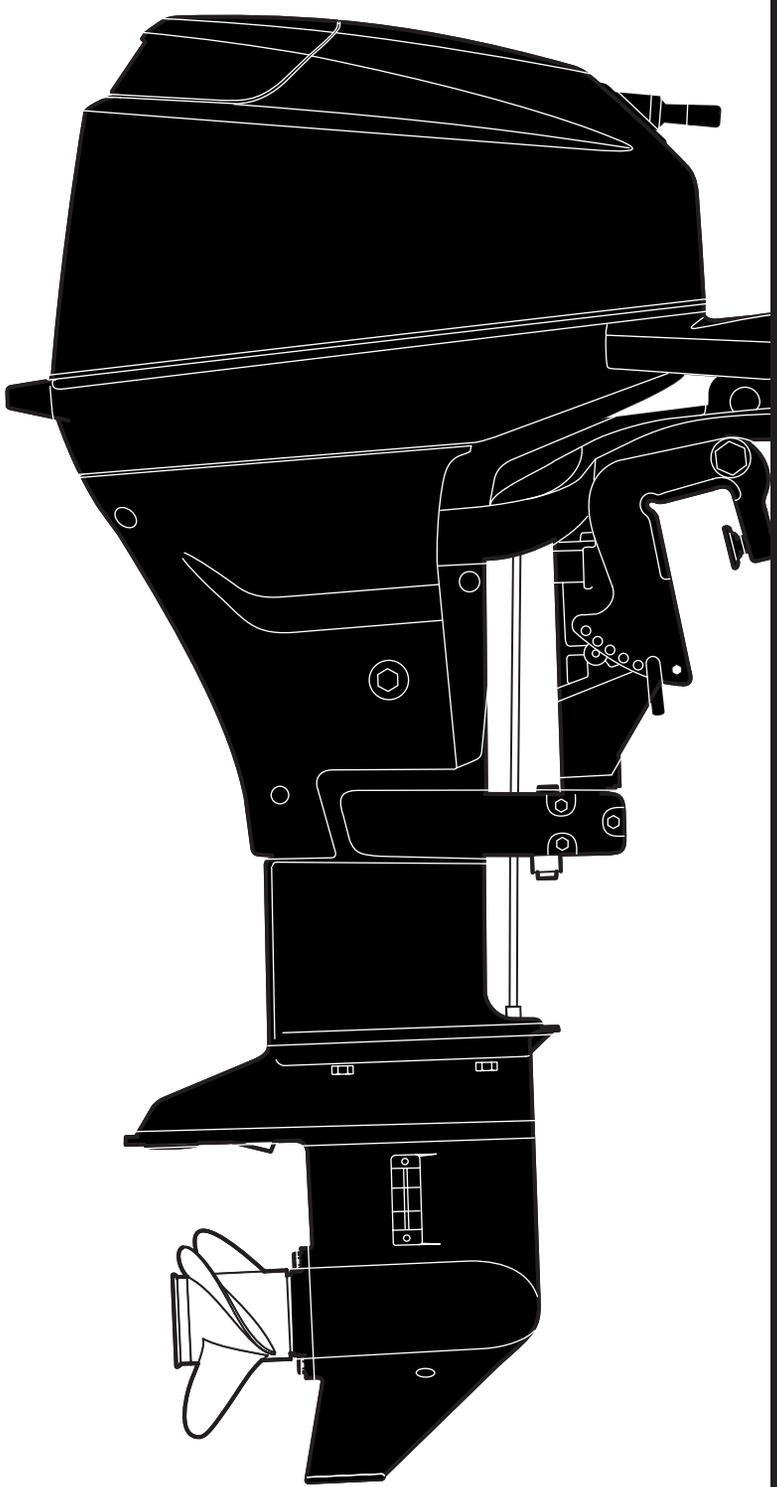
SERVICE MANUAL

TOHATSU
Outboards



4 Stroke
MFS
9.9/15/20C
Models

OB No.003-21062-1
12-04 NB

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

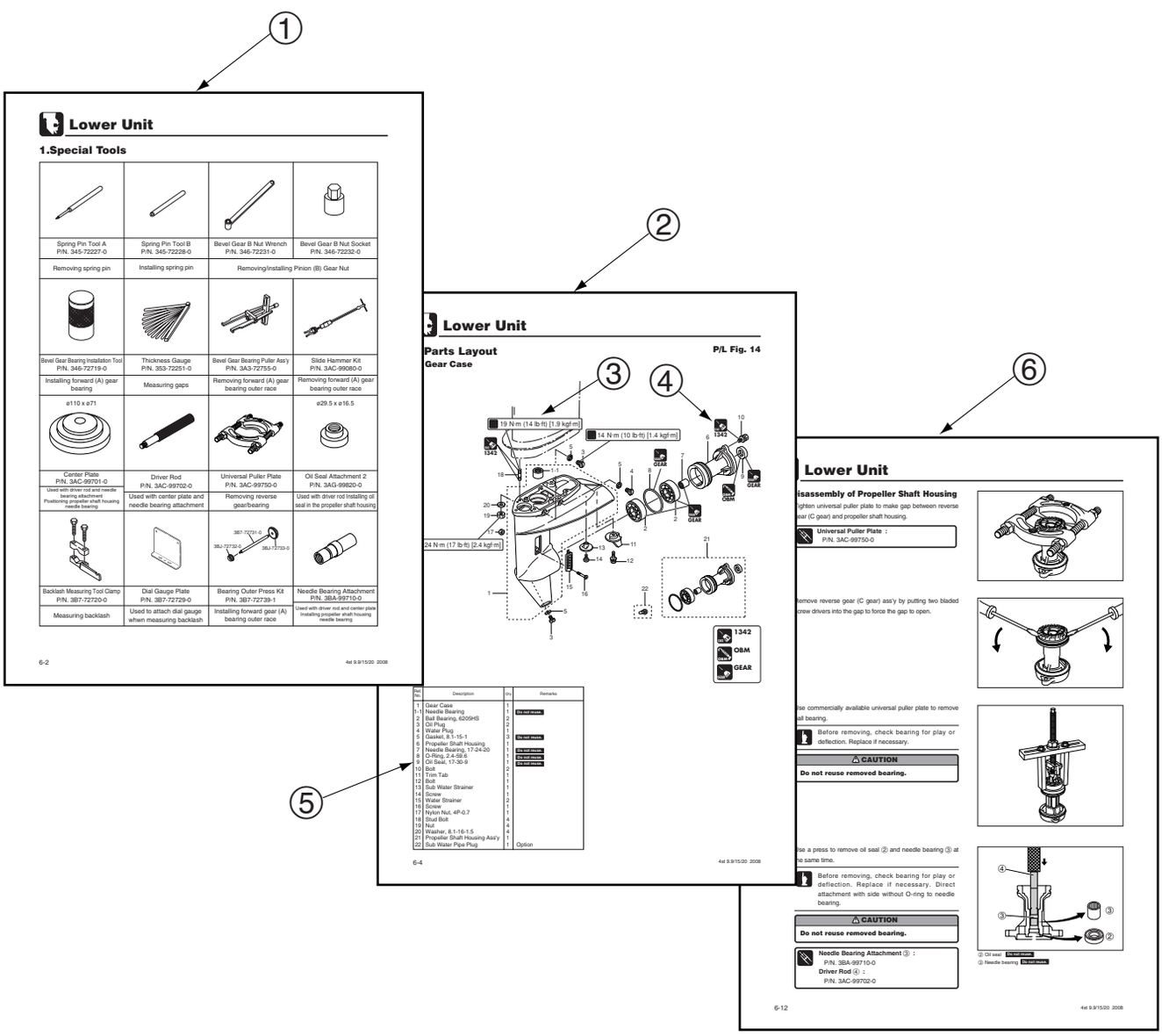
Indicates the presence of a hazard or an unsafe activity which, if ignored, could result in minor personal injury or damage to the products or facilities.

Attention:

About this manual

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

① Each chapter begins with the introduction of special tools that are used for the work described in the chapter so that the service persons are able to figure out the tools needed.
② Parts that are serviced in each chapter and their details are presented by using a component composition diagram.
③ Fastening torques are described in the component composition diagram and in the body text and are critical points of the applicable repair.
④ Pictograms indicate that there is an important instruction for the relevant parts. It also shows the type of lubricant and its application point(s).
⑤ The component composition diagrams describe the names of the parts, the quantity of the parts used, size of fasteners and special notes.
⑥ Specific 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/cm^2]

- [9.0 kgf/cm^2] — Conventional system (kilo-gram meter unit)
- (128 psi) — Conventional system (US pound inch unit)
- 0.90 MPa — SI unit (1 kgf/cm^2 = 0.0980665 MPa)

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

Example : <Torque>

18 N·m (13lb·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 cm^3 (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 
Power Unit 	Lower Unit 	Bracket 	Electrical System 
Troubleshooting 	Rigging 	Wiring Diagrams 	

The following symbols indicate items needed for 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 	Waterproof Grease 
Insulating Grease INS 	Low Temperature Resistant Lithium Grease 	Molybdenum Grease • Moly Paste 500 	Teflon® Grease TEFLON 
Oil Compound [Shinetsu Silicon] S.O.C 	[Konishi Bond] • G17 	Instant Adhesive [Three Bond®] • 1741 	Gasket Seal Agent [Loctite®] • 518 
Screw Lock Agent [Three Bond®] • 1342 	Screw Lock Agent [Three Bond®] • 1373B 		

1.Service Information

2.Service Data

3.Maintenance

4.Fuel System

5.Power Unit

6.Lower Unit

7.Bracket

8.Electrical System

9.Troubleshooting

10.Wiring Diagram

INDEX

4st 9.9/15/20 2012

1

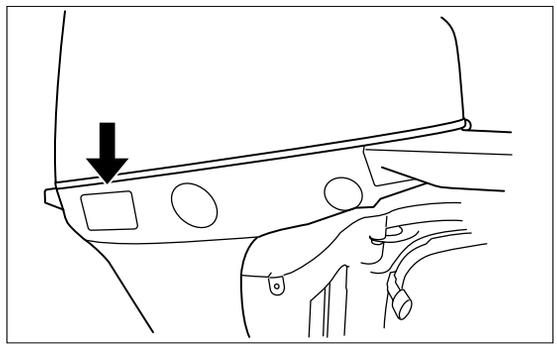
Service Information

1. Identification (Engine Serial Number)

Engine serial number is stamped on the bottom cowl of outboard motor body.

① Model Name
② Model Type
③ Serial Number

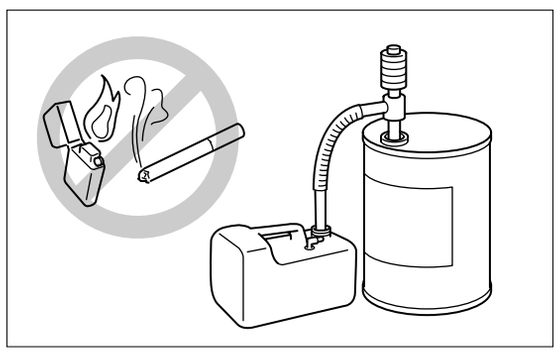
Outboard Motor
② 3BJ (F20C) ①
Rated Power: 14.7 kW-5750r/min
Mass: 51.5-65 kg
Serial No. XXXXXXXX ③



2. Work Safety

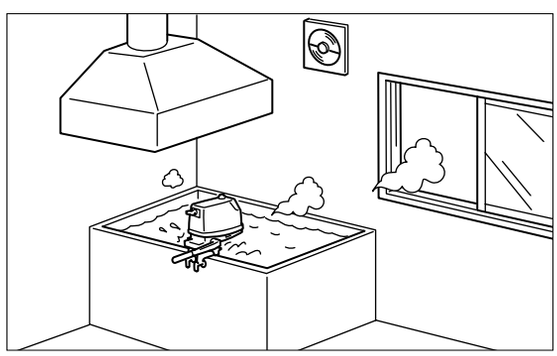
1) Fire Prevention

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



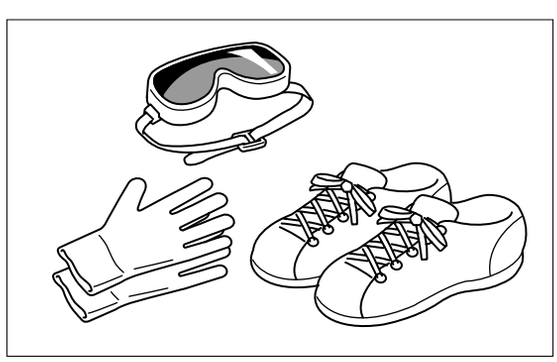
2) Ventilation

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



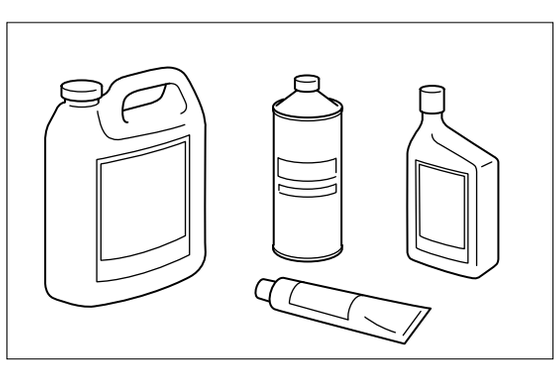
3) Protection

Wear a pair of goggles, working gloves and safety shoes to protect skin from chemicals and oils and eyes from particles generated by grinding or polishing. Avoid contact of oil, grease or sealing agent to the skin. In case of exposure to such matters, wash away with soap or warm water immediately.



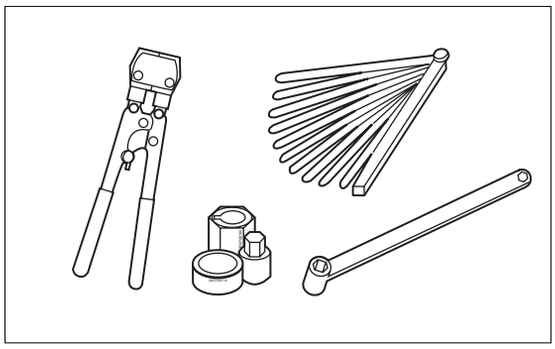
4) Genuine Parts

Use parts and/or chemicals that are genuine items or recommended.



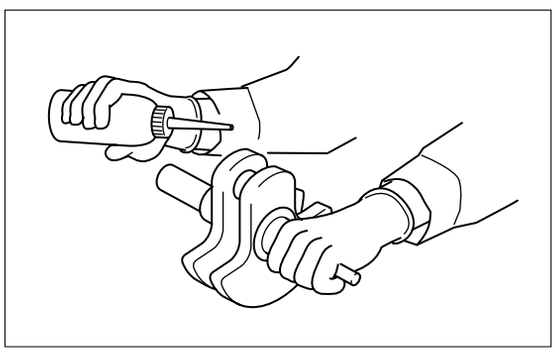
5) Tools

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



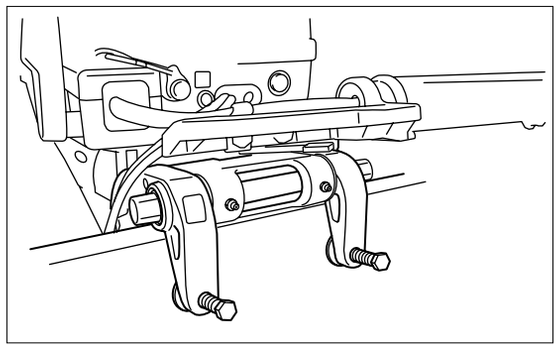
6) Recommendations on Service

Remove foreign substances and dirt from outboard motor and individual parts by cleaning. Apply recommended oil or grease to rotating areas and sliding surfaces. After individual assembly, always perform verifications such as ensuring smooth movement and sealing.



7) Cautions in Disassembling and Assembling Components

(1) Secure outboard motor to dedicated stand firmly.

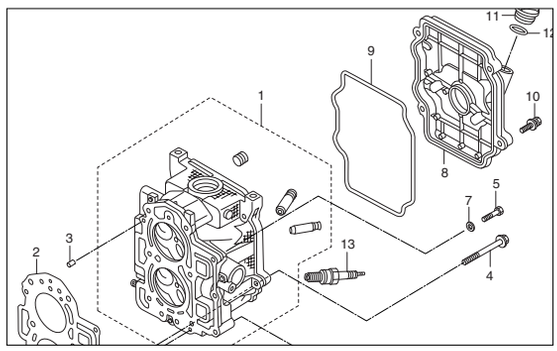


(2) Take special care not to scratch painted surfaces or mating surfaces of cylinder and crankcase.

(3) Replace parts such as packings, gaskets, O rings, oil seals, spring pins or split pins with new ones after they are removed. Replace deformed snap rings with new ones.

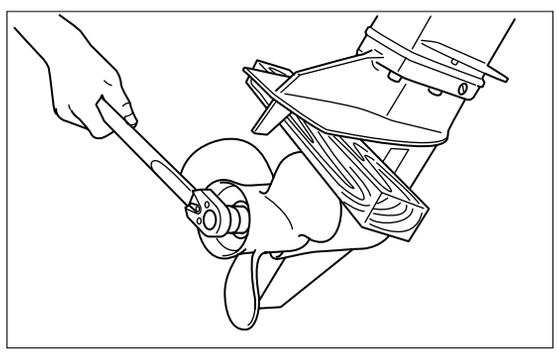
(4) When replacing parts, be sure to use genuine parts. For fluids such as gear oil, use genuine product.

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



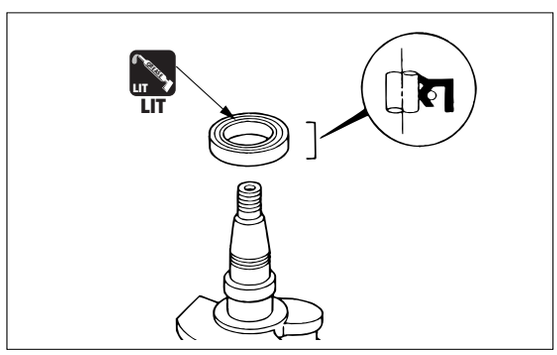
(6) When reassembling parts, use their mating marks. For parts without mating marks, simple marking makes reassembling easier. Use applicable parts list for reference.

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



(8) When assembling, be careful of the fit, repair limits, air-tightness, clogging of oil holes for oil feeding or greasing, packings, wirings, pipings and other detailed parts. For the components that use many bolts and nuts such as cylinder head or crank case, tighten the fasteners in the order shown by the numbers to prevent uneven tightening. If the numbers are not shown, tighten the fastners in diagonal or clockwise order from inner ones to outer ones evenly to specified torque. In either case, tighten the fastners to the specified torque in two or three steps. (Reverse the order when disassembling.)

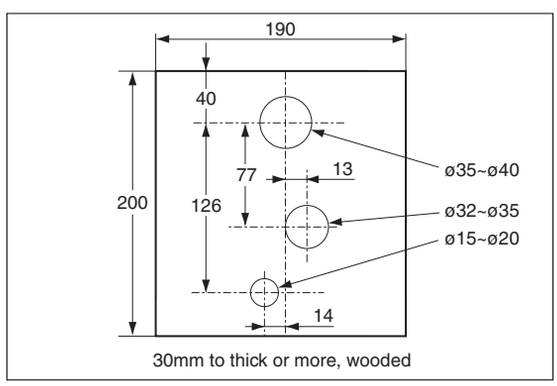
(9) When installing bearings, face the flat (numbered) side to the special assembling tool.



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

(11) When applying liquid sealant, take care to use sparingly. Excessive application may be oozed out, adversely affecting interior of the crankcase. Use adhesive after thoroughly reading the instructions.

(12) When servicing power unit, use of wooden work board makes the work easier.



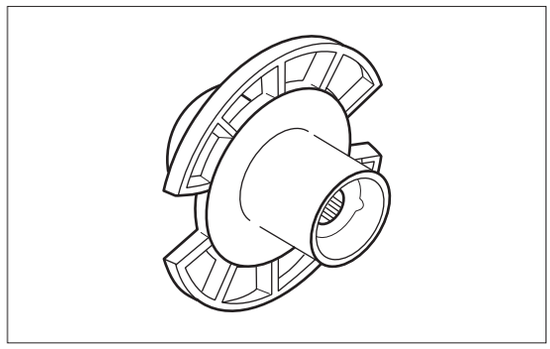
3. Tools and Instruments

1) Test Propeller

P/N. 362-64110-1

Outer diameter : 180mm

With : 16mm



Model	Rotational speed at WOT (Wide Open Throttle) (r/min)
F 9.9 C	approximately 4,500
F 15C	approximately 5,400
F 20C	approximately 5,700

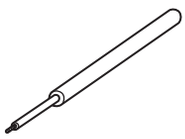
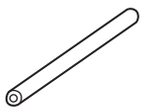
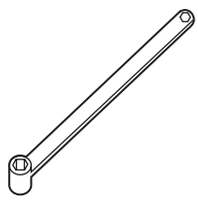
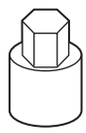
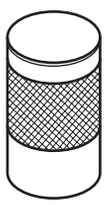
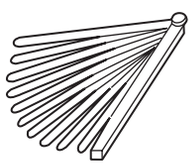
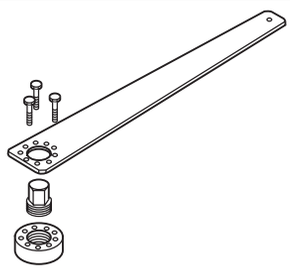
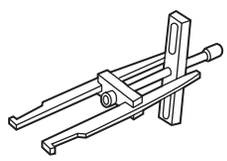
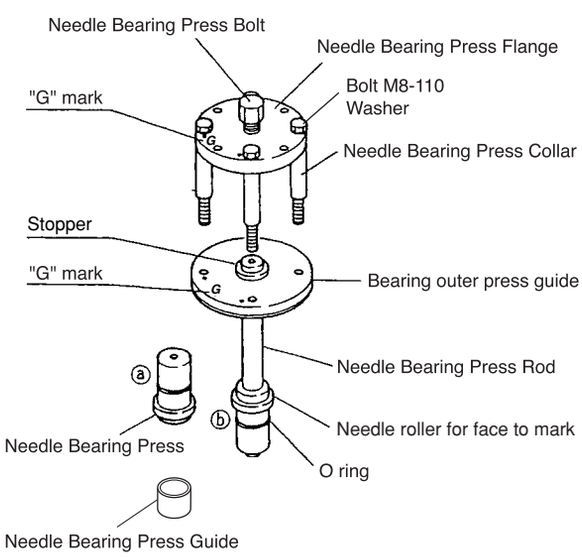
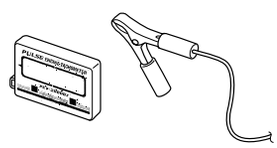
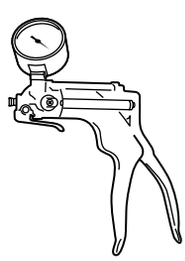
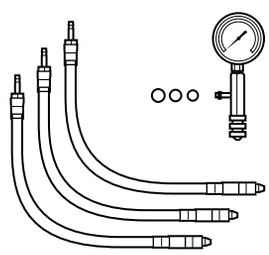
2) Measuring Instruments

For the following measuring instruments, use commercially available ones.

Circuit tester	(Resistance : 1Ω, 10Ω, 10 kΩ, AC voltage : 30 to 300V, DC voltage : 30V, Internal voltage 3V or less)
Vernier calipers	(M1 type, 300 mm)
Micrometer	(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	(ø5.5, ø16, ø25, ø30, ø61)
Dial gauge	(minimum graduation of 0.01)
Thickness gauge	(0.03 to 0.3 mm)
V block	
Surface plate	(500 mm x 500 mm)

Dial gauge magnet base or dial gauge stand

3) Special Tools

<table>
<tr><td>  </td><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Spring Pin Tool A
P/N. 345-72227-0</td><td>Spring Pin Tool B
P/N. 345-72228-0</td><td>Bevel Gear B Nut Wrench
P/N. 346-72231-0</td><td>Bevel Gear B Nut Socket
P/N. 346-72232-0</td></tr>
<tr><td>Removing spring pin</td><td>Installing spring pin</td><td colspan="2">Removing/installing Pinion (B) Gear Nut</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Bevel Gear Bearing Installation Tool
P/N. 346-72719-0</td><td>Thickness Gauge
P/N. 353-72251-0</td><td>Flywheel Puller Kit
P/N. 369-72211-0</td><td>Bevel Gear Bearing Puller Ass'y
P/N. 3A3-72755-0</td></tr>
<tr><td>Installing forward (A) gear bearing</td><td>Measuring gaps</td><td>Removing/installing flywheel</td><td>Removing forward (A) gear bearing outer race</td></tr>
<tr><td colspan="2" rowspan="3"> 
</td><td>  </td><td>  </td></tr>
<tr><td>Piston Slider
P/N. 3AC-72871-0</td><td>Tachometer
P/N. 3AC-99010-0</td></tr>
<tr><td>Installing piston</td><td>Measuring engine revolution speed</td></tr>
<tr><td colspan="2">Needle bearing press Ass'y
P/N. 3AC-72900-1</td><td> 
Vacuum/Pressure Gauge
P/N. 3AC-99020-1</td><td> 
Compression Gauge
P/N. 3AC-99030-0</td></tr>
<tr><td colspan="2">Installing/attaching drive shaft housing</td><td>Inspecting pressure</td><td>Measuring compression pressure</td></tr>
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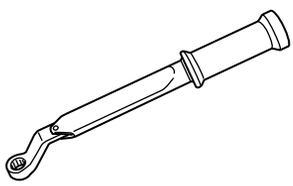
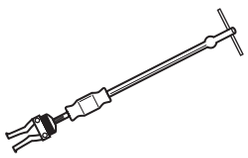
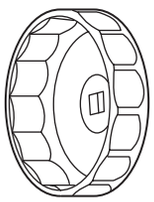
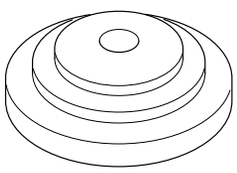
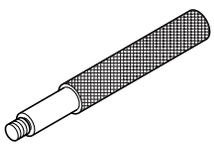
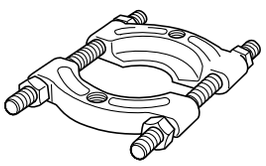
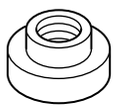
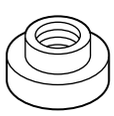
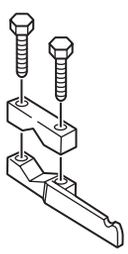
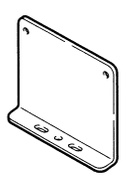
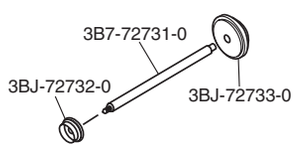
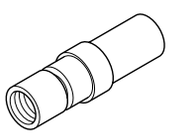
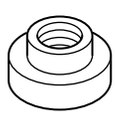
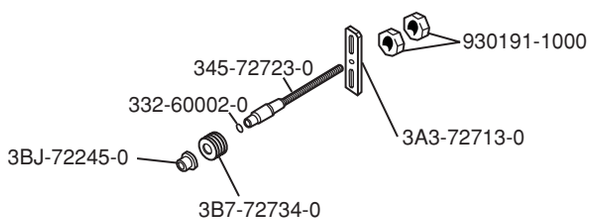
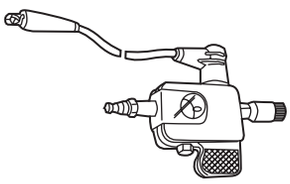
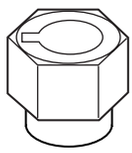
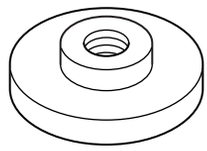
			
Torque Wrench P/N. 3AC-99070-0	Valve Clearance Driver P/N. 3AC-99071-0	Slide Hammer Kit P/N. 3AC-99080-0	Oil Filter Wrench P/N. 3AC-99090-0
Adjusting valve clearance	Adjusting valve clearance	Removing forward (A) gear bearing outer race	Removing/installing oil filter
ø110 x ø71 			ø34.5 x ø17.5 
Center Plate P/N. 3AC-99701-0	Driver Rod P/N. 3AC-99702-0	Universal Puller Plate P/N. 3AC-99750-0	Oil Seal Attachment P/N. 3AC-99820-0
Used with driver rod and needle bearing attachment Positioning propeller shaft housing needle bearing	Installing oil seal Used with center plate and needle bearing attachment	Removing reverse gear/bearing	Installing cam shaft oil seal
ø29.5 x ø16.5 			
Oil Seal Attachment 2 P/N. 3AG-99820-0	Backlash Measuring Tool Clamp P/N. 3B7-72720-0	Dial Gauge Plate P/N. 3B7-72729-0	Bearing Outer Press Kit P/N. 3B7-72739-1
Used with driver rod Installing oil seal in the propeller shaft housing	Measuring backlash	Used to attach dial gauge when measuring backlash	Installing forward gear (A) bearing outer race
	ø25.5 x ø12.5 		
Needle Bearing Attachment P/N. 3BA-99710-0	Oil Seal Attachment 3 P/N. 3BJ-99820-0	Backlash Measuring Tool Kit P/N. 3C8-72234-1	
Used with driver rod and center plate Installing propeller shaft housing needle bearing	Installing pump case (lower) oil seal	Measuring gap between forward and pinion gears (A and B gears)	

		ø51.5 x ø39.5 
Spark Tester P/N. 3F3-72540-0	Crank Shaft Holder P/N. 3BJ-72815-0	Oil Seal Attachment P/N. 3UI-99820-0
Inspecting sparks	Holding crank shaft	Use in combination with driver rod. Use oil seal attachment to press fit ball bearing. Installing forward (A) gear and revers (C) gear bearings

4. Pre-delivery Inspection

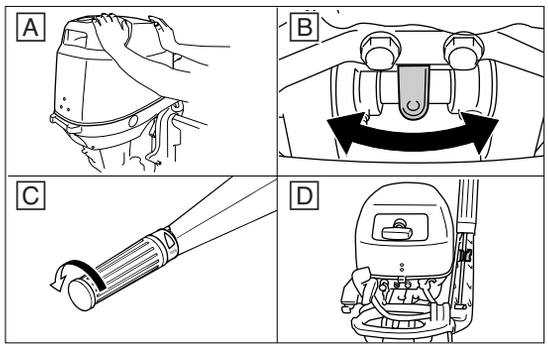
1) Steering Handle

A Check installations for clattering and play.

B Adjust steering friction.

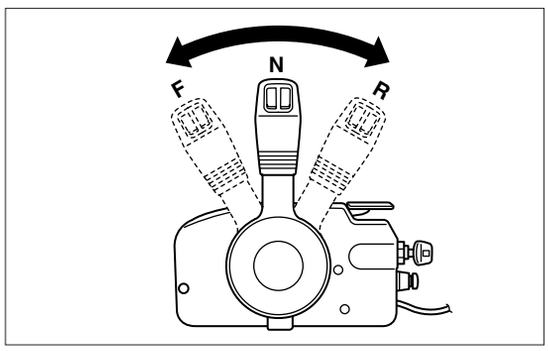
C Check throttle grip for movement. (full open/full close).

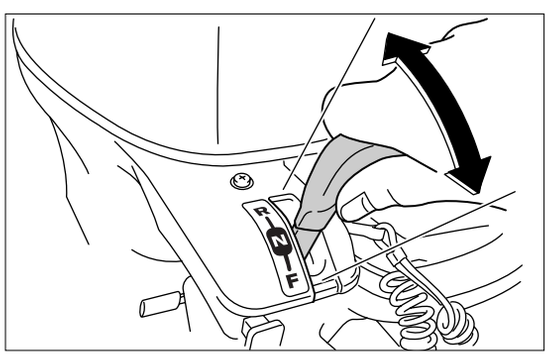
D Adjust throttle friction.



2) Gear Shift

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





3) Engine Oil

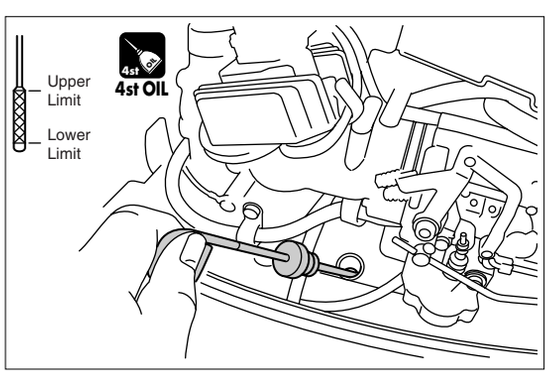
Fill engine with engine oil.

4 Stroke Engine Oil :
1.0 L (1.1 US.qt)[without oil filter replacement]
1.2 L (1.3 US.qt)[oil filter replaced]

Use oil level gauge to check oil quantity.

⚠ CAUTION

Engine oil is removed before shipment to prevent leakage during transportation.

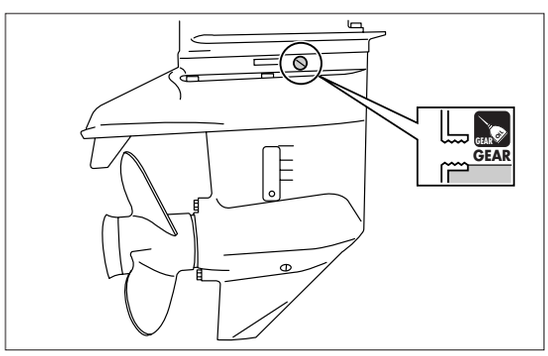


4) Gear Oil

Check quantity of gear oil.

Gear Oil :
370 cm³ (12.5 fl.oz)

Spill of some oil from plug hole as plug is removed indicates that gear case is filled with specified quantity of gear oil.

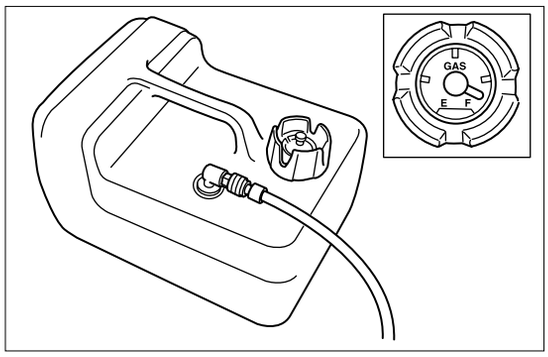


5) Fuel Line

Check that fuel tank contains sufficient amount of gasoline, fuel line is connected and is free of leak.

⚠ CAUTION

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

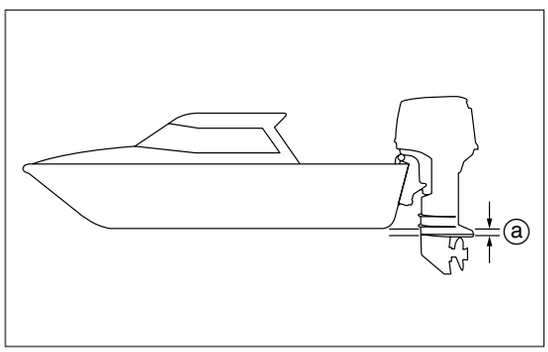


6) Rigging

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

Test-run to determine the best installation height.

Anti-ventilation plate standard position ⓐ :
Cavitation plate located 5 - 25 mm (0.2 - 1.0in) below boat bottom

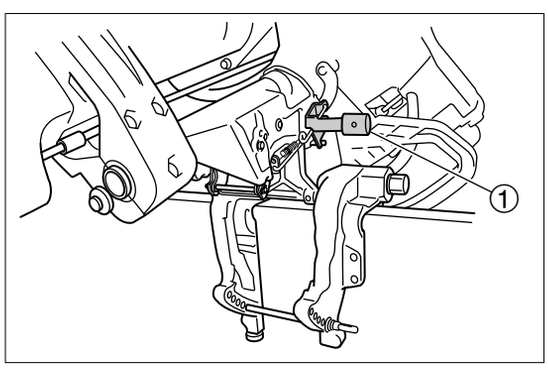


ⓐ5-25 mm（0.2-1.0 in）

7) Manual Tilt

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

2. Tilt up outboard motor and lock it with tilt lock lever ① to check holding mechanism functions normally.

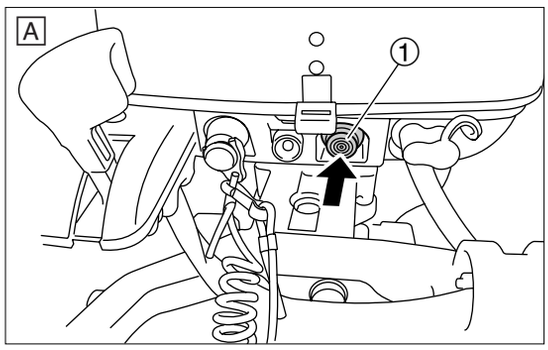


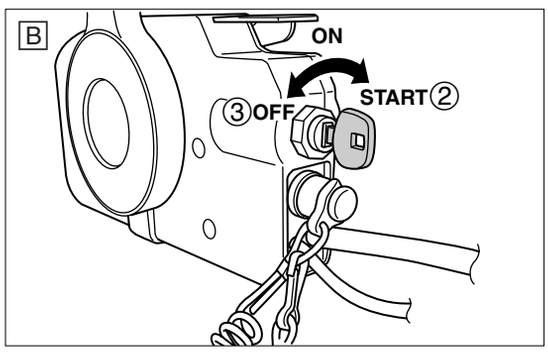
8) Inspection of Starting Switch and Stop Switch

1. Press start switch ① or turn main switch to START ② to check that engine starts.

2. Turn main switch to OFF ③ to check that engine stops.

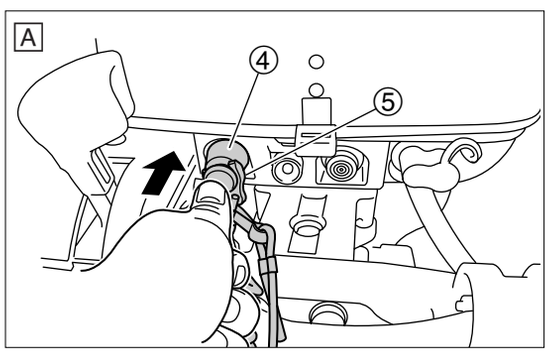
   A Tiller Handle Model — Push and hold to stop
   B Remote Control Model

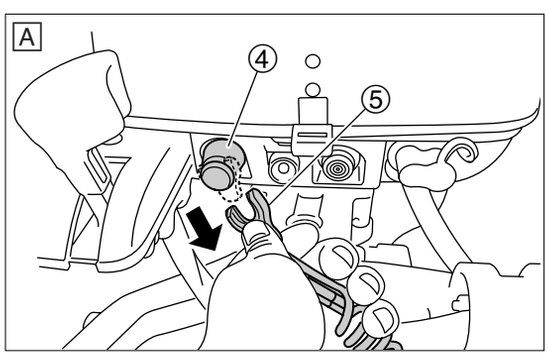


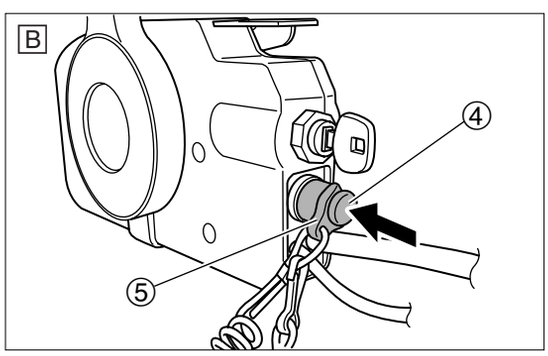


3. Press stop switch ④ hard or pull out lockplate ⑤ from stop switch ④ to check that engine stops.

   A Tiller Handle Model
   B Remote Control Model

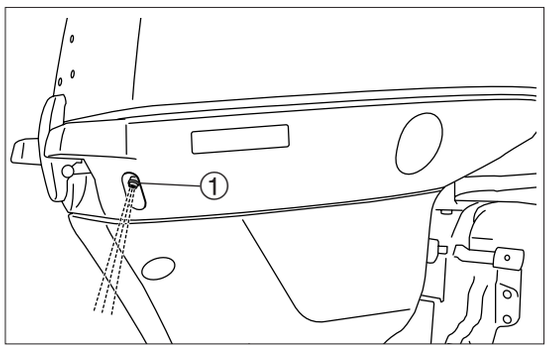






9) Cooling Water Check Port

Check that cooling water check port ① discharges water during engine runs.

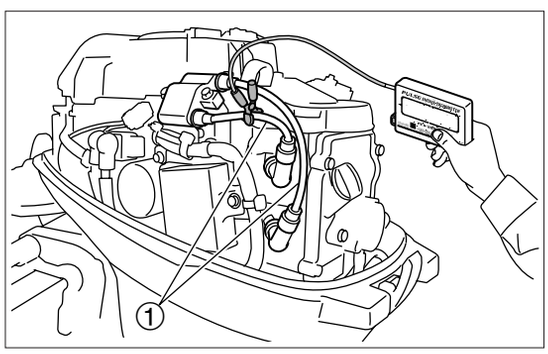


10) Idling

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

Idle Speed :
950 r/min

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



①High tension cord

11) Propeller Selection

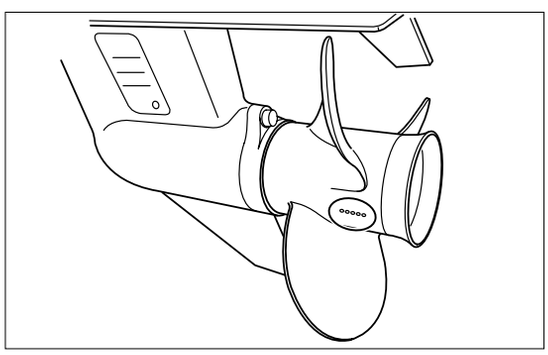
Select a propeller that is best-suited to type of boat and application.

Range of operating engine speed at WOT

9.9C : 5,000～6,000r/min
15C : 5,000～6,000r/min
20C : 5,400～6,100r/min

⚠ CAUTION

Miss-selection of propeller can cause adverse effects on engine life, fuel consumption, etc. as well as on performance.



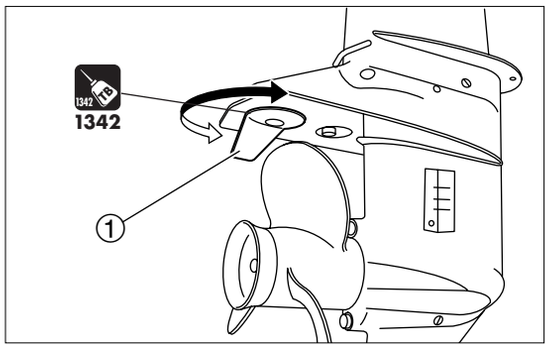
Propeller Marking (No. of Blades x Diameter [in/mm] x Pitch [in/mm])	11.5	3×9.25×11.5	(3×235×292)
	10	3×9.25×10	(3×235×254)
	9	3×9.25×9	(3×235×229)
	8	3×9.25×8 in	(3×235×203) mm
	7	3×9.2×6.9	(3×234×174)
	6	3×9.2×6.1	(3×234×155)

12) Trim Tab

Adjustment of trim tab angle

After installing outboard motor on the boat, use trim tab to achieve balance between port and starboard steering loads. Loosen trim tab bolt, adjust angle of trim tab ① as described below, and then tighten the bolt to specified torque.

Trim tab bolt :
6 N·m (5 lb·ft) 0.6 kg

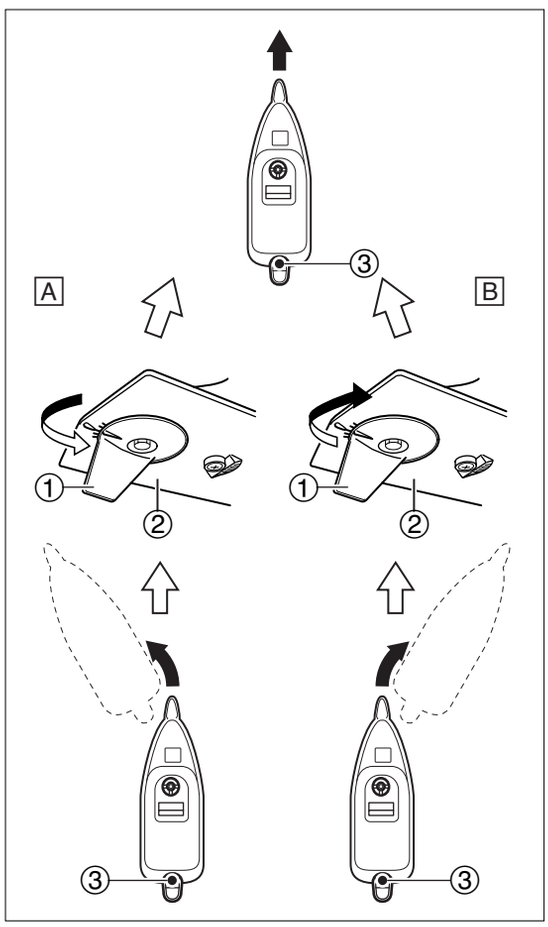


Example of trim tab angle adjustment

Ⓐ If it is necessary to steer to port to make boat run straight or if boat steers itself to port when steering is held amidships, move trailing edge of trim tab to port side, or

Ⓑ If it is necessary to steer to starboard to make boat run straight or if boat steers itself to starboard when steering is held amidships, move trailing edge of trim tab to starboard side.

Change trim tab angle a little for each test run and repeat the process several times until the best position is found.



① Trim Tab
② Anti-cavitation Plate
③ Steering Pivot (Swivel Shaft)

5. Break-in Operation

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

Break-in Operation…10 hours

Time	0	10 minutes	2 hours	3 hours	10 hours
Operation	Dead Slow or Idling	1/2 of WOT or less at approximately 3,000 r/min	3/4 of WOT or less at approximately 4,000 r/min	3/4 of WOT at approximately 4,000 r/min	Regular Operation
	Running at the slowest possible speed		WOT run for approximately 1 minute can be included every 10 minutes of run.	Short period WOT run can be included.	

6. Test Run

1. Start engine and check if gear shift can be moved smoothly.

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

Idling Revolution Speed :
950 r/min

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

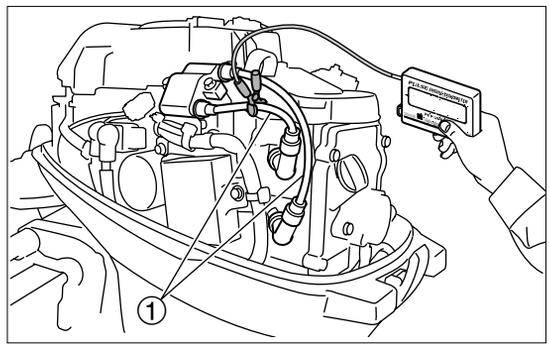
3. Shift gear into forward (F) and run dead slow for approximately 10 minutes.

Dead Slow Revolution Speed :
900 r/min

4. Run at 2,000 r/min or half of WOT for initial 2 hours, then at 3,000 r/min or 3/4 of WOT for 1 hour.

5. Check that shifting into reverse (R) will not tilt up outboard motor and allow water to run into boat.

Complete test run during break-in operation.

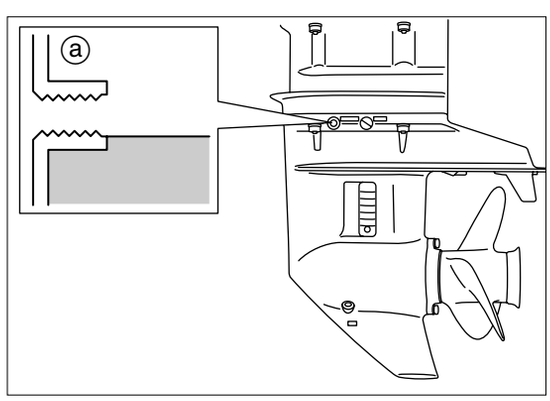


①High tension cord

7. Checks After Test Run

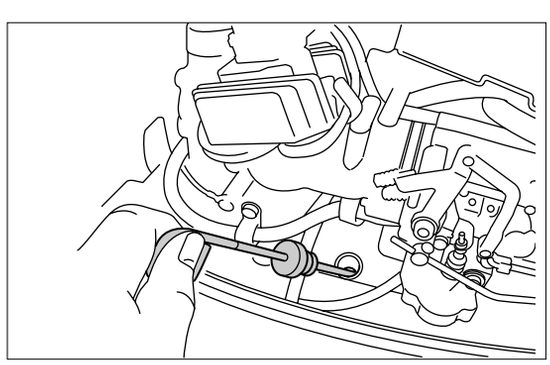
1. Check that no water is present in gear oil.

Gear oil turns to creamy white if mixed with water invading into gear case.

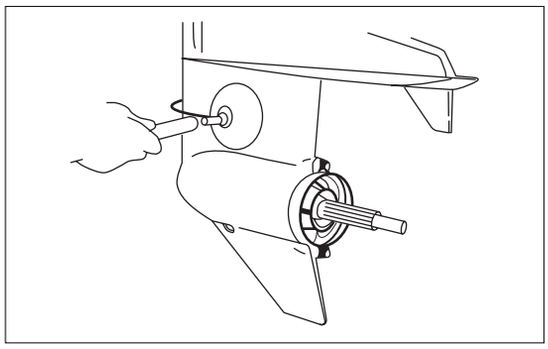


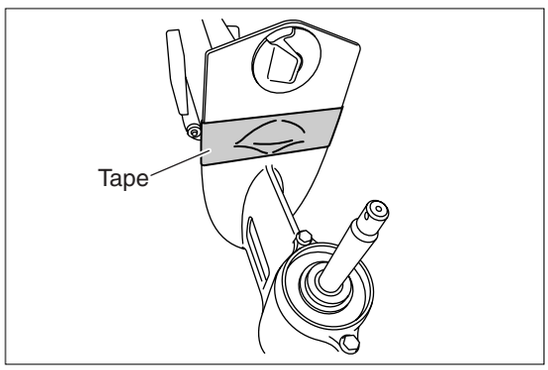
2. Check that no fuel leaks in the cowl.

3. Check that no oil and water leak in the cowl and no water is present in engine oil.



4. After test run, use flushing kit and fresh water to wash cooling water path by idling engine.



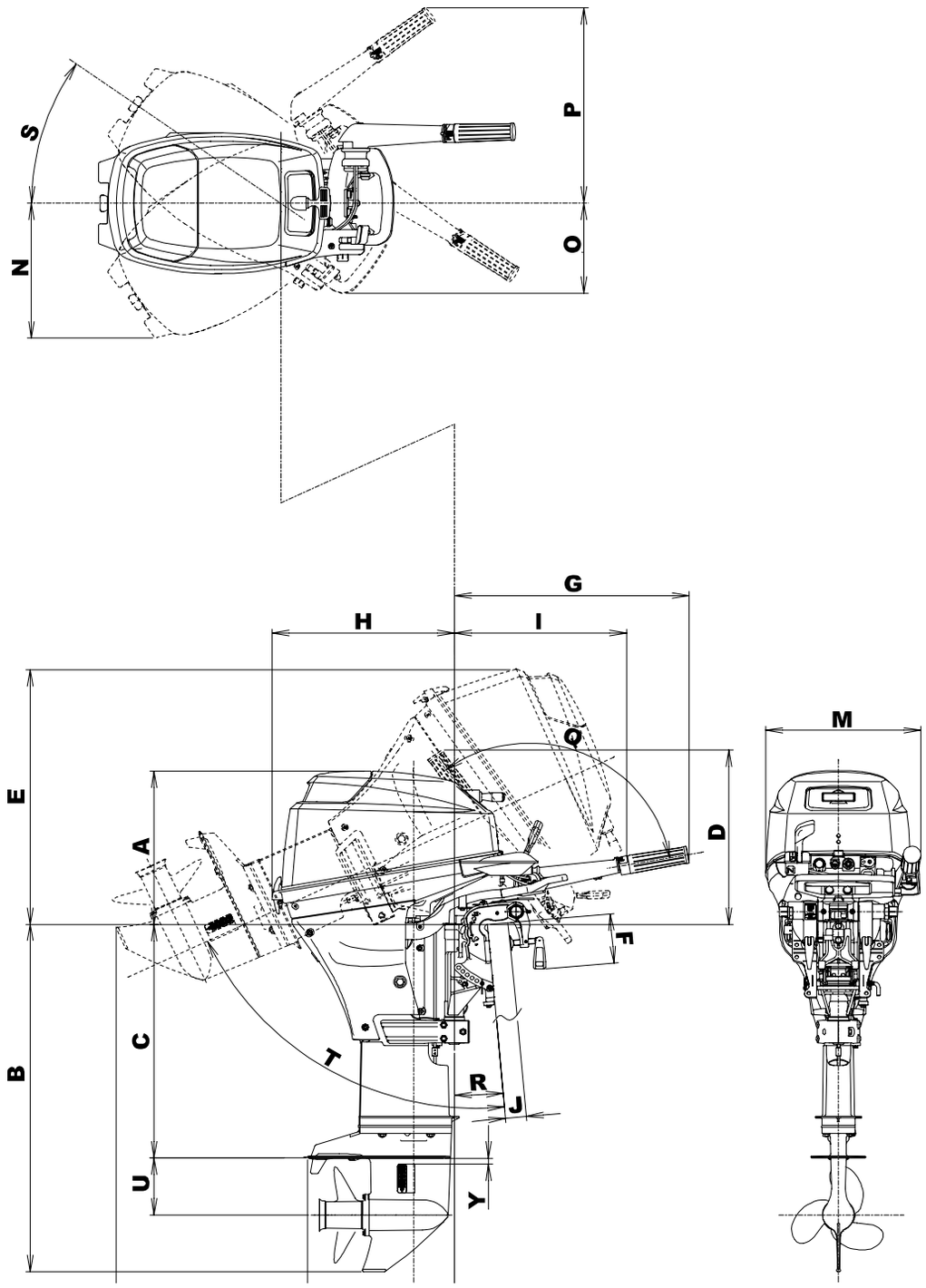


2

Service Data

1. Outline Dimensions

1) Engine Outer Dimensions



MF/EF/EP

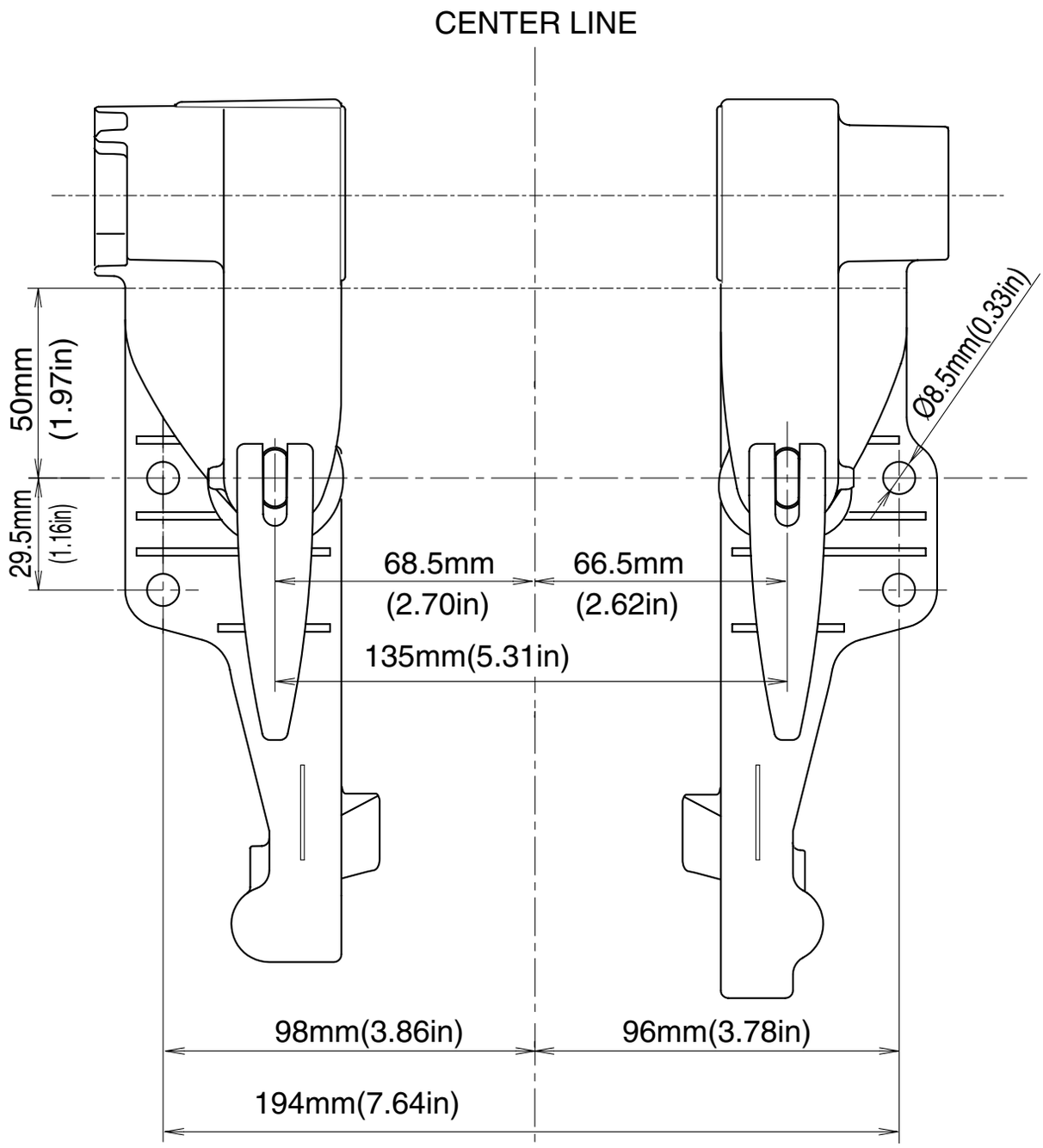
Item	Type	Unit	mm	in
A		mm	375	14.76
B	S	mm	690	27.17
	L	mm	840	33.07
	UL	mm	967	38.07
C	S	mm	413	16.26
	L	mm	562	22.13
	UL	mm	689	27.13
D		mm	370	14.57
E		mm	620	24.41
F		mm	120	4.72
G		mm	470	18.50
H		mm	510	20.08
I	Mechanical	mm	320	12.60
J		mm	40-60	1.57-2.36
K		mm	425	16.73
L	S	mm	740	29.13
	L	mm	880	34.65
	UL	mm	915	36.02
M	F	mm	365	14.37
	P	mm	345	13.58
N		mm	325	12.80
O		mm	210	8.27
P		mm	480	18.90
Q		deg.	130	
R		deg.	9	
S	Mechanical	deg.	35	
T		deg.	70	
U		mm/in	140	5.51
Y		mm/in	15	0.59
Trim angle (Position)		deg.	5-25 (6)	

EFT/EPT

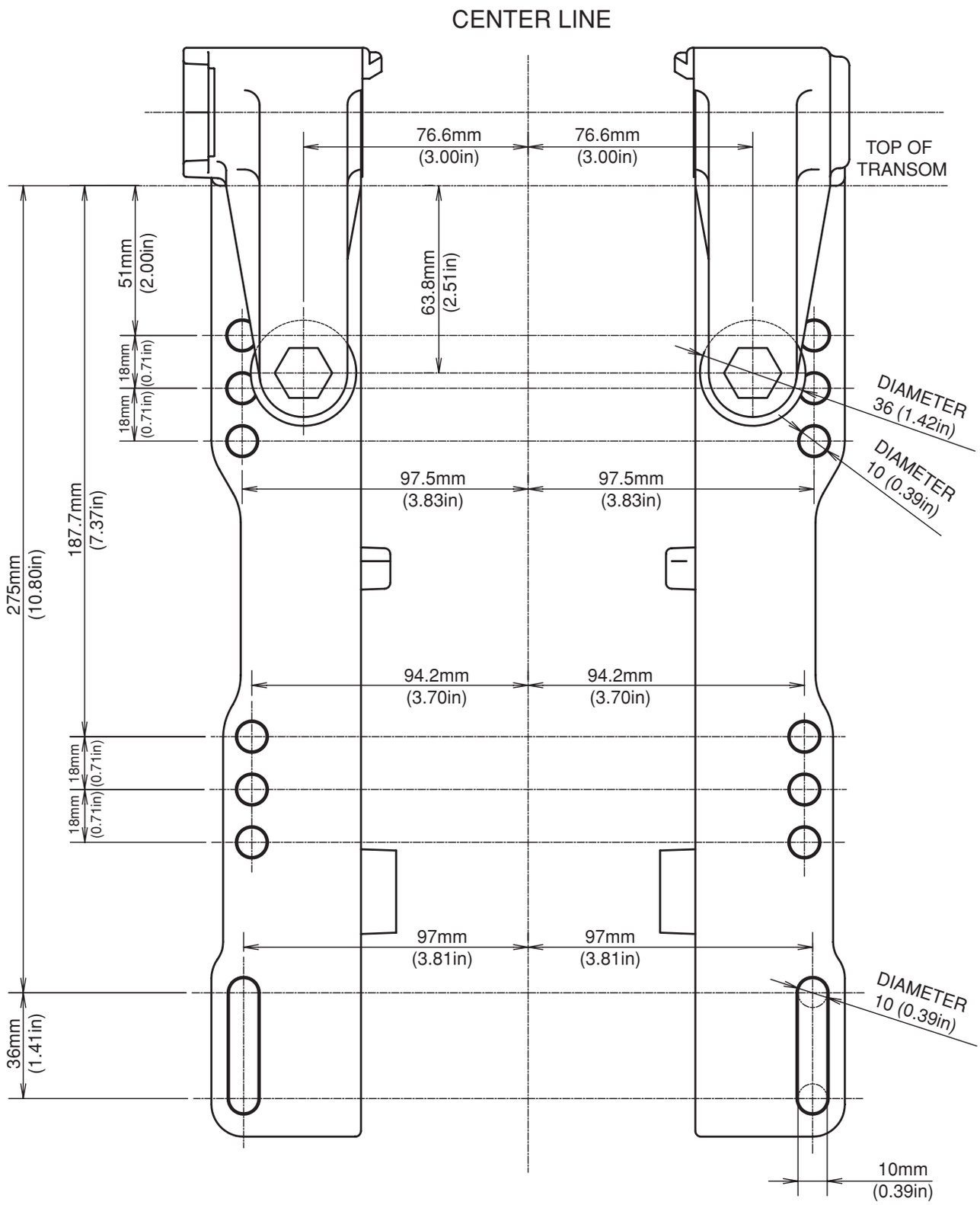
Item	Type	Unit	mm	in
A		mm	375	14.76
B	S	mm	690	27.17
	L	mm	840	33.07
	UL	mm	967	38.07
C	S	mm	413	16.26
	L	mm	562	22.13
	UL	mm	689	27.13
D		mm	370	14.57
E		mm	665	25.79
F		mm	105	4.13
G		mm	445	17.52
H		mm	540	21.26
I		mm	305	12.01
J		mm	30-70	1.18-2.76
K		mm	455	17.92
L	S	mm	755	29.73
	L	mm	895	35.24
	UL	mm	1010	39.77
M	F	mm	365	14.37
	P	mm	345	13.58
N		mm	325	12.80
O		mm	210	8.27
P		mm	480	18.90
Q		deg.	130	
R		deg.	9	
S		deg.	35	
T		deg.	71	
U		mm/in	140	5.51
Y		mm/in	15	0.59
Trim angle (Position)		deg.	4-16 (5)	

2) Transom Bolts

Mechanical Tilt Model

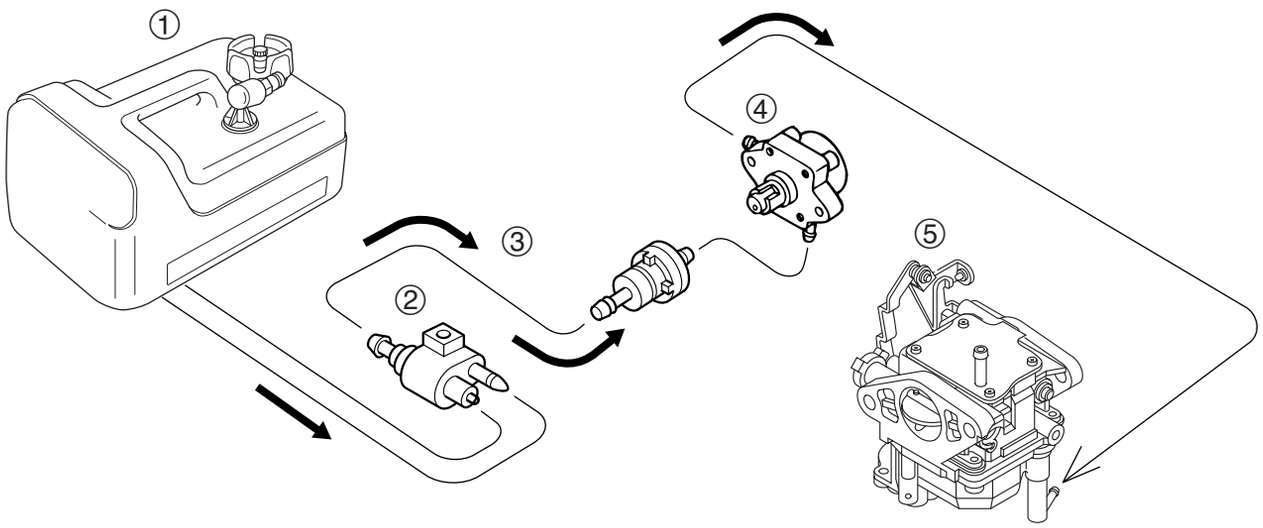


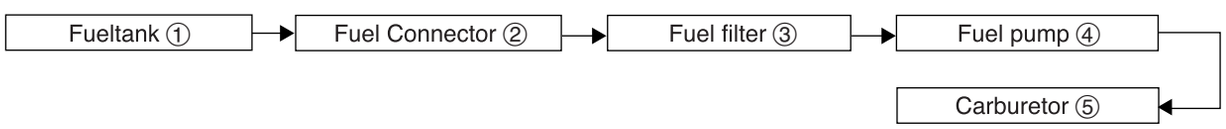
Power Tilt Model



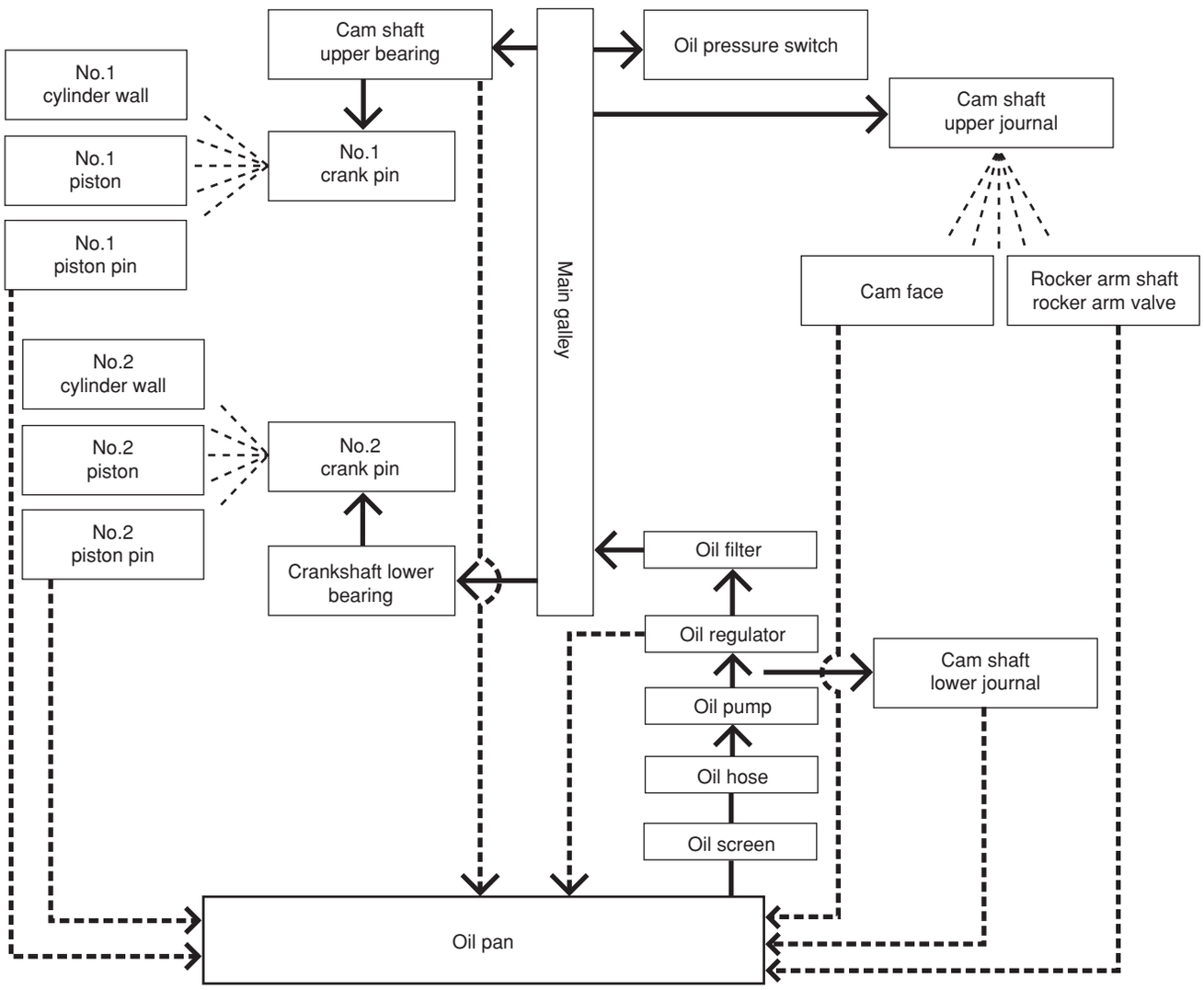
2. Fuel Feed System

1) Fuel Feed Route

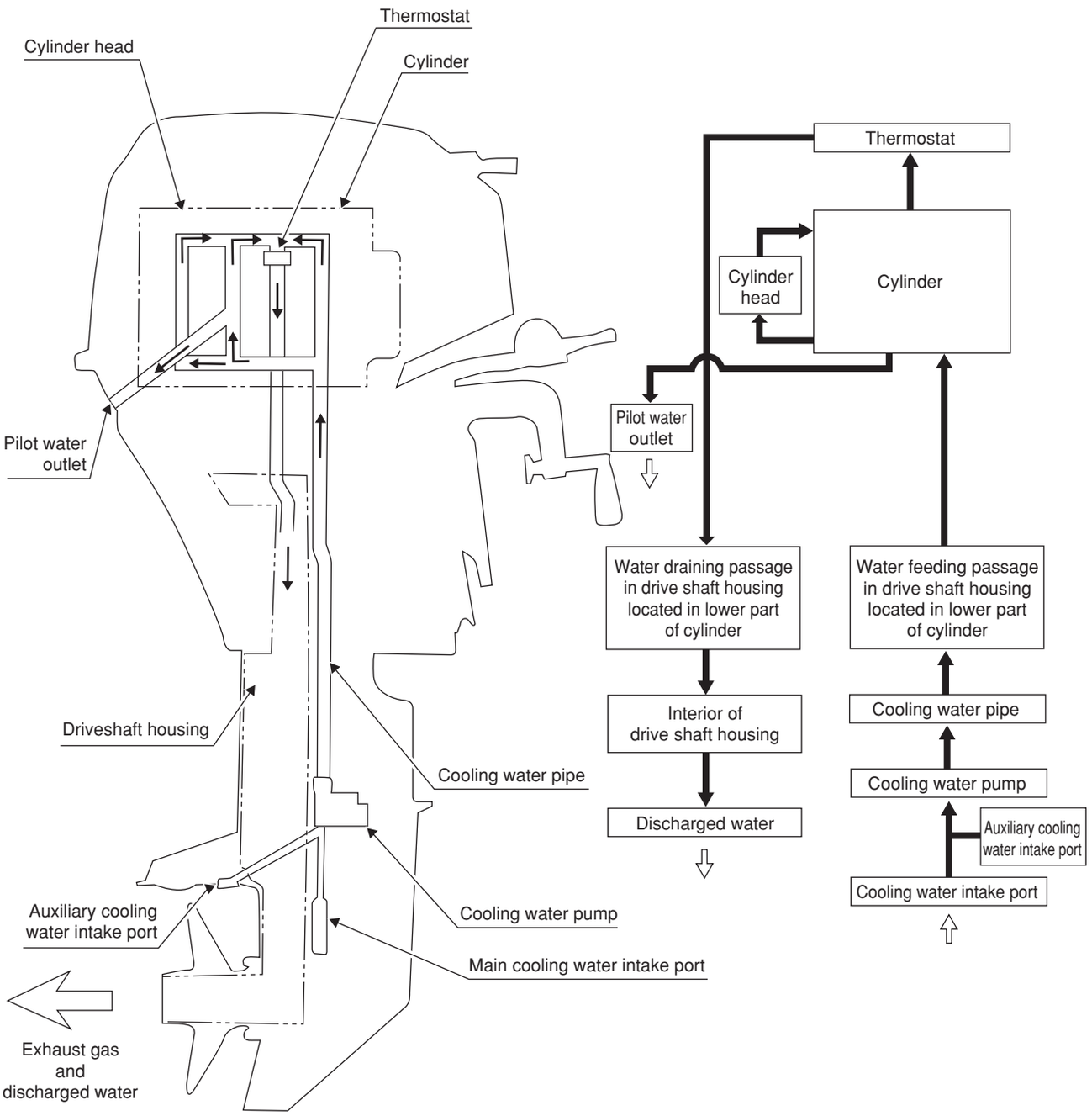




3. Engine Lubrication System Diagram



4. Cooling Water System Diagram



5. Specifications

Item		Unit	Model				
			MF	EF	EFT	EP	EPT
Dimensions							
Overall length		mm (in)	980 (38.6)			640 (25.1)	
Overall width		mm (in)	365 (14.4)			345 (13.6)	
Overall height	S	mm (in)	1,065 (42)				
	L	mm (in)	1,215 (48)				
	UL	mm (in)	1,342 (53)				
Transom height	S	mm (in)	413 (16.3)				
	L	mm (in)	562 (22.2)				
	UL	mm (in)	689 (27.1)				
Weight							
	S	Kg (lbs)	51.5 (114)	55.0 (121)	62.0 (136)	54.0 (119)	61.0 (134)
	L	Kg (lbs)	53.0 (117)	56.5 (125)	63.5 (139)	55.5 (122)	62.5 (138)
	UL	Kg (lbs)	54.5 (120)	58.0 (128)	65.0 (142)	57.0 (126)	64.0 (141)
Performance							
Maximum output		kW (Hp)	9.9C : 7.3 (9.9) 15C : 11.0 (15) 20C : 14.7 (20)				
Maximum fuel consumption		L/Hr (gph) gallons/Hr	9.9C : 3.9 (1.03) 15C : 5.0 (1.32) 20C : 6.2 (1.62)				
Wide open throttle operating rpm range		rpm	9.9C : 5,000-6,000 15C : 5,000-6,000 20C : 5,400-6,100				
Idling (Neutral: [N])		rpm	950				
Trolling (Forward: [F])		rpm	900				

Item	Unit	Model				
		MF	EF	EFT	EP	EPT

Power unit

Engine type			4 stroke			
No. of cylinders			2			
Total displacement		cm^3(c.i)	351 (21.41)			
Valve system			OHC Crossflow			
Bore x Stroke		mm(in)	61 X 60 (2.40 X 2.36)			
Compression ratio			9.2			
Shift operation			Front shift (manual)			Remote control
Starting system			Recoil starter	Recoil starter & starter motor		
Lubrication system			Wet sump (trochoid pump)			
Cooling system			Cooling water (rubber impeller)			
Exhaust system			Thru-hub exhaust system			
Ignition system			Flywheel magneto (CD ignition)			
Ignition timing			BTDC 5°- BTDC35°			
Spark plug			NGK DCPR6E			
Alternator output			12V - 145W (12A)			
Fuel feed system			Horizontal butterfly system (9.9C , 15C and 20C are equipped with acceleration pump)			

Fuel and oil

Type of fuel			Unleaded regular octane gasoline (Research octane number 90 or more)	
Fuel tank capacity		L (G)	12 (3.17)	
Starting fuel enrichment system			Choke valve	
Fuel pump			Mechanical (plunger) pump	
Engine oil	Type			4 stroke engine (motor) oil
	Grade		API	SE, SF, SG, SH, SJ, SL, SM
			SAE	10W-30, 10W-40
			NMMA	FWC certification 10W-30/40
	Amount of oil		L	1.0 (after oil filter is replaced)
Gear oil	Type			Hypoid gear oil
	Grade	*1	API	GL-5
		*1	SAE	#90
	Amount of oil		cm^3(fl · oz)	370 (12.5)

*1 Both API and SAE requirements are to be met.

Lower unit

Gear shift			F-N-R
Gear ratio			2.15(13 : 28)
Type of gear			Spiral bevel gear
Type of clutch			Dog clutch
Propeller shaft driving			Spline
Propeller rotation (direction)			Clockwise as viewed from stern at forward shift (F)
Propeller (standard)	S	Mark	9.9 : DS9(9P), 15, 20 : DS10(10P)
	L	Mark	9.9 : DS8(8P), 15, 20 : DS9(9P)
	UL	Mark	9.9 : DS8(8P), 15, 20 : DS9(9P)

Item	Unit	Model				
		MF	EF	EFT	EP	EPT

Bracket

No. of trim steps		No. of steps	6	5	6	5
Trim angle (transom 12¡)	*2	Degrees	5 - 25	4 - 16	5 - 25	4 - 16
Shallow water drive angle (transom 12¡)	*2	Degrees	32	Adjustable	32	Adjustable
Maximum tilt angle	*3	Degrees	70	71	70	71
Steering angle	*4	Degrees	70			
Maximum allowable transom board thickness		mm (in)	40 - 60 (1.57 - 2.36)	30 - 70 (1.18 - 2.76)	40 - 60 (1.57 - 2.36)	30 - 70 (1.18 - 2.76)

*2 Angle from horizontal line when transom is 12.
*3 Tilt operating range
*4 Steering right-left operating range

Warning system

Engine over-rev protection			Controls engine speed to approx. 6,400 r/min or lower (high speed ESG)
Engine oil pressure reduction protection	*5		Controls engine speed to approx. 2,000 r/min or lower (low speed ESG). Warning buzzer and lamp are turned on.
Confirmation of operation of warning system			Only lamp operates (7 seconds).

*5 To cancel this warning system, engine should be stopped and then restarted.

Optional parts

Propeller [Mark] (No. of blades x Diameter x Pitch) [in/mm]		Mark	11.5	(3x9.25x11.5)	(3x235x292)
			10	(3x9.25x10)	(3x235x254)
			9	(3x9.25x9)	(3x235x229)
			8	(3x9.25x8)in	(3x235x203)mm
			7	(3x9.2x6.9)	(3x234x174)
			6	(3x9.2x6.1)	(3x234x155)
Tachometer		No. of poles	12		
Remote control cable		Feet	Cable length : 5 - 32ft		

6. Maintenance Data

	Part name	Item	Standard value
Engine parts	Cylinder head	Carbon deposition on combustion chamber wall	
		Deformation of mating faces and flaws	
		Corrosion of mating faces	
		Plugging of cooling water passages	
	Cylinder	Deposition on water jacket interior walls	61.00mm (2.4016in)
		Wear of bore : Measure bore by using cylinder gauge.	
		Seizing, and damage and wear of cylinder liner Taper Roundness	
		Deformation and damage of cylinder head mating faces	
		Engine anode	
	Piston	Outer diameter Measure outer diameter at 9mm (0.35in) above lower end of piston skirt. (Measure at right angle to piston pin.) · Piston clearance	60.96mm (2.4000in) 0.020 - 0.055mm (0.00079 - 0.00217in)
		Carbon deposition on piston crown and in ring grooves	
		Flaws on sliding faces	
		Measure side clearance between piston ring and ring groove.	Top ring 0.04 - 0.08mm (0.0016 - 0.0031in) Second ring 0.03 - 0.07mm (0.0012 - 0.0028in) Oil ring 0.05 - 0.15mm (0.0019 - 0.0059in)
		Measure piston pin bore. Piston pin clearance	 0.002 - 0.012mm (0.00008 - 0.00047in)
	Piston pin	Outer diameter	16.00mm (0.6299in)
	Piston rings	Ring end gap Note : Measure ring end gap at the top or bottom cylinder bore that is worn little if ring gauge is not available.	Ring gauge 61.000mm (2.40157in)
		Top ring	Top ring 0.15 - 0.30mm (0.0059 - 0.0118in)
		Second ring	Second ring 0.35 - 0.50mm (0.0138 - 0.0197in)
		Oil ring	Oil ring 0.20 - 0.70mm (0.0079 - 0.0276in)
	Connecting rod	Small end bore	16.01mm (0.6303in)
		Big end oil clearance	0.015 - 0.041mm (0.00059 - 0.0161in)
		Big end side clearance	0.10 - 0.25mm (0.0039 - 0.0098in)
	Crankshaft	Crankshaft runout: Support crankshaft at journals of both ends by using V block.	To be less than 0.05mm (0.0020in) at both ends and at the center.
		Crank pin outer diameter	29.98mm (1.1803in)
		Main journal outer diameter	35.99mm (1.4169in)
		Metal bearing oil clearance	0.012 - 0.044mm (0.00047 - 0.00173in)
		Crankshaft side clearance	0.1 - 0.3mm (0.004 - 0.012in)

Serviceable limit	Action to be taken
	Clean to remove.
0.1mm (0.004in)	Correct. (Use #240 to 400 waterproof sand paper put of the surface plate to correct. Use #600 to ofinish.)
	Correct if possible, or replace.
	Clean to remove.
	Clean to remove.
61.06mm (2.4039in)	Replace if over serviceable limit.
0.08mm (0.0032in) 0.06mm (0.0024in)	Replace if face on which piston slides has deep flaws which cannot be removed by using sand paper of No. 400 to 600 or if over upper limit.
0.1mm (0.004in)	Correct. (Use #240 to 400 waterproof sand paper put of the surface plate to correct. Use #600 to ofinish.)
	Replace if severely worn (worn to 1/3 of original size).
60.90mm (2.3976in) 0.150mm (0.00591in)	Replace if under lower limit. Replace if over upper limit.
	Clean to remove.
	Use waterproof sand paper of No. 400 to 600 to correct if possible, or replace.
Top ring 0.10mm (0.0039in) Second ring 0.09mm (0.0035in) Oil ring 0.17mm (0.00669in)	Replace if over specified limit. Replace oil ring when top ring or second ring is replaced.
0.040mm (0.00157in)	Replace if over upper limit.
15.97mm (0.6287in)	Replace if under lower limit.
Top ring 0.50mm (0.0197in) Second ring 0.70mm (0.0276in) Oil ring 0.90mm (0.0354in)	Replace if the gap is over specified limit only if cylinder iner wear is less than specified limit. Replace oil ring when top ring or second ring is replaced.
16.04mm (0.6315in)	Replace if over upper limit.
0.060mm (0.00236in)	Replace if over upper limit.
0.60mm (0.0236in)	Replace if over upper limit.
0.05mm (0.0020in)	Replace if over upper limit.
29.95mm (1.1791in)	Replace if under lower limit.
35.97mm (1.4161in)	Replace if under lower limit.
0.06mm (0.0024in)	Replace if over upper limit.
0.6mm (0.024in)	Replace if over upper limit.

Service Data

	Part name	Item		Standard value		
Engine parts	Intake valve Exhaust valve	Valve clearance	IN : Intake EX : Exhaust	0.13 - 0.17mm (0.0051 - 0.0067in) 0.18 - 0.22mm (0.0071 - 0.0087in)		
		Valve stem outer diameter	IN : Intake EX : Exhaust	5.48mm (0.2157in) 5.46mm (0.2150in)		
		Valve guide inner diameter	IN : Intake EX : Exhaust	5.51mm (0.2169in) 5.51mm (0.2169in)		
		Clearance between valve guide and valve stem	IN : Intake EX : Exhaust	0.008 - 0.040mm (0.00031 - 0.00157in) 0.025 - 0.057mm (0.00098 - 0.00224in)		
		Width of area contacting with valve seat	IN : Intake EX : Exhaust	1.0mm (0.04in) 1.0mm (0.04in)		
	Valve spring	Free length		35.0mm (1.38in)		
	Cam shaft	Cam height (both IN and EX)		24.28mm (0.9559in)		
		Journal outer diameter		Pulley side Oil pump side		17.98mm (0.7079in) 15.97mm (0.6287in)
		Clearance with holder (journal)		0.02 - 0.05mm (0.0008 - 0.0020in)		
	Rocker arm and shaft	Rocker arm inner diameter		13.01mm (0.5122in)		
		Shaft outer diameter		12.99mm (0.5114in)		
		Shaft clearance		0.006 - 0.035mm (0.00024 - 0.00138in)		
	Timing belt	Appearance				
	Engine block	1.Compression pressure (Reference value)				
		· Decompressor active		0.5MPa (5.1kg/cm^2) (73psi)/650r/min±10%		
		· Decompressor not active		1.35MPa (13.1kg/cm^2) (186psi)/650r/min±10%		
Fuel and lubrication parts	Carburetor			F9.9C	F15C	F20C
		Setting mark		3FSF A 9	3BHF A 5	3BAF A 2
		Venturi bore	mm (in)	14.5 (0.571)	15 (0.591)	23 (0.906)
		Throttle bore	mm (in)	23(0.906)	30 (1.181)	30 (1.181)
		Main jet (MJ)		#88	#99	#121
		Main air jet (MAJ)	mm (in)	ø0.2 (0.078)	ø1.10 (0.433)	ø1.47 (0.0578)
		Main nozzle bore (MN)	mm (in)	ø2.8 (0.110)	ø1.7 (0.067)	ø2.3 (0.091)
		Slow jet (SJ)		#43	#46	#52
		Slow air jet (SAJ)	mm (in)	ø0.76 (0.0299)	ø0.85 (0.0334)	ø0.72 (0.0283)
		Throttle opening (at WOT)		75˚	83˚	83˚
		Pilot screw (PS)		-	-	-
		Fuel level (from flange face to float bottom)	mm (in)	26.2 (1.0314)	26.2 (1.0314)	26.2 (1.0314)
		Auto-bystarter PTC heater resistance	Ω	-	-	-
		Idling rpm	r.p.m	950	950	950
		Trolling rpm	r.p.m	900	900	900
	Oil pump	Pump body bore				
		Clearance between outer rotor and body				
		Height of outer rotor				
		Side clearance between rotor and body				
		Clearance between outer and inner rotors				

Serviceable limit	Action to be taken
	Adjust to specified range
5.46mm (0.2150in) 5.44mm (0.2142in)	Replace if under lower limit.
5.55mm (0.2185in) 5.57mm (0.2193in)	Replace if over upper limit.
0.070mm (0.00276in) 0.100mm (0.00394in)	Replace if over upper limit.
2.0mm (0.08in) 2.0mm (0.08in)	Replace if over upper limit.
33.5mm (1.32in)	Replace if under lower limit.
24.00mm (0.9449in)	Replace if under lower limit.
Pulley side : 17.95mm (0.7067in) Oil pump side : 15.95mm (0.6280in)	Replace if under lower limit.
0.09mm (0.0035in)	Replace if over upper limit.
13.05mm (0.5138in)	Replace if over upper limit.
12.94mm (0.5094in)	Replace if under lower limit.
0.060mm (0.00236in) Wear, damage, stretch	Replace if over upper limit. Replace if severely worn, damaged or stretch.
	Check that no pressure leaks through rotating parts, sliding parts and sealing parts.
29.04mm (1.1433in)	Replace if over upper limit.
0.36mm (0.1417in)	Replace if over upper limit.
14.96mm (0.5890in)	Replace if under lower limit.
0.11mm (0.0043in) (Wear of oil pump cover is included.)	Replace if over upper limit.
0.16mm (0.0063in)	Replace if over upper limit.

	Part name	Item	Standard value
Electrical parts	Magneto	Ignition timing	BTDC 5° - BTDC 35°
		Spark performance (@500r/min) (Use genuine spark tester to measure.)	10mm (0.4in) or over
		Alternator output (@5,000 r/min)	12V - 140W
		Stator coil resistance	
		Exciter coil Black/Red - Blue	12.5 - 18.8Ω
		Charge coil White - Yelllow	0.27 - 0.41Ω
		Pulser coil (#1) Red/White - Black	148 - 222Ω
	Ignition coil	Primary coil resistance Black - Orange	0.26 - 0.35Ω
		Secondary coil resistance (High tension cord - Black)	6.8 - 10.2kΩ
		[KΩ range] Plug cap - Black	11.8 - 15.2Ω
	Plug cap	Terminal-Terminal resistance [KΩ range]	3.0 - 7.0kΩ
	Spark plug	Plug type	DCPR6E [NGK]
		Spark gap	0.8 - 0.9mm (0.032-0.035in)
	Rectifier	Terminal-Terminal resistance	(Refer to Chapter 8.)
	Starter motor	Battery	12V-70AH - 12V-100AH
		Output	12V 0.6kW
		Clutch	Overrrunning clutch
		Brush length	12.5mm (0.492in)
		Commutator undercut	0.5 - 0.8mm (0.020 - 0.031in)
		Commutator outer diameter	30.0mm (1.181in)
	Fuse	Capacity	20A

Serviceable limit	Action to be taken
10mm (0.4in)	Replace if below specified value.
	Replace if out of specified range.
	Replace if out of specified range.
	Replace if out of specified range.
	Replace if out of specified range.
1.2mm (0.047in)	Clean to remove carbon deposit and dirt. Adjust gap by moving side electrode. Replace if electrode is severely eroded.
1.2mm (0.047in)	Replace if out of specified range.
9.5mm (0.374in)	Replace if under lower limit.
0.2mm (0.008in)	Replace if under lower limit.
29.0mm (1.142in)	Replace if under lower limit.
20A	

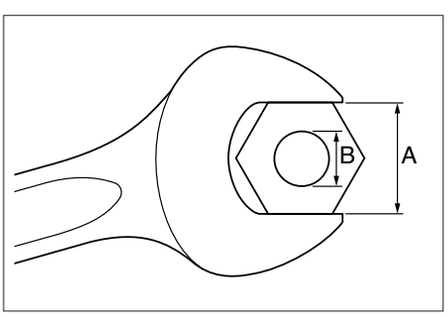
	Part name	Item	Standard value
Cooling system parts	Thermostat	Valve operation starting temperature (submerged)	60°C±1.5°C (140±3°F)
		Valve full open temperature (submerged)	75°C (167°F)
		Valve full open lift (submerged)	3.0mm (0.12in) or over
	Pump impeller	Wear, crack	
	Pump case (liner)	Wear	
	Guide plate	Wear	
Lower unit parts	Anode	Gear case anode, wear	
	Propeller shaft	Bearing outer diameter	16.989 - 17.000mm (0.6688 - 0.6692in)
		Wear and damage of bearing	
		Wear of oil seal	
		Runout of propeller shaft	
	Bevel gear	Backlash between forward gear (A) and pinion (B)	0.05 - 0.15mm (0.0019 - 0.0059in)
		Refer to relevant section of this chapter.	Dial gauge reading: 0.85 to 0.92in (target value : 0.9in)
		Reverse gear (C) washer thickness	1.5mm (0.0590in)
	Propeller	Wear, bend, crack, nick	
	Drive shaft	Spline (upper) base tangent length 3 teeth	7.9mm (0.311in)
		Damage of bearing	
		Wear and damage of oil seal	
		Drive shaft runout	
	Reverse lock spring	Free length S model	95.0mm (3.74in)
		L&UL models	98.0mm (3.86in)
Other parts	Oil seals	Wear, damage	

Serviceable limit	Action to be taken
Open even a little at ambient temperature	Replace if out of specified range.
Because thermostat operates with some time lag, measure the lift of open valve after maintaining at around 75°C(167°F) for approximately 5 minutes.	
3.0mm(0.12in)	Replace if under lower limit.
If the part is worn, cracked or damaged at the outer ends or at upper of lower lip	Replace pump case liner and guide plate as a set.
	Replace if severely worn.
	Replace if severely worn.
	Replace if severely worn.
16.97mm or less (0.6681in or less)	Replace.
	Replace if severely worn.
0.4mm (0.015in)	Replace if over upper limit.
0.05mm (0.0020in)	Replace if over upper limit.
0.05mm or less (0.0019in or less) 1.35mm or less (0.0531in or less)	Adjust or replace. Replace.
Damaged	Replace if out of specified range.
7.5mm (0.295in)	Replace if under lower limit.
	Replace if severely damaged.
0.4mm (0.015in)	Replace if severely damaged.
0.5mm (0.020in)	Replace if over upper limit.
97.0mm (3.82in)	Replace if over upper limit.
100.0mm (3.94in)	Replace if over upper limit.
Lip is deteriorated, degraded, or damaged, or the tightening margin is reduced to 0.5mm (0.020in) or less by wear.	Replace if out of specified range.

7. Tightening Torque Specifications

	Tightening location	Wrench A	Thread B x +Pitch	Type of fastener	Tightening torque		
					N·m	lb·ft	kg·m
Engine	Cylinder block-Cylinder head bolts	10	M6 x1.0	Bolt	① 6	4	0.6
					② 10	7	1.0
		12	M8 x1.25	Bolt	① 10	7	1.0
					② 30	22	3.0
	Cylinder block-Crank case bolt	10	M6 x1.0	Bolt	① 6	4	0.6
					② 11.5	8.5	1.2
		12	M8 x1.25	Bolt	① 10	7	1.0
					② 23.5	17	2.4
	Connecting rod	10	M7 x1.0	Bolt	① 6	4	0.6
					② 12	9	1.2
	Tappet lock nut	10	M6 x 0.75	Nut	7	5	0.7
	Flywheel	19	M16 x 1.5	Nut	80	58	8
	Drive (timing) pulley		M30 x 1.0	Nut	64	46	6.4
	Drive (cam shaft) pulley	10	M6 x 1.0	Bolt	11	8	1.1
	Plunger	19	M16 x 1.5	—	30	22	3.0
	Oil filter	—	M20 x 1.5	—	18	13	1.8
	Oil pressure switch	24	PT 1/8	—	8	6	0.8
	Cylinder head cover	10	No.7 M6 x 1.0	Bolt	① 6	4	0.6
					② 9	7	0.9
	Intake manifold	10	No.7 M6 x 1.25	Bolt	9	7	0.9
	Spark plug	16	M12 x 1.25	Bolt	18	13	1.8
	Power unit installation	13	M8 x 1.25	Bolt	30	22	3.0
PT unit	Tilt cylinder pin installing bolt (Upper)	10	M6x1.0	Bolt	13	9	1.3
	Retaining screw	13	M8x1.25	Bolt	13	9	1.3
	Pump installing screw	—	—	Bolt	5	4	0.5
	Motor ass'y installing screw	—	—	Bolt	5	4	0.5
	Reservoir tank cap	17	—	Bolt	1.5	1.1	0.15
	Manual valve	—	—	—	2	1.5	0.2
Lower unit	Bracket bolt and nut	—	7/8-14UNF - 2B	Nut	24	17	2.4
	Mounting rubber upper bolt	12	M8 x 1.25	Bolt	13	9	1.3
	Mounting rubber lower nut	12	M8 x 1.25	Nut	13	9	1.3
	Engine oil drain plug	16	M14 x 1.5	Bolt	24	17	2.4
	Bevel gear B nut		M10 x 1.5	Nut	35	25	3.5
	Gear case installatin nut	13	M8 x 1.25	Nut	24	17	2.4
	Propeller nut	10	M12 x	Nut	12	9	1.2

Standard torque	M5 bolt and nut	8	M5 x 0.8	Bolt and nut	4	3	0.4
	M6 bolt and nut	10	M6 x 1.0	Bolt and nut	6	4	0.6
	M8 bolt and nut	13	M8 x 1.25	Bolt and nut	13	9	1.3
	M10 bolt and nut	17	M10 x 1.25	Bolt and nut	27	20	2.7



8. Sealant and Lubricant

Apply to			Screw locking agent				Gasket sealing agent		Instantaneous adhesive	Adhesive	Cold resistant lithium grease LIT	Water resistant grease OBM	Teflon grease TEF	Silicone grease SOC	Molybdenum grease MOL	4 stroke engine oil	Tohatsu genuine gear oil	PT fluid	Remarks
			LOC-TITE	ThreeBond			LOC-TITE	ThreeBond		Konishi				Shin-Etsu Chemical	SUMICO LUBRI-CANT				
			271	1342	1373	1361	518	1207B	1741	G17	Centax L2	FM-531	LM-902	KS-64	500			ATF	
Engine block	Cylinder head	Camshaft (cam lobe, and fuel pump driving section)													○				Bearings and cams
		Oil seal (cam shaft)									○								Lip
																○			Periphery, at press fitting
		Rocker arm														○			Bearings and slippers
		Rocker arm shaft														○			Periphery
		Rocker arm spring														○			Whole area
		Washers (rocker arm)														○			Whole area
		Valves (INT,EX)														○			Stem and stem end
		Valve springs														○			Whole area
		Valve springs seat														○			Whole area
		Retainer, cotter														○			Whole area
		Valve stem seals (INT,EX)														○			Lip and inside
		Tappet adjusting screws														○			Whole area
		Oil pump														○			Approx. 2cc from bearing and intake port (undisassemblable)
		O ring (oil pump)														○			
		Fuel pump														○			Tip of plunger
		O ring (fuel pump)														○			
		O ring (filler cap)														○			
		Bolt (cam pulley)		○															Thread (when bolt is reused)
		Head cover																	Mating surfaces
		Tapered plug 1/4 (cylinder head)	○																Thread
	Cylinder block, crank case	Cylinder liner														○			Inner wall
		Pistons														○			Ring grooves and periphery
		Piston rings														○			Whole area
		Piston pins														○			Periphery
		Connecting rods														○			Big and small end bores
		Crankshaft														○			Sliding surface
		Crank metal														○			Both surface
		Oil seal (crankshaft)									○								Lip
		Mating faces of cylinder block and crank case					○												Mating surfaces
		Plunger ass'y														○			Inside (approx. 1cc, disassemblable)
		Bolt (oil filter)		○															Thread
		Oil filter														○			Sealing surface
		Tapered plug 1/4 (cylinder block)	○																Thread
		Tapered plug 1/8 (cylinder block)	○																Thread

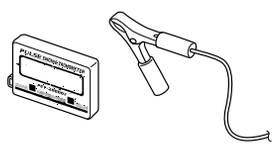
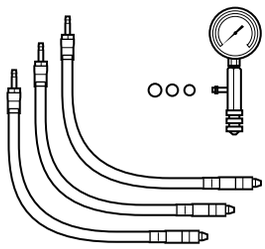
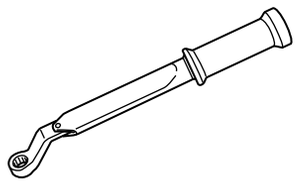
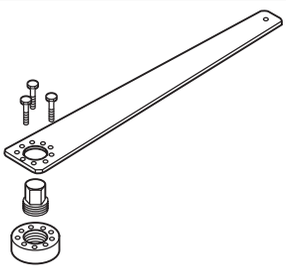
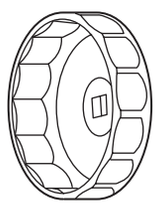
Apply to			Screw locking agent				Gasket sealing agent		Instantaneous adhesive	Adhesive	Cold resistant lithium grease LIT	Water resistant grease OBM	Teflon grease TEF	Silicone grease SOC	Molybdenum grease MOL	4 stroke engine oil	Tohatsu genuine gear oil	PT fluid	Remarks
			LOC-TITE	ThreeBond			LOC-TITE	ThreeBond		Konishi				Shin-Etsu Chemical	SUMICO LUBRI-CANT				
			271	1342	1373	1361	518	1207B	1741	G17	Centax L2	FM-531	LM-902	KS-64	500			ATF	
Engine block	Starter case	Starter case									○								Sliding face
		Starter spring									○								Whole area
		Ratchet									○								Sliding face
		Friction plate									○								Sliding face
		Reel									○								Sliding face
		Bolt (reel)		○															Thread
		Starter seal rubber							○										
	Electrical components	Spark plug cap								○				○					Spark plug bore High tension cord bore
		Oil pressure switch		○										○					Thread Terminal
		Starter motor										○		○					Apply lightly to terminal and pinion
		Starter solenoid												○					Terminal
Lower Unit	Shift system	Shift rod lever										○							Bearing
		Shift shaft										○							Sliding face, shift rod bore
	Drive shaft housing	Oil seal (drive shaft housing)											○						Apply 3 grams to lip, and to exterior of oil seal after installing drive shaft.
																○			Periphery, at press fitting
		Drive shaft guide		○															Periphery, at press fitting
		Tapered plug 1/8		○															Thread
		Bolt (upper rubber mount)		○															Thread
		Bolt (idle port cover)				○													Thread
		Stud bolt (gear case)		○															Female thread side
	Drive shaft	Drive shaft (spline)											○						Crankshaft side spline
		Ball bearing															○		at press fitting
		Pinion (B) gear nut			○														Thread
	Gear case	Oil seal (lower pump case)									○								Lip
																	○		Periphery, at press fitting
		Pump case liner										○							Impeller sliding surface
		Water pipe seal (lower)															○		Inside
		O ring (lower pump case)															○		
		O ring (cam rod bushing)									○								
		Bolt (cam rod bushing)			○							○							Thread
		Bolt (pump case)			○							○							Thread
		Ball bearing															○		at press fitting
		Needle bearing															○		at press fitting

Apply to			Screw locking agent				Gasket sealing agent		Instantaneous adhesive	Adhesive	Cold resistant lithium grease LIT	Water resistant grease OBM	Teflon grease TEF	Silicone grease SOC	Molybdenum grease MOL	4 stroke engine oil	Tohatsu genuine gear oil	PT fluid	Remarks
			LOC-TITE	ThreeBond			LOC-TITE	ThreeBond		Konishi				Shin-Etsu Chemical	SUMICO LUBRI-CANT				
			271	1342	1373	1361	518	1207B	1741	G17	Centax L2	FM-531	LM-902	KS-64	500			ATF	
Lower Unit	Propeller shaft housing	Bolt (propeller shaft housing)			○							○							Thread
		O ring															○		
		Oil seal									○								Lip
																	○		Periphery, at press fitting
		Propeller shaft										○							Spline
		Needle bearing															○		at press fitting
	Bracket	Clamp screw										○							Thread
		Swivel bracket (steering shaft bore)										○							Fill interior with grease.
		Swivel bracket (bracket bolt)										○							Sliding face
		Swivel bracket (tilt stopper mount)										○							Sliding face
		O ring (steering shaft)										○							at assembling
		Reverse lock (arm and lever)										○							Movable area
		Co-pilot bolt										○							Female side
		Nut 7/8 (bracket bolt)		○															Fixed side nut
		Bolt (steering bracket)		○															when bolt is reused
	Tiller handle	Bushing (tiller handle)										○							Inner and outer surfaces
		Throttle shaft										○							Sliding face (except slide adjusting section)
		Throttle wire										○							
	Bottom cowl	Grommet (shift rod)							○										Inner and outer surfaces
		Grommet (throttle cable)							○										Lip
		Grommet (PT cord)							○										
	Drive shaft housing cover	Seal (upper part of cover)							○										
Nipples				○															Press fit section
Amount of engine oil																○			1000ml when replaced, or 1200ml when disassembled
Gear case																	○		Oil capacity 370ml
PT unit																		○	

3

Maintenance

1.Special Tools

			
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. 369-72211-0	Oil Filter Wrench P/N. 3AC-99090-0		
Removing/installing flywheel	Removing/installing oil filter		

2.Inspection Schedule

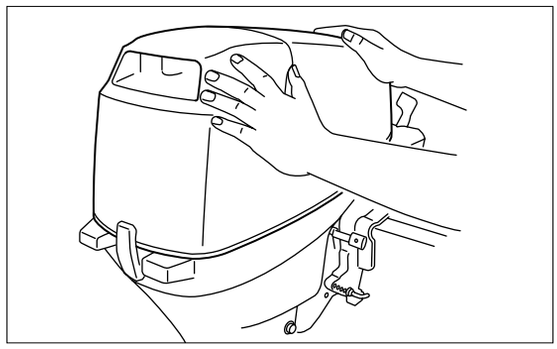
	Part to be inspected	Inspection period				Inspection item	Remarks
		Initial 20 hours or 1 month	50 hours or 3 months	100 hours or 6 months	200 hours or 1 year		
Fuel System	Carburetor			O	O	Disassembly, cleaning and inspection	
	Fuel Filter	O	O	O	O	Inspection and cleaning	
	Piping/Hoses	O	O	O	O	Damage and leak from connections	
	Fuel Tank	O	O	O	O	Cleaning	
	Fuel Tank cap	O	O	O	O	Check and clean or Replace if necessary	0.8 - 0.9mm
	Fuel Pump	O	O	O	O	Check and clean or Replace if necessary	
Ignition System	Spark Plugs	O	O	O	O	Spark gap, cleaning	
	Ignition Timing	O		O	O	Check timing	
Starting System	Starter Rope	O	O	O	O	Wear	
	Starter Motor			O	O	Salt, battery cords	
	Battery	O	O	O	O	State of installation, electrolyte level, specific gravity	
Engine	Engine Oil	O Replacement		O Replacement	O Replacement		
	Oil Filter					Replace every 200 hrs or 2 years	Entire cartridge
	Valve Clearance	O			O	Inspection, Adjustment	
	Compression Pressure				O	Inspection	
	Combustion Chamber					Cleaning every 1 year and a half	Include valve lapping if necessary.
	Anode		O	O	O	Corrosion, Wear	Replace
	Timing Belt			O	O	Wear, Damage, Elongation	
	Thermostat			O	O	Check and Replace if necessary	
Lower System	Propeller	O	O	O	O	Bend, damage, wear of blades	
	Gear Oil	O Replacement	O	O Replacement	O Replacement	Replacement or replenishment of oil, leak of water	Genuine gear oil (GL5,SAE80 to 90)
	Anode		O	O	O	Corrosion, Wear	Replace
	Water Pump Impeller		O	O	O	Wear, Crack	Replace impeller every 12 months.
Power Tilt		O		O	O	Check & replenish oil, manually operate	
Warning System			O	O	O	Check function	
Bolts and Nuts		O	O	O	O	Retighten.	
Sliding areas, rotating part, grease nipple		O	O	O	O	Applying grease, injecting grease	

3

3. Inspection Items

1) Inspection of Top Cowl

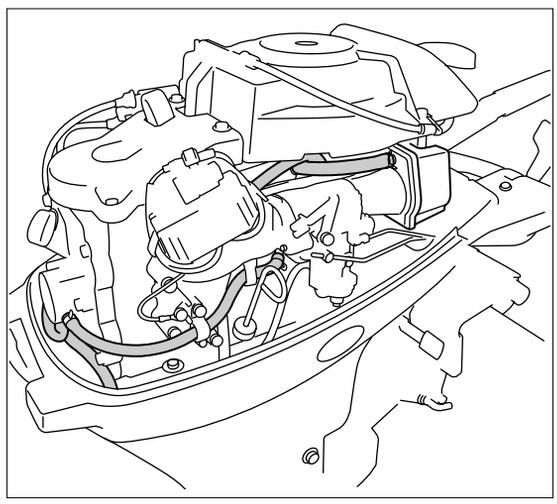
Push top cowl using both hands to check for looseness and state of closing.

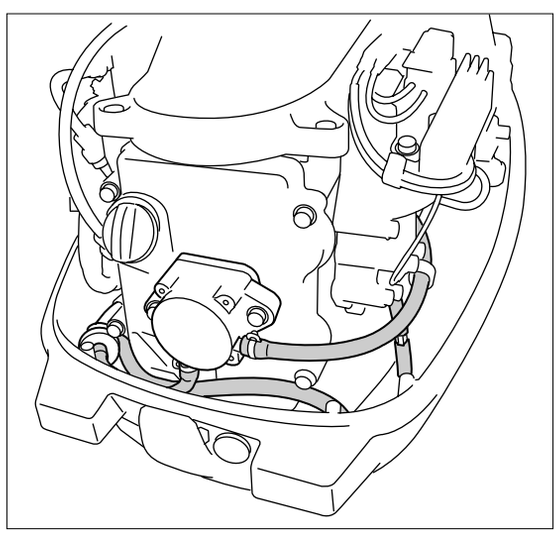


2) Fuel System

Check piping

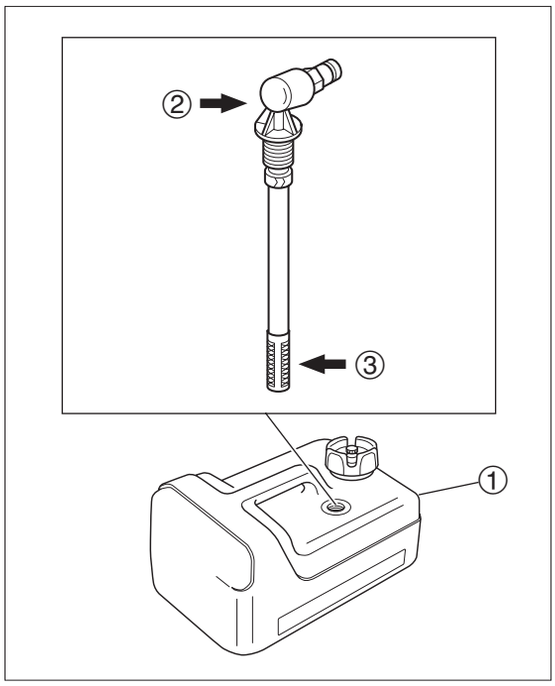
Check the fuel system piping for fuel leak, dirt, deterioration and damage, and replace or clean parts if necessary.





3) Inspection of Fuel Tank

Turn fuel pick up elbow ② of fuel tank ① counterclockwise to remove the part, and clean the filter ③. Remove dirt and water from fuel tank ① if any.

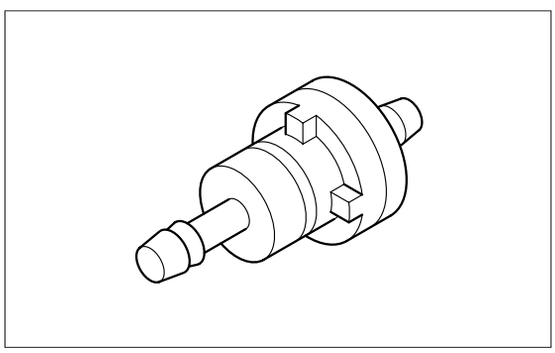


② Fuel pickup elbow
③ Filter

4) Inspection of Fuel Filter

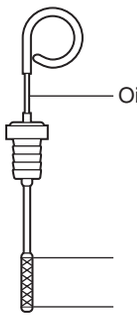
Check fuel filter for dirt, build up of fuel slag, and fuel filter for invasion of foreign matters and crack. Replace fuel filter if necessary.

Do not spill fuel when removing fuel filter.



5) Replacement of Engine Oil

1. Oil Level

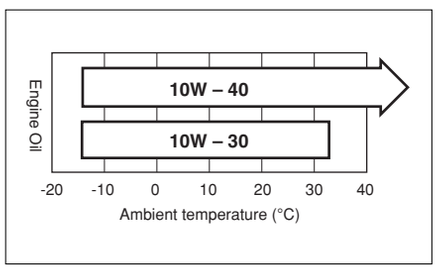


	Quantity of Oil for Full Replacement	
	When oil filter is replaced	When oil filter is not replaced
Upper Limit	1.2L	1.0L
Lower Limit	0.95L	0.75L

2. Oil Specification

Engine Oil :
4 Stroke Engine Oil
API: SE, SF, SG, SH, SJ, SL, SM
SAE: 10W-30, 10W-40
NMMA：FC-W Certified 10W-30/40

Quantity of Engine Oil :
(including oil filter) : 1.2L (1.3qt)
(not including oil filter) : 1.0L (1.1qt)

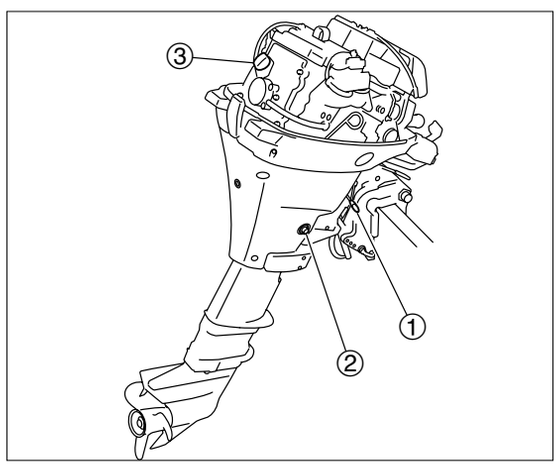


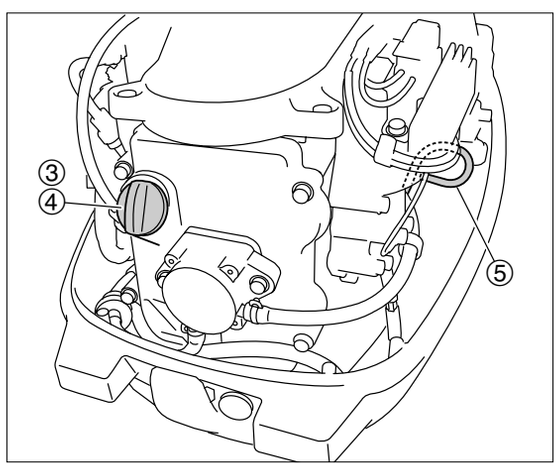
Use oil with viscosity that is suited to ambient air temperature of the operating region.

3. Engine Oil Replacement Procedure

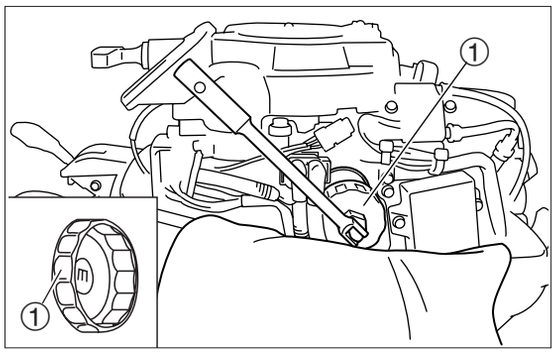
Use of engine oil containing dirt or water can significantly shorten the lives of rotating and sliding parts of engine.
Oil replacement procedure:

1. Stop engine, tilt-up outboard motor, and lock with tilt stopper ①.
2. Incline outboard motor so that drain bolt ② is directed downward.
3. Remove top cowl and then oil filler cap ③.
4. Place drain oil pan below drain bolt ②.
5. Remove drain bolt ② to drain oil.
6. Tighten drain bolt ②.
   Note: Apply engine oil to the washer (gasket) of drain bolt ②.
7. Disengage tilt lock and tilt down outboard motor.
8. Pour new engine oil into oil inlet ④ until oil level reaches upper limit mark of oil level gauge ⑤.
9. Attach oil filler cap ③ and oil level gauge ⑤, start and run engine for 5 minutes to warm up.
10. Stop engine and check oil level and oil leak after 5 minutes.





6) Replacement of Oil Filter

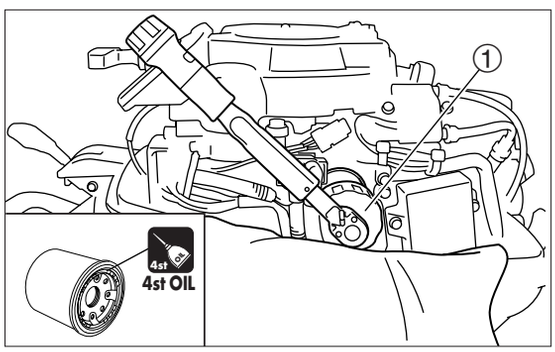


1. Drain engine oil.

2. Place a piece of rag below oil filter area, and remove oil filter by using oil filter wrench ①.

   · Leakage Replace oil filter 5 minutes or more after stopping engine.
   · Wipe off spilled oil completely.

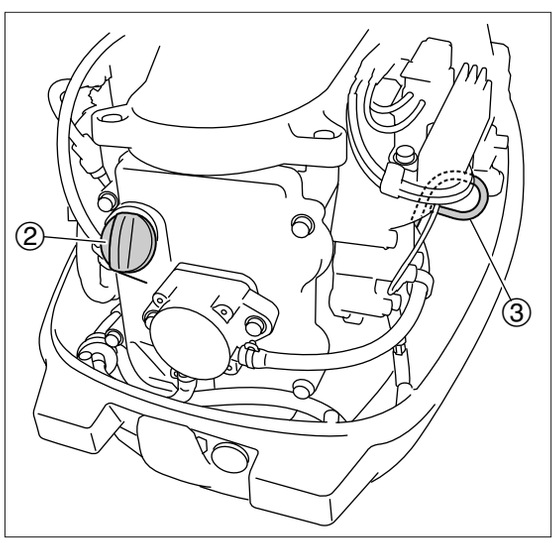
   Oil Filter Wrench ① :
   P/N. 3AC-99090-0



3. Apply thin coat of engine oil to O ring of filter before installing filter.

4. Install oil filter and tighten it to specified torque by using oil filter wrench ①.

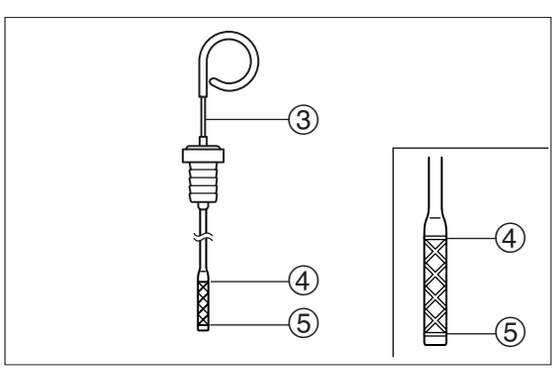
   Oil Filter :
   18N · m (13 lb-ft) [1.8kgf · m]



5. Pour engine oil into oil inlet ②.

   Engine Oil :
   4 Stroke Engine Oil
   API : SE, SF, SG, SH, SJ, SL, SM
   SAE : 10W-30, 10W-40
   NMMA : FC-W Certified 10W-30/40
   Quantity of Engine Oil :
   (including oil filter) : 1.2L (1.3qt)
   (not including oil filter) : 1.0L (1.1qt)

6. Attach oil filler cap ② and oil level gauge ③, start and run engine for 5 minutes to warm up.



④ Oil level gauge ⑤ upper limit (max) ⑥ lower limit (min)

7. Stop engine and check oil level and oil leak after 5 minutes. Do not overfill

7) Inspection of Gear Oil Quantity

1. Tilt down outboard motor to make it vertical.

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

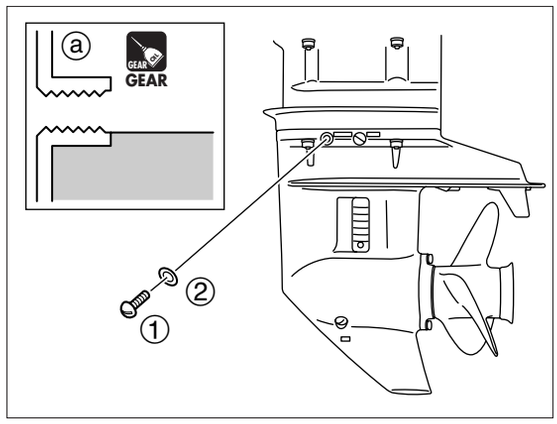
   Spill of some oil from plug hole ⓐ as plug is removed indicates that gear case is filled with specified quantity of gear oil.

3. Add recommended gear oil to specified level if it is lacking.

   Gear Oil :
   Hypoid Gear Oil
   API : GL-5 SAE : #90

   If the oil is lacking much, add through lower oil plug hole.

4. Attach upper oil plug ①.

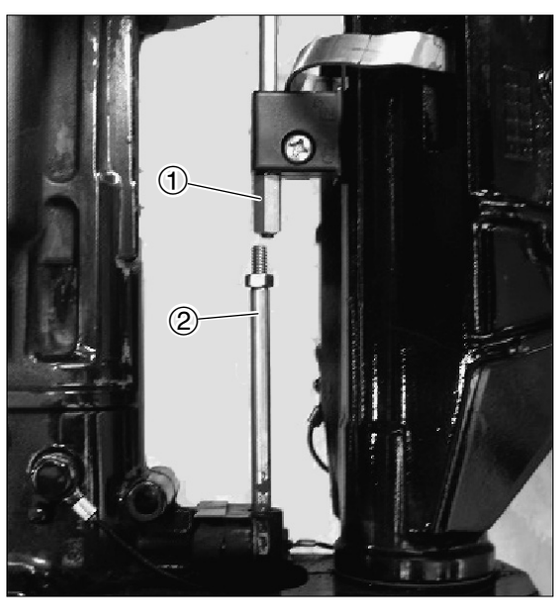


②Washer **Do not reuse.**

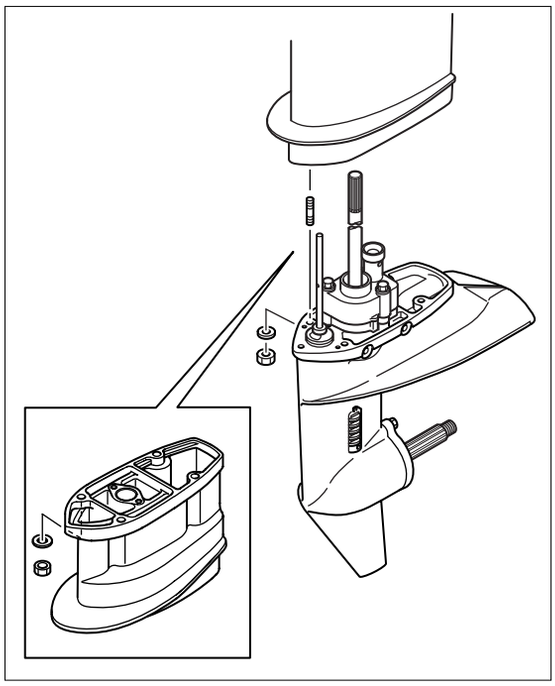
8) Inspection of Water Pump

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

1. Loosen shift rod joint ① and disconnect cam rod ②.



2. Remove lower unit installation bolts, and pull lower unit ass'y downward to remove.



3. Remove pump case (Upper) ③.

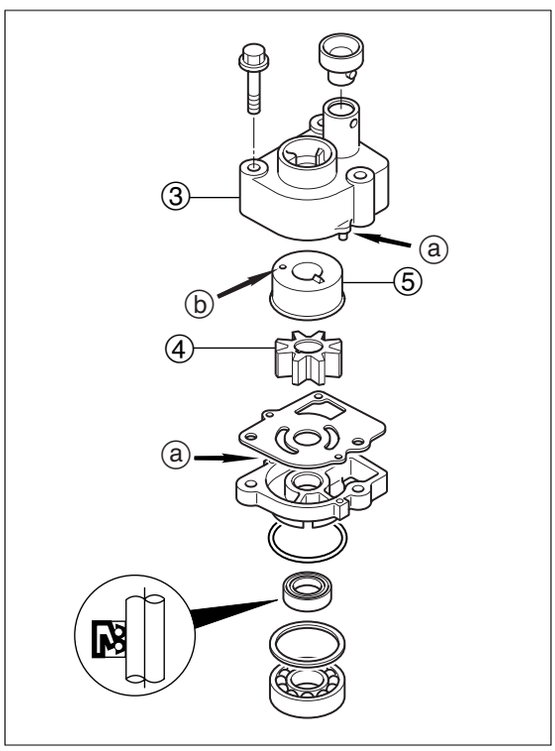
4. Remove impeller ④ and check it.

5. Check upper pump case for deformation. Replace if necessary.

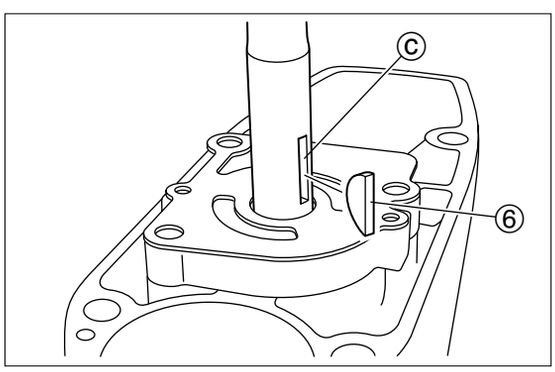
6. Check impeller ④ and pump case liner ⑤ for crack and wear. Replace if necessary.

7. Check key ⑥ and drive shaft groove ⓒ for wear. Replace if necessary.

8. Reinstall the part. For details, refer to Chapter 6.



ⓐ Projection ⓑ Hole



9) Replacement of Gear Oil

1. Tilt outboard motor a little as shown.

2. Place drain oil pan below lower oil plug ①, remove lower oil plug ① and then upper oil plug ② to drain oil.

> Remove lower oil plug first when draining.

3. Check gear oil for presence of metal particles, change of color (abnormal if clouded), and viscosity. Check lower unit internal components if necessary.

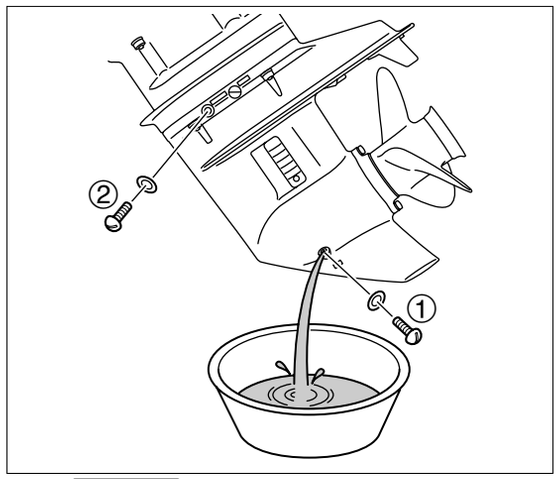
4. Fill with gear oil (from oil tube or pump) through lower plug hole ① until gear oil starts to spill from upper oil plug hole ⓐ without air bubble.

> **Gear Oil :**
> Hypoid Gear Oil
> API : GL-5 SAE : #90
> **Quantity of Gear Oil :**
> 370 cm^3 (12.5fl.oz)

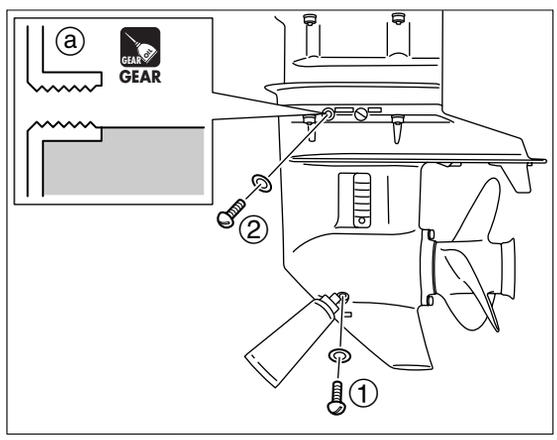
> Use lower plug hole when filling with gear oil. Upper hole cannot be used because doing so will not allow air to evacuate from gear case.

5. Attach new gasket and upper oil plug ②, and then new gasket and lower oil plug ① immediately.

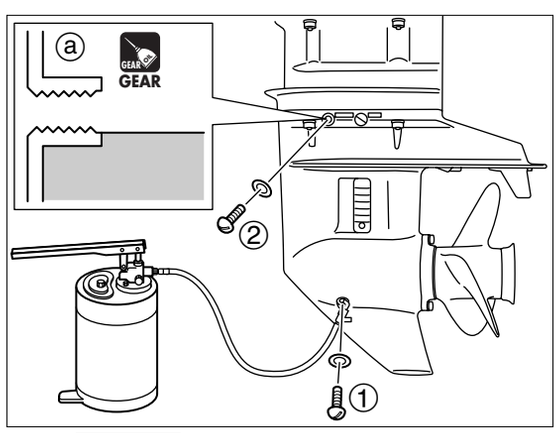
> When fully filled with oil, attach upper oil plug first.



Gasket **Do not reuse.**

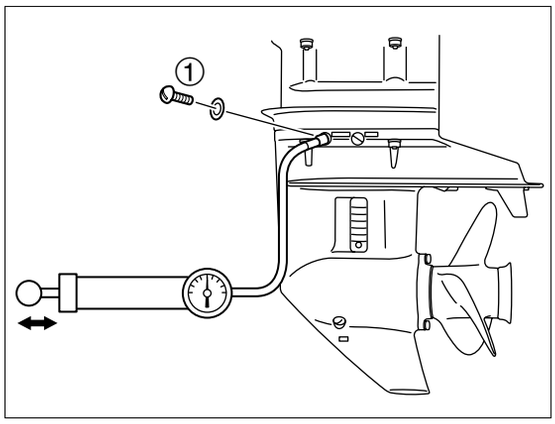


Gasket **Do not reuse.**



Gasket **Do not reuse.**

10) Inspection of Gear Case (for leakage)



1. Drain gear oil.

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

3. Apply specified pressure to gear base, and check if the pressure is maintained without further compression for 10 seconds.

Specified Gear Case Maintained Pressure :
0.069 MPa (10 psi) [0.7 kgf/cm²]

- Rotating propeller shaft while maintaining pressure and testing with gear oil drained make it easy to find leakage due to wear of oil seal lip.
- Depressurize gear case and cover oil plug area with a piece of rag before disconnecting leakage tester.

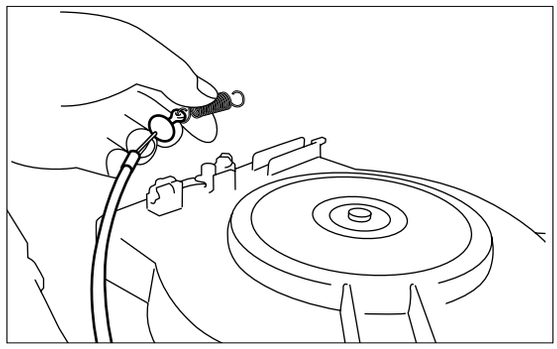
⚠ CAUTION

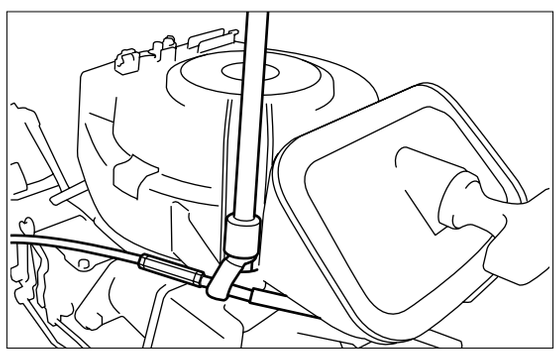
Do not apply pressure to gear case over specified value.
Doing so can cause damage to oil seal.

4. If the specified pressure cannot be maintained, check oil seals of drive shaft and propeller shaft and O ring of shift shaft, and propeller shaft housing and water pump case lower for damages.

11) Inspection of Timing Belt

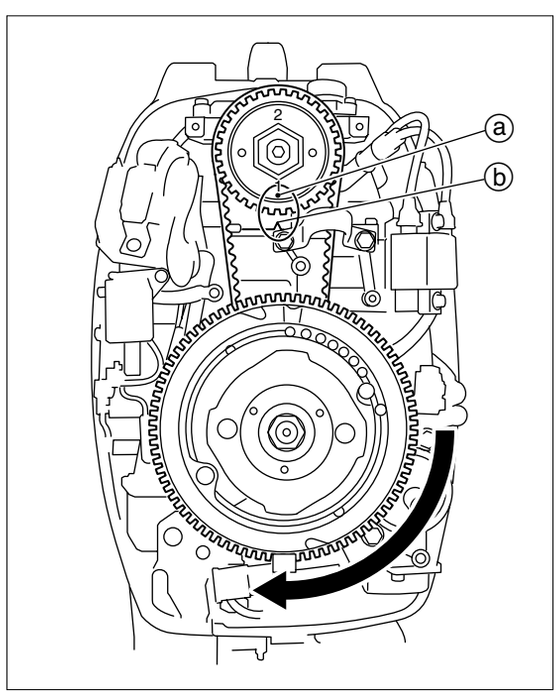
1. Disconnect starter lock cable, and then remove recoil starter and belt cover.





2. Check timing belt inner and outer surfaces for cracks, damages and wear while rotating flywheel clockwise with hands. Replace if necessary.

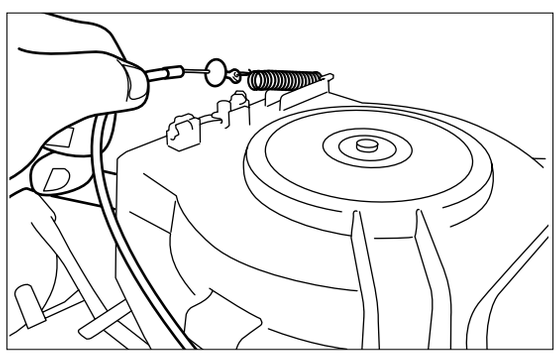
3. Rotate flywheel clockwise to bring "●1" mark ⓐ of cam shaft pulley to "▲" mark ⓑ of cylinder head.



> #1 piston is to be at top dead center of compression stroke.

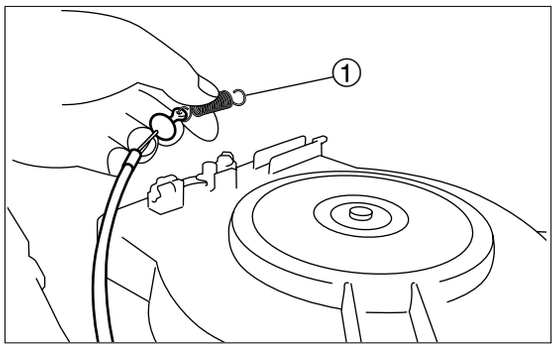
4. Reinstall recoil starter and belt cover.

5. Reconnect upper starter lock cable.

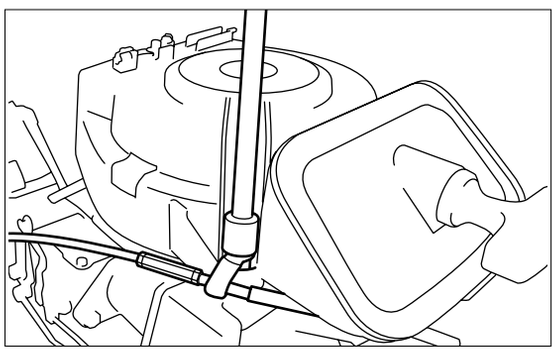


12) Replacement of Timing Belt

1. Disconnect starter lock cable ①.

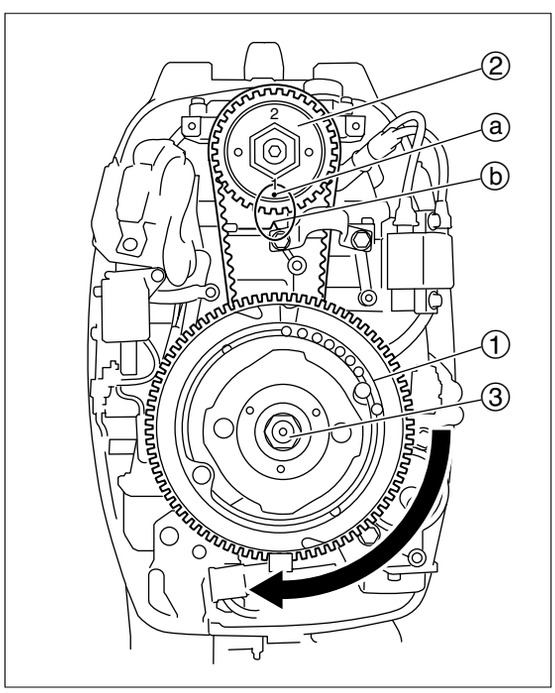


2. Remove recoil starter, belt cover and starter pulley.



3. Rotate flywheel ① clockwise to bring "●1" mark ⓐ of cam shaft pulley ② to "▲" mark ⓑ of cylinder head.

> #1 piston is to be at top dead center of compression stroke.

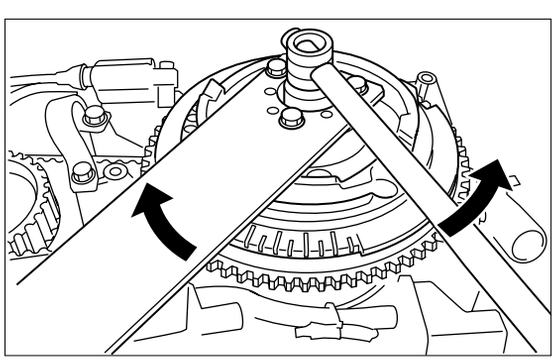


4. Loosen flywheel nut ③.

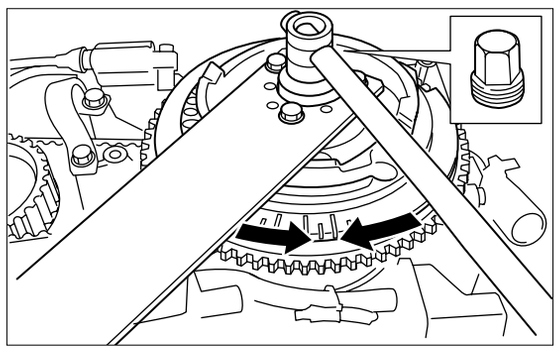
⚠ CAUTION

Apply forces to tools toward directions as shown, and perform work taking care not to allow flywheel holder to remove.

Flywheel Puller Kit :
P/N. 369-72211-0



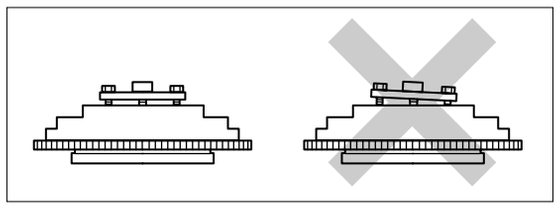
5. Use flywheel puller bolt to remove flywheel and then key.



⚠ CAUTION

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

Screw puller onto crankshaft end until flywheel is disengaged from tapered section of crankshaft.



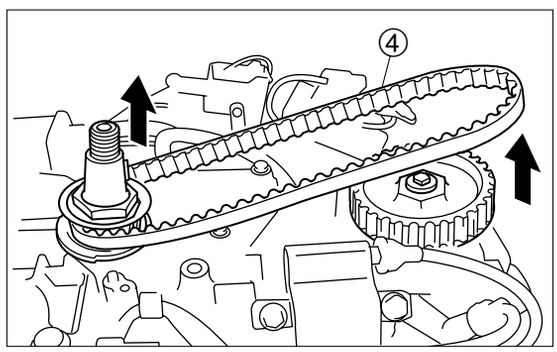
Ⓐ **Flywheel Puller :**
Use puller included in the following puller kit.

Ⓑ **Flywheel Puller Kit :**
P/N. 369-72211-0

6. Disconnect couplers (4) of alternator and pulser coils, and then, remove alternator and coil bracket ass'y.

7. Remove engine hanger.

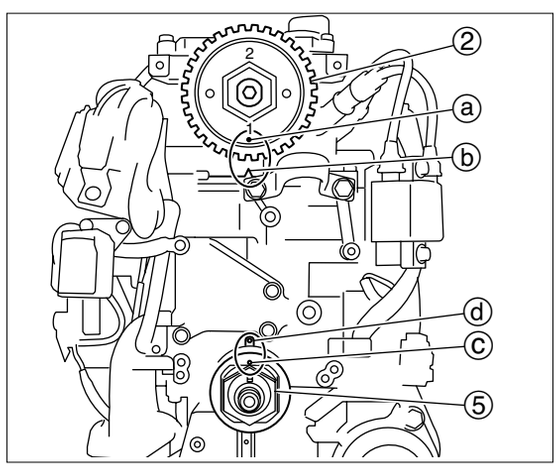
8. Remove timing belt ④ from cam shaft pulley and then from timing pulley.



⚠ CAUTION

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

9. Check that cam shaft pulley's "●1" mark ⓐ and cylinder head's "▲" ⓑ, and belt guide ⑤ 's "●" mark ⓒ and cylinder's "ⓞ" ⓓ are aligned with each other respectively.

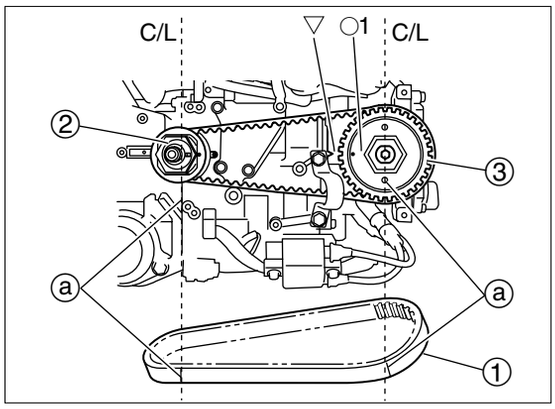


13) Installation of Timing Belt

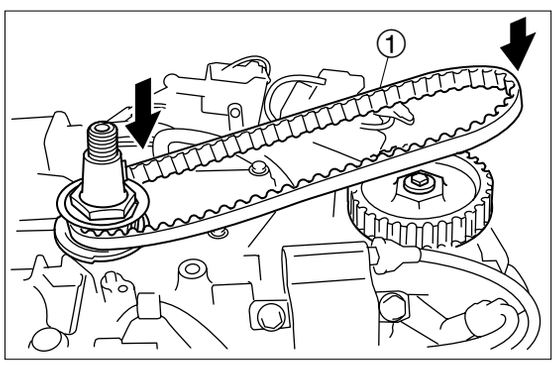
1. Align locating lines ⓐ of new timing belt ① as shown, face part number side up, and engage belt with timing pulley ② and then with cam shaft pulley ③.

⚠ CAUTION

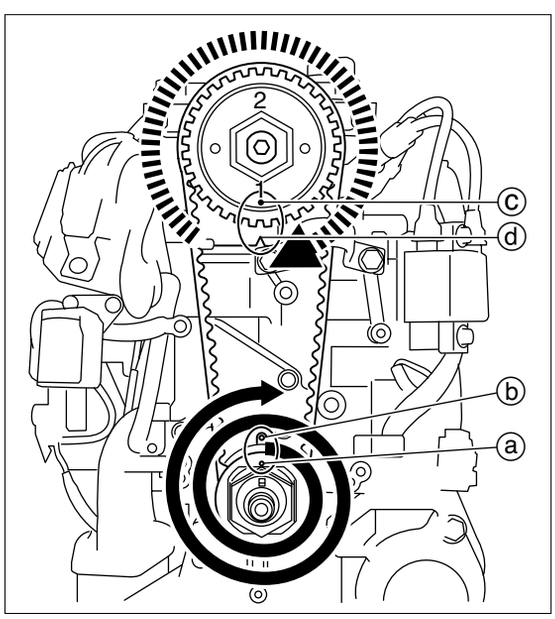
- **Be careful not to damage timing belt when installing.**
- **Do not twist timing belt, bring inside out, or bend sharp, or it may be damaged.**
- **Be careful not to allow oil or grease to adhere to timing belt.**



① Timing belt ③ Cam shaft pulley
② Timing pulley

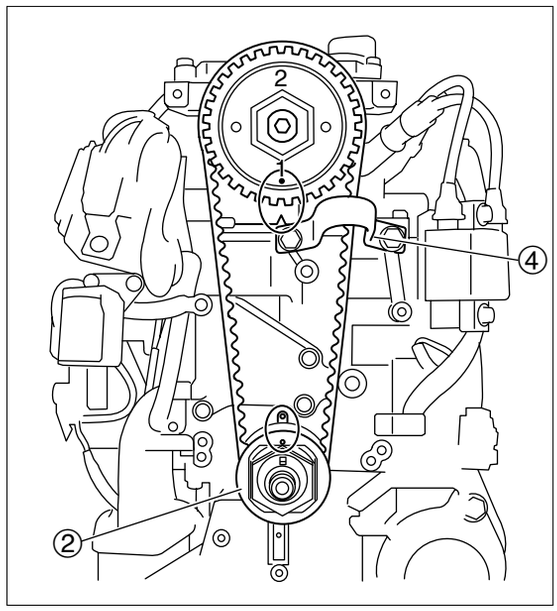


2. Turn timing pulley clockwise twice, and check that locating marks ⓐ, ⓑ and ⓒ, ⓓ of both pulleys are aligned with each other respectively.



3. Reinstall hanger ④ and tighten bolt to specified torque.

Hanger Bolt :
23 N・m (17 lb・ft) [2.3 kgf・m]



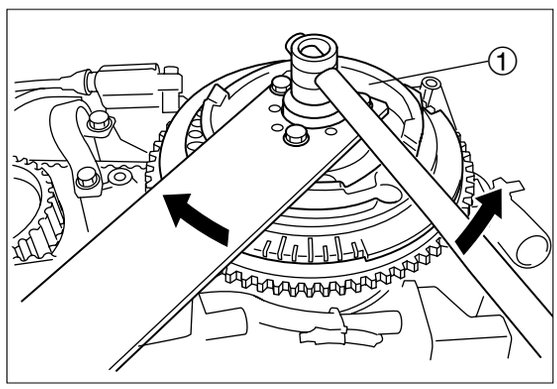
4. Install coil bracket ass'y and alternator, apply "Three Bond" 1342 to bolts, and tighten them to specified torque. Reconnect couplers (4) of alternator and pulser coil.

Coil Bracket and Alternator Bolts :
6 N・m (4 lb・ft) [0.6 kgf・m]

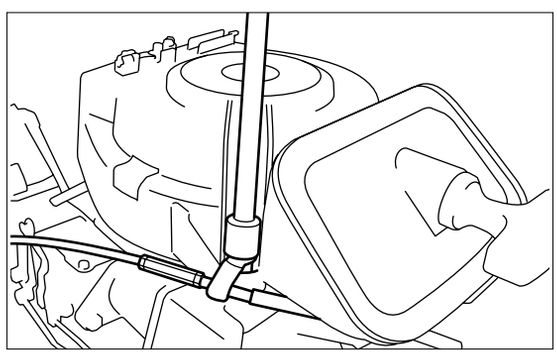
5. Reinstall key and flywheel ① and tighten nut to specified torque.

Flywheel Puller Kit :
P/N. 369-72211-0

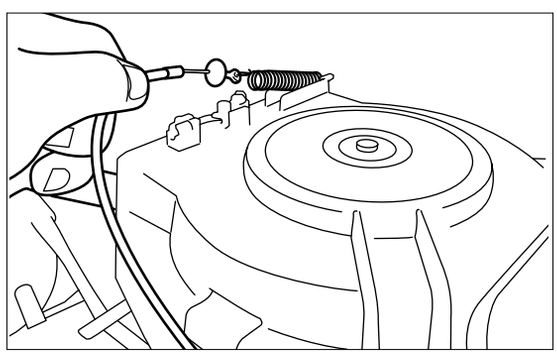
Flywheel Nut :
80 N・m (58 lb・ft) [8 kgf・m]



6. Reinstall starter pulley, recoil starter and belt cover.

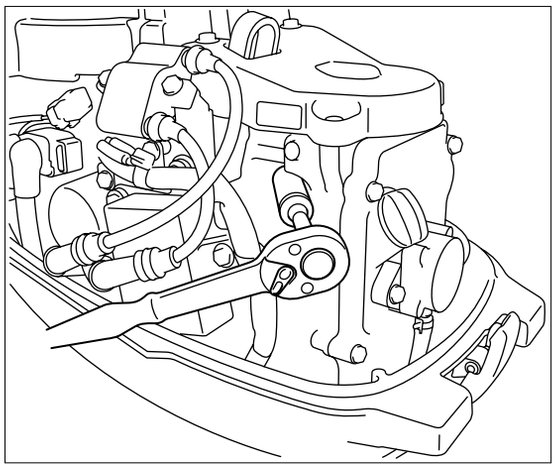


7. Reconnect upper starter lock cable.



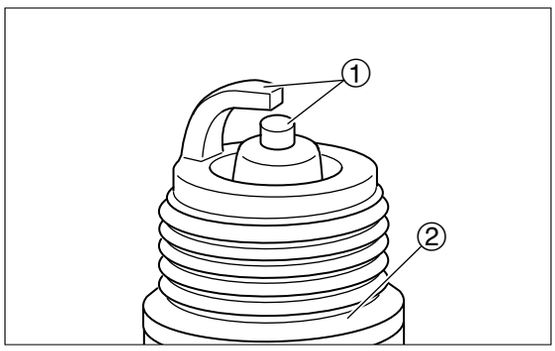
14) Inspection of Spark Plugs

1. Remove plug caps and then spark plugs.



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

3. Check electrodes ① for corrosion or excessive build up of carbon, and washer ② for damage. Replace if necessary.

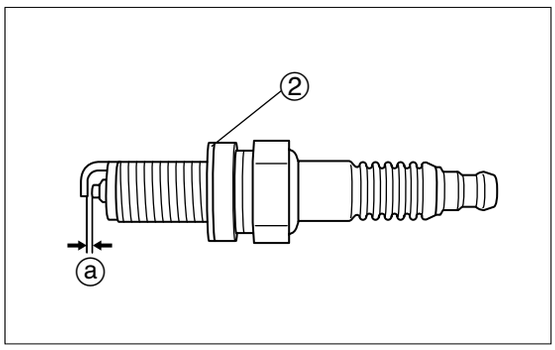


4. Check spark plug gap ⓐ. Replace if it is over specified value. Adjust gap if it is out of specified range.

Spark Plug Gap ⓐ : Standard value
0.8 - 0.9mm (0.032 - 0.035in)

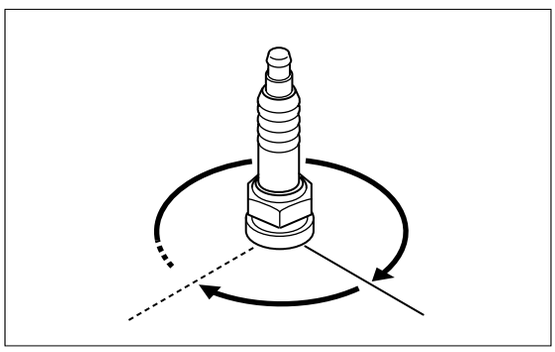
Functional Limit :
1.2mm (0.047in)

Specified Spark Plug :
DCPR6E [NGK]

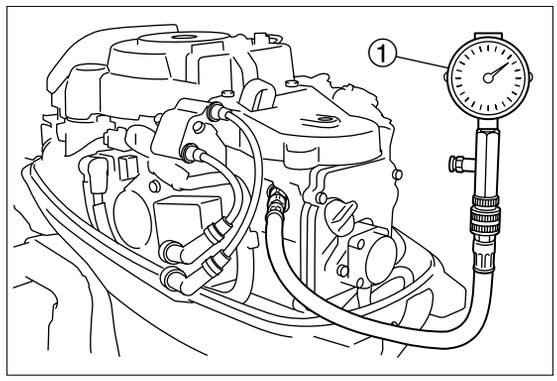


5. Install spark plug, fully hand-tighten, and then use plug wrench to tighten to specified torque.

Spark Plugs :
18 N・m (13 lb・ft) [1.8 kgf・m]



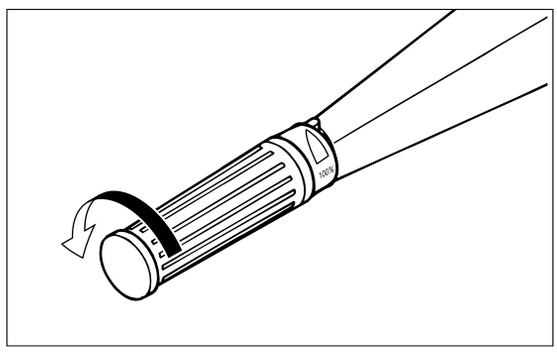
15) Inspection of Compression Pressure



1. Start and run engine for 5 minutes to warm up, and then stop.
2. Shift gear into neutral (N).
3. Remove lock plate (of stop switch lanyard) from stop switch.

⚠ CAUTION

Remove lock plate (of stop switch lanyard) from stop switch before measuring compression pressure. This will prevent engine from accidental starting.



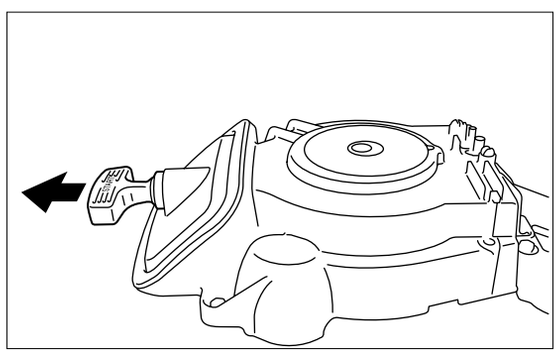
4. Remove all plug caps and then all spark plugs.

⚠ CAUTION

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

5. Install compression gauge ① to plug hole.

Compression Gauge ① :
P/N. 3AC-99030-0



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

Compression Pressure (Reference) :
With decompressor : 0.50 MPa (73 psi) [5.1 kgf/cm²]
Without decompressor
: 1.35 MPa (186 psi) [13.8 kgf/cm²]

Compression pressure varies depending on the cranking speed, and normally changes at least as much as approximately 10%.

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

- If compression pressure increases after the above measure, check pistons and piston rings for wear. Replace if necessary.
- If compression pressure does not increase after the above measure, check valve clearances, valves, valve seats, cylinder sleeves, cylinder head gaskets and cylinder head. Adjust or replace if necessary.
- If you obtain a leak down tester perform a leak down on each cylinder at TDC. If leakage is over 15%, then make note of air escaping into intake, crankcase, exhaust, or cooling passages to aid in diagnosing the problem.

16) Inspection and Adjustment of Valve Clearance

· Perform inspection and adjustment of valve clearances when engine is cold.
· #1 piston is to be at top dead center of compression stroke.

1. Disconnect starter lock cables, and then recoil starter, belt cover, spark plugs, fuel pump and cylinder head cover.

2. Rotate flywheel clockwise to bring "●1" mark of cam shaft pulley ① to "▲" mark ⓐ of cylinder head.

3. Check and adjust #1 cylinder's intake and exhaust valve clearances.
   • Put thickness gauge ⑤ into gap between valve end ② and adjust screw ③ to check the clearance. Use the following procedure to adjust the gap if necessary.
   · Loosen lock nut ④.
   · Turn adjust screw ③ to adjust valve clearance.
   · Tighten lock nut ④.
   · Check valve clearance again.

Valve Clearance (when engine is cold) :
(IN) intake side ⓓ : 0.13 - 0.17mm (0.0051 - 0.0067in)
(EX) exhaust side ⓔ : 0.18 - 0.22mm (0.0071 - 0.0087in)

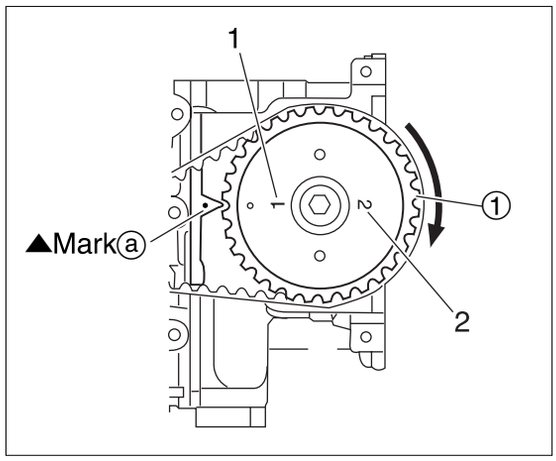
· When loosening or tightening lock nut, hold adjust screw by using valve clearance driver.
· Be sure to use torque wrench.

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

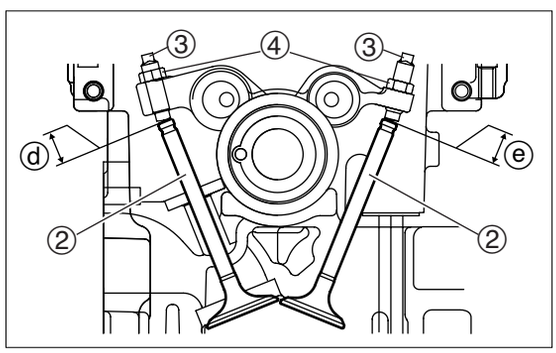
Valve Clearance Driver ⑥ :
P/N. 3AC-99071-0
Torque Wrench ⑦ :
P/N. 3AC-99070-0

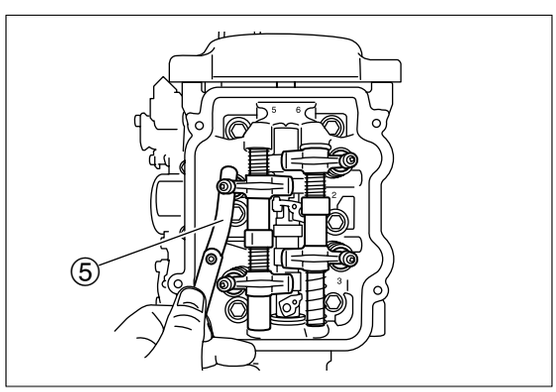
4. Rotate flywheel clockwise to bring "2" mark of cam shaft pulley ① to "▲" mark ⓐ of cylinder head.

5. Check and adjust #2 cylinder's intake and exhaust valve clearance in the same procedure as #1 cylinder.

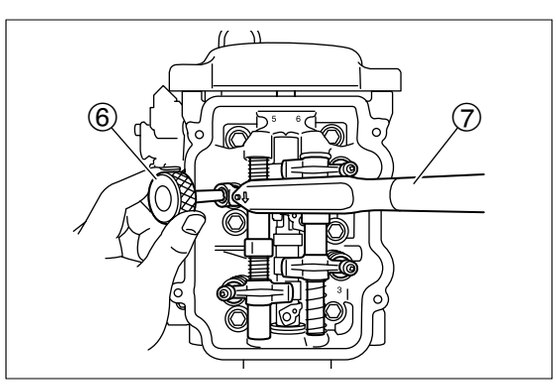


① Cam shaft pulley





⑤ Thickness gauge

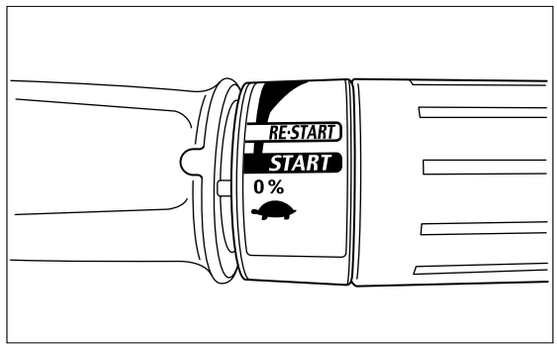


⑥ Valve Clearance Driver
(Concaved Tip, Square, Width Between Two Opposing Sides : 3mm)
⑦ Torque Wrench (10mm tip wrench)

17) Throttle Cable

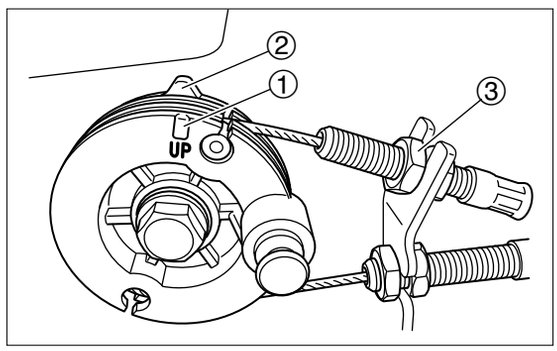
For F type

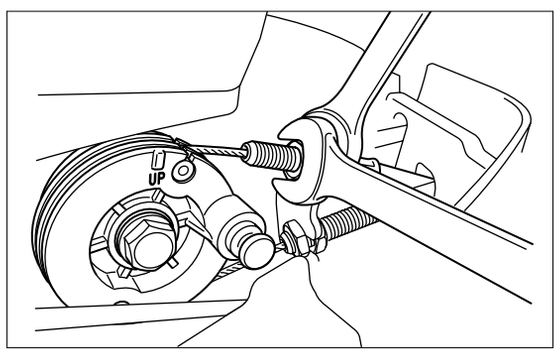
1. Turn throttle grip to START position.



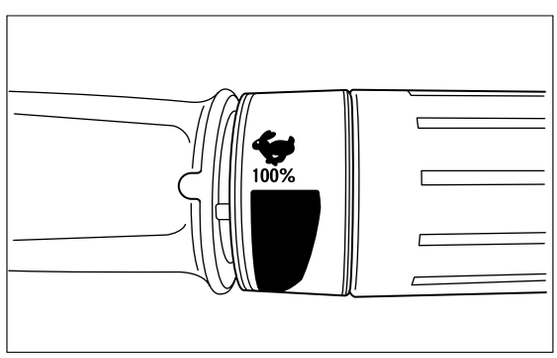
2. Bring alignment mark ① of throttle drum to pointer ② located on the bottom cowl, adjust throttle cable properly, and tighten with nut ③.

> Adjust cable tension so that it moves approximately 1mm when pushed lightly with a finger.

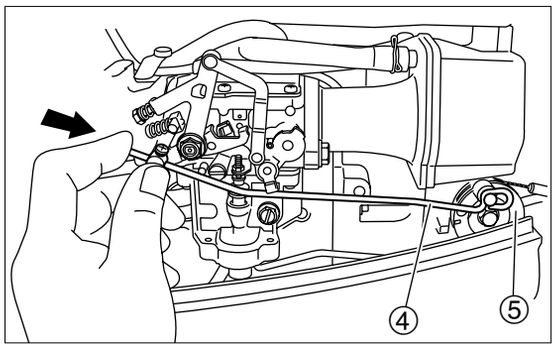




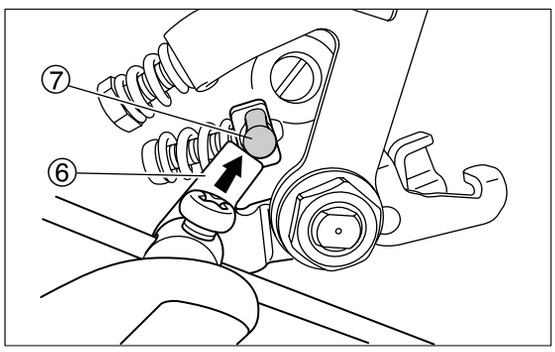
3. Turn throttle grip to wide open throttle position.



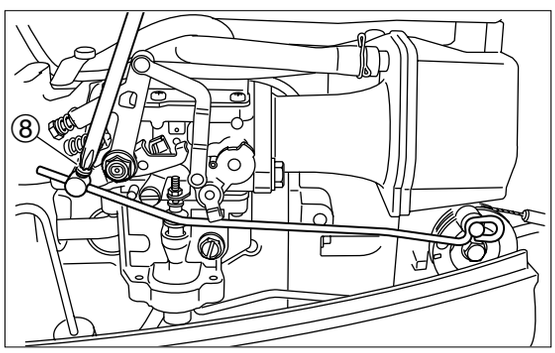
4. Attach throttle rod ④ to throttle drum ⑤, and push the rod toward direction shown with arrow.



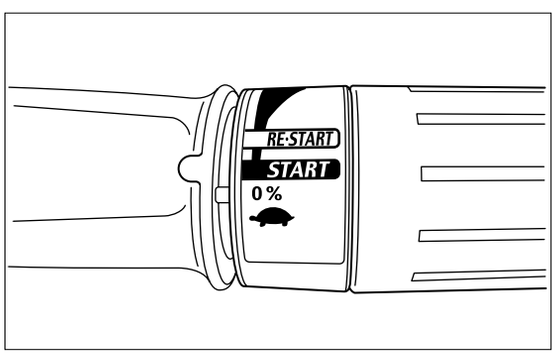
5. Open throttle to a position where carburetor link ⑥ touches full open stopper ⑦.



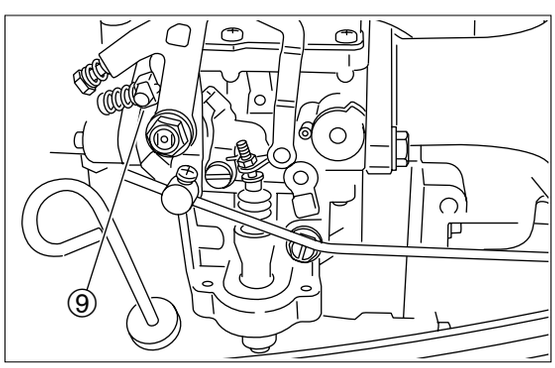
6. When carburetor's full open position and throttle rod position are determined, fix with screw ⑧.



7. Turn throttle grip to START position again.



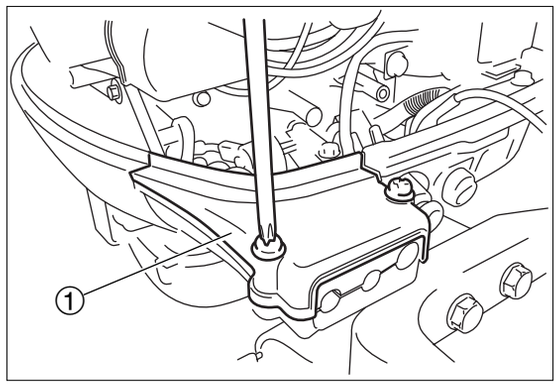
8. Carburetor's link should touch idle stopper ⑨.



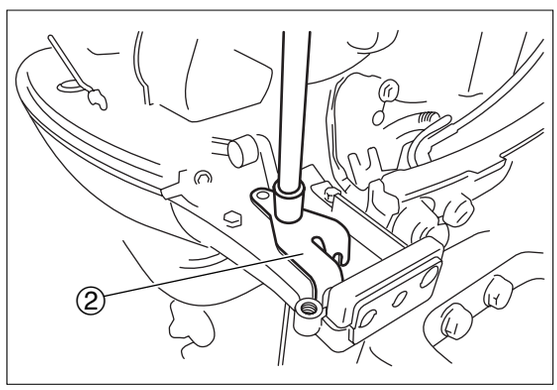
18) Throttle Cable

Adjustment of Throttle Link

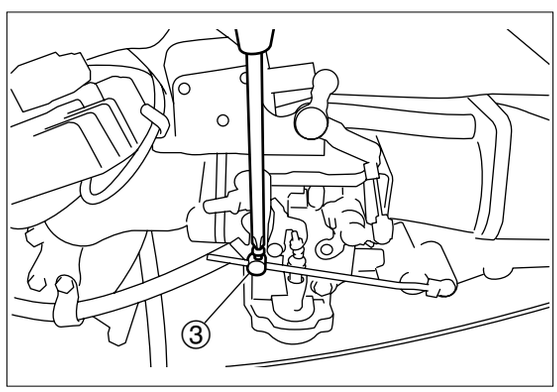
1. Remove bolt of remote control stay cover ① and bolt.



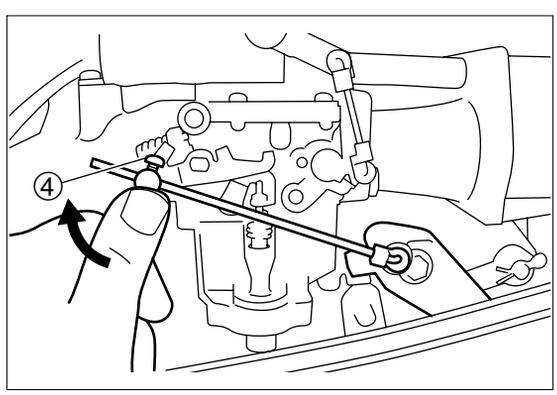
2. Remove bolt of cable clip ② and bolt.



3. Loosen throttle link rod stop screw ③.

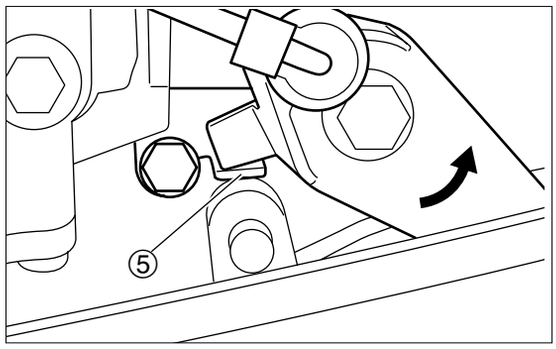


4. Set carburetor's throttle link ④ to full open position while holding throttle lever at full open position.



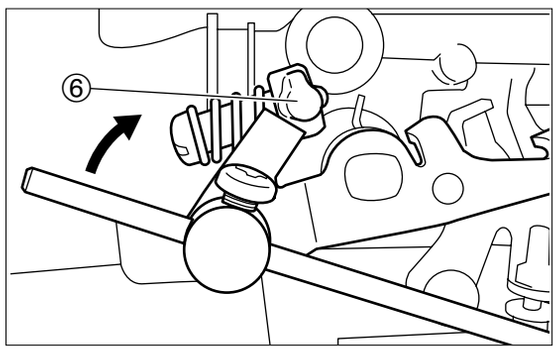
5. Set throttle lever to full open position.

Check that throttle lever touches throttle lever stopper ⑤.

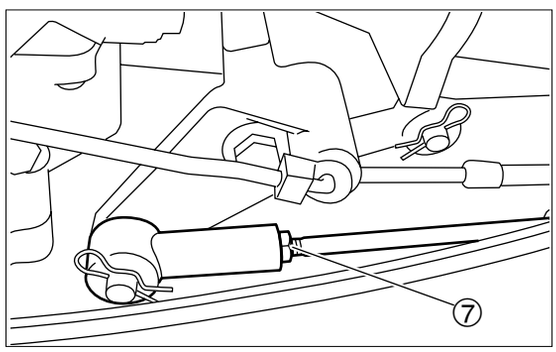


6. Set carburetor's throttle lever to full open position.

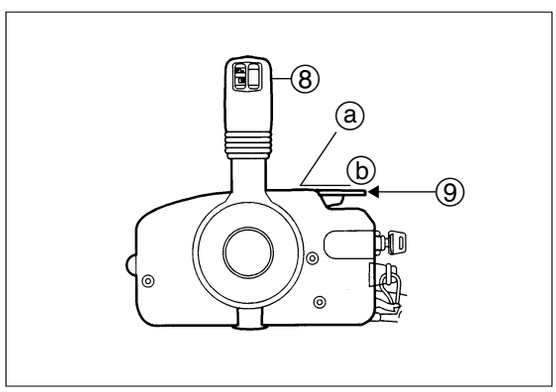
Check that throttle lever touches stopper ⑥.



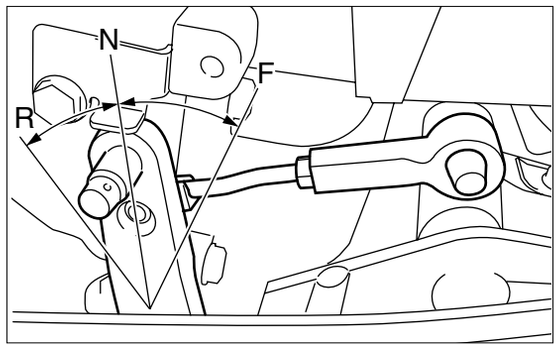
7. After checking full open stopper of throttle lever side and carburetor side, fix throttle rod's stop screw ⑦ at full open position.



8. Set remote control lever ⑧ to neutral (N) ⓐ, and check that free acceleration lever ⑨ is at full close position ⓑ.

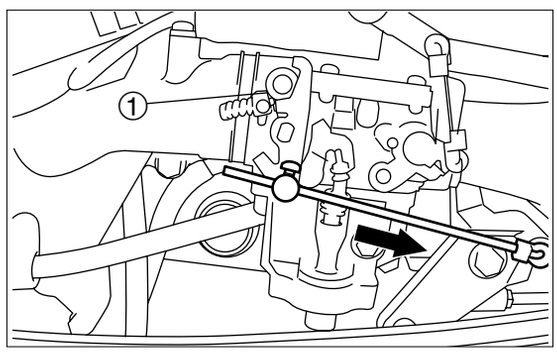


9. Set shift arm to forward (F), neutral (N), reverse (R) and then to neutral (N) positions.

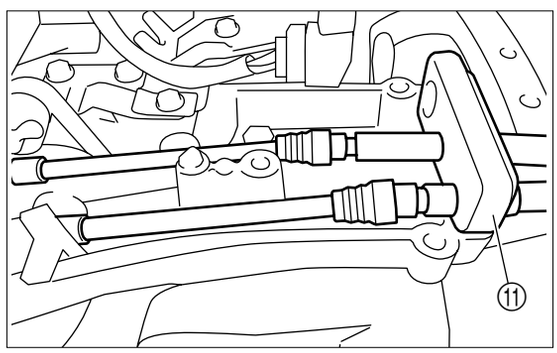


10. Set throttle lever ⑩ to full close position.

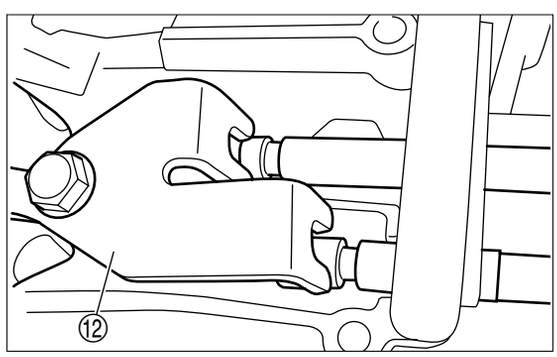
Check that throttle lever contacts with full close stopper ①.

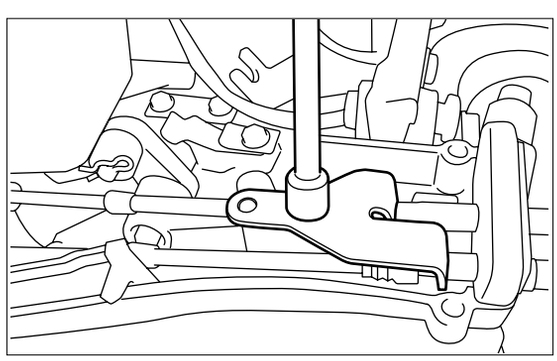


11. Run remote control cable through bottom cowl grommet ⑪.

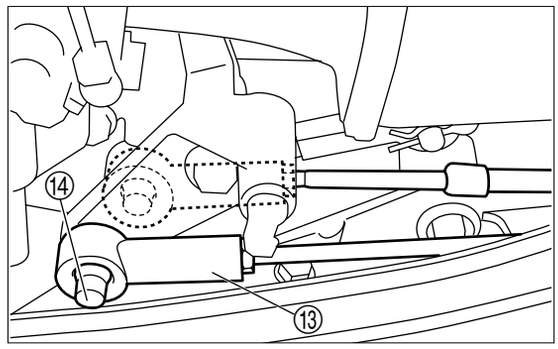


12. Bring cable clip ⑫ to groove of cable, and fix cable clip to lower cowl by using bolt.





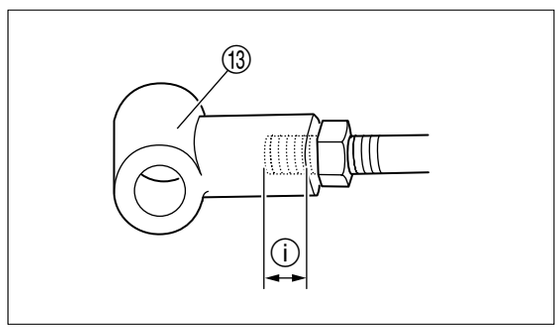
13. Adjust screw-in length of cable joint ⓘ so that hole of cable joint ⑬ is brought to throttle lever and shift arm pin ⑭.



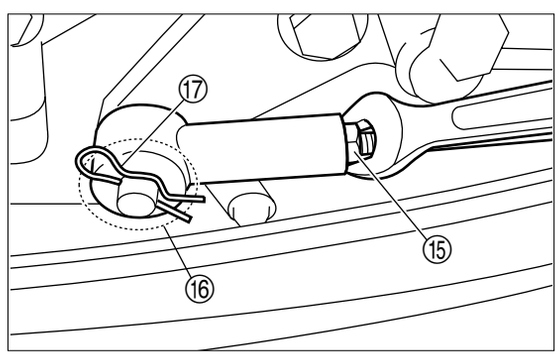
After adjusting remote control cable joint, fix it with remote control cable fully pushed in.

⚠ CAUTION

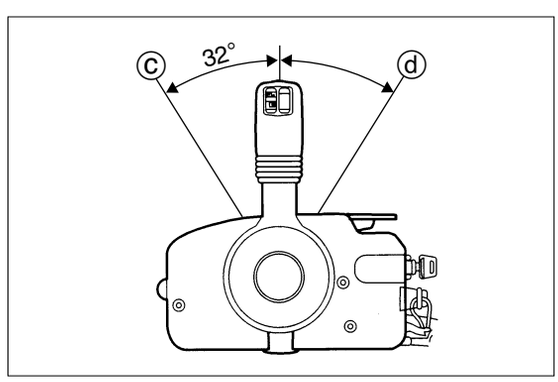
Screw-in remote control cable joint at lease 10mm ⓘ.



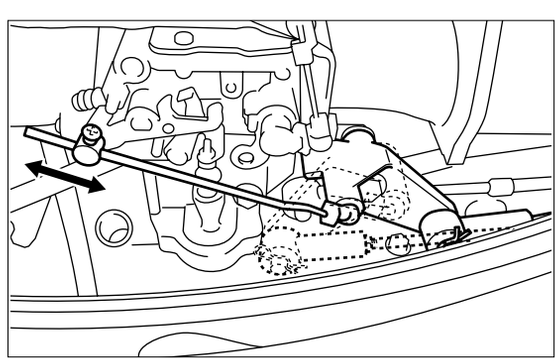
14. Lock cable joint with nut ⑮, attach it to pin, and then, fix with washer ⑯ and snap pin ⑰.



15. Check that shifting control lever forward (F) ⓒ by approximately 32 degrees (j), where it is stopped once, makes the gear engage, and then, fully shifting the lever makes throttle valve fully open Then, check that shifting the lever reverse (R) ⓓ by approximately 32 degrees (j), where it is stopped once, makes the gear engage, and fully shifting the lever makes throttle valve fully open.



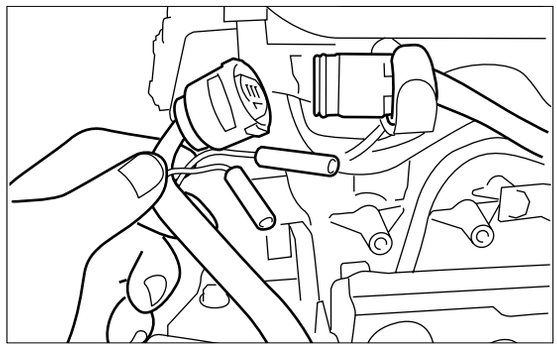
16. Check if throttle valve operates smoothly, and repeat steps 1. to 16. as necessary.



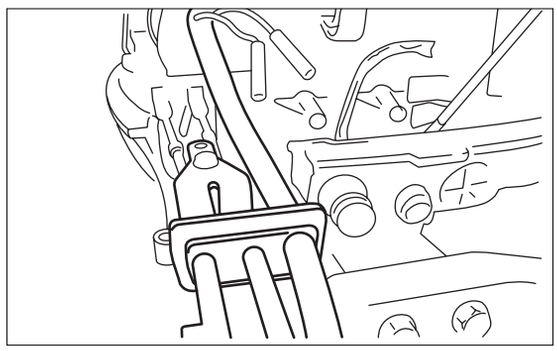
17. Reconnect cord ass'y connectors.

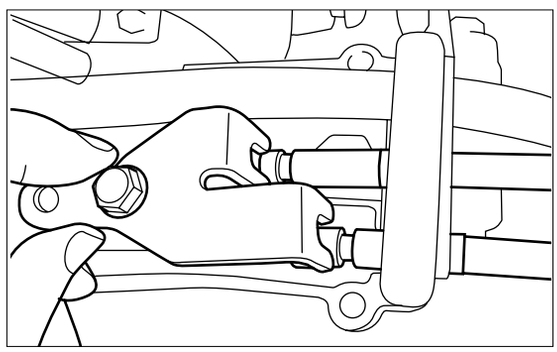
⚠ CAUTION

Do not disconnect cord ass'y while engine operates.

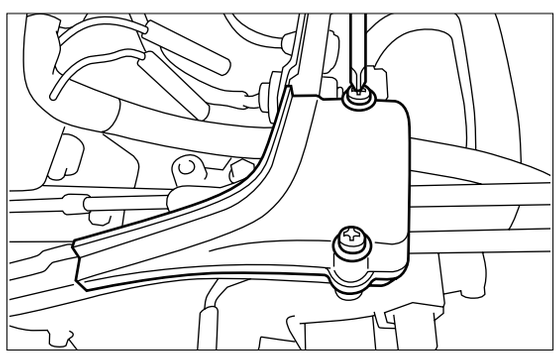


18. Run cord ass'y and remote control cable though bottom cowl grommet. Attach bracket to remote control cable groove securely, and then fix it to bottom cowl.



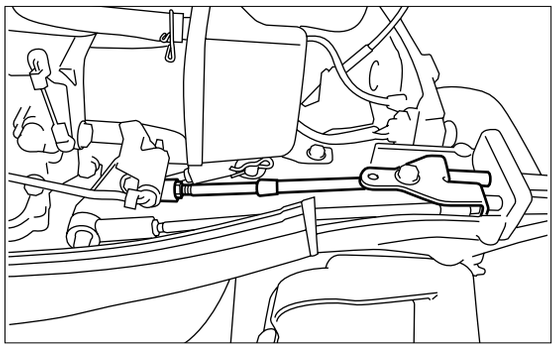


19. Secure remote control stay cover with screws.



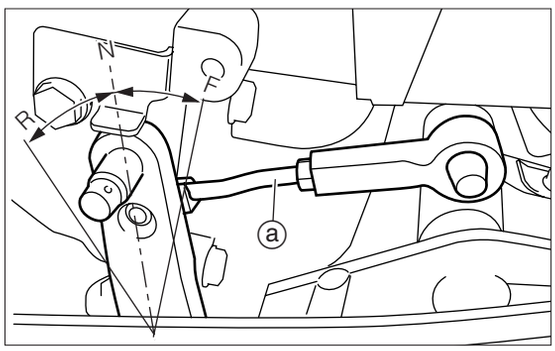
19) Inspection of Gear Shift Operation

Shift gear from neutral (N) to forward (F), neutral (N), and then to reverse (R) to check that shift operation is performed smoothly. Adjust shift link rod length and shift cable position if necessary.



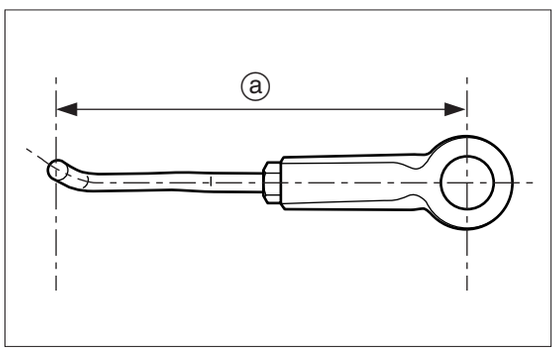
1. Shift gear into neutral (N).

2. Remove shift link rod ⓐ.



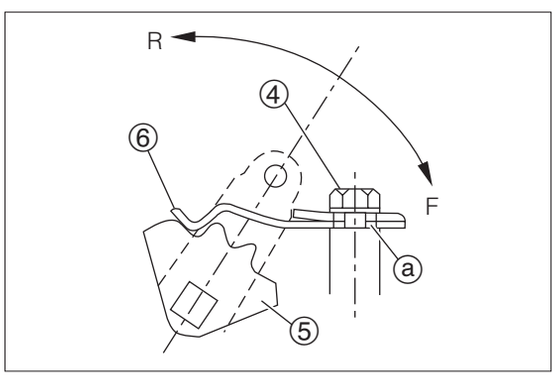
3. Check and adjust standard length ⓐ of shift link rod.

Remote Control Model ⓐ : 87mm

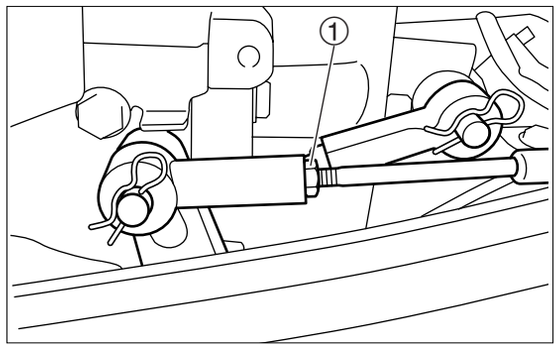


4. Check that shift lever's hole and shift arm are on a vertical line.

5. Perform shift adjustment after assembling lower unit. Loosen shift lever stopper bolt ④. Set shift lever shaft ass'y ⑤ fully to forward, adjust shift lever stopper ⑥ position, and then, tighten shift lever stopper bolt ④. Operate shift lever to check that operation from neutral (N) to forward (F) to neutral (N) to reverse (R) is normal, and forward and reverse movements are equal to each other.



6. Loosen lock nut ①, remove snap pin and washer, and then remote control cable joint. (Throttle lever is not shown to make the working procedure more comprehensible.

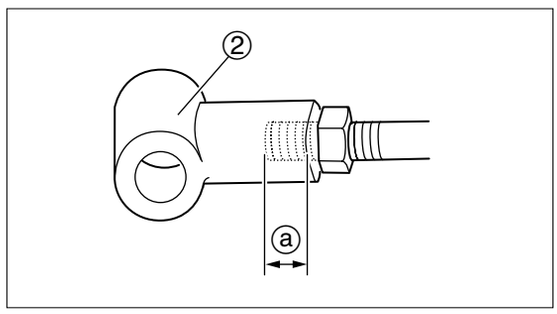


7. Adjust remote control cable length so that the cable joint ② hole aligns with set pin.

⚠ WARNING

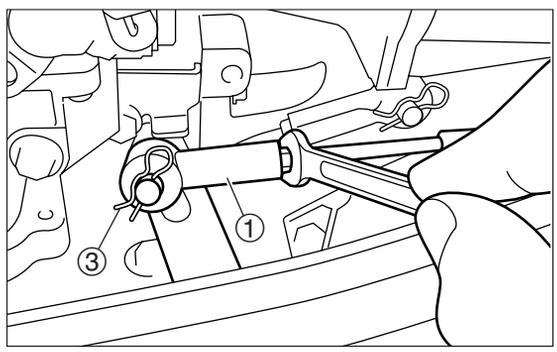
Screw-in remote control cable joint at lease 10mm ⓐ.

Adjust remote control cable joint with remote control cable fully pushed in.

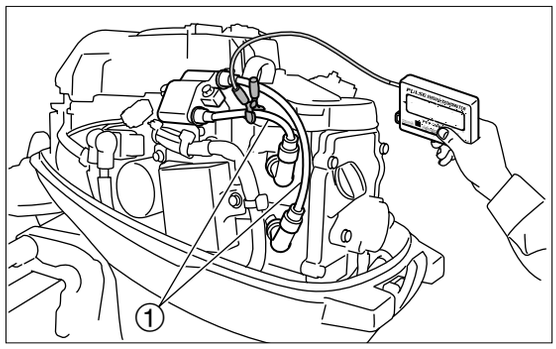


8. Reconnect remote control cable joint ①, attach snap pin ③, and tighten lock nut.

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



20) Inspection of Idle Engine Speed



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

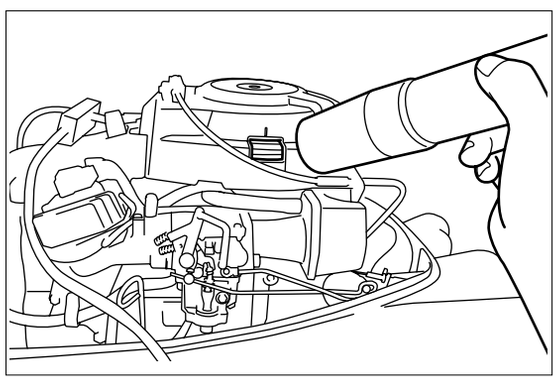
2. Attach tachometer to high tension cord ① to check idle speed.

More accurate and stable reading can be obtained when tachometer lead is connected with high tension cords of individual cylinders linked with each other.

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

Idle Speed :
950 ± 30r/min

21) Inspection of Ignition Timing



Adjusting system : Automatic control, no adjustment required
Run engine and use timing light to check ignition timing.
11 timings marks are found on the side of flywheel (TDC0°, ATDC5°, 10°, BTDC5°, 10°, 15°, 20°, 25°, 30°, 35° and 40°), and ignition timing is read with mark on the center of starter case window.

Outboard Model	Range of Ignition Angle	Engine Starting	Idling	Accelerating
F 9.9/15/20C	BTDC 5°— BTDC 35°	BTDC 5°	BTDC 5°	BTDC 35°

22) Inspection of Anode

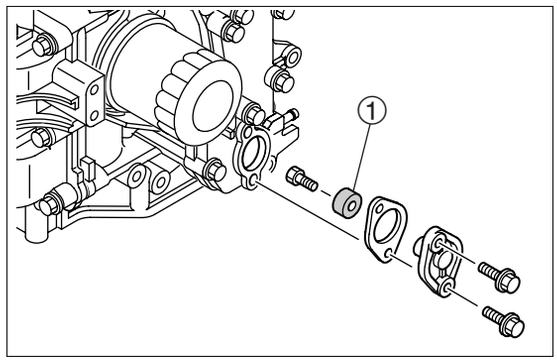
1. Check anode ① and trim tab ② for build up of scale and adherence of grease and oil. Clean, or replace if necessary.

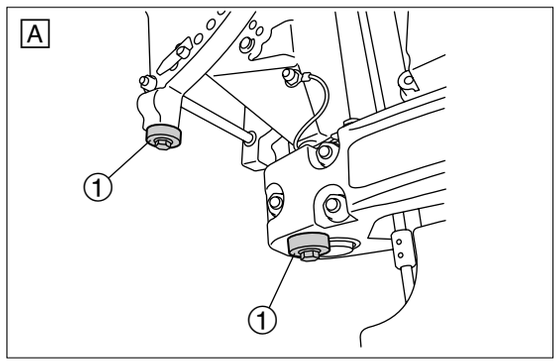
⚠ CAUTION

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

When it is necessary to disassemble outboard motor for inspection of anode, refer to disassembly procedure described in this manual. Reduction of anode volume can lead to outboard motor body damage.

2. Replace anode ① and/or trim tab ② if they are corroded excessively.





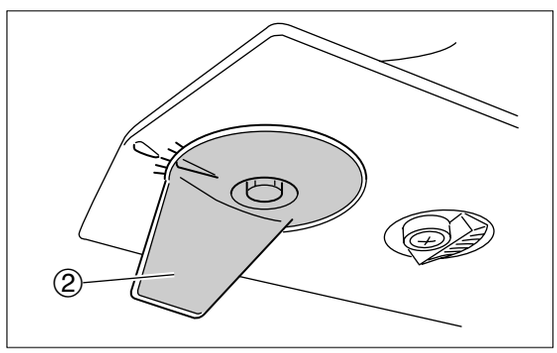
23) Replacement of Anode

Anode protects outboard motor from galvanic corrosion (corrosion of metal due to very weak electric current).

Anodes are used in the gear case, clamp bracket, and power unit cylinder.

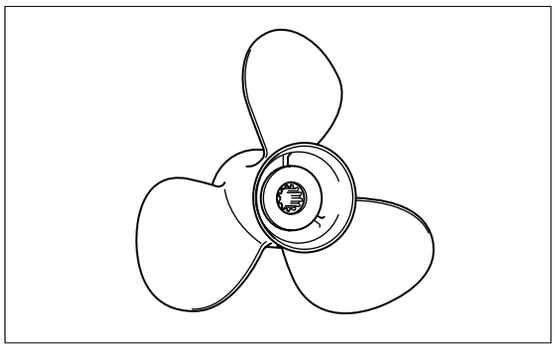
Replace anode if volume is reduced to 2/3 of new part.

- Do not coat anode with oil or paint.
- Since periphery of anode installation bolt is corroded more than other areas, be sure to retighten bolt at every inspection.



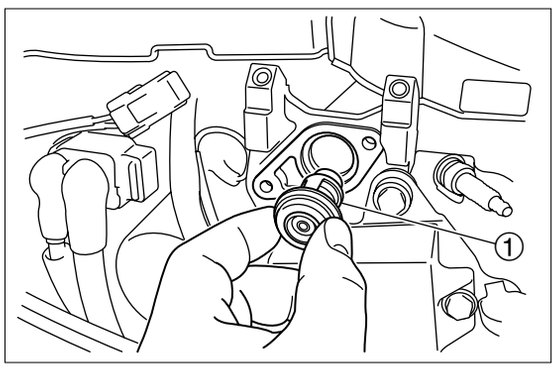
24) Inspection of Propeller

1. Check propeller blades and spline for cracks, damages, wear and corrosion. Replace if necessary.



25) Inspection of Thermostat

1. Loose thermostat cover nut and remove thermostat ①.

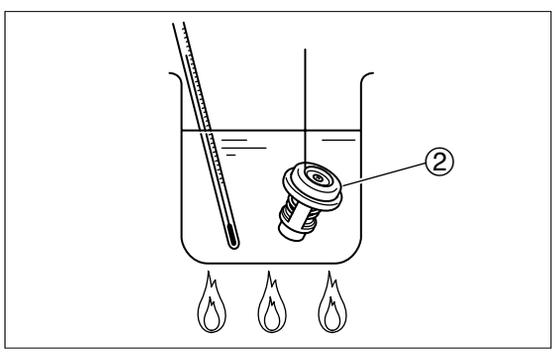


2. Hang thermostat ② in the water contained in vessel.

3. Put thermometer in the water, warm up water and measure water temperature when valve opens.

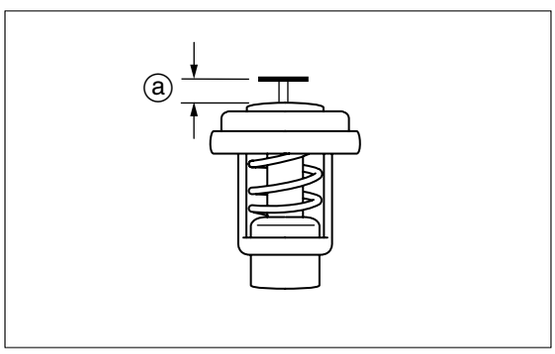
Put a piece of thread in the closed valve gap and hang it in the water. Valve opening moment can be known when thermostat is released to drop due to opening with rise of temperature.

Valve Opening Temperature :
60±1.5°C (140 ± 3°F)
(Valve starts to open at this temperature.)



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

Water Temperature	Valve lift ⓐ
75°C (167°F)	3.0mm (0.12in) or over

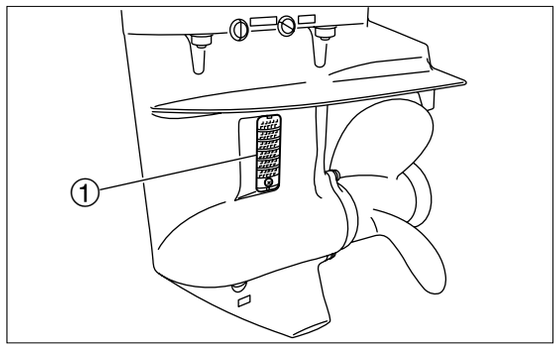


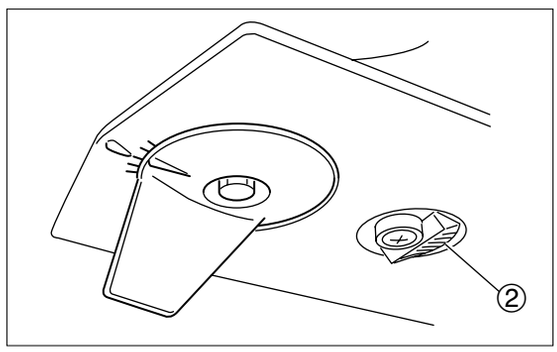
5. Install thermostat, new gasket and cover.

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

26) Inspection of Cooling Water Passage

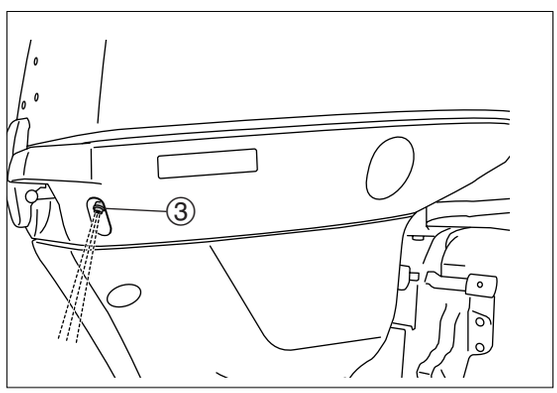
1. Check water strainer ① and sub water strainer ② for clogging. Clean if necessary.





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

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



27) Flushing with Water

⚠ CAUTION

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

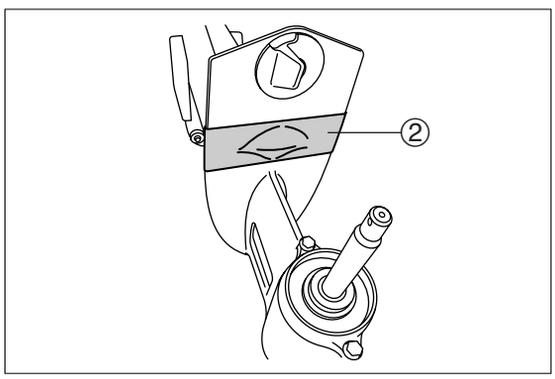
⚠ WARNING

Exhaust gas contains carbon monoxide, which will cause gas poisoning. Do not start engine with outboard motor placed in a closed area such as boat house.

Flushing with water using drive cleaner ③

1. Remove propeller and thrust holder.

2. Close sub water strainer ② with sticky tape.



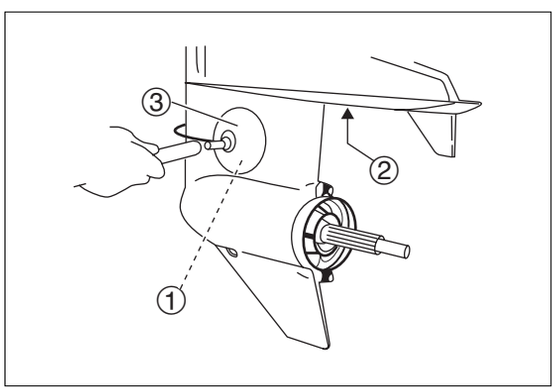
3. Attach driver cleaner ③ to water strainer ① area.

4. Put water hose to driver cleaner ③ and run water.

5. Set gear shift to neutral (N) and start engine.

6. Check that cooling water check port discharges water, and run engine for 3 to 5 minutes at low speed.

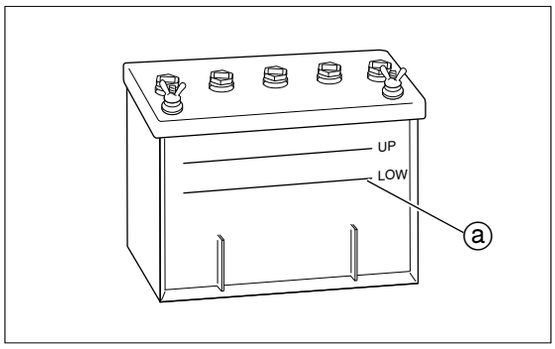
7. Stop engine and stop water supply, remove driver cleaner ③, and remove tape, and then, install propeller.



Remove tape after flushing with water.

28) Inspection of Battery

1. Inspect battery liquid level. If lower than "LOW" mark ⓐ, add distilled water until the level goes in between "UP" and "LOW" marks.



2. Measure specific gravity of battery liquid. Charge battery if specific gravity is less than specified value.

⚠ WARNING

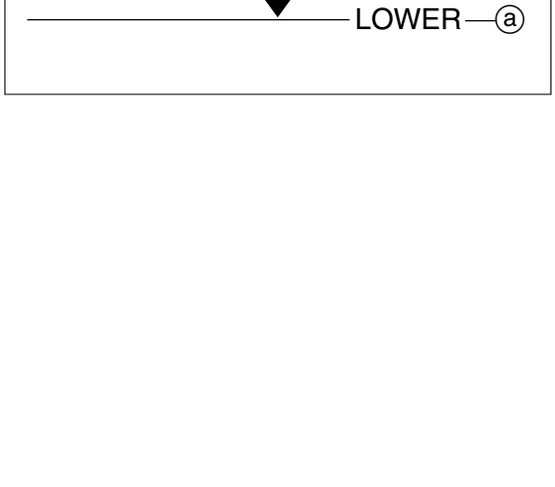
Electrolyte contains sulfuric acid that is poisonous and highly corrosive, and so it is dangerous. Always be careful of the following matters to prevent accident.
- **Handle electrolyte carefully not to allow adherence to any part of body, or it could cause serious chemical burn or blindness.**
- **Wear protective glasses when working near battery or handling battery.**

First Aid in Emergency (if electrolyte adhere to body)
- **Flush well with fresh water if adhered to skin.**
- **If gets in eye, flush well with fresh water for 15 minutes, and have ophthalmologic evaluation immediately.**

First Aid in Emergency (if swallowed)
- **Drink much water, magnesium hydrate solution (magnesium milk), fresh egg, or salad oil, and have doctor's evaluation immediately.**

Battery produces highly inflammable hydrogen gas. Always be careful of the following matters to prevent accident.
- **Charge battery in well ventilated place.**
- **Keep battery away from fire, sparks or flame. (such as live cigarette or operating welding machine)**
- **Do not smoke or allow smoking when handling or charging battery.**

Keep battery and electrolyte out of reach of children.



- Batteries are available with various types, varying among manufacturers. For any unclear matters, refer to manual attached to battery.
- When removing battery, disconnect negative lead first and then positive lead.

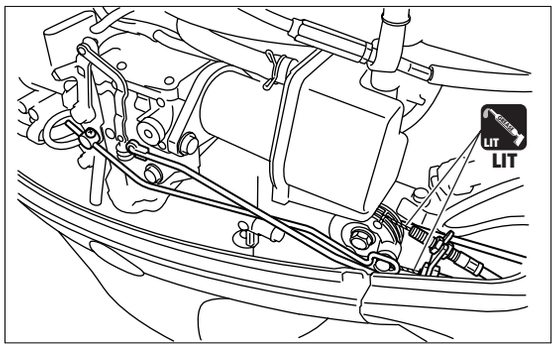
Battery :
12V70AH - 12V100AH

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

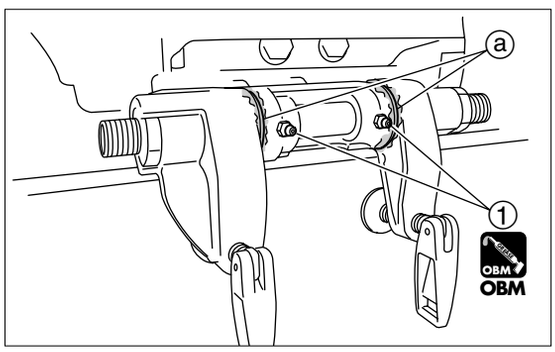
Charging Requirements : for 12V70AH battery
Charging Current : 70AH - 1/10 = 7A
Charging Hours : 70AH ÷ 7A = 10H

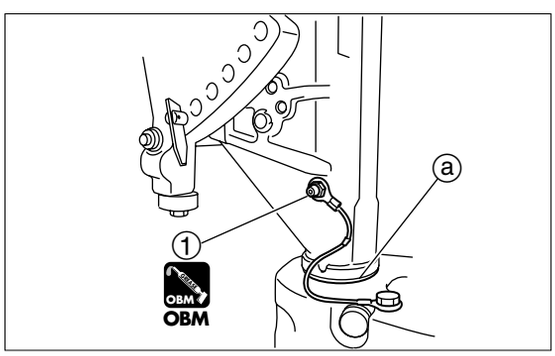
29) Greasing Points

1. Apply grease to throttle cable and sliding areas.

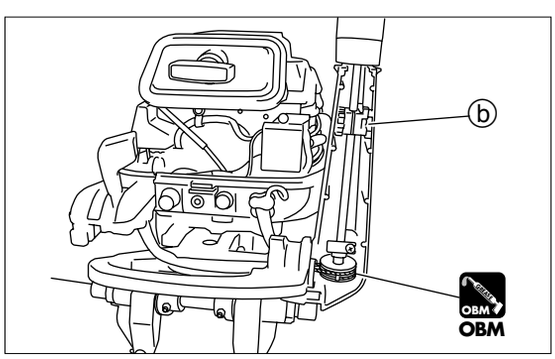


2. Put grease through grease nipples ① until excessive grease appears from bush ⓐ.





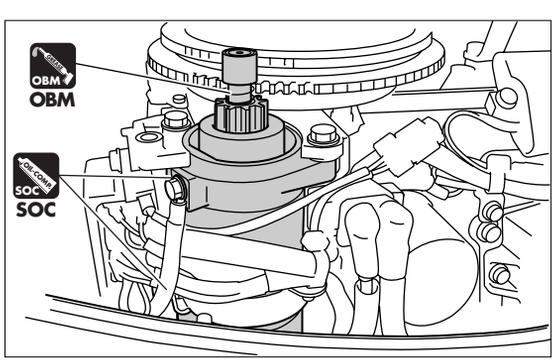
3. Apply grease to throttle cable and sliding areas.



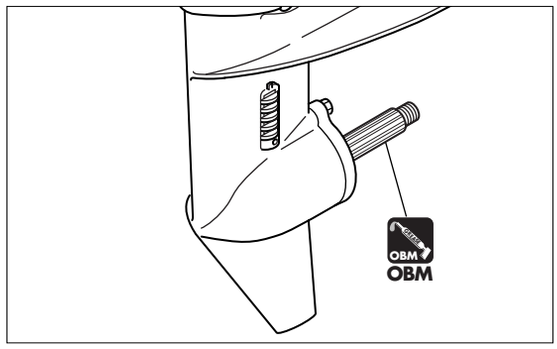
ⓑ Do not lubricate here.

4. No oil on teeth.

5. Apply grease to terminals of starter motor, starter solenoid and PT solenoid.



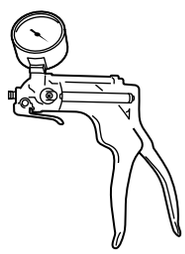
6. Apply grease to propeller shaft spline.



4

Fuel System

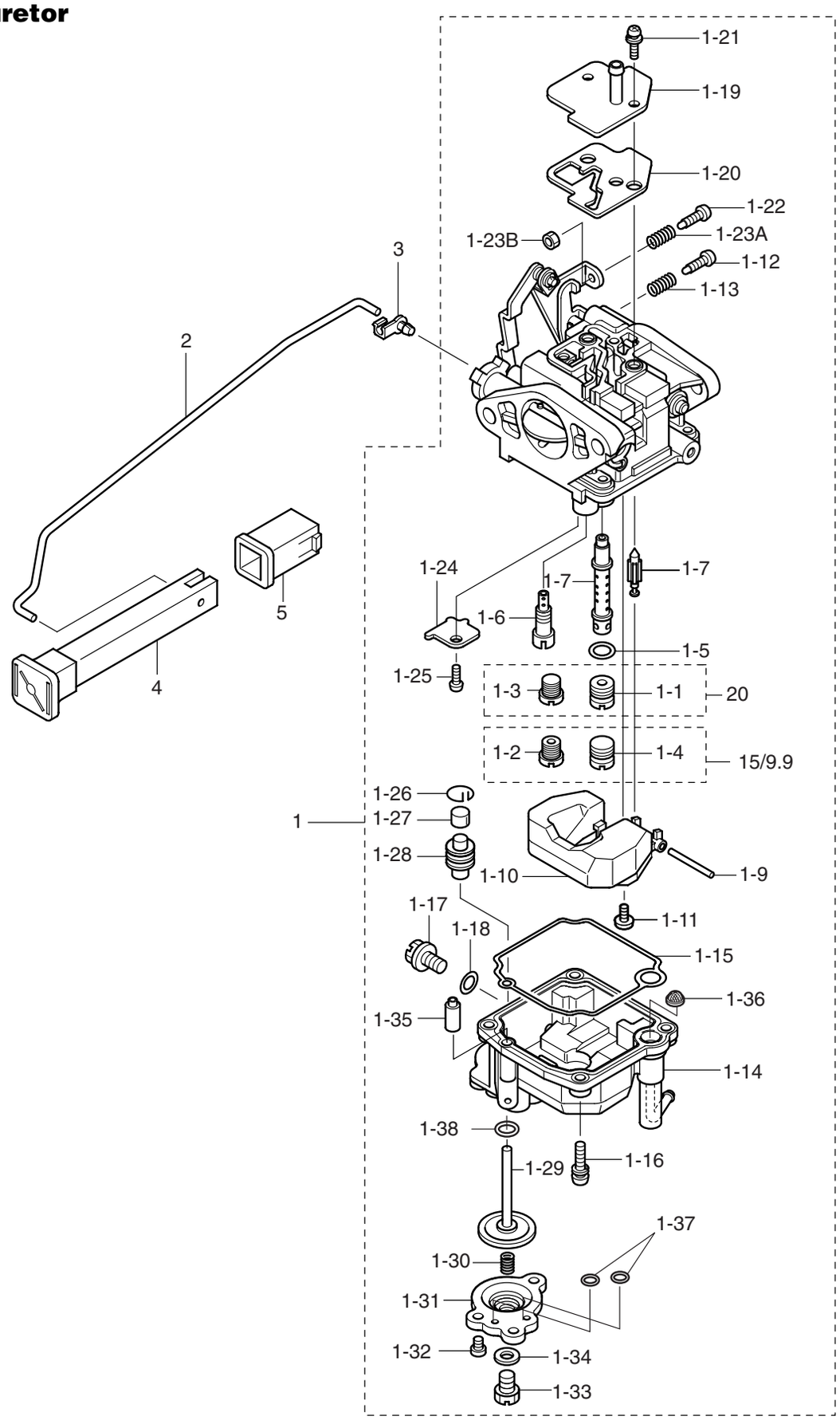
1.Special Tools


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

2.Parts Layout

P/L Fig. 5

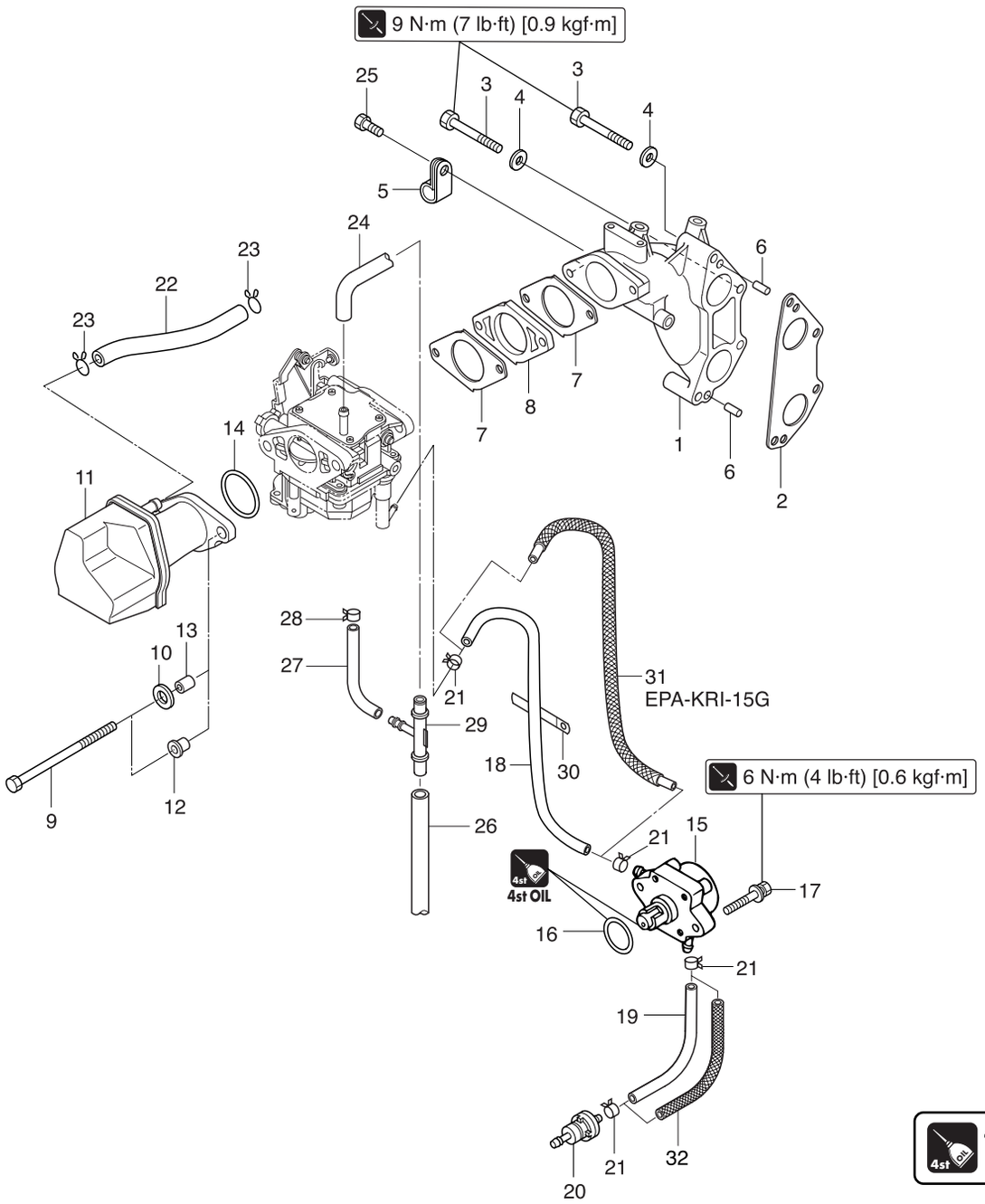
Carburetor



Ref. No.	Description	Q'ty	Remarks
1	Carburetor	1	for MF/EF/EFT (3BJFA)
	Carburetor	1	for EP/EPT (3BAPA)
	Carburetor	-	for MF/EF/EFT (3BHFA)
	Carburetor	-	for EP/EPT (3AZPA)
	Carburetor	-	for MF/EF/EFT (3FSFA)
1-1	Main Jet #121	1	
1-2	Plug	1	
1-3	Main Jet #99	-	
	Main Jet #88	-	
1-4	Plug	-	
1-5	O-Ring	1	Do not reuse.
1-6	Slow Jet #52	1	
	Slow Jet #46	-	
	Slow Jet #43	-	
1-7	Main Nozzle	1	for MF/EF/EFT
	Main Nozzle	1	for EP/EPT
	Main Nozzle	-	for MF/EF/EFT
	Main Nozzle	-	for EP/EPT
	Main Nozzle	-	for MF/EF/EFT
1-8	Float Valve	1	
1-9	Float Arm Pin	1	
1-10	Float	1	
1-11	Screw	1	
	Screw	-	
1-12	Stop Screw	1	L=18
1-13	Spring	1	L=14
1-14	Float Chamber	1	
	Float Chamber	-	
1-15	Float Chamber Gasket	1	
	Float Chamber Gasket	-	
1-16	Screw	4	
	Screw	-	
1-17	Drain Screw	1	
	Drain Screw	-	
1-18	Gasket	1	Do not reuse.
	Gasket	-	
1-19	Carburetor Cover	1	
	Carburetor Cover	-	
1-20	Carburetor Cover Gasket	1	Do not reuse.
	Carburetor Cover Gasket	-	
1-21	Screw	4	
	Screw	-	
1-22	Stop Screw	1	
	Stop Screw	-	L=15
1-23A	Spring	1	L=14
1-23B	Nut	-	
1-24	Plate	-	
1-25	Screw	-	
1-26	Retaining Ring	1	
1-27	Cap	1	
1-28	Rubber Boot	1	
1-29	Plunger Complete	1	
	Plunger Complete	-	
1-30	Coil Spring	1	
	Coil Spring	-	
1-31	Diaphragm Cover	1	
	Diaphragm Cover	-	
1-32	Screw	3	
	Screw	-	
1-33	Drain Screw	1	
1-34	Drain Screw Gasket	1	Do not reuse.
1-35	Check Valve	1	
	Check Valve	-	
1-36	Fuel Filter	1	
2	Choke Link Rod	1	for MF/EF/EFT
3	Rod Snap, 3.2-2	1	for MF/EF/EFT
4	Choke Rod	1	for MF/EF/EFT
5	Bushing	1	for MF/EF/EFT
1-37	O-ring	2	Do not reuse.
1-38	O-ring	1	Do not reuse.

Intake Manifold & Fuel Pump

P/L Fig. 4

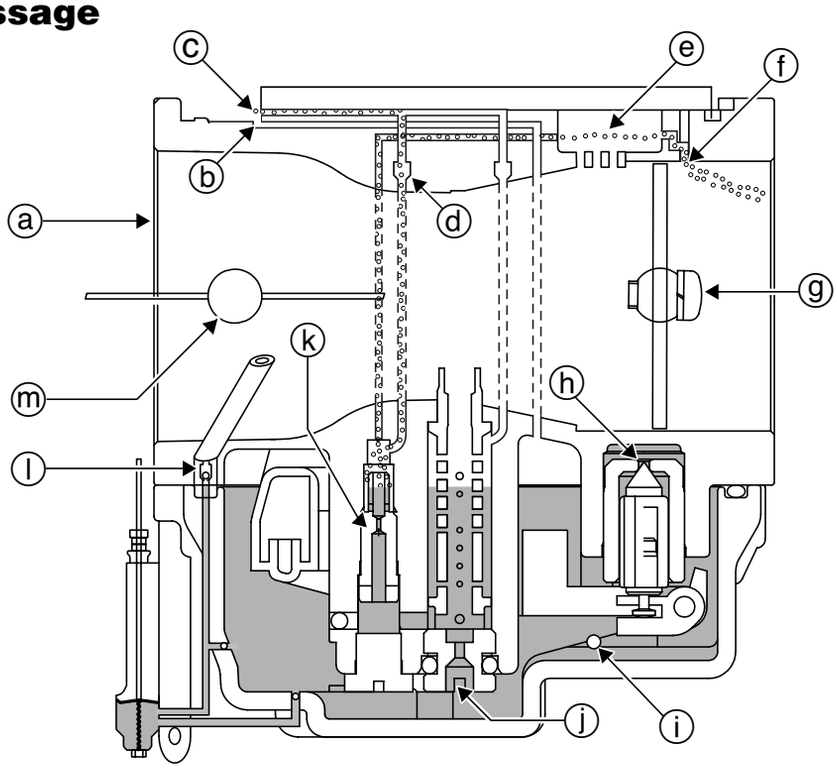


Ref. No.	Description	Q'ty	Remarks
1	Intake Manifold	1	
2	Intake Manifold Gasket	1	Do not reuse.
3	Bolt	5	M6 L=45mm
4	Washer	5	M6
5	Clamp, 6.5-14L	1	
6	Dowel Pin, 6-12	2	
7	Carburetor Gasket	2	Do not reuse.
8	Insulator	1	for 15/20
	Insulator	-	for 9.9
9	Bolt, 6-100	2	M6 L=100mm
10	Washer	2	for EP/EPT
11	Intake Silencer	1	
12	Collar, 6.1-14-8.9	2	for MF/EF/EFT
13	Collar, 6.2-9-7.4	2	for EP/EPT
14	Seal Ring, 2.4-35	1	
15	Fuel Pump	1	
16	O-Ring, 3.5-25.7	1	Do not reuse.

Ref. No.	Description	Q'ty	Remarks
17	Bolt	2	M6 L=25mm
18	Rubber Hose	1	L=300mm
19	Rubber Hose	1	L=120mm
20	Fuel Filter	1	
21	Clip ø9.5	4	
22	Rubber Hose	1	L=120mm, for Breather
23	Clip, ø12	2	
24	Breather Hose	1	for Carburetor
25	Bolt	1	M6 L=12mm
26	Breather Hose L=50	1	Carburetor
27	Hose	1	98AL-301000
28	Clip ø6.8	1	
29	Nipple	1	
30	Clamp 6.5-47.5P	1	
31	Fuel Hose W/Protector	1	Low Permeation Parts (for USA model)
32	Fuel Hose W/Protector	1	for USA

3.Carburetor Inner Passages

1) Idling Passage



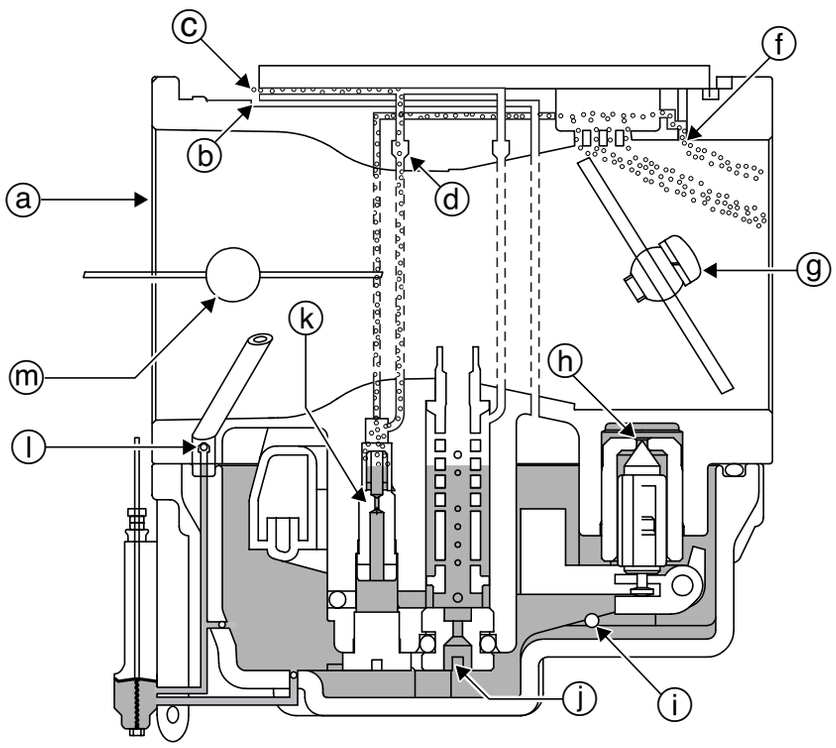
a - Air intake
b - Air vent inlet
c - Air-bleed inlet
d - Slow air jet
e - Bypass port
f - Idle Port
g - Throttle valve
h - Fuel inlet
i - Chamber drain
j - Main jet
k - Slow jet
l - Outlet check valve - Accelerator pump circuit
m - Choke valve

As engine rotates, intake valve opens and piston moves from top dead center toward bottom dead center, the piston movement causes vacuous area to occur in the back of throttle valve.

Then, the air enters carburetor through air intake port, runs through throat venturi and throttle valve, and then is sucked into the vacuous area in the cylinder that is in air intake stroke.

The float chamber receives atmospheric pressure through air vent. This pressure causes fuel to be sucked into vacuous area in the back of throttle valve. The fuel is sent to main fuel well through main jet, runs through idle passage, slow jet, bypass (off idle) port, and then is ejected from idle port. When this fuel goes through bypass port, it is mixed with air in the carburetor bore to be air-fuel mixture which is sucked into the cylinder.

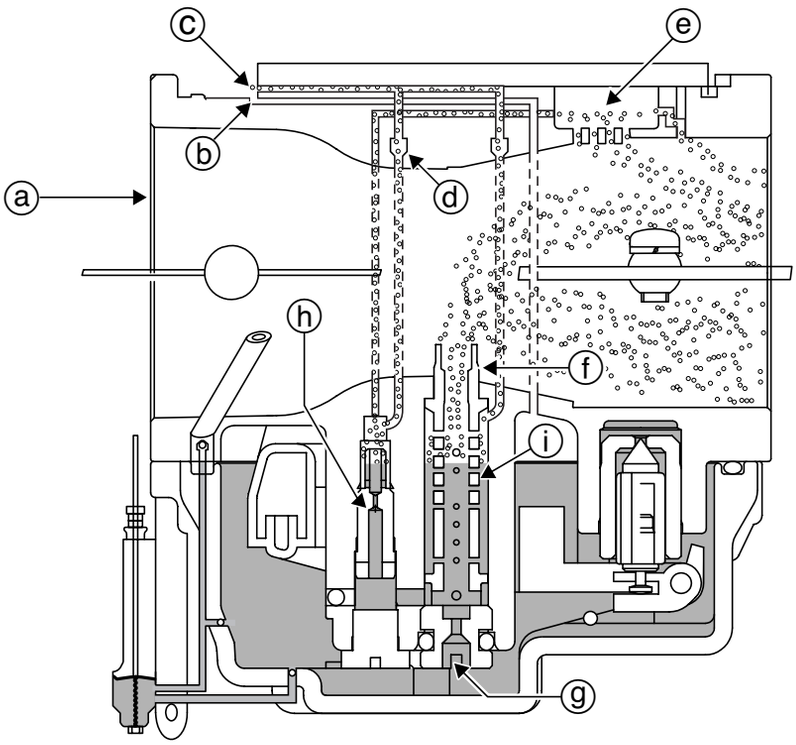
2) Off-Idle Passage



a - Air intake
b - Air vent inlet
c - Air-bleed inlet
d - Slow air jet
e - Bypass port
f - Idle Port
g - Throttle valve
h - Fuel inlet
i - Chamber drain
j - Main jet
k - Slow jet
l - Outlet check valve - Accelerator pump circuit
m - Choke valve

When throttle valve is turned to a position over bypass port, the bypass port is exposed to vacuous pressure existing in the back of throttle valve. The vacuous pressure causes the fuel to be ejected from bypass port and idle port.

3) High Speed Passage



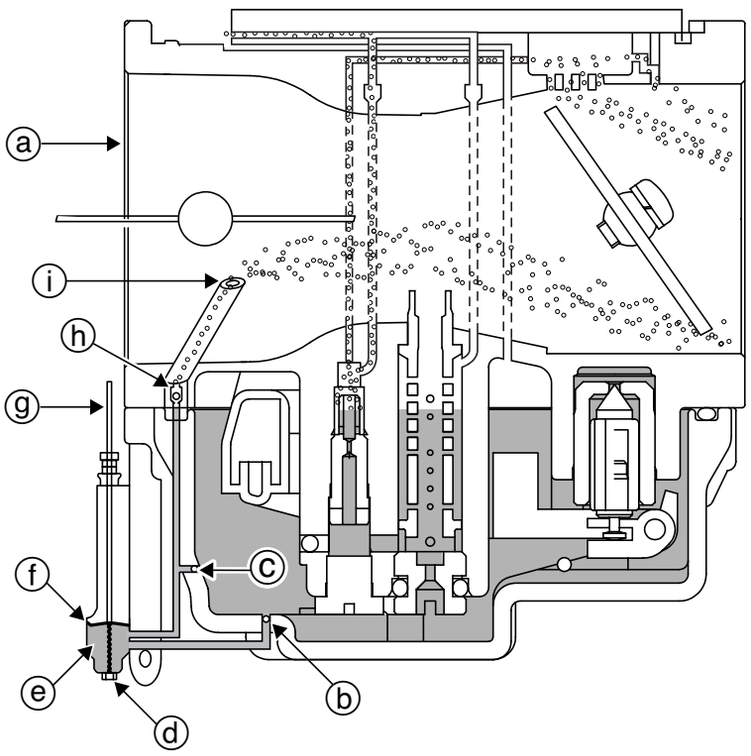
a - Air intake
b - Float chamber inlet
c - Air-bleed inlet
d - Slow air jet
e - Bypass port
f - Main nozzle
g - Main jet
h - Slow jet
i - Air bleed hole

As throttle valve is turned to a position over bypass port, the vacuum produced in the back of throttle valve extends to an area near main nozzle. At the same time, as flow of air that runs through carburetor bore increase, the whole space in the venturi becomes vacuous. The vacuous pressure in this venturi causes large suction force in the main nozzle. The fuel goes through main jet, flows into main fuel well, goes through main nozzle, and ejects from venturi.

The fuel that runs through main nozzle is mixed with air that comes from air bleed hole made on the side of main nozzle to make the fuel lighter. When throttle valve is fully open, the amount of fuel is determined by the size of main jet.

The idle and off-idle passages keep feeding fuel as well as air to the engine.

4) Acceleration Passage



a - Air intake
b - Inlet check valve
c - Jet
d - Drain
e - Return spring
f - Diaphragm
g - Diaphragm rod
h - Outlet check valve - Accelerator pump circuit
i - Pump discharge nozzle

When throttle valve is rapidly opened for attempting quick acceleration, the amount of air and vacuous pressure change almost simultaneously, but there is a tendency that the fuel delays a little because the fuel density is larger than the air, resulting in making the air-fuel mixture lean instantaneously. To prevent the air-fuel mixture from becoming lean during the acceleration, acceleration pump is provided to increase the fuel amount during the period to make engine revolution smoother.

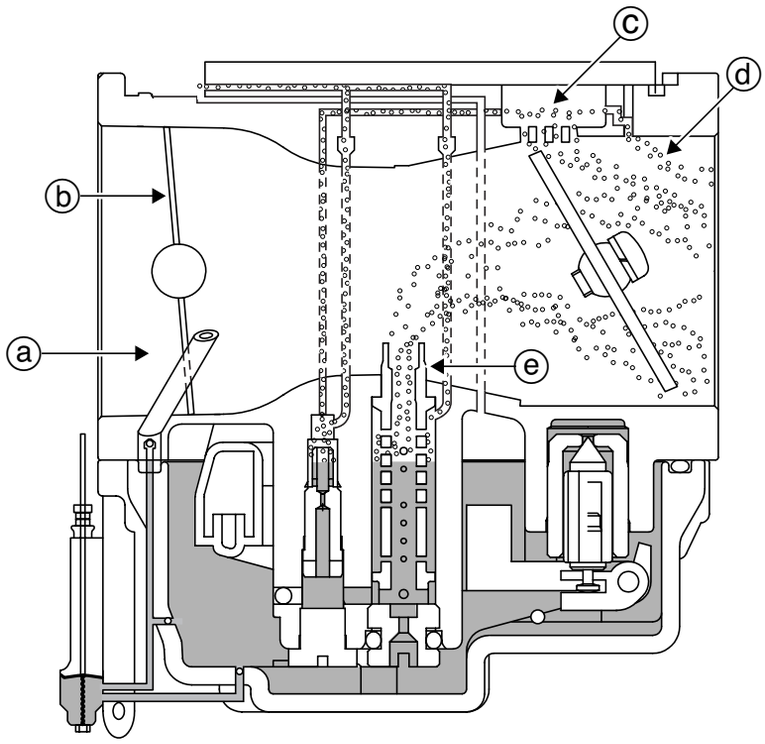
The fuel for the acceleration is fed by spring-loaded diaphragm pump that is driven by pump rod and lever assembly. The diaphragm that is driven returns to its original (unloaded) position by using the spring force in addition to the force produced by the elasticity of the diaphragm.

As the throttle valve is opened, the rod linking with the valve pushes down the pump rod. The downward movement of the rod causes the inlet check valve to close, fuel to be pushed into pump discharge passage, outlet check valve to be opened, and then the fuel is ejected from pump discharge nozzle into the venturi where it is atomized.

When the pump rod moves upward as the throttle valve is closed, the fuel goes through inlet check valve so that the pump well is filled with the fuel that is used for the next acceleration.

When the pump has discharged the fuel, the check valve closes to prevent further flow of fuel.

5) Choking Passage



a - Air intake
b - Choke valve
c - Bypass port
d - Idle Port
e - Main nozzle

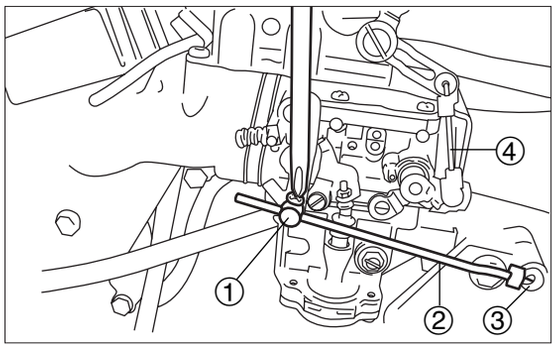
Choke system consists of choke valve, detent and push-pull cable or electric solenoid. When starting cold engine, the operator should judge whether it is necessary to operate the choke to make engine starting easier, and if necessary, to operate the handle of choke cable manually to set it to a proper position or to activate the solenoid for electric starting model.

When attempting to start cold engine, pull choke lever or activate the solenoid to close choke valve. When engine starts, low pressure (vacuous) area is formed in the venturi on the back of choke valve. Then, the fuel goes through main nozzle, bypass port and idle port, and sucked into carburetor bore, where it is mixed with air that runs in from opening of the choke valve to form thick air-fuel mixture.

As engine warms up, operate choke cable manually or turn off the solenoid to open choke valve. When engine has warmed up to a temperature suitable to the operation. For manual choke system, set choke lever to its original position.

4. Inspection Items

1) Removing Carburetor

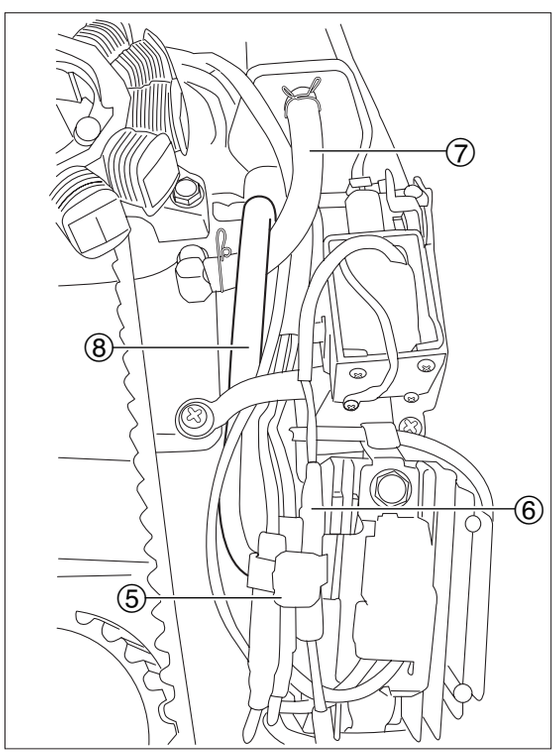


⚠ WARNING

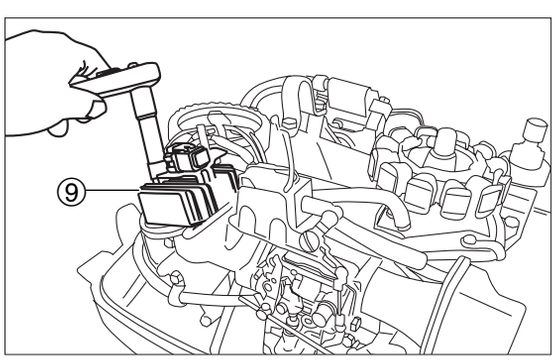
Before working on fuel system, make sure to disconnect battery cables from the battery, or electric sparks can occur, possibly igniting fuel or making fuel to explode.

Remote control model

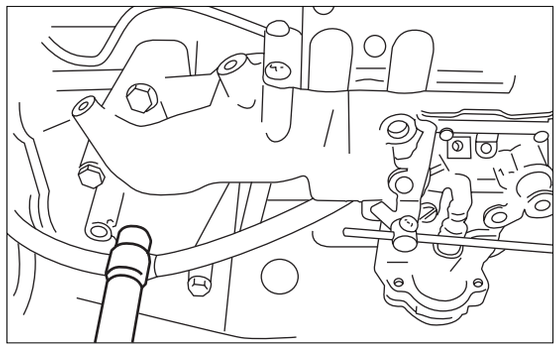
1. Loosen throttle link rod set screw ①. Remove throttle link rod ② from link drum ③.
2. Separate choke link rod ④ from carburetor.
3. Remove cable ⑤ for attaching solenoid wire of intake silencer head hose.
4. Disconnect choke solenoid wire ⑥ from engine wireharness.
5. Remove intake silencer head hose ⑦ from intake manifold.
6. Remove carburetor vent hose ⑧ from carburetor.
7. Disconnect connector of wiring from rectifier.



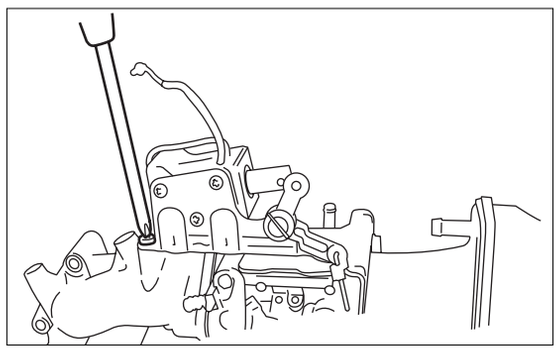
8. Remove rectifier ⑨.



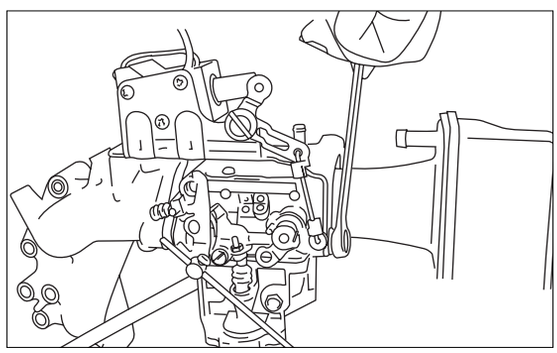
9. Loosen intake manifold installation bolts, and remove carburetor ass'y and silencer cover at the same time.



10. Loosen solenoid mount plate screws.



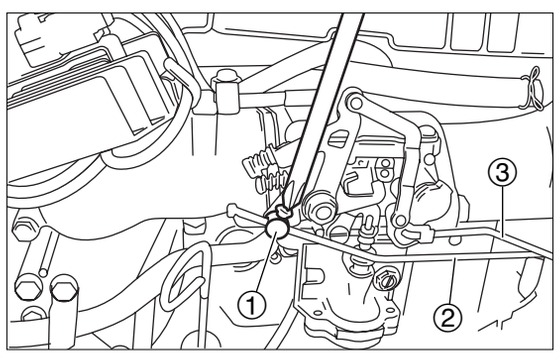
11. Loosen solenoid mount plate bolts and then remove carburetor.



Tiller Handle Model

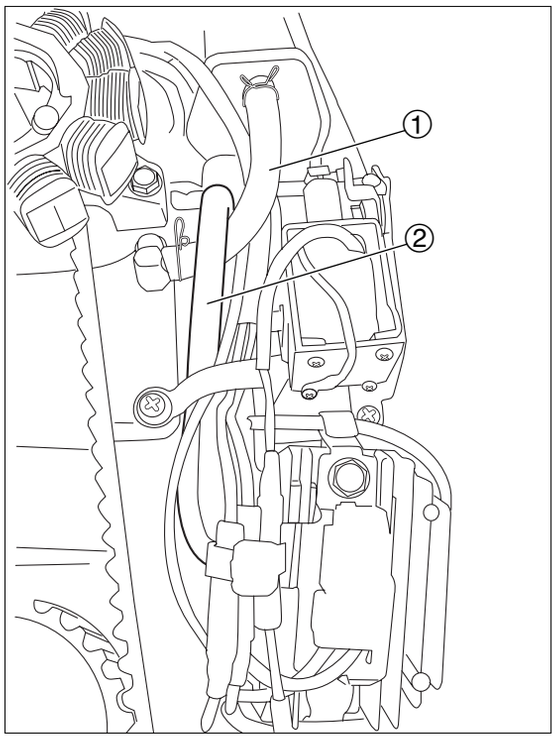
1. Loosen throttle link rod set screw ①. Remove throttle link rod ② from link drum.

2. Separate choke rod ③ from carburetor.

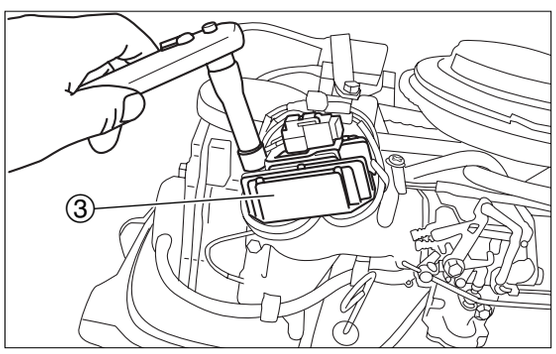


3. Remove air silencer head hose ① from intake manifold.

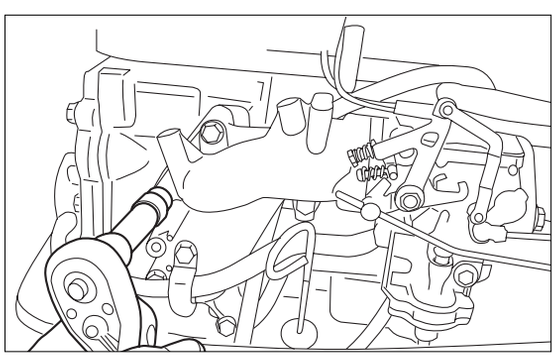
4. Remove breather hose ② from carburetor.



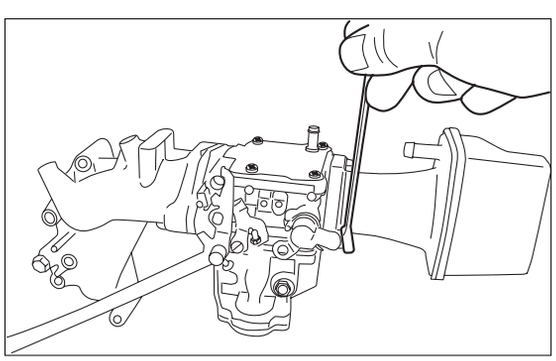
5. Remove rectifier lead wire band and then remove rectifier ③.



6. Loosen intake manifold installation bolts, and remove carburetor ass'y and silencer cover at the same time.



7. Loosen air silencer mount bolts and then remove carburetor.



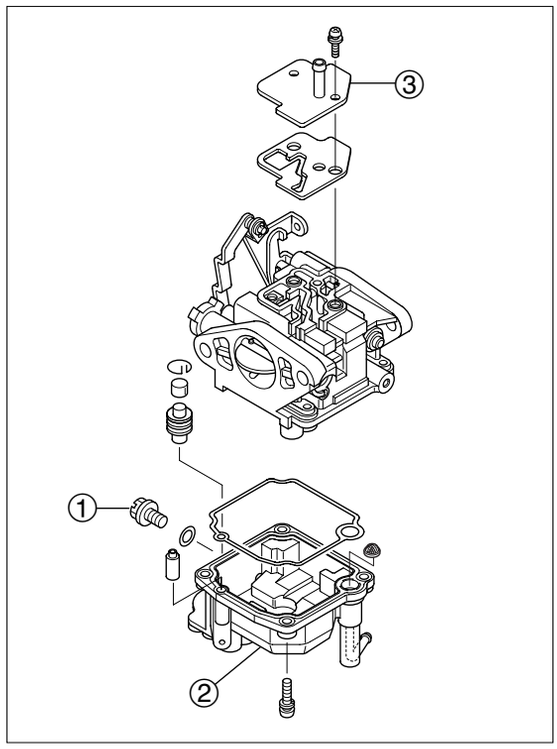
2) Disassembling Carburetor

1. Remove drain screw ① to drain fuel.

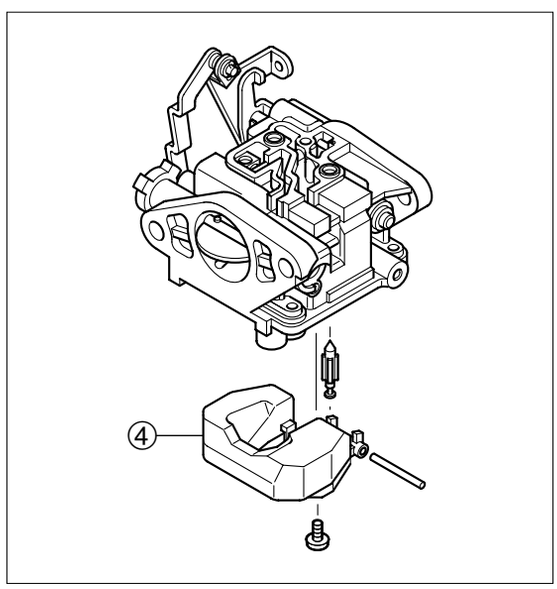
> **⚠ CAUTION**
>
> **To prevent fuel from dripping on the floor, use a vessel to catch the fuel.**

2. Remove float chamber ②.

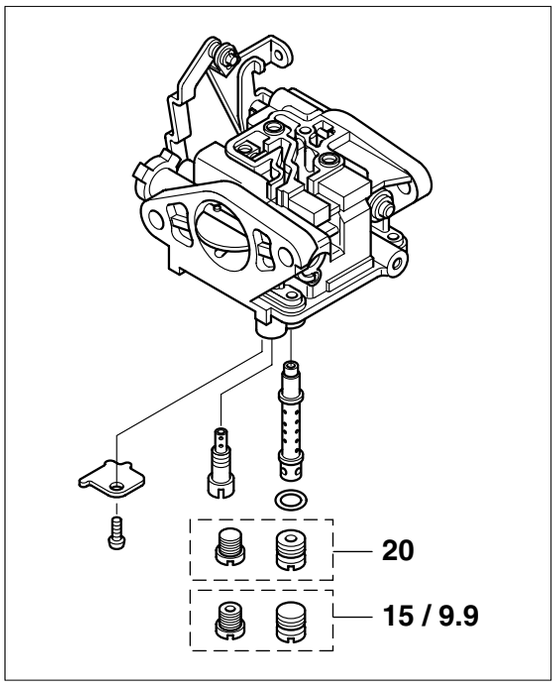
3. Remove carburetor cover ③.



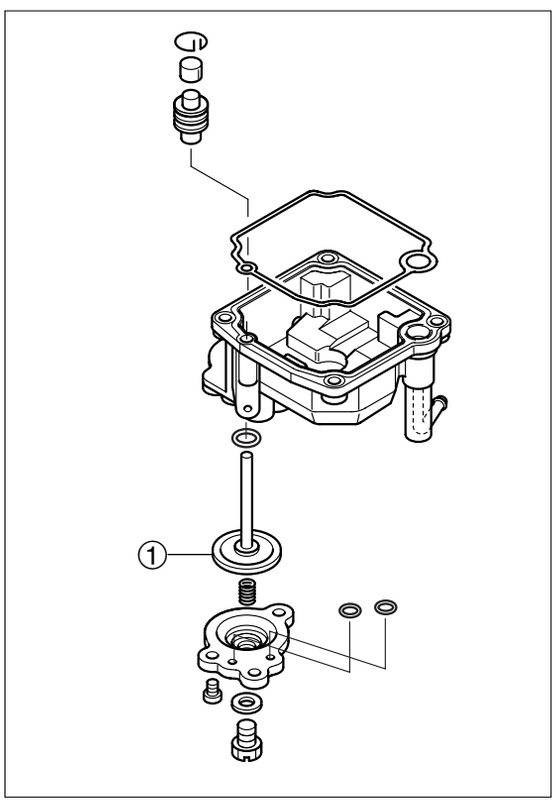
4. Remove float ass'y ④.



5. Remove jets and nozzle.

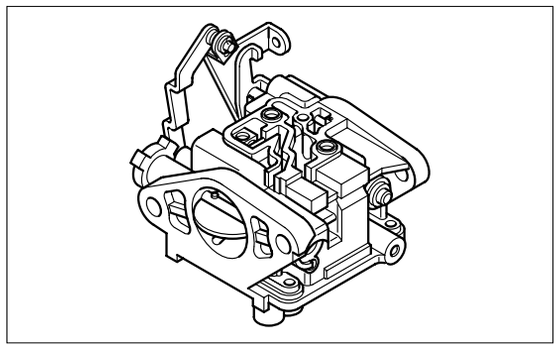


6. Remove acceleration pump diaphragm ①.



3) Cleaning and Inspection

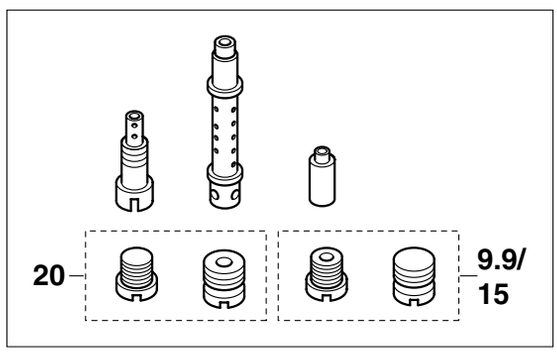
1. Check carburetor body for crack, damage and dirt. Replace or clean as necessary.



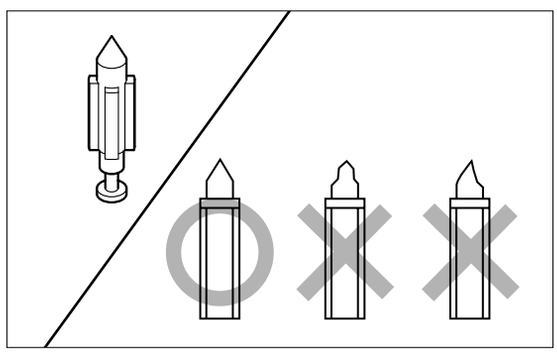
⚠ CAUTION

Use cleaning solution to remove dirt. Blow passages with compressed air to remove dirt. Do not use wire to remove dirt.

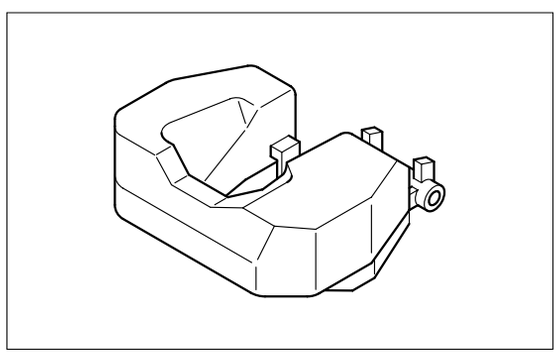
2. Check jets and nozzle for dirt, and replace if necessary.



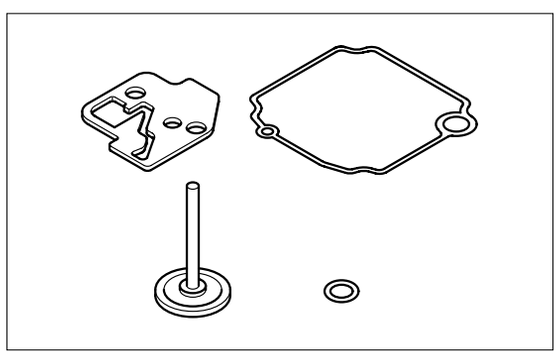
3. Check tip of needle valve, and replace if necessary.



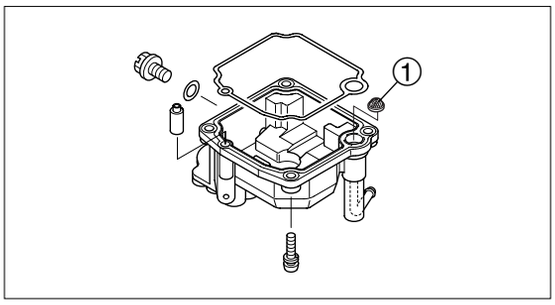
4. Check float for crack and damage, and replace if necessary.



5. Check plunger, O rings and gaskets for damage, and replace if necessary.



6. Clean and check filter ① in the carburetor, and replace with new one if necessary.



4) Inspection of Fuel Pump

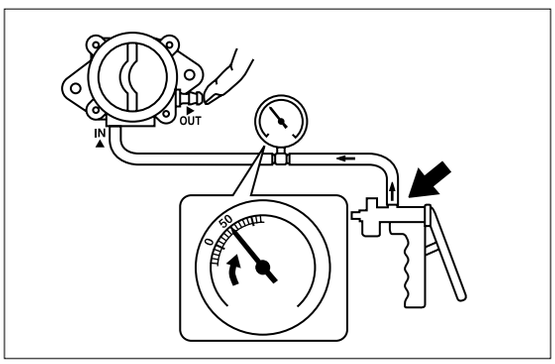
1. Remove fuel hoses (2) from fuel pump.

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

3. Close fuel pump outlet with a finger and apply specified pressure. Check if no air leaks.

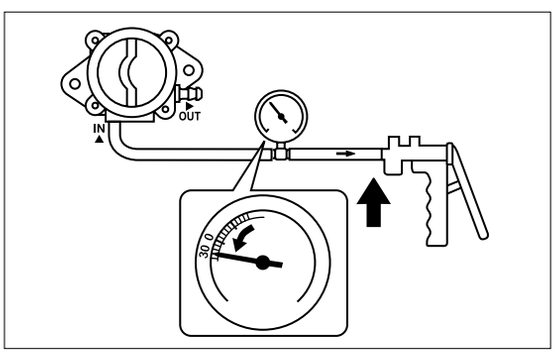
Vacuum/Pressure Gauge :
P/N. 3AC-99020-1

Specified Pressure :
0.049 MPa (7 psi) [0.5 kgf/cm²]



4. Apply specified vacuum pressure to check that no air leaks.

Specified Vacuum Pressure :
-0.029 MPa (-4 psi) [-0.3 kgf/cm²]

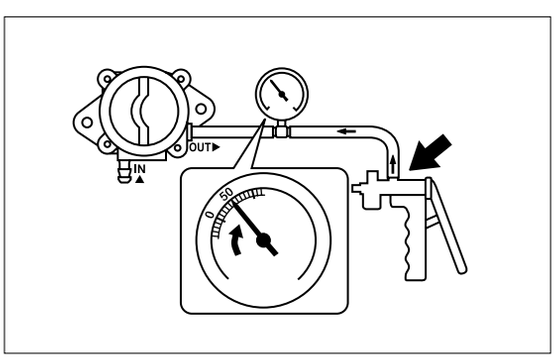


5. Connect vacuum/pressure gauge to outlet of fuel pump.

6. Apply specified pressure to check if no air leaks. Replace if necessary.

Air-tightness of fuel pump can be increased by making the interior wet with gasoline.

Specified Pressure :
0.029 MPa (4 psi) [0.3 kgf/cm²]

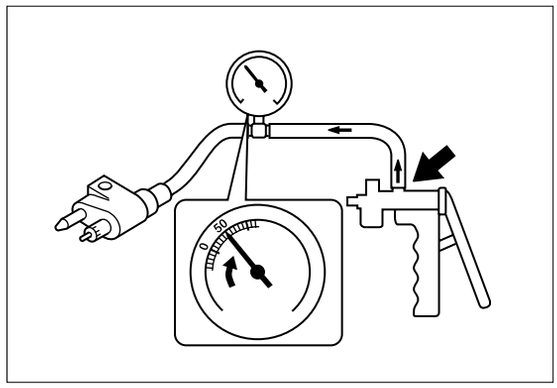


5) Inspection of Fuel Connector

1. Check fuel connector for crack and damage.
2. Connect vacuum/pressure gauge to outlet of fuel connector.
3. Apply specified pressure, and check if the pressure is maintained for 10 seconds. Replace if necessary.

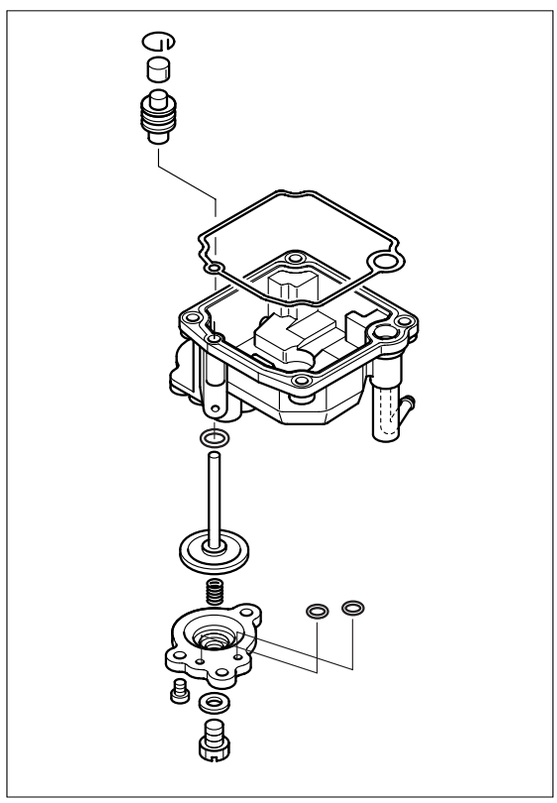
Vacuum/Pressure Gauge :
P/N. 3AC-99020-1

Specified Pressure :
0.029 MPa (4 psi) [0.3 kgf/cm²]

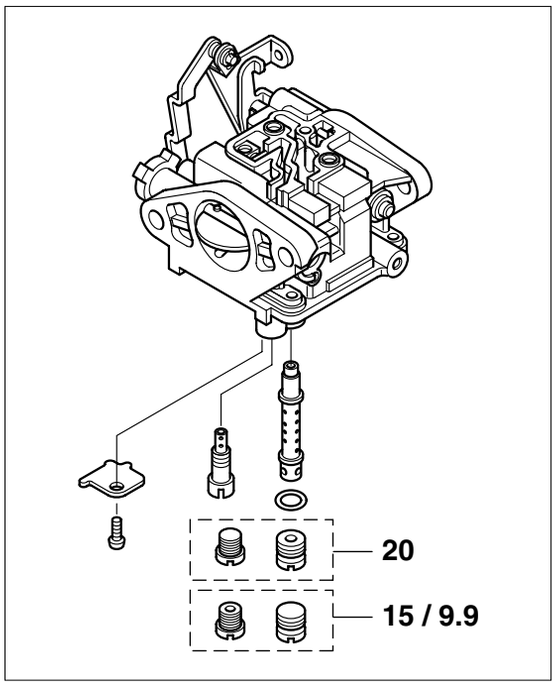


6) Assembling Carburetor

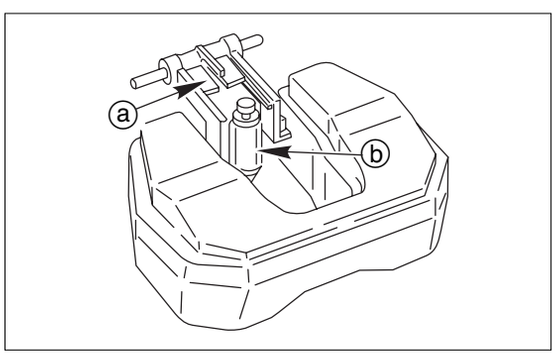
1. Attach diaphragm and diaphragm cover of accelerator pump, and secure them.



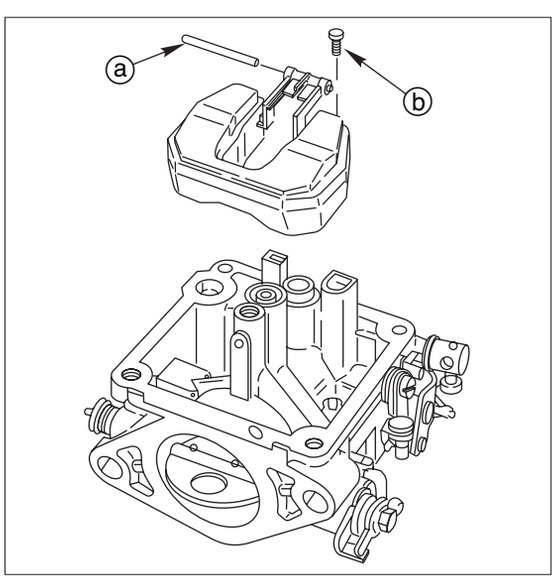
2. Install jets and nozzle.



3. Attach needle valve ⓑ to float hinge ⓐ.



4. Attach float ass'y with float arm pin ⓐ and secure with screw ⓑ.

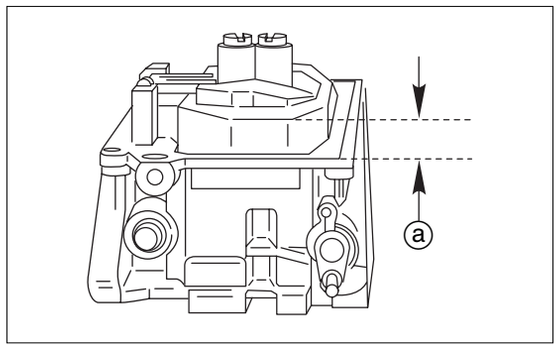


4

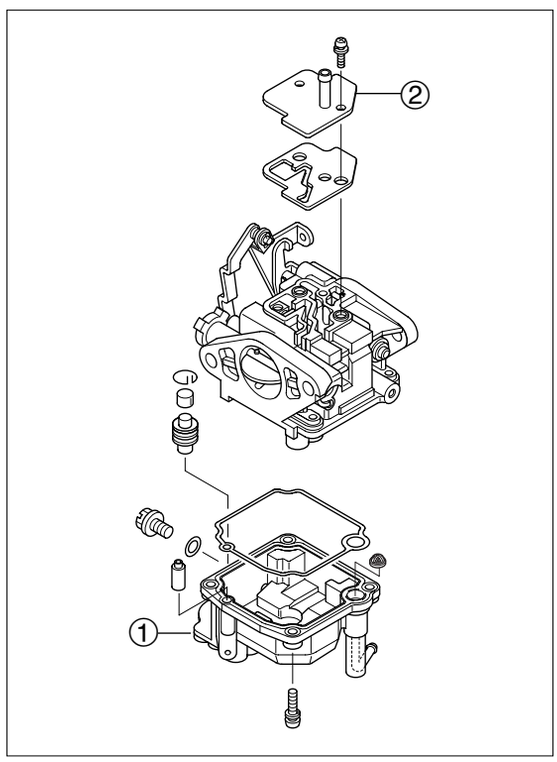
7) Adjusting Float Height

1. Measure float height as shown, and replace float if out of specification.

Float Height ⓐ :
26.2mm (1.0314in)



2. Install drain screw, float chamber ① and cover ②.



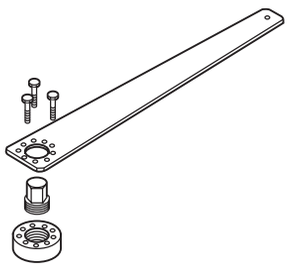
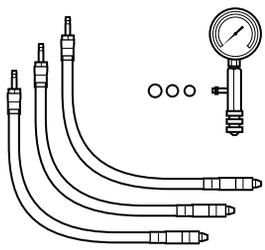
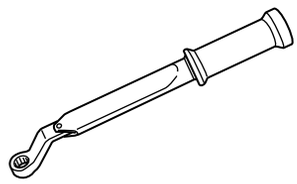
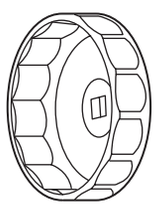
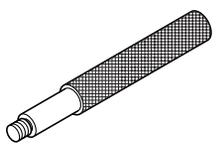
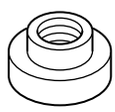
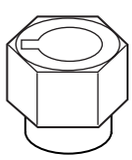
8) Installing Carburetor

1. Reverse carburetor removing steps to install.

5

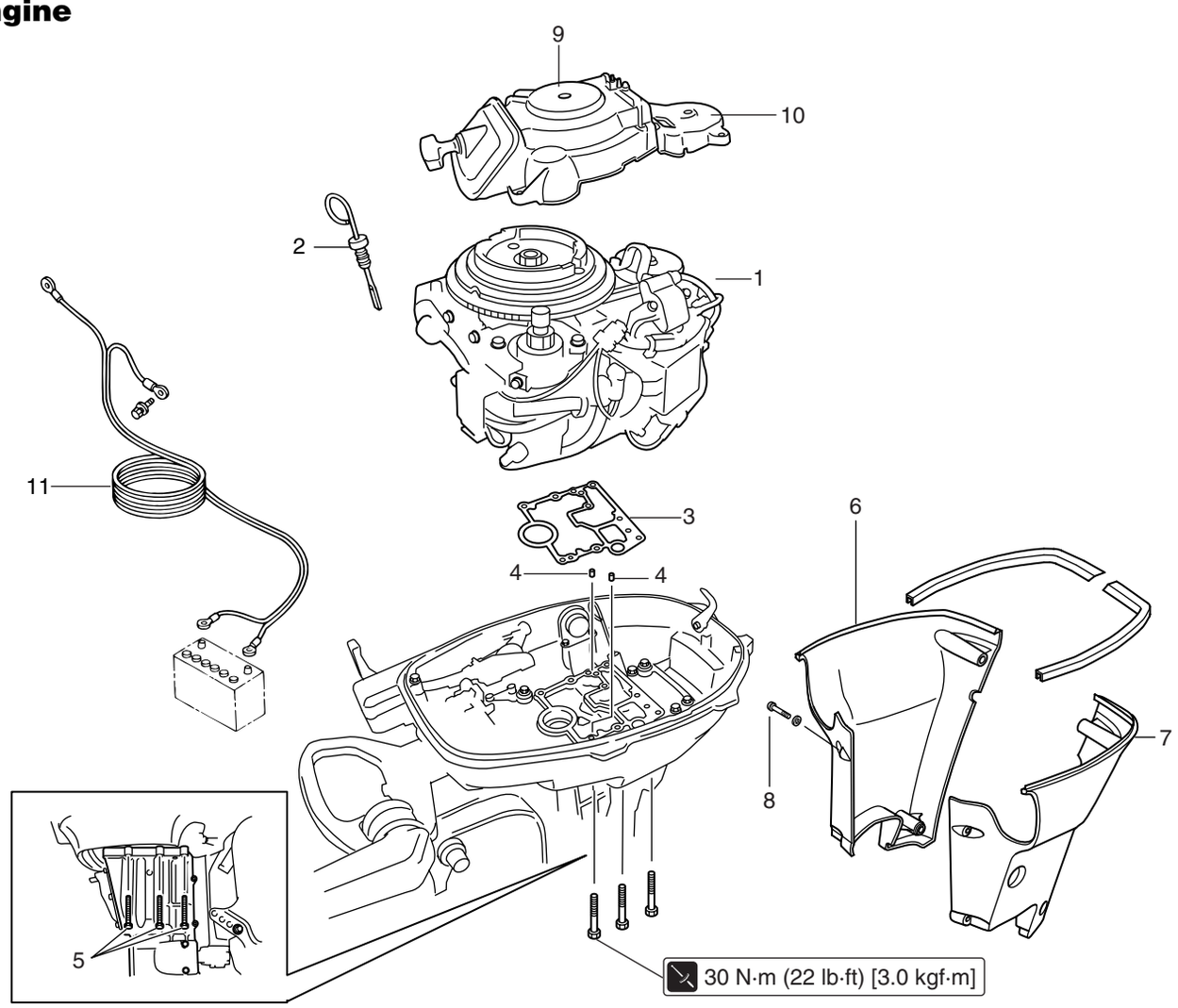
Power Unit

1.Special tools

			
Flywheel Puller Kit P/N. 369-72211-0	Piston Slider P/N. 3AC-72871-0	Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0
Removing/installing flywheel	Installing piston	Measuring compression pressure	Adjusting valve clearance
			ø34.5 x ø17.5 
Valve Clearance Driver P/N. 3AC-99071-0	Oil Filter Wrench P/N. 3AC-99090-0	Driver Rod P/N. 3AC-99702-0	Oil Seal Attachment P/N. 3AC-99820-0
Adjusting valve clearance	Removing/installing oil filter	Installing oil seal	Installing cam shaft oil seal
			
Crank Shaft Holder P/N. 3BJ-72815-0			
Holding crank shaft			

2.Parts Layout

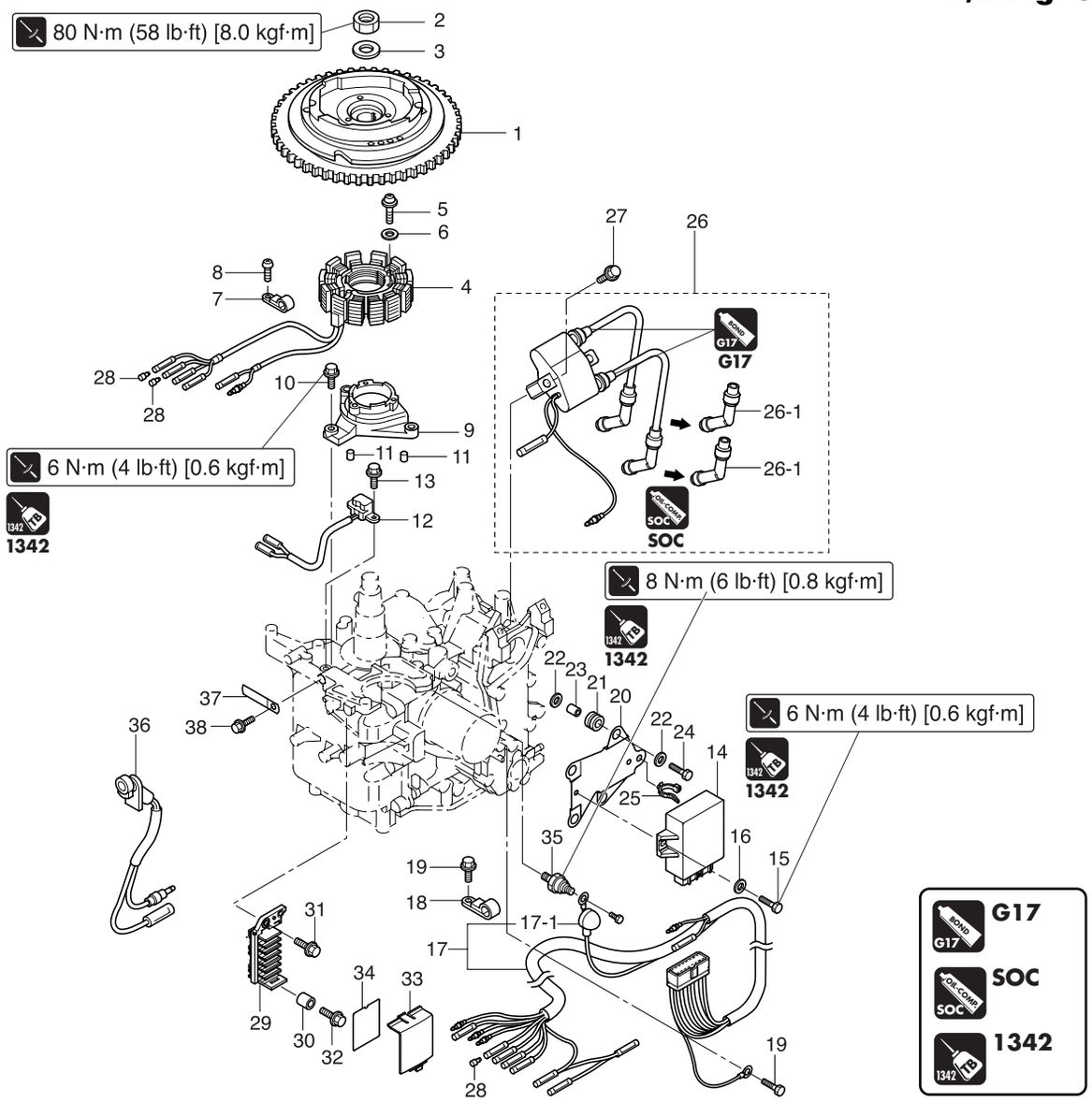
Engine



Ref. No.	Description	Q'ty	Remarks
1	Power Unit	1	
2	Oil Level Gauge	1	
3	Gasket	1	Do not reuse.
4	Dowel Pin	2	
5	Bolt	6	M8 L=105mm
6	Drive Shaft Housing Cover (Right)		
7	Drive Shaft Housing Cover (Left)		
8	Screw	2	M6 L=60mm
9	Recoil Starter	1	
10	Belt Cover	1	
11	Battery Cable	1	

Magneto

P/L Fig. 8

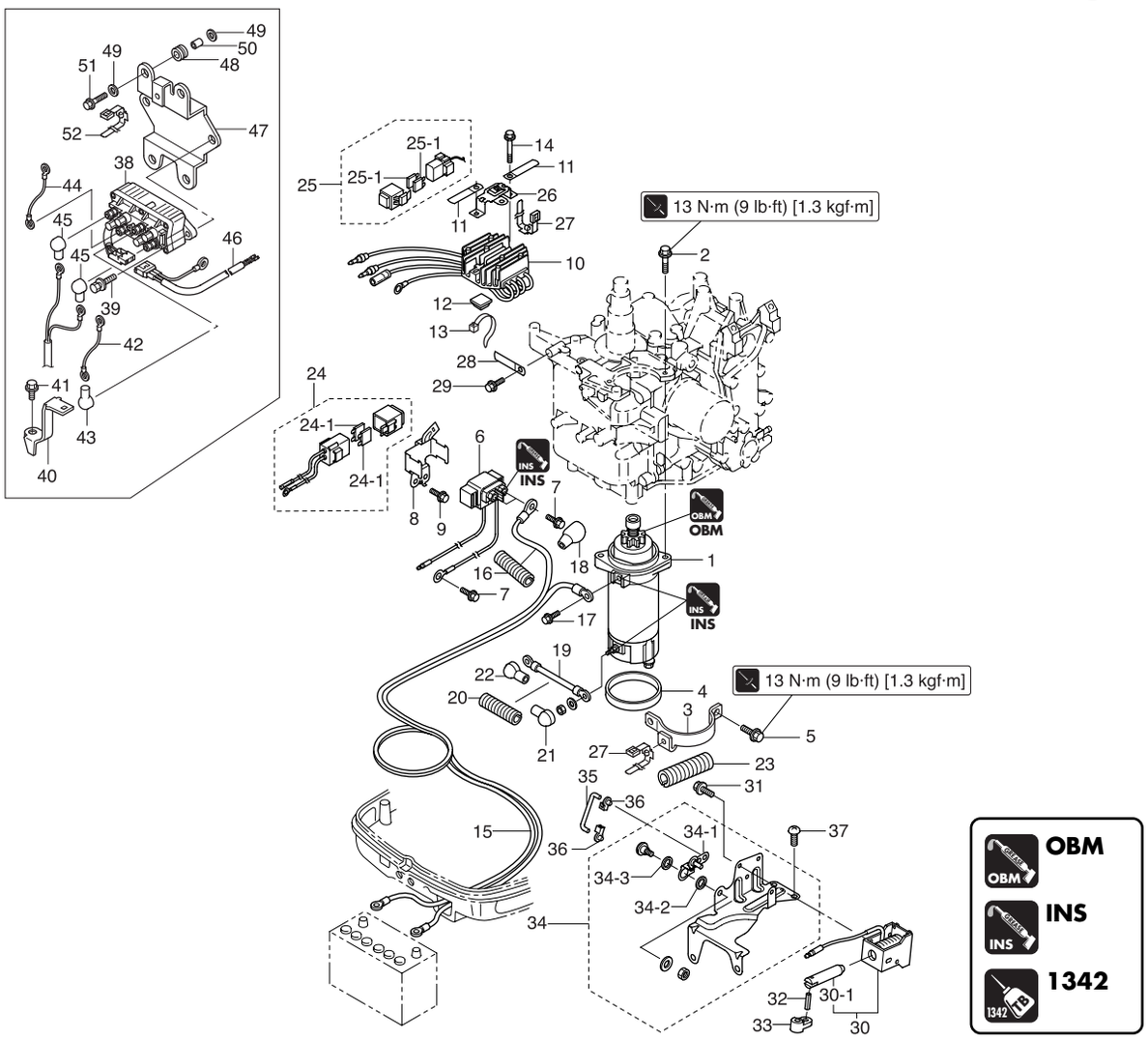


Ref. No.	Description	Q'ty	Remarks
1	Flywheel Cup (with Ring Gear)	1	
2	Nut, 16-P1.5	1	
3	Washer, 16-27-3.2	1	
4	Alternator	1	
5	Screw	3	M6 L=30mm
6	Washer	3	M6
7	Clamp, 6.5-14L	1	
8	Screw	1	M6 L=16mm
9	Coil Bracket	1	
10	Bolt, 6-25 Pre-coated	3	M6 L=25mm
11	Dowel Pin, 6-12	2	
12	Pulser Coil	1	
13	Bolt	2	M5 L=14mm
14	C.D. Unit	1	
15	Bolt, 6-16 Pre-coated	2	M6 L=16mm
16	Washer, 6-16-1.5	2	
17	C.D. Unit Cord Ass'y	1	
17-1	Grommet	1	
18	Clamp, 6.5-14L	1	
19	Bolt	2	
20	C.D. Unit Bracket	1	
21	Rubber Mount	4	
22	Washer, 6-16-1.5	8	
23	Collar, 6.2-9-8.7	4	

Ref. No.	Description	Q'ty	Remarks
24	Bolt	4	
25	Lead Wire Band, 135	1	
26	Ignition Coil	1	
26-1	Plug Cap (with Resistance)	2	
27	Bolt	2	
28	Cable Terminal Plug	AR	7 for MF, 4 for EF 3 for EFT 2 for EP/EPT
29	Cable Terminal Holder	1	with Collar
30	Collar, 6-8-6	1	
31	Bolt	1	Upper M6 L=16mm
32	Bolt	1	Lower M6 L=12mm
33	Terminal Holder Cover	1	
34	Wiring Diagram Decal	1	for MF/EF/EFT
	Wiring Diagram Decal	1	for EP/EPT
35	Oil Pressure Switch	1	
36	Warning Lamp	1	
37	Clamp, 6.5-67P	1	
38	Bolt	1	M6 L=12mm

Electric Parts

P/L Fig. 9

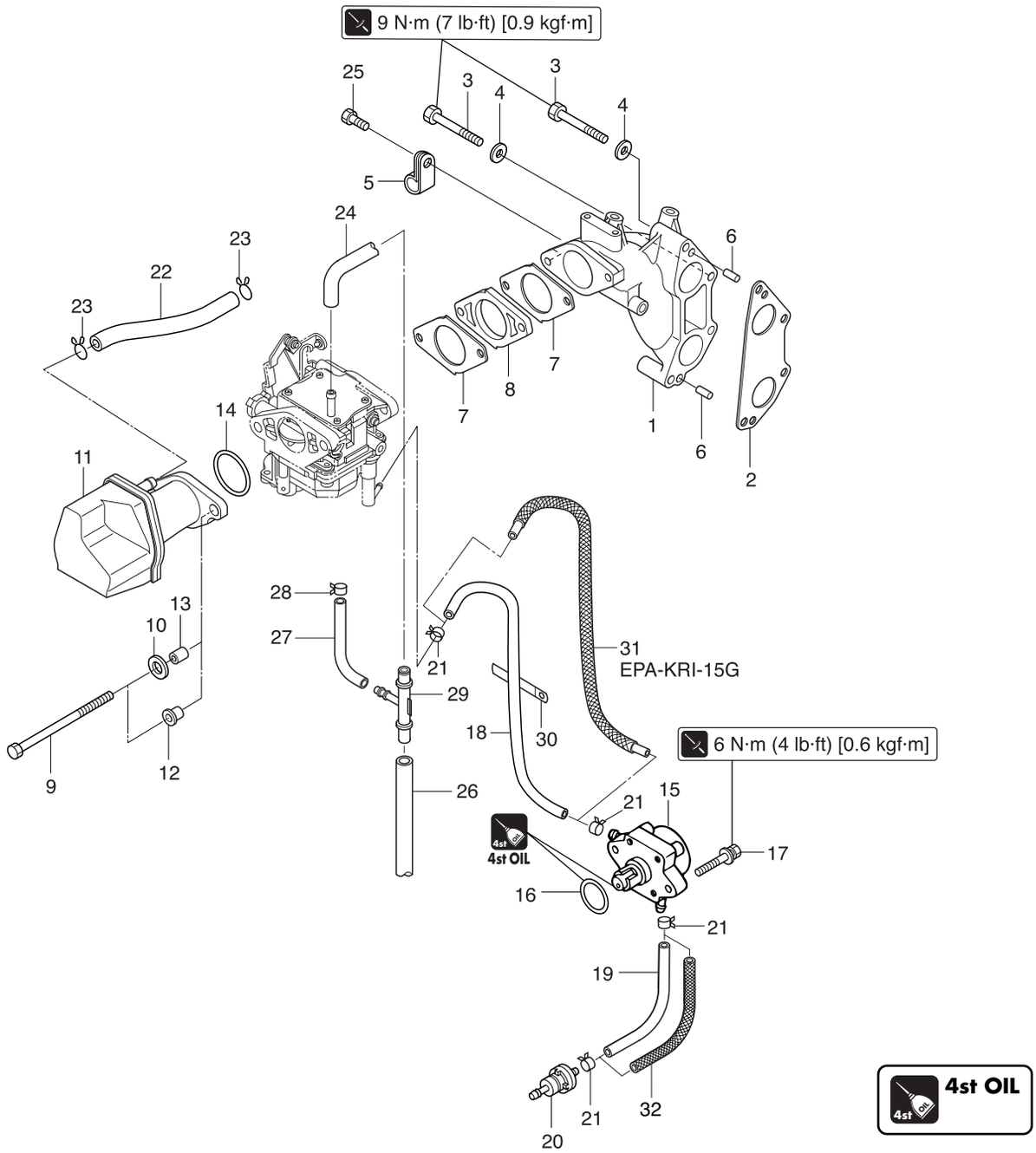


Ref. No.	Description	Q'ty	Remarks
1	Starter Motor	1	for EP/EF/EPT/EFT
2	Bolt	2	
3	Starter Motor Band	1	
4	Starter Motor Damper	1	for EP/EF/EPT/EFT
5	Bolt	2	or 910113-5818
6	Starter Solenoid	1	
7	Bolt	3	M6 L=10mm
8	Starter Solenoid Bracket	1	for EP/EF/EPT/EFT
9	Bolt	1	M6 L=12mm
10	Rectifier	1	
11	Clamp, 6.5-47.5P	2	for EP/EF/EPT/EFT
12	Band Mount	1	
13	Lead Wire Band, 203	1	
14	Bolt	2	for EP/EF/EPT/EFT M6 L=25mm
15	Battery Cable	1	L=2750
16	Protector	1	L=320
17	Bolt	1	M6 L=12mm
18	Terminal Cap	1	
19	Starter Cable	1	L=270
20	Protector	1	L=180
21	Terminal Cap	1	
22	Terminal Cap	1	for EP/EF/EPT/EFT
23	Protector	1	
24	Fuse Cable	1	L=185
24-1	Fuse (20A)	2	
25	Fuse Cable	1	L=720
25-1	Fuse (20A)	2	for EP/EF/EPT/EFT
26	Fuse Holder Bracket	1	
27	Lead Wire Band, 135	2	

Ref. No.	Description	Q'ty	Remarks
28	Clamp, 6.5-120P	1	for EP/EPT
29	Bolt	1	M6 L=12mm
30	Choke Solenoid	1	
30-1	Plunger	1	for EP/EPT
31	Screw	4	M4 L=6mm
32	Spring Pin, 3-12	1	
33	Choke Solenoid Hook	1	for EP/EPT
34	Choke Solenoid Bracket Ass'y	1	
34-1	Choke Lever	1	
34-2	Bushing, 8.1-15-2.9	1	for EP/EPT
34-3	Washer, 8.1-15-1.3	1	
35	Link Rod	1	
36	Rod Snap, 1.5-2	2	for EP/EPT
37	Screw	2	M5 L=10mm
38	PTT Solenoid Switch (A)	1	for EFT/EPT
39	Bolt	2	for EFT/EPT
40	Stay	1	for EFT/EPT
41	Bolt	1	for EFT/EPT
42	Solenoid Switch Cord (A) L=300	1	for EFT/EPT
43	Terminal Cap	1	for EFT/EPT
44	Solenoid Switch Cord (B) L=150	1	for EFT/EPT
45	Terminal Cap	2	for EFT/EPT
46	Extension Cord (PTT)	1	for EFT/EPT
47	Bracket PTT Solenoid	1	for EFT/EPT
48	Rubber Mount	4	for EFT/EPT
49	Washer 6-16-1.5	8	for EFT/EPT
50	Collar 6.2-9-8.7	4	for EFT/EPT
51	Bolt	4	for EFT/EPT
52	Band Lead Wire 135	1	for EFT/EPT

Intake Manifold & Fuel Pump

P/L Fig. 4

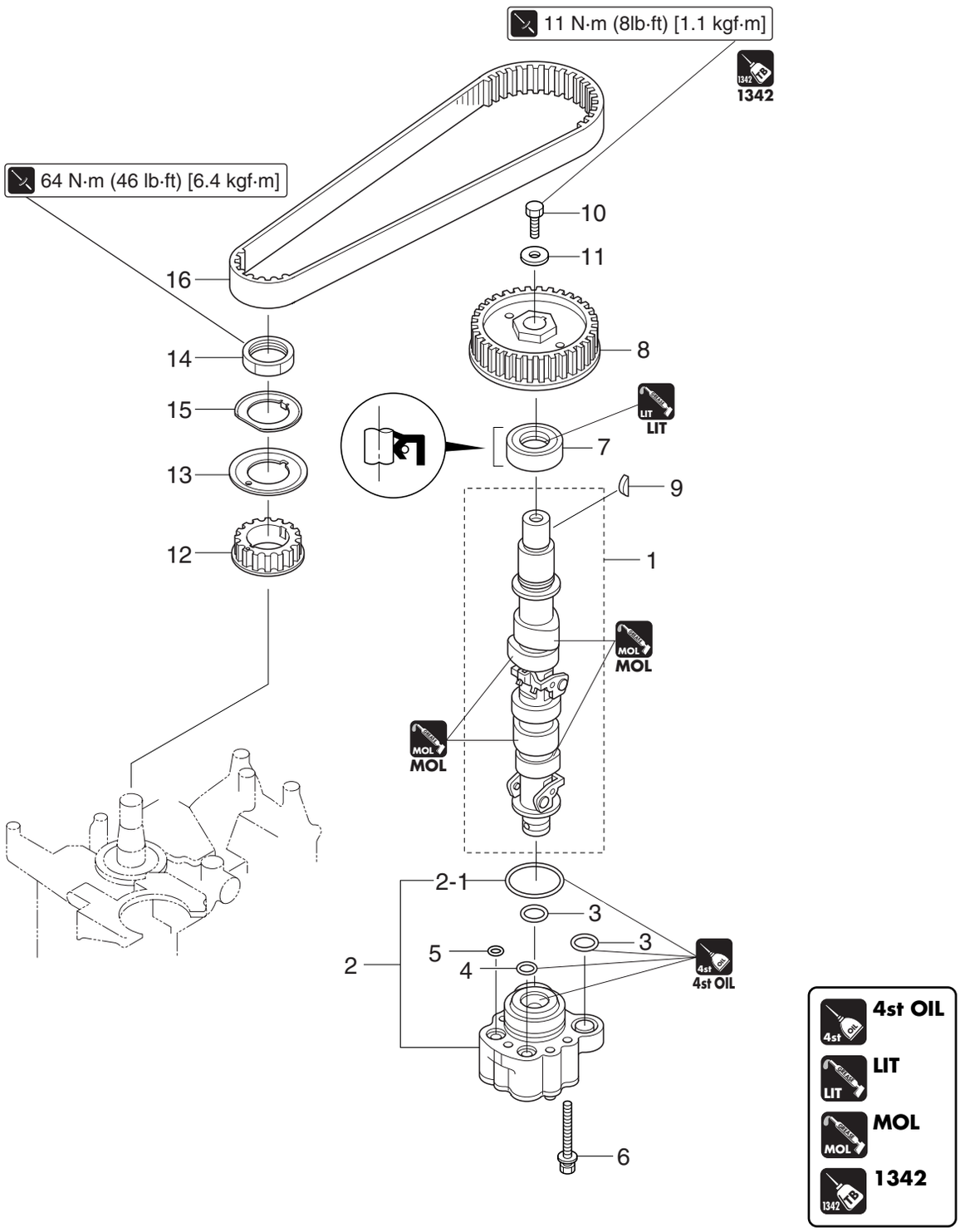


Ref. No.	Description	Q'ty	Remarks
1	Intake Manifold	1	
2	Intake Manifold Gasket	1	Do not reuse.
3	Bolt	5	M6 L=45mm
4	Washer	5	M6
5	Clamp, 6.5-14L	1	
6	Dowel Pin, 6-12	2	
7	Carburetor Gasket	2	Do not reuse.
8	Insulator	1	for 15/20
	Insulator	-	for 9.9
9	Bolt, 6-100	2	M6 L=100mm
10	Washer	2	for EP/EPT
11	Intake Silencer	1	
12	Collar, 6.1-14-8.9	2	for MF/EF/EFT
13	Collar, 6.2-9-7.4	2	for EP/EPT
14	Seal Ring, 2.4-35	1	
15	Fuel Pump	1	
16	O-Ring, 3.5-25.7	1	Do not reuse.

Ref. No.	Description	Q'ty	Remarks
17	Bolt	2	M6 L=25mm
18	Rubber Hose	1	L=300mm
19	Rubber Hose	1	L=120mm
20	Fuel Filter	1	
21	Clip ø9.5	4	
22	Rubber Hose	1	L=120mm, for Breather
23	Clip, ø12	2	
24	Breather Hose	1	for Carburetor
25	Bolt	1	M6 L=12mm
26	Breather Hose L=50	1	Carburetor
27	Hose	1	98AL-301000
28	Clip ø6.8	1	
29	Nipple	1	
30	Clamp 6.5-47.5P	1	
31	Fuel Hose W/Protector	1	Low Permeation Parts (for USA model)
32	Fuel Hose W/Protector	1	for USA

Camshaft & Oil Pump

P/L Fig. 6

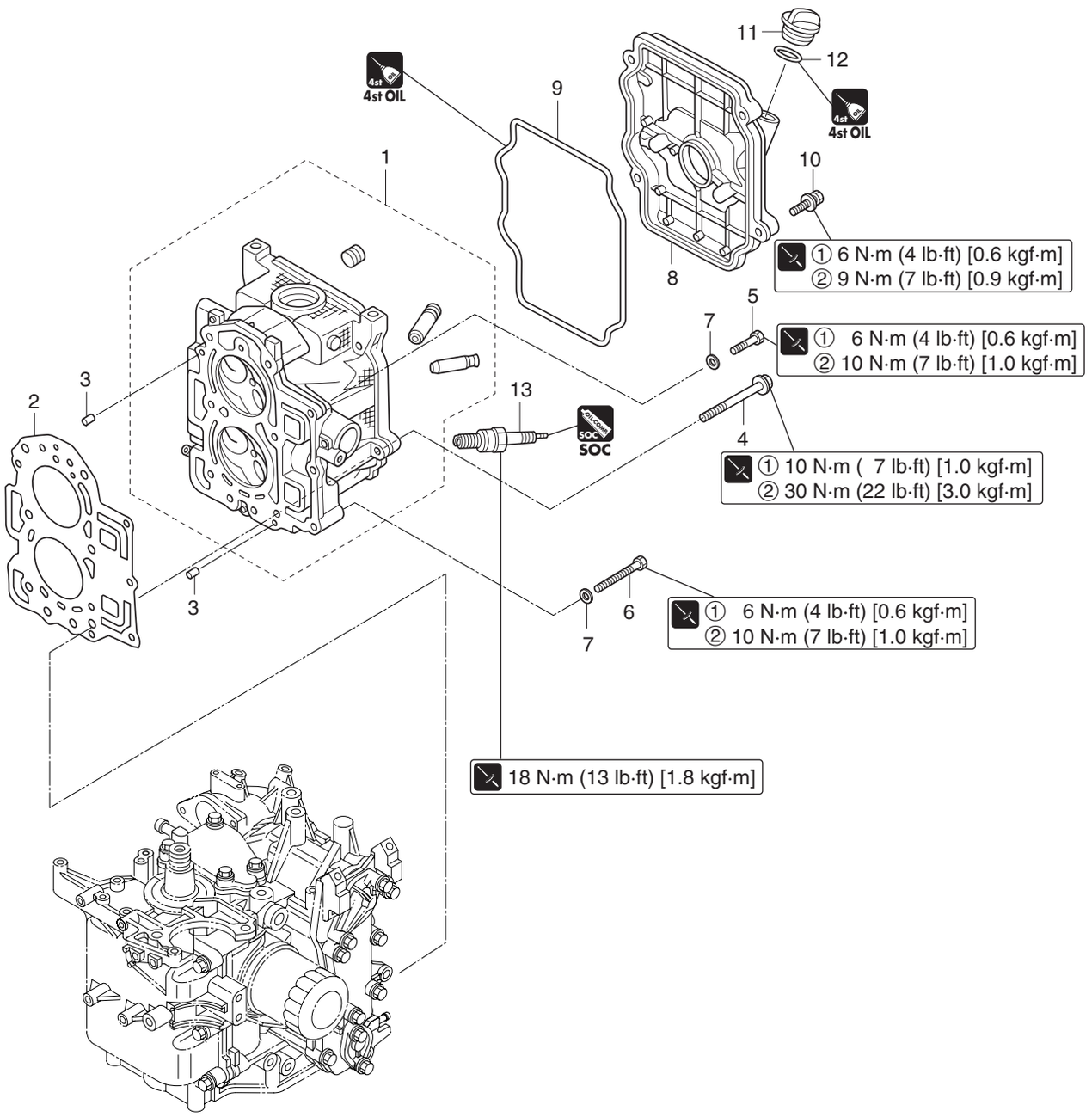


Ref. No.	Description	Q'ty	Remarks
1	Camshaft Ass'y	1	
2	Oil Pump	1	
2-1	Oil Pump O-Ring	1	Do not reuse.
3	O-Ring, 1.5-15.5	2	Do not reuse.
4	O-Ring, 1.5-10.7	1	Do not reuse.
5	O-Ring, 1.5-8.5	1	Do not reuse.
6	Bolt	3	M6 L=35mm
7	Oil Seal, 18-35-8	1	Do not reuse.
8	Driven Pulley	1	Camshaft Pulley
9	Key	1	t=3

Ref. No.	Description	Q'ty	Remarks
10	Bolt, 20 Pre-Coated	1	M6 L=20mm
11	Washer, 6.5-19-3.2	1	M6
12	Drive Pulley	1	Timing Pulley
13	Belt Guide	1	
14	Nut	1	Width between two sides : 36mm
15	Lock Washer	1	
16	Timing Belt	1	

Cylinder Head

P/L Fig. 1

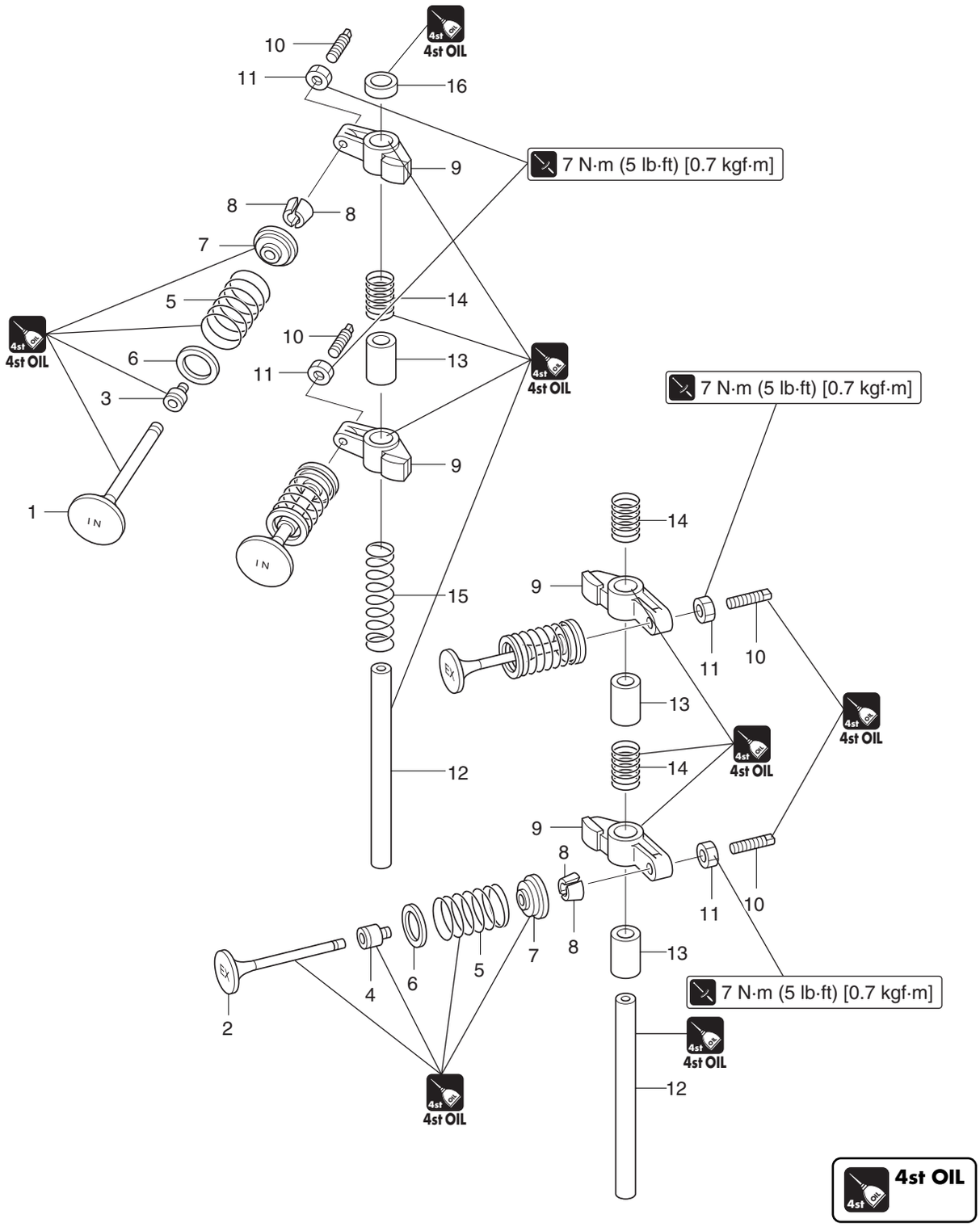


Ref. No.	Description	Q'ty	Remarks
1	Cylinder Head	1	
2	Cylinder Head Gasket	1	Do not reuse.
3	Dowel Pin, 6-12	2	
4	Cylinder Head Bolt	6	M8 L=60mm
5	Bolt	2	M6 L=25mm
6	Bolt	1	M6 L=40mm
7	Washer	3	
8	Cylinder Head Cover	1	
9	Cylinder Head Cover Gasket	1	Do not reuse.
10	Bolt	4	M6 L=30mm

Ref. No.	Description	Q'ty	Remarks
11	Engine Oil Filler Cap	1	
12	O-Ring, 3.1-24.4	1	Do not reuse.
13	Spark Plug	2	NGK : DCPR6E

Intake Valve & Exhaust Valve

P/L Fig. 7

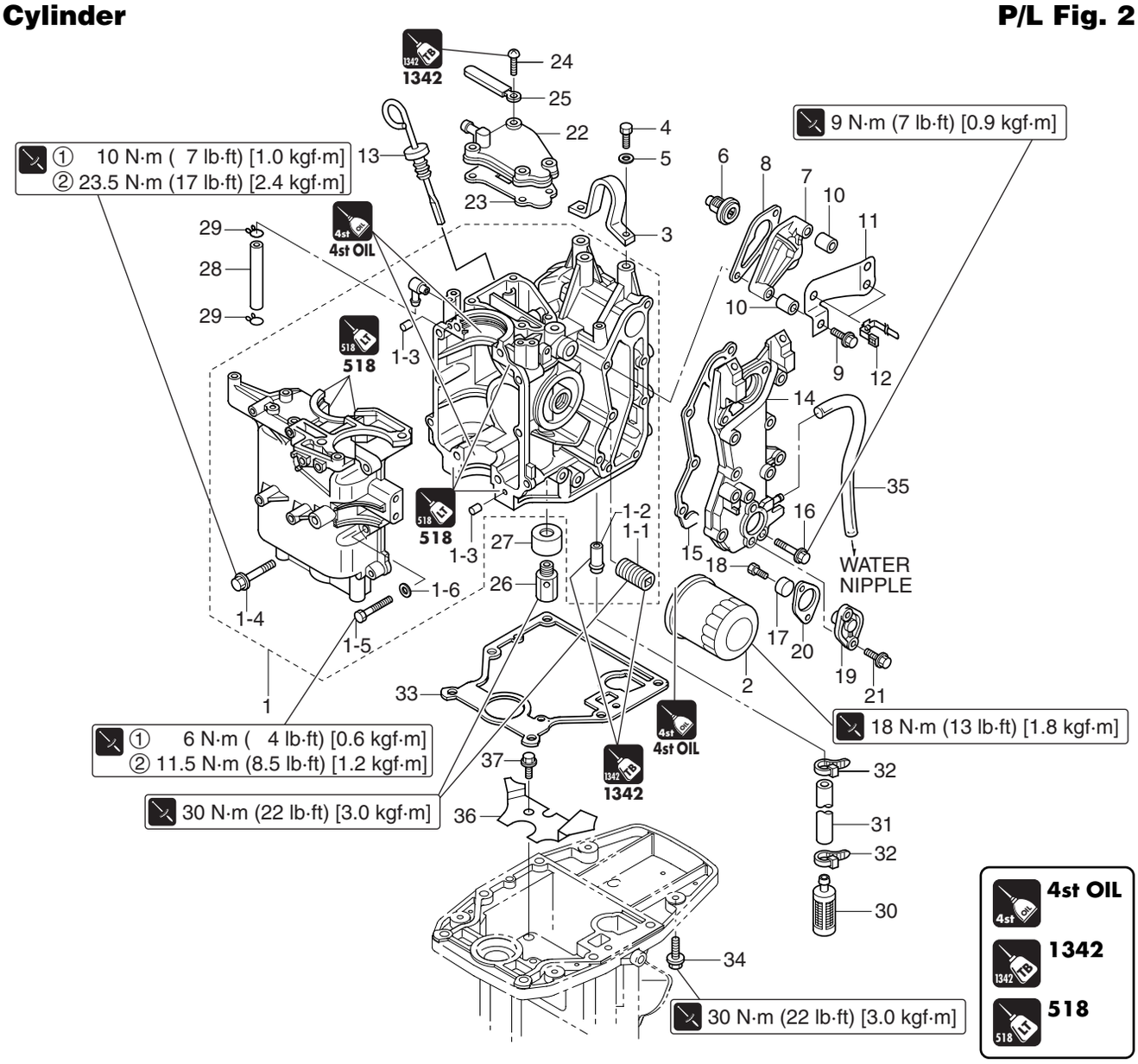


Ref. No.	Description	Q'ty	Remarks
1	Intake Valve	2	Intake valve diameter: 25mm
2	Exhaust Valve	2	Exhaust valve diameter: 24mm
3	Intake Valve Stem Seal	2	Black
4	Exhaust Valve Stem Seal	2	Green
5	Valve Spring	4	L=35
6	Valve Spring Seat	4	
7	Retainer	4	
8	Cotter	8	
9	Rocker Arm (t=17)	4	
10	Adjusting Screw	4	

Ref. No.	Description	Q'ty	Remarks
11	Adjusting Nut	4	
12	Rocker Arm Shaft	2	
13	Collar, 13.1-15.9-22.5	3	
14	Rocker Shaft Spring	3	L=30
15	Rocker Shaft Spring	1	L=51
16	Washer, 13.2-21.7-2	1	

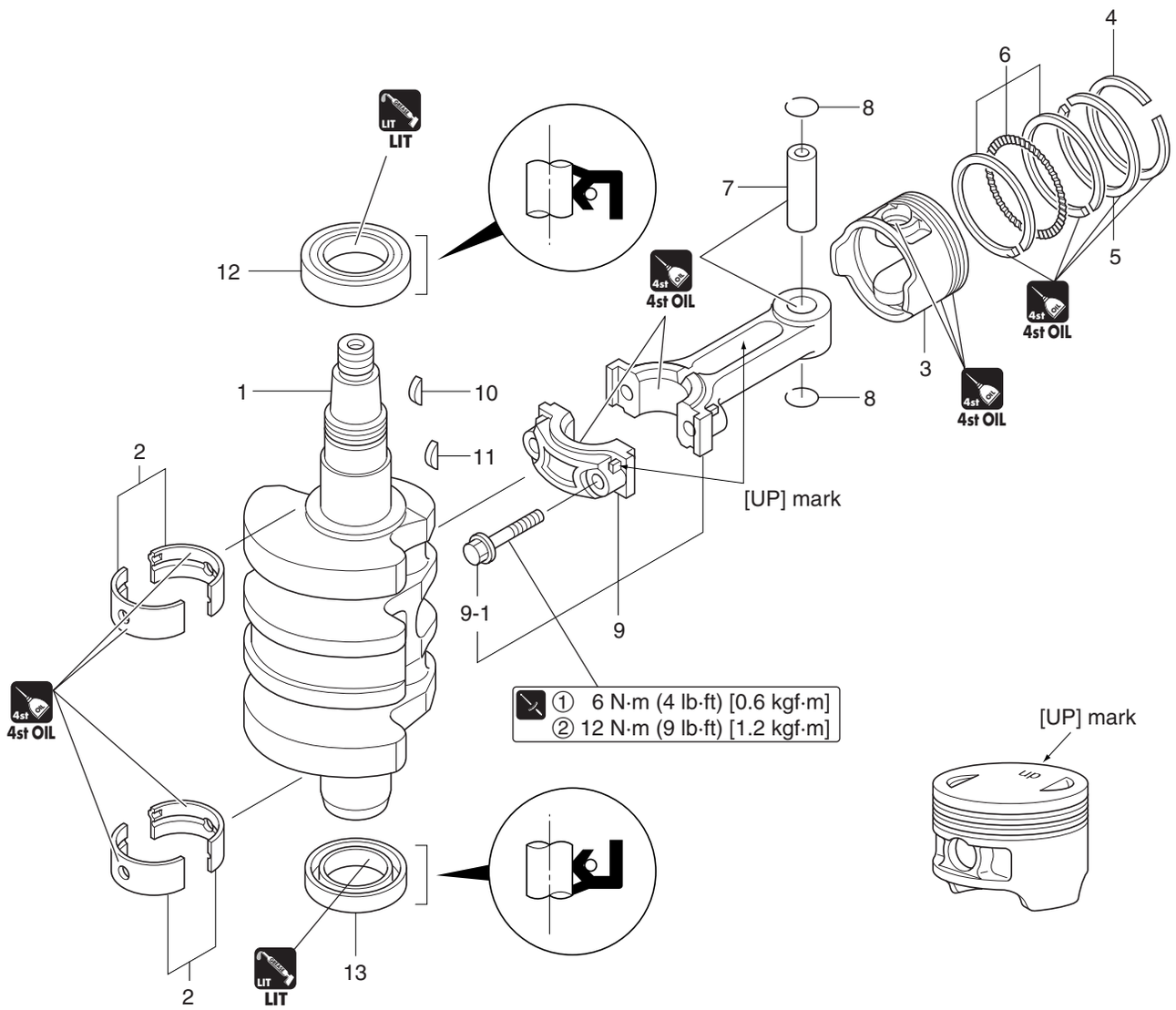
Cylinder

P/L Fig. 2



Ref. No.	Description	Q'ty	Remarks
1	Cylinder-Crank Case	1	
1-1	Oil Filter Bolt	1	
1-2	Nipple, 10-32	1	
1-3	Dowel Pin, 6-12	2	
1-4	Bolt, 8-50	4	M8 L=50mm
1-5	Bolt	6	M6 L=30mm
1-6	Washer	6	
2	Oil Filter	1	**Do not reuse.**
3	Hanger	1	
4	Bolt	2	M8 L=20mm
5	Washer	2	M8
6	Thermostat	1	Mark 60
7	Thermostat Cap	1	
8	Thermostat Cap Gasket	1	**Do not reuse.**
9	Bolt	2	M6 L=50mm
10	Collar,6.2-9-9.55	2	
11	Bracket	1	
12	Lead Wire Band, 135	2	
13	Oil Level Gauge	1	
14	Exhaust Cover	1	
15	Exhaust Cover Gasket	1	**Do not reuse.**
16	Bolt	5	M6 L=25mm
17	Anode	1	
18	Bolt	1	M6 L=16mm

Ref. No.	Description	Q'ty	Remarks
19	Anode Cap	1	
20	Anode Cap Gasket	1	**Do not reuse.**
21	Bolt	2	M6 L=20mm
22	Breather Chamber Cover	1	
23	Breather Chamber Cover Gasket	1	**Do not reuse.**
24	Screw, 6-20 Pre-Coated	4	M6 L=20mm
25	Clamp, 6.5-47.5P	1	Alternator Cable
26	Plunger	1	
27	Plunger Cover	1	
28	Rubber Hose	1	L=110mm
29	Clip,ø10	2	
30	Oil Strainer	1	
31	Rubber Hose	1	L=150mm
32	Lead Wire Band, 158	2	
33	Oil Pan Gasket	1	**Do not reuse.**
34	Bolt, 8-35	6	M8 L=35mm
35	Rubber Hose	1	L=330mm, for Water Nipple
36	Guide Plate	1	
37	Bolt	1	M6 L=12mm



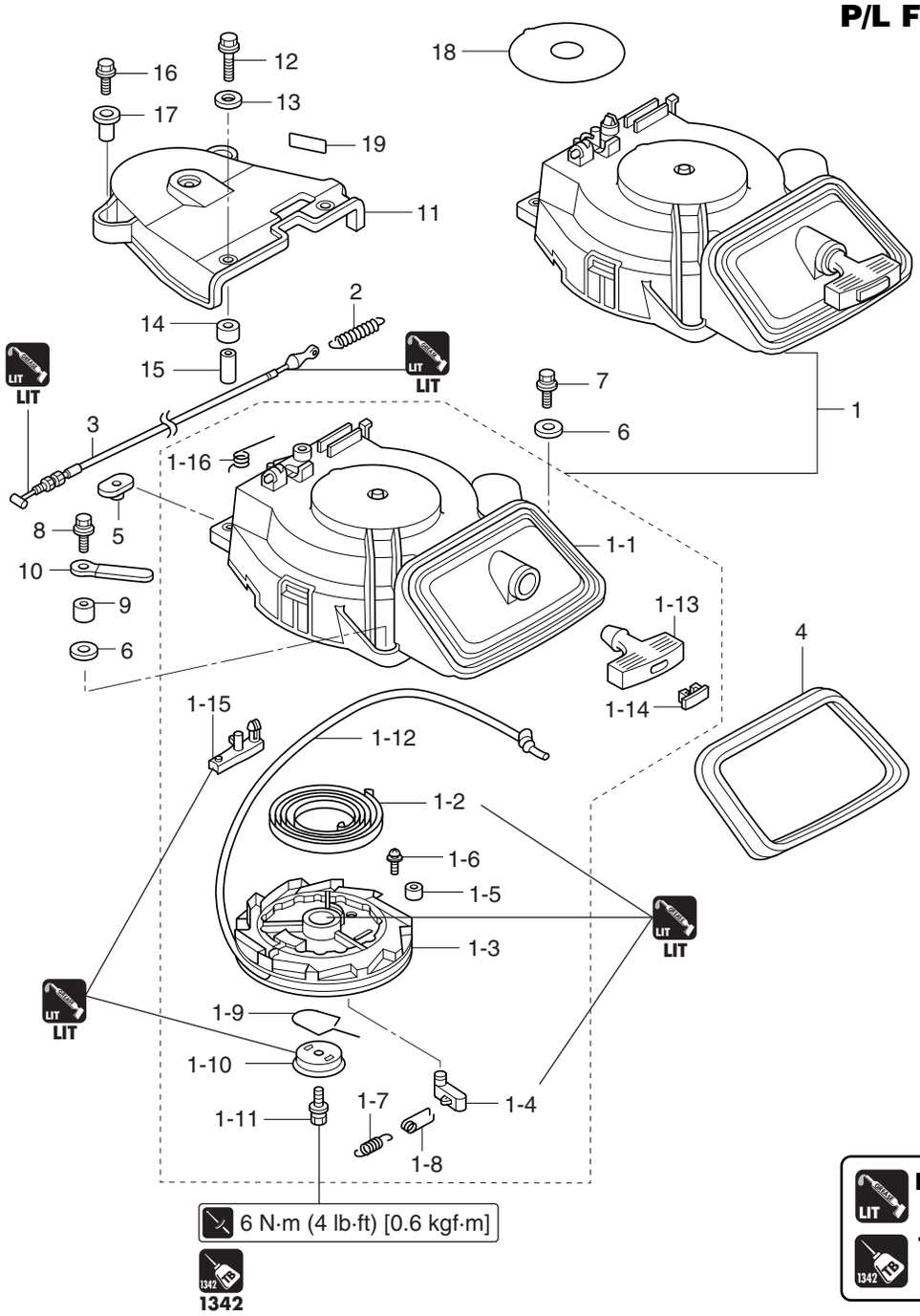
4st OIL
LIT

Ref. No.	Description	Q'ty	Remarks
1	Crankshaft Ass'y	1	
2	Bearing (Black)	4	t=1.5
	Bearing (Brown)	4	t=1.5
3	Piston	2	
4	Piston Ring Top	2	
5	Piston Ring 2nd	2	
6	Piston Ring Oil	2	
7	Piton Pin	2	
8	Piton Pin Clip	4	Do not reuse.
9	Connecting Rod	2	

Ref. No.	Description	Q'ty	Remarks
9-1	Connecting Rod Bolt	4	
10	Key	1	t=4, for Magneto
11	Key	1	t=3, for Drive Pulley
12	Oil Seal, 36-50-7	1	Do not reuse. Upper
13	Oil Seal, 32-44-9	1	Do not reuse. Lower

Recoil Starter

P/L Fig. 11

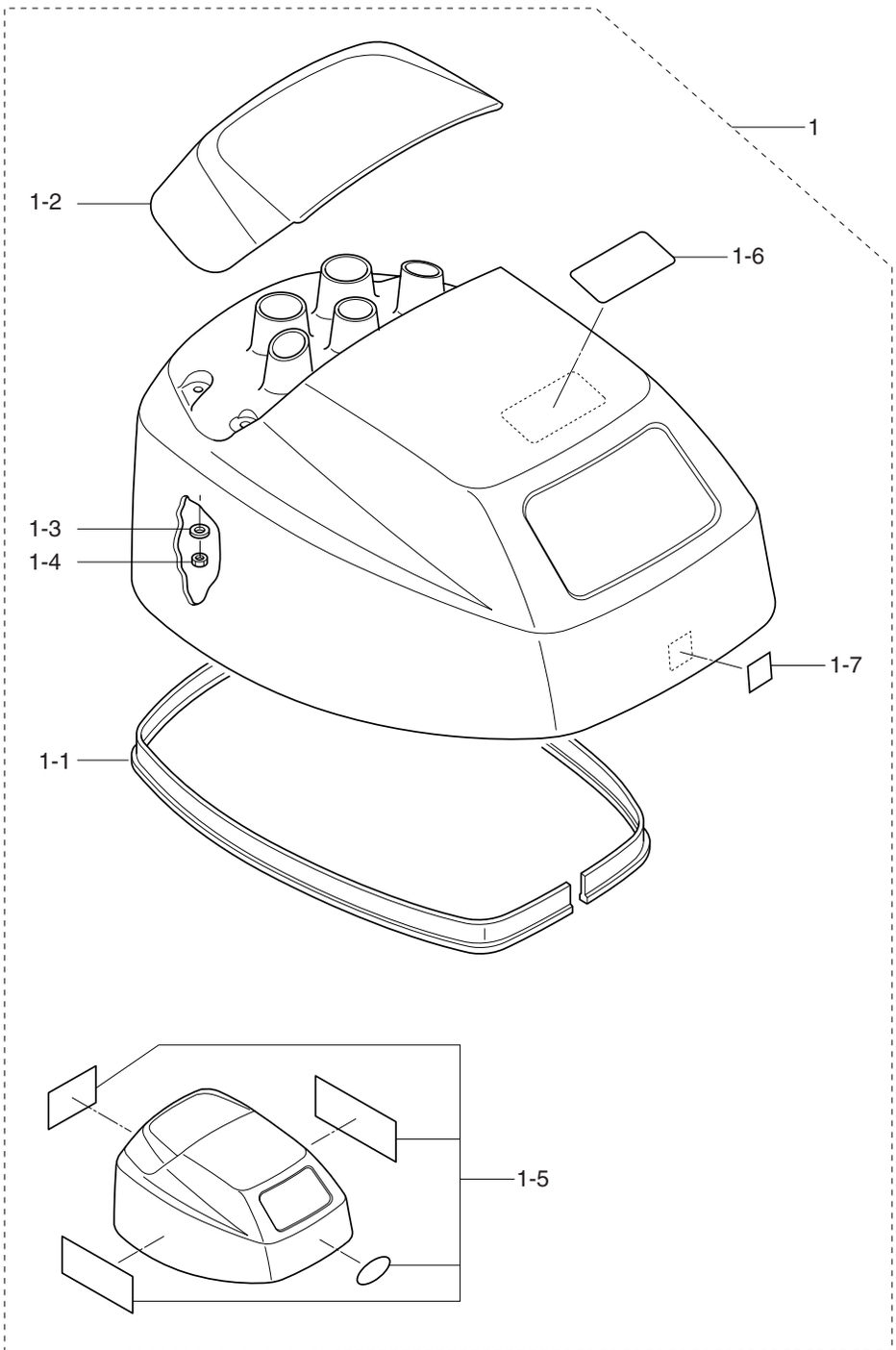


Ref. No.	Description	Q'ty	Remarks
1	Recoil Starter	1	
1-1	Starter Case	1	
1-2	Starter Spring	1	
1-3	Reel	1	
1-4	Ratchet	1	
1-5	Bushing	1	
1-6	Tapping Screw	1	
1-7	Return Spring	1	
1-8	Ratchet Guide	1	
1-9	Friction Spring	1	
1-10	Friction Plate	1	
1-11	Starter Shaft Bolt	1	
1-12	Starter Rope	1	ø5 L=1800mm
1-13	Starter Handle	1	
1-14	Starter Handle Cap	1	
1-15	Starter Lock	1	
1-16	Starter Lock Spring	1	
2	Starter Lock Cam Spring	1	

Ref. No.	Description	Q'ty	Remarks
3	Starter Lock Cable	1	
4	Starter Seal	1	
5	Nut	2	
6	Washer, 6.5-16-1.5	3	M6
7	Bolt	2	M6 L=20mm
8	Bolt	1	M6 L=30mm
9	Collar, 6.5-10.5-10	1	
10	Clamp, 6.5-47.5P	1	Starter Lock Cable
11	Belt Cover	1	
12	Bolt	2	M6 L=30mm
13	Washer, 6.5-16-1.5	2	M6
14	Rubber Mount	2	
15	Collar, 6.2-9-21	2	
16	Bolt	2	M6 L=20mm
17	Collar, 6.1-14-8.9	2	
18	Caution Decal "B"	1	
19	Spark Plug Decal (with Resistance)	1	

Top Cowl

P/L Fig. 21



Ref. No.	Description	Q'ty	Remarks
1	Top Cowl Ass'y	1	UNIQUE
1-1	Top Cowl Seal	1	L=1520
1-2	Tilt Handle	1	
1-3	Washer, 6-16-1.5	4	M6
1-4	Nut	4	M6

Ref. No.	Description	Q'ty	Remarks
1-5	Decal Set	1	UNIQUE
	Decal Set	-	UNIQUE
	Decal Set	-	
1-6	Caution Decal "A"	1	
1-7	Oil Pressure Decal	1	

3. Inspection Items

1) Inspection of Compression Pressure

1. Run engine 5 minutes to warm up, and then stop.

2. Shift gear into neutral (N).

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

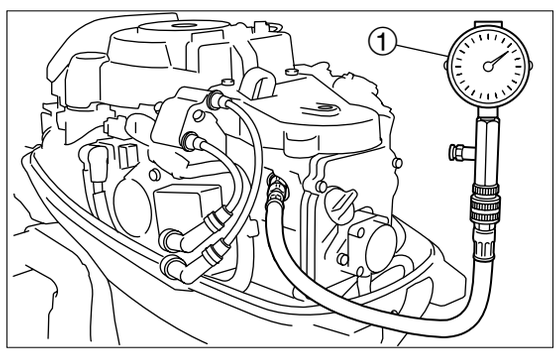
⚠ CAUTION

Remove lock plate (of stop switch lanyard) from stop switch before measuring compression pressure. This will prevent engine from accidental starting.

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

⚠ CAUTION

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

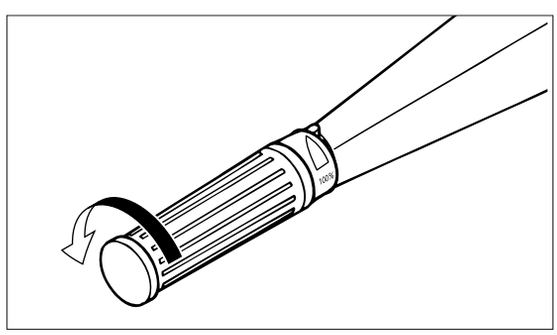


5. Install compression gauge to plug hole.

Compression gauge ① :
P/N. 3AC-99030-0

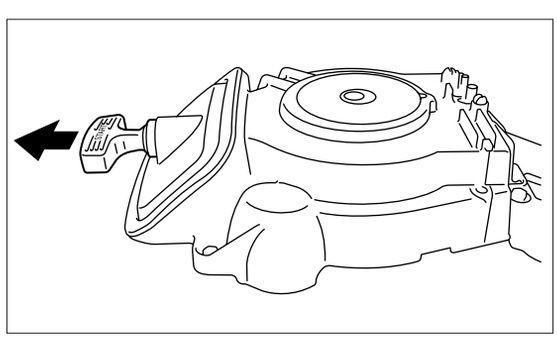
6. Fully open throttle, crank engine until compression gauge indication stabilizes, and then measure compression pressure.

Compression Pressure (Reference) :650 r/min
With decompressor : 0.50 MPa (73 psi) [5.1 kgf/cm]
Without decompressor : 1.35 MPa (186 psi) [13.8 kgf/cm]



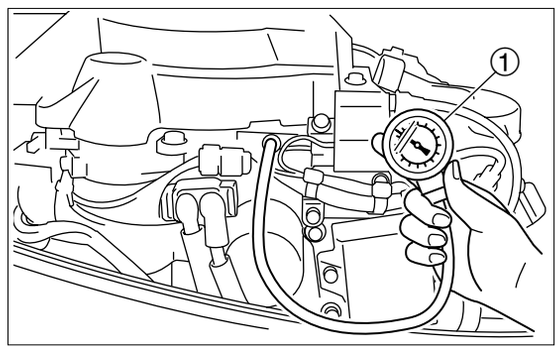
Compression pressure varies depending on the cranking speed, and normally changes at least as much as approximately 10%.

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



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

2) Inspection of Oil Pressure



1. Spread rag below oil pressure switch.

2. Remove oil pressure switch and connect oil pressure gauge ① to switch hole.

   Use commercially available oil pressure gauge (1/8" npt test port).
   Use the instrument applicable to 1 MPa (142 psi) [10 kgf/cm²].

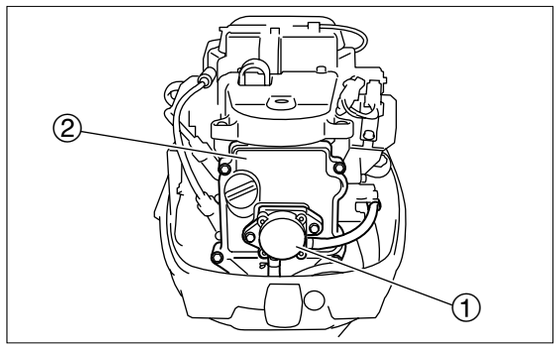
3. Start engine and run 5 minutes to warm up at idling revolution speed.

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

   Hydraulic Pressure (Reference)
   :Oil Temperature 70°C (167°F)
   0.03MPa (4 psi) [0.3 kgf/cm²] or higher at 1,000 r/min
   0.15 MPa (21 psi) [1.5 kgf/cm²] or higher at 5,000 r/min

5

3) Inspection of Valve Clearance



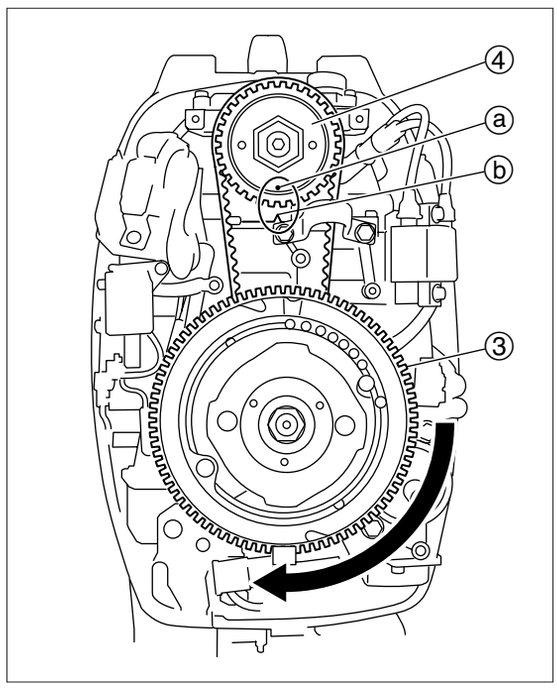
Perform adjustment of valve clearances when engine is cold.

1. Remove upper starter lock cable, and then recoil starter and belt cover.

2. Remove fuel pump ①.

3. Disconnect plug cap connection, and then, remove spark plug and cylinder head cover ②.

When removing or installing cylinder head cover, use 10mm ring wrench with large offset angle.

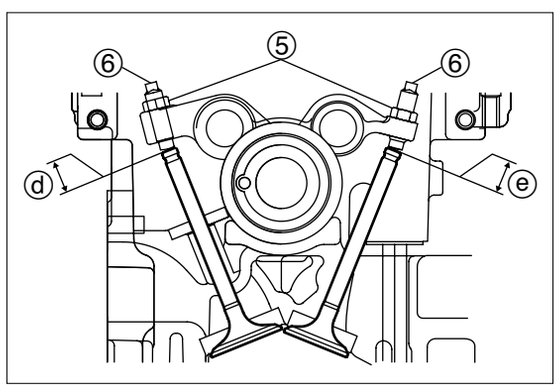


4. Rotate flywheel ③ clockwise to bring "●1" mark a of cam shaft pulley ④ to "▲" mark b of cylinder head.

No.1 piston is to be at top dead center of compression stroke.

5. Check and adjust No. 1 cylinder's intake and exhaust valve clearances. Adjust gap if it is out of specified range.

Valve Clearance (when engine is cold)
(IN) Intake valve : 0.13 - 0.17 mm (0.0051 - 0.0067 in)
(EX) Exhaust valve : 0.18 - 0.22 mm (0.0071 - 0.0087 in)



6. Loosen rocker arm lock nut ⑤, and turn adjusting screw ⑥ so that valve clearances are within the specified range.

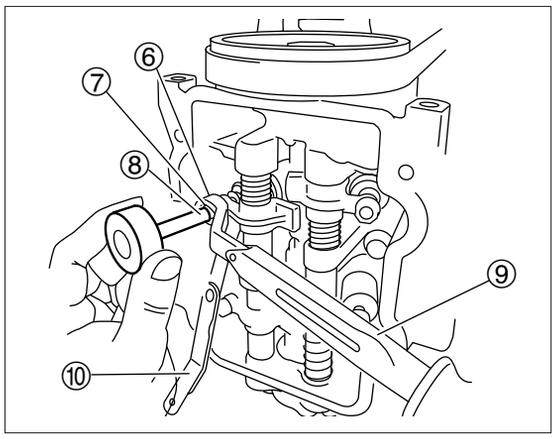
- Turning adjust screw ⑥ clockwise makes valve clearance smaller.
- Turning adjust screw ⑥ counterclockwise makes valve clearance larger.

Valve clearance driver ⑧ :
P/N. 3AC-99071-0
Torque wrench ⑨ :
P/N. 3AC-99070-0
Thickness gauge ⑩ :
Use commercially available item.

7. Tighten rocker arm lock nut ⑤ to specified torque, and check valve clearance again. Readjust if necessary.

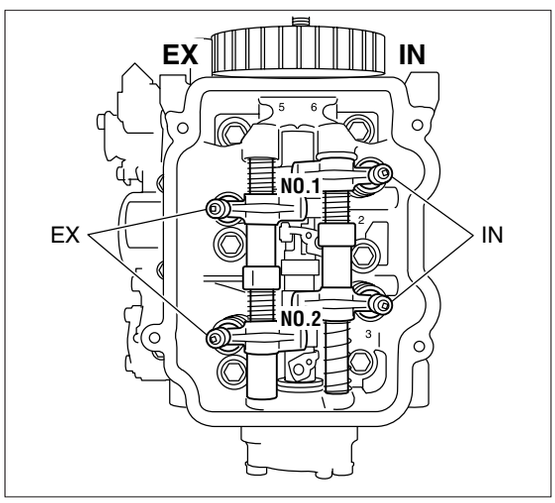
Rocker arm lock nut ⑤ :
7 N · m (5 lb · ft) [0.7 kgf · m]

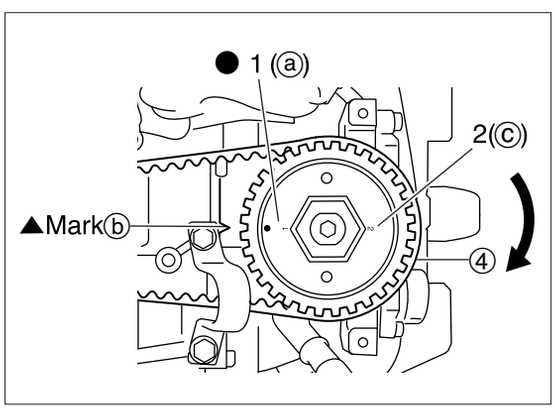
Valve Clearance (when engine is cold)
(IN) Intake valve : 0.13 - 0.17 mm (0.0051 - 0.0067 in)
(EX) Exhaust valve : 0.18 - 0.22 mm (0.0071 - 0.0087 in)



8. Rotate flywheel ③ clockwise to bring "2" mark ⓒ of cam shaft pulley ④ to "▲" mark ⓑ of cylinder head.

9. Check and adjust No. 2 cylinder's intake and exhaust valve clearances. Adjust gap if it is out of specified range.

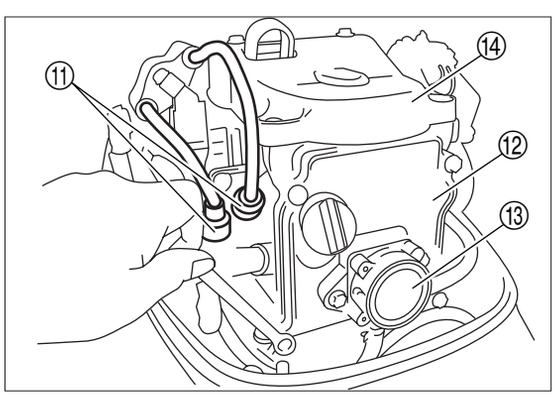




10. Reconnect plug cap ⑪.

11. Reconnect upper starter lock cable.

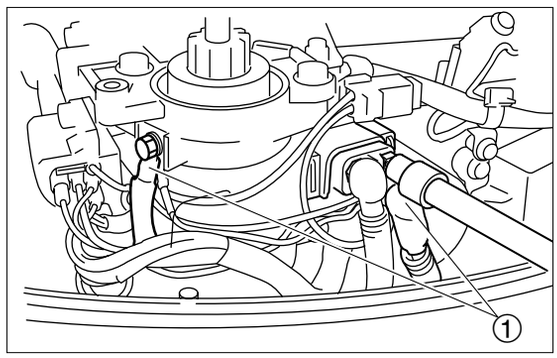
12 Install cylinder head cover ⑫, fuel pump ⑬, spark plugs, recoil starter and belt cover ⑭.



5

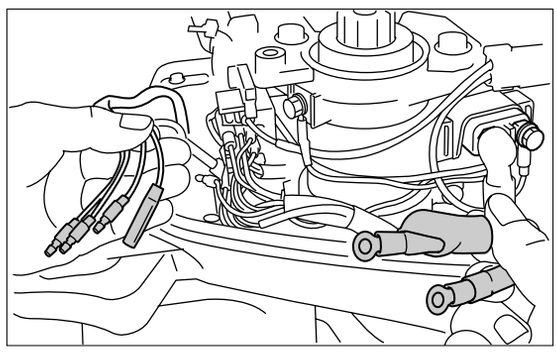
4) Removing Power Unit

1. Disconnect upper starter lock cable.

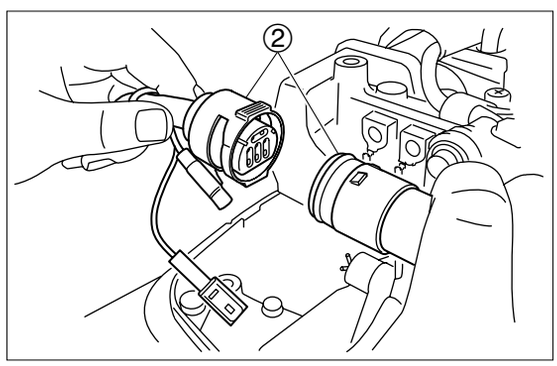


2. Disconnect battery cords ① (2). (Electric start model)

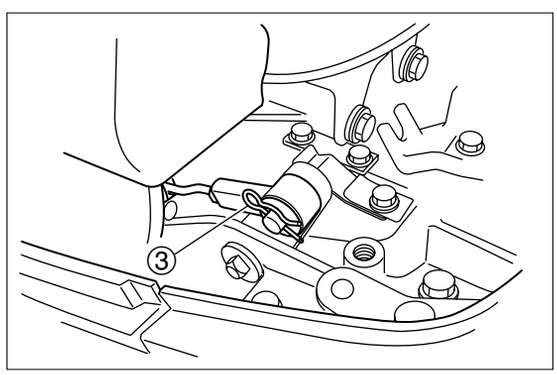
3. Disconnect warning lamp, starter switch and stop switch. (Tiller Handle Model)



4. Disconnect remote controller harness coupler ②. (Remote Control Model)

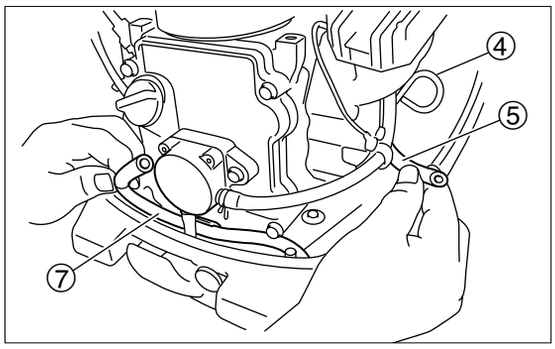


5. Remove spring pin ③ and disconnect shift link rod.

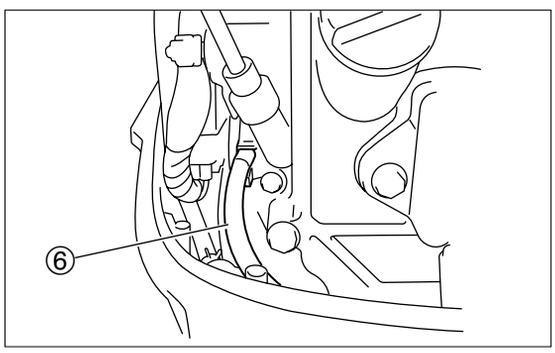


6. Remove oil level gauge ④.

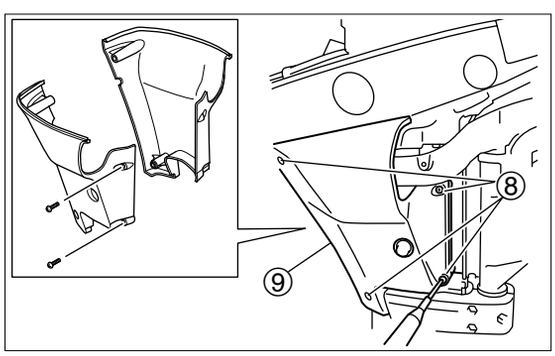
7. Disconnect lower breather hose ⑤.



8. Disconnect cooling water (pilot water) hose ⑥ and fuel hose ⑦.



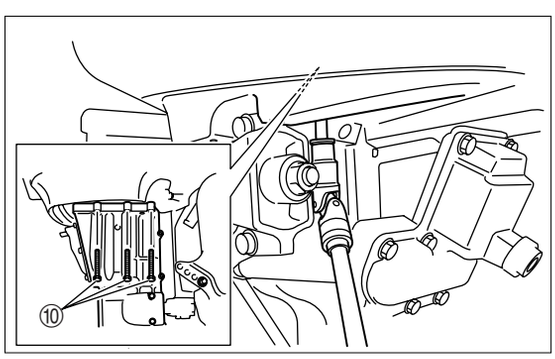
9. Remove bolt ⑧ (4), and then, remove drive shaft housing cover ⑨.

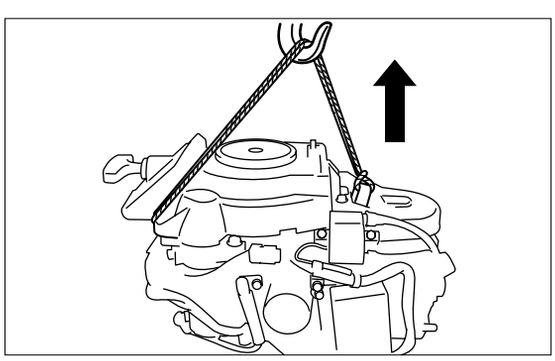


10. Remove power unit by removing bolts ⑩ (6) and then hoisting it.

When hoisting power unit, perform the work carefully while checking if wires and hoses are caught by other parts.

Before removing power head ass'y, note arrangement of oil strainer hose.





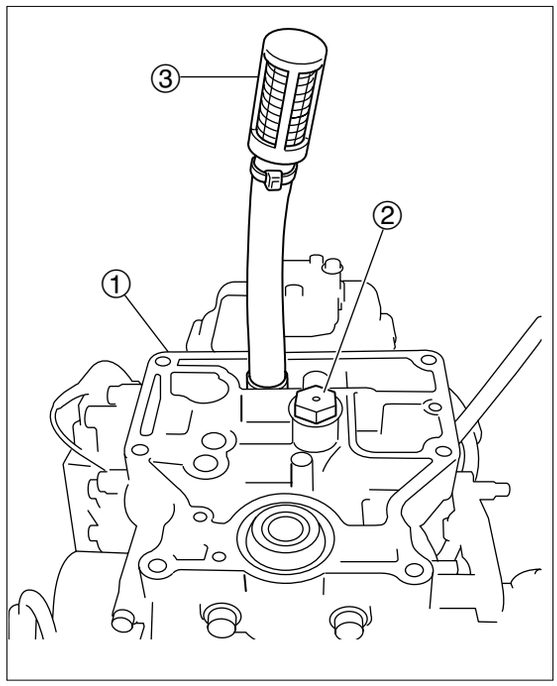
5) Removing Plunger and Oil Strainer

1. Put removed power head ass'y ① upside down on the work bench.

2. Remove plunger ② from power head ass'y ①.

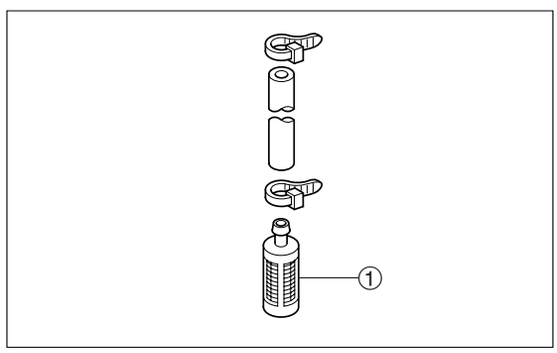
3. Remove oil strainer ③ from power head ass'y ①.

Before oil strainer hose, note arrangement of the hose.



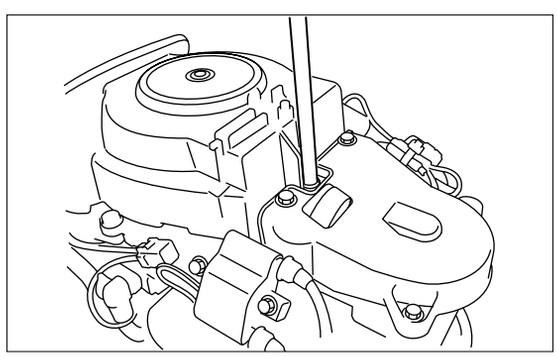
6) Inspection of Oil Strainer

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



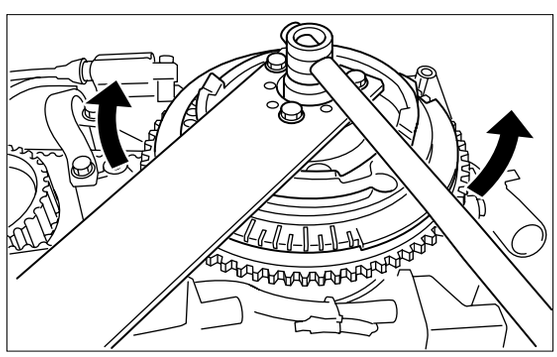
7) Flywheel and electrical components

1. Remove recoil starter, belt cover and starter pulley.



2. Loosen flywheel nut.

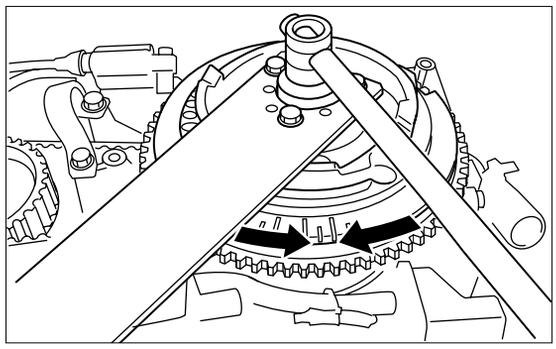
Flywheel puller kit :
P/N. 369-72211-0



3. Remove flywheel and key.

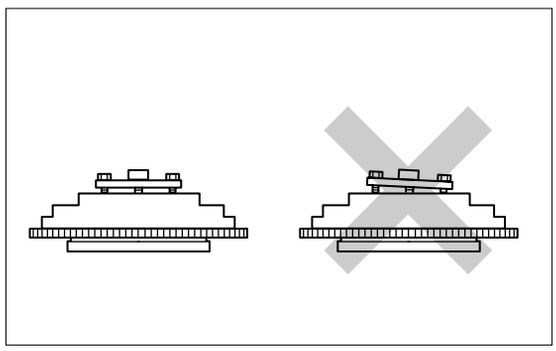
Flywheel puller kit :
P/N. 369-72211-0

Screw puller onto crankshaft end until flywheel is disengaged from tapered section of crankshaft.



⚠ CAUTION

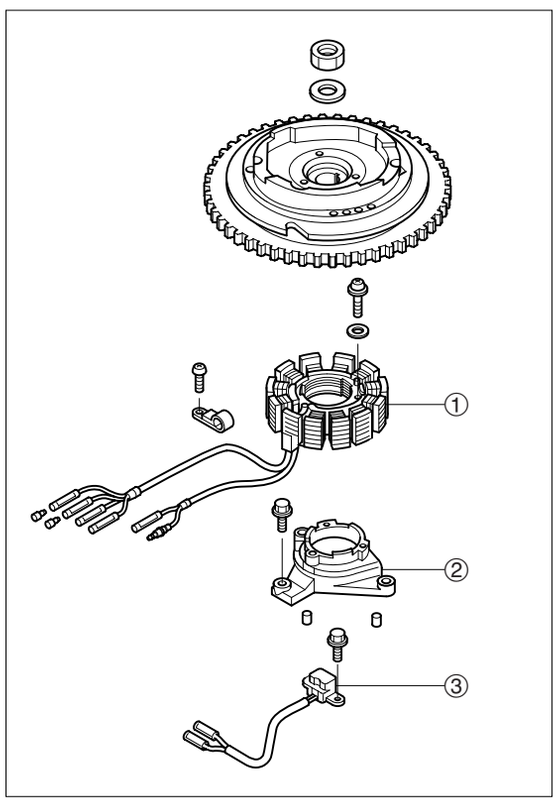
To prevent damages to engine and special tools, tighten flywheel puller set bolts evenly and keep flywheel puller parallel to flywheel while working.



4. Disconnect alternator and pulser coil.

5. Remove bolts of alternator ① and coil bracket ②, and remove alternator and coil bracket.

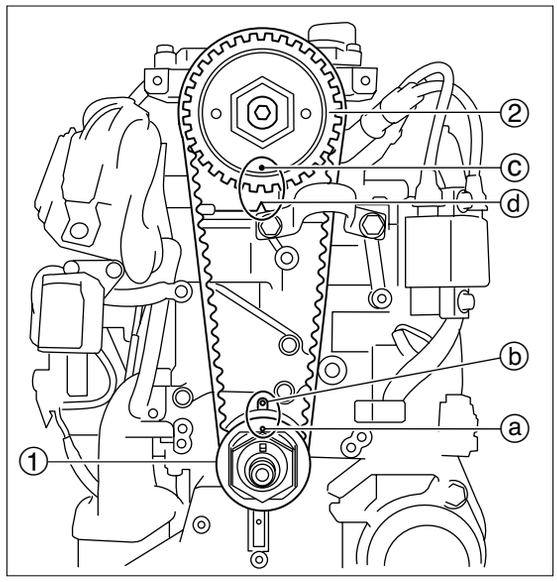
6. Remove bolts and then pulser coil ③.



5

8) Removing Timing Belt and Pulley

1. Turn timing pulley ① clockwise to bring "●" mark ⓐ of belt guide to "●" mark ⓑ of cylinder block, and check that "●1" mark ⓒ of cam shaft pulley ② and "▲" mark ⓓ of cylinder head are aligned with each other.

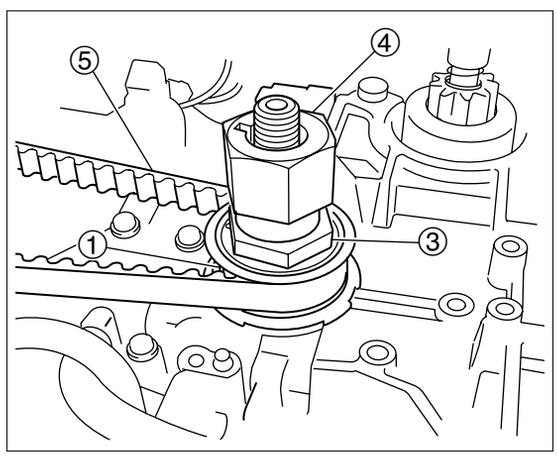


> No.1 piston is to be at top dead center of compression stroke.

2. Lay down timing pulley nut ③ lock washer's tab.

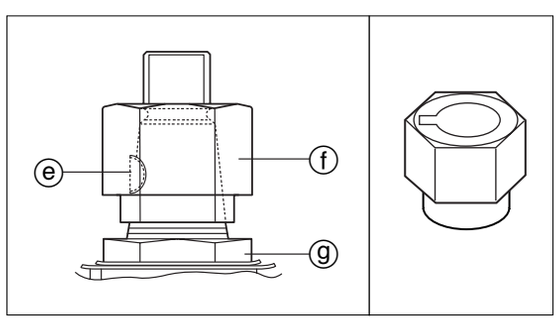
3. Attach crankshaft holder ④ to crankshaft and secure it.

4. Loosen timing pulley nut ③.



> · Use 36mm socket wrench and ring wrench for this step.
> · When loosening nut ③ of timing pulley ①, hold cam shaft pulley ② to prevent it from being turned.
> · Keep timing belt ⑤ engaged as a means of precaution.

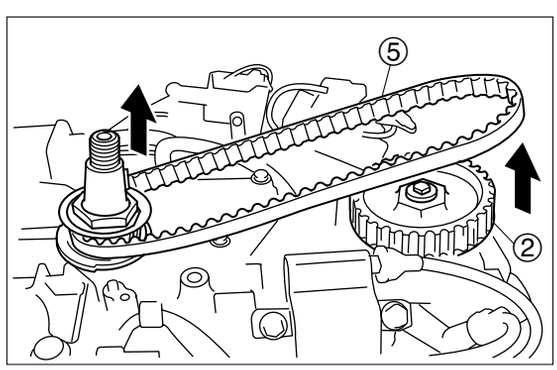
Crank Shaft Holder ④ :
P/N. 3BJ-72815-0



ⓔMagneto key
ⓕCrankshaft holder
ⓖPulley nut

5. Remove engine hanger.

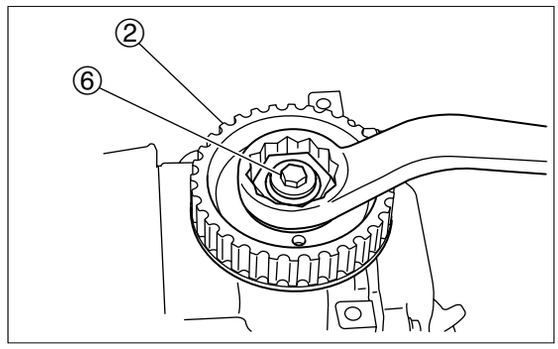
6. Remove timing belt ⑤ from cam shaft pulley ② side, and then, from timing pulley side.



⚠ CAUTION

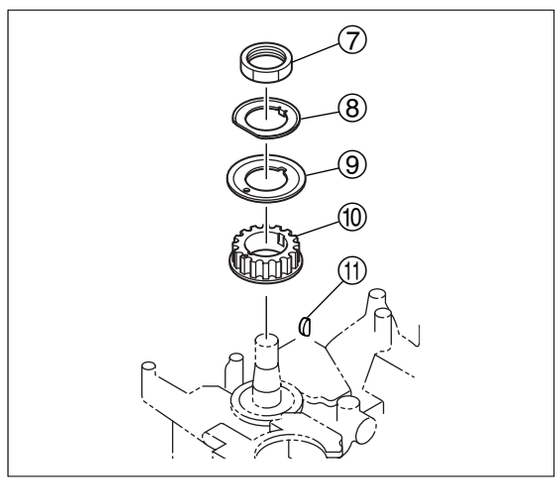
Do not turn timing pulley (crank shaft) or cam shaft pulley with timing belt removed. Doing so can make pistons and valves interfere with each other, possibly resulting in damages to these parts.

7. Remove cam shaft pulley ② bolt ⑥, and then, remove cam shaft pulley ②.



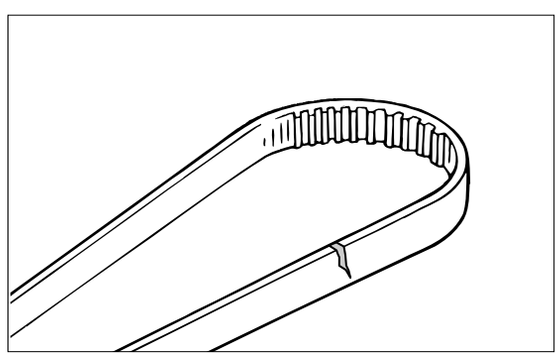
> When loosening cam shaft pulley bolt, be careful not to turn cam shaft pulley.

8. Remove nut ⑦, lock washer ⑧, belt guide ⑨, timing pulley ⑩ and key ⑪.



9) Inspection of Timing Belt

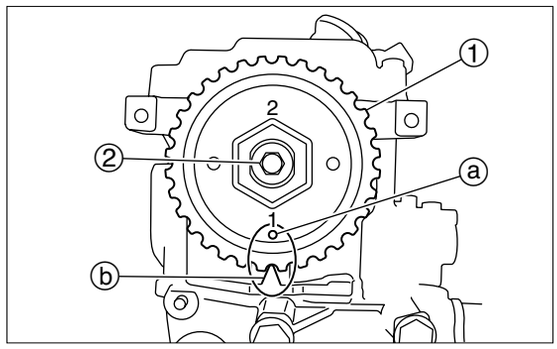
1. Check timing belt for crack, damage and wear on both faces. Replace if necessary.



2. Check timing pulley and cam shaft pulley for crack, damage and wear. Replace if necessary.

10) Installation of Pulley and Timing Belt

1. Install cam shaft pulley, bring "●1" mark ⓐ of cam shaft pulley ① to "▲" mark ⓑ of cylinder head, and then, tighten bolt ② to specified torque.

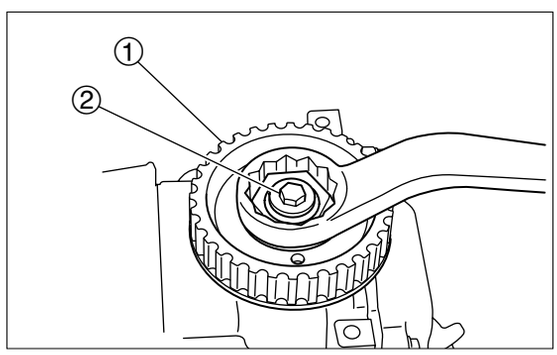


No.1 piston is to be at top dead center of compression stroke.

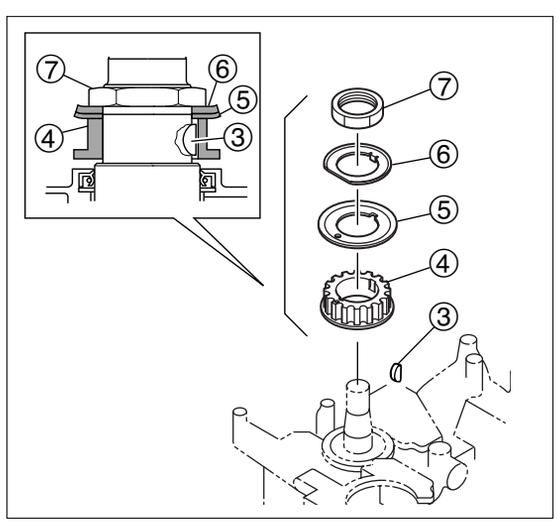
Cam shaft pulley bolt ② :
11 N · m (8 lb · ft) [1.1 kgf · m]

⚠ CAUTION

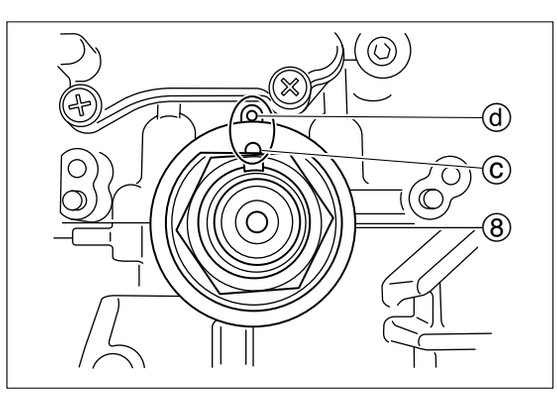
Do not turn timing pulley or cam shaft pulley with timing belt removed. Doing so can make pistons and valves interfere with each other, possibly resulting in damages to these parts.



2. Install key ③, timing pulley ④, belt guide ⑤, lock washer ⑥ and nut ⑦ in this order. Tightening to specified torque is performed later.



3. Check that "●" mark ⓒ of belt guide ⑧ and "●" mark ⓓ of cylinder block are aligned with each other.

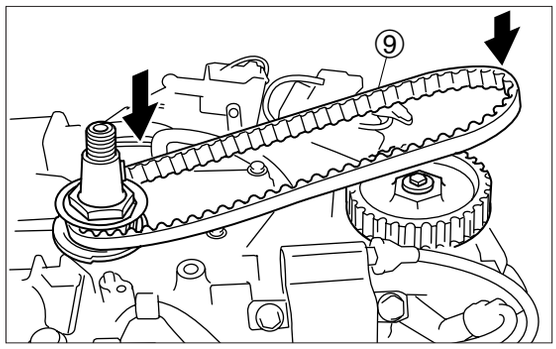


No.1 piston is to be at top dead center of compression stroke.

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

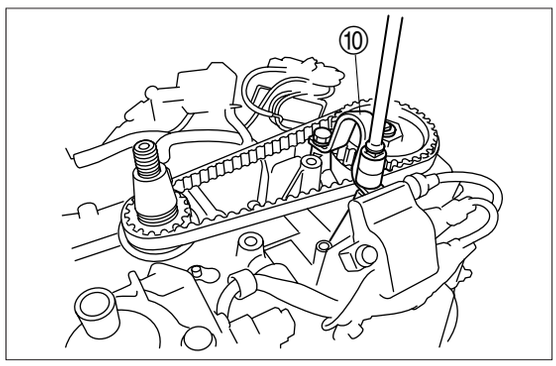
⚠ CAUTION

- **Be careful not give damage to timing belt when installing.**
- **Do not twist timing belt, bring inside out, or bend sharp, or it may be damaged.**
- **Be careful not to allow oil or grease to adhere to timing belt.**



5. Reinstall hanger ⑩ and tighten bolt to specified torque.

Hanger bolt ⑩ :
23 N · m (17 lb · ft) [2.3 kgf · m]

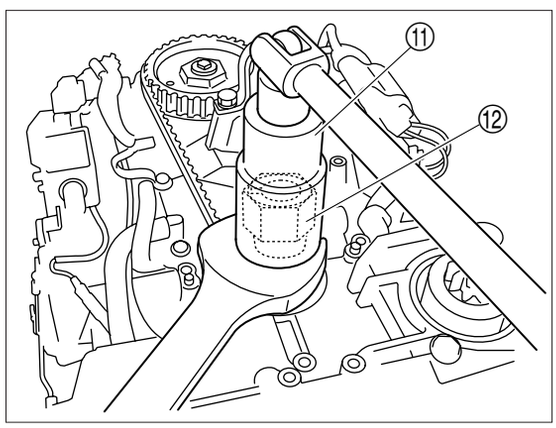


6. Tighten timing pulley nut to specified torque.

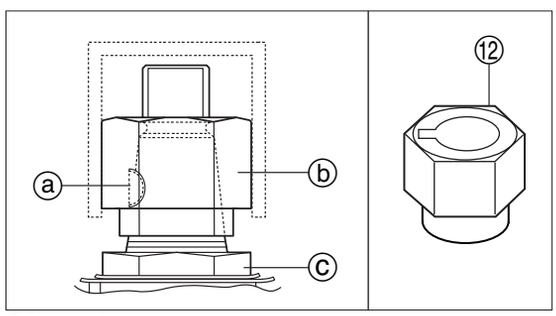
Use two 36mm wrenches for this step.
(Spanner wrench and socket wrench)

Crankshaft holder ⑫ :
P/N. 3BJ-72815-0

Timing Pulley Nut :
64 N · m (46 lb · ft) [6.4 kgf · m]



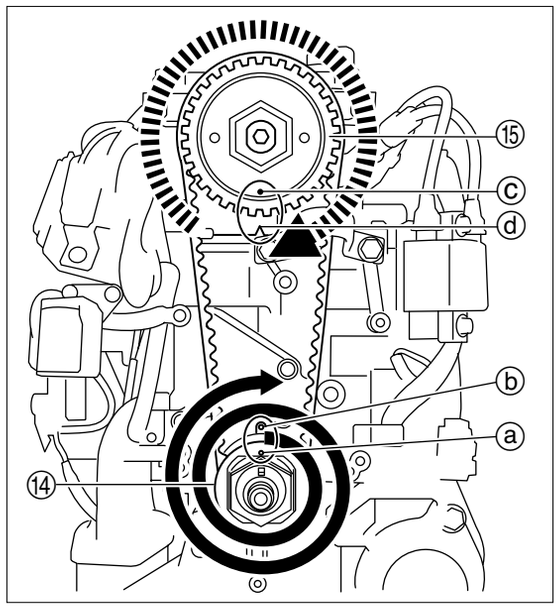
⑪Deep socket 36mm
⑫Crankshaft holder



ⓐMagneto key
ⓑCrankshaft holder
ⓒPulley nut

5

7. Turn timing pulley ⑭ clockwise twice, and check that locating marks ⓐⓑ and ⓒⓓ of pulleys ⑭ and ⑮ are aligned with each other respectively.



11) Removing Cylinder Head

· No.1 piston is to be at top dead center of compression stroke.
· Removal or installation of parts can be made easier when some of them are assembled together.

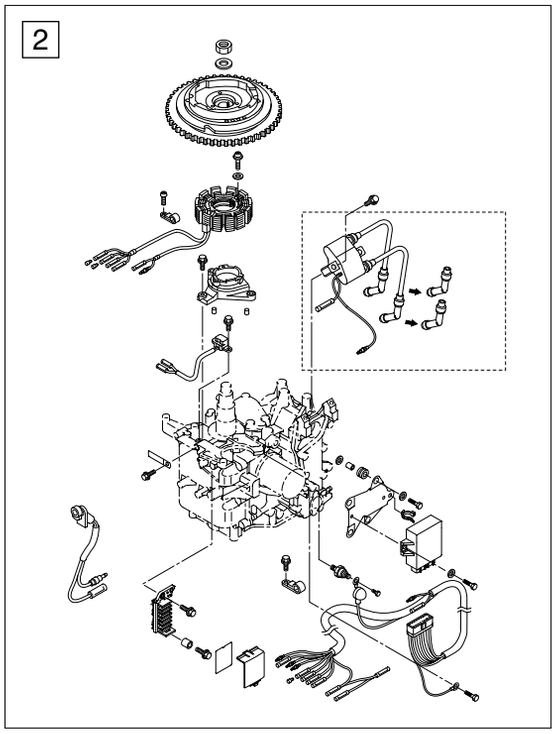
1. Remove power unit. (Refer to the section for removing power unit.)

2. Remove magneto related parts from power unit.

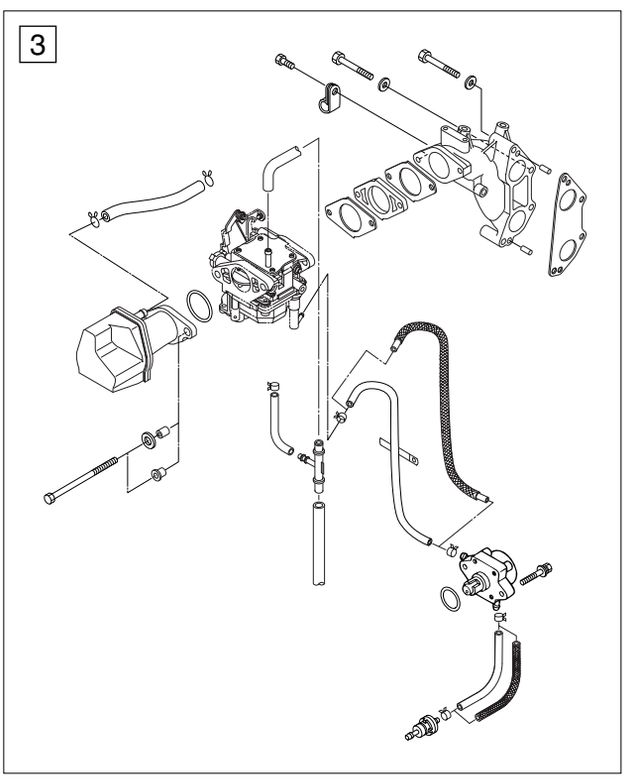
3. Remove intake manifold, carburetor and fuel pump.

4. Remove electrical system parts from power unit.

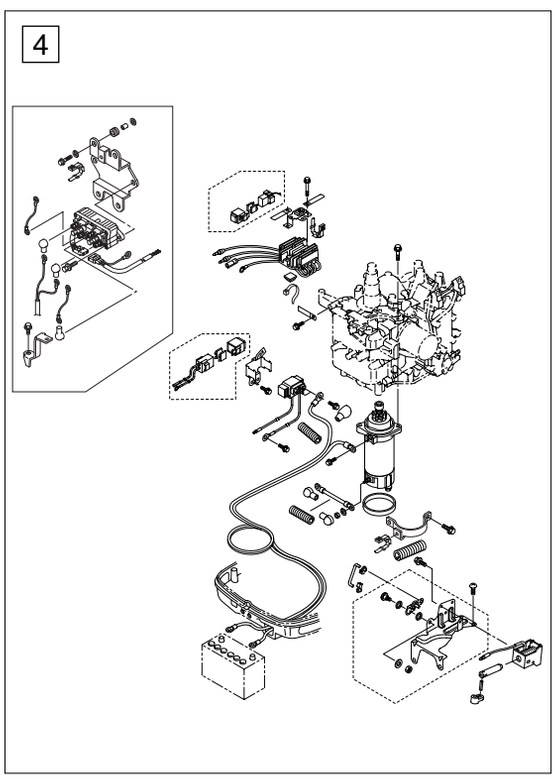
2



3



4



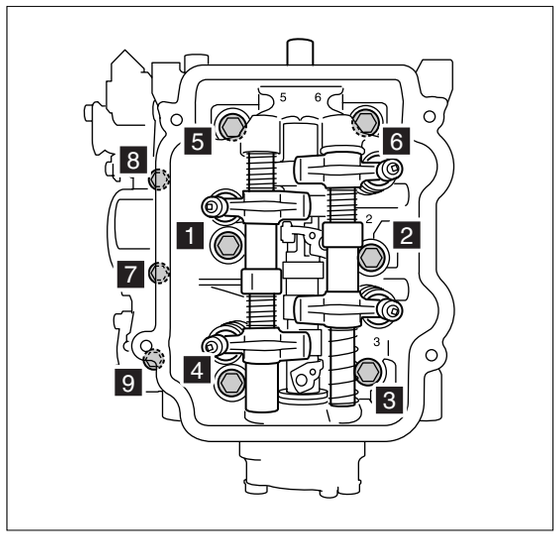
5

5. Remove cam pulley and cylinder head cover. Remove hose.

6. Remove cylinder head bolts in the reverse sequence of order shown, and remove cylinder head.

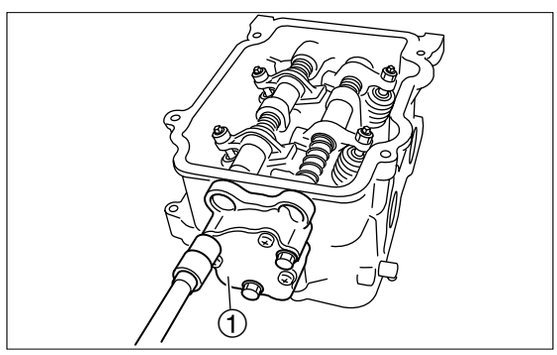
⚠ CAUTION

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



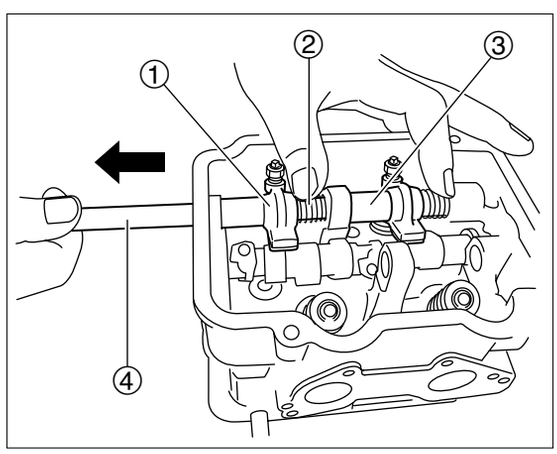
7. Loosen rocker arm lock nut, and loosen adjusting screw as much as possible.

8. Remove oil pump ass'y ①.



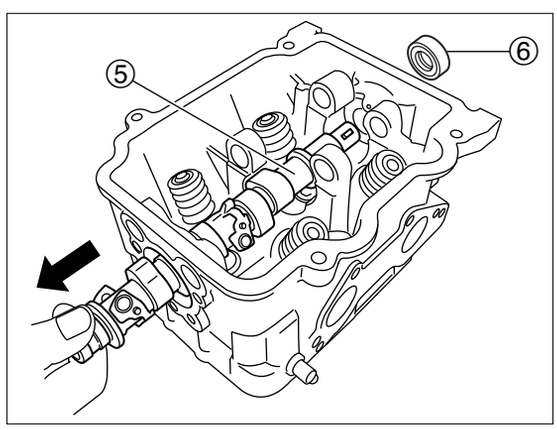
9. Remove rocker arm ①, spring ②, collar ③ and rocker arm shaft ④.

- Push in a proper bolt a little and pull the part out downward.
- Pull the shaft while holding other parts with a hand.



10. Remove cam shaft ⑤.

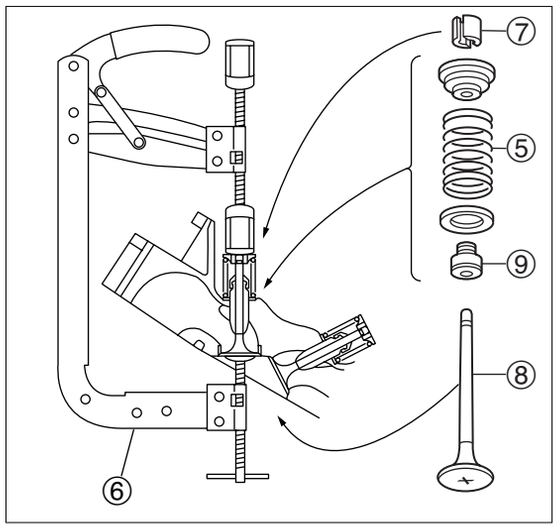
11. Remove oil seal ⑥.



12. Compress valve spring ⑤ using a commercially available valve spring compressor ⑥, remove cotter ⑦, and then, remove spring ⑤ and valve ⑧.

> Valves, springs and other related parts should be arranged in the order they are removed.

13. Remove stem seal ⑨.

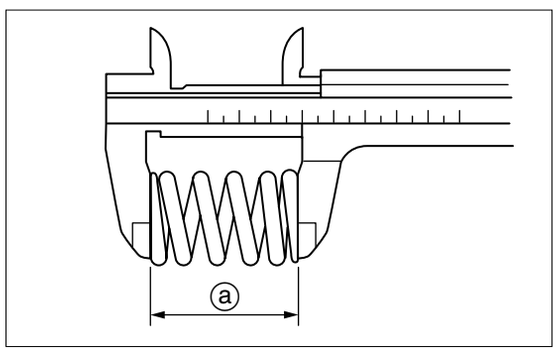


12) Inspection of Valve Spring

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

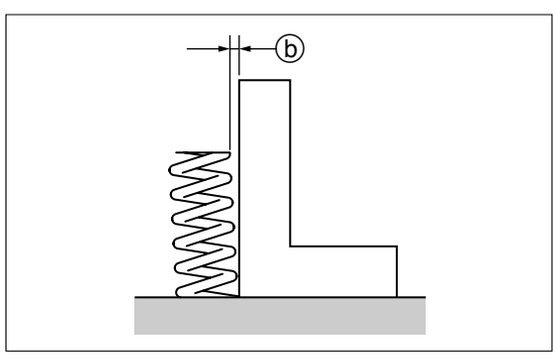
Valve Spring Free Length ⓐ : Standard Value
35.0 mm (1.38 in)

Functional Limit :
33.5 mm (1.32 in)



2. Measure valve spring inclination ⓑ. Replace if it is over specified value.

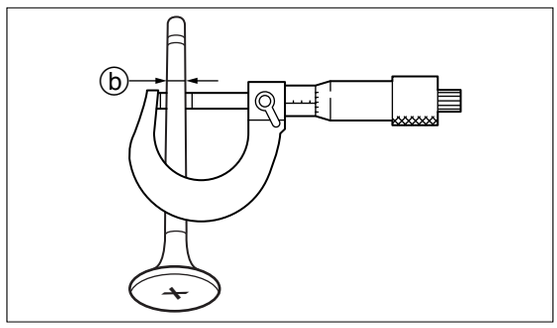
Valve Spring Inclination Limit ⓑ :
1.5 mm (0.06 in)



13) Inspection of Valve

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

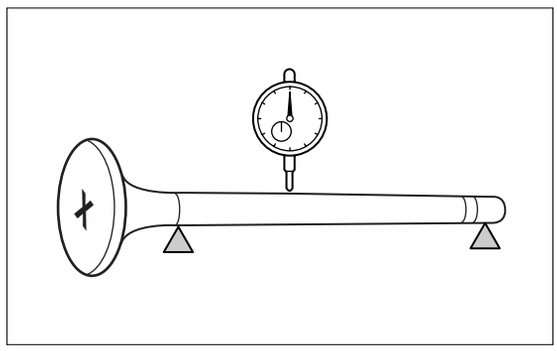
2. Measure valve stem outer diameter ⓑ. Replace if it is less than specified value.



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 valve stem runout. Replace if it is over specified value.

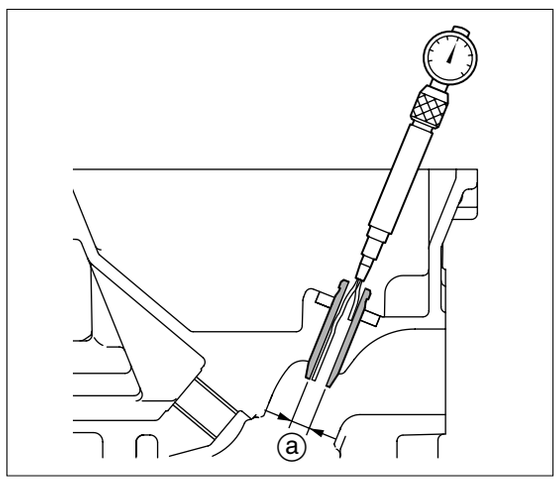


Valve Stem Runout Limit :
Intake Side : 0.05 mm (0.0020 in)
Exhaust Side : 0.03 mm (0.0012 in)

14) Inspection of Valve Guide

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

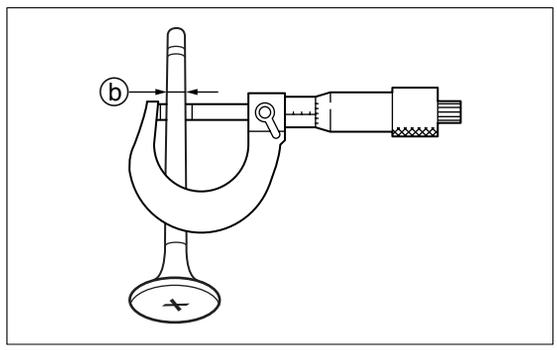
1. Measure valve guide inner diameter ⓐ. Replace cylinder head if the inner diameter is over specified value.



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

Functional Limit :
Intake Side : 5.55 mm (0.2185 in)
Exhaust Side : 5.57 mm (0.2193 in)

2. Obtain clearance between valve guide and valve stem by calculating as described below. Replace cylinder head and/or valve if the clearance is over 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)

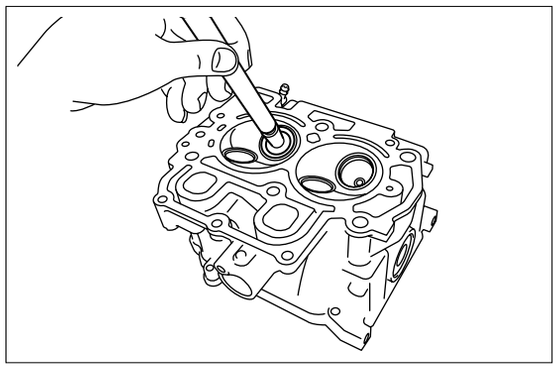
Functional Limit :
Intake Side : 0.070mm (0.00276 in)
Exhaust Side : 0.100 mm (0.00394 in)

15) Inspection of Valve Seat

1. Remove carbon built up on the valve.

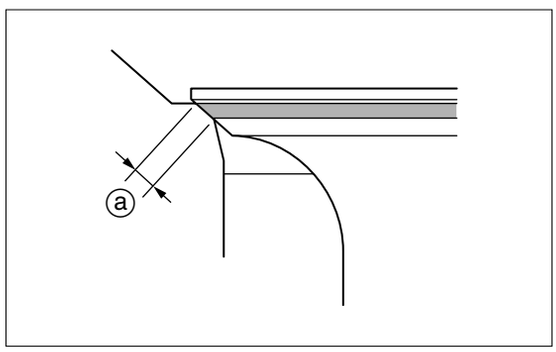
2. Apply thin coat of red lead on the valve seat evenly.

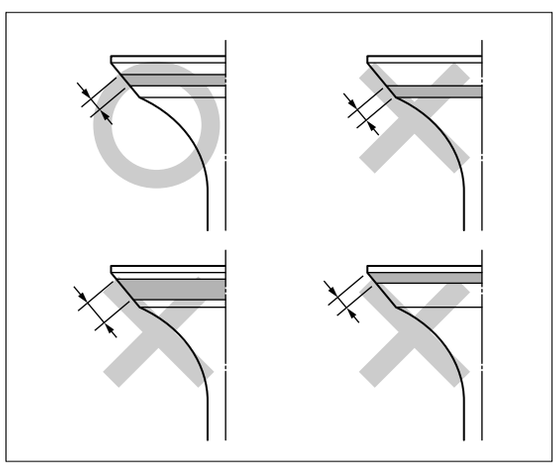
3. Use valve lapper (commercially available item) as shown to push valve onto valve seat lightly.



4. Measure width of area where valve face contacted with valve seat a that can be identified with red lead adhered to valve face. Correct valve seat if contact area is above or below the center or contact area of valve seat is over 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)



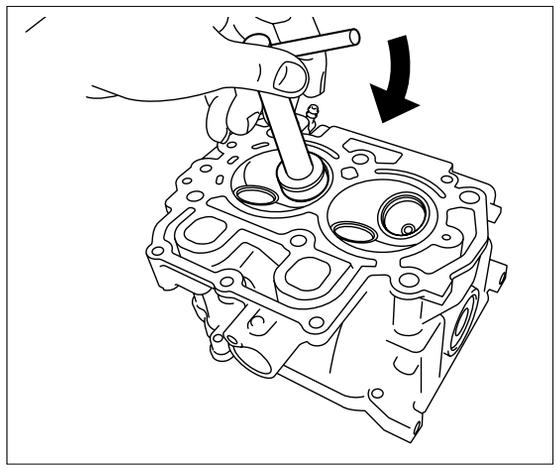


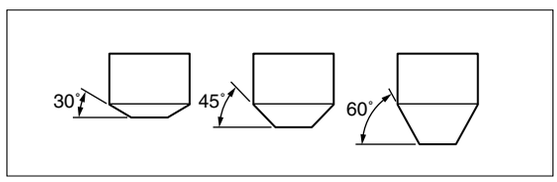
5

16) Correction of Valve Seat

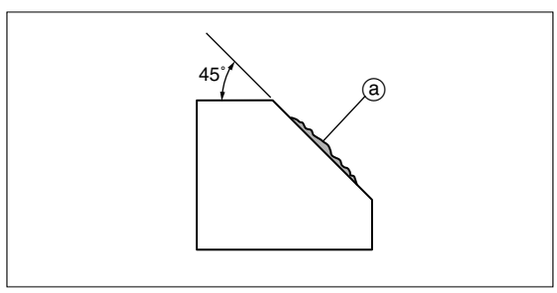
1. Use valve seat cutter (commercially available item) to correct valve seat.

> Be careful not to over-cut valve seat. Turn valve seat cutter while pushing down evenly.



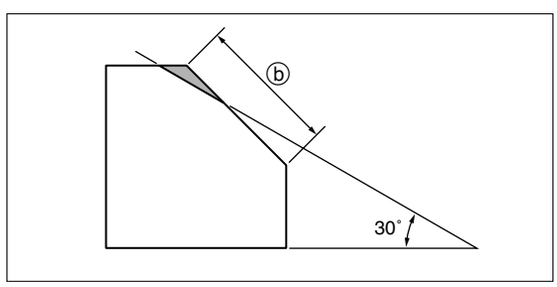


2. Turn 45° degree cutter clockwise to cut valve seat surface to make it smooth.



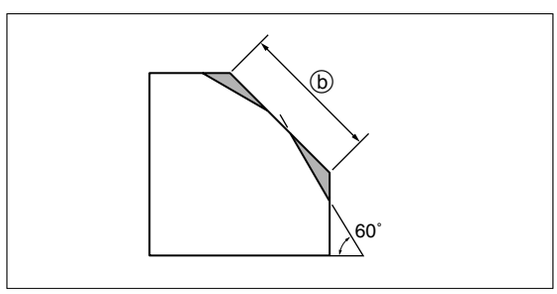
ⓐCarbon or uneven surface

3. Use 30° degree cutter to adjust contact position of valve seat upper end.



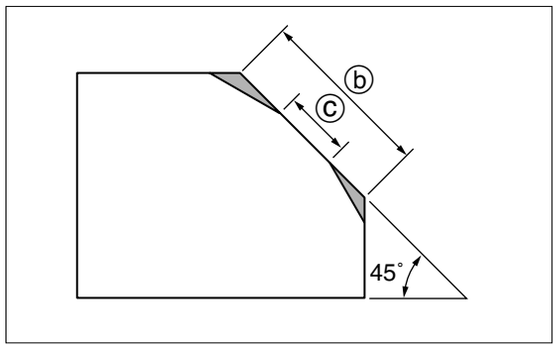
ⓑContact width before correction

4. Use 60° degree cutter to adjust contact position of valve seat lower end.



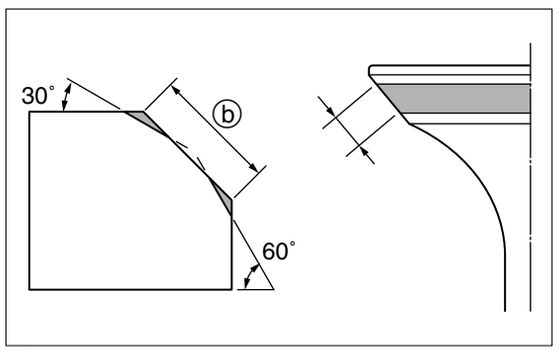
ⓑContact width before correction

5. Use 45° degree cutter to adjust contact width of valve seat ⓒ to specified value.



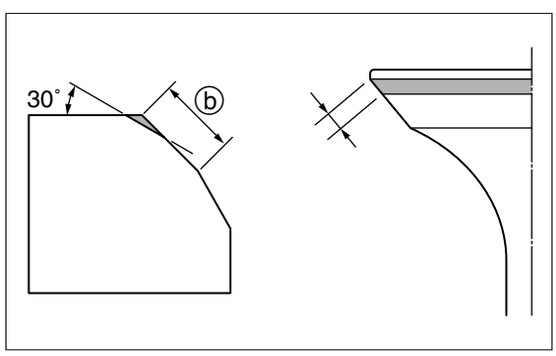
ⓑContact width before correction
ⓒSpecified width

6. Valve seat contact area is located on the center, which should be adjusted to specified value by cutting upper and lower ends by using 30° degree and 60° degree seat cutters respectively if the area is too wide.



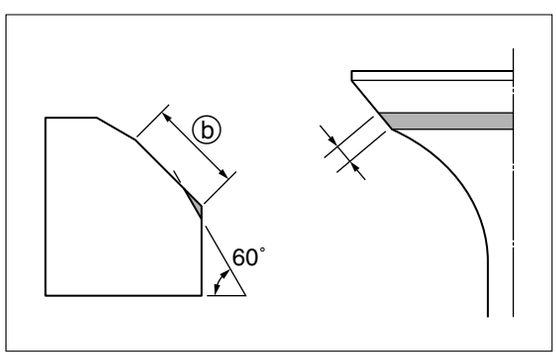
ⓑContact width before correction

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



ⓑContact width before correction

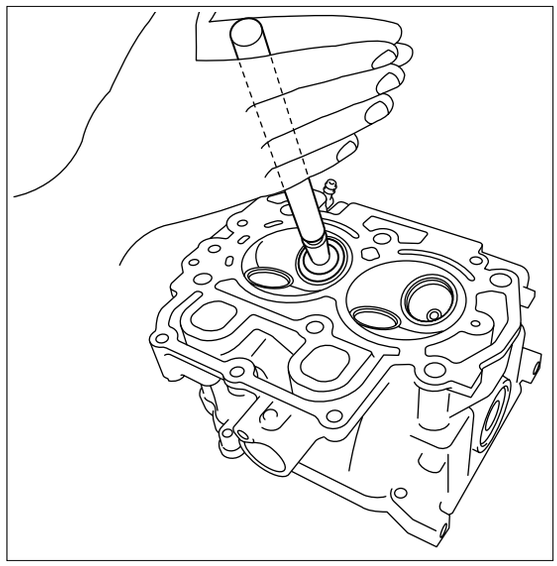
8. If valve seat contact area is very narrow and is located nearer to valve face lower end, use 60° degree seat cutter to cut lower end. If necessary, use 45° degree cutter to adjust contact width of valve seat to specified value.



ⓑContact width before correction

5

9. Apply thin coat of abrasive compound on the overall valve seat contact area, and turn valve lapper (commercially available item) while lapping valve.



⚠ CAUTION

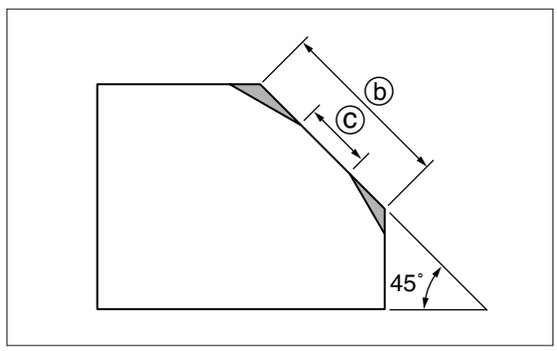
Perform the work by taking care not to allow abrasive compound to adhere to valve stem and valve guide.

- Use 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 ending the work, remove the compound completely from cylinder head and valve.

11. Check valve seat contact width ⓒ.

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

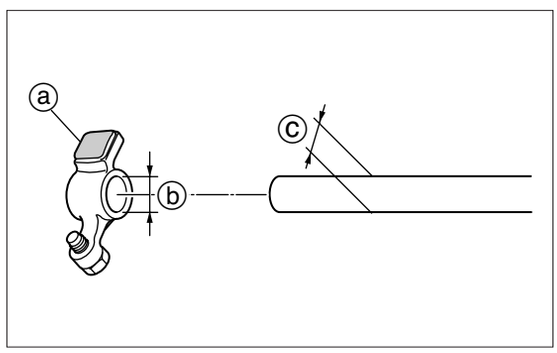


ⓑContact width before correction
ⓒSpecified width

17) Inspection of Locker Arm and Locker Arm Shaft

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

2. Measure rocker arm inner diameter ⓐ and rocker arm shaft outer diameter ⓒ. Calculate oil clearance ⓓ (ⓓ = ⓑ - ⓒ). Replace if out of specification.



ⓓ = ⓑ - ⓒ

Rocker Arm Inner Diameter ⓑ : Standard Value
13.01 mm (0.5122 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)

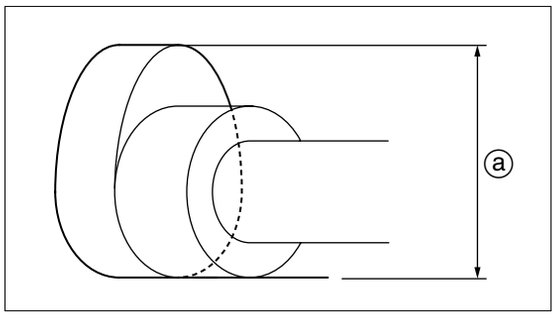
Functional Limit :
ⓑReplace if b is over 13.05 mm (0.5138 in).
ⓒReplace if c is less than 12.94 mm (0.5094 in).
ⓓReplace if b is over 0.060 mm (0.00236 in).

18) Inspection of Cam Shaft

1. Measure cam height. Replace if it is less than specified value.

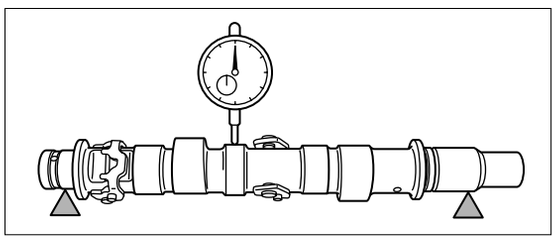
Cam Height a at Both Intake and Exhaust Side : Standard Value
24.28 mm (0.9559 in)

Functional Limit : Cam Height ⓐ at Both Intake and Exhaust Sides
24.00 mm (0.9449 in)



2. Measure cam shaft runout. Replace if it is over specified value.

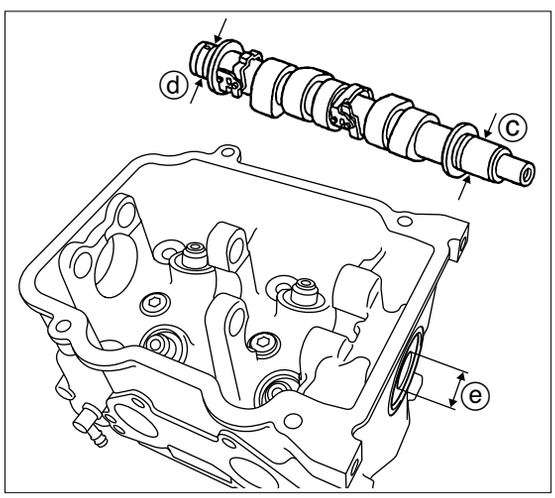
Cam Shaft Runout Limit :
0.05mm (0.0020 in)



3. Measure cam shaft journal outer diameters ⓒ and ⓓ. Replace cam shaft or cylinder head if either of the diameters is less than specified value.

Cam Shaft Journal Outer Diameter ⓒ : Standard Value
17.98 mm (0.7079 in)
Cam Shaft Journal Outer Diameter ⓓ : Standard Value
15.97 mm (0.6287 in)
Cylinder Head Journal Inner Diameter ⓔ (Upper) :
18.010 - 18.025 mm
(0.7091 - 0.7096 in)

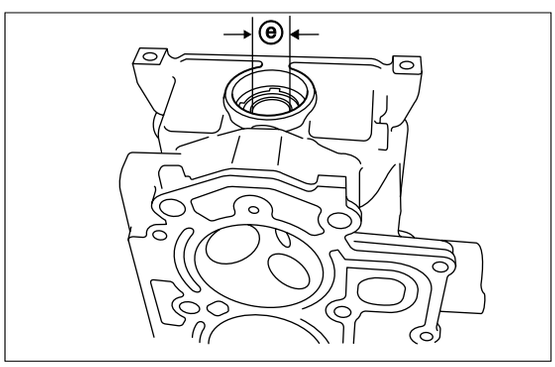
Functional Limit ⓒ :
17.95 mm (0.7067 in)
Functional Limit ⓓ :
15.95 mm (0.6280 in)



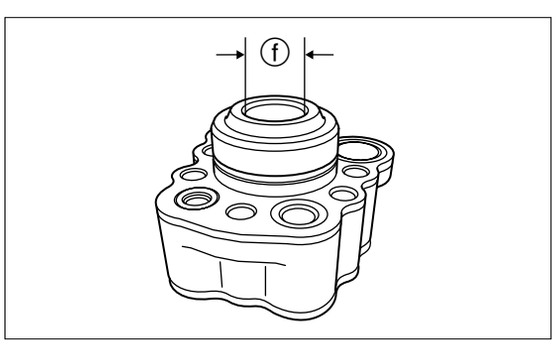
4. Measure cylinder head journal inner diameter ⓔ and oil pump journal inner diameter ⓕ. Calculate oil clearance. Oil clearances are obtained by ⓔ - ⓒ and ⓕ - ⓓ respectively. Replace cam shaft, cylinder head or oil pump if either of the clearances is over specified value.

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

Functional Limit :
0.09 mm (0.0035 in)



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

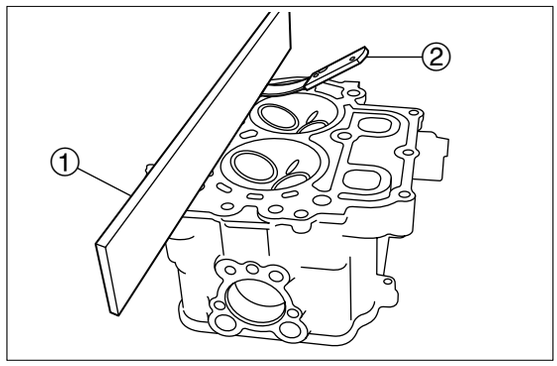


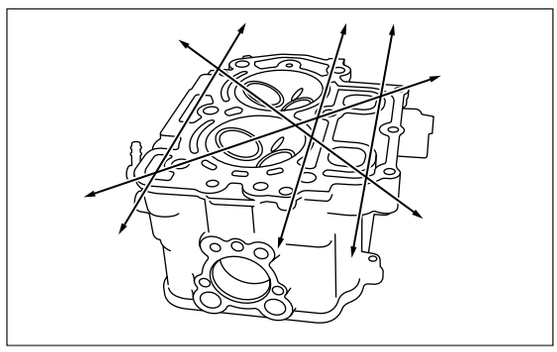
19) Inspection of Cylinder Head

1. Remove carbon build-up of combustion chamber, and check for deterioration.

2. Use straight edge ① and thickness gauge ② to check distortion of cylinder head in the directions shown. Replace if the distortion is over specified value.

Cylinder Head Distortion Limit :
0.10 mm (0.004 in)

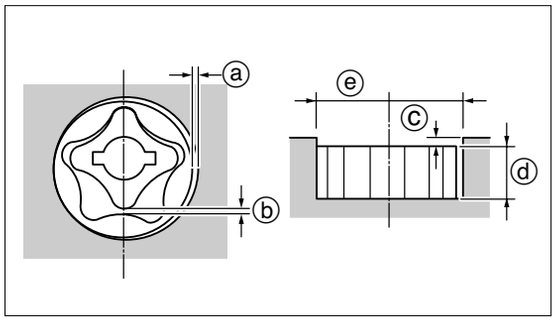


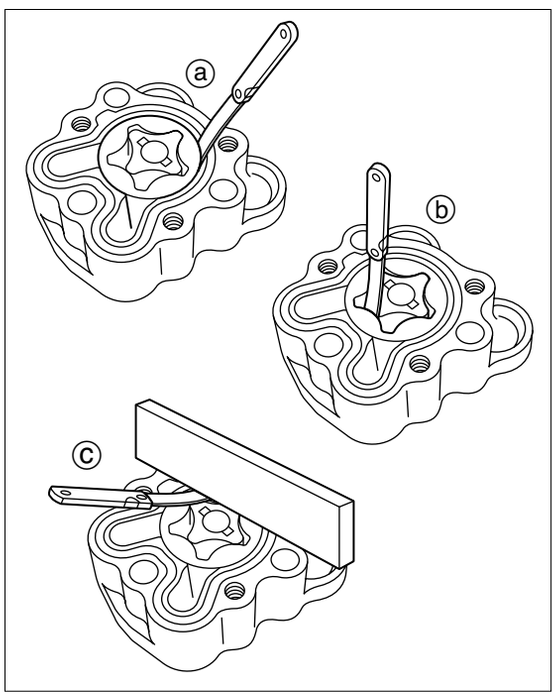


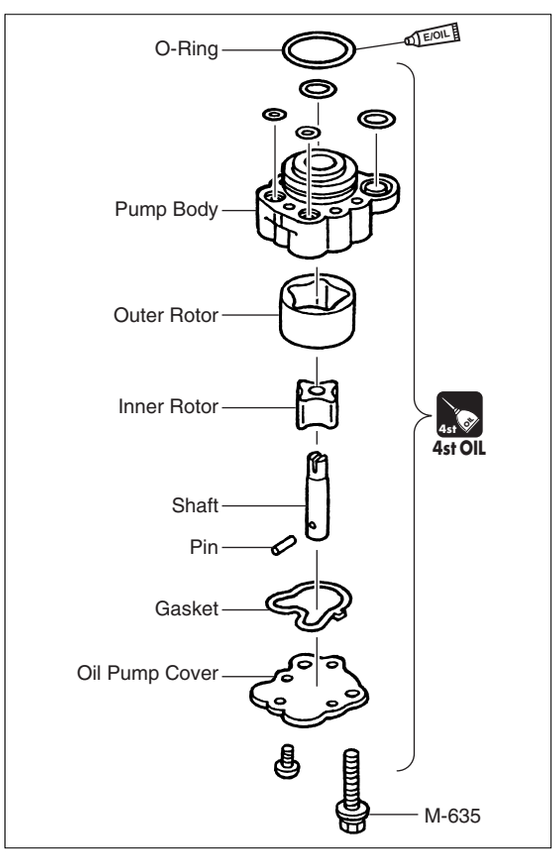
20) Inspection of Oil Pump

1. Use micrometer, cylinder gauge, depth gauge and thickness gauge to measure dimensions shown below. Replace oil pump if over 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)
Side clearance between rotor and body ⓒ :
0.11 mm (0.0043 in) (including wear of oil pump cover)
Height of Outer Rotor ⓓ :
14.96 mm (0.5890 in)
Pump Body Inner Diameter ⓔ :
29.04 mm (1.1433in)





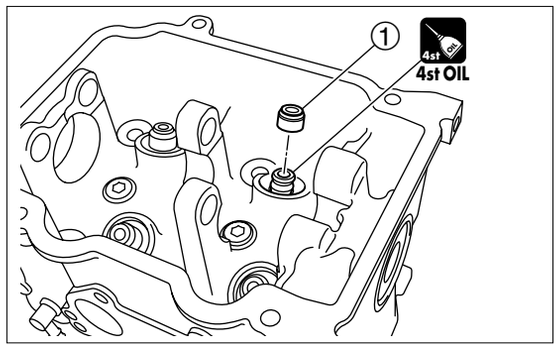


5

21) Installation of Valves

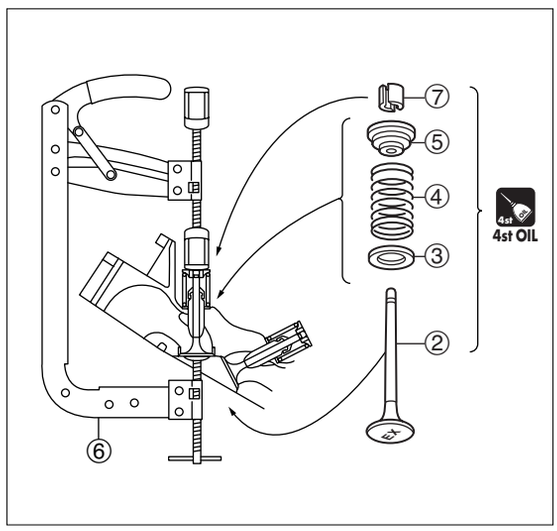
1. Apply oil to valve guide and attach new valve stem seal ①.

Intake Side : Black
Exhaust Side : Green

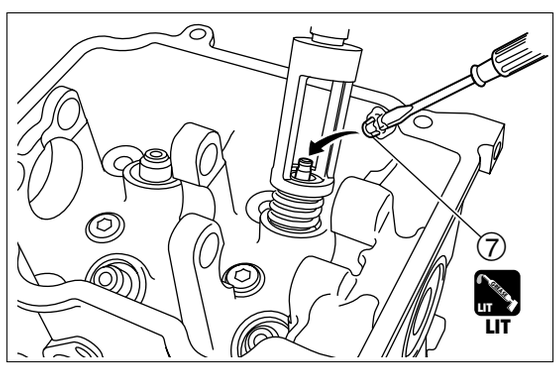


① **Do not reuse.**

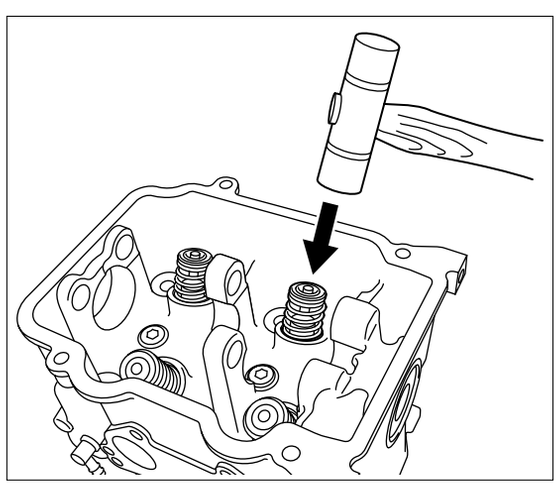
2. Install valve ②, valve spring seat ③, valve spring ④ and retainer ⑤ in the order shown, and then, attach commercially available valve spring compressor ⑥.



3. With valve spring ④ being compressed, use small screw driver with small amount of grease at the tip to put cotter ⑦.



4. Tap valve stem end with plastic hammer to fix cotter ⑦ securely.

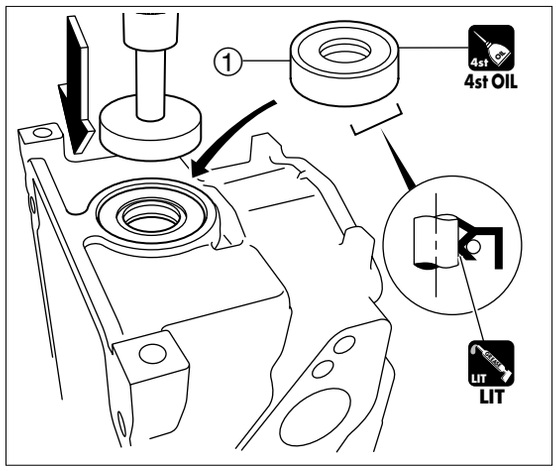


22) Installation of Cam Shaft

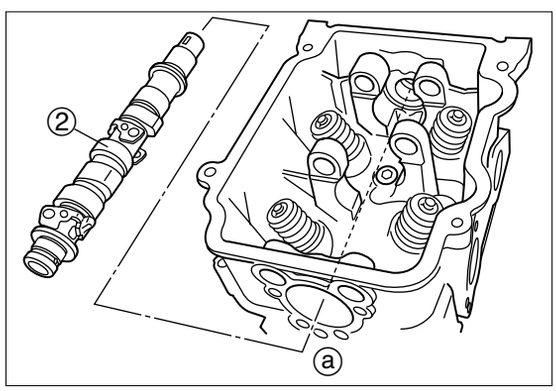
1. Apply engine oil to periphery of new oil seal ① and install it.

Driver Rod :
P/N. 3AC-99702-0
Oil Seal Attachment :
P/N. 3AC-99820-0

Apply grease to lip of oil seal before installing it.

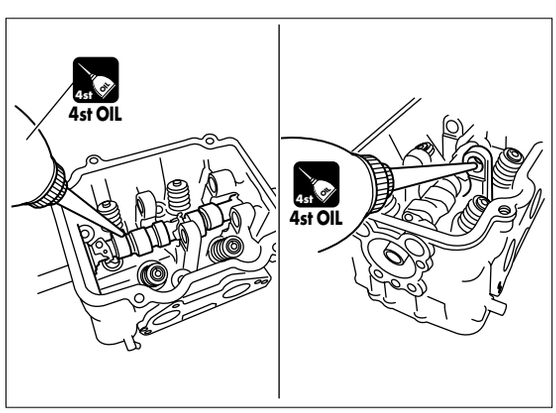


2. Install cam shaft ② from direction ⓐ shown.



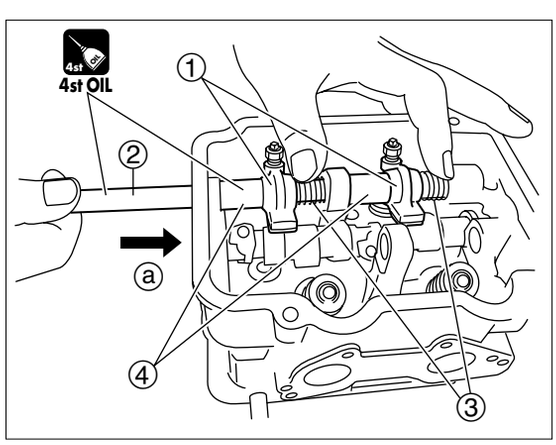
23) Installation of Rocker Arm Shaft

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



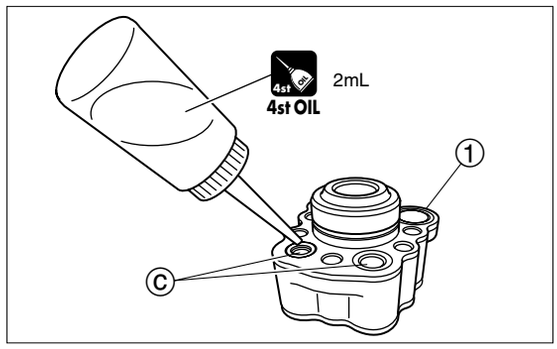
2. Install rocker arms ①, springs ③, washers and collar ④ from lower side of cylinder head ⓐ while installing rocker arm shaft ②.

Apply sufficient amount of oil to rocker arm and adjust screw after installing rocker arm.



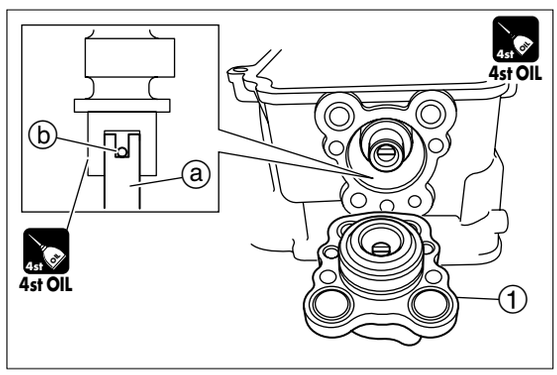
24) Installation of Oil Pump

Feed engine oil of approximately 1mL to oil passages ⓒ before installing oil pump.



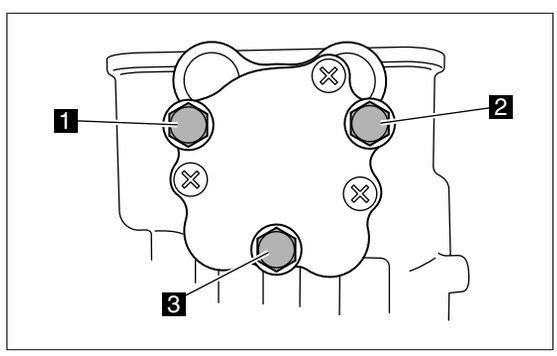
1. Align cuts of oil pump drive shaft ⓐ and cam shaft pin ⓑ with each other to install oil pump ①.

Apply engine oil to oil pump O-ring and cam shaft lower side journal, and install oil pump.



2. Secure oil pump using three M6 bolts by tightening them to specified torque in the order specified below.
Order of tightening : 1→2→3

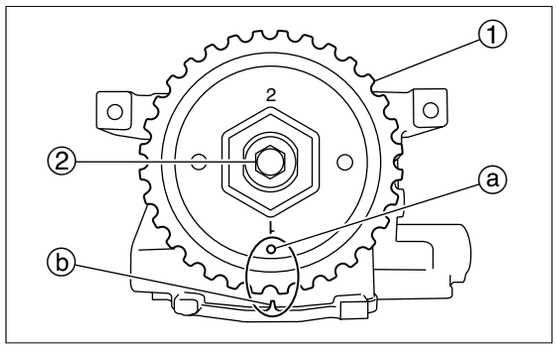
Oil Pump Bolts :
First tightening torque: 2.5 N · m (1.8 lb · ft) [0.25 kg · m]
Second Tightening Torque : 9 N · m (7 lb · ft) [0.9 kg · m]



25) Installation of Cylinder Head

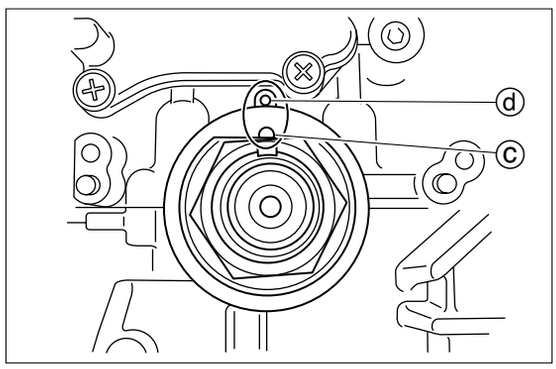
No.1 piston is to be at top dead center of compression stroke.

1. After installing cam shaft pulley, bring "●1" mark of pulley ① to "▲" mark ⓑ of cylinder head.

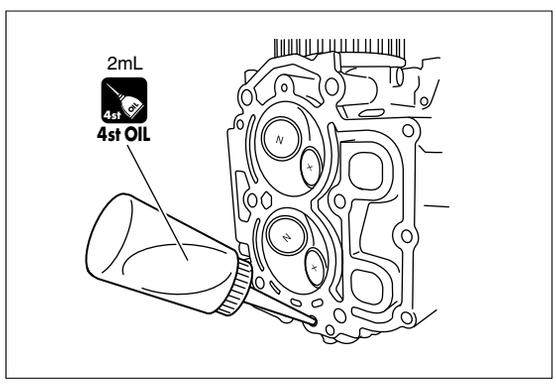


2. Check that "●" mark ⓒ of belt guide and "●" mark ⓓ of cylinder block are aligned with each other.

No.1 piston is to be at top dead center.



3. Before installing cylinder head, fill oil passages and oil pump again with oil as shown.

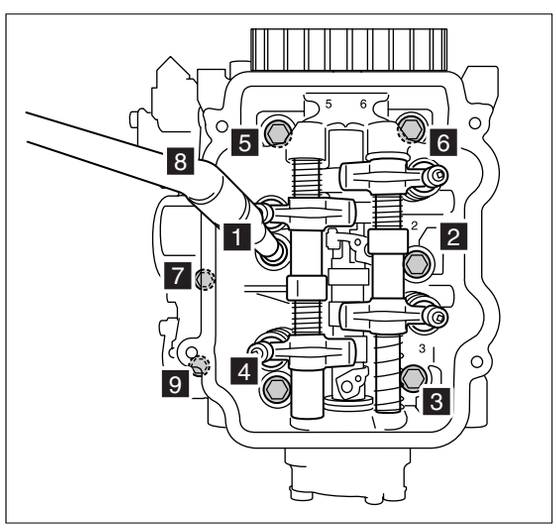


4. Install cylinder head with new gasket, and tighten bolts in the order shown in two steps to specified torque.

⚠ CAUTION

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

· First, tighten M8 bolts in two steps to specified torque.
· Then, tighten M6 bolts in two steps to specified torque.
· After installing cylinder head, install timing belt and check valve clearance. Refer to “Chapter 5 Checking Valve Clearance".

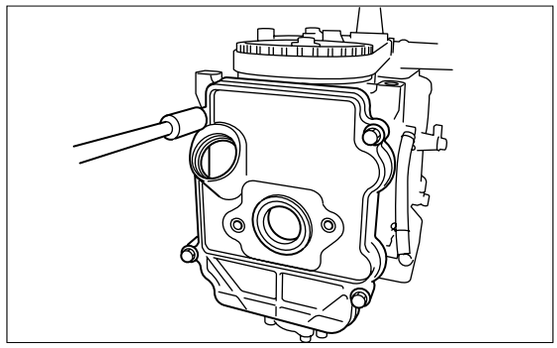


Cylinder head bolts (M8) 1 to 6
First Tightening Torque : 10 N · m (7 lb · ft) [1.0 kgf · m]
Second Tightening Torque : 30 N · m (22 lb · ft) [3.0 kgf · m]
Cylinder head bolts (M6) 7 to 9
First Tightening Torque : 6 N · m (4 lb · ft) [0.6 kgf · m]
Second Tightening Torque : 10N · m (7 lb · ft) [1.0 kgf · m]

5. Install cylinder head cover, apply "Three Bond" 1342 to bolts, and tighten them to specified torque.

Cylinder Head Cover Bolts :
First tightening torque: 6 N · m (4 lb · ft) [0.6 kg · m]

1342



ⓔ Install downward.

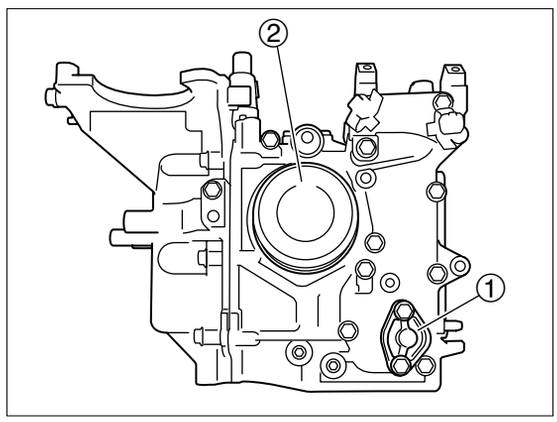
26) Disassembly of Cylinder Block

1. Remove anode cap ① and bolt.

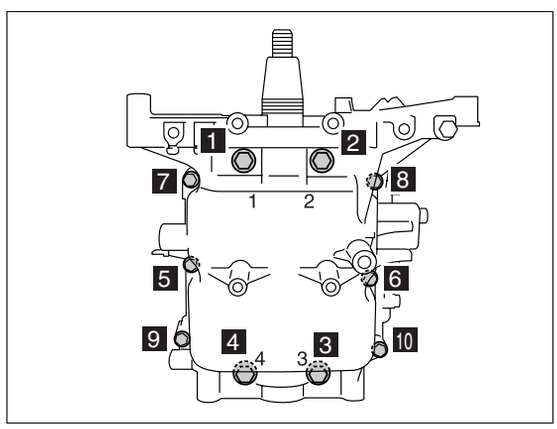
2. Remove oil filter ②.

Wipe off spilled oil completely.

Oil Filter Wrench :
P/N. 3AC-99090-0

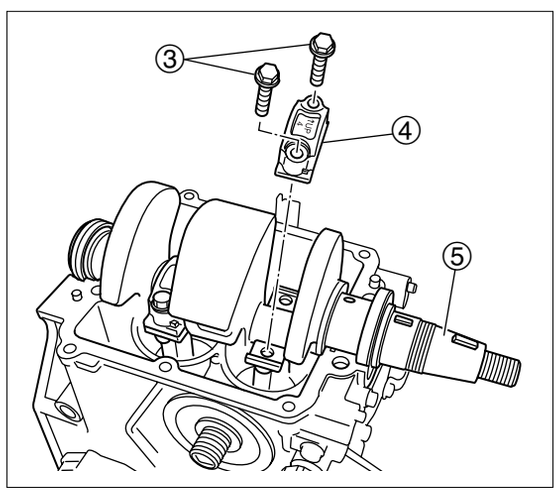


3. Loosen crank case bolts in several steps in the reverse sequence of order shown, and remove crank case. 10 to 1



4. Remove connecting rod bolts ③ and connecting rod cap ④, and then, crank shaft ⑤ and oil seal.

The mating connecting rods and caps should be arranged as pairs in the order they are removed. Removed parts should be marked and arranged so that they can be reassembled in their original positions and orientations.



5. Remove connecting rod and piston ass'y from cylinder block.

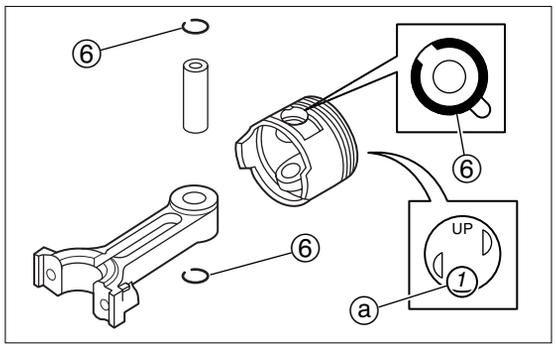
6. Remove bearings from cylinder block and crank case.

Take special care when reassembling connecting rod and connecting rod cap. Incorrect combination of the parts may cause burn of big end.

7. Remove piston pin clips ⑥ and piston pin, and then, piston.

Write cylinder number ⓐ on the mating piston.

Do not reuse piston pin clips. Be sure to replace with new ones.



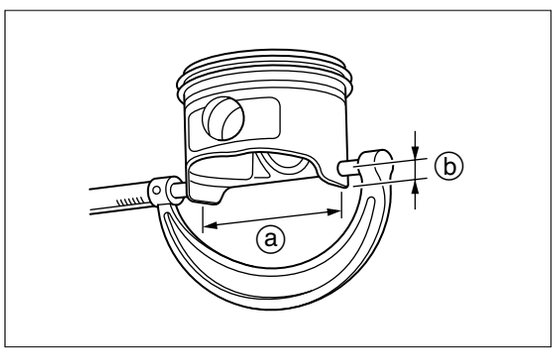
⑥ **Do not reuse.**

27) Inspection of Piston Outer Diameter

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

Piston Outer Diameter ⓐ : Standard Value
60.96 mm (2.4000 in)
Measurement point ⓑ: on the line at right angle to piston pin.
9mm (0.28 in) above piston skirt bottom

Functional Limit :
60.90 mm (2.3976 in)



28) Inspection of Cylinder Inner Diameter

1. Measure cylinder inner diameters (D1 to D6) at ⓐ, ⓑ and ⓒ in crank shaft directions ⓓ (D1, D3 and D5 respectively), and in crank web directions ⓔ (D2, D4 and D6 respectively).

Cylinder Inner Diameters (D1 to D6) : Standard Value
61.00 mm (2.4016 in)

Functional Limit :
Replace if over 61.06 mm (2.4039 in).

Note : Measure at the maximum wear points.

2. Obtain taper through calculation described below. Replace cylinder block if it is over specified value.

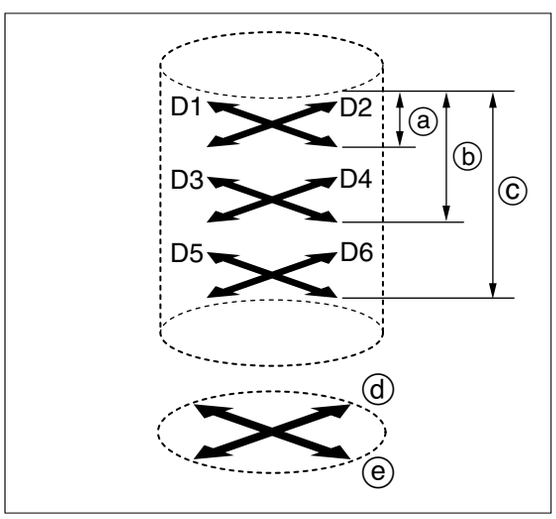
Taper Limit :
D1-D5 (direction ⓓ)
D2-D6 (direction ⓔ)

Functional Limit :
0.06 mm (0.0024 in)

3. Obtain out-of-roundness through calculation described below. Replace cylinder block if out-of-roundness is over specified value.

Out-of-roundness Limit :
D2-D1 (measuring point ⓐ)
D6-D5 (measuring point ⓒ)

Functional Limit :
0.06 mm (0.0024 in)



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

5

29) Inspection of Piston Clearance

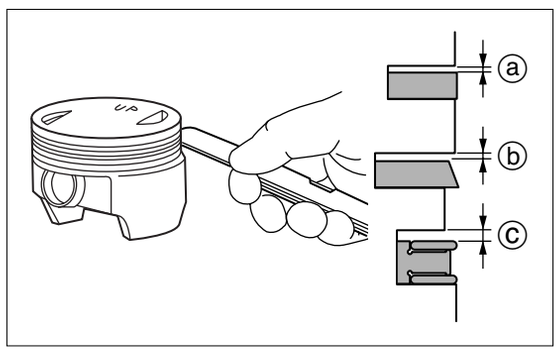
1. Obtain piston clearance through calculation described below. If piston clearance is over specified limit, replace cylinder block, or piston and piston rings as a set, or both cylinder block, piston and piston rings.

Piston clearance = Cylinder inner diameter (maximum) - Piston outer diameter ⓐ
0.020 - 0.055 mm (0.00079 - 0.00217 in)

Functional Limit :
0.150 mm (0.00591 in)

30) Inspection of Piston Ring Side Clearance

1. Measure piston side clearance. Replace piston and piston rings as a set if the clearance is over specified value.



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

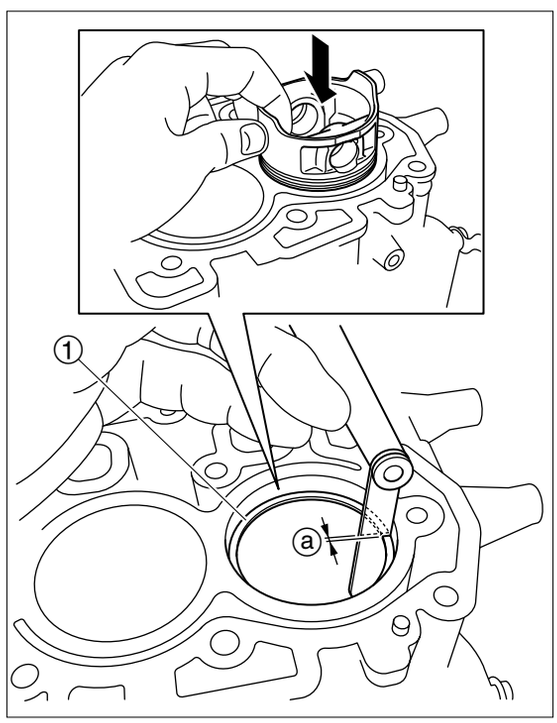
Functional Limit :
Top Ring ⓐ : 0.10 mm (0.0039 in)
Second Ring ⓑ : 0.09 mm (0.0035 in)
Oil Ring ⓒ : 0.17 mm (0.0067 in)

31) Inspection of Piston Rings

1 Push piston ring ① into ring gauge 61.000mm (2.40157in) parallel to top edge.

2. When ring gauge is not available, use piston crown to push piston ring ① into to cylinder.

Measure at the top or bottom of cylinder bore with no wear.



3. Measure piston ring closed gap ⓐ. Replace if it is over specified value.

Piston Ring Closed Gap ⓐ :
Top Ring : 0.15 - 0.30 mm (0.0059 - 0.018 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 (0.0197 in)
Second Ring : 0.70 mm (0.0276 in)

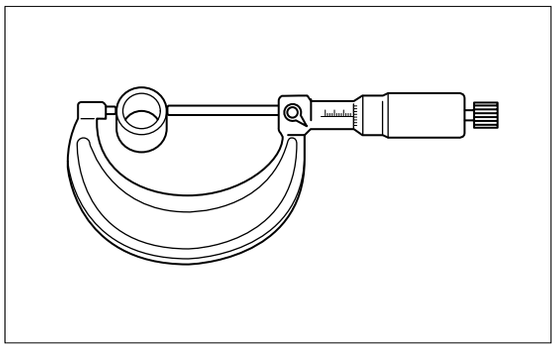
Replace oil ring when top ring or second ring is replaced.

32) Inspection of Piston Pins

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

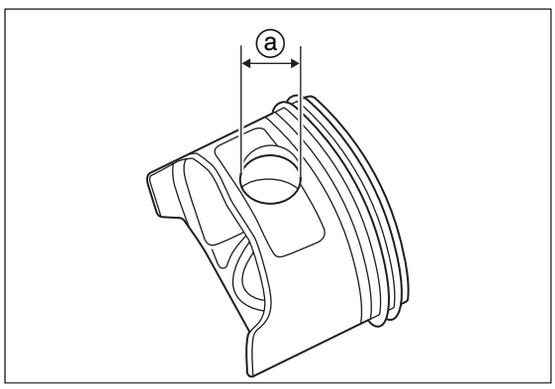
Piston Pin Outer Diameter : Standard Value
16.00 mm (0.6299in)

Functional Limit :
15.97 mm (0.6287 in)



2. Measure piston pin boss inner diameter ⓐ.

Piston Pin Boss Inner Diameter: Standard value
16.002 mm (0.63000 in)



3. Obtain clearance between piston pin and pin boss. Replace piston pin or piston if the clearance is over specified value.

Clearance Between Piston Pin and Pin Boss :
0.002 - 0.012 mm (0.00008 - 0.00047 in)

Functional Limit :
0.040 mm (0.00157 in)

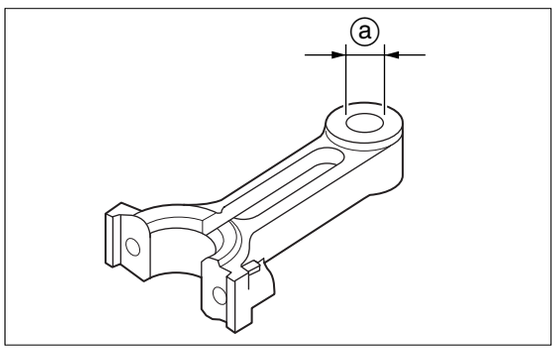
5

33) Inspection of Connecting Rod Small End Inner Diameter

1. Measure connecting rod small end inner diameter ⓐ. Replace connecting rod if the diameter is over specified value.

Connecting Rod Small End Inner Diameter ⓐ : Standard Value
16.01 mm (0.6303 in)

Functional Limit :
16.04 mm (0.6315 in)

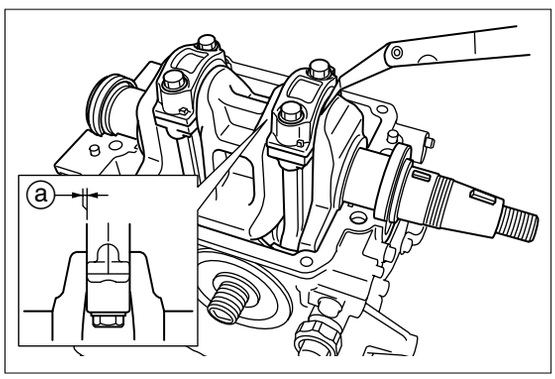


34) Inspection of Connecting Rod Big End Side Clearance

1. Measure connecting rod big end side clearance ⓐ. Replace connecting rod and/or crank shaft if the clearance is over 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)

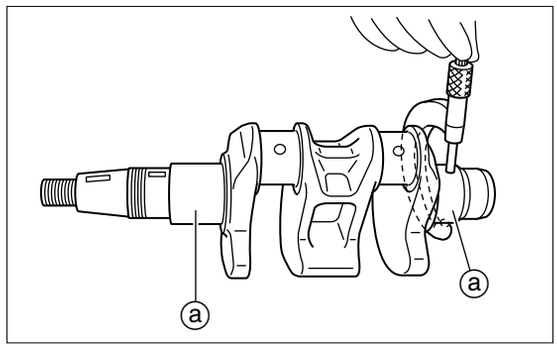


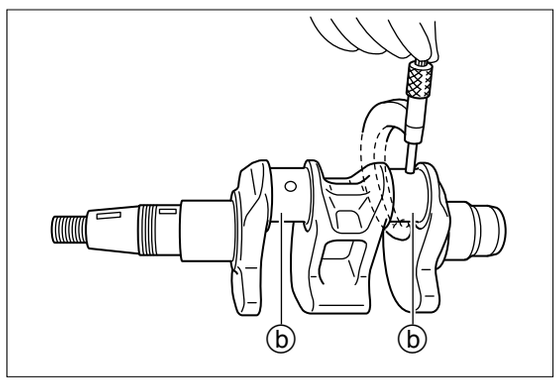
35) Inspection of Crank Shaft

1. Measure crankshaft journal outer diameter ⓐ and crank pin outer diameter ⓑ. Replace crankshaft if either outer diameter is less than specified value.

Crankshaft Journal Outer Diameter ⓐ : Standard Value
35.99 mm (1.4169 in)
Crank Pin Outer Diameter ⓑ : Standard Value
29.98mm (1.1803 in)

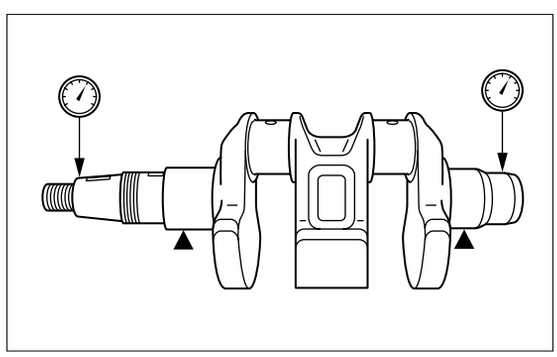
Functional Limit :
Crankshaft Journal Outer Diameter ⓐ :
Replace if less than 35.97 mm (1.4161 in).
Crank Pin Outer Diameter ⓑ :
Replace if less than 29.95mm (1.1791 in).





2. Measure crankshaft runout. Replace crankshaft if runout is over specified value.

Crankshaft Runout Limit :
0.05 mm (0.0020 in)



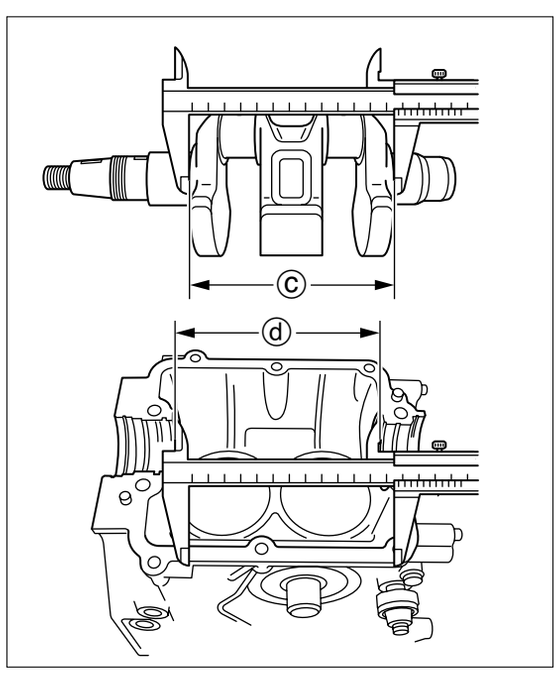
3. Use commercially available thickness gauge to measure side clearance.

Side Clearance :
0.1 - 0.3 mm (0.004 - 0.012 in)

Functional Limit :
0.6 mm (0.024 in)

If side clearance is over specified value, measure crank case (cylinder side) width ⓓ and crankshaft width ⓒ, and replace the part of which width is out of specified range.

Crankshaft Width ⓒ : Standard Value
126.8 - 126.9 mm (4.992 - 4.996 in)
Crank Case Width ⓓ : Standard Value
127.0 - 127.1 mm (5.000 - 5.004 in)

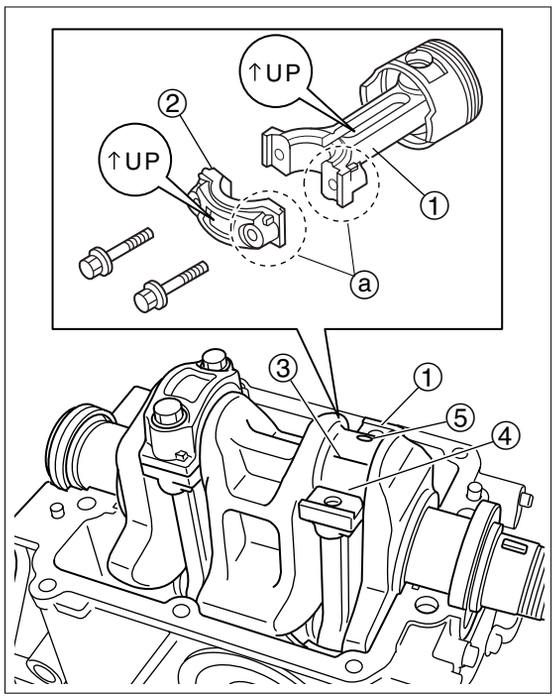


36) Inspection of Crank Pin Oil Clearance

1. Clean connecting rod.

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

   Piston rings are not to be attached to piston.



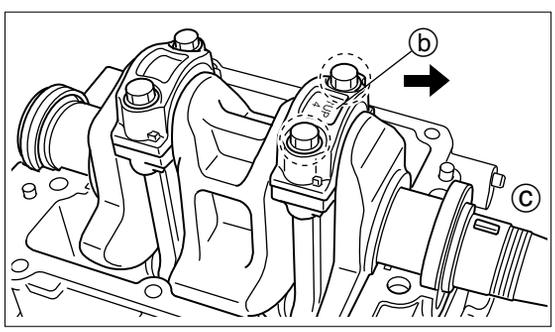
3. Install crankshaft on the cylinder block.

4. Place plasti-gauge ③ on each crank pin ④ parallel to crankshaft.

   Do not place plasti-gauge ③ on the oil hole ⑤ of crank pin ④.

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

   · Be sure that individual cap is installed to their original connecting rod.
   · Check that "UP" mark ⓑ of connecting rod is at crankshaft flywheel side ⓒ.



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

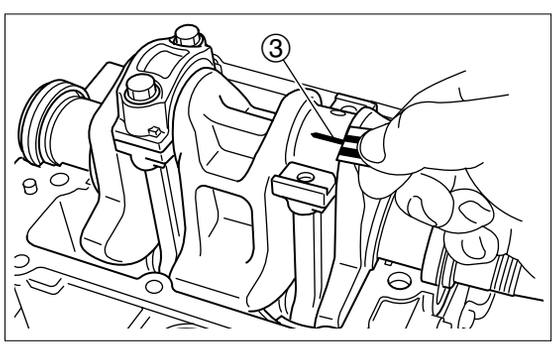
   Do not move connecting rod and crankshaft until oil clearance measurement is completed.

   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 ·

7. Remove connecting rod cap and measure width of crushed plasti-gauge ③ 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)

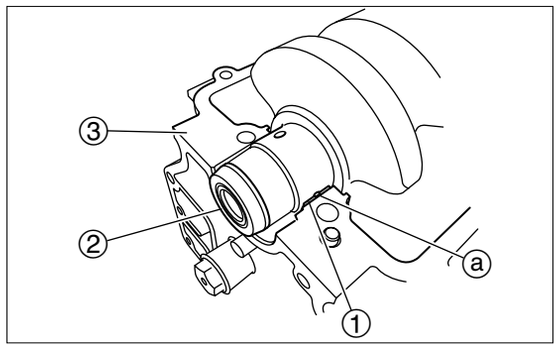


37) Crankshaft Main Journal Oil Inspection of clearance

1. Clean bearings, crankshaft main journal, and bearing installation areas of crank case and cylinder block.

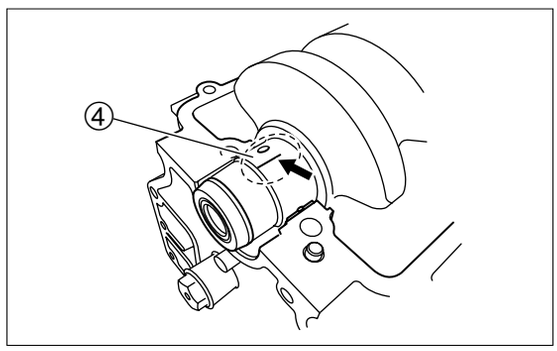
2. Place cylinder block on the work bench with cylinder head side facing downward.

3. Install bearing ① and crankshaft ② to cylinder block ③.



> · Be sure that individual bearings are installed to their original locations.
> · Install bearings with their projection ⓐ fit into cylinder block groove.

4. Place plasti-gauge ④ on each crankshaft main journal parallel to crankshaft.



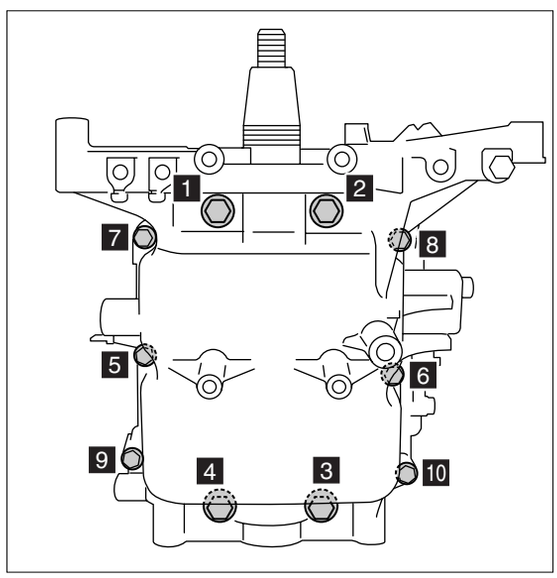
> Do not place plasti-gauge ④ on the oil hole of crankshaft main journal.

5. Install bearings to crank case.

> · Be sure that individual bearings are installed to their original locations.
> · Install bearings with their projection fit into crank case groove.

6. Install crank case to cylinder block.

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



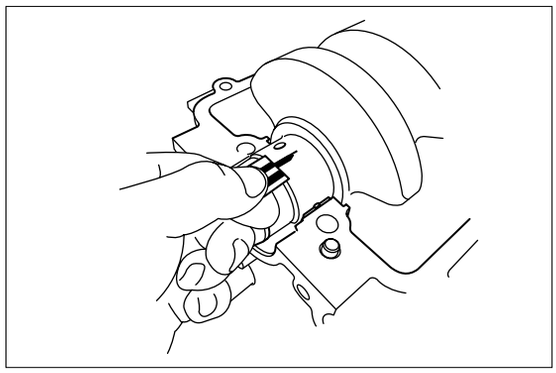
Crank Case Bolts (M8) : 1 to 4
First Tightening Torque : 10 N · m (7 lb · ft) [1.0 kgf · m]
Second Tightening Torque : 23.5 N · m (17 lb · ft) [2.4 kgf · m]
Crank Case Bolts (M6) : 5 to 10
First Tightening Torque : 6 N · m (4 lb · ft) [0.6 kgf · m]
Second Tightening Torque : 11.5 N · m (8.5 lb · ft) [1.2 kgf · m]

8. Loosen bolts in reverse order in several steps. Remove crank case and measure width of crushed plasti-gauge on each main journal. Replace bearing if the width is over specified value.

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 specified value, check that inner diameter code is as shown below.



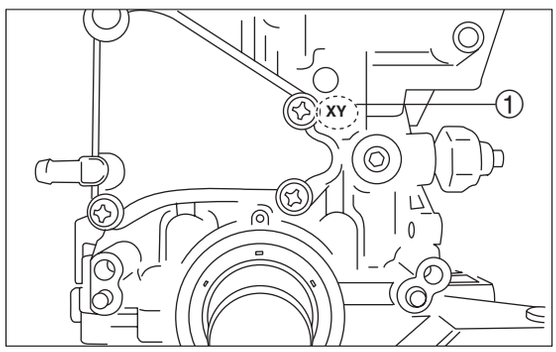
38) Inner Diameter of Cylinder/Crank Case Bearing Holder (Inner Diameter Code)

Cylinder is marked on its upper section with inner diameter code ① that indicates inner diameter of each bearing holder. There are the following two types of bearings that are indicated with the inner diameter code, which is to be used for identification of proper size part.

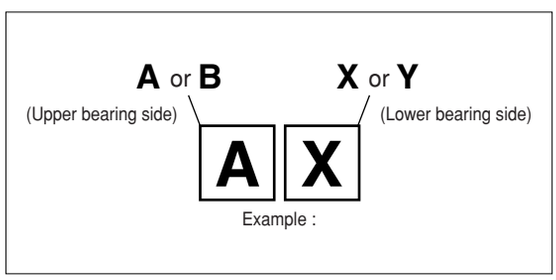
Inner diameter code ①	Standard value	Coloring of bearing
A or X	39.000 - 39.008 mm (1.53543 - 1.53575 in)	Blue
B or Y	39.008 - 39.016mm (1.53575 - 1.53606 in)	Red

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

Remarks : When cylinder/crank case is purchased as a part, fitting bearing comes with it.



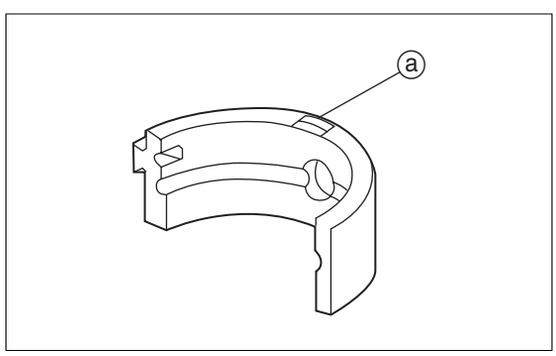
① Inner diameter code



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

Bearing is painted with color ⓐ that represents thickness. There are the following two types of bearings that are to be selected properly.

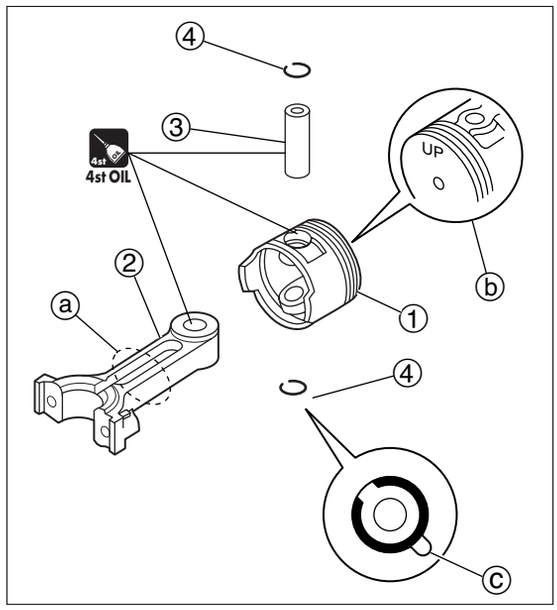
[Coloring (Inner Diameter Code)]	Thickness
Blue	1.488 - 1.494 mm (0.05858 - 0.05882 in)
Red	1.494 - 1.500 mm (0.05882 - 0.05906 in)



40) Assembling Piston and Connecting Rod

1. Install connecting rod ②, piston pin ③, and piston pin clip ④ to piston ①.

- Point "3RO-UP" mark ⓐ of connecting rod and "UP" mark ⓑ of piston at the same direction.
- Be sure to use new piston pin clip, and place clip gap away from piston pin groove ⓒ as shown.
- Be sure that individual connecting rod cap is installed to their original connecting rod.

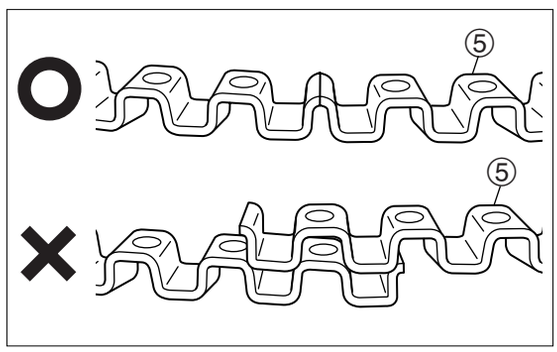


④ **Do not reuse.**

2. Put expander ⑤ (#4) into oil ring groove, and check that ring ends meet correctly as shown.

3. While holding expander ⑤ (#4) gap with thumb, put upper side rail (#3) end into the groove so that the gap is away from gap of expander ⑤ (#4) to the left by 90° degrees.

4. In similar way, put lower side rail (#5) into the groove so that the gap is away from gap of expander ⑤ (#4) to the right by 90° degrees.

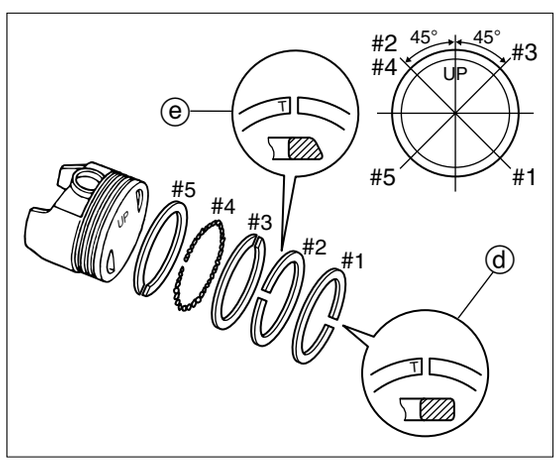


5. Install second ring (#2 taper) and top ring (#1) to piston. Install the rings so that their side with manufacturer's identification ⓓⓔ (T) faces upward.

6. Bring their gaps are away from each other as shown.

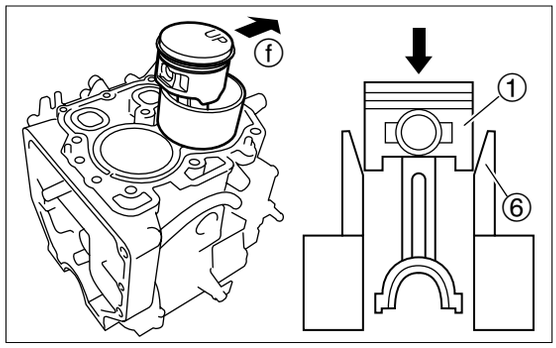
⚠ CAUTION

Be careful not to scratch piston surface and damage rings.



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

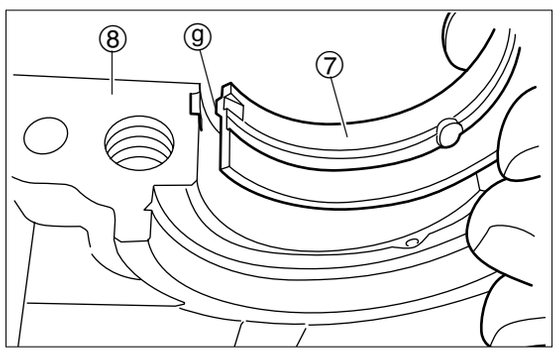
7. Put pistons into cylinder with piston crown ① "UP" mark directing flywheel side ⓕ, set pistons on the piston slider ⑥, install the piston into the cylinder.



Before installing, apply engine oil to piston peripheral surfaces, piston rings and piston sliders.

Piston Slider ⑥ :
P/N. 3AC-72871-0

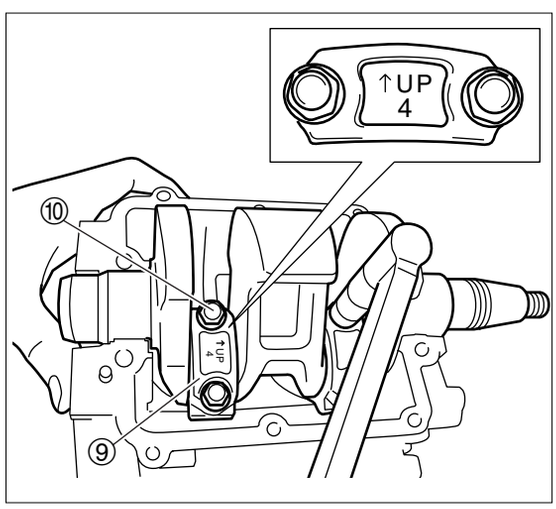
8. Install bearing half ⑦ to cylinder block ⑧.



- Be sure that individual bearings are installed to their original locations.
- Install bearings with their projection ⑨ fit into cylinder block groove.

9. Apply engine oil to bearings and crankshaft.

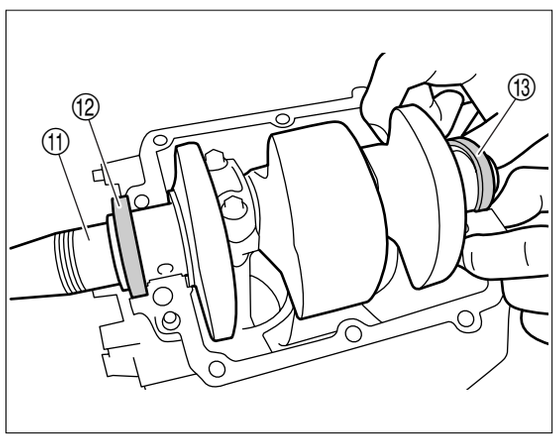
10. Attach connecting rod cap ⑨ to connecting rod, and tighten connecting rod bolts ⑩ in two steps to specified torque.



- Be sure that individual connecting rod caps are installed to their original connecting rod. Be careful of orientation of connecting rod cap.
- After installing connecting rod cap, apply engine oil to connecting rod side clearance.

Connecting rod bolt ⑩ :
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]

11. Install oil seals ⑫ and ⑬ to crankshaft ⑪ as shown.



- Apply grease to lip of oil seals before installing them.

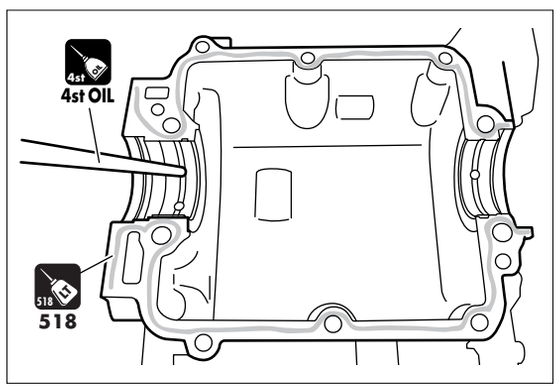
11. Install bearing half to crank case.

- Be sure that individual bearings are installed to their original locations.
- Install bearings with their projection fit into crank case groove.

12. Apply 4 stroke engine oil to bearings.

13. Apply sealing agent to mating surface of crank case (one side).

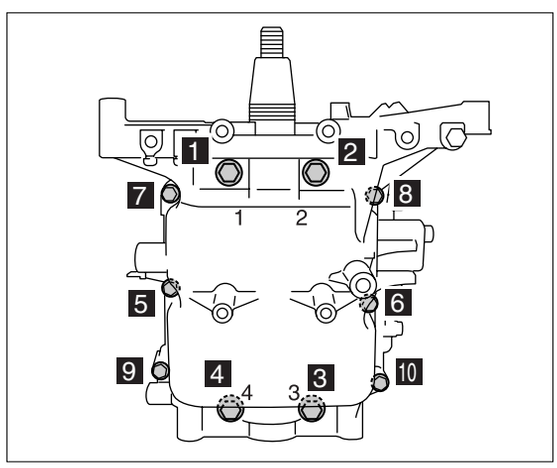
- Degrease mating surfaces of cylinder and crank case.
- Be careful not to allow sealing agent to adhere to bearing.
- Apply Loctite 518 to mating surface of one of crank case halves, taking care not to apply the agent excessively.



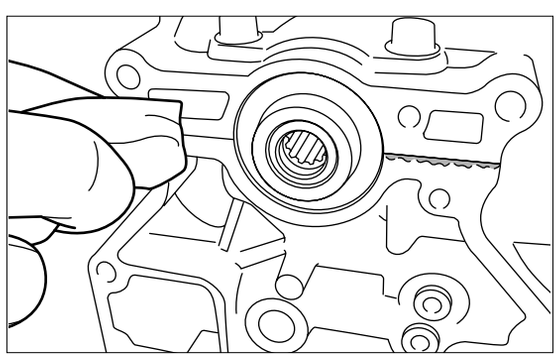
14. Install crank case to cylinder block.

15. Tighten crank case bolts M8 in two steps to specified torque in the order shown. Then, tighten M6 bolts in two steps to specified torque.

Crank Case Bolts (M8) 1 to 4 :
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]
Crank Case Bolts (M6) 5 to 10 :
First Tightening Torque : 6 N · m (4 lb · ft) [0.6 kgf · m]
Second Tightening Torque : 11.5 N · m (8.5 lb · ft) [1.2 kgf · m]

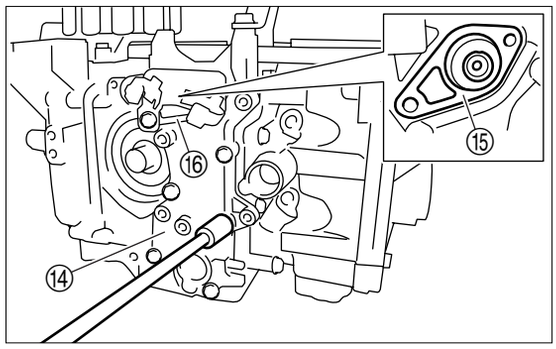


16. Wipe off excess Loctite 518 from lower mating surface of crankcase.



17. Install exhaust cover ⑭, and then install thermostat ⑮, new gasket and thermostat cover ⑯.

Install thermostat with the notch (shown by arrow) facing upward.

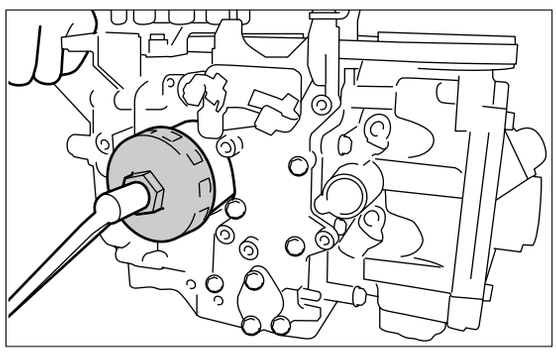


18. Install oil filter and tighten it to specified torque by using oil filter wrench.

Apply thin coat of engine oil to O-ring before installing oil filter.

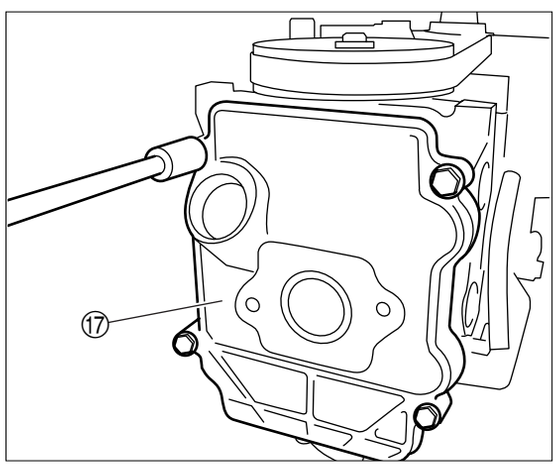
Oil Filter Wrench :
P/N. 3AC-99090-0

Oil Filter :
18 N · m (13 lb · ft) [1.8 kgf · m]



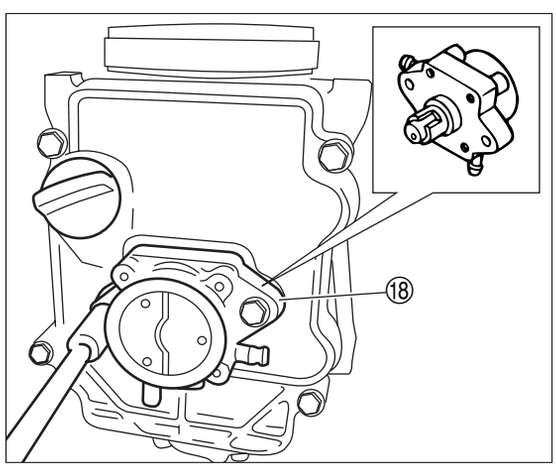
19. Install cylinder head and cylinder head cover ⑰.

For installation procedure, refer to "Chapter 5 Installation of Cylinder Head".



20. Install fuel pump ⑱.

Apply engine oil to fuel pump cam surface.



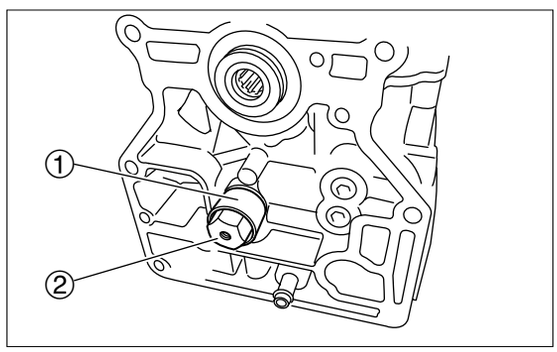
41) Installation of Timing Belt

1. Attach timing belt to crankshaft pulley and cam shaft pulley.

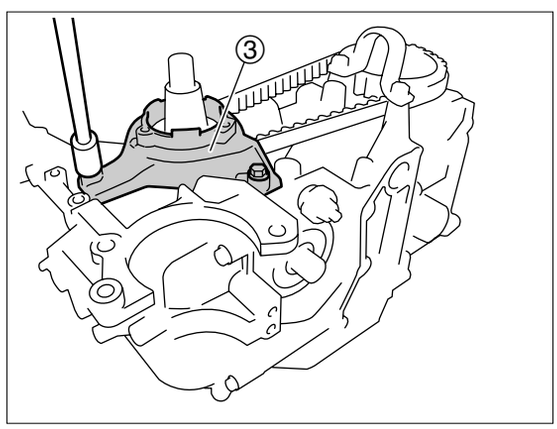
For the procedure, refer to :
Chapters 1 and 3 12) Replacement of Timing Belt
13) Attaching timing belt

2. Attach plunger cover ① and plunger ② before performing the next step.

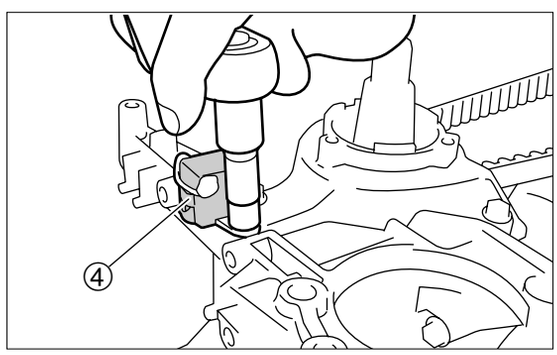
Plunger ② :
30 N · m (22 lb · ft) [3.0 kgf · m]



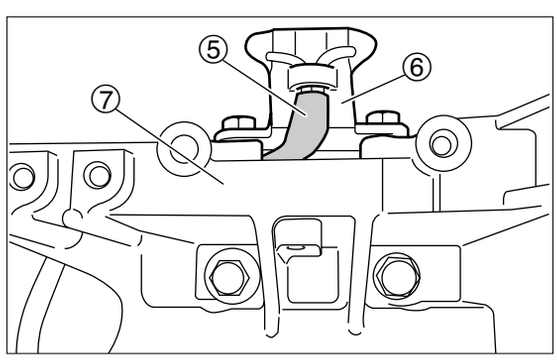
3. Install coil bracket ③.



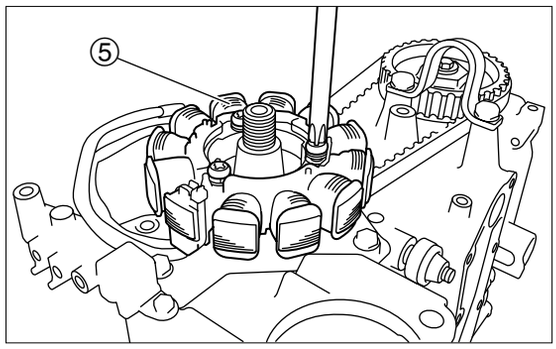
4. Install pulser coil ④ on coil bracket.



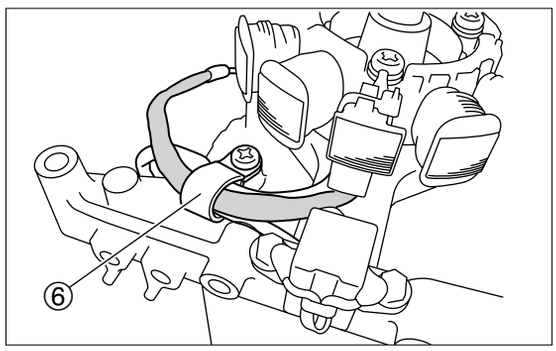
Run wire ⑤ from pulser coil through gap between coil ⑥ and bracket ⑦.



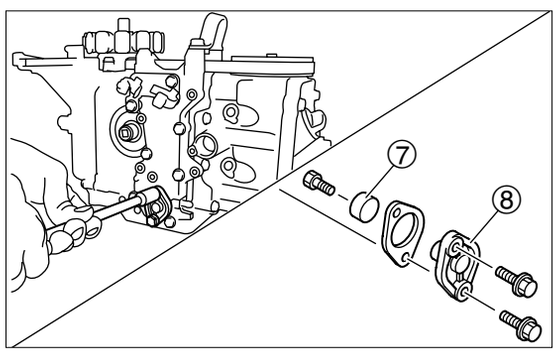
4. Install stator coil ⑤.



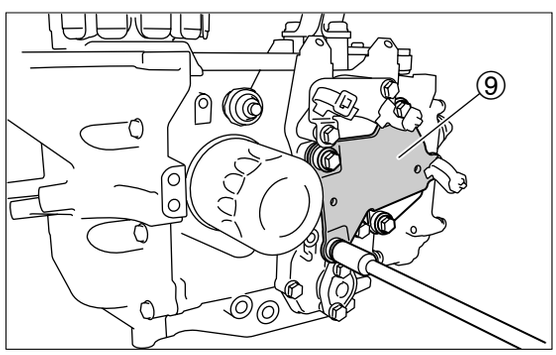
5. Bundle wires from stator coil and pulser coil with clamp ⑥ and install.

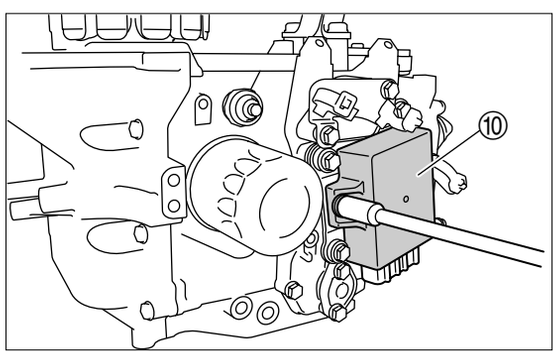


6. Install anode ⑦ and anode cap ⑧.

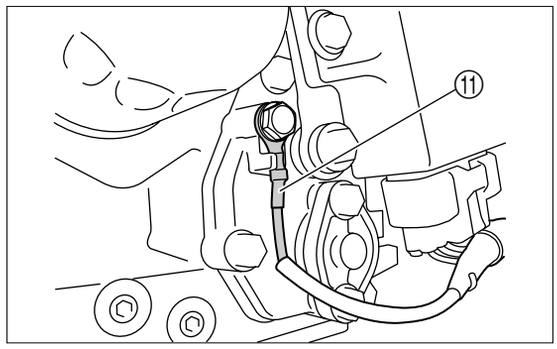


7. Install CD unit bracket ⑨ and secure CD unit ⑩ using bolts.

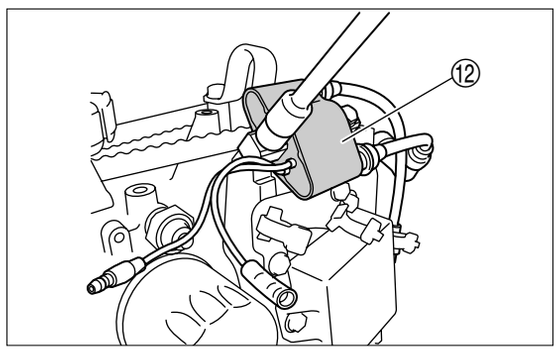




8. Attach ground wire ⑪ from CD unit.

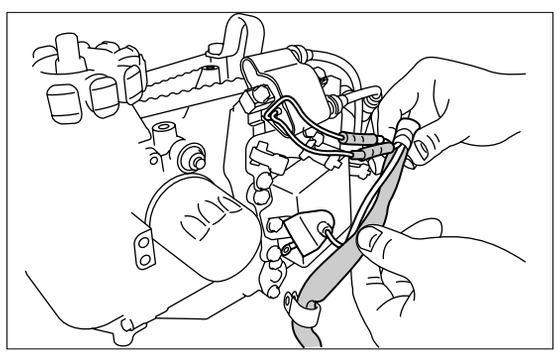


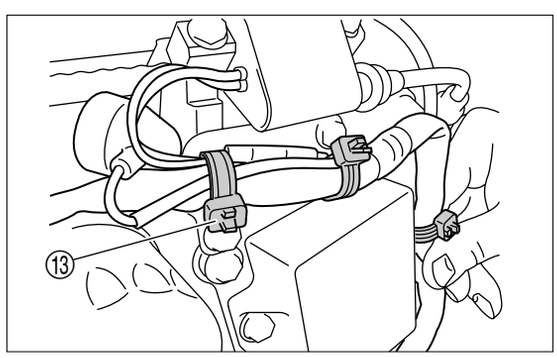
9. Install ignition coil ⑫ and connect wire to wireharness from CD unit.



10. Connect ignition coil wire and oil pressure sensor wire to CD unit cord as shown, and secure the wires with lead wire band ⑬.

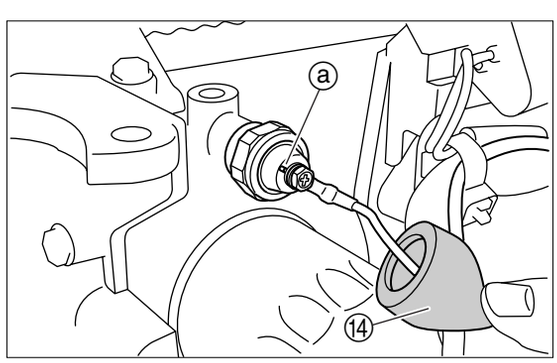
Secure the cords using band taking care not to allow them to contact top cowl.



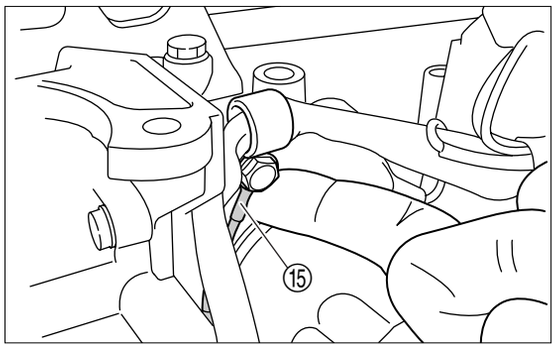


11. Attach sensor wire to oil pressure sensor, and install grommet ⑭.

When installing grommet, be careful not to plug small hole ⓐ of switch with grease.

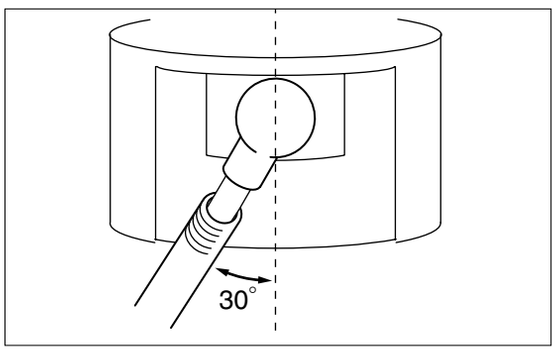


12. Attach ground wire ⑮ from CD unit.

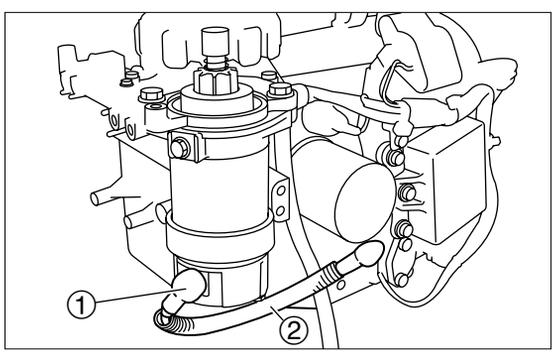


42) Installation of Starter Motor

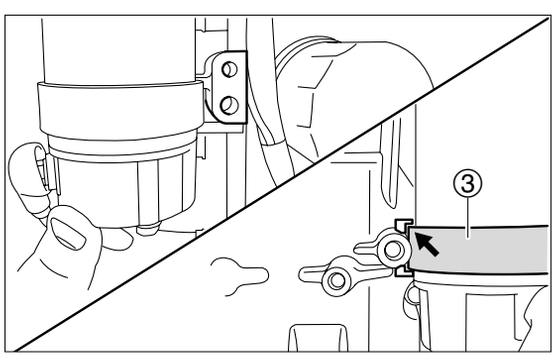
1. Attach starter cord to starter motor as shown.



2. Attach terminal cap ① and protector ② to starter cord.

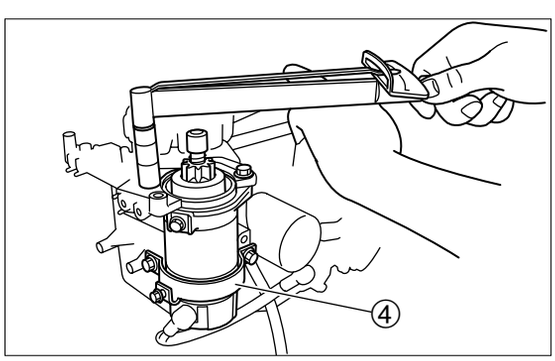


3. Fix starter motor with bolts temporarily, and position starter motor damper ③ on the locating groove (marked with arrow) on the crank case.



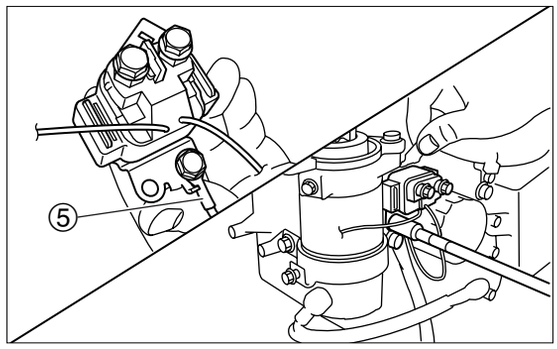
4. Attach starter motor band ④, and tighten the temporarily tightened bolt to specified torque.

Starter motor bolt :
13 N · m (9 lb · ft) [1.3 kgf · m]

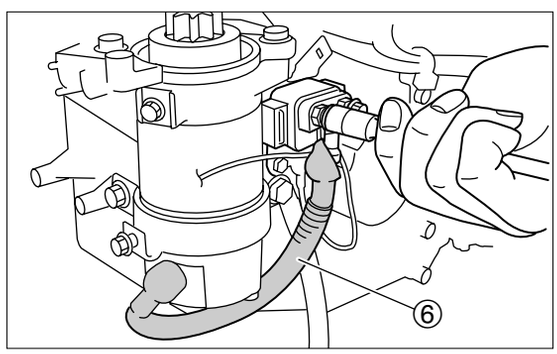


5. Install starter solenoid.

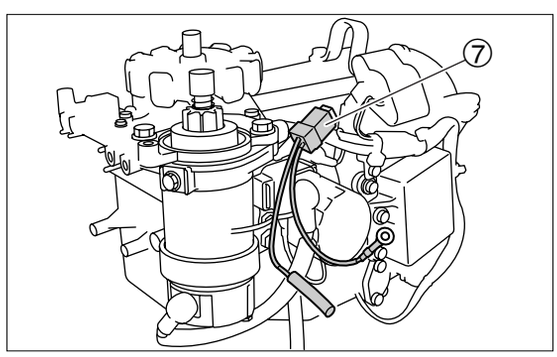
Secure ground wire ⑤ from solenoid to solenoid bracket by using existing solenoid bracket bolt.



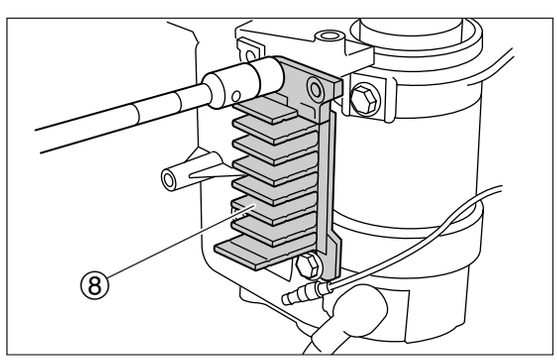
6. Connect cord wire ⑥ from starter motor to solenoid as shown.



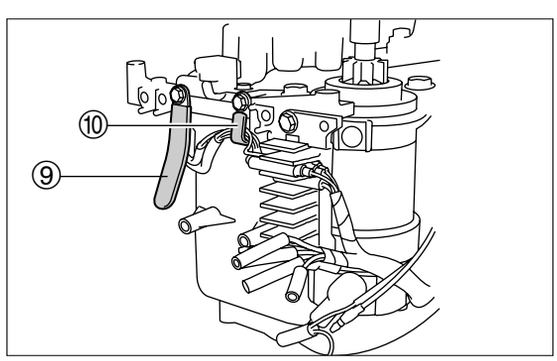
7. Attach fuse cord ⑦.



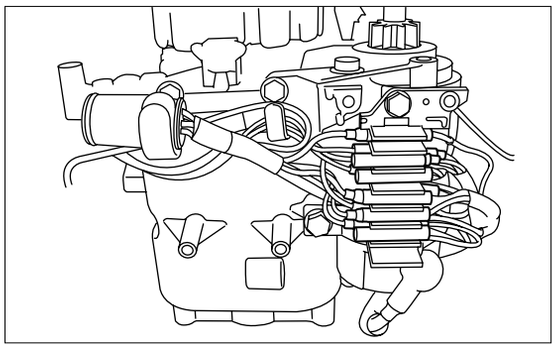
8. Install cable terminal holder ⑧.

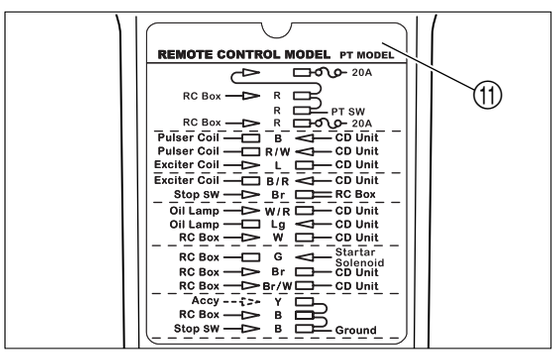


9. To attach cable terminal to holder, install clamps ⑨ (RC model only) and ⑩ to cylinder block.



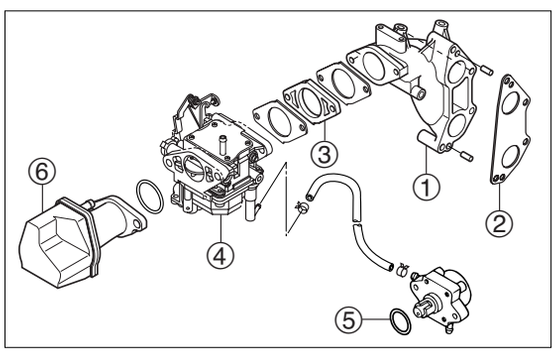
10. Put cable terminal in the holder in accordance with description on the sticker ⑪ located on the back of holder cover.





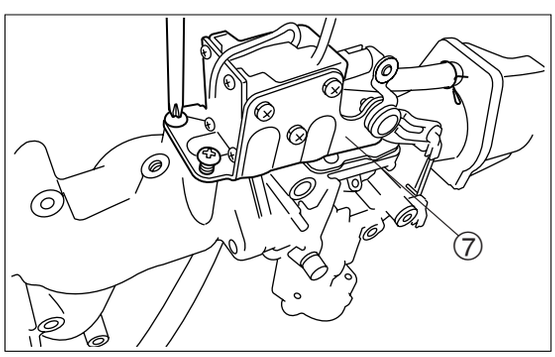
43) Installing Intake Manifold

1. Install gasket ②, insulator ③, carburetor ④, O ring ⑤ and intake silencer ⑥ to intake manifold ① in this order and secure with bolts.

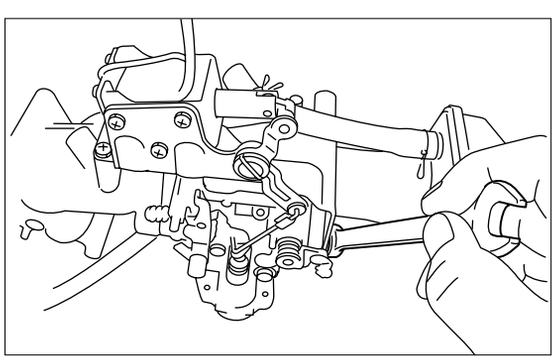


For EP model, put bracket for choke solenoid between carburetor ④ and intake silencer.

2. Install choke solenoid bracket ass'y ⑦ to intake manifold by using screws.

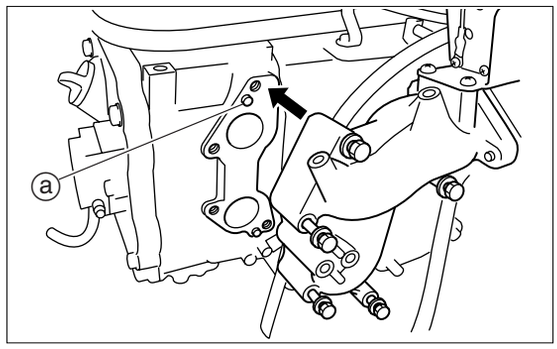


3. Install carburetor ass'y to intake manifold by using bolts.



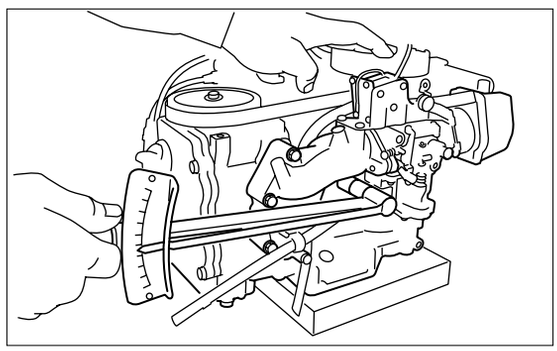
4. Install intake manifold ass'y to cylinder block.

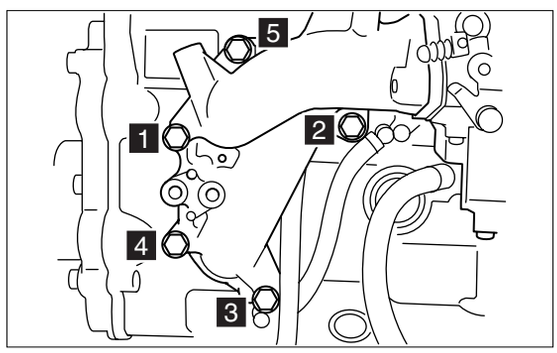
Use knock pin ⓐ to locate intake manifold ass'y on the cylinder block.



5. Secure intake manifold ass'y by tightening bolts in the specified order to specified torque.

Intake manifold ass'y securing bolts :
9 N · m (7 lb · ft) [0.9 kgf · m]

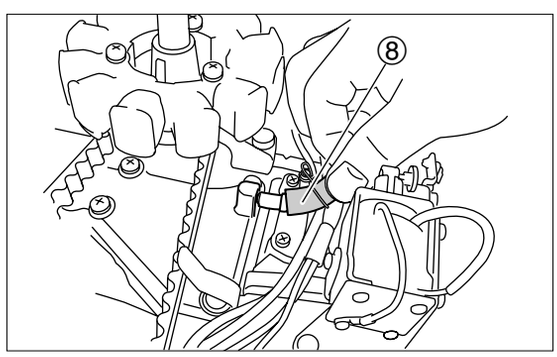


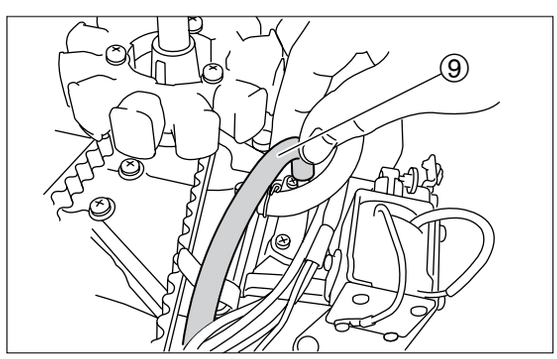


6. Attach breather hose ⑧.

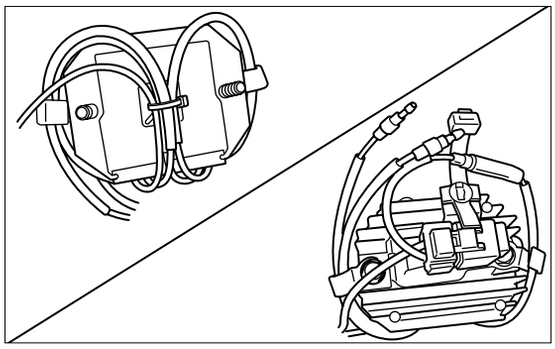
Place wires from magneto on the carburetor as shown, and put the breather hose on the nipple located on the breather chamber cover while holding the wires with the hose.

Then, attach breather hose ⑨ for carburetor.

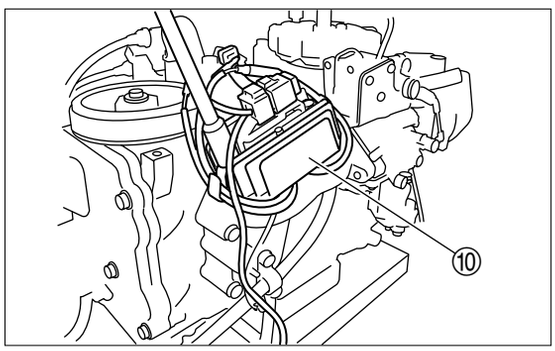




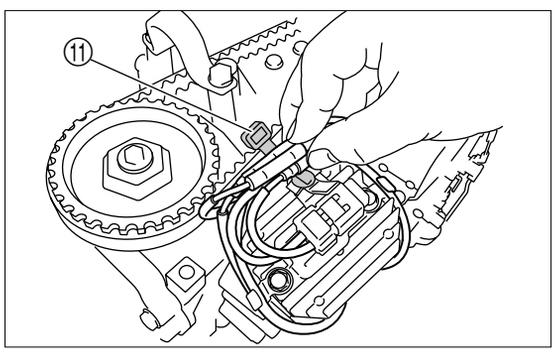
7. Prepare for installation of rectifier.
   Collect wires from rectifier as shown.



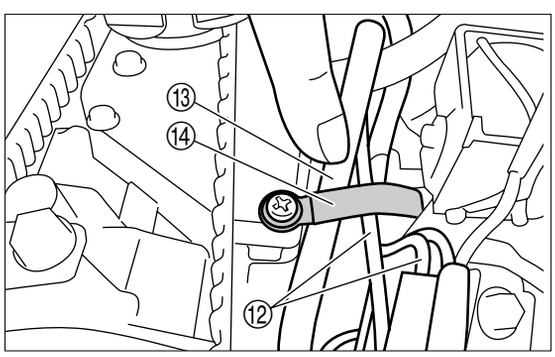
8. Install rectifier ⑩ to intake manifold.



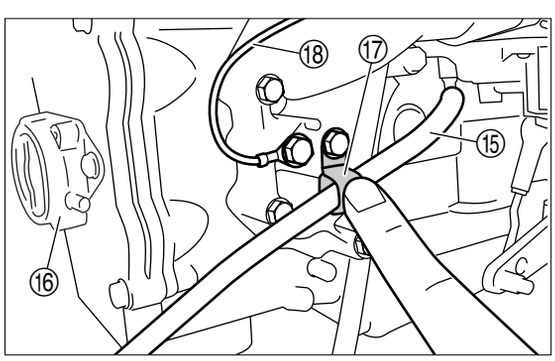
9. Connect wire couplers, and bind them using lead wire band ⑪ located on the rectifier.



10. Secure wires ⑫ and carburetor breather hose ⑬ using clamp ⑭.



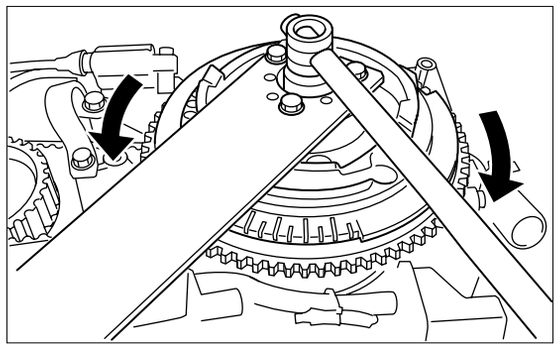
11. Attach carburetor fuel hose ⑮ to fuel pump ⑯.
    Fix fuel hose to intake manifold by using clamp ⑰.
    Attach ground wire ⑱ from rectifier.



5

44) Installing Flywheel

1. Install flywheel with flywheel engaged with crankshaft key.

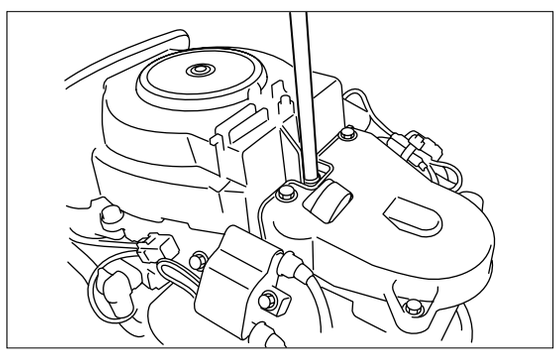


2. Tighten flywheel nut to specified torque.

Flywheel puller ass'y :
P/N. 369-72211-0

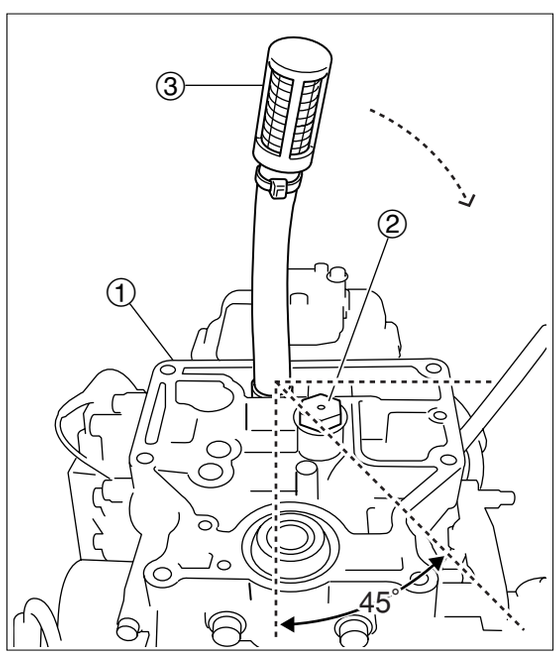
Flywheel Nut :
80 N · m (58 lb · ft) [8.0 kgf · m]

3. Install flywheel cover.



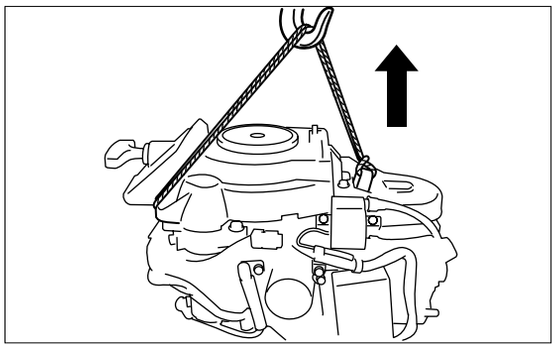
4. When flywheel attached to power unit, put power head ass'y ① upside down on the work bench, and install oil strainer ③. Attach hose so that it is tilted to the direction shown by arrow (45 degrees). As a guide, attach hose so that it is tilted toward plunger ②.

Complete this work in a short period. Doing this work for long time can cause engine oil to flow from breather pipe.



45) Installation of Power Unit

1. Hoist power unit with rope as shown.

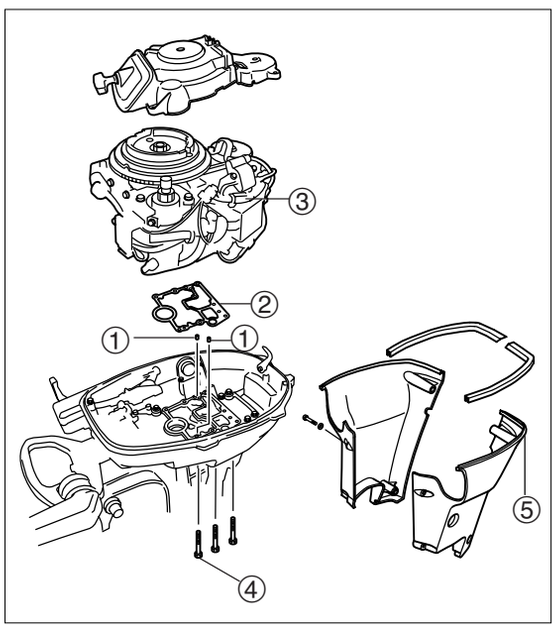


2. Clean surface of power unit that contacts with the engine base, and install dowel pin ① and new gasket ②.

3. Install power unit ③, and tighten bolts ④ in two or three steps to specified torque.

Power Unit Installation Bolt :
30 N · m (22 lb · ft) [3.0 kgf · m]

Be careful not to catch wires and hoses and other parts between power unit and engine base.



4. Attach drive shaft housing cover ⑤.

5. Install other parts by reversing the procedure described in “Chapter 5 Removing Power Unit”.

46) Removing Recoil Starter

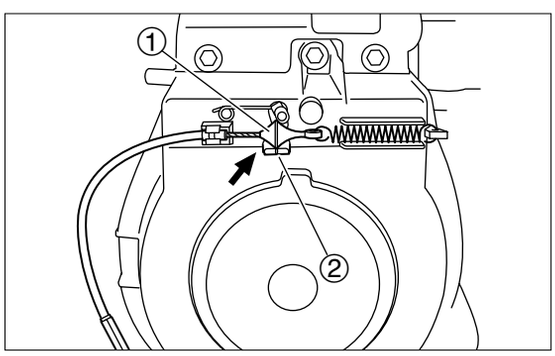
Adjustment of Starter Lock Cable

1. Shift gear into neutral (N).

2. Check that maximum diameter section of slide ① is at neutral start mark ②.

3. If not, adjust lower side of cable.

4. Perform shift operation to check that recoil starter is locked at other than neutral (N) position.

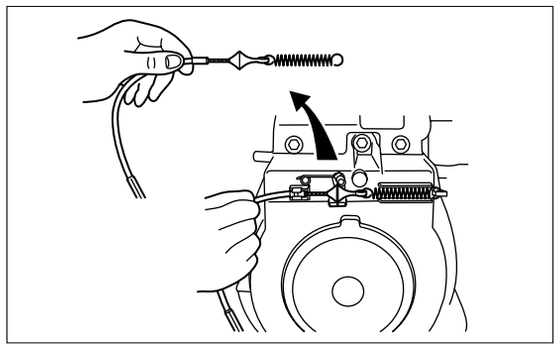


① Slide
② Neutral start mark

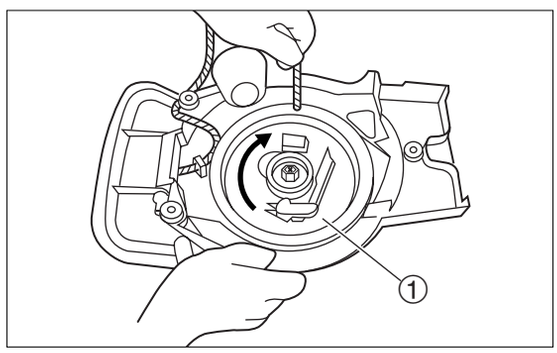
47) Disassembly of Recoil Starter

1. Disconnect upper starter lock cable.

2. Remove bolts, and then, recoil starter and belt cover.



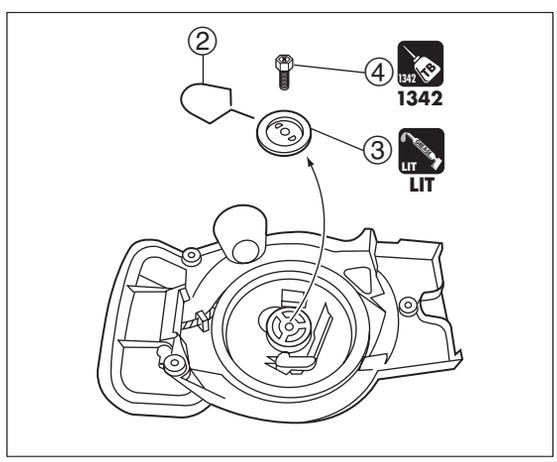
3. Put rope in the groove of reel ① and gently turn reel ① clockwise to release tension of starter spring.



① Reel

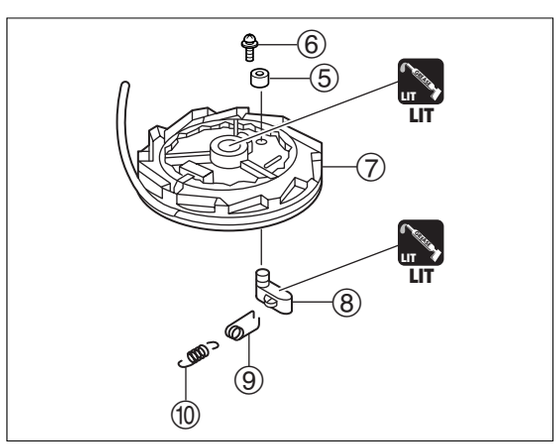
4. Remove start shaft bolt ④, and then, friction plate ③ and spring ②.

5. Take out reel carefully.



② Friction Spring
③ Friction Plate
④ Starter Shaft Bolt

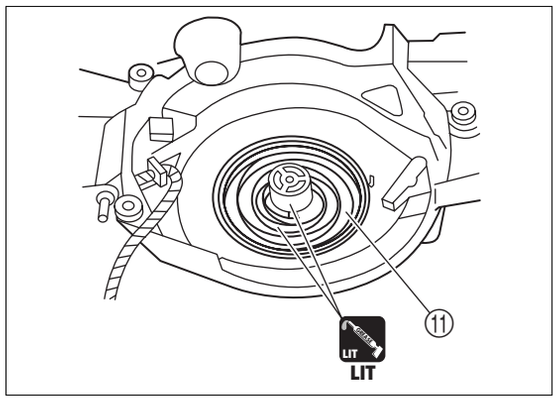
6. Remove bushing ⑤ and tapping screw ⑥, and then, ratchet ⑦, ratchet guide ⑧, and return spring ⑨.



⑤ Bushing
⑥ Tapping screw
⑦ Reel
⑧ Ratchet
⑨ Ratchet Guide
⑩ Return Spring

7. Remove starter spring ⑪.

It is not necessary to remove starter spring from starter case if it is not necessary to replace it. Starter spring can be inspected without removing from starter case.



⑪ Starter Spring

48) Inspection of Recoil Starter

1. Check ratchet, starter lock and all springs. Replace if any deformation, wear or damage is found.

2. Check reel and starter case. Replace if any crack or damage is found.

3. Check starter rope. Replace if any wear, unraveling or damage is found.

49) Installation of Recoil Starter

Reverse disassembly procedure to assemble by taking care of the following matters.

●When setting starter spring into starter case, face starter spring outer edge hook to the right and set it into peripheral cut of starter case.

●Run starter rope through rope guide ①.

●When installing reel into starter case, set projection of reel in the internal hook of starter spring.

●Apply cold resistance lithium grease to the following parts.

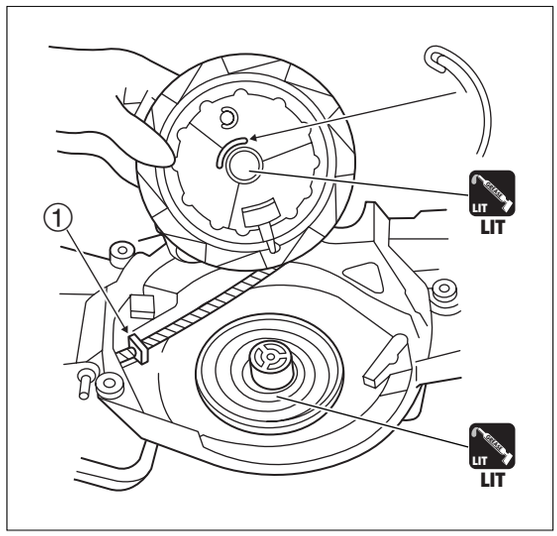
- Starter Spring
- Reel Center Hole
- Ratchet
- Starter Lock
- Friction Plate

●Apply "Three Bond" 1342 to starter shaft bolt, and tighten the bold to specified torque.

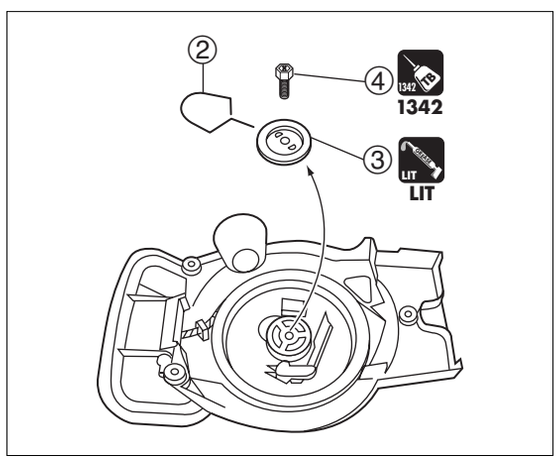
Starter Shaft Bolt :
6 N · m (4 lb · ft) (0.6 kgf · m)

●When applying tension to starter spring, turn reel 4 to 5 times to direction to which the reel rotates when pulling out starter rope (counterclockwise). When applying tension to starter spring, turn reel 4 to 5 times to direction to which the reel rotates when pulling out starter rope (counterclockwise).

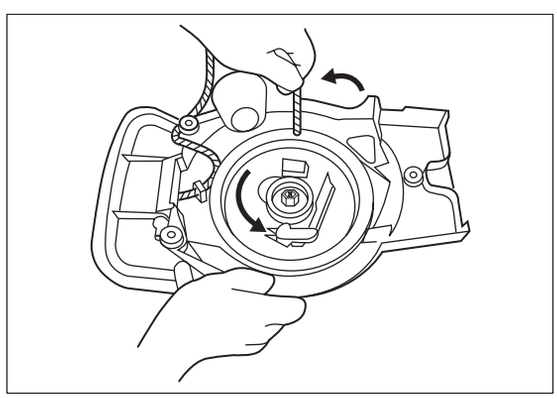
●Perform shift operation to check that recoil starter is locked at other than neutral (N) position.



① Rope Guide



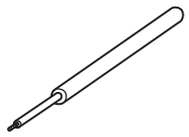
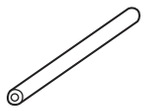
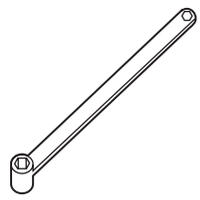
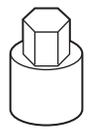
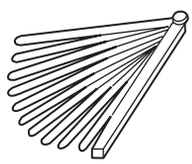
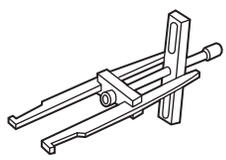
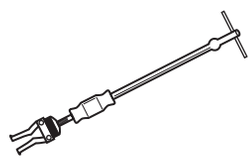
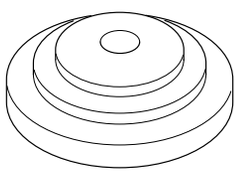
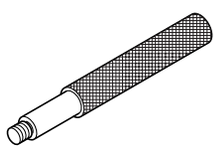
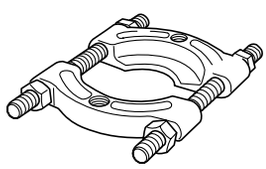
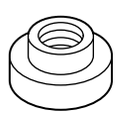
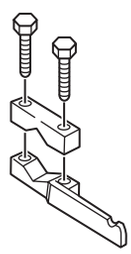
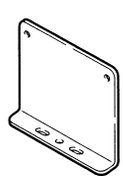
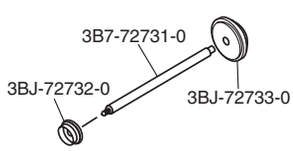
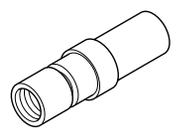
② Friction Spring
③ Friction Plate
④ Starter Shaft Bolt

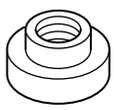
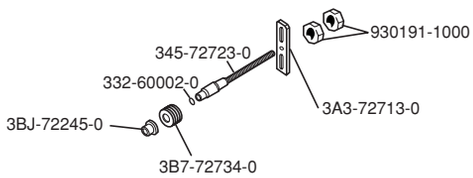
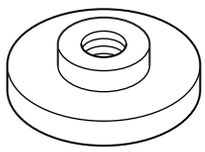


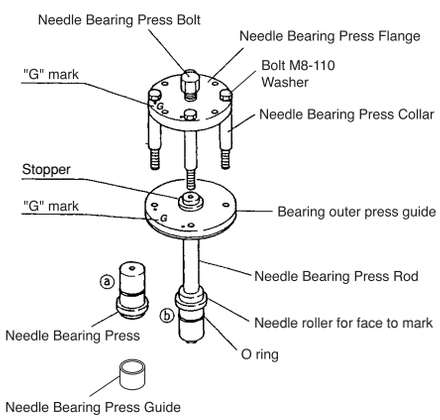
6

Lower Unit

1.Special Tools

			
Spring Pin Tool A P/N. 345-72227-0	Spring Pin Tool B P/N. 345-72228-0	Bevel Gear B Nut Wrench P/N. 346-72231-0	Bevel Gear B Nut Socket P/N. 346-72232-0
Removing spring pin	Installing spring pin	Removing/installing Pinion (B) Gear Nut	
			
Bevel Gear Bearing Installation Tool P/N. 346-72719-0	Thickness Gauge P/N. 353-72251-0	Bevel Gear Bearing Puller Ass'y P/N. 3A3-72755-0	Slide Hammer Kit P/N. 3AC-99080-0
Installing forward (A) gear bearing	Measuring gaps	Removing forward (A) gear bearing outer race	Removing forward (A) gear bearing outer race
ø110 x ø71 			ø29.5 x ø16.5 
Center Plate P/N. 3AC-99701-0	Driver Rod P/N. 3AC-99702-0	Universal Puller Plate P/N. 3AC-99750-0	Oil Seal Attachment 2 P/N. 3AG-99820-0
Used with driver rod and needle bearing attachment Positioning propeller shaft housing needle bearing	Used with center plate and needle bearing attachment	Removing reverse gear/bearing	Used with driver rod Installing oil seal in the propeller shaft housing
			
Backlash Measuring Tool Clamp P/N. 3B7-72720-0	Dial Gauge Plate P/N. 3B7-72729-0	Bearing Outer Press Kit P/N. 3B7-72739-1	Needle Bearing Attachment P/N. 3BA-99710-0
Measuring backlash	Used to attach dial gauge when measuring backlash	Installing forward gear (A) bearing outer race	Used with driver rod and center plate Installing propeller shaft housing needle bearing

ø25.5 x ø12.5 		ø51.5 x ø39.5 
Oil Seal Attachment 3 P/N. 3BJ-99820-0	Backlash Measuring Tool Kit P/N. 3C8-72234-1	Oil Seal Attachment P/N. 3UI-99820-0
Installing pump case (lower) oil seal	Measuring gap between forward and pinion gears (A and B gears)	Use in combination with driver rod. Use oil seal attachment to press fit ball bearing. Installing forward (A) gear and reverse (C) gear bearings

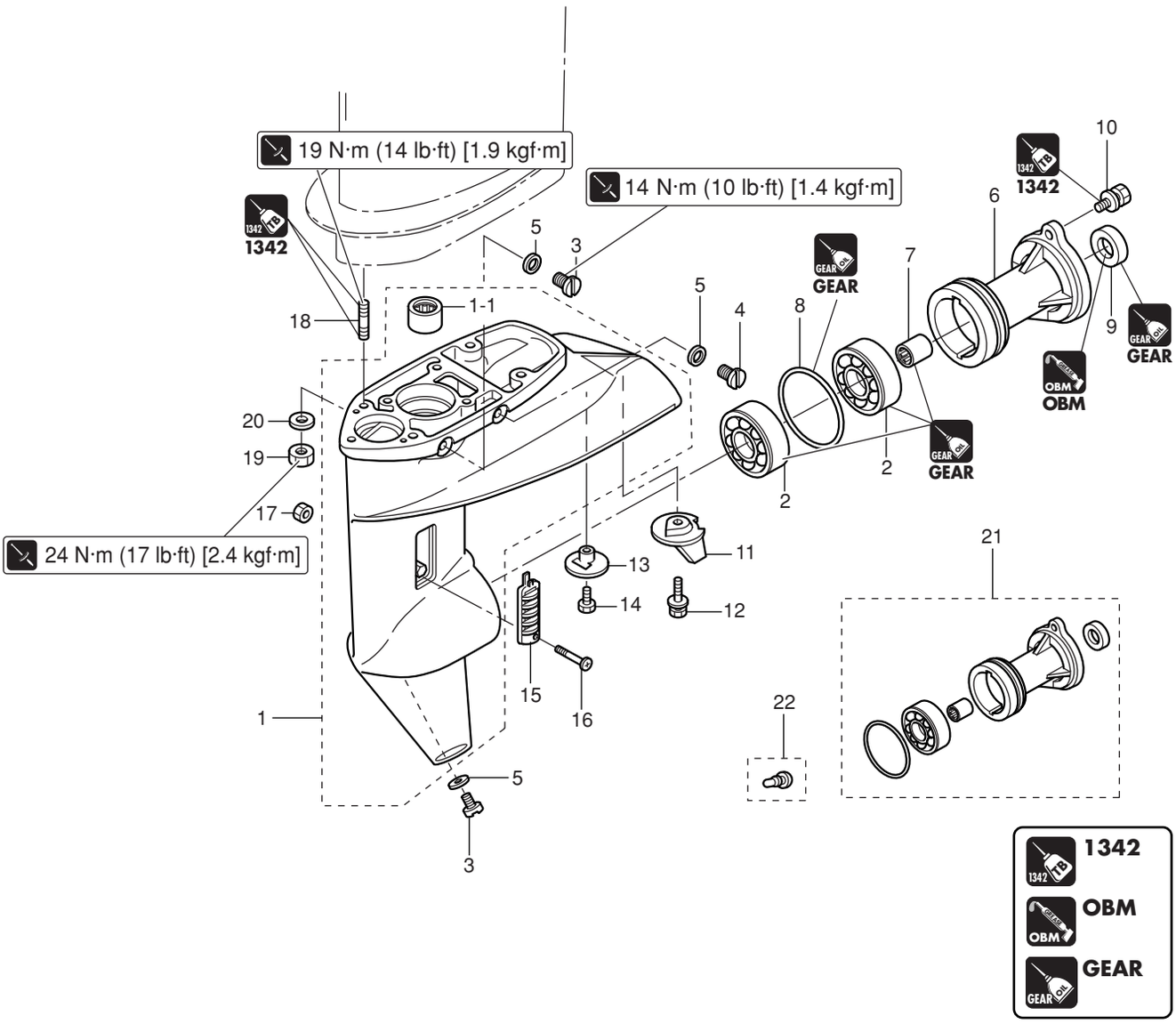

Needle bearing press Ass'y P/N. 3AC-72900-1
Installing/attaching drive shaft housing

6

2.Parts Layout

P/L Fig. 14

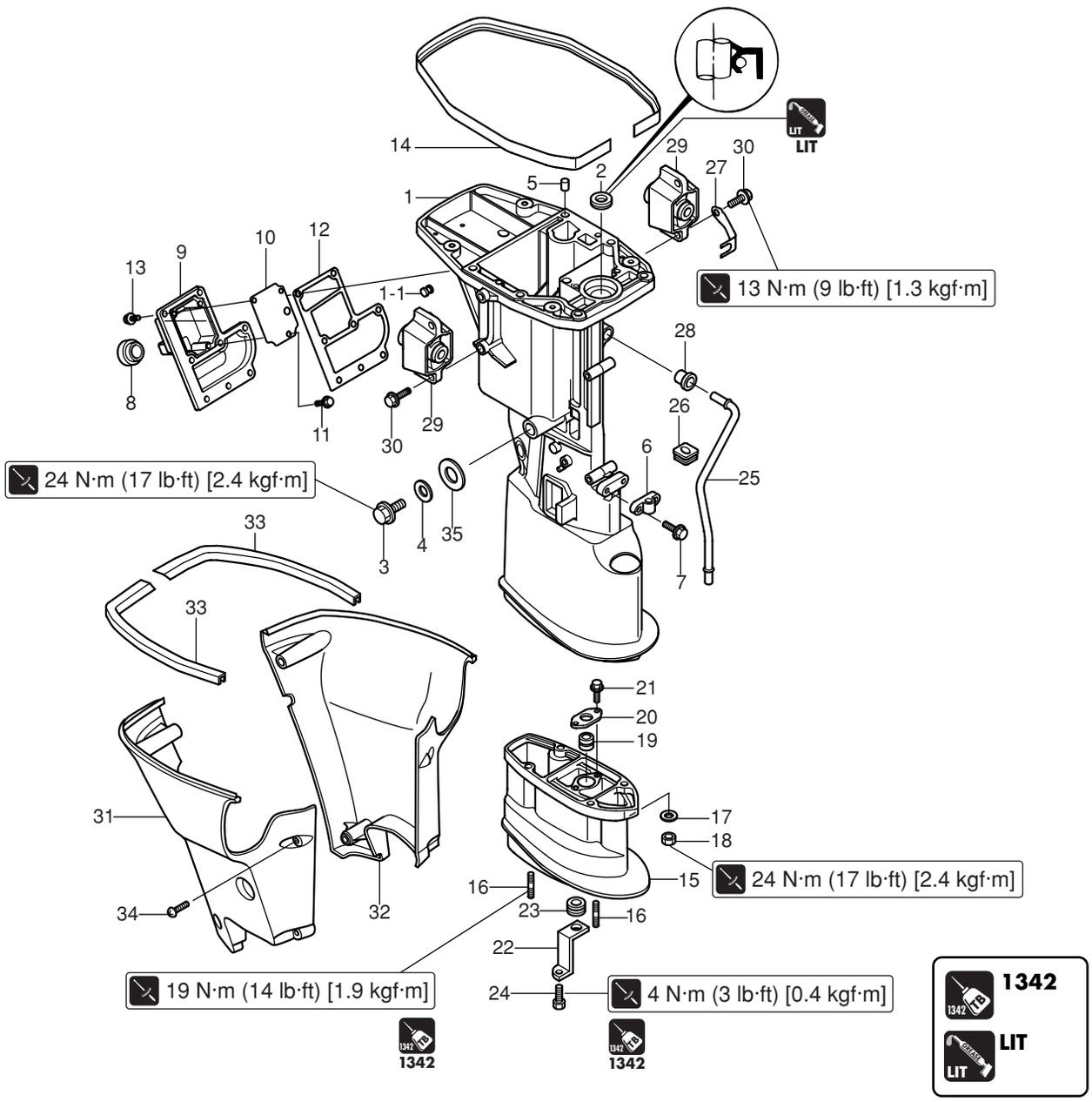
Gear Case



Ref. No.	Description	Q'ty	Remarks
1	Gear Case	1	
1-1	Needle Bearing	1	Do not reuse.
2	Ball Bearing, 6205HS	2	
3	Oil Plug	2	
4	Water Plug	1	
5	Gasket, 8.1-15-1	3	Do not reuse.
6	Propeller Shaft Housing	1	
7	Needle Bearing, 17-24-20	1	Do not reuse.
8	O-Ring, 2.4-59.6	1	Do not reuse.
9	Oil Seal, 17-30-9	1	Do not reuse.
10	Bolt	2	
11	Trim Tab	1	
12	Bolt	1	
13	Sub Water Strainer	1	
14	Screw	1	
15	Water Strainer	2	
16	Screw	1	
17	Nylon Nut, 4P-0.7	1	
18	Stud Bolt	4	
19	Nut	4	
20	Washer, 8.1-16-1.5	4	
21	Propeller Shaft Housing Ass'y	1	
22	Sub Water Pipe Plug	1	Option

Drive Shaft Housing

P/L Fig. 13

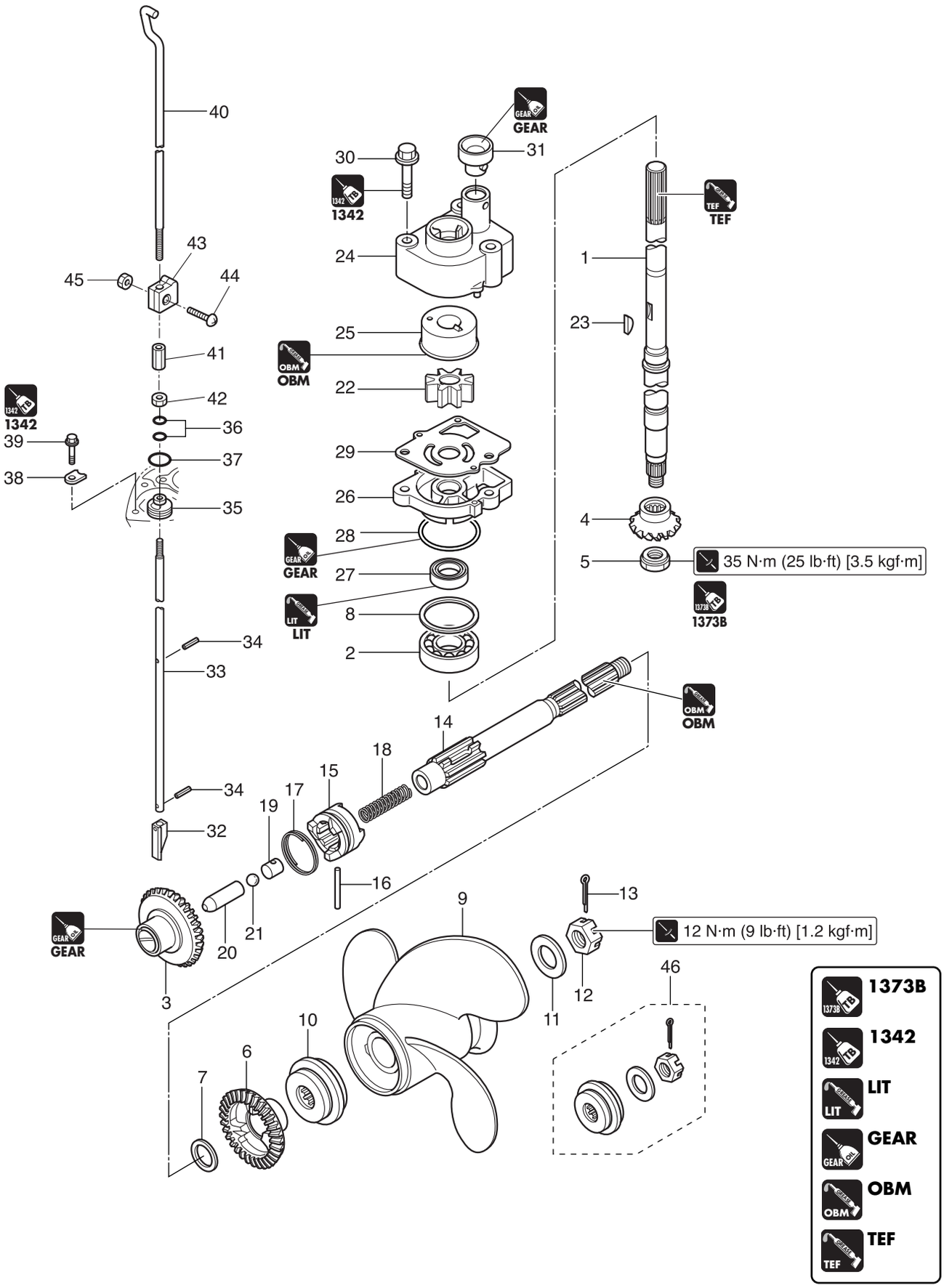


Ref. No.	Description	Q'ty	Remarks
1	Drive Shaft Housing "S"	1	
	Drive Shaft Housing "L"	1	
1-1	Exhaust Plug	1	
2	Oil Seal, 12.8-25-7	1	**Do not reuse.**
3	Drain Bolt	1	
4	Washer, 14.5-24-1	1	
5	Dowel Pin, 6-12	2	
6	Cam Rod Holder	1	for Transom "L" & "UL"
7	Bolt	2	
8	Idle Exhaust Port Grommet	1	
9	Idle Exhaust Port Cover	1	
10	Idle Exhaust Port Plate	1	
11	Bolt	3	
12	Idle Exhaust Port Gasket	1	**Do not reuse.**
13	Bolt	8	
14	Engine Basement Seal	1	
15	Extension Housing "UL"	1	for Transom "UL"
16	Stud Bolt	4	
17	Washer, 8.1-16-1.5	4	for Transom "UL"
18	Nut	4	
19	Drive Shaft Busing	1	

Ref. No.	Description	Q'ty	Remarks
20	Bushing Stopper	1	
21	Bolt	2	
22	Lock Plate	1	for Transom "UL"
23	Water Pipe Auxiliary Mount	1	
24	Screw	1	
25	Water Pipe "S"	1	for Transom "S"
	Water Pipe "L"	1	for Transom "L"
	Water Pipe "UL"	1	for Transom "UL"
26	Water Pipe Auxiliary Mount	1	
27	Water Pipe Lock Plate	1	
28	Water Pipe Seal (Upper)	1	
29	Rubber Mount (Upper)	2	for Transom "S" & "L"
	Rubber Mount (Upper)	2	for Transom "UL"
30	Bolt	4	
31	Drive Shaft Housing Cover (Right)	1	Starboard
32	Drive Shaft Housing Cover (Left)	1	Port
33	Apron Seal	2	
34	Tapping Screw, 6-60	4	
35	Oil Drain Grommet	1	

Drive System & Water Pump

P/L Fig. 15

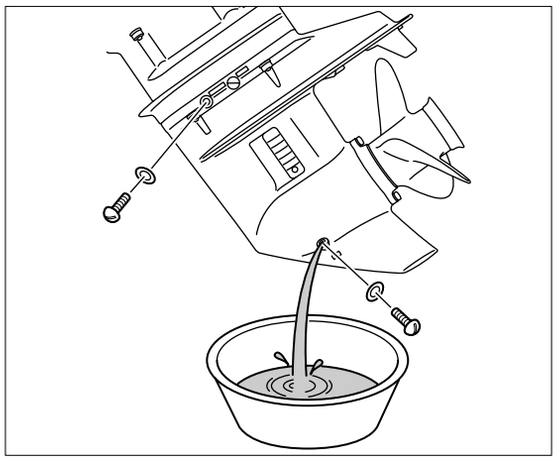


Ref. No.	Description	Q'ty	Remarks
1	Drive Shaft "S"	1	for Transom "S"
	Drive Shaft "L"	1	for Transom "L"
	Drive Shaft "UL"	1	for Transom "UL"
2	Ball Bearing, 7302A	1	Do not reuse.
3	Bevel Gear "A"	1	
4	Bevel Gear "B"	1	
5	Bevel Gear "B" Nut	1	
6	Bevel Gear "C"	1	
7	Washer, 17-22-1.5	1	
8	Shim, 35-41.9-0.1	AR	
	Shim, 35-41.9-0.15	AR	
	Shim, 35-41.9-0.3	AR	Selection if necessary.
	Shim, 35-41.9-0.5	AR	
9	Propeller (6), 3 x 234 x 155	1	
	Propeller (7), 3 x 234 x 174	1	
	Propeller (8), 3 x 235 x 203	1	STD: 9.9C "L"
	Propeller (9), 3 x 235 x 229	1	STD: 9.9C "S" STD: 15C/20C "L"&"UL"
	Propeller (10), 3 x 235 x 254	1	STD: 15C/20C "S"
	Propeller (11.5), 3 x 235 x 292	1	
	Propeller (7), 4 x 254 x 178	1	
10	Propeller Thrust Holder	1	
11	Washer, 12.5-32-2.5	1	
12	Propeller Nut	1	
13	Split Pin, 3-22	1	Do not reuse.
14	Propeller Shaft	1	
15	Clutch	1	
16	Clutch Pin	1	ø5-30mm
17	Clutch Pin Snap	1	Do not reuse.
18	Clutch Spring	1	
19	Clutch Spring Retainer	1	
20	Clutch Push Rod	1	
21	Steel Ball, 3/8	1	
22	Water Pump Impeller	1	
23	Water Pump Impeller Key	1	
24	Pump Case (Upper)	1	
25	Pump Case Liner	1	
26	Pump Case (Lower)	1	
27	Oil Seal, 13.8-26-9.5	1	Do not reuse.
28	O-Ring, 3.5-36	1	Do not reuse.
29	Water Pump Guide Plate	1	
30	Bolt	3	
31	Water Pipe Seal (Lower)	1	
32	Clutch Cam	1	
33	Cam Rod "S"	1	for Transom "S"
	Cam Rod "L"	1	for Transom "L"
	Cam Rod "UL"	1	for Transom "UL"
34	Spring Pin, 3-12	2	Do not reuse.
35	Cam Rod Bushing	1	
36	O-Ring, 2.4-5.8	2	Do not reuse.
37	O-Ring, 3.5-36	1	Do not reuse.
38	Cam Rod Bushing Stopper	1	
39	Bolt	1	
40	Shift Rod	1	
41	Shift Rod Joint	1	
42	Nut	1	
43	Reverse Lock Link Joint	1	for MF/EF/EP/EFT
44	Screw	1	for MF/EF/EP/EFT
45	Nut	1	for MF/EF/EP/EFT
46	Propeller Hard Wear Kit	set	

3. Inspection Items

1) Draining Gear Oil

1. Drain gear oil. Refer to "Replacement of Gear Oil" in Chapter 3.



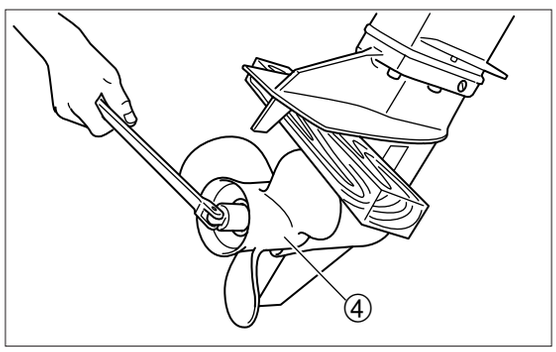
2) Removing Propeller

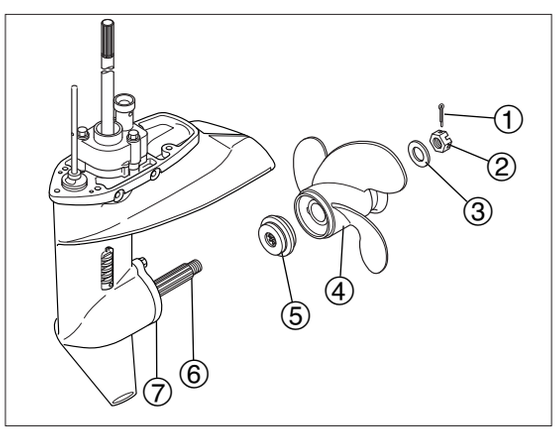
1. Shift gear into neutral (N).

2. Put a piece of wooden block between anti-cavitation plate and propeller ④ to prevent rotation of propeller ④, and then remove propeller nut ② and then propeller ④.

⚠ WARNING

- **Before removing or installing propeller, be sure to disconnect battery cables from battery and remove stop switch lock plate.**
- **When removing or installing propeller, do not handle propeller with bare hands.**
- **Put a piece of wooden block between anti-cavitation plate and propeller to prevent rotation of propeller.**



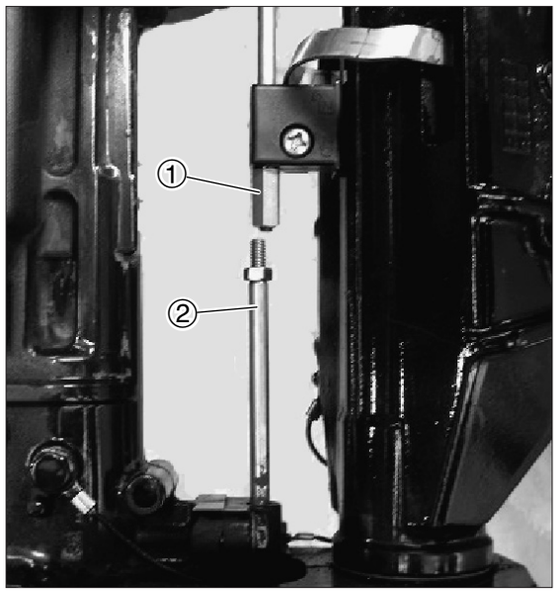


① Split pin
② Propeller nut
③ Washer
④ Propeller
⑤ Thrust holder
⑥ Propeller shaft
⑦ Propeller shaft housing

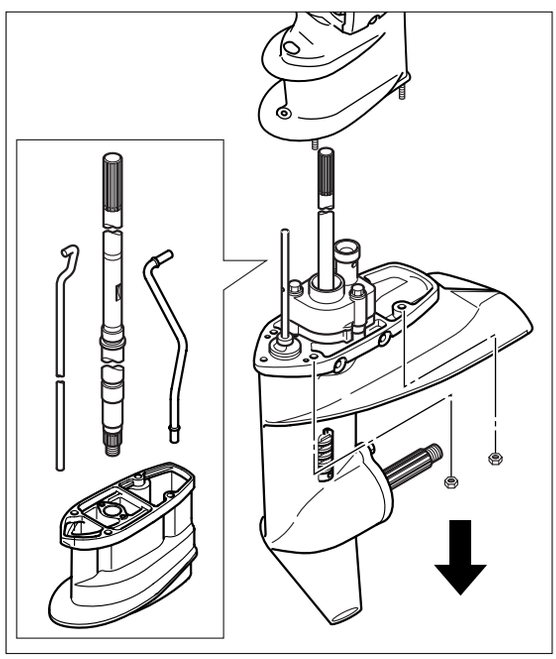
3) Removing Lower Unit

Removal of lower unit does not require removal of power unit from outboard motor body.

1. Loosen shift rod joint ① and disconnect cam rod ②.

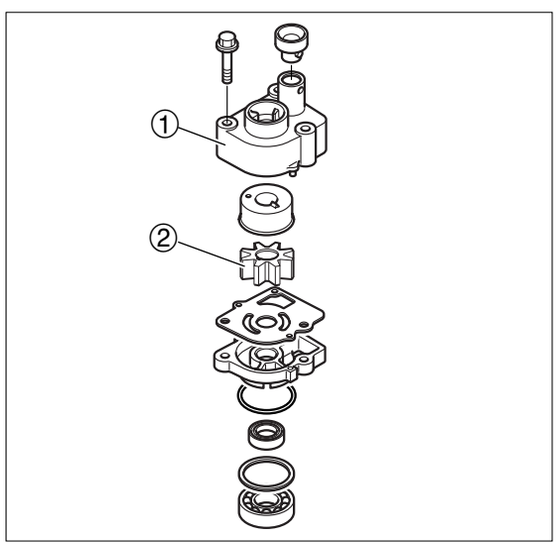


2. Remove lower unit installation bolts, and pull lower unit ass'y downward to remove.



4) Disassembly of Water Pump

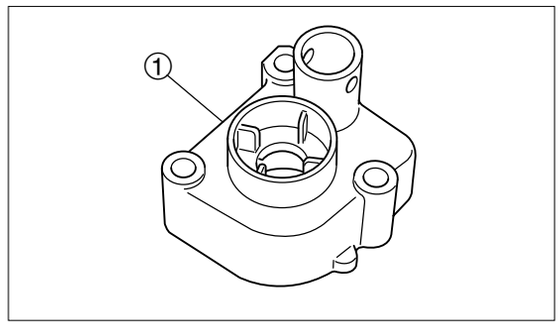
1. Remove pump case (Upper) ①.
2. Remove impeller ②.



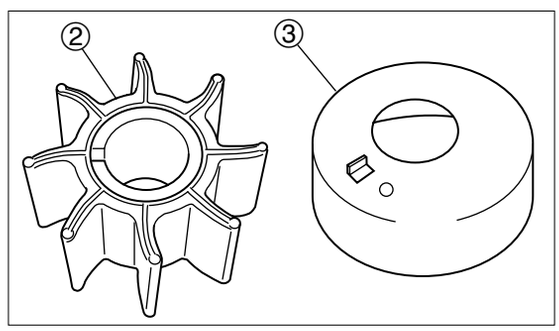
ⓐ Projection ⓑ Hole

5) Inspection of Water Pump

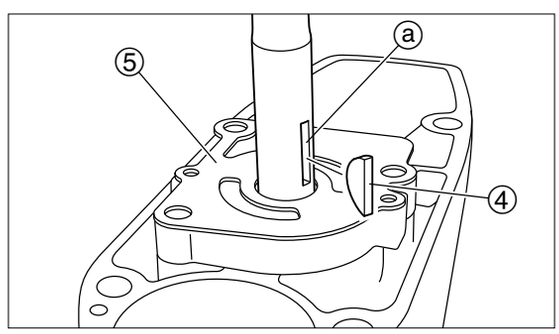
1. Check pump case (upper) ① for deformation. Replace if necessary.



2. Check impeller ② and pump case liner ③ for crack and wear. Replace if necessary.



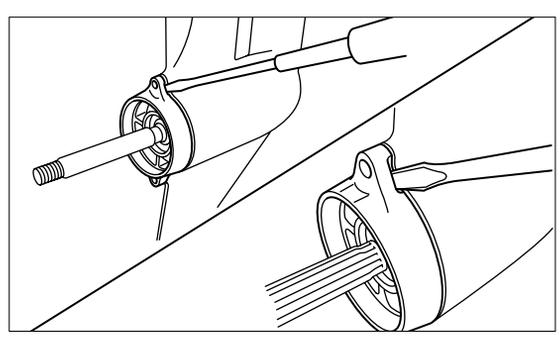
3. Check key ④, water pump guide plate ⑤ and drive shaft groove ⓐ for wear. Replace if necessary.



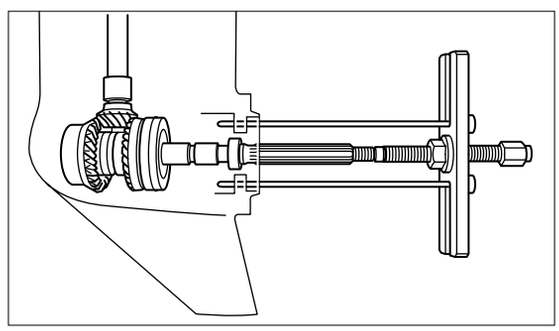
6) Removing Propeller Shaft Housing Ass'y

1. Remove propeller shaft ass'y.

Use a plastic hammer to remove the part if it cannot be removed by inserting a bladed screw driver.

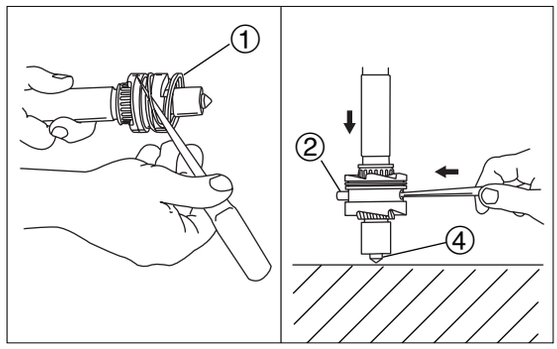


2. Use commercially available puller to remove.



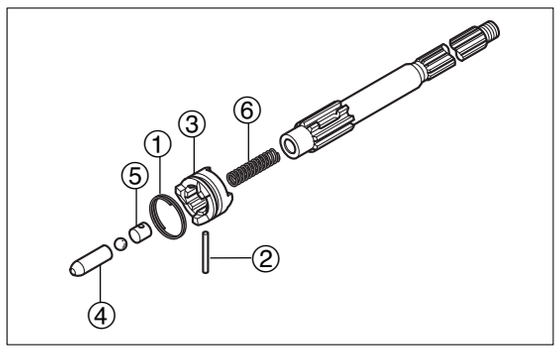
7) Disassembly of Propeller Shaft Ass'y

1. Push small bladed screw driver into clutch pin snap ① to remove it while rotating propeller shaft. Then, push clutch pin ② lightly while applying preload to push rod ④ to remove the pin. Remove clutch ③, push rod ④, ball, spring retainer ⑤, and spring ⑥.



- Take care not to allow ball fly out by easing spring tension gradually.
- Do not reuse removed clutch pin snap.

2. Check clutch ③, spring retainer ⑤, ball, and push rod ④ for crack and wear. Replace if necessary.

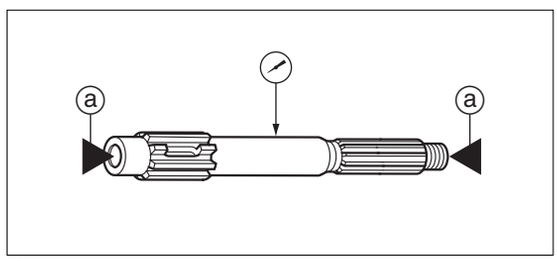


8) Inspection of Propeller Shaft

1. Check propeller shaft for bend and wear. Replace if necessary.

2. Measure propeller shaft runout.

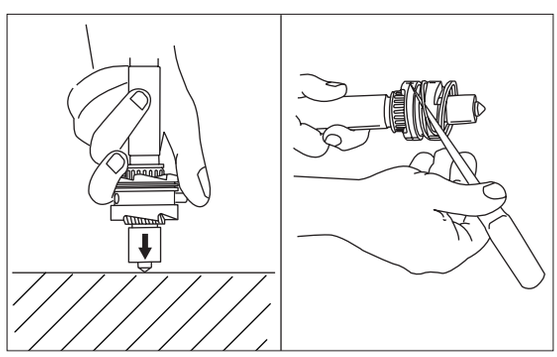
Runout Limit :
0.05 mm (0.0020 in)



ⓐ Support point

9) Assembly of Propeller Shaft Ass'y

1. Attach spring ⑥, spring retainer ⑤, ball, push rod ④, clutch ③ and clutch pin ② to propeller shaft.

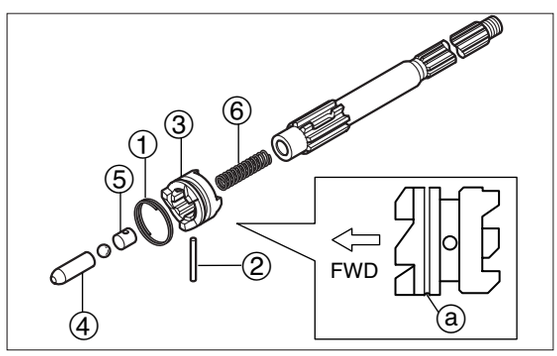


- Install clutch with groove ⓐ facing push rod side.
- Install clutch pin while applying preload to push rod.
- Be careful not to allow ball to fly out by spring tension.

2. Attach new clutch pin snap ① by using a small bladed screw driver to turn the snap spirally.

⚠ CAUTION

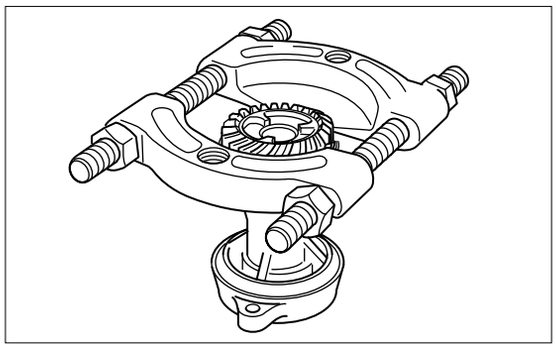
Do not reuse removed clutch pin snap.



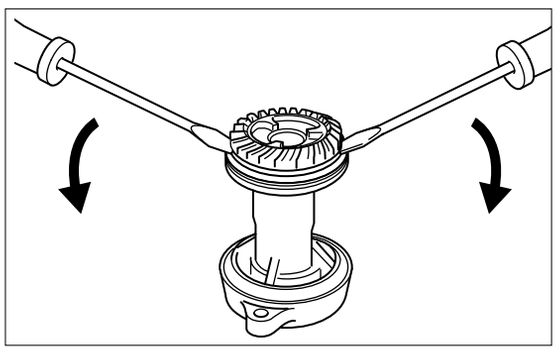
10) Disassembly of Propeller Shaft Housing

1. Tighten universal puller plate to make gap between reverse gear (C gear) and propeller shaft housing.

Universal Puller Plate :
P/N. 3AC-99750-0



2. Remove reverse gear (C gear) ass'y by putting two bladed screw drivers into the gap to force the gap to open.

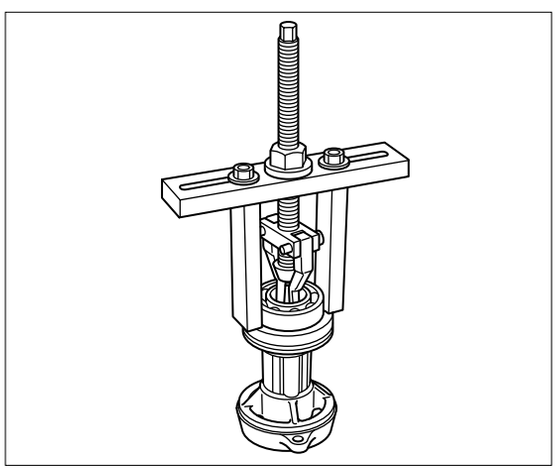


3. Use commercially available universal puller plate to remove ball bearing.

Before removing, check bearing for play or deflection. Replace if necessary.

⚠ CAUTION

Do not reuse removed bearing.



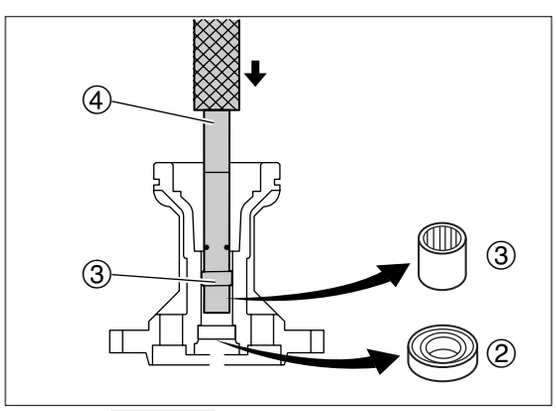
4. Use a press to remove oil seal ② and needle bearing ③ at the same time.

Before removing, check bearing for play or deflection. Replace if necessary. Direct attachment with side without O-ring to needle bearing.

⚠ CAUTION

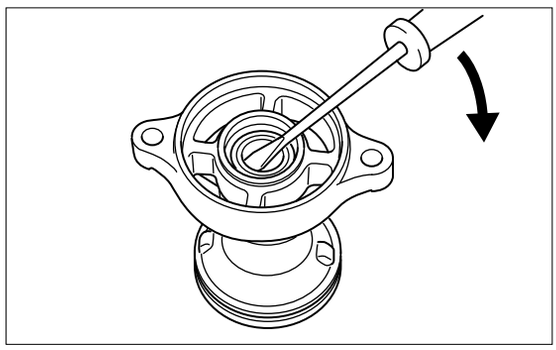
Do not reuse removed bearing.

Needle Bearing Attachment ③ :
P/N. 3BA-99710-0
Driver Rod ④ :
P/N. 3AC-99702-0



② Oil seal **Do not reuse.**
③ Needle bearing **Do not reuse.**

5. When removing only oil seal, use bladed screw driver to pry apart.



11) Inspection of Propeller Shaft Housing

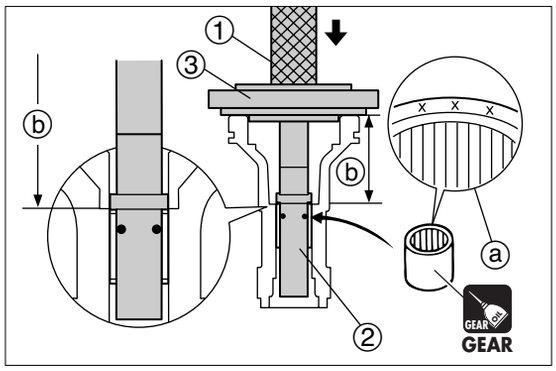
1. Use cleaning oil and cleaning brush to clean propeller shaft housing, and check it for crack or damage. Replace if necessary.

2. Check reverse (C) gear teeth and clutch for crack or damage. Replace if necessary.

3. When reusing bearing without removing it, check it for play or deflection. Replace if necessary.

12) Assembly of Propeller Shaft Housing

1. Use a press to push new needle bearing into propeller shaft bearing to specified depth.

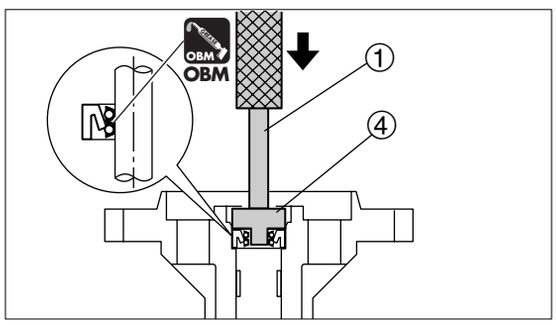


- Install needle bearing with manufacturer's marking ⓐ facing reverse (C) gear side.
- Screw needle bearing attachment ② into driver rod ① gently by using hand without making gap.

Driver Rod ① :
P/N. 3AC-99702-0
Needle Bearing Attachment ② :
P/N. 3BA-99710-0
Center Plate ③ :
P/N. 3AC-99701-0

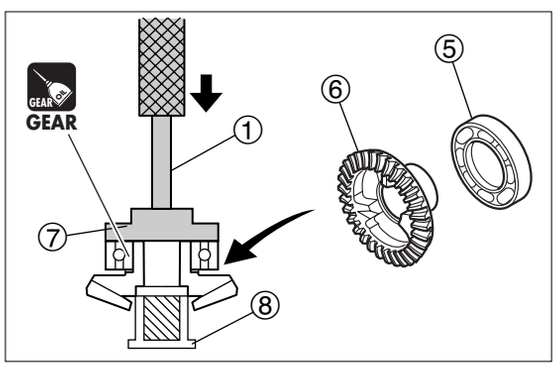
Push In Depth ⓑ :
39.0 ±0.2 mm (1.535 ±0.008 in)

2. Apply engine oil to periphery of new oil seal, and install into propeller shaft housing with number side facing upward. Apply grease to lip of oil seal after installing it.



Driver Rod ① :
P/N. 3AC-99702-0
Oil Seal Attachment 2 ④ :
P/N. 3AG-99820-0

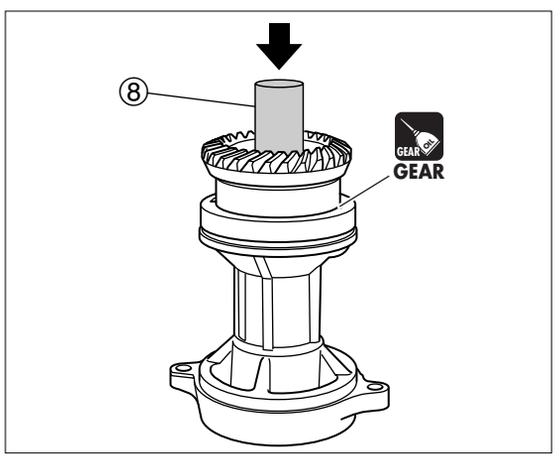
3. Use a press and suitable mandrel ⑧ to install new ball bearing ⑤ onto reverse (C) gear ⑥.



Driver Rod ① :
P/N. 3AC-99702-0
Oil Seal Attachment ⑦ :
P/N. 3UI-99820-0

- Install ball bearing with manufacturer's marking facing attachment side.

4. Use a press and suitable mandrel ⑧ to install reverse (C) gear ass'y into propeller shaft housing.

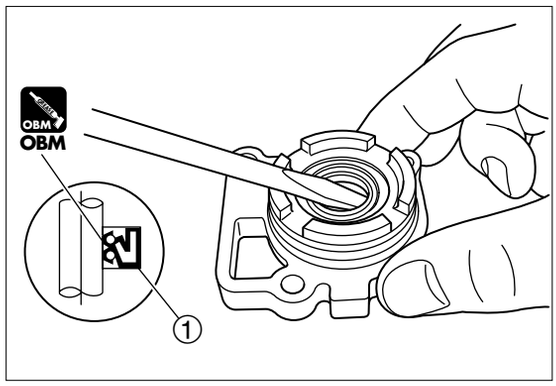


13) Removing Pump Case (Lower)

1. Remove pump case (lower).

14) Disassembly of Pump Case (Lower)

1. Use bladed screw driver to remove oil seal ①.

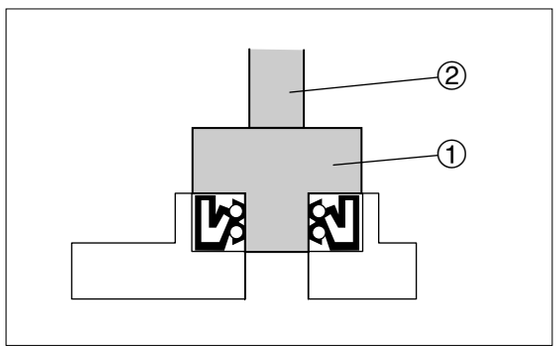


① Oil seal **Do not reuse.**

15) Assembly of Pump Case (Lower)

1. Apply engine oil to periphery of new oil seal, and install into pump case (lower) with number side facing downward.

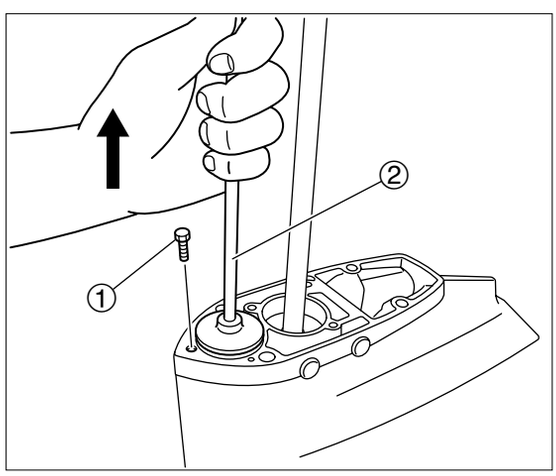
Oil Seal Attachment 3 ① :
P/N. 3BJ-99820-0
Driver Rod ② :
P/N. 3AC-99702-0



2. Apply OBM grease to lip of oil seal.

16) Removing Clutch Cam and Cam Rod

1. Remove cam rod bushing bolt ①, and pull cam rod ② ass'y upward to remove.

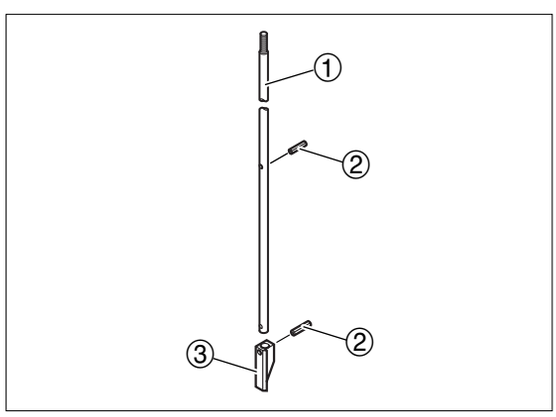


17) Disassembly of Clutch Cam and Cam Rod

1. Remove spring pin ②, clutch cam ③ and cam rod bushing from cam rod ①.

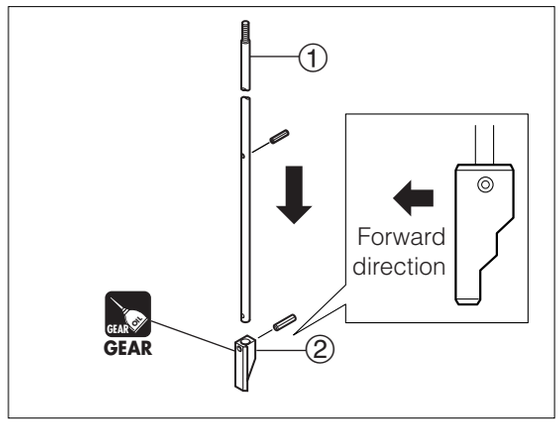
· Use spring pin tool A to remove spring pin.
· Do not reuse removed spring pin.

Spring Pin Tool A :
P/N. 345-72227-0



18) Inspection of Cam Rod and Clutch Cam

1. Check cam rod ① and clutch cam ② for crack and wear. Replace if necessary.



19) Assembly of Cam Rod and Clutch Cam

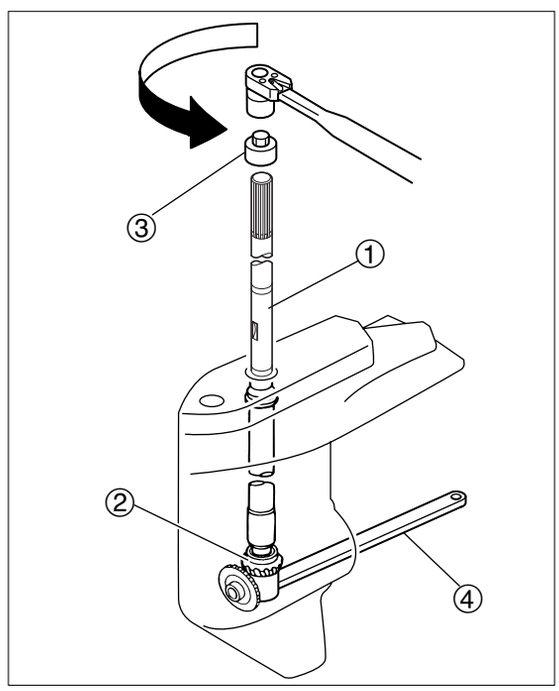
1. Reassemble.

Be careful of direction of cam rod.

20) Removing Drive Shaft

1. Remove pinion (B) gear nut, remove drive shaft ass'y ① and pinion (B) gear ②, and draw out forward (A) gear.

Bevel Gear B Nut Socket ③ :
P/N. 350-72232-0
Bevel Gear B Nut wrench ④ :
P/N. 346-72231-0



- When removing drive shaft, be careful not to give damage to shim on the bearing outer race and not to lose the part. Shim is reusable.
- Replace shim with new one of the same thickness if any deformation or damage is found on it.

21) Disassembly of Drive Shaft

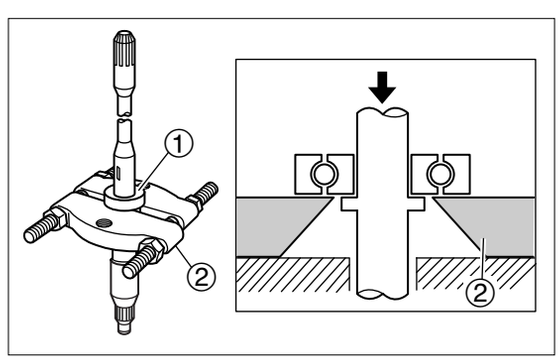
1. Remove drive shaft bearing ①.

Before removing, check bearing for play or deflection. Replace if necessary.

⚠ CAUTION

Do not reuse bearing. Be sure to replace with new one.

Universal Puller Plate ② :
P/N. 3AC-99750-0

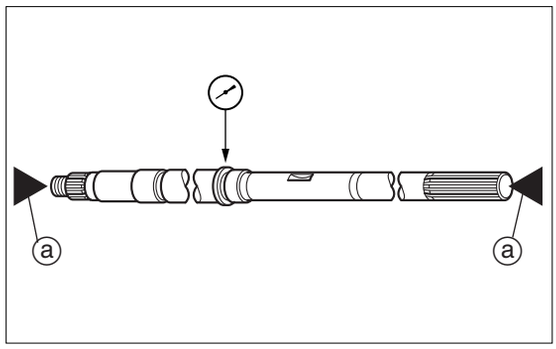


22) Inspection of Drive Shaft

1. Check drive shaft for bend and wear. Replace if necessary.

2. Measure drive shaft runout.

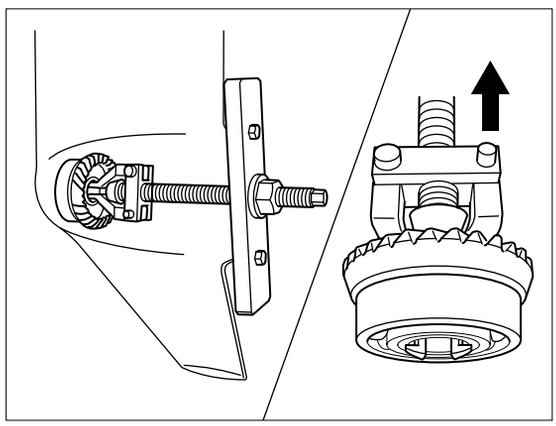
Runout Limit : 0.5 mm（0.020 in）



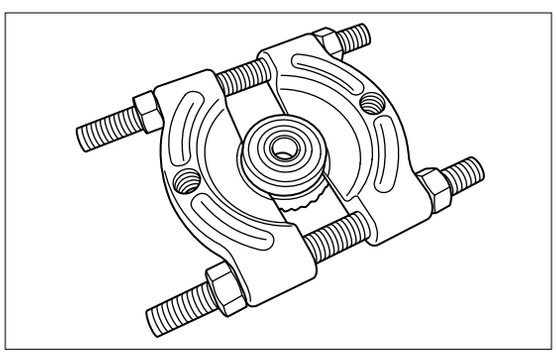
ⓐ Support point

23) Removing Forward (A) Gear

1. Use commercially available bearing puller ① to remove forward (A) gear from gear case.

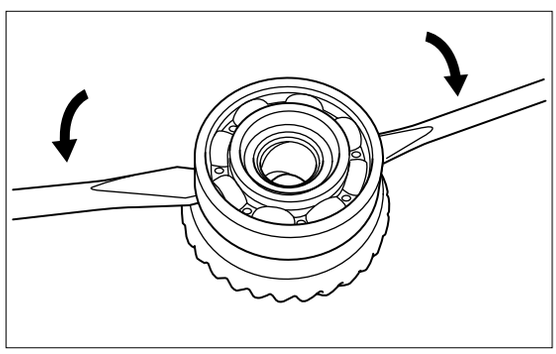


2. Use universal puller plate to make gap between ball bearing and forward gear.

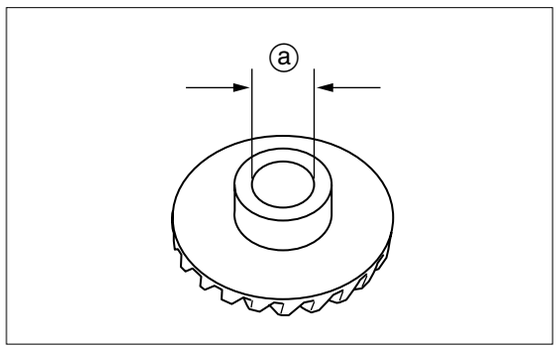


3. Put two bladed screw drivers in the gap and pry out forward (A) gear from bearing.

· Before removing, check bearing for play or deflection. Replace if necessary.



24) Inspection of Pinion (B) Gear and Forward (A) Gear

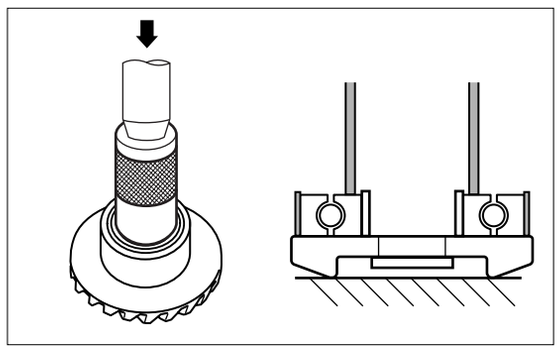


1. Check pinion (B) gear and forward (A) gear teeth and clutch for crack and wear. Replace if necessary.

2. Measure forward (A) gear bushing inner diameter ⓐ. If worn severely, replace gear with new one.

Forward (A) gear bushing inner diameter ⓐ: Standard value
16.013 - 16.077 mm (0.6304 - 0.6332 in)

25) Assembly of Forward (A) Gear

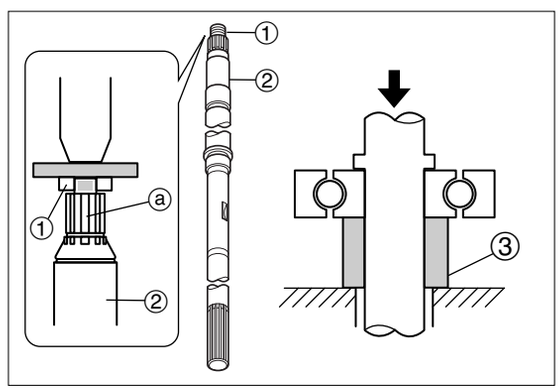


1. Attach removed shim or shim of the same thickness to forward (A) gear.

2. Use a press to install new ball bearing to forward (A) gear.

Bevel Gear Bearing Install Tool ① :
P/N. 346-72719-0

26) Assembly of Drive Shaft



1. Attach pinion (B) gear nut ① to drive shaft ② temporarily.

2. Use a press and a pipe with proper diameter ③ to install new drive shaft bearing on drive shaft ②.

⚠ CAUTION

- **Do not press drive shaft thread ⓐ directly.**
- **Do not reuse bearing. Be sure to replace with new one.**

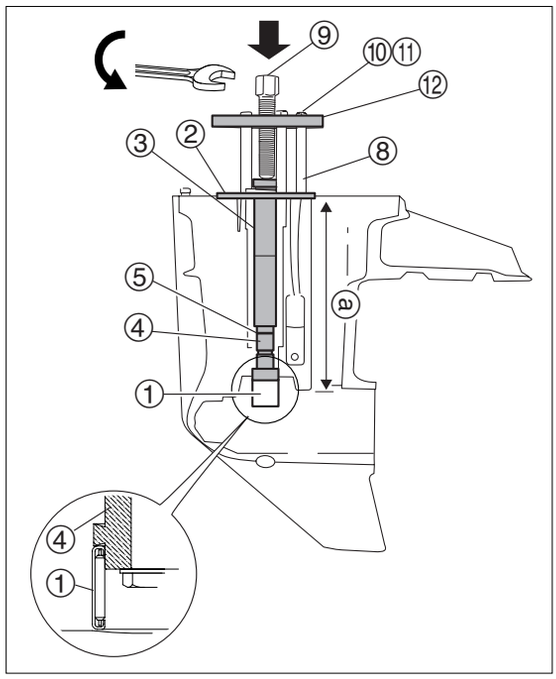
27) Disassembly of Gear Case

1. Remove needle bearing ① by using the following tools.

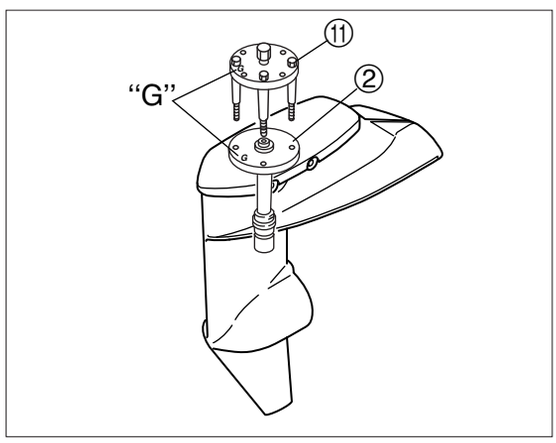
Needle bearing press Ass'y :
P/N. 3AC-72900-1
Bearing outer press guide ② :
Needle Bearing Press Rod ③ :
Needle Bearing Press ④ :
O ring ⑤ :
Needle Bearing Press Collar ⑧ :
Needle Bearing Press Bolt ⑨ :
Bolt M8-110 ⑩ :
Washer ⑪ :
Needle Bearing Press Flange ⑫ :

⚠ CAUTION

When installing guide ② and flange ⑫, face "G" mark forward direction.



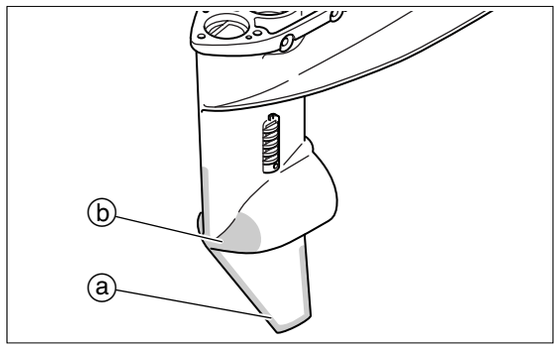
① Needle Bearing



6

28) Inspection of Gear Case

1. Check skeg area ⓐ and torpedo-like area ⓑ for crack and damage. Replace if necessary.



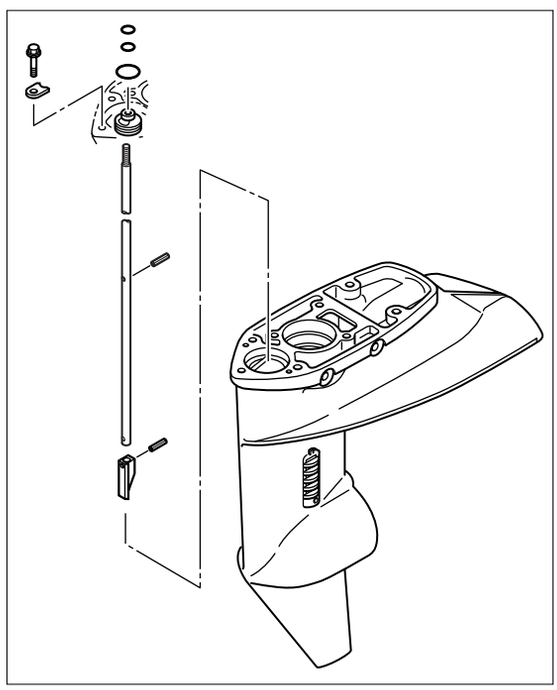
29) Assembly of Lower Unit

Perform shim adjustment when ball bearing, gear, drive shaft, propeller shaft or gear case is replaced.

1. Install cam rod ass'y ① as shown.

Cam Rod Bushing Bolt :
6 N · m (4 lb · ft) [0.6 kgf · m]

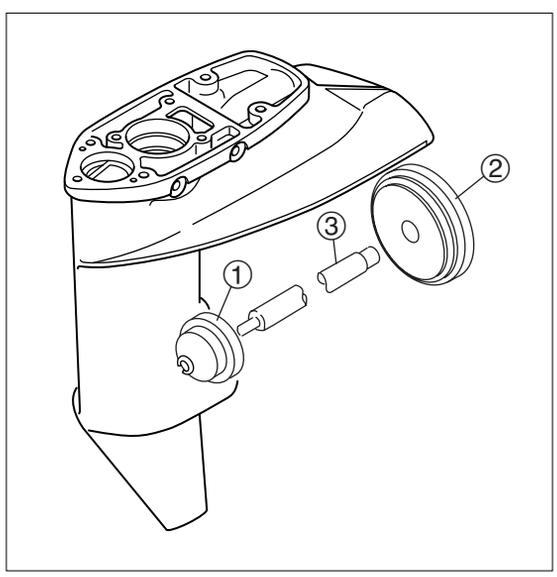
Be careful of direction of cam rod.



30) Assembly of Gear Case

1. Use the following tools to install taper roller bearing ① outer race.

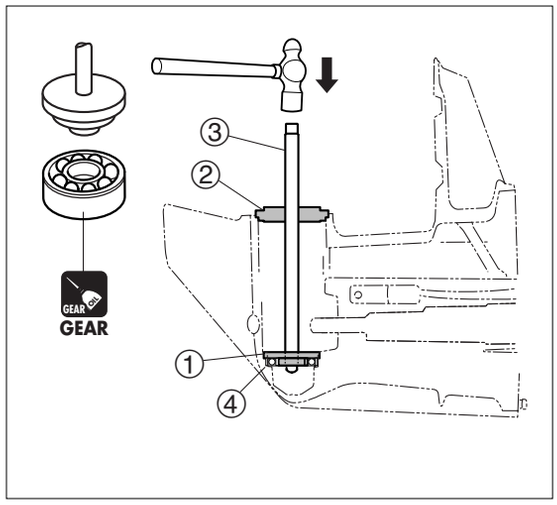
Bearing Outer Press Kit :
P/N. 3B7-72739-1
Bearing Outer Press Plate ① :
P/N. 3BJ-72732-0
Bearing Outer Press Guide ② :
P/N. 3BJ-72733-0
Bearing Outer Press Rod ③ :
P/N. 3B7-72731-0



2. Fix gear case on the vice with its propeller shaft opening facing upward.

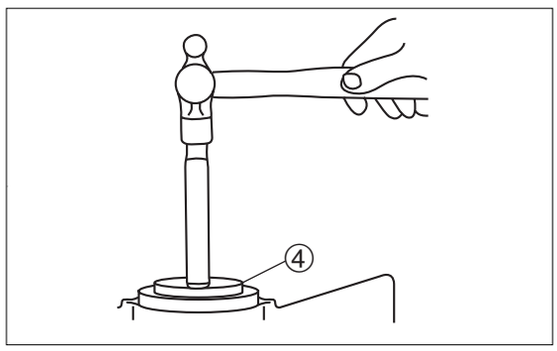
3. Clean outer race installation face in the gear case and apply gear oil.

4. Apply gear oil to external face of outer race, and put the outer race in the center of the housing with the marked face of the race facing in the housing.



5. Tap the end of the rod with a hammer to press-fit the ball bearing ④ in the housing securely.

The hammering sound changes when the ball bearing is set in the housing properly.



6. Check that ball bearing is press-fit in the housing surely, and then press-fit gear A by using the following tools.

Backlash Measuring Tool Kit :
P/N. 3C8-72234-1

Backlash Measuring Tool Shaft ⑤ :
P/N. 345-72723-0

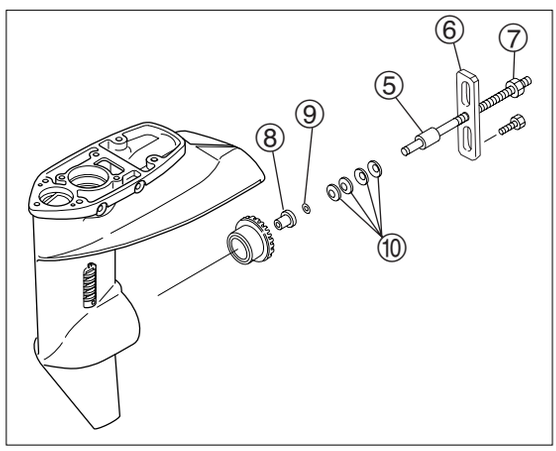
Backlash Measuring Tool Plate ⑥ :
P/N. 3A3-72724-0

Nut M12P1.5 ⑦ :
P/N. 930191-1000

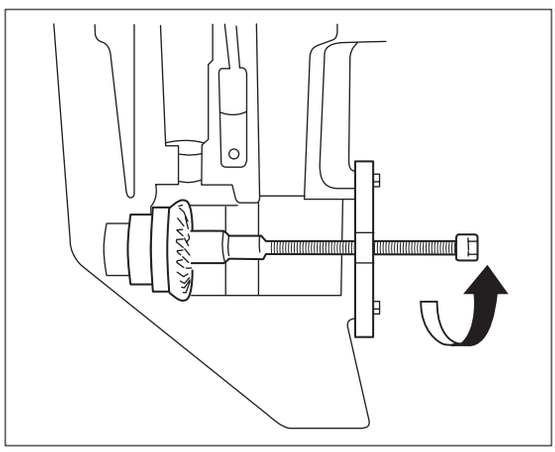
Measuring Tool Set Piece ⑧ :
P/N. 3BJ-72245-0

O-Ring ⑨ :
P/N. 332-60002-0

Cone Disk Spring ⑩ :
P/N. 3B7-72734-0



Fixing gear case on the vice with its propeller shaft opening facing upward makes the work easier.



7. Install needle bearing ① by using the following tools.

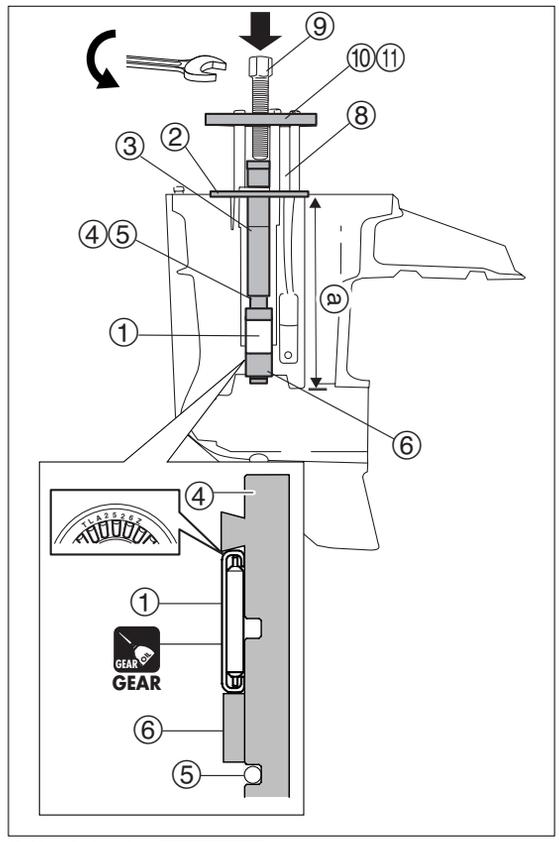
Needle bearing press Ass'y :
P/N. 3AC-72900-1
Bearing outer press guide ② :
Needle Bearing Press Rod ③ :
Needle Bearing Press ④ :
O ring ⑤ :
Needle Bearing Press Collar ⑧ :
Needle Bearing Press Bolt ⑨ :
Bolt M8-110 ⑩ :
Washer ⑪ :
Needle Bearing Press Flange ⑫ :

⚠ CAUTION

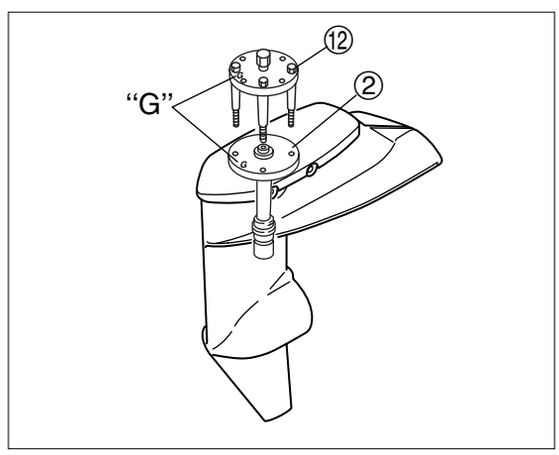
- **When installing guide ② and flange ⑫, face "F" mark forward direction.**
- **Install bearing so that marked side faces upward.**

· Before installing needle bearing, be sure to clean bearing installation face and apply gear oil.
· Do not reuse needle bearing. Use new item.

Push In Depth ⓐ :
189.75 ±0.3 mm (7.4705±0.008 in)



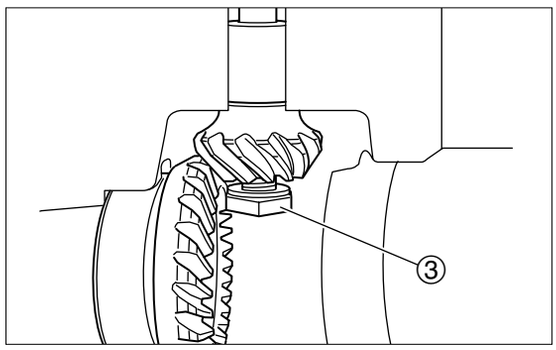
① Needle bearing **Do not reuse.**



31) Installation of Pinion (B) Gear

1. Clean gear case interior.

2. After installing forward (A) gear into bear case, install drive shaft ass'y ①, pinion (B) gear ② and pinion (B) gear nut ③, and tighten the nut to specified torque.

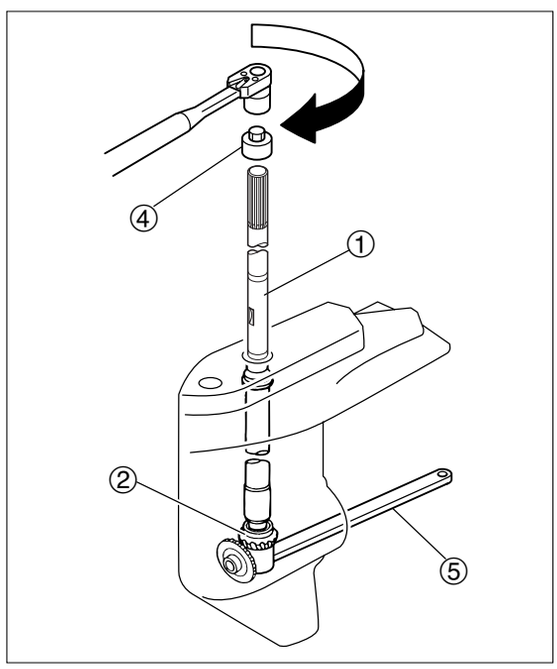


Pinion (B) Gear Nut :
35 N · m (25 lb · ft) [3.5 kgf · m]

Bevel Gear B Nut Socket ④ :
P/N. 346-72232-0
Bevel Gear B Nut wrench ⑤ :
P/N. 346-72231-0

3. Stand gear case vertically. (Make drive shaft vertical.)

Take case of direction of pinion (B) gear nut seating surface.

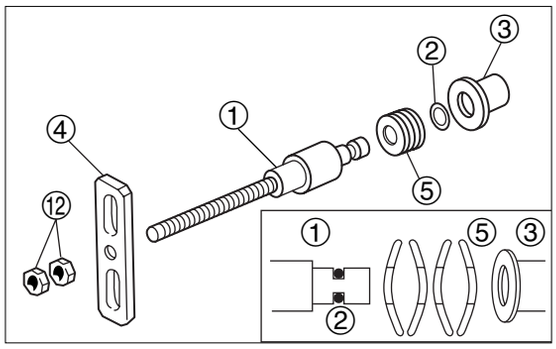


6

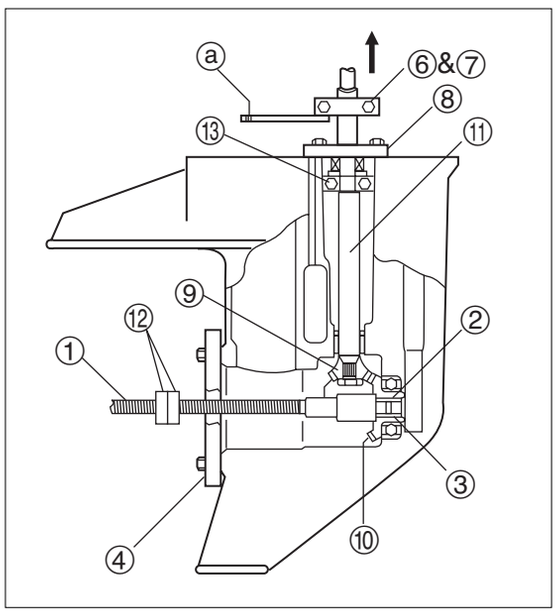
32) Determination of Forward (A) Gear Backlash

Backlash Measuring Tool Kit :
P/N. 3C8-72234-1
Backlash Measuring Tool Shaft ① :
O-Ring ② :
Measuring Tool Set Piece ③ :
Backlash Measuring Tool Plate ④ :
Cone Disk Spring ⑤ :
Nut M12P1.5 ⑫ :
Clamp A ⑥ :
P/N. 3B7-72720-0
Clamp B ⑦ :
P/N. 3B7-72720-0
Dial Gauge Plate :
P/N. 3B7-72729-0

⑧ Pump Case (Lower)
⑨ Pinion (B) Gear



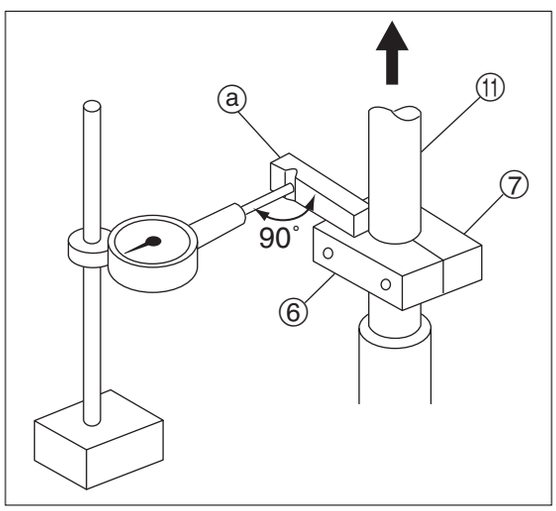
1. Perform measurement of backlash between forward (A) gear and pinion (B) gear with propeller shaft housing, propeller shaft and reverse (C) gear removed from gear case.
   Put conical disk springs ⑤ on the groove side of shaft ① getting their concave sides face to face, put O-ring ② in the groove, and then, collar ③. Then, screw plate ④ fully onto shaft ①. Put collar ③ side of shaft ① into bearing of forward (A) gear ⑩, and secure plate ④ to gear case with bolts.
   Put two nuts (M10) ⑫ on the aft-end of shaft ①, and screw the nuts onto the shaft with wrench. When drive shaft ⑪ starts to rotate as the nuts are turned, screw the nuts 45 degrees additionally. Keep shaft ① in this state.



2. Secure clamps A⑥ and B⑦ with bolt. Preload the bearing by turning drive shaft ⑪ several time while pulling it up toward direction shown by arrow to adapt it. Use dial gauge to read backlash at location of notch groove ⓐ.

Proper Backlash Obtained from Gauge Reading :
0.60 - 1.00 mm (0.0236 - 0.0393 in)

Sizes of Adjusting Shims :
For Pinion (B) Side : 0.1, 0.15, 0.3, 0.5mm



3. Perform shim adjustment as necessary based on the gauge value obtained. The table shows relation between dial gauge readings and shim adjustments.

1.Values in this table indicate dial gauge readings that are obtained when using special tool.
2.Change gear engagement position and measure backlash again.

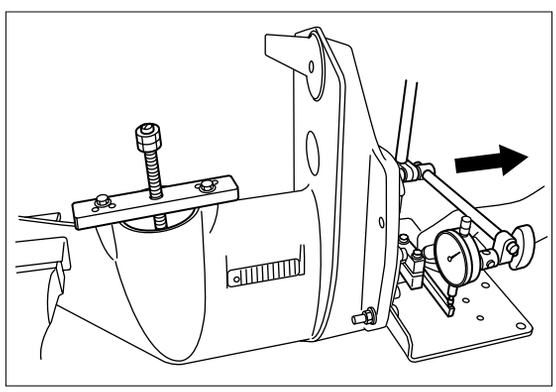
Gauge Reading mm	Shim Adjustment mm
0.60 - 1.00	0
1.01 - 1.15	0.1
1.16 - 1.40	0.2
1.41 - 1.65	0.3
1.66 - 1.90	0.4

4. After the adjustment, remove backlash measuring tool, and turn drive shaft while pulling it up to see if it turns smoothly. If not, reduce shim thickness 0.05mm and adjust backlash again.

If engagement of bevel (A) gear with pinion (B) gear is imperfect, they may produce abnormal noise when turning drive shaft while pulling it up. In such case, reduce shim thickness 0.05mm.

Keep the following matters in mind when performing the measurement.

- Shaft ① that secures forward (A) gear has been tightened so that drive shaft ⑪ cannot be turned over backlash if it is turned lightly.
- Fixing of drive shaft bearing ⑬ is performed only with pump case (lower) ⑧. Clamp halves A⑥ and B⑦ should be attached as close to pump case (lower) ⑧ as possible.
- When performing the measurement by using dial gauge, gear case and dial gauge are fixed and drive shaft ⑪ is turned while it is pulled up. During the measurement, be sure that other parts do not produce play (play of drive shaft ⑪ itself and the one between drive shaft ⑪ and bearing).



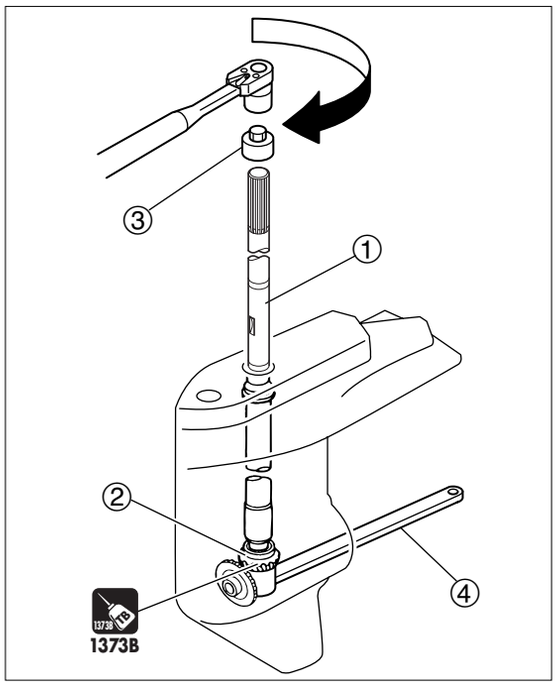
33) Reassembly of Pinion (B) Gear Nut

1. Assemble drive shaft ass'y ①, pinion (B) gear ② and pinion (B) gear nut, and tighten the nut to specified torque.

Bevel Gear B Nut Socket ③ :
P/N. 346-72232-0
Bevel Gear B Nut wrench ④ :
P/N. 346-72231-0

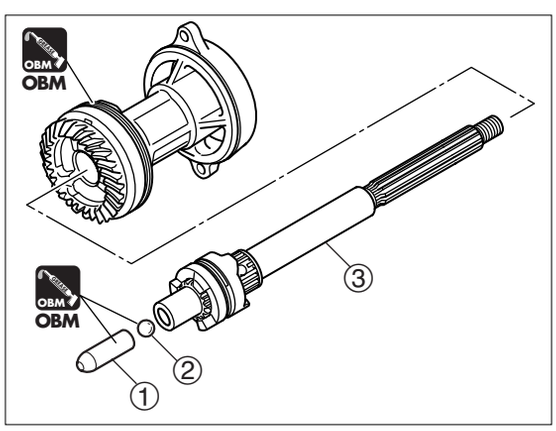
Pinion (B) Gear Nut :
35 N · m (25 lb · ft) [3.5 kgf · m]

After settling pinion (B) gear height and forward (A) backlash, apply "Three Bond 1373B" to pinion (B) gear nut thread and tighten the nut to specified torque.



34) Assembly of Propeller Shaft Housing

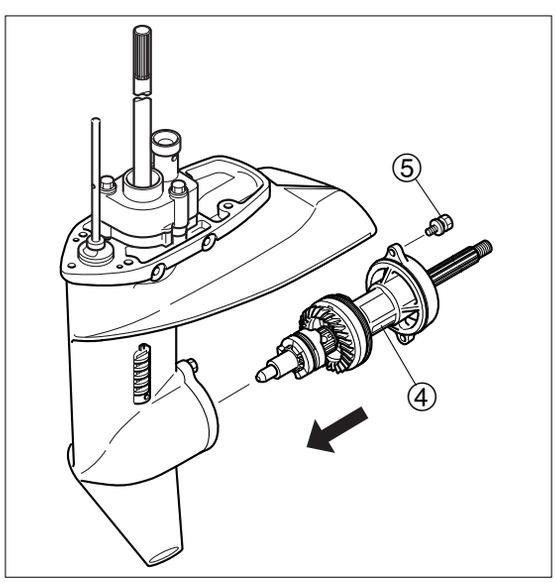
1. Check that OBM grease is applied to housing ass'y oil seal.
2. Attach washer and propeller shaft ass'y to propeller shaft housing ass'y.
3. Apply grease to new O-ring.
4. Apply grease to push rod ① and ball ②, and install them to propeller shaft ③.



5. Attach propeller shaft housing ass'y ④ to gear case, and tighten bolts ⑤ to specified torque.

Pinion (B) Gear Nut ⑤ :
13 N · m (9 lb · ft) [1.3 kgf · m]

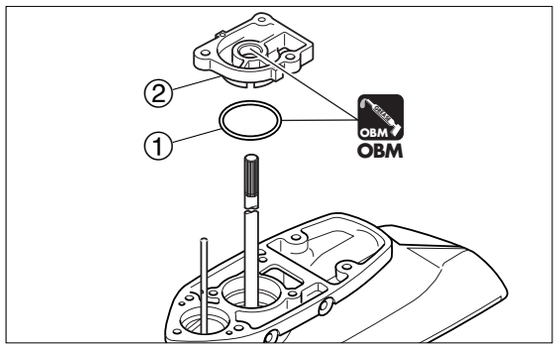
- Use grease to prevent ball from falling from push rod.
- When installing housing ass'y to gear case, tighten upper and lower bolts in 2 or 3 steps evenly to specified torque.



35) Reassembly of Pump Case (Lower)

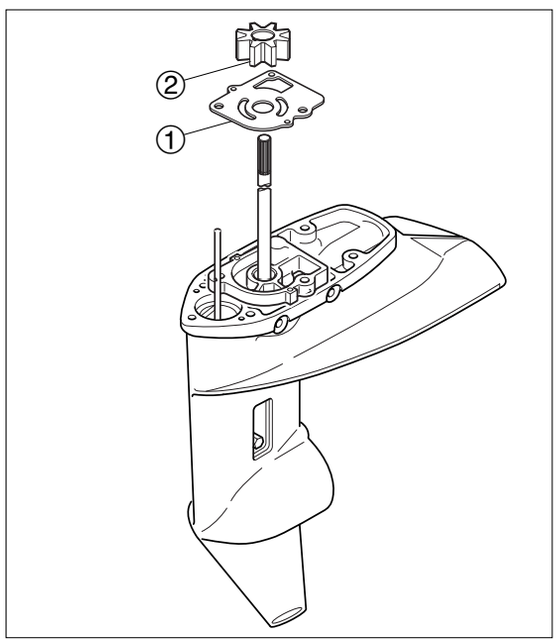
1. Remove pump case (lower) and apply OBM grease to oil seal.

2. Attach new O-ring ① and pump case (lower) ②.



36) Assembly of Water Pump

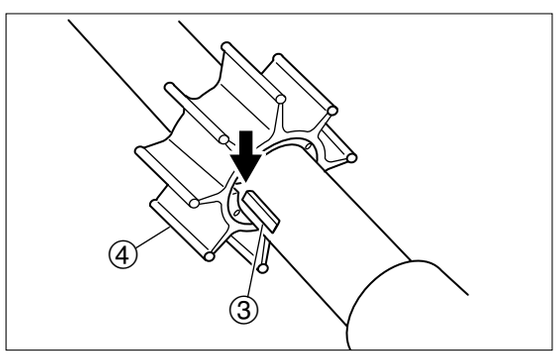
1. Assemble water pump guide plate ① and impeller ②.



2. Use plastic hammer to install key ③ to drive shaft.

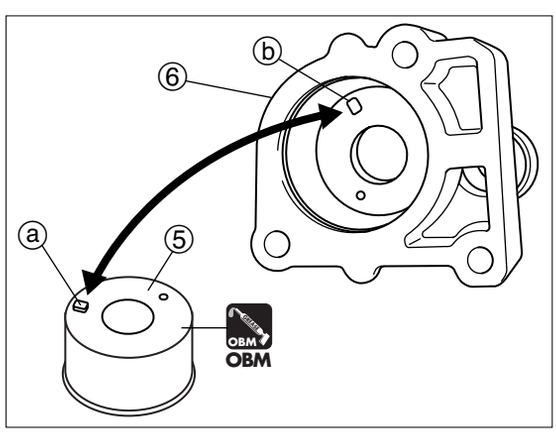
3. Bring impeller ④ groove to key ③ and install impeller to drive shaft.

> When reusing impeller, install it so that it rotates in original direction.



4. Attach pump case liner ⑤ to pump case (upper) ⑥, and apply grease to interior of pump case liner ⑤.

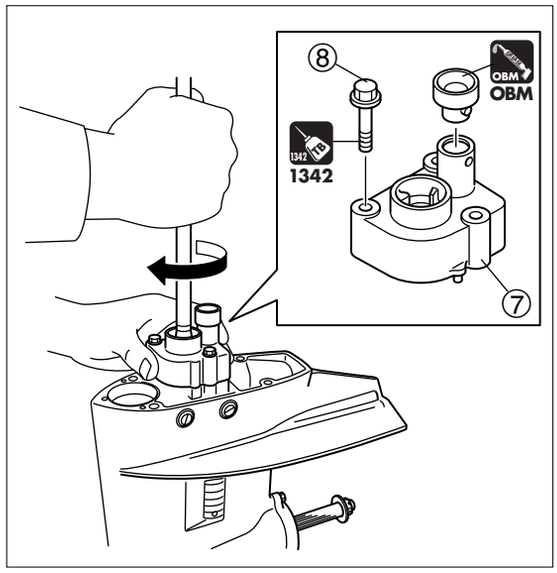
> Bring pump case liner projection ⓐ to pump case (upper) groove ⓑ.



5. Install pump case (upper) ass'y ⑦ on the gear case, and tighten bolts ⑧ in two or three steps to specified torque.

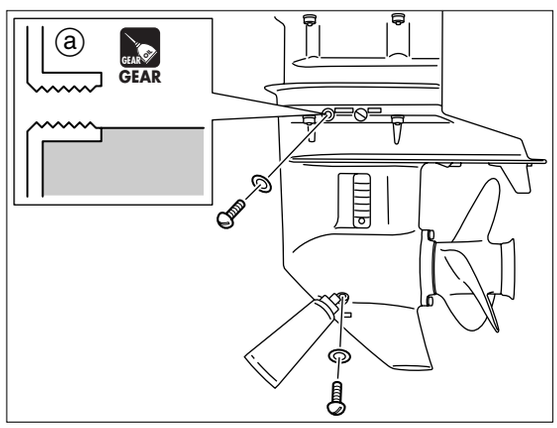
Apply grease to interior of pump case liner, and install pump case (upper) by pushing it down with hand while turning drive shaft clockwise.

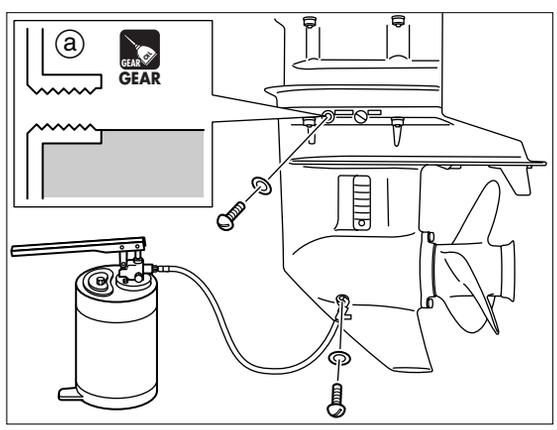
Pump Case (Upper) Bolt ⑧ :
6 N · m (4 lb · ft) [0.6 kgf · m]



6. Feed gear oil to specified quantity ⓐ. "Refer to Chapter 3."

Perform "Inspection of Gear Case (Air Leakage)" in Chapter 3 if necessary.

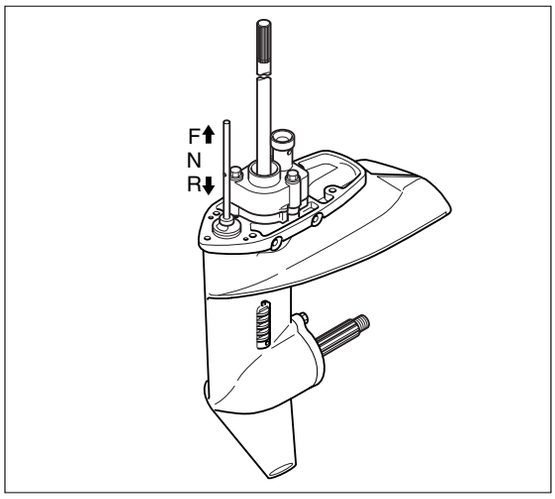




37) Installation of Lower Unit

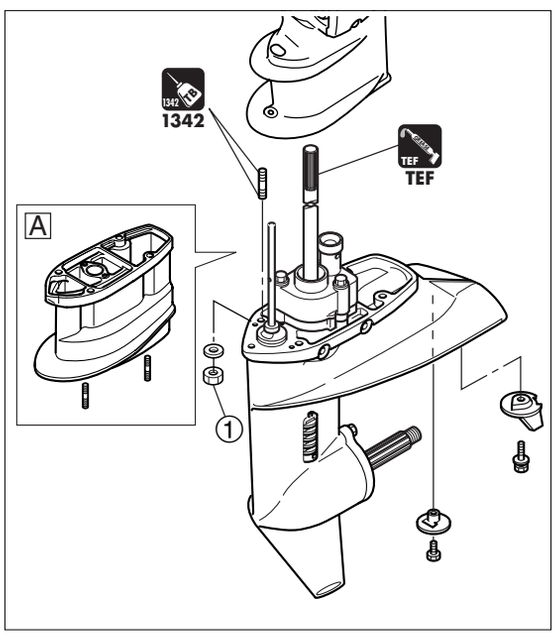
1. Set cam rod to reverse (R) position.

Connect water pipe securely. Move flywheel a little or shift gear into reverse (R), install propeller, and turn propeller shaft counterclockwise to engage spline.



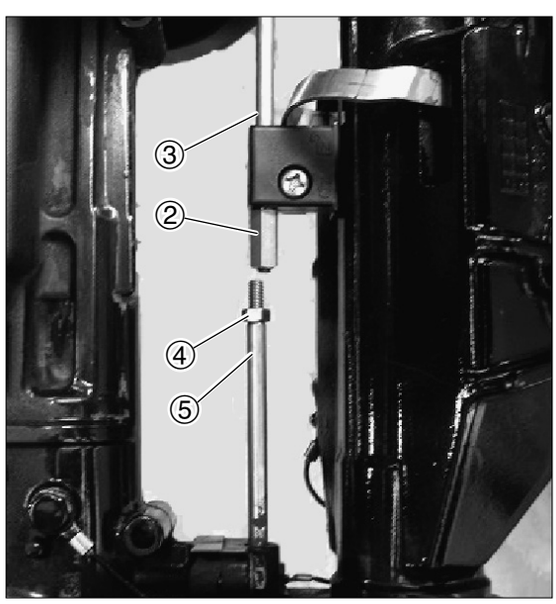
2. Attach lower unit ass'y to drive shaft housing, and tighten lower unit installation bolts (nuts) ① to specified torque.

Gear Case Installation Bolt (Nut) ① :
13 N · m (9 lb · ft) [1.3 kgf · m]



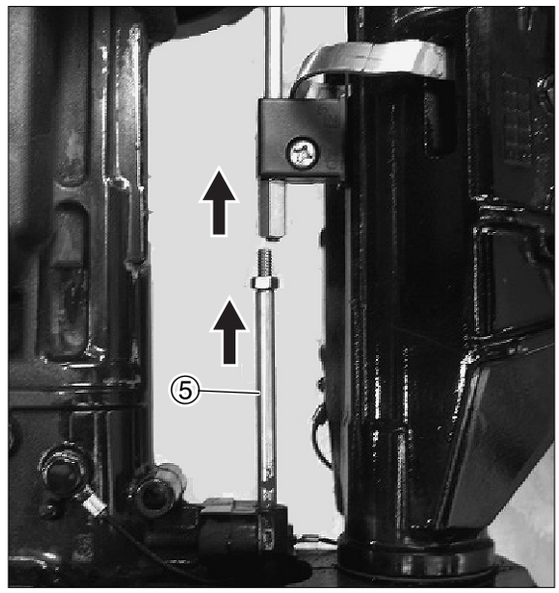
A "UL" Transom Model

3. Fully install shift rod joint ② onto the shift rod ③ and the jam nut ④ fully onto the cam rod ⑤.

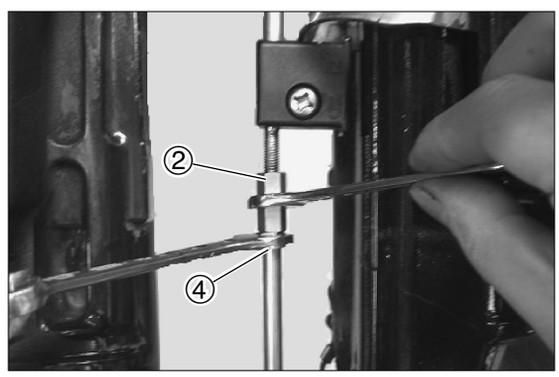


6

4. Place shift lever in the forward (F) position and pull cam rod ⑤ upward.

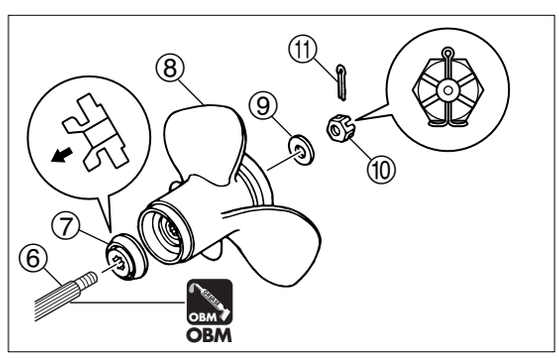


5. Connect shift rod and cam rod with shift rod joint ②. Hold jam nut ④ and tighten shift rod joint fully.



6. Apply grease to propeller shaft ⑥.

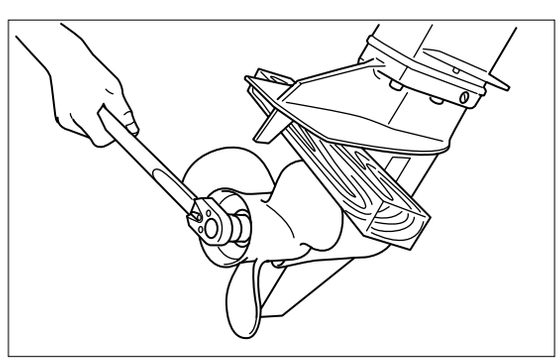
7. Attach thrust holder ⑦, propeller ⑧, washer ⑨ and propeller nut to propeller shaft ⑩. Put a piece of wooden block between anti-cavitation plate and propeller to prevent rotation of propeller, and tighten propeller nut to specified torque.



⚠ WARNING

- **Before removing or installing propeller, be sure to disconnect battery cables from battery and remove stop switch lock plate.**
- **When removing or installing propeller, do not handle propeller with bare hands.**
- **Put a piece of wooden block between anti-cavitation plate and propeller to prevent rotation of propeller.**

8. Turn propeller nut to tightening direction to align one of grooves to propeller shaft hole, and attach split pin ⑪.



If propeller nut groove cannot be aligned with split pin hole, loosen nut and repeat steps 6 and 7.

Propeller Nut ⑩ :
12 N · m (9 lb · ft) [1.2 kgf · m]

9. Check gear oil level. "Refer to Chapter 3."

Perform "Inspection of Lower Unit (Air Leakage)" in Chapter 3 if necessary.

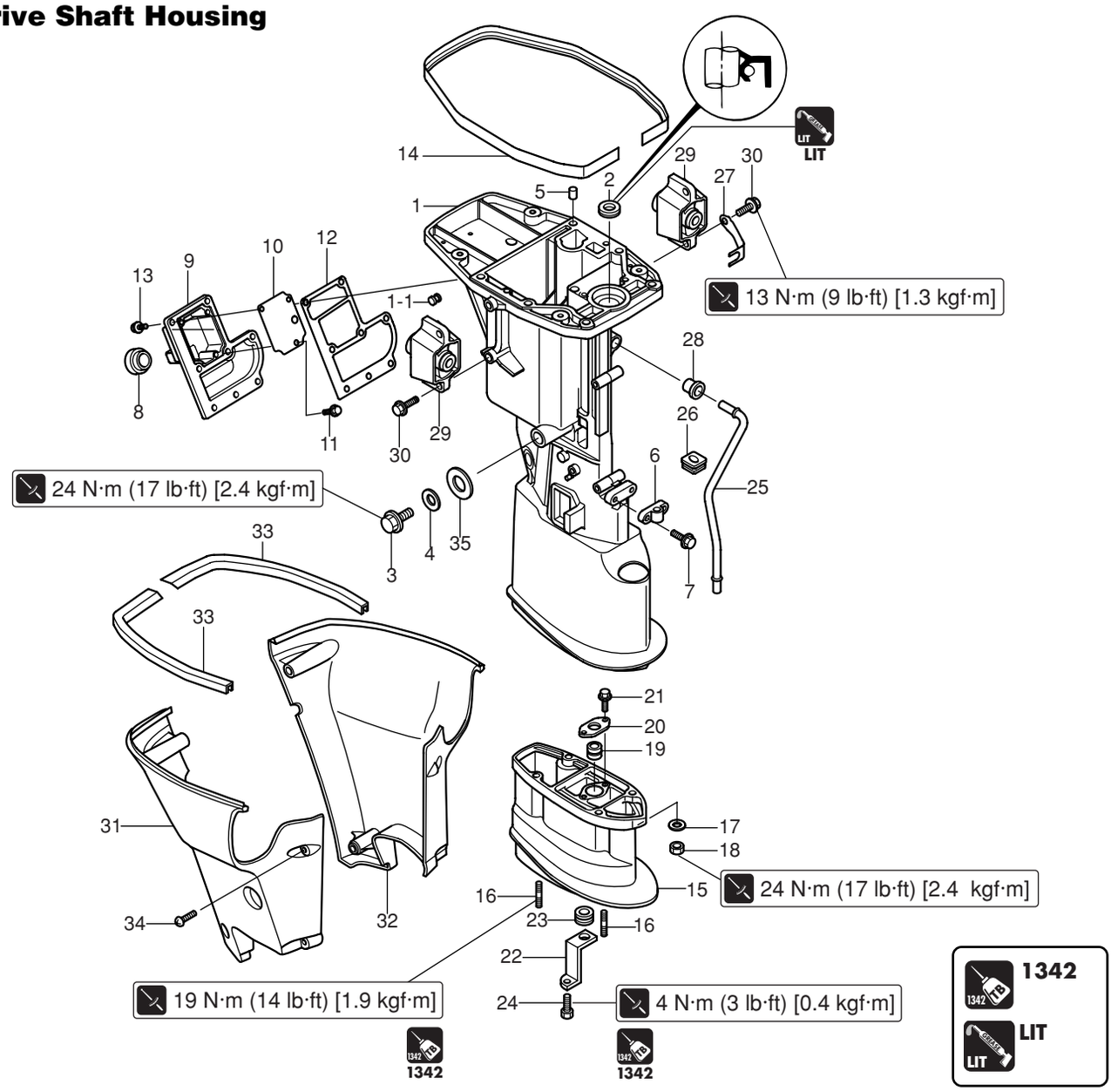
7

Bracket

1.Parts Layout

P/L Fig. 13

Drive Shaft Housing

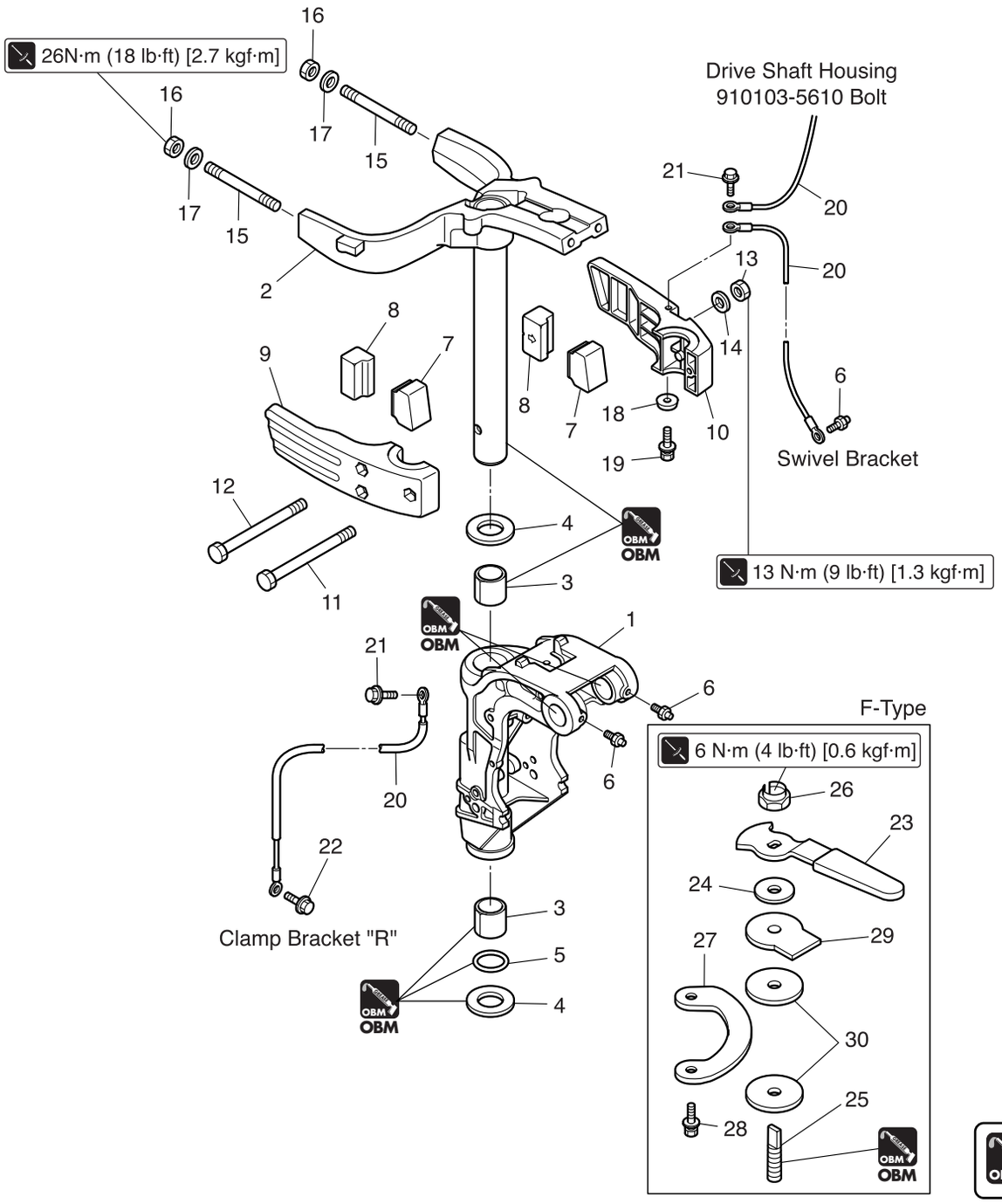


Ref. No.	Description	Q'ty	Remarks
1	Drive Shaft Housing "S"	1	
	Drive Shaft Housing "L"	1	
1-1	Exhaust Plug	1	
2	Oil Seal, 12.8-25-7	1	Do not reuse.
3	Drain Bolt	1	
4	Washer, 14.5-24-1	1	
5	Dowel Pin, 6-12	2	
6	Cam Rod Holder	1	for Transom "L" & "UL"
7	Bolt	2	
8	Idle Exhaust Port Grommet	1	
9	Idle Exhaust Port Cover	1	
10	Idle Exhaust Port Plate	1	
11	Bolt	3	
12	Idle Exhaust Port Gasket	1	Do not reuse.
13	Bolt	8	
14	Engine Basement Seal	1	
15	Extension Housing "UL"	1	for Transom "UL"
16	Stud Bolt	4	
17	Washer, 8.1-16-1.5	4	for Transom "UL"
18	Nut	4	
19	Drive Shaft Busing	1	

Ref. No.	Description	Q'ty	Remarks
20	Bushing Stopper	1	
21	Bolt	2	
22	Lock Plate	1	for Transom "UL"
23	Water Pipe Auxiliary Mount	1	
24	Screw	1	
25	Water Pipe "S"	1	for Transom "S"
	Water Pipe "L"	1	for Transom "L"
	Water Pipe "UL"	1	for Transom "UL"
26	Water Pipe Auxiliary Mount	1	
27	Water Pipe Lock Plate	1	
28	Water Pipe Seal (Upper)	1	
29	Rubber Mount (Upper)	2	for Transom "S" & "L"
	Rubber Mount (Upper)	2	for Transom "UL"
30	Bolt	4	
31	Drive Shaft Housing Cover (Right)	1	Starboard
32	Drive Shaft Housing Cover (Left)	1	Port
33	Apron Seal	2	
34	Tapping Screw, 6-60	4	
35	Oil Drain Grommet	1	

Swivel Bracket

P/L Fig. 18

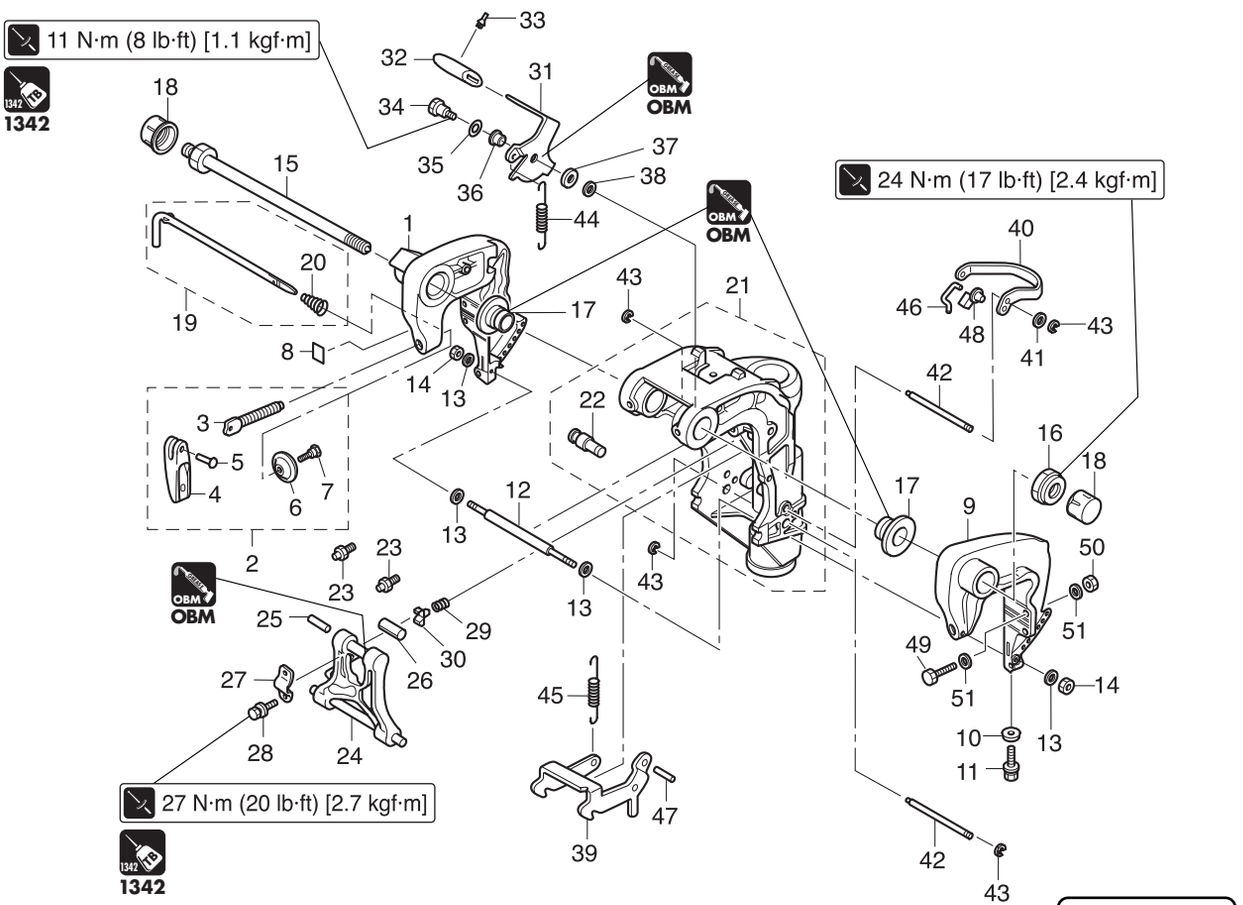


Ref. No.	Description	Q'ty	Remarks
1	Swivel Bracket	1	
2	Steering Shaft Ass'y	1	
3	Busing, 28-31-35	2	
4	Thrust Plate, 28.5-48-1	2	
5	O-Ring, 3.5-25.7	1	**Do not reuse.**
6	Grease Fitting	3	
7	Damper (Lower)	2	
8	Rubber Mount (Lower)	2	
9	Mount Bracket (Right)	1	Starboard
10	Mount Bracket (Left)	1	Port
11	Bolt	1	
12	Bolt	2	
13	Nut	3	
14	Washer, 8.1-16-1.5	3	
15	Stud Bolt, 10-95	2	

Ref. No.	Description	Q'ty	Remarks
16	Nylon Nut	2	
17	Washer	2	
18	Anode	1	
19	Bolt	1	
20	Ground Cable	3	L=130
21	Bolt	3	
22	Bolt	1	Clamp Bracket "R"
23	Co-Pilot Handle	1	for MF/EF/EFT
24	Washer, 8.1-20-0.8	1	for MF/EF/EFT
25	Co-Pilot Bolt	1	for MF/EF/EFT
26	Nylon Nut (2T), M8-P1.25	1	for MF/EF/EFT
27	Co-Pilot Plate	1	for MF/EF/EFT
28	Bolt	2	for MF/EF/EFT
29	Co-Pilot Washer	1	for MF/EF/EFT
30	Co-Pilot Disk	2	for MF/EF/EFT

Clamp Bracket & Reverse Lock

P/L Fig. 19

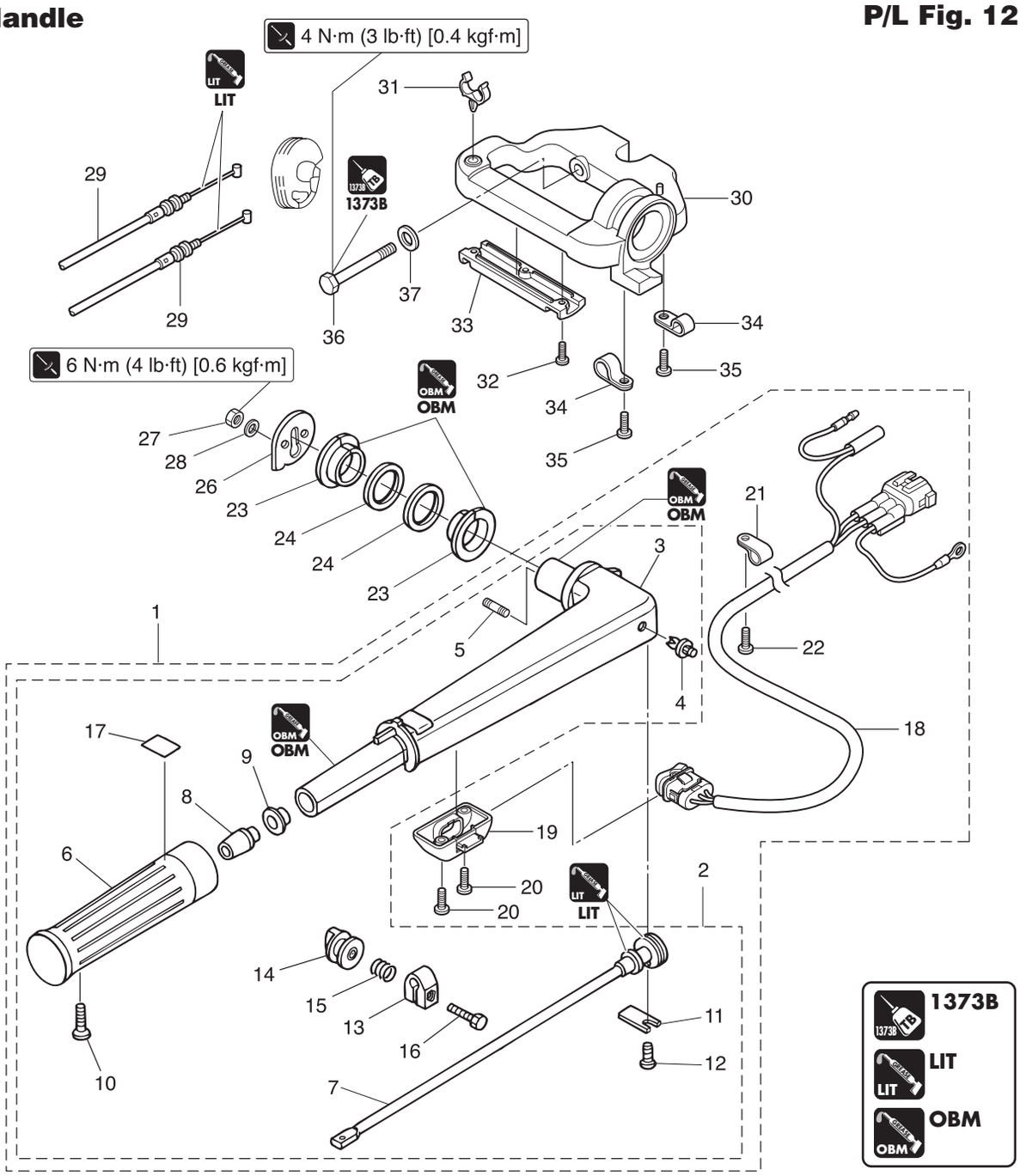


Ref. No.	Description	Q'ty	Remarks
1	Clamp Bracket (R)	1	Starboard Sid
2	Clamp Screw Kit	2	
3	Clamp Screw	1	
4	Clamp Screw Handle	1	
5	Rivet 3-22	1	
6	Clamp Screw Pad	1	
7	Shoulder Bolt	1	
8	Co-Pilot Decal	1	for MF/EF/EFT
9	Clamp Bracket (L)	1	Port Sid
10	Anode	1	
11	Bolt	1	
12	Distance Piece	1	
13-1	Washer	2	R
13-2	Washer	2	L
14	Nut	2	
15	Swivel Bracket Shaft Ass'y	1	Bracket Bolt
16	Nylon Nut 7/8	1	
17	Bushing 26-32	2	
18	Cap Nut Bracket Bolt	2	for MF/EF/EFT
19	Thrust Rod Ass'y	1	
20	Thrust Rod Spring	1	
21	Swivel Bracket Ass'y	1	
22	Pin	1	
23	Grease Fitting	3	
24	Tilt Stopper	1	
25	Spring Pin	1	

Ref. No.	Description	Q'ty	Remarks
26	Bushing 8.2-10-26.5	1	
27	Setting Plate	1	
28	Bolt	2	
29	Friction Spring	1	
30	Setting Piece Tilt Stopper	1	
31	Reverse Lock Lever	1	
32	Reverse Lock Lever Grip	1	
33	Stopper Reverse Lock Lever Grip	1	
34	Shoulder Bolt	1	
35	Washer	1	
36	Bushing	1	
37	Washer 8.5-18-1.6	1	
38	Washer 6-16-1.5	1	
39	Reverse Lock	1	
40	Reverse Lock Arm	1	
41	Collar	1	
42	Reverse Lock Shaft B	2	
43	E-Ring	4	
44	Reverse Lock Lever Spring	1	
45	Reverse Lock Spring	1	
46	Reverse Lock Link	1	
47	Spring Pin	1	
48	Rod Snap 3.5-2	1	
49	Bolt	4	OPT
50	Nut	4	OPT
51	Washer	8	OPT

Tiller Handle

P/L Fig. 12

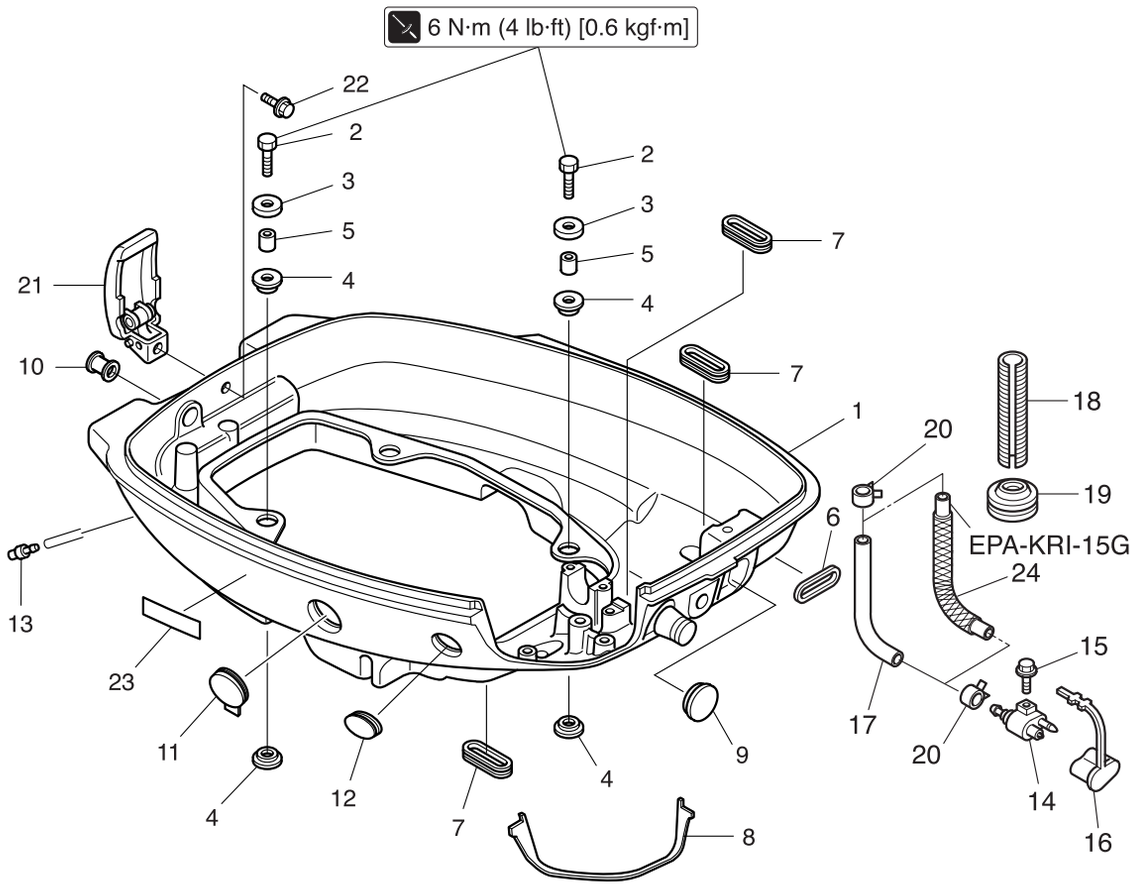


Ref. No.	Description	Q'ty	Remarks
1	Tiller Handle Ass'y (PT)	1	for EFT
2	Tiller Handle Ass'y	1	for MF/EF
3	Tiller Handle	1	
4	Plastic Rivet 6.5	1	
5	Stud Bolt	2	
6	Grip	1	
7	Throttle Shaft	1	
8	Throttle Shaft Damper	1	
9	Bushing 14-15.8-7	1	
10	Screw	1	
11	Throttle Shaft Support	1	
12	Screw	1	
13	Friction Piece	1	
14	Adjusting Nut	1	
15	Spring	1	
16	Bolt	1	
17	Throttle Decal	1	
18	PTT Switch Ass'y	1	for EFT

Ref. No.	Description	Q'ty	Remarks
19	Switch Box	1	for EFT
20	Screw	2	for EFT
21	Clamp 6-9.5L	1	for EFT
22	Screw	1	for EFT
23	Bushing Handle	2	for MF/EF
24	Washer 39-52-1	2	for MF/EF
26	Cover Plate Steering	1	for MF/EF
27	Nut	2	for MF/EF
28	Washer	2	for MF/EF
29	Throttle Wire	2	for MF/EF
30	Steering Bracket	1	for MF/EF
31	Cord Holder	1	for MF/EF
32	Screw	3	
33	Cord Holder	1	
34	Clamp 6-9.5L	2	for EFT
35	Screw	2	for EFT
36	Bolt	2	
37	Washer	2	

Bottom Cowl

P/L Fig. 20

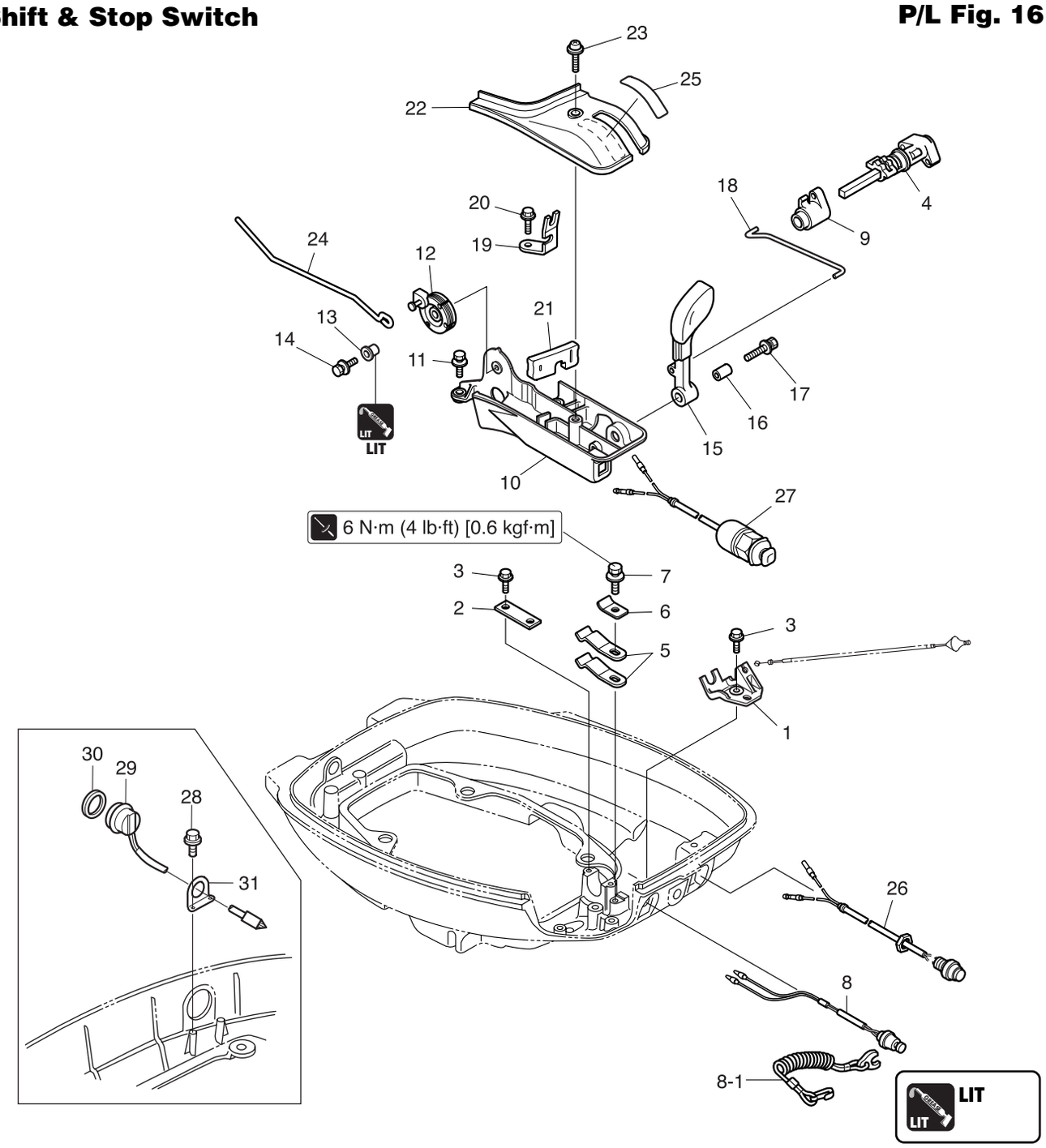


Ref. No.	Description	Q'ty	Remarks
1	Bottom Cowl	1	
2	Bolt	4	
3	Rubber Mount Washer	4	
4	Rubber Mount, 8.5-14-2.5	8	
5	Spacer, 6.2-9-15.7	4	
6	Battery Cable Grommet	1	
7	Shift Rod Grommet	3	
8	Shift Lever Bracket Seal	1	
9	Grommet, 17-2.7	1	for MF/EP/EPT
10	Grommet	1	
11	Grommet	1	
12	Grommet	1	
13	Water Nipple	1	

Ref. No.	Description	Q'ty	Remarks
14	Fuel Connector (Engine, Male)	1	
15	Bolt	1	
16	Fuel Connector Protector	1	
17	Rubber Hose	1	
18	Fuel Hose Protector	1	ø10.7-280
19	Grommet, 22-2.5	1	
20	Clip ø9.5	2	
21	Cowl Latch Ass'y	1	
22	Bolt	1	
23	Storage Decal	1	
24	Fuel Hose W/Protector	1	Low Permeation Parts (for USA model)

Shift & Stop Switch

P/L Fig. 16

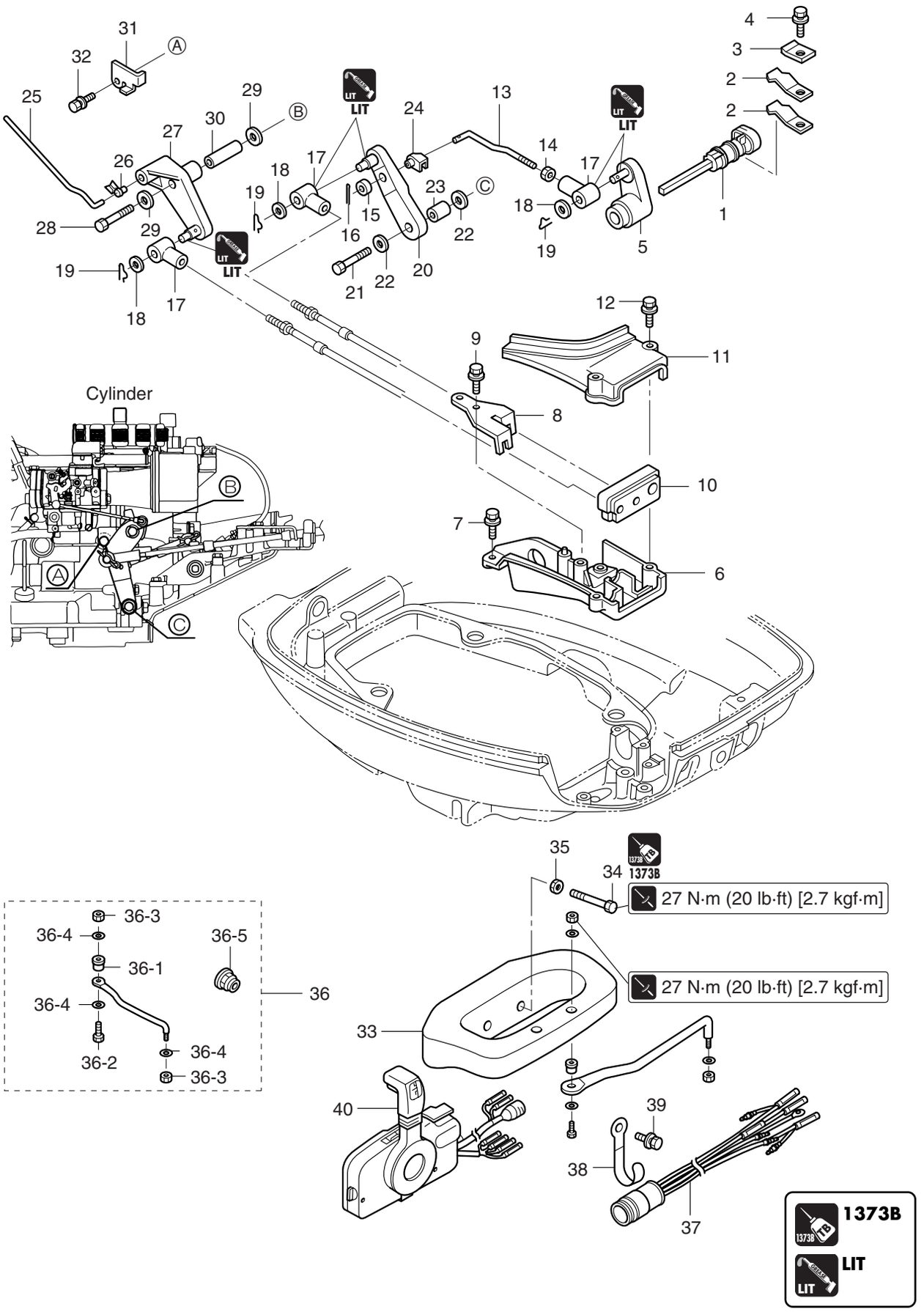


Ref. No.	Description	Q'ty	Remarks
1	Neutral Switch Bracket	1	
2	Shift Lever Shaft Holder	1	
3	Bolt	3	
4	Shift Lever Shaft	1	
5	Shift Lever Stopper	2	
6	Shift Lever Stopper Plate	1	
7	Bolt	1	
8	Stop Switch	1	
8-1	Stop Switch Lanyard	1	
9	Shift Arm	1	for MF/EF/EFT
10	Shift Lever Bracket	1	
11	Bolt	2	
12	Throttle Dram	1	
13	Collar, 6.1-14-8.9	1	for MF/EF/EFT
14	Bolt	1	
15	Shift Lever	1	

Ref. No.	Description	Q'ty	Remarks
16	Collar, 6.5-10.5-22.6	1	for MF/EF/EFT
17	Bolt	1	
18	Shift Lever Rod	1	for MF/EF/EFT
19	Throttle Cable Bracket	1	
20	Bolt	1	
21	Shift Lever Rod Grommet	1	for MF/EF/EFT
22	Shift Lever Bracket Cover	1	
23	Screw	1	
24	Throttle Rod	1	for MF/EF/EFT
25	Shift Decal (F, N, R)	1	
26	Main Switch	1	for EF/EFT
27	Neutral Switch	1	
28	Bolt	2	for EPT
29	PTT Switch Ass'y	1	for EFT/EPT
30	Gasket PTT/Switch	1	for EFT/EPT
31	PTT Switch Ass'y Bracket	1	for EFT/EPT

Shift (For EP & EPT Models)

P/L Fig. 17



Ref. No.	Description	Q'ty	Remarks
1	Shift Lever Shaft	1	
2	Shift Lever Stopper	2	
3	Shift Lever Stopper Plate	1	
4	Bolt	1	
5	Shift Arm (Remote Control)	1	for EP/EPT
6	Remote Control Cable Stay	1	
7	Bolt	3	
8	Cable Clip	1	for EP/EPT
9	Bolt	1	
10	Cable Grommet	1	
11	Remote Control Stay Cover	1	
12	Bolt, 5-35 (with Washer)	2	
13	Shift Lever Rod	1	for EP/EPT
14	Nut	1	
15	Spacer, 5-9.5-5	1	
16	Split Pin, 2-12	1	for EP/EPT
17	Cable Joint	3	
18	Washer, 8.5-18-1.6	3	
19	Snap Pin, d=8	3	for EP/EPT
20	Shift Lever (Remote Control)	1	
21	Bolt	1	
22	Washer, 6-16-1.5	2	
23	Collar, 6.2-9-9.3	1	for EP/EPT
24	Rod Snap, 5-3	1	
25	Throttle Rod (Remote Control)	1	
26	Rod Snap, ø3-B	1	
27	Throttle Lever (Remote Control)	1	for EP/EPT
28	Bolt	1	
29	Washer, 6-16-1.5	2	
30	Collar, 6.2-9-30.8	1	for EP/EPT
31	Throttle Lever Stopper	1	
32	Bolt	1	
33	Steering Bracket	1	for EP/EPT
34	Bolt	2	
35	Washer	2	
36	Drag Link "H"	1	
36-1	Drag Link Spacer	1	for EP/EPT
36-2	Bolt, 3/8-50	1	
36-3	Nylon Nut, 3/8	2	
36-4	Washer, 9.6-18-2	3	
36-5	Drag Link Seal Ring	1	for EP/EPT
37	Cord Ass'y	1	
38	Clamp, 6.5-120P	1	
39	Bolt	1	
40	Remote Control Box (RC5B)	1	

2. Inspection Items

1) Inspection of Throttle Cable

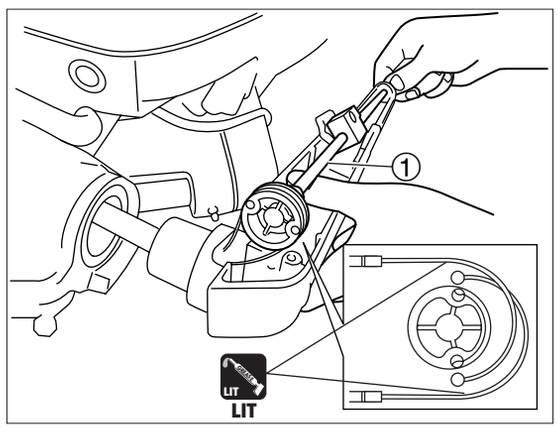
1. Check operation of throttle cable.

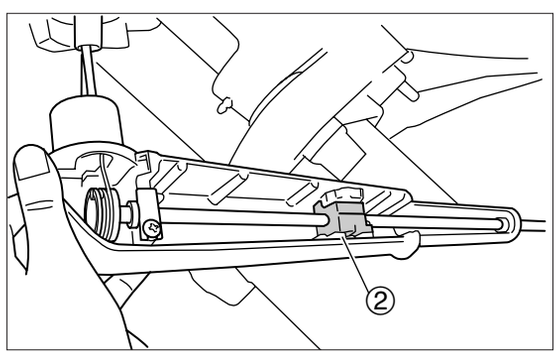
2. Check throttle cable inner wire and outer wire for bend and damage. Replace if necessary.

2) Installation of Tiller Handle

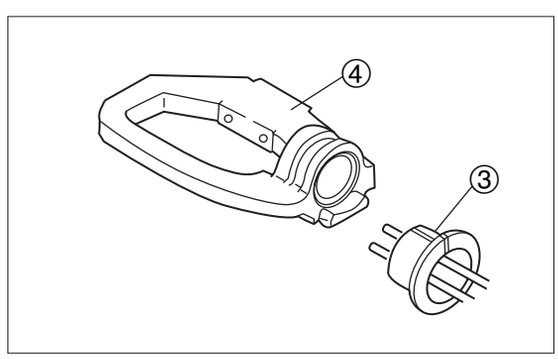
1. Attach cables to throttle shaft ① as shown.

2. Install throttle shaft ① with cable to Tiller handle. Be careful of location of throttle friction ②.





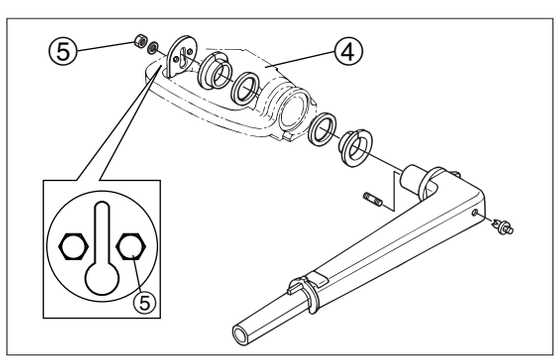
3. Install bushing ③ on the steering bracket ④.



4. Attach Tiller handle ass'y to steering bracket ④, and tighten nut ⑤ to specified torque.

Arrange throttle cable as shown.

Tiller Handle Nut ⑤ :
6 N · m (4 lb · ft) [0.6 kgf · m]

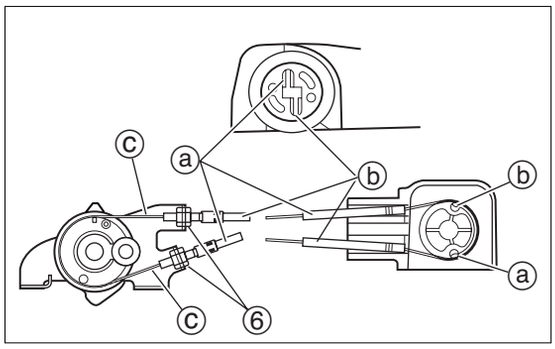


5. Install cable ⓑ of which inner wire is stretched when acceleration grip is set to full close position.

6. Then, install another cable ⓐ (of which inner wire is stretched when acceleration grip is set to full open position.

7. Adjust position of lock nuts ⑥ of throttle cable so that throttle grip can reach full open and full close positions.

Adjust cable tension so that it moves approximately 1mm when pushed lightly with a finger.



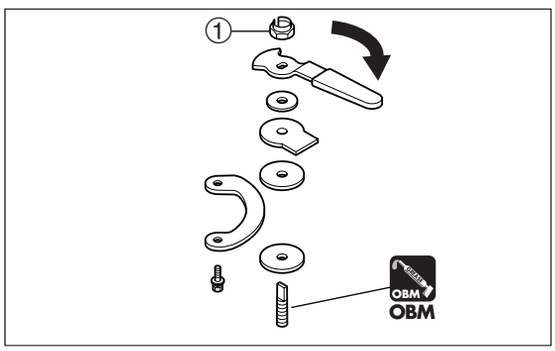
3) Adjustment of Co-pilot Plate (Tiller Handle Model)

1. Install co-pilot plate.

2. Move co-pilot handle to left to slide it to tightening position.

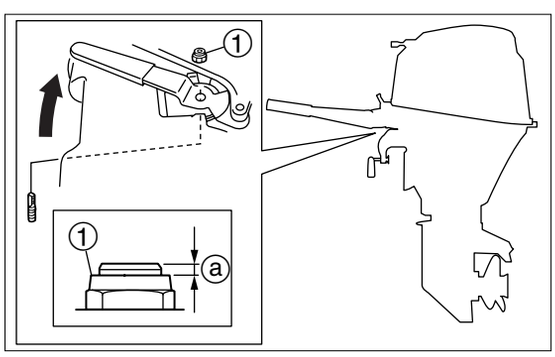
3. Tighten nylon nut ① until steering load becomes heavy.

Tighten nylon nut ① to approximately 6 N · m (4 lb · ft) [0.6 kgf · m] and check steering load.



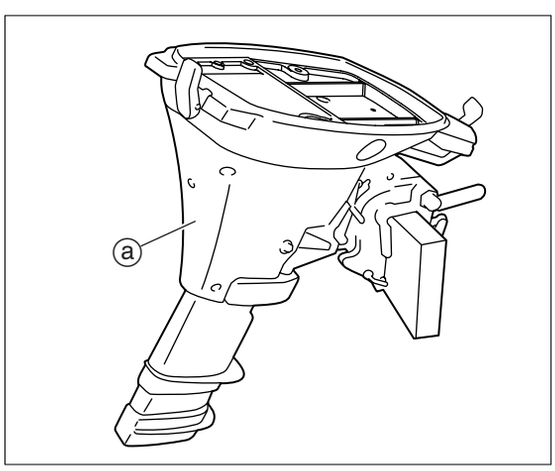
4. Move co-pilot handle to the right to slide it to release position, and check that steering can be made lightly. If not, repeat steps 2. to 4. to finely adjust.

To prevent nylon nut from falling, tighten nut until more than one thread of bolt ⓐ can be seen above the nut.



4) Removing Drive Shaft Housing

1. Remove drive shaft housing cover ⓐ, and drain engine oil completely by referring to “Chapter 3, 5) Replacement of engine oil".



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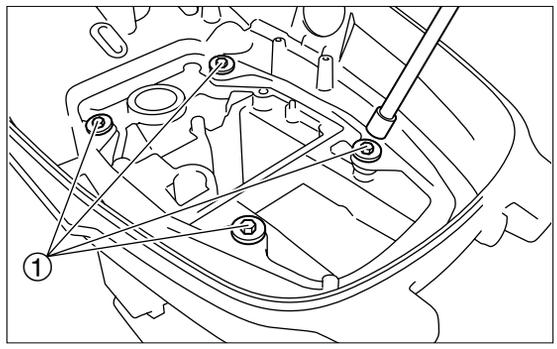
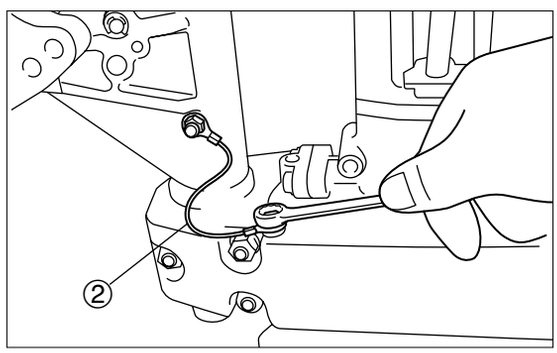
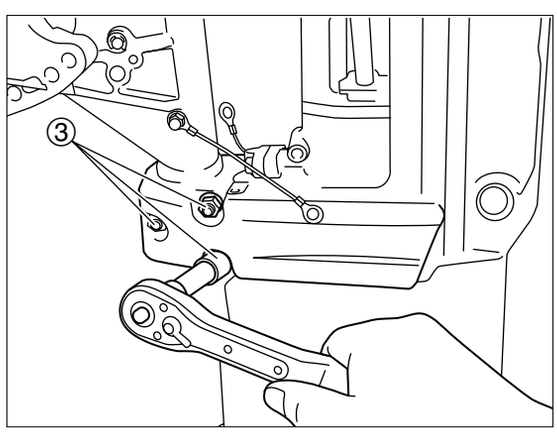
2. Loosen four bolts ① and remove bottom cowl from drive shaft housing.



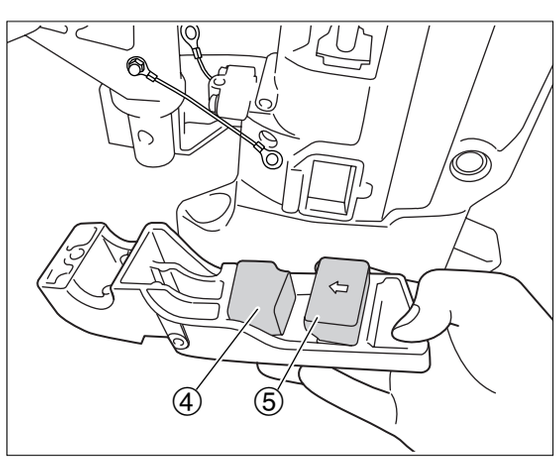
3. Remove grounding wires ②.



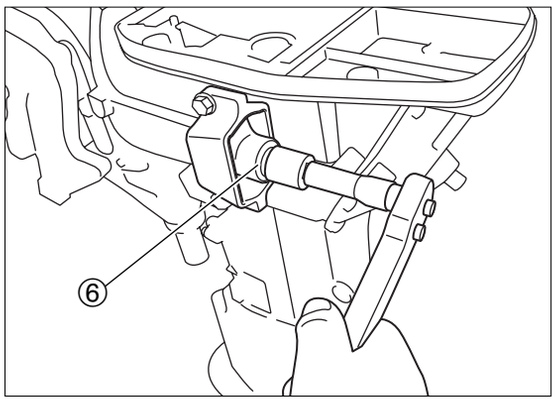
4. Remove bolts and nuts ③ lower mount bracket.



5. Check that dumper ④ and rubber mount ⑤ are normal. Replace if abnormal.

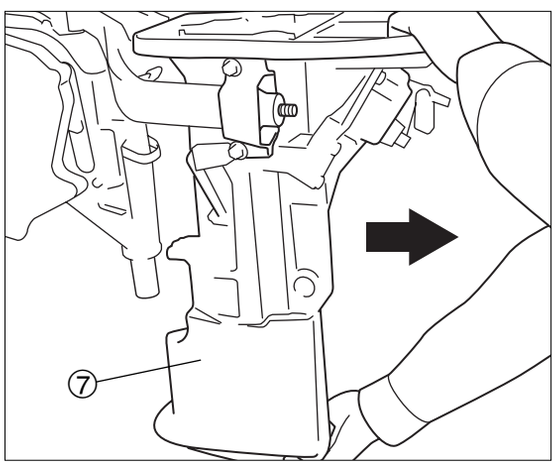


6. Remove nuts of upper rubber mount ⑥.



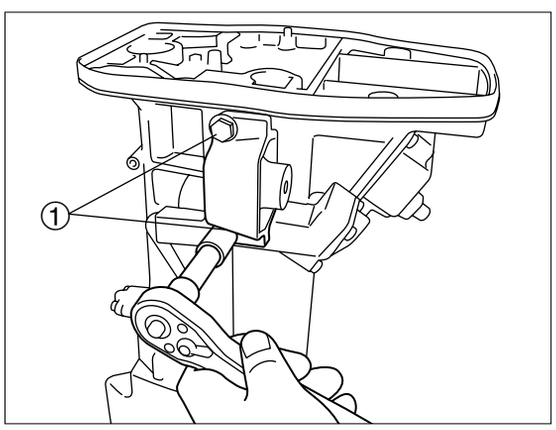
7. Remove drive shaft housing ⑦ from clamp bracket ass'y.

> Be careful not to drop drive shaft housing when removing the housing from clamp bracket.

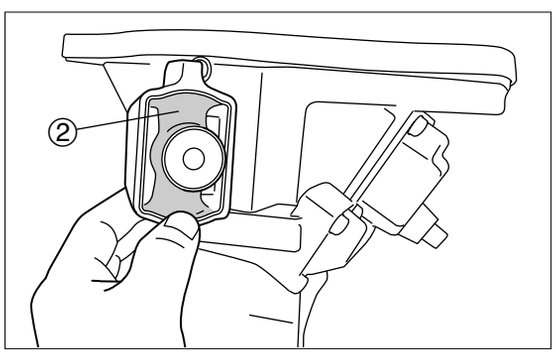


5) Disassembly of Drive Shaft Housing

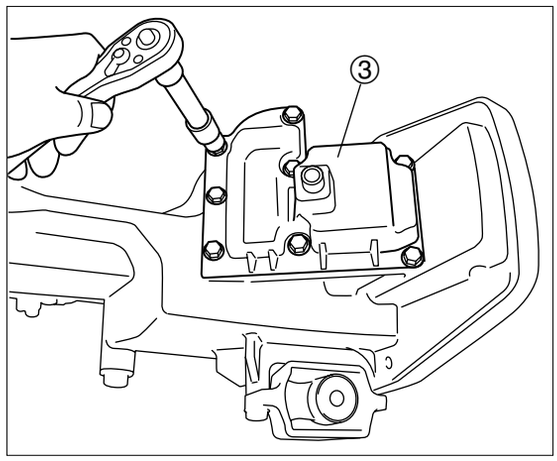
1. Remove upper rubber mount installation bolts ① and then remove rubber mount from drive shaft housing.

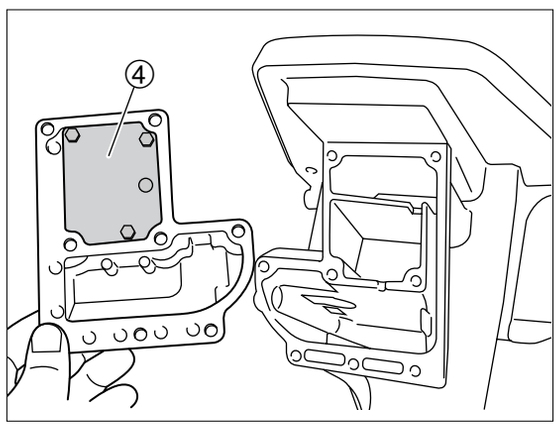


2. Check rubber mount ② for abnormality such as crack. Replace if any abnormality is found.

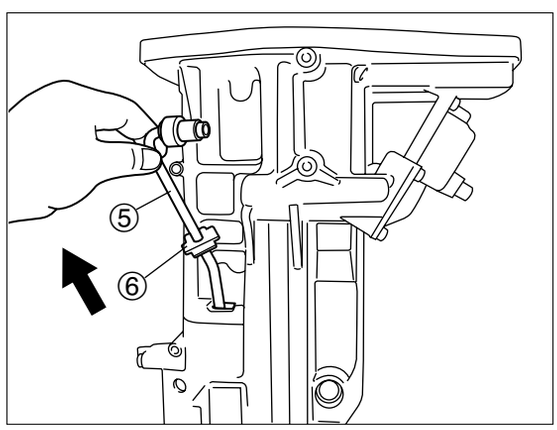


3. Remove idle exhaust cover ③, and check that idle exhaust port plate ④ has no abnormality such as cracks or flaws.





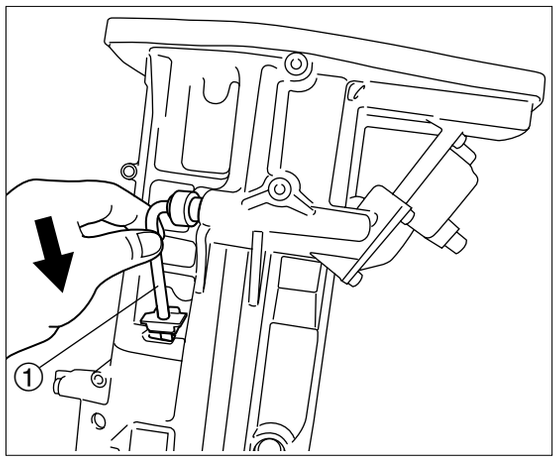
4. Remove water pipe ⑤ from drive shaft housing. Check water pipe auxiliary mount ⑥ for abnormality such as crack.

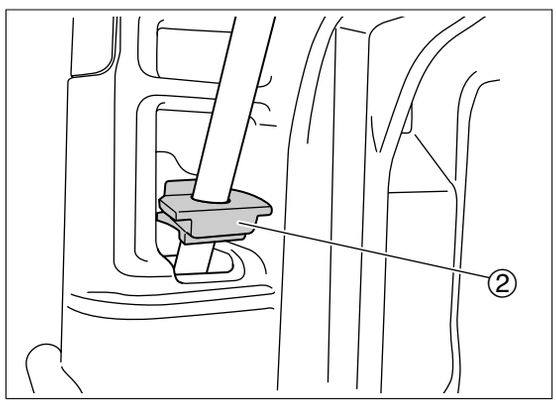


6) Assembly of Drive Shaft Housing

1. Install water pipe ① into drive shaft housing.

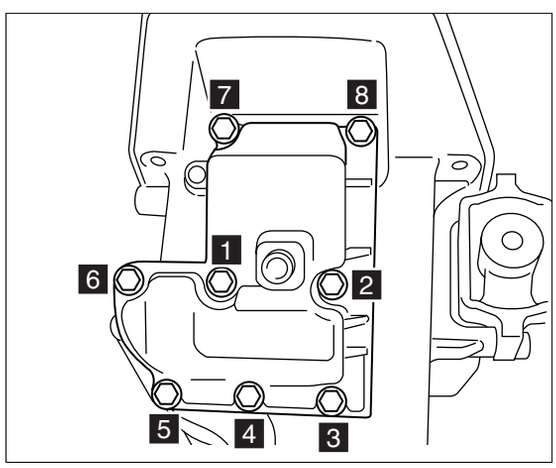
Insert pipe into drive shaft housing taking care of orientation of water pipe auxiliary mount ②.





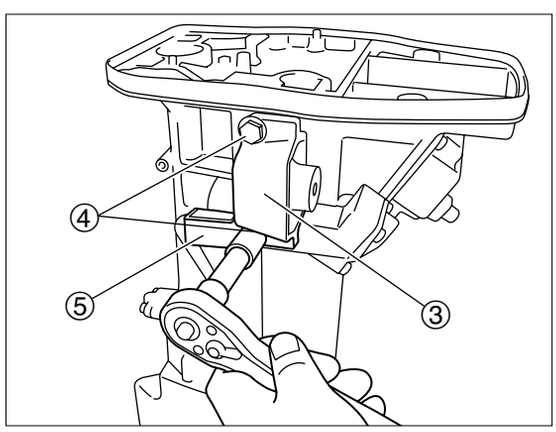
2. Attach exhaust cover securing bolts and tighten them in the order of their numbers shown to specified torque.

Idle Exhaust Installation Bolt :
6.0 N · m (4.3 lb · ft) [0.6 kgf · m]



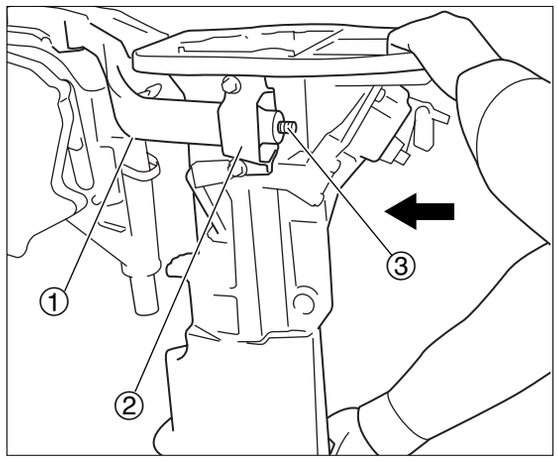
3. Install upper mount ③ on the drive shaft housing and tighten bolt ④ to specified torque.

Install water pipe lock plate ⑤ to pipe securely.



7) Installation of Drive Shaft Housing Ass'y

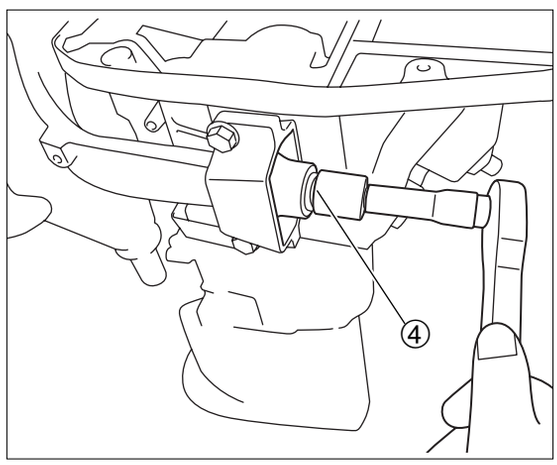
1. Insert drive shaft housing ass'y into stud bolt ③ of upper rubber mount ② of swivel bracket ①.

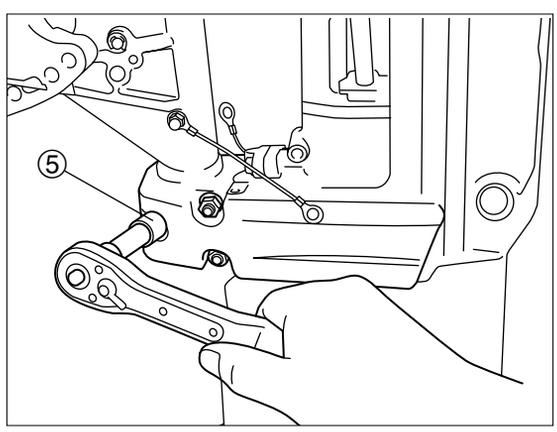


2. Install rubber mount and lower dumper and mount bracket to drive shaft housing. Tighten bolts and nuts to specified torque.

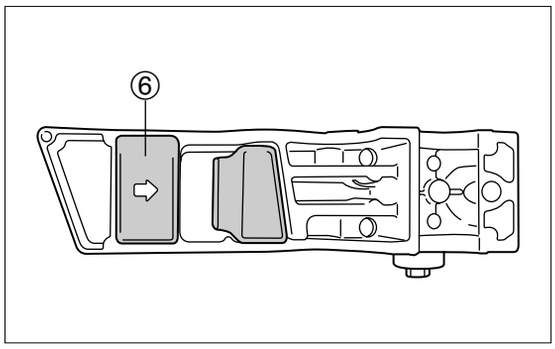
Upper Rubber Mount Nut ④ :
M8 13 · m (9 lb · ft) [1.3 kgf · m]

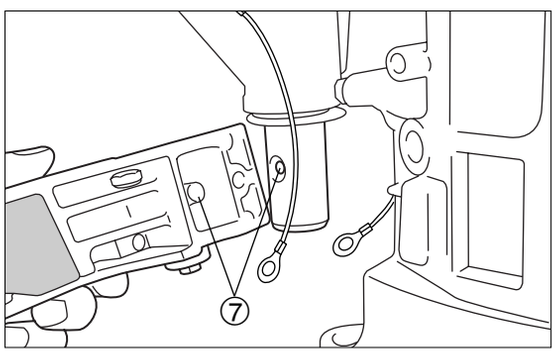
Lower Rubber Mount Bolt ⑤ :
M8 13 · m (9 lb · ft) [1.3 kgf · m]





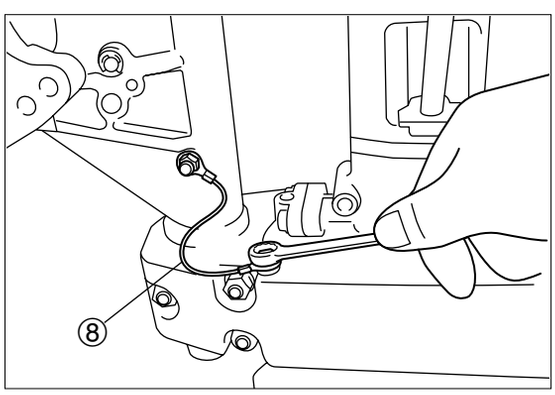
1 When assembling lower mount bracket, watch arrow mark of lower mount bracket rubber mount ⑥.
2 When assembling, watch spigot joint ⑦ for installation on the mount bracket.





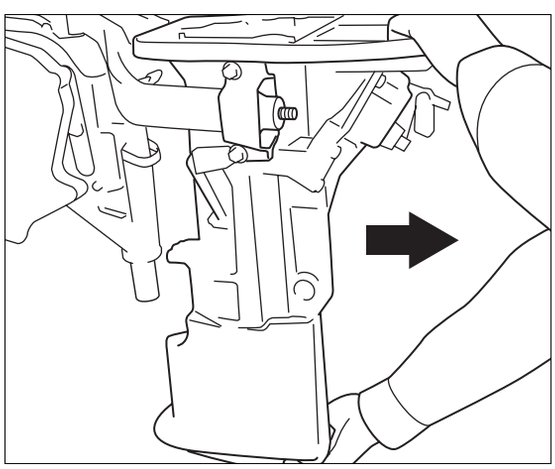
3. Attach earth wire ⑧.

Be careful not to paint earth wire attaching surface, or the anti-corrosion effect will be disabled.

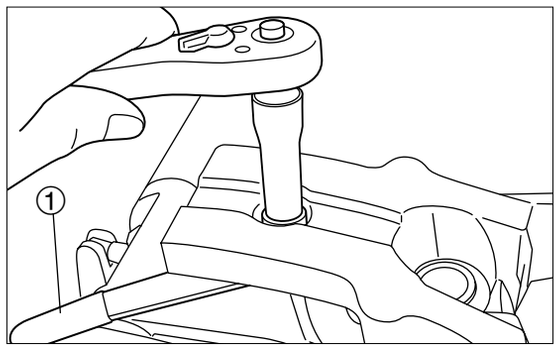


8) Removing Steering Shaft

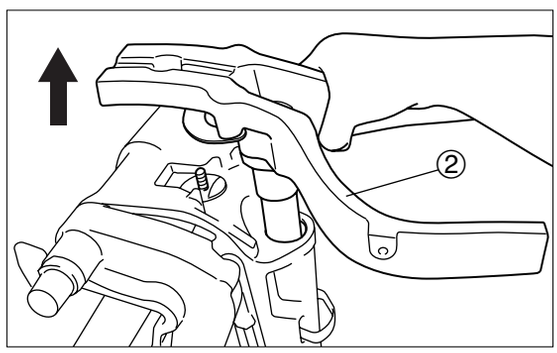
1. Remove drive shaft housing by referring to “Chapter 7 Removing Drive Shaft Housing”.



2. Loose co-pilot handle nut and remove handle ①.



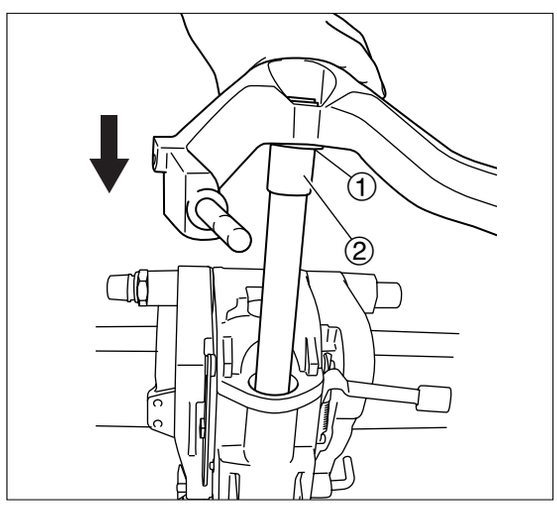
3. Pull out steering shaft ② from swivel bracket ass'y to remove.



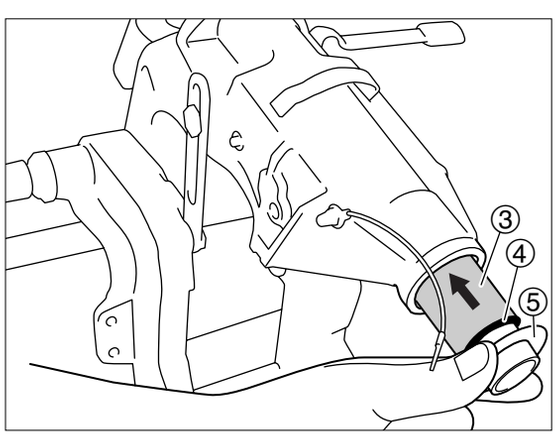
9) Installing Steering Shaft

1. Attach thrust plate ① and bushing ② to steering shaft.

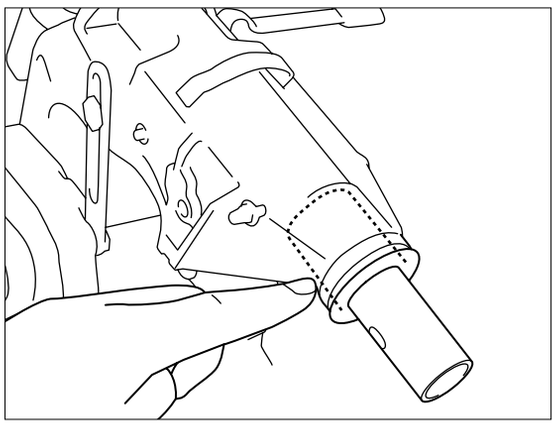
2. Stand swivel bracket ass'y vertically, and insert steering shaft into swivel bracket ass'y.



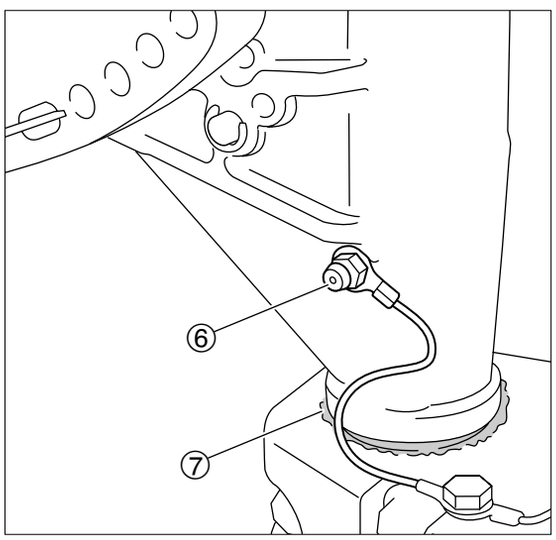
3. Attach bushing ③, new O ring ④, and thrust plate ⑤ to swivel bracket.



4. Put bushing and O ring into swivel bracket surely.



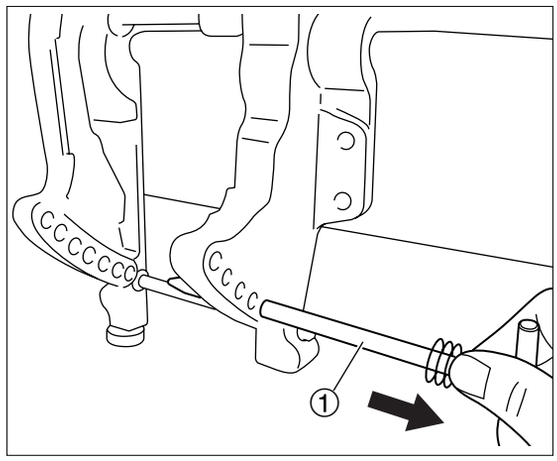
5. Put grease into bushing ⑦ through grease nipple ⑥ until it overflows.



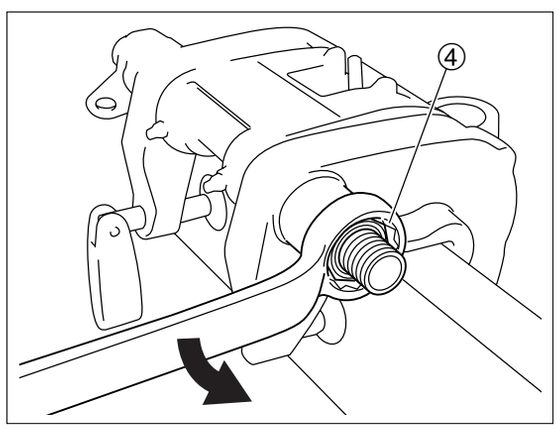
7

10) Disassembling Clamp Bracket (Manual Tilt Model)

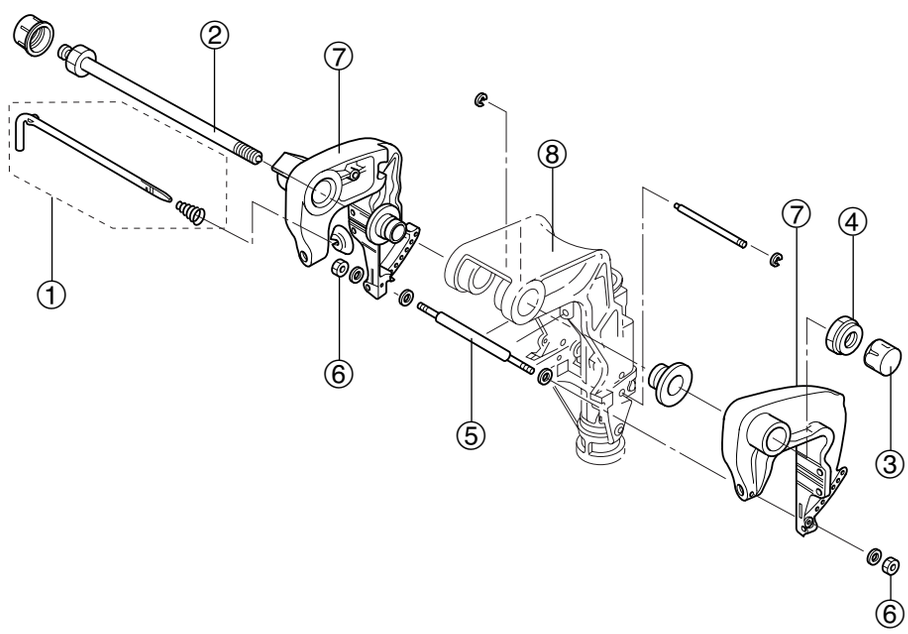
1. Remove thrust rod ① from clamp bracket.



2. Remove nut cap ③ of swivel bracket shaft ②, and then, loosen nut ④. Loose nut ⑥ of distance piece ⑤, and then, remove nut. Pull out swivel bracket shaft, and then, remove clamp bracket ⑦ from swivel bracket ⑧.

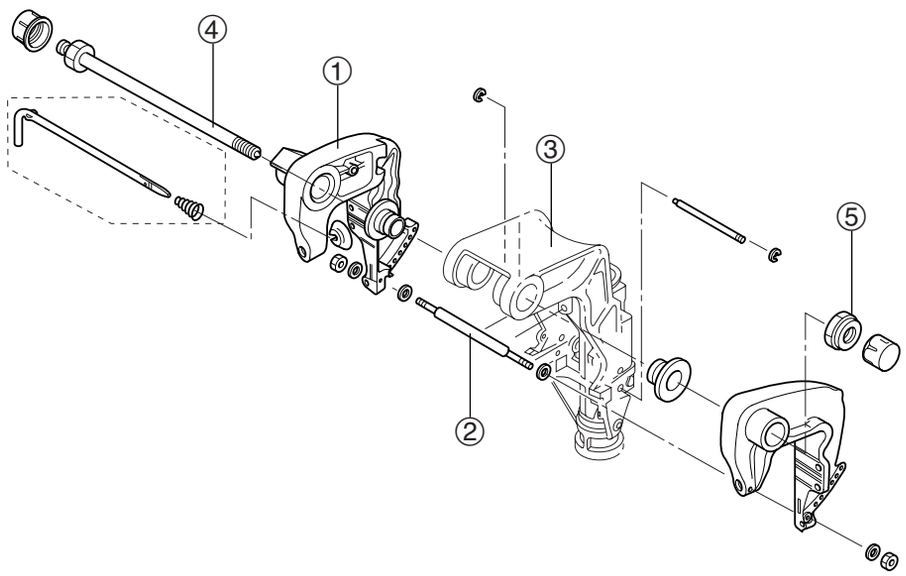


3. Check swivel bracket shaft and other parts for abnormality, and replace if necessary.



11) Assembly of Clamp Bracket

1. Insert distance piece ② into clamp bracket ①.

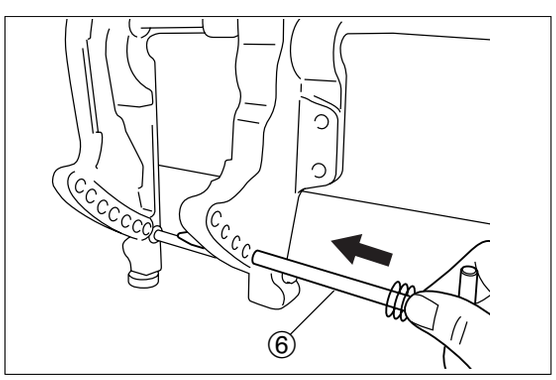


2. Install clamp bracket ① to swivel bracket ③, insert swivel bracket shaft ④, and then, tighten nylon nut ⑤ and nut to their specified torque respectively.

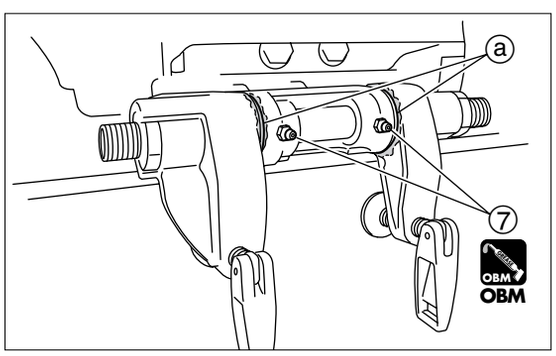
Nylon Nut ⑤ :
24 N · m (17 lb · ft) [2.4 kgf · m]

Nut :
6.0 N · m (4.3 lb · ft) [0.6 kgf · m]

3. Install thrust rod ⑥ and tighten clamp screw.



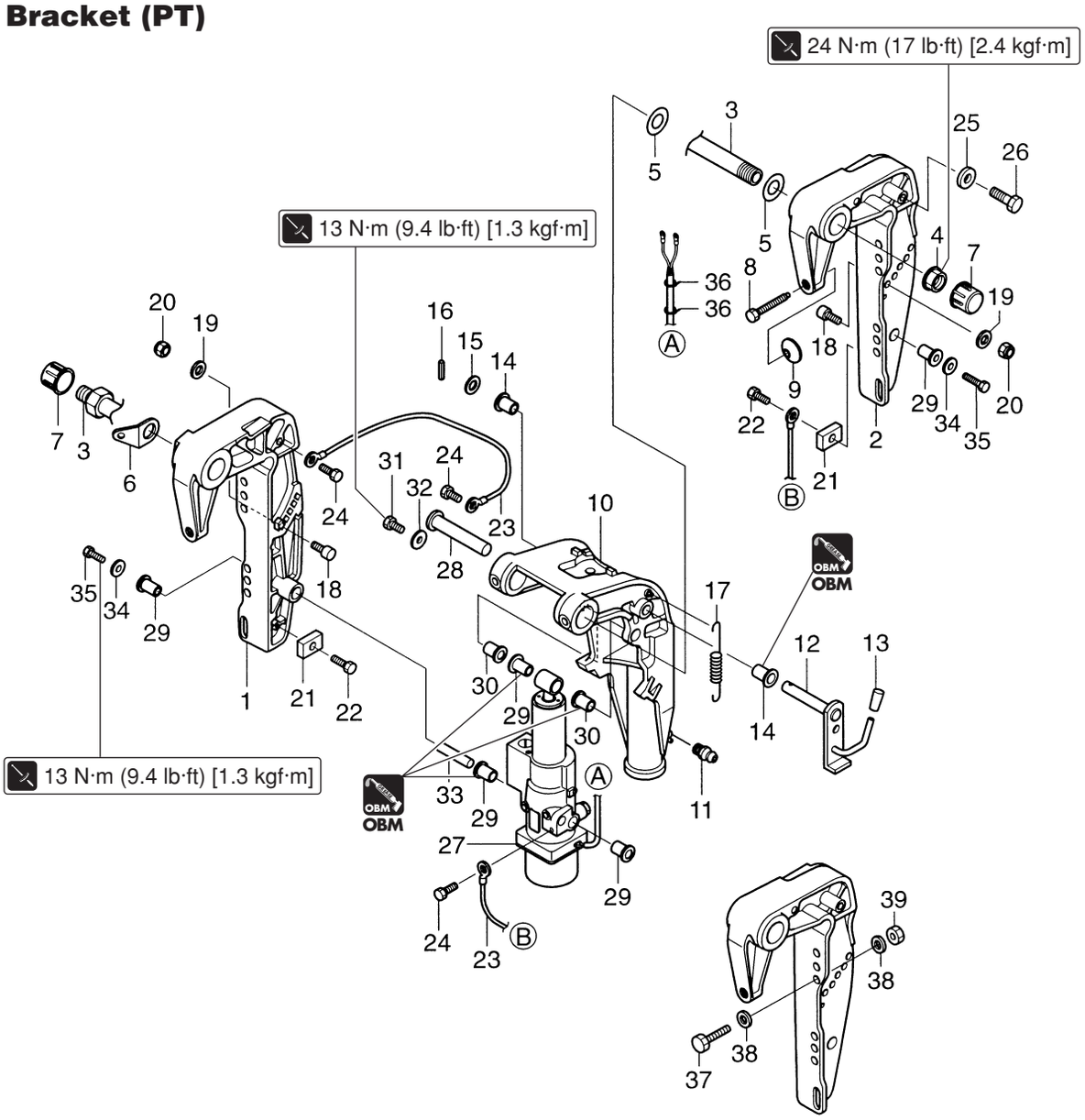
4. Put grease into bushing ⓐ through grease nipple ⑦ until it overflows.



3. Parts Layout (PT Model)

P/L Fig. 20

Bracket (PT)

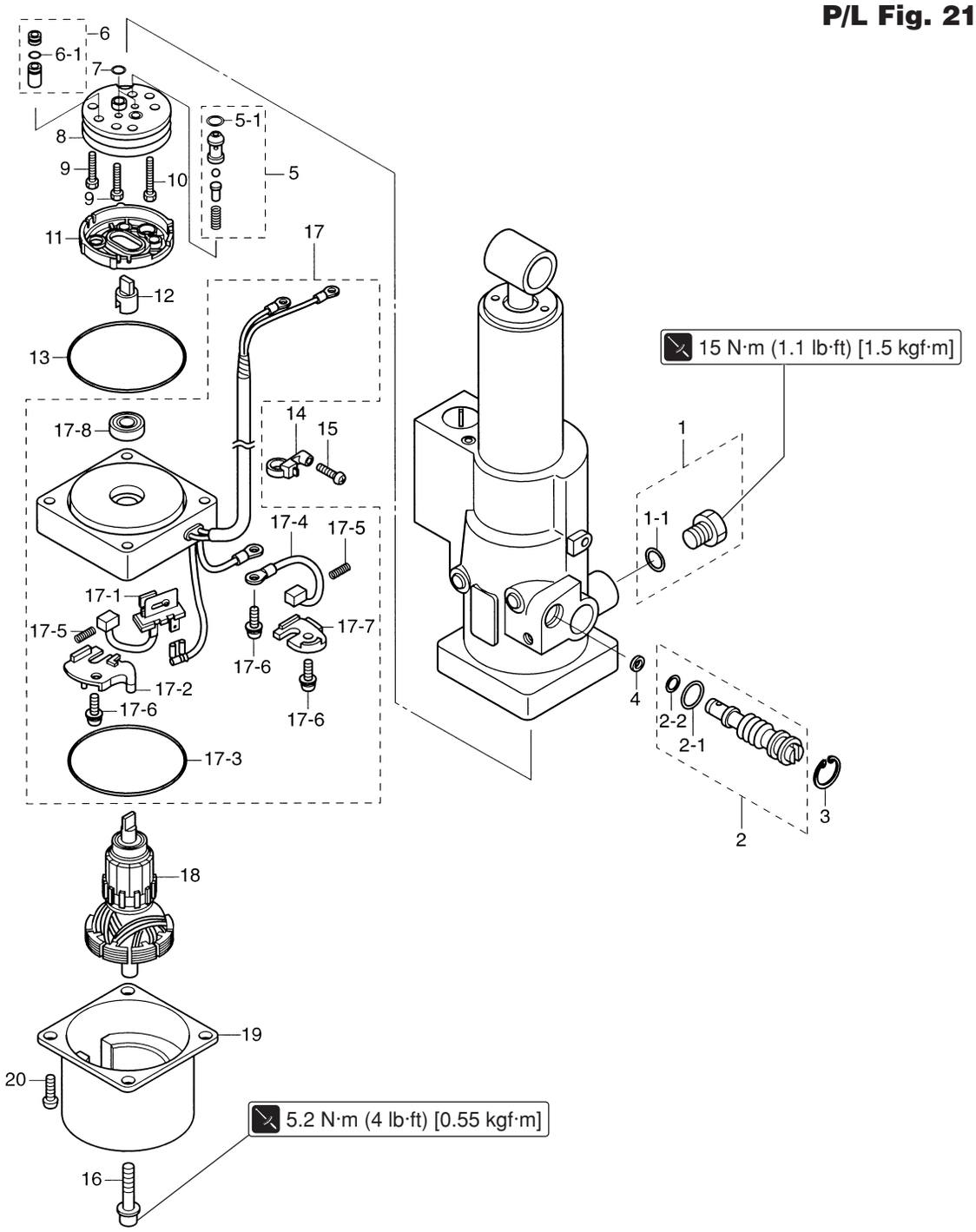


Ref. No.	Description	Q'ty 9.9	15	20	Remarks
1	Clamp Bracket (PTT-Right)	1	1	1	Starboard
2	Clamp Bracket (PTT-Left)	1	1	1	Port
3	Swivel Bracket Shaft Ass'y	1	1	1	
4	Nylon Nut, 7/8	1	1	1	
5	Washer, 22-36-1	2	2	2	Nylon
6	Plate	1	1	1	
7	Bracket Shaft Cap	2	2	2	for EFT
8	Clamp Screw	2	2	2	M14P-2.0
9	Clamp Screw Pad	2	2	2	
10	Swivel Bracket (PTT)	1	1	1	
11	Grease Fitting	3	3	3	
12	Tilt Stopper	1	1	1	
13	Tilt Stopper Grip	1	1	1	
14	Collar, 10.2-12-12	2	2	2	
15	Washer	1	1	1	
16	Spring Pin, 3.6-16	1	1	1	
17	Tilt Stopper Spring	1	1	1	
18	Trim Lock Pin	2	2	2	
19	Washer, 8.1-16-1.5	2	2	2	
20	Nylon Nut (2T), M8 P-1.25	2	2	2	

Ref. No.	Description	Q'ty 9.9	15	20	Remarks
21	Anode	2	2	2	
22	Bolt	2	2	2	
23	Ground Cable	2	2	2	L=130
24	Bolt	3	3	3	
25	Washer, 6.5-23-1.5	1	1	1	
26	Bolt	1	1	1	
27	Power Tilt Ass'y	1	1	1	
28	Cylinder Pin (Upper)	1	1	1	
29	Bushing, 13-16-31	5	5	5	
30	Bushing, 13-17-19.5	2	2	2	
31	Bolt	1	1	1	
32	Washer, 6.5-23-1.5	1	1	1	
33	Cylinder Pin (Lower)	1	1	1	
34	Washer, 9.5-28-1	2	2	2	
35	Bolt	2	2	2	
36	Lead Wire Band, 203	2	2	2	
37	Bolt	4	4	4	
38	Washer	8	8	8	
39	Nut	4	4	4	

Power Tilt

P/L Fig. 21



Ref. No.	Description	Q'ty 9.9	15	20	Remarks
1	Cap Ass'y	1	1	1	
1-1	O-Ring	1	1	1	Do not reuse.
2	Manual Valve Ass'y	1	1	1	
2-1	O-Ring, 2.4-9.8	1	1	1	Do not reuse.
2-2	O-Ring	1	1	1	Do not reuse.
3	C-Ring	1	1	1	
4	Seal Washer	1	1	1	
5	Relief Valve Ass'y	1	1	1	
5-1	O-Ring	1	1	1	Do not reuse.
6	Valve Ass'y	1	1	1	
6-1	O-Ring, 1.5-3.5	1	1	1	Do not reuse.
7	O-Ring	2	2	2	Do not reuse.
8	Pump	1	1	1	
9	Bolt	2	2	2	
10	Bolt	1	1	1	
11	Filter	1	1	1	
12	Pump Coupling	1	1	1	

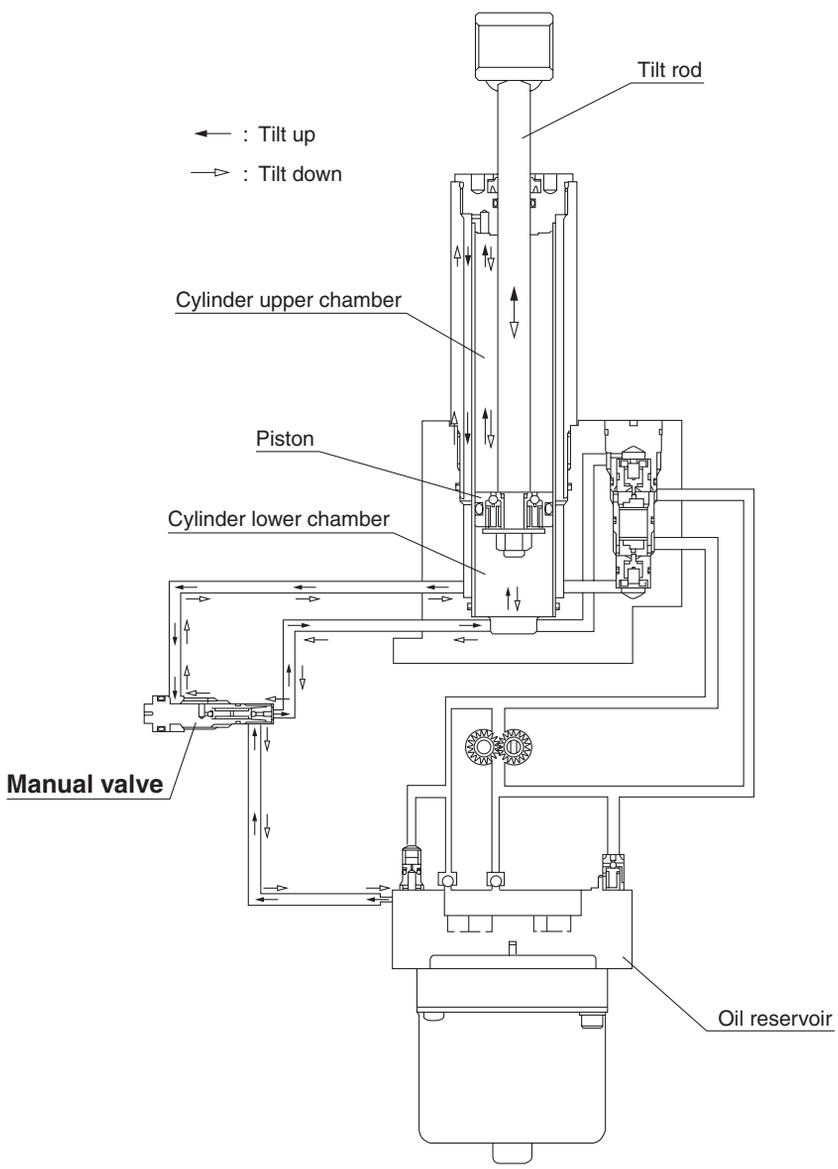
Ref. No.	Description	Q'ty 9.9	15	20	Remarks
13	O-Ring, 2-62.5	1	1	1	Do not reuse.
14	Band	1	1	1	
15	Screw	1	1	1	
16	Bolt	2	2	2	
17	Motor Bracket Ass'y	1	1	1	
17-1	Breaker	1	1	1	
17-2	Breaker Holder	1	1	1	
17-3	O-Ring	1	1	1	Do not reuse.
17-4	Brush	1	1	1	
17-5	Brush Spring	2	2	2	
17-6	Screw	3	3	3	
17-7	Brush Holder	1	1	1	
17-8	Oil Seal	1	1	1	
18	Armature Ass'y	1	1	1	
19	Yoke Ass'y	1	1	1	
20	Screw	2	2	2	

4. Operation of Power Tilt

· The power tilt system has an electric motor built in 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

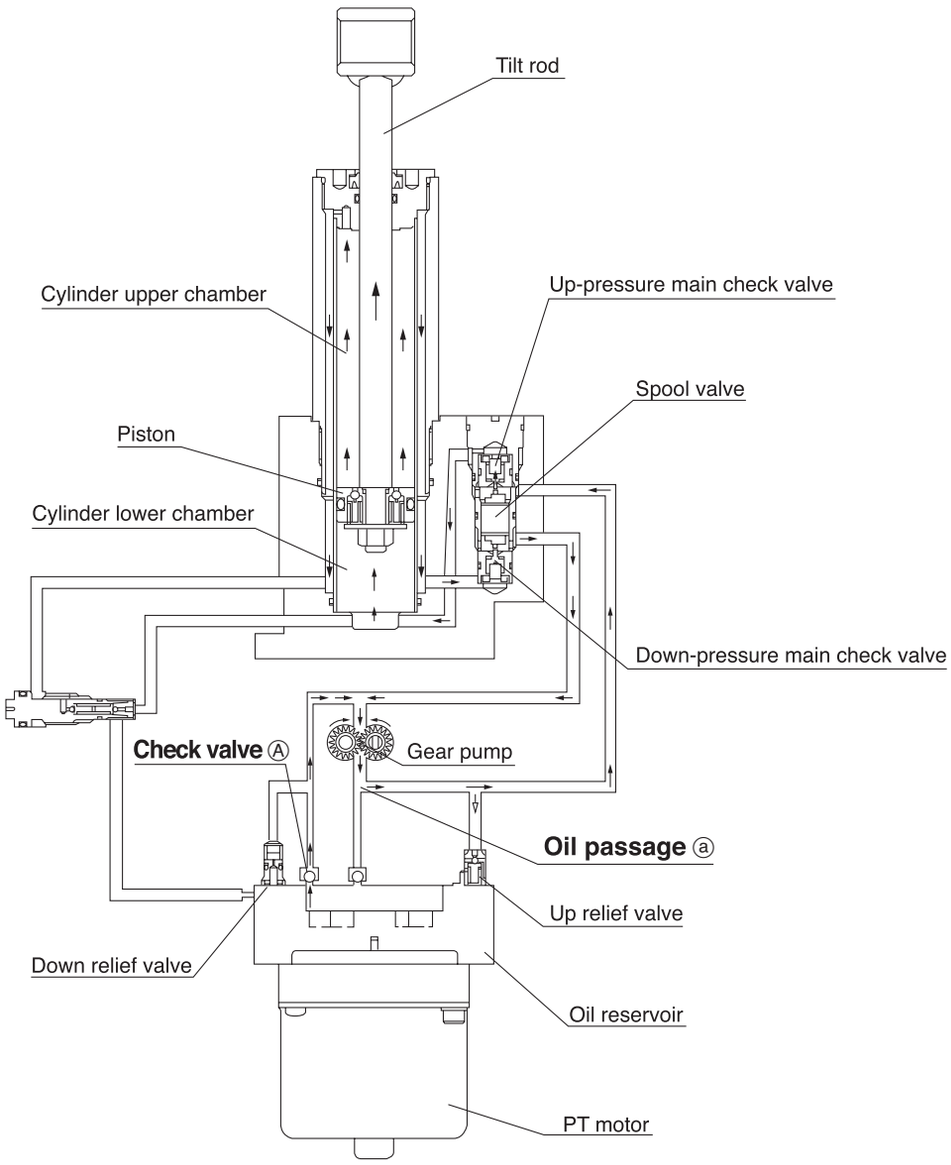


Manual Tilt Operation

Turning the manual operation valve counterclockwise 2 or 3 times opens the manual operation circuit.

The outboard motor can be tilted up or down easily by hand.

When the manual circuit is closed completely by turning the manual valve clockwise before the outboard motor reaches completely tilted up or down position, the outboard motor holds the position at the time.



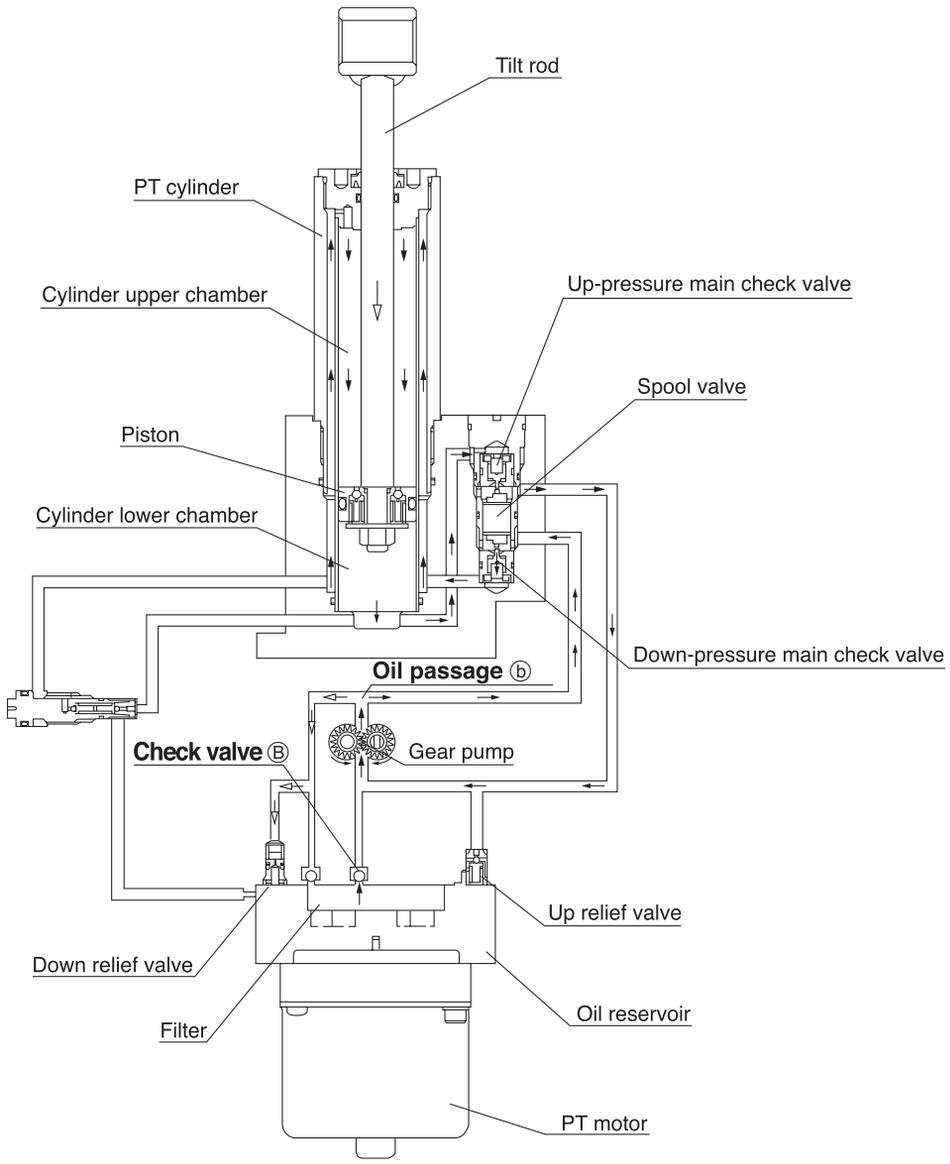
Tilt up Operation

Pressing "UP" side of PT switch causes the PT motor (gear of gear pump) to rotate clockwise.

Check valve Ⓐ opens to cause oil to flow from reservoir toward gear pump and spool valve. This oil flow shifts spool valve downward to open down-pressure main check valve. Oil in the cylinder upper chamber is returned to gear pump, hydraulic pressure of oil passage ⓐ is increased to open up-pressure main check valve, and the oil flows into cylinder lower chamber. As a result of the above operations, piston rod is pushed up to tilt up the outboard motor. The oil in the cylinder upper chamber returns to gear pump through down pressure main check valve.

Because of difference of capacity difference between cylinder upper chamber and lower chamber (piston rod at upper chamber side), oil flows into the pump through check valve Ⓐ to compensate for the lack of the oil. When the motor stops, down/up pressure main check valve closes, and spool valve moves to the center. As a result, piston rod is held at a position at the time.

When tilt rod fully extends, up relief valve opens to prevent increase of hydraulic pressure of cylinder lower chamber by relieving the pressure to protect PT unit.



Tilt down

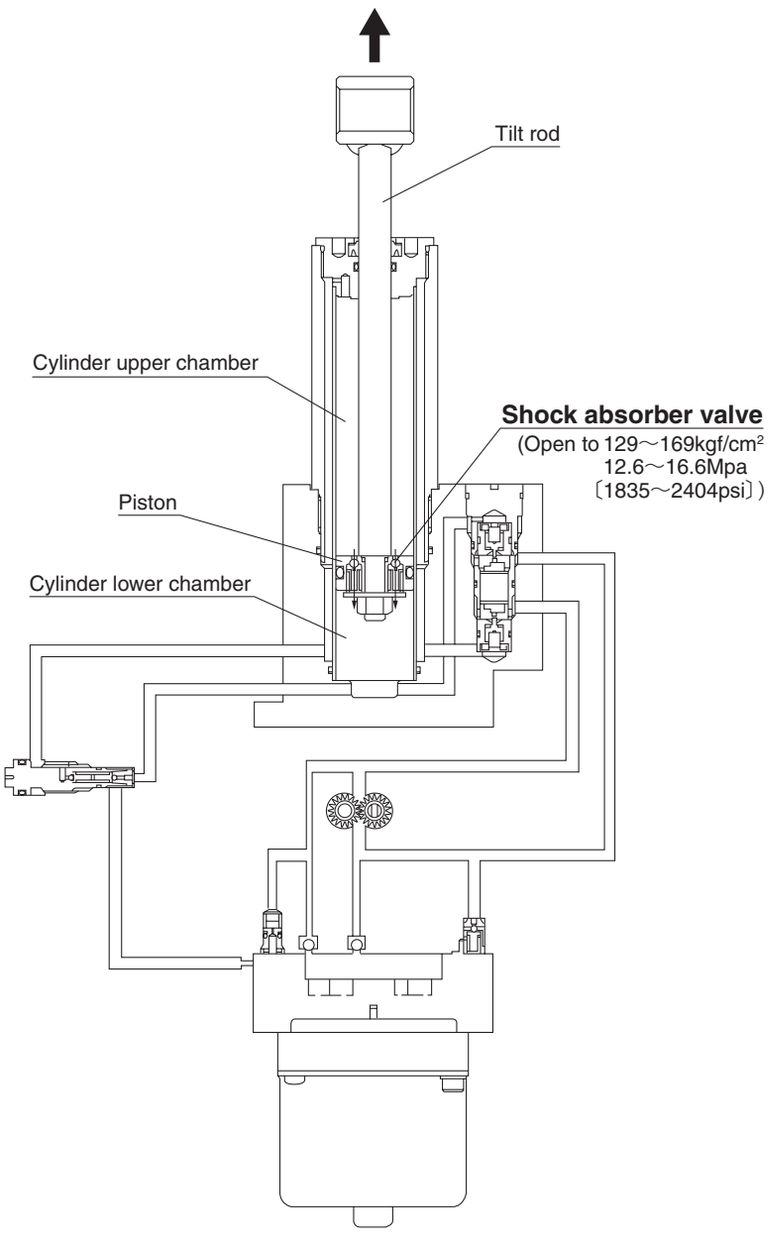
Pressing "DOWN" side of PT switch causes the PT motor (gear pump) to rotate counterclockwise.

Check valve Ⓑ opens to cause oil to flow from reservoir toward gear pump and spool valve. This oil flow shifts spool valve upward to open up-pressure main check valve. Oil in the cylinder lower chamber is returned to gear pump, hydraulic pressure of oil passage ⓑ is increased to open down-pressure main check valve, and the oil flows into cylinder upper chamber. As a result of the above operations, piston rod is pushed down to tilt down the outboard motor.

The oil in the cylinder lower chamber returns to gear pump through up-pressure main check valve.

Because of difference of capacity difference between cylinder upper chamber and lower chamber, oil of amount exceeding upper chamber requirement returns to gear pump.

When piston rod is drawn-in completely, all of oil discharged from the pump returns from down relief valve to the reservoir.

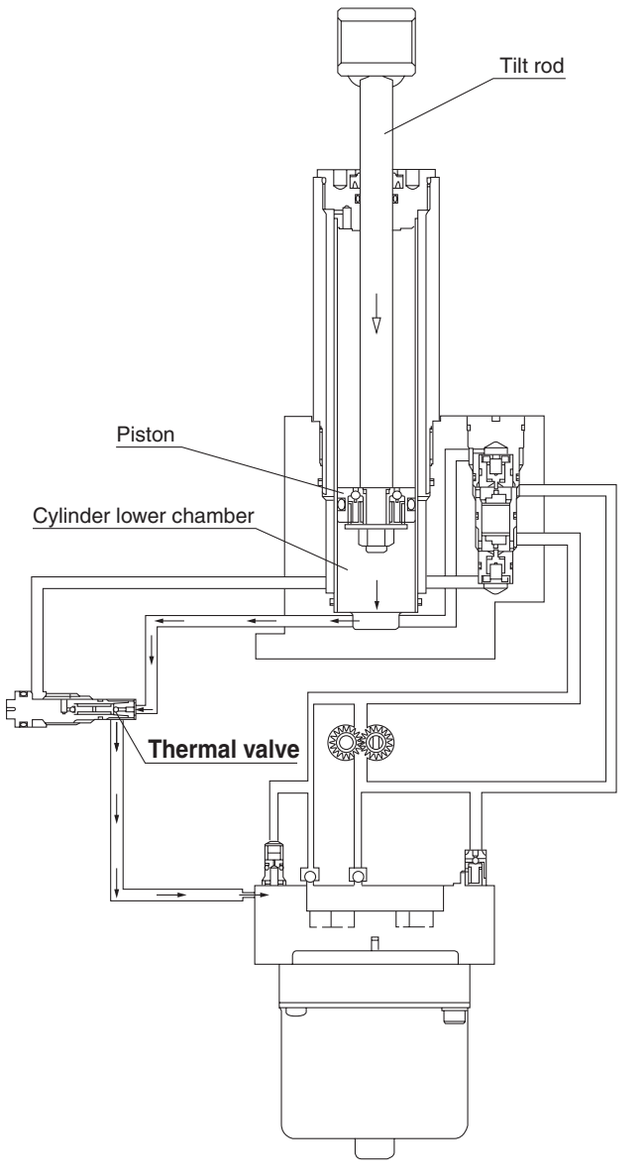


Shock Absorber Valve

The PT unit is provided with a shock absorber that protects the drive unit from an impact in case it hits underwater obstacle during cruising.

In case drive unit hits an underwater obstacle, the hydraulic pressure in the cylinder upper chamber is increased suddenly. The high pressure opens shock valve of piston.

When shock valve opens, oil in the cylinder upper chamber flows into the lower cylinder chamber to extend tilt rod upward to absorb the shock.



Thermal Valve

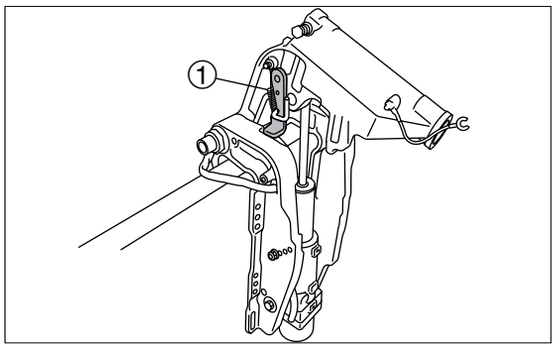
Thermal valve protects drive unit from excessive force that attempts to push down tilt rod when the outboard motor is at full tilt up position.

The piston rod to which excessive force is applied is pressed into the cylinder, resulting in increasing hydraulic pressure in the lower cylinder chamber over a rated value.

The increased hydraulic pressure reaches the thermal valve, resulting in opening the valve to dissipate itself.

6. Removing PT Unit

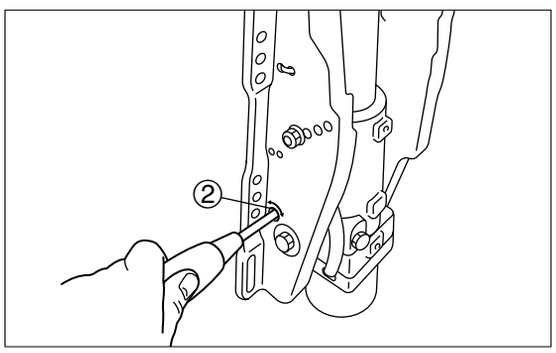
1. Fully tilt up outboard motor and lock with tilt stopper ①.



⚠ WARNING

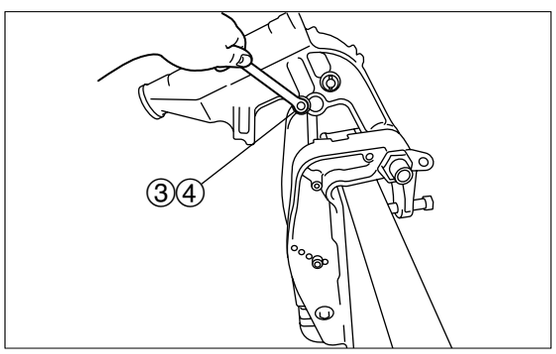
Be sure to lock outboard motor with tilt stopper after tilting up. Leaving outboard motor up without locking may lead to accidental descent due to reduction of PT hydraulic pressure.

IF PT unit will not operate, open manual valve and lift up outboard motor with hands. When manual valve is opened, be sure to tighten it with specified torque after tilting up outboard motor.

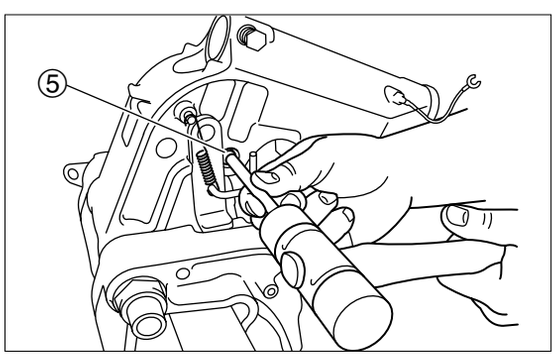


Manual valve ② :
2 N · m（1.5 lb · ft）[0.2 kgf · m]

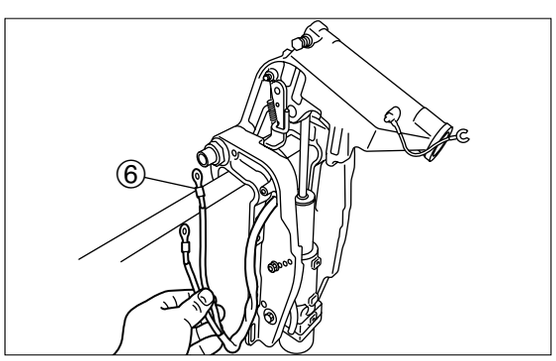
2. Remove bolt ③ and washer ④ located on the starboard side of the outboard motor, and then upper cylinder pin ⑤.



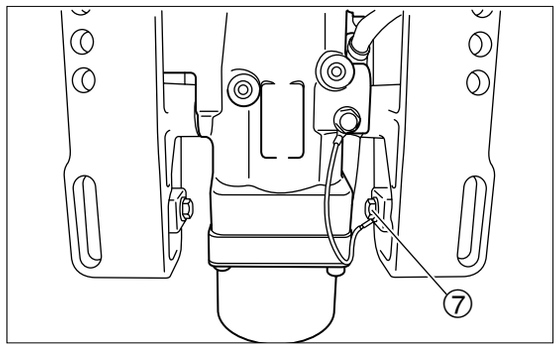
Upper cylinder pin can be removed easily when tilt rod is retracted a little by performing tilt down operation.



3. Disconnect PT cable ⑥ from PT solenoid, and earth code ⑦ from power tilt unit.

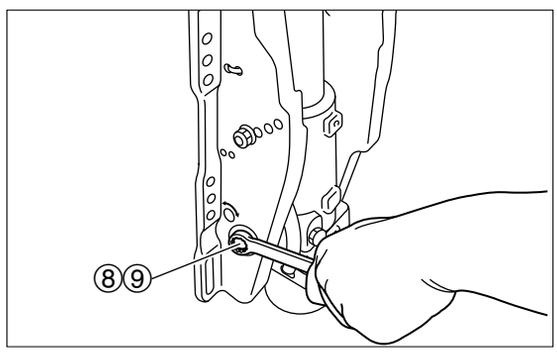


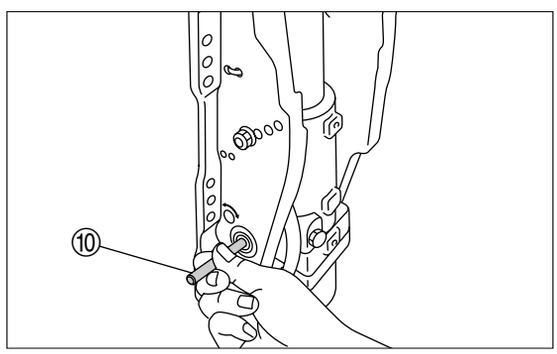
Disconnect negative battery cable first and then positive cable.



4. Remove bolt ⑧ and washer ⑨, and use a proper punch ⑩ to remove lower cylinder pin.

Be careful not to drop PT assembly.

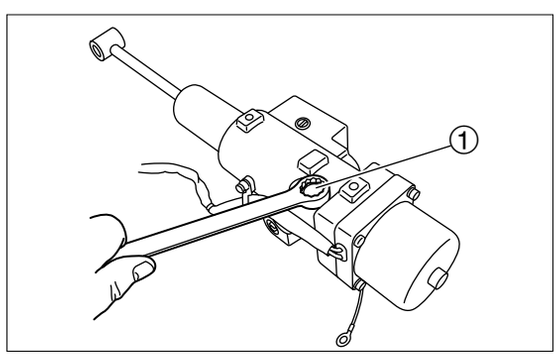




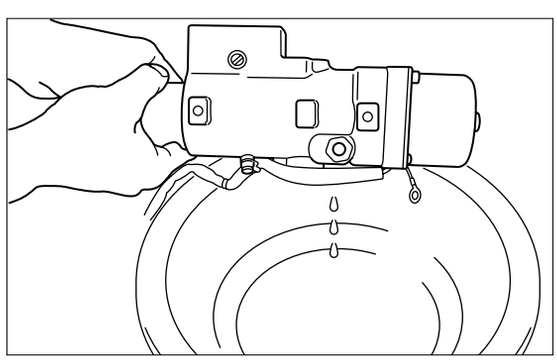
6. Removing and Repairing Manual Release Valve

1. Loosen fill cap ① of power tilt unit slowly, and then remove it.

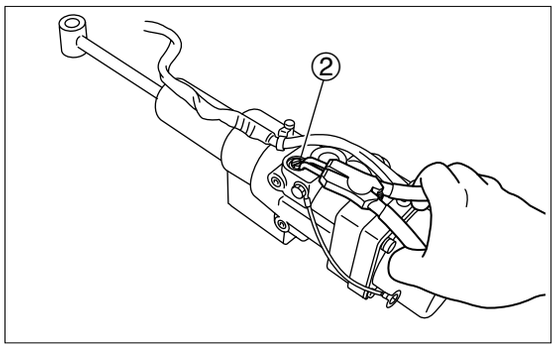
Fully extend tilt rod when removing fill cap.

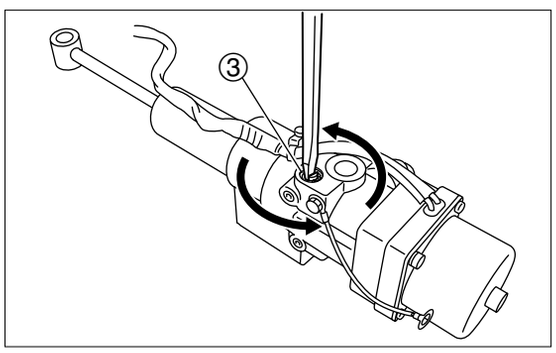


2. Drain power tilt fluid from filler cap outlet.



3. Remove manual valve C ring ② and turn manual valve ③ counterclockwise to remove.

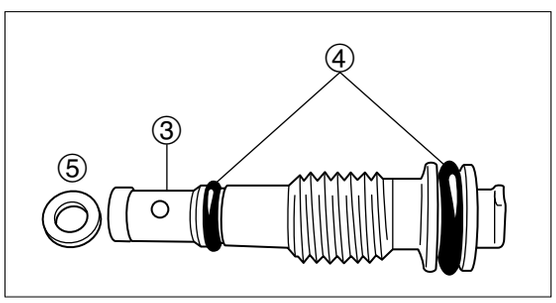




4. Remove O ring (2 pcs) ④ from manual valve ③, check O ring for damages and deterioration, and replace with new part if necessary.

5. Remove seal washer ⑤, and replace with new part if necessary.

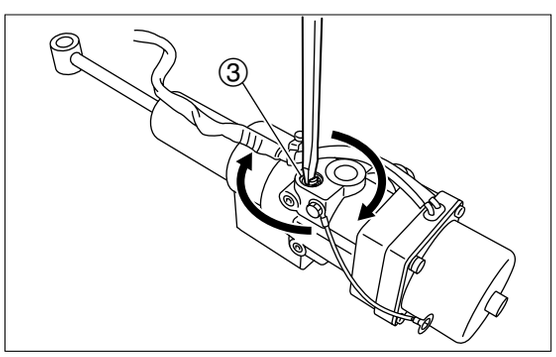
Apply PT fluid to new O ring before attaching it to power tilt assembly.



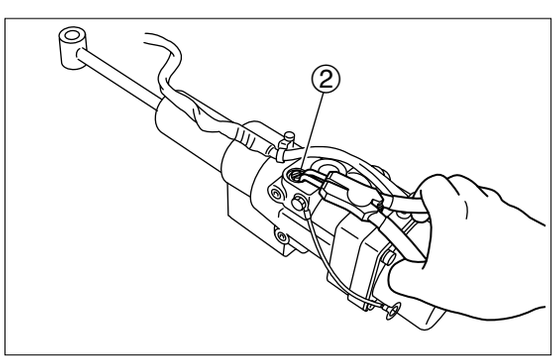
③ Manual valve
④ O ring
⑤ Seal washer

6. Attach O rings (2 pcs) ④ to manual valve.

7. Attach manual valve ③ to power tilt ass'y.



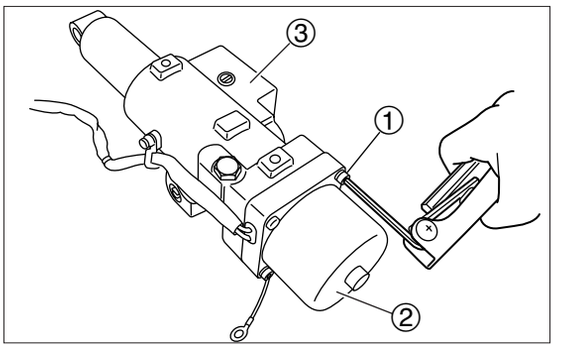
8. Attach C ring ②.



7.Power Tilt Motor

1) Removal, Check and Repair of Power Tilt Motor

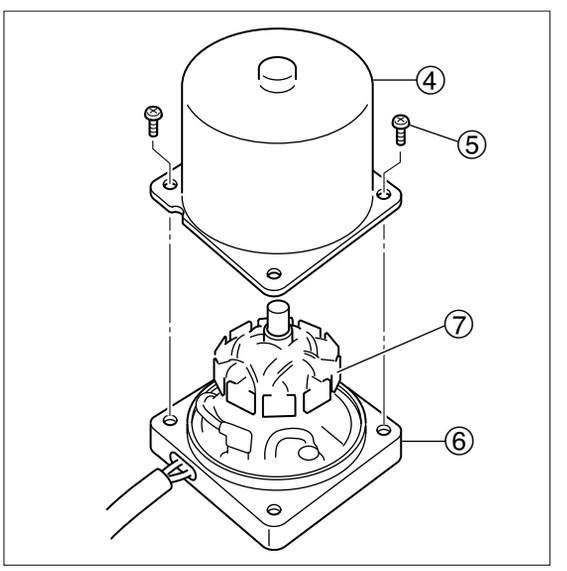
1. Remove 2 inner hex bolts ①, and then remove motor ass'y ② from power tilt pump and cylinder ass'y ③.



> Before disassembling power tilt motor, drain power tilt fluid. **<Refer to section 7.>**

2. Remove 2 screws ⑤, and then remove yoke ass'y ④ from motor bracket ass'y ⑥.

3. Remove armature ass'y ⑦ from yoke ass'y ④.

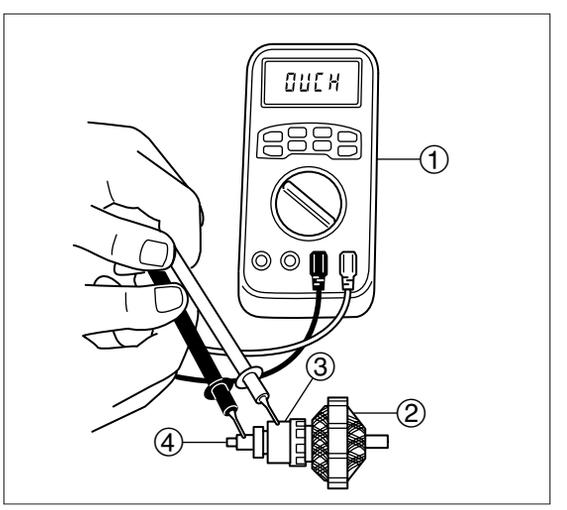


①Yoke ass'y
②Screw
③Motor bracket
④Armature ass'y

2) Continuity Test

1. Check electrical conductivity of armature ②. Replace armature ass'y if other than specification.

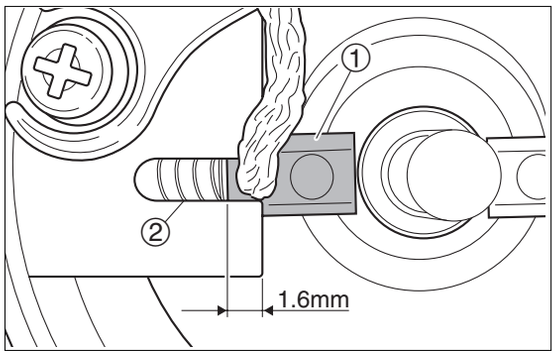
Armature Conductivity : ③Commutator ④Armature shaft	Non-conductive ∞



①Meter
②Armature
③Commutator
④Armature ass'y

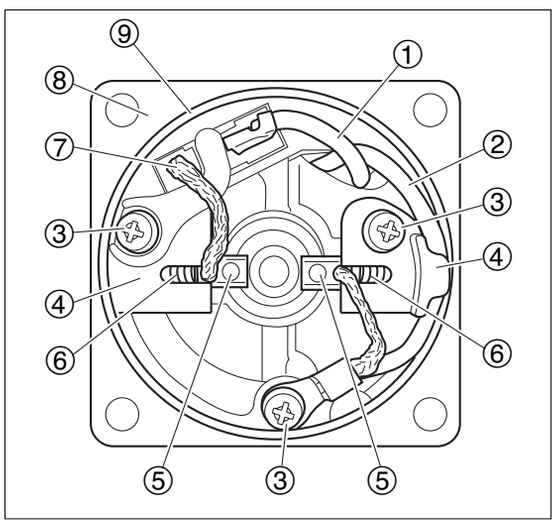
3) Inspection of Motor

1. Replace brush ⑤ if it is damaged or if gap between brush end in the groove of brush holder ④ and brush holder end is 1.6mm or less.



4) Replacement of Motor

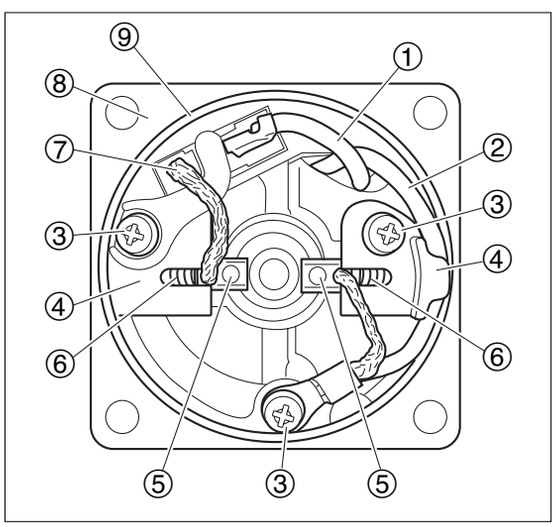
1. Remove 3 screws ③, and remove brush ⑤ and circuit breaker ⑦ from motor bracket ⑧.
2. Remove circuit breaker ⑦.
3. Remove brush holder ④ and brush ⑤.



①Wire (blue)
②Wire (green)
③Screw
④Brush holder
⑤Brush
⑥Spring
⑦Circuit breaker
⑧Motor bracket
⑨O ring

5) Assembling Power Tilt Motor

1. Attach circuit breaker ⑦ to motor bracket ⑧.
2. Attach circuit breaker holder securely by using screws.
3. Attach blue wire ① to terminal post of circuit breaker ⑦.
4. Place green wire ② along bore of bracket.
5. Attach brush holder ④ by using screw ③.
6. Attach green wire ② and brush wire end to motor bracket 8 securely by using screw ③.
7. Attach 2 springs ⑥ in the brush.
8. Attach circuit breaker ⑦ and brush ⑤ in the groove.

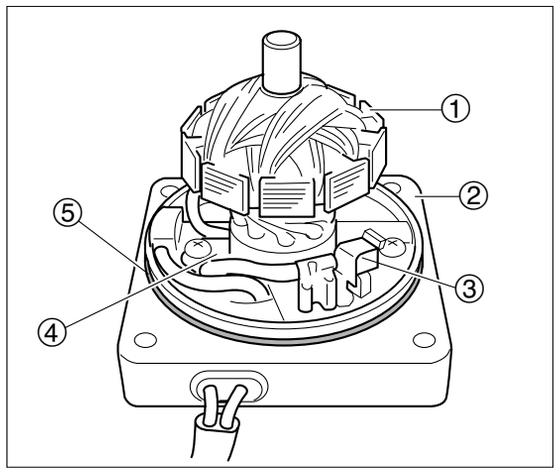


①Wire (blue)
②Wire (green)
③Screw
④Brush holder
⑤Brush
⑥Spring
⑦Circuit breaker
⑧ Motor bracket
⑨O ring

7

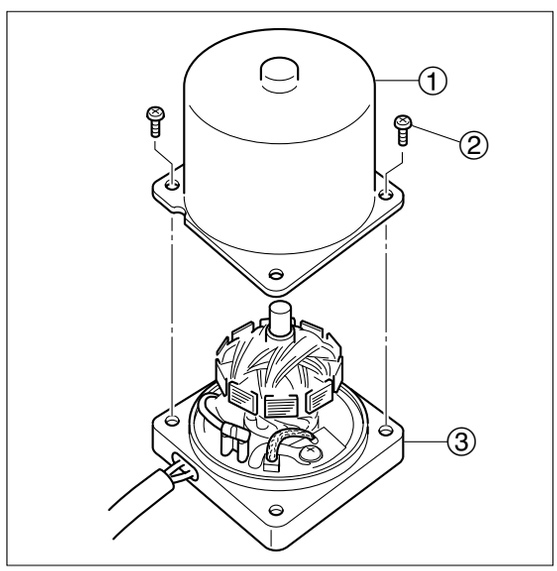
9. Attach armature ① while holding brush ③ located in the groove during installation of armature ① to motor bracket ②.

10. Attach O ring ⑤ to motor bracket ②.



①Armature
②Motor bracket
③Brush
④Brush
⑤O ring

11. Attach yoke ass'y ① by using 2 screws ②.



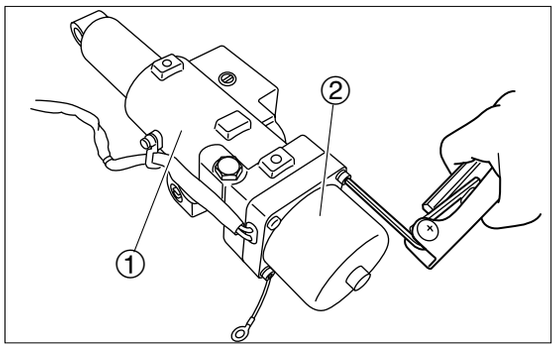
①Yoke ass'y
②Screw (2)
③Motor bracket

8.Power Tilt Pump

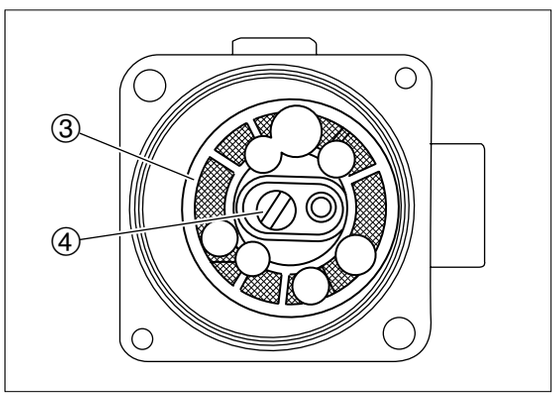
1) Disassembly of Power Tilt Pump

⚠ WARNING

Contamination of hydraulic system can give damage to the components and circuits, possibly resulting in serious damage to the product.
Before inspecting hydraulic circuit and parts, organize working space and tools.
Do not use cloth for inspection and servicing of parts.
Hydraulic circuit may be clogged.
Remove oil feed plug before beginning the work.
Keeps parts in the plastic bags during disassembly.



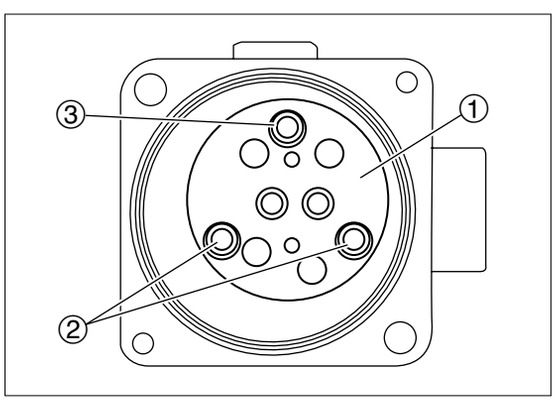
1. Remove power tilt ass'y from outboard motor.
2. Remove power tilt motor ass'y ② from power tilt ass'y ①.
3. Remove pump coupling ④.
4. Remove filter ③ from power tilt ass'y.



③Filter
④Pump/motor coupling

Relief valve ass'y is located in the power tilt pump.
When removing pump, be careful not to lose its parts.

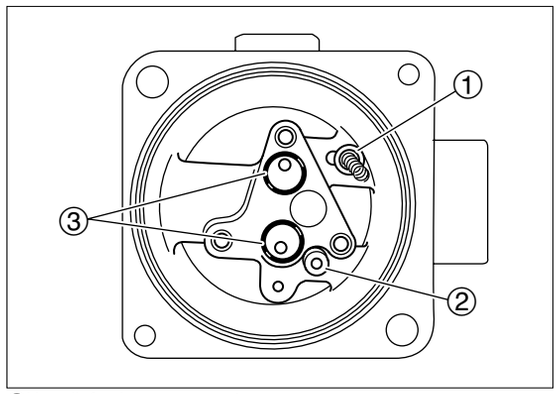
5. Remove 3 screws ②, ③ that secure power tilt pump ① and assembly.



①Power tilt pump
②Internal hex screw (5mm×20)
③Internal hex screw (5mm×25)

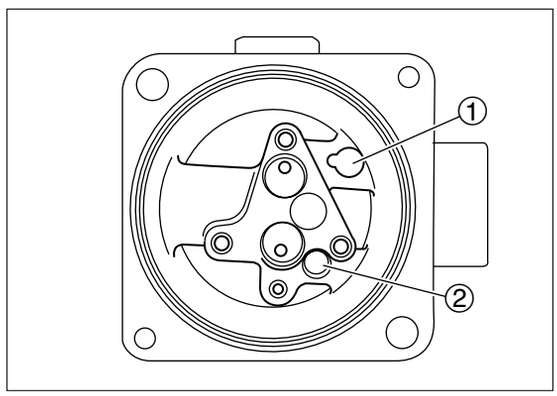
7

6. Remove UP side relief valve ①, DOWN relief orifice ② and O ring ③ from power tilt housing.



①Up relief valve component
②Down relief orifice
③O ring

7. Check down side orifice screen ② and up side relief valve seat face ①. Replace parts if necessary.



①Up relief valve seat
②Down orifice screen

2) Assembling Power Tilt Pump

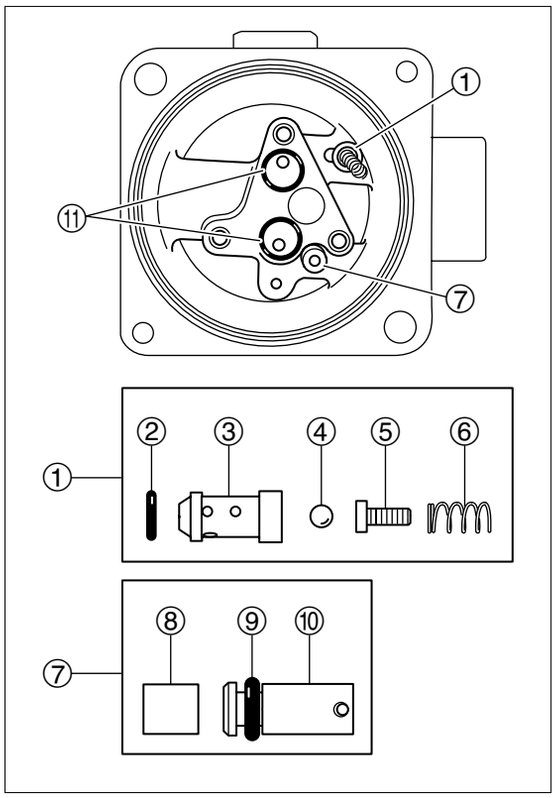
1. Coat new O rings (2) ⑪ with oil, and attach it to power tilt housing.

2. Coat new O ring ⑨ with oil, and attach it to orifice ⑩.

3. Attach filter ⑧ and orifice ⑩.

4. Attach up side relief valve ① to power tilt pump housing.

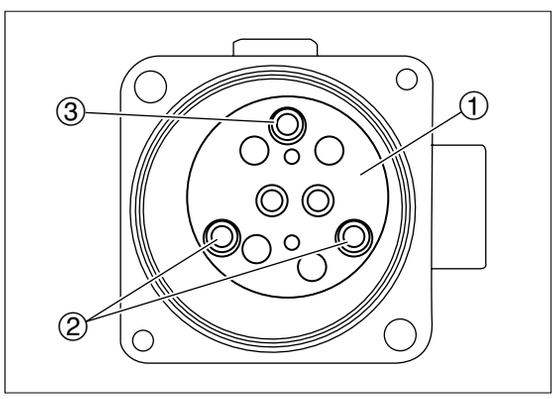
Recommended PT Fluid :
ATF DEXRON II



①Up relief valve ass'y
②O ring
③Valve seat
④Ball
⑤Spring guide
⑥Spring
⑦Down orifice ass'y
⑧Filter
⑨O ring
⑩orifice
⑪O ring

5. Secure pump with screws ②, ③.
Tighten screws to specified torque.

Pump mounting screw :
5N·m（4lb·ft）〔0.5kg f·m〕



①Power tilt pump
②Internal hex screw (5mm×20)
③Internal hex screw (5mm×25)

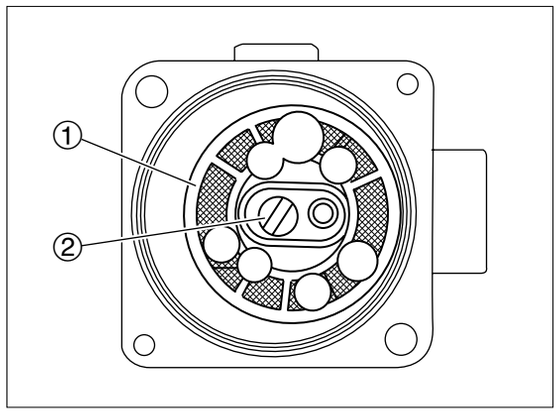
7

6. Attach cleaned screen ①.

7. Attach pump coupling ② to pump.

8. Install motor ass'y to power tilt pump and cylinder ass'y.

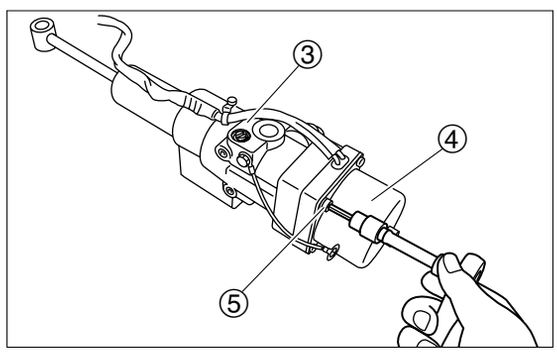
9. Attach wireharness mounting screws.



①Pump filter
②Pump/motor coupler

10. Install motor ass'y ④ to cylinder ass'y and power tilt pump ③ by using screws ⑤, and tighten screws to specified torque.

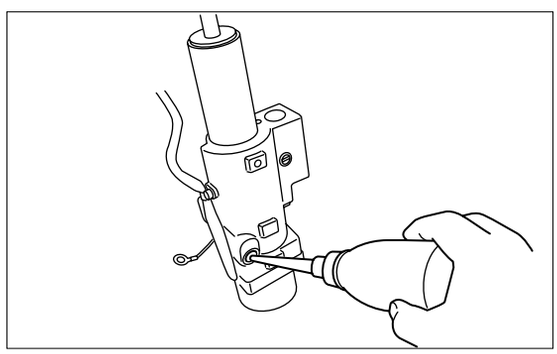
Motor ass'y installation screws:
5N·m（4lb·ft）〔0.5kg f·m〕



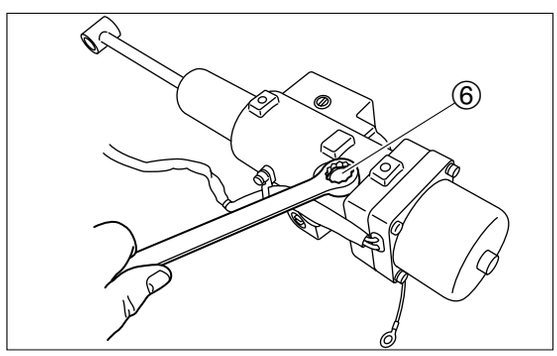
11. Fill power tilt system with PT fluid.

Recommended PT Fluid :
ATF DEXRON II

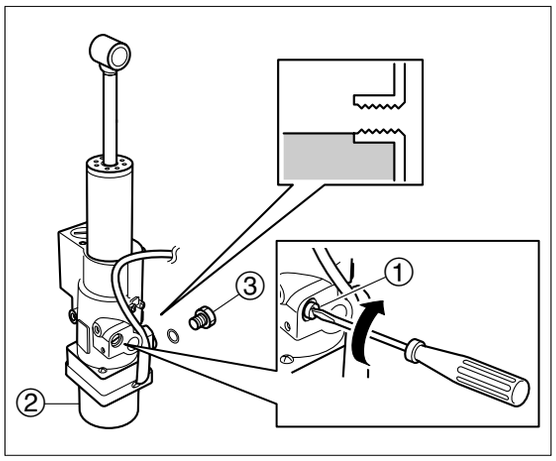
Extend tilt rod and put PT unit vertically. Pour fluid until it overflows from inlet.



12. Attach the cap ⑥.



3) Air-Purging PT Unit (Separated from Outboard Motor)



1. Turn manual valve ① clockwise fully.

2. Put PT unit ② on the work bench vertically, remove cap ③ and check level of fluid in the reservoir.

⚠ WARNING

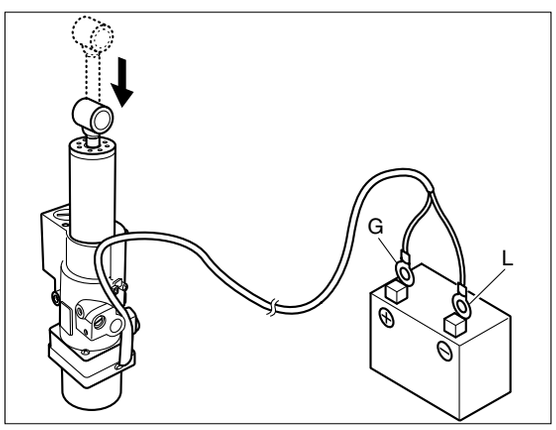
Check fluid level with tilt rod fully extended. Removing reserve tank cap with tilt rod at halfway position can cause blasting out of PT fluid, which is dangerous, and also result in inaccurate fluid level reading.

3. Add recommended PT fluid to specified level if it is lacking.

Recommended PT Fluid :
ATF DEXRON II

4. Put cap ③ and tighten to specified torque.

Reserve Tank Cap :
1.5N·m (1.1lb·ft) {1.5kgf·m}

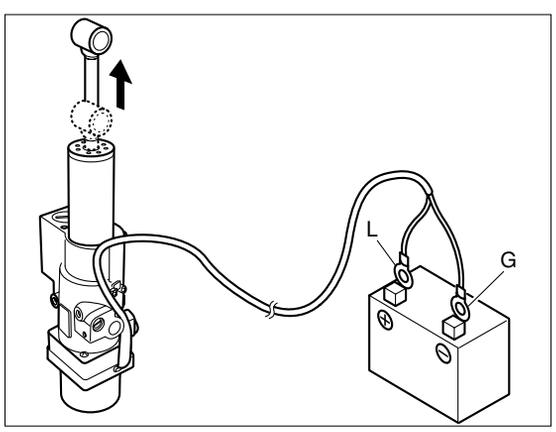


5. Reconnect PT motor lead wires to battery terminals to fully retract tilt rod.

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 above steps several times to move up and down tilt rod (When reversing motor lead wire connection, keep the connection open for two or three seconds.).

7. Check fluid level with tilt rod fully stretched.
Add recommended PT fluid to specified level if it is lacking.

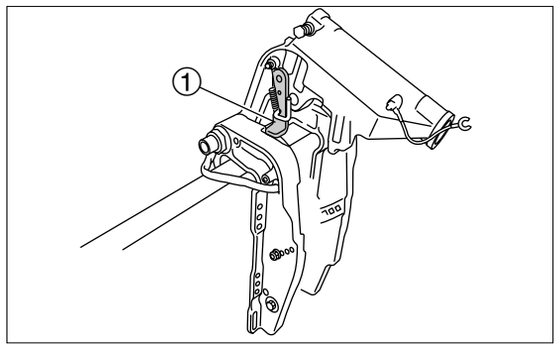
Recommended PT Fluid :
ATF DEXRON II

8. Repeat steps 2. to 7. until fluid reaches specified level.

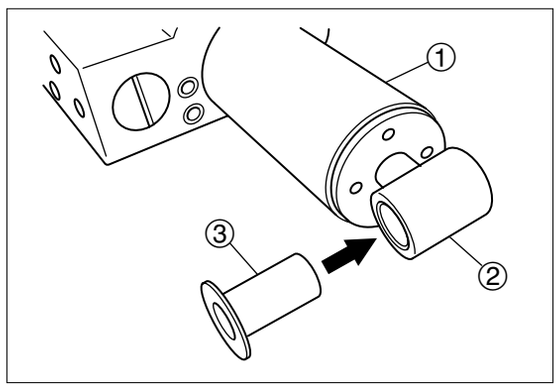
9. Reattach cap.

4) Installation of Power Tilt Ass'y

1. Fully tilt up outboard motor and lock with tilt stopper ①.



2. Install bushing ③ on the tilt cylinder rod ②.



①Power tilt cylinder
②Cylinder rod eye
③Bushing

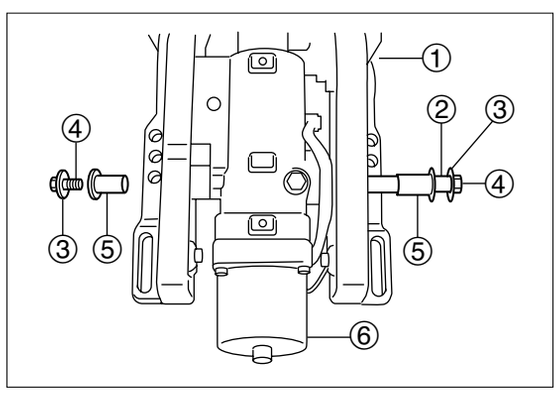
3. Attach pivot bushings ⑤ (2) to clamp bracket ①.

4. Place power tilt ass'y ⑥ between clamp brackets 1.

5. Put tilt cylinder pivot pin (lower) ② in the hole of clamp bracket ① to secure power tilt ass'y ⑥.

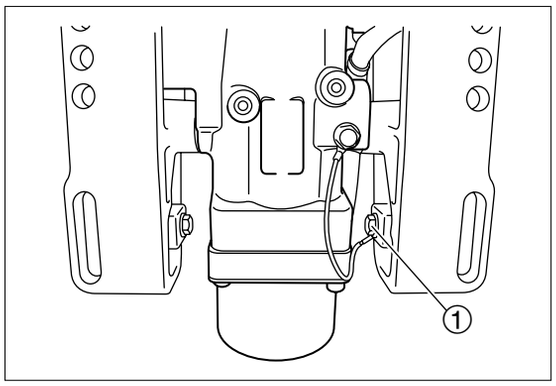
6. Put washer ③ and bolt ④ on the pin (lower) ② and tighten the bolt to specified torque.

Retaining screw ④ :
13N·m（9.4lb·ft）〔1.3kgf·m〕

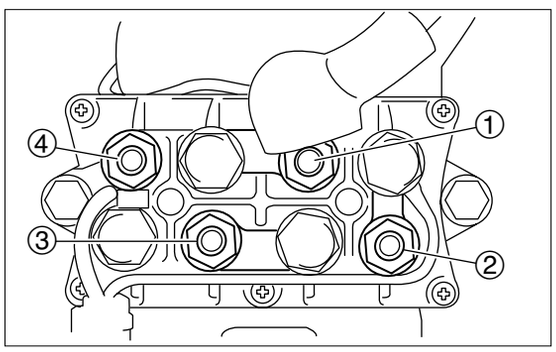


①Clamp bracket
②Pivot pin
③Washer (2)
④Retaining screw
⑤Pivot bushings (2)
⑥Power tilt ass'y

7. Secure earth cord ① by using screw.



8. Attach electrical cord of power tilt unit to power tilt relay ②, ④.

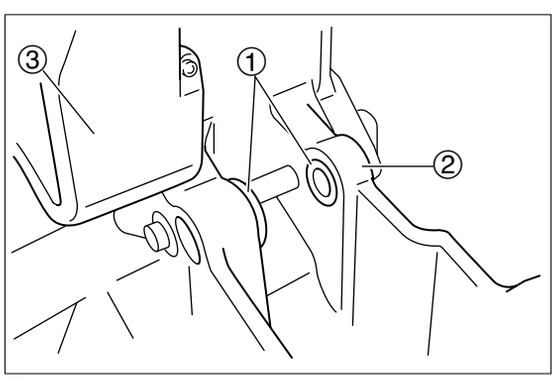


①Positive terminal (red)
②Up relay terminal (blue)
③Negative terminal (black)
④Down relay terminal (green)

9. Attach bushings (2) ① to swivel bracket ②.

10. Extend power tilt cylinder rod to align tilt cylinder rod and swivel bracket.

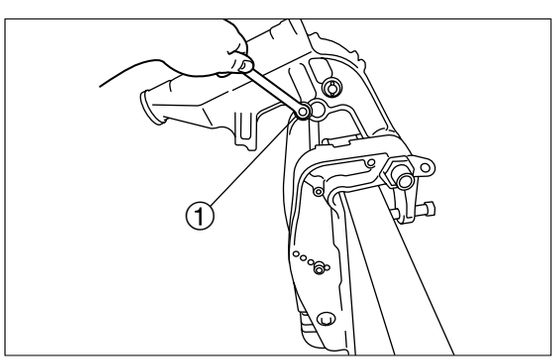
11. Fit tilt cylinder rod by using cylinder pin (upper).



①Bushings (2)
②Swivel bracket
③Clamp bracket

12. Tighten tilt cylinder pin (upper) securing screw ① to specified torque.

Tilt cylinder pin (upper) securing screw :
13N·m（9.4lb·ft）〔1.2kgf·m〕



13. Unlock tilt stopper, and repeat tilting up and down outboard motor to bleed air from hydraulic circuit.
< Refer to 3) Air-Purging PT Unit >

14. Check power tilt fluid level, and replenish if necessary.

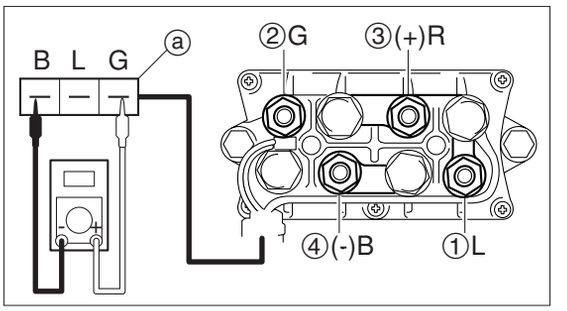
5) Inspection of PT Relay

This test can be made without removing parts.

1. Disconnect positive and negative cables from battery.

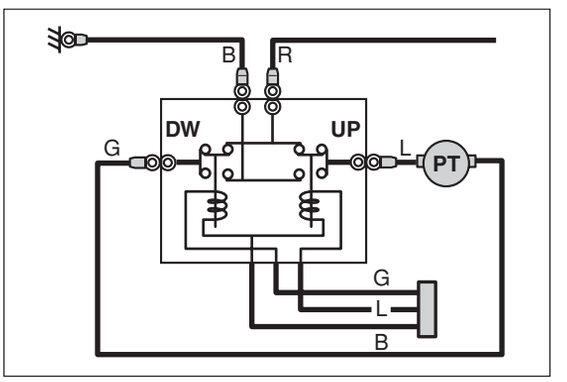
2. Remove PT lead wire socket ⓐ from coupler.

3. Check PT relay wires in accordance with the following table. Replace if out of specification.



Conductivity of PT relay

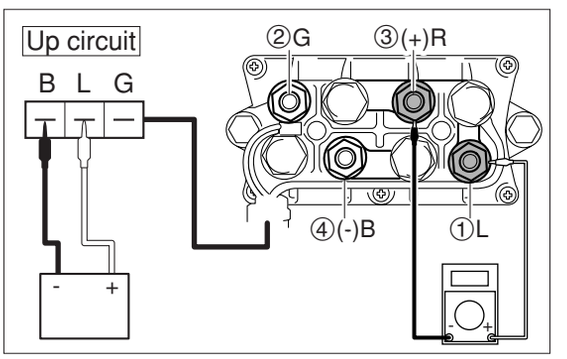
Coupler	Blue (L) - Black (B) Green (G) - Black (B)	Conductive
	Terminal 1 - Terminal 4 (-) Terminal 2 - Terminal 4 (-)	Conductive
	Terminal 1 - Terminal 3 (+) Terminal 2 - Terminal 3 (+)	Non-conductive



Inspection of UP side relay

4. As shown in the figure, connect blue terminal (L) in the coupler to battery positive terminal and black terminal (B) to negative terminal, and then, connect circuit tester leads to PT relay terminals ① and ③.

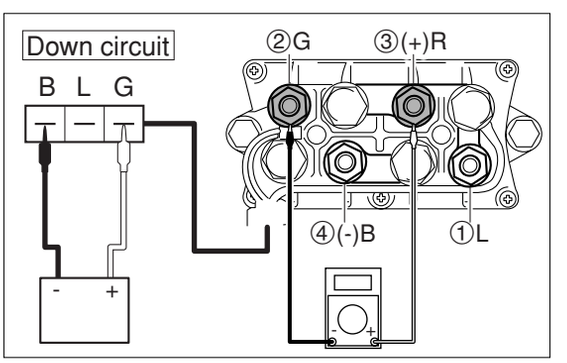
5. Check electrical conductivity between terminals ① and ③. Replace relay if non-conductive.



Inspection of DOWN side relay

6. As shown in the figure, connect green terminal (G) in the coupler to battery positive terminal and black terminal (B) to negative terminal, and then, connect circuit tester leads to PT relay terminals ② and ③.

7. Check electrical conductivity between terminals ② and ③. Replace relay if non-conductive.

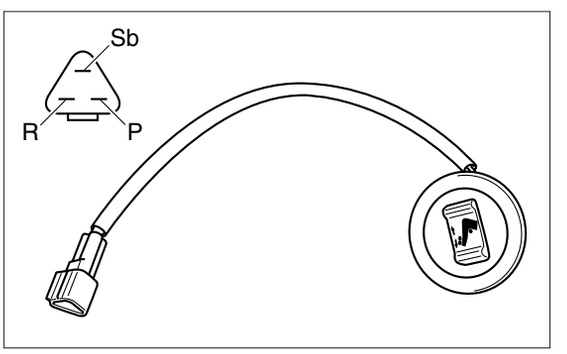


6) Inspection of PT Switch

1. Check electrical conductivity of PT switch. Replace if out of specification.

Lead Wires

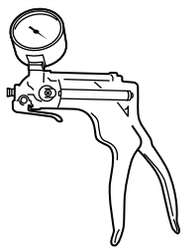
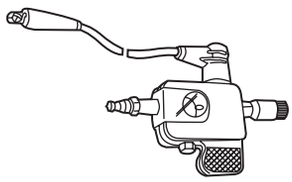
Switch Position	Sky Blue (Sb)	Red (R)	Pink (P)
UP (Tilt Up)	○	○	
Free			
DOWN (Tilt Down)		○	○



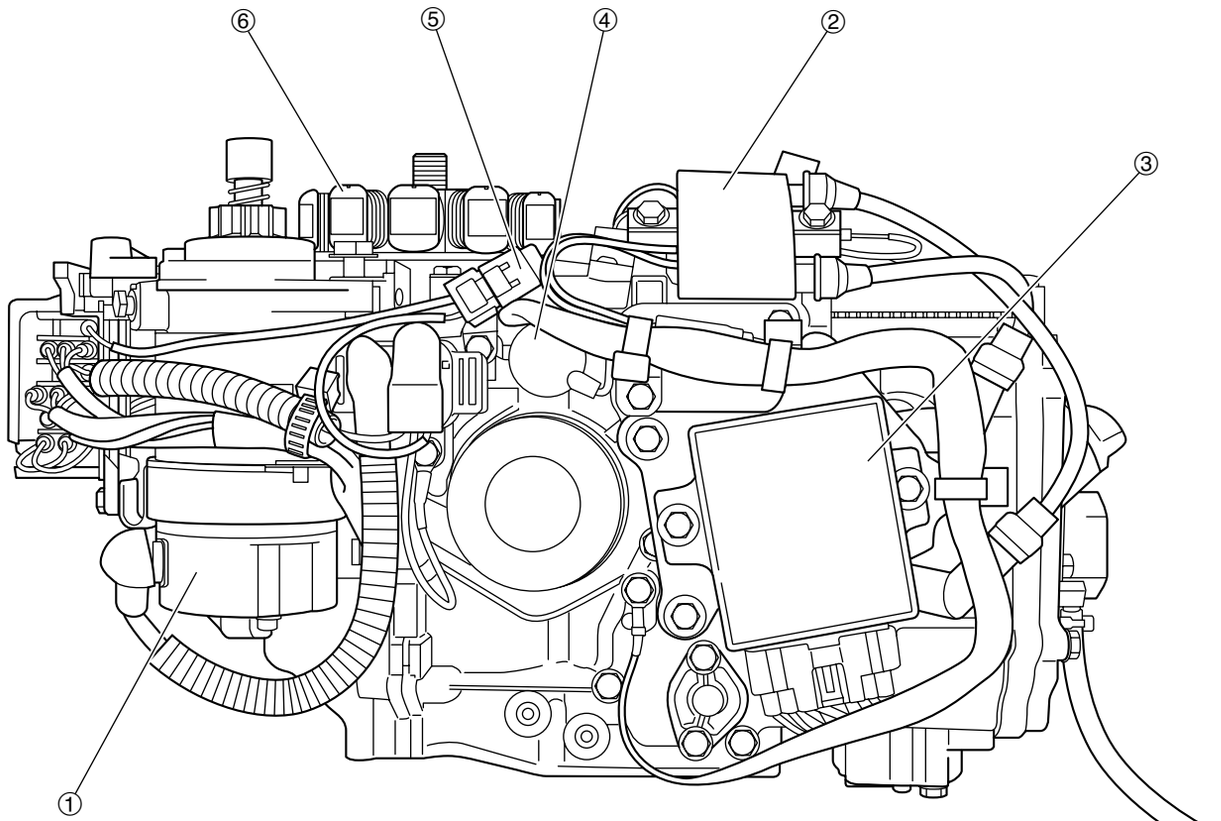
8

Electrical System

1.Special Tools

	
Vacuum/Pressure Gauge P/N. 3AC-99020-1	Spark Tester P/N. 3F3-72540-0
Inspecting pressure	Inspecting sparks

2. Electrical Component Layout
Port Side View

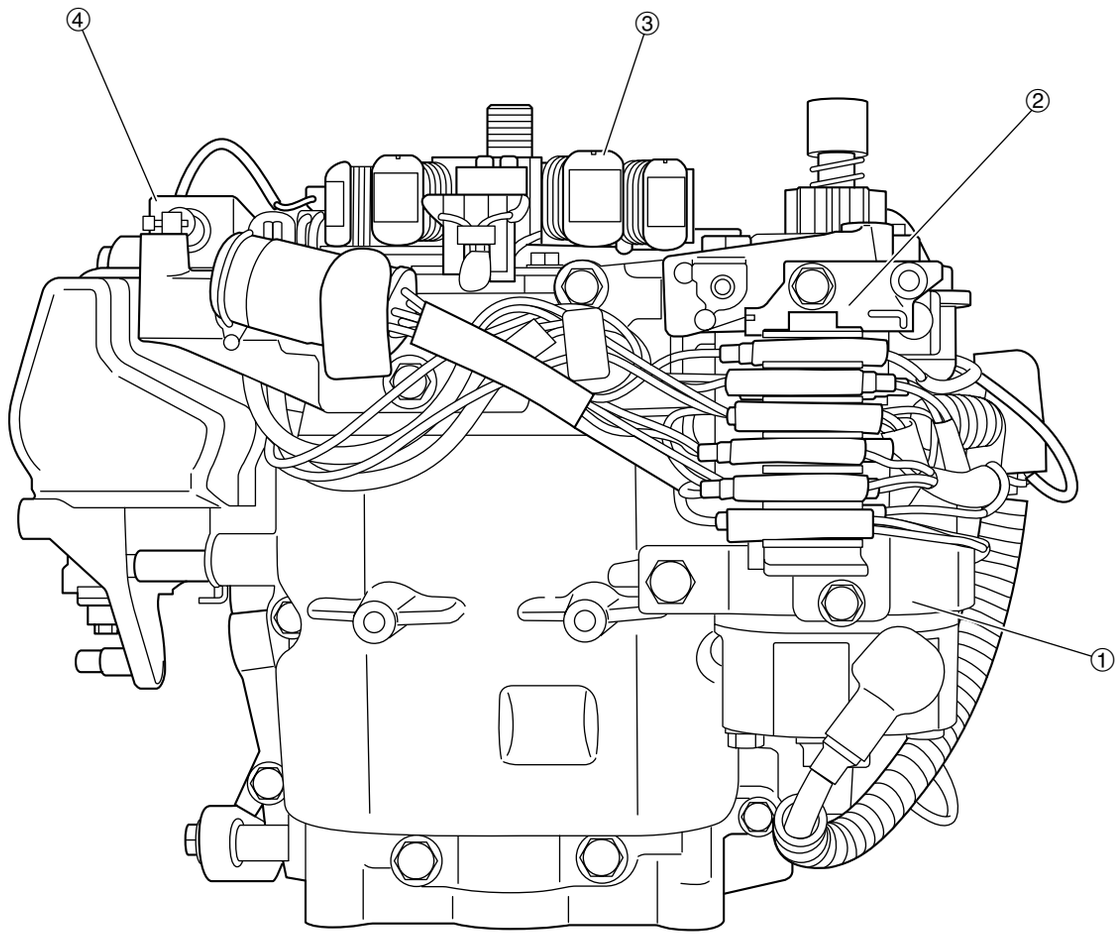


< EP Model >

8

① Starter Motor
② Ignition Coil
③ C.D. Unit
④ Oil Pressure Switch
⑤ Fuse
⑥ Alternator

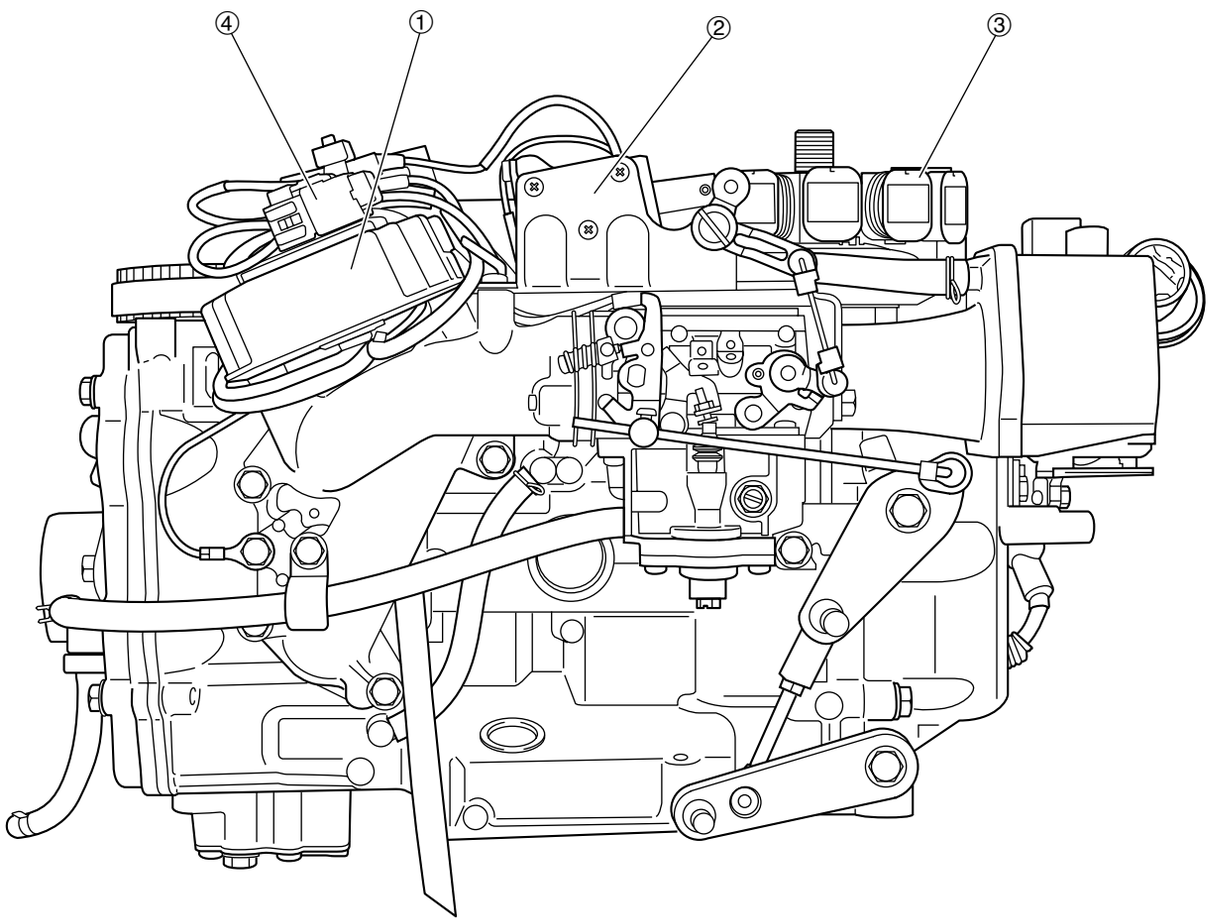
Bow Side View



< EP Model >

① Starter Motor
② Cable Terminal Holder
③ Alternator
④ Choke Solenoid

Starboard Side View

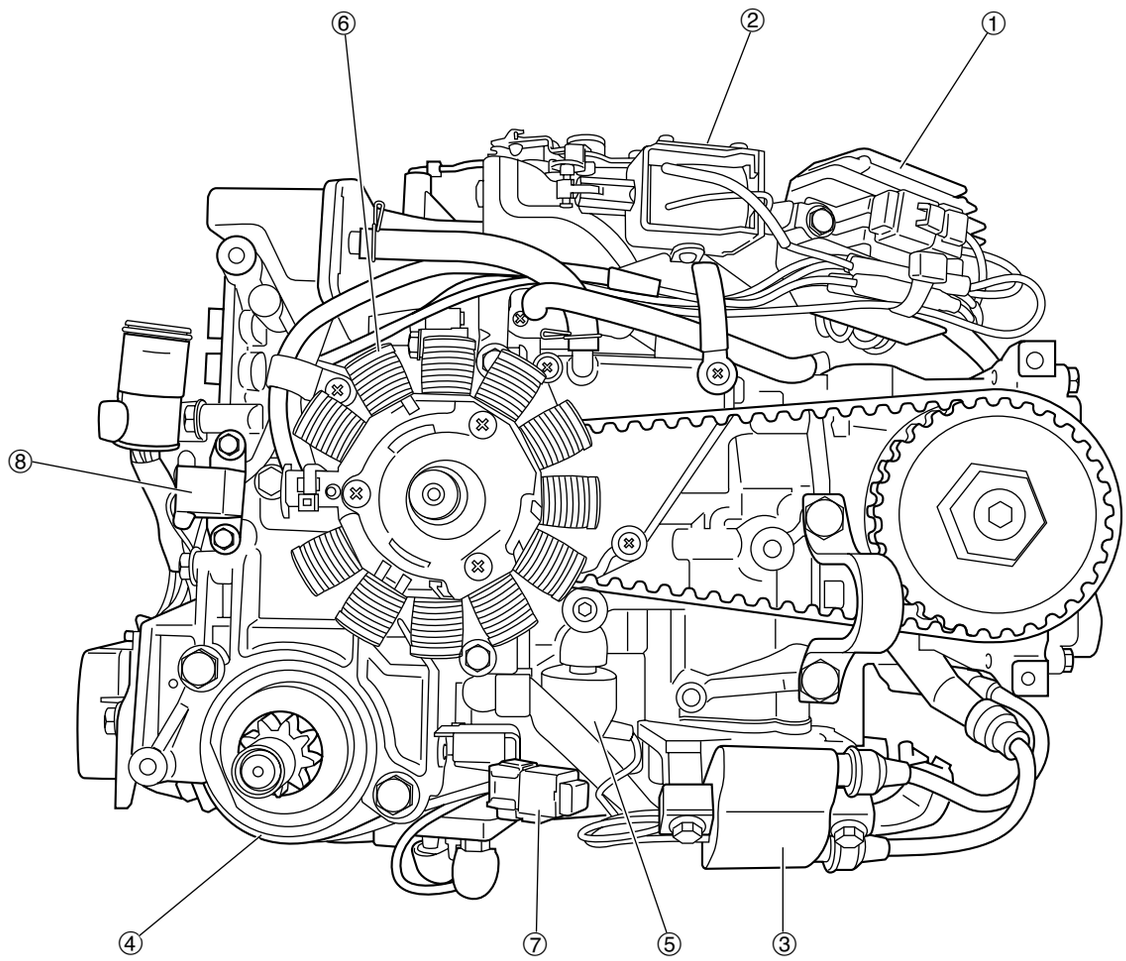


< EP Model >

8

① Rectifier
② Choke Solenoid
③ Alternator
④ Fuse Holder

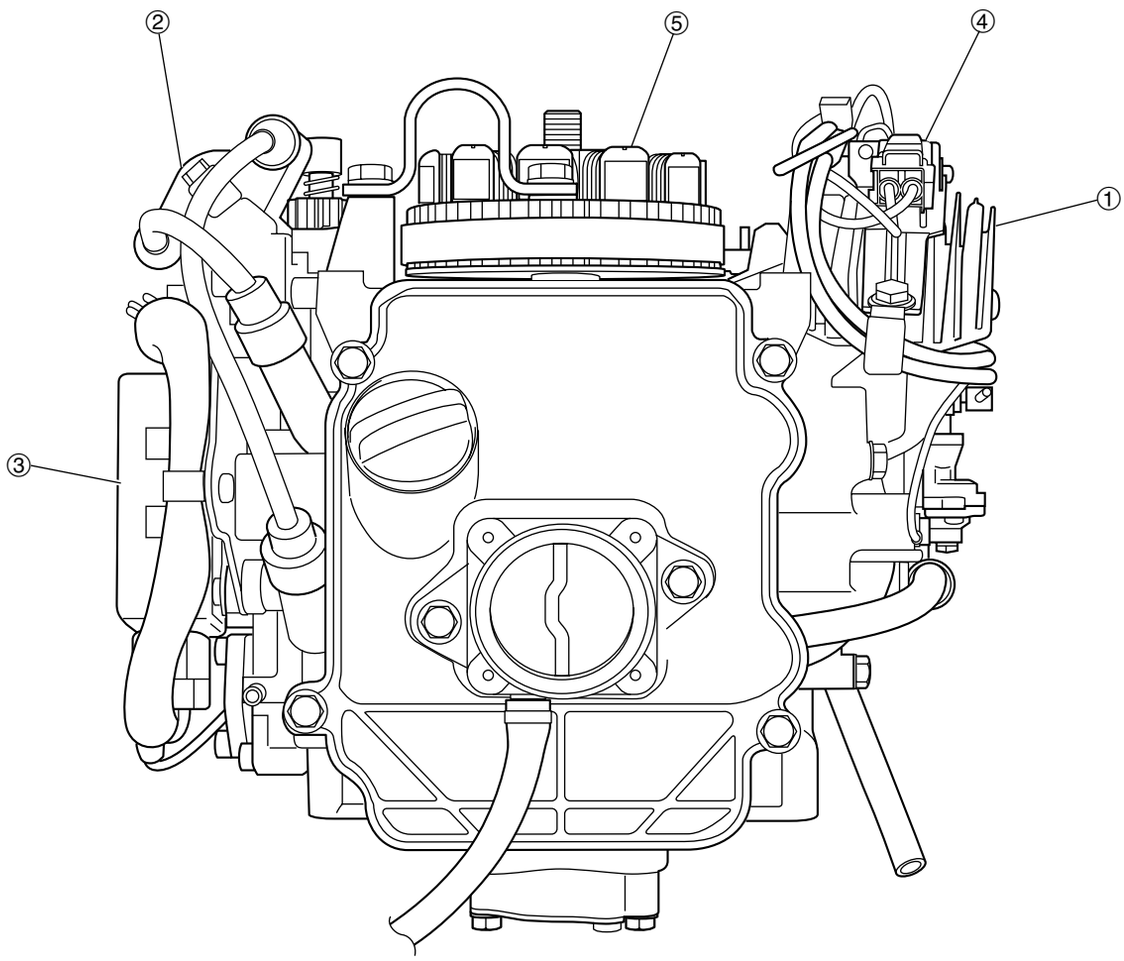
Top View



< EP Model >

① Rectifier
② Choke Solenoid
③ Ignition Coil
④ Starter Motor
⑤ Oil Pressure Switch
⑥ Alternator
⑦ Fuse
⑧ Pulser Coil

Back View

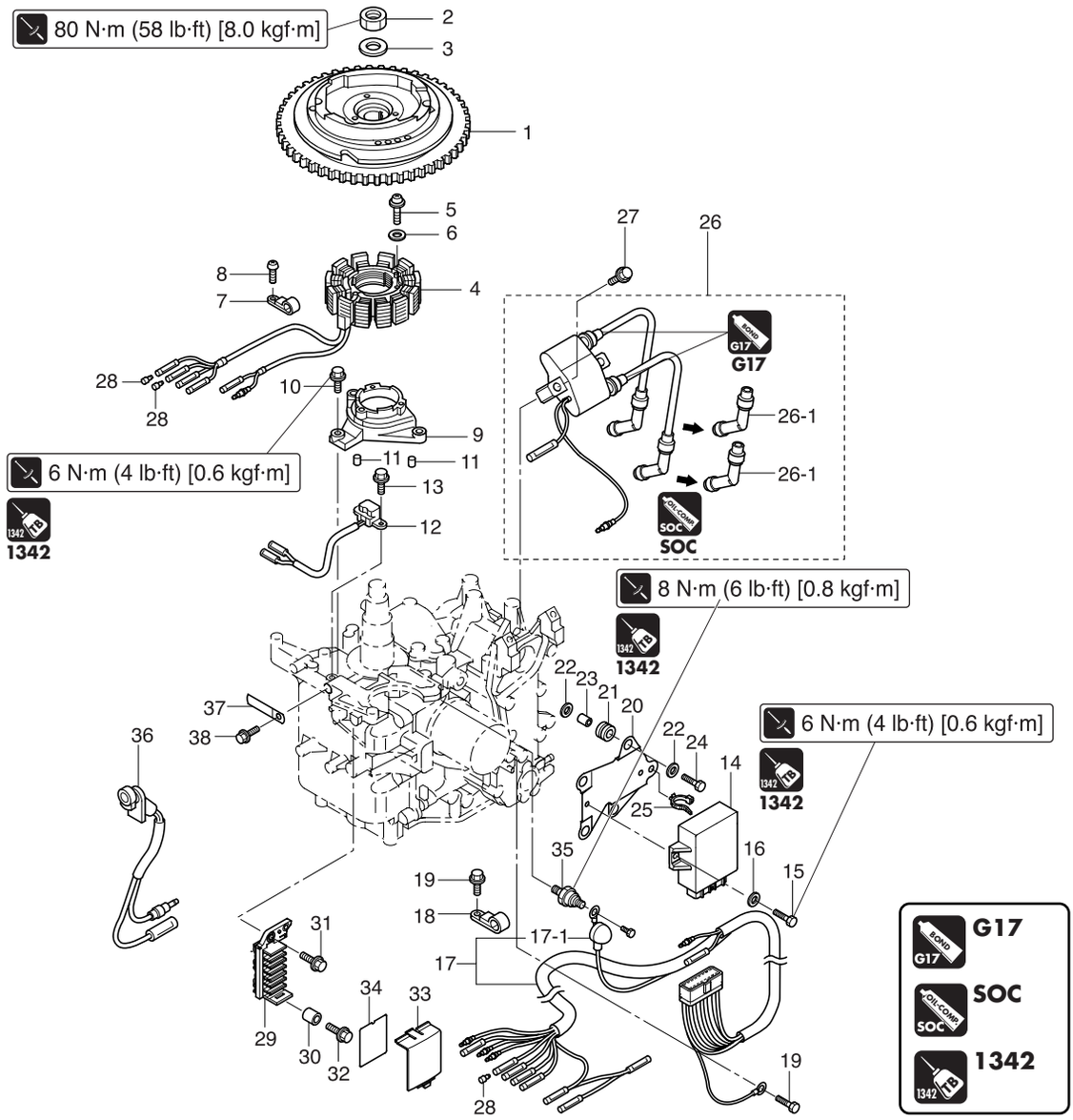


① Rectifier
② Ignition Coil
③ C.D. Unit
④ Fuse Holder
⑤ Alternator

3.Parts Layout

P/L Fig. 8

Magneto

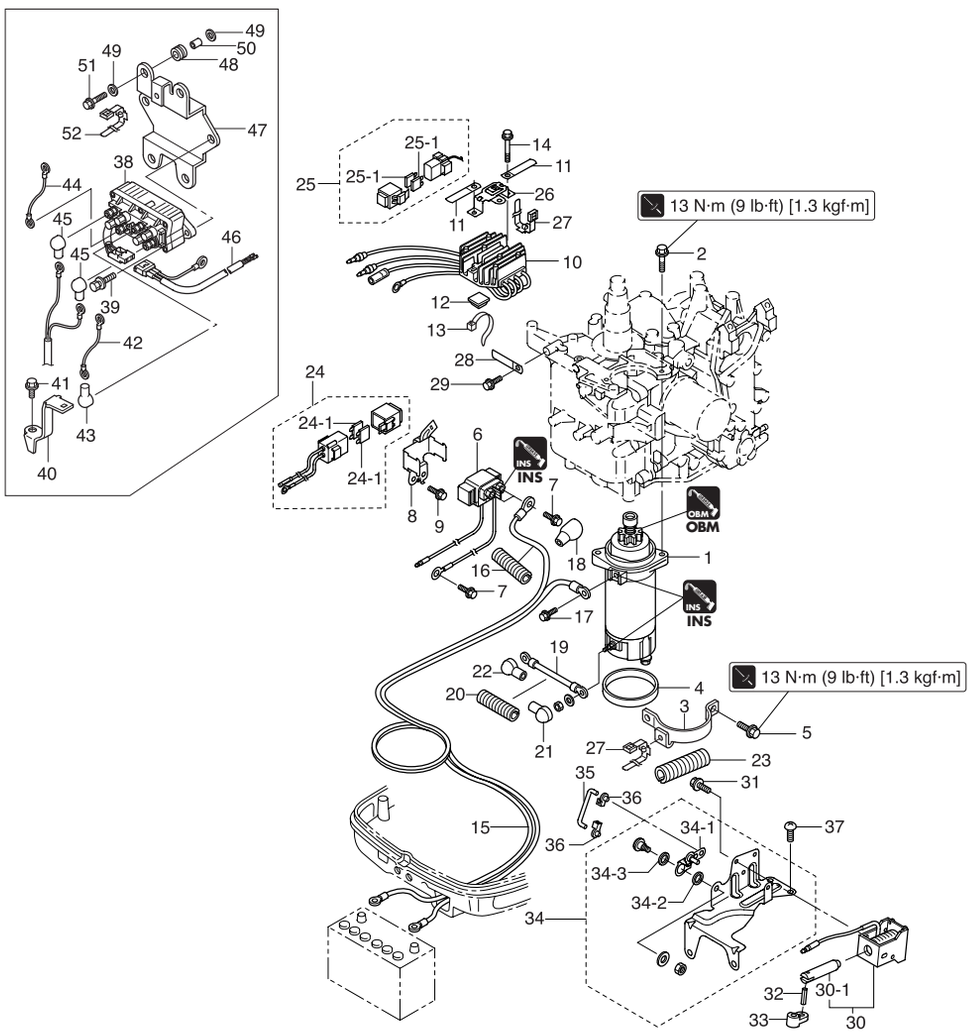


Ref. No.	Description	Q'ty	Remarks
1	Flywheel Cup (with Ring Gear)	1	
2	Nut, 16-P1.5	1	width between two sides : 24mm
3	Washer, 16-27-3.2	1	
4	Alternator	1	
5	Screw	3	M6 L=30mm
6	Washer	3	M6
7	Clamp, 6.5-14L	1	
8	Screw	1	M6 L=16mm
9	Coil Bracket	1	
10	Bolt, 6-25 Pre-coated	3	M6 L=25mm
11	Dowel Pin, 6-12	2	
12	Pulser Coil	1	
13	Bolt	2	M5 L=14mm
14	C.D. Unit	1	
15	Bolt, 6-16 Pre-coated	2	M6 L=16mm
16	Washer, 6-16-1.5	2	
17	C.D. Unit Cord Ass'y	1	
17-1	Grommet	1	
18	Clamp, 6.5-14L	1	
19	Bolt	2	
20	C.D. Unit Bracket	1	
21	Rubber Mount	4	
22	Washer, 6-16-1.5	8	
23	Collar, 6.2-9-8.7	4	

Ref. No.	Description	Q'ty	Remarks
24	Bolt	4	
25	Lead Wire Band, 135	1	
26	Ignition Coil	1	
26-1	Plug Cap (with Resistance)	2	
27	Bolt	2	
28	Cable Terminal Plug	AR	7 for MF, 4 for EF 2 for EP
29	Cable Terminal Holder	1	with Collar
30	Collar, 6-8-6	1	
31	Bolt	1	Upper M6 L=16mm
32	Bolt	1	Lower M6 L=12mm
33	Terminal Holder Cover	1	
34	Wiring Diagram Decal	1	for MF, EF
	Wiring Diagram Decal	1	for EP
35	Oil Pressure Switch	1	
36	Warning Lamp	1	
37	Clamp, 6.5-67P	1	
38	Bolt	1	M6 L=12mm

Electric Parts

P/L Fig. 9



OBM

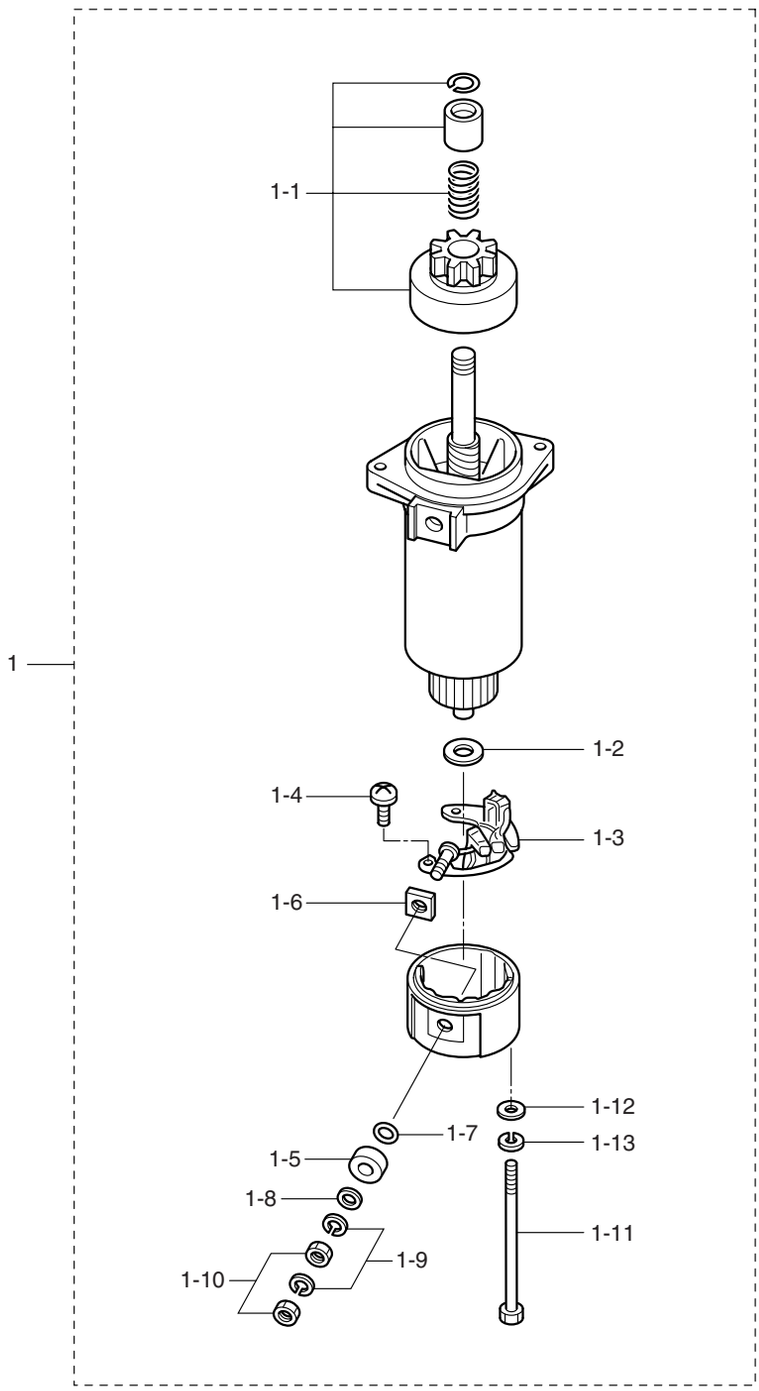
INS

Ref. No.	Description	Q'ty	Remarks
1	Starter Motor	1	for EP & EF
2	Bolt	2	
3	Starter Motor Band	1	
4	Starter Motor Damper	1	for EP & EF
5	Bolt	2	or 910113-5818
6	Starter Solenoid	1	
7	Bolt	3	M6 L=10mm
8	Starter Solenoid Bracket	1	for EP & EF
9	Bolt	2	M6 L=12mm
10	Rectifier	1	
11	Clamp, 6.5-47.5P	2	for EP & EF
12	Band Mount	1	
13	Lead Wire Band, 203	1	
14	Bolt	2	for EP & EF M6 L=25mm
15	Battery Cable	1	L=2750
16	Protector	1	L=320
17	Bolt	1	M6 L=12mm
18	Terminal Cap	1	
19	Starter Cable	1	L=270
20	Protector	1	L=180
21	Terminal Cap	1	
22	Terminal Cap	1	for EP & EF
23	Protector	1	
24	Fuse Cable	1	L=185

Ref. No.	Description	Q'ty	Remarks
24-1	Fuse (20A)	2	
25	Fuse Cable	1	L=720
25-1	Fuse (20A)	2	for EP & EF
26	Fuse Holder Bracket	1	
27	Lead Wire Band, 135	2	
28	Clamp, 6.5-120P	1	for EP
29	Bolt	1	M6 L=12mm
30	Choke Solenoid	1	
30-1	Plunger	1	for EP
31	Screw	4	M4 L=6mm
32	Spring Pin, 3-12	1	
33	Choke Solenoid Hook	1	for EP
34	Choke Solenoid Bracket Ass'y	1	
34-1	Choke Lever	1	
34-2	Bushing, 8.1-15-2.9	1	for EP
34-3	Washer, 8.1-15-1.3	1	
35	Link Rod	1	
36	Rod Snap, 1.5-2	2	for EP
37	Screw	2	M5 L=10mm

Starter Motor

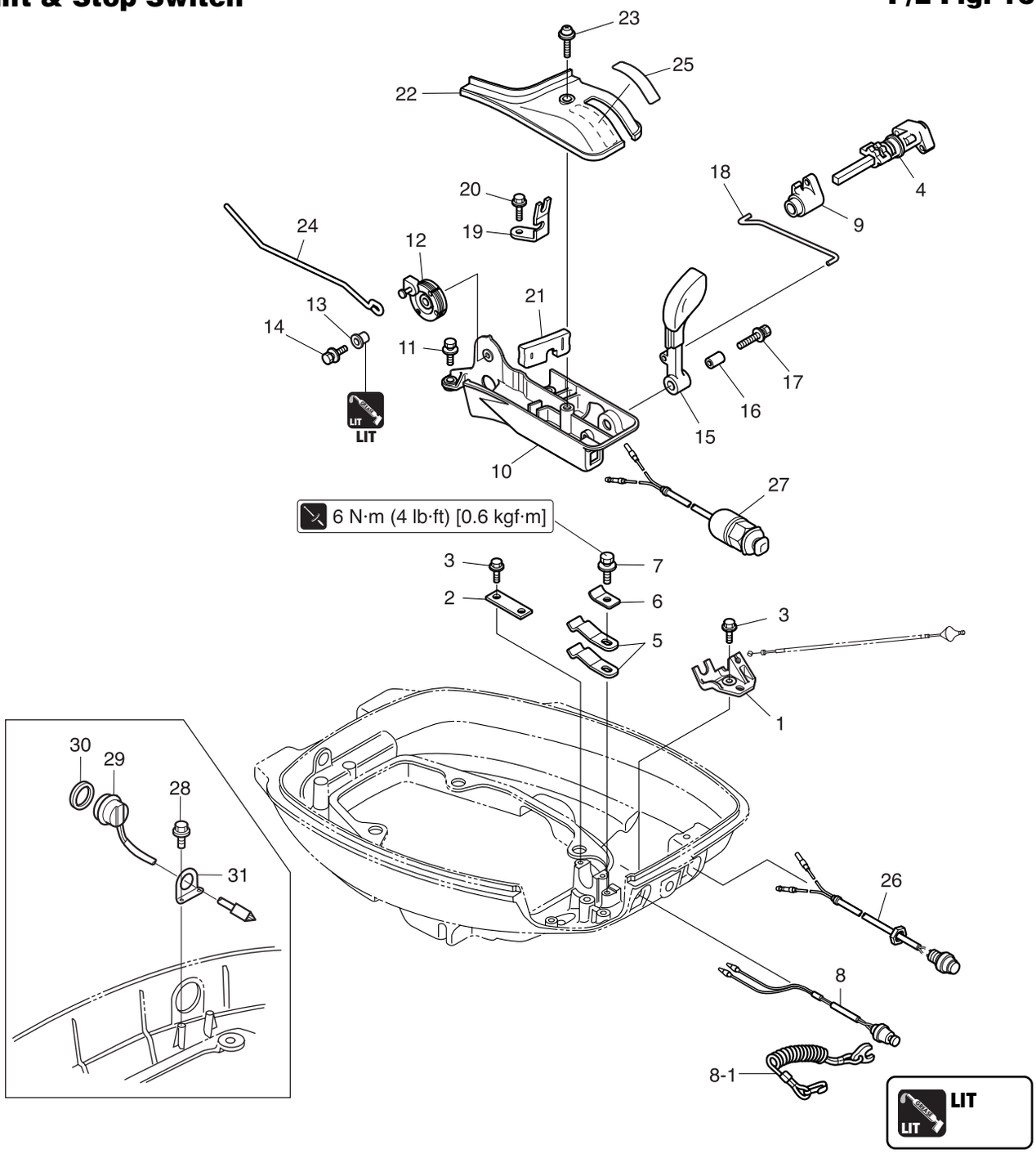
P/L Fig. 10



Ref. No.	Description	Q'ty	Remarks
1	Starter Motor	1	
1-1	Pinion Ass'y	1	
1-2	Washer	1	
1-3	Brush Holder	1	
1-4	Screw	2	
1-5	Bushing #1	1	
1-6	Bushing #2	1	
1-7	O-Ring	1	
1-8	Washer	1	
1-9	Spring Washer	2	
1-10	Nut	2	
1-11	Bolt	2	
1-12	Washer	2	
1-13	Spring Washer	2	

Shift & Stop Switch

P/L Fig. 16



Ref. No.	Description	Q'ty	Remarks
1	Neutral Switch Bracket	1	
2	Shift Lever Shaft Holder	1	
3	Bolt	3	
4	Shift Lever Shaft	1	
5	Shift Lever Stopper	2	
6	Shift Lever Stopper Plate	1	
7	Bolt	1	
8	Stop Switch	1	
8-1	Stop Switch Lanyard	1	
9	Shift Arm	1	for MF & EF
10	Shift Lever Bracket	1	
11	Bolt	2	
12	Throttle Dram	1	
13	Collar, 6.1-14-8.9	1	for MF & EF
14	Bolt	1	

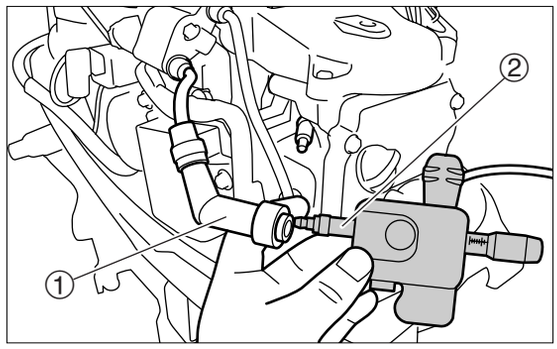
Ref. No.	Description	Q'ty	Remarks
15	Shift Lever	1	
16	Collar, 6.5-10.5-22.6	1	for MF & EF
17	Bolt	1	
18	Shift Lever Rod	1	for MF & EF
19	Throttle Cable Bracket	1	
20	Bolt	1	
21	Shift Lever Rod Grommet	1	for MF & EF
22	Shift Lever Bracket Cover	1	
23	Screw	1	
24	Throttle Rod	1	for MF & EF
25	Shift Decal (F, N, R)	1	
26	Main Switch	1	for EF
27	Neutral Switch	1	

4. Ignition System and Ignition Control System

1) Inspection of Ignition Sparks

1. Disconnect plug caps from spark plugs.

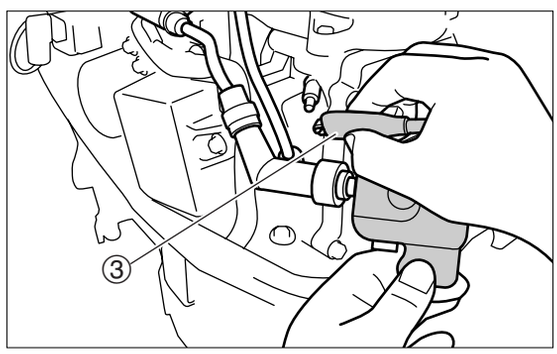
2. Connect plug cap ① to spark tester ②.



3. Connect spark tester clip ③ to spark plug tip electrode.

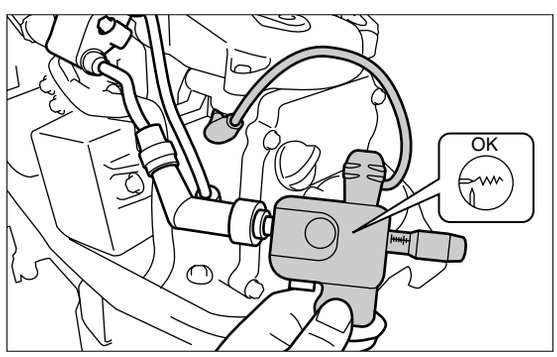
Spark Tester ② :
P/N. 3F3-72540-0

Spark Performance :
10 mm (0.4 in) or over



4. Start engine and check sparks. Check spark system if sparks are weak.

This test can be made without removing parts.

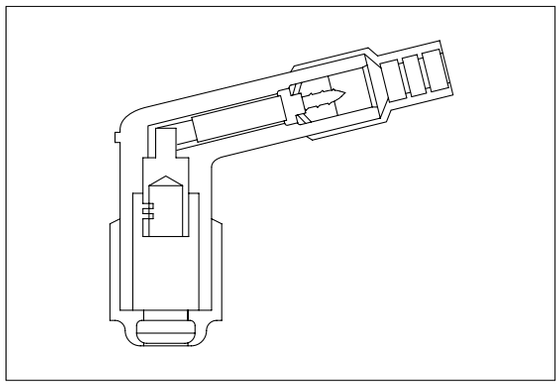


⚠ WARNING

- **When testing, put electrode cap assuredly to prevent direct contact with spark tester wiring and leak of electrical current, and perform test carefully.**
- **Keep inflammable gas, fuel, oil and fat away from tester to prevent them from catching sparks.**

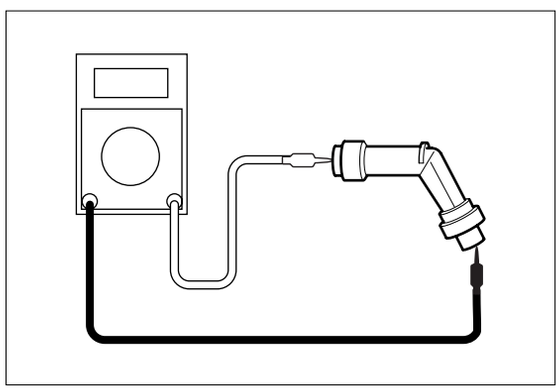
2) Inspection of Plug Cap

Remove the part and test it as a separate unit.



1. Disconnect plug caps from spark plugs.
2. Remove plug cap from high tension cable.
   (Cap screws on to wire)
   Remove by twisting counterclockwise.
3. Measure plug cap resistance. Replace if out of specification.

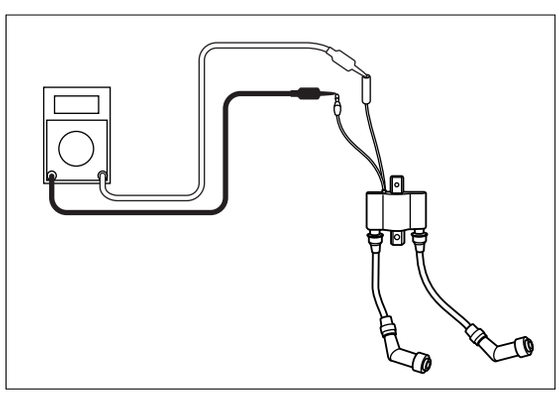
Plug Cap Resistance :
3.0 - 7.0 kΩ



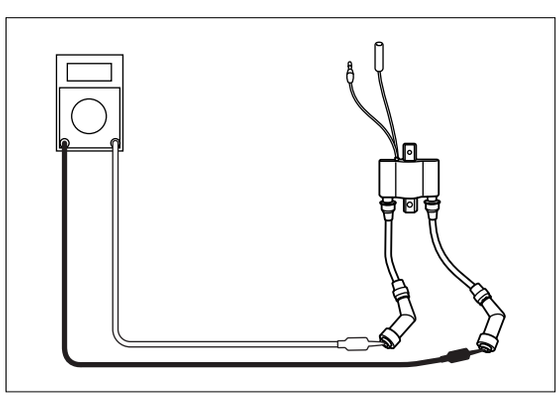
3) Inspection of Ignition Coils

1. Remove ignition coil coupler.
2. Measure ignition coil resistance. Replace if out of specification.

This test can be made without removing parts.



Ignition Coil Resistance :
Primary Coil : Between Orange (Or) - Black (B)
0.26 - 0.35 Ω
Secondary Coil : Between High Tension Cord - High Tension Cord
6.8 - 10.2 kΩ
Secondary Coil : Between Plug Cap - Plug Cap
11.8 - 15.2 kΩ



3. Install plug cap onto high tension cord by twisting clockwise.
4. Connect plug cap to spark plug.

8

4) Inspection of Pulser Coil

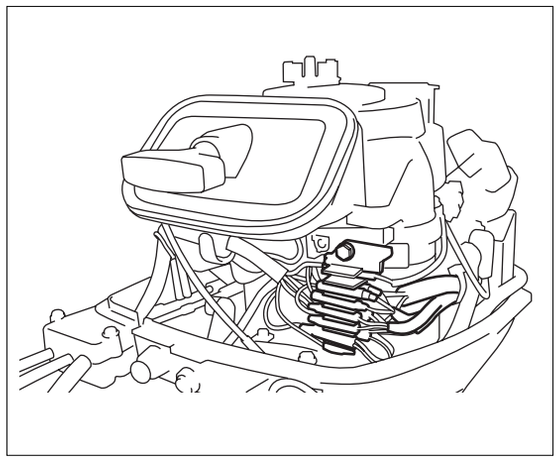
1. Remove cable terminal holder cover.

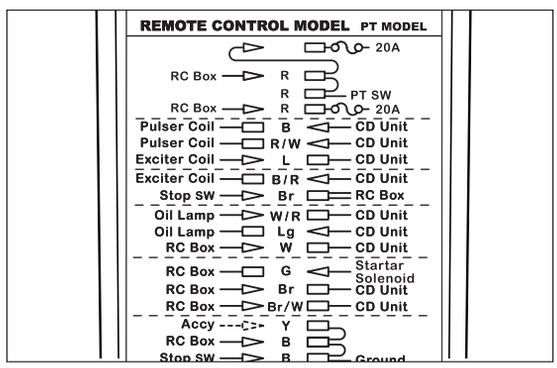
2. Disconnect cable coupler from pulser coil, and measure resistance.

This test can be made without removing parts.

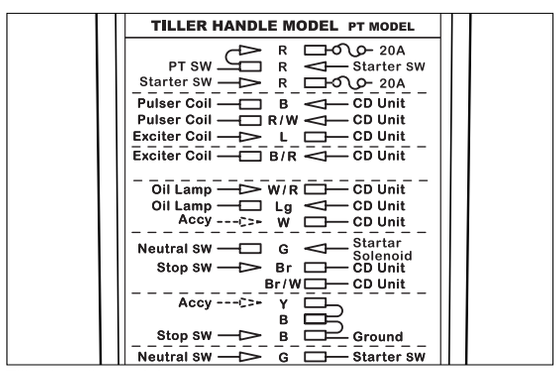
Pulser Coil Resistance (Reference value) :
Between Red/White (R/W) - Black (B) : 148 - 222Ω

Check the connection by referring to coupler connection chart located on the back of cable terminal holder cover.





Remote control model (EP)



Tiller handle model

5) Inspection of Exciter Coil

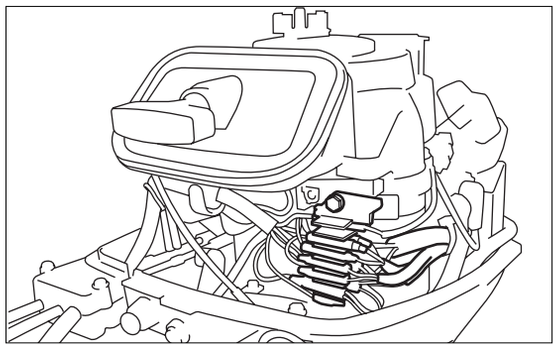
1. Remove cable terminal holder cover.

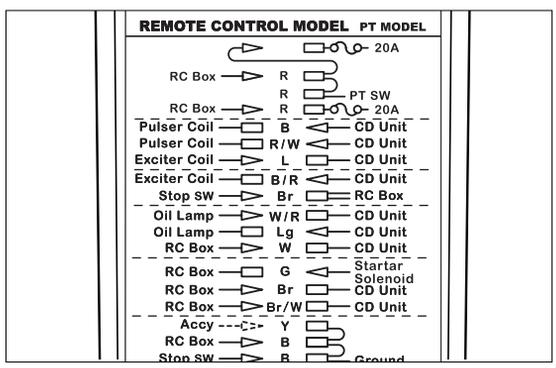
2. Disconnect cable coupler from exciter coil, and measure resistance.

This test can be made without removing parts.

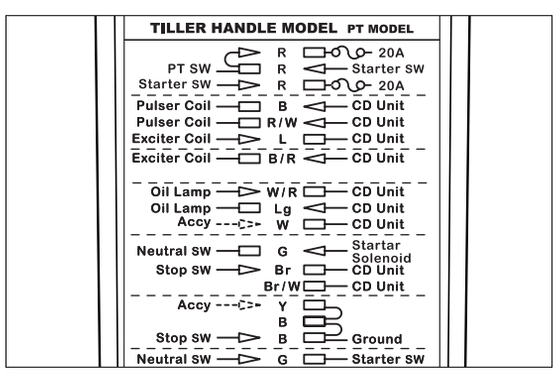
Exciter Coil Resistance (Reference value) :
Between Black/Red (B/R) - Blue (L) : 12.5 - 18.8 kΩ

Check the connection by referring to coupler connection chart located on the back of cable terminal holder cover.





Remote control model (EP)



Tiller handle model

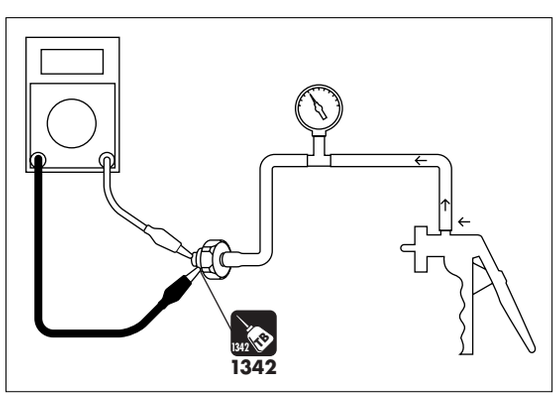
6) Inspection of Oil Pressure Switch

Remove the part and test it as a separate unit.

1. Check electrical conductivity of oil pressure switch. Replace if no conductivity.

2. Connect vacuum/pressure gauge to oil pressure switch.

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



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4. Apply pressure slowly with vacuum/pressure gauge.

5. Check that oil pressure switch is not conductive with specified pressure applied. Replace if conductive.

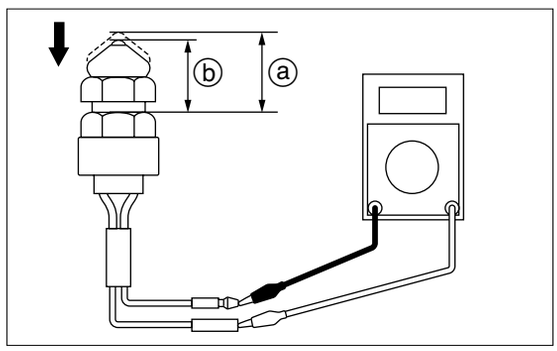
Specified Pressure :
0.020 - 0.029 MP(2.8 - 4.0 psi) [0.2 - 0.3 kgf/cm²]

6. Reinstall the part.

Uses tapered threads — Do not over torque or powerhead could be damaged.

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

7) Inspection of Neutral Switch (Tiller Handle Model)

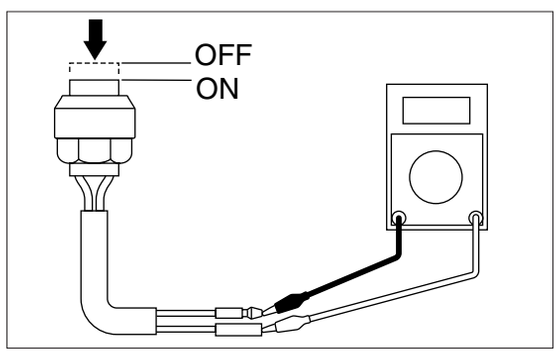


This test can be made without removing parts.

1. Check electrical conductivity of neutral switch. Replace if no conductivity.

Switch Position	Lead Wire Color	
	Green (G)	Green (G)
Released ⓐ		
Pushed ⓑ	○———	———○

8) Inspection of Start Switch (Tiller Handle Model)



1. Check conduction of stop switch, and replace if not conductive.

This test can be made without removing parts.

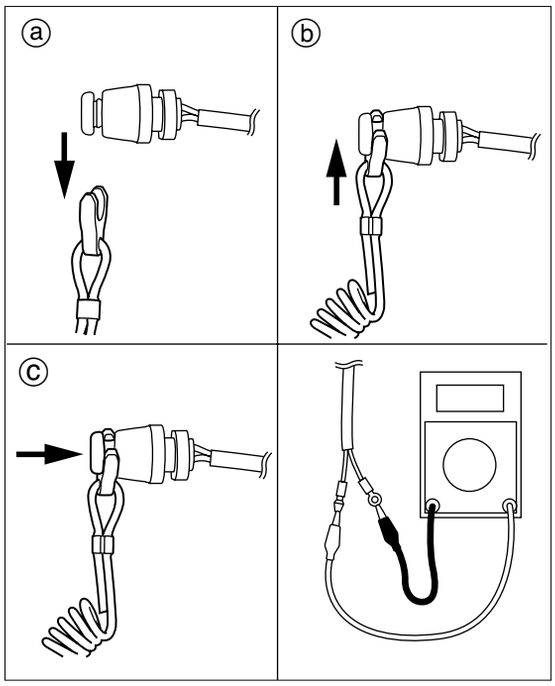
Switch Position	Lead Wire Color	
	Green (G)	Red (R)
Released : OFF		
Pushed : ON	○———	———○

9) Inspection of Stop Switch

1. Check conduction of stop switch, and replace if not conductive.

This test can be made without removing parts.

Switch Position	Lead Wire Color	
	Brown (Br)	Black (B)
Remove lock ⓐ	○	○
Attach lock ⓑ		
Press switch ⓒ	○	○

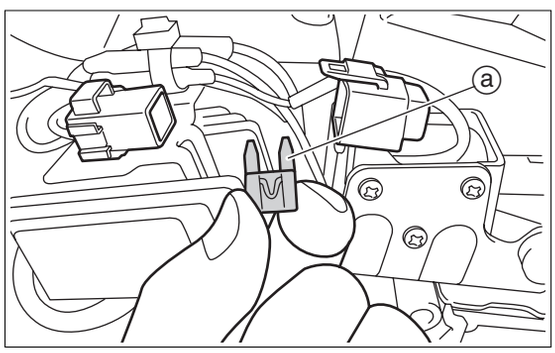


5. Starting System

1) Inspection of Fuse

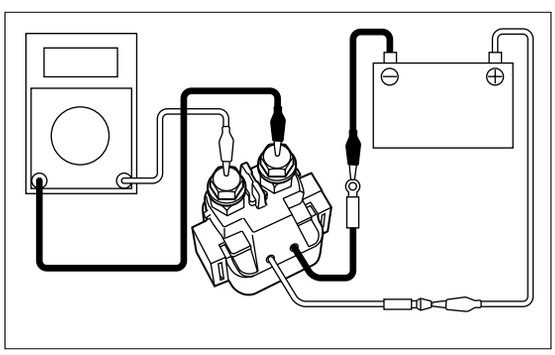
1. Check electrical conductivity of fuse ⓐ. Replace if no conductivity.

Flat or small sized plate fuse (20A) is adopted.



2) Inspection of Starter Solenoid

1. Connect tester lead wires to both terminals of starter solenoid.
2. Connector green (G) lead wire to battery positive terminal.
3. Connector black (B) lead wire to battery negative terminal.
4. Check electrical conductivity between terminals of starter solenoid. Replace if no conductivity.
5. Remove battery terminal from green (G) or black (B) lead wire, and check there is no conductivity between starter solenoid terminals. Replace if conductive.



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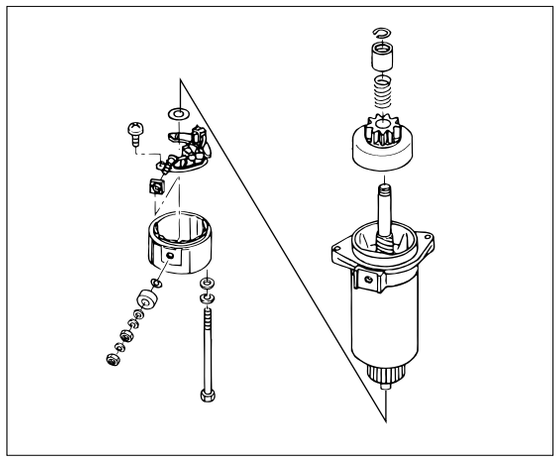
3) Disassembly of Starter Motor

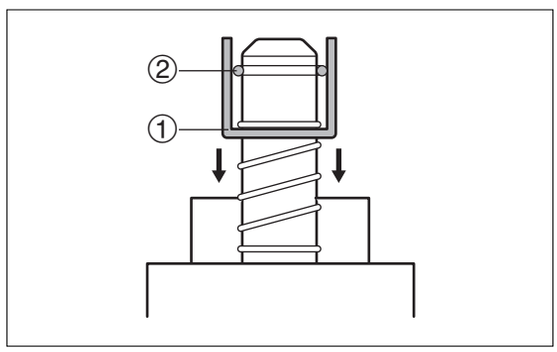
1. Put locating mark between starter motor body and cap. (This mark facilitates reassembly.)

2. Slide pinion stopper ① downward as shown and remove clip ②.

> Use small bladed screw driver to remove clutch. Be careful not to cut hand because clip is secured firmly.

3. Remove bolt and disassemble starter motor.



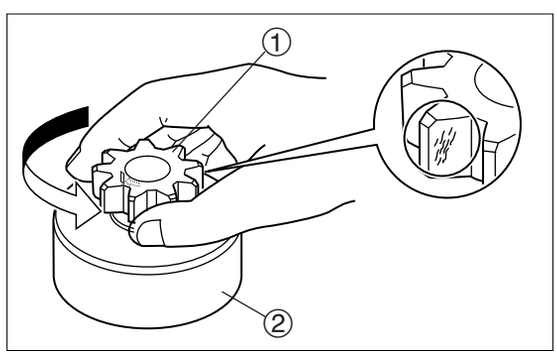


4) Inspection of Starter Motor Pinion

1. Check pinion teeth for crack and wear. Replace if necessary.

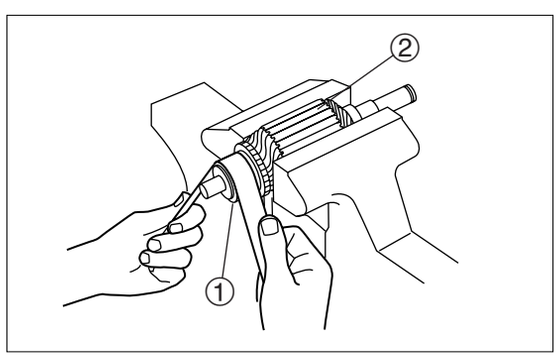
2. Fix clutch ②, and turn only pinion ① to check that it can be rotated smoothly in one direction. Replace if necessary.

> Turn pinion ① counterclockwise to check that it can be rotated smoothly. Also, check that pinion is locked when turned clockwise.

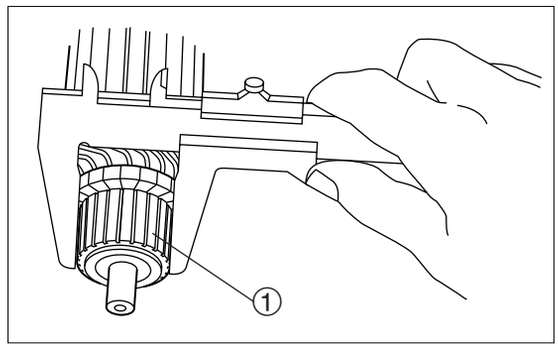


5) Inspection of Armature

1. Check commutator ① for dirt. If necessary, clean by using sand paper of No. 600 or by air-blowing.

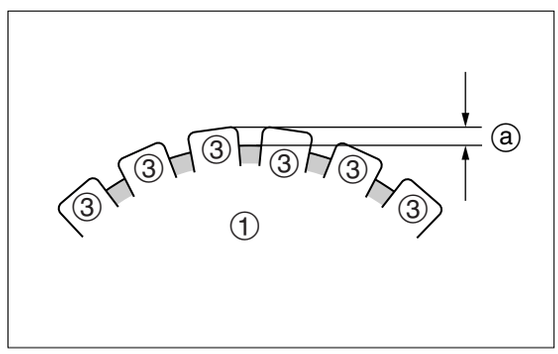


2. Measure commutator ① outer diameter. Replace starter motor ass'y if outer diameter is less than specified value.



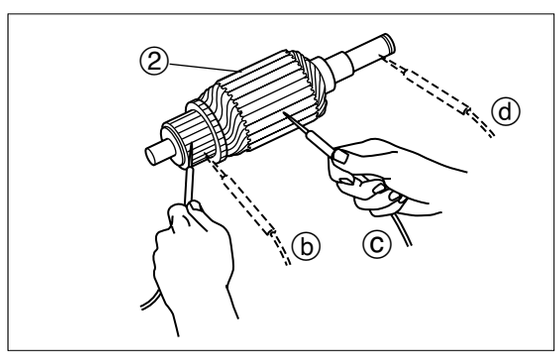
Commutator Outer Diameter : Standard Value	30.0 mm (1.181 in)
Wear Limit :	29.0 mm (1.142 in)

3. Measure undercut ⓐ of commutator ①. Replace starter motor ass'y if less than specified value.



Commutator Undercut : Standard Value	0.5 - 0.8 mm (0.020 - 0.031 in)
Wear limit ⓐ :	0.2 mm (0.008 in)

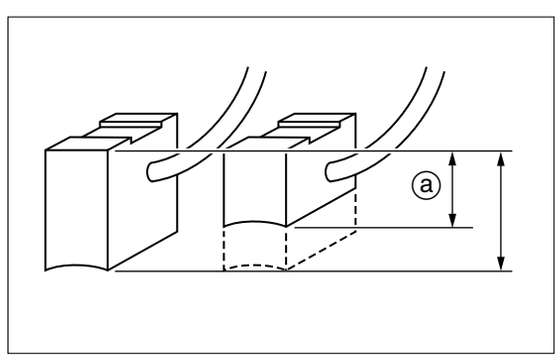
4. Check electrical conductivity of armature ②. Replace starter motor ass'y if other than specified condition.



Armature Conductivity :	
ⓑ between commutator segments ③-③	Conductive
ⓒ Between Segment - Armature Core	Non-conductive
ⓓ Between Segment - Armature Shaft	Non-conductive

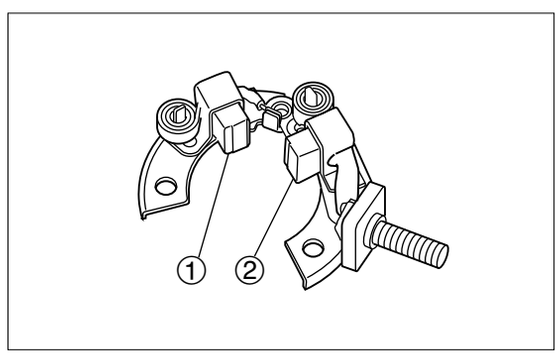
6) Inspection of Brushes

1. Measure brush length. Replace brush holder ass'y if brush length is less than specified value.



Brush Length ⓐ : Standard Value	12.5 mm (0.492 in)
Wear limit ⓐ :	9.5 mm (0.374 in)

2. Check conductivity of brush holder ass'y. Replace if out of specification.

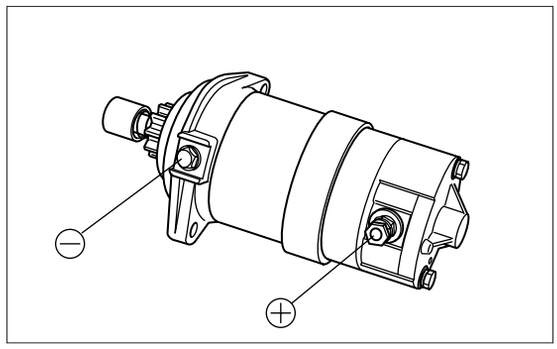


Conductivity Between Brushes	
Brush ① – Brush ②	Non-conductive
Between Brush ⑫ - Earth	Non-conductive

7) Inspection of Starter Motor Operation

1. Assemble starter motor, and check, before and after installing it on the power unit, by applying voltage between points "+" and "-" that it operates normally.

Energizing starter motor produces sparks, and thus, any inflammable matter must be kept away from the motor.

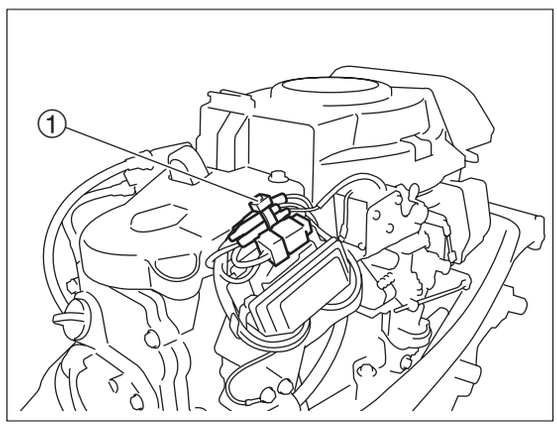


6. Battery Charging System

1) Inspection of Charge Coil

1. Remove wire band ① of cable that comes from alternator located in the rectifier.

2. Disconnect cable coupler from charge coil, and measure resistance.



This test can be made without removing parts.

Alternator (Charge Coil) Resistance
: Reference Value (at 20°C)
White (W) – Yellow (Y)
0.27- 0.41 Ω

2) Inspection of Rectifier

- Check wire harness for disconnection of lead wire and defective connection.
- Check conductivity between each point by referring to the following table. Value in ( ) is reference value.
- Perform the measurement with all connections disconnected to make the component a separated unit.

This test can be made without removing parts.

"ON" means "conductive", and "OFF" means "non-conductive".

Rectifier Tester Check Chart

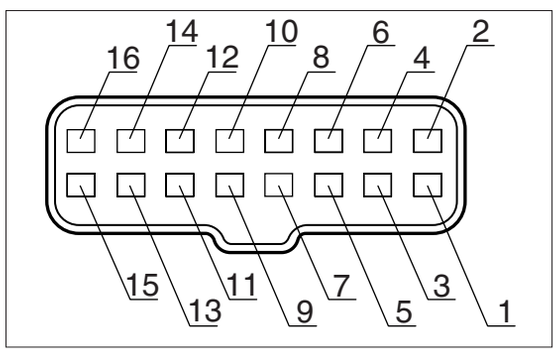
		Tester Lead Positive (+) Side (Red)			
		Red R	White W	Black B	Yellow Y
Tester Lead Negative (-) Side (Black)	Red R		OFF	OFF	OFF
	White W	ON (3.4Ω)		ON (2.3kΩ)	ON (4.6kΩ)
	Black B	ON (4.6kΩ)	ON (2.2kΩ)		ON (2.2kΩ)
	Yellow Y	ON (3.4kΩ)	ON (4.6kΩ)	ON (2.3kΩ)	

· Measurement condition Circuit tester to be used : HIOKI3030
Measurement Range : 1kΩ
· Permissible Error of Resistance : ±20%

Note) ① It is recommended to use "HIOKI HiTESTER MODEL 3030" for this measurement. Use of other instrument model for the measurement can cause indication of abnormal value for normal condition, resulting in inaccurate measurement.
② Disconnect all connections to measure as an independent unit.
③ Any movement of pointer indicates "ON" or "conductive" state.
④ "CON" means that the pointer moves once and then returned to the value shown in ( ) because of characteristic of capacitor.
⑤ The value in ( ) is the condition applied when "1kΩ" range is used. The measurement varies widely among types of instrument, situations (such as inner power supply), or measurement ranges due to diodes used in the unit.

7. CD Unit Coupler

●Check wire harness for disconnection of lead wire and defective connection.
●Terminals are arranged and numbered as shown.
●The following table shows names of terminals, their numbers and lead wire colors.



No.	Name	Lead Wire	
1	Ignition (GND)	Or	Orange
2	Ignition (+)	B	Black
3	Exciter (H)	B/R	Black/Red
4	Exciter (L)	L	Blue
5	Tachometer	W	White
6	LED power	W/R	White/Red
7	Vacant		
8	Stop Switch	Br	Brown
9	GND	B	Black
10	Vacant		
11	LED	Lg	Light Green
12	Pulser (+)	R/W	Red/White
13	Pulser (-)	B	Black
14	Vacant		
15	Oil Pressure Switch	Br/W	Brown/White
16	Vacant		

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Troubleshooting

1. Troubleshooting Chart

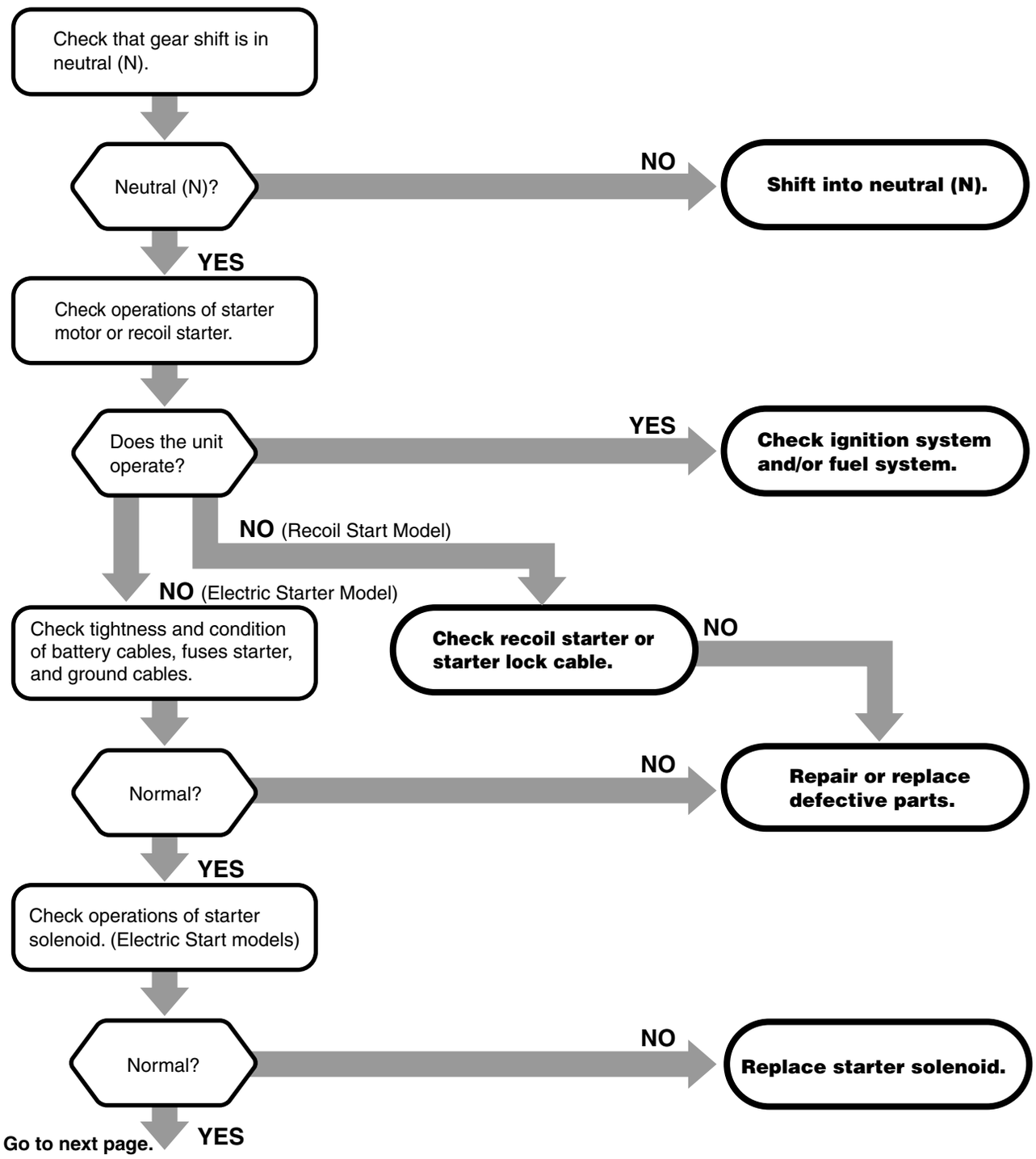
	Engine will not start.	Engine stalls immediately after starting.	Idles abnormally.	Defective acceleration.	Engine speed is very high causing high speed ESG to operate.	Engine speed is very low, causing low speed ESG to operate.	Boat cannot run at high speed.	Engine overheats.	Battery is not charged.	Starter motor will not operate.	Estimated Cause	Refer to page
Fuel and Lubrication Systems	○	○									Fuel level is low in the tank.	Chapter 1
	○	○	○	○		○	○	○			Fuel system connection is incomplete.	Chapter 2
	○	○	○	○		○	○	○			Air suctioned through fuel system	-
	○	○	○	○		○	○	○			Fuel pipe is twisted.	Chapter 3
	○	○	○	○		○	○	○			Cap vent is closed.	-
	○	○	○	○		○	○	○			Fuel filter, fuel pump or carburetor is clogged.	-
	○	○	○	○		○	○	○			Carburetor is maintained poorly.	Chapter 4
	○	○	○	○			○	○			Low quality gasoline is used.	-
	○	○	○	○		○	○				Fuel pump malfunction	-
	○	○	○								Choke system malfunction	-
	○			○							Fuel is fed excessively.	-
				○							Acceleration pump malfunction	Chapter 4
			○	○		○	○	○			Low quality engine oil is used.	Chapter 4
						○※		○			Engine oil is lacking (Oil warning lamp is lit).	Chapter 3
			○	○							Engine oil quantity excessive (Exhaust smoke is generated.)	Chapter 3
						○※		○			Oil filter is clogged (Oil warning lamp is lit).	Chapter 3
						○※		○			Oil pump malfunction (Oil warning lamp is lit)	Chapter 5
Compression	○	○	○	○			○				Incorrect valve timing due to stretching or incorrect installation of timing belt.	Chapter 3
	○	○	○	○			○				Valve clearance is incorrect.	Chapter 3
	○	○	○	○			○				Intake or exhaust valve sealing is defective.	Chapter 5
			○	○			○				Piston, piston ring and/or cylinder is worn excessively.	Chapter 5
			○					○			Combustion chamber carbon deposition is too much.	-
			○	○			○	○			Spark plug is loose.	Chapter 3
Electrical System	○	○	○	○		○	○	○			Use of spark plugs not specified	Chapter 3
	○	○	○	○		○	○				Spark plug is contaminated.	Chapter 3
	○	○	○	○		○	○				No sparks or weak sparks	Chapter 8
	○										Stop switch short-circuited	Chapter 8
	○		○	○		○	○				Ignition timing is not properly adjusted.	Chapter 3
	○										Stop switch lock is not attached.	Chapter 1
	○								○	○	Main switch malfunction	Chapter 8
	○								○	○	Disconnection of lead wires or loose earth wire	Chapter 8
	○								○	○	Battery is out of service life, or electrode is eroded. Battery electrolyte level is low.	Chapter 3
	○									○	Battery charged insufficiently	Chapter 3
	○									○	Shift lever neutral (N) position is not proper.	Chapter 3
	○									○	Starter motor or starter solenoid malfunction	Chapter 8
Others							○	○			Cooling water is not fed or low due to malfunction or clogging of pump	Chapter 6
			○		○		○	○			Thermostat operation is defective.	Chapter 3
				○	○		○	○			Anti-cavitation plate is damaged.	-
				○	○	○	○	○			Use of mismatched propeller.	Chapter 1
			○	○	○	○	○	○			Propeller is damaged or deformed.	Chapter 3
				○	○		○	○			Trim position is not correct.	-
				○	○	○	○	○			Boat is unbalanced due to improper load position.	-
				○		○	○	○			Transom is too high or too low.	Chapter 1
	○		○	○		○	○				Throttle link adjustment is defective.	Chapter 3

Before working on the engine, check that hull, rigging and engine installation are normal, and then battery is fully charged. For mechanical troubleshooting, refer to relevant troubleshooting section in this chapter. For checking and servicing the machine, refer to service procedures described in this manual to perform the works safely.

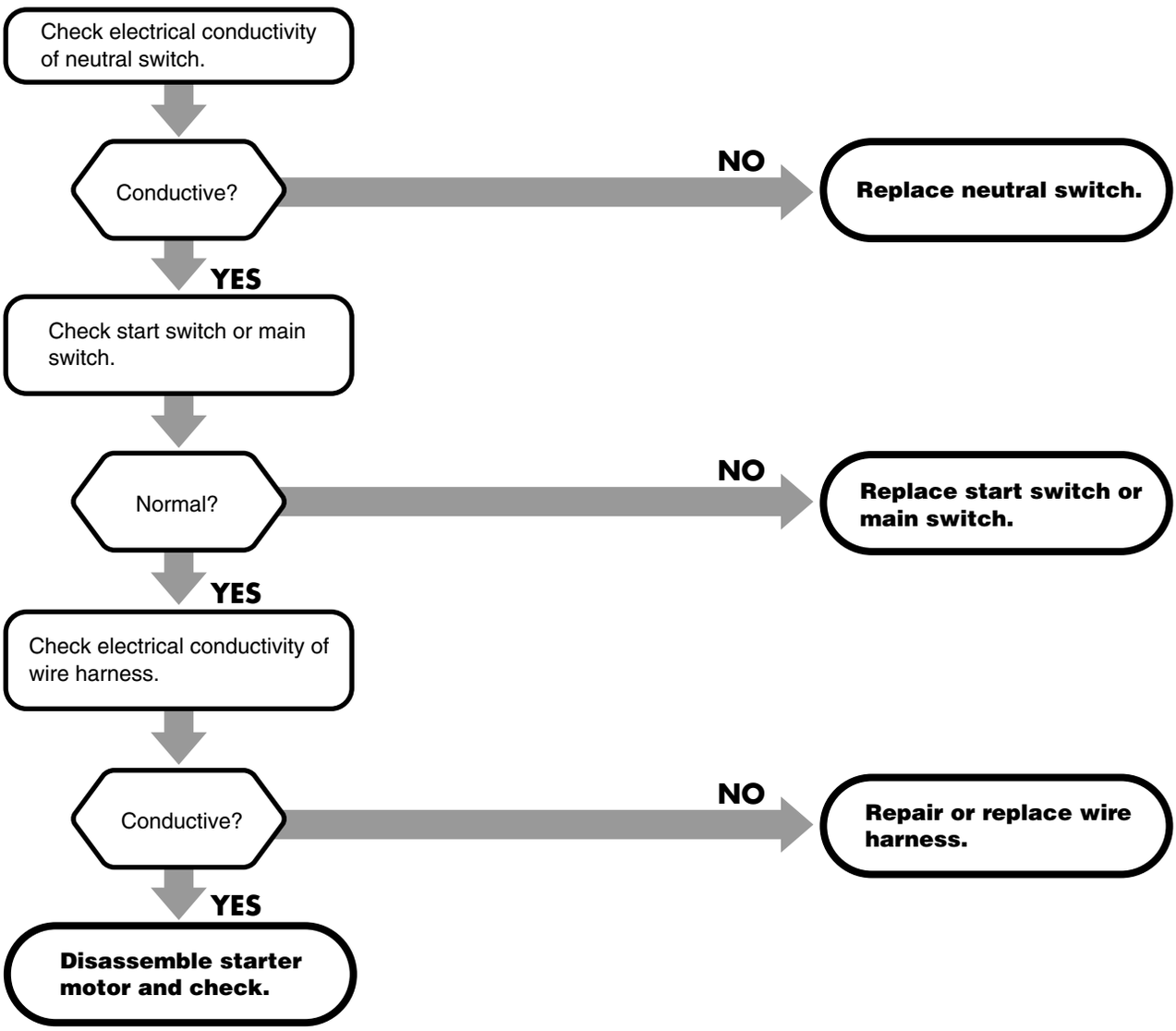
2. Power Unit

State 1 **Engine will not start.**

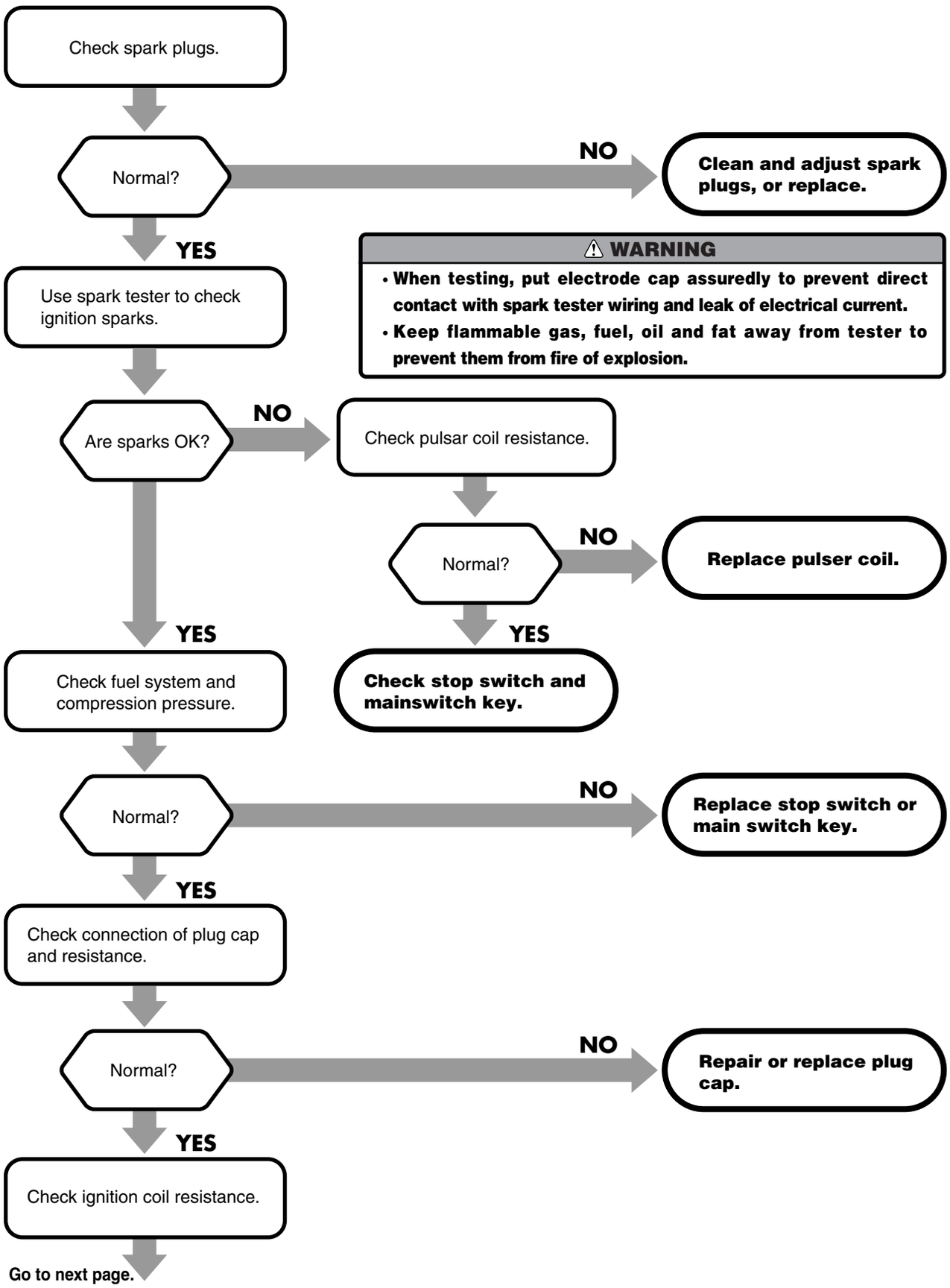
Starting System



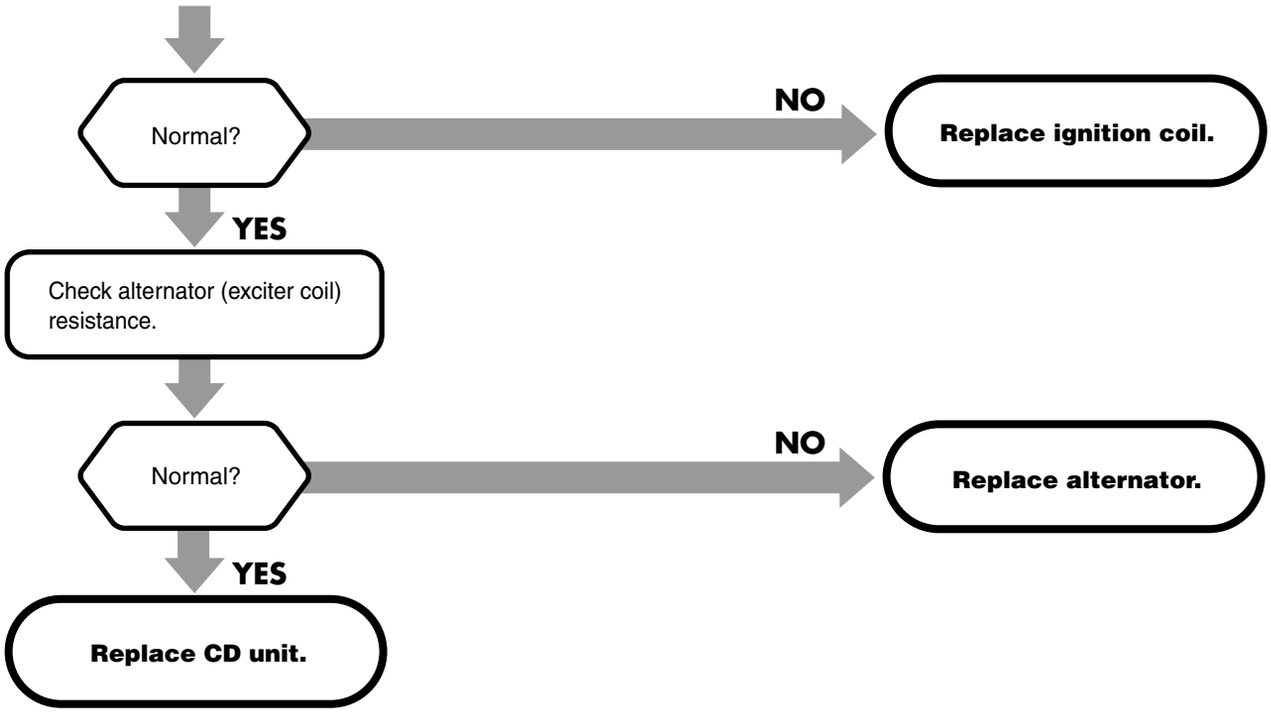
(State 1 : Engine will not start.)



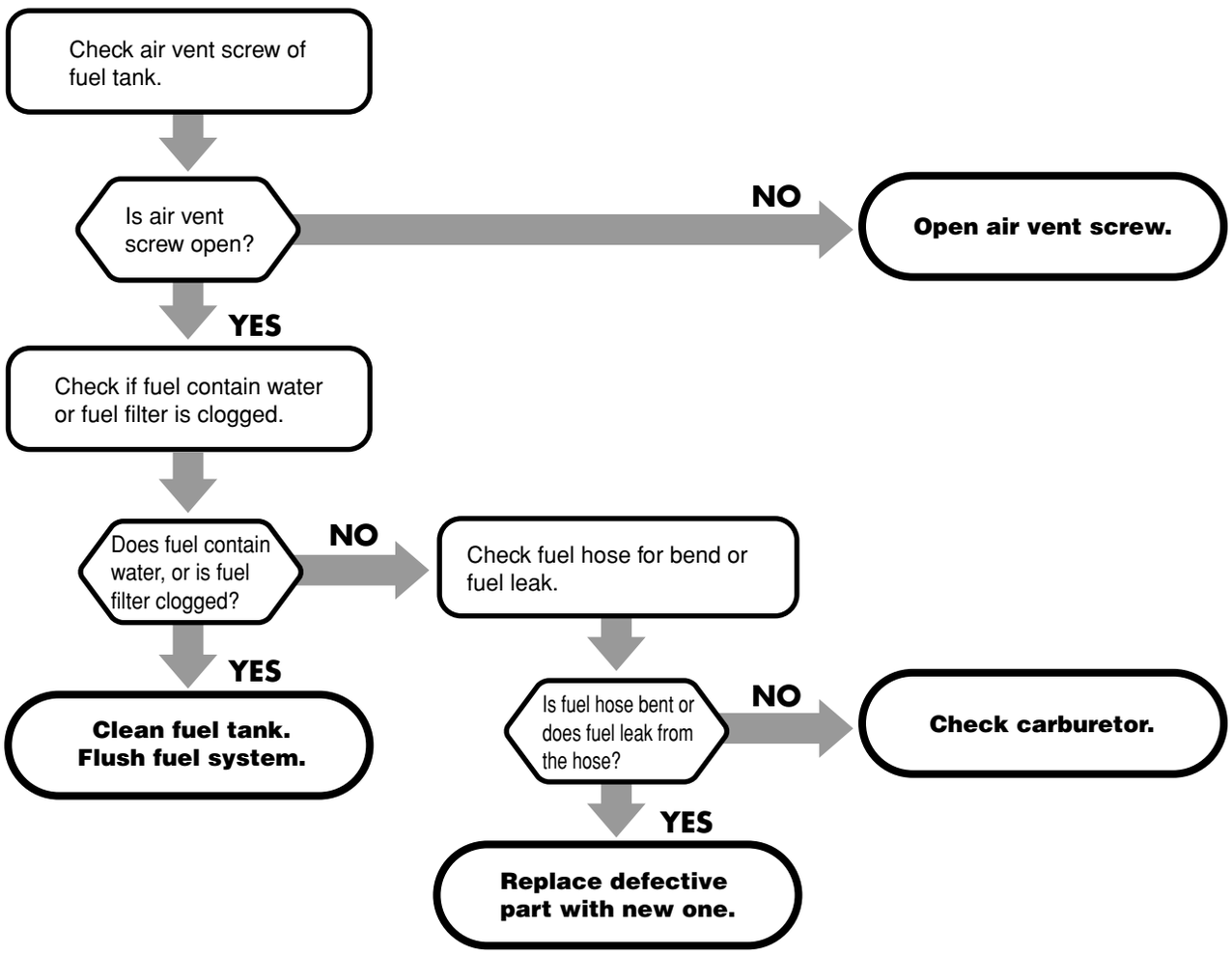
Ignition System



(State 1 : Engine will not start.)

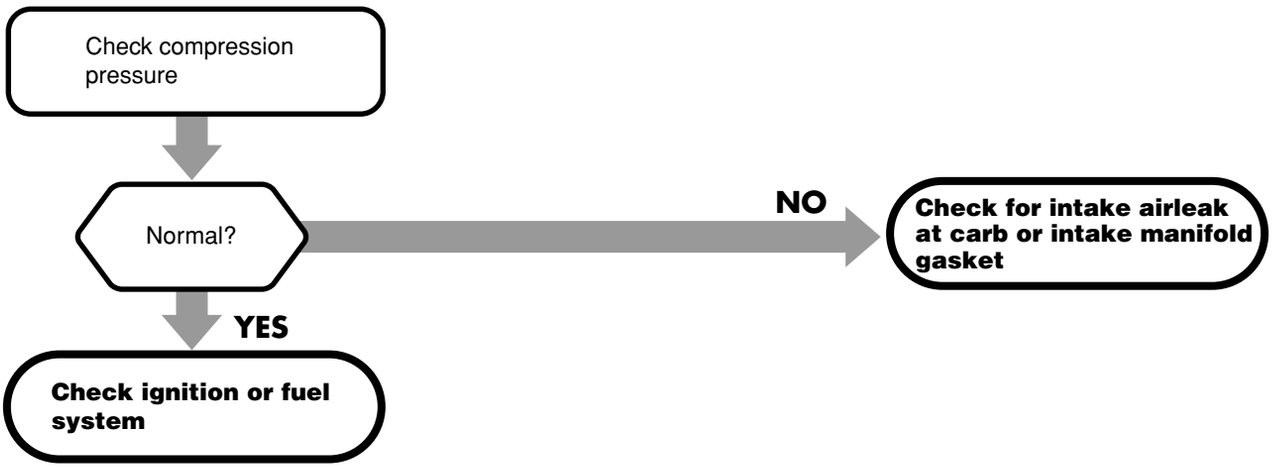


Fuel System


Check air vent screw of fuel tank.
Is air vent screw open?
NO
Open air vent screw.
YES
Check if fuel contain water or fuel filter is clogged.
Does fuel contain water, or is fuel filter clogged?
NO
Check fuel hose for bend or fuel leak.
YES
Clean fuel tank. Flush fuel system.
Is fuel hose bent or does fuel leak from the hose?
NO
Check carburetor.
YES
Replace defective part with new one.

(State 1 : Engine will not start.)

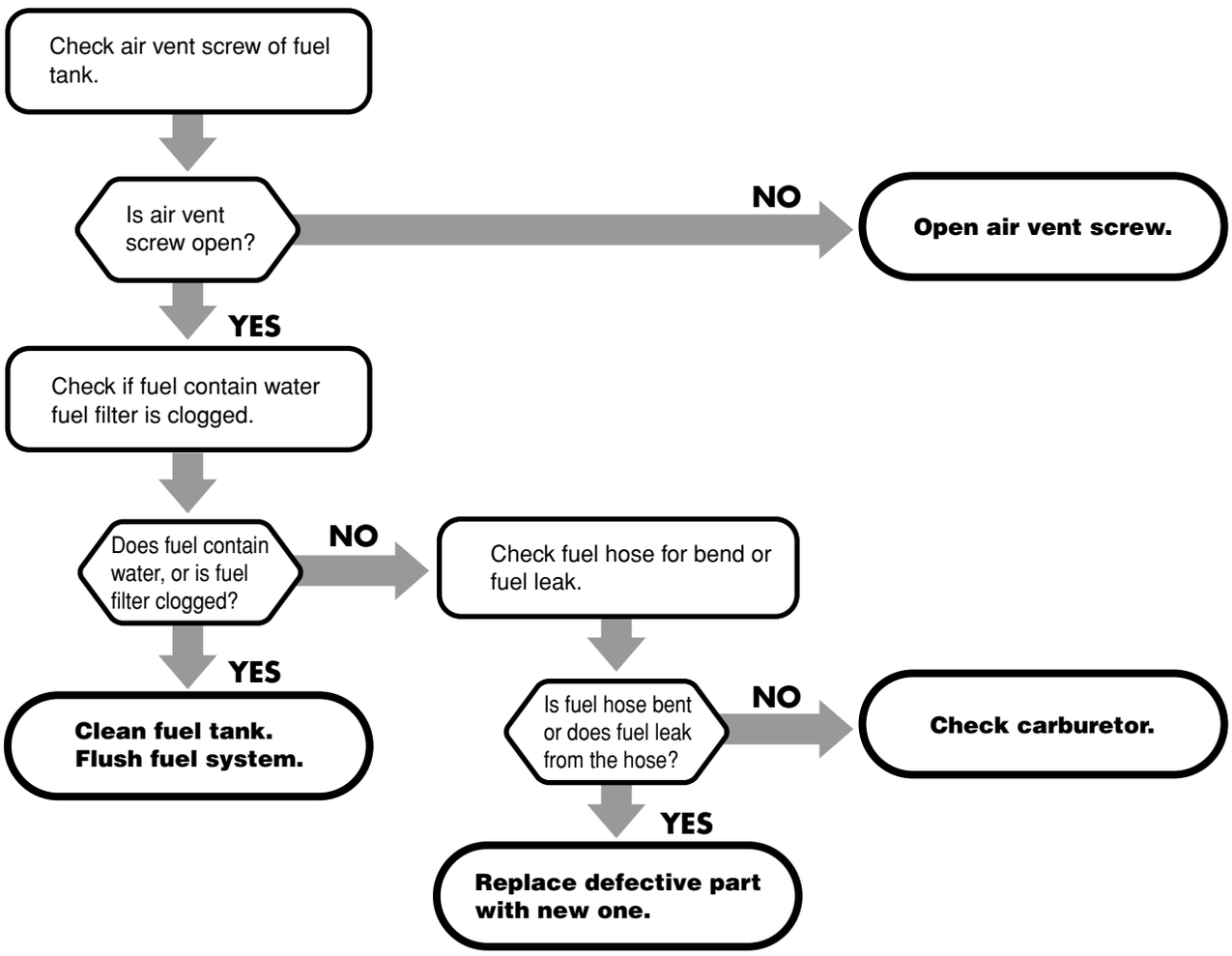
Compression Pressure



State 2 **Engine starts but stalls soon.**

• **Inspection of Fuel System, Ignition System, Compression Pressure.**

Fuel System



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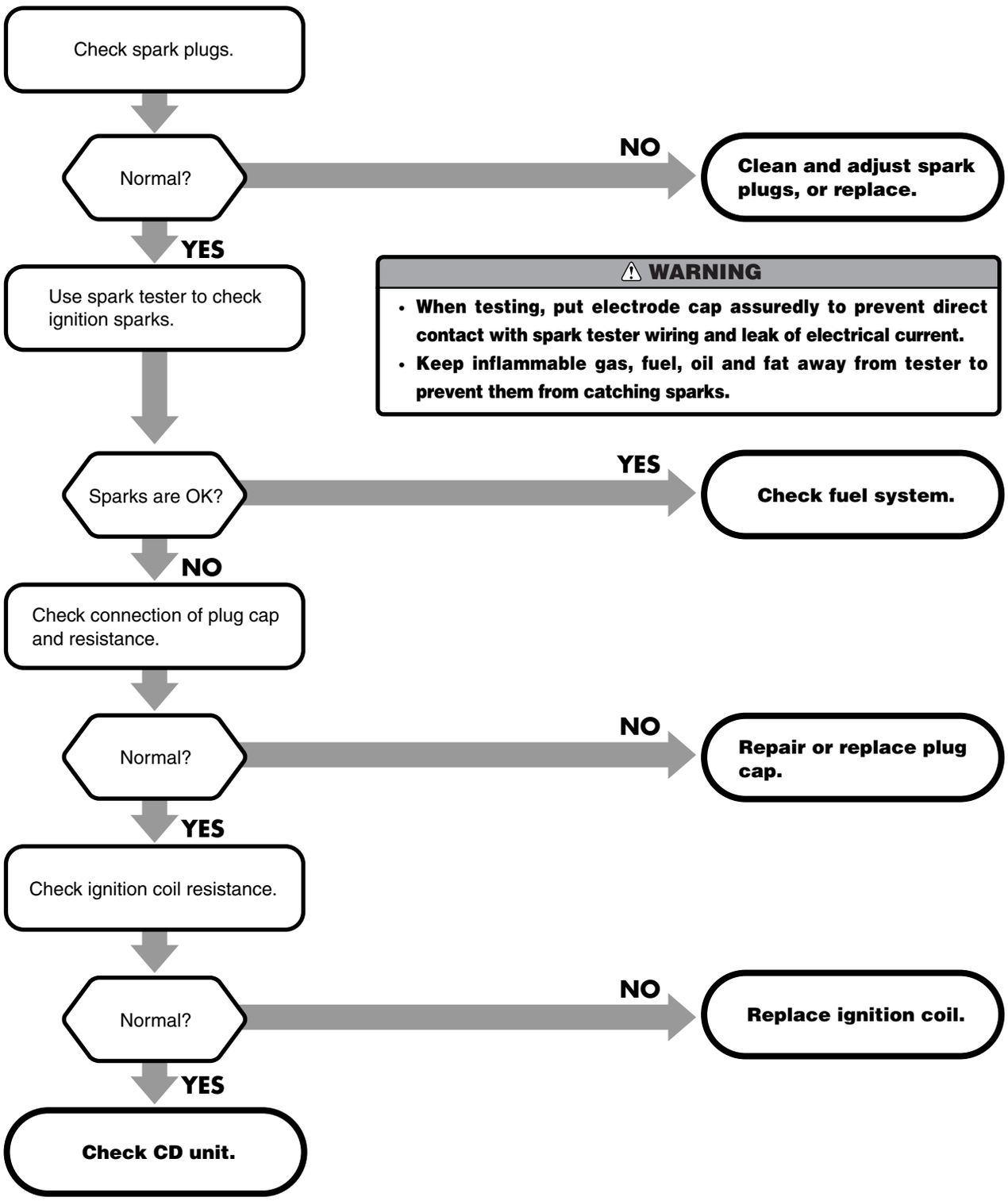
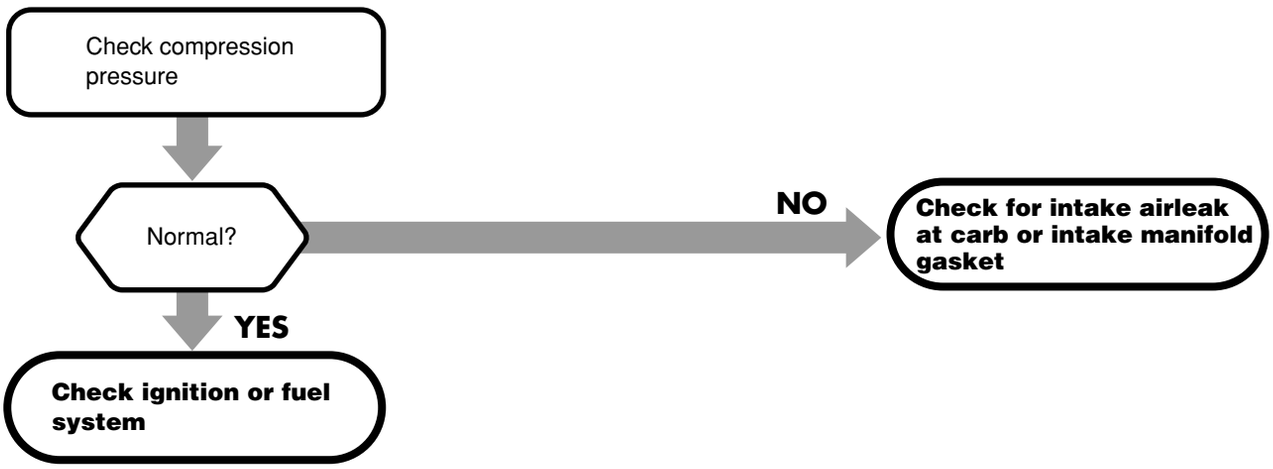
(State 2 : Engine starts but stalls soon.)

Ignition System

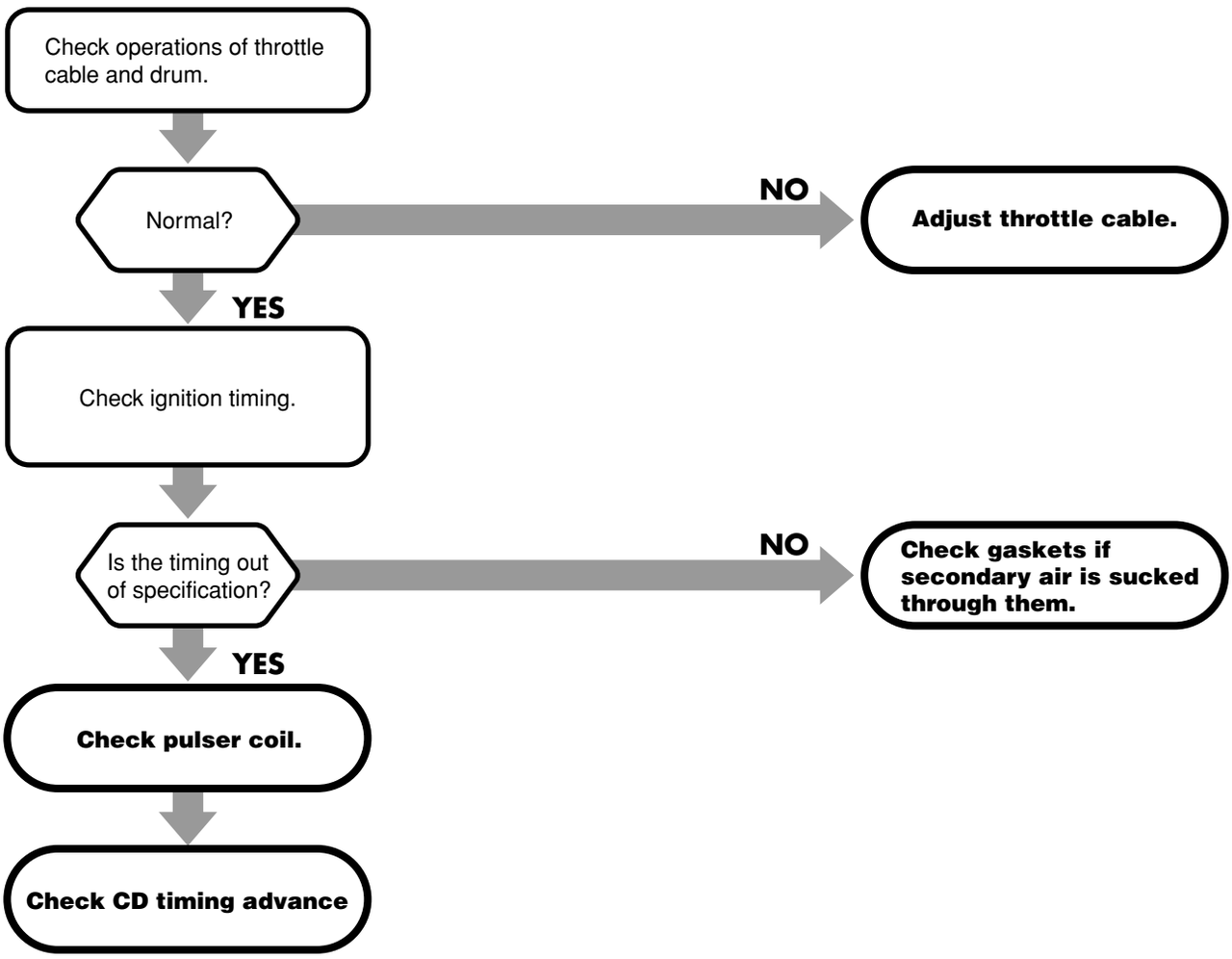


Compression Pressure



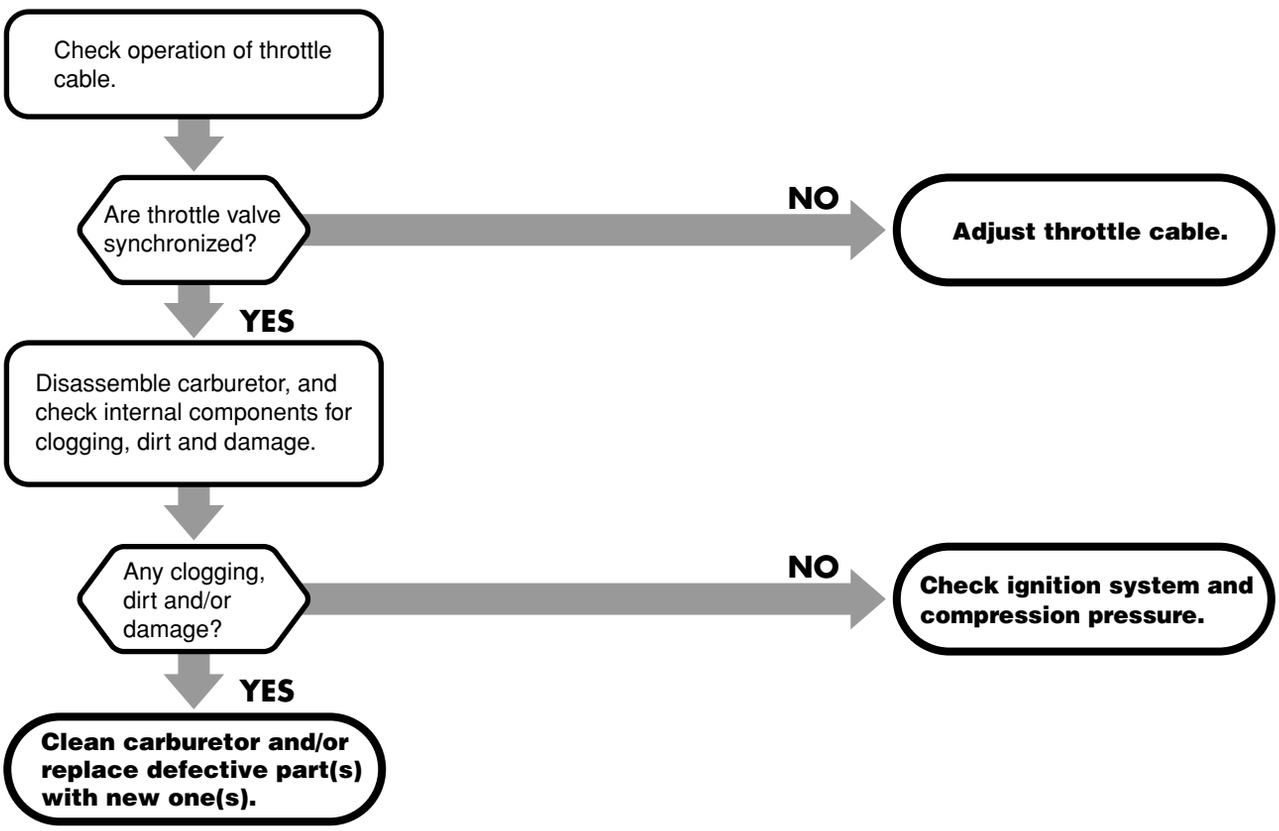
State 3 **Idle engine speed will not stabilize.**

• Inspection of Intake Manifold, Air Intake System and Ignition System.

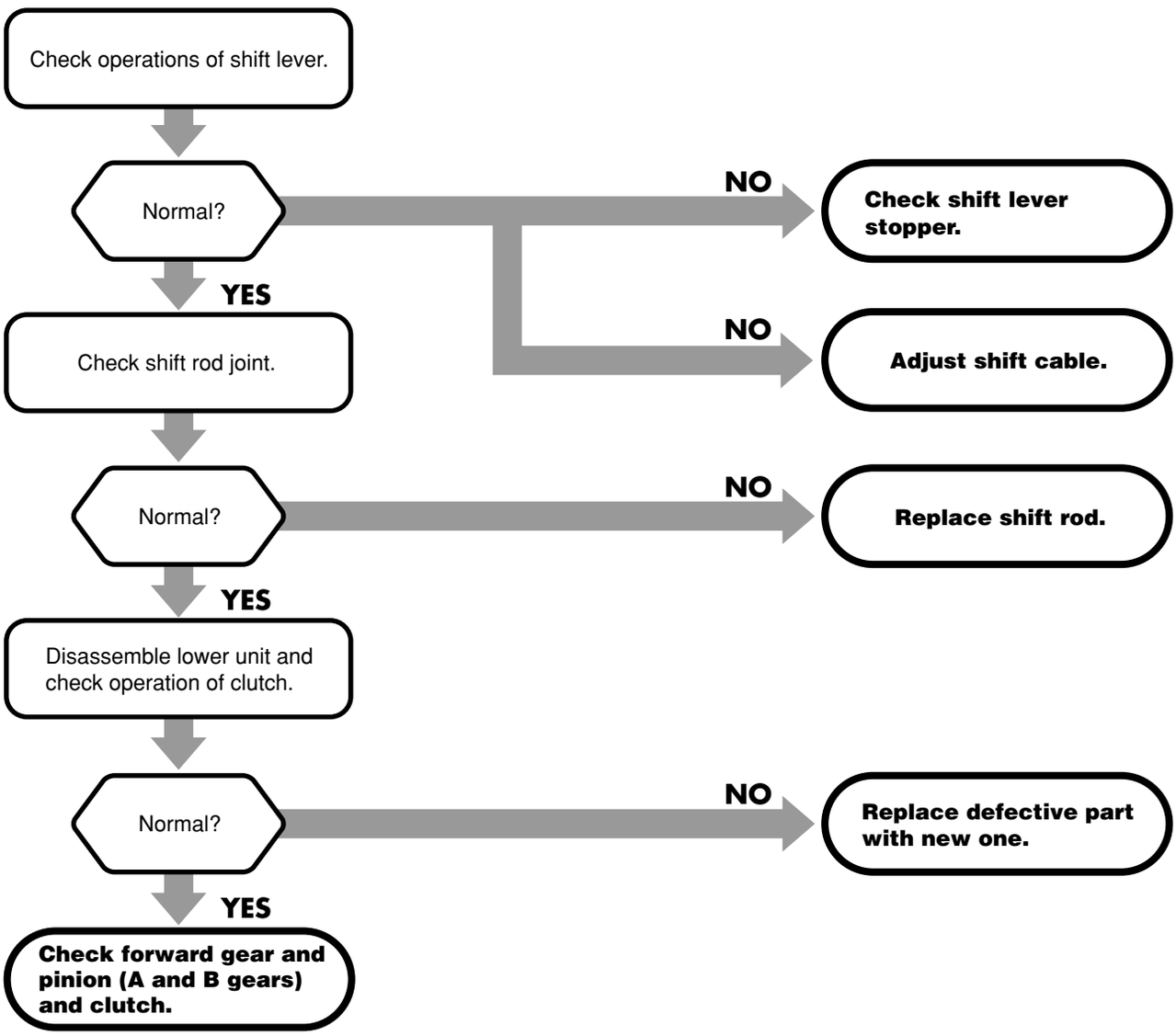


State 4 Rapid opening of throttle fails acceleration.

Rapid opening of throttle causes engine to stall. (Stops.)
Acceleration is not smooth.
• Inspection of Carburetor, Ignition System and Compression Pressure.



State 5 **Gear shifting cannot be made normally.**



3. Warning Indication
... Display for Abnormalities During Operation

Warning Indication			ESG revolution control	Condition	Reference	Estimated cause and action to be taken
Buzzer	Cowl lamp	Tachometer lamp				
×	×	–	High speed ESG	Engine over-rev. (operates at 6400rpm)	Controls to 6400±100rpm or less	Check propeller.
Continuous sound	Lit	Lit	Low speed ESG	Oil pressure reduced (operates at 4psi [0.25kg/cm^{2}])	Controls to 2000rpm or less	Stop engine and check oil level. Test oil pressure.
–	Lit	–	–	–	Warning lamp is lit always at starting engine for several seconds to check the operation.	If not lit, wire is disconnected or no power is generated.

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Wiring Diagram

TOHATSU
Outboards

SERVICE MANUAL

4 Stroke
MFS
9.9/15/20C
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