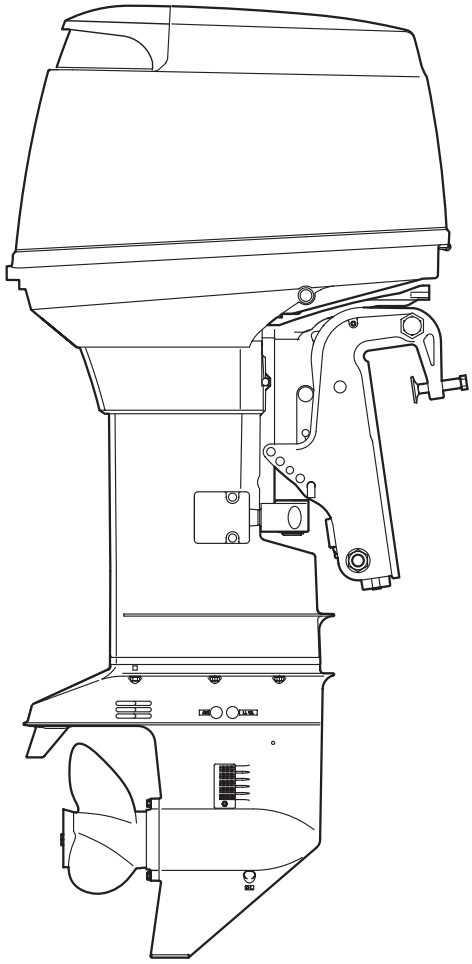
TOHATSU
OUTBOARD



TLDI
40·50

SERVICE MANUAL

TOHATSU CORPORATION

Chapter 1 Specifications

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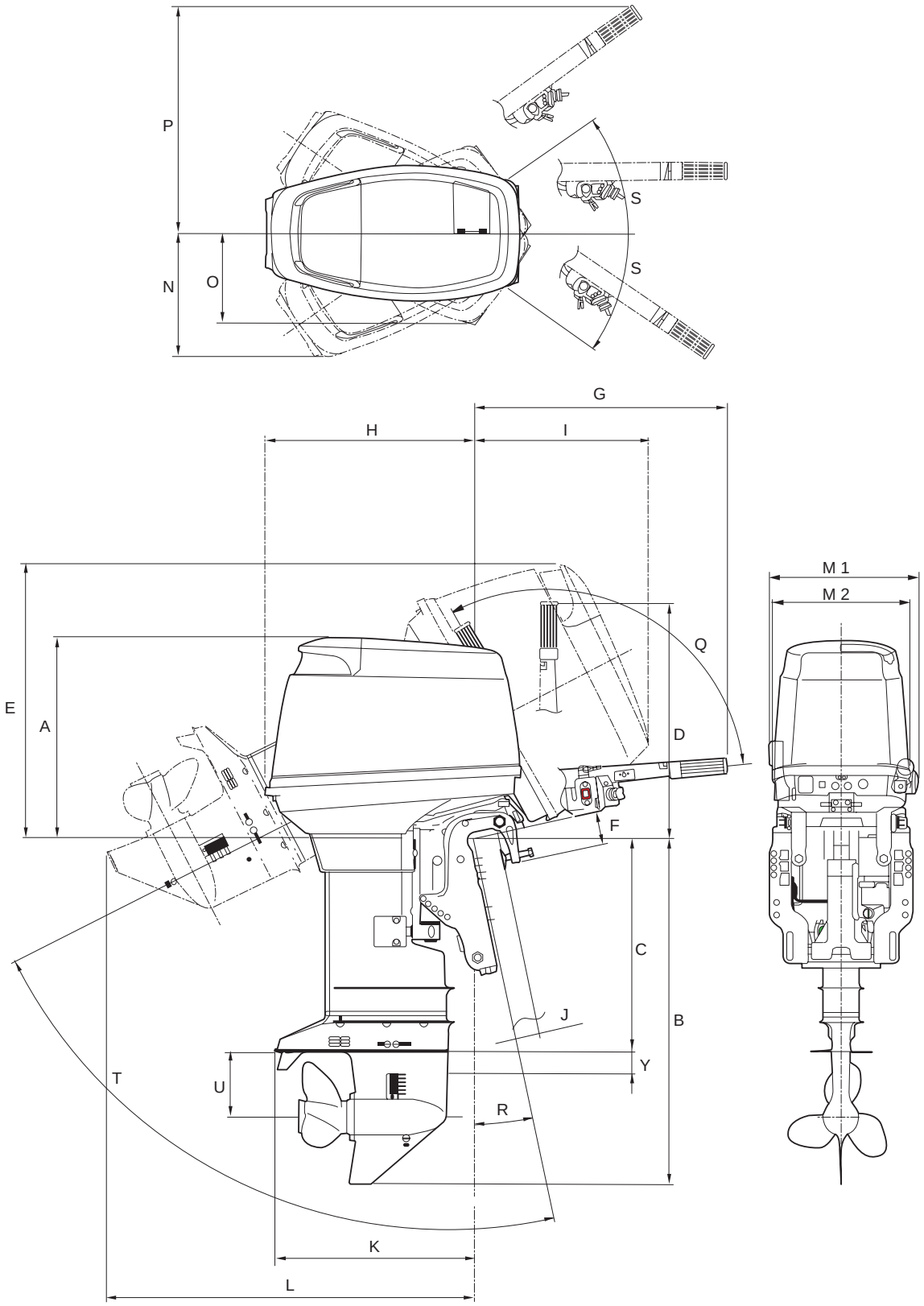
1. Specifications Table

Item \ MODEL		40A		50A
		EPTO	EFTO	EFO
Overall length (approx.)		630 mm (24.8 in)	1120 mm (44.1 in)	
Overall width (approx.)		345 mm (13.6 in)	384 mm (15.1 in)	
Overall height (approx.)	Transom (S)	1227 mm (48.3 in)		
	Transom (L)	1354 mm (53.3 in)		
	Transom (UL)	1481 mm (58.3 in)		
Weight (approx.)	Transom (S)	95.5 kg (211 lb)	98.5 kg (217 lb)	88.5 kg (195 lb)
	Transom (L)	96.5 kg (213 lb)	99.5 kg (219 lb)	89.5 kg (197 lb)
	Transom (UL)	99.0 kg (218 lb)	102.0 kg (225 lb)	92.0 kg (203 lb)
Transom length (outboard)	Transom (S)	403 mm (15.9 in)		
	Transom (L)	530 mm (20.9 in)		
	Transom (UL)	657 mm (25.9 in)		
Engine type		3-cylinder inline		
Piston displacement		697ml (42.5 cu.in)		
Bore & stroke		68 mm (2.68 in) x 64 mm (2.52 in)		
No. of cylinders		3		
Maximum output		29.4 kW		36.8 kW
Full-throttle range		5150~5850 rpm		
Trolling		700 rpm		
Idling		700 rpm		
Full-throttle fuel consumption (approx.)		17 L/Hr (4.5 US gal/Hr)		
Starting system		Electric starter motor		
Intake system		Reed valve		
Scavenging system		5-port loop		
Exhaust system		Through hub		
Lubrication system		Auto-mixing		
Cooling system		Forced water-cooling		
Water temp. control		Thermostat		
Ignition system		L-CDI		
Ignition timing control		Electronically advanced		
Firing order		1-2-3		
Sparkplug		Champion RC10ECC		
Alternator		12V 280W		
Battery		12V 100AH		
		12V 120AH (0°C or low)		
Trim angle		8°~24°		4°~24°
Trim angle settings		5		6
Maximum tilt-up angle		75°		
Transom board thickness		31~70 mm (1.22 ~ 2.76 in)		
Maximum steering angle		70°		80°
Gear shift		Dog clutch (F-N-R)		
Gear ratio		1.85 : 1 (13 : 24)		
Throttle control		Remote-control	Tiller handle	
Fuel tank		25L (6.60 US gal)		
Oil tank		2L (2.1 US qt)		
Fuel		Unleaded regular gasoline		
Engine oil		Genuine engine oil or TC-W, 2-stroke marine outboard oil*		
Gear oil		Genuine gear oil (500 ml) or API GL5, SAE #80		

*: Only those products that have been approved.

2. Outline Dimensions



External Dimensions

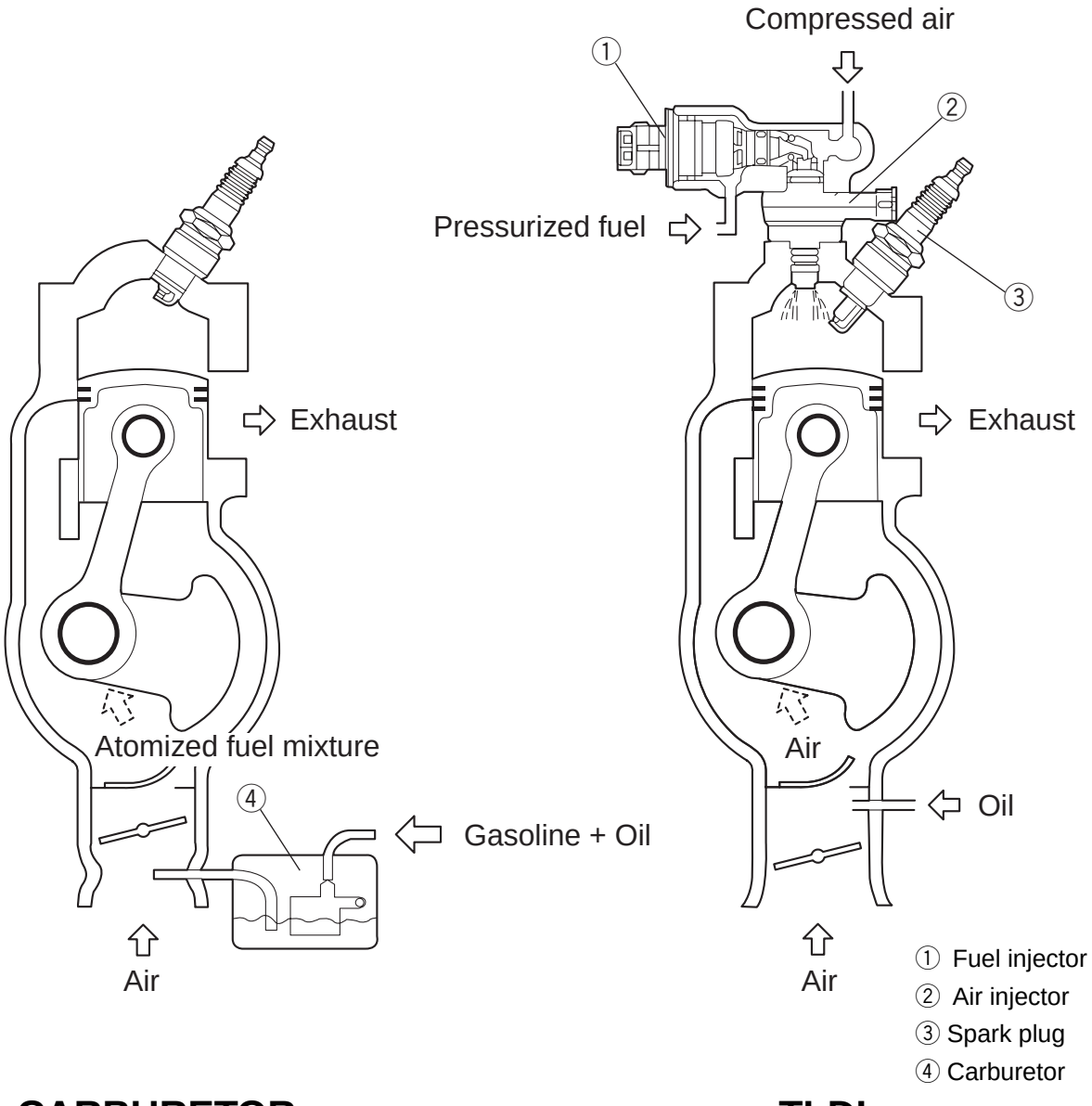
Item		Remarks
A	499 mm (19.6 in)	
B	Transom (S) 728 mm (28.7 in)	
	Transom (L) 855 mm (33.7 in)	
	Transom (UL) 982 mm (38.7 in)	
C	Transom (S) 403 mm (15.9 in)	
	Transom (L) 530 mm (20.9 in)	
	Transom (UL) 657 mm (25.9 in)	
D	568 mm (22.4 in)	Models EFTO, EFO
E	680 mm (26.8 in)	
F	85 mm (3.3 in)	
G	623 mm (24.5 in)	Models EFTO, EFO
H	520 mm (20.5 in)	
I	440 mm (17.3 in)	
J	30-75 mm (1.2~3.0 in)	
K	490 mm (19.3 in)	
L	Transom (S) 800 mm (31.5 in)	
	Transom (L) 910 mm (35.8 in)	
	Transom (UL) 1025 mm (40.4 in)	
M1	384 mm (15.1 in)	Models EFTO, EFO
M2	345 mm (13.6 in)	Model EPTO
N	310 mm (12.2 in)	
O	235 mm (9.3 in)	
P	565 mm (22.2 in)	Models EFTO, EFO
Q	120deg.	Models EFTO, EFO
R	12deg.	
S	35deg.	
T	75deg.	
U	161 mm (6.3 in)	
Y	54 mm (2.1 in)	

3. Background on TLDI

The abbreviation TLDI stands for Two-stroke Low-pressure Direct Injection and is the name Tohatsu applies to direct fuel-injection system engines.

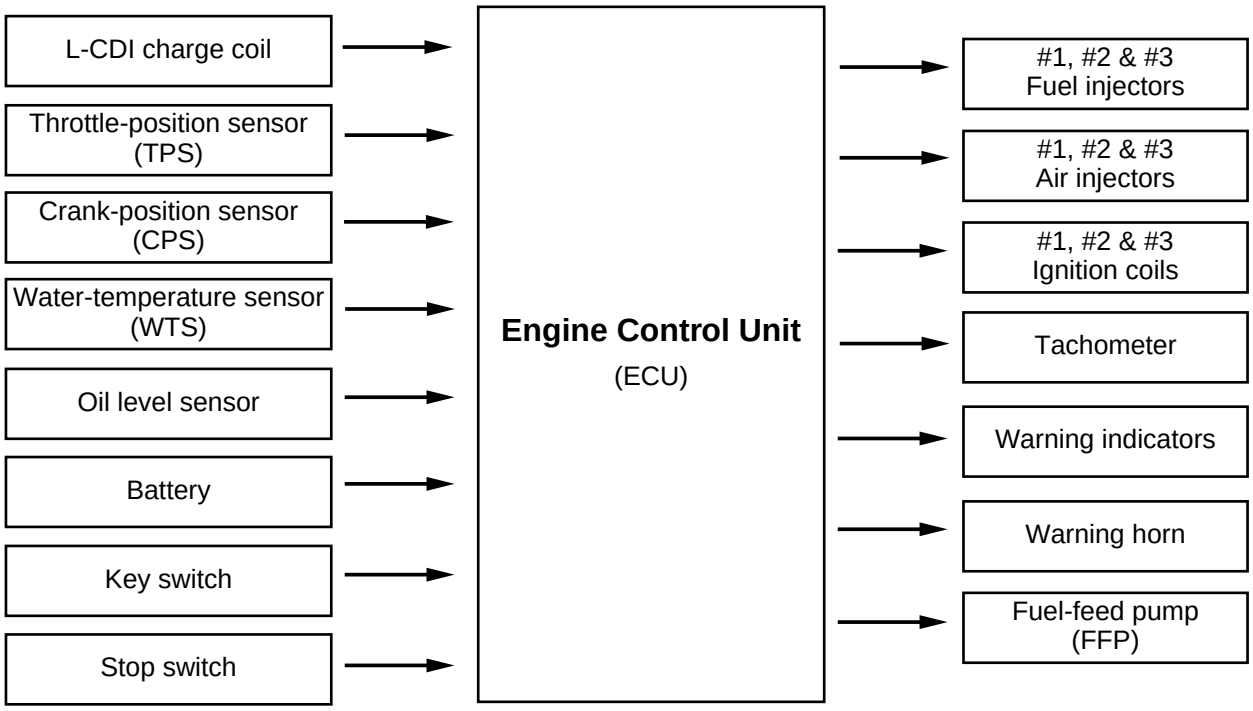
1. Two-Stroke Low-Pressure Direct Injection (TLDI)
   TLDI is the name Tohatsu uses for two-stroke engines that utilize the air-assisted, low-pressure direct injection system.
   The air-assisted, low-pressure direct injection system has been combined with the L-CDI or (Long-arc duration CDI ignition system and Engine Control Unit (ECU), which performs precision control of fuel mixture, injection timing and ignition timing to maximize combustion efficiency in the TLDI-50 engine. The result is better fuel economy, smaller size and greater power in a two-stroke engine.

2. Air-Assisted Low-Pressure Direct Injection
   With TLDI, the air-assisted, low-pressure direct injection process involves using an air compressor to pressurize the fuel supplied by the fuel pump to in order to propel or inject it directly into combustion chambers in the form of a finely atomized mixture to achieve maximum combustion efficiency.



3. ECU Control

With TLDI, a network of connected sensors enables the Engine Control Unit (ECU) to precisely regulates fuel mixture injection rate and ignition timing. The ECU also uses a stratified fuel feed process to provide lean combustion in the low-speed range, while utilizing more homogenized change to ensure the fuel mixture is distributed uniformly throughout the combustion chamber when operating in the high-speed range to ensure maximum combustion efficiency.



Long-duration CDI (L-CDI)

The L-CDI or Long-arc duration CDI ignition system is used as the TLDI ignition system to maximize combustion efficiency, fuel economy and minimize exhaust emissions. The L-CDI system offers a longer plug sparking interval, via spark plug, than used with conventional two-stroke engines. This is designed to ensure more complete combustion of the mixture in the chamber. L-CDI minimizes mis-firing and reduces fluctuation in engine speed during idling to offer a much smoother engine feel when compared with conventional two-stroke engines.

Throttle-Position Sensor (TPS)

The throttle-position sensor system is comprised of TPS1 and TPS2. These are used in combination to detect throttle butterfly valve, position advancer arm position, and to relay the information to the ECU.

Crank-Position Sensor (CPS)

The crank-position sensor is designed to sense the encoder located above the ring gear on the flywheel in order to detect crankshaft position and transmit the information to the ECU.

Water-Temperature Sensor (WTS)

Positioned on the water jacket installed on the cylinder, the water-temperature sensor (WTS) is used detect temperature of the cooling water in the cylinder and relay the information to the ECU.

Oil Level Sensor

The oil level sensor is used to detect the level of remaining oil and relay the information to the ECU.
The oil level sensor operates by lighting the indicator on the tachometer and sounding the beeper when engine oil is low.

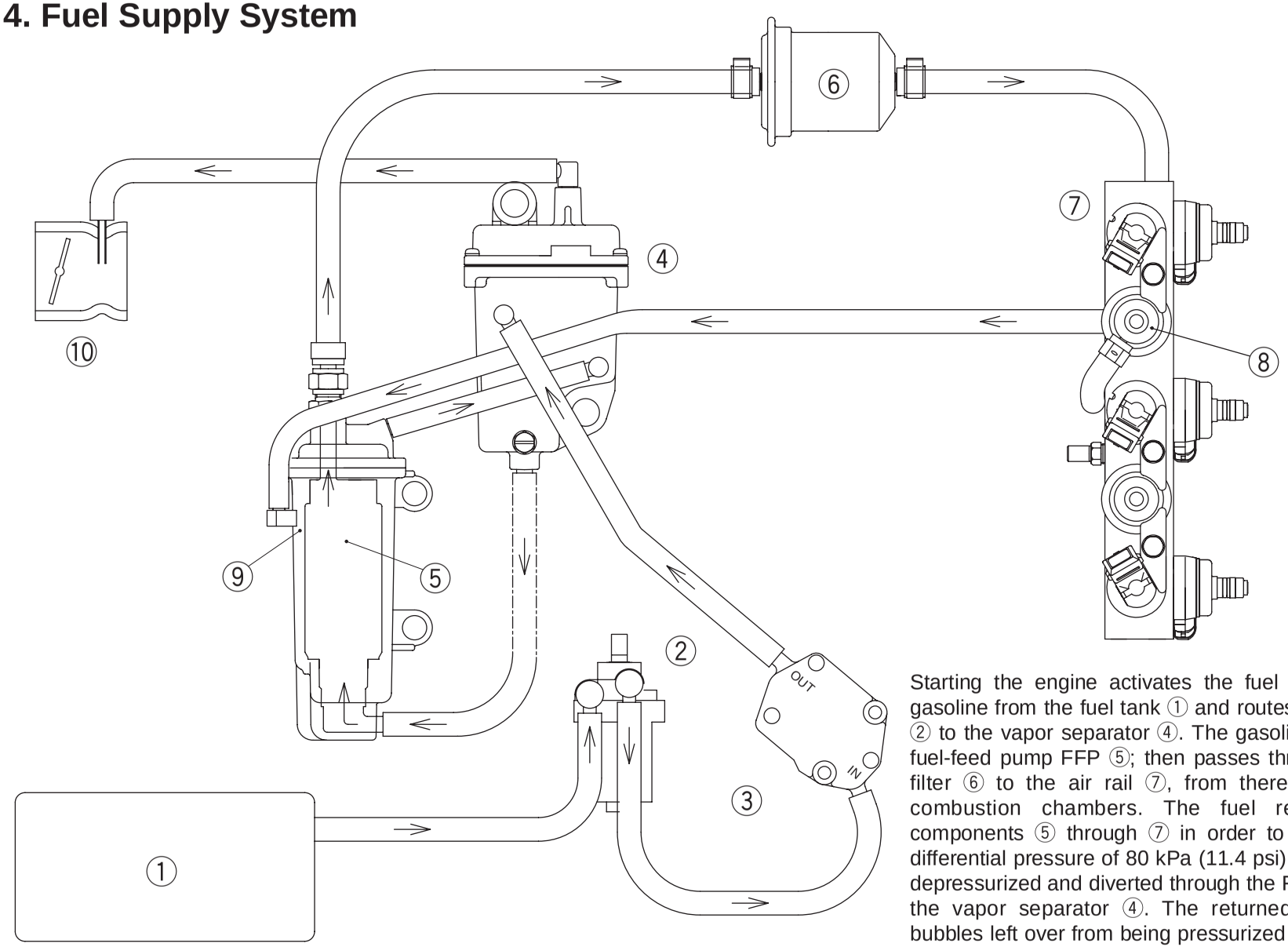
Air Injectors

The air injectors are used to inject a fine mist of fuel and air into the combustion chamber for each piston. The ECU determines the mixture and timing for injecting fuel according to current engine operating conditions based on information relayed from the various sensors.

Fuel Injector

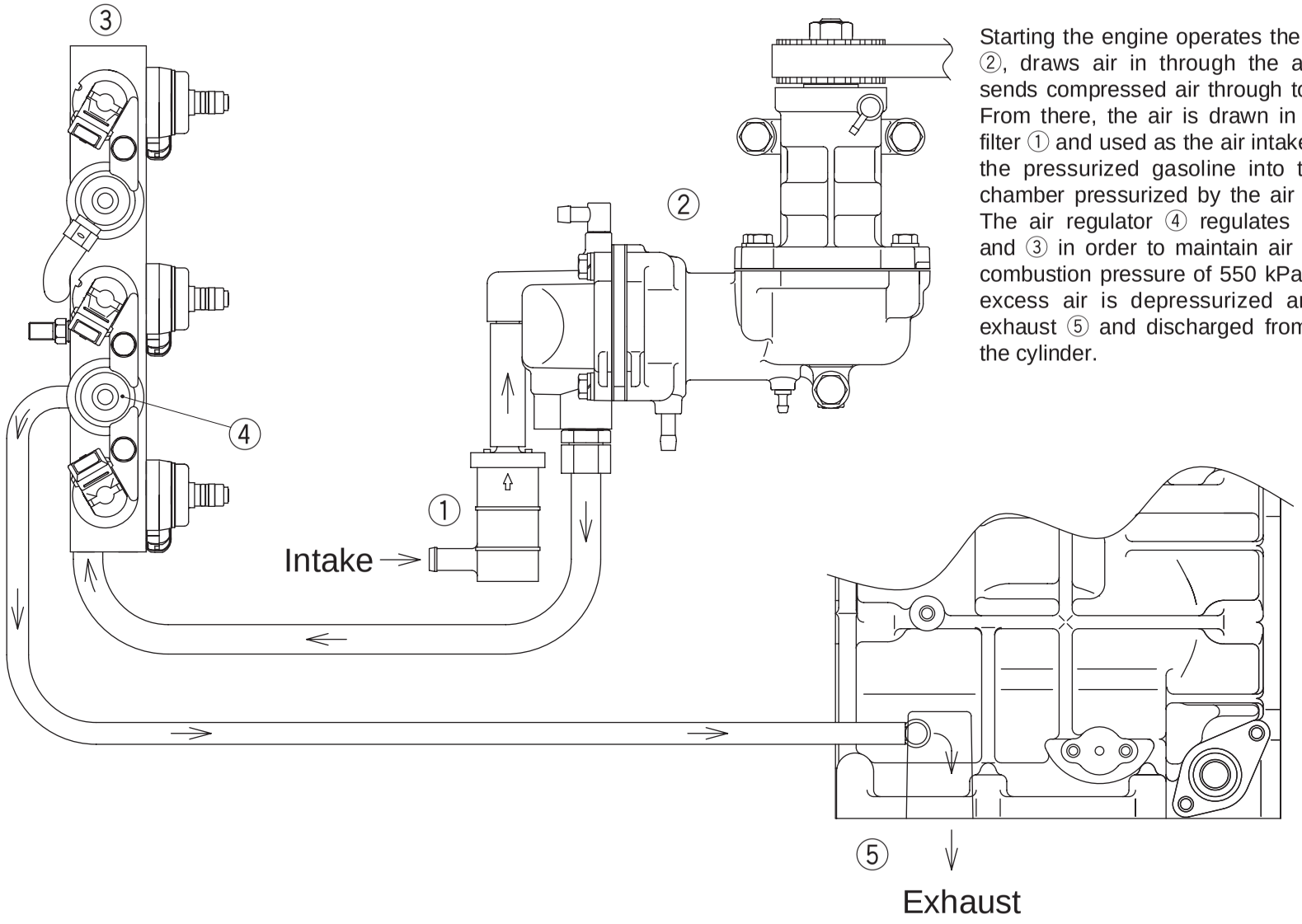
The fuel injectors supply the fuel in the air rail to the air injectors via the set pieces. The ECU determines the mixture for injecting fuel according to current engine operation based on information relayed from the various sensors.

4. Fuel Supply System



Starting the engine activates the fuel pump ③, which draws gasoline from the fuel tank ① and routes it through the fuel filter ② to the vapor separator ④. The gasoline is pressurized in the fuel-feed pump FFP ⑤; then passes through the high-pressure filter ⑥ to the air rail ⑦, from there it is injected into the combustion chambers. The fuel regulator ⑧ regulates components ⑤ through ⑦ in order to maintain gasoline at a differential pressure of 80 kPa (11.4 psi). Any excess gasoline is depressurized and diverted through the FFP case ⑨ and back to the vapor separator ④. The returned gasoline contains air bubbles left over from being pressurized at ⑤. These bleed from the top of the vapor separator ④ to the throttle body ⑩ and is fed to the air intake system.

5. Air Supply System

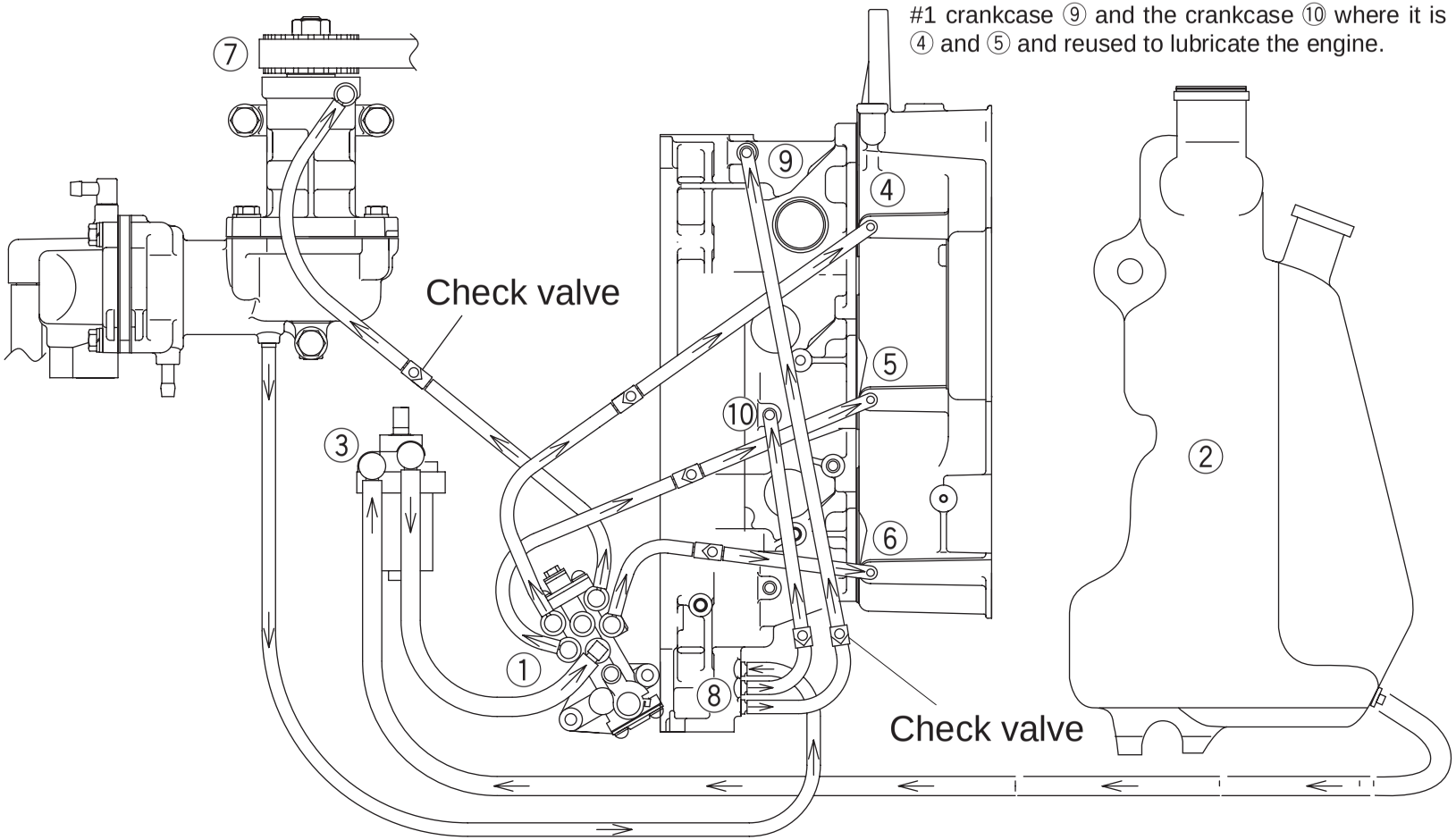


Starting the engine operates the air compressor ②, draws air in through the air filter ① and sends compressed air through to the air rail ③. From there, the air is drawn in through the air filter ① and used as the air intake when injecting the pressurized gasoline into the combustion chamber pressurized by the air compressor ②. The air regulator ④ regulates components ② and ③ in order to maintain air at the optimum combustion pressure of 550 kPa (79.8 psi). Any excess air is depressurized and sent to the exhaust ⑤ and discharged from the bottom of the cylinder.

6. Oil Supply System

Starting the engine operates the oil pump ①, which draws oil from the oil tank ② and routes it through the oil filter ③ to the oil pump ①. The oil pump channels the oil through four ports to #1 air box ④, #2 air box ⑤, #3 air box ⑥ and the air compressor ⑦. Ports ④, ⑤ and ⑥ serve to lubricate the engine's pistons, while port (7) lubricates the air compressor.

TLDI includes a recirculation system in which the excess oil from the air compressor ⑦ is diverted to #3 crankcase ⑧ for use in lubricating the drive gear ①. Any oil left over from there is diverted to #1 crankcase ⑨ and the crankcase ⑩ where it is added to oil from ④ and ⑤ and reused to lubricate the engine.



Chapter 2 Servicing Information

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1. General Precautions for Servicing

Users of this manual should observe the following general precautions when conducting disassembly and assembly work.

(1) Make sure that the outboard motor is securely mounted on a work stand before starting work.
(2) Take care not to scratch or damage painted surfaces and the mating surfaces where cylinders, the cylinder head, the crankcase and other parts are joined.
(3) Always replace packing, gaskets, O-rings and split pins with new ones when reassembling engine parts. Make a point of replacing snap rings as well.
(4) When replacing, be sure to use genuine Tohatsu brand parts and lubricants or products recommended by Tohatsu.
(5) Always use the recommended special tools to ensure work is done properly.
(6) When disassembling and assembling components, make note of position marks, adding your own marks if none are provided, as a way to ensure the various parts and components are properly mated when being reassembled.
(7) To prevent smaller parts, such as bolts, nuts and washers from getting lost or damaged, where possible, lightly insert or tighten them back in their original locations.
(8) As normal practice, check disassembled parts for any wear or damage by first wiping them clean; then washing them in solvent.
(9) With reassembly operations it is essential to observe precise detail in centering, vacuum sealing, lubricating (with oil or grease), packing parts and components, and connecting wiring and piping. Also ensure there are no blockages in fluid lines.

    1) When reassembling parts requiring numerous nuts and bolts (cylinder, crankcase etc.), begin by alternately tightening diagonally opposed inner bolts, moving in a concentric circle; then tightening the outer bolts. This will ensure that engine parts are assembled evenly and securely. (Use the same procedure in the reverse order when disassembling.)

    2) When installing oil seals, be careful not to scratch or reverse the sides that mate with the shaft and always apply grease to the lip surfaces.

    3) Confirm the correct quantity and thickness when applying sealant. Applying excessively will result in the excess portion being excreted into or outside of the case, potentially causing damage. Adhere strictly to the written instructions when applying adhesives.

    4) Apply penetrating oil spray to nuts or bolts that are difficult to remove due to rust and wait 5 minutes before removing.

    5) For the various inspection specifications, torque values, special tools, and the points where sealant, adhesive and grease are to be applied, refer to the relevant tables.

    6) The various nuts, bolts and washers referred to in this manual are listed below.

Name	Type	Diameter	Length
H820	Hexagon bolt	8 mm	20 mm
N8	Hexagon Nut	8 mm	
L8	Hexagon Nut	8 mm	
W8	Plain washer	8 mm	
SW8	Spring washer	8 mm	
Screw 620	Pan head screw	6 mm	20 mm

(10) Observe all necessary safety procedures to prevent accidents and injury during work operations.

2. Specifications and Standards Used in Servicing

Name of Part	Item to check	Standard values
Piston	• Outer diameter Measure at a point 12 mm (0.47 in) above the lower edge of the piston skirt.	• 67.96 mm (2.676 in)
Piston ring	• Ring end gap Note: If a ring gauge is unavailable, measure the lower end of the cylinder bore.	• Top: 0.22 to 0.37 mm (0.009 to 0.0145 in) • Second and third: 0.33 to 0.48 mm (0.013 to 0.019 in)
Crankshaft	• Deflection Measure with both ends supported on V blocks.	• 0.05 mm (0.002 in)
Connecting rod	• Deflection	
Cylinder head	• Mating surface	• 0.03 mm (0.0012 in) or less for scratches • 0.03 mm (0.0012 in) or less for distortion
Cylinder	• Mating surface • Cylinder liner scratches and wear	• 0.03 mm (0.0012 in) or less for scratches • 0.03 mm (0.0012 in) or less for distortion
Engine block	• Compression Measure after warming: Remove all 3 spark plugs. Remove air injector and fuel injector connectors.	• 0.83 MPa (8.5 kg/cm^2, 120 psi)
Reed valve stopper	• Lift height	• 9.3 to 9.5 mm (0.366 to 0.374 in)
Reed valve	• Fails to close, is worn or damaged	
Ignition coil	• Primary coil resistance (between black & white and orange lines) • Secondary coil resistance (between high tension core and B line)	• 1.1Ω ±15% (Ambient temperature) • 12.5 kΩ ±15% (Ambient temperature)
ECU	• Low-speed ESG trigger • High-speed ESG trigger	• Approx. 3,000 rpm • Approx. 6,000 rpm

Service limit	Servicing procedure
• 0.8 mm (0.031 in) or more • 0.9 mm (0.035 in) or more	• Replace with new piston ring if cylinder liner wear has not yet exceeded the repair limit.
• 0.05 mm (0.002 in) or more	• Replace with new crankshaft.
• 2 mm (0.08 in) or more	• Replace with new crankshaft assembly.
• Scratch depth or distortion is 0.03 mm (0.0012 in) or more	• Repair by polishing the surface plate, starting with #240 to #400 grit sandpaper and finishing with #600 grit sandpaper.
• Scratch depth or distortion is 0.03 mm (0.0012 in) or more • When the cylinder liner cannot be repaired using #400 to #600 sandpaper due to excessive scratching or scoring or when the difference between the maximum and minimum points of wear in liner bore is 0.06 mm (0.0024 in) or more	• Repair by polishing the surface plate, starting with #240 to #400 grit sandpaper and finishing with #600 grit sandpaper. • Bore and hone to ø68.55 (2.699 in) + 0 to 0.02 mm (0 to 0.0008 in). Check ports and grind if necessary. Use oversize pistons and piston rings.
1) When difference in compression between cylinders exceeds 0.1 MPa (1.05 kg/cm^2, 14.5 psi) 2) When abnormally higher than standard value	1) Bore and hone to ø68.55 (2.699 in) + 0 to 0.02 mm (0 to 0.0008 in). Check ports and grind if necessary. Use oversize pistons and piston rings. 2) Remove carbon from piston crown and cylinder head surfaces and clean exhaust gas bypass valve.
• No longer conforms to standard value	• Replace with new part.
• Valve reed fails to close • Excessive wear on valve seat • Valve is damaged	• Replace entire valve assembly.

Name of Part	Item to check	Standard values
Magneto	• Sparking performance Measured using spark tester • Sparking order • Alternator (max.) • Charging performance • Exciter coil resistance value (low-speed) (W/R wire to W/L wire) • Exciter coil resistance value (high-speed) (Green wire to W/Y wire) • Lighting coil resistance value (Y to Y wire)	• 10 mm (0.39 in) or more at 350 rpm • #1 ⇒ #2 ⇒ #3 • 280 W • 1,500 rpm12V 16.5A • 5,500 rpm12V 18.5A • 515Ω ± 15% (Ambient temperature) • 71.8Ω ± 15% (Ambient temperature) • 0.38Ω ± 15% (Ambient temperature)
Spark plug	• Standard plug • Plug gap	• CHAMPION: RC10ECC • 1.0 to 1.1 mm (0.039 to 0.043 in)
Crank-position sensor (CPS)	• Gap with encoder ring (flywheel) • Pickup coil resistance value (L wire to G wire)	• 0.5 to 0.9 mm (0.019 to 0.035 in) • 0.531Ω ± 15% (Ambient temperature)
Thermostat	• Opening and closing of thermostat valve	• Valve start temperature: 52°C (125.6°F) • Valve full-open temperature: 65°C (149.0°F) • Valve full-open lift: 3 mm (0.12 in) or more
Fuse	• Capacity	• 15A × 2, 30A × 1
Pump impeller Pump case liner Guide plate	• Wear and cracks	
Propeller shaft	• Damage to bearing • Wear on lip of oil seal	
Drive shaft	• Damage to bearing • Shaft run-out • Wear on lip of oil seal	• 0.3 mm (0.012 in) or less (Using both center holes for reference)
Starter motor	• Battery • Output • Brush length (wear limit) • Commutator under-cut (wear limit) • Commutator diameter (wear limit)	• 12V, 100AH-120AH • 12V to 0.6 kW • 12.5 mm (9.5 mm) 0.49 in (0.37 in) • 0.5 to 0.8 mm (0.2 mm) 0.02 to 0.03 in (0.01 in) • 30 mm (29 mm) 1.18 in (1.14 in)
Anode	• Corrosion	
Oil seals		

Service limit	Servicing procedure
1) 1.2 mm (0.047 in) or more 2) When electrodes show excessive wear	1) Repair so that plugs conform to standard values. 2) Replace with new spark plug.
• When sensor no longer conforms to standard value	• Repair so that sensor conforms to standard value.
• When fuse burns out	• Replace with new fuse.
• When the tips, and upper and lower surface lip areas show wear, cracks or damage	• Replace with new assembly.
• When depth of wear is 0.1 mm (0.004 in) or more	• Replace with new shaft.
• 0.4 mm (0.016 in) or more • When depth of wear is 0.1 mm (0.004 in) or more	• Replace with new shaft. • Repair so that shaft conforms to standard values. • Replace with new shaft.
	• Replace with new starter motor.
• When anode shows excessive corrosion	• Replace with new anode.
• When lip area shows deterioration, heat discoloration or damage or when wear reduces interference to 0.5 mm (0.02 in) or less	• Replace with new oil seal.

<table>
<tr><th>Name of Part</th><th>Item to check</th><th>Standard values</th></tr>
<tr><td rowspan="3">Power trim and tilt</td><td>Pump assembly:
• Relief valve opening pressure

• Spool check valve opening pressure

• Oil quantity
• Oil type

• Oil filter</td><td>• Tilted up: 13.7 to 16.7 MPa
(140 to 170 kg/cm²) (1987 to 2421 psi)
• Tilted down: 2.0 to 3.3 MPa
(2.0 to 34 kg/cm²) (290 to 479 psi)
• Upper chest: 0.24 MPa
(2.4 kg/cm²) (348 psi)
• Lower chest: 0.12 MPa
(1.2 kg/cm²) (17 psi)
• 550 ml (18.6 US fl. oz)
• Power Torque fluid
(ATF Dexron III or equivalent product)
• 150 mesh</td></tr>
<tr><td>Tilt cylinder:
• Shock absorber valve opening pressure

• Piston diameter
• Piston rod diameter
• Stroke</td><td>
• 3.4 to 5.4 MPa
(35 to 55 kg/cm²) (493 to 783 psi)
• 54 mm (2.13 in)
• 16 mm (0.63 in)
• 141 mm (5.55 in)</td></tr>
<tr><td>Motor:
• Rated timing
• Rated voltage
• Output
• Direction of rotation</td><td>
• 60sec.
• 12V (DC)
• 650W
• Forward/reverse</td></tr>
<tr><td>Air compressor</td><td>• Cylinder bore
• Piston diameter
Measure at a point 10 mm above the lower edge of the piston skirt.
• Piston ring end gap

• Reed valve tip clearance
• Drive belt</td><td>• 39.00 to 39.02 mm (1.53 to 1.54 in)
• 38.97 to 38.99 mm (1.534 to 1.535 in)

• Top: 0.10 to 0.25 mm
(0.004 to 0.098 in)
• Second: 0.10 to 0.25 mm
(0.004 to 0.098 in)
• Oil: 0.10 to 0.60 mm
(0.004 to 0.023 in)
• 0.2 mm (0.008 in) or less</td></tr>
<tr><td>Vapor separator</td><td>• Wear and damage on seal ring
• Float</td><td></td></tr>
<tr><td>FFP</td><td>• Wear and damage on seals and grommets</td><td></td></tr>
<tr><td>Air rail</td><td>• Wear and damage on O-rings</td><td></td></tr>
<tr><td>Air regulator</td><td>• Air pressure</td><td>• 0.55 MPa (5.6 kgf/cm²) ±7%
(80 psi ± 7%)</td></tr>
<tr><td>Fuel regulator</td><td>• Fuel pressure</td><td>• Measured air pressure
+ 0.07 MPa (0.7 kgf/cm²) ±10%
(10 psi ± 10%)</td></tr>
<tr><td>Air injector</td><td>• Measured value for resistance
• Operating condition (check for clicking sound when 12 volts is applied to the terminal)</td><td>• 1.3 ± 0.3Ω (Ambient temperature)</td></tr>
<tr><td>Fuel injector</td><td>• Measured value for resistance</td><td>• 1.8 ± 0.1Ω (Ambient temperature)</td></tr>
<tr><td rowspan="5">TPS</td><td rowspan="5">• Measured values of resistance between connectors.</td><td>• Between upper and lower connectors: 5.0Ω ±20%</td></tr>
<tr><td>• Between upper and middle connectors: resistance value (kΩ)</td></tr>
<tr><td><table><tr><td></td><td>Fully closed</td><td>Full open</td></tr><tr><td>TPS1</td><td>4 to 5</td><td>0.5 to 1</td></tr><tr><td>TPS2</td><td>4 to 5</td><td>4 to 5</td></tr></table></td></tr>
<tr><td>Water temp sensor</td><td>• Measured value for resistance</td><td>• 2.45kW±10% (20°C, 68°F),
0.32kW±10% (80°C, 176°F)</td></tr>
<tr><td>Oil level sensor</td><td>• Conductivity</td><td></td></tr>
<tr><td>Rectifiers</td><td>• Conductivity</td><td>Refer to tester checkpoint Table (Chapter 5).</td></tr>
</table>

Service limit	Servicing procedure
• When parts no longer conform to standard values • When parts show excessive wear or damage	• Replace with new parts.
• When parts show excessive wear or damage • When parts showed deterioration or contamination by fuel	• Replace with new parts.
• When parts show excessive wear or damage	• Replace with new parts.
• When parts show excessive wear or damage	• Replace with new parts.
• When parts no longer conform to standard values	• Replace with new parts.
• When parts no longer conform to standard values	• Replace with new parts.
• When parts no longer conform to standard values	• Replace with new parts.
• When parts no longer conform to standard values	• Replace with new parts.
• When parts no longer conform to standard values • When differences in resistance values between upper, middle and lower connectors becomes erratic	• Replace with new parts.
• When parts no longer conform to standard values	• Replace with new parts.
• When short occurs in sensor	• Replace with new parts.
	• Replace with new parts.

3. Lists of Points for Applying Sealant, Adhesive and Lubrication

		Three Bond Thread Lock 1342	Three Bond Thread Lock 1373B	Locitite Adhesive Adhesive 648 Primer 7471	Locitite Sealant 518	Three Bond Instant Adhesive 1741	Three Bond Adhesive G17
Engine block	Piston						
	Piston pin						
	Piston ring						
	Cylinder liner						
	Drive pulley			○			
	Pulley nut	○					
	Small-end bearing						
	Big-end bearing						
	Main bearing						
	Big-end bearing washer						
	Main bearing, upper						
	Main bearing, upper oil seal						
	Crankcase head O-ring						
	Crankshaft oil seal, lower						
	Drive shaft oil seal						
	Oil pump for drive gear						
	Oil pump for driven gear						
	Cylinder-crankcase mating surface				○		
	Water temperature sensor						
	Spark plug gaps						
	Advancer arm						
	Throttle cam						
	Clutch						
	Ball joint gap						
	Cable joint (clutch)						
	Starter motor						
	Solenoid switch (starter motor), 2 locations						
	Solenoid switch (PT&T), 6 locations						
Steering bar handle specifications	Grip						
	Bushing A						
	Bushing B						
	Washer						
	Wave washer						
	Throttle shaft bushing						
	Shift lever shaft bushing						
	Seal ring						
	Wave washer						
	Shift lever stopper						

Cold-&Heat-resistant lithium grease LT-2	Oil Center Research cold-resistant grease LOR#101	OBM grease	2st engine oil	Silicon grease, Shinetsu grease KS-64	Specified gear oil	Power torque fluid *1	Remarks
			○				Ring groove, piston pin hole and skirt
			○				Skirt
			○				
			○				Inwall
							Apply Loctite 648 to the punched side after applying primer to the shaft and punched surface
			○				Sliding surface
			○				Sliding surface
			○				Sliding surface
			○				Sliding surface
			○				Sliding surface
	○						Lip area
			○				
	○						Lip area (on oil seal in crankcase head)
	○						Lip area (on oil seal in crankcase head)
			○				
			○				
							Confirm thickness of coating
		○					O-ring
				○			Plug seat and high tension cored
○							Sliding surface
○							Sliding surface
○							Sliding surface
○							Sliding surface
		○					Sliding surface
		b○		a○			a) Terminal, b) Pinion
				○			Terminal
				○			Terminal
		○					
		○					
		○					
		○					
		○					
		○					
		○					
		○					
		○					
		○					

*1: ATF Dexron lll or equivalent product

		Three Bond Thread Lock 1342	Three Bond Thread Lock 1373B	Locitite Adhesive Adhesive 648 Primer 7471	Locitite Sealant 518	Three Bond Instant Adhesive 1741	Three Bond Adhesive G17
Air rail	Air injector O-ring						
	Fuel injector O-ring						
	Fuel regulator O-ring						
	Air regulator O-ring						
	Compressions seal						
	Spark plug O-ring						
	Air hose L nipple O-ring						
	Fuel hose L nipple O-ring						
	Valve assembly						
Air compressor	Air compressor piston	○					
	Air compressor cylinder						
	Air compressor piston pin						
	Air compressor piston ring						
	Air compressor oil ring						
	Big-end needle bearing						
	Compressor housing oil seal						
	Compressor crankshaft B/G						
	Adapter hose joint	○					
FFP assembly	Adapter hose joint	○					
	Cable Terminal grommet						
	FFP upper grommet						
	FFP lower grommet						
	Pipe grommet						
Gear case	Gear B nut	○					
	Propeller shaft housing						
	Propeller shaft housing O-ring						
	Propeller shaft oil seal						
	Propeller shaft						
	Propeller stopper						
	Propeller thrust holder						
	Water pump case, lower						
	Water pump case (lower) O-ring						
	Water pump case (lower) oil seal						
	Pump case bolt						
	Water pipe						
	Water pipe seal rubber, upper						
	Water pipe seal rubber, lower						a○
	Water pipe seal lock rubber						
	Pump case						
	Engine base seal rubber					○	
	Exhaust housing grommet					○	○
	Idling port grommet					○	○
	Trim tab retainer bolt						
	Drive shaft						

Cold-&Heat-resistant lithium grease LT-2	Oil Center Research cold-resistant grease LOR#101	OBM grease	2st engine oil	Silicon grease, Shinetsu grease KS-64	Specified gear oil	Power torque fluid *1	Remarks
			○				O-rings at 2 locations
			○				O-rings at 2 locations
			○				O-rings at 2 locations
			○				O-rings at 2 locations
			○				Air rail, 6 locations
			○				Air rail, 3 locations
			○				O-rings at 2 locations
			○				O-rings at 2 locations
							Taper screw
			○				Entire outer surface
			○				Entire outer surface
			○				Apply when inserting pin
			○				Entire outer surface
			○				Entire outer surface
			○				Rollers
	○						Inner and outer area of lip
			○				Rollers
			○				Embedded section (M10PI.O)
			○				Embedded section (M10PI.O)
			○				Both inner and outer surfaces
			○				Both inner and outer surfaces
			○				Both inner and outer surfaces
							Both inner and outer surfaces
							Apply after cleaning all grease from threading
		○					Lower inner surface
		○					
		○					Lip surface
		○					Spline surface
		○					Tapered surface
		○					Spline Surface
		○					Lower inner part
		○					
		○					Lip surface
		○					Under-neck surface
		○			○		Upper surface
					b○		Exterior
							a) Pump case, b) Interior
		○					Entire surface
		○					Lightly on inner surface
							Apply to one of the mating surfaces
							Apply to one of the mating surfaces
		○					
○							Apply to engine side spline

		Three Bond Thread Lock 1342	Three Bond Thread Lock 1373B	Locitite Adhesive Adhesive 648 Primer 7471	Locitite Sealant 518	Three Bond Instant Adhesive 1741	Three Bond Adhesive G17
Gear case	Cam rod bushing						
	Cam rod bushing O-ring, 2.4 to 5.9						
	Cam rod bushing O-ring, 3.5 to 21.7						
	Cam rod bushing stopper bolt						
	Gear case lubricating oil						
	Gear case bolt	○					
	Extension housing bolt	○					
	Propeller shaft housing bolt	○					
Stern bracket section	Bracket bolt						
	Bracket bolt cap						
	Stern bracket washer						
	Swivel bracket						
	Steering shaft						
	Steering shaft bushing						
	Steering shaft seal ring						
	Thrust plate						
	Mounting bolt, upper	○					
	Mounting bracket						
	Tilt stopper						
Motor cover, upper	Filler lid hinge						
	Hook lever						
	Hook lever bushing						
	Hook lever seal ring						
	Filler lid seal rubber						○
PT&T Section	PT&T cylinder pin, upper						
	PT&T cylinder pin, lower						
	PT&T assembly bolt						
	PT&T sensor cam bolt						
	PT&T tilt stopper knob						○
	PT&T oil						
	Drag link						
	Control box						
	Tilt stopper knob						○
	Relief valve O-ring						
	Spool valve						
	backup ring						
	manual valve O-ring						
	Free piston						
	O-ring						
	backup spring						
	piston						
	Piston rod assembly						
	O-ring						
	backup ring						
Nipples		○					

Cold-&Heat-resistant lithium grease LT-2	Oil Center Research cold-resistant grease LOR#101	OBM grease	2st engine oil	Silicon grease, Shinetsu grease KS-64	Specified gear oil	Power torque fluid *1	Remarks
		○					Entire surface
					○		
		○					
		○					Under-neck surface
					○		Oil capacity 500 ml
					○		Under-neck surface
							Under-neck surface
							Under-neck surface
		○					Fill with grease, apply grease to tapped hole
		○					Inner surface
		○					Both surfaces
		○					Fill interior with grease
		○					Sliding surface
		○					Sliding surface
		○					
		○					Sliding surface
							Thread
		○					Spline surface
		○					Sliding surface
		○					Sliding surface
		○					Sliding surface
		○					Sliding surface
			○				
			○				Sliding surface
			○				Shaft surface
						○	Use the specified lubricant
			○				Sliding surface
			○				
						○	
						○	
						○	
						○	
						○	
						○	
						○	
						○	
							Each press-in port

4. Torque Table

	Item	Part to tighten	Initial torque (N-m)	Full torque (N-m)	lb-ft
Engine	Cylinder head cover to cylinder head	Bolt (M6)	①2.0 to 2.9 (0.2 to 0.3 kg-m)	④4.6 to 6.3 (0.5 to 0.6 kg-m)	3.6 to 4.4
	Cylinder head cover cylinder head to and cylinder block	Bolt (M8)	②12 to 15 (1.2 to 1.5 kg-m)	③29 to 34 (3.0 to 3.4 kg-m)	22 to 25
	Crankcase	Bolt (M8)	12 to 15 (1.2 to 1.5 kg-m)	24 to 26 (2.4 to 2.6 kg-m)	17 to 19
	Exhaust cover	Bolt (M6)	3.9 to 5.9 (0.4 to 0.6 kg-m)	7.8 to 9.8 (0.8 to 1.0 kg-m)	5.8 to 7.3
	Compressor head	Bolt (M6)		7.8 to 9.8 (0.8 to 1.0 kg-m)	5.8 to 7.3
	Air box	Bolt (M6)		7.8 to 9.8 (0.8 to 1.0 kg-m)	5.8 to 7.3
	Water temperature sensor	—		20 to 23 (2.0 to 2.3 kg-m)	15 to 17
	Driven pulley	Nut, 10 (M10)		31 to 34 (3.2 to 3.5 kg-m)	23 to 25
	Drive pulley	Nut pulley (M30)		140 to 160 (14 to 16 kg-m)	102 to 116
	Flywheel	Nut, 18 (M18)		140 to 160 (14 to 16 kg-m)	102 to 116
	Adapter, hose joint	—		140 to 160 (14 to 16 kg-m)	102 to 116
	Nut, hose joint	—		140 to 160 (14 to 16 kg-m)	102 to 116
	Valve core (included in valve assembly)	—		0.4 to 0.6 (0.04 to 0.06 kg-m)	0.3 to 0.4
	Sparkplug			25 to 30 (2.5 to 3.0 kg-m)	18 to 22
Lower unit	Cylinder block and engine base to drive shaft housing	Bolt (M8)		19 to 21 (1.9 to 2.1 kg-m)	14 to 15
	Bevel gear B	Nut, bevel gear B (M12)		40 to 58 (4 to 6 kg-m)	29 to 44
	Stern bracket	Nylon nut 7/8		24 to 26 (2.4 to 2.6 kg-m)	17 to 19
	Mount rubber, upper	Bolt (3/8)		30 to 34 (3.0 to 3.5 kg-m)	22 to 25
	Mount rubber, lower	Nylon nut (M12)		40 to 44 (4.0 to 4.5 kg-m)	29 to 33
	Gear case	Bolt (M8P1.25)		19 to 21 (1.9 to 2.1 kg-m)	14 to 15
	Propeller nut	—		29 to 39 (3.0 to 4.0 kg-m)	22 to 29
	Fuel connector	—		5.0 to 6.9 (0.5 to 0.7 kg-m)	3.6 to 5.1
	Run yard stop switch	—		2.0 to 2.5 (0.2 to 0.25 kg-m)	1.5 to 1.8
Power trim and tilt	Lower cylinder pin	Nut, 18 (M18)		69 to 88 (7 to 9 kg-m)	51 to 65
	Oil plug (cap)	—		2.9 to 4.9 (0.3 to 0.5 kg-m)	2.2 to 3.6
	Manual valve	—		2.0 to 2.9 (0.2 to 0.3 kg-m)	1.5 to 2.2
	Motor screw	—		1.6 to 2.2 (0.16 to 0.22 kg-m)	1 2 to 1.6
	Motor assembly bolt	—		4.9 to 6.9 (0.5 to 0.7 kg-m)	3.6 to 5.1
	Oil pump bolt	—		4.9 to 5.4 (0.5 to 0.6 kg-m)	3.6 to 4.4
	Relief valve assembly	—		12 to 14 (1.2 to 1.4 kg-m)	8.7 to 10.2
	Check valve assembly	—		8.8 to 9.8 (0.9 to 1.0 kg-m)	6.5 to 7.3
	Tilt rod guide	—		80 to 120 (8 to 12 kg-m)	58 to 87
Standard torque	M4			1 to 2 (0.1 to 0 2 kg-m)	1
	M5			3 to 4 (0.3 to 0.4 kg-m)	2 to 3
	M6			5 to 6 (0.5 to 0.6 kg-m)	3 to 5
	M8			11 to 15 (1.1 to 1.5 kg-m)	8.0 to 11
	M10			23 to 31 (2.3 to 3.1 kg-m)	17 to 22

Remark: Tightening order of cylinder head cover and cylinder head is ①⇒②⇒③⇒④.

5. Special Tools

1. List of Special Tool

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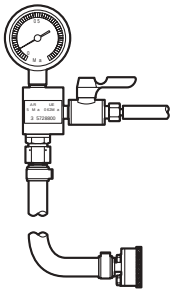
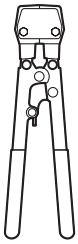
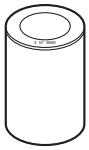
<tr>
<td> 
Pressure gauge assembly
3T5-72880-0</td>
<td> 
Crimping pliers
3T5-72864-0</td>
<td> 
Drive pulley press
3T5-72868-0</td>
<td>
Piston slider
3T5-72871-0</td>
</tr>
<tr>
<td>For measuring air rail fuel and air pressure.</td>
<td>For crimping OETIKER make clamps.</td>
<td>For press fitting in the drive pulley.</td>
<td>For installing the piston in the air compressor.</td>
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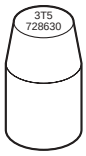
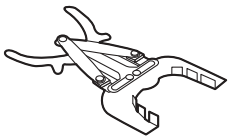
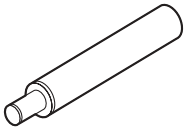
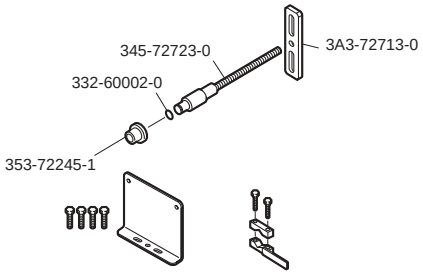
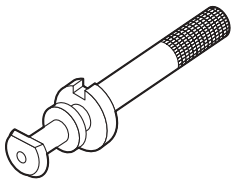
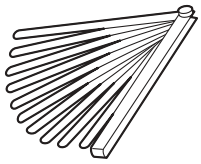
<tr>
<td>
Crankshaft holder
3T5-72815-0</td>
<td> 
O-ring setting tool (ø24)
3T5-72863-0</td>
<td> 
Piston ring wrench
353-72249-0</td>
<td> 
Piston pin tool
345-72215-0</td>
</tr>
<tr>
<td>For removing and tightening on the pulley nut.</td>
<td>For installing O-rings on the fuel injectors.</td>
<td>For installing and removing the piston rings.</td>
<td>For installing and removing piston pins.</td>
</tr>
<tr>
<td colspan="2"> 
Backlash measuring tool</td>
<td> 
Thumbing gauge
3C8-72250-0</td>
<td> 
Filler gauge
353-72251-0</td>
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<td colspan="2">For measuring backlash between bevel gears A and B.</td>
<td>For measuring between bevel gears A and B.</td>
<td>For measuring clearances.</td>
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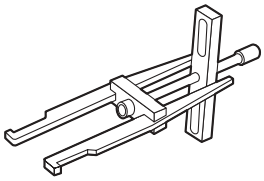
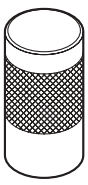
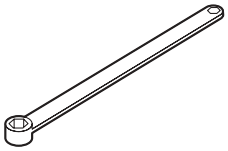
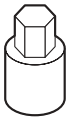
<td> 
Bevel gear A bearing puller assembly
345-72224-2</td>
<td> 
Bevel gear A bearing Setting tool
3C8-72719-0</td>
<td> 
Bevel gear B nut wrench
346-72231-0</td>
<td> 
Bevel gear B nut socket
346-72232-0</td>
</tr>
<tr>
<td>For removing bearing from bevel gear A.</td>
<td>For installing bevel gear A bearing.</td>
<td colspan="2">For removing and installing bevel gear B nut.</td>
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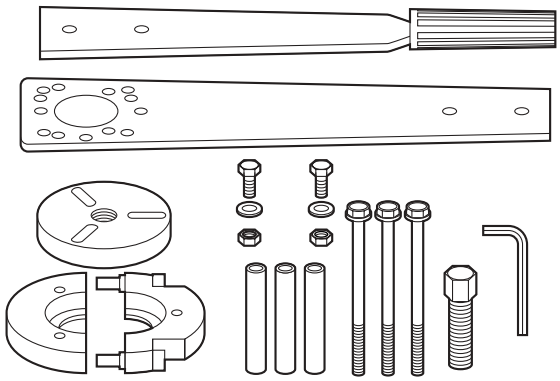
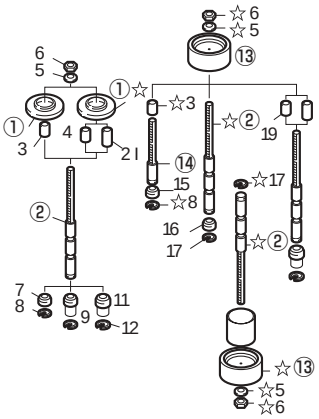


Drive pulley puller assembly
3T5-72890

For removing drive pulley.

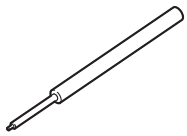
Flywheel puller kit
3C7-72211-1

For removing and installing flywheel.

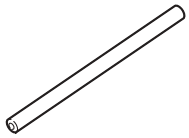


Needle bearing puller kit
3C8-72700-0

For removing and installing gear case needle bearing and propeller shaft housing.

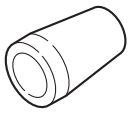


Spring pin tool A
345-72227-0



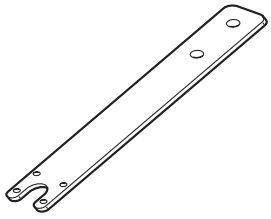
Spring pin tool B
345-72228-0

For removing and installing spring pins.



Clutch pin snap tool
345-72229-0

For installing clutch pin snap ring.



Tilt rod guide wrench
3C8-72791-0

For installing and removing PT&T piston rod assembly.

2. Using the Special Tool

① Pressure Gage Assembly

Measuring Fuel and Air Pressure

1. Mover the lever for cock (3T5-72883-0) to position A shown in the figure below.
2. Screw adapter B (3T5-72884-0) into either the air or fuel pressure measuring valves located on the air rail.

Caution:

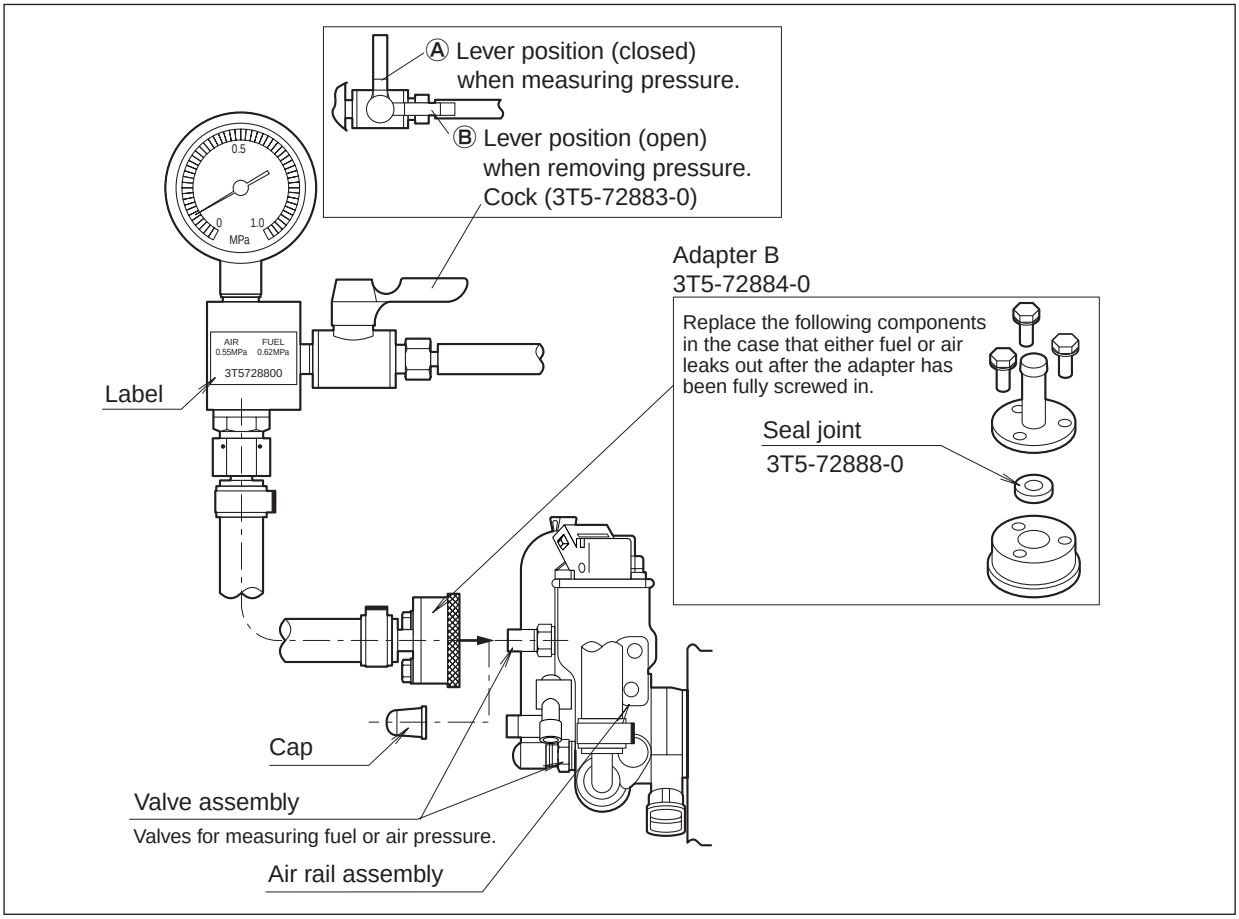
A small amount of fuel will spurt out as the adapter is inserted in the fuel measuring valve.

3. With the ignition key set the OFF position, turn it to START to activate the starter motor and turn over the engine for approximately 15 seconds. (Once the engine starts, allow it to idle at 700 rpm for approximately for 15 minutes.)
4. If both fuel and air pressure values fall within the standard (rated) range, engine operation is normal. (If not, service the engine by referring to the relevant sections in this manual.)

PRESSURE	Rated value (MPa, psi)	Rated range (MPa, psi)	Remarks
AIR PRESSURE	0.55, 80	0.55 ± 0.03, 80 ± 4	Pressure falls when engine stops turning over.
FUEL PRESSURE	0.62, 90	0.62 ± 0.03, 90 ± 4	

5. When finished measuring, turn the lever to position B (open) to relieve internal pressure; then remove adapter B from the measuring valve.

It is important to have a container handy. Once fuel measuring completes and the lever is set to position B (open), a certain amount of fuel will spurt out from the hose (98AB-5-0200). Be sure to point the hose (98AH-8-1000) on the cock side lower than valve position and drain all remaining fuel prior to removing adapter B.



② Crankshaft Holder (3T5-72815-0)

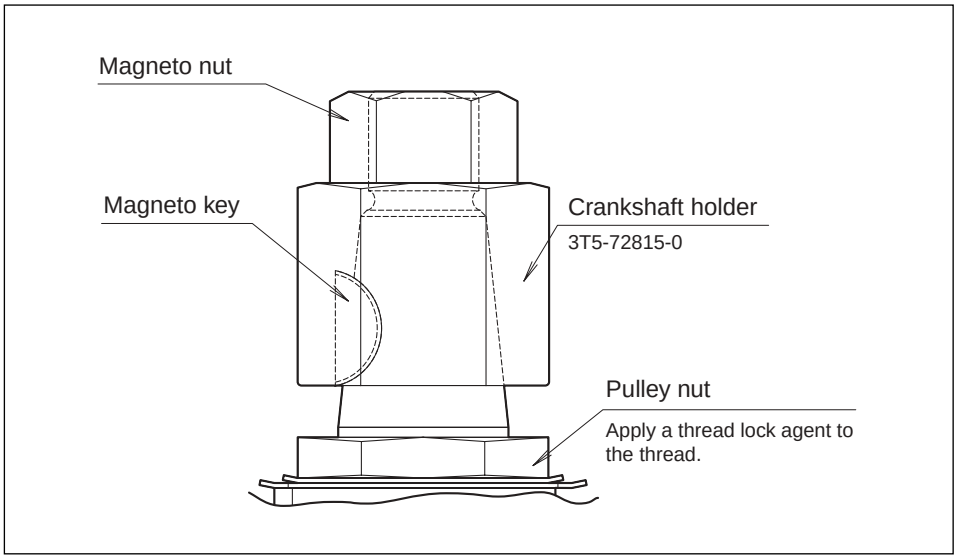
Removing Pulley Nut

1. Disassemble the flywheel. (Refer to section ① of this chapter.)
2. Install the magneto key and crankshaft holder for this engine.
3. Use the magneto nut to secure the crankshaft holder in place. (The magneto nut is threaded clockwise.)
4. Using two 36 mm wrenches, attach one to the crankshaft holder and use the other to loosen the pulley nut.

Installing Pulley Nut

1. Apply thread lock (Three Bond #1342) to the thread area.
2. Screw the pulley nut onto the crankshaft by hand.
3. Install the engine's magneto key; then install the crankshaft holder.
4. Use the magneto nut to secure the crankshaft holder in place.
5. Using two 36 mm wrenches, attach one to the crankshaft holder and use the other to tighten on the pulley nut, adjusting it to the torque shown below.

Tightening Torque: 140 to 160 N-m (14 to 16 kg-m) = (102 to 116 lb-ft)



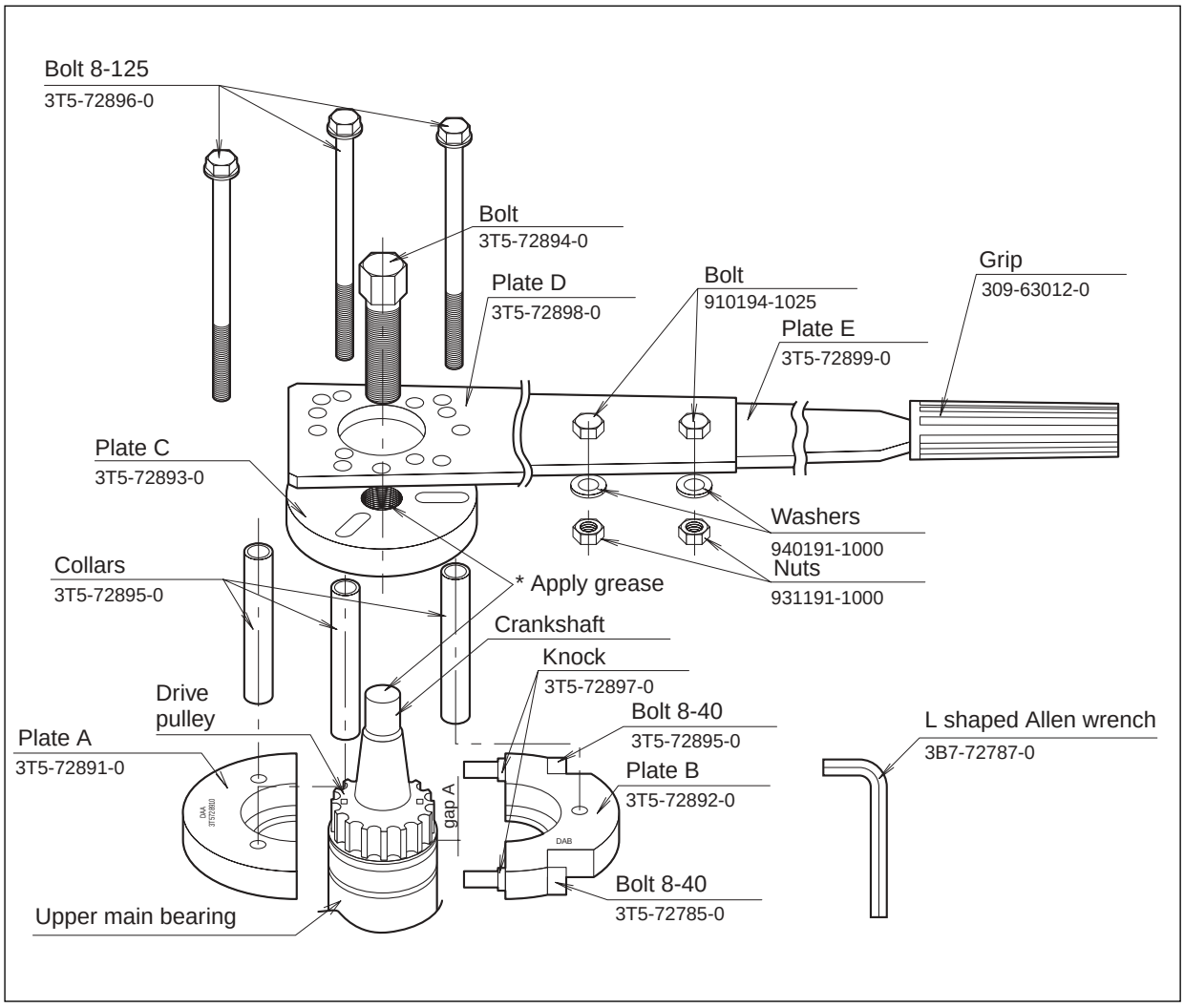
③ Drive Pulley Puller Assembly

Removing Drive Pulley

Begin the disassembly operation by removing the crankshaft from the power unit.

1. Remove pulley nut. (Refer to section ② of this chapter.)
2. Move the upper main bearing towards the crankshaft end in order to create a gap with the drive pulley.
3. Insert plate A (3T5-72891-0) and plate B (3T5-72892-0) into the gap by mating the two knock studs (3T5-72897-0) on plate B with plate A and tightening evenly the 8-40 bolts (3B7-72785-0) on both sides using the Allen wrench (3B7-72787-0).
4. Insert the three collars (3T5-72895-0) between plate C (3T5-72893-0) and the already joined plates A and B.
5. Using a 19 mm socket wrench, turn the bolt (3T5-72894-0) until the drive pulley comes away.

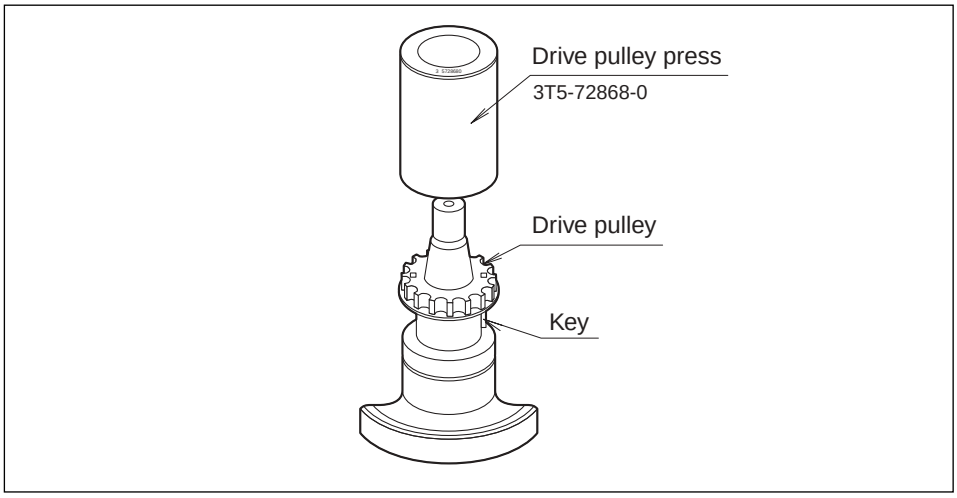
Note: Apply Tohatsu grease to the sections in the diagram marked by the asterisk (*).



④ Drive Pulley Press (3T5-72868-0)

Inserting Drive Pulley

1. Remove any oil or grease from crankshaft and drive pulley hole. Apply Loctite Primer 7471; wait 5 minutes; then apply Loctite 648 to the hole.
2. Insert the half moon key in the crankshaft and install the drive pulley.
3. Position the drive pulley press above the drive pulley.
   With the wide-open end of the press facing downward, place down over the drive pulley.
4. Tapping lightly on the top center area of the press with a hammer, press fit the drive pulley in place.
   (The beginning half is designed to insert easily, the remaining half requires press fitting.)

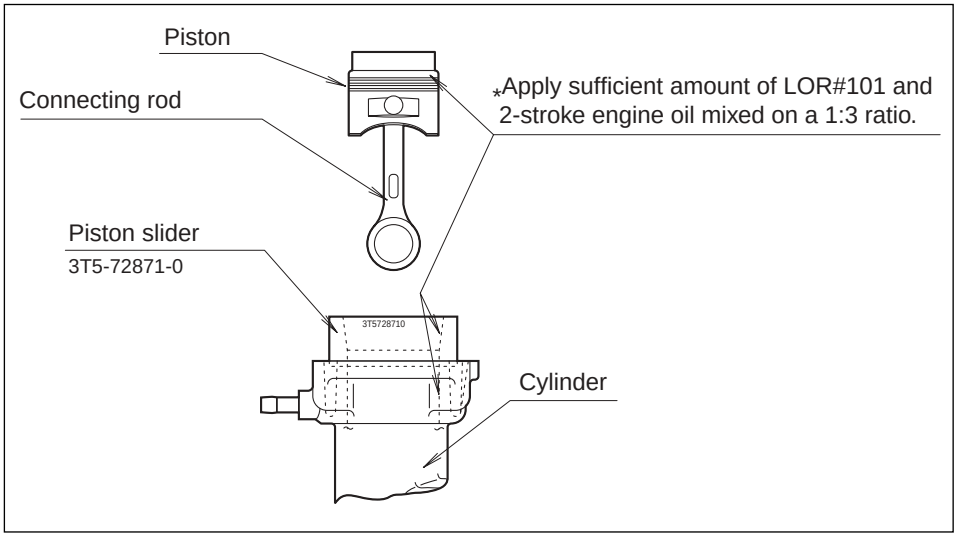


⑤ Piston Slider (3T5-72871-0)

Installing Air Compressor Piston

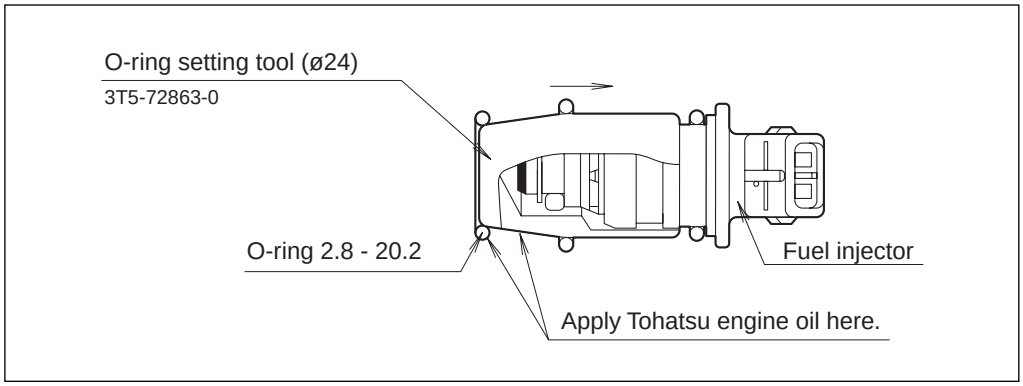
1. Apply sufficient amount of LOR#101 and 2-stroke engine oil mixed on a 1:3 ratio to the exterior of the piston, the interior of the piston slider and the interior of the compressor rings.
2. Place the piston with piston ring installed on the tapered part of the piston slider, line up the assembly with the top surface of the cylinder and press piston into the cylinder by hand.
3. Press the piston down in a single firm motion until it is properly inserted.

Note: If the piston ring should get caught part way through, repeat the operation from step 2.



⑥ O-ring Setting Tool (ø24) (3T5-72863-0)

Install the fuel injector 2.8-20.2 O-rings (3T5-10304-0).
Apply engine oil to both the O-rings and the O-ring setting tool.
Position the O-ring setting tool in place; then install O-rings by sliding them on.



⑦ Crimping Pliers (3T5-72864-0)

This tool is used to install the specified clamps on the fuel and air system hoses. It is intended for use with the following parts.

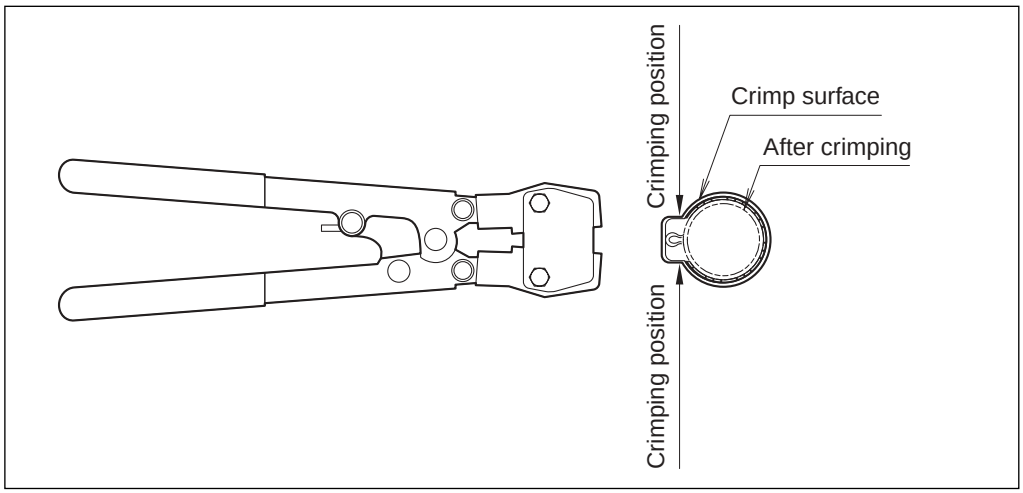
1. Fuel Hose Assembly (3T5-10089-0)
   Clamp 21/32 (385-10086-0): Installed at four locations on the hose connecting FFP case assembly to high-pressure fuel filter and the hose connecting high-pressure fuel filter to air rail assembly.
2. Air Hose Assembly (3T5-10088-0)
   Clamp 1/12 (3T5-10087-0): Installed at two locations on hose connecting air compressor to air rail assembly.
3. Clamp 29/64 (3T5-10091-0): Installed at two locations on hose connecting L nipple on air rail to fuel regulator.

Clamp Crimping Procedure

Crimping is performed by applying crimping forced to the locations indicated by arrows in the figure below. The crimping tool is designed to not open until it has crimped all the way.

Caution:

- Be sure to use new clamps.
- Note that the highly pressurized fuel or high temperature, highly pressurized air flowing through the hoses are liable to leak if the clamps are not firmly crimped in place.



Chapter 3 Inspection and Maintenance

1. **Periodic Inspections** 3-2
2. **Inspecting Engine Oil Systems** 3-3
3. **Inspecting Fuel Systems** 3-3
4. **Inspecting Compression System** 3-4
5. **Inspecting Gear Case Area** 3-5
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9. **Inspecting Air Rail Pressure** 3-8

1. Periodic Inspections

Category	Inspec ion points	Inspection intervals							Inspec ion procedure	Remarks
		10 hrs. or bimonthly	30 hrs or monthly	50 hrs. or 3 months	100 hrs. or 6 months	Yearly	1.5 years	200 hrs. or 2 years		
Fuel and compression systems	High press. Fuel filter			○	○	○	○	Replace		Entire cartridge
	Piping		○	○	○	○	○	Replace	Wear on pipes & leaking connectors	
	Fuel tank				○	○	○	○	Clean	Including filter
	Air filter					○		Replace		
	Drive belt					○		Replace		
	Fuel pressure					○		○		
	Air pressure		○			○		○		
Ignition system	Spark plug		○		○	○	○	○	Remove carbon Spark gap	1 0 to 1.1 mm (0 039 to 0.043 in)
Starting system	Starter motor		○		○	○	○	○	Salt deposits & battery cables	
	Battery	○	○	○	○	○	○	○	Mountings, fluid & spec, gravity levels	
Lower unit	Propeller	○	○	○	○	○	○	○	Wear, bending & chipping on blades; slipping of cushion rubber	
	Gear oil	Replace		○	○	○	○	○	Replenish or change oil, check for water leakage	
	Water pump			○	○	Replace	○	Replace	Wear and cracks on impeller & liner	
Oil systems	Oil tank	○			○	○	○	○	Oil leaks, damage faulty clip; wash filter	
	Oil pipes	○			○	○	○	○		
	Oil filters	○		○	○	○	○	○		
Warning system				○	○	○	○	○		
Nuts and bolts		○	○	○	○	○	○	○	Tighten	
Sliding & rotating parts, grease nipples				○	○	○	○	○	Apply or inject grease	
Power trim & ilt		○			○	○	○	○	Check & replenish oil; manually operate	
Anodes				○	○	○	○	○	Check for corrosion, warping and wear	

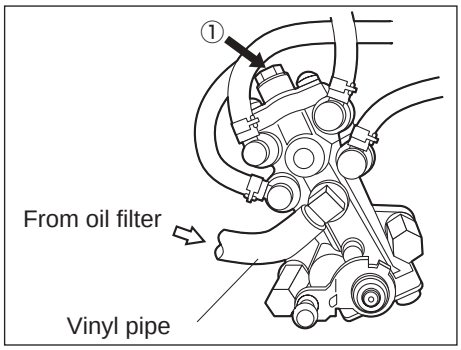
Note: The manual recommends the engine be overhauled after every 300 hours of operation.

2. Inspecting Engine Oil System

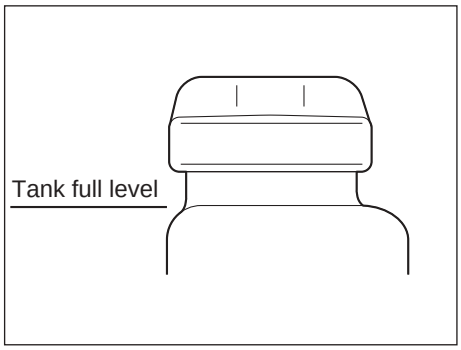
Bleeding Air From Oil Pump

Conduct a visual check of the clear vinyl pipes connecting the oil pump to the oil tank to inspect for the presence of air. Bleed hoses if necessary.

Do this by loosening the oil drain screw ① on the air pump and bleed until all air has been removed from the piping.
Use a cloth to wipe away the bled oil.

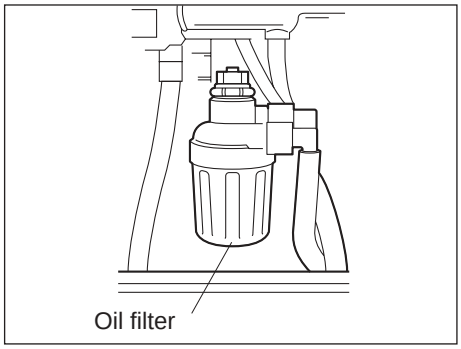


Note that the air may not bleed out properly if the oil in the tank is too low. Make sure to fill the tank prior to bleeding air from the piping.



Oil Filter and Oil Tank

Check the oil filter for water and foreign matter.
If present, disconnect all piping connecting the oil tank to the oil pump from the outboard engine and remove all oil and any water or foreign matter.
Reconnect oil tank and add new oil; then repeat the same air bleeding procedure used on the oil pump.



3. Inspecting Fuel System

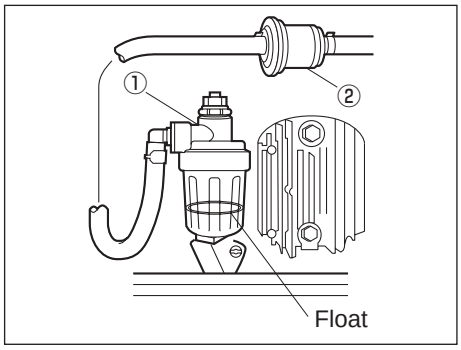
Replacing Engine Fuel Filter

① Fuel filter (Detachable type)

The red ring ① floats when water is present. If it floats, remove cup and empty out the water.

② High-Pressure Fuel Filter (Disposable type)

Refer to maintenance chart.



Cleaning Fuel Tank Filter

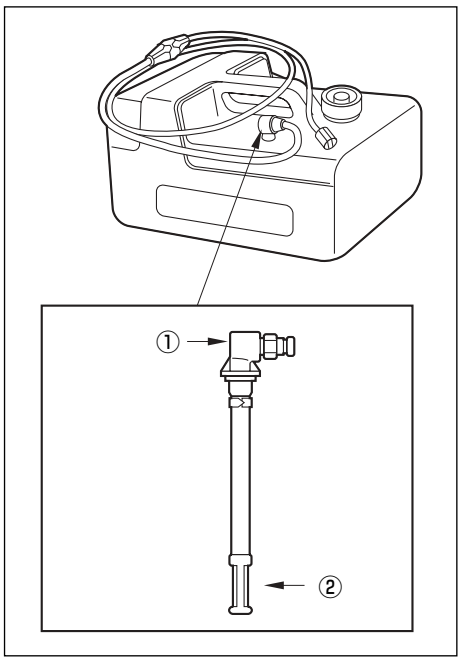
① Fuel pickup elbow

② Filter

Turn ① to the left to remove and clean ②.

Cleaning Fuel Tank

Clean the fuel tank whenever there is a buildup of water or foreign matter.



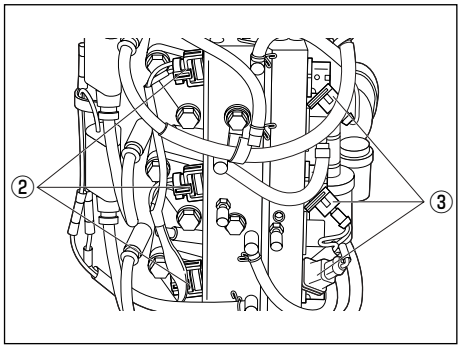
4. Inspecting Compression System

Measuring Procedures

Use the following procedures to measure the compression of the individual cylinders.

1. Fully charge the engine battery.
2. Start engine and idle for 3 minutes to warm.
3. Unlock the stop switch.
4. Remove all spark plugs.
5. Remove all air injector ② and fuel injector ③ connectors.

Accurate compression readings are only possible when all ② & ③ connectors are disconnected. It should also be noted that the ECU records detailed information on which connectors were disconnected during each inspection. Refer to the section on the TLDI self-diagnosing function for more information.



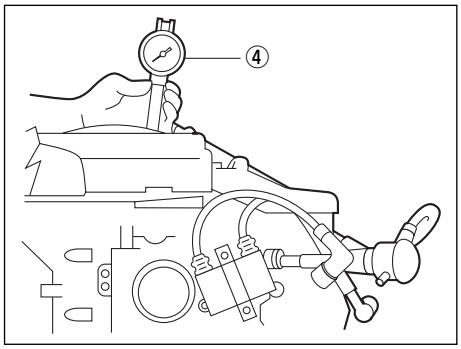
6. Attach the compression gauge ④ into the spark plug hole (only one at a time).
7. Use the starter motor to turn over the engine.

Engine speed: approx. 400 rpm for at least 5 seconds

(Note that throttle position does not affect compression readings.)

- Measure the compression for all cylinders
- Confirm that all compression readings conform to specifications.

Rated compression: 830 kPa (8.5 kg/cm^2, 120 psi) ±10%



Results and Steps to Take

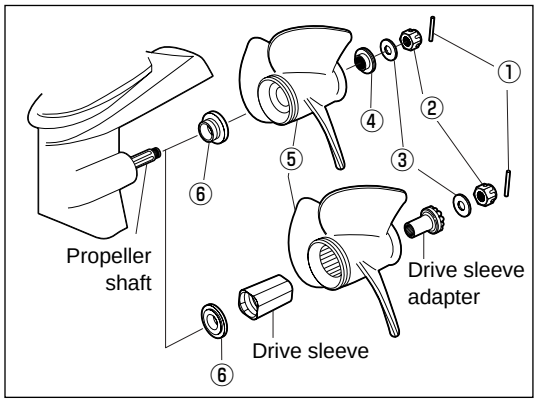
Repair or replace components as necessary when the readings fall under the following categories.

- Below specified compression:
- Difference between cylinders exceeds 103 kPa (1.05 kg/cm^2, 15 psi)
- Compression is abnormally high.

5. Inspecting Gear Case Area

Replacing Propeller

Worn or bent propeller blades will not only affect performance and can also lead to engine damage.



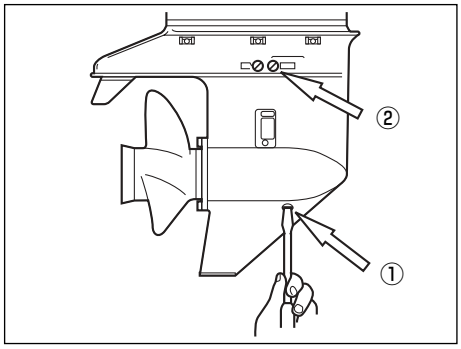
- Move the shift lever to the neutral position; stop the engine, then replace the propeller.
- Be sure to wear a thick pair of gloves and proceed carefully.

Remove the following components.

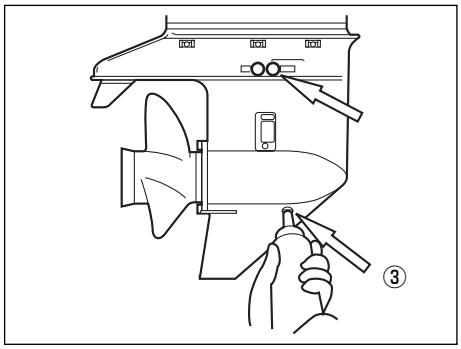
① Split pin * Replace with new pin
② Propeller nut
③ Washer
④ Propeller stopper or adapter
⑤ Propeller or with drive sleeve
⑥ Propeller thrust holder or washer

Replacing Gear Oil

- Place an oil container under the lower unit and remove the lower oil plug ①.
- Remove the upper oil plug ② and sufficiently drain the oil.

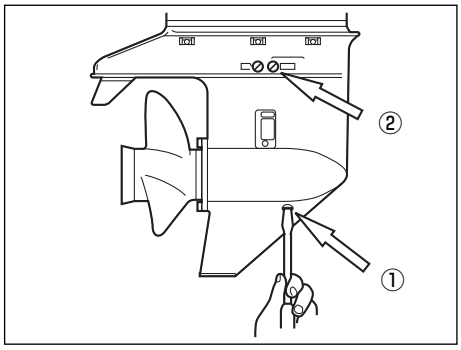


- Insert the gear oil container spigot ③ into the lower oil plug hole and squeeze the container until oil overflows from the upper oil plug hole.



Oil: Genuine gear oil or GL5, SAE#80, #90
Capacity: 500ml, 16.9 US fl. oz (approx.)

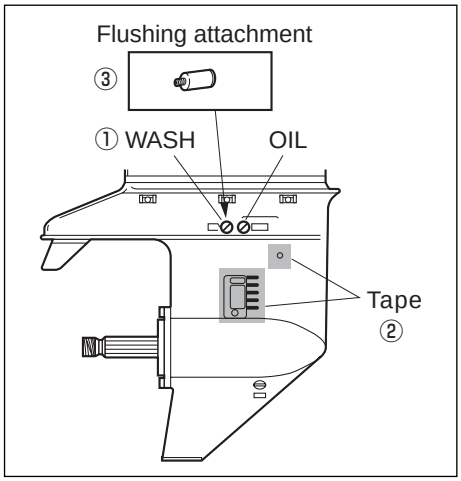
First tighten the upper oil plug ②; then remove the oil container and reinstall the lower oil plug ①.



6. Washing Procedure

Take care not to come into contact with the propeller while it is in motion. Be sure to remove the propeller when operating the engine on land.

Be sure not to operate the engine in confined areas, such as a boat house, as the exhaust fumes contain toxic carbon monoxide gas.



Washing With Flushing Attachment (Hose adapter)

Remove the following components.

- Propeller and thrust holder, etc.

① Water plug

Install the following components.

② Tape: at 2 locations (on water strainer)

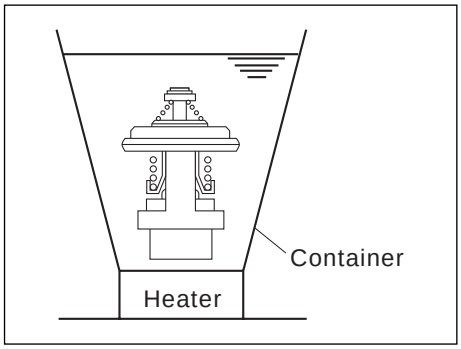
③ Flushing attachment

- Connect a hose to a water faucet and insert the end of the hose into ③.
- Move the gearshift lever to the neutral position and start the engine.
- Confirm that a steady stream of water is coming from the water checking port; then operate the engine at low speed for 3 to 5 minutes.
- Stop the engine, turn off the water supply, remove the flushing attachment ③ and tape, reinstall the water plug ①; then reinstall the propeller assembly.

7. Inspecting Cooling System

Thermostat test

- Place the thermostat into a suitable container and add either cold or warm water.
- Heat the water in the container and confirm that the thermostat valve operates when the temperature rises.



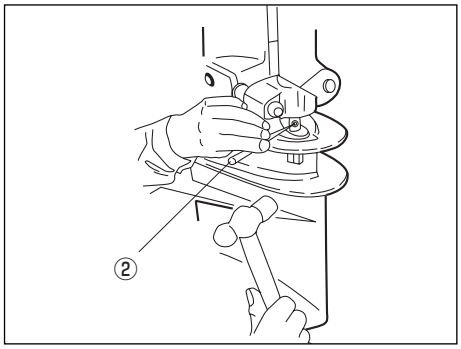
Valve operation start temperature	52°C ± 1.5°C (126°F ± 3°F)
Valve full open temperature	65°C ± 1.5°C (149°F ± 3°F)
Valve full open lift	3 mm or more

Replacing Pump Impeller

Remove the following components.

- ① Split pin

Special tool	② Spring tool A
	345-72227-0

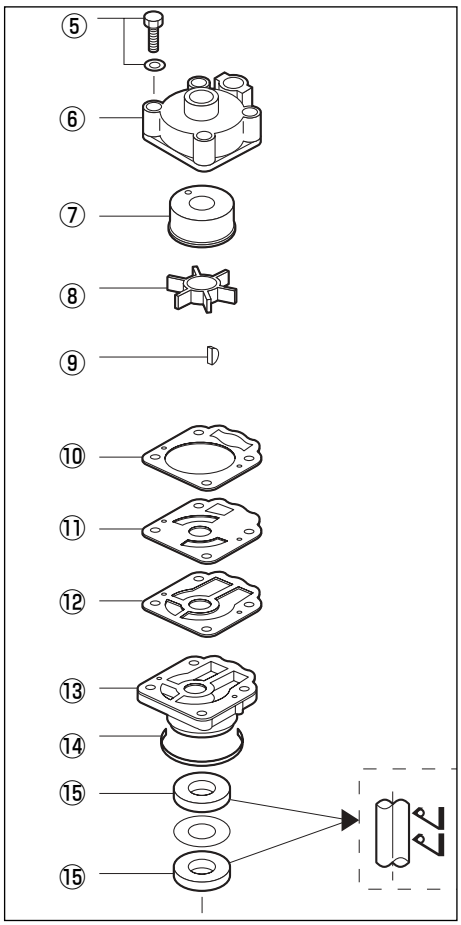


- Bolt: type H835 at 6 locations
- Remove the gear case assembly ③ from the drive shaft housing.

• ⑤ Bolt: type H835 at 4 locations

Inspect the following components.

• ⑥ Upper pump case
• ⑦ Pump case liner
• ⑧ Pump impeller * Replace with new one.
• ⑨ Key for water pump impeller
• ⑩ Gasket for pump case * Replace with new one.
• ⑪ Guide plate for water pump
• ⑫ Gasket for guide plate * Replace with new one.
• ⑬ Lower pump case
• ⑭ O-ring
• ⑮ Oil seal

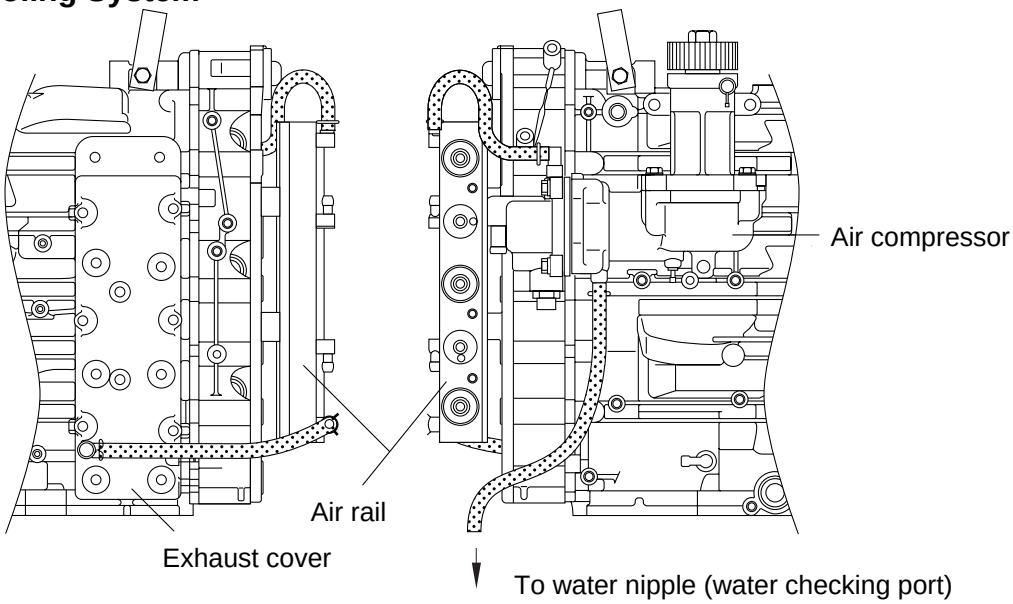


Inspection Procedure

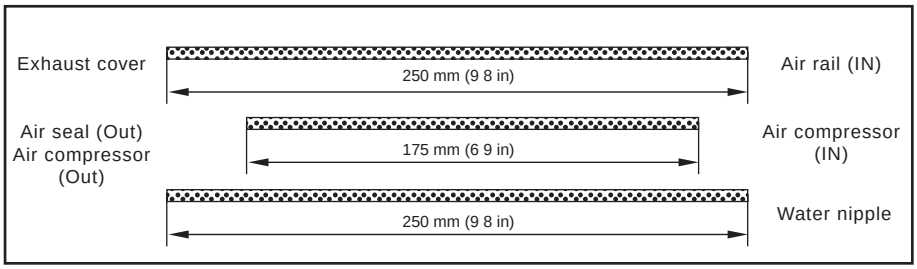
⑥-⑮: replace with new components if worn or damaged.

Make sure oil seals ⑮ are installed facing in the proper direction.

Overview of Cooling System



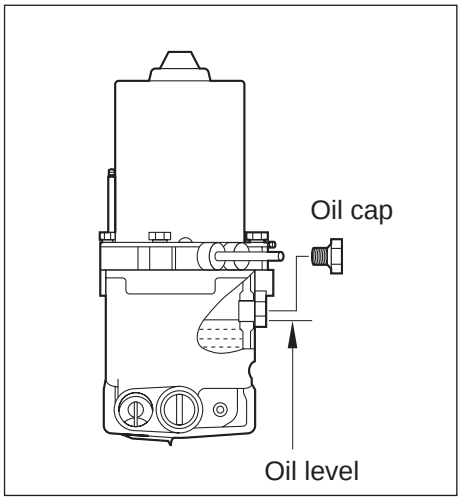
Tubing



8. Inspecting Power Trim and Tilt System

Checking Oil Level

Note that the oil level is checked by first tilting up the outboard engine (see figure), so that the reserve tank is in a perpendicular position. To check level, turn the oil plug counterclockwise to remove it; then confirm that oil level is even with the bottom of the oil plug hole.
When replenishing oil, add until oil begins to overflow from the oil plug hole.



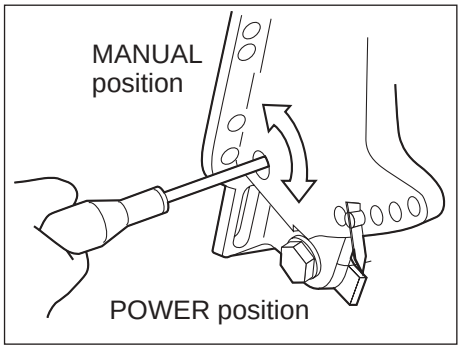
Caution:

In order to avoid damage and accidental injury that can occur when the tilted up (for storage and inspections etc.) outboard engine accidentally tilts back down, be use to insert the tilt stopper when tilted up.

Oil Type

Automatic transmission fluid (ATF)

Note that the presence of air in the oil can cause the engine to not tilt up and down properly.
If this occurs, bleed out the air using the following procedure.



- With the outboard engine installed on the boat, turn the manual valve to the MANUAL position (counter clockwise) and move the engine the full tilt up and down stroke 5 or 6 times; then turn the manual valve back to the POWER position (clockwise).

9. Inspecting Air Rail Pressure

Refer to the description for ② Pressure Gauge Assembly, listed under section 5. (Special Tools) in Chapter 2 (Servicing Information).

Chapter 4 Disassembling, Inspecting and Reassembling Power Unit

4

1. Power Unit 4-2

1) Removing Power Unit 4-3

2) Installing Power Unit 4-5

2. Peripheral Parts 4-6

1) Electrical System 4-6

2) Air Supply System 4-10

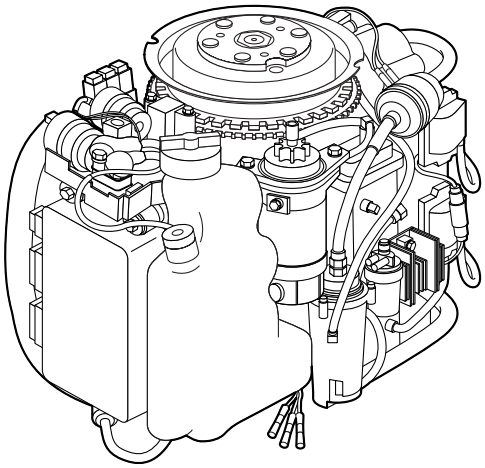
3) Fuel System 4-20

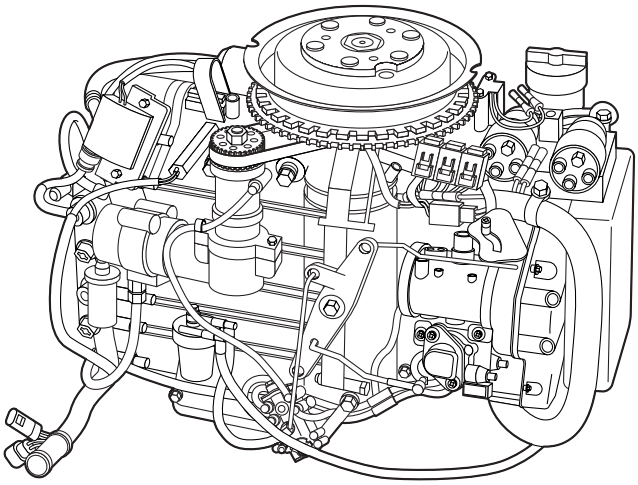
4) Oil Pump 4-29

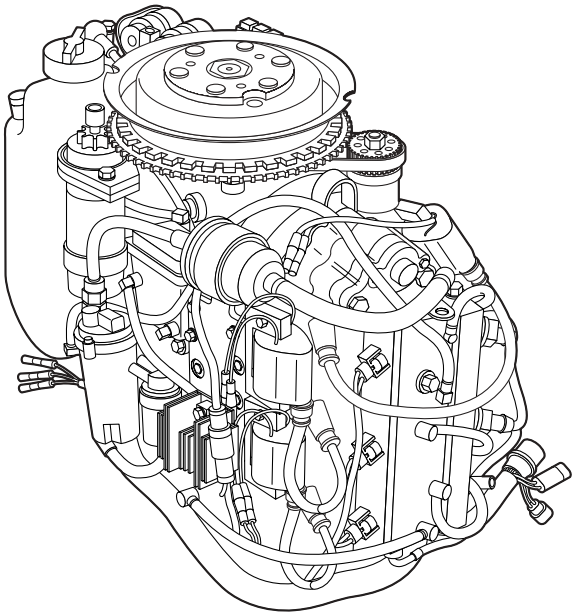
5) Throttle Mechanism 4-31

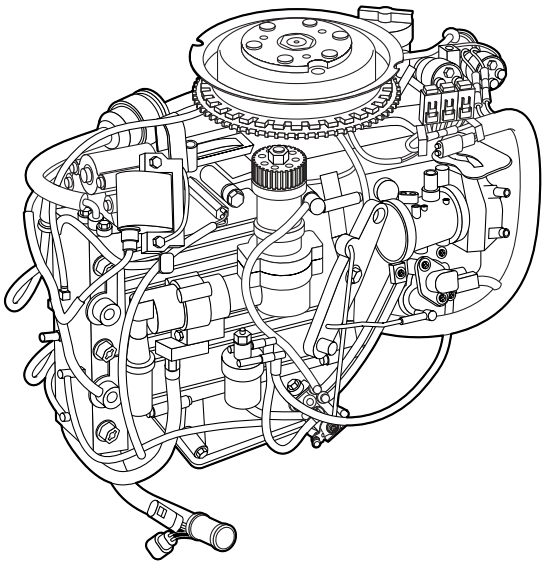
3. Engine Block 4-35

1. Power Unit







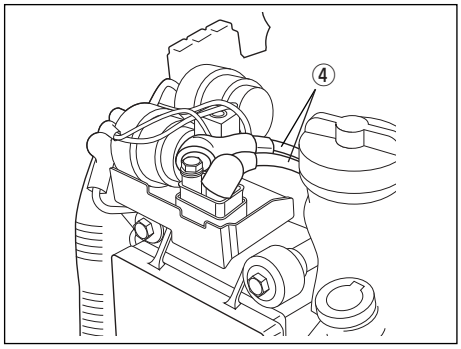


1) Removing Power Unit

Disassemble the following components.

- Fuel connector
- Battery
- Ring gear cover

④ Battery cable

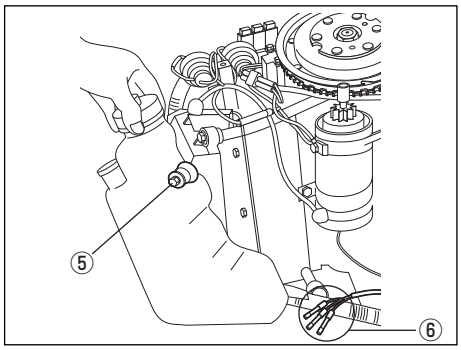


Disassemble the following components.
Begin by disassembling the oil tank; then remove the 3 connectors from the power trim and tilt (PT&T) switch.

⑤ Oil tank mounting bolts

⑥ PT&T switch cable connectors

- Fuel hose (remove from strainer inlet)



P Type

Disassemble the following components.

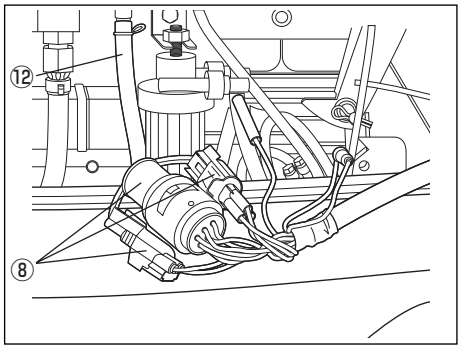
⑧ Wire harness connectors: 3

⑨ Throttle cable from advancer arm

⑩ Gearshift cable from gearshift arm

⑫ Water hose from compressor

- Ground connector from cylinder



F Type

Disassemble the following components.

⑧ Wire harness connectors: 3
Neutral switch cable

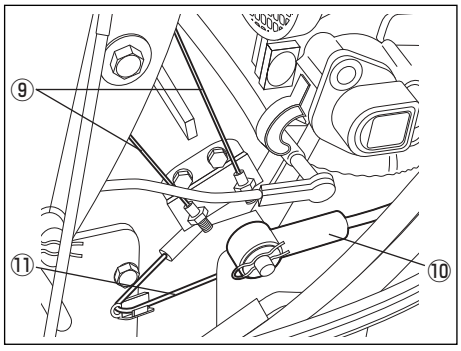
⑨ Throttle cable from advancer arm and cable bracket.

⑩ Gearshift rod from gearshift lever

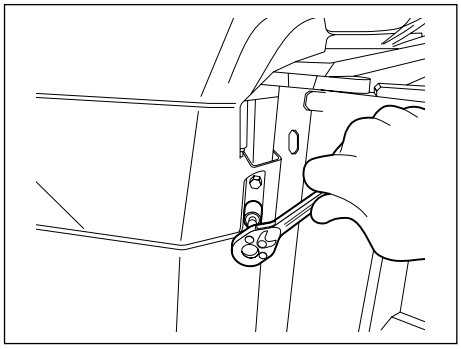
⑪ “S”-shape link from throttle stop arm

⑫ Water hose from compressor

- Ground connector from cylinder

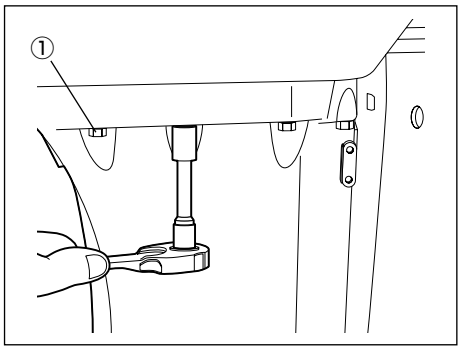


Disassemble splash pan.



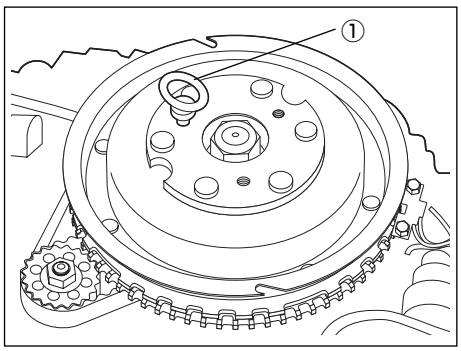
Remove engine mounting bolts.

① Bolt: type H880 at 6 locations

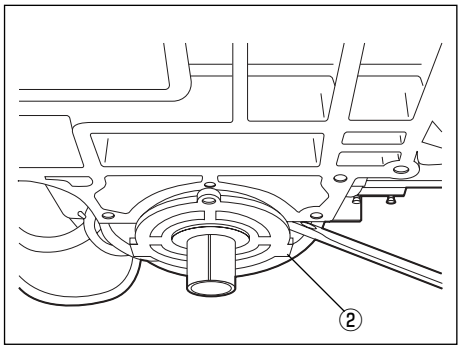


Secure eyebolts ① to the flywheel; then use a sufficiently strong hoist to suspend the power unit while keeping it in the horizontal position.

> Suspend slowly, taking care not to catch the power unit on any of the wiring or hoses.



② Remove crankcase head.
Remove with caution by gently inserting a flathead screwdriver in the groove.



Inspect the following components.

- Oil seals: at 2 locations
- O-rings
- Replace any damaged components.

2) Reassembling Power Unit

Install the following components.

- Install the engine base gasket. * Replace with new gasket.
- Knock pin

Secure eyebolts to the flywheel; then use a sufficiently strong hoist to suspend the power unit while keeping it in the horizontal position.

With power unit suspended, install the following components.

- Crankcase head

Apply a sufficient amount of heat-resistant grease (LOR #101) to the entire circumference of the oil seal lip.
Apply a sufficient amount of the recommended grease to the O-rings.
Refer to servicing information (section 3 in chapter 2).

Place power unit on to engine base.

Take care that none of the wiring or hoses gets caught between the power unit and engine base mating faces.

Referring to section 1), assemble power unit in the reverse order of the procedures described there.

2. Peripheral Parts

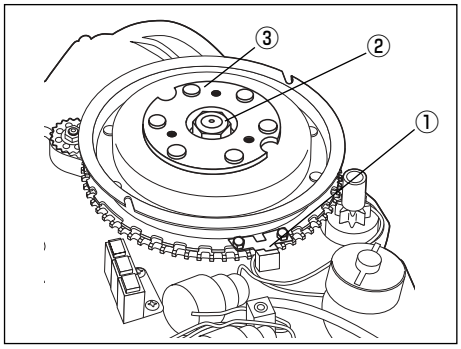
1) Electrical System

Removing CPS *, Flywheel and Alternator

Remove the following component.

① CPS

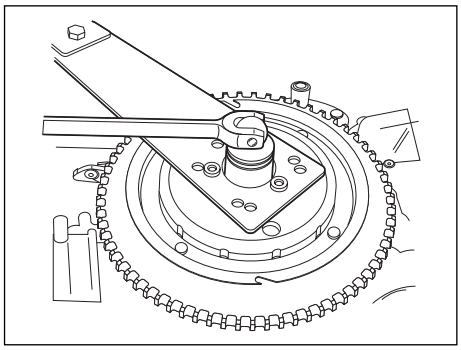
* CPS: abbreviation for crank position sensor.



Remove the following component.

② Flywheel nut

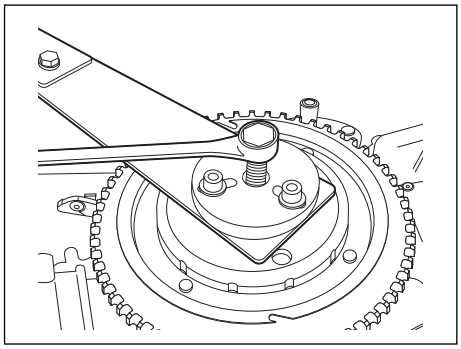
Special tool	● Plate ● Socket wrench: 27 mm ● Bolt: type M820



Remove the following component.

③ Flywheel

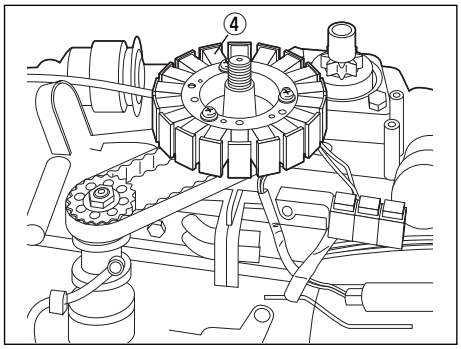
Special tool	● Flywheel puller kit 3C7-72211-1 ● Socket wrench: 17 mm



Remove the following components.

④ Alternator

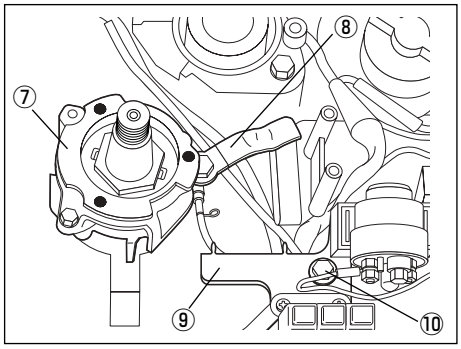
- Lighting coil output lead (3 plugs)
- Exciting coil output lead connector



Remove the following components.

⑦ Coil bracket

⑧ Cable clamp



Remove the following components.

⑨ Solenoid switch bracket

⑩ Bolt: type H625 at 3 locations

Removing ECU *

*** ECU: abbreviation for the engine control unit.**

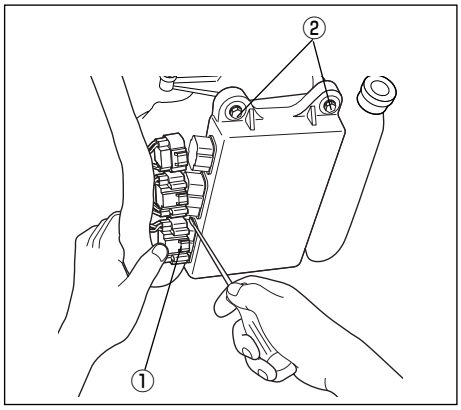
Remove the following components.

① ECU connector

While pressing down on hook, remove by prying gently with a flathead screwdriver.

② Rubber mount bolt: type H630 at 3 locations

Remove from 2 of the upper 3 locations; then take out ECU by pulling it upwards.



The collar used on the ECU rubber mount differs in length from the one used on the oil tank.

③ Clamp

Removing Harness Assembly

Remove the following components.

Remove harnesses in order starting from remote control side.

④ Water temperature connector

• Remove by pressing down on hook and pulling out connector.

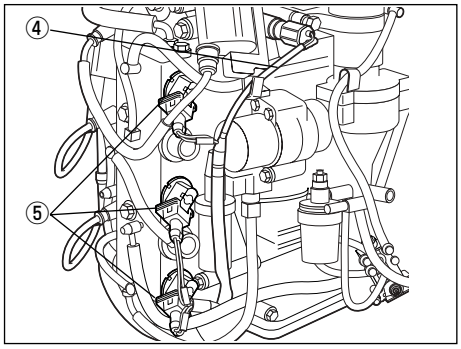
⑤ Fuel injector connector

• Remove by pressing down on wire hook and pulling out connector.

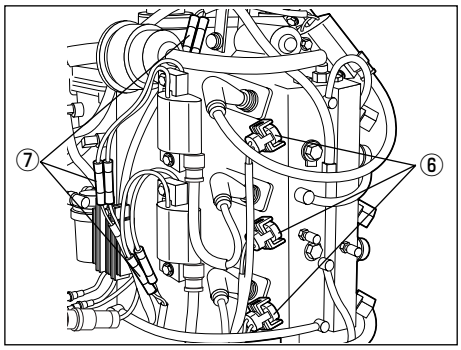
⑥ Air injector connector

• Remove by pressing open the claws on either side with a flathead screwdriver and pulling out.

⑦ Bullet connectors for ignition coils



When removing cable assembly with the compression head resting on the engine base, be sure to remove the air rail bolt to free the air rail.

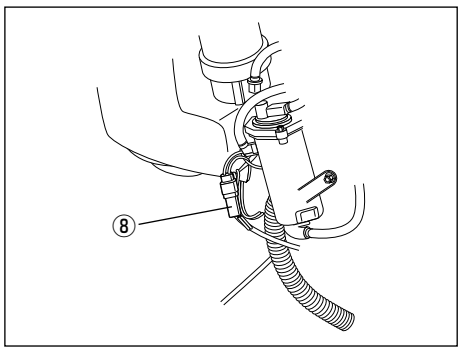


Remove the following components.

⑧ FFP * connector

• Remove by pressing down on hook and pulling out connector.

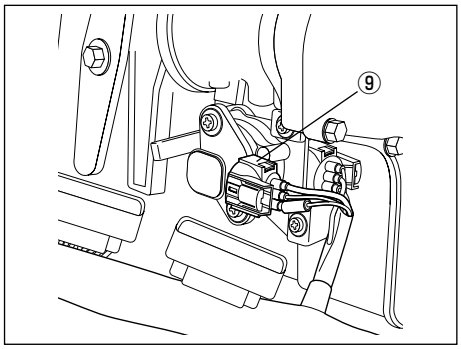
* FFP: abbreviation for fuel-feed pump.



⑨ TPS * connector

• Remove by pressing down on hook and pulling out connector.

* TPS: abbreviation for throttle position sensor.



Removing Ignition Coil and Rectifier Regulator

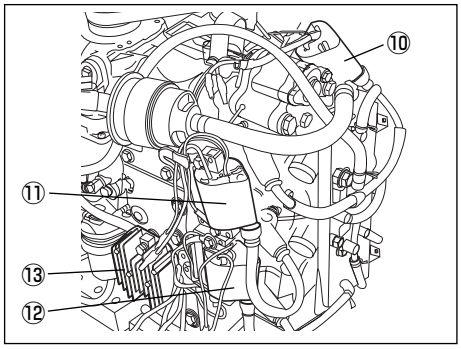
Remove the following components.

⑩ Ignition coil #1

⑪ Ignition coil #2

⑫ Ignition coil #3

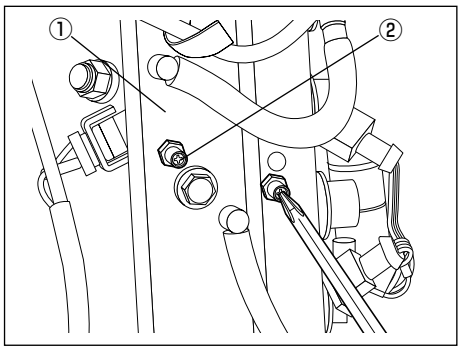
⑬ Rectifier regulator



2) Air Supply System

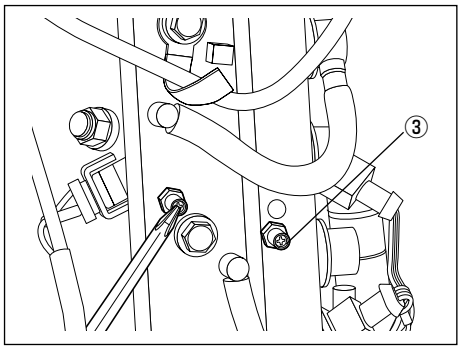
Prior to Removing Peripheral Components

(1) Press on the core of the air valve ② located on the air rail ① to release pressure from the air lines.



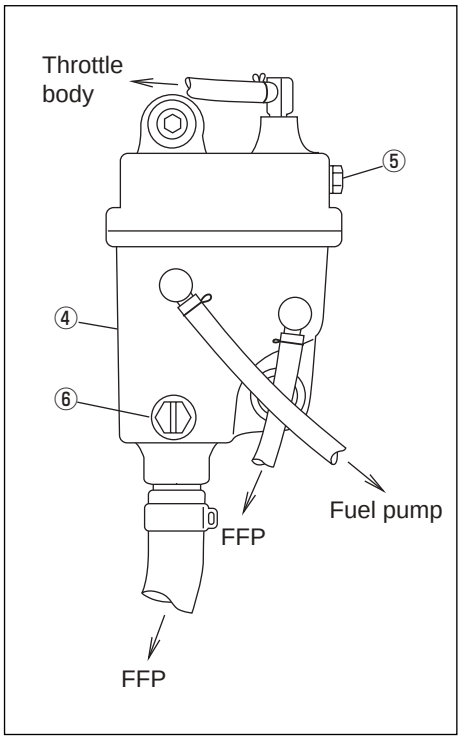
(2) Press on the core of the fuel valve ③ located on the air rail ① to release pressure from the fuel lines.

> Be sure to cover the fuel valve with a clean cloth, as fuel will spurt out when pressure is released

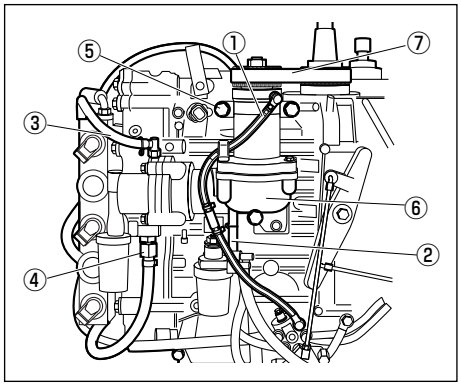


(3) After loosening the plug ⑤ on the upper section of the vapor separator ④ in order to release pressure, loosen the drain plug ⑥ on the lower section and drain out the fuel.

> Hold a cloth against the drain plug to absorb the fuel as it drains out.



Removing Air Compressor



Remove the following components.

① Detach the oil pipe on the compressor side.

② Detach recirculation pipe on the compressor side.

③ Detach cooling water pipe on compressor side.

④ Remove air hose on compressor side.

⑤ Compressor bolts: at 3 locations

Remove the following components.

⑥ Air compressor

> The air compressor is held in place by two knock pins, these should be removed with a gentle tilting motion.

⑦ Drive belt

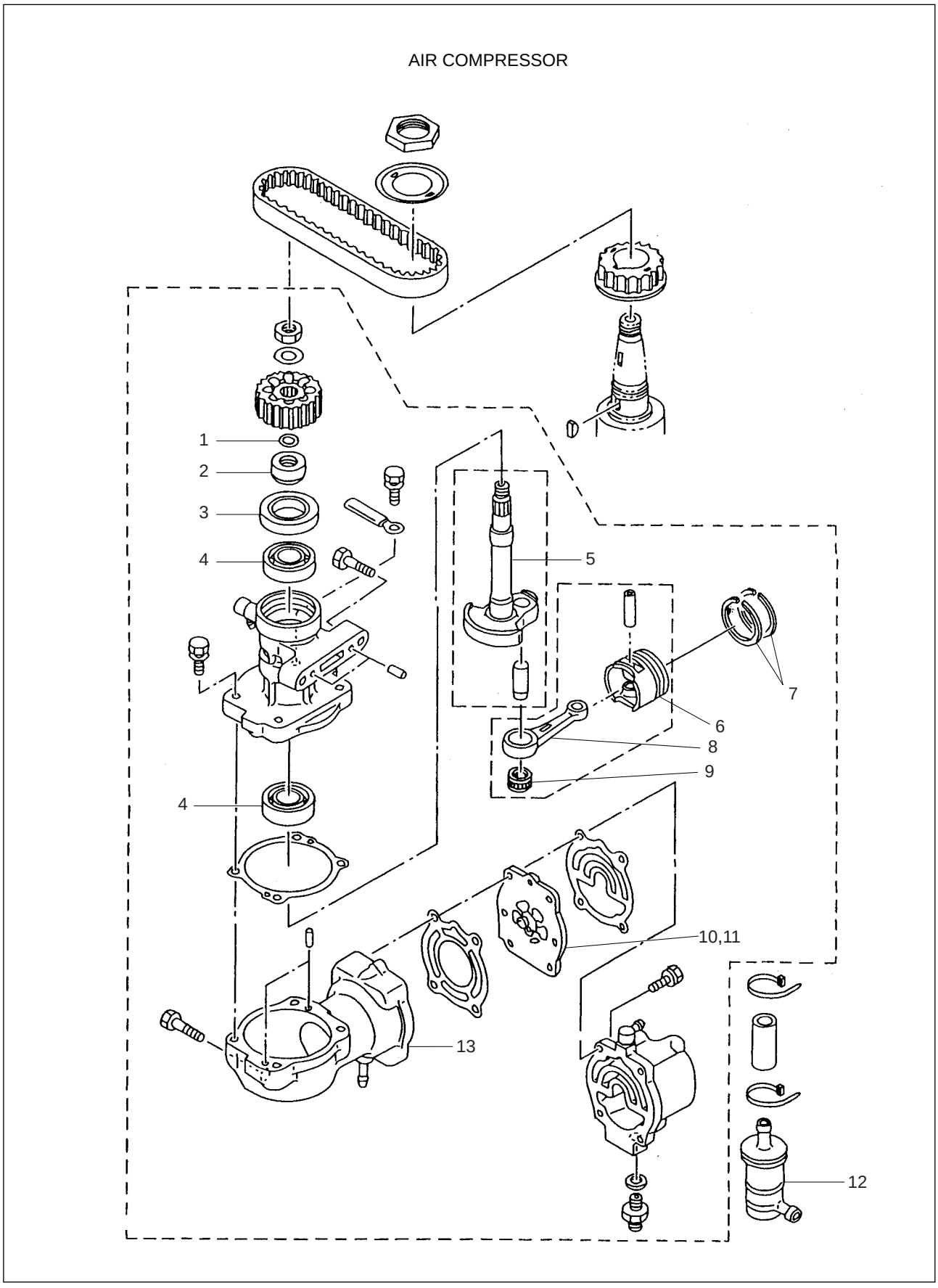
> Be sure to apply markings that identify the top and bottom sides in cases when the drive belt is being reused.

Inspecting Drive Belt

> • Check for wear and damage.
> • Check for missing teeth.
> • Check for presence of oil.

> Replace in cases where even the slightest defect is found.

Air Compressor Configuration



Inspecting Air Compressor

No.	Component	Points to check
1	O-ring	• Scratches and wear
2	Collar	• Wear and damage
3	Oil seal	• Wear and damage • Replace with new one if defects are found
4	Bearing	• Rotate by hand and check for play and catching • Replace with new one if defects are found • Be careful not to scratch housing when removing bearing • Apply force to outer race when press fitting bearing
5	Crankshaft	• Wear and damage
6	Piston	• Wear and damage • Check outer diameter of piston
7	Piston ring	• Measure piston ring end gap
8	Connecting rod	• Confirm smooth operation
9	Big end bearing	• Confirm smooth operation
10	Reed valve	• Wear and damage • Reed valve clearance: 0.2 mm (0.008 in) or less • Correct or replace if problems are detected
11	Reed valve stopper	• Wear and damage • Valve stopper height: 2 mm (0.08 in) • Correct or replace if problems are detected
12	Air filter	• Confirm whether dirty or clogged • Replace with new one if dirty
13	Cylinder	• Sliding surface of piston for scratches • Correct or replace if problems are detected

Assembling Piston

Assemble the following components.

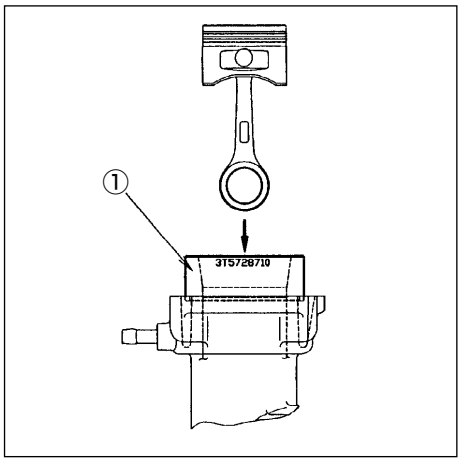
- Piston rings

> • Instaing order of rings:
> Expander ⇨ side rails ⇨ 2nd ⇨ Top.
> • Install so that the side rail gap of the oil ring is positioned at a 90° angle to the expander gap.
> • Install the top and secondary rings so that their gaps are positioned at 120° angles to the expander end gap.

Assembling Compressor

① Using the piston slider, insert the piston into the cylinder.

Special tool	① Piston slider
	3T5-72871-0



> • Prior to inserting piston, apply heat-resistant grease LOR #101 and genuine engine oil mixed at a 1:3 ratio and apply to:
> • Outer circumference of piston
> • Inside surface of piston slider
> • Cylinder wall
> • Insert piston with the UP marking at the top.

Assemble the following components.

- Nut
- Washer
- Pulley
- O-rings: apply LOR #101
- Bushing
- Oil seal: apply LOR #101
- Bearings: apply genuine engine oil
- Housing
- Crankshaft

Assemble the following components.

- Knock pins at 2 locations
- Gasket * Replace with new one.
- Bolt: type H625 at 4 locations

> • Apply genuine engine oil to the big end of the connecting rod.
> • Insert the crank pin in the big end of the connecting rod and install by gently moving the crankshaft.

Assemble the following components.

- Bolt: type H630 at 4 locations
- Cylinder head
- Upper gasket * Replace with new one.
- Reed valve assembly
- Lower gasket * Replace with new one.
- Cylinder

- Take care not to mistake the top and bottom and front and back sections of the reed valve assembly when installing.
- Take care not to mistake the top gasket for the bottom gasket.

Assemble the following components.

- Air filter
- Hose
- Band lead wire

Position the air filter intake opening as shown in the figure.

Disassembling Air Rail

Remove the following components.

① Fuel hose assembly and nipples

Disassemble and pull out the stopper plate.

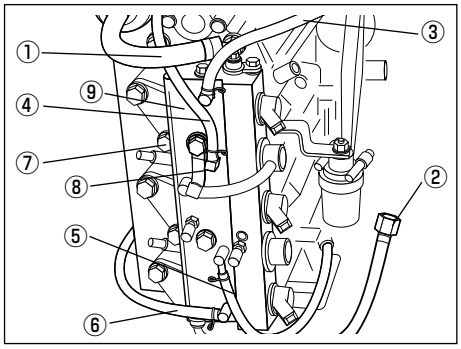
② Air hose assembly
Disconnect the hose joint on the compressor side.

③ Cooling water outlet hose

④ Fuel return hose

⑤ Air discharge hose

⑥ Cooling water inlet hose



Remove the following components.

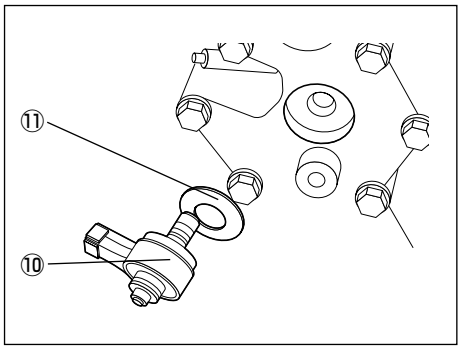
⑦ Bolt: type H865 at 2 locations

⑧ Clamp

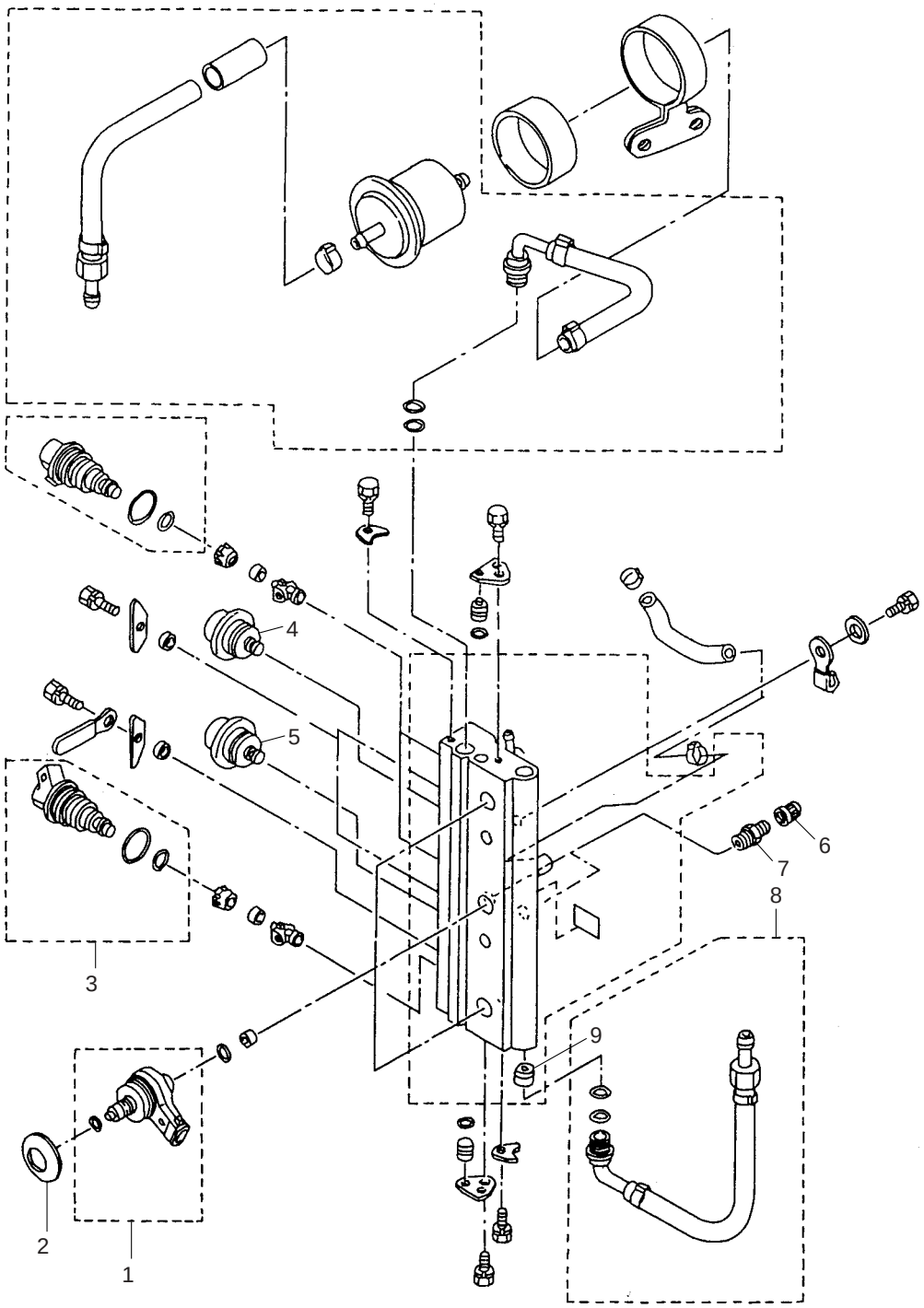
⑨ Air rail assembly

⑩ Air injector: at 3 locations

⑪ Air injector set piece: at 3 locations



Air Rail Assembly Configuration



Inspecting Air Rail

No.	Components	Points to check
1	Air injector	• Wear, deterioration and damage on O-rings and seal rings. Replace with new ones if problems are detected. • Remove any carbon buildup on tip using wire brush. • Refer to chapter 6 for electrical system inspection.
2	Set piece for air injector	• Wear, warpage and damage.
3	Fuel injector	• Wear, deterioration and damage on O-rings. Replace with new ones if problems are detected. • Refer to chapter 6 for electrical system inspection.
4	Fuel regulator	• Wear, deterioration and damage on O-rings. Replace with new ones if problems are detected. • Clogged regulator strainer. Clean if foreign matter is present. • Wear, deterioration and damage on pressure hose. Replace with new one if problems are detected.
5	Air regulator	• Wear, deterioration and damage on O-rings. Replace with new ones if problems are detected. • Clogged regulator strainer. Clean if foreign matter is present.
6	Valve core (part of valve assembly)	• Wear, deterioration and damage on rubber seal. Replace with new ones if problems are detected.
7	Plug	• Wear, deterioration and damage on O-rings. Replace with new ones if problems are detected.
8	Air hose assembly	• Wear and deterioration on hoses and O-rings. Replace with new ones if problems are detected.
9	Orifice (press fit to air rail)	• Foreign matter and clogging. Clean if foreign matter is present.

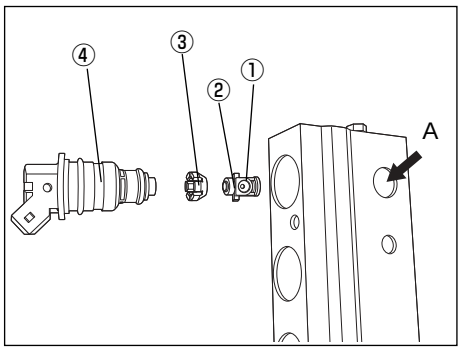
Assembling Air Rail

• Apply genunie engine oil to the O-rings.

Assemble the following components.

① Insert

② Seal ring

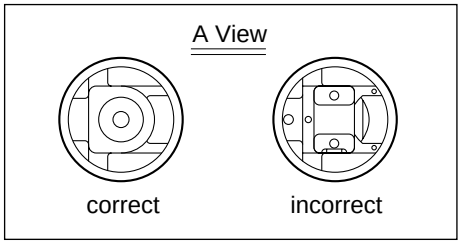


• Take care to install with insert ① facing in the proper direction as shown in View A to the right.

③ Adapter

④ Fuel injector

• Be sure to use the special tool when installing the O rings in the fuel injector.



Special tool	O-ring Setting Tool*
	3T5-72870-0

*: Refer to Section 2-5 in chapter.

Assemble the following components.

① Fuel regulator

② Hose clamp * Replace with new one.

Special tool	Crimping pliers*
	3T5-72864-0

*: Refer to Chapter 2-5 in chapter.

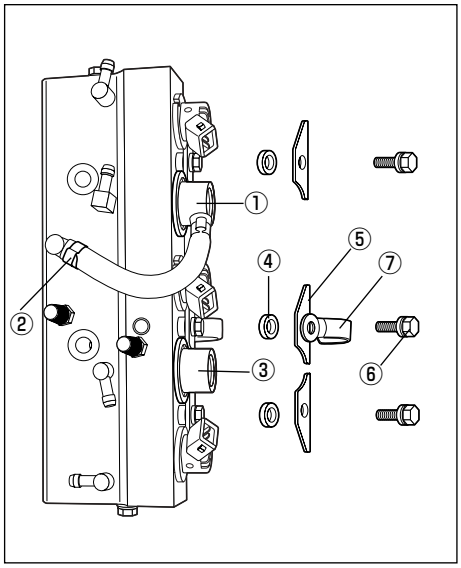
③ Air regulator

④ Collar

⑤ Plate

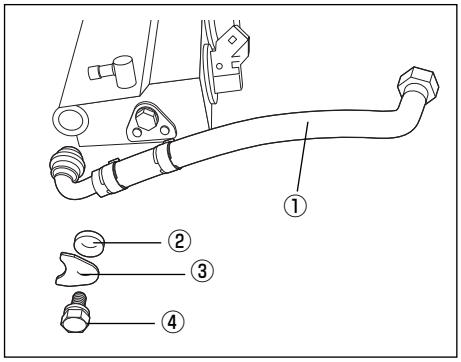
⑥ Bolt

⑦ Clamp



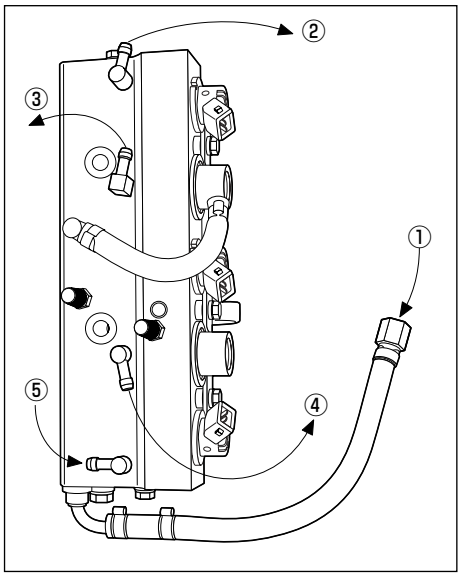
Assemble~components

① Air hose assembly
② Collar
③ Stopper plate
④ Bolt



Installing Hoses (See figure)

① From air compressor (air)
② To air compressor (cooling water)
③ To FFP (fuel)
④ To cylinder (air)
⑤ From exhaust cover (cooling water)

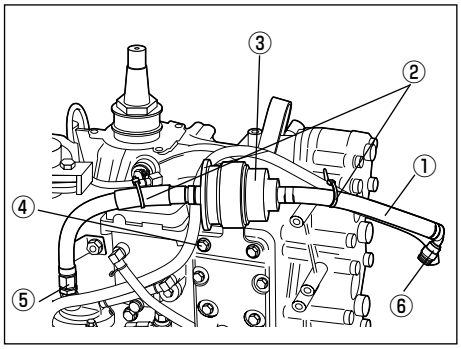


3) Fuel System

Disassembling Fuel Hose Assembly

Remove the following components.

① Fuel hose assembly
② Lead wire band: at 2 locations
③ High-pressure fuel filter
④ Bolts: at 2 locations
⑤ Connections to FFP
⑥ Connections to air rail



Hold a cloth in place to absorb spilling fuel when removing components ⑤ and ⑥.

Assembling Fuel and Air Assembly

Assemble in the reverse order of disassembly.

- Bolt: type H630 at 2 locations

Torque: 7.8 to 9.8 N-m: 0.8 to 1.0 kg-m: 5.8 to 7.2 lb-ft

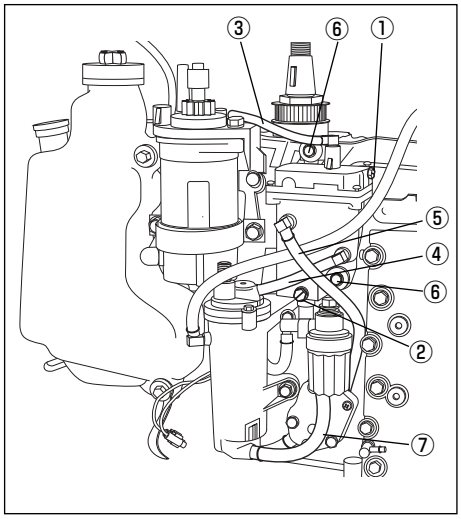
Disassembling Vapor Separator

Drain the fuel from the vapor separator using the following procedures.

① Loosen the air vent screw.

② Loosen the drain screw.

Hold a cloth in place to absorb spilling fuel when loosening ②.



Detach the following hoses.

③ Vapor discharge hose

④ Vapor return hose

⑤ Fuel inlet hose

Hold a cloth in place to absorb spilling fuel when detaching hose ④.

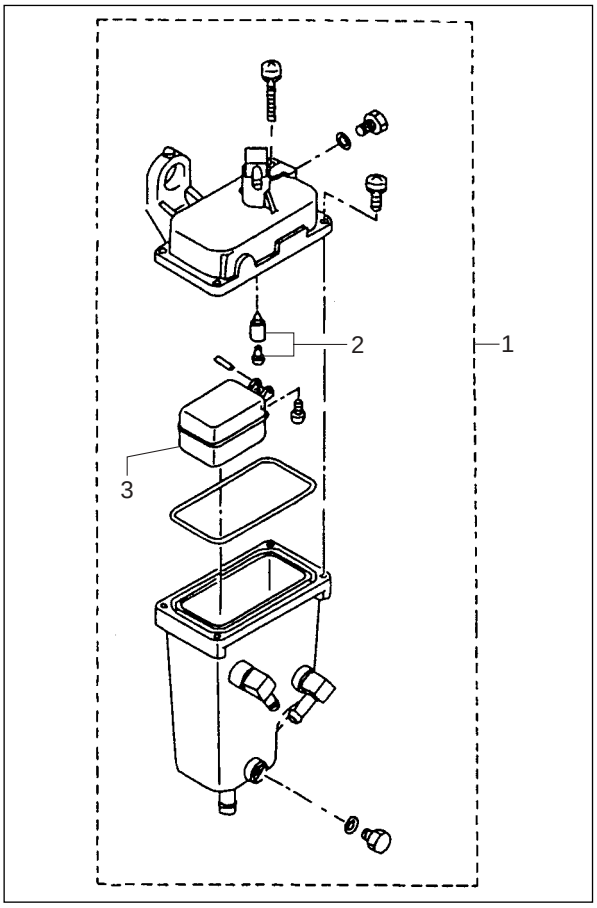
Remove the following components.

⑥ Bolt: type H630 at 2 locations

⑦ Fuel outlet hose

Hold a container in place to catch spilling fuel when removing hose ⑦.

Vapor Separator Configuration



Inspecting Vapor Separator

No.	Components	Points to check
1	O-rings	• Wear, deterioration and damage.
2	Float valve	• Wear, deterioration and damage.
3	Float	• Presence of cracks. • Contamination by fuel.

Assembling Vapor Separator

Assemble in the reverse order of disassembly.

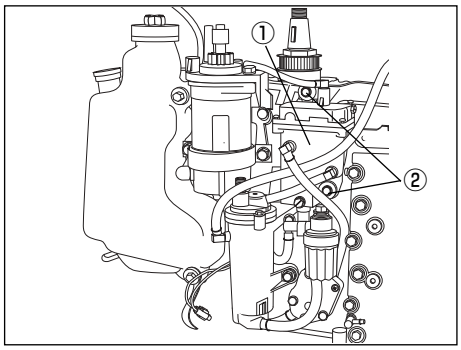
① Air vent screw Torque: 0.98 N-m: 0.1 kg-m: 0.7 lb-ft ② Drain screw Torque: 1.4 N-m: 0.14 kg-m: 1.0 lb-ft

Assembling Vapor Separator assembly

Assemble in the reverse order of disassembly.

① Vapor separator assembly
② Bolt: type H630 at 2 locations
- Washers: at 4 locations
- Collars: at 2 locations
- Rubber mounts: at 2 locations

② Torque: 4.6 to 6.3 N-m: 0.47 to 0.64 kg-m: 3.4 to 4.6 lb-ft



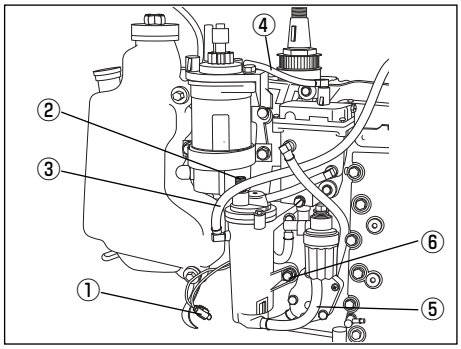
Disassembling FFP Assembly *

*** FFP:** abbreviation for fuel-feed pump.

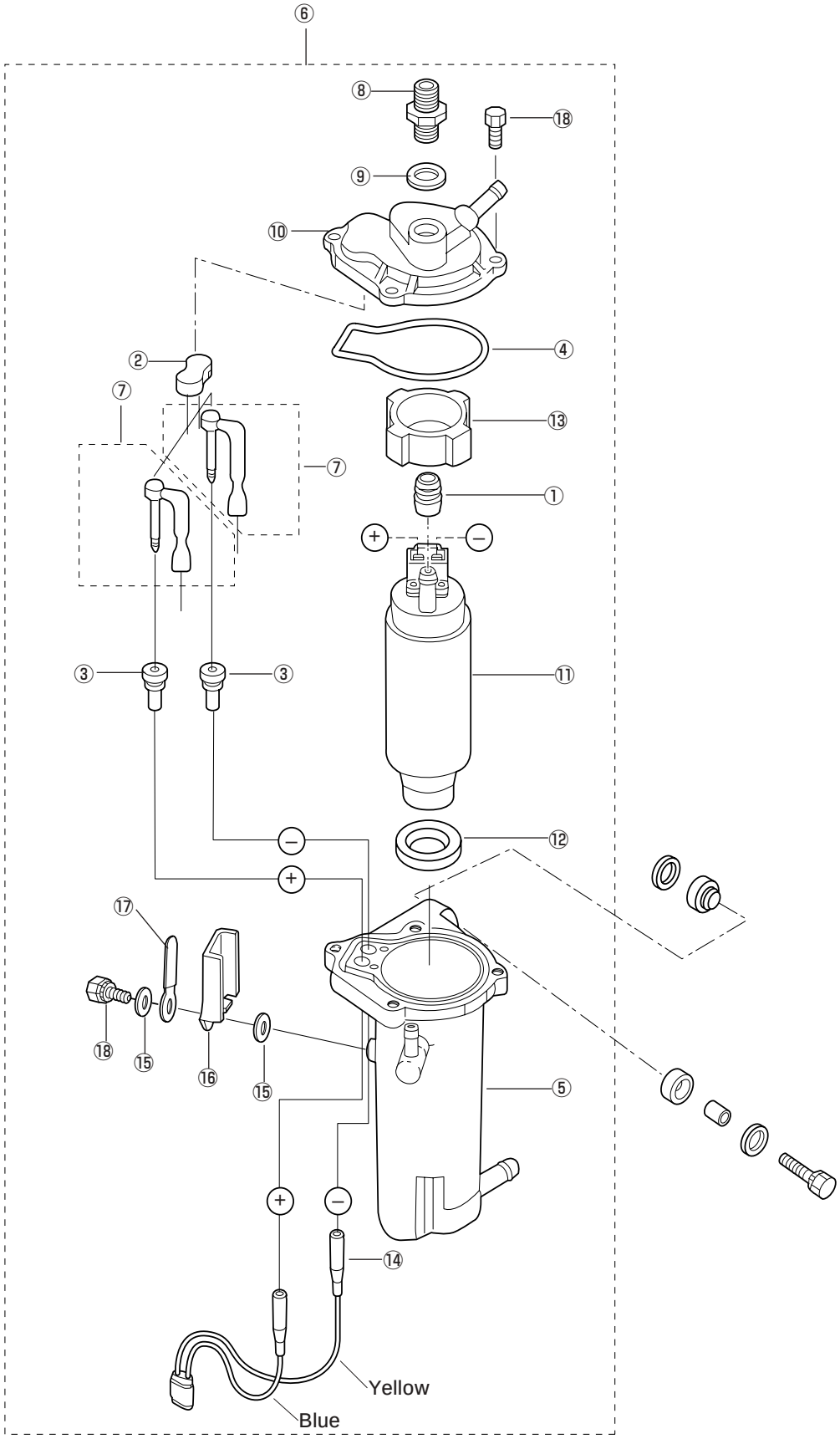
Remove the following components.

① FFP connector
② Hose joint
③ Fuel return hose
④ Vapor return hose
⑤ Fuel hose
⑥ Bolt: type H630 at 2 locations

Hold a cloth in place to absorb spilling fuel when detaching the hoses.



FFP Configuration



Inspecting FFP

No.	Components	Points to check
1	Pipe grommet	• Wear, deterioration and damage. Replace if defects are detected.
2	Upper cable terminal grommet	
3	Cable terminal grommet	
4	O-rings	
5	FFP Case	• Clogging by foreign matter and water.
6	FFP assembly	• Dirt and foreign matter on lower intake port. • Cracks and damage on upper and lower plastic sections.
7	Cable terminal assembly (+) (-)	• Damage on flat terminal and plug terminal. • Damage on wiring. • Scratches or bending on terminals. • Replace if defects are detected.

Assembling FFP

Assemble the following components.

⑧ Hose joint adapter

Torque: 14 to 16 N-m: 1.4 to 1.6 kg-m: 10 to 12 lb-ft
Adhesive to apply after degreasing thread area: Three Bond 1342

⑨ Metal washers

Always replace after disassembly.

⑩ Upper case

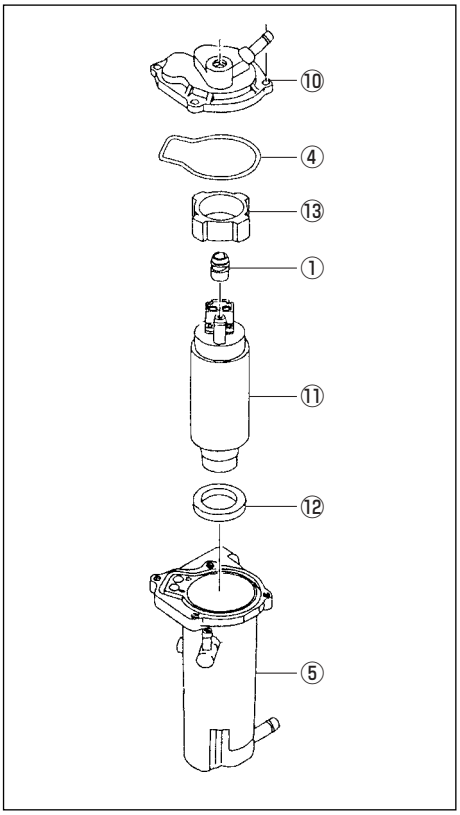
Assemble the following components.

① Pipe grommet

⑪ FFP

⑫ Lower grommet

Grease to apply	① and ⑫ Genuine engine oil



⑤ FFP case

⑩ Upper case

The position for ⑤ in relation to ⑪ is shown in the figure to the right. Place ⑩ on top and check position.

Assemble the following components.

⑬ Upper grommet

③ Cable terminal grommet

Grease to apply	③ and ⑬ Genuine engine oil

⑦ Cable terminal (-): black cable

⑦ Cable terminal (+): Red cable

Grease to apply	terminals ⑦ Genuine engineoil

Connect to the flat connector cable terminal by lining up with the ± mark on the FFP.

Assemble the following components

⑭ FFP cable

Attach cable to terminal by pressing firmly down from above.

⑮ Spacer (washer) : W5

⑯ Cable covering

Take care not to pinch cable when closing cover.

⑰ Bolt: type H510

Torque: 2.6 to 3.5 N-m: 0.27 to 0.36 kg-m: 2.0 to 2.6 lb-ft

Assemble the following components.

② Cable terminal upper grommet

④ Seal ring (O-ring)

Grease to apply:	② and ④ Genuine engine oil

⑩ Upper case

⑱ Bolt: type H518 at 4 locations

Torque: 2.6 to 3.5 N-m: 0.27 to 0.36 kg-m:2.0 to 2.6 lb-ft

Installing FFP Assembly on Cylinder

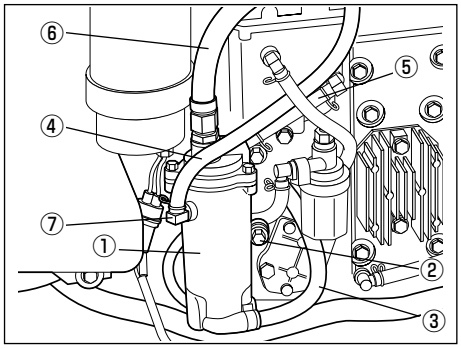
Install the following components.

① FFP assembly

② Bolt: type H630 at 2 locations

- Washer
- Rubber mounts
- Collars

Torque: 4.6 to 6.3 N-m: 0.47 to 0.64 kg-m: 3.4 to 4.6 lb-ft



③ Fuel hose

④ Fuel return hose

⑤ Vapor return hose

Install hose and apply clip.

⑥ High-pressure fuel hose

Torque: 14 to 16 N-m: 1.4 to 1.6 kg-m: 10 to 12 lb-ft

⑦ FFP cable connector (cable assembly)

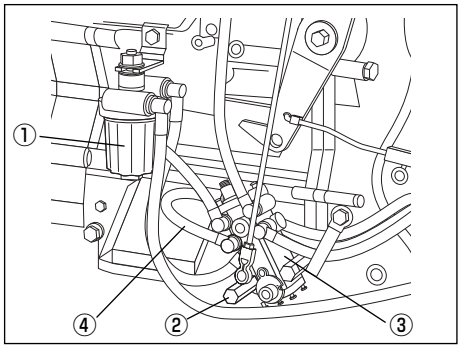
Secure the FFP cable connector to the cylinder using the clamp.

4) Oil Pump

Disassembling Oil Pump and Oil Tank

Disassemble the following components.

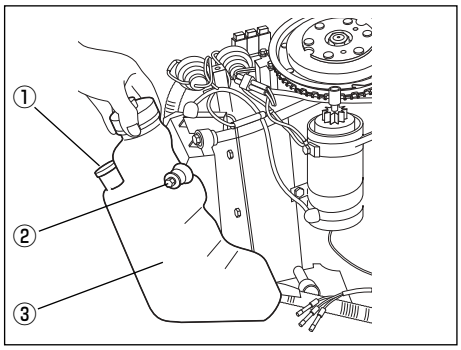
① Oil filter
② Oil pump bolt
③ Oil pump
④ Oil pipe :4



Remove by pulling the pipes (4) out from oil pump.

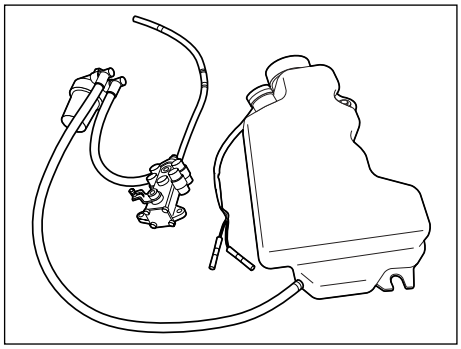
Remove the following components.

① Oil level sensor cable
② Bolt: type H630
③ Oil tank



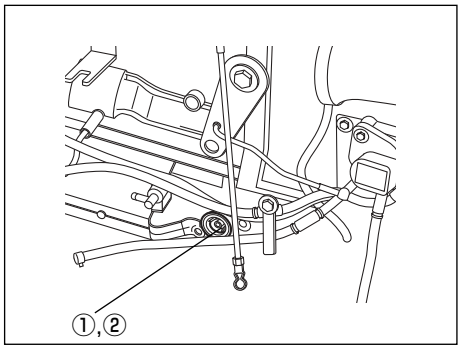
The oil tank is insert-mounted at the bottom, so can be removed by simply pulling upward.

Remove from power unit as shown in the figure to the right.



Remove the following components.

① Bushing
② Oil pump driven gear



Inspect the following components.

① Bushing

② Oil pump driven gear

Check for wear and damage.

Assembling Oil Pump

Assemble the following components

① Bushing

② Oil pump driven gear

Oil to apply	① and ② Genuine engine oil

• Make sure that ① faces right side up. • Section with large hole faces to the front.

Assembling Oil Pump and Oil Tank

Assemble the following components. (Refer to chapter 1.)

• Oil discharge pipe * #1 cylinder

• Oil discharge pipe * compressor

• Oil discharge pipe * #2 cylinder

• Oil discharge pipe * #3 cylinder

• Clamp

• Pass ③ and ④ through the rear of the oil pump. • Secure ①, ③ and ④ using the clamp ⑤.
Make sure that check valve faces in proper direction.

• Install the oil filter on the bracket.

Install the following components.

• Insert the oil tank into the lower rubber mount.

• Connect the oil level sensor.

• Secure the oil pipe using the clamp.

Install the following components.

• Bolt: type H630

• Washer

• Collar

• Rubber mount

5) Throttle Machanism

Disassembling Advancer Arm

Disassemble the following components.

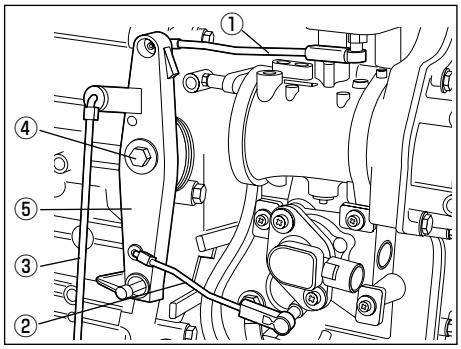
① Throttle link rod
② TPS* link rod
③ Oil pump link rod

* TPS: abbreviation for throttle position sensor

Prior to removing ①, ② and ③ it will be necessary to disconnect the rod snaps from the advancer arm.

Take care not to apply any force to the corresponding arm when disconnecting the ball joint.

④ Bolt: type H635, including washers and collar
⑤ Advancer arm



Inspect the following components.

① Throttle link rod
② TPS link rod
③ Oil pump link rod

• Check ball joint cap for wear and damage. • Check for bent link rods.

Inspect the following components.

- Throttle link rod snap
- TPS link rod snap
- Oil pump link rod snap

Check for wear and damage.

Assembling Advancer Arm

Assemble the following components.

- Advancer arm
- Throttle link rod
- TPS link rod
- Oil pump link rod
- Bolt: type H635
- Washers
- Collar

Install the following components.

- Throttle link ball joint cap
- TPS link ball joint cap
- Oil pump ball joint cap

Install ball joint and cap by hand using a pinching motion.

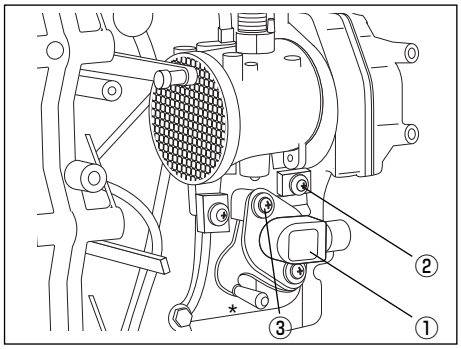
Take care not to apply force to the TPS lever.

Disassembling TPS

Disassemble the following components.

① TPS assembly
② Screw: type 420 panhead at 3 locations

- Washers
- Collars



Remove the following component.

① TPS assembly

• Confirm whether the arm springs back in the * direction • Confirm that arm moves smoothly. • Check the connectors for damage.

• Never loosen small screw ③ that s locked in place using paint. • Doing so will change the 0 point setting, making it unusable.

Refer to chapter 5 when conducting electrical inspections.

Assembling TPS

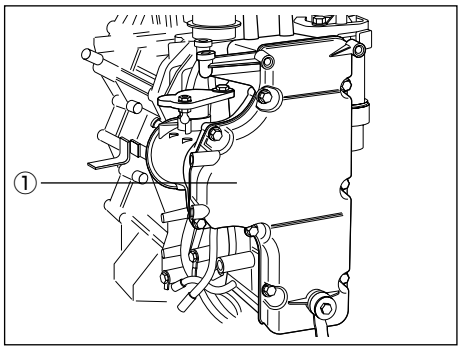
Assemble in the reverse order of disassembly.

Disassembling Air Box and Throttle Body

Disassemble the following components.

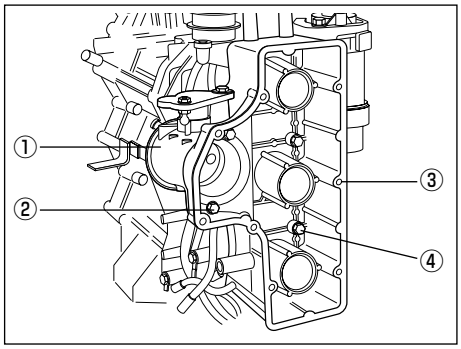
- Bolt: type H625 at 8 locations
- Clamp

① Air box cover



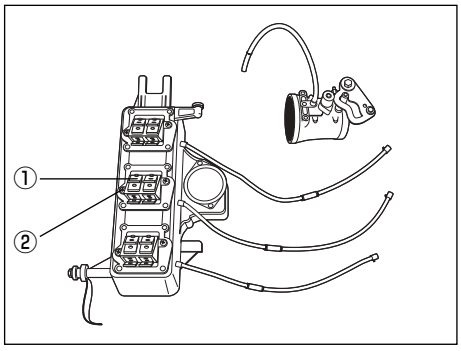
Remove the following components.

② Bolt: type H625 at 2 locations
① Throttle body assembly
④ Bolt: type H625 at 12 locations
③ Air box



Remove the following components.

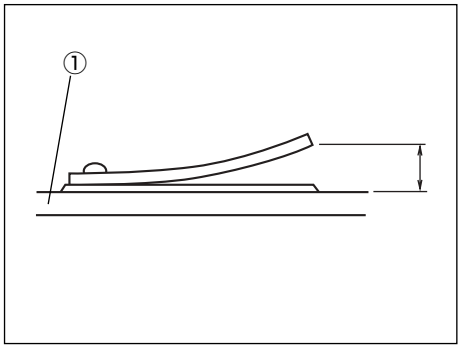
② Screws: type 516 panhead at six locations
① Reed valve assembly



Inspect the following component.

① Reed valve assembly

Valve stopper height: 9.3 to 9.5 mm: 0.366 to 0.374 in
Check whether valve closes properly, is worn or damaged.

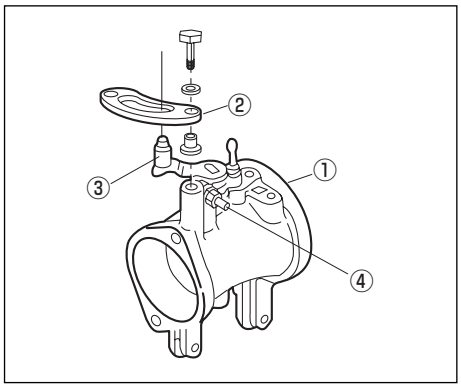


Inspect the following component.

① Throttle body

- Check throttle cam ② for wear.
- Check cam roller ③ for wear.
- Confirm that ② and ③ operate smoothly.

Do not touch adjuster screw ④.



Assembling Air Box

Assemble the Following Components.

① Throttle body assembly

② Gasket * Replace with new one.

③ Bolts: at 2 locations

Grease to apply:	Interacting surfaces of the throttle cam and roller
	OBM grease

④ Reed valve assembly

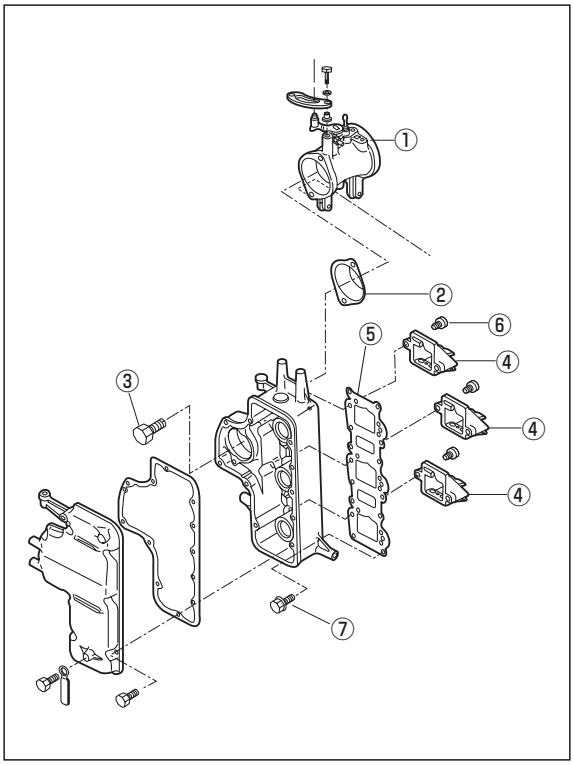
⑤ Gasket * Replace with new one.

⑥ Screws: at 6 locations

Assembling Air Box and Throttle Body

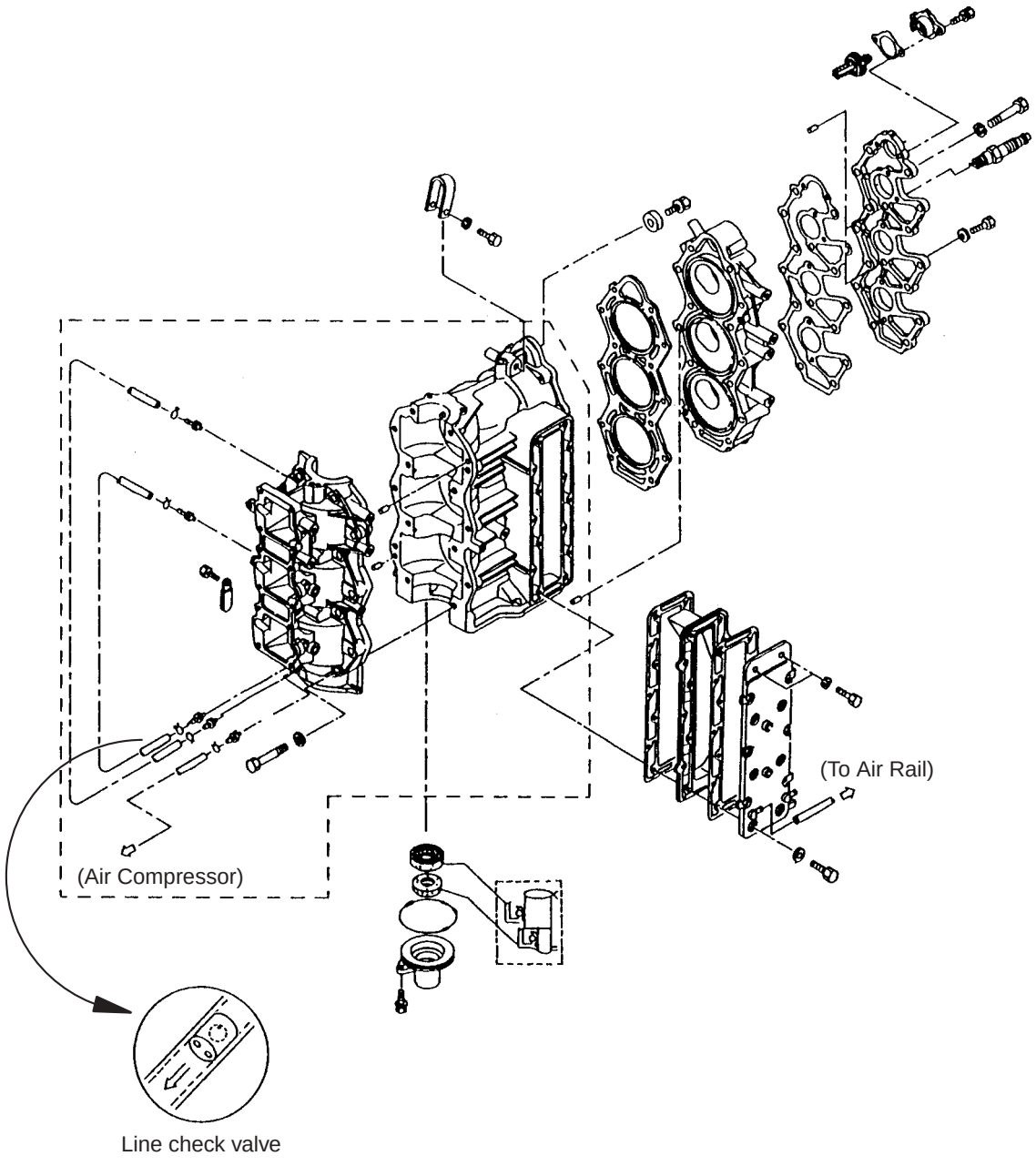
Assemble in the reverse order of disassembly.

⑦ Bolt: type H625 at 12 locations * Replace with new one.

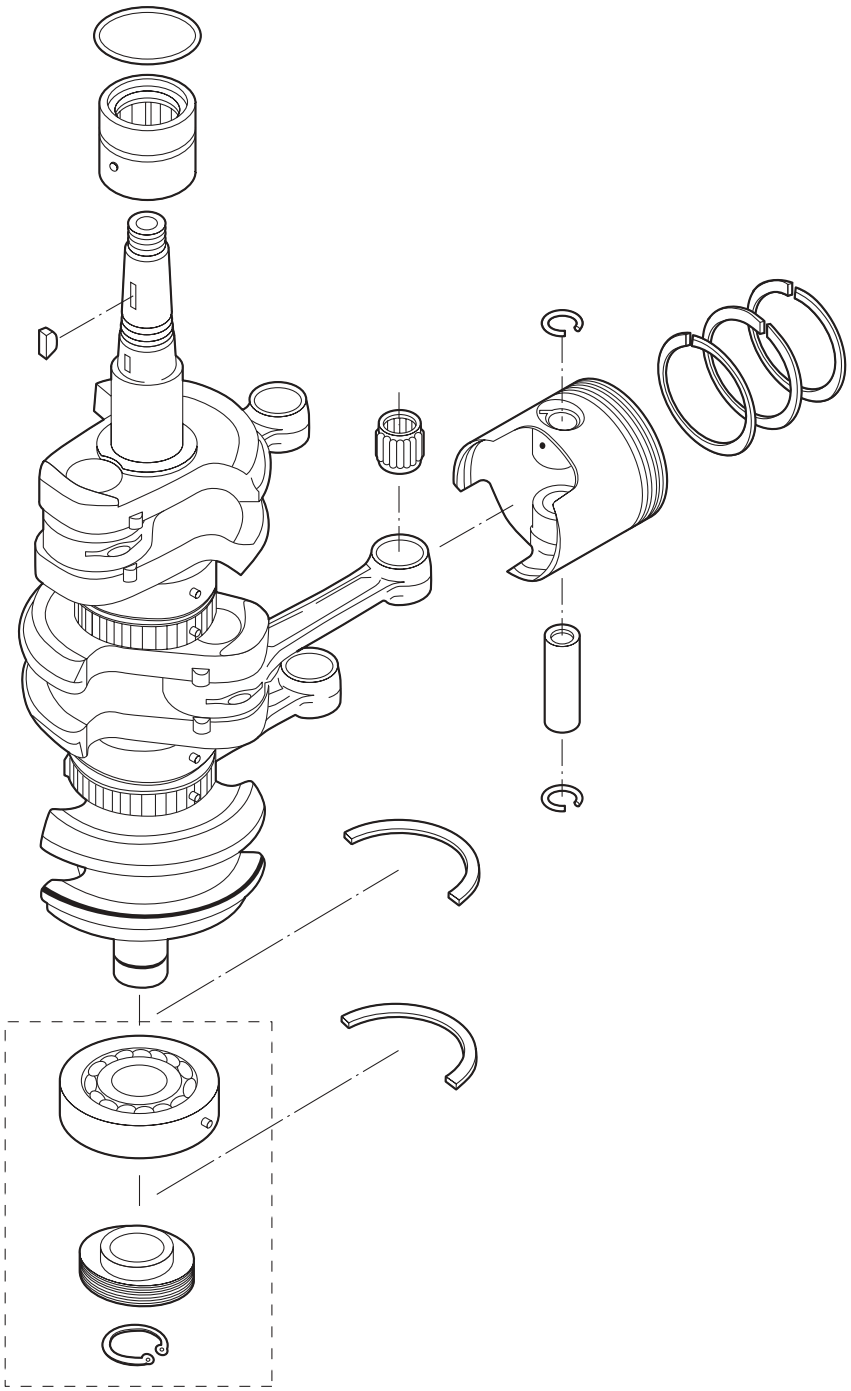


3. Disassembling Engine Block

Cylinder and Crankcase Assembly



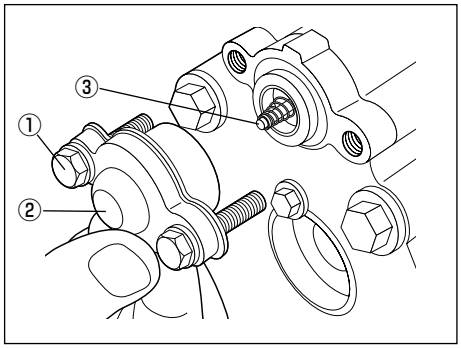
Piston and Crankshaft



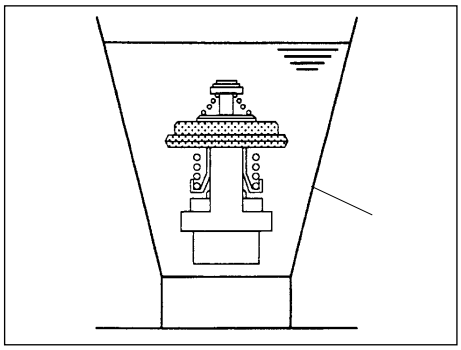
Removing Thermostat

Remove the following components.

① Bolt: type H625 at 2 locations
② Thermostat cap
③ Thermostat



Inspect the following components.



- Check to see whether foreign matter has entered valve.
- Confirm valve operates within designated temperature range.
- Valve opening temperature: 52°C ± 1.5°C
  : 126°F ± 3°F
- Valve closing temperature : 62°C ± 1.5°C
  : 149°F ± 3°F
- Valve full lift height: 3 mm (0.12 in) or more

Disassembling Cylinder Head and Head Cover

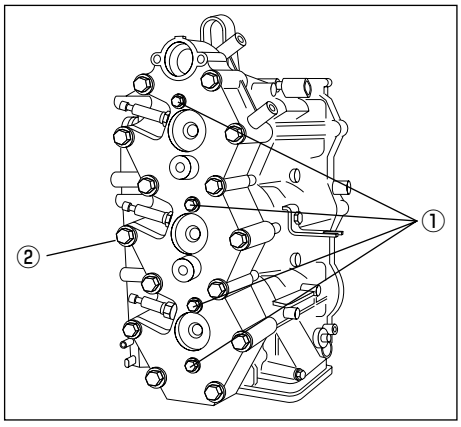
Remove the following components.

① Bolt: type H625 at 4 locations

Remove the 6 mm bolt first.

② Bolt: type H865 at 14 locations

When removing the 8 mm bolts, loosen in sequence starting from the highest embossed number.

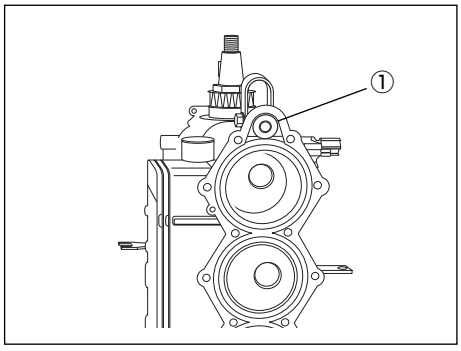


Inspecting Engine Anode

Inspect the following component.

① Engine anode

Replace when excessively worn.



Inspecting Cylinder Head

Inspect the following components.

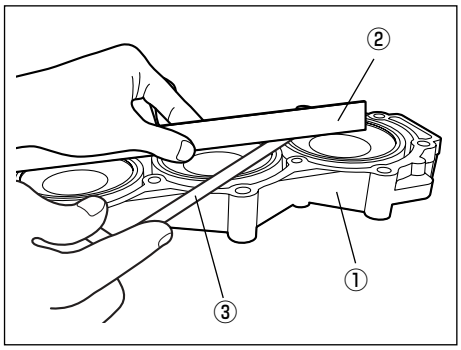
① Cylinder head

Inspecting:

Check for carbon deposit in combustion chamber.
Check for sediment in water jacket.

Inspecting:

- Use components ② and ③ to measure distortion.
- ② Straight gauge
- ③ Thickness gauge
- Maximum limit: 0.03 mm: 0.001 in



Cleaning:

- Clean using a scraper or brush.
- Take care not to scratch any surfaces that are being cleaned.

Adjustment:

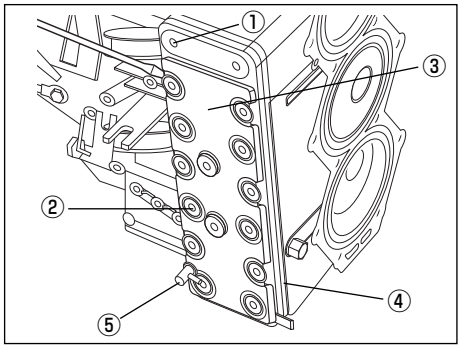
- If distortion exceeds limits, repair by polishing the surface plate using #240 to #400 sandpaper in a figure eight pattern.
- Once surface is repaired finish using #600 sandpaper.

Disassembling Exhaust Cover

Remove the following components.

① Bolt: type H630 at 2 locations

② Bolt: type H630 at 12 locations



Remove in order starting from the highest embossed number.

③ Outer exhaust cover

④ Inner exhaust cover

Remove by prying gently with a flathead screwdriver alternately along the 4 grooves on the sides of the cover. Prying too forcefully at only one groove may bend the cover.

Inspecting Exhaust Cover

Inspect the following components.

③ Outer exhaust cover

④ Inner exhaust cover

⑤ Cooling water nipple

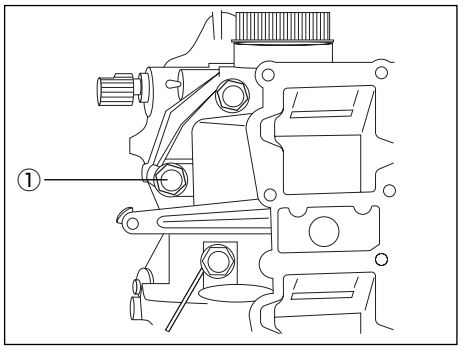
Inspecting

• Check for scratches and distortion on mating surfaces. • Check cooling water nipple and other passageways for clogging.

Disassembling Crankcase

Remove the following component.

① Crankcase bolt: type H845 at 14 locations



Remove in order starting from outer ones to inner ones diagonally or circularly.

Remove the following components.

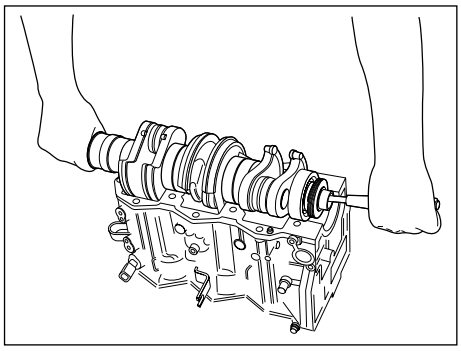
• Bolt: type H625 at 2 locations for lower head

• Lower head

• Crankcase

• Remove by prying gently along the grooves with a flathead screwdriver. • If the crankshaft is stuck to the crankcase, disengage by tapping lightly using a plastic hammer.

Remove the following component.
Crankshaft assembly

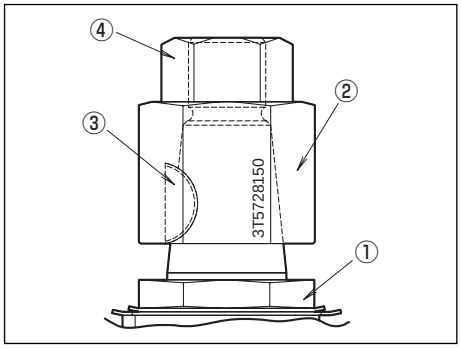


Disassembling Drive Pulley

Remove the following components.

① Pulley nut (36 mm)

Special tool	Crankshaft holder (36mm)
	3T5-72815-0



③ Magneto key

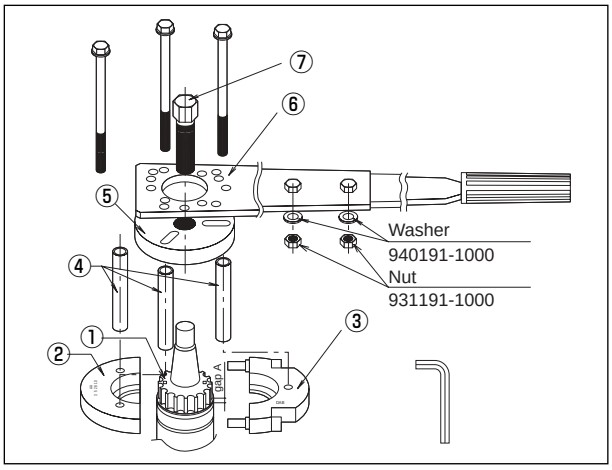
④ Magneto nut

- Install the magneto key on the crankshaft holder ② and secure using the magneto nut.
- Using two 36 mm wrenches, use one to secure the crankshaft holder and the other to loosen the pulley nut.
- After sufficiently loosening the pulley nut remove the key; then remove the pulley nut.

Remove the following components.

① Drive pulley

Special tool	Drive pulley puller assembly
	3T5-72890-0



- Install plates ② and ③ so that they enclose pulley; then install collars ④, ⑤ and ⑥.
- Apply grease to the tip and the thread area ⑦.
- Remove the pulley by tightening the bolt ⑦. (19 mm)

Removing Piston

Remove the following components.

• Piston pin clip at 2 locations

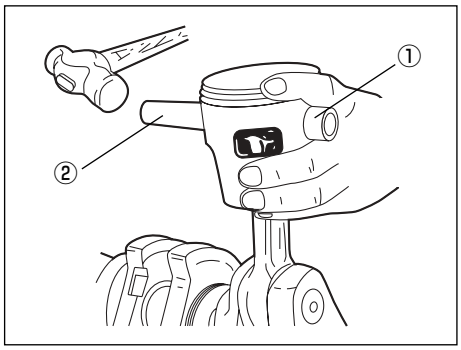
Remove both and take care not to scratch the pin hole.

Remove the following component.

② Piston pin

Special tool	② Piston pin tool
	345-72215-0

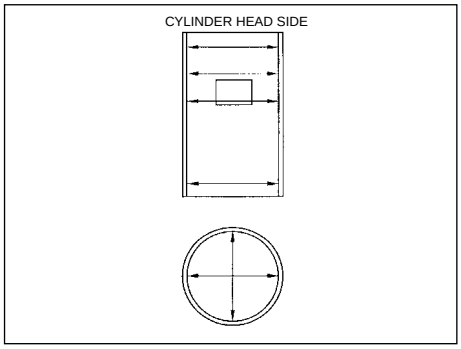
• Position ② against piston pin; then holding the opposite side by hand tap lightly on ② with a hammer to remove pin.
• Take care not to apply force to the connecting rod when using the hammer.



Inspecting Engine Components

Inspecting Cylinders

• Cylinder bore (using cylinder gauge)

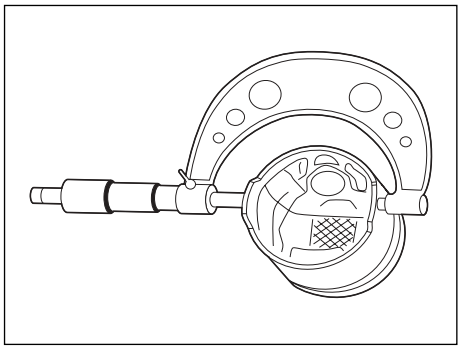


Standard value	Service limit
68.05 mm (2.679 in)	Replace when 68.11 mm (2.682 in) or more

- Measure the area showing the greatest wear.
- Also replace when difference between minimum and maximum cylinder bore is 0.06 mm (0.002 in) or more.

Inspecting Piston

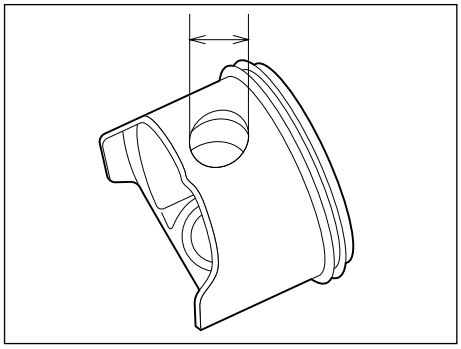
• Outer diameter of piston skirt (using micrometer)



Standard value	Service limit
67.96 mm (2.676 in)	Replace when 67.90 mm (2.673 in) or more

Measure at point 12 mm (0.47 in) from the bottom of the piston skirt.

• Piston clearance (between cylinder and piston)



Standard value	Service limit
0.08 to 0.12 mm (0.003 to 0.005 in)	Replace when 0.21 mm (0.008 in) or more

• Inner diameter of piston pin hole (using cylinder gauge)

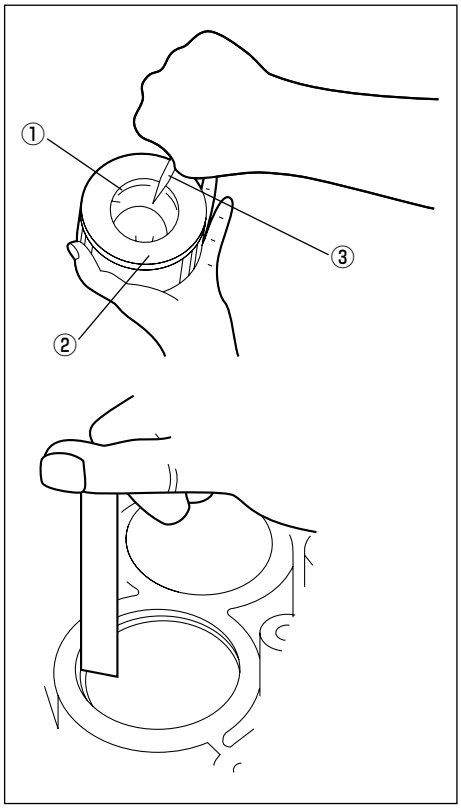
Standard value	Service limit
17.00 mm (0.67 in)	Depends on clearance with pin

• Clearance between piston pin and pin hole

Standard value	Service limit
Tight: 0.003 mm (0.00012 in)	Replace when 0.02 mm (0.0008 in) or more
Loose: 0.007 mm (0.00028 in)	

Inspecting Piston Rings

① Piston ring
② Ring gauge
③ Thickness gauge



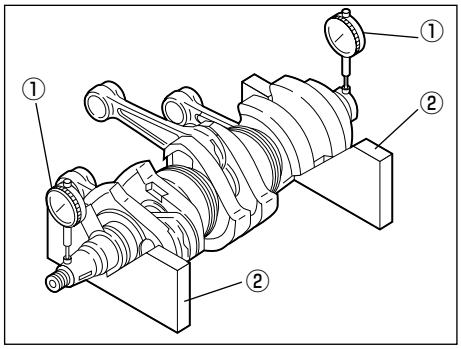
• Piston ring end gap

Ring	Standard value	Service limit
Top	0.22 to 0.37 mm (0.009 to 0.015 in)	Replace when 0.8 mm (0.032 in) or more
2nd, 3rd	0.33 to 0.48 mm (0.013 to 0.019 in)	Replace when 0.9 mm (0.035 in) or more

• Pressing the ring on the piston crown, place in ring gauge.
• Use cylinder when ring gauge is not available.

Inspecting Crankshaft

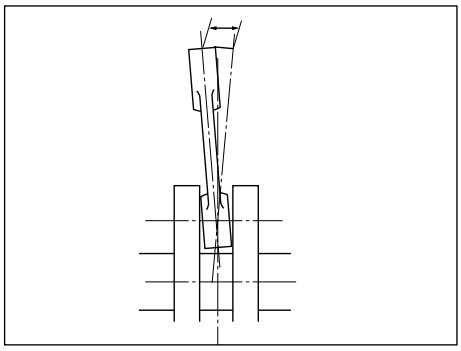
① Dial gauge
② V block



• Crankshaft run-out

Standard value	Service limit
Within 0.05 mm (0.002 in)	Replace when 0.05 mm (0.002 in) or more

• Connecting rod deflection



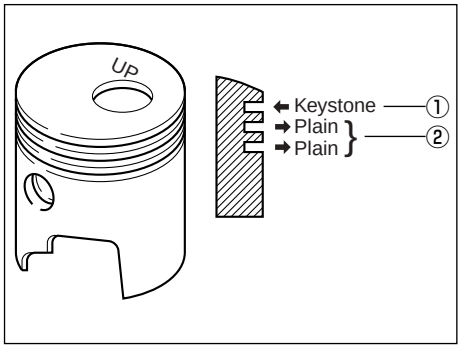
Standard value	Service limit
Within 2 mm (0.08 in)	Replace when 2 mm (0.08 in) or more

Assembling Piston

Assemble the following components.

① Top ring (Keystone ring: 1T)

② 2nd and 3rd rings (plain rings: stamped 2T)



Special tool	Piston ring tool
	353-72249-0

- Install starting from the 3rd ring.
- Install with the stamped mark facing upwards.
- Line up piston ring end gap with knock pin.

Assemble the following component.

- Piston pin clip

- Install only on one side first prior to installing piston pin.
- Always use a new piston pin clip.
- The piston pin clip gap should face in the opposite direction of groove.

Assemble the following components.

- Small end bearing
- Piston
- Piston pin
- Piston pin clip

Special tool	Piston pin tool
	345-72215-0

- Apply engine oil to the pin hole and small end bearing.
- Position piston to connecting rod; then place piston pin tool against pin and tap lightly with a hammer to install.
- After installation, install the other piston pin clip.

Assembling Short Block

Assemble in reverse order of disassembly.

Apply genuine engine oil to the following parts.

- Big end of connecting rod
- Small end of connecting rod and pin boss oil hole
- Main bearing
- Piston ring and entire circumference of piston
- Entire surface of cylinder bore
- Upper bearing O-ring

Line up piston ring end gap with knock pin.

Assembling Crankshaft

Desrease the surface of the crankcase

Assemble the crankshaft and the cylinder using the following procedures.

Points to Note:

Make sure that all pistons are positioned perpendicularly; then insert piston in perpendicular direction using gentle jiggling motion.
Make sure pistons are not twisted in horizontal direction.

Take the following steps prior to completing assembly of the crankshaft.

• Install thrust plates at 2 locations.

• Line up the bearing knock position.

Insert in groove on mating surface.

• Lining up position of upper bearing

Line up of the knock holes on the upper bearing with the knock pins on the journal of the cylinder.

Gently move the upper bearing to confirm it is correctly positioned on the knock pins.

Assembling Crankcase

Degrease the mating surface of the crankcase.

Caution:

Insufficient degreasing will render sealant less effective, resulting in oil leakage.

Apply sealant evenly over the mating surface on the cylinder.
Sealant: Loctite #518

Apply evenly inside the bolt holes so that there are no bare patches. Be careful not to apply too much.

Tap in knock pins at 2 locations on the cylinder; then install crankcase.

Install by tapping with a plastic hammer to ensure that there is an even clearance across the mating face.

Install the crankcase bolts.

Tighten bolts in the proper order.

M8 partial torque	: 12 to 15 N-m: 1.2 to 1.5 kg-m : 9 to 11 lb-ft
M8 full torque	: 24 to 26 N-m: 2.4 to 2.6 kg-m : 17 to 19 lb-ft

Assembling Cylinder Head

Degrease all mating surfaces on cylinder, cylinder head and head cover.

Install the following components.

- Anode
- Knock pins at 2 locations
- Head gasket * Replace with new one.
- Cylinder head
- Head cover gasket * Replace with new one.
- Head cover
- Washer
- Bolt

Tighten in two stages in the order of the embossed numbers.	
M6 partial torque	: 2.0 to 2.9 N-m: 0.2 to 0.3 kg-m : 1.5 to 2.1 lb-ft
M6 full torque	: 4.6 to 6.3 N-m: 0.4 to 0.6 kg-m : 2.9 to 4.3 lb-ft
M8 partial torque	: 12 to 15 N-m: 1.2 to 1.5 kg-m : 8.7 to 10.9 lb-ft
M8 full torque	: 29 to 34 N-m: 3.0 to 3.5 kg-m : 22 to 25 lb-ft

Install the following components.

- Thermostat
- Thermostat cap gasket * | Replace with new one.
- Thermostat cap
- Bolt: at 2 locations
- Bolt: at 4 locations

Torque : 4.6 to 6.3 N-m: 0.47 to 0.64 kg-m : 3.4 to 4.6 Ib-ft

Caution:

Be sure to tighten M6 bolts only after tightening the M8 bolts on the head cover. Never tighten the M6 bolts first.

Assembling Exhaust Cover

Clean away any dirt or foreign matter on the mating surfaces of the cylinder and inner and outer exhaust covers; then degrease.

Assemble the following components.

- Exhaust cover gasket * | Replace with new one.
- Inner exhaust cover
- Exhaust cover gaske * | Replace with new one.
- Outer exhaust cover
- Fuel filter band
- Washers: at 14 locations
- Bolt: type H625 at 14 locations

Tighten in the order of the embossed numbers.
Partial torque: 3.9 to 5.9 N-m: 0.4 to 0.6 kg-m : 2.9 to 4.3 Ib-ft Full torque : 7.8 to 9.8 N-m: 0.8 to 1.0 kg-m : 5.8 to 7.2 Ib-ft

Installing Recirculator Hose

Install the following components.

- Lubrication pipe
- Lubrication pipe
- Hose clips: at 4 locations

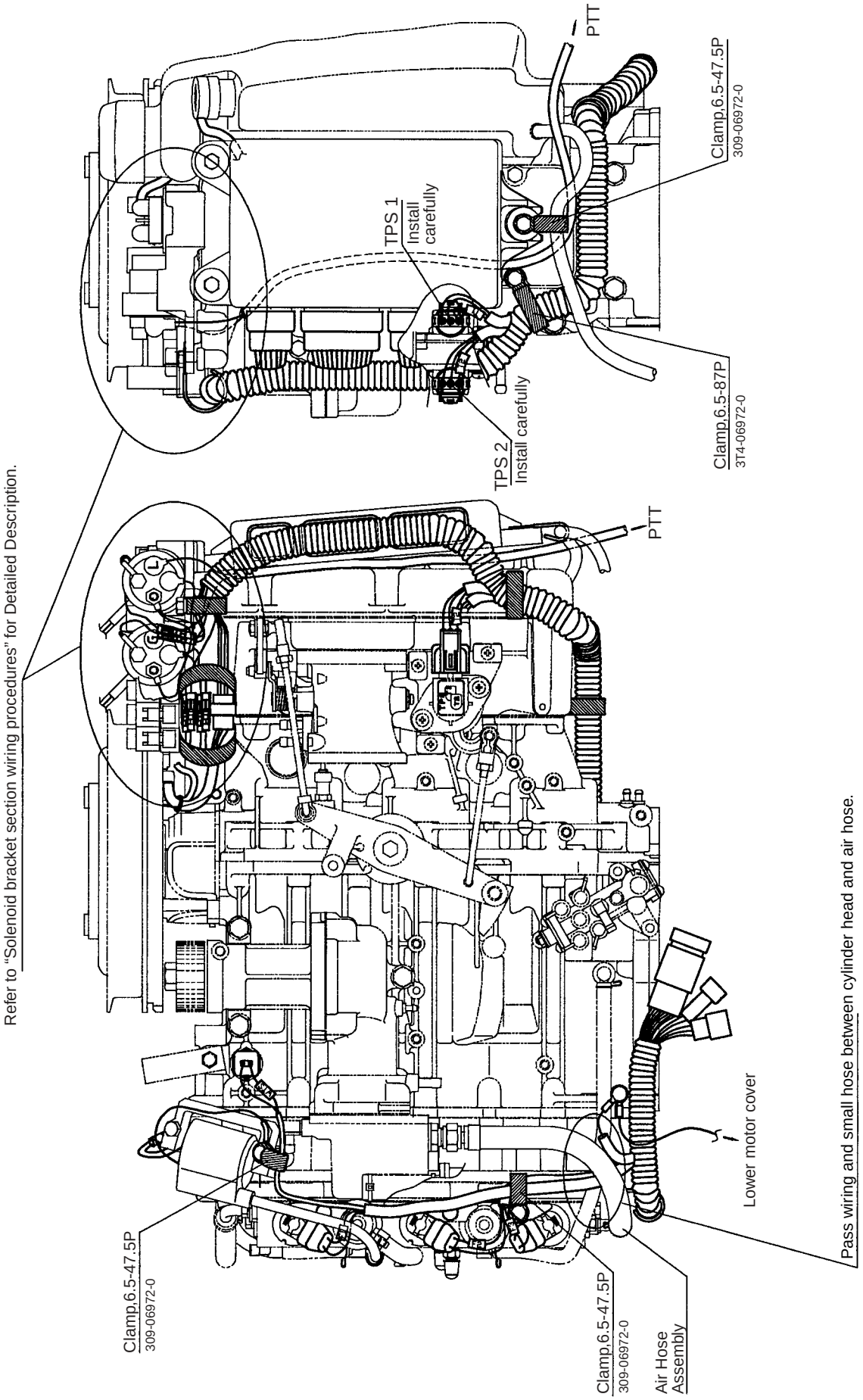
Caution:

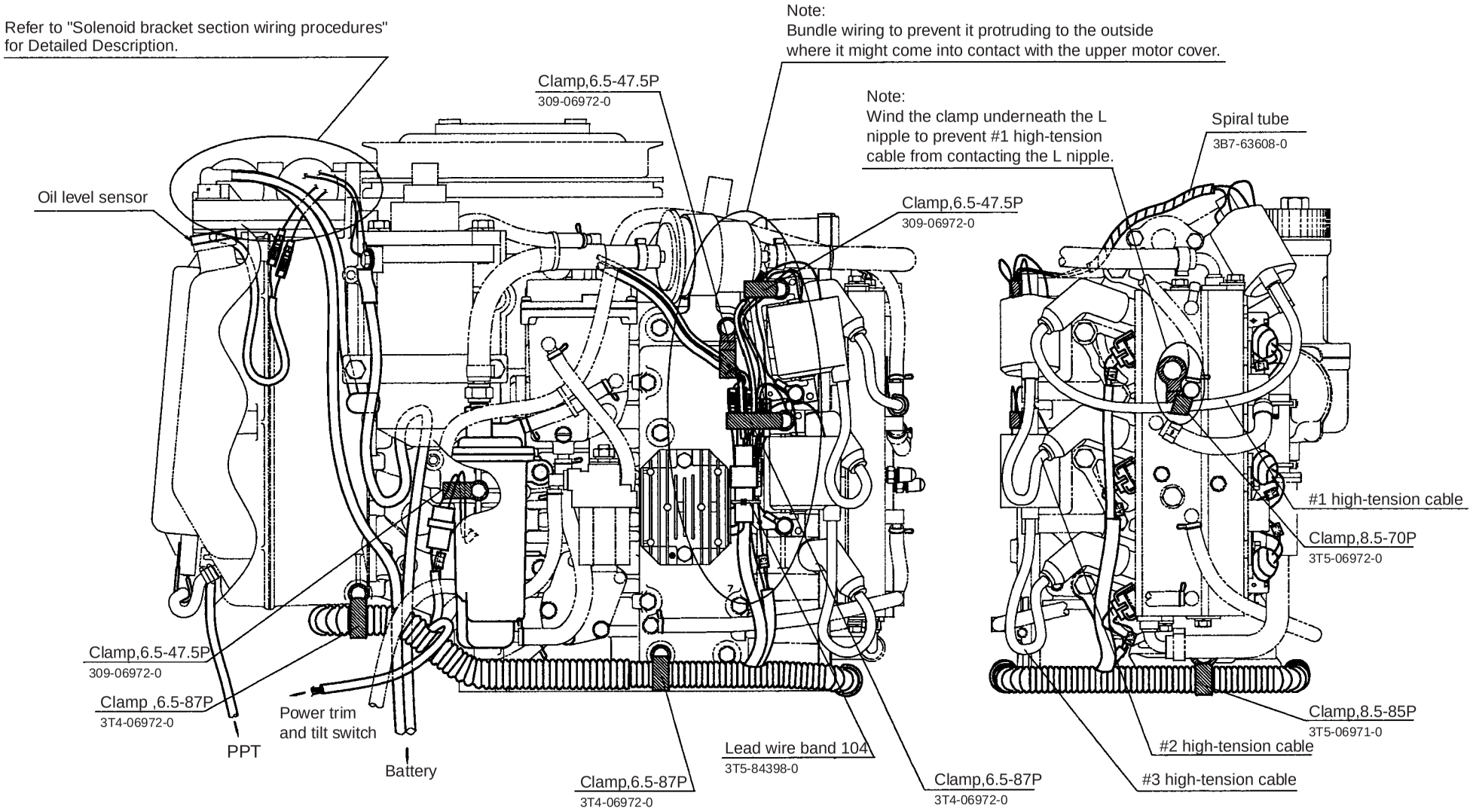
Insure proper installation of the check valve inside the hose.

Chapter 5 Installing and Inspecting Electrical Components

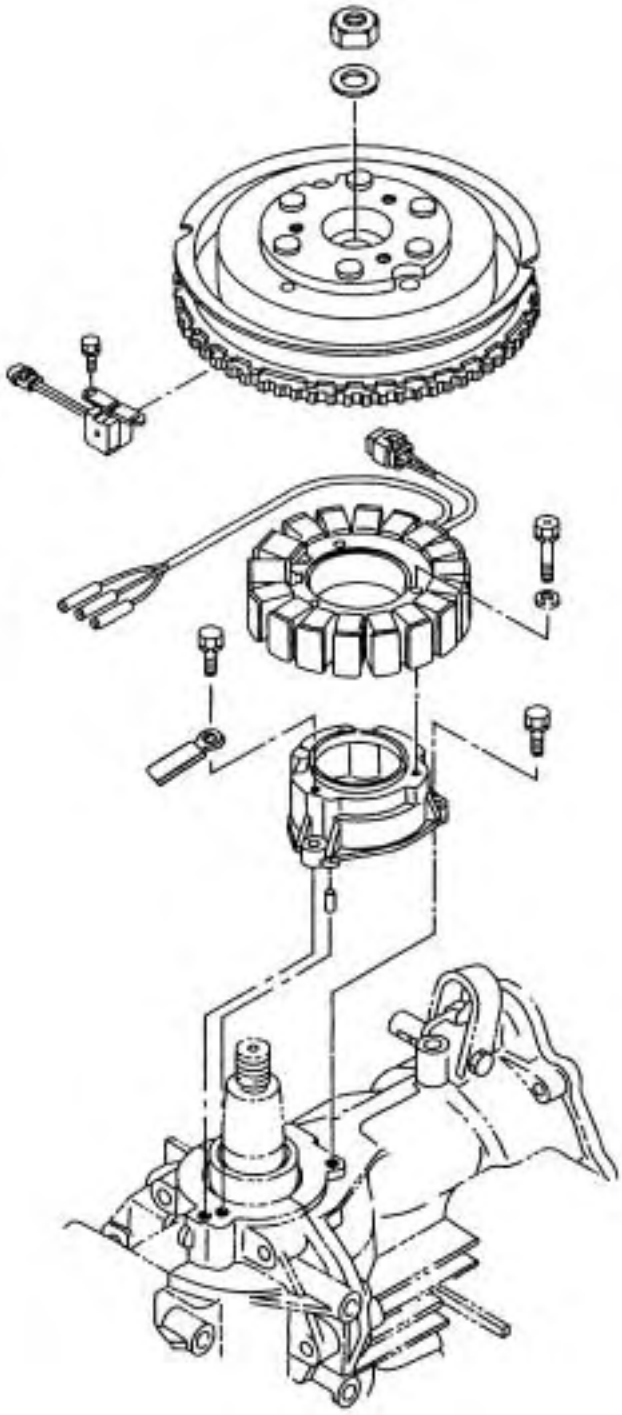
1. **Wire Routing.....5-2**
2. **Wiring Diagram 5-8**
3. **Assembly.....5-17**
4. **Inspection.....5-22**

1. Wire Routing

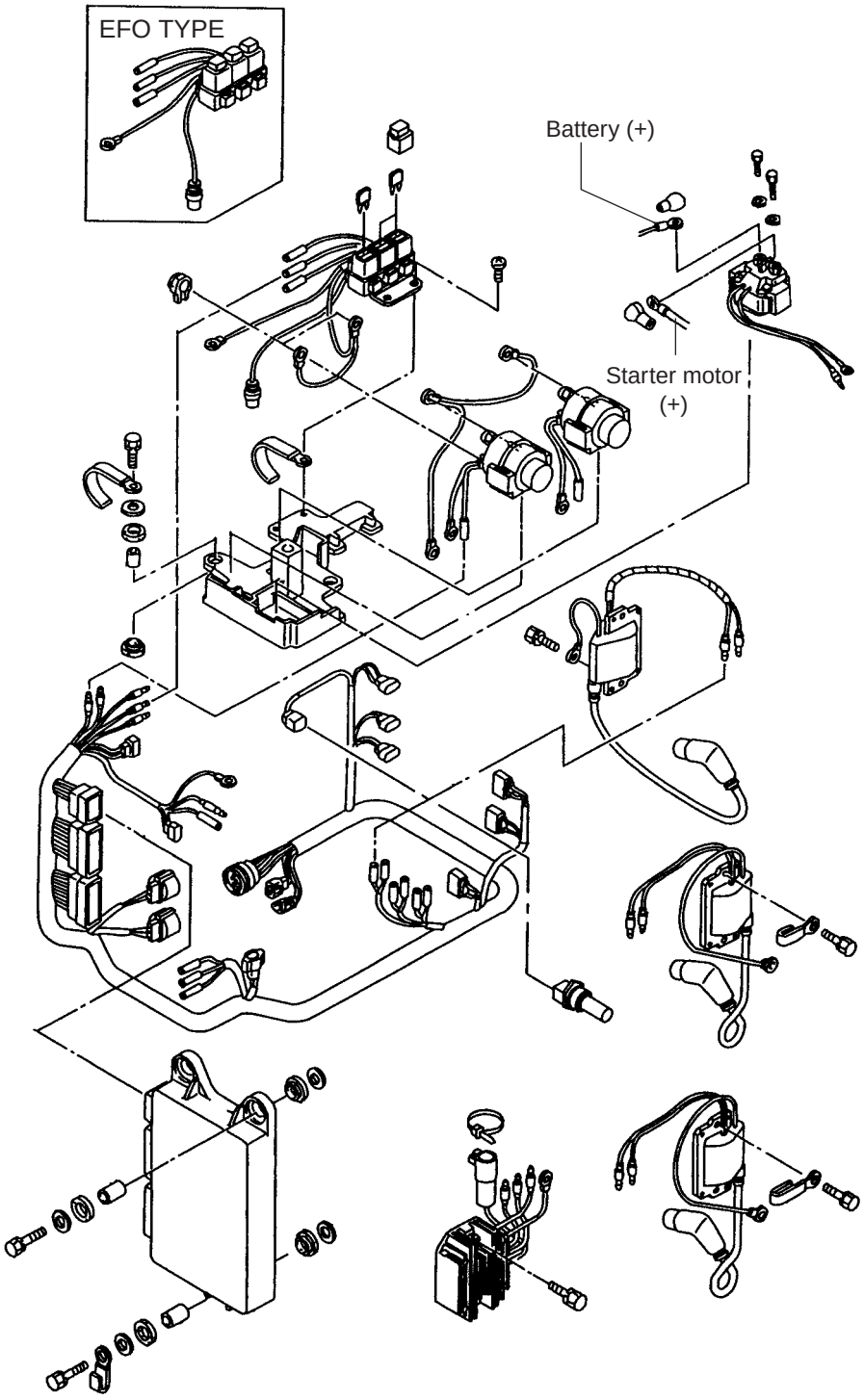



Refer to "Solenoid bracket section wiring procedures" for Detailed Description.
Note:
Bundle wiring to prevent it protruding to the outside where it might come into contact with the upper motor cover.
Clamp,6.5-47.5P
309-06972-0
Note:
Wind the clamp underneath the L nipple to prevent #1 high-tension cable from contacting the L nipple.
Spiral tube
3B7-63608-0
Oil level sensor
Clamp,6.5-47.5P
309-06972-0
#1 high-tension cable
Clamp,8.5-70P
3T5-06972-0
Clamp,6.5-47.5P
309-06972-0
Clamp ,6.5-87P
3T4-06972-0
Power trim and tilt switch
PPT
Battery
Clamp,6.5-87P
3T4-06972-0
Lead wire band 104
3T5-84398-0
Clamp,6.5-87P
3T4-06972-0
Clamp,8.5-85P
3T5-06971-0
#2 high-tension cable
#3 high-tension cable

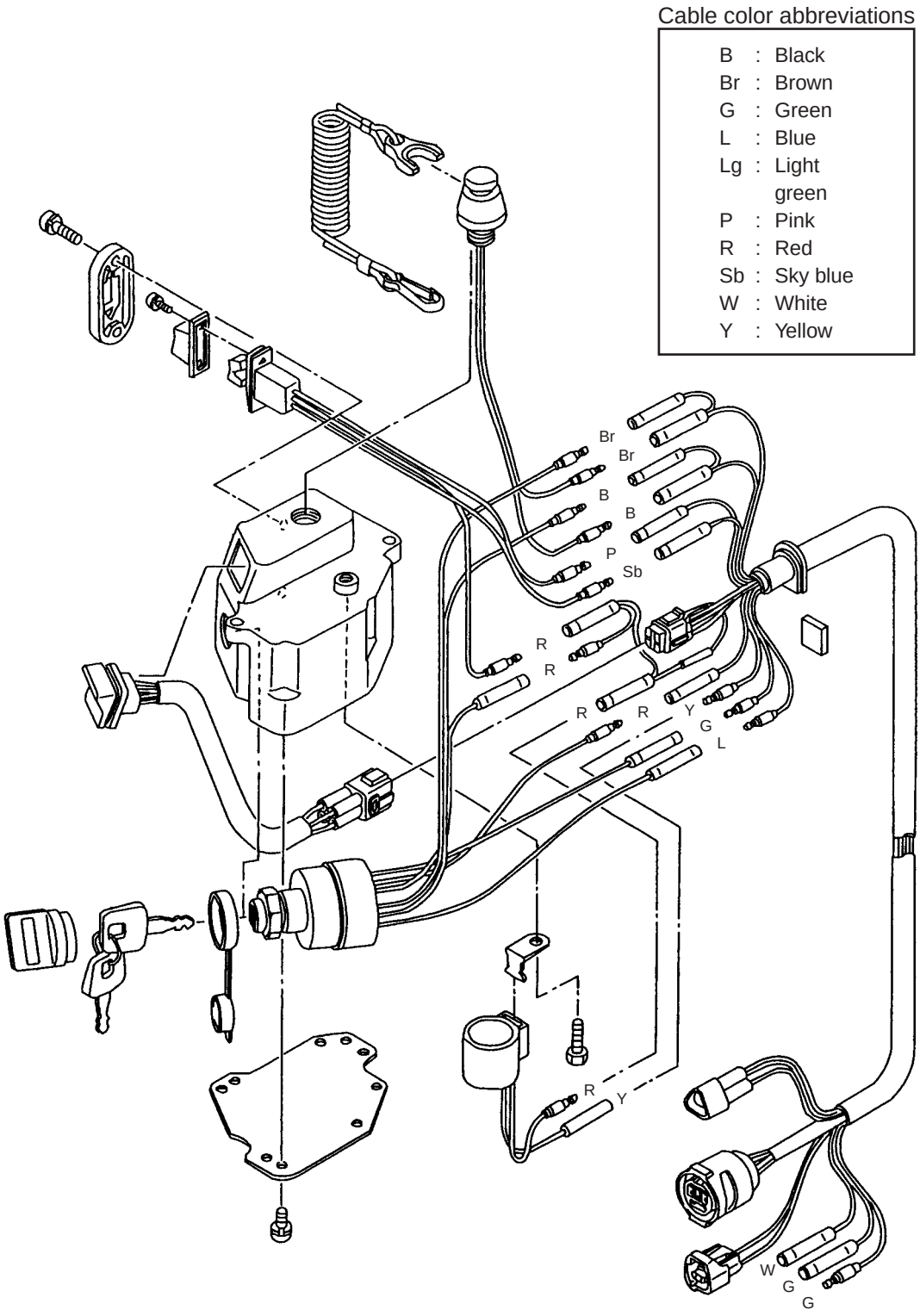
MAGNETO



ELECTRIC PARTS

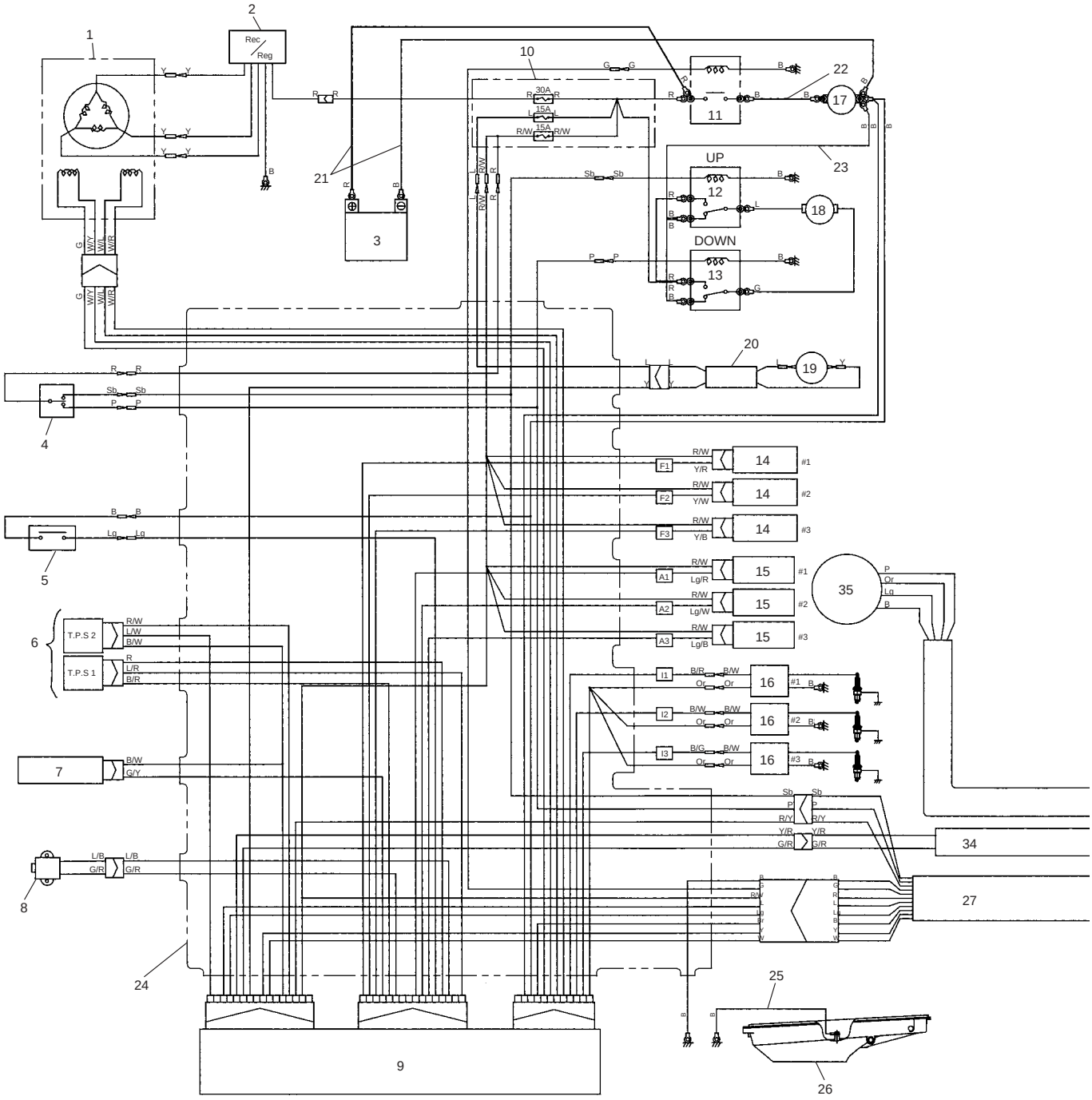


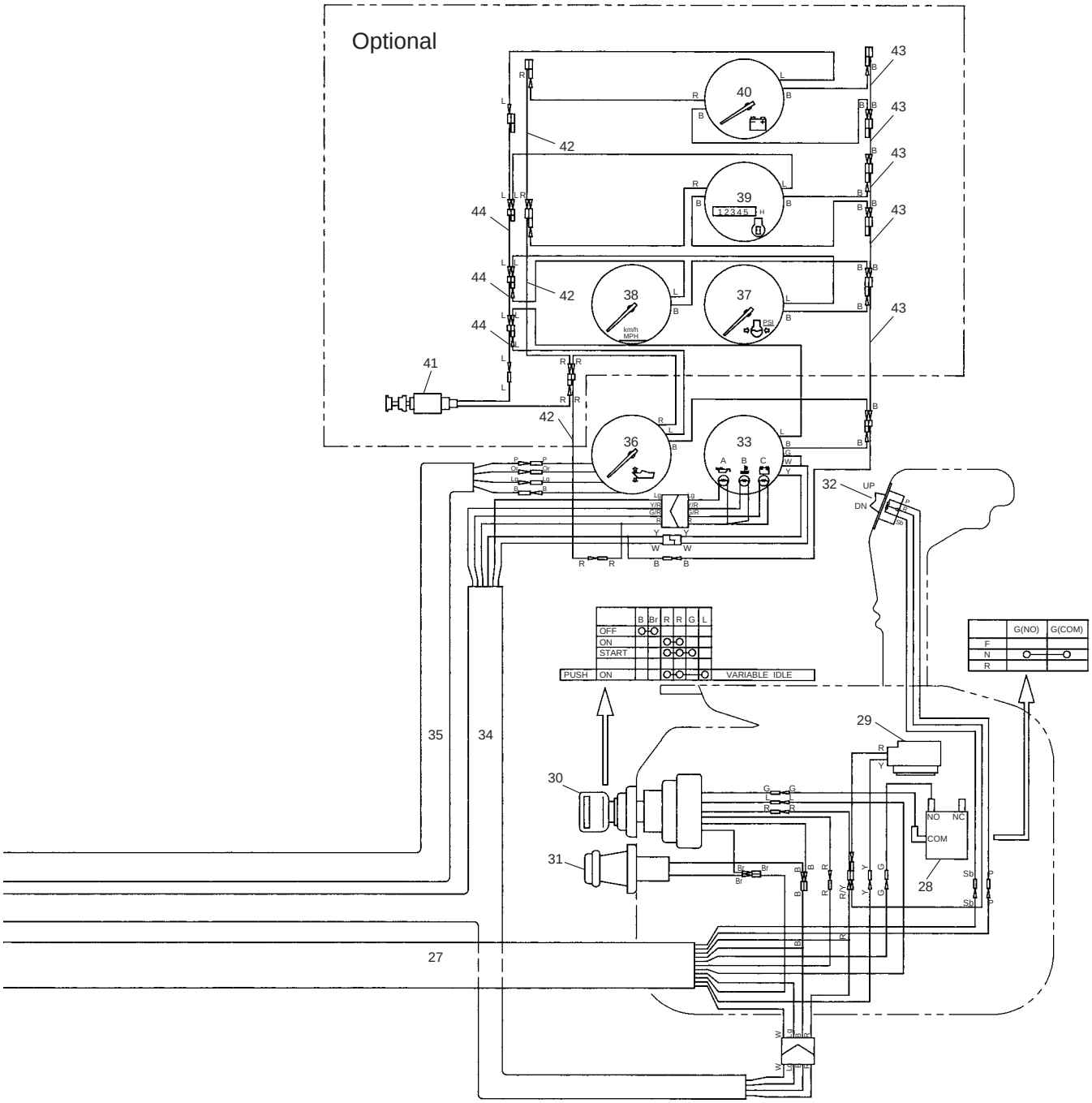
SWITCH BOX (F Type)



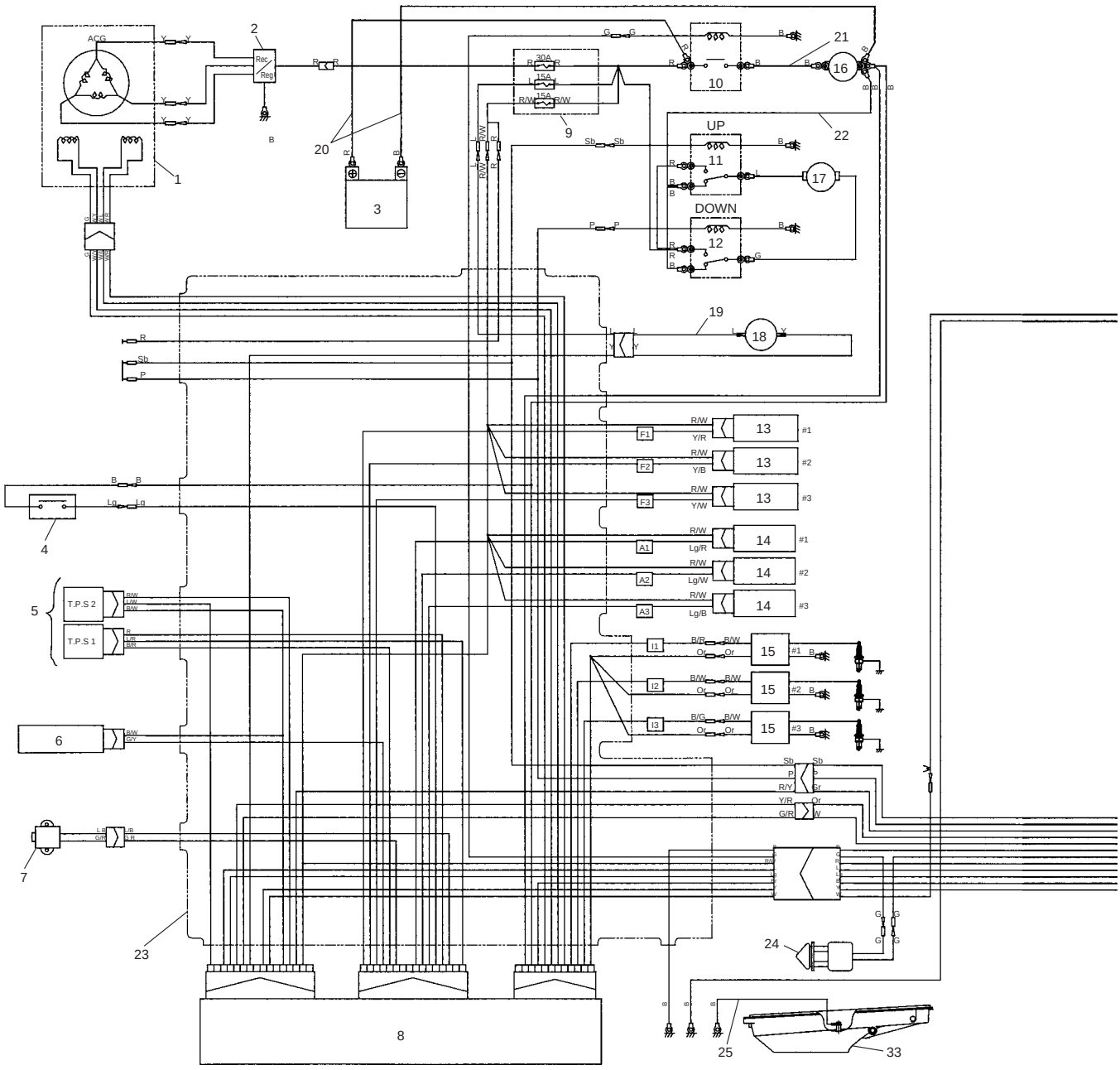
2. Wiring Diagram

EPTO




Optional
40
39
38
37
36
33
42
43
44
41
32
UP
DN
OFF
ON
START
PUSH
VARIABLE IDLE
G(NO)
G(COM)
F
N
R
29
30
31
28
NO
NC
COM
35
34
27

EFTO


ACG
Rec
Reg
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15A
15A
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DOWN
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T.P.S 1
F1
F2
F3
A1
A2
A3
I1
I2
I3
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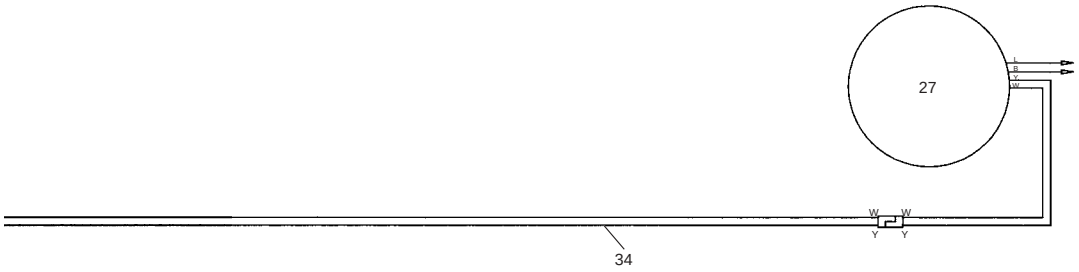
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B
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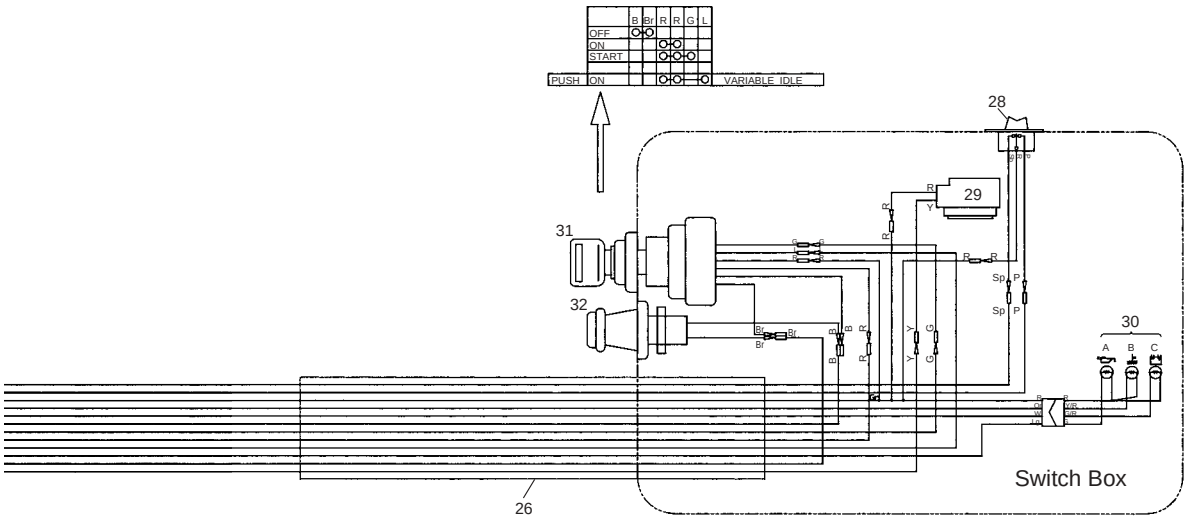
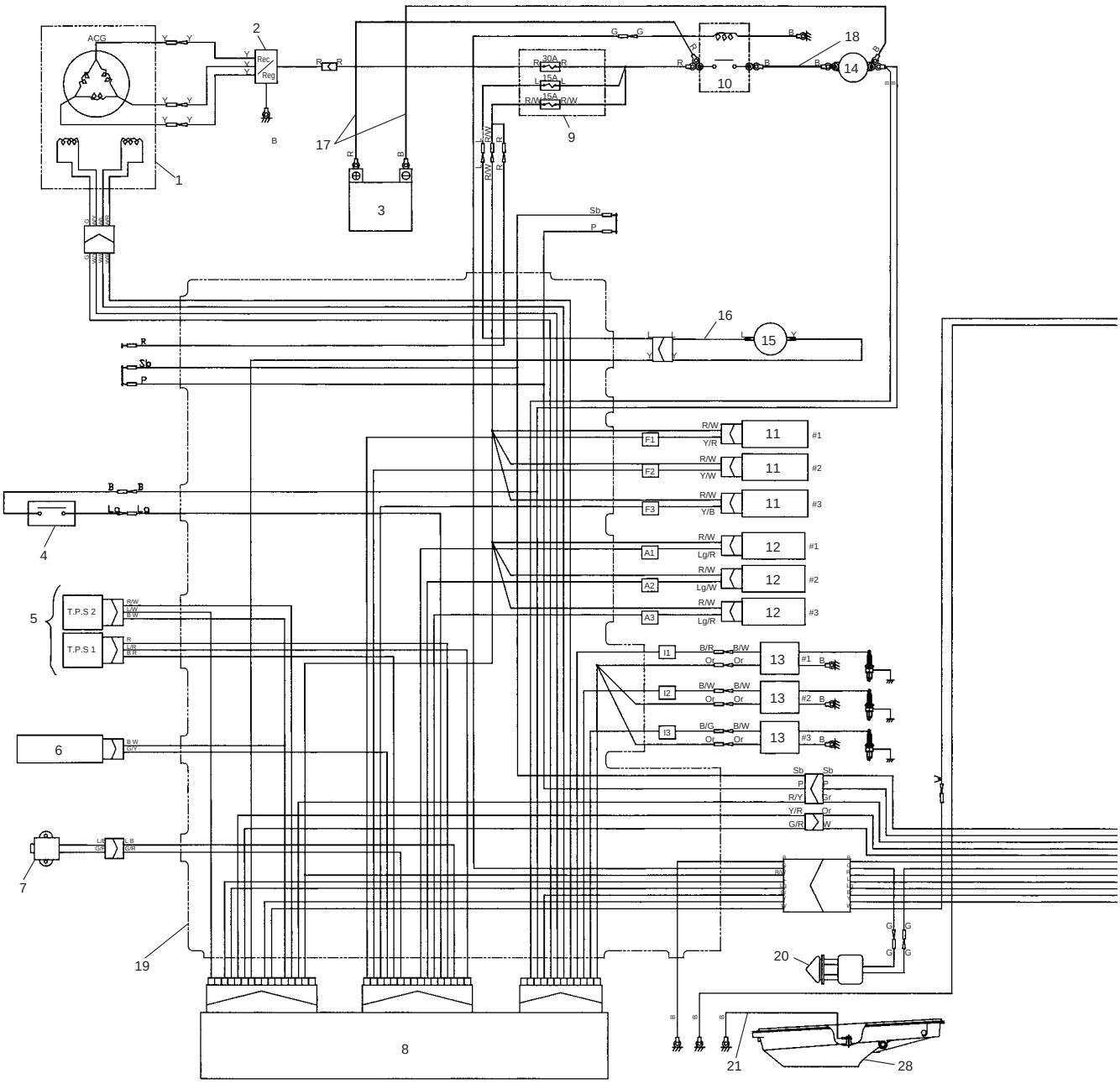

B Br R R G L
OFF
ON
START
PUSH ON
VARIABLE IDLE
28
29
31
32
30
A
B
C
Sp
P
Switch Box
26

EFO


ACG
Rec
Reg
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15A
15A
T.P.S 2
T.P.S 1
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11
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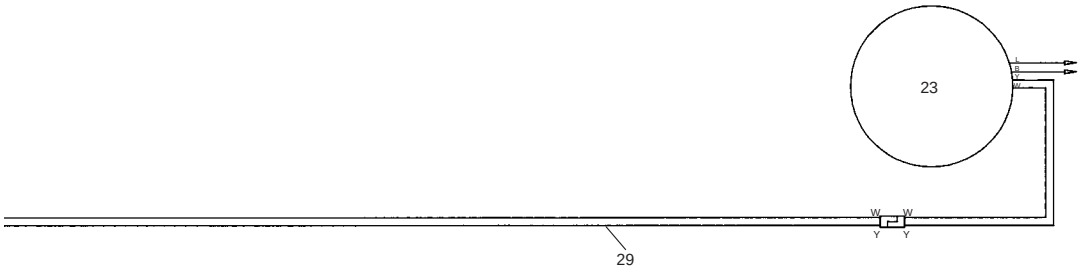
F2
F3
A1
A2
A3
I1
I2
I3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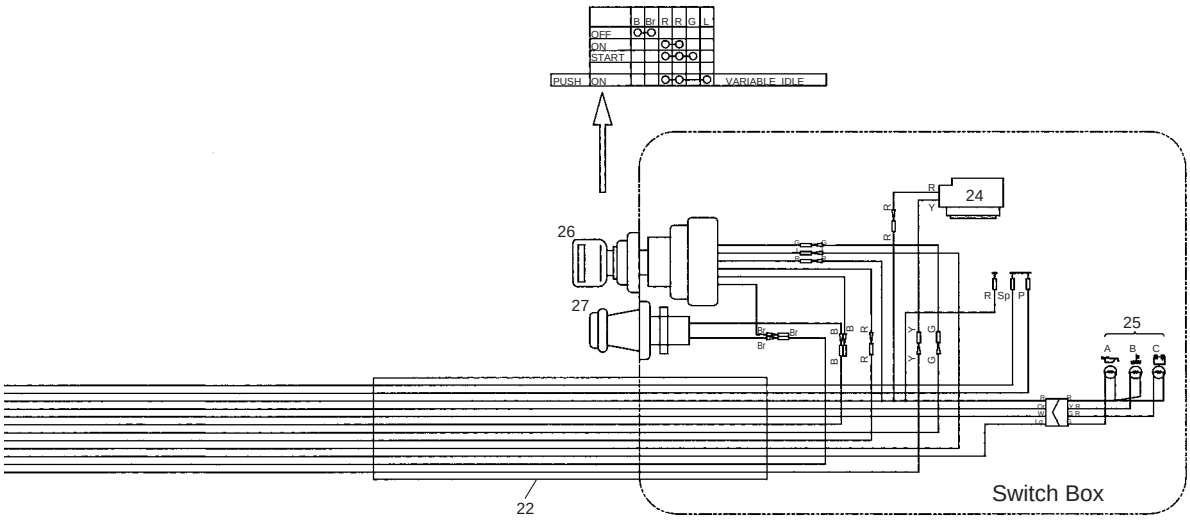
29


B Br R R G L
OFF
ON
START
PUSH ON
VARIABLE IDLE
24
26
27
25
A B C
R Sp P
Switch Box
22

EPTO

NO.	Component	NO.	Component
1	Alternator assembly	23	Ground cable
2	Rectifier complete	24	Cable assembly A
3	Battery (obtain locally)	25	Ground cable
4	PT&T switch B	26	Lower motor cover
5	Oil level sensor	27	Cable assembly B
6	Throttle position sensor	28	Neutral switch
7	Water temperature sensor	29	Beeper (Buzzer)
8	Crank position sensor	30	Main switch
9	ECU	31	Lanyard stop switch
10	Fuse holder assembly	32	PT&T switch
11	Starter solenoid	33	Tachometer
12	PT&T solenoid switch A	34	Meter lead wire
13	PT&T solenoid switch B	35	Trim sender
14	Fuel injector	36	Trim meter
15	Air injector	37	Water pressure meter
16	Ignition coil	38	Speedometer
17	Starter motor	39	Hour meter
18	PT&T	40	Voltmeter
19	FFP	41	Meter light switch
20	FFP cable	42	Assist cable, red
21	Battery cable	43	Assist cable, black
22	Starter cable	44	Assist cable, blue

* PT and T: abbreviation for power trim and tilt.

Cable color abbreviations

B	black
Br	brown
G	green
L	blue
Lg	light green
Or	orange
P	pink
R	red
Sb	sky blue
W	white
Y	yellow
Gr	gray

EFTO

NO.	Component	NO.	Component
1	Alternator assembly	18	FFP
2	Rectifier complete	19	FFP cable
3	Battery (obtain locally)	20	Battery cable
4	Oil level sensor	21	Starter cable
5	Throttle position sensor	22	Ground cable
6	Water temperature sensor	23	Cable assembly A
7	Crank position sensor	24	Neutral switch
8	ECU	25	Ground cable
9	Fuse holder assembly	26	Cable assembly C
10	Starter solenoid	27	Tachometer
11	PT&T solenoid switch A	28	PT&T switch
12	PT&T solenoid switch B	29	Beeper (Buzzer)
13	Fuel injector	30	Light assembly
14	Air injector	31	Main switch
15	Ignition coil	32	Lanyard stop switch
16	Starter motor	33	Lower motor cover
17	PT&T	34	Meter lead wire

* PT & T: abbreviation for power trim and tilt.

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Y	yellow
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EFO

NO.	Component	NO.	Component
1	Alternator assembly	16	FFP cable
2	Rectifier complete	17	Battery cable
3	Battery (obtain locally)	18	Starter cable
4	Oil level sensor	19	Cable assembly A
5	Throttle position sensor	20	Neutral switch
6	Water temperature sensor	21	Ground cable
7	Crank position sensor	22	Cable assembly C
8	ECU	23	Tachometer
9	Fuse holder assembly	24	Beeper (Buzzer)
10	Starter solenoid	25	Light assembly
11	Fuel injector	26	Main switch
12	Air injector	27	Lanyard stop switch
13	Ignition coil	28	Lower motor cover
14	Starter motor	29	Meter lead wire
15	FFP		

* PT and T: abbreviation for power trim and tilt.

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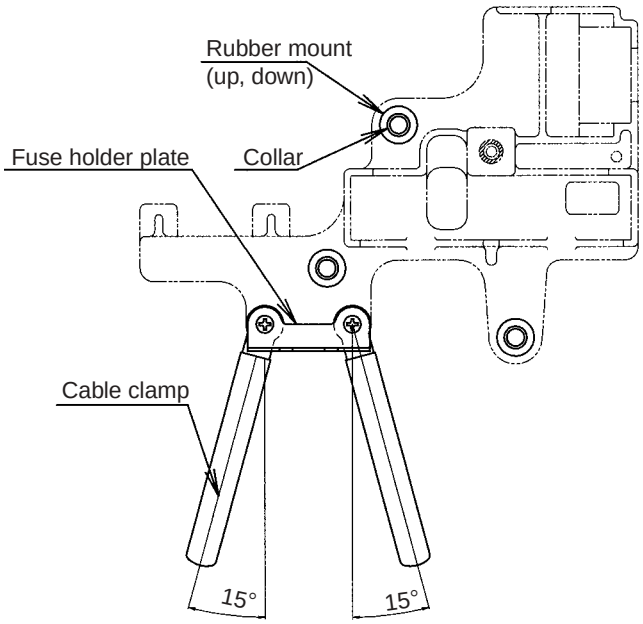
R	red
Sb	sky blue
W	white
Y	yellow
Gr	gray

3. Assembly

Solenoid Bracket

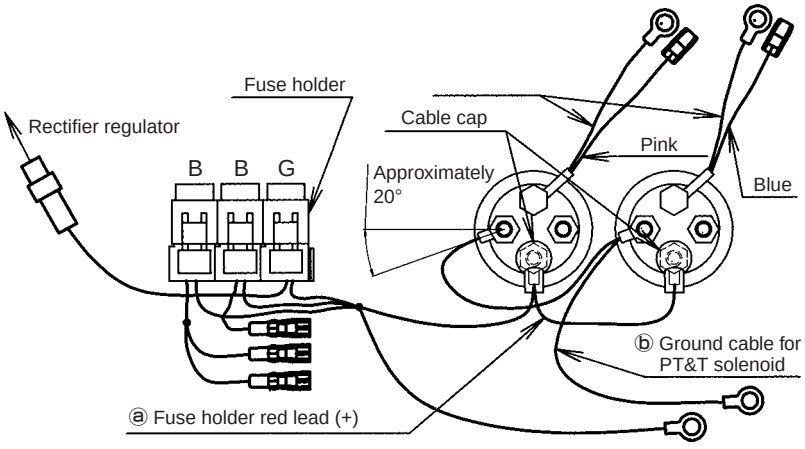
① Pre-Assembly step 1

Attach the cable clamp, fuse holder plate and rubber mount to the bracket.



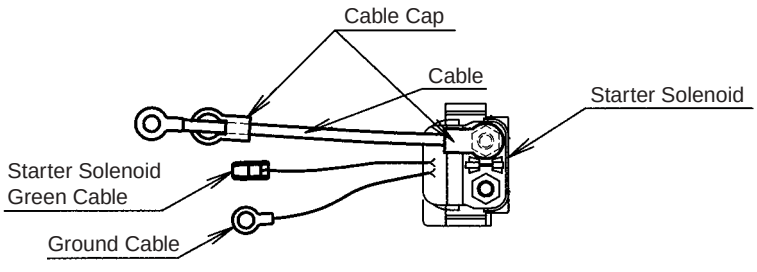
② Pre-Assembly Step 2

Attach the fuse holder red lead (+) ⓐ to the PT&T solenoids and put on the cable caps.
Attach the ground cable ⓑ to the PT&T solenoids.



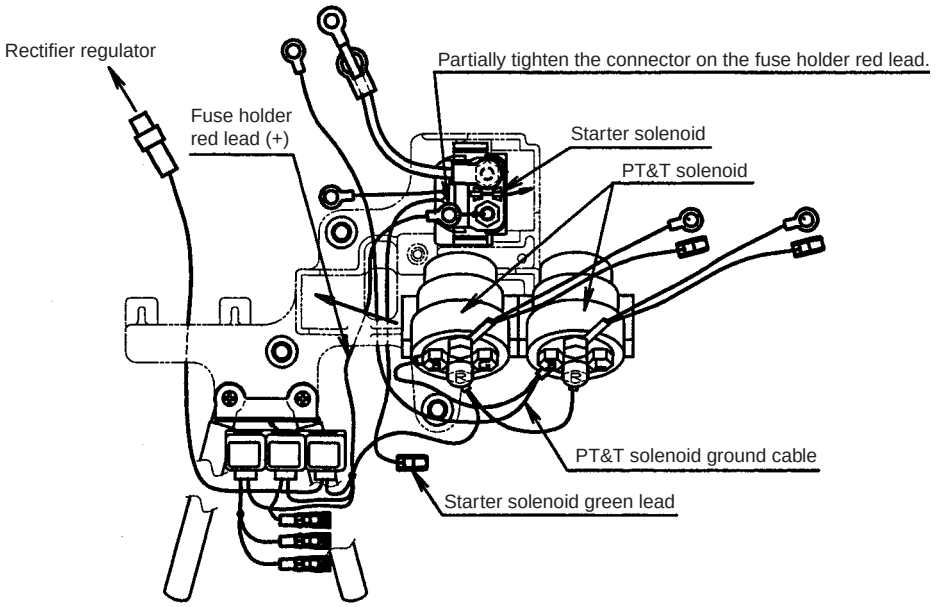
③ Pre-Assembly Step 3

Attach the cable to the starter solenoid and put on the cable caps.

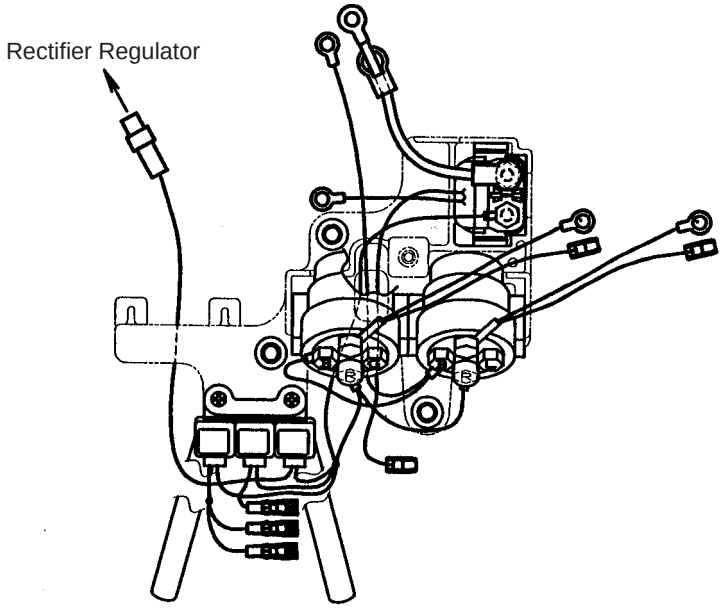


④ Pre-Assembly Step 4

Past the fuse holder red lead (+),PT&T solenoid ground cable and starter solenoid green lead through the hole in the center of the solenoid bracket; then install the starter solenoid, power trim and tilt solenoid and fuse holder.



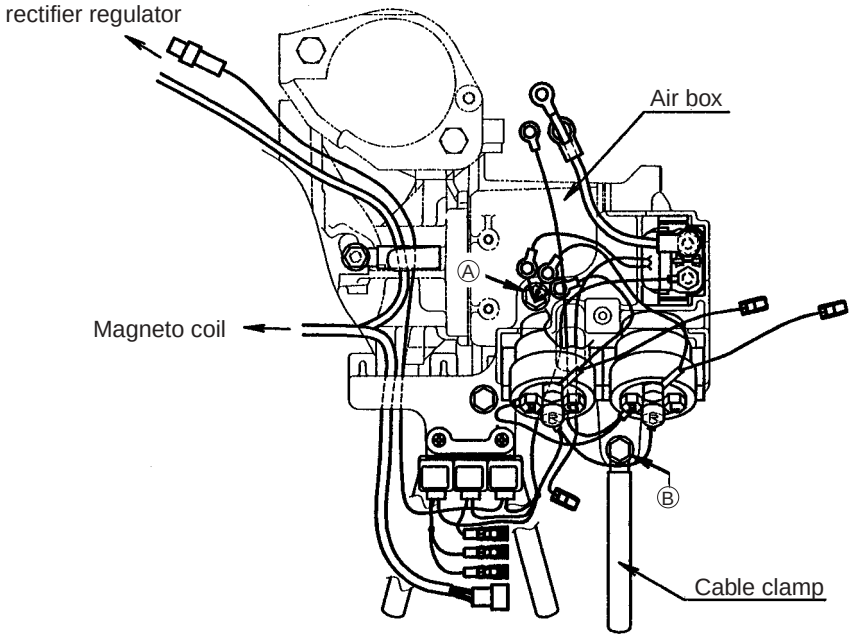
⑤ Completed Pre-Assembly



⑥ Assembly Step 1

Install bracket on air box.

When installing bracket be sure to install starter solenoid and PT&T solenoid ground cables on bolt Ⓐ and the cable clamp on bolt Ⓑ.

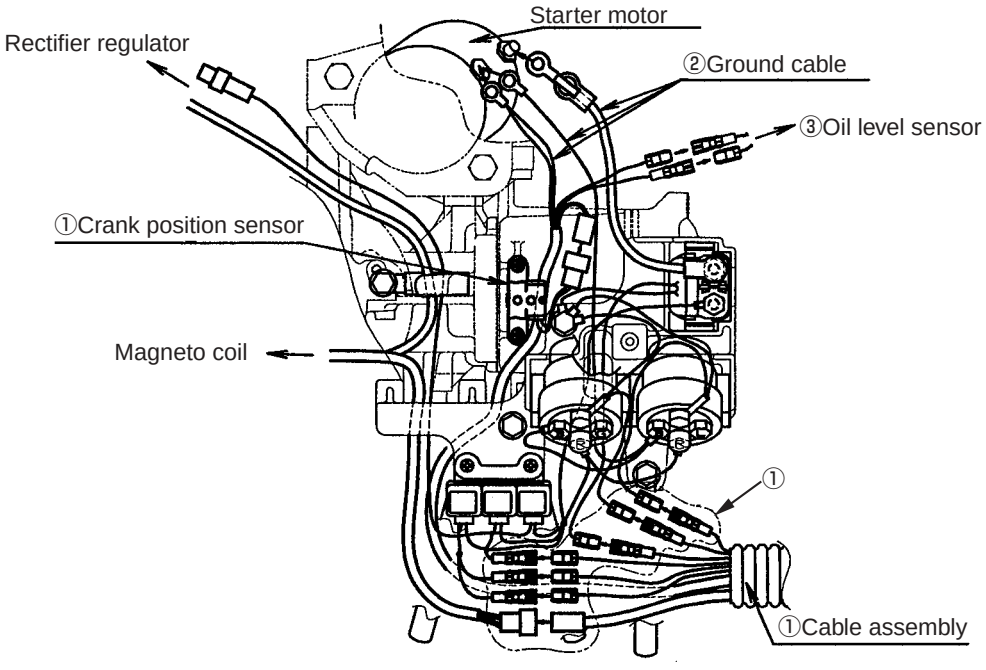


⑦ Assembly Step 2

① Install the crank position sensor and cable assembly sensor and connect wiring.

② Connect the three ground cables to the starter motor.

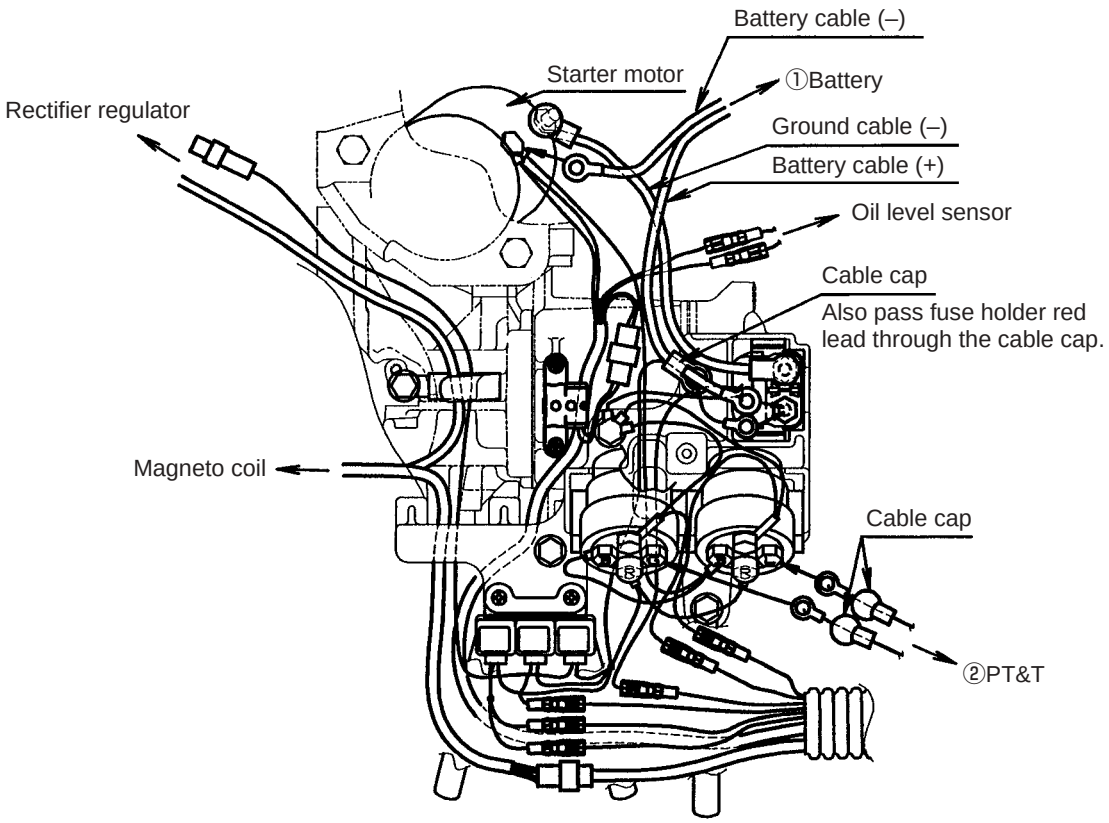
③ Connect wiring to the oil level sensor.



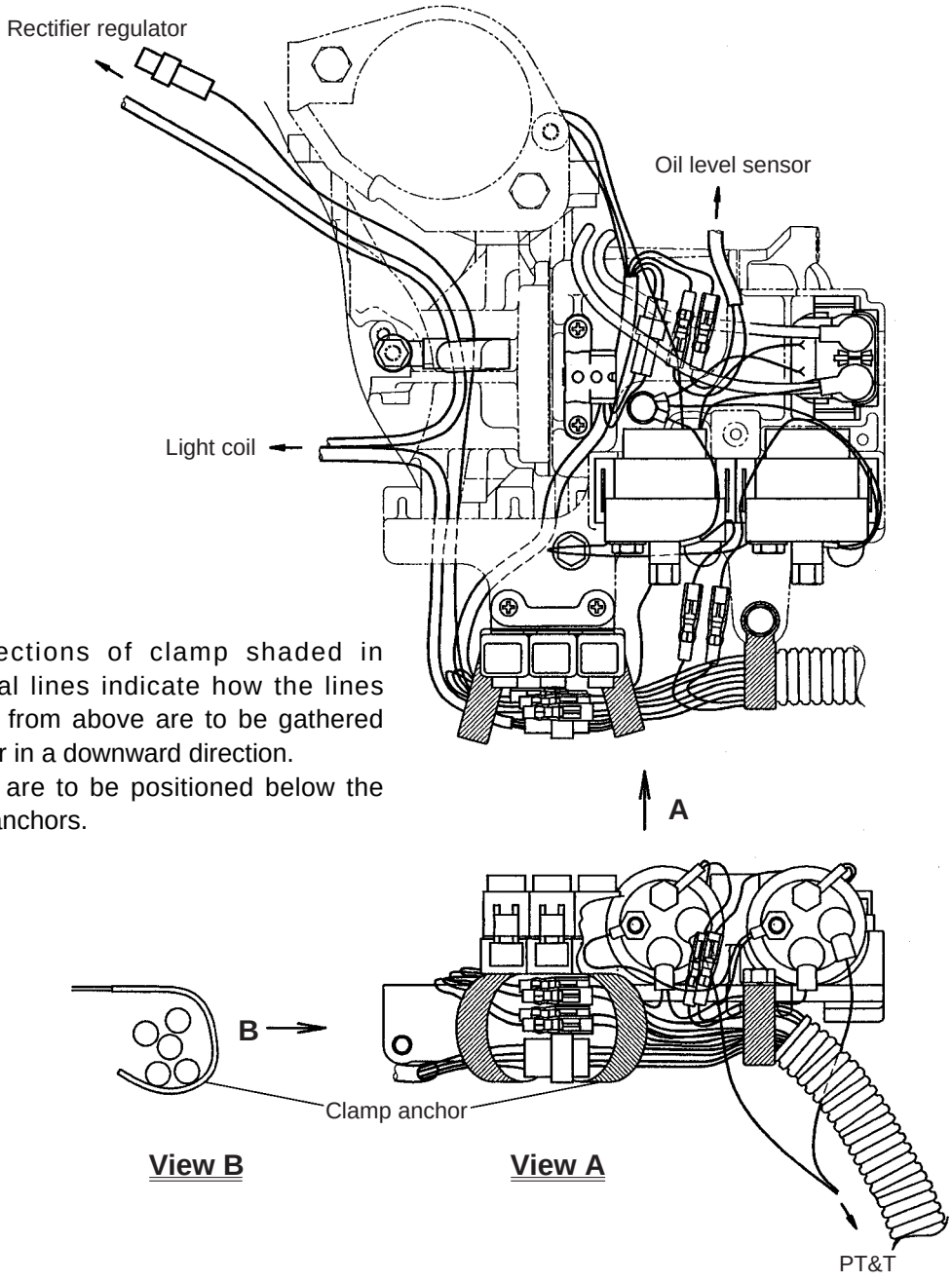
⑧ Assembly Step 3

① Install the battery cables (+,–).

② Install the PT&T cables using the blue and green leads.



⑨ Assembly Completed



Note:
The sections of clamp shaded in diagonal lines indicate how the lines coming from above are to be gathered together in a downward direction.
Cables are to be positioned below the clamp anchors.

4. Inspection

Flywheel Magneto

The flywheel magneto itself does not require inspection, however, the following precautions are necessary when operating in the flywheel area during servicing operations. The magnets is attached to the flywheel using adhesive glue, so it will be necessary to observe the following precautions.

Precautions

- Avoid applying shock or impact to the flywheel, such as that from the tapping of a hammer.
- Be sure to use the recommended tool rather than selecting from any standard tools that happen to be available.
- Always replace the flywheel if it has been dropped on the floor or any other hard surface.

Resistance Values for Coils

- These include values for the ignition coil, alternator coil, exciting coil, lighting coil and pickup coil.

Refer to the section “Specifications and Standards Used in Servicing” in Chapter 2.

Rectifier Regulator

Inspect

- For faulty connections or severed lines in the wire harness.
- Measure conductivity and resistance values by referring to the check sheet table below. (Values listed are standard values.)
- Disconnect wiring and measure with regulator isolated from electrical system.

Rectifier Checkpoint Table

		Tester + lead (red)				
		Red	Yellow	Black	Yellow	Yellow
Tester - lead (black)	Red		OFF	OFF	OFF	OFF
	Yellow	ON (4kΩ)		OFF	OFF	OFF
	Black	ON (5kΩ)	ON (4kΩ)		ON (4kΩ)	ON (4kΩ)
	Yellow	ON (4kΩ)	OFF	OFF		OFF
	Yellow	ON (4kΩ)	OFF	OFF	OFF	

Note:

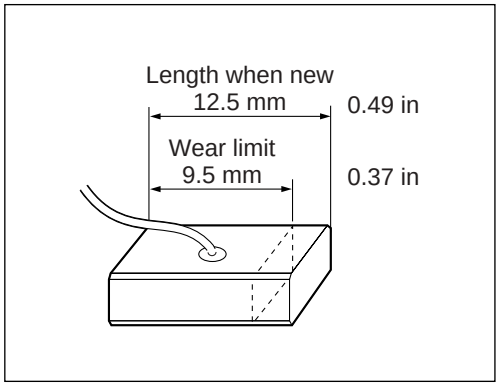
① Measure using the Hioki HiTester model 3030 or equivalent product. Do not use an insulation tester.

② The tester needle moving represents an On reading and not moving represents an Off reading. The ( ) contain approximate values for the 1 kΩ range. Note that values will vary depending on tester condition (internal power supply), testing range and the individual model.

③ Be sure to disconnect any wiring connections in order to isolate each component before measuring.

④ The readings obtained using this testing procedure are not absolute values and are intended for use only as reference.

Starter Motor



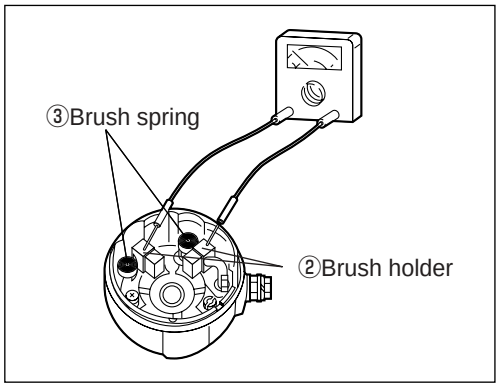
Brushes and Springs

① Check the brushes for wear.

When brush length is 9.5 mm (0.37 in) or less * Replace with new one.

② Inspect insulation between brush holders.

If conductive, determine cause or replace insulation.



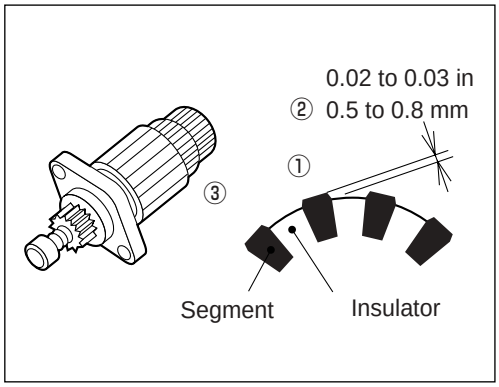
③ Brush spring tension

When there is a loss of tension * replace spring.

Armature

① Measure the depth of the insulator on the commutator.

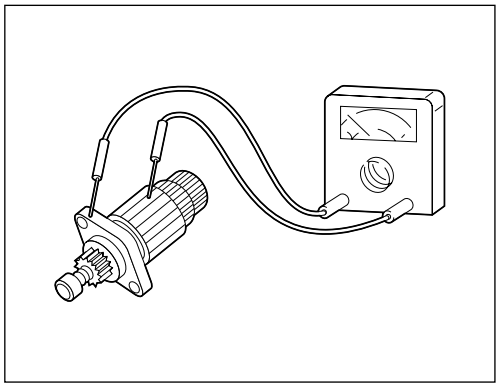
② When the distance at location ② does not fall within the 0.5 to 0.8 mm (0.02 to 0.03 in) range or when deformed from excessive wear, repair the teeth attached to the plate so that they conform to the designated range.



③ To remove excessive carbon buildup on the commutator, select a sandpaper in the #500 to #600 range.

④ Inspect the armature insulation.

When conductive * Replace starter motor assembly.



Chapter 6 Disassembly, Inspection and Reassembly Lower Unit

1. Configuration.....6-2

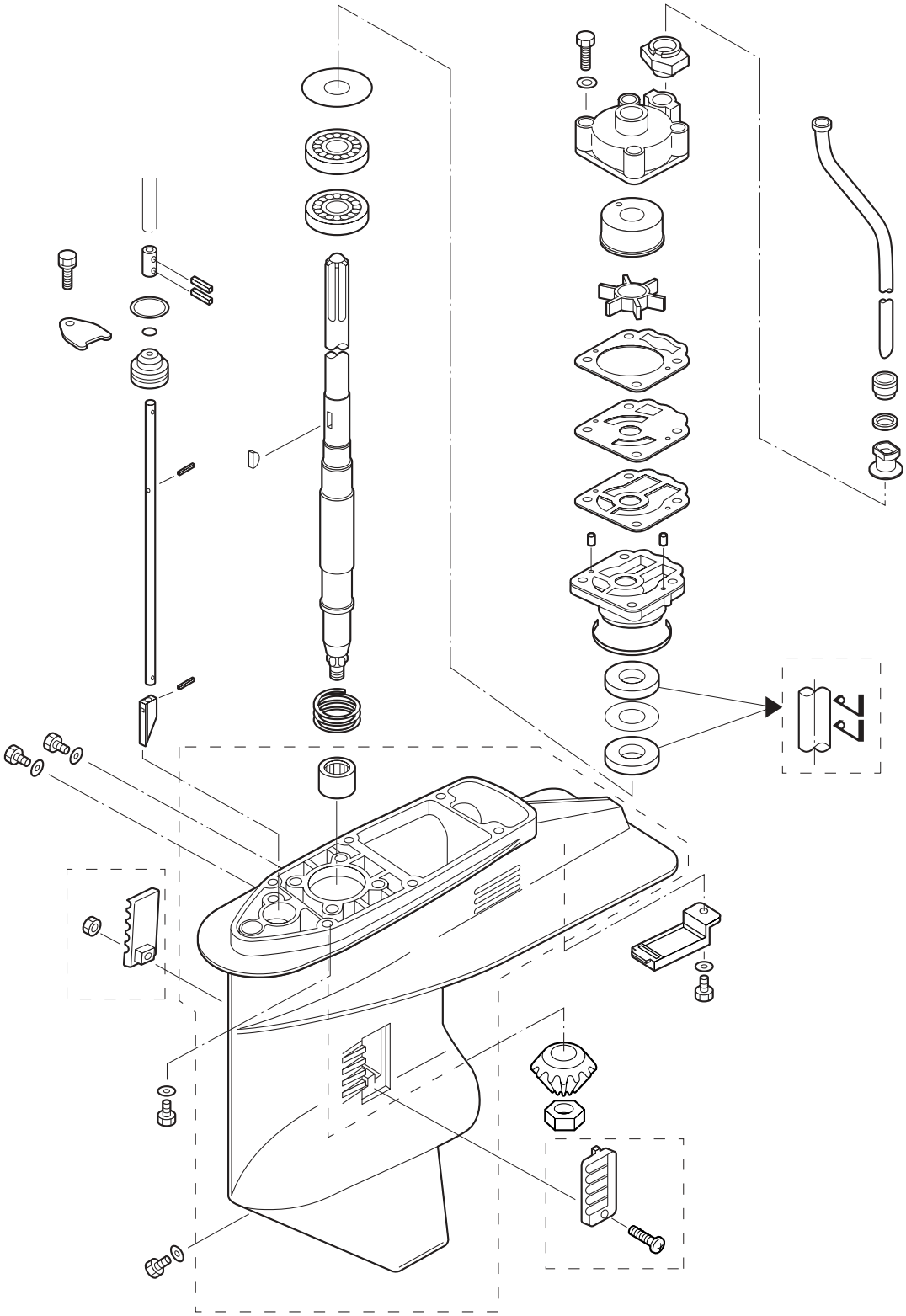
2. Disassembly 6-4

3. Inspection 6-7

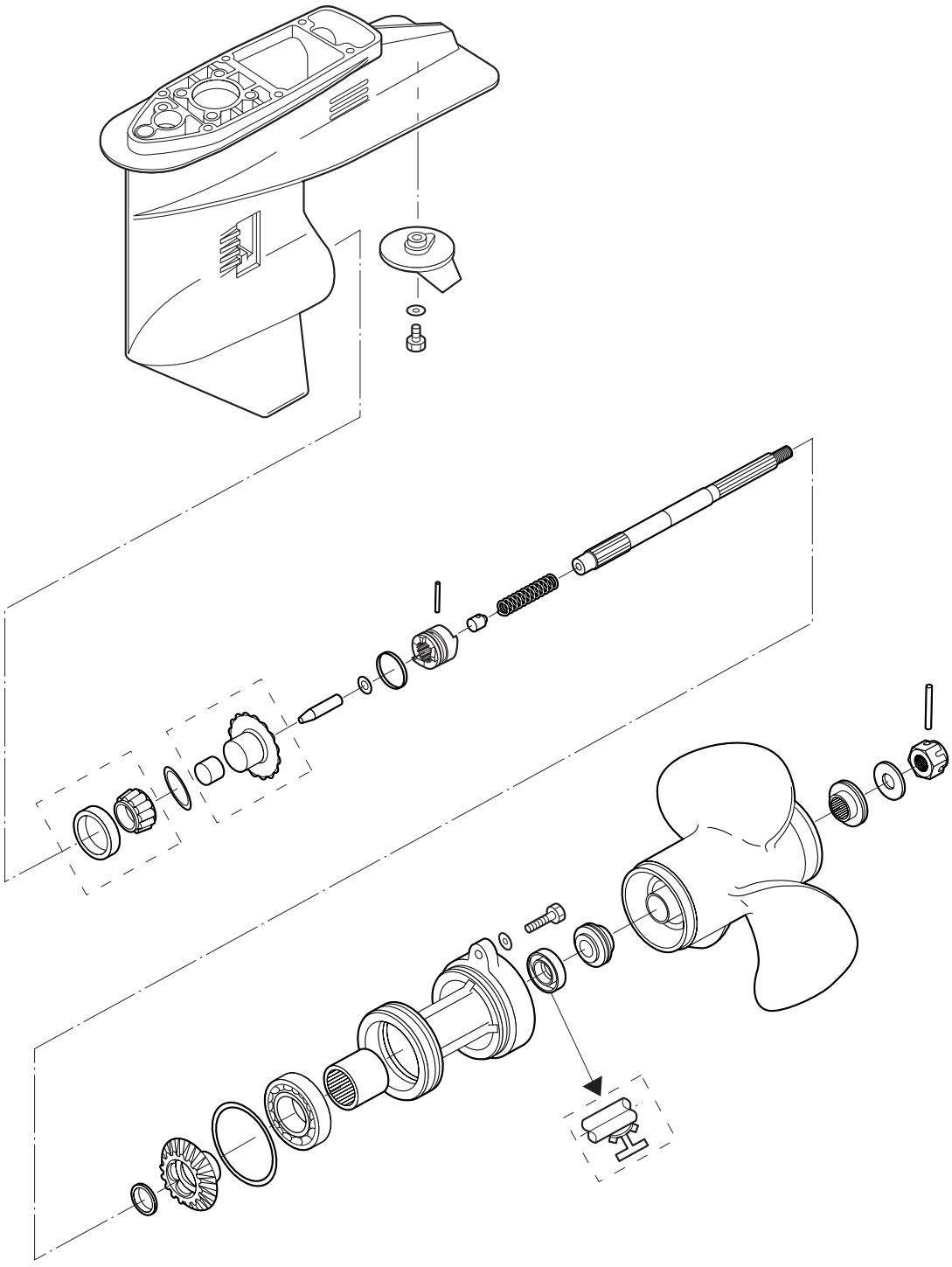
4. Reassembly 6-9

1. Configuration

GEAR CASE (DRIVE SHAFT)



GEAR CASE (PROPELLER SHAFT)



2. Disassembly

Caution:

- Begin the procedure by first removing the spark plug caps and then removing the spark plugs.
- When working with the outboard engine tilted full up, make sure to secure the engine firmly in place using a tilt up stopper.
- In cases where the outboard engine (S and L shaft models) is not mounted on its board, it is important to take care that the bracket spring up when the reverse lock lever is released.

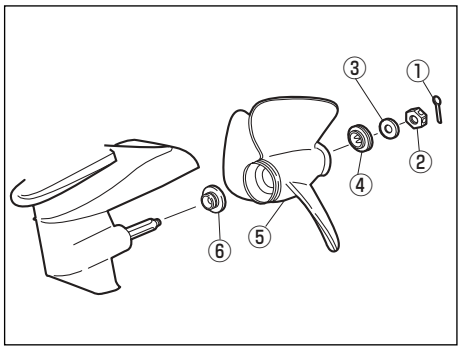
Disassembling Gear Case

The gear case can be disassembled from this outboard engine without having to remove the power unit.

Removing Propeller

Remove The Following Components.

① Split pin
② Propeller nut
③ Washer
④ Stopper
⑤ Propeller
⑥ Thrust holder

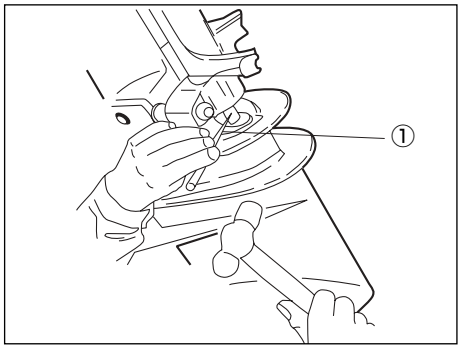


Removing Gear Case

Remove the following components.

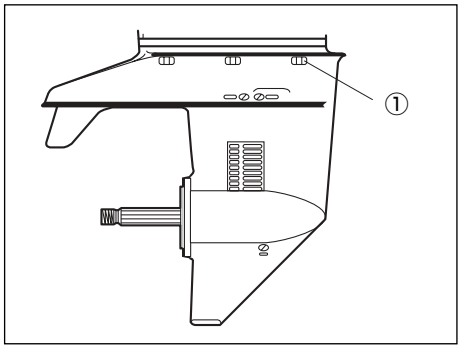
① Split pin

Special tool	Spring pin tool A
	345-72227-0



Remove the following components.

① Bolt: type H835 at 6 locations
② Gear case assembly (remove in downward motion.)



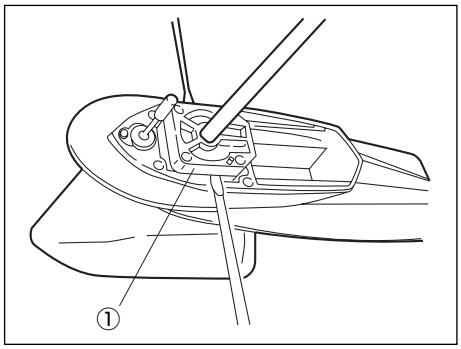
Drainning Gear oil

Refer to section on inspecting gear case contained in Chapter 3 (Inspection and Maintenance).

Disassembling Water Pump Case

① Remove the lower section of the water pump case.

Remove by inserting a flathead screwdriver along the case removal groove.



Disassembling Propeller Shaft and Clutch

Remove the various components using the following procedures.

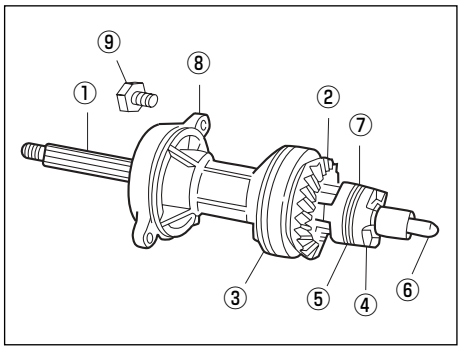
⑨ Bolt: type H625 at 2 locations

⑧ Propeller shaft housing (with ① to ⑦)

⑤ Clutch pin snap ring * Replace with new pin

⑦ Clutch pin

Press lightly on ⑥ in order to remove clutch pin ⑦.



① Propeller shaft

② Bevel gear, C

③ O-ring

④ Clutch

⑤ Clutch pin snap ring

⑥ Push rod

⑧ Propeller shaft housing

Take care when removing ⑦ as the push rod ⑥, chutch spring holder ⑩ and steel ball ⑫ are liable to spring out.

Remove the following components.

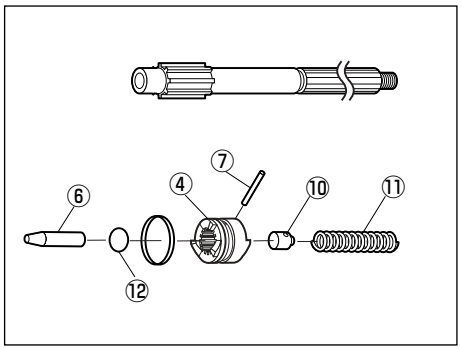
④ Clutch

⑥ Push rod

⑩ Clutch spring holder

⑪ Clutch spring

⑫ Steel ball



Removing Bevel Gear and Drive Shaft

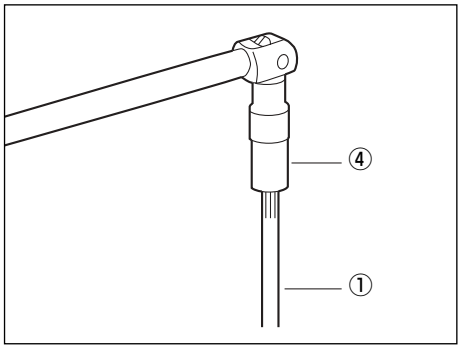
Remove the following components.

- Bevel gear B nut
- Bevel gear B
- Drive shaft
- Bevel gear A
- Bevel gear A bearing
- Bevel gear C

Removal Procedure

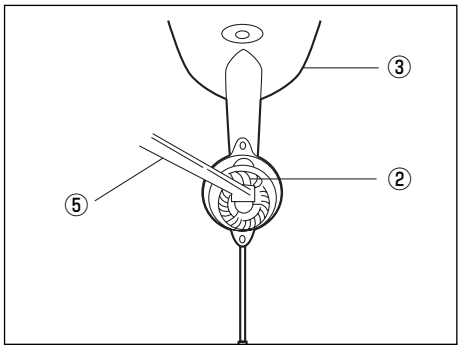
1. Insert ④ onto spline ①.
2. Attach ⑤ to ②.

Special tool	⑤ Bevel gear B nut wrench: 346-72231-0
	④ Bevel gear B nut socket: 346-72232-0



3. Turn ⑤ to loosen nut ② and remove.
4. Remove ②.
5. Remove ①.

① Drive shaft
② Bevel gear B
③ Gear case
④ Bevel gear B nut socket
⑤ Bevel gear B nut wrench



3. Inspection

Inspect the following components.

Component	Inspection points	Remarks
Bevel gears A, B, C and clutch	• Wear and damage on pawls of bevel gears A and C.	Replace.
	• Wear and damage on clutch pawl.	Replace.
	• Meshing of bevel gears A, B and C and backlash*.	Replace as necessary.
	• Wear on bearings for bevel gears A and C.	Replace as necessary.
Propeller shaft	• Play between clutch and spline.	Replace as necessary.
Drive shaft	• Misalignment of drive shaft.	Replace.★
	• Wear on spline area.	Replace as necessary.
	• Wear contact surface of needle roller bearing.	Replace as necessary.
Water pump	• Wear on pump impellor.	Replace.
	• Wear and defamation of pump case liner.	Replace.
	• Wear on pump guide plate.	Replace as necessary.
	• Wear and cracking on the lip area of pump case lower oil seal.	Replace as necessary.

* : Refer to the table on the next page listing the backlash readings and corresponding adjusting shim sizes.

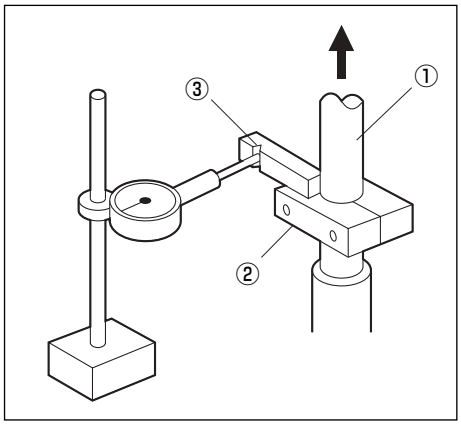
★ : Refer to Chapter 2-2.

Inspecting Bevel Gear Backlash

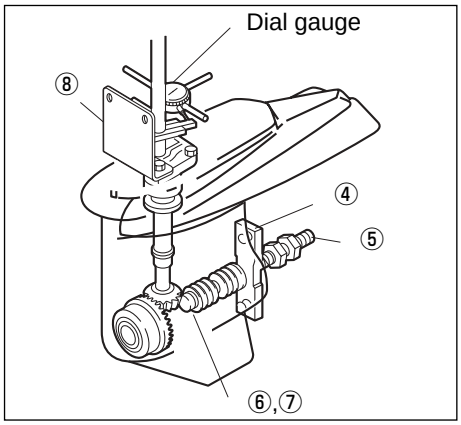
Backlash Measuring Tool

Install the clamp assembly ② on the drive shaft ①. Line up the tip of the dial gauge with center of the V groove ③ on the clamp assembly.

① Drive shaft



Special tool		
	② Clamp assembly	: 3B7-72720-0
	④ Plate	: 3A3-72713-0
	⑤ Shaft	: 345-72723-0
	⑥ O-ring	: 332-60002-0
	⑦ Collar	: 353-72245-1
	⑧ Plate	: 3B7-72729-0



1. Securely tighten the tool securing bevel gear A to ensure it does not move together with the drive shaft when the shaft rotates.
2. Install of the upper and lower pump cases on the gear case with the pump impellor not yet installed. Install so that the clamp assembly ② is positioned as close to the pump case as possible.
3. With the gear case and dial gauge stationery, pull up on the drive shaft ① while rotating it and take a dial gauge reading. This technique is used to prevent drive shaft play from affecting dial gauge readings.

Backlash Reading And Corresponding adjusting shim sizes

	Gauge reading
Backlash	0.31 to 0.62 mm 0.0119 to 0.0244 in

Notes:

1. The values listed in the table represent the range of dial gauge readings taken using the various specials tools.
2. Replace shims as necessary in order to adjust to the required thickness. A + sign indicates that shim thickness should be increased, while a - sign it should be decreased.
3. It is important to repeat the measuring procedure several times in order to obtain an accurate backlash reading.

Example:

Shim replacement is unnecessary in cases where backlash values fall within the designated range.
As an example, a shim of 0.15 mm (0.0059 in) should be added for a dial gauge reading of 1.00 mm (0.0394).

Shim size: mm	Location
0.1, 0.3, 0.5 (0.0039, 0.0118, 0 0197 in)	Between lower pump case and bearing.
0.1, 0.15, 0.3 (0.0039, 0.0059, 0 0118 in)	Between bevel gear A and bearing.

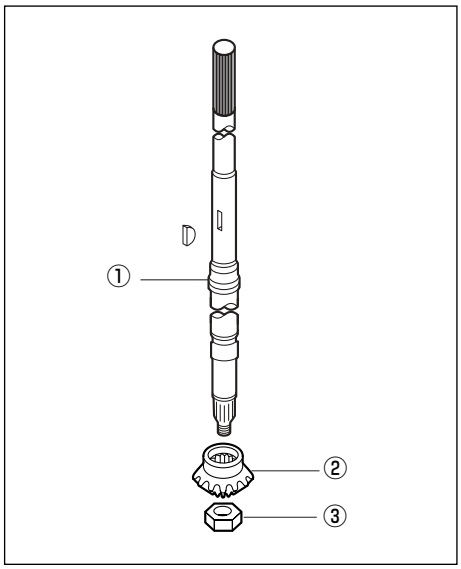
Gauge reading (mm)	Shim size (mm)
0.00 to 0.16	-0.10
0.17 to 0.30	-0.05
0.31 to 0.62	±0.00
0.63 to 0.74	+0.05
0.75 to 0.94	+0.10
0.95 to 1.13	+0.15
1.14 to 1.33	+0.20
1.34 to 1.52	+0.25
1.53 to 1.72	+0.30
1.73 to 1.92	+0.35
1.93 to 2.11	+0.40
2.12 to 2.31	+0.45
2.32 to 2.51	+0.50

Gauge reading (in)	Shim size (in)
0.0000 to 0.0063	-0.0039
0.0064 to 0.0118	-0.0020
0.0119 to 0.0244	±0.0000
0.0254 to 0.0291	+0.0020
0.0292 to 0.0370	+0.0039
0.0371 to 0.0445	+0.0059
0.0446 to 0.0524	+0.0079
0.0525 to 0.0598	+0.0098
0.0599 to 0.0677	+0.0118
0.0678 to 0.0756	+0.0138
0.0757 to 0.0831	+0.0157
0.0832 to 0.0909	+0.0177
0.0910 to 0.0988	+0.0197

4. Reassembly

Assembling Gear Case

Observe the precautionary notes provided at various steps while assembling in the reverse order of disassembly.



Installing Bevel Gear on Drive Shaft

Install the following components.

• Bevel gear A bearing

Use the outer race to press fit the bearing in place.

① Drive shaft
② Bevel gear B
③ Bevel gear B nut

Torque: 40 to 58 N-m (4 to 6 kg-m) (29 to 43 lb-ft)

Special tool	Bevel gear B nut wrench: 346-72231-0
	Bevel gear B nut socket: 346-72232-0

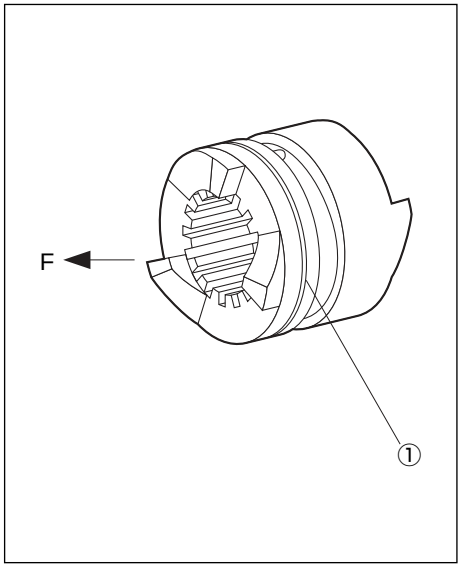
Applying Adhesive

Drive shaft *	Over entire thread area	Three Bond 1373B
Bevel gear B nut		

*: Be careful not to get any adhesive on the spline and tapered surface area.

Assembling Propeller Shaft and Clutch

Assemble in reverse order of the disassembly procedure.



Direction of Clutch

Install with the groove ① side facing in bevel gear A (direction F).

Clutch pin snap rings * Replace with new one.

Special tool	Clutch pin snap tool
	345-72229-0

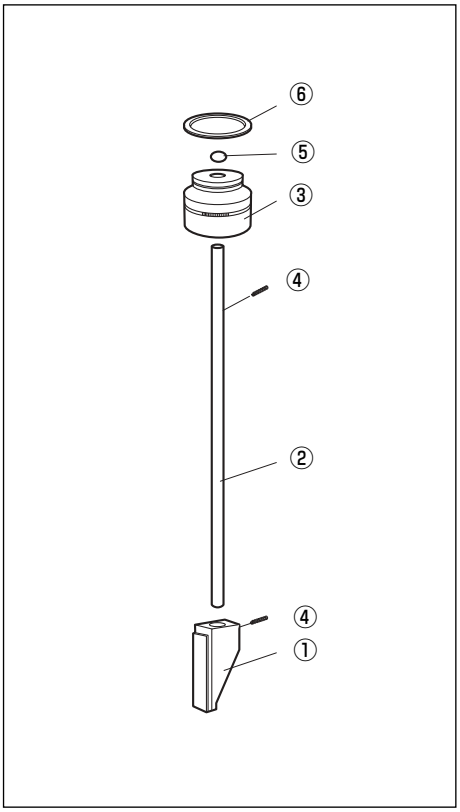
Assembling Clutch Cam, Cam Rod and Clutch Cam Rod Bushing

Install the following components.

① Clutch cam
② Clutch cam rod
③ Cam rod bushing
④ Clutch cam spring pin: 3-12
⑤ O-ring: 2.4 to 5.8
⑥ O-ring: 3.5 to 21.7

Special tool	Spring pin tool B
	345-72228-0

Spring pins must never be reused.
Apply gear oil to the O-rings.
Install so that the spring pin does not protrude out from the clutch cam.



Install the following components on the gear case.

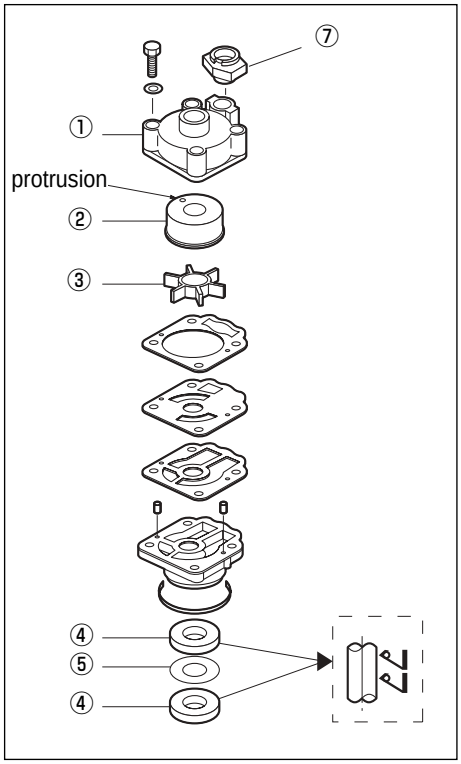
① Cam rod assembly
② Cam rod bushing stopper

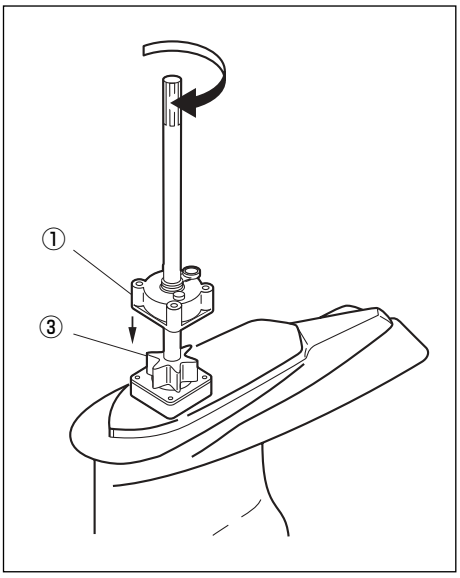
Once installation is completed, operate the cam rod to confirm that it moves freely up and down.

Assembling Water Pump

Install the following components. Refer to section 7 (Inspecting Cooling System) of Chapter 3 (Inspection and Maintenance) for detailed descriptions of components.

- Confirm oil seals ④ are facing right side up.
- Be sure to insert shim ⑤ between the oil seals ④.
- While taking care not to scratch the lip area of the oil seals ④, insert the drive shaft into the pump case.
- Carefully fit the protruding side of the pump case liner ② into the recession in the upper pump case ①.
- Insert the pump impeller key firmly onto the drive shaft.
- When installing the pump impeller ③ in the upper pump case ①, do so by rotating the drive shaft as shown in the bottom figure to the right. (Make sure that the pump impeller ③ blades are facing right side up.)





Adding Gear oil

Refer to section 5 (Inspecting Gear Case Area) of Chapter 3 (Inspection and Maintenance) for detailed description of gear oil replacement procedure.

Assembling Gear Case Assembly

• Apply a thin coating of the specified grease to the spline area on the engine side of the drive shaft.
Grease Type: Nippeko LT-2

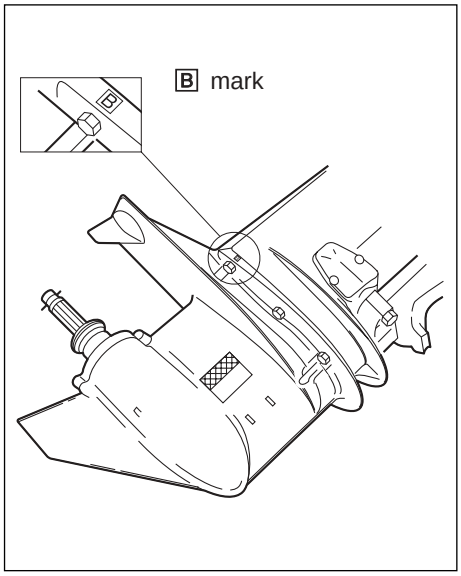
Install water pipe by first applying oil to the water pipe seal rubber and sliding it through the rubber seal.

Assemble by first installing bolts at the 2 locations on the gear case marked with the [B] then install the remaining bolts.

Torque: 19 to 21 N-m: 1.9 to 2.1 kg-m: 14 to 15 lb-ft

Spring pin * Replace with new one.

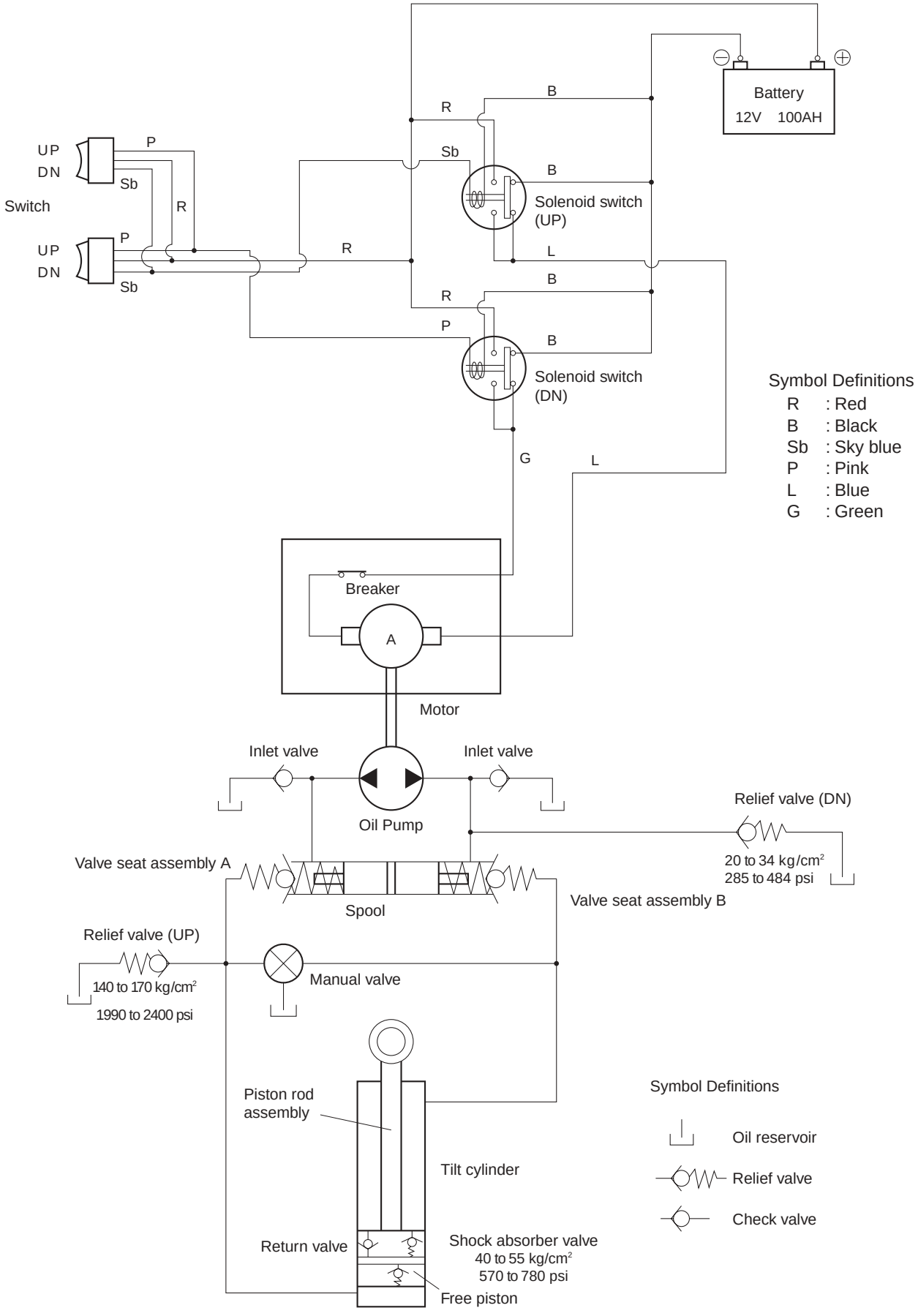
Special tool	Spring pin tool B
	345-72228-0



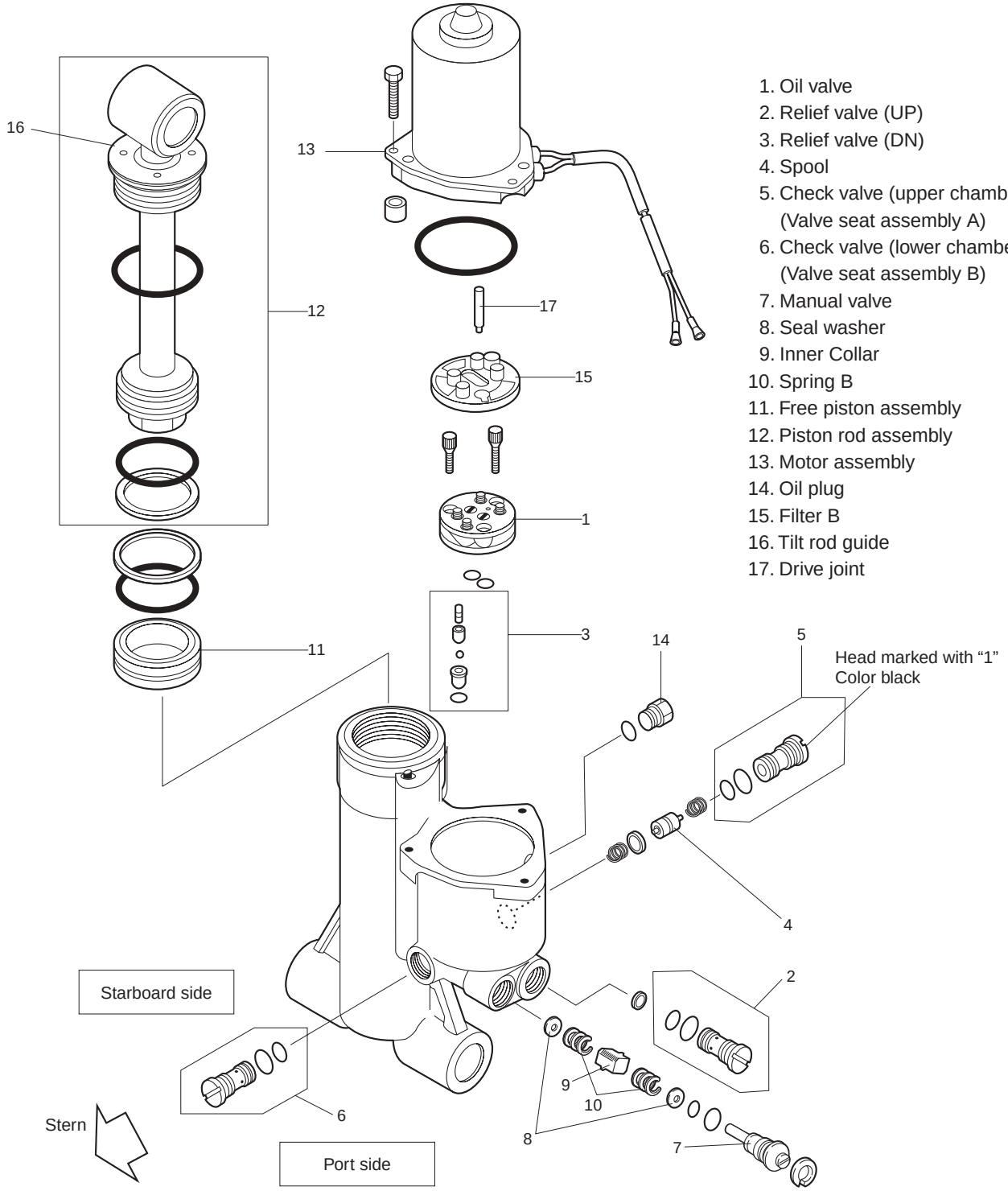
Chapter 7 Power Trim and Tilt

1. **Configuration 7-2**
2. **Names of Parts.....7-3**
3. **Troubleshooting.....7-4**
4. **Disassembly and Assembly.....7-12**

1. Configuration



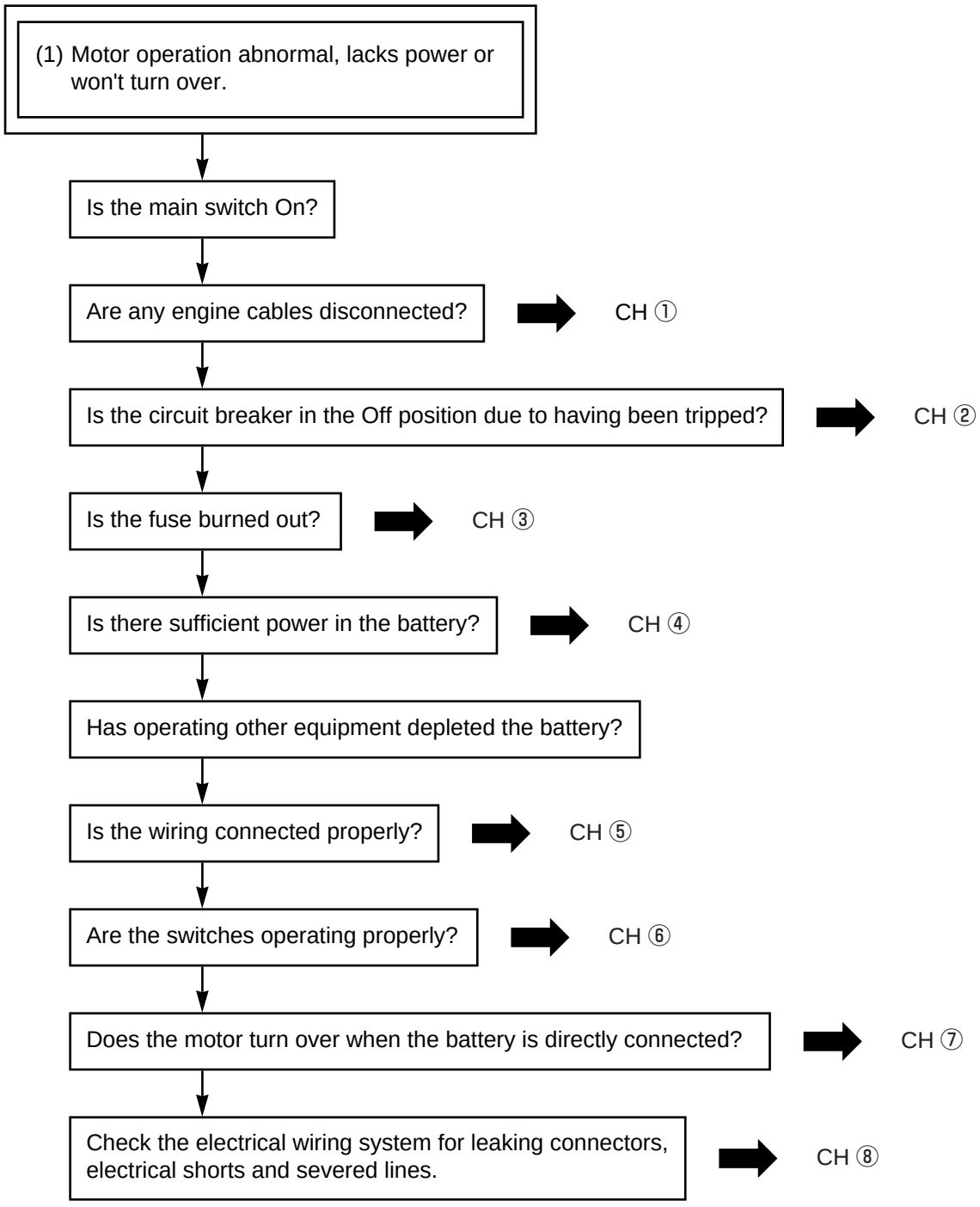
2. Names of Parts

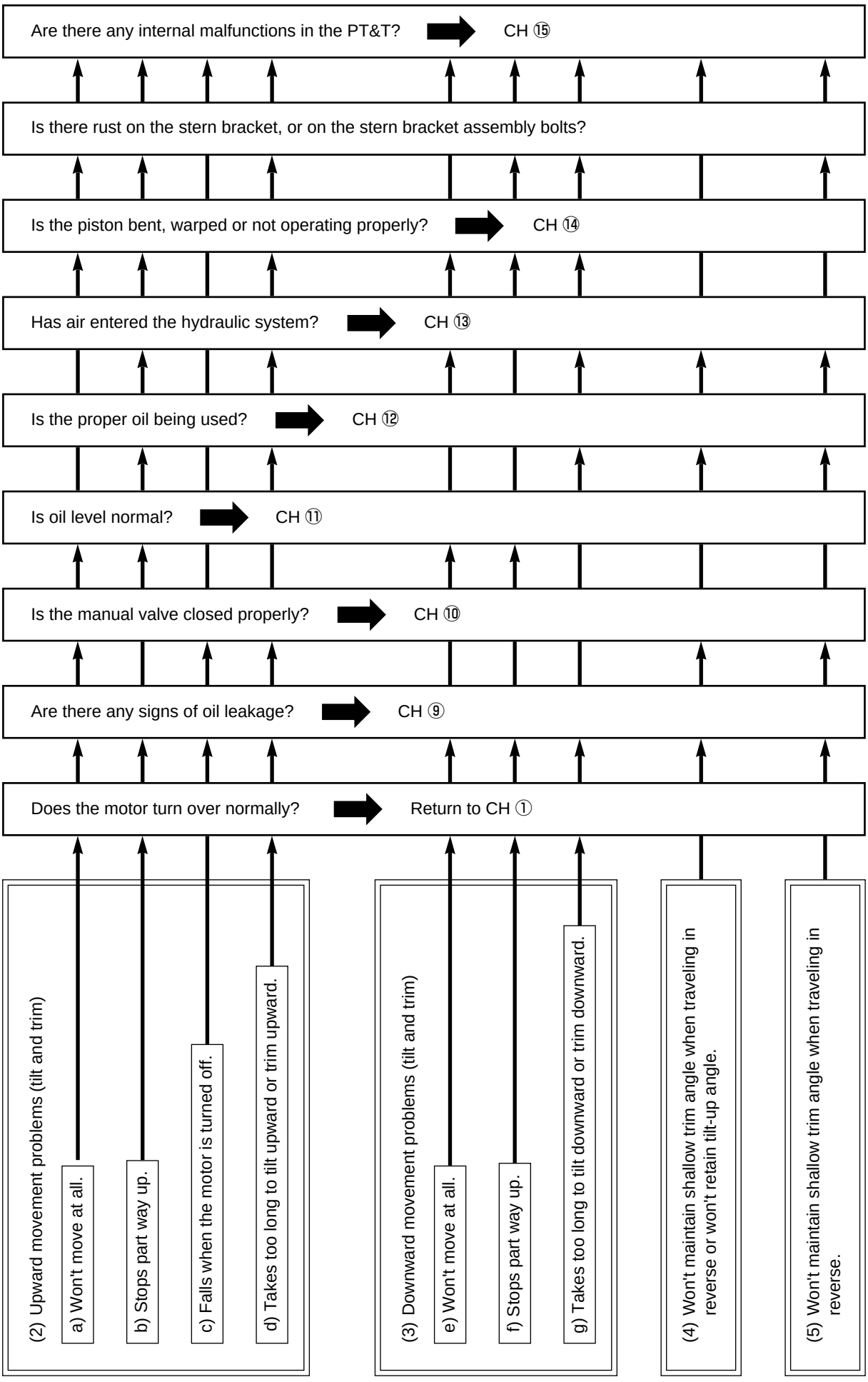


1. Oil valve
2. Relief valve (UP)
3. Relief valve (DN)
4. Spool
5. Check valve (upper chamber) (Valve seat assembly A)
6. Check valve (lower chamber) (Valve seat assembly B)
7. Manual valve
8. Seal washer
9. Inner Collar
10. Spring B
11. Free piston assembly
12. Piston rod assembly
13. Motor assembly
14. Oil plug
15. Filter B
16. Tilt rod guide
17. Drive joint

3. Troubleshooting

(1) Symptoms and Points to Check




Are there any internal malfunctions in the PT&T? CH ⑮
Is there rust on the stern bracket, or on the stern bracket assembly bolts?
Is the piston bent, warped or not operating properly? CH ⑭
Has air entered the hydraulic system? CH ⑬
Is the proper oil being used? CH ⑫
Is oil level normal? CH ⑪
Is the manual valve closed properly? CH ⑩
Are there any signs of oil leakage? CH ⑨
Does the motor turn over normally? Return to CH ①
(2) Upward movement problems (tilt and trim)
a) Won't move at all.
b) Stops part way up.
c) Falls when the motor is turned off.
d) Takes too long to tilt upward or trim upward.
(3) Downward movement problems (tilt and trim)
e) Won't move at all.
f) Stops part way up.
g) Takes too long to tilt downward or trim downward.
(4) Won't maintain shallow trim angle when traveling in reverse or won't retain tilt-up angle.
(5) Won't maintain shallow trim angle when traveling in reverse.

(1) Checking Procedure

CH① Are any engine cables disconnected?

- Confirm that battery cables are connected to battery.
- Confirm that cable connectors are firmly secured in place.

CH② Is the circuit breaker in the Off position due to having been tripped?

- Run a hand over the motor to check for overheating as this may indicate a tripped breaker. Allow motor to cool for 3 minutes.

CH③ Is the fuse burned out?

- Open the engine cover and inspect the fuses installed on the electric bracket.

CH④ Is there sufficient power in the battery?

- Make sure that the battery outputs 12V and 100AH or more.
- Check specific gravity of battery fluid. Recharge if specific gravity is 1.22 or less at a temperature of 20°C (68°F).
- Try turning over the starter motor. If it turns over, the battery is OK.

CH⑤ Is the wiring connected properly?

- Check for improperly connected wiring using the wiring diagram.

CH⑥ Are the switches operating properly?

- Checking Main Switch:
  Turn the main switch on. If the choke solenoid, starter motor and beeper (buzzer) function the main switch is okay.
  Use a tester to confirm that current is passing between the red lead lines. Okay if conductive when the switch is ON.
- PT&T switch:
  Disconnect the sky blue (or pink) lead on the solenoid switch installed on the engine's electric bracket and touch the plug against the connector on the red cable. If the PT&T operates, it indicates a faulty PT&T switch (UP: Sky blue, DN: Pink).
  The alternative is to use an electrical tester to check the conductivity of the PT&T switch unit.
  Check for conductivity between the red and sky blue leads when the switch is set to UP.
  Check for conductivity between the red and pink leads when the switch is set to DN.
- Solenoid Switch:
  Disconnect the sky blue (or pink) solenoid lead mentioned above and touch it against the red cable terminal. If this causes a clicking sound, the solenoid switch is okay.
  Next, check the solenoid switch connectors. The connectors are okay if they produce the results shown in the following table when the solenoid switch is turned On and Off.
  Note: The red, blue and green cables must be disconnected.
  Simply switching the switch between UP and DN will suffice if it is known that one of the connectors is okay.

Conductivity		Solenoid switch	
		ON	OFF
DN Solenoid Switch	Blue to black	no	yes
	Blue to red	yes	no
UP solenoid switch	Green to black	no	yes
	Green to red	yes	no

CH⑦ Does the motor turn over when the battery is directly connected?

- Disconnect the blue lead and green lead of the PT&T and touch the plugs against the red and black lead terminals, respectively. Operation is normal if the blue-to-red and green-to-black contacts move the motor up and the blue-to-black and green-to-red contacts move the motor down.
- Disconnect the PT&T cable from the engine cover and touch the end against the battery terminal. If this does not activate the motor is defective.

CH⑧ Check the electrical wiring system for leaking connectors, electrical shorts and severed lines.

- With the focus on the various cables, check for electrical shorts.
- Also check the various switches for damaged cables.

CH⑨ Are there any signs of oil leakage?

- Conduct an external visual check for oil leakage.
  To check for minor leaks, operate the PT&T unit and look for signs of oil leakage on the surrounding water's surface.
- In cases where oil leaks are discovered in the PT&T unit or the cylinder, it will be necessary to conduct a disassembly test to check for damage. Repair as necessary.

CH⑩ Is the manual valve closed properly?

- Firmly close the manual valve.
  Direction: clockwise, torque: 2 to 3 N-m (0.2 to 0.3 kg-m, 17 to 26 lb-in)

CH⑪ Is oil level normal?

- Check the oil level.
  The oil level should be even with the bottom of the oil plug hole when the engine is tilted up (piston rods are fully extended).

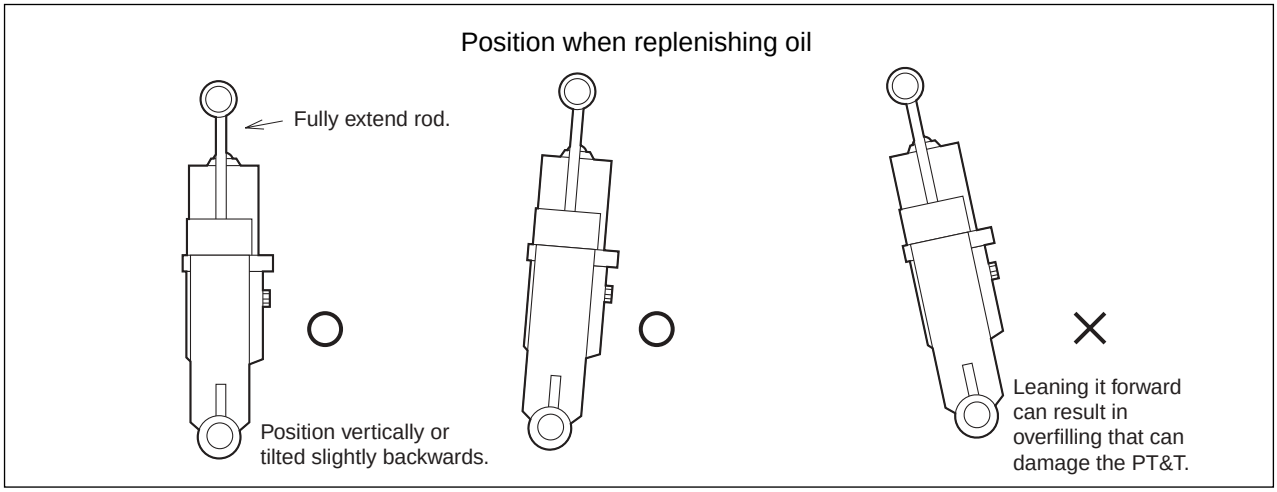
Note: Always make sure to bleed air from the lines and check oil level once more after replenishing oil.

- Refer to CH ⑬ for description of air bleeding procedure.
- Be sure to use the specified oil (Japan Oil ATF Dexron).

• When unable to tilt up due to lack of oil:

When the oil reservoir is empty and powered tilting up is not possible, turn the manual valve a few turns counter- clockwise; then tilt the engine up manually and set the tile stopper.
When replenishing oil, fill until oil is even with the bottom of the oil plug hole. Added the oil gradually by lightly rotating the PT&T in the tilt up direction. Close the manual valve to prevent air bubbles from contaminating the oil.
Once oil has been replenished, remove the tilt stopper, bleed out the air, and check oil level again. Tilt down again, repeat their air bleeding procedure and check oil level again.

• The PT&T should normally contain 550 ml (18.7 fluid ounces) of oil.



CH⑫ Is the proper oil being used?

• Use only the specified types of oil.

(The oil specified for this engine is ATF Dexron made by Japan Oil.)
Recommended oil types: Automatic transmission fluid (conforming to GM Standards)

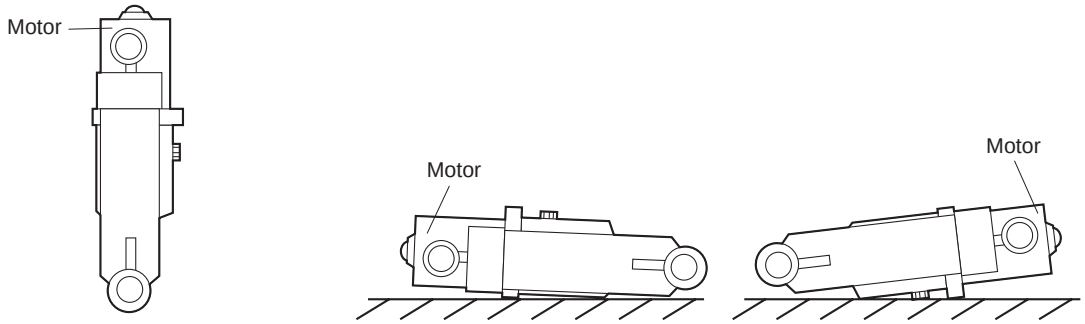
Japan Oil	Super Highland #2	Maruzen	Maruzen ATF Dexron
	PAN Torque Dexron	Mitsubishi	Diamond ATF Dexron
	PAN Automatic DZ	Kyoseki	Kyoseki ATF Dexron
Fujikosan	Fukkol Dexron ATF		
Mobile	Mobile DTE #22		
	Mobile ATF 220		
Esso	Esso Automatic Transmission Fluid		
Shell	Shell Dexron-II		
	Shell Terrace Oil #22, K22		
Idemitsu	Apollo Oil Dexron		

CH⑬ Has air entered the hydraulic system?

- The presence of the air in the lines is relatively easy to detect, as the PT&T unit will occasionally generate sluggish sounds.
- Air Bleeding Procedure(oil plug must be closed during air removal procedure):
  With the manual valve opened, repeat a full stroke manual tilt up and down operation five or more times. Complete the operation by tilting up and checking the oil level.
- Be sure to close the manual valve immediately after inspection.
- When air has found its way into the core of the system:
  A single air bleeding operation is not sufficient to remove air that has found its way into the center of the system. This must be removed by repeating the air bleeding operation over a period of several days.

  Note: Paying close attention to engine position is important to prevent air from entering the system.

The figure below shows storage positions that will prevent air contamination.
(Do not stand the motor upside down.)



CH⑭ Is the piston rod bent, warped or not operating properly?

- With the manual valve opened, perform a manual tilt up and down motion to confirm the piston moves freely.
- Conduct a visual inspection.

CH ⑮ Are there any internal malfunctions in the PT&T? ..... The cause of the problem varies according to the type of symptom, so it is important to refer to the table below.

Replace the PT&T assembly.

Inspect the shock absorber valve on the tilt cylinder. → CH ㉒

Inspect the free piston on the tilt cylinder. → CH ㉑

Inspect the piston on the tilt cylinder. → CH ㉑

Replace the oil pump.

Inspect the spool on the spool valve. → CH ⑳

Inspect the check valve on the upper part of the spool valve chamber. → CH ⑲

Inspect the check valve on the lower part of the spool valve chamber. → CH ⑲

Inspect the relief valve (DN). → CH ⑲

Inspect the relief valve (UP). → CH ⑲

Check to see if the filter is clogged. → CH ⑱

Inspect the drive joint. → CH ⑰

Disassemble and inspect the manual valve. → CH ⑯

(2) Upward movement problems (tilt and trim)
- a) Won't move at all.
- b) Stops part way up.
- c) Falls when the motor is turned off.
- d) Takes too long to tilt upward or trim upward.

(3) Downward movement problems (tilt and trim)
- e) Won't move at all.
- f) Stops part way up.
- g) Takes too long to tilt downward or trim downward.

(4) Won't maintain shallow trim angle when traveling in reverse or won't retain tilt-up angle.

(5) Won't maintain shallow trim angle when traveling in reverse.

Note: Pay close attention to the precautions for disassembly and assembly operations when disassembling any parts of the engine.

CH⑯ Disassemble and inspect the manual valve.

- Check the tip of the valve for damage.
- Check the O-rings for damage.
- Check the seal washers for damage, especially the rubber seals.
- Check for wear and damage deep within the valve mounting holes.

Note: Watch for collapsed seal washers when reassembling.

CH⑰ Inspect the drive joint.

Remove motor and inspect drive joint.

- Confirm integrity of joint.
- Check for damage.

CH⑱ Check to see if the filter is clogged.

Remove motor, extract filter and clean.

CH⑲ Inspect the relief valve and check valve.

- Check spring for fatigue and damage.
- Check valve seat for damage.
- Check valve (ball) for wear and damage.
- Press the ball to check how it returns to confirm it is operating smoothly and is not affected by foreign matter.
- Also, check to see if the filter is clogged when checking the relief valve (UP).

CH⑳ Inspect the spool and spool valve.

- Confirm that spool moves freely when pressed by hand.
- Check backup ring for wear and damage.

CH㉑ Inspect the piston and tilt cylinder.

- Check the piston for damage.
- Check O-rings and backup ring for wear and damage.
- Check the sliding surface of the cylinder for damage.

CH㉒ Inspect the shock absorber valve on the tilt cylinder.

Disassemble the piston.

- Check spring for a fatigue.
- Check valve ball for damage.
- Check valve seat for damage.
- Confirm valve has not been contaminated by foreign matter.

4. Disassembly and Assembly

● Precautions For Disassembling and Assembling Power Trim and Tilt (PT&T) System

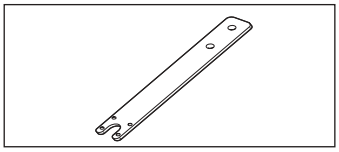
(1) Make sure to disassemble with the engine tilted up and piston fully extended. Open the manual valve slightly and leave to set for a while. Make sure that internal pressure has been reduced to zero before commencing operations.

(2) Remove the oil plug from the reserve tank and drain out all the oil.

(3) Be sure to take all necessary precautions during disassembly as oil tends to spurt and spray about, getting into clothing, skin and eyes, when parts are being removed.

(4) Be sure to use the specially designed tools when disassembling the PT&T unit.

Tilt rod guide wrench: 3C8-72791-0



(5) Carefully wash and clean all parts prior to assembly to prevent foreign matter entering the system.

(6) Avoid touching the motor unit when handling the PT&T.

● Precautions for Assembly

(1) Oil pump assembly (pump not designed for disassembly):
- Bolt torque: 1.5 to 0.55 kg-m (43.4 to 47.7 lb-in)
- Apply oil to O-rings.

(2) Relief valve (UP)
- Bolt torque: 1.2 to 1.4 kg-m (8.7 to 10.1 lb-ft)
- Apply oil to O-rings.

(3) Relief valve (DN)
- Apply oil to O-rings.

(4) Spool valve
- Apply oil to exterior of spool and to backup ring.
- Be careful not to mistake check valve A (for upper chamber) with check valve B (for lower chamber).
- Check valve torque: 0.9 to 1.0 kg-m (6.5 to 7.2 lb-ft)

(5) Manual valve
- Be sure to follow the proper order when assembling seal washers, seal plate, spring and inner collar.
- Make sure the seal washers are positioned facing in the proper direction. They can be damaged if positioned sideways.
- Torque: 0.2 to 0.3 kg-m (17 to 26 lb-in)
- Apply oil to O-rings.

(6) Cylinder assembly and piston rod assembly
- Apply oil to the free piston oil ring, backup ring and exterior of piston.
- Apply oil to the O-rings and backup ring on the piston rod assembly.
- Apply oil to the O-ring on of the rod guide.
- Rod guide torque: 8.0 to 12.0 kg-m (58 to 87 lb-ft)

(7) Motor
- Screw torque: 0.35 to 0.45 kg-m (30 to 39 lb-in)
- Bolt torque (Motor assembly): 0.5 to 0.7 kg-m (43 to 61 lb-in)

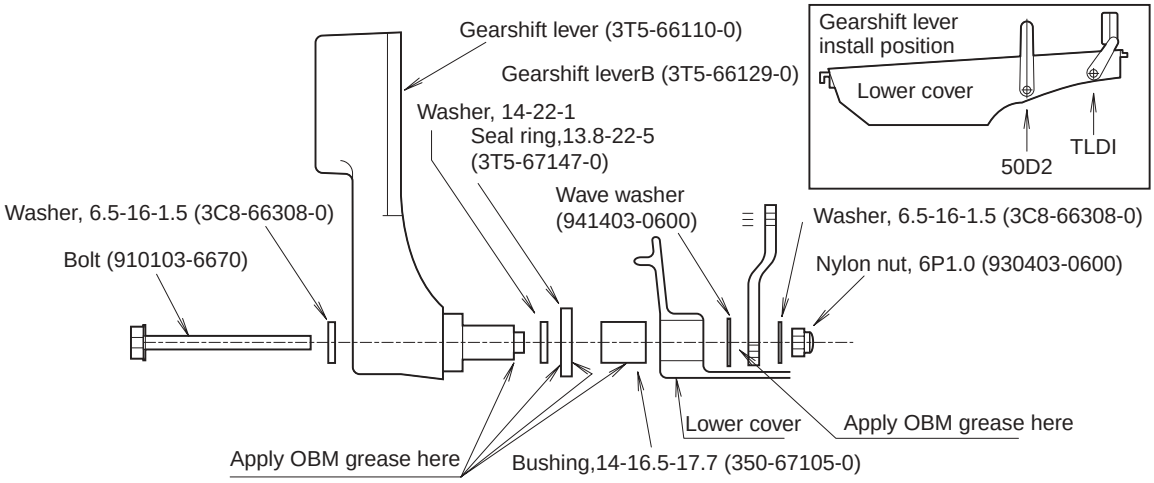
(8) Oil plug Torque
- 0.3 to 0.5 kg-m (26 to 43 lb-in)

Chapter 8 Tiller Handle Type

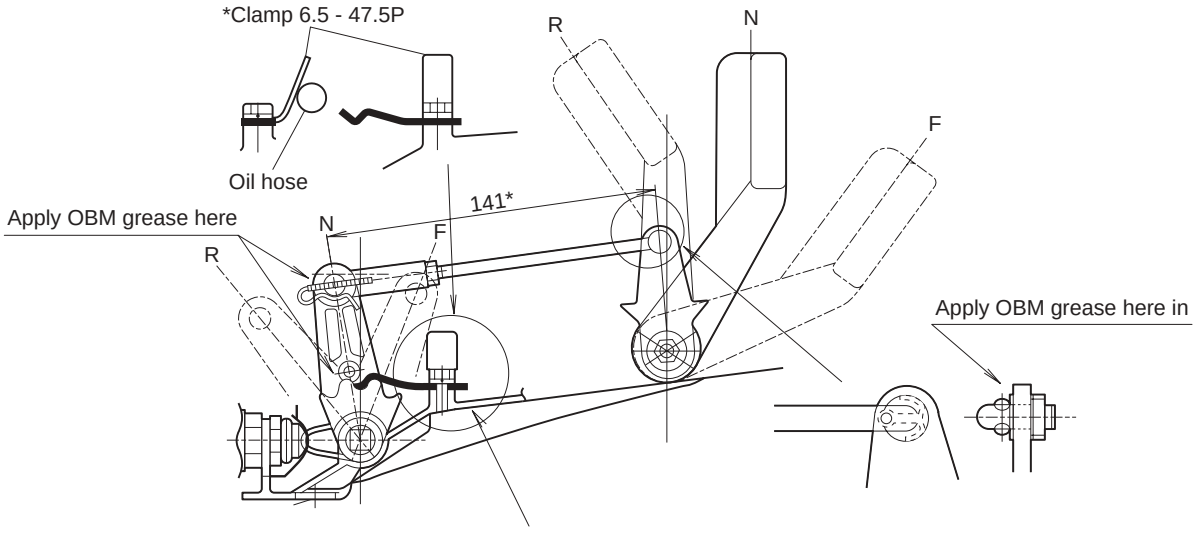
1. **Installing Gearshift Lever Assembly.....8-2**
2. **Installing Switchbox Assembly 8-3**
3. **Installing Handle Assembly 8-4**
4. **Installing Handle To Engine.....8-4**

1. Installing Gearshift Lever Assembly

(1) Following the procedures illustrated in the figure below, apply grease to the designated locations and install the gearshift lever on the lower cover.



(2) Adjust the pitch of the link rod by 141 mm(*), and then link gearshift lever B to the shift arm. (Once the length has been adjusted, secure in place using the locknut.)



- Use 3 gearshift lever stoppers
- Gearshift lever stopper plate not required
- Clamps should be tightened together

- Insert washers on both sides of gearshift lever B and be sure to bend split pin over completely.

2. Installing Switchbox Assembly

(1) Screw in the lanyard stop switch to the switch box; then tighten the switch from the inside of the box with a pliers.

(2) Insert the stay into the overheat warning beeper (buzzer) and secure using the bolt (910103-6612) from the inside of the switchbox.

(3) Insert the light assembly into the switchbox; then taking care not to damage other components, press in the assembly using a flathead screwdriver.

(4) Install the main switch by lining it up with the notch. Then install the main switch cap.

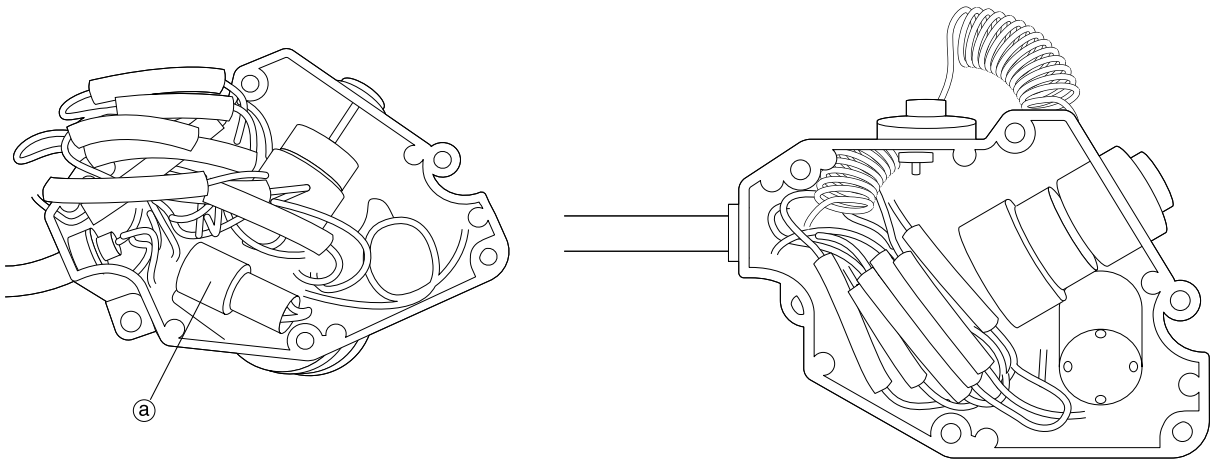
(5) For the PT&T switch (EFO type is not applied), insert the pink (P) lead on the stop switch side from the outside of the switch box.
Apply silicon grease over the entire mating surfaces of the power trim and tilt switch cover and install together with the power trim and tilt switch using the screws (921503-5206).

(6) Install the PT&T switch cover with the embossed UP letters on the stop switch side. Place the switch cover over the power trim and tilt switch and secure with the screws (921503-5512).
* In conformance with EFO types, install power trim and tilt switch cover B.

(7) Install cable assembly C, ensuring that all lines are connected to those of matching color. (Refer to the electric circuit diagram.)

(8) Once all lines have been connected, insert the grommet for cable assembly C into the switch box; then place ⓐ 4P coupler into the back of the switch box.
Tuck the remaining lines in above the 4P coupler to ensure they all fit neatly into the switchbox.

(9) After inserting the grommet (3B7-76035-0), install the switch box plate using the screws (921503-5510), while taking care not to pinch any lines.



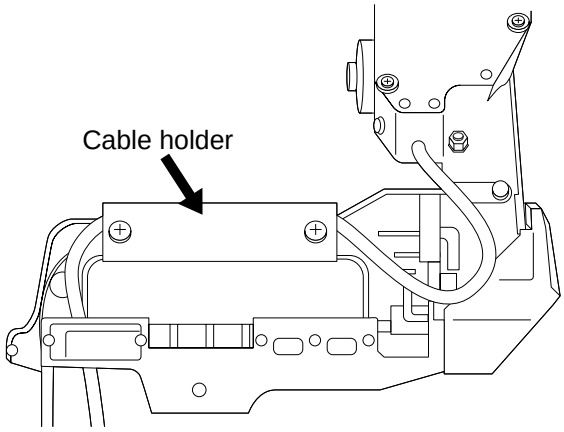
3. Installing Handle Assembly

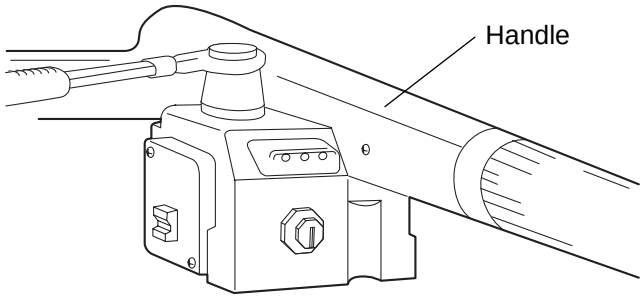
(1) Install the switch box on the handle using the bolt (910103-6625).

(2) Position the cable holder so that one end is approximately 200 mm from the cable outlet of the cable assembly C switch box; then press into place and secure to the steering bracket using the screws (921903-0625).

- Position the span of cable between the switch box outlet and the cable holder 200 mm away so that it is tucked against the underside of the steering handle holder.

- After installation, confirm that there is no excessive pulling or bending stress applied to the cable by moving the handle up and down.





4. Installing Handle To Engine

(1) Pass the cable assembly C cable the battery cables together through the grommet (3T5-67162-0), install handle bracket; then insert the grommet into lower cover.

(2) Connect cable assembly C to both cable assembly A and the neutral switch.

- Apply silicon grease to the plugs and seal surface of the neutral switch and connect.

- Secure cable assembly C and the oil hose together to the gearshift lever stopper to prevent them from interfering with the gearshift mechanism.

Chapter 9 Troubleshooting

1. **Troubleshooting Tables.....9-2**

2. **TLDI Self-Diagnosing Functions 9-14**

1. Troubleshooting Tables

This section on troubleshooting covers the various malfunctions and failures that can occur in the engine's electrical components. Notification of malfunctions and failures is provided using a system of warning beep (buzzer) and indicator lights.
This system of beeps and indicators is described in a separate section.

Symptom	Item		Self-diagnosable points	Beeps	Warning indicator A (oil)	Warning indicator B (water temp)	Warning indicator C (battery)
1. Starter motor dead or turns very slowly	1-1.	Gearshift					
	1-2.	Battery	◯				Flashing
	1-3.	Fuse					
	1-4.	Wiring					
	1-5.	Electrical components					
2. Engine turns over but won't start	2-1. Power head	Insufficient compression					
	2-2. Fuel system	Fuel tank					
		Low fuel pressure in air rail [normal: 0.6 to 0.64 MPa] 87 to 93 psi					
			◯		Flashing	Flashing	Flashing

Cause		Remedy (see chapter on Servicing Information for specs.)
1-1-1.	Gearshift in forward or reverse position.	Shift to neutral position.
1-2-1.	Battery low; or battery cables or circuit line connections may be loose or corroded.	Recharge or replace battery. Check battery terminal and cable condition.
1-3-1.	Burnt out fuse.	Check the 3 fuses. Check circuits connected to faulty fuse and repair as necessary.
1-4-1.	Severed wire or loose connection.	
1-5-1.	Faulty main switch, neutral switch, starter solenoid or starter motor.	Inspect and replace as necessary.
2-1-1.	Stuck piston ring.	Inspect and repair or replace as necessary.
2-1-2.	Reed valve fails to close, is worn or damaged.	
2-2-1.	Fuel is low or empty in tank.	Replenish fuel and perform step 2-2-3.
2-2-2.	Air vent is closed.	Open air vent and perform step 2-2-3.
2-2-3.	Fuel not coming to fuel lines.	Check primer valve for stiffness. Pinch primer valve, when it stiffens turn main switch ON for 2 seconds. Repeat until primer valve is sufficiently stiff.
2-2-4.	Fuel not fed to fuel lines after tank is filled.	
2-2-5.	Fuel filter is clogged.	Inspect fuel tank, boat and engine fuel filters and clean and replace as necessary.
2-2-6.	Water in fuel filter. (Indicated by floating of red float.)	
2-2-7.	Air pressure too low in air rail.	Refer to step 2-3.
2-2-8.	Clogged fuel lines.	Check for twisted, flattened or bent fuel lines.
2-2-9.	FFP (*1) does not function.	Confirm that sound of FFP assembly motor continues for approximately 2 seconds when the main switch is turned from OFF to ON.
2-2-10.	FFP (*1) internal components damaged.	Replace FFP.
2-2-11.	Internal leak in FFP (*1) case.	Replace rubber seal on internal components and inspect FFP.

Symptom	Item		Self-diagnosable points	Beeps	Warning indicator A (oil)	Warning indicator B (water temp)	Warning indicator C (battery)
2. Engine turns over but won't start	2-2. Fuel system	Low fuel pressure in air rail [normal: 0.6 to 0.64 MPa]					
		High fuel pressure in air rail [normal: 0.6 to 0.64 MPa] 87 to 93 psi					
	2-3. Air system	Low air pressure in air rail [normal: 0.53 to 0.57 MPa] 77 to 83 psi					
		High air pressure in air rail [normal: 0.53 to 0.57 MPa]					
	2-4. Electrical system	Fuse					
		Stop switch					
		Air injector					
		Spark plug					

Cause		Remedy (see chapter on Servicing Information for specs.)
2-2-12.	Fuel regulator leakage.	Replace.
2-2-13.	Fuel leakage.	Inspect piping and connectors for damage.
2-2-14.	Return circuit from fuel regulator outlet to vapor separator is clogged.	Inspect and repair.
2-2-15.	Faulty fuel regulator.	Replace.
2-2-16.	High air pressure in air rail.	Refer to steps 2-3-9 and 2-3-10.
2-3-1.	Loose nut on air hose connector.	Inspect and repair as necessary.
2-3-2.	Air filter is clogged.	Inspect and replace as necessary.
2-3-3.	Orifice is clogged.	Inspect and replace as necessary.
2-3-4.	Worn or damaged O-rings on air hose connector.	Inspect and repair as necessary.
2-3-5.	Collapsed air hose path.	
2-3-6.	Air regulator leakage.	Replace.
2-3-7.	Damaged reed valve in air compressor.	Inspect and replace as necessary.
2-3-8.	Worn cylinder or piston ring in air compressor.	
2-3-9.	Faulty air regulator.	Replace.
2-3-10.	Path downstream from air regulator is clogged.	Inspect and repair as necessary.
2-4-1.	Burnt out fuse.	Inspect for cause of fuse burn out (overload), and repair and replace fuse.
2-4-2.	Malfunctioning lock.	Inspect.
2-4-3.	Short circuit in stop switch.	Inspect and repair as necessary.
2-4-4.	Carbon buildup or damage to fuel injector.	Connect operational injector to each harness and confirm that injector generates clicking sound of normal operation when engine is turned over. Clean and replace as necessary.
2-4-5.	Faulty sparkplugs.	Repair gap to specifications. Replace if electrodes are excessively worn, cracked or damaged. Replace in cases of leakage or blackened electrodes due to carbon buildup. Replace if wet with fuel.

Symptom	Item		Self-diagnosable points	Beeps	Warning indicator A (oil)	Warning indicator B (water temp)	Warning indicator C (battery)
2. Engine turns over but does not start	2-4. Electrical system	Sparkplug cap.					
		Crank position sensor.					
		ECU					
		Self-diagnosing function indicates low (abnormal) battery voltage.	○				Flashing
		Self-diagnosing function indicates faulty components.	○				
		Self-diagnosing function indicates TPS idling position error.	○		Flashing	Flashing	Flashing
			○				
3. Engine starts but idling falters or is unstable	3 -1. Power head	Engine rpm abnormally low (seized up).					
		Low compression.					
	3-2. Fuel system	Fuel tank.					
		Fuel filter.					
		Low fuel pressure in air rail [normal: 0.6 to 0.64 MPa] 87 to 93 psi					

Cause		Remedy (see chapter on Servicing Information for specs.)
2-4-6.	Loose cap.	Inspect.
2-4-7.	Faulty cap.	Replace.
2-4-8.	Incorrect gap with encoder (flywheel).	Inspect and adjust.
2-4-9.	ECU not functioning.	Replace ECU.
2-4-10.	Battery low or less than 10V during turnover due to faulty starter motor voltage.	Recharge or replace battery. Check condition of cables and terminals. Inspect starter motor condition.
2-4-11.	Faulty components, connections or severed line in harness.	Inspect, repair and replace as necessary.
2-4-12.	TPS initial values incorrect.	Inspect and repair; then reset TPS. (*2)
2-4-13.	TPS (*1) and/or ECU have been replaced.	Reset TPS. (*2)
3-1-1.	Scratched piston or other factor causing increased resistance.	Inspect and repair.
3-1-2.	Piston rings stuck.	
3-1-3.	Reed valve fails to close, is worn or damaged.	
3-1-4.	Faulty cylinder head or engine base gasket.	
3-1-5.	Loose head bolts or crankcase bolts.	
3-2-1.	Fuel is low or empty in tank.	Refer to step 2-2-1.
3-2-2.	Air vent is clogged.	Refer to step 2-2-2.
3-2-3.	Water in fuel filter.	Inspect fuel tank, boat and engine fuel filters and clean and replace as necessary.
3-2-4.	Fuel filter is clogged.	
3-2-5.	Fuel lines are clogged.	Check for twisted, flattened or bent fuel lines.
3-2-6.	Lift pump (*1) not functioning.	Inspect, repair and replace as necessary.
3-2-7.	Leak in FFP (*1) case.	Refer to step 2-2-11.

Symptom	Item		Self-diagnosable points	Beeps	Warning indicator A (oil)	Warning indicator B (water temp)	Warning indicator C (battery)
3. Engine starts but idling falters or is unstable	3-2. Fuel system	Low fuel pressure in air rail. [normal: 0.6 to 0.64 MPa] 87 to 93 psi					
		High fuel pressure in air rail. [normal: 0.6 to 0.64 MPa]					
	3-3. Air system	Low air pressure in air rail. [normal: 0.53 to 0.57 MPa]					
		High air pressure in air rail.					
	3-4. Electrical system	Spark plugs					
		Spark plug caps					
		Self-diagnosing function indicates faulty components.	○				
		Self-diagnosing function indicates faulty TPS idling position.	○		Flashing	Flashing	Flashing
			○				
		Air injector					
4. Engine idles too high	4-1. Electrical system	Variable idling switch					
		Self-diagnosing function indicates faulty TPS idling position.	○		Flashing	Flashing	Flashing
			○		Flashing	Flashing	Flashing
5. Engine unstable above 3,000 rpm	5-1.	Spark plugs					
	5-2.	Engine rpm control					
	5-3.	Fuel pressure or air pressure too low.					
	5-4.	TPS (*1) not functioning.	○		Flashing	Flashing	Flashing
6. No acceleration at full throttle	6-1. Engine compression	Advancer arm is poor movement.					
		Faulty compression.					

Cause		Remedy (see chapter on Servicing Information for specs.)
3-2-8.	Fuel regulator leakage.	Refer to steps 2-2-12.
3-2-9.	Fuel leakage.	Refer to step 2-2-13.
3-2-10.	Low compression in air rail.	Refer to step 2-3.
3-2-11.	Faulty fuel regulator.	Replace.
3-2-12.	Return circuit from fuel regulator outlet to vapor separator is clogged.	Inspect and repair.
3-3-1.		Refer to step 2-3.
3-3-2.		
3-4-1.		Refer to step 2-4-3.
3-4-2.	Loose cap.	Inspect.
3-4-3.	Faulty cap.	Replace.
3-4-4.	Faulty components or connections.	Inspect, repair and replace as necessary.
3-4-5.	TPS initial values incorrect.	Refer to step 2-4-13.
3-4-6.	TPS (*1) and/or ECU have been replaced.	Refer to step 2-4-13.
3-4-7.	Malfunction.	Connect operational injector to each harness and confirm that injector generates clicking sound of normal operation when engine is turned over. Clean and replace as necessary.
4-1-1.	Idling speed setting was changed.	Use variable idling switch to set idling speed.
4-1-2.	TPS initial values in correct.	Refer to step 2-4-13.
4-1-3.	TPS (*1) and/or ECU have been replaced.	Refer to step 2-4-13.
		Refer to step 2-4-3.
		Refer to step 10-1.
		Refer to step 3-3
		Refer to steps 2-4-12 and 2-4-13.
6-1-1.	Remote control cable not properly installed.	Inspect and replace as necessary.
6-1-2.	Disfiguration or wear of throttle link components.	Inspect and adjust.
6-1-3.	Scratches on piston or cylinder liner.	Inspect and repair as necessary.
6-1-4.	Carbon buildup in combustion chamber.	
6-1-5.	Excessive wear or sticking of piston ring.	

Symptom	Item		Self-diagnosable points	Beeps	Warning indicator A (oil)	Warning indicator B (water temp)	Warning indicator C (battery)
6. No acceleration at full throttle	6-1. Power head	Faulty compression					
	6-2. Air system	Low air pressure in air rail					
		High air pressure in air rail					
	6-3. Fuel system	Fuel tank					
		Fuel Hose					
		Fuel filter					
		Low air pressure in air rail [normal value: 0.6 to 0.64 MPa] 87 to 93 psi					
	6-4. Electrical system	Spark plugs					
		Air injector					
		Self-diagnosing function indicates faulty components.	○				
7. Engine accelerates, boat speed does not increase	7-1. Outboard engine	Propeller					
		Installation					
		Boat					
8. Unable to turn off engine with main switch	8-1. Electrical system	Main switch					
		Stop switch					
		Ground line					

Cause		Remedy (see chapter on Servicing Information for specs.)
6-1-6.	Faulty oil seal on crankcase.	Inspect and repair as necessary.
6-2-1.		Refer to step 2-3.
6-3-1.	Fuel is low or empty in tank.	Refer to step 2-2-1.
6-3-2.	Air vent is clogged.	Refer to step 2-2-2.
6-3-3.	Air being sucked in through cracks or faulty connectors.	Inspect and repair as necessary.
6-3-4.	Water in fuel filter.	Inspect and clean as necessary.
6-3-5.	Fuel filter is clogged.	Inspect fuel tank, boat and engine fuel filters and clean and replace as necessary.
6-3-6.	Fuel lines are clogged.	Check for twisted, flattened or bent fuel lines.
6-3-7.	Lift pump (*1) not functioning.	Inspect, repair and replace as necessary.
6-3-8.	Leak in FFP (*1) case.	Inspect rubber seal on internal components and inspect electric fuel pump.
6-3-9.	Leakage in fuel regulator.	Replace.
6-3-10.	Fuel leakage.	Inspect lines and connectors for wear and damage.
6-3-11.	Low air pressure in air rail.	Refer to step 2-3.
6-4-1.		Refer to step 2-4-3.
6-4-2.	Carbon buildup in fuel injector.	Inspect, clean and replace as necessary.
6-4-3.	Faulty connection or component.	Inspect, repair and replace as necessary.
7-1-1.	Incorrect propeller pitch.	Inspect, repair and replace as necessary.
7-1-2.	Propeller is slipping.	
7-1-3.	Propeller is warped or damaged.	
7-1-4.	Transom length unsuitable for boat.	Inspect and adjust.
7-1-5.	Incorrect trim angle.	
7-1-6.	Boat bottom is dirty.	Inspect and clean as necessary.
7-1-7.	Incorrect loading position.	Inspect and adjust.
7-1-8.	Overloading of boat.	
7-1-9.	Problem with shape of boat.	
8-1-1.	Faulty electrical contact on main switch or severed line in harness.	Inspect, repair and replace as necessary.
8-1-2.	Faulty contract on stop switch or severed line in harness.	
8-1-3.	Faulty ground line contact or severed line in harness.	

Symptom	Item		Self-diagnosable points	Beeps	Warning indicator A (oil)	Warning indicator B (water temp)	Warning indicator C (battery)
9. Poor acceleration at full throttle or sudden drop down to idling speed	9-1. Electrical control system	Cooling water temperature too high (temp. indicator flashes)	○	Continuous		Flashing	
			○	Continuous		Flashing	
		Battery voltage abnormally high (battery indicator flashes)	○				Flashing
			○				Flashing
		TPS not functioning	○		Flashing	Flashing	Flashing
	9-2. Remote control system	Advancer arm not functioning					
10. Unable to exceed 3000 rpm at full throttle or suddenly drops and stays at 3000 rpm	10-1. Electrical control system	Cooling water temperature too high (temp. indicator flashes)	○	Continuous		Flashing	
			○	Continuous		Flashing	
			○	Continuous		Flashing	
			○	Continuous		Flashing	
		Battery voltage abnormally low (battery indicator flashes)	○				Flashing
			○				Flashing
			○				Flashing
			○				Flashing
			○				Flashing
		TPS not functioning	○		Flashing	Flashing	Flashing
		Remote control					

*1. TPS: abbreviation for throttle position sensor
FFP: abbreviation for fuel-feed pump (electric pump)
Lift pump: diaphragm type fuel pump

*2. TPS reset: TPS reset required under following conditions
① Indicates occurrence of TPS error due to remote control cable setup. Readjust cable.
② Indicates that TPS and/or ECU have been replaced.
③ Indicates that the link or rod snap ring is replaced due to warpage or wear in linkage.
Refer to the section on self-diagnosis functions and reset the TPS to its initial values.

Cause		Remedy (see chapter on Servicing Information for specs.)
9-1-1.	Cooling water inlet is clogged.	Inspect.
9-1-2.	Faulty water pump.	Inspect, repair and replace as necessary.
9-1-3.	Faulty battery or 2 batteries connected in series.	Inspect.
9-1-4.	Faulty rectifier regulator.	Inspect and replace as necessary.
9-1-5.	Faulty TPS, faulty wiring connections or severed line in harness.	Inspect, repair and replace as necessary.
9-1-6.	Wiring connections for TPS connectors (TPS1, TPS2) are reversed.	Reconnect at proper installation location.
9-2-1.	Remote control cable unit incorrectly installed or fault in remote control box.	Inspect, repair and replace as necessary.
10-1-1.	Cooling water inlet clogged.	Inspect.
10-1-2.	Faulty water pump.	Inspect, repair and replace as necessary.
10-1-3.	Faulty thermostat.	
10-1-4.	Cooling water path clogged.	
10-1-5.	Faulty battery.	Replace.
10-1-6.	Faulty charging coil.	Inspect and replace as necessary.
10-1-7.	Faulty wiring to charging coil.	Inspect and repair as necessary.
10-1-8.	Faulty battery cables or connectors.	
10-1-9.	Faulty rectifier regulator.	Inspect and replace as necessary.
10-1-10.	Faulty TPS, faulty wiring connections or severed line in harness.	Inspect, repair and replace as necessary.
10-1-11.	Engine was started with neutral warm-up lever raised.	Return lever to normal position and restart.

2. TLDI Self-Diagnosing Functions

The TLDI engine self-diagnosing function is used to display detailed information on the locations of faults in the electrical system that have been detected by the engine control unit (ECU). Special devices, such as monitoring equipment and personal computers, are not required for the self-diagnosis function. It utilizes a system of key switch operation, tachometer readings and three types of warning indicator lights to provide the information required for the four operating modes listed below.

That TLDI self-diagnosis function is comprised of the following four modes.

Mode 1: tachometer operation test
Mode 2: engine operating time display
Mode 3: fault location and fault log display
Mode 4: fault log delete

(1) Glossary of Self-Diagnosis Terminology

Key switch:

On the EP models, the key switch is located on the remote control box. On the EF models, it is located on the switchbox attached to the tiller handle. There are four key positions, the Off, On, Start and the key pressed at On position. The self-diagnosing function is used with the key in the On position.

Warning indicators:

On the EP models, the warning indicators are installed on the tachometer. On the EF models, they are installed on the switch box attached to the tiller handle.

All three indicators flash and beeps sound when a fault or failure is detected in an electrical component. (Refer to Warning Indicator Definition Table.)

The self-diagnosing function uses the three indicator lights in combination with the tachometer to indicate the type of malfunction or failure that has occurred.

(Refer to Fault Indication Table.)

Beeper:

On the EP models, the beeper is located on the remote control box. On the EF models, it is located on the swithch box. The beeper emits the following four sound patterns.

Long beep: 2 seconds

Short beep: 0.3 seconds

Intermittent short beep: 3 short beeps at 2 minute intervals

Continuous uninterrupted beep

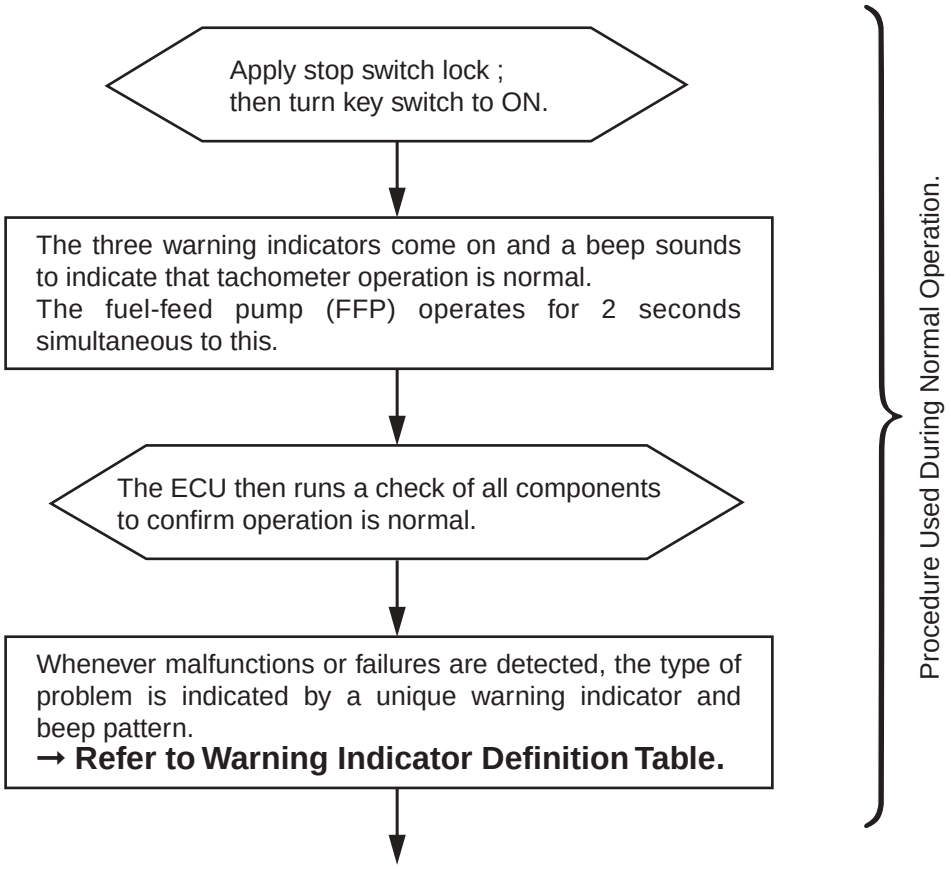
Fault log:

Any malfunctions or failures that have occurred in the past that the system has recovered from are logged in the ECU memory.

The self-diagnosing function is able to access this fault log information.

(2) Self-Diagnosing Function Procedures

- The self-diagnosing function can only be enabled when the engine is not running.
- The self-diagnosing function can be terminated during any of the steps listed below by simply turning the key switch to the Off position.
- Note that the optional tachometer and cable are required when using the self-diagnosing function with the EF models.



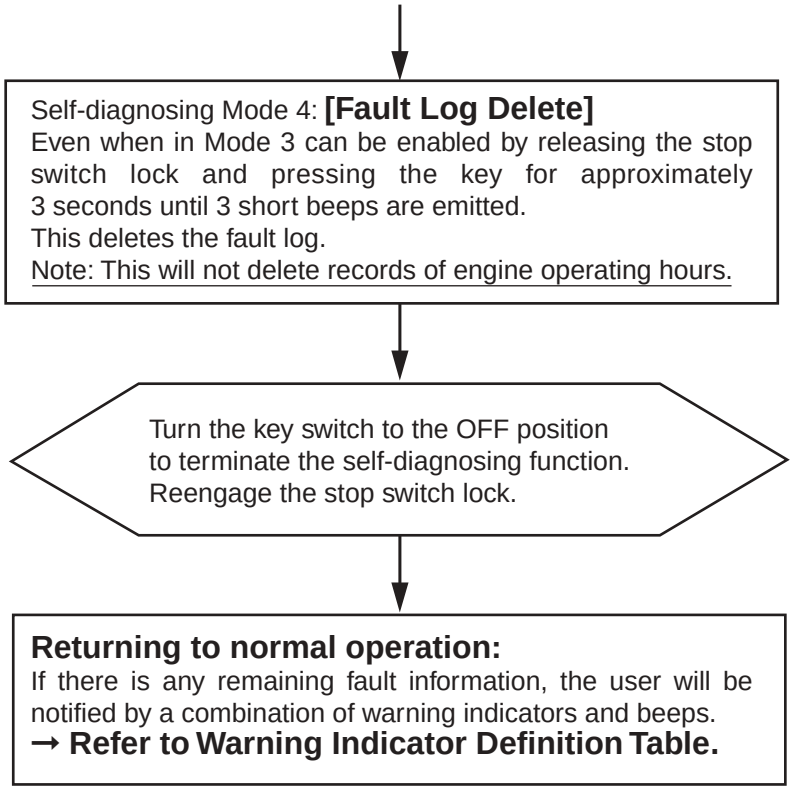
With the switch in the ON position,
press the key for a period of approximately
5 seconds until a beep sounds.

Self-diagnosing Mode 1: **[Tachometer Operation Test]**
Mode 1 starts with two long beeps as the tachometer needle points to 5,000 rpm.
The needle then returns to 0 and operation automatically proceeds to Mode 2.

Self-diagnosing Mode 2: **[Engine Operating Hours Display]**
This Mode displays the number of engine operating hours on the tachometer in combination with the three warning indicators.
→ Refer to Engine Operating Hours Table.

With the key in the On position, press for approximately
1 second until the beep sounds to enable Mode 3.

Self-diagnosing Mode 3: **[Fault Location and Fault Log Display]**
This Mode displays after one short beep sounds, the fault location and fault log for first incident at a time using the tachometer in combination with the three warning indicators.
→ Refer to the Fault Indication Table.
The locations and logs for successive faults can be viewed by pressing for approximately 1 second until the beep sounds with the key switch in the ON position.
Once Mode 3 has been used to display the location and log information for all recorded faults, the display goes blank.
Pressing the key switch at this point will repeat display of location and log information from the first fault.
Note that nothing is displayed if there is currently no recorded fault information.
(Tachometer and warning indicators are inactive.)



Note: The self-diagnosing function can be terminated during any of the steps listed above by simply turning the key switch to the OFF position.

Warning Indicator Definition Table ···· while operating engine

Warning indicators				ESG speed control (*1)	Fault Description	Reference	Remedy
Beeps	Indicator A	Indicator B	Indicator C				
Continuous	×	×	×	High-speed	Engine overrun	Approx. 6,000 rpm	Readjust propeller and outboard engine mounting height and trim.
Intermitten (3 short every 2 minutes)	Flashing	×	×	—	Oil level low	Approx. 350 ml or less	Replenish engine oil.
Continuous	×	Flashing	×	Low-speed	Cooling water temp. high		Refer to troubleshooting table.
Continuous	×	Flashing	×	Forced idling	Cooling water temp. abnormally high		
—	×	×	Flashing	Low-speed	Battery voltage abnormally low	Approx. 9V or less	
—	×	×	Flashing	—	Battery voltage low	Approx. 10V or less	
—	Flashing	Flashing	Flashing	—	Battery voltage high	Approx. 18V or more	Refer to Fault Indication Table used for self-diagnosing function.
—	Flashing	Flashing	Flashing	Forced idling	Battery voltage abnormally high	Approx. 20V or more	
—	Flashing	Flashing	Flashing	—	Faulty TPS (*2) idle position		
—	Flashing	Flashing	Flashing	Forced idling	Faulty TPS	TPS1 & TPS2	
—	Flashing	Flashing	Flashing	Low-speed	Faulty TPS	TPS1 & TPS2	
—	Flashing	Flashing	Flashing	Forced idling	Faulty TPS power supply	TPS1 & TPS2	
—	Flashing	Flashing	Flashing	Low-speed	Faulty TPS power supply	TPS1 & TPS2	
—	Flashing	Flashing	Flashing	—	Faulty air injector		* 1: ESG speed control High-speed : regulated to approx. 6,000 rpm. Low-speed : regulated to approx. 3,000 rpm. Forced idling : regulated to idling speed. * 2: TPS : abbreviation for throttle position sensor. * 3: FFP : abbreviation for fuel-feed pump. * 4: CPS : abbreviation for crank position sensor.
—	Flashing	Flashing	Flashing	—	Faulty fuel injector		
—	Flashing	Flashing	Flashing	—	Faulty ignition coil		
—	Flashing	Flashing	Flashing	—	Faulty FFP (*3)		
—	Flashing	Flashing	Flashing	—	Faulty CPS (*4)		
—	Flashing	Flashing	Flashing	—	Faulty engine temperature sensor		

Engine Operating Hours Table (Self-Diagnosing Mode 2)

Engine operating hours (h)	Tachometer reading (rpm)	Warning indicators		
		Indicator A	Indicator B	Indicator 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	—	—	On
8 – 9	900	—	—	On
10 – 14	1,000	—	—	On
14 – 24	2,000	—	—	On
25 – 34	3,000	—	—	On
35 – 44	4,000	—	—	On
45 – 54	5,000	—	—	On
55 – 64	6,000	—	—	On
65 – 74	7,000	—	—	On
75 – 84	800	—	On	On
85 – 94	900	—	On	On
95 – 149	1,000	—	On	On
150 – 249	2,000	—	On	On
250 – 349	3,000	—	On	On
350 – 449	4,000	—	On	On
450 – 549	5,000	—	On	On
550 – 649	6,000	—	On	On
650 – 749	7,000	—	On	On
750 – 849	800	On	On	On
850 – 949	900	On	On	On
950 – 1499	1,000	On	On	On
1500 – 2499	2,000	On	On	On
2500 or more	3,000	On	On	On

Fault Indication Table (Self-Diagnosing Mode 3)

Malfunction & failure indication		Description	Fault log	
			Fault	Fault log (yes)
Tachometer (rpm)	Indicator A		Indicator B	Indicator C
0	Off	No malfunction or failure	OFF	OFF
0	On	Battery voltage high	ON indicates severed line or component fault.	ON indicates severed line or component fault.
0	Flashing	Battery voltage abnormally high		
(*6) 500	Off	Oil level low	On indicates oil level low.	On indicates that low oil level occurred.
(*6) 500	On	Battery voltage low	On indicates battery voltage low.	On indicates that low battery voltage level occurred.
(*6) 500	Flashing	Battery voltage abnormally low		
1,000	Off	Faulty #1 air injector	Stays off, even when line is severed or component is faulty. → Refer to *1	→ Refer to *2
1,000	On	Faulty #1 fuel injector		
1,000	Flashing	Faulty #1 ignition coil		
2,000	Off	Faulty #2 air injector		
2,000	On	Faulty #2 fuel injector		
2,000	Flashing	Faulty #2 ignition coil		
3,000	Off	Faulty #3 air injector		
3,000	On	Faulty #3 fuel injector		
3,000	Flashing	Faulty #3 ignition coil		
(*6) 4,000	Off	Oil level low	On indicates oil level low.	On indicates that low oil level occurred.
(*6) 4,000	On	Battery voltage low	On indicates battery voltage low.	On indicates that low battery voltage level occurred.
(*6) 4,000	Flashing	Battery voltage abnormally low		
5,000	Off	Faulty CPS (*3)	On indicates that severed line or component fault.	On indicates that there was a severed line or component fault.
5,000	On	#1 TPS (*4) idling position error	On indicates incorrect TPS initial settings.	On indicates incorrect TPS default setting occurred.
5,000	Flashing	#2 TPS idling position error		
5,500	Off	Faulty #1 TPS	On indicates severed line or component fault.	On indicates that there was a severed line or a component fault.
5,500	On	#1 TPS power supply high		
5,500	Flashing	#1 TPS power supply low		
6,000	Off	Faulty #2 TPS		
6,000	On	#2 TPS power supply high		
6,000	Flashing	#2 TPS power supply low		
6,500	Off	Faulty water temp. sensor		
6,500	On	Cooling water temp. high	On indicates rise in cooling water temperature.	On indicates rise in cooling water temperature occurred.
6,500	Flashing	Cooling water temp. abnormally high		
7,000	Off	Faulty FFP (*5)	ON indicates severed line or component fault.	On indicates that there was a severed line or component fault.

* 3. CPS : abbreviation for crank position sensor
* 4. TPS : abbreviation for throttle position sensor
* 5. FFP : abbreviation for fuel-feed pump
* 6. : Rated value for oil level low, battery voltage low and battery voltage abnormally low indication is 500 rpm (50A#10001-#10957)or 4,000 rpm(50A#10958-,40A#40001-) depending on engine serial numbers.

Remedial Measures and Added Notes
Refer to troubleshooting tables.
Replenish engine oil. * Indicator B staying on after engine oil is replenished indicates severed or shorted line or faulty component.
Refer to troubleshooting tables.
Check wiring and connections and repair or replace components as necessary. * 1: With regard to injector and ignition coil faults, indicator B does not go on when self-diagnosing modes are enabled while the engine is off in order to determine operation under proper ECU control. * 2: Indicator C indicates that there is a severed line or fault in a component. → Remedy: Delete current fault log (using Mode 4), operate (or simply turn over engine for 5 or more seconds) the engine; then run the self-diagnosing function again to determine the type of fault. In cases where indicator C comes on for the same malfunction or failure, take remedial measures. → In the case of injectors ...Replace with new injector. If the fault remains, check the wiring. → In the case of ignition coils ...If only one is indicated as faulty, replace with new ignition coil. If the fault remains, check the wiring. ...If all three are indicated as faulty, it means that there could be a short in the wiring or in one of the ignition coils.
Replenish engine oil. * Fault indicator staying on after engine oil is replenished indicates severed or shorted line or faulty component.
Refer to troubleshooting tables.
Replace parts and check wiring and connections for fault; then repair as necessary. * Note that, even if there are no wiring or component problems, the indicators will indicate presence of a fault when engine speed fluctuations.
Refer to procedure for restoring TPS initial values.
Replace parts and check wiring and connections for faults, then repair as necessary.
Refer to troubleshooting tables.
Replace parts and check wiring and connections for fault; then repair as necessary.

(3) Resetting TPS Initial Values

Use the following procedures to reset of the ECU and TPS in cases where self-diagnosing indicates idling position errors for TPS1 and TPS2.

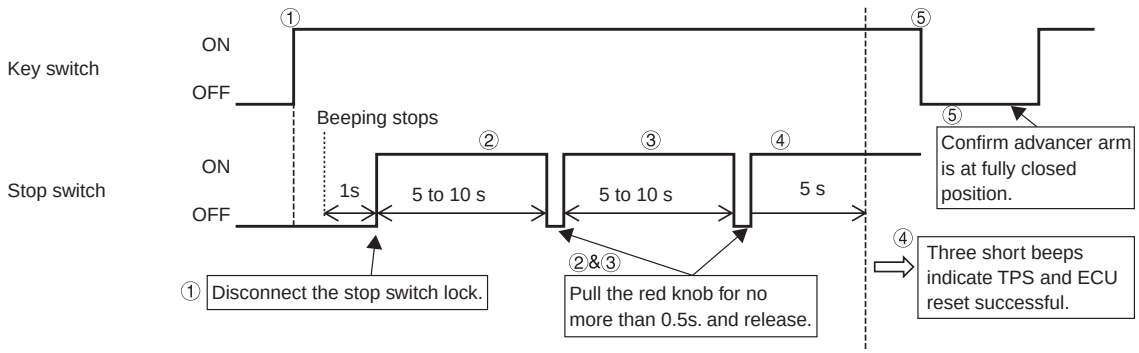
① When either the TPS or ECU is replaced:
② When the self-diagnosing function indicates [TPS idling position error]:
③ When links and rod snap rings are replaced due to warpage and wear in the linkage:
④ When the [TPS idling position error] indication appears after performing engine disassembly and assembly operations:
⑤ When engine is first put into service:

It is necessary to reset the ECU and the TPS if one of the above conditions occurs.

Reset Procedure

(1) With the throttle in the fully closed state, adjust the cables or wires in order to advance the advancer arm to the fully closed stopper position.
Then move the throttle several times to confirm that the arm is snug against the fully closed stopper.
(2) Perform the following procedures with the throttle in the fully closed state. (Refer to the chart below)
① Turned the key switch to the On position. Within one second after the beep (buzzer) stops sounding, disconnect the stop switch lock.
② Wait approximately 5 to 10 seconds (7 seconds to be exact); then pull the red knob on the stop switch for 0.5 second or less and release it.
③ Wait another 5 to 10 seconds (7 seconds to be exact); then pull the red knob on the stop switch again for 0.5 second or less and release it.
④ The sounding of 3 short beeps approximately 5 seconds after the knob is returned indicates a successful reset of the TPS and ECU.
If no beeps are heard, replace stop switch lock. And start again.
⑤ Next, turn the key switch to OFF, confirm that the throttle (advancer arm) is at the fully closed position; then turn the key switch to ON.

Reset Procedure Chart



Chapter 10 Test Run and Inspection After Servicing

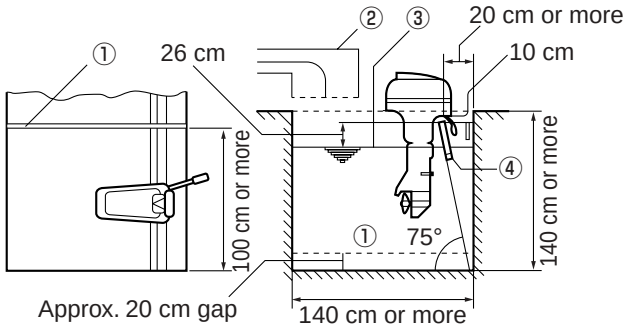
1. **Test Run Tank and Test Propeller.....10-2**
2. **Inspection.....10-3**

1. Test Run Tank and Test Propeller

● Test Run Tank Requirements and Precautions For Use

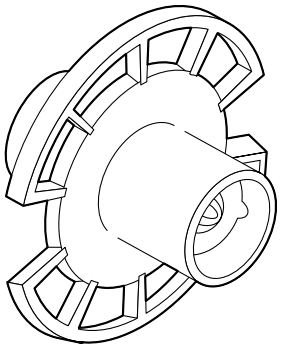
① Partition (required when testing two engines in one tank)
② Ventilation duct
③ Water level
④ Transom board

- The figure to the right shows the minimum dimensions required for the test run tank.
- The dimensions shown in the figure are the minimum that must be provided for a single engine, whether it be in a tank partitioned for two engines.



● Test Propeller

Out to diameter: 198 mm
Out width: 20 mm
Blade width: 40 mm



Engine speed at full throttle (rpm)
Approx. 5,000

● Precautions for Operation

- Continuous operation will raise the temperature of water in the tank, potentially causing the engine to seize up, so it is important to maintain water temperature in the 25°C (77°F) range. It is also recommended that cooling and overflow systems be installed.
- Over periods of continued use the tank water gradually becomes contaminated by the waste discharged from the engine. This waste, which eventually coats the interior of the engine's cooling system, will reduce the engine's cooling capability, so it is important to change tank water on a regular basis.
- Over periods of continued use, engine exhaust fumes will accumulate in the vicinity of the engine. Engine performance is affected as the engine takes in air with increasing levels of these gases from the the throttle body, so it is important to install mechanical ventilation system to maintain an exhaust gas-free environment around the engine.
- The water in the tank will tend to splash and spray out unless a sufficiently high of water is maintained in the tank.

2. Inspection

● Items to Check Prior to Test Run

- Fuel line condition
- Gearshift lever operation
- Electrical wiring, connections and clamps
- Operation, including catch, of reverse lock
- Integrity of self-diagnosing function
- Oil line condition

● Items to Check During the Test Run

Check the following items while the engine is in an idling state.

- Fuel leakage from the various joined seams of the engine.
- Water leakage from the various joined seams of the engine.
- Unusual sounds during operation.
- Idling speed and stability
- Stop switch operation
- Tachometer needle operation
- Clutch operation
- Engine speed during acceleration and deceleration
- Cooling water discharge (with sufficient force from water inspection hole)

● Additional Tightening After Test Run

- Retighten the various bolts to specified torque values.

● Breaking in Engine

- It is important to perform a breaking in of the engine in order to properly seat the sliding surfaces of the various parts in cases where pistons, piston rings, piston pins and cylinders have been replaced.
- Perform the various breaking in steps listed in the table below after pressure feeding engine oil and allowing the engine to idle for 30 minutes.
- Breaking in period: 10 hours.

Time	0 to 10 min. ➡	10 min. to 1 hr. ➡	1 hr. to 2 hrs. ➡	2 hrs. to 10 hrs. ➡	10 hours or more
Breaking in engine	At minimum speed At closed throttle	At half throttle	Full throttle for 1 minute, at 10 minute intervals At 3/4 throttle or less	At full throttle for short intervals At 3/4 throttle	At normal operating speed
Operating range		Approx. 3,000 rpm or less	Approx. 4,000 rpm or less	Approx. 4,000 rpm	5,150 to 5,850 rpm

Caution

- The use of inferior or non-standard fuels and oils can not only shorten engine life but can also cause starting problems and lead to breakdowns. Be sure to always use the designated fuel and engine oil types.
- Do not use a gasoline/oil mixture in this engine.

Chapter 11 Installation on Boat and Test Run

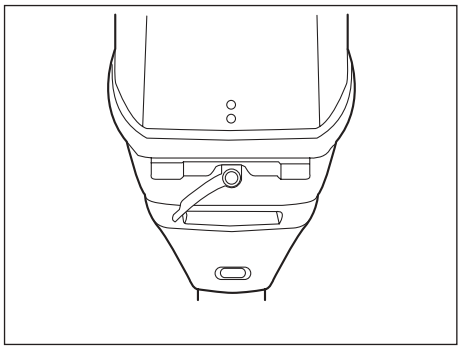
1. **Precautions for Using This Engine 11-2**
2. **Remote Control System 11-3**
3. **Gauges and Battery 11-4**
4. **Operating the Engine.....11-6**

1. Precautions for Using This Engine

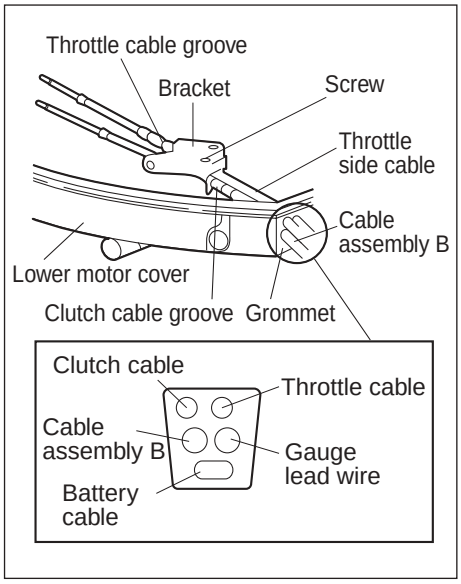
The other chapters in this manual provide general information required for using this outboard engine. This chapter is dedicated to only those points on which special user caution is required.

2. Remote Control System—Installing Cable (Engine side) for EP Series

① Pull the hook lever on the lower motor cover down to detach the upper motor cover.



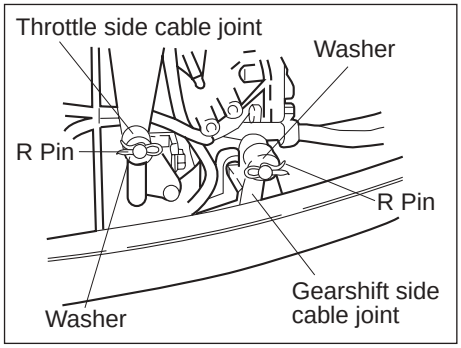
② Remove the bracket from the front of the lower motor cover; then pass cable assembly B and the remote control cable through the grommet. Install the grooved tip of the remote control cable in the bracket and secure the bracket to the lower motor cover using a Philips 420 screw.



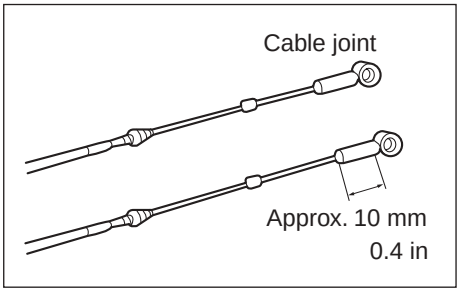
Remarks:

After fully loosening the screw (Philips 420), install the throttle and clutch cables as shown in the figure to the right; then tighten the screw again.

③ **Remove the R pins holding the throttle and gearshift side cable joints in place and remove both cable joints.**

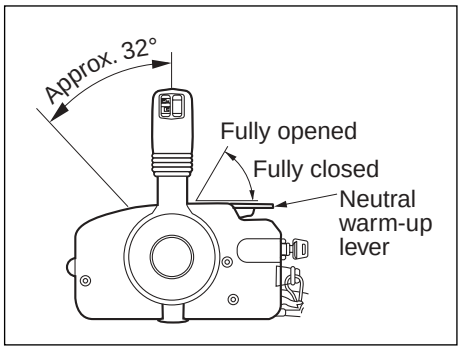


Screw the cable joint on to the tip of the remote control cable up to a length of approximately 10 mm.

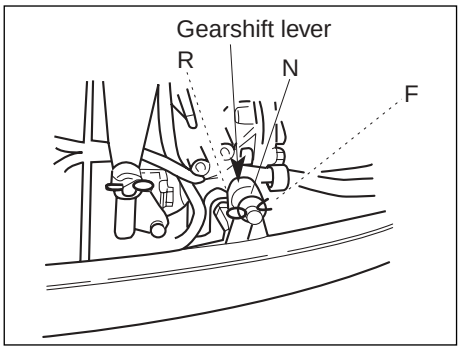


- While observing the cables, move the remote control box's remote control lever down in the forward direction until it stops (approx. 32°).The cable that moves first is the gearshift cable.
  * A distance of 10 mm (0.4 in) is equivalent to about nine threads on the joint.

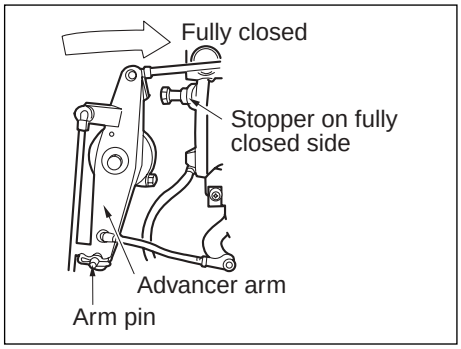
⑤ Confirm that the remote control lever on the remote control box is in Neutral and the neutral warm-up lever is in at the fully closed position.



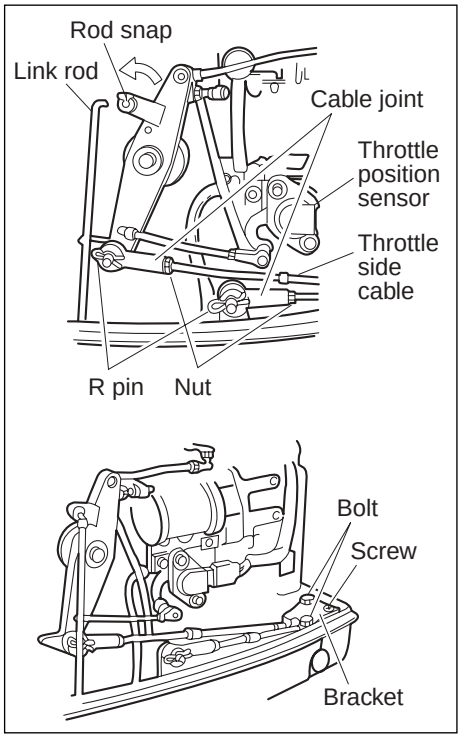
⑥ Move the gearshift lever to Forward, Neutral and Reverse; then back to Neutral.



⑦ Move the advancer arm to the fully closed position.



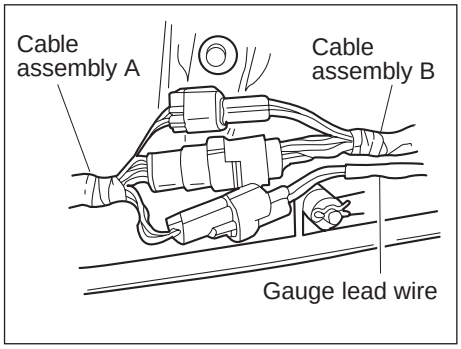
⑧ Turn the cable joint on the end of the remote control cable in order to line up the cable joint with the gearshift arm and advancer arm pins. Secure in place using the locknut; then insert the arm pin and secure it using the R pin and washers.



Remarks:

- Confirm that, when pushing the remote control lever fully down in the Forward and Reverse directions (approx. 32°), the outboard engine gears engage at a certain point and that, when pushed completely down, the throttle is at the fully opened position.
  Return the remote control lever to Neutral position and confirm that this also moves the advancer arm on the outboard engine to the fully closed position. Note that the throttle position sensor will malfunction unless the advancer arm is snug against the fully closed stopper. If it is not, remove and adjust the cable joint position on the engine side and reinstall.
- When attaching the throttle side cable to the advancer arm pin, be sure to remove the rod snap from the link rod as shown in the figure.

⑨ Connect both cable assembly B and the gauge lead wire to cable assembly A.



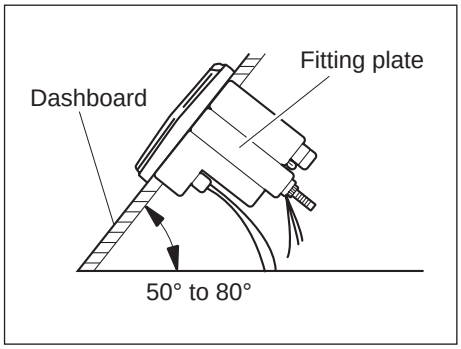
Caution:

Never disconnect the cable assemblies while the engine is in operation.

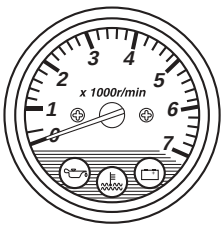
3. Gauges and Battery

1) Installing the Various Gauges

Be sure to install the various gauges on a proper dashboard in a location where they are protected from spray from the water. The dashboard may be anywhere from 2 to 11 mm (0.08 to 0.43 in) in thickness.
It will be necessary to install a separate fitting plate with holes cut to gauge sizes if thickness exceeds 11 mm (0.43 in).

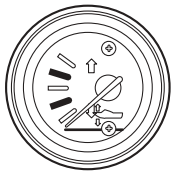


- Mounting angle
  The recommended installation angle for the dashboard is in the 50° to 80° range.



Cut mounting holes to bore size 85 mm

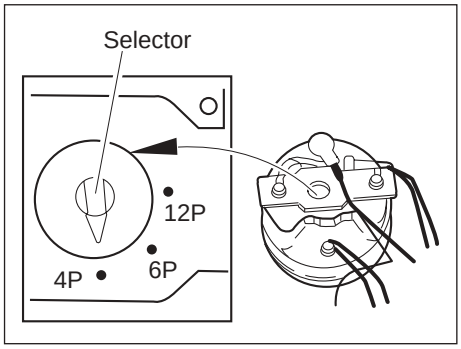
Tachometer



Cut mounting hole to bore size 52.5 mm

Trim gauge

- Tachometer (EP series)
  Turning the tachometer selector knob to the 4P setting.

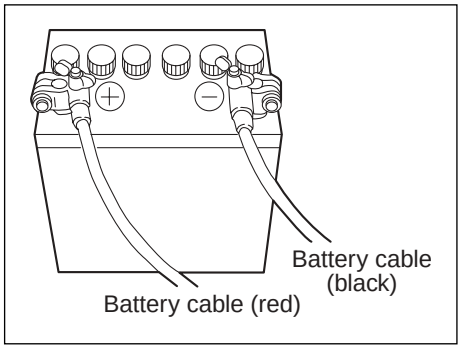


2) Installing Battery

This outboard engine requires battery power in order to operate. Use a 12V 100AH (or 12V 120AH in colder climates) battery.

① The battery should be secured in place in its own box to protect it from water spray and prevent it from tipping over with the movement of the boat.

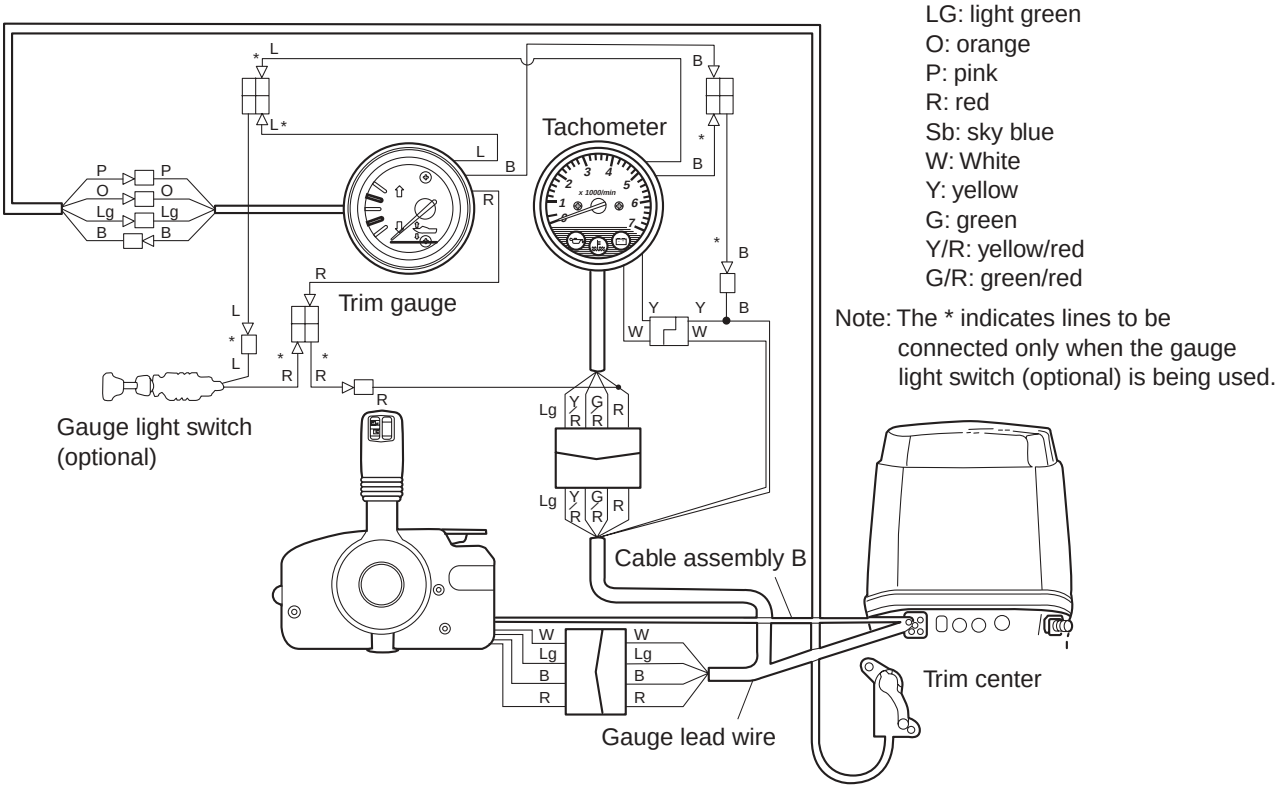
② Connect the battery cable with the red connector to the positive terminal and the cable with black connector to the negative terminal. (Be sure to remove the negative (black) connector first when disconnecting the cables.)
The battery cable enclosed in red plastic tubing is the one that connects to the positive terminal.



Caution:

- Be sure to carefully read the warning label on the battery prior to use.
- Never disconnect battery cables while the engine is in operation.

3) Wiring Diagram for Remote Control Unit and Gauges

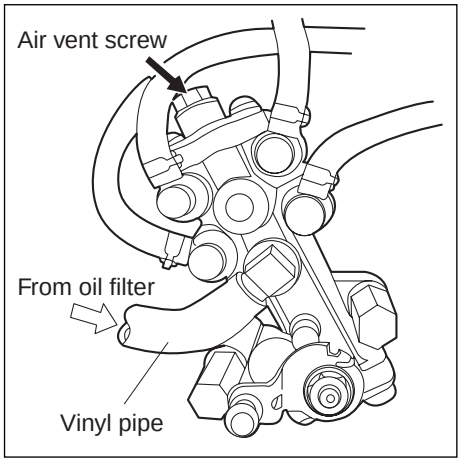


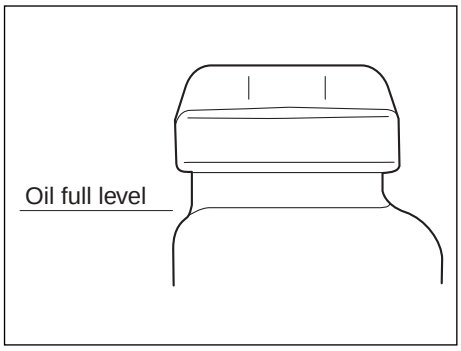
4. Operating the Engine

1) Starting Procedure

① Bleeding air from oil pump
Conduct a visual check of the clear vinyl pipes connecting the oil pump to the oil tank to inspect for the presence of air. Bleed hoses if necessary.

- Do this by loosening the air vent screw on the oil pump and bleeding until all air has been removed from the piping.
- Note that the air may not bleed out properly if the oil in the tank is too low. Make sure to fill the tank prior to bleeding air from the piping.

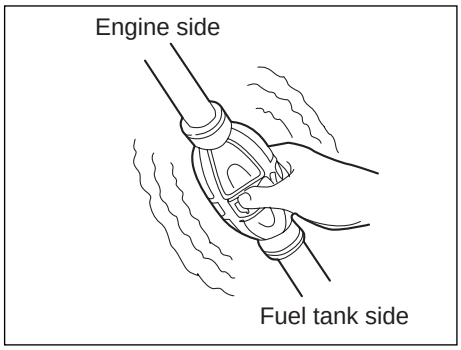




② Force-Feeding Fuel

The following fuel force-feeding procedure must be performed for engines that are new, overhauled, in storage for long periods or that ran out of fuel.

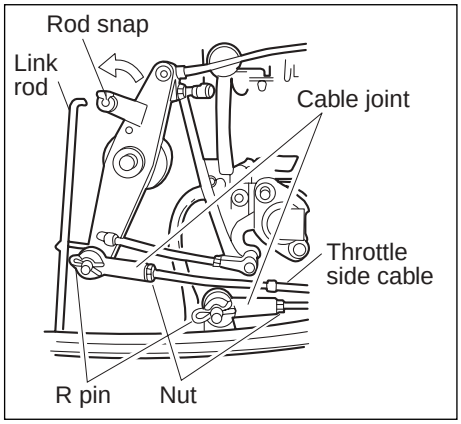
a. Begin by squeezing the primer bulb until it becomes firm.
b. Turn the main switch to On and hold for approximately 3 seconds. This actuates the fuel-feed pump (FFP).
c. Return the main switch to Off and squeeze the primer bulb once again until it becomes hard.
d. Repeat steps b and c until the primer bulb remains firm.

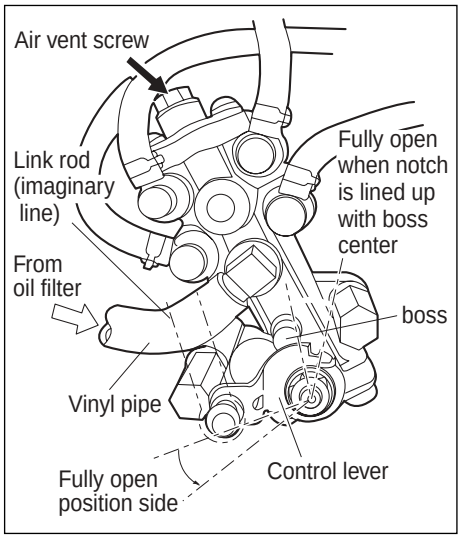


③ Force-Feeding Engine Oil

Perform the following oil force-feeding procedure for engines that are new, that have been serviced and reassembled, that have run out of oil or that have been stored for long periods.

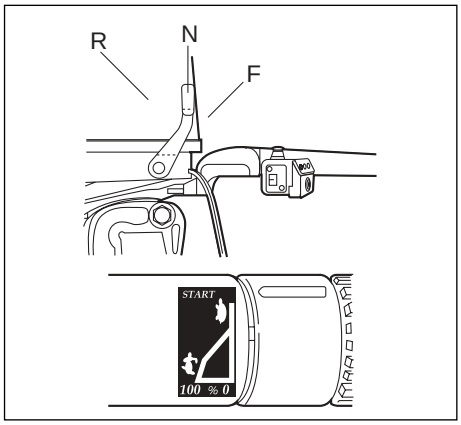
a. As shown in the figure to the right, turn the rod snap connected to the oil pump and remove the link rod.
b. Confirm that the control valve on the oil pump is set to the fully open position.
c. Operate the engine at idling speed for a minimum of 30 minutes.
d. Reattach the disconnected link rod to the rod snap.





EFO and EFTO Series

④ Confirm that the gearshift lever is in the Neutral position.



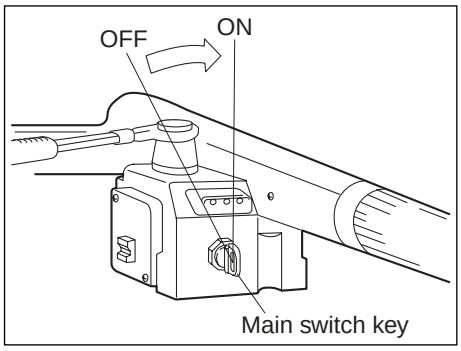
Remarks:

The engine will not start unless the gearshift lever is in Neutral (N).

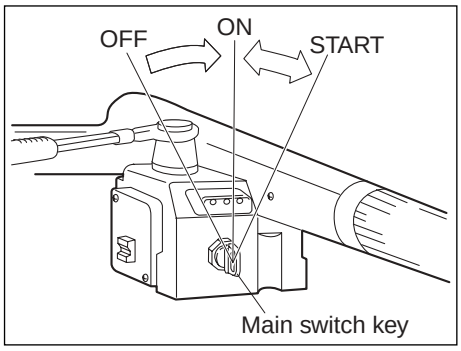
⑤ Turn the throttle grip to the START (fully closed) position.

Remarks:

Prior to turning the main switch key to ON, make sure that the throttle grip has been set to START(fully closed).
Mistakenly turning the key to ON with the throttle grip open will result in the operational error being recorded in the engine control unit (ECU). Repeating this error will, in turn, result in the 3 warning indicators flashing simultaneously.
Should this occur, turn the main switch key to OFF; then move the throttle grip to START (fully closed) and proceed to the next step.



⑥ Turn the main switch key to ON, when the beep stops (after 1 or 2 seconds) turn it to START and turn over the engine.
⑦ As soon as the engine starts, release the key.
The key will automatically return to its normal position.

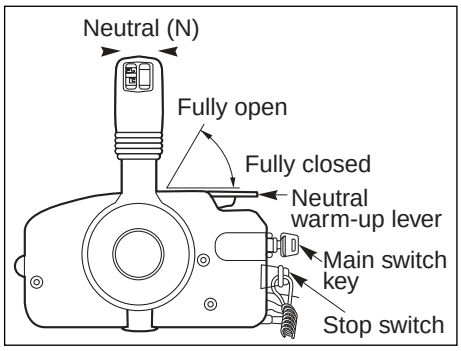


Remarks:

Turning the key to Start for a period of 1 second during engine idling or trolling has the effect of increasing engine speed. A beep sounds each time and engine speed increases progressively in the following increments.
700 rpm * 800 * 900 * 800 * 700 * 800 * 900 rpm

EPTO Series

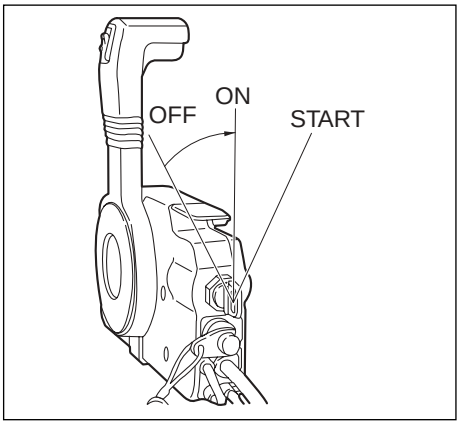
④ Insert the key in the switch.



Remarks:

The engine will not start unless the remote control lever is in the Neutral position.

⑤ Set the remote control lever to neutral.
Make sure that the neutral warm-up lever has been set to fully closed position.

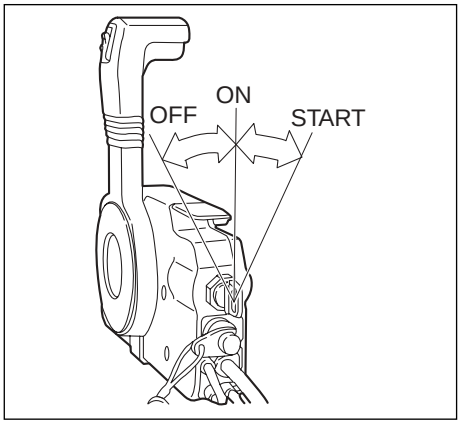


Remarks:

Prior to turning the main switch key to On, make sure that the neutral warm-up lever has been set to fully closed position.
Mistakenly turning the key to On with the neutral warm-up lever open will result in the operational error being recorded in the engine control unit (ECU). Repeating this error will in turn result in the 3 warning indicators flashing simultaneously.
Should this occur, turn the main switch key to Off; then move the neutral warm-up lever to fully closed position and proceed to the next step.

⑥ Turn the main switch key to On, when the beep stops (after 1 or 2 seconds) turn it to Start and turn over the engine.

⑦ As soon as the engine starts, release the key.
The key will automatically return to its normal position.



Remarks:

Turning the key to Start for a period of 1 second during engine idling or trolling has the effect of increasing engine speed. A beep sounds each time and engine speed increases progressively in the following increments.
700 * 800 * 900 * 800 * 700 * 800 * 900 rpm

2) Warning Process

Whenever engine trouble occurs, the warning indicators begin flashing and the beeper sounds.
The remedial actions described in the following sections must be taken whenever engine faults occur.

① Engine Speed Control System (ESG)
A sudden drop in engine load can cause the engine to race out of control. Whenever this condition occurs, the warning beeper sounds and the ESG mechanism is regulated.

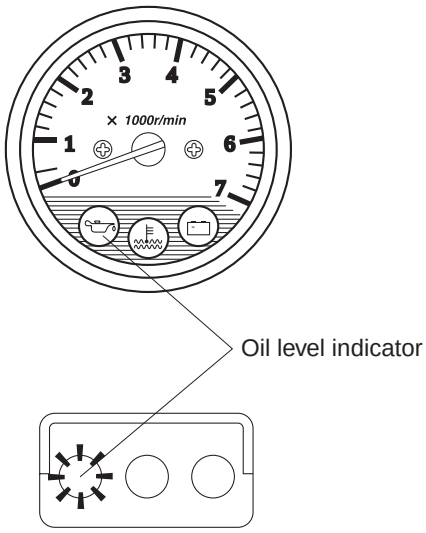
ESG regutated speed: approx. 6,000 rpm

② Oil Level Indicator
An oil level warning is displayed whenever the oil falls below the designated level (approx. 350 ml). The warning consists of flashing indicators accompanied by 3 short beeps at 2 minute intervals.
Note: The warning is displayed whether the gearshift lever is in the Neutral, Forward or Reverse positions.

Remedial Action:

Reduce engine speed, move the boat to a safe harbor and turn the main switch to OFF. Replenish the oil in the oil tank only after the engine has stopped. Restart the engine and confirm that the tachometer (or switchbox) warning indicators are off and the beeper stays silent.

Tachometer on EPTO series



Switchbox on EPO and EPTO series

③ Cooling Water Indicator

A water temperature warning is displayed and the engine automatically reduces speed whenever the cooling water rises above the designated level.

No.	Sensor setting	Regulated rpm
1	Threshold	2,800 to 3,200 rpm
2	Over threshold	700 to 900 rpm

Remedial Action:

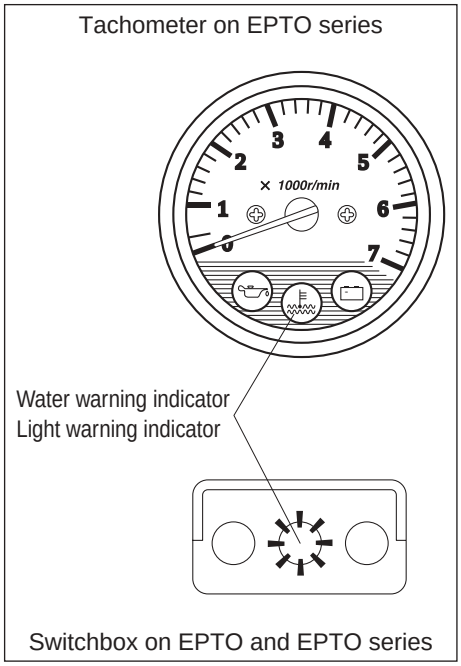
Quickly move the boat to a safe harbor, set the throttle grip or remote control lever to the low speed range and set the gearshift or remote control lever to the Neutral (N) position. Confirm whether cooling water is discharged with sufficient force from the water inspection hole; then turn off the engine. Remove any trash or plastic material from the vicinity of the gear case.

Remarks:

The following procedure is required to cancel the engine regulation mode once it has been activated, regardless of whether temperature has returned to normal.
Table No. 1: lower to idling speed.
Table No. 2: turn off engine.

Remarks:

This warning applies to only to cooling water temperature and is not related to fuel combustion and lubrication oil related warnings.

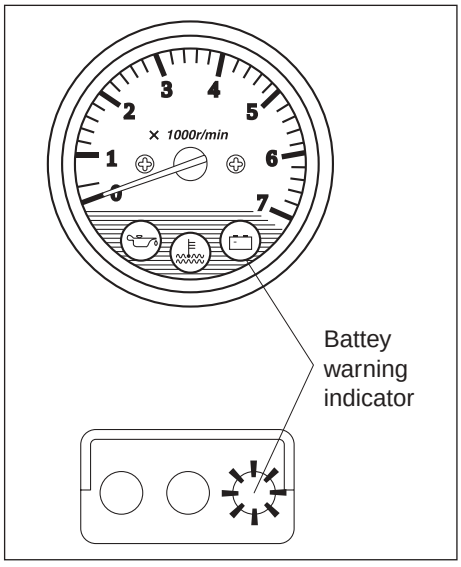


④ Battery Level Warning

- The battery warning indicator flashes when the battery level falls below 10V. All 3 warning indicators flash when battery voltage rises to abnormally high levels.
- The battery warning indicator flashes and engine speed is automatically reduced to the 2,800 to 3,200 rpm range when a battery fault occurs or there are faulty battery cable connections. Note that the engine will completely shut down in the case of serious faults.

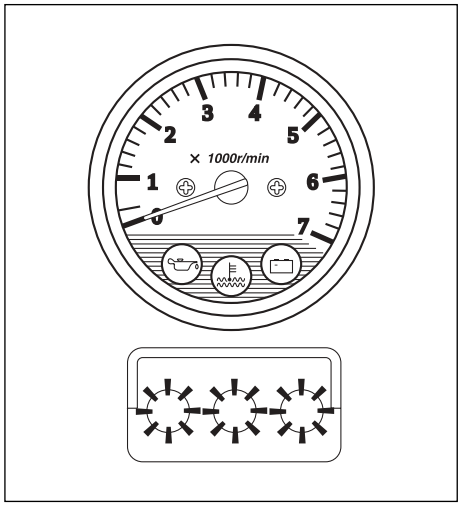
Remedial Action:

- Inspect and properly install battery connectors.
- Recharge battery.
- Replace battery.



⑤ Engine Trouble Warning

Whenever faults or engine trouble occur the three warning indicators begin flashing simultaneously.



Remarks:

One of the following three types of warnings is output, depending on the cause (seriousness) of the trouble.

1. Warning indicators only flash.
2. Warning indicators flash and engine speed is regulated to the 2,800 to 3,200 rpm range.
3. Warning indicators flash and engine speed is regulated to the 700 to 900 rpm range.

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No. 00321050-1
0209012600
Printed in Japan