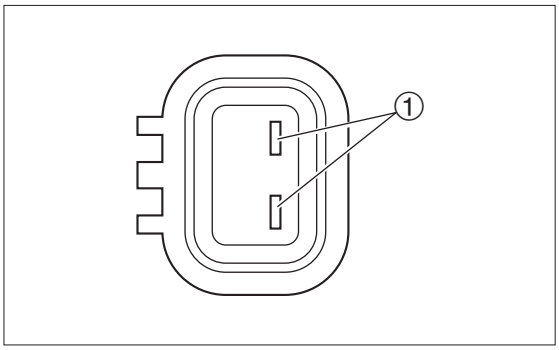
2) Inspection of the ISC Valve

1. Measure the resistance between the ISC valve terminals .

ISC Valve Resistance (Reference Value): (at 20°C)
21 to 27 Ω

The ISC valve operation test can be conducted using the "Engine Shut-down Test" or "Engine Running Test" of the diagnosis system.

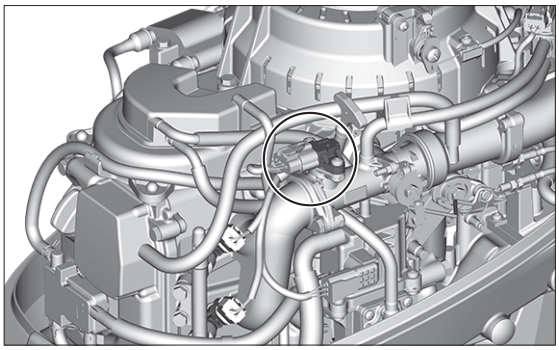




8

3) Inspection of the T-MAP Sensor

The MAP (manifold pressure) sensor and MAT (intake air temperature) sensor are integrated in this sensor.



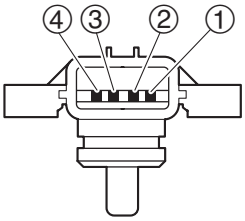
Inspection of the MAT Sensor

1. Measure the ambient temperature.

2. Connect a computer to the outboard motor and use the diagnosis system to display "Air Temperature (Intake Air Temperature)."

3. Replace the T-MAP sensor if the difference between the ambient temperature and "Air Temperature (Intake Air Temperature)" is greater than ±5°C.

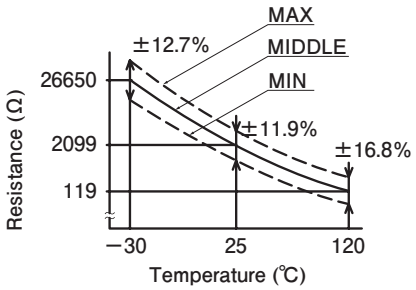
Inspect the MAT sensor when the engine is cold.



4. Measure the MAT sensor resistance. Replace the T-MAP sensor if the value is not as specified.

This test can be conducted without removing the part.

MAT (Intake Air Temperature) Sensor Resistance (Reference Value):
Between Vout TEMP ④ and GND terminal ②:
5.40 to 6.60 kΩ (0°C)
0.28 to 0.39 kΩ (80°C)
* If the ambient temperature is neither, refer to the graph on the right.



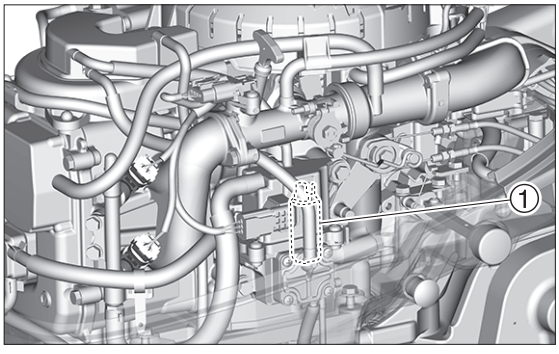
Inspection of the MAP Sensor

1. Measure the MAP sensor resistance. Replace the T-MAP sensor if the value is not as specified.

MAP (Intake Pressure) Sensor Conductivity:
Between Vout MAP ① and Vout TEMP ④: Conductive
Between Vout MAP ① and Vcc ③: Conductive

4) Inspection of the Fuel Feed Pump (FFP)

1. Connect a computer to the outboard motor and use the diagnosis system to check the operation of the fuel feed pump (FFP) ①.



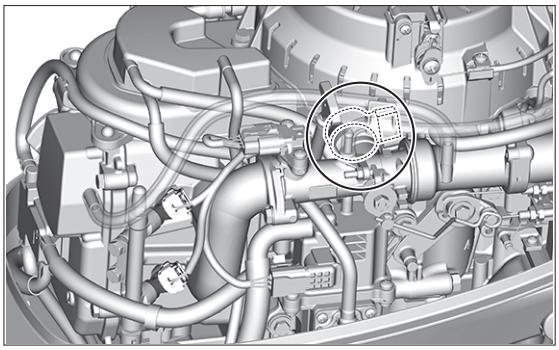
2. Check for the operating sound of the fuel feed pump (FFP). If it cannot be heard, check the electrical system.

This test can be conducted without removing the component.

5) Inspection of the Throttle Position Sensor (TPS)

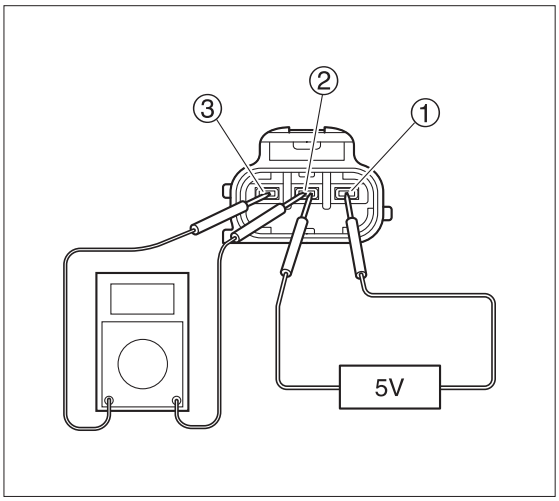
1. Check the throttle position sensor resistance. Replace the entire throttle body if the value is not as specified.

Resistance Between Terminals:
3.5 – 6.5 kΩ



2. Apply a voltage of 5 V between Vta ① and E2 ② and check the change in voltage between ③ and Vc ③.

The TPS output is proportional to the degree the main valve is open, from fully closed to fully open.

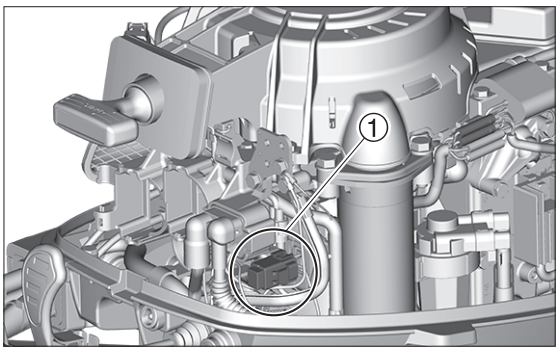


6. The Starting System (Except for MF)

1) Inspection of the Fuse

1. Check the conductivity of the fuse. Replace it if it is not conductive.

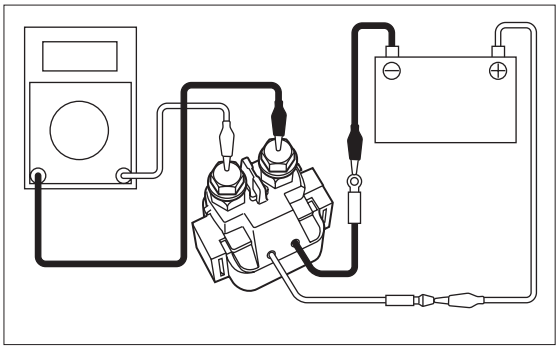
A flat, compact blade fuse is used.



① Fuse box

2) Inspection of the Starter Solenoid Switch

1. Connect the lead wires of the tester to the terminals of the starter solenoid switch.
2. Connect the green (G) lead wire to the battery's positive terminal.
3. Connect the black (B) lead wire to the battery's negative terminal.
4. Check the conductivity between the terminals of the starter solenoid switch. Replace it if it is not conductive.
5. Remove the battery terminal from the green (G) or the black (B) lead wire and check that there is no conductivity between the terminals of the starter solenoid switch. Replace it if it is conductive.



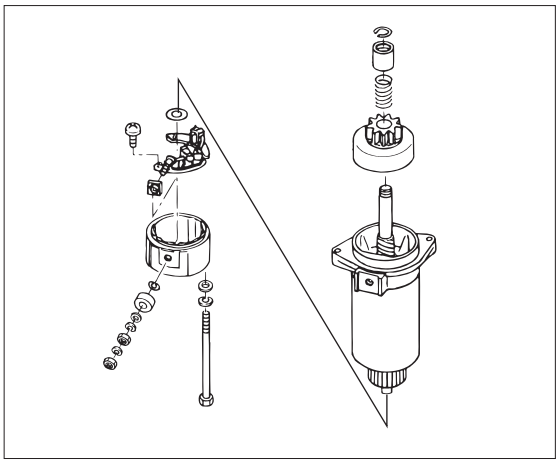
3) Disassembly of the Starter Motor Assy

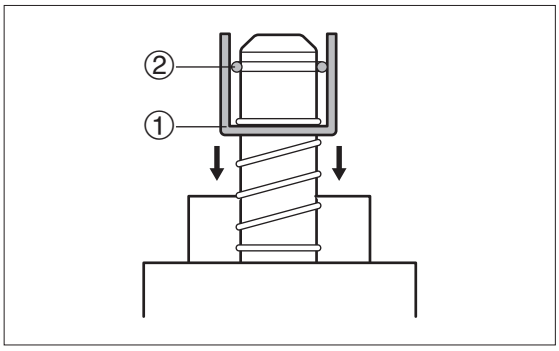
1. Mark the starter motor body and the cap with a locating mark (for ease of reassembly).

2. Slide the pinion stopper ① downward as shown and remove the clip ②.

> Use a small flathead screwdriver to remove the clutch. Be careful not to cut your hand, because the clip is secured firmly.

3. Remove the bolt and disassemble the starter motor assy.



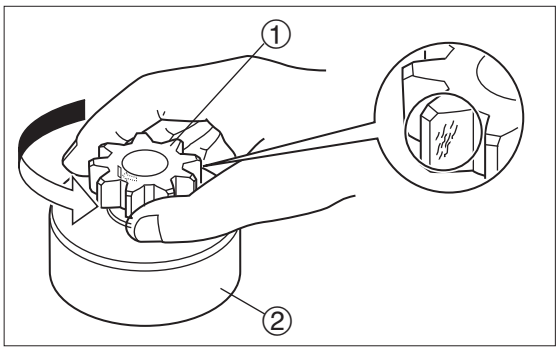


4) Inspection of the Pinion Assy

1. Check the pinion teeth for cracks and wear. Replace if necessary.

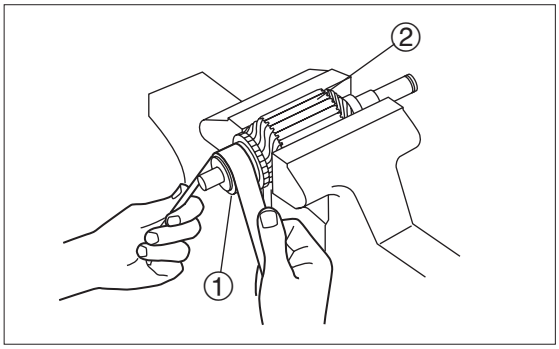
2. Secure the clutch ② and turn only the pinion gear ① to check that the pion gear moves smoothly in one direction. Replace if necessary.

> Turn the pinion gear counterclockwise and check that it rotates smoothly. Also, check that the pinion locks when it is turned clockwise.



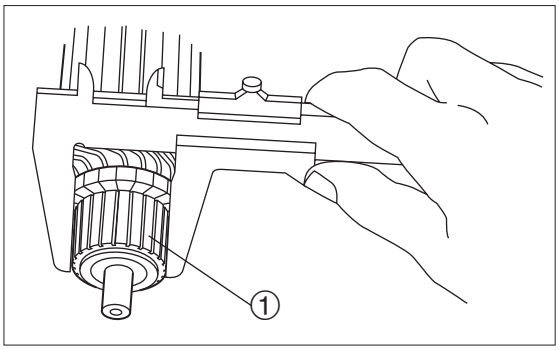
5) Inspection of the Armature

1. Check the commutator ① for dirt. Clean it using sand paper No. 600 or compressed air, if necessary.



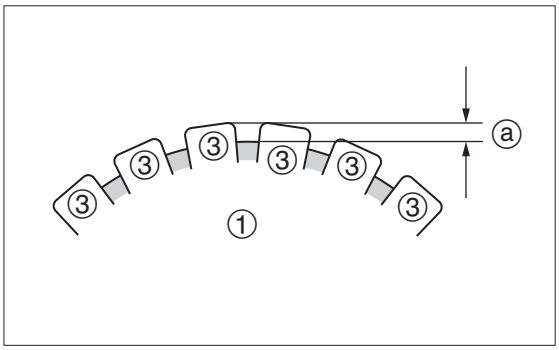
2. Measure the outer diameter of the commutator ①. Replace the starter motor assy if the value is below the specified value.

Commutator Outer Diameter: Standard Value	19.9 - 20 mm (0.783 - 0.787 in)
Wear Limit:	19.8 mm (0.780 in)



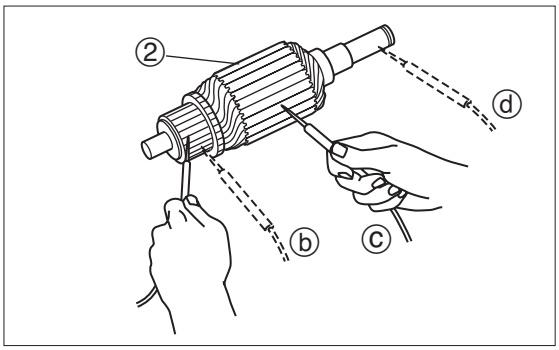
3. Measure the undercut ㉑ of the commutator . Replace the starter motor assy if the value is below the specified value.

Commutator Undercut: Standard Value	1.1 mm (0.043 in)
Wear Limit ⓐ:	-



4. Check the conductivity of the armature ②. Replace the starter motor assy if the value is not as specified.

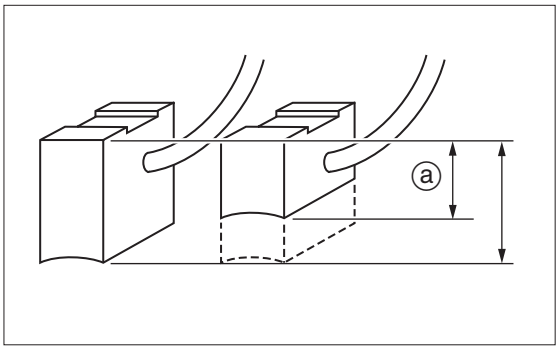
Armature Conductivity:	
ⓑ Between commutator segments ③ and ③	Conductive
ⓒ Between segment and armature core	Not conductive
ⓓ Between segment and armature shaft	Not conductive



6) Inspection of the Brush

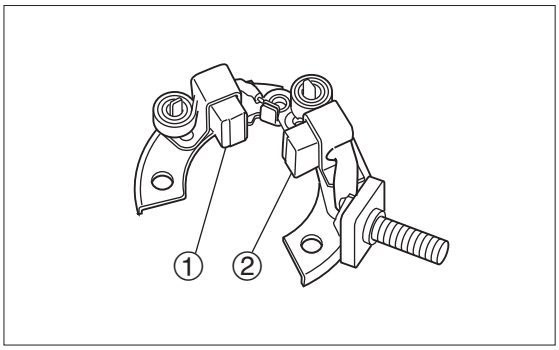
1. Measure the brush length. Replace the brush holder ass'y if the brush length is shorter than the specified value.

Brush Length ⓐ: Standard Value	6.9 - 7.1 mm (0.272 - 0.280 in)
Wear Limit ⓐ:	4.5 mm (0.177 in)



2. Check the conductivity of the brush holder ass'y. Replace if other than the specified value.

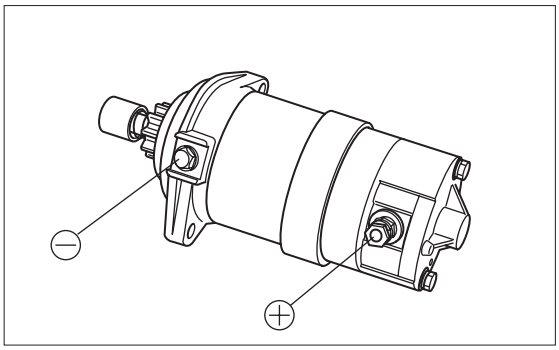
Conductivity Between Brushes	
Between Brush ① and Brush ②	Not conductive
Between brushes ①② and Ground	Not conductive



7) Operation Test of Starter Motor Assy

1. Assemble the starter motor assy and, before and after installing it in the power unit, apply an electric current between the positive and negative points to confirm that it is working normally.

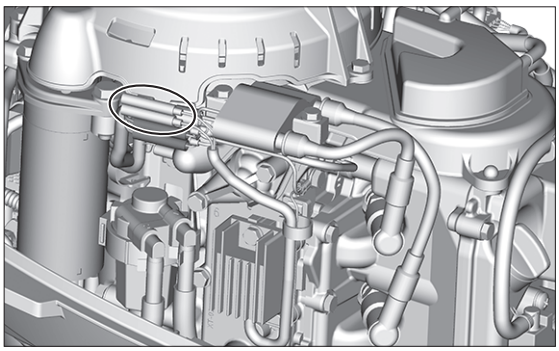
Be careful of fire, because the operating test generates sparks.



7. The Charging System (Except for MF)

1) Inspection of the Charge Coil

1. Cut and remove the band of the protector above the fuel filter assy.



2. Disconnect the cable connector from the charge coil and measure the resistance.

This test can be conducted without removing the part.

Alternator (Charge Coil) Resistance:
Reference (at 20°C)
Between White (W) – Yellow (Y)
0.46 to 0.68 Ω

2) Inspection of the Rectifier

- Check the wire harness for any disconnections or problems with the terminal connection.
- Check the conductivity of each part according to the following table. The values in ( ) are reference values.
- Disconnect all connections and measure as a separate unit.

This test can be conducted without removing the part.

Rectifier Tester Check Table "ON" means conductive, and "OFF" means not conductive.

	Tester Lead Positive (+) Side (Red)				
Tester Lead Negative (–) Side (Black)		Red R	White W	Black B	Yellow Y
	Red R		ON (7 kΩ)	ON (5 kΩ)	ON (7 kΩ)
	White W	OFF		ON (7 kΩ)	OFF
	Black B	OFF	OFF		OFF
	Yellow Y	OFF	OFF	ON (7 kΩ)	

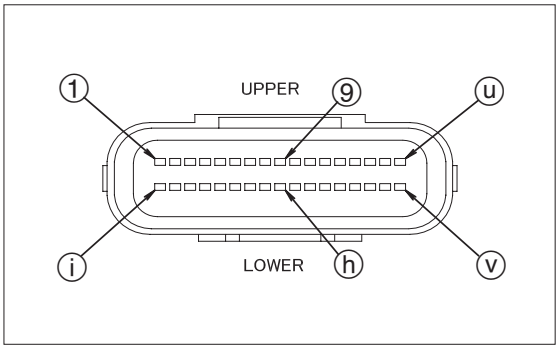
- Measurement conditions Circuit tester to be used: HIOKI3030
- Range to be used: 1kΩ
- Permissible error of resistance is ±20%

Note) ① HIOKI HiTESTER MODEL 3030 was used for this measurement. Using another tester can result in an abnormal resistance value and an inaccurate test.
② Disconnect all connections and measure as a separate unit.
③ Any movement of the tester needle is displayed as "ON" and indicates that it is conductive.
④ "CON" display is a characteristic of the condenser in which the needle moves once and then returns to stabilize at the value shown in ( ).
⑤ The value in ( ) is the value when the "1kΩ" range is used. Because the unit contains diodes, this value varies widely depending on the type and state of the tester (such as the internal power supply) and the range.

8. ECU Coupler

- Check the wire harness for any disconnections or problems with the terminal connection.
- The location of each terminal number is shown in the diagram to the right.
- The name and lead wire color of each terminal number are shown in the table below.

Terminal	Name	Lead Wire (Color)	
A1	Ignition Coil	Or	Orange
A2	Warning Buzzer	Y	Yellow
A3	H ECU Coil	B/R	Black/White
A4	Injector Power Supply (12 V)	L	Blue
A5	L ECU Coil	L	Blue
A6	T-MAP Sensor (MAP)	G/Or	Green/Orange
A7	Sensor Power Supply (5 V)	R/W	Red/White
A8	Pulser Coil	R/W	Red/White
A9	Pulser Coil (Ground)	B	Black
A10	Ground	B	Black
A11	Diagnosis	W	White
A12	Diagnosis Communication Power Supply (5 V)	R/W	Red/White
A13	Power Supply Input (COM.)	R	Red
A14	Boot Mode	L	Blue
A15	Fuel Pump (FFP) W	B/G	Black/Green
A16	Fuel Pump (FFP) V	B/Y	Black/Yellow
A17	Fuel Pump (FFP) U	B/W	Black/White
A18	#1 Injector	Lg/R	Light Green/Red
A19	#2 Injector	Lg/B	Light Green/Black
A20	ISC Valve	G/R	Green/Red
A21	Tachometer	W	White
A22	Tachometer Lamp	Lg	Light Green
A23	TPS	L/W	Blue/White
A24	Engine Temperature Sensor	G/Y	Green/Yellow
A25	T-MAP Sensor (MAT)	G/W	Green/White
A26	Blank		
A27	Sensor (Ground)	B/L	Black/Blue
A28	Diagnosis	Y	Yellow
A29	Stop Switch	Br	Brown
A30	Oil Pressure Switch	Br/W	Brown/White
A31	Blank		
A32	Blank		
A33	Warning Lamp	Lg	Light Green
A34	Ground	B	Black



ECU Coupler

9

Troubleshooting

1. Troubleshooting List

* Low speed ESG is activated

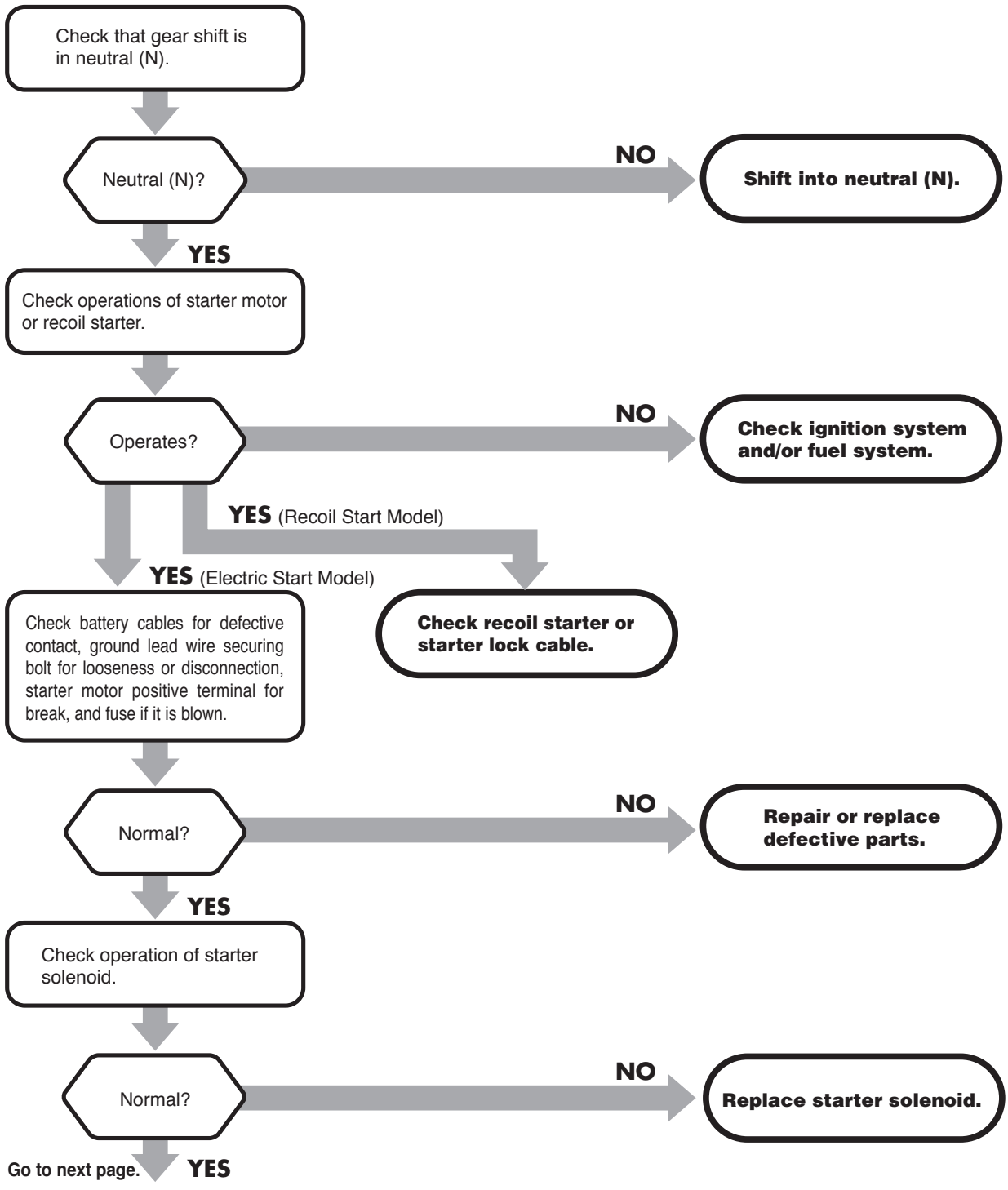
	Engine will not start	Engine stalls immediately after starting	Defective idling	Defective acceleration	Engine RPM is high High speed ESG is activated	Engine RPM is low (*Low speed ESG is activated)	Boat cannot run at high speed.	Engine overheats.	Battery is not charging	Starter motor does not operate	Power tilt does not operate	Warning lamp ON	Warning lamp flashing	Probable Cause
Fuel and Lubrication Systems	○	○												Fuel level is low in the tank.
	○	○	○	○		○	○	○						Fuel system connection is incomplete.
	○	○	○	○		○	○	○						Fuel system sucks air.
	○	○	○	○		○	○	○						Fuel pipe is twisted.
	○	○	○	○		○	○	○						Cap vent is closed.
	○	○	○	○		○	○	○						Fuel filter, fuel pump or injector is clogged.
	○		○	○			○	○						Low quality gasoline is used.
	○													Primer bulb is clogged.
	○	○	○	○		○	○	○						Fuel feed pump (FFP) malfunctions or is clogged.
						○ *							○ *	Engine temparature sensor is defective or the sensor circuit is disconnected.
			○	○		○	○	○						Low quality engine oil is used.
			○	○										Engine oil quantity excessive (Exhaust smoke is generated.)
						○ *		○				○ *		Insufficient engine oil (oil pressure switch activated).
						○ *		○				○ *		Clogged engine filter (oil pressure switch activated).
						○ *		○				○ *		Defective oil pump (oil pressure switch activated).
Electrical System	○	○	○	○		○	○	○						Use of spark plugs not specified.
	○	○	○	○		○	○							Spark plug is contaminated.
	○	○	○	○		○	○							No spark or weak spark.
	○													Stop switch short-circuited.
	○													Stop switch lock is not installed.
	○								○	○	○			Defective wiring, ground, wire disconnected or loosened.
	○								○	○	○			Battery charging is defective, or rectifier malfunctions.
	○								○	○	○			Battery is dead, connection is loose or corroded. Battery electrolyte level is low.
	Cell (o)								○	○	○			20A fuse is blown.
	○									○				Shift lever neutral (N) position is not proper position.
	○									○	○			Start switch or main switch is defective.
	○									○				Starter motor or starter solenoid operation is defective.
											○			PT switch or solenoid is defective.
											○			Air is mixed in PT fluid.
Compression System	○	○	○	○			○							Valve timing is not correct (Belt is stretched or installed incorrectly).
	○	○	○	○			○							Valve clearance is defective.
	○	○	○	○			○							Valve seat sealing is defective.
	○	○	○	○			○							Piston, piston ring and/or cylinder is worn excessively.
			○					○						Combustion chamber carbon deposition is too much.
			○	○			○	○						Spark plug is loose.
Other			○			○ *	○	○				○ *		(Insufficient cooling water) Pump defective or clogged.
						○ *	○	○				○ *		Thermostat operation is defective.
				○	○		○	○				○		Anti-ventilation plate is damaged
				○	○	○	○	○				○		Use of mismatched propeller.
			○	○	○	○	○	○				○		Propeller is damaged or deformed.
				○	○		○	○				○		Thrust rod position is not correct.
				○	○	○	○	○				○		Boat is unbalanced by load position.
				○	○	○	○	○				○		Transom installation height is too high or too low.
				○		○	○							Throttle link adjustment is defective.

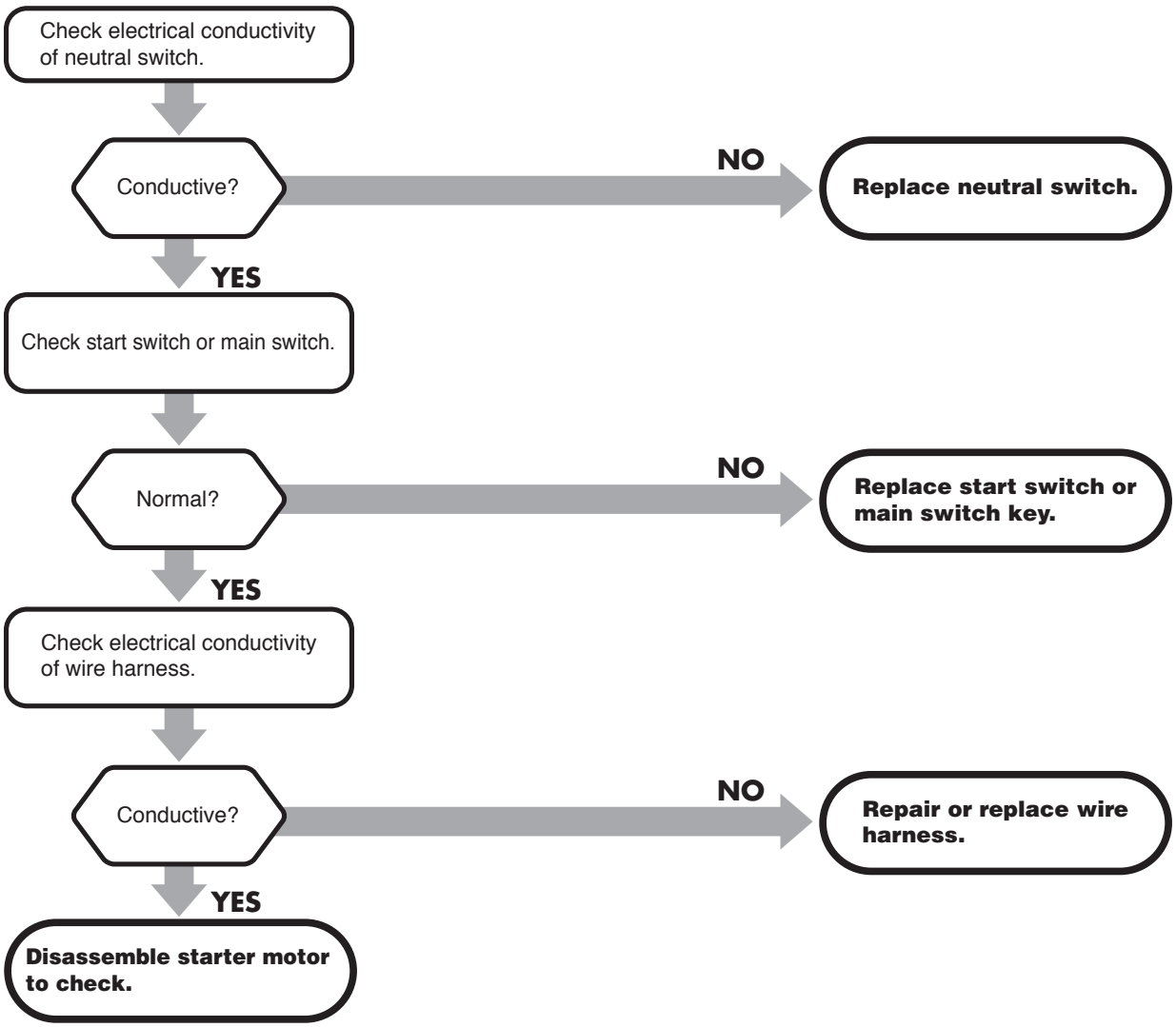
Before working on the engine, check the installation condition of the hull, rigging, and engine, and make sure the fuel is normal and the battery is fully charged. For mechanical troubleshooting, refer to the relevant troubleshooting section in this chapter. For checking and servicing the outboard motor, refer to the service procedures described in this manual to perform the work safely.

Power Unit

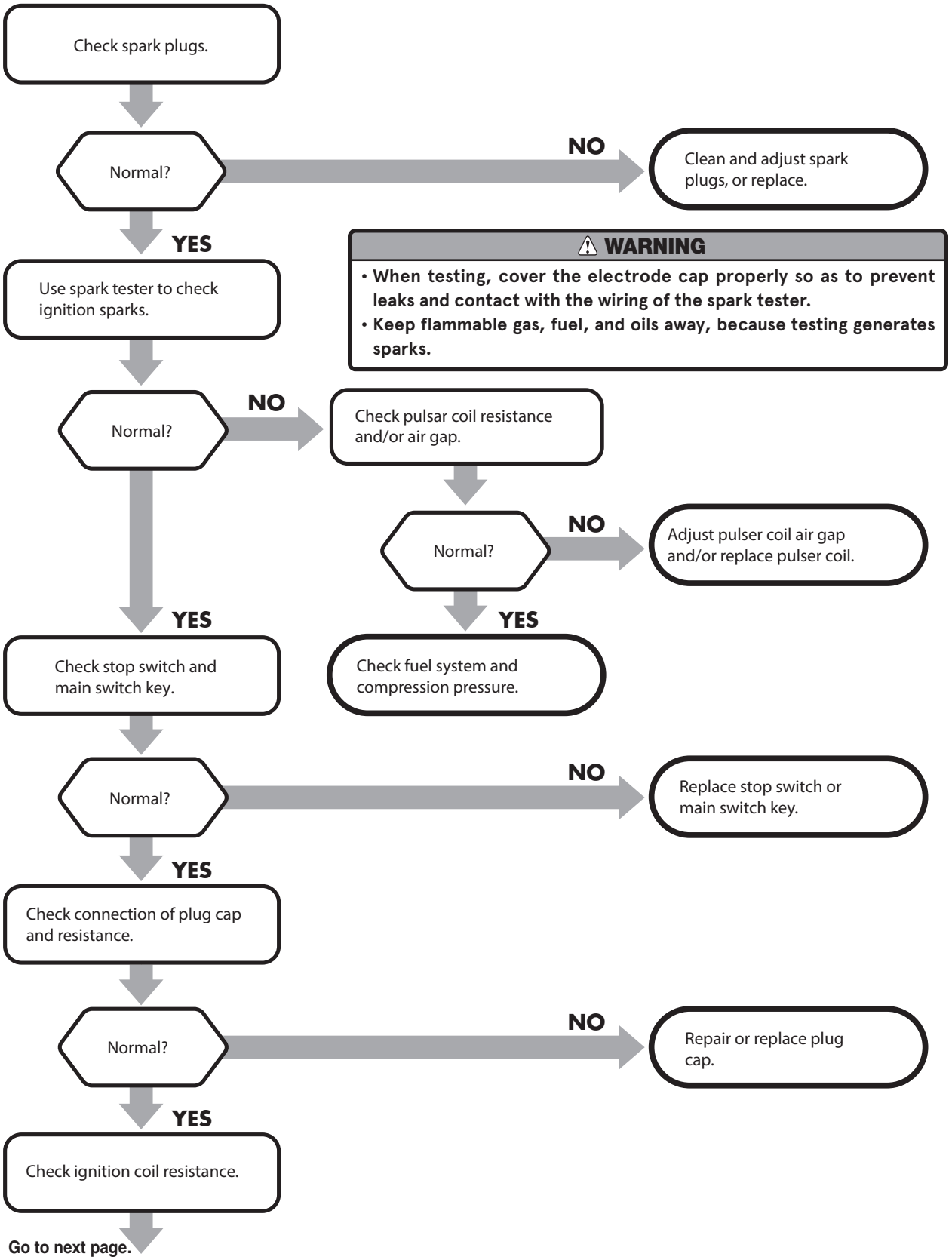
State 1 **Engine will not start or is hard to start.**

Starting System

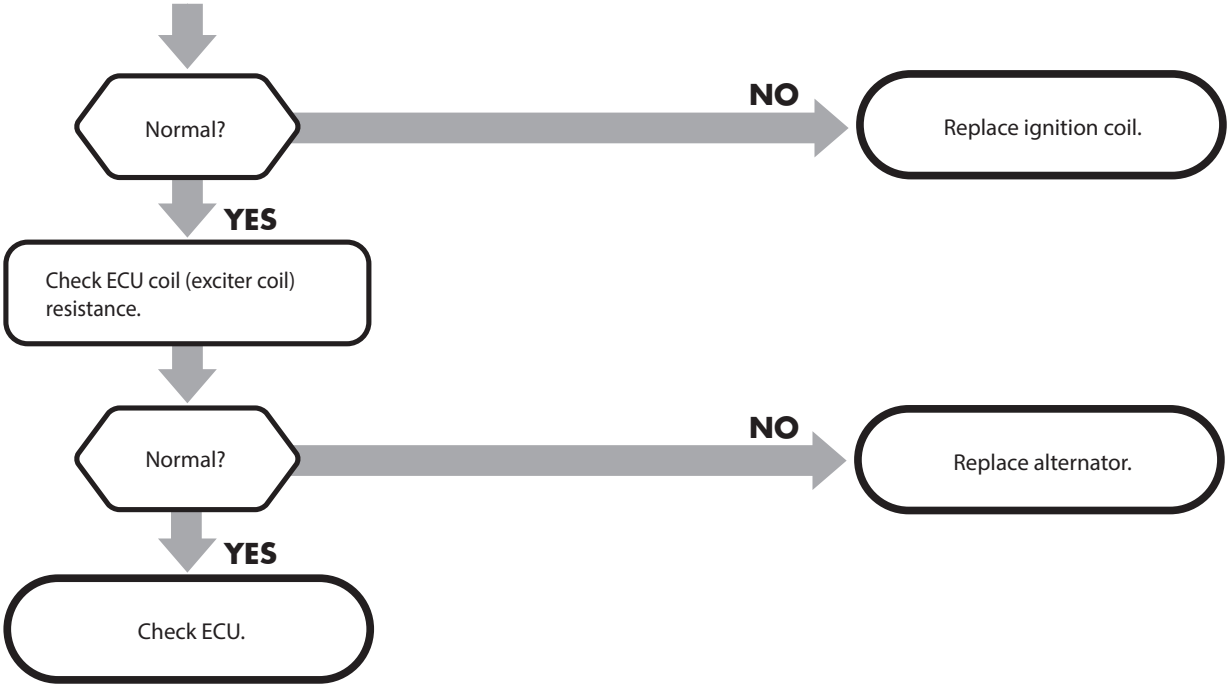


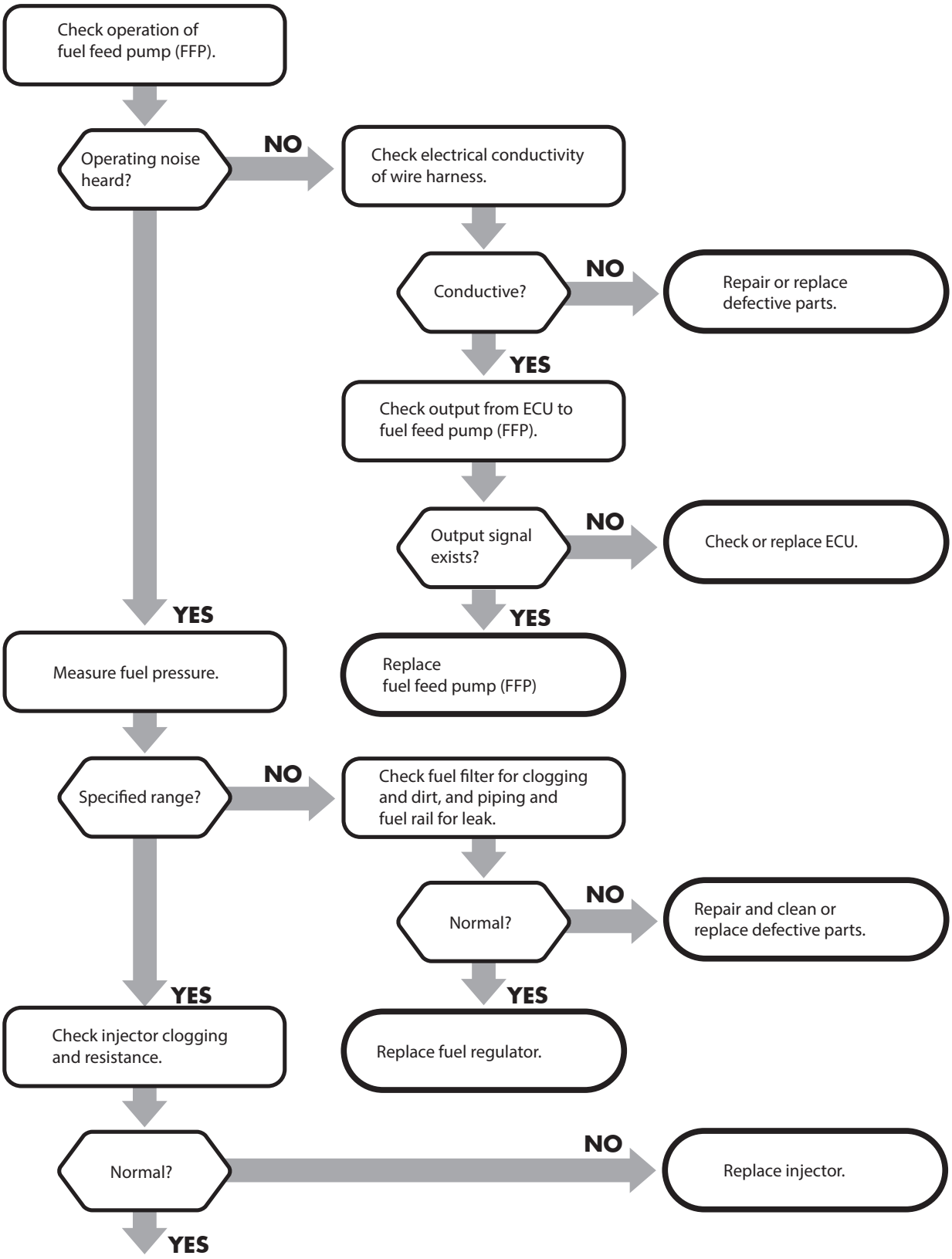

Check electrical conductivity of neutral switch.
Conductive?
NO
Replace neutral switch.
YES
Check start switch or main switch.
Normal?
NO
Replace start switch or main switch key.
YES
Check electrical conductivity of wire harness.
Conductive?
NO
Repair or replace wire harness.
YES
Disassemble starter motor to check.

Ignition System

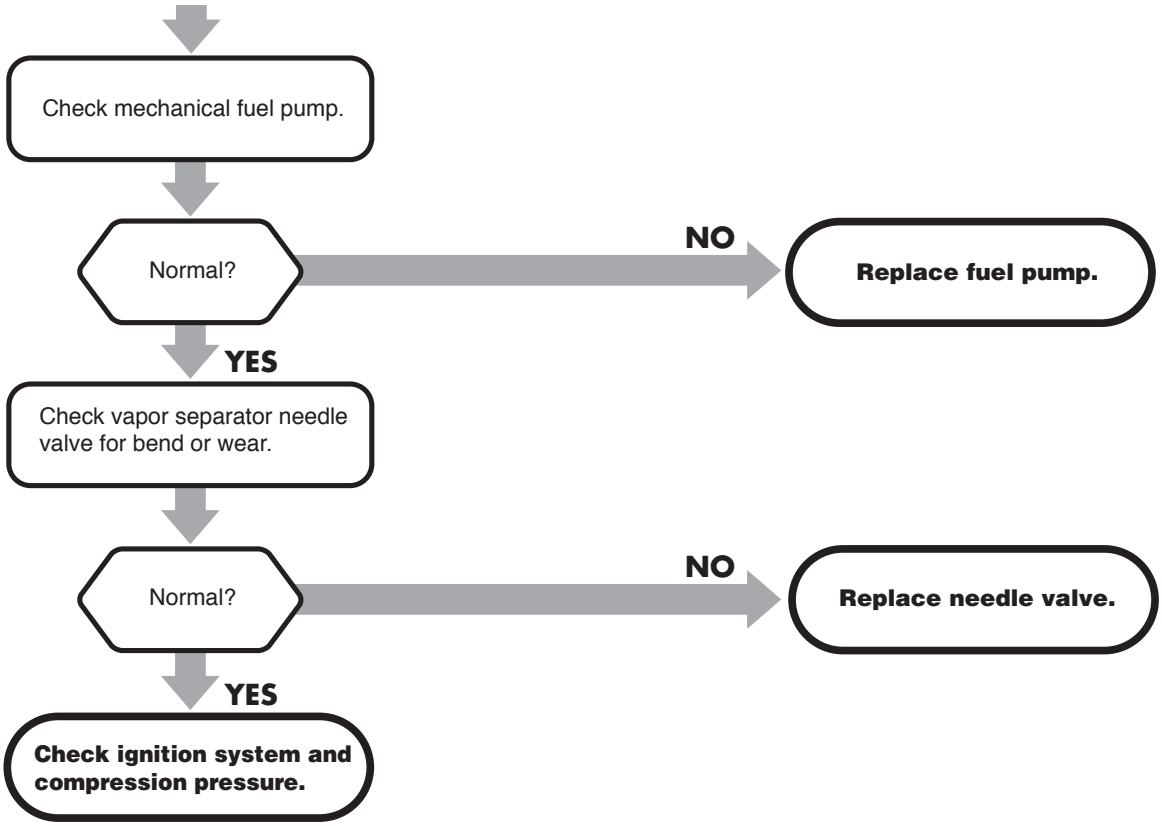


9

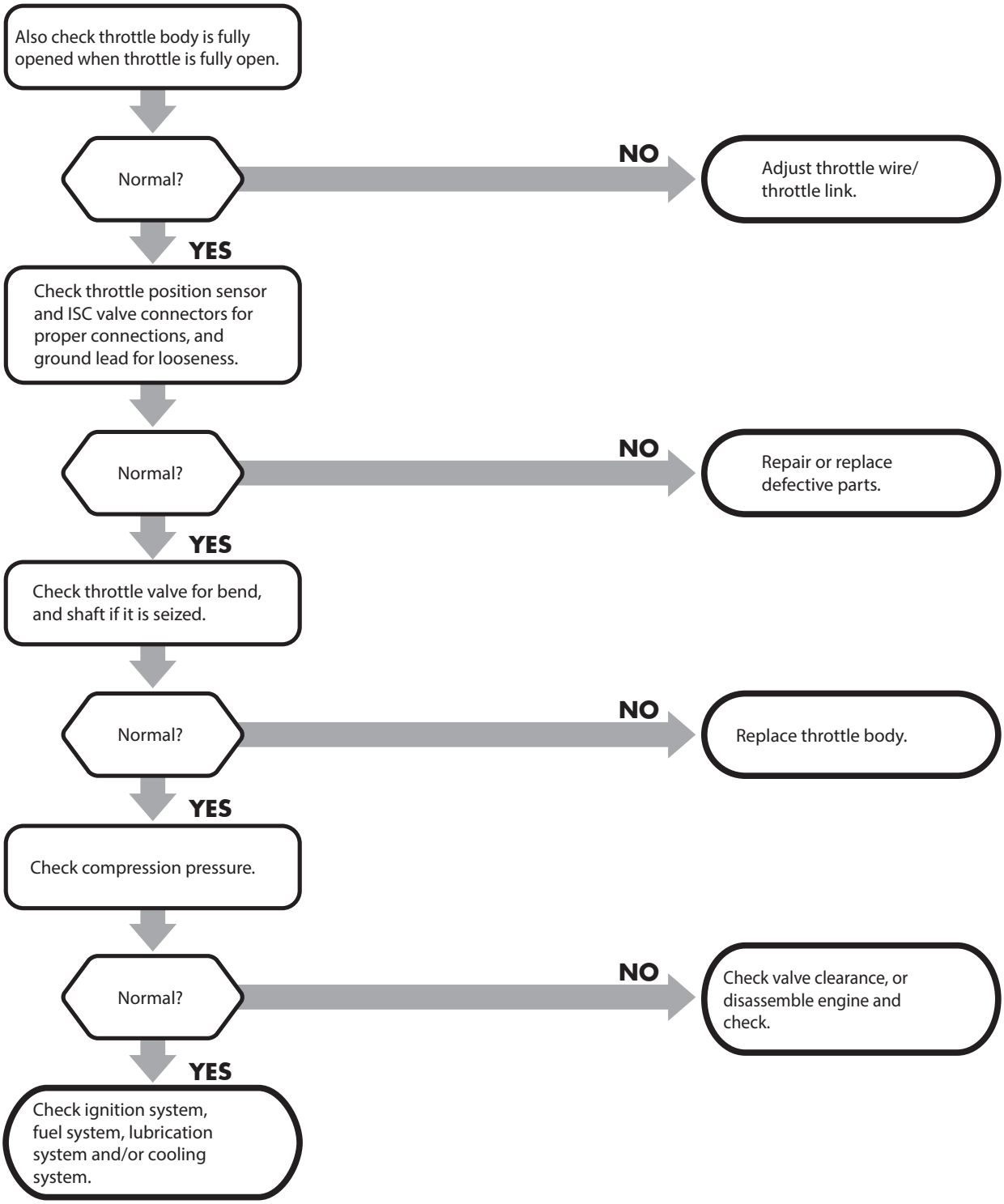

Normal?
NO
Replace ignition coil.
YES
Check ECU coil (exciter coil) resistance.
Normal?
NO
Replace alternator.
YES
Check ECU.



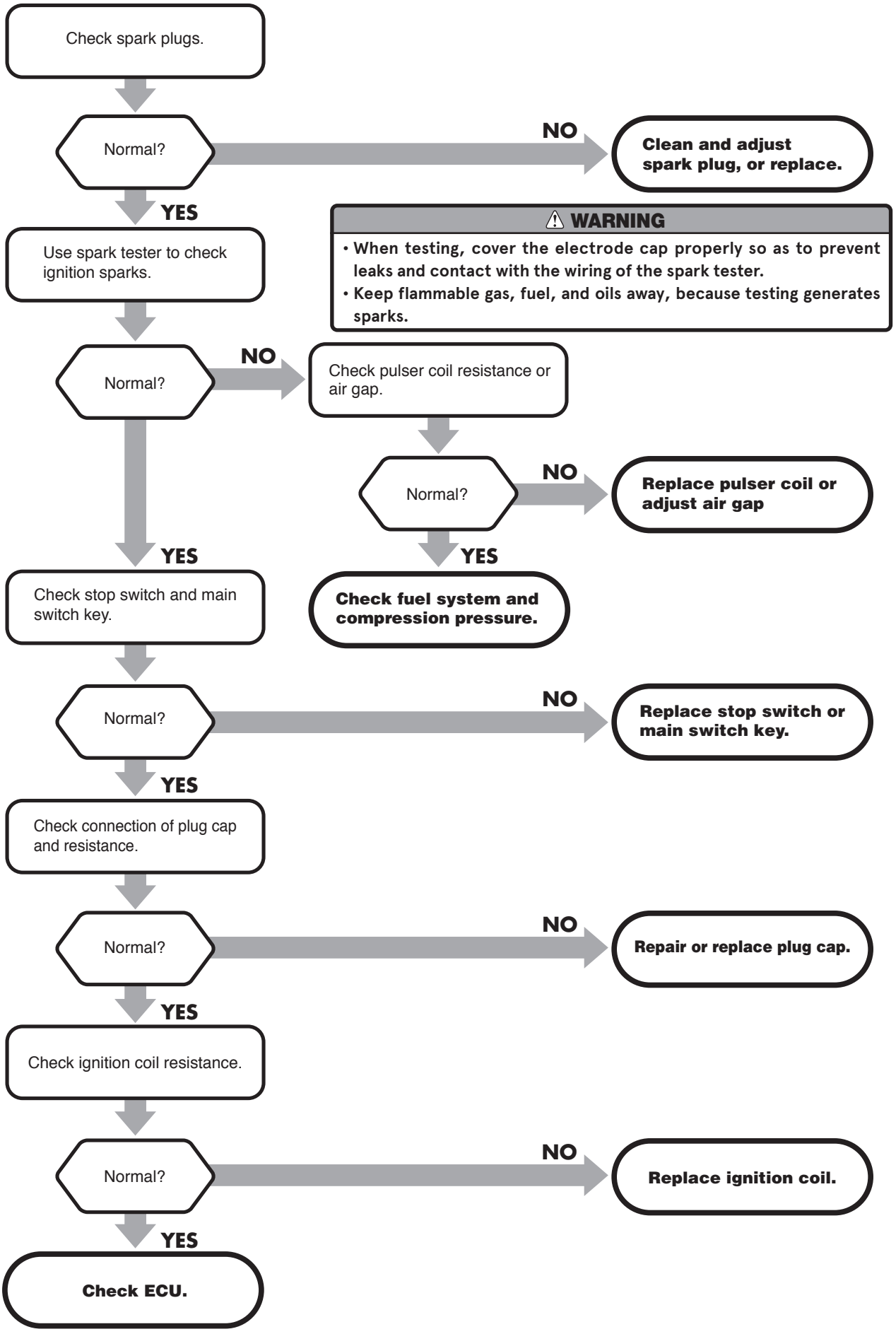
Go to next page.

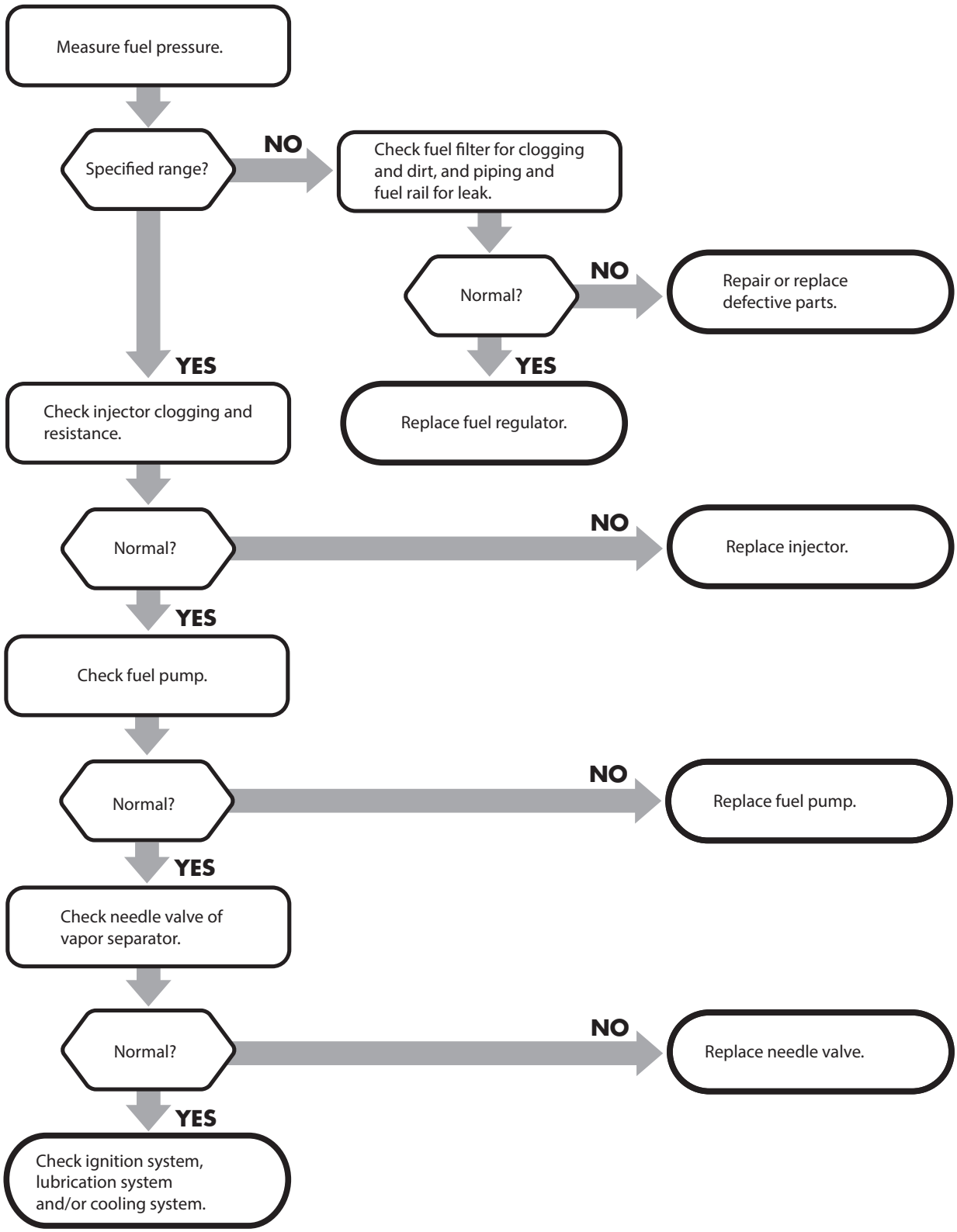

Check mechanical fuel pump.
Normal?
NO
Replace fuel pump.
YES
Check vapor separator needle valve for bend or wear.
Normal?
NO
Replace needle valve.
YES
Check ignition system and compression pressure.

State 2 **Full throttle engine revolution speed is low. Engine revolution speed falls off. Engine stalls. (Defective acceleration or deceleration)**

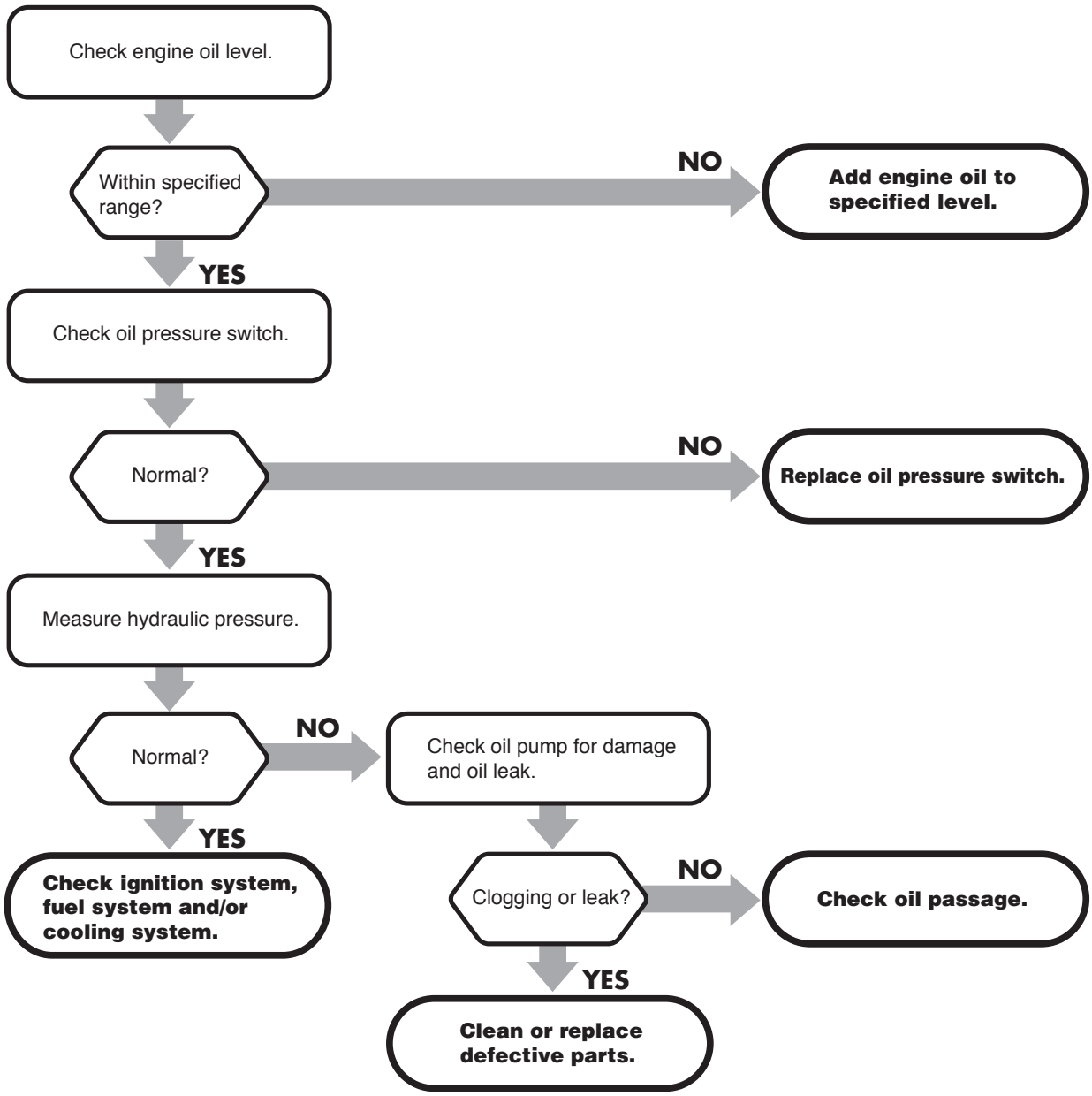


Ignition System

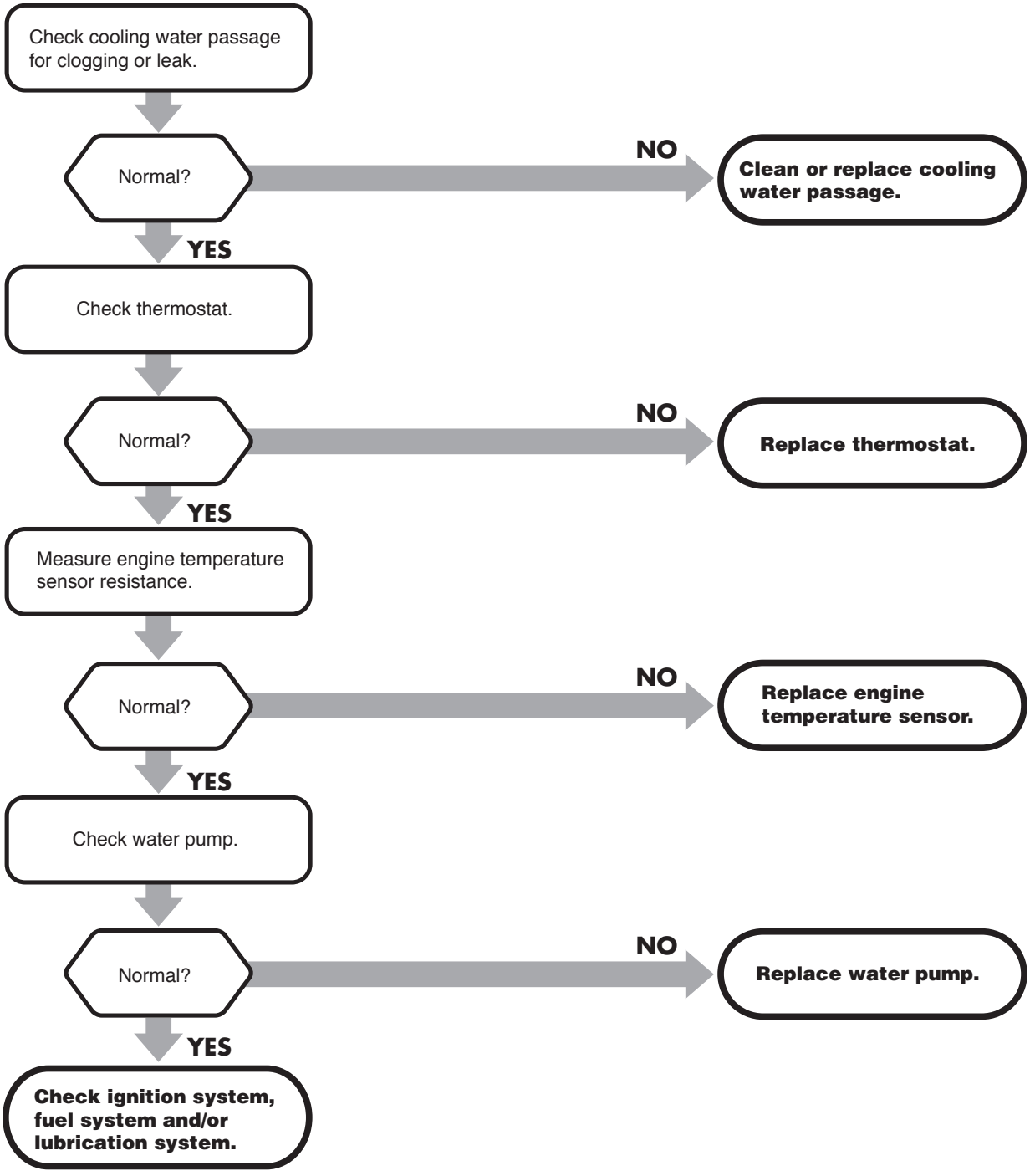



Measure fuel pressure.
Specified range?
NO
Check fuel filter for clogging and dirt, and piping and fuel rail for leak.
Normal?
NO
Repair or replace defective parts.
YES
YES
Check injector clogging and resistance.
Replace fuel regulator.
Normal?
NO
Replace injector.
YES
Check fuel pump.
Normal?
NO
Replace fuel pump.
YES
Check needle valve of vapor separator.
Normal?
NO
Replace needle valve.
YES
Check ignition system, lubrication system and/or cooling system.

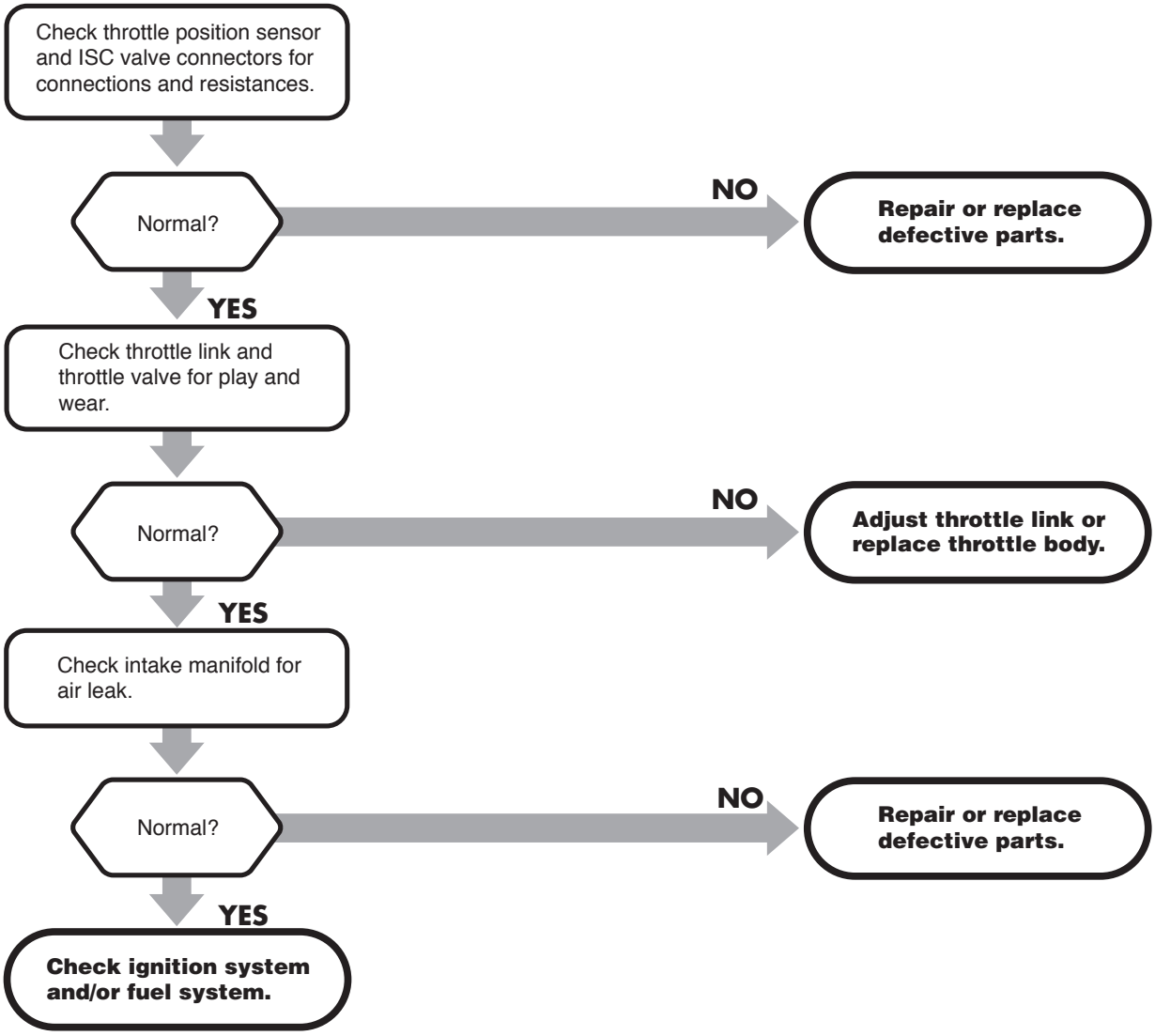
Lubrication System



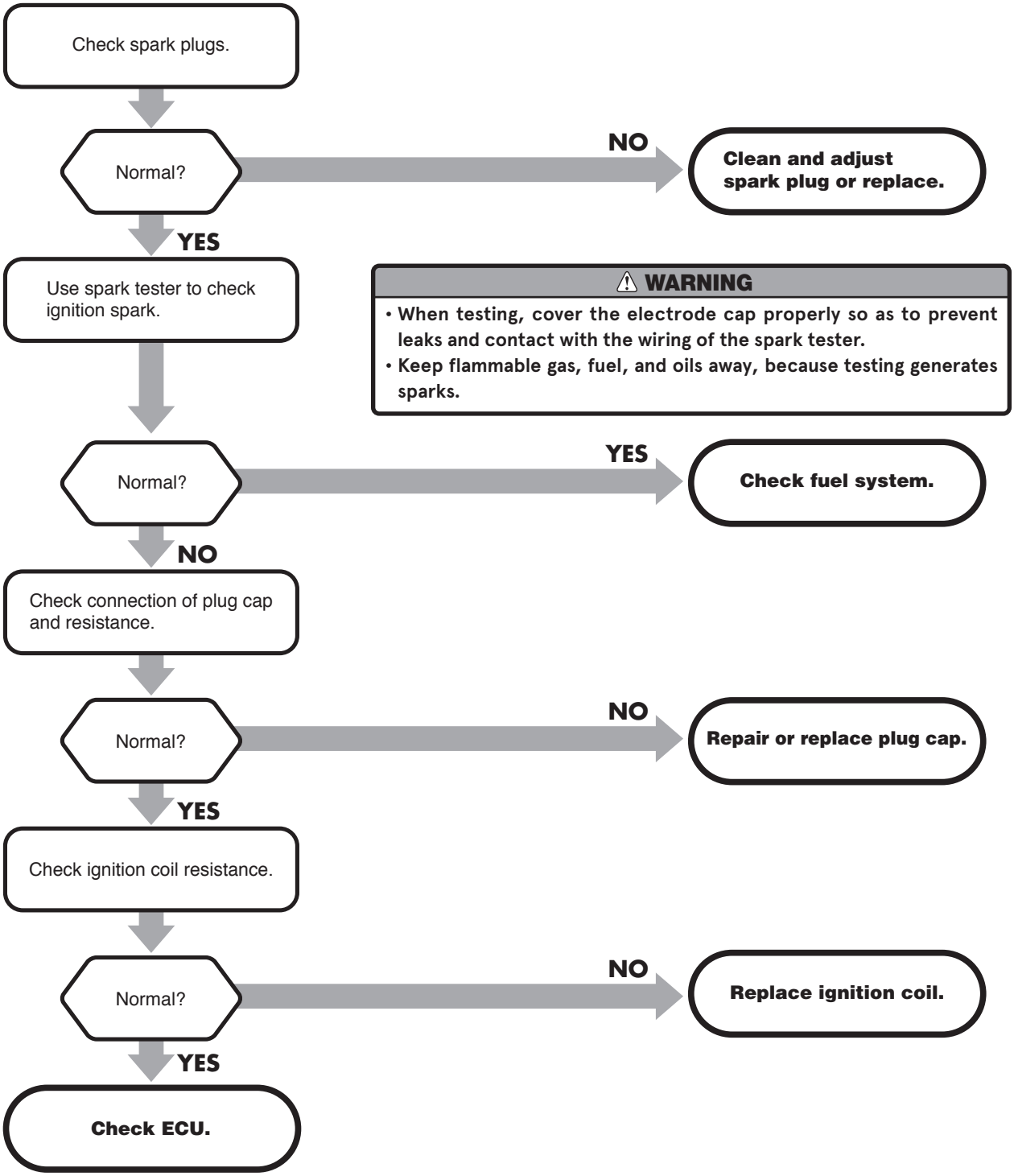
Cooling System



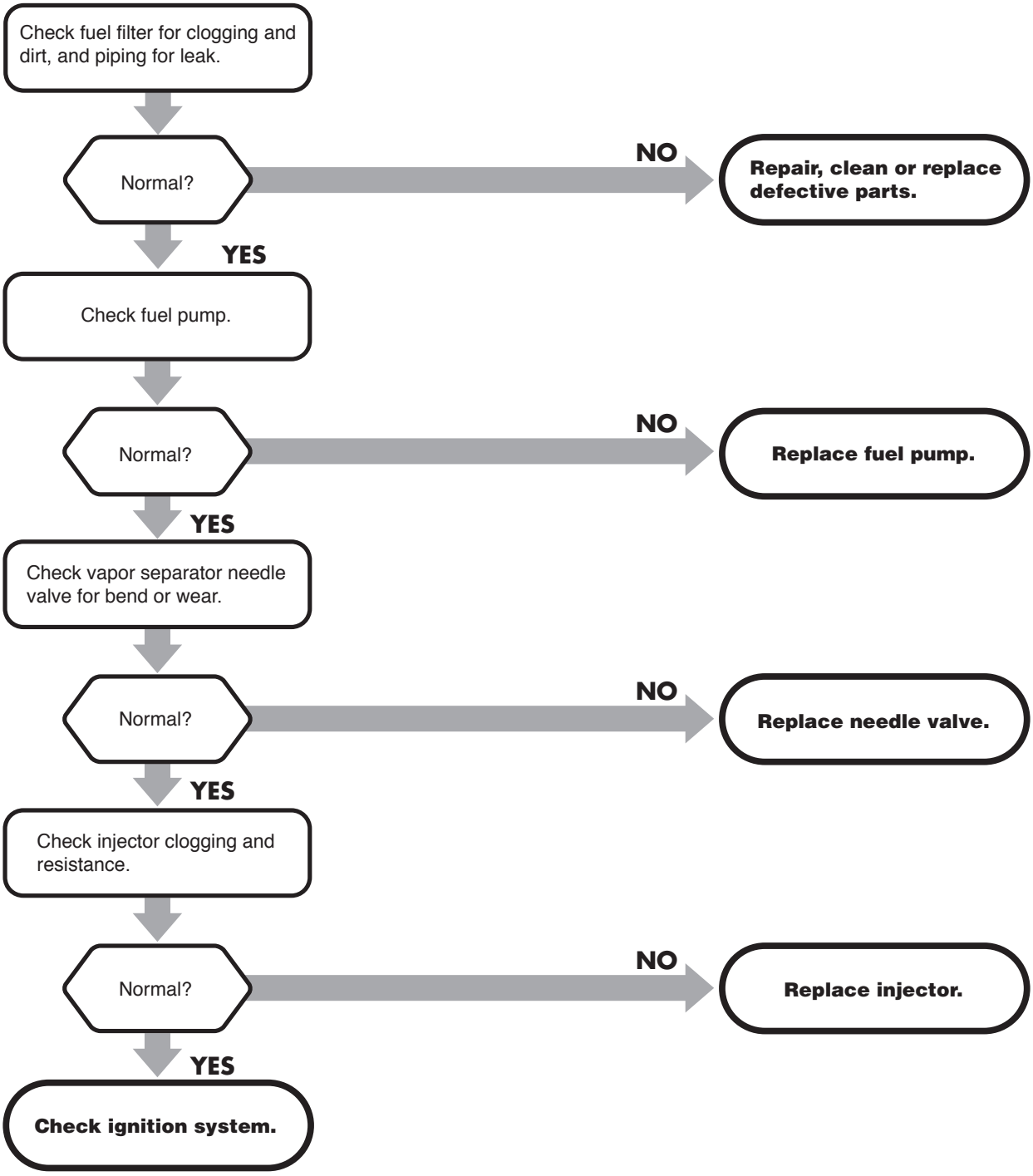
State 3 **Engine rotation is unstable or hunting occurs in low speed range.**



Ignition System

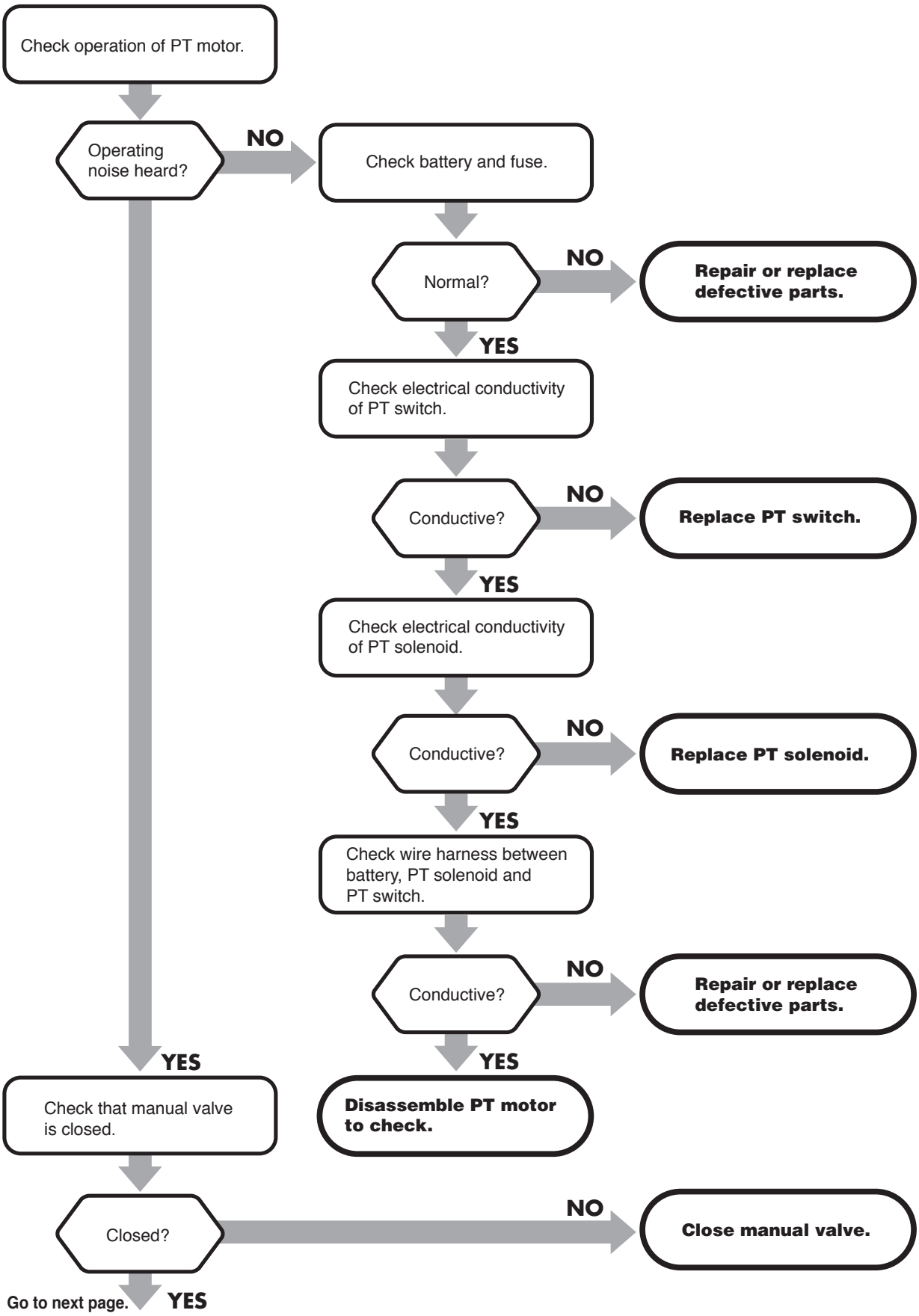


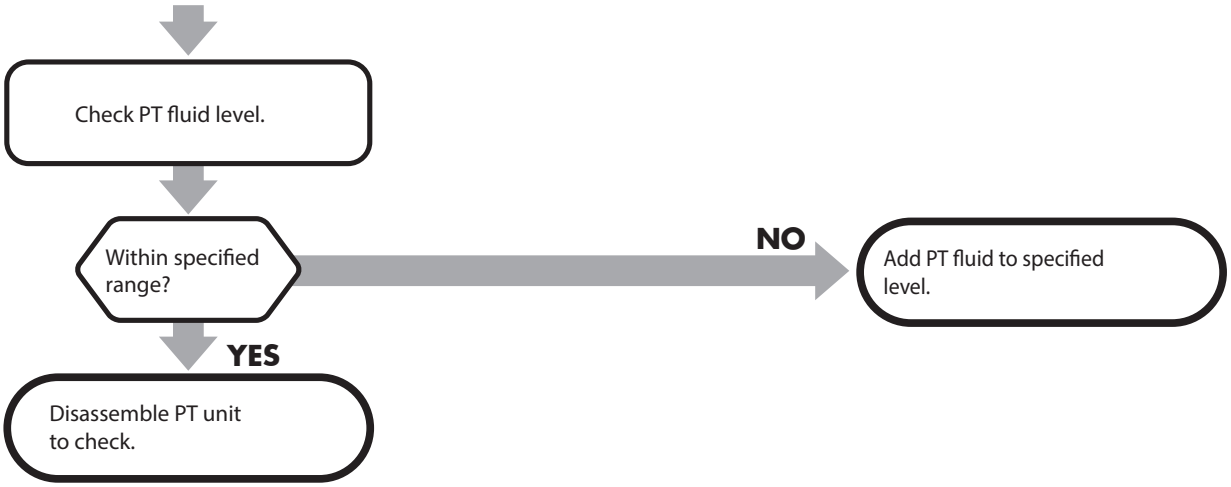
Fuel System


Check fuel filter for clogging and dirt, and piping for leak.
Normal?
NO
Repair, clean or replace defective parts.
YES
Check fuel pump.
Normal?
NO
Replace fuel pump.
YES
Check vapor separator needle valve for bend or wear.
Normal?
NO
Replace needle valve.
YES
Check injector clogging and resistance.
Normal?
NO
Replace injector.
YES
Check ignition system.

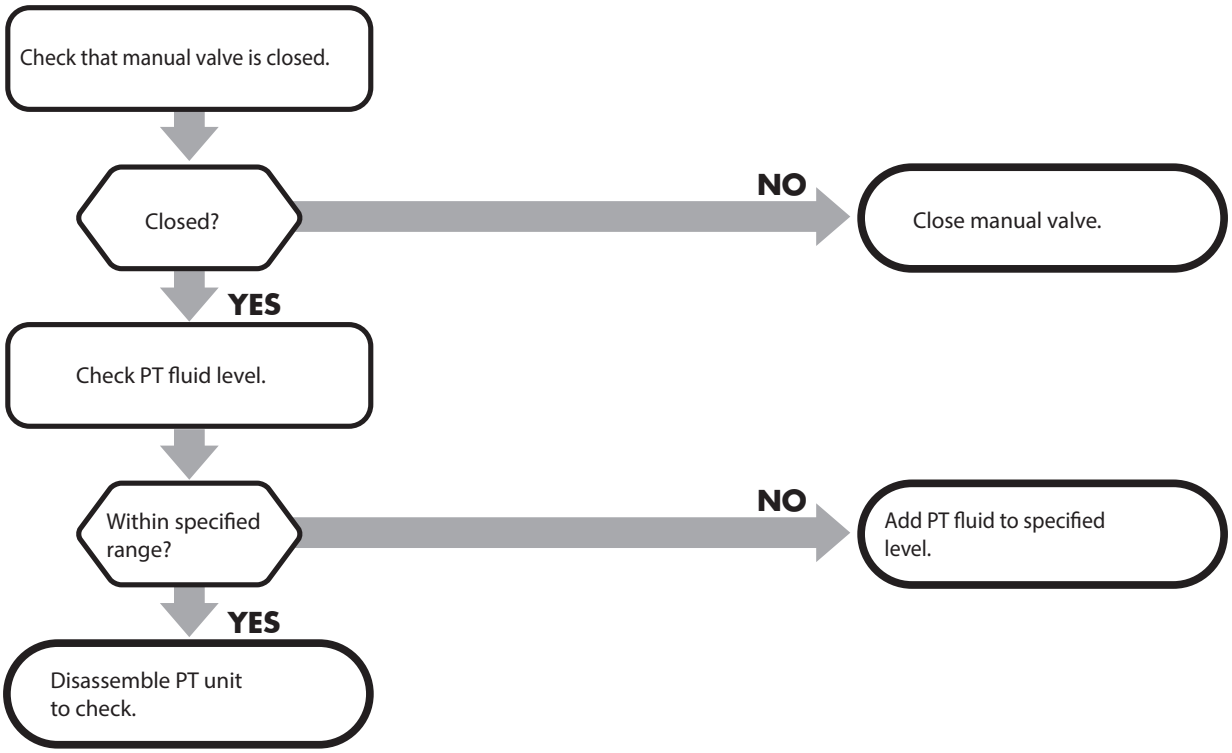
PT Unit

State 1 **PT unit will not operate.**





State 2 **PT unit is not capable of sustaining the outboard motor.**



Diagnosis

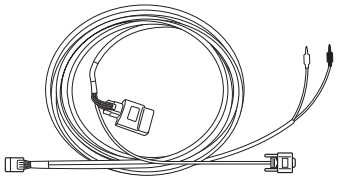
An electronically controlled engine can be connected to a PC to diagnose the status of the engine.

Information that can be viewed include self-diagnosis, malfunction records, and status during operation.

The operation of individual electronic components of the engine can be viewed to determine the malfunction.

To use the diagnosis tool kit, the software must be installed.

For how to install the software and how to use the diagnosis tool kit, refer to the instruction manual in the downloaded diagnostic program.



Diagnosis Tool Kit
P/N. 3RS-72920-0

Used to diagnose engine failures

10

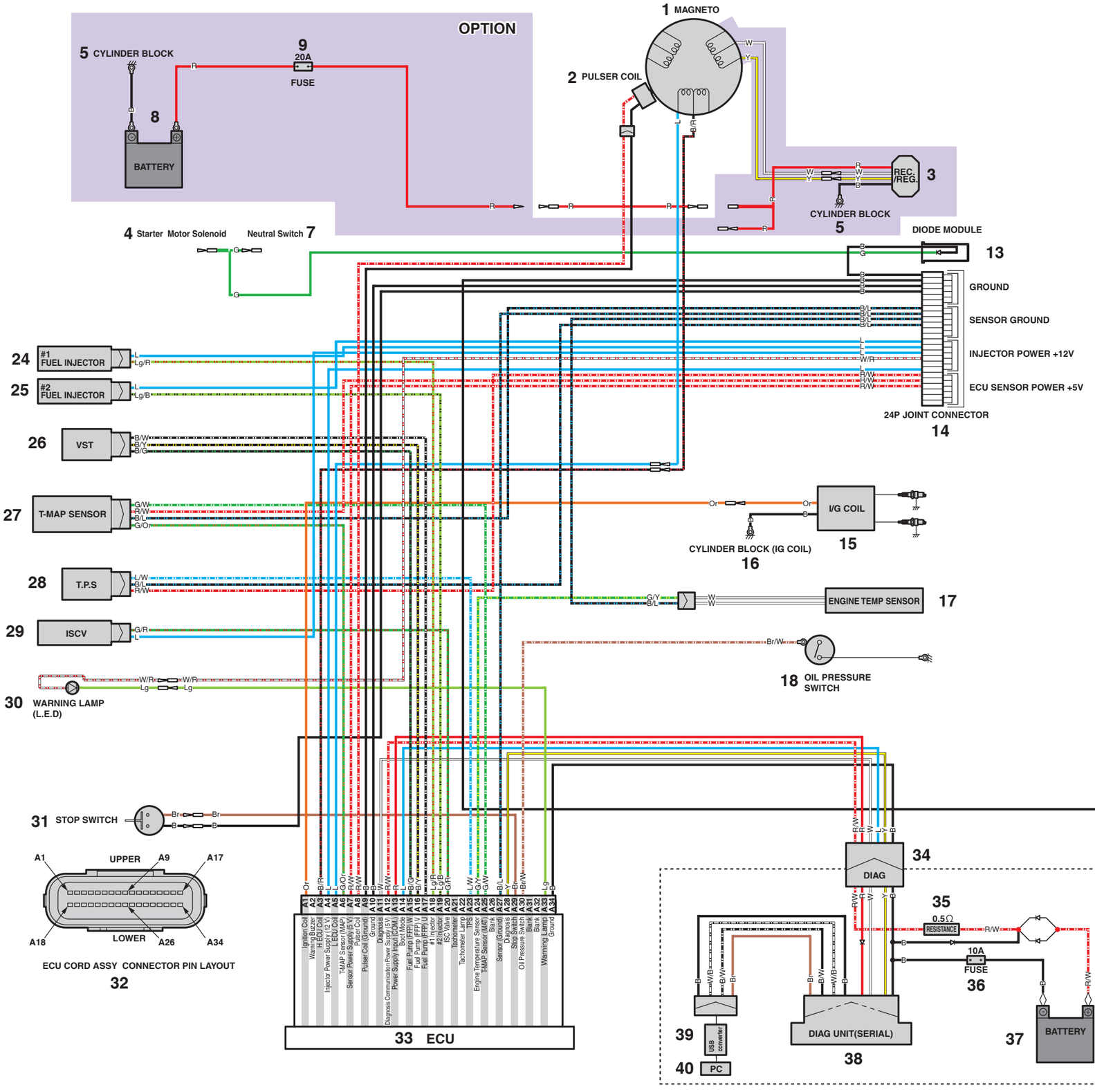
Wiring Diagram

Wiring Chart

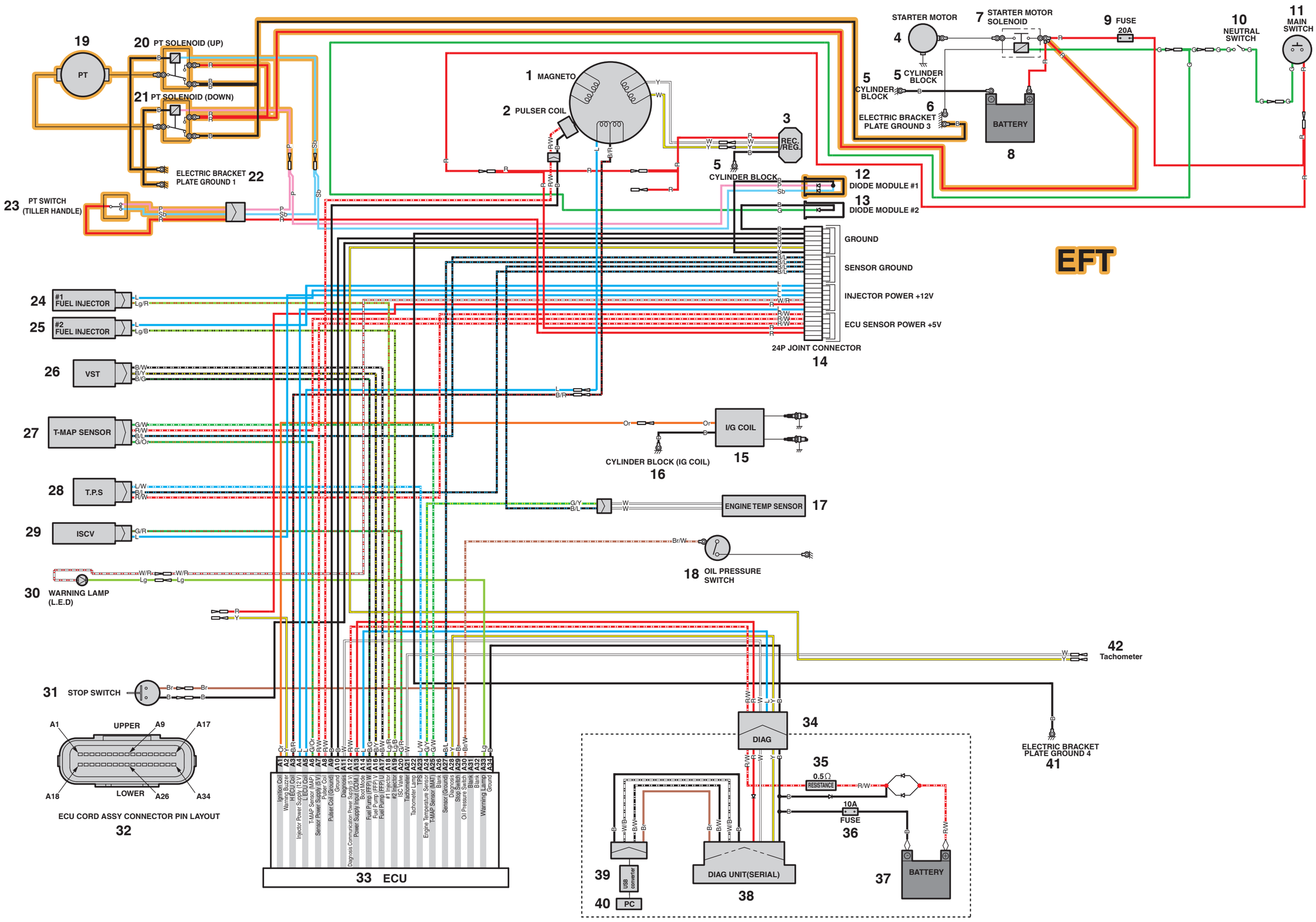
NO.	Name	Remarks	ECU	Lead Wire Color				ECU
1	Magneto	ECU Coil	A5	L	Blue	B/R	Black/Red	A3
		Charge Coil (except for MF model)	-	Y	Yellow	W	White	-
2	Pulser Coil		A8	R/W	Red/White	B	Black	A9
3	Rectifier/Regulator	(except for MF model)	-	R	Red	W	White	-
			-	Y	Yellow	B	Black	-
4	Starter Motor	(except for MF model)	-	B	Black	B	Black	-
5	Cylinder Block	Ground	-	B	Black	Ground		-
			-	B	Black	-	-	-
6	Electrical Bracket Plate	Ground	-	B	Black	B	Black	-
7	Starter Solenoid	(except for MF model)	-	R	Red	B	Black	-
			-	G	Green	B	Black	-
8	Battery	(except for MF model)	-	R	Red	B	Black	-
9	Fuse	20A (except for MF model)	-	R	Red	R	Red	-
10	Neutral Switch	EFT Model	-	G	Green	G	Green	-
11	Main Switch	EFT Model	-	R	Red	G	Green	-
12	Diode Module	#1	-	Sb	Sky Blue	P	Pink	-
			A10	B	Black	-	-	-
13	Diode Module	#2	-	G	Green	B	Black	A10
14	Joint Connector	24P	-	-				-
15	Ignition Coil		A1	Or	Orange	B	Black	-
16	Cylinder Lock (Ignition Coil)		-	B	Black	-	-	-
17	Engine TEMP Sensor		A24	G/Y	Green/Yellow	B/L	Black/Blue	A27
18	Oil Pressure Switch		A30	Br/W	Brown/White	Ground		-
19	PT Motor	PT Model	-	L	Blue	G	Green	-
20	PT Solenoid	UP Side / PT Model	-	Sb	Sky Blue	L	Blue	-
			-	R	Red	B	Black	-
			-	B	Black	-	-	-
21	PT Solenoid	DOWN Side / PT Model	-	P	Pink	G	Green	-
			-	R	Red	B	Black	-
			-	B	Black	-	-	-
22	Electrical Bracket Plate		-	B	Black	B	Black	-
23	PT Switch	PT Model	-	Sb	Sky Blue	P	Pink	-
			-	R	Red	-	-	-
24	Fuel Injector	#1	A18	Lg/R	Light Green/Red	L	Blue	A4
25	Fuel Injector	#2	A19	Lg/B	Light Green/Black	L	Blue	A4
26	Fuel Feed Pump	F.F.P.	A15	B/G	Black/Green	B/Y	Black/Yellow	A16
			A17	B/W	Black/White	-	-	-
27	T-MAP Sensor	MAP: A6	A6	G/Or	Green/Orange	R/W	Red/White	A7
		MAT: A25	A25	G/W	Green/White	B/L	Black/Blue	A27
28	Throttle Position Sensor	TPS	A23	L/W	Blue/White	R/W	Red/White	A7
			A27	B/L	Black/Blue	-	-	-
29	Idle Speed Control Valve	ISC Valve	A20	G/R	Green/Red	L	Blue	A4
30	Warning Lamp	LED	A33	Lg	Light Green	W/R	Blue	A4
31	Stop Switch	MF model, EFT model	A29	Br	Brown	B	Black	-
32	ECU Connector		-	-				-
33	ECU		-	-				-

NO.	Name	Remarks	ECU	Lead Wire Color				ECU
34	Service Connector	Diagnosis Port	A13	R	Red	R/W	Red/White	A12
			A11	W	White	Y	Yellow	A28
			A14	L	Blue	B	Black	A34
35	Resistance		-	R/W	Red/White	R/W	Red/White	-
36	Fuse	Option, 10A	-	B	Black	B	Black	-
37	Battery	Option	A12	R/W	Red/White	B	Black	A34
38	Interface Unit	Option	-	-				-
39	USB conversion	Option	-	-				-
40	Personal Computer	Option	-	-				-
41	Electrical Bracket	Ground	-	B	Black	-	-	-
42	Tachometer	Option	A21	W	White	Lg	Light Green	A22
43	PT Switch Circuit	Remote Control Model	-	-				-
44	PT Switch	PT Model	-	Sb	Sky Blue	P	Pink	-
			-	R	Red	-	-	-
45	Neutral Switch Circuit	Remote Control Model	-	-				-
46	Warning Buzzer Circuit	Remote Control Model	-	-				-
47	Main Switch Circuit	Remote Control Model	-	-				-
48	Main Switch Key	Remote Control Model	-	G	Green	L	Blue	-
			-	R	Red	R	Red	-
			-	B	Black	Br	Brown	-
49	Stop Switch	Remote Control Model	A29	Br	Brown	B	Black	A10
50	Stop Switch Circuit	Remote Control Model	-	-				-
51	Warning Buzzer	Remote Control Model	A2	Y	Yellow	R	Red	-
52	Neutral Switch (RC12A)	Remote Control Model	-	G	Green	R	Red	-
			-	R	Red	-	-	-
53	Neutral Switch (RC12F)	Remote Control Model	-	G	Green	G	Green	-
54	Neutral Switch Circuit	Remote Control Model	-	-				-
55	Crankcase		A10	B	Black	-	-	-

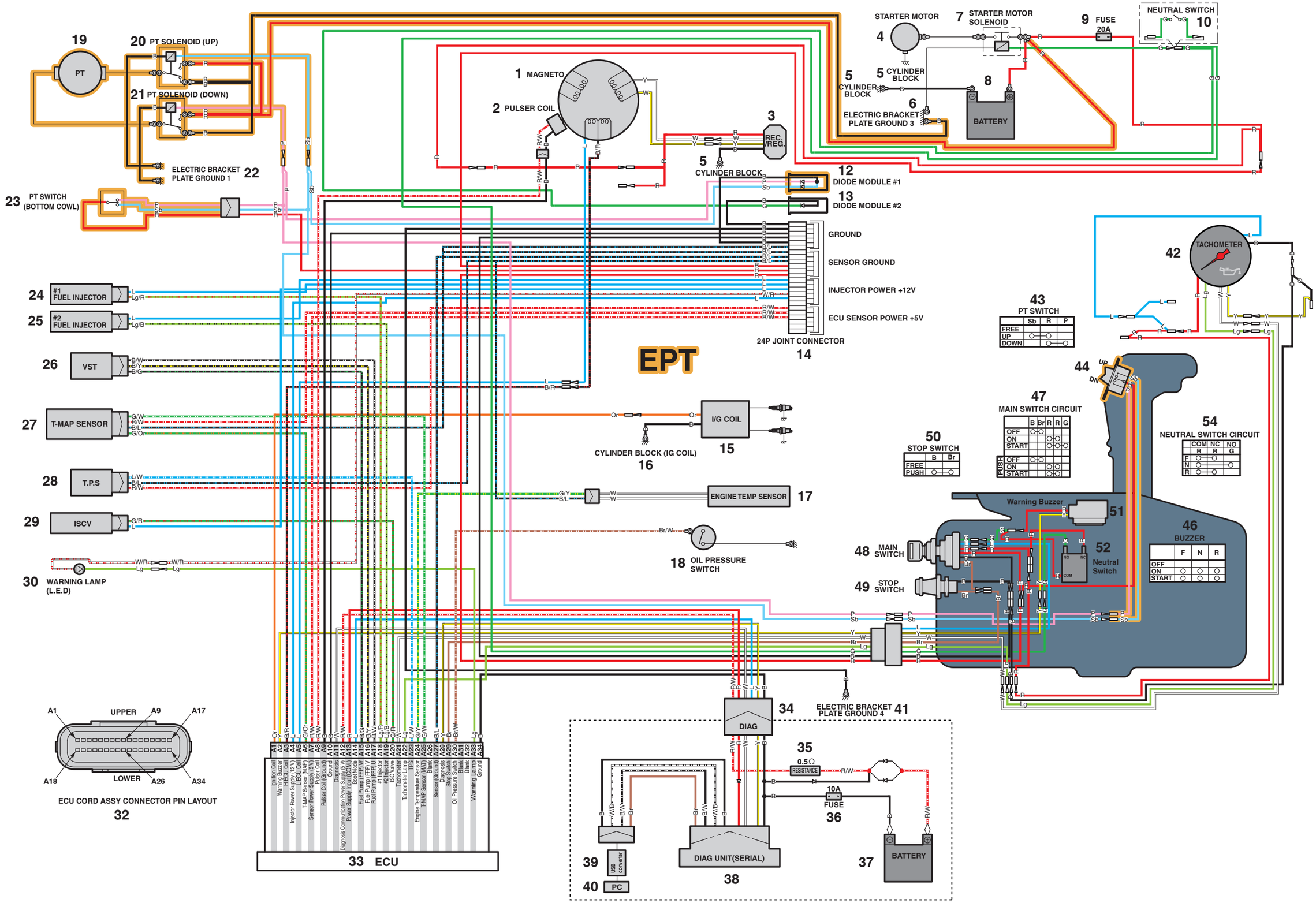
MFS6CZ/8C/9.8C/9.9CY MF Electric Circuit



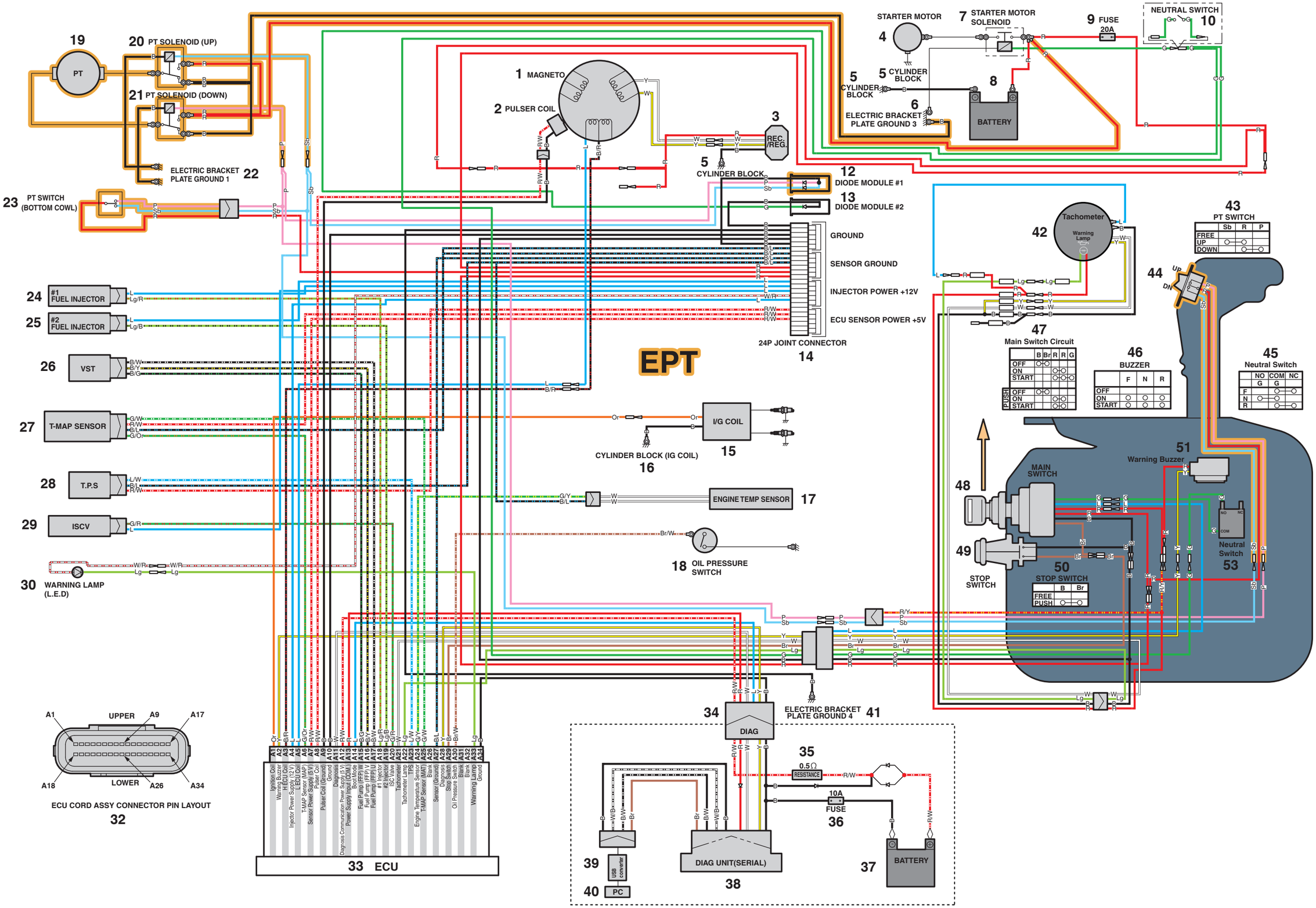
MFS6CZ/8C/9.8C/9.9CY EF/ EFT Electric Circuit



MFS6CZ/8C/9.8C/9.9CY EP/EPT (RC12A) Electric Circuit

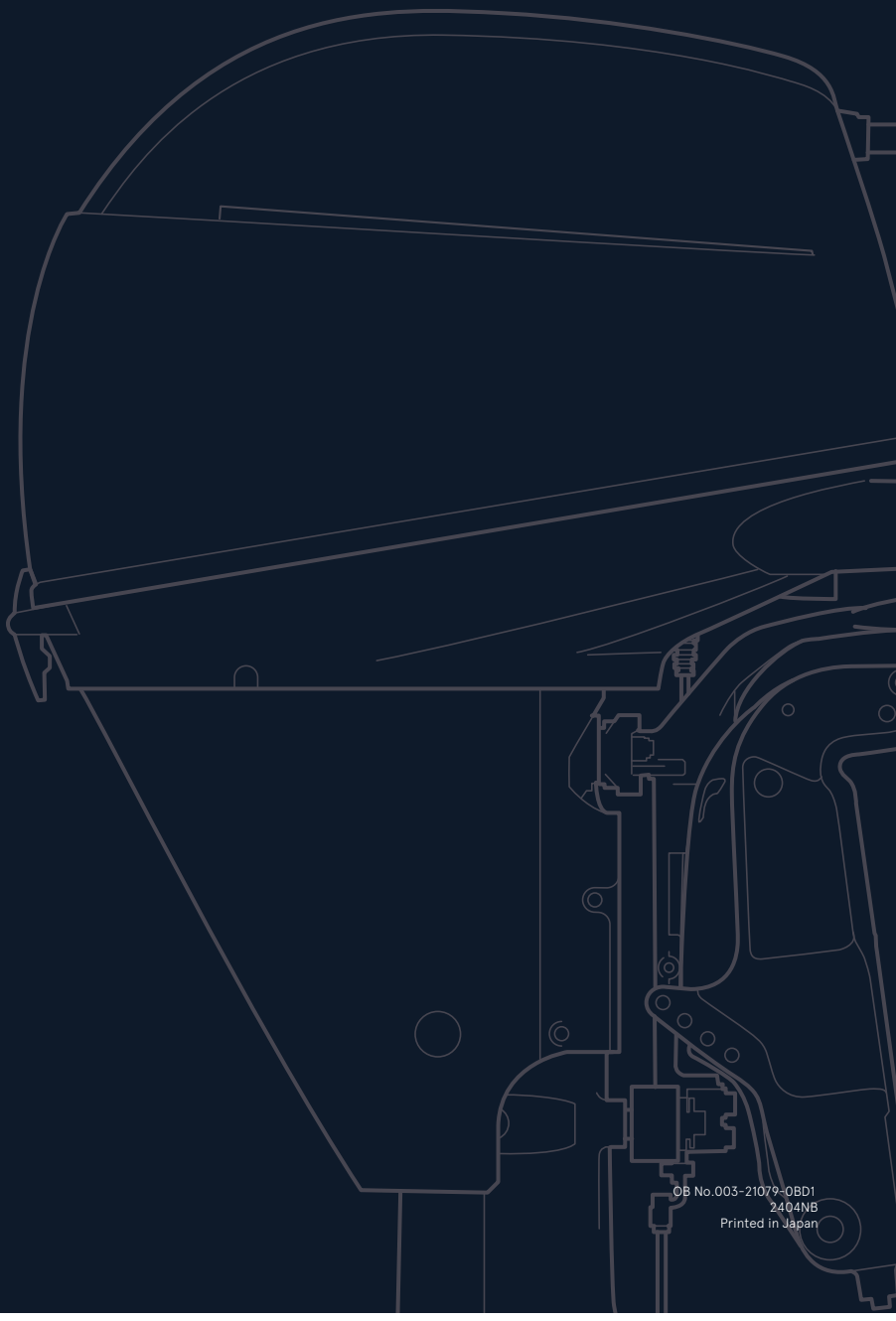


MFS8C/9.8C EP/EPT (RC12F) for US models Electric Circuit



SERVICE MANUAL

4 STROKE
MFS 6CZ
MFS 8C
MFS 9.8C
MFS 9.9CY
Models



TOHATSU CORPORATION

5-4, Azusawa 3-Chome, Itabashi-Ku
Tokyo 174-0051, Japan
Tel: +81-3-3966-3117 Fax: +81-3-3966-2951
www.tohatsu.com

OB No.003-21079-0BD1
2404NB
Printed in Japan