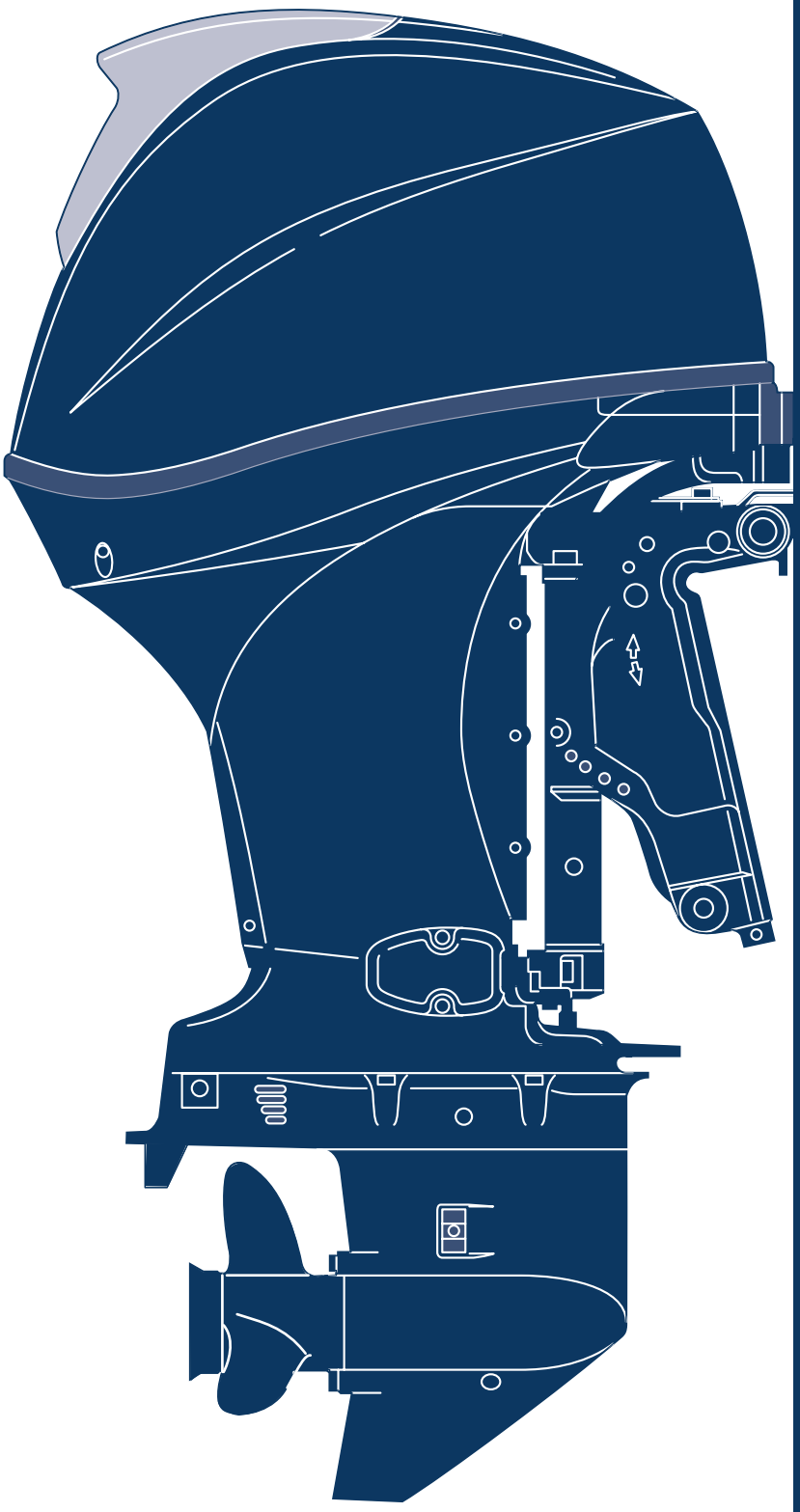
SERVICE MANUAL

TOHATSU
Outboards



4 Stroke
MFS 40/50A Models

OB No.003-21067-0
14-09 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.

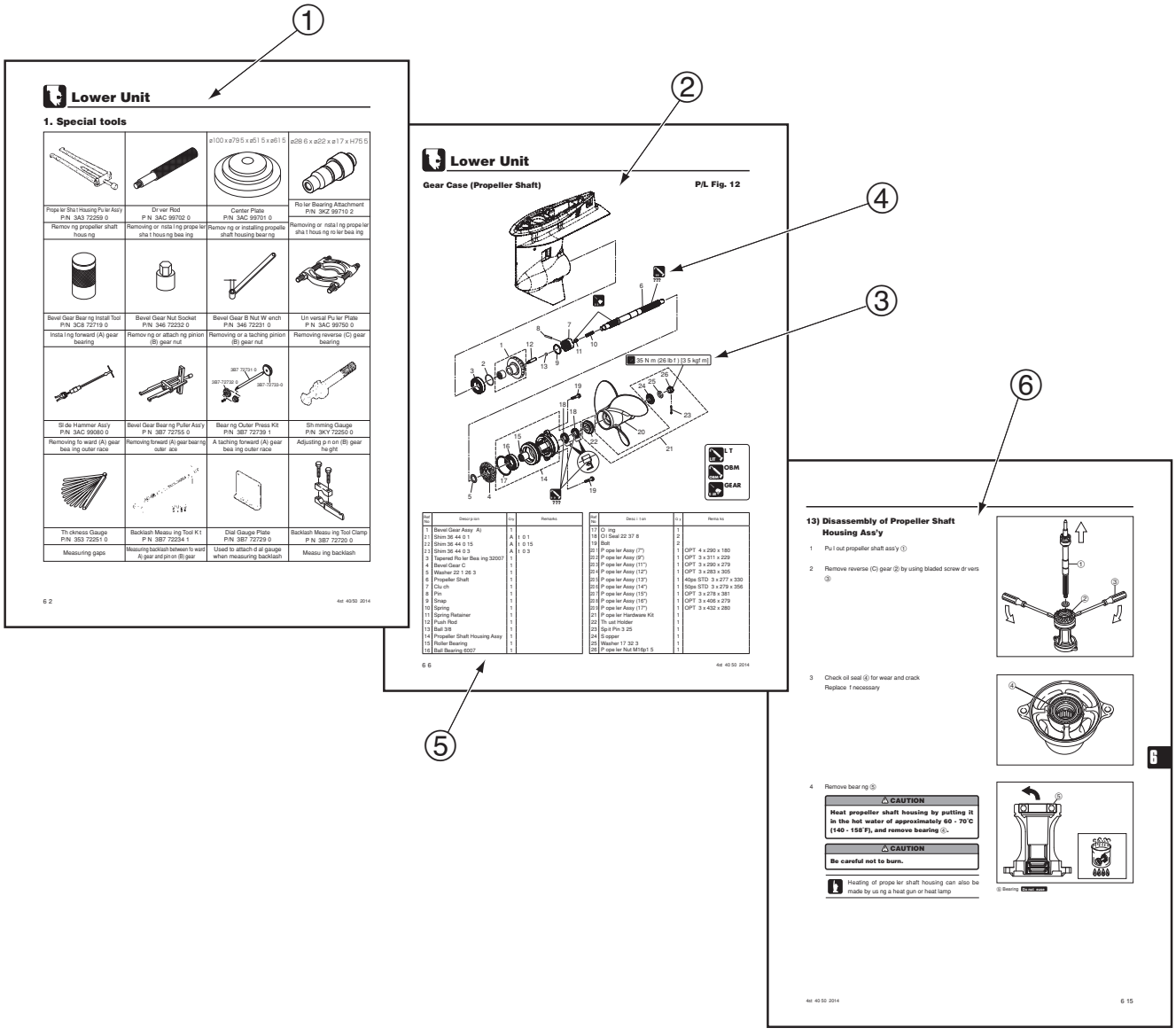
Attention:

About this manual

Composition and use of this manual

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

① Each chapter begins with the introduction of special tools that are used for the work described.
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. In the body text are critical points of the applicable work.
④ Pictograms indicate that there is an important work 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 number of pieces 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]

Conventional system (kilo-gram meter unit)
Conventional system (US pound inch unit)
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 (Fuel Injection) 
Power Unit 	Lower Unit 	Bracket 	Electrical System 
Troubleshooting 	Rigging 	Wiring Diagrams 	

The following symbols indicate items needed for the service.

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

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

4 stroke engine oil 	Gear oil 	ATF DEXRON Ⅲ 	OBM Grease 
Teflon® Grease TEFLON 	Low Temperature Lithium Grease LITHIUM 	Oil Compound [Shietsu Silicon] S.O.C 	[Konishi Bond] • G17 
Instant Adhesive [Three Bond®] • 1741 (7782) 	Screw Locking Agent [Loctite®] • 263 (271) 	Sealant [Loctite®] • 581 	Screw Locking Agent [Loctite®] • 1327 
Screw Locking Agent [Three Bond®] • 1342 	Screw Locking Agent [Three Bond®] • 1373B 	Screw Locking Agent [Three Bond®] • 1401 	

1.Service Information

2.Service Data

3.Maintenance

4.Fuel System (Fuel Injection)

5.Power Unit

6.Lower Unit

7.Bracket

8.Electrical System

9.Troubleshooting

10.Rigging

11.Wiring Diagram

INDEX

1
Service Information

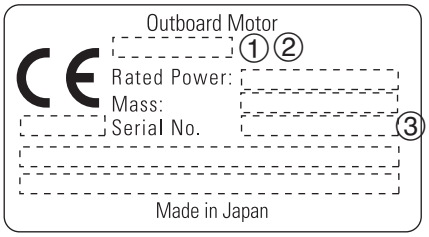
1. Identification (Engine Serial Number)

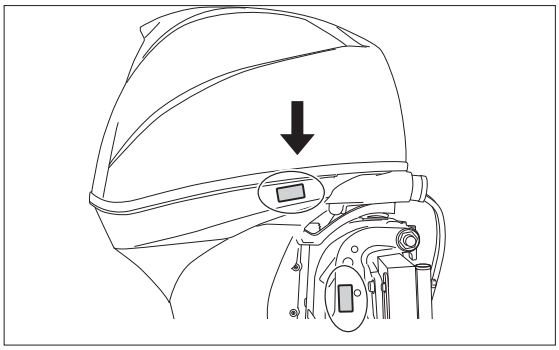
Engine serial number is stamped on the bottom cowl of outboard motor body.

① Model Name

② Model Type

③ Serial Number

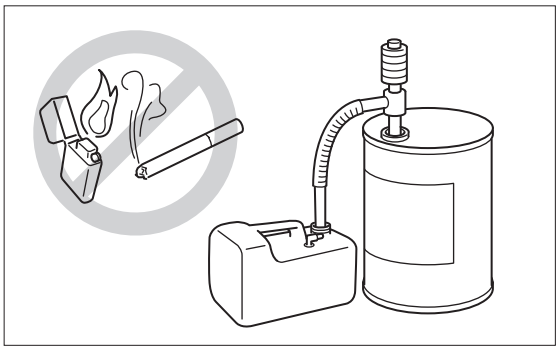




2. Securing of work safety

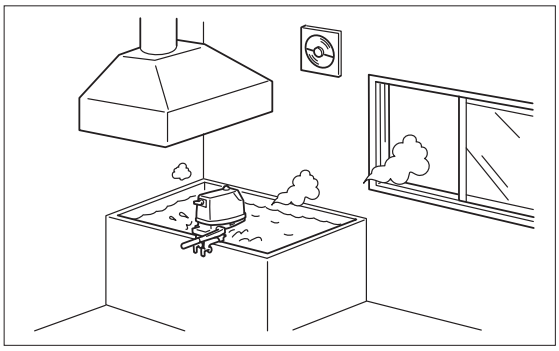
1) Fire Prevention

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



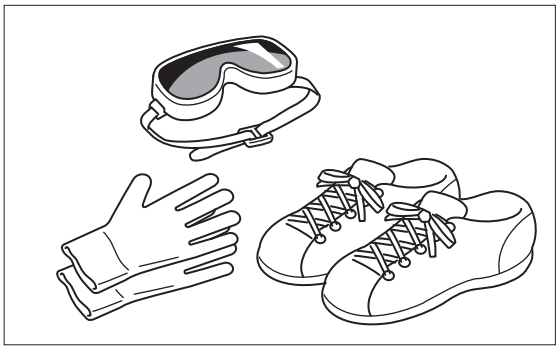
2) Ventilation

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



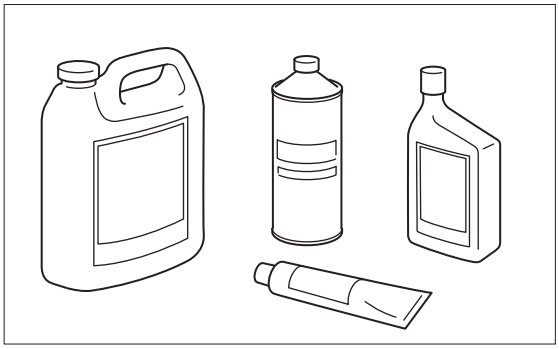
3) Protection

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



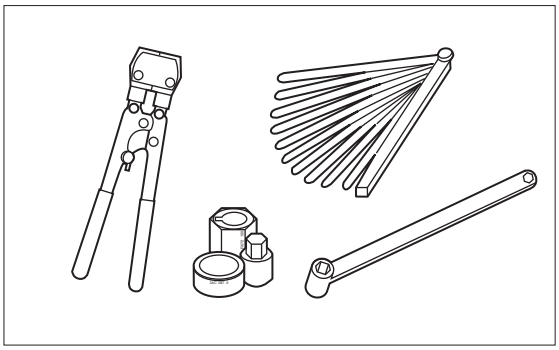
4) Genuine Parts

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



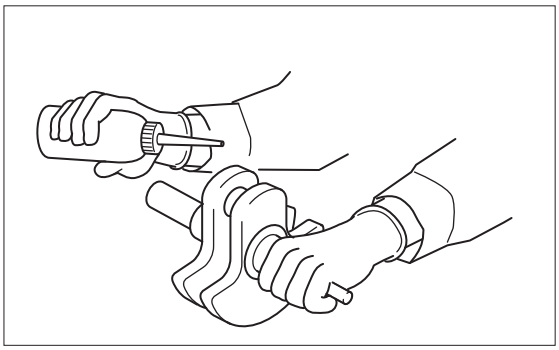
5) Tools

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 body and individual parts by cleaning. Apply recommended oil or grease to rotating areas and sliding surfaces. After individual works, 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 surface or mating surfaces of cylinder and crankcase.

(3) Replace unreusable parts such as packings, gaskets, O rings, oil seals, spring pins or split pins with new ones after they were 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 works 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 conditions.

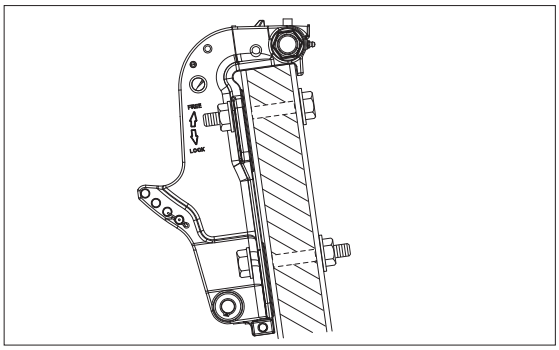
(8) When reassembling parts, take sufficient care also for details such as fits, repair limits, air tight, clogging of oil holes for lubrication and greasing, packings, wirings and piping. For components using many bolts and nuts for assembling, such as cylinder head and crankcase, tighten all the fasteners evenly to their specified torques clockwise in two or three stages, inner ones first and then outer ones. (Reverse the order when disassembling.)

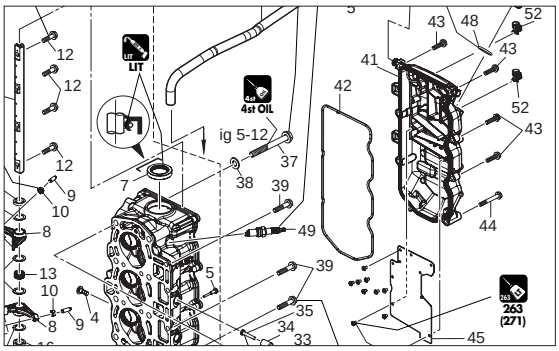
(9) When installing bearings, face the flat (numbered) side to the special assembling tool.

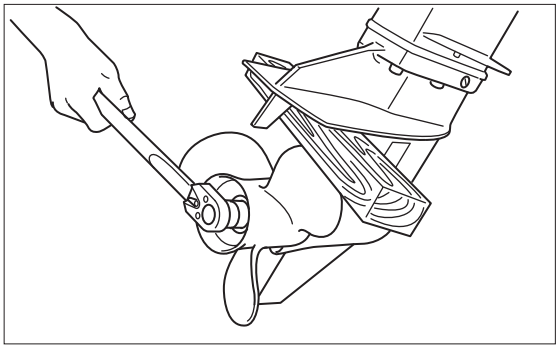
(10) When installing oil seals, be careful not to scratch the surface of the lip that contacts with the shaft, and install them in correct orientation. Apply recommended grease to the lip before installation.

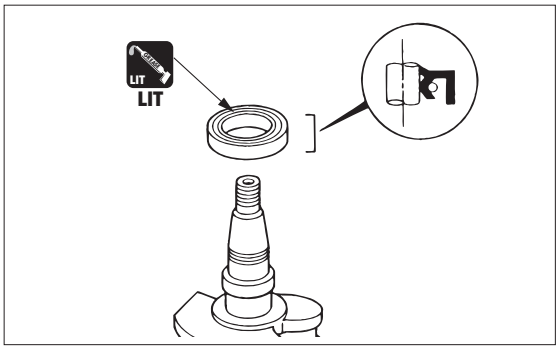
(11) When applying liquid packing, take sufficient care for the thickness and quantity. Excessive application may be oozed out, adversely affecting interior of the crankcase. Use adhesive after thoroughly reading the instructions.

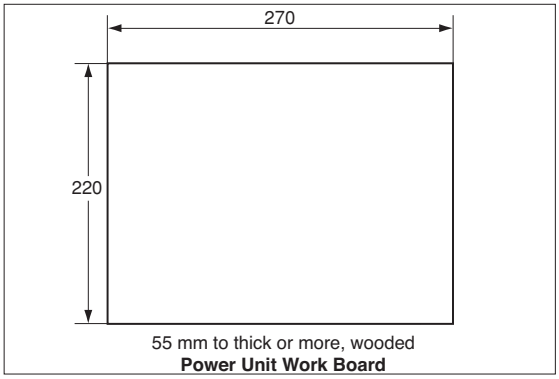
(12) When servicing power unit, use of wooden work board makes the work easier.





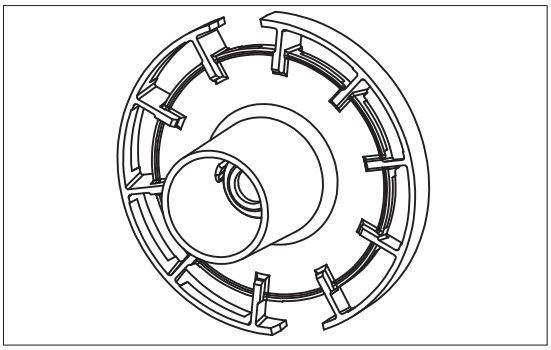






3. Tools and Instruments

1) Test Propeller



P/N. 3KY-64110-0

Outer diameter : 236 mm

With : 21 mm

Outboard motor model	Rotational speed at WOT (Wide Open Throttle) (r/min)
MFS40A	4500 - 5500
MFS50A	5000 - 6000

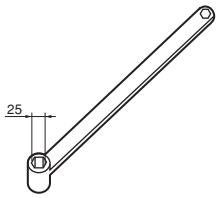
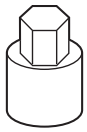
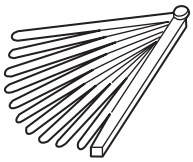
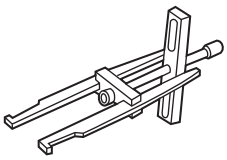
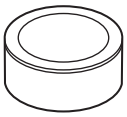
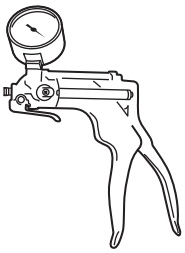
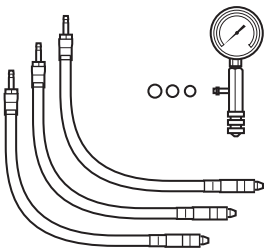
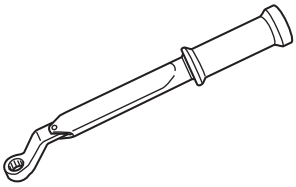
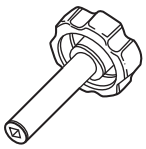
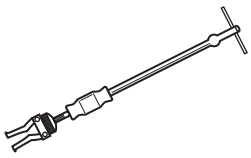
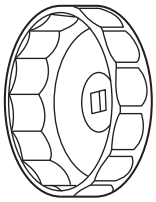
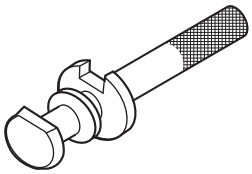
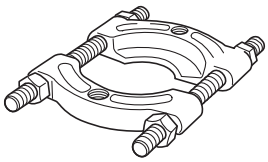
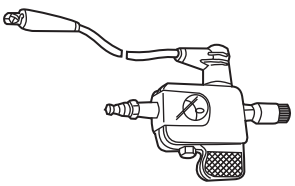
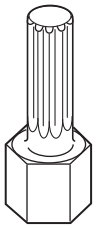
2) Measuring instruments

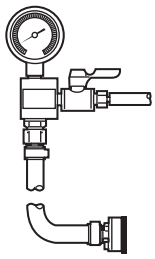
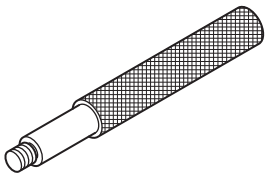
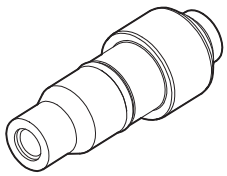
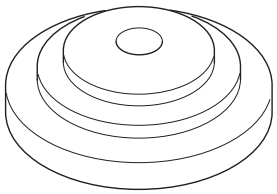
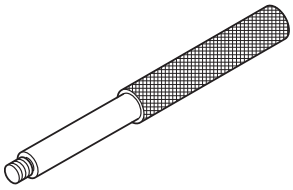
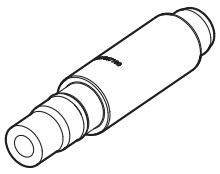
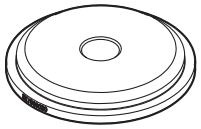
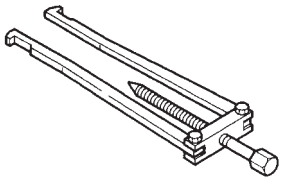
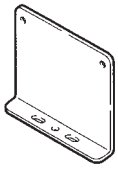
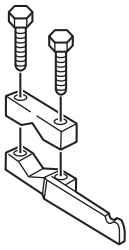
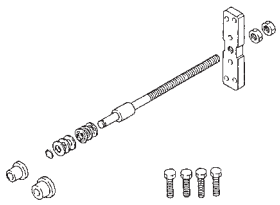
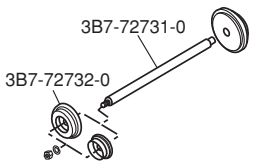
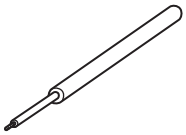
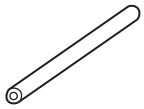
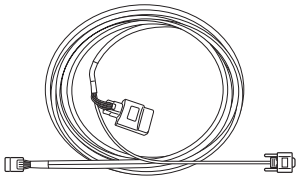
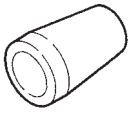
For the following measuring instruments, use commercially available ones.

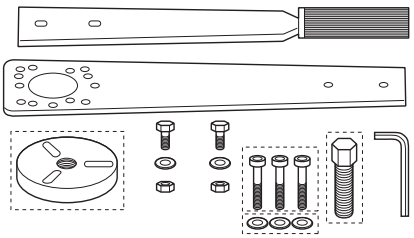
Circuit tester	(Resistance : 1Ω, 10Ω, 10 kΩ, AC voltage : 30 to 300V, DC voltage : 30V)
Vernier calipers	(M1 type, 300 mm)
Micrometer	(minimum graduation of 0.01, outer, 0 to 25 mm, 25 to 50 mm, 50 to 75 mm)
Cylinder gauge	(4 to 6 mm, 10 to 25 mm, 25 to 30 mm, 50 to 75 mm)
Ring gauge	(ø5.5, ø17, ø42, ø70)
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

			
Bevel Gear B Nut Wrench P/N. 346-72231-0	Bevel Gear B Nut Socket P/N. 346-72232-0	Bevel Gear Bearing Installation Tool P/N. 3AC-72719-0	Thickness Gauge P/N. 353-72251-0
Removing/installing Pinion Nut (B Gear Nut)		Installing forward gear (A gear) bearing	Measuring gaps
			
Bevel Gear Bearing Puller Ass'y P/N. 3A3-72755-0	Piston Slider P/N. 3KY-72871-0	Vacuum/Pressure Gauge P/N. 3AC-99020-1	Compression Gauge P/N. 3AC-99030-0
Removing forward gear (A gear) bearing outer race	Installing piston	Inspecting pressure	Measuring compression pressure
			
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 gear (A gear) bearing outer race	Removing/installing oil filter
			
Shimming Gauge P/N. 3KY-72250-0	Universal Puller Plate P/N. 3AC-99750-0	Spark Tester P/N. 3F3-72540-0	Crank Shaft Holder P/N. 3KY-72815-0
Measuring pinion gear (B gear) height	Removing reverse gear/ bearing	Inspecting sparks	Holding crank shaft

		ø28.6 x ø22 x ø17 x H75.5 	ø100 x ø79.5 x ø51.5 x ø61.5 
Pressure Gauge Ass'y P/N. 3T5-72880-0	Driver Rod P/N. 3AC-99702-0	Roller Bearing Attachment P/N. 3KZ-99710-2	Center Plate P/N. 3AC-99701-0
Measuring fuel pressure	Removing or installing propeller shaft housing bearing	Removing or installing propeller shaft housing roller bearing	Removing or installing propeller shaft housing bearing
	ø28.3 x ø22.15 x ø20 x H128 		
Driver Rod P/N. 3AB-99702-0	Roller Bearing Attachment P/N. 3KY-99710-0	Bearing attachment P/N. 3KY-99905-0	Propeller Shaft Housing Puller Ass'y P/N. 3A3-72259-0
Removing or instaing gear case roller bearing	Removing or instaing gear case roller bearing	Removing or instaing gear case roller bearing	Removing propeller shaft housing
			
Dial Gauge Plate P/N. 3B7-72729-0	Backlash Measuring Tool Clamp P/N. 3B7-72720-0	Backlash Measuring Tool Kit P/N. 3B7-72234-1	Bearing Outer Press Kit P/N. 3B7-72739-1
Used to attach dial gauge when measuring backlash	Measuring gap between forward and pinion gears (A and B gears)	Measuring gap between forward and pinion gears (A and B gears)	Installing forward gear (A gear) bearing outer race
			
Spring Pin Tool A P/N. 345-72227-0 (ø3.0)	Spring Pin Tool B P/N. 345-72228-0 (ø3.0)	Diagnosis Tool Kit P/N. 3KY-72920-0	Clutch Pin Snap Tool P/N. 3KY-72229-0
Removing spring pin	Installing spring pin	Used to engine diagnosis	Installing clutch pin


Flywheel Puller Kit P/N. 3T1-72211-0
Removing/installing flywheel

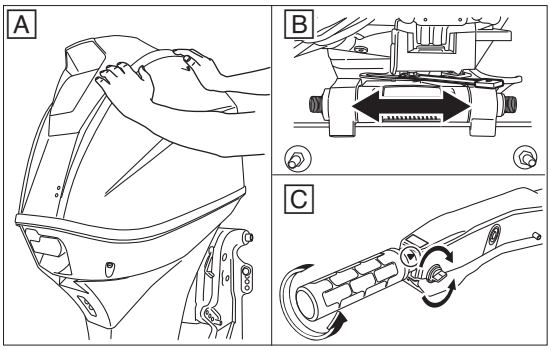
4. Pre-delivery Inspection

1) Steering Handle

A Check installations for clattering and play.

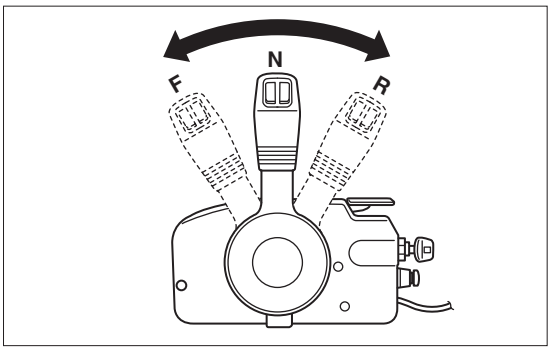
B Adjust steering friction.

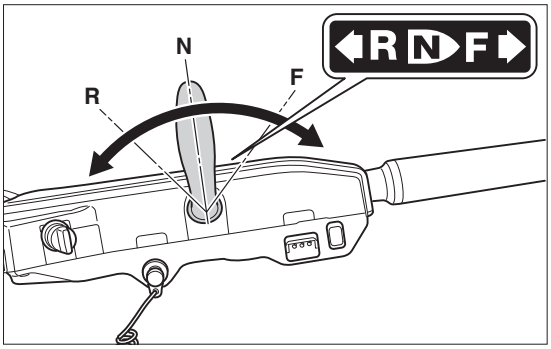
C Check throttle grip for movement. (full open/full close).
Adjust throttle friction.



2) Gear Shift

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





3) Engine Oil

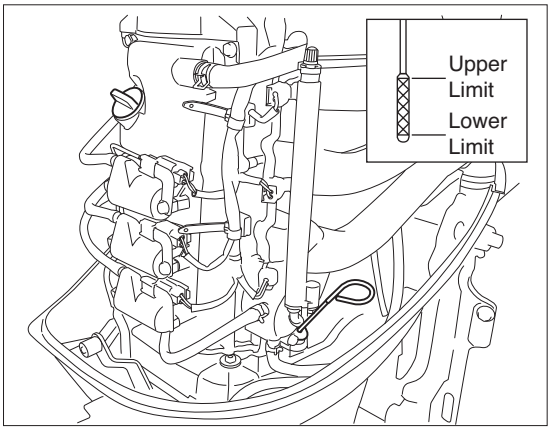
Fill engine with engine oil.

4 Stroke Engine Oil :
2.2 L (2.3 US.qt) [without oil filter replacement]
2.4 L (2.5 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.

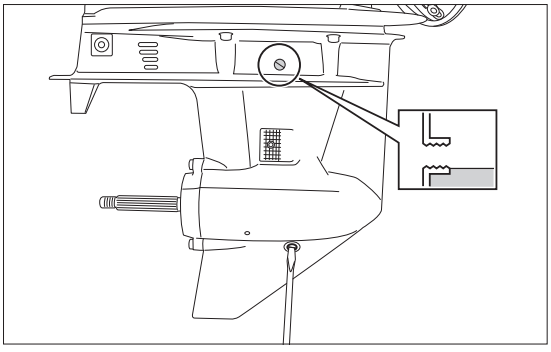


4) Gear Oil

Check quantity of gear oil.

Gear Oil :
500 cm^3 (16.9 fl.oz)

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

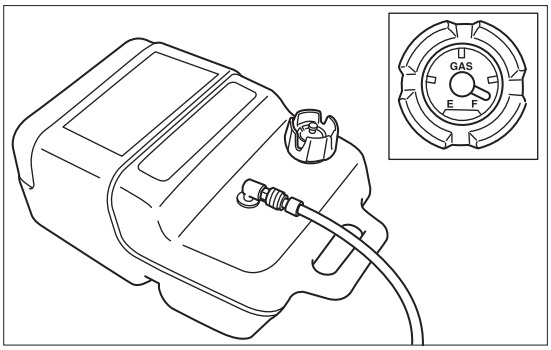


5) Fuel Line

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.

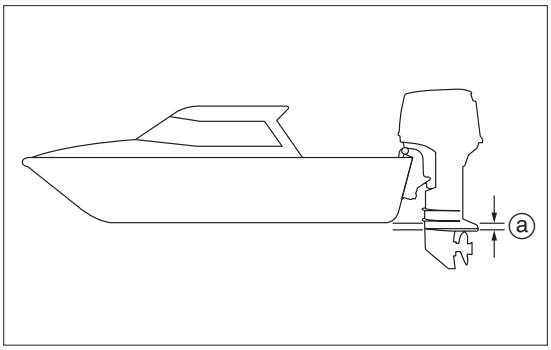


6) Rigging

Check that clamp bracket is fixed securely to hull. Check location of cavitation 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.

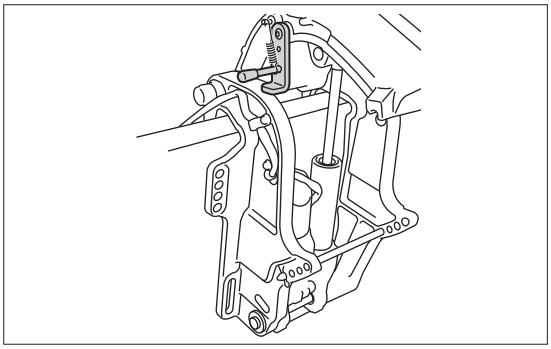
Standard installation height :
Cavitation plate located 10 to 30 mm (0.4 to 1.2 in) below boat bottom



ⓐ10 to 30 mm (0.4 to 1.2 in)

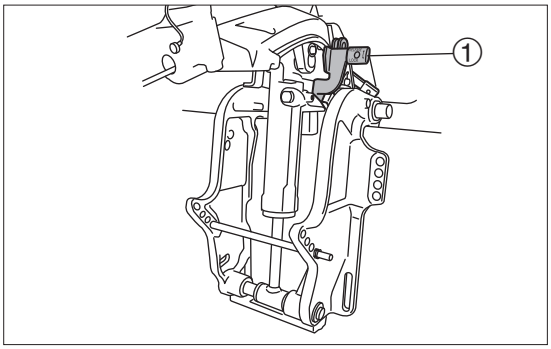
7) Inspection of PTT unit

1. Operate PTT switch to check that outboard motor tilts up/down smoothly.
2. Operate PTT switch to check that tilting up/down outboard makes no abnormal noise.
3. Tilt up outboard motor and steer fully to the right and left to check that cables and hoses do not interfere with each other and with any part of hull.
4. Tilt down outboard motor to check that trim meter indicates the lowest position.



8) Inspection of gas shock absorber

1. Check that outboard motor tilts up/down smoothly.
2. Tilt up outboard motor and lock it with tilt lock lever ① to check that gas assisted holding mechanism functions normally.

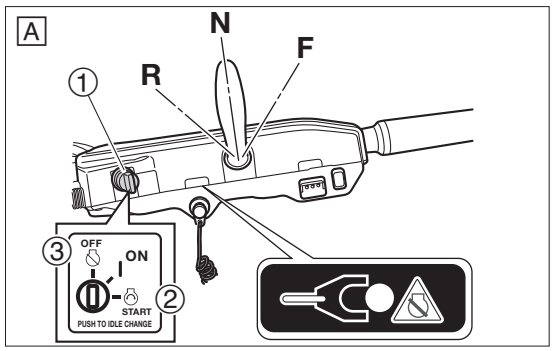


9) Inspection of starting switch and stop switch

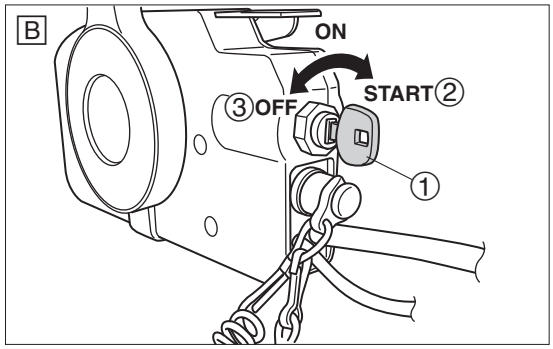
1. Press start switch ① or turn main switch to START ② to check that engine starts.

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

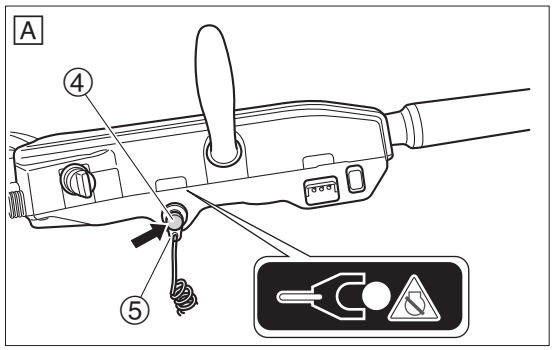
   A Multi Tiller Handle Model
   B Remote Control Model

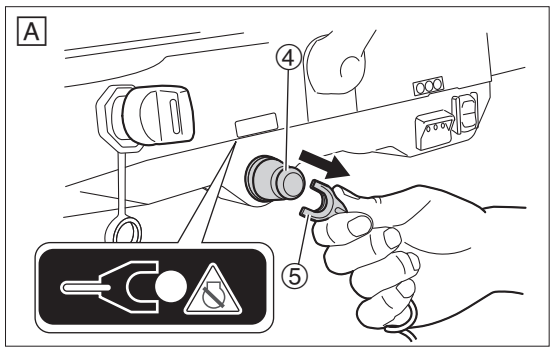


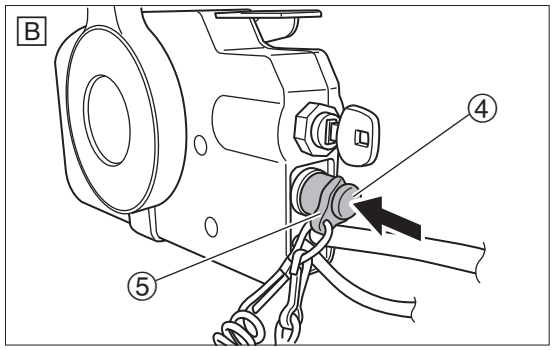
3. Set the shift lever or control lever to "F" and "R" position, to check taht engin not starts. Adjust neutral switch if necessary.



4. Press stop switch ④ hard or pull out lock ⑤ from stop switch ④ to check that engine stops.
   A Multi Tiller Handle Model
   B Remote Control Model

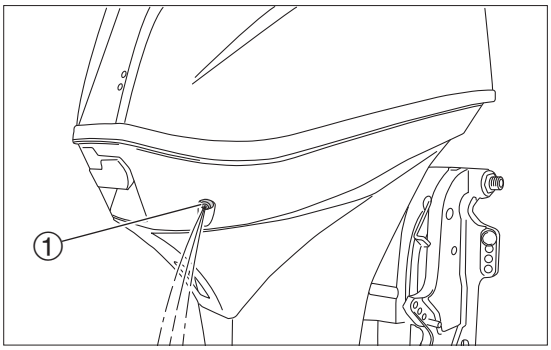






10) Cooling water check port

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

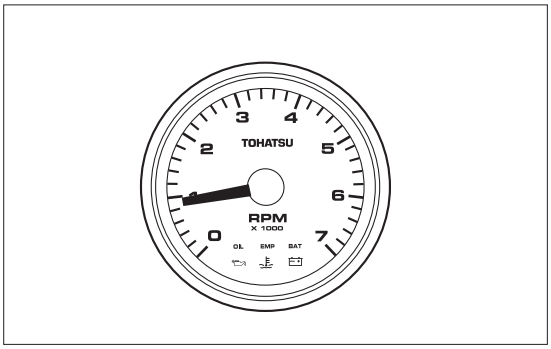


11) Idling

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

Idle Speed :
850±30 r/min

Tachometer :
P/N. 3GF-72647-1



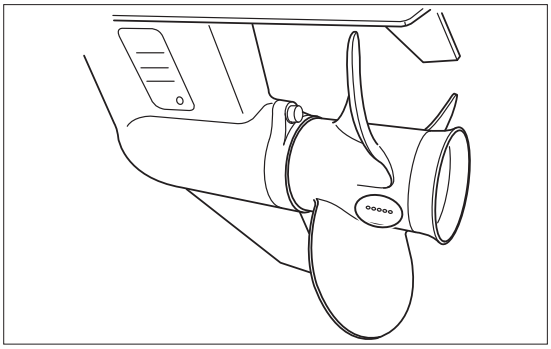
12) Propeller Selection

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

Range of operating engine speed at WOT
5000 - 6000 r/min

⚠ CAUTION

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



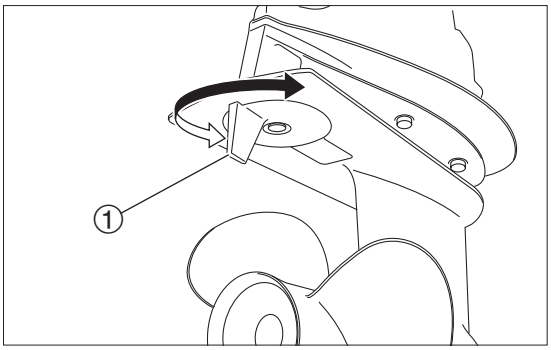
Plopeller Table

Plopeller Mark	No. of Blades x Pitch (mm) x Diameter (mm)	Part No.	Remarks
CS17	3 X 432 X 280	3KYB64536-0	
CS16	3 X 406 X 279	3KYB64534-0	
CS15	3 X 381 X 278	3T5B64532-0	
CS14	3 X 356 X 279	3T5B64529-0	50 : STD
CS13	3 X 330 X 277	3T5B64527-0	40 : STD
CS12	3 X 305 X 283	3T5B64525-0	
CS11	3 X 279 X 290	3T5B64523-0	
CS9	3 X 229 X 311	3T5B64518-0	
7	4 X 180 X 290	348B64108-1	4 blades

13) 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.



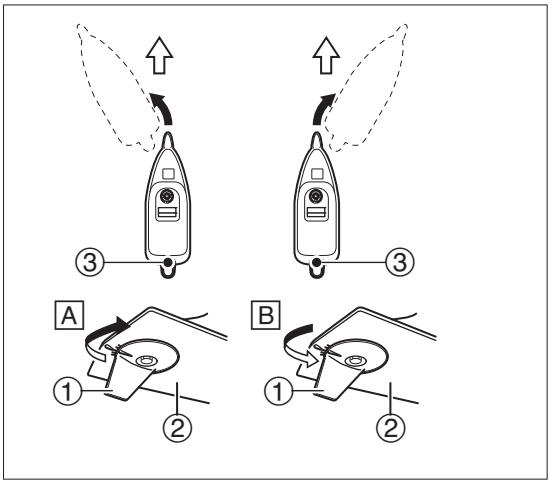
Trim tab bolt :
13 N · m (10 lb·ft) 1.3kgf · m

Example of trim tab angle adjustment

Ⓐ If it is necessary to steer to starboard to make boat run straight or if boat steers itself to port when steering is held amidships, move trim tab as shown "A", or

Ⓑ If it is necessary to steer to port to make boat run straight or if boat steers itself to starboard when steering is held amidships, move trim tab as shown "B".

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)

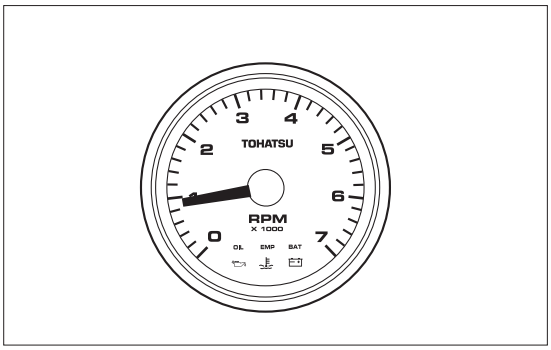
5. Break-in Operation

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 made smoothly.

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

Idling Revolution Speed :
850±30 r/min

Tachometer :
P/N. 3GF-72647-1

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

Dead Slow Revolution Speed :
850±30 r/min

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

7. Checks After Test Run

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

2. Check that no fuel leaks in the cowl.

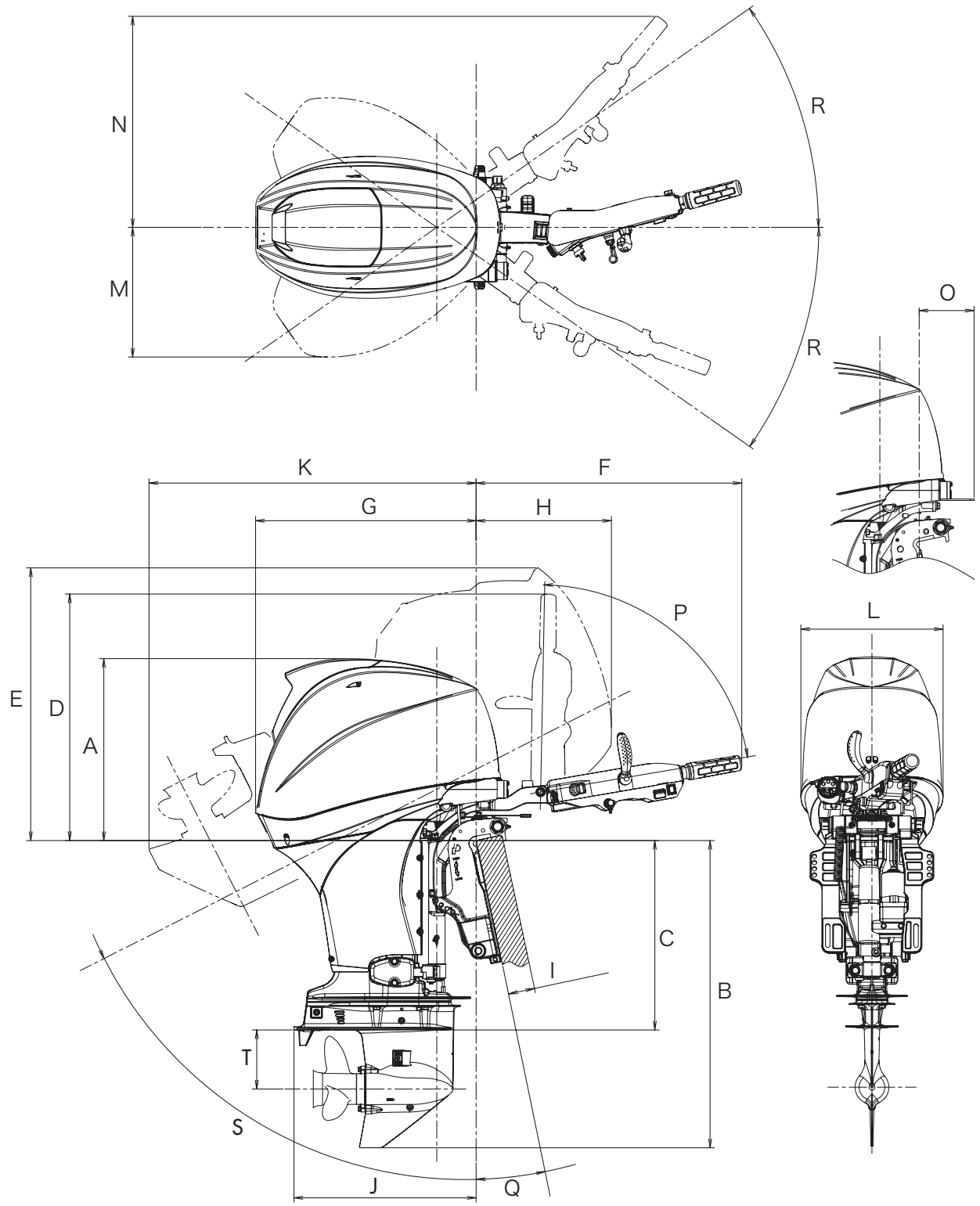
3. Check that no oil and water leak in the cowl and no water is present in engine oil.

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

2
Service Data

1. Outline Dimensions

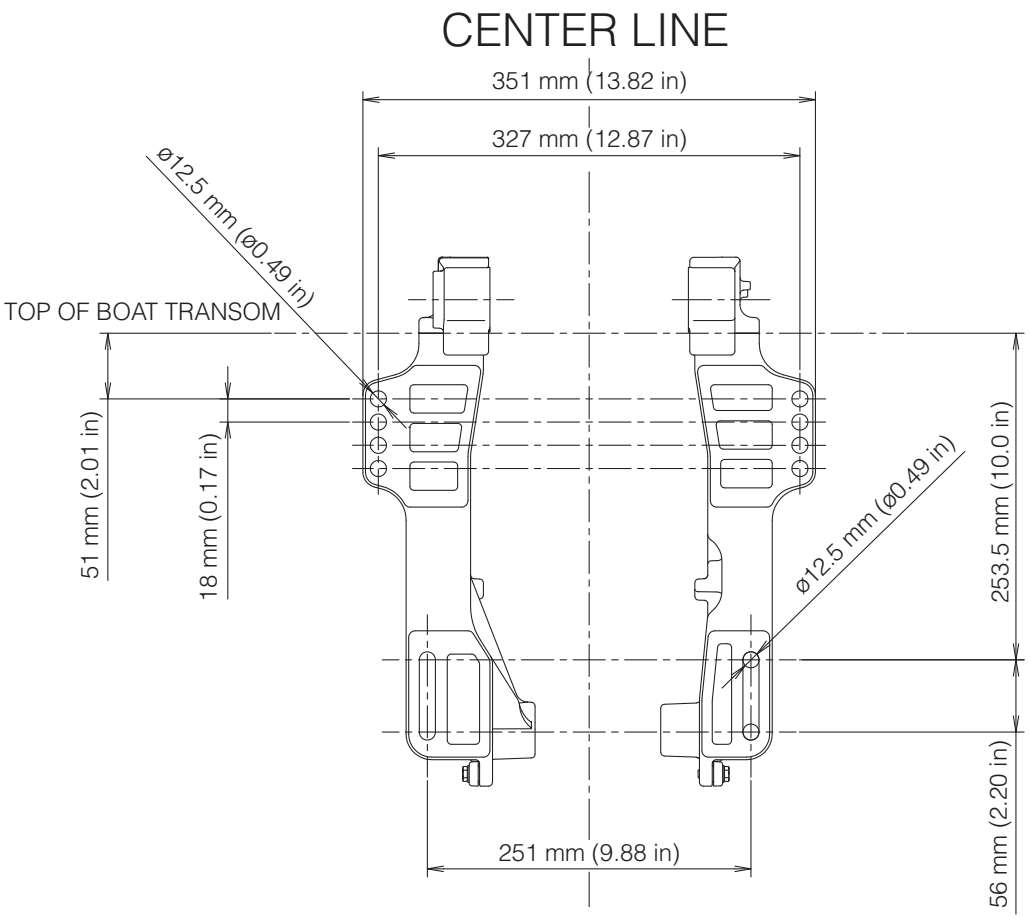
1) Engine Dimensions



Item	Type	Unit	ET (with Remote Control)		ET (with Multi Tiller Handle)		EG (with Multi Tiller Handle)	
			mm	in	mm	in	mm	in
A		mm/in	517	20.35	517	20.35	517	20.35
B	S	mm/in	740	29.13	740	29.13	740	29.13
	L	mm/in	873	34.37	873	34.37	873	34.37
	UL	mm/in	987	38.86	987	38.86	987	38.86
C	S	mm/in	405	15.94	405	15.94	405	15.94
	L	mm/in	538	21.18	538	21.18	538	21.18
	UL	mm/in	652	25.67	652	25.67	652	25.67
D		mm/in	701	27.60	701	27.60	701	27.60
E		mm/in	775	30.51	775	30.51	775	30.51
F		mm/in	—	—	755	29.72	755	29.72
G		mm/in	627	24.68	627	24.68	627	24.68
H		mm/in	385	15.16	385	15.16	385	15.16
I		mm/in	31 – 70	1.22 – 2.76	31 – 70	1.22 – 2.76	31 – 70	1.22 – 2.76
J		mm/in	518	20.39	518	20.39	518	20.39
K	S	mm/in	811	31.93	811	31.93	811	31.93
	L	mm/in	930	36.61	930	36.61	930	36.61
	UL	mm/in	1031	40.59	1031	40.59	1031	40.59
L		mm/in	404	15.91	404	15.91	404	15.91
M		mm/in	369	14.53	369	14.53	369	14.53
N		mm/in	600	23.62	600	23.62	600	23.62
O		mm/in	156	6.14	—	—	—	—
P		deg.	—		80		80	
Q		deg.	12		12		—	
R		deg.	35		35		—	
S		deg.	62		62		56	
T		mm/in	168	6.61	168	6.61	168	6.61
Trim Angle (Position)		deg. *1	-4 to +16 (4)		-4 to +16 (4)		-4 to +16 (4)	

*1: The angle to the horizontal when 12 deg. transom

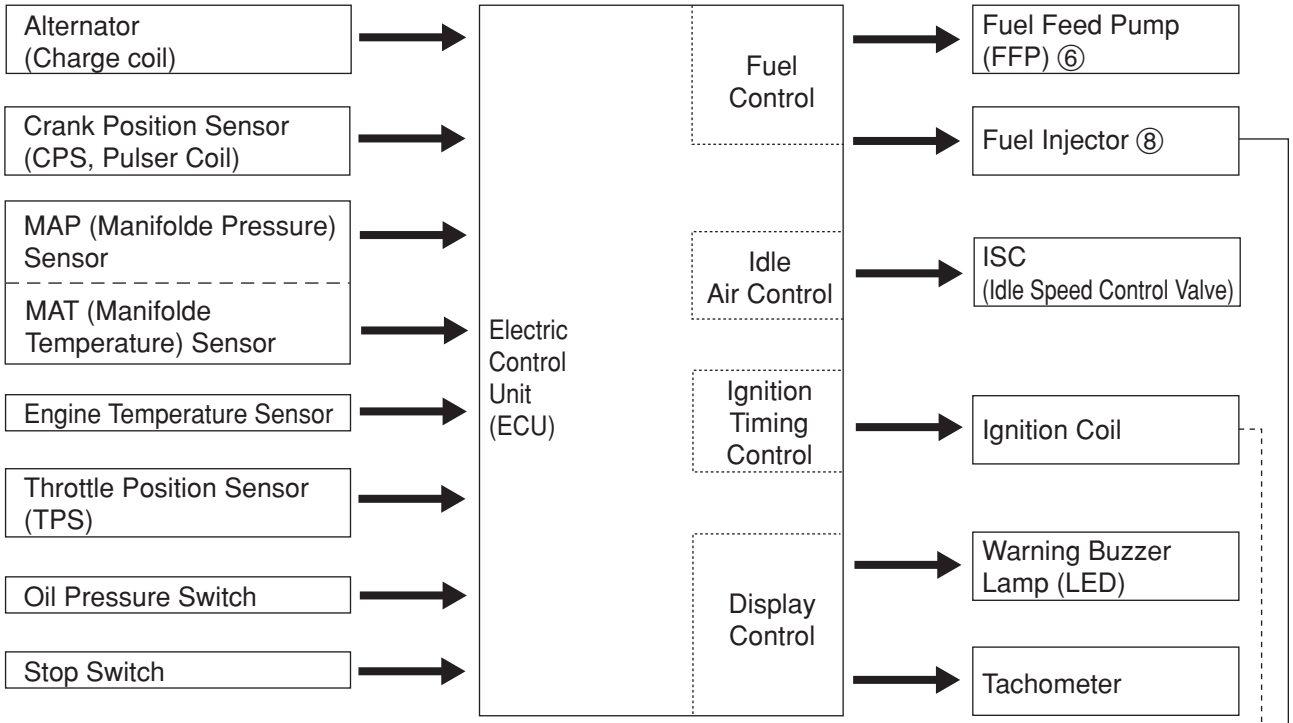
2) Transom Bolts

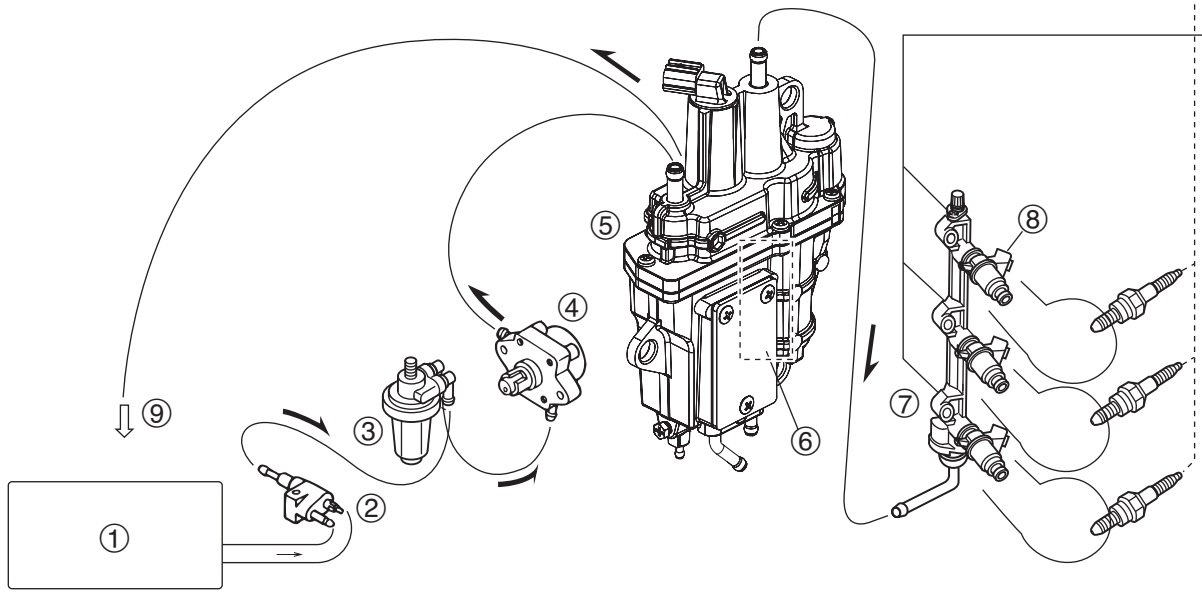


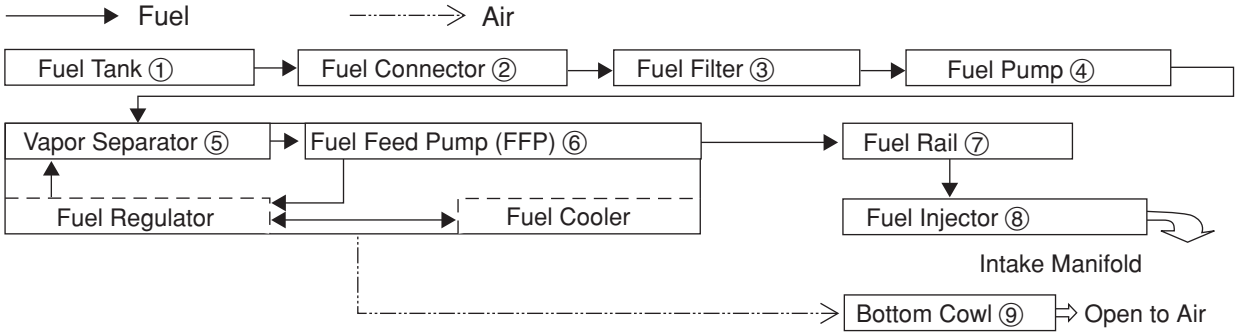
2.Fuel Injection System

1) ECU Fuel Feed System

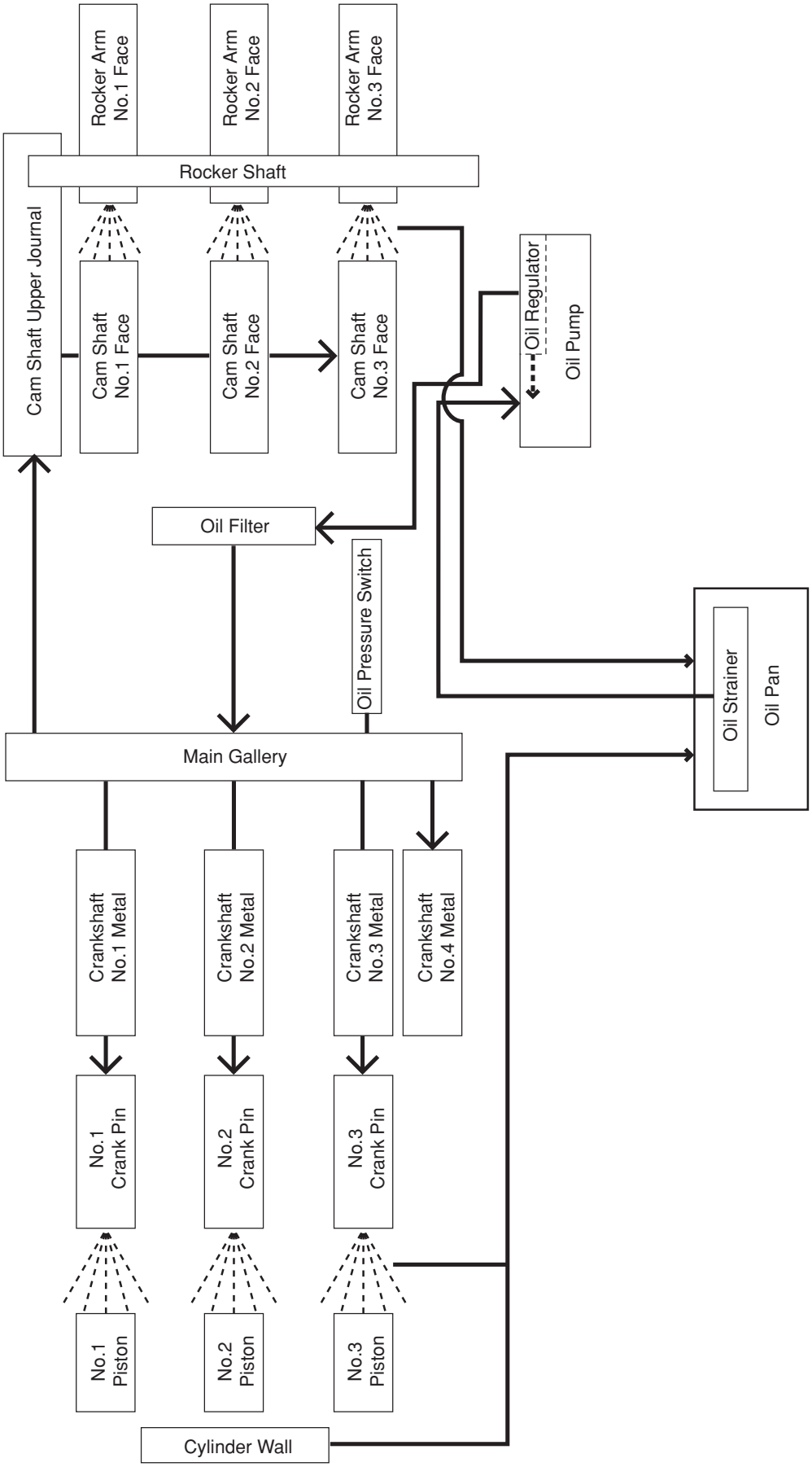
ECU uses various sensors to precisely control injected fuel amount and ignition timing.



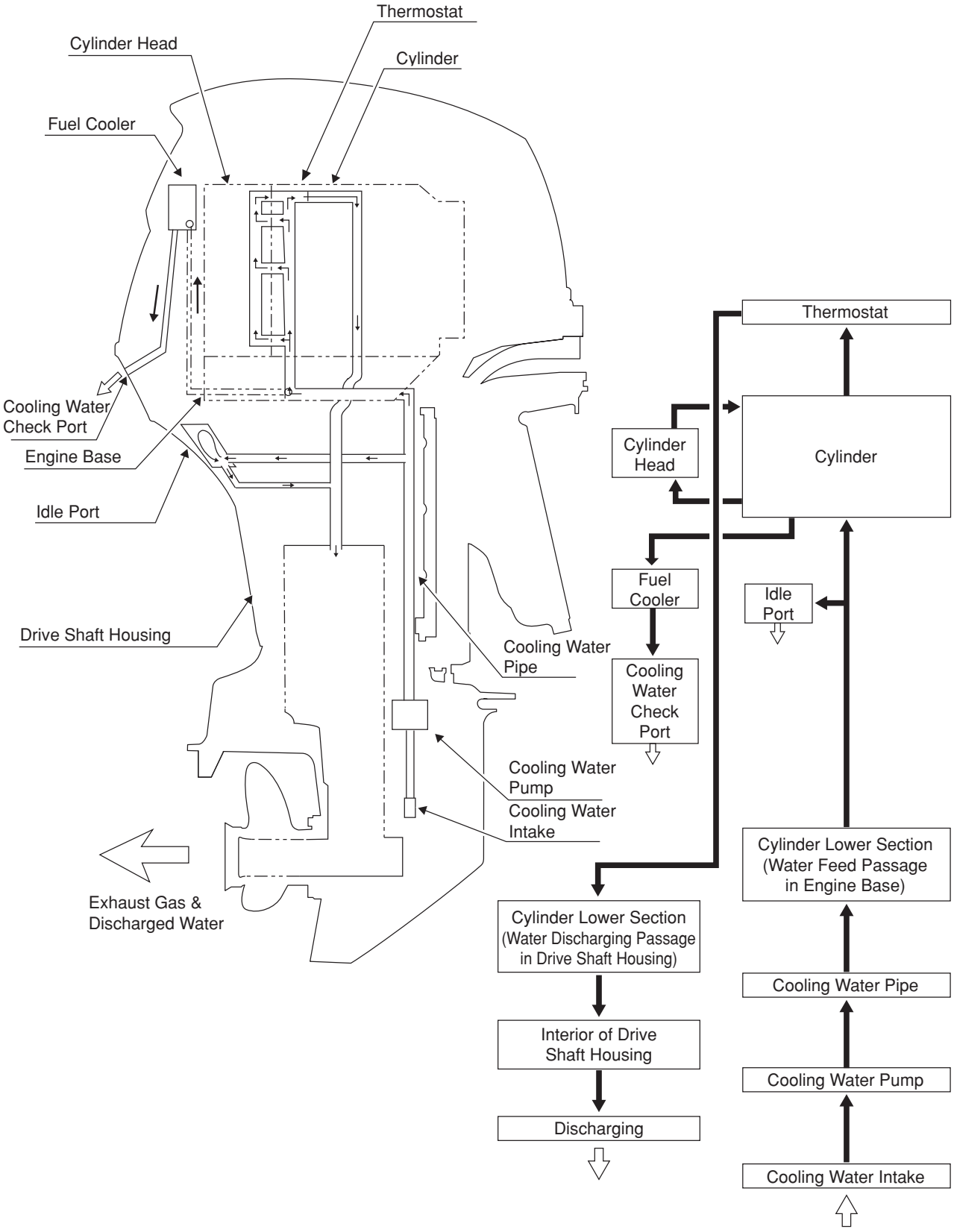




3.Engine Lubrication System Diagram



4.Cooling Water System Diagram



5.Specifications

Item	Unit	Model		
		MFS40A		MFS50A
		ET (with Remote Control)	ET (with Multi Tiller Handle)	EG (with Multi Tiller Handle)

Dimensions (approx.)

Overall Length		mm (in)	with Remote Control : 783 (30.8) with Multi Tiller Handle : 1,382 (54.4)
Overall Width		mm (in)	404 (15.9)
Overall Height	S	mm (in)	1,257 (49.5)
	L	mm (in)	1,390 (57.4)
	UL	mm (in)	1,504 (59.2)
Transom Length	S	mm (in)	405 (15.9)
	L	mm (in)	538 (21.2)
	UL	mm (in)	652 (25.7)

Weight (approx.)

	S	kg (lb)	95 (209)	100 (220)	97.5 (215)
	L	kg (lb)	97 (214)	102 (225)	99.5 (219)
	UL	kg (lb)	100 (221)	105 (231)	102.5 (226)

Performance

Maximum Output		kW (ps)	40A : 29.4 (40)	50A : 36.8 (50)
Full-throttle revolution speed range		r/min	5,000 to 6,000	
Full-throttle Fuel Consumption		L (gal.)/hr	40A : 13.7 (3.62)	50A : 15.7 (4.15)
Idling (Neutral [N])		r/min	650/750/850/950	
Trolling (Forward [F])		r/min	650/750/850/950	

Power Unit

Engine Type			4 stroke	
No. of Cylinders			3	
Piston Displacement		cm^3 (cui)	866 (52.8)	
Valve System			SOHC	
Bore x Stroke		mm (in)	70 x 75 (2.76 x 2.95)	
Compression Ratio			9.51	
Shift Operation System			Remote Control	Front Shift (Manual)
Starting System			Electric Start	
Lubrication System			Wet Sump	
Cooling System			Water Cooling (Impeller System)	
Exhaust System			Through-the-prop Exhaust	
Ignition System			Battery Ignition	
Range of Ignition Augle			BTDC2° to BTDC27°(ECU timing control)	
Spark Plugs			DCPR6E [NGK]	
Alternator Output			12V–252W, 21A	
Fuel Feed System			Electronic Fuel Injection	

Item			Unit	Model		
				MFS40A		MFS50A
				ET (with Remote Control)	ET (with Multi Tiller Handle)	EG (with Multi Tiller Handle)

Fuel & Oil

Type of Fuel				Unleaded Gasoline (Research Octane Number 90 or over,Pump posted Octane Number 87 or over)	
Fuel Tank Capacity			L	25	
Fuel Priming System				ECU (Electronic Control Unit)	
Fuel Pumping System				Mechanical (Plunger) pump + Electric System	
Engine Oil	Type			4 Stroke Engine (Motor) Oil	
	Grade		API	SH, SJ, SL	
			SAE	10W-30, 10W-40	
	Quantity		L	2.4 (when oil filter is replaced with new one)	
Gear Oil	Type			Hypoid Gear Oil	
	Grade	*1	API	GL-5	
		*1	SAE	#80-90	
	Quantity		cm^3 (US qt)	500 (0.53)	

Lower Unit

Gear Shift Positions			F – N – R	
Gear Ratio			2.08 (13 : 27)	
Type of Gears			Spiral Bevel Gear	
Clutch			Dog Clutch	
Propeller Shaft Driving			Spline	
Propeller Rotation Direction			Clockwise at forward (F) shift as viewed from rear	
Propeller (Standard)		Marking	13P	14P

Bracket

No. of Trim Steps		Steps	4	
Trim Angle (Transom 12)	*2	Degrees	–4° to +16°	
Shallow Water Drive Angle (Transom 12)	*2	Degrees	Adjustable	
Max. Tilt Angle	*3	Degrees	62	56
Steering Angle	*4	Degrees	35+35	
Max. Allowable Transom Thickness		mm (in)	31 to 70 (1.22 to 2.76)	

*1 Both API and SAE requirements shall be met.
*2 Angle relative to horizon when transom angle is 12 degrees.
*3 Tilting Range
*4 Full Steering Angle Range to Starboard and Port

Item	Unit	Model		
		MFS40A		MFS50A
		ET (with Remote Control)	ET (with Multi Tiller Handle)	EG (with Multi Tiller Handle)

Warning System

Over-revolution Protection			Controls engine speed to approximately 6,200 r/min or less (High Speed ESG). Warning buzzer sounds.
Engine Hydraulic Pressure Low	*1		Controls engine speed to approximately 2,800 r/min or less (Low Speed ESG). Warning buzzer sounds, and warning lamp A is lit.
Engine Cooling Water Temperature High.			Controls engine speed to approximately 2,800 r/min or less (Low Speed ESG). Warning buzzer sounds, and warning lamp B is blink.
Engine Cooling Water Temperature Abnormally High.			Controls engine speed to approximately 850 r/min (force Idling Speed). Warning buzzer sounds, and all warning lamps are blink.
Each Engine Sensor Malfunction	*1		Controls engine speed to approximately 2,800 r/min or lmore (Low Speed ESG). All warning lamps are blink.
Warning System Operation Check			Warning buzzers sounds for 1 second and lamp is lit for 1 second.

*1 Stop engine to cancel warning system operation.

6. Maintenance Data

	Parts Name	Item	Standard Value
Engine Parts	**Cylinder Head**	Build up of carbon in combustion chamber	
		Measure the cam journal clearance	42.000 to 42.025 mm (1.65354 to 1.65453 in)
		Distortion or damage on mating surface	Distorsion Limit : 0.05 mm (0.0020 in) or less
		Corrosion on the mating surface	
		Cooling water passage clogged	
	Cylinder	Deposition in water jacket	
		Wear of bore : Use cylinder gauge to measure inner diameter.	70.00 mm (2.7559 in)
		Seizure, cylinder liner damage, or wear Taper Out-of-roundness	
		Distortion or damage on cylinder head mating surface	Distorsion Limit : 0.05 mm (0.0020 in) or less
		Engine Anode	
	Piston	Outer Diameter Measure outer diameter at 12 mm (0.47 in) above lower end of piston skirt (at right angle to piston pin).	69.97 mm (2.7547 in)
		• Piston Clearance	0.020 to 0.055 mm (0.00079 to 0.00217 in)
		Carbon build up on piston crown and in ring grooves	
		Scratch on the sliding surface	
		Measure side clearance between piston ring and ring groove.	Top Ring : 0.04 to 0.08 mm (0.0016 to 0.0031 in)
			Second Ring : 0.04 to 0.08 mm (0.0016 to 0.0031 in)
			Oil Ring : 0.03 to 0.13 mm (0.0012 to 0.0051 in)
		Measure piston pin hole diameter.	17.005 mm (0.66949 in)
		Clearance between piston pin and pin hole	0.002 to 0.012 mm (0.00008 to 0.00047 in)
	Piston Pin	Outer Diameter	17.000 mm (0.66929 in)
	Piston Ring	Ring End Gap Note : Measurement of ring end gap : If ring gauge is not available, use cylinder bore top or bottom with small wear.	Ring Gage 70.000 mm (2.75591 in)
		Top Ring	Top Ring : 0.20 to 0.35 mm (0.0079 to 0.0138 in)
		Second Ring	Second Ring : 0.35 to 0.50 mm (0.0138 to 0.0197 in)
		Oil Ring	Oil Ring : 0.20 to 0.70 mm (0.0079 to 0.0276 in)
	Connecting Rod	Small End Inner Diameter	17.012 mm (0.66976 in)
		Big End Oil Clearance	0.020 to 0.045 mm (0.00079 to 0.00177 in)
		Big End Side Clearance	0.10 to 0.20 mm (0.0039 to 0.0079 in)
	Crankshaft	Crankshaft runout : Use V blocks to support crankshaft at journals of both ends.	Less than 0.05mm (0.0020in) at both ends and at the center.
		Crank pin outer diameter	37.99 mm (1.4957 in)
		Main journal outer diameter	39.99 mm (1.5744 in)
		Metal bearing oil clearance	0.020 to 0.041 mm (0.0008 to 0.0016 in)
		Crankshaft side clearance	0.05 to 0.15 mm (0.0020 to 0.0059 in)

Functional Limit	Action To Be taken
	Clean to remove.
42.050 mm (1.65551 in)	Replace if more than specified limit.
0.1 mm (0.004 in)	Correct. (Use water proof sand paper of #240 to 400 on the surface plate to level. Use #600 to finish.)
	Correct if possible, or replace.
	Clean to remove.
	Clean to remove.
70.06 mm (2.7583 in)	Replace if more than specified limit.
0.08 mm (0.0031 in) 0.06 mm (0.0024 in)	Replace if severely damaged on the piston sliding surface, which cannot be repaired with sand paper of No. 400 to 600, or damaged over specified limit.
0.1 mm (0.004 in)	Correct. (Use water proof sand paper of #240 to 400 on the surface plate to level. Use #600 to finish.)
	Replace if severely consumed.
69.90 mm (2.7520 in)	Replace if less than specified limit.
0.150 mm (0.00591 in)	Replace if more than specified limit.
	Clean to remove.
	Correct if possible (with #400 to 600 water proof sand paper), or replace.
Top Ring : 0.10 mm (0.0039 in)	Replace if more than specified limit. Replace oil ring when top ring or second ring is replaced.
Second Ring : 0.10 mm (0.0039 in)	
Oil Ring : 0.15 mm (0.0059 in)	
17.012 mm (0.66976 in)	Replace if more than specified limit.
0.040 mm (0.00157 in)	
16.970 mm (0.66811 in)	Replace if less than specified limit.
Top Ring : 0.55 mm (0.0217 in)	Replace if the gap is over specified limit only if cylinder inner wear is less than specified limit. Replace oil ring when top ring or second ring is replaced.
Second Ring : 0.70 mm (0.0276 in)	
Oil Ring : 1.00 mm (0.0394 in)	
17.040 mm (0.6709 in)	Replace if more than specified limit.
0.060 mm (0.00236 in)	Replace if more than specified limit.
0.30 mm (0.0118 in)	Replace if more than specified limit.
0.05 mm (0.0020 in)	Replace if more than specified limit.
37.97 mm (1.4949 in)	Replace if less than specified limit.
39.97 mm (1.5736 in)	Replace if less than specified limit.
0.060 mm (0.00236 in)	Replace if more than specified limit.
0.50 mm (0.0197 in)	Replace if more than specified limit.

	Parts Name	Item		Standard Value
Engine Parts	**Intake Valve**	Valve Clearance	IN	0.15 to 0.25 mm (0.006 to 0.010 in)
	Exhaust Valve		EX	0.25 to 0.35 mm (0.010 to 0.014 in)
		Valve Stem Outer Diameter	IN	5.48 mm (0.2157 in)
			EX	5.46 mm (0.2150 in)
		Valve Guide Inner Diameter	IN	5.51 mm (0.2169 in)
			EX	5.51 mm (0.2169 in)
		Clearance between valve guide	IN	0.008 to 0.040 mm (0.00031 to 0.00157 in)
		and valve stem	EX	0.025 to 0.057 mm (0.00098 to 0.00224 in)
		Width of contact with valve seat	IN	1.4 mm (0.06 in)
			EX	1.4 mm (0.06 in)
	Valve Spring	Free Length		38.7 mm (1.52 in)
	Cam Shaft	Cam Height (Both IN and EX)		IN : 35.78 mm (1.4087 in) EX : 35.81 mm (1.4098 in)
		Journal Outer Diameter		Pulley Side : 41.92 mm (1.6504 in) Oil Pump Side : 41.95 mm (1.6516 in)
		Clearance between cam shaft and holder (journal area)		#1: 0.075 to 0.110 mm (0.00295 to 0.00433 in) #2/3/4: 0.045 to 0.080 mm (0.00177 to 0.00315 in)
	Rocker Arm & Shaft	Rocker Arm Inner Diameter		16.01 mm (0.6303 in)
		Shaft Outer Diameter		15.99 mm (0.6295 in)
		Shaft Clearance		0.006 to 0.035 mm (0.00024 to 0.00138 in)
	Timing Belt	External Appearance		
	Engine Block	Compression Pressure (Reference) at 600 to 700r/min		1.4 MPa (203 PSI) [14.3 kgf/cm^2] ± 10%
Fuel and Lubrication Parts	**Fuel Regulator**	Fuel Pressure		Atmospheric Pressure + 0.29 MPa (43 psi) [3.0 kg/cm^2] ± 10%
	Vapor Separator	Seal Ring Wear and Damage		
		Float Height		Float Height : 44 to 50 mm (1.732 to 1.969 in)
		Float Valve		Float Drop (Reference) : 30.0 mm (1.181 in)
	Oil Pump	Pump Body Inner Diameter		–
		Clearance between Outer Rotor and Body		–
		Height of Outer Rotor		–
		Clearance between sides of rotor and body		–
		Clearance between outer and inner rotors		–

Functional Limit	Action To Be taken
	Adjust into specified range.
5.46 mm (0.2150 in) 5.44 mm (0.2142 in)	Replace if less than specified limit.
5.55 mm (0.2185 in) 5.57 mm (0.2193 in)	Replace if more than specified limit.
0.070 mm (0.00276 in) 0.100 mm (0.00394 in)	Replace if more than specified limit.
2.0 mm (0.08 in) 2.0 mm (0.08 in)	Replace if more than specified limit.
37.1 mm (1.46 in)	Replace if less than specified limit.
IN : 35.40 mm (1.3937 in) EX : 35.45 mm (1.3957 in)	Replace if less than specified limit.
Pulley Side : 41.89 mm (1.6492 in) Oil Pump Side : 41.92 mm (1.6504 in)	Replace if less than specified limit.
#1: 0.0150 mm (0.0059 in) #2/3/4: 0.120 mm (0.0047 in)	Replace if more than specified limit.
16.05 mm (0.6319 in)	Replace if more than specified limit.
15.94 mm (0.6276 in)	Replace if less than specified limit.
0.090 mm (0.00354 in)	Replace if more than specified limit.
Wear, Damage, Elongation	Replace if necessary.
	Check if rotating parts, sliding parts and sealing parts cause compression leakage.
	Replace if out of specified range.
Wear, Damage, Deterioration Due To Gasoline	Replace if necessary.
	Replace if out of specified range.
Wear, Deterioration, Damage	Replace if necessary.
40.8 mm (1.606 in)	Replace if more than specified limit.
0.25 mm (0.0098 in)	Replace if more than specified limit.
14.96 mm (0.5890 in)	Replace if less than specified limit.
0.11 mm (0.0043 in) (Including oil pump cover wear)	Replace if more than specified limit.
0.16 mm (0.0063 in)	Replace if more than specified limit.

	Parts Name	Item		Standard Value
Electric Parts	**Magneto**	Ignition Timing	(at 850 r/min)	BTDC 2°±5°
		Spark Performance	(at 500 r/min)	10mm (0.4in) or over
		(Use genuine spark tester.)		
		Alternator Output	(at 4,000 r/min)	12 V 252 W
		Alternator Resistance	Between Yellow and Yellow (at 20°C)	0.28 to 0.42Ω
	Crank Position Sensor (CPS, Pulser Coil)	Resistance Between Terminals	Between Red/White and Black (at 20°C)	148 to 222Ω
		Encoder Ring (Flywheel) Clearance		0.7 to 0.9 mm (0.028 to 0.035 in)
	Ignition Coil	Primary Coil Resistance	Between Black/White and Black (at 20°C)	3.82 to 5.18Ω
		Secondary Coil Resistance	(Between High Tension Cable and Black) (at 20°C)	15.6 to 23.4 kΩ
		[KΩRange]	Between Plug Cap and Black	19.4 to 29.6 kΩ
	Plug Cap	Resistance Between Terminals [kΩRange]		3.0 to 7.0 kΩ
	Spark Plugs	Plug Type		DCPR6E (NGK)
		Spark Gap		0.8 to 0.9 mm (0.032 to 0.035 in)
	Fuel Injector	Resistance Between Terminals		11.40 to 12.66Ω
	Throttle Position Sensor	Resistance Between Terminals[kΩRange]	Between Blue and Black	Less than 5 kΩ
	ISC Valve	Resistance Between Terminals		27 to 33Ω "Refer to 8-24 page"
	MAT (Manifold Temperature) Sensor	Resistance Between Terminals[kΩRange]	(at 25°C)	1.8 to 2.2 kΩ
	Engine Temperature Sensor	Resistance Between Terminals[kΩRange]	(at 5°C)	4.24 to 4.86 kΩ
			(at 25°C)	1.90 to 2.10 kΩ
			(at 100°C)	0.166 to 0.204 kΩ
	Rectifier	Resistance Between Terminals		"Refer to 8-34 page"
	Starter Motor	Battery		12 V-100 AH to 12 V-120 AH
		Output		12 V 1.4 kW
		Clutch		Overrunning Clutch
		Brush Length		16.0 mm (0.63 in)
		Commutator Undercut		0.5 to 0.8 mm (0.020 to 0.032 in)
		Commutator Outer Diameter		29.0 mm (1.142 in)
	Fuse	Capacity		20 A x 2, 30 A x 1

Functional Limit	Action To Be taken
10 mm (0.4 in)	Replace if less than specified value.
	Replace if out of specified range.
	Replace if out of specified range. Adjust to specified range.
	Replace if out of specified range.
	Replace if out of specified range.
	Clean to remove carbon build up and dirt. Adjust with side electrode. Replace if electrodes are severely worn.
1.2 mm (0.047 in)	
	Replace if out of specified range.
	Replace throttle body ass'y if out of specified range.
	Replace if out of specified range.
	Replace if out of specified range.
	Replace if out of specified range.
	Replace if out of specified range.
12.0 mm (0.472 in)	Replace if less than specified value.
0.2 mm (0.008 in)	Replace if less than specified value.
28.0 mm (1.102 in)	Replace if less than specified value.
Burn out	

	Parts Name	Item		Standard Value
Coolong 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)		3.0 mm (0.12 in) or more
	Pump Impeller	Wear, Crack		
	Pump Case (Liner)	Wear		
	Guide Plate	Wear		
Lower Unit Parts	**Anode**	Gear Case Anode Consumption		
	Clutch Spring	Free Length		66 to 70 mm mm (2.60 to 2.76 in)
	Propeller Shaft	Bearing Wear and Damage		
		Oil Seal Wear		
		Propeller Shaft Runout		
	Bevel Gears	Pinion Gear (B Gear) Height		0.60 to 0.64 mm (0.0236 to 0.0252 in)
		Backrush between forward gear and pinion (A and B gears) "Refer to Chapter 6."		0.31 to 0.62 mm (0.0122 to 0.0244 in)
		Reverse Gear (C Gear) Washer Thickness		3.0 mm (0.118 in)
	Propeller	Wear, Bend, Crack, Break		
	Drive Shaft	Spline (Upper) Base Tangent Length, 3 Gears		7.9 mm (0.311 in)
		Bearing Damage		
		Oil Seal Wear and Damage		
		Drive Shaft Runout		
Power Tilt Parts	**Oil Pump**	Type		Gear Pump
		Oil Capacity		325 cm^3 (11.0 fl.oz.)
		Recommended Oil		ATF (DEXRON III)
	PTT Motor	Voltage		DC 12V
		Continuous Run		60 seconds or less
		Output		250 W
		Direction of Revolution		Forward, Reverse
		Circuit Breaker	Type	Bimetal
			ON/Reset Time	40 sec or more (36 A)/30 sec or less [25°C (77°F)]
		Brush Length		9.75 mm (0.384 in)
		Commutator	Outer Diameter	22.0 mm (0.866 in)
			Depth of Undercut	1.8 mm (0.071 in)
	Tilt Cylinder	Piston Diameter		32.0 mm (1.260 in)
		Tilt Rod Diameter		16.0 mm (0.630 in)
		Stroke		101.0 mm (3.976 in)
	PTT Switch			Paddle Rocker Switch (3A)
				Toggle Switch (20A)
Other Parts	**Oil Seals**	Damage, Wear		

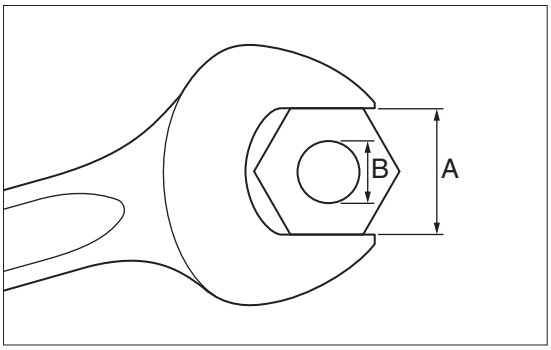
Functional Limit	Action To Be taken
Any opening under ambient temperature	Replace if out of specified range.
75°C (167°F) because thermostat operation is delayed. Measure valve open lift after 5 minutes.	
3.0 mm (0.12 in)	Replace if less than specified limit.
Wear, crack or damage on tips and upper and lower surface lips	Replace pump case liner and guide plate as a set.
	Replace if severely worn
	Replace if severely worn
	Replace if severely worn
	Replace if necessary.
0.4 mm (0.015 in)	Replace if more thanspecified limit.
0.05 mm (0.0020 in)	Replace if more thanspecified limit.
0.60 to 0.64 mm (0.0236 to 0.0252 in)	Adjust, or replace.
	Adjust, or replace.
2.85 mm (0.112 in)	Replace if less than specified limit.
Severe Damage	Replace if out of specified range
7.5 mm (0.295 in)	Replace if less than specified limit.
	Replace if necessary.
0.4 mm (0.015 in)	Replace if necessary.
0.5 mm (0.020 in)	Replace if more thanspecified limit.
5.0 mm (0.236 in)	Replace if less than specified limit.
20.4 mm (0.803 in)	Replace if less than specified limit.
1.0 mm (0.039 in)	Replace if less than specified limit.
Lip deteriorated, degraded or damaged, or tightening margin reduced to 0.5mm (0.020in) due to wear	Replace if out of specified range.

7. Tightening Torque Data

	Fastened Components	Wrench A	Screw B x Pitch	Type of Fastener	Tightening Torque N•m		
					N•m	lb•ft	kg•m
Engine	Cylinder Head (Cylinder Block and Cylinder Head)	14	M10 x 1.25	Bolt	① First Tightening Torque :		
					30	22	3
					② Final Tightening Torque :		
					60	44	6
		12	M8 x 1.25	Bolt	① First Tightening Torque :		
					15	11	1.5
					② Final Tightening Torque :		
					30	22	3
	Spark Plug	16	M12 x 1.25	Special	18	13	1.8
	Tappet Lock Nut	10	M6 x 0.75	Nut	7	5	0.7
	Locker Shaft	12	M8 x 1.25	Bolt	18	13	1.8
	Thrust Bolt	10	M6 x 1.0	Bolt	9	7	0.9
	Anode Plug	10	M16 x 1.5	Special	18	13	1.8
	Anode	—	M5 x 0.8	Screw	2	1.4	0.2
	Oil Filter	—	M20 x 1.5	Special	30	22	3
	Oil Pump	10	M6 x 1.0	Bolt	8	6	0.8
	Oil Filter	—	M20 x 1.5	Special	Tighten to 3/4 turn fom tempolary (270º)		
					18	13	1.8
	Crankcase (Cylinder Block to Crankcase)	12	M8 x 1.25	Bolt	① First Tightening Torque :		
					12	9	1.2
					② Final Tightening Torque :		
					24	18	2.4
		10	M6 x 1.0	Bolt	① First Tightening Torque :		
					6	4.5	0.6
					② Final Tightening Torque :		
					11.5	8.5	1.15
	Connecting Rod	10	M8 x 0.75	Bolt	① First Tightening Torque :		
					15	11	1.5
					② Final Tightening Torque :		
					30	22	3
	Flywheel	30	M20 x 1.25	Bolt	150	110	15
	Timing Pully	50	M39 x 1.5	Bolt	120	88	12
	Cam Shaft Pully	17	M10 x 1.25	Bolt	27	20	2.7
	Oil Pressure Switch	—	PT1/8	Special	8	6	0.8
	Power Unit	13	M8 x 1.25	Bolt	① First Tightening Torque :		
					15	11	1.5
					② Final Tightening Torque :		
					30	22	3
Clamp Blacket		24	7/8-14UNF-2A	Nylon Nut	24	18	2.4
PTT	Manual Valve	—	M12	Special	1.8	1.4	0.18
Drive Shaft Housing	Engine Base Rubber Mount Upper (Center only)	13	M8 x 1.25	Bolt	① First Tightening Torque :		
					15	11	1.5
					② Final Tightening Torque :		
					30	22	3
	Engine Base Main Body (Exhoust passage side)	13	M8 x 1.25	Bolt	① First Tightening Torque :		
					15	11	1.5
					② Final Tightening Torque :		
					30	22	3
	Engine Base Main Body (Rear 2 part)	13	M8 x 1.25	Bolt	① First Tightening Torque :		
					15	11	1.5
					② Final Tightening Torque :		
					30	22	3
	Oil Drain	16	M14 x 1.5	Bolt	24	18	2.4
	Rubber Mount (Upper)	14	M10 x 1.25	Bolt, Nut	27	20	2.7
	Rubber Mount (Lower)	17	M12 x 1.25	–––	40	29	4
Gear Case	Pinion Gear (B Gear)	17	M12 x 1.0	Nut	50	37	5
	Propeller	21	M16 x 1.5	Nut	35	26	3.5

	Fastened Components	Wrench A	Screw B x Pitch	Type of Fastener	Tightening Torque N•m		
					N•m	lb•ft	kg•m
Top Cowl	Tilt Handle	10	M6 x 1.0	Nylon Nut	2	1.4	0.2

	Fastened Components	Wrench A	Screw B x Pitch	Type of Fastener	Tightening Torque N•m		
					N•m	lb•ft	kg•m
Standard Tightening Torque	M4	—	M4 x 0.7	Bolt, Nut	1.5	1.1	0.15
	M5	—	M5 x 0.8	Bolt, Nut	3	2.2	0.3
	M6	—	M6 x 1.0	Bolt, Nut	6	5	0.6
	M8	—	M8 x 1.25	Bolt, Nut	13	10	1.3
	M10	—	M10 x 1.25	Bolt, Nut	27	20	2.7
	M4	—	M4 x 0.7	Screw	1.5	1.1	0.15
	M5	—	M5 x 0.8	Screw	2.5	1.8	0.25
	M6	—	M6 x 1.0	Screw	3.5	2.5	0.35
	M8	—	M8 x 1.25	Screw	4.5	3.3	0.5



8. Sealant Application Locations

Part Name		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Anti-leakage, Anti-rust screw locking agent	Sealing Agent		Instantaneous Adhesive	Bond	Low Temperature Resistant Lithium Grease	OBM Grease	Tefron Grease	Silicon Grease	Molybudenium Grease	4 Stroke Engine Oil	Gear Oil	PTT Fluid	Remarks
		L it	Thr B nd				L it	Thr B nd	Thr B nd	K nishi	Tyu h Yuka			Shinetsu	Sunik				
		263 (271)	1342	1327	1373 B	1401	51	1207 B	1741 (7782)	G17	S n ax L2	FM-531	LM-902	KS-64	M ry past 500			ATF	
Engine Block	Camshaft															●			Cam head
																●			Bearing
	Oil Seal (Cam Shaft)										●								Lip
																●			Outer surface, press fit
	Thrust Bolt															●			Thread
	Camshaft Pully Bolt		●																Thread
	Rocker Arm															●			Bearing, slipper face
	Rocker Arm Shaft															●			Outer face
	Rocker Arm Spring															●			Entire Surface
	Washer (Rocker arm)															●			Entire Surface
	Valve (INT, EX)															●			Shaft, stem head
	Valve Spring															●			Entire Surface
	Valve Sparing Seat															●			Entire Surface
	Retainer • Cotter															●			Entire Surface
	Valve Stem Seal (INT, EX)															●			Lip and inside
	Tappet Adjusting Screw															●			Entire Surface
	Oil Pump															●			Approx. 2 cm^3 from intake port
	Fuel Pump															●			Plunger tip
	O-Ring (Fuel Pump)															●			Outer face
	O-Ring (Anode Plug)											●							O-ring
	Head Bolt															●			Thread
	O-Ring (Filler Cap)															●			Outer face
	Breather Chamber							●											Rib upper
	Screw (Breather Chamber Cover)	●																	Thread
	Cylinder Liner															●			Inner wall
	Piston															●			Ring grooves, outer face
	Piston Ring															●			Entire Surface
	Piston Pin															●			Outer face
	Connecting Rod															●			Small ends inside
	Connecting Rod Metal Bearing															●			Only for bearing, remove grease of out side.
	Crankshaft															●			Sliding face, thrust face
	Crankshaft Metal Bearing															●			Only for bearing, remove grease of out side.
	Oil Seal (Crankshaft Upper, Lower)										●								Lip
	Cylinder Block, Crankcase Mating Surface						●												
	Bolt (Oil Filter)		●																Thread
	Oil Filter															●			Seal
	Plug Cap													●					Spark plug insertion area
										●									High tension cable

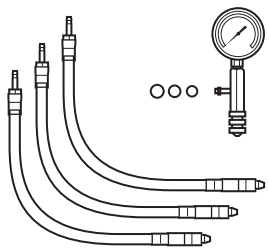
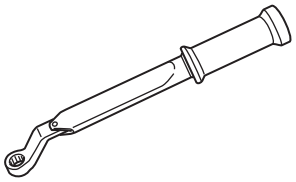
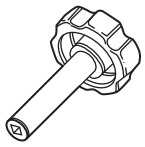
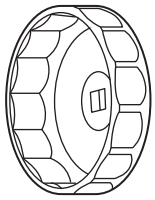
	Part Name	High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Anti-leakage, Anti-rust screw locking agent	Sealing Agent		Instantaneous Adhesive	Bond	Low Temperature Resistant Lithium Grease	OBM Grease	Tefron Grease	Silicon Grease	Molybudenium Grease	4 Stroke Engine Oil	Gear Oil	PTT Fluid	Remarks
			Thread Bond				Lit	Thread Bond	Thread Bond	Knishi	Tyuh Yuka			Shinetsu	Sunk				
		263 (271)	1342	1327	1373B	1401	51	1207B	1741 (7782)	G17	Sntax L2	FM-531	LM-902	KS-64	Mry past 500			ATF	
Engine Block	Oil Pressure Switch			●															Thread
														●					Terminals
	Starter Motor													●					Terminals
												●							Thin coat to pinion part
	Starter Motor													●					Terminals
Drive Shaft Housing	Oil Seal (Engine Base)												●						Lip and oil seal of drive shaft on applox. 3 g, when install.
																●			Outer surface, press fit
	Seal Rubber (Engine Base)								●										
	Bolt (Drain Cover)		●																Thread
	Bolt (Idle Exhaust Cover)		●																Thread
	Screw (Guide Plate of Oil Pan)		●																Thread
	Water Pipe Seal (Upper)											●							Outer face
	Auxiliary Water Pipe											●							Inner face
	Bolt (Engine)											●							Thread
	Stud (for UL)														●				Stud bolt thread
Lower Unit	Drive Shaft (Crank Side Spline)												●						Crankshaft side spline
	Nut (B Gear)				●														Thread
	Bolt (Gear Case)					●													Thread
	Bolt (Pump Case)		●																Thread
	Pump Case (Liner)											●							Impeller sliding aria
	O-Ring (Pump Case, Lower)											●							
	Oil Seal (Pump Case, Lower)										●								Lip
																	●		Outer surface, press fit
	Water Pipe Seal (Lower)											●							Inner face
	O-Ring (Cam Rod Bushing)											●							
	Bolt (Cam Rod Bushing)											●							Thread
	Taper Roller Bearing (Outer)																●		Outer surface, press fit
	Needle Bearing																●		Outer surface, press fit
	Needle Bearing																●		Outer surface, press fit
	Propeller Shaft (Propeller side spline)											●							Spline
	Clutch																●		Spline
	Push Rod																●		Entire Surface
	Ball																●		Entire Surface
	Retainer																●		Entire Surface
	Spring																●		Entire Surface
	O-Ring																●		
	Oil Seal										●								Lip
																	●		Outer surface, press fit

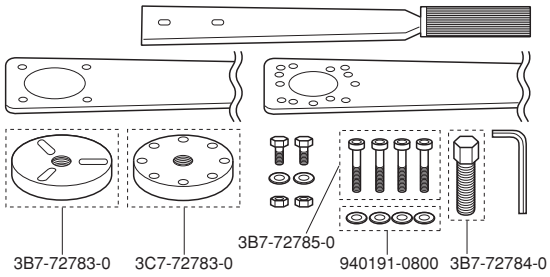
Part Name		High-strength screw locking agent	Low-strength screw locking agent	Middle-strength screw locking agent	High-strength screw locking agent	Anti-leakage, Anti-rust screw locking agent	Sealing Agent		Instantaneous Adhesive	Bond	Low Temperature Resistant Lithium Grease	OBM Grease	Tefron Grease	Silicon Grease	Molybudenium Grease	4 Stroke Engine Oil	Gear Oil	PTT Fluid	Remarks
		L it	Thr B nd				L it	Thr B nd	Thr B nd	K nishi	Tyu h Yuka			Shinetsu	Sunik				
		263 (271)	1342	1327	1373 B	1401	51	1207 B	1741 (7782)	G17	S n ax L2	FM-531	LM-902	KS-64	M ry past 500			ATF	
Lower Unit	Ball Bearing																●		Outer surface, press fit
	Needle bearing																●		Outer surface, press fit
	Bolt (Propeller Shaft Housing)		●																Thread
Swivel & Starn Blacket	Swivel Blacket (Steering Shaft)											●							Apply grease to inside
	Swivel Blacket (Blacket Bolt)											●							Apply grease
	Tilt Stopper Bush											●							Sliding face
	Tilt Stopper Grip									●									
	Tilt Stopper (Shaft)											●							Sliding face
	Mount Blacket											●							Spline
	O-Ring (Steering Blacket)											●							at assembly
	Co-Pilot Bolt											●							Stud bolt thread
	Nut 7/8 (Blacket Bolt)		●																Locking side nut
	Upper Mount Bolt Nut	●																	Thread, after remove grease
PTT Unit	Cylinder Pin Bush (Upper, Lower)											●							Sliding face
	PTT Fluid																	(●)	
	O-Ring																	(●)	
Bottom Cowl	Bush (Hook Lever)											●							Inside
	Seal Ring (Hook Lever)											●							Lip
	Bolt (Hook Lever)	●																	Thread
	Throttle Arm										●								Sliding face
	Throttle Cam										●								Sliding face
	Link Rod Ass'y										●								Jyoint
	Shift Arm										●								Sliding face
	Link Rod Ass'y										●								Sliding face
	Shift Lever Shaft										●								Sliding face, Shift rod insert part
Apron	Seal Rubber (Apron)								●										Adheasive part for apron and seal rubber.
														●					Thin coat to slot of bottom cowl (seal rubber outer)
Grease Nipples, Seal Plug			●																Press fit
Re Use Pre-coat Bolt			●																Thread

3

Maintenance

1. Special Tools

			
Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0	Valve Clearance Driver P/N. 3AC-99071-0	Oil Filter Wrench P/N. 3AC-99090-0
Measuring compression pressure	Adjusting valve clearance	Adjusting valve clearance	Removing/installing oil filter



Flywheel Puller Kit P/N. 3T1-72211-0
Removing/installing flywheel

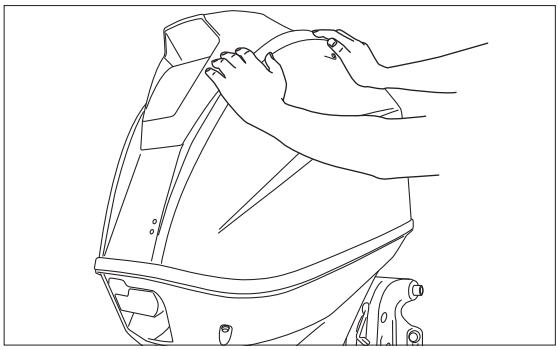
2. Inspection Schedule

	Description	Inspection intervals				Inspection procedure	Remarks
		First 20 hours of 1 month	Every 50 hours of 3 months	Every 100 hours of 6 months	Every 200 hours of 1 year		
Fuel Syste	Fuel filter	❍	❍			Check and clean or Replace if necessary.	
	Piping/Hoses	❍	❍			Check and clean or Replace if necessary.	
	Fuel tank	❍	❍			Clean	
Igni-tion	Spark plug	❍		❍		Remove carbon deposits or Replace if necessary.	0.8 to 0.9 mm (0.032 to 0.035 in)
Starting System	Starter motor			❍		Check for salt deposits and the battery cable condition.	
	Battery	❍	❍			Check installation, fluid quantity, gravity.	
Engine	Engine oil	Replace		Replace		Replace	Oil filter replaced : 2.4 L (2.5 US qt.) Oil filter not replaced : 2.2 L (2.3 US qt.)
	Oil filter	Replace			Replace	Replace every 200 hrs or 1 year.	Replace oil filter cartrige.
	Compression pressure				❍	Check every 200 hrs or 1 year.	
	Combustion chamber					Clean every 200 hrs or 2 years.	Include valve lapping if necessary.
	Valve clearance	❍		❍		Check and adjust	IN: 0.15 to 0.25 mm (0.0059 to 0.0098 in) OUT: 0.25 to 0.35 mm (0.0098 to 0.0138 in)
	Timing belt			❍		Check and Replace if necessary.	
	Thermostat			❍		Check and Replace if necessary.	
Lower Unit	Propeller	❍	❍			Check for bent blades, damage, wear.	
	Gear oil	Replace	❍	Replace		Change or replenish-oil and check for water leaks.	Hypoid gear oil (GL5, SAE#80-90) 500 ml
	Water pump		❍		Replace	Check for wear or damage. Replace every 1year.	
Power trim & tilt		❍		❍		Check & replenish oil, manually operate.	
Warning system			❍			Check function	
Bolts and Nuts		❍	❍			Retighten	
Sliding and Rotating Parts. Grease Nipples		❍	❍			Apply and pump in grease.	
Anode				❍		Check for corrosion and deformation.	Replace if necessary.
Control System	Shift cable/ Throttle cable		❍			Check for operation and damage.	

3. Inspection Items

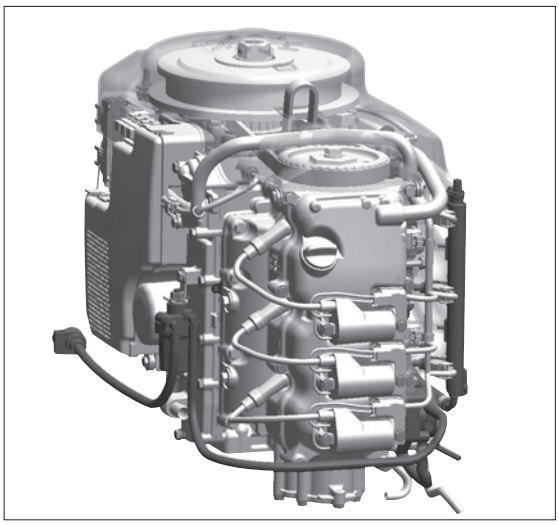
1) Inspection of Top Cowl

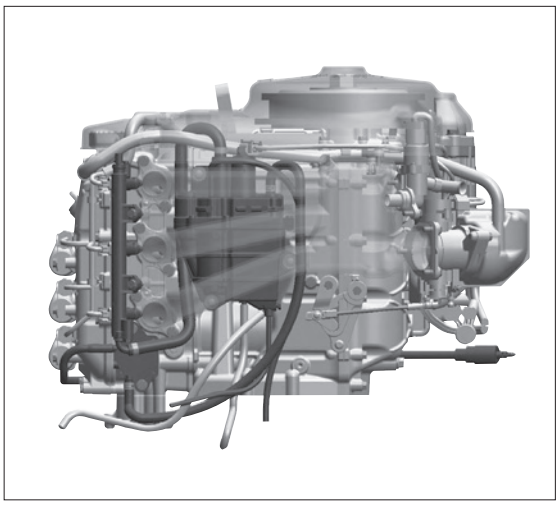
Push top cowl to check for looseness and state of closing.



2) Inspection of Fuel System Piping

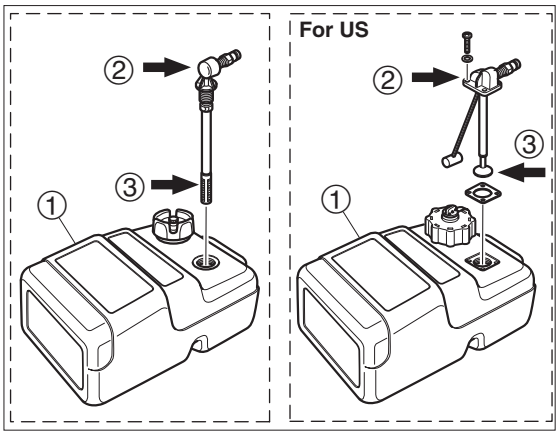
Check the fuel system piping for fuel leak, dirt, deterioration and damage, and replace or repair parts if necessary.





3) Inspection of Fuel Tank

Remove 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.



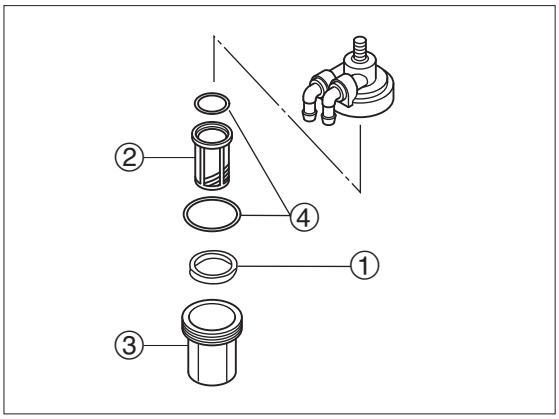
② Fuel Pick Up Elbow
③ Filter

4) Inspection of Fuel Filter

⚠ CAUTION

- **If red ring ① is floating, remove and empty filter cup.**
- **Be careful not to spill fuel during cup removal and dispose of properly.**

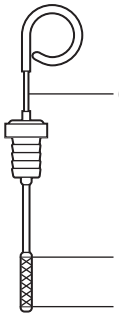
Check fuel filter ② for dirt, build up of fuel slag, and fuel filter cup ③ for invasion of foreign matters and crack. Clean fuel filter cup with gasoline, and replace fuel filter ② if necessary.



④ O Ring **Do not reuse.**

5) Replacement of Engine Oil

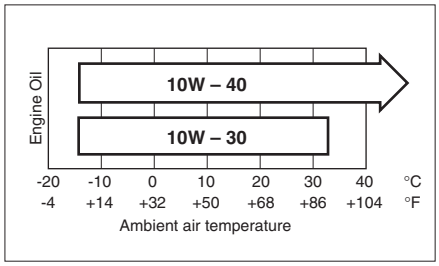
1. Oil Level



	Quantity of Oil for Full Replacement	
	When oil filter is replaced	When oil filter is not replaced
Upper Limit	2.4L (2.5 US qt.)	2.2L (2.3 US qt.)
Lower Limit	1.9L (2.0 US qt.)	1.7L (1.8 US qt.)

2. Oil Specification

Recommended Engine Oil :
4 Stroke Engine Oil
API : SH, SJ, SL
SAE : 10W-30, 10W-40
Quantity of Engine Oil :
When oil filter is replaced: 2.4L (2.5 US qt.)
When oil filter is not replaced: 2.2L (2.3 US qt.)

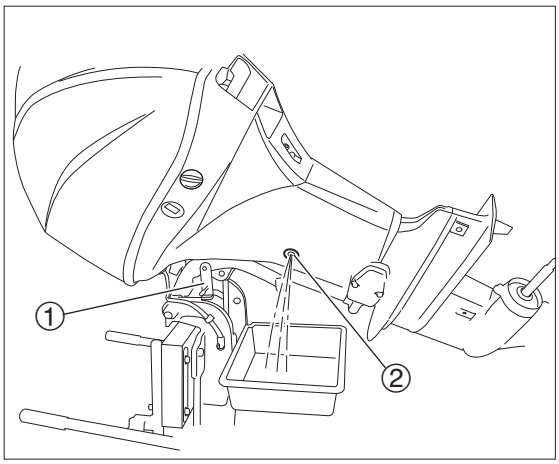


Use oil with viscosity that is suited to ambient air temperature of the operating region.

3. Oil Replacement Procedure

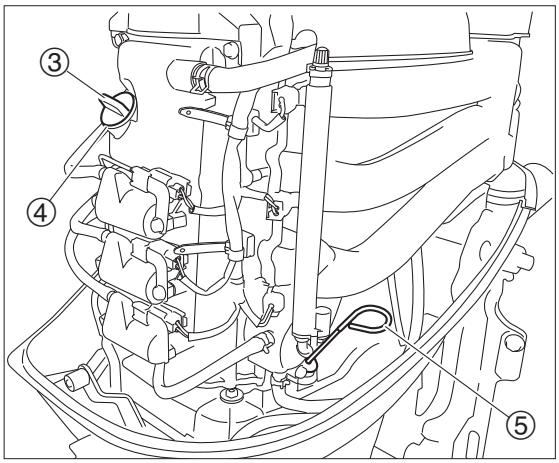
Use of engine containing dirt or water can significantly shorten the lives of rotating and sliding parts of engine.
Oil replacement procedure:

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.



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

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.



⚠ CAUTION
Do not overfill or running problems can occur.

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.

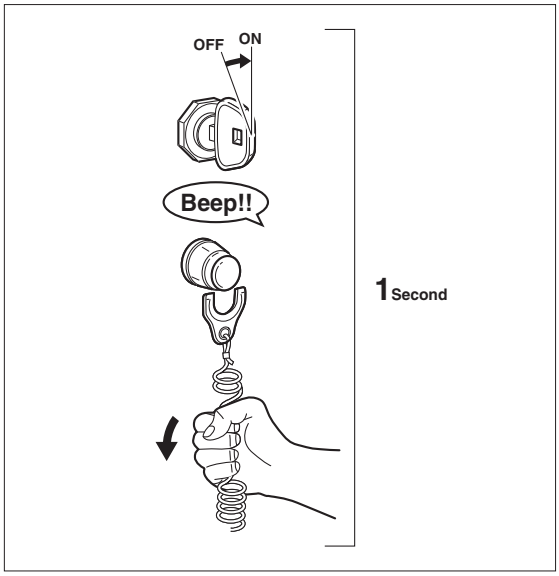
6) Engine oil replacement indicator function reset method

As for "Engine oil replacement indicator function", informing the appropriate timing of engine oil replacement by blinking of the lamp, when beyond 100 hours operating.

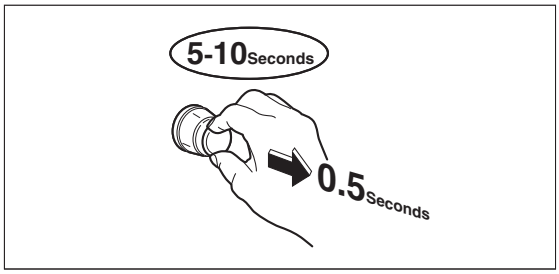
⚠ CAUTION

- **Replace engine oil first 20 hours and after 100 hours, or every 6 month at engine operation.**
- **Be sure to reset this function after engine oil replacement.**

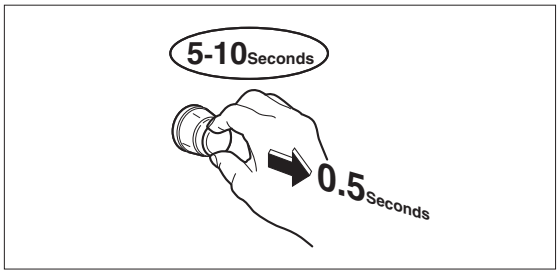
1. Be certain the safety lanyard is installed. Turn the key to the 'ON' position and with ib 1 second, pull the safety lanyard off.



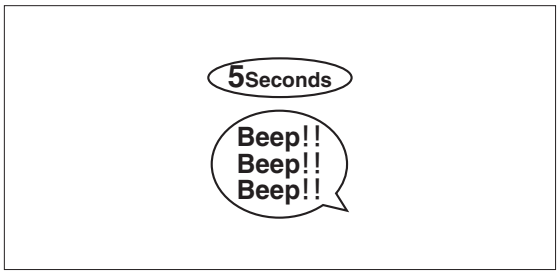
2. Within 5-10 seconds, Pull the red knob on the safety switch out and release.



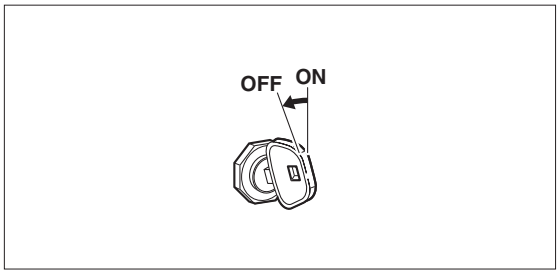
3. Wait 5-10 seconds and pull the red knob out and release.



4. Within 5-10 seconds you will here 3 beeps to inform you that you have successfully reset the system



5. Turn the ley to the 'OFF' position and replace the safety lanyard lock.

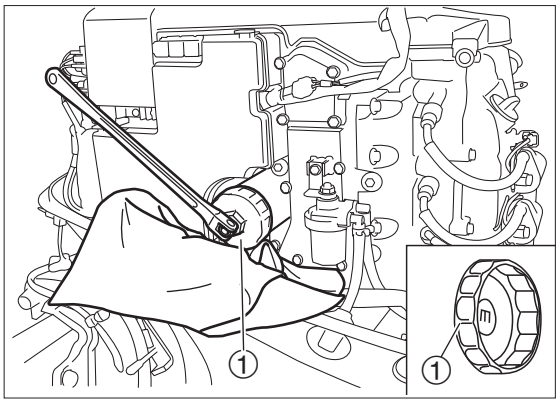


The engine oil replacement indicators function operates again after 100 hours operation from reset of this function.

7) Replacement of Oil Filter

1. Drain engine oil.

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

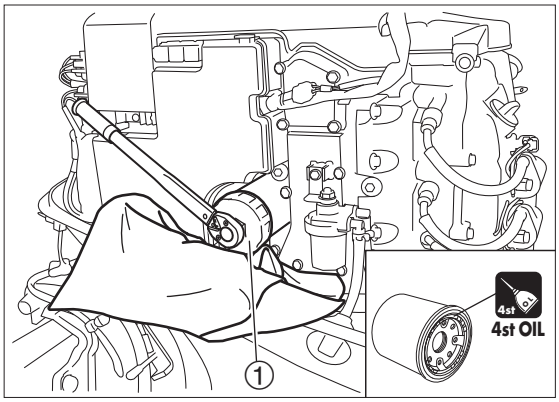


- Replace oil filter 5 minutes or more after stopping engine.
- Wipe off spilt oil completely.

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

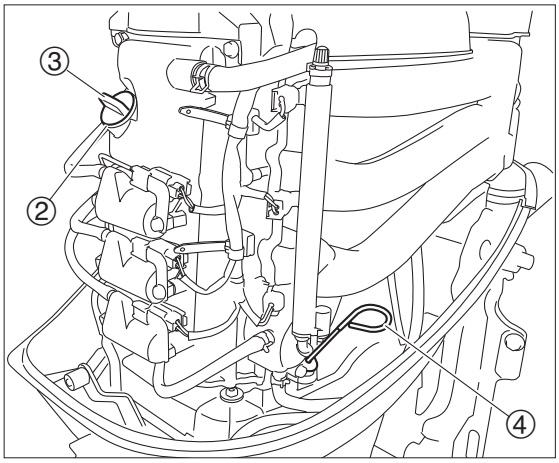
3. Apply thin coat of engine oil to O ring of filter before installing filter. Clean the cylinder at the location where the oil filter is installed.

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



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

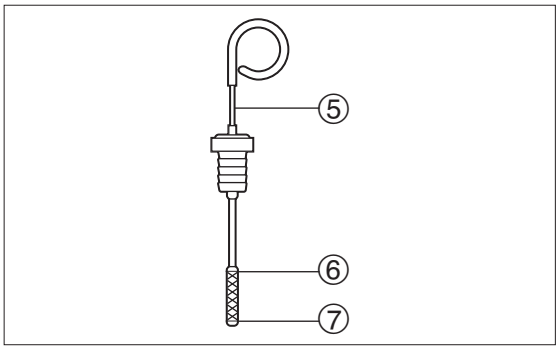
5. Pour engine oil into oil inlet ②.



Recommended Engine Oil :
4 Stroke Engine Oil
API : SH, SJ, SL
SAE : 10W-30, 10W-40
Quantity of Engine Oil :
When oil filter is replaced : 2.4L (2.5 US qt.)
When oil filter is not replaced: 2.2L (2.3 US qt.)

6. Attach oil filler cap ③ and oil level gauge ④, start and run engine for 5 minutes to warm up.

7. Stop engine and check oil level and oil leak after 5 minutes.



⑤ Oil Level Gauge ⑥ Upper Limit (MAX) ⑦ Lower Limit (MIN)

8) 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.

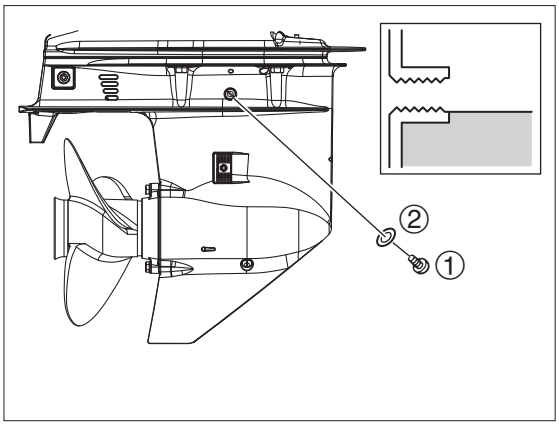
   Spill of some oil from plug hole as plug is removed indicates that gear case is filled with specified quantity of gear oil.

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

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

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

4. Attach upper oil plug ①.



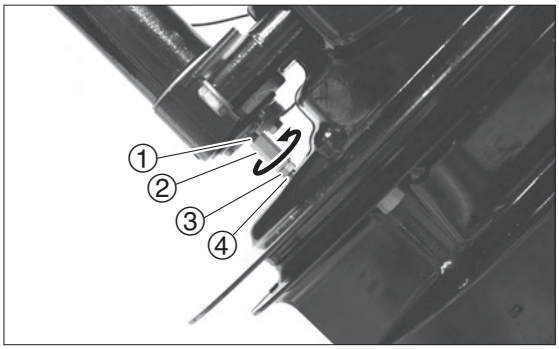
② Washer **Do not reuse.**

9) Inspection of Water Pump

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

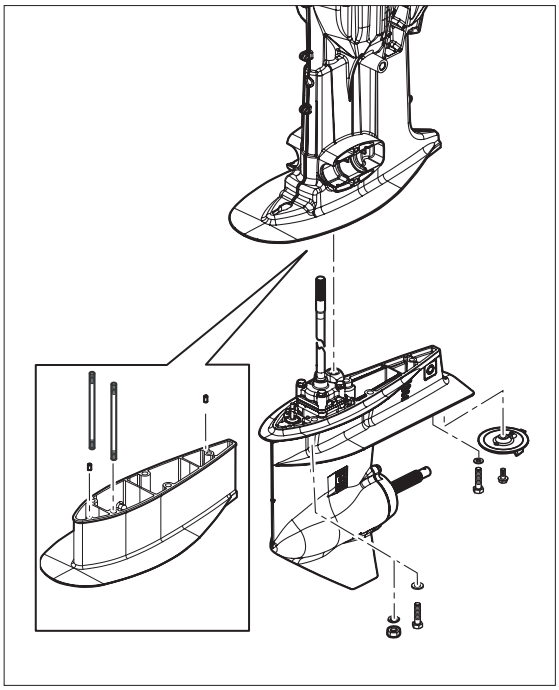
1. Set the shift lever to "Foward (F)" position to pull up shift rod.

2. Loosen nut ③, and then turn shift rod ② allow direction to disconnect shift rod ① and shift rod ④.



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

> Be sur to remove single bolt on back side of trim tab.



4. Remove pump upper case ①.

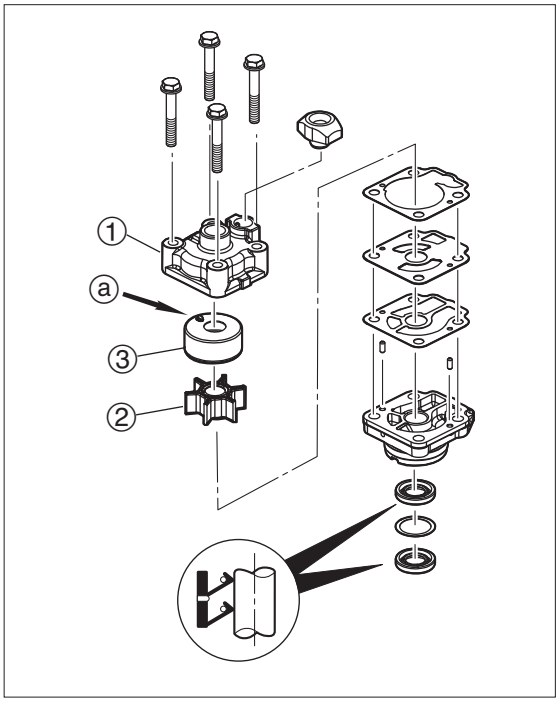
5. Remove impeller ② and check it.

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

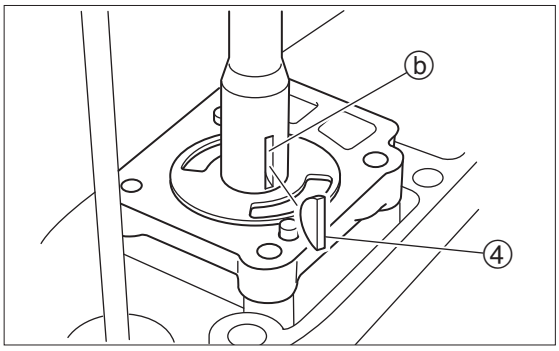
7. Check impeller ② and pump case liner ③ for crack and wear. Replace if necessary.

8. Check key ④ and drive shaft groove ⓑ for wear. Replace if necessary.

9. Reinstall the components removed. For details, refer to Chapter 6.



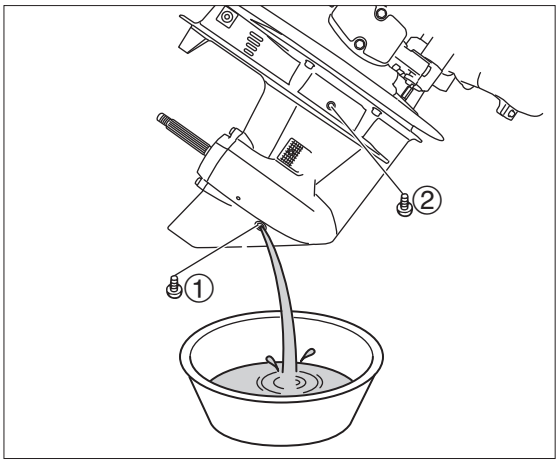
ⓐ Projection



10) Replacement of Gear Oil

1. Tilt outboard motor a little as shown.

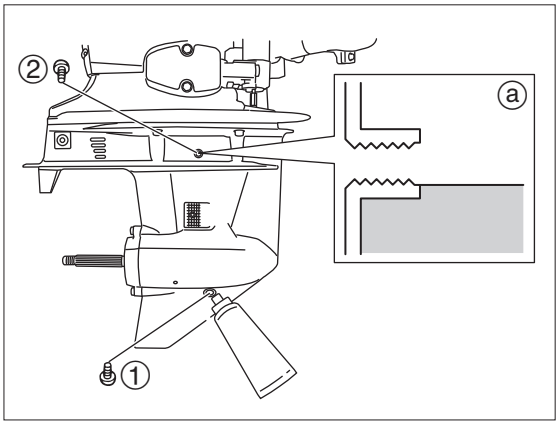
2. Place drain oil pan below drain bolt ①, remove lower oil plug ① and then upper oil plug ② to drain oil.



Remove lower oil plug first when draining.

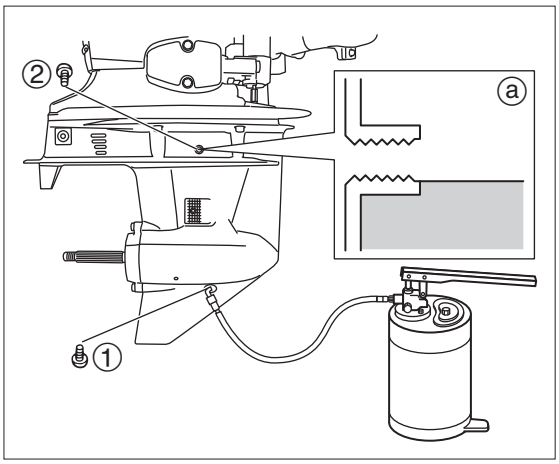
3. Check gear oil for presence of metal particles, change of color (abnormal if clouded), and viscosity. Check lower unit internal components if necessary.

4. Tilt down outboard motor to vertical position, and 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.



Recommended Gear Oil :
Hypoid Gear Oil
API : GL-5 SAE : #80 - 90
Quantity of Gear Oil :
500 cm^3 (16.9 fl.oz.)

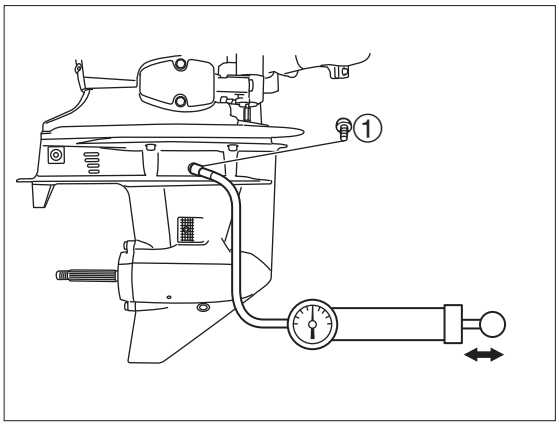
- Use lower plug hole when filling with gear oil. Upper hole cannot be used because doing so will not allow air to evacuate from gear case.
- Be sure to set outboard motor vertical position and fill specified quantity.



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.

11) 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/cm^2]

- 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

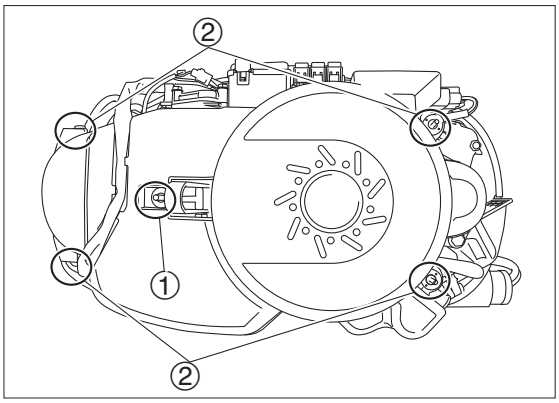
Do not apply pressure to gear case over specified value.
Doing so can cause damage to oil seal.

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

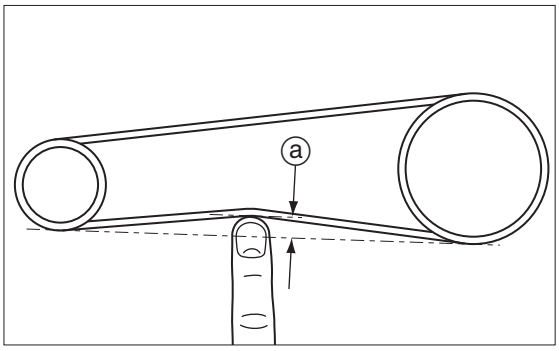
12) Inspection of timing belt

1. Remove flywheel cover, and then check timing belt inner and outer surfaces for crackes, damages and wear while roating flywheel clockwise with hands. Replace if necessary.

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



① Bolt ② Rubber Grommet

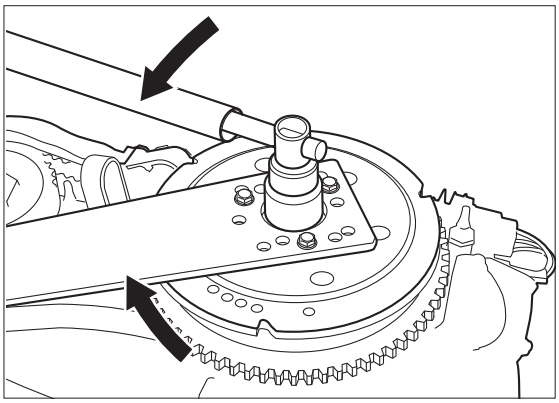


13) Replacement of timing belt

1. Remove flywheel cover.
2. Loosen flywheel nut.

Flywheel Puller Kit :
P/N. 3T1-72210-0

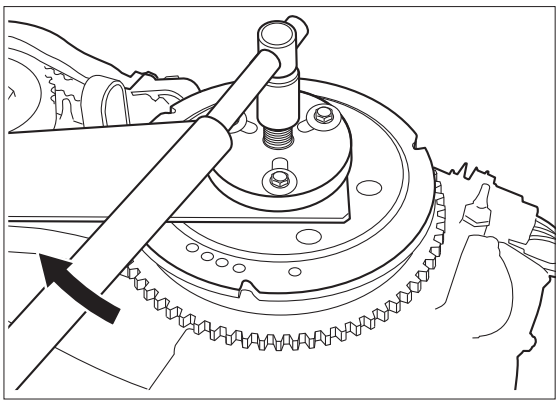
Remove flywheel nut and washer. Turn flywheel clockwise until the flywheel/crankshaft keyway faces rear cam pulley when it is lined up with "I" (#1 TDC) that is facing the triangle mark on the cylinder block.



3. Remove flywheel and key.

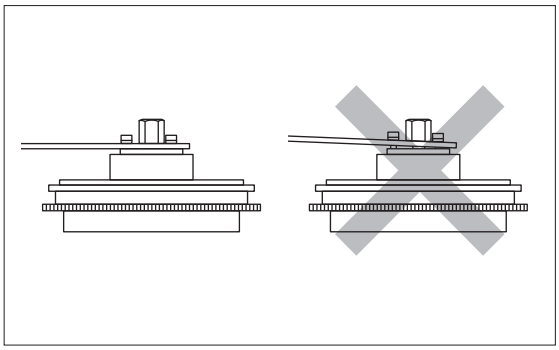
Flywheel Puller Kit :
P/N. 3T1-72210-0

Turn center bolt clockwise to remove flywheel.

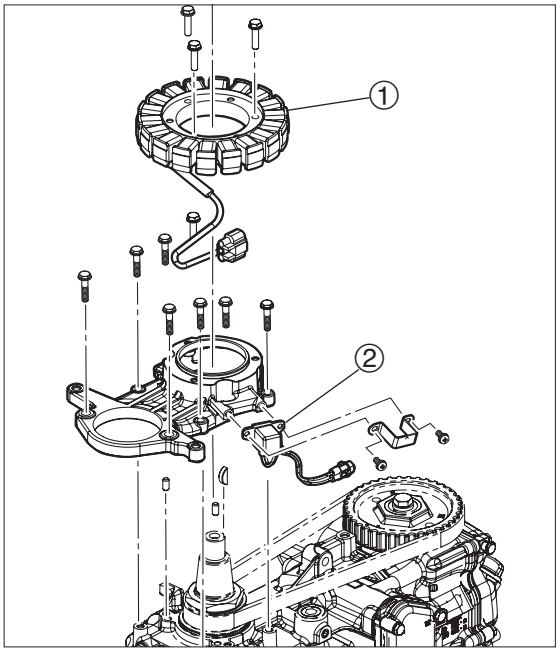


⚠ CAUTION

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

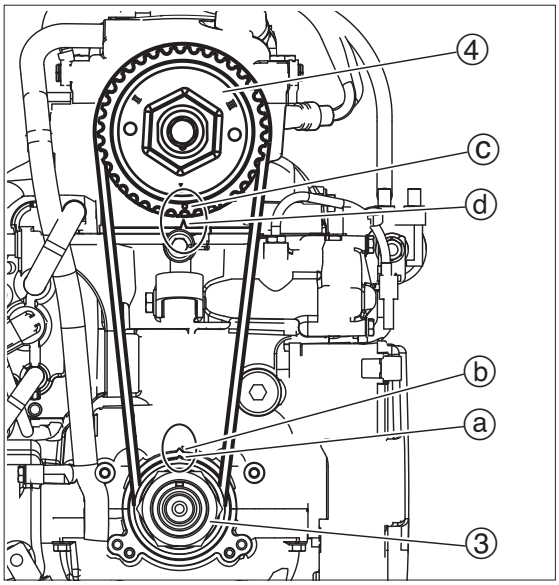


4. Disconnect alternator coupler ① and pulser coil coupler ②, and then remove alternator and coil bracket ass'y.

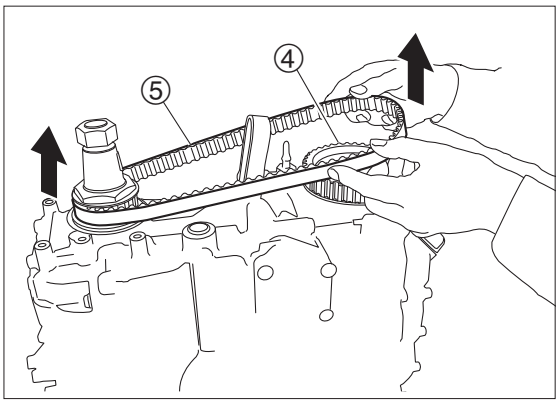


5. Turn timing pulley ③ clockwise to bring "▲" mark ⓐ of timing pulley to "▲" mark ⓑ of cylinder block, and check that "● I" mark ⓒ of cam shaft pulley ④ and "▲" mark ⓓ of cylinder head are aligned with each other.

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



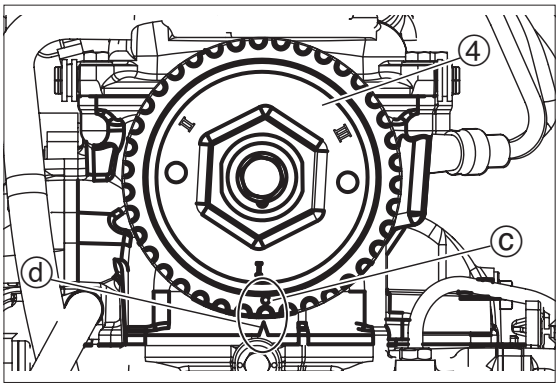
6. Remove timing belt ⑤ from cam shaft pulley ② side, and then, from timing pulley side.



⚠ CAUTION

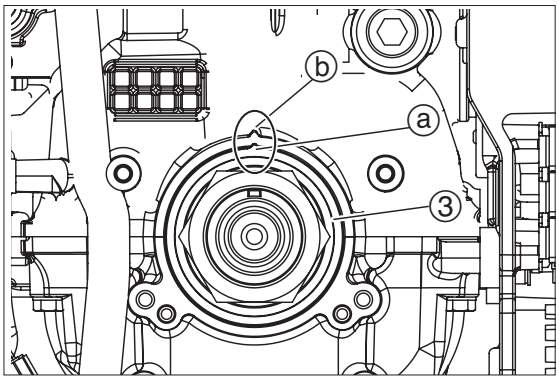
Do not turn timing pulley (crank shaft) or cam shaft pulley with timing belt removed. Doing so can make pistons and valves interfere with each other, resulting in damage to these parts.

7. Check that "● I" mark ⓒ of cam shaft pulley ④ and "▲" mark ⓓ of cylinder head are aligned

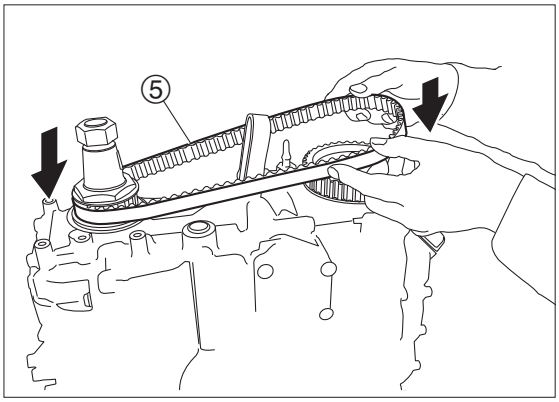


8. Check that "▲" mark ⓐ of timing pulley ③ and "▲" mark ⓑ of cylinder block are aligned with each other.

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



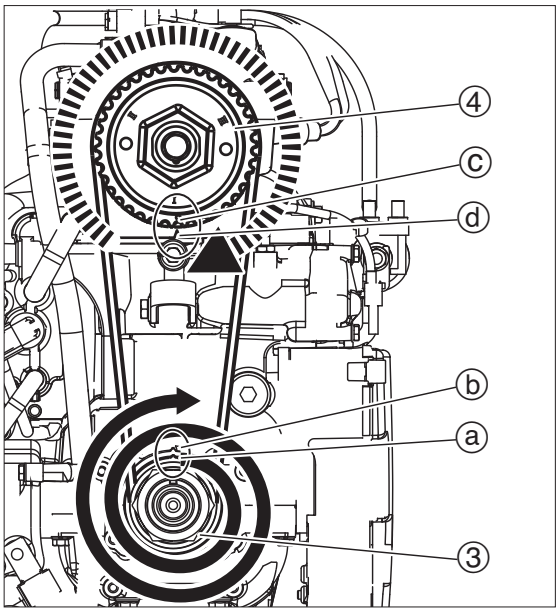
9. Attach new timing belt ⑤ to timing pulley with its part number side facing upward, and then to cam shaft pulley.



⚠ CAUTION

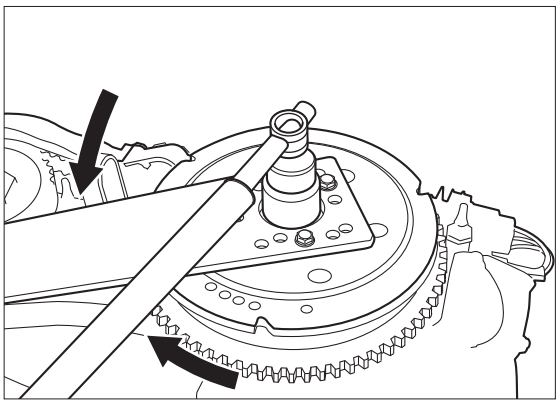
- **Be careful not give damage to timing belt when installing.**
- **Do not twist timing belt, bring inside out, or bend sharp, or it may be damaged.**
- **Be careful not to allow oil or grease to adhere to timing belt.**

10. Turn timing pulley ③ clockwise twice to adapt, and check that locating marks ⓐ and ⓑ, and ⓒ and ⓓ of pulleys ③ and ④ are aligned with each other respectively.



11. Install coil bracket ass'y and alternator.

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



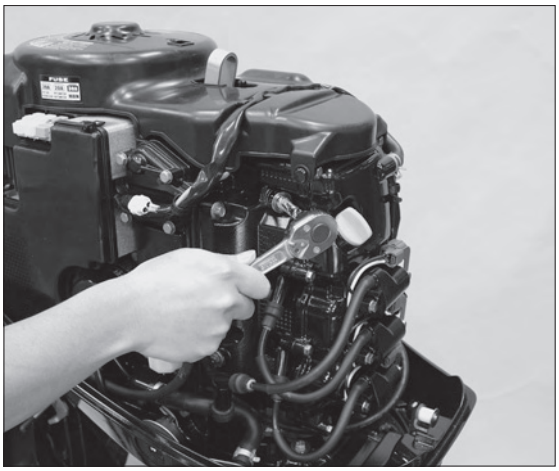
13. Tighten flywheel nut to specified torque.

Flywheel Puller Kit :
P/N. 3T1-72211-0

Flywheel Puller Nut :
150 N·m (108 lb·ft) [15 kgf·m]

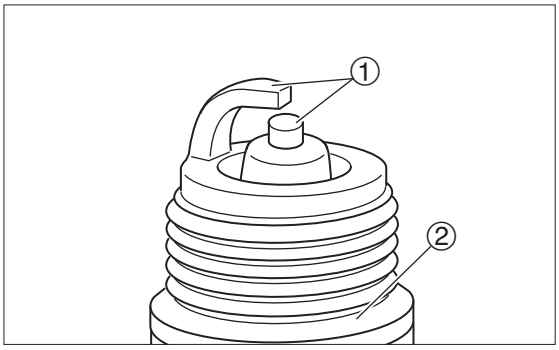
14) Inspection of Spark Plugs

1. Remove plug cap 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.

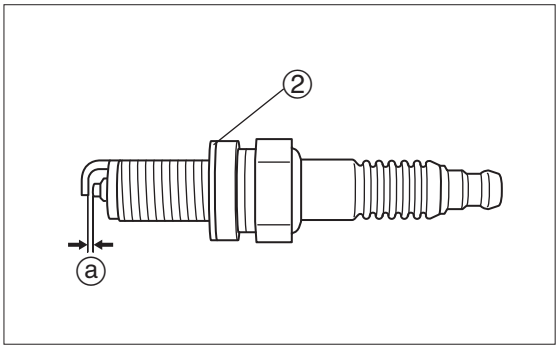


4. Check spark plug gap ⓐ. Replace if gap is over specified value. Adjust gap if it is less than specified value.

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

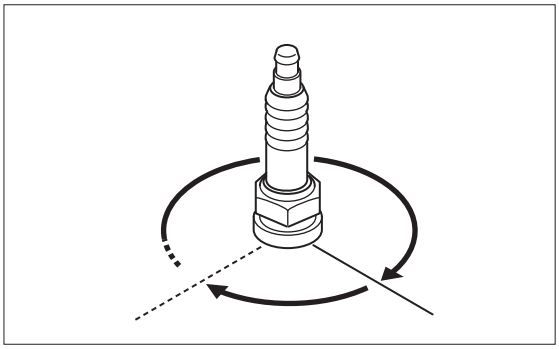
Functional Limit :
1.2 mm (0.047 in)

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 (stop switch lanyard) from stop switch.

⚠ CAUTION

Remove lock plate (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 :
P/N. 3AC-99030-0

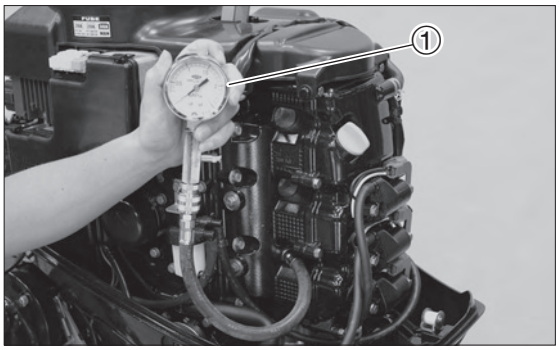
6. Fully open throttle, crank engine until compression gauge indication stabilizes, and then measure compression pressure.

Compression Pressure (Reference) :
1.4 MPa (203 psi) [14.27 kgf/cm²] ± 10 %

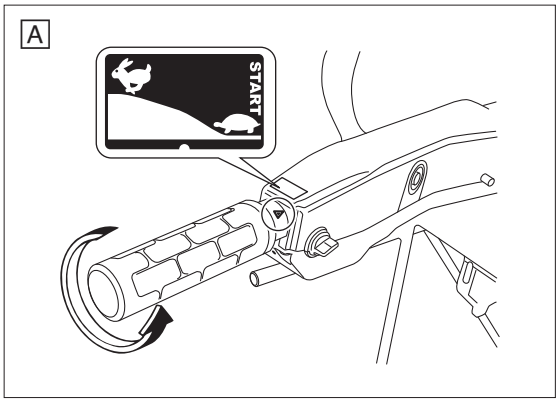
- Compression pressure is affected much by cranking speed, and normally changes in the range from 10 % to 20 %.
- For remote control model :
  Remove cable joint and fully open throttle cam by finger, and then measure compression pressure.

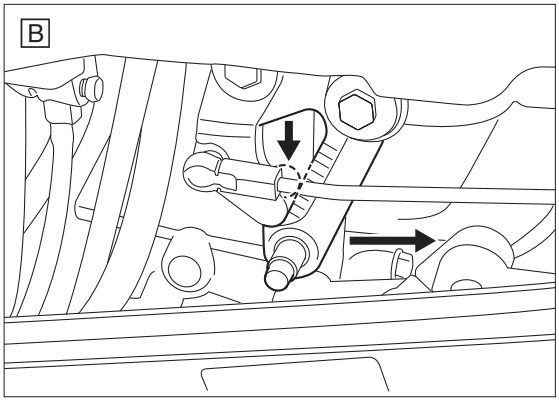
7. If compression pressure is below specified value or varies much among cylinders, put small amount of engine oil into cylinders, and perform leak down test again.

- 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.



① Compression gauge





A Multi Tiller-handel Type
B Remote Control Type

16) Inspection and Adjustment of Valve Clearance

- Perform inspection and adjustment of valve clearances when engine is cold.
- No.1 piston is to be at top dead center of compression stroke(make sure both valves are closed).

1. Remove flywheel cover, spark plug, cylinder head cover, ignition coil connector and harness.

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

3. Check and adjust No. 1 cylinder's intake and exhaust valve clearances.
   - Insert thickness gauge in the gap between valve end ② and adjust screw ③.
   - Loosen lock nut ④.
   - Turn adjust screw ③ to adjust valve clearance.
   - Tighten lock nut ④.
   - Check valve clearance again.

Valve Clearance :
Intake valve : 0.15 - 0.25 mm (0.006 - 0.010 in) ⓓ
Exhaust valve : 0.25 - 0.35mm (0.010 - 0.014 in) ⓔ

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

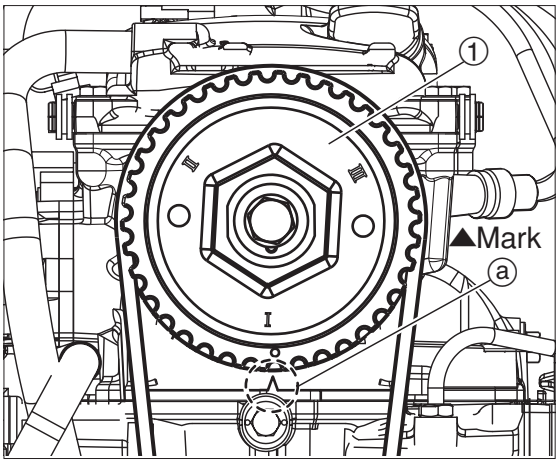
Lock nut :
7 N·m (5 lb·ft) [0.7 kgf·m]

Valve Clearance Driver ⑤ :
P/N. 3AC-99071-0
Torque Wrench ⑥ :
P/N. 3AC-99070-0

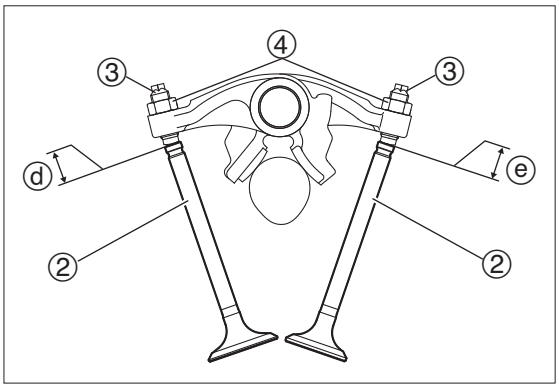
4. Rotate flywheel clockwise to bring "Ⅲ" mark of cam shaft pulley ① to "▲" mark ⓐ of cylinder head.

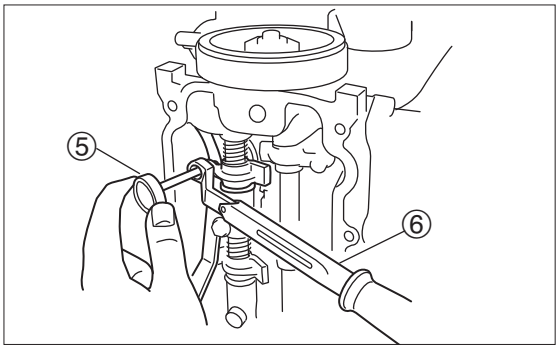
5. Check and adjust No. 3 cylinder's intake and exhaust valve clearances in the same procedure as No. 1 cylinder.

6. Check and adjust No. 2 cylinder's valve clearances in the same procedure as No. 1 cylinder.



① Cam Shaft Pulley





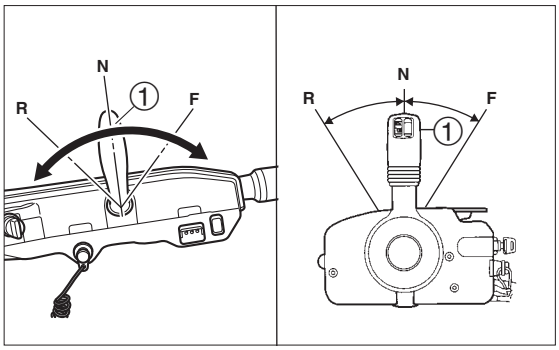
⑤ Valve Clearance Driver (Concaved Tip, Square, Width Between Two Opposing Sides : 3mm)
⑥ Torque Wrench (10mm tip wrench)

17) Adjustment of shift • throttle cable

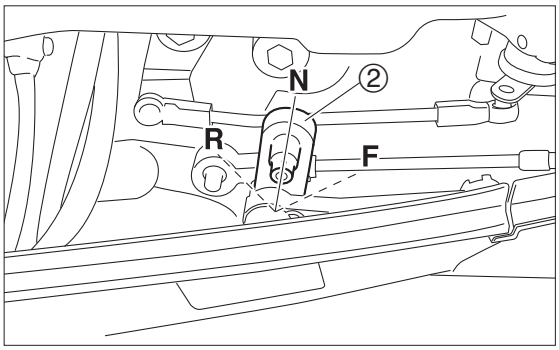
1. Set shift lever ① to neutral (N) position.

⚠ CAUTION

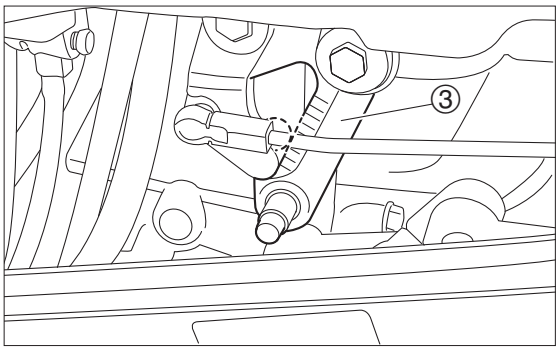
To operate shift lever on tiller models, make sure the throttle is closed to ensure no damage occurs to the throttle link.



2. Set shift arm ② to forward (F) to neutral (N) to reverse (R), and check position, then set to neutral (N).



3. Set throttle cam ③ to fully close position.

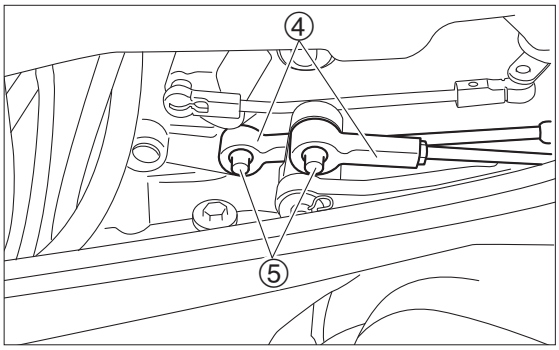


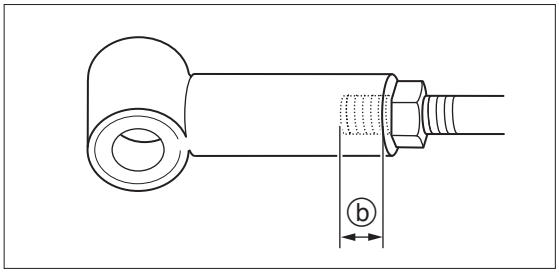
4. Adjust screw-in length of cable joint ④ so that hole of cable joint is brought to throttle arm and shift arm pin ⑤.

⚠ WARNING

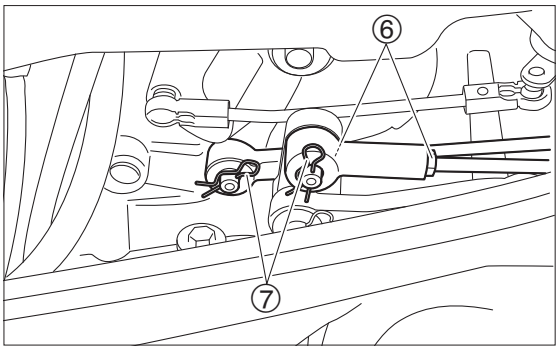
Screw-in remote control cable joint at lease 12 mm ⓑ.

- Cable joint is shipped with a outboard motor packing box.
- When adjusting cable joint, adjust it with cable fully pushed in.

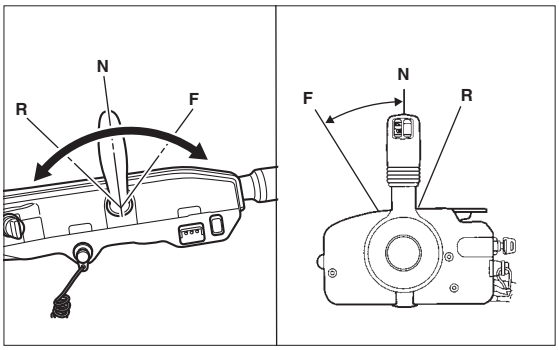




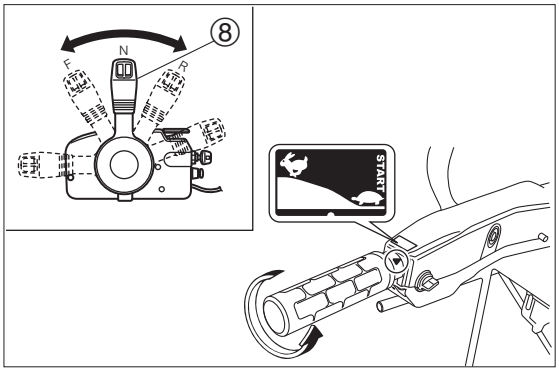
5. Tighten nut ⑥, put it on the pin, and secure with washer and snap pin ⑦.



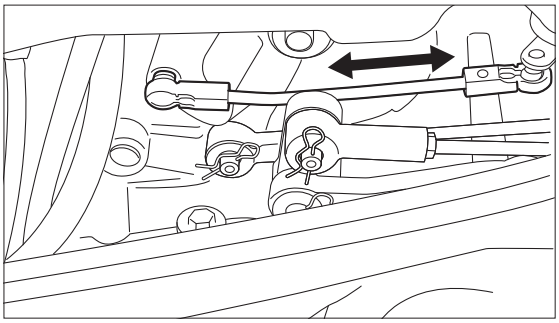
6. Check shift lever oprate to foward (F) to neutral (N) to reverse (R),.



7. Check that shifting control lever ⑧ forward (F) by approximately 32 degrees , where it is stopped once, makes the gear engage, and fully shifting the lever makes throttle valve fully open. (for tiller handle model, check that throttle grip operate to throttle valve fully open.),
   Then, check that, when control lever is returned to neutral position (N), throttle valve is fully closed. If throttle valve does not contact with full close stopper with the valve fully closed, readjust cable joint position at outboard motor side and reinstall it if the valve does not contact with full close stopper in this case.



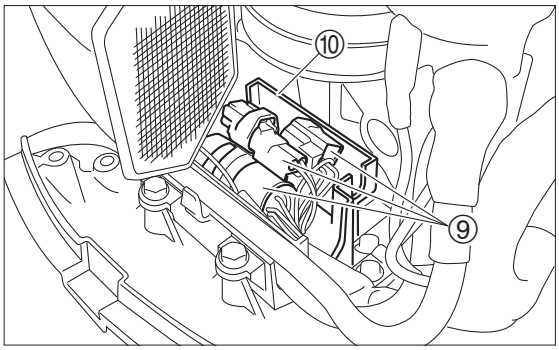
8. Check if throttle valve operates smoothly, and repeat steps 1. to 7. as necessary.



9. Reconnect coupler ⑧ (3 pices) and install holder cover.

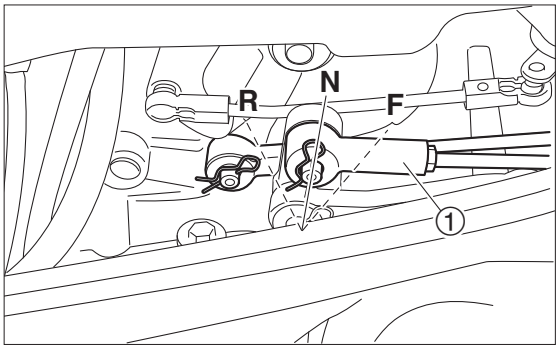
⚠ CAUTION

Do not disconnect cord ass'y while engine operates.



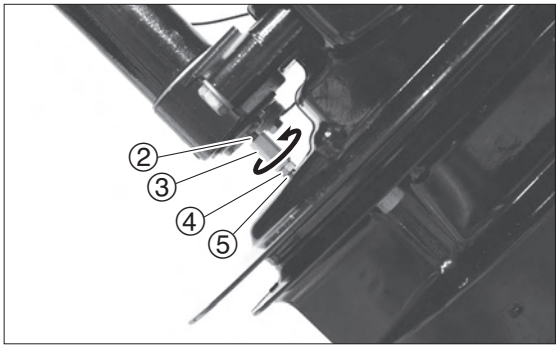
18) Inspection of Shift Lever Gear Operations

Shift gear from neutral (N) to forward (F), neutral (N), and then to reverse (R) while rotating propeller slowly to allow clutch engagement to check that shift operation is performed smoothly. Adjust shift link rod ① length, shift rod and cam rod position if necessary.

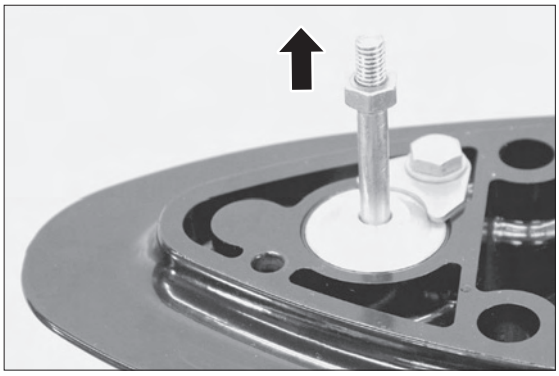


1. Shift gear into foward (F).

2. Remove joint nut ④ from shift rod ② and cam rod ③.

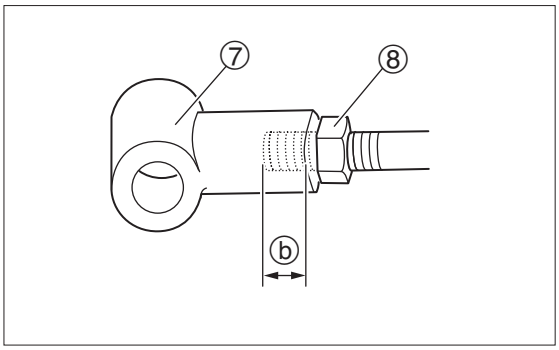


3. Shift gear into forward (F) completely again by pulling up the cam rod fully.



4. Reconnect cam rod and shift rod, and then check that gear shift operation is performed smoothly.

5. Adjust length so that remote control cable joint ⑦ hole aligns with set pin. (Remote Control Model)



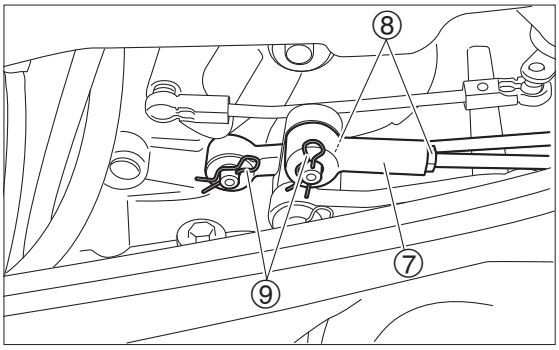
⚠ WARNING

Screw-in remote control cable joint at lease 12 mm ⓑ.

When adjusting remote control cable joint, adjust it with remote control cable fully pushed in.

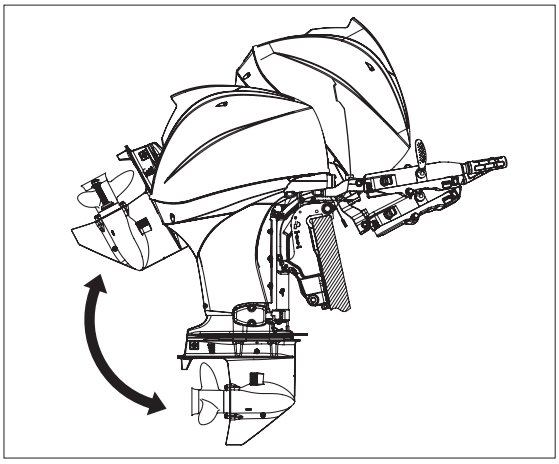
6. Reconnect remote control cable joint ⑦, attach snap pin ⑨, and tighten lock nut ⑧. (Remote Control Model)

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



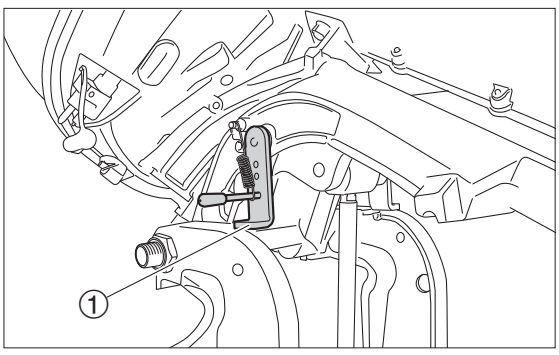
19) Inspection of PTT Unit Operation

1. Tilt up and down outboard motor several times to check that PTT unit operates smoothly in full range. Check PTT fluid quantity if necessary. Refer to "Inspection of PTT Fluid Quantity" described in the next page.



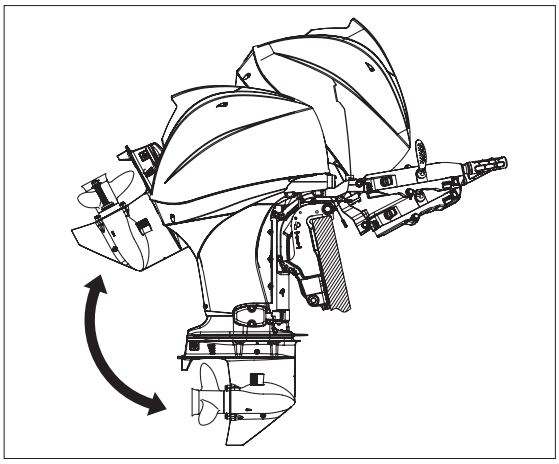
Check that PTT motor produces noise of normal revolution.

2. Fully tilt up outboard motor, lock with tilt stopper ①, and check that stopper ① lock mechanism functions normally.



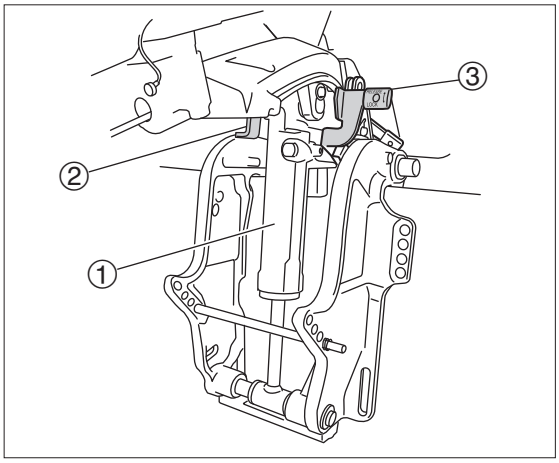
20) Inspection of Gas Assistant Unit Operations

1. Tilt up and down outboard motor several times to check that gas assistant unit operates smoothly in full range.



2. Fully tilt up outboard motor, lock with tilt stopper ②, and check that stopper ② lock mechanism functions normally.

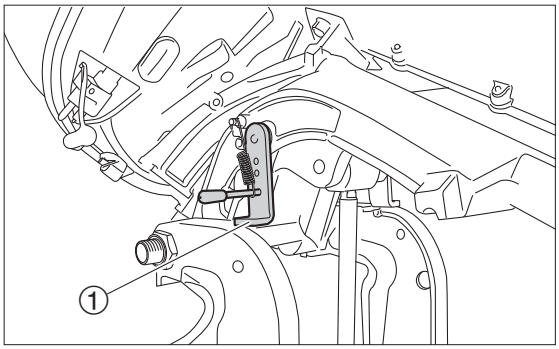
3. Tilt up outboard motor a little, set lock lever ③ to locking position, and check that holding mechanism of gas shock absorber ① functions normally.



In case any failure is found as a result of inspection, replace gas shock absorber. Gas shock absorber cannot be disassembled.

21) Inspection of PTT Fluid Quantity

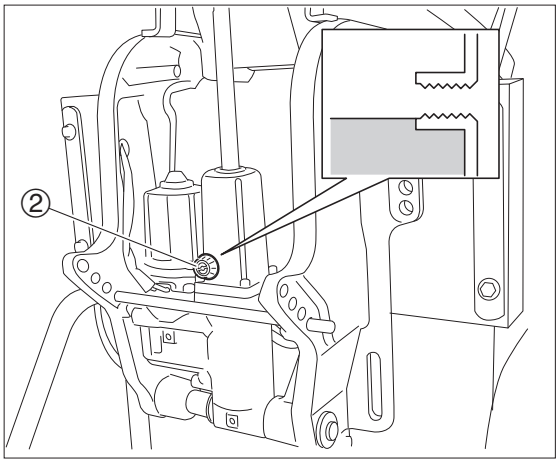
1. Fully tilt up outboard motor and lock with tilt stopper ①.



⚠ WARNING

Be sure to lock outboard motor with tilt stopper after fully tilting up. Leaving outboard motor without locking may lead to accidental descent due to reduction of PTT hydraulic pressure.

2. Remove reserve tank cap ② and check quantity of PTT fluid contained in the tank.



⚠ WARNING

Check PTT fluid level with outboard motor fully tiled up. Removing reserve tank cap at halfway position can cause blasting out of PTT fluid, which is dangerous, and also result in inaccurate fluid level reading.

Quantity of PTT fluid is normal when some fluid spills out of cap hole when cap is removed.

3. Add recommended PTT fluid to specified level if it is lacking.

Recommended PTT Fluid :
ATF DEXRON III

4. Attach reserve tank cap ② and tighten to specified torque.

Reserve Tank Cap :
1.5 N·m (1.1 lb·ft) [0.15 kgf·m]

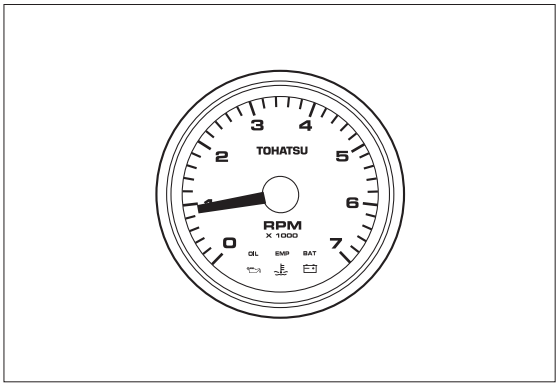
22) Inspection of Idle Speed

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

2. Check idle speed to use tachometer or diagnostic program.

Tachometer :
P/N. 3GF-72647-1

Idle Speed :
850-± 30 r/min

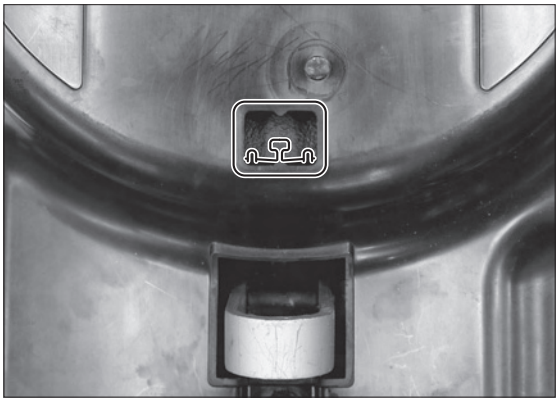


23) Inspection of Ignition Timing

Adjusting system : Automatic control, requiring no manual adjustment.

Run engine and use timing light to check ignition timing.

9 timings marks are found on the side of flywheel (TDC0°, ATDC5°, 10°, BTDC5°, 10°, 15°, 20°, 25°, 30°), and ignition timing is read with mark on the center of starter case window.



Outboard Model	Range of Ignition Angle	Engine Starting	Idling	Accelerating
40/50	BTDC 2° - BTDC 27°	TDC 0°	BTDC 2°±5°	BTDC 27°

24) Inspection of Anodes

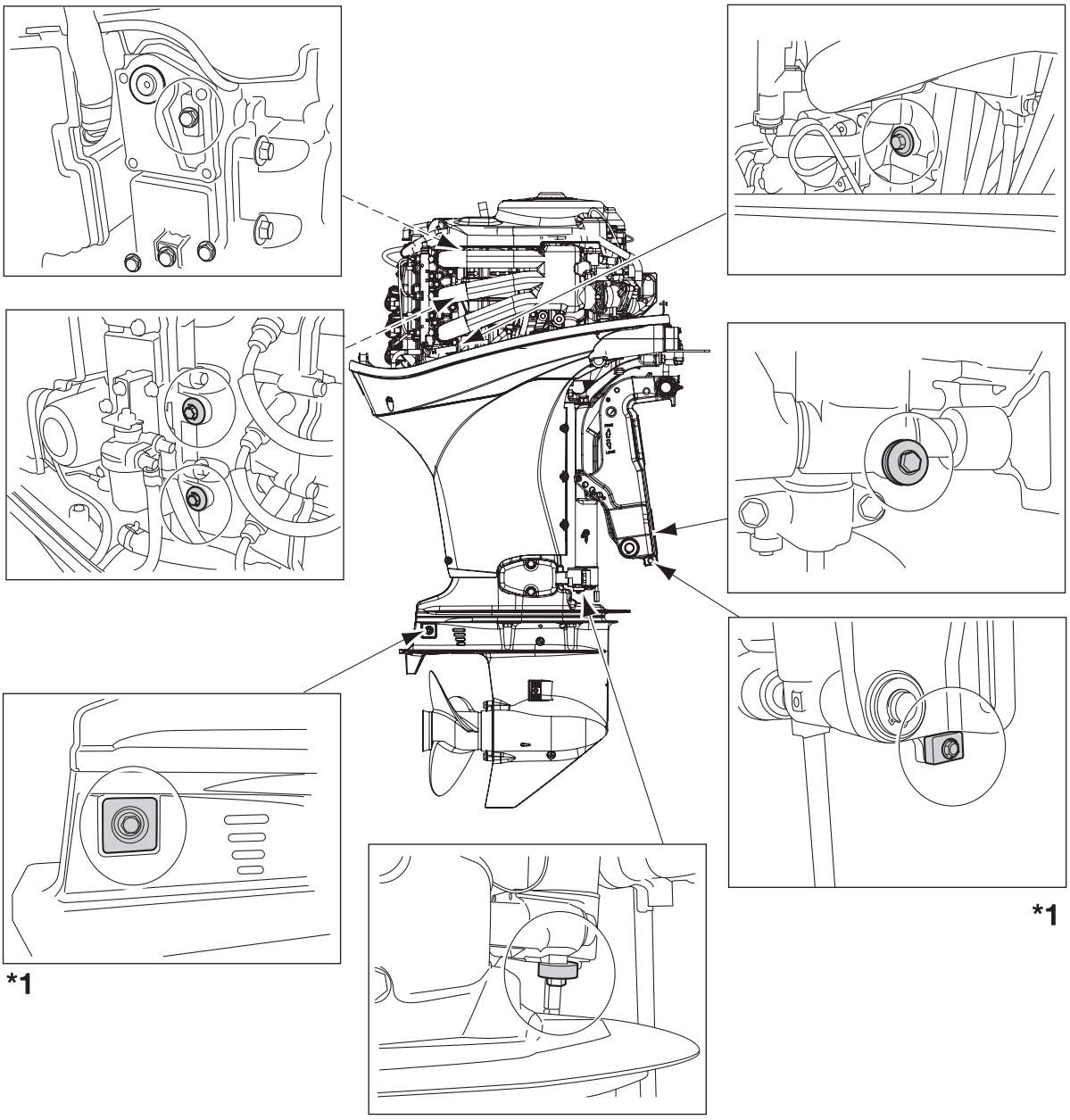
1. Check anodes and trim tab for build up of scale and adherence of grease and oil. Clean, or replace if necessary.

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

⚠ 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 described in this manual.



*1 Same as mounted on opposite side.

25) Replacement of Anodes

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

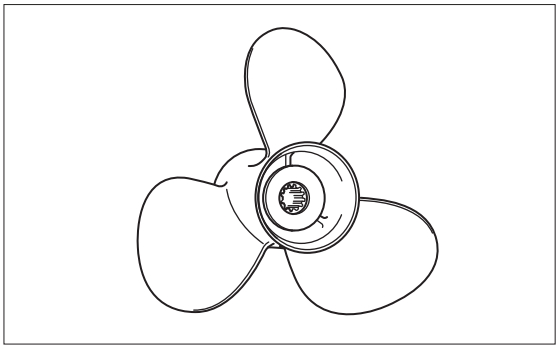
Anodes are used in the gear case, clamp bracket, and power unit cylinder.

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.

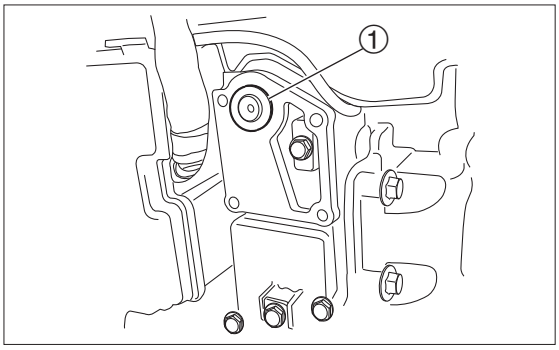
26) Inspection of Propeller

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



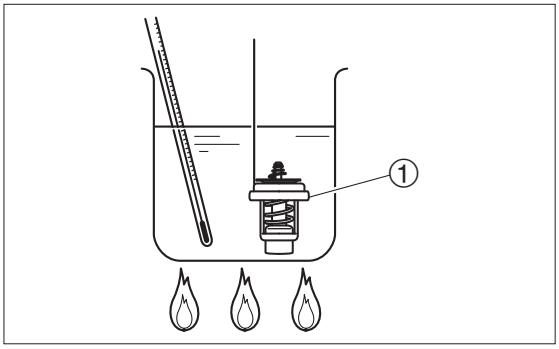
27) Inspection of Thermostat

1. Remove cover and thermostat ①.



2. Hang thermostat ① in the water contained in vessel.

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

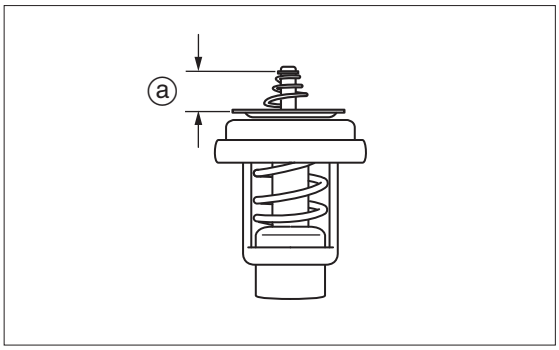


Put a piece of thread in the closed valve gap and hang it in the water. Valve opening moment can be known when thermostat is released to drop due to opening with rise of temperature.

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

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

Water Temperature	Valve Lift ⓐ
75°C (167°F)	3.0 mm (0.118 in) or over

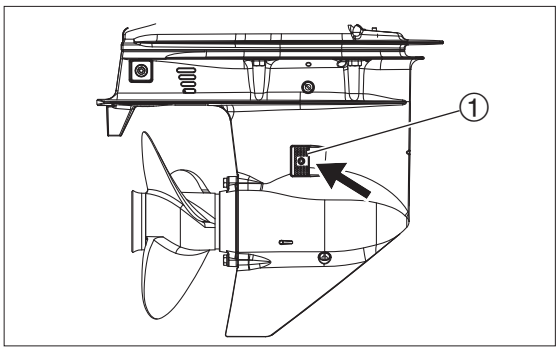


5. Install thermostat, new gasket and cover.

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

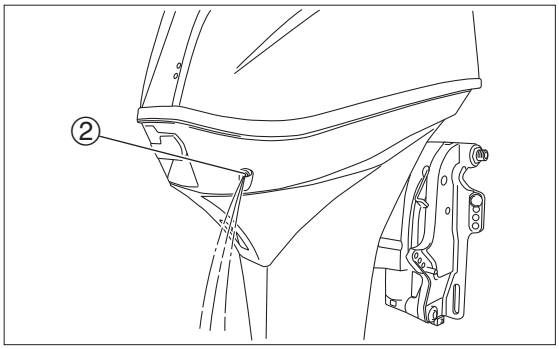
28) Inspection of Cooling Water Passage

1. Check water strainer ① 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 ②. If not, check water pump and cooling water passage in the engine.



29) Inspection of Cooling Water Pressure

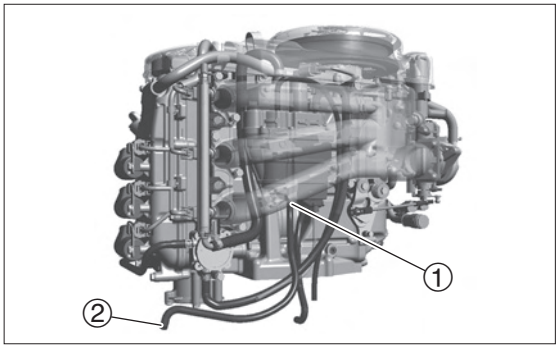
1. Connect pressure gauge to cooling water check port of fuel cooler.

2. Start engine and check water pressure at each engine speed.

Engine Speed	Water Pressure
850 r/min	3.0 kPa (0.4 psi)
1500 r/min	13.6 kPa (1.9 psi)
3000 r/min	27.3 kPa (3.9 psi)
5000 r/min	41.3 kPa (6 psi)

Shown water pressure values are reference.

3. Check cooling water passage of water pump and inside the engine, if water pressure is very low.



① Fuel coolor
② Cooling water check port

30) Flushing with Water

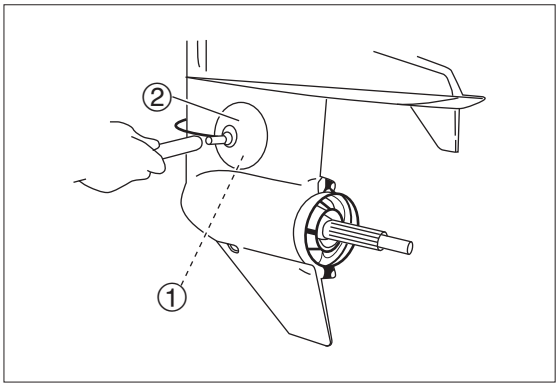
⚠ CAUTION

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

⚠ WARNING

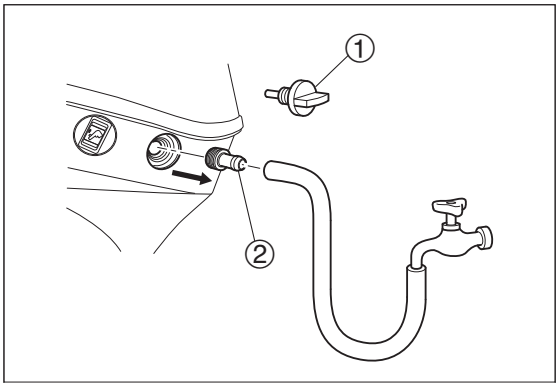
Exhaust gas contains carbon monoxide, which will cause gas poisoning. Do not start engine with outboard motor placed in a closed area such as boat house.

Flushing with water using drive cleaner ②



1. Remove propeller and thrust holder.
2. Attach driver cleaner ② to water strainer ① area.
3. Put water hose to drive cleaner ② and run water.
4. Set gear shift to neutral (N) and start engine.
5. Check that cooling water check port discharges water, and run engine for 3 to 5 minutes at low speed.
6. Stop engine and stop water supply, remove drive cleaner ②, and then, reinstall propellor parts removed.

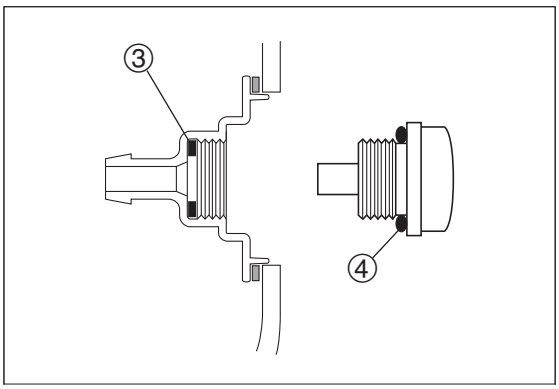
Flushing with water using flushing attachemnt



1. Tilt down the out board motor.
2. Remove the flushing connector cap ① from the outboard motor, and screw in the flushing attachment ②.
3. Attach the flushing attachment and connect a water hose. Turn on the water and adjust the flow. Continue flushing the outboard motor for 3 to 5 minutes.

⚠ CAUTION

Do not operate the engine.
Water pressure requirement:
0.12 to 0.2 MPa (1.74 to 2.84 psi) [1.2 to 2.0 kgf/cm^3]



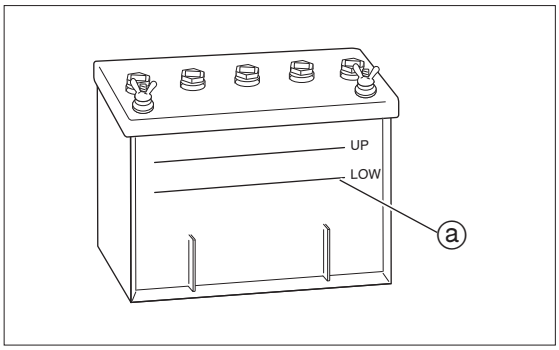
4. Remove flushing attachment.
5. Check for damege or crack in the seal ③ and O ring ④, then install flushin connector cap.

⚠ CAUTION

Leak of cooling water flow could lead to engine over heating. Be sure to reattach the flushing connector cap.

31) Inspection of Battery

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



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

⚠ WARNING

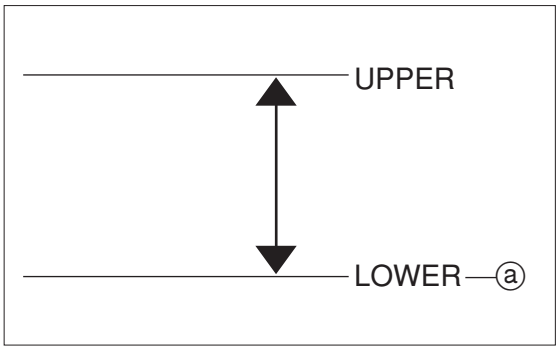
Electrolyte contains sulfuric acid that is poisonous and highly corrosive, which is dangerous. Always be careful of the following matters to prevent accident.
- **Handle electrolyte carefully not to allow adherence to any part of body, or it could cause serious chemical burn or blindness.**
- **Wear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

First Aid in Emergency (if electrolyte adhered 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 allow smoking when handling or charging battery.**

Keep battery and electrolyte out of reach of children.



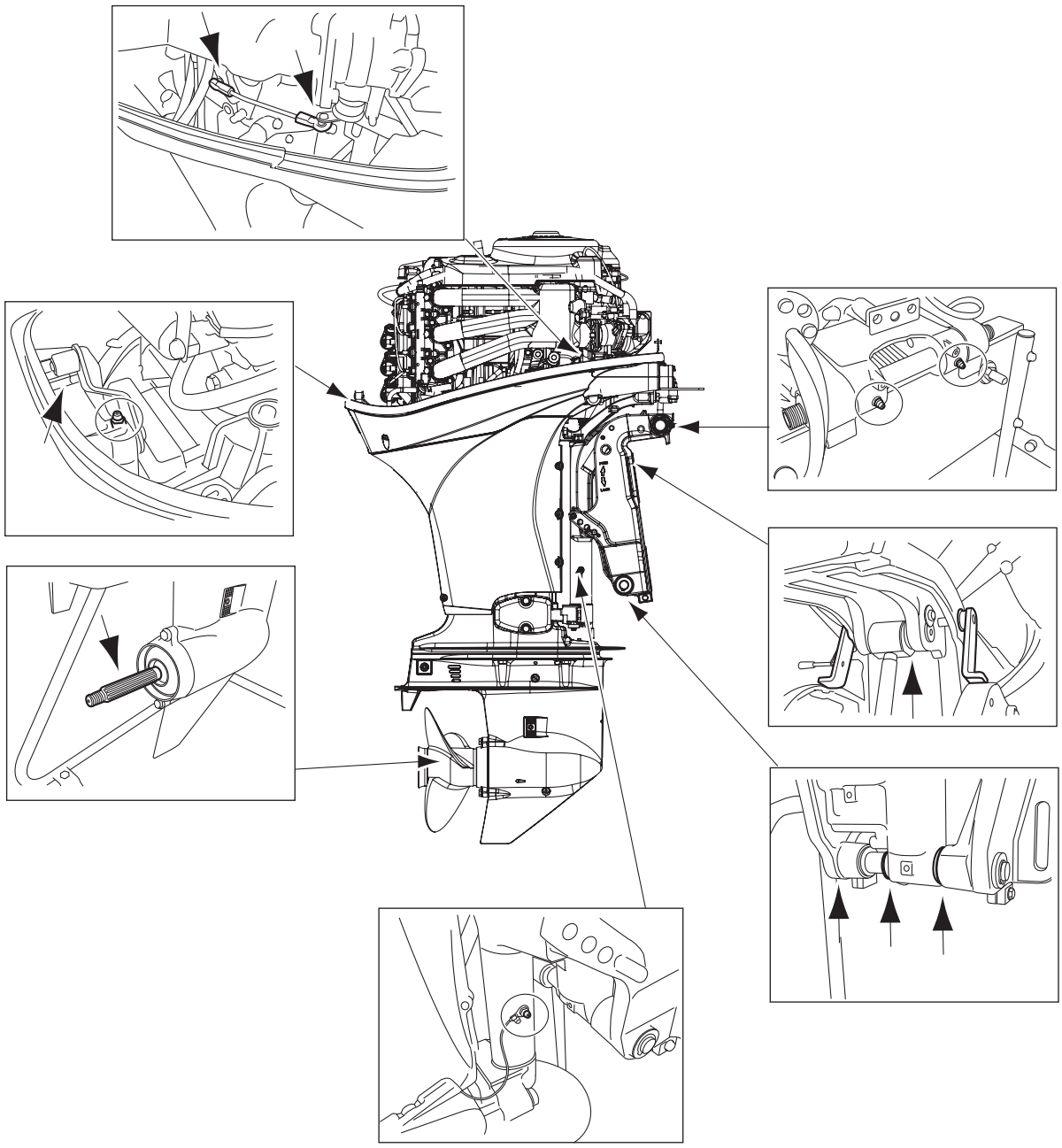
- Batteries are available with various types, varying among manufacturers. For any unclear matters, refer to manual attached to battery.
- When removing battery, disconnect negative lead first and then positive lead.

Recommended Battery :
12V 100AH/5HR 850CCA
(12V 120AH/5HR at below freezing temperature)
1000CCA

Specific Gravity of Electrolyte :
1.280 (at 20˚)

32) Greasing points

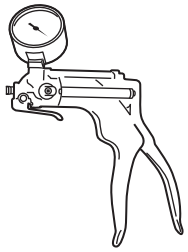
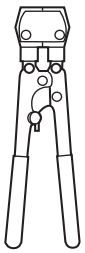
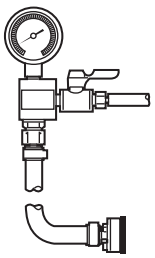
Apply water proof grease to the parts shown below.



4

Fuel System (Fuel Injection)

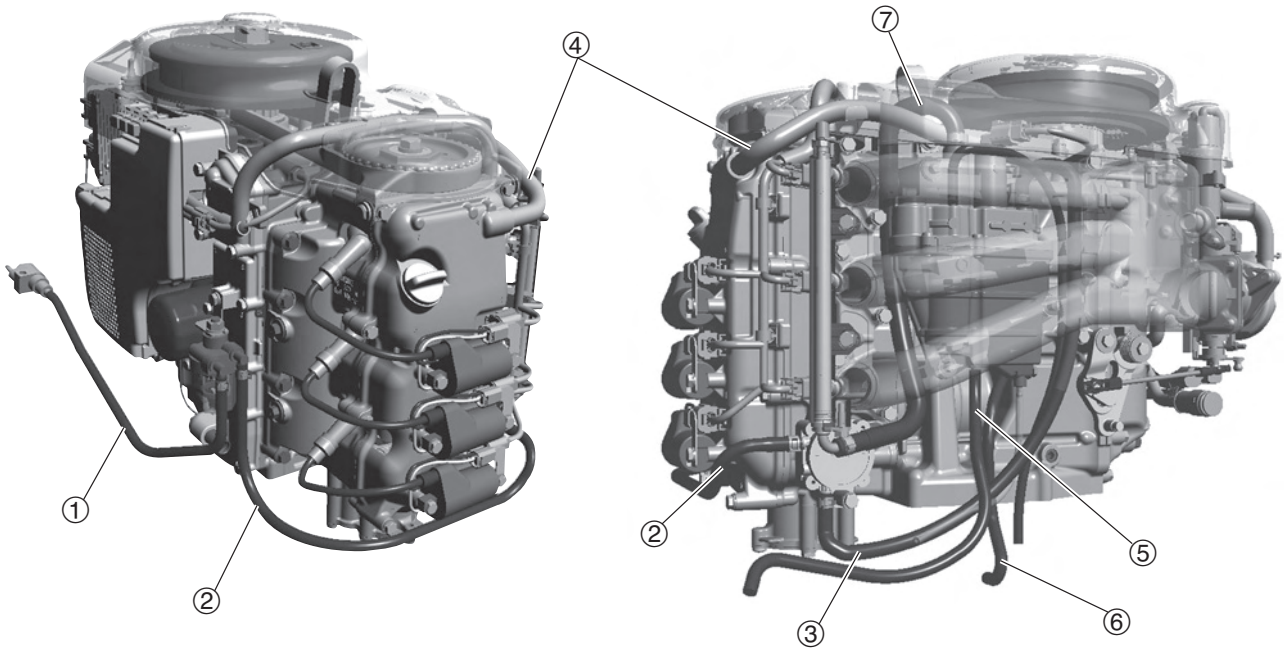
1. Special Tools

		
Vacuum/Pressure Gauge P/N. 3AC-99020-1	Clamp Plier P/N. 3T5-72864-0	Pressure Gauge Ass'y P/N. 3T5-72880-0
Inspecting pressure	Caulking clamp	Measuring fuel pressure

2. Piping Arrangement Diagram
Fuel Hose, Vent Hose, Breather Hose, Cooling Water Hose

Rear Section

Port Side

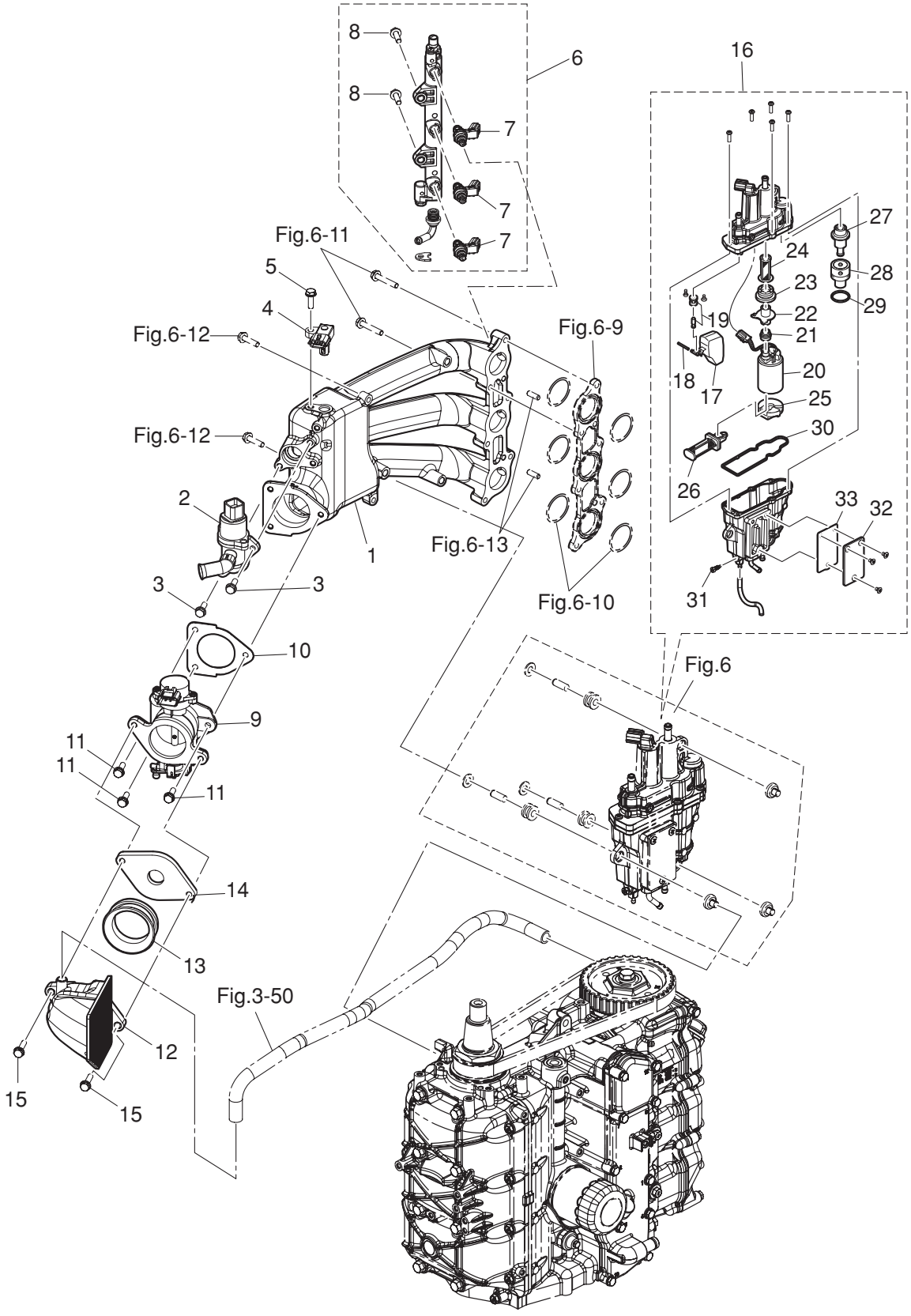


Ref. No..	Description
①	Fuel Hose (Fuel Connector to Fuel Filter)
②	Fuel Hose (Fuel Filter to Fuel Pump)
③	Fuel Hose (Fuel Pump to Vapor Separator)
④	Breather Hose (Cylinder Head to Throttle Body)
⑤	Cooling Water Hose (Engine Base to Fuel Cooler)
⑥	Cooling Water Hose (Fuel Cooler to Cooling Water Check Port)
⑦	High Pressure Fuel Hose (Vapor Separator to Fuel Rail)

3. Parts Layout

P/L Fig. 5

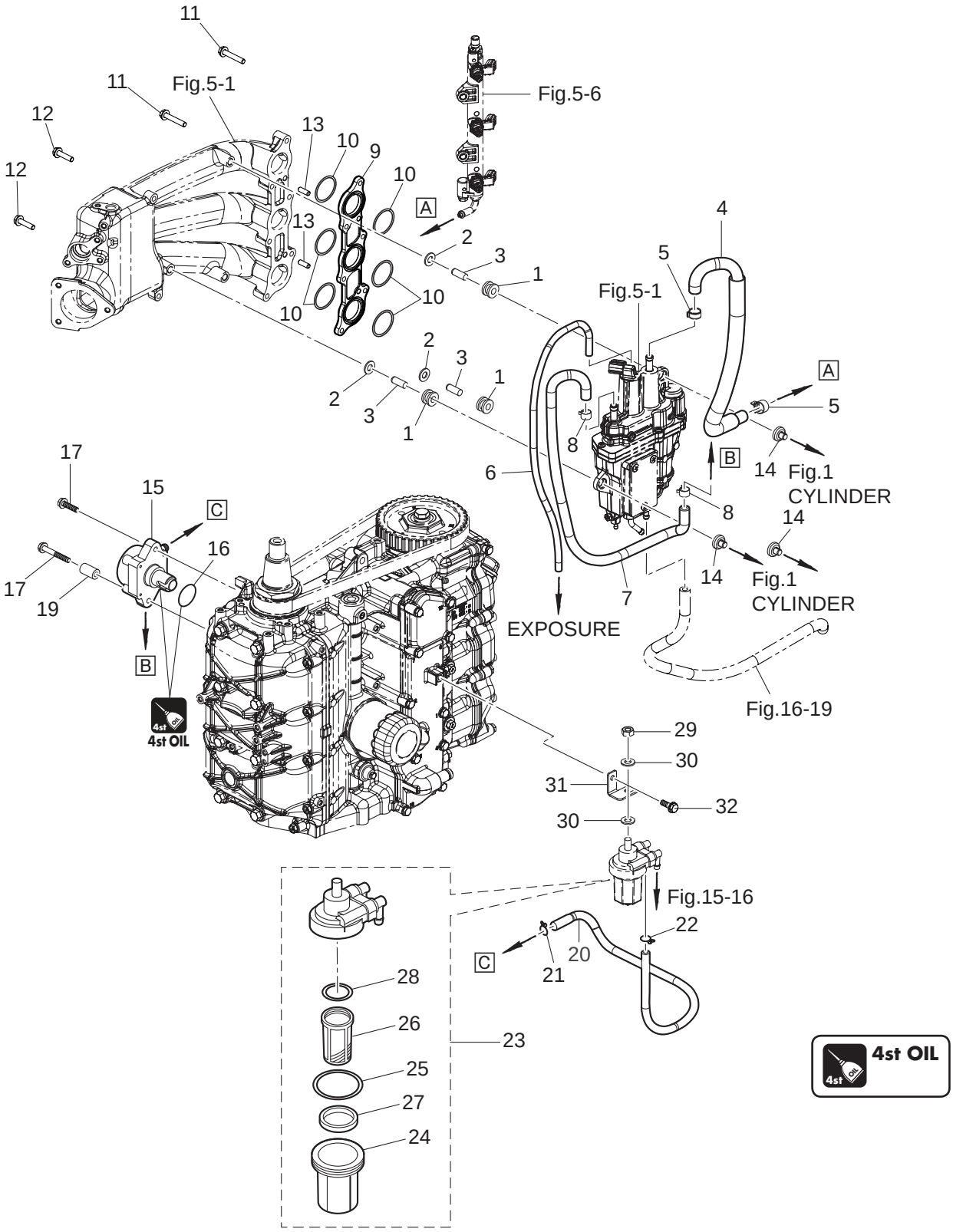
Intake Manufold



Ref. No.	Description	Q'ty	Remarks
1	Intake Manifold	1	
2	ISC Valve	1	Idle Speed Control Valve
3	Bolt	2	M6 L=20mm
4	Map Sensor	1	Manifold Air Temperature & Pressure
5	Bolt	1	M6 L=20mm
6	Fuel Rail Ass'y	1	
7	Fuel Injector Ass'y	3	
8	Bolt	2	M6 L=20mm
9	Throttle Body Ass'y	1	ø45
10	Gasket	1	Do not reuse.
11	Bolt	3	M6 L=20mm
12	Intake Silencer Ass'y	1	
13	Gasket	1	Do not reuse.
14	Gasket	1	40ps
15	Bolt	2	M6 L=25mm
16	Vapor Separator Ass'y	1	
17	Float	1	
18	Float Arm Pin	1	
19	Float Valve Ass'y	1	
20	Fuel Feed Pump	1	Upper
21	Grommet	1	Upper
22	Joint	1	Upper
23	Grommet	1	Upper
24	Filter (Outlet)	1	Lower
25	Grommet	1	Lower
26	Filter (Inlet)	1	
27	Fuel Regulator	1	
28	Holder	1	
29	O-ring	1	Do not reuse.
30	O-ring	1	Do not reuse.
31	Drain Screw	1	
32	Cover	1	
33	Seal	1	Do not reuse.

Fuel System

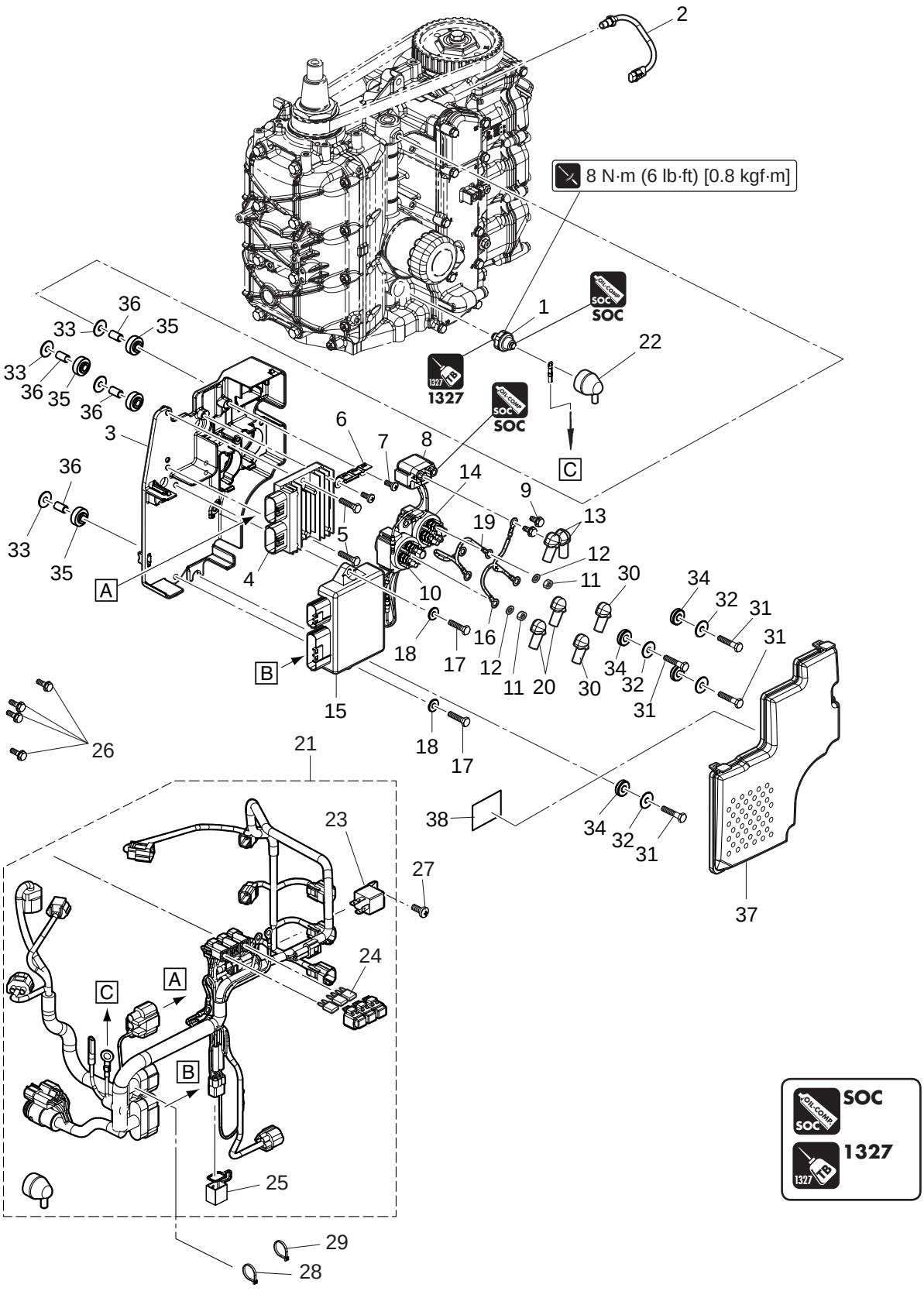
P/L Fig. 6



Ref. No.	Description	Q'ty	Remarks
1	Rubber Mount	3	
2	Washer	3	M8
3	Pin ø8-22	3	
4	Fuel Hose W/Protector	1	V/Separator-Fuel Rail EPA-KRI-15G
5	Clamp ø16.8	2	
6	Fuel Hose 4-9	1	V/Separator-Exposure
7-1	Fuel Hose W/Protector ø12	1	Fuel Pump-V/Separator USA EPA-KRI-15G
7-2	Fuel Hose W/Protector ø12	1	Fuel Pump-V/Separator STD
8	Clip ø11.3	2	
9	Insulator	1	
10	O-ring 1.9-33.2	6	Do not reuse.
11	Bolt	6	M6 L=35mm
12	Bolt	2	M6 L=25mm
13	Dowel Pin 6-16	2	Intake Manifold-Vapor Separator Assy
14	Bushing	3	
15	Fuel Pump Ass'y	1	
16	O-ring 3.5-25.7	1	Do not reuse.
17	Bolt	1	M6 L=25mm
18	Bolt	1	M6 L=45mm
19	Spacer 6.2-13-22	1	
20-1	Low Permeation Hose L=445	1	Fuel Filter-Fuel Pump USA EPA-KRI-15G L=445mm
20-2	Fuel Hose 5-10 L=445	1	Fuel Filter-Fuel Pump STD L=445mm
21	Clip ø11.3	1	
22	Clip ø9.4	1	
23	Fuel Filter Ass'y	1	
24	Cup	1	
25	O-ring	1	Do not reuse.
26	Filter	1	
27	Float	1	
28	O-ring	1	Do not reuse.
29	Nut	1	M8
30	Washer	2	M8
31	Plate	1	
32	Bolt	1	M6 L=12mm

Electric Parts

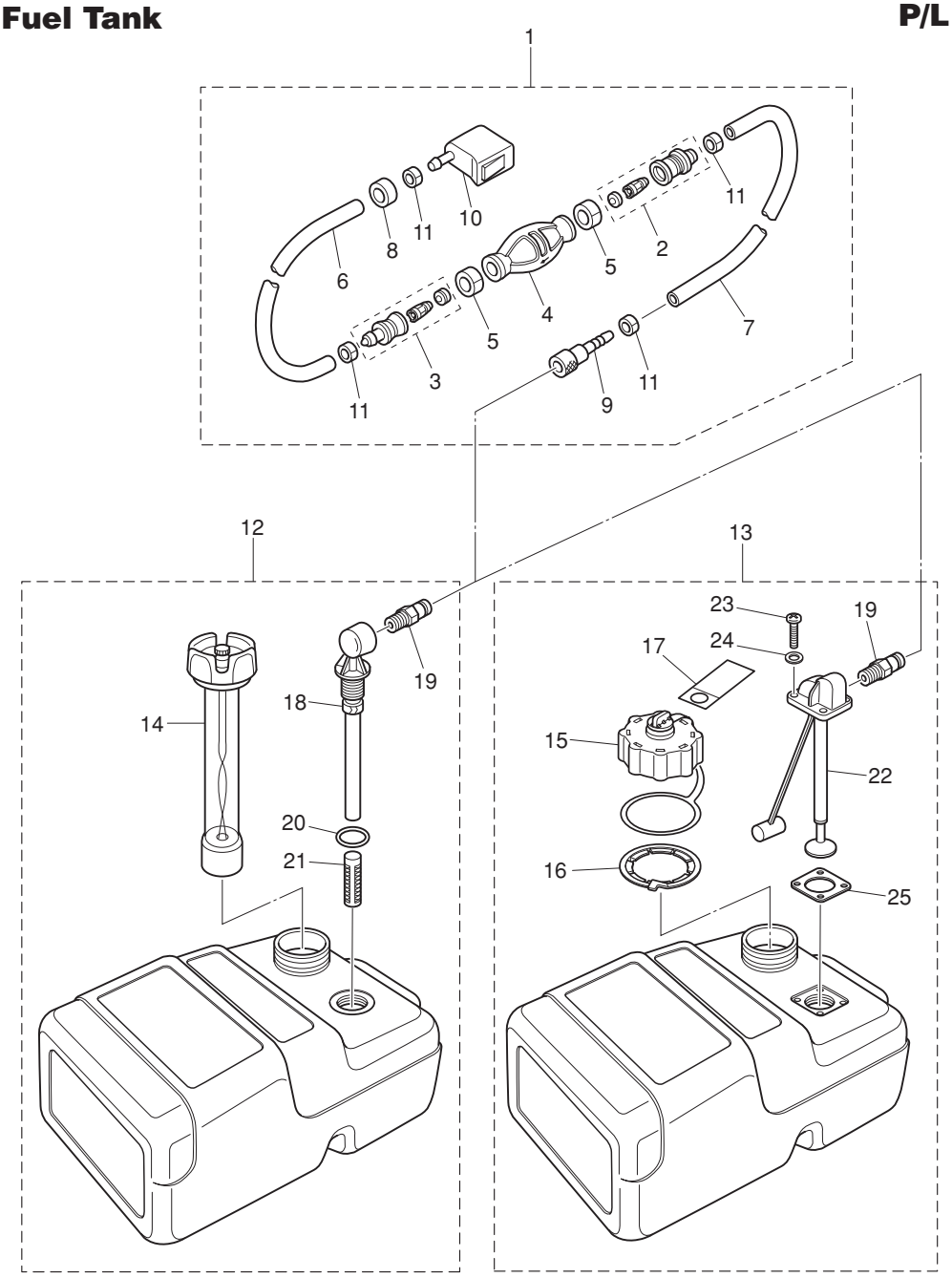
P/L Fig. 9



Ref. No.	Description	Q'ty	Remarks
1	Oil Pressure Switch	1	
2	Engine Temp Sensor	1	
3	Bracket	1	Electric Braket
4	Rectifier Complete	1	
5	Bolt	2	M6 L=25mm
6	Fuse Holder Bracket	1	
7	Screw	2	M5 L=12mm
8	Starter Solenoid	1	
9	Bolt	2	M6 L=8mm
10	PTT Solenoid Switch (A)	1	Up 4 Side (Sb) for PTT Model
11	Nut	3	M6
12	Spring Washer	3	M6
13	Terminal Cap 8-13-28	2	Red for Gas Assist Model
14	PTT Solenoid Switch (B)	1	Down Side (P) for PTT Model
15-1	ECU Ass'y	1	50ps EU
15-2	ECU Ass'y	1	40ps EU
15-3	ECU Ass'y	1	50ps STD
15-4	ECU Ass'y	1	40ps STD
16	Solenoid Switch Cord (A)	1	Red for PTT Model
17	Bolt	2	M6 L=20mm
18	Washer 6-16-1.5	2	M6
19	Solenoid Switch Cord (B)	1	Black for PTT Model
20	Terminal Cap 8-13-28	6	Red for PTT Model
21	Cord Ass'y	1	
22	Grommet	1	
23	Relay	1	
24-1	Fuse 30A	1	
24-2	Fuse 20A	2	
25	Cable Terminal Plug	1	
26	Bolt	4	M6 L=12mm
27	Screw	1	M5 L=12mm
28	Band 104	1	Do not reuse.
29	Band 203	1	Do not reuse.
30	Terminal Cap 8-13-28	2	Black for PTT Model
31	Bolt	4	M6 L=30mm
32	Washer 6-16-1.5	4	In Side M6
33	Washer 6.5-21-1	4	Out Side M6
34	Mount 8.5-14-2.5	4	In Side
35	Rubber Mount 8.5-14-2.5	4	Out Side
36	Spacer 6.2-9-15.7	4	
37	Cover	1	
38	Wiring Diagram Decal	1	

Separate Fuel Tank

P/L Fig. 19

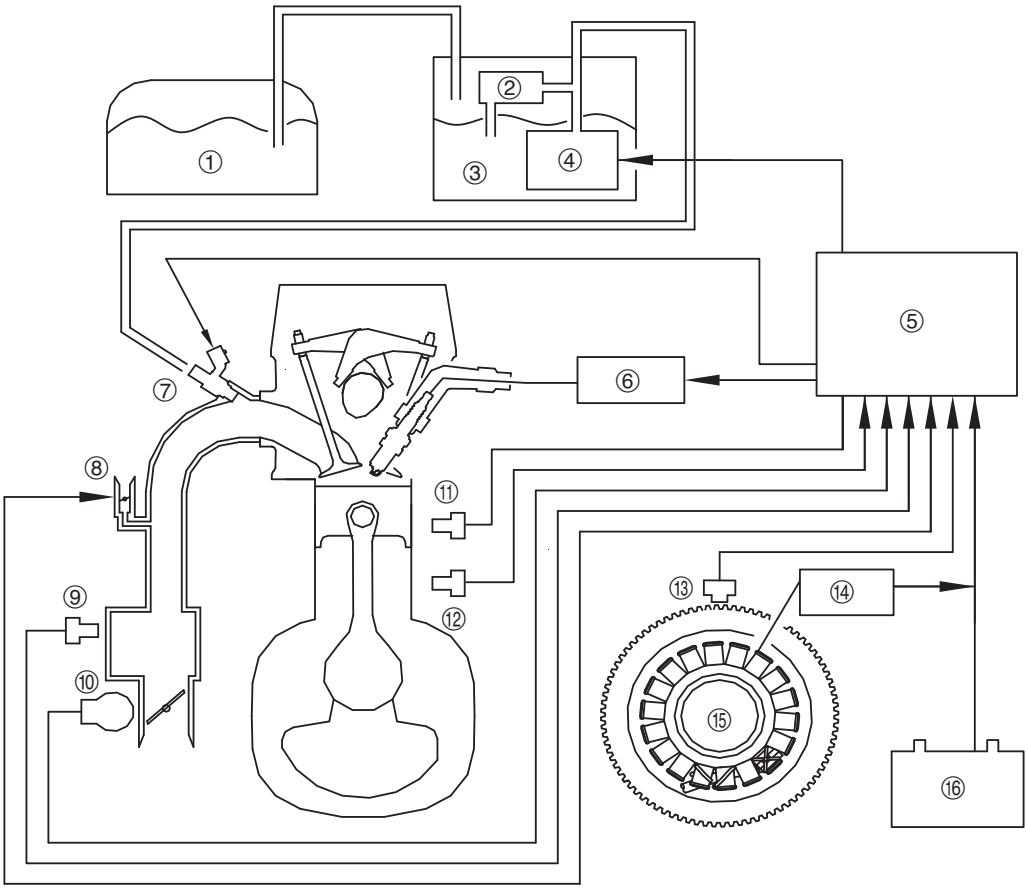


Ref. No.	Description	Q'ty	Remarks
1-1	Primer Bulb Assy	1	STD
1-2	Primer Bulb Assy	1	Low Permeation Parts for USA Model
2	Joint Assy (Inlet)	1	
3	Joint Assy (Outlet)	1	
4-1	Primer Bulb	1	STD
4-2	Primer Bulb	1	Low Permeation Parts for USA Model
5	Clamp	2	
6-1	Hose	1	STD 98AB-701000
6-2	Low Permeation Hose L=700	1	Low Permeation Parts USA EPA-KRI-15G
7-1	Hose	1	STD 98AB-701000 x 2
7-2	Low Permeation Hose L=1600	1	Low Permeation Parts USA EPA-KRI-15G
8	Fuel Connector Mark	1	Yellow for USA Model see Owners Manual
9	Fuel Connector	1	
10	Fuel Connector	1	

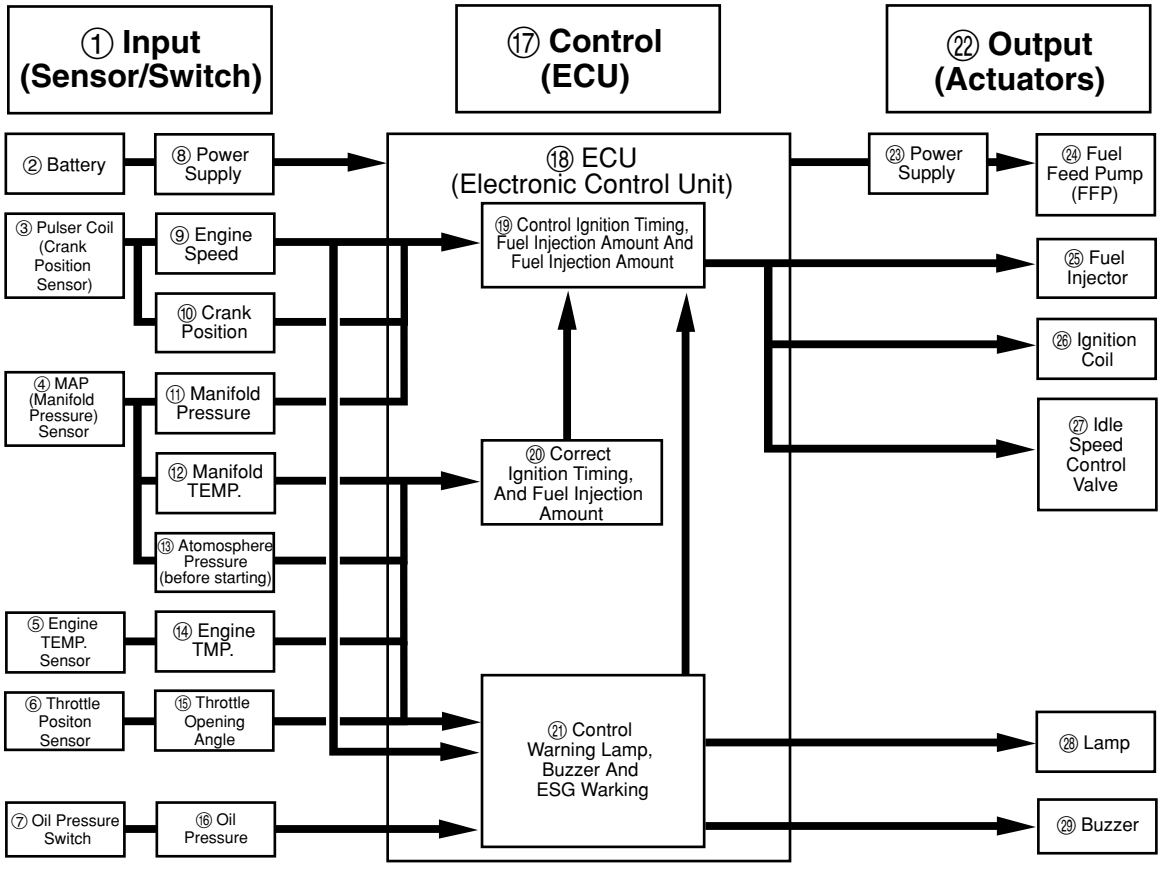
Ref. No.	Description	Q'ty	Remarks
11	Clamp	4	
12	Fuel Tank Assy 25L	1	STD
13	Fuel Tank Assy 25L	1	for USA Model
14	Fuel Gauge Vent Cap Assy (25L)	1	STD
15	Fuel Tank Cap Assy	1	for USA Model
16	Retaining Ring	1	for USA Model
17	Instruction Tag	1	for USA Model
18	Pick-up Elbow Assy (25L)	1	STD
19	Quick-connector (Male)	1	
20	O-ring	1	STD **Do not reuse.**
21	Filter	1	STD
22	Fuel Pick-up Assy W/gauge	1	for USA Model
23	Screw	4	for USA Model
24	Washer	4	for USA Model
25	Gasket	1	for USA Model

4. ECU System
(1) Configuration of ECU System

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



① Fuel Tank
② Fuel Regulator
③ Vapor Separator
④ Fuel Feed Pump (FFP)
⑤ ECU
⑥ Ignition Coil
⑦ Fuel Injector
⑧ ISC Valve
⑨ MAP/MAT Sensor
⑩ TPS
⑪ Engine TEMP. Sensor
⑫ Oil Pressure Switch
⑬ Pulser Coil
⑭ Rectifire
⑮ Alternator
⑯ Battery

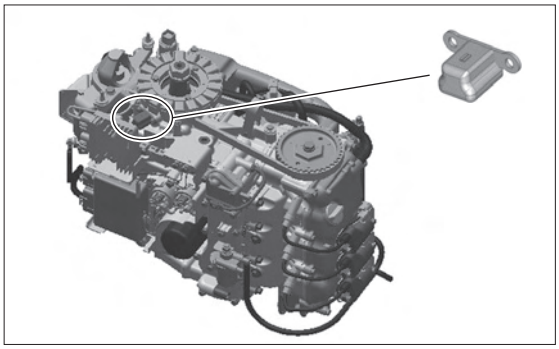


1) Sensors

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

1. Pulser Coil [Crank Position Sensor]

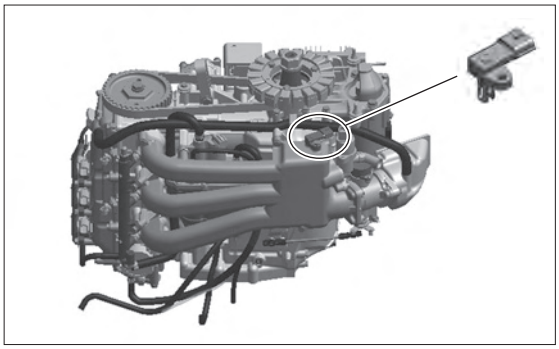
   Pulser coils function as crank position sensors. As flywheel rotates, pulser coil sends the crank position signals to ECU. ECU uses this signal to establish fuel injection amount and ignition timing.



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

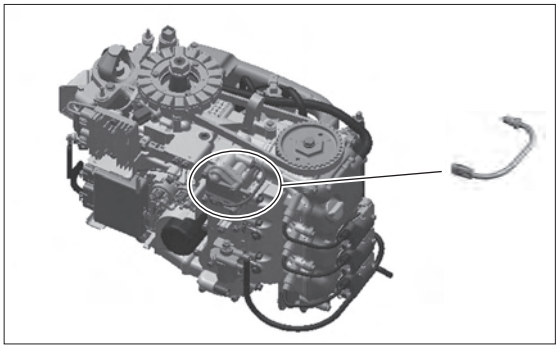
   MAP sensor is located on the upper area of intake manifold to detect intake manifold inner pressure (intake vacuum pressure and intake temperature) and send the signal to ECU.

   ECU uses this signal to establish fuel injection amount and ignition timing.



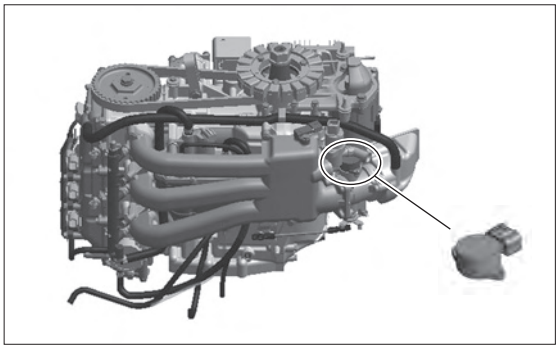
3. Engine Temperature Sensor

   Engine temperature sensor is located on the upper area of cylinder block. The sensor detects temperature of cooling water passage wall of which flow through engine is controlled with thermostat and sends the signal to ECU.



4. Throttle Position Sensor (TPS)

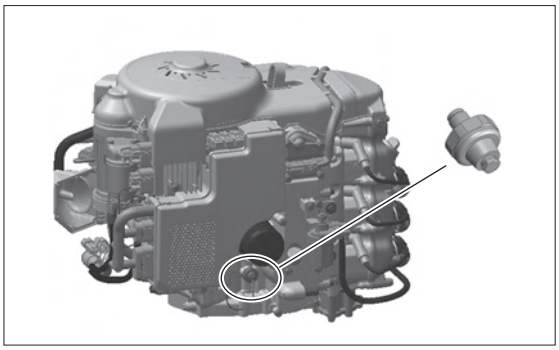
   Throttle position sensor is located on the top of throttle body, and is connected to throttle shaft. Throttle position sensor sends throttle opening angle information to ECU.



5. Oil Pressure Switch

Oil pressure switch is located on the port side of engine block below oil filter, and is projected into oil passage. Oil pressure switch sends oil pressure low signal to ECU.

ECU operates low speed ESG, warning buzzer and lamp based on this information.



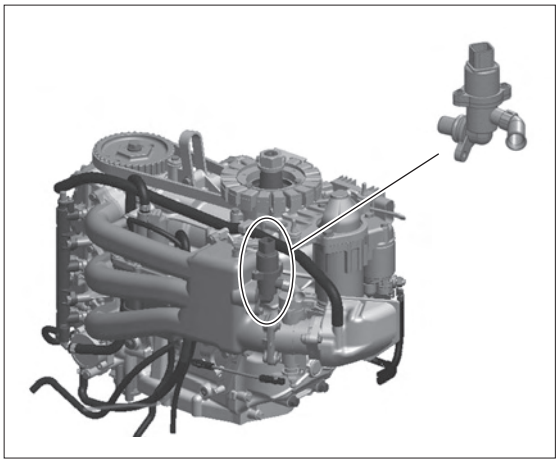
2) Actuators

Actuator section receives signals from ECU to control air/fuel ratio, ignition timing and idle revolution speed.

1. ISC (Idle Speed Control) Valve

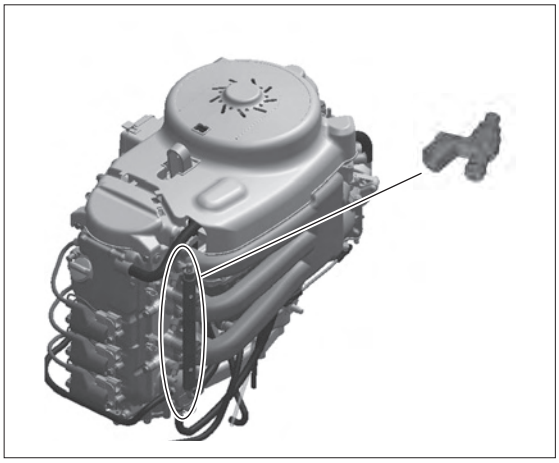
   ISC is also referred to as IAC (Idle Air Control). ISC valve is the stepping motor with needle valve, and controls amount intake air that bypasses closed throttle valve. Signal from ECU controled opening angle of ISC valve varies between 0% to 100% to control the following three functions.

   1. To increase idle revolution speed during engine warm-up by adding intake air amount at engine starting.
   2. To control idle revolution speed according to varying engine load and operating conditions.
   3. To prevent engine from stalling by adding intake air amount (bypass), functioning as dash pot, when throttle is closed quickly for rapid deceleration.



2. Fuel Injector

   Fuel injector is an electrical solenoid valve with built-in spring, and feeds fuel into intake manifold passage. It injects high pressure fuel when engine starts, electricity is supplied from ECU charge coil into injector, and then ECU closes ground circuit to lift solenoid. Fuel injector closes to stop its operation when ECU opens ground circuit.

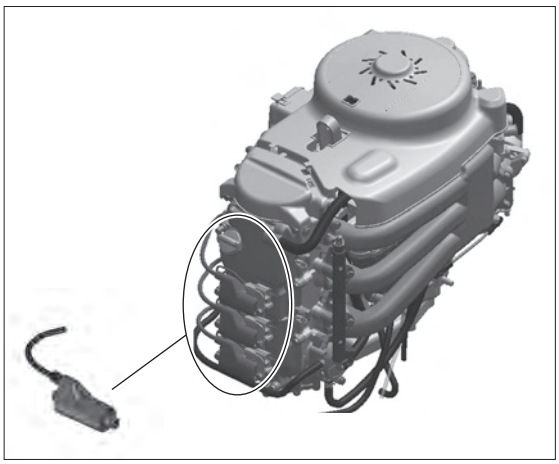


3. Fuel Feed Pump (FFP)

   Refer to description of vapor separator in Chapter 4.

4. Ignition Coil

   Refer to Chapter 4.



5. Warning Buzzer and Lamp (LED)

   Refer to Chapter 4.

6. Tachometer

   Refer to Chapter 4.

3) Control System (ECU)

Accidental malfunction of ECU stops engine.

ECU provides the following functions.

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

Operations of engine can be monitored and malfunction diagnosis can be made by using a personal computer installed with 3AC DIAGNOSIS (software) and diagnosis harness.

(2) Control System

ECU (Engine Control Unit) is installed on the electric blacket. Data received from sensors such as pulser coil, T - MAP (Manifold Pressure, Manifold Temperature) sensor and water temperature sensor are processed with computer to drive actuators (fuel injector, ISC valves, etc.) corresponding to current operating conditions to control fuel injection amount and ignition timing.

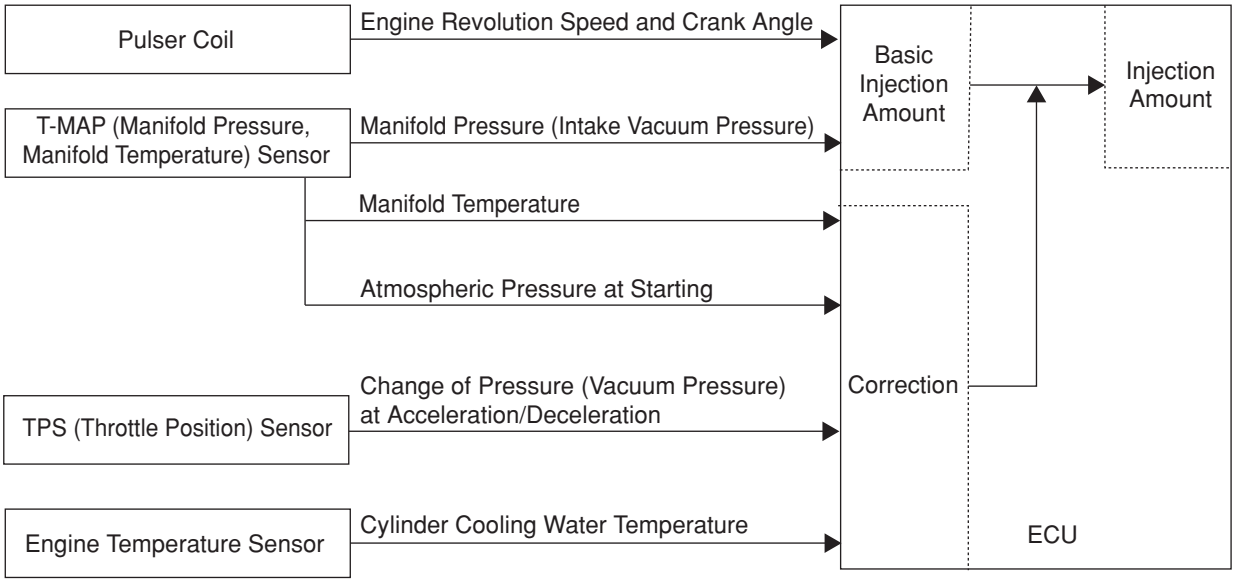
Principal control items are as follows.

Control Item	Description
Ignition Timing	Sets the most suitable ignition timing according to current operating conditions.
Fuel Injection Amount	Sets the most suitable fuel injection amount according to current operating conditions
ISC (Idle Speed Control)	Stabilizes engine revolution speed during idling or low speed running by driving ISC valve to control air flow in bypass passage.
Fuel Feed Pump	Controls driving of fuel feed pump (FFP)
Tachometer	Outputs tachometer driving pulses. Number of pulses per one revolution of crankshaft : 6 pulses (18 poles)
Warning Buzzer	Makes buzzer sound when an abnormality is detected. • Short period beep : For 2 seconds at Key turned "ON" to notify of normal system operation, meaning no problem. • Continuous sound : When engine high speed ESG is "ON". When engine temperature (over 100°) is abnormally high (over 150°) When engine oil pressure is abnormally low. • Intermittent sound : When water temperature sensor or MAP (Manifold Pressure) sensor is defective or sensor circuit is disconnected.
Warning Lamp (LED) (Tachometer warning lamp synchronizes and light ON, brinking.)	Makes the lamp light or blink when an abnormality is detected. • Short period lighting : For 5 seconds after starting engine to notify of normal system operation, meaning no problem. • Continuous lighting : When engine high speed ESG is "ON". When engine (over 100°) temperature is abnormally high (over 150°) • Intermittent lighting : When electrical component is defective or sensor circuit is disconnected. * Oil lamp intermittent lighting for "Oil change reminder".
Memorizing operational data	Manages the following engine operation information. • Engine operating hours • Maximum water temperature record (Maximum water temperature and time of occurrence) • Engine high speed ESG operation record • Engine low speed ESG operation record • Malfunction records

(3) Fuel Injection Control

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

At engine starting, during warm-up, acceleration/deceleration, and idling, ECU performs correction control based on information from sensors.



1) Fuel Injection Timing

Fuel injection timings at starting and during normal operation are described in the following table.

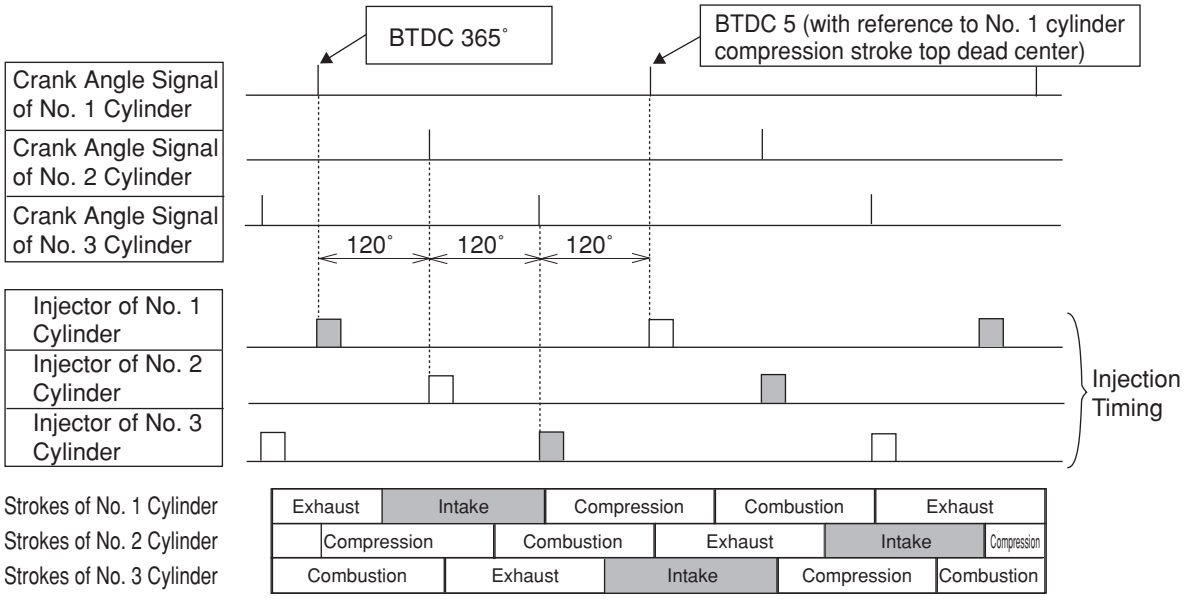
Cylinder No.	Reference Signal	Injection Timing (with reference to individual cylinders)
1	#1 Crank Angle Signal	BTDC 420° and BTDC 60°
2	#2 Crank Angle Signal	BTDC 420° and BTDC 60°
3	#3 Crank Angle Signal	BTDC 420° and BTDC 60°

Remarks 1) Number of fuel injections : Once per revolution per cylinder (around the end of compression and exhaust strokes)

2) Injection order : #1→#2→#3→#1→#2→#3→#1 (every 120 degrees of crank angle)

3) Combustion order : #1 → #3 → #2 → #1 (every 240 degrees of crank angle)

4) Injection timing diagram is shown below.



Injection Timing Diagram

2) Starting Fuel Increase Correction

At engine starting (cranking), amount of fuel injection of each cylinder is increased to facilitate starting.

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

3) Acceleration Fuel Increase Correction

When pressure in the intake manifold is reduced below a certain setting value, ECU determines that engine is accelerated and increases fuel injection amount.

4) Deceleration Fuel Decrease Correction

When pressure in the intake manifold is increased over a certain setting value, ECU determines that engine is decelerated and decreases fuel injection amount.

5) Correction Based On Intake Air Temperature

ECU adjusts fuel injection amount for correction according to manifold intake air temperature that depends much on outboard motor operating conditions and whether engine is cold or warm.

6) Correction Based On Cylinder Cooling Water Temperature

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

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

(4) Control of Fuel Feed Pump (FFP)

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

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

When stopping : Power supply to motor is shut off to stop pump (FFP).

(5) Control of Tachometer

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

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

When using accessory tachometer, set selector switch to 4 p (poles).

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

Warning System

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

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

1) Locations of warning buzzer and lamp (LED)

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

2) Warning notification, abnormality and action to be taken

Warning Indicators				ESG	Description of faults or notice	Remarks	Remedy
Buzzer	A Lamp	B Lamp	C Lamp				
Continuous	×	×	×	High-Speed ESG	Engine speed exceeds maximum allowable RPM	Approx. 6,200 r/min	(1)
Continuous	ON	×	×	Low-Speed ESG	Low oil pressure		(2)
Continuous	×	Flashing ①	×	Low-Speed ESG	Engine temp. high	100 ºC (212 ºF)	(3)
Continuous	Flashing ①	Flashing ①	Flashing ①	Foced idling	Engine temp. abnormally high	140 ºC (284 ºF)	(3)
-	×	×	Flashing ①	-	Vattery voltage is low	Approx. under 9 V, Idle speed up	(4)
-	Flashing ①	Flashing ①	Flashing ①	Low-Speed ESG	Malfunction of sensor		(5)
-	Flashing ①	Flashing ①	Flashing ①	-	Malfunction of fuel injector		(5)
-	Flashing ①	Flashing ①	Flashing ①	-	Malfunction of ignition coil		(5)
-	Flashing ①	Flashing ①	Flashing ①	-	Malfunction of FFP		(5)
-	Flashing ①	Flashing ①	Flashing ①	-	Malfunction of CPS (*1)	(*1) open circuit is not ditection.	(5)
-	Flashing ①	Flashing ①	Flashing ①	-	Malfunction of TPS		(5)
-	Flashing ①	Flashing ①	Flashing ①	Low-Speed ESG	Malfunction of engine temp sensor		(5)
-	Flashing ①	Flashing ①	Flashing ①	Low-Speed ESG	Malfunction of MAP sensor		(5)
-	Flashing ①	Flashing ①	Flashing ①	-	Malfunction of MAT sensor		(5)
Continuous (*2)	ON (*2)	ON (*2)	ON (*2)	-	Normal system test when key ON	(*2) 1 second	Normal operation is an operation check of warning system at the starting
-	Flashing ②	×	×	-	Inform the recommended timing of engine oil replacement (every 100 hrs.)	Reset by stop switch	(6)
Once Beep	×	×	×	-	Lowest idling speed of variable idling system		Normal operation is an operation check of control system
Twice Beep	×	×	×	-	Hoghest idling speed of variable idling system		Normal operation is an operation check of control system

Short sound 1 : 0.3 sec.	Flashing ① pattern : ON 1 sec., OFF 1 sec.	Low sepeed ESG : 2800 r/min
Short sound 2 : ON 0.3 sec. – OFF 0.3 sec. – ON 0.3 sec.	Flashing ② pattern : ON 1 sec., OFF 9 sec.	High sepeed ESG : 6200 r/min

Note : When engine low speed ESG goes on, the speed is reduced to 2,800 r/min or lower.
Therefore, continuous operation in this state should be avoided.
When engine high speed ESG goes on, the speed is set to 6,200 r/min.
ECU stops feeding of fuel to control the speed to 6,200 r/min.
Continuous operation in this state should be avoided.

Action to be taken

(1) : Run immediately to a safe location, set throttle to slow speed, shift into neutral (N), check that cooling water is discharged to check port, and then, stop engine.
Remove dirt, plastic sheet or other matters that clogs water intake port, if any.
If no water is discharged from the port, check each section of the outboard motor.

(2) : Run immediately to a safe location, set throttle to slow speed, shift into neutral (N), and stop engine.
Check engine oil level, and add oil if necessary.
If engine oil level is within specified range, check other sections.

(3) : Run immediately to a safe location, set throttle to slow speed, shift into neutral (N), and stop engine.
Check propeller blades for bend or damages.
If this abnormality continues even after propeller is replaced with new one, check other sections.

(4) : Replace or recharg battery.

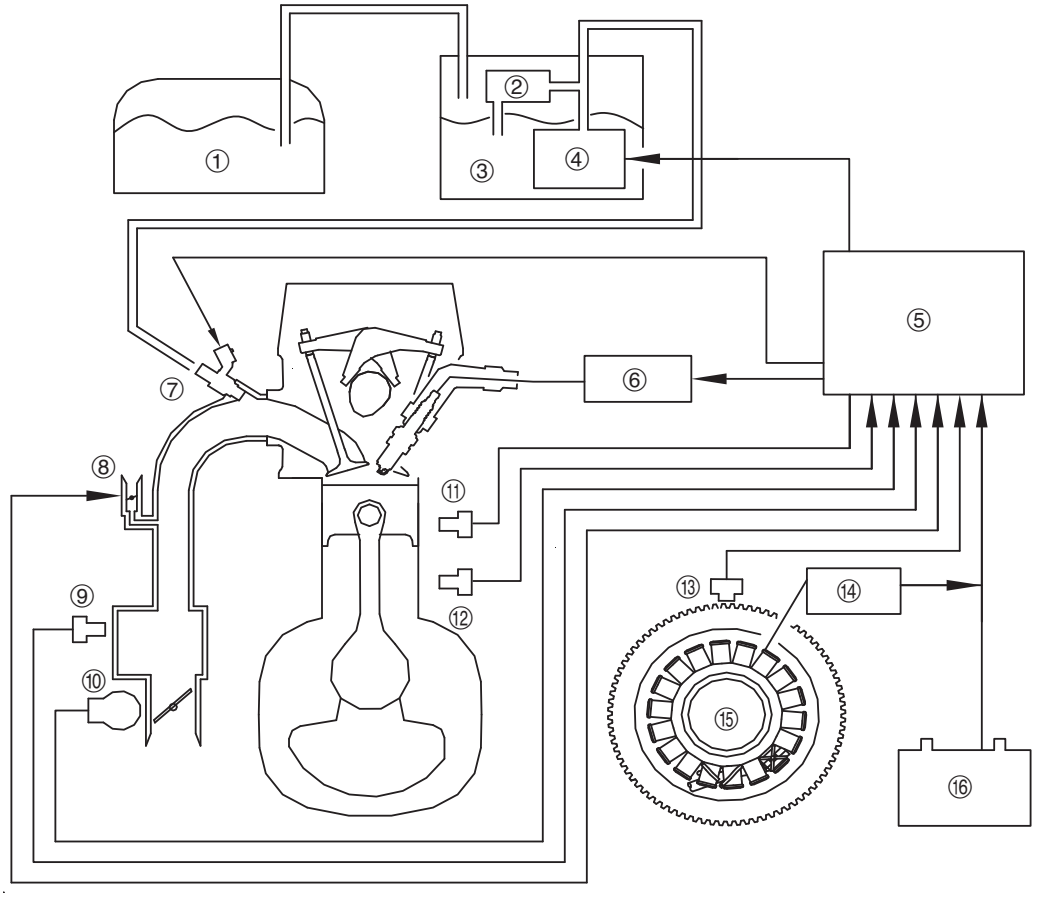
(5) : Go to the nearest port immediately and check each section after stopping engine.

(6) : Replace engine oil, and then reset the oil presser warning indicator.

5. Ignition System

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

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



① Fuel Tank
② Fuel Regulator
③ Vapor Separator
④ Fuel Feed Pump (FFP)
⑤ ECU
⑥ Ignition Coil
⑦ Fuel Injector
⑧ ISC Valve
⑨ MAP/MAT Sensor
⑩ TPS
⑪ Engine TEMP. Sensor
⑫ Oil Pressure Switch
⑬ Pulser Coil
⑭ Rectifire
⑮ Alternator
⑯ Battery

4

(1) Configuration of Ignition System

Ignition system consists mainly of the following components.

(1) Sensors and switches that transmit engine operating states to ECU.

(2) ECU that performs electronic control.

(3) Ignition coils and spark plugs that operate in accordance with control by ECU.

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

• Pulser coil	Crank position (Crank Position Sensor)
• Throttle Position Sensor (TPS)	Throttle opening angle
• Water Temperature Sensor	Temperature of ENGINE (Crankcase)
• MAP (Manifold Pressure) Sensor	Vacuum pressure of intake air
• MAT (Manifold Temperature) Sensor	Temperature of intake air
• Oil Pressure Switch	Reduction of hydraulic pressure

* Integrated MAP (Manifold Pressure) Sensor and MAT (Manifold Temperature) Sensor

(2) Ignition Control

ECU's microcomputer is programmed with ignition timings best suited to engine's operating conditions. ECU obtains information about engine operating state such as revolution speed, throttle opening, manifold pressure (air intake vacuum pressure) and cooling water temperature based on the signals from the abovementioned sensors to generate ignition timing signal at the most suitable timings.

1) Ignition Timing Controls

Controls of ignition timing is classified into two controls, which are correction of ignition timing during normal operation and fixing of ignition timing (at engine starting and when an abnormality has occurred). In either case, ECU corrects ignition time or fixes it to the base.

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

2) Ignition and Combustion Orders

No. of Ignitions : Once per revolution per cylinder (around the end of compression and exhaust strokes)
Ignition Order : #1→#2→#3→#1→#2→#3→#1 (every 120 degrees of crank angle)
Combustion Order : #1 → #3 → #2 → #1 (every 240 degrees of crank angle)

3) Ignition Timing

Ignition timing is set as described below.

Model	Range of Ignition Angle	Engine Starting	Idling	Accelerating
40/50B	BTDC 2° to BTDC 27°	TDC 0°	BTDC 2°±5°	BTDC 27°

4) Operations

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

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

- During normal operation
  Microcomputer determines ignition timing in accordance with ECU's program by using cooling water temperature, manifold intake air temperature, atmospheric pressure and engine revolution speed as input signals. The maximum timing during normal operation is BTDC 25°.

- During acceleration/Deceleration
  When engine revolution speed changes much and is reduced below (or exceed) a setting value, ECU determines that engine is accelerating (or decelerating), and microcomputer determines the ignition timing based on the program installed in ECU.

- At engine over-revolution
  When engine revolution speed exceeds the maximum allowable value (6,200r/min), ECU stops feeding of fuel to control the revolution based on pulser coil signals. This is the state that engine high speed ESG is "ON".

- Engine low speed ESG is "ON".
  When any of the following state has been detected, engine revolution speed is controlled to 2,800r/min to prevent or reduce engine damage. This is the state that engine low speed ESG is "ON".
  - Engine is overheating. : Engine temperature sensor detects 100° or higher.
  - Engine hydraulic pressure is low. : Oil pressure switch ON (24.5kPa (3.6PSi) [0.25kg/cm^2] or less) is detected for 5 seconds or longer.

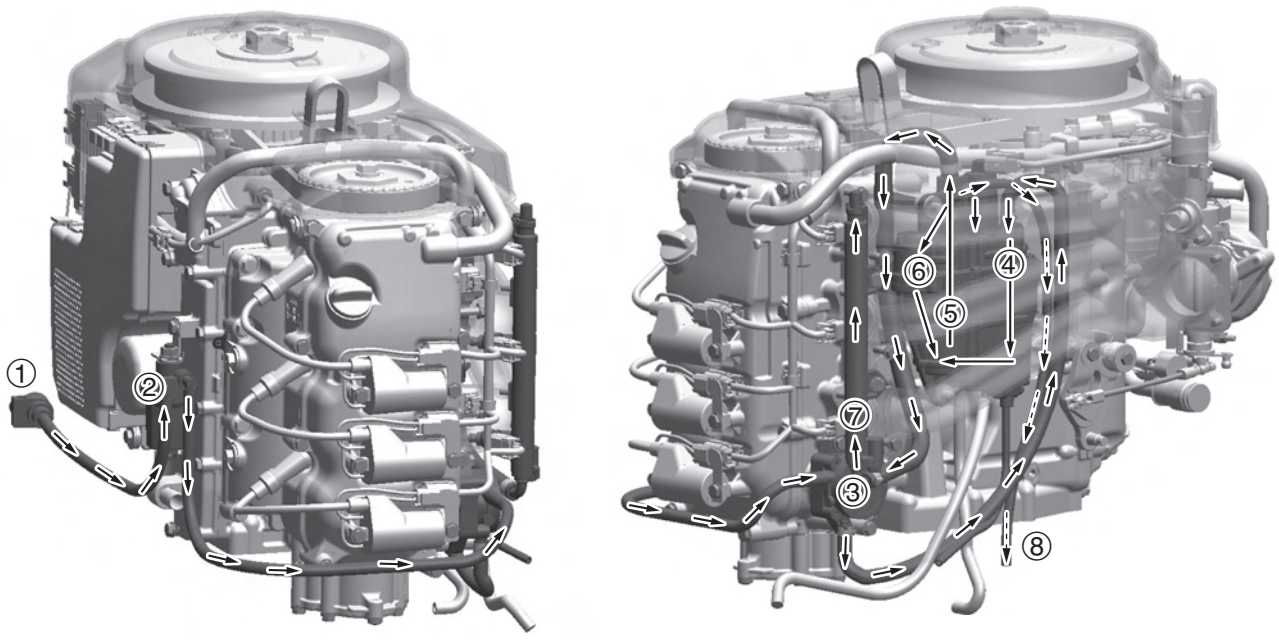
(3) Fuel Feed System

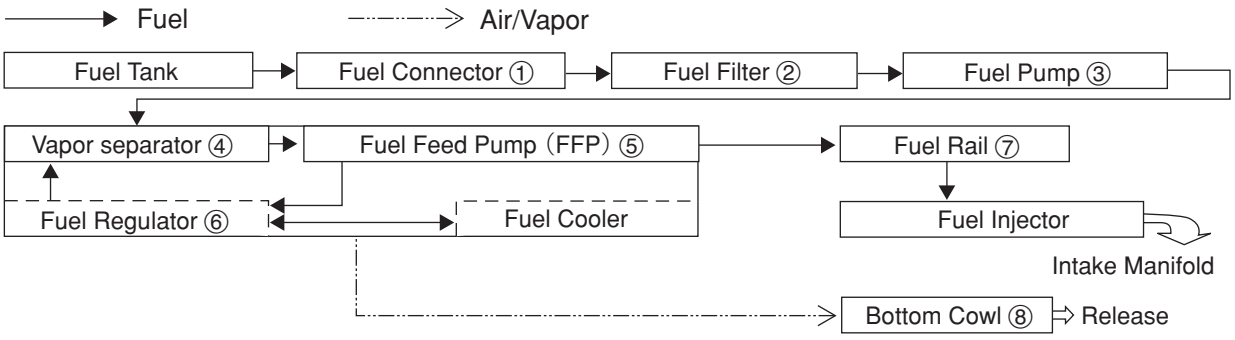
Fuel pump ③ (low pressure mechanical type) draws fuel from fuel tank, and feed it to fuel feed pump ⑤ (FFP) located in the vapor separator ④ through fuel connector ① and fuel filter ②.

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

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

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



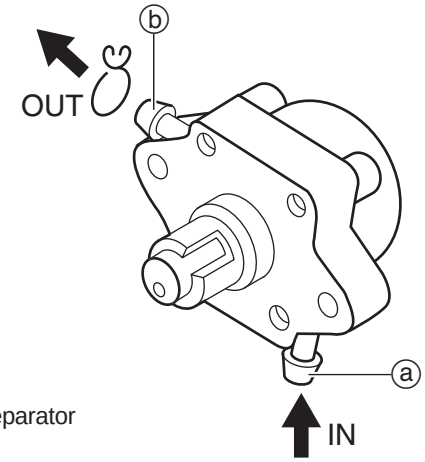


6. Components of Fuel Feed System

1) Fuel Pump (Low Pressure Mechanical Pump)

Fuel pump is diaphragm pump that is operated mechanically by camshaft and lifter.

Pump base is plastic and insulates heat from the engine block to protect fuel pump and reduce vapor.



ⓐ IN : Fuel from Filter/Tank

ⓑ OUT : Fuel Outlet to Vapor Separator

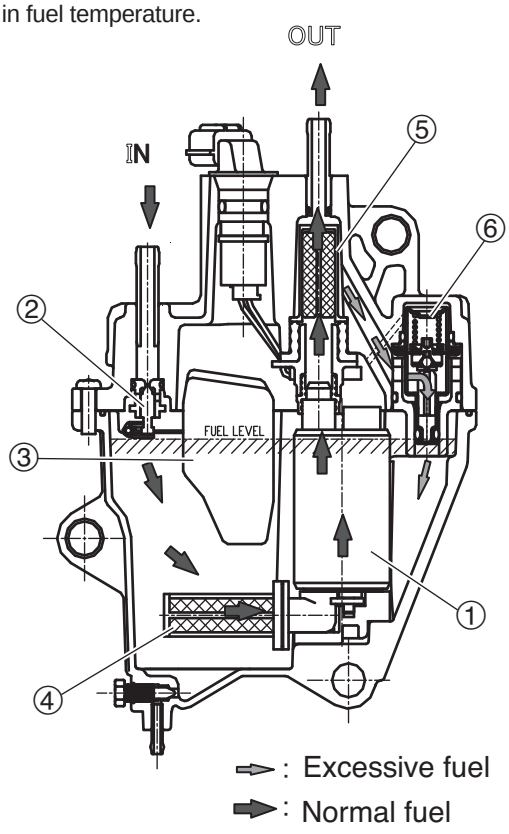
2) Vapor Separator

Vapor separator feeds only liquid fuel for internal fuel feed pump (FFP) ① (electrical high pressure pump). Fuel that is fed from fuel pump (low pressure mechanical pump) is sent to upper part of vapor separator, where it is controlled with needle valve ②/float ③ ass'y.

Removes trash and fuel filter (suction side) ④ Fuel filter (discharge side) ⑤ when passing through the Fuel Feed Pump (FFP).

Filters inside the vapor separator to remove dust from the fuel. Fuel filter ④ (Inlet filter) and fuel filter ⑤ (outlet filter) privent dust to enter the fuel flow.

High pressure fuel from fuel feed pump (FFP) is fed to fuel rail and fuel injector. Excessive fuel is returned to chamber by fuel regulator that is built into the vapor separator. In addition, fuel cooler is mounted in the vapor separator, thereby suppressing an increase in fuel temperature.



① Fuel Feed Pump (FFP)

② Needle Valve

③ Float

④ Fuel Filter (suction side)

⑤ Fuel Filter (discharge side)

⑥ Fuel Regulator

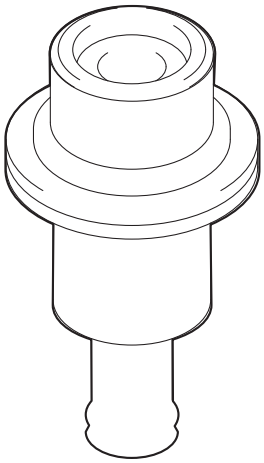
3) Fuel Regulator

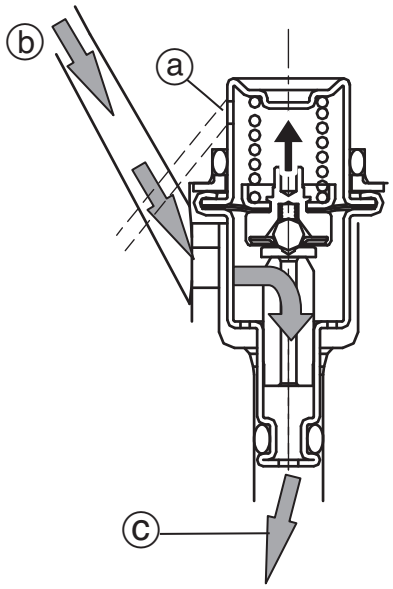
Fuel regulator located on the inside section of vapor separator serves to keep regular fuel pressure.

Fuel regulator consists of diaphragm with built in spring that actuates valve/seat, and returns (pressurized) excessive fuel to vapor separator when the pressure exceeds certain value.

Excessive fuel is returned to vapor separator through internal pipe below fuel level to prevent it from bubbling.

Spring side ⓐ of diaphragm is open to air so that change of atmospheric pressure is applied to diaphragm.





ⓐ To Bottom Cowl (open to air)

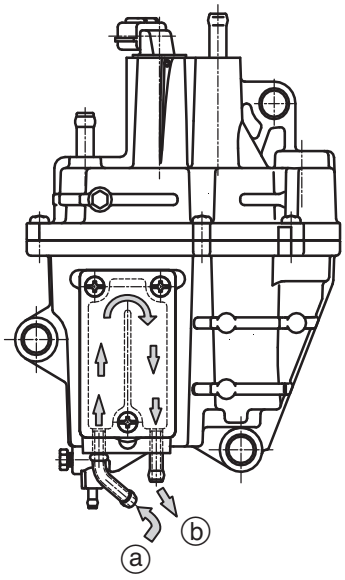
ⓑ High Pressure Fuel from Fuel Cooler

ⓒ Excessive fuel returns to vapor separator.

4) Fuel Cooler

Fuel cooler (heat exchanger) is built into the vapor separator to cool the fuel in the vapor separator, which also uses the cooling water of the engine. It is possible to remove heat from the fuel, which serves to protect from wear (FFP) fuel feed pump and the fuel vapor. Cooling water that has been sent from the water pump is divided into two passages by the engine base, headed to the fuel cooler and inside the engine. Cooling water from the engine enters the base of the cooling water inlet of ⓐ fuel cooler and out from the cooling water outlet ⓑ, and directed to the cooling water pilot hole, and discharged.

*This water does not pass through the engine first.



ⓐ Cooling Water Inlet

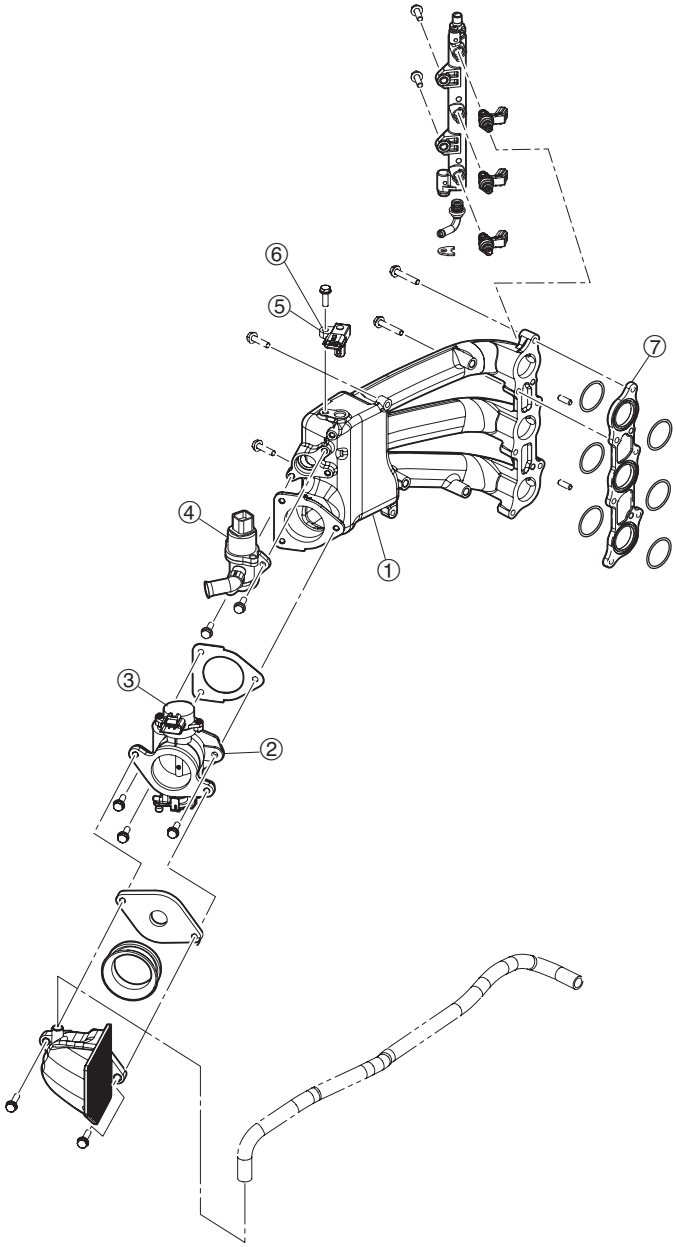
ⓑ Cooling Water Outlet

7. Outline of Fuel Injection System

1) Air Intake System

Air intake system consists of components including intake manifold ① (passage to cylinders that is coupled with common air chamber), throttle position sensor ②, throttle body/shutter ③, ISC (idle speed control) valve ④, MAP (manifold pressure) sensor, and MAT (manifold temperature) sensor ⑤.

Intake manifold ① is provided with fuel rail and fuel injectors.

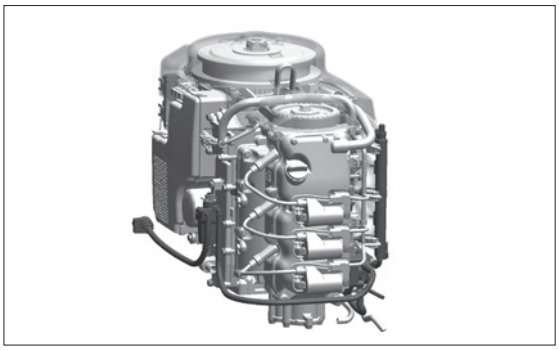


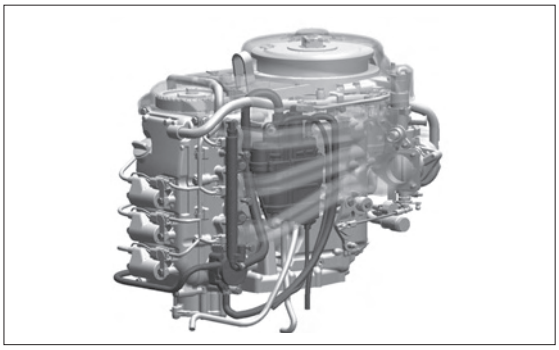
① Intake Manifold
② Throttle Body/Shutter
③ Throttle Position Sensor
④ ISC (Idle Speed Control) Valve
⑤ MAP Sensor
⑥ MAT Sensor
⑦ Insulator (heat shield panel)

8. Inspection Items

1) Inspection of Fuel Supply System Piping

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



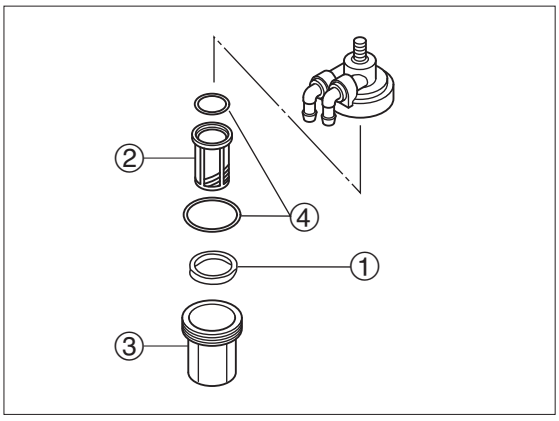


2) Inspection of Filter

⚠ CAUTION

- **If red ring ① is floating, remove and empty filter cup.**
- **Be careful not to spill fuel during cup removal and dispose of properly.**

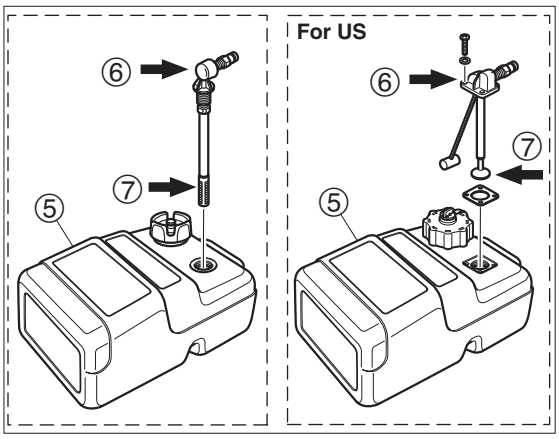
1. Check fuel filter ② for dirt, build up of fuel slag, and fuel filter cup ③ for invasion of foreign matters and crack. Clean fuel filter cup with gasoline, and replace fuel filter ② if necessary.



④ O Ring **Do not reuse.**

2. Cleaning Fuel Tank Filter
   Remove fuel pick up elbow ⑥ of fuel tank ⑤ counterclockwise to remove the part, and clean the filter ⑦.

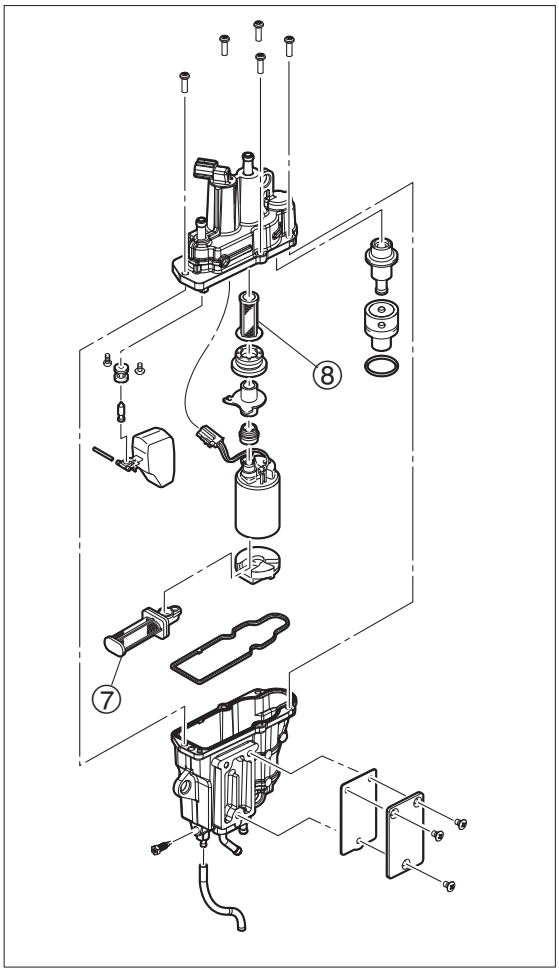
3. Cleaning Fuel Filter
   Remove dirt and water from fuel tank ⑤ if any.



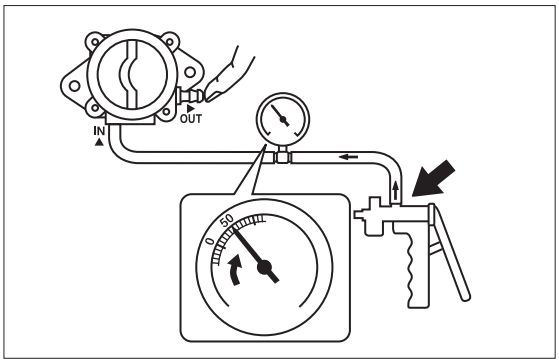
⑤ Fuel Tank ⑥ Fuel Pick Up Elbow
⑦ Filter

4. Cleaning Fuel Feed Pump (FFP) Filter

Remove and clean fuel filter ⑦ (suction side) and ⑧ (discharge side) from fuel feed pump (FFP) bilted in vapor sepalator.



3) Inspection of Fuel Pump



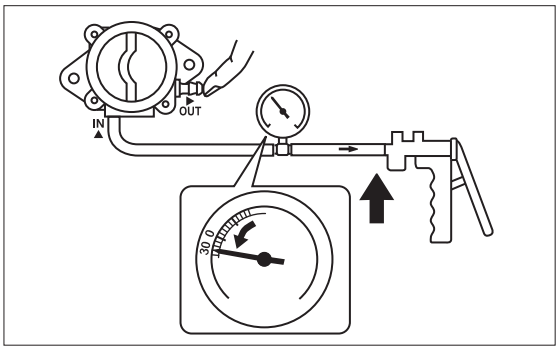
1. Remove fuel hoses (2) from fuel pump.

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.

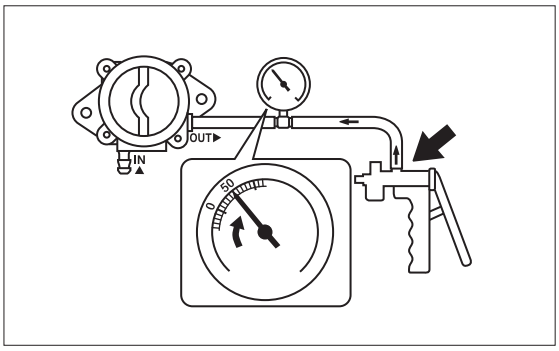
Vacuum/Pressure Gauge :
P/N. 3AC-99020-1

Specified Pressure :
0.049 MPa (7 psi) [0.5 kgf/cm^2]



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

Specified Pressure :
−0.029MPa (−4 psi) [−0.3 kgf/cm^2]



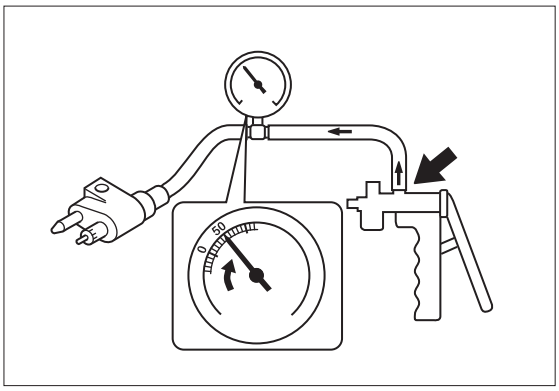
5. Connect vacuum/pressure gauge to outlet of fuel pump.

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/cm^2]

4) Inspection of Fuel Connector



1. Check fuel connector for crack and damage.

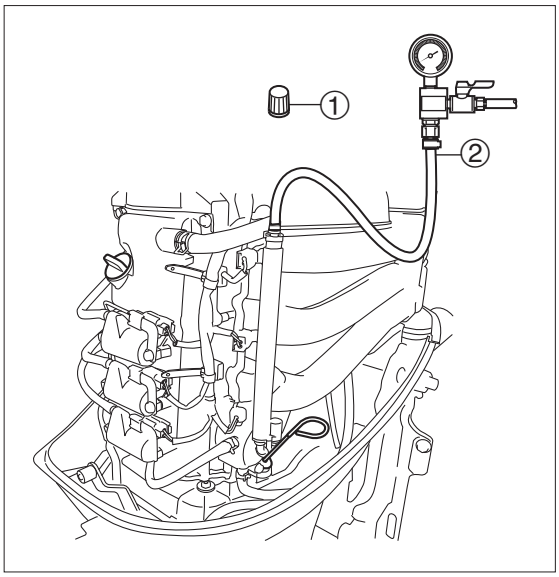
2. Connect vacuum/pressure gauge to outlet of fuel connector.

3. Apply 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/cm^2]

5) Measuring fuel pressure



1. Remove cap ①.

2. Connect pressure gauge ② as shown.

⚠ WARNING

- **Before connecting pressure gauge, cover connection between pressure gauge and valve with clean and dry cloth to prevent fuel from releasing.**
- **Connect pressure gauge securely.**

Pressure Gauge Ass'y :
P/N. 3T5-72880-0

⚠ WARNING

Before measurement, check that pressure relief valve is fully closed.

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

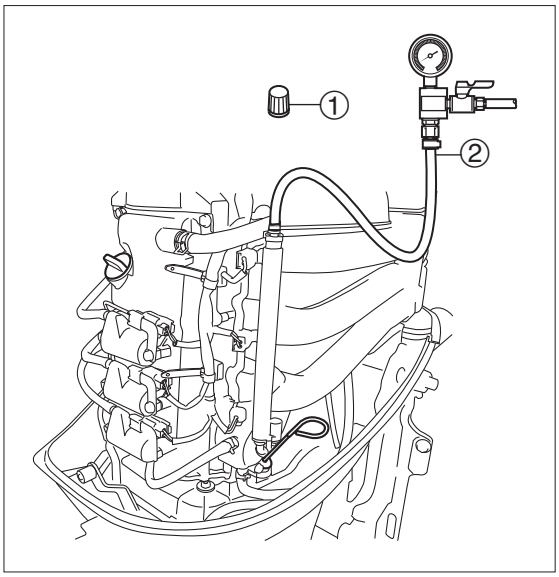
⚠ WARNING

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

Fuel Pressure (Reference) :
0.29 MPa (43 psi) [3.0 kgf/cm^2] ±10%

Turn the main sweitch to "ON" (fuel feed pump operate on 8 seconds), to measure the fuel pressure without engine opration.

6) Inspection of Fuel Regulator



1. Remove cap ①.

2. Connect pressure gauge ② as shown.

⚠ WARNING

- **Before connecting pressure gauge, cover connection between pressure gauge and valve with clean and dry cloth to prevent fuel from releasing.**
- **Connect pressure gauge ass'y securely.**

Pressure Gauge Ass'y :
P/N. 3T5-72880-0

3. Start engine and keep running at idle revolution speed.

Fuel Pressure (Reference) :
0.29 MPa (43 psi) [3.0 kgf/cm^2] ±10%

⚠ WARNING

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

7) Draining Fuel

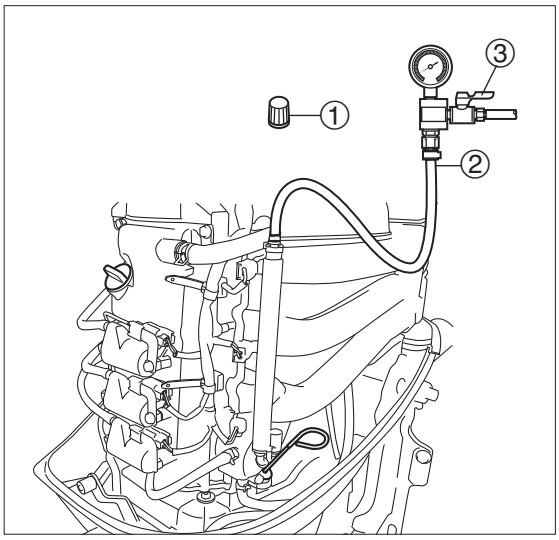
1. Remove cap ①.

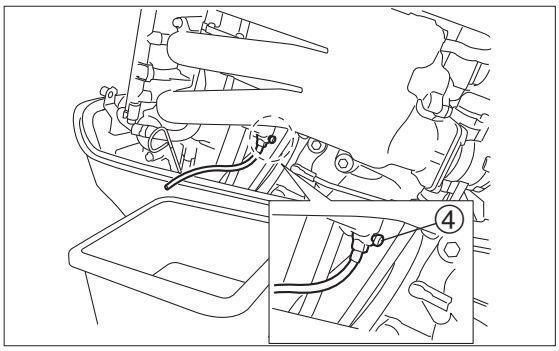
2. Connect pressure gauge ass'y ② as shown, place a vessel below pressure relief hose, and open pressure relief valve ③ to release fuel pressure.

⚠ WARNING

Be sure to reduce fuel pressure in high pressure fuel passage before servicing fuel passage and/or vapor separator. Performing the service without releasing pressure allows compressed fuel to blast out, possibly causing hazard.

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



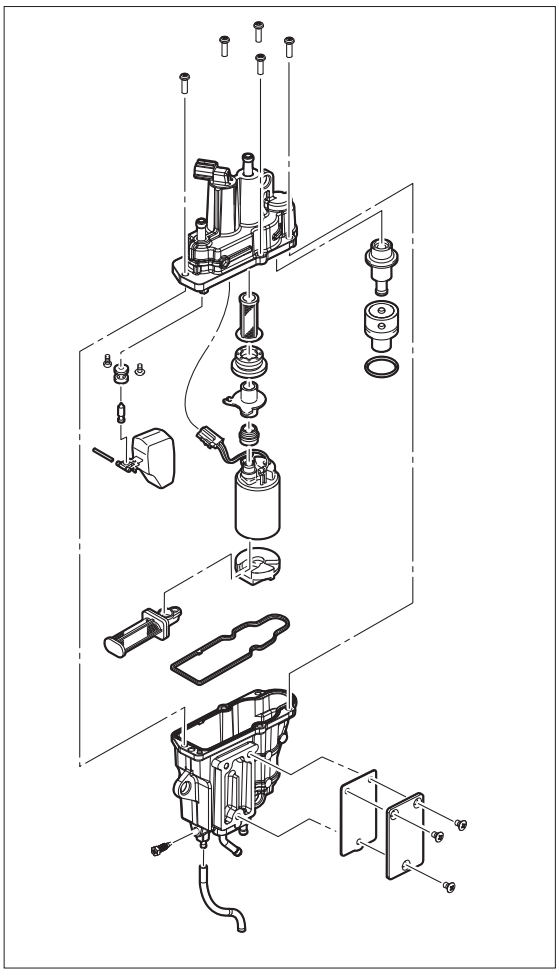


8) Disassembly of Vapor Separator

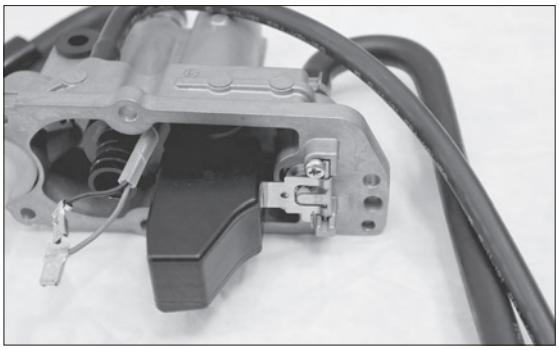
⚠ WARNING

Be sure to reduce fuel pressure in high pressure fuel passage before servicing fuel passage and/or vapor separator. Performing the service without releasing pressure allows compressed fuel to blast out, possibly causing hazard.

1. Remove float chamber of vapor separator.

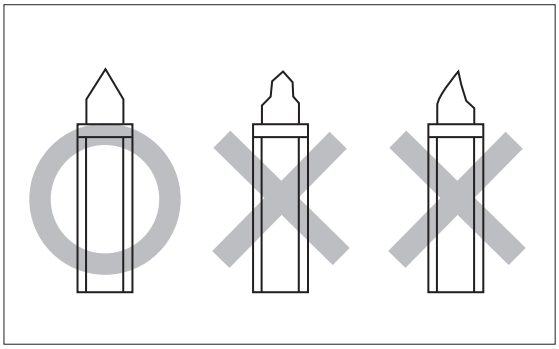


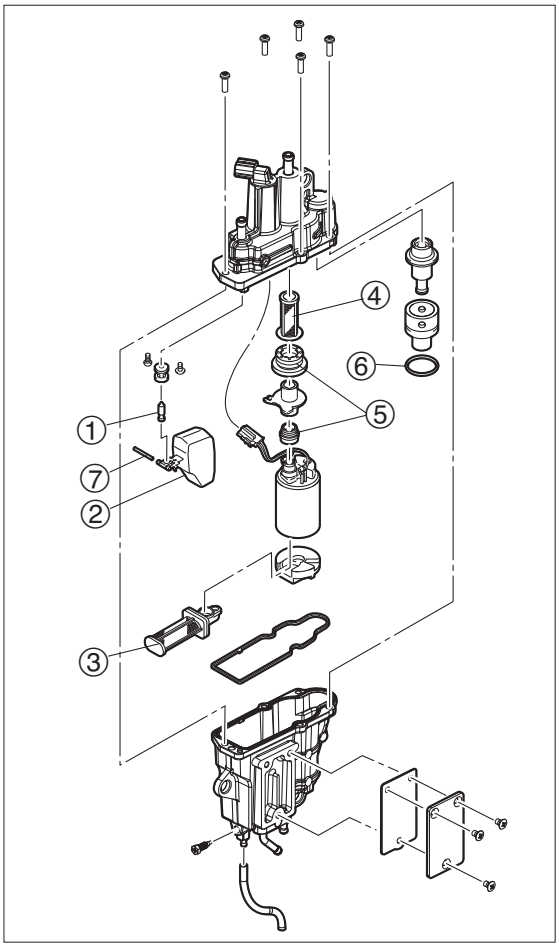
2. Remove needle valve, float pin and float.



9) Inspection of Vapor Separator

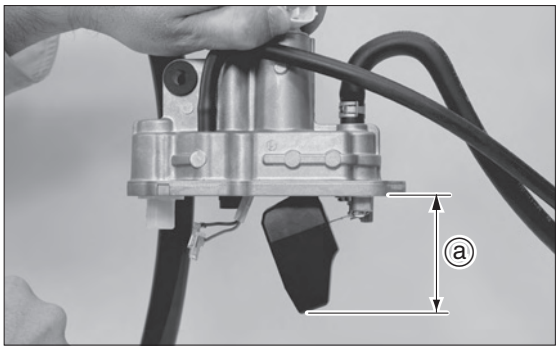
1. Check needle valve ① for bend and wear. Replace if necessary.
2. Check float ② for deformation. Replace if necessary.
3. Check filter for inlet ③ and outlet ④ for dirt and clogging. Clean if necessary.
4. Check grommet ⑤ and O-ring ⑥ condition. Replace if necessary.
5. Reinstall needle valve ①, float ② and float pin ⑦, and check that the parts moves smoothly.





6. Check float drop ⓐ as shown.

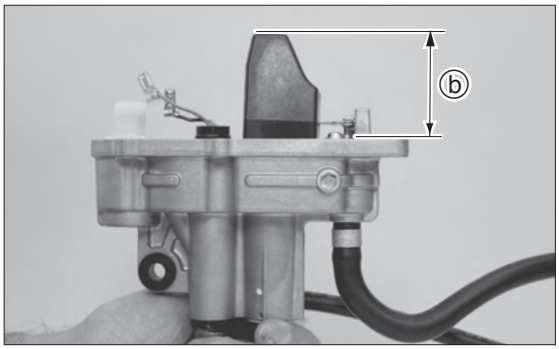
Float Drop (Reference) ⓐ :
30.0 mm (1.181 in)



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

Do not press needle valve with float.

Float Height ⓑ :
20.0 to 23.0 mm (0.787 to 0.906 in)

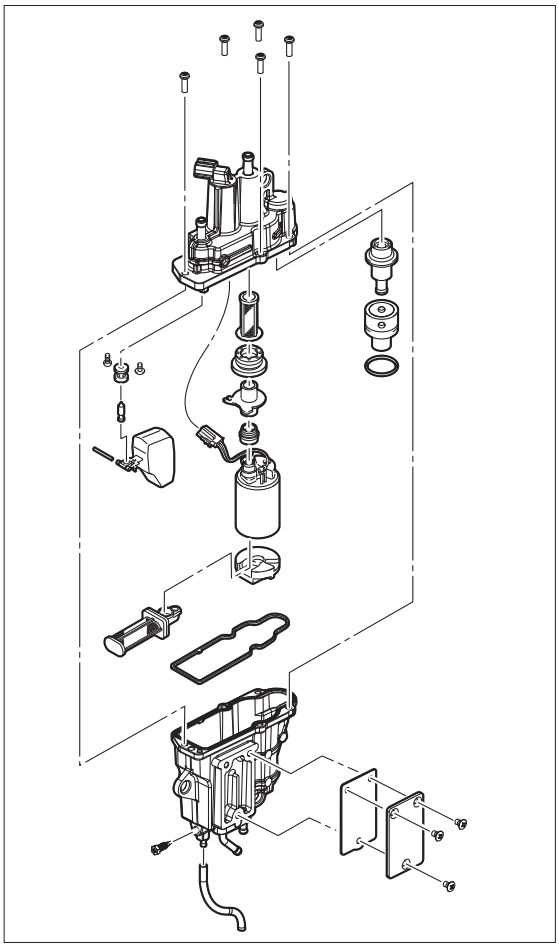


10) Reassembly of Vapor Separator

1. Attach float chamber to vapor separator.

2. Reassemble all parts that were removed.

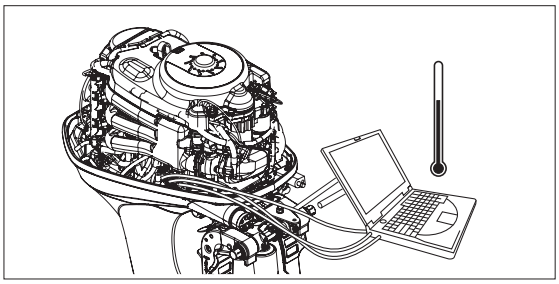
Check that hose is reconnected correctly.



11) Inspection of ISC (Idle Speed Control)

1. Use diagnosis system to check operation of ISC (Idle Speed Control) valve.

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



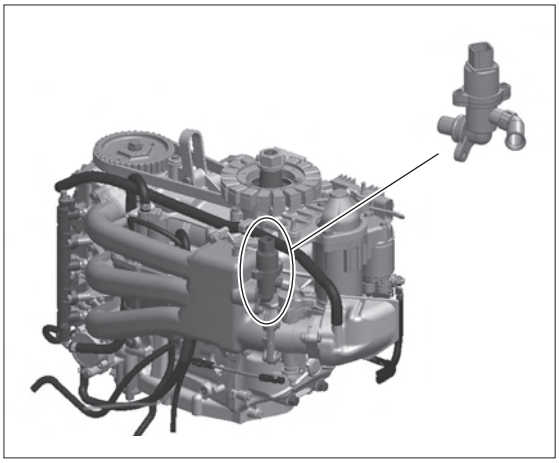
12) Inspection of Idle Speed

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

2. Check idle speed.

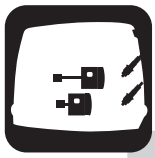
Tachometer :
P/N. 3GF-72647-1
3GL-72647-1

Idle Speed :
850-± 30 r/min

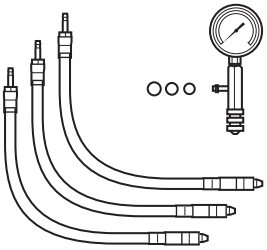
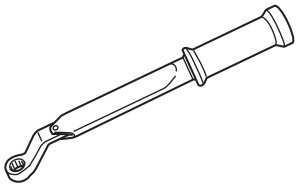
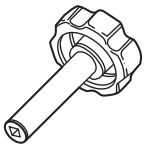
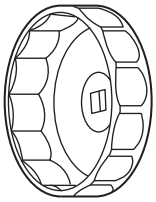
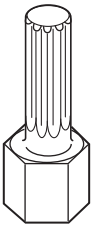
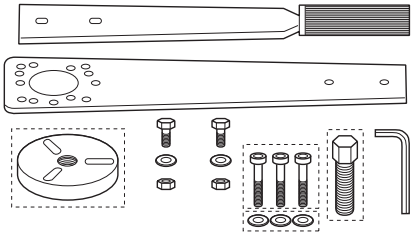


5

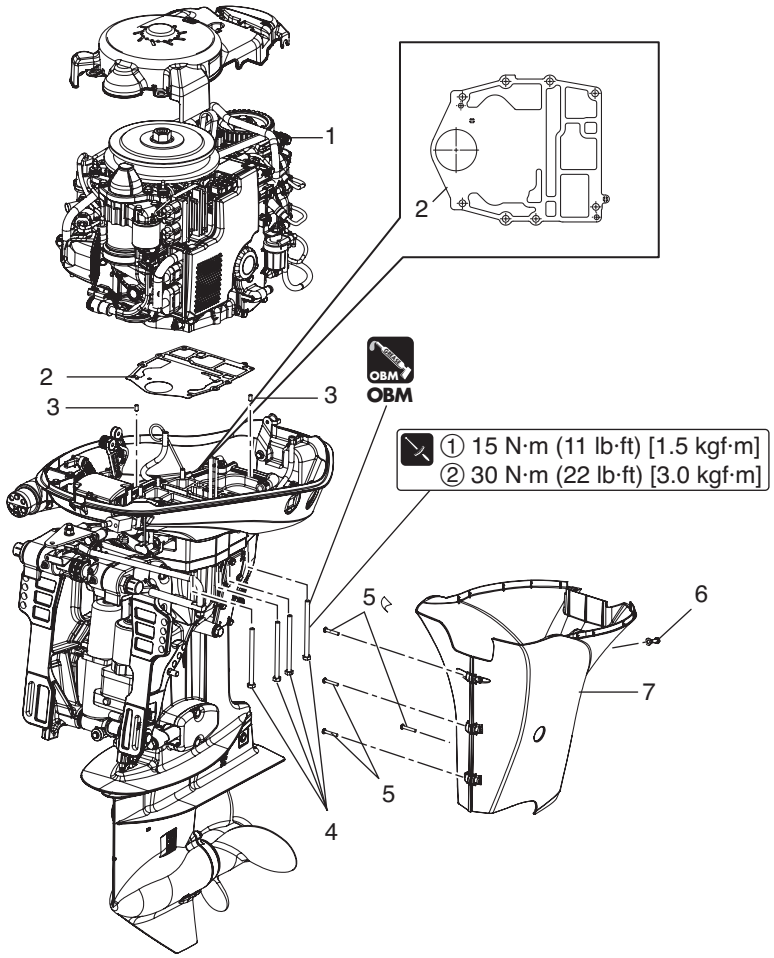
Power Unit



1.Special Tools

			
Piston Slider P/N. 3KY-72871-0	Compression Gauge P/N. 3AC-99030-0	Torque Wrench P/N. 3AC-99070-0	Valve Clearance Driver P/N. 3AC-99071-0
Installing piston	Measuring compression pressure	Adjusting valve clearance	Adjusting valve clearance
			
Oil Filter Wrench P/N. 3AC-99090-0	Crank Shaft Holder P/N. 3KY-72815-0	Flywheel Puller Kit P/N. 3T1-72211-0	
Removing/installing oil filter	Holding crank shaft	Removing/installing flywheel	

2. Parts Layout
Engine

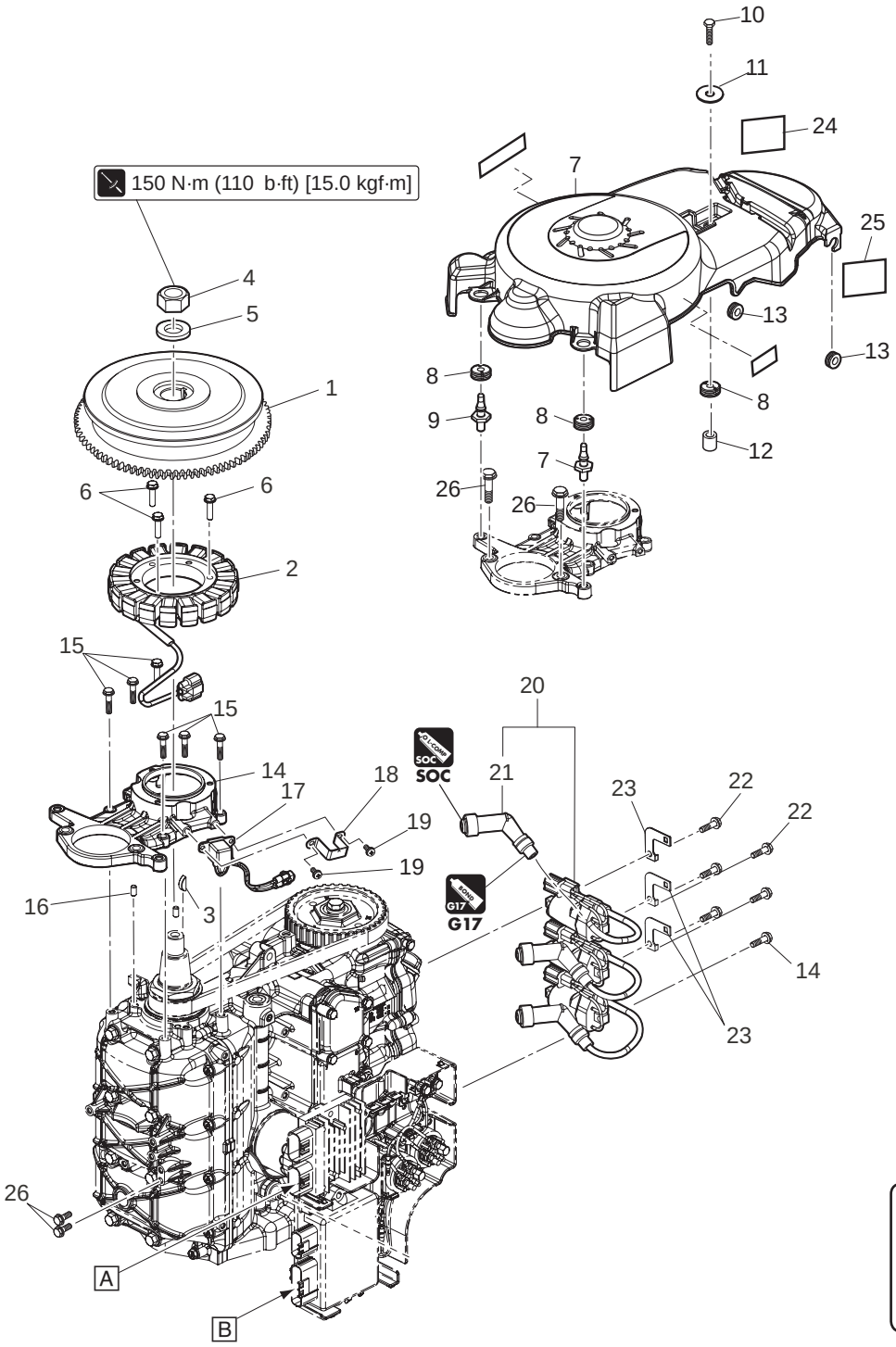


OBM

Ref. No.	Description	Q'ty	Remarks
1	Power Unit	1	
2	Engine Base Gasket	1	Do not reuse.
3	Dowell Pin	2	
4	Bolt	8	M8 L=115mm
5	Tapping Screw	4	
6	Bolt	1	M6 L=16mm
7	Apron	1	

Magneto

P/L Fig. 7

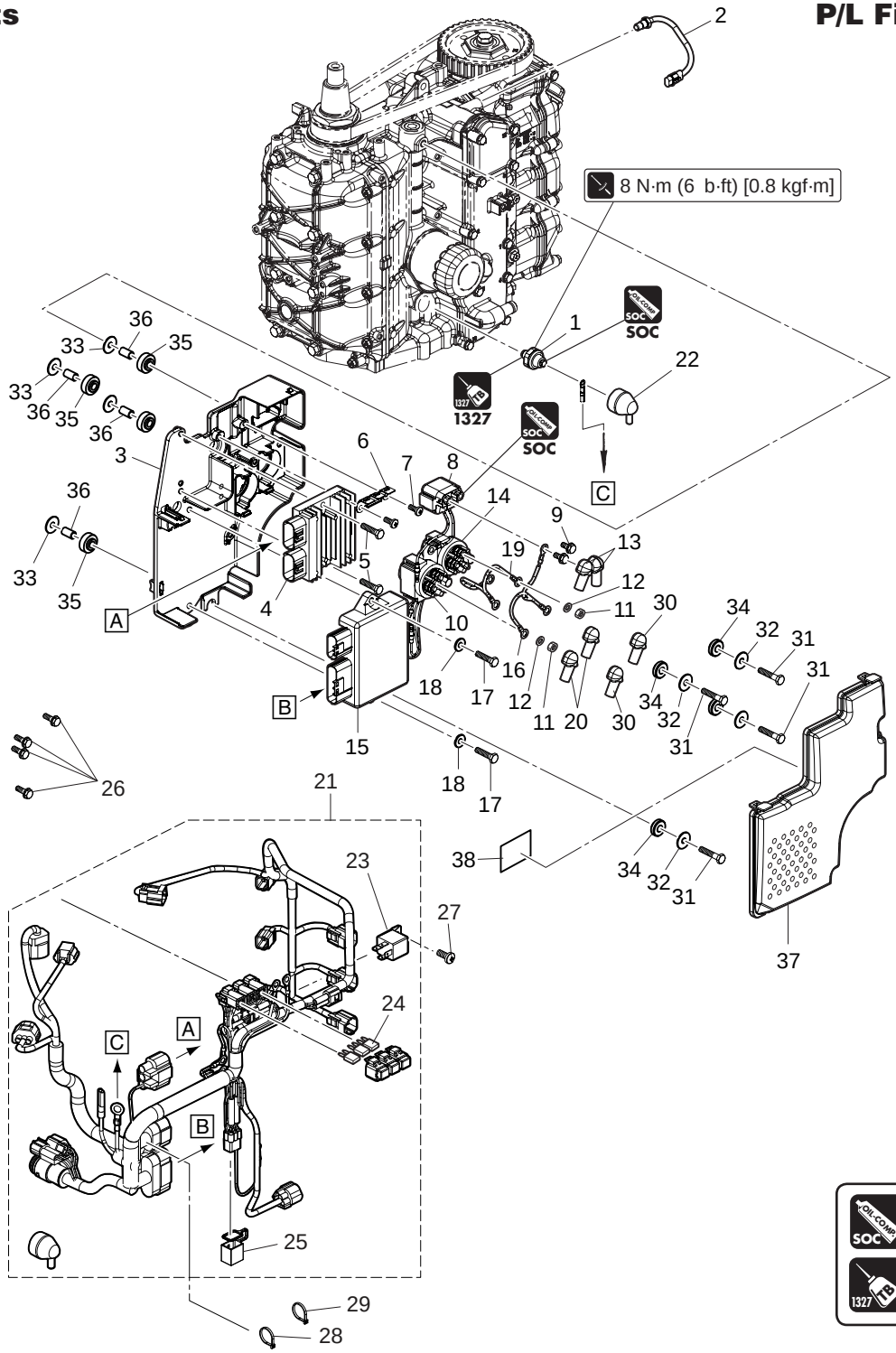


Ref. No.	Description	Q'ty	Remarks
1	Flywheel W/Gear	1	
2	Alternator Ass'y	1	
3	Key 19-7-5	1	
4	Nut 20-p1.25	1	M20
5	Washer 20.5-37-5	1	M20
6	Bolt	3	M6 L=25mm
7	Ring Gear Cover	1	
8	Grommet 16-2.5	3	
9	Hook	2	
10	Bolt	1	M6 L=20mm
11	Washer 6-16-1.5	1	M6
12	Collar 6.2-9-7.4	1	
13	Grommet 13-2	2	
14	Coil Bracket	1	

Ref. No.	Description	Q'ty	Remarks
15	Bolt	6	M6 L=25mm
16	Dowel Pin 6-12	2	Cylinder Blok-CoilBraket
17	Pulsar Coil	1	
18	Pulsar Coil Guard	1	
19	Screw	2	
20	Ignition Coil W/R-cap	3	
21	Plug Cap W/Resistance	1	
22	Bolt	6	M6 L=20mm
23	Stay	3	
24-1	Caution Decal (B)	1	
24-2	Caution Decal (B)	1	
25	Fuse Decal	1	
26	Bolt	2	M8 L=30mm

Electric Parts

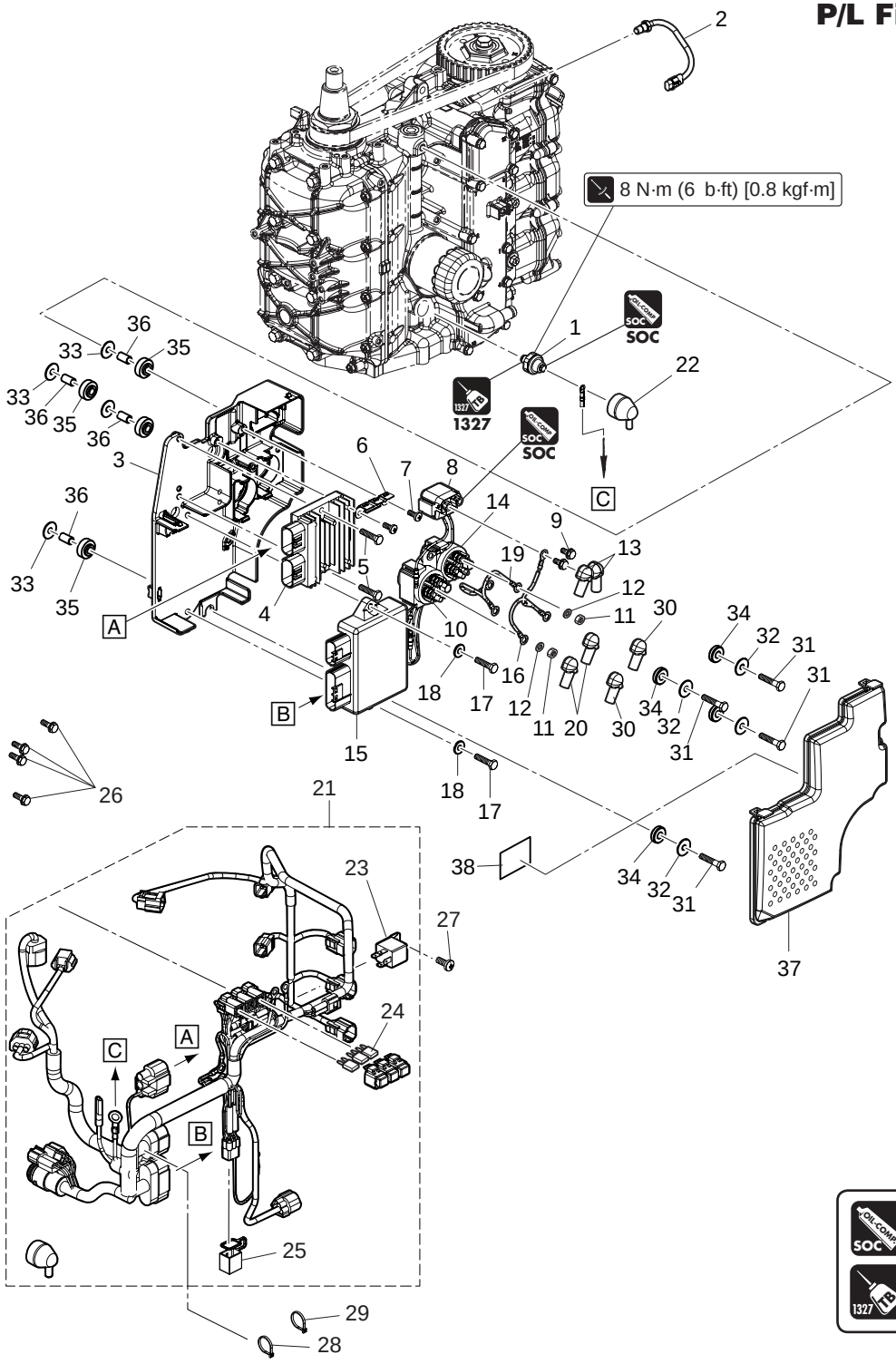
P/L Fig. 9



Ref. No.	Description	Q'ty	Remarks
1	Oil Pressure Switch	1	
2	Engine Temp Sensor	1	
3	Bracket	1	Electric Braket
4	Rectifier Complete	1	
5	Bolt	2	M6 L=25mm
6	Fuse Holder Bracket	1	
7	Screw	2	M5 L=12mm
8	Starter Solenoid	1	
9	Bolt	2	M6 L=8mm
10	PTT Solenoid Switch (A)	1	Up 4 Side (Sb) for PTT Model
11	Nut	3	M6

Ref. No.	Description	Q'ty	Remarks
12	Spring Washer	3	M6
13	Terminal Cap 8-13-28	2	Red for Gas Assist Model
14	PTT Solenoid Switch (B)	1	Down Side (P) for PTT Model
15-1	ECU Ass'y	1	50ps EU
15-2	ECU Ass'y	1	40ps EU
15-3	ECU Ass'y	1	50ps STD
15-4	ECU Ass'y	1	40ps STD
16	Solenoid Switch Cord (A)	1	Red for PTT Model
17	Bolt	2	M6 L=20mm
18	Washer 6-16-1.5	2	M6
19	Solenoid Switch Cord (B)	1	Black for PTT Model

P/L Fig. 9

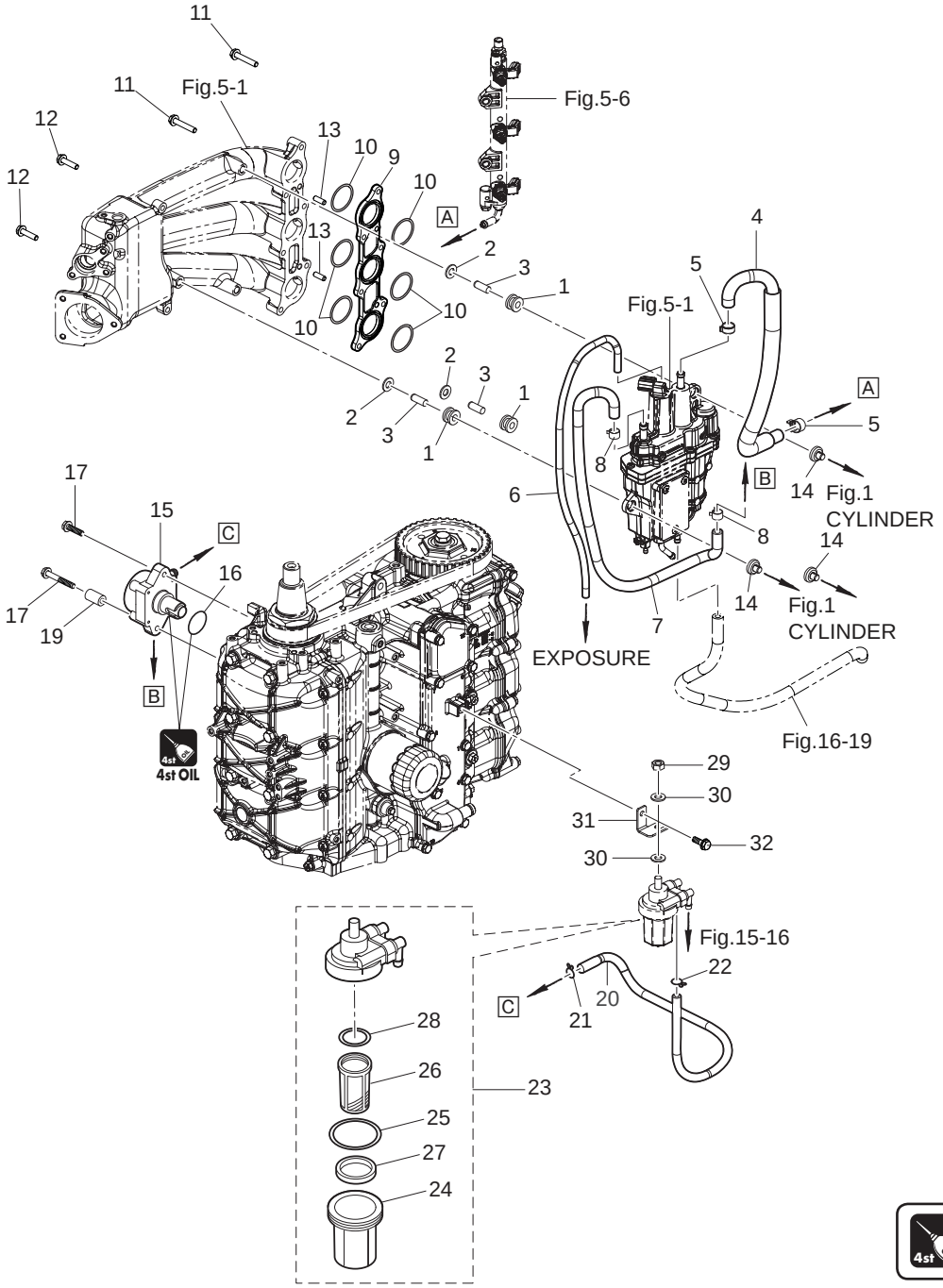


Ref. No.	Description	Q'ty	Remarks
20	Terminal Cap 8-13-28	6	Red for PTT Model
21	Cord Ass'y	1	
22	Grommet	1	
23	Relay	1	
24-1	Fuse 30A	1	
24-2	Fuse 20A	2	
25	Cable Terminal Plug	1	
26	Bolt	4	M6 L=12mm
27	Screw	1	M5 L=12mm
28	Band 104	1	Do not reuse.

Ref. No.	Description	Q'ty	Remarks
29	Band 203	1	Do not reuse.
30	Terminal Cap 8-13-28	2	Black for PTT Model
31	Bolt	4	M6 L=30mm
32	Washer 6-16-1.5	4	In Side M6
33	Washer 6.5-21-1	4	Out Side M6
34	Mount 8.5-14-2.5	4	In Side
35	Rubber Mount 8.5-14-2.5	4	Out Side
36	Spacer 6.2-9-15.7	4	
37	Cover	1	
38	Wiring Diagram Decal	1	

Fuel system

P/L Fig. 6

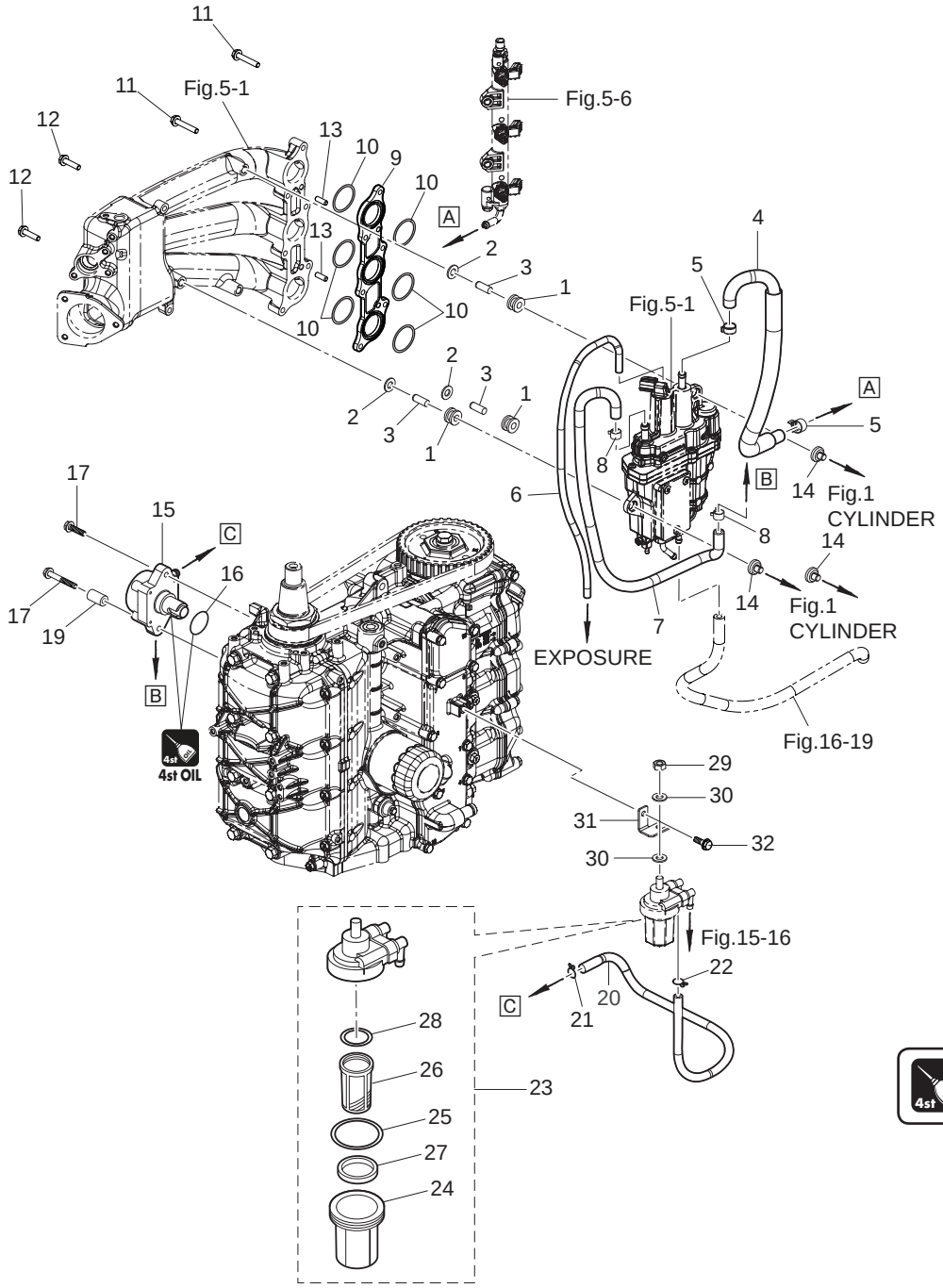


4st OIL

Ref. No.	Description	Q'ty	Remarks
1	Rubber Mount	3	
2	Washer	3	M8
3	Pin ø8-22	3	
4	Fuel Hose W/Protector	1	V/Separator-Fuel Rail EPA-KRI-15G
5	Clamp ø16.8	2	
6	Fuel Hose 4-9	1	V/Separator-Exposure
7-1	Fuel Hose W/Protector ø12	1	Fuel Pump-V/Separator USA EPA-KRI-15G
7-2	Fuel Hose W/Protector ø12	1	Fuel Pump-V/Separator STD
8	Clip ø11.3	2	
9	Insulator	1	
10	O-ring 1.9-33.2	6	**Do not reuse.**
11	Bolt	6	M6 L=35mm

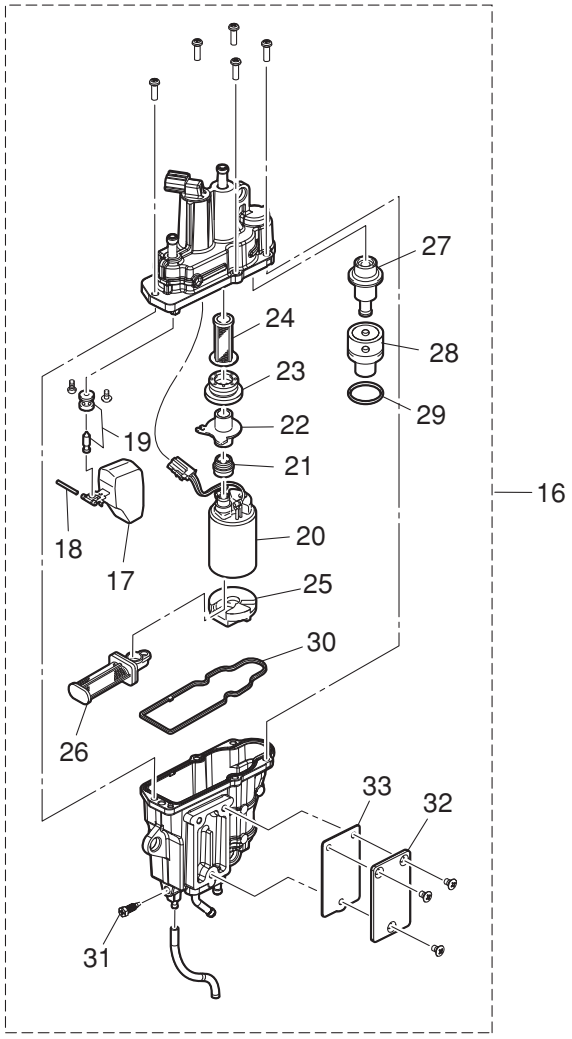
Ref. No.	Description	Q'ty	Remarks
12	Bolt	2	M6 L=25mm
13	Dowel Pin 6-16	2	Intake Manifold Vapor Separator Assy
14	Bushing	3	
15	Fuel Pump Ass'y	1	
16	O-ring 3.5-25.7	1	**Do not reuse.**
17	Bolt	1	M6 L=25mm
18	Bolt	1	M6 L=45mm
19	Spacer 6.2-13-22	1	
20-1	Low Permeation Hose L=445	1	Fuel Filter-Fuel Pump USA EPA-KRI-15G L=445mm
20-2	Fuel Hose 5-10 L=445	1	Fuel Filter-Fuel Pump STD L=445mm
21	Clip ø11.3	1	

P/L Fig. 6



Ref. No.	Description	Q'ty	Remarks
22	Clip ø9.4	1	
23	Fuel Filter Ass'y	1	
24	Cup	1	
25	O-ring	1	Do not reuse.
26	Filter	1	
27	Float	1	
28	O-ring	1	Do not reuse.
29	Nut	1	M8
30	Washer	2	M8
31	Plate	1	
32	Bolt	1	M6 L=12mm

Vapor Separator

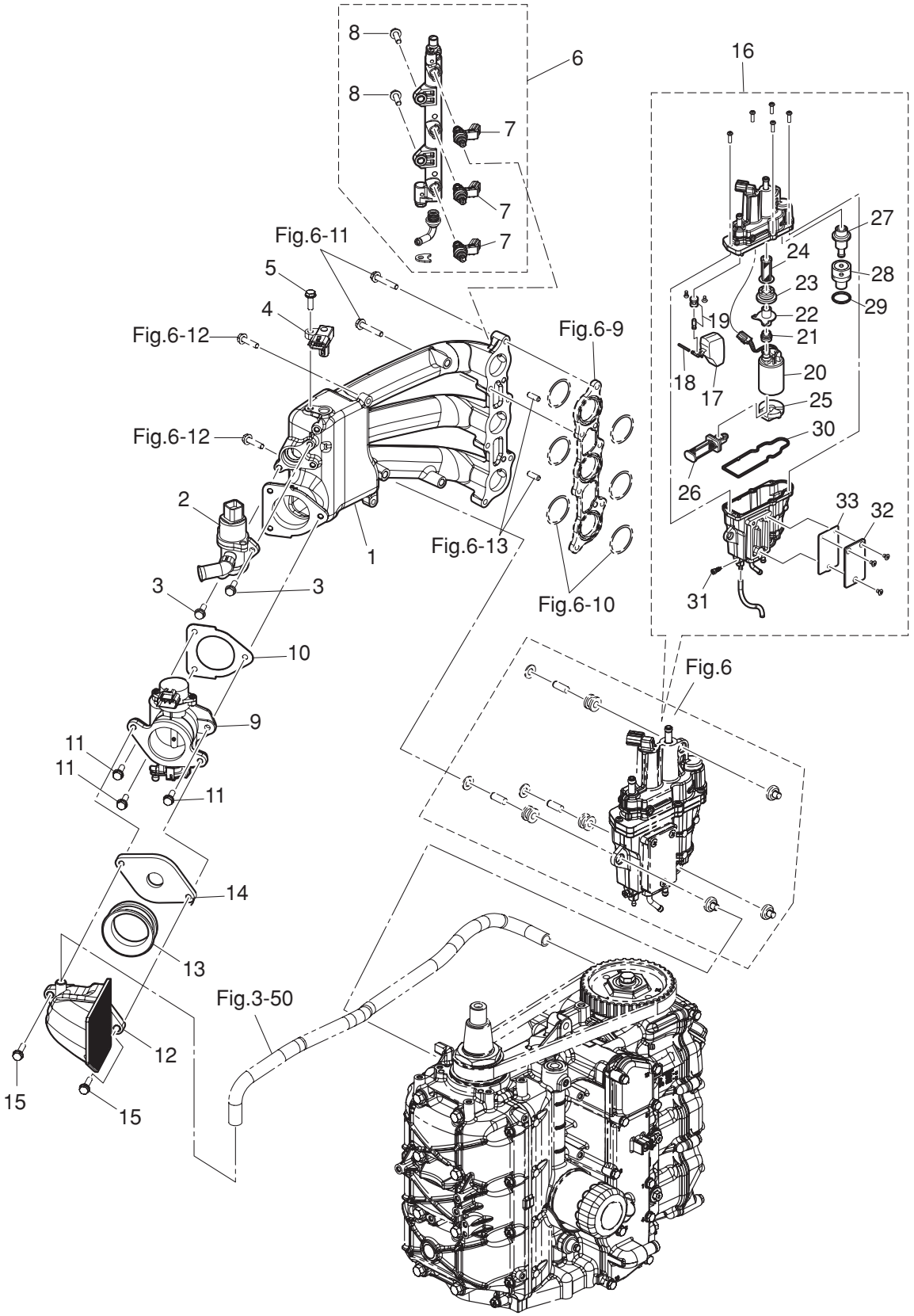


Ref. No.	Description	Q'ty	Remarks
16	Vapor Separator Ass'y	1	
17	Float	1	
18	Float Arm Pin	1	
19	Float Valve Ass'y (W/valve pin)	1	
20	Fuel Feed Pump	1	Upper
21	Grommet	1	Upper
22	Joint	1	Upper
23	Grommet	1	Upper
24	Filter (outlet)	1	Lower

Ref. No.	Description	Q'ty	Remarks
25	Grommet F.F.P. Lower	1	Lower
26	Filter (intlet)	1	
27	Fuel Regulator	1	
28	Holder	1	
29	O Ring	1	Do not reuse.
30	O Ring	1	Do not reuse.
31	Drain Screw	1	
32	Cover	1	
33	Seal	1	Do not reuse.

Intake Manifold

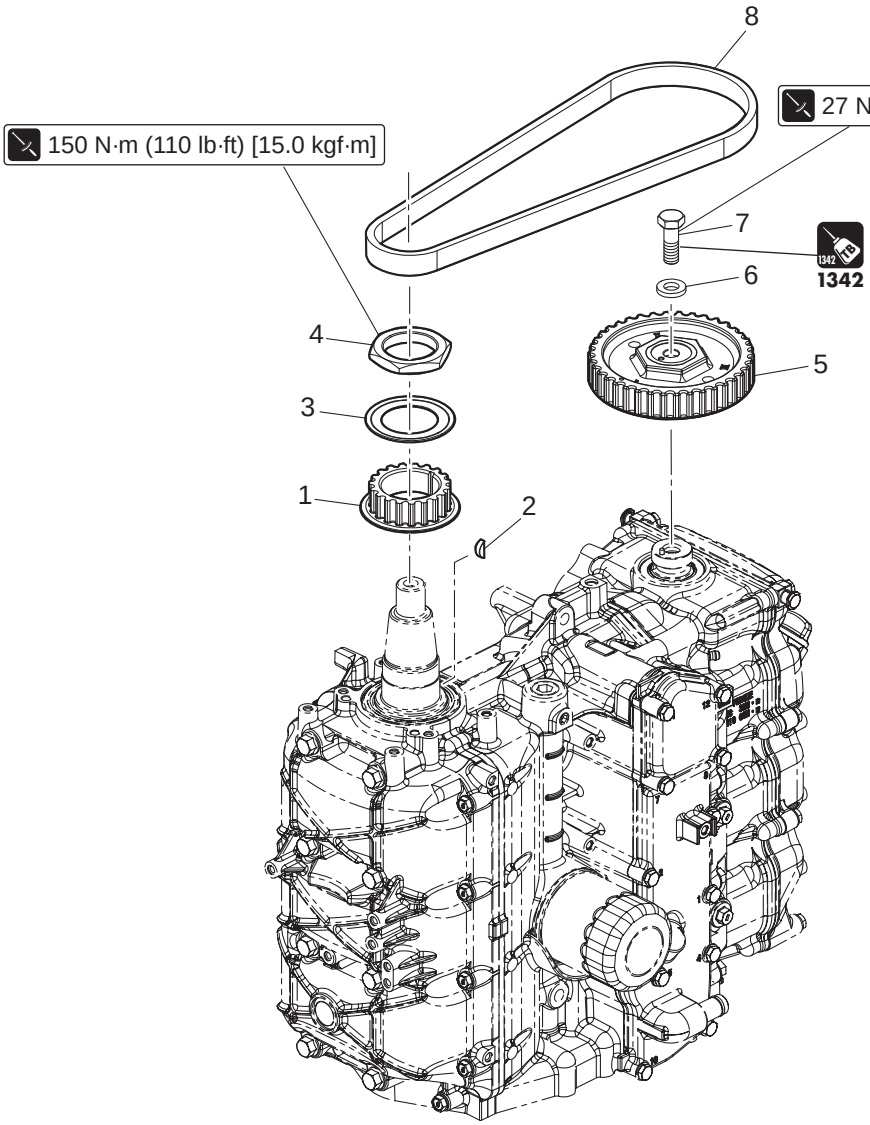
P/L Fig. 5



Ref. No.	Description	Q'ty	Remarks
1	Intake Manifold	1	
2	Isc Valve	1	Idle Speed Control Valve
3	Bolt	2	M6 L=20mm
4	Map Sensor	1	Manifold Air Temperature & Pressure
5	Bolt	1	M6 L=20mm
6	Fuel Rail Ass'y	1	
7	Fuel Injector Ass'y	3	
8	Bolt	2	M6 L=20mm
9	Throttle Body Ass'y	1	ø45
10	Gasket	1	Do not reuse.
11	Bolt	3	M6 L=20mm
12	Intake Silencer Ass'y	1	
13	Gasket	1	Do not reuse.
14	Restrictor	1	40ps
15	Bolt	2	M6 L=25mm
16	Vapor Separator Ass'y	1	
17	Float	1	
18	Float Arm Pin	1	
19	Float Valve Ass'y	1	
20	Fuel Feed Pump	1	Upper
21	Grommet	1	Upper
22	Joint	1	Upper
23	Grommet	1	Upper
24	Filter (Outlet)	1	Lower
25	Grommet	1	Lower
26	Filter (Inlet)	1	
27	Fuel Regulator	1	
28	Holder	1	
29	O-ring	1	Do not reuse.
30	O-ring	1	Do not reuse.
31	Drain Screw	1	
32	Cover	1	
33	Seal	1	Do not reuse.

Pulley • Timing Belt

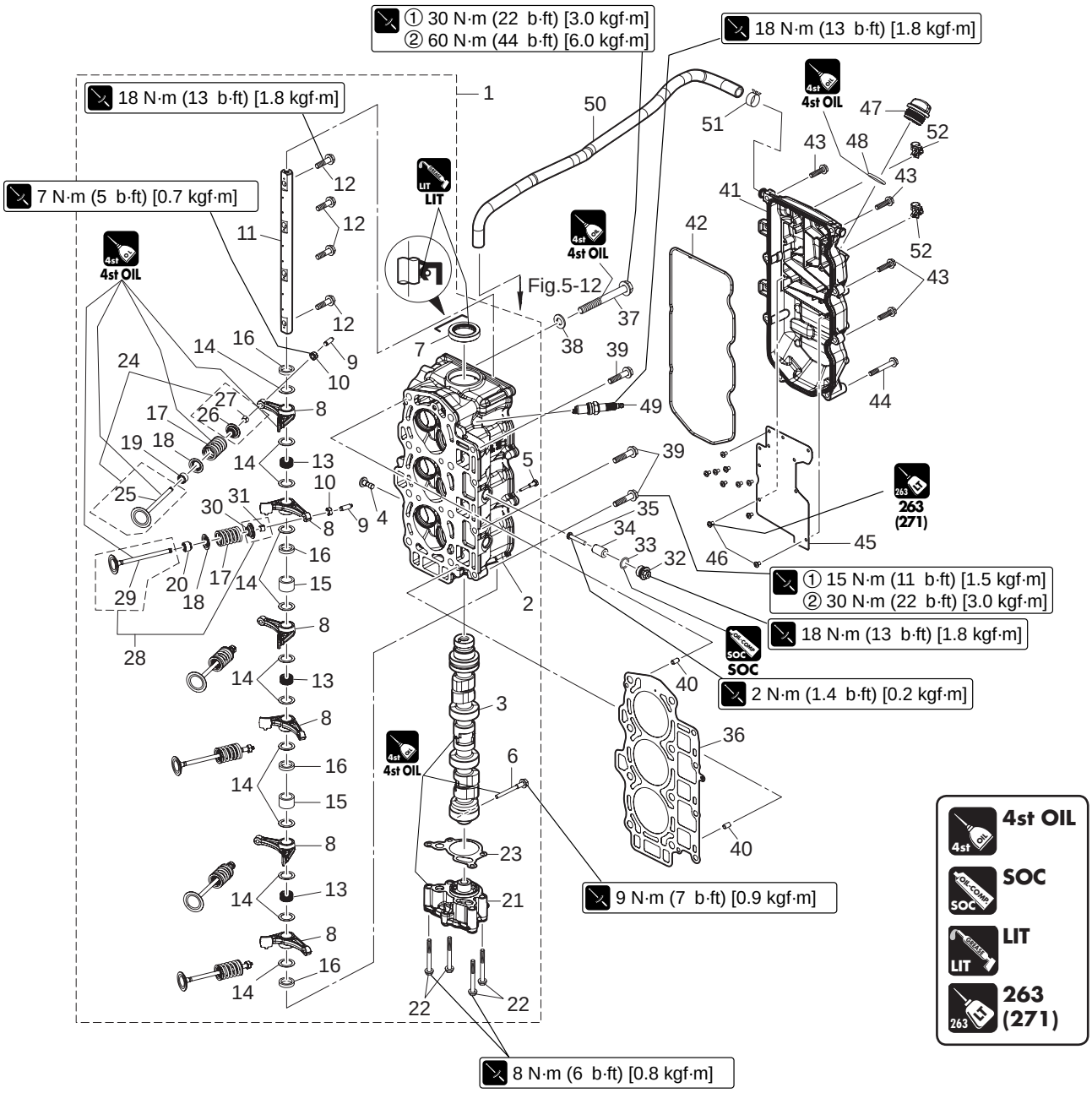
P/L Fig. 4



Ref. No.	Description	Q'ty	Remarks
1	Drive Pulley	1	Timing Pulley
2	Key t=4	1	Crankshaft
3	Belt Guide	1	
4	Nut 39-p1.5	1	M39
5	Driven Pulley	1	Camshaft Pulley
6	Washer 10.5-20-3.2	1	M10
7	Bolt 10-p1.25	1	M10 L=30mm
8	Timing Belt	1	

Cylinder Head & Oil Pump

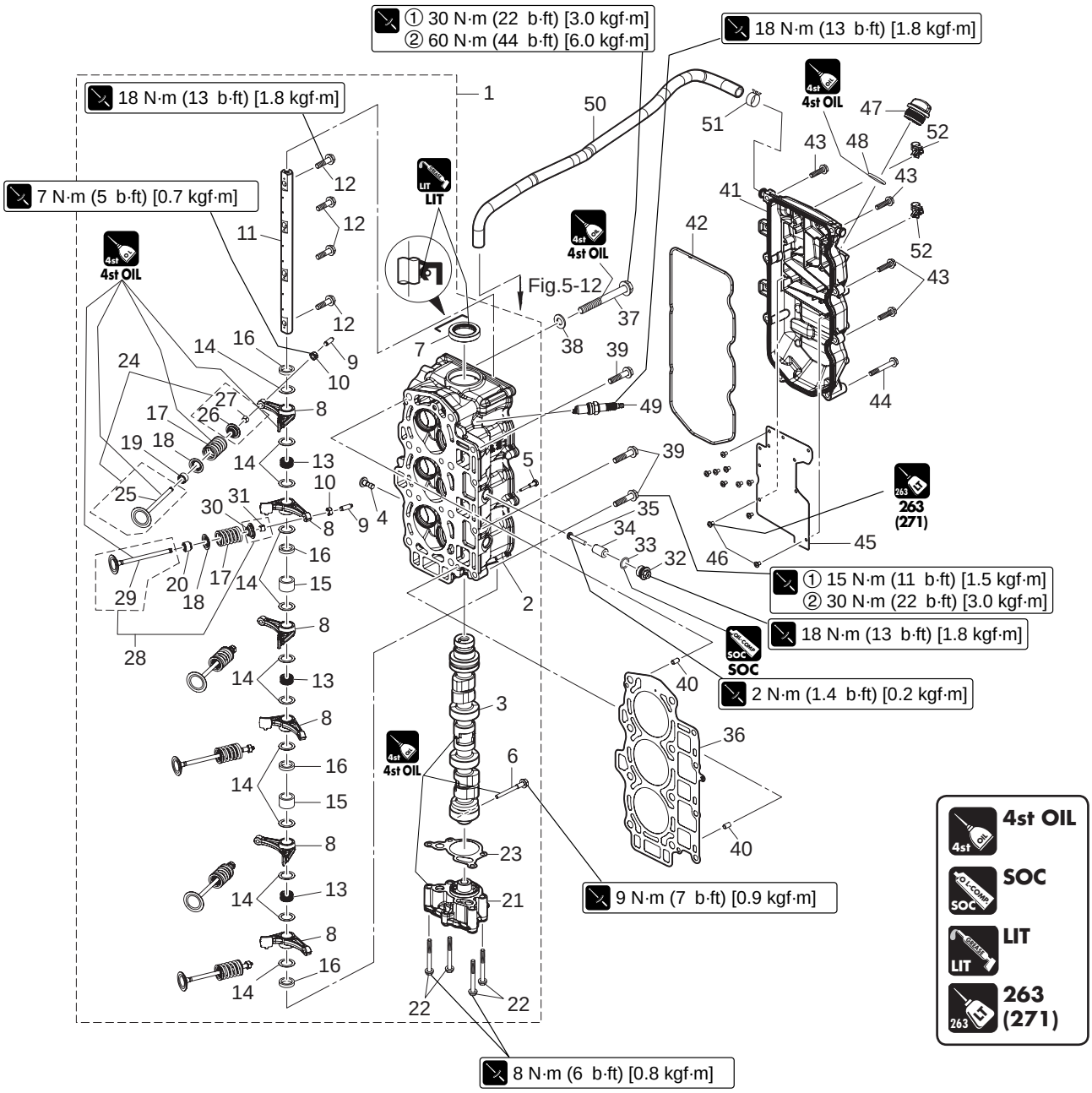
P/L Fig. 3



Ref. No.	Description	Q'ty	Remarks
1	Cylinder Head Complete	1	
2	Cylinder Head Ass'y	1	Valve Guide Valve Seat
3	Camshaft Ass'y	1	
4	Lifter	1	
5	Lifter Bolt	1	
6	Thrust Bolt	1	Camshaft
7	Oil Seal 30-45-8	1	Camshaft Upper **Do not reuse.**
8	Rocker Arm	6	
9	Adjusting Screw	6	
10	Adjusting Nut	6	
11	Rocker Arm Shaft	1	
12	Rocker Shaft Bolt	4	
13	Rocker Shaft Spring	3	
14	Washer 16-23-0.5	12	
15	Collar 16-21.7-14.25	2	
16	Collar 16-21.7-4.25	4	

Ref. No.	Description	Q'ty	Remarks
17	Valve Spring	6	
18	Valve Spring Seat	6	
19	Intake Valve Stem Seal	3	Black
20	Exhaust Valve Stem Seal	3	Green
21	Oil Pump Ass'y	1	
22	Bolt	4	M6 L=50mm
23	Oil Pump Gasket	1	**Do not reuse.**
24	Intake Valve Kit	1	
25	Intake Valve ø32	3	
26	Retainer	3	
27	Cotter	6	
28	Exhaust Valve Kit	1	
29	Exhaust Valve ø28	3	
30	Retainer	3	
31	Cotter	6	
32	Anode Plug	3	

P/L Fig. 3

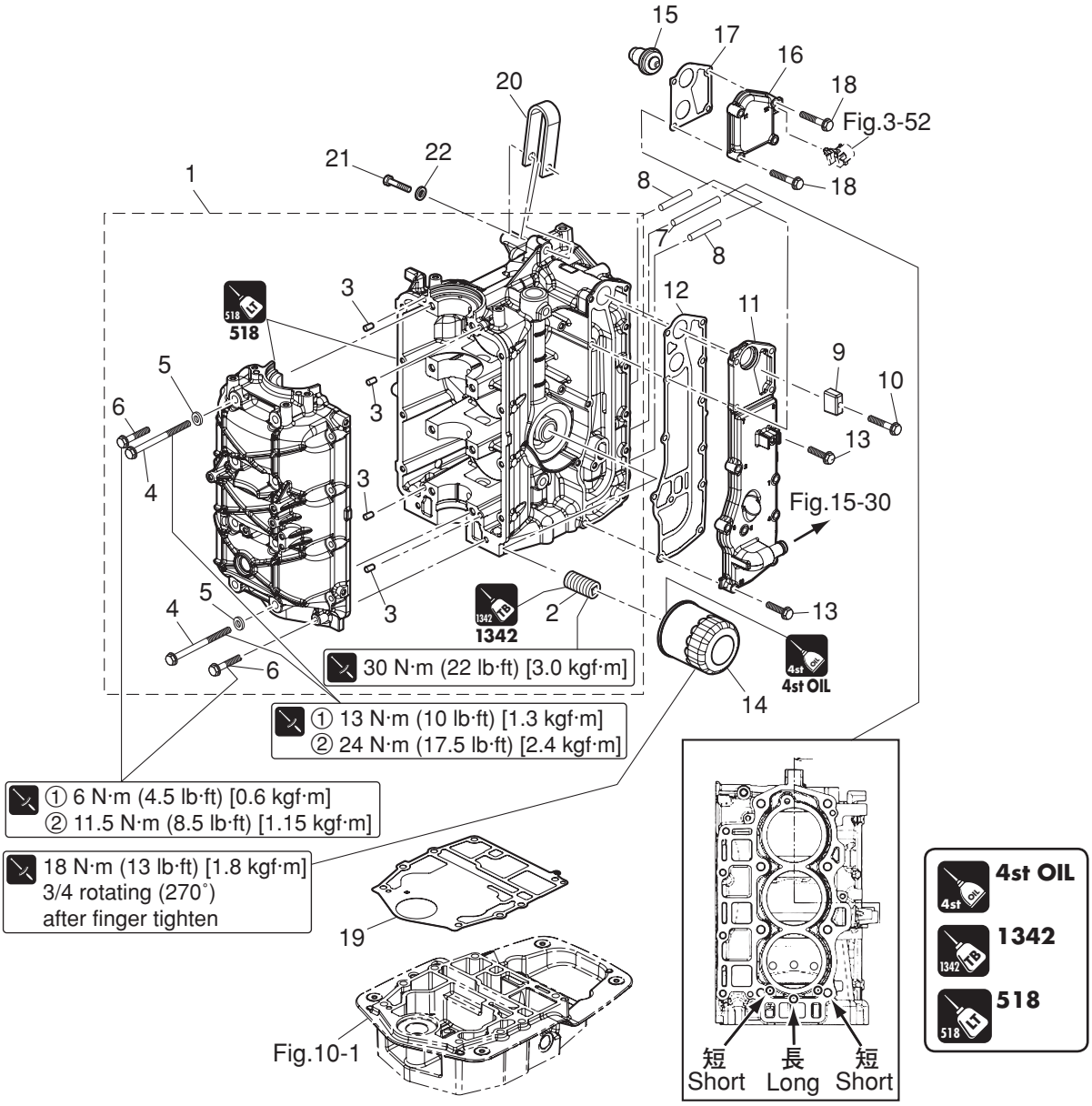


Ref. No.	Description	Q'ty	Remarks
33	O-ring 1.9-13	3	Do not reuse.
34	Anode	3	
35	Screw	3	M5 L=30mm
36	Cylinder Head Gasket	1	Do not reuse.
37	Cylinder Head Bolt M10-90	8	
38	Washe	8	M10
39	Bolt 8-p1.25	4	
40	Dowel Pin 6-12	2	Cylinder Block-Cylinder Head
41	Cylinder Head Cover Ass'y	1	
42	Cylinder Head Cover Gasket	1	Do not reuse.
43	Bolt	6	M6 L=25mm
44	Bolt	2	M6 L=45mm
45	Breather Chamber Cover	1	
46	Screw	10	M4 L=6mm
47	Oil Filler Cap	1	

Ref. No.	Description	Q'ty	Remarks
48	O-ring 3.1-24.4	1	Do not reuse.
49	Spark Plug (DCPR6E)	3	NGK
50	Breather Hose	1	Cylinder Head Cover-Intake Silencer
51	Clip ø15.5	1	
52	Band	3	

Cylinder • Crankcase

P/L Fig. 1

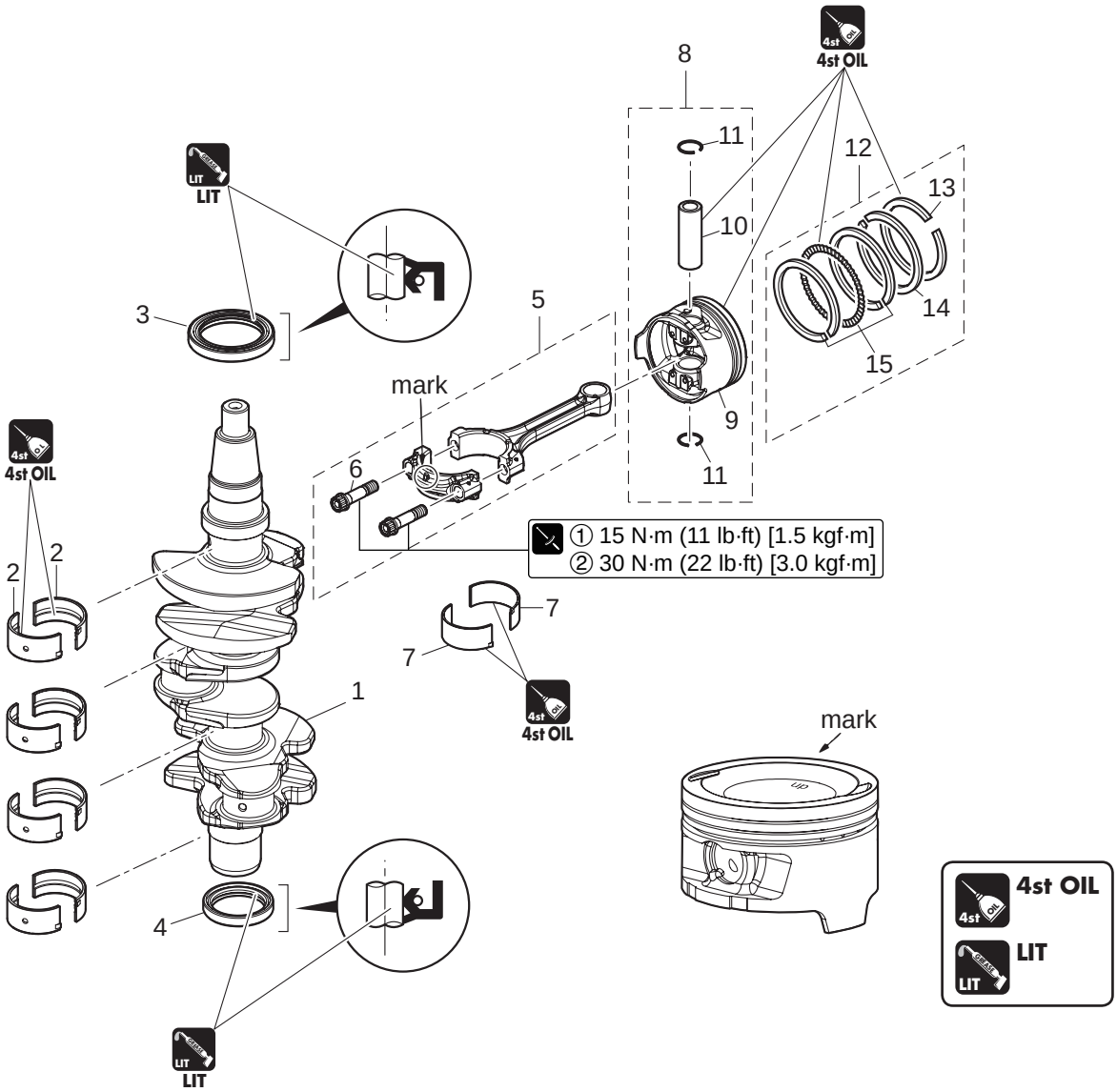


Ref. No.	Description	Q'ty	Remarks
1	Cyl Block & Crankcase Ass'y	1	
2	Oil Filter Bolt	1	
3	Dowel Pin 6-12	4	Crankcase-Cylinder Block
4	Bolt 8-90	8	
5	Washer	8	M8
6	Bolt M6-35	10	M6 L=35mm
7	Water Jacket Insert (R) L=55	1	Long
8	Water Jacket Insert (L) L=35	2	Shot
9	Anode	1	
10	Bolt	1	M6 L=35mm
11	Exhaust Cover Ass'y	1	

Ref. No.	Description	Q'ty	Remarks
12	Exhaust Cover Gasket	1	Do not reuse.
13	Bolt	8	M6 L=25mm
14	Oil Filter	1	
15	Thermostat	1	Mark 60
16	Thermostat Cap	1	
17	Thermostat Cap Gasket	1	Do not reuse.
18	Bolt	4	M6 L=35mm
19	Engine Basement Gasket	1	Do not reuse.
20	Hanger	1	
21	Bolt	1	M8 L=35mm
22	Washer	1	M8

Piston & Crankshaft

P/L Fig. 2

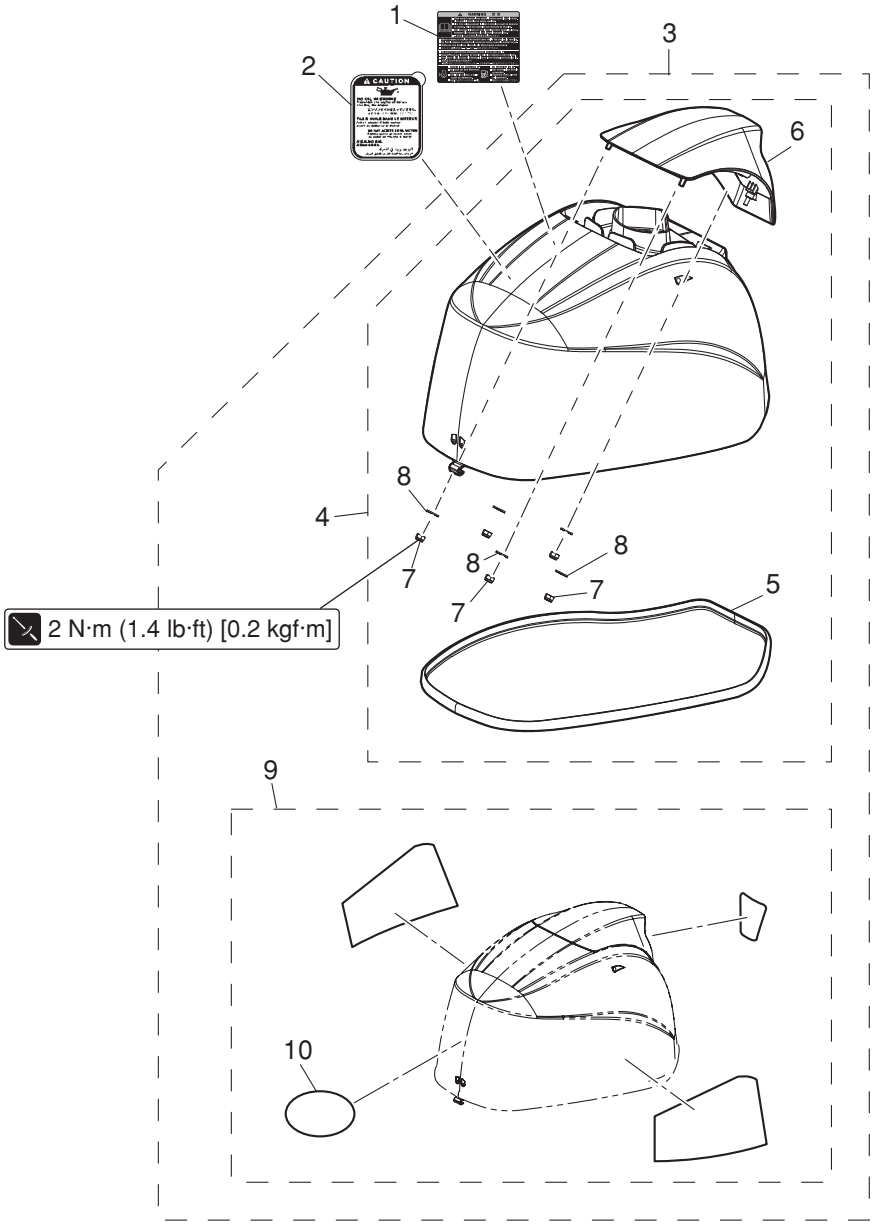


Ref. No.	Description	Q'ty	Remarks
1	Crankshaft A'ssy	1	
2-1	Plain Shaft Bearing (Brown)	A	Brown see Service Manual
2-2	Plain Shaft Bearing (Black)	A	Black see Service Manual
2-3	Plain Shaft Bearing (Blue)	A	Blue see Service Manual
3	Oil Seal 50-68-9	1	Upper **Do not reuse.**
4	Oil Seal 38-50-8	1	Lower **Do not reuse.**
5	Connecting Rod Ass'y	3	
6	Connecting Rod Bolt	2	
7-1	Big End Bearing (Brown)	A	Brown see Service Manual
7-2	Big End Bearing (Black)	A	Black see Service Manual
7-3	Big End Bearing (Blue)	A	Blue see Service Manual
8-1	Piston Repair Kit	3	STD
8-2	Piston Repair Kit (0.5 O/S)	3	OPT

Ref. No.	Description	Q'ty	Remarks
9-1	Piston	1	STD
9-2	Piston (0.5 O/S)	1	OPT
10	Piston Pin	1	
11	Piston Pin Clip	2	**Do not reuse.**
12-1	Piston Ring Set	3	STD
12-2	Piston Ring Set (0.5 O/S)	3	1st OPT
13-1	Piston Ring	1	1st STD
13-2	Piston Ring (0.5 O/S)	1	OPT
14-1	Piston Ring 2nd	1	2nd STD
14-2	Piston Ring (0.5 O/S) 2nd	1	2nd OPT
15-1	Piston Ring-oil	1	Oil STD
15-2	Piston Ring-oil (0.5 O/S)	1	Oil OPT

Top Cowl

P/L Fig. 18



Ref. No.	Description	Q'ty	Remarks
1	Caution Decal (A)	1	
2	Oil Caution Decal	1	for EU
3	Top Cowl Assy (Service)	1	
4	Top Cowl Sub-Ass'y	1	
5	Top Cowl Seal	1	
6	Tilt Handle Gray	1	
7	Nylon Nut 6-p1.0	5	
8	Washer 6-16-1.5	5	
9-1	Decal Set (MFS40A)	1	
9-2	Decal Set (MFS50A)	1	
10	Front Decal	1	

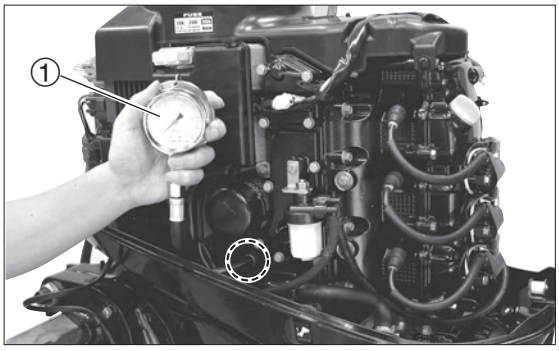
3. Inspection Items

1) Inspection of Compression Pressure

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

Compression Pressure (Reference) :
1.4 MPa (203 PSI) [14.3 kgf/cm²] ±10 %

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 (Thread spec : R 1/8).
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 hydraulic pressure. If the pressure is below specified value, check oil pump for oil leak, and oil strainer and plunger.

Hydraulic Pressure (Reference) : Oil Temperature 60°(140°F)
0.14 MPa (21 PSI) [1.5 kgf/cm²] or higher at 850 r/min
0.29 MPa (43 PSI) [3.0 kgf/cm²] or higher at 5750 r/min

3) Inspection of Valve Clearance

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

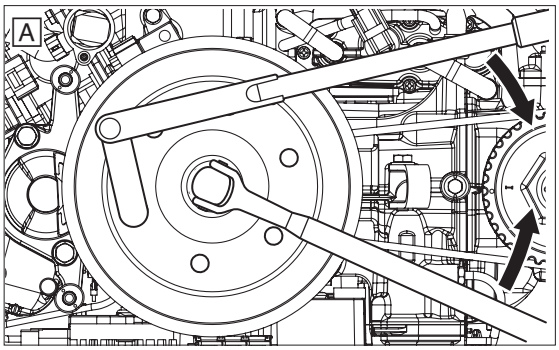
Valve Clearance (when engine is cold)
(IN) Intake valve ⓓ :
0.15 – 0.25 mm (0.006 – 0.010 in)
(EX) Exhaust valve ⓔ :
0.25 – 0.35 mm (0.010 – 0.014 in)

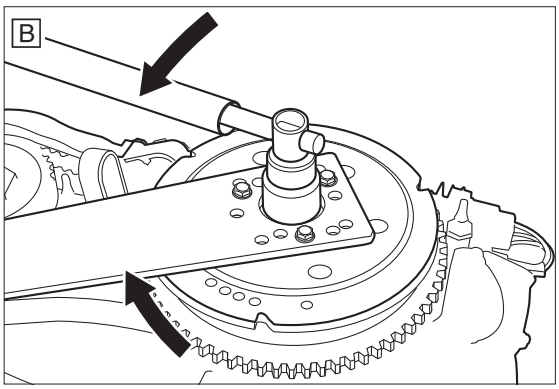
4) Removing Power Unit

1. Remove flywheel cover.

3. Loosen flywheel nut.

Loosen flywheel nut before removing power unit to make the work easier.



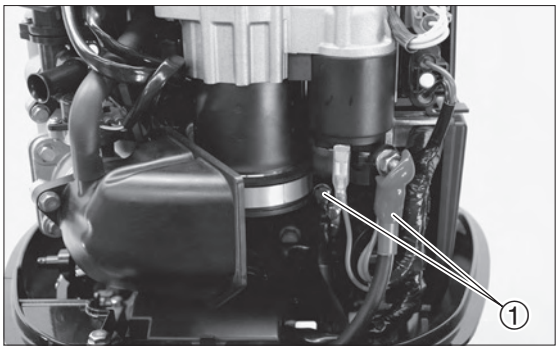


A **Flywheel Holder :**
Commercially available item
B **Flywheel puller kit :**
P/N. 3T1-72211-0

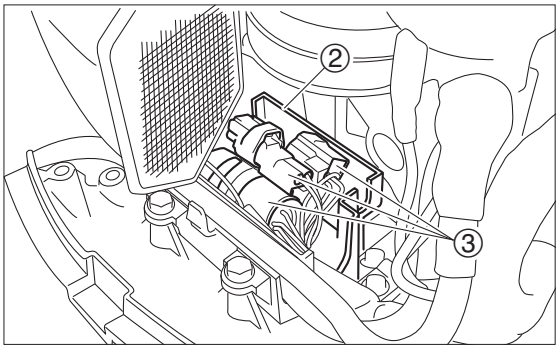
⚠ CAUTION

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

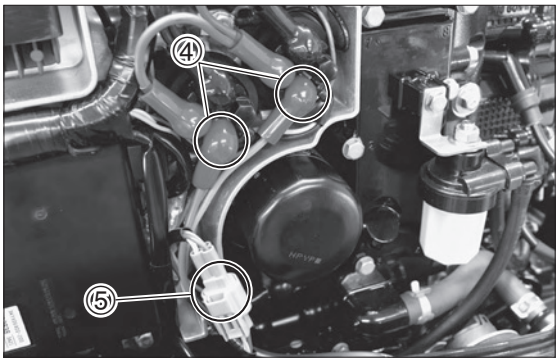
4. Disconnect battery cables ①.



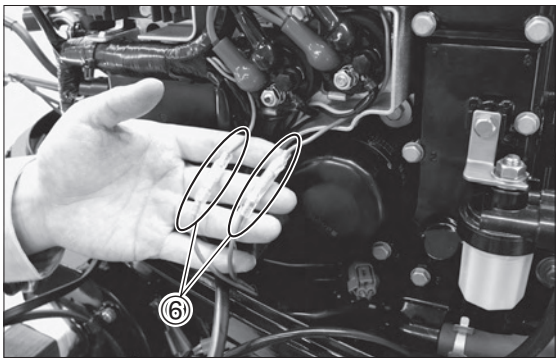
5. Open the cable terminal holder cover ② and disconnect connecter ③ (3).



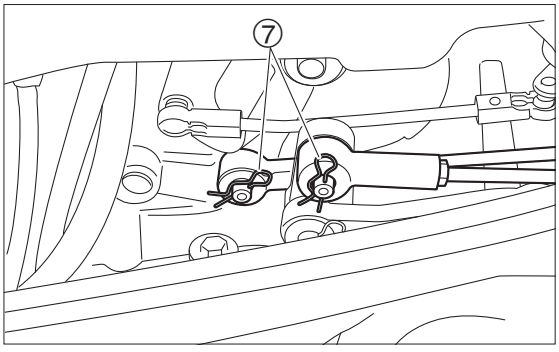
5. Remove the electrical box cover and disconnect PTT motor leads ④ and PTT switch coupler ⑤.



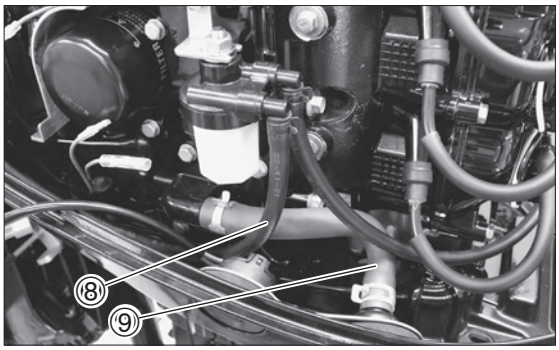
6. Disconnect neutral switch leads (green) ⑥.



7. Remove the pin ⑦ and then remove the cable joint.

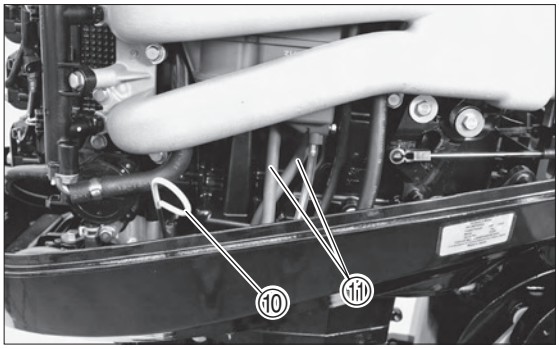


8. Disconnect the fuel ⑧ hose and flushing hose ⑨ .

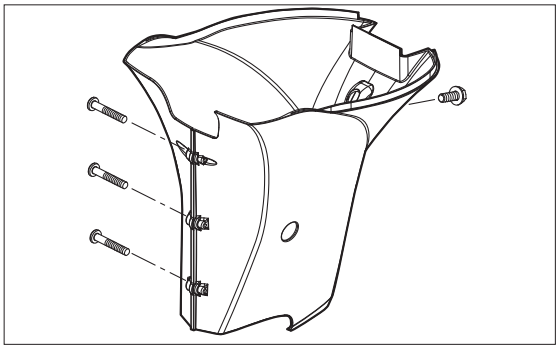


9. Remove oil level gauge ⑩.

10. Disconnect cooling water (fuel cooler) hose ⑪.

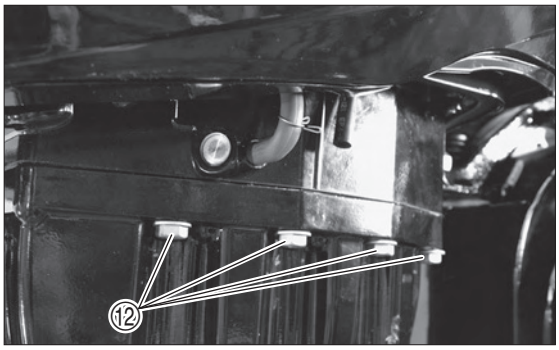


11. Remove tapping screws (L = 4 pieces. S = 3 pieces.) and bolt (one piece.), then remove apron.



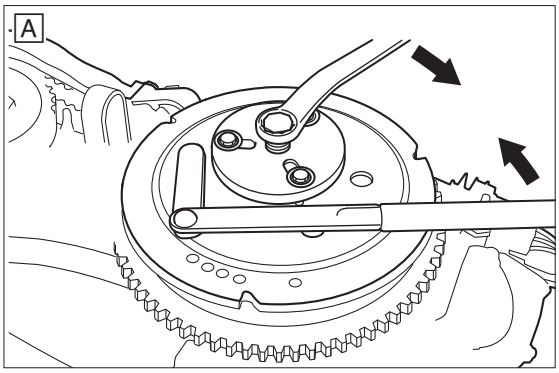
12. Remove power unit by removing bolts ⑫ (8) and then lifting it.

- When lifting power unit, perform the work carefully, checking if wires and hoses are caught by other parts.
- Loosen the bolts to reverse tightening secence.



13. Remove flywheel and key.

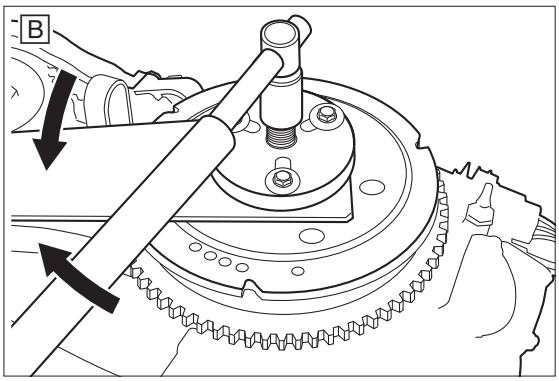
A **Flywheel Holder :**
Commercially available item
A **Flywheel Puller :**
Use puller contained in the following puller kit.
B **Flywheel Puller Kit :**
P/N. 3T1-72211-0



⚠ CAUTION

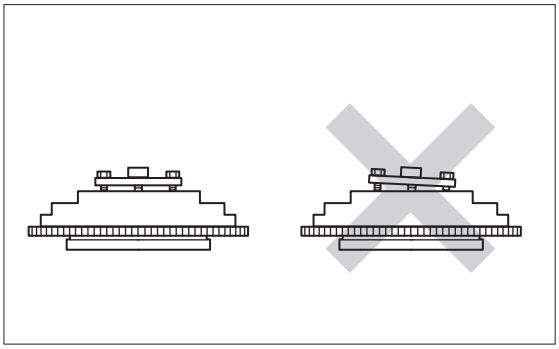
Apply forces to tools toward directions as shown, and perform work taking care not to allow flywheel holder to remove.

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



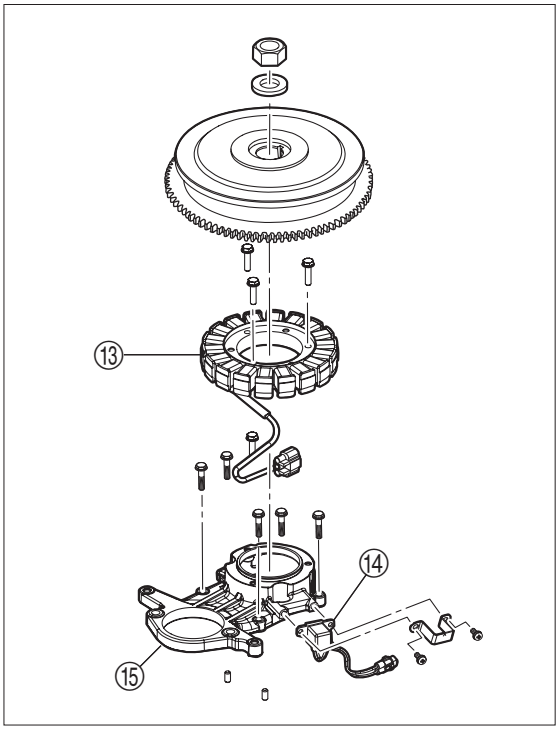
⚠ CAUTION

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



14. Disconnect alternatorr ⑬ and pulser coilr ⑭ .

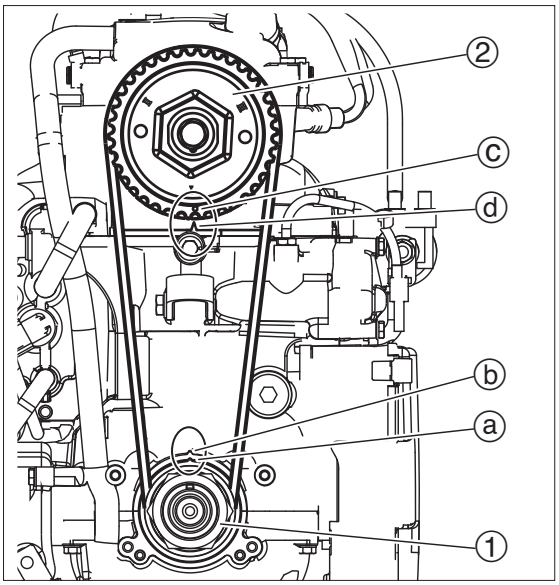
15. Remove bolts of alternator ⑬ and coil bracket ⑭, and remove alternator and coil bracket.



5

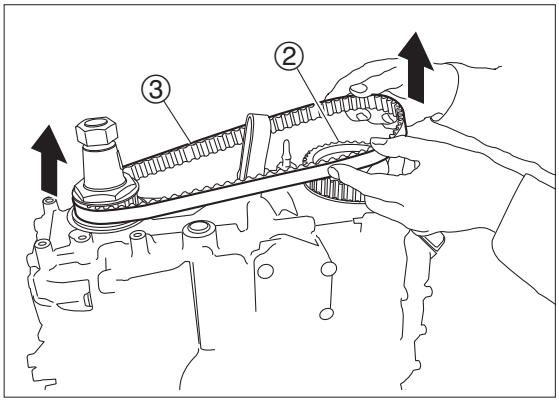
5) Removing Timing Belt and Pulley

1. Turn timing pulley ① clockwise to bring "▲" mark ⓐ of timing pulley to "▲" mark ⓑ of cylinder block, and check that "● I" 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.

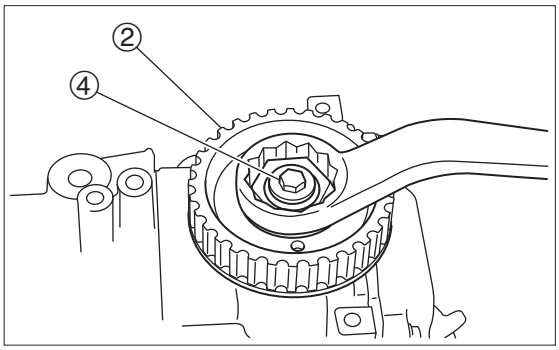
2. Remove timing belt ③ from cam shaft pulley ② side, and then, from timing pulley side.



⚠ 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, resulting in damages to these parts.

3. Remove cam shaft pulley ② bolt ④, and then, remove cam shaft pulley ②.

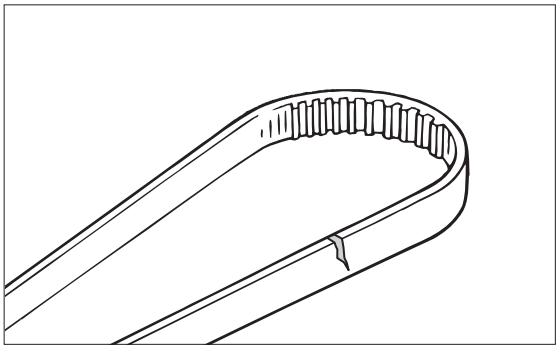


> When loosening cam shaft pulley bolt, be careful not to turn cam shaft pulley.

6) Inspection of Timing Belt

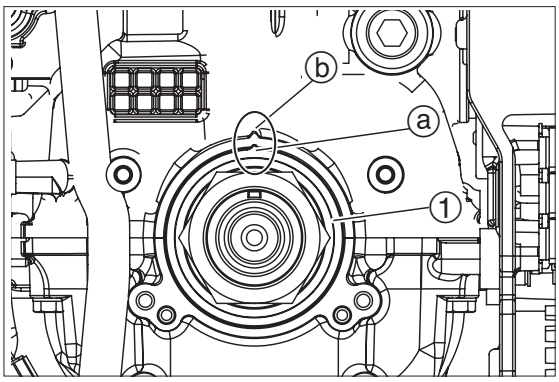
1. Check timing belt for crack, damage and wear on both faces. Replace if necessary.

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



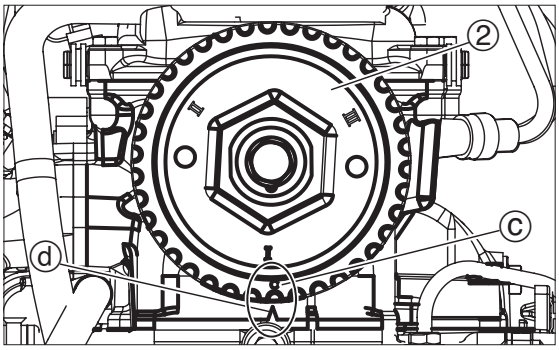
7) Installation of Pulley and Timing Belt

1. Check that "▲" mark ⓐ of timing pulley ① and "▲" mark ⓑ of cylinder block are aligned with each other.



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

2. Install cam shaft pulley, bring "● I" mark ⓒ of cam shaft pulley ② to "▲" mark ⓓ of cylinder head, and then, tighten bolt ③ to specified torque.

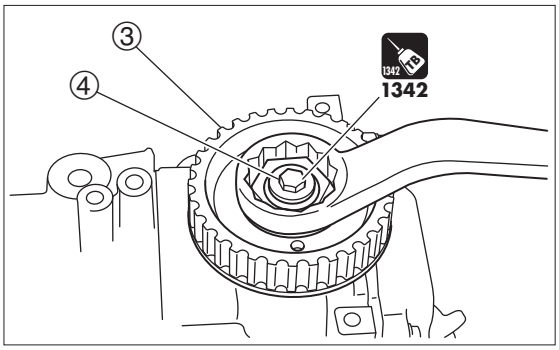


Cam Shaft Pulley Bolt ④ :
11 N·m (8 lb·ft) [1.1 kgf·m]

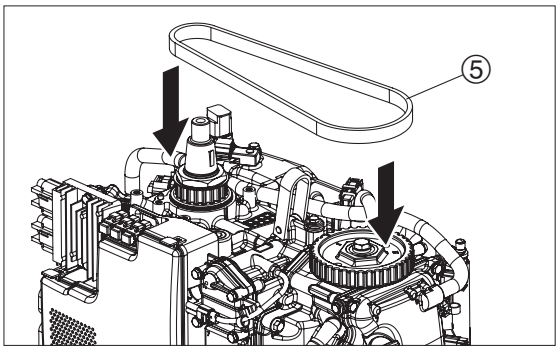
⚠ CAUTION

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

1342



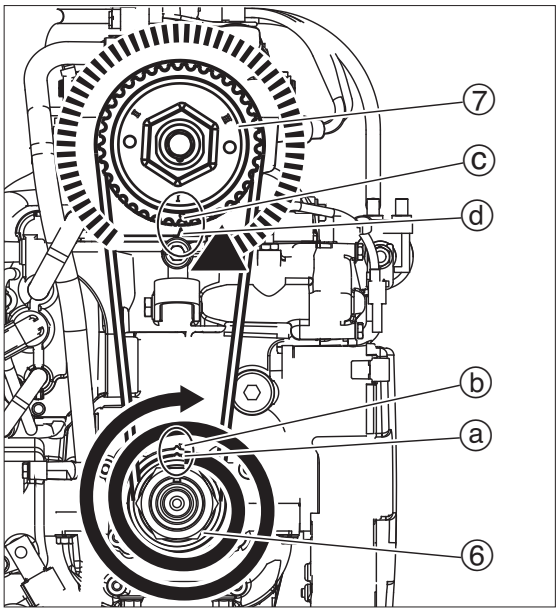
3. Attach timing belt ⑤ to timing pulley with its part number side facing upward, and then to cam shaft pulley.



⚠ 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.**

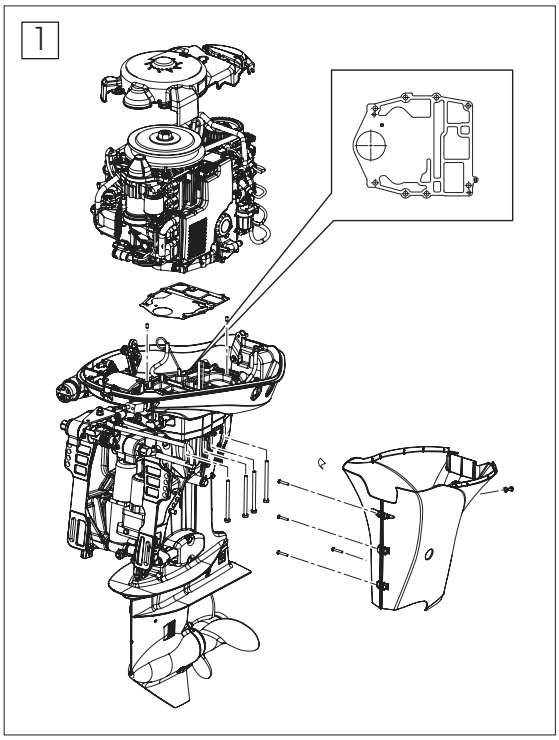
4. Turn timing pulley ⑥ clockwise twice, and check that locating marks ⓐ and ⓑ, and ⓒ and ⓓ of pulleys ⑥ and ⑦ are aligned with each other respectively.



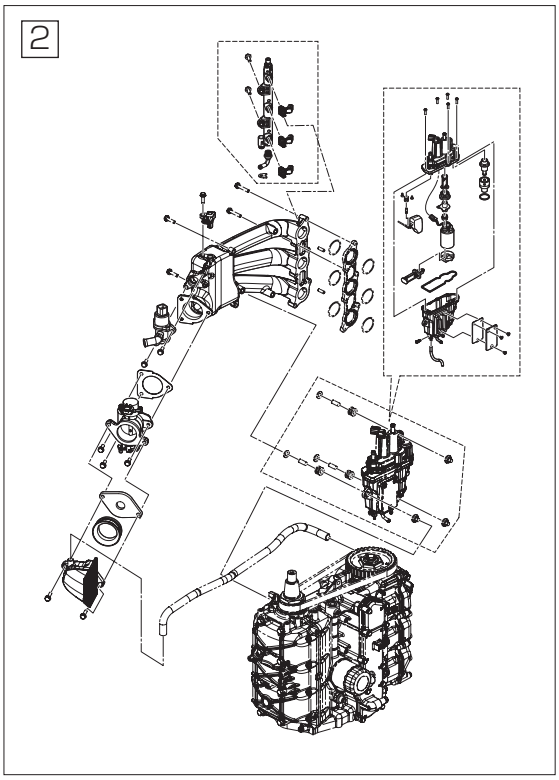
8) Removing Cylinder Head

- 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.

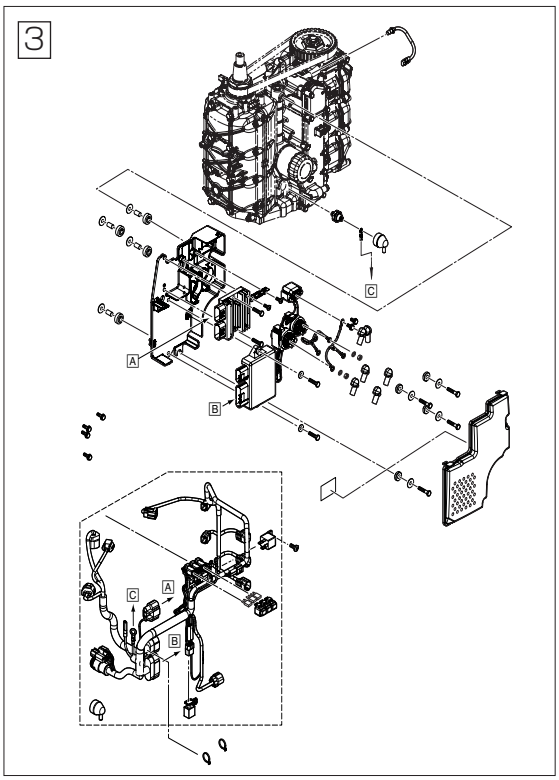
1. Remove power unit. (Refer to the section for removing power unit.)



2. Remove fuel system parts and intake manifold ass'y.



3. Remove electrical system parts from power unit.



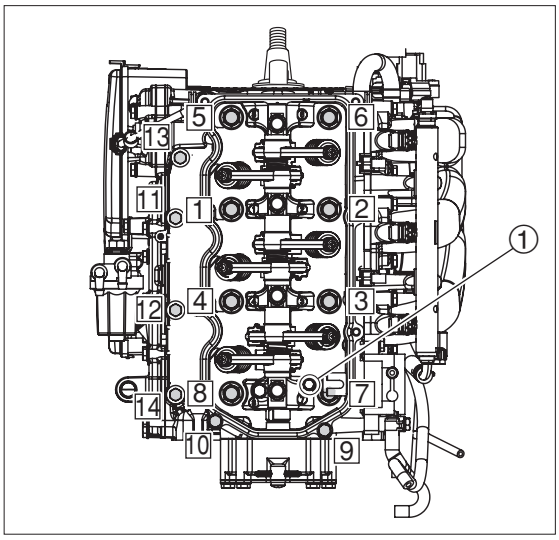
4. Remove camshaft pulley, cylinder head cover and hose.

> To remove, refer to the "Removing Timing Belt and Pulley" section in Chapter 5.

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

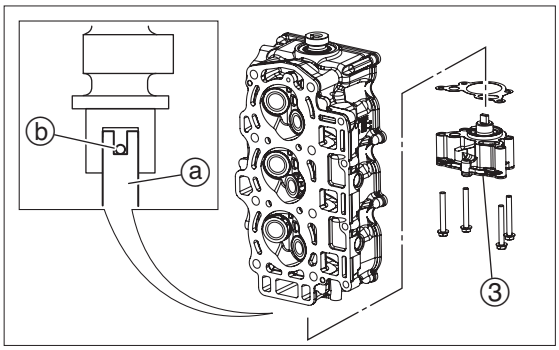
> **⚠ CAUTION**
> **Do not scratch or give damage to mating surfaces of cylinder head and cylinder block.**

> To loosen "No. 7" bolt, loosen fuel pump lift bolt, and then remove fuel pump lift.



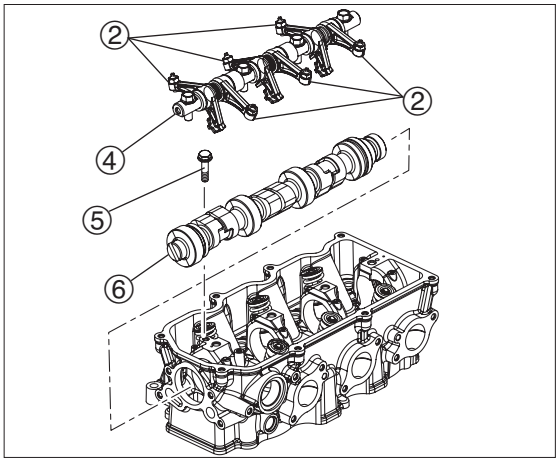
6. Loosen rocker arm lock nut ②, and loosen adjusting screw as much as possible.

7. Remove oil pump ass'y ③.



8. Remove rocker arm shaft ass'y ④.

> • The work can be made easier when cam shaft is brought to a position of low valve spring force.
> • Bind with tiewrap, to remove easier.

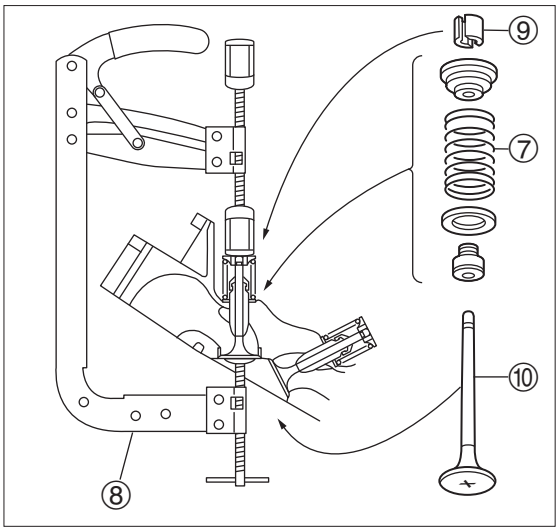


9. Remove cam shaft mounting bolt ⑤ and cam shaft ⑥.

10. Compress valve spring ④ by using compressor ⑤, remove cotter ⑥, and then, spring and valve ⑦.

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

Valve Spring Compressor ⑤ :
Commercially available item

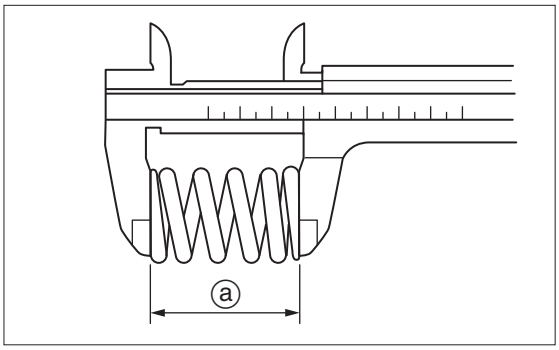


9) Inspection of Valve Spring

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

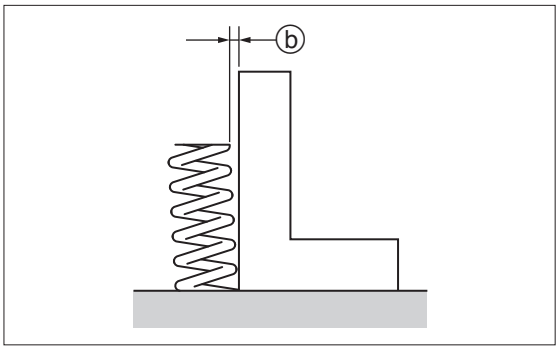
Valve Spring Free Length ⓐ : Standard Value
38.7 mm (1.52 in)

Functional Limit :
37.1 mm (1.46 in)



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

Valve Spring Inclination Limit ⓑ :
2.0 mm (0.08 in)

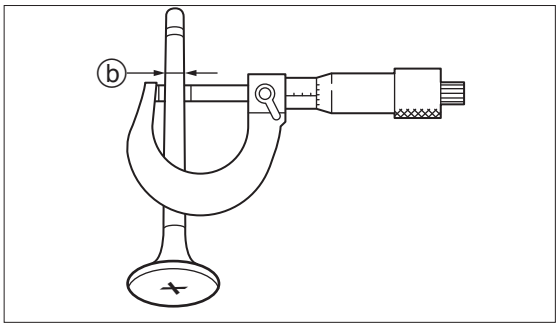


5

10) Inspection of Valve

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

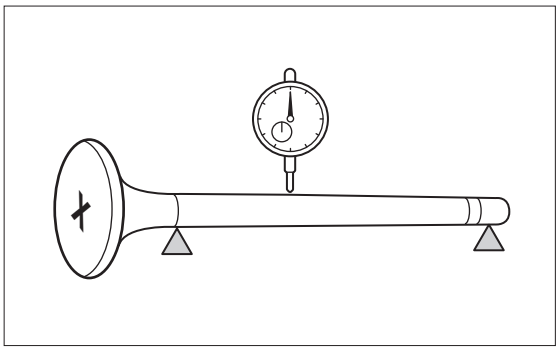
2. Measure valve stem outer diameter ⓑ. Replace if the diameter is less than specified value.



Valve Stem Outer Diameter ⓑ : Standard Value
Intake Side : 5.48 mm (0.216 in)
Exhaust Side : 5.46 mm (0.215 in)

Functional Limit :
Intake Side : 5.46 mm (0.215 in)
Exhaust Side : 5.44 mm (0.214 in)

3. Measure valve stem runout. Replace if the runout is over specified value.

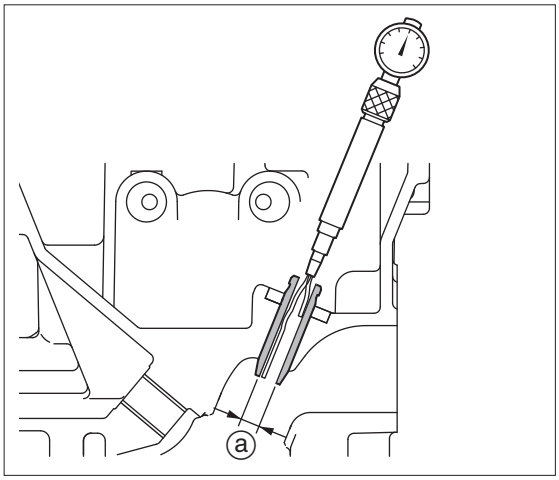


Valve Stem Runout Limit :
Intake Side : 0.07 mm (0.0028 in)
Exhaust Side : 0.05 mm (0.0020 in)

11) Inspection of Valve Guide

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

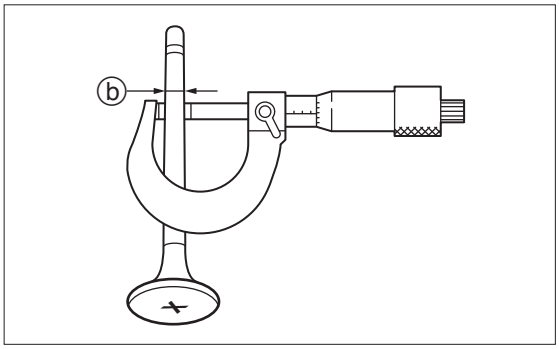
1. Measure valve guide inner diameter ⓐ. Replace cylinder head if the inner diameter is over specified value.



Valve Guide Inner Diameter ⓐ : Standard Value
Intake/Exhaust Side : 5.51 mm (0.217 in)

Functional Limit :
Intake Side : 5.55 mm (0.0218 in)
Exhaust Side : 5.57 mm (0.0219 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 to 0.040 mm (0.00031 to 0.00157 in)
Exhaust Side : 0.025 to 0.057 mm (0.00098 to 0.00224 in)

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

12) Inspection of Valve Seat

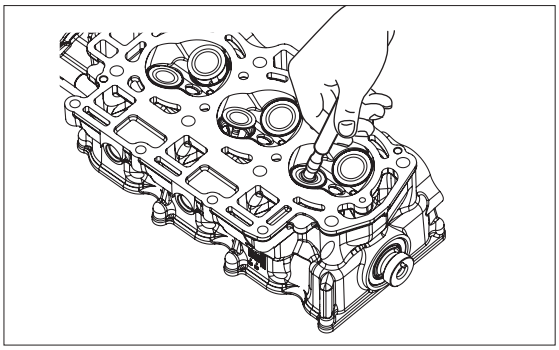
1. Remove carbon built up on the valve.

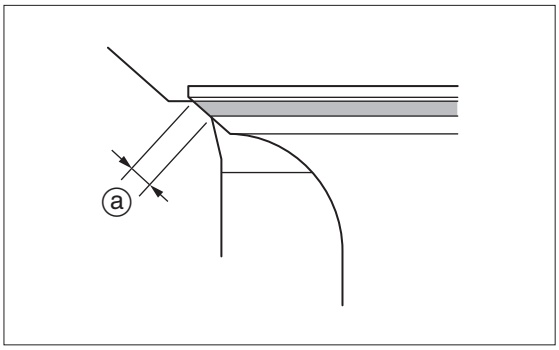
2. Apply thin coat of red lead on the valve seat.

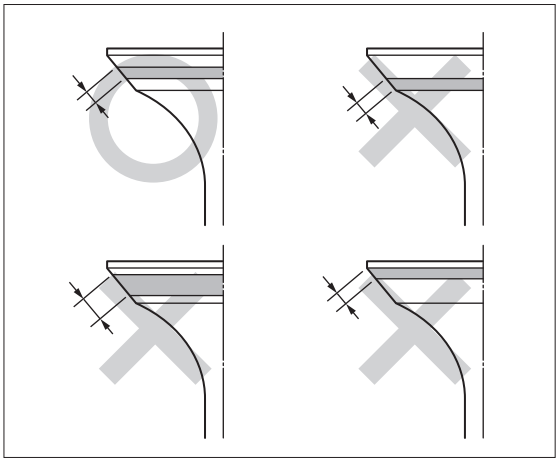
3. Use valve lapper (commercially available item) as shown to push valve onto valve seat lightly.

4. Measure width of area where valve face contacted with valve seat ⓐ 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 : 1.4 mm (0.06 in)
	Functional Limit : Intake/Exhaust Side : 2.0 mm (0.08 in)



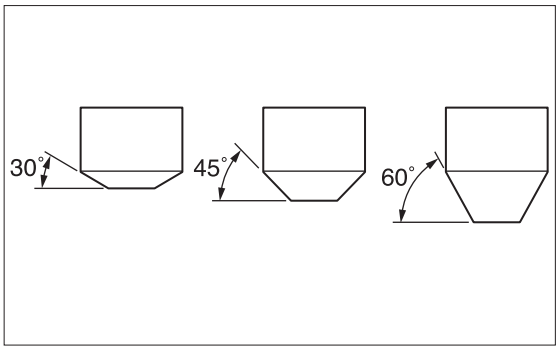




5

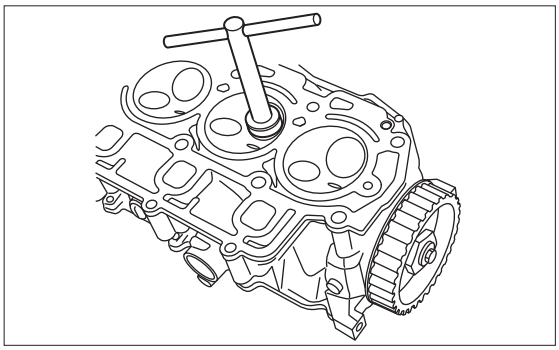
13) Correction of Valve Seat

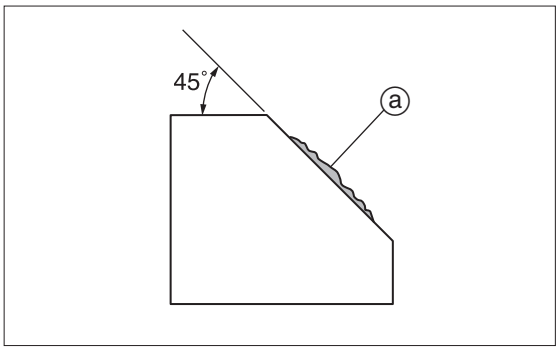
1. Use valve seat cutter (commercially available item) to correct valve seat.



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

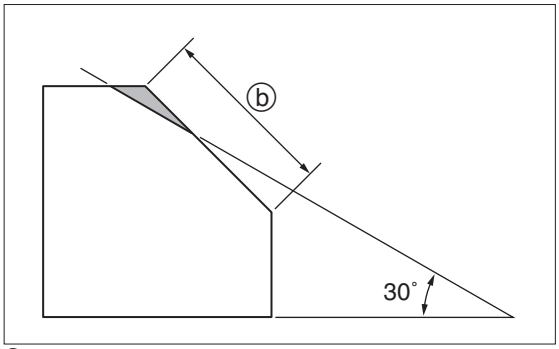
> Be careful not to over-cut valve seat. Turn valve seat cutter while pushing down evenly.





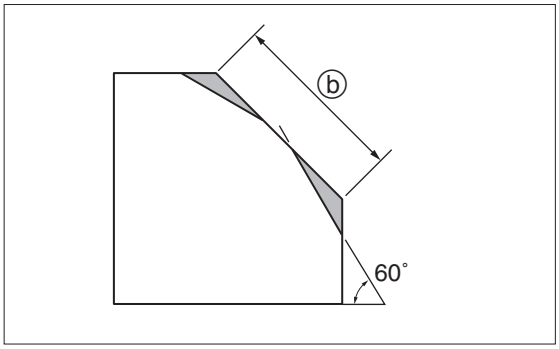
ⓐ Carbon build-up or uneven surface.

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



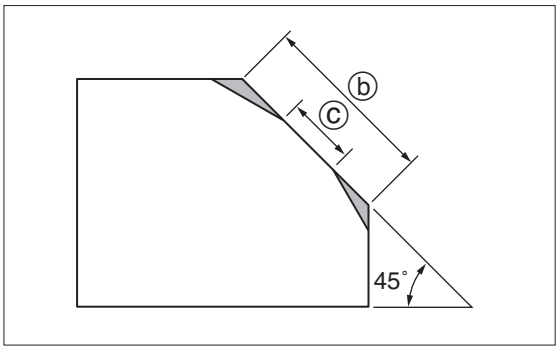
ⓑ Width before correction

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



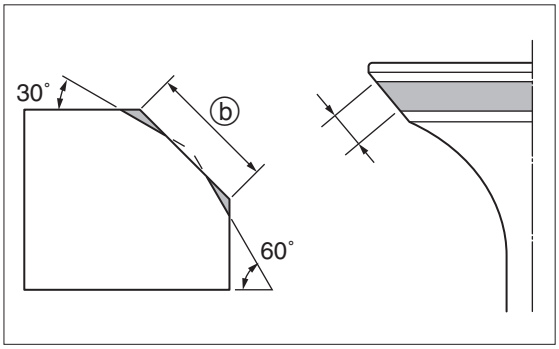
ⓑ Width before correction

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



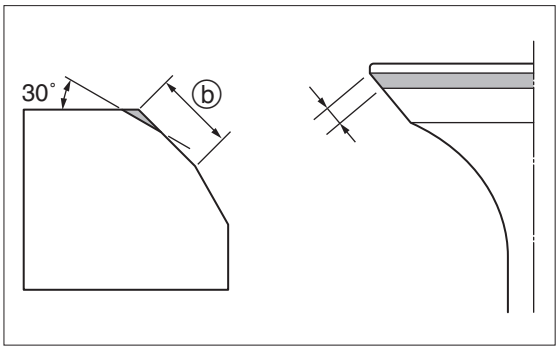
ⓑ Width before correction
ⓒ Specified width

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.



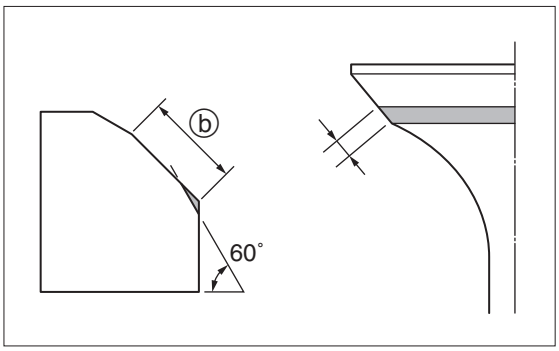
ⓑ Width before correction

7. If valve seat contact area is too narrow and is located neater to valve face upper end, use 30 degree seat cutter to cut upper end. Use 45 degree cutter to adjust contact width of valve seat to specified value.



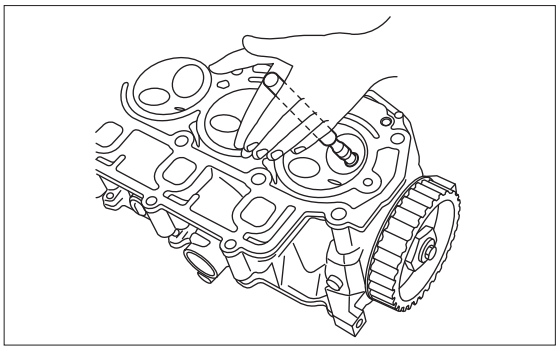
ⓑ Width before correction

8. If valve seat contact area is too narrow and is located neater to valve face lower end, use 60 degree seat cutter to cut lower end. Use 45 degree cutter to adjust contact width of valve seat to specified value.



ⓑ Width before correction

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



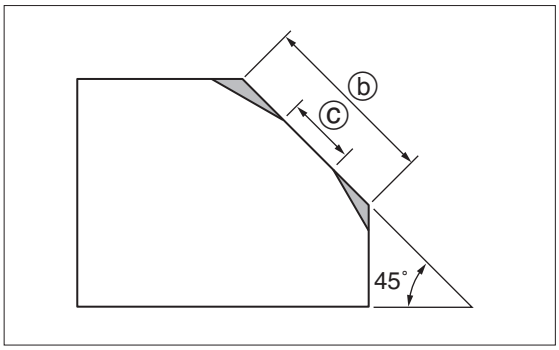
⚠ CAUTION

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.

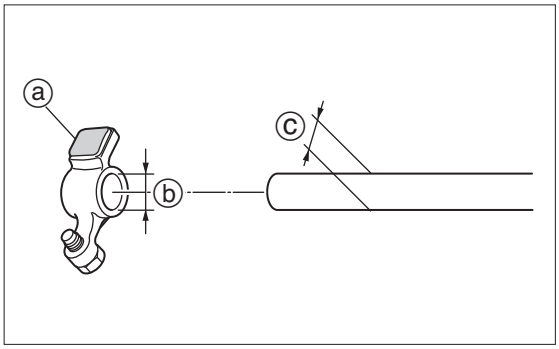
10. After ending the work, remove the compound completely from cylinder head and valve.

11. Check valve seat contact width ⓒ.



Valve Seat Contact Width ⓒ : Standard Value
1.4 mm (0.06 in)

14) Inspection of Rocker Arm and Rocker 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 ⓒ. Obtain oil clearance ⓓ (ⓓ = ⓑ – ⓒ). Replace if the clearance is out of specified range.

Rocker Arm Inner Diameter ⓑ : Standard Value
16.01 mm (0.6303 in)
Rocker Arm Shaft Outer Diameter ⓒ : Standard Value
15.99 mm (0.6295 in)
Oil Clearance Between Rocker Arm Hole and Shaft ⓓ : ⓑ – ⓒ
0.006 to 0.035 mm (0.00024 to 0.00138 in)

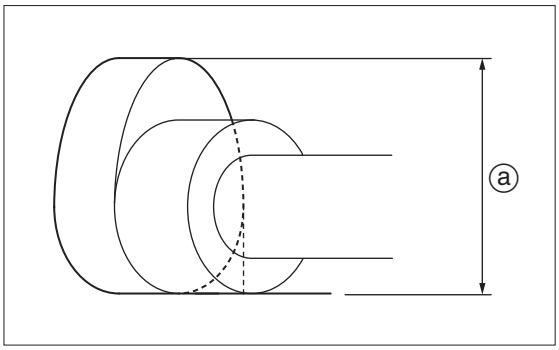
Functional Limit :
Replace if ⓑ is over 16.05 mm (0.6319 in).
Replace if ⓒ is less than 15.94 mm (0.6276 in).
Replace if ⓓ is over 0.090 mm (0.00354 in).

15) Inspection of Cam Shaft

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

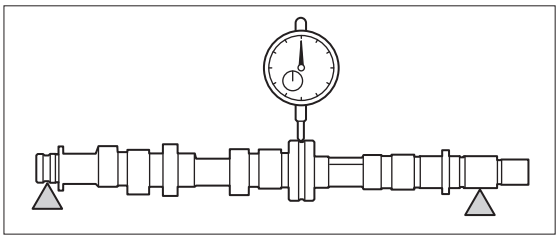
Cam Height at Both Intake and Exhaust Sides ⓐ : Standard Value
Intake side : 35.78 mm (1.4087 in)
Exthoust side : 35.81 mm (1.4078 in)

Functional Limit : Cam Height at Both Intake and Exhaust Sides ⓐ
Intake side : 35.40 mm (1.3937 in)
Extaust side : 35.43 mm (1.3957 in)



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

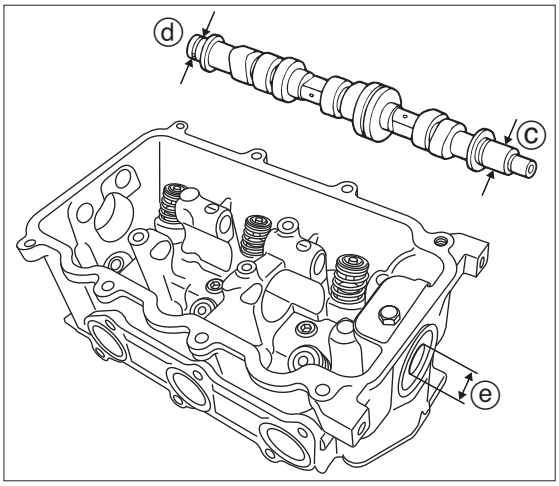
Cam Shaft Runout Limit :
0.05mm (0.0020 in)



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 Outer Diameter (pulley side bearing) ⓒ : Standard Value
41.92 mm (1.6504 in)
Cam Shaft Outer Diameter (oil pump side and center bearing) ⓓ : Standard Value
41.95 mm (1.6516 in)

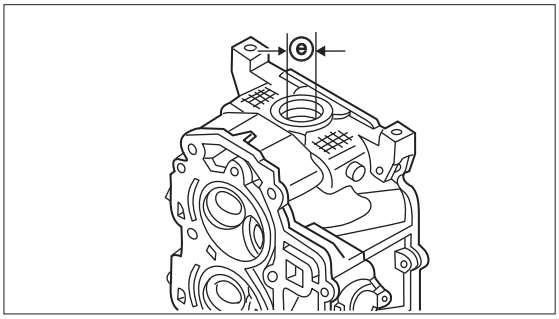
Limit :
ⓒ 41.89 mm (1.6492 in)
ⓓ 41.92 mm (1.6504 in)



4. Measure cylinder head journal inner diameter ⓔ and oil pump journal inner diameter ⓖ. Obtain oil clearances. They are calculated as ⓔ – ⓒ and ⓖ – ⓕ respectively. Replace cam shaft, cylinder head or oil pump if either of the clearances is over specified value.

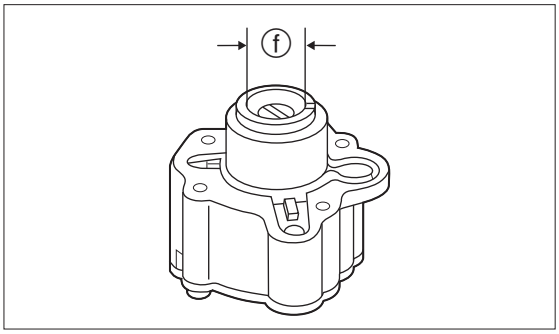
Cylinder head jounal inside diameter ⓖ (upper): Standard Value
42.000 to 42.025 mm (1.65354 to 1.65453 in)

Functional Limit :
42.050 mm (1.65551 in)



Oil Clearance ⓔ – ⓒ: Standard Value
0.02 to 0.05 mm (0.0008 to 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.

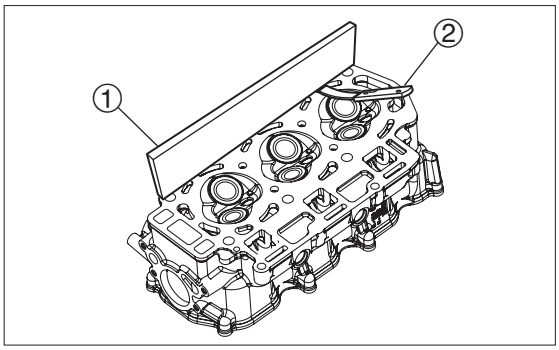
5

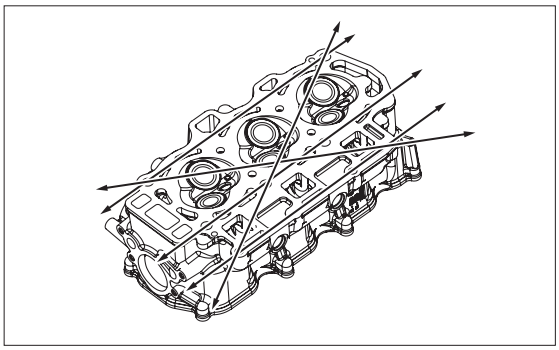
16) Inspection of Cylinder Head

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)

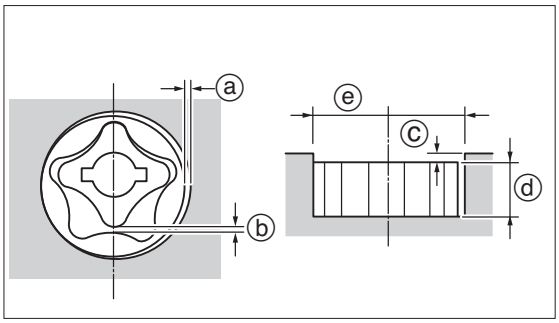


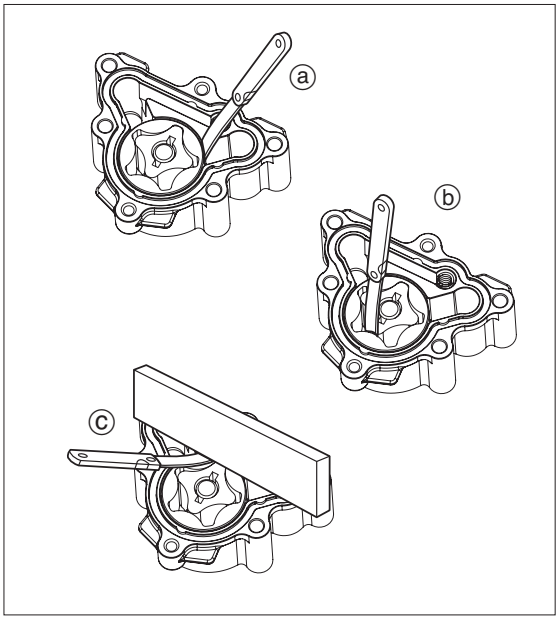


17) Inspection of Oil Pump

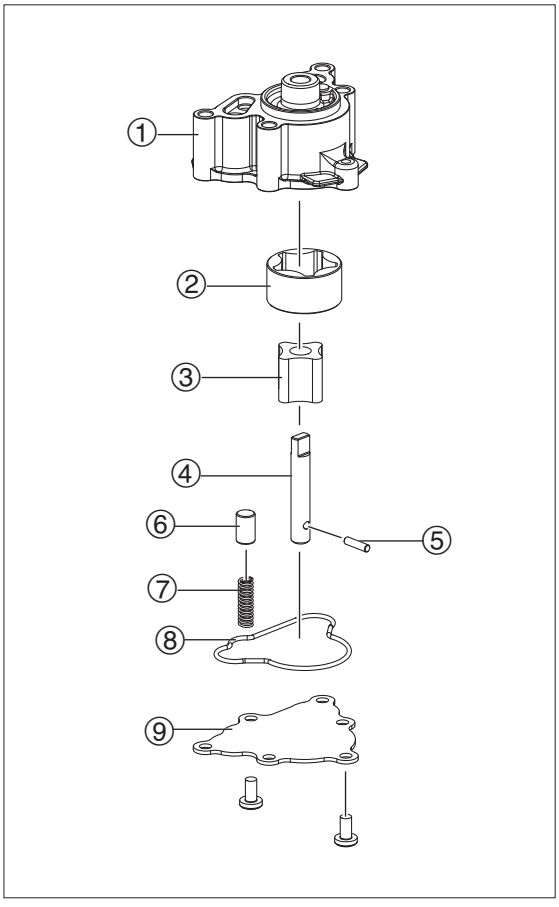
1. Use micrometer, cylinder gauge, depth gauge and thickness gauge to measure dimensions shown below. Replace oil pump if over specified value.

Functional Limit :
Clearance between Outer Rotor and Body ⓐ :
0.25 mm (0.0098 in)
Clearance between outer and inner rotors ⓑ :
0.16 mm (0.0063 in)
Clearance between sides of rotor and body ⓒ :
0.11 mm (0.0043 in) (including wear of oil pump cover)
Height of Outer Rotor ⓓ :
14.96 mm (0.5890 in)
Pump Body Inner Diameter ⓔ :
40.8 mm (1.605 in)





① Pump body
② Outer rotor
③ Inner rotor
④ Shaft
⑤ Pin
⑥ Plunger piston
⑦ Plunger spring gasket
⑧ Gasket
⑨ Oil pump cover

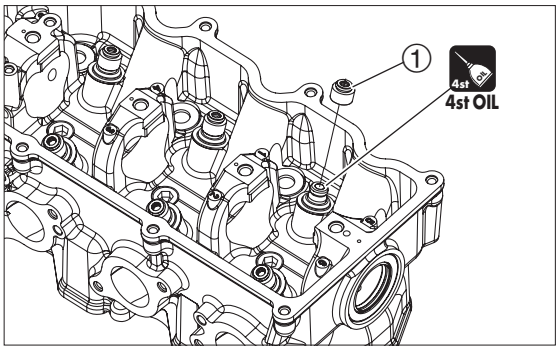


5

18) Installation of Valves

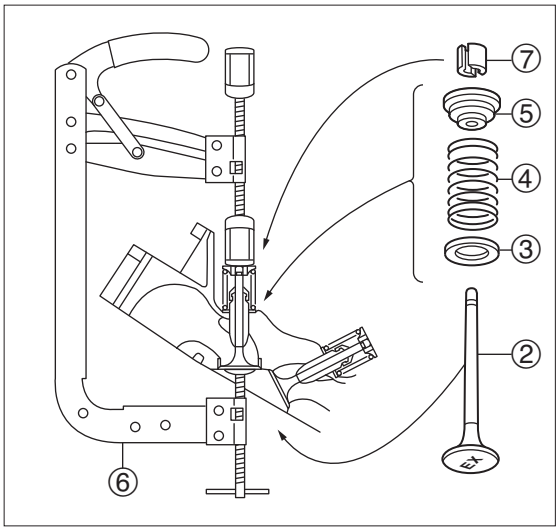
1. Apply oil to valve guide and attach new valve stem seal.

Intake Side : Black
Exhaust Side : Green

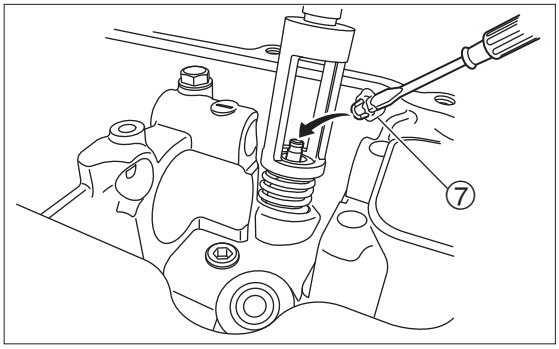


2. Install valve ②, valve spring seat ③, valve spring ④ and retainer ⑤ in the order shown, and then, attach valve spring compressor ⑥.

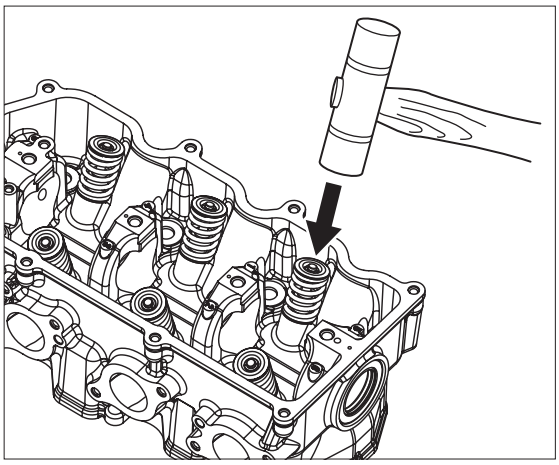
Valve Spring Compressor ⑥ :
Commercially available item



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 retainer ⑤ with plastic hammer to fix cotter ⑦ securely.



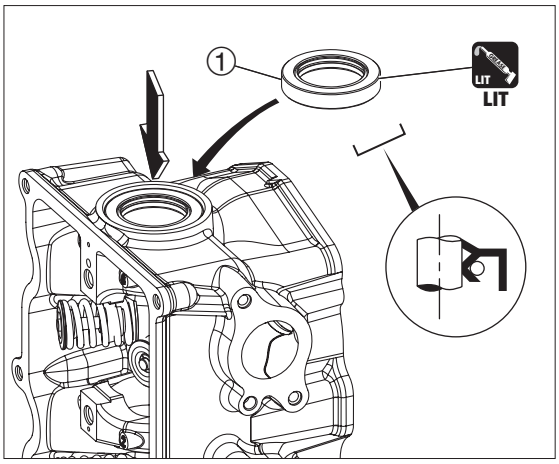
19) Installation of Cam Shaft

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

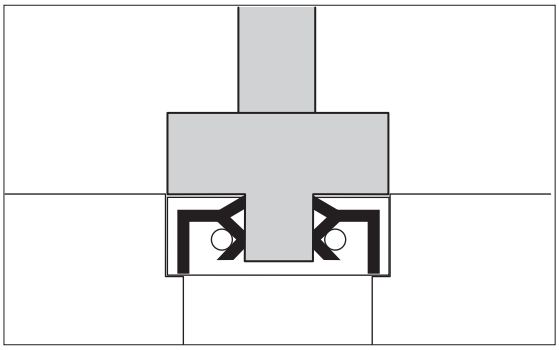
Driver Rod :
P/N. 3AC-99702-0
Oil Seal Attachment :
P/N. 3AC-99820-0

Apply grease to lip of oil seal before installing it.

LIT



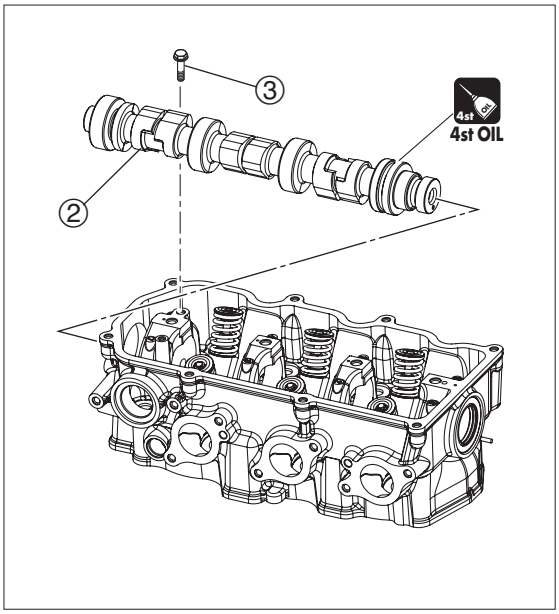
① Oil seal 50-68-9



2. Install cam shaft ② from direction shown.

3. Tighten camshaft locating bolt ③ to specified torque.

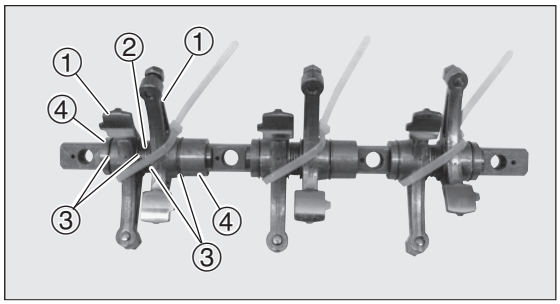
Thrust Bolt :
9 N·m (7 lb·ft) [0.9 kgf·m]



5

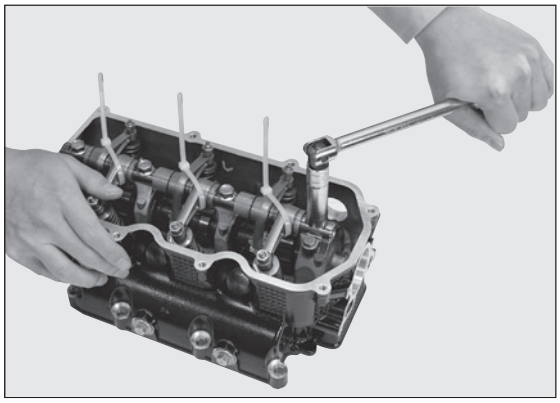
20) Installation of Rocker Arm Shaft

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



It is easy to assemble and kept together each rocker arm with tie wraps.

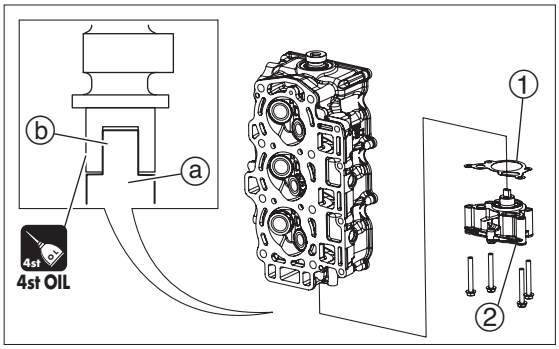
2. Tighten rocker arm shaft locating bolt to specified torque.



Rocker Arm Shaft Bolt :
18 N·m (13 lb·ft) [1.8 kgf·m]

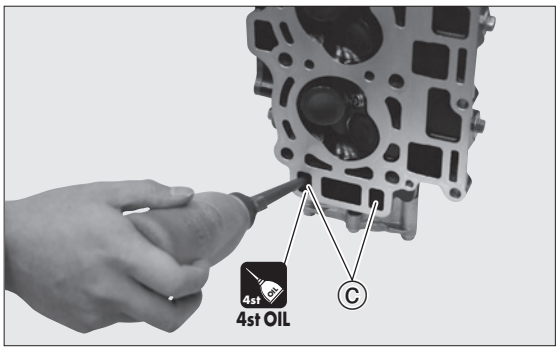
21) Installation of Oil Pump

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

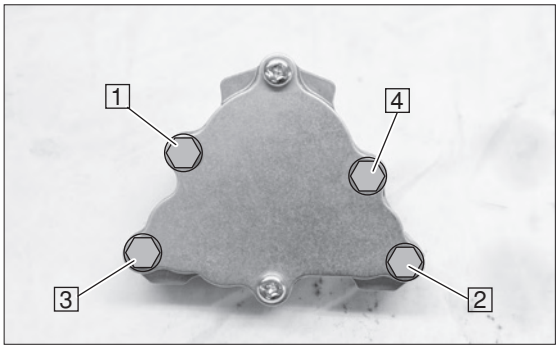


2. Apply engine oil to pump O-ring and cam shaft lower side journal ⓒ (approx. 2 ml), and install oil pump.

3. Secure oil pump using Four M6 bolts by tightening them to specified torque in the order specified below.
Bolt tightening order : 1→2→3→4



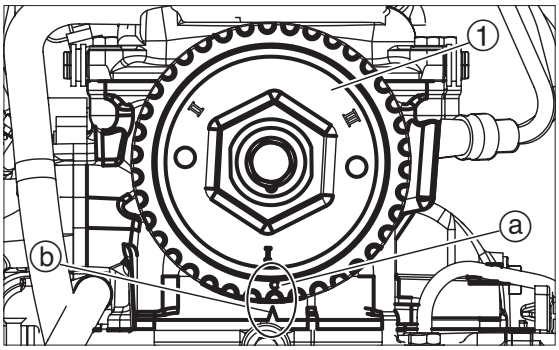
Oil Pump Bolts :
8 N·m (6 lb·ft)[0.8 kg·m]



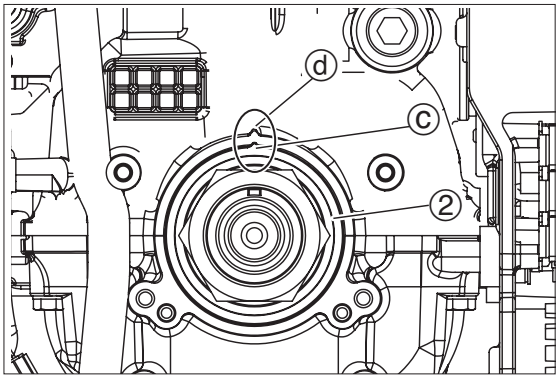
22) Installation of Cylinder Head

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

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



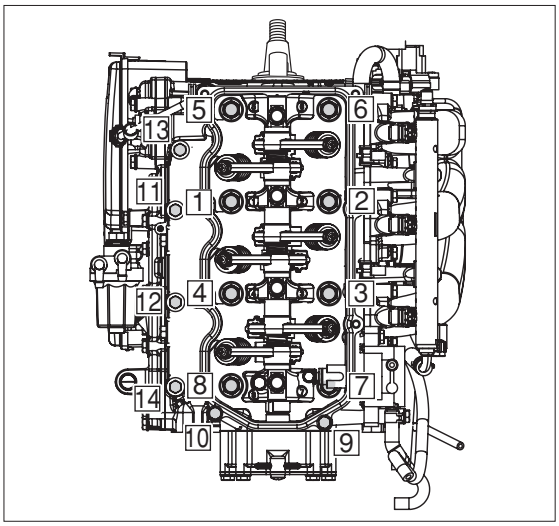
2. Check that "▲" mark ⓒ of belt guide and "▲" mark ⓓ of cylinder block are aligned with each other.



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

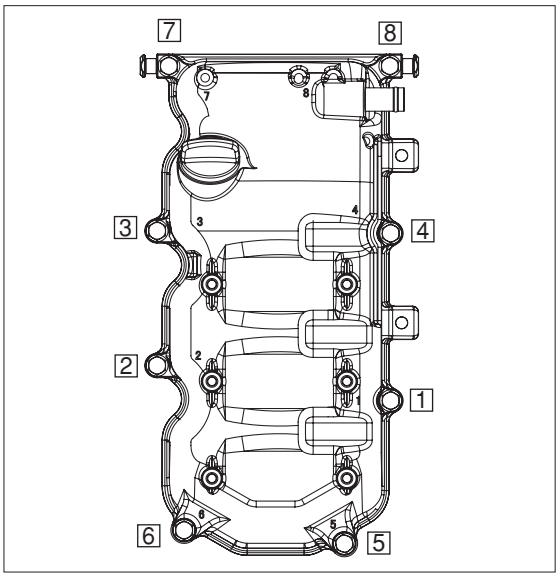
⚠ CAUTION

- **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, resulting in damages to these parts.**



- First, tighten M10 bolts in two steps to specified torque. Then, tighten M8 bolts in two steps to specified torque.
- After installing cylinder head, install timing belt and check valve clearance. For the procedure, refer to relevant sections.

First step:
Cylinder Head Bolts (M10) 1 ~ 8
30 N·m (22 lb·ft) [3.0 kgf·m]
Cylinder Head Bolts (M8) 9 ~ 14
15 N·m (11 lb·ft) [1.5 kgf·m]
Second step:
Cylinder Head Bolts (M10) 1 ~ 8
60 N·m (44 lb·ft) [6.0 kgf·m]
Cylinder Head Bolts (M8) 9 ~ 14
30 N·m (22 lb·ft) [3.0 kgf·m]

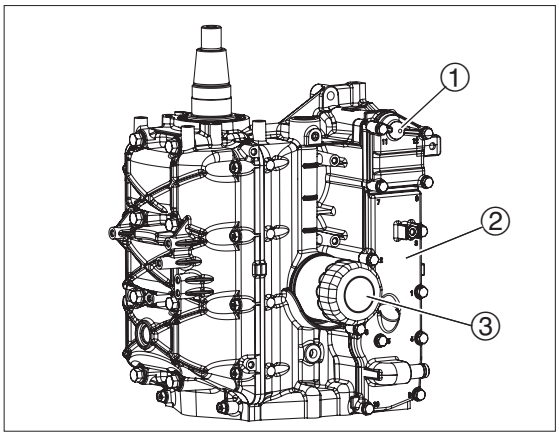


4. Install cylinder head cover, and tighten them.

5

23) Disassembly of Cylinder Block

1. Remove thermostat cover bolt and the cover ① and exhaust cover ②..

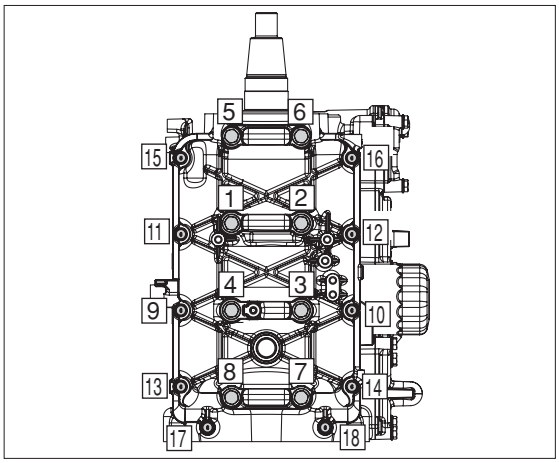


2. Remove oil filter ③.

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. 18 ~ 1

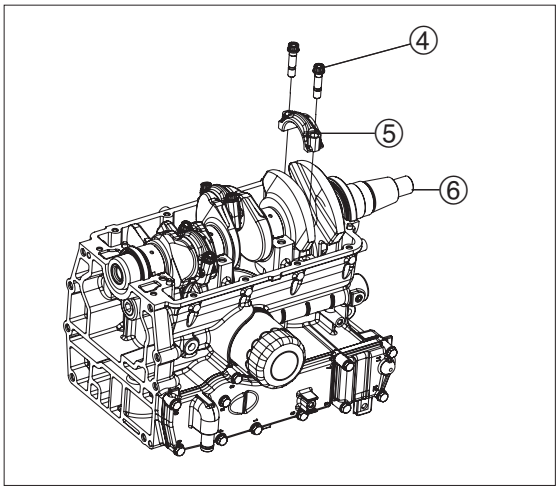


4. Remove connecting rod bolts ④ and connecting rod cap ⑤, and then, crankshaft ⑥ and oil seal.

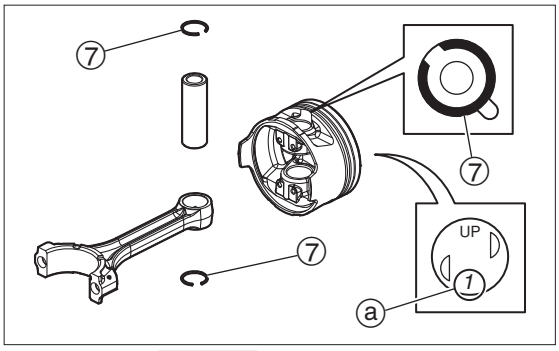
5. Remove bearings from cylinder block and crankcase.

6. Remove connecting rods and piston assemblies from cylinder block.

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



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



⑥ piston pin clips **Do not reuse.**

24) Removing of Drive Pulley

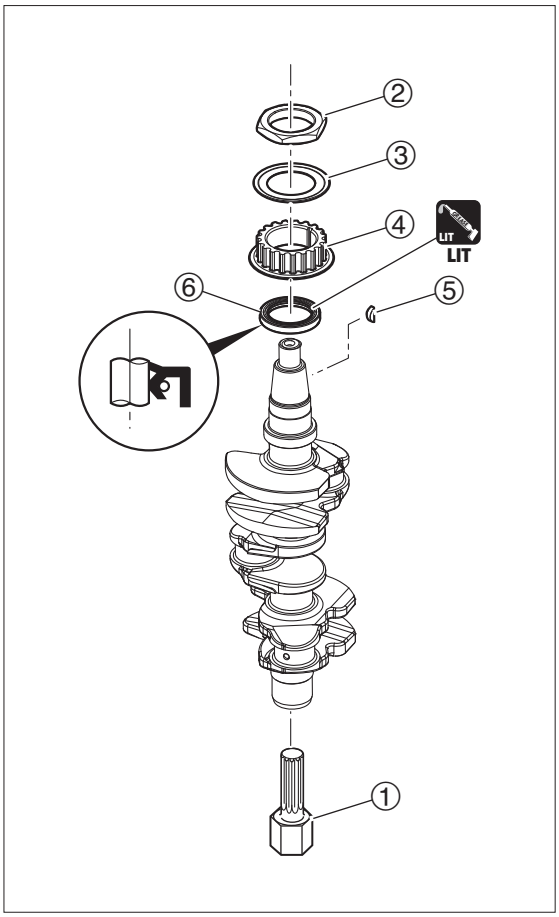
1. Secure crankshaft holder ① with vice, and then insert crankshaft.

Crankshaft Holder ① :
P/N. 3KY-72815-0

It may help to heat the nut with a small torch to be able to remove easier. Also, many front wheel drive auto sockets work well for removal/ installation drive belt pulley nuts.

2. Loosen drive pulley nut ②, use socket wrench (50 mm).

3. Remove drive pulley nut ②, belt guide ③, drive pulley ④, key ⑤ and oil seal ⑥.



25) Installing of Drive Pulley

1. Secure crankshaft holder ① with bice, and then insurt crankshaft.

Crankshaft Holder ① :
P/N. 3KY-72815-0

2. Apply Lithum grease to oil seal lip and install oil seal ⑥.

3. Install key ⑤, drive pulley ④, belt guide ③ and drive pulley nut ②.

3. Tighten drive pulley nut ② to specified torque, use socket wrench (50 mm).

Drive Pulley Nut ② :
150 N·m (110 lb·ft)[15.0 kg·m]

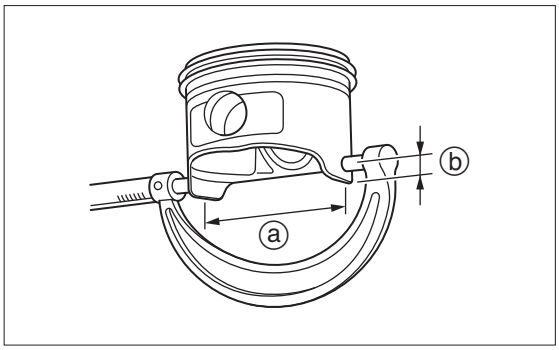
5

26) Inspection of Piston Outer Diameter

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

Piston Outer Diameter ⓐ : Standard Value
69.97 mm (2.7547 in)
Measurement Points ⓑ :
9mm (0.35 in) above piston skirt bottom

Functional Limit :
69.90 mm (2.7520 in)



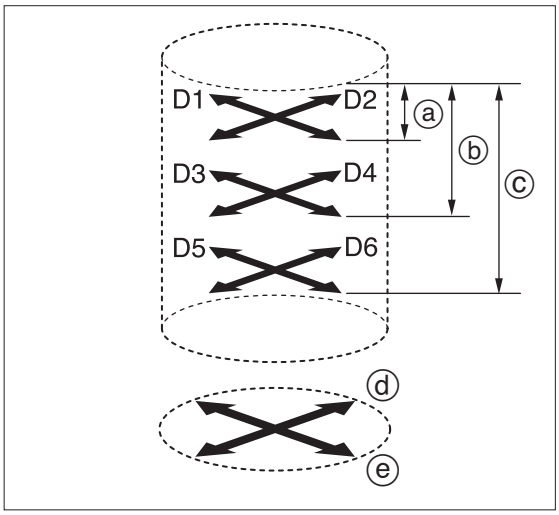
27) Inspection of Cylinder Inner Diameter

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

Cylinder Inner Diameters (D1 to D6) : Standard Value
70.00 mm (2.7559 in)

Functional Limit :
Replace if over 70.06 mm (2.7583 in).

Note : Measure at the maximum wear points.



ⓐ 15mm (0.6in)
ⓑ 35mm (1.4in)
ⓒ 55mm (2.2in)

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

Taper :
D1–D5 (Measurement Point ⓐ)
D2–D6 (Measurement Point ⓒ)

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

Functional Limit :
0.06 mm (0.0024 in)

28) Inspection of Piston Clearance

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

Piston Clearance (Cylinder inside diameter – Piston outside diameter):
0.020 to 0.055 mm (0.00079 to 0.00217 in)

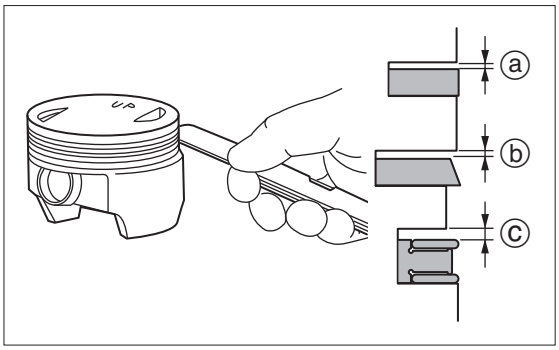
Functional Limit :
0.150 mm (0.00591 in)

29) 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 Side Clearance :
Top Ring ⓐ : 0.04 to 0.08mm (0.0016 to 0.0031 in)
Second Ring ⓑ : 0.03 to 0.08mm (0.0012 to 0.0031 in)
Oil Ring ⓒ : 0.03 to 0.13mm (0.0012 to 0.0051 in)

Functional Limit :
Top Ring ⓐ : 0.10 mm (0.0039 in)
Second Ring ⓑ : 0.10 mm (0.0039 in)
Oil Ring ⓒ : 0.15 mm (0.0059 in)



30) Inspection of Piston Rings

1 Push piston ring ① into ring gauge 70.000mm (2.75591in) parallel to top edge. Measure at the top or bottom of cylinder bore with no wear.

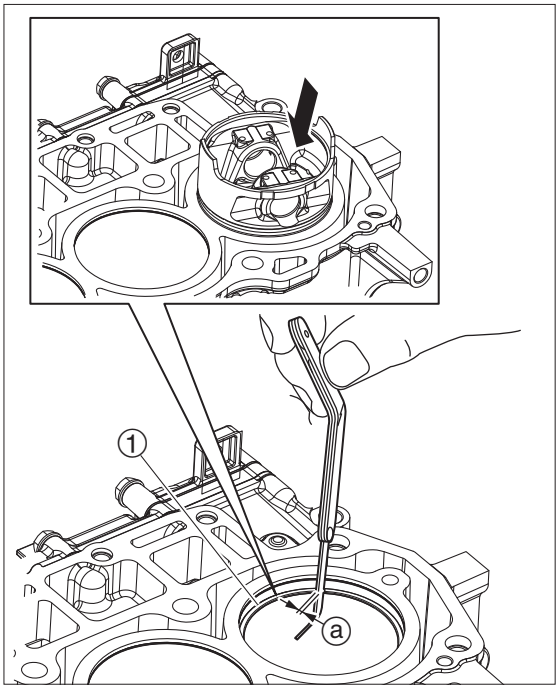
2. When ring gauge is not available, use piston crown to push piston ring ① into to cylinder.

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

Piston Ring Closed Gap ⓐ :
Top Ring : 0.20 to 0.35 mm (0.0079 to 0.0138 in)
Second Ring : 0.35 to 0.50 mm (0.0138 to 0.0197 in)
Oil Ring : 0.20 to 0.70 mm (0.0079 to 0.0276 in)

Functional Limit :
Top Ring : 0.50 mm (0.0197 in)
Second Ring : 0.70 mm (0.0276 in)
Oil Ring : 1.00 mm (0.0394 in)

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



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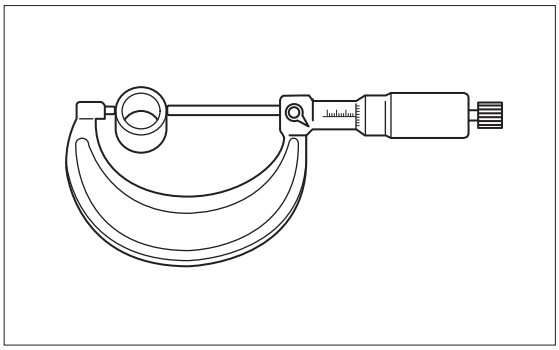
31) Inspection of Piston Pins

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

Piston Pin Outer Diameter : Standard Value
17.00 mm (0.6693 in)

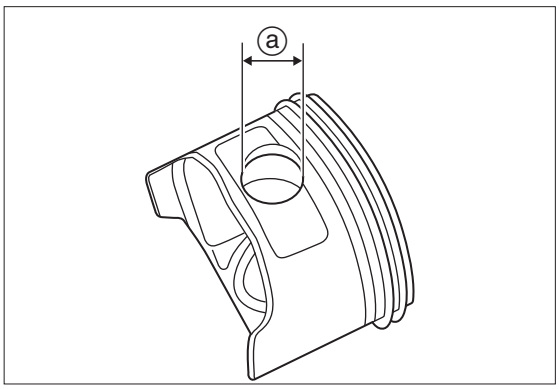
Functional Limit :
16.970 mm (0.66811 in)



2. Measure piston pin inner diameter ⓐ. Replace piston pin if the inner diameter is over specified value.

Piston Pin Inner Diameter ⓐ : Standard Value
17.005 mm (0.66949 in)

Functional Limit :
17.012 mm (0.66976 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 to 0.012 mm (0.00008 to 0.00047 in)

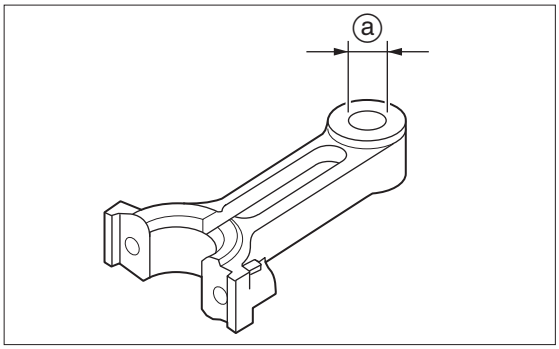
Functional Limit :
0.040 mm (0.00157 in)

32) 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)

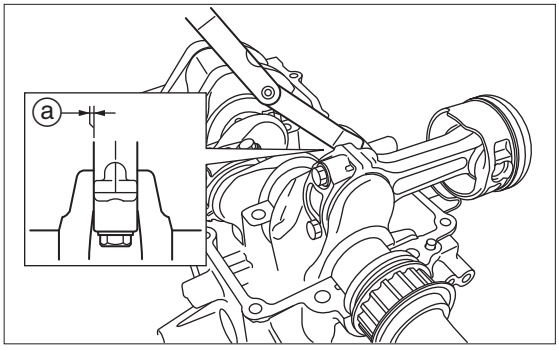


33) Inspection of Connecting Rod Big End Side Clearance

1. Measure connecting rod big end side clearance ⓐ. Replace connecting rod and/or crankshaft if the clearance is over specified value.

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

Functional Limit :
0.60 mm (0.0236 in)

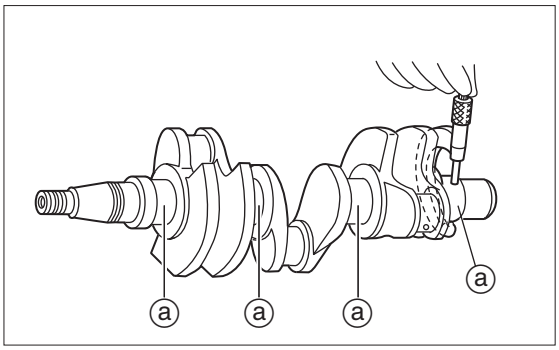


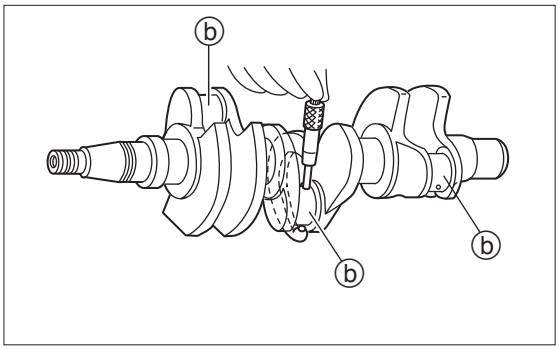
34) Inspection of Crankshaft

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
39.97 mm (1.5744 in)
Crank Pin Outer Diameter ⓑ : Standard Value
37.99 mm (1.4957 in)

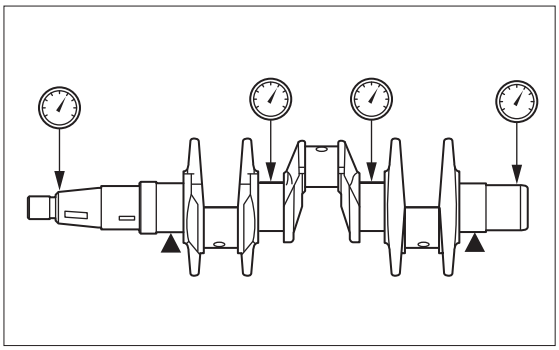
Functional Limit :
Crankshaft Journal Outer Diameter ⓐ :
Replace if ⓐ is less than 39.97 mm (1.5736 in).
Crank Pin Outer Diameter ⓑ :
Replace if ⓑ is less than 37.97 mm (1.4949 in).





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

Crankshaft Runout Limit :
0.05 mm (0.0020 in)



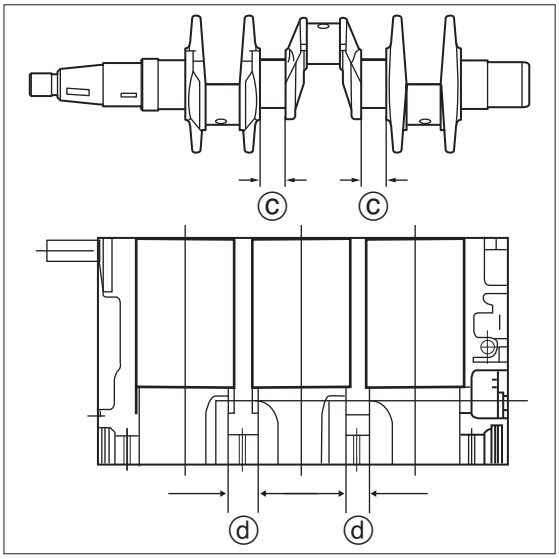
3. Side Clearance

Side Clearance :
0.05 to 0.25 mm (0.0020 to 0.0098 in)

Functional Limit :
0.50 mm (0.0197 in)

If side clearance is out of specified range, 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
24.05 to 24.10 mm (0.9468 to 0.9488 in)
Crank Case Width ⓓ : Standard Value
23.95 to 24.00 mm (0.9429 to 0.9449 in)



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35) Inspection of Crank Pin (rod journal) Oil Clearance

1. Clean connecting rod and metal bearing, and then install metalbearing.

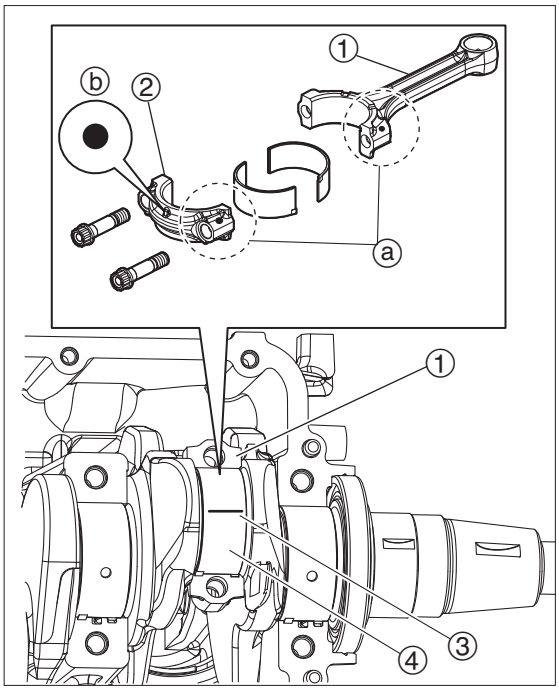
2. Place cylinder block upside down on the work bench. Install piston to connecting rod ①.

   Do not attach piston rings.

3. Install crankshaft on the cylinder block.

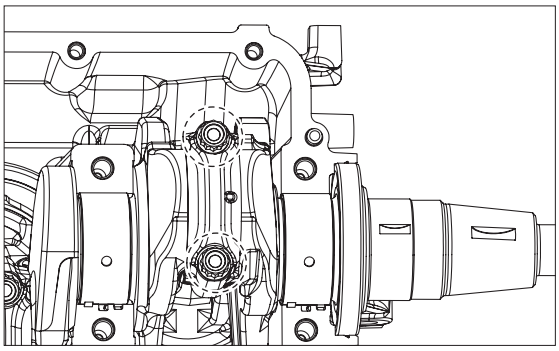
4. Place plasti-gauge ③ on each crank pin ④ parallel to crankshaft.

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



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

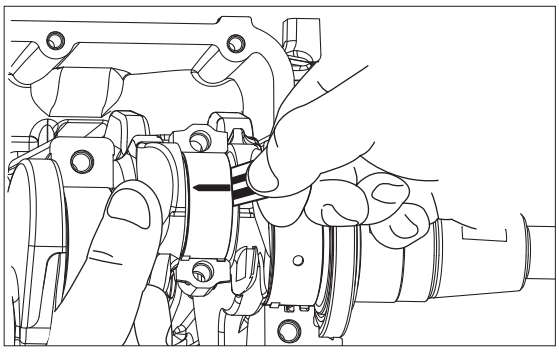
   - Be sure that individual cap is installed to their original connecting rod. (ⓐ)
   - Check that "Δ" mark ⓑ of connecting rod is directed to crankshaft flywheel side.



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

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

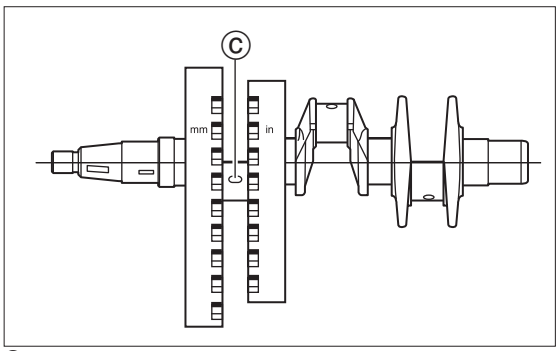
   Connecting Rod Bolts :
   First Tightening Torque : 15 N·m (11 lb·ft) [1.5 kgf·m]
   Final Tightening Torque : 30 N·m (22 lb·ft) [3.0 kgf·m]



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

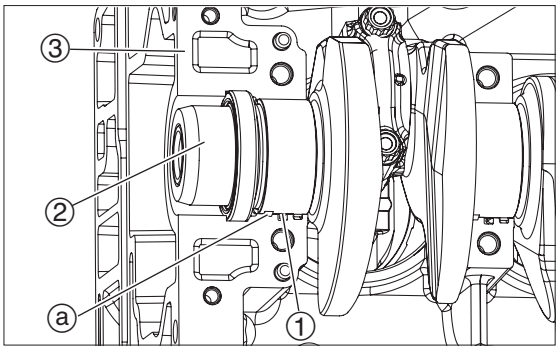
   Crank Pin Oil Clearance ⓒ :
   0.020 to 0.045 mm (0.00079 to 0.00177 in)

   Functional Limit :
   0.060 mm (0.00236 in)



ⓒ Plasti-gauge

36) Inspection of Crank Shaft Main Journal Oil Clearance

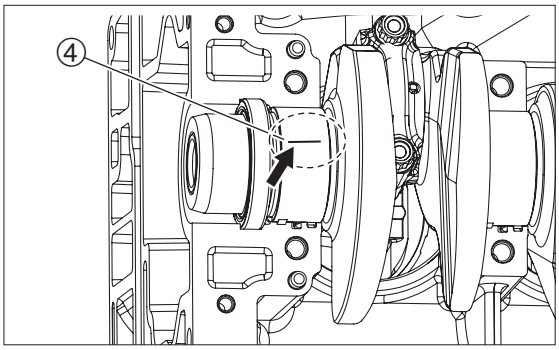


1. Clean bearings, crankshaft main journal, and bearing installation areas of crank case and cylinder block.

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.



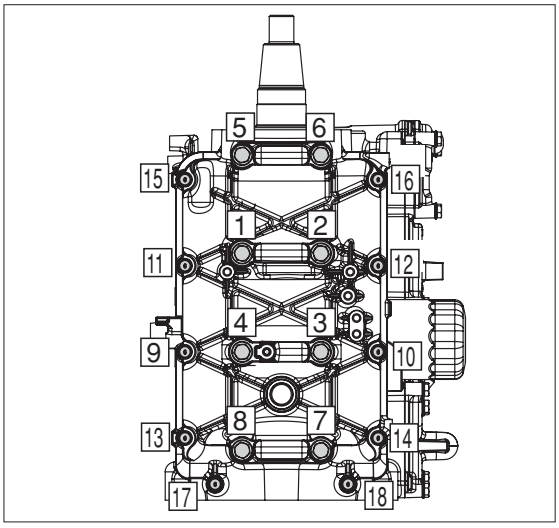
4. Place plasti-gauge ④ on each crankshaft main journal parallel to crankshaft.

> Do not place plasti-gauge 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 crank case bolts in two steps to specified torque in the order shown.

> **First Tightening Torque :**
> 1 ~ 8 **: Crank Case Bolts (M8)**
> 15 N·m (11 lb·ft) [1.5 kgf·m]
> 1 ~ 8 **: Crank Case Bolts (M6)**
> 6 N·m (4 lb·ft) [0.6 kgf·m]
> **Final Tightening Torque :**
> 9 ~ 18 **: Crank Case Bolts (M8)**
> 24 N·m (17 lb·ft) [2.4 kgf·m]
> 9 ~ 18 **: Crank Case Bolts (M6)**
> 11.5 N·m (8.5 lb·ft) [1.15 kgf·m]

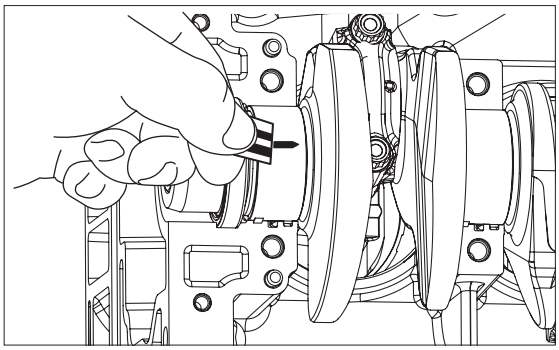
> Do not move crankshaft until oil clearance measurement is completed.

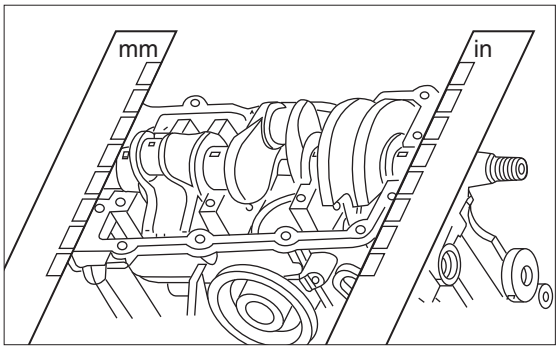
8. Loosen bolts in reverse order in several steps. Remove crank case and measure width of crushed plasti-gauge on each main journal. Replace bearing if the width is over specified value.

Crankshaft Main Journal Oil Clearance :
0.020 to 0.041 mm (0.00079 to 0.00161 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.





37) Selecting of Cylinder/Crankcase Metal Bearing

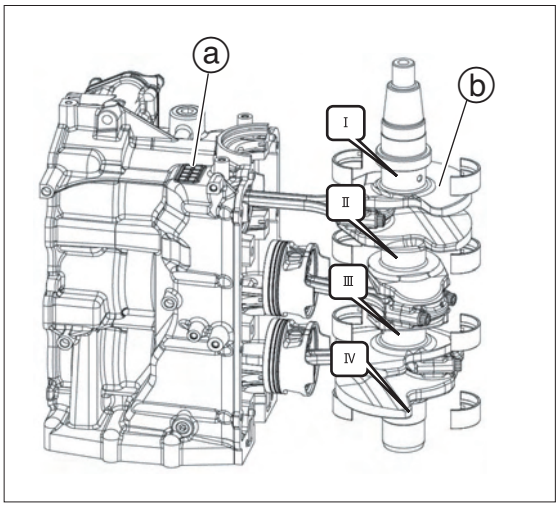
1 Check that metal bearing inner diameter code ⓐ and crankshaft journal outside diameter code ⓑ as shown below chart.

Marked on cylinder upper section with inner diameter code ⓐ that indicates inner diameter of each bearing holder. There are three types of bearing in accordance with inner diameter code.

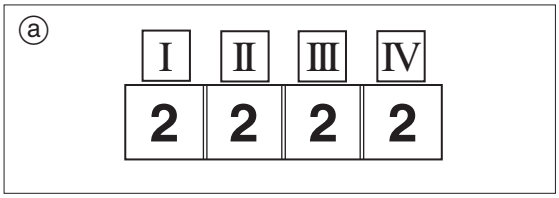
Code	Inner Diameter
1	44.000 to 44.004 mm (1.73228 to 1.73244 in)
2	44.005 to 44.009 mm (1.73248 to 1.73263 in)
3	44.010 to 44.014 mm (1.73267 to 1.73283 in)

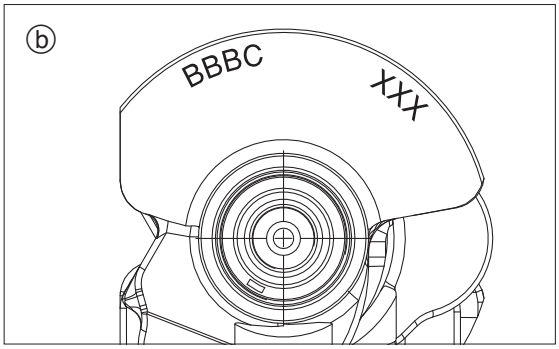
And, crankshaft is marked on its upper section with outer diameter code ⓑ that indicates outer diameter of each crankshaft journal.

Code	Outer Diameter
A	39.996 to 40.000 mm (1.57464 to 1.57480 in)
B	39.971 to 39.975 mm (1.57444 to 1.57460 in)
C	39.986 to 39.990 mm (1.57425 to 1.57441 in)



ⓐ Inner Diameter Code ⓑ Outer Diameter Code





2. Check that maching chart of crank jounal metal bearing code as shown below chart, and then select crank jounal metal bearing.

Code	1	2	3
A	Brown	Brown	Black
B	Brown	Black	Black
C	Black	Black	Blue

Crank journal metal bearing thicness

Parts No.	Color	Thickness
3KY-07707-0	Brown	1.996 to 2.000 mm (0.07858 to 0.07874 in)
3KY-07708-0	Black	2.000 to 2.005 mm (0.07874 to 0.07894 in)
3KY-07750-0	Blue	2.005 to 2.010 mm (0.07894 to 0.07913 in)

38) Selecting of Connecting Rod Metal Bearing

1 Check that connecting rod metal inner diameter code ⓐ and crankpin outside diameter code ⓑ as shown right illustration.

Marked on mating position of each connecting rod and connecting rod cap with inner diameter code ⓐ that indicates inner diameter. There are three types of bearing in accordance with inner diameter code.

Code	Inner Diameter
1	41.000 to 41.006 mm (1.61417 to 1.61441 in)
2	41.007 to 41.012 mm (1.61445 to 1.61464 in)
3	41.013 to 41.018 mm (1.61468 to 1.61488 in)

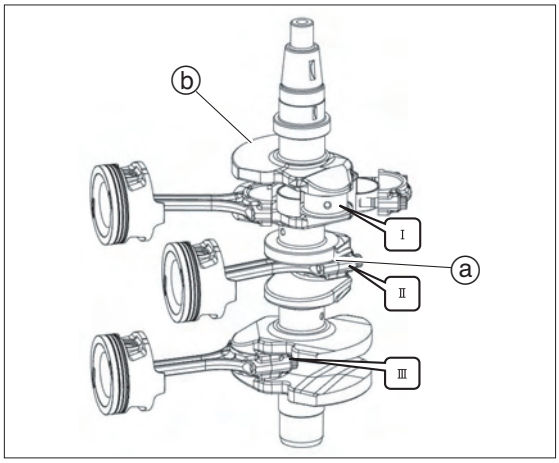
The code is not means cylinder No..

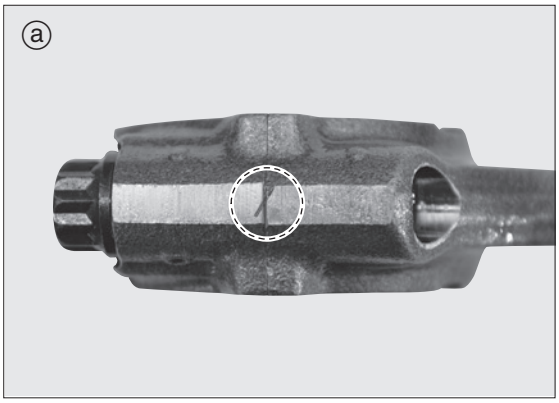
And, marked on crankshaft upper section with outer diameter code ⓑ that indicates outer diameter of each crank pin.

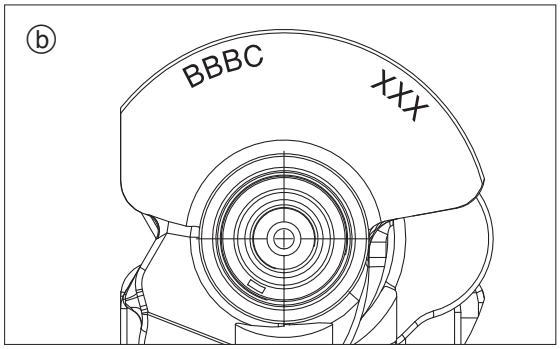
Code	Outer Diameter
X	37.996 to 38.000 mm (1.49590 to 1.49606 in)
Y	37.991 to 37.995 mm (1.49571 to 1.49586 in)
Z	37.986 to 37.790 mm (1.49551 to 1.49567 in)

2. Check that maching chart of connecting rod metal bearing code as shown below chart, and then select connecting rod metal metal bearing.

Code	1	2	3
X	Brown	Brown	Black
Y	Brown	Black	Black
Z	Black	Black	Blue







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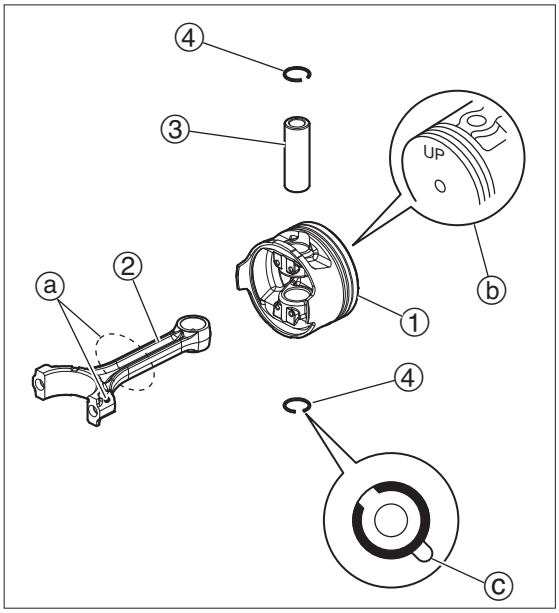
Connecting rod metal bearing thicness

Parts No.	Color	Thickness
3KY-00080-0	Brown	1.491 to 1.495 mm (0.05870 to 0.05886 in)
3KY-00081-0	Black	1.495 to 1.500 mm (0.05886 to 0.05906 in)
3KY-00082-0	Blue	1.500 to 1.505 mm (0.05906 to 0.05925 in)

39) Assembling Piston and Connecting Rod

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

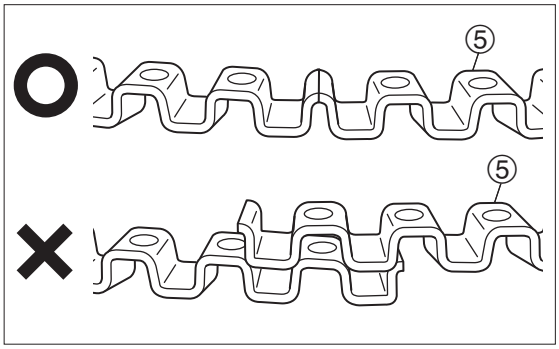


- Point "Δ" mark of connecting rod ⓐ and "UP" mark ⓑ of piston at the same direction.
- Be sure to use new piston pin clip, and place clip gap away from piston pin groove ⓒ as shown.
- Be sure that individual connecting rod cap is installed to their original connecting rod.

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

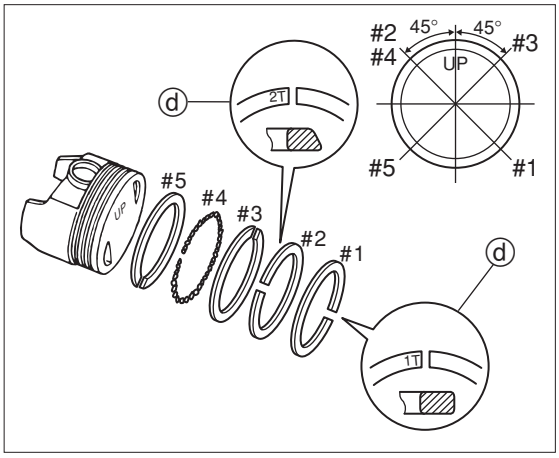
3. While holding expander ⑤ (#4) gap with thumb, put upper side rail (#3) into the groove so that the gap is away from gap of expander ⑤ (#4) to the left by 90 degrees.

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. Install piston ring so that their gaps are away from each other.



⚠ CAUTION

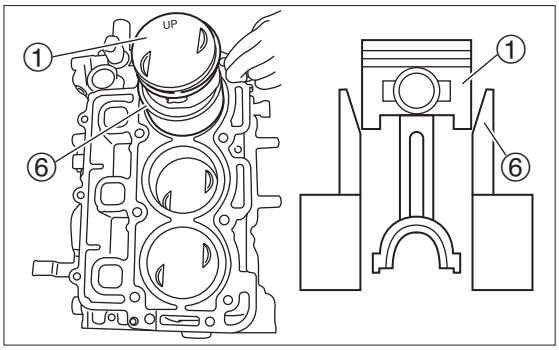
Be careful not to scratch piston surface and damage rings.

- 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 ① "UP" mark directing flywheel side and piston slider ⑥ set on the pistons.

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

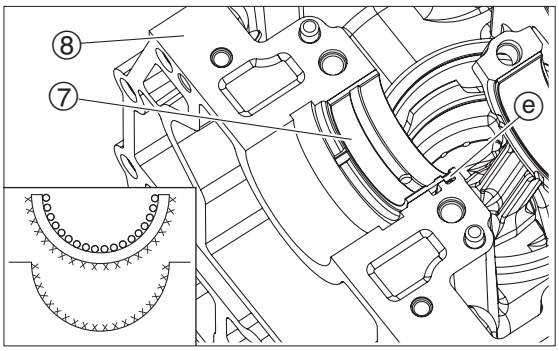
Piston Slider ⑥ :
P/N. 3KY-72871-0



8. Clean and remove grease on bearing holder of crankscase (x).

9. Install bearing half ⑦ to cylinder block ⑧ and connecting rod.

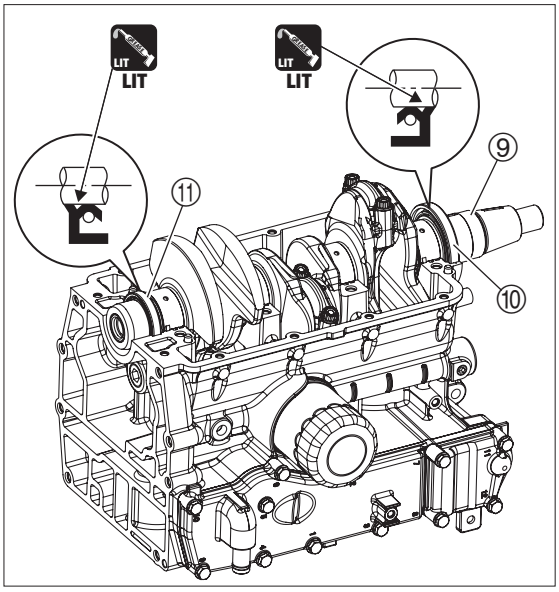
- Be sure that individual bearings are installed to their original locations.
- Install bearings with their projection ⓔ fit into cylinder block groove.



10. Apply engine oil to bearings and crankshaft (o).

11. Install crankshaft ⑨ and oil seals ⑩ and ⑪ on the cylinder block.

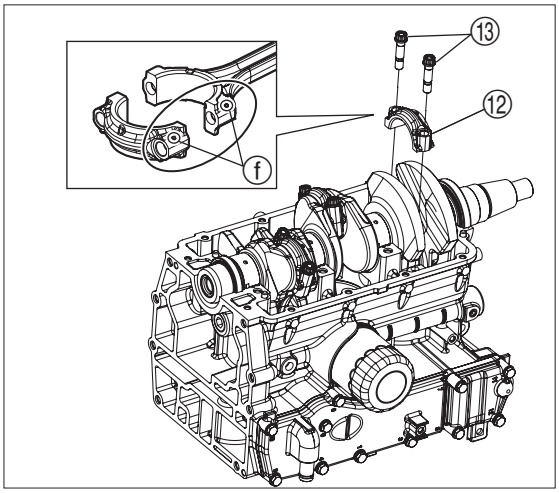
- Apply grease to lip of oil seal before installing it.
- Be sure that individual connecting rod cap is installed to their original connecting rod.



12. Attach connecting rod cap ⑫ with metal bearing to connecting rod, and tighten connecting rod bolts ⑬ in two steps to specified torque.

- Lubricate connecting rod journals and connecting rod bearings.
- Align mating marks ⓕ of connection rod cap and connecting rod with each other.

Connecting Rod Bolts ⑬ :
First Tightening Torque : 15 N·m (11 lb·ft) [1.5 kgf·m]
Final Tightening Torque : 30 N·m (22 lb·ft) [3.0 kgf·m]



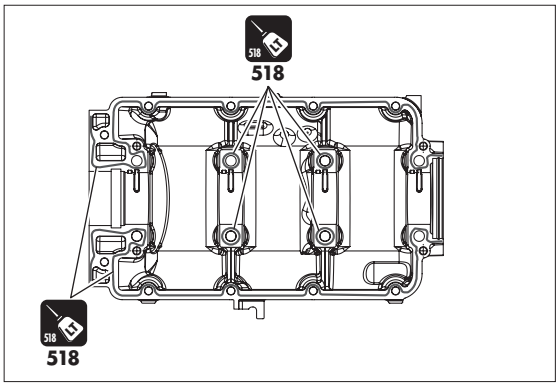
13. Install bearing half to crank case.

- Be sure that individual bearings are installed to their original locations.
- Install bearings with their projection fit into crank case groove.
- Remove grease from surface of crankcase and outside of bearing half.

14. Apply 4 stroke engine oil to bearings.

15. Apply sealing agent to mating surface of crank case (halves).

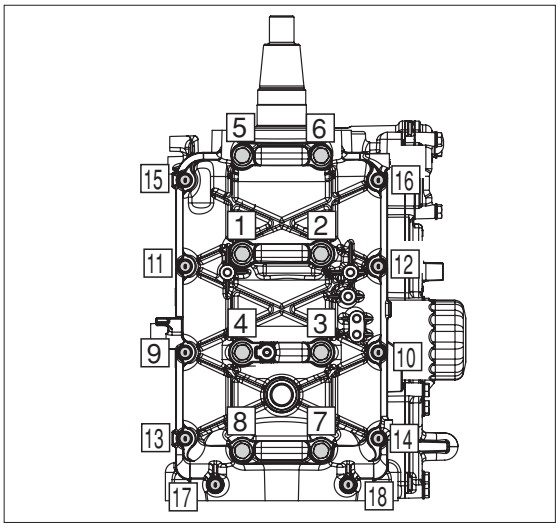
- Degrease mating surfaces of cylinder and crank case.
- Be careful not to allow sealing agent to adhere to bearing.
- Apply Loctite 518 to mating surfaces of crankcase halves, taking care that no excessive agent protrudes.
- Be sure apply Loctite 518 constantly and to be approximately 2 mm width.



16. Install crank case to cylinder block.

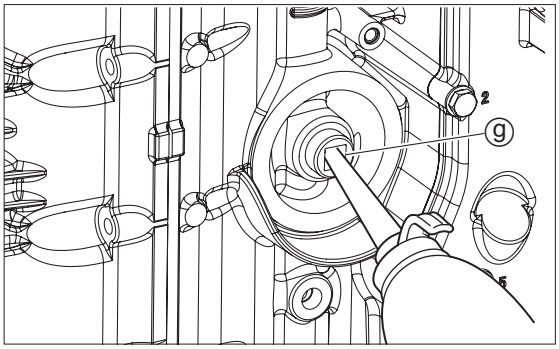
17. Tighten crank case M8 bolts, and then tighetn M6 bolts to first specified torque in the order shown. Then tighten final specified torque.

First Tightening Torque :
1 ~ 8 : Crank Case Bolts (M8)
15 N·m (11 lb·ft) [1.5 kgf·m]
1 ~ 8 : Crank Case Bolts (M6)
6 N·m (4 lb·ft) [0.6 kgf·m]
Final Tightening Torque :
9 ~ 18 : Crank Case Bolts (M8)
24 N·m (17 lb·ft) [2.4 kgf·m]
9 ~ 18 : Crank Case Bolts (M6)
11.5 N·m (8.5 lb·ft) [1.15 kgf·m]



Make no forced assemblies. After torquing crankcase use flywheel nut to turn crankshaft to check for crankshaft rotate smoothly.

18. Put some engine oil into oil passage ⓖ of oil filter bolt before installing oil filter.

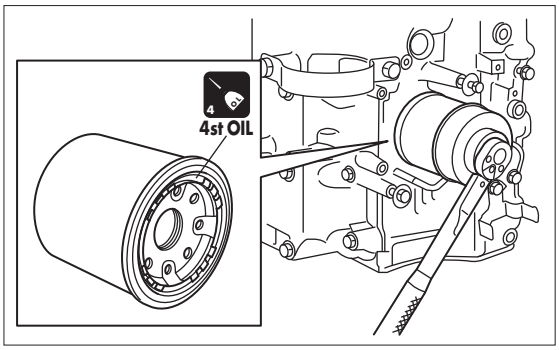


19. Install oil filter and tighten it to specified torque by using oil filter wrench.

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]

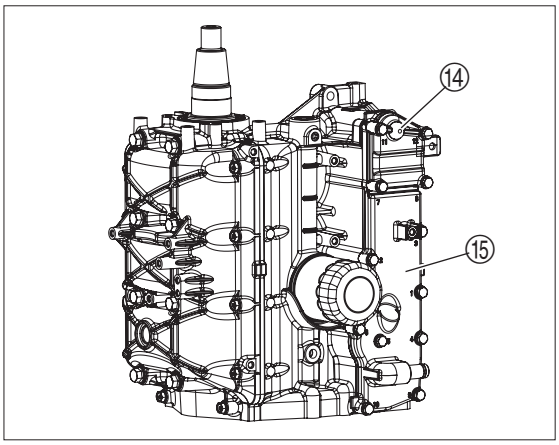


20. Install thermostat, new gasket, thermostat cover ⑭ and exthoust cover ⑮.

Exhaust cover Bolt :
6 N·m (5 lb·ft) [0.6 kgf·m]

21. Install cylinder head.

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



5

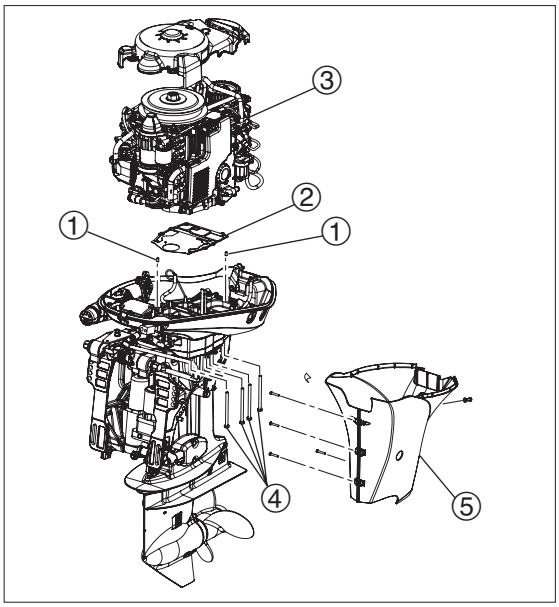
40) Installation of Power Unit

1. Clean power unit mating surface, and install dowel pin ① and gasket ②.

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

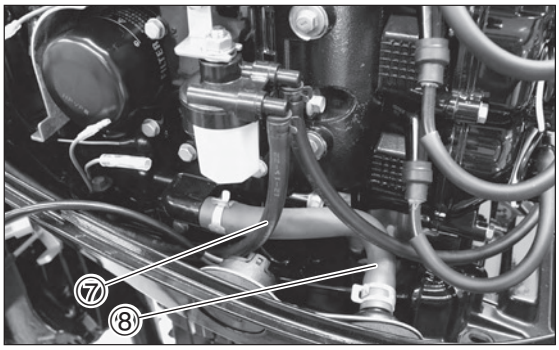
> **Power Unit Installation Bolt :**
> First Tightening Torque : 15 N·m (11 lb·ft) [1.5 kgf·m]
> Final Tightening Torque : 30 N·m (22 lb·ft) [3.0 kgf·m]

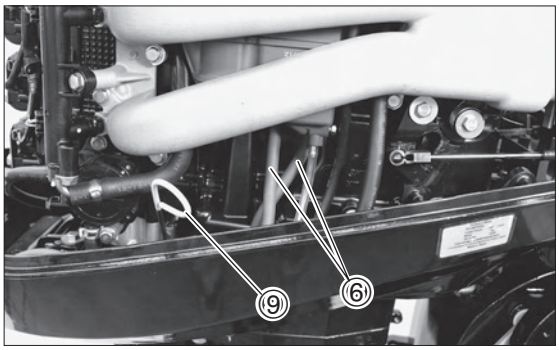
3. Install apron ⑤.



4. Reconnect cooling water (fuel cooler) hose ⑥, fuel hose ⑦ and flushing hose ⑧.

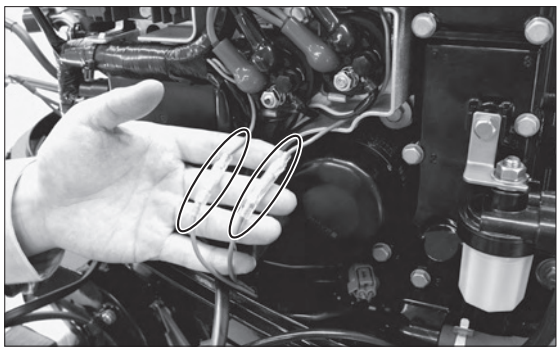
5. Install oil level gauge ⑨.





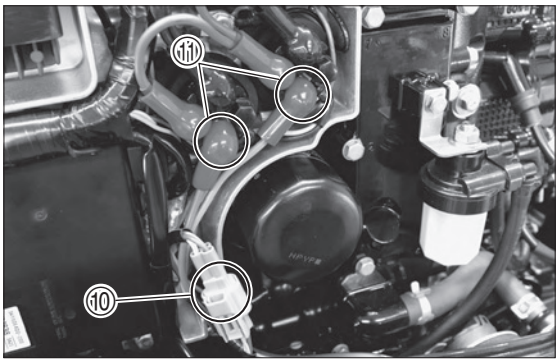
6. Apply grease to sliding parts such as links and cables and install pin to hold cable joint.

7. Connect neutral switch leads.



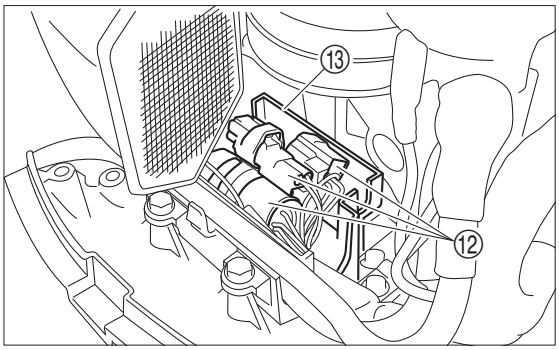
8. Install PTT switch coupler ⑩ and PTT motor leads ⑪.

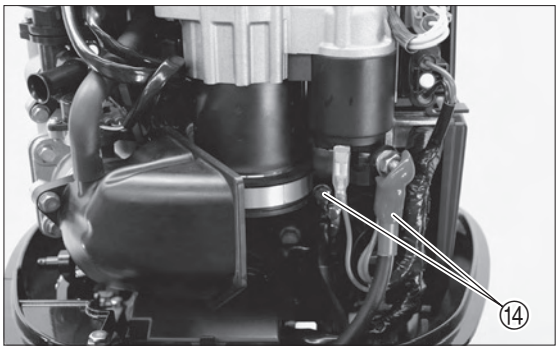
Positive Battery Cable Nut :
4 N·m (3 lb·ft) [0.4 kgf·m]
PTT Motor Lead Bolt :
4 N·m (3 lb·ft) [0.4 kgf·m]



9. Reconnect coupler ⑫ (3 pices), and then place them into cable terminal holder ⑬ and install holder cover.

10. Connect battery cable ⑭.



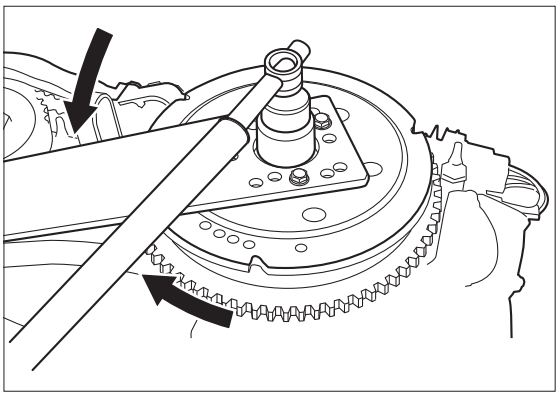


11. Install key and flywheel.

⚠ 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. 3T1-72211-0

Flywheel Nut :
150 N·m (108 lb·ft) [15.0 kgf·m]



12. Reinstall flywheel cover.

13. Fill with specified amount of engine oil.

Recommended Engine Oil :
4 Stroke Engine Oil
API : SH, SJ, SL
SAE : 10W-30 , 10W-40
Quantity of Engine Oil:
When oil filter is not replaced : 2.2 L
When oil filter is replaced : 2.4 L

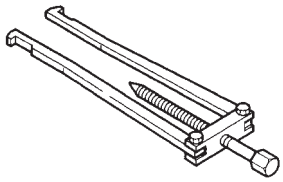
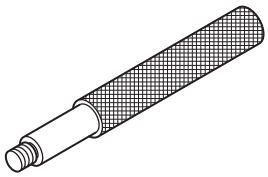
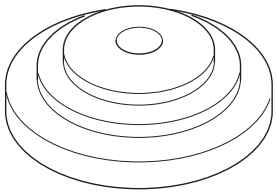
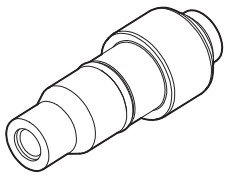
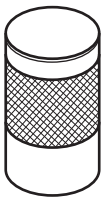
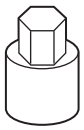
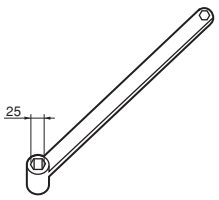
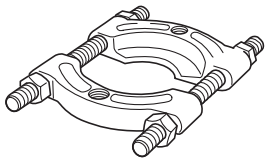
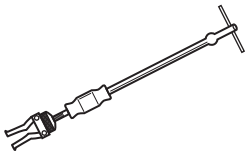
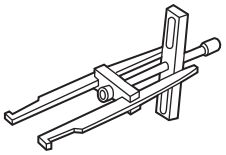
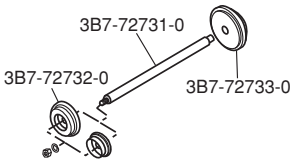
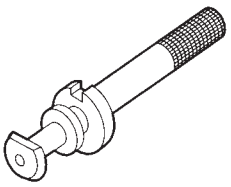
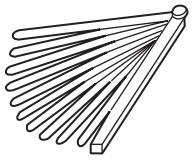
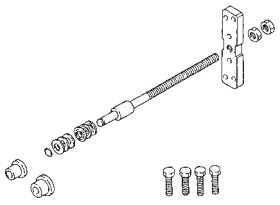
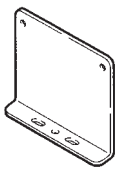
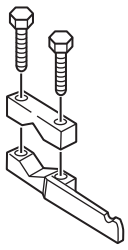
Crank engine with lanyard removed to build oil pressure before test running the engine.

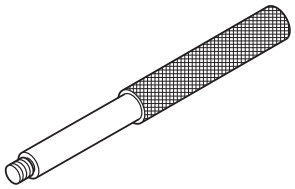
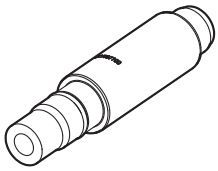
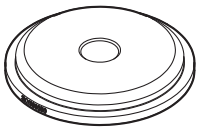
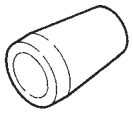
5

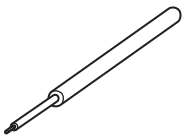
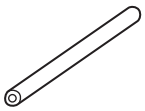
6

Lower Unit

1. Special tools

		ø100 x ø79.5 x ø51.5 x ø61.5 	ø28.6 x ø22 x ø17 x H75.5 
Propeller Shaft Housing Puller Ass'y P/N. 3A3-72259-0	Driver Rod P/N. 3AC-99702-0	Center Plate P/N. 3AC-99701-0	Roller Bearing Attachment P/N. 3KZ-99710-2
Removing propeller shaft housing	Removing or installing propeller shaft housing bearing	Removing or installing propeller shaft housing bearing	Removing or installing propeller shaft housing roller bearing
			
Bevel Gear Bearing Install Tool P/N. 3C8-72719-0	Bevel Gear Nut Socket P/N. 346-72232-0	Bevel Gear B Nut Wrench P/N. 346-72231-0	Universal Puller Plate P/N. 3AC-99750-0
Installing forward (A) gear bearing	Removing or attaching pinion (B) gear nut	Removing or attaching pinion (B) gear nut	Removing reverse (C) gear bearing
			
Slide Hammer Ass'y P/N. 3AC-99080-0	Bevel Gear Bearing Puller Ass'y P/N. 3B7-72755-0	Bearing Outer Press Kit P/N. 3B7-72739-1	Shimming Gauge P/N. 3KY-72250-0
Removing forward (A) gear bearing outer race	Removing forward (A) gear bearing outer race	Attaching forward (A) gear bearing outer race	Adjusting pinion (B) gear height
			
Thickness Gauge P/N. 353-72251-0	Backlash Measuring Tool Kit P/N. 3B7-72234-1	Dial Gauge Plate P/N. 3B7-72729-0	Backlash Measuring Tool Clamp P/N. 3B7-72720-0
Measuring gaps	Measuring backlash between forward (A) gear and pinion (B) gear	Used to attach dial gauge when measuring backlash	Measuring backlash

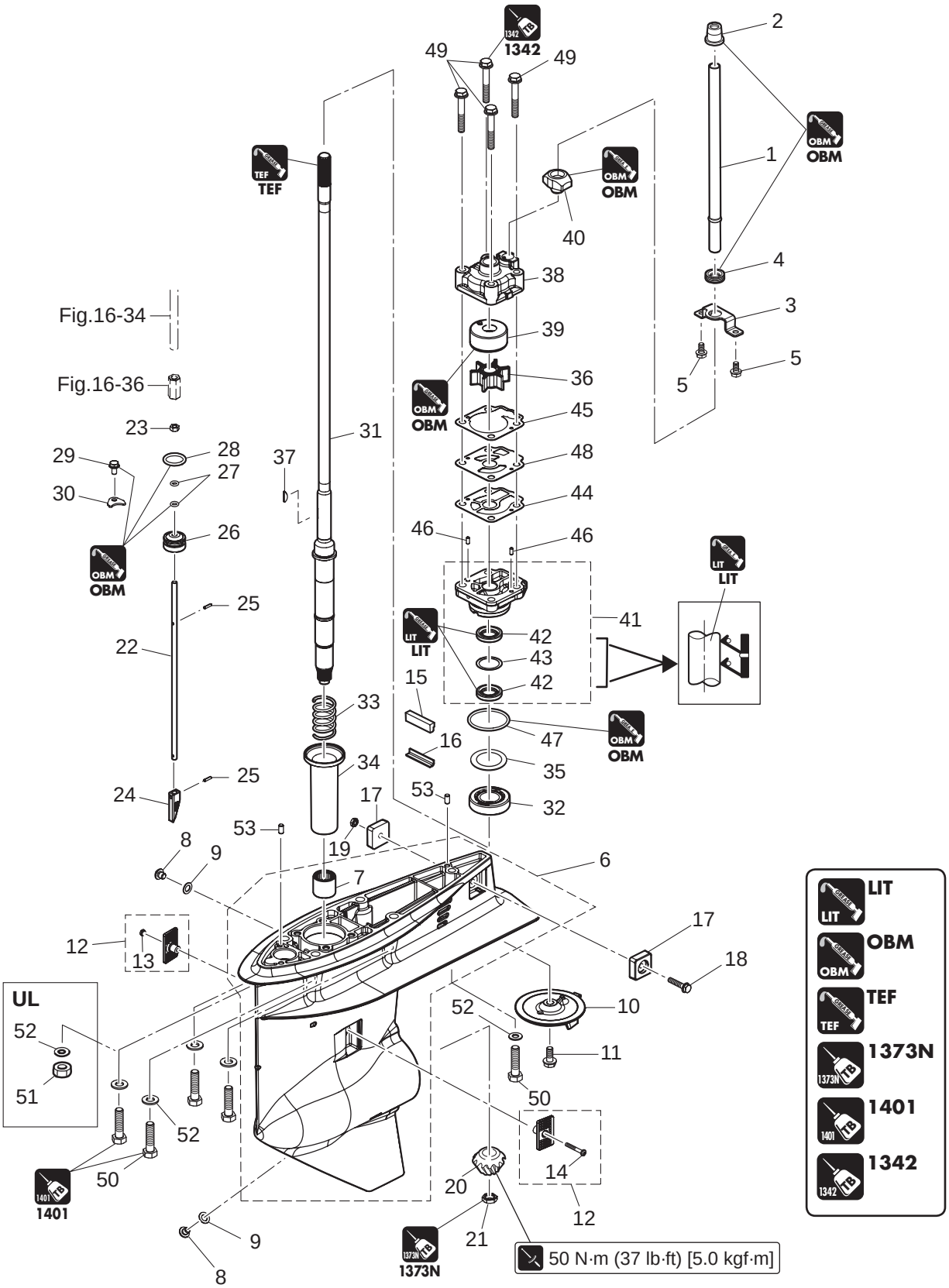
	ø28.3 x ø22.15 x ø20 x H128 		
Driver Rod P/N. 3AB-99702-0	Roller Bearing Attachment P/N. 3KY-99710-0	Bearing Attachment P/N. 3KY-99905-0	Clutch Pin Snap Tool P/N. 3KY-72229-0
Removing or instaing gear case roller bearing	Removing or instaing gear case roller bearing	Removing or instaing gear case roller bearing	Installing clutch pin

	
Spring Pin Tool A P/N. 345-72227-0 (ø3.0)	Spring Pin Tool B P/N. 345-72228-0 (ø3.0)
Removing spring pin	Installing spring pin

2. Parts Layout

P/L Fig. 11

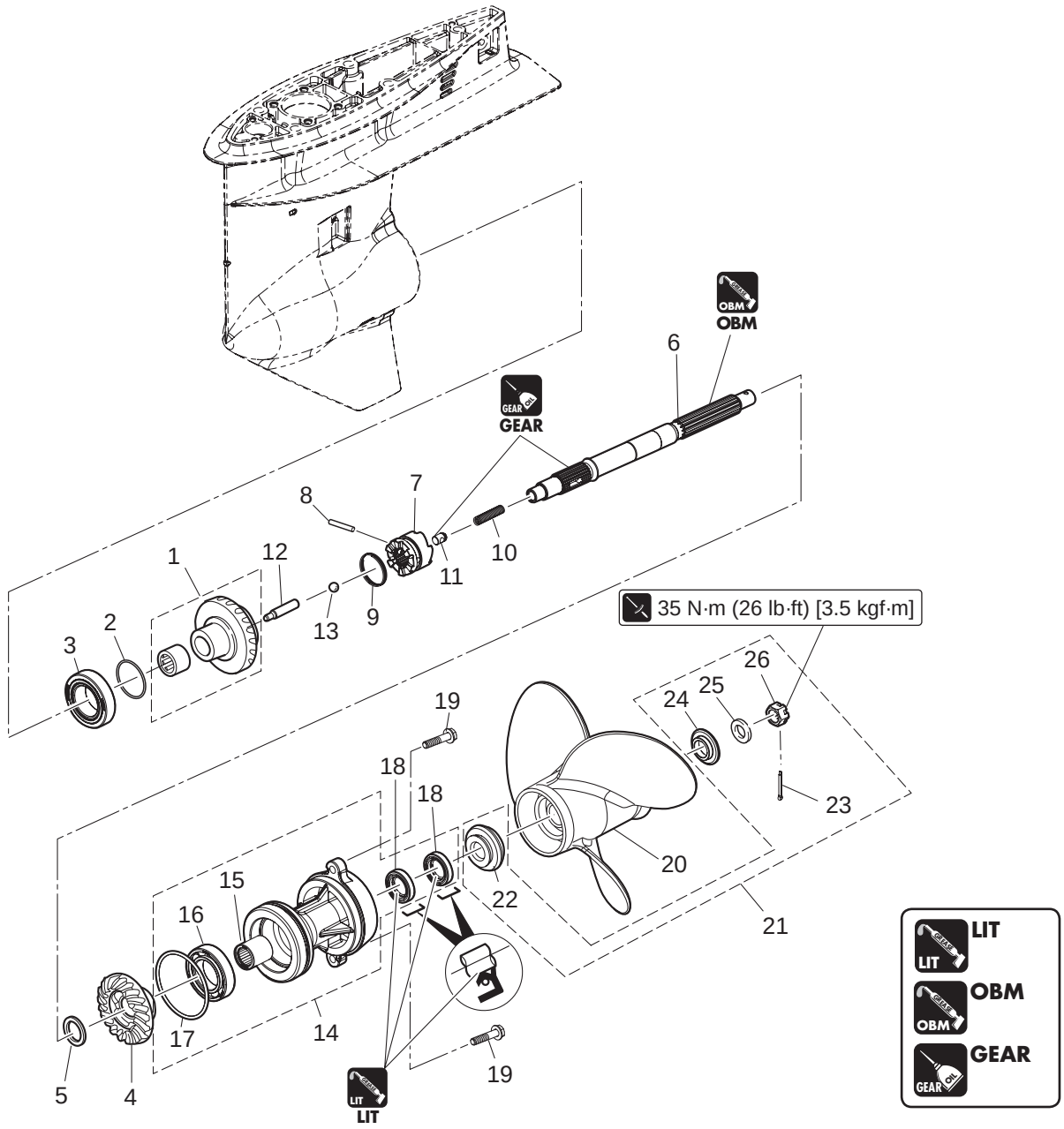
Gear Case (Drive Shaft)



Ref. No.	Description	Q'ty	Remarks
1-1	Water Pipe (L)	1	for Transom "L"
1-2	Water Pipe (S)	1	for Transom "S"
1-3	Water Pipe (UL)	1	for Transom "UL"
2	Water Pipe Seal (UPPER)	1	
3	Lock Plate	1	
4	Water Pipe Auxiliary Mount	1	
5	Bolt	2	
6	Gear Case Assy	1	
7	Roller Bearing	1	
8	Plug 8-8	2	
9	Gasket 8.1-15-1	2	
10	Trim Tab	1	
11	Bolt	1	
12	Water Strainer Set	1	
13	Nylon Nut 4-p0.7	1	
14	Screw	1	
15	Water Seal Rubber	1	
16	Water Seal Plate	1	
17	Anode	2	
18	Bolt	1	
19	Nylon Nut 6-p1.0	1	
20	Bevel Gear B	1	
21	Nut	1	
22-1	Cam Rod (UL)	1	for Transom "UL"
22-2	Cam Rod (L)	1	for Transom "S"&"L"
23	Nut	1	
24	Clutch Cam	1	
25	Spring Pin 3-12	2	
26	Cam Rod Bushing	1	
27	O-ring 2.4-5.8	2	
28	O-ring 3.5-21.7	1	
29	Bolt	1	
30	Stopper	1	
31-1	Drive Shaft (S)	1	for Transom "S"
31-2	Drive Shaft (UL)	1	for Transom "UL"
31-3	Drive Shaft (L)	1	for Transom "L"
32	Tapered Roller Bearing	1	
33	Drive Shaft Spring	1	
34	Drive Shaft Spring Guide	1	
35-1	Shim 41-51.5-0.1	A	t=0.1
35-2	Shim 41-51.5-0.15	A	t=0.15
35-3	Shim 41-51.5-0.3	A	t=0.3
35-4	Shim 41-51.5-0.5	A	t=0.5
36	Water Pump Impeller	1	
37	Key 20-4.6-2	1	
38	Pump Case (UPPER)	1	
39	Pump Case Liner	1	
40	Water Pipe Seal (LOWER)	1	
41	Pump Case Assy (LOWER)	1	
42	Oil Seal 17-33-6	2	
43	Shim 32.9-26-0.5	A	
44	Guide Plate Gasket	1	
45	Pump Case Gasket	1	
46	Dowel Pin 4-10	2	Pump Case Lower
47	O-ring 3.2-47	1	
48	Water Pump Guide Plate	1	
49	Bolt	4	
50	Bolt	5	for Transom "S"&"L"
51	Nut 10-p1.25	5	for Transom "UL"
52	Washer	5	
53	Dowel Pin 6-12	2	Gear Case

Gear Case (Propeller Shaft)

P/L Fig. 12



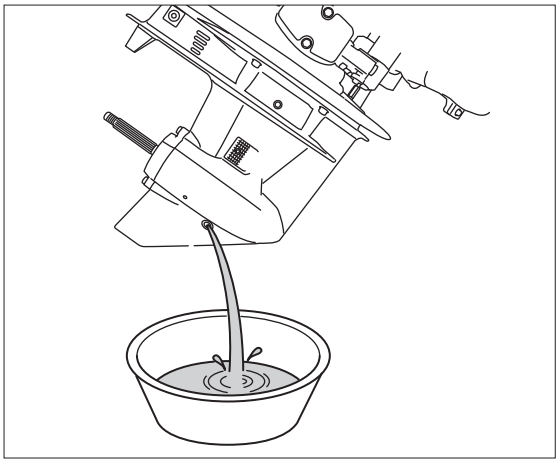
Ref. No.	Description	Q'ty	Remarks
1	Bevel Gear Assy (A)	1	
2-1	Shim 36-44-0.1	A	t=0.1
2-2	Shim 36-44-0.15	A	t=0.15
2-3	Shim 36-44-0.3	A	t=0.3
3	Tapered Roller Bearing 32007	1	
4	Bevel Gear C	1	
5	Washer 22.1-26-3	1	
6	Propeller Shaft	1	
7	Clutch	1	
8	Pin	1	
9	Snap	1	
10	Spring	1	
11	Spring Retainer	1	
12	Push Rod	1	
13	Ball 3/8	1	
14	Propeller Shaft Housing Assy	1	
15	Roller Bearing	1	
16	Ball Bearing 6007	1	

Ref. No.	Description	Q'ty	Remarks
17	O-ring	1	
18	Oil Seal 22-37-8	2	
19	Bolt	2	
20-1	Propeller Assy (7")	1	OPT 4 x 290 x 180
20-2	Propeller Assy (9")	1	OPT 3 x 311 x 229
20-3	Propeller Assy (11")	1	OPT 3 x 290 x 279
20-4	Propeller Assy (12")	1	OPT 3 x 283 x 305
20-5	Propeller Assy (13")	1	40ps STD 3 x 277 x 330
20-6	Propeller Assy (14")	1	50ps STD 3 x 279 x 356
20-7	Propeller Assy (15")	1	OPT 3 x 278 x 381
20-8	Propeller Assy (16")	1	OPT 3 x 406 x 279
20-9	Propeller Assy (17")	1	OPT 3 x 432 x 280
21	Propeller Hardware Kit	1	
22	Thrust Holder	1	
23	Split Pin 3-25	1	
24	Stopper	1	
25	Washer 17-32-3	1	
26	Propeller Nut M16p1.5	1	

3. Inspection Items

1) Draining Gear Oil

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



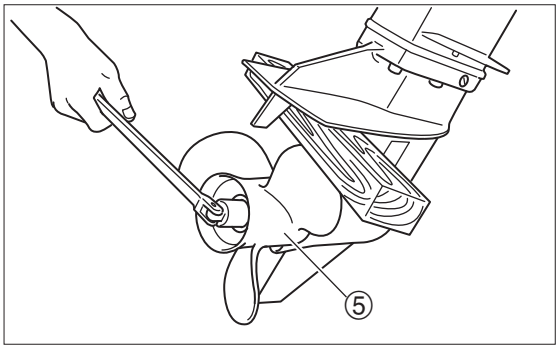
· Drain all gear oil, and check if any metal particle is found in the drained oil.
· Check gear oil color. White or cream color possibly indicates that water is contained in the gear oil.
· Note the above matters and use them as a reference if disassemble is required.

2) Removing Propeller

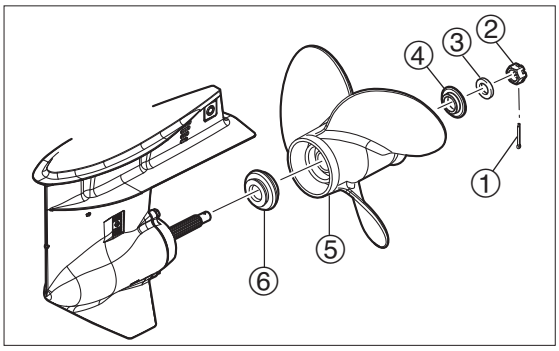
⚠ WARNING

- **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 when removing or installing propeller.**

1. Shift gear into forward (F).



2. Put a piece of wood between anti-cavitation plate and propeller ⑤ to prevent the propeller ⑤ from accidental rotation. Pull out split pin ①, loosen propeller nut ②, and then, propeller ⑤.



① Split Pin
② Propeller Nut
③ Washer
④ Stopper
⑤ Propeller
⑥ Thrust Holder

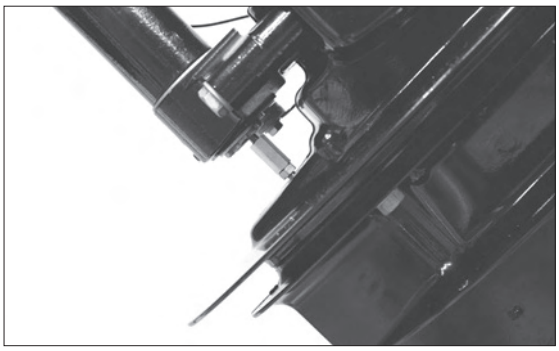
3) Removing Lower Unit

⚠ WARNING

When working with outboard motor in tilt up position, be sure to lock with tilt stopper.

· Removal of lower unit does not require removal of power unit from outboard motor body.
· When removing lower unit from outboard motor, tilting the outboard motor makes the work easier.

1. Shift the gear into forward (F) to set shift rod to upper position.
2. Loosen shift rod joint nut, and then disconnect shift rod and cam rod.



3. Remove trim tab and lower unit mount bolt (5 pieces), and then remove lower unit ass'y pull down.

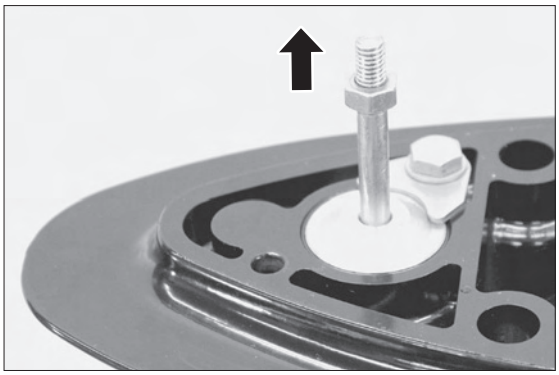
⚠ CAUTION

Hold lower unit while removing it to prevent it dropping on the floor.

① Trim Tab

4) Disassembly of Cam Rod

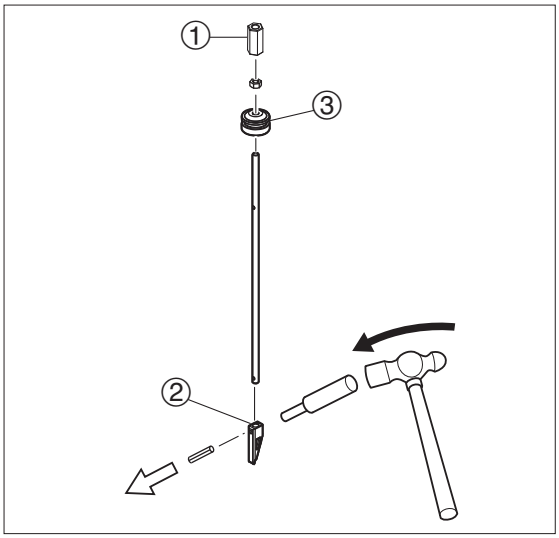
1. Remove stopper, pull out cam rod bushing, and take out cam rod from gear case.



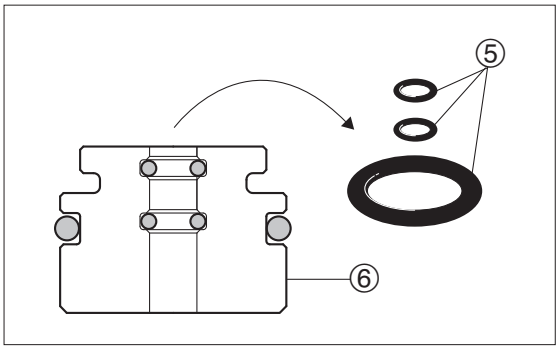
When removing cam rod bushing, put a bladed screw driver into groove of the bushing and pull out while lifting it.

2. Remove shift rod joint ① and clutch cam ②.

Spring Pin Tool A ③ (ø3.0) :
P/N. 345-72227-0



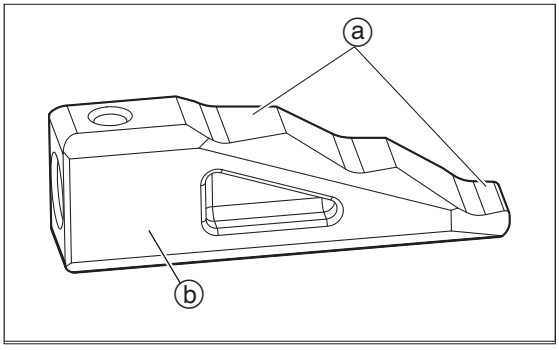
3. Remove O ring ⑤ from cam rod bushing ⑥.



⑤ O Ring **Do not reuse.**

5) Inspection of Clutch Cam

1. Check the part for wear and damage.
Replace if necessary.



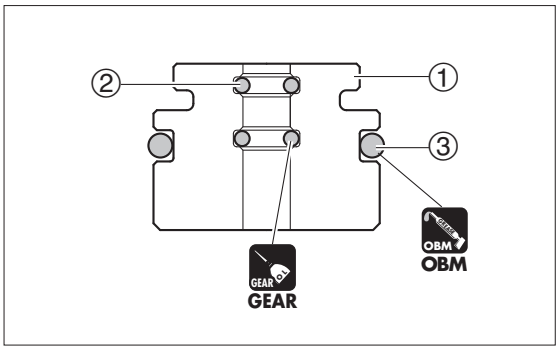
Check especially for wear on the face ⓐ that scrapes against push rod and flaws on the circumference ⓑ.

6) Assembly of Clutch Cam Parts

1. Attach O rings 2.4-5.8 ② and O ring 3.5-21.7 ③ to cam rod bushing ①.

OBM

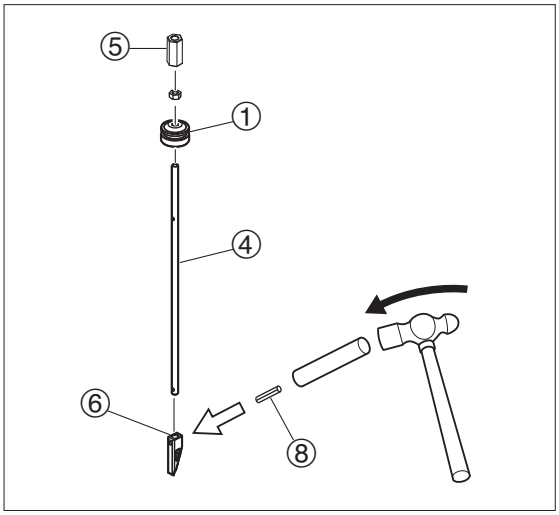
GEAR



②③ O Rings **Do not reuse.**

2. Attach cam rod bushing ①, shift rod joint ⑤ and clutch cam ⑥ to cam rod ④.

Spring Pin Tool B ⑦ (ø3.0) :
P/N. 345-72228-0

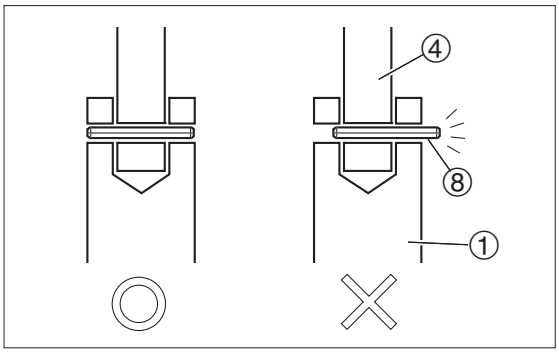


⑨ Spring Pin **Do not reuse.**

3. Drive spring pin ⑧.

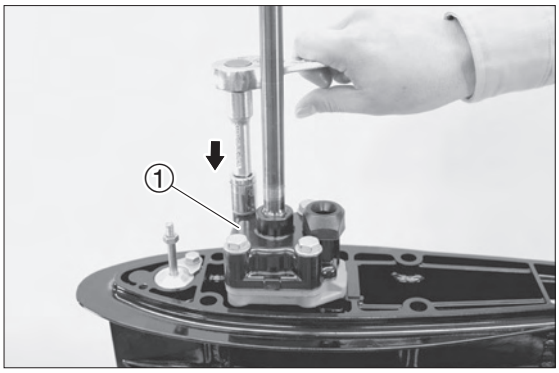
⚠ CAUTION

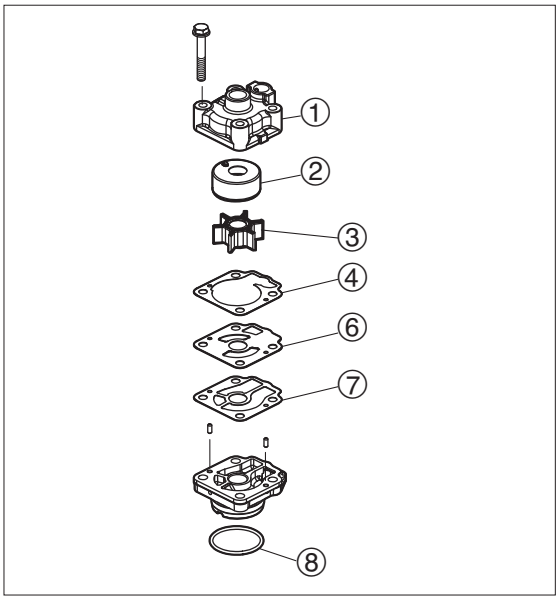
Drive spring pin ⑧ so that it is flush with clutch cam surface as shown.



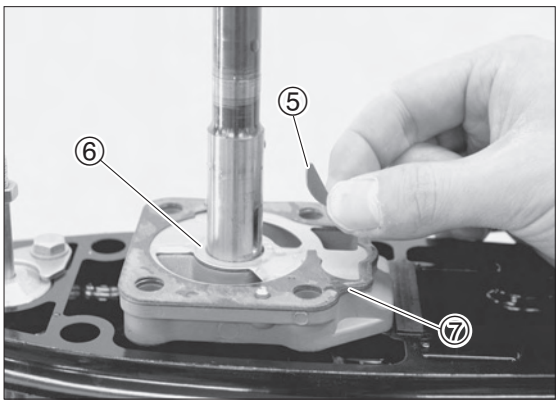
7) Removing Water Pump

1. Loosen and remove pump case (upper) bolts, and remove pump case (upper) parts ①, ②, ③ and ④ in this order.



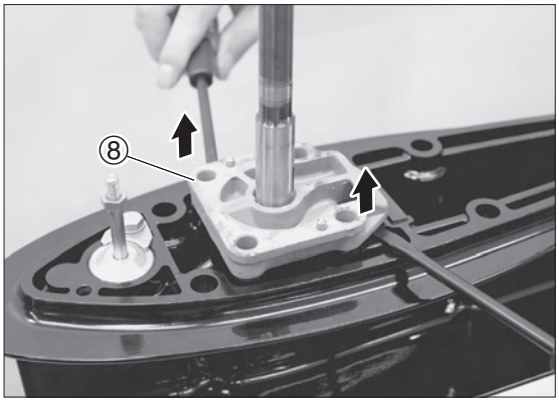


2. Remove water pump impeller key ⑤.



3. Remove guide plate ⑥, gasket ⑦ and pump case (lower) ⑧.

When removing pump case (lower), insert bladed screw driver into the groove of the case, and pry slowly to separate the part.



6

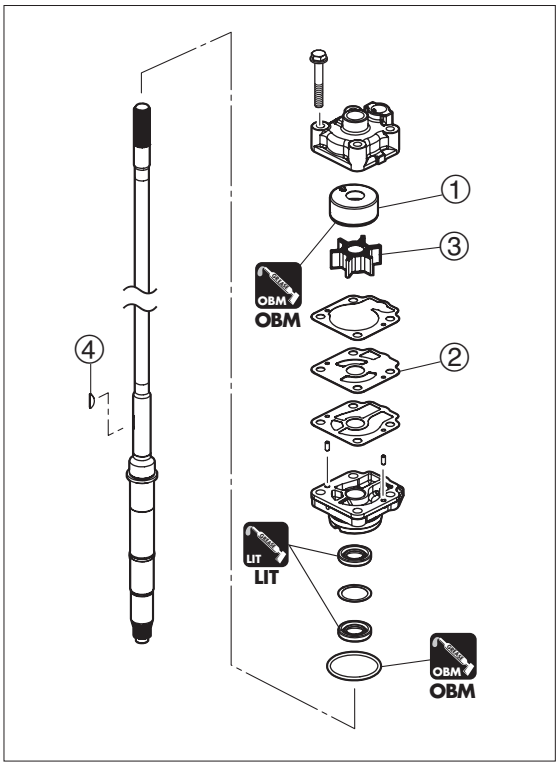
8) Inspection of Water Pump

1. Check pump case liner ① and guide plate ② for deformation and wear.
   Replace if necessary.

2. Check pump impeller ③ for crack, damage and wear.
   Replace if necessary.

- The impeller may show gloss or have melted area if it is rotated with insufficient water.
- Even if impeller shows no abnormality on its surface, the blade(s) may be separated from the hub.
- Replace guide plate if a groove(s) of 0.5 mm or over is produced on it due to wear by impeller.

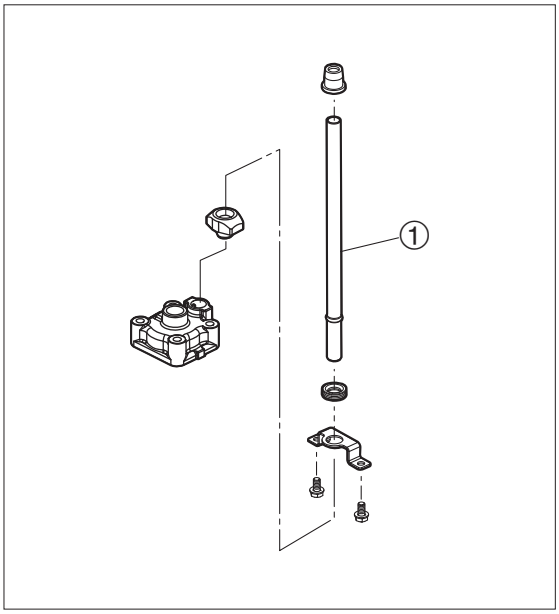
3. Check impeller key ④ and key groove for wear.
   Replace if necessary.



9) Inspection of Water Pipe

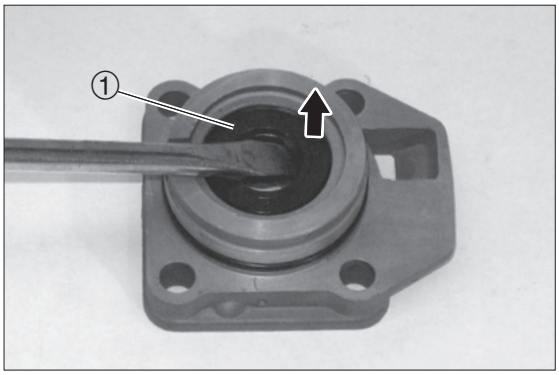
1. Remove water pipe ① from drive shaft housing.
   Refer to 7-27.

2. Check water pipe ① for corrosion, deformation and restriction.



10) Disassembly of Water Pump Case (Lower)

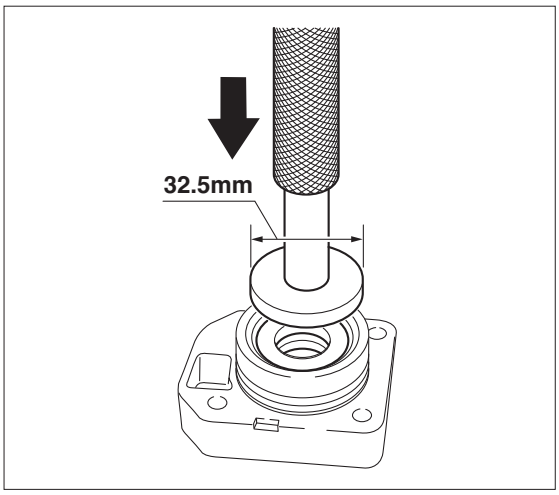
1. Use bladed screw driver or seal remover to remove oil seal ①.



· Two oil seals are used. Note that there is a shim in between oil seals.
· Be careful not to damage the seal mating surface on the case.

11) Assembly of Water Pump Case (Lower)

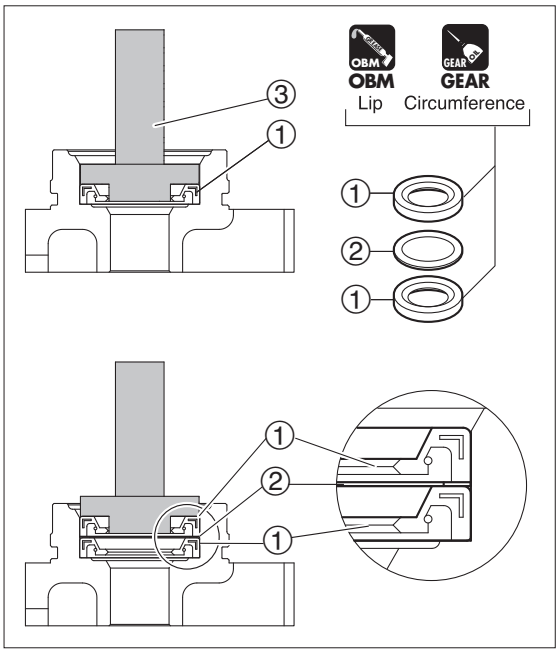
1. Install oil seal ① and shim ② by using suitable press ③ and then press-fit perpendicularly.



· Apply gear oil to oil seal circumference before installing oil seal.
· Apply OBM grease to oil seal lip.

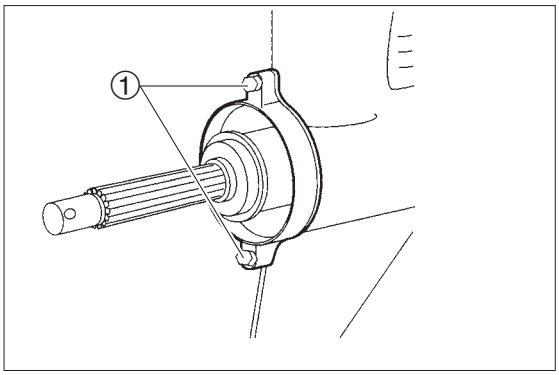
OBM

GEAR



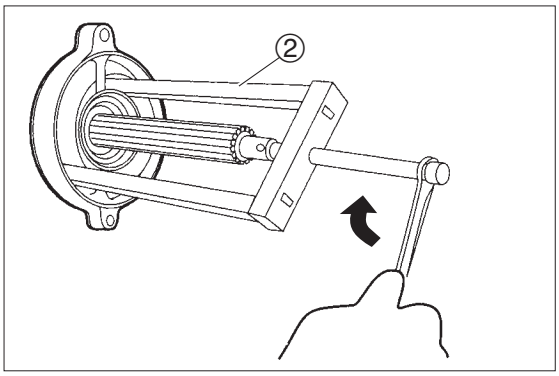
12) Removing Propeller Shaft Housing Ass'y

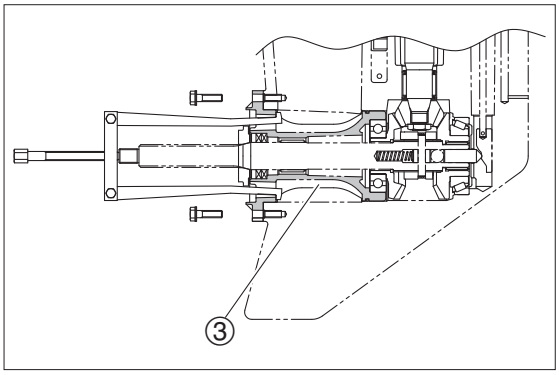
1. Loosen and remove bolts ①.



2. Use propeller shaft housing puller to pull out propeller shaft housing to the position where O ring of the housing can be removed.

Propeller Shaft Housing Puller Ass'y ② :
P/N. 3A3-72259-0

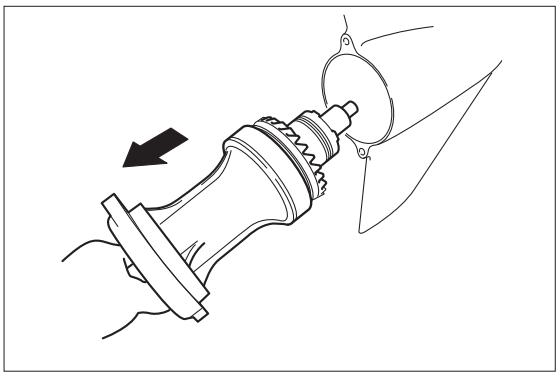




③ Propeller Shaft Housing Ass'y

3. Hold propeller shaft and remove propeller shaft housing ass'y.

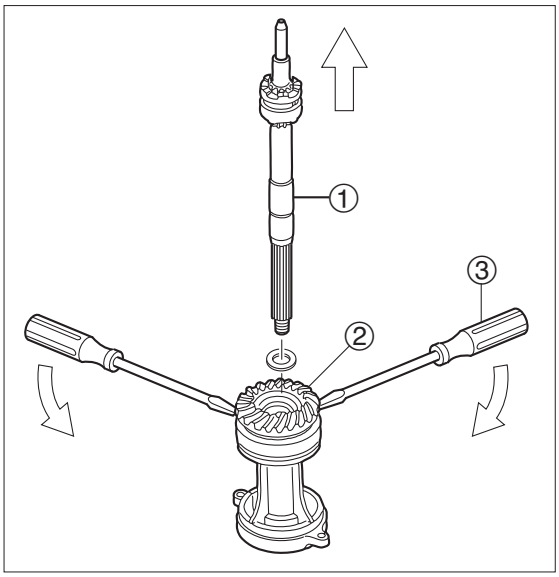
When pulling out propeller shaft housing ass'y, remove clutch push rod and steel balls together with the housing ass'y.



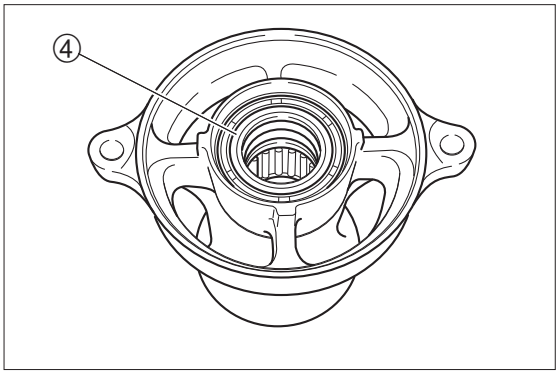
13) Disassembly of Propeller Shaft Housing Ass'y

1. Pull out propeller shaft ass'y ①.

2. Remove reverse (C) gear ② by using bladed screw drivers ③.



3. Check oil seal ④ for wear and crack.
   Replace if necessary.



4. Remove bearing ⑤.

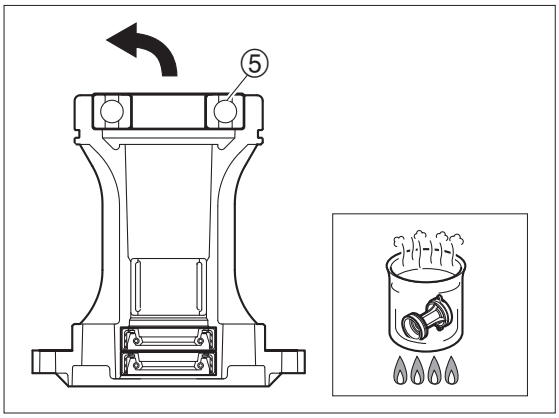
⚠ CAUTION

Heat propeller shaft housing by putting it in the hot water of approximately 60 - 70˚C (140 - 158˚F), and remove bearing ④.

⚠ CAUTION

Be careful not to burn.

Heating of propeller shaft housing can also be made by using a heat gun or heat lamp.

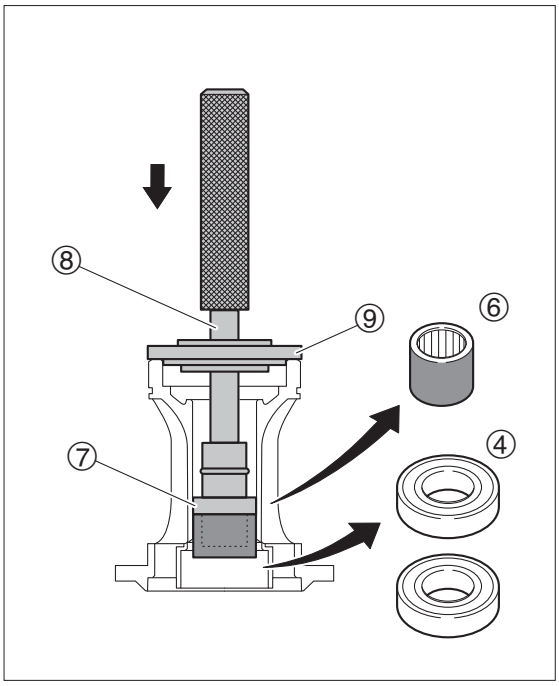


⑤ Bearing **Do not reuse.**

5. Use a press to remove oil seal ④ and roller bearing ⑥ at the same time.

· Before removing, check bearing for play or deflection. Replace if necessary.
· Direct the side of attachment without O-ring to roller bearing.

Roller Bearing Attachment ⑦ :
P/N. 3KZ-99710-0
Driver Rod ⑧ :
P/N. 3AC-99702-0
Center Plate ⑨ :
P/N. 3AC-99701-0



④ Oil Seal **Do not reuse.**
⑥ Roller Bearing **Do not reuse.**

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

Be careful not to damage the propeller shaft housing when removing oil seal.

14) Inspection of Propeller Shaft Housing

1. Clean the part by using a solvent and then check.
Replace if necessary.

2. Check reverse (C) gear for crack or abnormal wear of the teeth and dog.
Replace if necessary.

3. Check bearing for abnormality.
Replace if necessary.

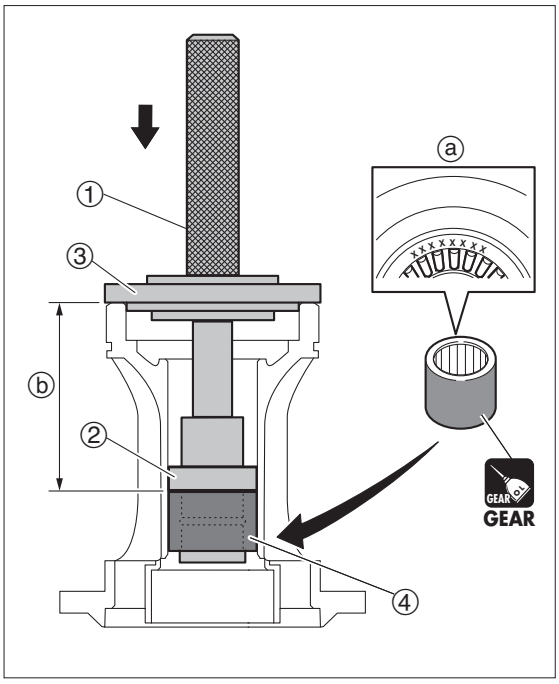
15) Assembly of Propeller Shaft Housing

⚠ CAUTION

When gear case, propeller shaft, bearing, housing or reverse (C) gear is replaced, measure the backlash and perform shim adjustment.

1. Use a press to push new roller bearing ④ into propeller shaft bearing to specified depth.

· Install roller bearing with the manufacturer's mark ⓐ facing the tool side.
· Screw in roller bearing attachment ② lightly by a hand so that no gap is made at driver rod ①.
· Clean roller bearing installation face and apply gear oil before installation.



④ Roller Bearing **Do not reuse.**

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

Depth of Installation ⓑ :
57.3 - 57.7 mm (2.256 - 2.272 in)

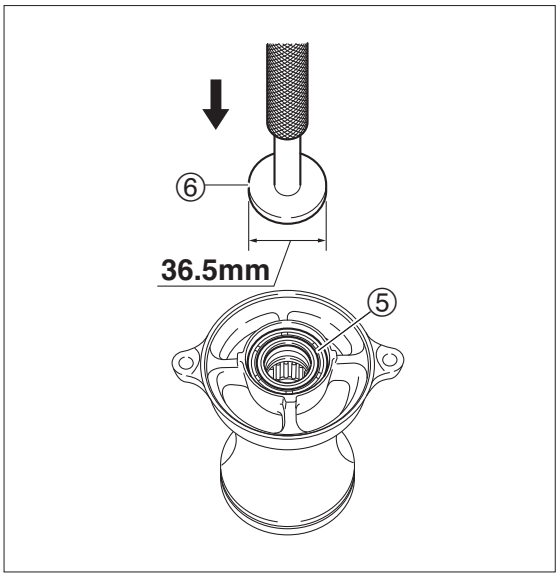
GEAR

2. Install oil seals ⑤.
Use a suitable press ⑥ to install new oil seal to propeller shaft housing.

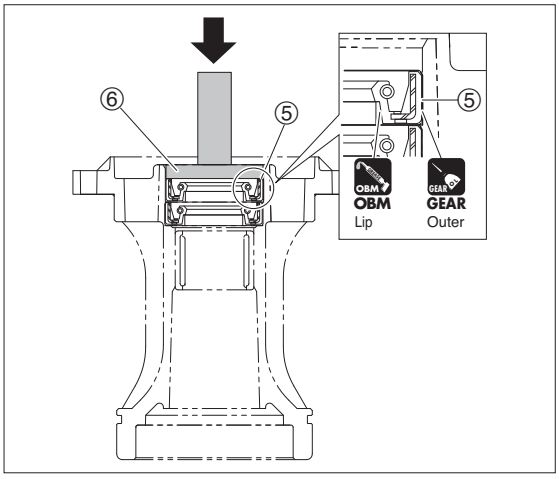
· Install oil seal with the marking facing tool side.
· Clean oil seal installation face and apply gear oil before installation.
· Apply grease to lip of oil seal after installing it.

OBM

GEAR



⑤ Oil seal **Do not reuse.**

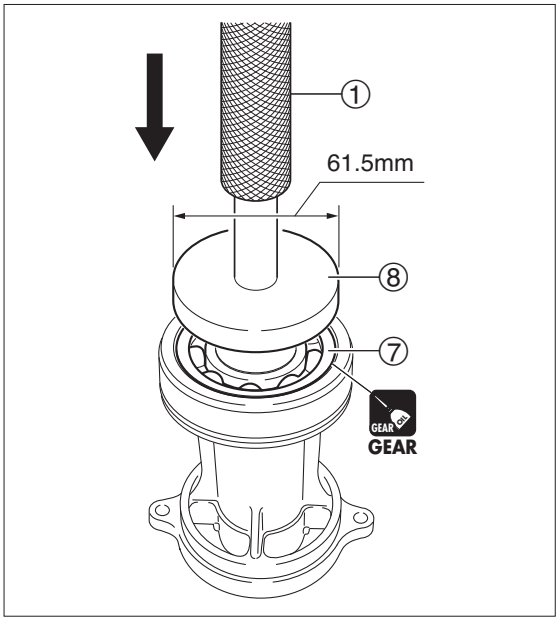


⑤ Oil Seal **Do not reuse.**

3. Install bearing ⑦.
Use a suitable press ⑧ to install new bearing to propeller shaft housing.

Clean bearing installation face and apply gear oil before installation.

GEAR

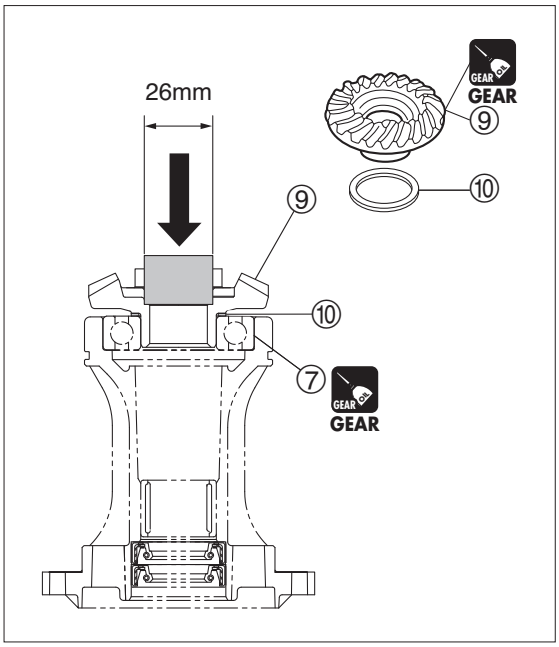


⑦ Bearing **Do not reuse.**

4. Attach shim ⑩ used on the reverse (C) gear ⑨ to the gear.
   Use a suitable press to install reverse gear (C) to new bearing ⑧.

· Clean reverse (C) gear bearing installation face and apply gear oil before installation.
· Put in reverse gear (C), your hands canbe used. When use a suitable press, fit the reverse gear (C) inner as shown.

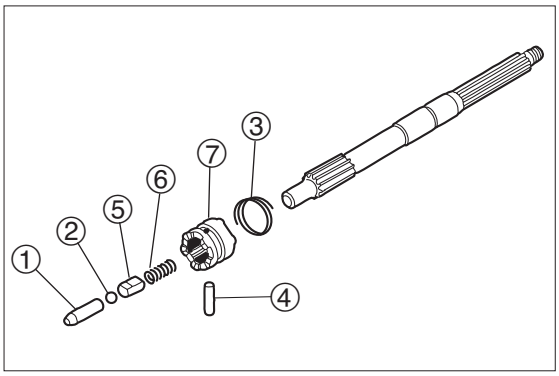
GEAR



⑦ Bearing **Do not reuse.**

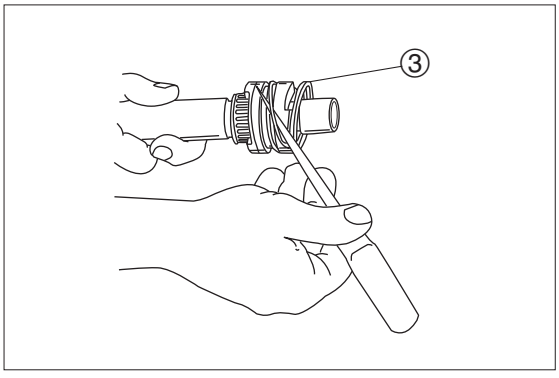
16) Disassembly of Propeller Shaft Ass'y

1. Remove push rod ① and steel ball ②.



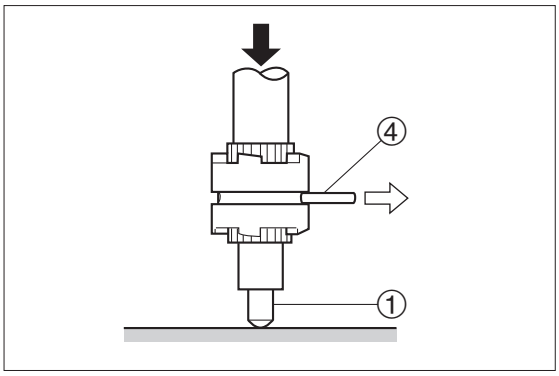
③ Clutch Pin Snap **Do not reuse.**

2. Put a bladed screw driver into one of clutch pin snap ③ end, and take the snap out from the clutch groove while winding it.



③ Clutch Pin Snap **Do not reuse.**

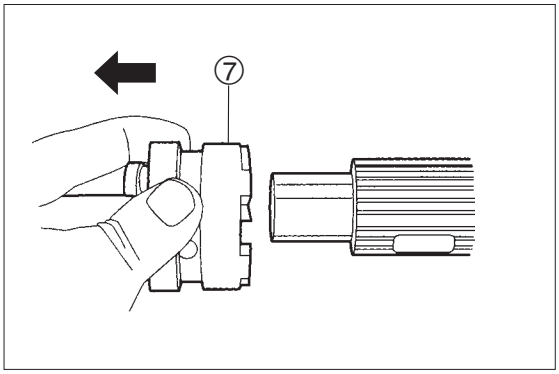
3. Pull out clutch pin ④, and remove clutch spring retainer ⑤, clutch spring ⑥, and clutch by referring to the figure.



⚠ WARNING

- **When removing clutch pin, wear protective glasses, and do not point opening of propeller shaft to your face or body while holding the propeller shaft. Clutch pin or spring holder may fly out very quickly.**
- **Install push rod ①, and pull out pin ④ while pushing propeller shaft onto a plane to prevent retainer ⑤ and spring ⑥ from flying out.**

4. After taking out clutch spring retainer ⑤ and clutch spring ⑥, remove clutch ⑦ from propeller shaft.

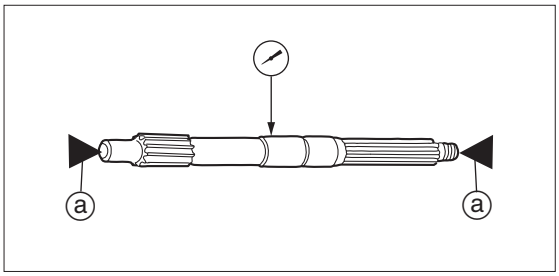


17) Inspection of Propeller Shaft Ass'y

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

2. Measure propeller shaft runout.

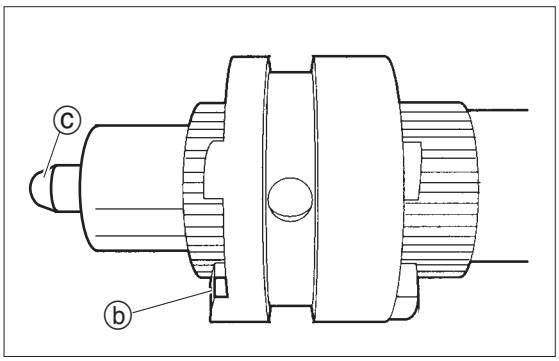
Runout Limit :
0.05 mm (0.0020 in)



ⓐ Supporting Points

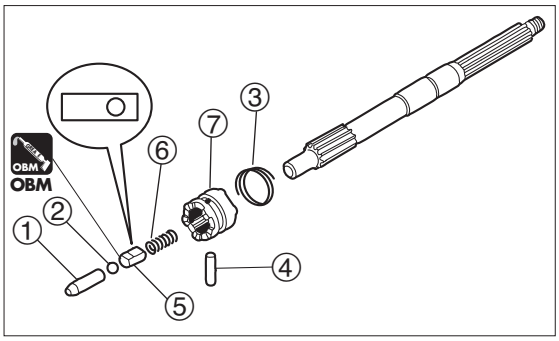
3. Check clutch claw ⓑ and push rod ⓒ for crack and wear. Replace if necessary.

When attaching clutch, face the narrower claw ⓒ to push rod (forward) side.



18) Assembly of Propeller Shaft Ass'y

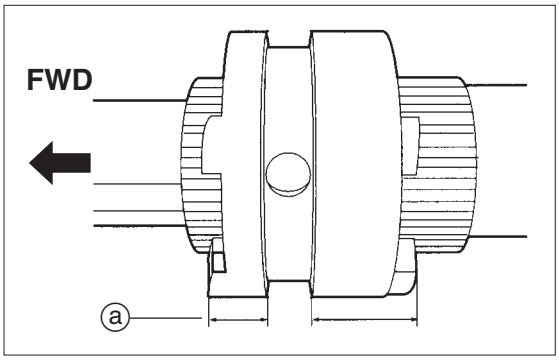
1. Attach spring ⑥, spring retainer ⑤, steel ball ②, push rod ①, clutch ⑦ and clutch pin ④ to propeller shaft.

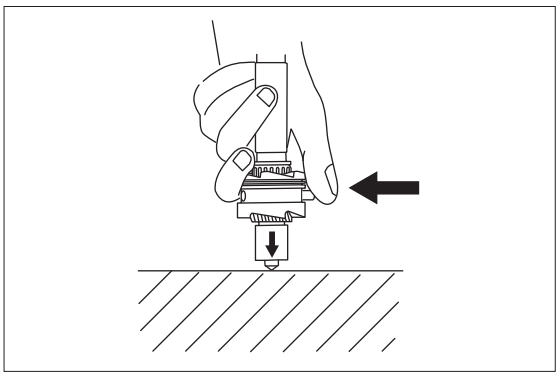


③ Clutch Pin Snap **Do not reuse.**

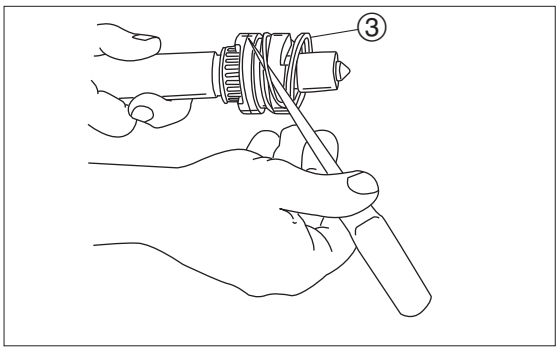
- When attaching clutch, face the narrower claw ⓐ to push rod side.
- When installing spring retainer, direct the end father away from the hole toward foward gear ⓐ (FWD).
- Install clutch pin while applying preload to push rod.
- Apply OBM grease to spring retainer to prevent ball from dropping.
- Be careful not to allow ball to fly out by spring tension.

OBM





2. Attach new clutch pin snap ③ by using a bladed screw driver to turn the snap.



③ Clutch Pin Snap **Do not reuse.**

- When attaching clutch pin snap, do not apply excessive force to the part, or the snap may expand during operation of the engine, resulting in damaging gear and/or other parts severely.
- This waok can also be done by using the following tool.

Clutch Pin Snap Tool :
P/N. 3KY-72229-0

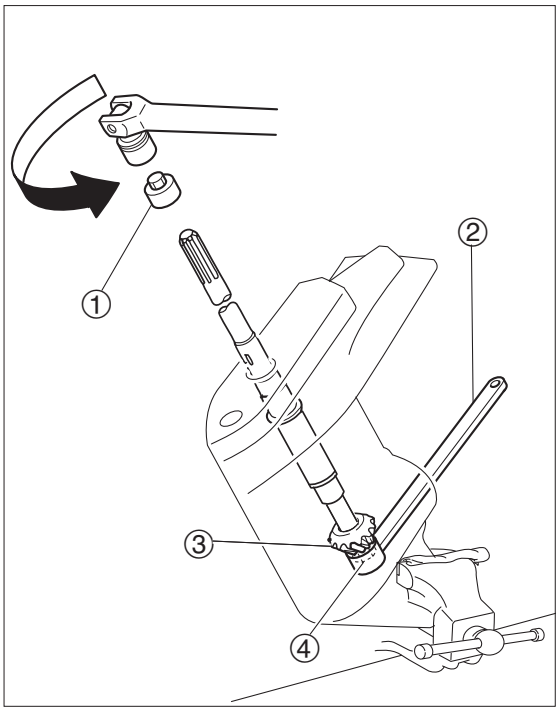
3. After assembling, check that clutch can be operated smoothly, taking care not to allow push rod to drop out.

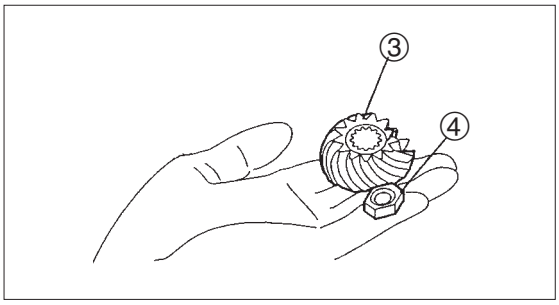
19) Removing Drive Shaft Ass'y

1. Remove pinion (B) gear nut ④, and then, remove pinion (B) gear ③ and drive shaft.

· Degrease pinion (B) gear nut completely so that the nut wrench does not slip on the nut.
· Loosen and remove the nut by using a drive shaft socket and a wrench and turning the wrench counterclockwise. Cover the wrench ② with rag to prevent it from hitting the case directly.
· This work can be made easier when the opening of gear case of propeller shaft side is faced upward and fixed horizontally with a holder.

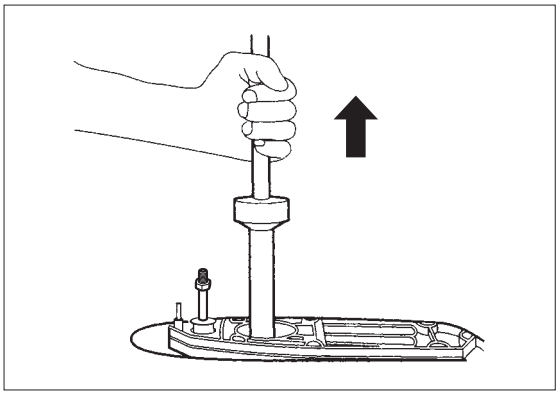
Bevel Gear Nut Socket ① :
P/N. 346-72232-0
Bevel Gear B Nut Wrench ② :
P/N. 346-72231-0



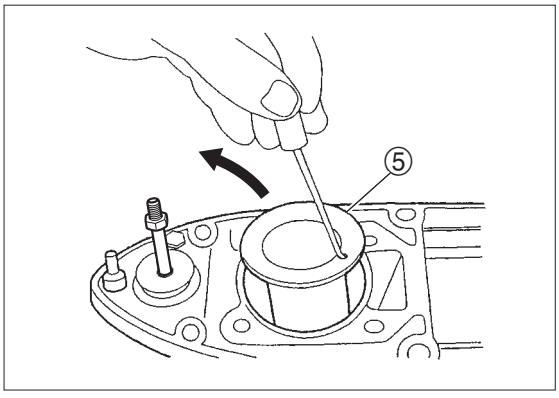


2. Pull out drive shaft from gear case.

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



3. Remove drive shaft spring guide ⑤.



20) Disassembly of Drive Shaft Ass'y

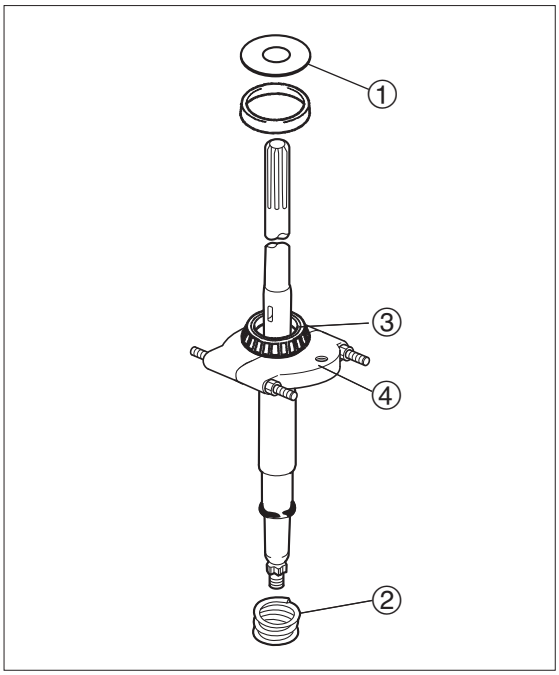
1. Remove outer shim ①.
2. Remove drive shaft spring ②.
3. Remove taper ball bearings ③ by using press and universal puller ④.

⚠ CAUTION

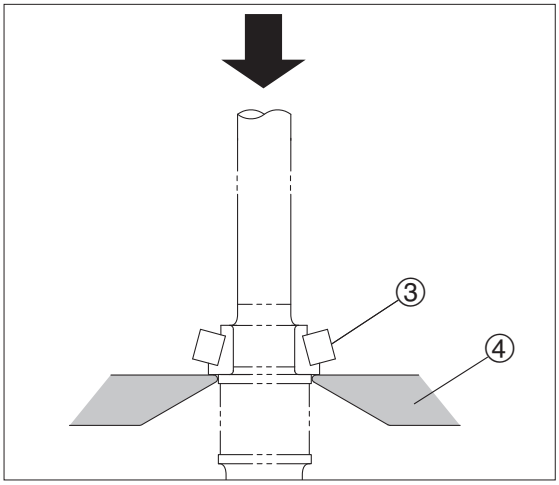
Do not reuse removed bearing.
Be sure to replace with new one.

· Check bearing for play or deflection before removing, and replace if necessary.
· When putting universal puller plate on the bearing, hook the tip of puller's claw on the inner race of bearing correctly.

Universal Puller Plate ④ :
P/N. 3AC-99750-0



③ Bearings **Do not reuse.**

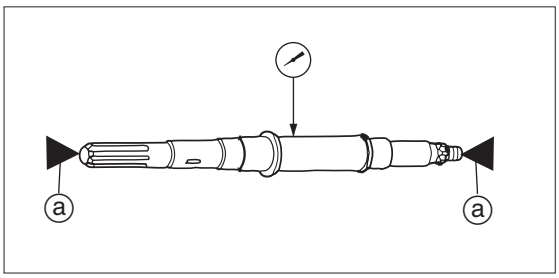


③ Bearings **Do not reuse.**

21) 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)



ⓐ Supporting Points

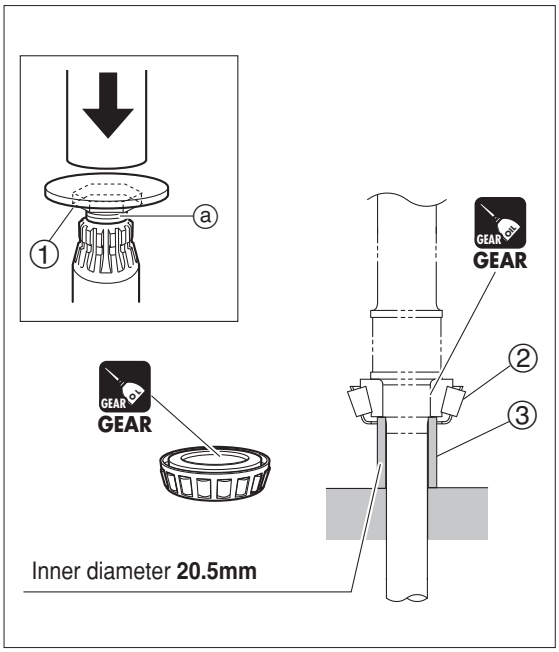
22) Inspection of Pinion (B) Gear

1. Check gear teeth and dog for crack, wear and damage.
   Replace if necessary.

23) Assembly of Drive Shaft Parts

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

2. Install bearing ② by using press and a suitable pipe ③.
   Before installing bearing, be sure to clean drive shaft installation face and apply gear oil.



② Bearing **Do not reuse.**

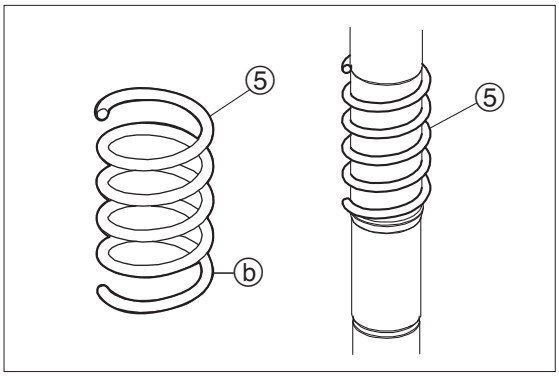
⚠ CAUTION

Do not press drive shaft thread ⓐ directly. Put ⓐ piece of protector (steel plate) on the tip of the shaft.

A nut that fits the thread can be used to protect the shaft tip when pressing.

GEAR

3. Attach drive shaft spring ⑤.



⚠ CAUTION

When attaching the spring, face the side ⓑ toward pinion (B) gear side.

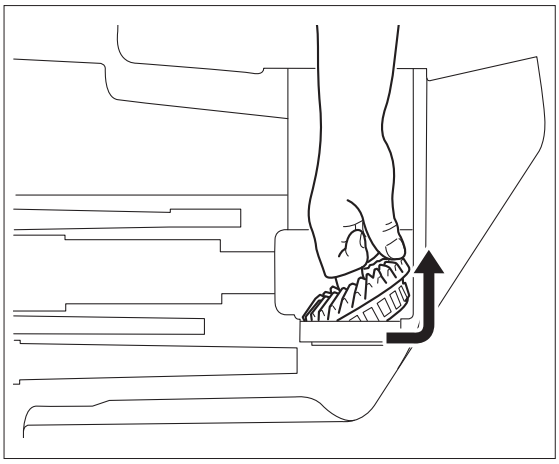
Attach spring white painted upward..

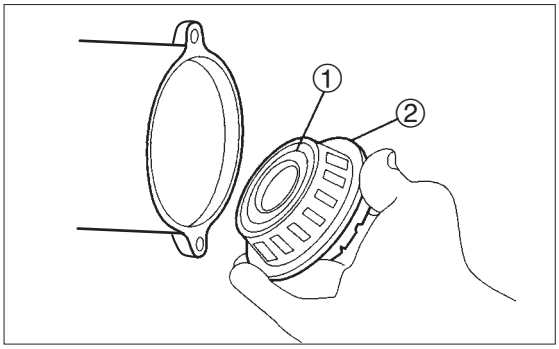
24) Removing Forward (A) Gear Ass'y

1. Remove pinion (B) gear. (Refer to 6-22 page)

2. Take out bearing ① and forward (A) gear ② by using a hand put in the gear case.

· Put mid finger into forward (A) gear hole and take it between the finger and the first finger (thumb), and lift the thumb side of the gear to remove it.
· Pull up the drive shaft and remove foward gear (A), so that without removing pinion (B) gear and drive shaft.



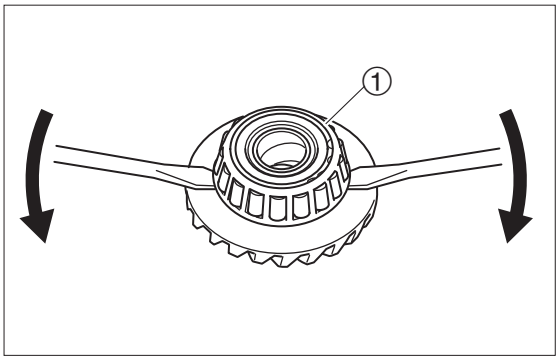


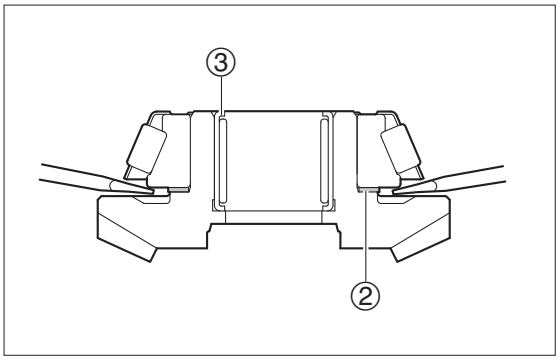
25) Disassembly of Forward Gear (A) Gear

1. Remove taper roller bearing ①.
   Use two bladed screw drivers to remove taper roller bearing from forward gear (A) gear.
   Put the drivers into grooves of forward (A) gear, and pry out taking care not to damage the shim.

⚠ CAUTION

Be careful not to damage shim ②.





26) Inspection of Forward (A) Gear

1. Check forward (A) gear teeth and clutch claws for crack, damage and wear.
   Replace if necessary.

27) Assembly of Forward (A) Gear Parts

⚠ CAUTION

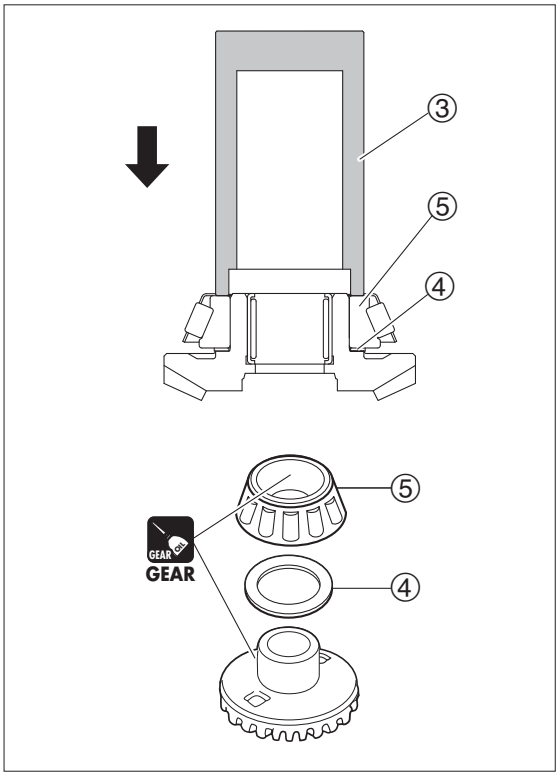
When gear case, forward (A) gear or bearing is replaced, measure backlash and attach a proper shim.
Refer to "Chapter 6 Shim Adjustment".

1. Attach shim ④ used before disassembly to taper roller bearing ⑤, and press-fit the part.

Apply gear oil to press-fit face when press-fitting taper roller bearing.

Bevel Gear Bearing Install Tool ③ :
P/N. 3C8-72719-0

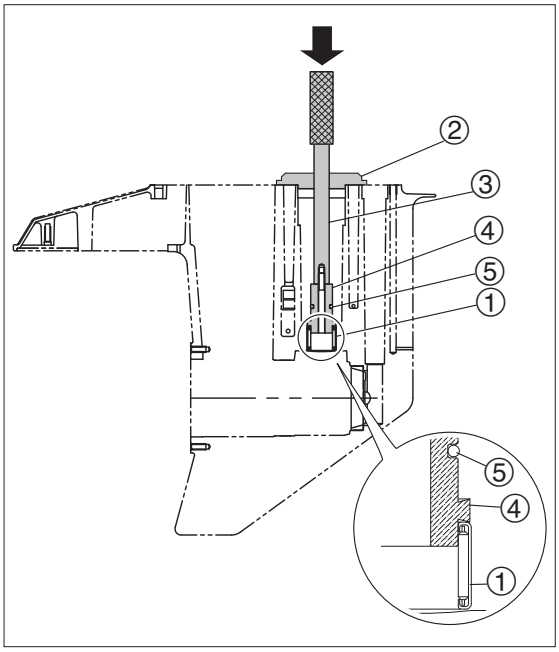
GEAR



28) Disassembly of Gear Case

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

Bearing Attachemnt ② :
P/N. 3KY-99905-0
Driver Rod ③ :
P/N. 3AB-99702-0
Roller Bearing Attachemnt ④ :
P/N. 3KY-99710-0
O Ring ⑤ :
P/N. 332-66032-0

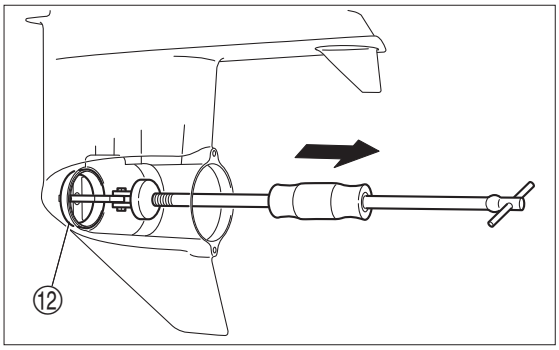


① Roller Bearing **Do not reuse.**

2. Remove taper roller bearing outer race ⑫.
Put the slide hammer in the gear case, hook claw of slide hammer on the outer race to fix it, and slide the hammer to pull out the outer race.

Slide Hammer Ass'y :
P/N. 3AC-99080-0

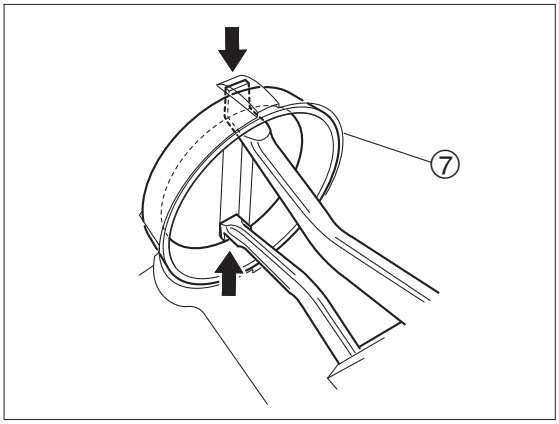
Confirm the position of insertion groove in the back of outer race, and put the claw of slide hammer in the groove.



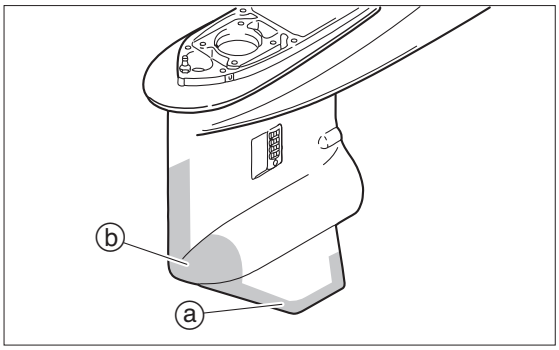
⑫ Outer Race **Do not reuse.**

This work can also be done by using the following tool.

Bevel Gear Bearing Puller Ass'y :
P/N. 3B7-72755-0

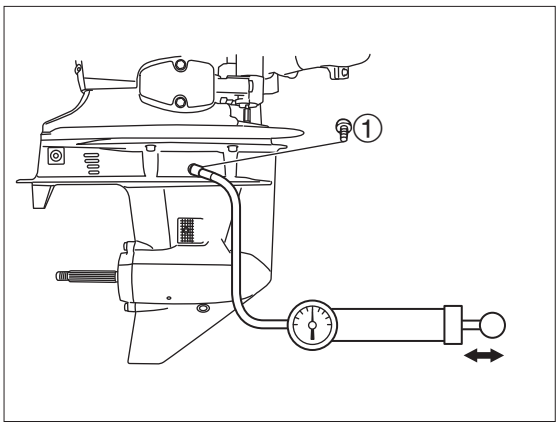


29) Inspection of Gear Case



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

30) Inspection of Gear Case (for leakage)



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

2. 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/cm^2]

- 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.

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

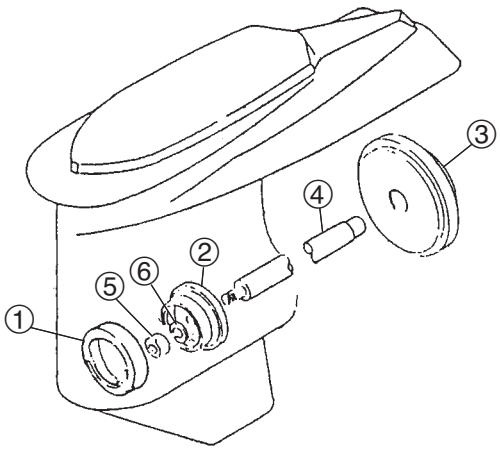
31) Assembly of Gear Case Parts

⚠ CAUTION

When gear case, forward (A) gear or bearing is replaced, measure backlash and attach a proper shim.
Refer to "Chapter 6 Shim Adjustment".

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

Bearing Attachemnt ③ :
P/N. 3KY-99905-0
Bearing Outer Press Kit :
P/N. 3B7-72739-1
Bearing Outer Press Plate ② :
P/N. 353-72732-0
Bearing Outer Press Rod ④ :
P/N. 3B7-72731-0
Nut M10 ⑤ :
P/N. 930191-1000
Spring Washer ⑥ :
P/N. 941392-1000

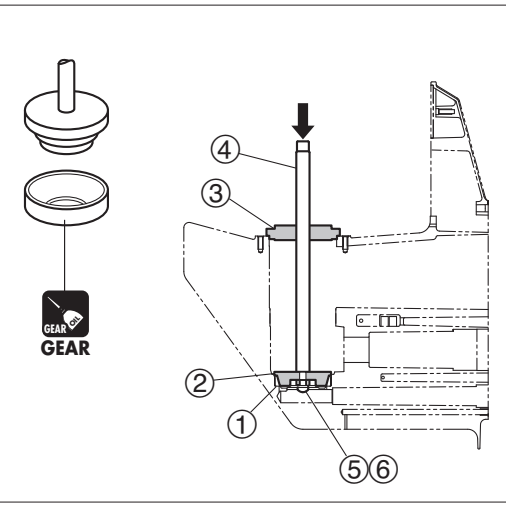


2. Fix gear case on a holder with its propeller shaft opening facing upward.

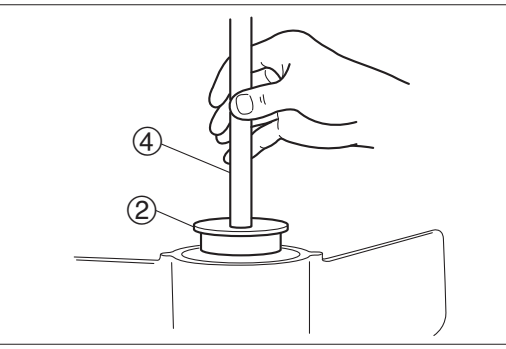
3. Clean outer race installation face in the gear case and apply gear oil.

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.

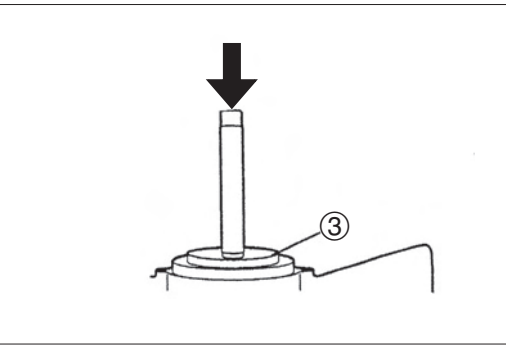
GEAR



5. Put rod ass'y into gear case slowly so that plate ② contacts inside of the outer race, and put the guide ③ on the rod ④ and set it in the opening of the gear case.



6. Tap the end of the rod with a hammer to press-fit the outer race in the housing securely.



7. Install roller bearing ⑦ by using the following tools.

⚠ CAUTION

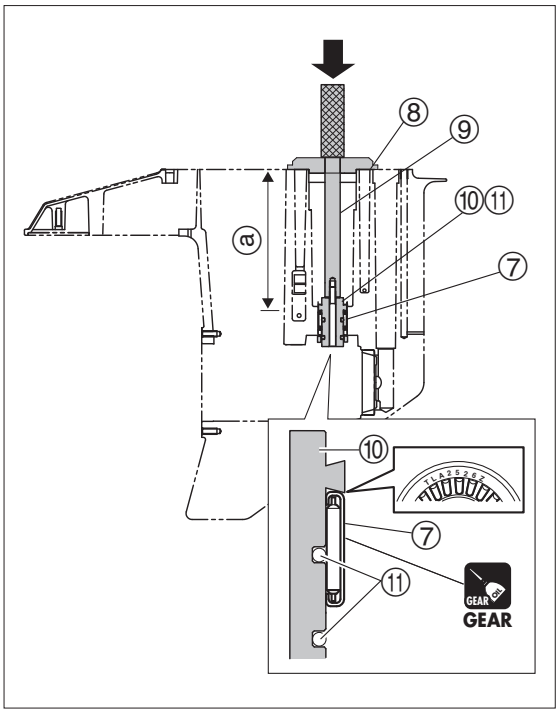
Install bearing so that marked side faces upward.

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

GEAR

Bearing Attachemnt ⑧ :
P/N. 3KY-99905-0
Driver Rod ⑨ :
P/N. 3AB-99702-0
Roller Bearing Attachemnt ⑩ :
P/N. 3KY-99710-0
O Ring ⑪ :
P/N. 332-66032-0

Installation Depth ⓐ :
173.1 - 173.5 mm (6.815 - 6.831 in)



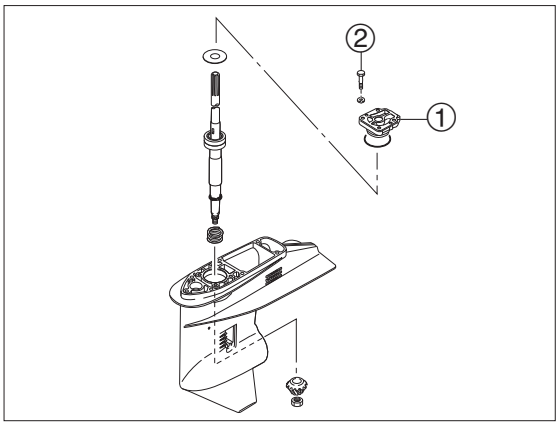
⑦ Roller Bearing **Do not reuse.**

32) Measurement of Pinion (B) Gear Height and Shim Selection

⚠ CAUTION

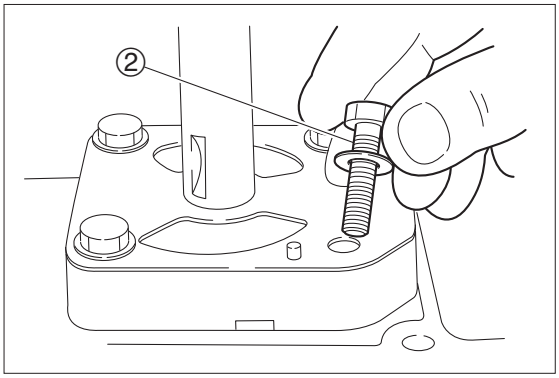
When gear case, drive shaft or pump case (lower) is replaced, measure pinion (B) bear height and back lash between gears, and perform shim adjustment.

1. Before measuring back lash of each gear, measure drive shaft pinion (B) gear height and adjust the height to proper value if necessary.
   In accordance with procedure described in "Assembly of Lower Unit Parts" on Chapter 6, install the parts up to pump case ①, and secure it by using M8 bolt (L=30mm) and flat washer ②.

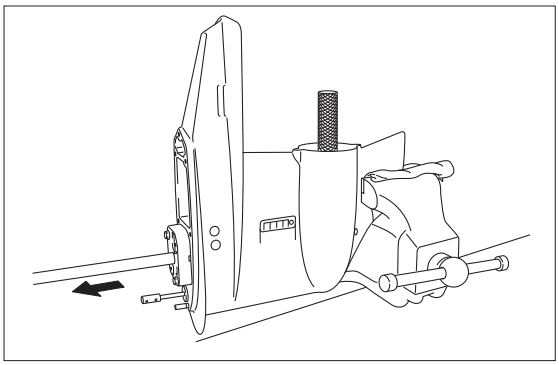


Remove forward (A) gear before beginning the work.

M8 Bolt (L=30mm) +Flat Washer ② :
13N · m (9.0 lb · ft) [1.3kgf · m]



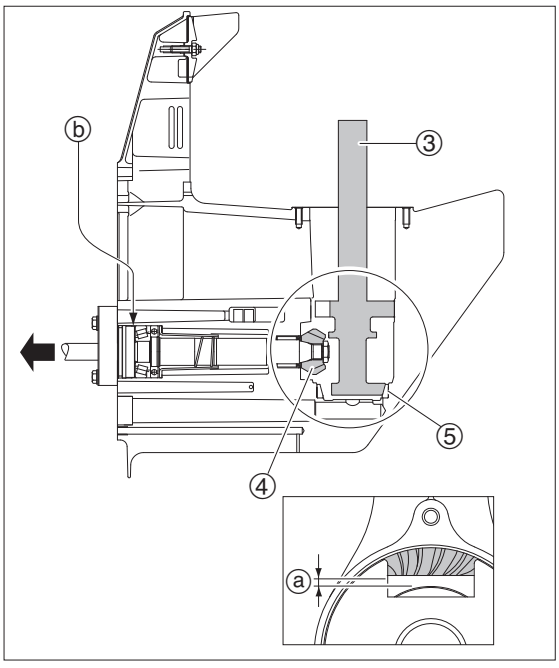
2. This work can be made easier when the opening of gear case of propeller shaft side is faced upward and fixed horizontally with a holder.
   Put a shimming gauge ③ into gear case, and measure gap ⓐ between shimming gauge ③ and pinion (B) gear ④.



⚠ CAUTION

- **Contact shimming gauge ③ with taper roller bearing ⑤ outer race tapered face.**
- **When measuring the gap, fully pull up drive shaft to eliminate the play.**

Thickness gauge measures the gap between shimming gauge ③ and pinion (B) gear end.

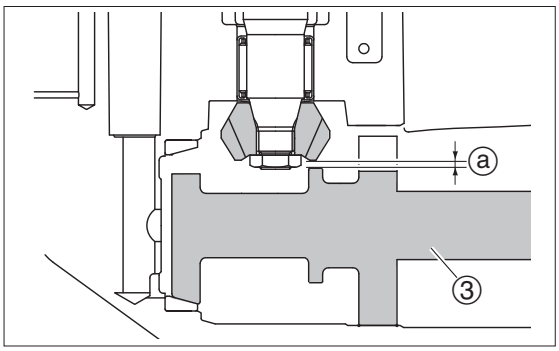


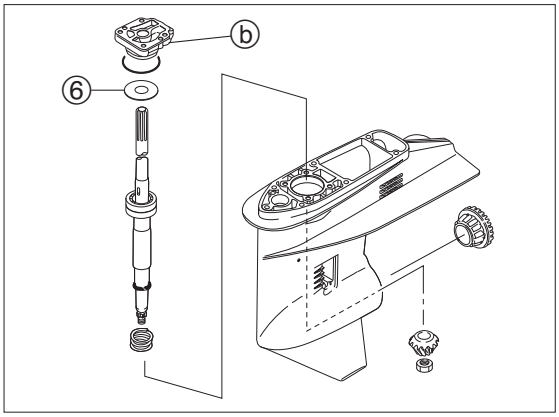
Shimming Gauge ③ :
P/N. 3KY-72250-0
Thickness Gauge :
P/N. 353-72251-0

3. Add shim ⑥ to bottom of ⓑ pump case (lower) to adjust the gap ⓐ to specified value.

Pinion (B) Gear Height ⓐ :
0.60 - 0.64 mm (0.0236 - 0.0252 in)

Type of Shims ⑥ Applicable :
0.1 mm (0.0039 in) P/N. 345-64081-0
0.15 mm (0.0059 in) P/N. 345-64082-0
0.3 mm (0.0118 in) P/N. 345-64083-0
0.5 mm (0.0197 in) P/N. 345-64084-0





32) Measurement of Back Lash between Forward (A) and Pinion (B) Gears and Shim Selection

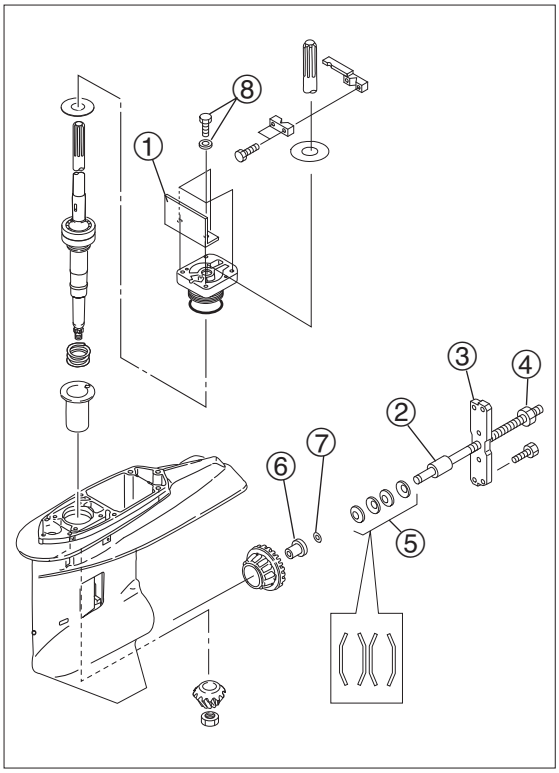
⚠ CAUTION

Before measuring backlash between forward (A) and pinion (B) gears, measure pinion (B) gear height.
Refer to "Measurement of Pinion (B) Gear Height and Shim Selection" in Chapter 6.

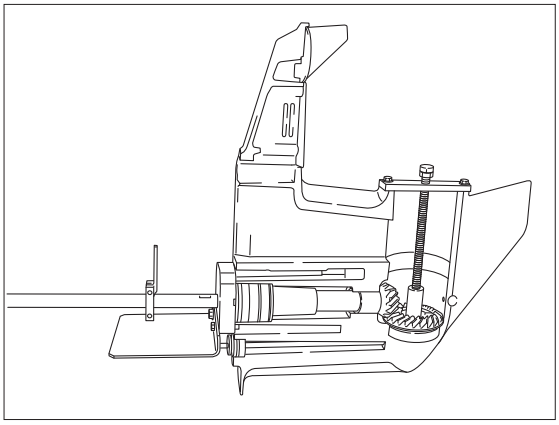
1. In accordance with procedure described in "Assembly of Lower Unit Parts" on Chapter 6, install parts up to pump case (lower).

2. Install dial gauge plate ① and secure it with bolt (M8-35) and flat washer ⑧.

M8 Bolt (L=35mm) +Flat Washer ⑧ :
13N · m (9.0 lb · ft) [1.3kgf · m]



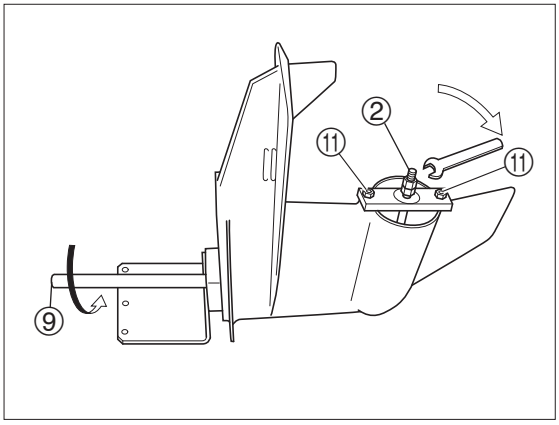
3. Install backlash measuring tool parts ② to ⑦ and secure them with installation bolts (M8 L=30mm) ⑧.



Dial Gauge Plate ① :
P/N. 3B7-72729-0
Backlash Measuring Tool Kit :
P/N. 3B7-72234-0
Backlash Measuring Tool Shaft ② :
P/N. 3B7-72723-0
Backlash Measuring Tool Plate ③ :
P/N. 3B7-72724-0
Nut ④ :
P/N. 3B7-72735-0
Coned Disk Spring ⑤ :
P/N. 3B7-72734-0 (4pcs.)
Measuring Setting Piece ⑥ :
P/N. 3KY-72245-0
O Ring ⑦ :
P/N. 332-60002-0

· Fixing gear case on the holder with its propeller shaft opening facing upward makes the work easier.
· Be sure that cone discs ⑤ are arranged as illustrated. Put three of the parts aligned in the same direction, and then, put both sets of the parts with their convex sides face-to-face.

4. Tighten shaft ② until drive shaft ⑨ starts to move (rotate). When drive shaft starts to move, additionally tighten shaft ② 1/2 of a turn (180˚).

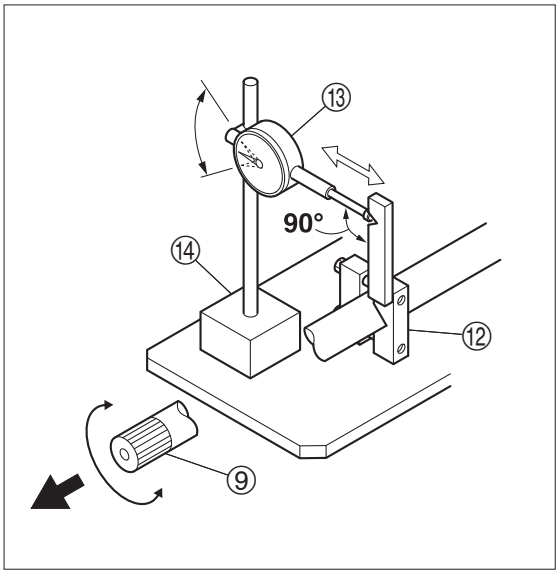


· As an alternative to the above measuring tool, a tool used for pulling out the following propeller shaft housing can be used to secure forward gear (A) gear.
· When performing the work, assemble propeller shaft ass'y and housing ass'y and bolts to tighten to specified torque.

Propeller Shaft Housing Bolt ⑪ :
13 N · m (10 lb · ft) [1.3 kgf · m]

5. Attach backlash measuring tool clamp ⑫ to drive shaft.

6. Turn drive shaft ⑨ clockwise / counterclockwise slowly while pulling it up, and read change of dial gauge ⑬ indication.



· When measuring, contact dial gauge tip to inside of V groove located in the clamp ass'y.
· Attach backlash measuring tool clamp ⑫ onto drive shaft so that the place near as possible to pump case.
· When pull up drive shaft, make sure to hold drive shaft that the place near as pump case.

Backlash Measuring Tool Clamp ⑫ :
P/N. 3B7-72720-0
Dial Gauge ⑬ :
Commercially Available Item
Magnetic Stand ⑭ :
Commercially Available Item

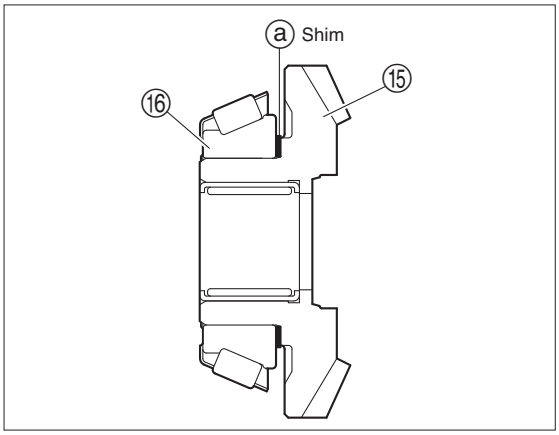
7. Select proper thickness of shim based on the backlash measured with dial gauge and on the table shown.

· Confirm dial gauge reading and adjust backlash by using thickness of shim selected.
· Measure backlash several times while changing gear teeth contact position.
· When measuring backlash, make drive shaft pulling up force equal among the measurements.
· This work can be made easier when the opening of gear case of propeller shaft side is faced upward and fixed horizontally with a holder.

Proper Backlash :
0.31 - 0.62 mm (0.0122 - 0.0244 in)

Dial Gauge Reading : mm (in)	Shim Thickness : mm (in) +means addition of shim/- means removal of shim
0.00 - 0.01	–0.15
0.02 - 0.17	–0.10
0.18 - 0.30	–0.05
0.31 - 0.62	0
0.63 - 0.75	+0.05
0.76 - 0.91	+0.10
0.92 - 1.07	+0.15
1.08 - 1.22	+0.20
1.23 - 1.38	+0.25
1.39 - 1.53	+0.30
1.54 - 1.69	+0.35
1.70 - 1.84	+0.40

8. Add shim ⓐ into the gap between forward (A) gear ⑮ and taper roller bearing ⑯ if necessary.



⚠ CAUTION

For removal or installation of taper roller bearing, refer to;
"Disassembly of Forward (A) Gear"
or "Assembly of Forward (A) Gear"
respectively.

Types of Shims ⓐ :
0.1 mm (0.0039 in) P/N. 353-64038-0
0.15 mm (0.0059 in) P/N. 353-64037
0.3 mm (0.0118 in) P/N. 353-64036-0
0.5 mm (0.0197 in) P/N 345-64084-0

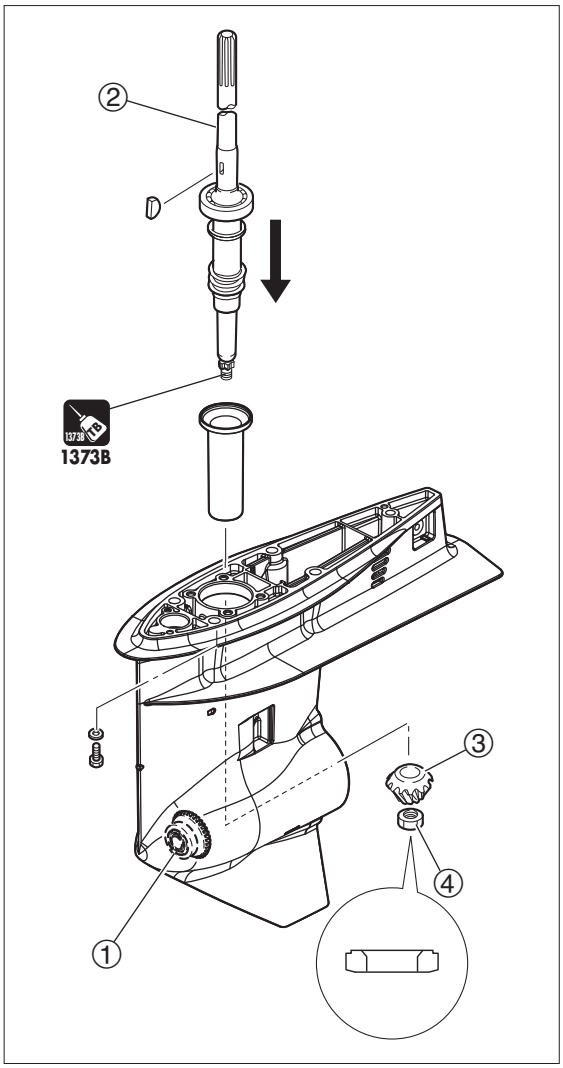
34) Assembly of Lower Unit Parts

1. After installing forward (A)gear with taper roller bearing ①, install drive shaft ass'y ②, pinion (B) gear ③ and pinion (B) gear nut ④, and tighten the nut to specified torque.

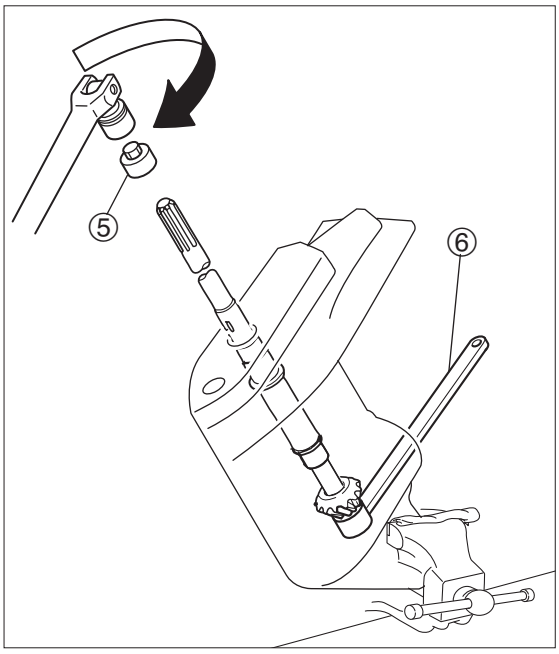
OBM

GEAR

1373B



- Tighten the nut by using a drive shaft socket ⑤ and a wrench and turning the wrench clockwise. Cover the wrench ⑥ with rag to prevent it from hitting the case directly.
- This work can be made easier when the opening of gear housing of propeller shaft side is faced upward and fixed horizontally with a holder.
- Before tightening pinion (B) gear and nut, apply ThreeBond 1373B to the thread.
- Degrease taper area of drive shaft pinion (C) gear installation section and thread of gear nut completely.



Bevel Gear B Nut Wrench ⑥ :
P/N. 346-72231-0
Bevel Gear Nut Socket ⑤ :
P/N. 346-72232-0

Pinion (B) Gear Nut ④ :
50 N · m (37 lb · ft) [5 kgf · m]

35) Assembly of Pump Case

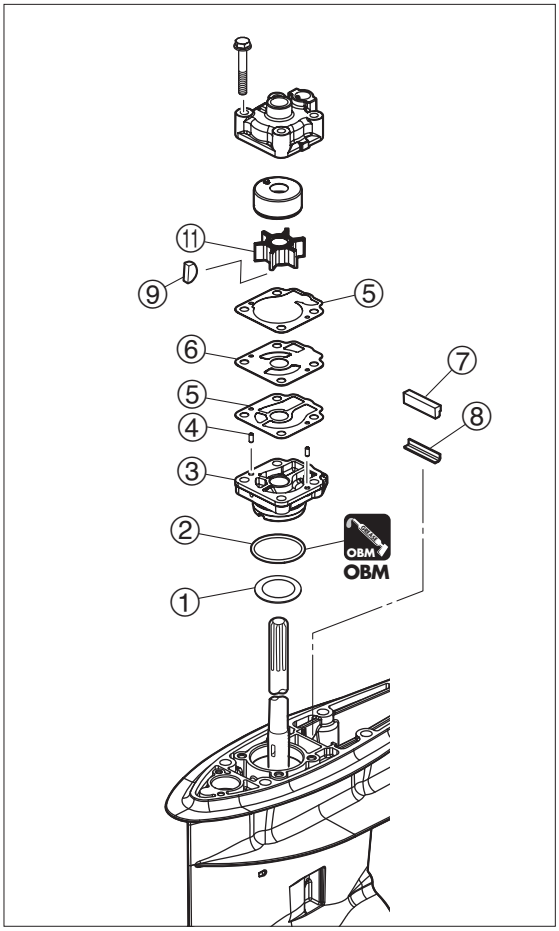
1. Attach shim ① that is removed when disassembly.
2. Attach O ring ② to pump case (lower) ③ and install pump case (lower) to gear case.

Apply OBM grease to O ring and oil seal rip.

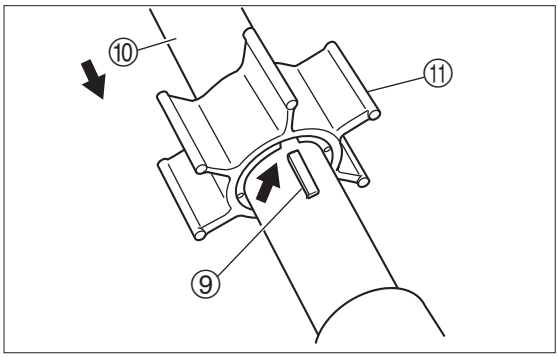
OBM

3. Put dowel pin ④ on the pump case (lower) ③, and attach pump case guide plate gasket ⑤ and pump case guide plate ⑥.

Do not forget install the water seal rubber ⑦ and water seal plate ⑧. Otherwise could rusult to engine over heating.



4. Attach water pump impeller key ⑨ to drive shaft ⑩, align the key with the water pump impeller ⑪ side key groove, and install the impeller.



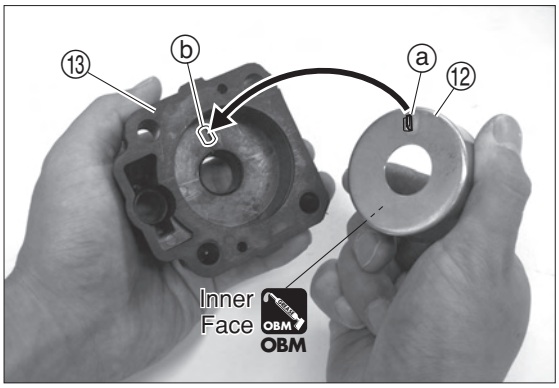
5. Attach water pump liner ⑫ to pump case (upper) ⑬.

⚠ CAUTION

Align pump liner ⑪ protrusion ⓐ with pump case (upper) ⑬ concave ⓑ.

Apply OBM grease to inside of water pump liner.

OBM

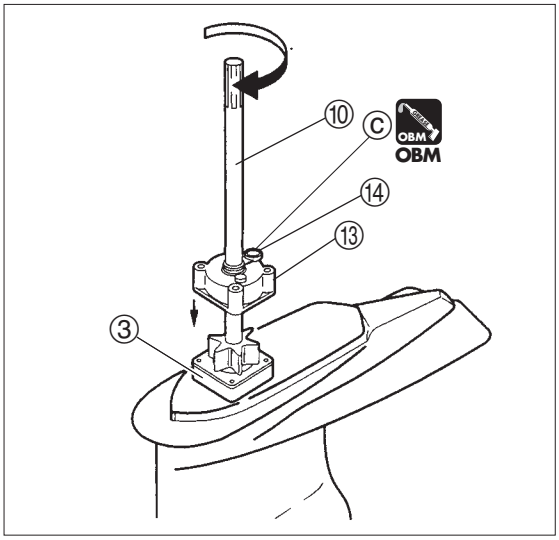


6. Put pump case (upper) ⑬ and gasket (2 pcs.) on the drive shaft, and install them on the pump case (lower) ③.

⚠ CAUTION

While installing pump case ⑬, turn drive shaft ⑩ clockwise to bend all impeller blades in counterclockwise on power unit direction.

OBM



7. Attach water pipe seal ⑭.

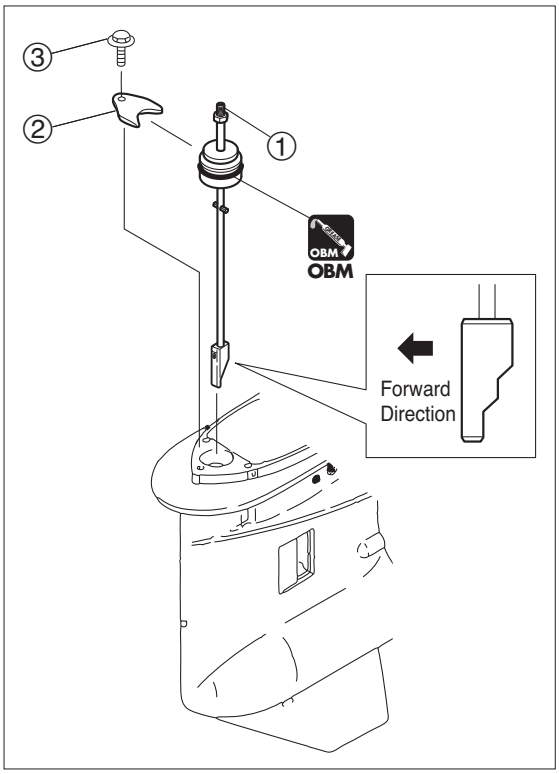
Apply OBM grease thinly on the inside ⓒ of water pipe seal so that water pipe can be inserted smoothly.

36) Attaching Clutch Cam Ass'y

1. Install clutch cam ass'y ①.

Apply OBM grease to O ring of clutch cam ass'y, and install the assembly by pushing cam rod bushing into gear case.
Be careful of direction of clutch cam.

OBM



2. Attach stopper ② and bolt ③.

37) Installing Propeller Shaft Housing Ass'y

1. Attach O ring ② to propeller shaft housing ①.

   Apply OBM grease to O ring.

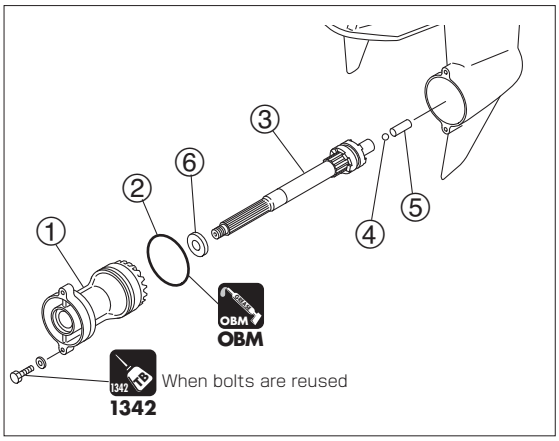
2. Attach steel ball ④, clutch push rod ⑤ and washer ⑥ that was removed when disassembling to propeller shaft ③.

3. Install propeller shaft ③ to propeller shaft housing ①, and install the assembly to gear case.

   · Install propeller shaft housing to gear case securely, and tighten the securing bolts after confirming that O ring is set in the case properly.
   · Apply ThreeBond 1342 to thread of propeller shaft housing installation bolts.

Propeller Shaft Housing Bolts :
13 N · m (9 lb · ft) [1.3 kgf · m]

1342



② O Ring **Do not reuse.**

38) Measurement of Propeller Shaft Play and Selection of Washer Thickness

⚠ CAUTION

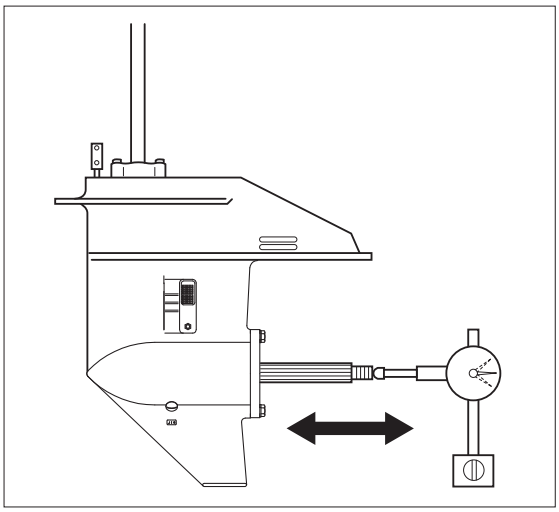
Before measuring propeller shaft play, adjust backlash between forward (A) and pinion (B) gears and reverse (C) and pinion (B) gears.
Refer to "Measurement of Backlash between Forward (A) and Pinion (B) Gears and Shim Selection" and "Measurement of Backlash between Pinion (B) and Reverse (C) Gears and Shim Selection" in Chapter 6.

1. Assemble lower unit parts in accordance with procedure described in "Assembly of Lower Unit Parts" on Chapter 6.

2. Measure play of propeller shaft in forward and reverse directions.

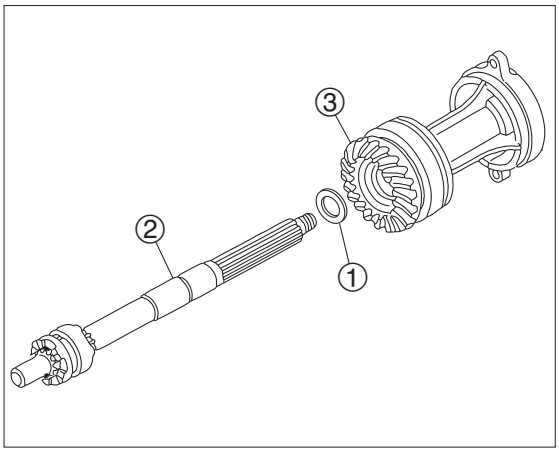
Specified Value of Play :
0.1 - 0.5 mm (0.004 - 0.020 in)

3. If out of specification, measure the reverse (C) gear washer thickness.



4. Replace the washer ①, if the washer thickness out of specification.

Specified Value of Thickness :
2.85 - 3.00 mm (0.1122 - 0.1181 in)



5. Replace washer ① between propeller shaft ② and reverse (C) gear ③ if necessary.

⚠ CAUTION

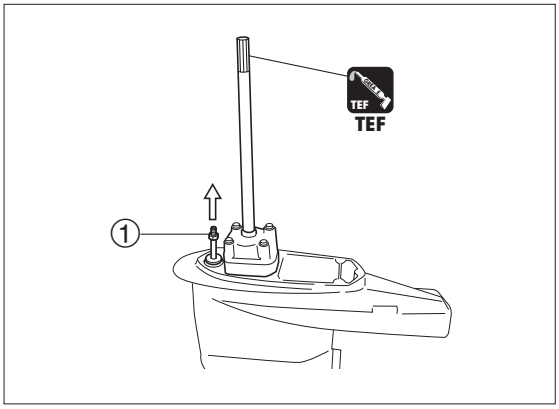
For removal or installation of propeller shaft housing, refer to;
"Removing Propeller Shaft" and "Assembling Lower Unit Parts" in Chapter 6.

Play of propeller shaft in forward-reverse direction out of the specified range can cause revolution of propeller even in neutral gear while engine is operating.

39) Installation of Lower Unit

1. Tilt-up outboard motor and lock with tilt stopper.

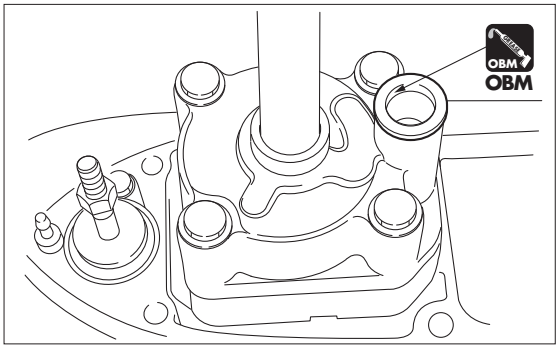
2. Set shift rod ① to up position.



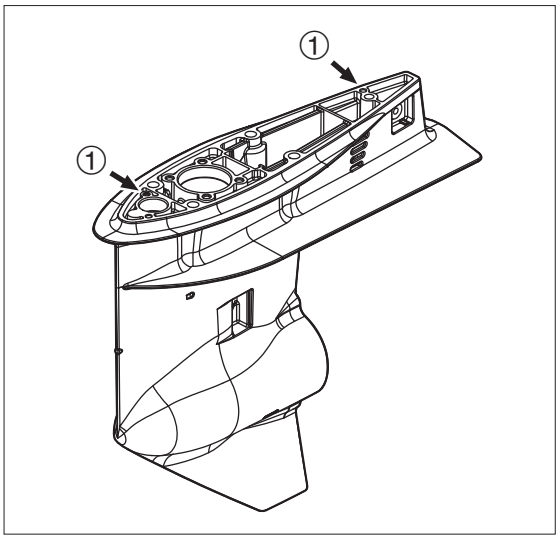
- Apply thin coat of OBM grease to spline of drive shaft before assembling.
- Apply thin coat of OBM grease to water pipe seal rubber.
- Lower unit installation can be made easier with the outboard motor tilted up.
- When installing the lower unit, insert water pipe into seal rubber properly.

TEF

OBM



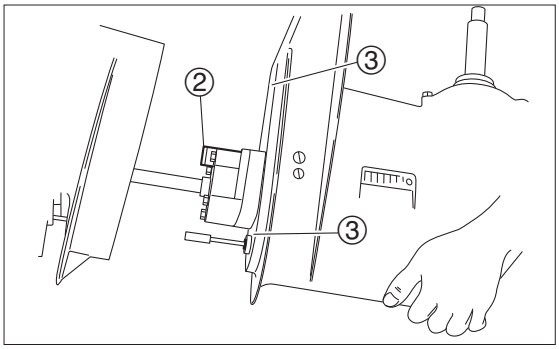
3. Install dowell pins ① (2 pices).



① Dowell pin

4. Put lower unit ass'y into drive shaft housing.
Align the position of water pipe, water pipe seal ② and dowel pin ③.

Apply OBM grease to O ring.

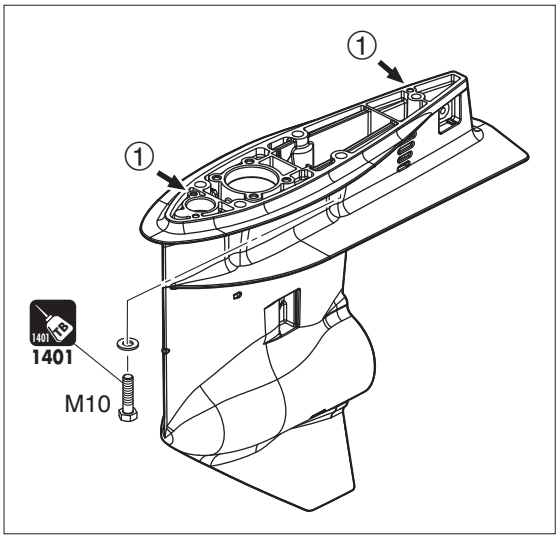


5. Tighten lower unit ass'y installation bolts and nut to specified torque.

27 N · m (20 lb · ft) [2.7 kgf · m]

1401

Make sure to tighten the bolt on back side of anode.

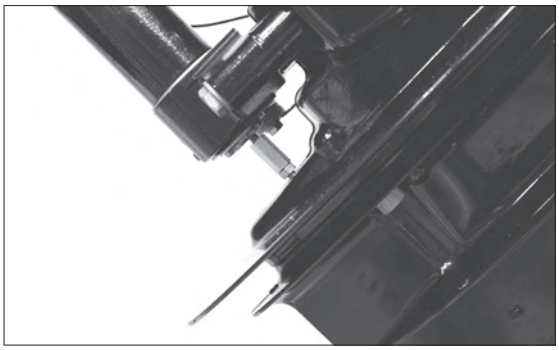


M10 5pcs.
① Dowell pin

6. Install trim tab.

7. Tighte the shift cam joint nut, and then connect shift rod and camrod.

Make sure to check for shift ro pullig compleatly. And check for shift lever is shifted in forward (F). If joint is tightened when not in forward, it will not shift correctly.

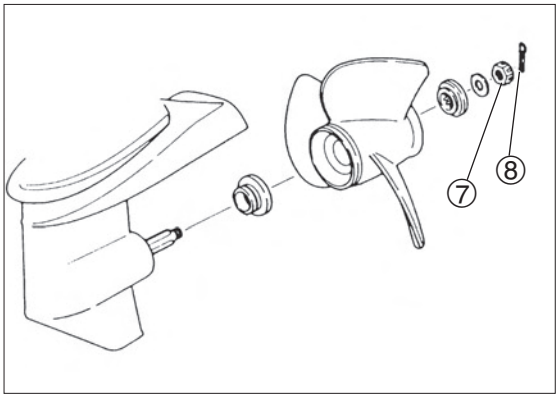


8. Attach propeller and tighten propeller nut ⑦ to specified torque.

⚠ CAUTION

- **Before removing or installing propeller, be sure to 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-ventilation plate and propeller to prevent rotation of propeller when removing or installing propeller.**

Propeller Nut ⑦ :
35 N · m (25 lb · ft) [3.5 kgf · m]

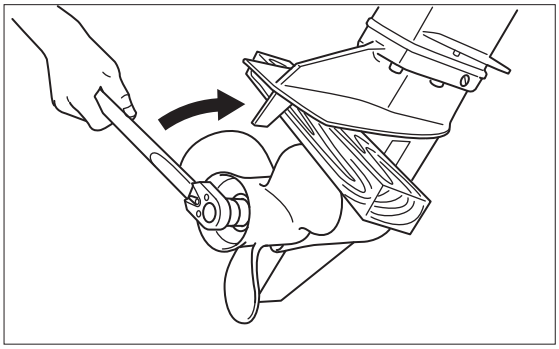


⑧ Split Pin **Do not reuse.**

9. Attach split pin ⑧.

⚠ CAUTION

If propeller shaft pin hole and propeller nut pin groove do not align, additionally tighten the nut until they align.



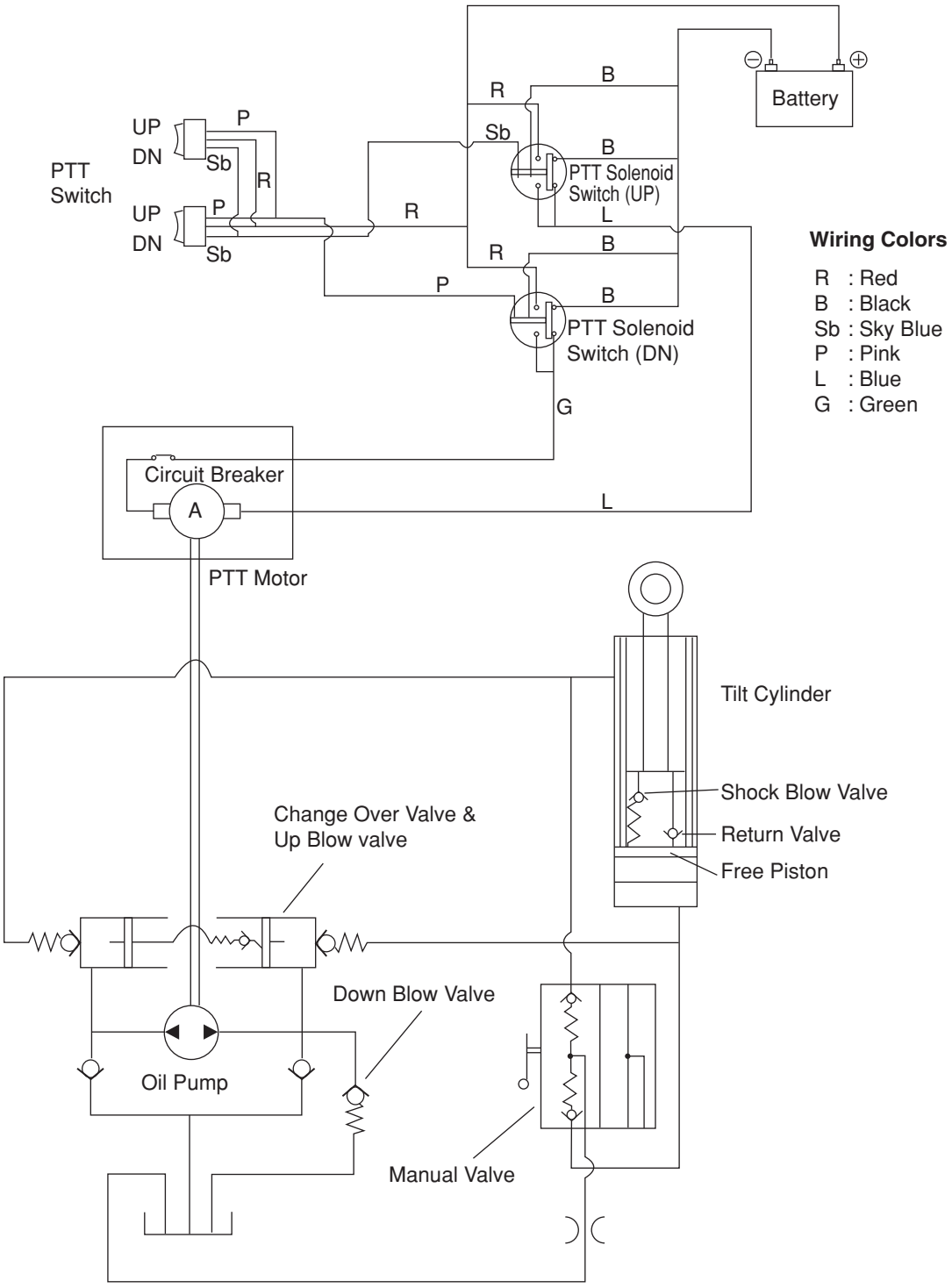
10. Fill gear case with gear oil to specified level.
Refer to “Replacement of Gear Oil” in Chapter 3.

6

7

Bracket

1. PTT Wiring and Layout Diagram



Mark

Oil Reservoir

Release Valve

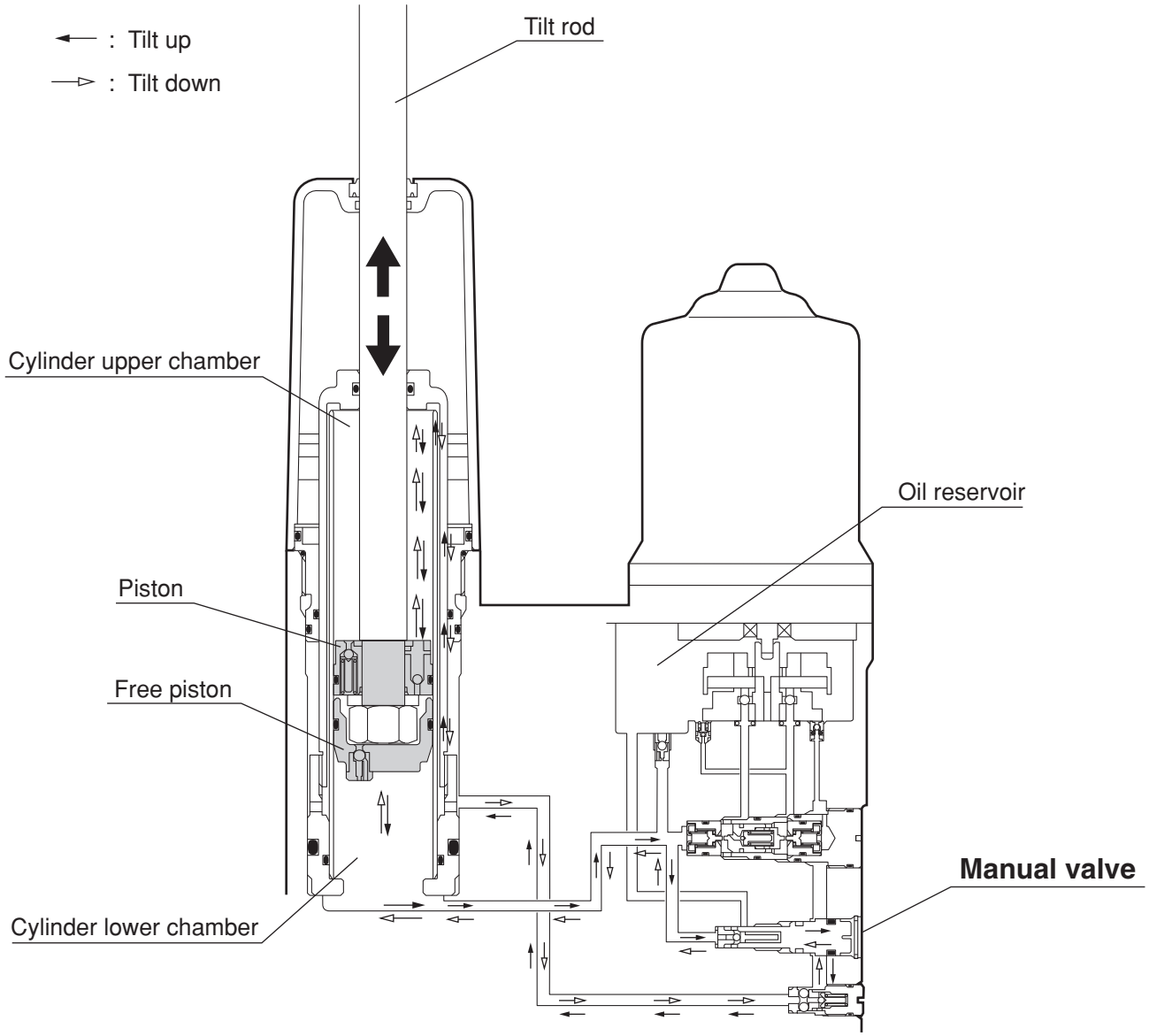
Check Valve

Orifice

2. 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 trim switch located on the tiller handle or remote control box is used to tilt-up or down the outboard motor.
- The switch is also used for trim operation of the outboard motor during driving at low speed.

3. Operations of Hydraulic Circuit

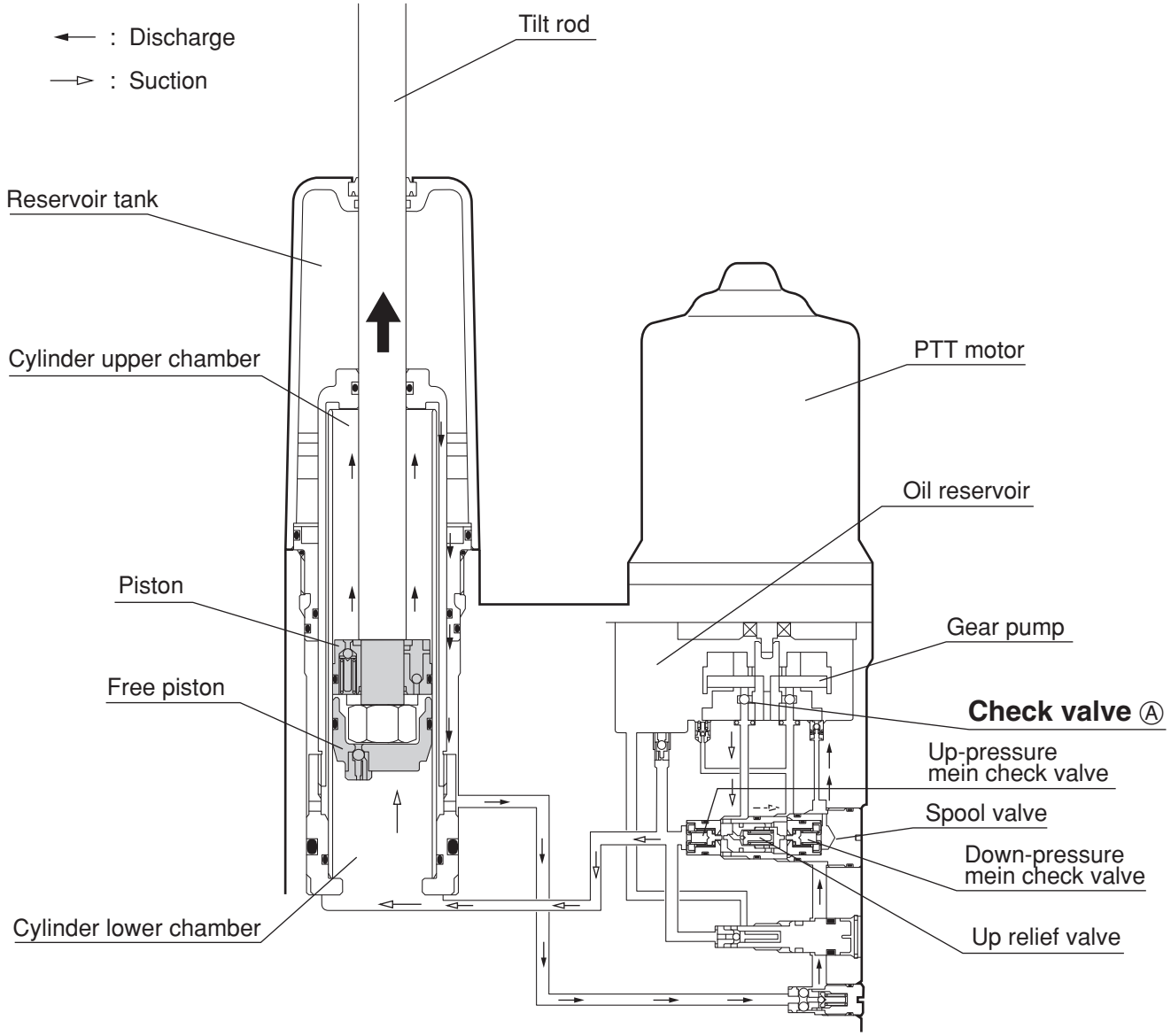


Manual Tilt Operation

Turning the manual operation valve counterclockwise to open completly 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.



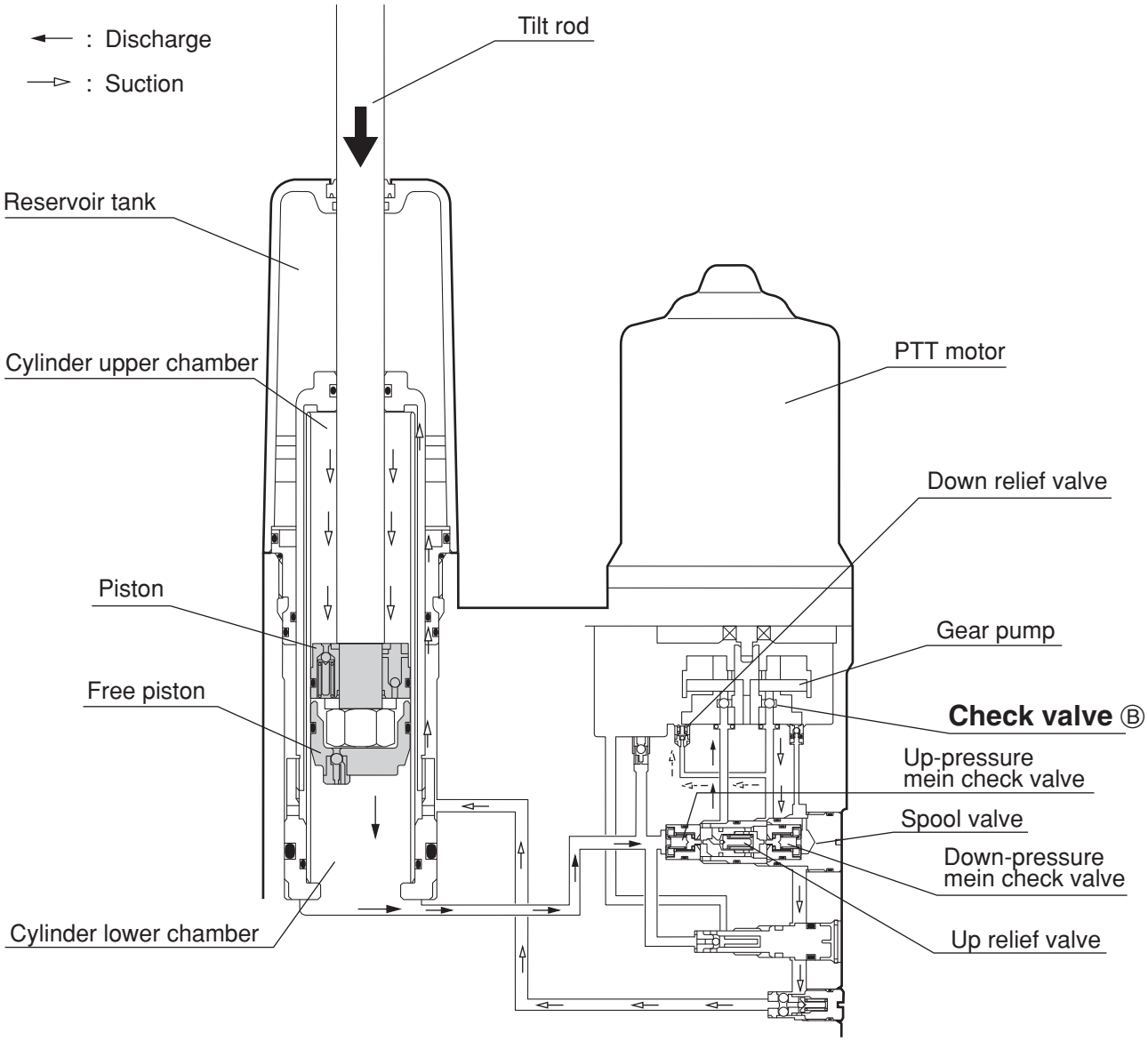
Tilt up Operation

Pressing "UP" side of PTT switch causes the PTT 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 right side to open down-pressure main check valve. Oil in the cylinder upper chamber is returned to gear pump. 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.

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.

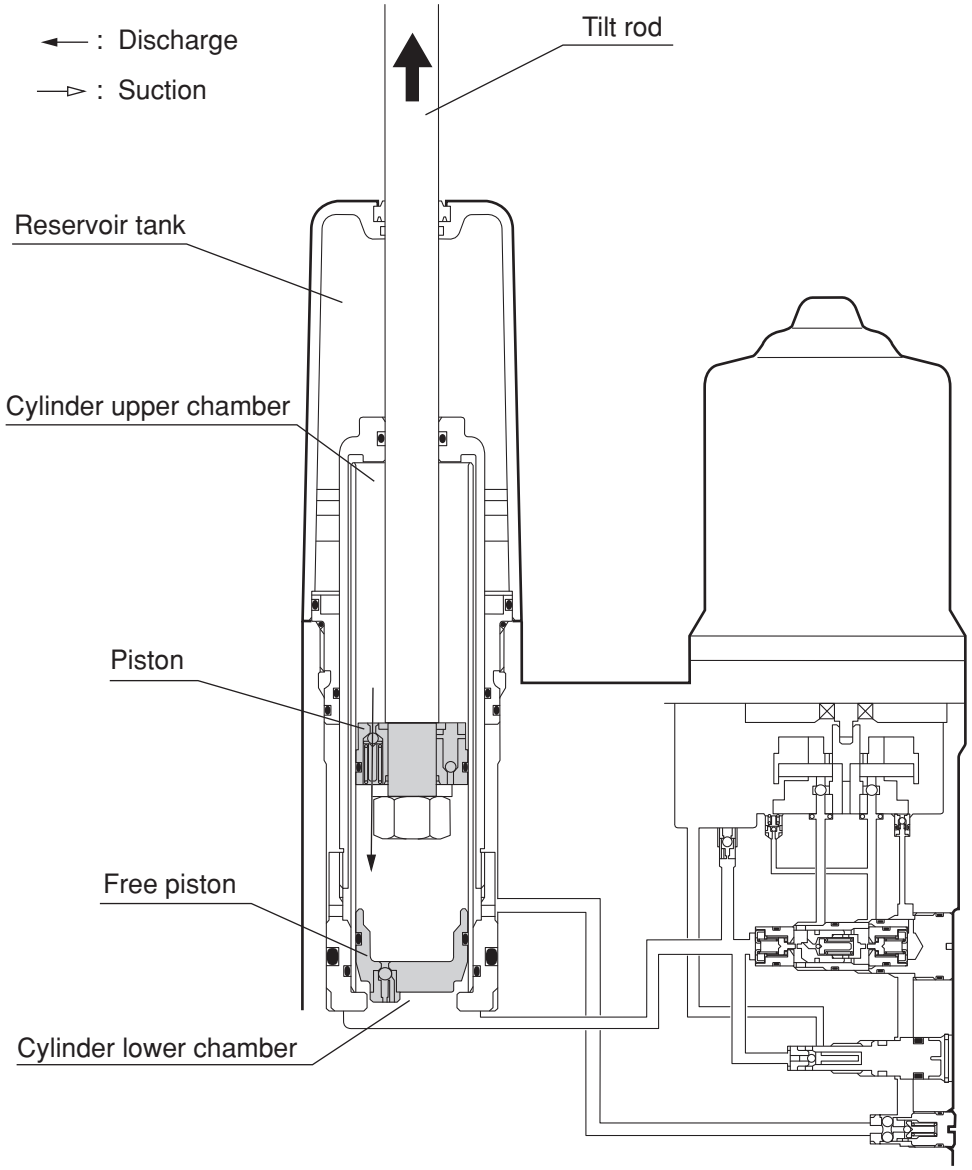
When tilt rod fully extends, up relief valve opens to prevent increase of hydraulic pressure of cylinder lower chamber by relieving the pressure to protect PTT unit.



Tilt down/Trim in

Pressing "DOWN" side of PTT switch causes the PTT 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 left side to open up-pressure main check valve. Oil in the cylinder lower chamber is returned to gear pump. As a result of the above operations, piston rod is pushed down to tilt down the outboard motor.



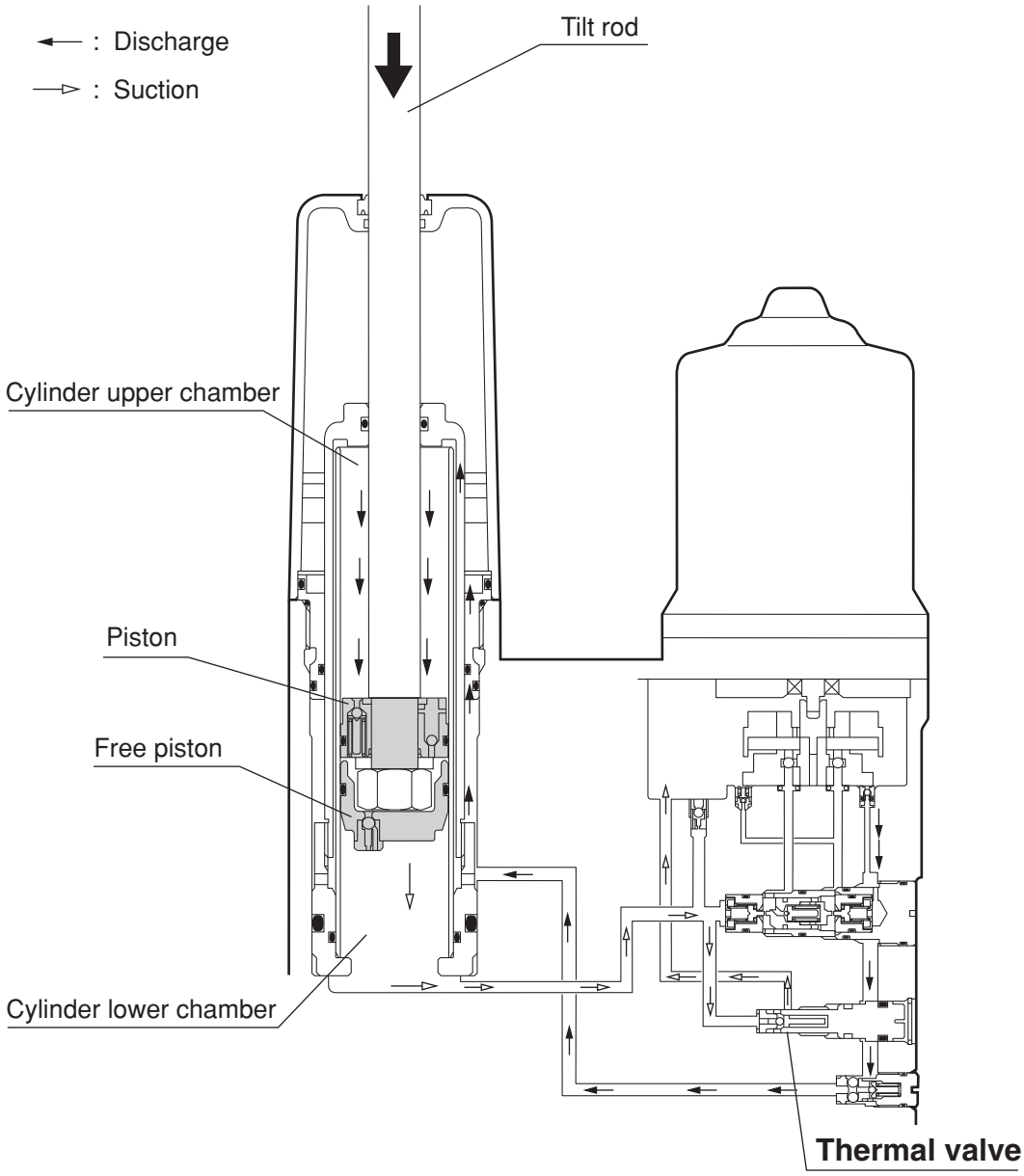
Shock Absorber Valve

The PTT 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 piston andfree piston 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.

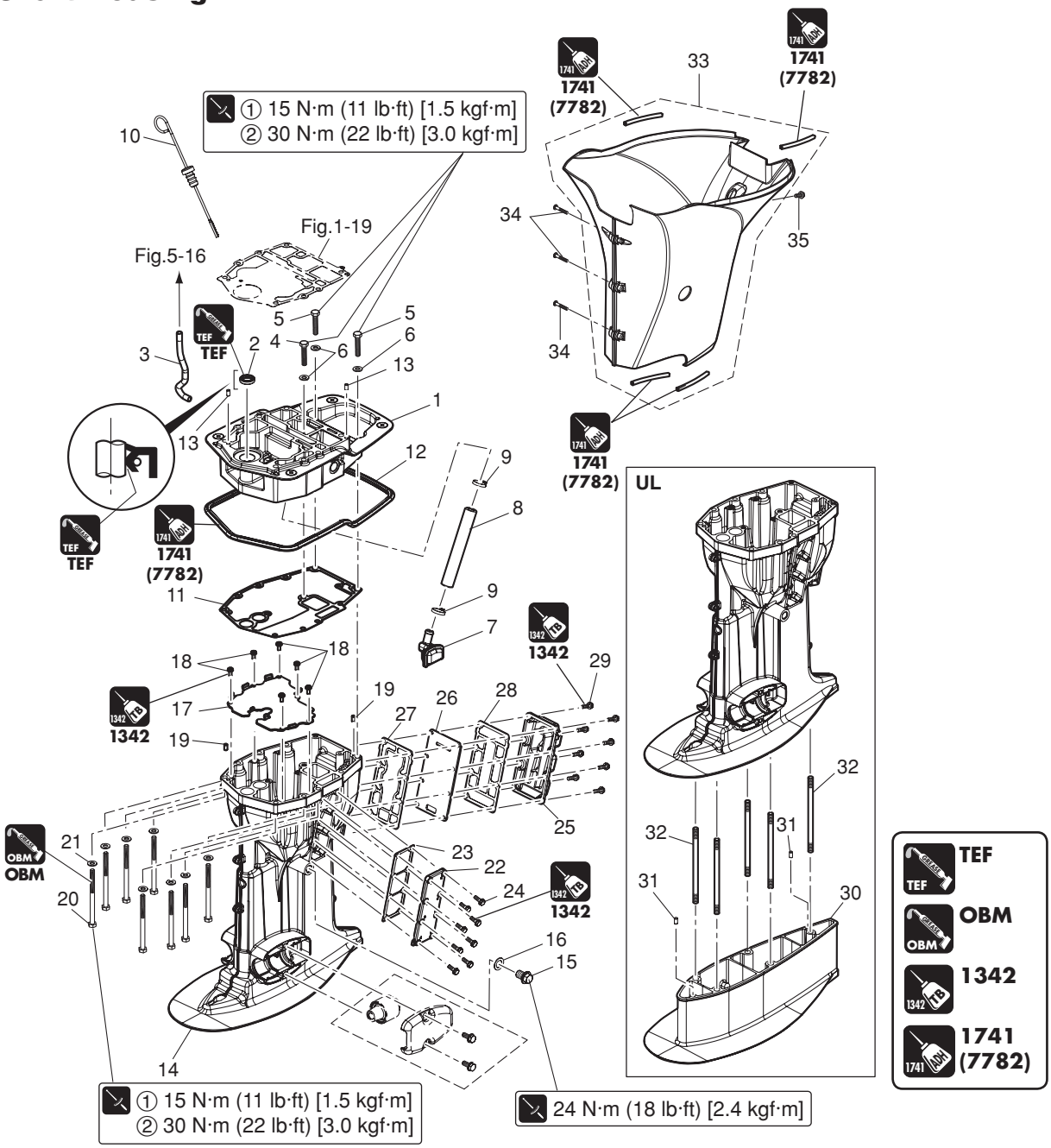
The piston rod to which excessive force is applied is pressed into the cylinder, resulting in increasing hydraulic pressure in the lower cylinder chamber over a rated value.

The increased hydraulic pressure reaches the thermal valve, resulting in opening the valve to dissipate itself.

4.Parts Layout

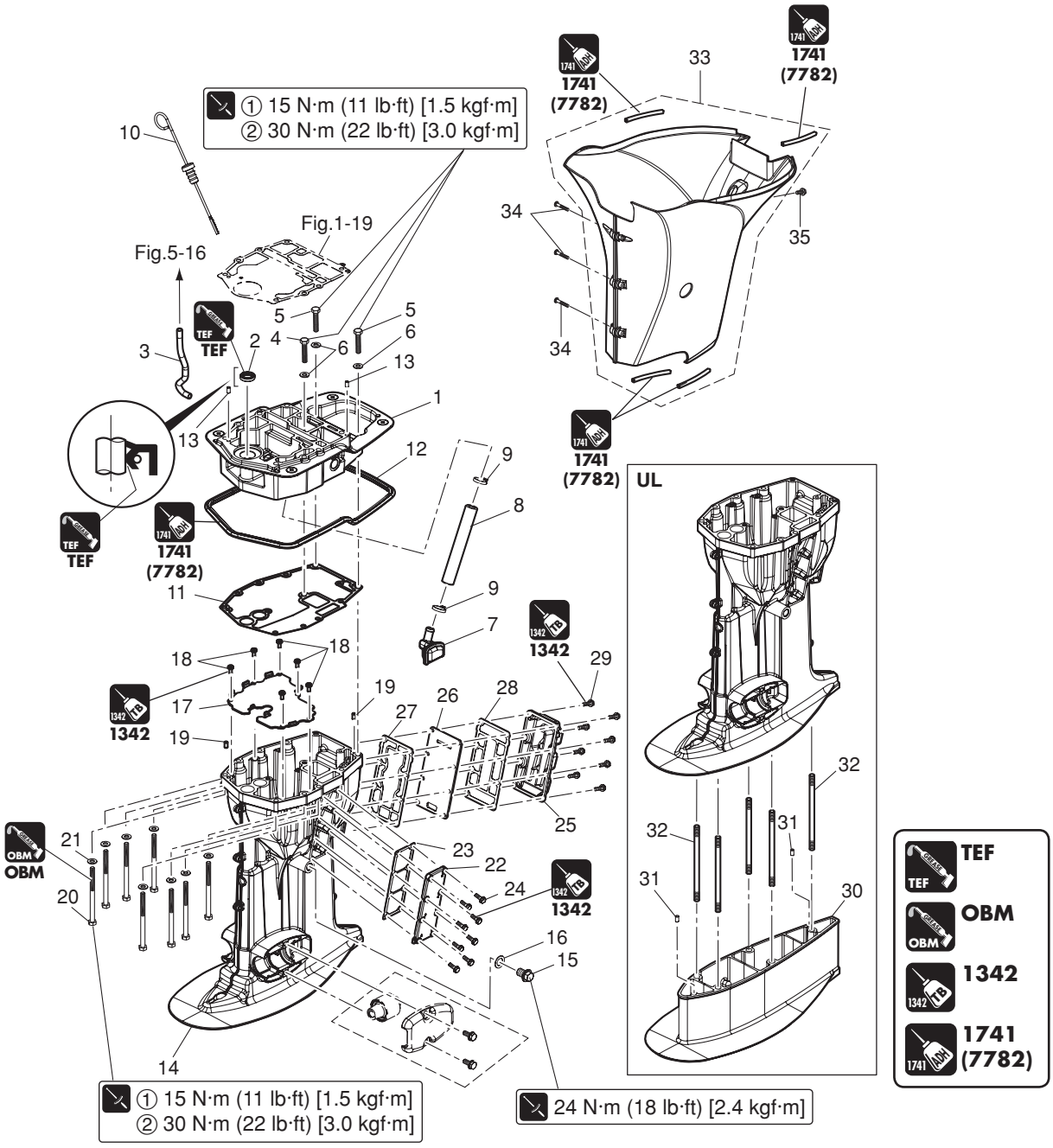
P/L Fig. 10

Drive Shaft Housing



Ref. No.	Description	Q'ty	Remarks
1	Engine Basement Ass'y	1	
2	Oil Seal 16-28-6	1	Do not reuse.
3	Cooling Hose	1	Engine Basement-Fuel Cooler
4	Bolt 8-40	1	
5	Cylinder Head Bolt	2	
6	Washer	3	
7	Oil Strainer Ass'y	1	L=150
8	Pipe L=150	1	Engine Basement-Oil Strainer
9	Band 158	2	
10	Oil Level Gauge	1	
11	Drive Shaft Housing Gasket	1	Do not reuse.
12	Engine Basement Seal	1	
13	Dowel Pin 6-12	2	Engine Basement

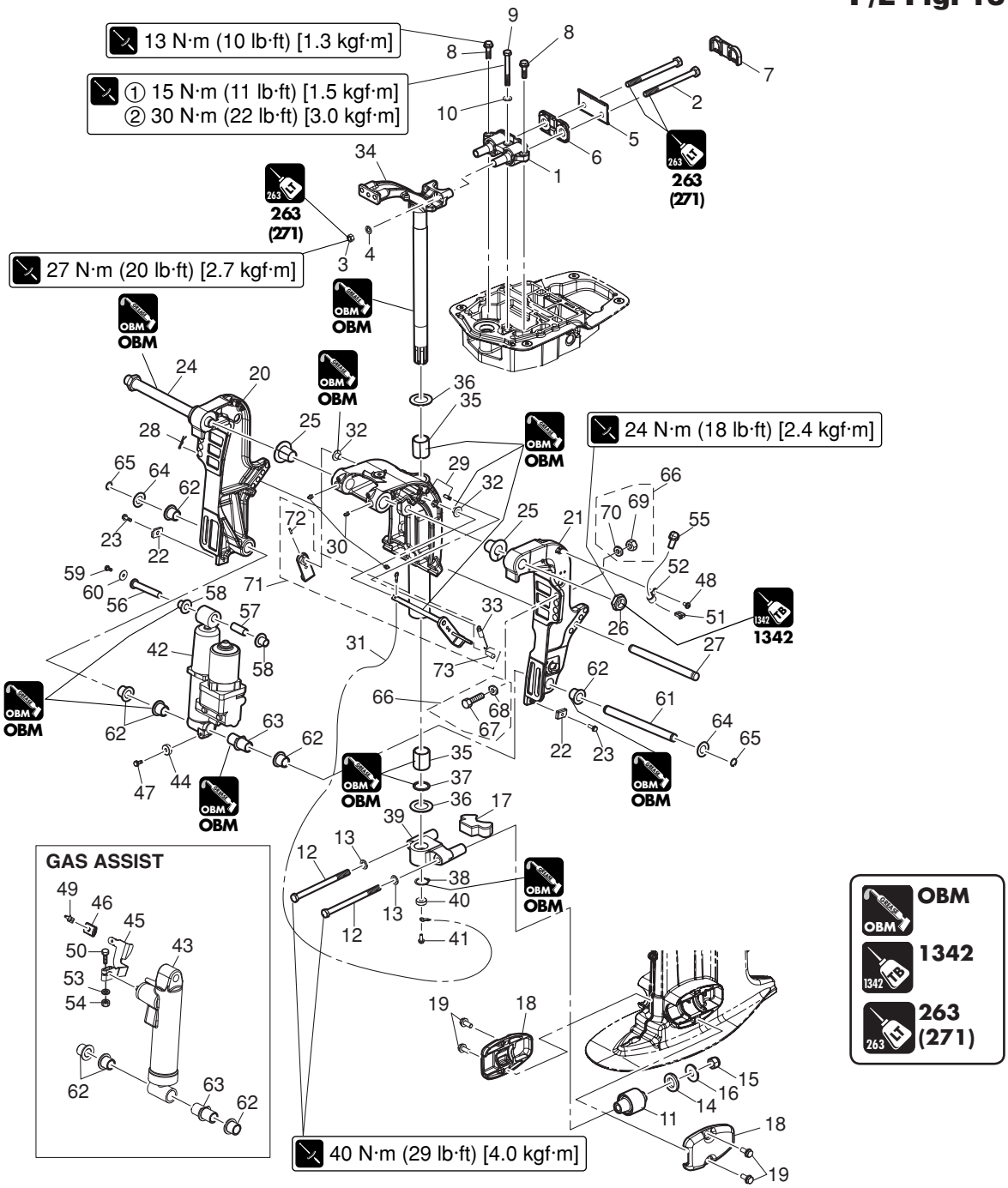
Ref. No.	Description	Q'ty	Remarks
14-1	Drive Shaft Housing Ass'y (S)	1	for Transom "L"&"UL"
14-2	Drive Shaft Housing Ass'y (L)	1	for Transom "S"
15	Drain Bolt 14-20	1	
16	Washer 14.5-24-1	1	
17	Guide Plate	1	
18	Screw	6	
19	Dowel Pin 6-12	2	Drive Shaft Housing
20	Bolt 8-115	8	
21	Washer	8	M8
22	Cover	1	
23	Gasket	1	Do not reuse.
24	Bolt	8	M6 L=18mm
25	Idle Exhaust Port Cover	1	



Ref. No.	Description	Q'ty	Remarks
26	Plate	1	
27	Idle Exhaust Port Gasket	1	Inside Do not reuse.
28	Idle Exhaust Port Gasket	1	Outside Do not reuse.
29	Bolt	8	M6 L=20mm
30	Extension Housing	1	for Transom "UL"
31	Dowel Pin 6-12	2	for Transom "UL"
32	Studm 10-145	5	for Transom "UL"
33-1	Apron Ass'y	1	for Transom "L"&"UL"
33-2	Apron Ass'y	1	for Transom "S"
34-1	Tapping Screw 5-30	2	for Transom "S"
34-2	Tapping Screw 5-30	4	for Transom "L"&"UL"
35	Bolt	1	M6 L=16mm

Bracket

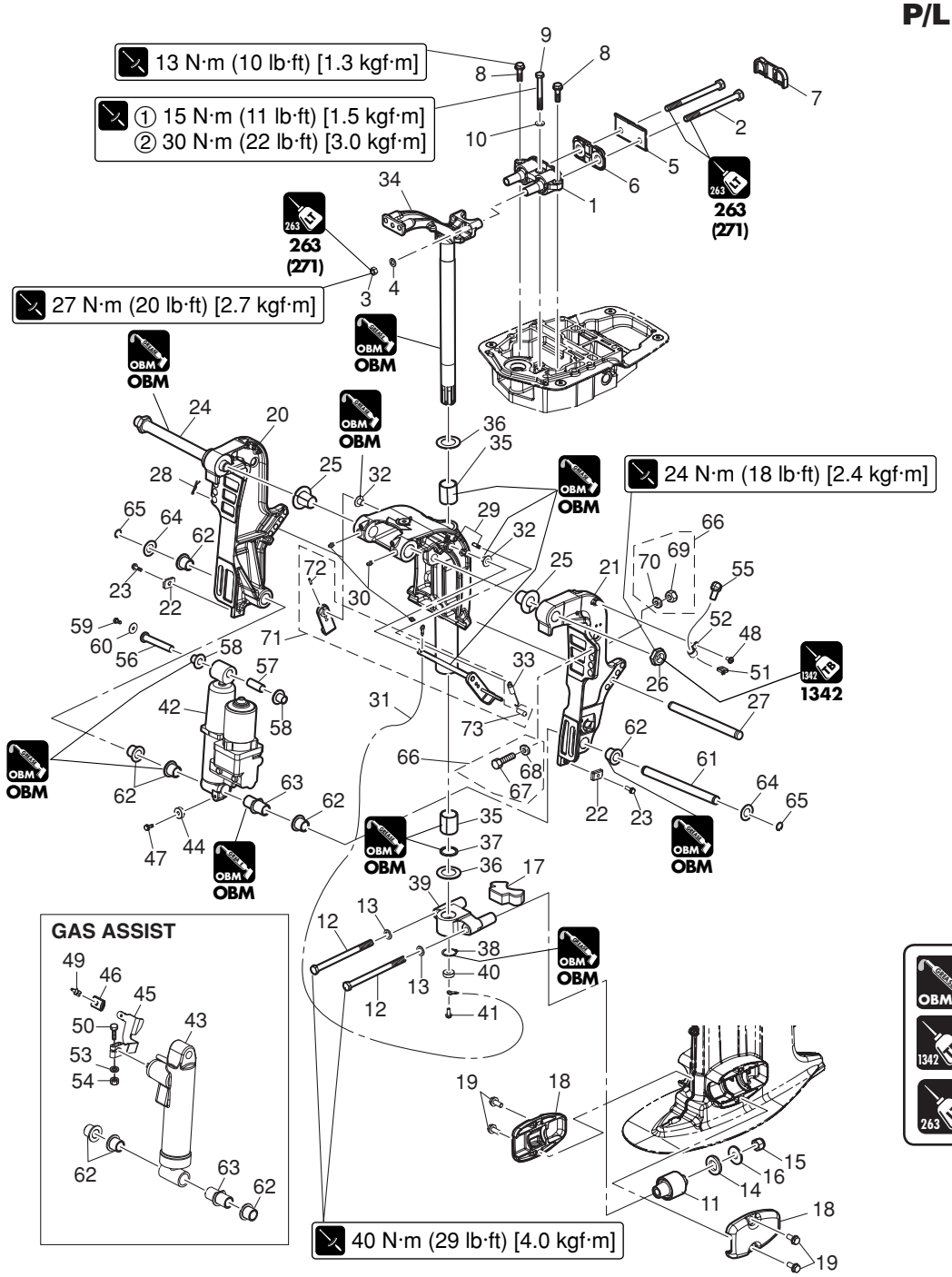
P/L Fig. 13



Ref. No.	Description	Q'ty	Remarks
1	Rubber Mount (Upper)	1	
2	Bolt M10-P1.25-130	2	
3	Nut 10-P1.25	2	
4	Washer	2	M10
5	Lock Plate	1	
6	Damper (Upper)	1	Front Side
7	Damper (Upper)	1	Rear Side
8	Bolt	2	M8 L=30mm
9	Bolt M8-70	1	M8 L=70mm
10	Washer	1	M8
11	Rubber Mount (Lower)	2	Mount Bracket -Drive Shaft Housing
12	Bolt M12,P1.25-177.5	2	
13	Washer 13-34-3	2	Bolt Side

Ref. No.	Description	Q'ty	Remarks
14	Damper 21-36-5	2	
15	Nylon Nut 12-P1.25	2	Do not reuse.
16	Washer	2	Nut Side M12
17	Damper (Lower)	1	Mount Bracket
18	Mount Holding Plate (Lower)	2	
19	Bolt	4	M8 L=20mm
20	Clamp Bracket (PTT-R)	1	Starboard Side
21	Clamp Bracket (PTT-L)	1	Port Side
22	Anode	2	Clamp Bracket
23	Bolt	2	M6 L=20mm
24	Swivel Bracket Shaft Assy	1	
25	Bushing	2	
26	Nylon Nut 7/8-14	1	Do not reuse.

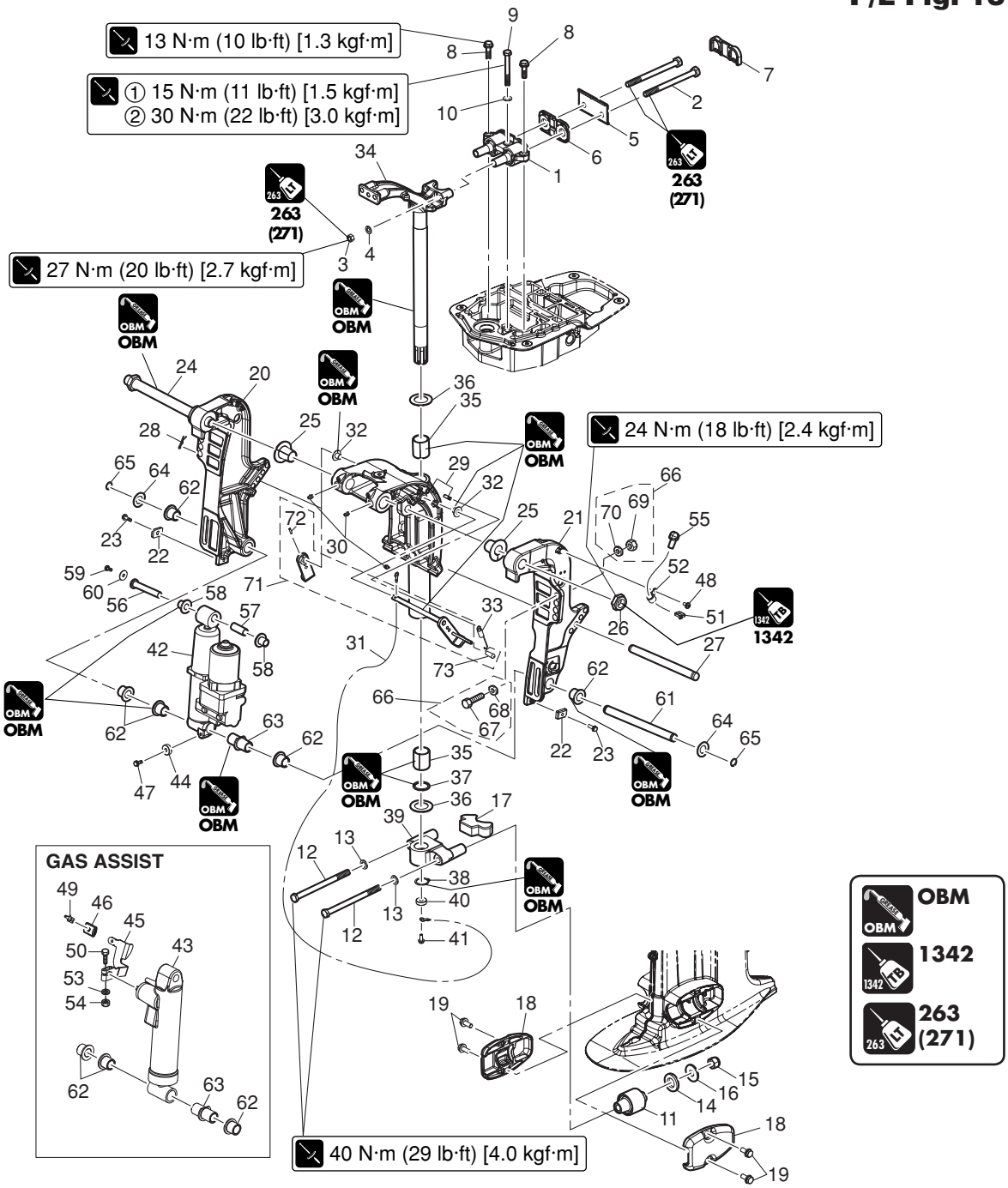
P/L Fig. 13



Ref. No.	Description	Q'ty	Remarks
27	PTT Thrust Rodptt	1	
28	Snap Pin	1	
29-1	Swivel Bracket Ass'y	1	for Transom "S"
29-2	Swivel Bracket Ass'y	1	for Transom "L"&"UL"
30	Grease Fitting	3	
31	Ground L=210	1	Swivel Bracket-Drive Shaft Housing
32	Collar 10.2-12-12	2	
33	Tilt Stopper Spring	1	
34-1	Steering Shaft Ass'y	1	for Transom "S"
34-2	Steering Shaft Ass'y	1	for Transom "L"&"UL"
35	Bushing 30-36-41	2	
36	Thrust Plate (Upper) 31-50-2	2	Upper & Lower
37	O-ring 3.5-29.7	1	Do not reuse.

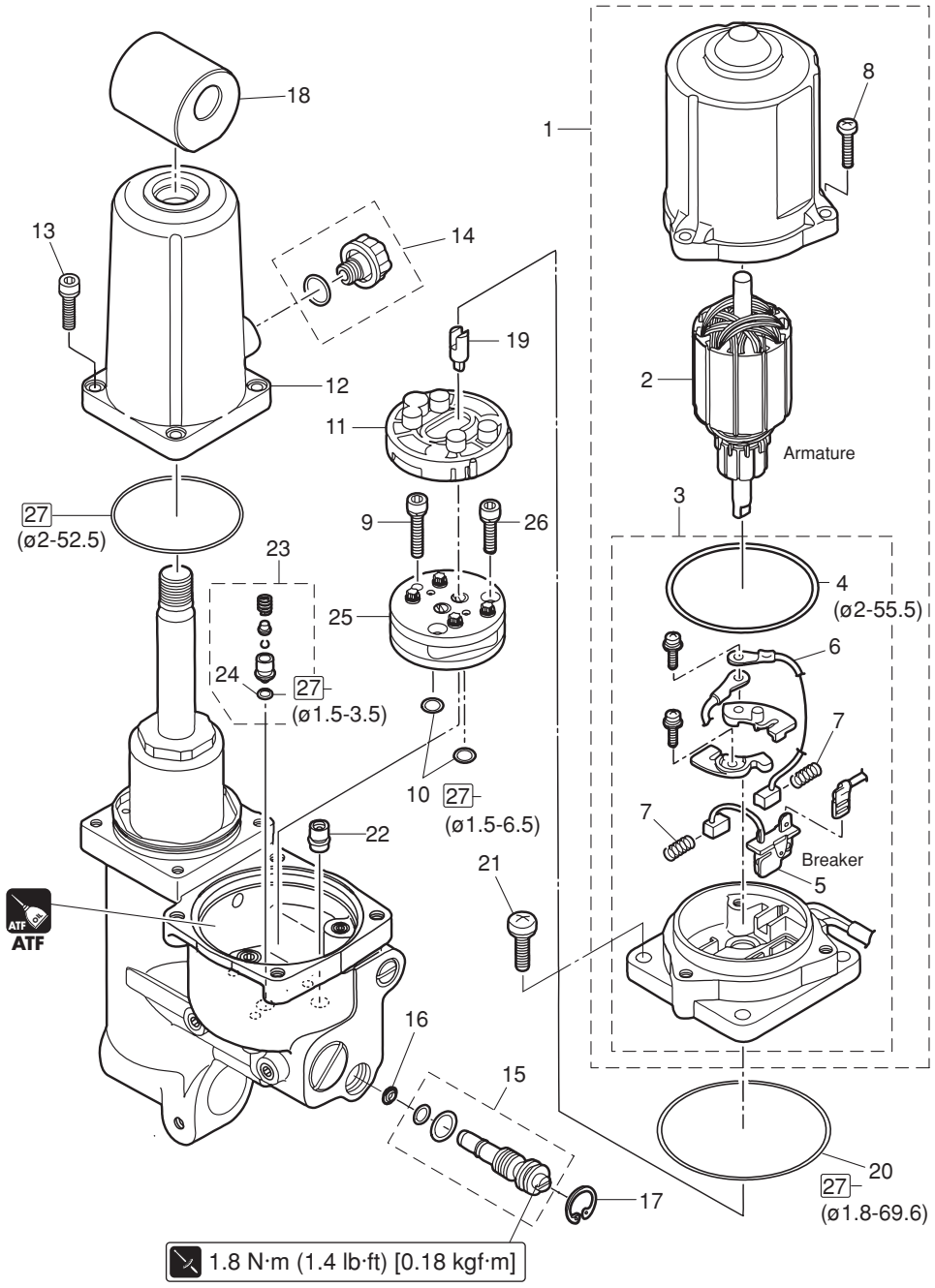
Ref. No.	Description	Q'ty	Remarks
38	C-ring d=28	1	Do not reuse.
39	Mount Bracket	1	
40	Anode	1	Mount Bracket
41	Bolt	1	M6 L=16mm
42	PTT Ass'y	1	
43	Gas Shock Absorber	1	
44	Anode	1	for PTT Model
45	Reverse Lock Lever	1	for Gas Assist Model
46	Reverse Lock Lever Grip	1	for Gas Assist Model
47	Bolt	1	M6 L=16mm
48	Screw	1	for PTT Model M6 L=12mm
49	Stopper	1	for Gas Assist Model
50	Bolt 6-35	1	for Gas Assist Model

P/L Fig. 13



Ref. No.	Description	Q'ty	Remarks
51	Band 203	1	for PTT Model
52	Clamp 6.5-14L	1	for PTT Model
53	Washer	1	for Gas Assist Model M6
54	Nut	1	for Gas Assist Model M6
55	Terminal Cap 8-13-28	2	Red for PTT Model
56	Cylinder Pin (Upper)	1	
57	Bushing 13-16-40	1	
58	Bushing 18-24-22	2	
59	Bolt	1	M6 L=12mm
60	Washer 6.5-23-1.5	1	
61	Cylinder Pin (Lower)	1	
62	Bushing 18-24-22	5	
63	Bushing 18-24-60	1	

Ref. No.	Description	Q'ty	Remarks
64	Washer 18.2-34-1	2	
65	C-ring d=18	2	Do not reuse.
66	Rigging Bolt Set	1	
67	Bolt 12-105 P1.25	4	
68	Washer 13-34-3	4	
69	Nut 12-P1.25	4	
70	Washer	4	M12
71-1	Tilt Stopper Kit	1	for PTT Model two hole
71-2	Tilt Stopper Kit	1	for Gas Assist Model non hole
72	Spring Pin 3.5-16	1	
73	Tilt Stopper Grip	1	

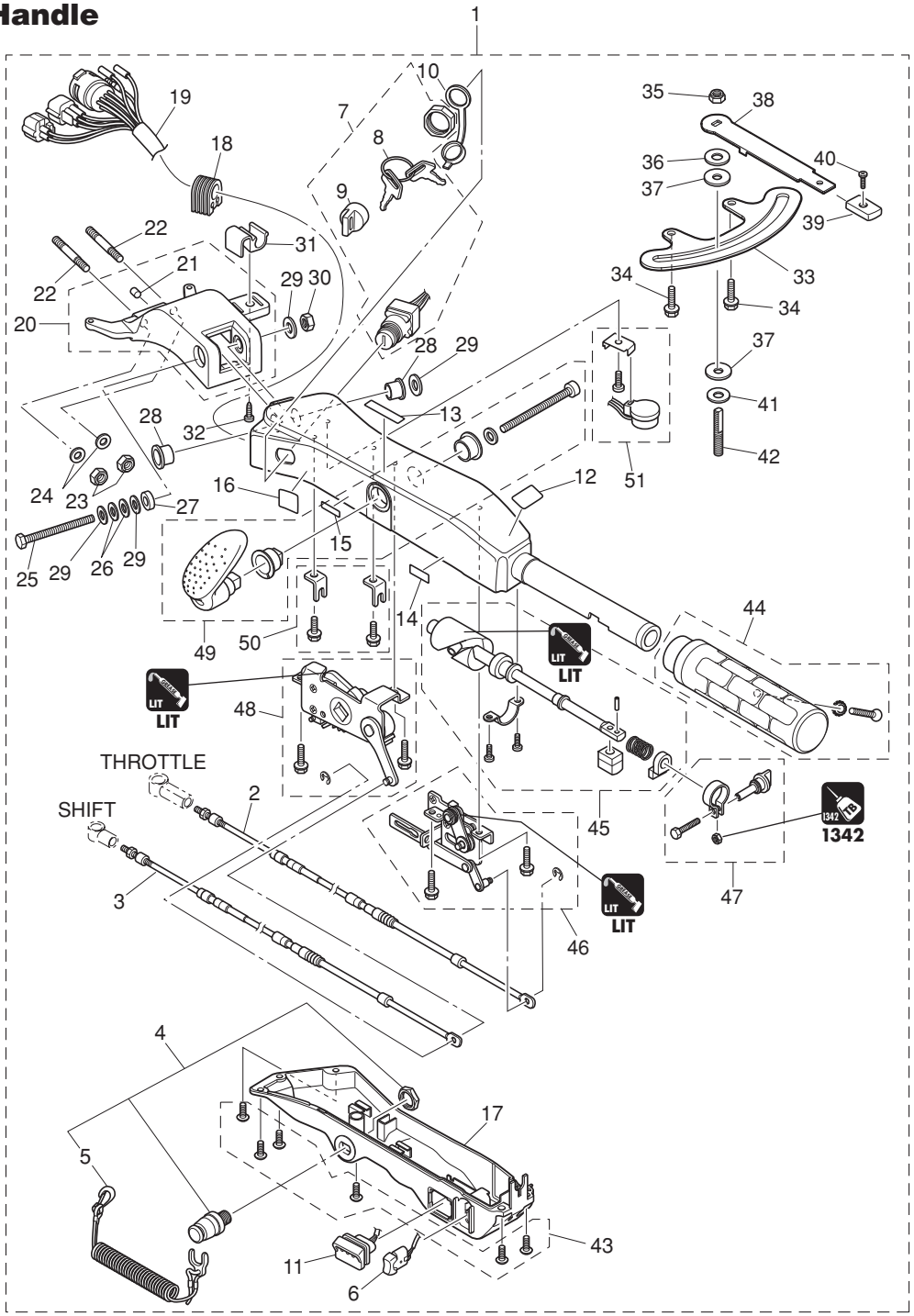


Ref. No.	Description	Q'ty	Remarks
1	Motor Ass'y	1	for PTT Model
2	Armature Ass'y	1	
3	Motor Bracket Ass'y	1	
4	O-ring 2-55.5	1	Do not reuse.
5	Breaker	1	
6	Brush	1	
7	Brush Spring	2	
8	Screw	3	
9	Bolt	1	
10	O-ring 1.5-6.5	2	Do not reuse.
11	Filter	1	
12	Reserve Tank	1	
13	Bolt	4	
14	Cap Ass'y	1	

Ref. No.	Description	Q'ty	Remarks
15	Manual Valve Ass'y	1	
16	Seal Washer	1	
17	C-ring	1	Do not reuse.
18	Joint	1	
19	Coupling	1	
20	O-ring 1.8-69.6	1	Do not reuse.
21	Screw	4	
22	Valve Ass'y	1	
23	Relief Valve Ass'y	1	
24	O-ring 1.5-3.5	1	Do not reuse.
25	Pump	1	
26	Bolt	2	
27	PTT O-ring Set	1	

Tiller Handle

P/L Fig. 20



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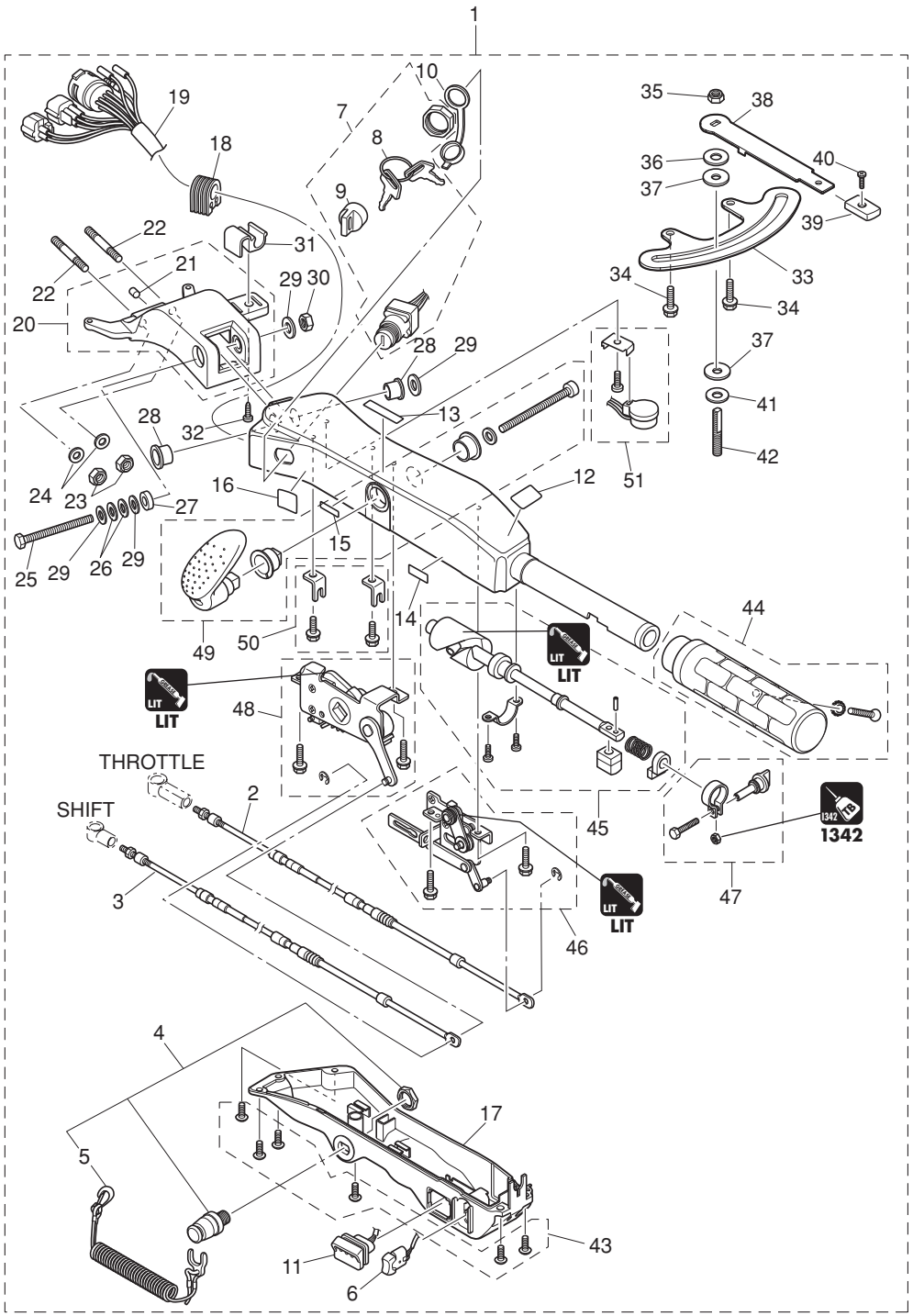
Ref. No.	Description	Q'ty	Remarks
1	Tiller Handle Kit	1	
2	Throttle Wire	1	
3	Shift Cable	1	
4	Stop Switch Ass'y	1	
5	Stop Switch Lanyard Ass'y	1	
6	Ptt Switch Ass'y	1	
7	Main Switch Ass'y	1	
8-1	Main Switch Key	1	
8-2	Main Switch Key	1	
8-3	Main Switch Key	1	
9	Main Switch Key Covering Cap	1	
10	Main Switch Cap (Waterproof)	1	
11	Pilot Lamp Ass'y	1	
12	Throttle Decal	1	

Ref. No.	Description	Q'ty	Remarks
13	Shift Decal	1	
14	Warning Lamp Decal	1	
15	Stop Switch Decal	1	
16	Instruction Decal	1	
17	Tiller Handle Cover	1	
18	Grommet	1	
19	Cord Ass'y	1	
20	Steering Bracket Ass'y	1	
21	Dowel Pin 8-16	1	
22	Studm 10-40	2	M10 L=40mm
23	Nylon Nut 10-P1.5	2	Do not reuse.
24	Washer	2	M10
25	Bolt 10-80 P1.25	1	
26	Conical Spring Washer 10.5-21-2.3	2	

P/L Fig. 20



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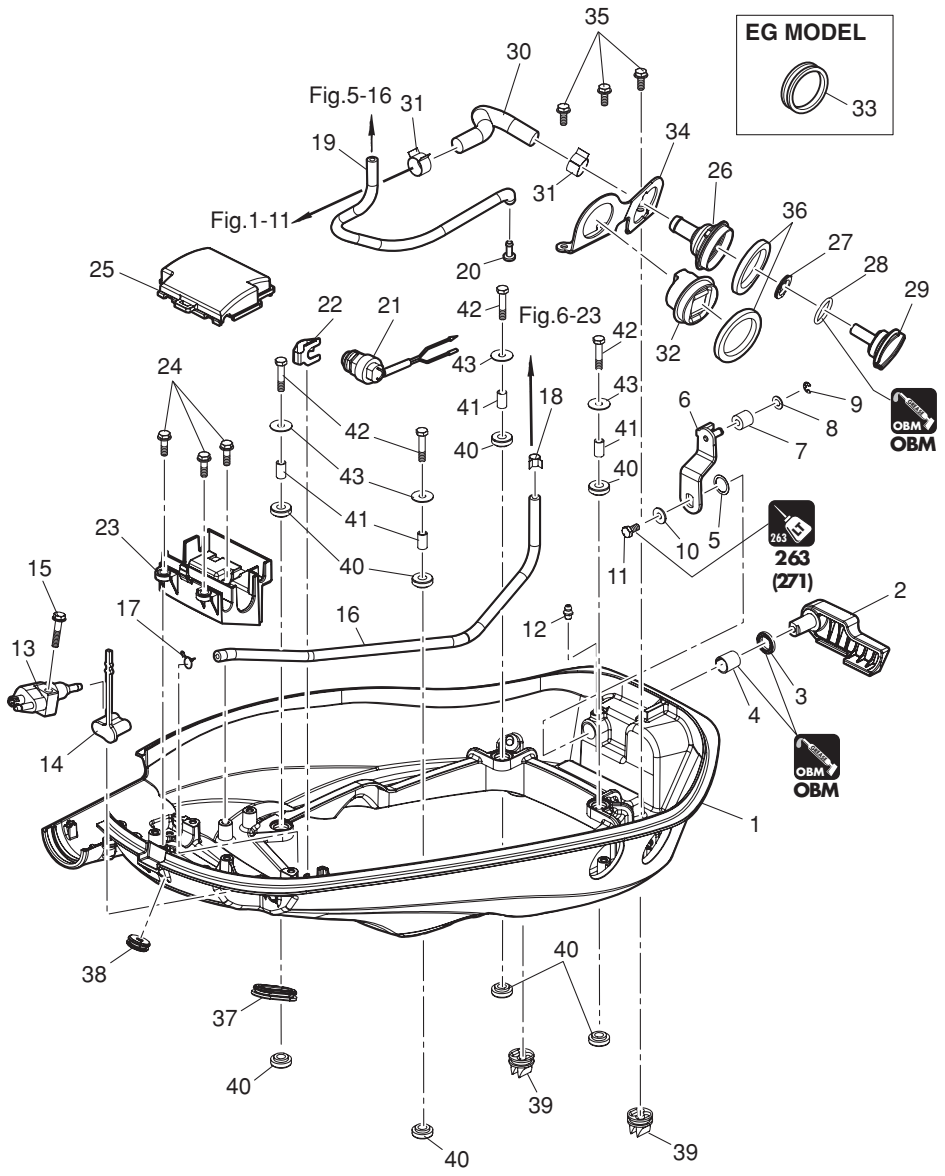
Ref. No.	Description	Q'ty	Remarks
27	Spacer 10.5-23-9	1	
28	Bushing 10.5-12.7-13.5	2	
29	Washer	4	M10
30	Lock Nut 10-P1.25	1	
31	Cord Holder	1	
32	Tapping Screw 6-16	1	
33	Plate	1	
34	Pre-coated Bolt 6-16	2	
35	Nylon Nut 8-P1.25	1	
36	Washer 8.5-24-1.5	1	
37	Disc 8.5-25-2	2	
38	Friction Lever	1	
39	Grip	1	
40	Stopper	1	

Ref. No.	Description	Q'ty	Remarks
41	Washer 8.1-20-0.8	1	
42	Bolt 8-32 P1.25	1	
43	Screw Set	1	
44	Grip Parts Kit	1	
45	Throttle Shaft Kit	1	
46	Throttle Link Ass'y	1	945303-0400 E-Ring
47	Throttle Friction Ass'y	1	
48	Shift Unit Ass'y	1	945303-0400 E-Ring
49	Shift Lever Kit	1	
50	Cable Bracket Kit	1	
51	Buzzer Kit	1	

Bottom Cowl

P/L Fig. 15



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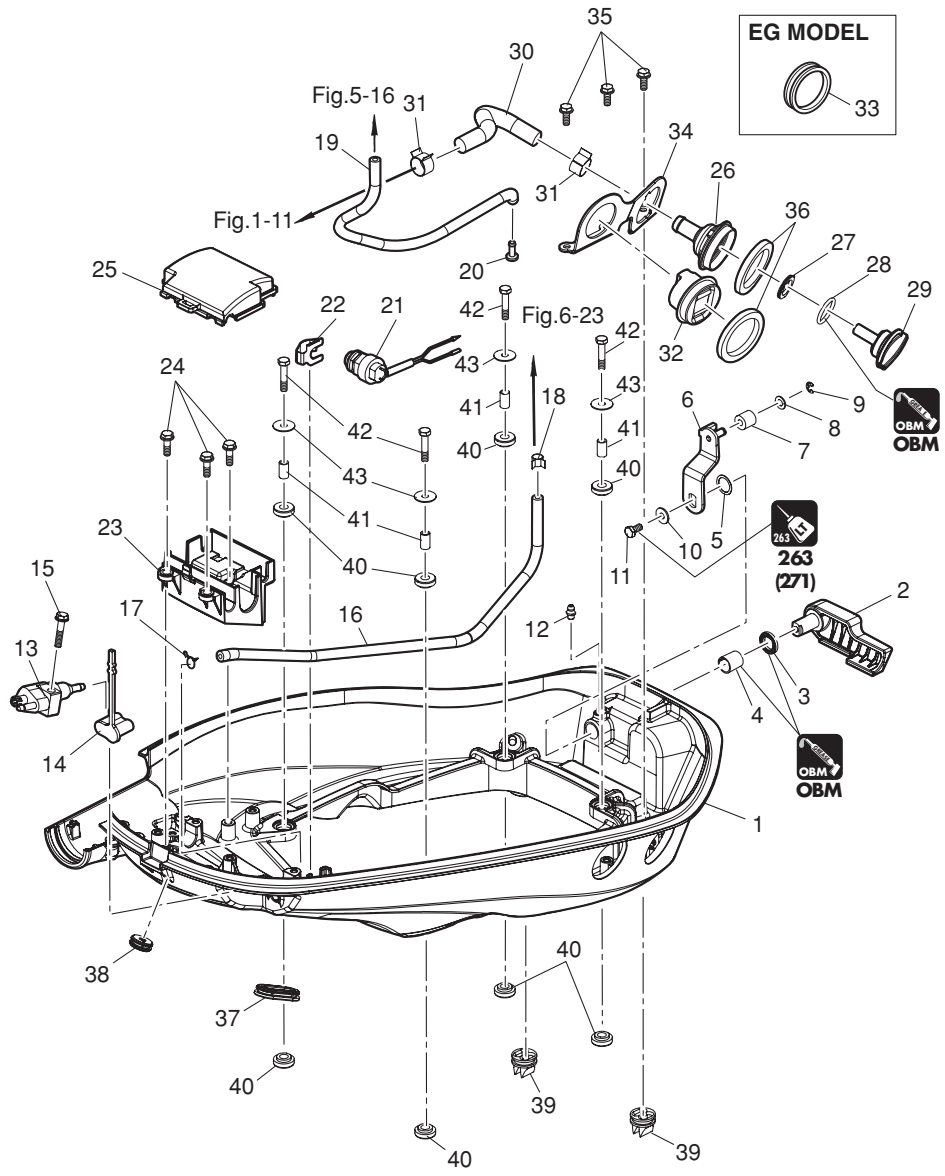
Ref. No.	Description	Q'ty	Remarks
1	Bottom Cowl	1	
2	Hook Lever	1	
3	Seal Ring 13.8-22-3.7	1	
4	Hook Lever Bushing 14-16.5-17.7	1	
5	Wave Washer d=14	1	
6	Cover Hook	1	
7	Roller 6.1-14.7-14	1	
8	Washer 6.5-21-1	1	
9	E-ring d=5	1	Do not reuse.
10	Washer 6-16-1.5	1	
11	Bolt	1	M6 L=12mm
12	Grease Fitting	1	
13	Fuel Connector (Male)	1	

Ref. No.	Description	Q'ty	Remarks
14	Fuel Connector Protector	1	
15	Bolt	1	M6 L=30mm
16-1	Hose	1	Fuel Connector-Fuel Filter STD 98AB-501000 L=450mm
16-2	Low Permeation Hose	1	Fuel Connector-Fuel Filter USA EPA-KRI-15G
17	Clip ø10	1	Fuel Connector Side
18	Clip ø9.4	1	Fuel Filter Side
19	Water Hose	1	Fuel Cooler-Water Nipple
20	Nipple 6-8-11	1	Black
21	Neutral Switch	1	
22	Neutral Switch Actuator	1	
23	Cable Terminal Holder	1	
24	Bolt	3	M6 L=20mm

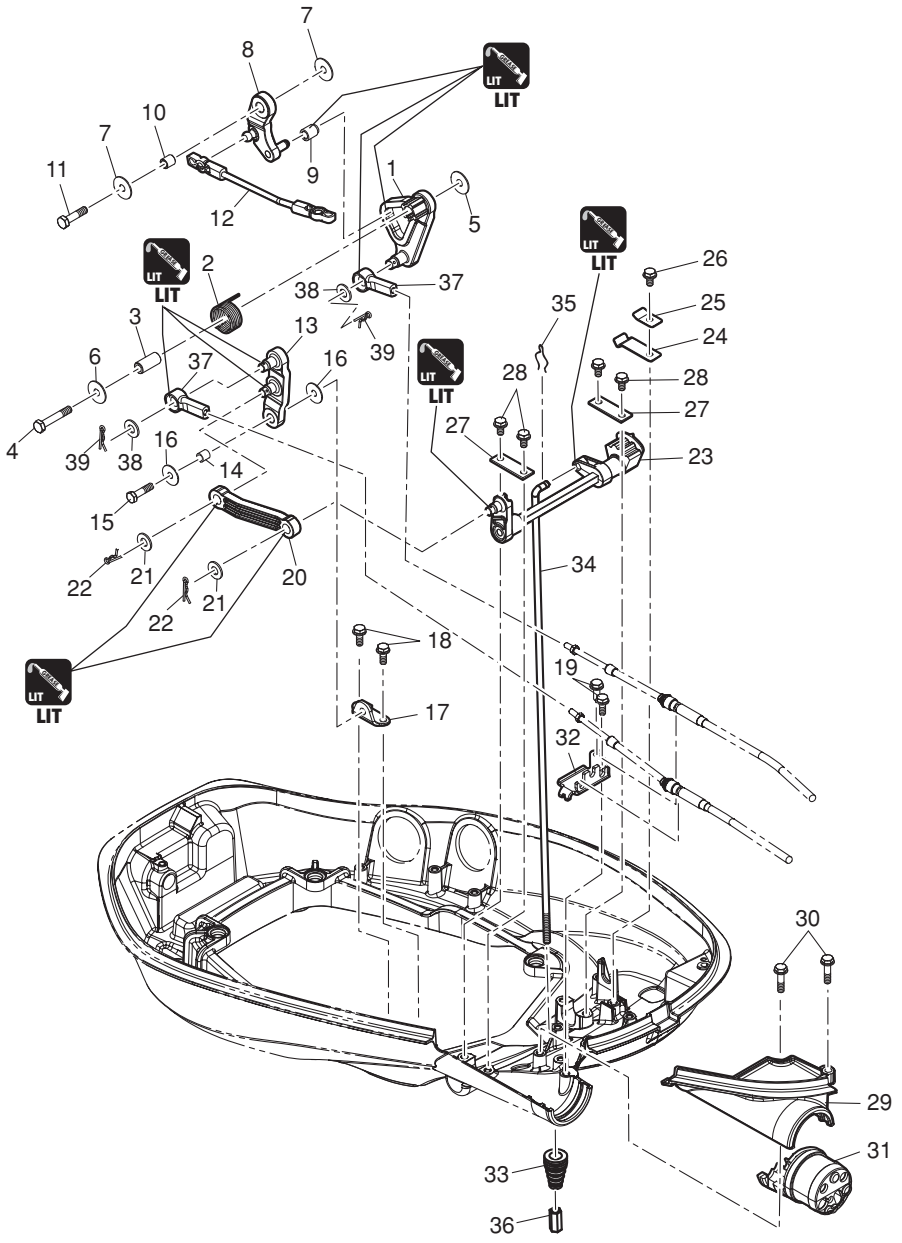


Ref. No.	Description	Q'ty	Remarks
25	Cover	1	
26	Flushing Connector	1	
27	Seal Ring	1	
28	O-ring 3.1-24.4	1	Do not reuse.
29	Flushing Connector Cap	1	
30	Flushing Hose	1	
31	Clip ø17.8	2	
32	PTT Switch Ass'y	1	for EPT Model
33	Grommet	1	PTT Switch for EFG Model
34	Flushing Connector Bracket	1	
35	Bolt	3	M6 L=16mm
36	Gasket	2	
37	Grommet 40-18-3	1	PTT Cord

Ref. No.	Description	Q'ty	Remarks
38	Grommet	1	Trim Sender
39	Grommet	2	Drain
40	Mount 8.5-14-2.5	8	
41	Spacer 6.2-9-15.7	4	
42	Bolt	4	M6 L=30mm
43	Washer 6.5-21-1	4	

Shift • Throttle

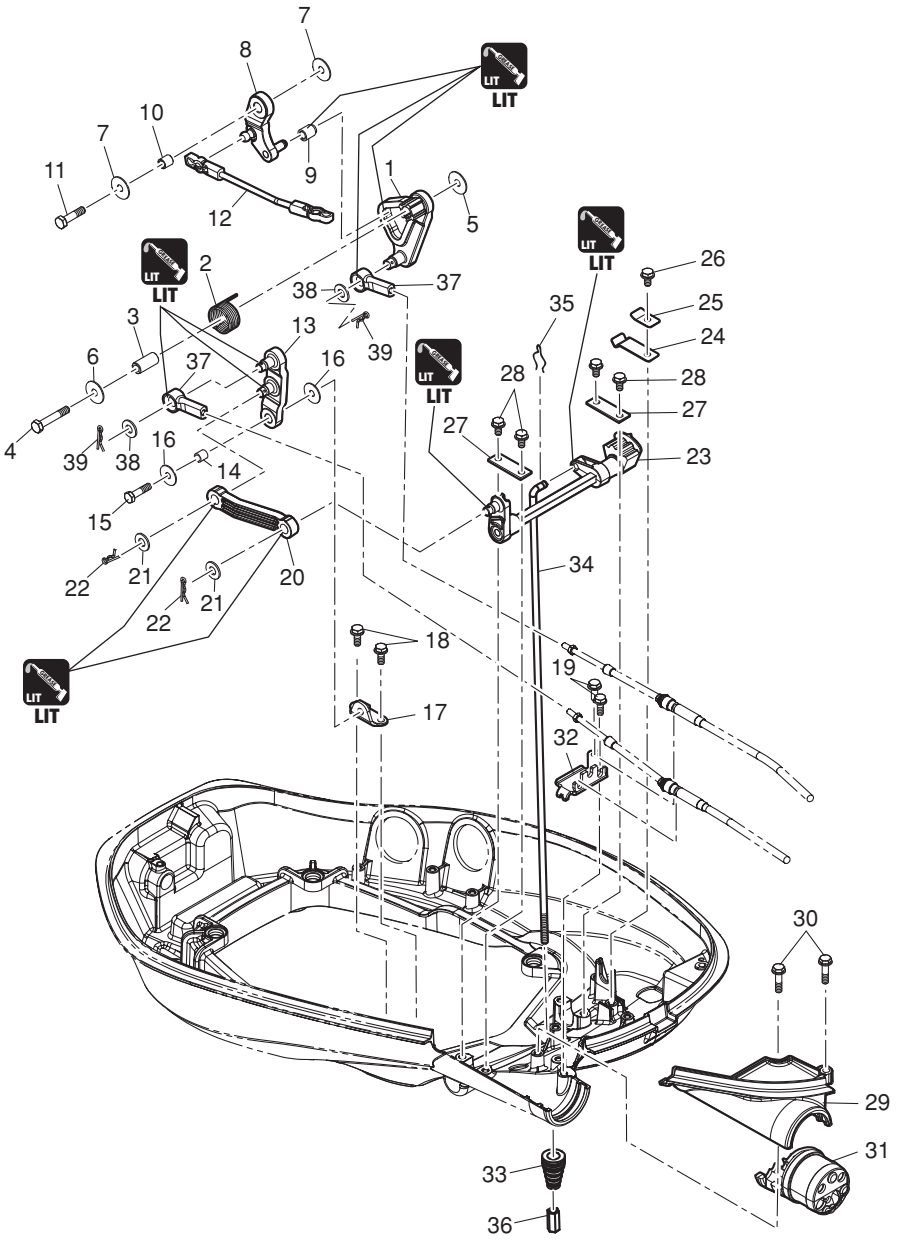
P/L Fig. 16



Ref. No.	Description	Q'ty	Remarks
1	Throttle Cam	1	
2	Spring	1	
3	Collar 6.5-10.5-22.6	1	
4	Bolt	1	M6 L=35mm
5	Washer 6.5-21-1	1	
6	Washer 6.5-23-1.5	1	
7	Washer 6.5-21-1	2	
8	Throttle Arm	1	
9	Throttle Roller	1	
10	Collar 6.5-10.5-9.3	1	
11	Bolt	1	M6 L=20mm
12	Throttle Rod	1	
13	Shift Arm	1	

Ref. No.	Description	Q'ty	Remarks
14	Collar 6.5-10.5-9.3	1	
15	Bolt	1	M6 L=25mm
16	Washer 6.5-21-1	2	
17	Bracket	1	
18	Bolt	2	Shift Arm Bracket M6 L=16mm
19	Bolt	2	Cable Clip M6 L=16mm
20	Shift Lever Rod	1	
21	Washer 8.5-18-1.6	2	
22	Snap Pin d=8	2	
23	Shift Lever Shaft Ass'y	1	
24	Shift Lever Stopper	1	
25	Shift Lever Stopper t=0.8	1	
26	Bolt	1	M6 L=12mm

P/L Fig. 16



Ref. No.	Description	Q'ty	Remarks
27	Holder	2	
28	Bolt	4	M6 L=12mm
29	Remote Control Cable Stay Cover	1	M6 L=25mm
30	Bolt	2	
31	Grommet	1	
32	Cable Clip	1	
33	Grommet 17-3	1	
34-1	Shift Rod (S)	1	Shift Rod
34-2	Shift Rod (L)	1	for Transom "S"
35	Snap Pin d=5	1	for Transom "L"&"UL"
36	Shift Rod Joint M6-22	1	
37	Cable Joint	2	
38	Washer 8.5-18-1.6	2	

Ref. No.	Description	Q'ty	Remarks
39	Snap Pin d=8	2	

LIT

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5. Inspection Items

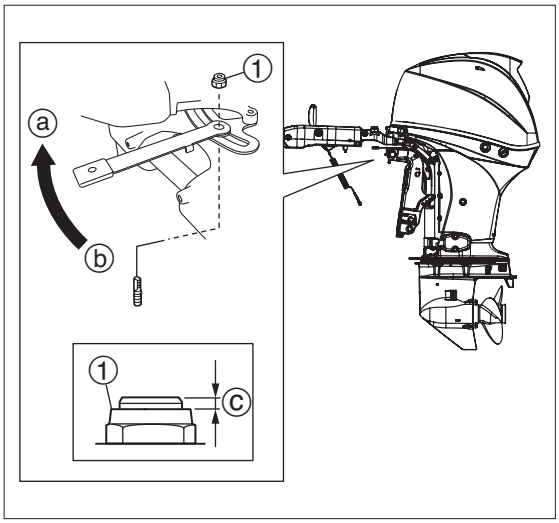
1) Inspection of Throttle Cable

1. Check operation of throttle cable and shift cable.

2. Check cable inner wire and outer wire for bend and damage. Replace if necessary.

3. Turn the throttle full open to full close to check operation the throttle cam turned full open and full close (the throttle cam is not full open, because adjust it at full closed).

2) Friction Lever adjustment and operation



1. Move friction lever towards starboard side ⓐ and tighten nylon nut ① to adjust maximum friction.

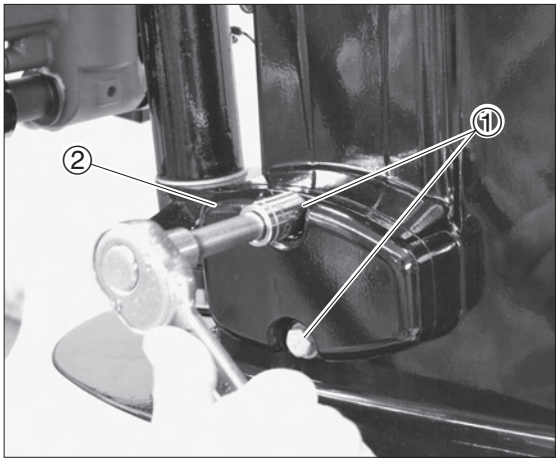
2. Move friction lever towards port side ⓑ and confirm steering moves easily.

⚠ WARNING

- **Do not release tiller handle while operating. Friction lever is not for holding steering completely.**
- **Do not overtighten the steering friction or it could result in difficulty of movement resulting in the loss of control causing an accident and could lead to severe injury.**

Do not tighten bolt until more than one thread of bolt ⓒ can be seen above the nut or if could result in interfere with tiller handle.

3) Removing Drive Shaft Housing



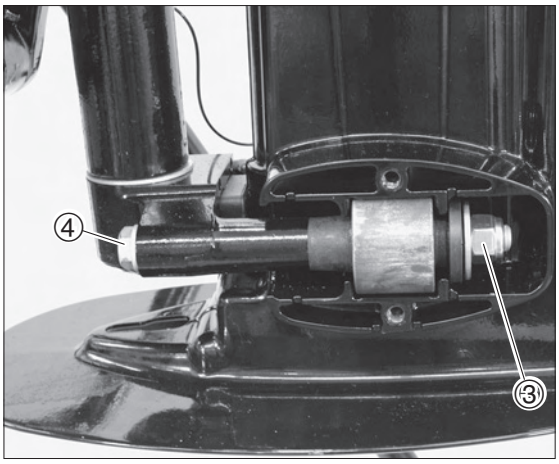
1. Remove engine power head "Refer to chapter 5".

2. Remove the bottom cowl and tie out of the way.

3. Place draining container below drain hole, and remove drain bolt to drain engine oil. "Refer to Chapter 3."

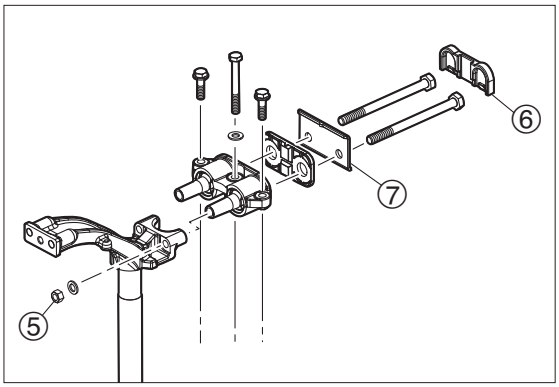
4. Remove bolt ① and remove mount cover ②.

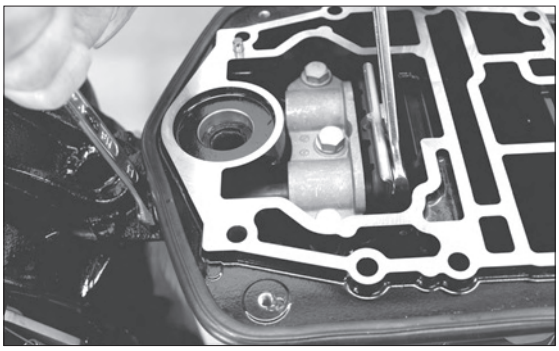
5. Remove lower mount nuts ③ and bolts ④.

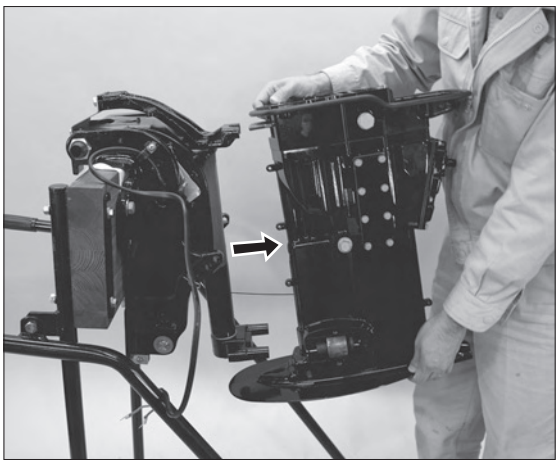


6. Remove upper mount nut ⑤, and then, remove drive shaft housing Ass'y .

Put in the nut to damper gromet ⑥ and lockplate ⑦ and loosen the bolt to holding bolt.







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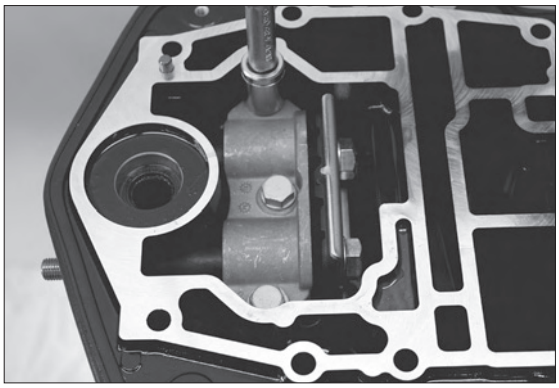
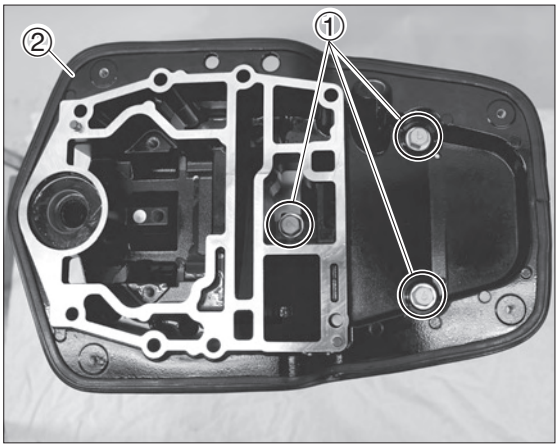
4) Pulling Out Upper Mount

1. Remove three bolts, and then remove upper mount rubber.



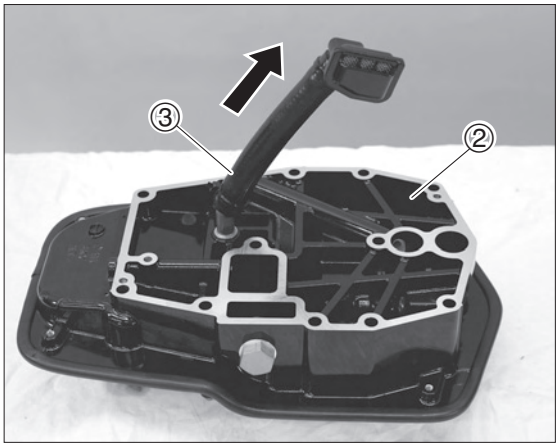
5) Disassembly of Drive Shaft Housing

1. Remove three bolts ①, and then reemove engine base ② from drive shaft housing ass'y.

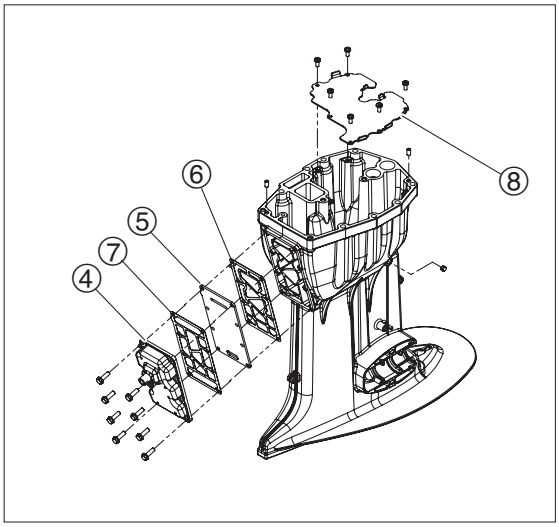


2. Remove oil strainer ③ from engine base ass'y ②.

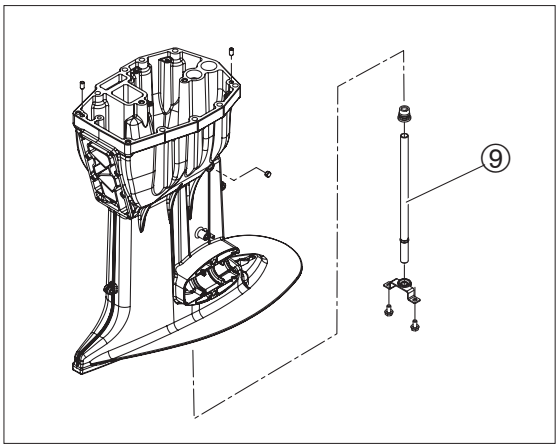
> Before removing engine base ass'y, note arrangement of oil strainer hose.



3. Remove idle port ④, plate ⑤, gasket ⑥ and oilpan guide plate ⑦ from drive shaft housing.



4. Remove screws, then remove water pipe ⑧.



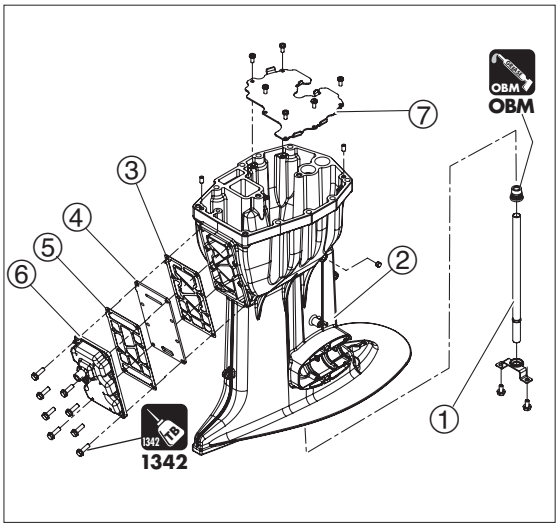
6) Inspection of Oil Strainer

1. Check filter for dirt and sediment. Clean, or replace if necessary.

7) Assembly of Drive Shaft Housing

1. Install water pipe ① into drive shaft housing ②.

2. Install gasket ③ (inner), plate ④, gasket ⑤ (outer), idle port ⑥ and oilpan guide plate ⑦ to drive shaft housing.



- Set the mark ⓐ to ⓑ and then install idle plate.
- Tighten the bolts in the order 1 to 8 numbering on the parts.

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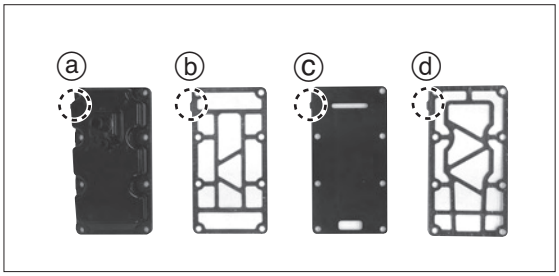
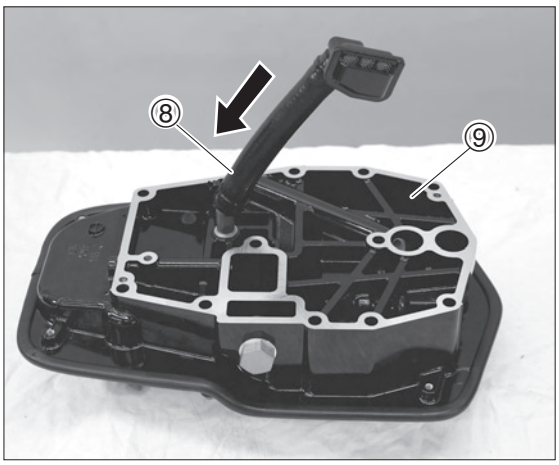


3. Install oil strainer ⑧ to engine base ⑨, and secure it with plastic tie.



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4. Install new gasket ⑩ and engine base Ass'y ⑪ to drive sahft housing ②.

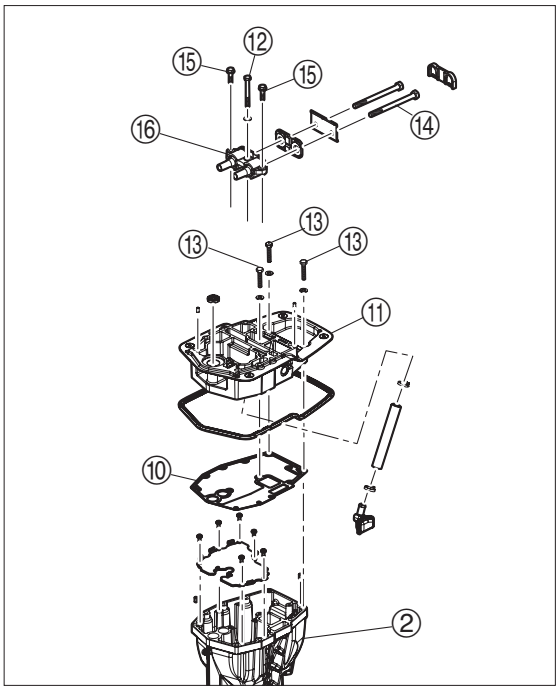
> To install, be careful to correctly place the oil strainer hose.

5. Tighetn four bolts ⑫ and ⑬ to specified torque.

> Attach upper mount bolts ⑭ into the upper mount rubber ⑯, before tighten four bolts.

> **Engine Base Bolts ⑫, ⑬ :**
> Tempraly tighten :15 N•m (11 lb•ft) [1.5 kgf•m]
> Final tighten : 30 N•m (22 lb•ft) [3.0 kgf•m]

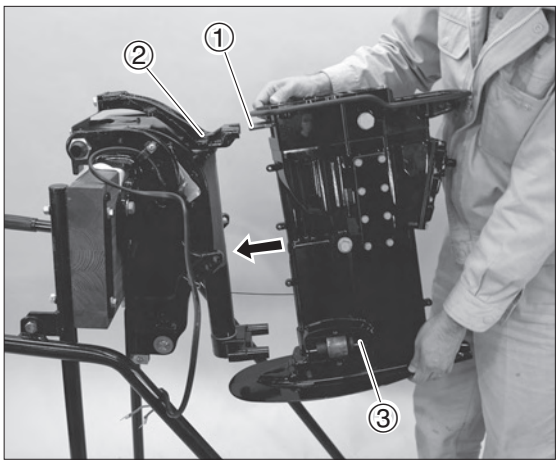
6. Tighetn upper mount bolts ⑮ to install the upper mount rubber ⑯.



8) Installation of Drive Shaft Housing Ass'y

1. Insert upper mount bolt ① into swivel bracket ass'y ②.

2. Insert lower mount bolt ③ into swivel bracket ass'y ②.



3. Apply locking agent to upper mount nut ④ and tighten it to specified torque.

> **Upper Mount Nut ④ :**
> 21 N•m (15 lb•ft) [2.1 kgf•m]

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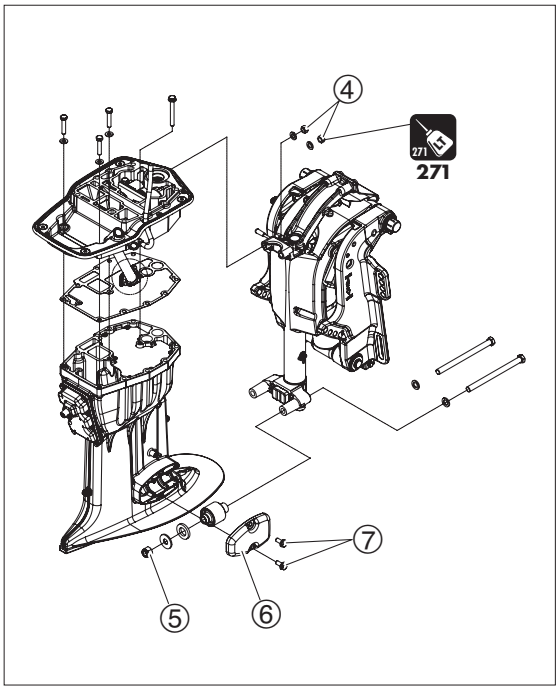
> Be sure to apply specified locking agent.

4. Install lower mount nut ⑤ and tighten it to specified torque.

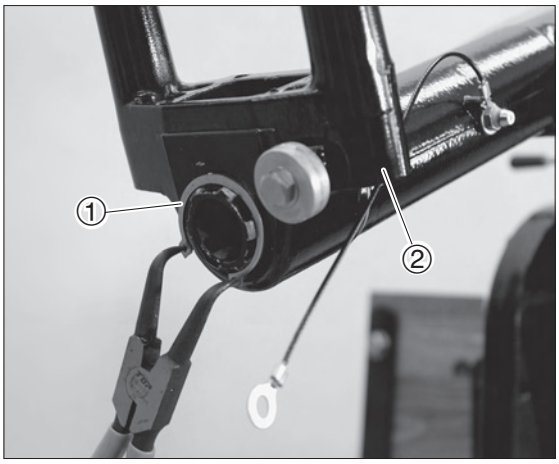
> **Lower MountBolt • Nut ⑧ :**
> 40 N•m (29 lb•ft) [4.0 kgf•m]

5. Install mount cover ⑥ and tighten it bolt ⑦.



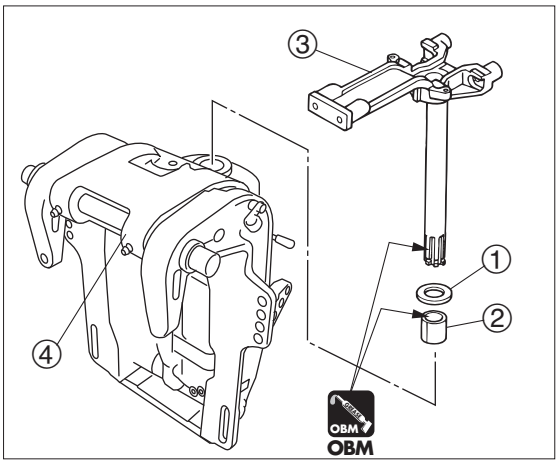
9) Removing Steering Shaft

1. Remove drive shaft housing ass'y. For the procedure, refer to "Removing Drive Shaft Housing" in Chapter 7.
2. Remove "C" ring ①.
3. Remove mount bracket ② by tapping it with plastic hammer.
4. Pull out steering shaft from swivel bracket ass'y to remove.

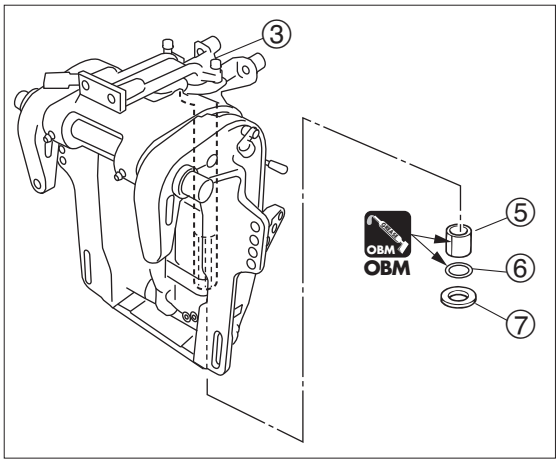


10) Installing Steering Shaft

1. Put thrust plate ① and bushing ② onto steering shaft ③.
2. Stand swivel bracket ass'y ④ vertically, and insert steering shaft ③ into swivel bracket ass'y ④.



3. Put bushing ⑤, new O-ring ⑥ and thrust plate ⑦ on the steering shaft ③.



⑥ O-Ring **Do not reuse.**

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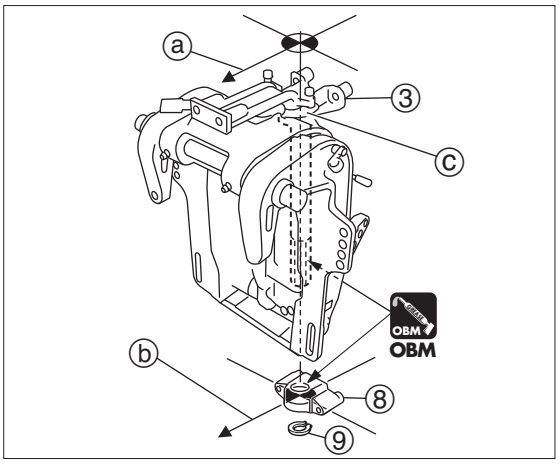
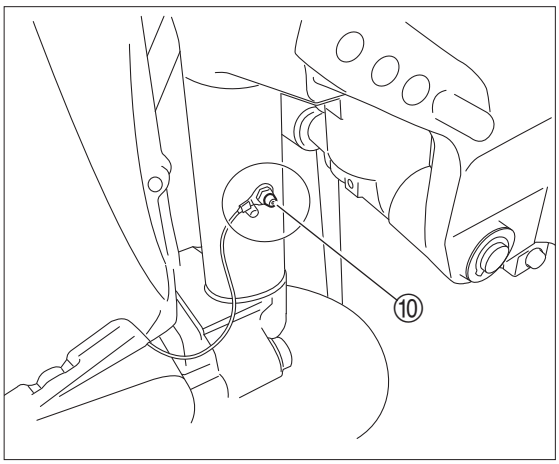
4. Assemble steering shaft ③ and mount bracket ⑧ in the same directions ⓐ and ⓑ.

5. Attach "C" ring ⑨.



6. Put grease through grease nipple ⑩ until grease leaks from bushing (upper) ⓒ.

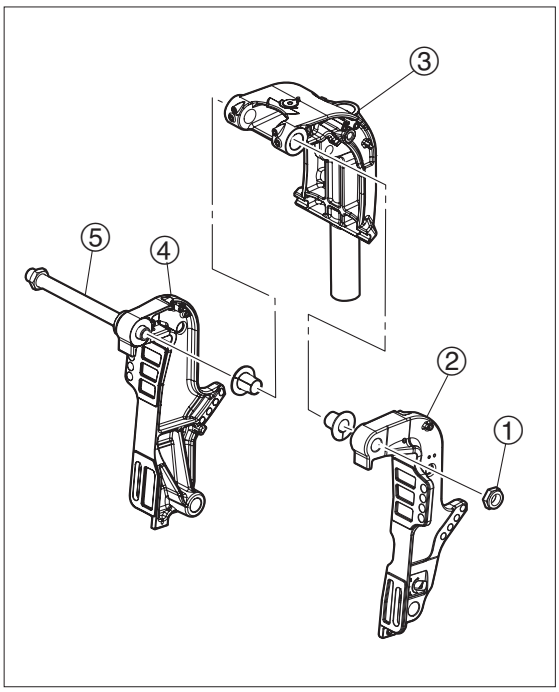


11) Removing Clamp Bracket (PTT or Gas Assistant Model)

1. Remove PTT unit or gas shock absorber. Refer to "Removing PTT Unit/Gas Shock Absorber" described later in this chapter.

2. Remove nylon nut ①, and then, clamp bracket ② and swivel bracket ③.

3. Remove shaft ⑤ from clamp bracket ④.

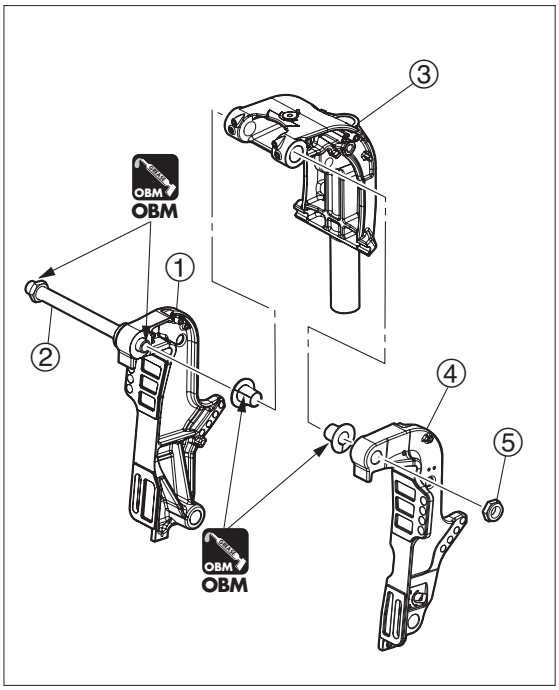


12) Installation of Clamp Bracket (PTT or Gas Assistant Model)

1. Install swivel bracket shaft ② to clamp bracket ①.

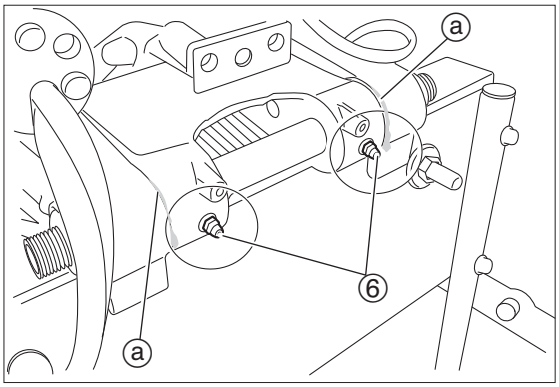
2. Assemble swivel bracket ③ and clamp bracket ④, and tighten nylon nut ⑤ to specified torque.

Nylon Nut ⑤ :
24N·m (17 lb·ft) [2.4kgf·m]



3. Install PTT unit or shock absorber. Refer to "Installation of PTT Unit/Shock Absorber".

4. Put grease through left and right grease nipples ⑥ until grease leaks from bushings ⓐ.

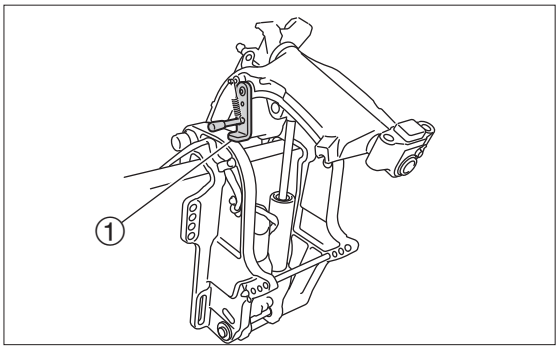


13) Removing PTT Unit/Gas Shock Absorber

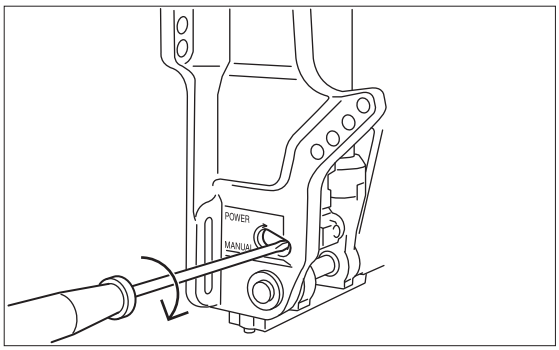
1. Fully tilt up outboard motor and lock with tilt stopper ①.

⚠ WARNING

Be sure to lock outboard motor with tilt stopper after tilting up. Leaving outboard motor without locking may lead to accidental descent due to reduction of PTT hydraulic pressure.



- If PTT unit will not operate, open manual valve completely against lock ring 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 :
1.8 N·m (1.4 lb·ft) [0.18 kgf·m]

2. Remove thrust rod ②.

3. Remove bolt ③ and remove cylinder pin (upper) ④.

4. Perform tilt down operation to retract tilt rod a little.

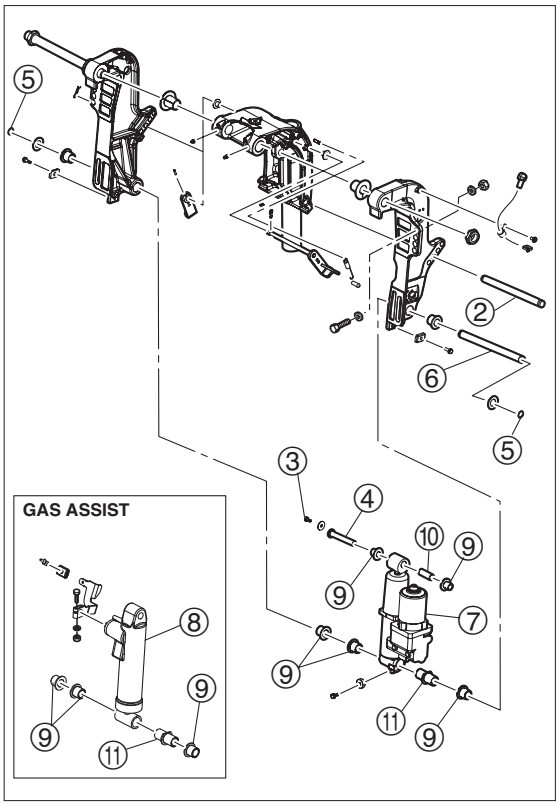
5. Disconnect PTT motor leads from PTT solenoid.

6. Remove "C" ring ⑤, and then cylinder pin (lower) ⑧.

> Hold PTT unit or gas shock absorber with a hand, and use another hand to pull out cylinder pin (lower) and remove PTT unit rearward.

7. Remove PTT unit ⑦ or gas shock absorber ⑧.

8. Remove bushings ⑨, ⑩ and ⑪.



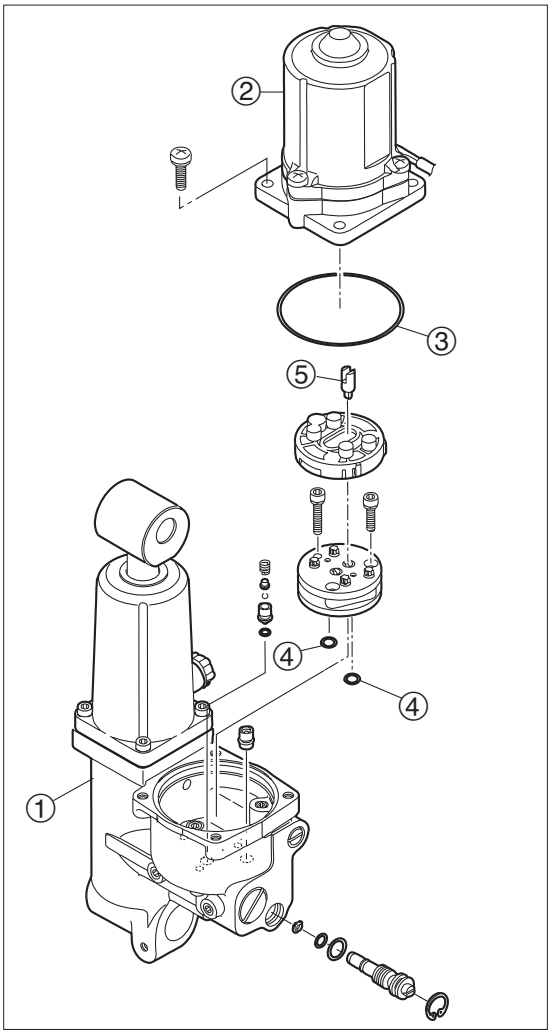
14) Removing PTT Motor

1. Remove reservoir tank ②, PTT motor ③, O-ring ④ and ⑤, coupling ⑥ from PTT unit ①.

⚠ CAUTION

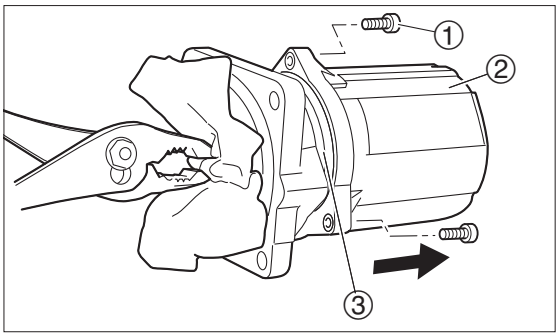
- **When removing PTT motor (reservoir tank), fully extend tilt rod to prevent fluid from blasting out due to internal pressure.**
- **Do not push down tilt rod with PTT motor removed from PTT unit, or fluid will blast out from PTT unit.**

2. Energize removed PTT motor to check that it operates. If not, replace PTT motor ass'y.



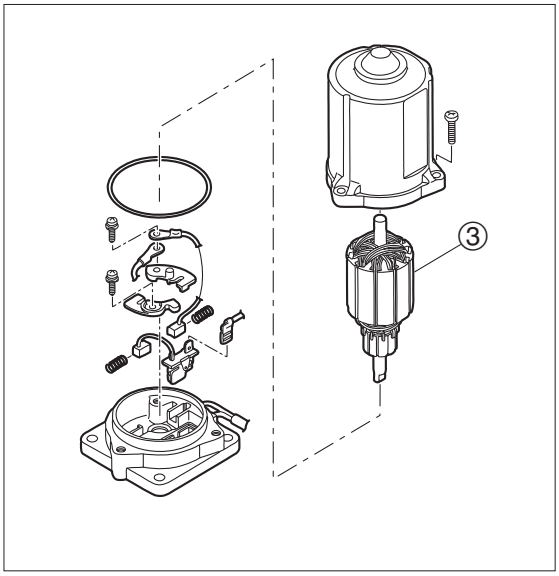
15) Disassembling PTT Motor

1. Remove bolt ①, and then remove stator ②.



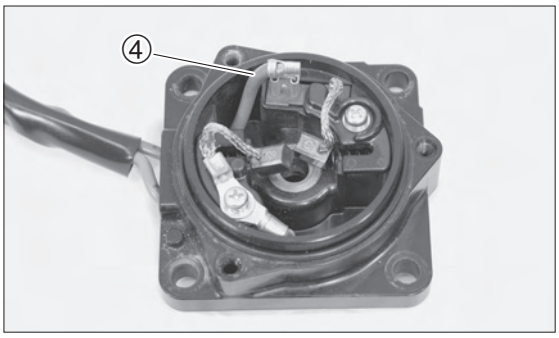
> Cover armature shaft end with clean cloth, hold the shaft using a pair of pliers, and remove armature ③ from stator carefully.

2. Remove armature ③ from PTT motor base.

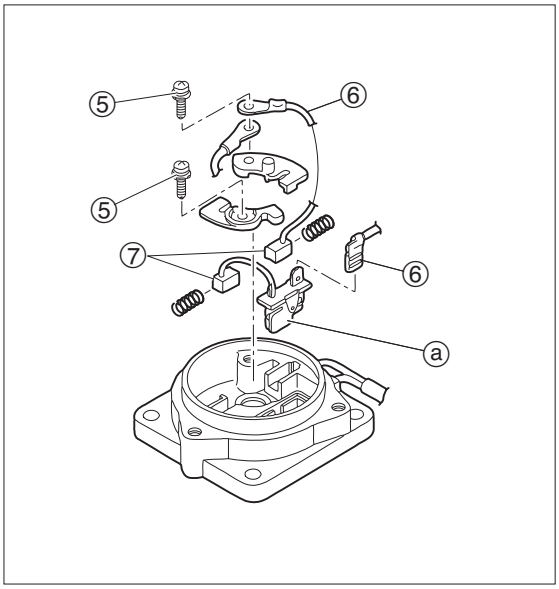


> Do not apply grease or oil to commutator.

3. Disconnect PTT motor lead wire ④.



4. Remove screw ⑤, disconnect PTT motor lead ⑥, and then, remove brushes ⑦.



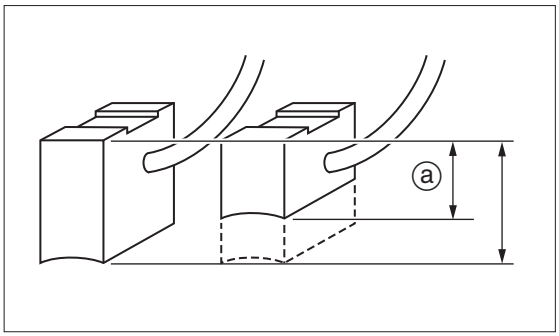
⚠ CAUTION

- **Do not disconnect PTT motor lead from stator.**
- **Do not touch bi-metal ⓐ. Doing so affects operation of circuit breaker.**

16) Inspection of PTT Motor

1. Measure brush length.
   Replace if it is less than specified value.

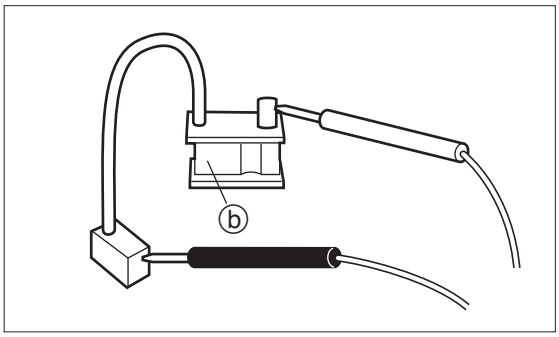
Brush Wear Limit ⓐ :
5.0 mm (0.1969 in.)



2. Check electrical conductivity of brush and circuit breaker.
   Replace if not conductive.

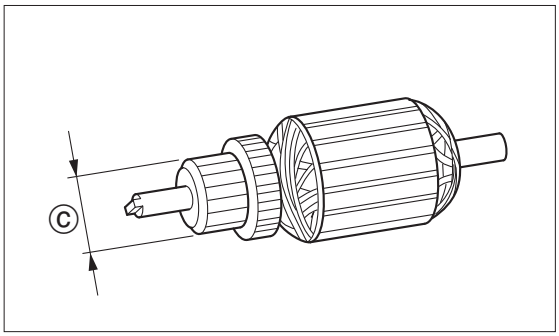
⚠ CAUTION

- **Do not disconnect PTT motor lead from stator.**
- **Do not touch bi-metal ⓑ. Doing so affects operation of circuit breaker.**



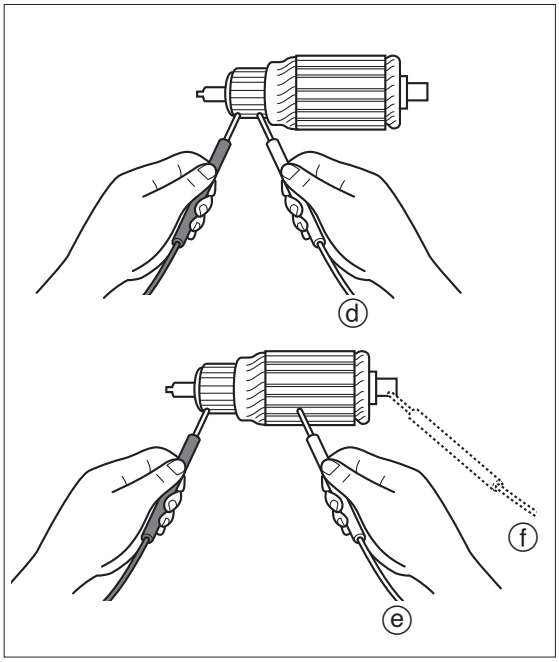
3. Measure diameter of commutator.
   Replace if the following specification is not met.

Lower Limit of Commutator Diameter ⓒ :
20.4 mm (0.8032 in.)



4. Check electrical conductivity of armature.
   Replace if any of the following conditions is not met.

Armature Conductivity	
Commutator	Conductive
Commutator ⓓ - Armature Core ⓔ	Not Conductive
Commutator ⓓ - Armature Shaft ⓕ	Not Conductive



5. Check the base for crack and damage, and replace if necessary.

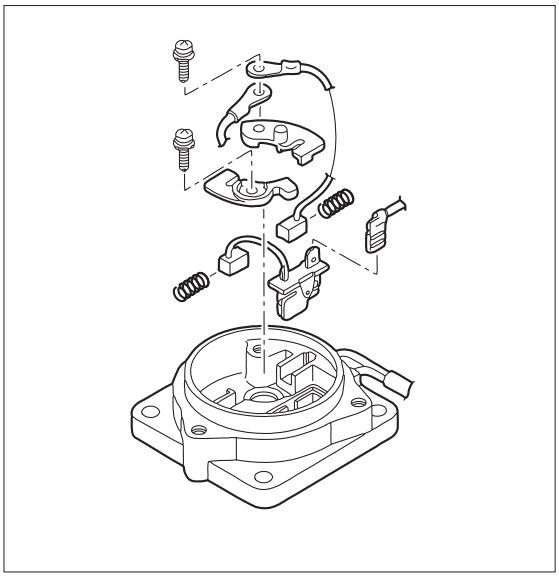
6. Check bearing and oil seal for damage, and replace if necessary.

⚠ CAUTION

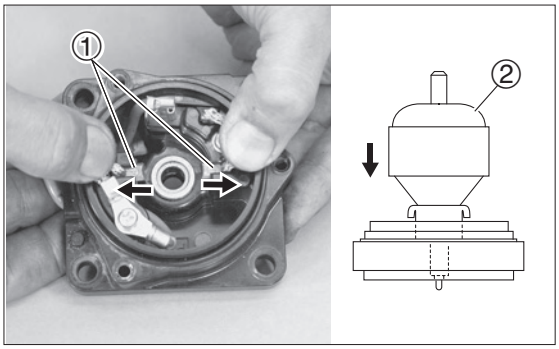
When bearing or oil seal is removed, replace it with new one.

17) Assembling PTT Motor Parts

1. Connect PTT motor leads and secure them with screws.

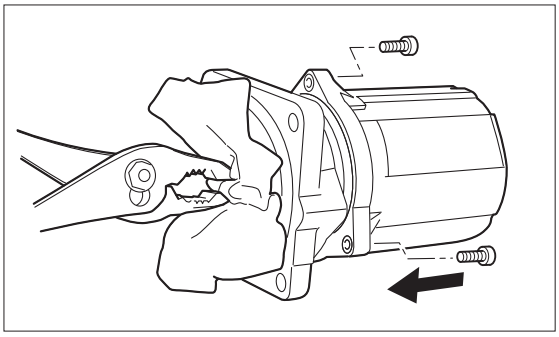


2. Put brushes ① into brush holders, and attach armature ②.



3. Install stator to base.

> Cover armature shaft end with clean cloth, hold the shaft using a pair of pliers, and install armature to stator carefully.

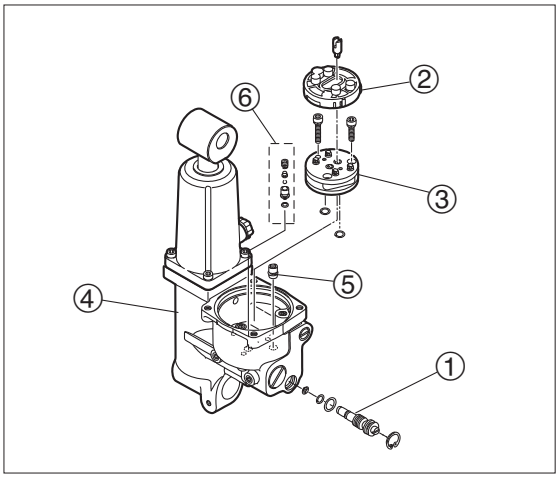


18) Removing PTT Pump and Valves

1. Remove manual valve ① and filter ② then PTT pump ass'y ③.

2. Remove valve assy's ⑤ and releaf valve ass'y ⑥ from PTT unit ④.

> Be careful not to lose removed parts which are small.



19) Inspection of PTT Pump and Valves

1. Clean piston and ball, and check them for damages and wear. Replace PTT pump if necessary.

2. Check drive gear and driven gear for damages and wear. Replace PTT pump if necessary.

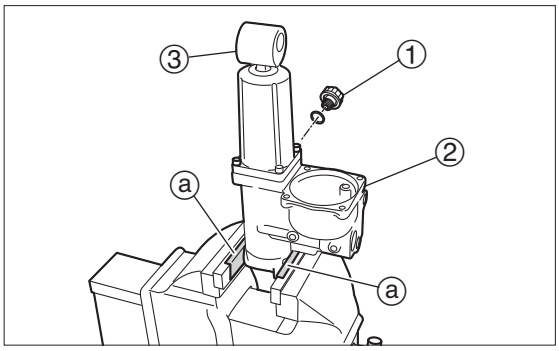
3. Check valve for damage and clogging. Replace if necessary.

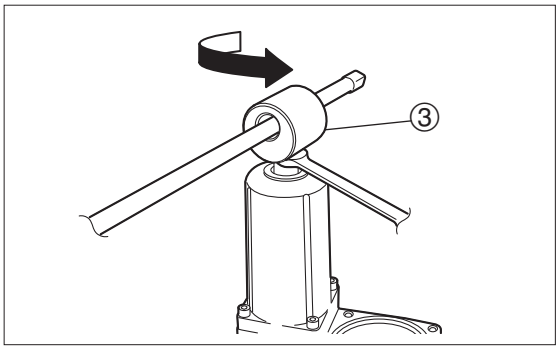
20) Removing Oil Reservoir Tank

1. Loosen reserver tank cap ① and then drain PTT fluied.

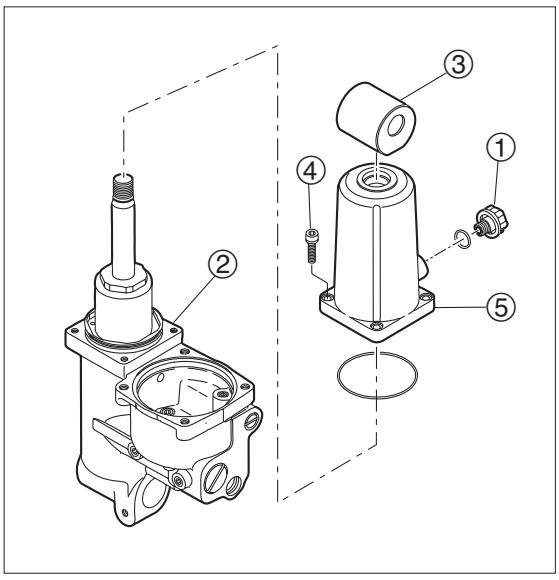
2. Use vise to fix PTT unit ② that is protected at both sides with wood pieces or aluminum plates ⓐ.

3. Secure tilt rod and loosen joint metal (rod eye) ③ by using wrench, and remove them.

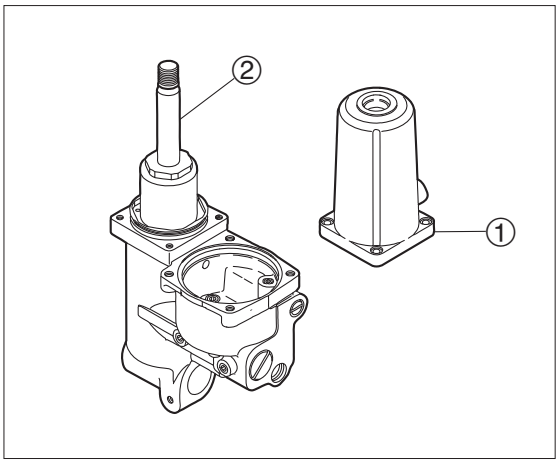




4. Loosen reserve tank bolt ④ and then remove reserve tank ⑤.



21) Inspection of Tilt Cylinder and Oil Reservoir Tank

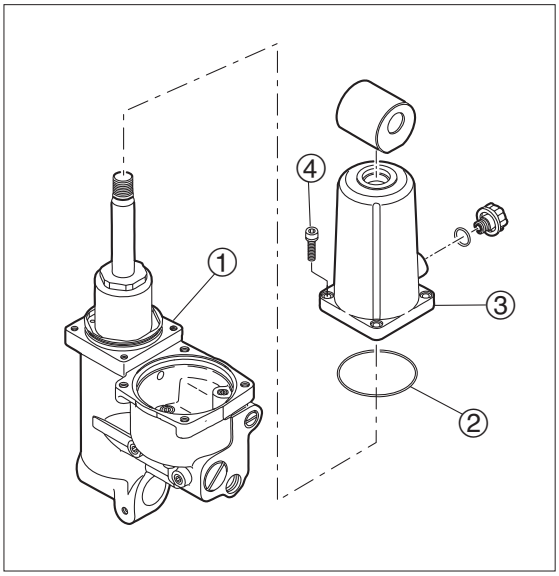


1. Check reservoir ① and upper oil seal for dameges and wear. Replace reserve tank if necessary.

2. Check tilt rod ② for bend, any scratched of sliding surface and wear. Replace tilt rod if necessary.

3. Check tilt rod for bend and hard rusting. If lightly rusting, finish by using sand paper #400 - #600, and or replace tilt rod if necessary.

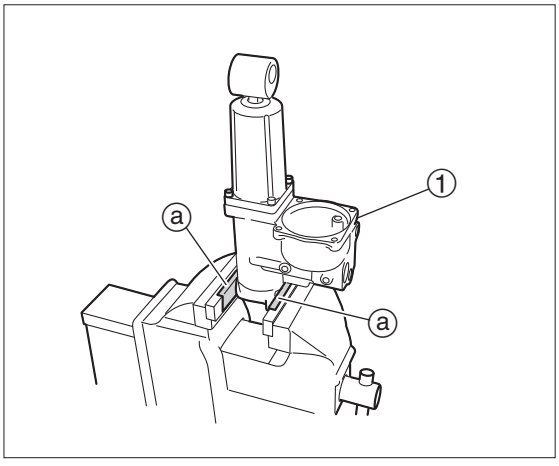
22) Installation of Reserve Tank



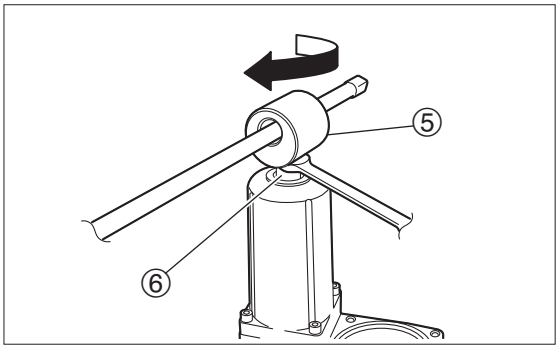
1. Install new o-ring ① to PTT unit ①.

2. Install reservoir ③ to PTT unit and tighten bolts ④ to specified torque.

Resreve Tank Bolt ④ :
4.5 N · m (3.3 lb · ft) [0.45 kgf · m]



3. Use vise to fix PTT unit ① that is protected at both sides with wood pieces or aluminum plates ⓐ.



4. Secure tilt rod ⑥ and tighten joint metal (rod eye) ⑤ by using wrench.

Joint Metal ⑤ :
39 N · m (28 lb · ft) [3.9 kgf · m]

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23) Installation of PTT Pump and Motor

1. Use vise to fix PTT unit ① that is protected at both sides with wood pieces or aluminum plates.

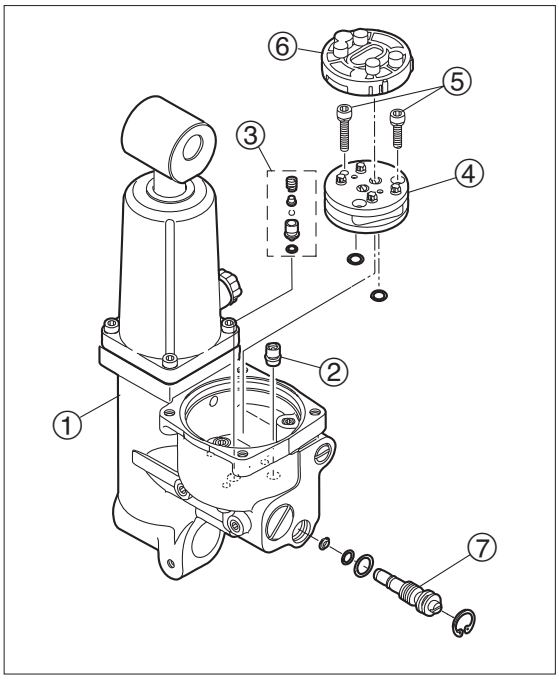
2. Assemble valve ass'y ②, releaf valve ass'y ③ and PTT pump ass'y ④, and tighten bolt ⑤ to specified torque.

PTT Pump Bolt :
5.2 N·m (3.8 lb·ft) [0.52 kgf·m]

3. Install filter ⑥ to PTT unit.

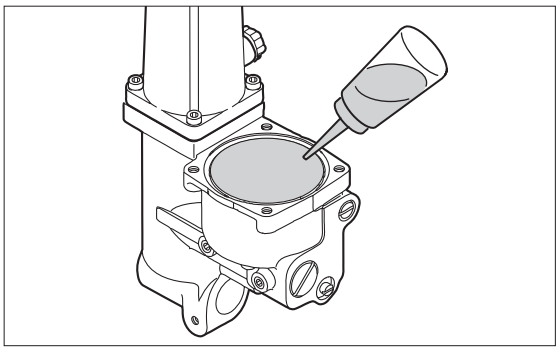
4. Install manual valve ⑦ and tighten to specified torque.

Manual Valve :
1.8 N·m (1.3 lb·ft) [0.18 kgf·m]



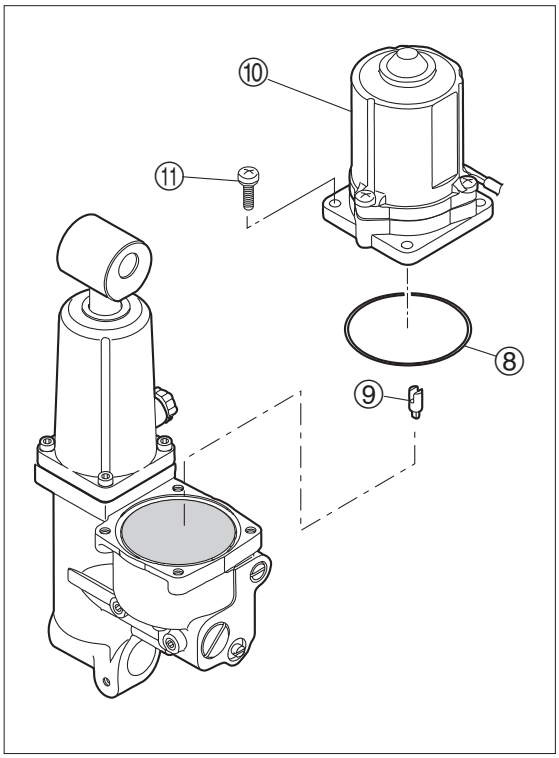
4. Fill pump chamber with PTT fluid to top edge as shown.

Recommended PTT Fluid :
ATF DEXRON III

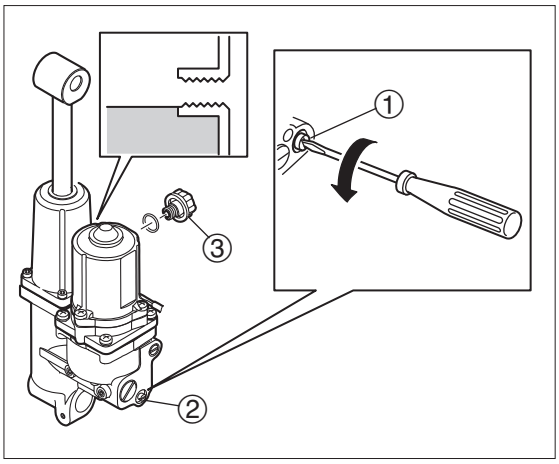


5. Install new o-ring ⑧, cupling ⑨ and PTT motor ass'y ⑩ and tighten to specified torque.

Screw :
6 N·m (4 lb·ft) [0.6 kgf·m]



24) Air-Purging PTT Unit (separated from outboard motor)



1. Turn manual valve ① counterclockwise fully. Extend tilt rod to upmost position.

2. Place PTT unit ② vertically.

   PTT unit must be in vertical position as shown.

3. Remove cap ③ and check fluid level in the reservoir tank. Add recommended PTT fluid, if disassemble PTT unit.

   ⚠ WARNING

   Check fluid level with tilt rod fully stretched. Removing reservoir cap at halfway position can cause blasting out of PTT fluid, which is dangerous, and also result in inaccurate fluid level reading.

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

4. Add recommended PTT fluid to specified level if it is lacking.

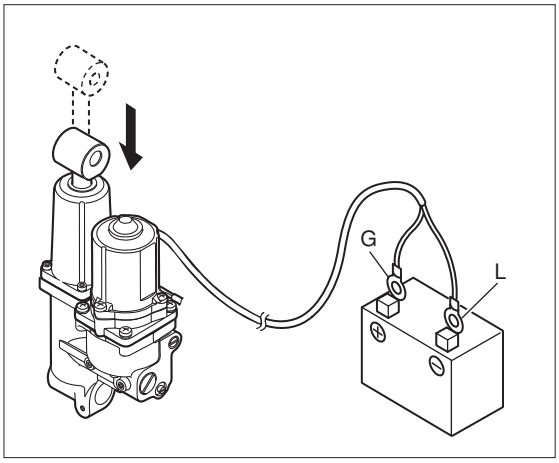
   Recommended PTT Fluid :
   ATF DEXRON III

5. Put cap ③ and tighten to specified torque.

   Reserve Tank Cap :
   1.2 N·m (0.9 lb·ft) [0.12 kgf·m]

6. Turn manual valve clockwise fully.

   Manual Valve :
   1.8 N·m (1.3 lb·ft) [0.18 kgf·m]



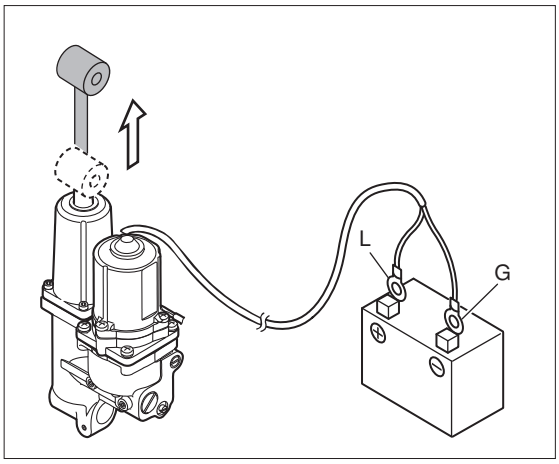
7. Reconnect PTT motor lead wires to battery terminals to fully retract tilt rod.

Tilt Rod	PTT Motor Lead Wires	Battery Terminals
Retraction	Green (G)	+ : Positive Terminal
	Blue (L)	– : Negative Terminal

7

7. Reverse connection of PTT motor lead wires to battery terminals to fully stretch tilt rod.

Tilt Rod	PTT Motor Lead Wires	Battery Terminals
Stretch	Blue (L)	+ : Positive Terminal
	Green (G)	– : Negative Terminal



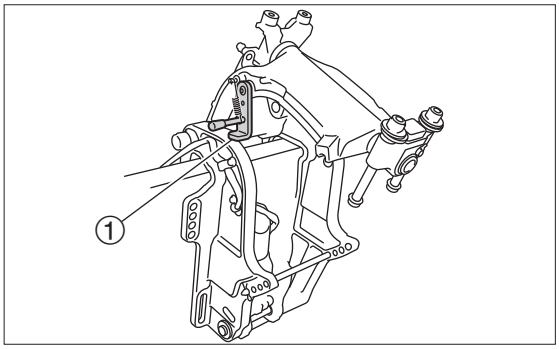
- Repeat above steps several times to move up and down tilt rod (When reversing motor lead wire connection, keep the connection open for two or three seconds.).
- If tilt rod does not move smoothly when connected to battery, assist the movement with hand.

8. Check fluid level with tilt rod fully stretched. Add recommended PTT fluid to specified level if it is lacking.

Recommended PTT Fluid :
ATF DEXRON II

25) Installation of PTT Unit/Gas Shock Absorber

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 without locking may lead to accidental descent due to reduction of PTT hydraulic pressure.

2. Reinstall bushings ②, ③ and ④ to their original positions.

3. Install PTT unit ⑤ or gas shock absorber ⑥, and then cylinder shaft (lower) ⑦.

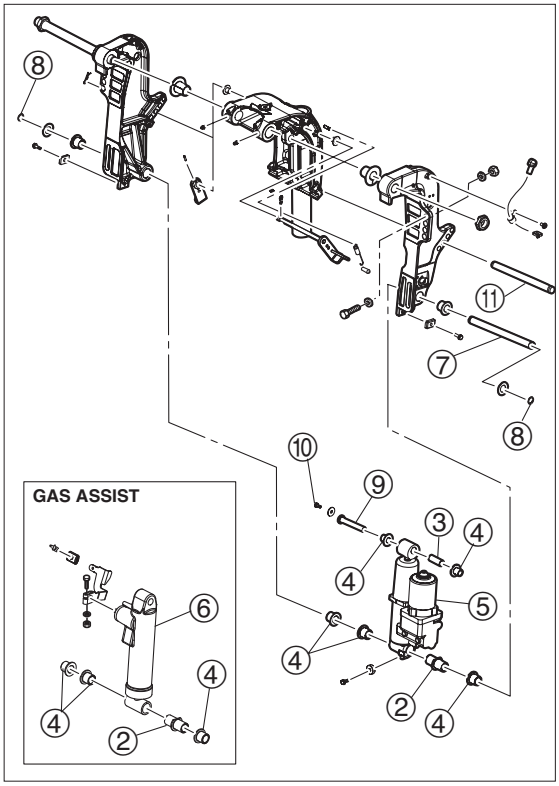
Retract tilt rod a little.

4. Attach "C" ring ⑧.

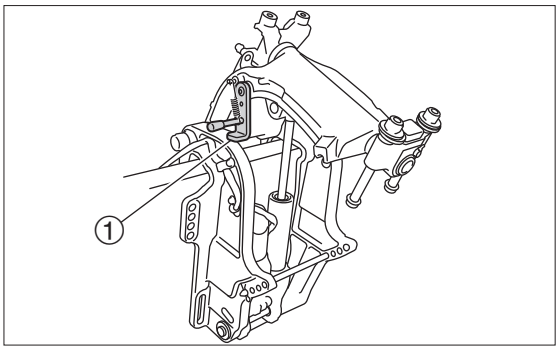
5. Connect lead wires to battery to fully stretch tilt rod.

6. Install cylinder shaft (upper) ⑧ and tighten bolt ⑩.

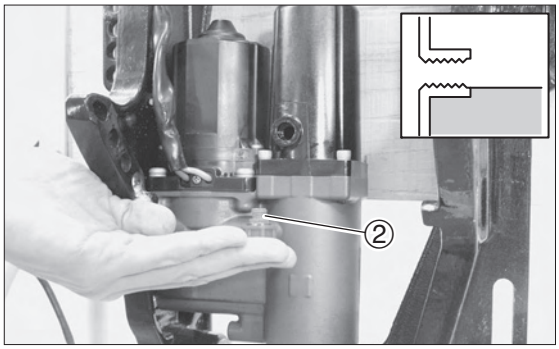
7. Install thrust rod ⑪.



26) Air-Purging PTT Unit (installed on the outboard motor)



1. Install outboard motor on the boat.
2. Fully tilt up outboard motor and lock with tilt stopper.
3. Remove cap ② and check fluid level in the reservoir tank.
4. Turn manual valve counterclockwise fully.
5. Release tilt stopper while holding in the UP position and let the motor drop down gravitationally.

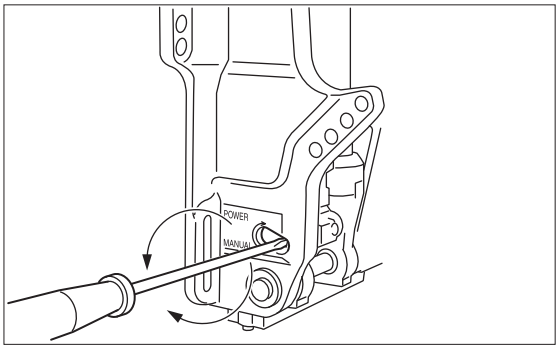


6. Turn manual valve clockwise fully.

Manual Valve :
1.8 N·m (1.3 lb·ft) [0.18 kgf·m]

7. Leave the unit for five minutes to stabilize PTT fluid.
8. Push PTT switch to check that outboard motor fully tilt up.

If not, loosen manual valve, tilt up with hands and lock with tilt stopper.



9. Lock outboard motor with tilt stopper ①.

⚠ WARNING

Be sure to lock outboard motor with tilt stopper after tilting up. Leaving outboard motor without locking may lead to accidental descent due to reduction of PTT hydraulic pressure.

10. Remove cap ② and check fluid level in the reservoir tank.

⚠ WARNING

Check PTT fluid level with outboard motor fully tiled up. Removing reserve tank cap at halfway position can cause blasting out of PTT fluid, which is dangerous, and also result in inaccurate fluid level reading.

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

7

11. Add recommended PTT fluid to specified level if it is lacking.

Recommended PTT Fluid :
ATF DEXRON III

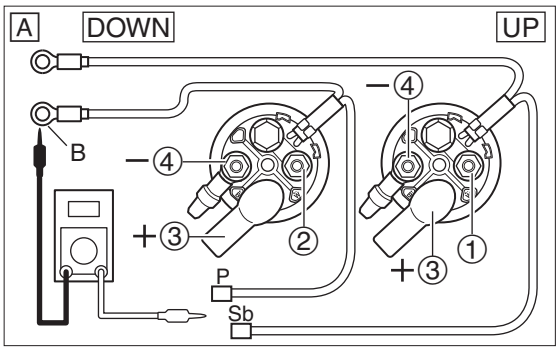
12. Reservoir tank cap and tighten to specified torque.

Reserve Tank Cap :
1.2 N·m (0.9 lb·ft) [0.12 kgf·m]

13. Repeat steps from 5. to 12. until specified PTT fluid level is attained.

27) Inspection of PTT Solenoid

This test can be made without removing parts.



1. Disconnect positive and negative cables from battery.

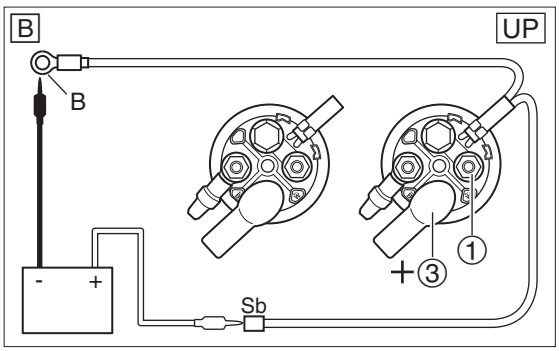
2. Disconnect PTT motor leads from terminals ① and ②.

3. Check electrical conductivity of PTT solenoid. Replace if other than specified conditions.

PTT Solenoid Conductivity	
Sky Blue (Sb) - Black (B) Pink (P) - Black (B)	Conductive
Terminal ① - Terminal ④ (–) Terminal ② - Terminal ④ (–)	Conductive
Terminal ① - Terminal ③ (+) Terminal ② - Terminal ③ (+)	Non-conductive

4. Connect circuit tester leads between terminals ① and ③.

5. As shown in diagram B, connect sky blue (Sb) terminal to positive battery terminal, and black (B) lead wire to negative battery terminal.

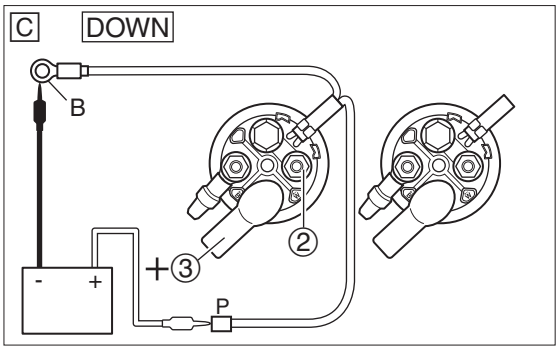


6. Check electrical conductivity between terminals ① and ③. If non conductive, replace UP side PTT solenoid.

7. Connect circuit tester leads between PTT solenoid terminals ② and ③.

8. As shown in diagram C, connect pink (P) terminal to positive battery terminal, and black (B) lead wire to negative battery terminal.

9. Check electrical conductivity between terminals ② and ③. If non conductive, replace DOWN side PTT solenoid.

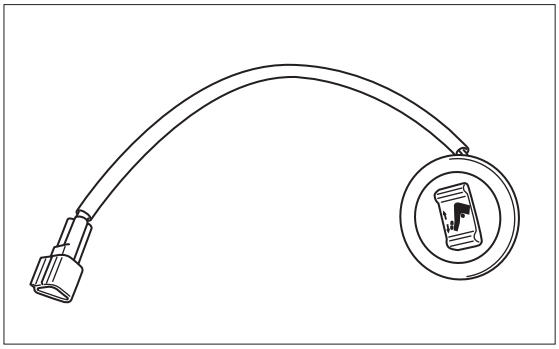


28) Inspection of PTT Switch

1. Check electrical conductivity of PTT switch. Replace if other than specified conditions.

Lead Wires

Switch Position	Sky Blue (Sb)	Red (R)	Pink (P)
UP (Tilt Up)	○	○	
Free			
DOWN (Tilt Down)		○	○



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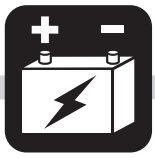
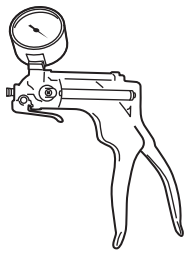
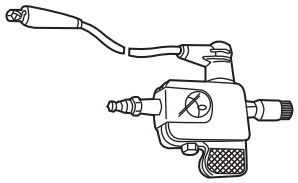
8

Electrical System

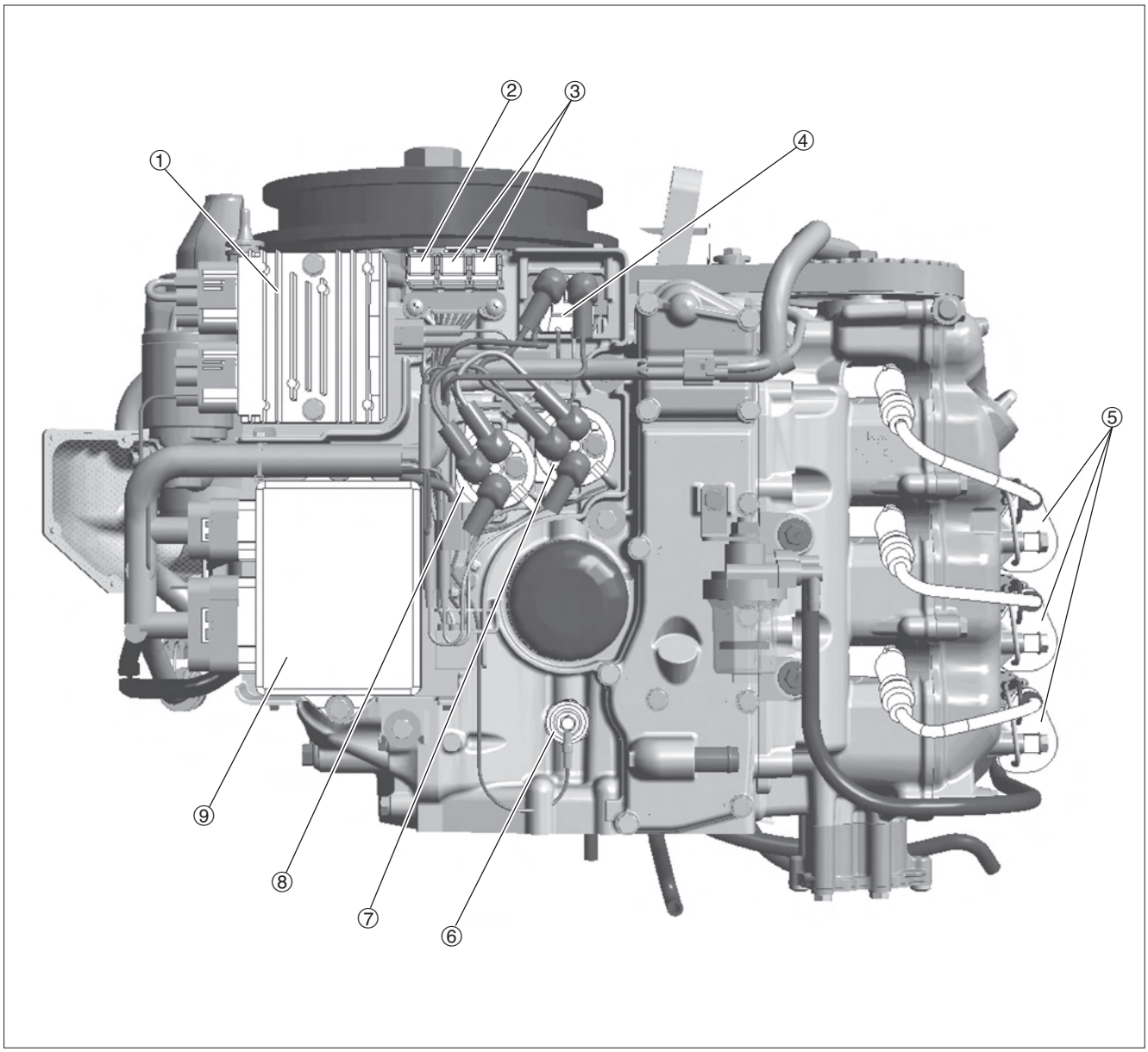


1. Special Tools

	
Vacuum/Pressure Gauge P/N. 3AC-99020-1	Spark Tester P/N. 3F3-72540-0
Inspecting pressure	Inspecting sparks

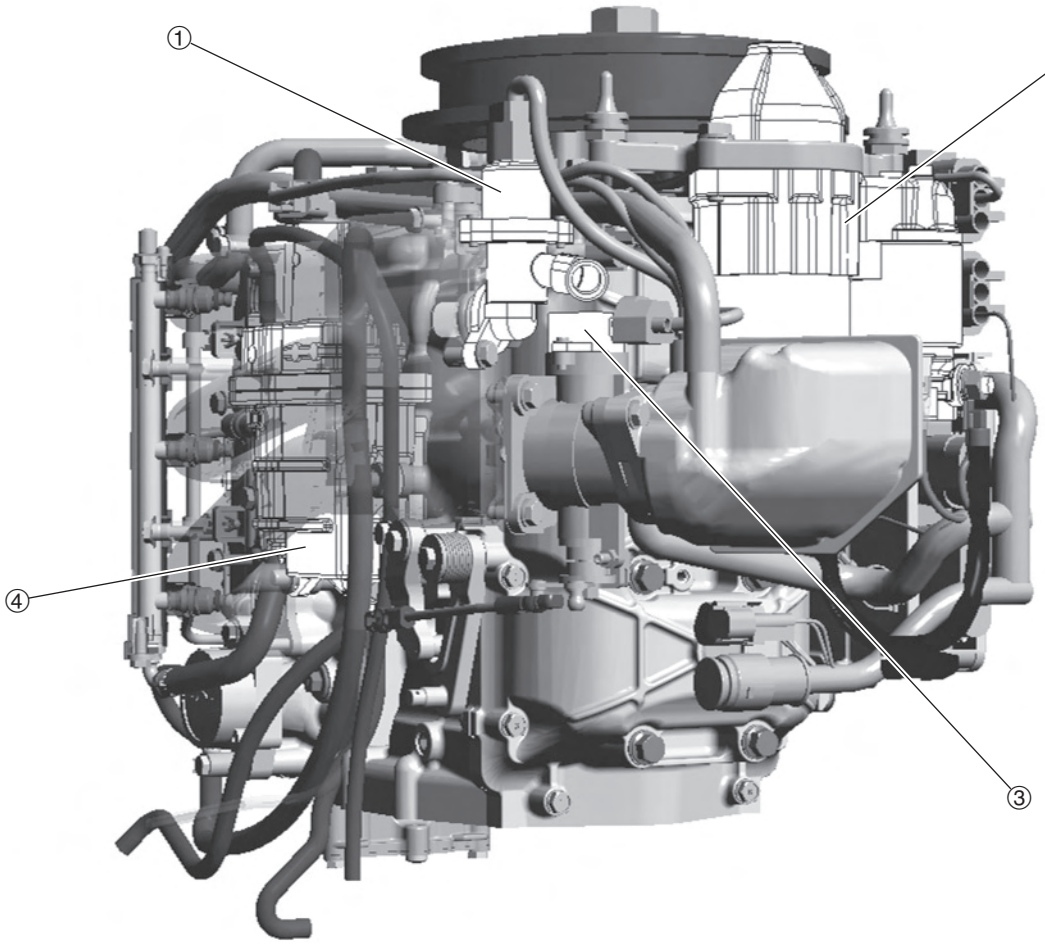
2.Electrical Component Layout

Port Side View



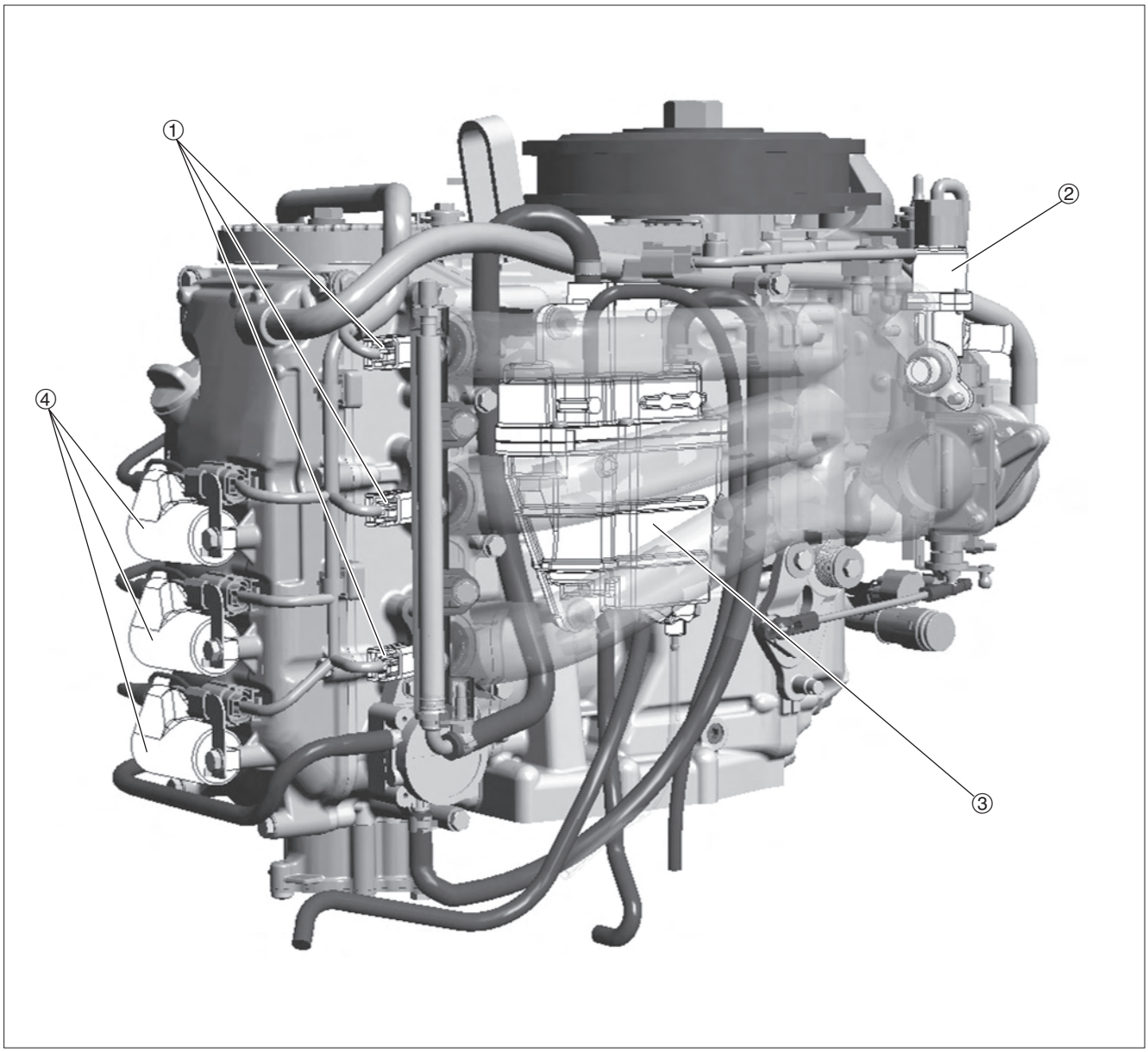
① Rectifire
② Fuse (30A)
③ Fuse (20A)
④ Starter Solenoid
⑤ Ignition Coil
⑥ Oil Pressure Switch
⑦ PTT Solenoid Switch A (tilt up)
⑧ PTT Solenoid Switch B (tilt down)
⑨ ECU (Electronic Control Unit)

Bow Side View



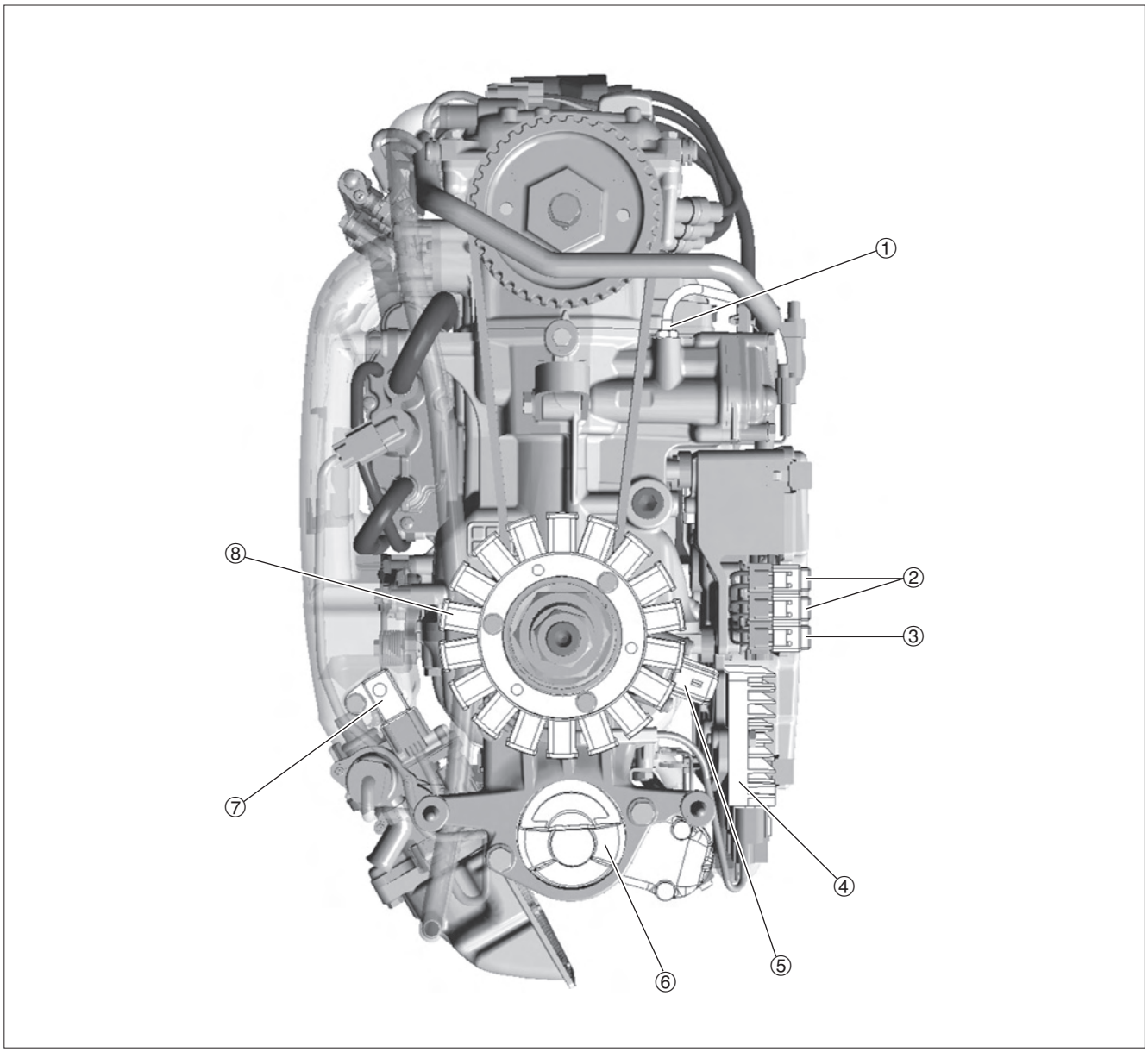
① ISC (Idle Speed Control) Valve
② Starter Motor
③ Throttle Position Sensor
④ Vapor Separator

Starboard Side View



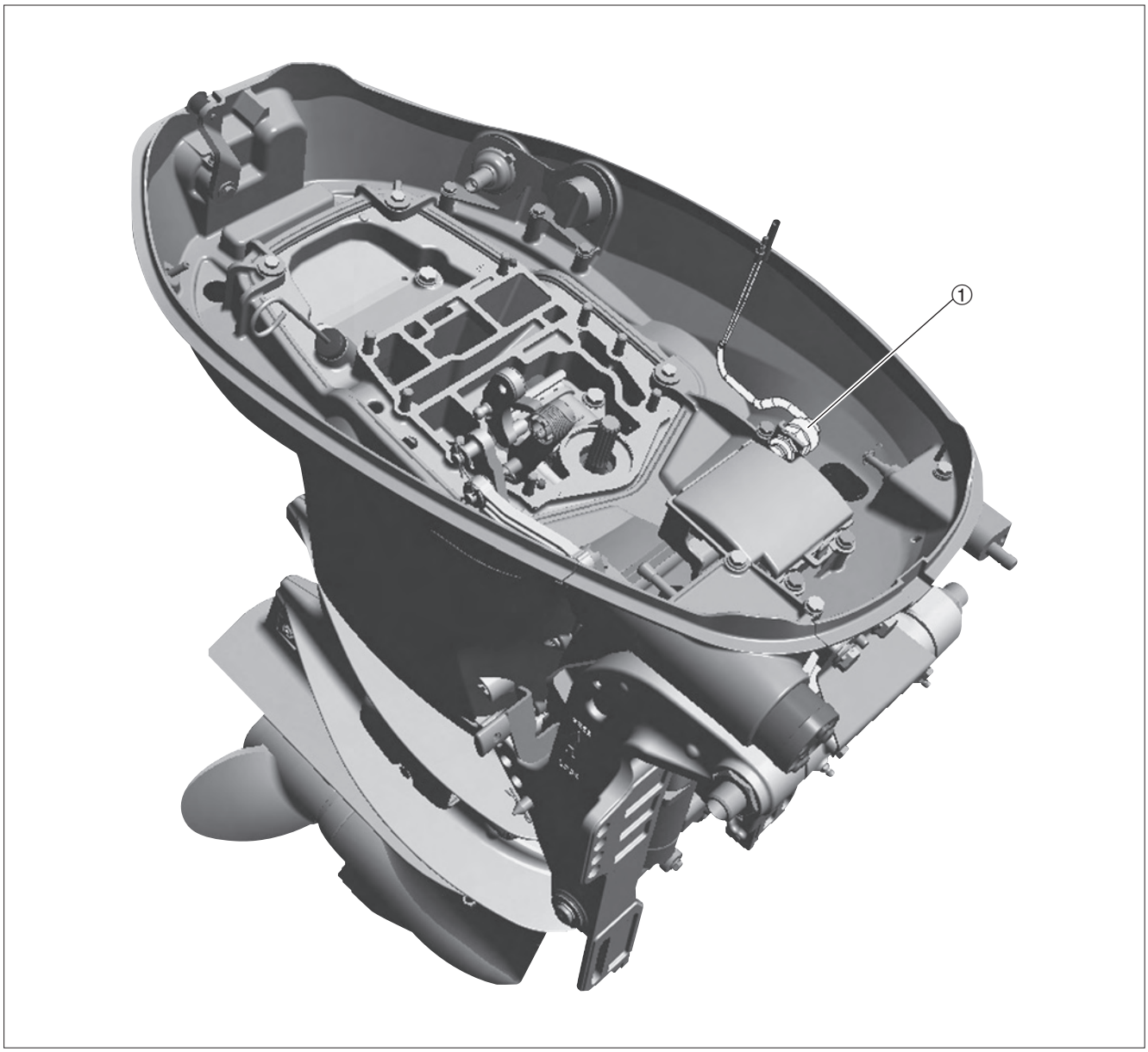
① Fuel injector
② ISC (Idle Speed Control) Valve
③ Vapor Separator
④ Ignition Coil

Top View



① Engine Temperature Sensor
② Fuse (20A)
③ Fuse (30A)
④ Rectifier
⑤ Crank Position Sensor (CPS)
⑥ Starter Motor
⑦ T-MAP (Manifold Pressure) Sensor
⑧ Alternator

Bottom Cowl

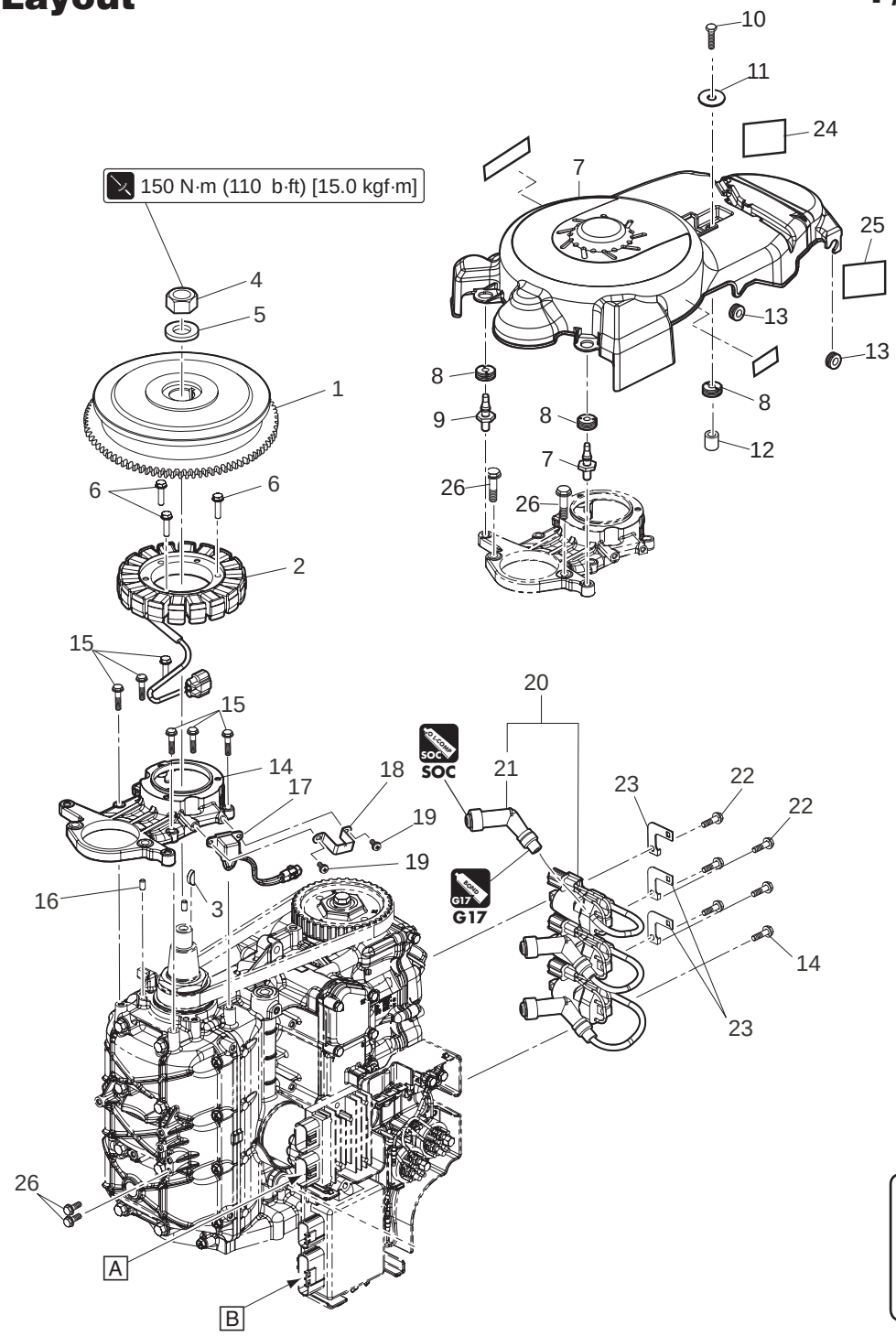


① Neutral Switch

3.Parts Layout

P/L Fig. 7

Magneto



G17

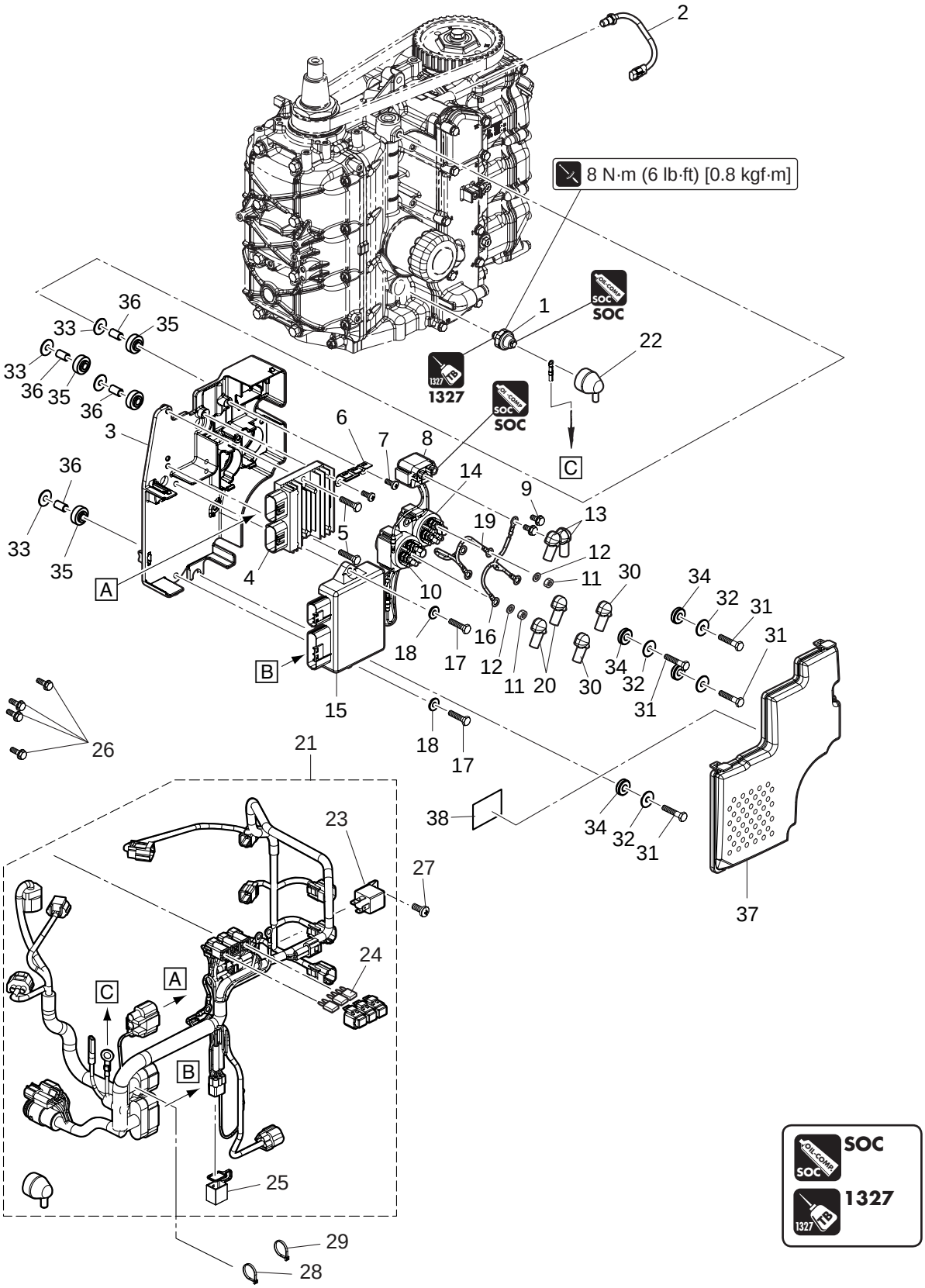
SOC

Ref. No.	Description	Q'ty	Remarks
1	Flywheel W/Gear	1	
2	Alternator Ass'y	1	
3	Key 19-7-5	1	
4	Nut 20-p1.25	1	M20
5	Washer 20.5-37-5	1	M20
6	Bolt	3	M6 L=25mm
7	Ring Gear Cover	1	
8	Grommet 16-2.5	3	
9	Hook	2	
10	Bolt	1	M6 L=20mm
11	Washer 6-16-1.5	1	M6
12	Collar 6.2-9-7.4	1	
13	Grommet 13-2	2	
14	Coil Bracket	1	

Ref. No.	Description	Q'ty	Remarks
15	Bolt	6	M6 L=25mm
16	Dowel Pin 6-12	2	Cylinder Blok-CoilBraket
17	Pulsar Coil	1	
18	Pulsar Coil Guard	1	
19	Screw	2	
20	Ignition Coil W/R-cap	3	
21	Plug Cap W/Resistance	1	
22	Bolt	6	M6 L=20mm
23	Stay	3	
24-1	Caution Decal (B)	1	
24-2	Caution Decal (B)	1	
25	Fuse Decal	1	
26	Bolt	2	M8 L=30mm

Electric Parts

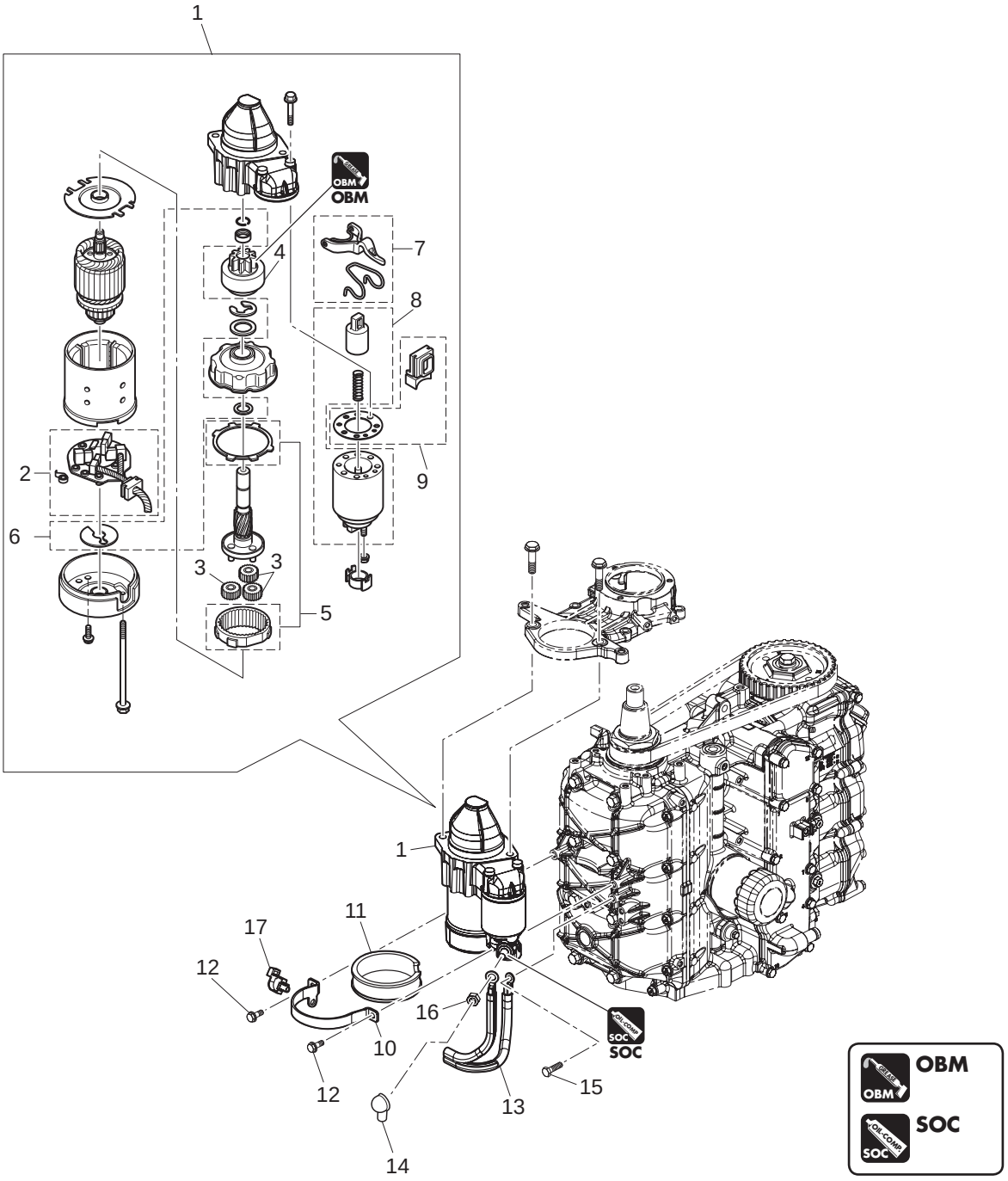
P/L Fig. 9



Ref. No.	Description	Q'ty	Remarks
1	Oil Pressure Switch	1	
2	Engine Temp Sensor	1	
3	Bracket	1	Electric Braket
4	Rectifier Complete	1	
5	Bolt	2	M6 L=25mm
6	Fuse Holder Bracket	1	
7	Screw	2	M5 L=12mm
8	Starter Solenoid	1	
9	Bolt	2	M6 L=8mm
10	PTT Solenoid Switch (A)	1	Up 4 Side (Sb) for PTT Model
11	Nut	3	M6
12	Spring Washer	3	M6
13	Terminal Cap 8-13-28	2	Red for Gas Assist Model
14	PTT Solenoid Switch (B)	1	Down Side (P) for PTT Model
15-1	ECU Ass'y	1	50ps EU
15-2	ECU Ass'y	1	40ps EU
15-3	ECU Ass'y	1	50ps STD
15-4	ECU Ass'y	1	40ps STD
16	Solenoid Switch Cord (A)	1	Red for PTT Model
17	Bolt	2	M6 L=20mm
18	Washer 6-16-1.5	2	M6
19	Solenoid Switch Cord (B)	1	Black for PTT Model
20	Terminal Cap 8-13-28	6	Red for PTT Model
21	Cord Ass'y	1	
22	Grommet	1	
23	Relay	1	
24-1	Fuse 30A	1	
24-2	Fuse 20A	2	
25	Cable Terminal Plug	1	
26	Bolt	4	M6 L=12mm
27	Screw	1	M5 L=12mm
28	Band 104	1	Do not reuse.
29	Band 203	1	Do not reuse.
30	Terminal Cap 8-13-28	2	Black for PTT Model
31	Bolt	4	M6 L=30mm
32	Washer 6-16-1.5	4	In Side M6
33	Washer 6.5-21-1	4	Out Side M6
34	Mount 8.5-14-2.5	4	In Side
35	Rubber Mount 8.5-14-2.5	4	Out Side
36	Spacer 6.2-9-15.7	4	
37	Cover	1	
38	Wiring Diagram Decal	1	

Electric Parts (Starter Motor)

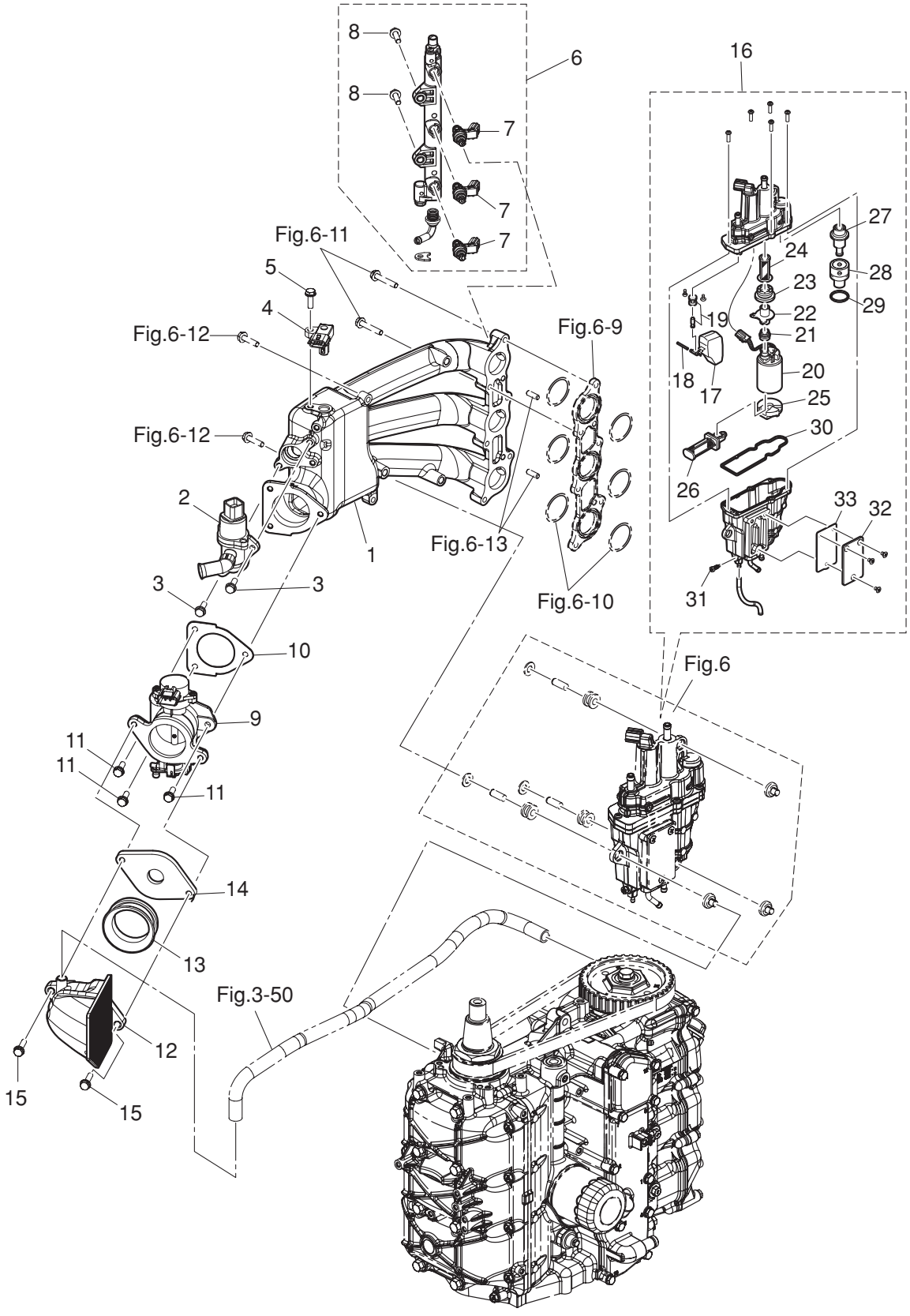
P/L Fig. 8



Ref. No.	Description	Q'ty	Remarks
1	Starter Motor Ass'y	1	
2	Brush Holder	1	
3	Internal Gear	3	
4	Pinion Assy	1	
5	Planet Gear	1	
6	Washer Set	1	
7	Shift Lever Set	1	
8	Magnetic Switch	1	
9	Dust Cover Set	1	
10	Starter Motor Band	1	
11	Damper	1	
12	Bolt	2	M6 L=16mm
13	Battery Cable	1	
14	Terminal Cap 15.5-18.28	1	Red
15	Bolt	1	Battery Cable-Ground M6 L=12mm
16	Nut	1	Starter Motor M8
17	Band 135	1	

Intake Manifold

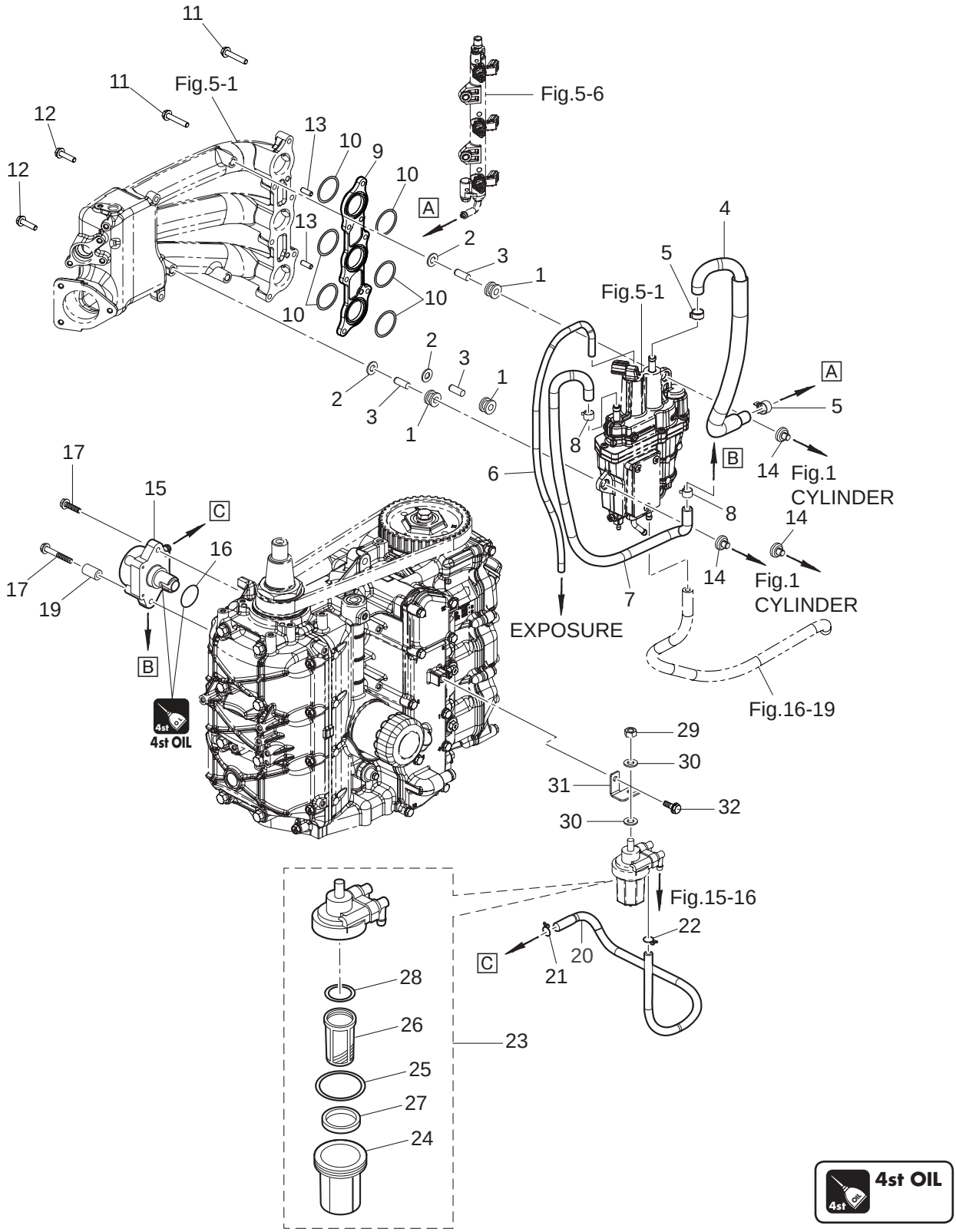
P/L Fig. 5



Ref. No.	Description	Q'ty	Remarks
1	Intake Manifold	1	
2	Isc Valve	1	Idle Speed Control Valve
3	Bolt	2	M6 L=20mm
4	Map Sensor	1	Manifold Air Temperature & Pressure
5	Bolt	1	M6 L=20mm
6	Fuel Rail Ass'y	1	
7	Fuel Injector Ass'y	3	
8	Bolt	2	M6 L=20mm
9	Throttle Body Ass'y	1	ø45
10	Gasket	1	Do not reuse.
11	Bolt	3	M6 L=20mm
12	Intake Silencer Ass'y	1	
13	Gasket	1	Do not reuse.
14	Restrictor	1	40ps
15	Bolt	2	M6 L=25mm
16	Vapor Separator Ass'y	1	
17	Float	1	
18	Float Arm Pin	1	
19	Float Valve Ass'y	1	
20	Fuel Feed Pump	1	Upper
21	Grommet	1	Upper
22	Joint	1	Upper
23	Grommet	1	Upper
24	Filter (Outlet)	1	Lower
25	Grommet	1	Lower
26	Filter (Inlet)	1	
27	Fuel Regulator	1	
28	Holder	1	
29	O-ring	1	Do not reuse.
30	O-ring	1	Do not reuse.
31	Drain Screw	1	
32	Cover	1	
33	Seal	1	Do not reuse.

Fuel system

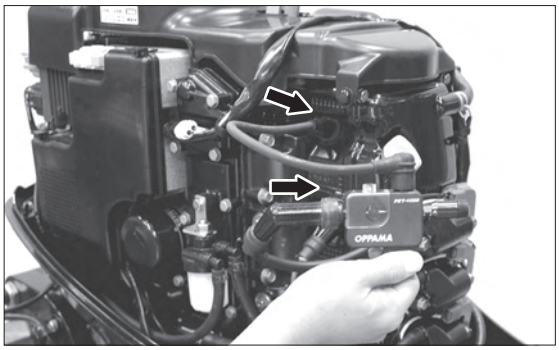
P/L Fig. 6



Ref. No.	Description	Q'ty	Remarks
1	Rubber Mount	3	
2	Washer	3	M8
3	Pin ø8-22	3	
4	Fuel Hose W/Protector	1	V/Separator-Fuel Rail EPA-KRI-15G
5	Clamp ø16.8	2	
6	Fuel Hose 4-9	1	V/Separator-Exposure
7-1	Fuel Hose W/Protector ø12	1	Fuel Pump-V/Separator USA EPA-KRI-15G
7-2	Fuel Hose W/Protector ø12	1	Fuel Pump-V/Separator STD
8	Clip ø11.3	2	
9	Insulator	1	
10	O-ring 1.9-33.2	6	Do not reuse.
11	Bolt	6	M6 L=35mm
12	Bolt	2	M6 L=25mm
13	Dowel Pin 6-16	2	Intake Manifold-Vapor Separator Assy
14	Bushing	3	
15	Fuel Pump Ass'y	1	
16	O-ring 3.5-25.7	1	Do not reuse.
17	Bolt	1	M6 L=25mm
18	Bolt	1	M6 L=45mm
19	Spacer 6.2-13-22	1	
20-1	Low Permeation Hose L=445	1	Fuel Filter-Fuel Pump USA EPA-KRI-15G L=445mm
20-2	Fuel Hose 5-10 L=445	1	Fuel Filter-Fuel Pump STD L=445mm
21	Clip ø11.3	1	
22	Clip ø9.4	1	
23	Fuel Filter Ass'y	1	
24	Cup	1	
25	O-ring	1	Do not reuse.
26	Filter	1	
27	Float	1	
28	O-ring	1	Do not reuse.
29	Nut	1	M8
30	Washer	2	M8
31	Plate	1	
32	Bolt	1	M6 L=12mm

4. Ignition System, Ignition Control System

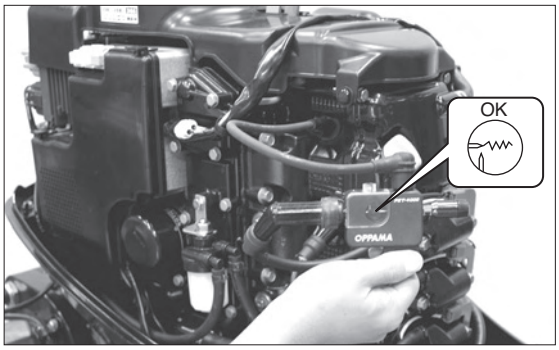
1) Inspection of Ignition Sparks



1. Disconnect plug caps from spark plugs.
2. Connect plug cap to spark tester.
3. Connect spark tester clip to spark plug tip electrode.

Spark Tester :
P/N. 3F3-72540-0

Spark Performance :
10 mm (0.4 in) or over



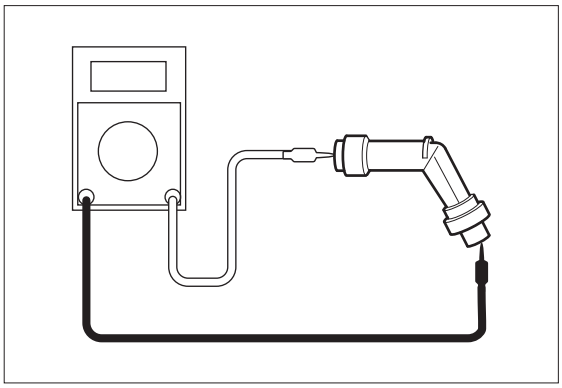
4. Start engine and check sparks. Check spark system when sparks are weak.

- This test can be made without removing parts.
- Ignition coil operation test can be made by using "Running (Drop) Test" of diagnosis system.

⚠ 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

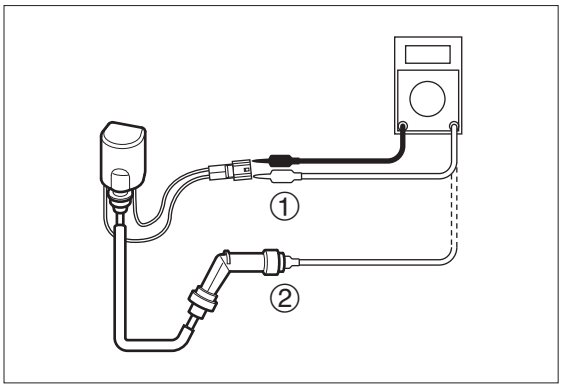


Remove plug cap to test it as a separate unit.

1. Disconnect plug caps from spark plugs.
2. Remove plug caps from their high tension cables by turning caps.
3. Measure plug cap resistance. Replace if other than specified value.

Plug Cap Resistance :
3.0 to 7.0 kΩ

3) Inspection of Ignition Coils



1. Remove ignition coil coupler.

2. Measure ignition coil resistance. Replace if other than specified value.

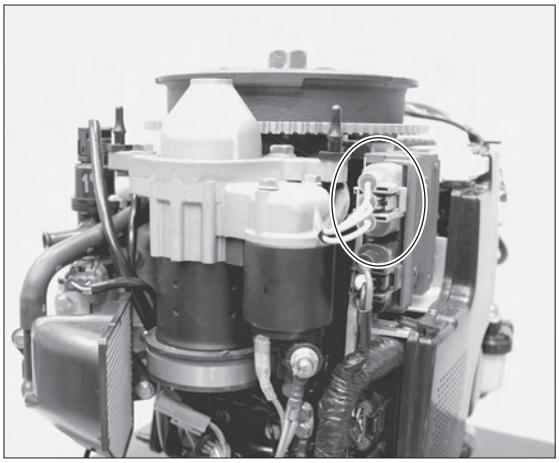
This test can be made without removing parts.

Ignition Coil Resistance :
Puraimaly Coil : Between Couplers
3.82 - 5.18 Ω (at 20°C)
Secondary Coil : Between High Tension Cord
15.6 to 23.4 kΩ (at 20°C)
19.4 to 29.6 kΩ (at 20°C, with spark plug cap)

3. Install plug cap onto high tension cord by entwisting clockwise.

4. Connect plug cap to spark plug.

4) Inspection of Alternator



1. Disconnect alternator coupler (3 pin).

2. Measure alternator resistance. Replace if other than specified value.

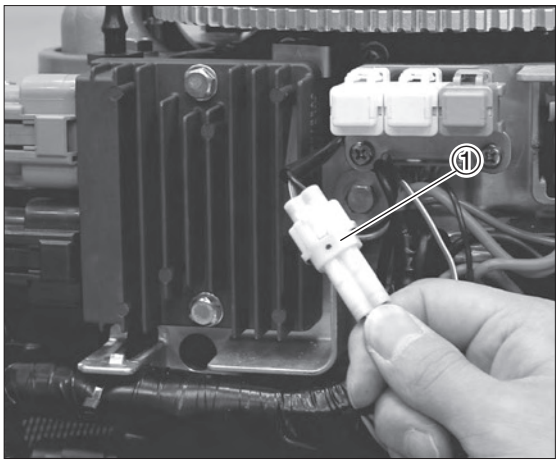
This test can be made without removing parts.

Alternator (Charge Coil) Resistance :
Between Yellow (Y) - Yellow (Y)
0.28 to 0.42 Ω (at 20°C)

8

5) Inspection of Crank Position Sensor (CPS)

1. Disconnect #1 CPS coupler 1 (2 pin) of Port side.



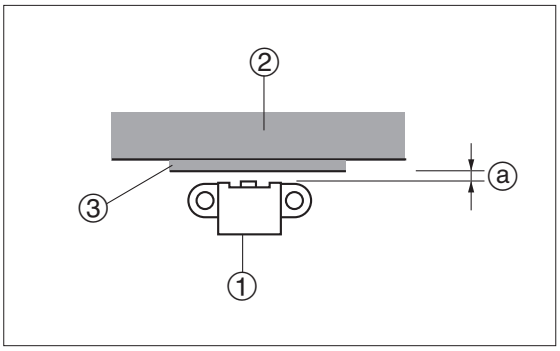
2. Measure #1 CPS resistance. Replace if other than specified value.

This test can be made without removing parts.

Crank Position Sensor Resistance (Reference Value) :
Between Red/White (R/W) - Black (B)
148 to 222 Ω

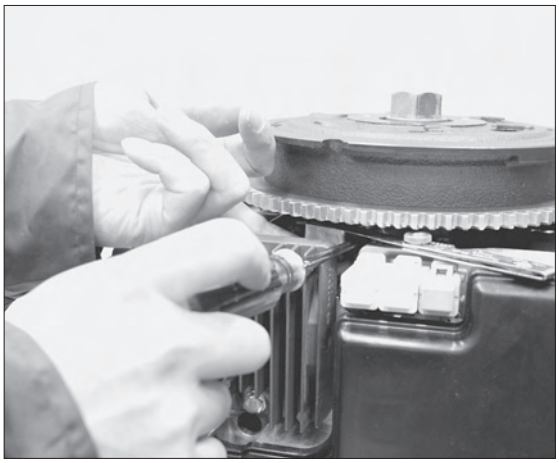
6) Adjustment of Crank Position Sensor (CPS) Air Gap

1. Loosen CPS ① mounting screw, and insurt the thickness gaiuge between CPS ① and encorder ring ③ of flywheel ②.



Crank Position Sensor (CPS) Air Gap : ⓐ
0.7 to 0.9 mm（0.028 to 0.035 in）

2. Tighten CPS mounting screw.

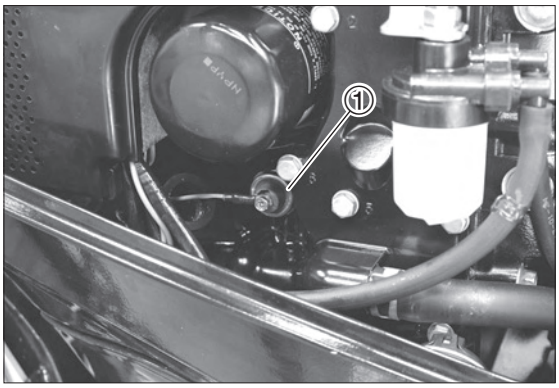


Keep palarell the CPS air gap of CPS and encorder ring, to tighten the screw while pushing up.

7) Inspection of Oil Pressure Switch

Remove oil pressure switch to test it as a separate unit.

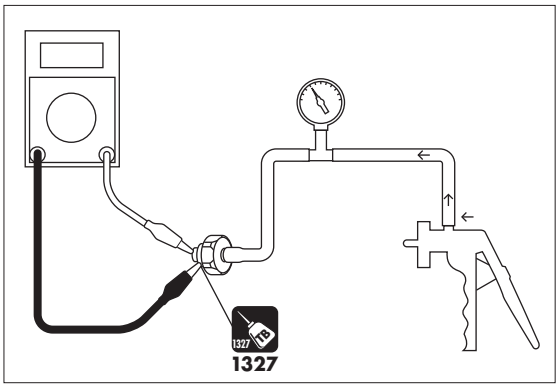
1. Remove oil pressure switch ①.



2. Check electrical conductivity of oil pressure switch ① (Between the terminal connection and the threaded area of the switch base.). Replace if no conductivity.

3. Connect vacuum/pressure gauge to oil pressure switch.

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



4. Apply pressure slowly with vacuum/pressure gauge.

5. Check that oil pressure switch is not conductive with specified pressure applied. Replace if conductive.

Oil Pressure Switch pressure :
0.020 to 0.029 MPa (2.8 to 4.0 PSi)
[0.2 to 0.3 kgf/cm^2]

6. Reinstall the component removed.

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

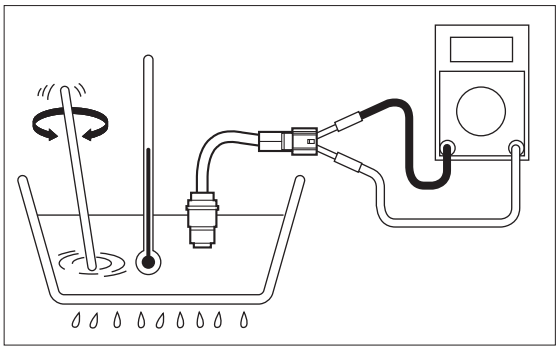
1327 LB **1327**

If oil lamp (LED) was the problem, check the oil pressure with a mechanical gauge if switch test is good.

8

8) Inspection of engine Temperature Sensor

Remove engine temperature sensor to test it as a separate unit.



1. Remove engine temperature sensor from engine.

2. Test sensor when cold and then place in warm water and increase the temperature slowly while conducting your test.

3. Measure the engine temperature sensor resistance. Replace if out of specifications.

Engine Temperature Resistance (Reference Value) :

Between terminal

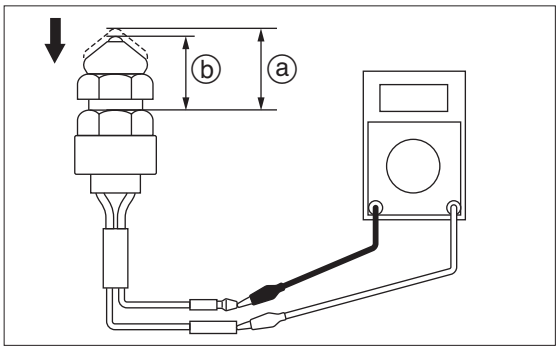
about at 5°C : 4.24 to 4.86 kΩ

about at 25°C : 1.90 to 2.10 kΩ

about at 100°C : 0.166 to 0.204 kΩ

9) Inspection of Neutral Switch

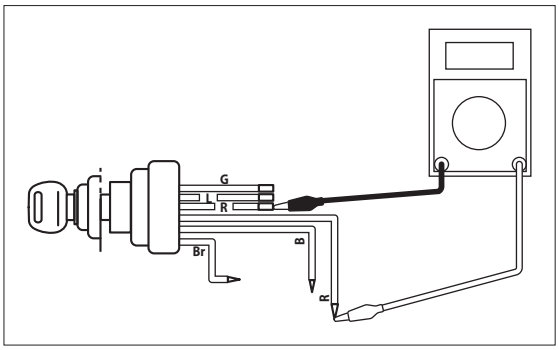
This test can be made without removing parts.



1. Check electrical conductivity of neutral switch. Replace if no conductivity.

Switch Position	Lead Wire Color	
	Green (G)	Green (G)
Free ⓐ		
Pushed (shift in) ⓑ	○———	———○

10) Inspection of Main (key) Switch



1. Open tiller handle or remote control box to access to the switch.

2. Check electrical conductivity of main switch. Replace if no conductivity.

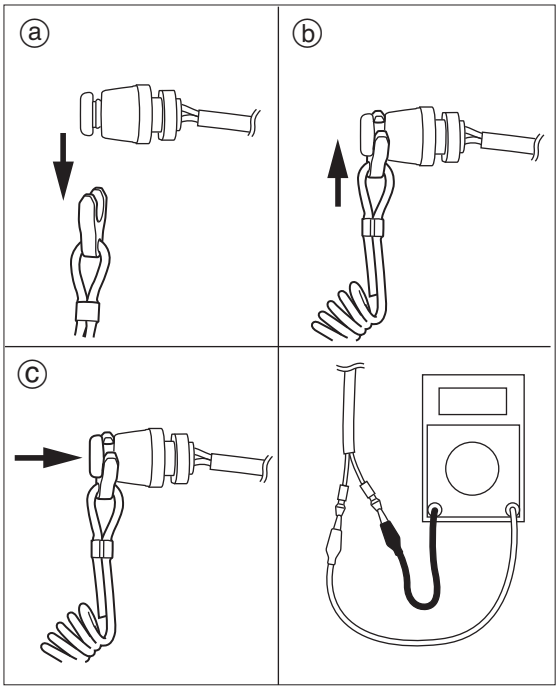
Disconnect the part and test it as a separate unit.

	Switch Position	Lead Wire Color						
		B	Br	R	R	G	L	
	OFF	○	○					
	ON			○	○			
	START			○	○	○		
PUSH	ON			○	○		○	Valiable Idle Speed

11) Inspection of Stop Switch

1. Check electrical conductivity of stop switch. Replace if no conductivity.

Switch Position	Lead Wire Color	
	Brown (Br)	Black (B)
Remove lock. ⓐ	○	○
Install lock. ⓑ		
Press switch. ⓒ	○	○

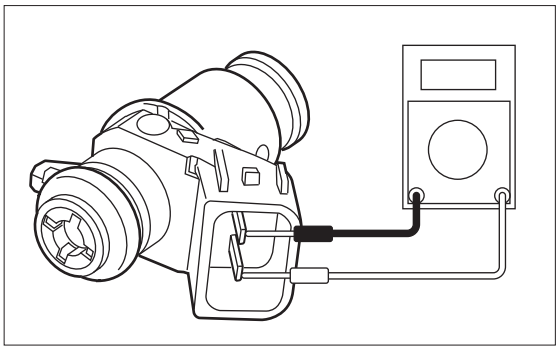


8

5. Fuel Control System

1) Inspection of Injectors

1. Measure injector resistance.

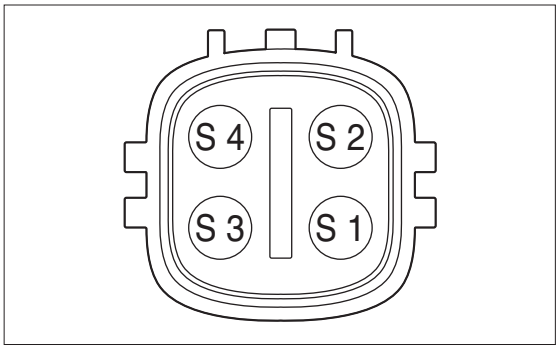


- This test can be made without removing parts.
- Injector operation test can be made by using "Function, or Running (Drop) Stop Test" of diagnosis system.

Injector Resistance (Reference Value) : (at 25°C)
11.40 to 12.66 Ω

2) Inspection of ISC Valve

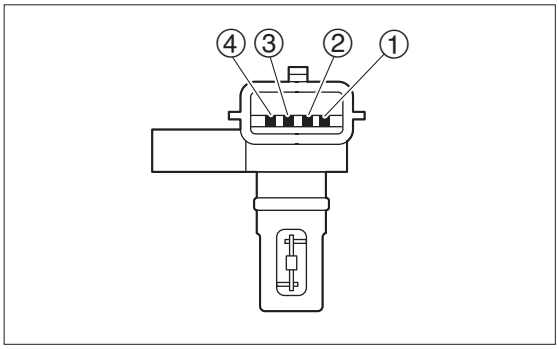
1. Measure ISC valve resistance.



ISC Valve Resistance (Reference Value) : (at 20°C)
Between S1 to S2 : 27 to 33 kΩ
Between S3 to S4 : 27 to 33 kΩ

ISC valve operation test can be made by using "Function, or Running (Drop) Stop Test" of diagnosis system.

3) Inspection of T-MAT Sensor



MAP (manifold pressure) sensor and MAT (intake air temperature) sensor are integrated in this sensor.

Inspection of MAT Sensor

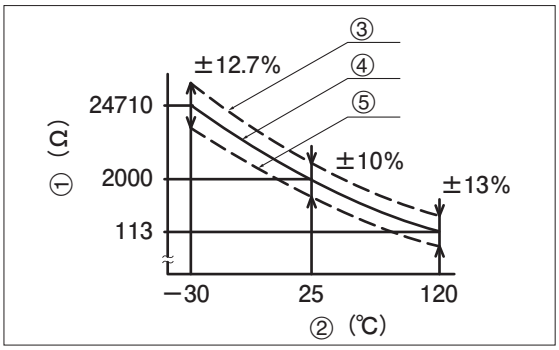
1. Measure ambient temperature.
2. Connect computer to outboard motor, and use diagnosis system to display "Air Temperature (Intake Air Temperature)".
3. Replace T-MAP sensor if difference between ambient temperature and "Air Temperature (Intake Air Temperature)" is over ± 5°C.

Perform inspection MAT sensor when engine is cold.

4. Measure MAT sensor resistance. Replace T-MAP sensor if out of specification.

This test can be made without removing parts.

MAT (Intake Air TEMP) Sensor Resistance (Reference Value) :
at 25°C Between TEMP ① to GND ②:
1.8 to 2.2 kΩ
* In the case of other temperature, the right illustration shown.



① Resistance
② Ambient temperature
③ MAXMUM
④ NORMAL
⑤ MINMUM

Inspection of MAP Sensor

1. Measure MAP sensor resistance. Replace T-Map sensor if out of specification.

MAP (Intake Air Pressure) Sensor Resistance (Reference Value) :
Between Vout TEMP ① to Vout MAP ③:
No conductivity
Between Vout TEMP ① to Vcc ④:
No conductivity

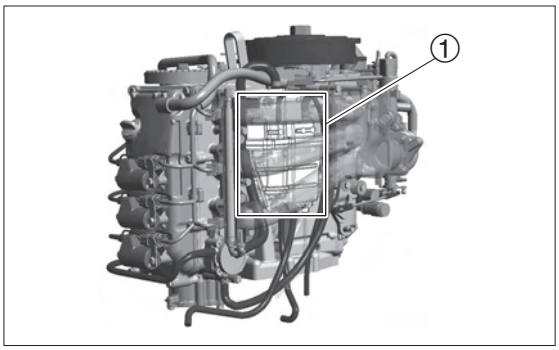
4) Inspection of Fuel Feed Pump (FFP).

1. Turn the main switch to "ON" and check for operate fuel feed pump (FFP).

FFP should operate 5-8 seconds when switch is turned "ON".

2. Check that fuel feed pump (FFP) ① operation sound is heard. If not, check fuel system.

This test can be made without removing parts.



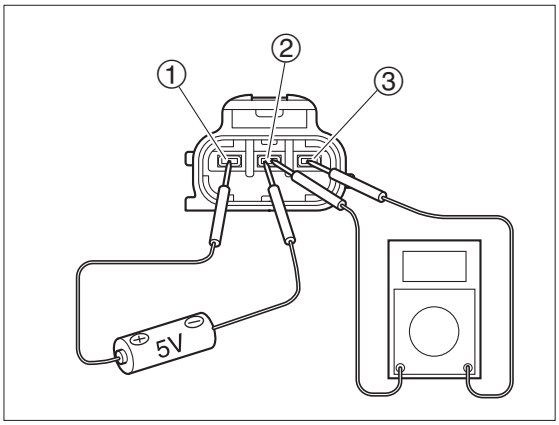
5) Inspection of Throttle Position Sensor (TPS).

1. Check throttle position sensor resistance. Replace throttle body with throttle position sensor if other than specified value.

Crank Position Sensor Resistance :
5 kΩ or less

2. Apply 5V between terminals Vta ① and E2 ②, and measure output voltage between terminals E2 ② and Vc ③.

TPS output is proportional to the degree of opening the main valve fully closed - fully open.



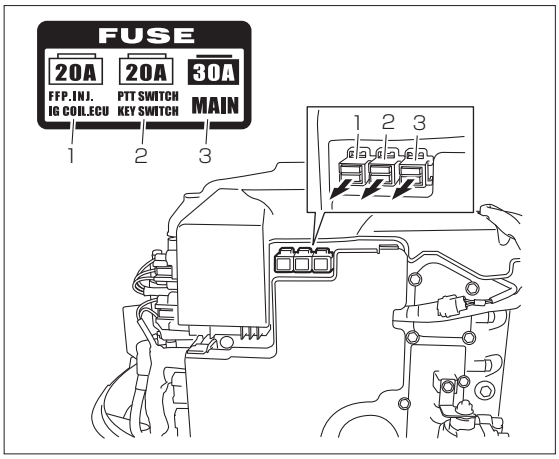
8

6. Starting System

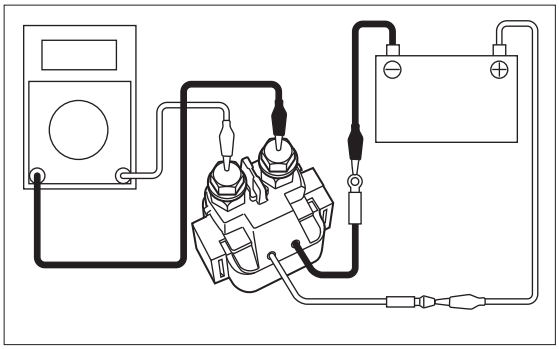
1) Inspection of Fuse

1. Check electrical conductivity of fuse. Replace if no conductivity.

Small blade fuse of the flat type is used.



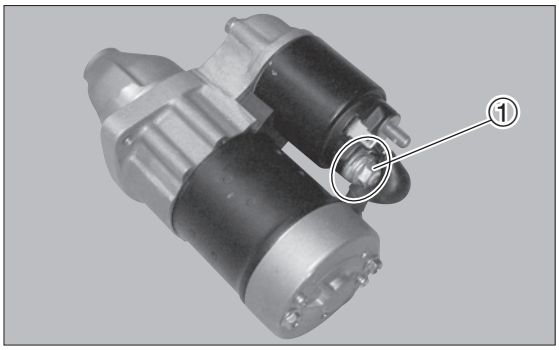
2) Inspection of Starter Solenoid



1. Connect tester lead wires to both terminal 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.

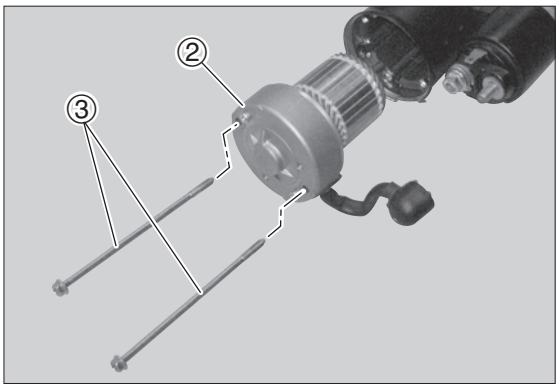
3) Disassembly of Starter Motor

1. Remove starter motor from power unit.
   Refer to “Removing Starter Motor” in chapter 5.



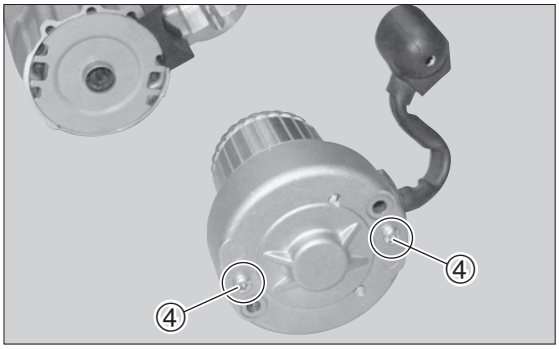
2. Loosen M8 nut ① of magneto switch terminal, and then, remove motor lead.

3. Loosen bolts ③ (M5, 2 pcs.) of starter motor rear cover ②, and then, remove the cover.



> Take care not to give damage to permanent magnets of yoke when pulling out armature.

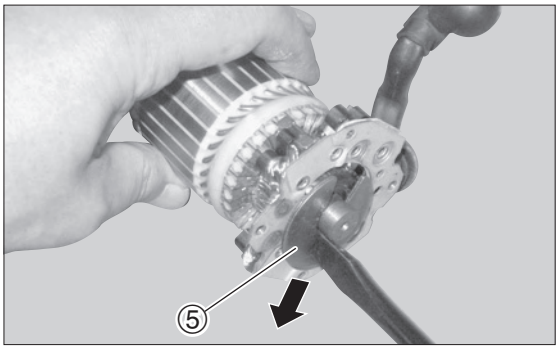
4. Loosen screws ④ (M4, 2 pcs.) of starter motor rear cover, and then, remove armature.



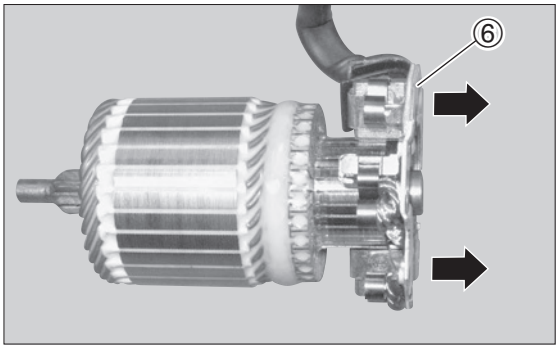
> **⚠ CAUTION**
>
> **Take care not to lose thrust washers that are located on the bottom of metal bearing of rear cover.**

> Brush holders are left in the motor body at the time rear cover is removed.

5. Use bladed screw driver to remove thrust washer A ⑤ from groove of armature shaft.

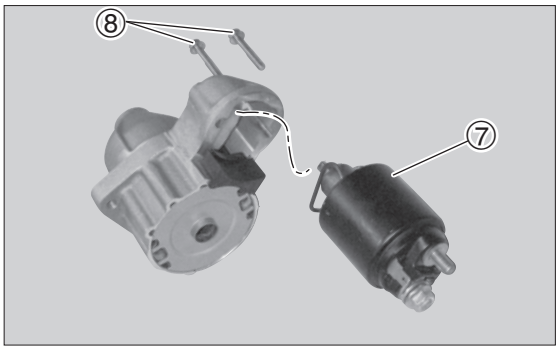


6. Remove brush holder ⑥ from commutator carefully, and then, remove armature.

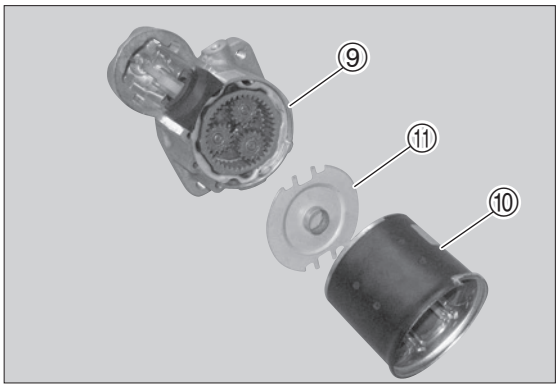


> **⚠ CAUTION**
>
> **Be careful not to give damage to brushes and commutator.**

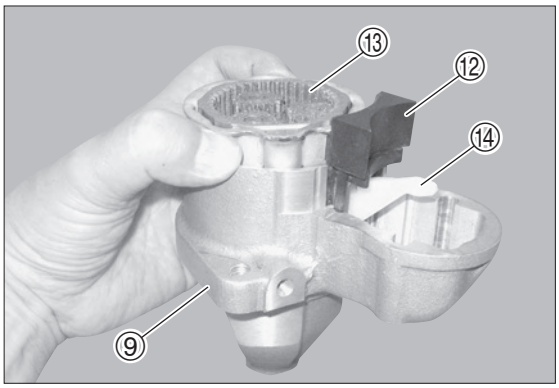
7. Loosen bolts ⑧ (M6, 2 pcs.) on the upper part of magneto switch ⑦, and then, remove magneto switch ass'y.



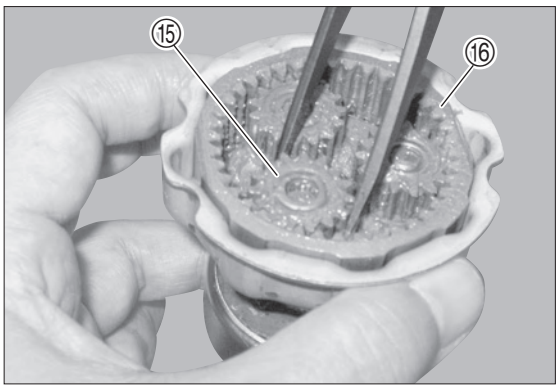
8. Remove yoke ⑩ and center bracket A ⑪ from gear case ⑨.



9. After removing dust rubber ⑫ from gear case ⑨, remove shift lever ⑭ together with center bracket ass'y ⑬.
Check dust rubber for cracks and damages. Check shift lever for wears and damages. Replace if necessary.



10. Remove planetary gear ⑮ and outer gear ⑯ from center bracket ass'y.
Check planetary gear and outer gear for wears and damages. Replace if necessary.

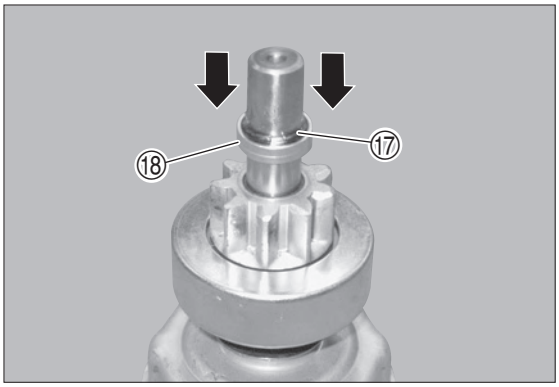


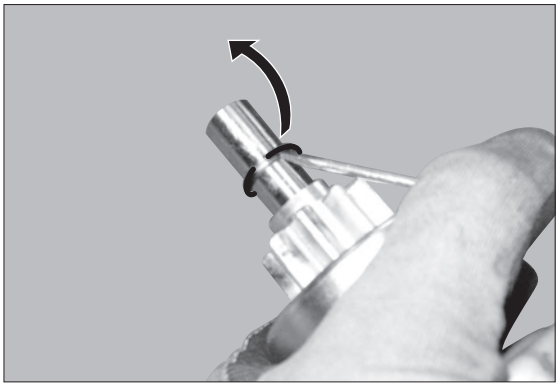
11. Remove clip ⑰ from pinion shaft, and then, remove pinion clutch.

⚠ CAUTION

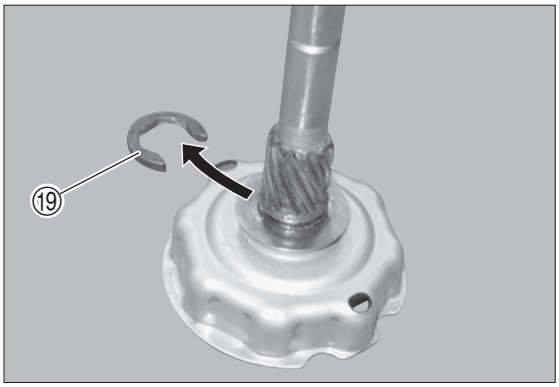
When removing clip, be careful not to give damage to surface of pinion shaft.

- · Move pinion stopper ⑱ fully to clutch side.
- · Use bladed screw driver to remove clip from groove of shaft.
- · Do not reuse clip.

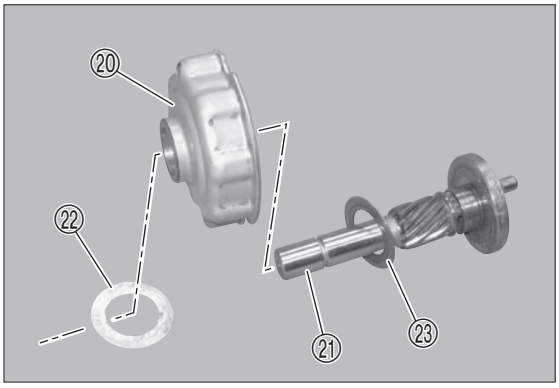




12. Remove E clip ⑲ from groove of pinion shaft.



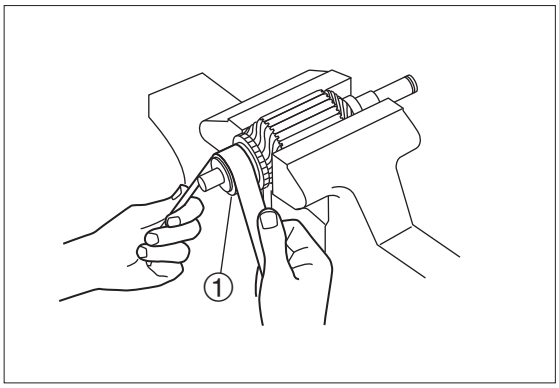
13. Remove pinion shaft ㉑, and 2 washers ㉒ and ㉓ from center bracket ⑪.



8

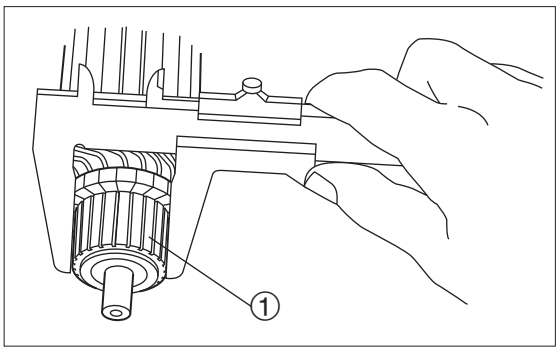
2) Inspection of Armature

1. Check commutator ① for dirt. If necessary, clean by using sand paper of No. 600 or by air-blowing.



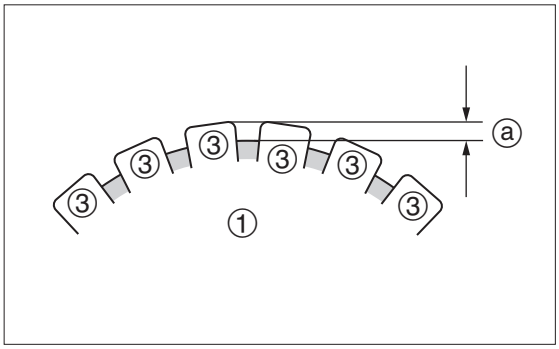
2. Measure commutator ① outer diameter. Replace starter motor ass'y if outer diameter is less than specified value.

Commutator Outer Diameter : Standard Value 29.0 mm (1.142 in)
Wear Limit : 28.0 mm (1.102 in)



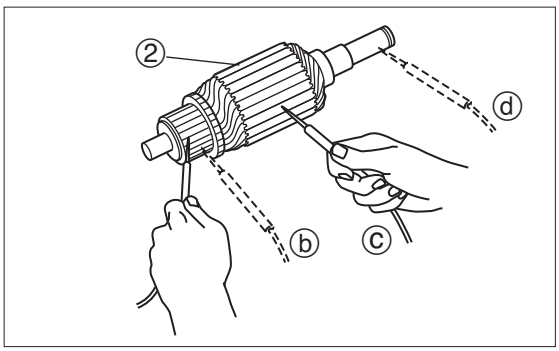
3. Measure undercut ⓐ of commutator ①. Replace starter motor ass'y if less than specified value.

Commutator Undercut : Standard Value 0.5 - 0.8 mm (0.020 - 0.032 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.

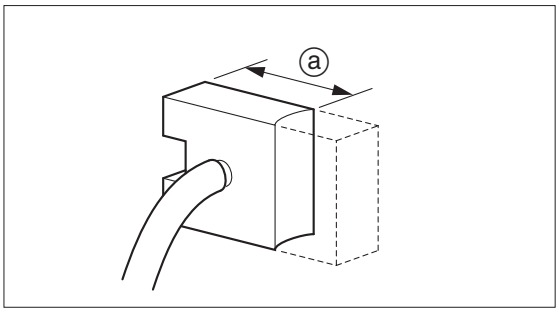
Armature Conductivity :	
ⓑ Between commutator segments ③-③	Conductive
ⓒ Between Segment - Armature Core	Non-conductive
ⓓ Between Segment - Armature Shaft	Non-conductive



5) Inspection of Brushes

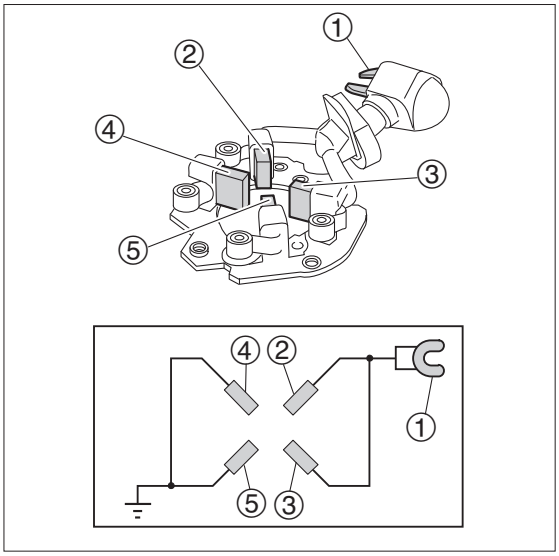
1. Measure brush length ⓐ, and replace brush if the length is less than specified value.

Brush Length ⓐ : Standard Value 16.0 mm (0.630 in)	
Wear Limit : 12.0 mm (0.472 in)	



2. Check conductivity between brush and starter terminal. Replace brush ass'y if any of the following conditions are not met.

Brush—Brush	②–③ ④–⑤	Conductive
Brush—Starter motor terminal	②–① ③–①	Conductive
Brush—Starter motor terminal	④–① ⑤–①	Non-Conductive
For all brush and terminal combinations not listed above		Non-Conductive

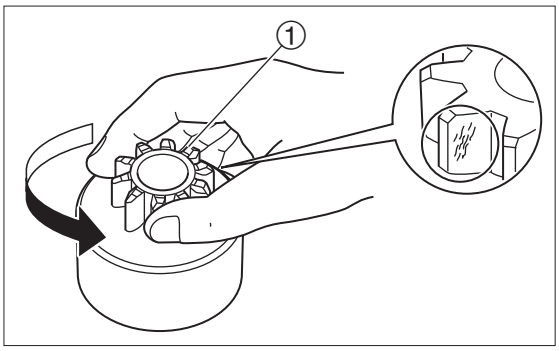


6) Inspection of Starter Motor Pinion

1. Check pinion teeth for crack and wear. Replace if necessary.

2. Turn only pinion to check that pinion ① can be rotated smoothly in one direction. Replace if necessary.

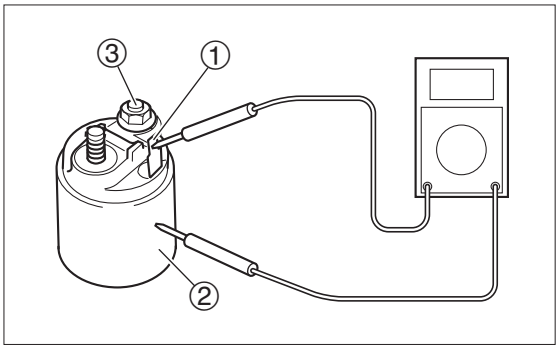
Turn pinion ① counterclockwise to check that it can move up smoothly, and then clockwise to check that it can be locking.



7) Inspection of Magneto Switch

1. Measure resistance of magneto switch. Replace magneto switch if the resistance is out of specified range.

Resistance of magneto switch at 20˚C (68 ˚F)
Holding side (between ① and ②): 0.56 to 0.68 Ω
Attracting side (between ① and ③): 0.33 to 0.41 Ω

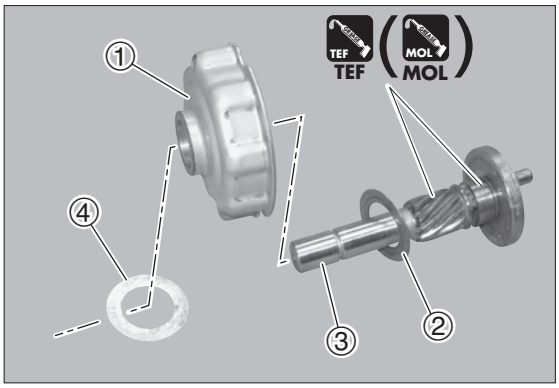


8

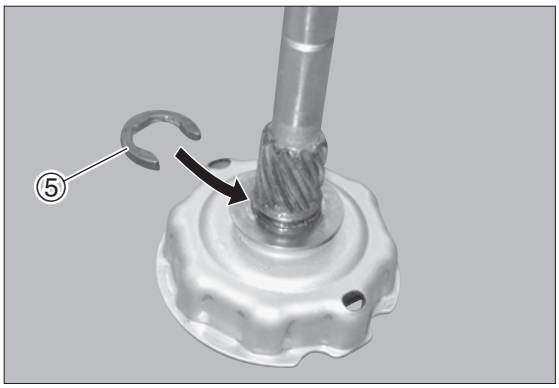
8) Assembly of Starter Motor

1. Attach washer ②, pinion shaft ③ and washer ④ to center bracket ① in this order.

Apply TEF grease or molybdenum grease to pinion shaft.

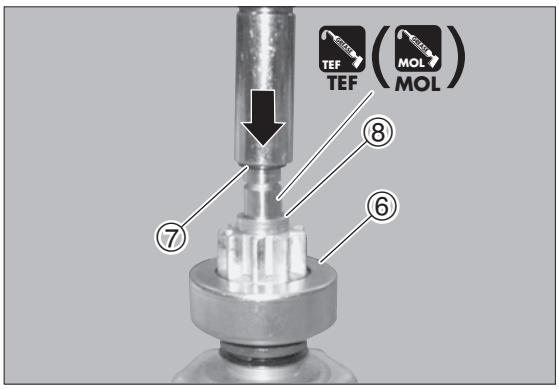


2. Attach E clip ⑤ to groove of pinion shaft.



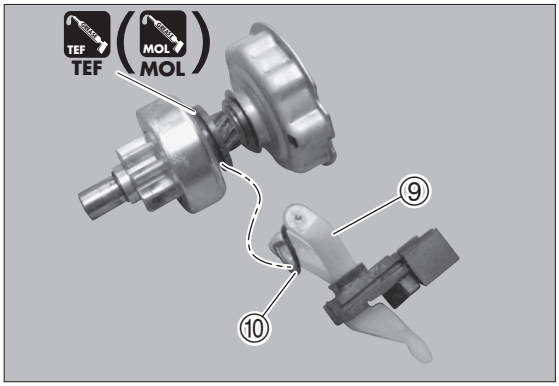
3. Attach pinion clutch ⑥ to pinion shaft, and secure with clip ⑦.

- Use new clip.
- Apply TEF grease or molybdenum grease to pinion shaft.
- Use 13mm deep socket wrench or equivalent when putting clip in the groove of pinion shaft.
- After attaching clip, raise pinion stopper ⑧ to lock it.

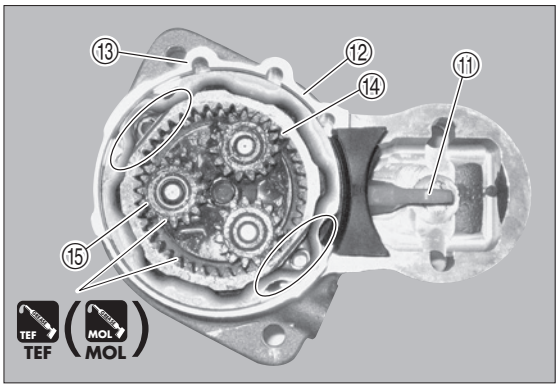


4. Insert torsion spring ⑩ of shift lever ⑨ into groove of pinion collar.

Apply TEF grease or molybdenum grease to pinion collar.

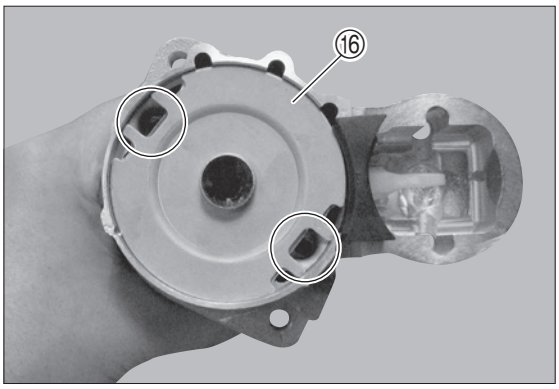


5. Attach shift lever ⑪ and pinion shaft ass'y ⑫ to center bracket ass'y ⑬, and then, put outer gear ⑭ and planetary gear ⑮.



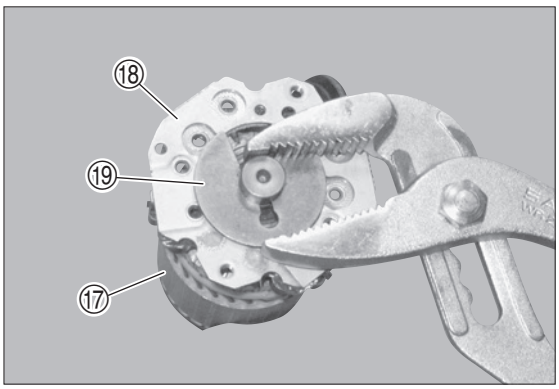
- Align center bracket ass'y and outer gear with bolt through holes, and attach to location shown.
- Put outer gear with chamfered side facing bracket.
- Apply TEF grease or molybdenum grease to pinion gear and outer gear.

6. Attach center plate A ⑯ to center bracket.



Align center place A with bolt through holes, and attach to location shown.

7. Attach armature ⑰ to brush holder ⑱, and install thrust washer A ⑲ to groove of shaft.



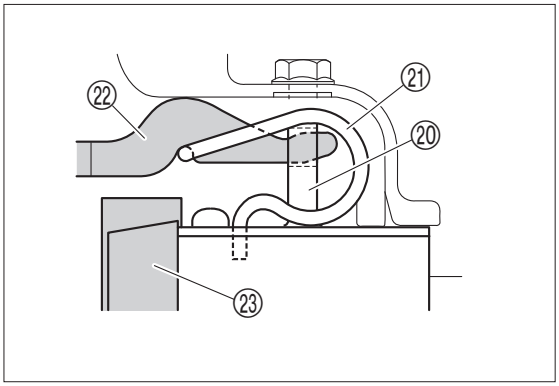
⚠ CAUTION

When attaching armature to bush holder, be careful not to give flaw and damage to commutator and brushes.

Insert commutator while pushing each brush outward.

8. Attach armature ass'y to starter motor rear cover, and secure with screws (M4, 2 pcs.).

9. Attach magneto switch ass'y, and secure by tightening bolts (M6, 2 pcs.) to specified torque.



Attach plunger ⑳, torsion spring ㉑, shift lever ㉒ and dust cover ㉓ of magneto switch by referring to illustration.

Magneto switch mounting bolt:
7 N · m (5 lb · ft) [0.7 kgf · m]

10. Attach other parts by reversing disassembling procedure.

Starter motor through bolt:
6 N · m (4 lb · ft) [0.6 kgf · m]

8

7. Battery Charging System

1) Inspection of Rectifier

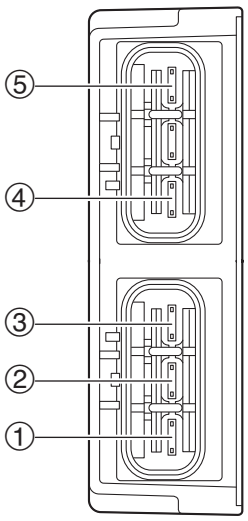
- Check wire harness for disconnection of lead wire and defective connection.
- Check conductivity between each point by referring to the following table.
- Perform the measurement with all connections disconnected to make the component a separated unit.

This test can be made without removing parts.

Rectifier Tester Check Chart
Between Terminal Resistance

		Tester Lead Positive (+) Terminal				
		1	2	3	4	5
Tester Lead Negative (–) Terminal	1		∞	∞	1.1kΩ – 12kΩ	∞
	2	∞		∞	1.1kΩ – 12kΩ	∞
	3	∞	∞		1.1kΩ – 12kΩ	∞
	4	∞	∞	∞		∞
	5	1.1kΩ – 12kΩ	1.1kΩ – 12kΩ	1.1kΩ – 12kΩ	1.6kΩ – 34kΩ	

Terminal No.



- Measurement Conditions : Type of Circuit Tester : HIOKI3030
  Measurement Range : 1kΩ
- Permissible Error of Resistance : ±20%

※: The resistance values may vary widely among circuit testers because of their error characteristics.

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, and measure as an independent unit.

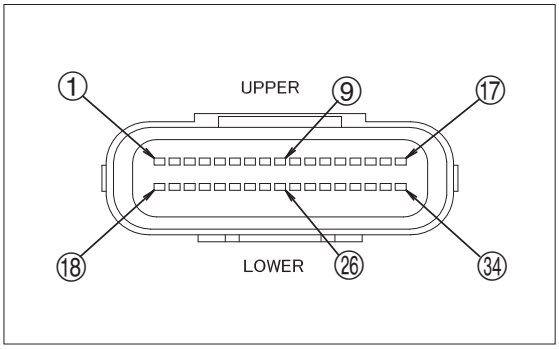
③ Any movement of pointer indicates "ON" or "conductive" state.

④ 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.

8. ECU Coupler

- Check wire harness for disconnection of lead wire and defective connection.
- Terminals are arranged and numbered as shown.
- The following table names of terminals, their numbers and lead wire colors.

Terminal	Name	Leads Wire (Color)	
A1	—		
A2	—		
A3	Com. GND	G	Green
A4	—		
A5	Com. Power Supply	R	Red
A6	TPS	L/W	Blue/White
A7	—		
A8	—		
A9	MAT Sensor	G/W	Green/White
A10	Engine TEMP Sensor	G/Y	Green/Yellow
A11	—		
A12	Variable Idle Speed Switch	L	Blue
A13	Stop Switch	Br	Brown
A14	—		
A15	ISC 4	G	Green
A16	ISC 3	G/B	Green/Black
A17	Pulser Coil (–)	B	Black
A18	Com. (mode)	L	Blue
A19	Com. (TXD)	Y	Yellow
A20	Com. (RXD)	W	White
A21	—		
A22	—		
A23	MAP Sensor	G/Or	Green/Orange
A24	Sensor Power Supply (5V)	R/W	Red/White
A25	—		
A26	GND for Sensor	B/L	Black/Blue
A27	—		
A28	Oil Pressure Switch	Br/W	Brown/White
A29	—		
A30	Tachometer	W	White
A31	—		
A32	ISC 2	G/R	Green/Red
A33	ISC 1	G/L	Green/Blue
A34	Pulser Coil (+)	R/W	Red/White

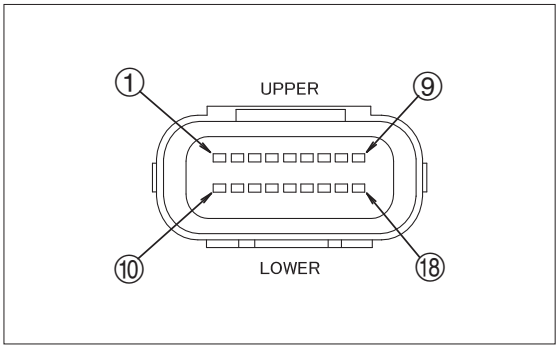


①②③④⑤⑥⑦⑧⑨⑩⑪⑫⑬⑭⑮⑯⑰

⑱⑲⑳㉑㉒㉓㉔㉕㉖㉗㉘㉙㉚㉛㉜㉝㉞

ECU A Connector

Terminal	Name	Leads Wire (Color)	
B1	Water Temperature Warning Lamp	Y/R	Yellow/Red
B2	Oil Pressure Warning Lamp	Lg	Light Green
B3	—		
B4	Main Switch Key	R/Y	Red/Yellow
B5	GND for Power Supply	B	Black
B6	Warning Buzzer	Y	Yellow
B7	Ignition Coil #3	B/G	Black/Green
B8	Ignition Coil #2	B/Y	Black/Yellow
B9	Ignition Coil #1	B/W	Black/White
B10	GND	B	Black
B11	Voltage Warning Lamp	G/R	Green/Red
B12	Fuel Feed Pump	L/B	Blue/Black
B13	Main Relay	Br/Y	Brown/Yellow
B14	Battery	L	Blue
B15	—		
B16	Injector #3	Lg/L	Light Green/Blue
B17	Injector #2	Lg/B	Light Green/Black
B18	Injector #1	Lg/R	Light Green/Red



①②③④⑤⑥⑦⑧⑨

⑩⑪⑫⑬⑭⑮⑯⑰⑱

ECU B Connector

9

Troubleshooting

1.Troubleshooting List

This troubleshooting information covers malfunctions and abnormalities of electrical parts which are warned of by the buzzer and warning lamp.

For the operations of the buzzer and warning lamp, refer to “Warning Indication List”.

Symptom	Item		Self-diagnosable (❍)	Beep	Warning indicator A 	Warning lamp B 	Warning lamp C 
Starter motor will not rotate or is slow.	1-1.	Shift					
	1-2.	Battery	❍				Flashing
	1-3.	Fuse					
	1-4.	Wiring					
	1-5.	Electrical components					
Engine can be cranked but will not start.	2-1. Power head	Compression insufficient					
	2-2. Fuel system	Fuel tank					
		Fuel filter					
		Fuel pressure is low. 0.29 MPa (43 psi) [3.0 kgf/cm^3±10%]	❍		Flashing	Flashing	Flashing

FFP (*1) : Fuel Feed Pump

Cause		Action to be taken (Refer to reference value or service data.)
1-1-1.	Shift is in "F" or "R" position.	Shift into neutral position.
1-2-1.	Battery is low, or battery cable or circuit connection is loose or corroded.	Replace battery or charge. Check terminals and cables.
1-3-1.	Fuse is burned.	Check all of three fuses. Check areas related to the fuses, and repair the part(s) and then, replace the fuse.
1-4-1.	Defective wire or electrical connections	
1-5-1.	Main switch, neutral switch, starter solenoid or starter motor malfunctions.	Check and replace as necessary.
2-1-1.	Piston ring(s) is seized.	Check, repair or replace as necessary.
2-1-2.	In or Ex valve have a gap, is worn or damaged.	
2-2-1.	Fuel tank is empty or fuel level is low.	Replenish fuel and perform operation described in 2-2-3.
2-2-2.	Air vent is closed.	Open air vent and perform operation described in 2-2-3.
2-2-3.	Water is found in the fuel filter.	Check if any water exists in the fuel line, and clean if necessary.
2-2-4.	Fuel is not supplied to fuel line.	Check if primary bulb is hard. Squeeze to make it hard if necessary, and set main switch to ON for 2 seconds. Repeat the operation until the bulb becomes hard.
2-2-5.	Lack of or no operation to feed fuel to fuel line after replenishing fuel.	
2-2-6.	Fuel filter is clogged.	Check interior of fuel tank, hull, and engine fuel filter, and clean or replace fuel filter if necessary.
2-2-7.	Fuel hose is clogged.	Check fuel hose if they are twisted, collapsed or bent.
2-2-8.	FFP (*1) is not operating.	Check that the motor in the FFP (*1) assembly generates operating noise for approximately 2 seconds when main switch key is turned from [OFF] to [ON] position.
2-2-9.	FFP (*1) internal component(s) is damaged.	Replace FFP (*1) with new one.
2-2-10.	FFP (*1) leaks in the case.	Check FFP or seal rubber of its internal parts.

Symptom	Item		Self-diagnosable (❍)	Beep	Warning indicator A	Warning lamp B	Warning lamp C
Engine can be cranked but will not start.	2-2. Fuel system	Fuel pressure is low. 0.29 MPa (43 psi) [3.0 kgf/cm^3±10%]					
		Fuel pressure is high. 0.29 MPa (43 psi) [3.0 kgf/cm^3±10%]					
	2-4. Electrical System	Fuse					
		Stop switch					
		Fuel injector					
		Spark plug					
		Spark plug cap					
		Crank position sensor					
		ECU					
		Self-diag. reports that battery voltage is abnormally low.	❍				Flashing
		Self-diag. reports that a component is abnormal.	❍				
		Self-diag. reports that TPS (*2) is faulty.	❍				

TPS (*2) : Throttle Position Sensor

Cause		Action to be taken (Refer to reference value or service data.)
2-2-12.	Fuel regulator is faulty.	Replace.
2-2-13.	Fuel leak	Check hose damage and joints.
2-2-14.	Vapor separator to fuel regulator inlet passage is obstructed.	Check, and repair if necessary.
2-2-15.	Fuel regulator is faulty.	Replace.
2-4-1.	Fuse is burnt.	Check the cause of fuse burning (overload), and replace the fuse after repairing.
2-4-2.	Lock is removed.	Check.
2-4-3.	Stop switch is short-circuited.	Check, and repair if necessary.
2-4-4.	Fuel injector is deposited with carbon or malfunctions.	Clean, or replace if necessary. Connect injector(s) to harness, and the injector should produce operating noise (click) during cranking.
2-4-5.	Spark plug (s) is faulty.	Correct the gap is out of specified range. Electrode is worn much. Replace if cracked or damaged. Replace if electricity leaks at the gap due to carbon deposit or electrode is entirely black due to carbon deposits. Replace if fuel fouled, also a carbon fouled plug will give an ignition coil code replace plug and clear the code.
2-4-6.	Cap is loose.	Check.
2-4-7.	Cap is faulty.	Replace.
2-4-8.	CPS Gap.	Check, and adjust if necessary.
2-4-9.	ECU malfunction.	Replace ECU.
2-4-10.	Battery power is low. Battery voltage becomes less than 10 V at cranking due to faulty starter motor.	Replace battery or charge. Check terminals and cables. Check starter motor.
2-4-11.	As component malfunction, connection is faulty or wire-harness is broken.	Check, and repair or replace if necessary.
2-4-12.	TPS (*2) malfunction.	Check, and replace if necessary.

Symptom	Item		Self-diagnosable (❍)	Beep	Warning indicator A	Warning lamp B	Warning lamp C
Engine can be cranked and starts, but idling cannot be maintained or is unstable.	3-1. Power Head	Engine revolution is slow (seizure).					
		Compression insufficient					
	3-2. Fuel System	Fuel tank					
		Fuel filter					
		Fuel pressure is low. 0.29 MPa (43 psi) [3.0 kgf/cm^3±10%]					
		Fuel pressure is high. 0.29 MPa (43 psi) [3.0 kgf/cm^3±10%]					
	3-4. Electrical System	Spark plug					
		Spark plug cap					
		Self-diag. reports component abnormality.	❍				
		Self-diag. reports TPS (2) is faulty.	❍				
		Fuel injector					
Idling speed is too high.	4-1. Electrical System	Variable idle switch					
		Self-diag. reports TPS (2) is faulty.	❍		Flashing	Flashing	Flashing

FFP (*1) : Fuel Feed Pump TPS (*2) : Throttle Position Sensor Lift pump (*3) : Diaphragm type fuel pump

Cause		Action to be taken (Refer to reference value or service data.)
3-1-1.	Piston has a scratch or a cause that produces resistance.	Check, and repair if necessary.
3-1-2.	Piston ring(s) is seized.	
3-1-3.	In or Ex valve have a gap, is worn or damaged.	
3-1-4.	Cylinder head gasket or engine base gasket is faulty.	
3-1-5.	Head bolt(s) or crank case bolt(s) is loose.	
3-2-1.	Fuel is empty or low in the tank.	Refer to 2-2-1.
3-2-2.	Air vent is closed.	Refer to 2-2-2.
3-2-3.	Water is deposited in the fuel filter.	Check interior of fuel tank, hull, and engine fuel filter, and clean or replace fuel filter if necessary.
3-2-4.	Fuel filter is clogged.	
3-2-5.	Fuel hose is clogged.	Check fuel hoses if they are twisted, collapsed or bent.
3-2-6.	Lift pump (*3) is not operating.	Check, and repair if necessary. Or replace.
3-2-7.	FFP (*1) leaks in the case.	Refer to 2-2-10.
3-2-8.	Fuel regulator is faulty.	Refer to 2-2-12.
3-2-9.	Fuel leaks.	Refer to 2-2-13.
3-2-10.	Fuel pressure is low.	Refer to 2-3.
3-2-11.	Fuel regulator is faulty.	Replace.
3-2-12.	Vapor separator to fuel regulator inlet passage is obstructed.	Check, and repair if necessary.
3-4-1.	Refer to 2-4-3.	Refer to 2-4-3.
3-4-2.	Cap is loose.	Check.
3-4-3.	Cap is faulty.	Replace.
3-4-4.	Component malfunction or loose connection	Check, and repair if necessary. Or replace.
3-4-5.	TPS (*2) malfunction.	Check, and replace if necessary.
3-4-7.	Malfunction	Clean, or replace if necessary. Connect injector(s) to harness, and the injector should produce operating noise (click) during cranking.
4-1-1.	Idle revolution setting is changed.	Change setting of idling revolution by using variable idle switch.
4-1-2.	TPS (*2) malfunction.	Check, and replace if necessary.

Symptom	Item		Self-diagnosable (❍)	Beep	Warning indicator A	Warning lamp B	Warning lamp C
							
Engine revolution is unstable at 2800rpm or higher.	5-1.	Spark plug					
	5-2.	Engine speed is controlled. (due to ESG)					
	5-3.	Fuel pressure is low.					
	5-4.	TPS (*2) function is faulty.					
Engine will not fully increase speed with wide open throttle.	6-1. Power head	Throttle arm will not move.					
		Compression insufficient 1.4 MPa (203 psi) [14.27 kgf/cm^2] ± 10 %					
	6-2. Fuel System	Fuel tank					
		Fuel hose					
		Fuel filter					
		Fuel pressure is low. 0.29 MPa (43 psi) [3.0 kgf/cm^3±10%]					
	6-3. Electrical System	Spark plug					
		Fuel injector					
		Self-diag. reports component abnormality.	❍				

FFP (*1) : Fuel Feed Pump
TPS (*2) : Throttle Position Sensor

Cause		Action to be taken (Refer to reference value or service data.)
5-1-1.	Refer to 2-4-3.	Refer to 2-4-3.
5-1-2.	Refer to 10-1.	Refer to 10-1.
5-1-3.	Refer to 3-2.	Refer to 3-2.
5-1-4.	Refer to 2-4-12.	Refer to 2-4-12.
6-1-1.	Remote control cable is installed incorrectly.	Check, and adjust if necessary.
6-1-2.	Throttle link component(s) is deformed or worn.	Check, and replace if necessary.
6-1-3.	Piston or cylinder liner is scratched.	Check, and repair if necessary.
6-1-4.	Combustion chamber is deposited with carbon.	
6-1-5.	Piston ring is worn abnormally or seized.	
6-1-6.	Crankcase head oil seal is faulty.	Check, and repair if necessary.
6-2-1.	Fuel tank is empty or fuel level is low.	Refer to 2-2-1.
6-2-2.	Air vent is closed.	Refer to 2-2-2.
6-2-3.	Sucks air through crack or loose connection.	Check, and repair if necessary.
6-2-4.	Water is in the fuel filter.	Check and clean if necessary.
6-2-5.	Fuel filter is clogged.	Check interior of fuel tank, hull, and engine fuel filter, and clean or replace fuel filter if necessary.
6-2-6.	Fuel hose is clogged.	Check fuel pipes if they are twisted, collapsed or bent.
6-2-7.	Lift pump is not operating.	Check, and repair if necessary. Or replace.
6-2-8.	FFP (*1) leaks in the case.	Check internal component rubber seal and electric fuel pump.
6-2-9.	Fuel regulator leaks.	Replace.
6-2-10.	Fue leaks.	Check hose damage and connections.
6-3-1.	Refer to 2-4-3.	Refer to 2-4-3.
6-3-2.	Fuel injector deposited with carbon.	Check. and clean, or replace if necessary.
6-3-3.	Component(s) malfunctions or connections are loose.	Check, and repair or replace if necessary.

Symptom	Item		Self-diagnosable (❍)	Beep	Warning indicator A	Warning lamp B	Warning lamp C
Engine accelerates but boat will not.	7-1. Outboard Motor	Propeller					
		Installation					
		Boat					
Turning of main switch will not stop engine.	8-1. Electrical System	Main Switch					
		Stop Switch					
		Ground Wire					
Throttling up will not increase engine speed over 2800rpm. Engine speed is reduced to 2800rpm and is limited.	10-1. Electrical Control	Engin temp. is high (100 ºC) *In addition, forced idle A, B, C, and lamp flashes when the engine temp. israised (140 ºC) .	❍	Continuous sounding		Flashing	
			❍	Continuous sounding		Flashing	
			❍	Continuous sounding		Flashing	
			❍	Continuous sounding		Flashing	
		Battery voltage is abnormally low. (Battery lamp is flashing.)	❍				Flashing
			❍				Flashing
			❍				Flashing
			❍				Flashing
			❍				Flashing
		TPS does not function.	❍		Flashing	Flashing	Flashing

TPS (*2) : Throttle Position Sensor

Cause		Action to be taken (Refer to reference value or service data.)
7-1-1.	Incorrect propeller selection	Check, and repair or replace if necessary.
7-1-2.	Propeller slips on the shaft.	
7-1-3.	Propeller is deformed or damaged.	
7-1-4.	Shaft length - boat transom mismatching	Check, and adjust if necessary.
7-1-5.	Trim angle incorrect	
7-1-6.	Boat's bottom is foul.	Check, and clean if necessary.
7-1-7.	Boat loading position incorrect	Check, and adjust if necessary.
7-1-8.	Boat is overloaded.	
7-1-9.	Hull shape incorrect.	
8-1-1.	Main switch contact point is faulty or harness is internally broken.	Check, and repair if necessary. Or replace.
8-1-2.	Stop switch contact point is faulty or harness is internally broken.	
8-1-3.	Ground wire connection is loose or harness is internally broken.	
10-1-1.	Cooling water inlet is blocked.	Check, and repair if necessary.
10-1-2.	Water pump is faulty.	
10-1-3.	Thermostat is faulty.	
10-1-4.	Cooling water passage is blocked.	
10-1-5.	Battery is faulty.	Replace.
10-1-6.	Charging coil is faulty.	Check, and replace if necessary.
10-1-7.	Charging coil wiring is broken.	Check, and repair if necessary.
10-1-8.	Battery cable or electrical connection is faulty.	
10-1-9.	Rectifier-regulator is faulty.	Check, and replace if necessary.
10-1-10.	TPS (*2) malfunctions, wire is not connected or wire harness is broken.	Check, and repair if necessary. Replace.

Troubleshooting

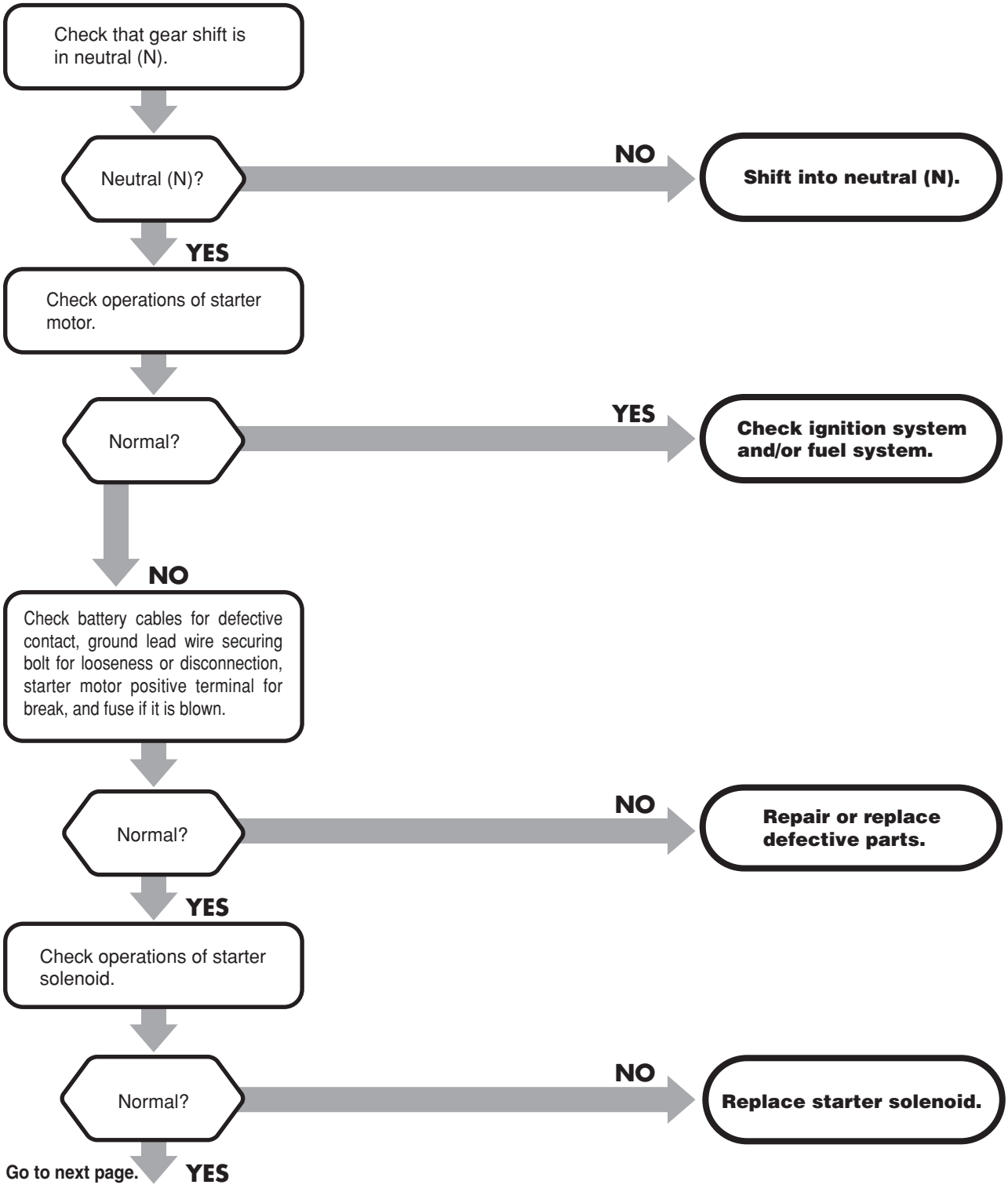
	Engine will not start	Engine speed is unstable	Defective acceleration / Defective ideling	Battery is not charged	Starter motor will not operate	Powertilt will not operate	Warning lamp A is lit	Warning lamp B blinks	Warning lamp C blinks	Three warning lamps blink	Warning buzzer operate	Probable Cause
Fuel Systems	●											Fuel level is low in the tank.
	●	●	●									Fuel system connection is incomplete.
	●	●	●									Fuel system sucks air.
	●	●	●									Fuel pipe is twisted, damaged.
	●	●	●									Cap vent is closed.
	●	●	●									Fuel filter, fuel pump or injector is clogged.
	●	●	●									Fuel feed pump (FFP) malfunctions or is clogged.
			●				●					Low quality engine oil is used.
	●	●	●									Low quality gasoline is used.
	●											Forget fuel pumped in the primer bulb.
Electrical System	●	●	●	●	●	●	●	●	●	●		Defective wiring, ground, wire disconnected or loosened.
		●	●									Use of spark plugs not specified.
	●	●	●									Spark plug is contaminated.
	●	●	●									No sparks or weak spark.
	●											Stop switch short-circuited.
	●											Stop switch lock is not put.
				●					●			Rectifier malfunctions.
	●				●	●						Fuse is blown.
	●				●							Shift lever neutral (N) position is not proper.
	●			●	●	●			●			Battery is dead, connection is loose or corroded. Battery electrolyte level is low.
	●				●							Key sewitch malfunctions.
	●				●							Starter motor or starter solenoid operation is defective.
						●						PTT switch or solenoid is defective.
Compression and Lubrication Systems	●	●	●									Compression pressure is low.
		●	●									Combustion chamber car deposition is too much.
		●	●									Valve clearance is defective.
			●				●				●	Oil pressure is low, oil level is low, oil pump is defective (Oil pressure switch operates).
		●	●					●		●	●	Cooling water is lacking, pump is defective or clogged.
Others		●	●					●		●	●	Thermostat operation is defective.
		●	●					●		●	●	Anti-cavitation plate is damaged.
		●	●								●	Use of mismatched propeller.
		●	●								●	Propeller is damaged or deformed.
			●									Thrust rod position is not correct.
			●									Boat is unbalanced by load position.
		●	●								●	Transom installation height is too high or too low.
						●						Air is mixed in PTT fluid.
			●									Throttle link adjustment is defective.

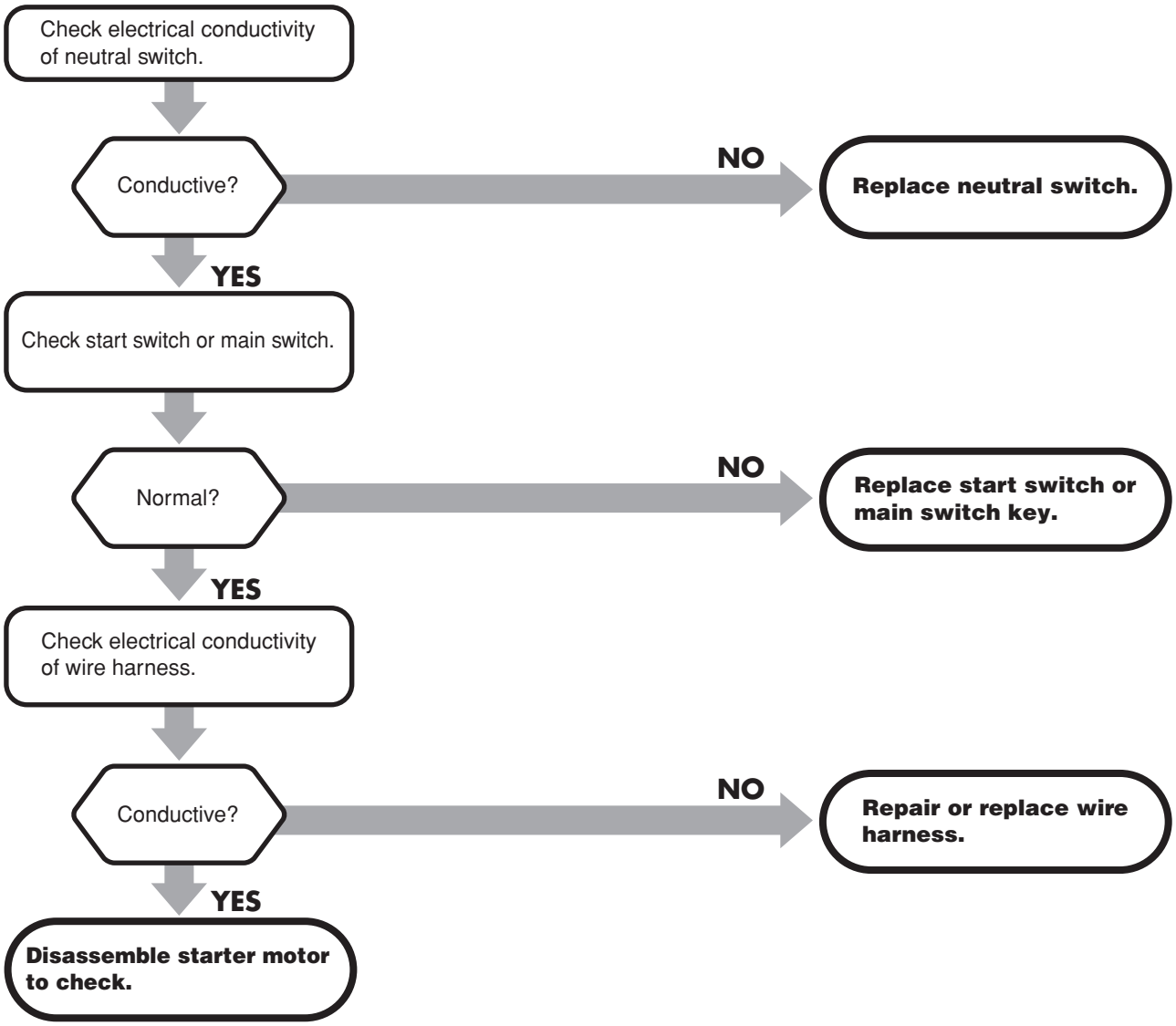
Before working on the engine, check that full, rigging and engine installation are normal, and then battery is fully charged. For mechanical troubleshooting, refer to relevant troubleshooting section in this chapter. For checking and servicing outboard motor, refer to service procedures described in this manual to perform the works safely.

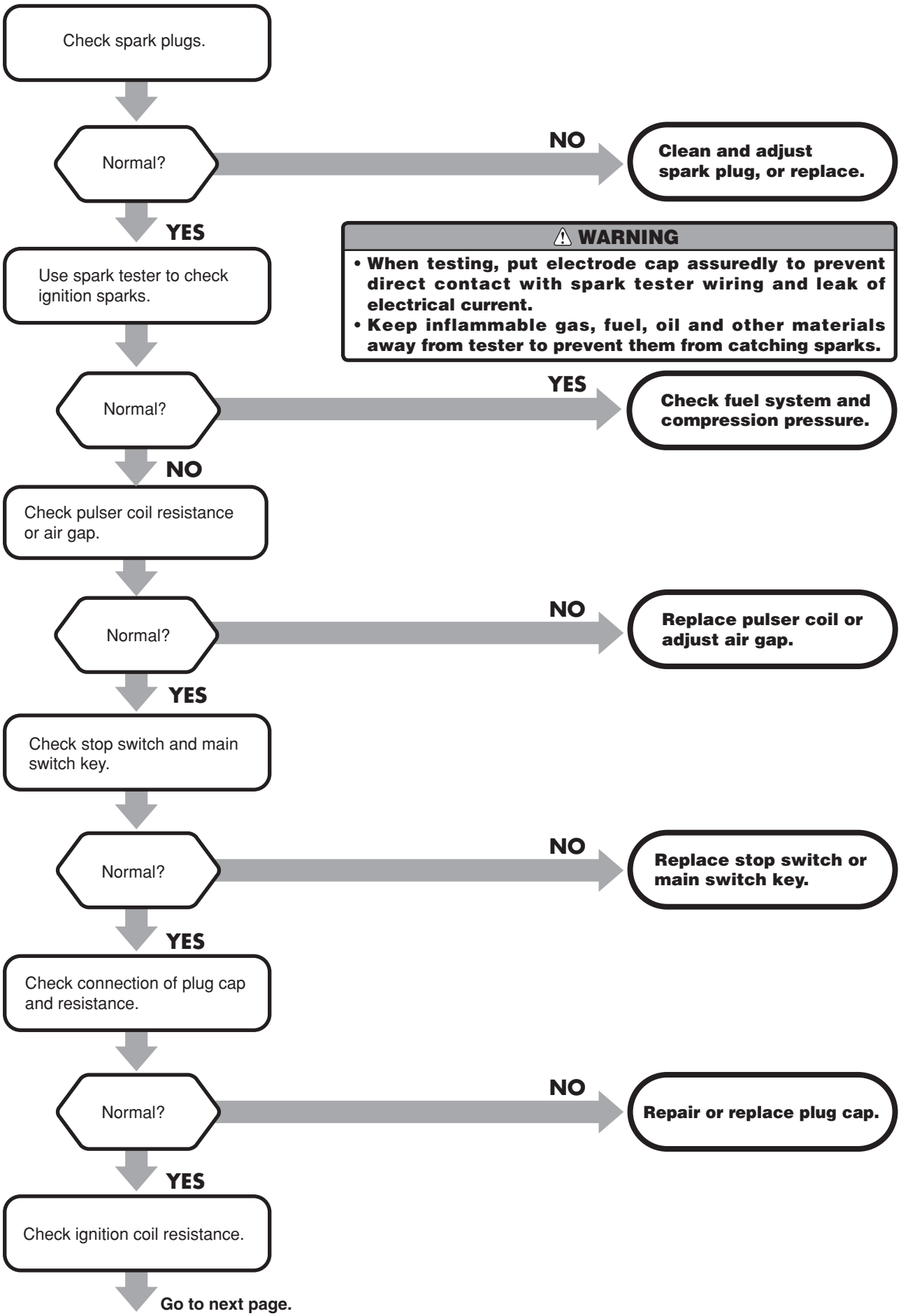
Power Unit

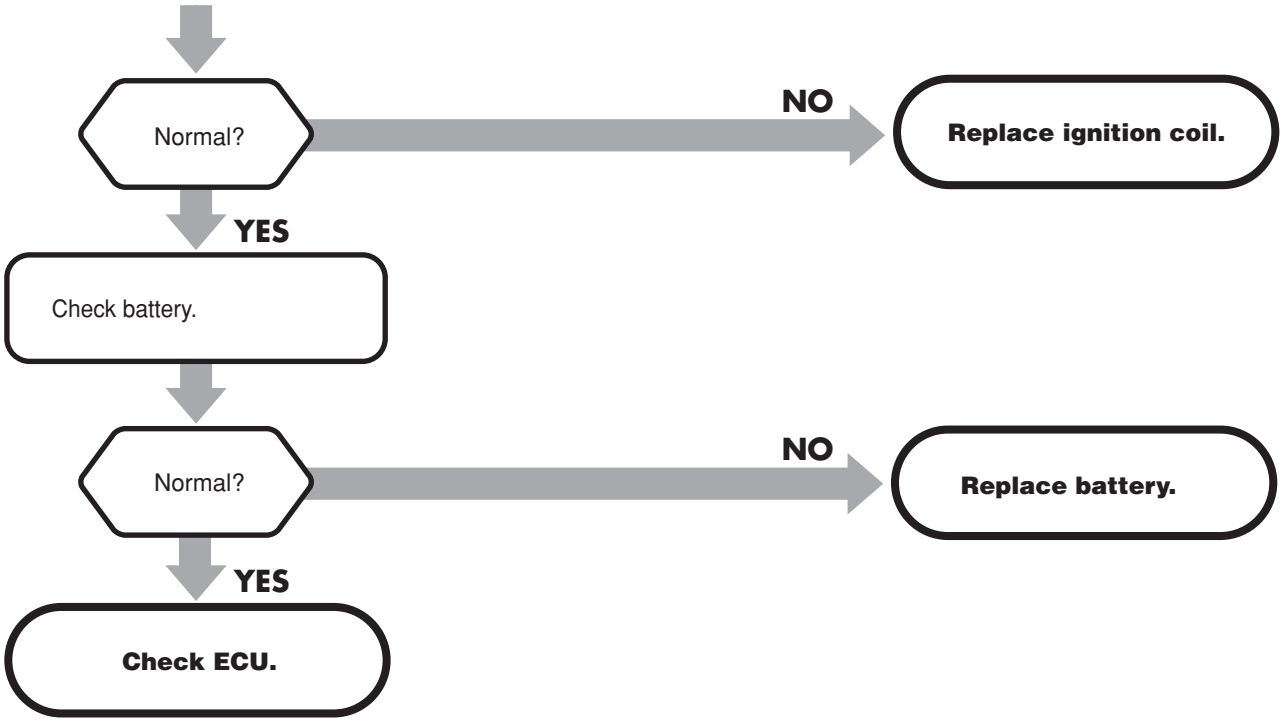
State 1 **Engine will not start or is a little hard to start.**

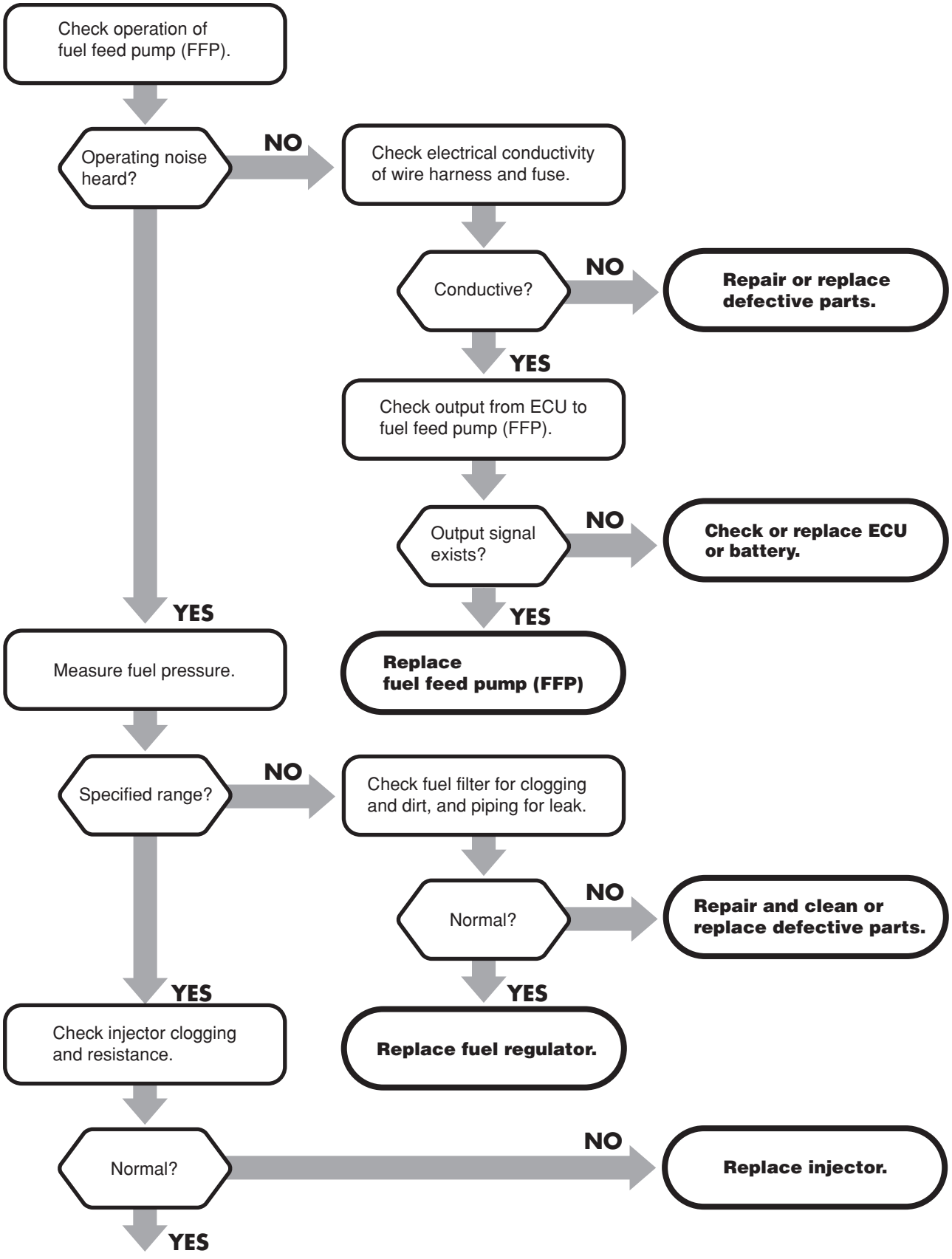
Starting System




Check electrical conductivity of neutral switch.
Conductive?
NO
Replace neutral switch.
YES
Check start switch or main switch.
Normal?
NO
Replace start switch or main switch key.
YES
Check electrical conductivity of wire harness.
Conductive?
NO
Repair or replace wire harness.
YES
Disassemble starter motor to check.


Check spark plugs.
Normal?
NO
Clean and adjust spark plug, or replace.
YES
Use spark tester to check ignition sparks.
⚠ WARNING
• When testing, put electrode cap assuredly to prevent direct contact with spark tester wiring and leak of electrical current.
• Keep inflammable gas, fuel, oil and other materials away from tester to prevent them from catching sparks.
Normal?
YES
Check fuel system and compression pressure.
NO
Check pulser coil resistance or air gap.
Normal?
NO
Replace pulser coil or adjust air gap.
YES
Check stop switch and main switch key.
Normal?
NO
Replace stop switch or main switch key.
YES
Check connection of plug cap and resistance.
Normal?
NO
Repair or replace plug cap.
YES
Check ignition coil resistance.
Go to next page.


Normal?
NO
Replace ignition coil.
YES
Check battery.
Normal?
NO
Replace battery.
YES
Check ECU.



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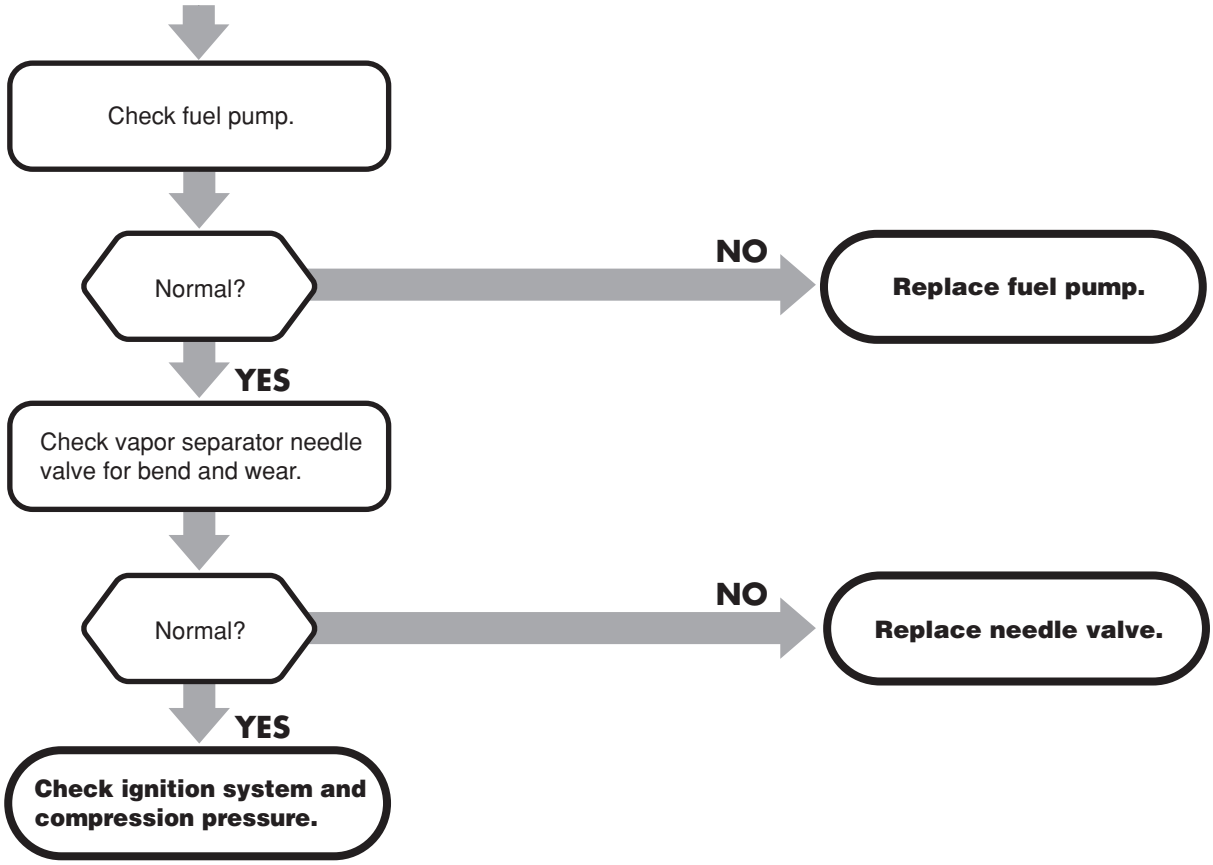
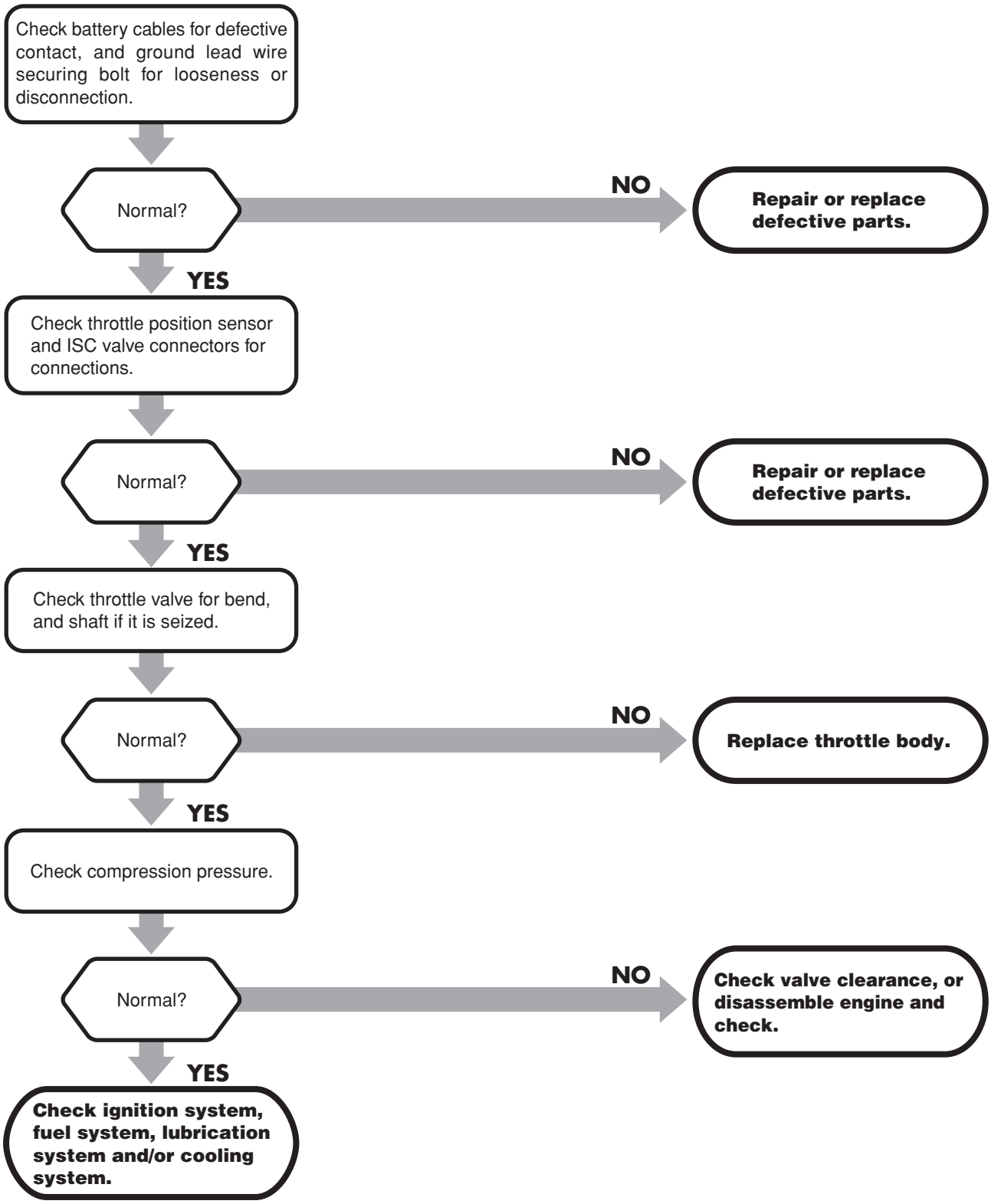
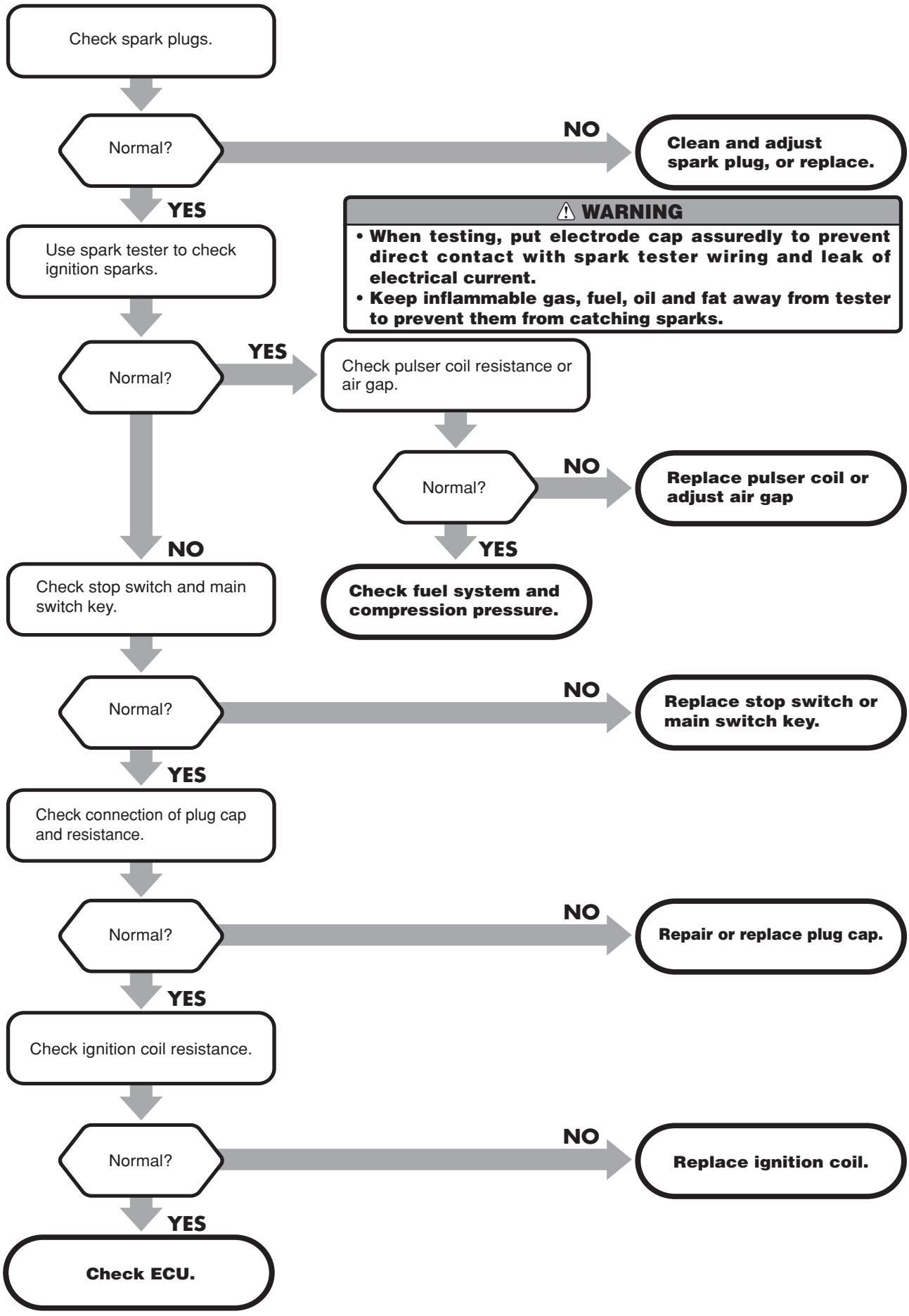

Check fuel pump.
Normal?
NO
Replace fuel pump.
YES
Check vapor separator needle valve for bend and wear.
Normal?
NO
Replace needle valve.
YES
Check ignition system and compression pressure.

State 2 Full throttle engine revolution speed is low. Engine revolution speed fall off. Engine stalls. (Defective acceleration or deceleration)

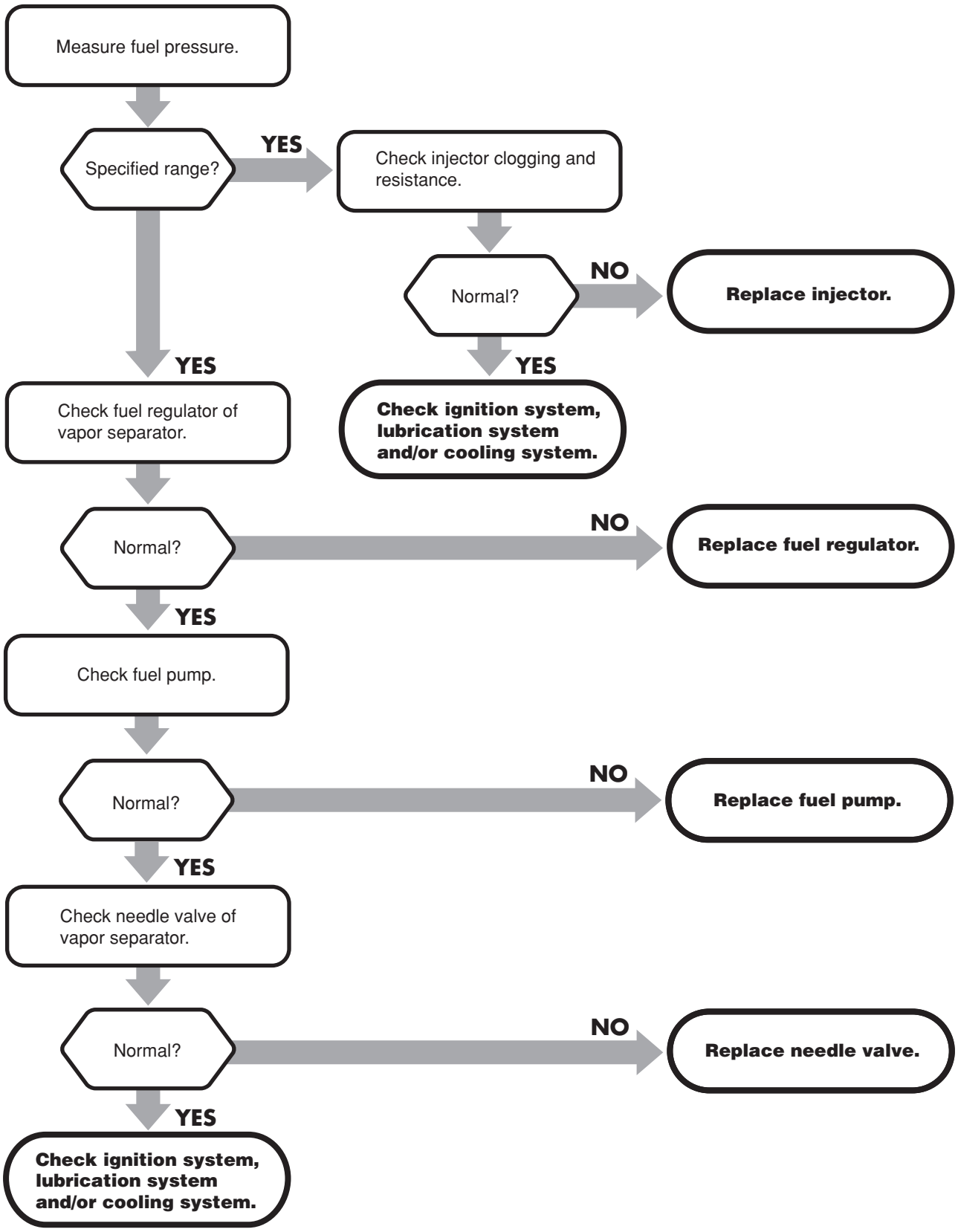


9

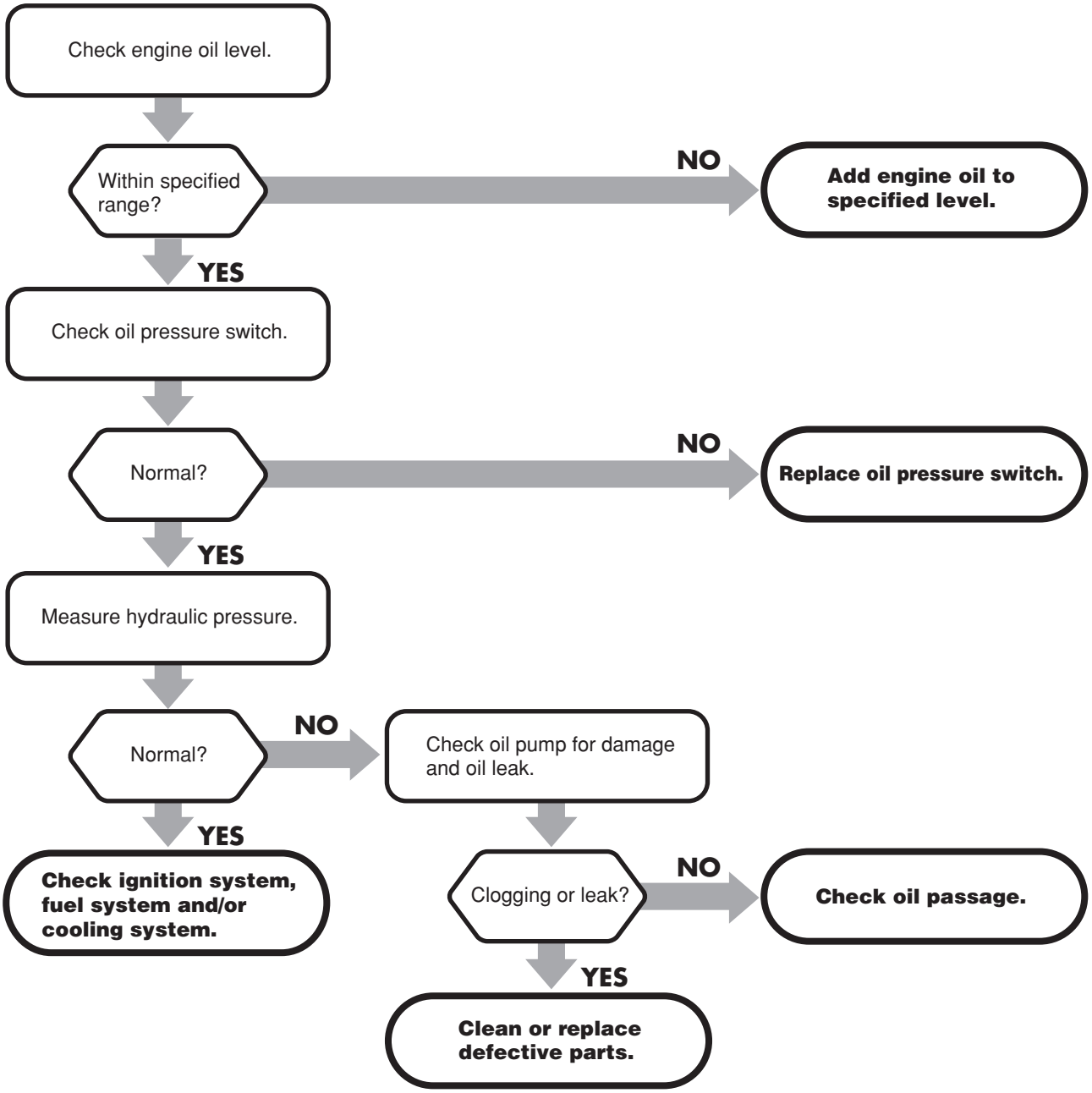
Ignition System



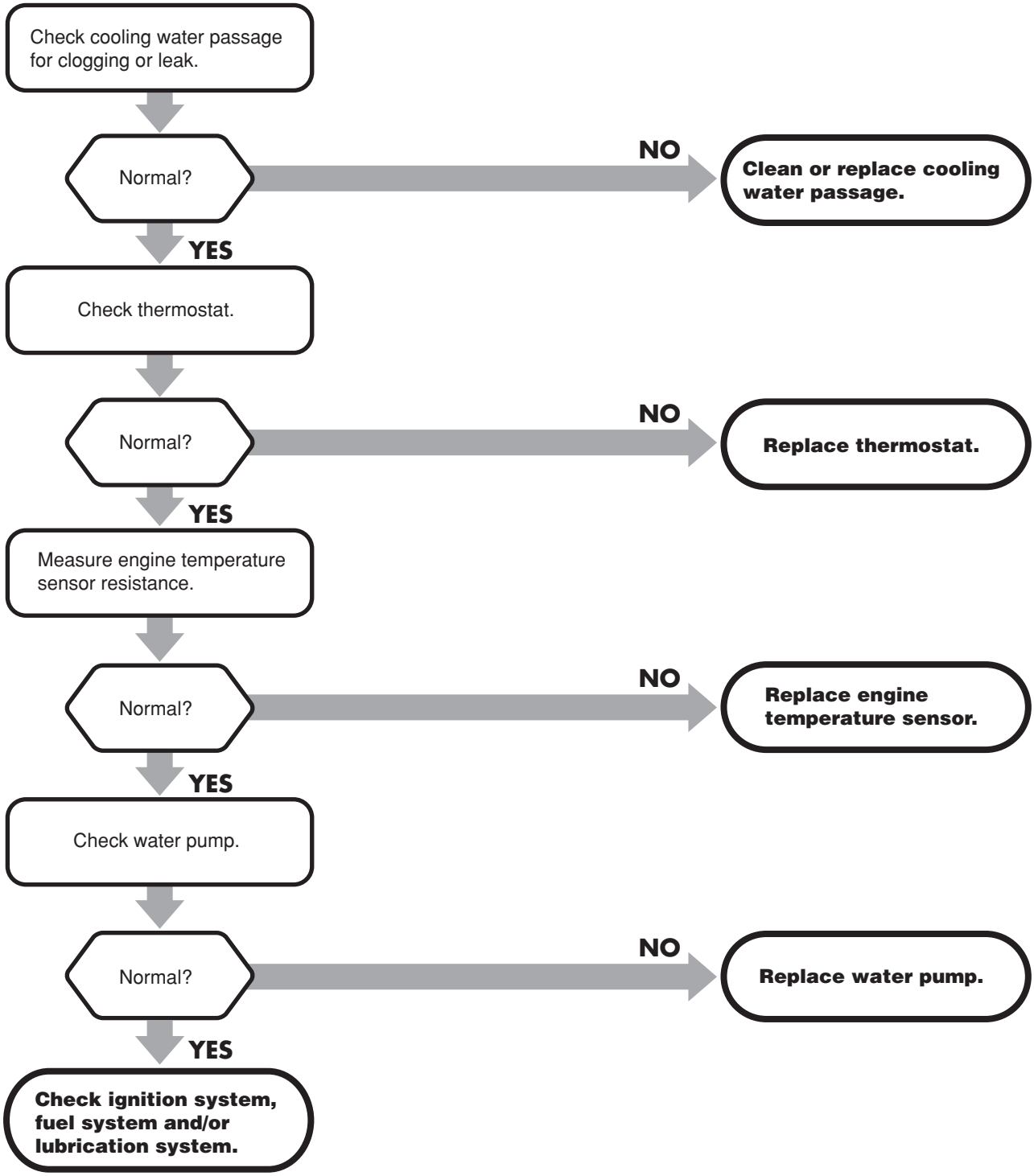
Fuel System


Measure fuel pressure.
Specified range?
YES
Check injector clogging and resistance.
Normal?
NO
Replace injector.
YES
Check ignition system, lubrication system and/or cooling system.
YES
Check fuel regulator of vapor separator.
Normal?
NO
Replace fuel regulator.
YES
Check fuel pump.
Normal?
NO
Replace fuel pump.
YES
Check needle valve of vapor separator.
Normal?
NO
Replace needle valve.
YES
Check ignition system, lubrication system and/or cooling system.

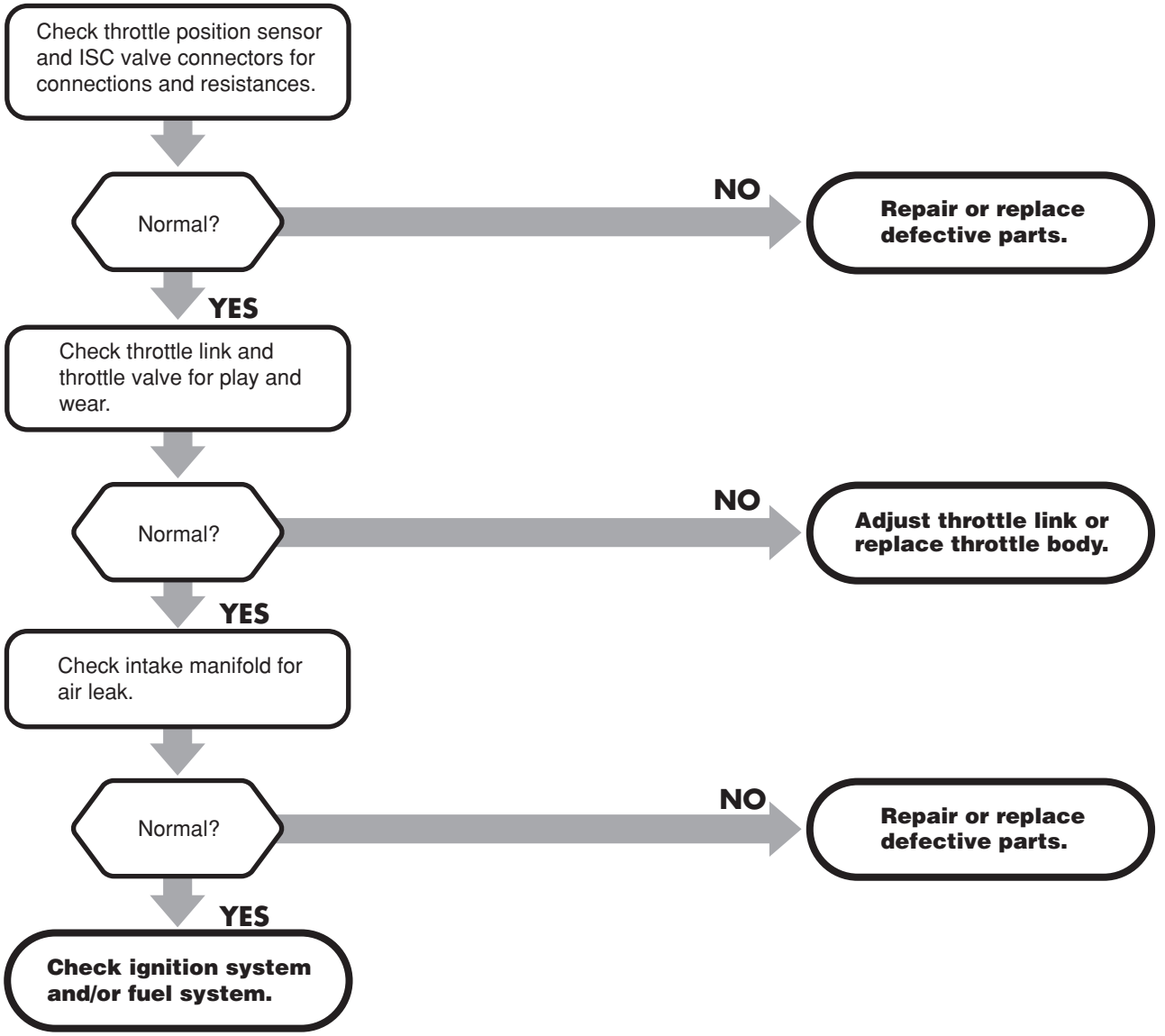
Lubrication System



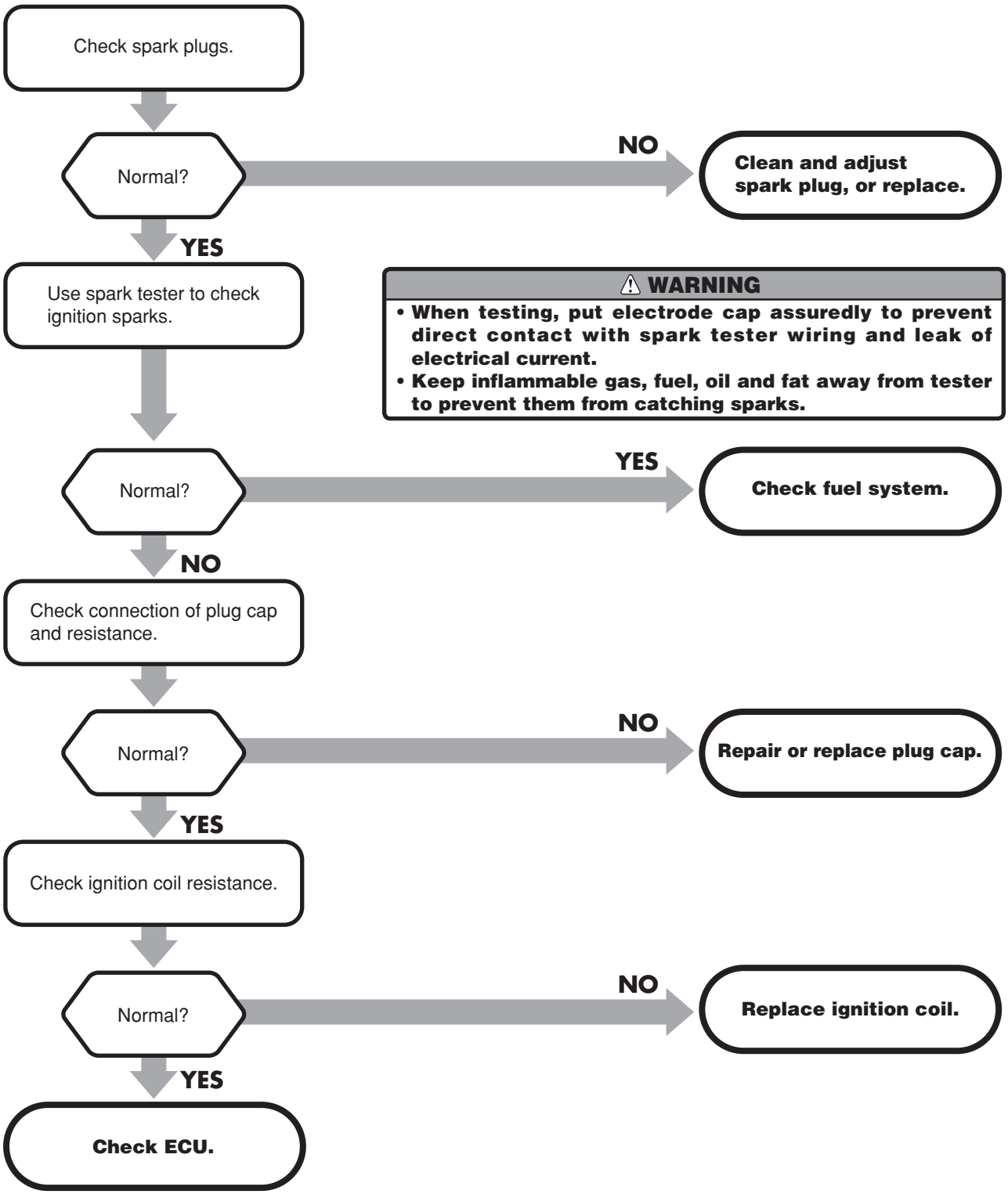
Cooling System



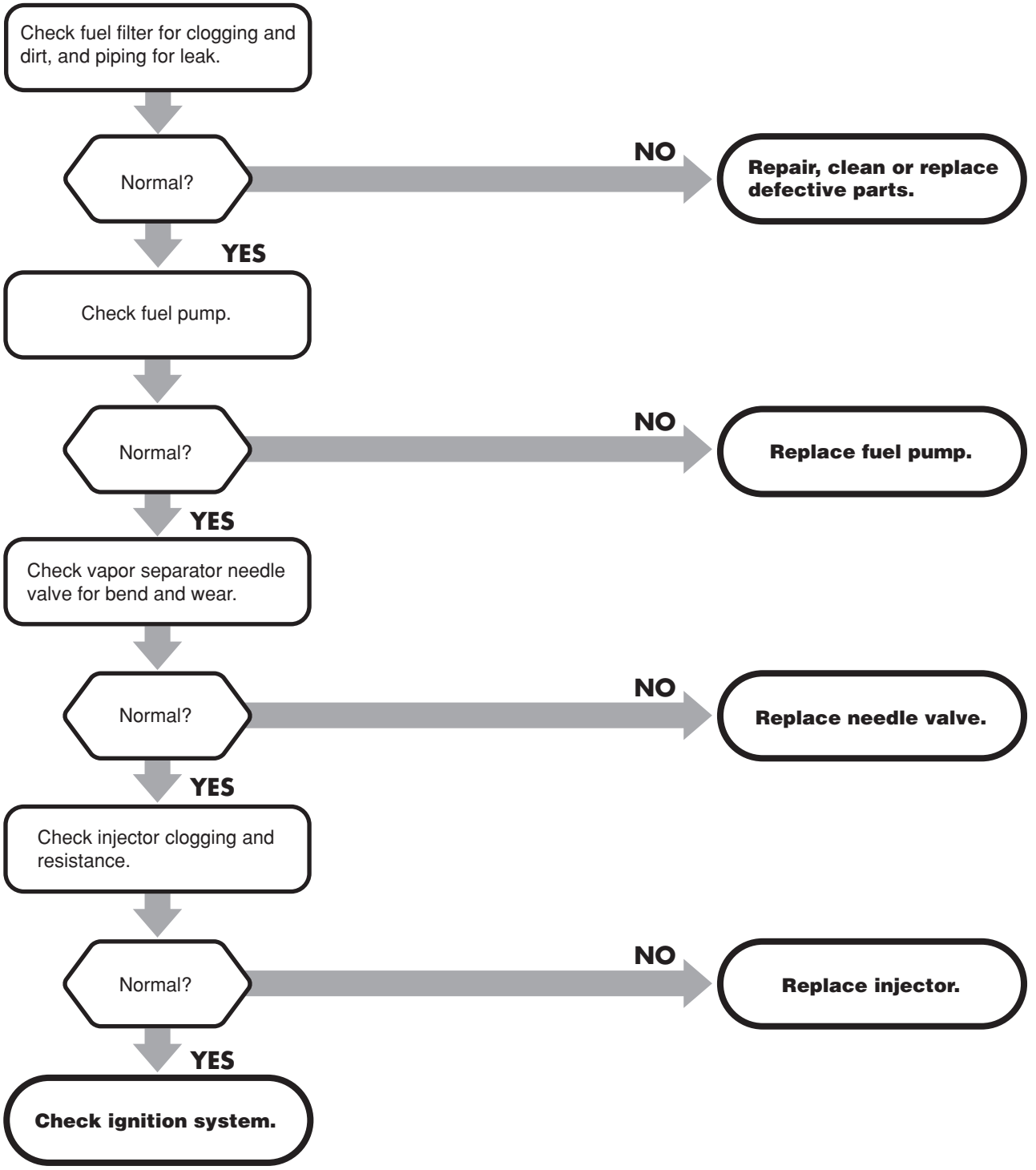
State 3 **Engine rotation is unstable or hunting occurs in low speed range.**



Ignition System

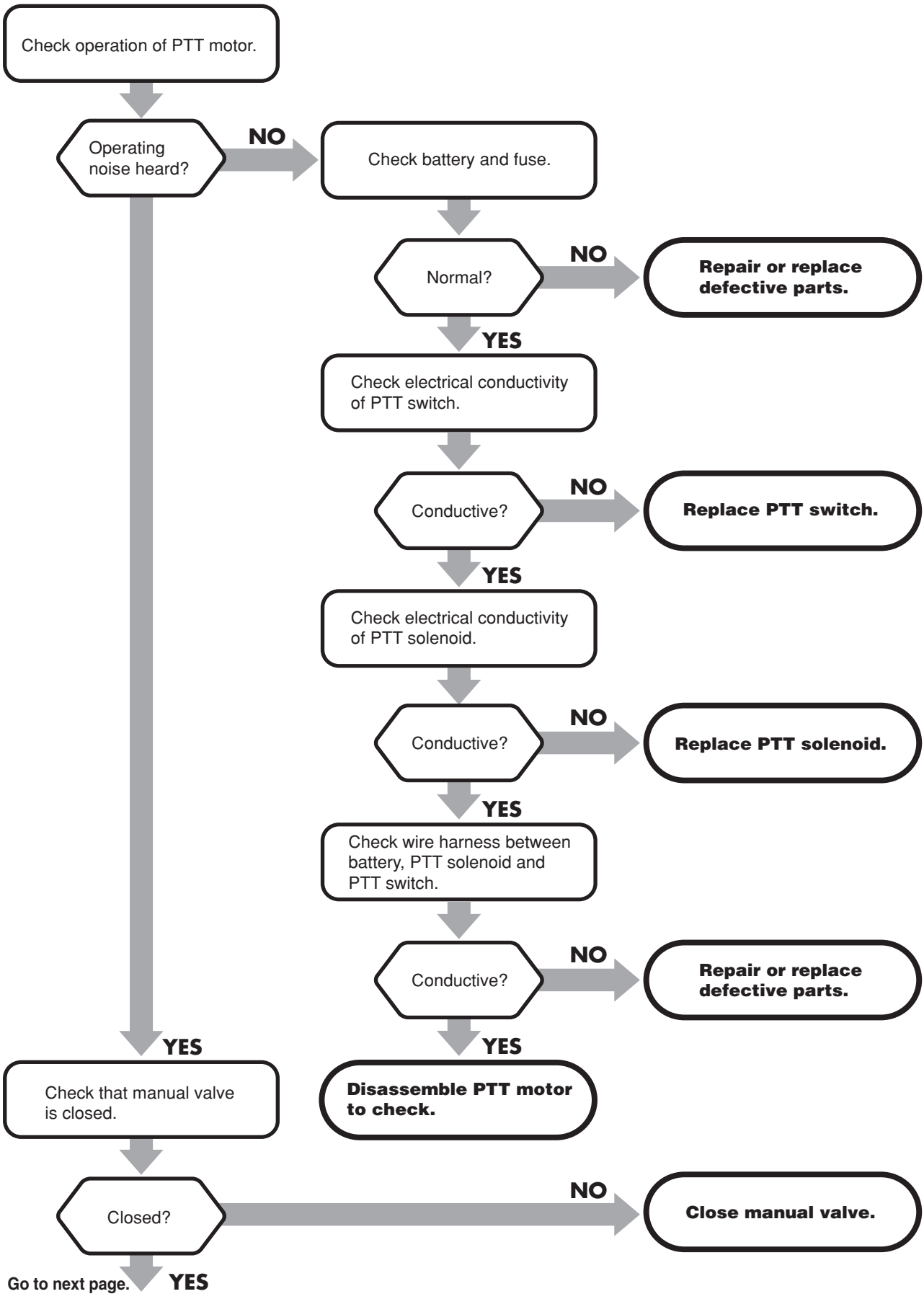


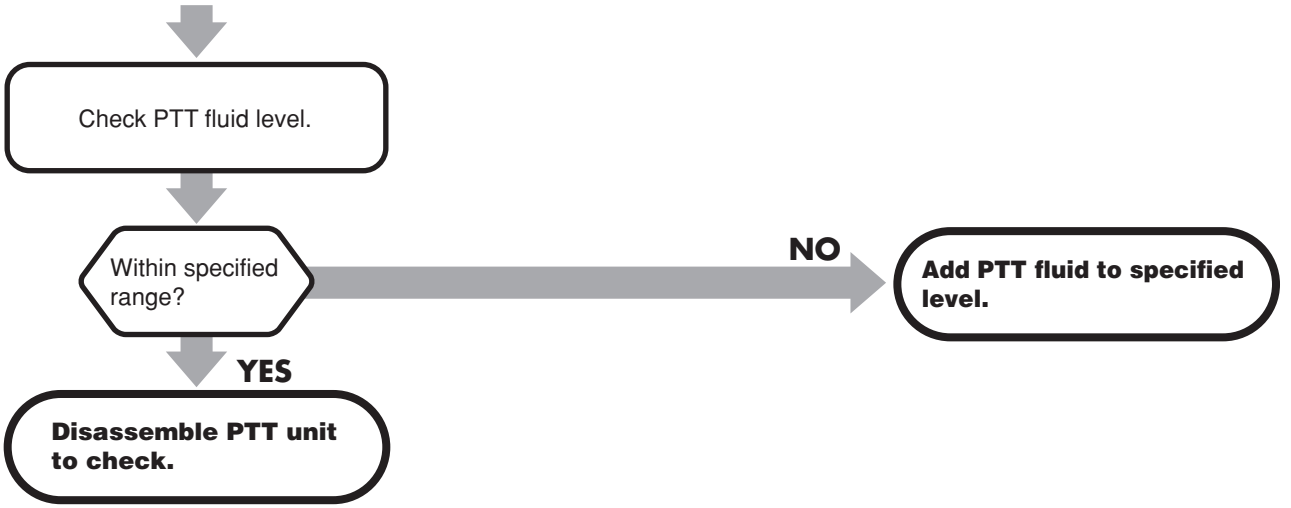
Fuel System


Check fuel filter for clogging and dirt, and piping for leak.
Normal?
NO
Repair, clean or replace defective parts.
YES
Check fuel pump.
Normal?
NO
Replace fuel pump.
YES
Check vapor separator needle valve for bend and wear.
Normal?
NO
Replace needle valve.
YES
Check injector clogging and resistance.
Normal?
NO
Replace injector.
YES
Check ignition system.

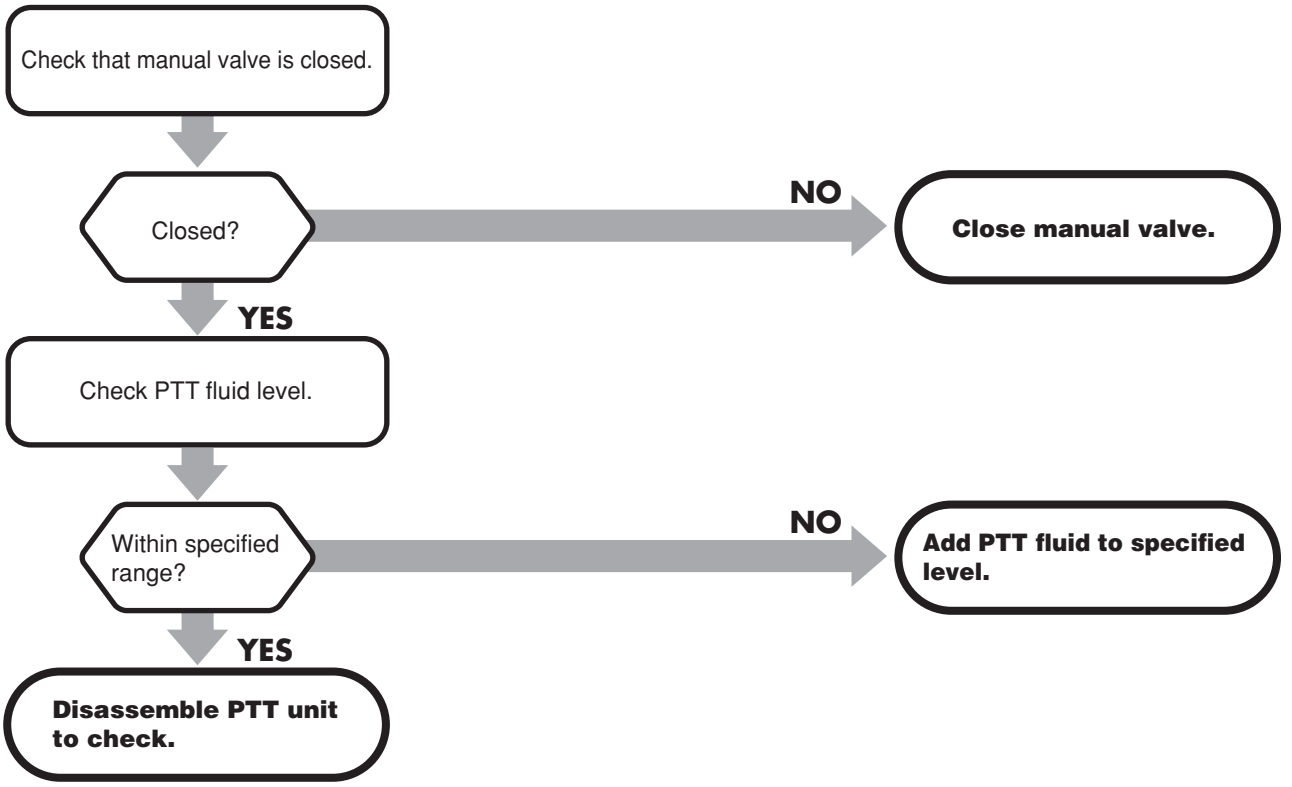
PTT Unit

State 1 **PTT will not operate.**





State 2 **PTT is not capable of sustaining outboard motor.**

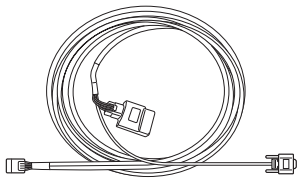


Diagnosis

1. Set Up

Read this manual thoroughly, connect diagnosis cable to computer, and then, perform software operations.

- Check that computer is normal.
- Fully charge battery (12 V or more).
- Clean battery terminal to remove dirt and corrosion, and connect battery cables securely.
- Check diagnosis cable and other cables for connection.
- Shift gear into neutral (N).



Diagnosis Tool Kit
P/N. 3KY-72920-0

Used to engine diagnosis

Applicable Models

Diagnosis is applicable to the following models. (Special cable canbe use for each models.)

- **MFS40/50**

⚠ WARNING

- **Before using Diagnosis, read notes described in this chapter.**
- **Do not use Diagnosis during operating boat.**

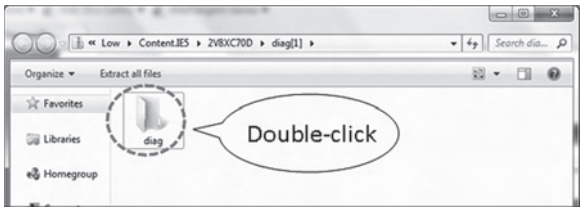
⚠ CAUTION

Be careful not to expose computer and cables to water spray.

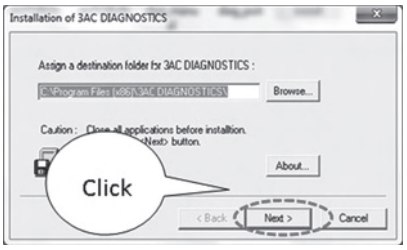
1) Diagnosis Software Install

1. After entering the dealer-only page, then click the download of diagnostic software.

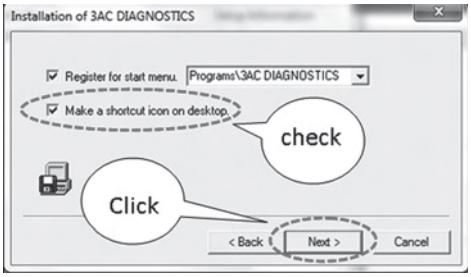
2. Double-click the "diag".



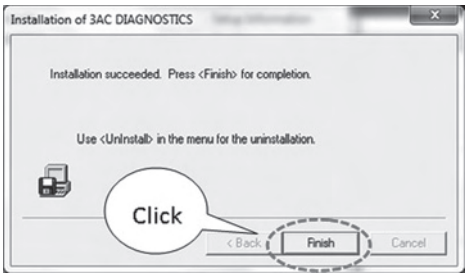
3. Double-click the "install".



4. Click "Next".



5. Click "Next" put a check in "to create a shortcut to Desktop."



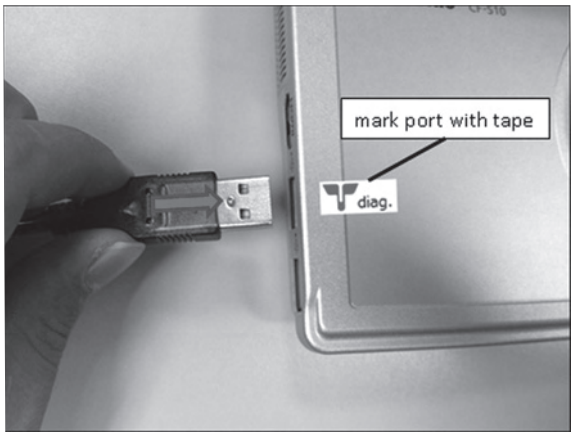
6. Shortcut of diagnostic software is created on the desktop by clicking the "Finish".

7 Double-click the shortcut of Desktop, activate the diagnostic software.

2) Installing USB to serial converter driver (If there is no RS232 port)

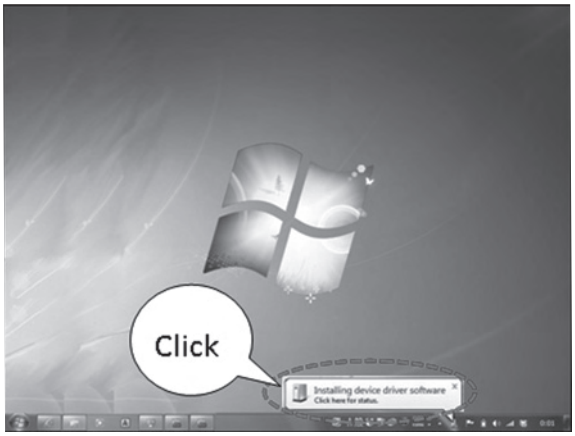
By the manufacturer of the serial converter, how to install the driver of the serial converter is also vary depending on the computer you are using.

The following is an example, detailed procedure of installation to refer to the instruction manual of the converter to be used.



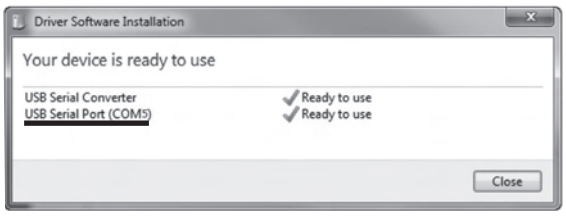
1. Connect serial adapter to USB port (It should be a mark on the USB port which connects to for later).

2. Click, explanatory text that appears in lower.



3. Window appears, the drivers is autmatically set.

4. Note the infomation of COM ports required diagnostic software when connected.



If the window does not appear, then (refer to "Checking the COM port" of diagnostic software within) check the COM port from the "Device Manager".

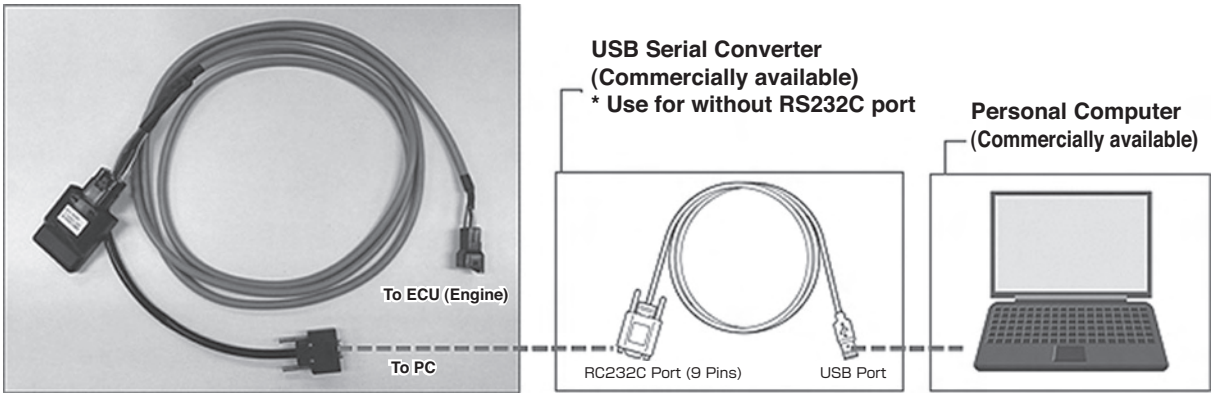
9

2. Diagnosys Software Connection

1) Preparation

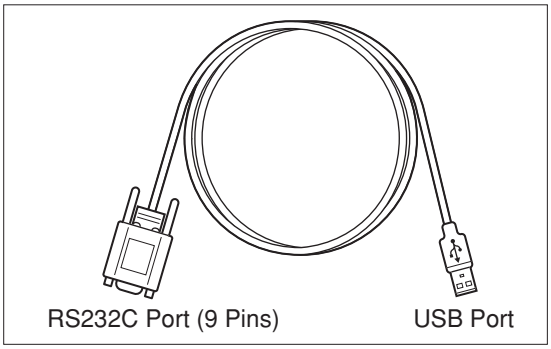
Diagnosis Harness
Battery (12V)
Computer

Not in the battery cable terminal.
It is necessary to connect the battery to the battery cable of the engine.



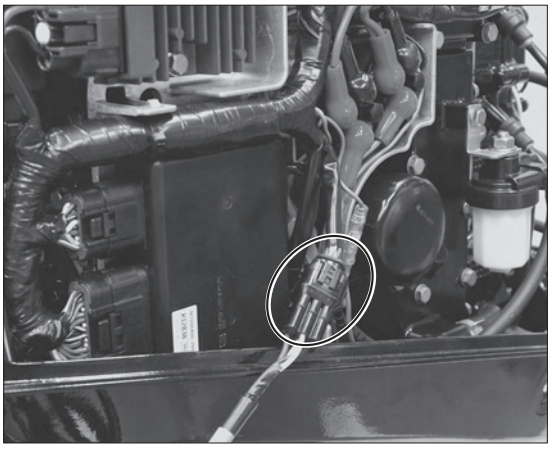
If your computer is not provided with RS232C Port (9 Pins), use USB conversion cable as shown.

- When using USB conversion cable, install necessary software in accordance with the instructions, and then, proceed to next operation.
- USB cable operates only on OS of Windows 98 and after. (It will not operate on Windows 95.)



3AC DIAGNOSIS connection point (engine)

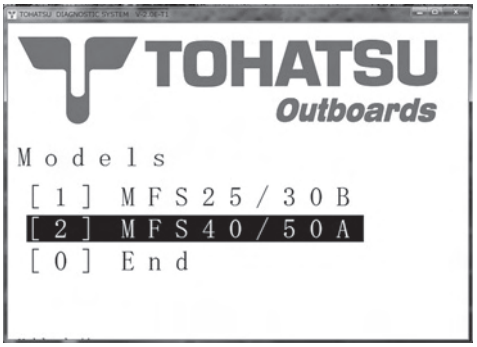
- Connect to connector on side part of ECU.



3.Operating Procedure

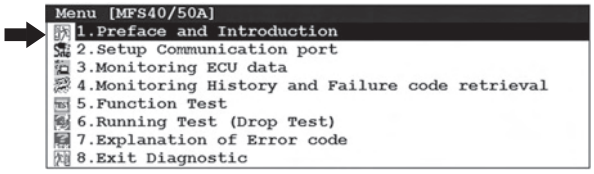
1) Start Up

Double-click "3AC_DIAGNOSTICS" in "PROGRAM" or its short-cut icon. Model select appears.



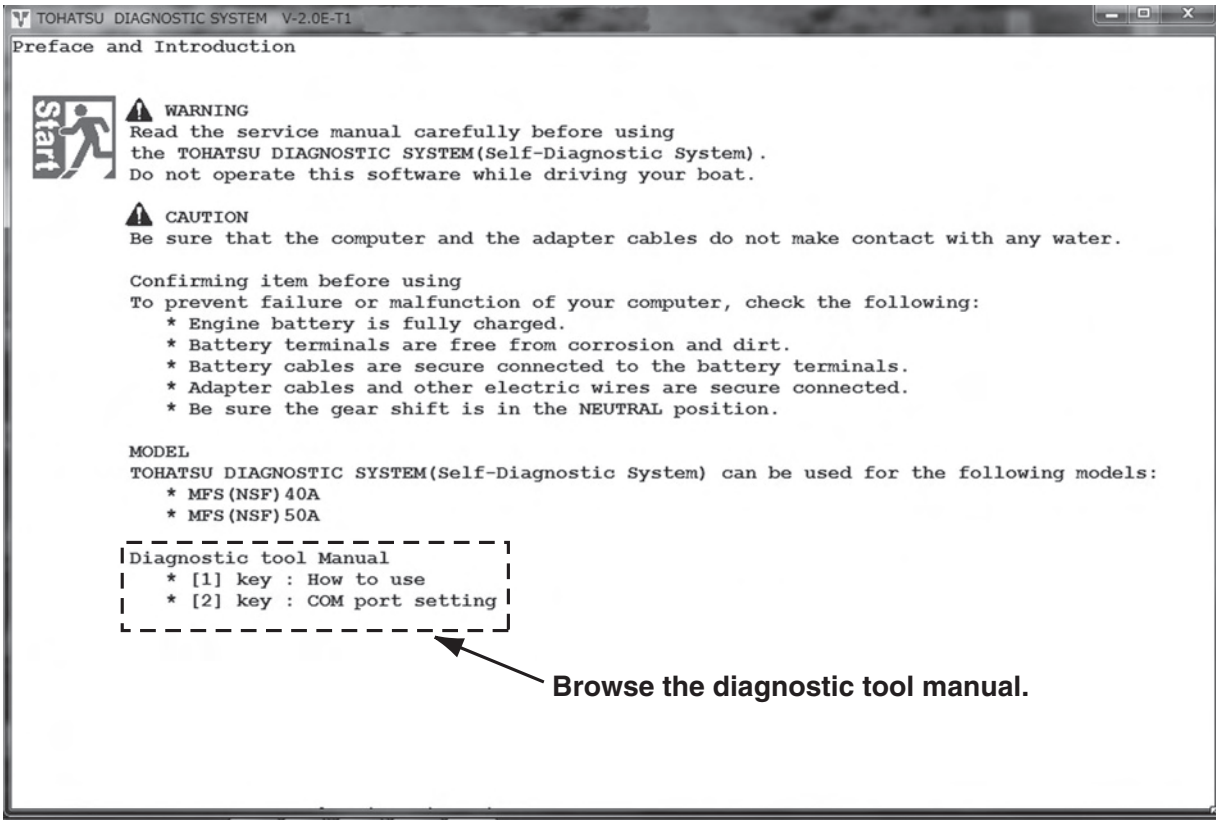
2) Models and Menu Selection

Use " ↑ " or " ↓ " key on the keyboard or press the "1" to "9" number to move cursor to list to be executed, and press "Enter" key.



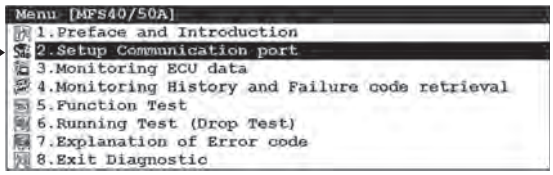
3) Preface and Introduction

Thoroughly read notes described in "Set Up" section of Chapter 9 before operation.



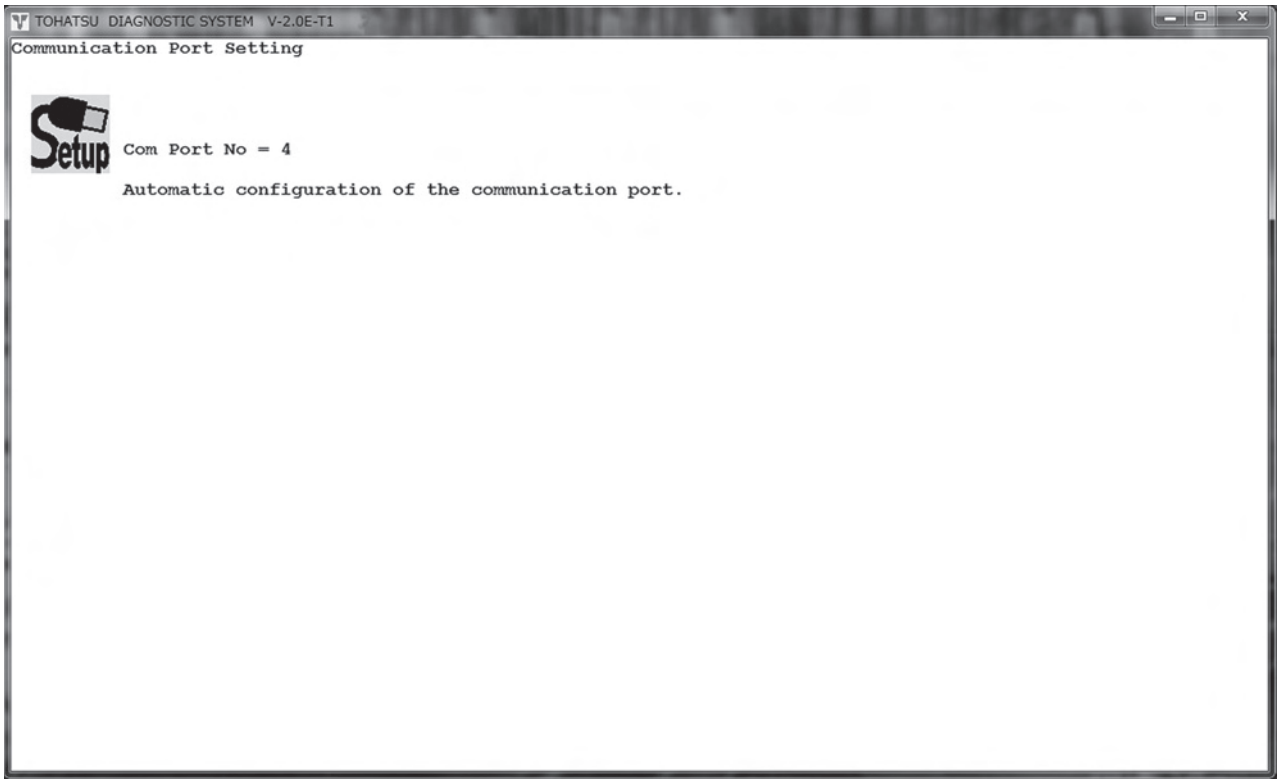
9

4) Setting Communication (COM) Port



- COM port of the following "5" in the automatic is assigned.
- COM port of 5 or less is used when all the diagnostic cable is not connected switches to manual setup screen (next page).

* it is necessary to turn ON the engine key.



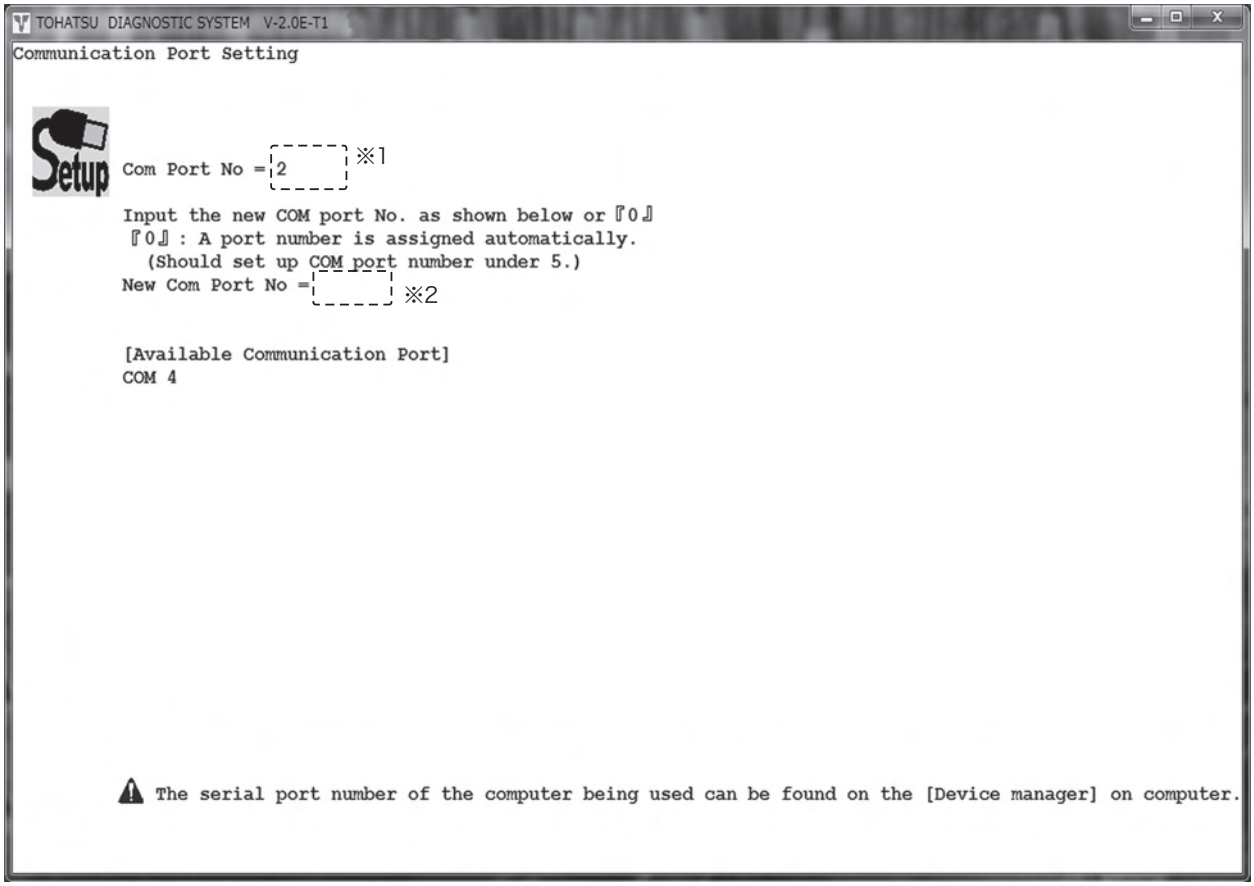
"Com port No = ☐ "
Current COM port number appears.

"New Com Port No = ☐ "
New COM port number can be input.

Input COM port number of your computer.

Press "Enter" key to return to "Menu" screen.

- Current COM port number can be known by going through "Control Panel" → "Hardware" → "Device Manager".
- Only one of numbers "1" to "5" can be input to COM port.
- If COM port number of USB port of computer on which USB adapter is used is one of numbers aborve "6", change it to a vacant COM port of one of numbers from "1" to "5", and set new COM port number.



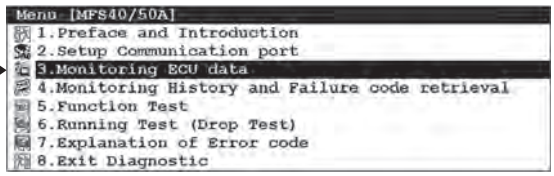
*1 Current COM port number

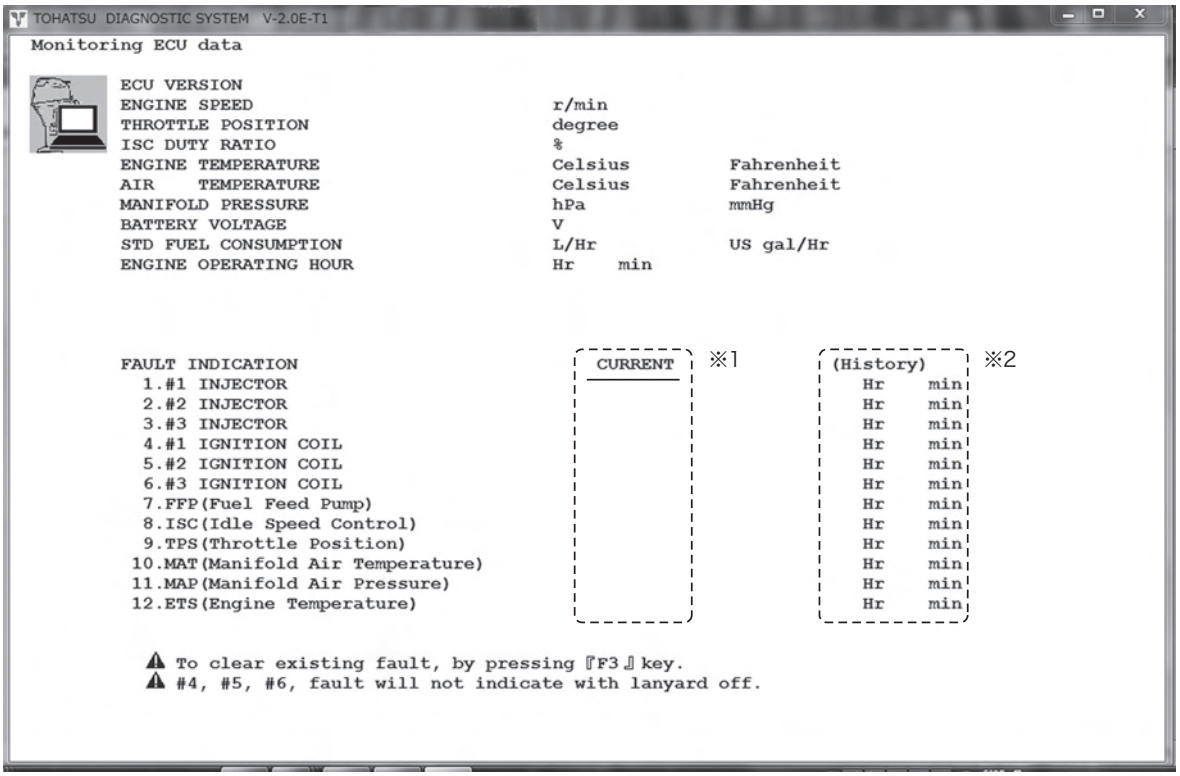
*2 Enter the COM port number to use. Refer to "setting - the diagnostic tool manual ~ COM port".

5) Engine Monitor

Current states of engine can be seen on the screen.

Press "F1" key to return to "Menu" screen.





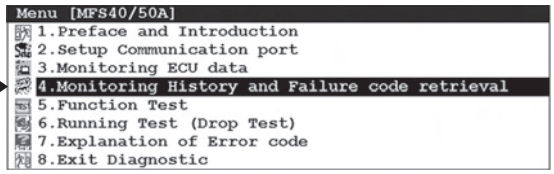
*1 Currently, it is displayed as "failure" if the problem has occurred.

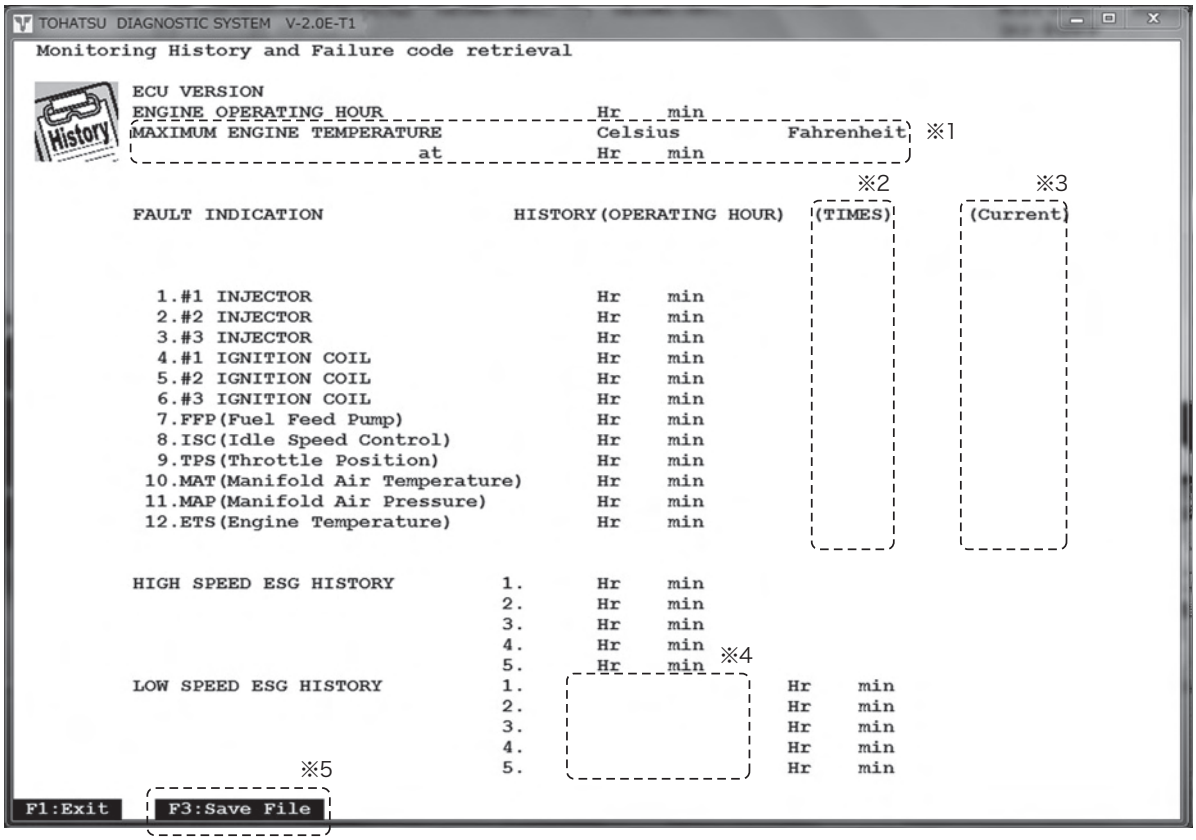
*2 If there is a problem in the past, I indicates the time at which the failure occurred at the end..

6) Diagnostic History

Malfunction history of engine can be seen on the screen.

Press "F1" key to return to "Menu" screen.





*1 Engine temperature is raised or how much to the highest in the past as shown. In addition, the time of occurrence.

*2 Number of times that something goes ploblem.

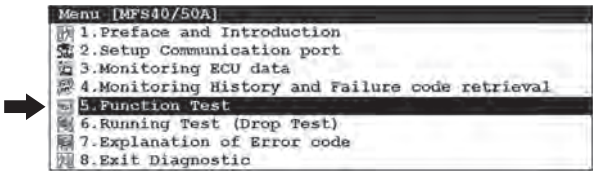
*3 Problems is whether is going currently.

*4 Shown slow ESG will be making operated which sensor is activated (example: oil pressure switch).

*5 Screen shot can be saved by pressing the F3.

7) At Engine Shut-down Test

Malfunction of injectors or their operating state can be checked.



Enter the number of item to be checked.

"1" : Operation (on/off) of #1 injector

"2" : Operation (on/off) of #2 injector

"3" : Operation (on/off) of #3 injector

"4" : Operation (on/off) of ISC valve

"5" : Operation (on/off) of fuel feed pump (FFP) in vapor separator

"6" : Operation of warning buzzer

"7" : Lighting of warning lamp

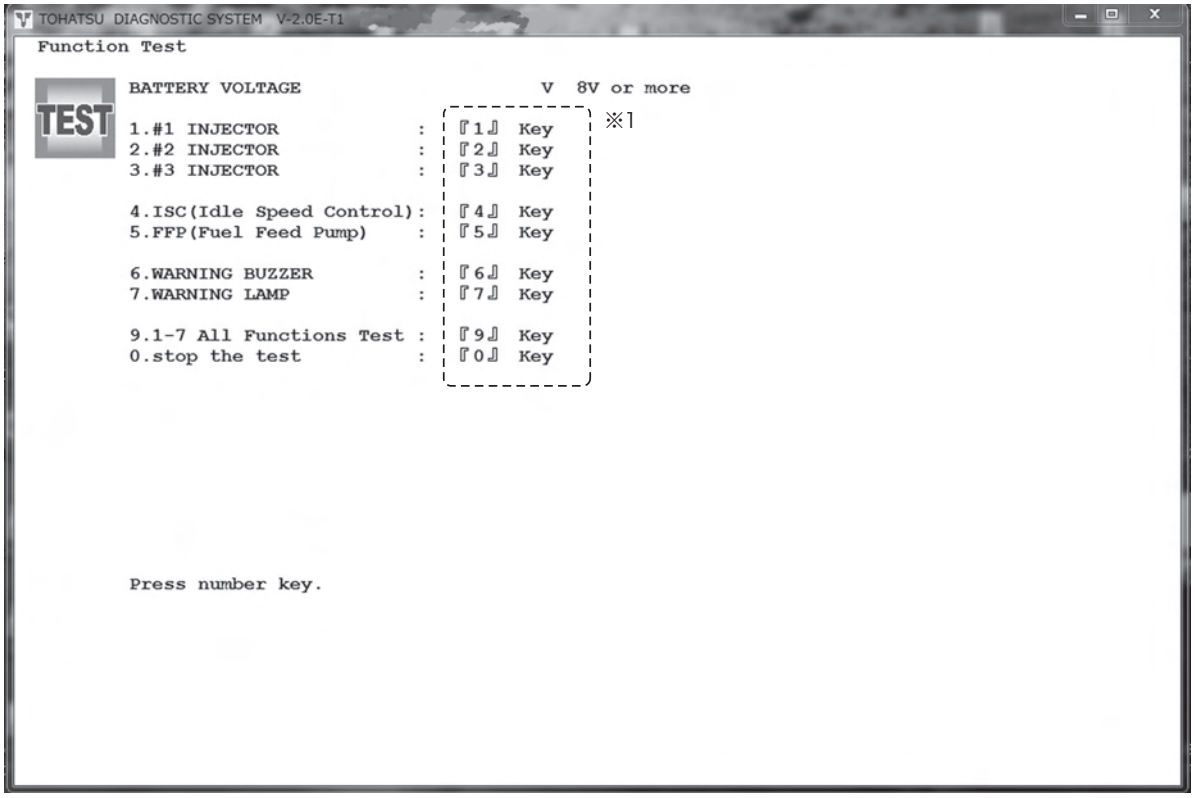
Tiller Handle Model : Warning lamp (LED) on the tiller handle

Remote control model : Warning lamp on the tachometer

"9" : "1" to "7" of all item to be checkd.

"0" : Cancelling

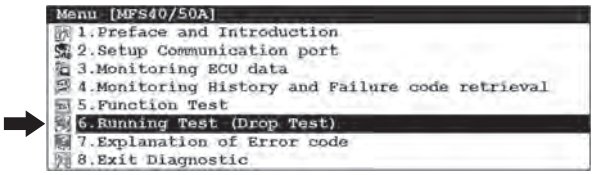
Press "F1" key to return to "Menu" screen.



*1 Press the key of each component, normal decision to check the operation sounds.

8) At Engine Running Test

This test stops operation injector or ignition coil temporarily during engine operation for checking operating state according to reduction or operating noise level and engine speed.

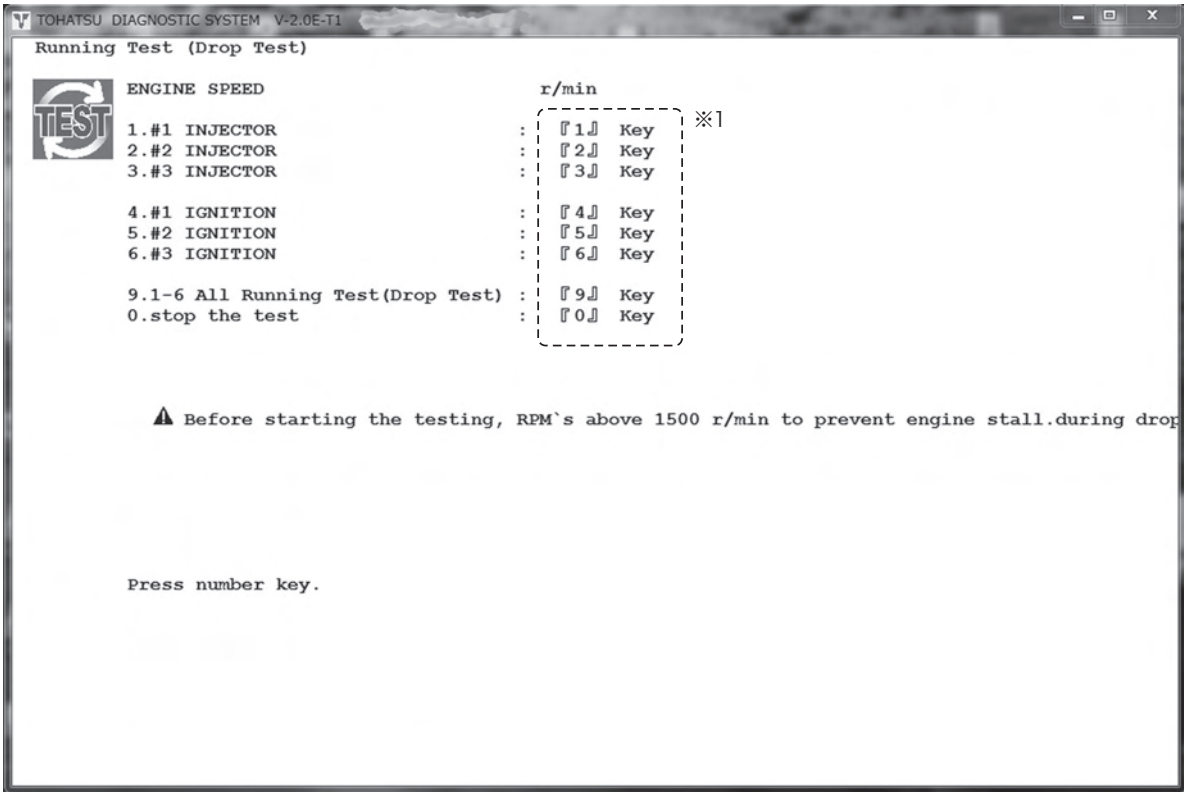


Enter the number of item to be diagnosed.

"1" : Temporary stop of #1 injector
"2" : Temporary stop of #2 injector
"3" : Temporary stop of #3 injector
"4" : Temporary stop of "1" ignition coil
"5" : Temporary stop of "2" ignition coil
"6" : Temporary stop of "3" ignition coil

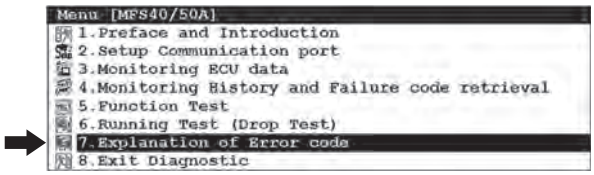
"9" : "1" to "6" of all item to be checkd.
"0" : Cancelling

Press "F1" key to return to "Menu" screen.



*1 Press the key of each component, the operation of the component will be temporarily interrupted. To check the operating condition from the change in rotation and sound when stopping the operation of each component. (Stop #1 injector operation, the engine speed decreased. → # 1 injector was operating normally.)

9) Explanation of Error code



Description of error code appears on the screen.

Example :

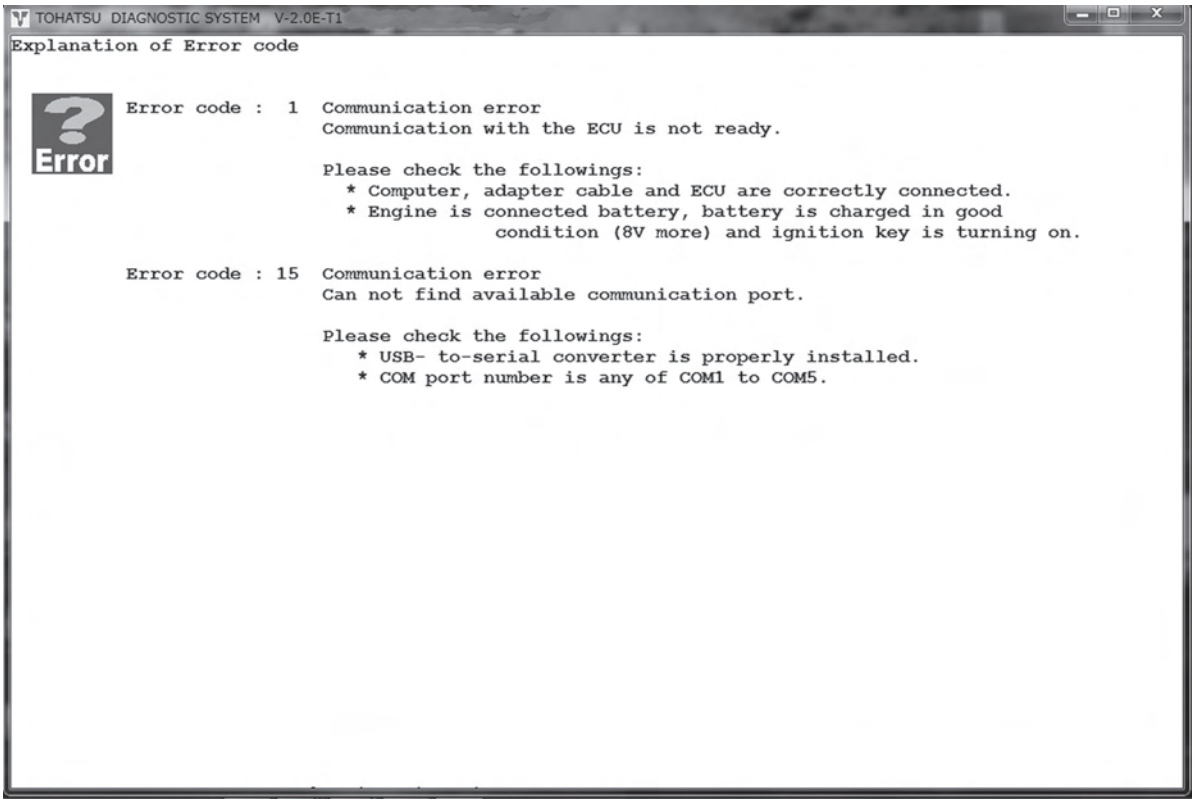
Error code : 1 Communication Error

Communication with ECU is not ready.

Check following items.

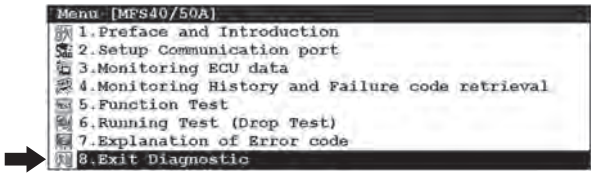
* Connection between computer and ECU
* Connection with battery
* Setting of computer COM port number. Use "Setup Communication port" on the "Menu" screen to set COM port number.

Press any key to return to "Menu" screen.



10) Exit Diagnostic

Select "Exit Diagnostic" to end DIAGNOSIS.

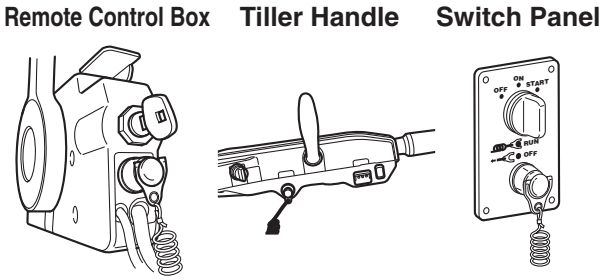


2. Self-Diagnosis Function

The self-diagnosis function detects a trouble(s) of electrical system of engine and displays the part by using ECU installed in the engine. This engine requires no instruments and special equipment such as personal computer when executing the self-diagnosis function that uses key switch operation, tachometer's RPM indication and a combination of three warning lamps to show information necessary for troubleshooting through the following four modes.

The self-diagnosis function of this engine consists of the following four modes.

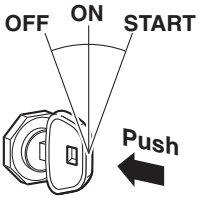
Mode 1……Tachometer operation test
Mode 2……Display of engine operation hours
Mode 3……Display of fault location and fault history
Mode 4……Deletion of fault history



1) Terms related to self-diagnosis function

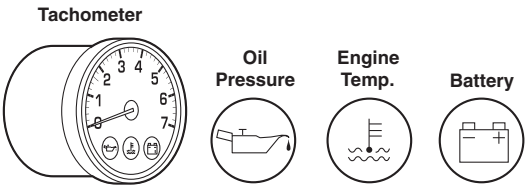
Key Switch

Key switch is on the remote control box, tiller handle or switch panel.
The key positions include the following four positions; "OFF", "ON", "START" and push-in position when it is at "ON".
The self-diagnosis function is enabled when the key is at "ON".



Warning Lamp

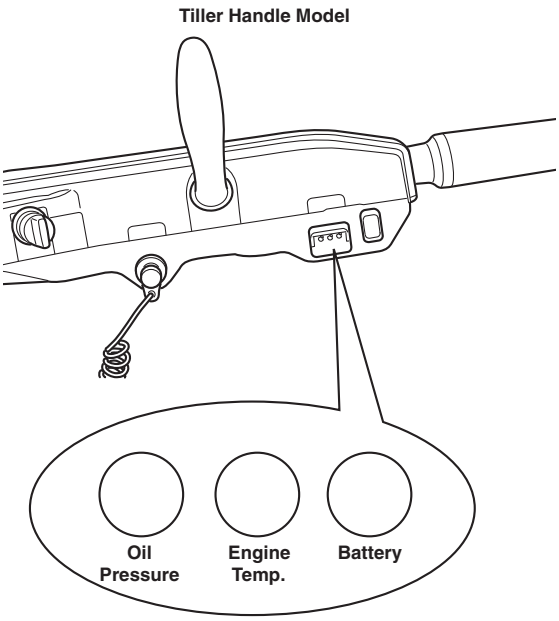
The warning lamp is mounted on the tachometer or tiller handle to indicate abnormality of cooling water temperature, oil level and battery in case it occurred.
In case of electrical part trouble or abnormality, three lamps blink at the same time to inform of the trouble. (Refer to Warning Indications List.)
The self-diagnosis function uses combinations of these three lamps and tachometer indication to inform of the type of trouble occurred. (Refer to Trouble Indication List.)



Warning Buzzer

The warning buzzer is built in the remote control box, tiller handle or switch panel.
The buzzer uses one of the following operation patterns to inform of a trouble.

Beep…Two seconds
Beep…0.3 second
Continuous sounding



Trouble History

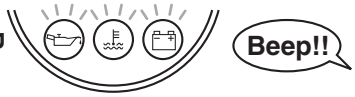
The function stores the history of the troubles or abnormalities that occurred and then recovered in the memory of ECU.
The function allows confirmation of the trouble history.

2) Operation Procedure of Self-Diagnosis Function

* The self-diagnosis function is enabled only when the engine is stopped state.
* The self-diagnosis function is stopped at any moment during the following procedure when the key switch is set to “OFF”.

After attaching stop switch lock,
set key switch to "ON".

For confirmation of meter operation, three warning lamps go on and buzzer sounds.
At the same time, fuel feed pump (FFP) operates approximately two seconds.
IF all three warning lamps do not come on and go off, then find that problem first to get the correct diagnosis.



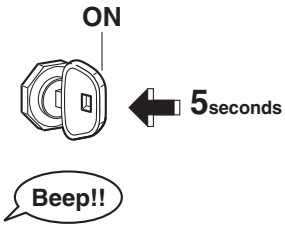
ECU attempts to identify existence of a trouble or abnormality of a part if any.

If there exists any trouble or abnormality, the warning buzzer lamps and buzzer operates according to the type of the trouble.
→**Refer to Warning Indications List.**

Regular Operations

Go into process of the self-diagnosis operation from here.

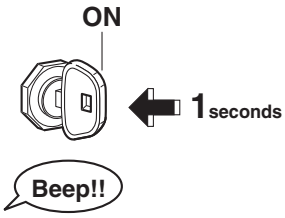
Leave the key to "ON" position, and push it in (for approximately 5 seconds) until the buzzer sounds.



Self-Diagnisos Mode 1[Tachometer Operation Test]
After the pointer returns to "zero", the process goes to mode 2 automatically.

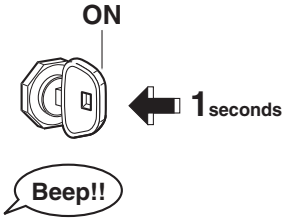
Self-Diagnisos Mode 2[Indication of engine operation hours]
A combination of tachometer indication and three warning lamps represents engine operation hours.
→Refer to Operating Hours Indication List.

Leave the key to "ON" position and push it in (for approximately 1 seconds) until the buzzer sounds to proceed to mode 3.



Self-Diagnisos Mode 3[Indication of fault location(s) and fault history]
After the buzzer "Beeps" once, a combination of tachometer indication and three warning lamps represents the first fault location and fault history.
→Take action(s) by referring to the fault indication list.

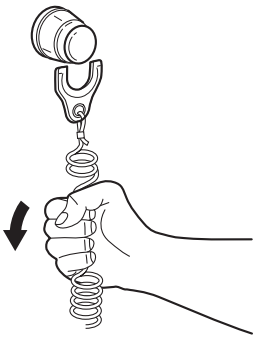
Then, every time the key switch is pushed in at "ON" position for approximately 1 second until the buzzer sound, the next fault location and the fault history are represented.
When all the fault locations are represented by going through the above operations, a state of no indication occurs. Then, when the key switch is pressed, representation of the fault locations starts again from the first one.
No indications are represented when there is no fault history (Tachometer and warning lamps do not operate.)



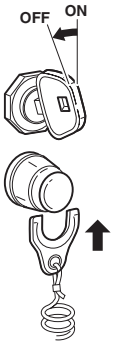
9

Self-Diagnisos Mode 4 [Deletion of fault history]
In any of the states in the self-diagnosis mode 3, the fault history is deleted by removing stop switch lock plate and pushing in key for approximately 3 seconds. At this moment, the buzzer "Beeps" three times.

Note: The operating hours is not deleted.



Set key switch to "OFF".
The self-diagnosis function ends.
Attach stop switch lock plate.



Regular operation is resumed.
The warning lamps and buzzer operate if any fault or abnormality is left unsolved.
→Refer to Warning Indications List.

Note : The self-diagnosis function is stopped at any moment during the above procedure when the key switch is set to "OFF".

3 Warning Indication List •••• Display for abnormalities during operation

Warning Indicators				ESG Speed Control
Buzzer Sounding				
	Indicator A	Indicator B	Indicator C	
Countinuous	×	×	×	High speed ESG (*8)
Countinuous	Lightning	×	×	Low speed ESG (*9)
Countinuous	×	Flashing ①	×	Low speed ESG (*9)
Countinuous	Flashing ①	Flashing ①	Flashing ①	Foced idling
—	×	×	Flashing ①	—
—	Flashing ①	Flashing ①	Flashing ①	Low speed ESG (*9)
—	Flashing ①	Flashing ①	Flashing ①	—
—	Flashing ①	Flashing ①	Flashing ①	—
—	Flashing ①	Flashing ①	Flashing ①	—
—	Flashing ①	Flashing ①	Flashing ①	—
—	Flashing ①	Flashing ①	Flashing ①	—
—	Flashing ①	Flashing ①	Flashing ①	Low speed ESG (*9)
—	Flashing ①	Flashing ①	Flashing ①	Low speed ESG (*9)
—	Flashing ①	Flashing ①	Flashing ①	—
Countinuous (*2)	Lightning (*2)	Lightning (*2)	Lightning (*2)	—
—	Flashing ②	×	×	—
Short sound 1	×	×	×	—
Short sound 2	×	×	×	—

Short sound 1 : 0.3 sec.
Short sound 2 : ON 0.3 sec. – OFF 0.3 sec. – ON 0.3 sec.

Flashing ① pattern : ON 1 sec., OFF 1 sec
Flashing ② pattern : ON 1 sec, OFF 9 sec.

FFP (*3) : Fuel Feed Pump
CPS (*4) : Crank Position Sensor
TPS (*5) : Throttle Position Sensor
MAP (*6) : Intake Air Temp.
MAT (*7) : Intake Air Pressur
High speed ESG (*8) : Controlled to 6,200 r/min
Low speed ESG (*9) : Controlled to 3,000 r/min

Fault Description	Reference	Remedy
Engine over-rev	Approx. 6,200 r/min	Readjust propeller, outboard engine mounting height and/or trim.
Low oil level		Replenish engine oil.
Engine temp. high	100 ºC (212˚F)	Refer to troubleshooting.
Engine temp. abnormally high	140 ºC (284˚F)	
Battery voltage low	Approx. 9V or less. Idling speed up	
Sensor power supply malfunction		Refer to fault indication table.
Fuel injector malfunction		
Ignition coil malfunction		
FFP (*3) malfunction		
CPS (*4) malfunction (*1)	(*1) Impossible to find snapping of wiring	
TPS (*5) malfunction		
Temp sensor malfunction		
MAP (*6) sensor malfunction		
MAT (*7) sensor malfunction		
When the key turned ON	(*2) Activate 1 sec.	
Indicate oil replacement period (every 100 hrs)	Reset by stop switch	Refer to resetting procedure.
Lowest idling speed of variable system		
Highest idling speed of variable system		

4) Operating Hour Indication List (Self Diagnosis • Mode 2)

Engine Operating Hours(h)	Tacho meter Tach. Indication(r/min)	Lamp Indication		
		Lamp A	Lamp B	Lamp C
0 – 1	1,000	–	–	–
1 – 2	2,000	–	–	–
2 – 3	3,000	–	–	–
3 – 4	4,000	–	–	–
4 – 5	5,000	–	–	–
5 – 6	6,000	–	–	–
6 – 7	7,000	–	–	–
7 – 8	800	–	–	Goes on.
8 – 9	900	–	–	Goes on.
9 – 10	1,000	–	–	Goes on.
10 – 20	2,000	–	–	Goes on.
20 – 30	3,000	–	–	Goes on.
30 – 40	4,000	–	–	Goes on.
40 – 50	5,000	–	–	Goes on.
50 – 60	6,000	–	–	Goes on.
60 – 70	7,000	–	–	Goes on.
70 – 80	800	–	Goes on.	Goes on.
80 – 90	900	–	Goes on.	Goes on.
90 – 100	1,000	–	Goes on.	Goes on.
100 – 200	2,000	–	Goes on.	Goes on.
200 – 300	3,000	–	Goes on.	Goes on.
300 – 400	4,000	–	Goes on.	Goes on.
400 – 500	5,000	–	Goes on.	Goes on.
500 – 600	6,000	–	Goes on.	Goes on.
600 – 700	7,000	–	Goes on.	Goes on.
700 – 800	800	Goes on.	Goes on.	Goes on.
800 – 900	900	Goes on.	Goes on.	Goes on.
900 – 1,000	1,000	Goes on.	Goes on.	Goes on.
1,000 – 2,000	2,000	Goes on.	Goes on.	Goes on.
2,000 – 3,000	3,000	Goes on.	Goes on.	Goes on.

5) Trouble Indication List (Self Diagnosis • Mode 3)

Malfunction / Failure Indication		Description of Problem	Fault Log	
			Fault	Fault Log (Yes)
 Tachometer Indication (r/min)	 Indicator A		 Indicator B	 Indicator C
0	Off	No malfunction of failure	Off	Off
1,000	On	# 1 Fuel injector malfunction	× (*1)	Lighting of the lamp means that the wiring was once broken or a component once malfunctioned.(*2)
2,000	On	# 2 Fuel injector malfunction		
3,000	On	# 3 Fuel injector malfunction		
1,000	Flashing	#1 Ignition coil malfunction		
2,000	Flashing	#2 Ignition coil malfunction		
3,000	Flashing	#3 Ignition coil malfunction		
500	Off	Oil level low	× (*3)	Oil pressure was once low
500	On	Battery voltage low	Lighting means that battery voltage is low.	Lighting means that the battery voltage was once low.
5,000	Off	CPS (*5) malfunction	Lighting means that the wiring is broken or a component malfunction.(*4)	Lighting means that the component was once broken.
5,500	Off	TPS (*6) malfunction	Lighting means that the wiring is broken or a component malfunction	Lighting means that the wiring was once broken or a component once malfunctioned.
5,500	On	Sensor power voltage high	Lighting means that the power voltage high	Lighting means that the power voltage was once high
5,500	Flashing	Sensor power voltage low	Lighting means that the power voltage low	Lighting means that the power voltage was once low
6,500	Off	Engine temp. sensor malfunction	Lighting means that the wiring is broken or a component malfunction	Lighting means that the component was once broken.
6,500	On	Engine temp. high	Lighting means that the cooling water tem. is high	Lighting means that the cooling water tem. was once high
6,500	Flashing	Engine temp. over heat	Lighting means that the cooling water tem. is abnormally high	Lighting means that the cooling water tem. was once abnormally high
7,000	Off	FFP (*7) malfunction	Lighting means that the wiring is broken or a component malfunction	Lighting means that the wiring was once broken or a component once malfunctioned.
4,500	On	MAP (*8) sensor malfunction		
4,500	Off	MAT (*9) sensor malfunction		

CPS (*5) : Crank Position Sensor
TPS (*6) : Throttle Position Sensor
FFP (*7) : Fuel Feed Pump (electric)
MAP (*8) : Intake Air Temp.
MAT (*9) : Intake Air Pressur

Remedial Measures and Added Notes
*1 B lamp does not goes on even a malfunction in the engine stopped, because of the abnormality determination impossible. *2. If the lamp C goes on, the wiring may be broken or a component may be faulty at present. → Corrective action : Delete current fault log (Mode 4. Refer to "Deleting Malfunction Log".) Then, start the engine (or crank for 5 seconds or longer) to confirm the details of malfunction or abnormality in the self-diagnosing mode. Take a corrective action if the same malfunction or abnormality is indicated with the lamp C. → If an ignition is suspected to be defective --- Check wirings and connectors, and if no problem is found, replace injector. → If an ignition coil is suspected to be defective --- If "only one malfunctions" indication is displayed, replace the component with new one, and if the fault indication still appears, check the wiring. If "all of four malfunction" indication is displayed, a short-circuit may exist, or any one of the ignitioncoils may be short-circuited internally.
*3 B lamp does not goes on even a malfunction in the engine stopped, because of the abnormality determination impossible. If the lamp indicating a malfunction is still lit after replenishing engine oil, a short-circuit may exist or a component may be faulty.
Refer to troubleshooting.
*4 The lamp may show malfunction even when no faulty component or wiring exists if the engine revolution changes much. Replace the component, or check wiring and connections for abnormality, and repair if necessary.
Replace the component, or check wiring and connections for abnormality, and repair if necessary.
Refer to troubleshooting.
Replace the component, or check wiring and connections for abnormality, and repair if necessary.
Refer to troubleshooting.
Replace the component, or check wiring and connections for abnormality, and repair if necessary.

10
Rigging

1. Service Information

The persons who perform the rigging should take sufficient care for prevention of damages to himself or herself and the products, prevention of fire, and ventilation of the shop.

The persons who operate the boat equipped with this product for test run should read the operating instructions of the outboard, and be familiar with the operating procedure.

2. Service Data

1) Load Limit of Boat

Do not over-power the boat and take care not to over-load the engine. Boat manufacturers specify the maximum allowable engine power and complement of their boats in accordance with certain standards and show the data on the plate attached to the boats. For unknown matters, if any, inquire of the dealer or manufacturer of the boat.

⚠ WARNING

Never use boat equipped with an outboard motor(s) that outputs power exceeding the maximum allowable limit specified by the manufacturer of the boat, or the following problems can occur.

- **The boat can go out of control.**
- **The buoyancy property of the boat varies from the designed value if the boat is overloaded especially at the transom.**
- **The boat may crack or be damaged around the transom.**

Over-powering boats can cause serious injury, fatal accident and/or serious damages to the hull.

2) Installation Dimensions

Minimum Allowable Size of Transom Opening : ⓐ

Single Machine Installation (Remove Control Models)

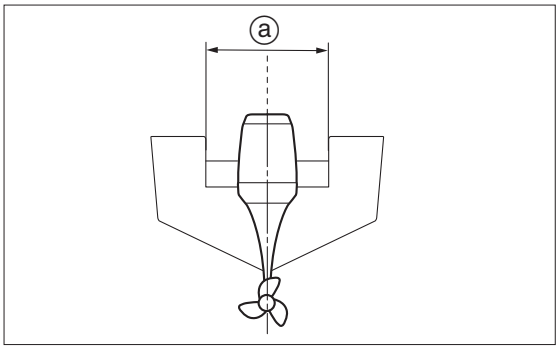
848 mm (33.39 in.)

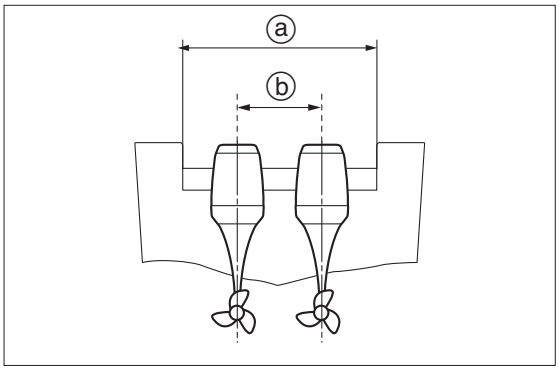
Twin Machine Installation 1,518mm (59.76 in.)

Minimum center-to-center distance for twin installation : ⓑ

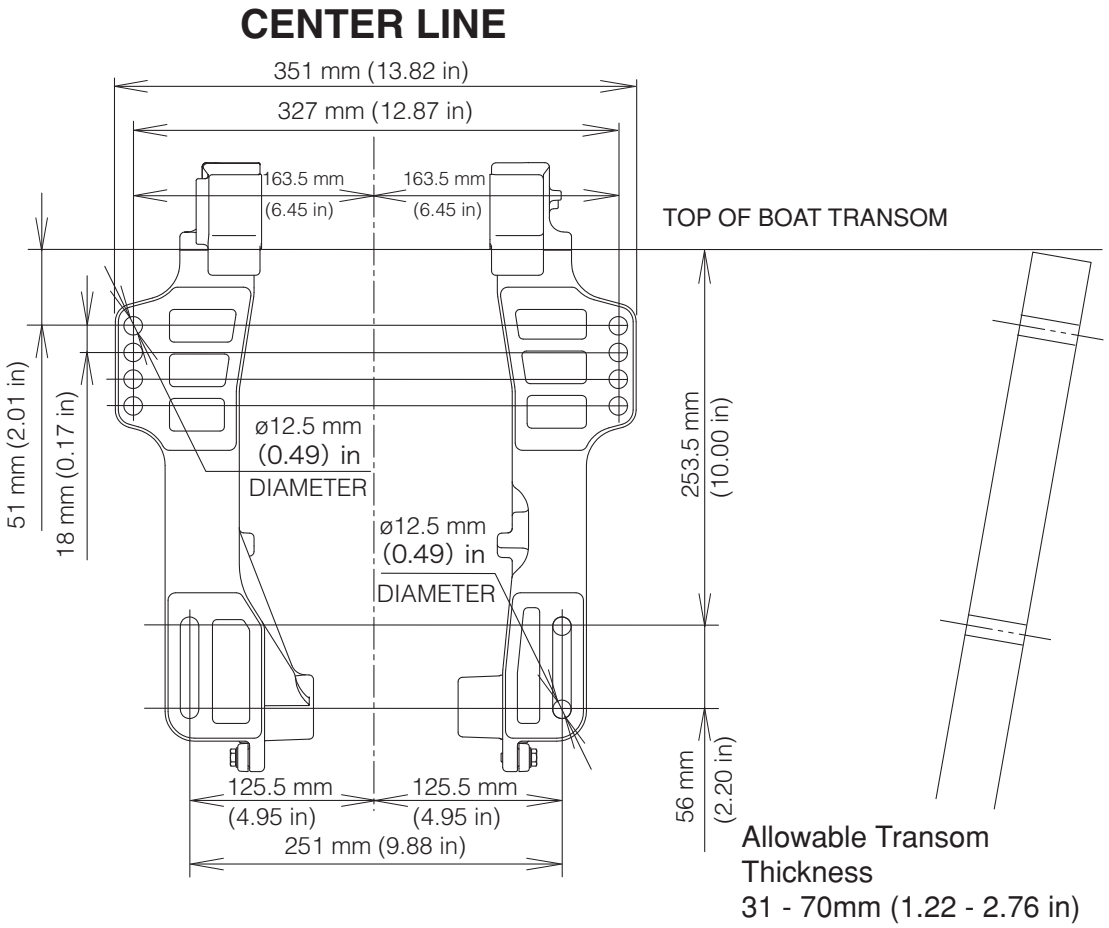
560 - 660 mm (22.05 - 26.00 in.)

Installation of an outboard motor(s) at higher position(s) can cause engine overheating and/or damages to gear case components.



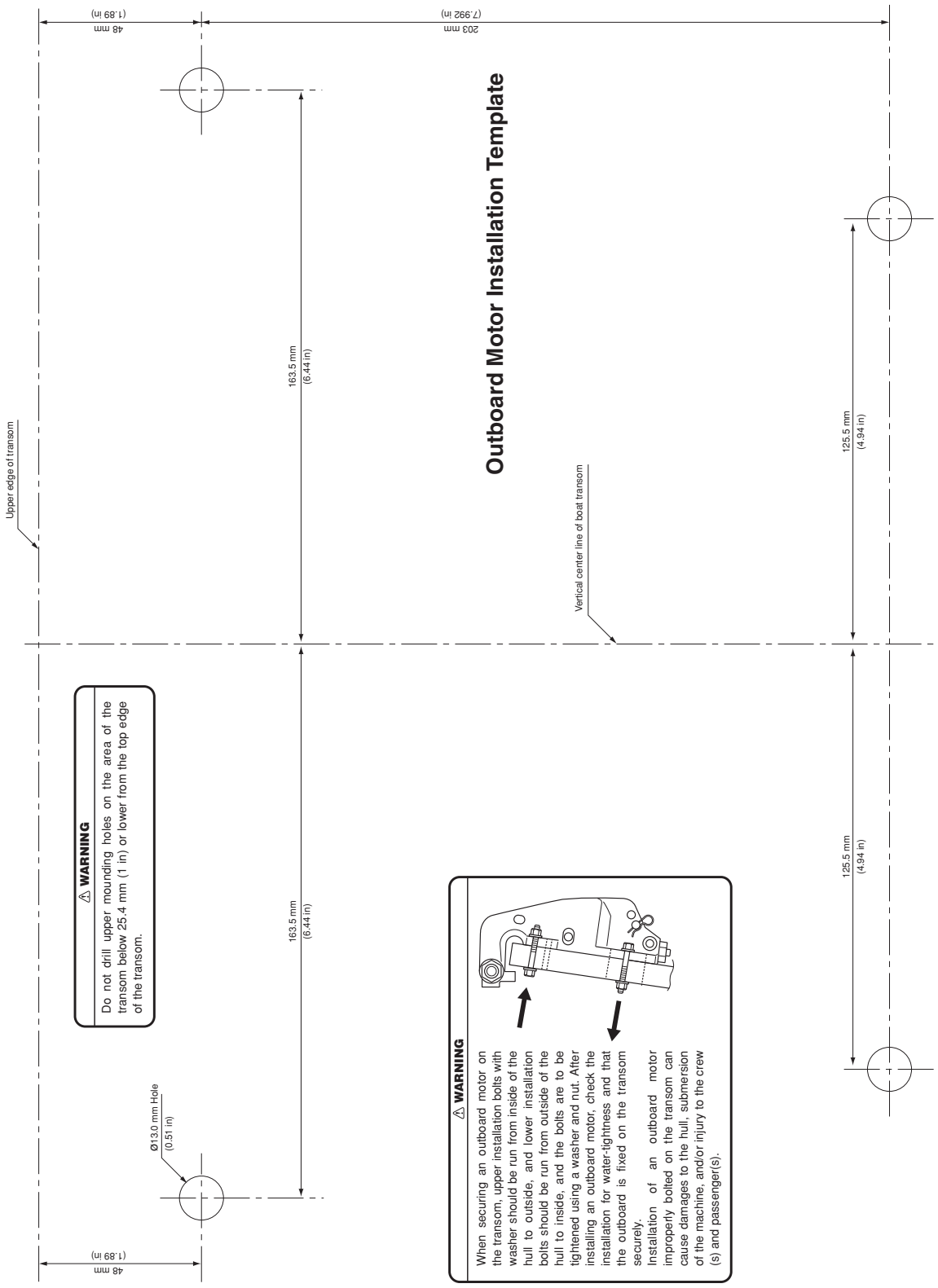


3) Clamp Dimensions



Transom Dimensions and Drilling Template (An example)

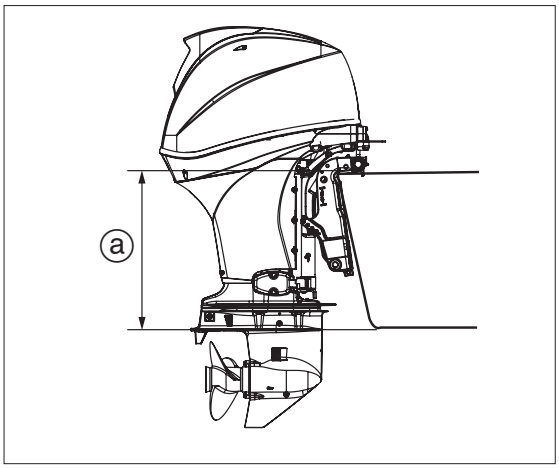
* Full scale transom dimensions and drilling template is shown at the end of this manual.



Installation of an outboard motor at higher position can cause the matters described below.

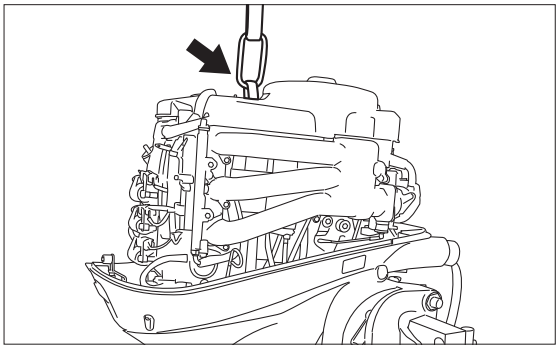
1) Sucking in air from the cooling water inlet causing an overheat
2) Possible loss of steering control.
3) Propeller can easily run above water surface (over-revs) during planing or when the boat is turning causing a loss of control.

ⓐ : Outboard installation height is the distance from the boat's bottom to upper edge of outboard motor transom bracket.



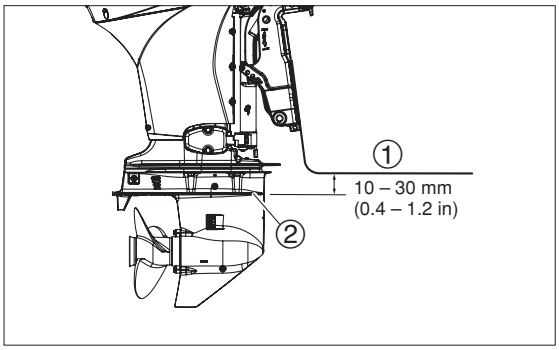
4) Hanging Outboard Motor

Use hanger installed on the engine.



5) Installation of Outboard Motor

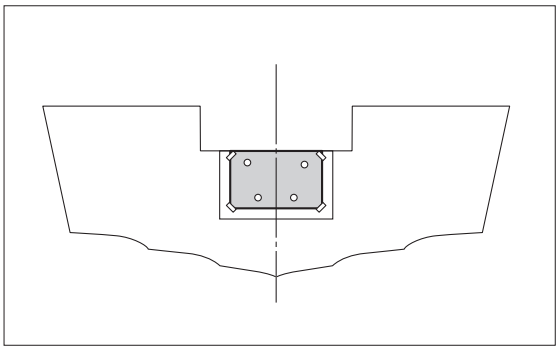
1. Besure that the antiventilation plate of the outboard motor is 10 – 30 mm (0.4 – 1.7 mm) below the bottom of hull..



① : Bottom of hull
② : Anti ventilation plate

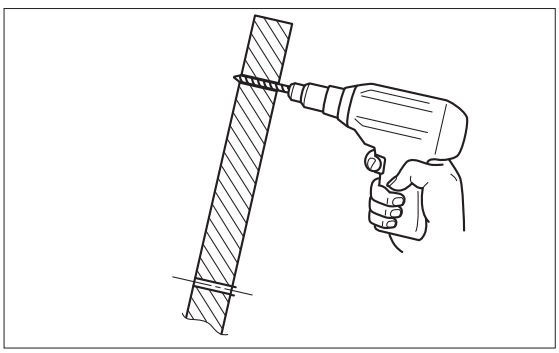
2. Put the outboard motor installation template on the transom.

Align center line of template with center line of transom accurately.



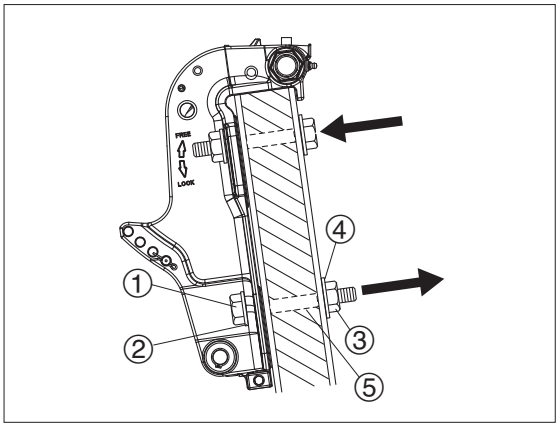
3. Mark up the transom with four 12.5 mm (0.49 in) mounting holes and drill.

Drill at right angle to transom surface to align the transom holes with outboard motor's transom bracket holes accurately.



4. Install outboard motor(s).

5. Secure the outboard motor by using fasteners contained in the package of the product.
   ① : 12mm diameter, Bolts (4 pcs.)
   ② : Flat Washers (4 pcs.)
   ③ : Lock Nuts (4 pcs.)
   ④ : Flat Washers (4 pcs.)
   ⑤ : Marine Sealant : Apply to the bolts' surface excluding their threaded area.



3. Fuel System

It is recommended to install additional large sized fuel/water separator on the boat to effectively remove water and foreign substances contained in the fuel. At the same time however, note that the fuel filter added to the fuel system may prevent smooth flow of fuel, possibly causing the engine to stall at low speeds, or fuel to be lean at higher engine speed resulting in giving damage to the engine. Use of valve fitting can also cause similar troubles.

1) Fuel

Avoid the use of old gasoline or gasoline containing impurities such as sand or mud in any occasion such as break-in operation of the engine and even after the break-in.

⚠ WARNING

Do not use gasoline pre-mixed with engine oil for this engine.

2) Oil

Recommended Engine Oil :
4 Stroke Engine Oil
API : SH, SJ, SL
SAE : 10W-30, 10W-40

Quantity of Engine Oil :
When oil filter is replaced : 2.4L (2.5 US qt.)
When oil filter is not replaced: 2.2L (2.3 US qt.)

3) Electric Fuel Pump

Electric fuel pump pressure, if used in conjunction with engine mechanical fuel pump, must be limited to no more than 0.03 MPa (4 psi) [0.3kg/cm^2].

4) Installation of Fuel Filter

<Portable Fuel Tank>

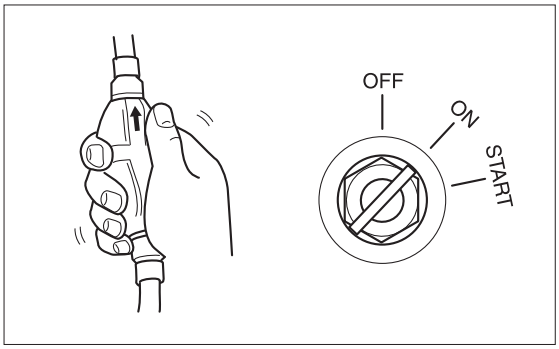
Fix the tank on the proper location of the boat taking into consideration the engine's fuel hose length.

<Stationary Fuel Tank>

Install the tank in accordance with regulations relevant to grounding, ventilation and other matters.

5) Filling Fuel System

Fill the fuel system as described below before initially starting new engine, after engine exhausted fuel, or after draining fuel from engine.



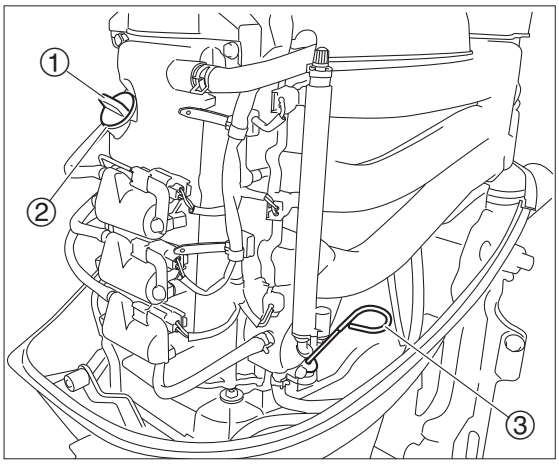
⚠ WARNING

To prevent damaging to fuel pump, fill engine's fuel system with fuel. If not, the fuel pump operates without fuel during priming of oil pump.

1. Squeeze priming bulb of fuel hose until it becomes stiff.
2. Set key switch to "ON" position for three seconds to operate electric fuel feed pump.
3. Return key switch to "OFF" position and squeeze priming bulb again until it becomes stiff. Set key switch to "ON" position for three seconds again. Repeat these steps until primary bulb of fuel hose becomes stiff.

6) Engine Oil

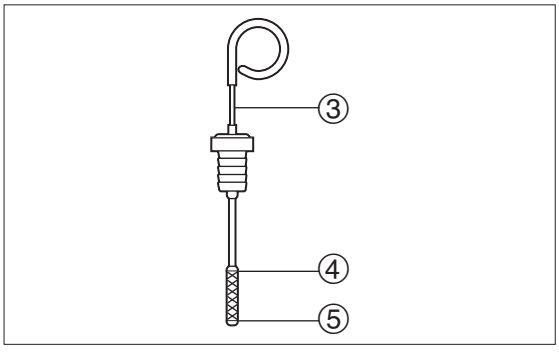
1. Remove top cowl, and then remove oil filler cap ①.



2. Pour specified quantity of engine oil into oil filler hole ②. Oil level should be check by oil filler gauge ③.

Recommended Engine Oil :
4 Stroke Engine Oil
API : SH, SJ, SL
SAE : 10W-30, 10W-40
Quantity of Engine Oil :
When oil filter is replaced : 2.4L (2.5 US qt.)
When oil filter is not replaced: 2.2L (2.3 US qt.)

Some oil may still be in oil pan. Use the gauge and do not overfill or running issues may occur.



③ Oil level gauge ④ Upper MAX ⑤ Lower MIN

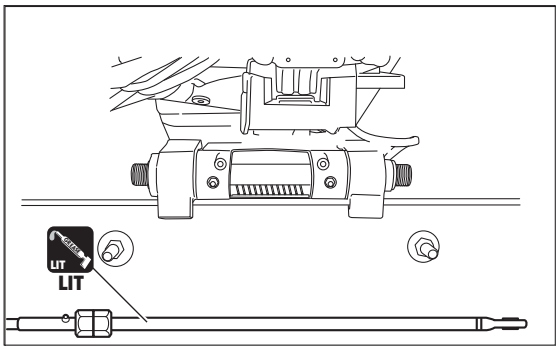
3. Put oil filler cap on the cylinder head. Reinstall top cowl.

4. Connections to Outboard Motor

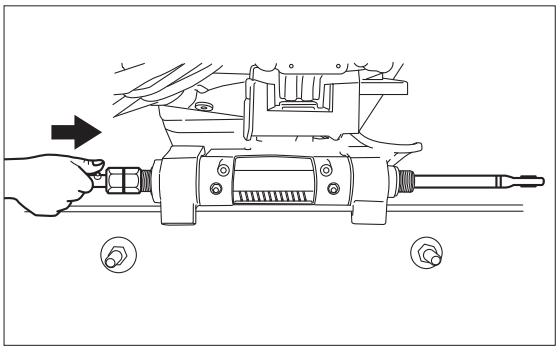
1) Steering Cable

Cable arranged on the starboard side

1. Apply thin coat of grease to entire area of cable end.



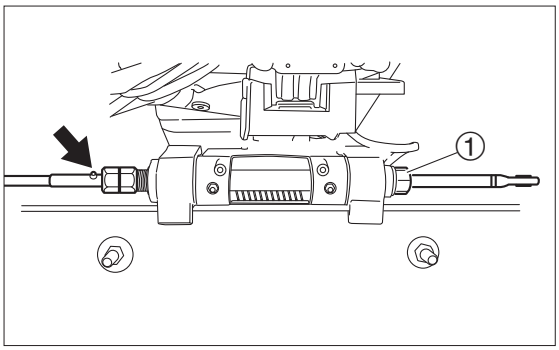
2. Run steering cable into tilt tube.



3. Tighten nut to specified torque.

Nut :
48 N · m (35 lb · ft) [4.8 kgf · m]

Be sure to attach drag link seal ring ①.



2) Drag Link

1. Attach drag link as shown.

When installing steering rod that connects engine and steering cable, be sure to use special bolt ①, nylon lock nuts ② washer ③ and coller ④. Do not use regular bolts and non-lock type nuts in place of these bolts and lock nuts, or the nuts may be loosened due to mechanical vibration resulting in disconnection of the link rod.

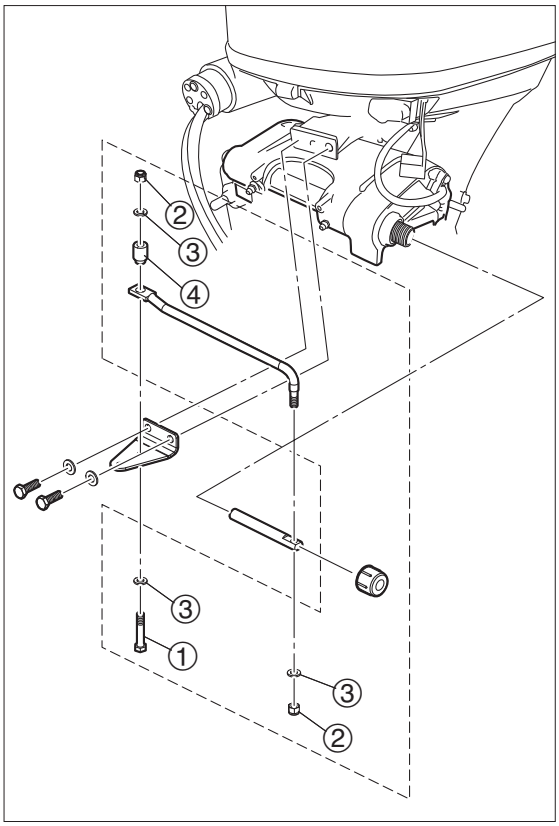
⚠ WARNING

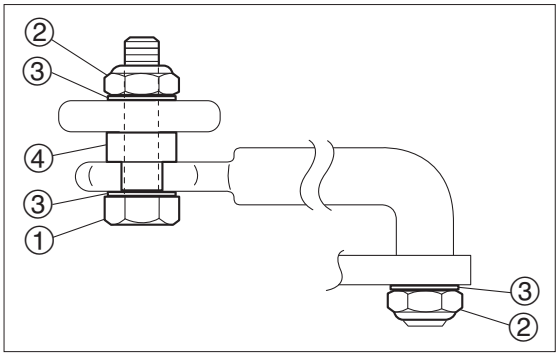
Disconnection of steering rod will cause the boat to turn accidentally. The sudden turn of the boat may cause the passenger to be thrown overboard, leading to serious injury or fatal accident.

Bolt ① :
27 N · m (20 lb · ft) [2.7 kgf · m]
Nylon Nuts ② :
Fully tighten, and then loosen 1/4 of a turn.

Washer ③

Coller ④





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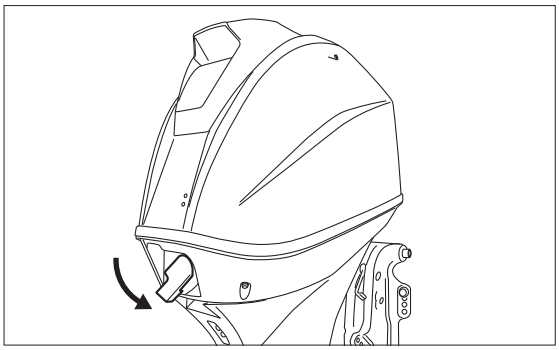
3) Installation of Remote Control Cable (Engine Side)

1. Turn top cowl hook levers and remove top cowl.

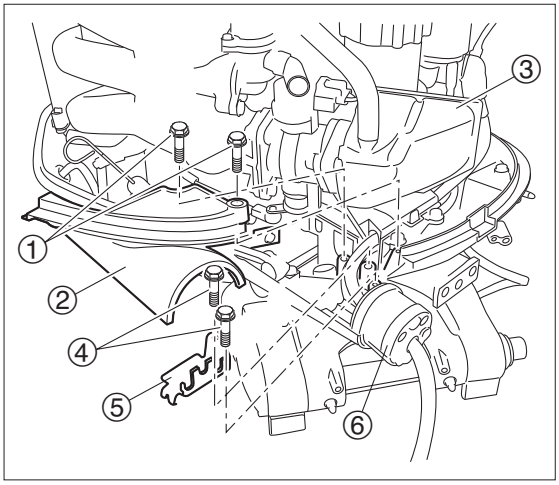


2. Remove bolts ① and then remove remote control cable stay cover ②.

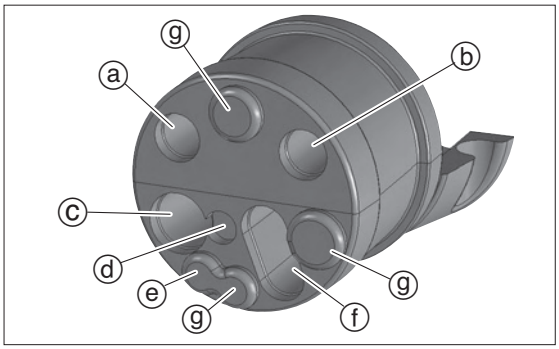
Remove air scilencer ③ to easlly remove bolts ①.

3. Remove bolts ④ and then remove cable clip ⑤.

4. Remove grommet ⑥.



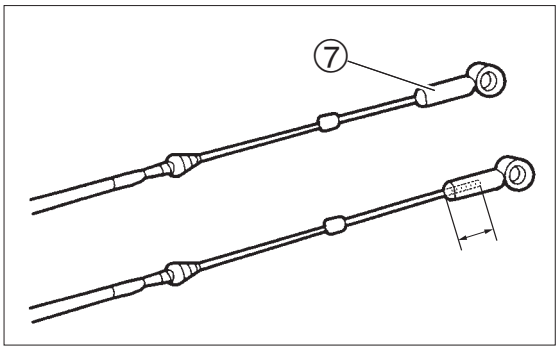
ⓐ Shift cable
ⓑ Throttle cable
ⓒ Main harness
ⓓ Meter cord Ass'y
ⓔ Trim sensor
ⓕ Battery cables
ⓖ Service hole

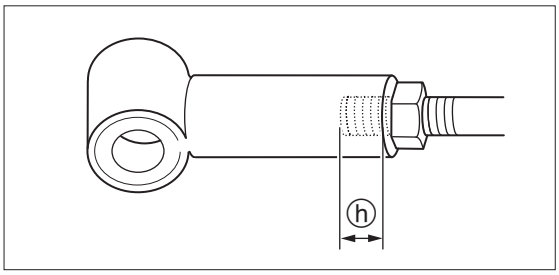


5. Pass through cord Ass'y, hose and control cable into the specifide hole of cord grommet, as shown.

6. Screw cable joint ⑦ on the tip of remote control cable by approximately 12 mm (0.47 in). Open the cut of grommet and run meter cord ass'y and cord ass'y B attached to remote control box from front of lower motor cover. Then, run two remote control cables.

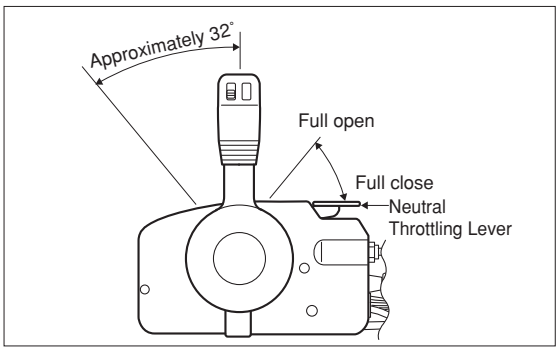
The screw-in distance of cable joint at least 12 mm (0.47 in) ⓗ.





7. Shift cable is the one of which tip is moved when remote control lever is set to forward (F) side until it stops once (approx. 32 degrees).

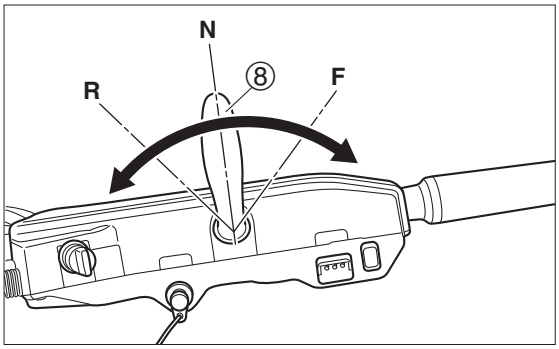
8. Set remote control lever to neutral (N), and check that neutral throttling lever is at full close position.

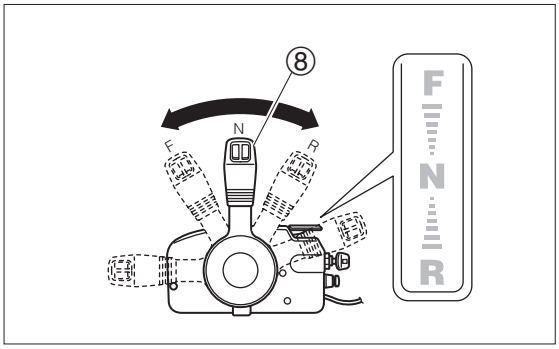


9. Place shift lever ⑧ at neutral position.

⚠ CAUTION

Shift lever cannot work unless throttle is fully closed. Do not force the shift.





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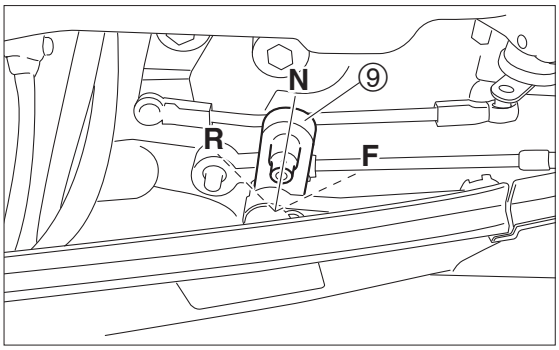
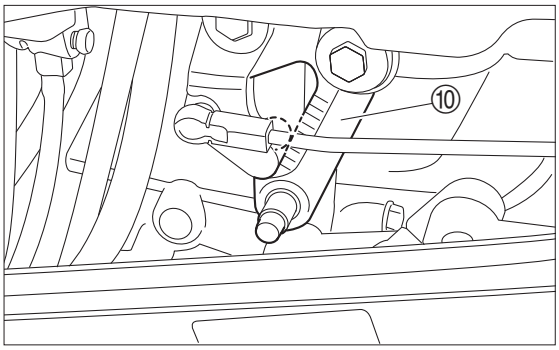
10. Set shift arm ⑨ to forward (F), neutral (N), reverse (R) and then to neutral (N) positions.



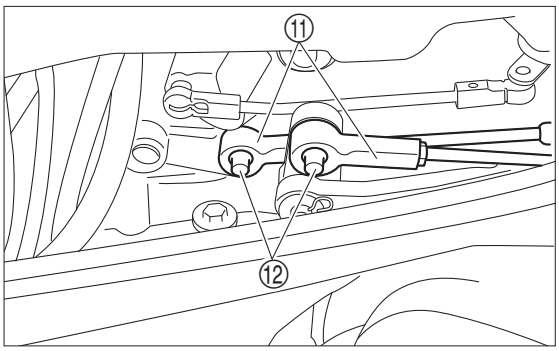
11. Set throttle cam ⑩ to full close position.



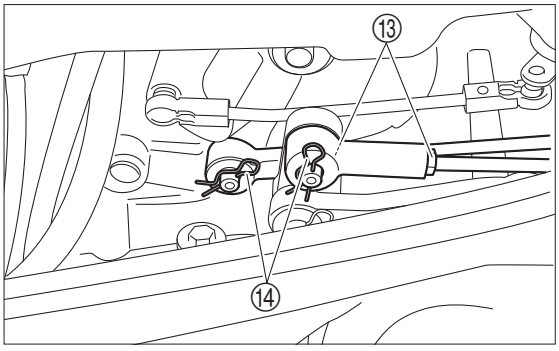
12. Adjust screw-in length of cable joint ⑪ so that hole of cable joint is brought to throttle arm pin and shift arm pin ⑫.

⚠ WARNING

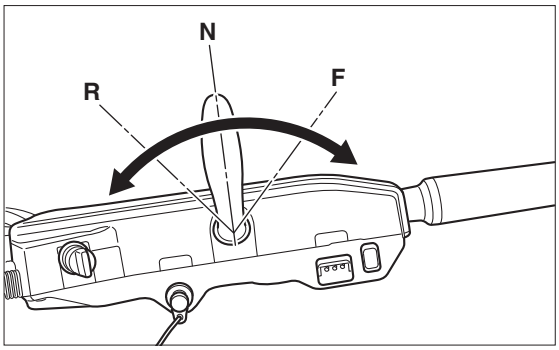
Screw-in remote control cable joint at least 12 mm (0.47 in) ⓗ.

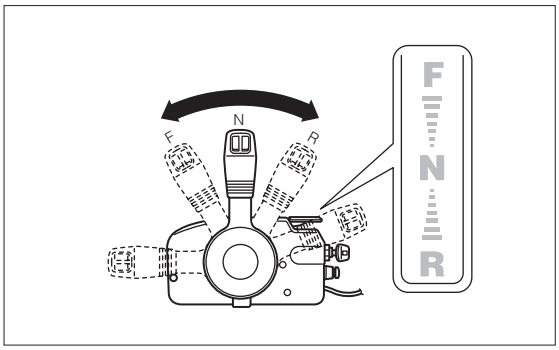


13. Lock joint with nut ⑬, put in on the pin, and secure with washer and R-pin ⑭.



14. Check the shift lever operation.to forward (F), neutral (N) and reverse (R) position.





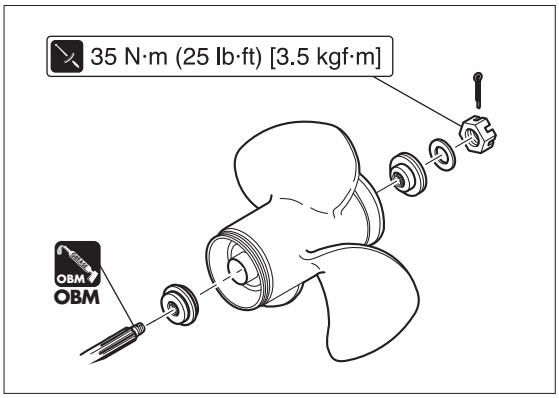
5. Lower Unit

1) Installation of Propeller

⚠ 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 when removing or installing propeller.**

1. Set shift lever to neutral (N) position.
2. Remove spark plug caps from spark plugs.
3. Apply grease to propeller shaft.
4. Put propeller parts on the propeller shaft in the order as shown.
5. Put a piece of wood in between gear case and propeller, and tighten nut to specified torque.



Propeller Nut :
35 N · m (25 lb · ft) [3.5 kgf · m]

6. Put split pin in the nut and bend.

⚠ CAUTION

Check nut for looseness at least every 20 hours of operation.

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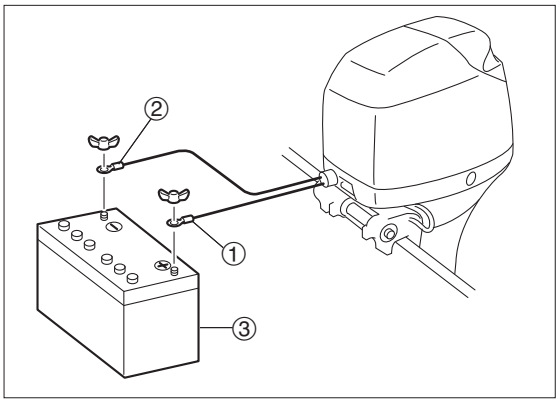
6. Electric System

1) Battery Capacity

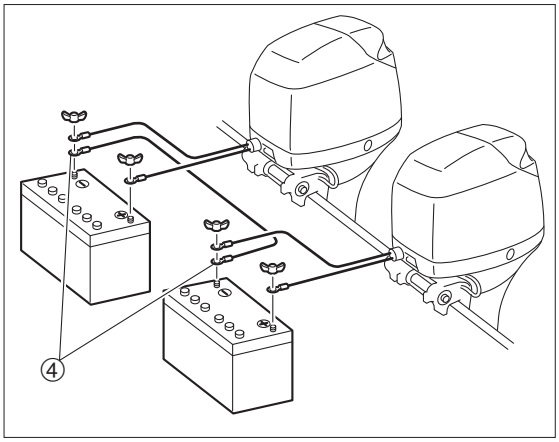
12V100 AH/5HR or more
CCA : 850
12V120 AH/5HR or more (in cold regions)
CCA : 1000

2) Connection of Battery Cables

1. Single Outboard Installation
   ① : Red Sleeve (Positive Side)
   ② : Black Sleeve (Negative Side)
   ③ : Starting Battery



2. Twin Outboard Installation
   Be sure to connect negative terminals of the starting batteries by using common earth lead ④ of which size is equal to that of the main battery cables.

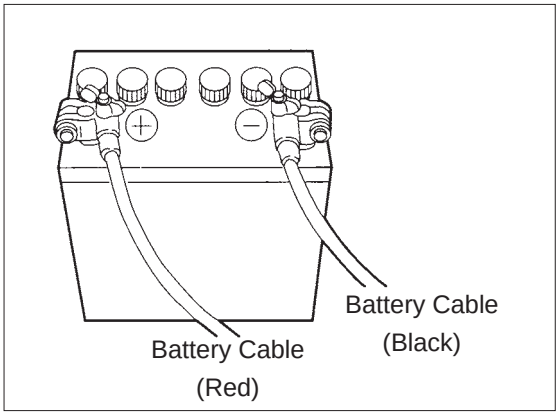


3) Installation of Battery (ies)

This outboard motor cannot be operated without using battery.
Use battery of 12V.100AH/5HR or more (12V.120AH for use in cold areas)

1. Battery should be stored in battery storage box and secured to hull to prevent it from falling due to rolling or pitching or any shock in the place where it is protected from water spray.

2. When connecting battery cables, connect red cable first, and then black one. (Reverse the order when disconnecting.)
   Positive cable is the one with red tube on the terminal end.



⚠ CAUTION

- **Before using battery, thoroughly read warning label.**
- **Do not disconnect battery cable during engine operation.**

7. Accessories and Meters

1) Accessories.

Start In-Gear Protection (Neutral Safe Starting Switch)

Neutral safety switch on the bottom cowl disables the engine starting when shift gear is engaged.

⚠ WARNING

If engine starts with the shift gear engaged, the boat may start to move unexpectedly, possibly leading to serious injury or fatal accident. To prevent this accident, the outboard motor is equipped with the start in-gear protection (neutral safe starting switch), which must not be disabled.

<Selection of Outboard Motor Accessories>

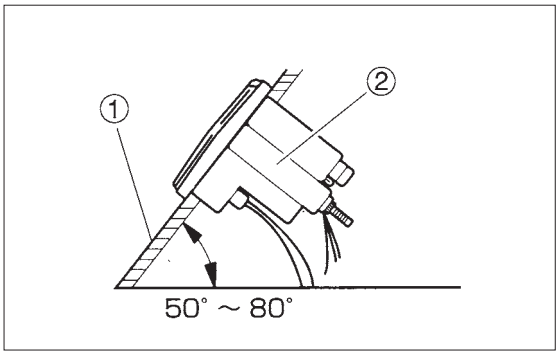
For this outboard motor, use the manufacturer's genuine parts and accessories.

For safety reasons, it is not recommended to use parts and accessories supplied by other than the manufacturer. Before using any accessories, thoroughly read the installation manual and operation manual.

2) Installation of Meters

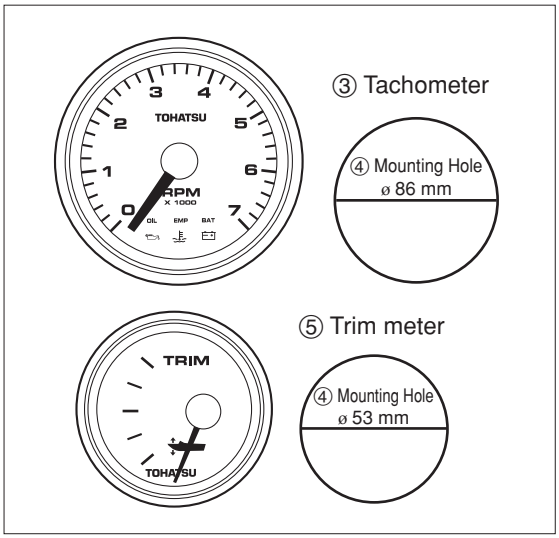
When installing meters, select a place on the dash board ① where operator can watch them easily and they are not exposed to water spray.

The meters can be installed on the dashboard of 2 to 11 mm thick. When the thickness is over 11mm, cut fitting plate ② so that the meters can be installed.



<Installation Angle>

Install meters so that the angle is in between 50 to 80 degrees from horizontal plane.



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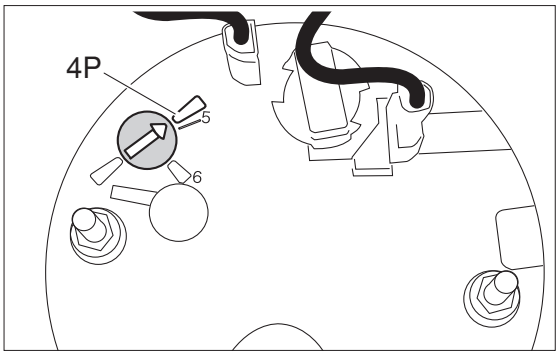
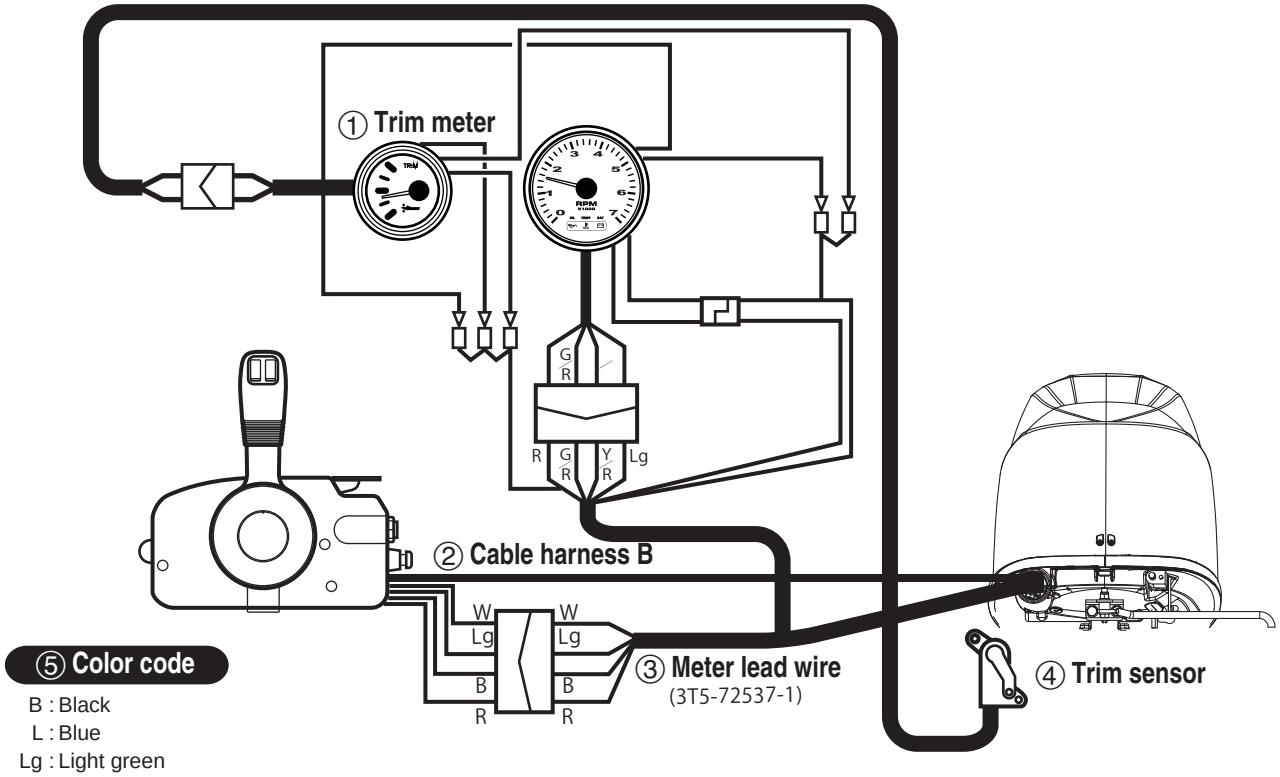
<Tachometer>

Set selector to “4P” on the back of the meter.



1. Connect cord ass’y B and meter lead wire to cord ass’y A.



⑤ Color code

B : Black
L : Blue
Lg : Light green
P : Pink
R : Red
W : White
Y : Yellow
Y/R : Yellow/Red
G/R : Green/Black

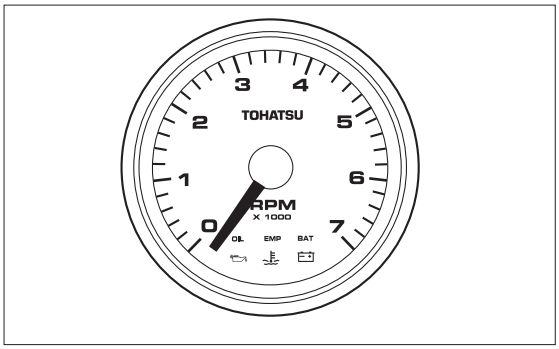
8. Operation

1) Warning Indication

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

Take actions described below if abnormal state has occurred.

1. When engine started, warning lamp is lit for 5 seconds and warning buzzer operates for two seconds (generating intermittent sound) indicating that operation warning system is operating normally.



2. Over revolution Prevention System (High Speed ESG)
If engine load is reduced for some reason, the revolution speed may increase abnormally. In such case, warning buzzer operates (generating continuous sound), warning lamp is lit, and at the same time, high speed ESG operates to reduce the speed to 6,200 r/min or less.

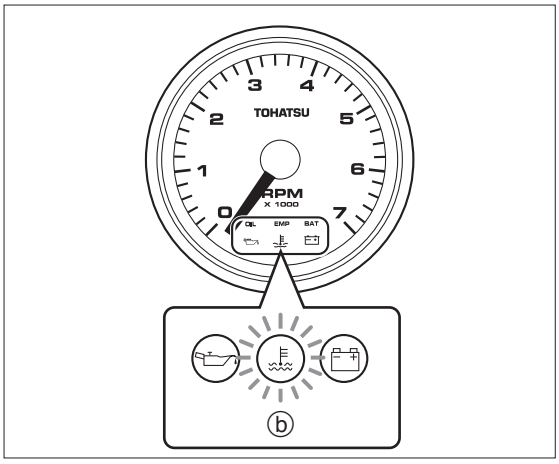
Sensor Detection Level	Speed Controlled to
Over revolution	Approximately 6,200 r/min

3. Overheat Warning
When engine temperature exceeds above 100°C during operation, warning lamp ⓑ brinks, and at the same time, low speed ESG operates to reduce the speed to 2,800r/min or less. Furthermore engine temperature exceeds 140°C, warning lamp ⓐⓑⓒ blinks, idle speed control operates to reduce the speed to 850 r/min.

Sensor Detection Level	Speed Controlled to
Overheat 100°C	2,800 r/min
Overheat 140°C	850 r/min

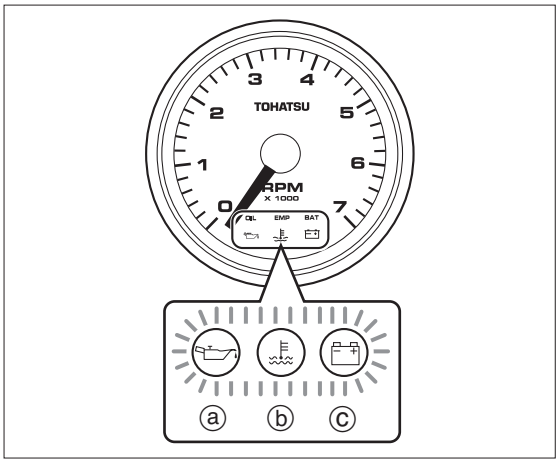
- Run immediately to safe place, and set throttle grip or control lever to slow. Set shift lever or control lever to neutral (N), check if cooling water check port discharges water, and then, stop engine. Remove plastic sheet or other matters that clogs water intake port, if any.
- The revolution control is cancelled when the engine temperature returns to normal state, and in throttle range of 2,800 r/min or over, the engine speed increases gradually.
- This warning is effective only for overheating, and not effective for combustion or lubrication.

Engin High Temperature



Lamp is brinking

Engine Overheat



Lamp is brinking

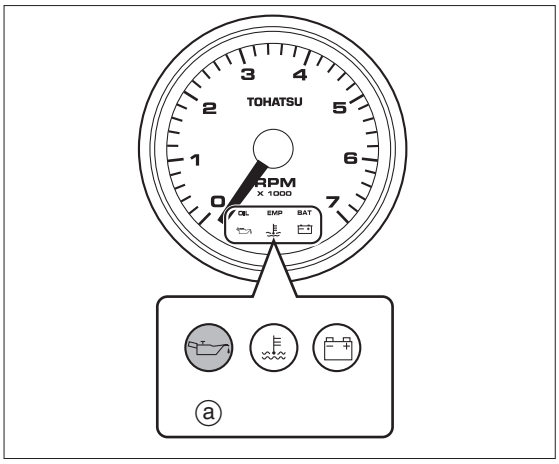
10

4. Oil Pressure Warning

When Oil pressure is reduced below setting value during operation, warning buzzer operates (generating continuous sound), warning lamp ⓐ is lit, and at the same time, low speed ESG operates to reduce the speed to 2,800 r/min or less.

- Reduce engine speed and run to safe place, set main switch key to "OFF" to stop engine, and then, check oil level and add oil if necessary. After adding oil, start engine and check that warning lamp on the tachometer and bottom cowl is not lit and warning buzzer does not go on.
- Even after oil pressure returns to normal state, engine speed control for oil pressure cannot be cancelled unless engine is stopped.
- This warning is effective only for oil pressure detection at oil pressure switch section, and is not effective for overall oil pressure detection.

Sensor Detection Level	Speed Controlled to
Reduction of oil pressure	2,800 r/min



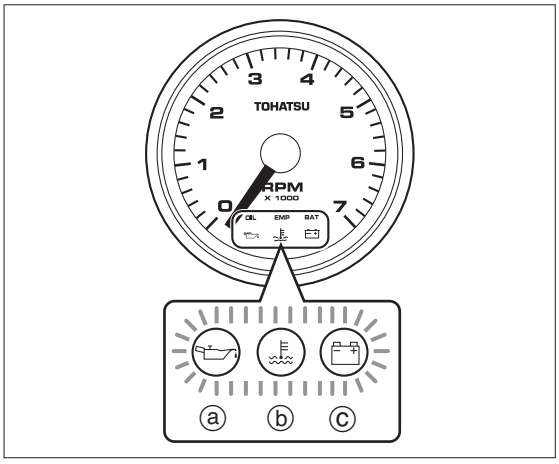
Lamp is lit

5. Engine Trouble Warning

When each sensor detects abnormality, warning lamp ⓐⓑⓒ blinks, warning buzzer operates (generating intermittent sound), and at the same time, low speed ESG operates to reduce the speed to 2,800 r/min or less

Sensor Detection Level	Speed Controlled to
Engine Trouble	2,800 r/min

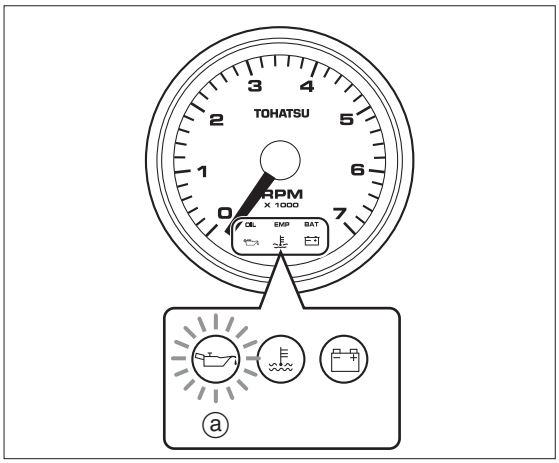
- Engine revolution is reduced to 2,800 r/min, warning lamp blinks and warning buzzer sounds (generating intermittent sound).
  1. Each sensor defective
  2. Wire defective contact or disconnected
- Even after sensor returns to normal state, engine speed control for malfunction cannot be cancelled unless engine is stopped.



Lamp is brinking

6. Engine oil replacement indicator

As for "Engine oil replacement indicator function", informing the appropriate timing of engine oil replacement by blinking of the lamp (lamp ⓐ ON 1 sec. and OFF 9 sec.), when beyond 100 hours operating.



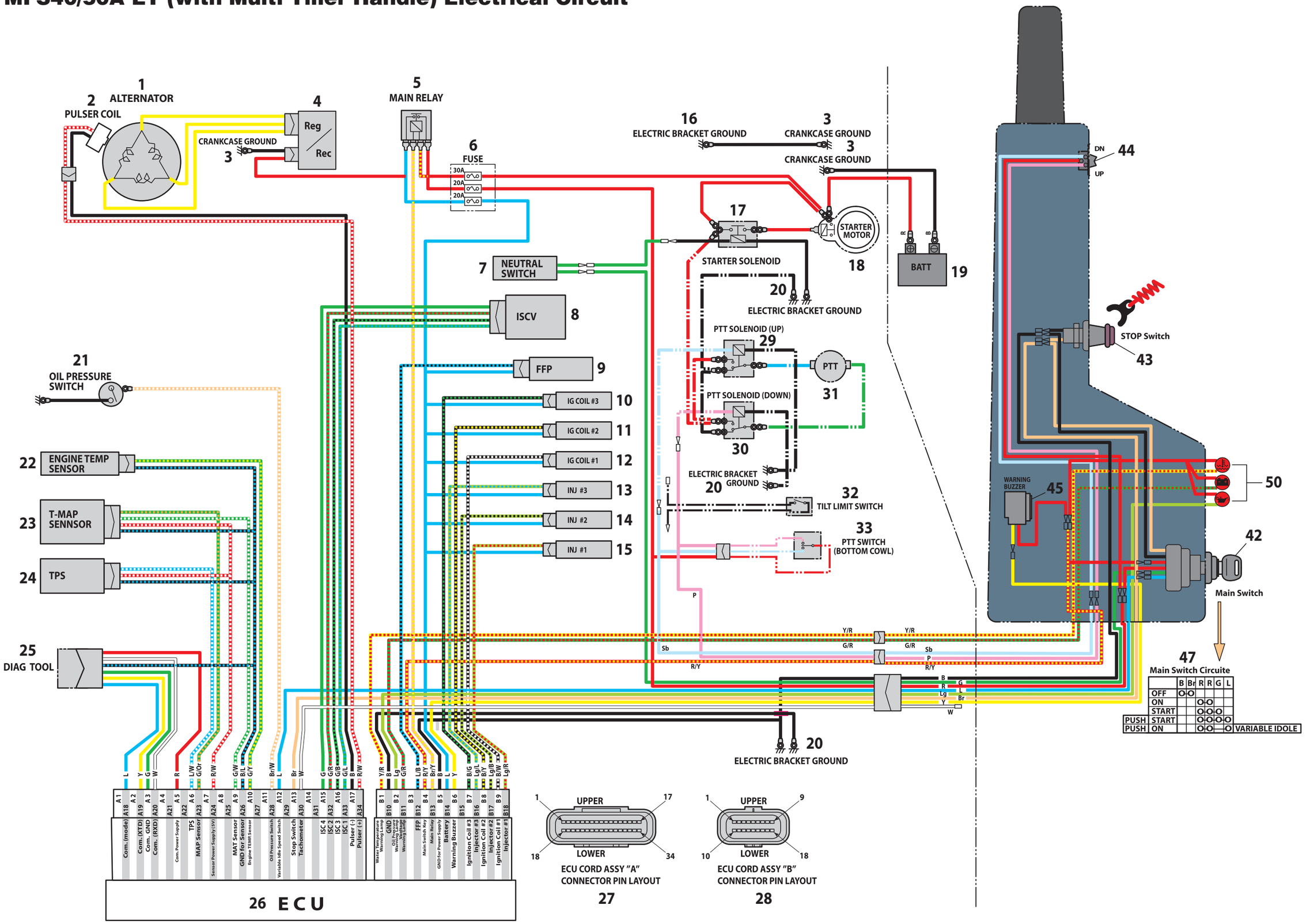
Lamp is brinking

11
Wiring Diagram

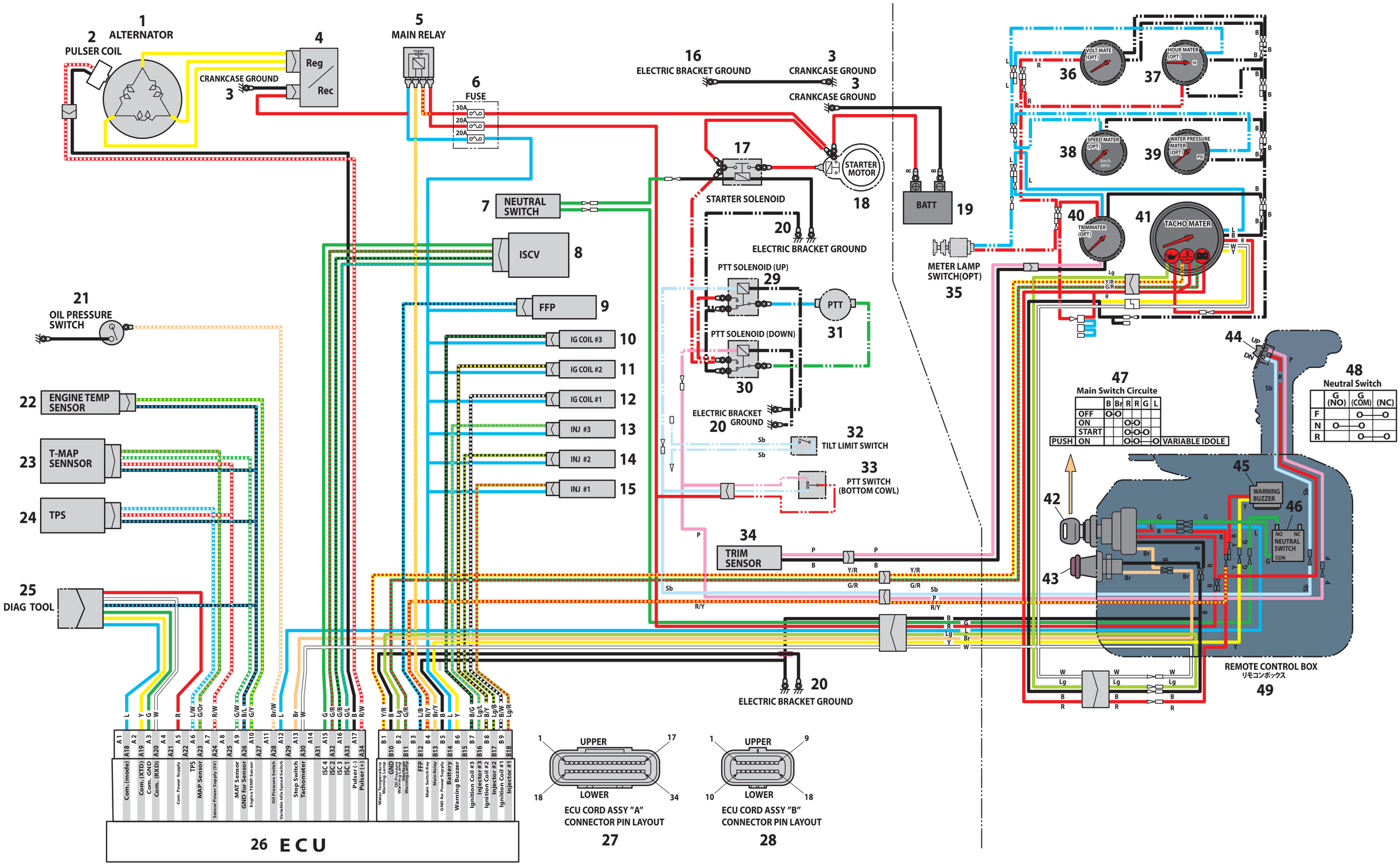
Wiring Chart

NO.	Name	Remarks	ECU	Lead Wire Color				ECU
1	Alternator	Charge Coil	–	Y	Yellow	Y	Yellow	–
2	Palser Coil	CPS	A34	R/W	Red/White	B	Black	A17
3	Crankcase	Ground	–	B	Black	B	Black	–
4	Rectifire/Regurator		–	Y	Yellow	R	Red	–
5	Main Relay		B13	Br/Y	Brown/Yellow	L	Blue	–
6	Fuse Holder		–	R	Red	L	Blue	B14
7	Neutral Switch	Bottom Cowl	–	G	Green	G	Green	–
8	Idle Speed Control Valve	ISC Valve	A15	G	Green	G/R	Green/ Red	A32
			A16	G/B	Green/Black	G/L	Green/Black	A33
9	Fuel Feed Pump	FFP	B12	L/B	Blue Black	L	Blue	B14
10	Ignition Coil	#3	B7	B/G	Black/Green	L	Blue	B14
11	Ignition Coil	#2	B8	B/Y	Black/Yellow	L	Blue	B14
12	Ignition Coil	#1	B9	B/W	Black/White	L	Blue	B14
13	Fuel Injector	#3	B16	Lg/L	Light Green Blue	L	Blue	B14
14	Fuel Injector	#2	B17	Lg/B	Light Green Black	L	Blue	B14
15	Fuel Injector	#1	B18	Lg/R	Light Green/Red	L	Blue	B14
16	Electric Blacket	Ground	–	B	Black	B	Black	–
17	Starter Solenoide		–	G	Green	R	Red	–
18	Starter Motor		–	R	Red	R	Red	–
19	Battery		–	R	Red	B	Black	–
20	Electric Blacket	Ground	B5	B	Black	B	Black	B10
21	Oil Pressure Switch		A28	Br/W	Brown/White	Ground	–	–
22	Engine Temp Sensor	E-WTS	A10	G/Y	Green/Yellow	B/L	Black/Blue	A26
23	T-MAP Sensor	MAP	A23	G/Or	Green/Orange	R/W	Red/White	A24
		MAT	A9	G/W	Green/White	B/L	Black/Blue	A26
24	Throttle Position Sensor	TPS	A6	L/W	Blue/White	R/W	Red/White	A24
			–	–		B/L	Black/Blue	A26
25	Service Connector	Diagnosis Port	A18	L	Blue	G	Green	A3
			A19	Y	Yellow	R	Red	A5
			A20	W	White	B/L	Black/Blue	A26
26	ECU	Electric Control Unit	–	–				–
27	ECU Connector	Main Harness	–	–				–
28	ECU Connector	Sab Harness	–	–				–
29	PTT Solenoide	UP-side/PTT Model	–	Sb	Sky Blue	L	Blue	–
30	PTT Solenoide	DOWN-side/PTT Model	–	P	Pink	G	Green	–
31	PTT Motor	PTT Model	–	L	Blue	G	Green	–
32	Tilt Limit Switch	PTT Model	–	Sb	Sky Blue	Sb	Sky Blue	–
33	PTT Switch	Bottom Cowl/PTT Model	–	Sb	Sky Blue	P	Pink	–
34	Trim Sensor	Option	–	P	Pink	B	Black	–
35	Meter Lamp Switch	Option	–	L	Blue	R	Red	–
36	Volt Meter	Option	–	R	Red	B	Black	–
37	Hour Meter	Option	–	R	Red	B	Black	–
38	Speed Meter	Option	–	–				–
39	Water Pressure Meter	Option	–	–				–
40	Trim Meter	Option	–	P	Pink	B	Black	–
41	Tachometer	Option	A30	W	White	Y	Yellow	–
42	Main Switach Key		B4	R/Y	Red/Yellow	L	Blue	A12
43	Stop Switch		A13	Br	Brown	B	Black	–
44	PTT Switch	Option	–	Sb	Sky Blue	P	Pink	–
45	Warning Buzzer		B6	Y	Yellow	R	Red	–
46	Neutral Switch	Option	–	G	Green	G	Green	–
47	Main Switch Circuite		–	–				–
48	Neutral switch Circuite	Option	–	–				–
49	Remote Control	Option	–	–				–
50	Warning Lamp	Multi Tiller Handle Model/LED	B1	Y/R	Yellow Red	G/R	Green Red	B11
			B2	Lg	Light Green	–		–

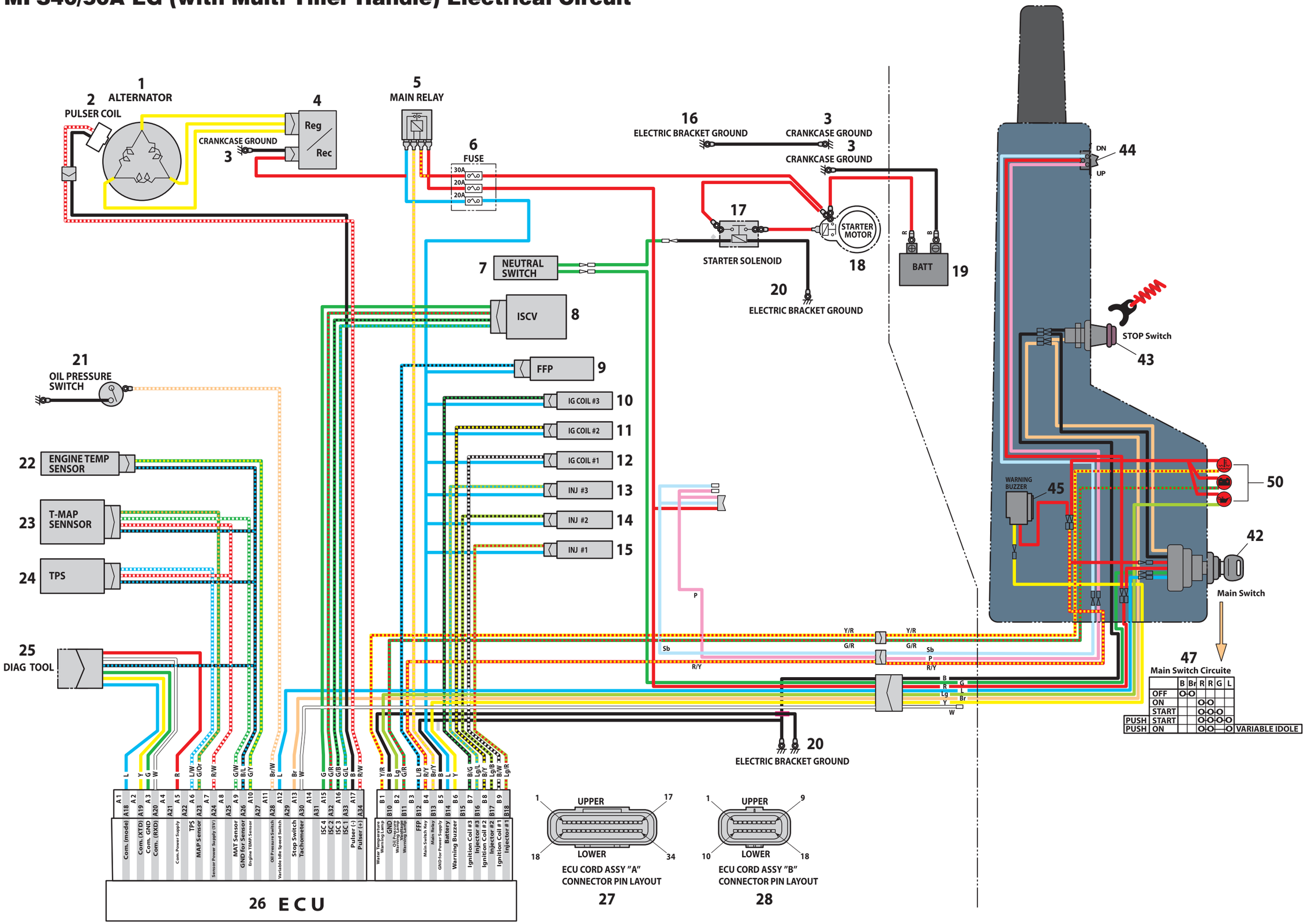
MFS40/50A ET (with Multi Tiller Handle) Electrical Circuit



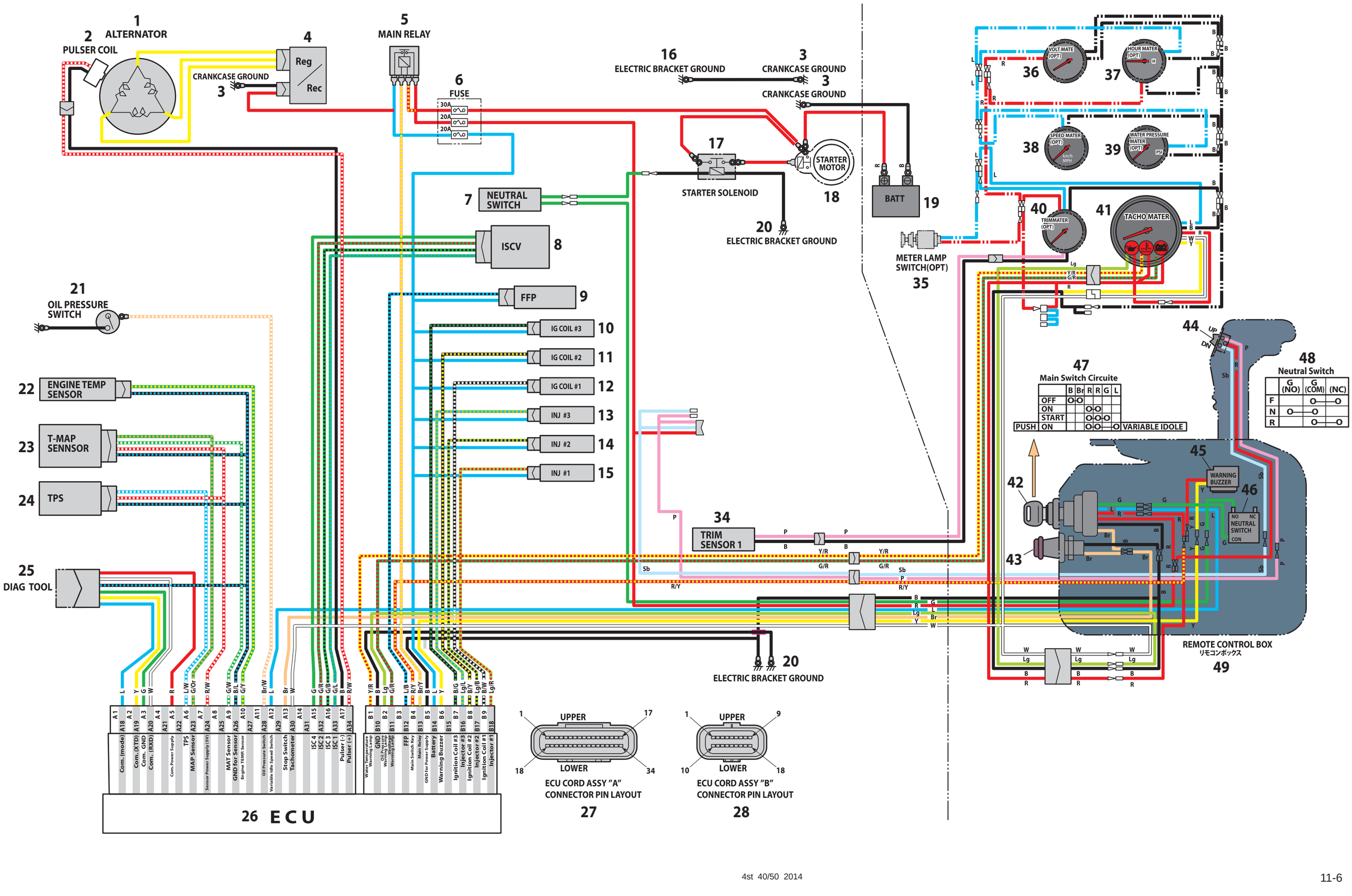
MFS40/50A ET (with Remote Control) Electrical Circuit



MFS40/50A EG (with Multi Tiller Handle) Electrical Circuit



MFS40/50A EG (with Remote Control) Electrical Circuit



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