

PREFACE

This manual covers the construction, function and servicing procedures of the Honda BF15D, BF20D Outboard Motors.

All information contained in this manual is based on the latest product information available at the time of printing. We reserve the right to make changes at anytime without notice.

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As you read this manual, you will find information that is preceded by a **NOTICE** symbol. The purpose of this message is to help prevent damage to the outboard motor, other property, or the environment.

SAFETY MESSAGES

Your safety, and the safety of others, are very important. To help you make informed decisions, we have provided safety messages and other safety information throughout this manual. Of course, it is not practical or possible to warn you about all the hazards associated with servicing these outboard motors. You must use your own good judgment.

You will find important safety information in a variety of forms, including:

- **Safety Messages** -- preceded by a safety alert **⚠** symbol and one of three signal words, **DANGER**, **WARNING**, or **CAUTION**.

These signal words mean:

⚠ DANGER You **WILL** be **KILLED** or **SERIOUSLY HURT** if you don't follow instructions.

⚠ WARNING You **CAN** be **KILLED** or **SERIOUSLY HURT** if you don't follow instructions.

⚠ CAUTION You **CAN** be **HURT** if you don't follow instructions.

- **Instructions** -- how to service this outboard motor correctly and safely.

Honda Motor Co., Ltd
Service Publication Office

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1. SPECIFICATIONS

DIMENSIONS AND WEIGHTS

BF15D

Model	BF15D					
Description Code	BALJ					
Type	SH	SHS	SR	LH	LHS	LR
Overall length	650 mm (25.6 in)		640 mm (25.2 in)	650 mm (25.6 in)		640 mm (25.2 in)
Overall width	350 mm (13.8 in)					
Overall height	1,110 mm (43.7 in)			1,240 mm (48.8 in)		
Dry weight (With propeller mounted)	46.5 kg (103 lb)	50.0 kg (110 lb)	50.5 kg (111 lb)	49.5 kg (109 lb)	53.0 kg (117 lb)	52.0 kg (115 lb)
Operating weight	47.9 kg (106 lb)	51.4 kg (113 lb)	51.9 kg (114 lb)	50.9 kg (112 lb)	54.4 kg (120 lb)	53.4 kg (118 lb)
Transom height	433 mm (17.0 in)			563 mm (22.2 in)		
Transom angle	5 stage adjustment (4° , 8° , 12° , 16° , 20°)					
Tilting angle	71°			72°		
Swivel angle	45° right and left					

BF20D

Model	BF20D					
Description Code	BAMJ					
Type	SH	SHS	SR	LH	LHS	LR
Overall length	650 mm (25.6 in)		640 mm (25.2 in)	650 mm (25.6 in)		640 mm (25.2 in)
Overall width	350 mm (13.8 in)					
Overall height	1,110 mm (43.7 in)			1,240 mm (48.8 in)		
Dry weight	46.5 kg (103 lb)	50.0 kg (110 lb)	50.5 kg (111 lb)	49.5 kg (109 lb)	53.0 kg (117 lb)	52.0 kg (115 lb)
Operating weight	47.9 kg (106 lb)	51.4 kg (113 lb)	51.9 kg (114 lb)	50.9 kg (112 lb)	54.4 kg (120 lb)	53.4 kg (118 lb)
Transom height	433 mm (17.0 in)			563 mm (22.2 in)		
Transom angle	5 stage adjustment (4° , 8° , 12° , 16° , 20°)					
Tilting angle	71°			72°		
Swivel angle	45° right and left					

ENGINE

Model	BF15D	BF20D
Type	Water cooled 4-stroke, overhead valve, vertical twin	
Displacement	350 cm ³ (21.5 cu. in)	
Bore x stroke	59 x 64 mm (2.3 x 2.5 in)	
Rated horsepower	11.0 kW (15 PS) at 5,000 min ⁻¹ (rpm)	14.7 kW (20 PS) at 5,500 min ⁻¹ (rpm)
Maximum torque	25.2 N·m (2.6 kgf·m, 18.8 lbf·ft) at 3,500 min ⁻¹ (rpm)	25.8 N·m (2.6 kgf·m, 18.8 lbf·ft) at 5,000 min ⁻¹ (rpm)
Compression ratio	9.2: 1	
Fuel consumption	313 g (11.0 oz.)/kWh	337 g (11.9 oz.)/kWh
Cooling system	Forced water circulation by impeller pump with thermostat	
Ignition system	CDI	
Ignition timing	0° ± 2° B.T.D.C.	
Spark plug	CR5EH-9 (NGK), U16FER9 (DENSO)	
Carburetor	Horizontal butterfly valve type single carburetor	
Lubricating system	Forced lubrication by trochoid pump	
Oil capacity	1.0 ℓ (1.06 US qt, 0.88 Imp qt) at oil change 1.3 ℓ (1.37 US qt, 1.14 Imp qt) with oil filter replacement	
Recommended oil	SAE 10W-30, API Service classification SG/SH/SJ	
Starting system	SH, LH Type: Recoil starter SHS, SR, LHS, LR Type: Electric starter and recoil starter	
Stopping system	Ignition primary circuit ground	
Fuel used	Automotive unleaded gasoline (minimum 86 pump octane)	
Fuel tank capacity	Steel tank: 13 ℓ (3.43 US gal, 2.86 Imp gal) Plastic tank: 12 ℓ (3.17 US gal, 2.64 Imp gal)	
Fuel pump	Mechanical plunger type	
Exhaust system	Under water type	

LOWER UNIT

Model	BF15D, BF20D	
Clutch	Dog clutch (Forward-neutral-reverse)	
Gear ratio	0.48 (13/27)	
Reduction type	Spiral bevel gear	
Gear case oil capacity	0.285 ℓ (0.27 US qt, 0.23 Imp qt)	
Propeller	Number of blades	4
	Diameter	235 mm (9-1/4 in)
	Pitch	203 mm (8.0 in)
	Rotating direction	Clockwise (viewed from rear)

BF15D·BF20D

Types of Honda BF15D/BF20D Outboard Motors

It may be necessary to refer to this chart for reference purposes when reading this manual.

Model	Type	Shaft length	Tiller handle	Remote control	Electric starter	Recoil starter	Charge coil	Starting enrichment system
BF15D/ BF20D	SH	S	●			●	6A	Manual
	SHS	S	●		●	●	12A	Automatic
	SR	S		●	●	●	12A	Automatic
	LH	L	●			●	6A	Manual
	LHS	L	●			●	12A	Automatic
	LR	L			●	●	12A	Automatic

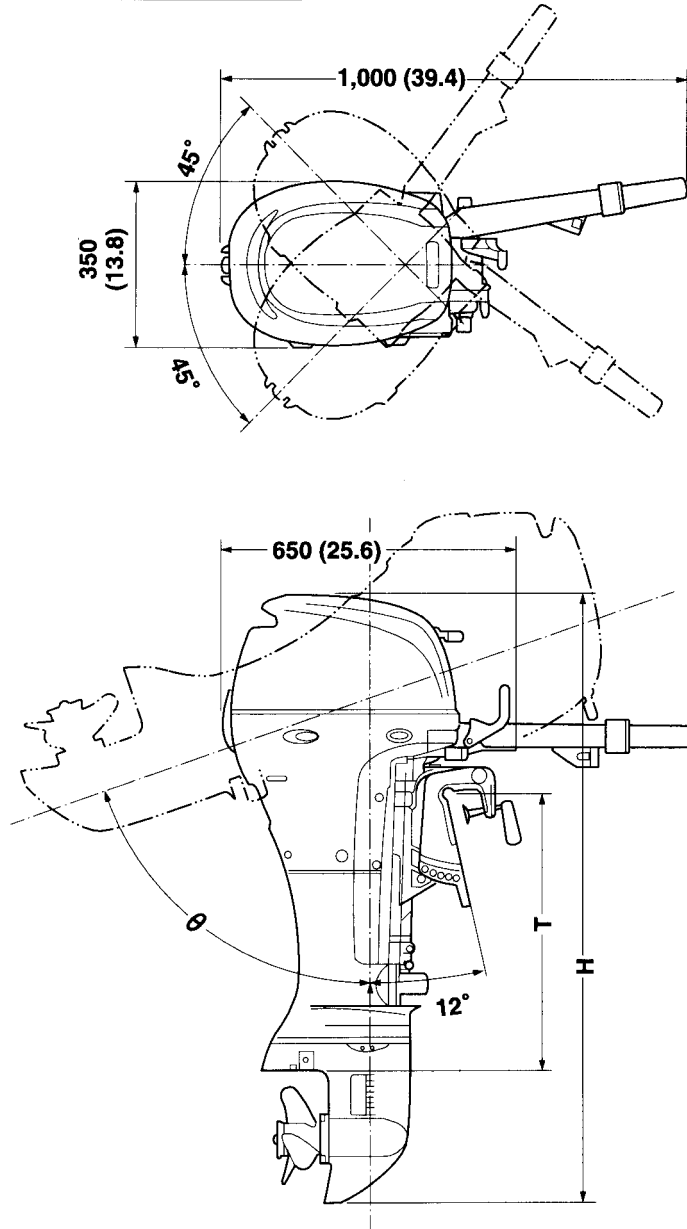
S: Short shaft L: Long shaft

2. DIMENSIONAL DRAWINGS

• Tiller Handle Type

[1] Type	H	T	θ
S	1,110 (43.7)	433 (17.0)	71°
L	1,240 (48.8)	563 (22.2)	72°

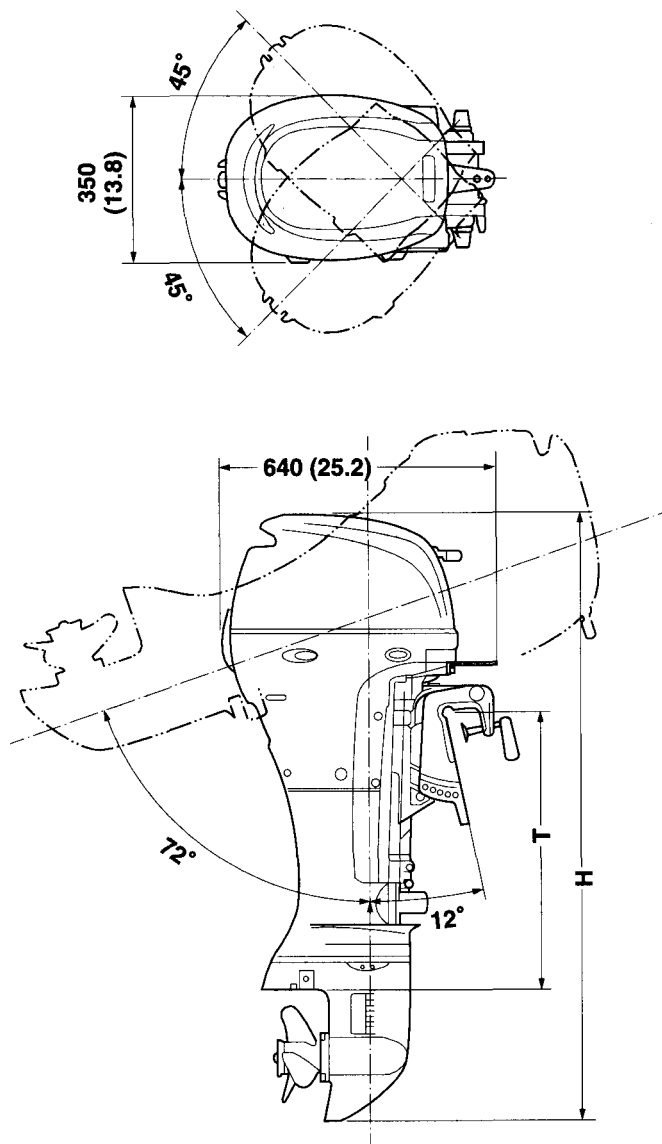
Unit: mm (in)



• Remote Control Type

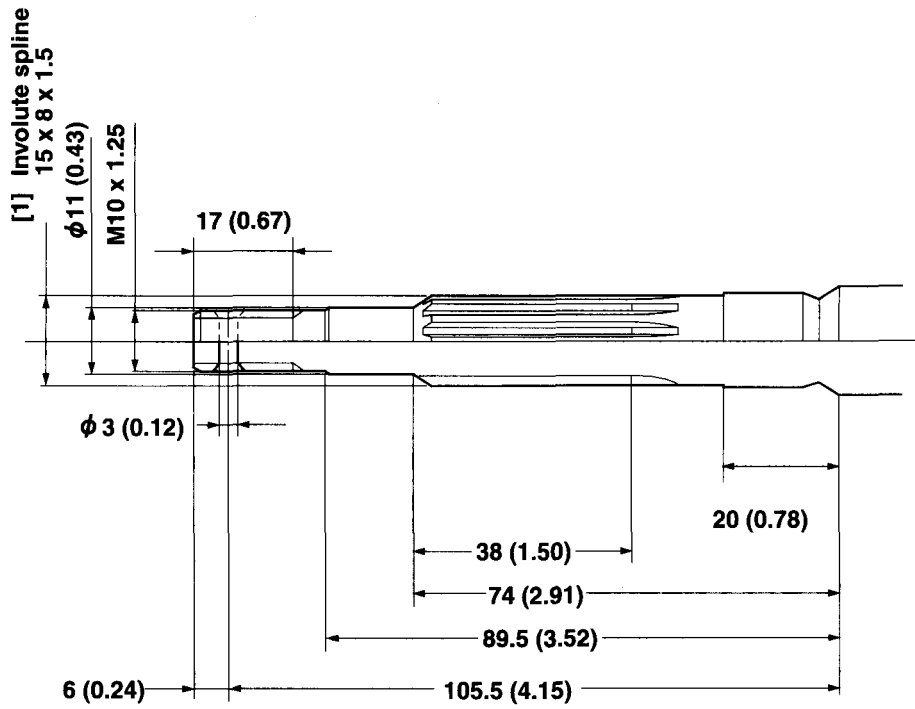
[1] Type	H	T
S	1,110 (43.7)	433 (17.0)
L	1,240 (48.8)	563 (22.2)

Unit: mm (in)



• Propeller Shaft Detail

Unit: mm (in)



- | | |
|---------------------------------------|----------------------------|
| 1. THE IMPORTANCE OF PROPER SERVICING | 6. TORQUE VALUES |
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| 3. SYMBOLS USED IN THIS MANUAL | 8. TROUBLESHOOTING |
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| 5. MAINTENANCE STANDARDS | 10. LUBRICATION POINTS |

1. THE IMPORTANCE OF PROPER SERVICING

Proper servicing is essential to the safety of the operator and the reliability of the engine. Any error or oversight made by the technician while servicing can easily result in faulty operation, damage to the engine or injury to the operator.

⚠ CAUTION

Improper servicing can cause an unsafe condition that can lead to serious injury or death.

Follow the procedures and precautions in this shop manual carefully.

Some of the most important precautions are given below. However, we cannot warn you of every conceivable hazard that can arise in performing maintenance or repairs. Only you can decide whether or not you should perform a given task.

⚠ WARNING

Failure to follow maintenance instructions and precautions can cause you to be seriously hurt or killed.

Follow the procedures and precautions in this shop manual carefully.

2. IMPORTANT SAFETY PRECAUTIONS

Make sure you have a clear understanding of all basic shop safety practices and that you are wearing appropriate clothing and using safety equipment. When performing any service task, be especially careful of the following:

- Read all of the instructions before you begin, and make sure you have the tools, the replacement or repair parts, and the skills required to perform the tasks safely and completely.
- Protect your eyes by using proper safety glasses, goggles, or face shields any time you hammer, drill, grind, or work around pressurized air or liquids, and springs or other stored-energy components. If there is any doubt, put on eye protection.
- Use other protective wear when necessary, for example gloves or safety shoes. Handling hot or sharp parts can cause severe burns or cuts. Before you grab something that looks like it can hurt you, stop and put on gloves.
- Protect yourself and others whenever you have engine-powered equipment up in the air. Any time you lift an outboard motor with a hoist, make sure that the hoist hook is securely attached to the outboard motor.

Make sure the engine is off before you begin any servicing procedures, unless the instruction tells you to do otherwise. This will help eliminate several potential hazards:

- Carbon monoxide poisoning from engine exhaust. Be sure there is adequate ventilation whenever you run the engine.
- Burns from hot parts. Let the engine and exhaust system cool before working in those areas.
- Injury from moving parts. If the instruction tells you to run the engine, be sure your hands, fingers, and clothing are out of the way.

Gasoline vapors and hydrogen gasses from batteries are explosive. To reduce the possibility of a fire or explosion, be careful when working around gasoline or battery.

- Use only a nonflammable solvent, not gasoline, to clean parts.
- Never drain or store gasoline in an open container.
- Keep all cigarettes, sparks, and flames away from all fuel-related parts.

3. SYMBOLS USED IN THIS MANUAL

As you read this manual, you may find the following symbols with the instructions.



: A special tool is required to perform the procedure.



: Apply grease.



: Apply oil.



: Indicates the diameter, length, and quantity of metric flange bolt used.

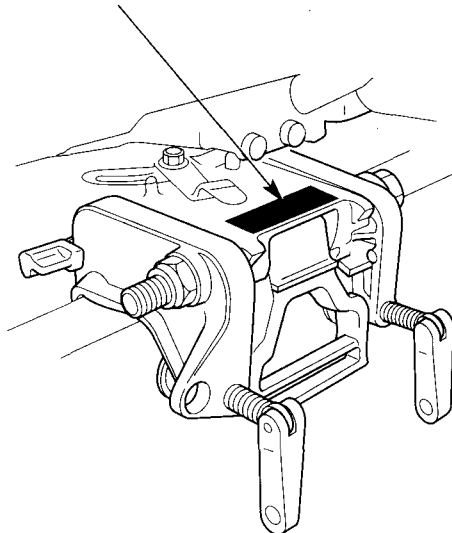


: Indicates the reference page.

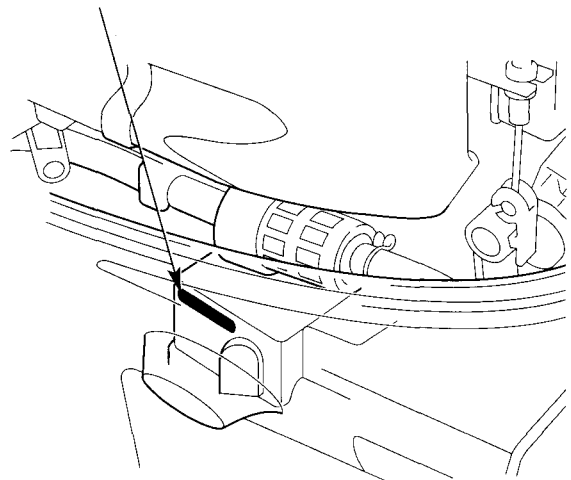
4. SERIAL NUMBER LOCATIONS

The engine serial number is located on the cylinder block and the frame serial number is located on the stern bracket. Always refer to these numbers when making technical inquiries or ordering parts in order to obtain the correct parts for the outboard motor being serviced.

FRAME SERIAL NUMBER



ENGINE SERIAL NUMBER



5. MAINTENANCE STANDARDS

• ENGINE

Part	Item	Standard	Service limit	
Engine	Idle speed (in neutral)	900 ± 50 min ⁻¹ (rpm)	—	
	Recommended full throttle rpm	BF15D	4,500 – 5,500 min ⁻¹ (rpm)	—
		BF20D	5,000 – 6,000 min ⁻¹ (rpm)	—
	Cylinder compression	1,370 ± 98 kPa (14.0 ± 1.0 kgf/cm ² , 199 ± 14 psi) at 600 min ⁻¹ (rpm)	—	
Cylinder heads	Warpage	0.05 mm (0.002 in) max.	0.08 mm (0.003 in)	
	Valve seat width	IN/EX 0.9 – 1.1 mm (0.035 – 0.043 in)	2.0 mm (0.08 in)	
	Camshaft journal I.D.	No. 1 20.000 – 20.021 mm (0.7874 – 0.7882 in)	20.05 mm (0.789 in)	
Valves	Clearance	IN	0.15 – 0.19 mm (0.006 – 0.007 in)	—
		EX	0.21 – 0.25 mm (0.008 – 0.010 in)	—
	Stem O.D.	IN	4.975 – 4.990 mm (0.1959 – 0.1965 in)	4.95 mm (0.195 in)
		EX	4.955 – 4.970 mm (0.1951 – 0.1957 in)	4.93 mm (0.194 in)
Valve guides	Guide I.D.	IN/EX 5.000 – 5.012 mm (0.1969 – 0.1973 in)	5.04 mm (0.198 in)	
	Stem-to-guide clearance	IN	0.010 – 0.037 mm (0.0004 – 0.0015 in)	0.07 mm (0.003 in)
		EX	0.030 – 0.067 mm (0.0012 – 0.0026 in)	0.12 mm (0.005 in)
Valve springs	Free length	33.28 mm (1.310 in)	32.0 mm (1.26 in)	
Rocker arms, rocker arm shaft	Shaft O.D.	12.962 – 12.980 mm (0.5103 – 0.5110 in)	12.92 mm (0.509 in)	
	Arm I.D.	13.000 – 13.018 mm (0.5118 – 0.5125 in)	13.04 mm (0.513 in)	
	Shaft-to-rocker arm clearance	0.020 – 0.056 mm (0.0008 – 0.0022 in)	0.07 mm (0.003 in)	
Camshaft	Camshaft axial play	0.05 – 0.30 mm (0.002 – 0.012 in)	0.4 mm (0.016 in)	
	Cam height (IN/EX)	BF15D	23.725 – 23.885 mm (0.9341 – 0.94041 in)	23.103 mm (0.9010 in)
		BF20D	24.976 – 25.136 mm (0.9833 – 0.9896 in)	24.493 mm (0.9643 in)
	Journal O.D.	No. 1	19.959 – 19.980 mm (0.7858 – 0.7866 in)	19.93 mm (0.785 in)
		Oil pump	15.966 – 15.984 mm (0.6286 – 0.6293 in)	15.94 mm (0.628 in)
Journal-to-shaft clearance	No. 1	0.020 – 0.062 mm (0.0008 – 0.0024 in)	0.08 mm (0.003 in)	
Oil pump	Rotor tip clearance	0.15 mm (0.006 in) max.	0.20 mm (0.008 in)	
	Outer rotor-to-body clearance	0.15 – 0.21 mm (0.006 – 0.008 in)	0.26 mm (0.010 in)	
	Rotor-to-pump body side clearance	0.04 – 0.09 mm (0.002 – 0.004 in)	0.12 mm (0.005 in)	
	Pump body I.D.	40.71 – 40.74 mm (1.603 – 1.604 in)	40.76 mm (1.605 in)	
	Pump body depth	12.04 – 12.07 mm (0.474 – 0.475 in)	12.11 mm (0.477 in)	
	Outer rotor height	11.98 – 12.00 mm (0.4717 – 0.4724 in)	11.96 mm (0.471 in)	
	Camshaft journal I.D.	16.000 – 16.018 mm (0.6299 – 0.6306 in)	16.05 mm (0.632 in)	
	Pump body-to-camshaft clearance	0.016 – 0.052 mm (0.0006 – 0.0020 in)	0.07 mm (0.003 in)	
	Pump body O.D.	30.950 – 30.975 mm (1.2186 – 1.2195 in)	—	
Fuel pump	Pump arm I.D.	13.000 – 13.080 mm (0.5118 – 0.5150 in)	13.10 mm (0.516 in)	
	Shaft-to-pump arm clearance	0.020 – 0.118 mm (0.0008 – 0.0046 in)	0.13 mm (0.005 in)	
Cylinders	Sleeve I.D.	59.000 – 59.015 mm (2.3228 – 2.3234 in)	59.055 mm (2.3250 in)	
	Warpage	0.07 mm (0.003 in) max.	0.10 mm (0.004 in)	

BF15D-BF20D

ENGINE (continued)

Part	Item		Standard	Service limit
Pistons	Skirt O.D.		58.970 – 58.990 mm (2.3216 – 2.3224 in)	58.92 mm (2.320 in)
	Piston-to-cylinder clearance		0.010 – 0.045 mm (0.0004 – 0.0015 in)	0.10 mm (0.004 in)
	Piston pin bore I.D.		16.002 – 16.008 mm (0.6300 – 0.6302 in)	16.02 mm (0.638 in)
Piston pins	Piston pin O.D.		15.994 – 16.000 mm (0.6297 - 0.6299 in)	15.97 mm (0.629 in)
	Piston-to-piston pin clearance		0.002 – 0.014 mm (0.0001 – 0.0006 in)	0.04 mm (0.002 in)
Piston rings	Side clearance	Top/second	0.025 – 0.055 mm (0.0010 – 0.0022 in)	0.10 mm (0.004 in)
		Oil	0.055 – 0.140 mm (0.0022 – 0.0055 in)	0.20 mm (0.008 in)
	End gap	Top	0.15 – 0.30 mm (0.006 – 0.012 in)	0.50 mm (0.020 in)
		Second	0.35 – 0.50 mm (0.014 – 0.020 in)	0.70 mm (0.028 in)
		Oil	0.20 – 0.80 mm (0.008 – 0.031 in)	1.0 mm (0.04 in)
	Thickness	Top/second	1.175 – 1.190 mm (0.0463 – 0.0469 in)	1.08 mm (0.043 in)
Oil (side rail)		2.380 – 2.450 mm (0.0937 – 0.0965 in)	2.28 mm (0.090 in)	
Connecting rods	Small end I.D.		16.007 – 16.022 mm (0.6302 – 0.6308 in)	16.05 mm (0.632 in)
	Big end I.D.		32.020 – 32.033 mm (1.2606 – 1.2611 in)	32.06 mm (1.262 in)
	Big end oil clearance		0.020 – 0.044 mm (0.0008 – 0.0017 in)	0.06 mm (0.002 in)
	Big end side clearance		0.1 – 0.4 mm (0.004 - 0.016 in)	0.5 mm (0.02 in)
Crankshaft	Main journal O.D.		35.979 – 35.990 mm (1.4165 – 1.4169 in)	35.96 mm (1.416 in)
	Crank pin O.D.		31.989 – 32.000 mm (1.2594 – 1.2598 in)	31.96 mm (1.258 in)
	Main journal oil clearance		0.018 – 0.042 mm (0.0007 - 0.0017 in)	0.06 mm (0.002 in)
	Side clearance		0.1 – 0.4 mm (0.004 – 0.016 in)	0.55 mm (0.022 in)
Carburetor	Main jet	BF15D	Except Bodensee type: #102 Bodensee type: #102	—
		BF20D	Except Bodensee type: #125 Bodensee type: #115	—
	Pilot screw opening		See pages 6-9 and 10.	—
	Float height		13.7 mm (0.54 in)	—

• ELECTRICAL

Part	Item		Standard	Service limit
Spark plug	Gap		0.8 – 0.9 mm (0.031 – 0.035 in)	—
Ignition coil	Primary coil resistance		0.8 – 1.0 Ω	—
	Secondary coil resistance (with plug caps)		23.0 – 34.8 kΩ	—
Starter Motor	Brush length		10 mm (0.4 in)	6 mm (0.23 in)
	Mica depth		—	0.2 mm (0.01 in)
Charge coil	Resistance	12A charge coil	0.2 – 0.3 Ω	—
		6A charge coil	0.23 – 0.29 Ω	—
Exciter coil	Resistance	Electric starter type	5.0 – 7.4 Ω	—
		Recoil starter type	6.1 – 7.5 Ω	—
Pulse generator	Resistance		351 – 429 Ω	—
SE thermal valve heater coil	Resistance		1.2 – 1.8 Ω	—

• LOWER UNIT

Part	Item		Standard	Service limit
Propeller shaft	Shaft O.D.	Forward gear area	16.973 – 16.984 mm (0.6682 – 0.6687 in)	16.95 mm (0.667 in)
Forward gear	I.D.		17.000 – 17.018 mm (0.6693 – 0.6700 in)	17.04 mm (0.671 in)
Vertical shaft	Shaft O.D.		14.989 – 15.000 mm (0.5901 – 0.5906 in)	14.97 mm (0.589 in)

6. TORQUE VALUES

• Engine

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Crankcase cover bolts	M6 x 1.0	14	1.4	10
Oil pressure switch	PT1/8 (Apply sealant to the threads)	8	0.8	6
Oil drain bolt	M8 x 1.25	6	0.6	4
Oil filter cartridge	M20 x 1.5	12	1.2	9
Spark plugs	M10 x 1.0	12	1.2	9
Cylinder head bolts (L=83 mm)	M8 x 1.25 (Apply oil to threads)	26	2.7	20
Cylinder head bolts (L=40 mm)	M8 x 1.25	24	2.4	17
Valve adjusting lock nuts	M5 x 0.5	8	0.8	5.8
Connecting rod bolts	M6 x 1.0	12	1.2	9
Timing belt driven pulley bolt	M6 x 1.0	16	1.6	12
Recoil starter pulley bolts	M6 x 1.0	11	1.1	8
Flywheel nut	M16 x 1.5 (Apply oil to the thread)	132	13.5	98
Timing belt drive pulley lock nut	M30 x 1.0 (Apply oil to the thread)	69	7.0	51
Oil pump cover bolts	M5 x 0.8	5	0.5	3.6
Oil pump bolts	M6 x 1.0	11	1.1	8
Silencer bolts	M6 x 1.0	9	0.9	6.5
Silencer cover bolt	M6 x 1.0	10	1.0	7
Oil case bolts	M8 x 1.25	24	2.4	17
Thermo sensor	M12 x 1.5	18	1.8	13
Exhaust chamber cover bolts	M6 x 1.0	11	1.1	8

• Gear Case

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Gear case bolts	M6 x 1.0	12	1.2	9
Propeller 10 mm crown head nut	M10 x 1.25	See page 4-2		
Propeller shaft holder bolts	M6 x 1.0	12	1.2	9
Oil level bolt	M8 x 1.25	3.5	0.36	2.6
Oil drain bolt	M8 x 1.25	3.5	0.36	2.6
Water pump housing bolts	M6 x 1.0	12	1.2	9
Impeller housing bolts	M6 x 1.0	11	1.1	8
Water screen nuts	M5 x 0.8	1	0.1	0.7
Anode metal nut	M6 x 1.0	10	1.0	7
Shift rod B lock nut	M6 x 1.0	10	1.0	7

BF15D·BF20D

• Cover

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Left engine under cover screw	M5 x 0.8	4.5	0.46	3.3
Right engine under cover screw	M5 x 0.8	4.5	0.46	3.3

• Extension Case/Mount Rubber

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Extension case bolts	M8 x 1.25	24	2.4	17
Upper mount rubber stay bolt	M6 x 1.0	12	1.2	9
Lower mount rubber bolts	M8 x 1.25	22	2.2	16
Lower mount rubber cover bolts	M6 x 1.0	12	1.2	9
Upper mount rubber bolt	M10 x 1.25	38	3.9	28
Steering friction lever lock nut	M8 x 0.75	2.5	0.25	1.8

• Stern Bracket

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Tilting bolt lock nut (Tiller handle S type)	M8 x 1.25	24	2.4	17
Tilting shaft nut (Except tiller handle S type)	7/8-14UNF	17	1.7	13
Stern bracket nut (Except tiller handle S type)	M8 x 1.25	21	2.1	15

• Tiller Handle

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Tiller handle bracket bolts	M10 x 1.25	33	3.4	25
Tiller handle pivot nut	M8 x 1.25	8	0.8	6
Throttle cable set plate screws	4 mm screw	1.5	0.15	1.1
Shift lever pivot bolt	M6 x 1.0	12	1.2	9
Emergency stop switch nut	M16 x 1.0	1.5	0.15	1.1
Reverse lock bolt	M6 x 1.0	12	1.2	9
Throttle cable lock nut	M6 x 1.0	4.5	0.45	3.3
Starter switch nut	M16 x 1.0	1.5	0.15	1.1

• Frame/Electrical Equipment

Item	Thread dia. x pitch	Torque		
		N•m	kgf•m	lbf•ft
Shift rod B lock nut	M6 x 1.0	10	1.0	7
Fuel connector B bolt	M6 x 1.0	12	1.2	9
Choke cable nut	M11 x 1.25	2.5	0.25	1.8
SE valve nut	M12 x 1.0	2	0.2	1.4
Neutral switch nut	M20 x 1.0	2.5	0.25	1.8
Neutral start cable nut	M6 x 1.0	3.5	0.36	2.6
Starter magnetic switch bolts	M6 x 1.0	7	0.7	5
Starter cord terminal nut	M6 x 1.0	6.5	0.65	4.7
Starter coard self-locking nut	M6 x 1.0	5.5	0.55	4.0
Starter cable terminal nut	M6 x 1.0	5.5	0.55	4.0

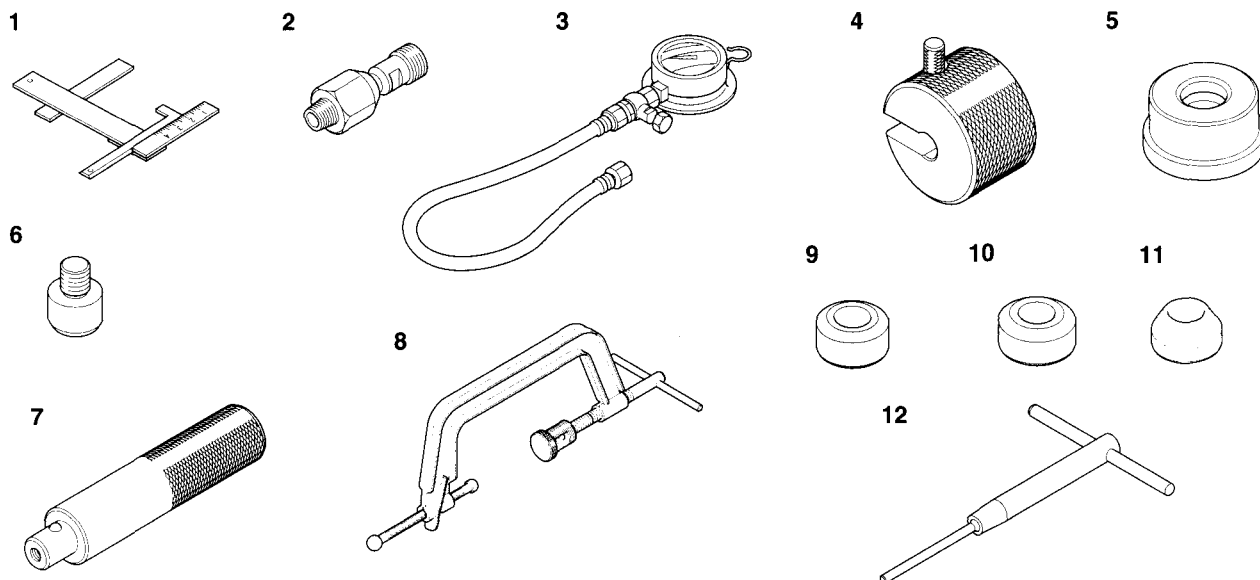
• Use standard torque values of fastener that are not listed in this table below.

STANDARD TORQUE

Item	Thread dia. x pitch	Torque		
		N•m	kgf•m	lbf•ft
Screw	4 mm	2	0.2	1.4
	5 mm	4.2	0.43	3.1
	6 mm	9	0.9	6.5
Hex. bolt and nut	5 mm	5.2	0.53	3.8
	6 mm	10	1.0	7
	8 mm	21.5	2.19	15.8
	10 mm	34	3.5	26
	12 mm	54	5.5	40
Flange bolt and nut	6 mm	12	1.2	9
	8 mm	26.5	2.7	20
	10 mm	39	4.0	29
	12 mm	59	6.0	43
SH (small head flange) bolt	6 mm	10	1.0	7
CT (self tapping) bolt	5 mm	5.5	0.56	4.0
	6 mm	12	1.2	9

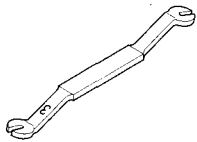
7. SPECIAL TOOLS

No.	Tool name	Tool number	Application
1	Float level gauge	07401-0010000	Carburetor float level inspection
2	Oil pressure gauge attachment	07406-0030000	Oil pressure inspection
3	Oil pressure gauge set	07506-3000000	Oil pressure inspection
4	Remover weight	07741-0010201	Bearing or bearing outer race removal
5	Attachment, 32 x 35 mm	07746-0010100	Needle bearing installation
	Attachment, 42 x 47 mm	07746-0010300	6005 ball bearing installation Taper roller bearing outer race installation
	Attachment, 24 x 26 mm	07746-0010700	Propeller shaft water seal installation
	Attachment, 22 x 24 mm	07746-0010800	Propeller shaft needle bearing removal Water pump water seal installation
6	Pilot, 15 mm	07746-0040300	Water pump needle bearing installation Water pump water seal installation
	Pilot, 17 mm	07746-0040400	Needle bearing installation Propeller shaft water seal installation
	Pilot, 25 mm	07746-0040600	6005 ball bearing installation Taper roller bearing outer race installation
7	Driver	07749-0010000	Bearing, oil seal or water seal installation (driver for No. 5 and 6)
8	Valve spring compressor	07757-0010000	Valve cotter removal/installation
9	Valve seat cutter, 45° 27.5 mm	07780-0010200	Intake valve seat reconditioning
	Valve seat cutter, 45° 22 mm	07780-0010701	Exhaust valve seat reconditioning
10	Valve seat cutter, 32° 25 mm	07780-0012000	Exhaust valve seat reconditioning
	Valve seat cutter, 32° 30 mm	07780-0012200	Intake valve seat reconditioning
11	Valve seat cutter, 60° 22 mm	07780-0014202	Exhaust valve seat reconditioning
	Valve seat cutter, 60° 26 mm	07780-0014500	Intake valve seat reconditioning
12	Cutter holder 5.0 mm	07781-0010400	Valve seat reconditioning



No.	Tool name	Tool number	Application
13	Valve adjusting wrench 3 mm	07908-KE90200	Valve clearance adjustment
14	Crankshaft holder, 26 mm	07923-ZA00100	Crankshaft holding
15	Bearing remover handle	07936-3710100	Taper roller bearing outer race removal
16	Bearing remover, 15 mm	07936-KC10500	Needle bearing removal
17	Bearing remover, 25 mm	07936-ZV10100	Bearing removal
18	Driver handle, 325 mm	07946-MJ00100	Needle bearing removal/installation
	Driver handle, 280 mm	07949-3710001	Needle bearing removal/installation
	Driver handle, 370 mm	07VMF-KZ30200	Needle bearing removal
19	Valve guide reamer, 5.0 mm	07984-MA60001	Valve guide reaming
20	Oil filter wrench	07HAA-PJ70100	Oil filter removal
21	Bearing race puller	07LPC-ZV30100	Taper roller bearing outer race removal
22	Puller jaw, 25 mm	07WPC-ZW50100	Taper roller bearing outer race removal
23	Driver 14.5 x 18.5 mm	07ZPF-ZW90300	Needle bearing installation
24	Installer shaft	07VMF-KZ30200	Needle bearing removal
25	Bearing installer	070PD-ZY10100	Needle bearing removal

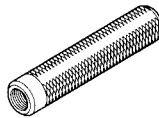
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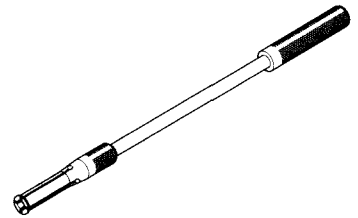
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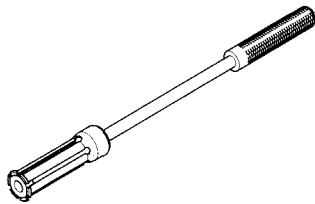
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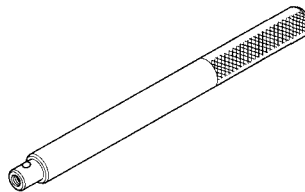
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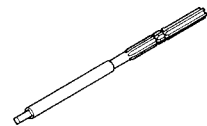
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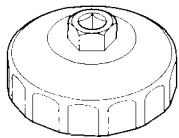
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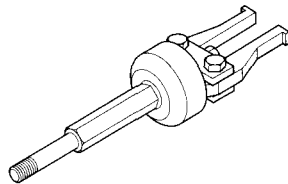
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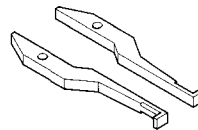
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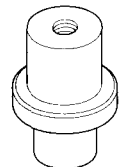
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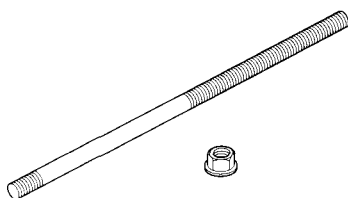
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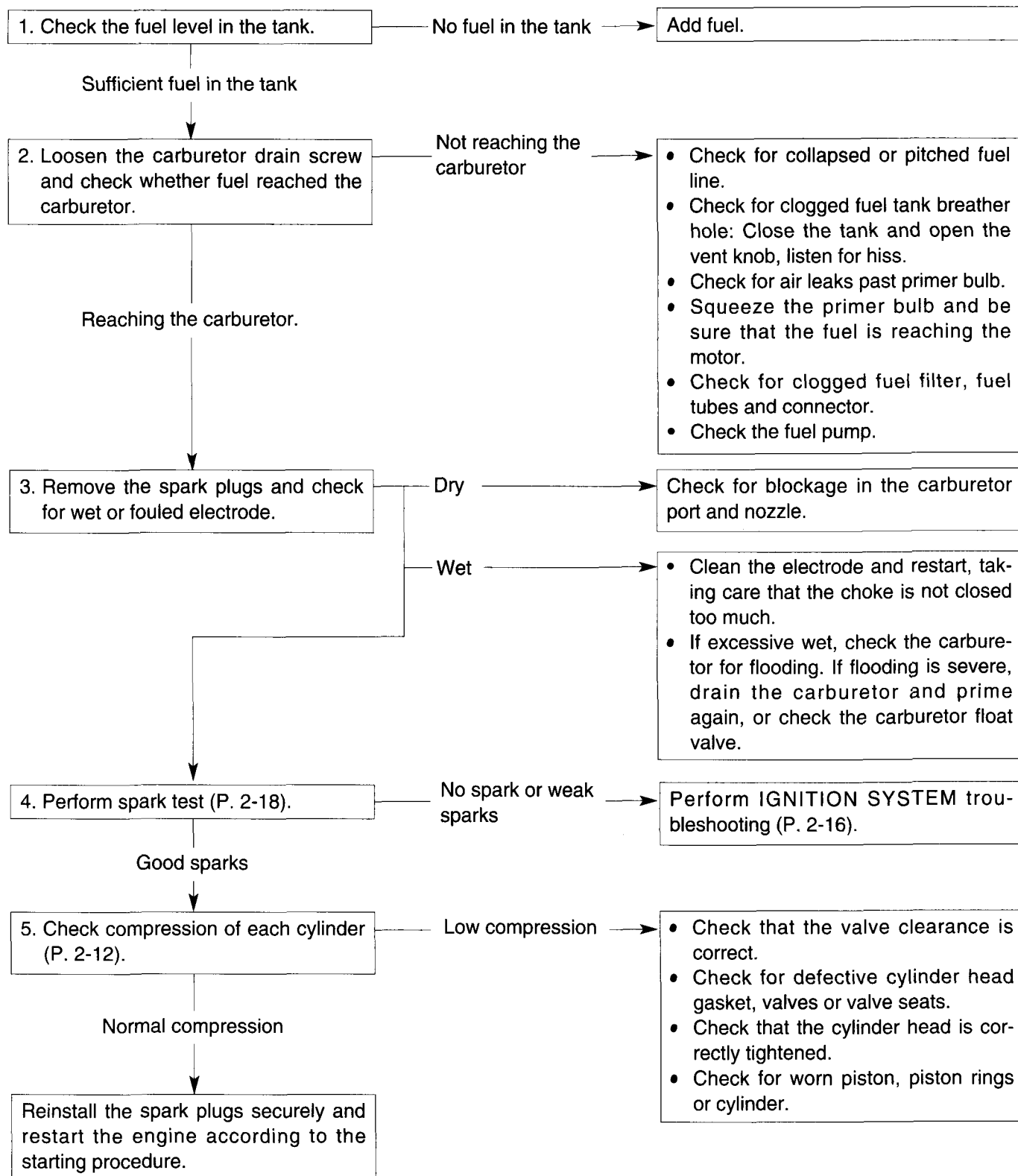
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8. TROUBLESHOOTING

a. ENGINE

• Hard Starting



• CYLINDER COMPRESSION CHECK

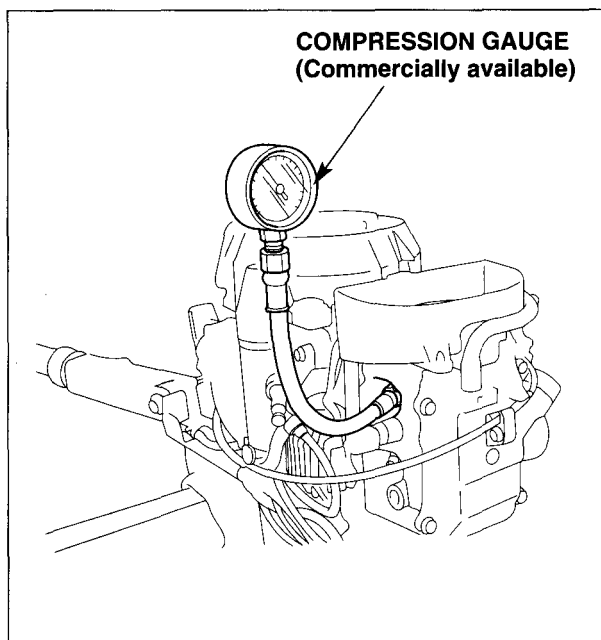
- 1) Shift the gear into the neutral position.
- 2) Disengage the emergency stop switch clip from the emergency stop switch.
- 3) Remove the engine cover and the both spark plugs.
- 4) Install a compression gauge in the No. 1 cylinder plug hole.
- 5) Disconnect the remote control throttle cable from the throttle arm (remote control type only).
- 6) Manually hold the throttle arm or throttle lever in the full open position
- 7) Electric starter type: Turn the starter motor using the starter switch (tiller handle type) or ignition switch (remote control type) until stable compression is obtained.

Do not operate the starter motor for more than 5 seconds at one try. If stable compression is not obtained within 5 seconds, stop the starter motor and wait 10 - 20 seconds, and repeat the operation again.

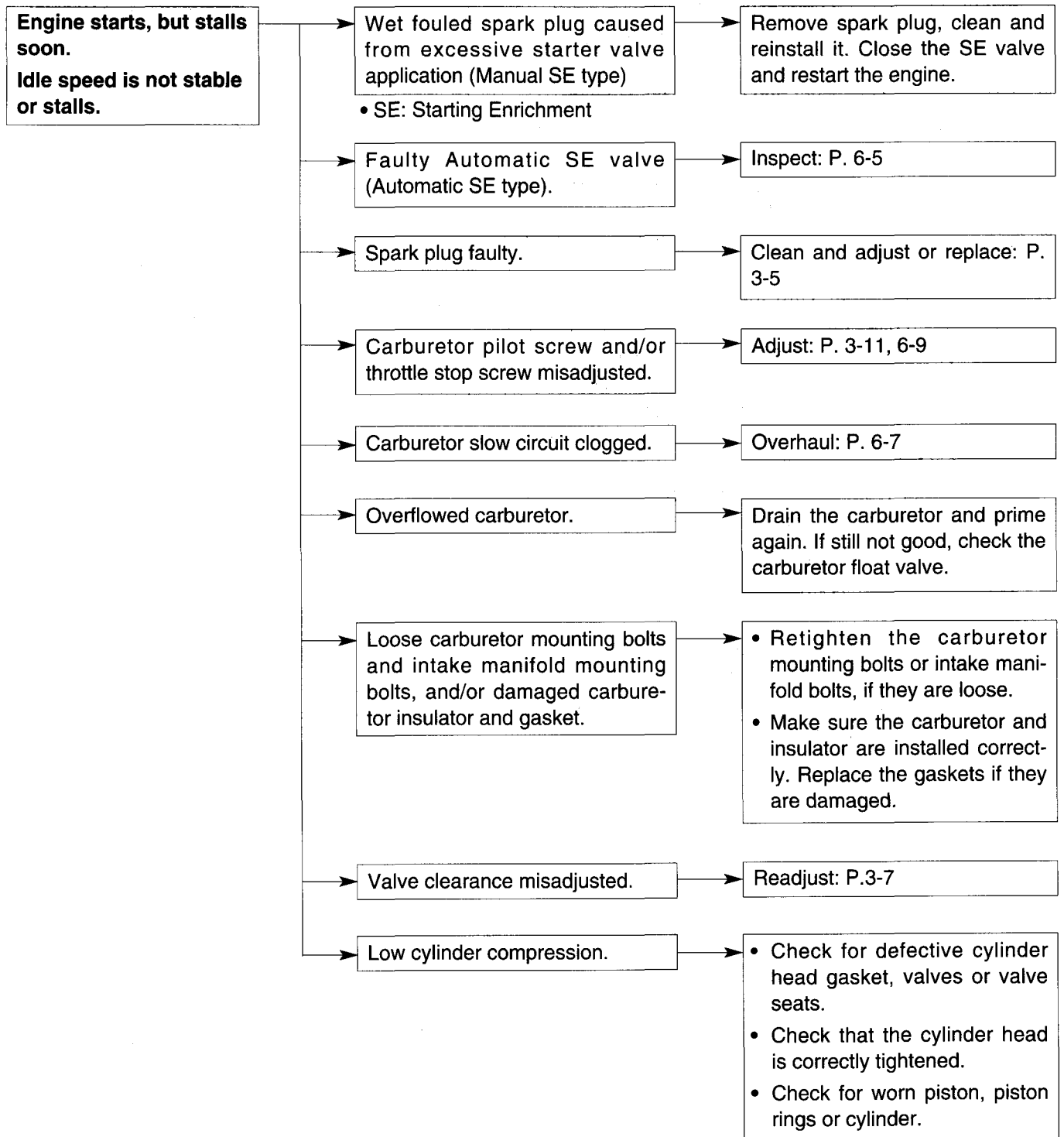
Recoil starter type: Pull the recoil starter several times until stable compression is obtained

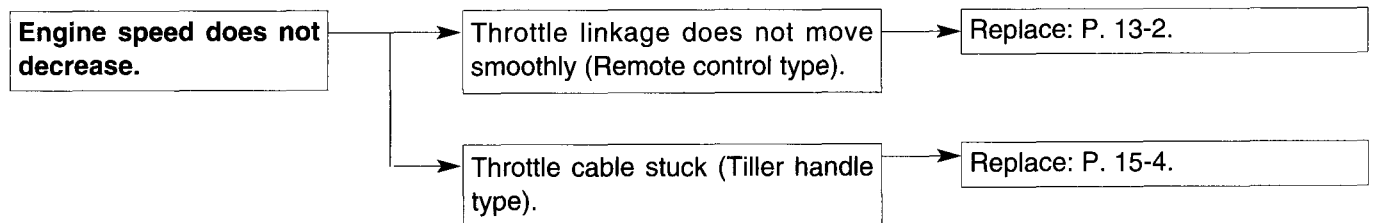
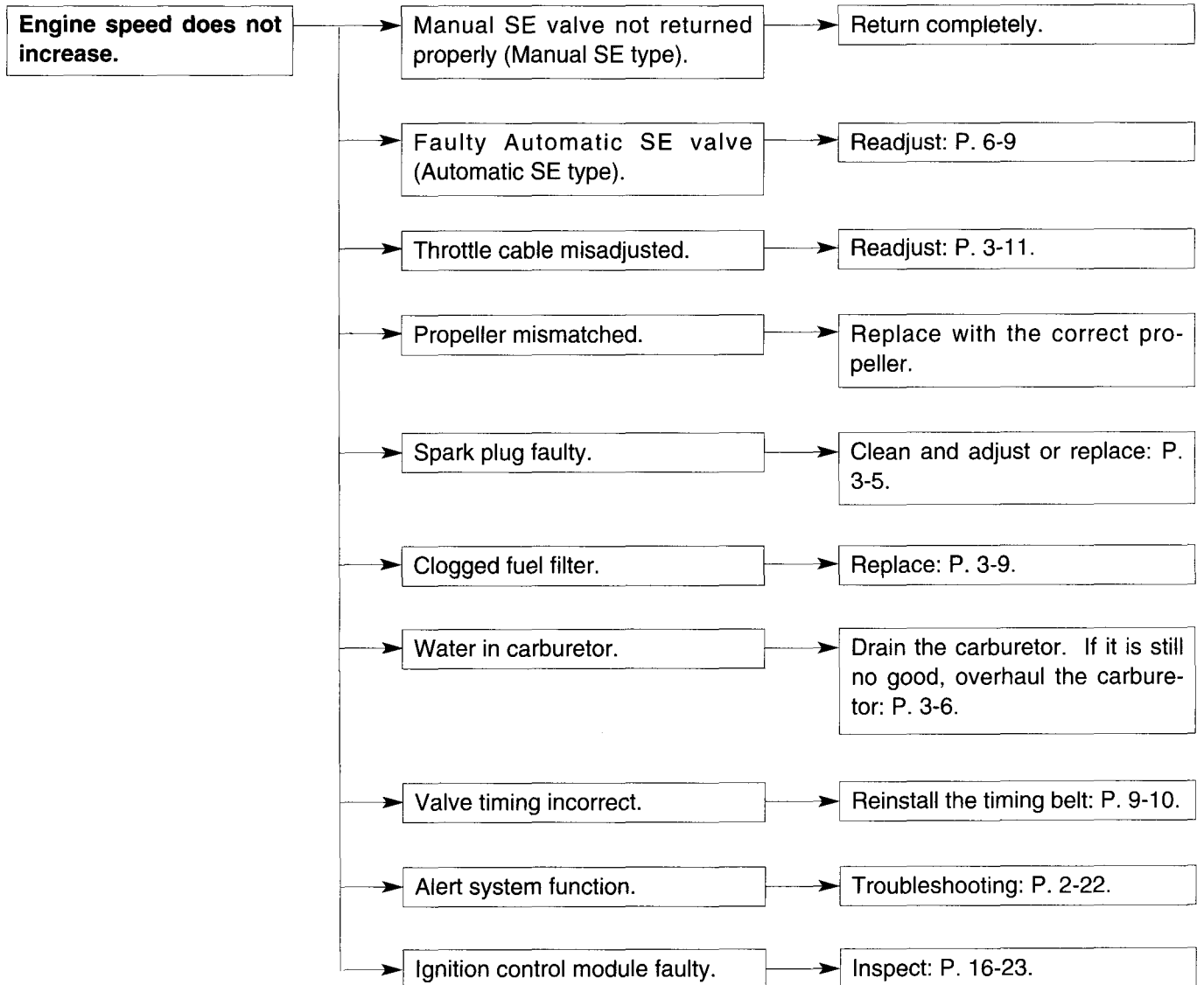
Cylinder compression	1,370±98 kPa (14.0±1.0 kgf/cm ² , 199±14 psi)
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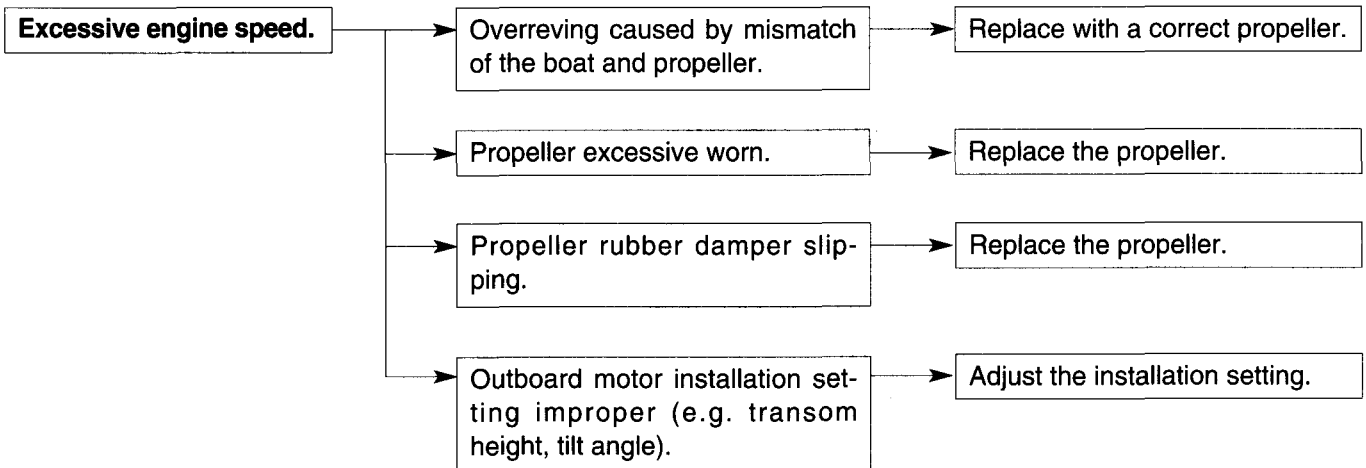
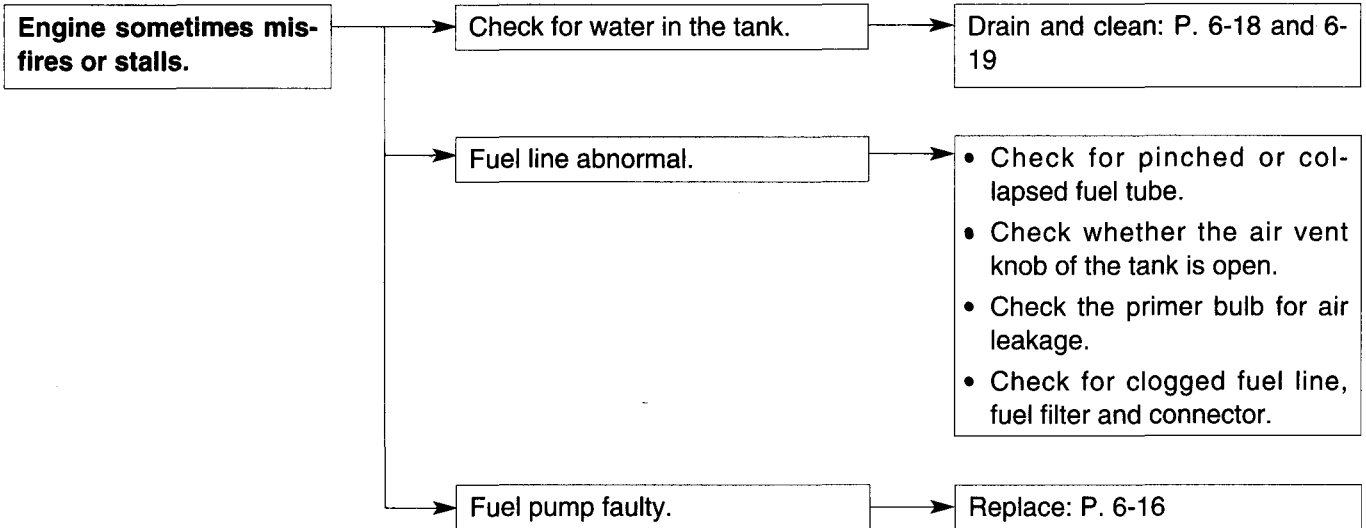
- 8) Reinstall the compression gauge in the No. 2 cylinder plug hole and repeat steps 6 and 7.
- 9) After inspection, reinstall the removed parts in the reverse order of removal.



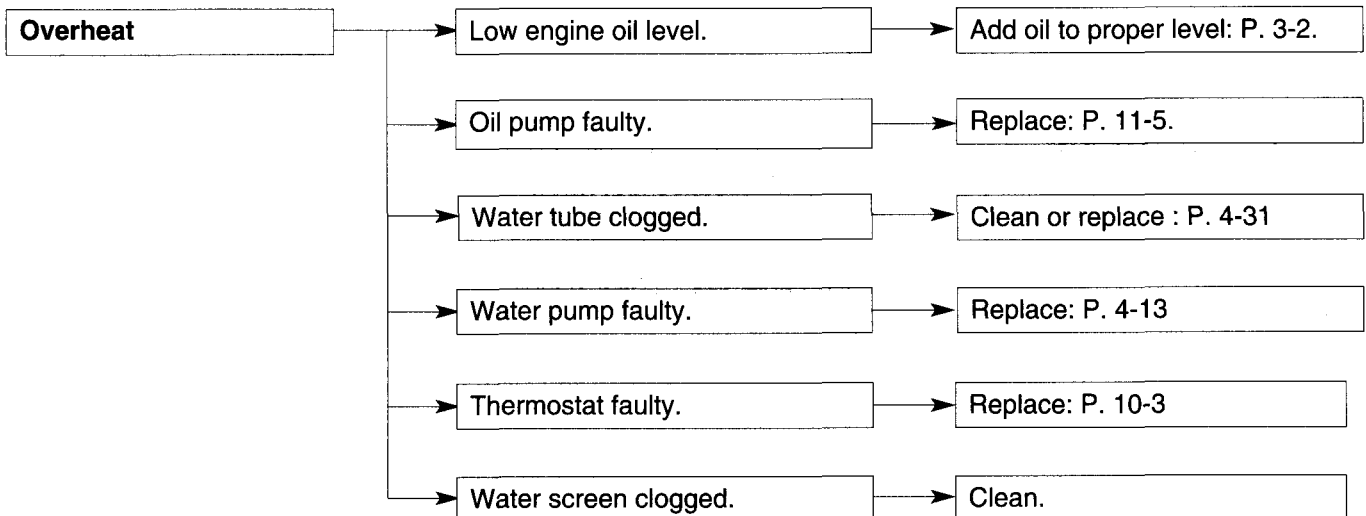
• Engine Does Not Run Smoothly





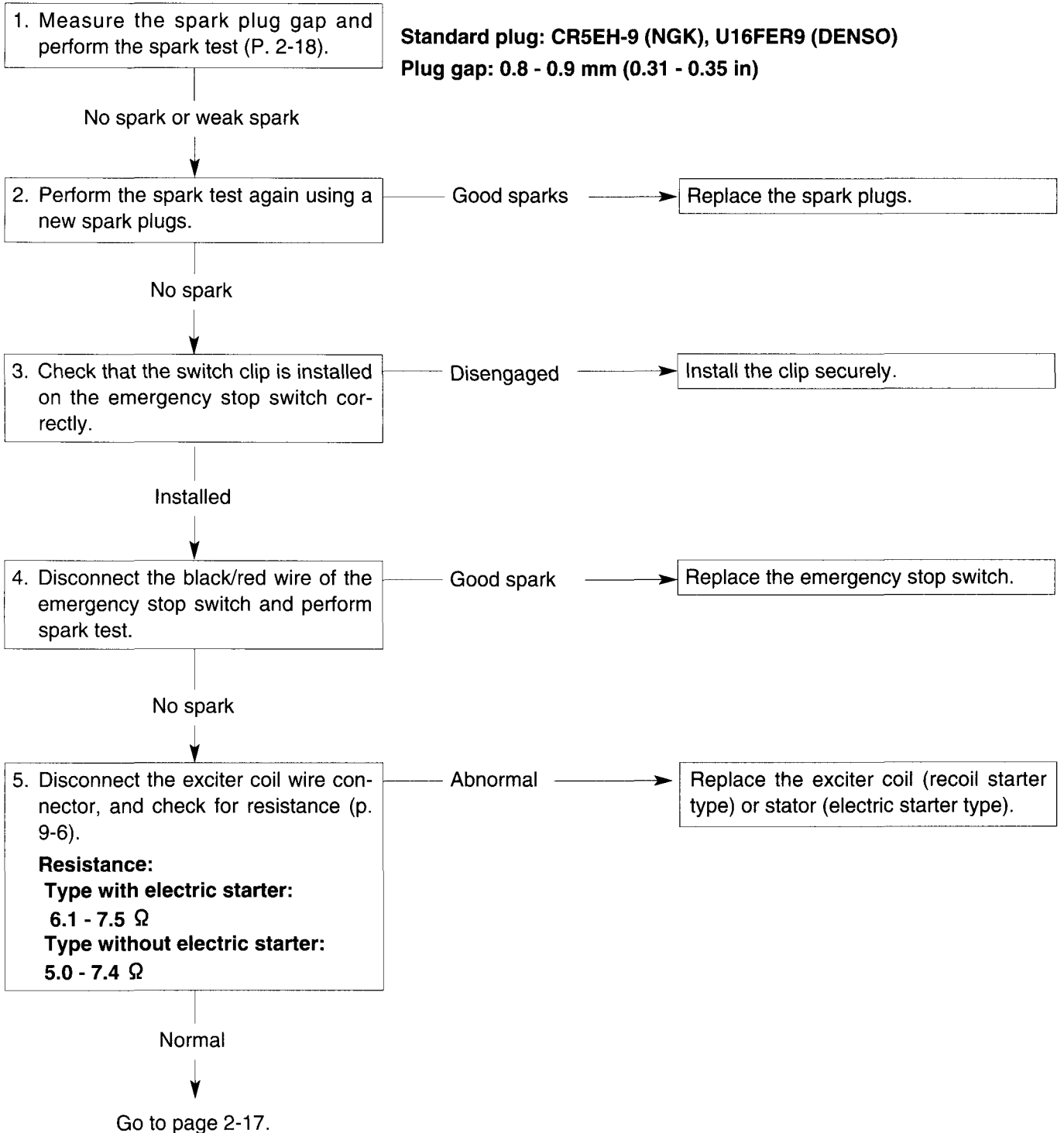


• Overheat



b. IGNITION SYSTEM

These outboard motors are equipped with an engine overrev limiter which is provided in the ignition control module. The overrev limiter is activated when the engine rpm exceeds (BF20D: 6,300 rpm, BF15D: 5,800 rpm). When activated the sparks are emitted to the No. 1 and No. 2 cylinders. The overrev limiter may be activated under such conditions as; light propeller load or propeller ventilation.

• Hard Starting

From page 2-16.

6. Disconnect the pulse generator coil wire connector, and check for resistance (P. 9-5).

Resistance: 351 - 429 Ω

Abnormal

Replace the pulse generator coil.

Normal

7. Check for voltage leakage caused by damaged high tension wire insulation. Check the ignition coil resistances (P. 16-28).

Resistance:

Primary: 0.8 - 1.0 Ω

Secondary: 23.0 - 34.8 k Ω

Abnormal

Replace the ignition coil

Normal

8. Remove the ignition control module and check for resistance between the terminals (P. 16-23).

Abnormal

Replace the ignition control module.

Normal

Check the wire harness for short or open circuit. Replace or repair the wire harness.

• SPARK TEST

- 1) Remove the engine cover. Drain the gasoline from the carburetor.

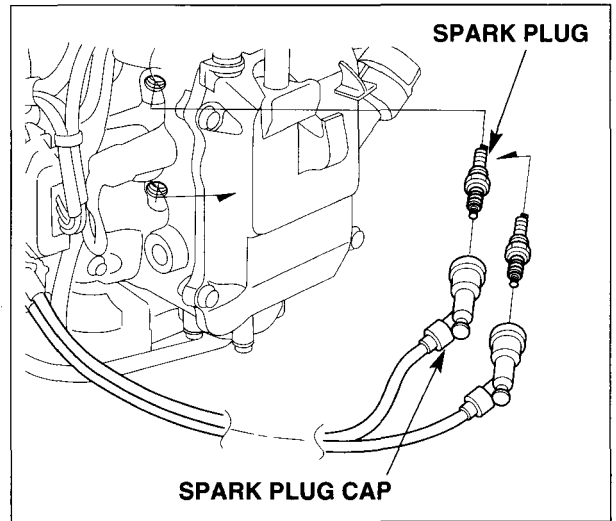
▲ WARNING

Gasoline is highly flammable and explosive. If ignited, gasoline can burn you severely.

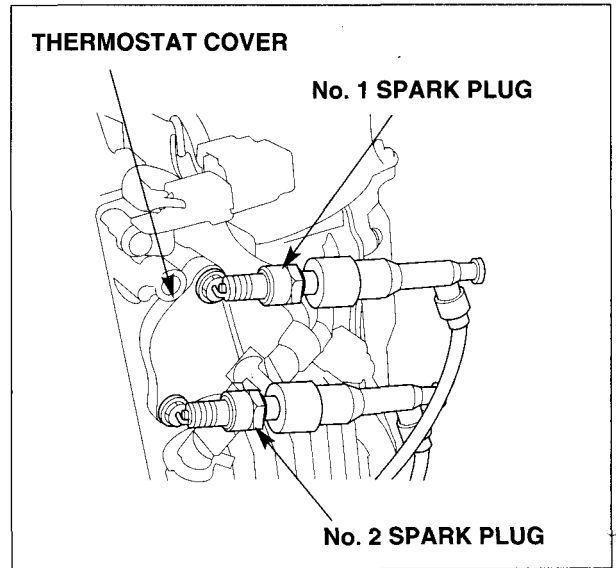
- Be sure there is no spilled fuel near the engine.
- Place the spark plug away from the spark plug hole.

Unburned gas can ignite if it is left in the cylinder.

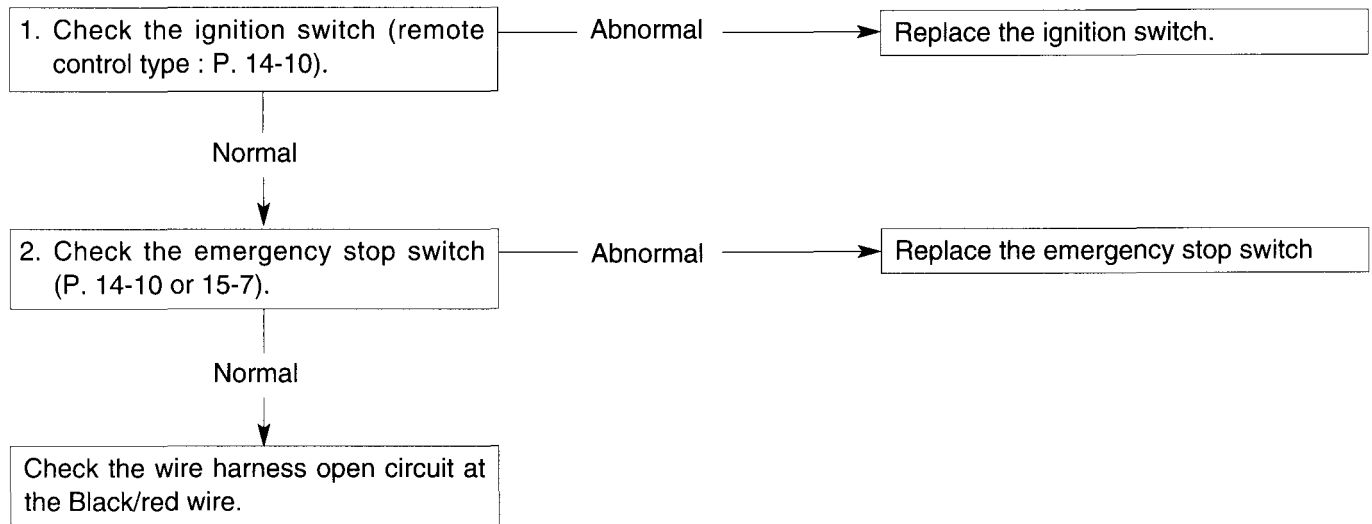
- Loosen the carburetor drain screw to drain the carburetor thoroughly. Pull the recoil starter several times to release the unburned gas from the cylinder before test.



- 2) Remove the spark plug caps and spark plugs.
- 3) Pull the recoil starter several times to release the unburned gas from the cylinders.
- 4) Attach the removed spark plugs to the plug caps.
- 5) Set the ignition switch to the ON position (remote control type only) and make sure that the emergency stop switch clip is engaged properly. Ground the negative (-) electrode (i.e. threaded part) of the both spark plugs against the thermostat cover bolt and pull the recoil starter rope to check whether sparks jump across the electrodes.
- 6) Remove the spark plugs from the spark plug caps and install the spark plugs to the other cylinder spark plug cap and check spark for the other cylinder.

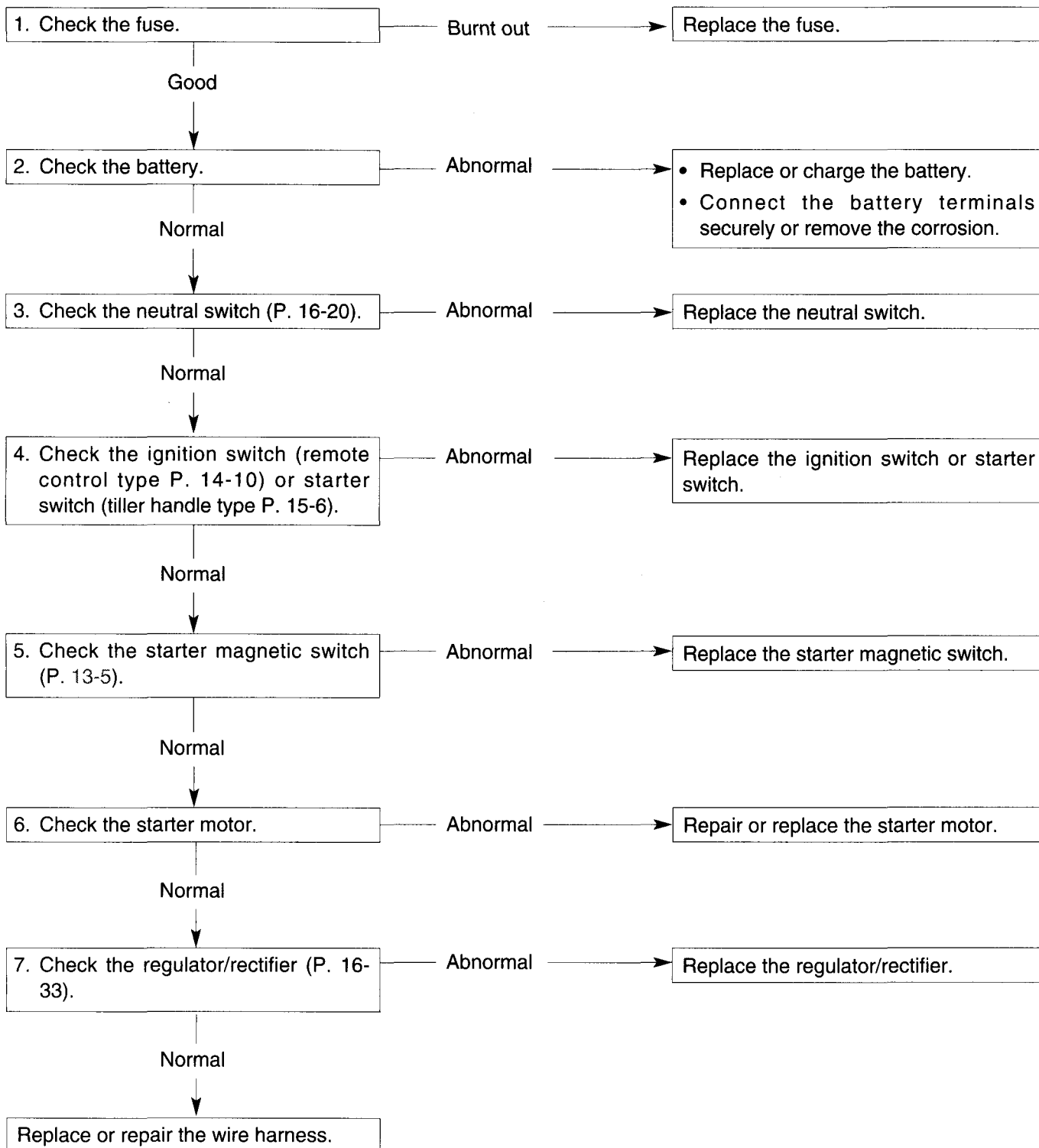


• Engine Does Not Stop With The Ignition Switch Turned OFF or Emergency Stop Switch Operated

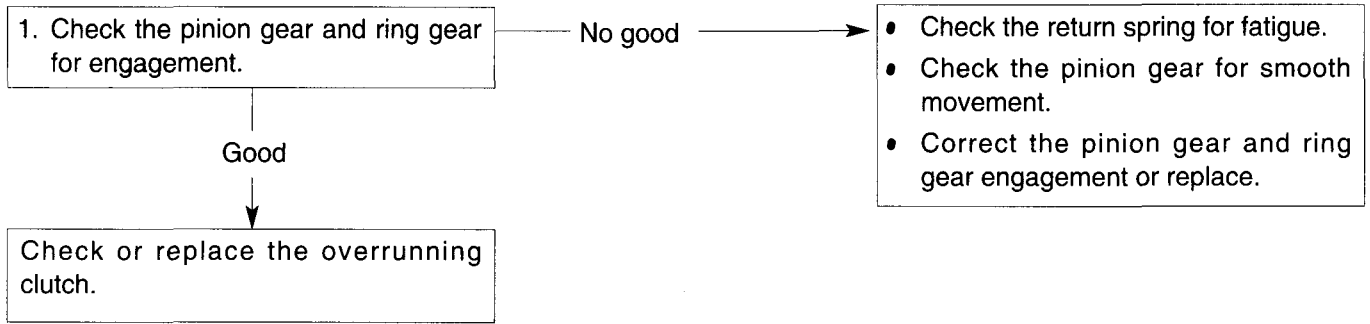


c. ELECTRIC STARTER SYSTEM

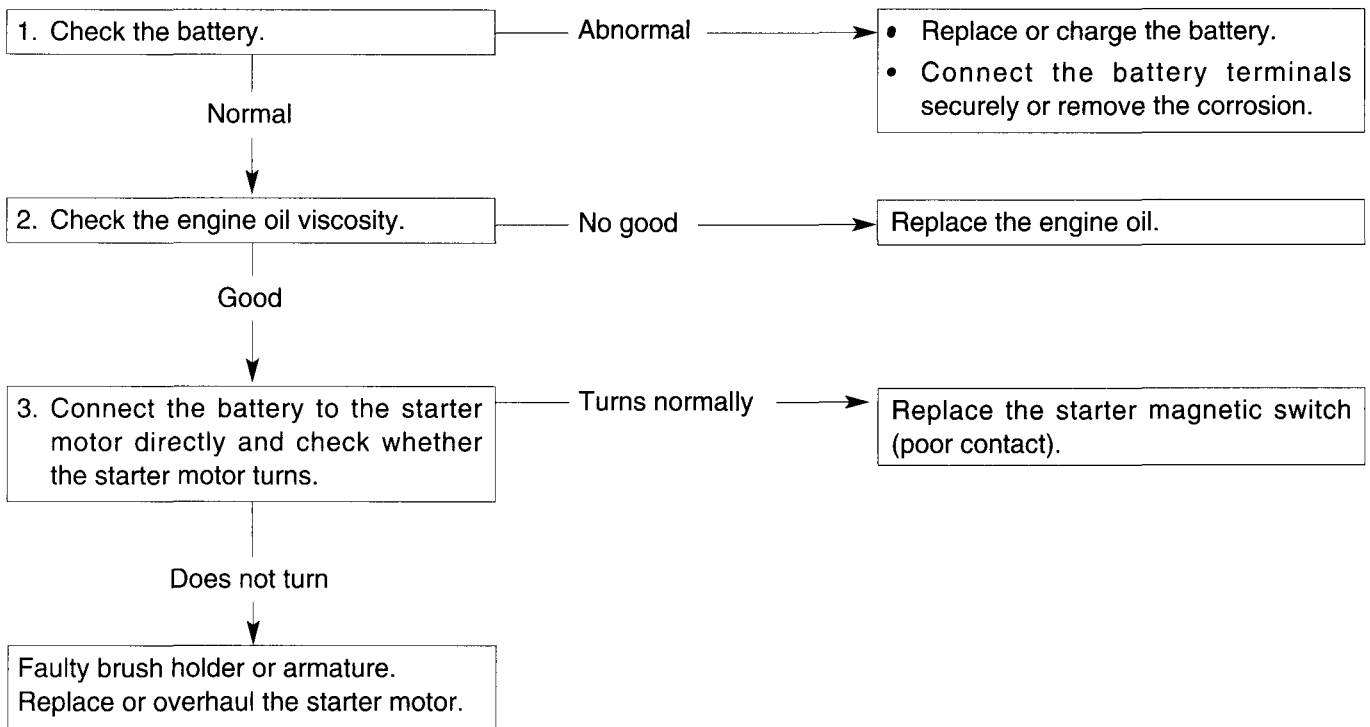
• Starter Motor Will Not Turn



• Starter Motor Turns but Engine Does Not Turn.

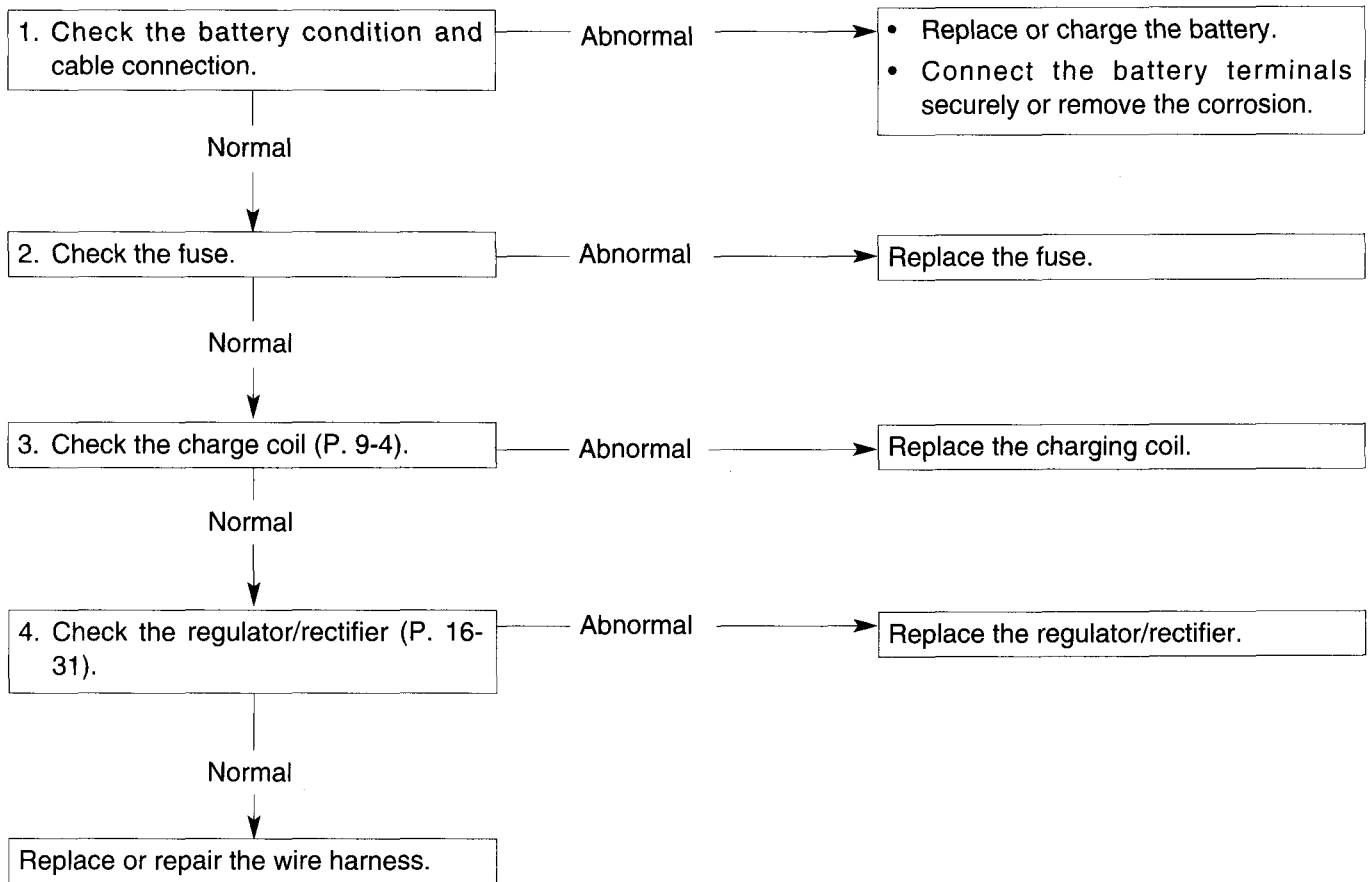


• Starter Motor and Engine Turn Slowly



d. CHARGING SYSTEM

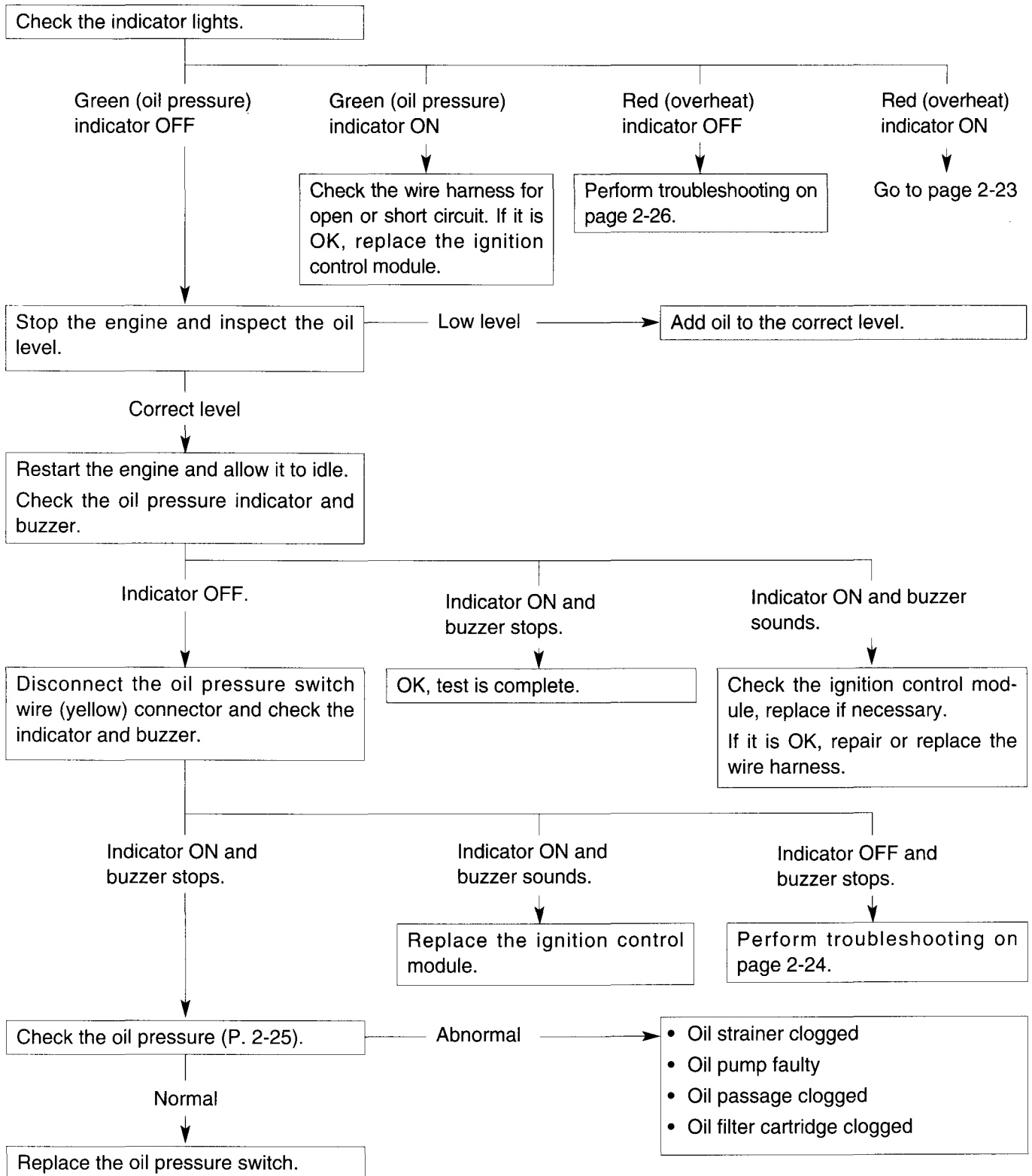
• Battery Under Charged

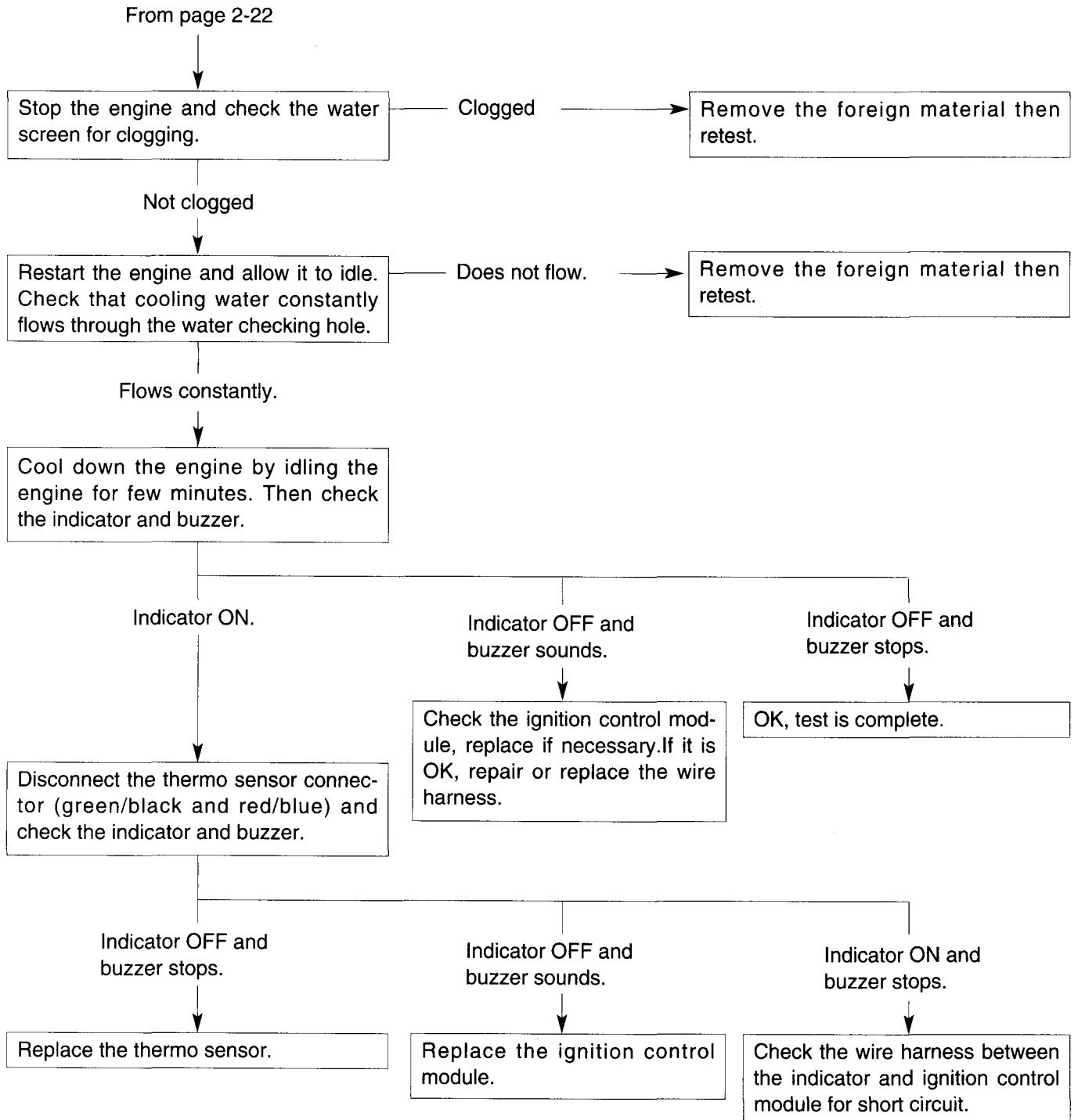


e. ALERT SYSTEM

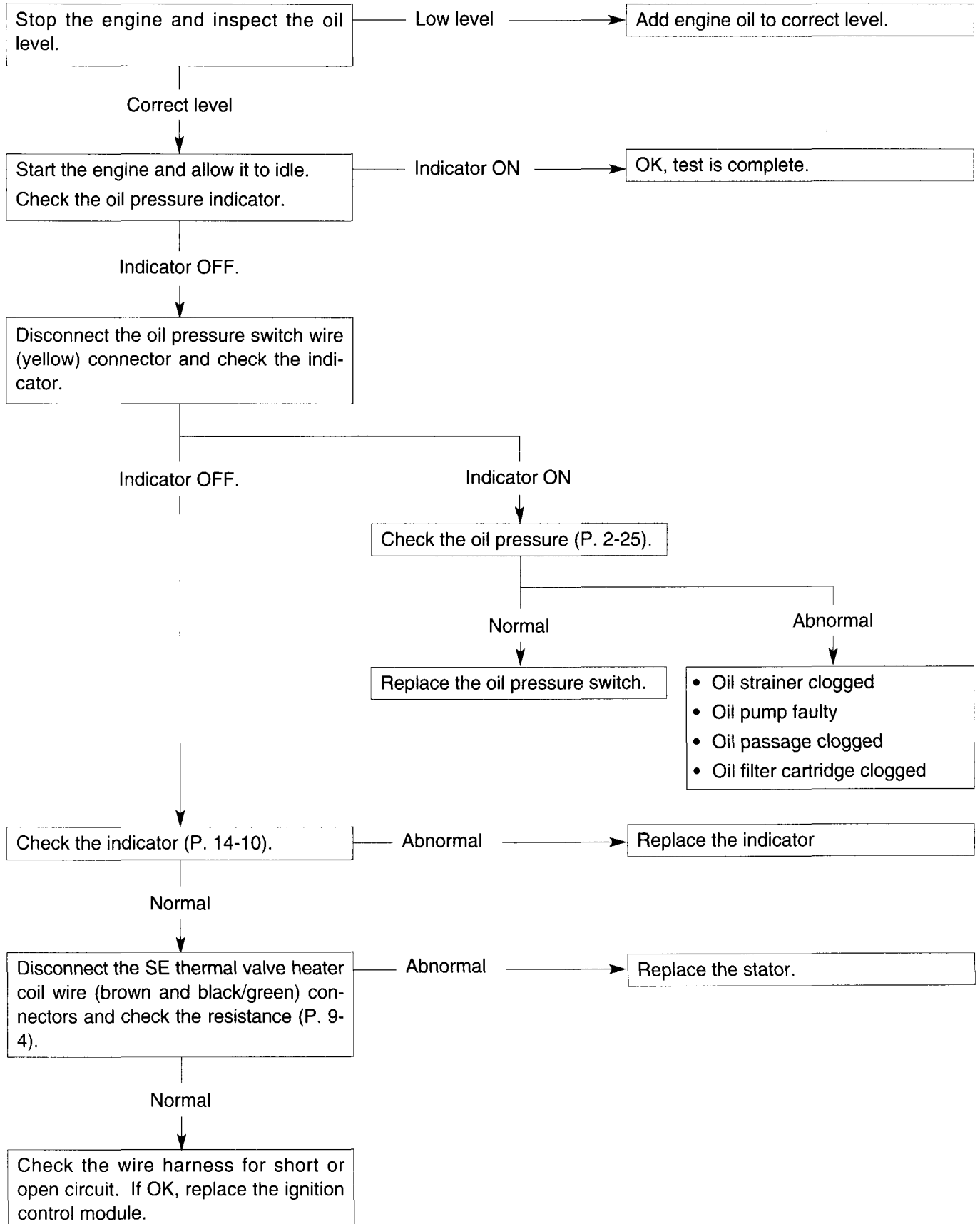
These outboard motor are equipped with an alert system which protects the engine by controlling the engine speed in the ignition control module. When trouble occurs, the system slows down the engine speed gradually. The system is provided with indicator light and buzzer sound (remote control type only) to indicate the cause of trouble.

• Warning Buzzer Sounds (Remote control type only)





• Oil Pressure Indicator (Green) Test



• OIL PRESSURE TEST

- 1) Remove the engine cover and check the engine oil level (P. 3-2).
- 2) Disconnect the oil pressure switch wire connector.
- 3) Remove the oil pressure switch and install a commercially available PT 1/8" adapter and an oil pressure gauge that has a scale calibrated to a maximum of 686 - 981 kPa (7 - 10 kgf/cm², 99 - 43 psi).

NOTICE

Tighten the adapter to the specified torque. Do not overtighten the adapter to avoid damaging the threads of the crankcase.

TORQUE: 8 N•m (0.8 kgf•m, 6 lbf•ft)

- 4) Run the outboard motor in an outboard test tank with the water at least 4 inches above the antivibration plate. Allow the engine to warm up to normal operating temperature (engine oil temperature 80° C/176° F).

▲ WARNING

Engine exhaust contains poisonous carbon monoxide gas that can cause unconsciousness and death.

- If the engine must be running, make sure the area is well ventilated.

- 5) Measure the oil pressure.

Standard oil pressure: 147 kPa (1.5 kgf/cm², 21.3 psi)

If the oil pressure is less than the specification, check the oil pump (section 10) for wear, or oil filter screen and oil passage for clogged.

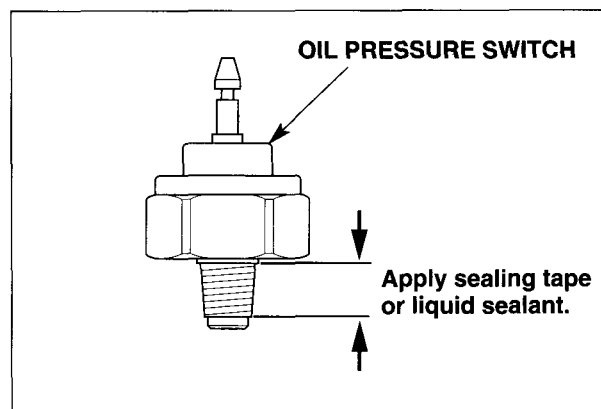
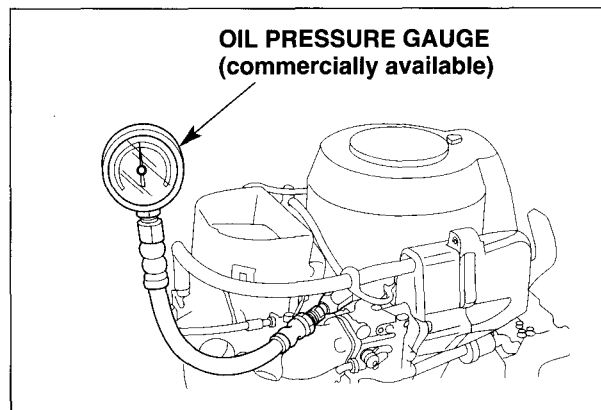
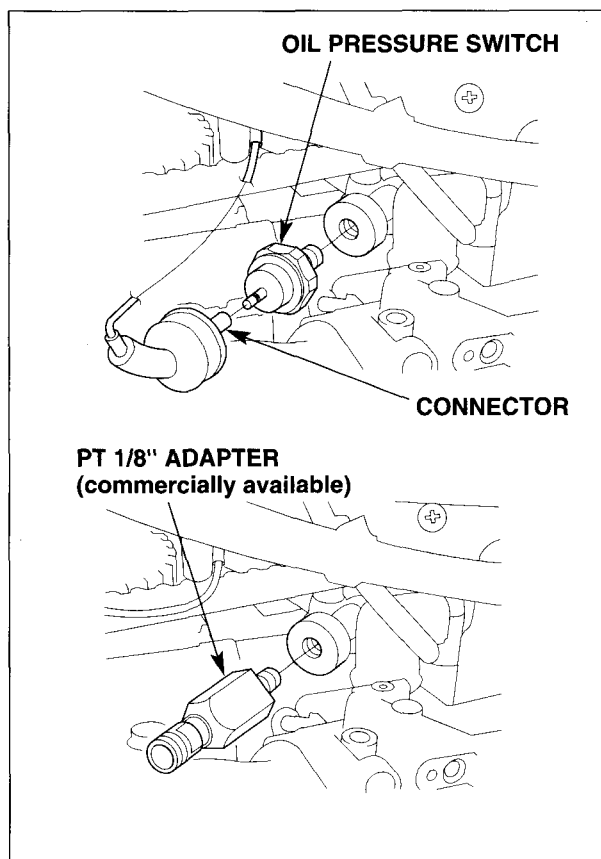
- 6) Remove the oil pressure gauge and adapter.
- 7) Protect the threads by applying sealing tape 1.5 to 2 turns or applying the liquid sealant, and tighten the oil pressure switch to the specified torque using a torque wrench.

NOTICE

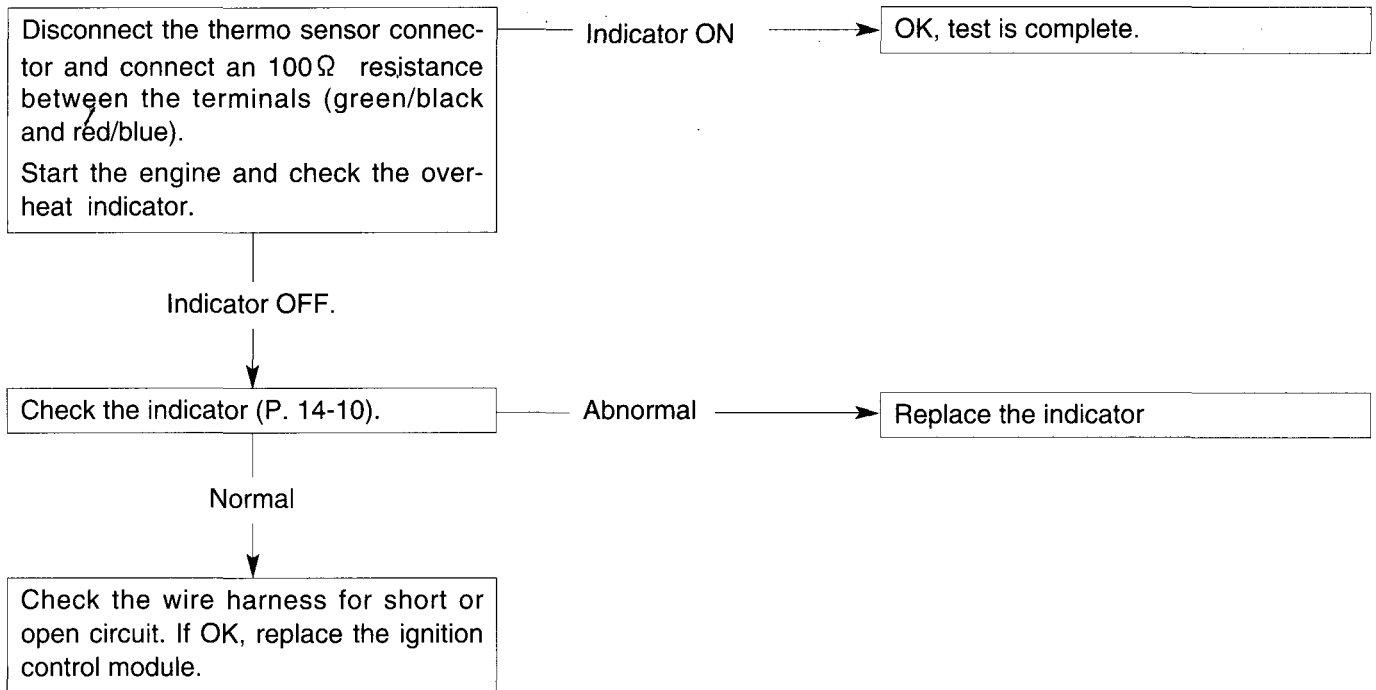
Tighten the oil pressure switch to the specified torque. Do not overtighten to avoid damaging the threads of the crankcase cover.

TORQUE: 8 N•m (0.8 kgf•m, 6 lbf•ft)

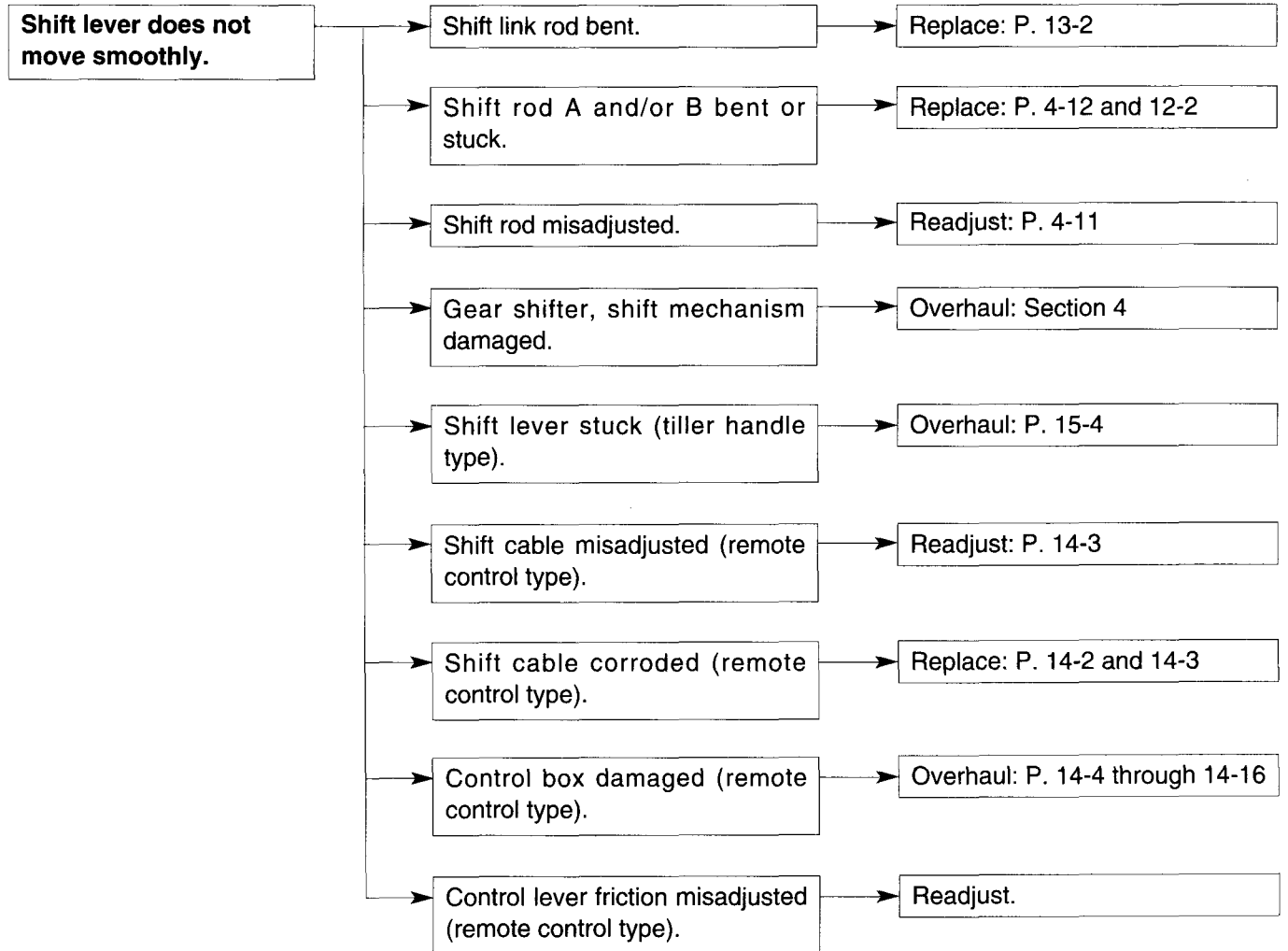
- 8) Connect the oil pressure switch wire and install the engine cover.



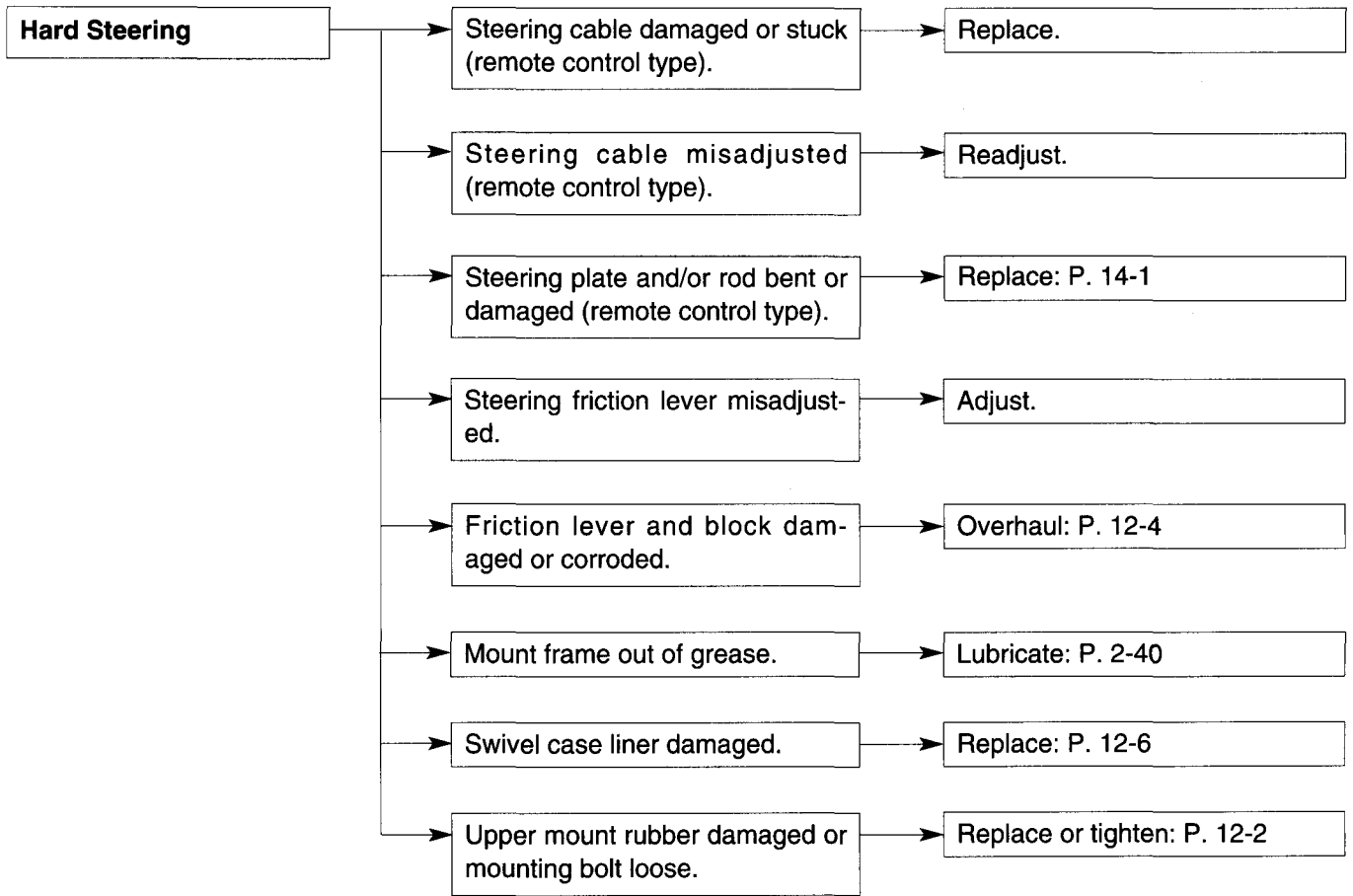
• Overheat Indicator (Red) Test (Remote control type only)



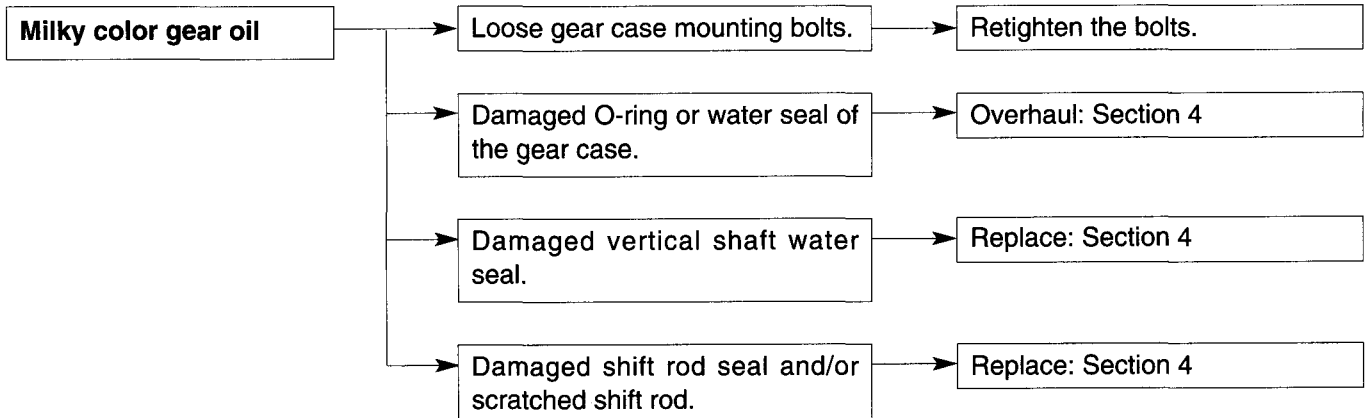
f. SHIFT LEVER



g. STEERING



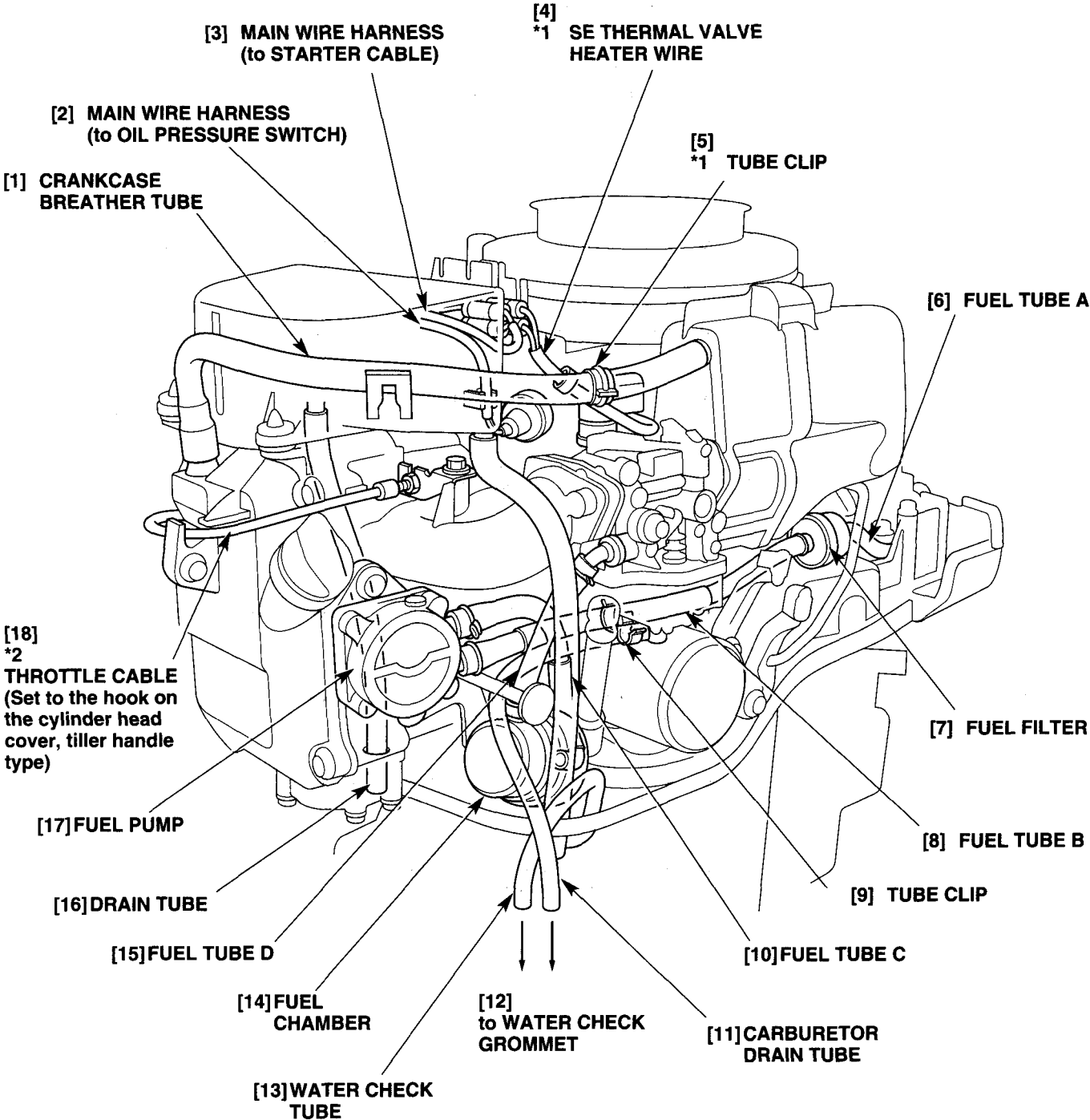
h. LOWER UNIT



9. CABLE & HARNESS ROUTING

*1: Type with electric starter

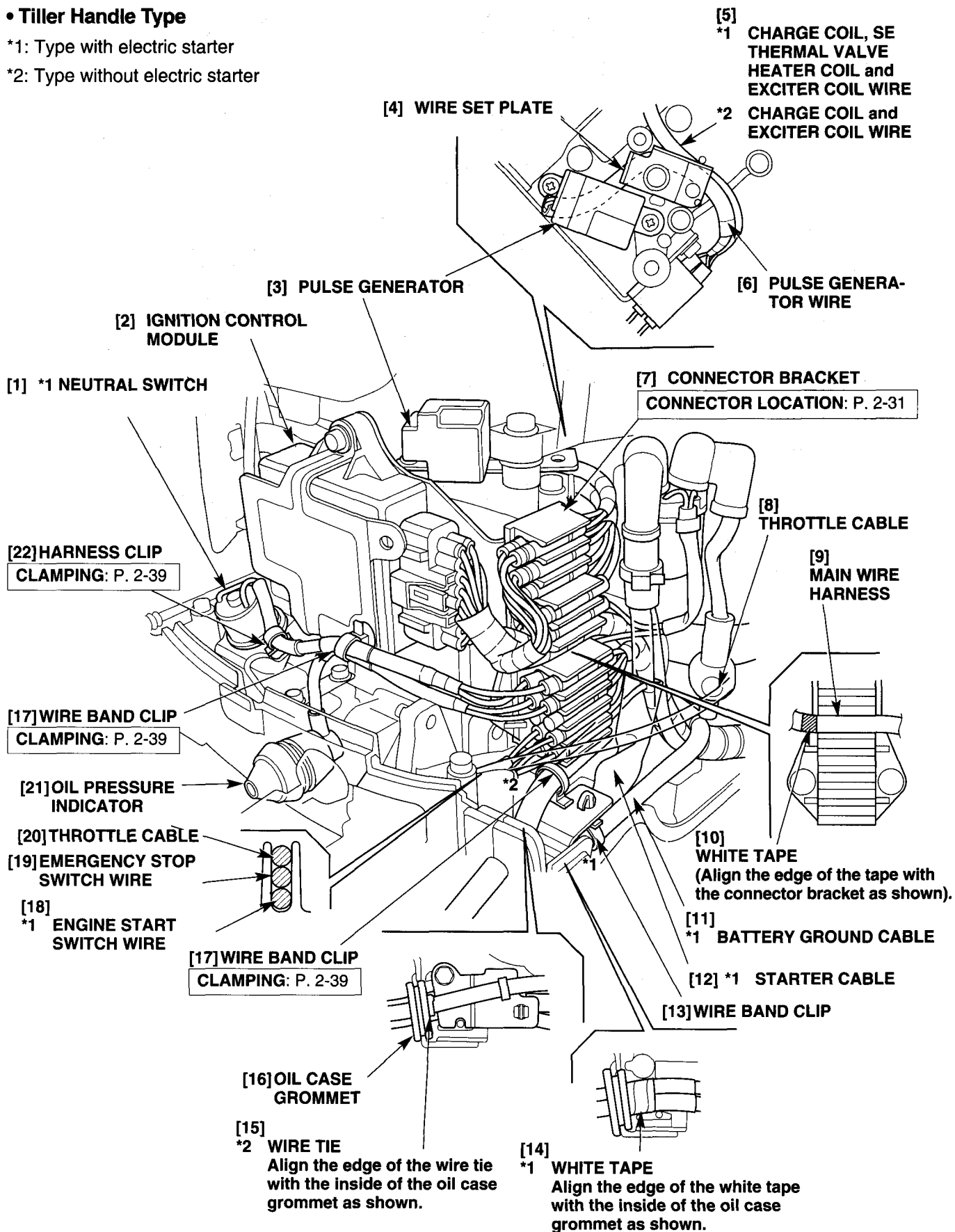
*2: Tiller handle type



• Tiller Handle Type

*1: Type with electric starter

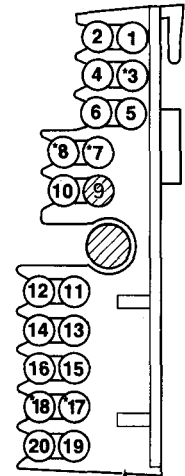
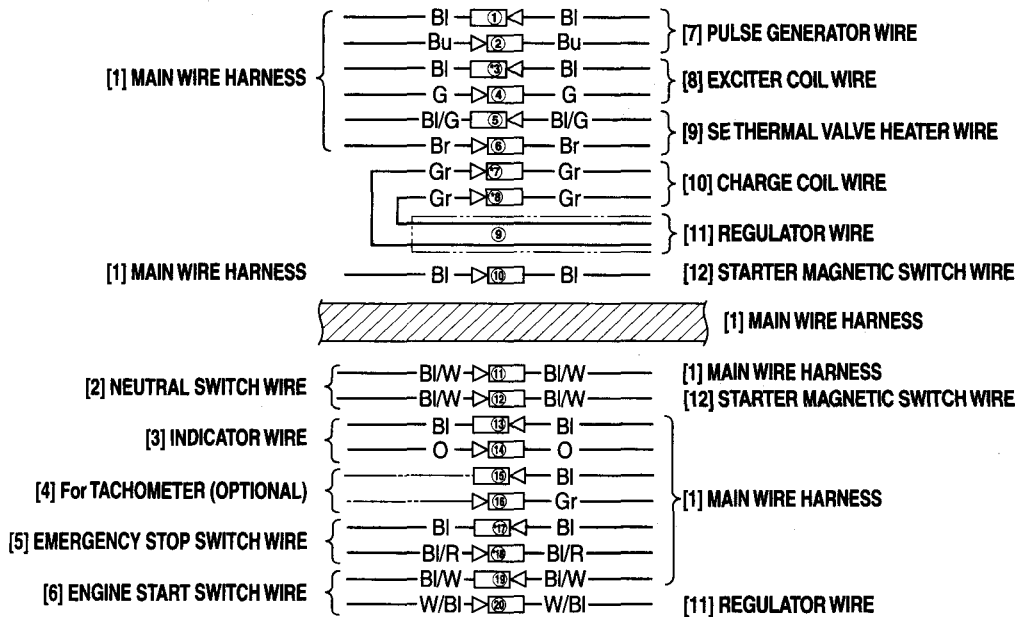
*2: Type without electric starter



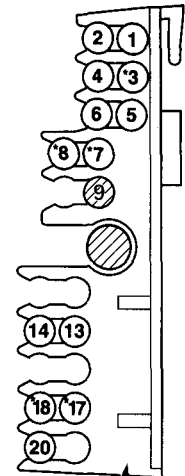
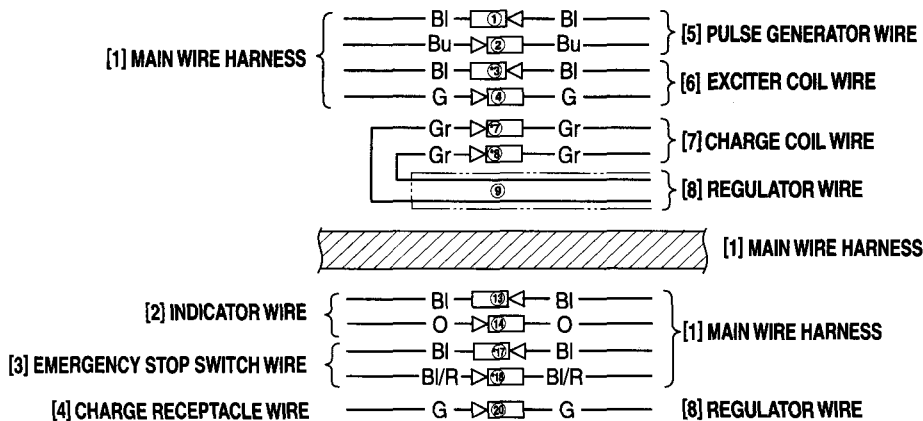
CONNECTOR LOCATION

*: Gray insulator

• Type with electric starter

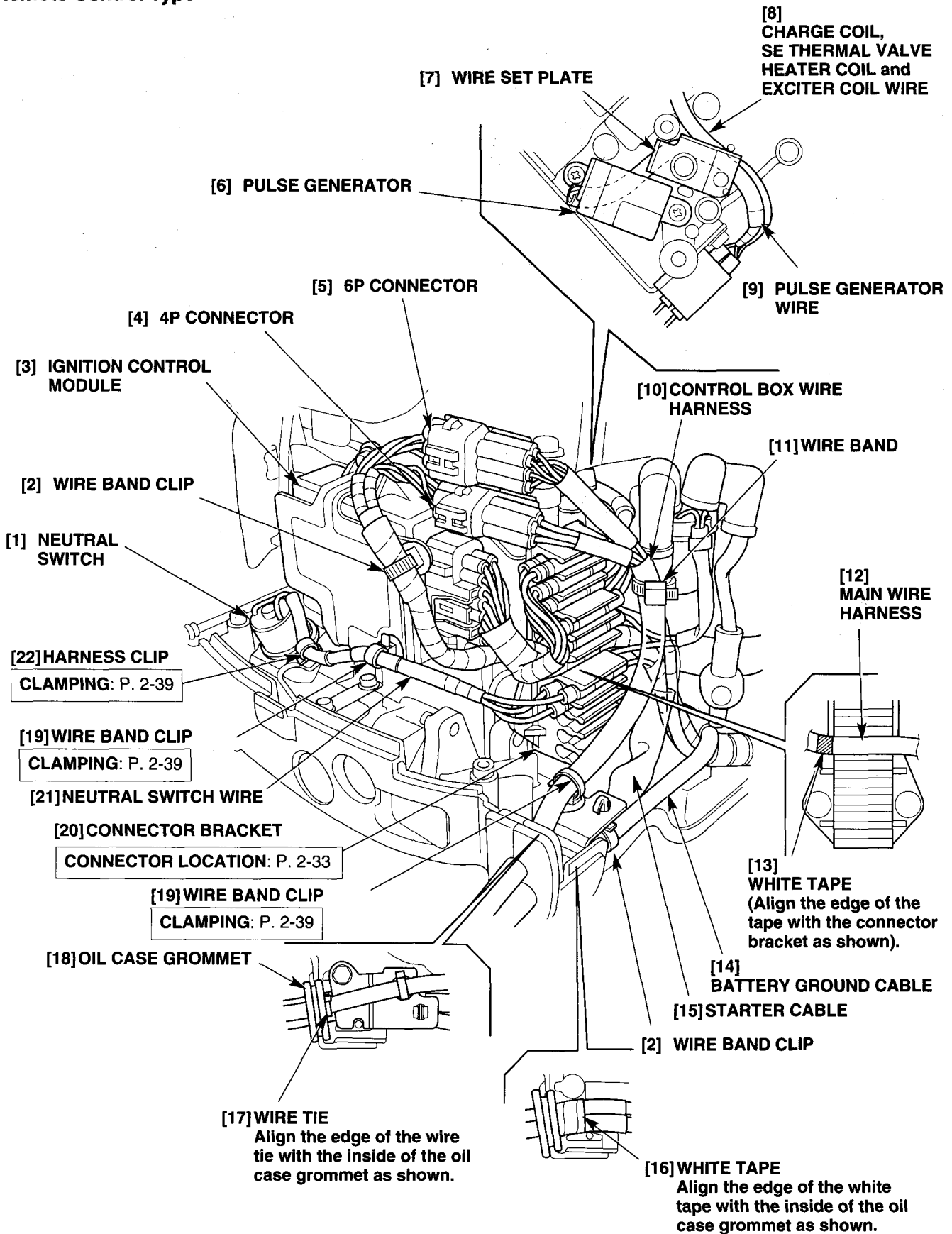


• Type without electric starter



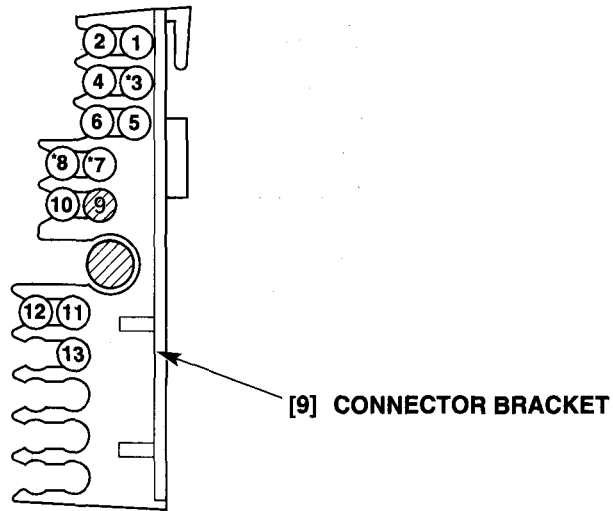
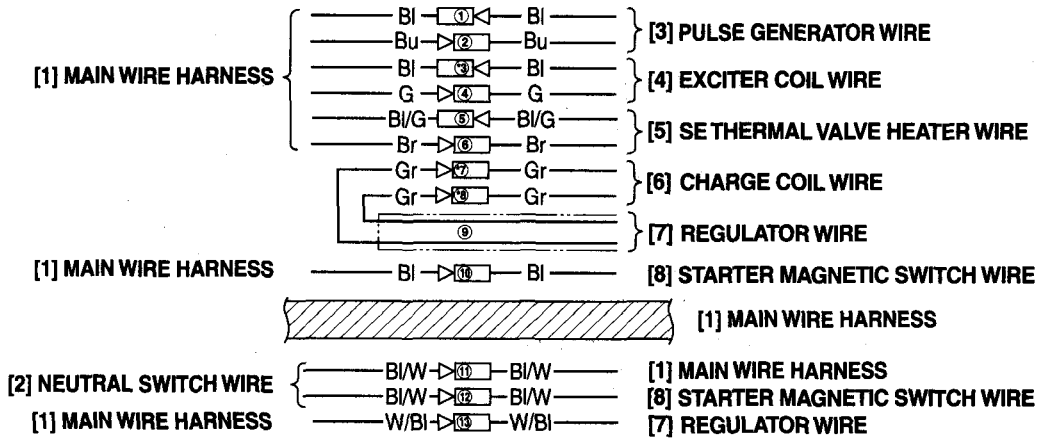
BI	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

• Remote Control Type



CONNECTOR LOCATION

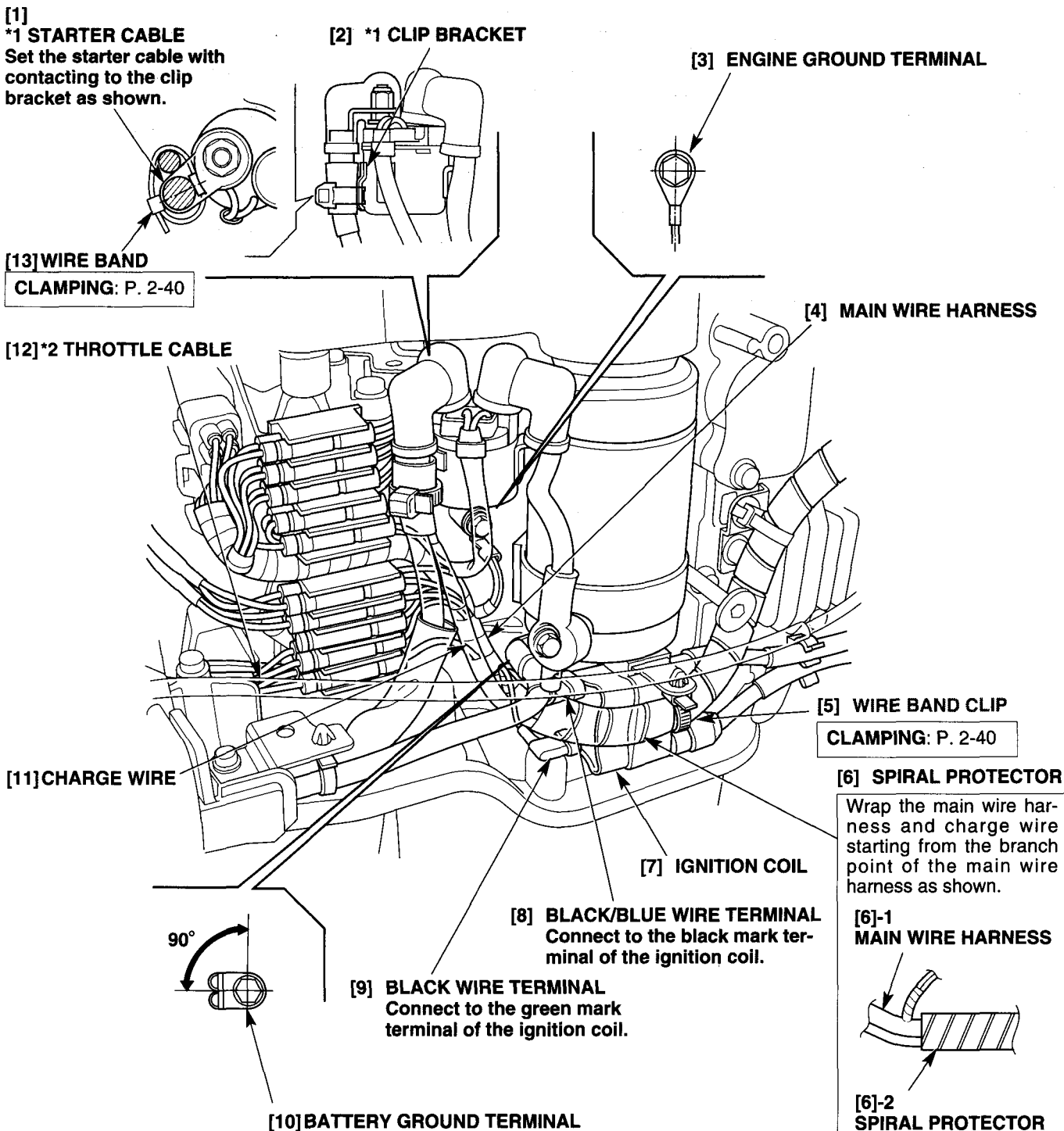
*: Gray insulator



Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

*1: Type with electric starter

*2: Tiller handle type



*1: Type with electric starter

*2: Tiller handle type

*3: Type without electric starter

[3] *1 STARTER CABLE
(to fuse box)

*3 CHARGE RECEPTACLE WIRE
(to fuse box)

[4] *1 STARTER CABLE
(to regulator/rectifier)

*3 CHARGE RECEPTACLE WIRE
(to regulator/rectifier)

[1] *1 REGULATOR WIRE
GROUND TERMINAL

[5] *1 MAIN WIRE HARNESS
(to SE thermal valve heater
and regulator/rectifier)

[6] MAIN WIRE HARNESS
(to oil pressure switch)

[2] FUSE HOLDER

[7] REGULATOR/RECTIFIER
WIRE



[17] WIRE BAND CLIP
CLAMPING: P. 2-40

[8] WIRE HOLDER
CLAMPING: P. 2-36

[9] THERMO SENSOR
CONNECTOR

[16] *2 THROTTLE CABLE

[10] WIRE BAND
CLAMPING: P. 2-40

[13] CORD CLAMP

[11] No. 1 HIGH TENSION CORD

[15] ENGINE SIDE
STOPPER

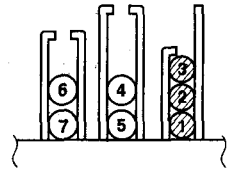
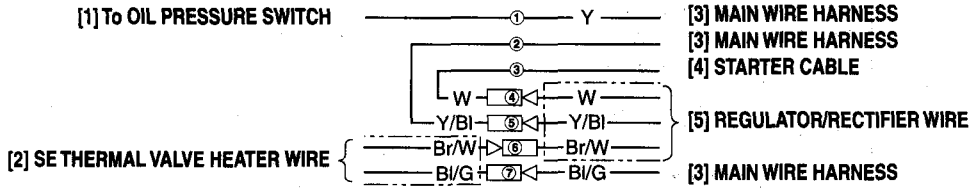
[12] No. 2 HIGH TENSION CORD

[14] Make sure that there is clearance
between the wire harness and
engine side stopper.

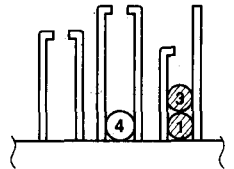
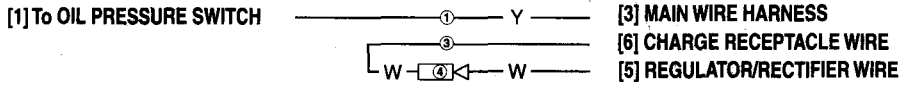
*1: Type with electric starter

*2: Type without electric starter

*1

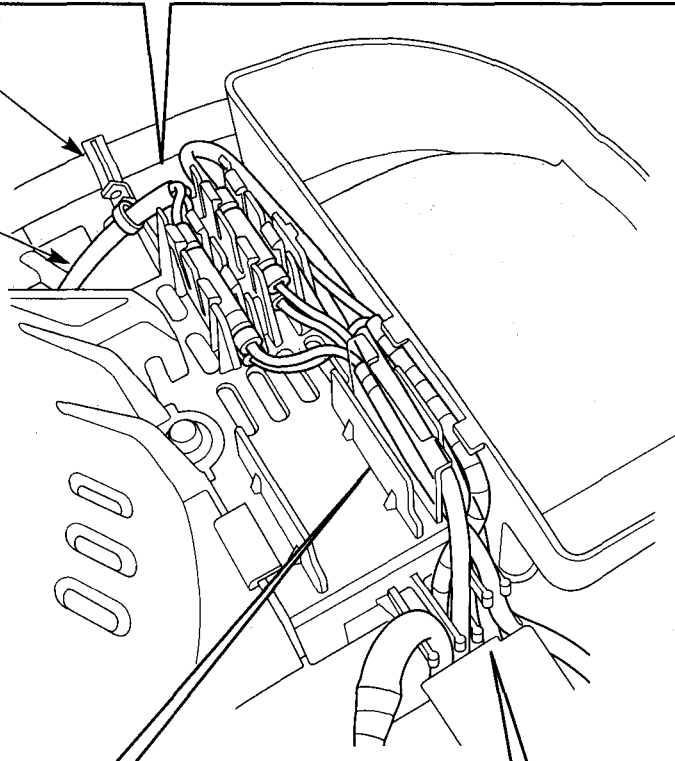


*2



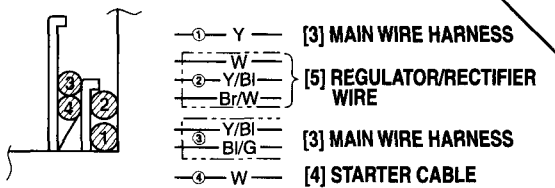
[7] *1 TUBE CLIP

[8] *1 THERMAL VALVE HEATER WIRE

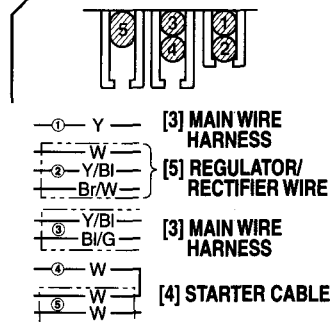


Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

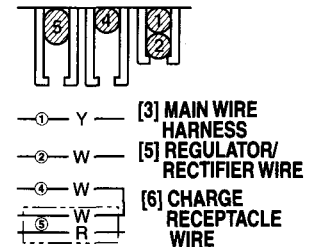
*1



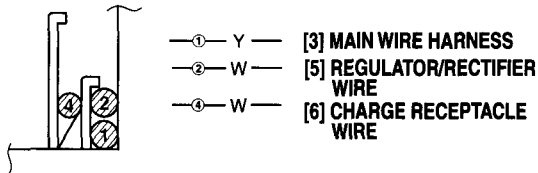
*1



*2



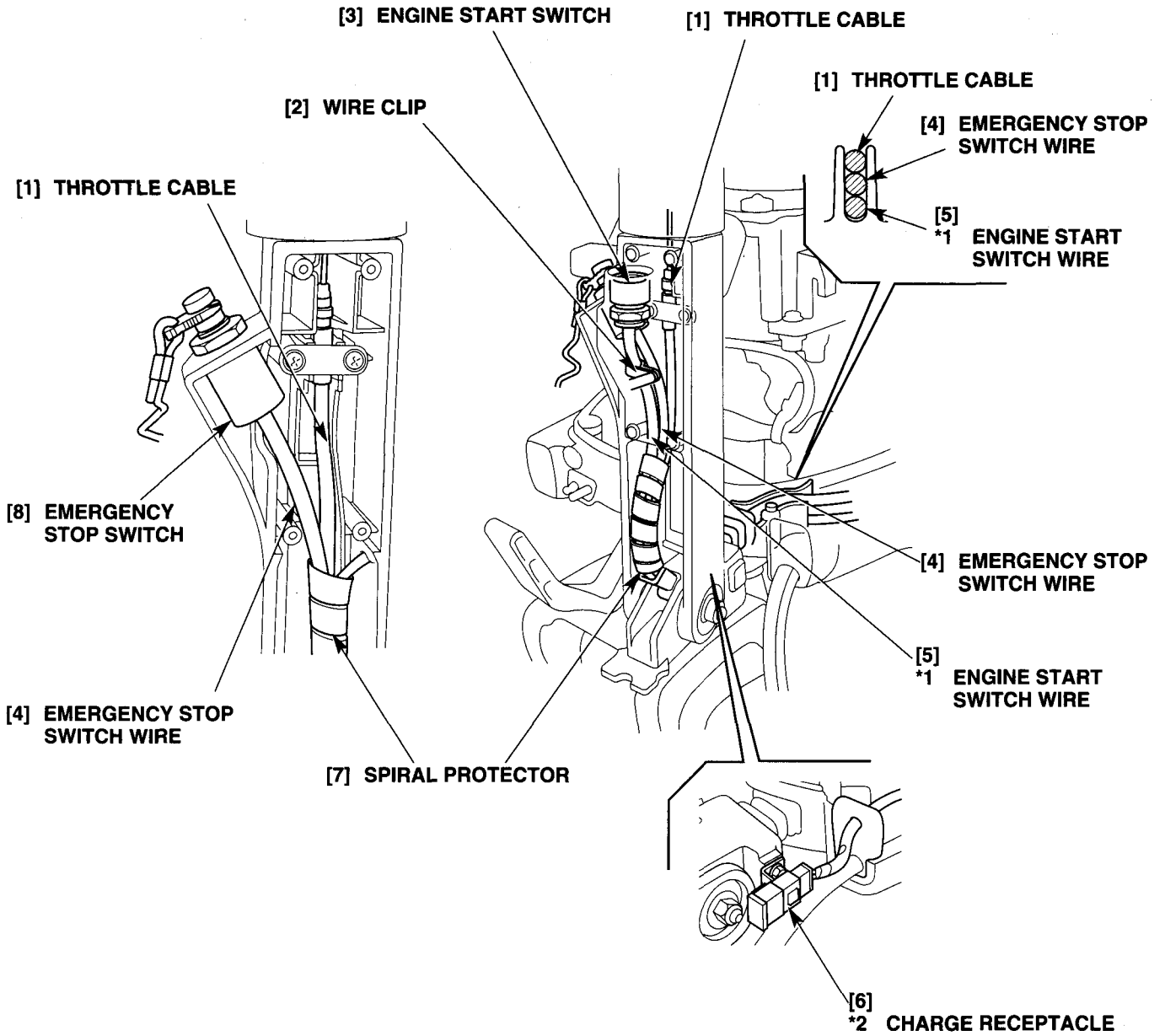
*2



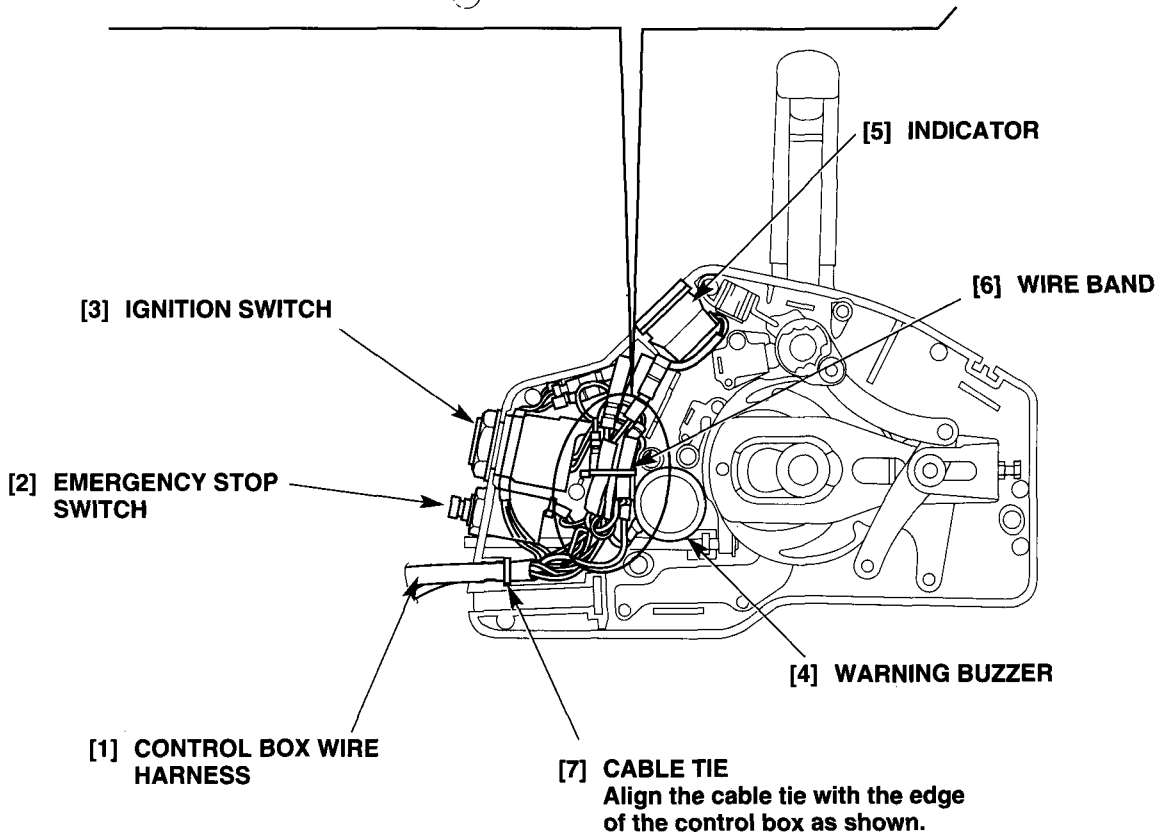
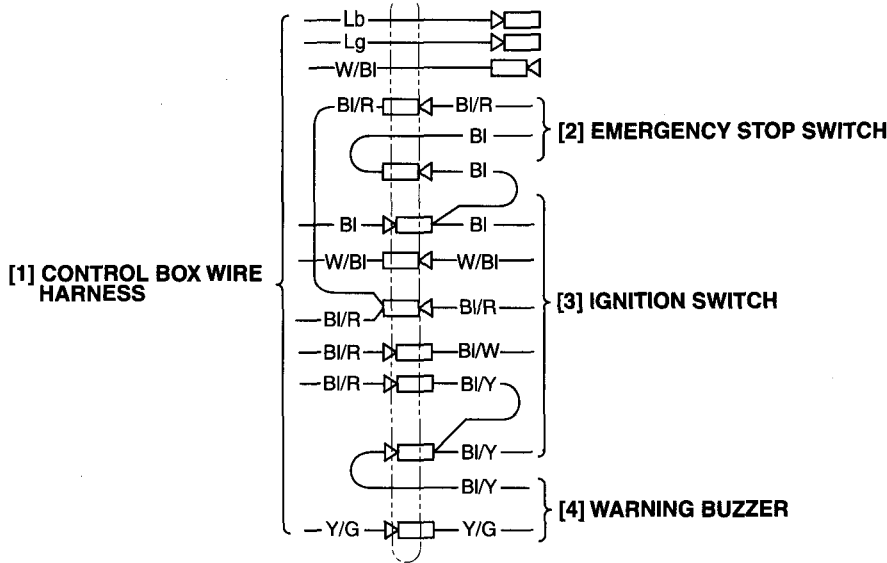
• Tiller Handle

*1: Type with electric starter

*2: Type without electric starter



• Remote Control Box



Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

• WIRE CLAMPING

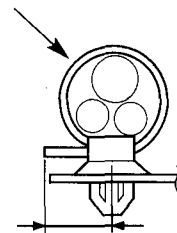
- Replace the wire band with new one, if it has been cut.
- After securing the wires with a new wire band, cut the end of the wire band as projected length is about 15 mm (0.6 in), except the wire band securing the control box wire harness or charge receptacle wire on the battery cable bracket (see below).

*1: Remote control type

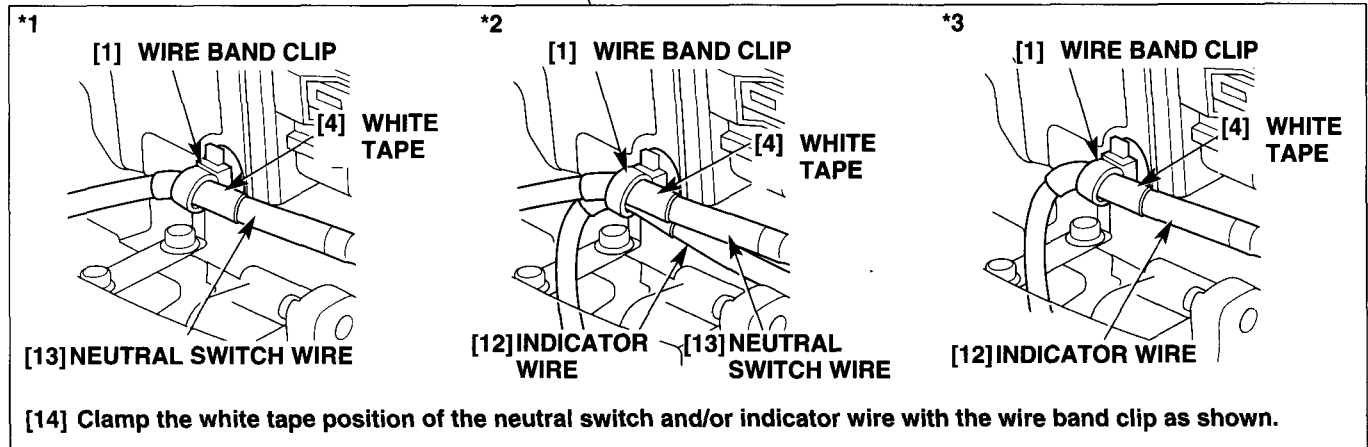
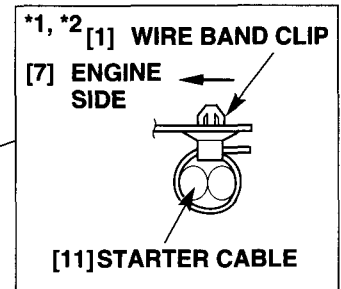
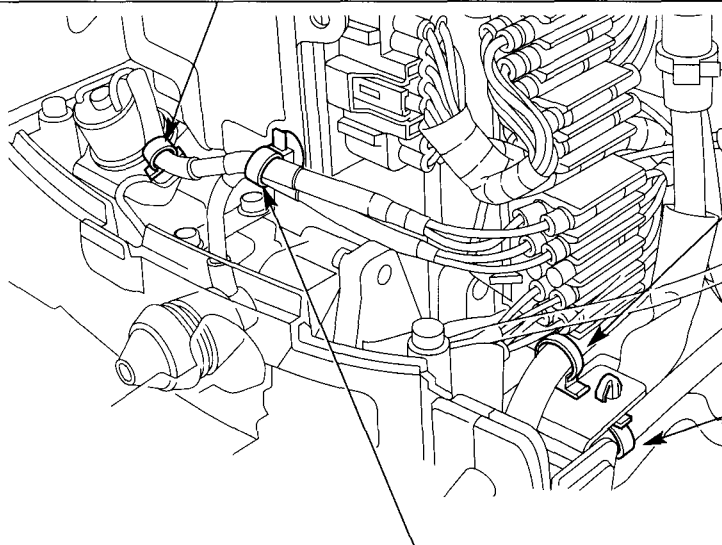
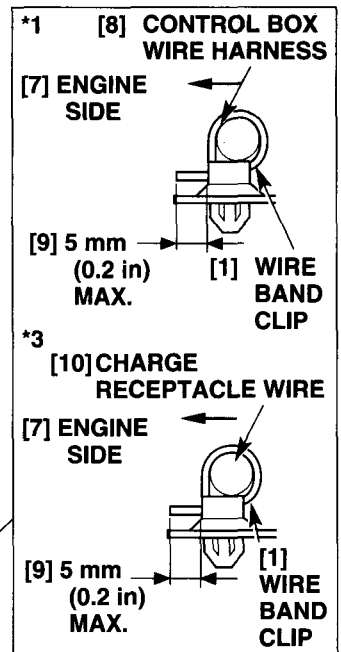
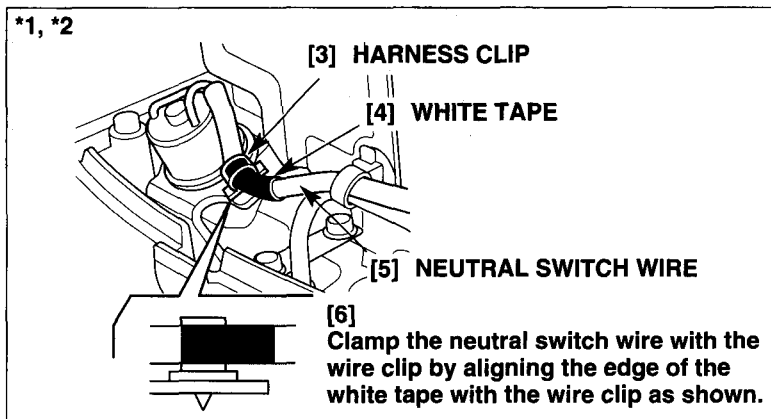
*2: Tiller handle type with electric starter

*3: Tiller handle type without electric starter

[1] WIRE BAND CLIP



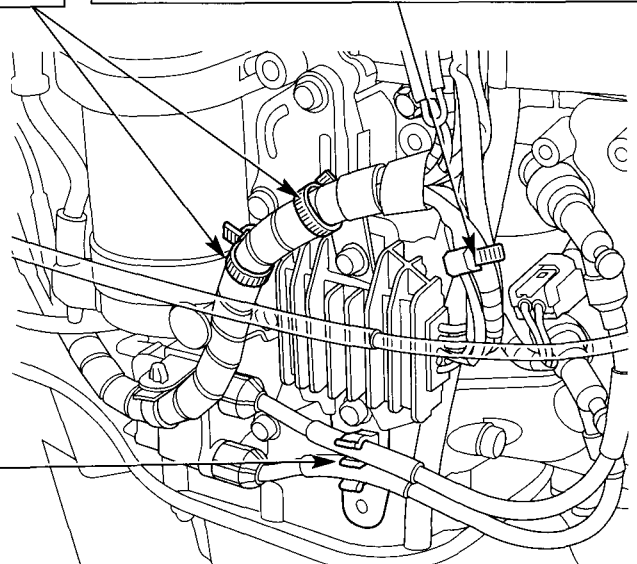
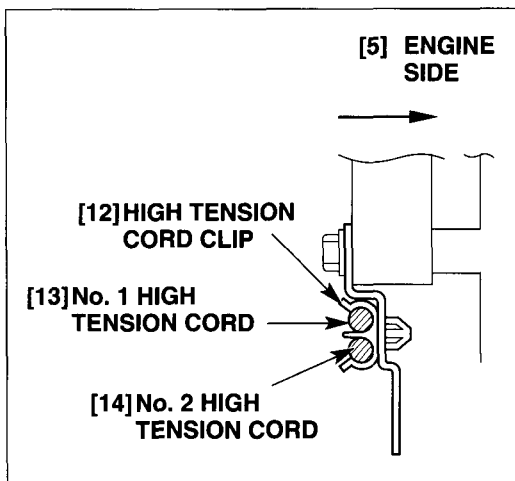
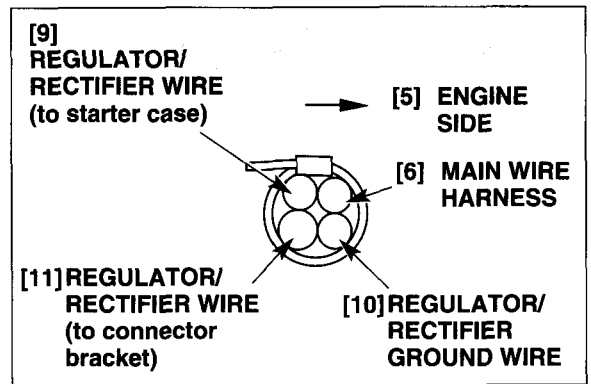
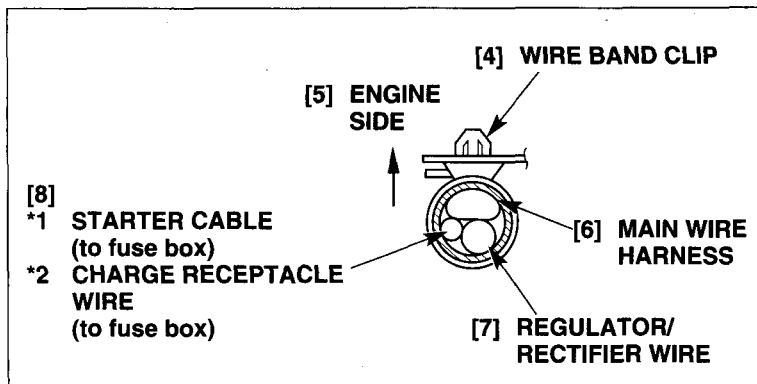
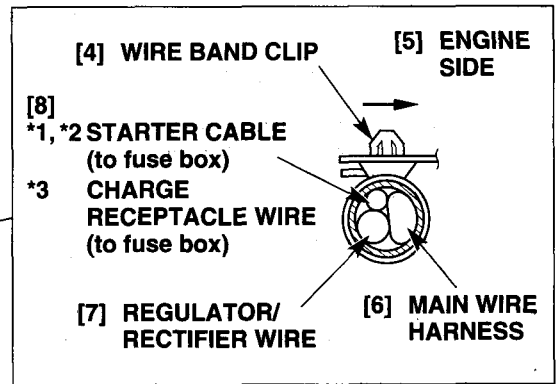
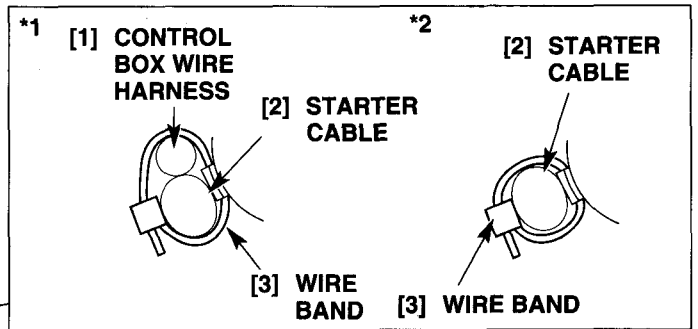
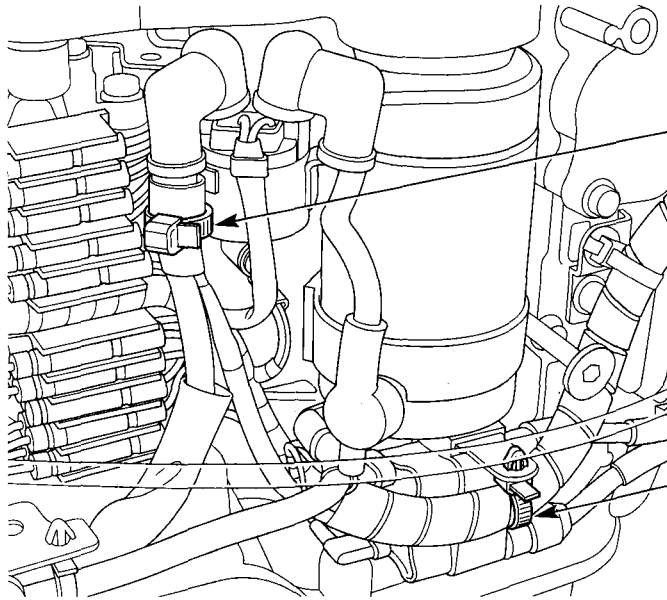
[2] About 15 mm (0.6 in)



*1: Remote control type

*2: Tiller handle type with electric starter

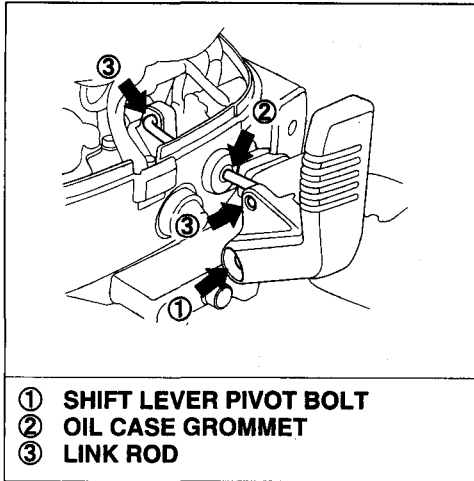
*3: Tiller handle type without electric starter



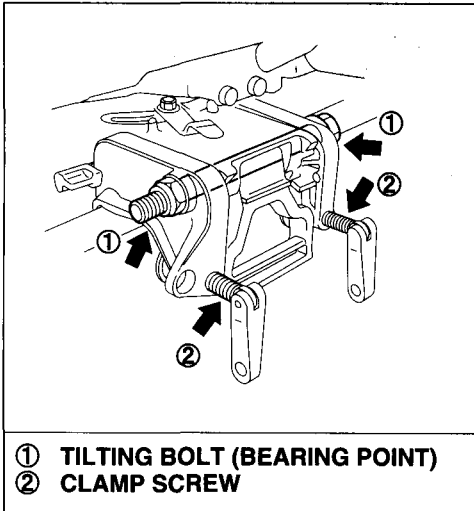
10. LUBRICATION POINTS

Apply marine anti-corrosion grease to the parts shown below.

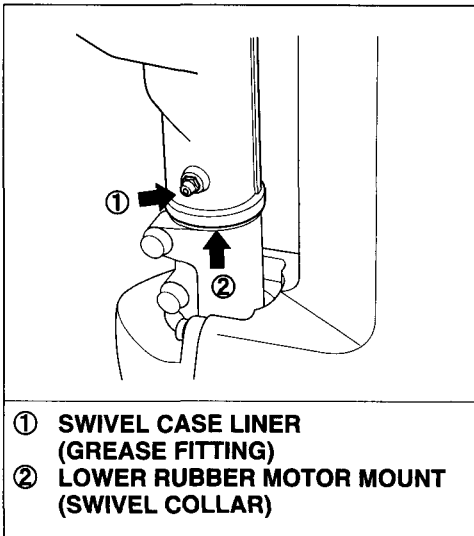
[1]



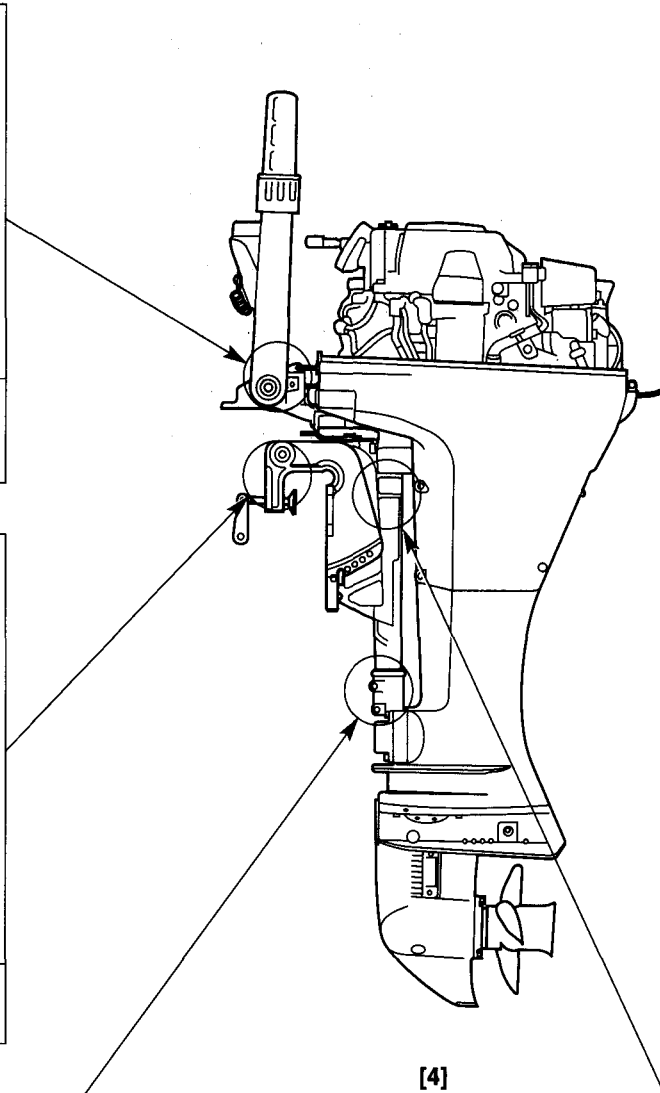
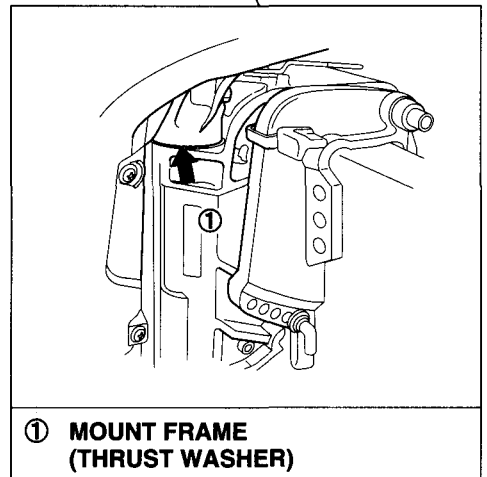
[2]



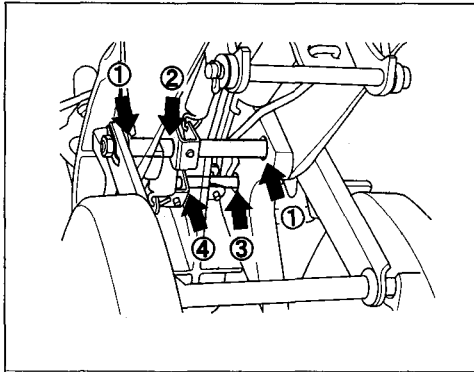
[3]



[4]

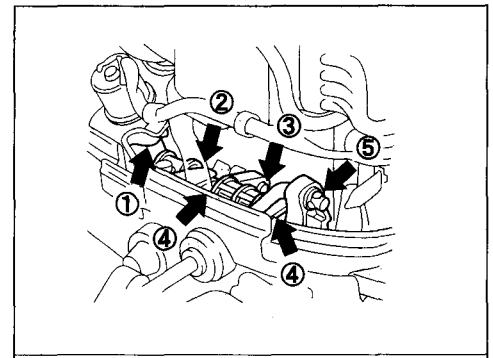


[1]



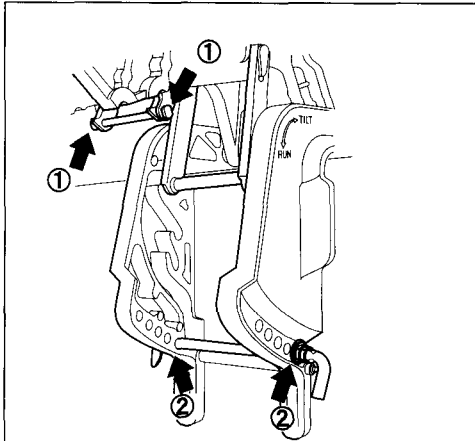
- ① TILT SHAFT
- ② TILT SHAFT BRACKET
- ③ TILT LEVER
- ④ RELEASE ROD BRACKET, TILT LEVER BRACKET

[4]



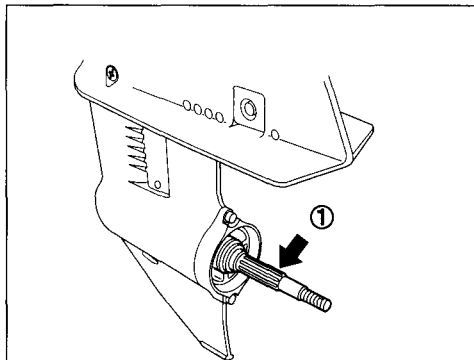
- ① SHIFT SHAFT (SWITCH CAM)
- ② DETENTE SPRING (DETENTE POINT)
- ③ SHIFT ROD A (BEARING)
- ④ SHIFT SHAFT PLATE (BEARINGS)
- ⑤ LINK ROD (BEARING)

[2]

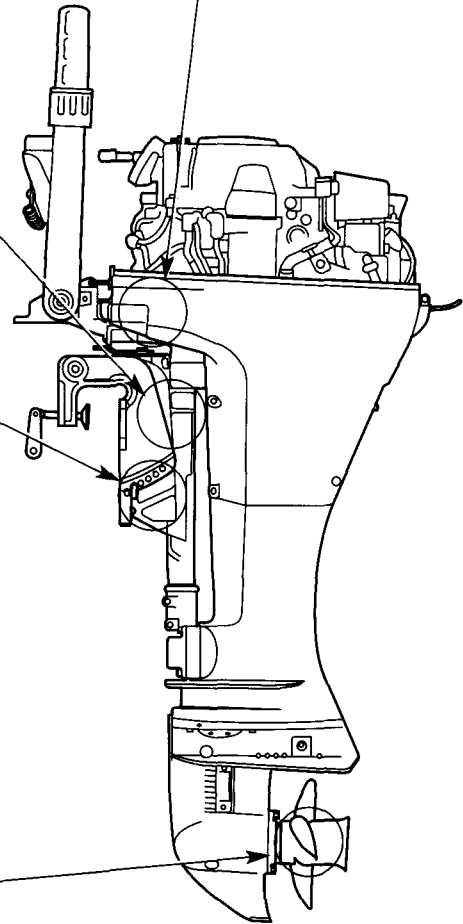


- ① REVERSE LOCK SHAFT
- ② ADJUSTING ROD

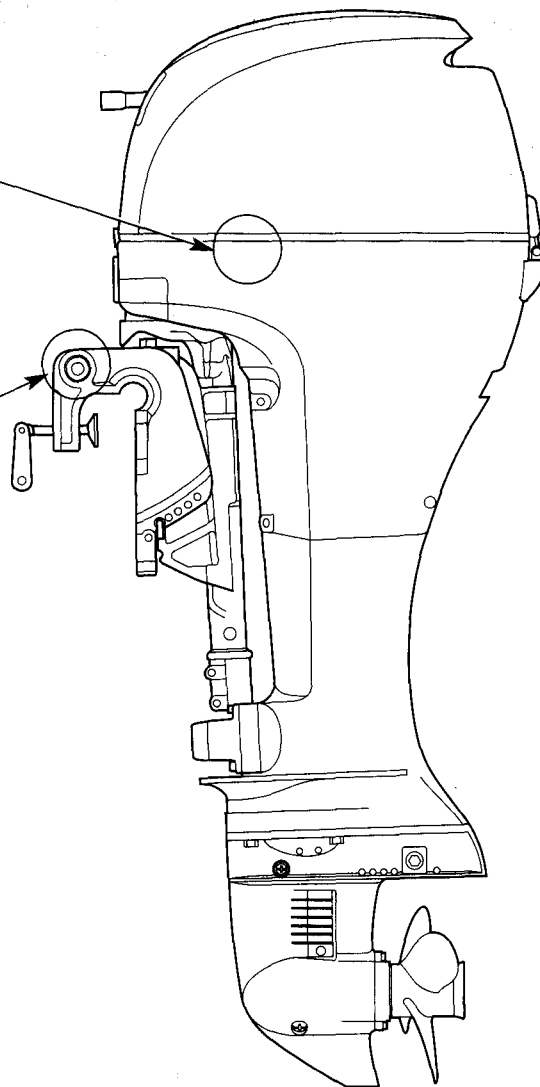
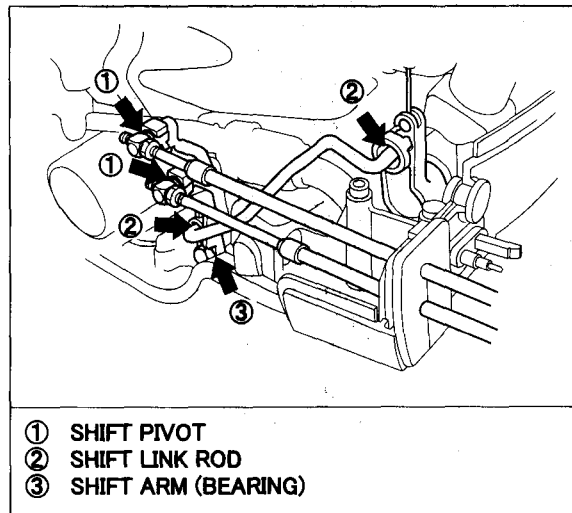
[3]



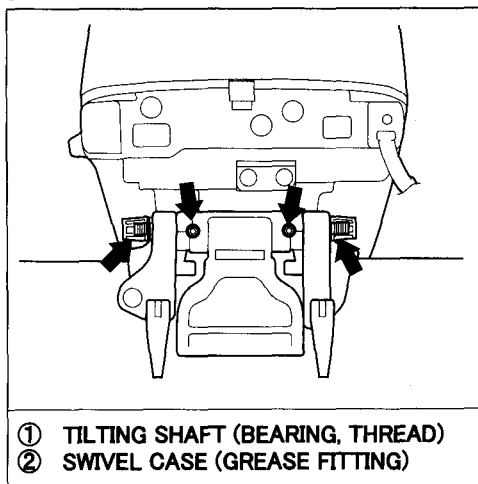
- ① PROPELLER SHAFT



[1]



[2]



1. MAINTENANCE SCHEDULE	8. FUEL FILTER
2. ENGINE OIL	9. FUEL TANK STRAINER
3. OIL FILTER CARTRIDGE	10. FUEL TUBES
4. GEAR CASE OIL	11. THROTTLE LINKAGE
5. SPARK PLUG	12. TIMING BELT
6. VALVE CLEARANCE	13. EXHAUST EMISSION (Bodensee model)
7. CARBURETOR	

1. MAINTENANCE SCHEDULE

ITEM	REGULAR SERVICE PERIOD (2) Perform at every indicated month or operating hour interval, whichever comes first.	Each use	After use	First month or 20 Hrs	Every 6 months or 100 Hrs	Every Year or 200 Hrs	Refer to page
* Engine oil	Check level	○					3-2
	Change			○	○		
Oil filter	Replace					○	3-3
Gear case oil	Change			○	○		3-5
Starter rope	Check				○		—
* Carburetor linkage	Check-adjust			○	○		3-13
* Valve clearance	Check-adjust			○		○	3-4
Spark plugs	Check-adjust				○		3-6
	Replace					○	
Propeller and cotter pin	Check	○					—
Anode	Check	○					—
Idle speed	Check-adjust			○	○		3-7
Lubrication	Grease			○(1)	○(1)		2-38
* Fuel tank and tank filter	Clean					○	5-1
* Thermostat	Check					○	11-5
* Fuel filter	Check				○		3-8
	Replace					○	
* Fuel line	Check	○					3-9
	Replace	Every 2 years (if necessary)					
Battery and cable connection	Check level-tighten	○					—
Bolts and nuts	Check-tighten			○	○		—
* Crankcase breather tube	Check					○	6-2
Cooling water passage	Clean		○(3)				—

* Emission item for Borden-sea model.

(1) Lubricate more frequently when used in salt water.

(2) For professional commercial use, log hours of operation to determine proper maintenance interval.

(3) When operating in salt water, turbid or muddy water, the engine should be flushed with clean water after each use.

2. ENGINE OIL

• Oil Level Check

- 1) Run the outboard motor in an outboard test tank with the water at least 4 inches above the antivibration plate. Allow the engine to warm up to normal operating temperature.

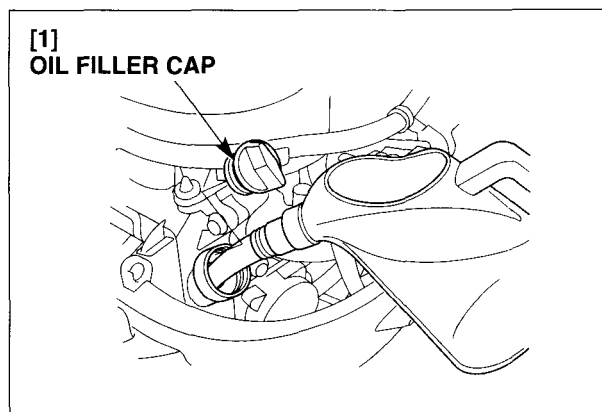
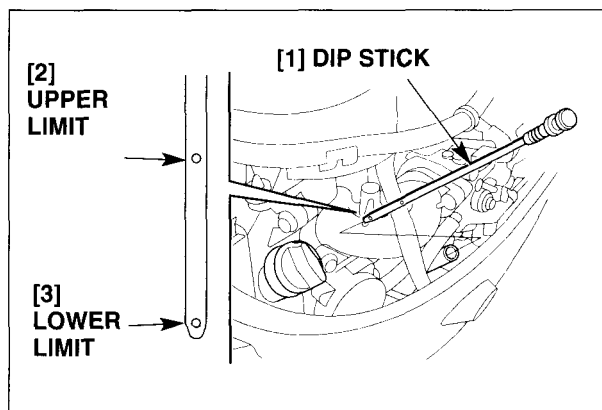
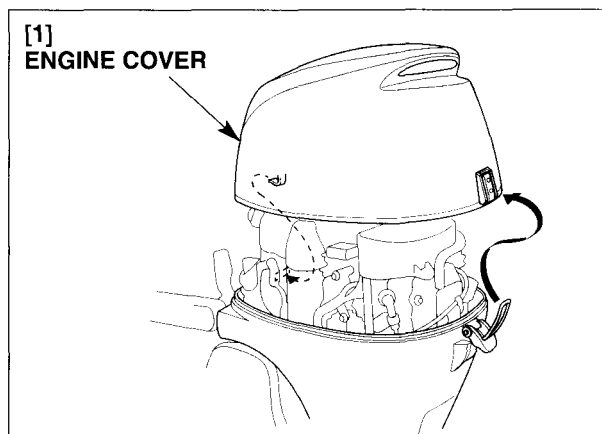
⚠ WARNING

Engine exhaust contains poisonous carbon monoxide gas that can cause unconsciousness and death.

- If the engine must be running, make sure the area is well ventilated.

- 2) Stop the engine and remove the engine cover. Hold the outboard motor vertical.
- 3) Remove the dipstick and wipe it clean.
- 4) Insert the dipstick all the way in, then pull it out and check the oil level. Check the engine oil condition, change the engine oil if it is stale or contaminated with foreign material.

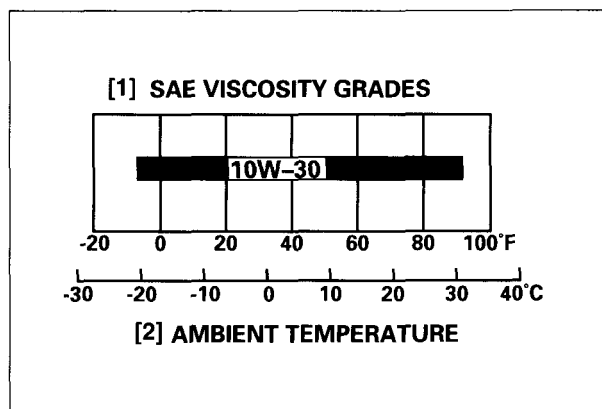
- 5) If the oil level is low, remove the oil filler cap and add the recommended engine oil to reach the upper limit mark on the dipstick



Recommended engine oil	SAE 10W-30 API Service classification SG/SH/SJ
------------------------	---

Use a 4-stroke motor oil that meets or exceeds the requirements for API service classification SG, SH or SJ. Always check the API service label on the oil container to be sure it includes the letters SG, SH or SJ.

Engine oil is a major factor affecting performance and service life. Use 4-stroke automotive detergent oil.



• Oil Change

Drain the used oil while the engine is warm. Warm oil drains quickly and completely.

- 1) Hold the outboard motor vertical.
- 2) Remove the oil filler cap and oil drain bolt, and drain the engine oil into a suitable container.

Please dispose of the used motor oil in a manner that is compatible with the environment. We suggest you take used oil in a sealed container to your local recycling center or service station for reclamation. Do not throw it in the trash, pour it on the ground, or down a drain.

▲ CAUTION

- Used engine oil contains substances that have been identified as carcinogenic. If repeatedly left in contact with the skin for prolonged periods, it may cause skin cancer.
- Wash your hands thoroughly with soap and water as soon as possible after contact with used engine oil.

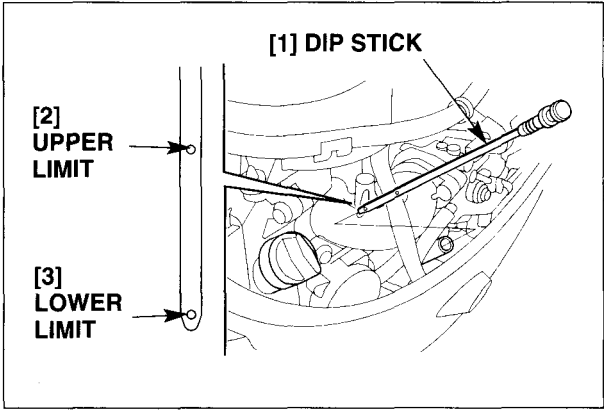
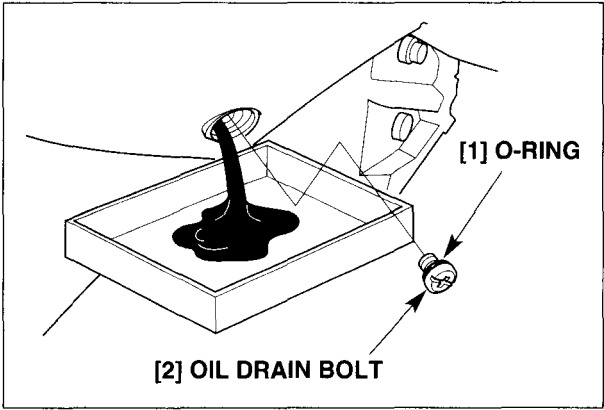
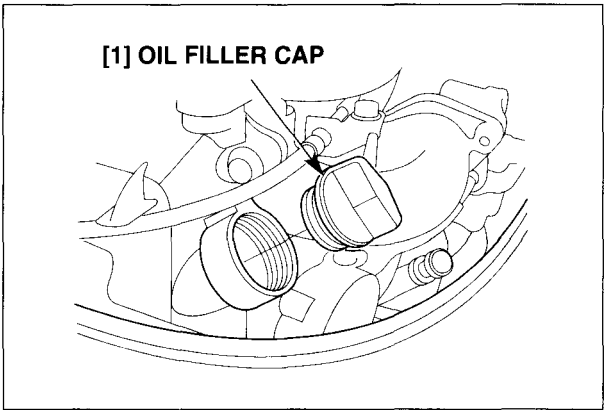
- 3) Make sure the O-ring is in good condition, replace it with new one if necessary. Reinstall the drain bolt and the O-ring, and tighten the drain bolt securely.

TORQUE: 6.5 N•m (0.65 kgf•m, 4.7 lbf•ft)

- 4) Fill to the engine with the correct amount of the recommended oil. Reinstall the oil filler cap securely.

Engine oil capacity	1.0 ℓ (1.06 US qt, 0.88 Imp qt)
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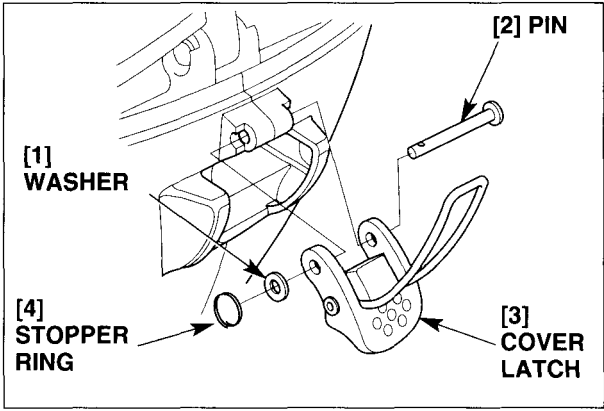
- 5) Recheck the oil level shown on the level gauge; if near or below the lower limit mark, fill to the upper limit mark with the recommended oil.



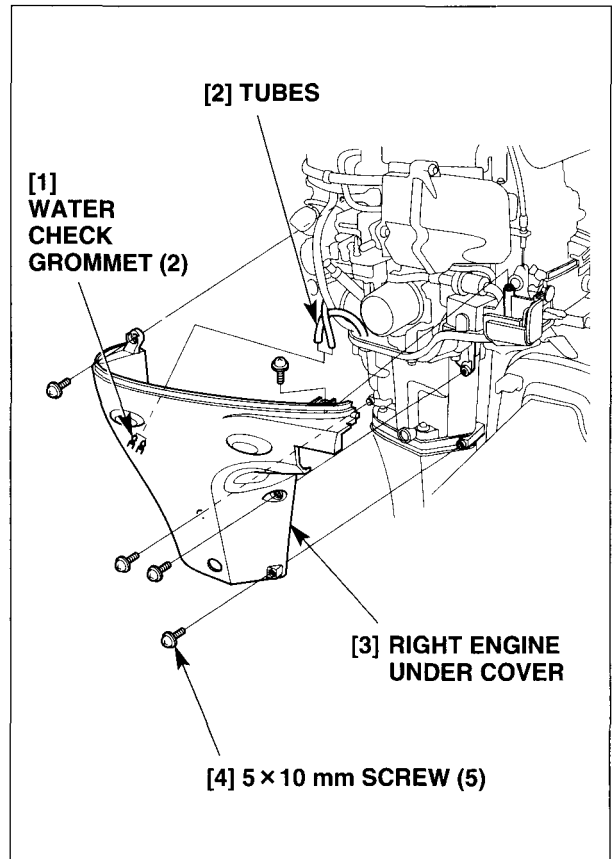
3. OIL FILTER CARTRIDGE

• Replacement

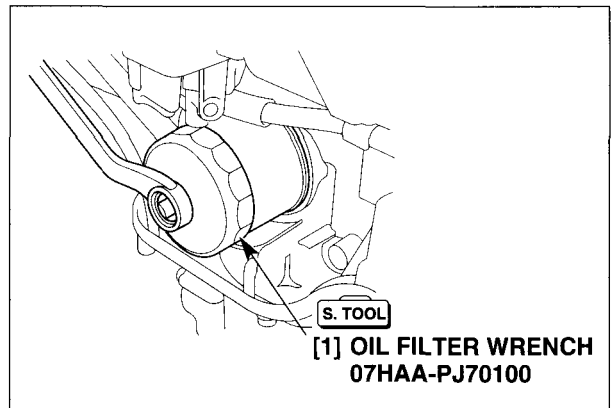
- 1) Remove the engine cover.
- 2) Drain the engine oil.
- 3) Remove the stopper ring and then remove the washer, pin and cover latch.



- 4) Remove the five 5 × 10 mm screws attaching the right engine under cover. Pull the right engine under cover and disconnect the tubes from the water check grommets on the right engine under cover, then remove the right engine under cover.

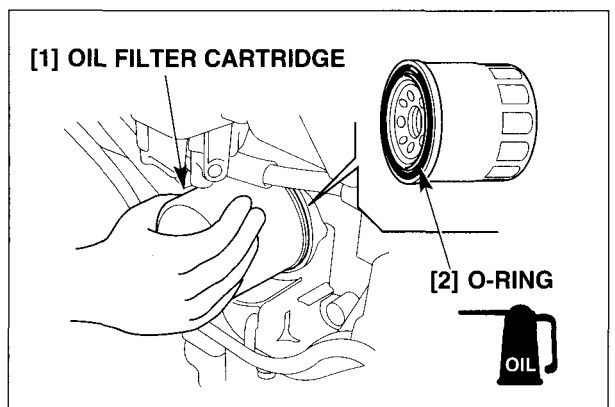


- 5) Place a rag under the oil filter to trap oil leakage.
 6) Remove the oil filter using a commercially available oil filter socket and let the remain oil drain out. Dispose of the oil filter in a manner that is compatible with the environment.



- 7) Apply a thin coat of engine oil to the new oil filter O-ring.
 8) Clean the oil filter mounting boss with clean rag, the apply a thin coat of engine oil to the filter mounting boss.
 9) Screw on the new oil filter cartridge by hand until the O-ring contacts the filter base, then tighten the oil filter an additional 7/8 turn using the oil filter wrench.

TORQUE: 12 N•m (1.2 kgf•m, 8.7 lbf•ft)



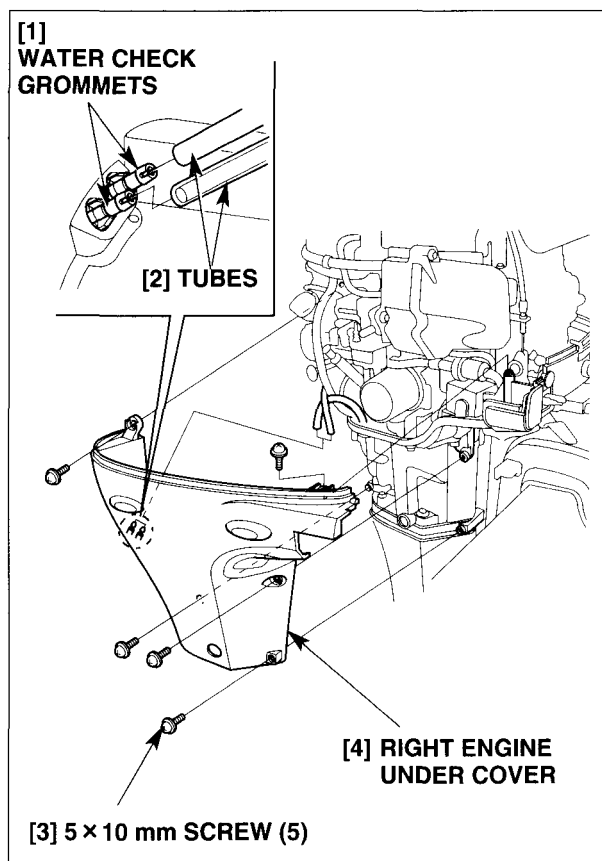
10) Fill the crankcase with the specified amount of recommended engine oil.

Engine oil capacity (with oil filter replacement)	1.3 ℓ (1.37 US qt, 1.14 Imp qt)
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11) Start and run the motor for a few minutes, then stop and check for oil leaks in the oil filter cartridge area and the oil level. Fill to the upper limit mark if necessary.

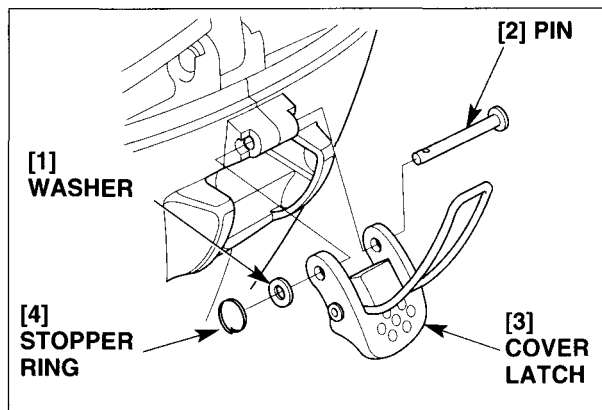
12) Connect the tubes to the water grommet on the right engine under cover, then install the right engine under cover and tighten the 5 mm screws.

TORQUE: 4.5 N•m (0.45 kgf•m, 3.3 lbf•ft)



13) Install the cover latch with the washer, pin and stopper ring securely.

14) Reinstall the engine cover

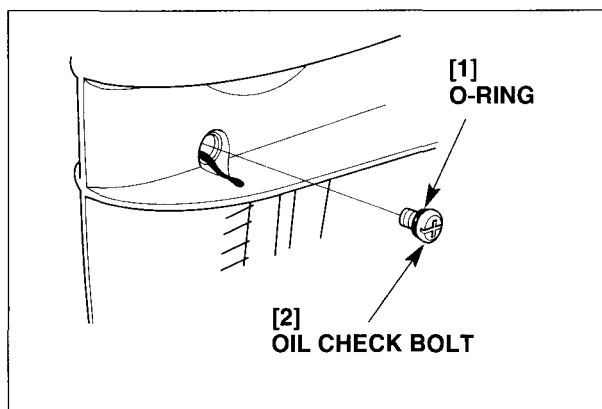


4. GEAR CASE OIL

• Inspection

- 1) Place the outboard motor vertical.
- 2) Remove the oil check bolt, and check whether the gear case oil flows out of the check bolt hole.

If it flows out, reinstall the oil check bolt. If the oil does not flow out, add oil (P. 3-6).



• Additional Gear Case Oil

- 1) Remove the oil check bolt.
- 2) Remove the oil drain bolt, and install a commercially available gear oil pump or gear oil bottle in the oil drain bolt hole. Add gear case oil until it flows out of the oil check bolt hole.

Recommended gear case oil	SAE #90 Hypoid gear oil or equivalent
---------------------------	---------------------------------------

• Oil Change

- 1) Place the outboard motor vertical.
- 2) Remove the oil check bolt, oil drain bolt, and drain the gear case oil into a suitable container.

Check for water in the drained gear case oil.

If there is water in the gear case oil, check the gasket and water seal for damage and check torque at each tightening point of the gear case.

- 3) Install a commercially available gear oil pump or gear oil bottle in the oil drain bolt hole.

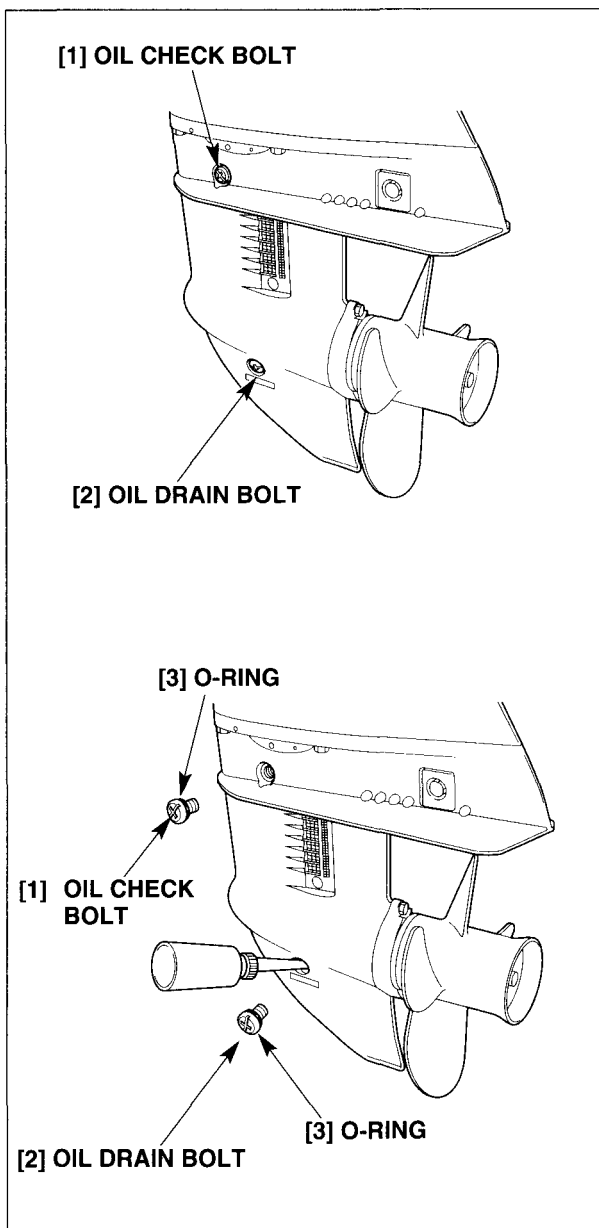
Gear case oil capacity	285 cc (17.4 cu. in)
------------------------	----------------------

- 4) When the oil flows out of the oil level check hole, install the O-ring and oil check bolt quickly.

Before installing the oil check and drain bolts, make sure that the O-rings are in good condition, replace with new one if necessary.

- 5) Then install the O-ring and oil drain bolt.
- 6) Tighten the oil drain bolt and oil check bolt to the specified torque.

TORQUE: 3.5 N•m (0.35 kgf•m, 2.5 lbf•ft)

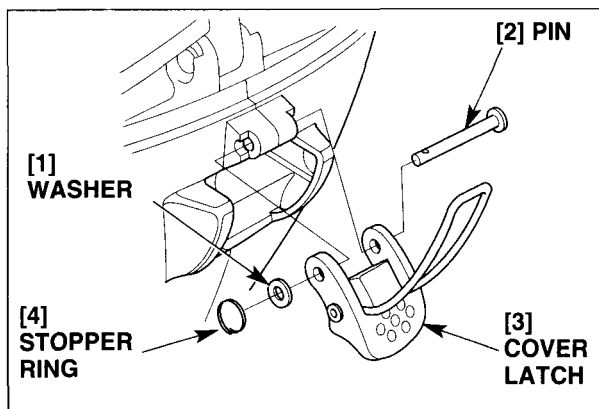


5. SPARK PLUG

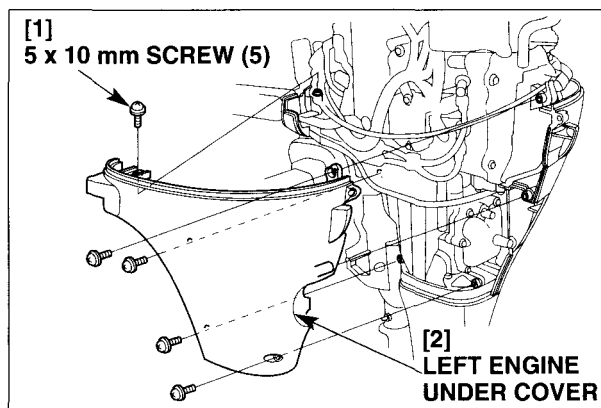
• Inspection/Cleaning

If the engine has been running, the engine will be very hot. Allow it to cool before proceeding.

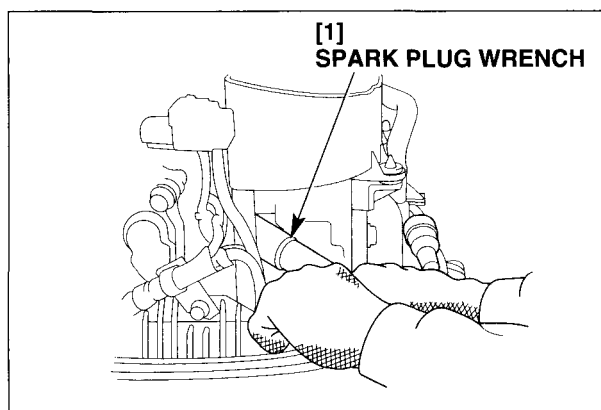
- 1) Remove the engine cover.
- 2) Remove the stopper ring and then remove the washer, pin and cover latch.



- 3) Remove the five 5 × 10 mm screws and left engine under cover.



- 4) Remove the spark plug caps, then remove the spark plugs using a spark plug wrench.
- 5) Visually inspect the spark plug. Discard the plug if the insulator is cracked or chipped.
- 6) Remove carbon or other deposits with a stiff wire brush.
- 7) Measure the plug gap with a wire-type feeler gauge. If necessary, adjust the gap by bending the side electrode.



Standard spark plug	CR5EH-9 (NGK) U16FER9 (DENSO)
Spark plug gap	0.8 - 0.9 mm (0.031 - 0.036 in)

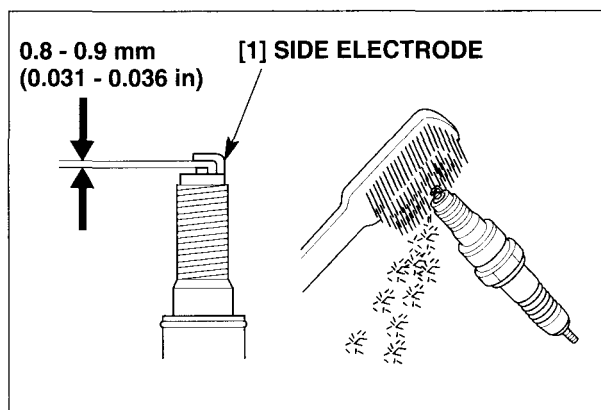
- 8) Make sure the sealing washers are in good condition; replace if necessary.
- 9) Install the plug fingertight to seat the washer, then tighten with a plug wrench to compress the sealing washer.

If reinstalling the used spark plug, tighten 1/8 - 1/4 turn after the spark plug seats.

If installing a new spark plug, tighten 1/2 turn after the spark plug seats.

NOTICE

- The spark plugs must be securely tightened. An improperly tightened spark plug can become very hot and may damage the engine.
- Overtightening the spark plug can damage the threads in the cylinder head.



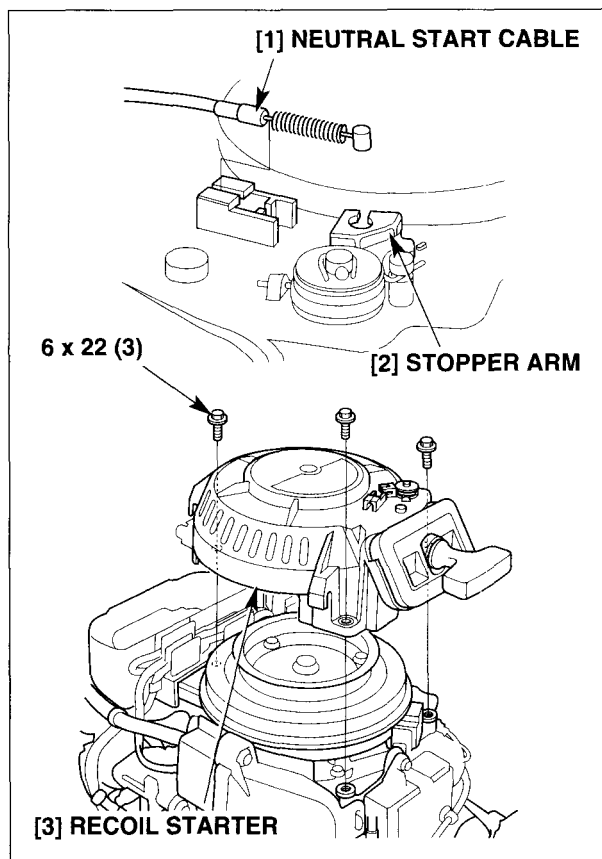
- 10) Reinstall the spark plug caps and then install the removed parts in the reverse order of removal.

6. VALVE CLEARANCE

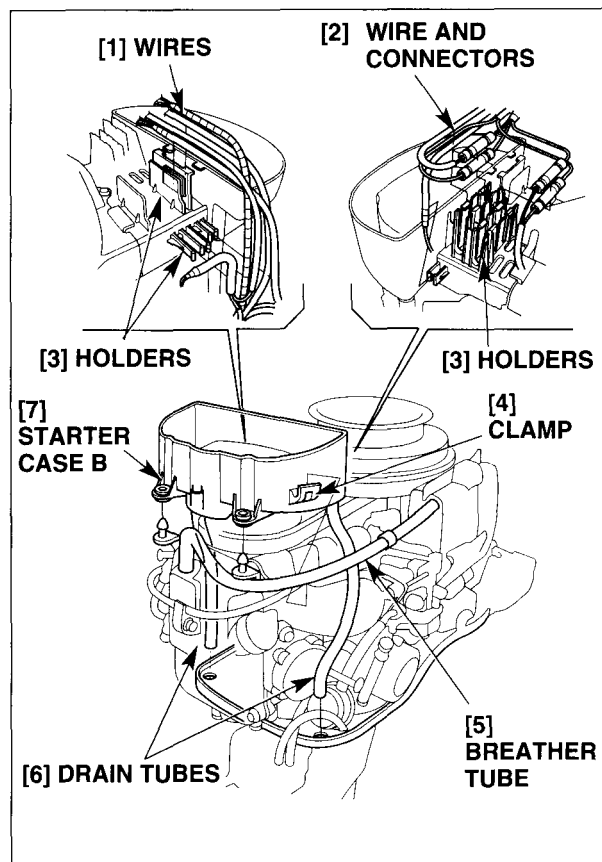
• Inspection

Valve clearance inspection and adjustment must be performed with the engine cold.

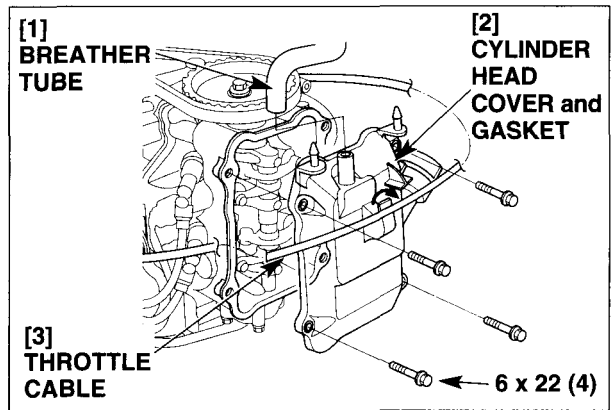
- 1) Remove the engine cover.
- 2) Set the gear in the neutral position.
- 3) Remove the right engine under cover (P. 3-3 and 4) and left engine under cover (P. 3-6 and 7).
- 4) Disconnect the neutral start cable from the stopper arm on the recoil starter.
- 5) Remove the three 6 X 22 mm flange bolts and recoil starter.



- 6) Pull out the connectors and wires from the holders on the starter case B.
 - See page 2-39 for wire and connector locations.
- 7) Release the breather tube from the clamp on the starter case B.
- 8) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.



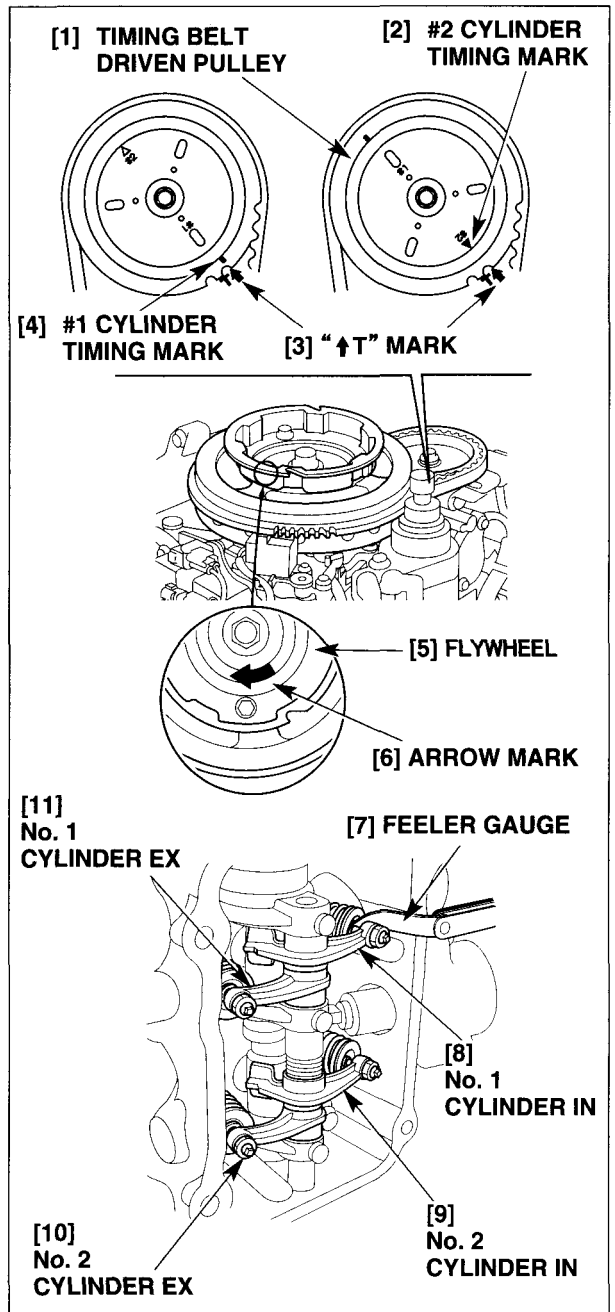
9) Disconnect the breather tube from the cylinder head cover and pull the throttle cable off from the hook on the cylinder head cover (tiller handle type only). Remove the four 6 x 22 mm flange bolts and the cylinder head cover and head cover gasket.



10) Turn the crankshaft clockwise by turning the flywheel clockwise (as the arrow marked direction) until the "■" #1 timing mark on the timing belt driven pulley aligns with the "↑T" mark on the cylinder head.

- In this position, the No. 1 cylinder is at top dead center of its compression stroke.
- Don't turn the flywheel counterclockwise.

11) With the engine in the position described in step 10, check the intake and exhaust valve clearances at No. 1 cylinder by inserting a feeler gauge between the valve stem and the rocker arm.



Valve clearances	IN: 0.15 - 0.19 mm EX: 0.21 - 0.25 mm
------------------	--

12) Turn the crankshaft 360 degrees ("▲" #2 timing mark should align with the "↑T" mark on the cylinder head) to put the No. 2 cylinder at top dead center of its compression stroke, and then check the intake and exhaust valve clearances for No. 2 cylinder.

If adjustment is necessary, perform the valve clearance adjustment according to the procedures described on the next page.

• **Adjustment**

If the valve clearance adjustment is necessary, proceed as follows:

- 1) Hold the valve adjusting screw using the valve adjust wrench and loosen the lock nut
- 2) Turn the valve adjusting screw to obtain the specified intake and exhaust valve clearances.

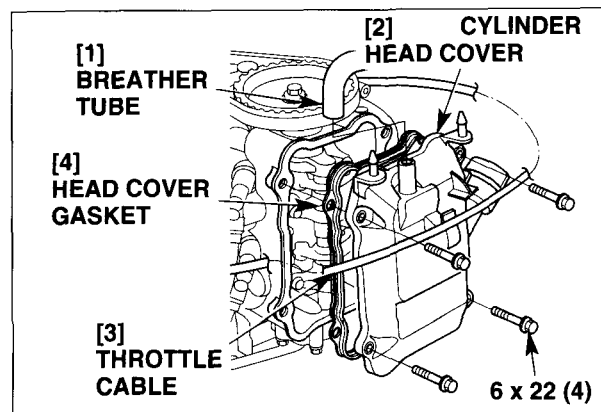
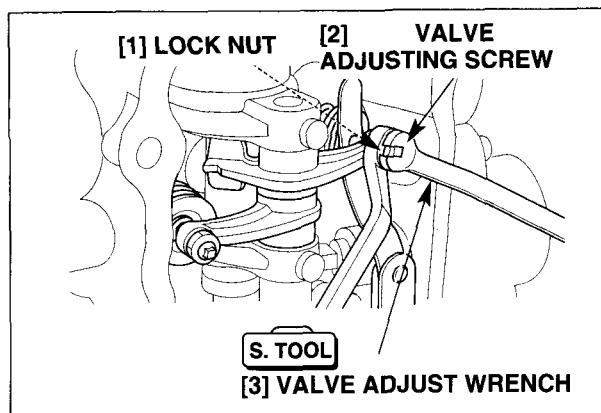
Valve clearances	IN: 0.15 - 0.19 mm (0.006 - 0.007 in)
	EX: 0.21 - 0.25 mm 0.008 - 0.010 in)

- 3) Hold the valve adjusting screw and tighten the lock nut to the specified torque.

TORQUE: 8 N•m (0.8 kgf•m, 5.8 lbf•ft)

- 4) Recheck the valve clearance after tightening the lock nut.
- 5) After adjustment, install the cylinder head cover and tighten the 6 x 22 mm flange bolts securely.
Make sure that the head cover gasket is in the place.
- 6) Connect the breather tube and set the throttle cable to the hook on the cylinder head cover (tiller handle type only).
- 7) Install the following removed parts:
 - the starter case B (P. 7-10).
 - the recoil starter (P. 7-9).
 - the left engine under cover (P. 5-2).

Make sure that the wire harnesses and connectors are set in the place correctly (see pages 2-29 through 2-37 for wire harness and cable routing).



7. CARBURETOR

• **Idle Speed Adjustment**

- 1) Run the outboard motor in an outboard test tank with the water at least 4 inches above the antivibration plate. Allow the engine to warm up to normal operating temperature (engine oil temperature 50 - 60C/122 - 140F).

▲ WARNING

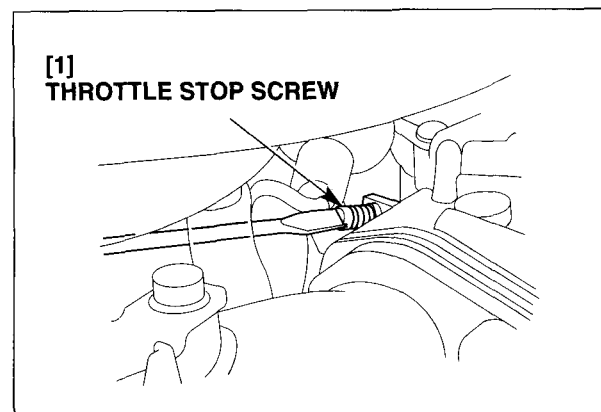
Engine exhaust contains poisonous carbon monoxide gas that can cause unconsciousness and death.

- **If the engine must be running, make sure the area is well ventilated.**

- 2) Stop the engine and remove the engine cover.
- 3) Attach an engine tachometer and restart the engine.
Follow the tachometer manufacturer's instructions.
- 4) After engine speed has stabilized, turn the throttle stop screw to obtain the specified idle speed.

Specified idle speed in neutral	900±50min ⁻¹ (rpm)
---------------------------------	-------------------------------

- 5) Install the engine cover.



8. FUEL FILTER

• Inspection

- 1) Remove the engine cover.
- 2) Check the fuel filter for water accumulation or sediment. if water or sediment is found, replace the fuel filter.

• Replacement

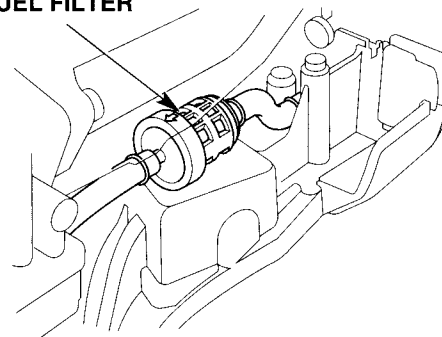
⚠ WARNING

Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

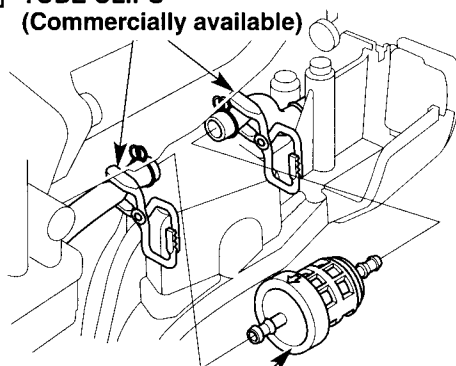
- Keep heat, sparks, and flame away.
- Wipe up spills immediately.

- 1) Remove the right engine under cover (P. 3-3 and 4).
- 2) Pinch the fuel tubes at both sides of the fuel filter with two commercially available hose clips.
- 3) Disconnect the fuel tubes being careful to prevent fuel leakage and remove the fuel filter with filter suspension attached.
- 4) Remove the fuel filter from the filter suspension and discards the fuel filter.
- 5) Install a new fuel filter into the filter suspension so the arrow mark points same direction as shown.
- 6) Install the new fuel filter with the filter suspension attached so the arrow mark on the filter suspension points toward the fuel pump side.
- 7) Connect the fuel tubes and remove the hose clips.
- 8) Connect the fuel hose connector to the outboard motor. Pump the primer bulb, and make sure that there is no fuel leaks.

[1] FUEL FILTER

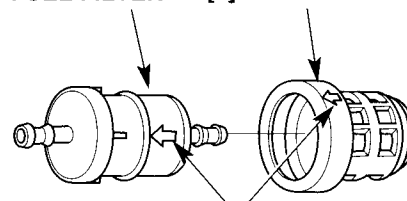


[1] TUBE CLIPS
(Commercially available)



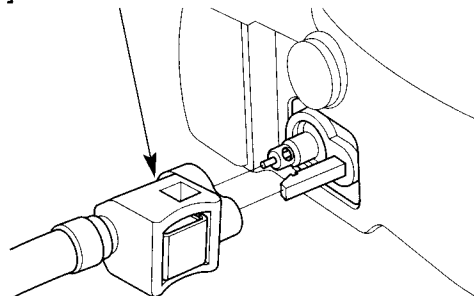
[2] FUEL FILTER
(With filter suspension attached)

[3] FUEL FILTER [4] FILTER SUSPENSION



[5] ARROW MARKS

[6] FUEL HOSE CONNECTOR



9. FUEL TANK STRAINER

• Inspection/Cleaning

▲ WARNING

Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Wipe up spills immediately.

- 1) Drain the fuel tank into a suitable container.
- 2) Remove the fuel tank hose connector and fuel tank strainer from the fuel tank:

Plastic tank:

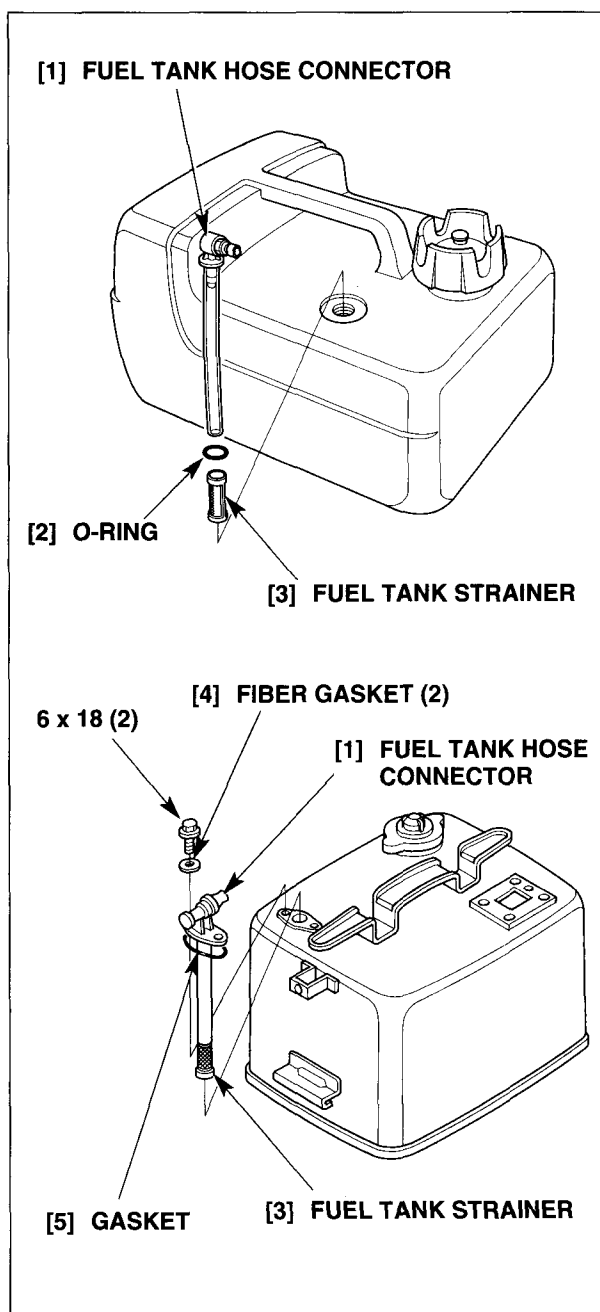
Remove the fuel tank connector by turning the connector.

Steel tank:

Remove the 6 x 18 mm flange bolts and fiber gasket, then remove the fuel tank connector and gasket.

- 3) Remove any dirt or foreign material from the fuel tank strainer, and check for tears in the strainer mesh. Replace the strainer if necessary.
- 4) Clean the fuel tank with cleaning solvent and allow the fuel tank to dry thoroughly.
- 5) Reinstall the fuel tank connector in the reverse order of removal.

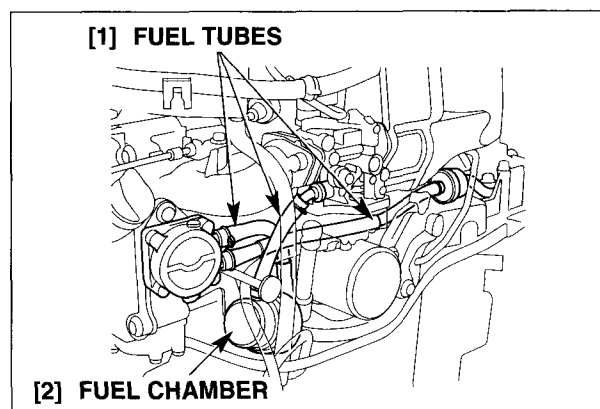
Make sure that the O-ring (plastic tank) or gasket (steel tank) is in good condition, replace if necessary.



10. FUEL TUBES

• Inspection/Replacement

- 1) Check the fuel tubes and fuel chamber for deterioration, cracks, and other damage.
- 2) Replace the fuel tube(s) and/or fuel chamber if necessary (P. 6-16).
- 3) After install the fuel tube(s), connect the fuel hose connector to the outboard motor. Pump the primer bulb, and make sure that there is no fuel leaks.



11. THROTTLE LINKAGE

• Inspection/Adjustment

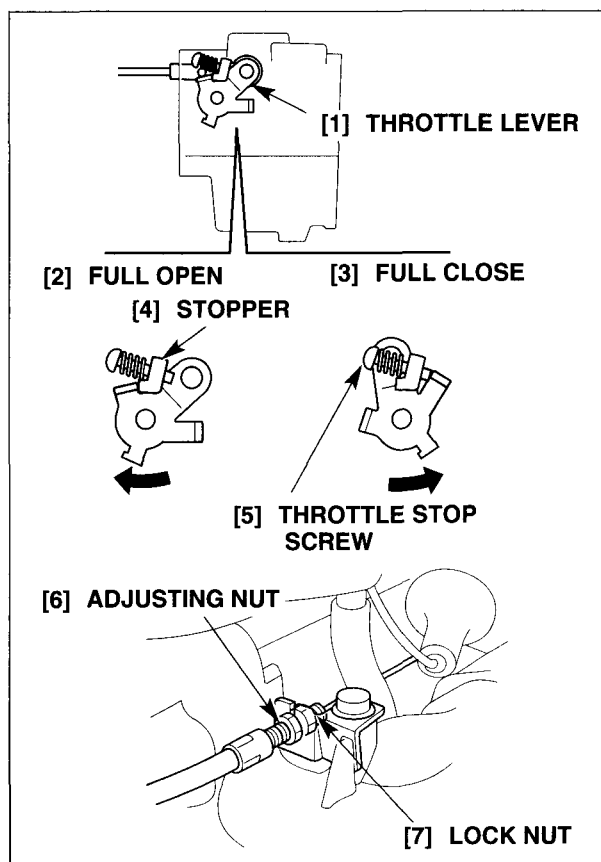
TILLER HANDLE TYPE

- 1) Remove the engine cover.
- 2) Turn the throttle grip to the full open position, and check that the throttle lever is in contact with the stopper. If it is not, adjust as follows.

- 3) Loosen the lock nut and turn the adjusting nut.
- 4) After adjustment, tighten the lock nut securely.

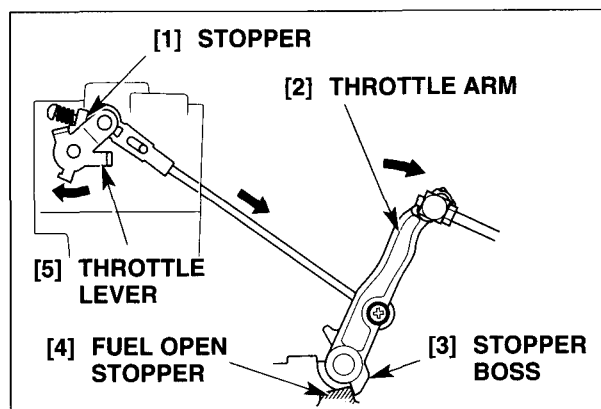
TORQUE: 4.5 N•m (0.45 kgf•m, 3.3 lbf•ft)

- 5) Operate the throttle grip several times, then turn the throttle grip from fully closed position to fully open position and check that the throttle lever is in contact with the stopper with full open position, and contact to the throttle stop screw with full closed position.

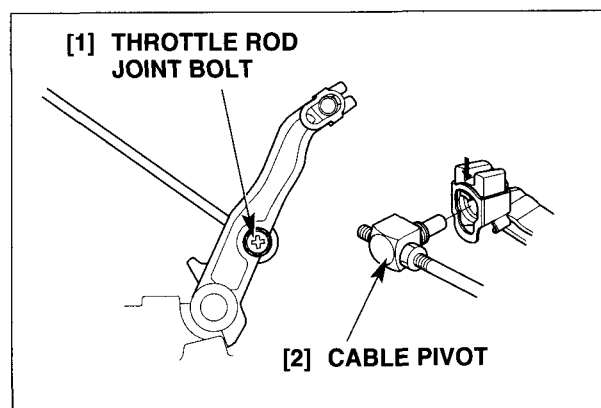


REMOTE CONTROL TYPE

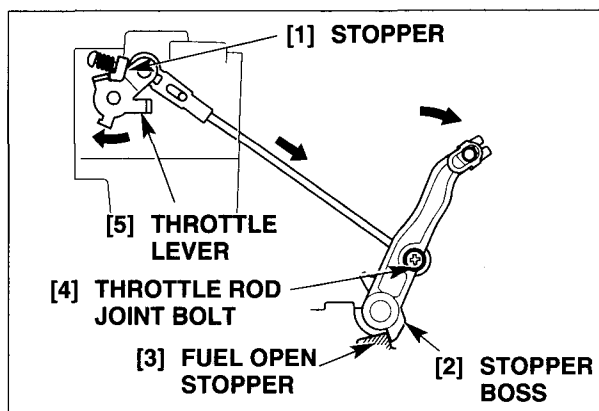
- 1) Remove the engine cover and right engine under cover (P. 3-3 and 4).
- 2) Move the control lever to the full open position, and check that the throttle arm stopper boss is in contact with the full open stopper. At this time, the throttle lever should contact to the stopper. If it is not, adjust as follows.



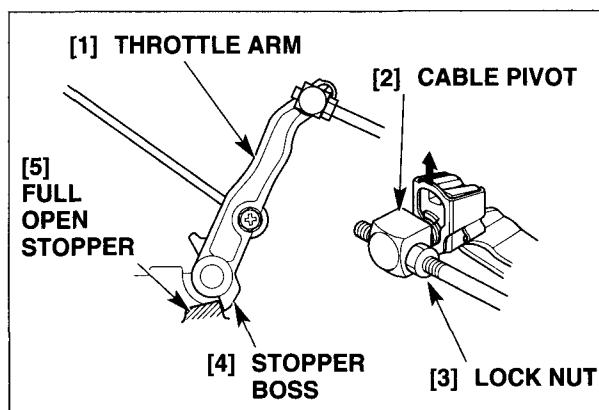
- 3) Disconnect the throttle control cable pivot from the throttle arm.
- 4) Loosen the 5 × 8 mm throttle rod joint bolt.



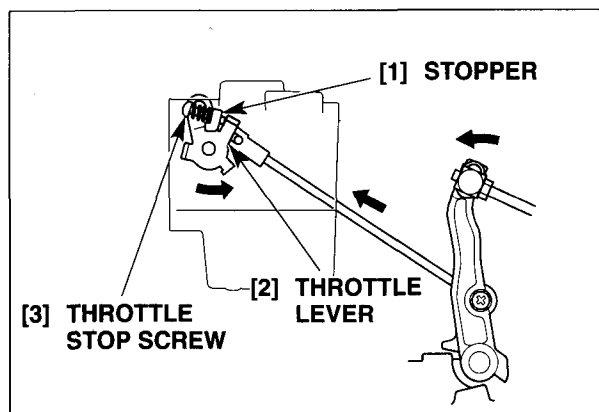
- 5) Move the throttle arm until the throttle arm stopper boss is in contact with the full open stopper and hold the throttle arm in this position.
- 6) Move the throttle rod until the carburetor throttle lever is in contact with the stopper and tighten the 5 × 8 mm rod joint bolt securely.



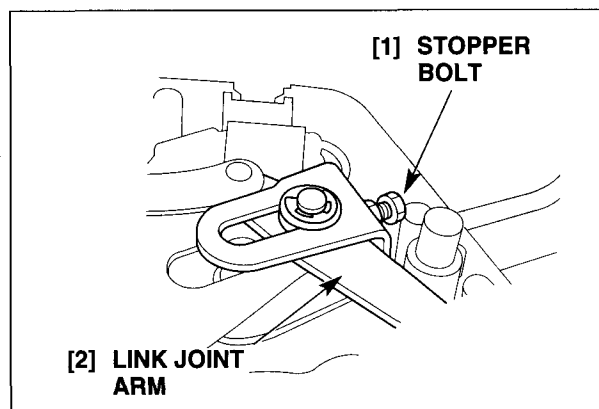
- 7) Set the remote control lever in the full open position.
- 8) Loosen the pivot lock nut, and adjust by turning the pivot, then install the pivot to the throttle arm with the throttle arm in full open position (the stopper should contact to the full open stopper).
- 9) Tighten the pivot lock nut securely.



- 10) Move the control lever to the full close position and check that the carburetor throttle lever is in contact with the throttle stop screw.



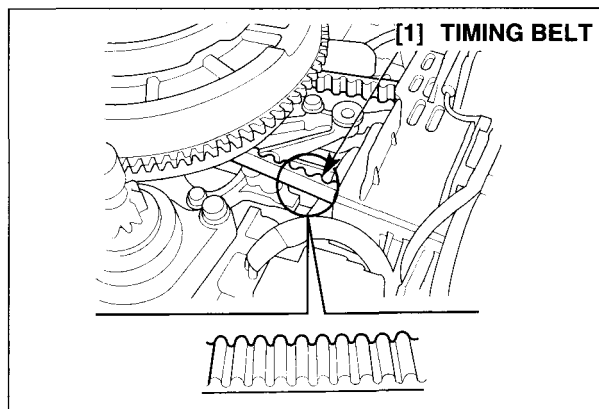
- 11) Remove the remote control box covers B and C (P. 14-4).
- 12) Move the control lever to the full open position and make sure that the link joint arm is in contact with the stopper bolt. If not in contact, turn the stopper bolt until it contacts to the link joint arm.
- 13) Move the control lever to full open position and make sure that the link joint arm is in contact with the stopper bolt. If not in contact, turn the stopper bolt until it contacts with the link joint arm.
- 14) After adjustment, reinstall the removed part in the reverse order of removal.



12. TIMING BELT

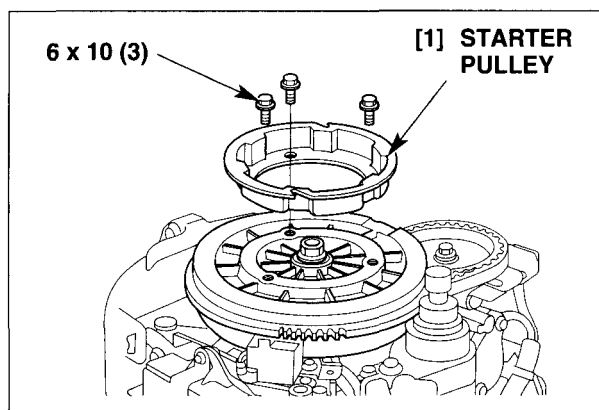
• Inspection

- 1) Remove the engine cover.
- 2) Remove the recoil starter (P. 3-8).
- 3) Check the timing belt for wear or damage. Replace the timing belt if it is worn or damaged.
- 4) Check the timing belt and the related parts for oil and grease. If contaminated with oil or grease, clean the parts and replace the timing belt.

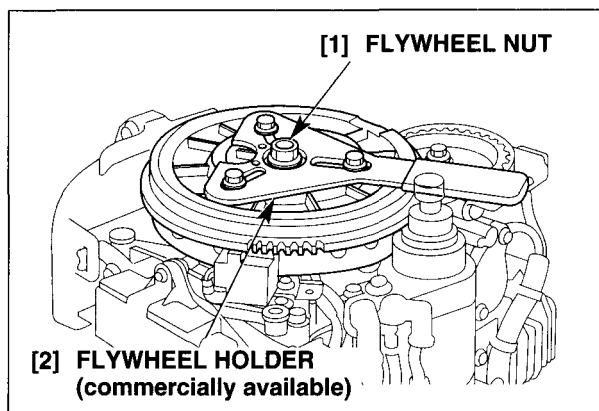


• Replacement

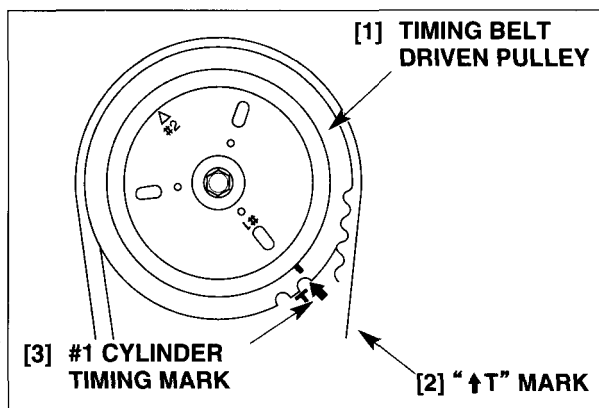
- 1) Remove the starter case B (P. 3-8).
- 2) Remove the three 6 x 10 mm flange bolts and starter pulley.



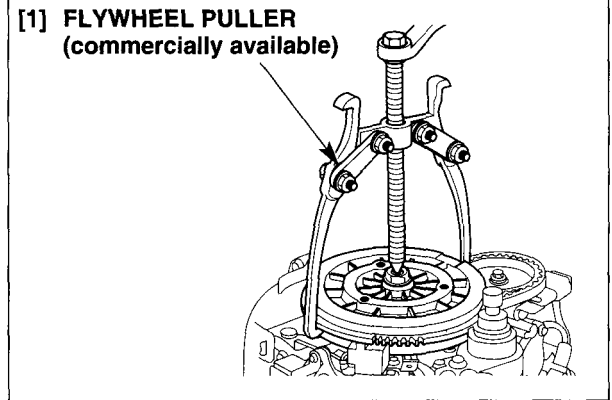
- 3) Hold the flywheel using the commercially available flywheel holder and remove the flywheel nut.



- 4) Before removing the flywheel, turn the flywheel clockwise until the No. 1 cylinder is at top dead center of its compression stroke (the "■" #1 timing mark on the timing belt driven pulley aligns with the "↑T" mark on the cylinder head).



- 5) Set a commercially available flywheel puller to the flywheel securely avoiding the magnet sections and taking care not to damage the ring gear. Remove the flywheel.
- Do not hit the flywheel with a hammer.



- 6) Remove the 6 x 14 mm flange bolt and harness set plate.
 7) Remove the 6 mm flange bolts and charge coil:

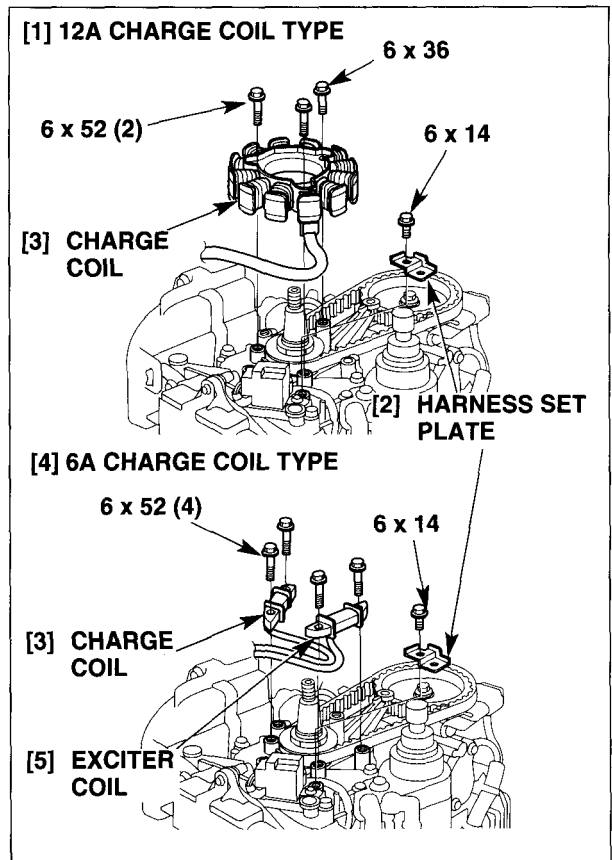
12A charge coil type:

two 6 x 52 mm and 6 x 36 mm flange bolts and charge coil

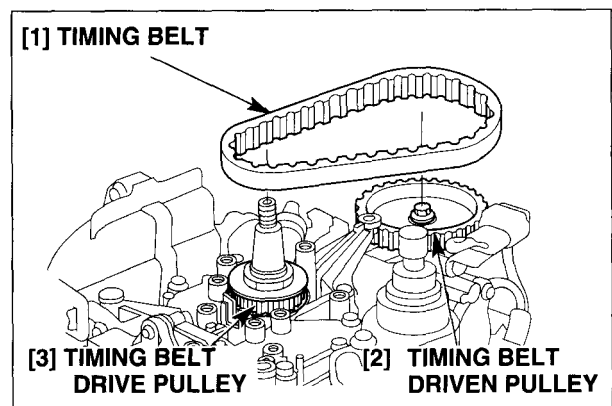
6A charge coil type:

two 6 x 52 mm flange bolts and charge coil

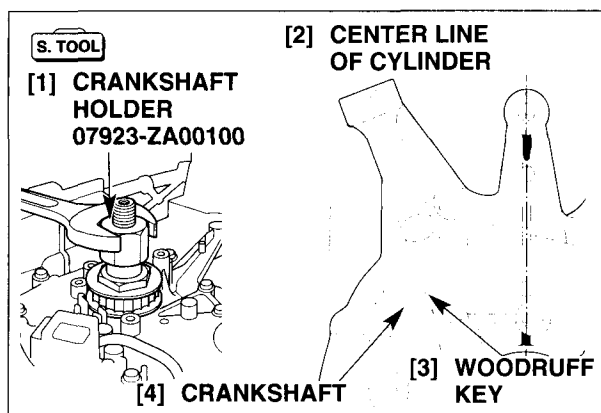
two 6 x 52 mm flange bolts and exciter coil.



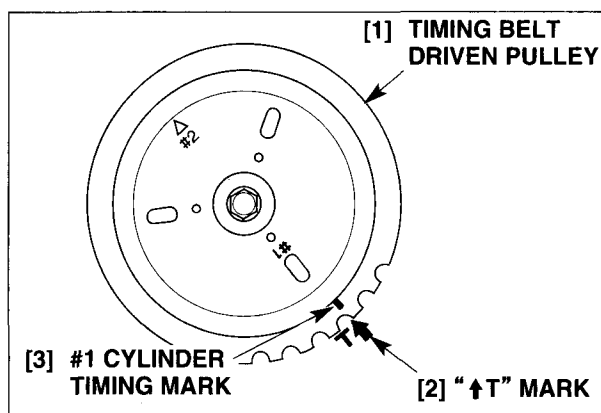
- 8) Remove the timing belt from the timing belt driven pulley, then remove the timing belt from the timing belt drive pulley.



- 9) Make sure that the woodruff key on the crankshaft aligns with the center line of cylinder as shown. If necessary, remove the spark plug caps and spark plugs, and turn the crankshaft using the crankshaft holder.



- 10) Make sure that the "■" #1 mark on the timing driven pulley aligns with the "↑T" mark on the cylinder head. If necessary align the mark by turning the driven pulley.

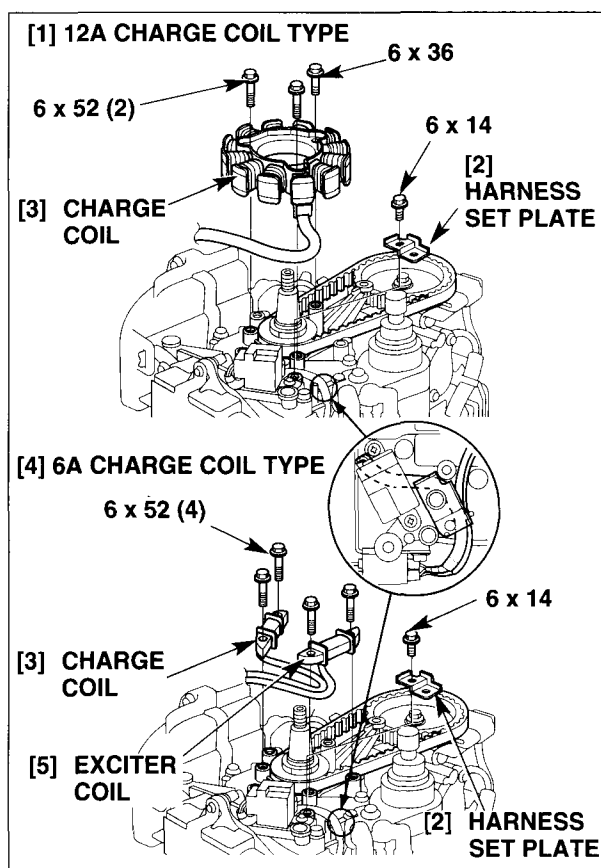


- 11) Install a new timing belt on the timing belt drive pulley and then on the driven pulley taking care not to allow the alignment marks to come out of alignment.

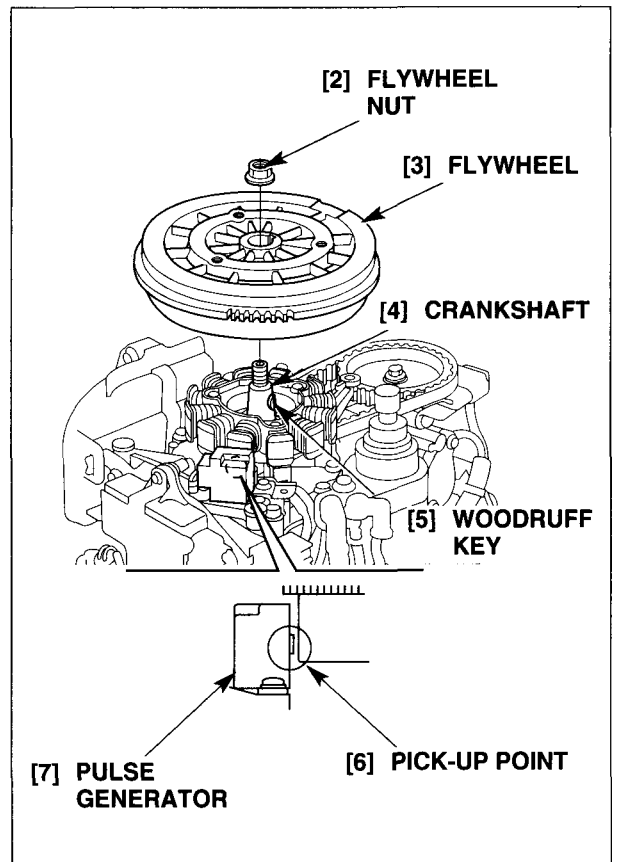
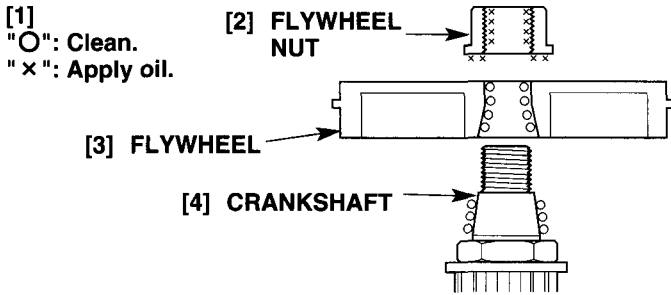
- 12) After installation, be sure that the alignment marks are in the proper alignment.

- 13) Reinstall the charge coil and exciter coil.

- 14) Route the charge coil and exciter coil wire(s) on the crankcase as shown and secure them with the wire set plate and tighten the 6 x 14 mm flange bolt.

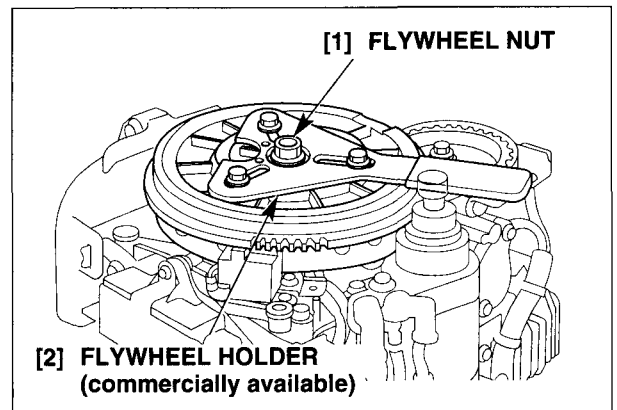


- 15) Clean off oil or grease from the crankshaft and flywheel mating surfaces (tapered section "O"mark). Make sure that there are no metal objects stuck to the magnets of the flywheel.
- 16) Install the flywheel by aligning the woodruff key on the crankshaft with the key groove of the flywheel taking care not to damage the pic-up point of the ignition pulse generator.
- 17) Apply oil to the thread and seating surface of the flywheel nut ("x"mark).



- 18) Hold the flywheel using the flywheel holder and tighten the flywheel nut.

TORQUE: 88 N•m (9.0 kgf•m, 65 lbf•ft)

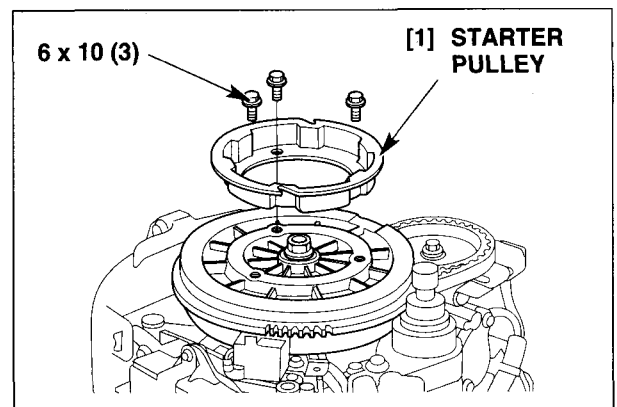


- 19) Install the starter pulley and tighten the three 6 x 10 mm flange bolts.

TORQUE: 11 N•m (1.1 kgf•m, 8 lbf•ft)

- 20) Install the following removed parts:

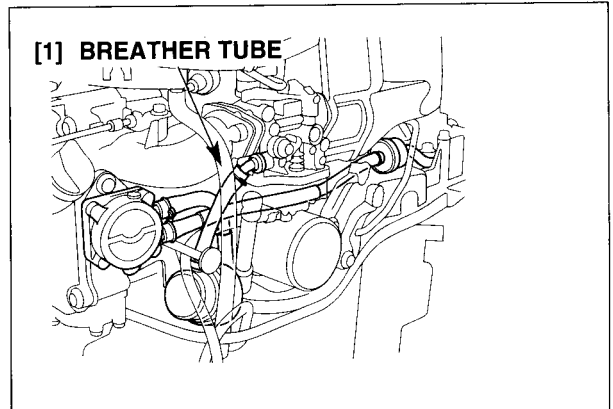
- the starter case B (P. 7-10).
- the recoil starter (P. 7-9).
- the left engine under cover (P. 5-2).



13. CRANKCASE BREATHER

• Inspection

- 1) Check the breather tube for deterioration, cracks, and other damage.
- 2) Replace the breather tube if necessary (P. 6-16).



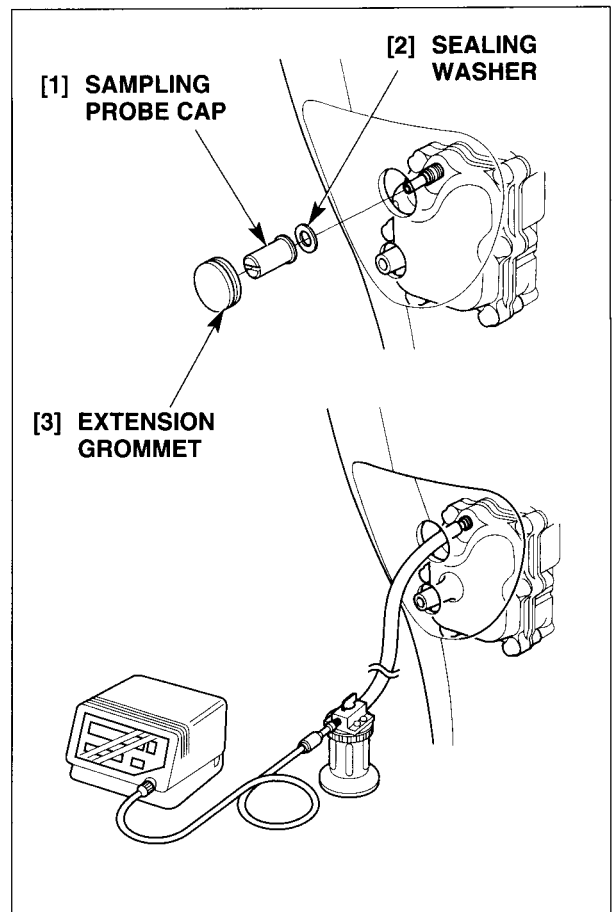
14. EXHAUST EMISSION (Bodensee model)

⚠ WARNING

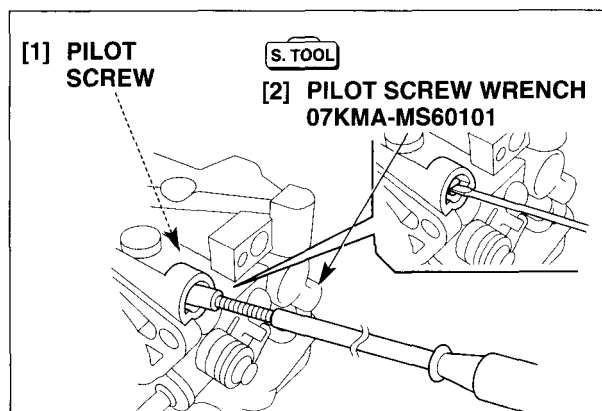
- Engine, exhaust system and analyzer become very hot. Wear insulation glove to avoid severe burns.
- Running the outboard motor for long time without sufficient water will damage the lower unit parts.
- Keep clear of moving parts.

Before this operation perform the following maintenance.

- Spark plug (P. 3-6).
 - Valve clearances (P. 3-8).
 - Idle speed (P. 3-10).
 - Crankcase breather (P. 3-18).
- 1) Remove the extension grommet.
 - 2) Remove the cap and gasket.
 - 3) Route the sampling tube through the tube joint installation hole and connect the tube end to the sampling probe. Pinch the sampling tube using a clip to avoid leaking exhaust gas.
 - 4) Start the engine and run at 3,500 – 4,000 min⁻¹ (rpm) for about 2 minutes to warm up the engine until the engine temperature is 55 ± 5° C (131 ± 9° F).
 - Run the outboard motor in an outboard test tank with the water at least 150 mm (6 in) above the antiventilation plate.
 - 5) Connect the sampling tube to an analyzer for exhaust emission according to the manufacturer's instructions.
 - 6) Remove the tube pinch to free the sampling tube and measure value of CO, HC and CO₂ at idle.



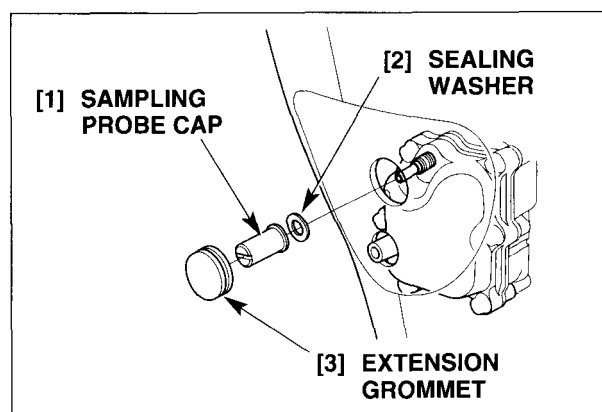
- 7) If the measurements are without the specifications, adjust as following:
- Turn the pilot screw in or out to obtain the standard values using the pilot screw wrench.
 - If the measured value have not yet reached standard, inspect and repair the following and recheck.
 - Dcarbonization from the combustion chamber.
 - Refacing valve seats and lapping valve and valve seat.
 - Checking valve stem seal condition.
 - Checking piston ring conditions.
 - Disassembling and cleaning the carburetor.



- 8) After inspection, remove the test equipment and reinstall the gasket and tighten the cap to the specified torque.

TORQUE: 5 N•m (0.5 kgf•m, 3.6 lbf•ft)

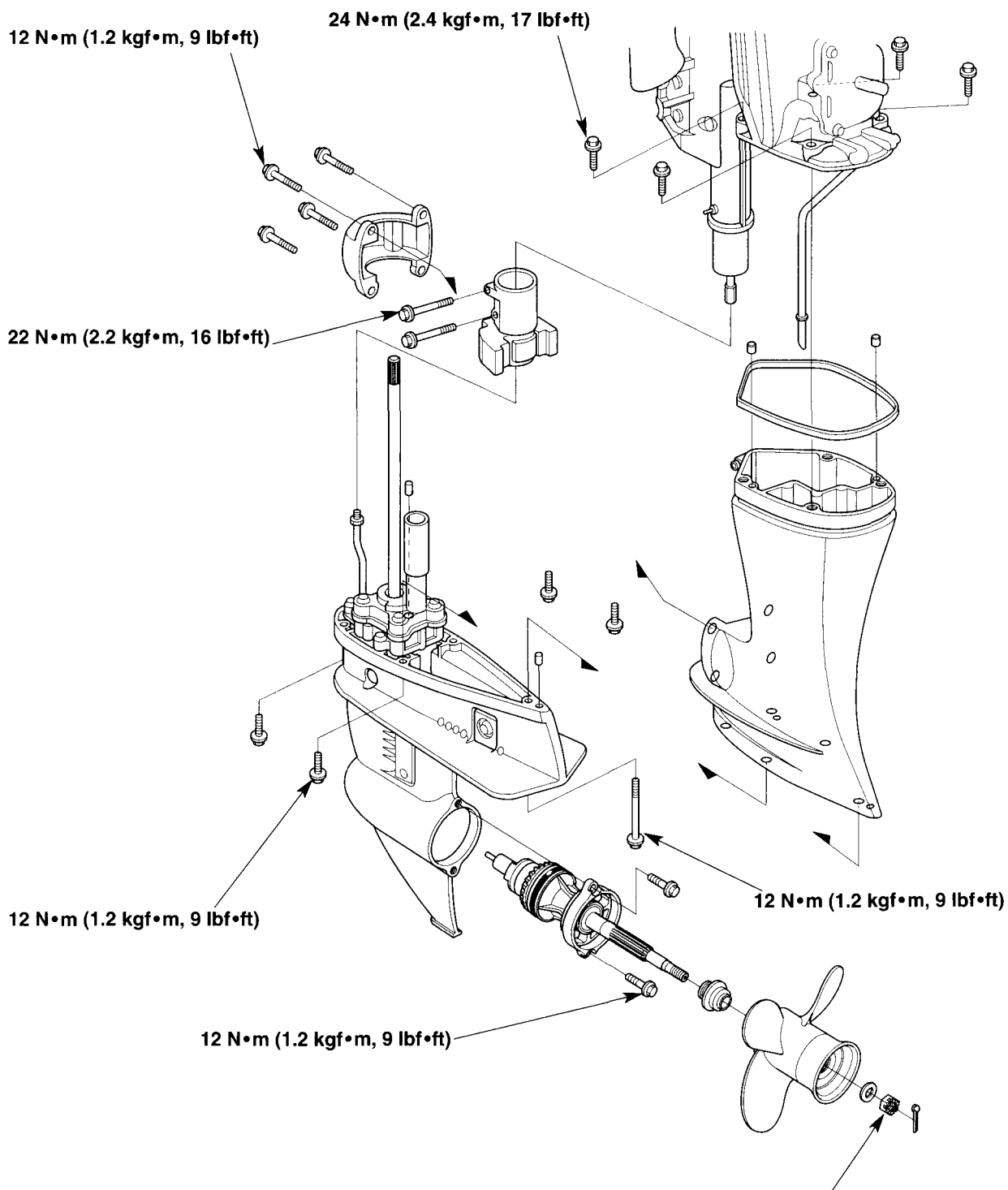
- 9) Install the grommet and engine cover.



4. PROPELLER/GEAR CASE/EXTENSION CASE

BF15D·BF20D

- | | |
|------------------------------|---------------------------------|
| 1. PROPELLER | 6. WATER PUMP HOUSING |
| 2. PROPELLER SHAFT HOLDER | 7. GEAR CASE/ANODE/WATER SCREEN |
| 3. GEAR CASE ASSEMBLY | 8. EXTENSION CASE |
| 4. WATER PUMP | 9. EXHAUST CHAMBER COVER |
| 5. VERTICAL SHAFT/BEVEL GEAR | |

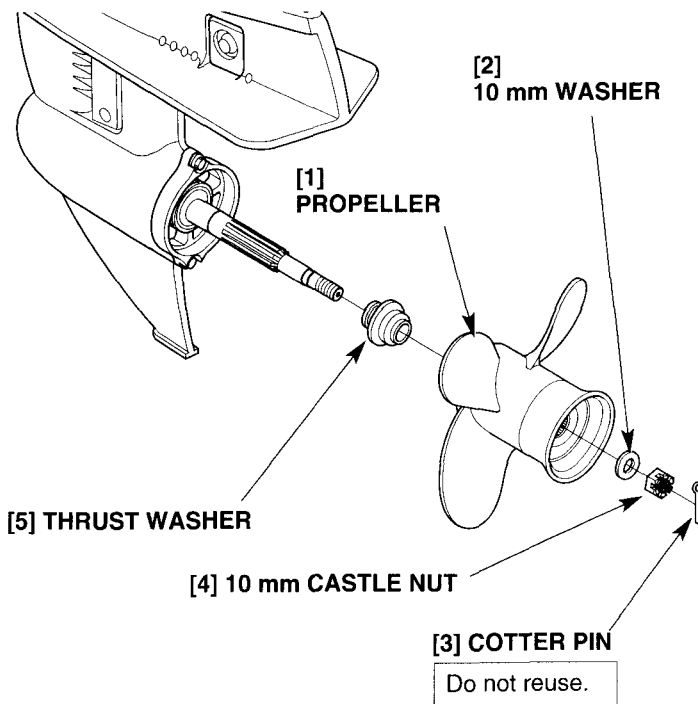


[1] See page 4-2 for tightening torque.

1. PROPELLER

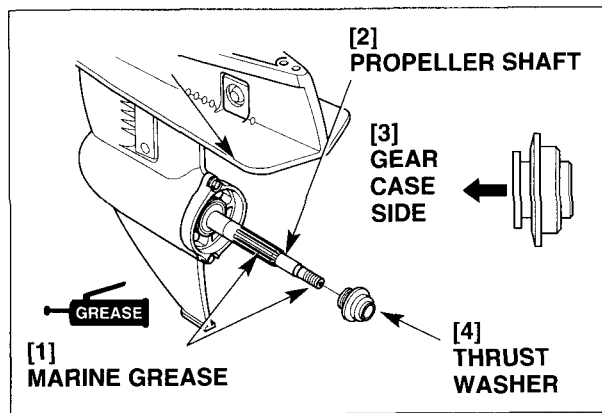
a. REMOVAL

- 1) Remove the 3 mm cotter pin and discard it.
- 2) Remove the 10 mm castle nut and washer.
- 3) Remove the propeller and thrust washer.



b. INSTALLATION

- 1) Apply marine grease to the spline and thread sections of the propeller shaft.
- 2) Install the thrust washer with the flange section toward the gear case.



- 3) Install the propeller and 10 mm washer onto the propeller shaft.

- 4) Tighten the 10 mm castle nut to the specified torque.

TORQUE: 1 N•m (0.1 kgf•m, 0.7 lbf•ft)

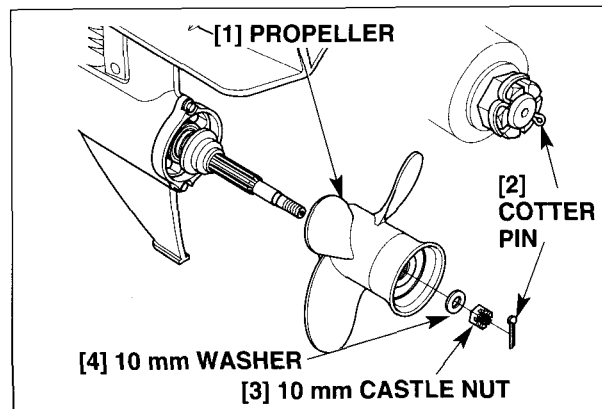
- 5) If the cotter pin cannot be set, tighten the nut additionally until the cotter pin can be set.

- Do not overtighten exceeding the maximum torque.

MAX. TORQUE: 35 N•m (3.5 kgf•m, 25 lbf•ft)

- 6) Install a new cotter pin and bend the pin ends as shown to stake the castle nut as shown.

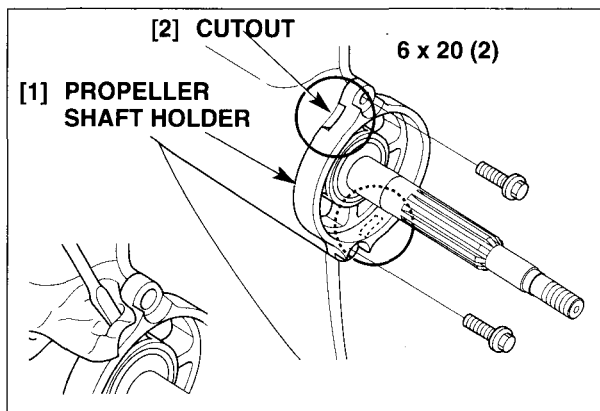
- Be sure to use the genuine honda part (stainless steel made) or equivalent.



2. PROPELLER SHAFT HOLDER

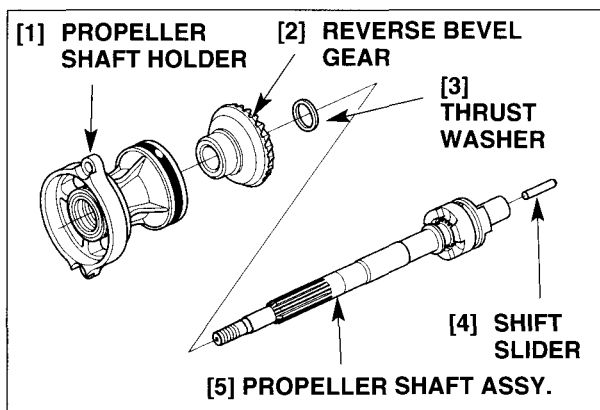
a. REMOVAL

- 1) Remove the propeller (P. 4-2).
- 2) Set the gear in the neutral position and remove the two 6 x 20 mm flange bolts.
- 3) Using a screw drivers and remove the propeller shaft holder assembly with care not to damage the gear case.

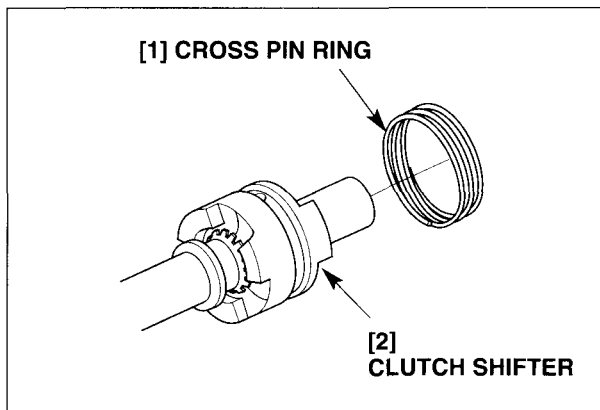


b. DISASSEMBLY

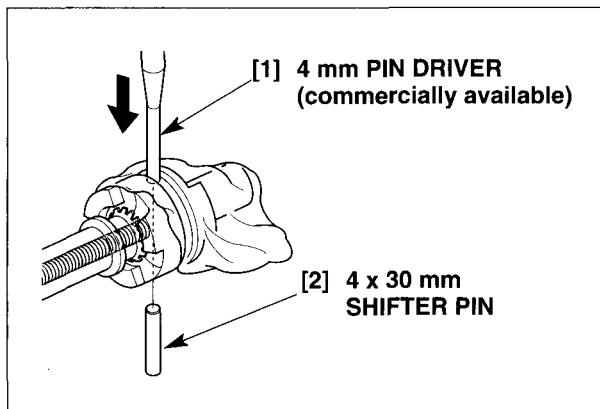
- 1) Remove the shift slider.
- 2) Remove the propeller shaft assembly, reverse bevel gear and thrust washer from the propeller shaft holder.



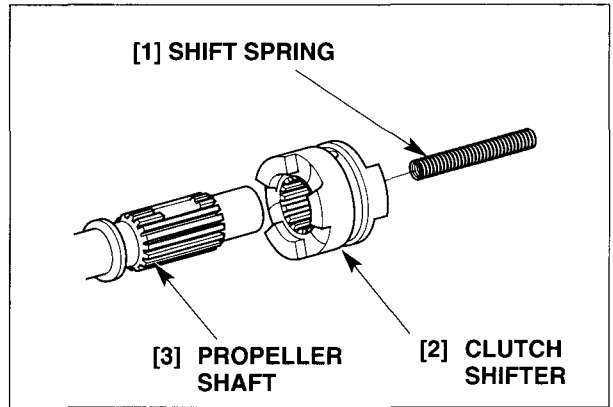
- 3) Remove the cross pin ring from the clutch shifter.



- 4) Drive out the 4 x 30 m shifter pin using a commercially available 4 mm pin driver.



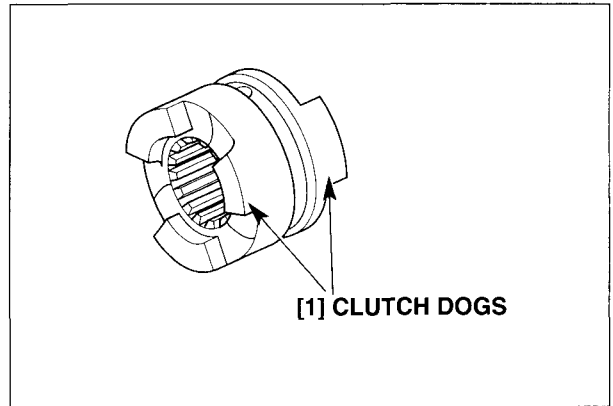
5) Remove the shift spring and clutch shifter from the propeller shaft.



c. INSPECTION

• CLUTCH SHIFTER

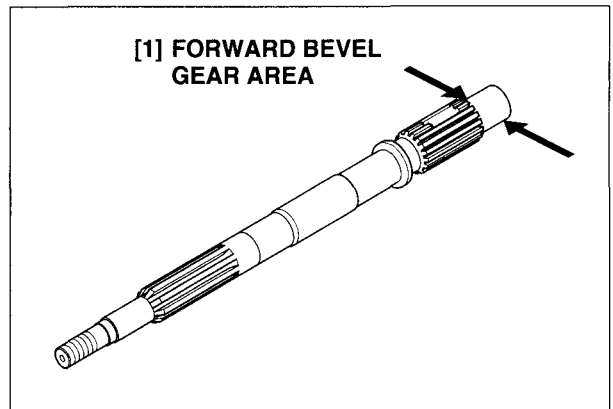
Check the clutch dogs for wear or damage.



• PROPELLER SHAFT

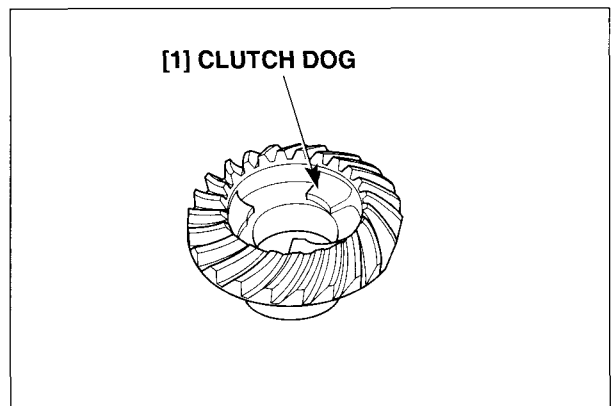
Measure the O.D. of the propeller shaft at the forward bevel gear area.

Standard	Service limit
16.973 – 16.984 mm (0.6682 – 0.6687 in)	16.95 mm (0.667 in)



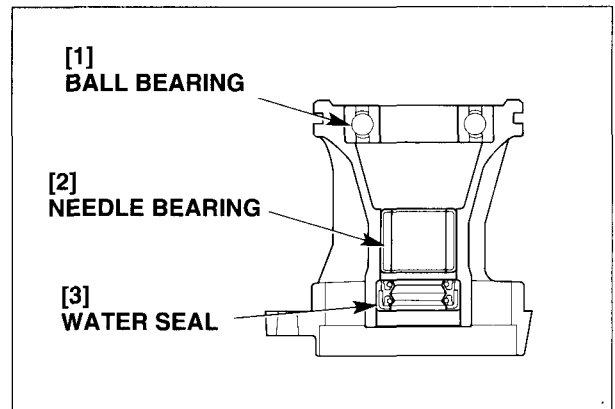
• REVERSE BEVEL GEAR

Check the clutch dogs and gear teeth for wear or damage. Replace as an assembly with the propeller shaft if necessary.



• PROPELLER SHAFT HOLDER

- 1) Check the ball bearing by turning the inner race with your finger. Replace the ball bearing with new one if bearing inner race does not turn smoothly, quietly, or outer race fits very loose.
- 2) Inspect the needle bearing for wear or damage. Replace if necessary.
- 3) Inspect the water seal for damage or water leaks. Replace if necessary.



d. BALL BEARING REPLACEMENT

- 1) Remove the ball bearing using the bearing remover, and weight.

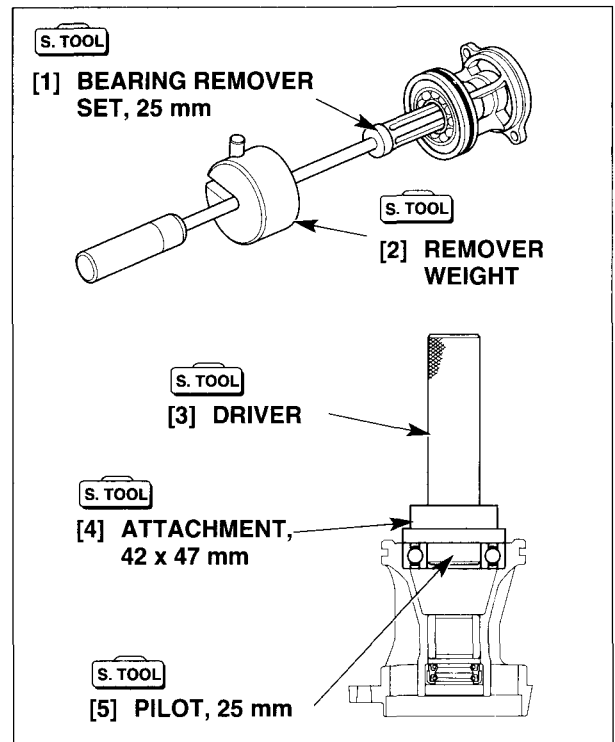
TOOLS:

Bearing remover set, 25 mm 07936-ZV10100
Remover weight 07741-0010201

- 2) Install a new ball bearing using the driver, attachment 42 x 47 mm and pilot 25 mm.

TOOLS:

Driver 07749-0010000
Attachment, 42 x 47 mm 07746-0010300
Pilot, 25 mm 07746-0040600



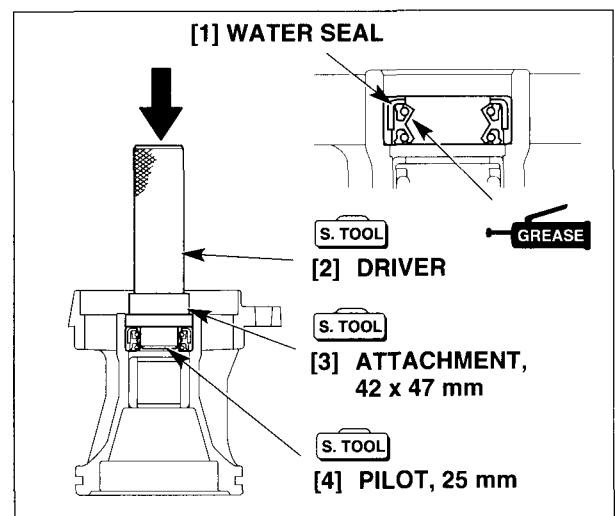
e. WATER SEAL REPLACEMENT

- 1) Remove the water seal from the propeller shaft holder using a commercially available seal remover.
- 2) Clean the installation area of the propeller shaft holder and apply soapy water to the outside of a new water seal.
- 3) Install the new water seal using the driver, attachment 24 x 26 mm and pilot 17 mm noting installation direction.

TOOLS:

Driver 07749-0010000
Attachment, 24 x 26 mm 07746-0010700
Pilot, 17 mm 07746-0040400

- 4) After installation, apply grease to the lip of the water seal.



f. NEEDLE BEARING REPLACEMENT

- 1) Remove the water seal from the propeller shaft holder using a commercially available seal remover.
- 2) Remove the needle bearing using the driver, attachment 24 x 26 mm and pilot 17 mm

TOOLS:

Driver 07749-0010000
Attachment, 24 x 26 mm 07746-0010700
Pilot, 17 mm 07746-0040400

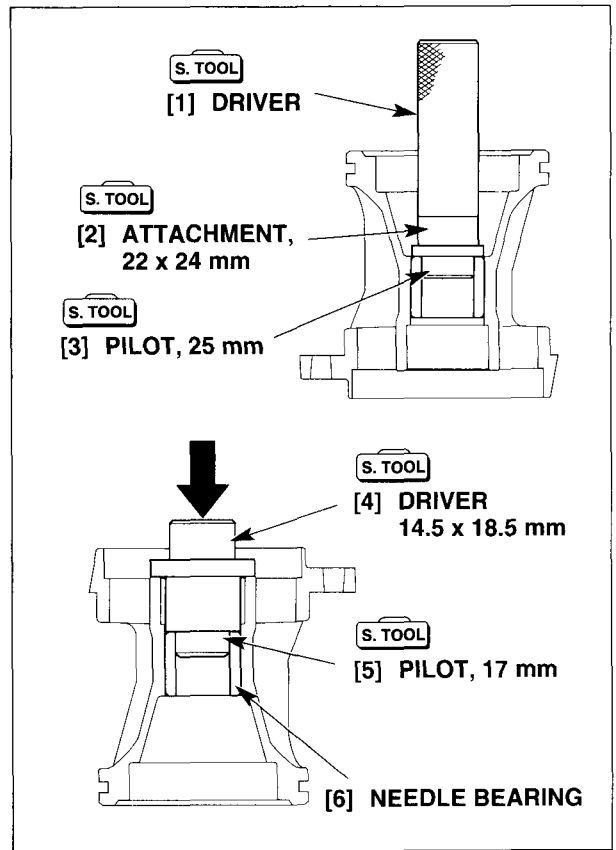
- 3) Press in a new needle bearing with the driver 14.5 x 18.5 mm and pilot 17 mm using the hydraulic press.

Set the pilot 17 mm to the larger diameter side of the attachment as shown.

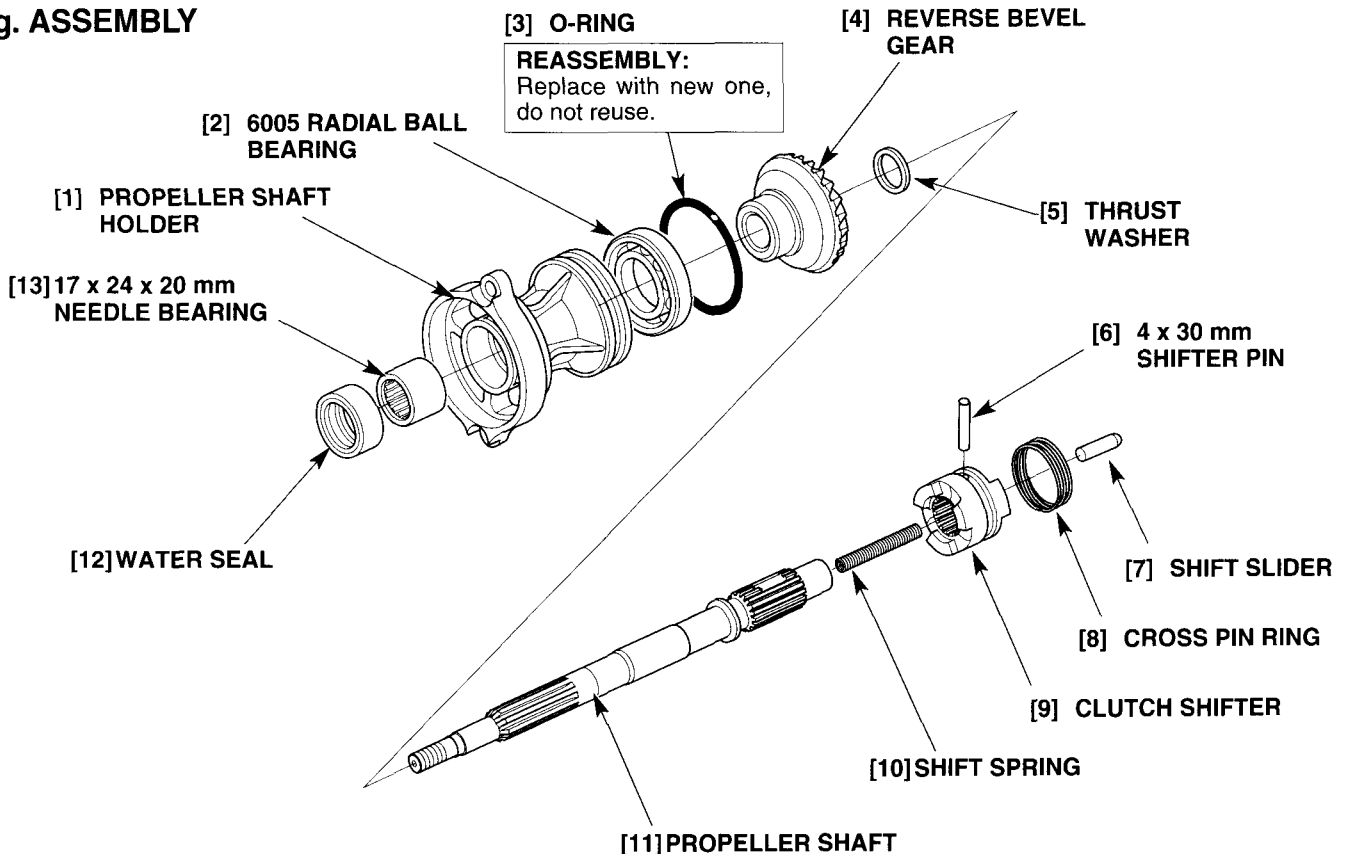
TOOLS:

Driver, 14.5 x 18.5 mm 07ZPF-ZW90300
Pilot, 17 mm 07746-0040400

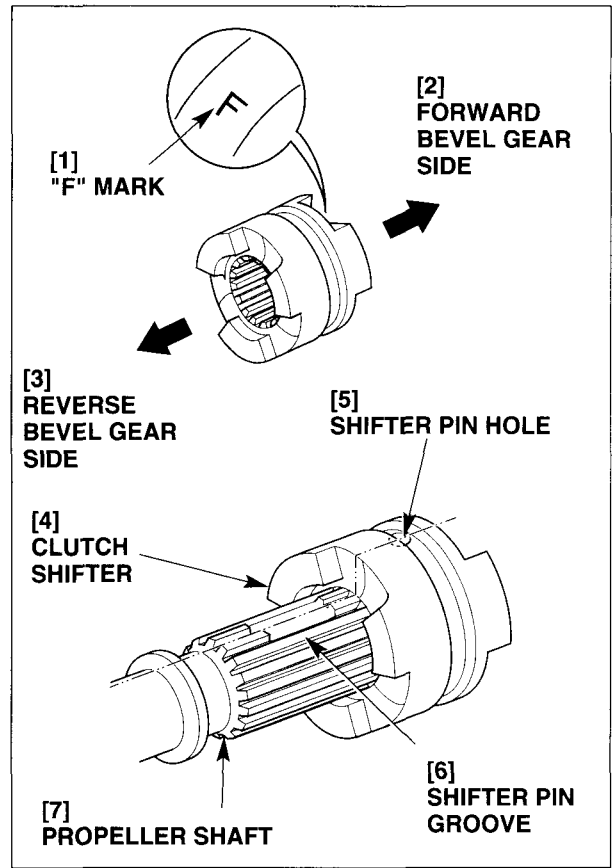
- 4) Install a new water seal (P. 4-5).



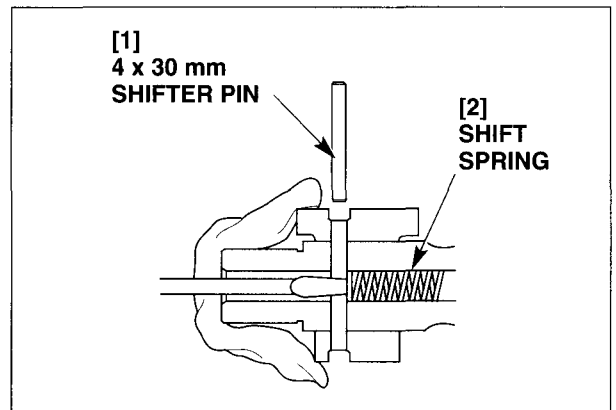
g. ASSEMBLY



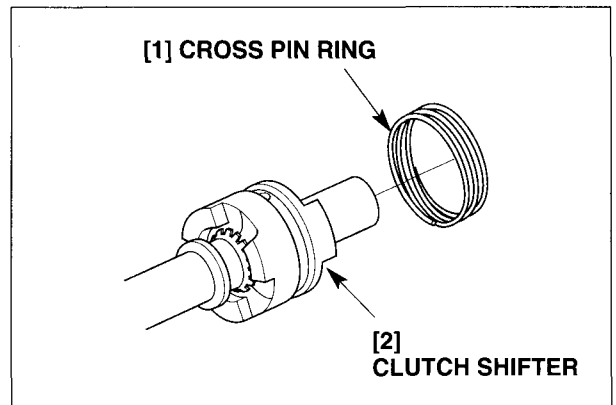
- 1) Install the clutch shifter with the "F" mark facing toward the forward bevel gear side and align the center of the clutch shifter pin hole with the shifter pin groove of the propeller shaft as shown.



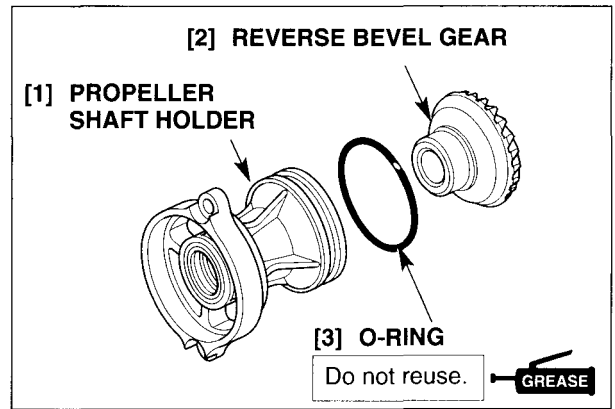
- 2) Install the shift spring into the propeller shaft.
- 3) Push the shift spring with a screw driver and install the 4 x 30 mm shifter pin.



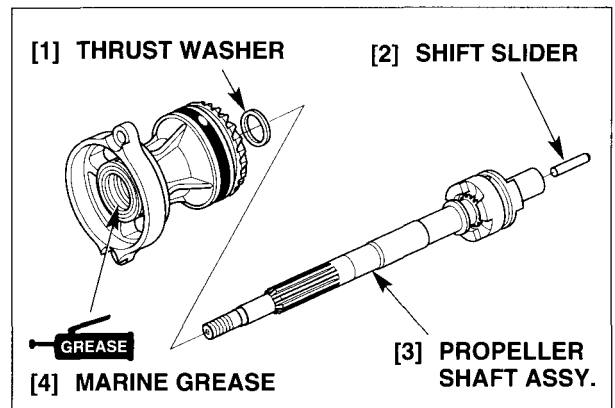
- 4) Install the cross pin ring.



- 5) Apply marine grease to a new O-ring and install it to the propeller shaft holder.
- 6) Install the reverse bevel gear to the ball bearing inner race of the propeller shaft holder.



- 7) Apply marine grease to the water seal lips.
- 8) Install the thrust washer onto the propeller shaft, then install them into the propeller shaft holder.
- 9) Install the shift slider.

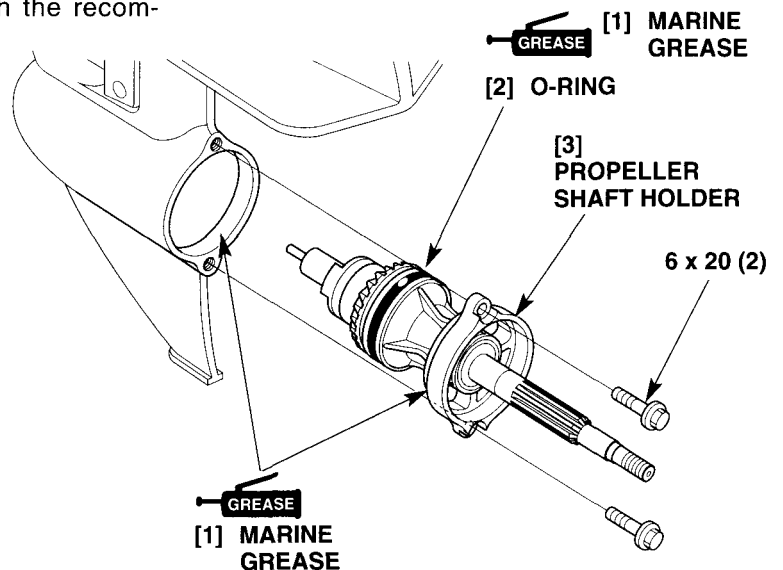


h. INSTALLATION

- 1) Apply marine grease to the O-ring and mating surfaces of the propeller shaft holder and gear case.
- 2) Install the propeller shaft assembly to the gear case and tighten the two 6 x 20 mm flange bolts to the specified torque.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

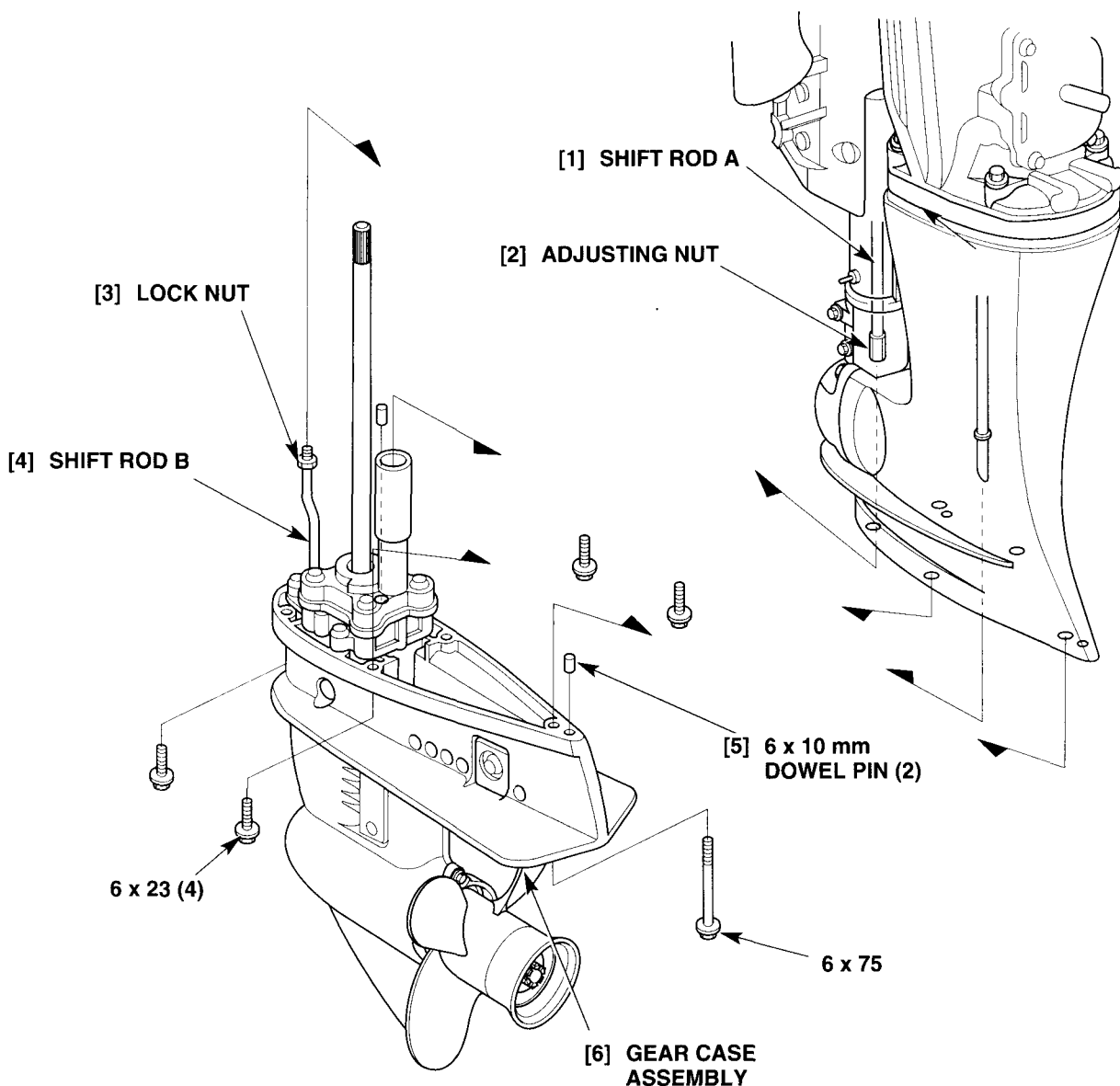
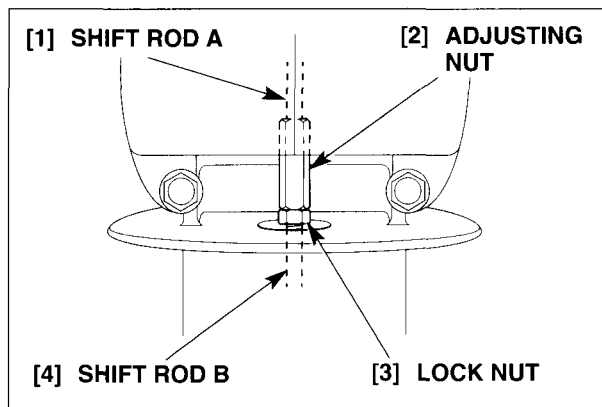
- 3) After reassembly, add the gear case with the recommended oil (P. 3-6).



3. GEAR CASE ASSEMBLY

a. REMOVAL

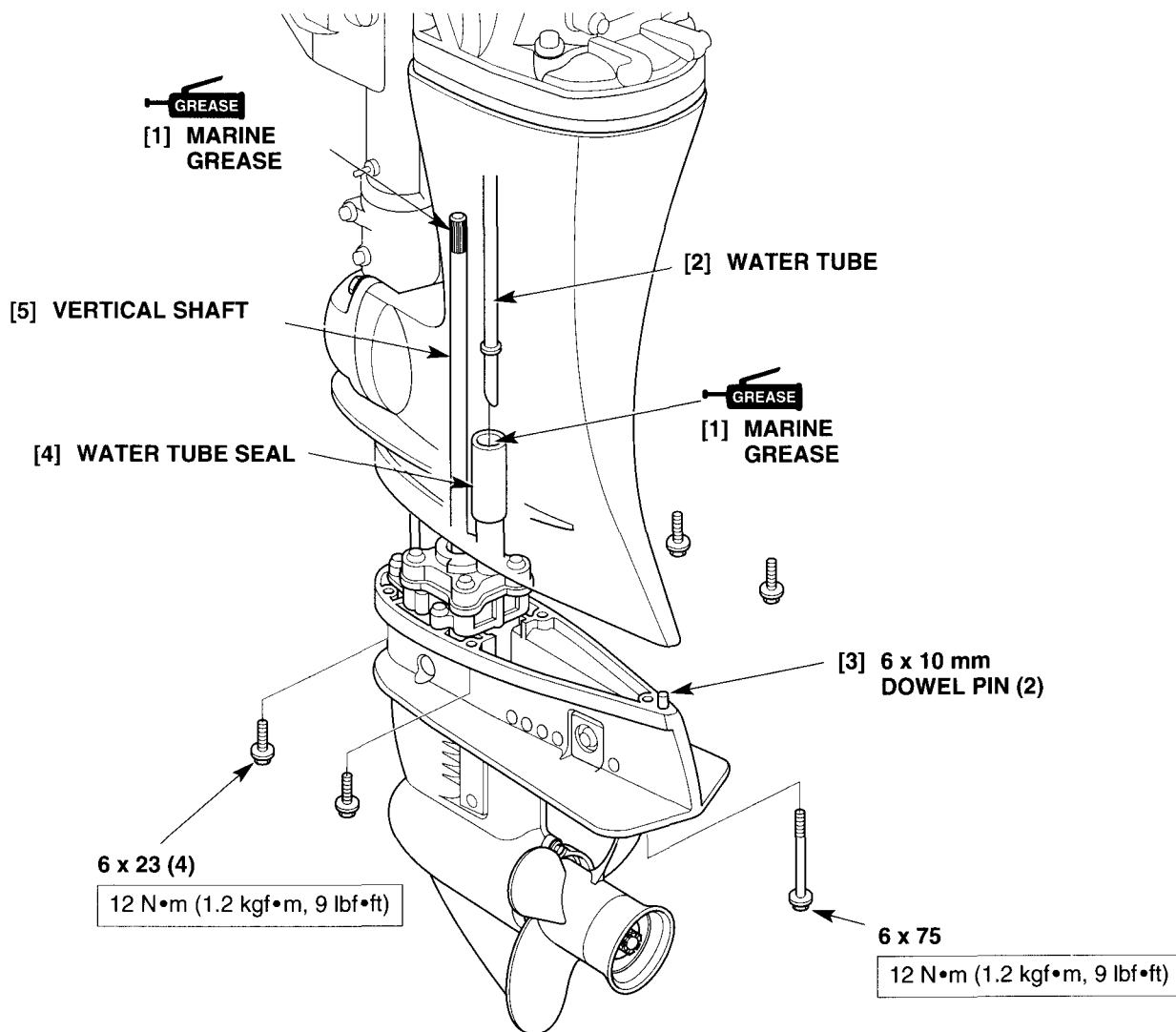
- 1) Shift the gear into the R "reverse" position.
- 2) Loosen the lock nut and disconnect the shift rod B from the shift rod A by turning the adjusting nut.
- 3) Tilt up the motor.
- 4) Remove the 6 mm flange bolts.
- 5) Remove the gear case and two 6 x 10 mm dowel pins.



b. INSTALLATION

- 1) Install the two 6 x 10 mm dowel pins on the gear case.
- 2) Apply marine grease to the following position:
 - spline of the vertical shaft.
 - inside of the water tube seal.
- 3) Install the gear case assembly by aligning the vertical shaft spline with the crankshaft, and water tube with the water tube seal.
- 4) Loosely install the 6 mm flange bolts or 6 mm self-locking nuts.
- 5) Tighten the 6 mm flange bolts or 6 mm self-locking nuts in a crisscross patten in 2-3 steps to the specified torque.

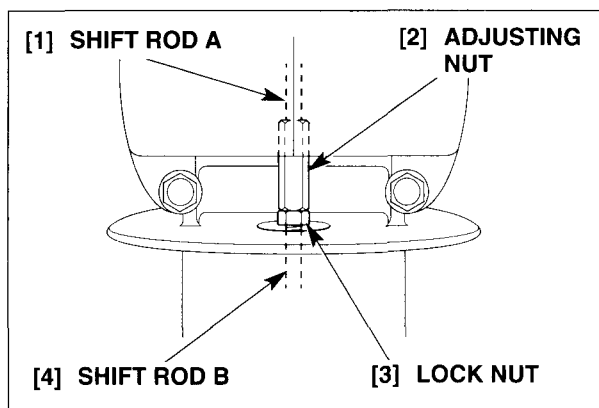
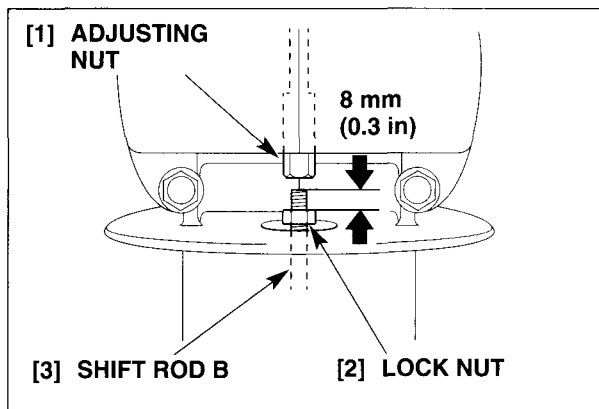
TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)



- 6) Make sure that the gear shift in the "R" (reverse) position.
- 7) Turn the lock nut on the shift rod B to obtain 8 mm (0.3 in) from top of the shift rod B to top of the lock nut as shown.
- 8) Make sure that the shift rod is in reverse position and connect the shift rod B to the shift rod A by threading the adjusting nut until the adjusting nut comes in contact with the lock nut.
- 9) When the adjusting nut contacts the lock nut, tighten the lock nut by holding the adjusting nut.

TORQUE: 10 N•m (1.0 kgf•m, 7 lbf•ft)

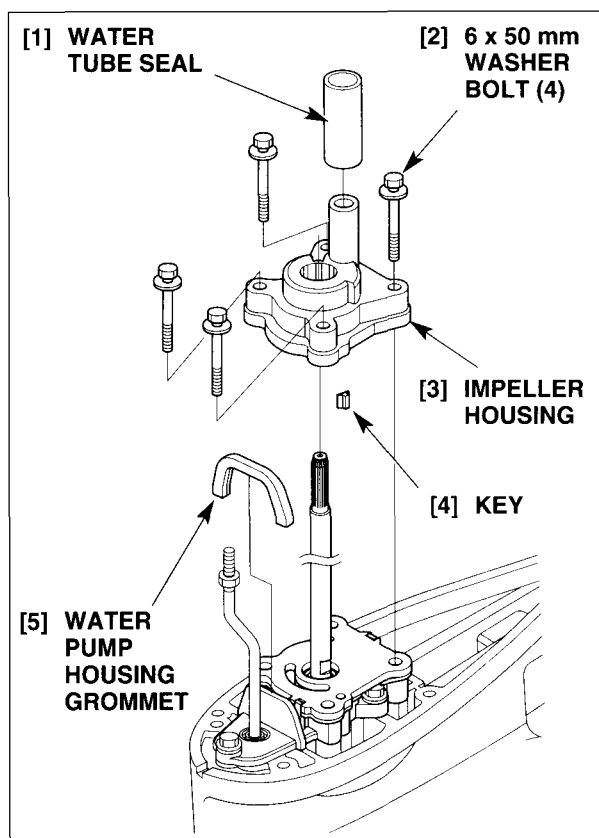
- 10) After adjustment, be sure that the gearshift lever or remote control lever moves smoothly into all position.
- 11) After reassembly, add the gear case with the recommended oil (P. 3-6).



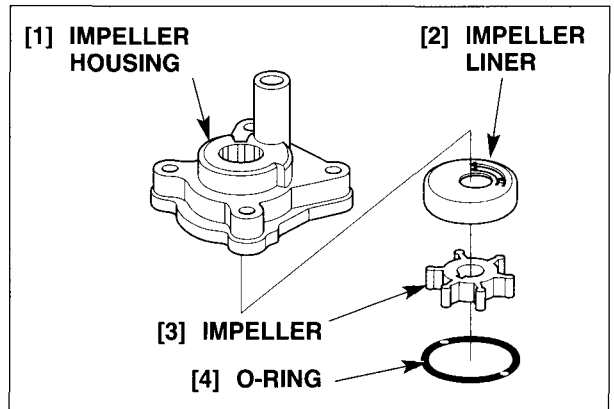
4. WATER PUMP

a. DISASSEMBLY

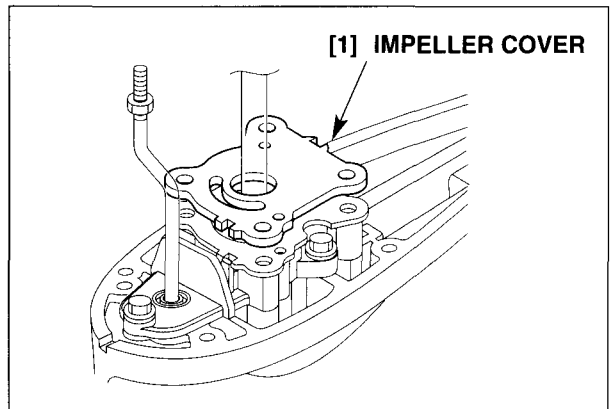
- 1) Remove the following:
 - the propeller (P. 4-2).
 - the propeller shaft holder (P. 4-3).
 - the gear case assembly (P. 4-9).
- 2) Remove the water tube seal ring and water pump housing grommet.
- 3) Remove the four 6 mm washer bolts and impeller housing.
- 4) Remove the key from the vertical shaft.



5) Remove the O-ring., pump impeller and impeller liner from the impeller housing.

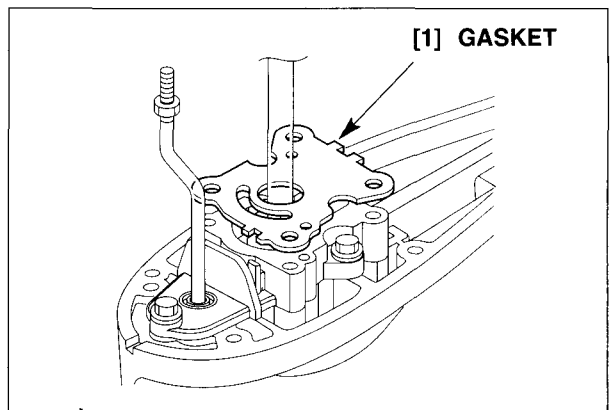


6) Remove the impeller cover



7) Remove the gasket.

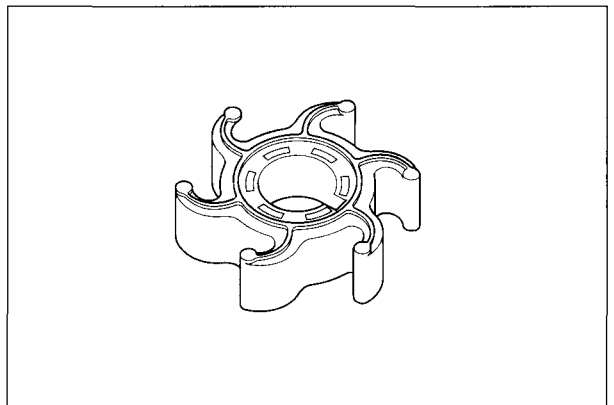
- Replace the gasket with new one when the gasket is removed.



b. INSPECTION

• PUMP IMPELLER

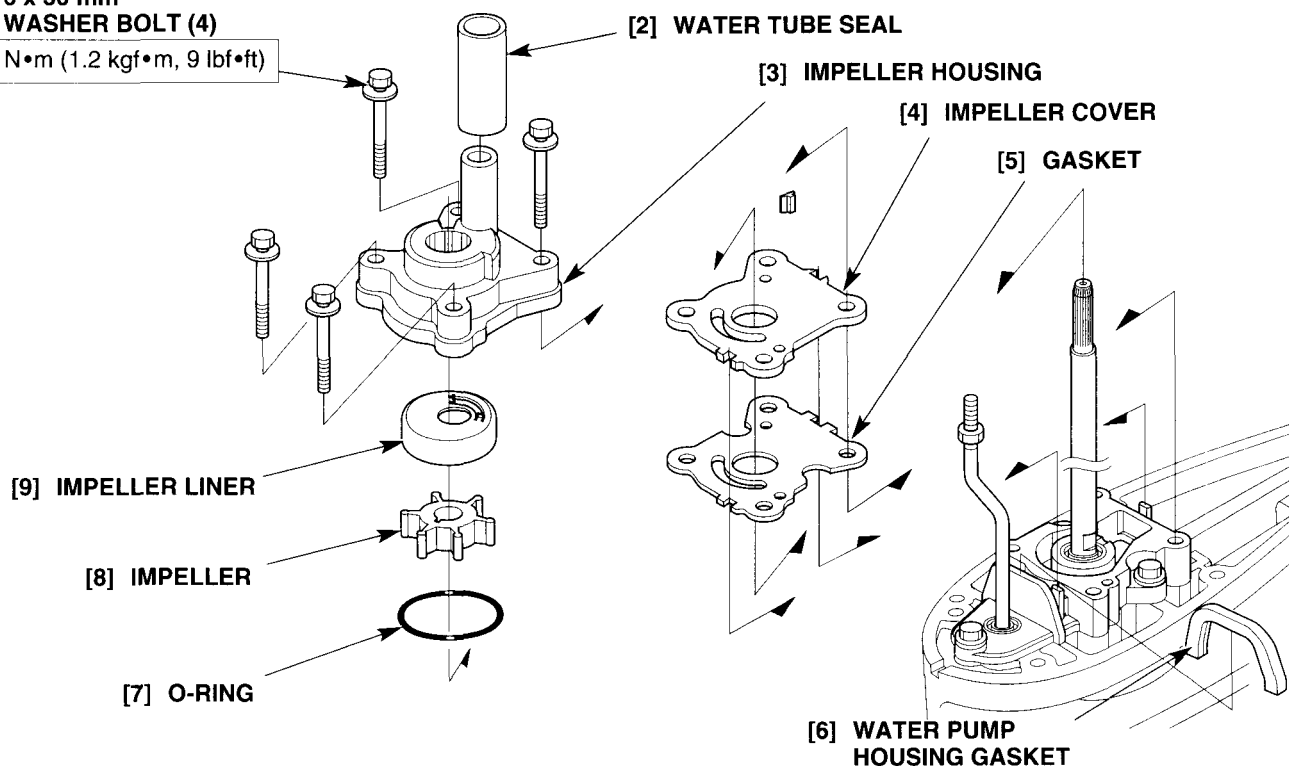
Check the pump impeller for wear, damage or cracks, replace if necessary.



c. ASSEMBLY

[1] 6 x 50 mm
WASHER BOLT (4)

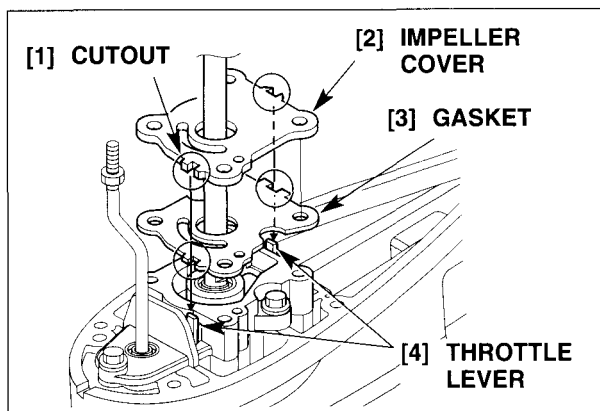
12 N•m (1.2 kgf•m, 9 lbf•ft)



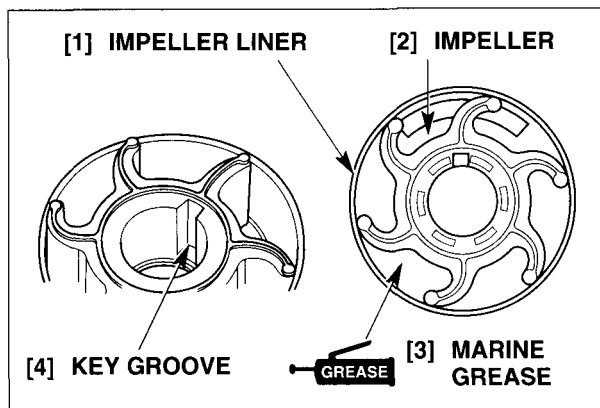
1) Install a impeller gasket by aligning the cutout with the boss of the water pump housing.

- Replace the gasket with new one when the gasket is removed.

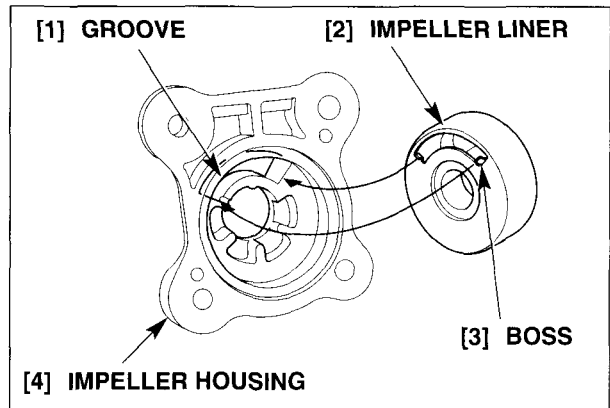
2) Install the impeller cover by aligning the cutout with the boss of the water pump housing.



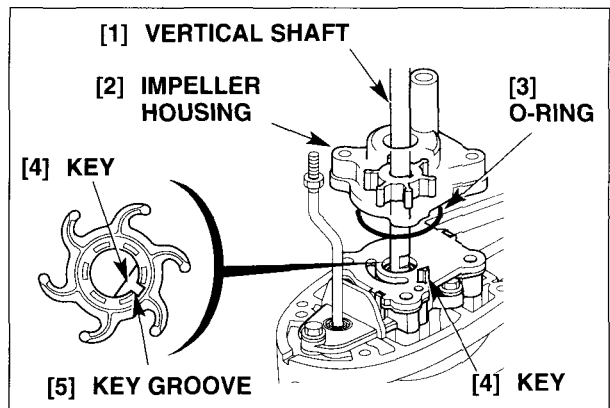
3) Apply marine grease to the inside of the impeller liner, and install the impeller by turning it counterclockwise with the open end of the key groove toward the bottom of the motor. Align the holes of the impeller and pump liner.



- 4) Apply thin coat of grease to the outside of the liner to hold them in the impeller housing, install the pump liner and impeller as an assembly by aligning the tabs of the liner with the groove of the impeller housing.

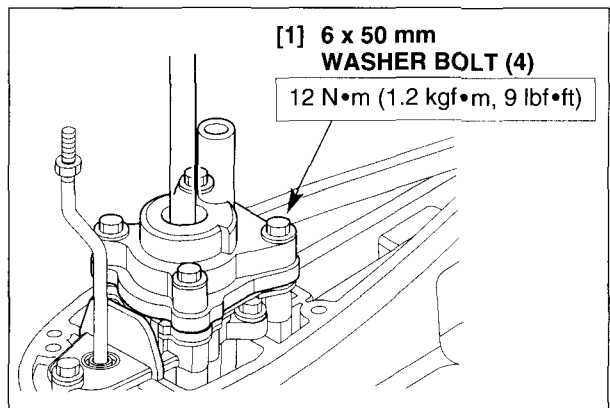


- 5) Apply marine grease to a new O-ring and install it to the impeller housing.
- 6) Apply thin coat of grease to the key setting groove of the vertical shaft and set the key.
- 7) Install the impeller housing assembly by aligning the key groove of the impeller with the key on the vertical shaft by turning the vertical shaft clockwise taking care not to come off the key from the vertical shaft.



- 8) Install the 6 x 50 mm washer bolts and tighten the bolts to the specified torque.

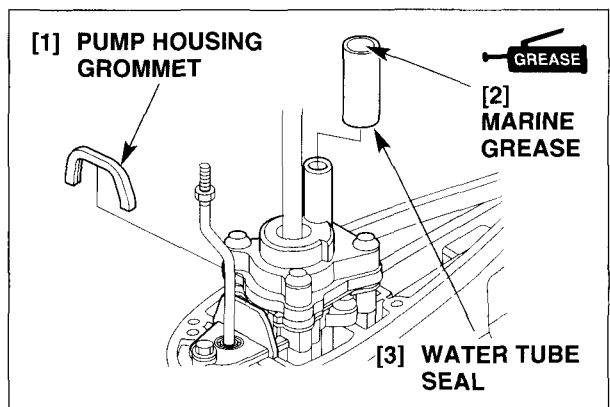
TORQUE: 11 N•m (1.1 kgf m, 8 lbf ft)



- 9) Apply marine grease to the inside of the water tube seal ring and install it to the impeller housing. Install the water pump housing grommet.

- 10) Install the following:

- gear case assembly (P. 4-10 and 11)
- propeller shaft holder (P. 4-8).
- propeller (P. 4-2).

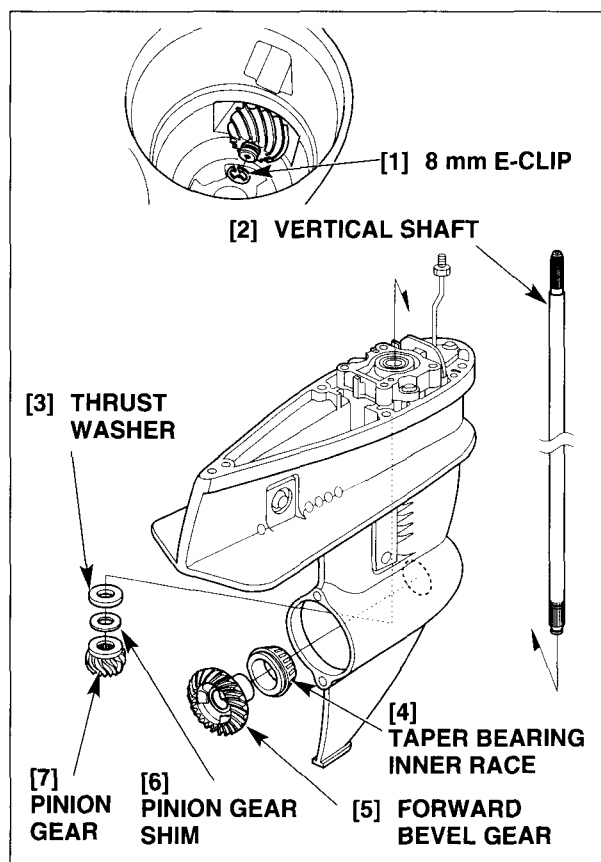


5. VERTICAL SHAFT/BEVEL GEAR

a. DISASSEMBLY

- 1) Remove the following:
 - propeller (P4-2)
 - propeller shaft holder (P. 4-3).
 - gear case (P. 4-9)
 - water pump (P. 4-11).
- 2) Remove the 8 mm E-clip from the vertical shaft and discard it. Replace with new one when reassembly.
- 3) Remove the vertical shaft.
- 4) Remove the pinion gear, thrust washers and vertical shaft.
- 5) Remove the forward bevel gear

When replacing the gear case, vertical shaft, pinion gear and/or forward bevel gear, select the shim according to the shim selection on page 4-24.

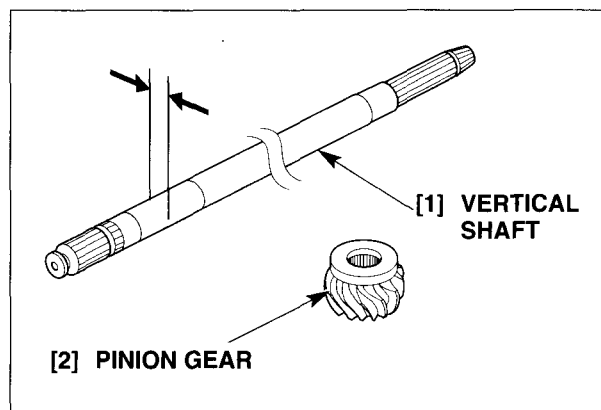


b. INSPECTION

• VERTICAL SHAFT/PINION GEAR

- 1) Check the pinion gear for wear or damage, replace if necessary.
- 2) Check the mating section of the vertical shaft and pinion gear for wear or damage, replace if necessary.
- 3) Measure the O.D. of the vertical shaft at the needle bearing section. If the measurement is lower than the service limit, replace the vertical shaft and check the needle bearing in the gear case (P. 4-13).

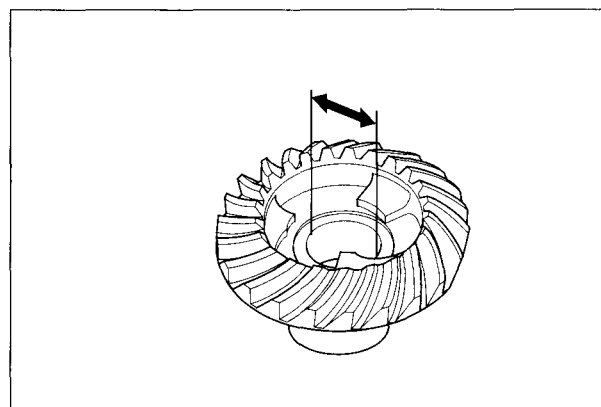
Standard	Service limit
14.989 – 15.000 mm (0.5905 – 0.5906 in)	14.97 mm (0.589 in)



• FORWARD BEVEL GEAR

Check the clutch dogs and gear for wear or damage. Measure I.D. of the gear.

Standard	Service limit
17.000 – 17.018 mm (0.6693 – 0.6700 in)	17.04 mm (0.671 in)



• BEARING

Check the taper roller bearing. Replace the bearing with new one if it is worn or damaged.

Check the needle bearing for wear or damage. Replace if necessary.

c. TAPER ROLLER BEARING REPLACEMENT

1) Before removing the bearing outer race, replace the jaw of the bearing race puller with the 25 mm puller jaw as shown.

2) Set the bearing race puller to the bearing outer race and remove the bearing outer race, then remove the 40 mm shim.

TOOLS:

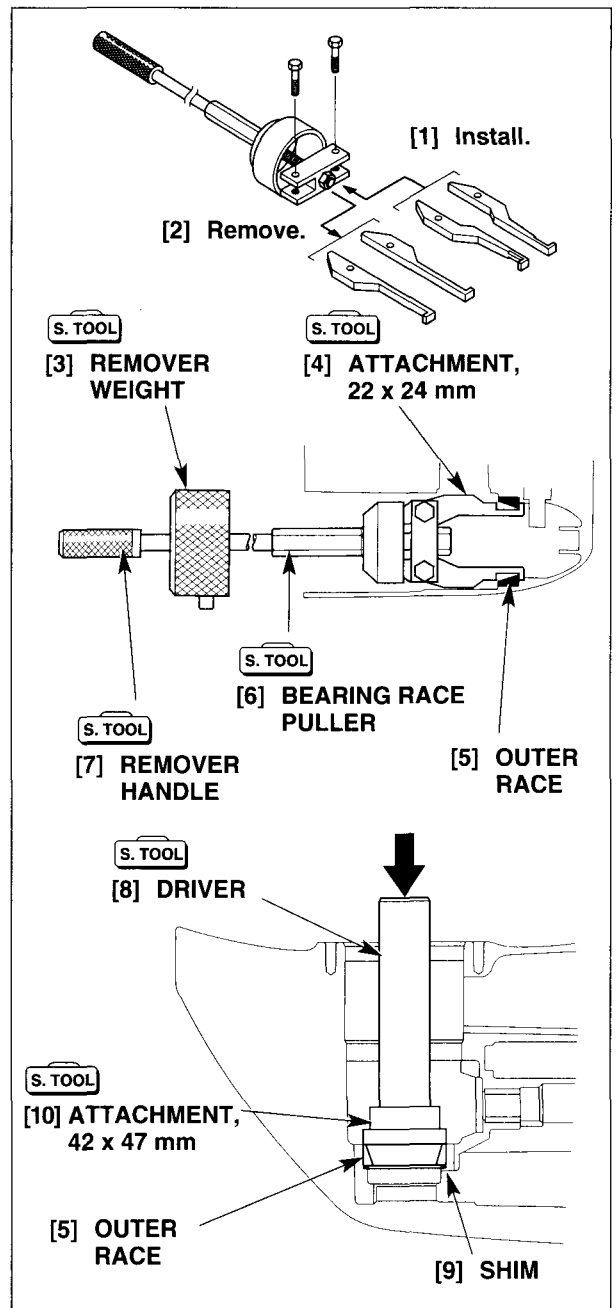
- Bearing race puller 07LPC-ZV30100
- Remover weight 07741-0010200
- Remover handle 07936-3710100
- Puller jaw, 25 mm 07WPC-ZW50100

3) Select the shim (P. 4-23).

4) Apply gear oil to the outside of a new bearing outer race. Place the 40 mm shim to the gear case. Drive in the bearing outer race to the gear case with the larger I.D. side toward out.

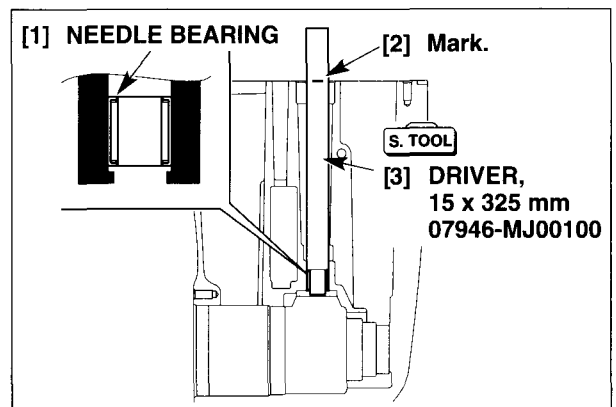
TOOLS:

- Driver, 15 x 280 mm 07949-3710001
- Attachment, 42 x 47 mm 07746-0010300



d. NEEDLE BEARING REPLACEMENT

1) Set the driver and mark the gear case upper surface position on the driver as shown



- 2) Set the tools and remove the needle bearing and discard it.

NOTICE

Take care not to damage the flange section of the gear case.

TOOLS:

- | | |
|-------------------------------|----------------------|
| Attachment, 24 x 26 mm | 07746-0010700 |
| Attachment, 32 x 35 mm | 07746-0010100 |
| Installer shaft | 07VMF-KZ30200 |
| Bearing installer | 070PD-ZY10100 |

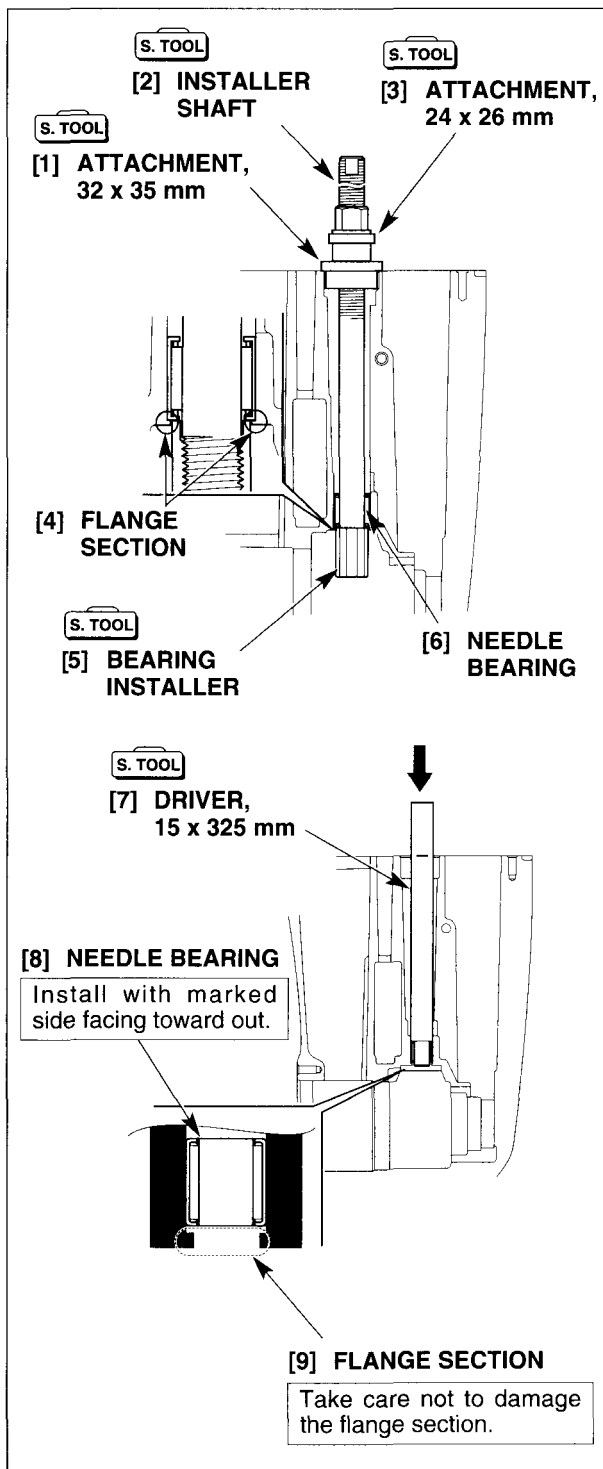
- 3) Apply gear oil to outer surface of a new needle bearing.
- 4) Drive in the needle bearing to the marked position with the marked side toward out.

TOOLS:

- | | |
|----------------------------|----------------------|
| Driver, 15 x 325 mm | 07946-MJ00100 |
|----------------------------|----------------------|

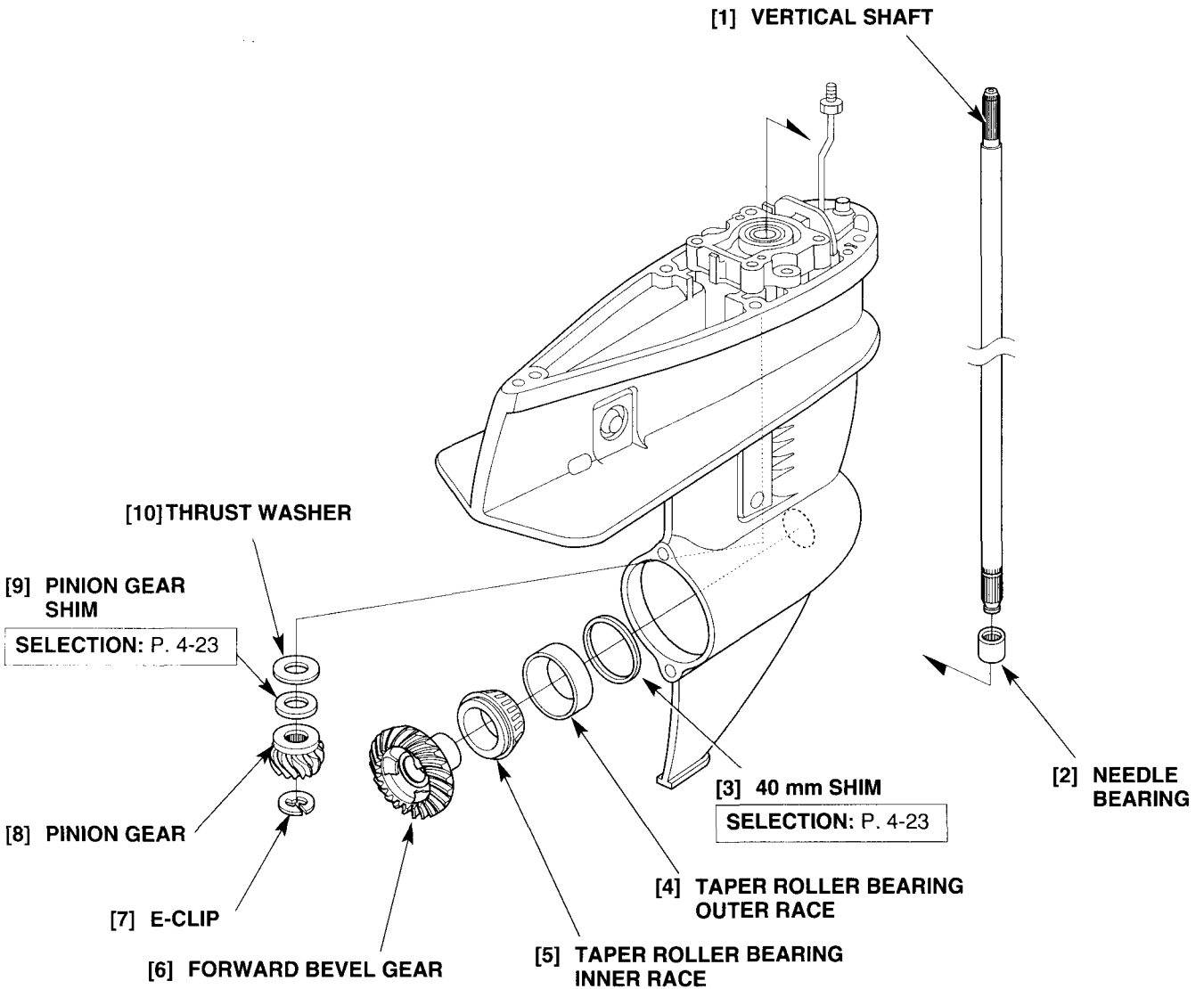
NOTICE

- Drive in up to the mark on the driver that had been put before removal.
- Do not drive in too deep beyond the mark, as it damages the flange.

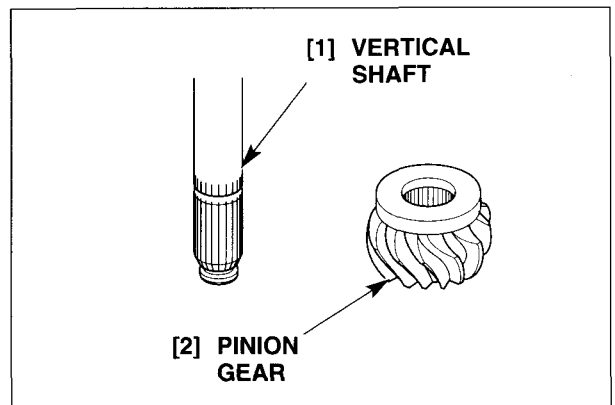


e. ASSEMBLY

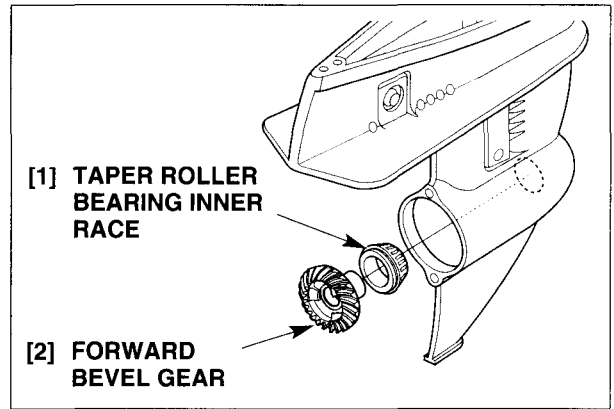
When replacing the gear case, vertical shaft and/or taper roller bearing, select the shim according to the procedure of the Shim Selection on page 4-23.



- 1) Clean off oil or grease from the spline section of the vertical shaft lower end and pinion gear I.D.



- 2) Apply gear oil to the taper roller bearing inner race.
- 3) Install the taper roller bearing inner race to the forward bevel gear.
- 4) Install the forward bevel gear and taper roller bearing to the gear case.



- 5) Install the vertical shaft into the gear case.

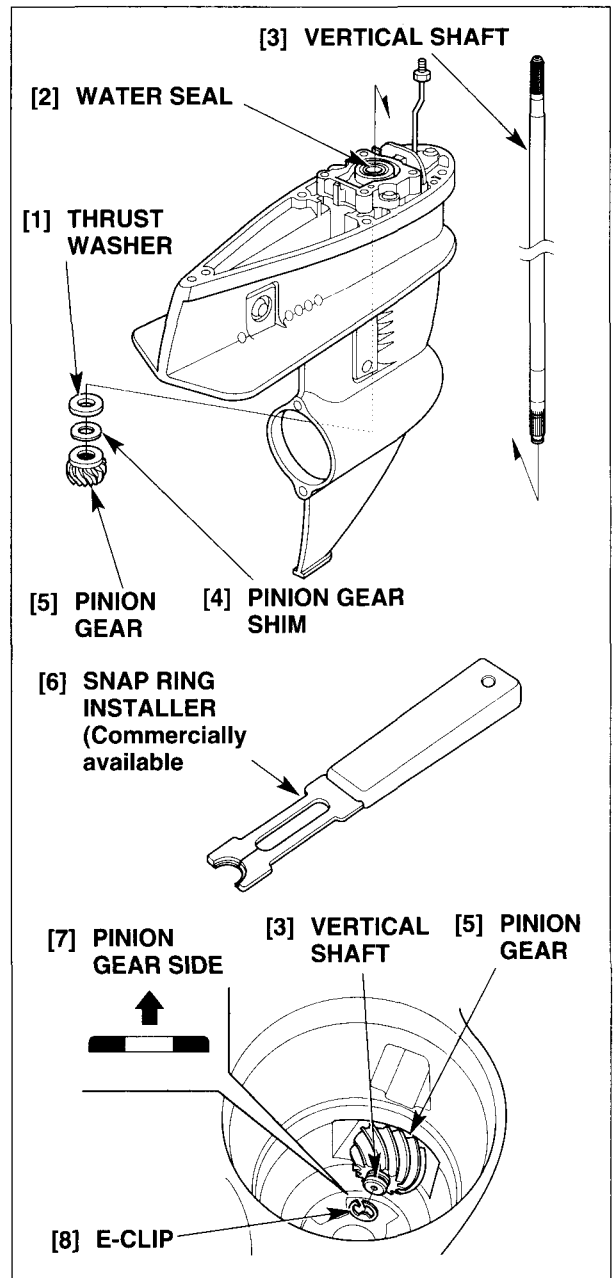
NOTICE

Take care not to damage the water seal lip of the water pump housing.

- 6) Install the thrust washer, pinion gear shim (see page 3-23 for shim selection) and pinion gear.
- 7) Install a new E-clip using a commercially available snap ring installer taking care not to bend or deform the E-clip.
 - Do not reuse the removed E-clip.

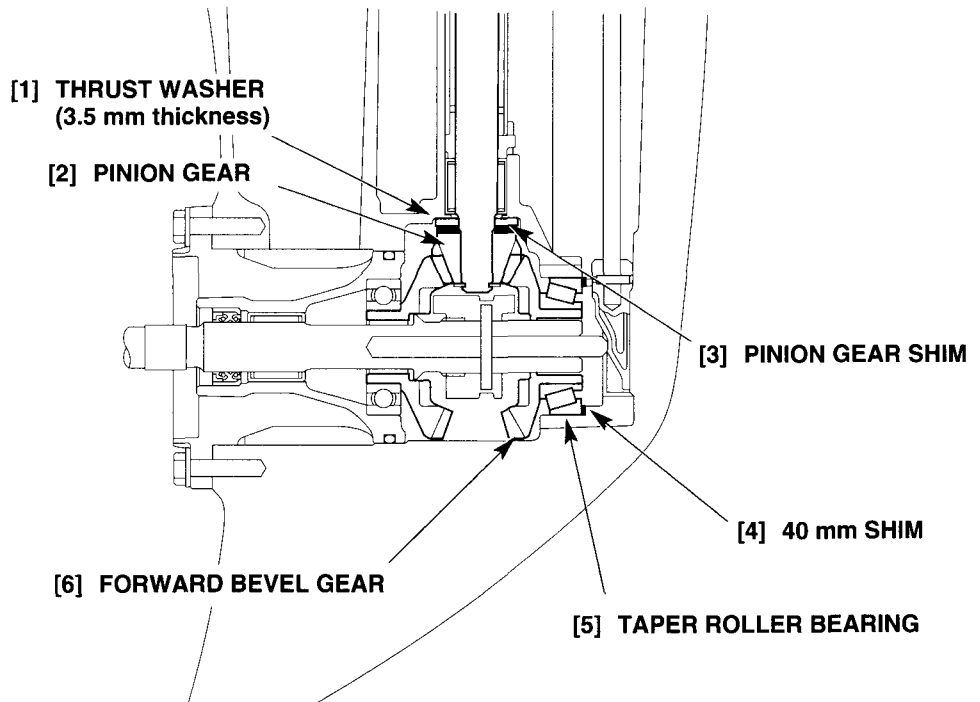
- 8) Install the following:
 - water pump (P. 4-16).
 - propeller shaft holder (P. 4-8).
 - propeller (P. 4-2).

- 9) Install the gear case assembly (P. 4-10).



f. SHIM SELECTION

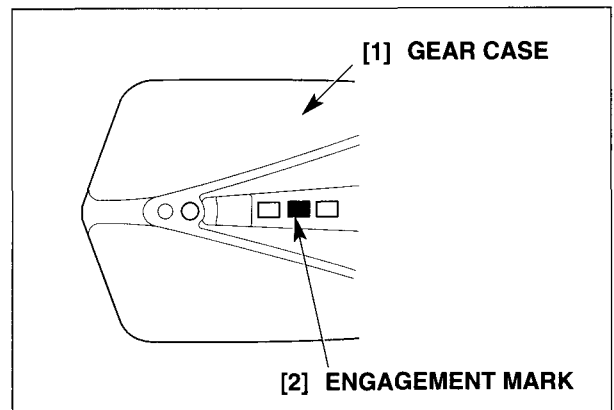
When replacing the gear case, vertical shaft, and/or taper roller bearing , select the shim as following:



• PINION GEAR SHIM

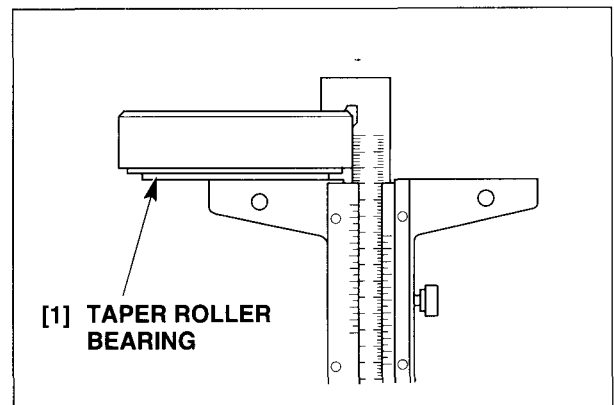
Select the shim according to the engagement mark on the gear case.

Engagement mark	Thrust washer	Thickness
B	Thrust washer B	1.53 mm (0.060 in)
C	Thrust washer C	1.56 mm (0.061 in)



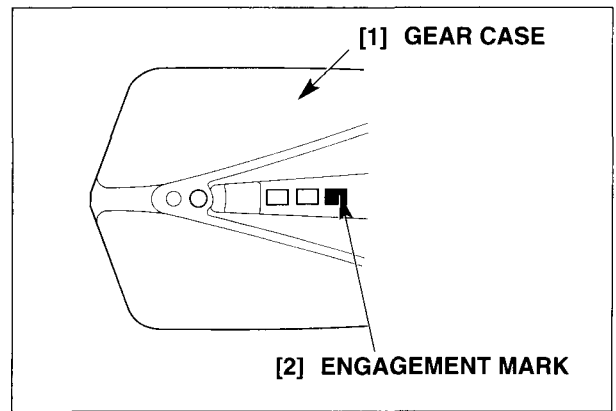
• 40 mm SHIM

- 1) Clean the taper roller bearing.
- 2) Assemble the outer race and inner race of the taper roller bearing and turn the outer race 2 - 3 turns, then measure the bearing height from the outer race end to the inner race end as shown and record the measurement.



- 3) Cross reference the bearing height and engagement mark on the gear case, and select shim of the appropriate thickness from the shim selection table.

Shim type	Thickness
Shim A	0.08 mm (0.003 in)
Shim B	0.10 mm (0.004 in)
Shim C	0.12 mm (0.005 in)
Shim D	0.15 mm (0.006 in)



Shim Selection Table (Shim thickness and selection example)

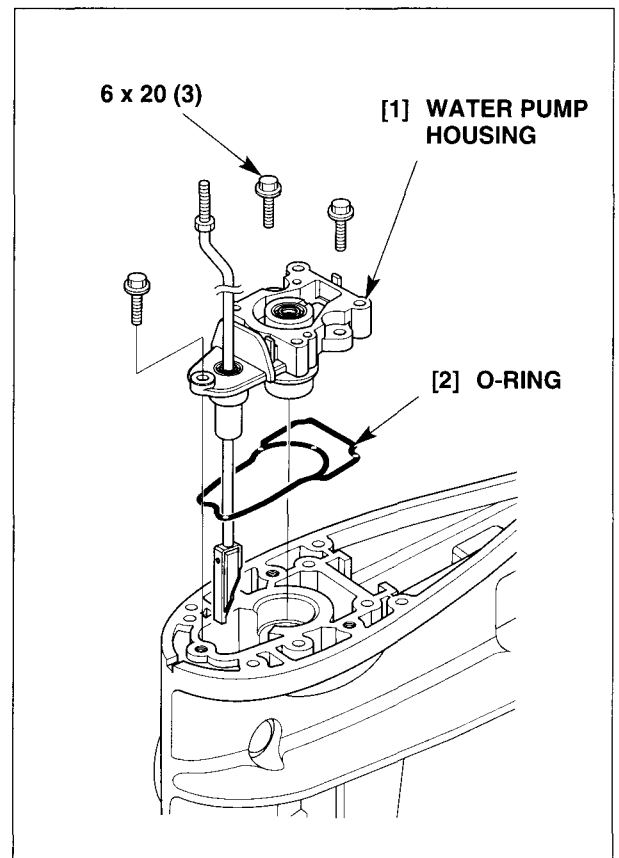
[3] Unit: mm (in)

		[1] Bearing height							
		15.15 - 15.20 (0.596 - 0.598)	15.10 - 15.15 (0.594 - 0.596)	15.05 - 15.10 (0.593 - 0.594)	15.00 - 15.05 (0.591 - 0.593)	14.95 - 15.00 (0.589 - 0.591)	14.90 - 14.95 (0.587 - 0.589)	14.85 - 14.90 (0.585 - 0.587)	14.80 - 14.85 (0.583 - 0.585)
[2] Engagement mark	3	0.15 mm D x 1	0.18 mm A x 1, B x 1	0.24 mm C x 2	0.28 mm A x 1, B x 2	0.34 mm B x 1, C x 2	0.38 mm A x 1, D x 2	0.44 mm A x 1, C x 3	0.48 mm C x 4
	2	0.12 mm C x 1	0.16 mm A x 2	0.22 mm B x 1, C x 1	0.26 mm A x 2, D x 1	0.32 mm B x 2, C x 1	0.36 mm C x 3	0.42 mm C x 1, D x 2	0.46 mm B x 1, C x 3
	1	0.10 mm B x 1	0.15 mm D x 1	0.20 mm B x 2	0.24 mm C x 2	0.30 mm D x 2	0.34 mm B x 1, C x 2	0.40 mm B x 1, D x 2	0.44 mm A x 1, C x 3

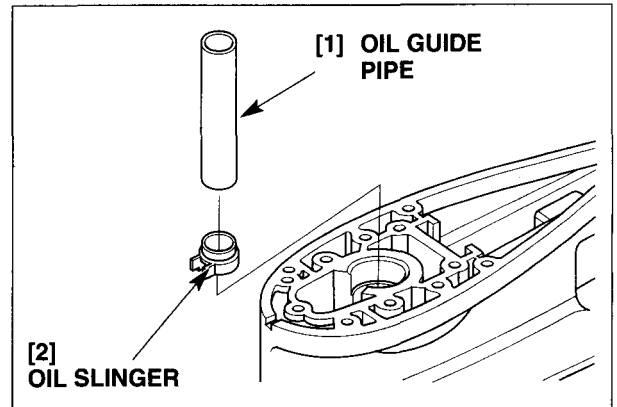
6. WATER PUMP HOUSING

a. REMOVAL

- Remove the following:
 - propeller (P. 4-2).
 - propeller shaft holder (P. 4-3).
 - gear case assembly (P. 4-9).
 - water pump (P. 4-11).
 - vertical shaft (P. 4-15)
- Remove the three 6 x 20 mm flange bolts, and remove the water pump housing and O-ring.

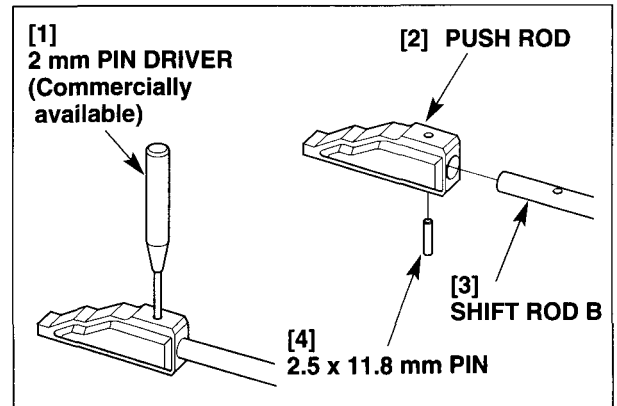


3) Remove the oil guide pip and oil slinger.

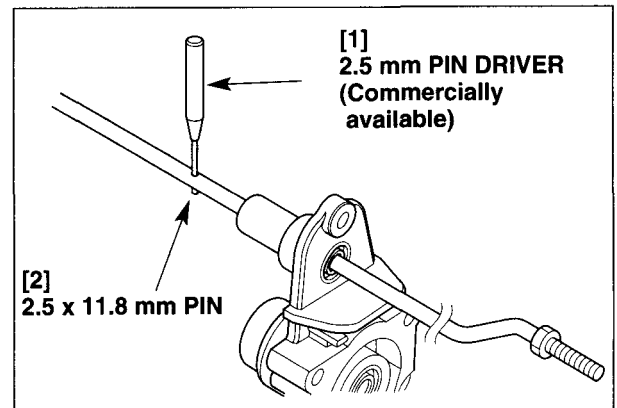


b. DISASSEMBLY

1) Drive out the 2.5 x 11.8 mm pin using commercially available pin driver, and remove the push rod from the shift rod B.



2) Drive out the 2.5 x 11.8 mm pin using commercially available pin driver, and remove the shift rod B from the water pump housing.

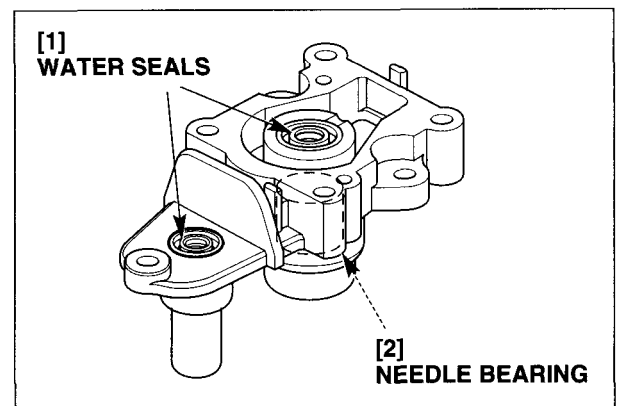


c. INSPECTION

• WATER PUMP HOUSING

Check the water seals and needle bearing for wear or damage.

Replace if necessary (P. 4-23).



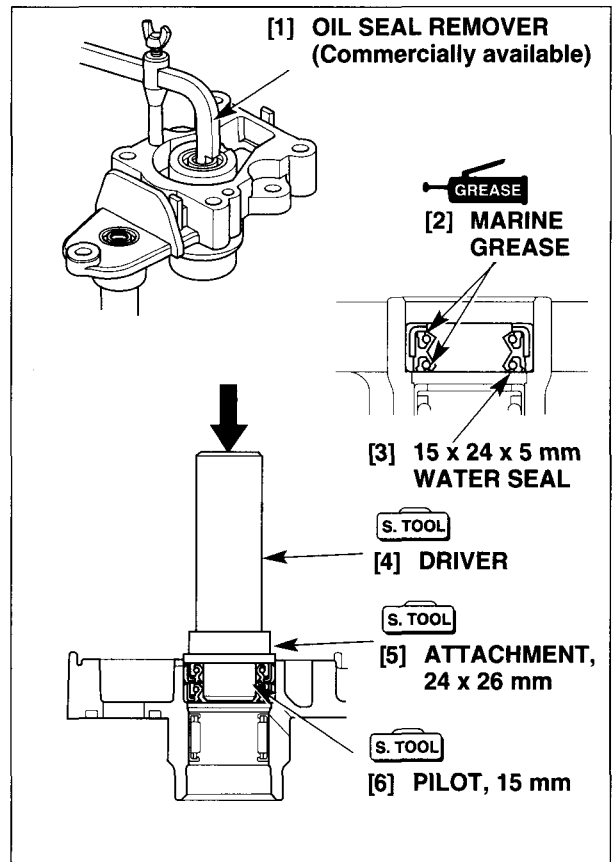
d. 15 x 24 x 5 mm WATER SEAL REPLACEMENT

- 1) Remove the water seals.
- 2) Apply soapy water to the outside of new water seals, and install them in the direction as shown using the following tools.

TOOLS:

Driver	07749-0010000
Attachment, 24 x 26 mm	07746-0010700
Pilot, 15 mm	07746-0041500

- 3) After installation, apply marine grease to the lip of the water seals.



e. NEEDLE BEARING REPLACEMENT

- 1) Remove the water seals.
- 2) Remove the needle bearing using the bearing remover.

TOOLS:

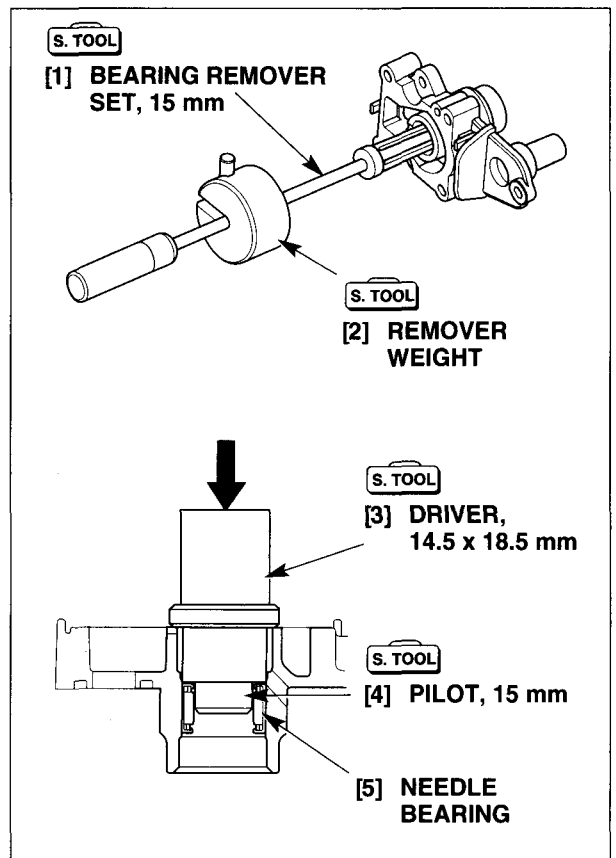
Bearing remover set, 15 mm	07936-KC10500
Remover weight	07741-0010201

- 3) Apply gear oil to the out side of the new needle bearing and set it and tools as shown.
- 4) Press in the needle bearing using hydraulic press.

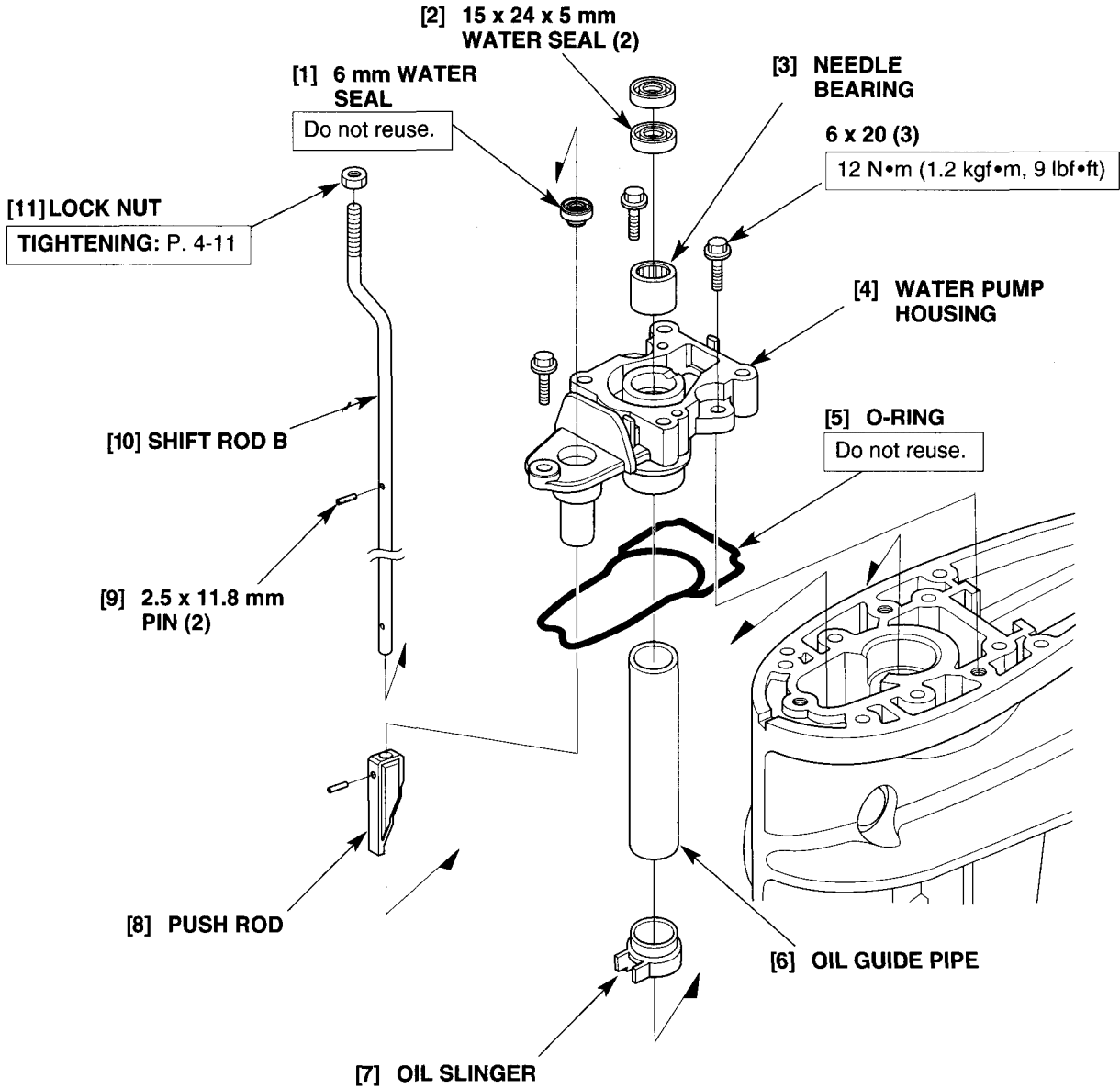
TOOLS:

Driver, 13 x 15 mm	07ZPF-ZW90200
Pilot, 15 mm	07746-0040300

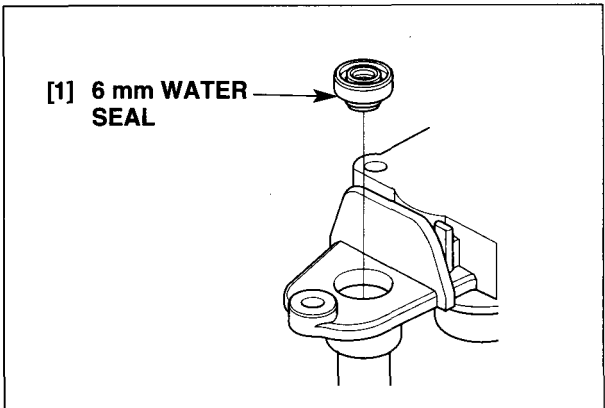
- 5) Install a new water seals.



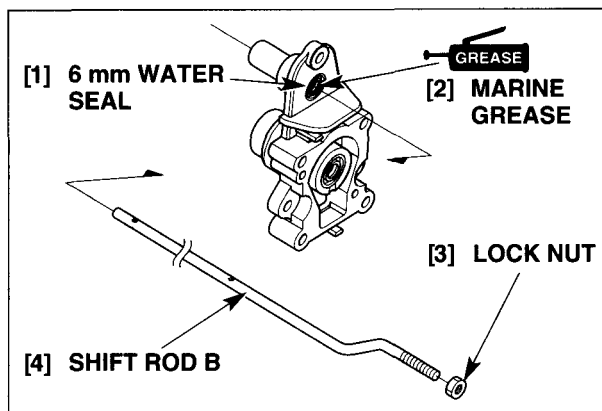
f. ASSEMBLY



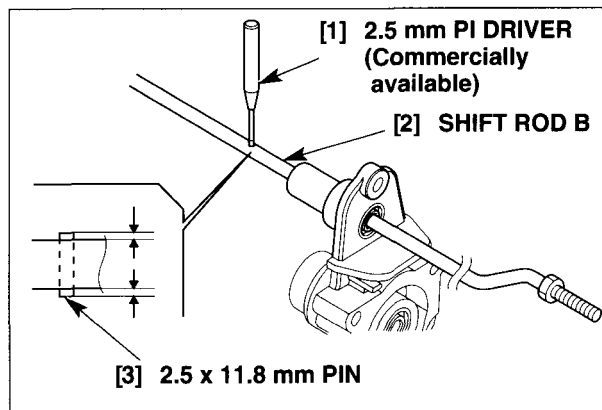
- 1) Install a new 6 mm oil seal, if it was removed;
 - a. Clean off any grease or oil from the water seal installation area of the water pump housing.
 - b. Apply soapy water to the outside of the water seal and install it securely.



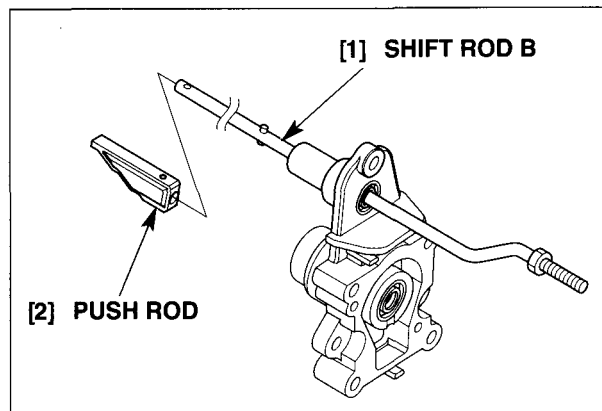
- 2) Apply marine grease to the lip of the water seal.
- 3) Install the lock nut to the shift rod B and install the shift rod B to the water pump housing.



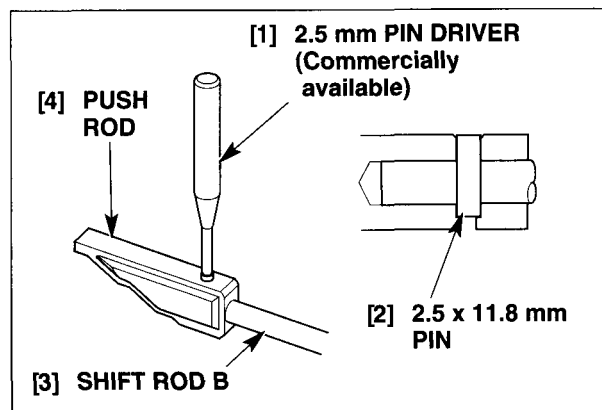
- 4) Install the 2.5 x 11.8 mm pin to the shift rod B as shown using a commercially available pin driver.
 - The projected height of the both side of the pin should be equally.



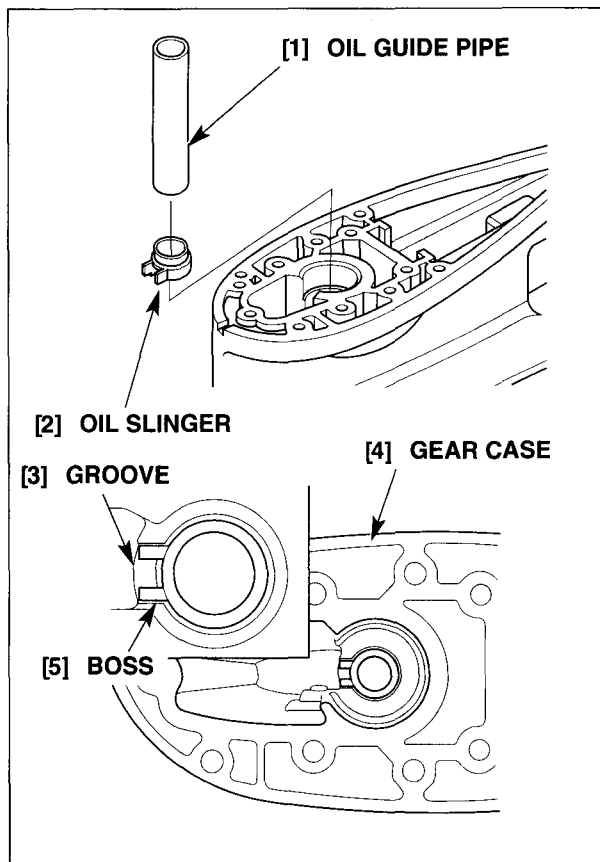
- 5) Place the shift rod B as shown and set the push rod to the shift rod B noting the installation direction.



- 6) Align the pin holes of the push rod with the pin hole of the shift rod B, and drive the 2.5 x 11.8 mm pin in from the chamfer side using a commercially available pin driver.



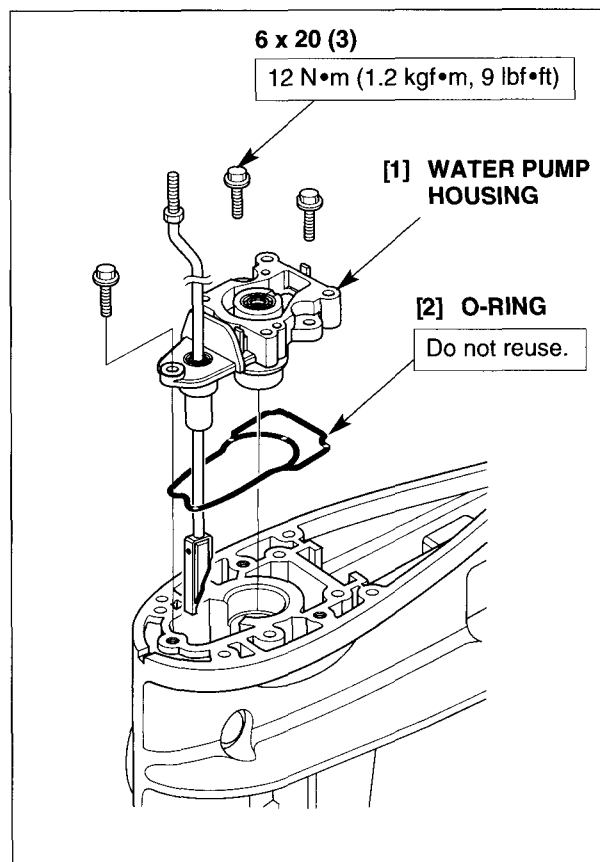
- 7) Install the oil slinger to the gear case by aligning the boss with the groove of the gear case as shown.
- 8) Install the oil guide pipe.



- 9) Apply marine grease to the O-ring and install the O-ring to the water pump housing.
- 10) Install the water pump housing assembly to the gear case with the shift slider contacting surface facing toward the propeller side as shown and tighten the four 6 x 20 mm flange bolts.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

- 11) Install the following:
 - forward bevel gear and vertical shaft (P. 4-18).
 - water pump (P. 4-16).
 - propeller shaft holder (P. 4-8).
 - propeller (P. 4-2).

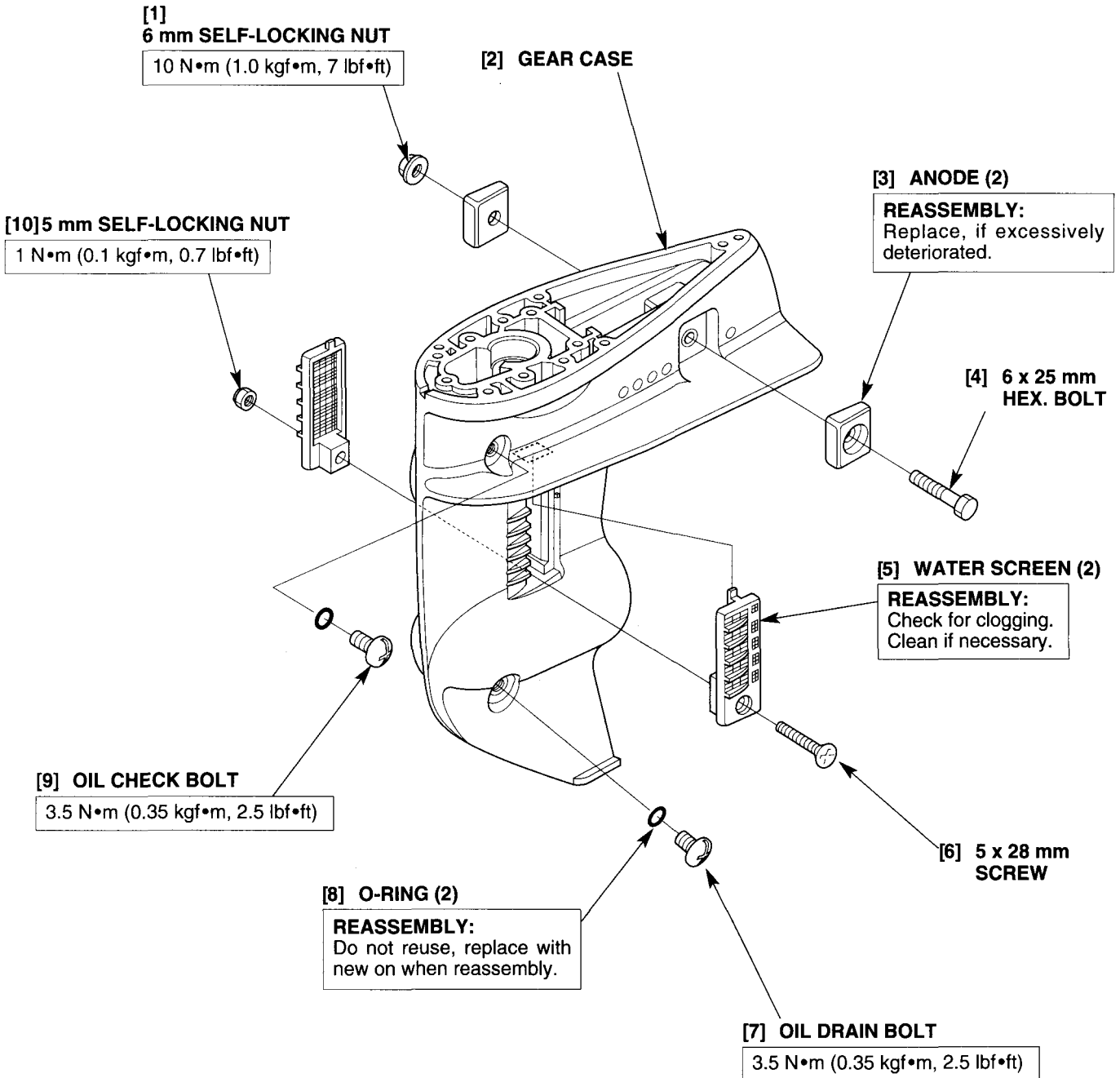


7. GEAR CASE/ANODE/ WATER SCREEN

a. DISASSEMBLY/REASSEMBLY

The anodes and water screens can be serviced with the gear case mounted on the outboard motor.

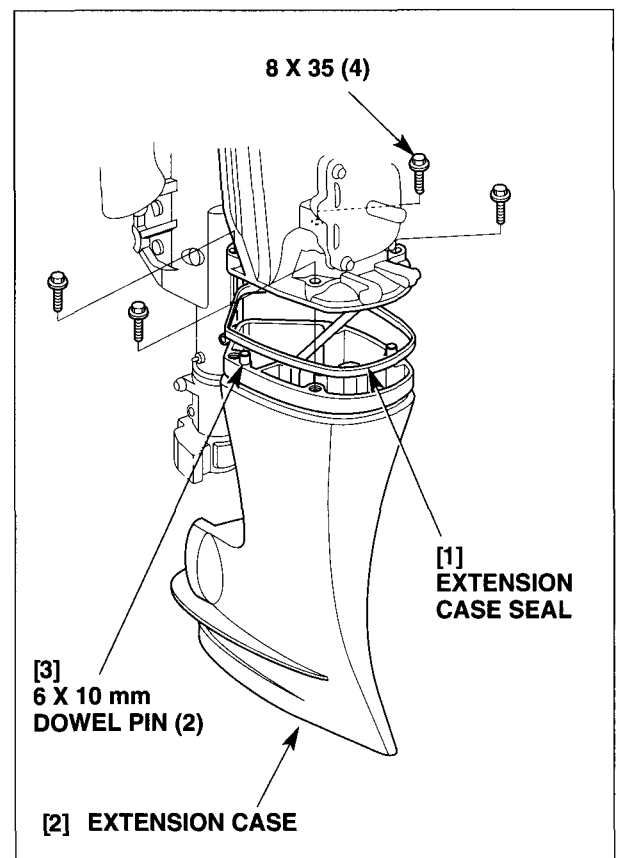
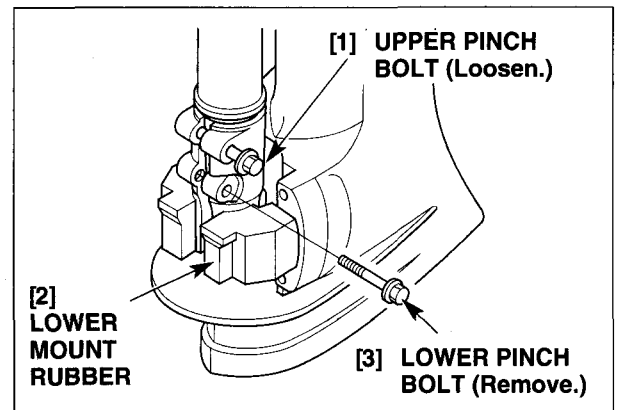
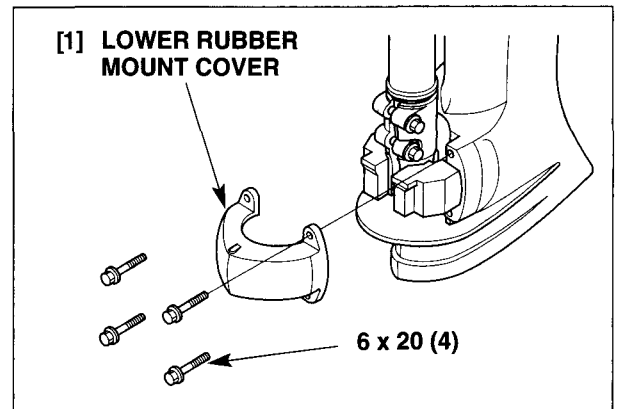
- After reassembly, fill the gear case with gear oil (P. 3-6).



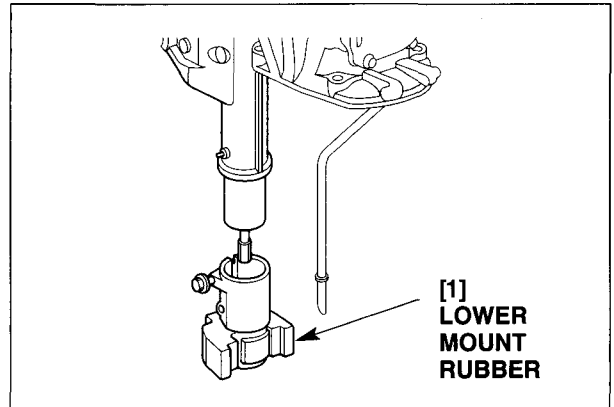
8. EXTENSION CASE

a. REMOVAL

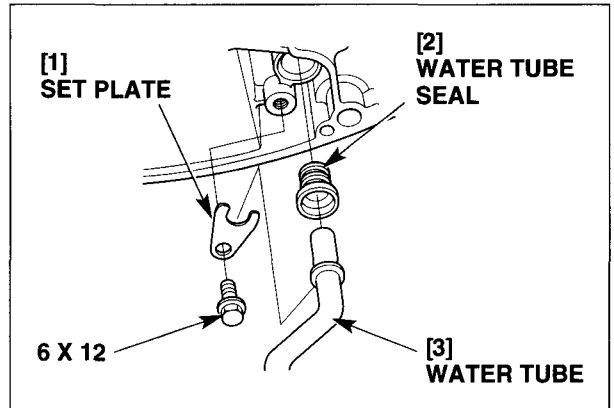
- 1) Remove the following:
 - engine cover (P. 5-1).
 - left and right engine under covers (P. 5-2, 3).
 - gear case assembly (P. 4-9).
- 2) Remove the four 6 x 20 mm flange bolts and lower mount rubber cover.
- 3) Loosen the 8 x 45 mm upper pinch bolt and remove the lower pinch bolt.
- 4) Remove the four 8 x 35 mm flange bolt attaching the extension case.
- 5) Remove the extension case and lower rubber motor mount.
- 6) Remove the two 6 x 10 mm dowel pins and extension case seal.



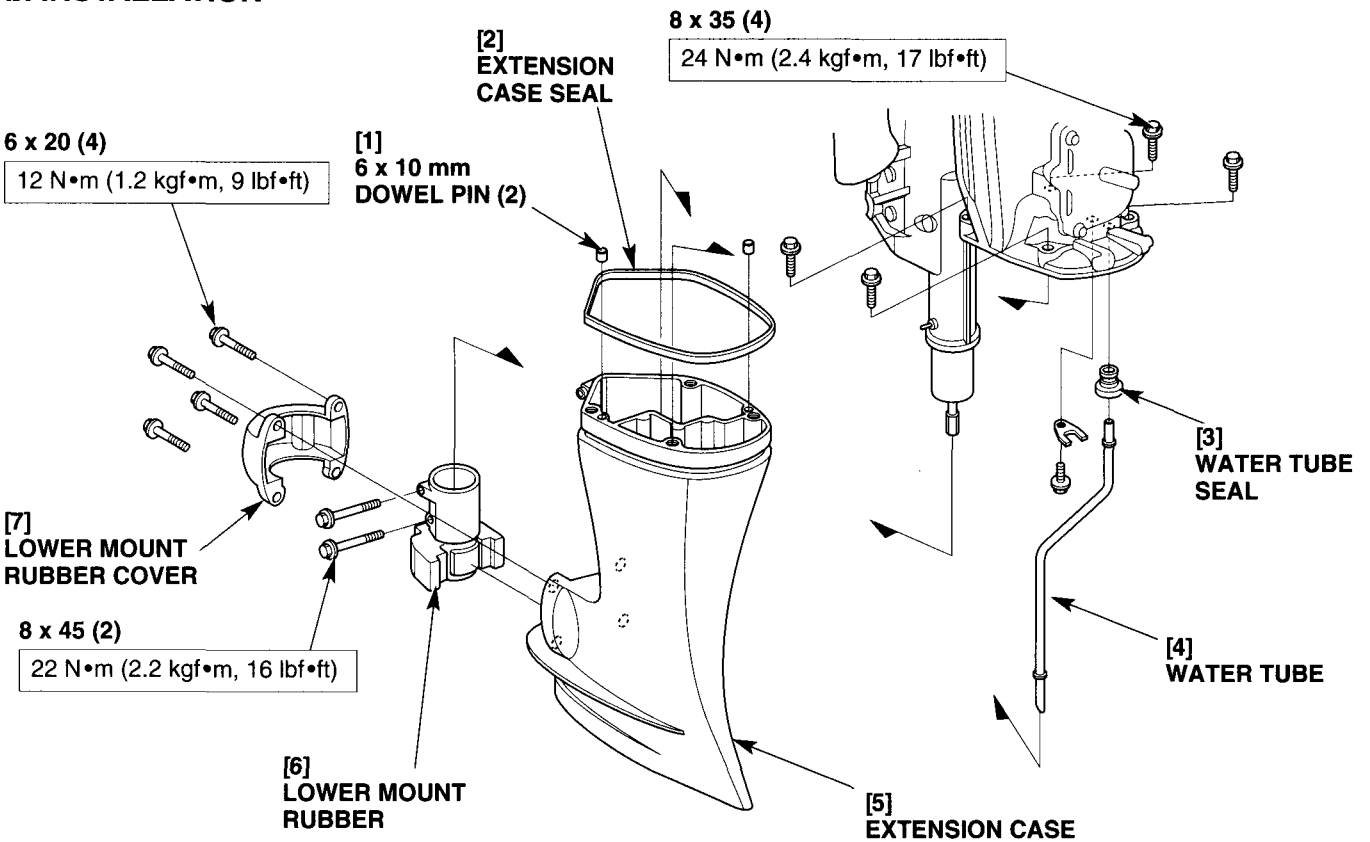
7) Remove the lower rubber motor mount.



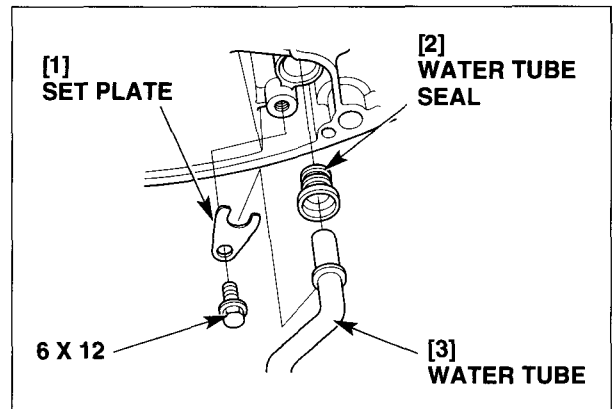
8) Remove the 6 x 12 mm flange bolt and set plate, and remove the water tube and water tube seal.



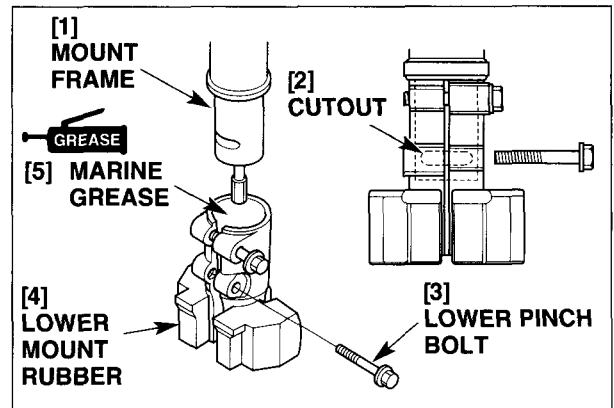
b. INSTALLATION



- 1) Apply marine grease to the water tube seal and set it to the mount case.
- 2) Set the water tube in the place and secure the set plate and 6 x 12 mm flange bolt.

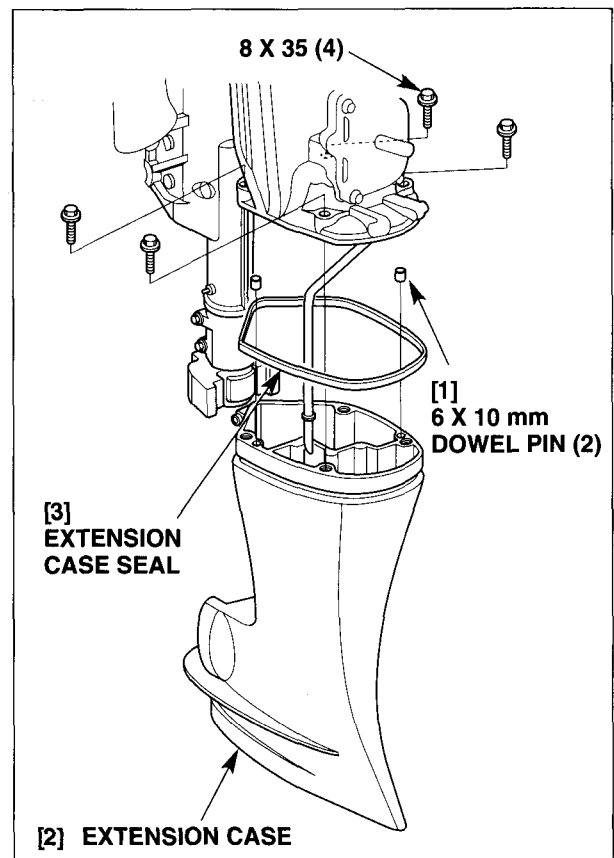


- 3) Apply grease to the inside of the lower mount.
- 4) Install the lower mount rubber to the mount frame.
- 5) Align the lower pinch bolt hole with the cutout on the mount frame as shown and loosely install the lower pinch bolt



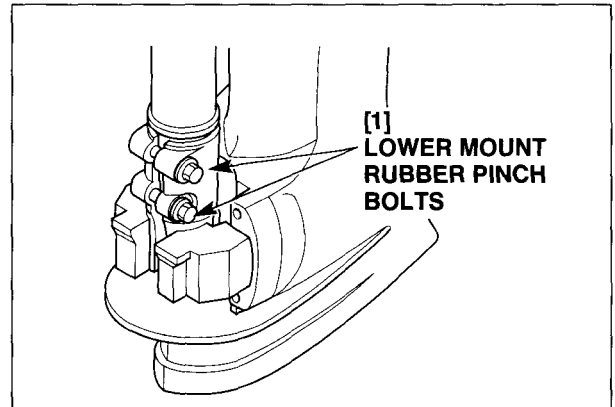
- 6) Install the two 6 x 10 mm dowel pins onto the extension case.
- 7) Apply sealant to the sealing surface and install the extension case seal onto the extension case and assemble the extension case to the mount case.
- 8) Tighten the four 8 x 35 mm flange bolts to the specified torque.

TORQUE: 24 N m (2.4 kgf m, 17 lbf ft)



- 9) Tighten the 8 x 45 mm lower mount rubber pinch bolts to the specified torque.

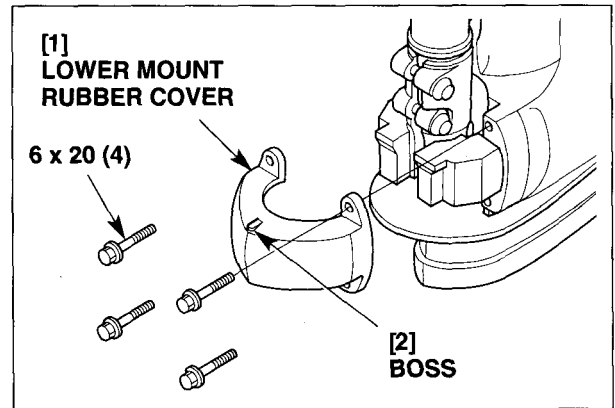
TORQUE: 22 N m (2.2 kgf m, 16 lbf ft)



- 10) Install the lower mount rubber cover with the boss toward up, and tighten the four 8 x 20 mm flange bolts.

TORQUE: 12 N m (1.2 kgf m, 9 lbf ft)

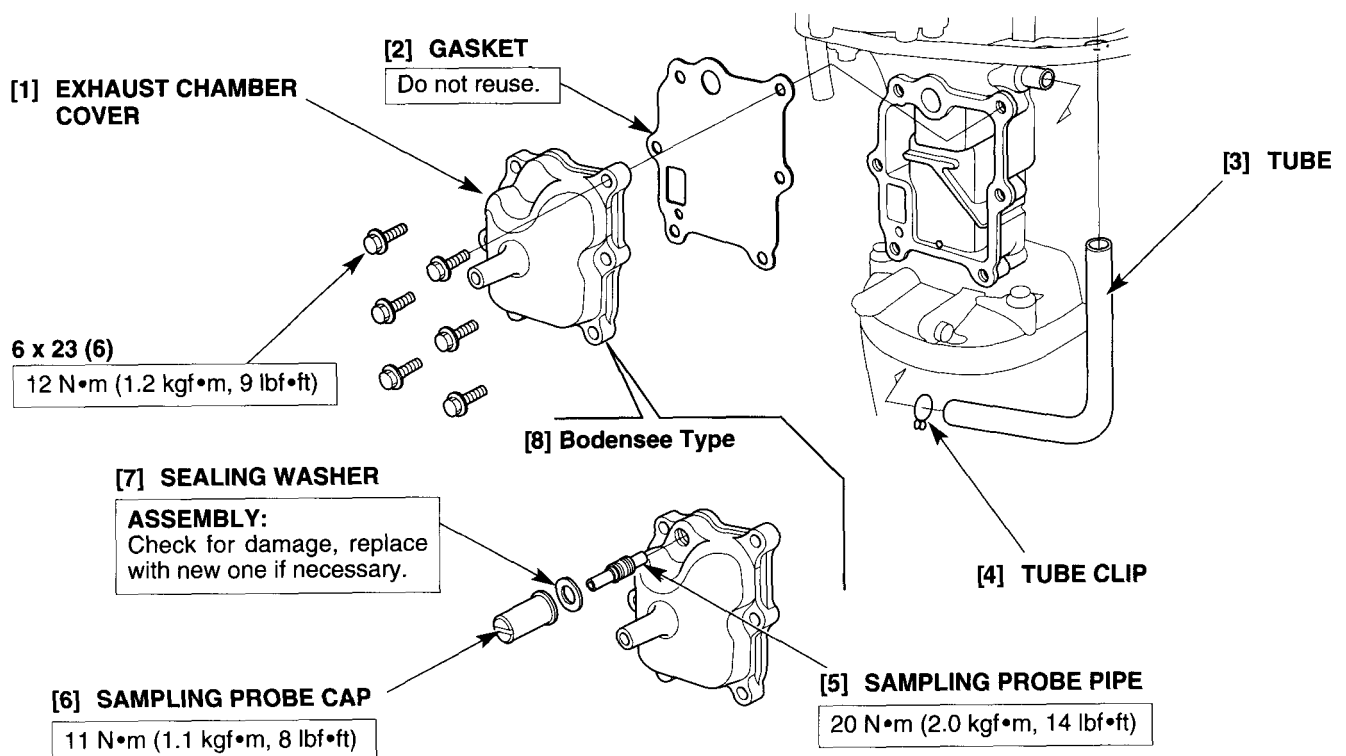
- 11) Reinstall the following:
- gear case assembly (P. 4-10).
 - left and right engine under covers (P. 5-2, 3).
 - engine cover (P. 5-1).



8. EXHAUST CHAMBER COVER

a. DISASSEMBLY/REASSEMBLY

- 1) Remove the engine cover (P. 5-1)
- 2) Remove the left and right engine under covers (P. 5-2, 3).

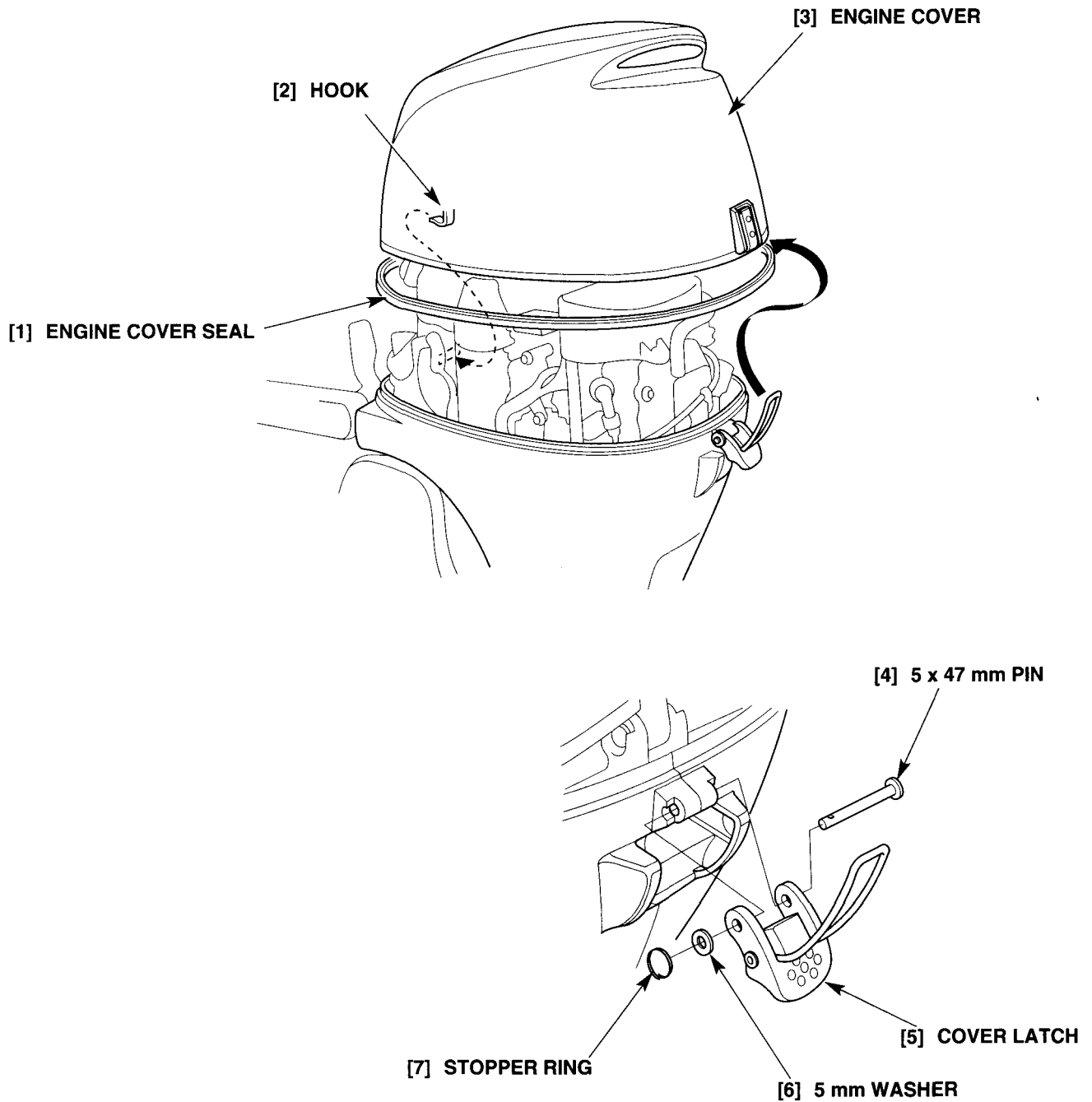


- 1. ENGINE COVER
- 2. LEFT ENGINE UNDER COVER

- 3. RIGHT ENGINE UNDER COVER

1. ENGINE COVER

a. DISASSEMBLY/REASSEMBLY



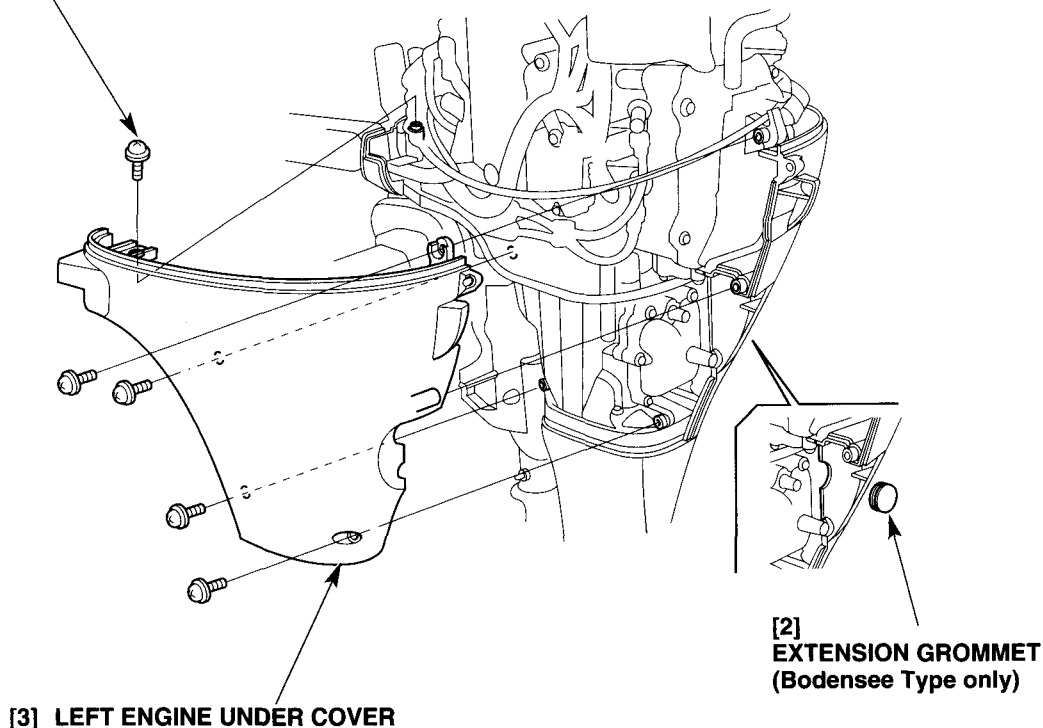
2. LEFT ENGINE UNDER COVER

a. REMOVAL

- 1) Remove the engine cover and cover latch (P. 5-1).
- 2) Remove the five 5 x 10 mm washer screws.
- 3) Pull off the engine under cover from the boss of the oil case at the front of the outboard motor, then remove the left engine under cover.

[1] 5 x 10 mm WASHER SCREW (5)

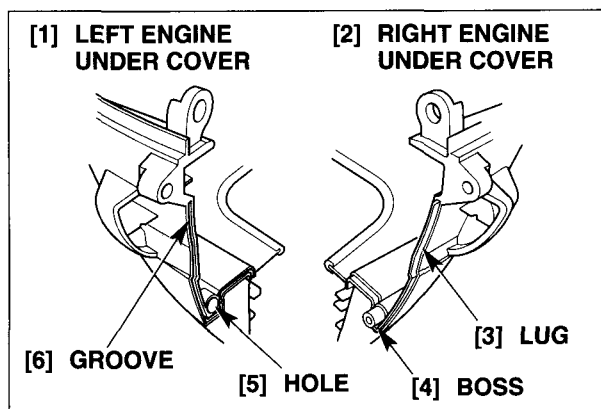
4.5 N·m (0.45 kgf·m, 3.3 lbf·ft)



b. INSTALLATION

- 1) Install the left engine under cover.
 - At the front side; align the hole of the left engine under cover to the boss of the oil case
 - At the rear side; align the groove of the left engine under cover with the lug of the right engine under cover and the hole with the boss.
- 2) Tighten the washer screws securely.

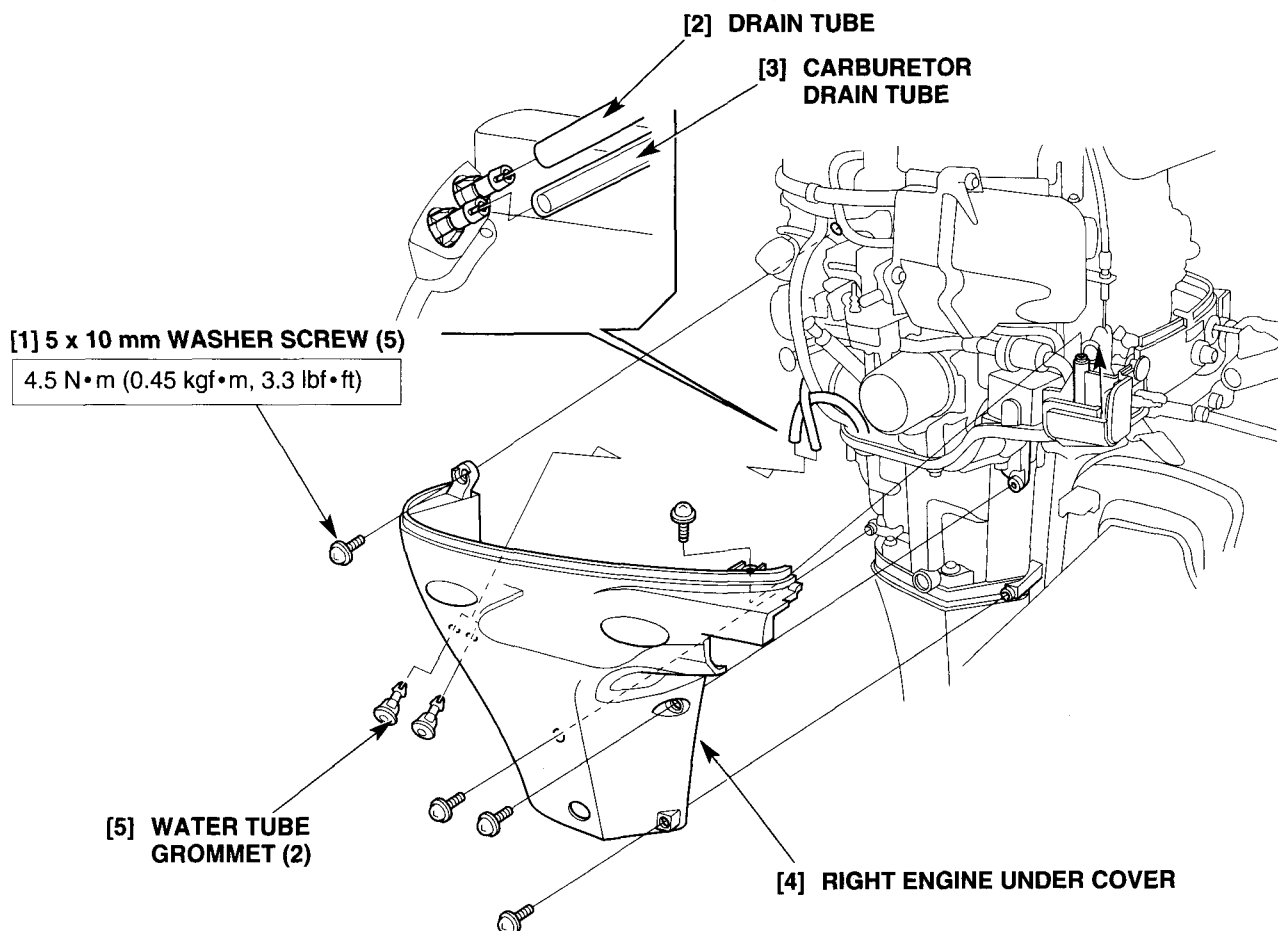
TORQUE: 4.5 N·m (0.45 kgf·ft, 3.3 lbf·ft)
- 3) Reinstall the cover latch and engine cover (P. 5-1).



3. RIGHT ENGINE UNDER COVER

a. REMOVAL

- 1) Remove the engine cover and cover latch (P. 5-1).
- 2) Remove the five 5 x 10 mm washer screws.
- 3) Pull off the engine under cover from the boss of the oil case at the front of the outboard motor and disconnect the drain tube from the water tube grommet, then remove the left engine under cover.

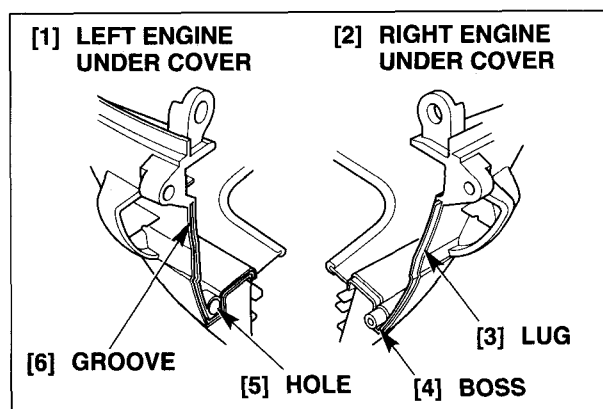


b. INSTALLATION

- 1) Connect the drain tubes to the water tube grommet.
- 2) Install the right engine under cover.
 - At the front side; align the hole of the right engine under cover to the boss of the oil case
 - At the rear side; align the lug of the right engine under cover with the grooves of the left engine under cover and the boss with the hole.
- 3) Tighten the washer screws securely.

TORQUE: 4.5 N·m (0.45 kgf·ft, 3.3 lbf·ft)

- 4) Reinstall the cover latch and engine cover (P. 5-1).



6. FUEL SYSTEM

BF15D-BF20D

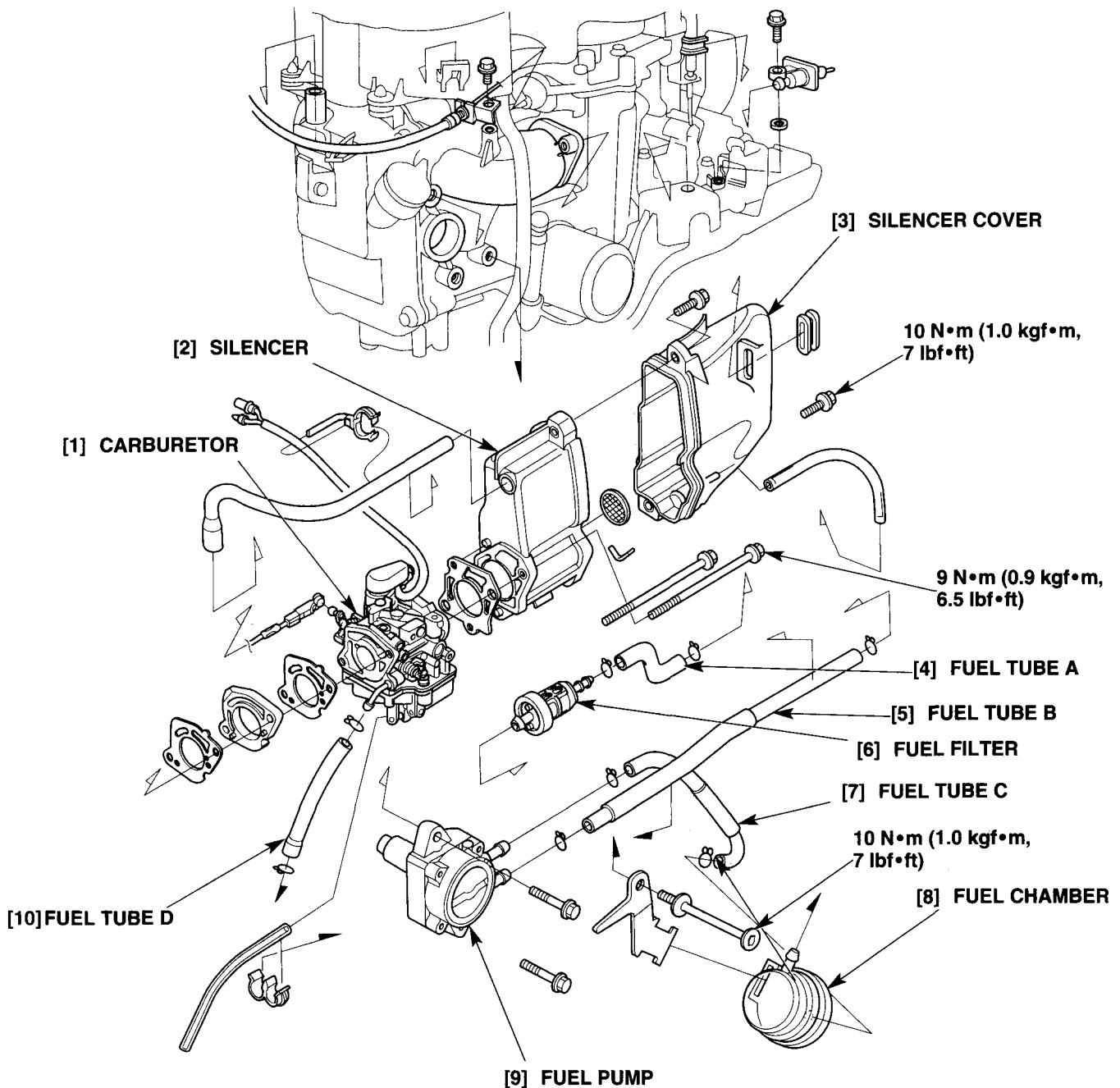
- 1. SILENCER/CARBURETOR
- 2. CHOKE CABLE

- 3. FUEL PUMP/FUEL FILTER
- 4. FUEL TANK

⚠ WARNING

Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.



1. SILENCER/CARBURETOR

a. REMOVAL

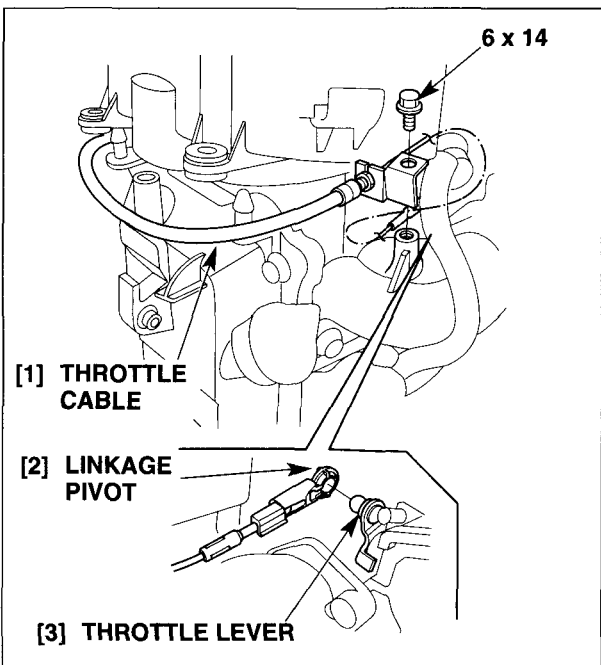
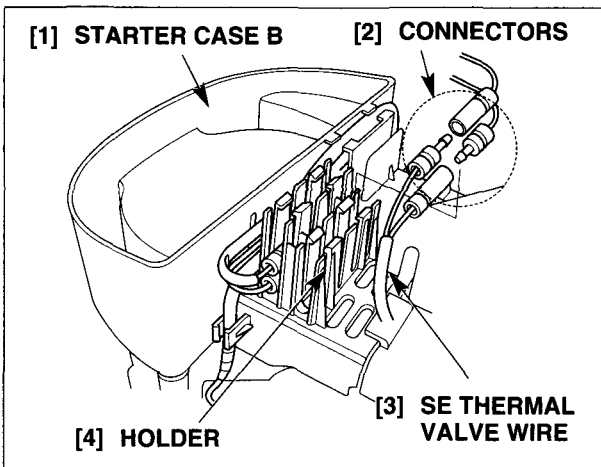
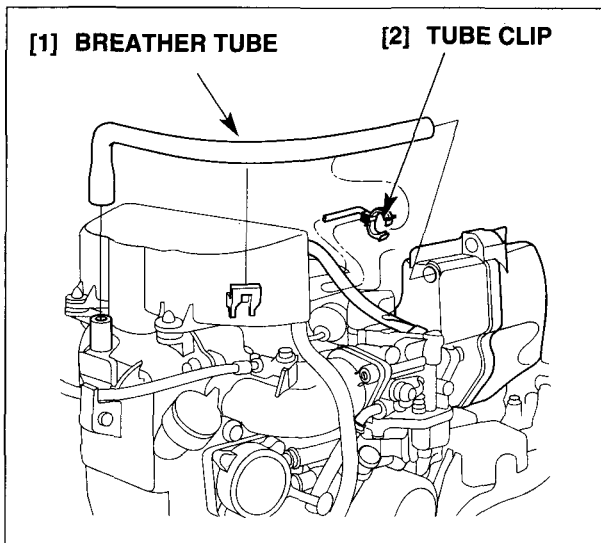
Before removal, drain the gasoline to a suitable container from the carburetor by loosening the drain screw.

▲ WARNING

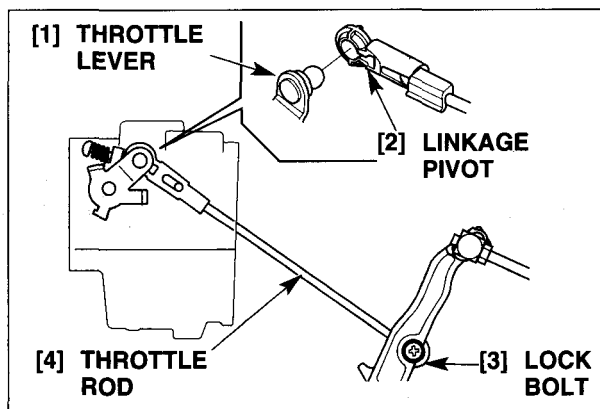
Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**

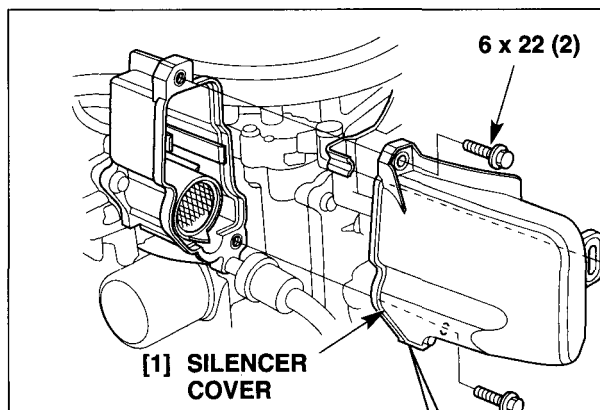
- 1) Remove the engine cover and right engine under cover (P. 5-3).
- 2) Open the tube clip (Electric starter type only) and disconnect the crankcase breather tube from the silencer.
 - Check the breather tube for deterioration, cracks or other damage. Clean or replace if necessary.
- 3) Disconnect the SE thermal valve wire connectors and remove the wire from the holders on the starter case B (Electrical starter type).
- 4) Disconnect the drain tube from the starter case B.
- 5) Remove the 6 x 14 mm flange bolt and remove the throttle cable holder, and then disconnect the throttle cable pivot linkage from the throttle lever (Tiller handle type).



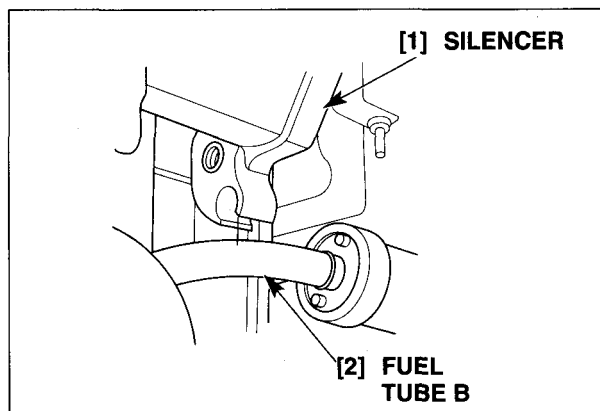
- 6) Loosen the throttle rod lock bolt and disconnect the linkage pivot from the carburetor throttle lever (Remote control type).



- 7) Remove the two 6 x 22 mm flange bolts and silencer cover.

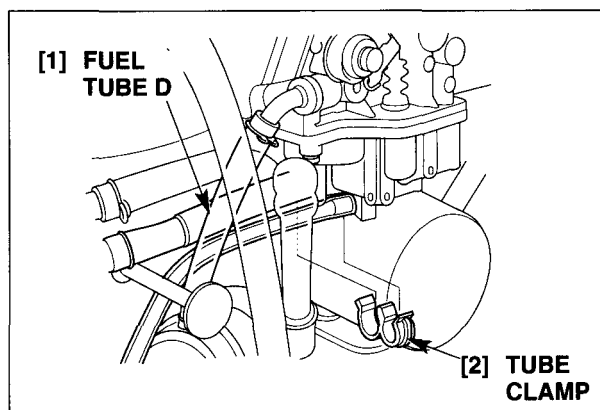


- 8) Remove the fuel tube B from the hook of the silencer.



- 9) Disconnect the fuel tube D from the carburetor.

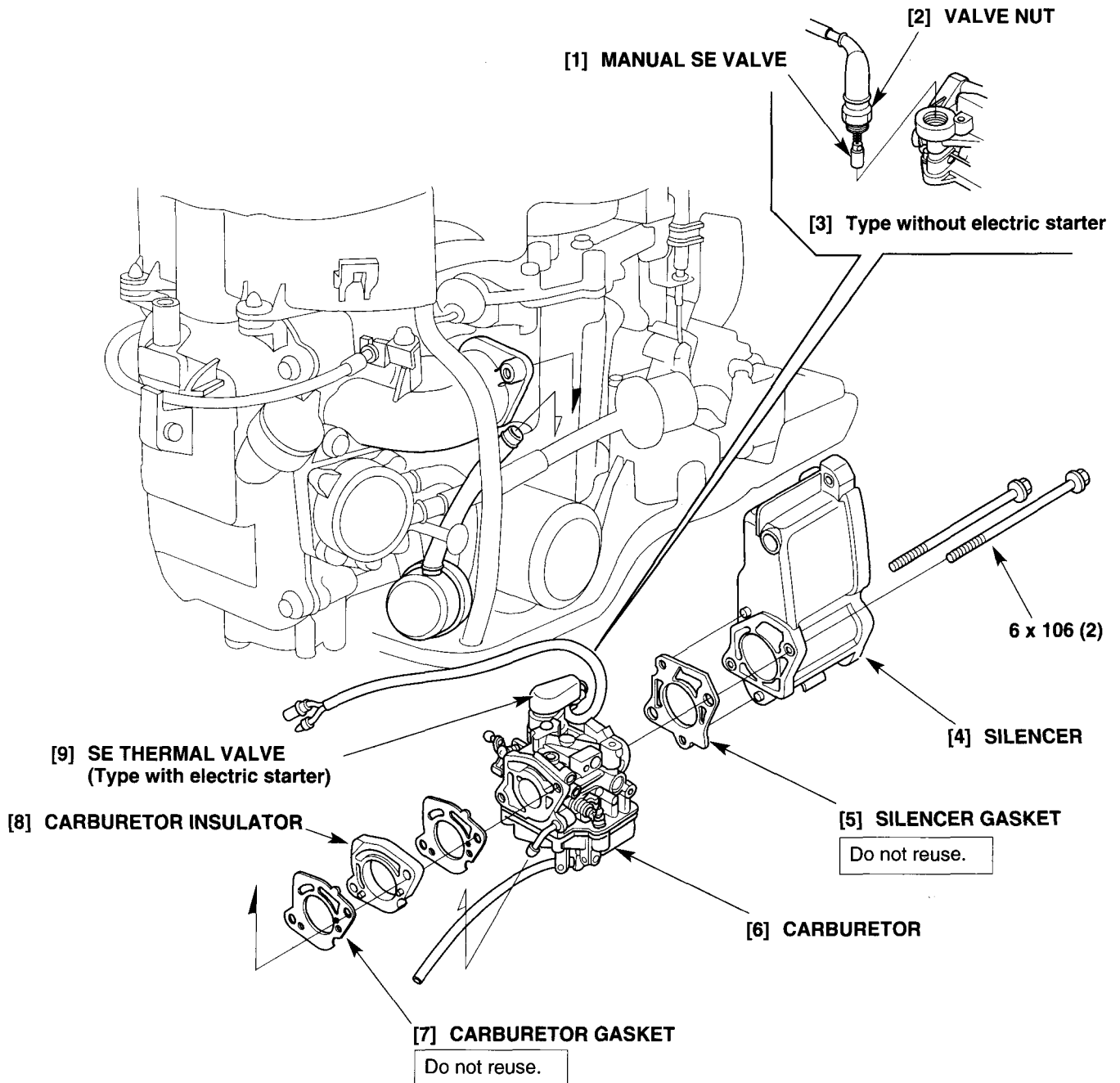
- 10) Remove the tube clamp.



11) Remove the two 6 x 106 mm flange bolts, silencer, carburetor, gasket and carburetor insulators.

- Replace the carburetor gasket and insulator gaskets with new ones when disassembly. Do not reuse.

12) Loosen the valve nut and remove the manual SE valve (Type without electric starter).



b. CARBURETOR DISASSEMBLY

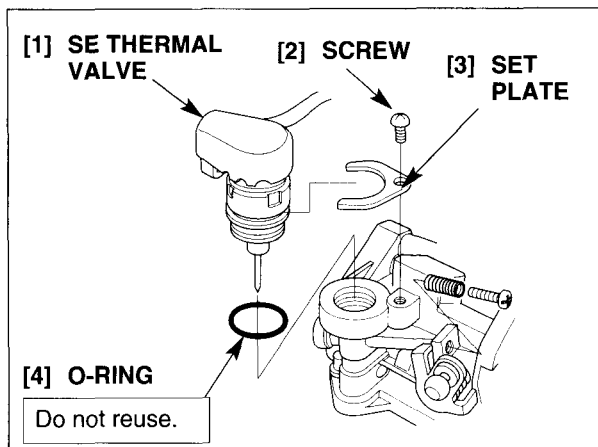
- Before disassembly, completely drain the carburetor by loosening the drain screw. Clean the outside of the carburetor before disassembly.

⚠ WARNING

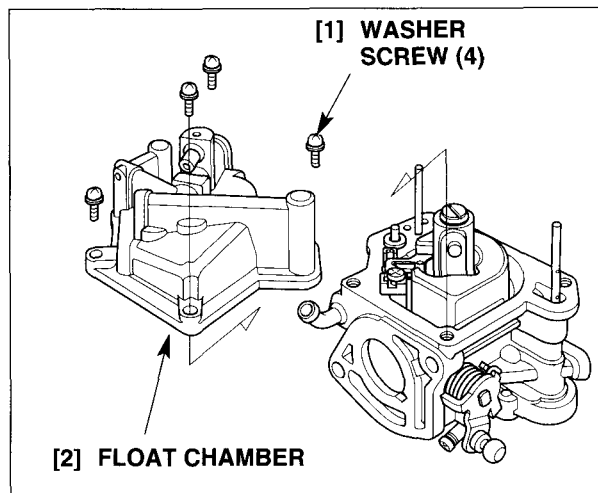
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.

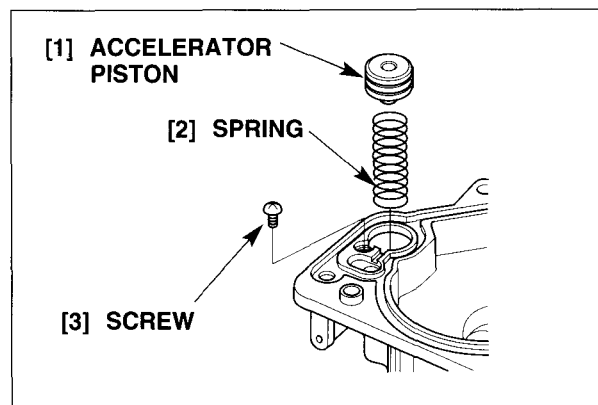
- 1) Remove the screw and set plate, then remove the auto SE thermal valve and O-ring (Type with electric starter).



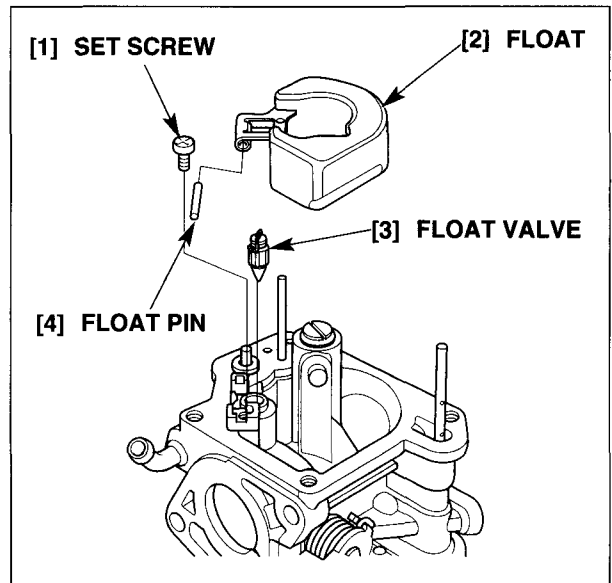
- 2) Remove the drain tube from the float chamber.
- 3) Remove the four washer screws and remove the float chamber and O-ring.



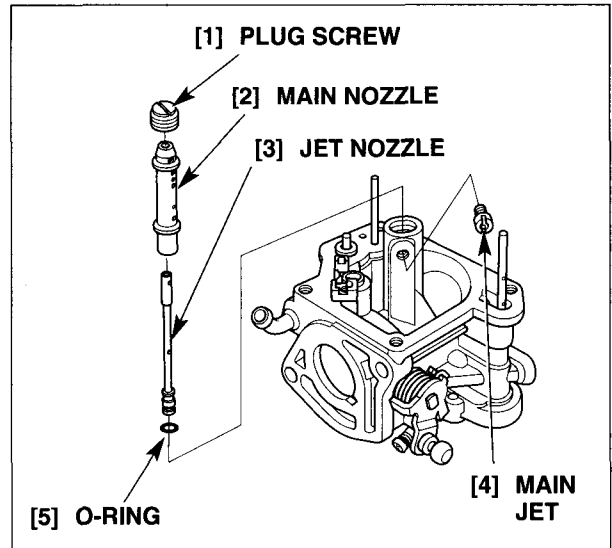
- 4) Remove the set screw and remove the accelerator piston and spring.



- 5) Remove the set screw, then pull out the float pin and remove the float and float valve.



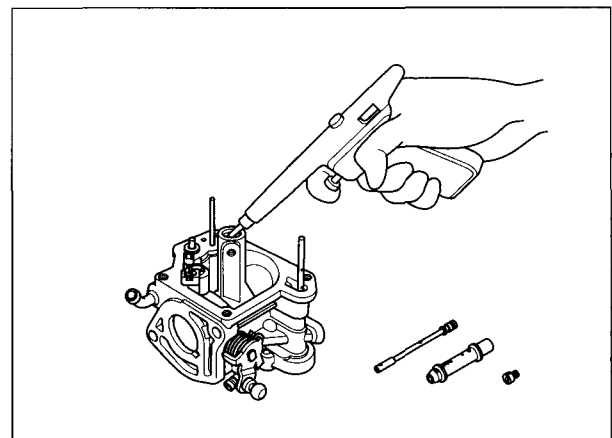
- 6) Remove the main jet with care not to damage the main jet.
- 7) Remove the plug screw, main nozzle and jet nozzle taking care not to damage them.



c. CLEANING

NOTICE

- Some commercially available chemical cleaners are caustic. These cleaner may damage plastic parts such as O-rings, float and float valve. Check the container for instructions. If you are in doubt, do not use these products to clean carburetor.
 - High air pressure may damage the carburetor. Use low pressure setting when cleaning the passages and parts.
- 1) Clean the carburetor body, removed parts and float chamber with cleaning solvent.
 - 2) Use low air pressure and blow off the removed jets, nozzles and passages of the carburetor body and float chamber.



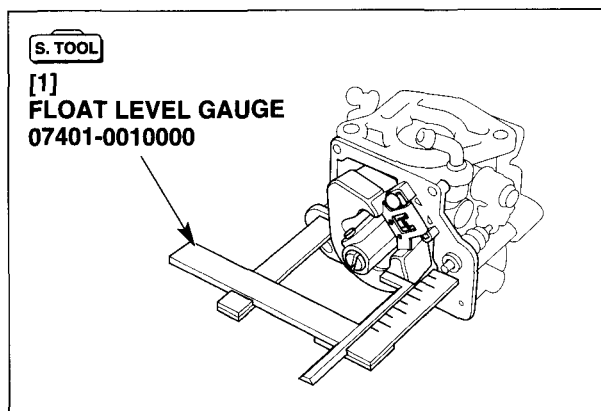
d. INSPECTION

• FLOAT LEVEL HEIGHT

Place the carburetor in the position as shown and measure the distance between the float top and carburetor body when the float just contacts the seat without compressing the valve spring.

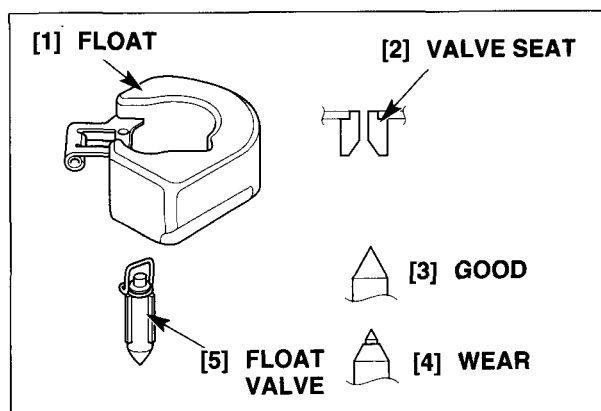
Standard float height	13.7 mm (0.54 in)
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If the height is out of specification, adjust the float height by bending the float mounting tab carefully.



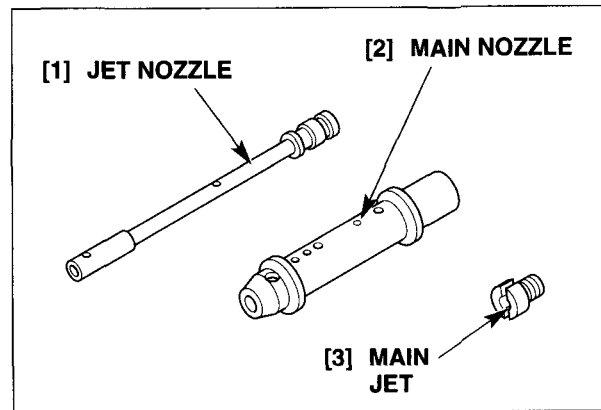
• FLOAT /FLOAT VALVE/FLOAT VALVE SEAT

- 1) Check the float for crack or damage. Replace if necessary.
- 2) Check the float valve for wear or damage, replace if necessary.



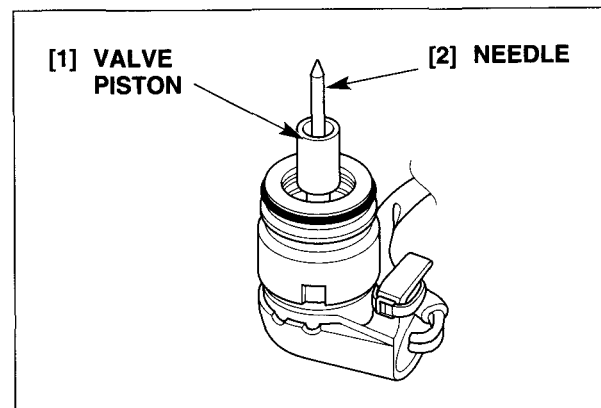
• NOZZLES/JETS

Check the main jet, main nozzle jet nozzle for clogged or damage. Replace if necessary.



• SE THERMAL VALVE

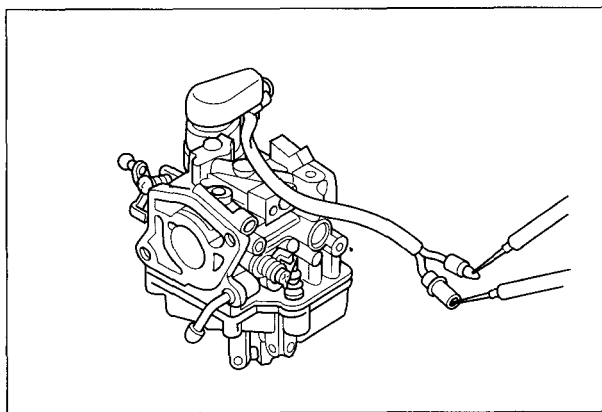
- 1) Check the valve piston and needle for wear or scratch. replace as assembly, if necessary.



2) Measure the resistance between the terminals

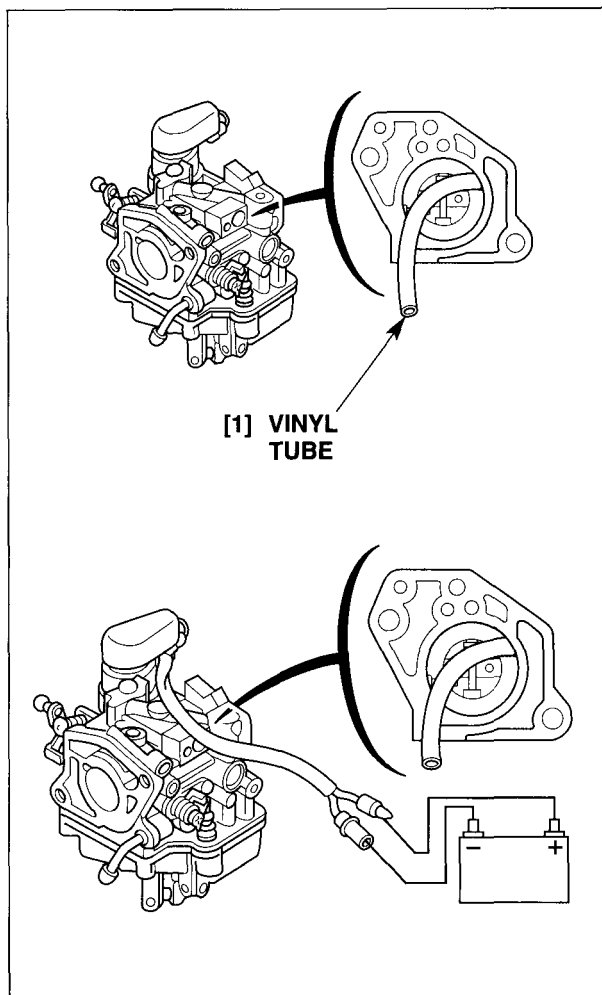
- This test can be made with the carburetor installed on the motor.

Resistance	15.8 - 24.2 Ω
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3) Install a vinyl tube as shown.

- 4) At room temperature, make sure that breath should be passed through passage.
- 5) Connect the 12V battery positive terminal to the Brown/white terminal and negative to Black/green terminal for about five minutes. Then check that breath should not be passed through.



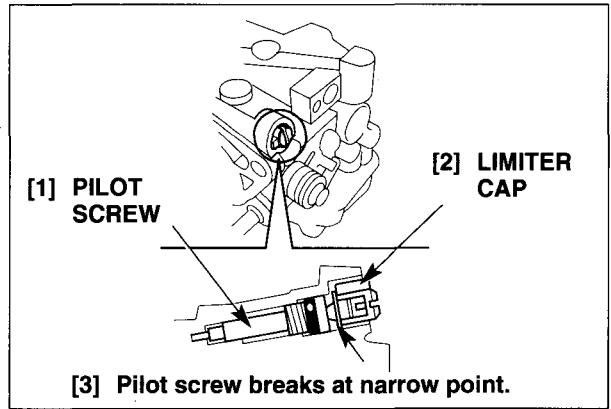
e. PILOT SCREW

• Canadian model only:

Leave the pilot screw and limiter cap in place during carburetor cleaning. Remove only if necessary for carburetor repair.

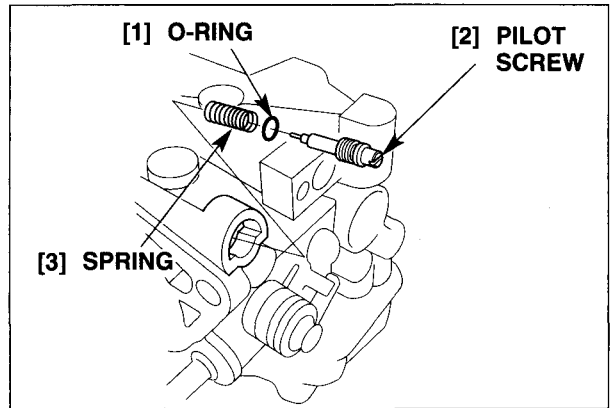
Removal of the limiter cap requires breaking the pilot screw. A new pilot screw and limiter cap must be installed.

1) When the limiter cap has been broken off, remove the broken pilot screw.



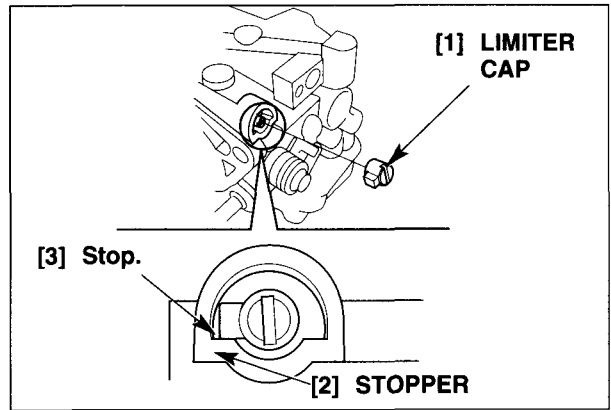
2) Place a new O-ring on the replacement pilot screw, and install the spring and pilot screw on the carburetor.

3) Turn the pilot screw in until it is fully seated, then turn the screw out the required number of turns.



Pilot screw opening	BF15D	2-1/4 turns out
	BF20D	2-1/8 turns out

4) Apply LOCTITE ® 638 to the inside of the limiter cap, then install the cap so its stop prevents the pilot screw from being turned counterclockwise.



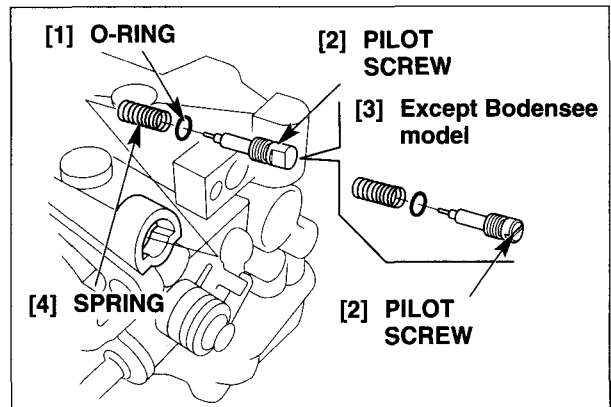
Be careful to avoid turning the pilot screw while installing the limiter cap. The pilot screw must stay at its require setting.

• Except Canadian model:

• Do not remove the pilot screw except for cleaning.

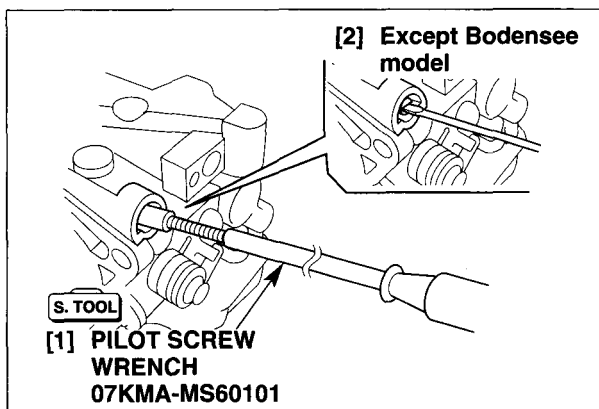
1) If the pilot screw has been removed to clean the carburetor body.

2) Place a new O-ring on the replacement pilot screw, and install the spring and pilot screw on the carburetor.

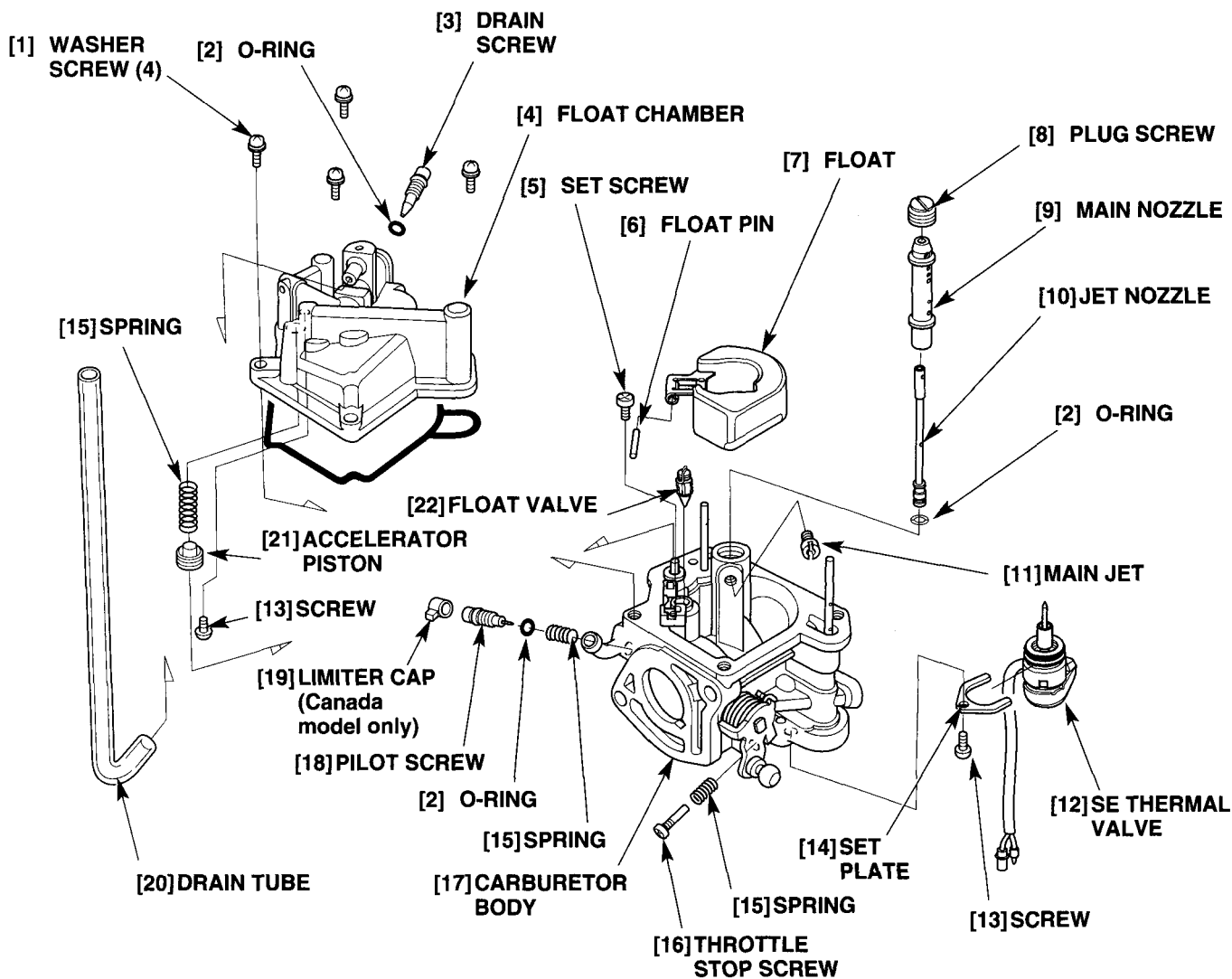


3) Turn the pilot screw in until it is fully seated, then turn the screw out the required number of turns.

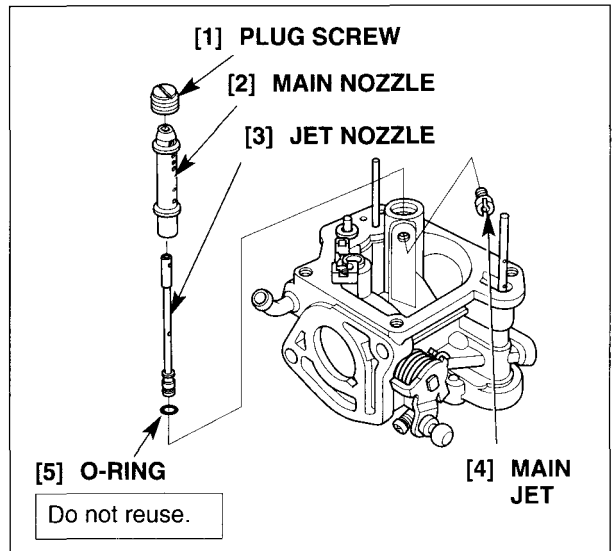
Pilot screw opening	BF15D	2-1/4 turns out
	BF20D	2-1/8 turns out



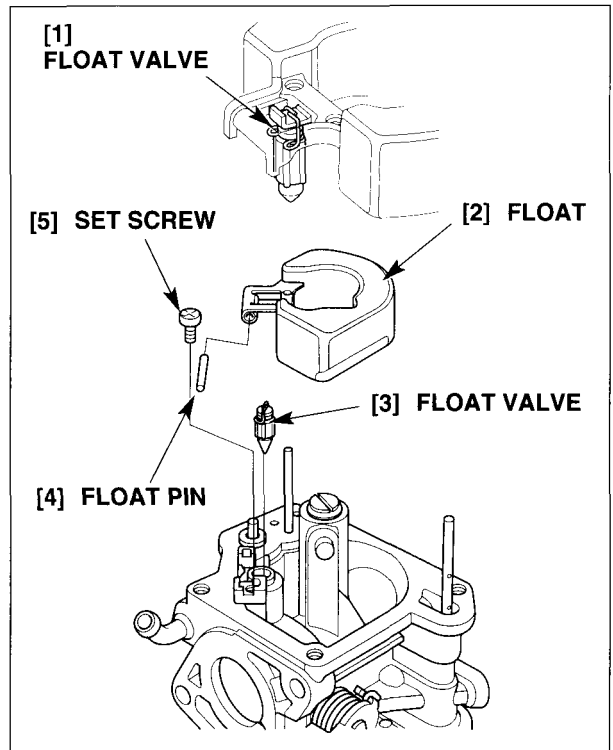
f. CARBURETOR ASSEMBLY



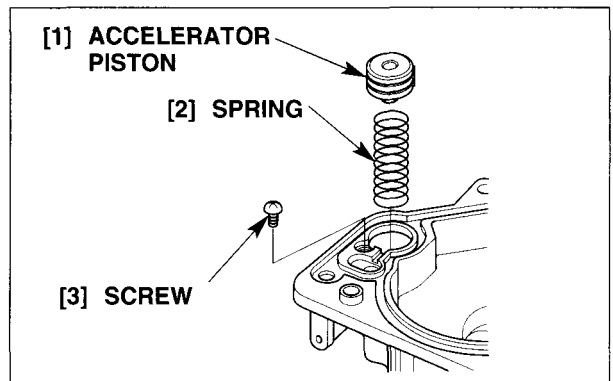
- 1) Install a new O-ring to the jet nozzle.
- 2) Install the jet nozzle, main nozzle and secure them with the plug screw.
- 3) Install the main jet.
 - Take care not damage the jet and nozzle when handling them.



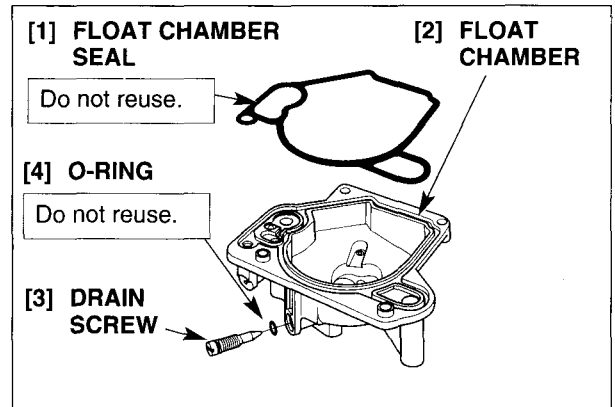
- 4) Install the float valve to the float tab as shown.
- 5) Insert the float pin to the float and set them onto the carburetor body and secure them with the set screw.



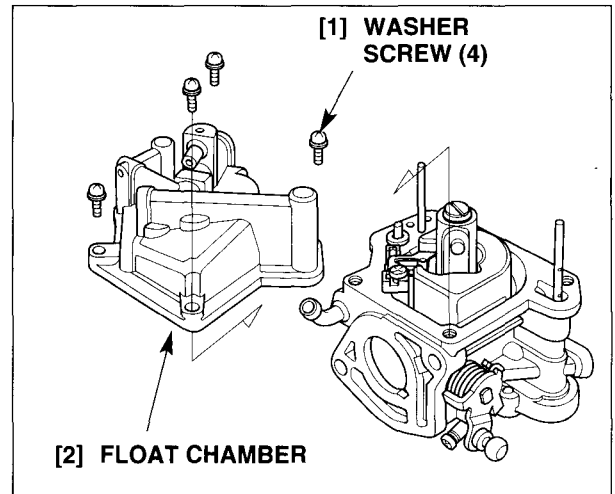
- 6) Install the spring and accelerator piston and secure the piston with the set screw.



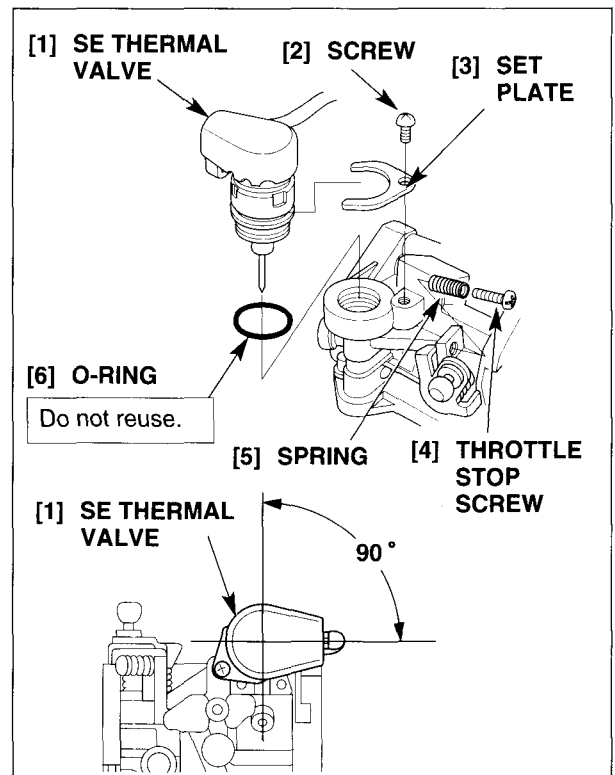
- 7) Install a new O-ring to the drain screw and install the drain screw to the float chamber.
- 8) Install a new O-ring (float chamber seal) onto the float chamber.



- 9) Install the float chamber to the carburetor body and tighten the four washer screws securely.

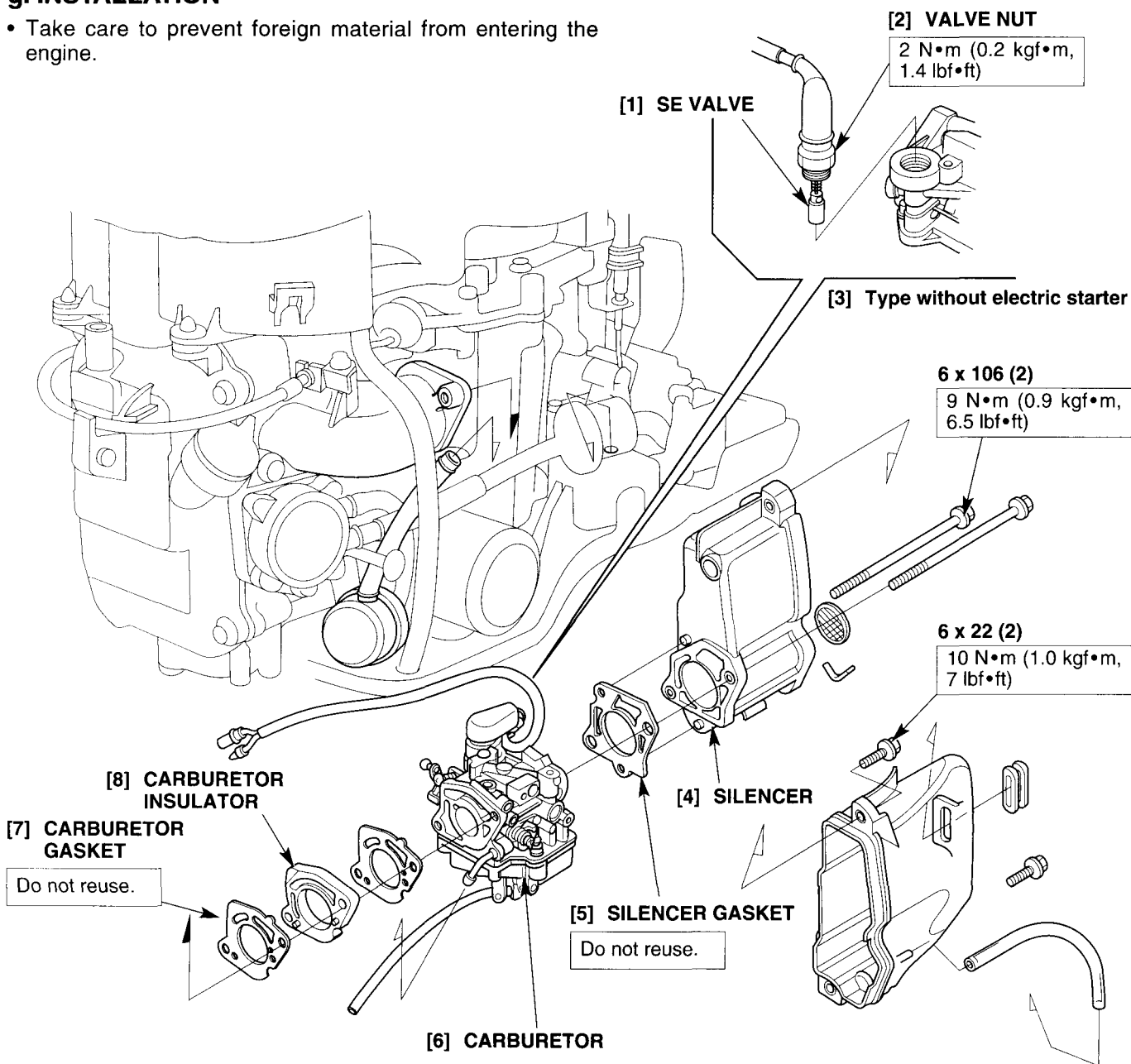


- 10) Install the throttle stop screw and spring.
- 11) Install a new O-ring to the SE thermal valve and install the SE thermal valve with the setting plate and loosely install the setting screw.
- 12) Set the SE thermal valve as shown noting the direction and tighten the set screw securely.



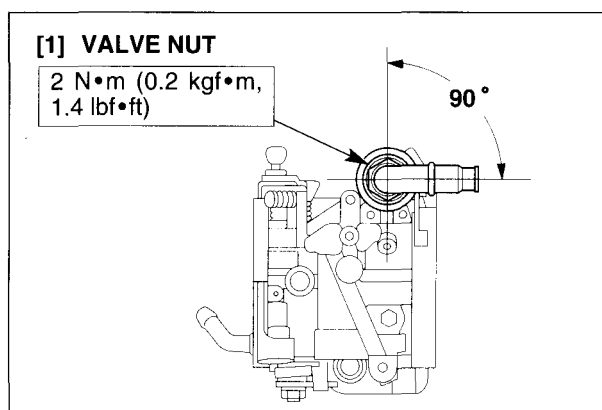
g. INSTALLATION

- Take care to prevent foreign material from entering the engine.



- 1) Install the SE valve noting the direction, and secure the valve nut (Type without electric starter).

TORQUE: 2 N·m (0.2 kgf m, 1.4 lbf ft)

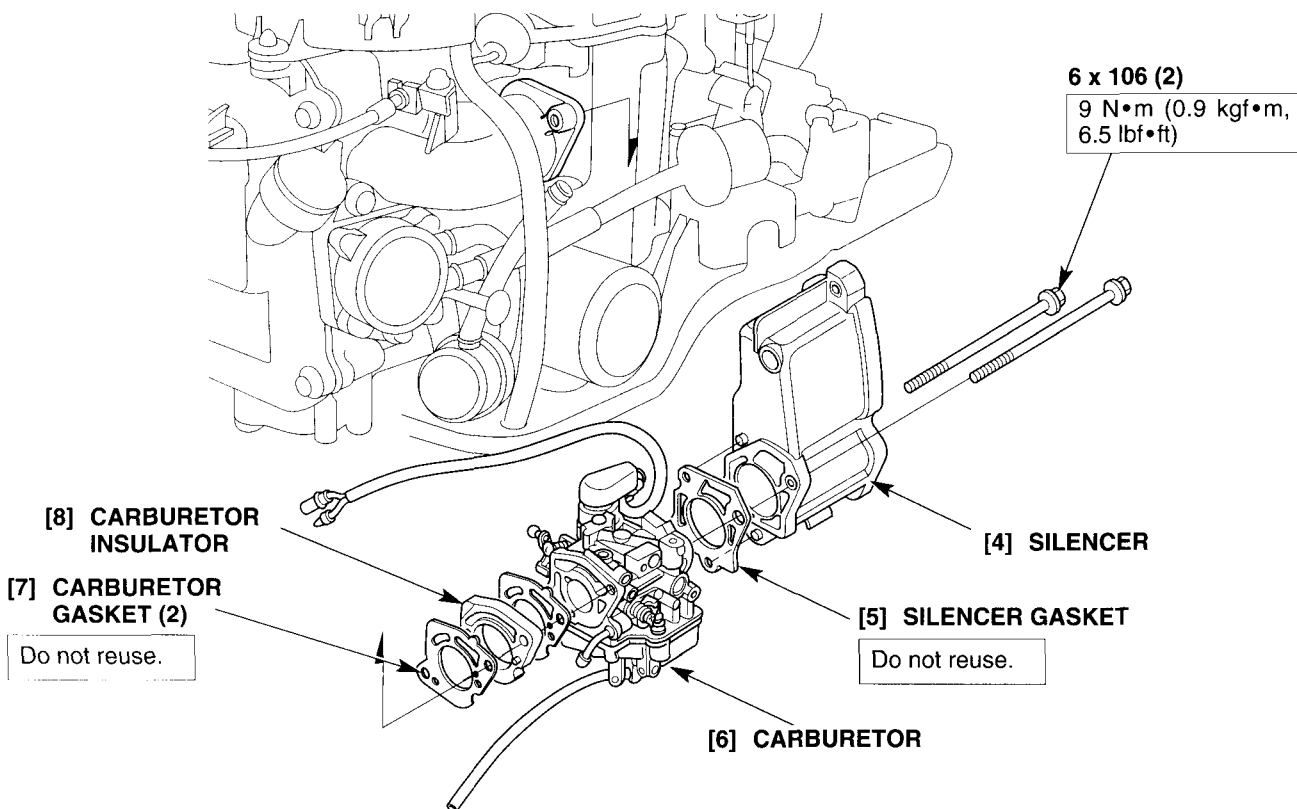
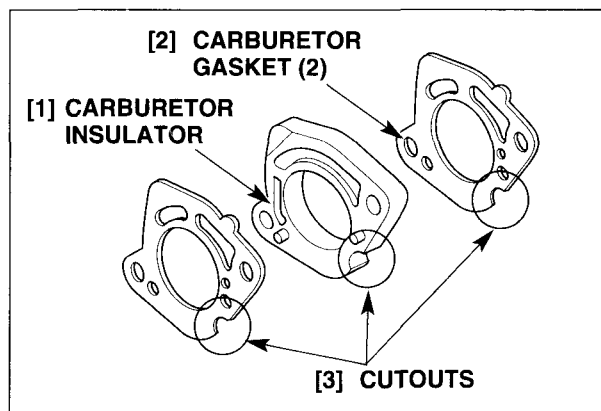


- 2) Install the carburetor, silencer, carburetor insulator, new carburetor gaskets and a silencer gasket.

Align the cutouts of the carburetor insulator and carburetor gaskets.

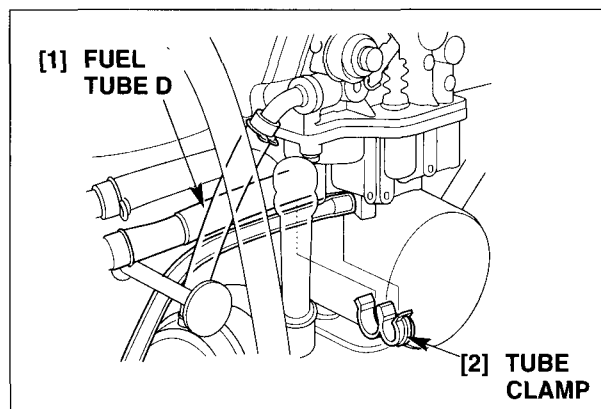
- 3) Tighten the two 6 x 106 mm flange bolt to the specified torque.

TORQUE: 9 N m (0.9 kgf m, 7 lbf•ft)

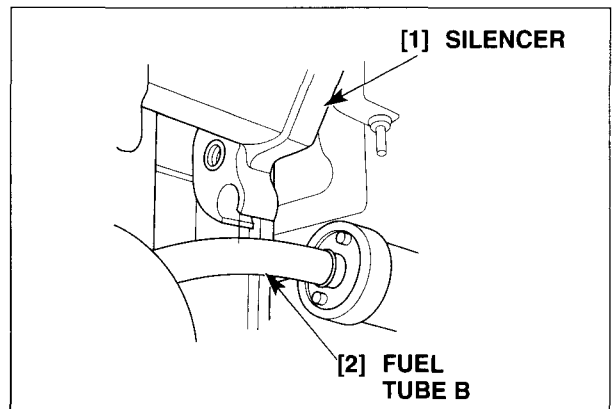


- 4) Connect the fuel tube to the carburetor.

- 5) Set the tube clamp.



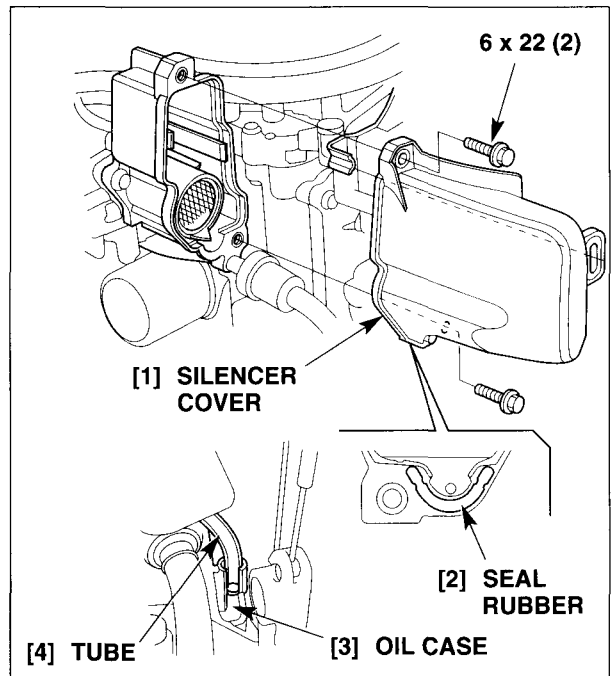
6) Clump the fuel tube to the hook of the silencer cover.



7) Install the seal rubber to the silencer cover as shown. Install the silencer cover to the silencer and tighten the 6 x 22 mm flange bolts to the specified torque.

TORQUE: 9 N·m (0.9 kgf·m, 7 lbf·ft)

8) Insert the tube end to the recess on the oil case as shown.

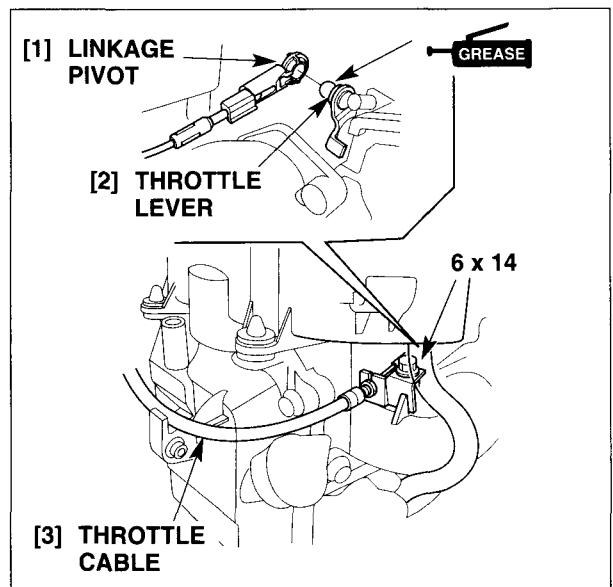


9) Connect the linkage pivot to the carburetor throttle lever.

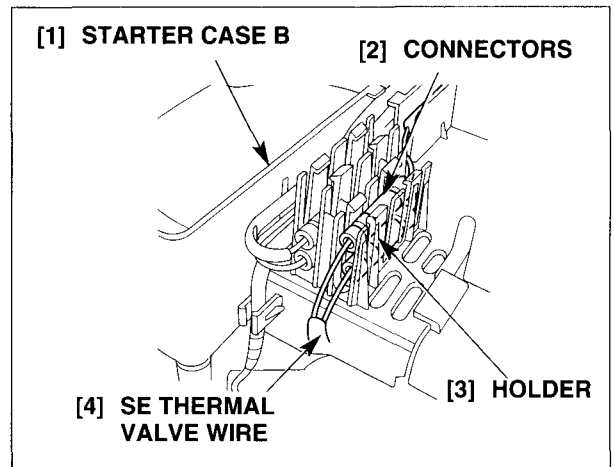
10) Install the throttle cable stay with the 6 x 14 mm flange bolt (Tiller handle type). After installation, adjust the throttle linkage (P. 3-13).

11) Connect the tube to the tube join of the starter case B, and set the starter case B securely by setting the grommets to the bosses of the cylinder head cover.

12) Connect the throttle control cable to the throttle arm (Remote control type). After installation, adjust the throttle linkage (P. 3-14).



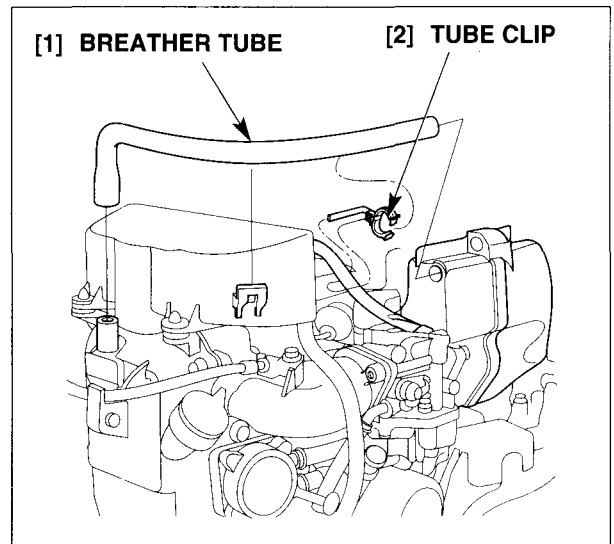
13) Connect the SE thermal valve wire connectors and secure the wires with the clamp on the starter case B (Electric starter type).



14) Install the breather tube between the silencer and cylinder head cover.

15) Clump the tube with the 13 mm tube clip (electric starter type).

16) Reinstall the right engine under cover (P. 5-2, 3) and engine cover.



2. CHOKE CABLE

(Type Without electric starter type)

- Take care to prevent foreign material from entering the carburetor.

a. DISASSEMBLY

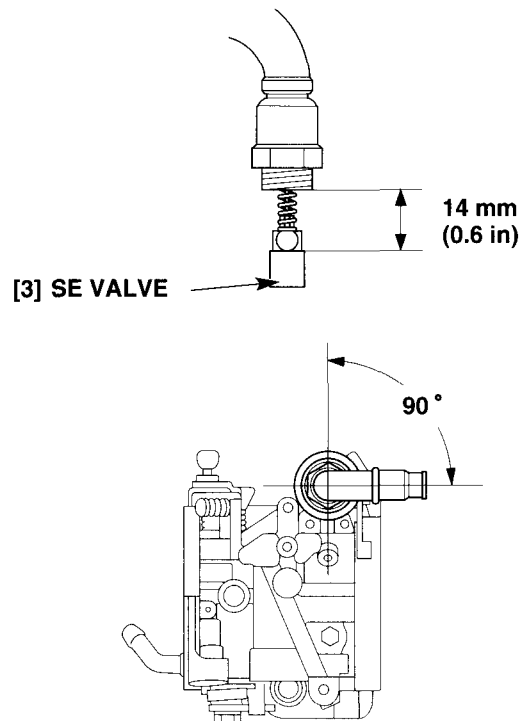
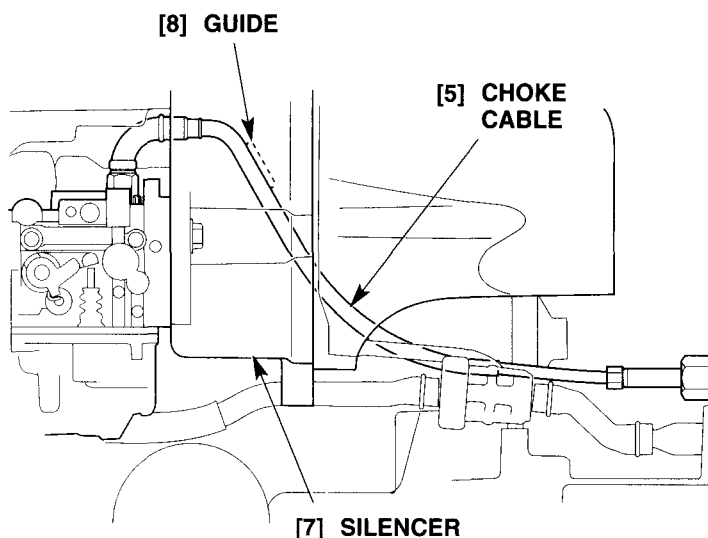
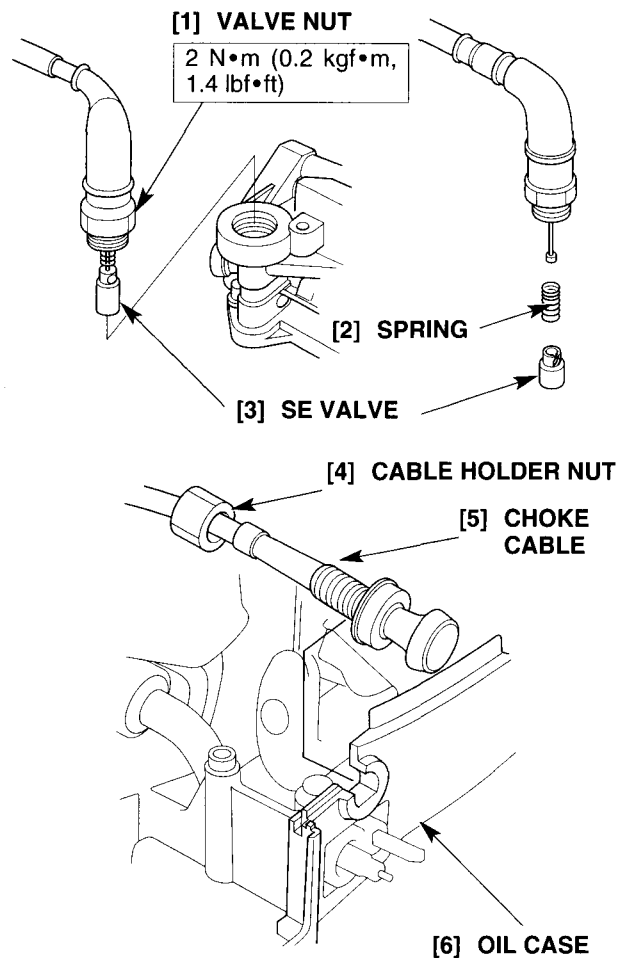
- 1) Remove the engine cover and right engine under cover (P. 5-2).
- 2) Remove the recoil starter (P. 7-2).
- 3) Loosen the valve nut, then disconnect the SE valve from the carburetor
- 4) Remove the SE valve and spring.
- 5) Loosen the cable nut and remove the choke cable from the oil case.

b. INSPECTION

Check the distance from the end of the valve nut to the stopped surface of the SE valve. It should be 14 mm (0.6 in).

c. REASSEMBLY

- 1) Completely loosen the cable holder nut and install the choke cable onto the oil case.
- 2) Secure the choke cable by tightening the cable holder nut.
- 3) Install the spring and SE valve.
- 4) Route the choke cable as shown below.
- 5) Install the SE valve to the carburetor and loosely tighten the valve nut. Adjust the cable direction as shown and tighten the valve nut securely.



3. FUEL PUMP/FUEL FILTER

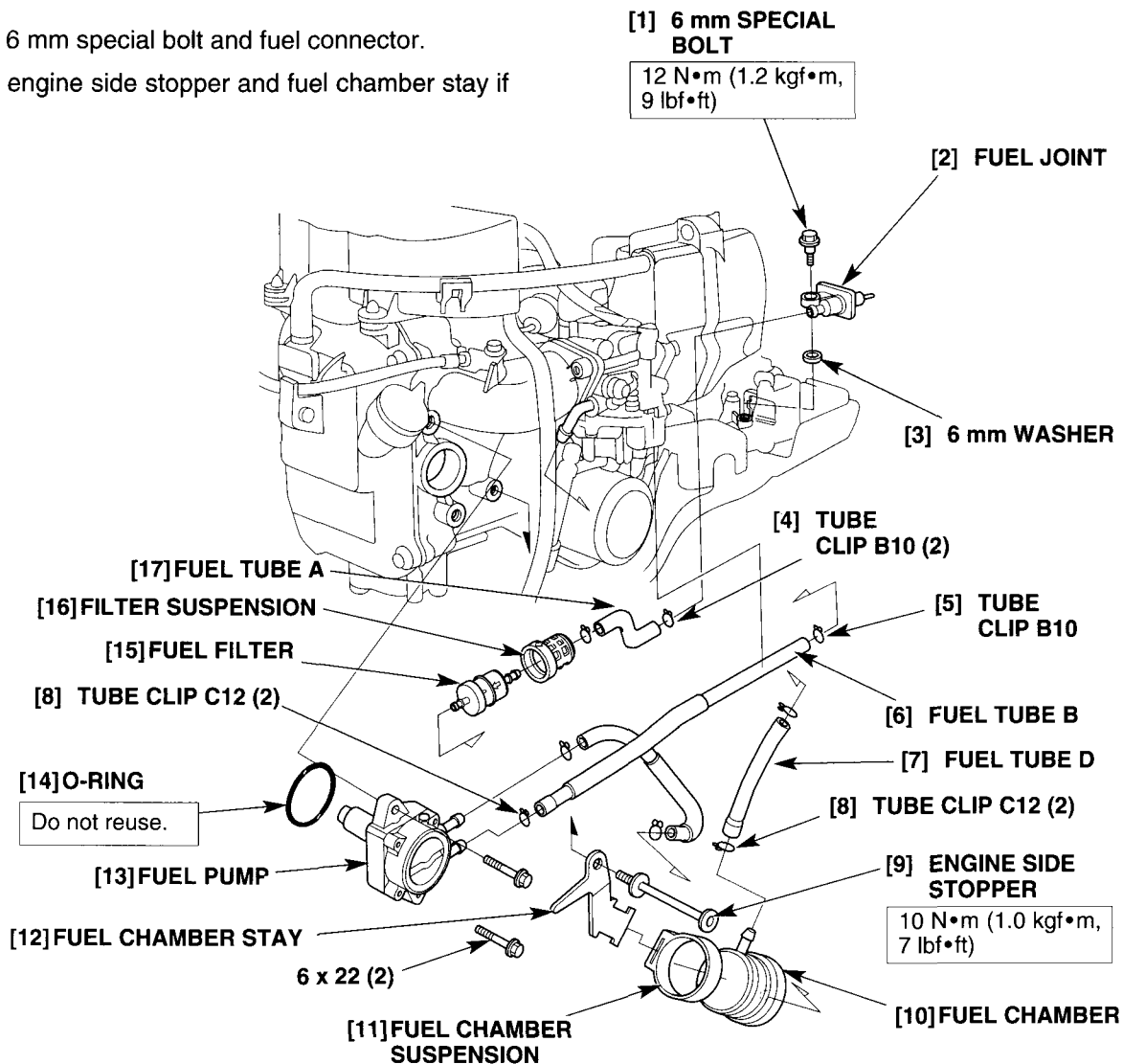
a. REMOVAL

▲ WARNING

Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.

- 1) Remove the engine cover and right engine under cover (P. 5-2).
- 2) Slide the tube clips and disconnect the fuel tubes
 - Wipe up the spilled gasoline immediately.
- 3) Remove the two 6 x 22 mm flange bolts and fuel pump.
 - Take care to prevent foreign material from entering the engine.
- 4) Remove the 6 mm special bolt and fuel connector.
- 5) Remove the engine side stopper and fuel chamber stay if necessary.



b. INSPECTION

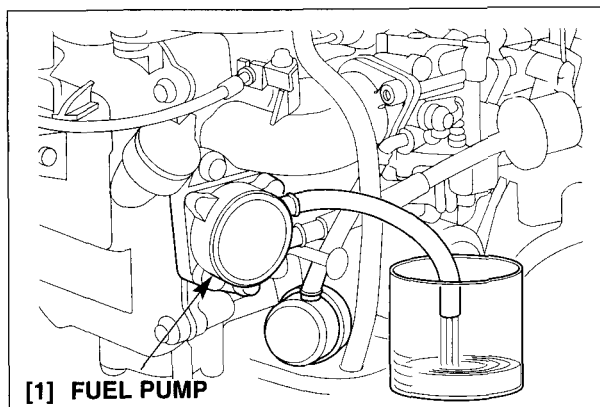
• FUEL PUMP

⚠ WARNING

Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.

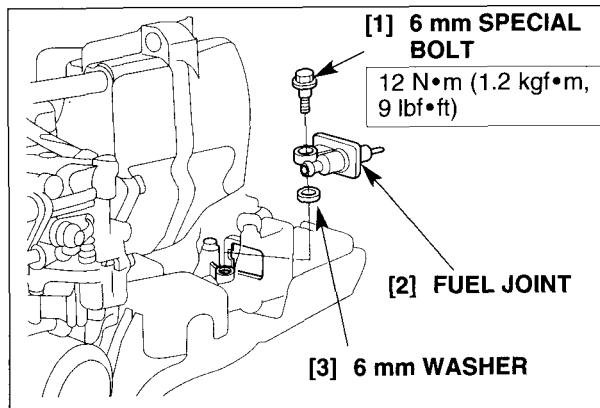
- 1) Remove the spark plugs from the No. 1 and 2 cylinder.
- 2) Connect the fuel tube from the fuel tank to the fuel connector.
- 3) Disconnect the fuel tube C from the fuel chamber.
- 4) Squeeze the primer bulb until the fuel reaches to the fuel pump.
 - Receive the flowing fuel with suitable container.
- 5) Turn the camshaft by operating the recoil starter several times (without electric starter type) or starter motor several seconds (with electric starter type), and check for fuel flow.
- 6) After inspection, reconnect the fuel tube C to the fuel chamber and make sure that there is no fuel leak.



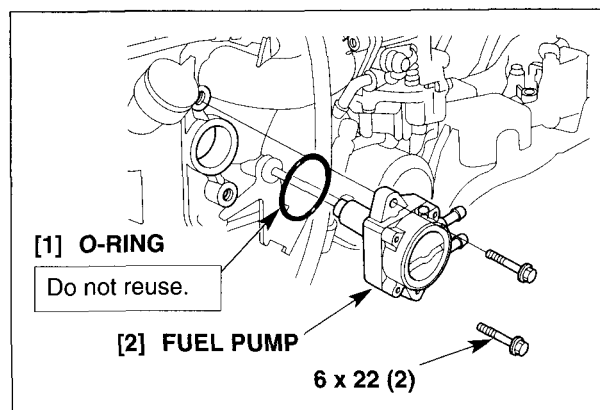
c. INSTALLATION

- Before installation check the fuel tubes for deterioration, cracks, and other damage. Replace if necessary.

- 1) Install the fuel connector using the 6 mm special bolt and 6 mm washer.

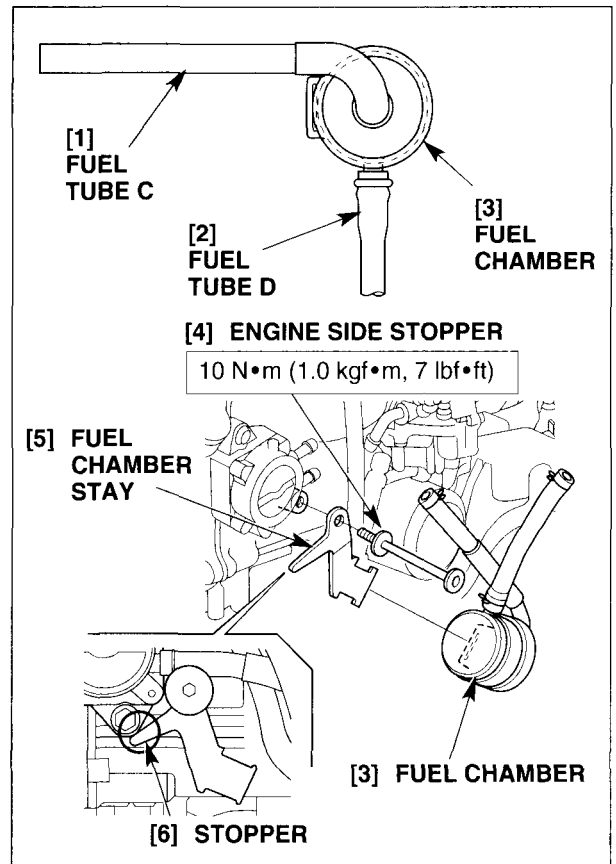


- 2) Apply oil to a new O-ring and install it to the fuel pump.
- 3) Install the fuel pump with the tube joints facing the carburetor side and tighten the 6 x 22 mm flange bolts securely.

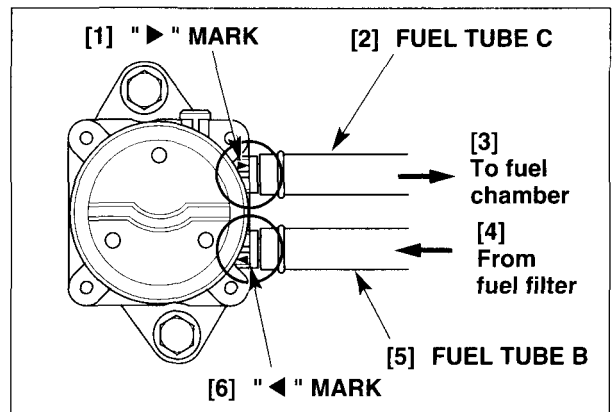


- 4) Connect the fuel tube C and D to the fuel chamber as shown and secure them with the tube clips.
 - Connect the fuel tube C to the fuel chamber with the big side toward fuel chamber side.
- 5) Install the fuel chamber stay with the stopper contact to the fuel pump mounting boss as shown, and tighten the engine side stopper to the specified torque.

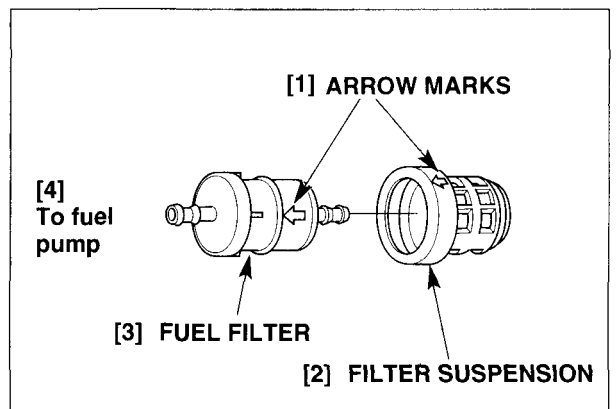
TORQUE: 10 N•m (1.0 kgf•m, 7 lbf•ft)



- 6) Connect the fuel tube B to the lower joint (◀ mark) and fuel tube C to the upper joint (▶ mark).



- 7) Install the fuel filter into the filter suspension so the arrow mark points same direction as shown. Install them so the arrow mark on the filter suspension points toward the fuel pump side.
- 8) After installation, connect the fuel hose connector to the outboard motor. Pump the primer bulb, and make sure that there is no fuel leaks.



4. FUEL TANK

a. DISASSEMBLY/REASSEMBLY

Drain the fuel tank and fuel line completely before disassembly.

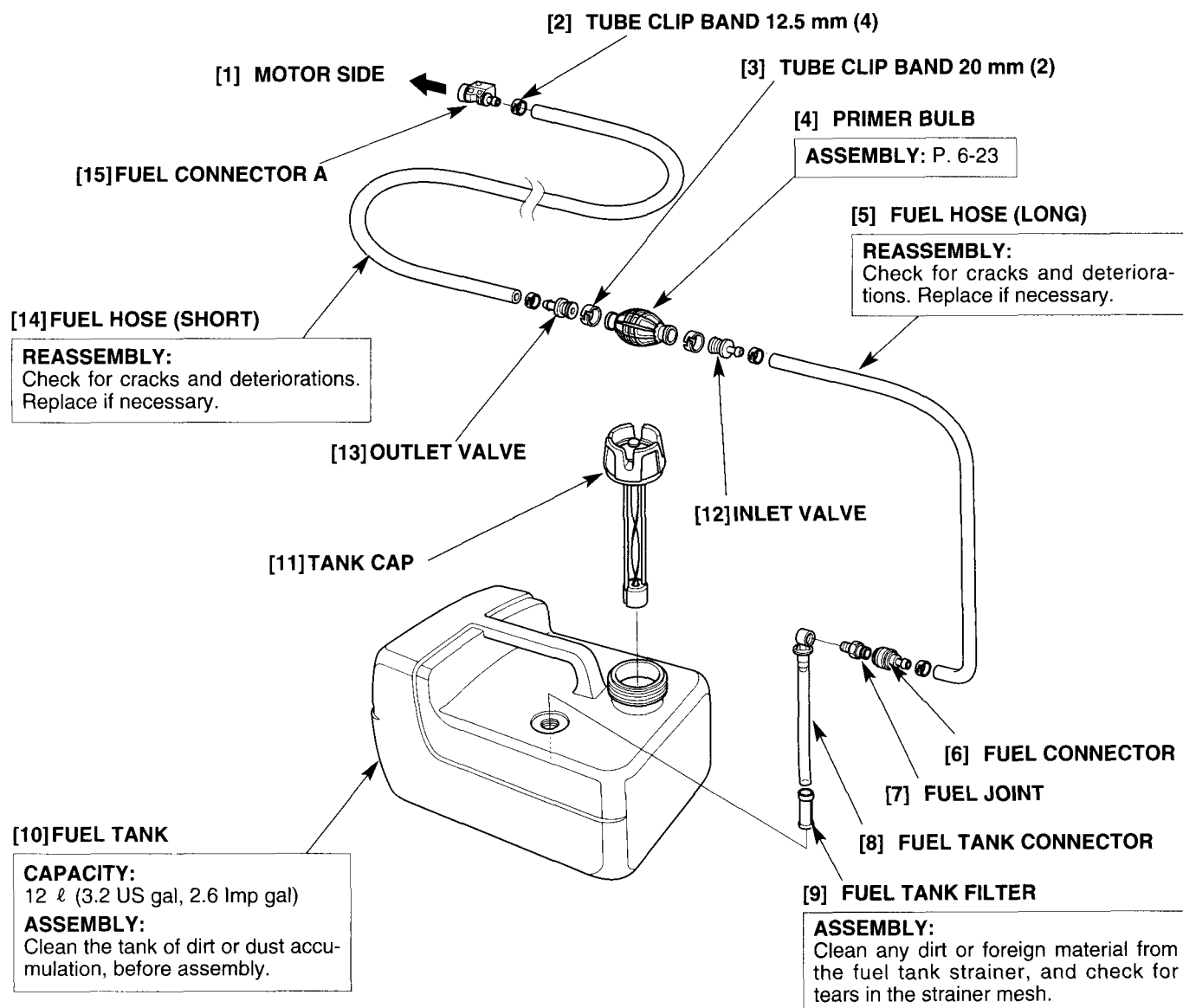
⚠ WARNING

Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

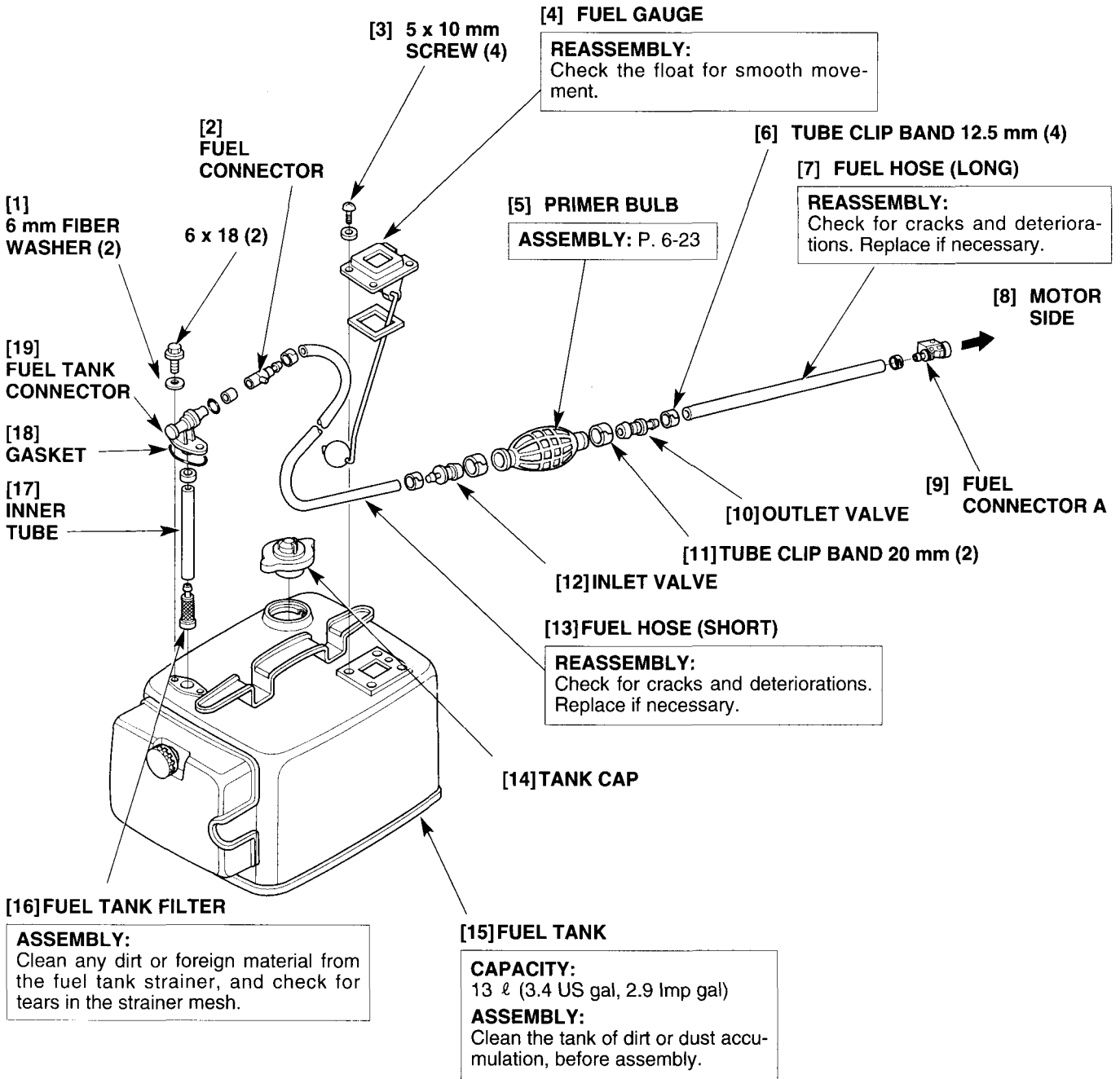
- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.

- Remove any dirt or foreign material from the fuel tank strainer, and check for tears in the strainer mesh. Replace the strainer if necessary.

• Plastic Tank

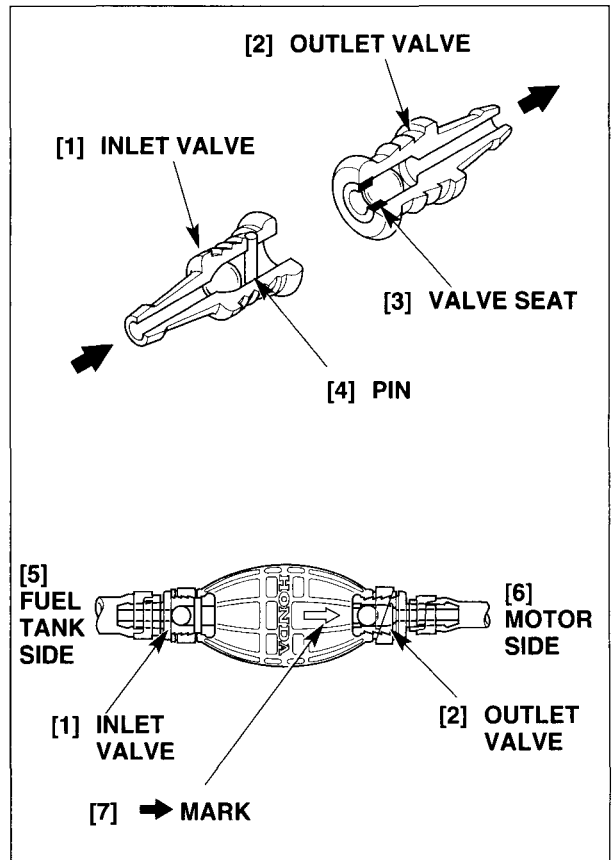


• Steel Tank



• **PRIMER VALVE ASSEMBLY**

- 1) Install the inlet valve (has the pin) at the side marked with "➔" on the priming bulb.
- 2) Install the outlet valve (has the valve seat) at the other side.
 - Do not confuse the inlet valve and the outlet valve.
 - Install the priming bulb with the "➔" mark toward the motor side.



- 1. NEUTRAL START CABLE
- 2. RECOIL STARTER

3. STARTER CASE B

1. NEUTRAL START CABLE

a. REMOVAL

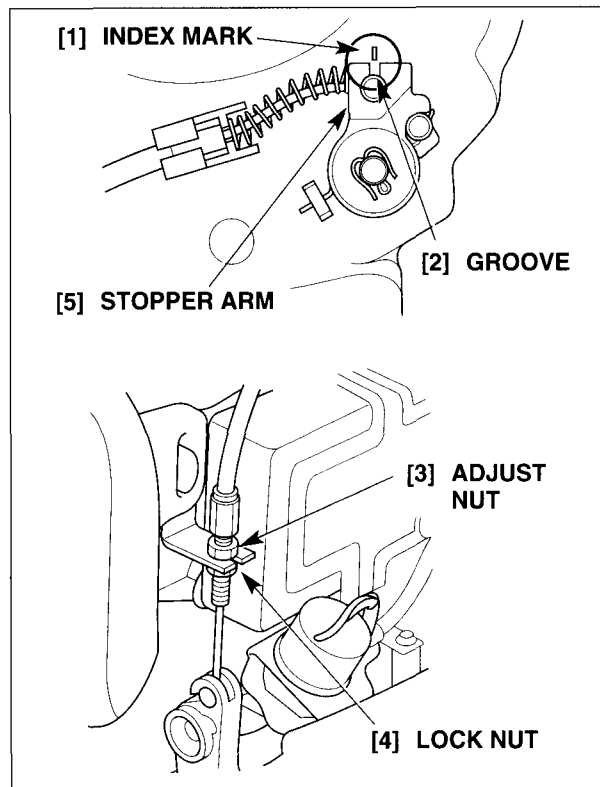
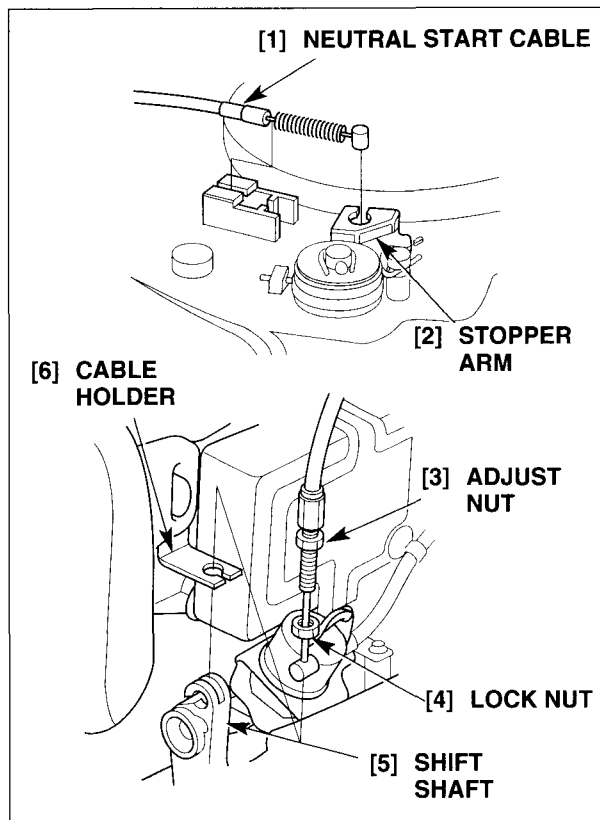
- 1) Remove the engine cover.
- 2) Shift the gear into the neutral position.
- 3) Disconnect the upper cable end from the stopper arm.
- 4) Disconnect the lower cable end from the shift shaft.
- 5) Loosen the lock nut and adjusting nut, then remove the neutral start cable.

b. INSTALLATION

- 1) Make sure the gear in the neutral position.
- 2) Connect the neutral starter cable lower end to the shift shaft.
- 3) Route the cable properly (P. 2-28) and set the cable outer end to the recoil starter case, then connect the cable upper end to the stopper arm.
- 4) Adjust the neutral start cable as follows.

c. ADJUSTMENT

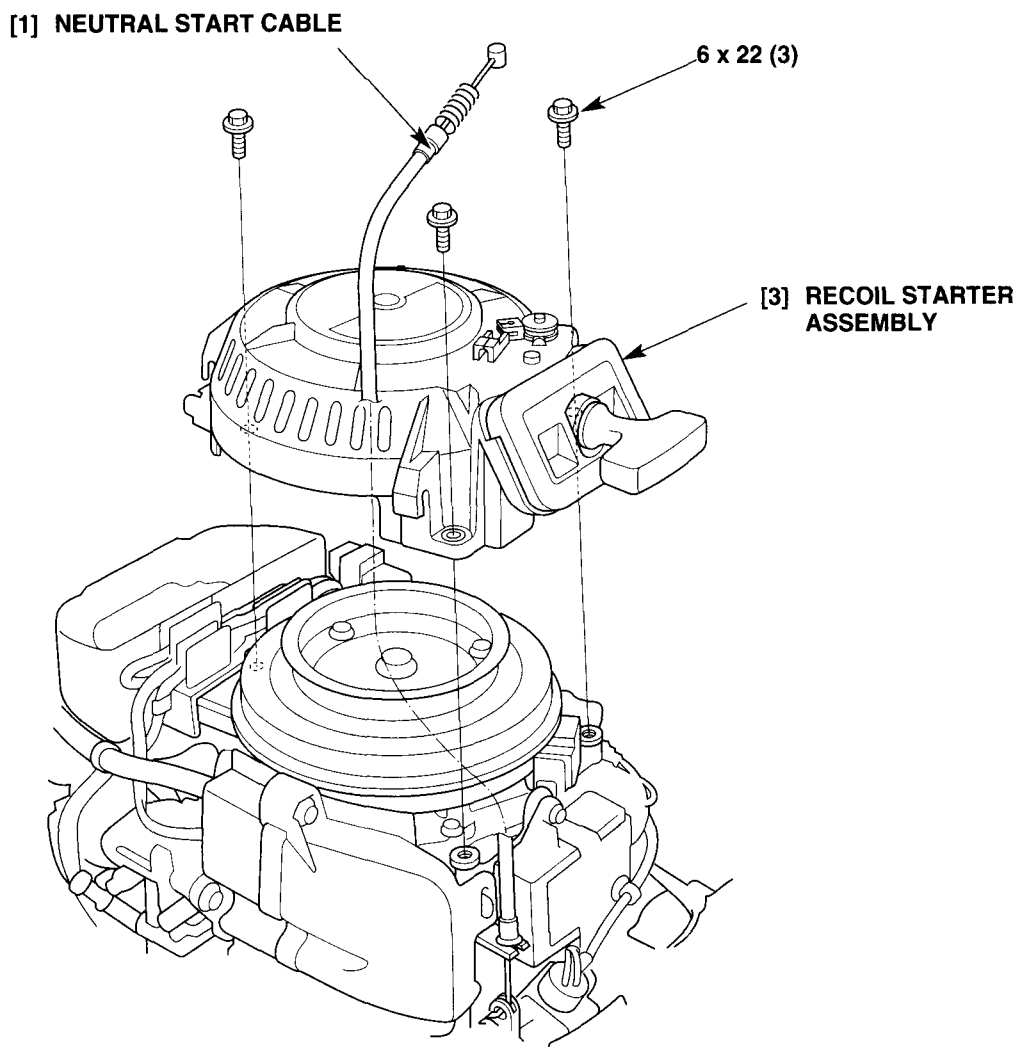
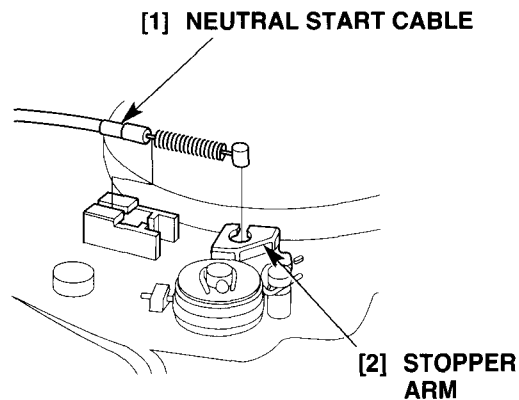
- 1) Remove the engine cover and shift the gear into the neutral position.
- 2) Loosen the lock nut and turn the adjust nut until the groove of the stopper arm aligns with the index mark on the recoil starter case.
- 3) Tighten the lock nut securely.
- 4) After adjustment check for proper operation of the neutral start mechanism by operating the recoil starter.
- 5) Install the engine cover.



2. RECOIL STARTER

a. REMOVAL

- 1) Remove the engine cover.
- 2) Disconnect the neutral start cable from the stopper arm.
- 3) Pull out the neutral start cable from the recoil starter case.
- 4) Remove the three 6 x 22 mm flange bolts and recoil starter assembly.

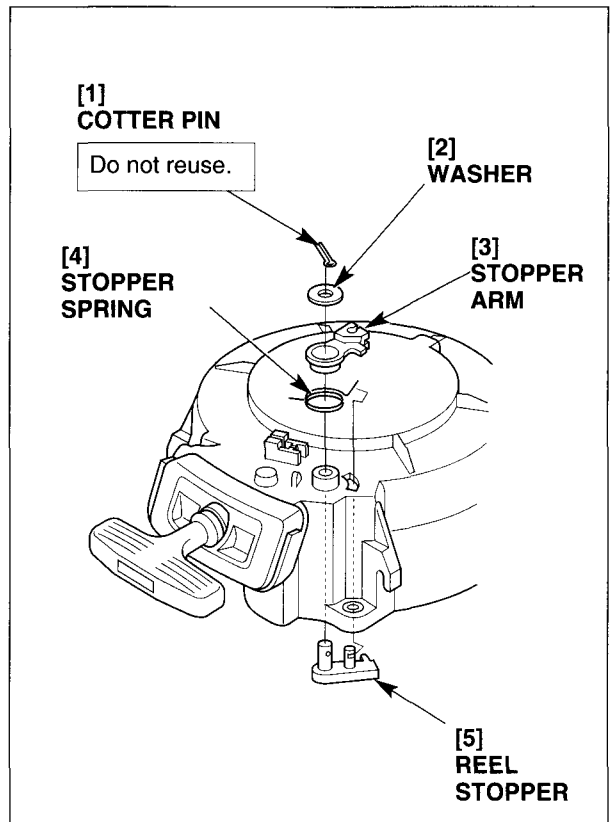


b. DISASSEMBLY

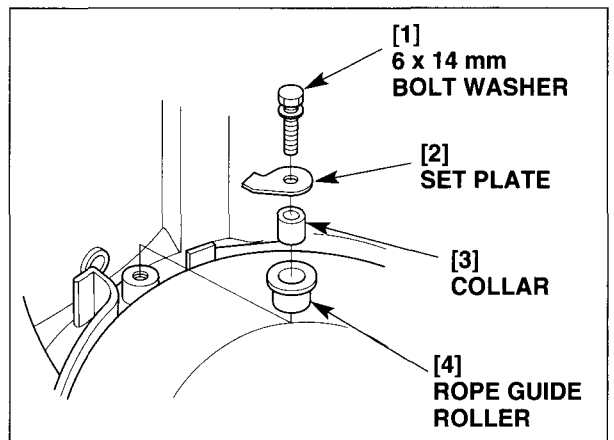
⚠ CAUTION

- Wear gloves and eye protection.
- During disassembly, take care not to allow the return spring to come out.

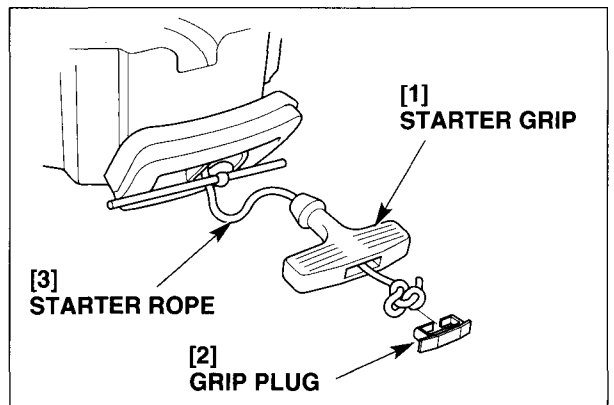
- 1) Remove the cotter pin and washer, and discard the cotter pin.
 - Replace with new one when reassembly.
- 2) Unhook the stopper spring from the reel stopper.
- 3) Remove the stopper arm, stopper spring and reel stopper.



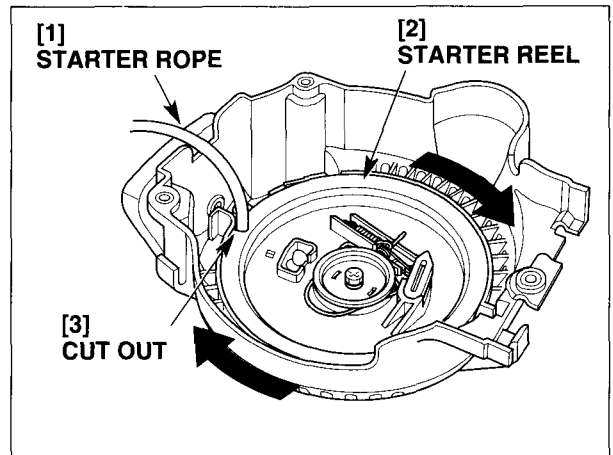
- 4) Remove the 6 x 14 mm washer bolt, set plate, collar and rope guide roller.



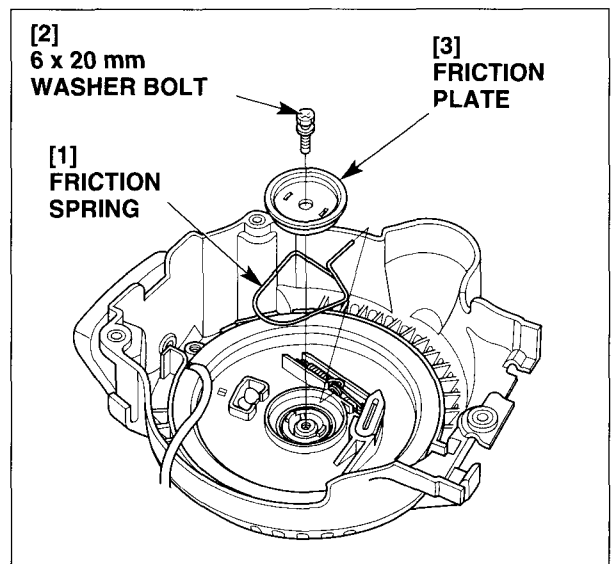
- 5) Hold the starter rope.
- 6) Remove the grip plug and pull out the starter rope end from the start grip. Untie the rope end and remove the starter grip.



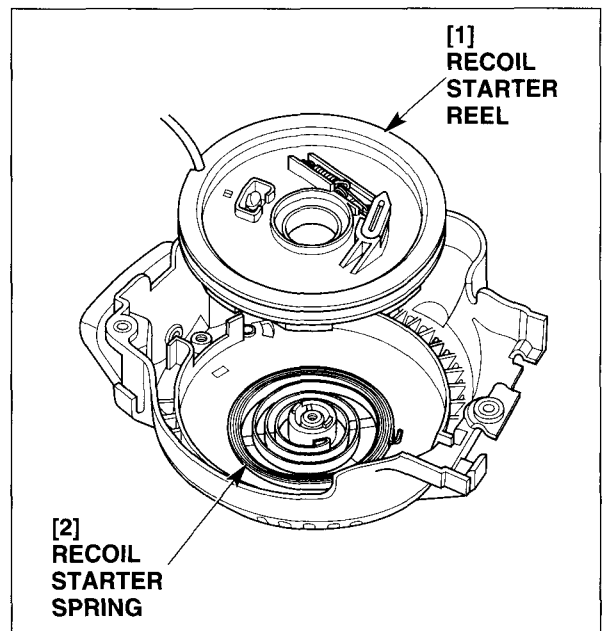
- 7) Pull out the starter rope from the starter case holding the starter reel to prevent from turning the reel.
- 8) Align the starter rope with the cutout of the starter reel. Hold the starter rope end and slowly turn the reel clockwise to release the spring preload.



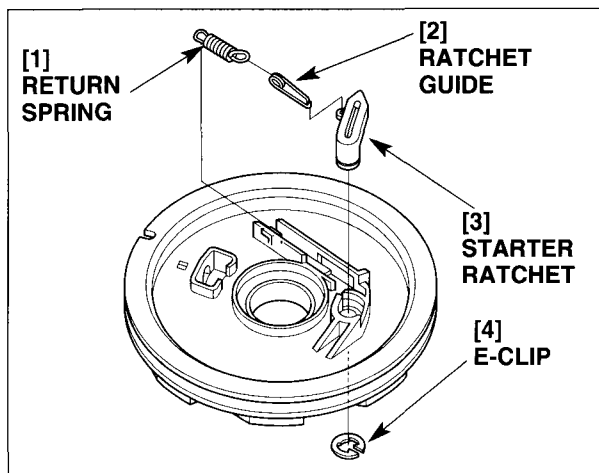
- 9) Remove the 6 x 20 mm washer bolt and friction plate and friction spring.



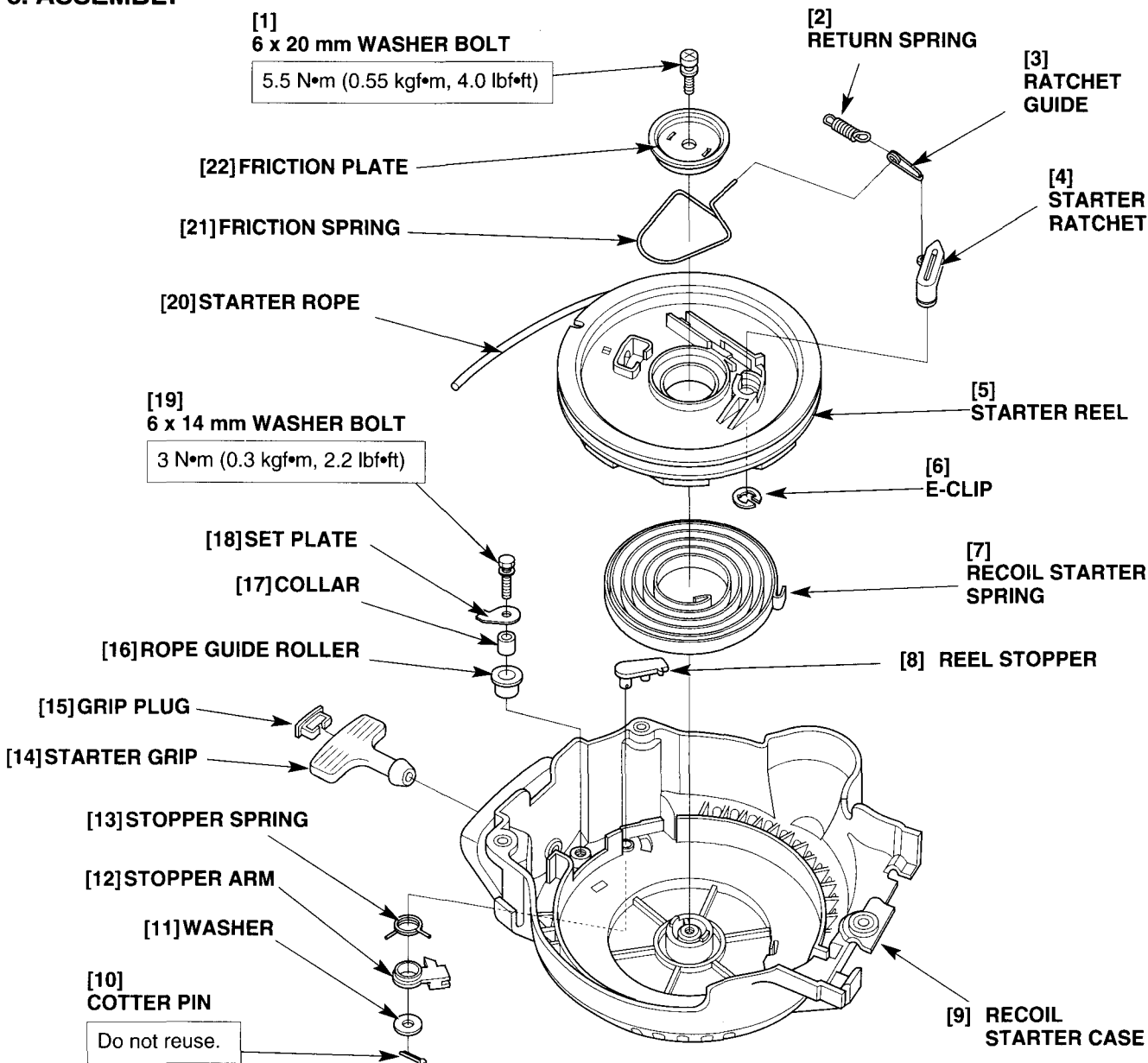
- 10) Remove the recoil starter reel from the starter case taking care not to allow the starter spring to come out.
 - It is not necessary to remove the recoil starter spring except replacing the starter case or recoil starter spring.
 - Take care not to allow the recoil starter spring to come out.



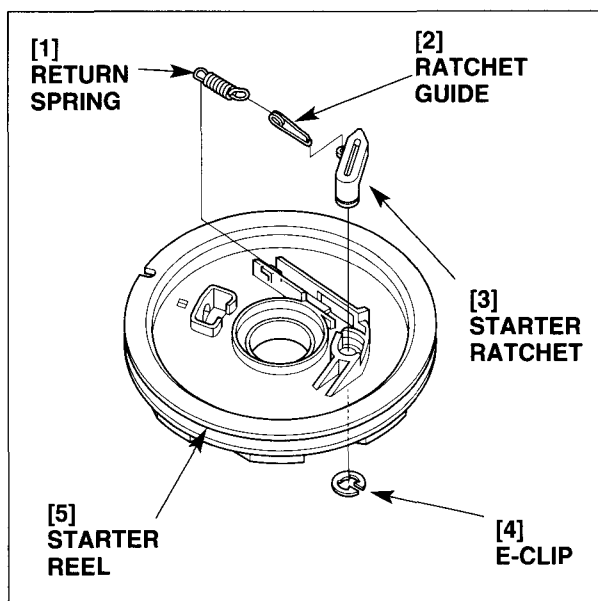
- 11) Pry off the E-clip from the starter ratchet behind the starter reel.
- 12) Remove the starter ratchet, ratchet guide and ratchet return spring.
- 13) Check the starter rope for fraying or wearing. Pull out the starter rope if replacement is necessary.



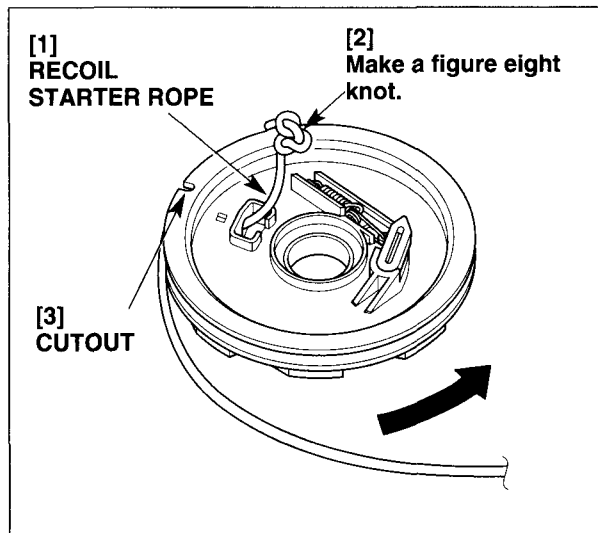
c. ASSEMBLY



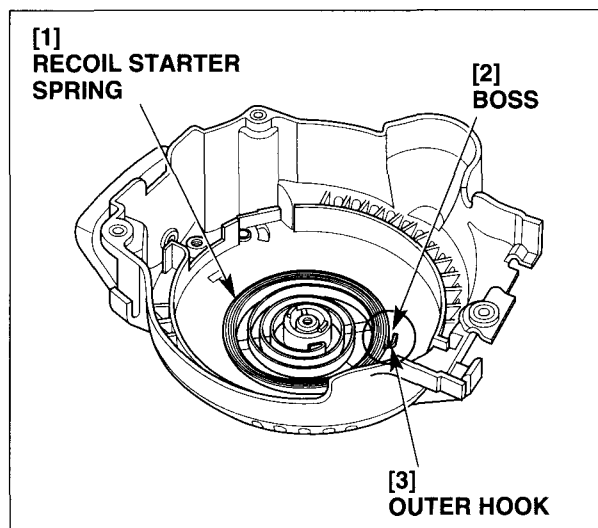
- 1) Install the return spring, ratchet guide and starter ratchet, and set the E-clip



- 2) Check the starter rope for fraying or wearing, replace if necessary.
- 3) Insert new starter rope end into the starter reel and make a figure eight knot at the rope end.
- 4) Wind the starter rope onto the starter reel counterclockwise with ratchet mounting section facing up and align the rope with cutout of the starter reel.



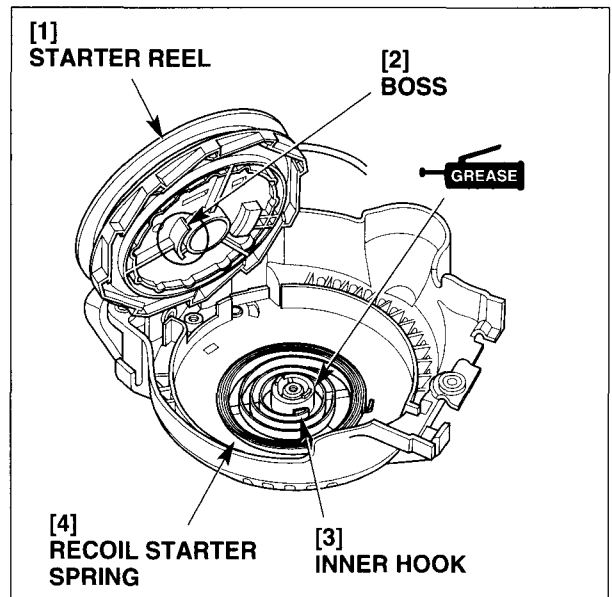
- 5) If the recoil starter spring is removed, wind the return spring and install it on the starter case. Hook the outer hook of the return spring to the boss of the starter case as shown.



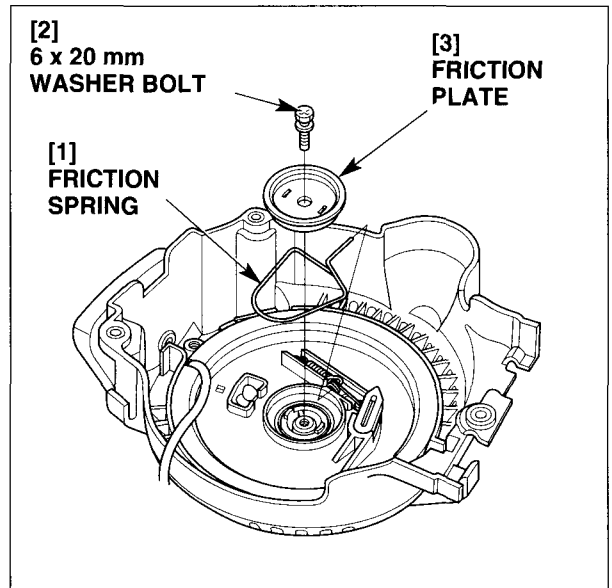
CAUTION

- Wear gloves and eye protection.
- During disassembly, take care not to allow the return spring to come out.

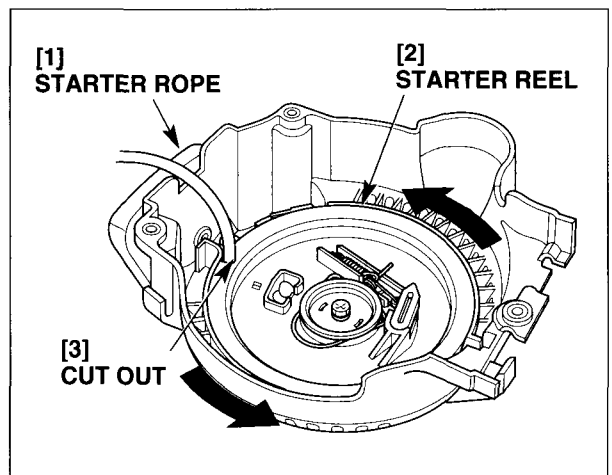
- 6) Apply grease to the starter reel mounting boss on the starter case.
- 7) Install the starter reel and turn the starter reel counter-clockwise to align the spring inner hook to the tab on the starter case with the rope end drawn out from the cutout of the starter reel



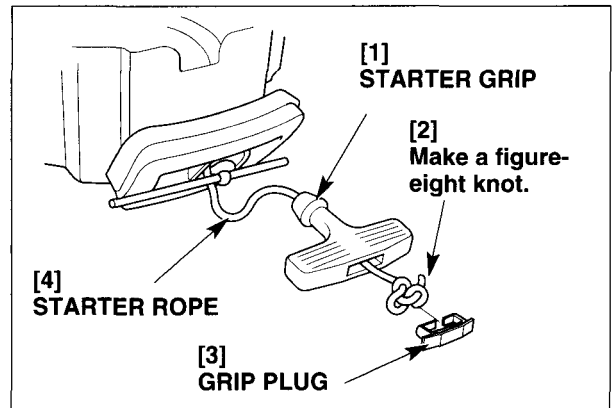
- 8) Set the friction spring onto the friction plate.
- 9) Insert the friction spring end into the ratchet guide and secure them with the 6 x 20 mm washer bolt.



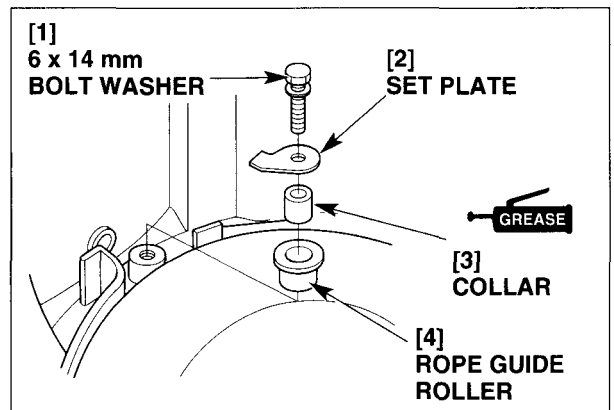
- 10) Turn the starter reel 2 turns in the direction of the arrow for pre-tensioning of the starter spring holding the starter rope end to prevent out off the cutout.



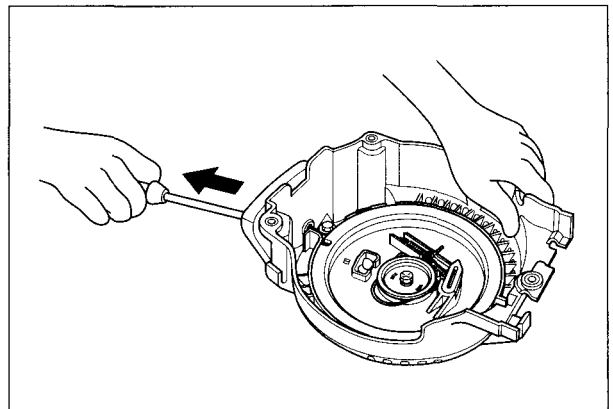
- 11) Pull out the rope end from the starter case hole holding the starter reel not to turn and hold the starter rope.
- 12) Install the starter grip, and make a figure eight knot. Pull the starter rope into the starter grip and install the grip plug.



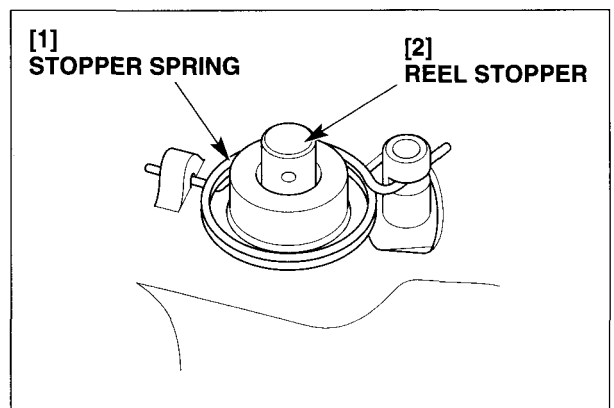
- 13) Apply grease to the outside of the collar.
- 14) Install the rope guide roller, collar and set plate, and tighten the 6 x 14 mm washer bolt securely.



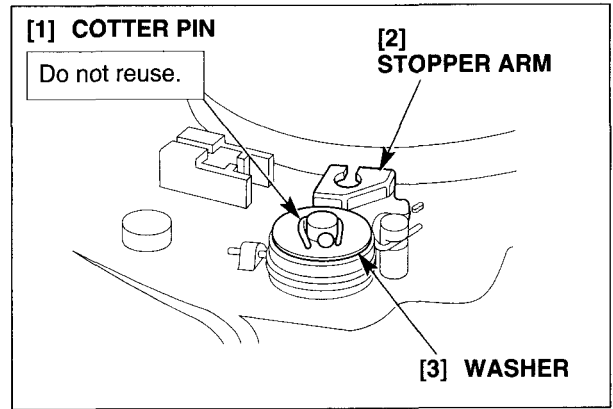
- 15) Check the operation of starter assembly by pulling the starter rope several times.



- 16) Install the reel stopper and stopper spring, and set the spring as shown.

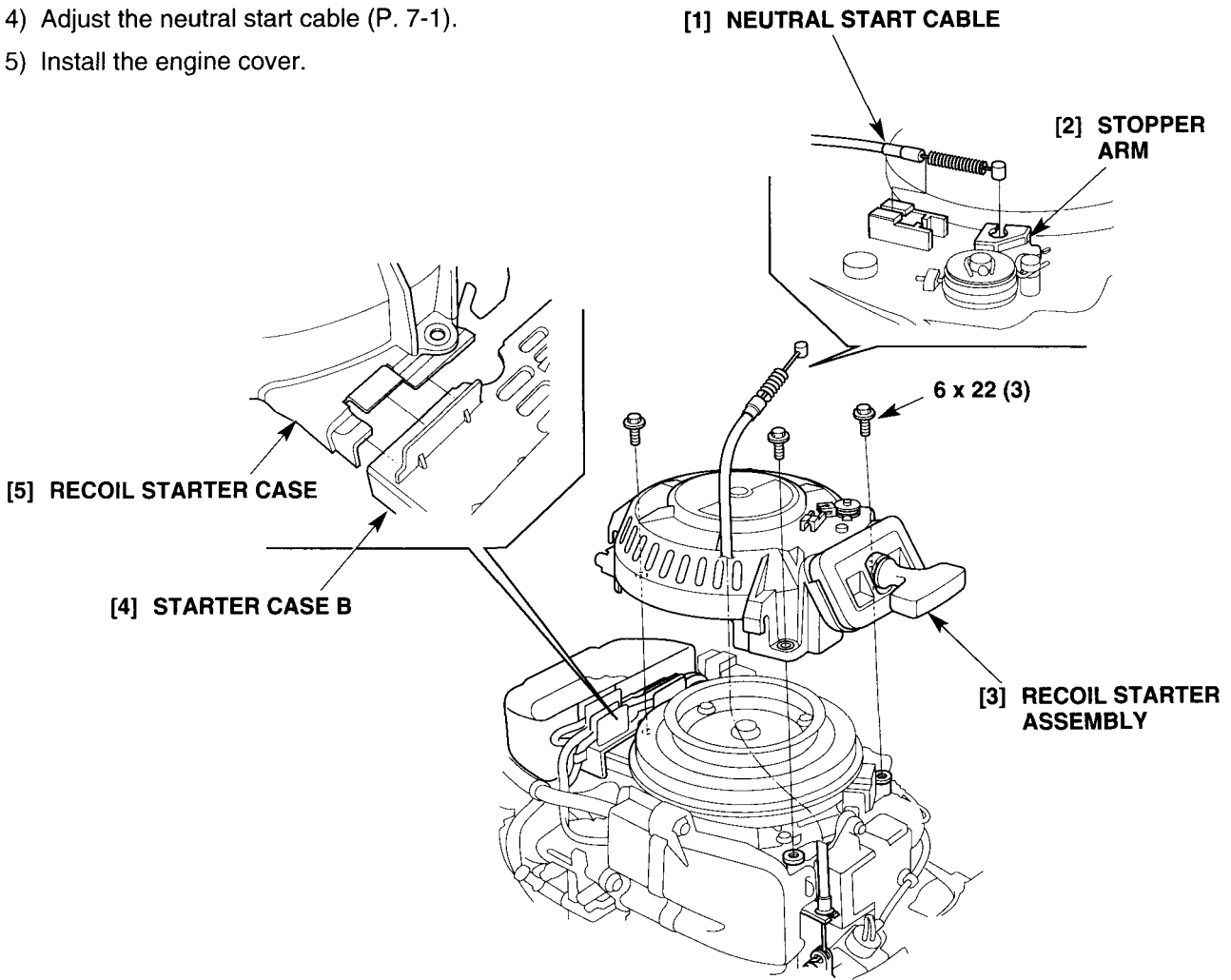


17) Install the stopper arm and washer, then secure them using a new cotter pin.



d. INSTALLATION

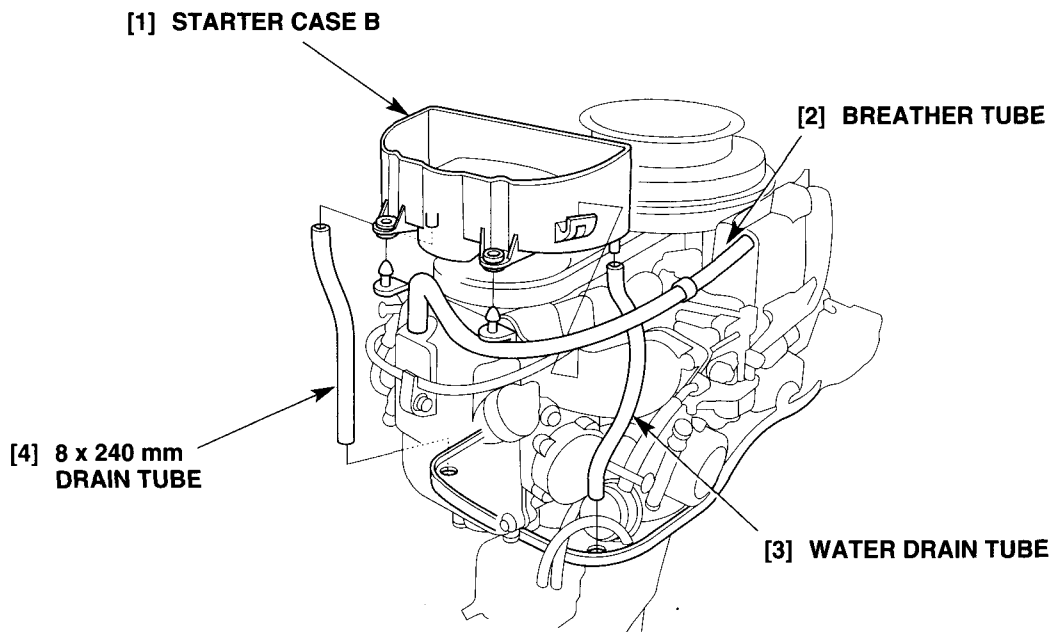
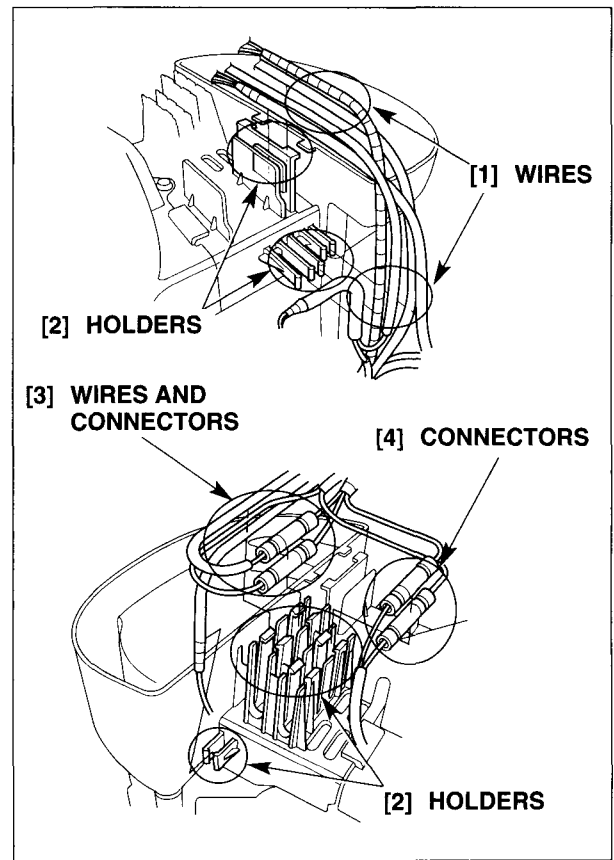
- 1) Install the recoil starter assembly by aligning the recoil starter case and starter case B as shown.
- 2) Tighten the 6 X 22 mm flange bolt securely.
- 3) Connect the neutral start cable to the stopper arm.
- 4) Adjust the neutral start cable (P. 7-1).
- 5) Install the engine cover.



3. STARTER CASE B

a. REMOVAL

- 1) Remove the following parts:
 - engine cover (P. 5-1).
 - Left engine under cover (P. 5-2).
 - right engine under cover (P. 5-3).
 - recoil starter (P. 7-2).
- 2) Pull out the connectors and wires from the holder on the starter case B
- 3) Pull off the breather tube from the clamp on the starter case B and remove it. Disconnect the breather tube from the cylinder head cover.
- 4) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.



b. INSTALLATION

Installation is the reverse order of removal.

- See page 2-36 for wires and connectors clamping.

1. ENGINE REMOVAL

2. ENGINE INSTALLATION

1. ENGINE REMOVAL

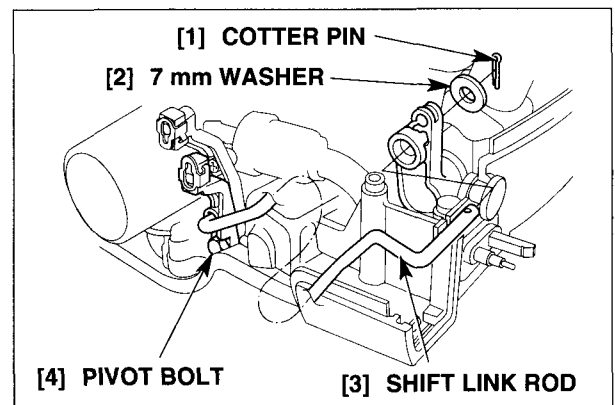
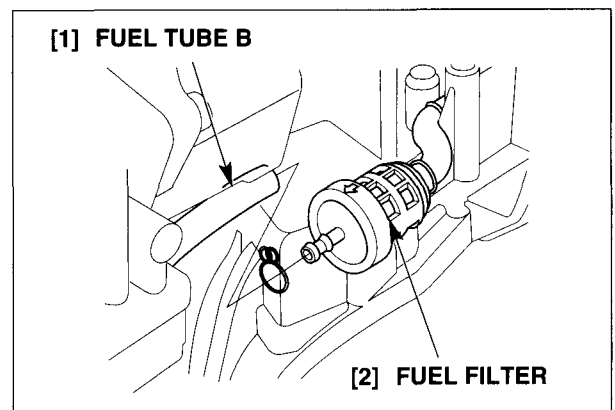
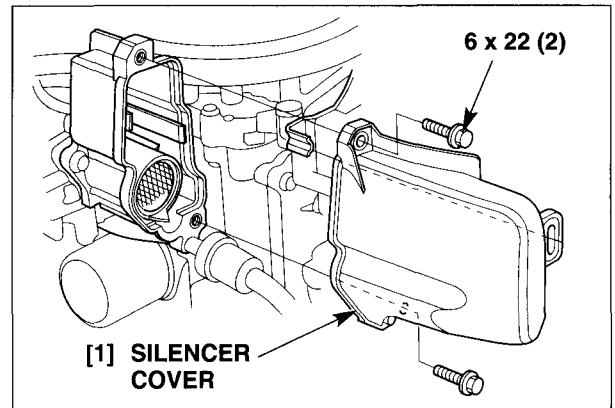
- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
 - right engine under cover (P. 5-3).
 - recoil starter (P. 7-1) and neutral start cable (P. 7-9).
 - remote control cables (P. 14-2).
 - remote control box wire harness (P. 14-3).
- 2) Drain the engine oil to a suitable container (P. 3-3).
- 3) Remove the two 6 x 22 mm flange bolts and silencer cover.
- 4) Loosen the carburetor drain screw and drain the carburetor to a suitable container.

⚠ WARNING

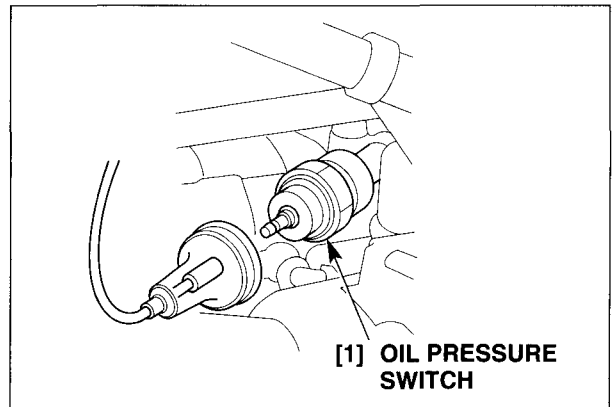
Gasoline is highly flammable and explosive. You can be burned or seriously injured when handling fuel.

- Keep heat, sparks, and flame away.
- Handle fuel only outdoors.
- Wipe up spills immediately.

- 5) Disconnect the fuel tube B from the fuel filter.
- 6) Loosen the pivot bolt fully. Remove the cotter pin and 7 mm washer and disconnect the shift linkage from the shift shaft (Remote control type only).



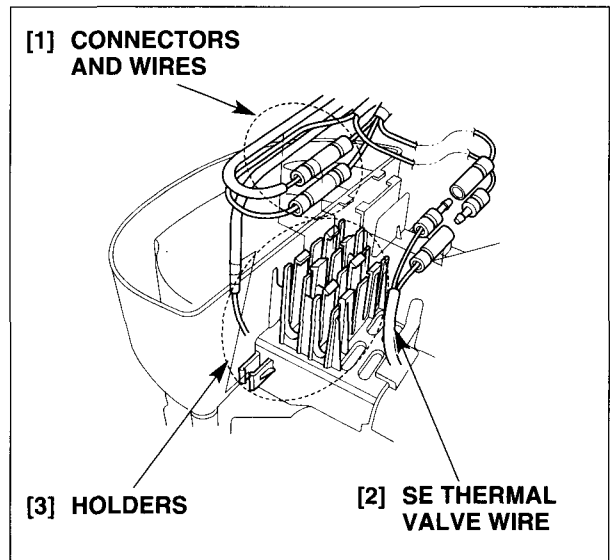
- 7) Disconnect the wire connector from the oil pressure switch.



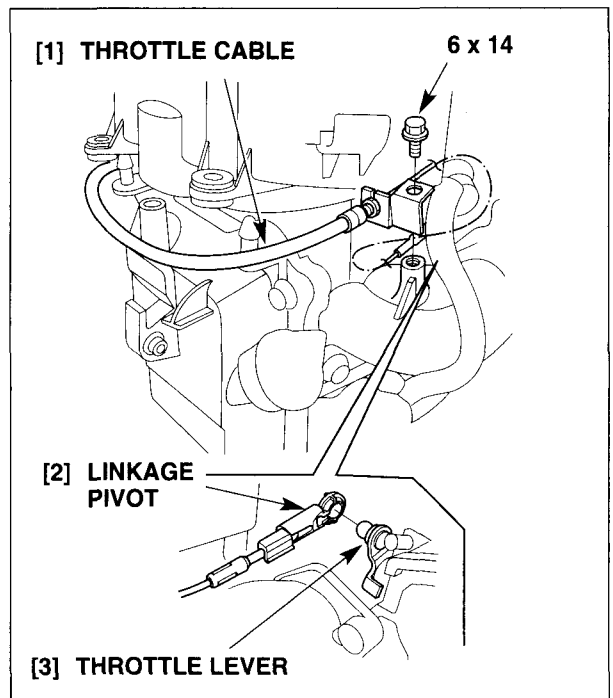
- 8) Remove the wires and connectors from the holder of the starter case B.

- Refer to page 2-36 for connector location.

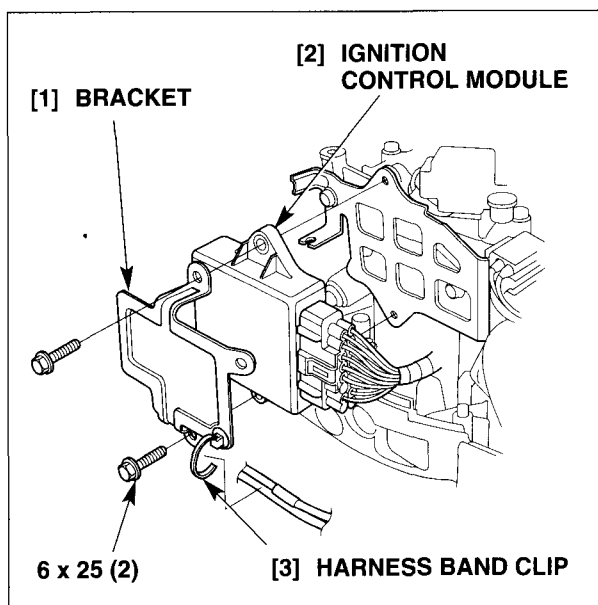
- 9) Disconnect the SE thermal valve wire connectors (Type with electric starter).



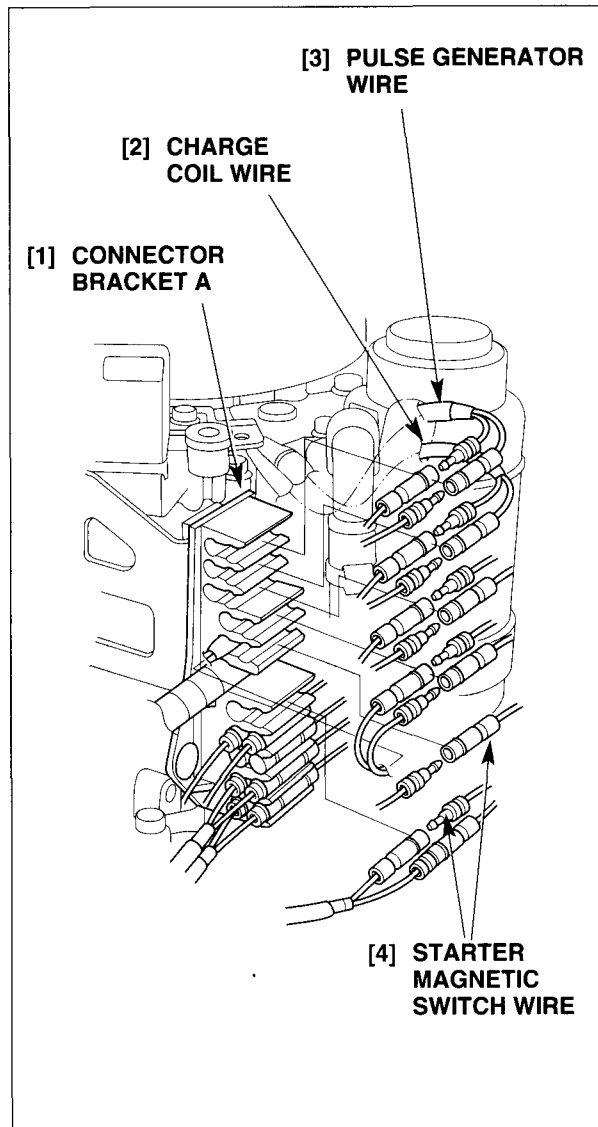
- 10) Pull up the starter case B slightly and disconnect the drain tube from the starter case B. Remove the 6 x 14 mm flange bolt and throttle cable stay, then disconnect the linkage pivot of the throttle cable from the carburetor throttle lever (Tiller handle type).



- 11) Unfasten the harness band clip and free the wires (neutral switch wire and/or indicator wire).
- 12) Remove the two 6 x 25 mm flange bolts, ignition control module and bracket.

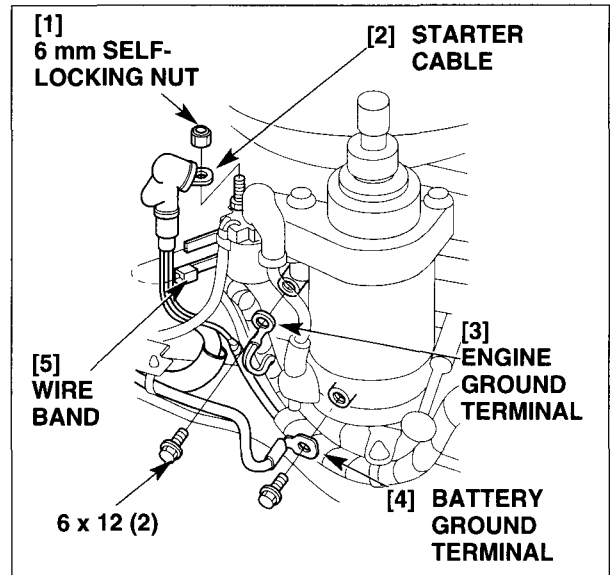


- 13) Pull out the following connectors from the connector bracket A, and disconnect the connectors:
- charge coil wire.
 - exciter coil wire.
 - pulse generator coil wire.
 - starter magnetic switch wire.
- Refer to page 2-31 (Tiller handle type) or 2-33 (Remote control type) for connector location.

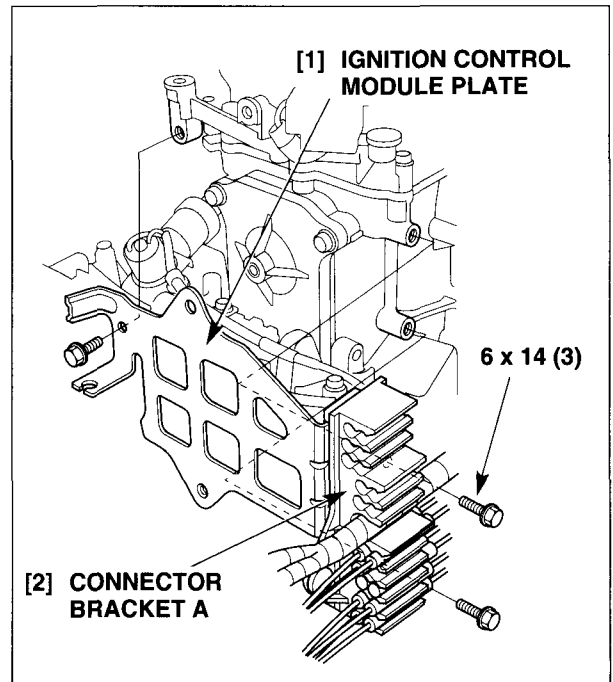


14) Unfasten the wire band at the starter magnetic switch and disconnect the starter cable from the starter magnetic switch by removing the 6 mm self-locking nut (Type with electric starter).

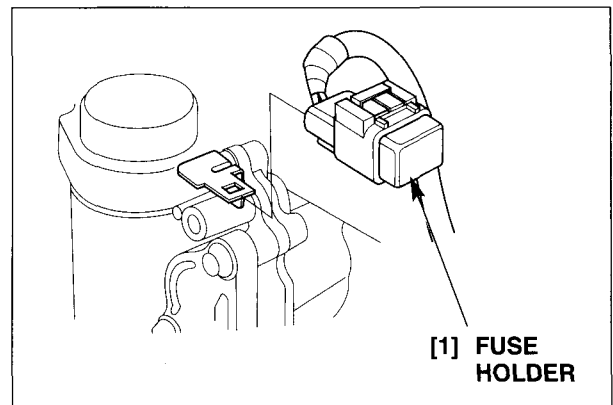
15) Remove the 6 x 12 mm flange bolts and disconnect the battery ground terminal (Type with electric starter) and engine ground terminal.



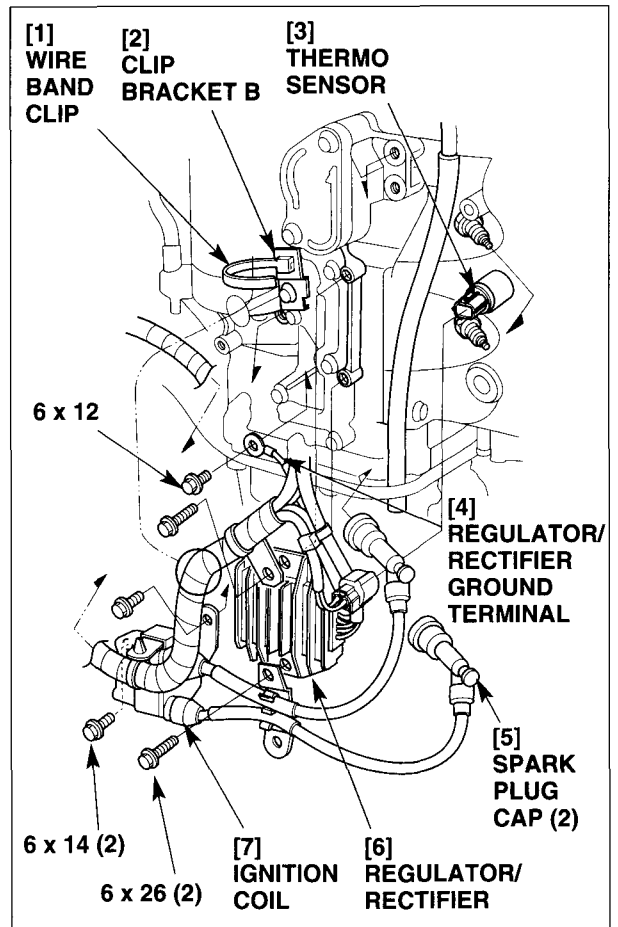
16) Remove the three 6 x 14 mm flange bolts and ignition control module plate with connector bracket A attached.



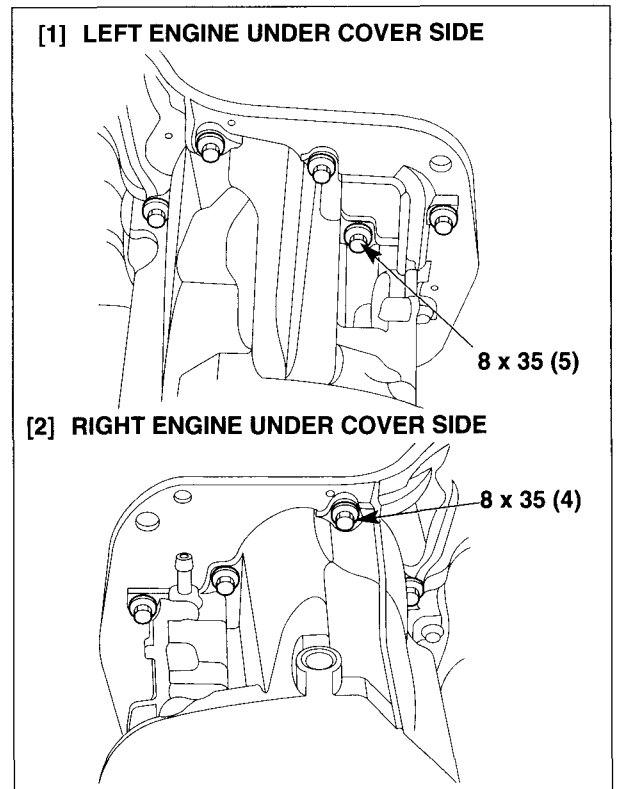
17) Pull off the fuse holder.



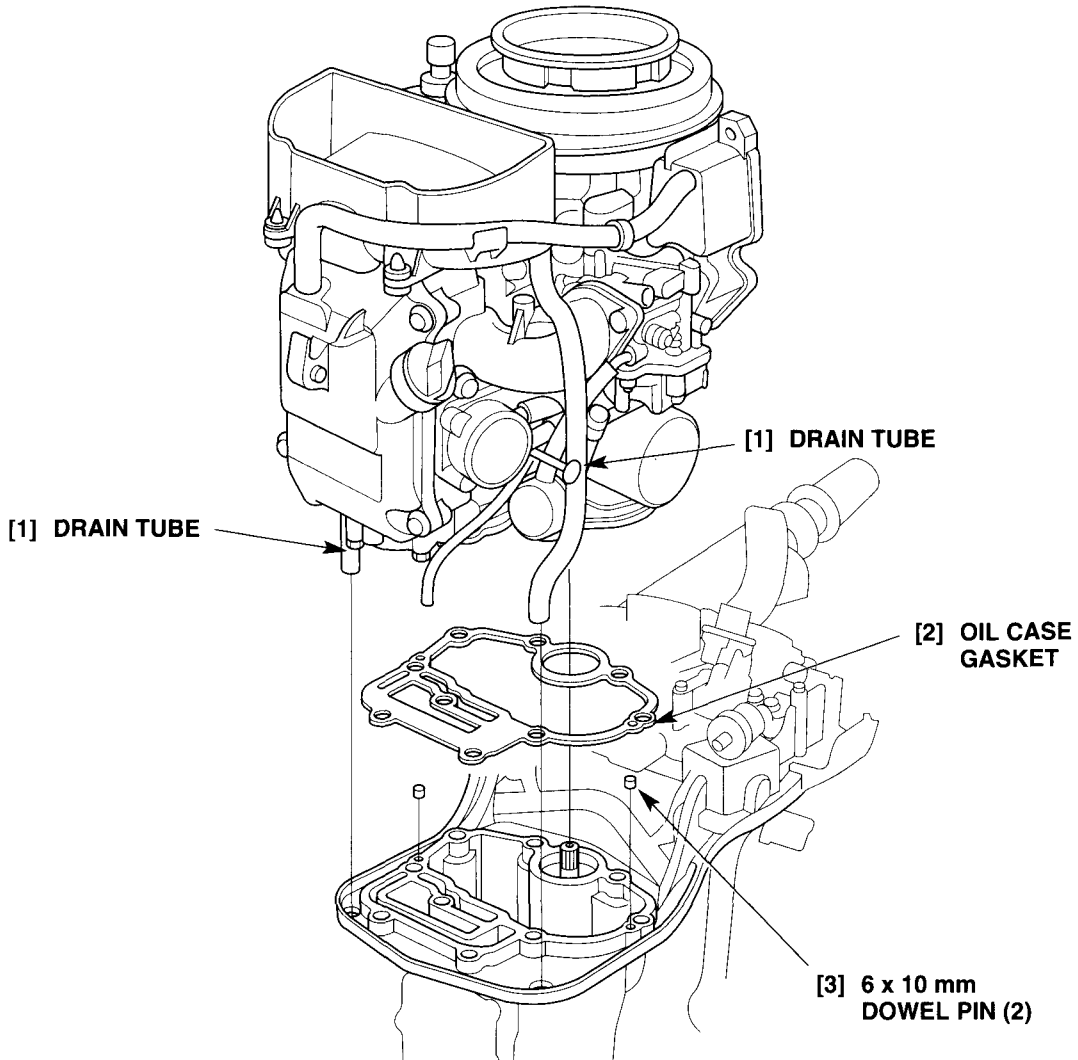
- 18) Disconnect the spark plug caps and thermo sensor wire connector.
- 19) Unfasten the harness band clip on the clip bracket B and free the wire harness.
- 20) Remove the two 6 x 26 mm flange bolts mounting the regulator/rectifier.
- 21) Remove the 6 x 12 mm flange bolt and disconnect the regulator/rectifier ground terminal (Type with electric starter).
- 22) Remove the two 6 x 14 mm flange bolts and ignition coil with the bracket attached.



- 23) Remove the exhaust chamber cover (P. 4-31).
- 24) Remove the nine 8 x 35 mm engine mounting bolts.

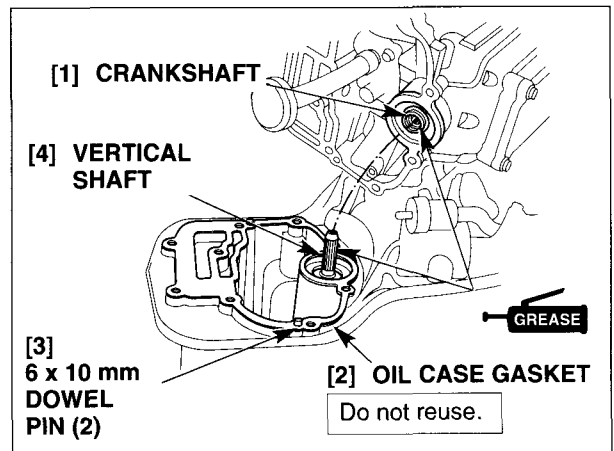


- 25) Pull out the drain tubes from the oil case and remove the engine from the oil case
- 26) Remove the two 6 x 10 mm dowel pins and oil case gasket.



2. ENGINE INSTALLATION

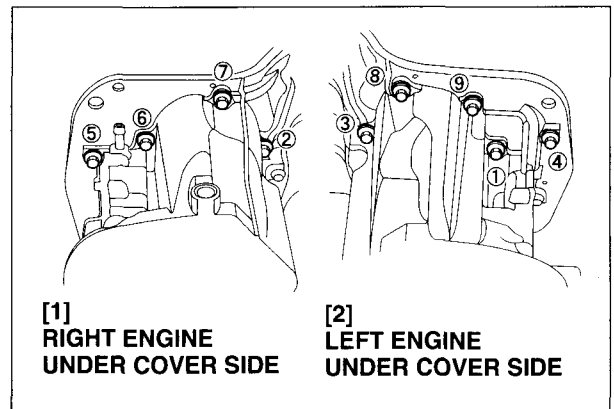
- 1) Install the two 6 x 10 mm dowel pins and a new oil case gasket.
 - Replace the oil case gasket with new one, when reassembling.
- 2) Apply marine grease to the spline of the vertical shaft, and install the engine by aligning the vertical shaft and crankshaft.



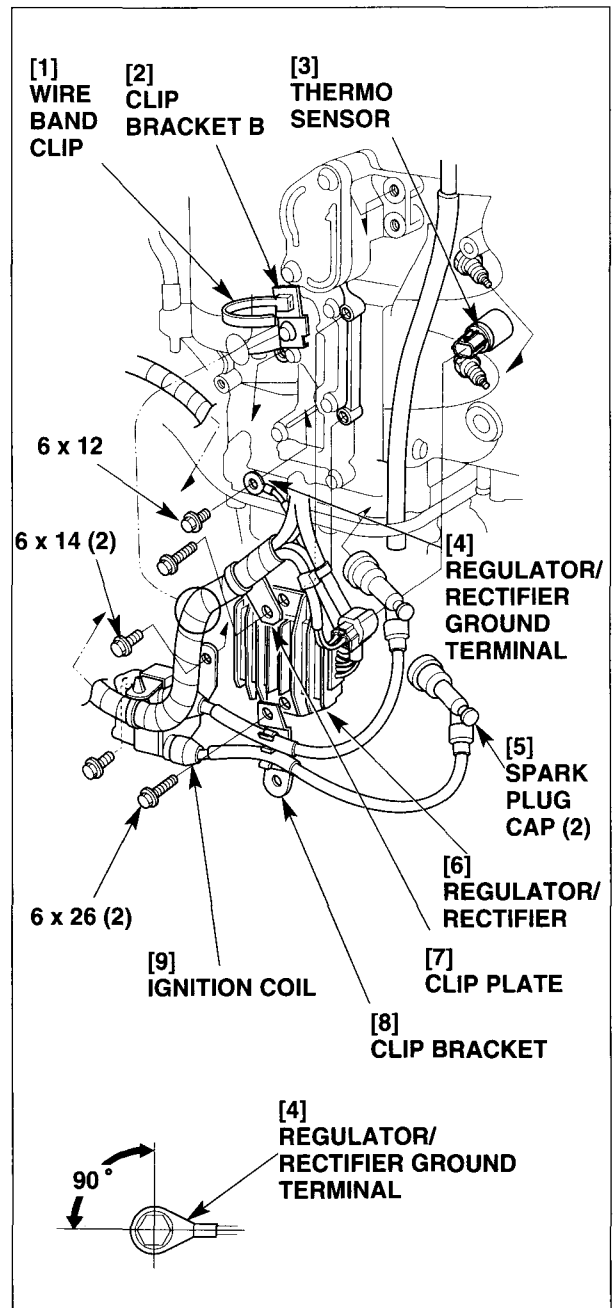
- 3) Tighten the engine mount bolts to the specified torque.
- Tighten the bolt in the numbered sequence as shown and 2 - 3 steps.

TORQUE: 24 N•m (2.4 kgf•m, 17 lbf•ft)

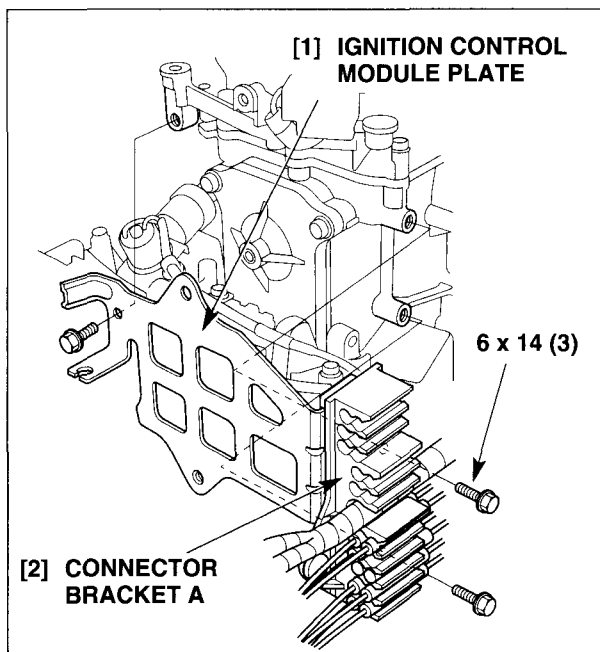
- 4) Install the exhaust chamber (P. 4-31).



- 5) Install the following:
- ignition coil.
 - regulator/rectifier.
 - clip plate and clip bracket.
 - regulator/rectifier ground terminal.
- 6) Route the wires and connect the spark plug caps, and thermo sensor connector. Secure the wires with the wire band.
- Replace the wire band with new one, if it is cut.



- 7) Install the ignition control module plate with the connector bracket A attached and secure the three 6 x 14 mm flange bolts.



- 8) Connect the starter cable to the starter magnetic switch and tighten the 6 mm self-locking nut to the specified torque.

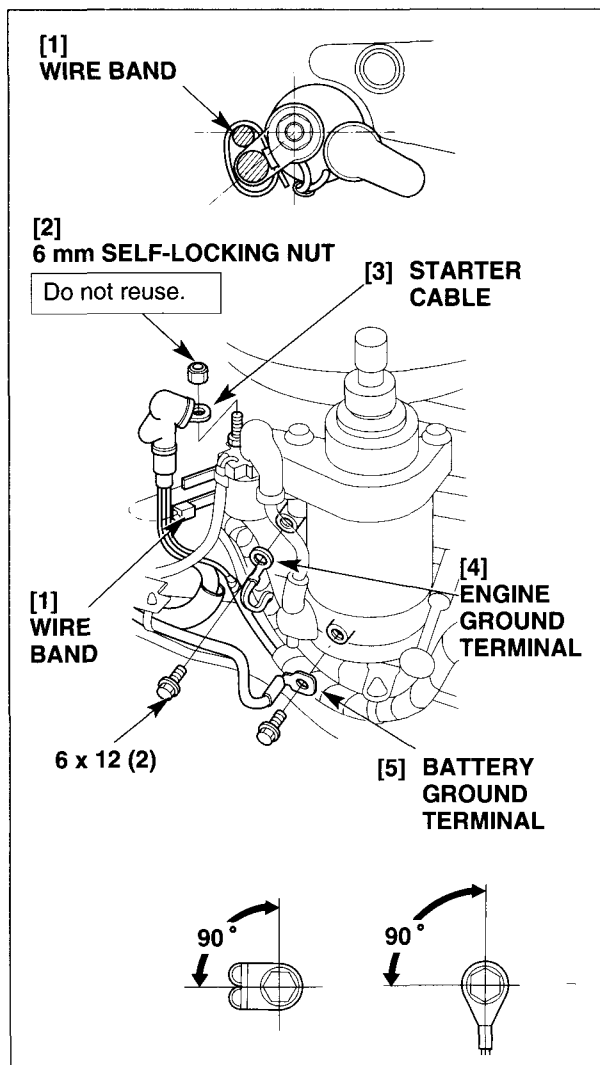
TORQUE: 5.5 N•m (0.55 kgf•m, 4.0 lbf•ft)

- 9) Tighten the 6 x 12 mm flange bolts to the ground terminals:

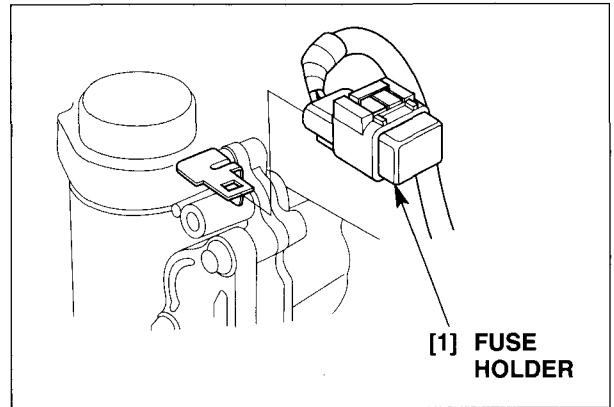
- battery ground terminal.
- engine ground terminal

- 10) Secure the starter cable with the wire band as shown.

- Replace the wire bands with new ones if they are cut.

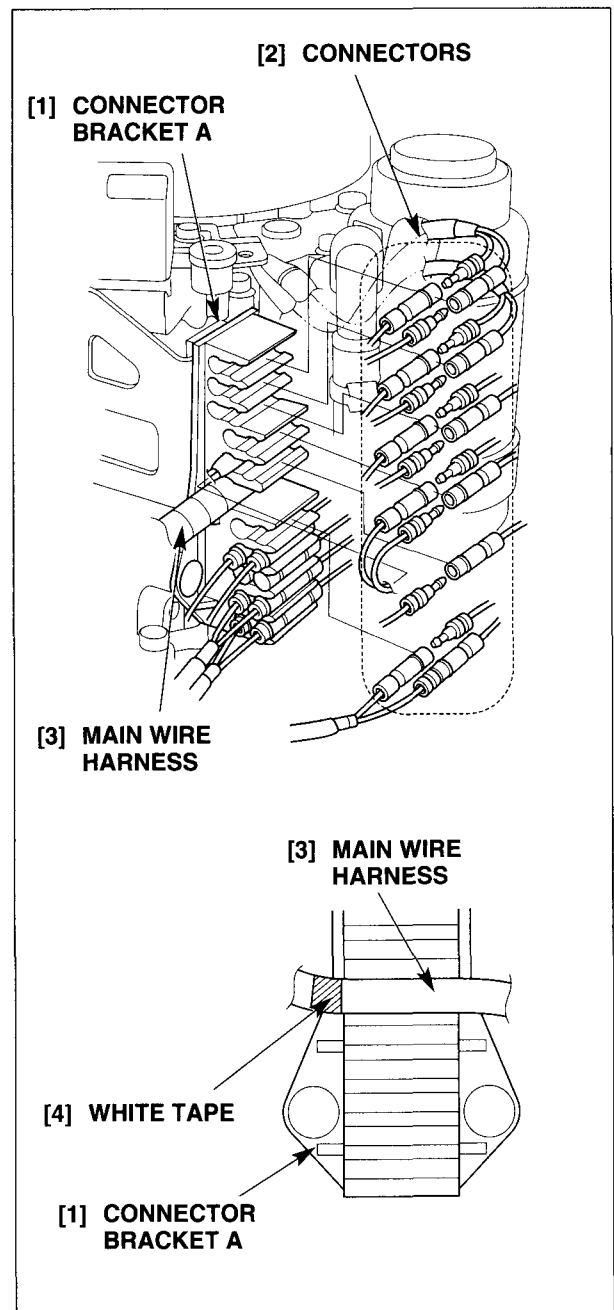


11) Set the fuse holder to the holder plate.

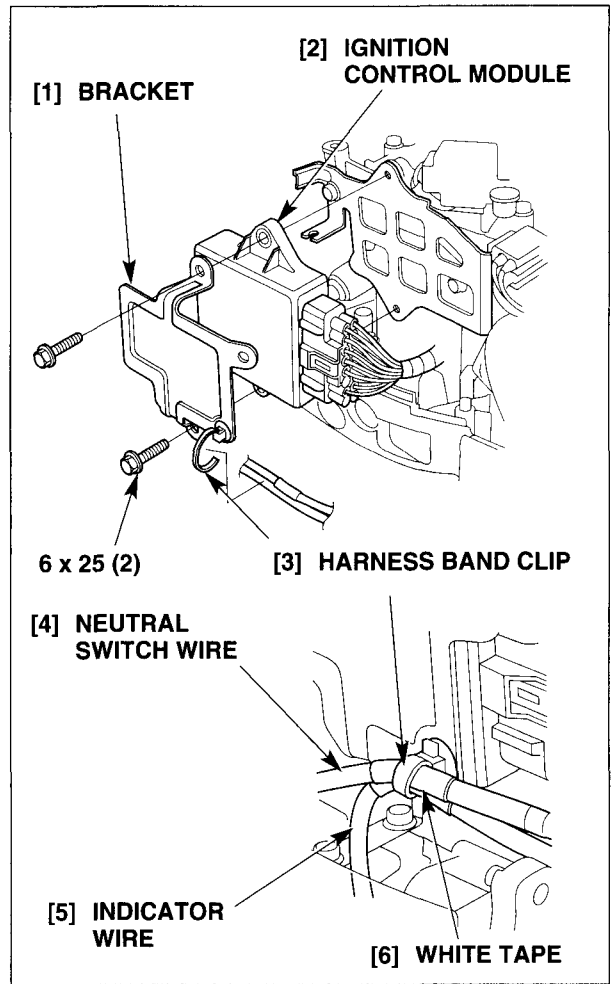


12) Connect the wire connectors and set them to the connector bracket A.

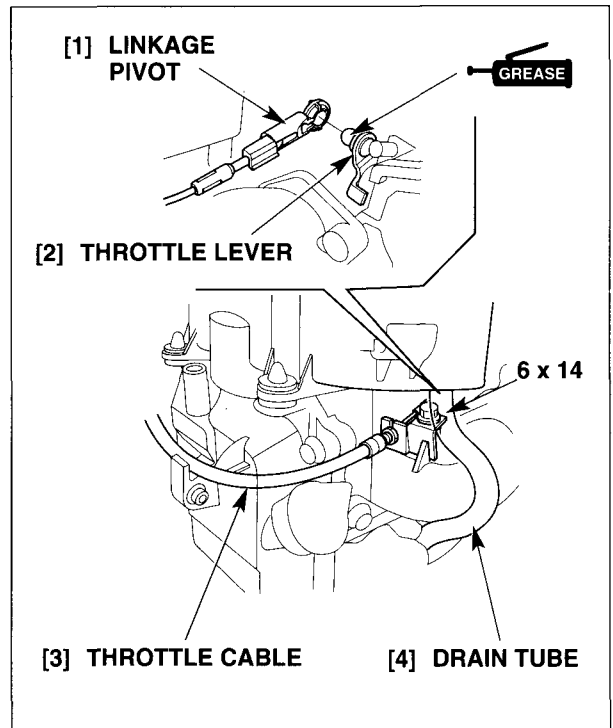
- Refer to page 2-31 (Tiller handle type) or 2-33 (Remote control type) for connector location.
- Set the main wire harness by aligning the white tape of the main wire harness with the edge of the connector bracket A.



- 13) Install the ignition control module and bracket using the two 6 x 25 mm flange bolts.
- 14) Secure the indicator wire (Tiller handle type) and neutral switch wire (Type with electric starter) with the harness band clip.
- Replace the wire bands with new ones if they are cut.
 - Clamp at the white tape section of the wire(s).



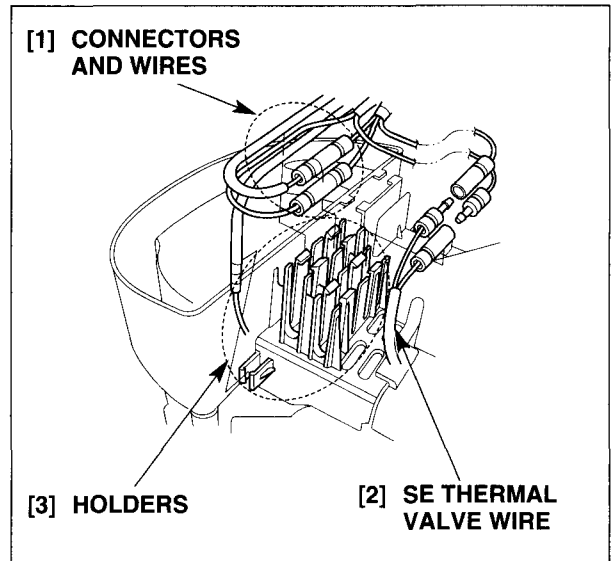
- 15) Apply grease to the pivot of the throttle lever and connect the throttle cable linkage pivot to the carburetor throttle lever.
- 16) Place the throttle cable holder by aligning the flange to the space of the lib and mounting boss, and tighten the 6 x 14 mm flange bolt.
- 17) Set the starter case in the place and connect the drain tube to the starter case.



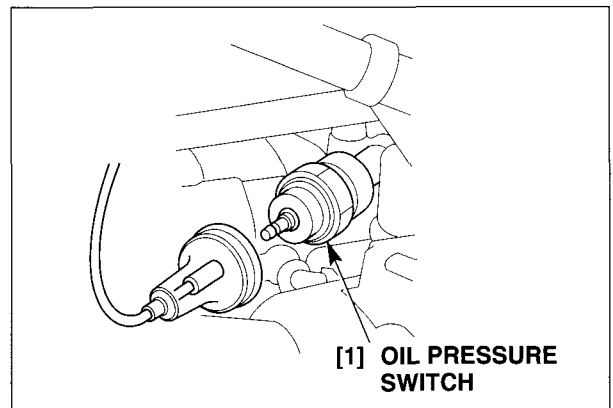
18) Connect the SE thermal valve wire connectors (Type with electric starter).

19) Set the connectors and wires to the holders of the starter case B.

- Refer to page 2-36 for connector location.

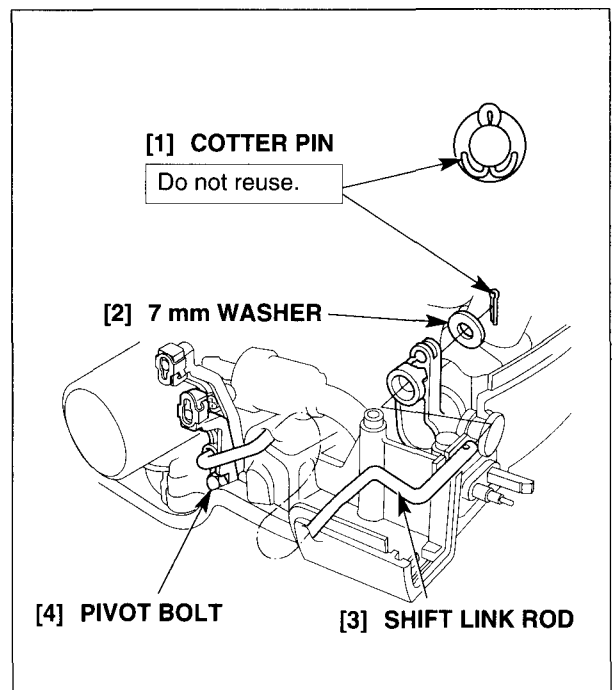


20) Connect the wire terminal to the oil pressure switch.

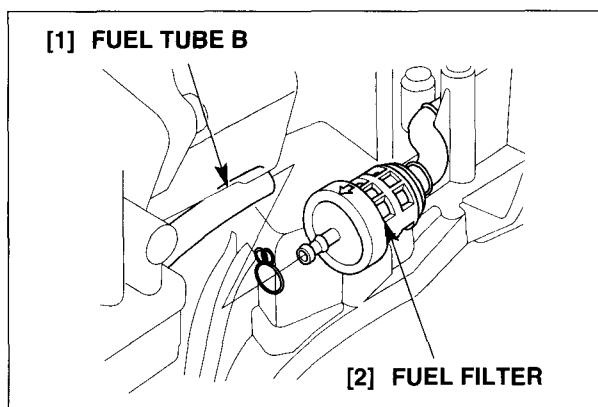


21) Install the shift link rod to the shift shaft and install the 6 mm plain washer to the shift link rod and secure it with a new 2 mm cotter pin.

Replace the 2 mm cotter pin with a new one, when removed.



22) Connect the fuel filter to the fuel tube.



23) Install the silencer cover and insert the tube end to the recess on the oil case as shown.

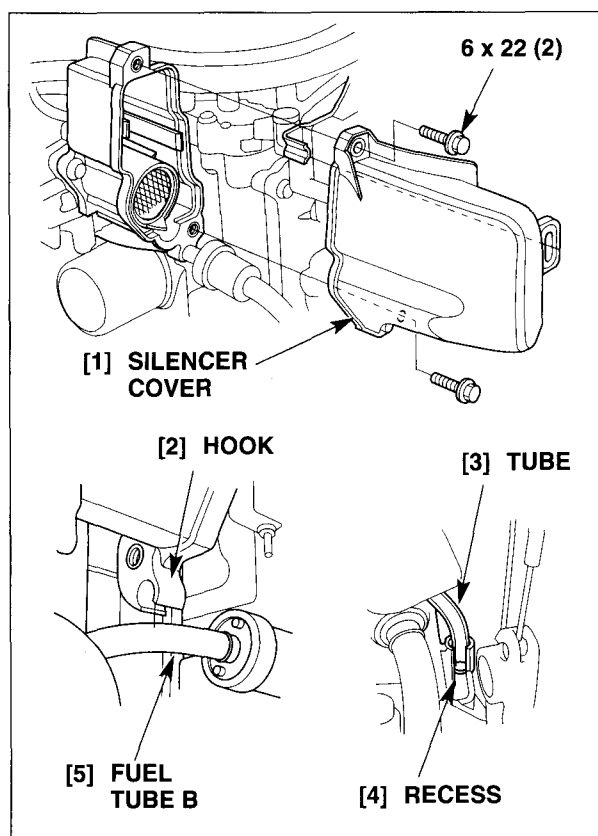
24) Hook the fuel tube to the hook of the silencer cover.

25) Reinstall the removed parts in the reverse order of removal.

- recoil starter (P. 7-1) and neutral start cable (P. 7-9).
- remote control cable (P. 14-2).
- left engine under cover (P. 5-2).
- right engine under cover (P. 5-3).
- engine cover (P. 5-1).

26) After installation check following and adjust if necessary.

- throttle cable (P. 3-13).
- neutral start cable (P. 7-2).



9. FLYWHEEL/TIMING BELT

BF15D·BF20D

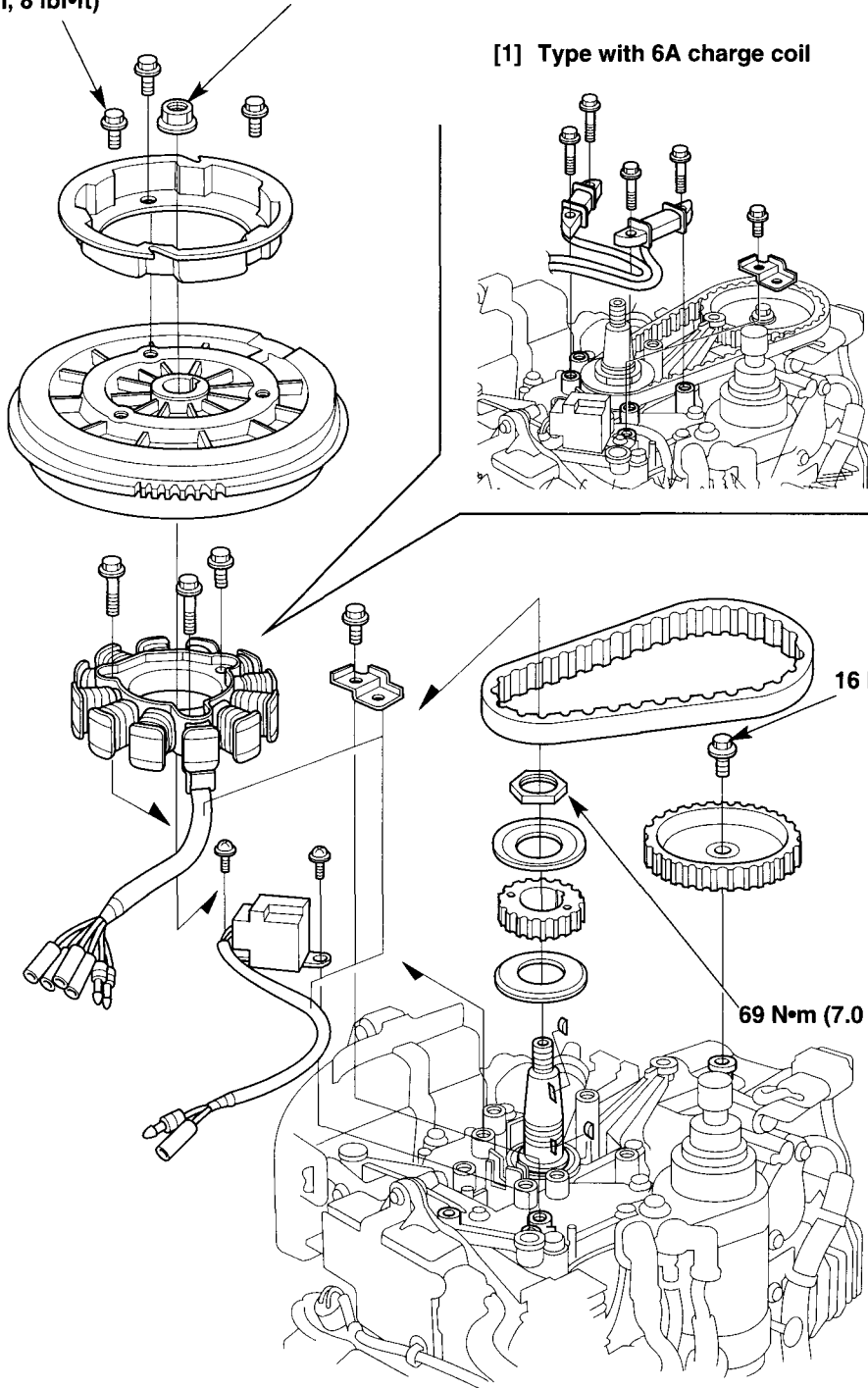
1. FLYWHEEL/COILS

2. TIMING BELT/PULLEYS

11 N·m (1.1 kgf·m, 8 lbf·ft)

132 N·m (13.5 kgf·m, 98 lbf·ft)

[1] Type with 6A charge coil



1. FLYWHEEL/COILS

a. REMOVAL

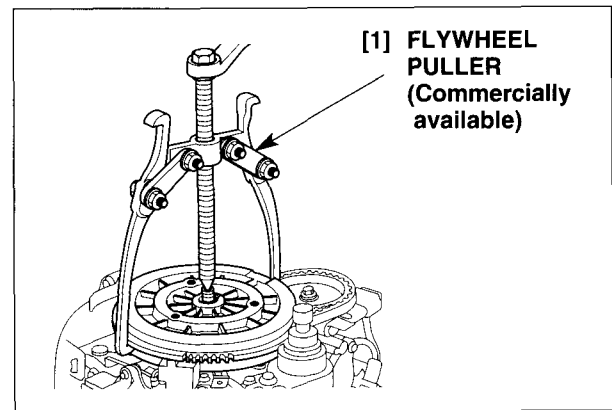
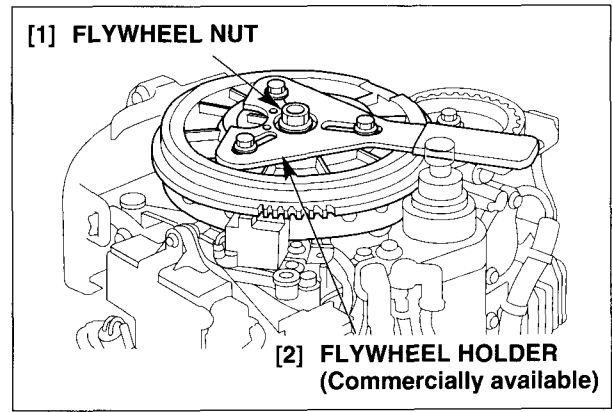
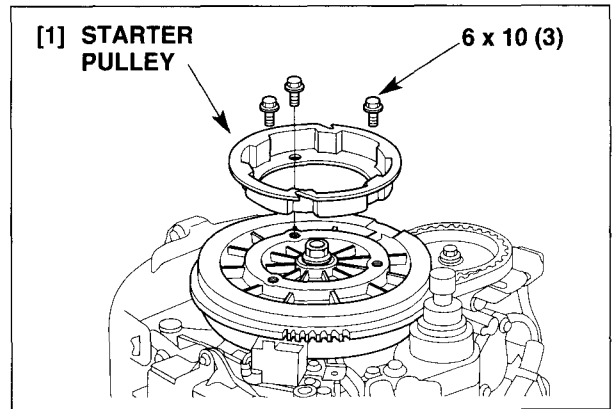
- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
 - right engine under cover (P. 5-3).
 - recoil starter (P. 7-2).
 - starter case B (P. 7-10).

- 2) Remove the three 6 x 10 mm flange bolts and starter pulley.

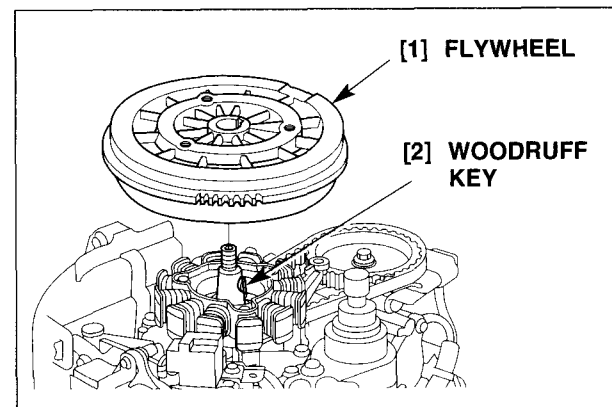
- 3) Hold the flywheel using the commercially available flywheel holder and remove the flywheel nut.

- 4) Set a commercially available flywheel puller to the flywheel securely avoiding the magnet sections and taking care not to damage the ring gear.

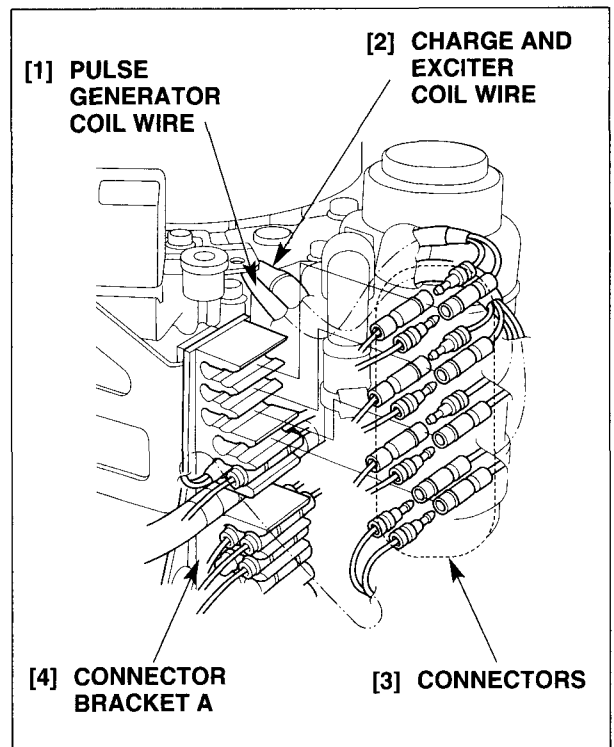
Do not hit the flywheel with a hammer.



- 5) Remove the flywheel and woodruff key.



- 6) Remove the connectors from the connector bracket A and disconnect the connectors.
- See page 2-31 (Tiller handle type) or 2-33 (Remote control type) for connector locations.



- 7) Remove the 6 x 14 mm flange bolt and harness set plate.
 8) Remove the 6 mm flange bolts and coil:

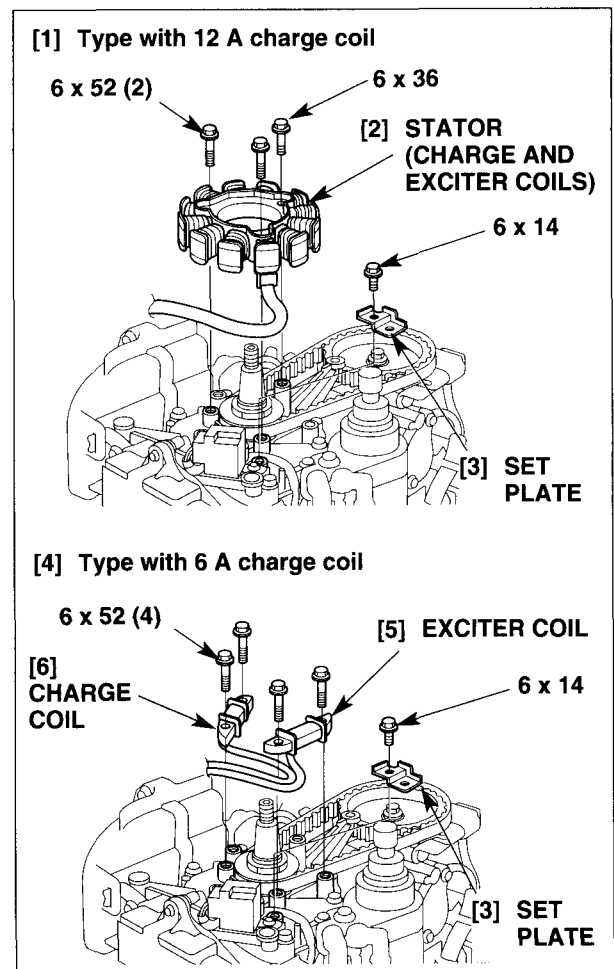
Type with 12A charge coil:

two 6 x 52 mm, one 6 x 36 mm flange bolts and stator (charge/exciter coils).

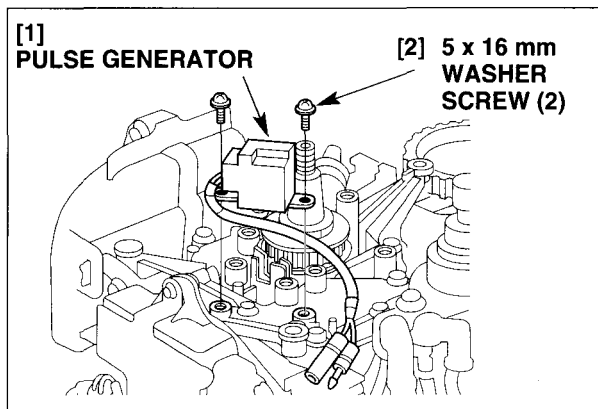
Type with 6A charge coil:

two 6 x 52 mm flange bolts and charge coil.

two 6 x 52 mm flange bolts and exciter coil.



9) Remove the two 5 x 16 mm washer screws and ignition pulse generator.

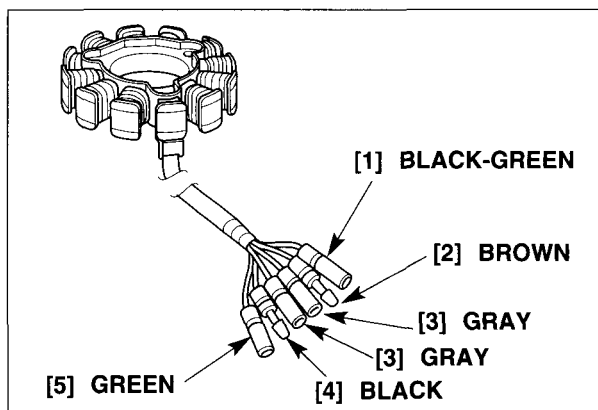


b. INSPECTION

• STATOR COILS (Type with 12A charge coil)

Measure the resistance between the each coil terminals.

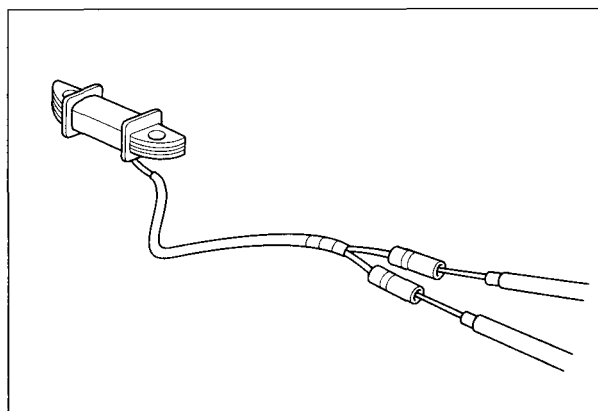
Coil	Wire color	Standard resistance
Charge coil	Gray and Gray	0.2 - 0.3 Ω
Exciter coil	Black and Green	5.0 - 7.4 Ω
SE thermal valve coil	Black/green and Brown	1.2 - 1.8 Ω



• CHARGE COIL (Type with 6A charge coil)

Measure the resistance between the Gray terminals.

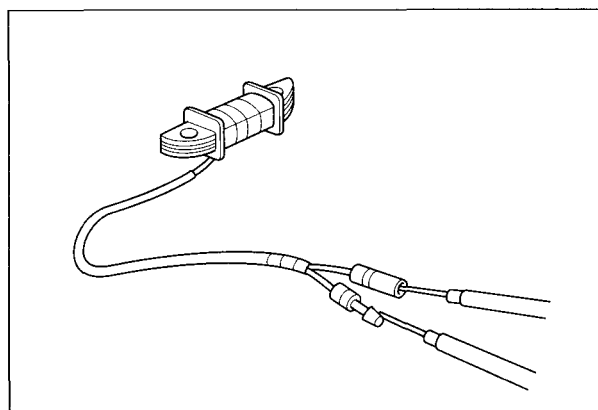
Standard resistance	0.23 - 0.29 Ω
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• EXCITER COIL (Type without electric starter)

Measure the resistance between the Black and Green terminals.

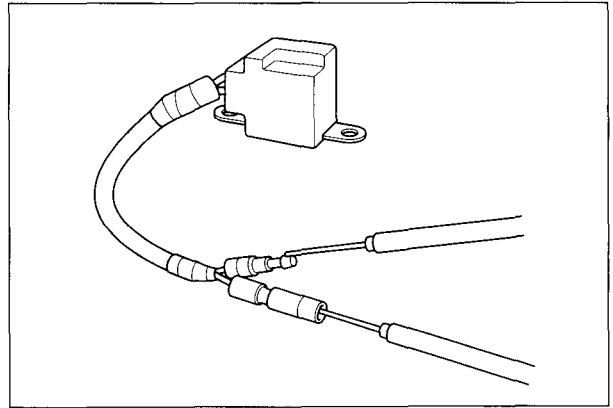
Standard resistance	6.1 - 7.5 Ω
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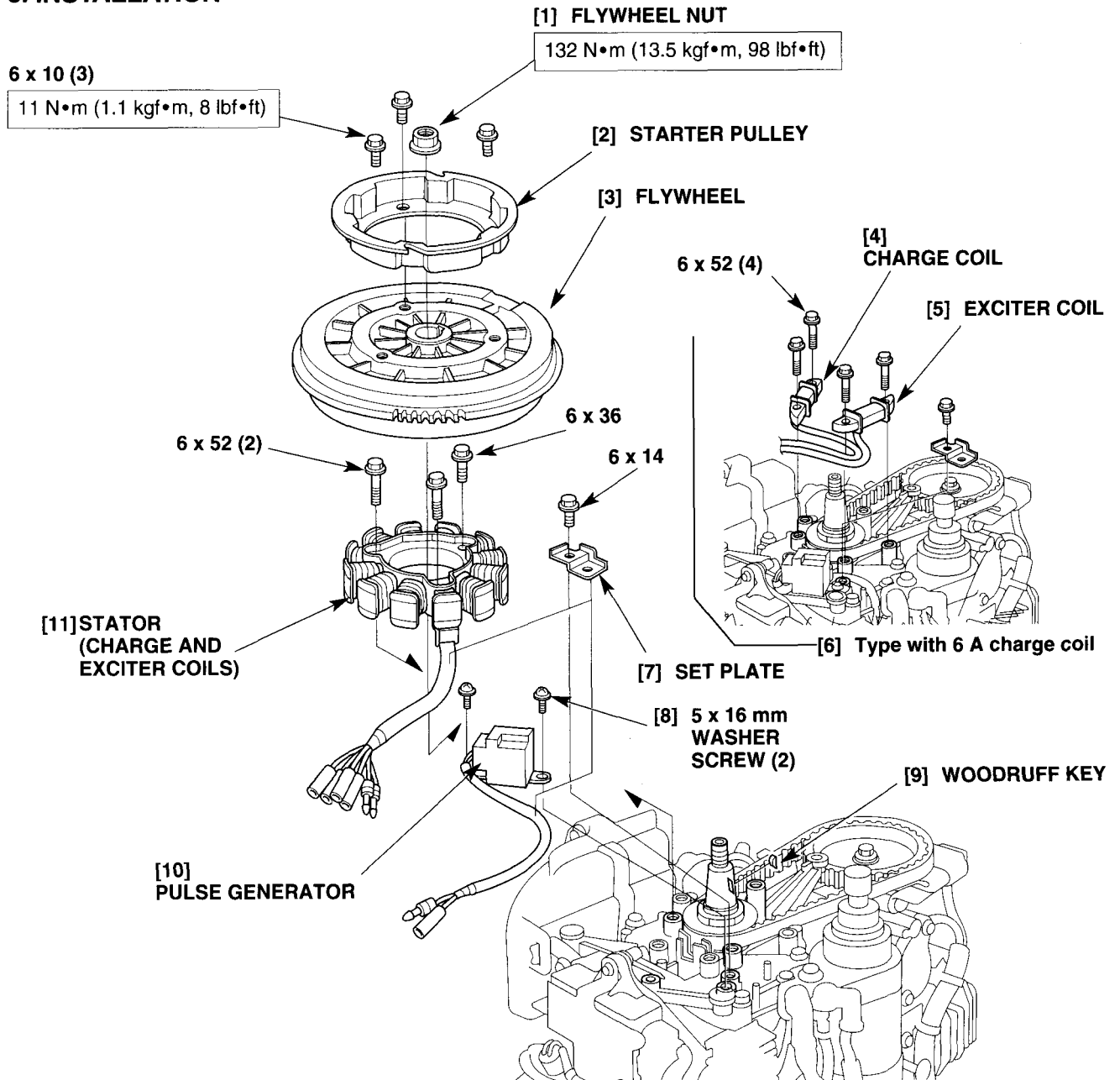
• IGNITION PULSE GENERATOR

Measure the resistance between the Blue and Black terminals.

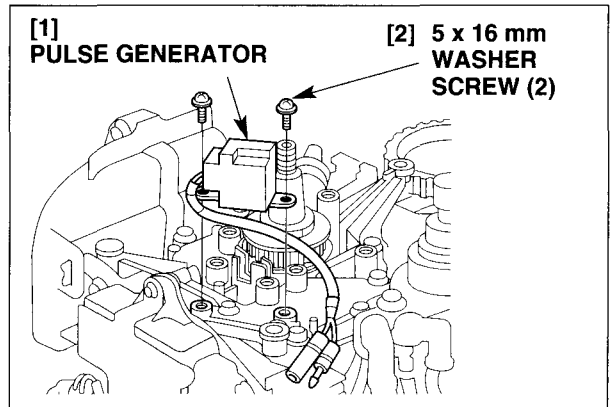
Standard resistance	351 - 429 Ω
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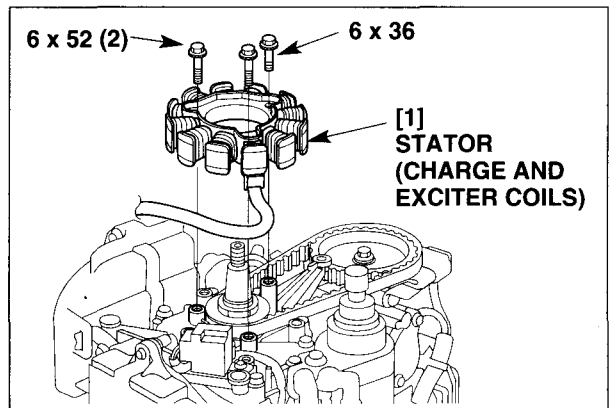
c. INSTALLATION



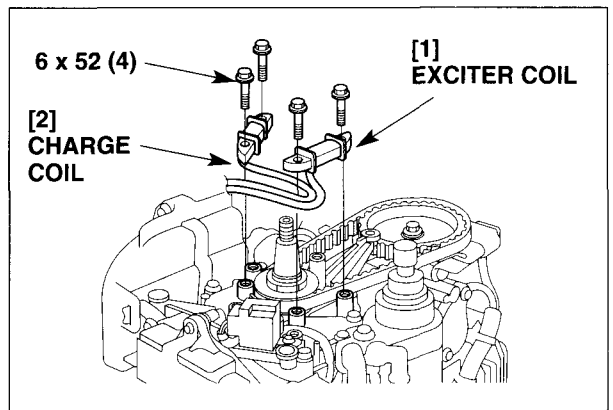
- 1) Route the pulse generator wire under the pulse generator bracket as shown and install the pulse generator.
- 2) Tighten the two 5 x 16 mm washer screws.



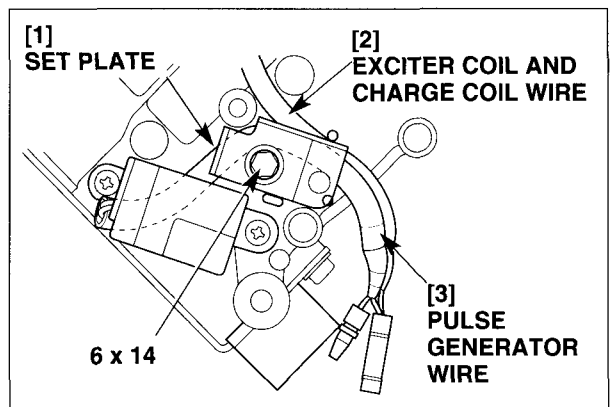
- 3) Install the charge and exciter coils or stator coil:
 12A charge coil type:
 Install the stator coil and tighten the two 6 x 52 mm and one 6 x 36 mm flange bolts.



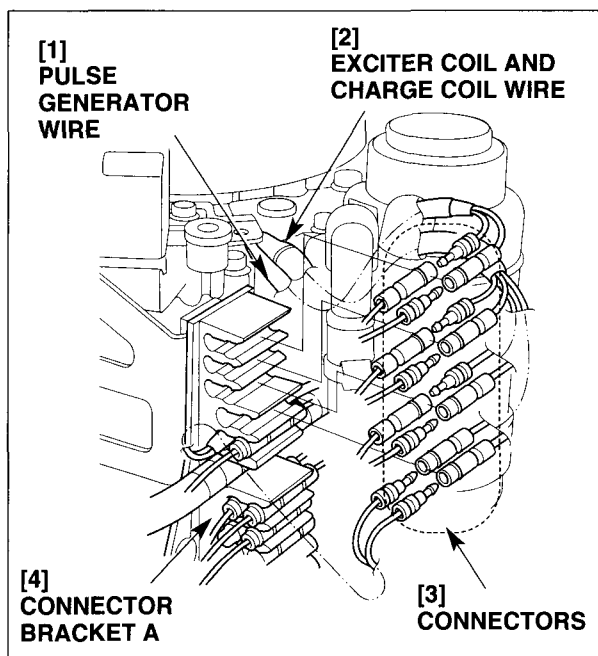
- 6A charge coil type:
 Install the charge and exciter coils and tighten the four 6 x 52 mm flange bolts.



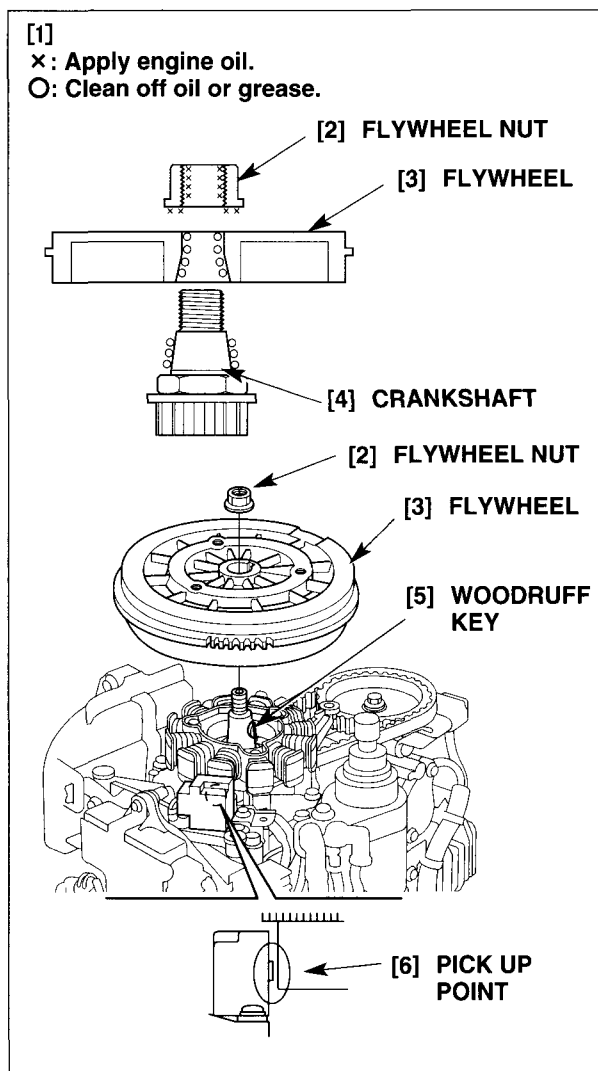
- 4) Route the coil wires on the crankcase as shown and secure them with the set plate and tighten the 6 x 14 mm flange bolt.



- 5) Route the wire harness and connect the charge coil wire connectors. Set the connectors in the connector bracket A.
 - Refer to page 2-31 (Tiller handle type) or 2-33 (Remote control type) for connector location.

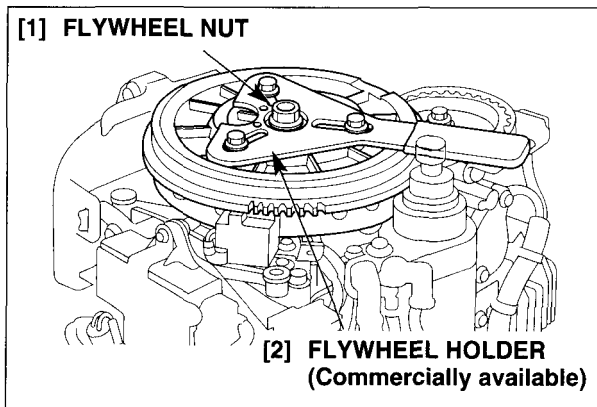


- 6) Clean off oil or grease from the crankshaft and flywheel mating surfaces (tapered section). Make sure that there are no metal objects stuck to the magnets of the flywheel.
- 7) Install the flywheel by aligning the woodruff key on the crankshaft with the key groove of the flywheel taking care not to damage the pick-up point of the ignition pulse generator.
- 8) Apply oil to the thread and seating surface of the flywheel nut and install it to the crankshaft.



- 9) Hold the flywheel using the commercially available flywheel holder and tighten the flywheel nut.

TORQUE: 132 N•m (13.5 kgf•m, 98 lbf•ft)

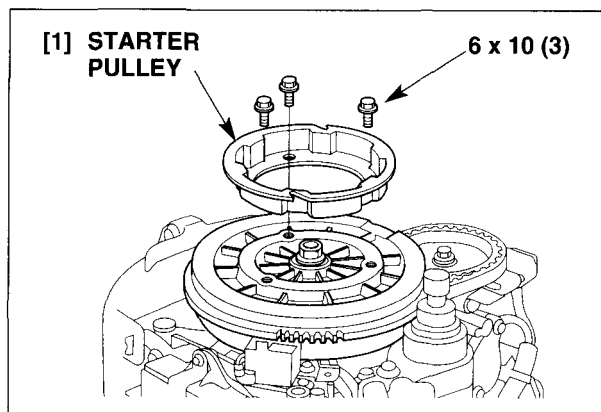


- 10) Remove the flywheel holder. Install the starter pulley and tighten the three 6 x 12 mm flange bolts.

TORQUE: 11 N•m (1.1 kgf•m, 8 lbf•ft)

- 11) Install the following removed parts in the reverse order of removal.

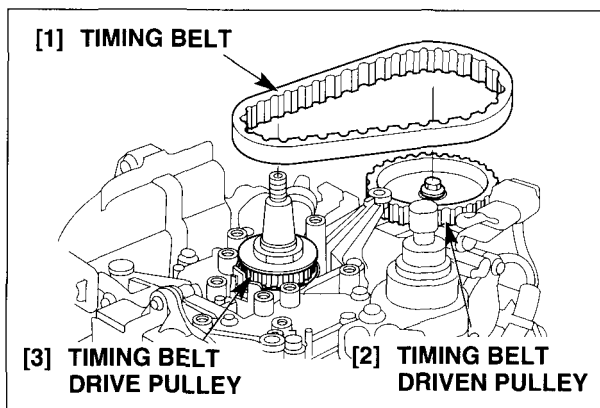
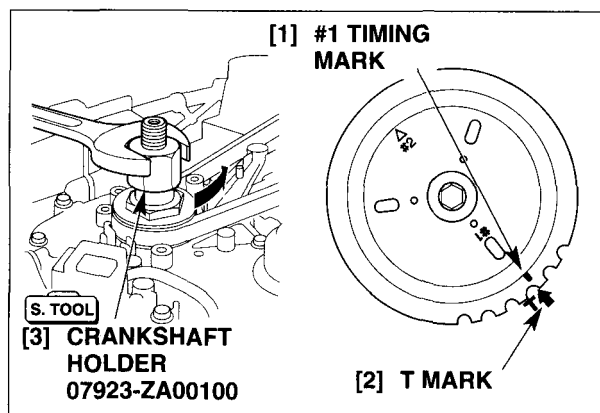
- starter case B (P. 7-10).
- recoil starter (P. 7-9).
- neutral start cable (P. 7-1).
- left and right engine under covers (P. 5-2 and 3).
- engine cover.



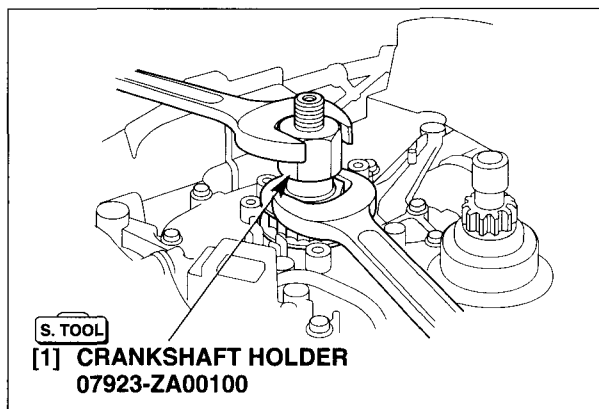
2. TIMING BELT/PULLEYS

a. REMOVAL

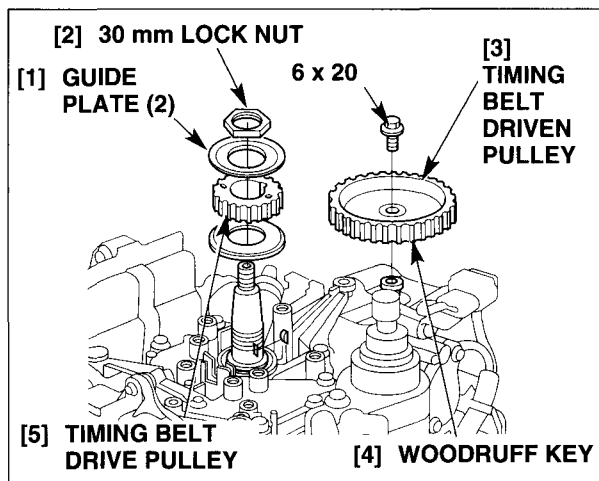
- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
 - right engine under cover (P. 5-3).
 - recoil starter (P. 7-2)
- 2) If it is necessary to remove the timing belt driven pulley, loosen the timing belt driven pulley mounting bolt.
- 3) Remove the flywheel and coils (P. 9-2).
- 4) Turn the crankshaft clockwise using the crankshaft holder (as the arrow marked direction) until the "■" #1 timing mark on the timing belt driven pulley aligns with the "↑T" mark on the cylinder head.
- 5) Remove the timing belt from the timing belt driven pulley first, then remove the timing belt from the timing belt drive pulley.



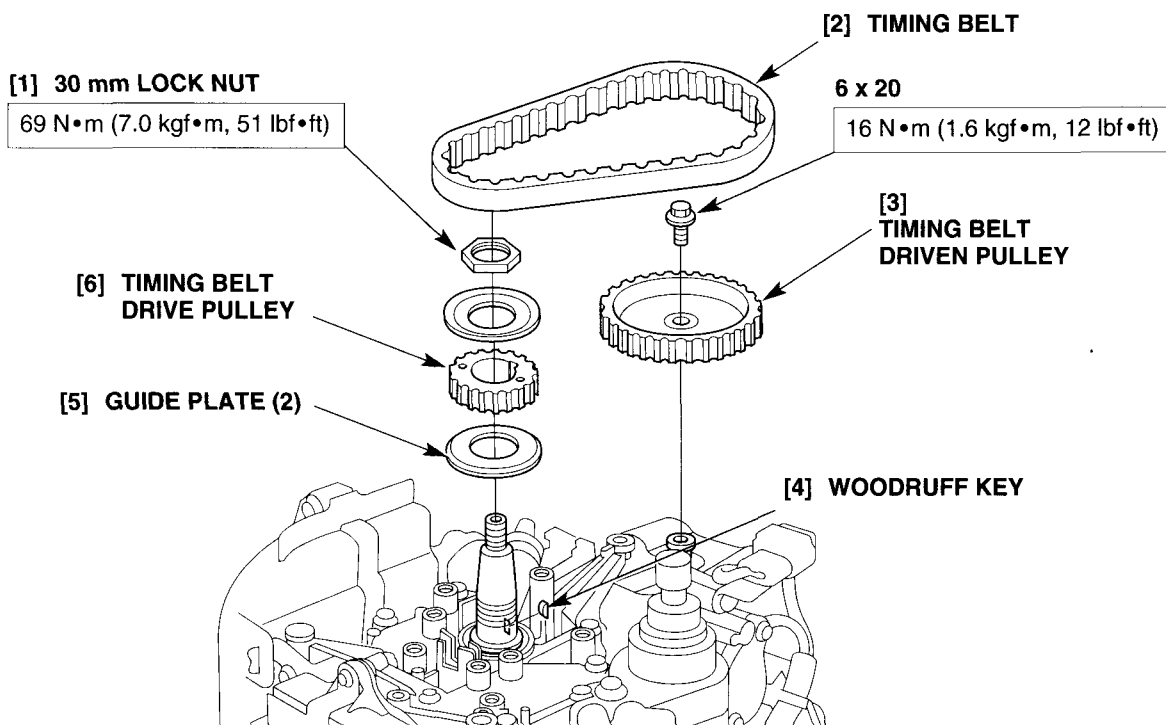
- 6) Hold the crankshaft using the crankshaft holder as shown and loosen the 30 mm lock nut.



- 7) Remove the 30 mm lock nut, timing belt drive pulley, guide plates and woodruff key.
- 8) Remove the 6 x 20 mm flange bolt and timing belt driven pulley

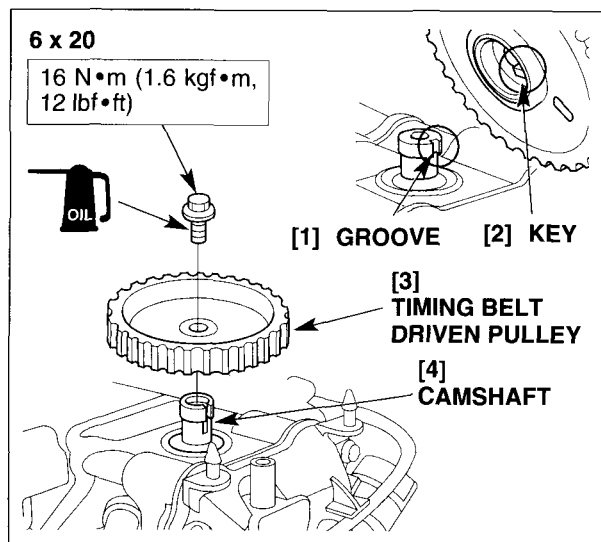


b. INSTALLATION

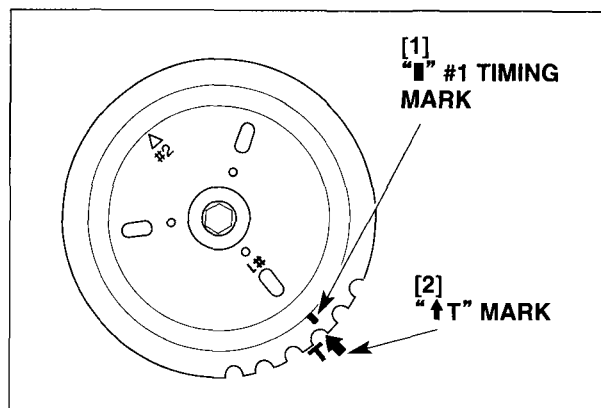


- 1) Disconnect the spark plug caps and remove the spark plugs.
- 2) Install the timing belt driven pulley on the camshaft by aligning the key of the pulley with the key groove of the camshaft.
- 3) Apply oil to the thread and seating surface of the 6 x 20 mm flange bolt and tighten it to the specified torque.

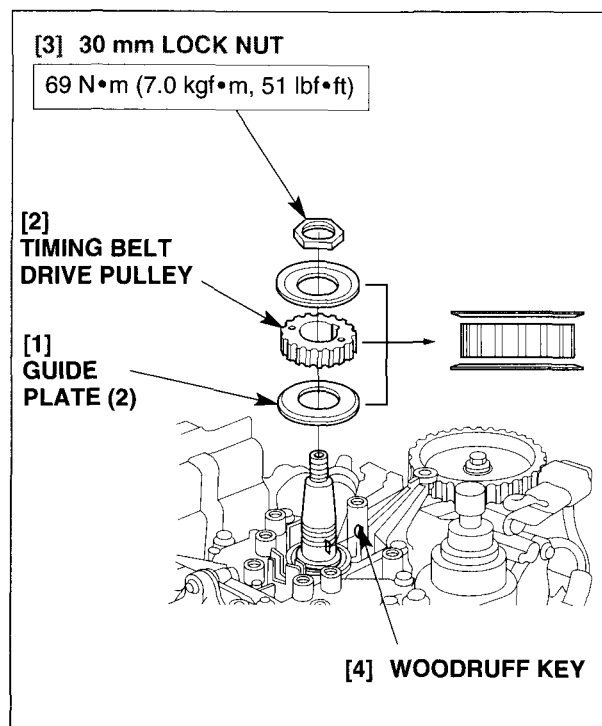
TORQUE: 16 N•m (1.6 kgf•m, 12 lbf•ft)



- 4) Make sure that the "■" #1 timing mark on the timing belt driven pulley aligns with the "↑T" mark on the cylinder head. If necessary align the mark by turning the driven pulley counterclockwise.

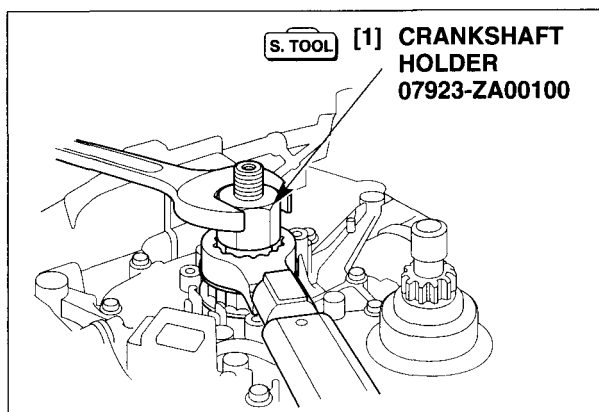


- 5) Install the woodruff key onto the crankshaft and install the timing belt drive pulley and guide plates in the direction shown.
- 6) Apply oil to the thread and seating surface of the 30 mm lock nut, and install it loosely onto the crankshaft.

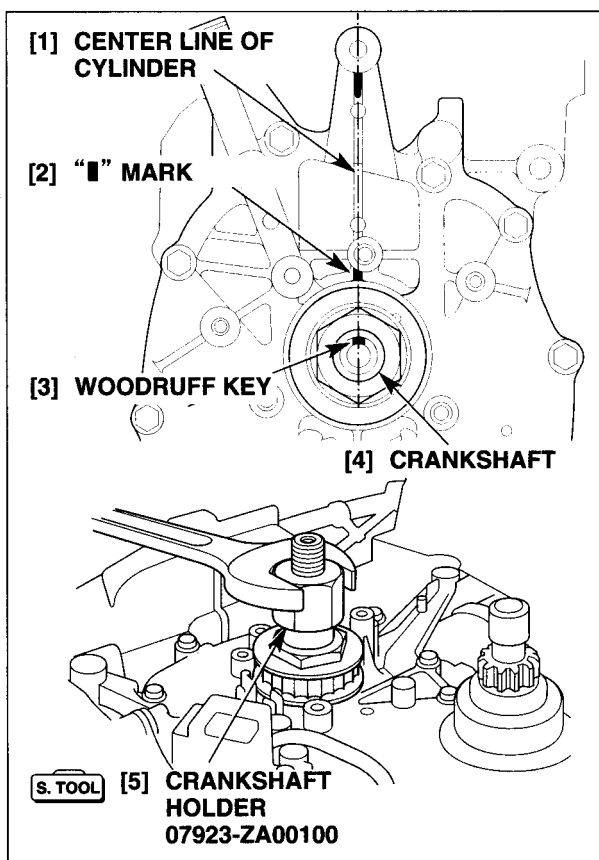


- 7) Hold the crankshaft with the crankshaft holder and tighten the 30 mm lock nut to the specified torque.

TORQUE: 69 N·m (7.0kgf·m, 51 lbf·ft)

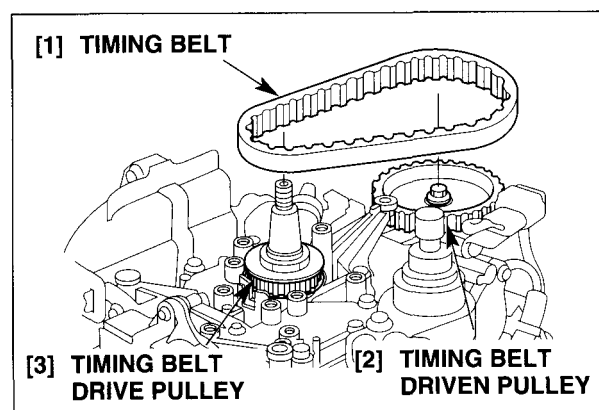


- 8) Make sure that the woodruff key on the crankshaft aligns with the center line of the cylinder as shown (woodruff key should align with the “■” mark on the crankcase cover). If necessary, turn the crankshaft clockwise using the crankshaft holder.



- 9) Check the timing belt, replace the timing belt if it is worn or damaged. Check the timing belt and the related parts for oil and grease. If contaminated with oil or grease, clean the parts and replace the timing belt with new one.

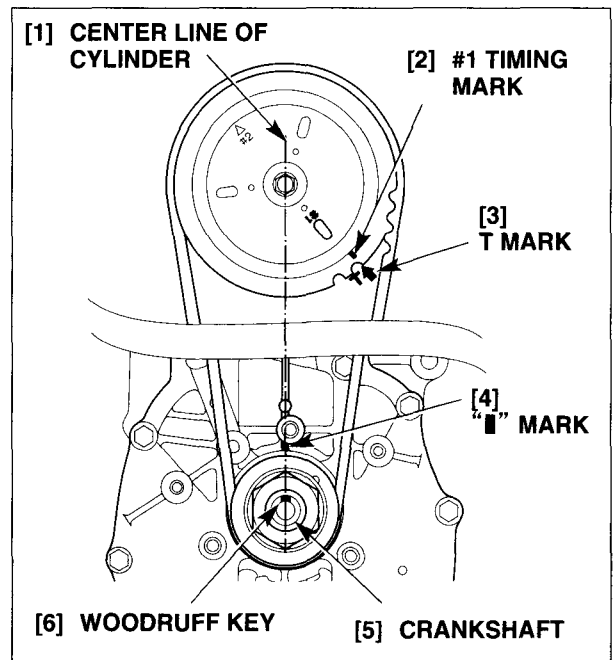
- 10) Install the timing belt on the timing belt drive pulley first and then on the driven pulley taking care not to allow the alignment marks to come out of alignment.



11) After installation, be sure that the alignment marks are in the proper alignment.

12) Reinstall the removed parts:

- flywheel (P. 9-9).
- pulse generator (P. 9-6).
- charge coil (P. 9-6)
- starter case B (P. 7-10).
- recoil starter (P. 7-9).
- neutral start cable (P. 7-1).
- left and right engine under covers (P. 5-2 and 3).
- engine cover.

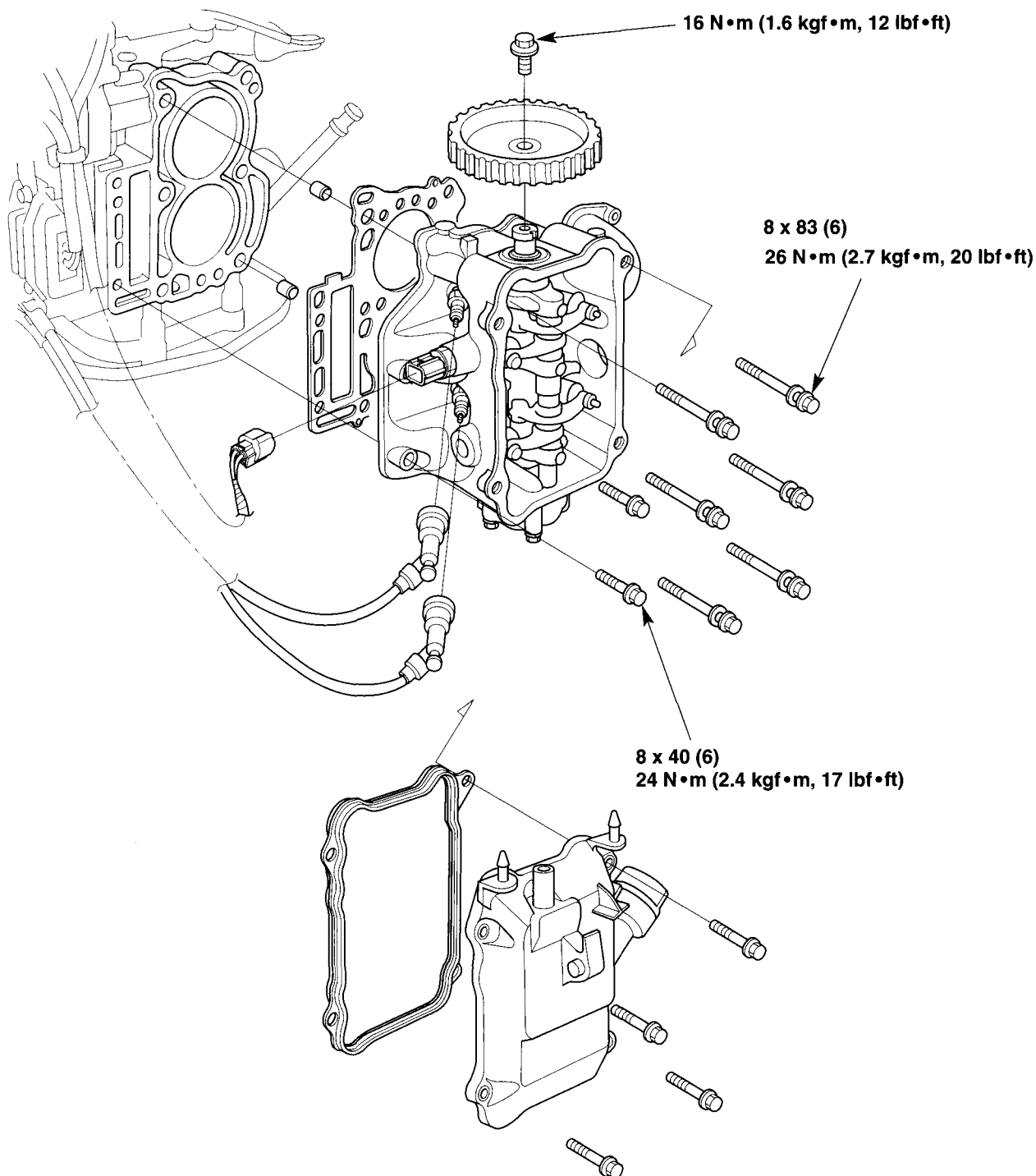


10. CYLINDER HEAD/VALVES/OIL PUMP

BF15D·BF20D

1. CYLINDER HEAD REMOVAL
2. OIL PUMP
3. CYLINDER HEAD DISASSEMBLY

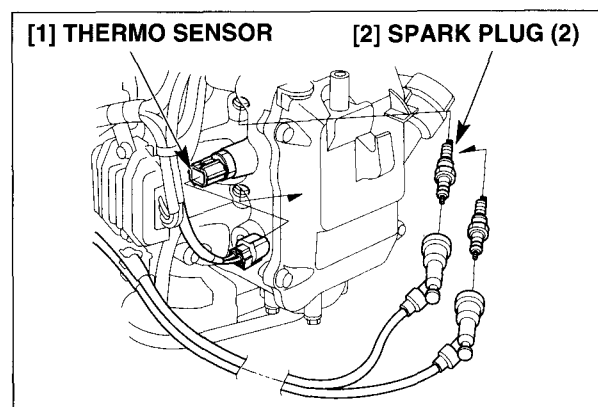
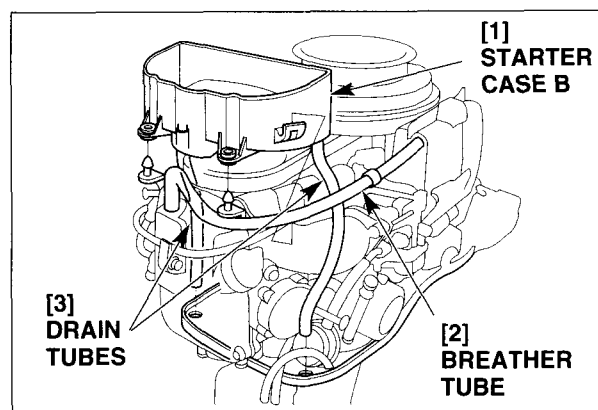
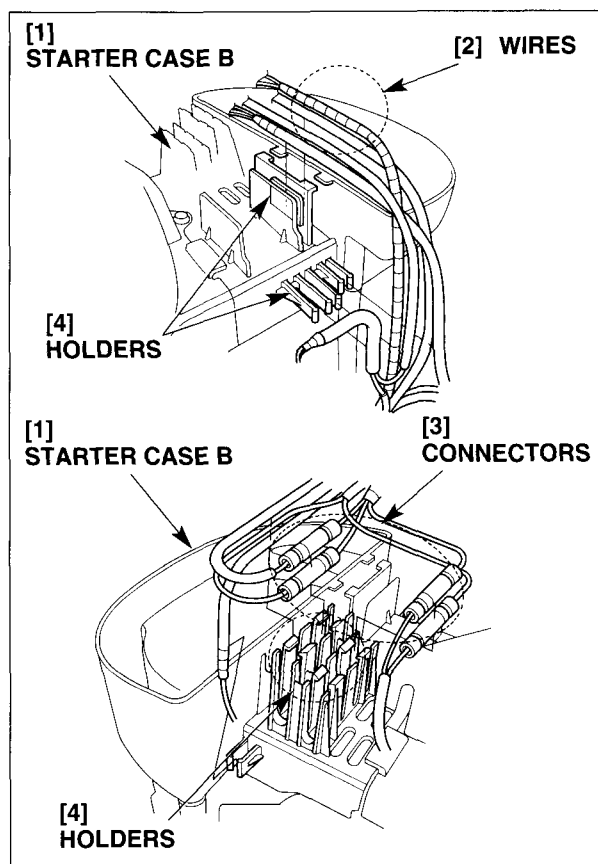
4. VALVE SEAT REFACING
5. CYLINDER HEAD ASSEMBLY
6. CYLINDER HEAD INSTALLATION



1. CYLINDER HEAD REMOVAL

Cylinder head assembly can be serviced with the engine installed on the frame.

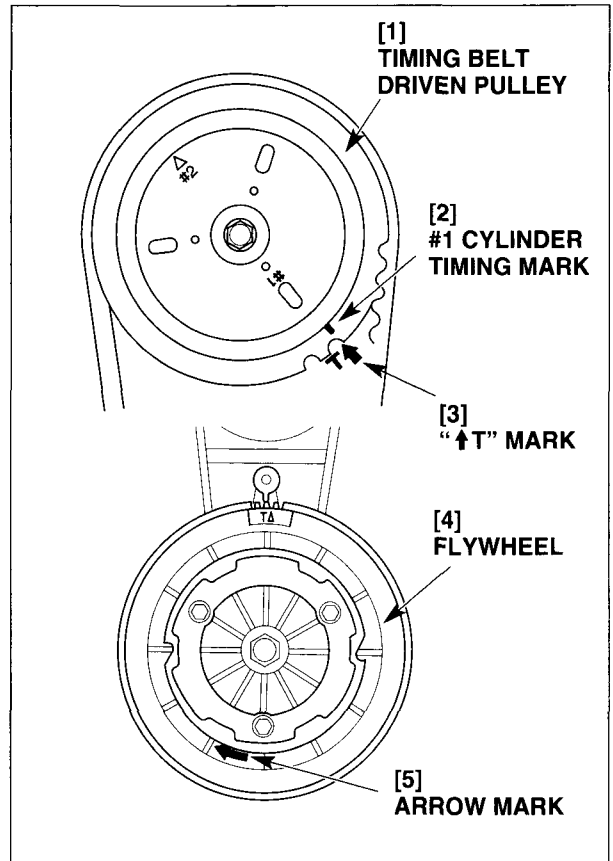
- 1) Remove the oil filler cap and oil drain bolt, and drain the engine oil into a suitable container (P. 3-3).
 - 2) Remove the following parts:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
 - right engine under cover (P. 5-3).
 - recoil starter (P. 7-2).
 - 3) Pull out the connectors and wires from the holder on the starter case B
- 4) Pull off the breather tube from the clamp on the starter case B and remove it. Disconnect the breather tube from the cylinder head cover.
 - 5) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.
 - 6) Remove the silencer and carburetor (P. 6-2) and fuel pump (P. 6-17).
 - 7) Disconnect the thermo sensor connector and spark plug caps, and remove the spark plugs.



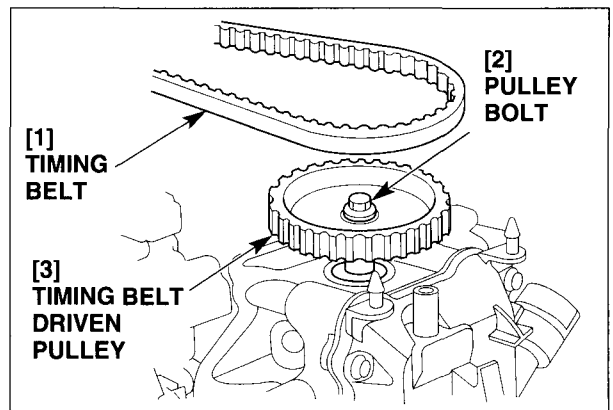
- 8) Loosen the timing belt driven pulley mounting bolt.
- 9) Turn the crankshaft clockwise by turning the flywheel clockwise (in the arrow marked direction) until the “■” #1 timing mark on the timing belt driven pulley aligns with the “↑T” mark on the cylinder head.

NOTICE

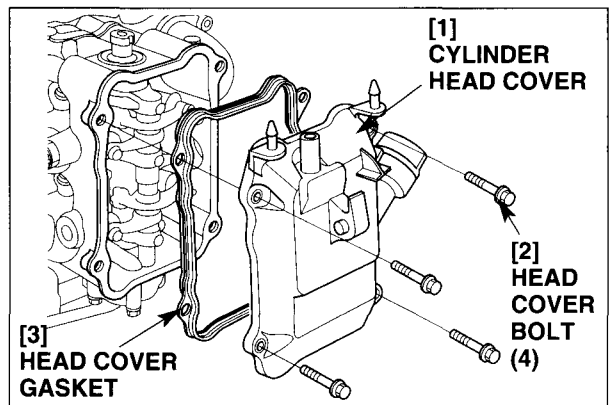
Don't turn the flywheel counterclockwise or the water pump may be damage.



- 10) Remove the timing belt from the timing belt driven pulley taking care not to damage the timing belt.
- 11) Remove the pulley bolt and timing belt driven pulley

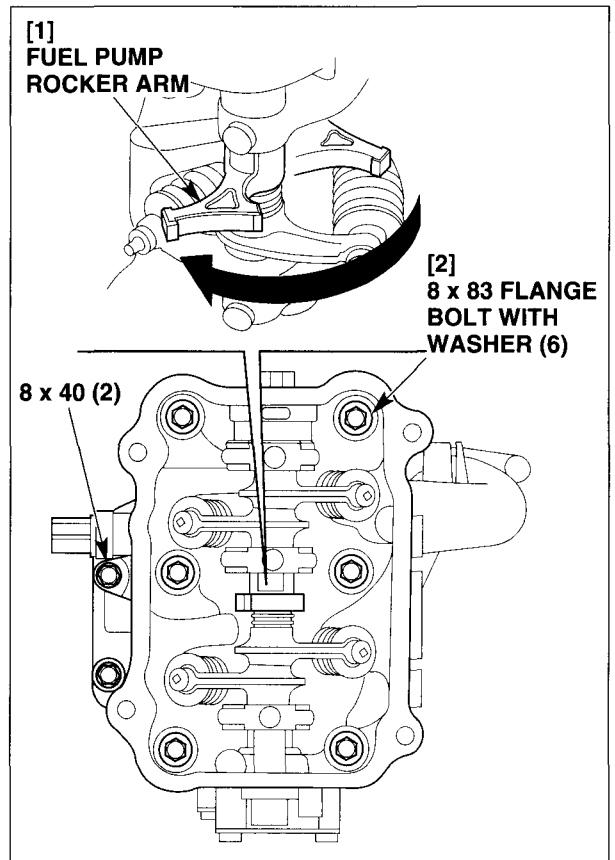


- 12) Remove the four head cover bolts, cylinder head cover and head cover gasket.

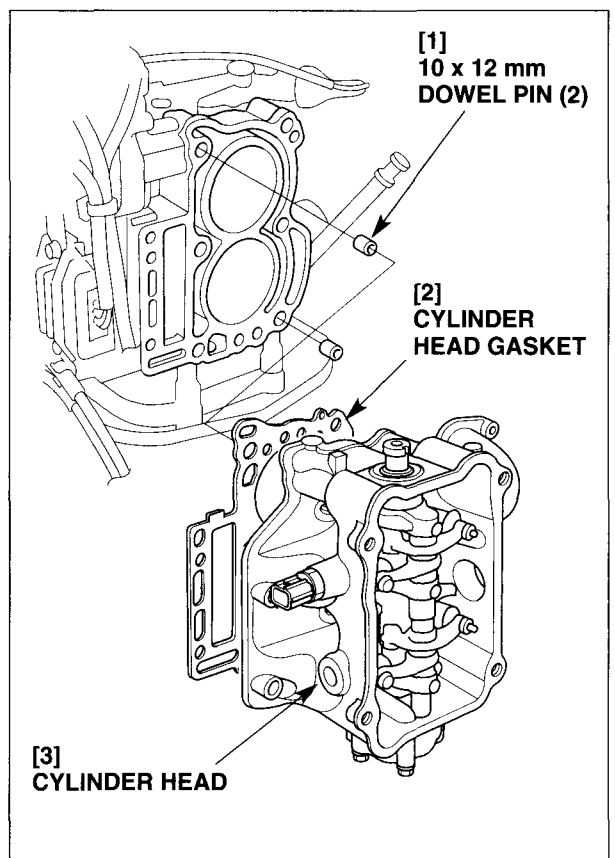


13) Turn the fuel pump lifter as shown.

14) Loosen the cylinder head bolts in a crisscross pattern in 2 - 3 steps, then remove the cylinder head bolts.



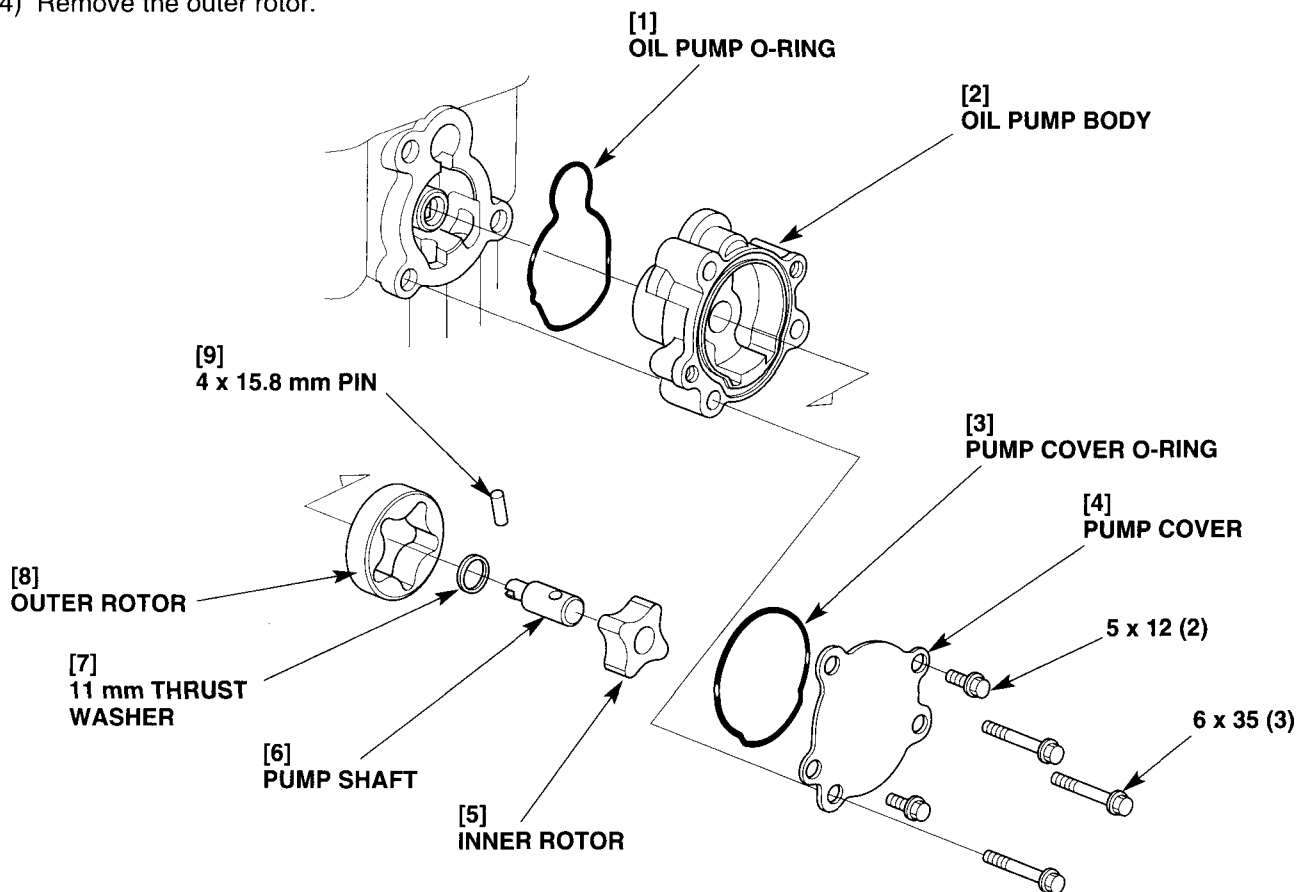
15) Remove the cylinder head, gasket and dowel pins.



2. OIL PUMP

a. DISASSEMBLY

- 1) Remove the three 6 x 35 mm flange bolts and remove the oil pump assembly and oil pump O-ring. Discard the O-ring, replace with new one when reassembly.
- 2) Remove the two 5 x 12 mm flange bolts and remove the oil pump cover and cover O-ring. Discard the O-ring, replace with new one when reassembly.
- 3) Remove the inner rotor, pump shaft, 4 x 15.8 mm pin and 11 mm thrust washer.
- 4) Remove the outer rotor.

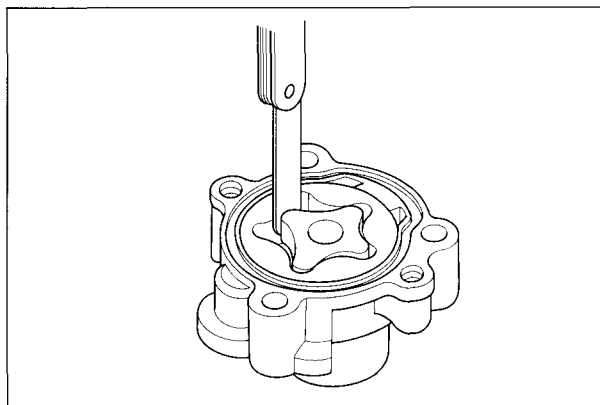


b. INSPECTION

• ROTOR-TIP CLEARANCE

Measure the oil pump rotor tip clearance with the pump shaft installed.

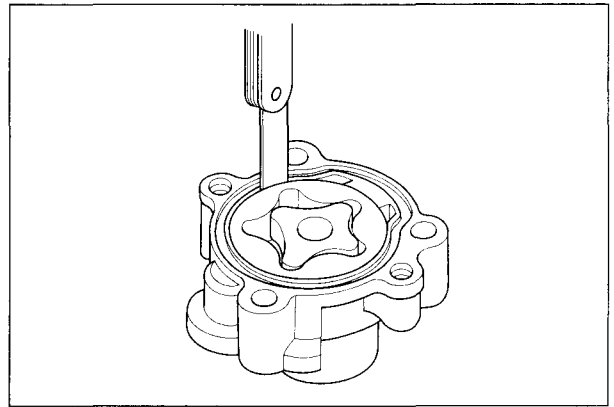
Standard	Service limit
15 mm (0.6 in) max.	0.20 mm (0.008 in)



• OUTER ROTOR-TO-BODY CLEARANCE

Measure the outer rotor-to-body clearance with the pump shaft installed.

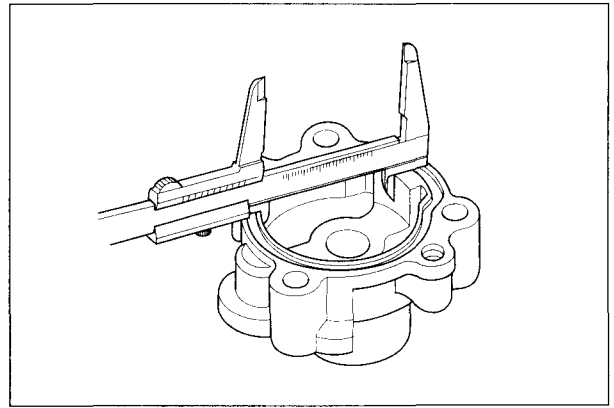
Standard	Service limit
0.15 - 0.21 mm (0.006 - 0.008 in)	0.26 mm (0.010 in)



• OIL PUMP BODY I.D.

Measure the pump body I.D.

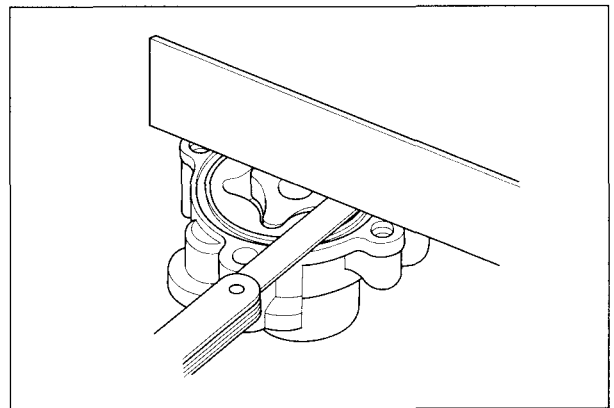
Standard	Service limit
40.71 - 40.74 mm (1.603 - 1.604 in)	40.76 mm (1.605 in)



• ROTOR-TO-BODY SIDE CLEARANCE

Measure the rotor-to-body side clearance.

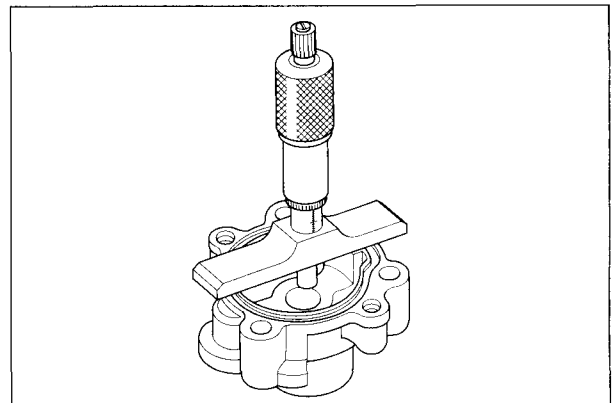
Standard	Service limit
0.04 - 0.09 mm (0.002 - 0.004 in)	0.12 mm (0.005 in)



• OIL PUMP BODY DEPTH

Measure the pump body depth.

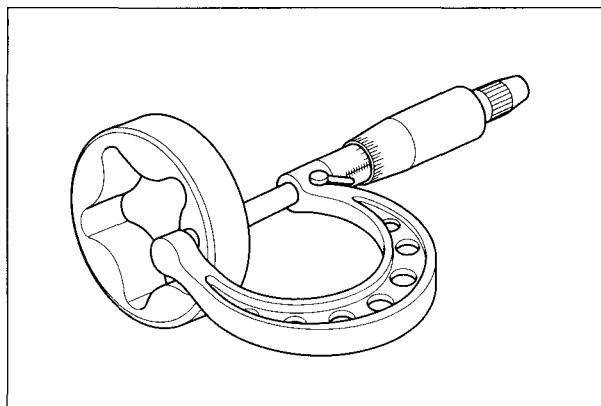
Standard	Service limit
12.04 - 12.07 mm (0.474 - 0.475 in)	12.11 mm (0.477 in)



• **OUTER ROTOR HEIGHT**

Measure the outer rotor height.

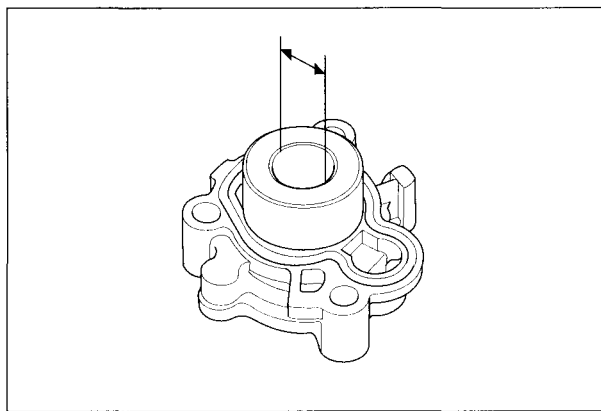
Standard	Service limit
11.98 - 12.00 mm (0.4717 - 0.4724 in)	11.96 mm (0.471 in)



• **CAMSHAFT JOURNAL I.D.**

Measure and record the oil pump body camshaft journal I.D.

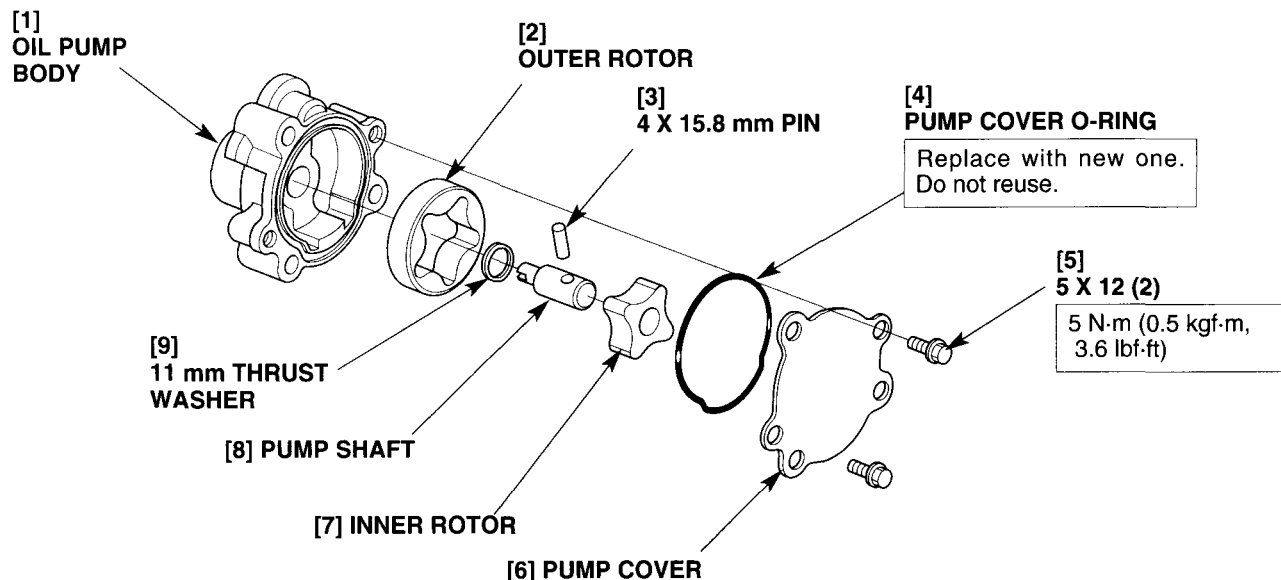
Standard	Service limit
16.000 - 16.018 mm (0.6299 - 0.6306 in)	16.05 mm (0.632 in)



c. ASSEMBLY

- 1) Clean the all disassembled parts with solvent.
- 2) Install the 4 x 15.8 mm pin to the oil pump shaft.
- 3) Install the 11 mm thrust washer, pump shaft with the 4 mm pin attached to the inner rotor by aligning the pin with the groove of the inner rotor.
- 4) Install the outer rotor, and install the inner rotor with the pump shaft, washer, and pin attached to the pump body.
- 5) Install a new pump cover O-ring and pump cover, then tighten the 5 x 12 mm flange bolts.

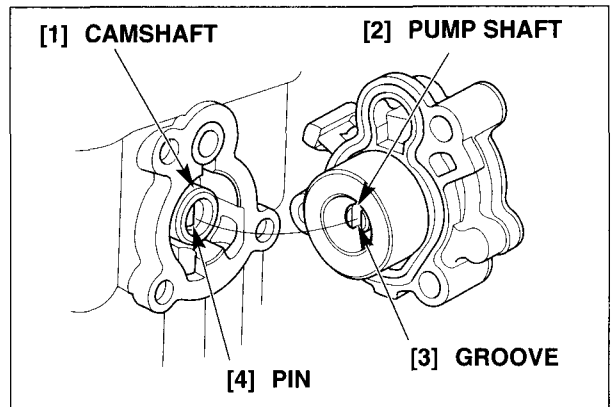
TORQUE: 5 N·m (0.5 kgf·m, 3.6 lbf·ft)



c. INSTALLATION

- 1) Install a new oil pump O-ring to the oil pump body.
- 2) Install the oil pump assembly by aligning the groove of the oil pump shaft with the pin on the camshaft as shown.
- 3) Tighten the three 6 x 35 mm flange bolt to the specified torque.

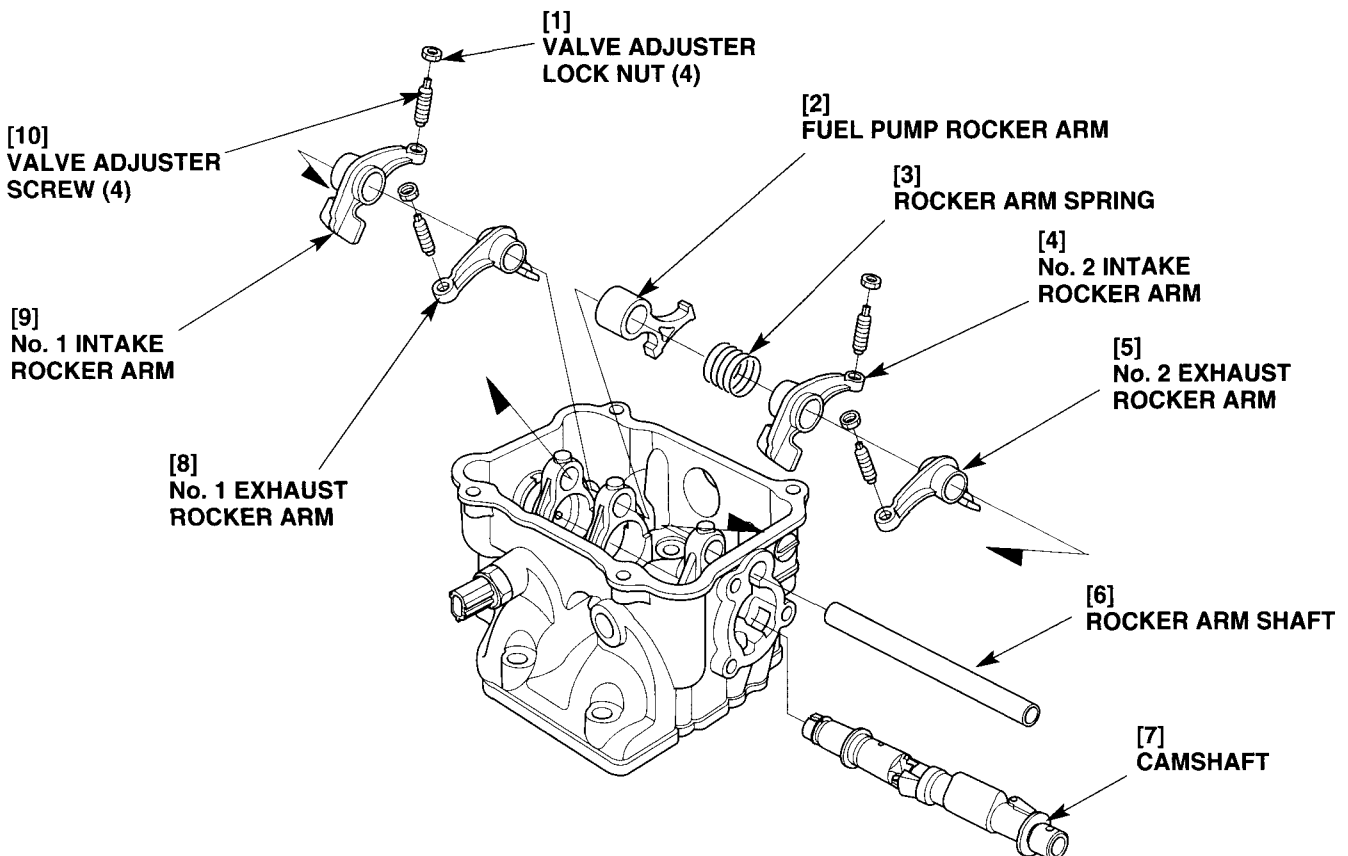
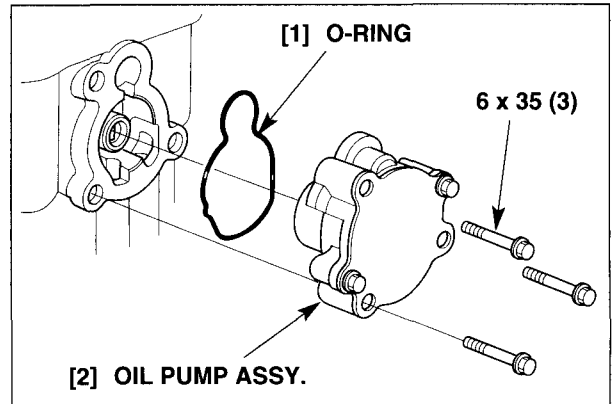
TORQUE: 11 N•m (1.1 kgf•m, 8 lbf•ft)



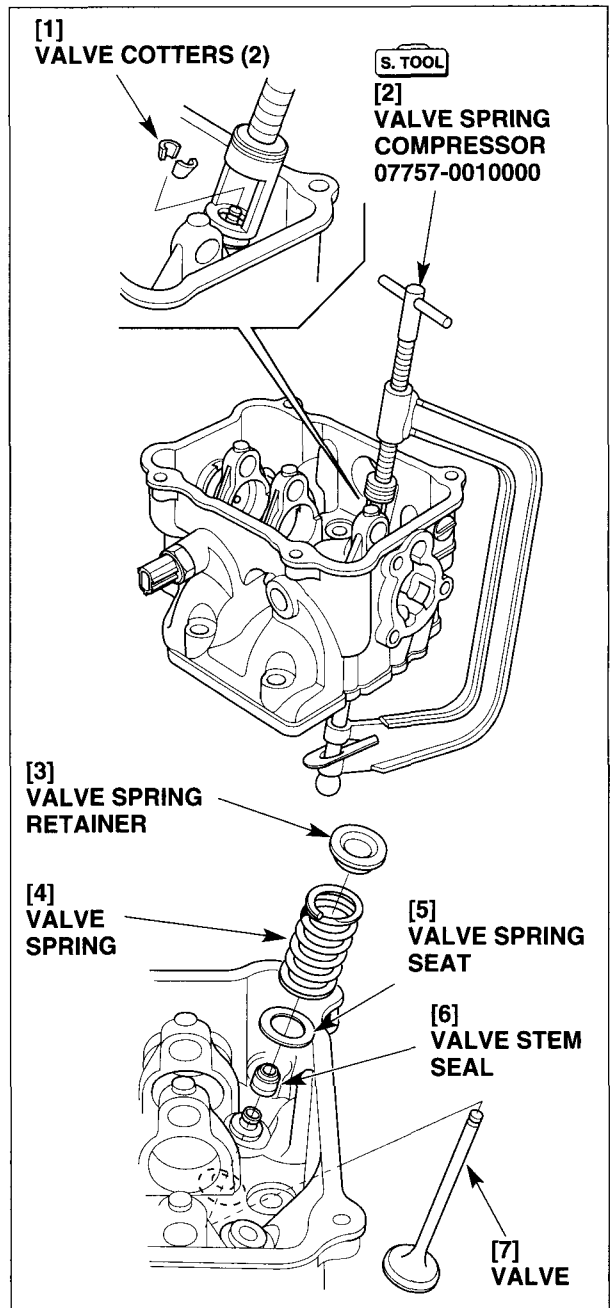
3. CYLINDER HEAD DISASSEMBLY

Before removing the cylinder head, check the camshaft axial play (P. 10-10).

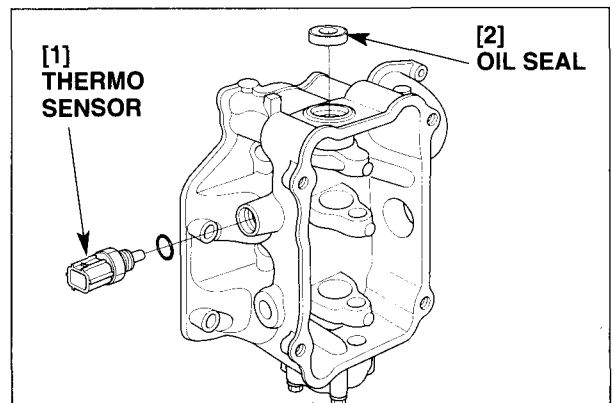
- 1) Remove the three 6 x 35 mm flange bolts oil pump and O-ring.
- 2) Loosen the all valve adjust lock nuts and valve adjusters firmly.
- 3) Pull the rocker arm shaft slowly, and remove the rocker arms, spring, and fuel pump lifter.
 - Mark the rocker arm shaft and all rocker arms so they can be placed back in their original position.
- 4) Remove the camshaft.



- 5) Set the valve spring compressor and compress the valve spring.
- 6) Remove the valve cotters, then release the valve spring compressor and remove the spring retainer, valve spring, valve spring seat and valve. Remove the valve stem seal if necessary.
 - Valve stem seal must be replaced with new one when disassembled.
 - Store all parts according the cylinder so they can be placed back in their original position.



- 7) Inspect the oil seal for damage, replace if necessary.
- 8) Remove the thermo sensor.

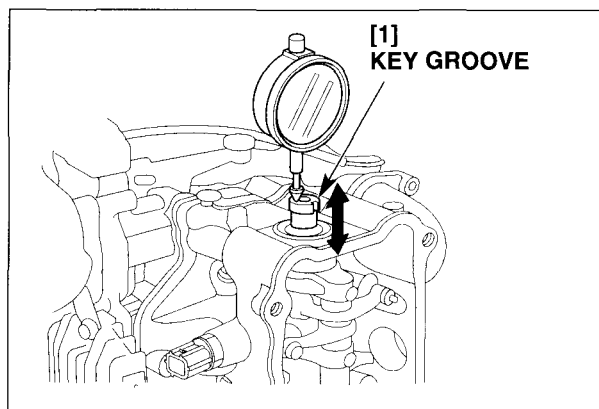


a. INSPECTION

• CAMSHAFT AXIAL PLAY

• Perform this inspection with the rocker arms, rocker arm shaft, and oil pump installed.

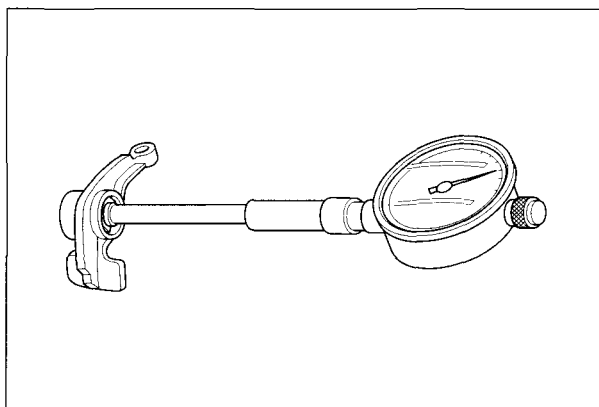
- 1) Loosen the valve adjust lock nuts and valve adjusters fully.
- 2) Turn the camshaft so the key groove facing toward the cylinder head cover as shown.
- 3) Measure the camshaft axial play with a dial indicator by moving the camshaft up and down.



Standard	Service limit
0.05 - 0.20 mm (0.002 - 0.008 in)	0.30 mm (0.012 in)

• ROCKER ARMS

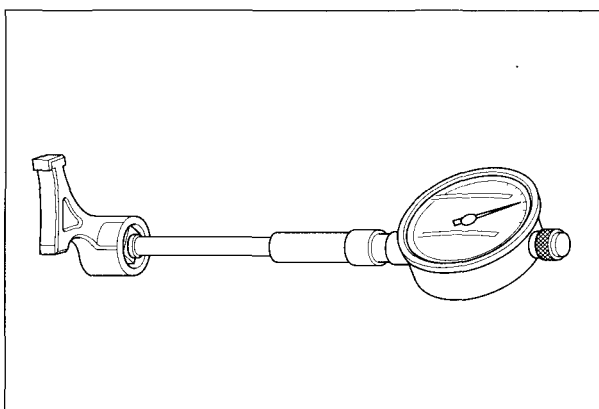
- 1) Inspect the sliding surface of the rocker arms for wear or damaged where they contact the camshaft.
- 2) Inspect the contact surface of the valve adjuster for wear or damage.
- 3) Measure and record the I.D. of the rocker arm.



Standard	Service limit
13.000 - 13.018 mm (0.5118 - 0.5125 in)	13.04 mm (0.513 in)

• FUEL PUMP ARM

- 1) Inspect the sliding surface of the fuel pump lifter for wear or damaged where they contact the camshaft.
- 2) Measure and record the I.D. of the fuel pump lifter.



Standard	Service limit
13.000 - 13.080 mm (0.5118 - 0.5150 in)	13.10 mm (0.516 in)

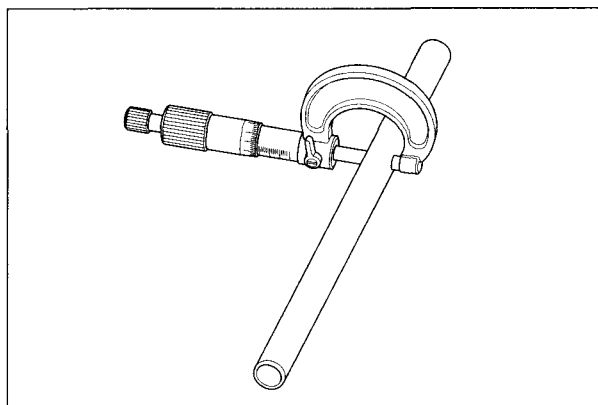
• ROCKER ARM SHAFT

- 1) Measure and record the O.D. of the rocker arm shaft.

Standard	Service limit
12.962 - 12.980 mm (0.5103 - 0.5110 in)	12.92 mm (0.509 in)

- 2) Calculate the rocker arm shaft-to-rocker arm and fuel pump lifter-to-rocker arm shaft clearance.

	Standard	Service limit
Rocker arm-to-shaft	0.020 - 0.056 mm (0.0008 - 0.0022 in)	0.07 mm (0.003 in)
Fuel pump arm-to-shaft	0.020 - 0.118 mm (0.0008 - 0.0046 in)	0.13 mm (0.005 in)



• CAMSHAFT

- 1) Inspect that the decompressor weight moves smoothly, and spring is not weak or worn.
 2) Inspect the cam lobe surface for scoring or evidence of insufficient lubrication. Measure the cam lobe height.

	Standard	Service limit
BF15D	23.725 - 23.885 mm (0.9340 - 0.9404 in)	23.103 mm (0.9096 in)
BF20D	24.976 - 25.136 mm (0.9833 - 0.9896 in)	24.493 mm (0.9643 in)

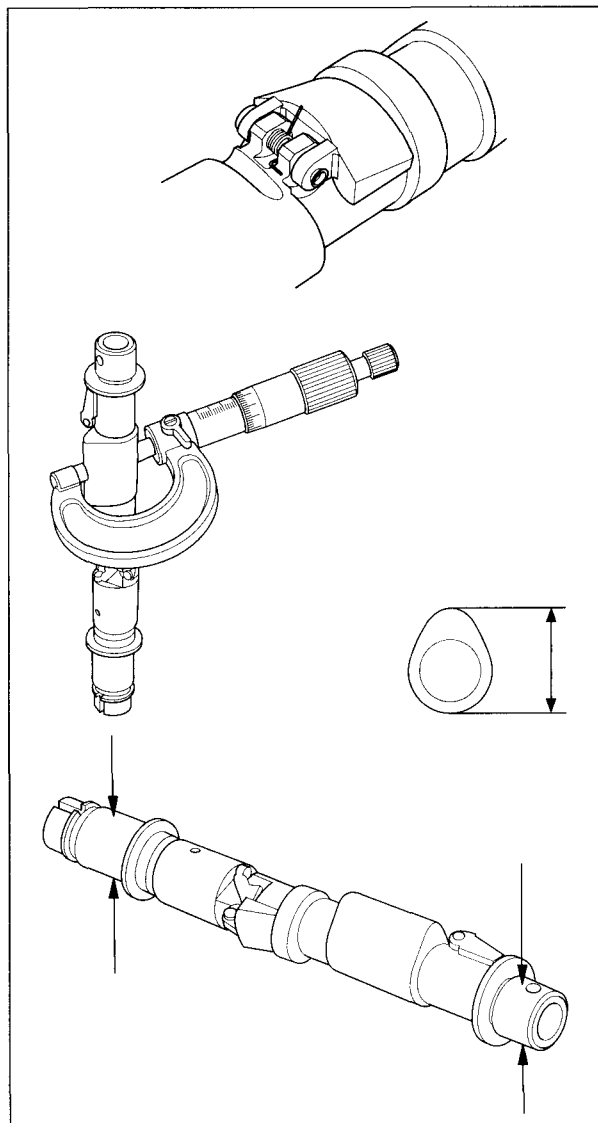
- Inspect the rocker arm if the cam lobe is worn or damaged.

- 2) Inspect the camshaft journal surface for wear or damage. Measure and record the camshaft journal O.D.

	Standard	Service limit
No. 1	19.959 - 19.980 mm (0.7858 - 0.7866 in)	19.93 mm (0.785 in)
Oil pump	15.966 - 15.984 mm (0.6286 - 0.6293 in)	15.94 mm (0.628 in)

- 3) Calculate the camshaft-to-oil pump body clearance.

Standard	Service limit
0.016 - 0.052 mm (0.0006 - 0.0020 in)	0.07 mm (0.003 in)



• CYLINDER HEAD

- 1) Remove the carbon deposits from the combustion chamber.
- 2) Check the spark plug hole and valve are for cracks.
- 3) Check the cylinder head for warpage with a straight edge and feeler gauge.

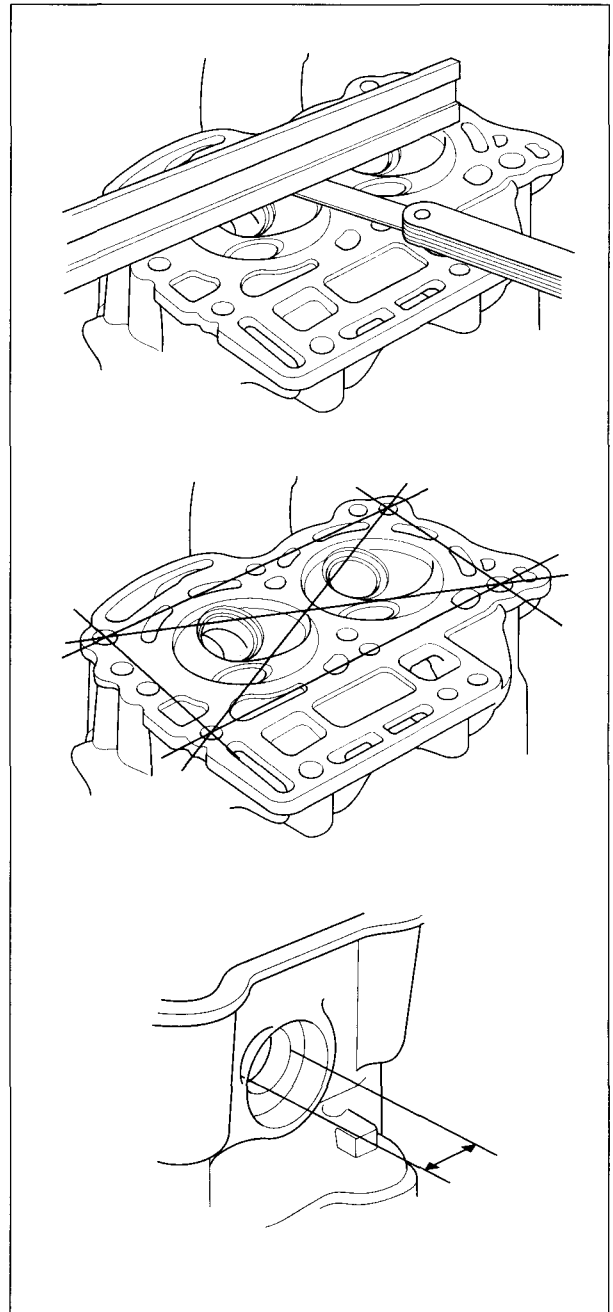
Standard	Service limit
0.05 mm (0.002 in)	0.08 mm (0.003 in)

- 4) Measure and record the camshaft journal I.D.

	Standard	Service limit
No. 1	20.000 - 20.021 mm (0.7874 - 0.7882 in)	20.05 mm (0.785 in)

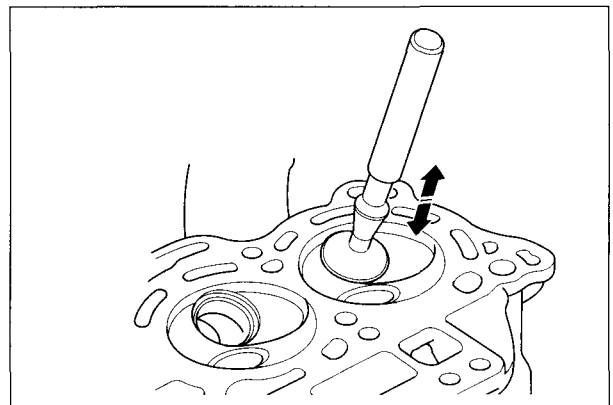
- 5) Calculate the camshaft-to-cylinder head clearance.

	Standard	Service limit
No. 1	0.020 - 0.062 mm (0.0008 - 0.0024 in)	0.08 mm (0.003 in)



• VALVE SEATS

- 1) Thoroughly clean the combustion chamber and valve seats to remove carbon deposits.
- 2) Apply a light coat of Prussian Blue compound or erasable felt-tipped marker ink to the valve seats.
- 3) Insert the valves, and then lift them and snap them closed against their seats several times. Be sure the valve does not rotate on the seat. The transferred marking compound will show any area of the seat.

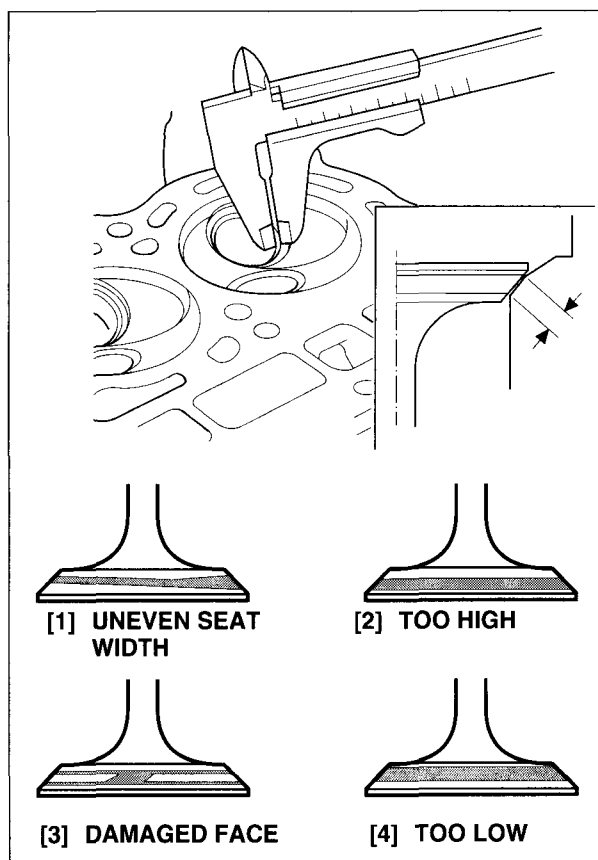


- 4) Remove and inspect the valve seat face. The valve seat contact should be within the specified width and even all around the circumference.

Standard	Service limit
1.0 mm (0.04 in)	2.0 mm (0.08 in)

Inspect the valve seat face for:

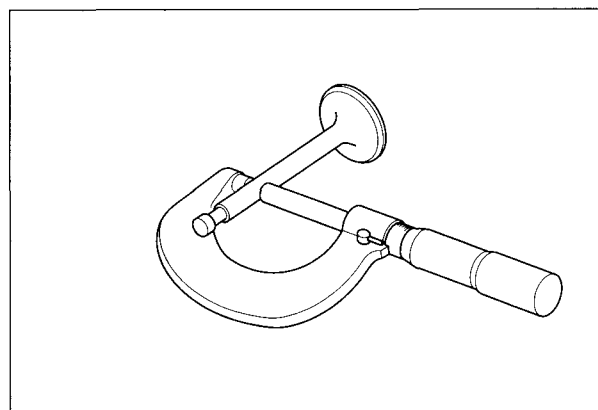
- Uneven seat width: replace the valve and reface the valve seat.
- Damaged face: replace the valve and reface the valve seat.
- Contact area too high or too low: reface the valve seat (P. 10-14).
- The valve cannot be ground. If the valve face is burned or badly worn or if it contacts the seat unevenly, replace the valve.



• VALVES

- 1) Inspect each valve for bending, burning or abnormal seat wear.
- 2) Insert the valve in the guide and check the valve movement.
- 3) Measure and record the valve stem O.D.

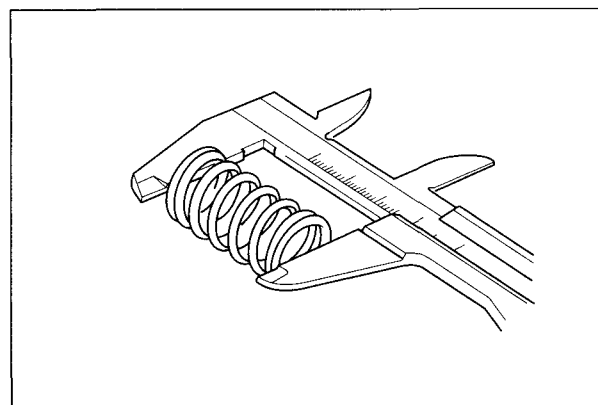
	Standard	Service limit
Intake	4.975 - 4.990 mm (0.1959 - 0.1965 in)	4.95 mm (0.195 in)
Exhaust	4.955 - 4.970 mm (0.1951 - 0.1957 in)	4.93 mm (0.194 in)



• VALVE SPRING FREE LENGTH

Measure the valve spring free length.

Standard	Service limit
33.28 mm (1.310 in)	32.0 mm (1.26 in)



• VALVE GUIDES

- 1) Ream the valve guide to remove any deposits before checking the valve guide I.D.
 - Insert the valve guide reamer from the combustion chamber side of the head and always rotate the reamer clockwise.
- 2) Measure and record the valve guide I.D.

	Standard	Service limit
Intake	5.000 - 5.012 mm (0.1969 - 0.1973 in)	5.04 mm (0.198 in)
Exhaust	5.000 - 5.012 mm (0.1969 - 0.1973 in)	5.04 mm (0.198 in)

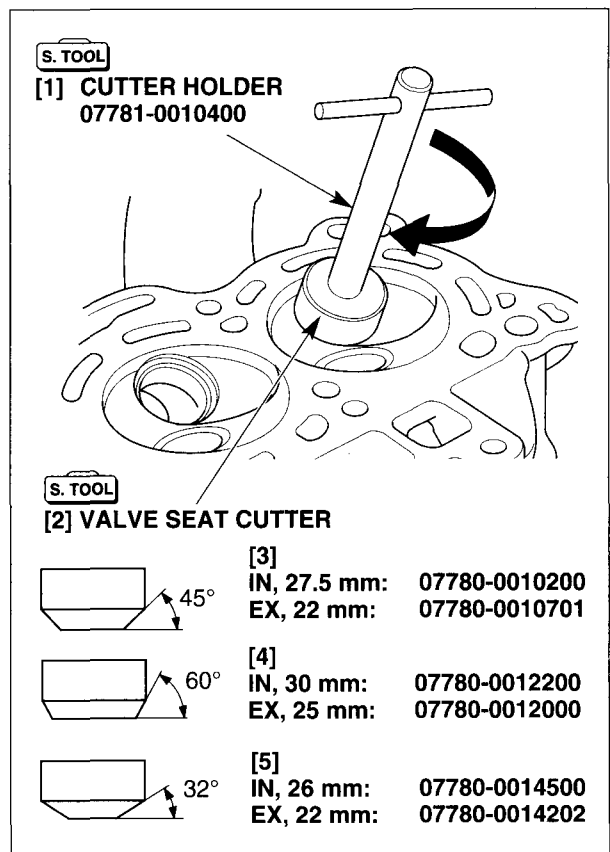
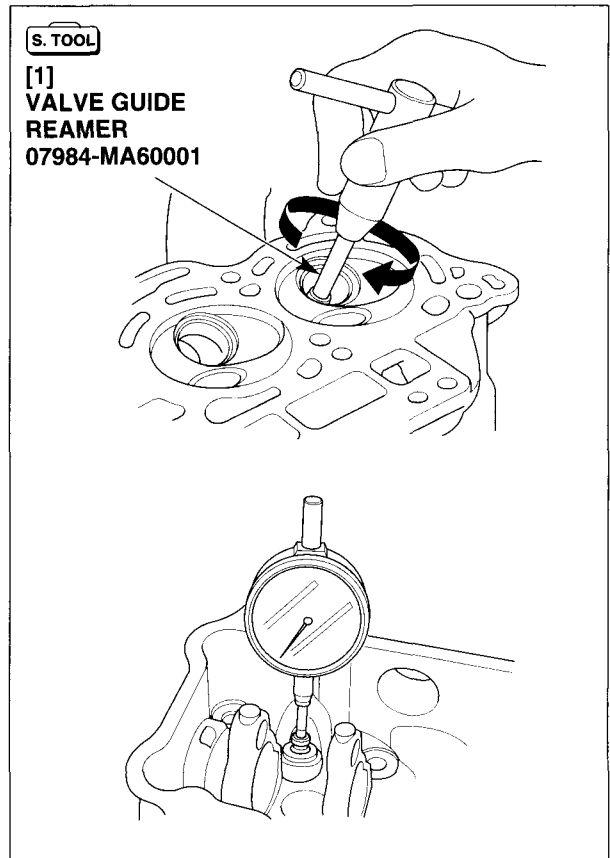
- 3) Substrate each valve stem O.D. from the corresponding guide I.D. to obtain the stem-to-guide clearance.

	Standard	Service limit
Intake	0.010 - 0.037 mm (0.0004 - 0.0015 in)	0.07 mm (0.003 in)
Exhaust	0.030 - 0.067 mm (0.0012 - 0.0026 in)	0.12 mm (0.005 in)

- 4) If the stem-to-guide clearance is out of the specification, determine if a new valve with standard dimensions would bring the clearance within tolerance. If so, replace the valve as necessary. If the clearance is out of the specification with the new valve, replace the cylinder head as assembly.

4. VALVE SEAT REFACING

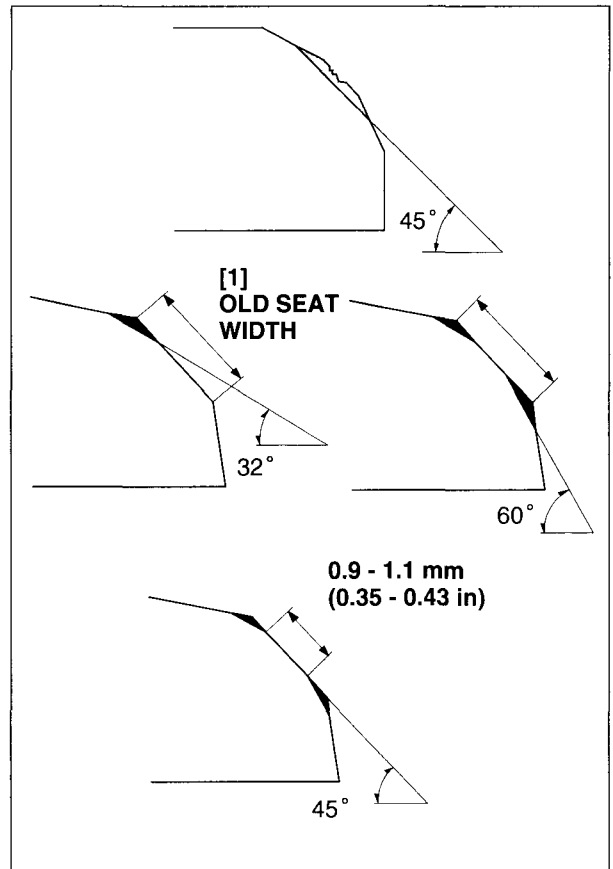
- Recondition the valve seat. Follow the valve seat cutter manufacturer's Instructions.
- Be careful not to grind the seat more than necessary.



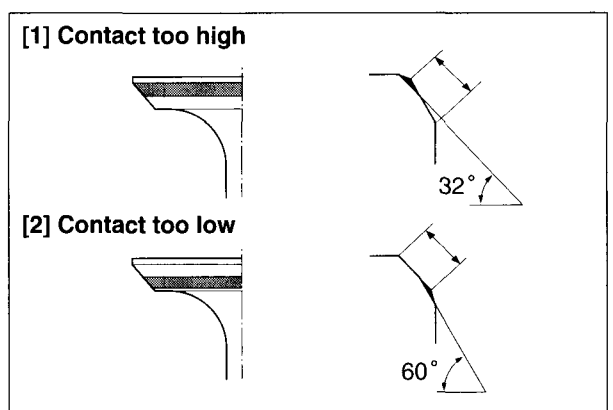
- 1) Using a 45° cutter, remove enough material to produce a smooth and concentric seat. Turn the cutter clockwise, never counterclockwise. Continue to turn the cutter as you lift it from the valve seat.
- 2) Use the 32° and 60° cutter to narrow and adjust the valve seat so that it contacts the middle of the valve face.
 - The 32° cutter removes material from the top edge.
 - The 60° cutter removes material from the bottom edge.
- 3) Be sure that the width of the finished valve seat is within specification.

Standard valve seat width	0.9 - 1.1 mm (0.035 - 0.043 in)
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- 4) Make a light pass with 45° cutter to remove any possible burrs at the edges of the seat.



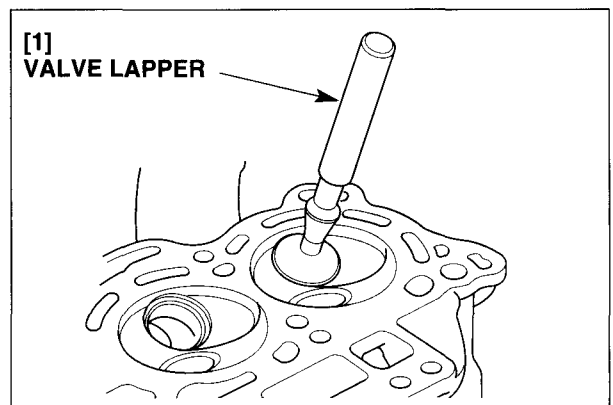
- 5) After resurfacing the seats, inspect for even valve seating. Apply Prussian Blue compound or erasable felt-tipped marker ink to the valve faces. Insert the valves, and then lift them and snap them closed against their seats several times. Be sure the valve does not rotate on the seat. The seating surface, as shown by the transferred marking compound, should have good contact all the way around.
 - If the contact position is too high, resurface with the 32° cutter and then to the specified width with the 45° cutter.
 - If the contact position is too low, resurface with the 60° cutter and then to the specified width with the 45° cutter.



- 6) Lap the valves into their seats, using a hand valve lapper and lapping compound (commercially available).
- 7) Check valve clearance after assembly.

NOTICE

To avoid severe engine damage, be sure to remove all lapping compound from the cylinder head before assembly.

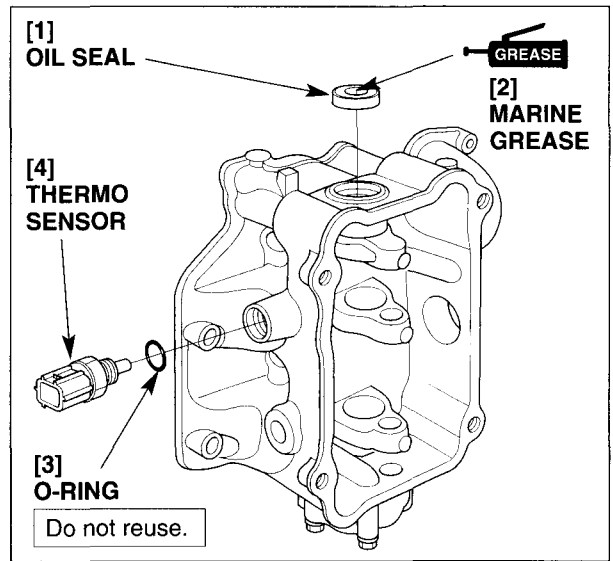


4. CYLINDER HEAD ASSEMBLY

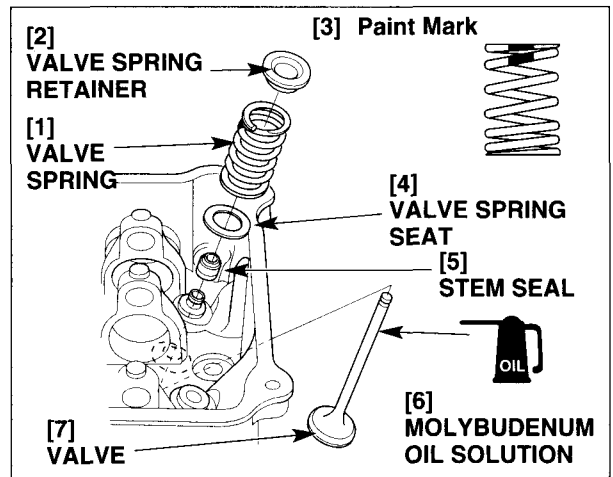
- 1) Clean the cylinder head with a solvent and blow through all oil passages with compressed air.
- 2) Install a new O-ring onto the thermo sensor.
- 3) Apply liquid sealant (Three bond #1201, #1215 or equivalent) to the thread of the thermo sensor. Then install the thermo sensor and tighten it to the specified torque.

TORQUE: 18 N•m (1.8 kgf•m, 13 lbf•ft)

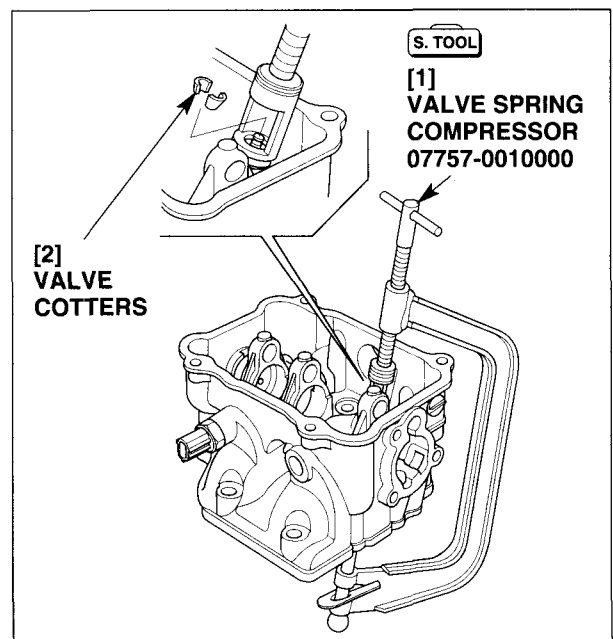
- 4) Install a new oil seal, then apply grease to the lip of the oil seal.



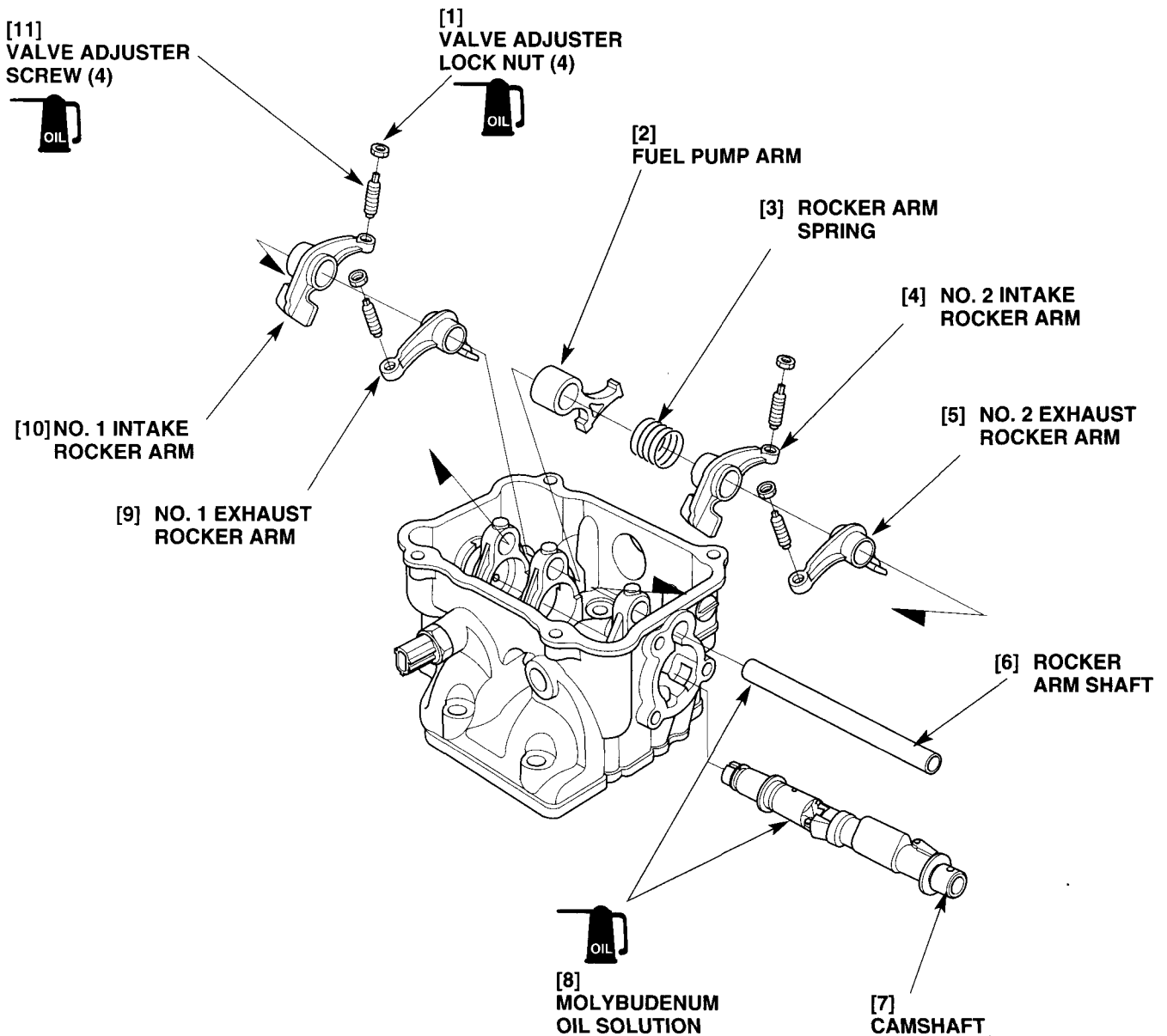
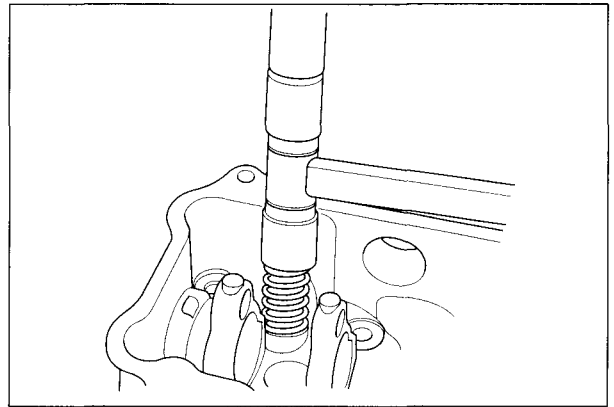
- 5) Install the valve spring seats and new stem seals.
- 6) Lubricate the valve stem with molybdenum oil solution and insert the valve into the valve guide by turning the valve slowly to prevent damage to the stem seal.
- 7) Install the valve springs with the narrow pitch side facing down as shown and install the valve spring retainers.



- 8) Install the valve cotters using the valve spring compressor taking care not to damage the cylinder head.
 - Do not interchange the intake and exhaust valves.
 - Do not compress the valve spring more than necessary to prevent loss of tension.



- 9) Support the cylinder head above the work bench surface to prevent possible valve damage. Tap the valve stems gently using two plastic hammers as shown to seat the cotters firmly.
- 10) Apply molybdenum oil solution to the camshaft journals and cam lobes. Install the camshaft with the key groove facing the rocker arm side as shown.
 - Take care not to damage the oil seal
- 11) Lubricate the rocker arms and rocker arm shaft with molybdenum oil solution.
- 12) Make sure the valve adjusters and lock nuts are loose fully. Install the intake and exhaust rocker arms, rocker arm spring and fuel pump lifter.
- 13) Install the oil pump (P. 10-8).



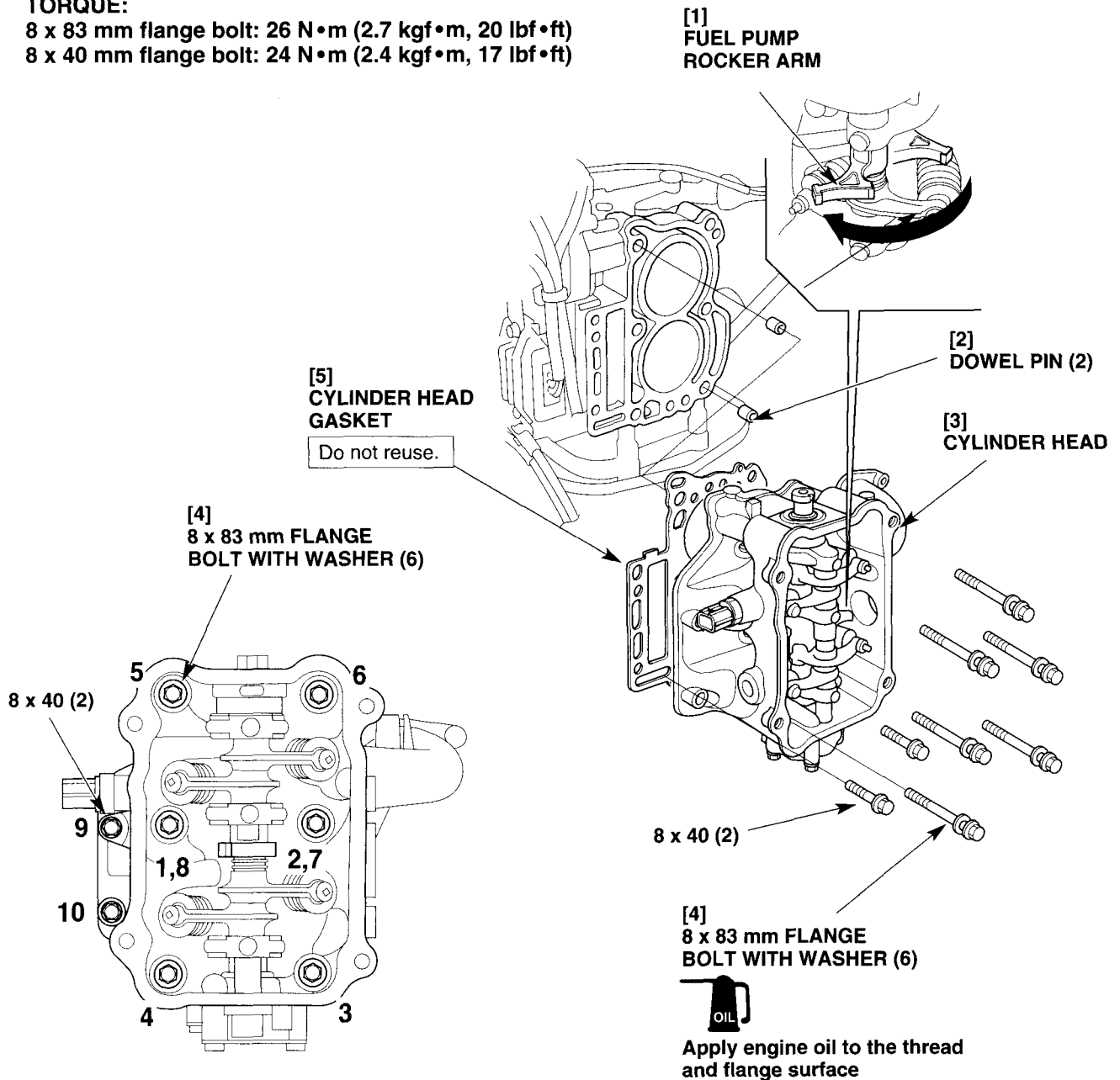
6. CYLINDER HEAD INSTALLATION

- 1) Install the two dowel pins and a new cylinder head gasket.
- 2) Turn the fuel pump lifter as shown and install the cylinder head.
- 3) Apply oil to the 8 x 83 mm bolt threads and flange surfaces and install them.
 - Do not apply oil to the 8 x 40 mm flange bolts.
- 4) Tighten the cylinder head bolts to the specified torque.
 - Tighten the bolts in the numbered sequence shown in 2 - 3 steps.

TORQUE:

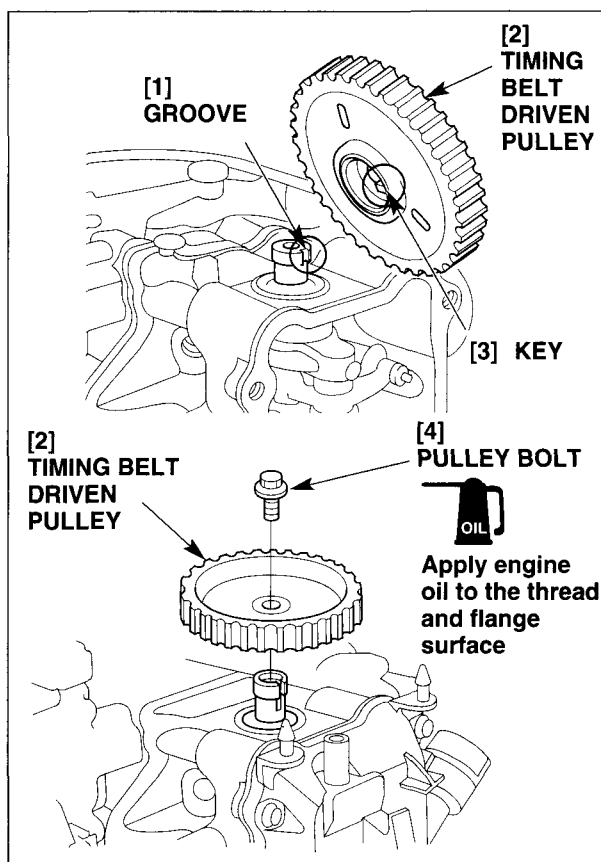
8 x 83 mm flange bolt: 26 N•m (2.7 kgf•m, 20 lbf•ft)

8 x 40 mm flange bolt: 24 N•m (2.4 kgf•m, 17 lbf•ft)

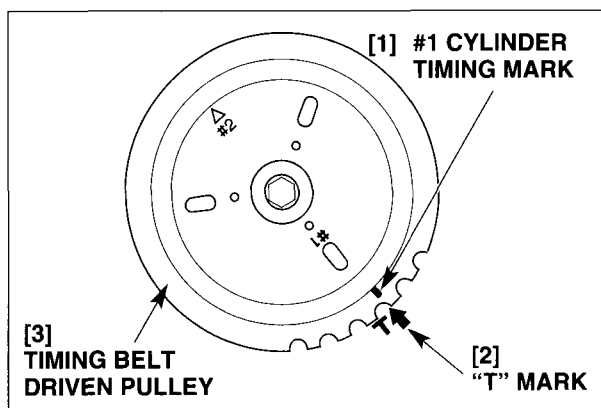


- 5) Install the timing belt driven pulley on the camshaft by aligning the key of the pulley with the groove of the camshaft.
- 6) Apply oil to the threads and flange surface of the pulley bolt. Tighten the bolt to the specified torque.

TORQUE: 16 N•m (1.6 kgf•m, 12 lbf•ft)



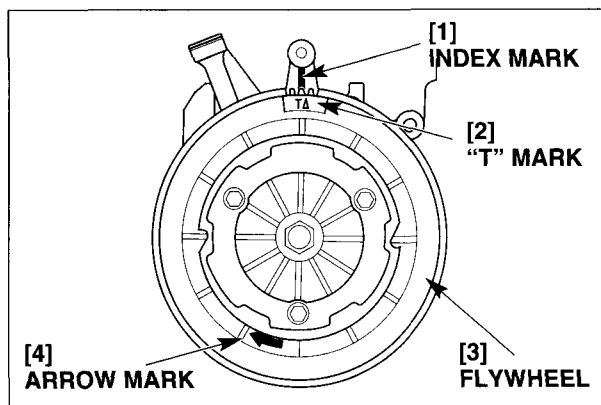
- 7) Make sure that the valve adjusters and lock nuts are loose firmly. Turn the timing belt driven pulley clockwise until the “■” #1 timing mark on the timing belt driven pulley aligns with the “↑T” mark on the cylinder head.



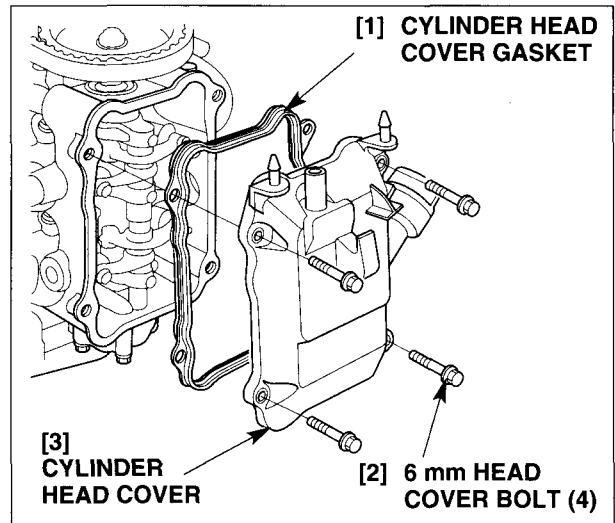
- 8) Turn the crankshaft clockwise by turning the flywheel clockwise (in the arrow marked direction) until the “↑T” mark on the flywheel aligns with the “■” index mark on the crankcase.

- Don't turn the flywheel counterclockwise.

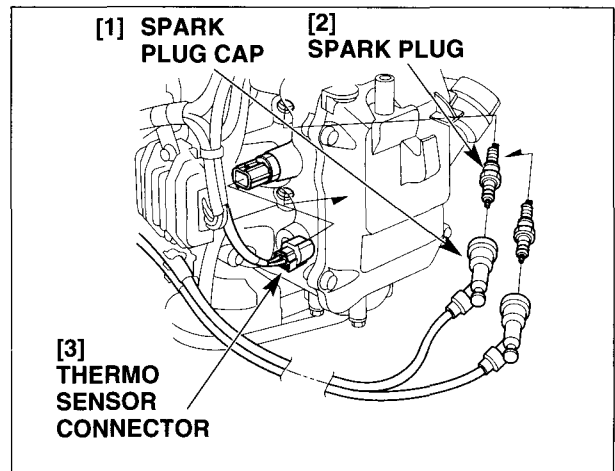
- 9) Install the timing belt on the timing belt driven pulley taking care not to allow the alignment marks to come out of alignment.
- 10) After installation, be sure that the alignment marks are in the proper alignment.
- 11) Adjust the valve clearances (P. 3-9 and 10).



- 12) Set the cylinder head cover gasket to the cylinder head cover, then install the cylinder head cover.
- 13) Tighten the four head cover bolts securely.
- 14) Secure the throttle cable by hooking to the clamp of the cylinder head cover (tiller handle type only).



- 15) Install the spark plugs and connect the spark plug caps and thermo sensor connector.
- 16) Reinstall the removed parts:
 - starter case B (P. 7-10).
 - recoil starter (P. 7-9).
 - neutral start cable (P. 7-1).
 - left and right engine under covers (P. 5-2 and 3).
 - engine cover.

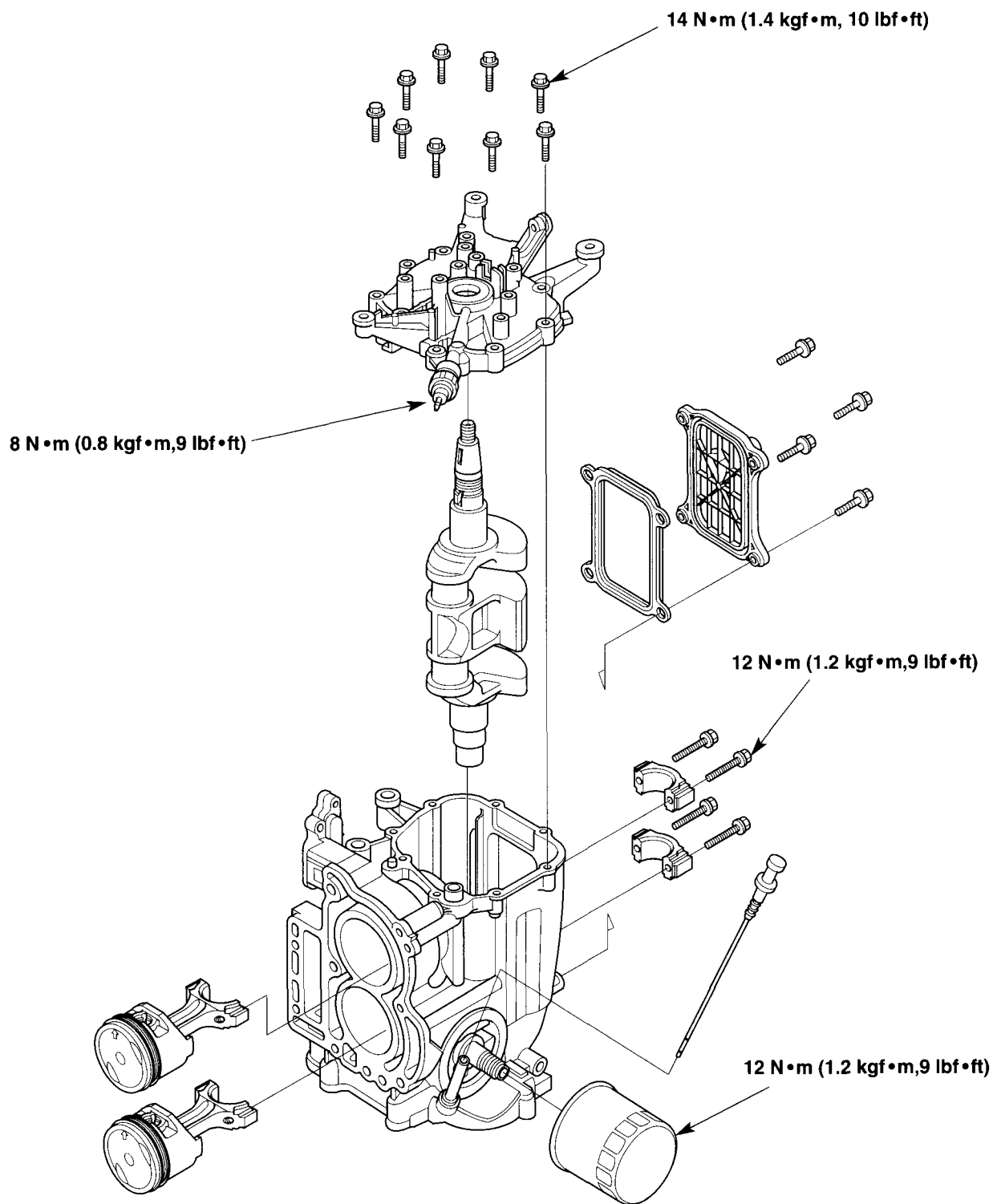


11. CRANKCASE/CRANKSHAFT/PISTONS

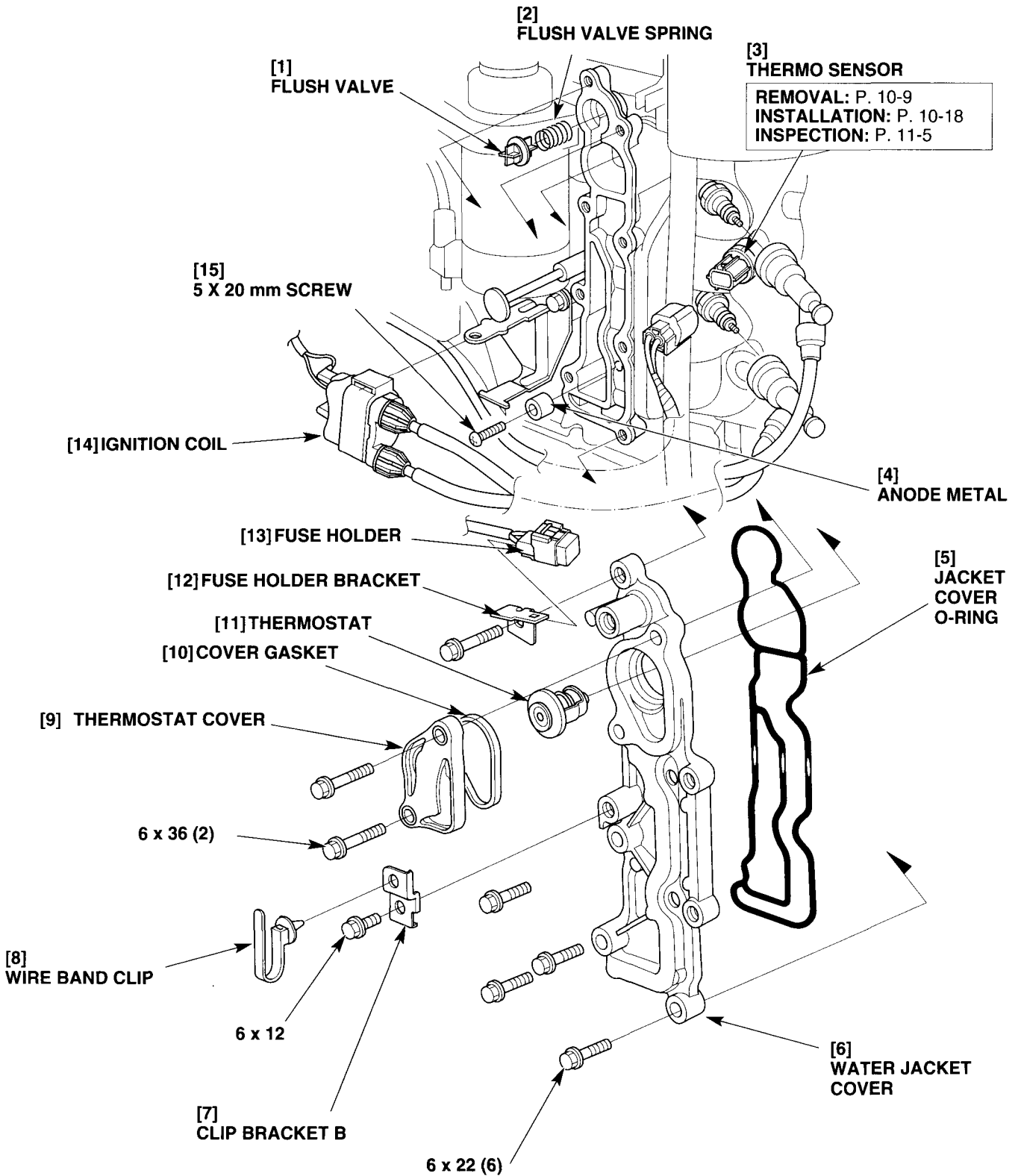
BF15D-BF20D

- 1. THERMOSTAT/WATER JACKET
- 2. OIL STRAINER

- 3. PISTON
- 4. CRANKSHAFT/CYLINDER BLOCK

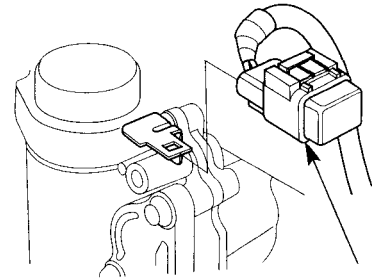


1. THERMOSTAT/WATER JACKET

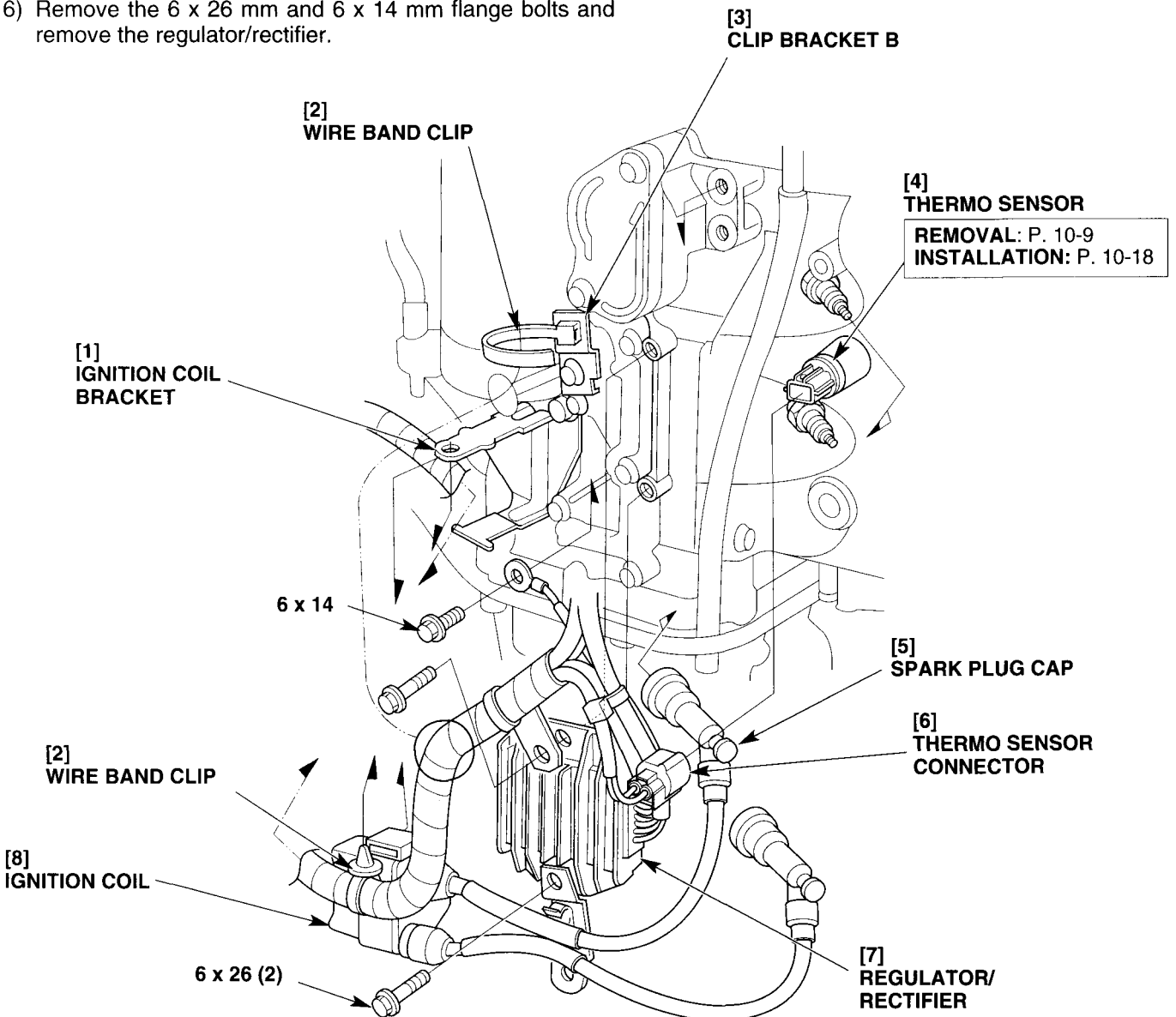


a. REMOVAL

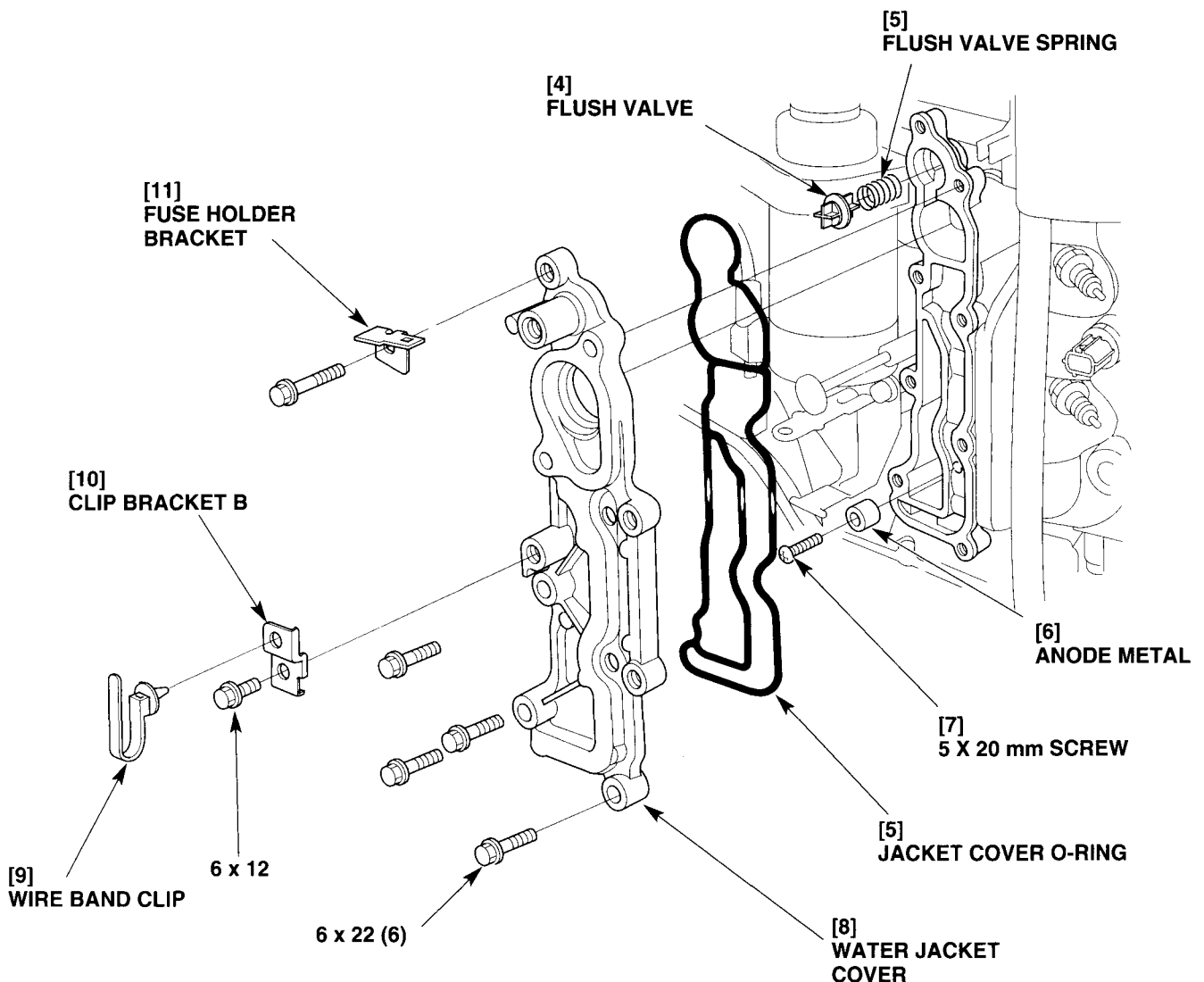
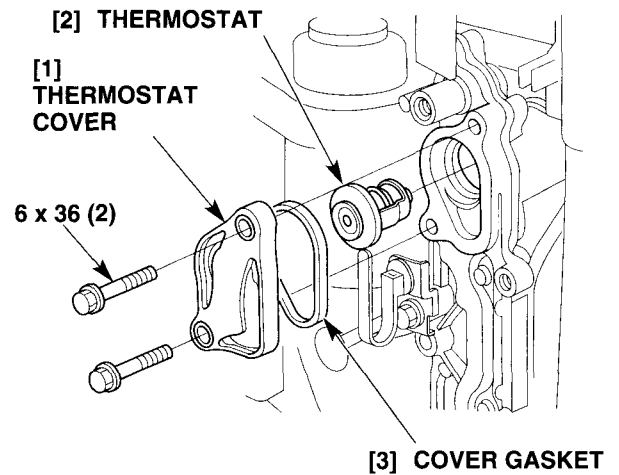
- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
 - recoil starter (P. 7-2).
- 2) Pull off the fuse holder from the fuse holder bracket.
- 3) Disconnect the thermo sensor wire connector.
- 4) Remove the spark plug caps from the spark plugs and disconnect the ignition coil primary wires. Remove the wire band clip from the ignition coil bracket and remove the ignition coil.
- 5) Open the wire band clip on the clip bracket B and free the wire harness.
- 6) Remove the 6 x 26 mm and 6 x 14 mm flange bolts and remove the regulator/rectifier.



[1] FUSE HOLDER



- 7) Remove the two 6 x 36 mm flange bolts and remove the thermostat cover, cover gasket and thermostat.
- 8) Remove the six 6 x 22 mm flange bolts and remove the following:
 - fuse holder bracket.
 - water jacket cover.
 - jacket cover O-ring.
 - water tube seal.
 - flush valve and flush valve spring.
- 9) Remove the 5 x 20 mm screw and anode.
 - Replace the anode with new one, if it is excessively corroded.

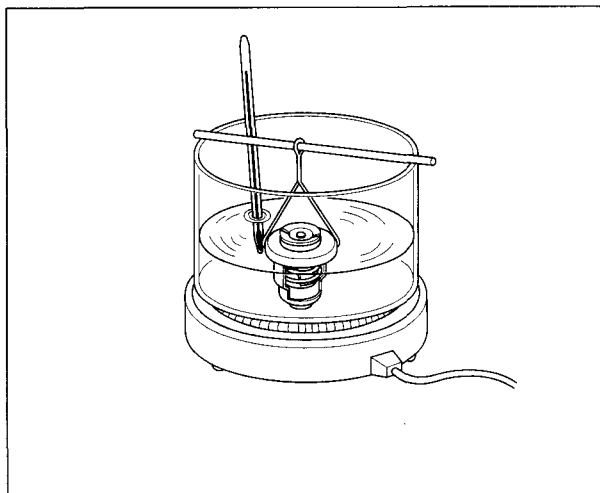


b. INSPECTION

• THERMOSTAT

- 1) Immerse the thermostat in water as shown.
- 2) Heat the water and observe the operation of the thermostat as the water temperature increase.
- 3) Measure the water temperature when the thermostat starts opening.
 - Don't let the thermometer and thermostat touch the container; this may cause a false reading.
- 4) Measure the lift height when fully open.

Start opening	60°C (144°F)
Fully open	70°C (158°F)
Lift height	More than 3.0 mm (0.12 in)



• THERMO SENSOR

- The sensor resistance decreases as the coolant temperature increases as shown right table.
- 1) Disconnect the 2P connector from the thermo sensor and measure the resistance between the sensor terminals at the room temperature.

Standard resistance: 1 - 5 kΩ

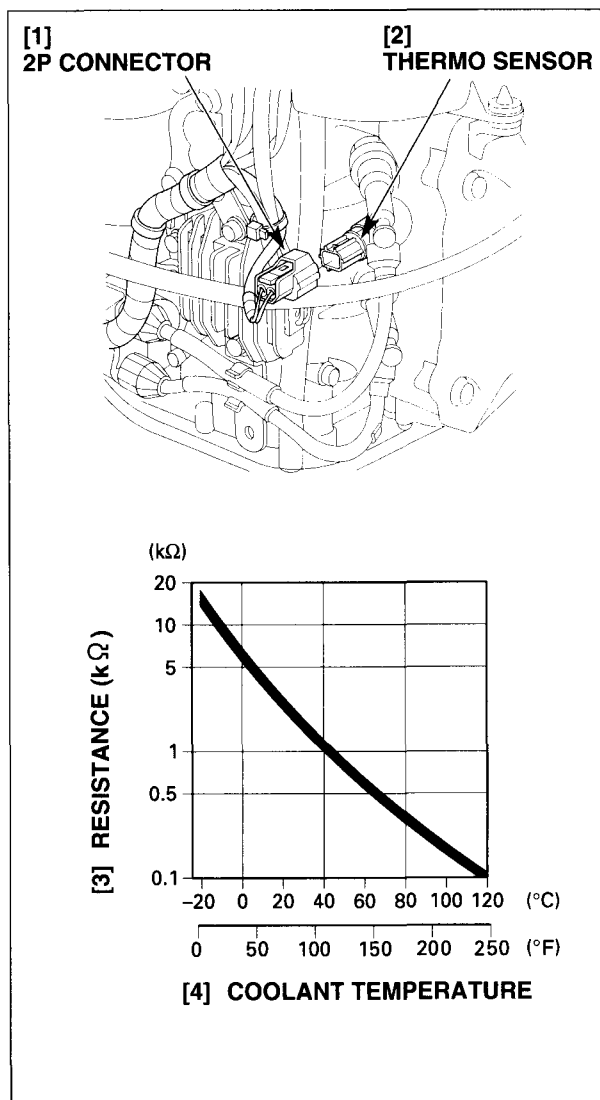
- 2) Connect the sensor connector and start the engine, check the voltage between the Red/blue (+) and Green/black (-).

If there is no voltage, check the open circuit in the wires and ignition control module.

- 3) Start the engine and warm up the engine to normal operating temperature.
- 4) Stop the engine, and disconnect the 2P connector and measure the resistance.

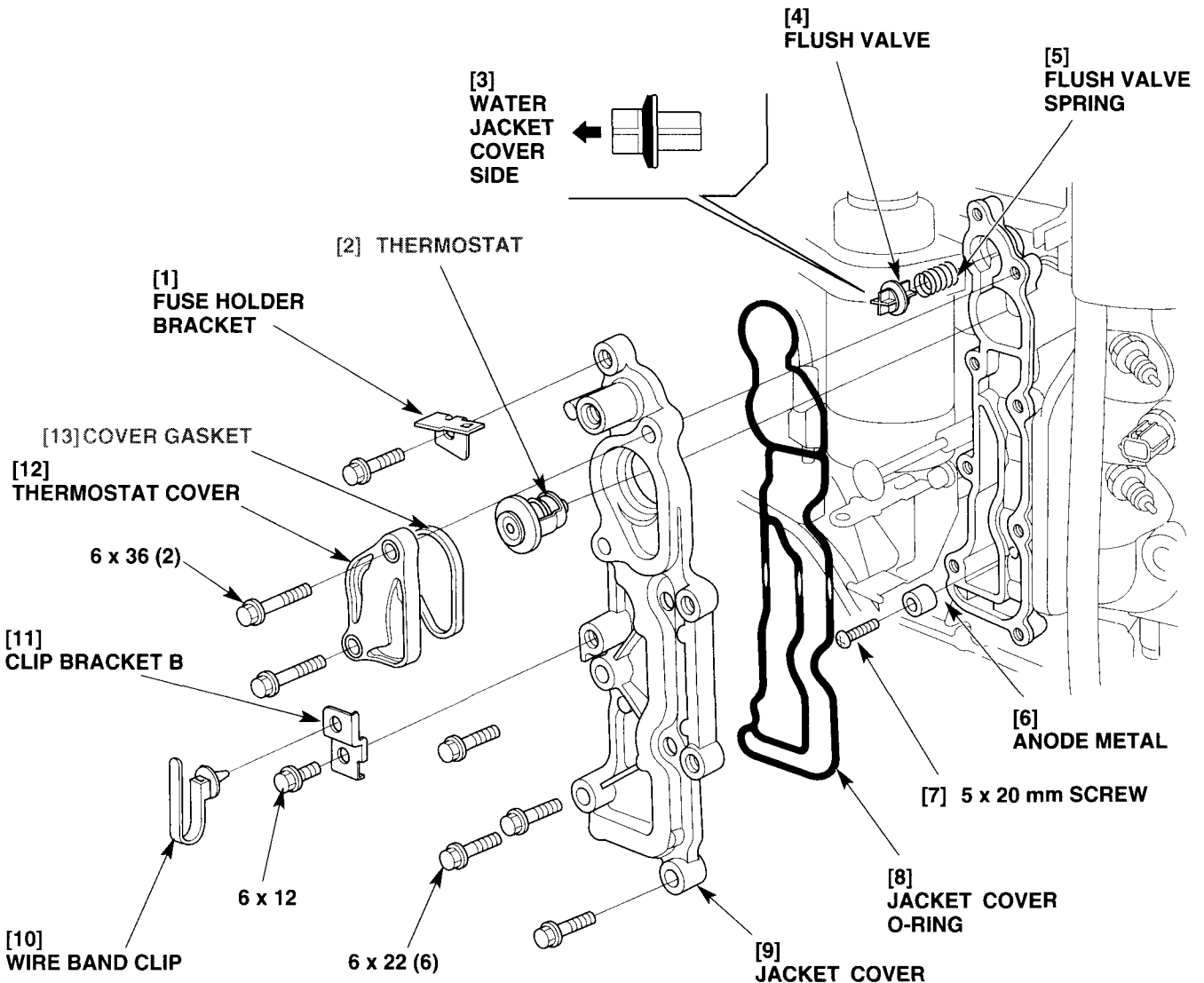
Standard resistance: 200 - 400 Ω

- See page 10-9 for removal and page 10-16 for installation.

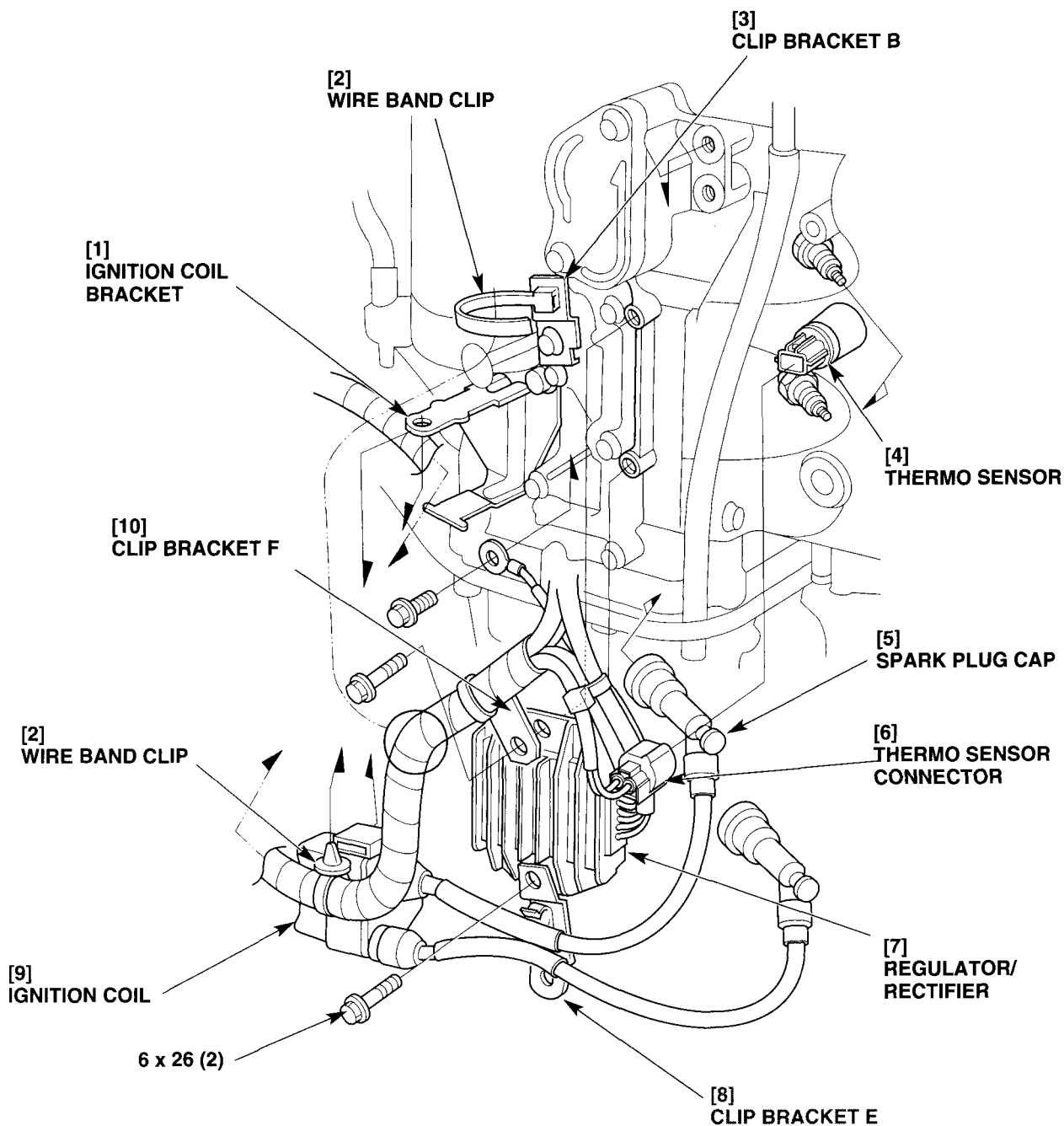


c. INSTALLATION

- 1) Check the anode, if it is excessively corroded. replace with new one. Install the anode and tighten the 5 x 20 mm screw securely.
- 2) Install a new jacket cover O-ring to the water jacket cover securely.
- 3) Check the water tube seal. Replace with new one if it is damaged. Install the water tube seal to the water jacket cover.
- 4) Install the flush valve spring and flush valve with the short side facing the cover side as shown.
- 5) Install the water jacket cover and tighten the six 6 x 22 mm flange bolts.
- 6) Install the clip bracket B and wire clamp.
- 7) Install a new cover gasket to the thermostat cover.
- 8) Install the thermostat and thermostat cover and tighten the 6 x 36 mm flange bolts securely.



- 9) Install the ignition coil to the ignition coil bracket.
- 10) Install the regulator/rectifier and clip brackets E and F and tighten the 6 x 26 mm flange bolts.
- 11) Route the wire harness and ignition coil wires and secure them with the wire band clips.
 - Replace the wire band with new one if it is cut.
- 12) Connect the thermo sensor connector and spark plug caps.
- 13) Reinstall the removed parts in the reverse order of removal.

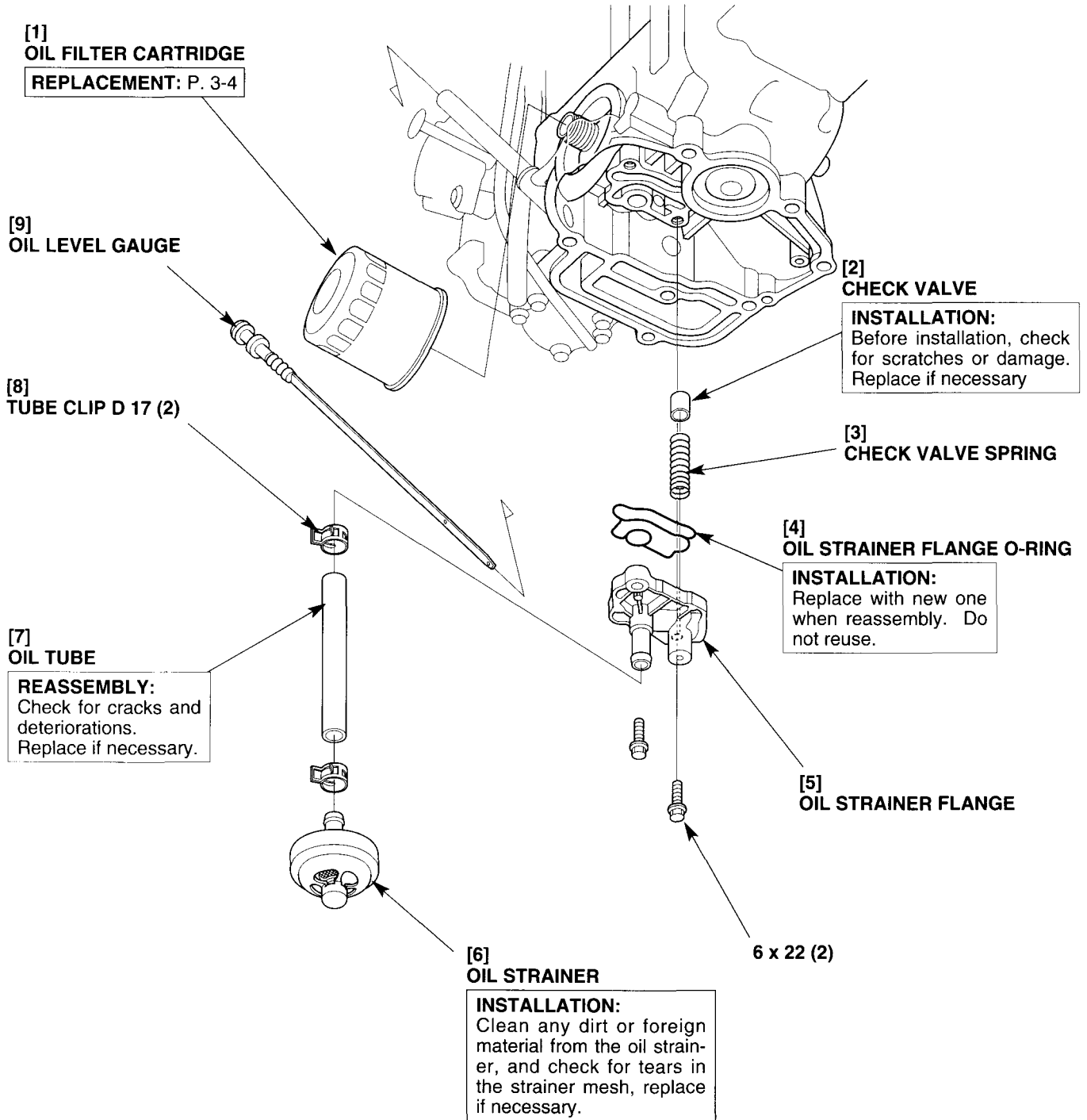


2. OIL STRAINER

a. DISASSEMBLY/REASSEMBLY

Remove the engine (Section 8).

- Before installation check the fuel tubes for deterioration, cracks, and other damage. Replace if necessary.



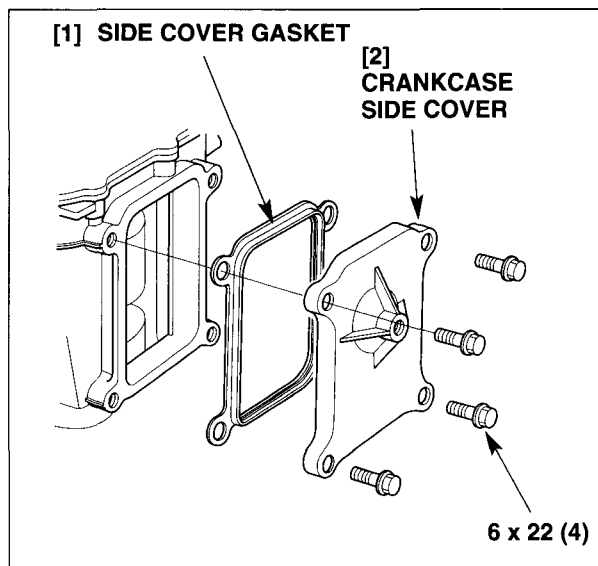
3.PISTON

a. REMOVAL

- 1) Remove the engine (Section 8) and remove the following:
 - flywheel and timing belt drive pulley (P. 9-2).
 - silencer and carburetor (P. 6-2)
 - fuel pump and fuel filter (P. 6-16).
 - cylinder head (P. 11-2).

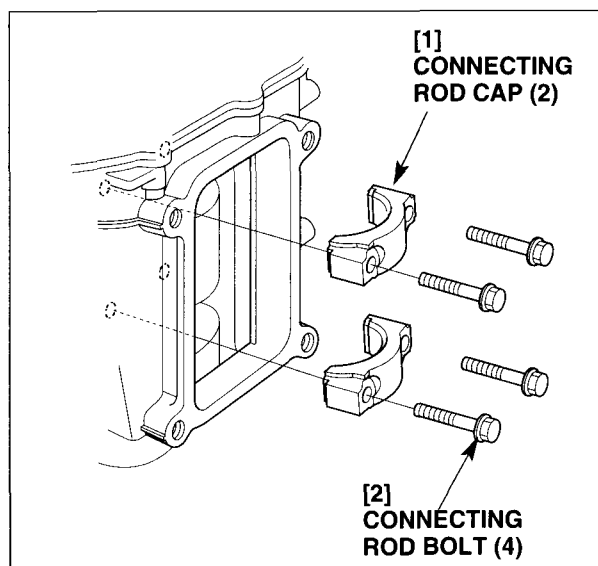
- 2) Remove the four 6 x 22 mm flange bolts and crankcase side cover and side cover gasket.

- 3) Turn the crankshaft until the piston is at top dead center.



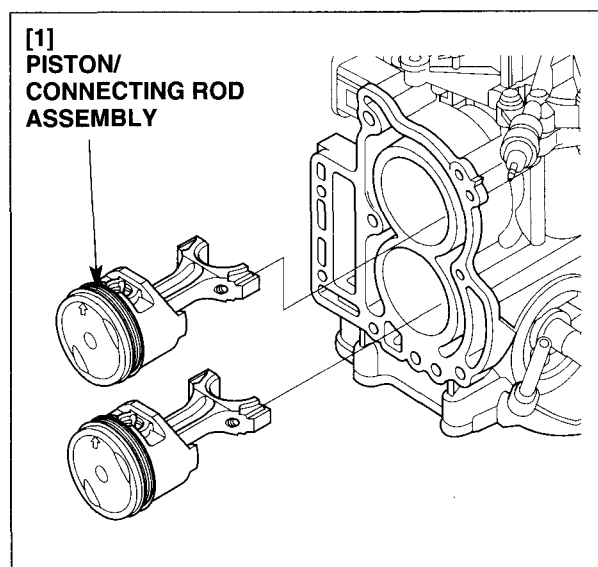
- 4) Remove the connecting rod bolts and connecting rod caps.

- Mark the connecting rod caps so they can be placed back in their original position.



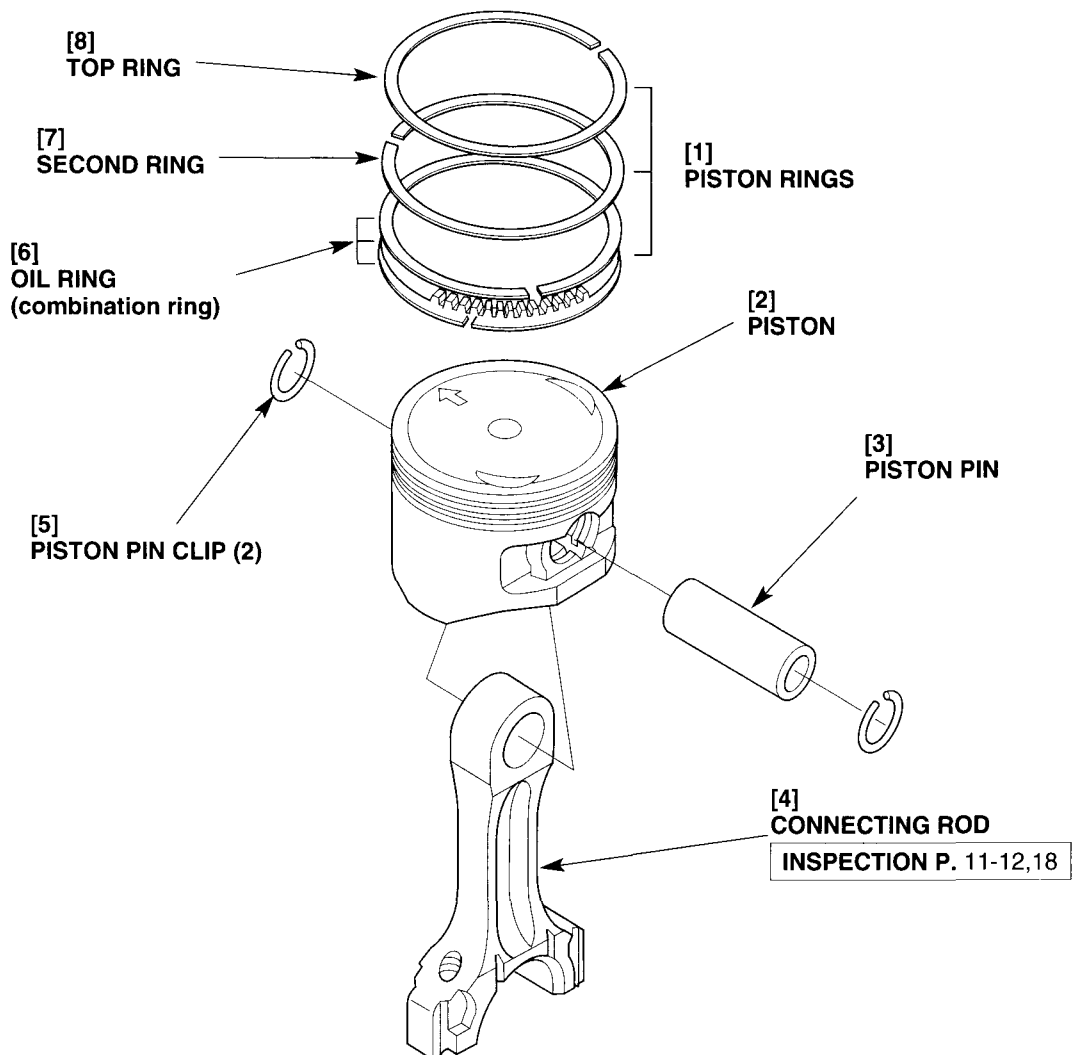
- 5) Remove the piston/connecting rod assemblies.

- Mark the piston/connecting rod assemblies so they can be placed back in their original position.



b. DISASSEMBLY

- 1) Remove the piston pin clip using a log nose pliers, and remove the piston pin and connecting rod from the piston.
- 2) Spread each piston ring and remove it by lifting it up at a point just opposite the gap.
 - Take care not to damage the piston ring by spreading the ends too far.
 - Be careful no to damage the piston when the piston ring removal.



b. INSPECTION

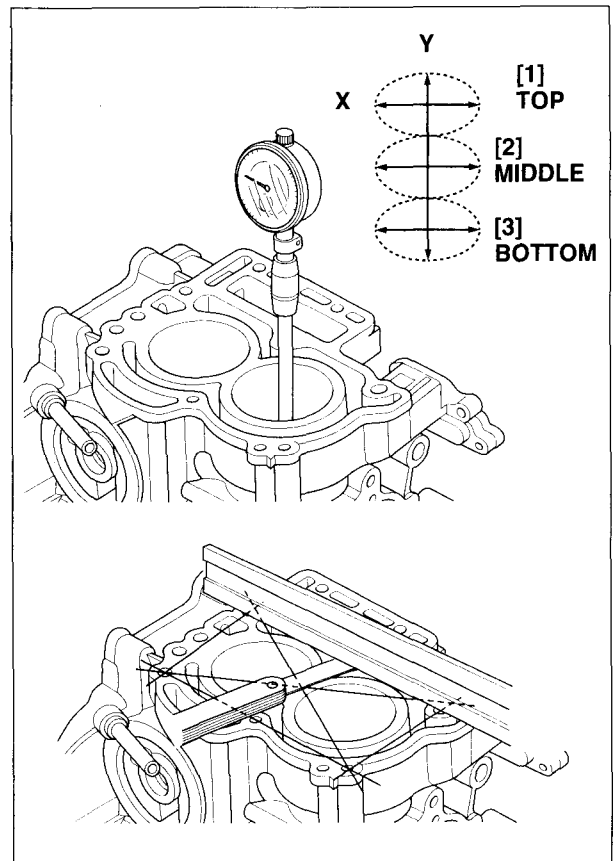
• CYLINDER

- 1) Check the cylinder wall for scratches and wear.
- 2) Measure and record the cylinder I.D. at three levels in both the X and Y axis. Take the maximum reading to determine the cylinder I.D.

Standard	Service limit
59.000 - 59.012 mm (2.3228 - 2.3233 in)	59.055 mm (2.3250 in)

- 3) Check the cylinder head mating surface for warpage with a straight edge and feeler gauge.

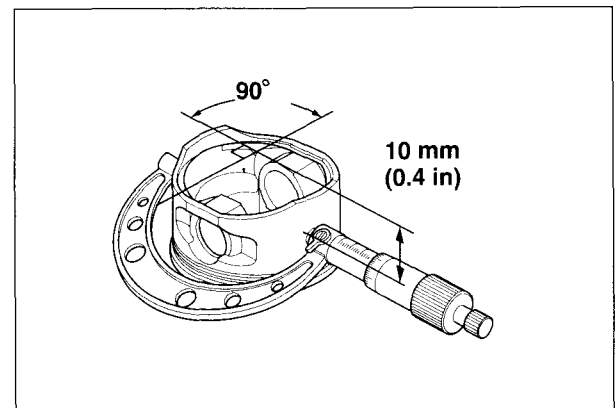
Standard	Service limit
0.05 mm (0.002 in)	0.10 mm (0.004 in)



• PISTONS

- 1) Inspect the piston for cracks or other damage. Inspect the ring grooves for excessive wear and carbon buildup.
- 2) Measure and record the piston O.D.
 - Take measurements 10 mm (0.4 in) from the bottom, and 90° to the piston pin hole.

Standard	Service limit
58.970 - 58.990 mm (2.3216 - 2.3224 in)	58.92 mm (2.132 in)

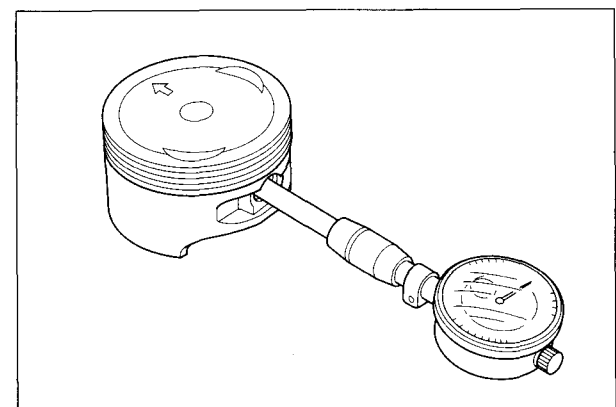


- 3) Measure the piston pin hole I.D. in an X and Y axis. Take the maximum reading to determine I.D.

Standard	Service limit
16.002 - 16.008 mm (0.6300 - 0.6302 in)	16.02 mm (0.638 in)

- 4) Calculate the piston-to-cylinder clearance.

Standard	Service limit
0.010 - 0.037 mm (0.0004 - 0.0015 in)	0.10 mm (0.004 in)



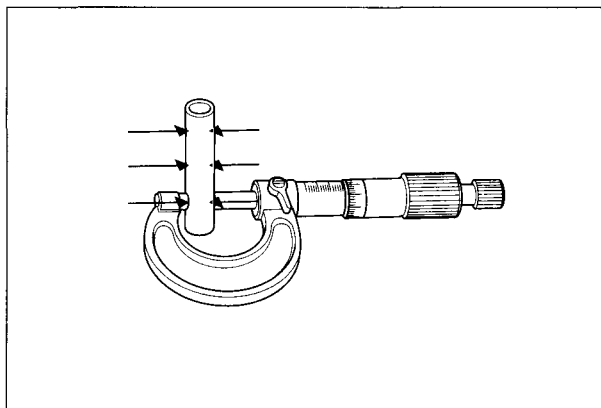
• PISTON PINS

- 1) Measure and record the piston pin O.D. at three position shown.

Standard	Service limit
15.994 - 16.000 mm (0.6297 - 0.6299 in)	15.97 mm (0.629 in)

- 2) Calculate the piston pin-to-piston clearance.

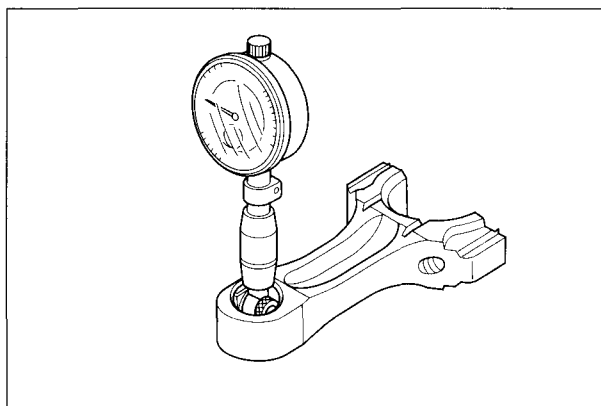
Standard	Service limit
0.002 - 0.014 mm (0.0001 - 0.0006 in)	0.04 mm (0.002 in)



• CONNECTING ROD SMALL END I.D.

Measure and record the connecting rod small end I.D.

Standard	Service limit
16.007 - 16.022 mm (0.6302 - 0.6308 in)	16.05 mm (0.632 in)



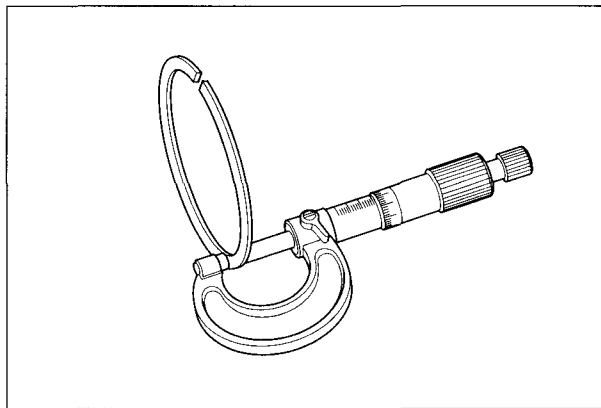
• PISTON RINGS

- 1) Inspect the piston rings, replace them if they are worn.

- Replace the piston ring as a set.

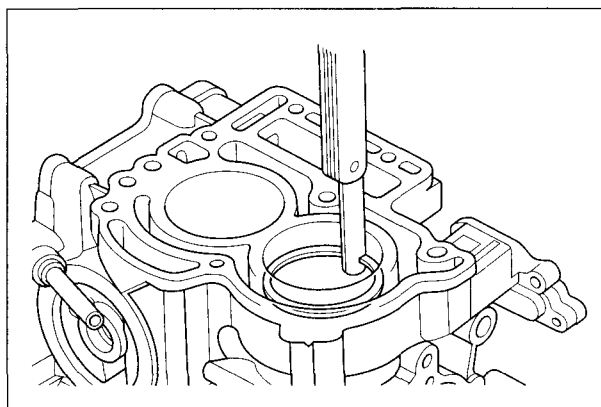
- 2) Measure the piston ring thickness.

	Standard	Service limit
Top/second	1.175 - 1.190 mm (0.0463 - 0.0469 in)	1.08 mm (0.043 in)



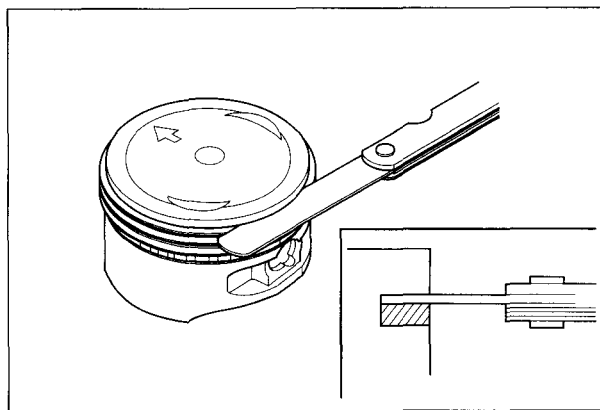
- 3) Using a piston, push the ring securely into the cylinder and measure the end gap using a feeler gauge.

	Standard	Service limit
Top	0.15 - 0.30 mm (0.006 - 0.012 in)	0.5 mm (0.02 in)
Second	0.35 - 0.50 mm (0.014 - 0.020 in)	0.5 mm (0.02 in)
Oil (side rail)	0.20 - 0.80 mm (0.008 - 0.031 in)	1.0 mm (0.04 in)



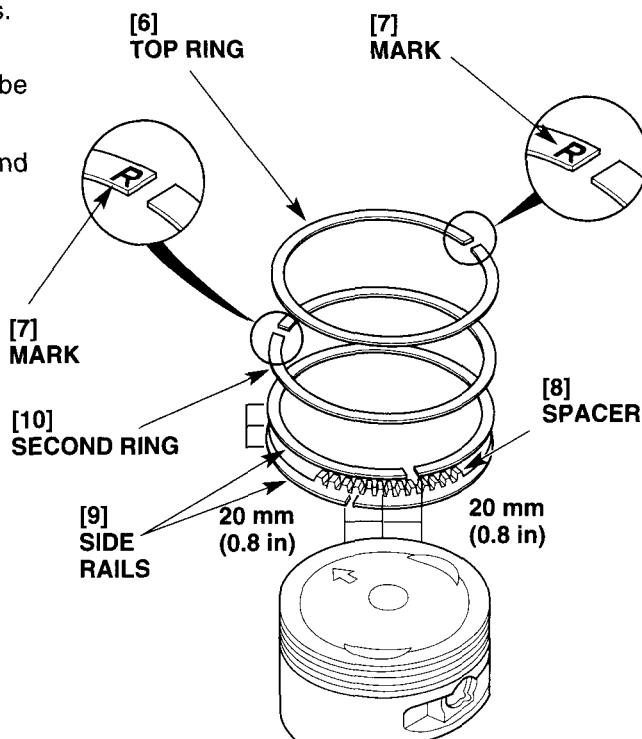
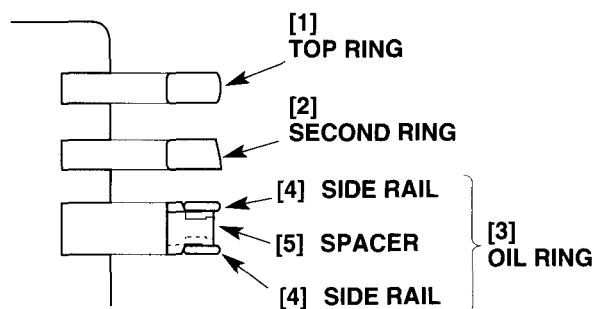
- 4) Reinstall the piston rings into the piston grooves. Push in the ring until the outer surface of the piston ring is nearly flush with the piston and measure the side clearance using a feeler gauge.

	Standard	Service limit
Top/ Second	0.025 - 0.055 mm (0.0010 - 0.0022 in)	0.10 mm (0.004 in)
Oil	0.055 - 0.140 mm (0.0022 - 0.0055 in)	0.20 mm (0.008 in)

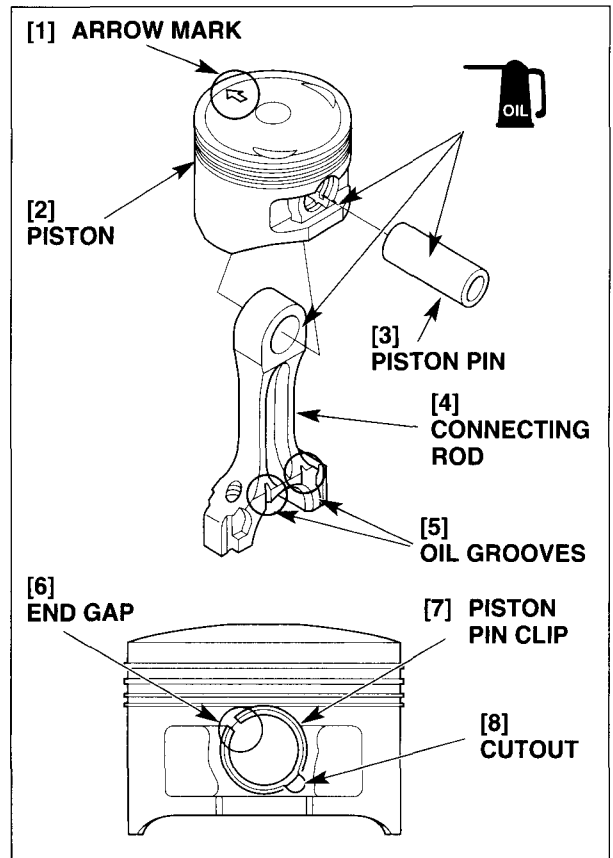


d. ASSEMBLY

- 1) Clean the piston and carefully install the piston rings.
 - Take care not to damage the piston ring by spreading the ends too far.
 - Be careful no to damage the piston when the piston ring removal.
 - Clean carbon deposits from the piston ring grooves with a ring that will be discarded. Never use a wire brush; it will scratch the grooves.
 - Do not confuse the top and second rings. The top ring is chrome-coated (gray) and second not coated (black).
 - Install the top and second rings with the mark facing up.
 - Oil ring; first install the spacer the install the side rails.
- 2) After installing the ring make sure that they should rotate freely, without sticking.
- 3) Space the ring end gaps 120° apart and side rail end gaps about 20 mm (0.8 in) as shown.

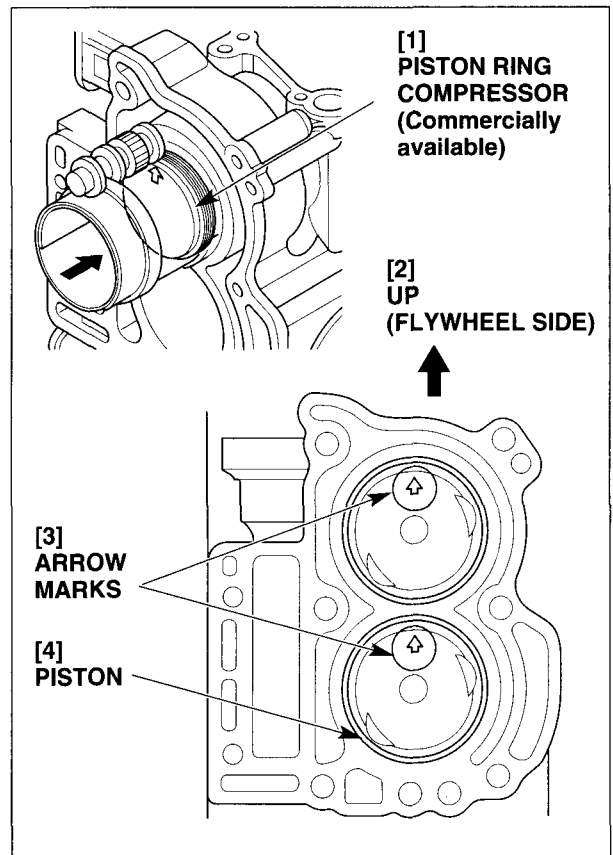


- 4) Apply engine oil to the piston pin and connecting rod small end I.D. and piston pin bore.
- 5) Install the connecting rod to the piston with the oil groove facing the opposite side of the arrow mark on the piston head.
- 6) Install the piston pin.
- 7) Install a new piston pin clip.
 - Always use a new piston pin clip, never reuse used clip.
 - Set the piston pin clip in the groove properly.
 - Do not align the clip's end gap with the cutout.



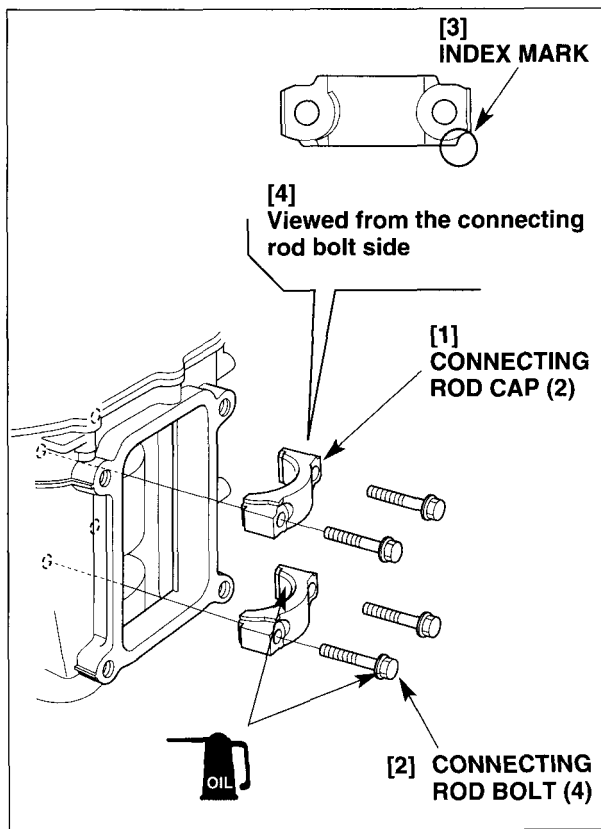
e. INSTALLATION

- 1) Apply engine oil to the piston outer surface, piston rings and cylinder wall.
- 2) Set the piston to a commercially available piston ring compressor. Install the pistons with the arrow mark on the piston head facing up.
 - Take care not to damage the piston rings and cylinder wall.

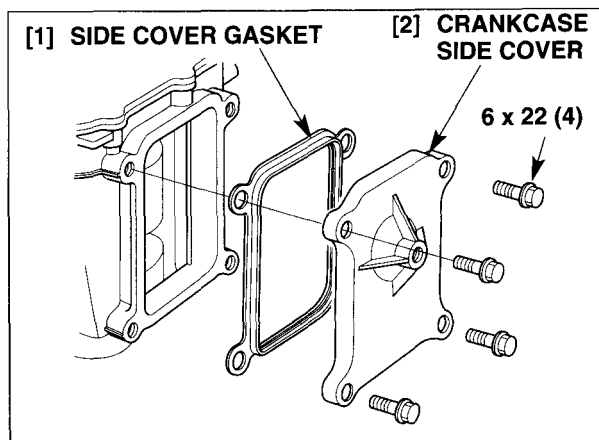


- 3) Align the connecting rod big ends to the crankshaft.
- 4) Apply engine oil to the crank pins and connecting rod caps.
- 5) Install the connecting rod cap with the index mark facing down as shown.
- 6) Apply oil to the threads and flange section of the connecting rod bolts and tighten them to the specified torque.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)



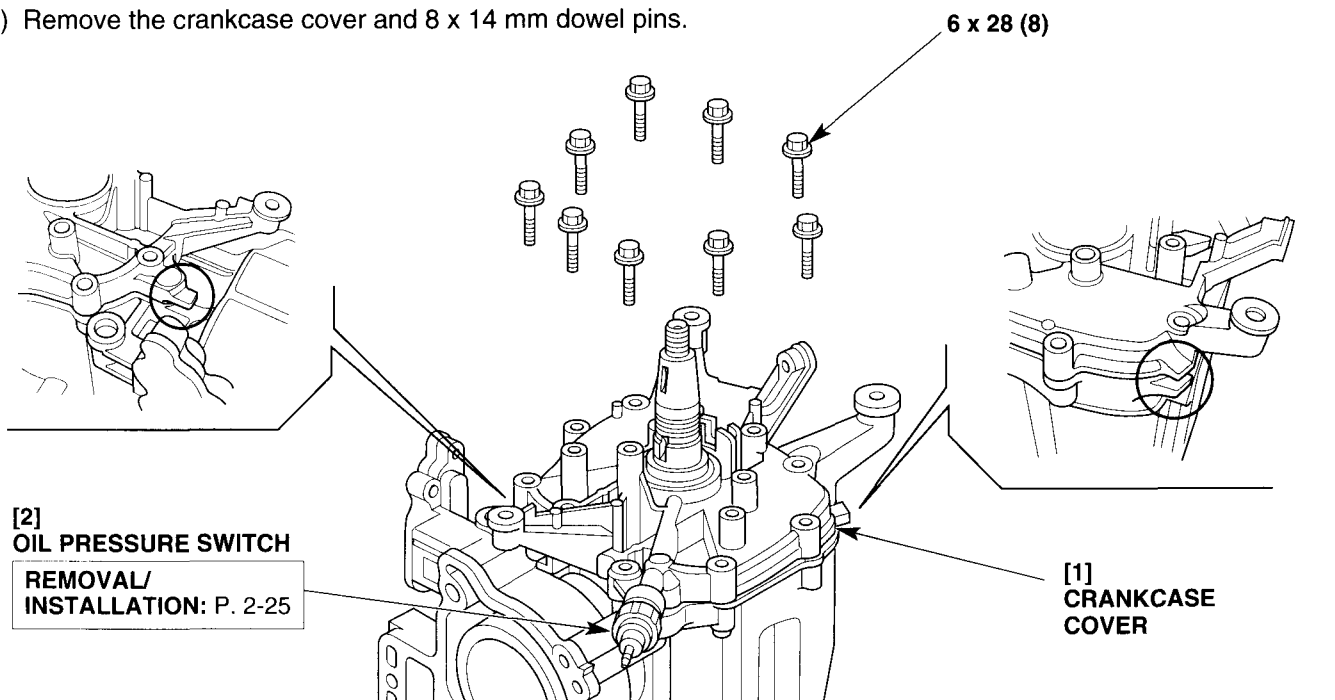
- 7) Set the side cover gasket to the crankcase side cover, and install them to the crankcase and tighten the 6 x 22 mm flange bolts securely.
- 8) Reinstall the removed parts in the reverse order of removal.



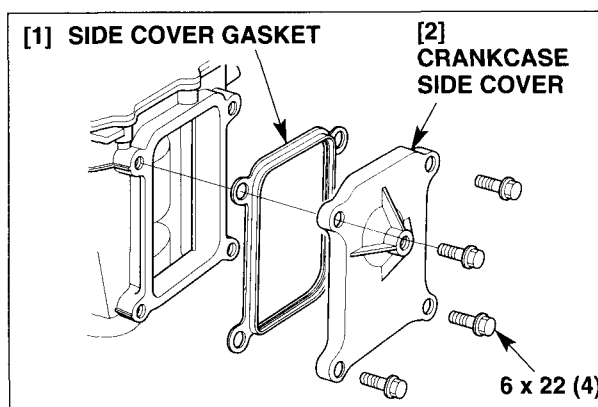
4. CRANKSHAFT/CYLINDER BLOCK

a. DISASSEMBLY

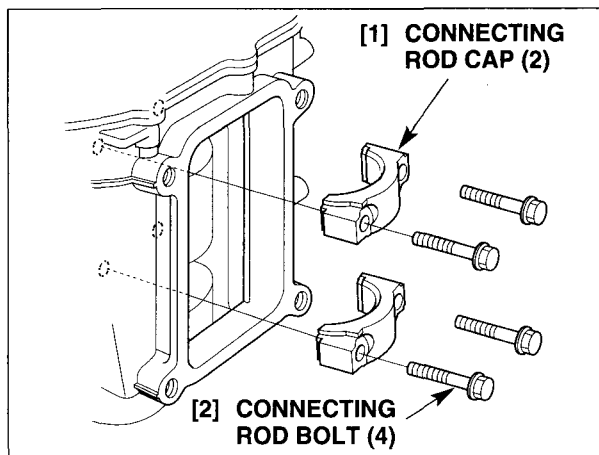
- 1) Remove the engine (Section 8) and remove the following:
 - flywheel and timing belt drive pulley (P. 9-2 and 10).
 - silencer and carburetor (P. 6-2)
 - fuel pump and fuel filter (P. 6-17).
 - cylinder head (P. 10-2).
- 2) Turn the crankshaft until the piston is at top dead center.
- 3) Remove the eight 6 x 28 mm flange bolts.
 - Loosen the bolts in a crisscross pattern in 2 - 3 steps.
- 4) Insert a screwdriver or equivalent tool into the concave in the position shown, and lift the crankcase cover slightly.
 - Be careful not to damage the mating surface when removing the crankcase cover.
- 5) Remove the crankcase cover and 8 x 14 mm dowel pins.



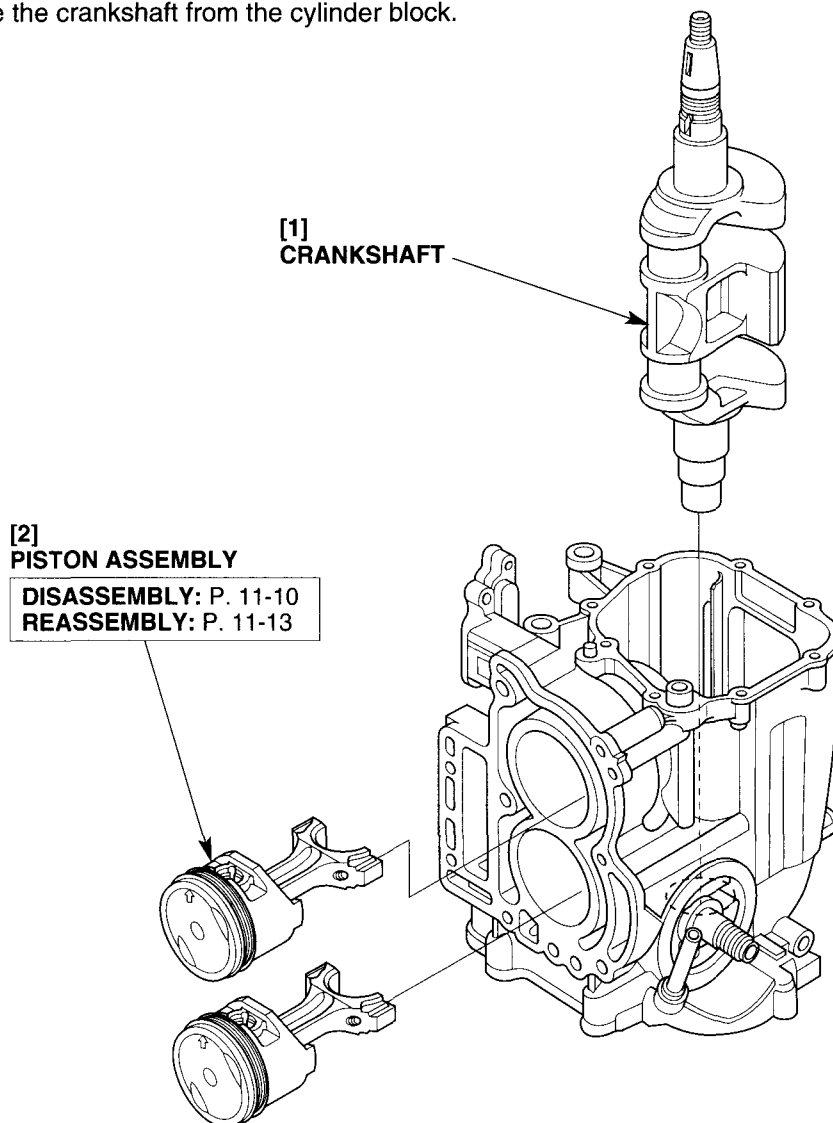
- 6) Remove the four 6 x 22 mm flange bolts and crankcase side cover and side cover gasket.



- 7) Remove the connecting rod bolts and connecting rod caps.
- Mark the connecting rod caps so they can be placed back in their original position.



- 8) Remove the piston assemblies.
- Mark the pistons so they can be placed back in their original position.
- 9) Remove the crankshaft from the cylinder block.



b. INSPECTION

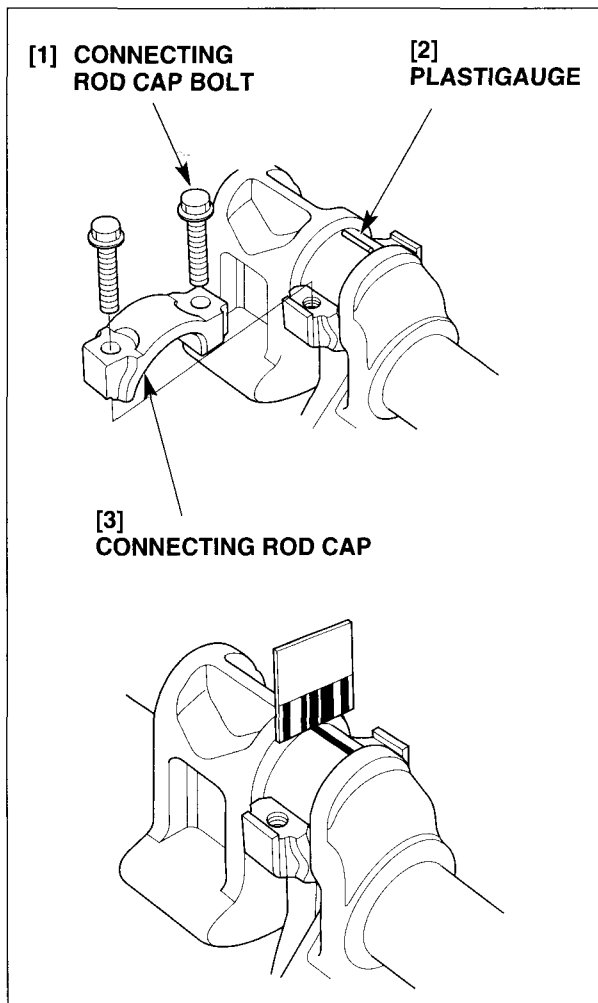
• CRANKSHAFT

- 1) Clean all oil from the crank pin and connecting rod big end I.D.
- 2) Place a piece of plastigauge on the crank pin, install the connecting rod and cap and tighten the bolts.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

- Do not rotate the crankshaft while the plastigauge is in place.
- 3) Remove the connecting rod and measure the plastigauge at its widest portion.

Standard	Service limit
0.020 - 0.049 mm (0.0008 - 0.0019 in)	0.06 mm (0.002 in)

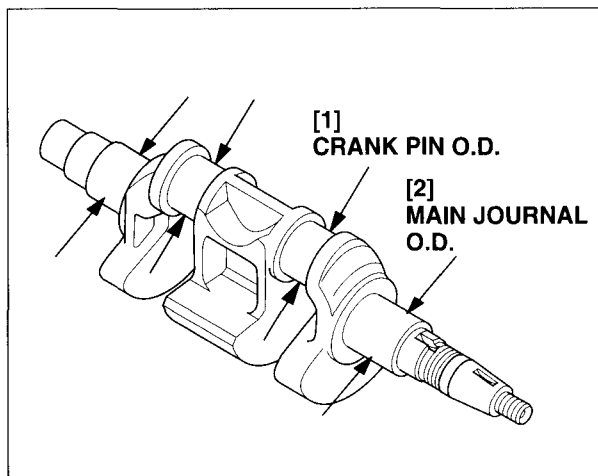


- 4) Measure and record the main journal O.D.

Standard	Service limit
35.979 - 35.990 mm (1.4165 - 1.4169 in)	35.96 mm (1.416 in)

- 5) Measure the crank pin journal O.D.

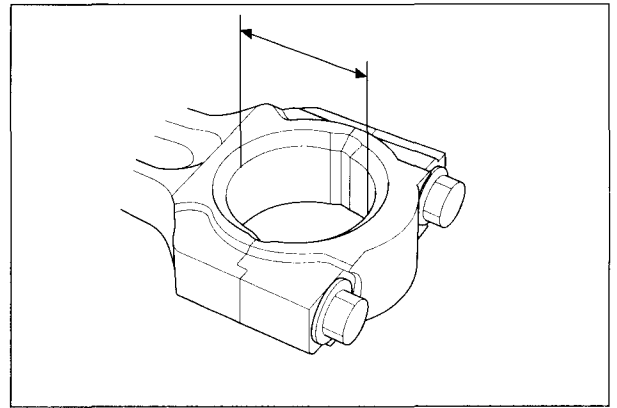
Standard	Service limit
31.989 - 32.000 mm (1.2594 - 1.2598 in)	31.96 mm (1.258 in)



• CONNECTING ROD

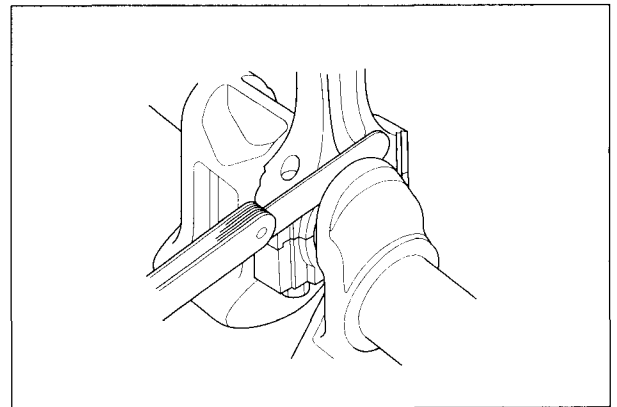
- 1) Measure the connecting rod big end I.D.

Standard	Service limit
32.020 - 32.033 mm (1.0626 - 1.2611 in)	32.06 mm (1.262 in)

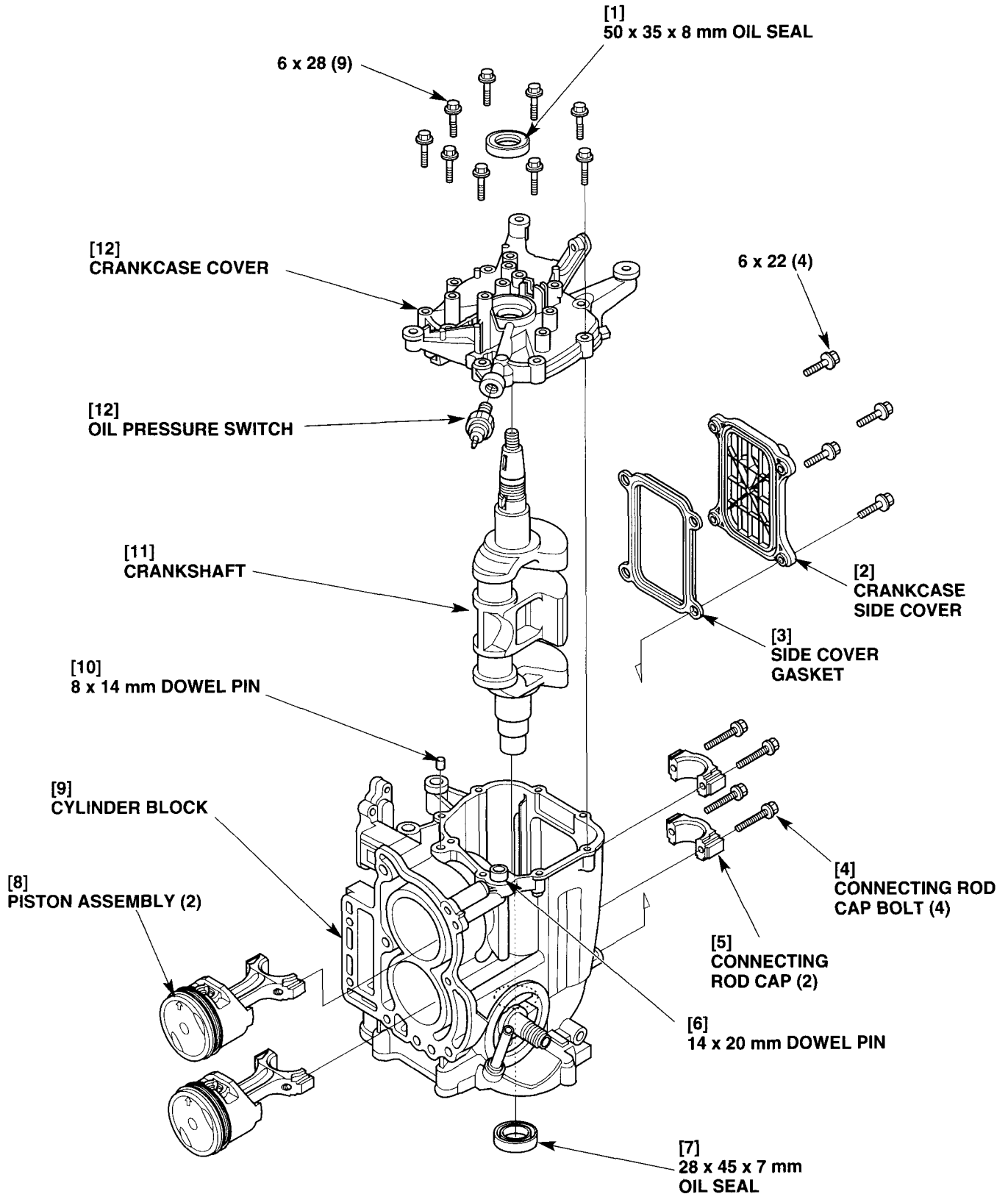


- 2) Install the connecting rod and connecting rod cap, and tighten the connecting rod cap bolts. Measure the connecting rod big end side clearance with the connecting rod facing up as shown using a feeler gauge.

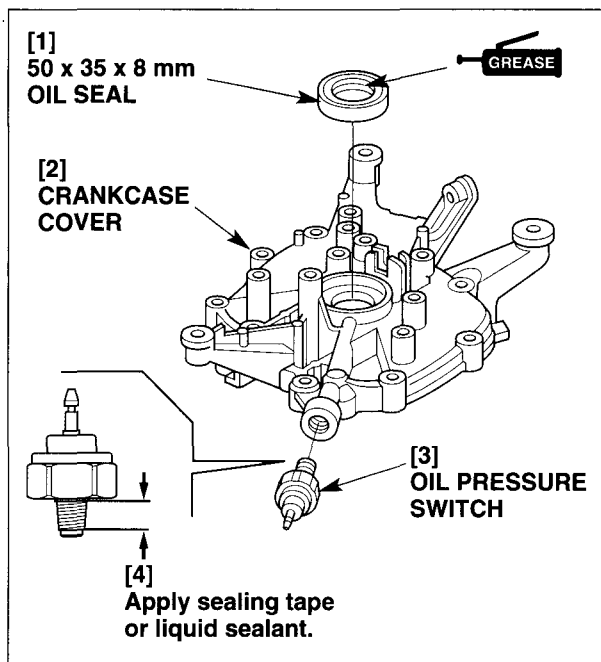
Standard	Service limit
0.10 - 0.40 mm (0.004 - 0.016 in)	0.5 mm (0.02 in)



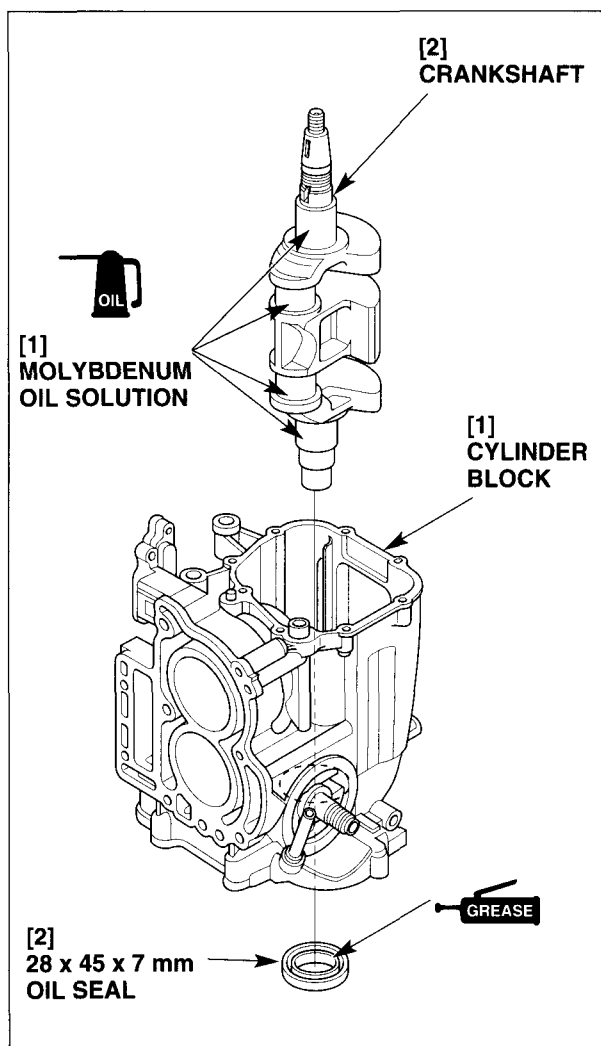
c. ASSEMBLY



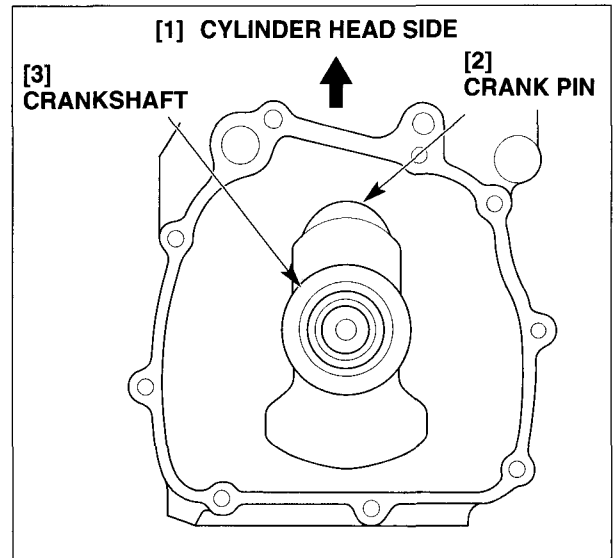
- 1) Check the oil seal of the crankcase cover, replace if damaged. Remove the oil seal and discard it. Install a new oil seal securely.
 - 2) Apply grease to the lip of the oil seal.
 - 3) If the oil pressure switch removed, install the oil pressure switch.
 - Protect the threads by applying sealing tape 1.5 to 2 turns or applying the liquid sealant, and tighten the oil pressure switch to the specified torque using a torque wrench. Do not overtighten the adapter to avoid damaging the threads of the crankcase cover.
- TORQUE: 8 N·m (0.8 kgf·m, 6 lbf·ft)**



- 4) Check the oil seal of the cylinder block, replace if damaged. Remove the oil seal and discard it. Install a new oil seal securely.
- 5) Apply grease to the lip of the oil seal.
- 6) Apply molybdenum oil solution to the crankshaft journals and crank pins. Install the crankshaft.
 - Take care not to damage the oil seal



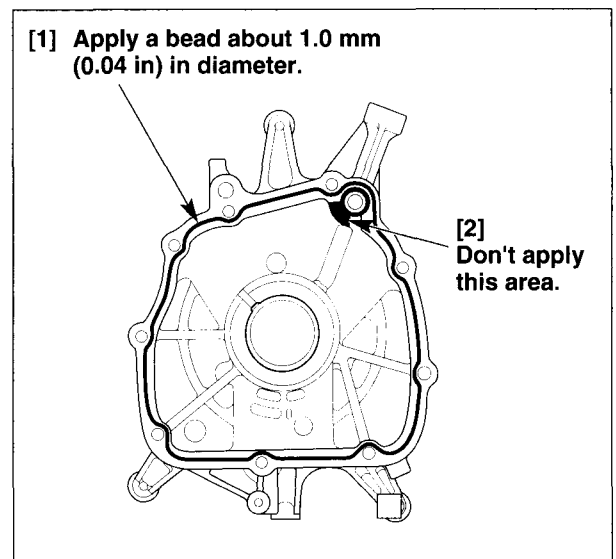
7) Set the crankshaft at T.D.C. by turning.



8) Clean the crankcase cover and cylinder block mating surfaces with a degreasing cleaning agent or a clean shop towel.

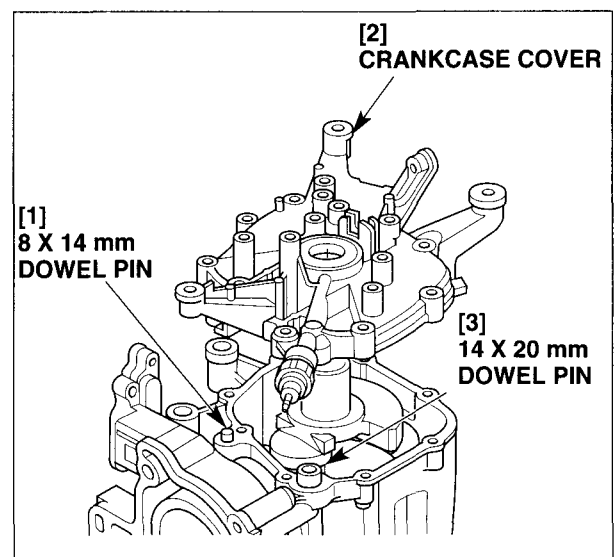
9) Apply liquid sealant (Three Bond 1280 or equivalent) to the position shown on the crankcase cover.

- Apply a bead about 1.5 mm (0.06 in) in diameter.
- Assemble the crankcase side cover within 3 minutes after application of the liquid sealant.
- Wait for 20 minutes after assembly. Do not add oil or start the engine during this period.



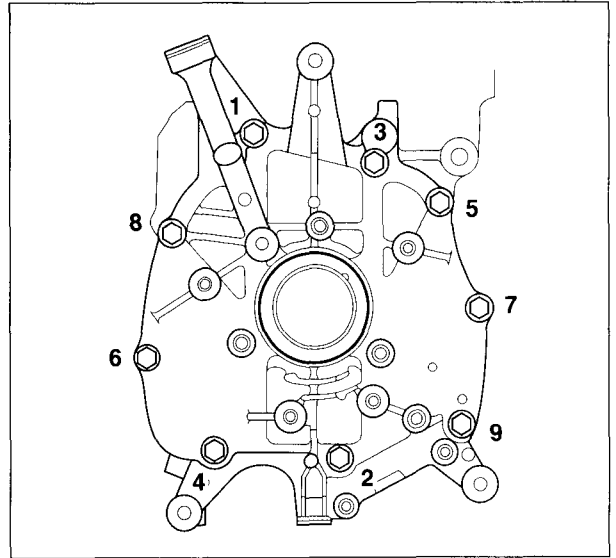
10) Make sure that the 14 x 20 mm dowel pin is in the place.

11) Install the 8 x 14 mm and crankcase cover.



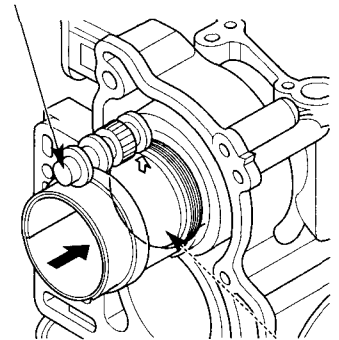
- 12) Apply oil to the threads and flange surfaces of the 6 x 28 mm flange bolts and tighten them to the specified torque.
- Tighten the bolts in the numbered sequence shown in 2 - 3 steps.

TORQUE: 14 N•m (1.4 kgf•m, 10 lbf•ft)



- 13) Apply engine oil to the piston outer surface, piston rings and cylinder wall.
- 14) Set the piston to a commercially available piston ring compressor. Install the pistons with the arrow mark on the piston head facing up.
- Take care not to damage the piston rings and cylinder wall.

**[1]
PISTON RING COM-
PRESSOR
(Commercially available)**

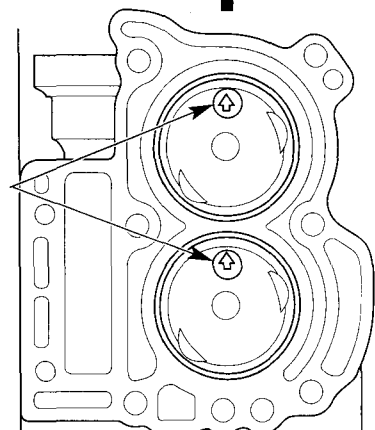


**[4]
PISTON**

[2] UP (FLYWHEEL SIDE)

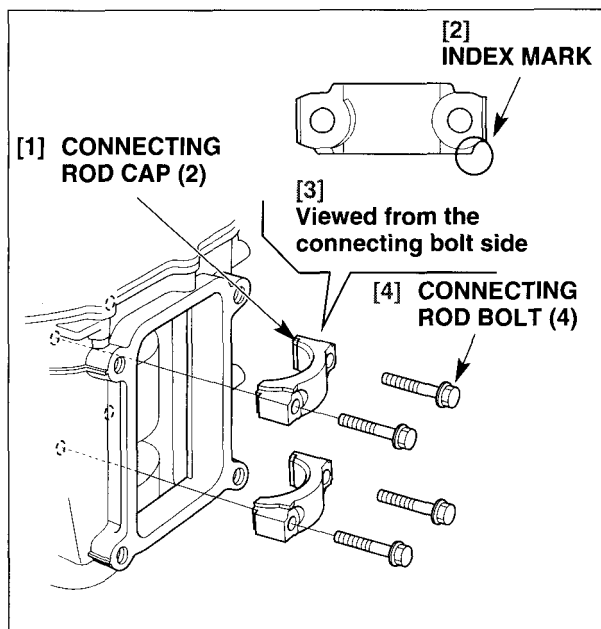


**[3]
ARROW
MARKS**



- 15) Align the connecting rod big ends to the crankshaft.
- 16) Apply engine oil to the crank pins and connecting rod caps.
- 17) Install the connecting rod cap by aligning the index mark.
- 18) Apply oil to the threads and flange section of the connecting rod bolts and tighten them to the specified torque.

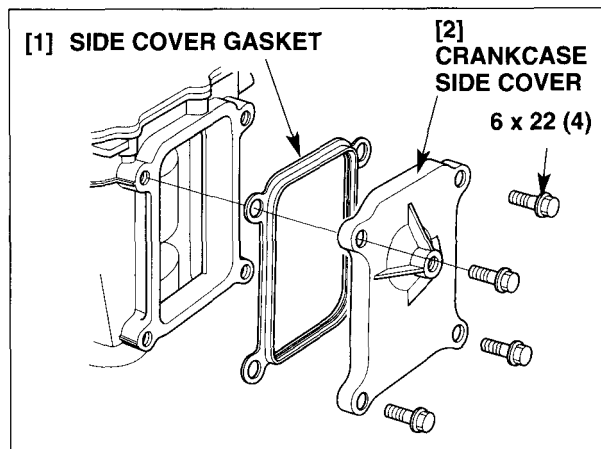
TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)



- 19) Set the side cover gasket to the crankcase side cover, and install them to the crankcase and tighten the 6 x 22 mm flange bolts securely.

- 20) Reinstall the removed parts:

- timing belt drive pulley (P. 9-11).
- charge coil and flywheel (P. 9-8).
- cylinder head (P. 10-20).
- recoil starter (P. 7-9).
- fuel pump and fuel filter (P. 6-18).
- carburetor and silencer (P. 6-13).

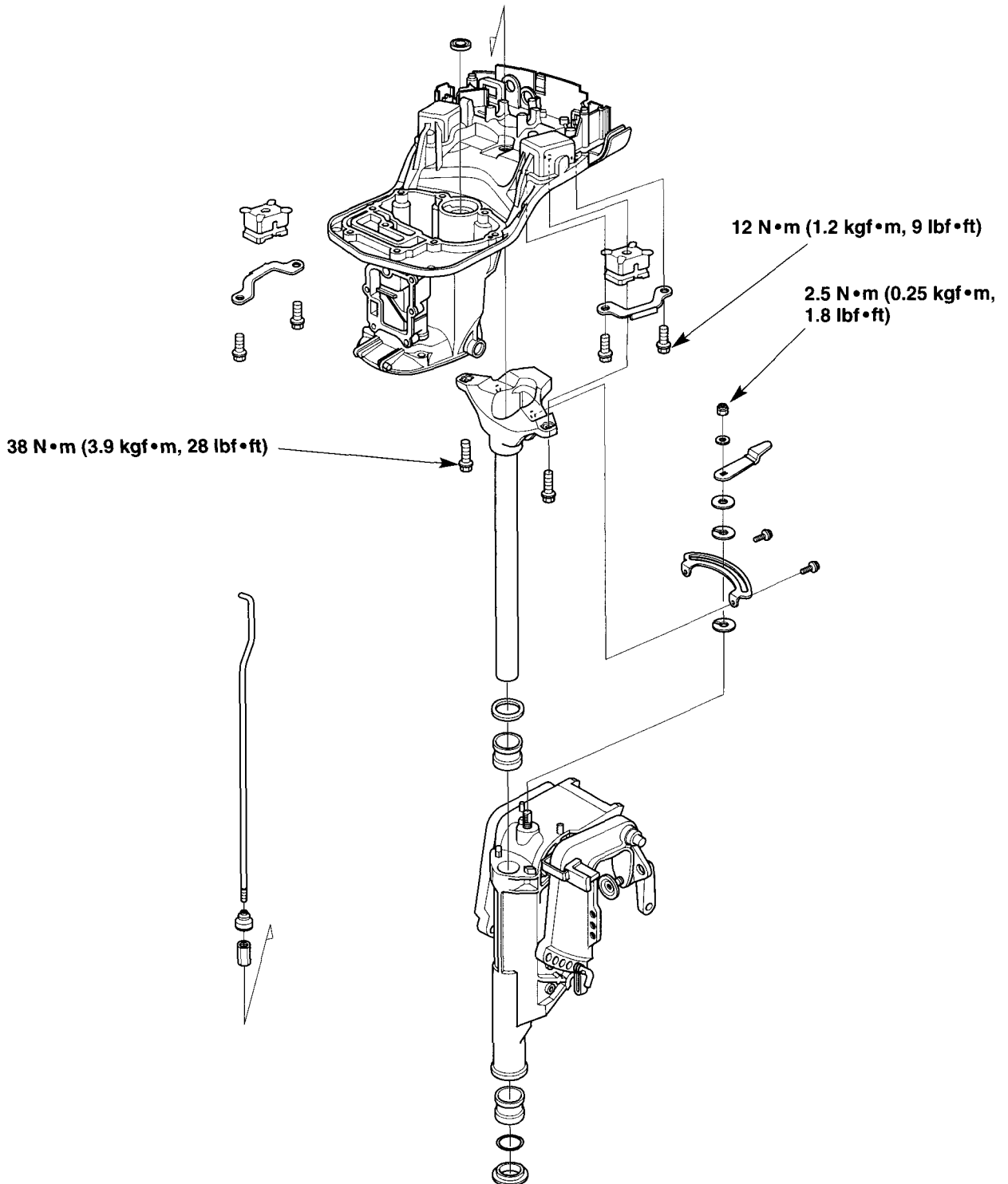


12. OIL CASE/STERN BRACKET/SWIVEL CASE

BF15D-BF20D

1. OIL CASE
2. FRICTION ADJUST LEVER
3. MOUNT FRAME

4. STERN BRACKET
5. SWIVEL CASE



1. OIL CASE

a. DISASSEMBLY

- 1) Remove the engine (section 8) then, remove the following:
 - propeller and gear case (P. 4-9).
 - extension case and lower mount rubber (P. 4-26).
 - remote control cable (P. 14-2).
 - tiller handle (P. 15-2).
 - shift linkage (P. 13-2).
- 2) Remove the shift rod A, adjusting nut and oil case grommet
- 3) Remove the two 10 x 25 mm flange bolts and remove the oil case.
- 4) Remove the four 6 x 12 mm flange bolts and remove the upper mount rubber and set plates.
 - Check the upper mount rubber for damage or deterioration, replace if necessary.

[7]
UPPER MOUNT
RUBBER (2)

[6]
SET PLATE (2)

6 x 12 (4)

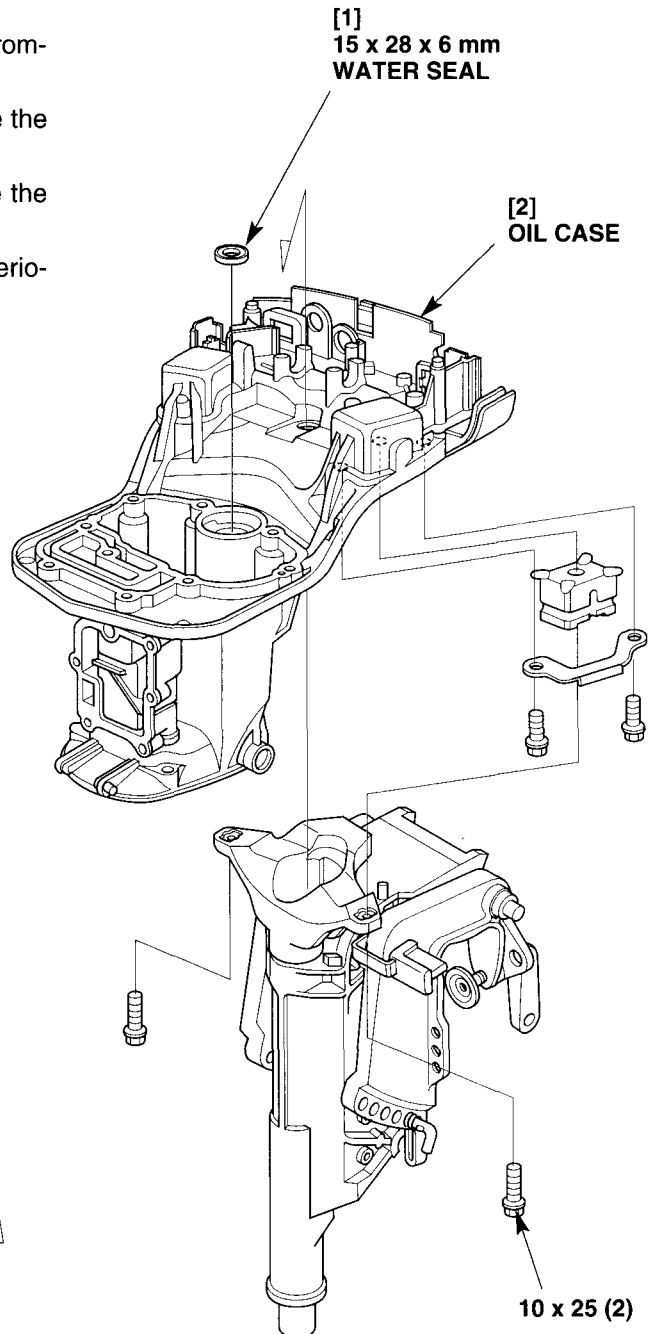
[5]
SHIFT ROD A

[4]
OIL CASE GROMMET E

[3]
ADJUSTING NUT

[1]
15 x 28 x 6 mm
WATER SEAL

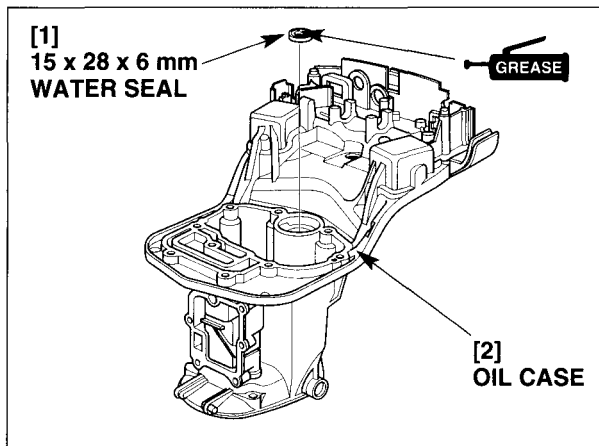
[2]
OIL CASE



10 x 25 (2)

b. WATER SEAL REPLACEMENT

- 1) Check the water seal, replace with new one if damaged. Remove and discard the water seal.
- 2) Install a new water seal properly.
- 3) Apply marine grease to the lips of the water seal.



c. ASSEMBLY

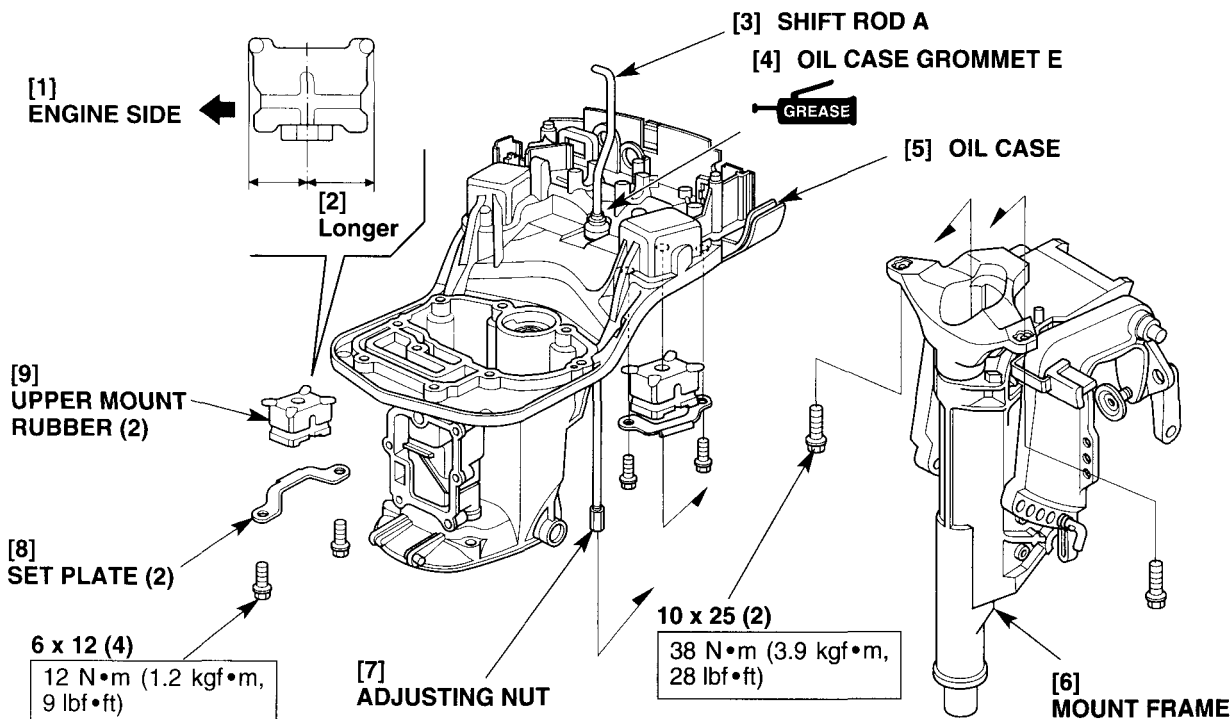
- 1) Apply marine grease to the inside of the oil case grommet E. Install the shift rod A, adjusting nut and oil case grommet.
- 2) Inspect the upper mount rubber for cracks or damage, replace if necessary. Install the upper mount rubber with the shorter side facing toward the engine as shown. Install the set plate and tighten the 6 x 12 mm flange bolts to the specified torque.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

- 3) Install the oil case onto the mount frame assembly.
- 4) Tighten the the two 10 x 25 mm flange bolts to the specified torque.

TORQUE: 38 N•m (3.9 kgf•m, 28 lbf•ft)

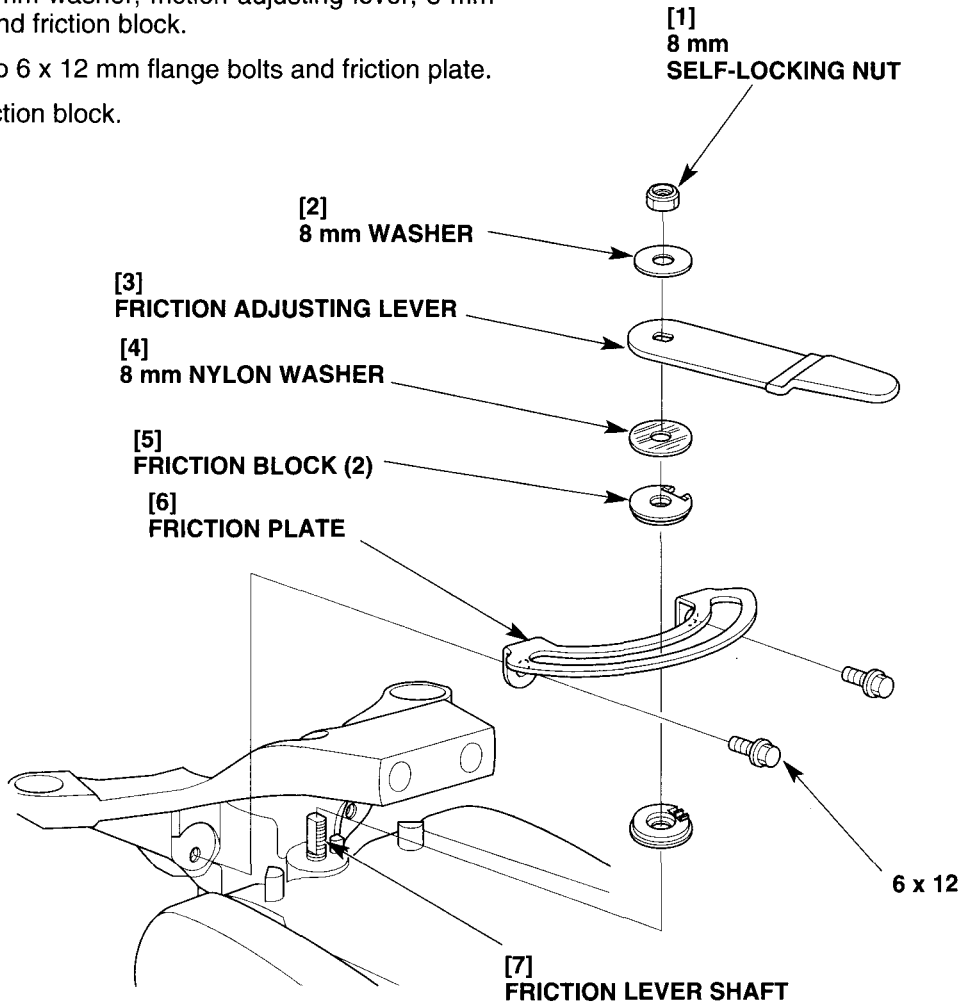
- 5) Install the removed parts in the reverse order of removal.



2. FRICTION ADJUSTING LEVER

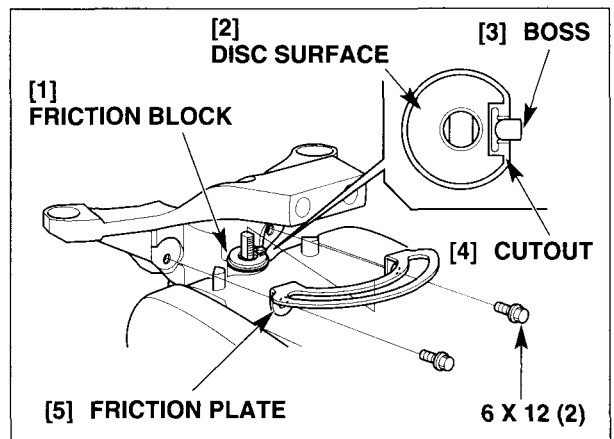
a. DISASSEMBLY

- The friction adjusting lever can be serviced with the oil case and engine installed.
- 1) Remove the 8 mm self-locking nut.
- 2) Remove the 8 mm washer, friction adjusting lever, 8 mm nylon washer and friction block.
- 3) Remove the two 6 x 12 mm flange bolts and friction plate.
- 4) Remove the friction block.

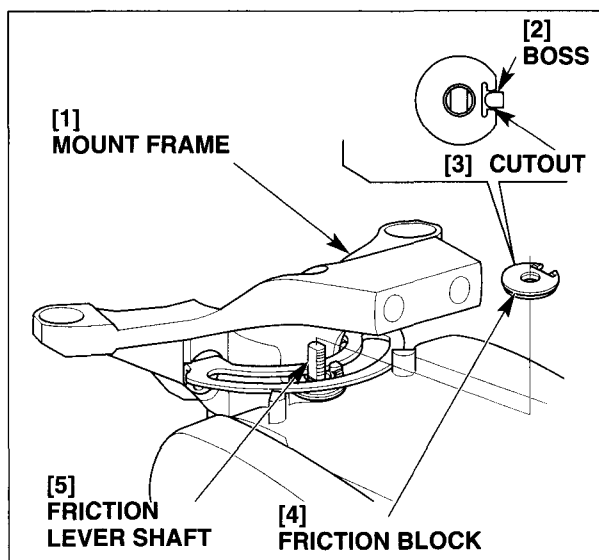


b. ASSEMBLY

- 1) Before installation, check the disc surface of the friction block for wear. Replace if necessary.
- 2) Clean off grease or oil from the disc surfaces of the friction blocks and friction plate. Install one of the friction block onto the friction lever shaft by aligning the cutout with the boss on the swivel case and facing the disc surface toward the friction plate as shown.
- 3) Install the friction plate to the mount frame by aligning the groove with the friction lever shaft.



- 4) Install the other friction block onto the friction lever shaft by aligning the cutout with the boss on the swivel case and facing the disc surface toward the friction plate.



- 5) Install the 8 mm nylon washer, friction adjusting lever and 8 mm washer.
- 6) Turn the adjusting lever to the right fully, and hold it in this position and tighten the 8 mm self-locking nut to the specified torque.

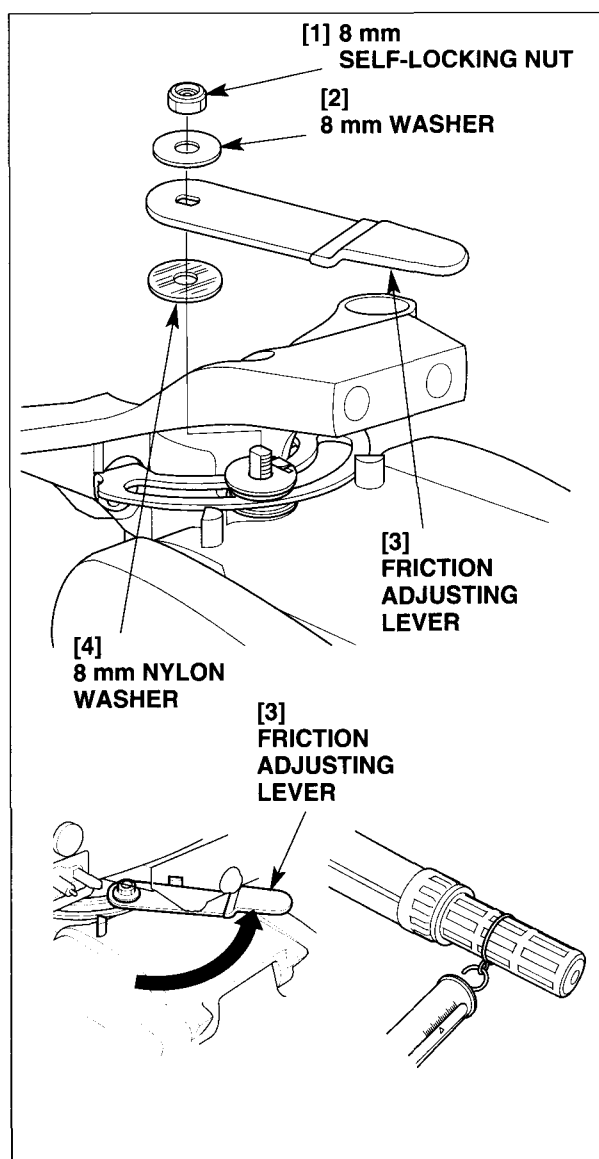
TORQUE: 2.5 N•m (0.25 kgf•m, 1.8 lbf•ft)

- 7) Check the starting torque by measuring the starting force by using a spring scale at the center of the tiller handle as shown.

Set the friction adjusting lever to right fully.

The motor should start to move with 20 N (20 kgf, 44 lbf).

- 8) If NO, loosen the lock nut once, the retighten the self-locking nut to the specified torque.




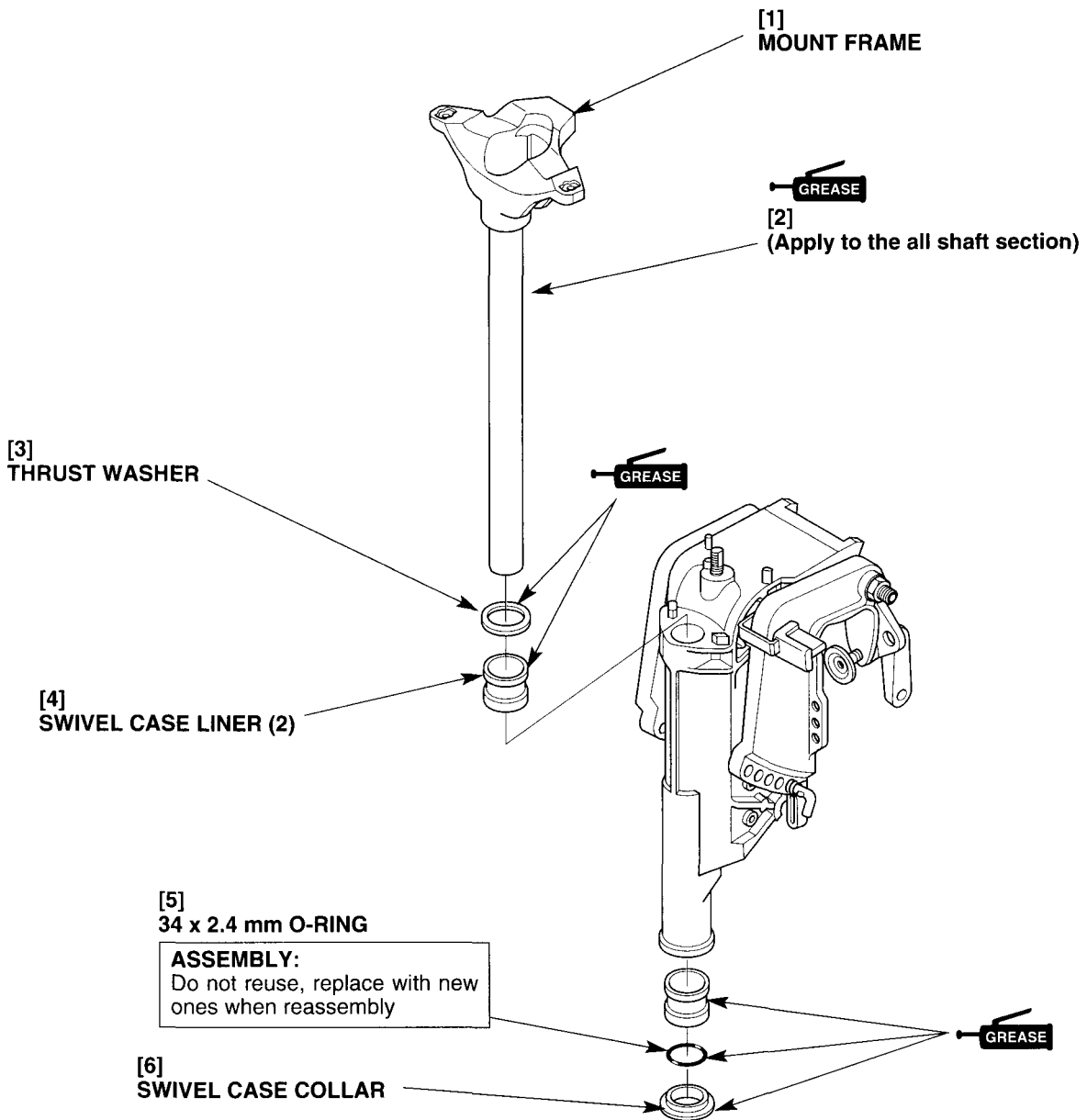
3. MOUNT FRAME

a. REMOVAL/INSTALLATION

Refer to page for removal/installation:

- engine removal/installation (section 8).
- oil case removal (P. 12-2), installation (P. 12-3).
- friction adjusting lever removal (P. 12-4), installation (P. 12-4).

-  : Apply marine grease.

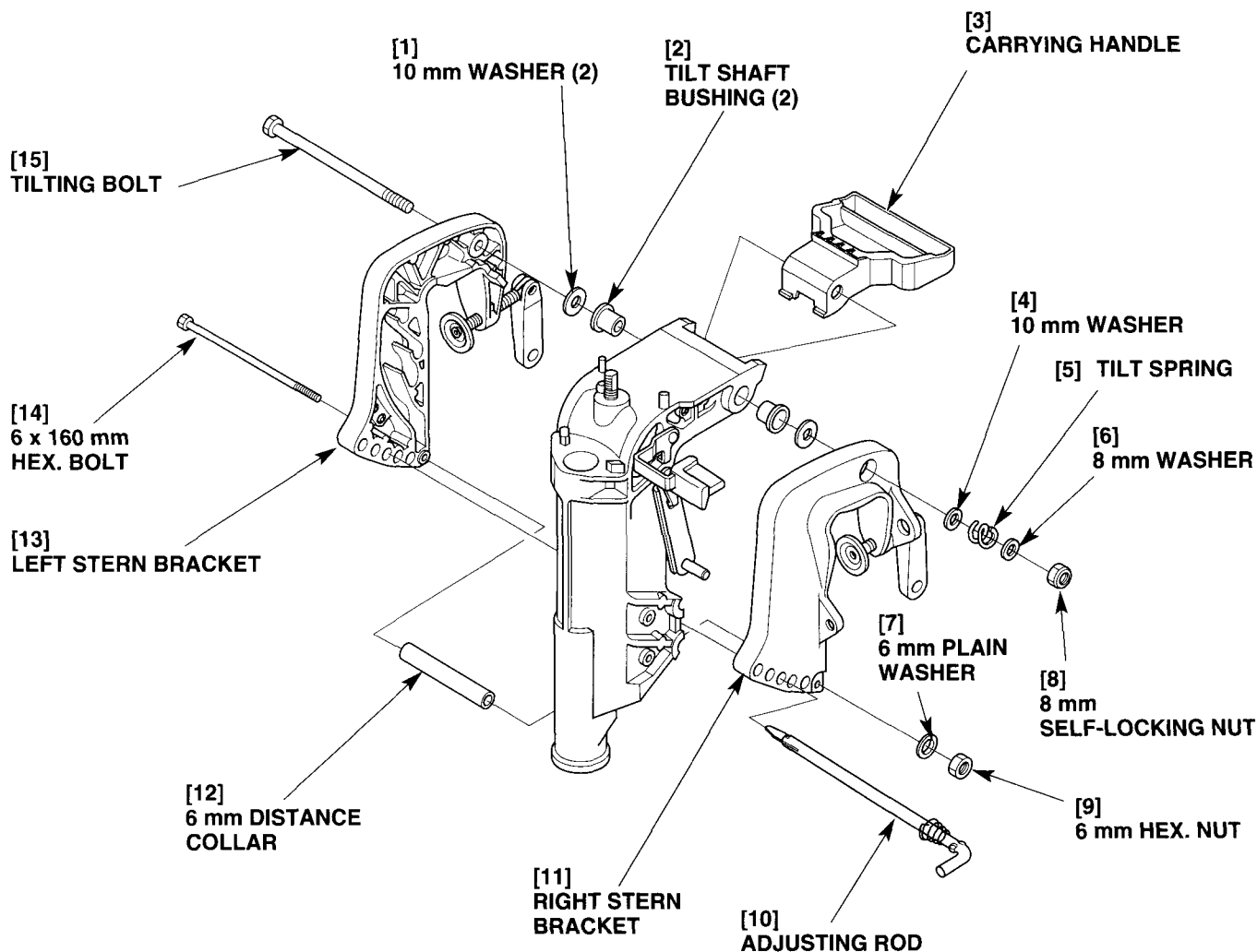


4. STERN BRACKET

a. REMOVAL

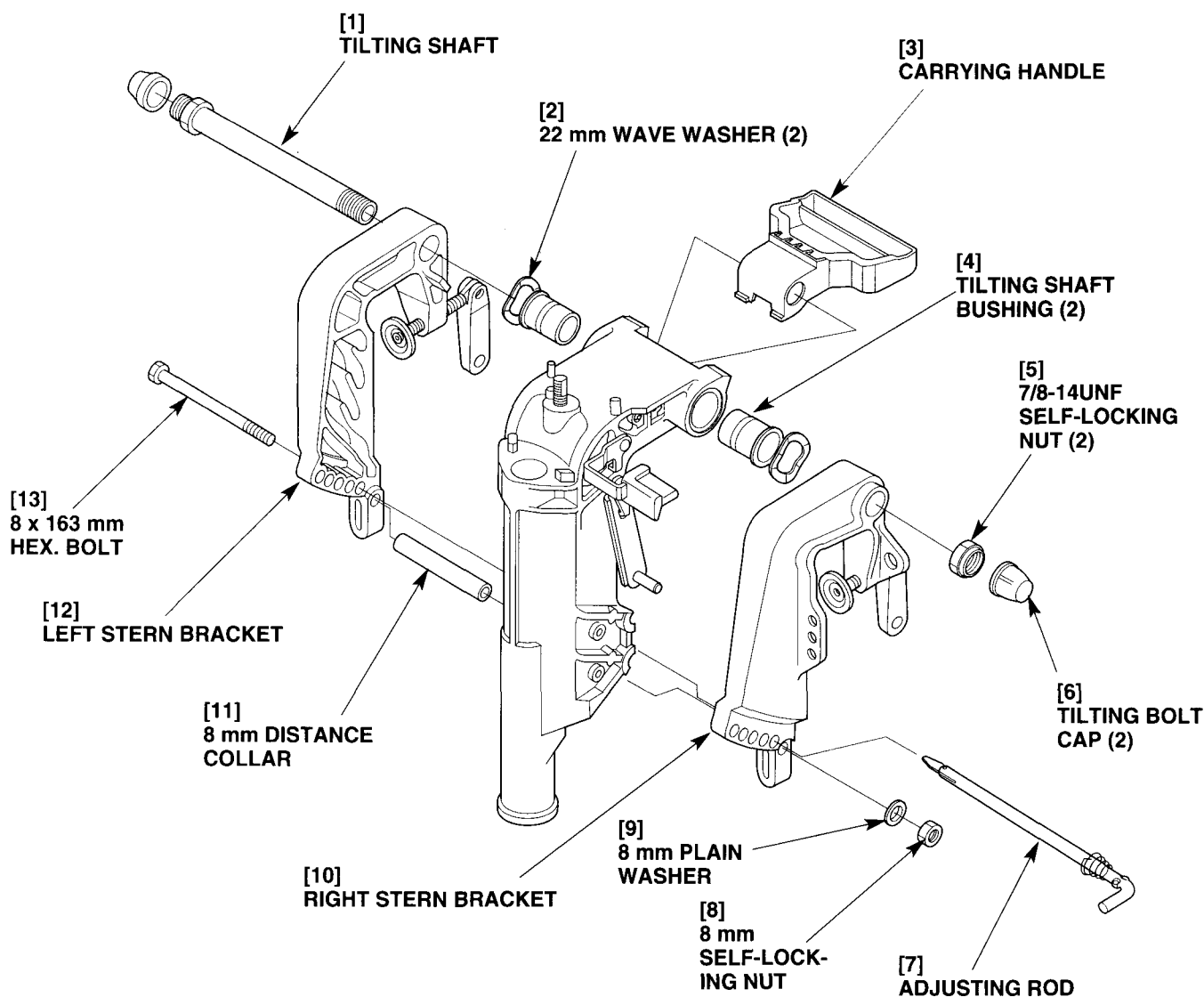
• Tiller handle S type

- 1) Remove the following:
 - oil case (P. 12-2).
 - friction adjusting lever (P. 12-4).
 - mount frame (P. 12-6).
- 2) Remove the adjusting rod.
- 3) Loosen the 8 mm self-locking nut, then remove the 6 mm hex. nut, 6 mm plain washer, 6 mm distance collar and 6 x 160 mm hex bolt.
- 4) Remove the 8 mm self-locking nut, 8 mm washer, tilt spring and 10 mm washer.
- 5) Remove the right stern bracket and 10 mm washers.
- 6) Remove the tilting bolt, 10 mm washer, carrying handle and left stern bracket.
- 7) Remove the tilting bushings if necessary.



• **Except tiller handle S type**

- 1) Remove the following:
 - oil case (P. 12-1).
 - friction adjusting lever (P. 12-3).
 - mount frame (P. 12-5).
- 2) Remove the adjusting rod.
- 3) Remove the tilting bolt cap and loosen the 7/8-14UNF self-locking nut, then remove the 8 mm self-locking nut, 8 mm plain washer, 8 mm distance collar and 8 x 163 mm hex. bolt.
- 4) Remove the 7/8-14UNF self-locking nut.
- 5) Remove the right stern bracket and 22 mm wave washer.
- 6) Remove the tilting shaft, 22 mm wave washer, carrying handle and left stern bracket.
- 7) Remove the tilting bushings if necessary.



b. INSTALLATION

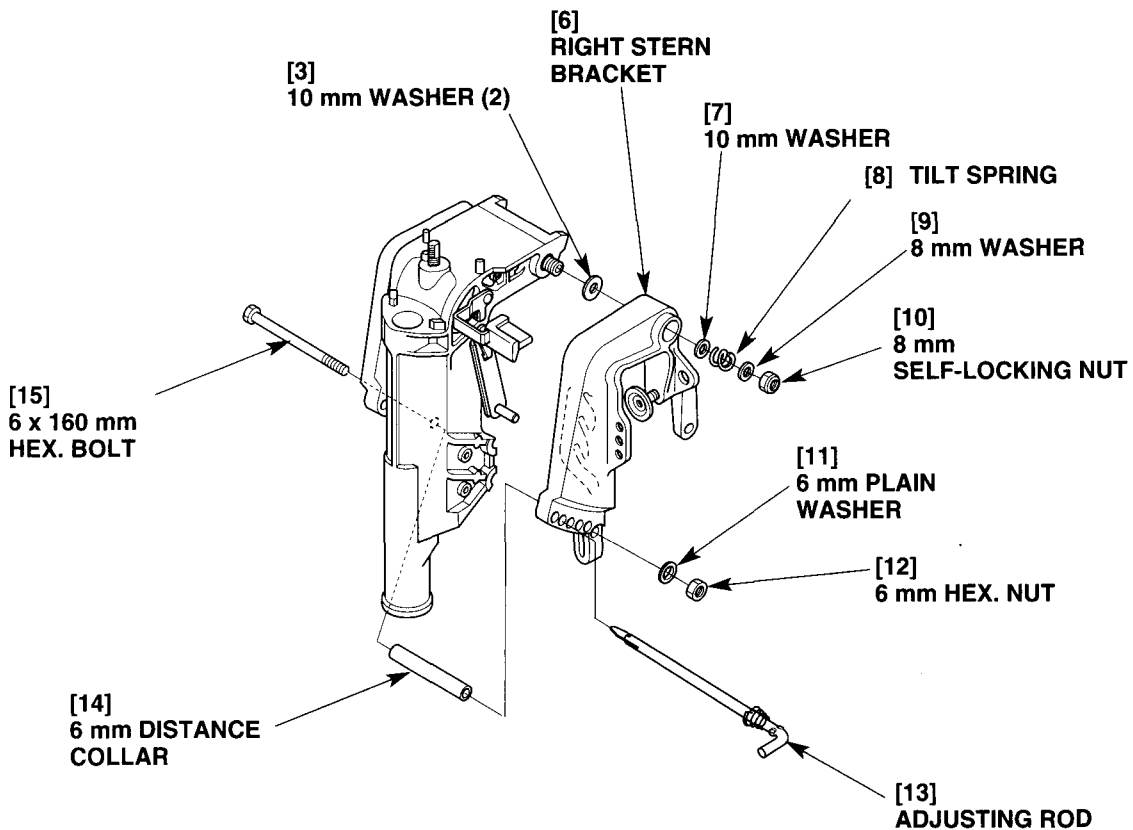
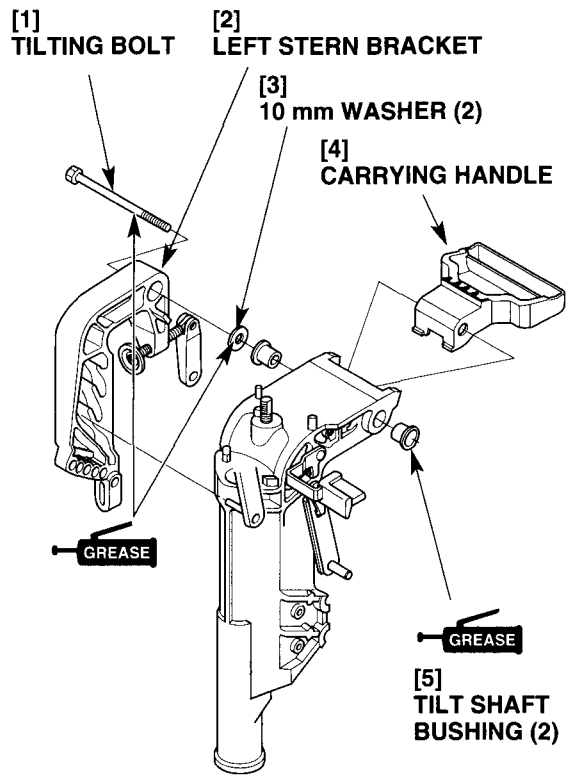
• Tiller handle S type

- 1) Apply grease to new swivel case bushings and install them to the swivel case.
- 2) Apply grease to the threads of the tilting bolt and mounting hole.
- 3) Install the left stern bracket, carrying handle, and washer by aligning the groove with the pin and install, and install the tilting bolt.

- 4) Install the washer and right stern bracket.
- 5) Install the 10 mm washer, tilt spring 8 mm washer and loosely install the 8 mm self-locking nut.
- 6) Install the 6 mm distance collar, 6 x 160 mm bolt, 6 mm washer and 6 mm hex. nut. Tighten the 6 mm hex nut securely.
- 7) Tighten the 8 mm self-locking nut to the specified torque.

TORQUE: 24 N·m (2.4 kgf·m, 17 lbf·ft)

- 8) Install the adjusting rod.



• **Except tiller handle S type**

- 1) Apply grease to new swivel case bushings and install them to the swivel case.
- 2) Apply grease to the threads of the tilting shaft, mounting hole and wave washer.
- 3) Install the left stern bracket, carrying handle, and wave washer by aligning the groove with the pin and install the tilting shaft.

4) Install the wave washer and right stern bracket.

5) Loosely install the 7/8-14UNF self-locking nut.

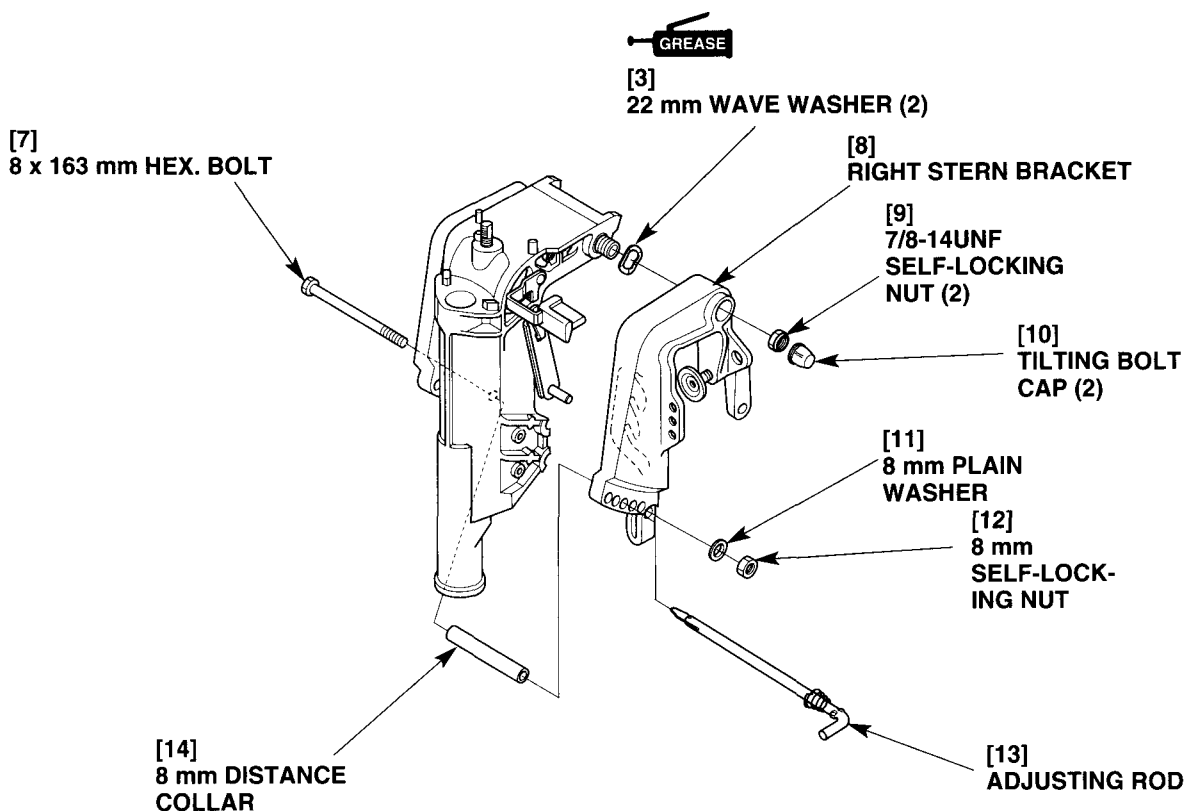
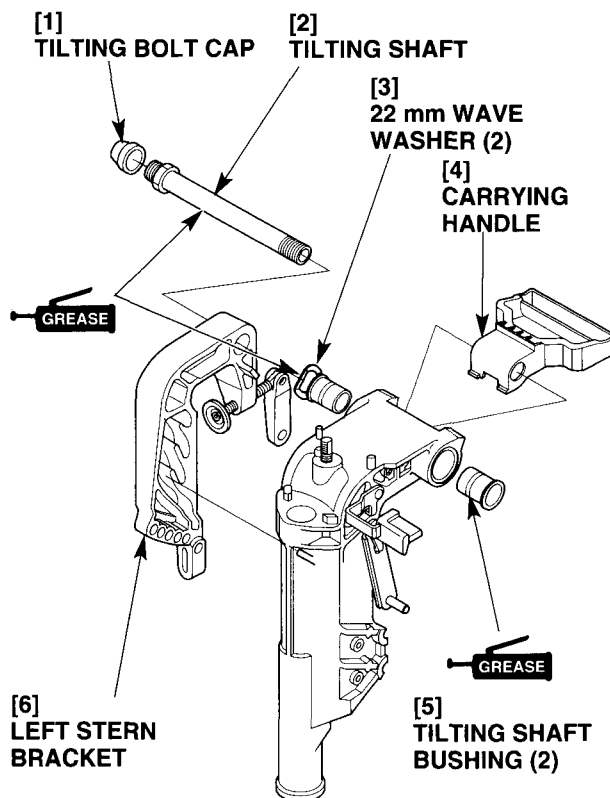
6) Install the 8 mm distance collar, 8 x 163 mm bolt, 8 mm washer and 8 mm self-locking nut. Tighten the 8 mm self-locking nut to the specified torque.

TORQUE: 21 N·m (2.1 kgf·m, 15 lbf·ft)

7) Tighten the 7/8-14UNF self-locking nut to the specified torque.

TORQUE: 17 N·m (1.7 kgf·m, 12 lbf·ft)

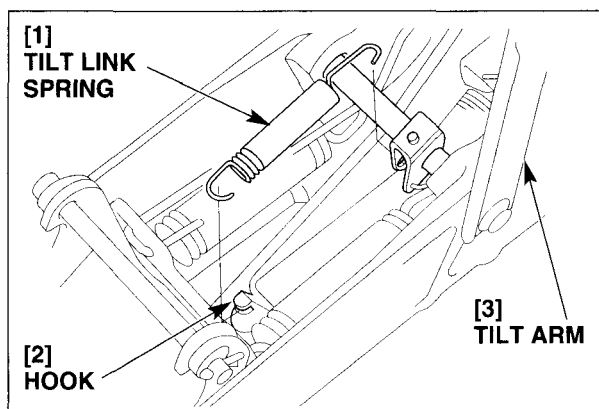
8) Install the adjusting rod.



5. SWIVEL CASE

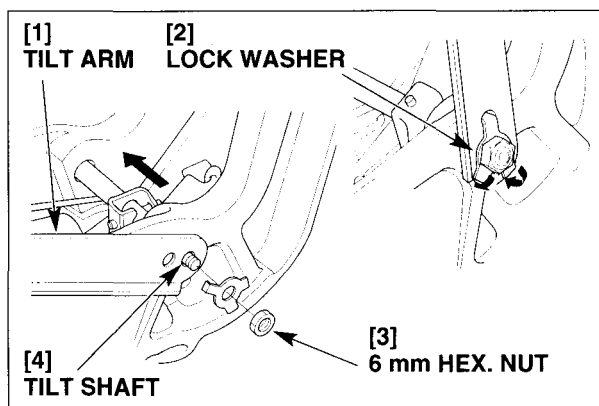
a. DISASSEMBLY

- 1) Raise up the tilt arm and unhook the tilt link spring from the hook on the swivel case then remove the tilt link spring.



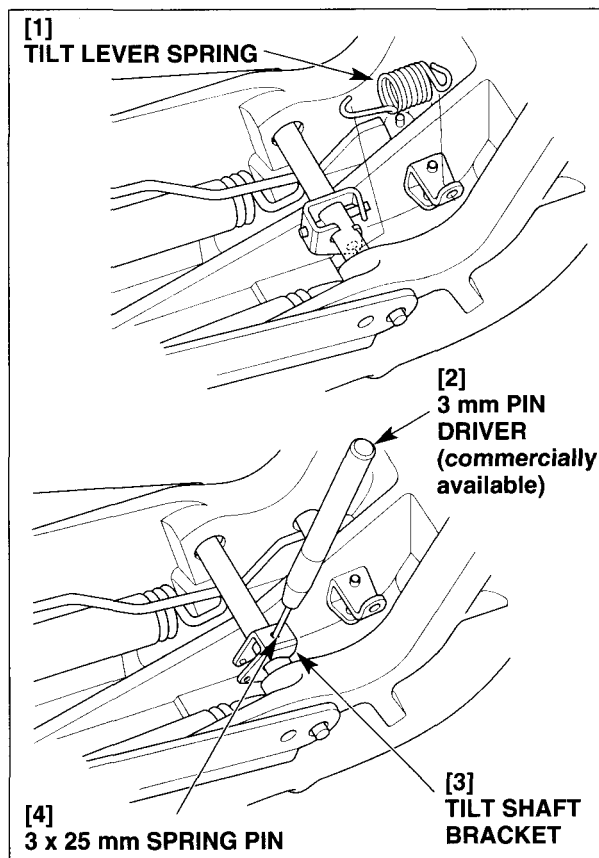
- 2) Stretch the bent tabs of the lock washer and loosen the 6 mm hex. nut. Remove the 6 mm hex nut and lock washer, then push the tilt arm shaft slightly.

- Replace the lock washer with new one when reassembly.

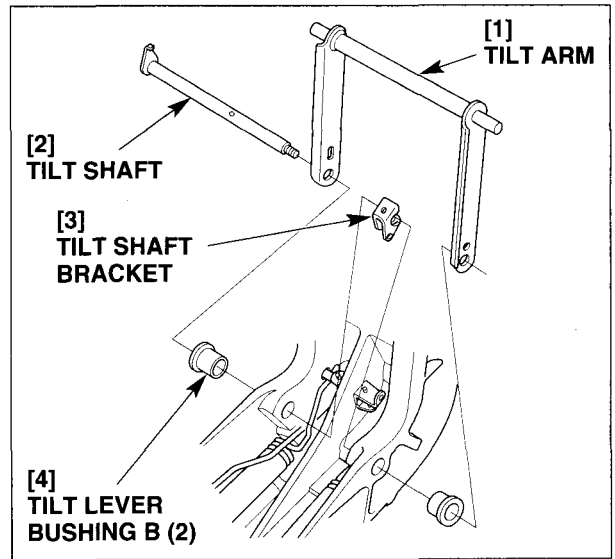


- 3) Remove the tilt lever spring.

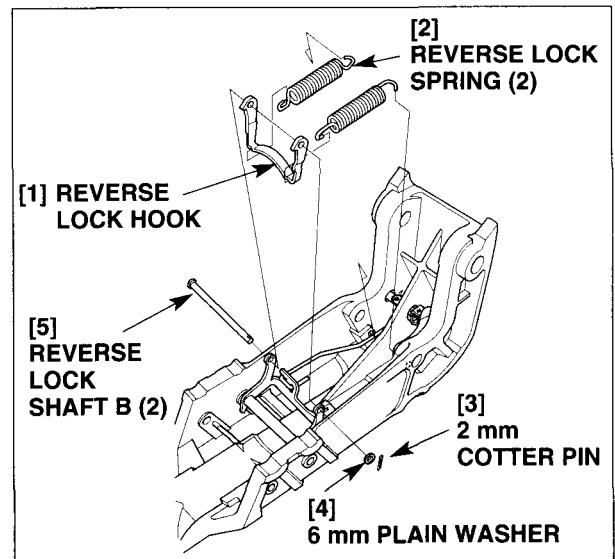
- 4) Drive out the 3 x 25 mm spring pin using a commercially available 3 mm pin driver and discard the spring pin. Replace the spring pin with new one when reassembly.



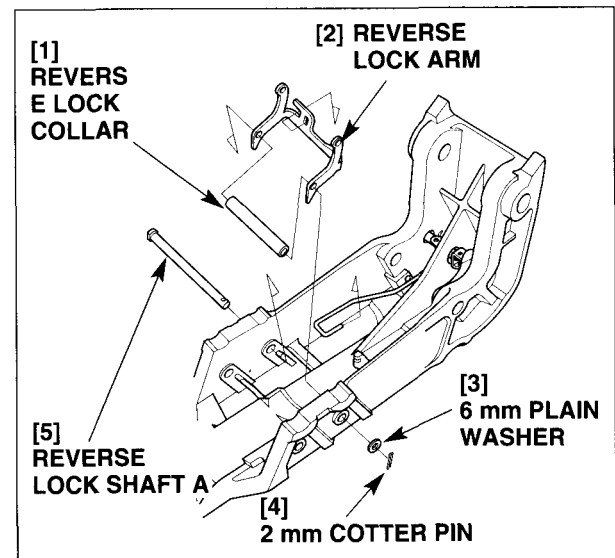
- 5) Remove the tilt shaft, tilt arm shaft bracket and tilt arm.
- 6) Check the tilt lever bushing B for wear or damage. replace if necessary.



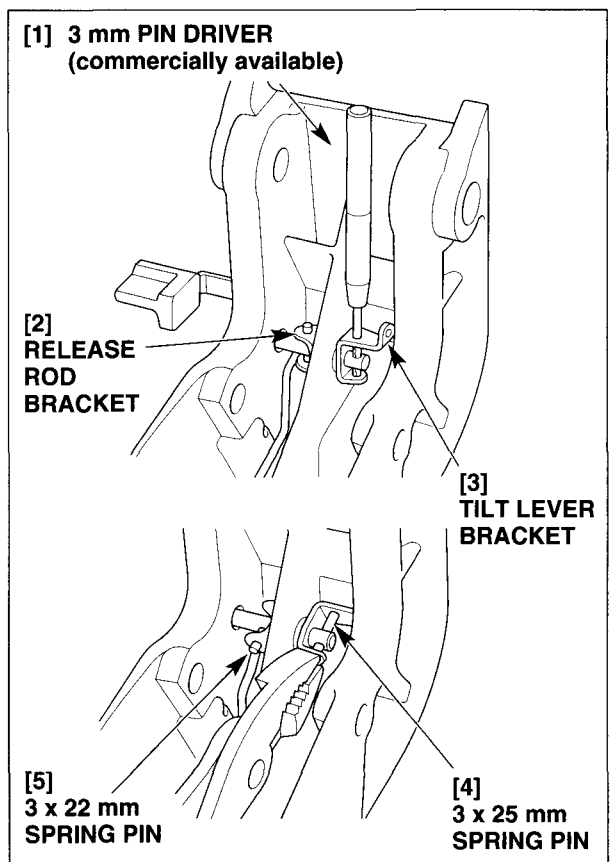
- 7) Remove and discard the 2 mm cotter pin.
 - Replace the 2 mm cotter pin with new one when reassembly. Don't reuse.
- 8) Remove the 6 mm washer and reverse lock shaft B, then remove the reverse lock hook and two reverse lock spring.



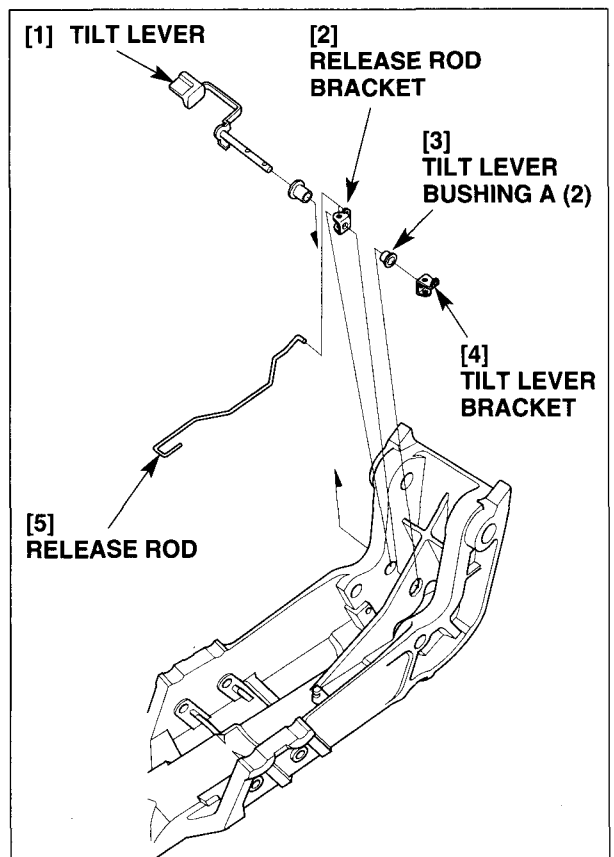
- 9) Remove and discard the 2 mm cotter pin.
 - Replace the 2 mm cotter pin with new one when reassembly. Don't reuse.
- 10) Remove the 6 mm washer and reverse lock shaft A and reverse lock collar. Disengage the release rod from the reverse lock arm and remove the reverse lock arm.



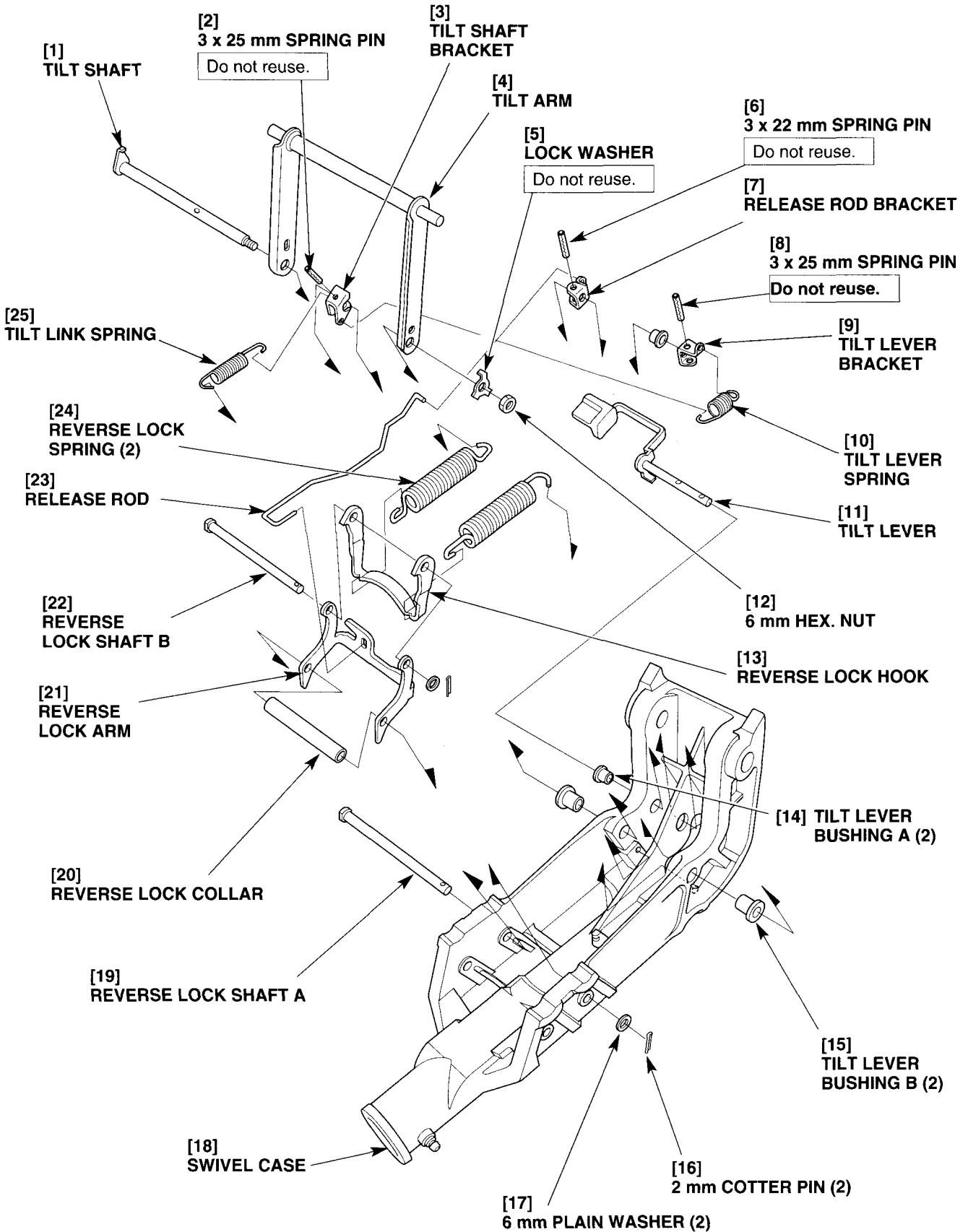
- 11) Drive the 3 x 25 mm spring pin using a commercially available 3 mm pin driver until it comes clear of the upper side of the tilt lever bracket.
- 12) Drive the 3 x 22 mm spring pin according to the above procedure until it comes clear of upper side of the release rod bracket.
- 13) Pull the spring pins out of the bracket using a vise pliers and discard the spring pins. Replace the spring pins with new ones when reassembly.



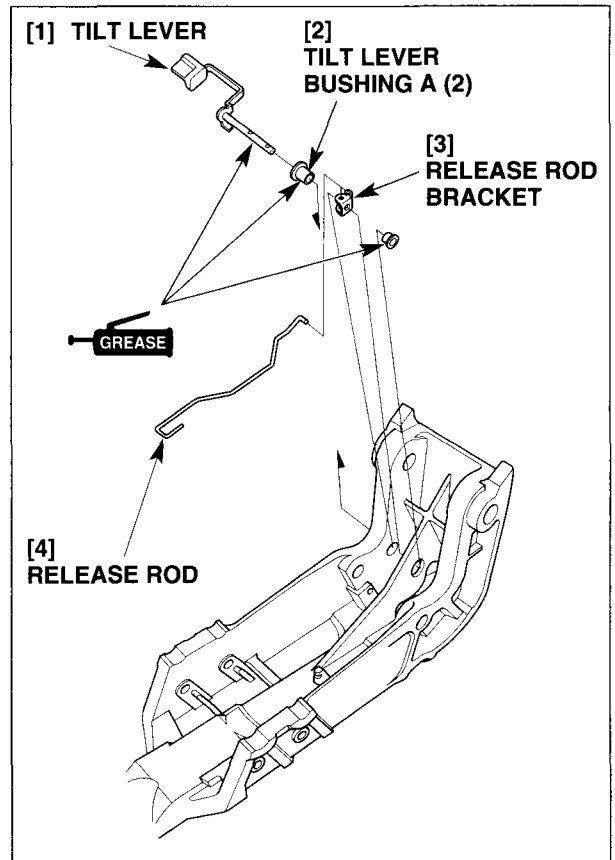
- 14) Remove the tilt lever, then remove the release rod, release rod bracket tilt lever bracket.
- 15) Check the tilt lever bushing A for wear or damage. Replace if necessary.



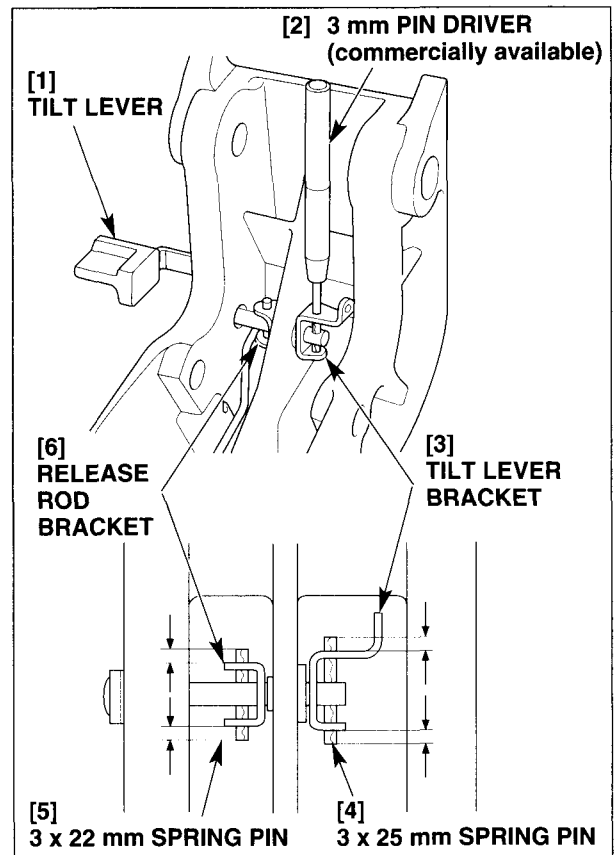
b. ASSEMBLY



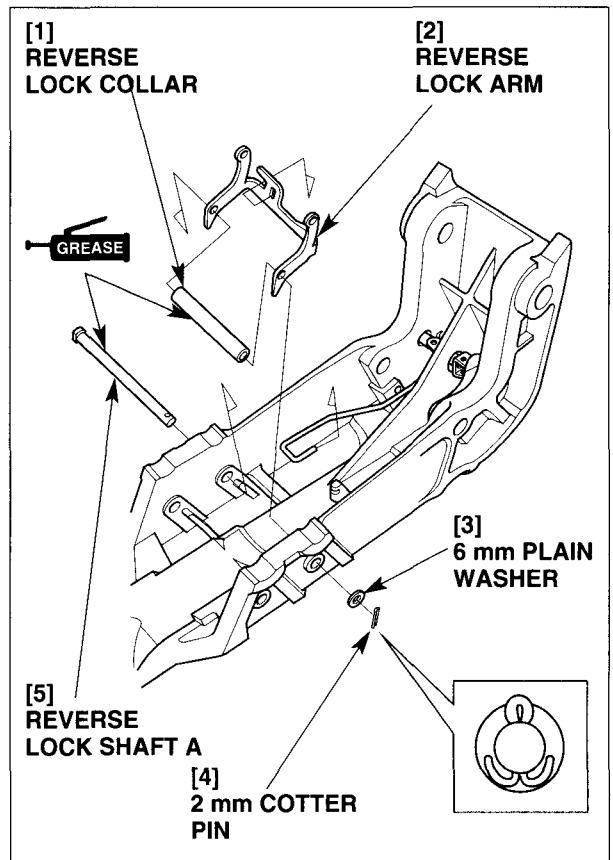
- 1) Check the tilt lever bushing B for wear or damage, replace with new one if necessary.
- 2) Apply grease to the tilt lever bushing B.
- 3) Connect the release rod to the release rod bracket. Install the tilt lever, release rod bracket and tilt lever bracket.



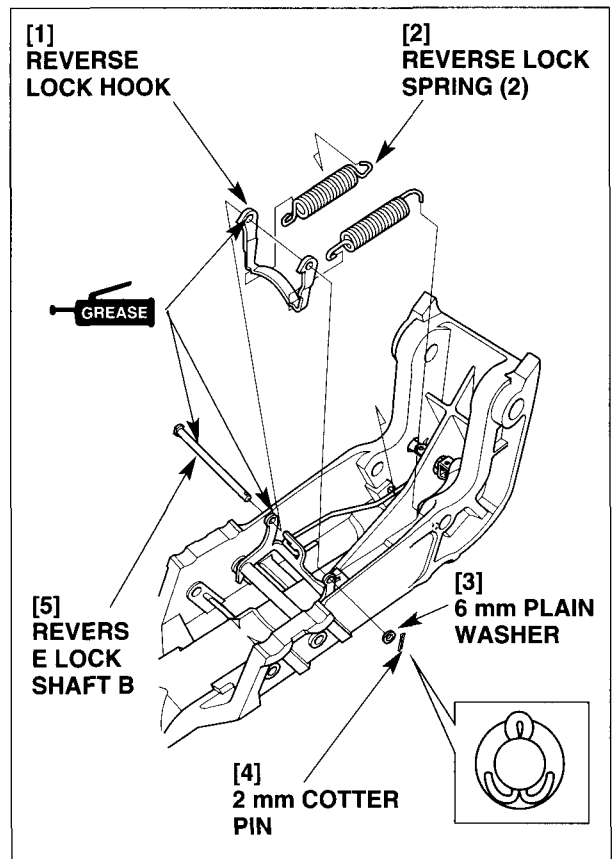
- 4) Set the tilt lever, release rod bracket and tilt lever bracket in the position shown and set the 3 x 22 mm and 3 x 25 mm new spring pins.
- 5) Drive the spring pins using a commercially available pin driver until the both projected distances are equally as shown.



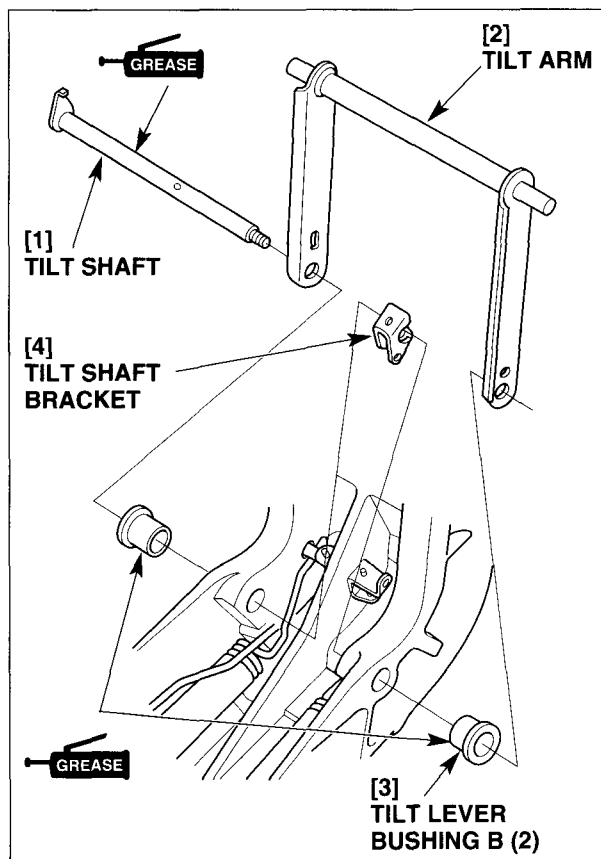
- 6) Engage the release rod to the reverse lock arm.
- 7) Apply grease to the shaft pivot holes of the swivel case and install the reverse lock arm, reverse lock collar and reverse lock shaft A.
- 8) Install the 6 mm plain washer and install a new 2 mm cotter pin, and spread the ends as shown.



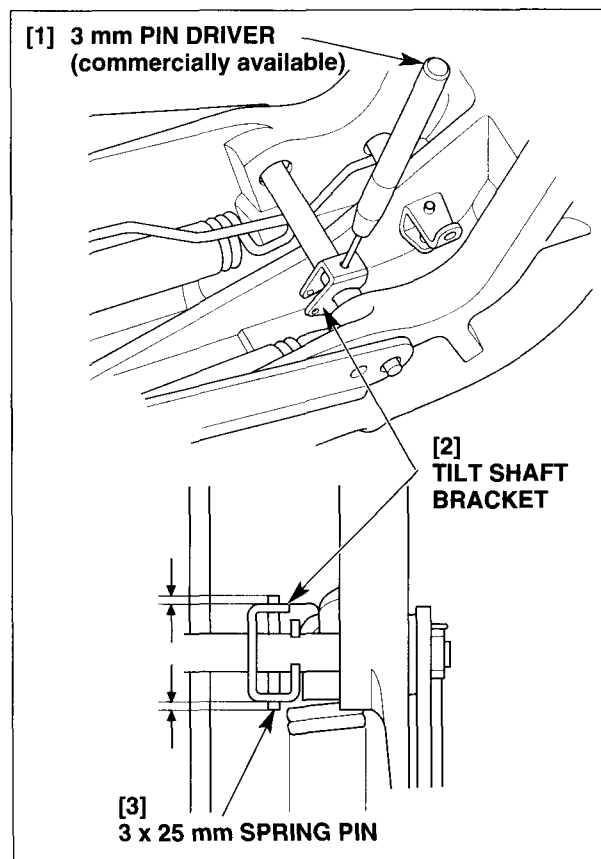
- 9) Apply grease to the reverse lock hook pivot holes of the reverse lock arm.
- 10) Install the reverse lock springs, reverse lock hook and reverse lock shaft B.
- 11) Install the 6 mm plain washer and install a new 2 mm cotter pin, and spread the ends as shown.



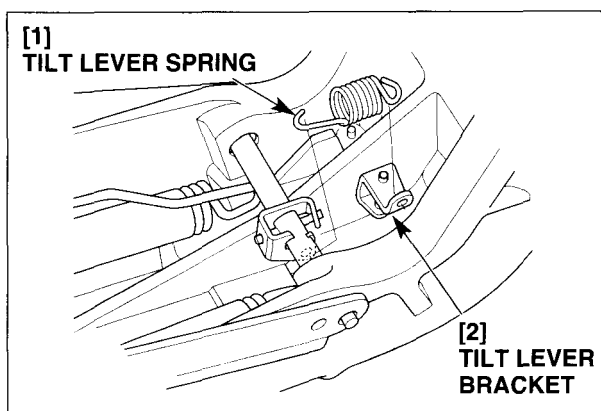
- 12) Check the tilt lever bushing A for wear or damage, replace with new one if necessary.
- 13) Apply grease to the tilt lever bushing B.
- 14) Install the tilt arm, tilt shaft and tilt shaft bracket.



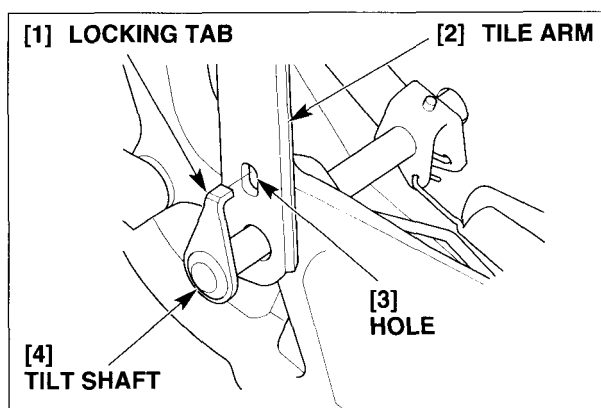
- 15) Turn the tilt shaft until the locking tab faces toward up, and align the pin holes of the tilt shaft bracket with pin hole of tilt shaft and set a new 3 x 25 mm spring pin.
- 16) Drive the spring pins using a commercially available pin driver until the both projected distances are equally as shown.



17) Install the tilt lever spring with the short end toward the tilt lever bracket.

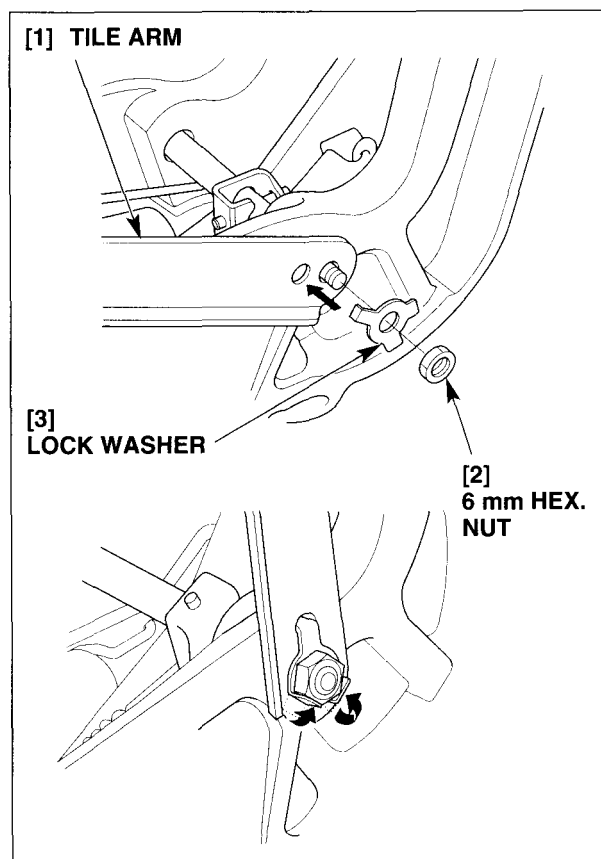


18) Set the locking tab to the hole on the tilt arm as shown.

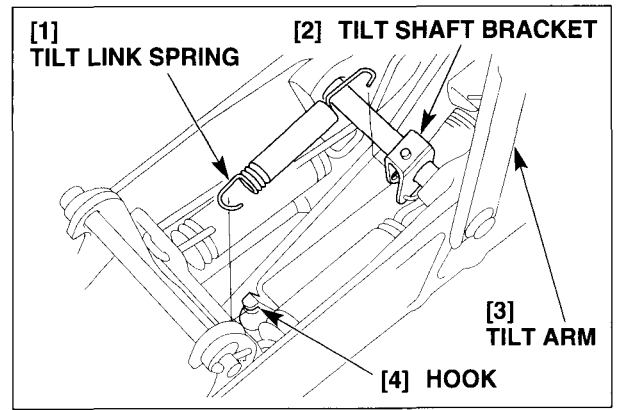


19) Install new lock washer by aligning the locking tab with the hole on the tilt arm.

20) Tighten the 6 mm hex. nut securely, then bend the tab to lock the nut as shown.



21) Install the tilt link sprig with the long end hook to the tilt shaft bracket.

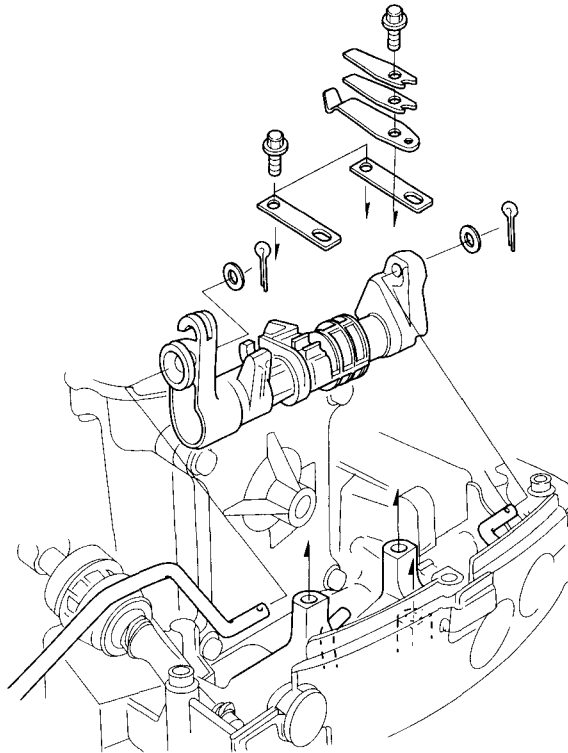


13. SHIFT LINKAGE

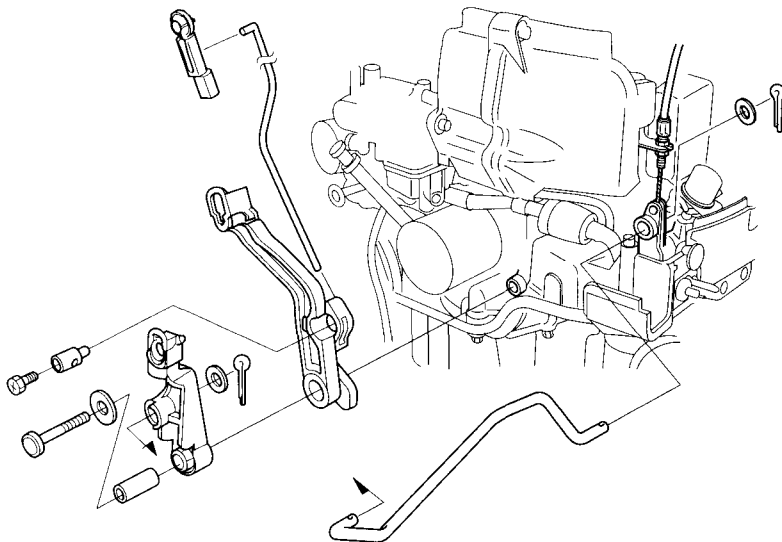
BF15D·BF20D

- 1. SHIFT ARM/THROTTLE ARM
- 2. SHIFT LEVER

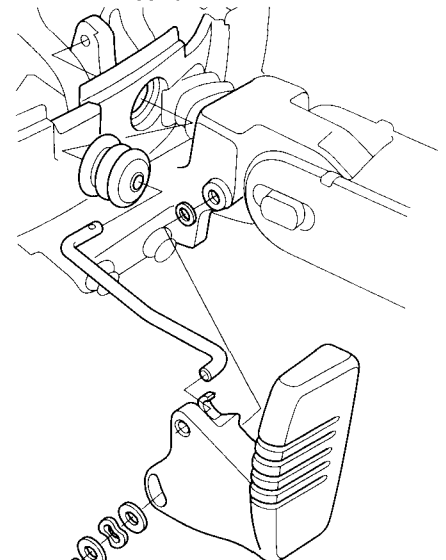
- 3. SHIFT SHAFT



[1] SHIFT ARM/THROTTLE ARM
(Remote control type)



[2] SHIFT ARM/THROTTLE ARM
(Tiller handle type)



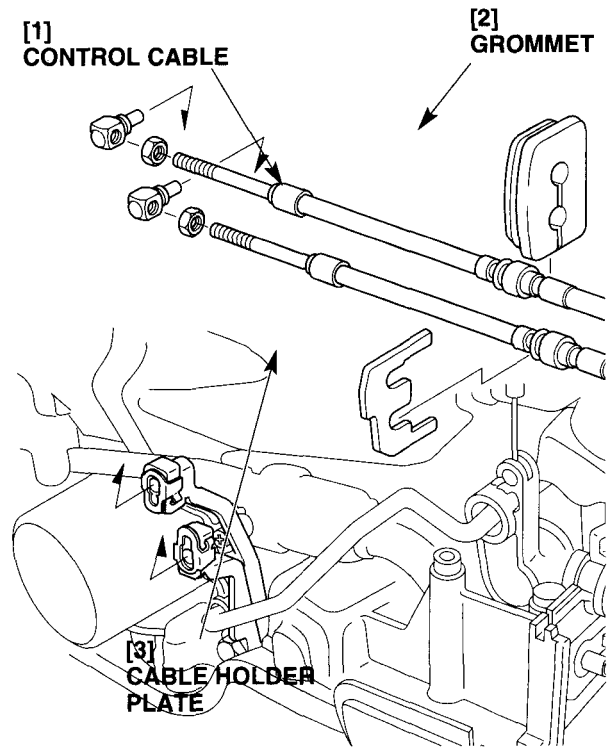
12 N·m (1.2 kgf·m, 9 lbf·ft)

1. SHIFT ARM/THROTTLE ARM

(Remote control type)

a. REMOVAL

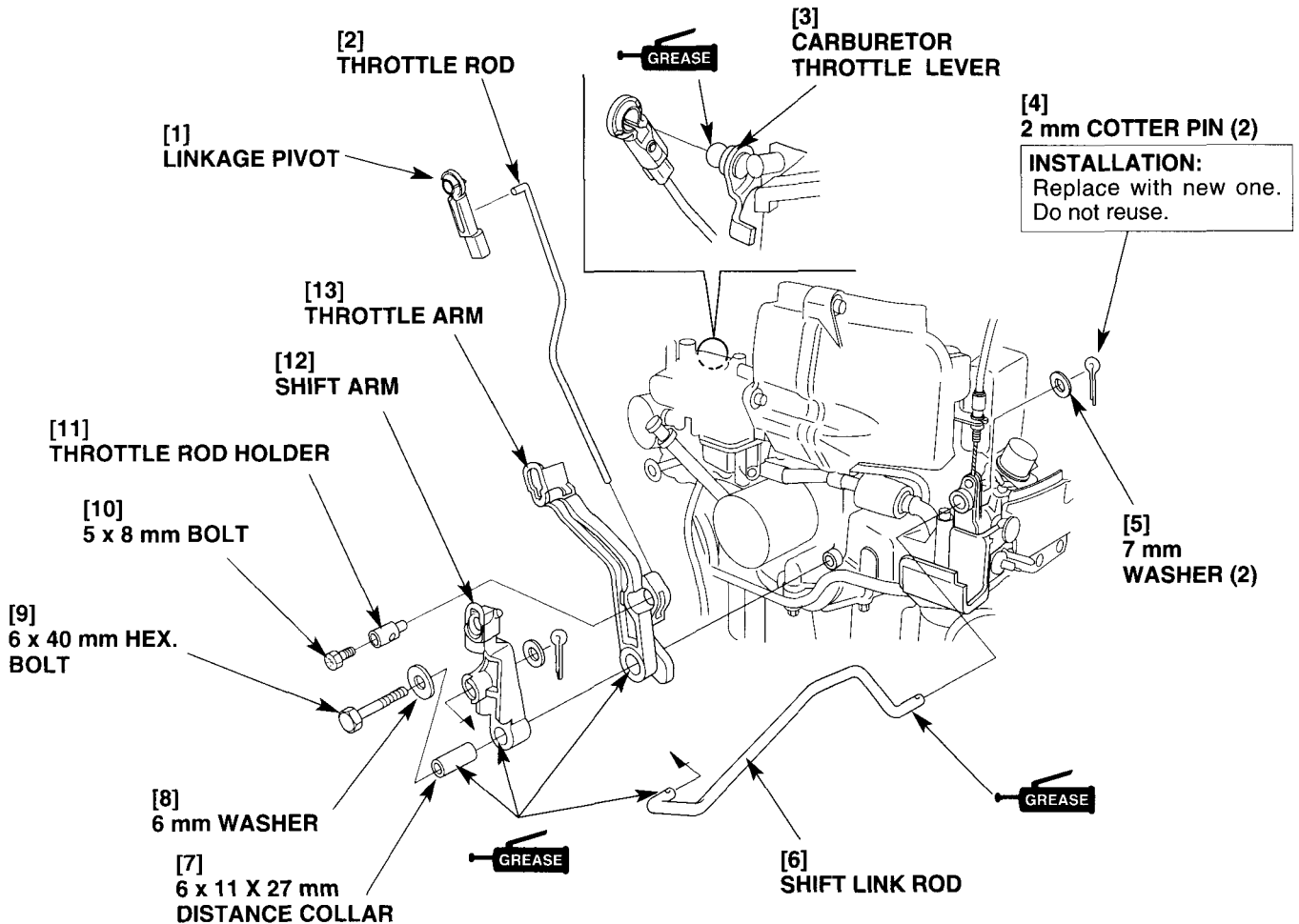
- 1) Remove the following:
 - engine cover (P. 5-1).
 - right engine under cover (P. 5-3).
- 2) Disconnect the remote control cables.
- 3) Loosen the 5 x 8 mm bolt, then disconnect the link pivot from the carburetor throttle lever.
- 4) Remove the 6 x 40 mm hex bolt, then remove the distance collar, shift arm and throttle arm.
- 5) Stretch the 2 mm cotter pin and and remove it and 7 mm washer, then disconnect the shift link rod from the shift arm.



b. INSTALLATION

Installation is the reverse order of removal.

- After installation adjust the throttle linkage (P. 3-13).



2. SHIFT LEVER

(Tiller handle type)

a. REMOVAL

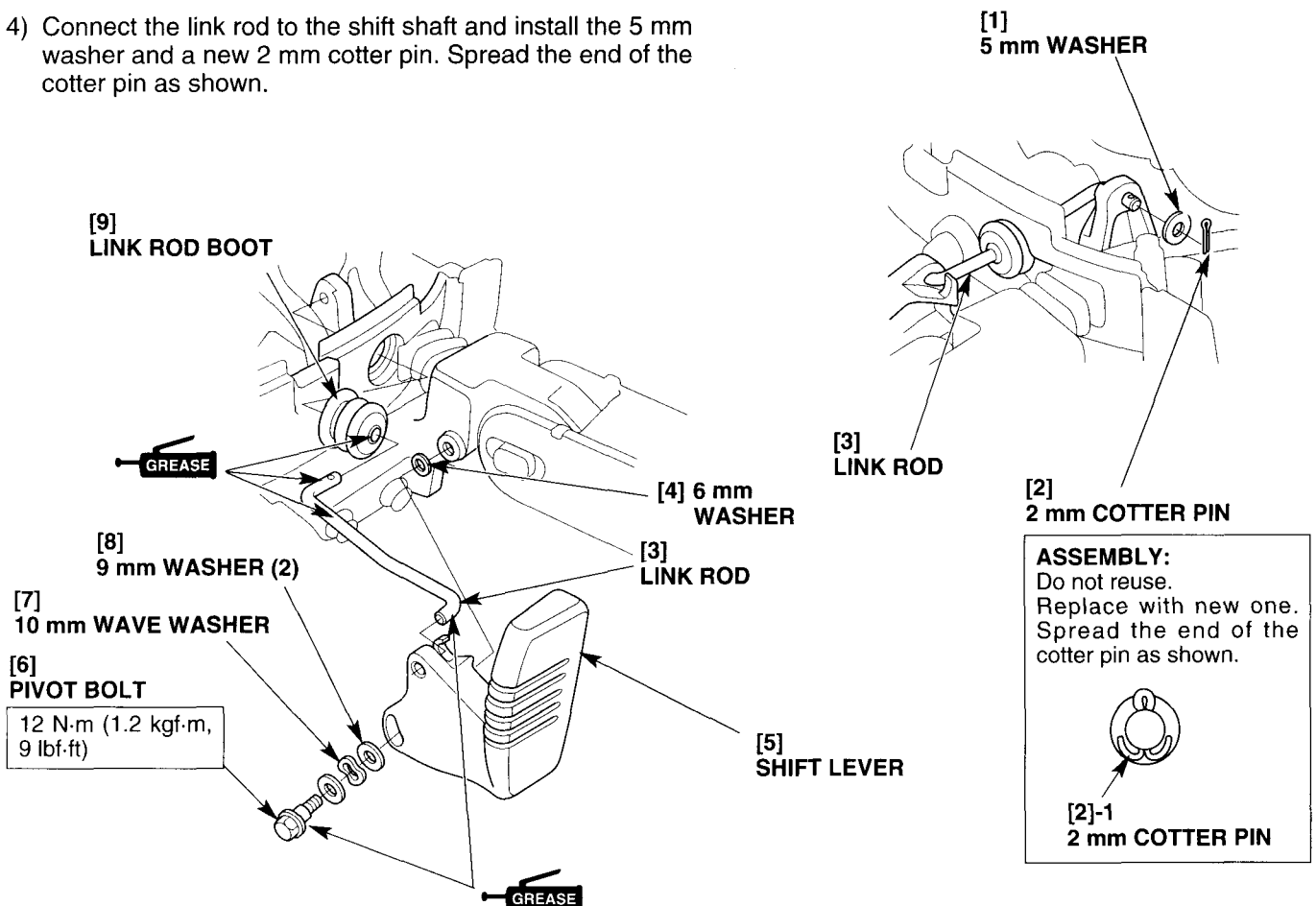
- 1) Remove the 2 mm cotter pin and 5 mm washer, disengage the link rod from the shift shaft.
- Do not reuse the 2 mm cotter pin, replace with new one when reassembly.
- 2) Remove the shift lever pivot bolt, 10 mm wave washer, two 9 mm plain washers, 6 mm plain washer and shift lever from the tiller handle.
- 3) Remove the link rod boot, link rod and shift lever.

b. INSTALLATION

- 1) Apply grease to the link rod end. Connect the link rod to the shift lever.
- 2) Apply grease to the sliding surface of the pivot bolt. Install the shift lever, 6 mm washer, two 9 mm washers, 10 mm wave washer and tighten the pivot bolt.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

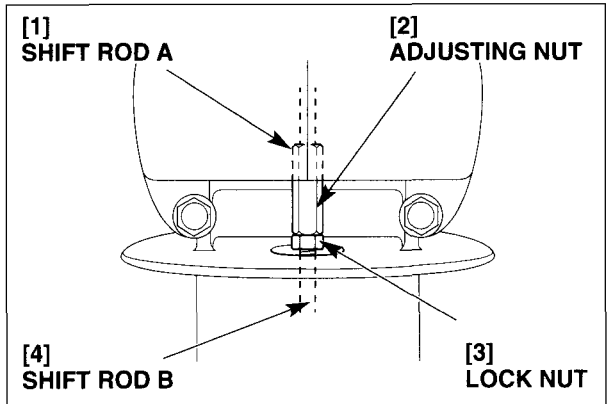
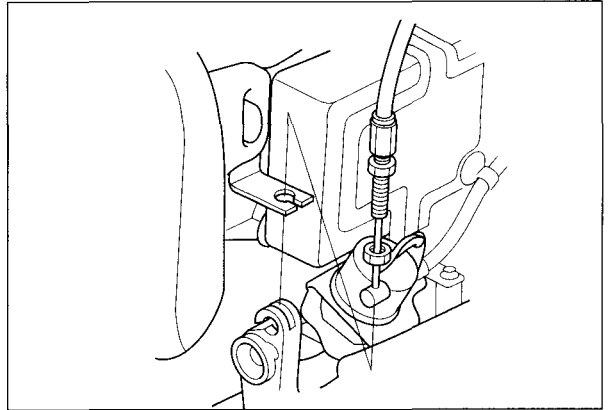
- 3) Set the link rod boot securely.
- 4) Connect the link rod to the shift shaft and install the 5 mm washer and a new 2 mm cotter pin. Spread the end of the cotter pin as shown.



3. SHIFT SHAFT

a. REMOVAL

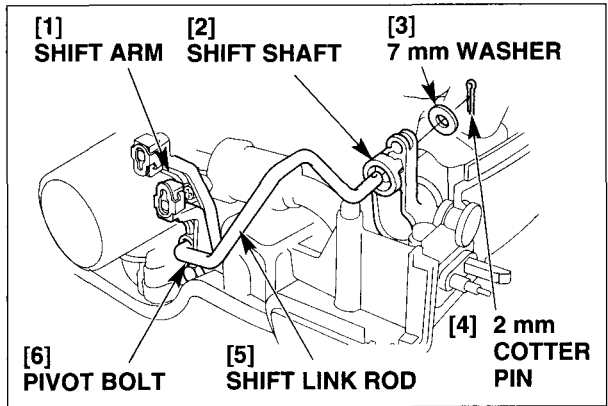
- 1) Remove the following:
 - engine cover (P. 5-1).
 - right engine under cover (P. 5-3).
 - ignition control module and neutral switch (Section 16).
- 2) Disconnect the remote control cables (Remote control type).
- 3) Disconnect the neutral start cable from the shift shaft (P. 7-9).
- 4) Shift the gear into the reverse position and loosen the lock nut. Disconnect the shift rod A from the shift rod B by turning the adjusting nut.



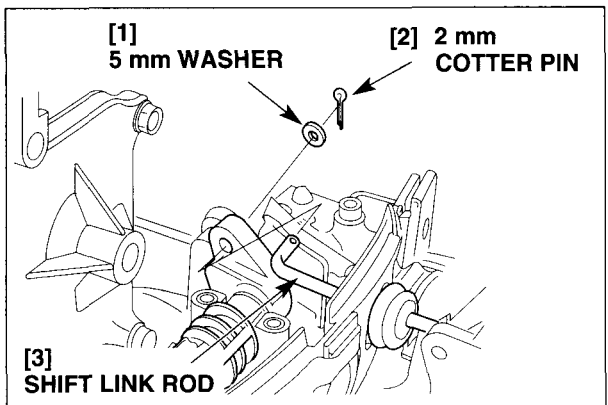
- 5) Remote control type:

Loosen the shift arm pivot bolt fully. Remove and discard the 2 mm cotter. Remove the 7 mm washer and disconnect the link rod from the shift shaft.

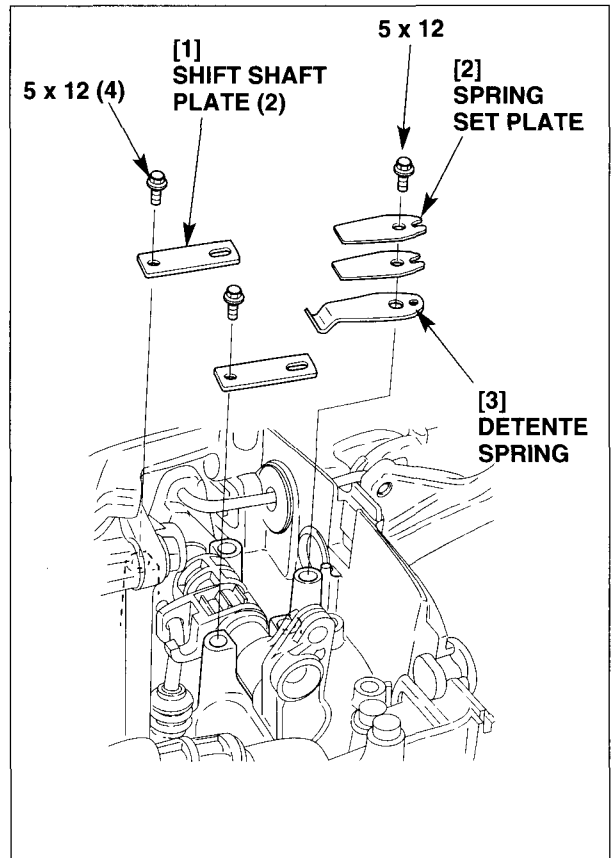
 - Replace the cotter pin with new one when reassembly.



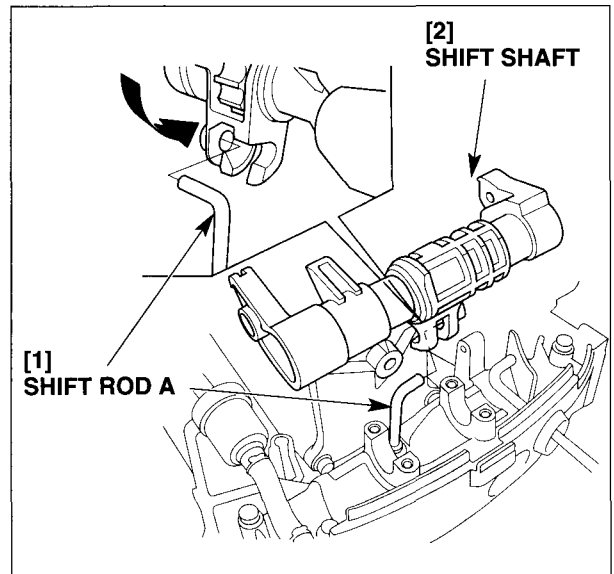
- Tiller handle type:
- Remove and discard the 2 mm cotter. Remove the 5 mm washer and disconnect the link rod from the shift shaft.
- Replace the cotter pin with new one when reassembly.



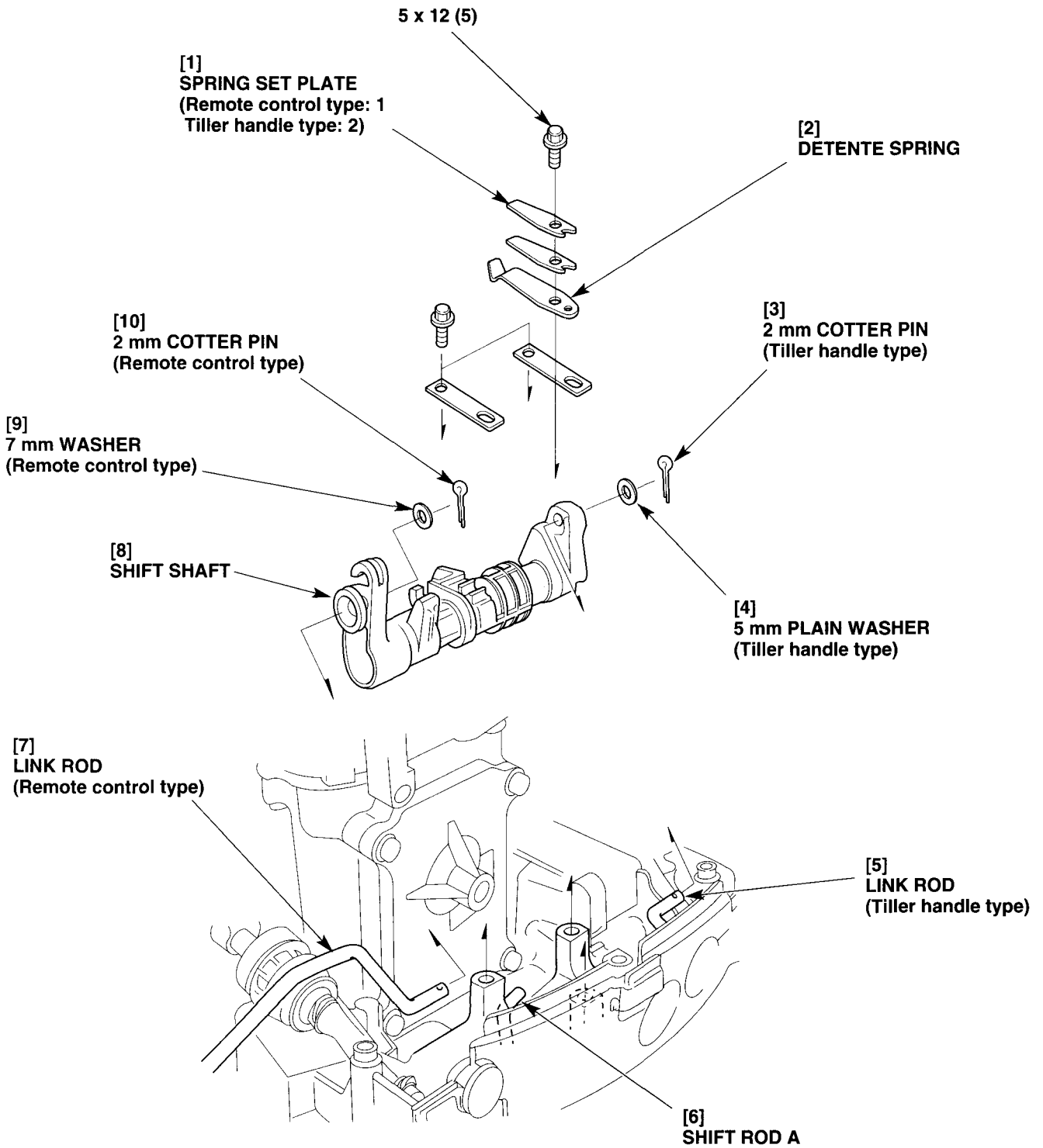
- 6) Remove the 5 x 12 mm flange bolt, detente spring and spring set plates (remote control type: one plate, tiller handle type: two plate).
- 7) Remove the four 5 x 12 mm flange bolts and shift shaft plates.



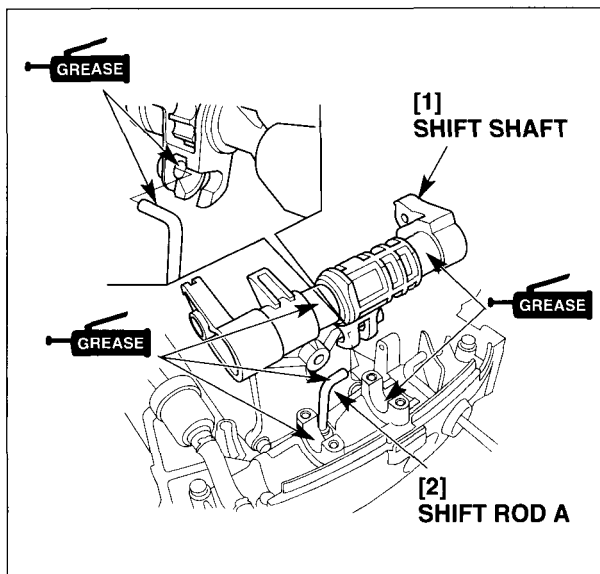
- 8) Disconnect the shift rod A from the shift shaft and remove the shift shaft.



b. INSTALLATION

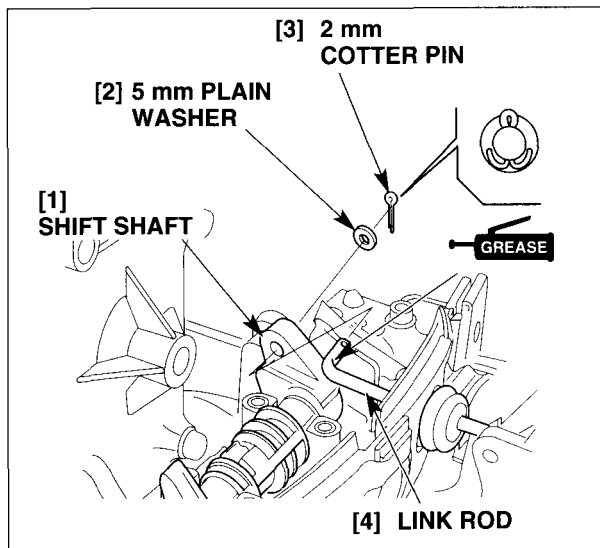


- 1) Apply grease to the shift shaft;
 - link pivot holes.
 - detente spring sliding area.
 - set plate sliding area.
- 2) Connect the shift shaft to the shift rod A then set it in the place.

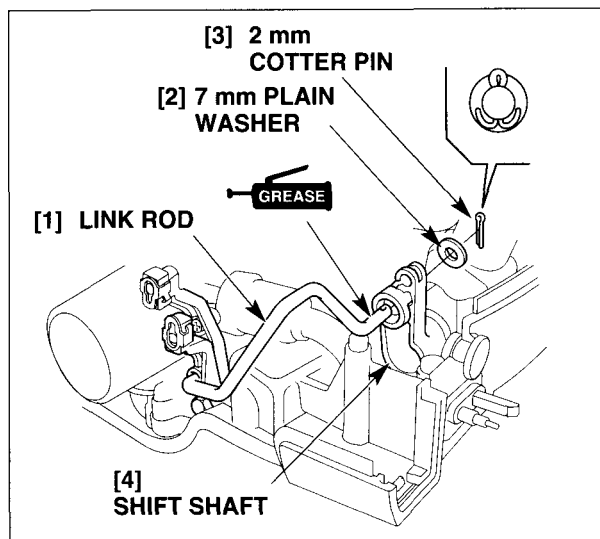


- 3) Tiller handle type;

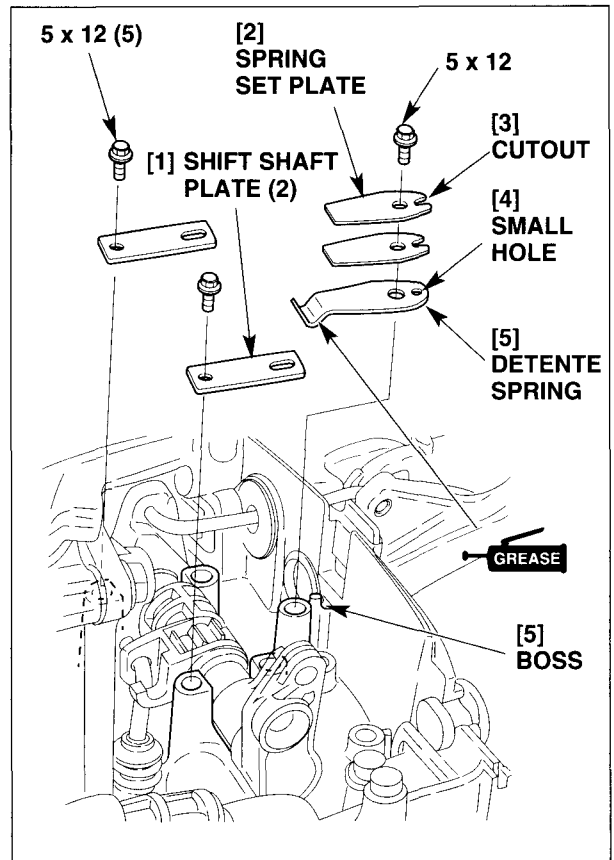
Apply grease to the link rod, and connect the link rod to the shift shaft. Install the 5 mm washer and a new 2 mm cotter pin, spread the end of the cotter pin as shown.



- Remote control type;
- Apply grease to the link rod, and connect the link rod to the shift shaft. Install the 7 mm washer and a new 2 mm cotter pin, spread the end of the cotter pin as shown.



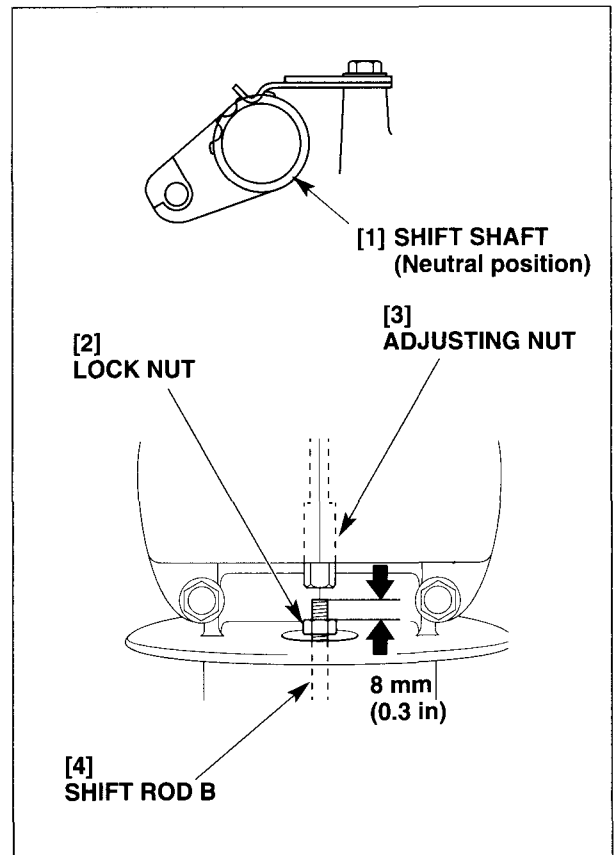
- 4) Install the shift shaft plates with the slotted hole toward front as shown and tighten the 5 x 12 mm flange bolts securely.
- 5) Install the detente spring and spring set plate (Remote control type: 1, tiller handle type: 2) and tighten the 5 x 12 mm flange bolt securely.
 - Align the small hole with the boss of the oil case.
 - Align the cutout of the spring set plate with the boss of the oil case.



- 6) Set the shift shaft in the reverse position as shown.
- 7) Turn the lock nut on the shift rod B to obtain 8 mm (0.3 in) from top of the shift rod B to top of the lock nut as shown.
- 8) Make sure that the shift rod is in reverse position and connect the shift rod B to the shift rod A by threading the adjusting nut until the adjusting nut comes in contact with the lock nut.
- 9) When the adjusting nut contacts the lock nut, tighten the lock nut by holding the adjusting nut.

TORQUE: 10 N•m (1.0 kgf•m, 7 lbf•ft)

- 10) Connect the control cables (Remote control type).
- 11) After installation, be sure that the gearshift lever or remote control lever moves smoothly into all gear position.
- 12) Reinstall the removed parts in the reverse order of removal:
 - ignition control module and neutral switch (Section 16).
 - right engine under cover (P. 5-2).
 - engine cover (P. 5-1).

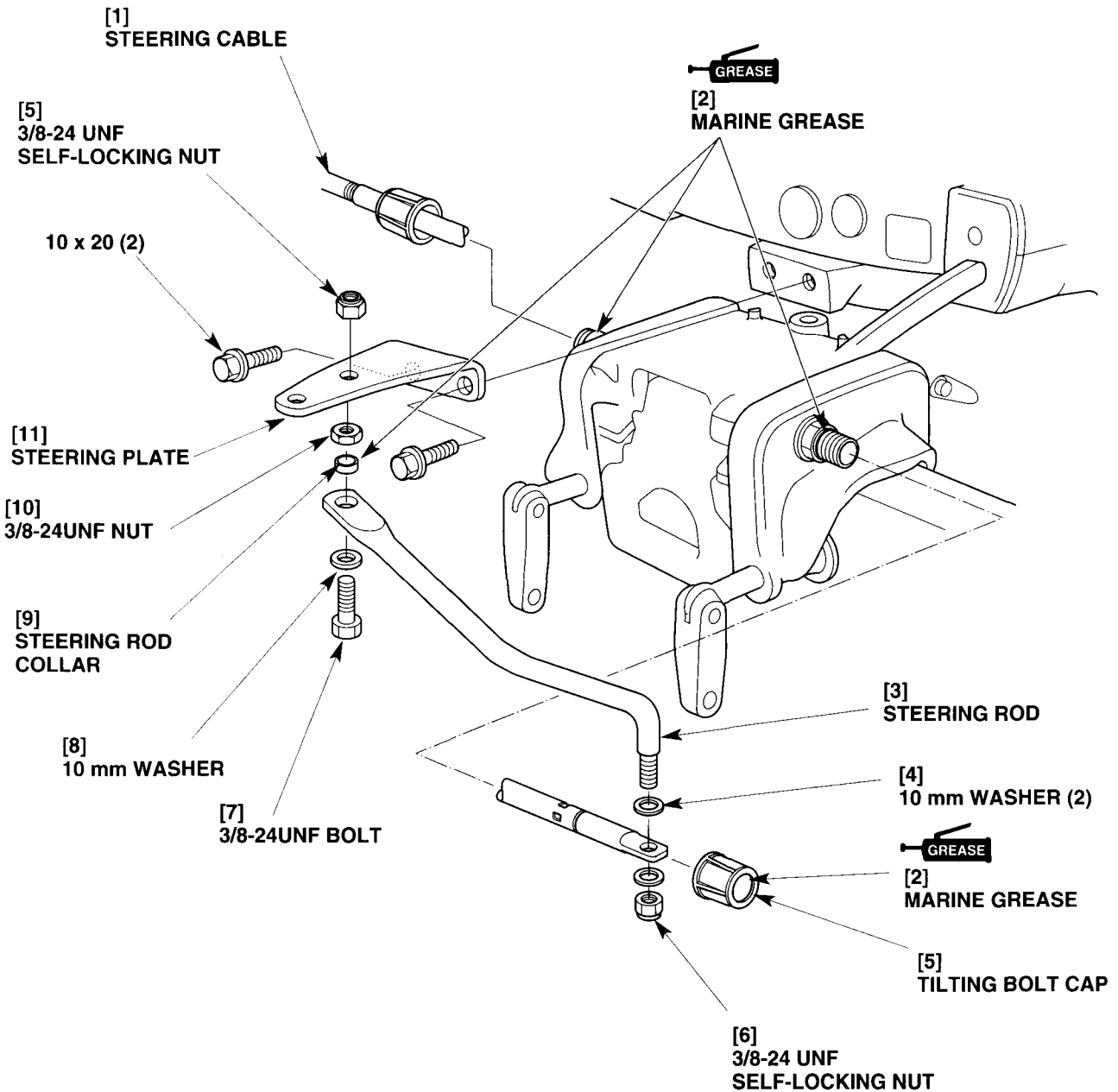


- 1. STEERING ROD
- 2. REMOTE CONTROL CABLE

- 3. CONTROL BOX WIRE HARNESS
- 4. REMOTE CONTROL BOX

1. STEERING ROD

a. DISASSEMBLY/REASSEMBLY



2. REMOTE CONTROL CABLES

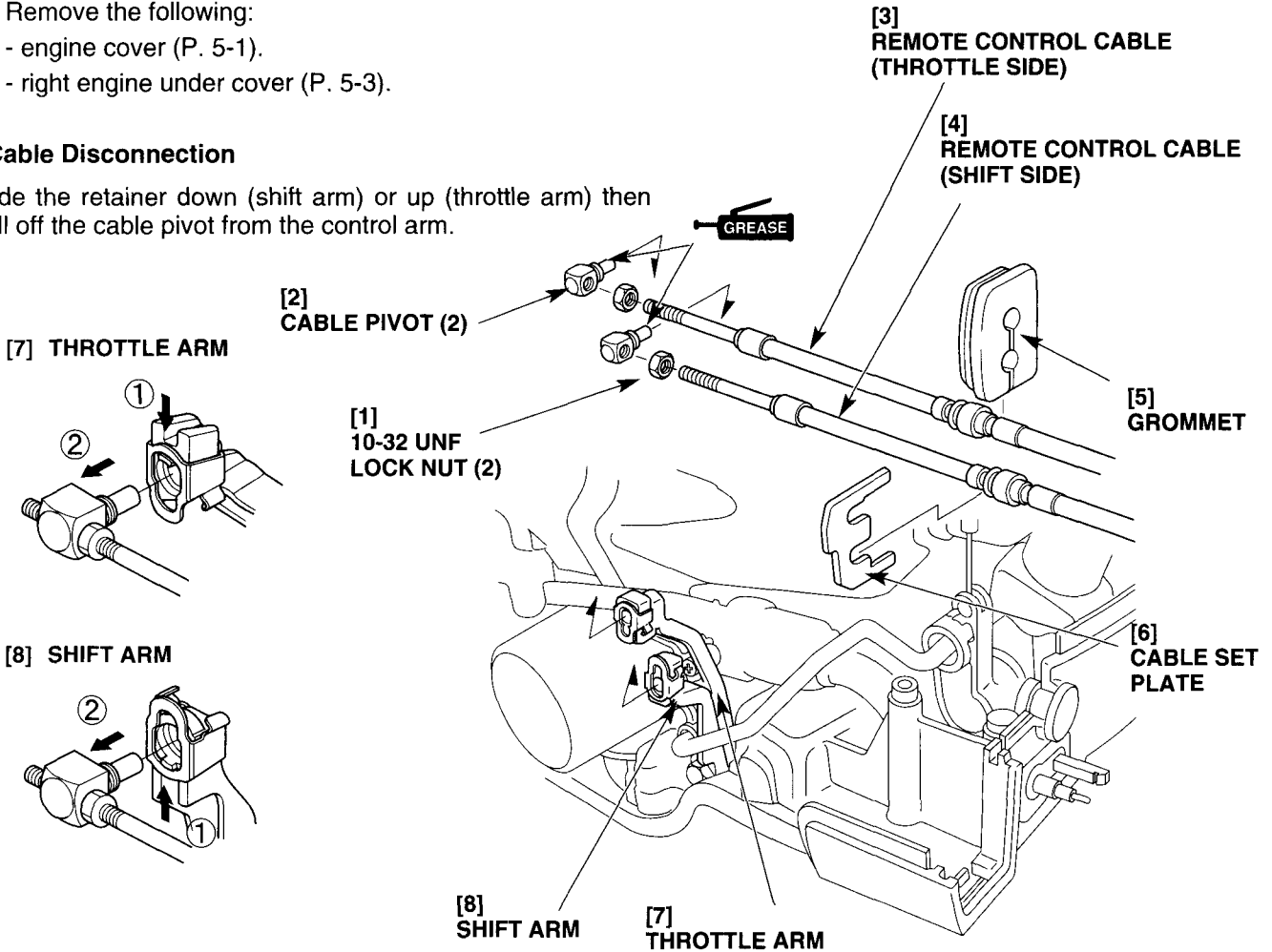
a. REMOVAL/INSTALLATION

• MOTOR SIDE

- 1) Remove the following:
 - engine cover (P. 5-1).
 - right engine under cover (P. 5-3).

• Cable Disconnection

Slide the retainer down (shift arm) or up (throttle arm) then pull off the cable pivot from the control arm.



• Cable Connection

- 1) Before connection, adjust the cable pivot position as following.

Shift Cable:

- a. Set the control lever to the neutral position.
- b. Adjust the cable pivot position by tuning the cable pivot with the shift shaft in neutral position.

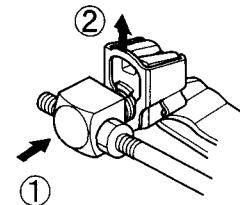
Throttle Cable:

- a. Set the control lever to the fully open position.
- b. Adjust the cable pivot position by tuning the cable pivot with the carburetor full throttle position.

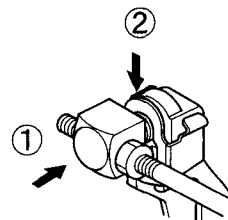
- 2) Slide up the retainer, then set the cable pivot and secure the pivot by sliding down the retainer aligning it with the groove of the cable pivot.

- 3) Tighten the lock nuts securely.

[1] THROTTLE ARM

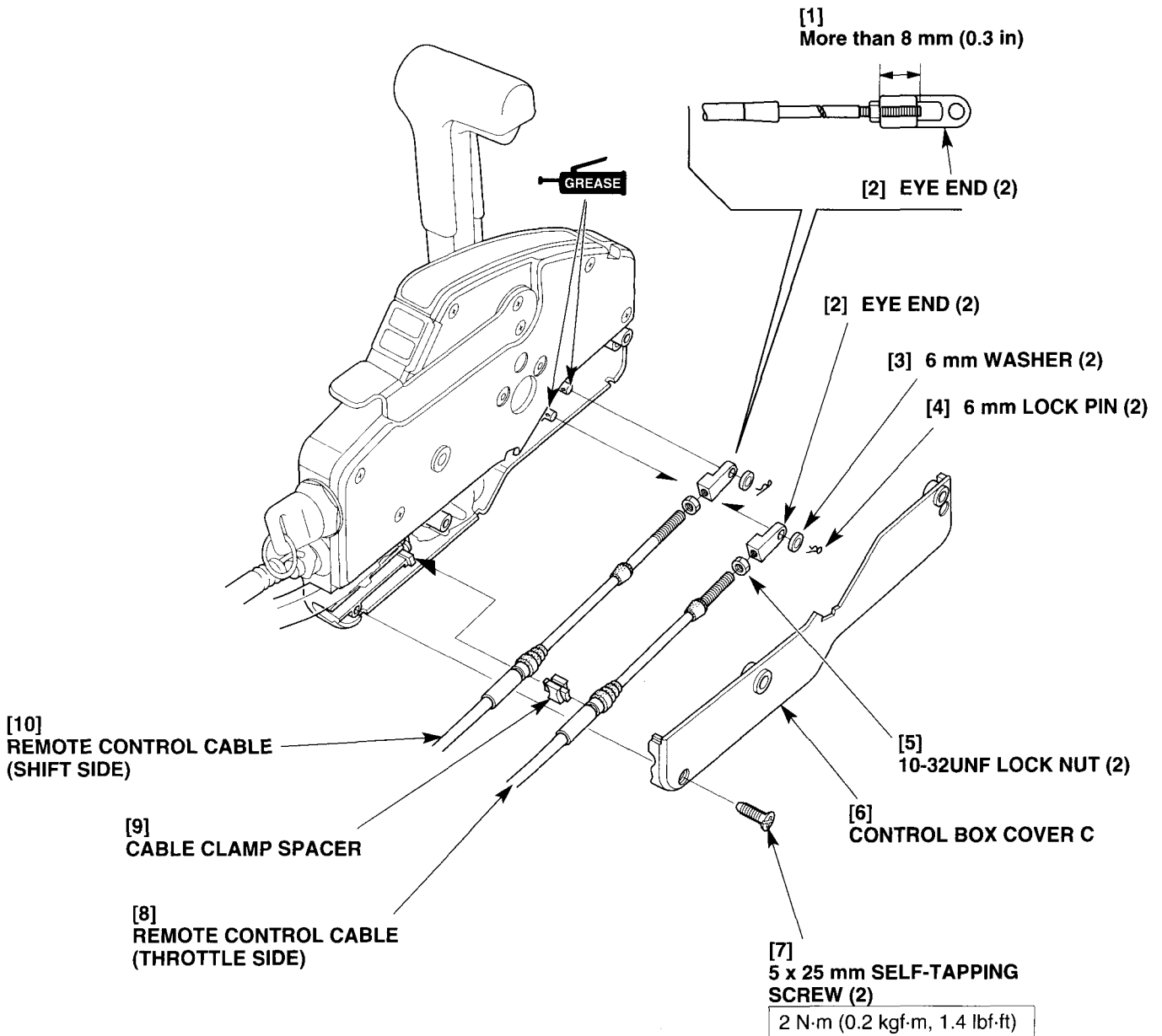


[2] SHIFT ARM



• **CONTROL BOX SIDE**

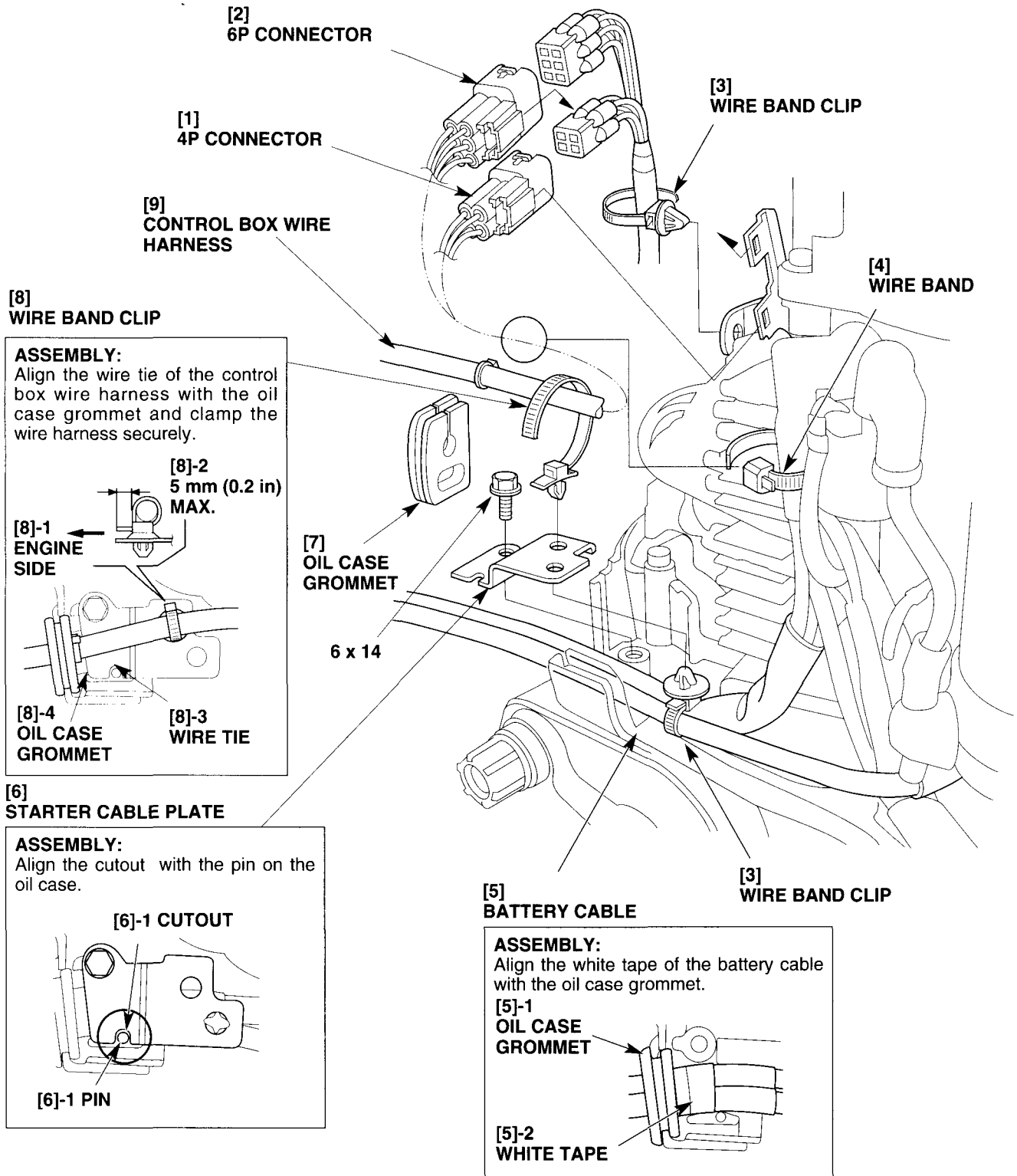
- Screw the lock nut and eye end more than 8 mm (0.3 in) onto the threads of the remote control cable and tighten the lock nut securely.
- Apply grease to the pin of the control arm before connecting the cable.
- After installation, adjust the cables and connect to the motor (P. 14-2).



3. CONTROL BOX WIRE HARNESS

a. REMOVAL/INSTALLATION

1) Remove the engine cover.

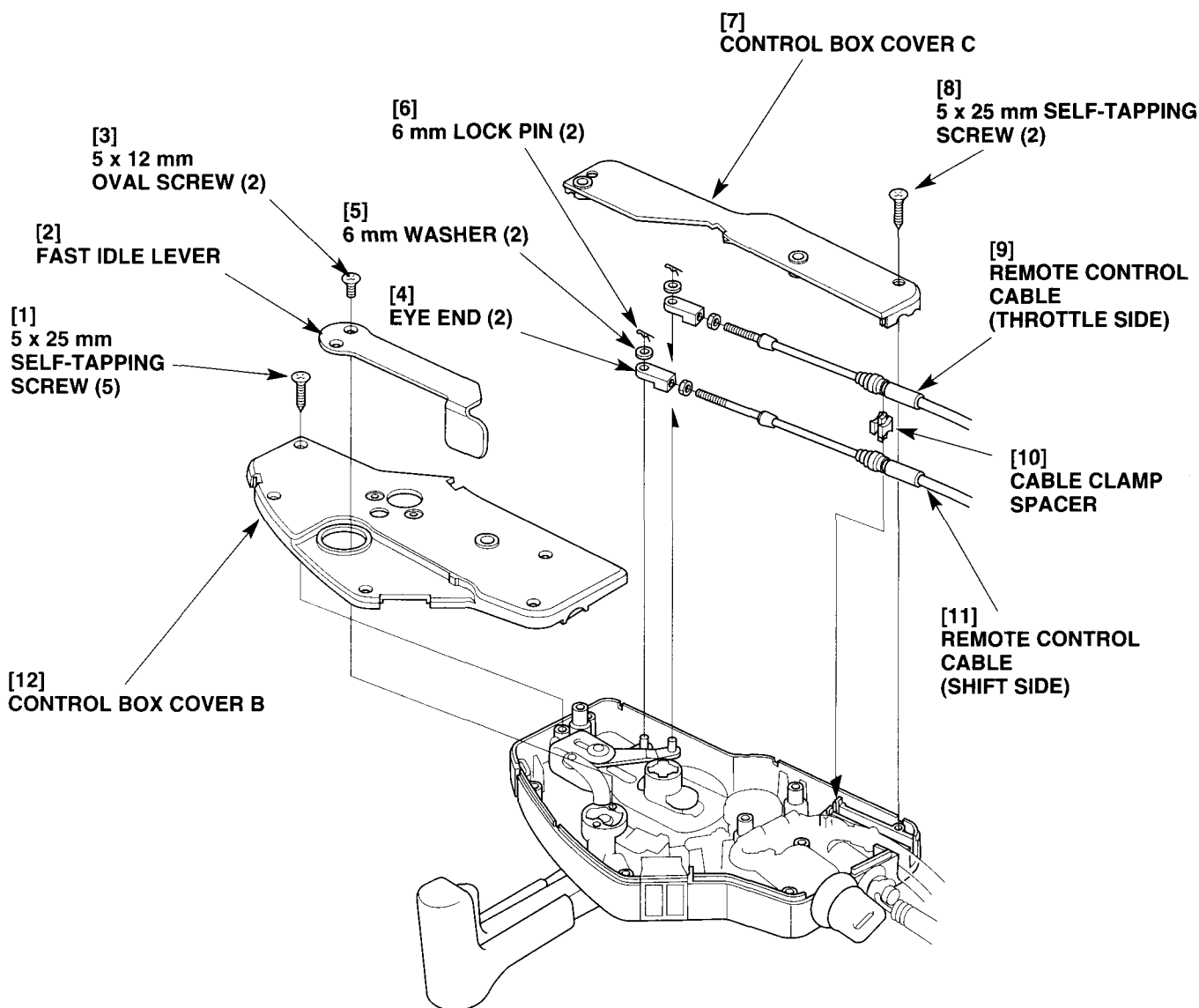


4. REMOTE CONTROL BOX

a. DISASSEMBLY

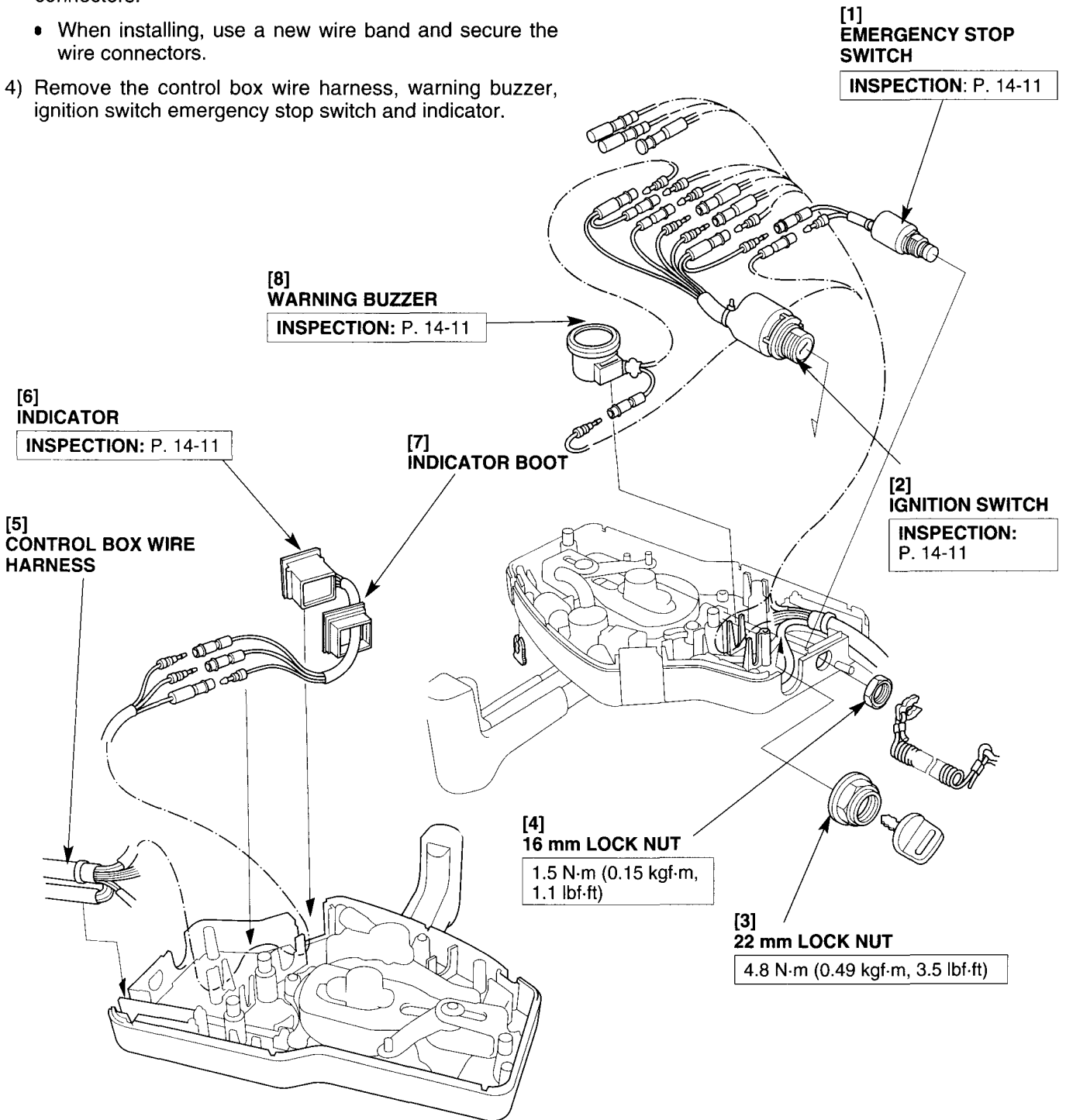
• COVERS AND CABLES

- 1) Remove the two 5 x 25 mm self-tapping screws and control box cover.
- 2) Remove the 6 mm lock pins and washers and disconnect the control cables, two 6 mm washers and cable clamp spacer.
- 3) Remove the 5 x 12 mm oval screws and fast idle lever.
- 4) Remove the five 5 x 25 mm self-tapping screws and control box cover B.



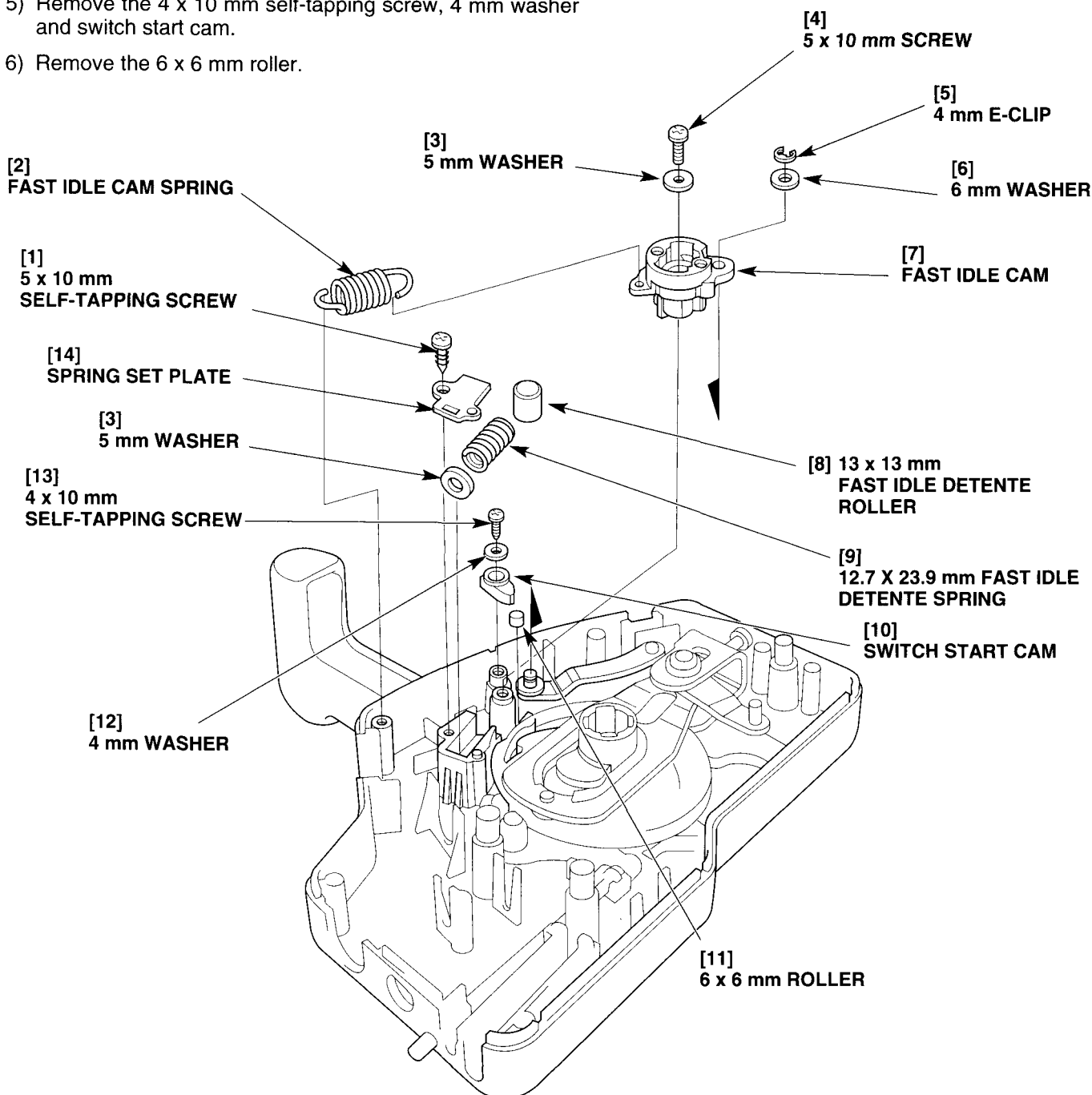
• **ELECTRICAL EQUIPMENT**

- 1) Remove the 22 mm lock nut and ignition switch.
- 2) Remove the 16 mm lock nut and emergency stop switch.
- 3) Cut the wire band and discard it and disconnect the wire connectors.
 - When installing, use a new wire band and secure the wire connectors.
- 4) Remove the control box wire harness, warning buzzer, ignition switch emergency stop switch and indicator.

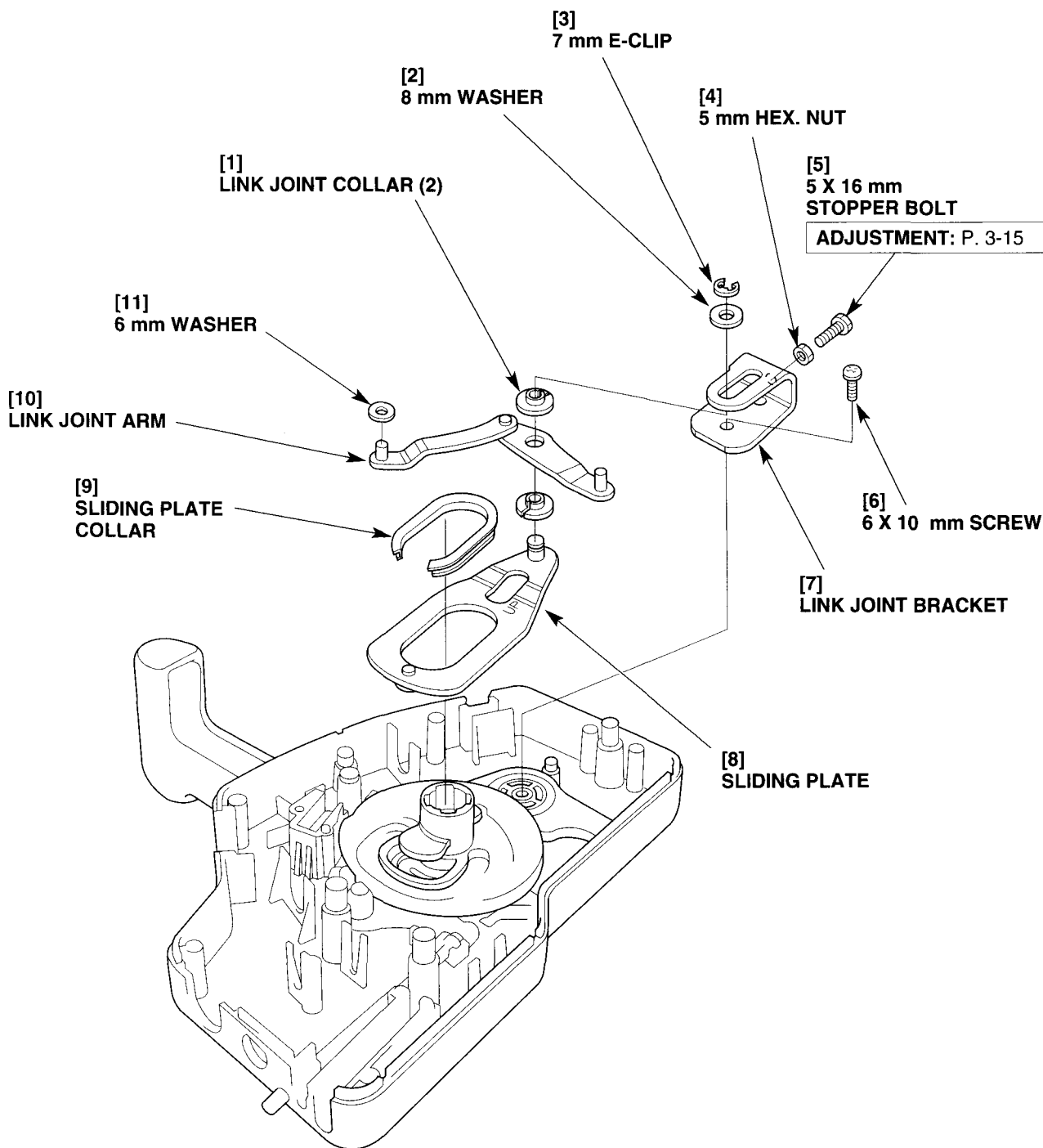


• **SLIDING PLATE**

- 1) Remove the 4 mm E-clip and 6 mm washer and disconnect the link joint arm from the fast idle wheel.
- 2) Remove the fast idle spring.
- 3) Remove the 5 x 10 mm screw and 5 mm washer. Remove the fast idle cam and spring.
- 4) Remove the 5 x 10 mm self-tapping screw, and remove the spring set ring, 13 x 13 mm fast idle detente roller, fast idle detente spring and 5 mm washer.
- 5) Remove the 4 x 10 mm self-tapping screw, 4 mm washer and switch start cam.
- 6) Remove the 6 x 6 mm roller.

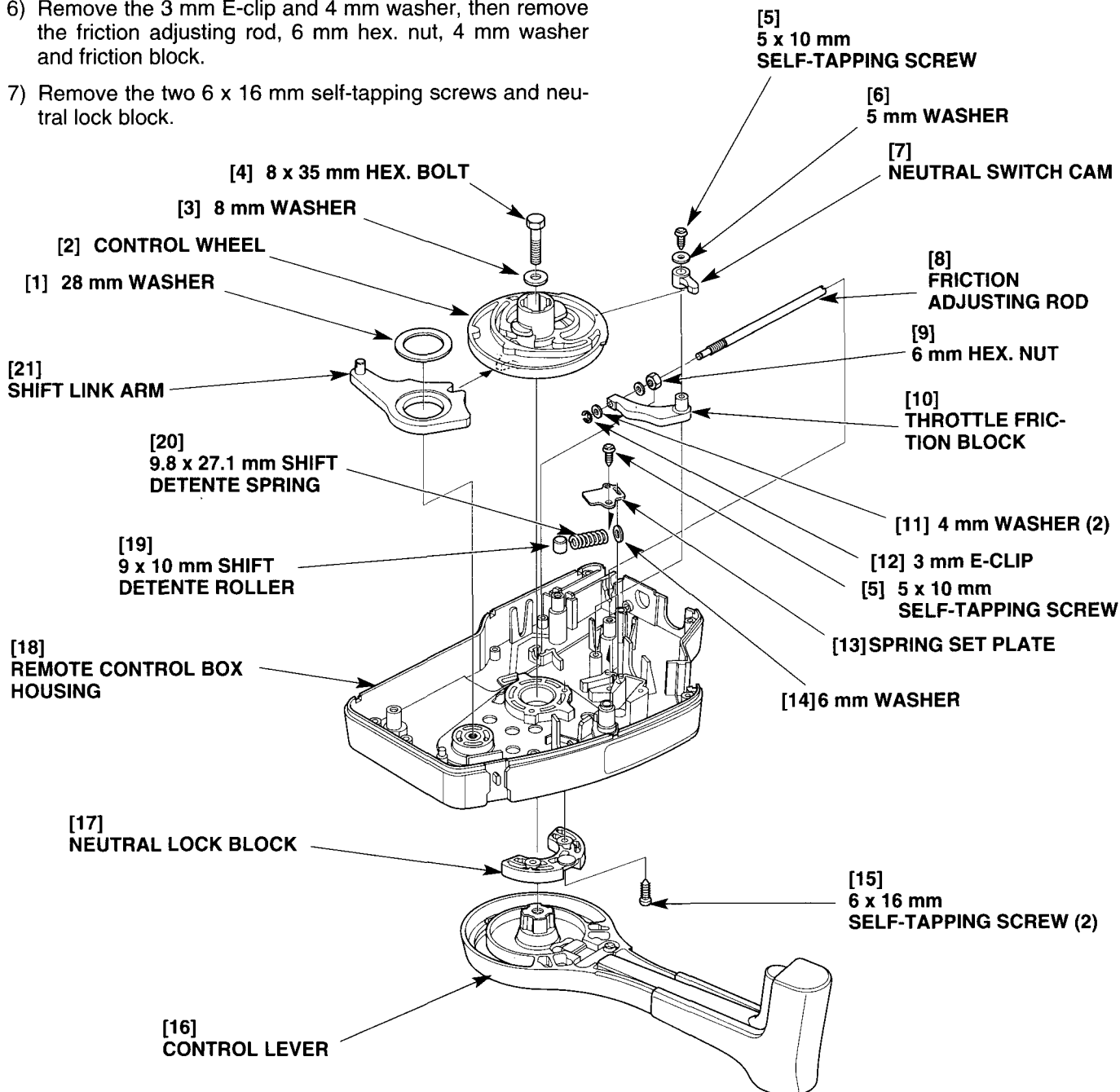


- 7) Remove the 7 mm E-clip and 8 mm washer and remove the link joint arm and link joint collars.
- 8) Remove the 6 x 10 mm screw and remove the joint link bracket and sliding plate



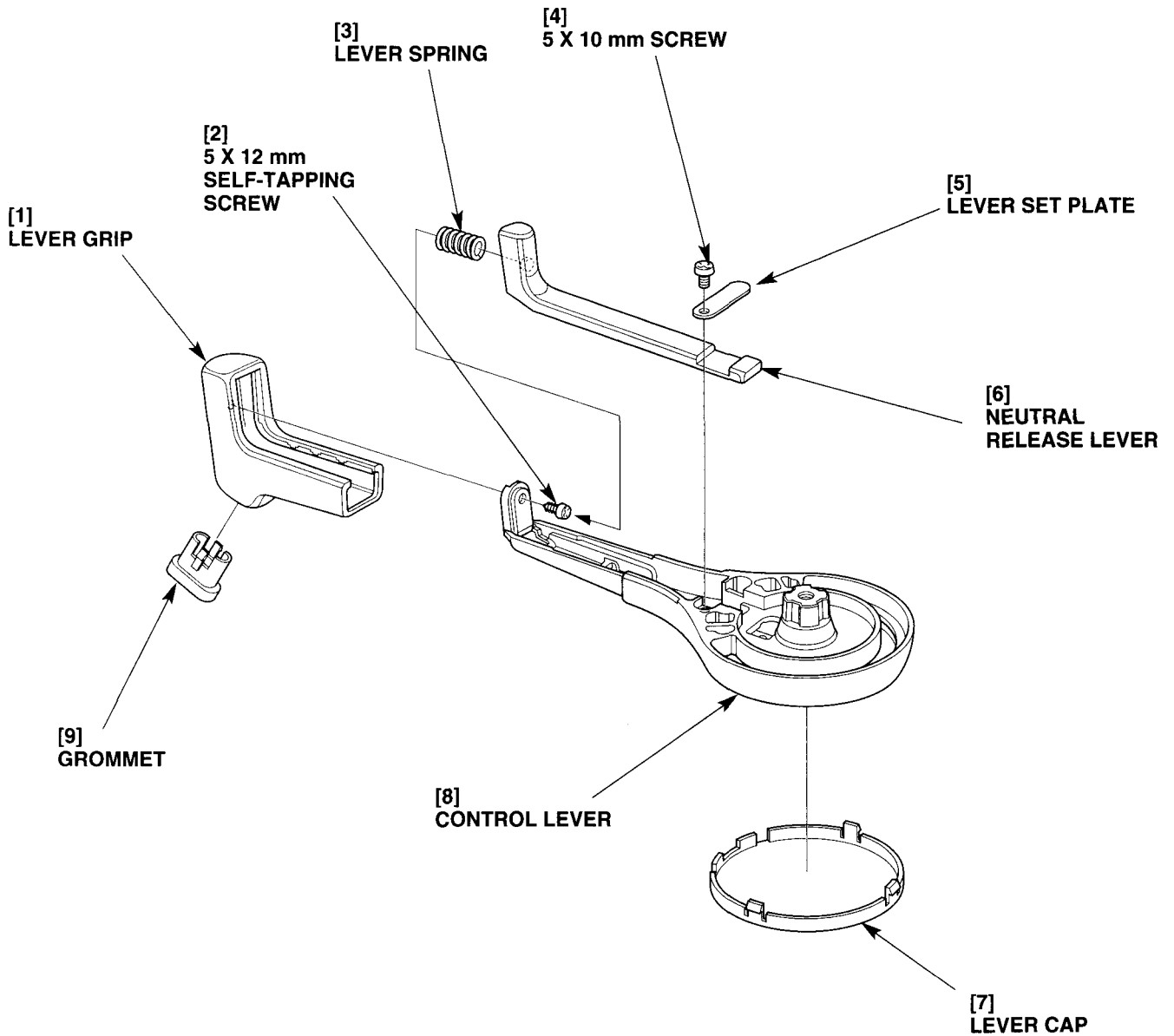
• **CONTROL WHEEL**

- 1) Remove the 8 x 35 mm hex bolt and washer.
- 2) Remove the control lever and control wheel.
- 3) Remove the shift link arm.
- 4) Remove the 5 x 10 mm self-tapping screw, and remove the spring set plate, 9 x 10 mm detente roller, spring and 6 mm washer.
- 5) Remove the 5 x 10 mm self-tapping screw, 5 mm washer and neutral switch cam.
- 6) Remove the 3 mm E-clip and 4 mm washer, then remove the friction adjusting rod, 6 mm hex. nut, 4 mm washer and friction block.
- 7) Remove the two 6 x 16 mm self-tapping screws and neutral lock block.



• **CONTROL LEVER**

- 1) Remove the 5 x 10 mm screw, lever set plate and neutral release lever and lever spring.
- 2) Remove the 5 x 12 mm self-tapping screw and control lever grip.



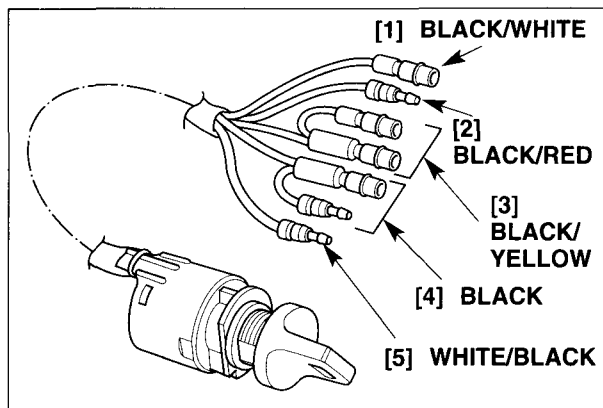
c. INSPECTION

• IGNITION SWITCH

Check for continuity between the terminals according to the table below.

There should be continuity between ○—○.

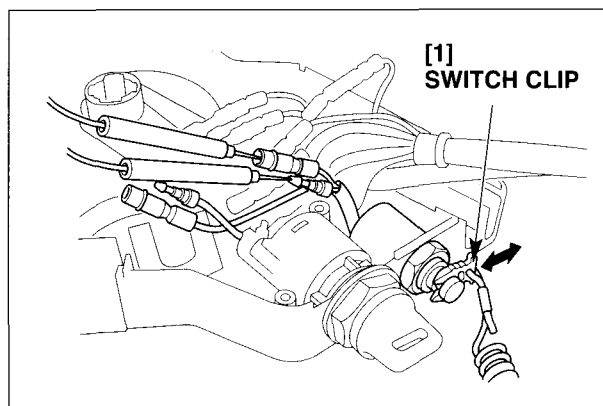
Collar Position	Black	Black/ red	White black	Black/ yellow	Black/ white
OFF	○—○				
ON			○—○		
START			○—○	○—○	○—○



• EMERGENCY STOP SWITCH

Check for continuity between the terminals according to the table below.

Clip engaged.	There should be no continuity.
Clip disengaged.	There should be continuity.
Clip engaged and button pushed.	There should be continuity.

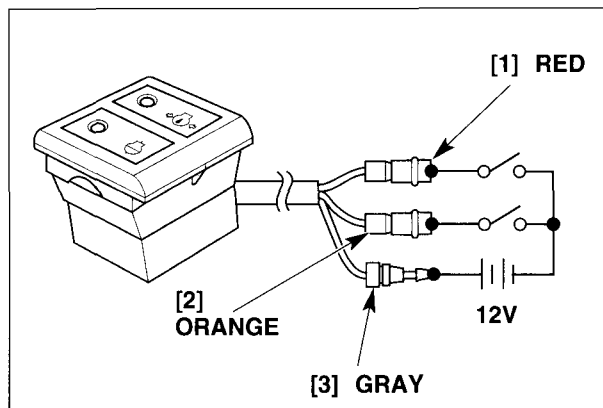


• INDICATOR

The green indicator should turn on when connecting a 12V battery (+) terminal to the Gray terminal and (-) to the Orange terminal.

The red indicator should turn on when connecting a 12V battery (+) terminal to the Gray terminal and (-) to the Red terminal.

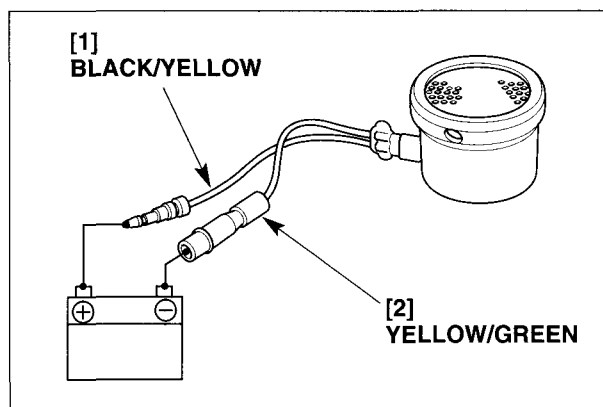
- Be sure the battery is in good condition before performing the test



• WARNING BUZZER

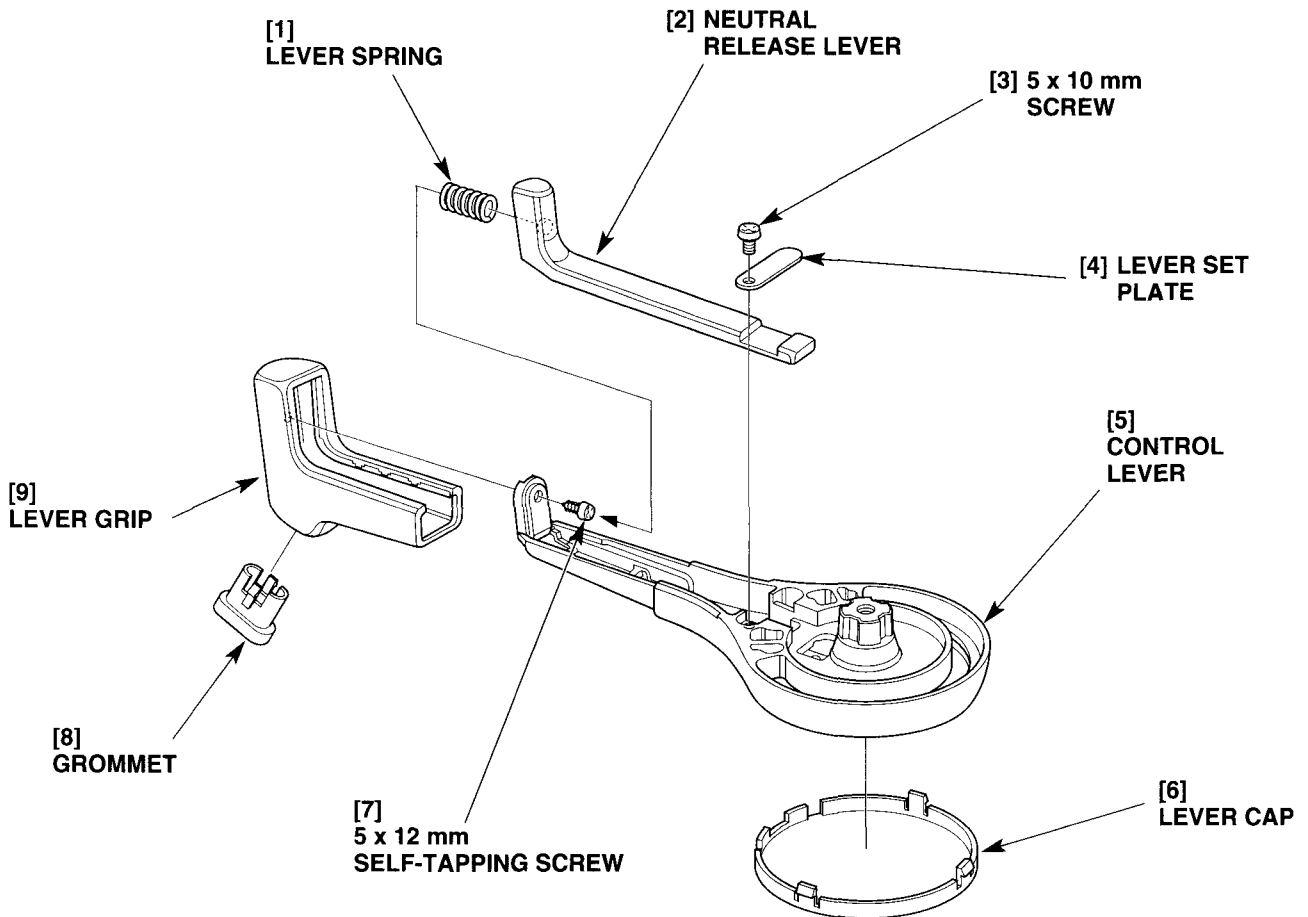
Connect a battery (+) terminal to the Black/yellow terminal and (-) terminal to the Yellow/green. The warning buzzer should sound.

- Be sure the battery is in good condition before performing the test

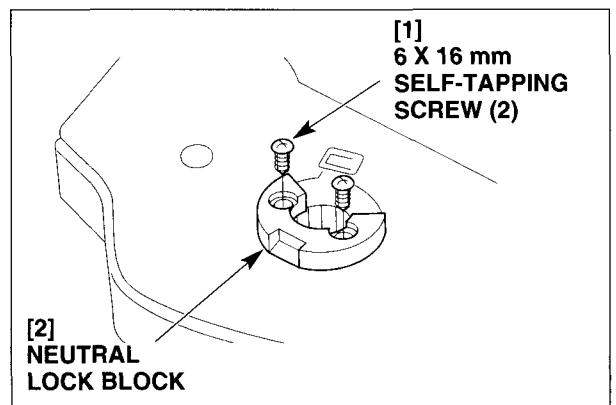


d. ASSEMBLY

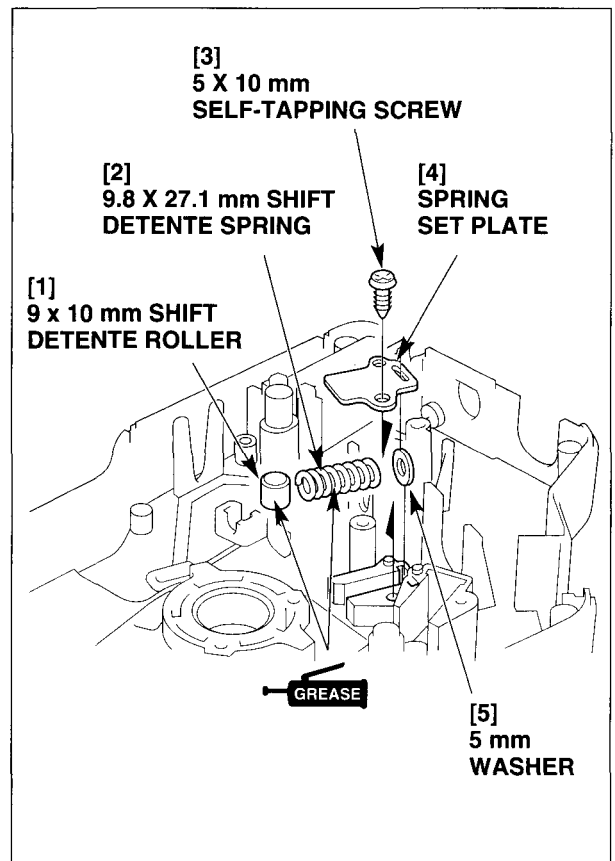
- 1) Install the lever grip and secure it with the 5 x 12 mm self-tapping screw.
- 2) Install the lever spring, neutral release lever and lever set plate, tighten the 5 x 10 mm self-tapping screw.



- 3) Install the neutral lock block as shown and secure it with the 6 x 16 mm self-tapping screws.

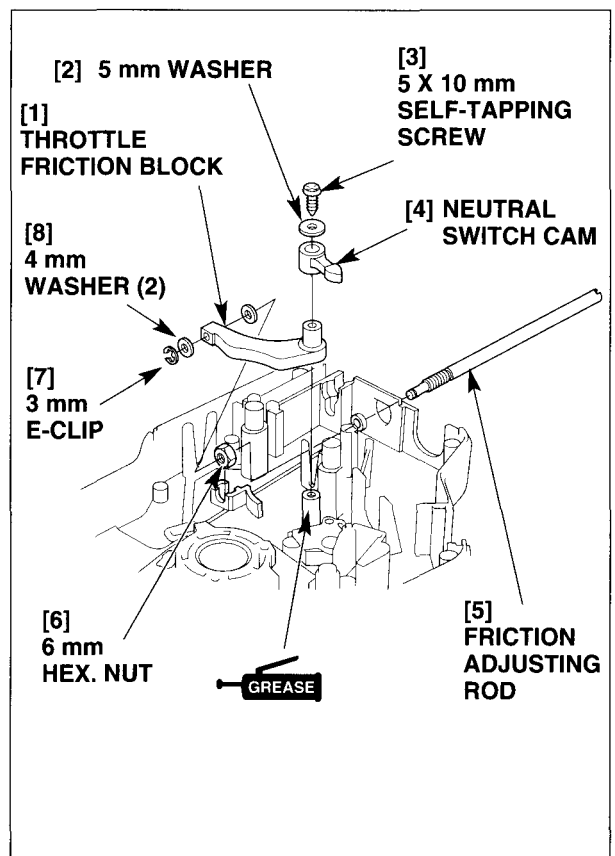


- 4) Apply marine grease to the detente spring (9.8 x 27.1 mm) and detente roller (9 x 10 mm). Install the 5 mm washer, spring and detente roller. set the spring set plate by aligning the hole of the set plate with the boss of the control box housing, and tighten the 5 x 10 mm self-tapping screw.



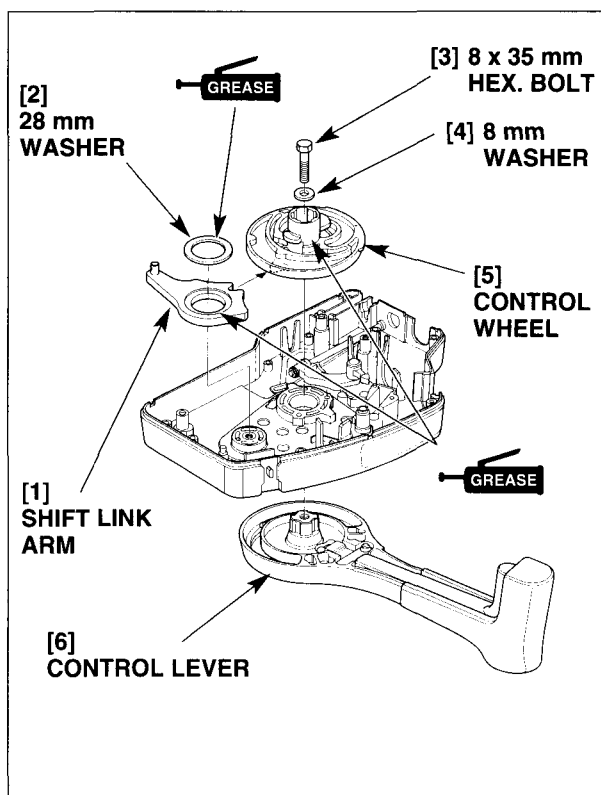
- 5) Apply marine grease to the friction block pivot point. Set the 6 mm hex. nut in the control box housing, and thread the adjusting rod slightly. Install the 4 mm washer to the adjusting rod, then install the throttle friction block and 4 mm washer and secure the 3 mm E-clip.

- 6) Install the neutral switch cam and 5 mm washer and secure the 5 x 10 mm self- tapping screw.

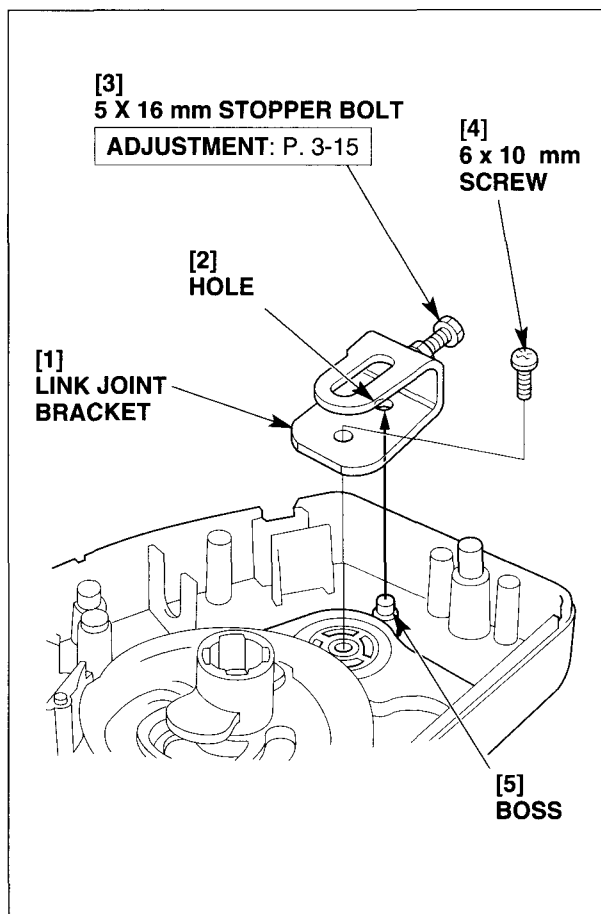


- 7) Apply marine grease to the sliding surfaces of the shift link arm, 28 mm washer, control wheel and control lever, then install them to the control box housing.
- 8) Install the 8 mm washer and tighten the 8 x 35 mm hex bolt to the specified torque.

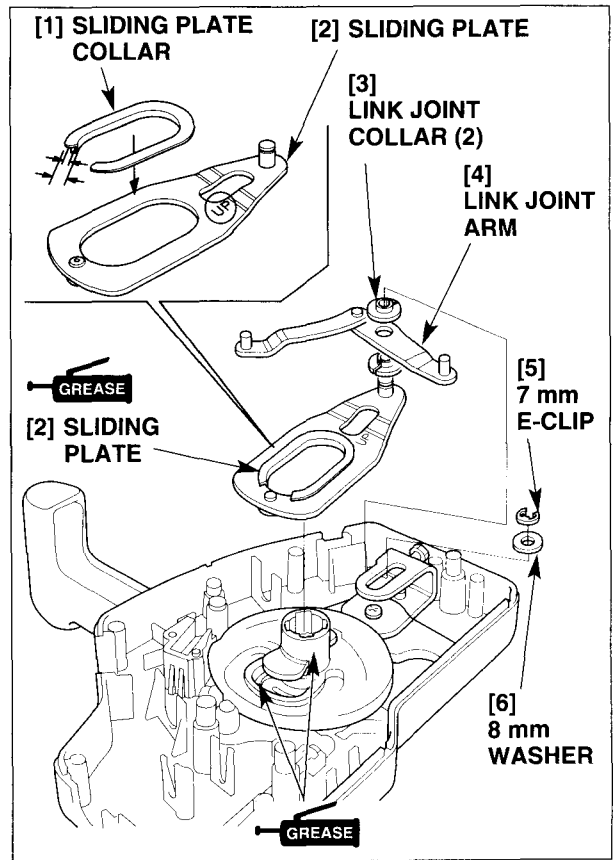
TORQUE: 20 N·m (2.0 kgf·m, 14 lbf·ft)



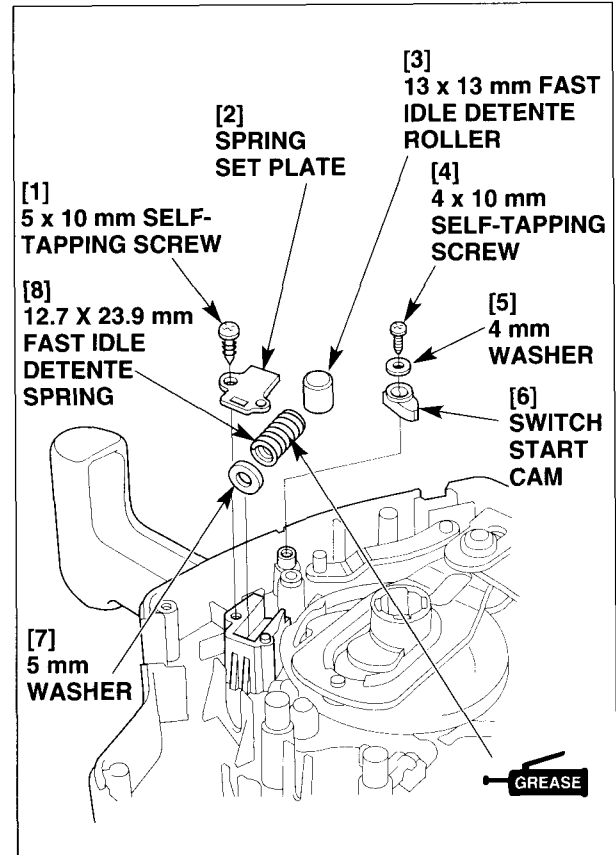
- 9) Install the link joint bracket by aligning the hole of the link joint bracket with the boss on the control box housing. Tighten the 6 x 10 mm screw.



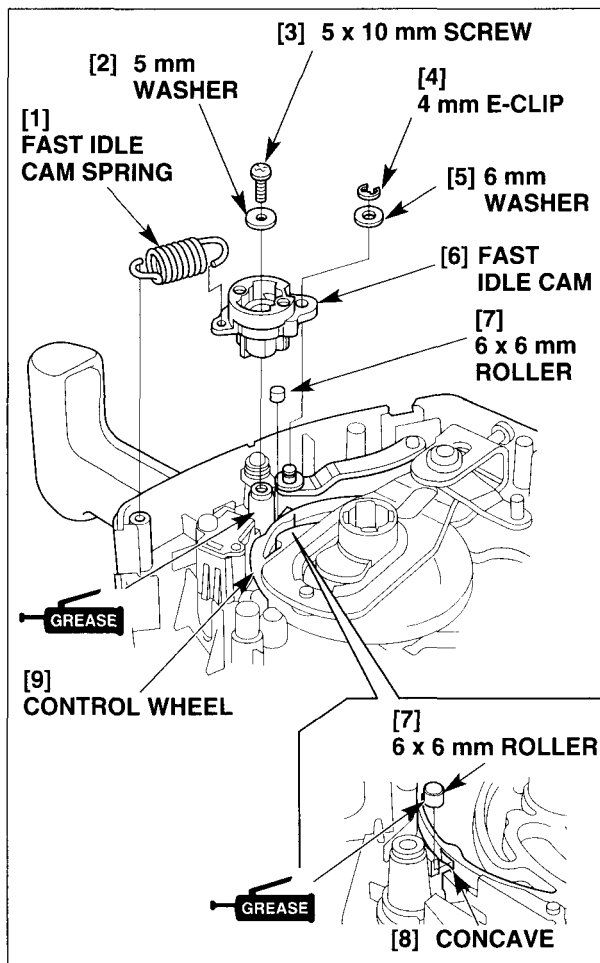
- 10) Attach the sliding plate collar to the sliding plate with its opening toward the opposite side of the UP mark and shorter lip facing down as shown.
- 11) Apply marine grease to the sliding surfaces of the sliding plate and control wheel, and install the sliding plate with the UP mark facing up.
- 12) Install the link joint arm and joint collars to the sliding plate, then install them onto the control wheel and secure them with the 8 mm washer and 7 mm E-clip.



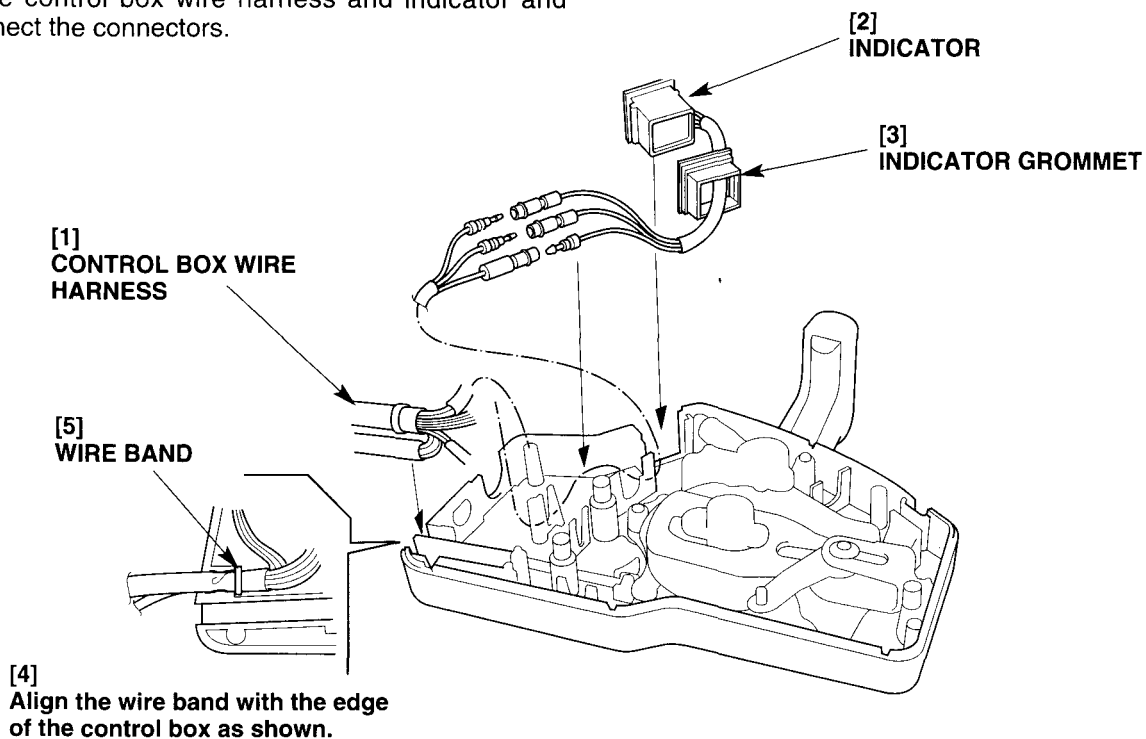
- 13) Apply marine grease to the detente spring (12.7 x 23.9 mm) and detente roller (13 x 13 mm). Install the 5 mm washer, spring and detente roller. set the spring set plate by aligning the hole of the set plate with the boss of the control box housing, and tighten the 5 x 10 mm self-tapping screw.
- 14) Install the starter switch cam, 4 mm washer and 4 x 10 self-tapping screw.



- 15) Apply marine grease to the 6 x 6 mm roller and install it in the concave of the control wheel as shown.
- 16) Apply marine grease to the sliding surfaces of the fast idle cam. Set the fast idle spring to the fast idle cam and install them onto the idle cam pivot shaft by pushing the detente roller slightly. Install the 5 mm washer and tighten the 5 x 10 mm screw.
- 17) Install the 6 mm washer and secure the 4 mm E-clip.



- 18) Install the control box wire harness and indicator and then connect the connectors.



19) Install the emergency stop switch and ignition switch and tighten the lock nuts to the specified torque.

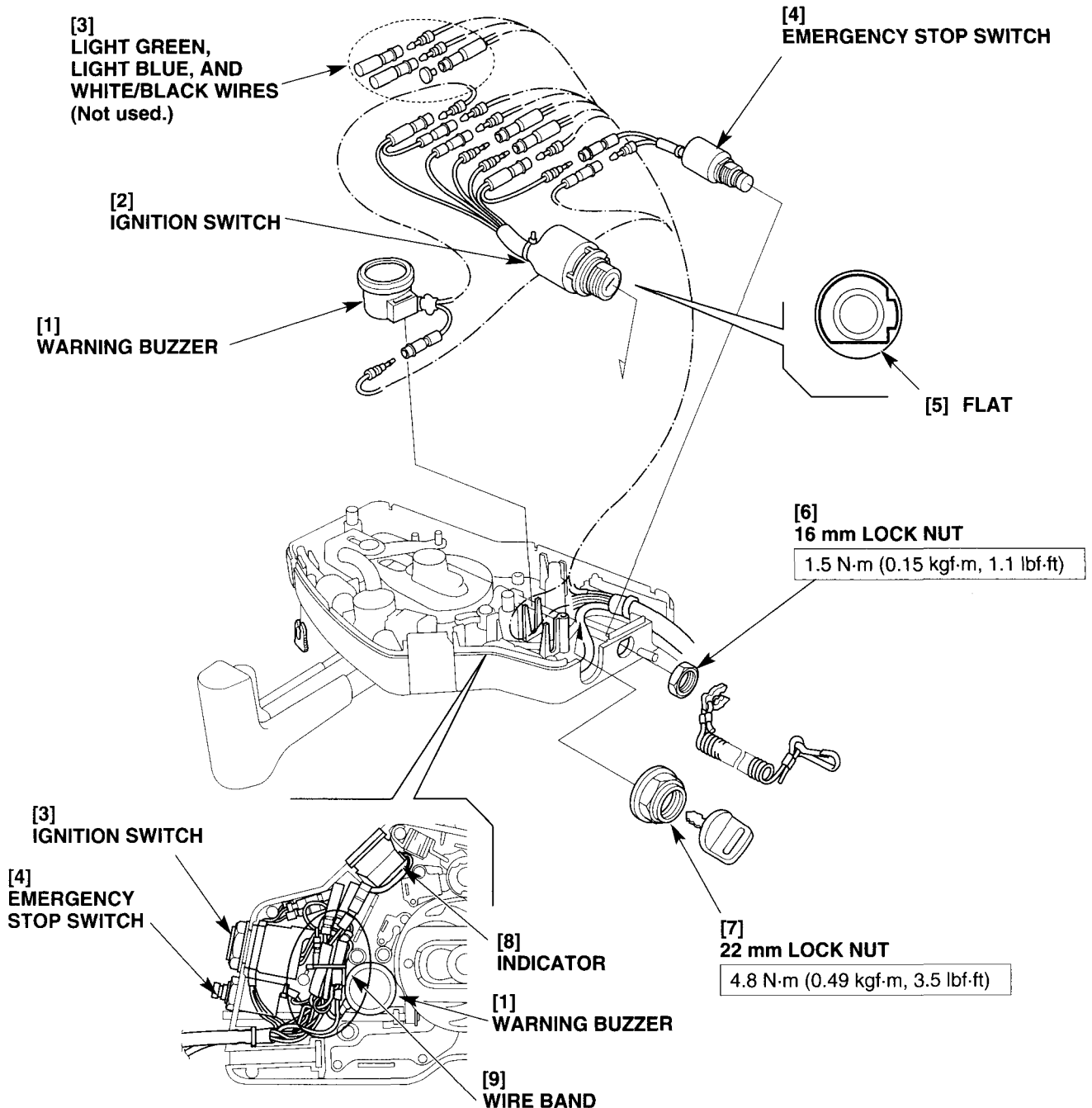
- Install the ignition switch with the flat of the flange facing down as shown.

TORQUES:

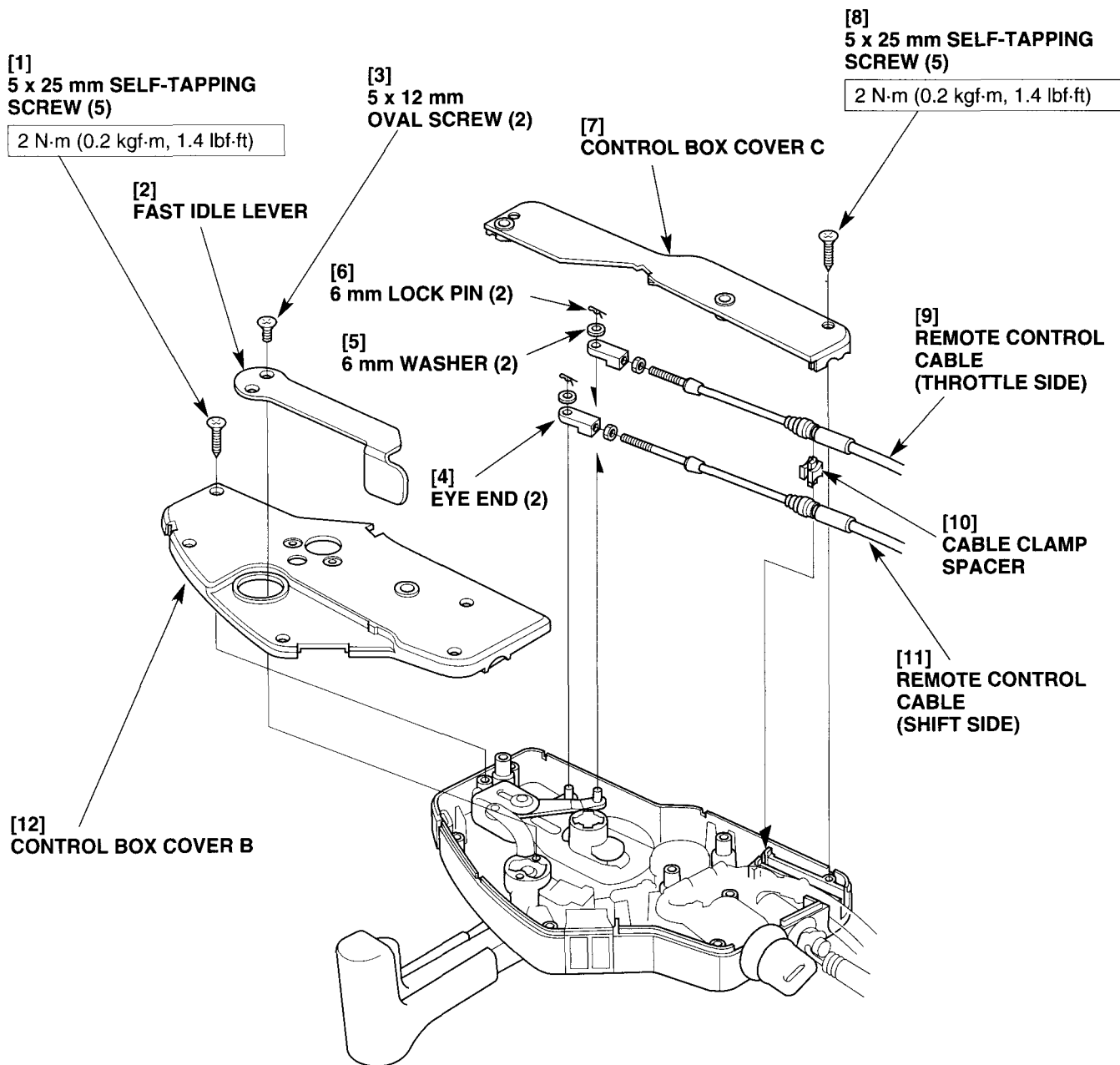
16 mm Lock nut: 1.5 N·m (0.15 kgf·m, 1.1 lbf·ft)

22 mm Lock nut: 4.8 N·m (0.49 kgf·m, 3.5 lbf·ft)

20) Install the warning buzzer. Connect the connectors and clamp the connectors with the wire band and set the wires in the control box housing as shown.



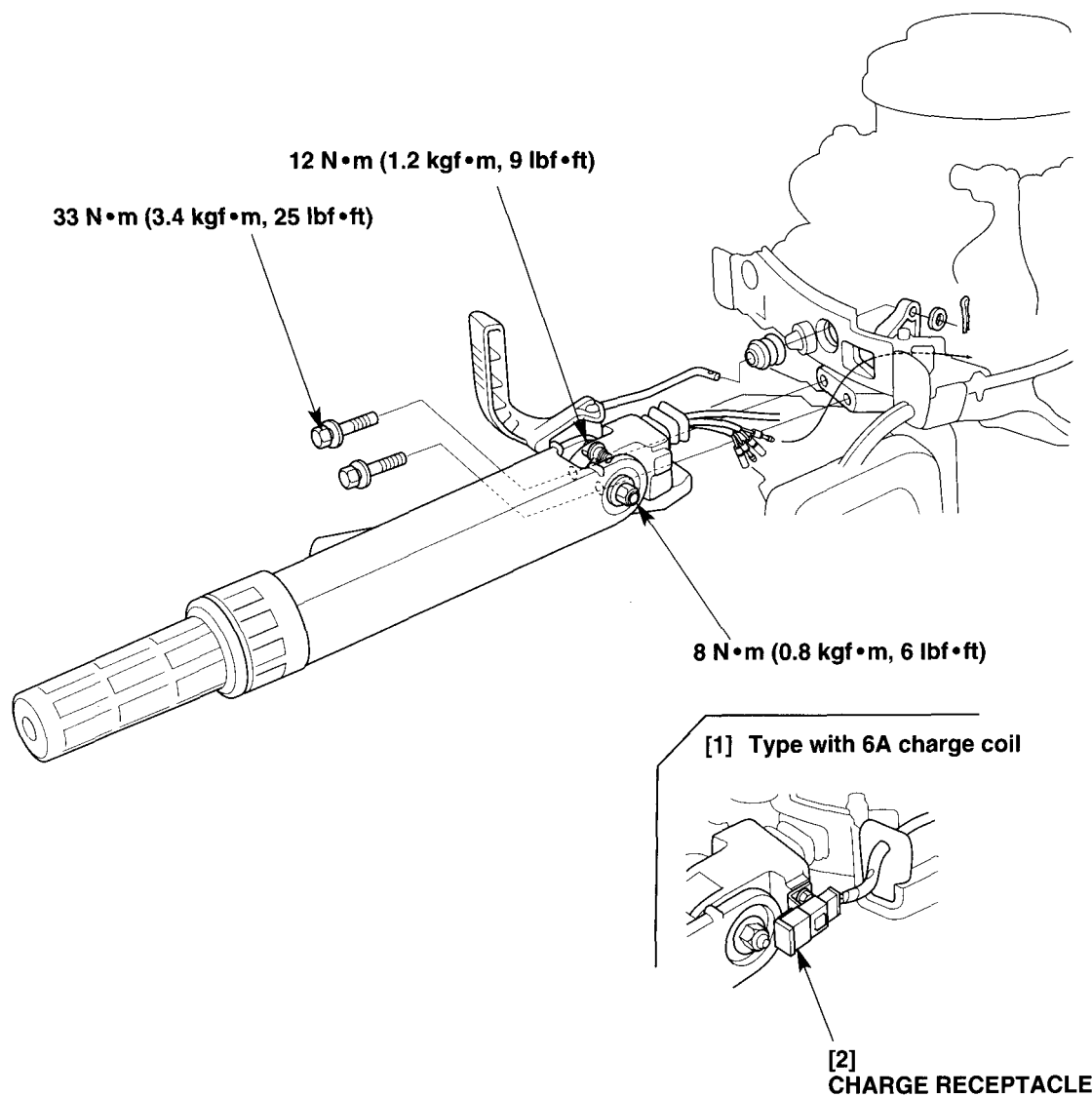
- 21) Install the control box cover B and tighten the 5 x 25 mm self-tapping screws.
- 22) Install the fast idle lever and tighten the 5 x 12 mm oval screws.
- 23) Connect the control cables (see page 14-3) and install the control box cover C and tighten the 5 x 25 mm self-tapping screws.



15. TILLER HANDLE

BF15D·BF20D

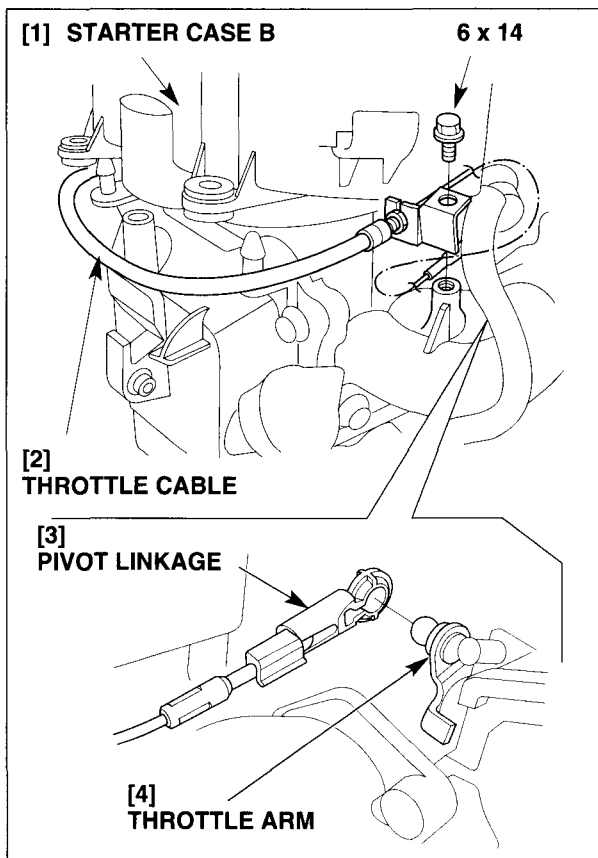
- | | |
|--------------------------|--------------------------|
| 1. TILLER HANDLE | 4. STARTER SWITCH |
| 2. TILLER HANDLE BRACKET | 5. EMARGENCY STOP SWITCH |
| 3. THROTTLE GRIP | |



1. TILLER HANDLE

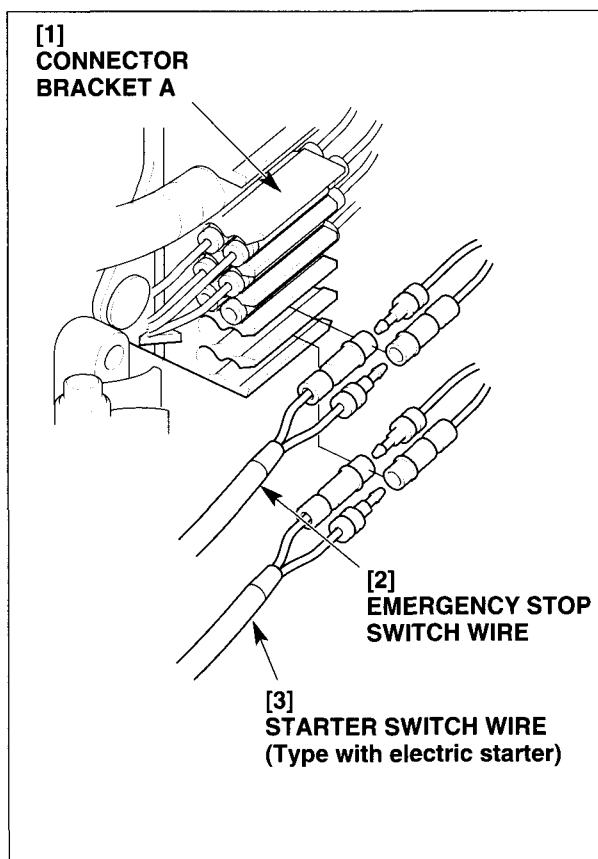
a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
- 2) Lift the starter case B slightly, and disconnect the tube from the starter case B at the carburetor side.
- 3) Remove the 6 x 14 mm flange bolt and throttle cable stay. Disconnect the throttle cable pivot linkage from the carburetor throttle lever.

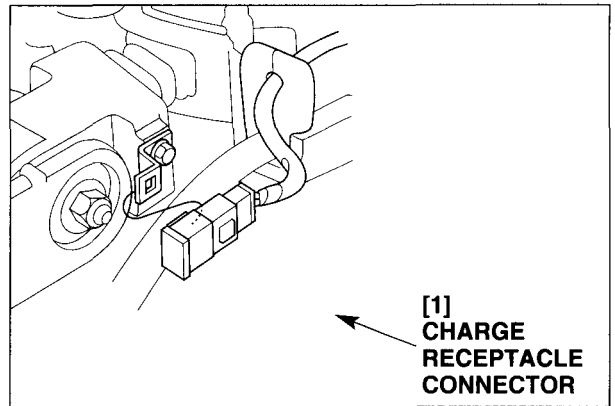


- 4) Type without electric starter: Remove the emergency stop switch wire connectors from connector bracket A and disconnect them.

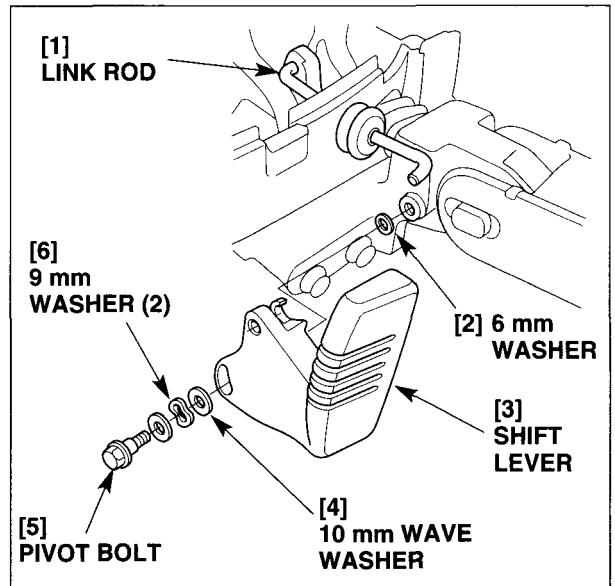
Type with electric starter: Remove the starter switch and emergency stop switch wire connectors from the connector bracket A and disconnect them.



5) Remove the charge connector from the stay.



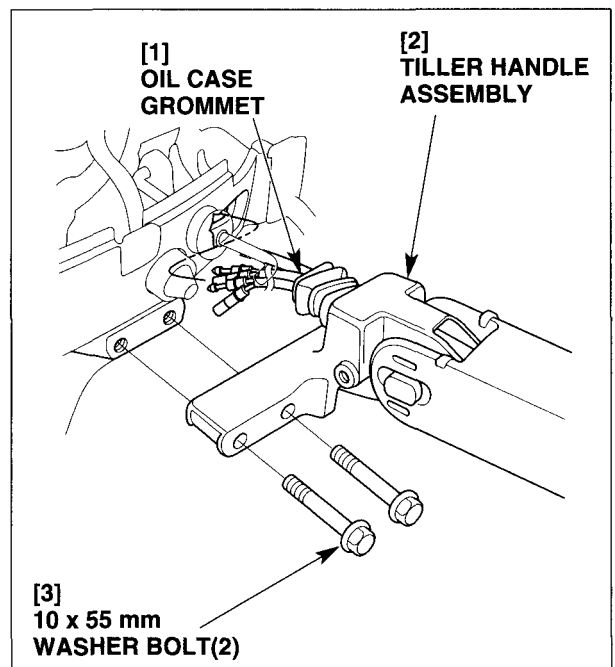
6) Remove the shift lever pivot bolt, 10 mm wave washer, two 9 mm plain washers, 6 mm plain washer.



7) Disconnect the link rod from the shift lever then remove the shift lever.

8) Pull off the oil case grommet from the oil case.

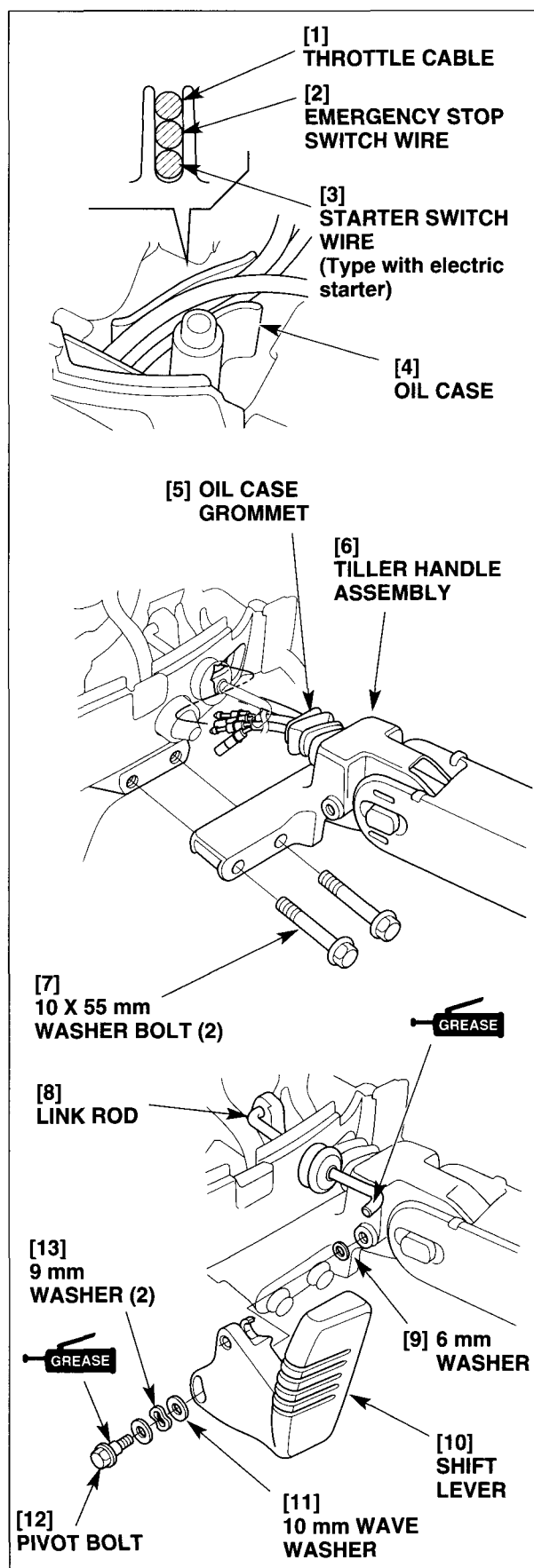
9) Remove the 10 x 55 mm washer bolts and tiller handle assembly.



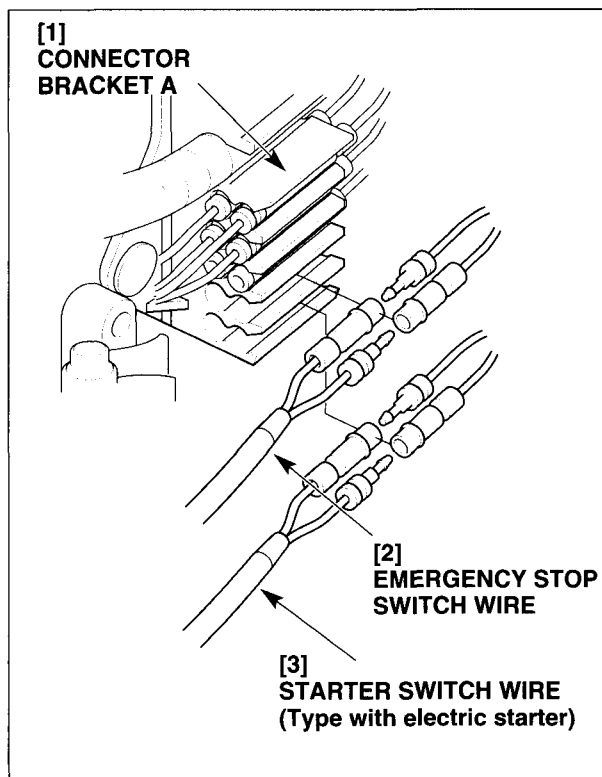
b. INSTALLATIO

- 1) Set the tiller handle assembly to the oil case and loosely install the 10 x 55 mm washer bolts.
- 2) Pass the throttle cable, switch wires through the oil case hole
 - Route the wires and throttle cable as shown.
- 3) Set the oil case grommet securely.
- 4) Apply grease to the link rod and connect to the shift lever.
- 5) Apply grease to the shift lever pivot bolt and install the shift lever to the tiller handle with the shift lever pivot bolt, 10 mm wave washer, two 9 mm plain washers and 6 mm plain washer.
- 6) Tighten the 10 x 55 mm washer bolts to the specified torque.

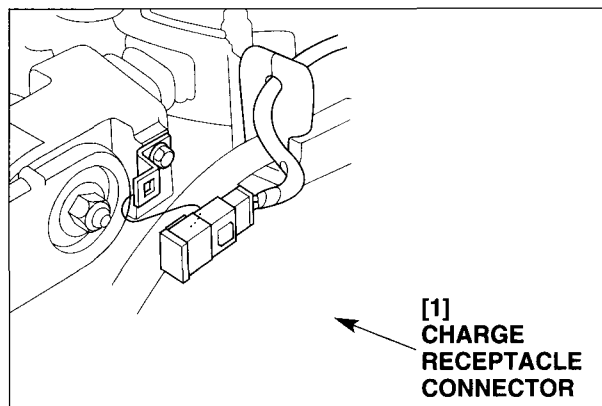
TORQUE: 33 N•m (3.4 kgf•m, 25 lbf•ft)



7) Connect the wire connectors and set them to the connector bracket A.

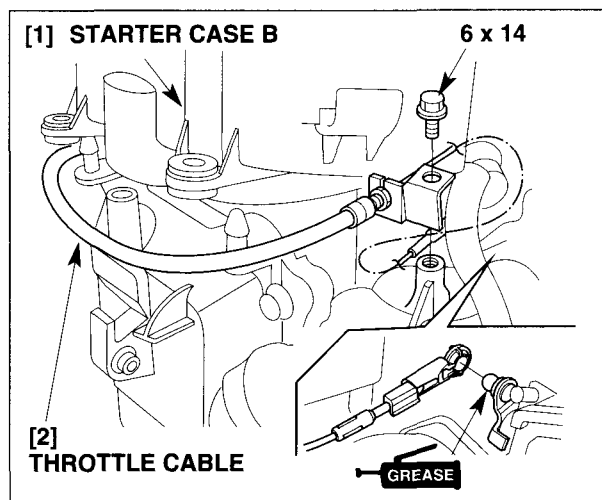


8) Set the charge receptacle to the bracket (Type without electric starter).



9) Connect the throttle cable to the carburetor and install the throttle cable holder.

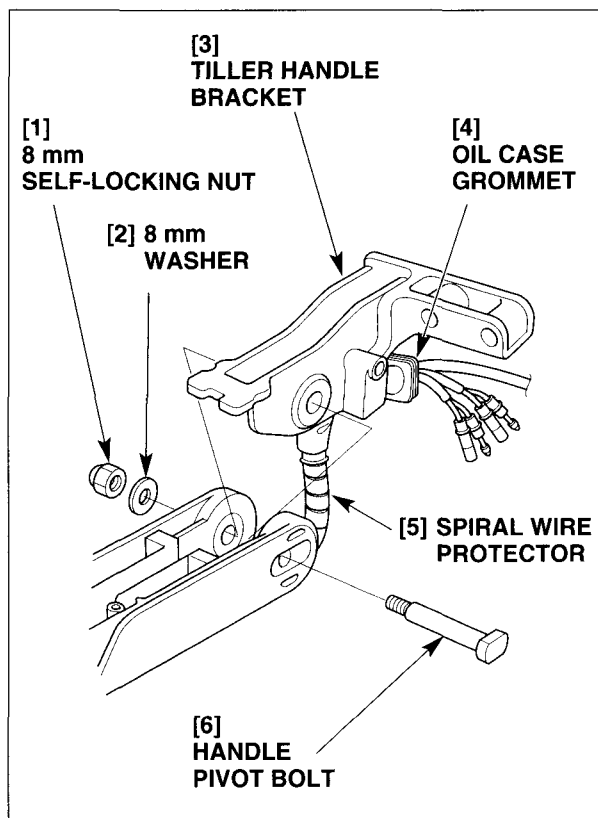
10) Install the left engine under cover (P. 5-2) and engine cover.



2. TILLER HANDLE BRACKET

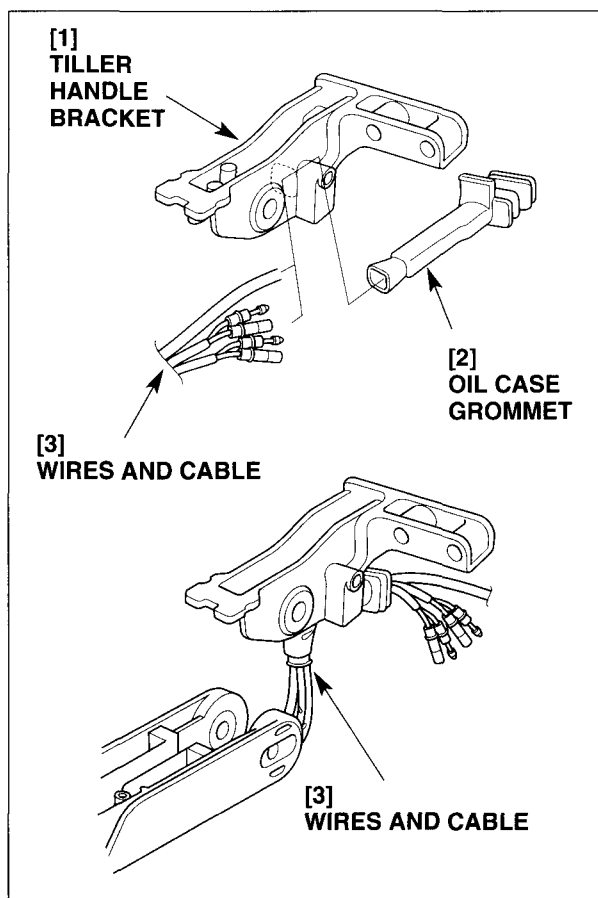
a. REMOVAL

- 1) Remove the 8 mm self-locking nut and 8 mm washer. Remove the handle pivot bolt and separate the tiller handle bracket.
- 2) Remove the spiral protector, then pull out the throttle cable and switch wires tacking care not to damage the switch wires.
- 3) Remove the oil case grommet.
- 4) Remove the tiller handle bracket.



b. INSTALLATION

- 1) Install the oil case grommet to the tiller handle bracket, then install the switch wires and throttle cable through the oil case grommet.
- 2) Set the tiller handle bracket to the tiller handle.

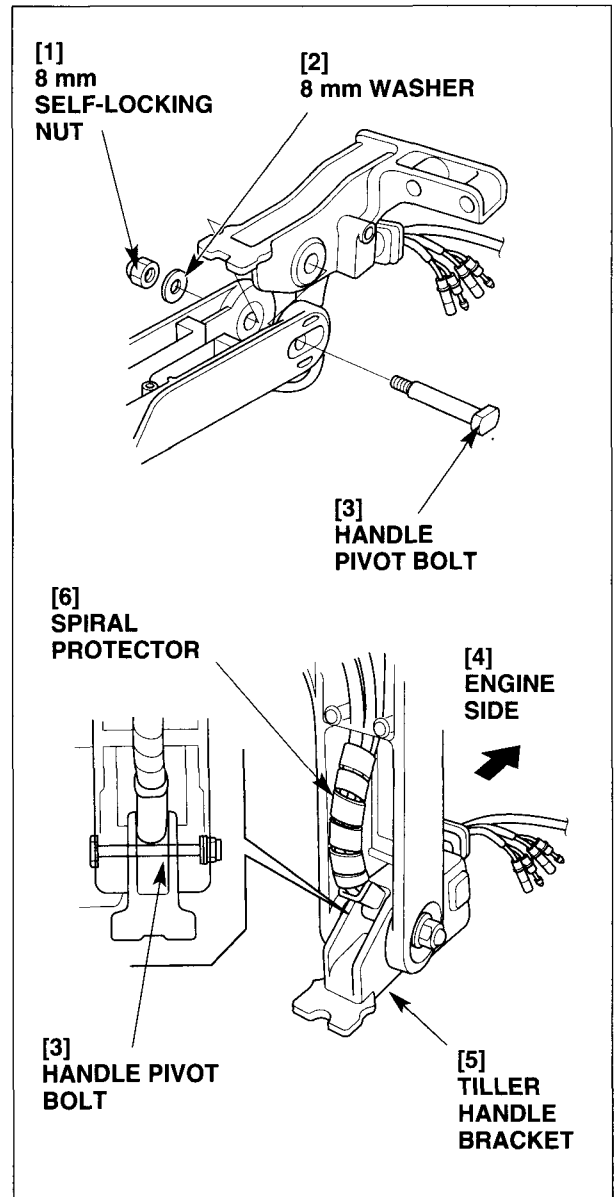


- 3) Install the handle pivot bolt and 8 mm washer, and tighten the 8 mm self-locking nut to the specified torque.

TORQUE: 8 N•m (0.8 kgf•m, 6 lbf•ft)

- Route the throttle cable and switch wires over the pivot bolt as shown.

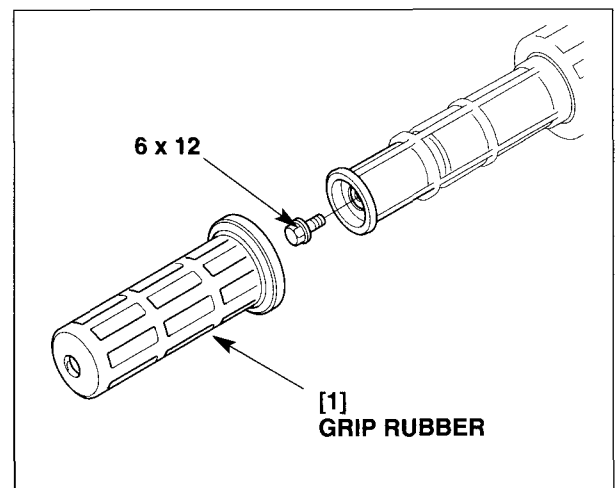
- 4) Lap the spiral protector around the throttle cable and switch wires as shown.



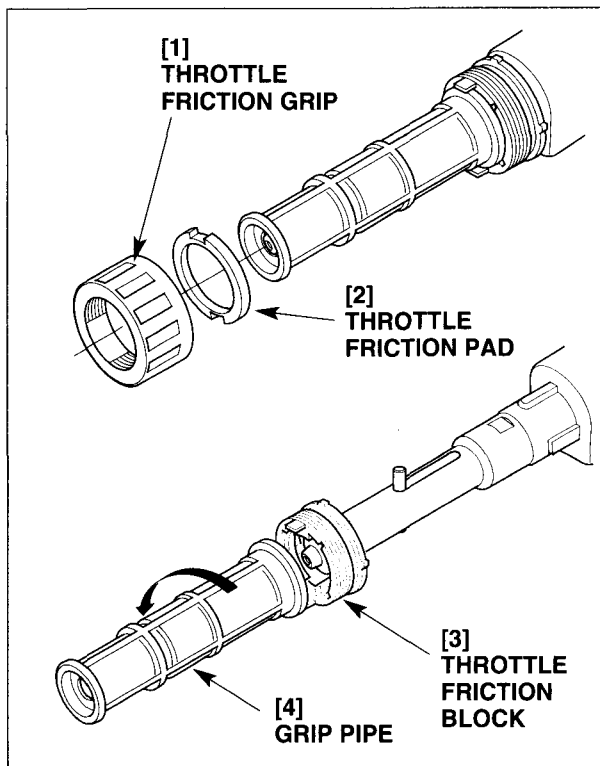
3. THROTTLE GRIP

a. DISASSEMBLY

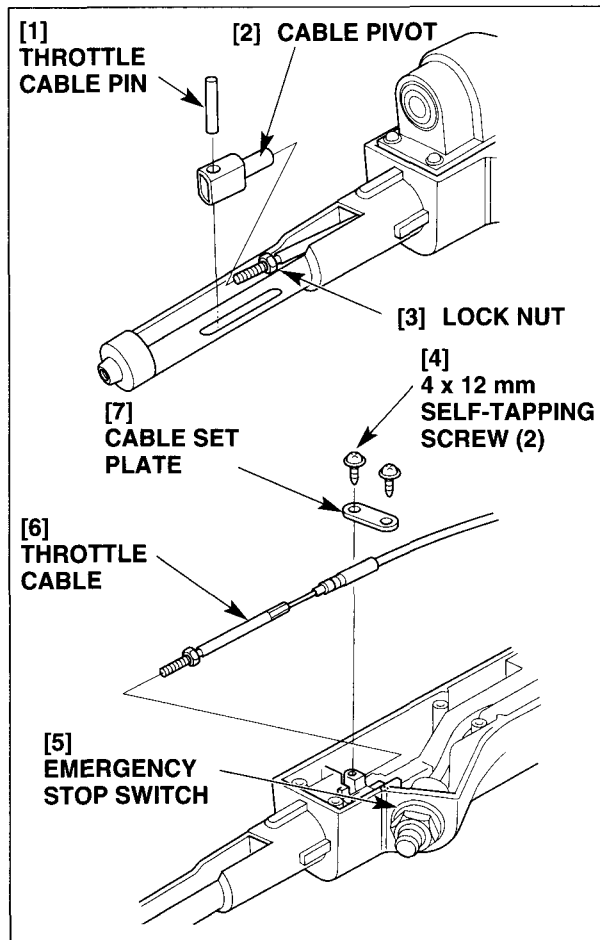
- 1) Remove the grip rubber, then remove the 6 x 12 mm flange bolt.



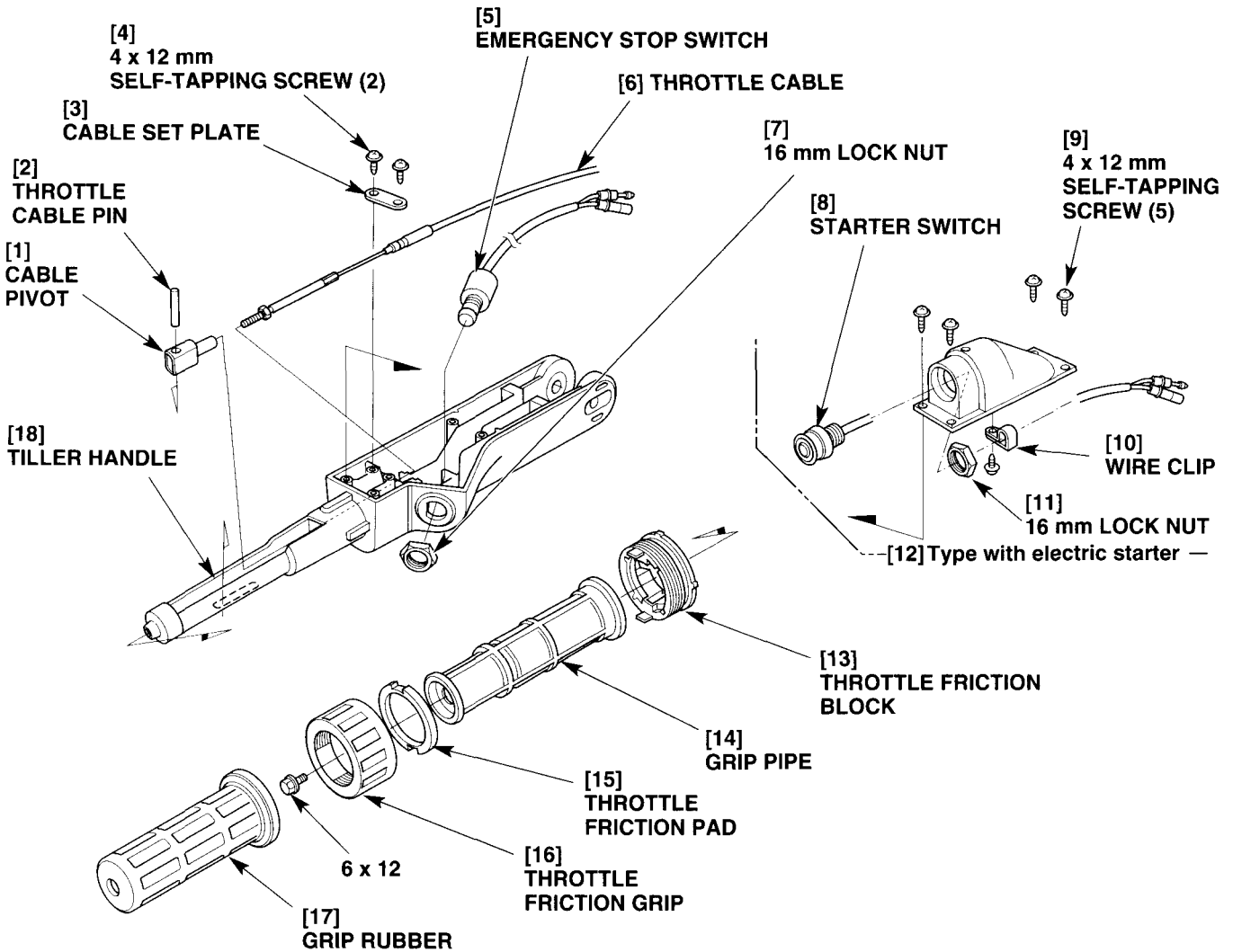
- 2) Remove the throttle friction grip and throttle friction pad.
- 3) Remove the throttle grip pipe by turning counterclockwise viewed from grip end and remove the throttle friction block



- 4) Remove the throttle cable pin from the cable pivot.
- 5) Loosen the lock nut and remove the throttle cable pivot.
- 6) Type with electric starter: Remove the four 4 x 10 mm self-tapping screws and lift up the starter switch housing with the starter switch attached (P. 15-12).
- 7) Remove the two 4 x 12 mm self-tapping screws and cable set plate. Remove the throttle cable.
 - See page 15-14 for the emergency stop switch replacement.



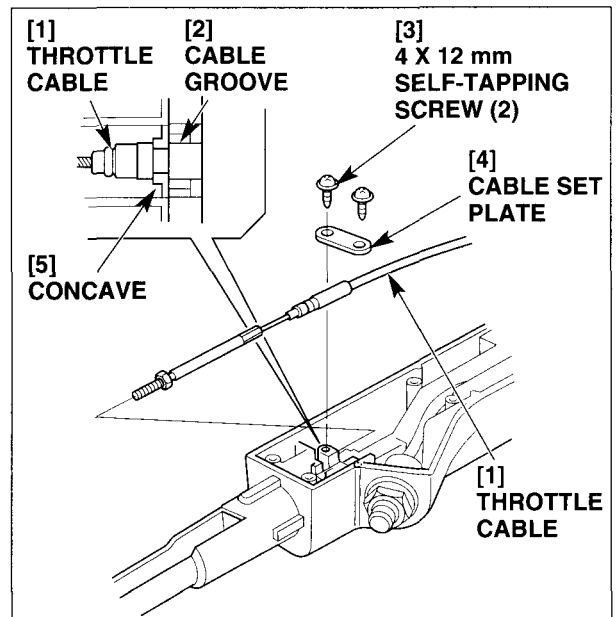
b. ASSEMBLY



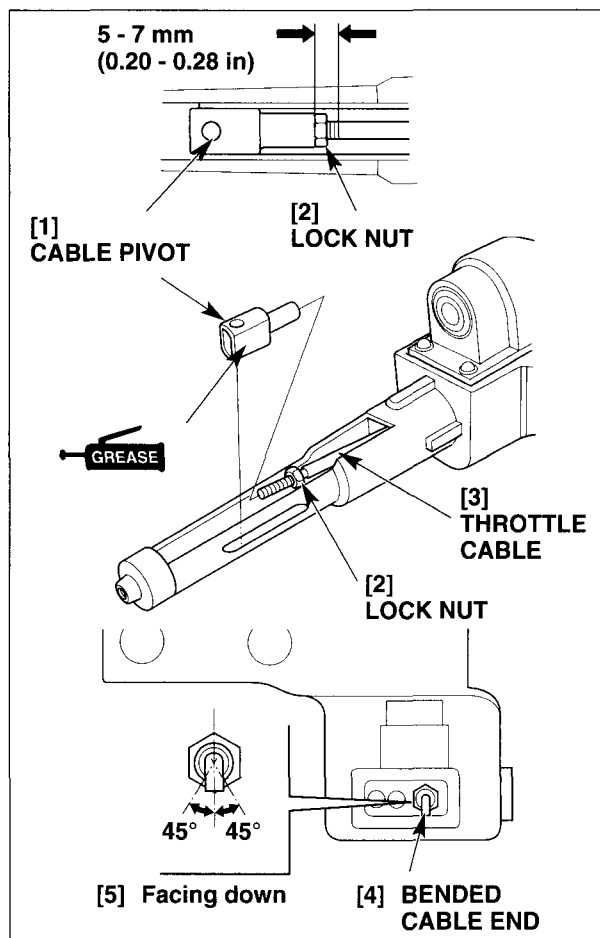
1) Install the throttle cable on the tiller handle by aligning the setting groove of the cable outer into the concave of the tiller handle as shown. Set the cable set plate and tighten the two 4 x 12 mm self-tapping screws. securely.

TORQUE: 1.5 N•m (0.15 kgf•m, 1.1 lbf•ft)

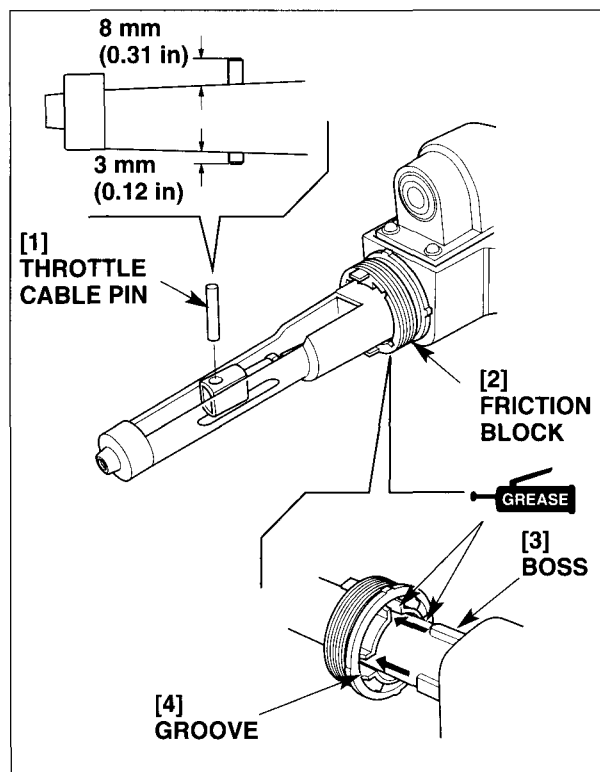
2) Install the emergency stop switch if it is removed.



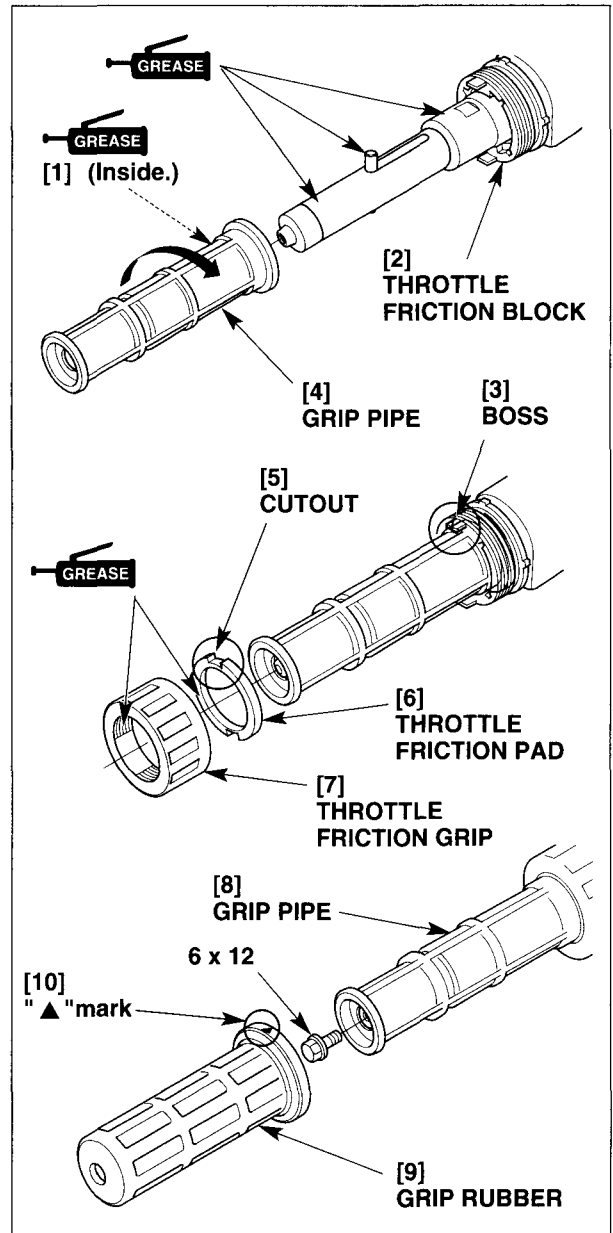
- 3) Type with electric starter: Install the starter switch housing assembly to the tiller handle and tighten the four 4 x 10 mm self-tapping screws.
- 4) Loosen the lock nut fully and screw the cable pivot as shown.
 - Make sure that the bent end (motor side) of the throttle cable facing as shown.
- 5) Tighten the lock nut securely. Apply grease to the sliding surfaces of the cable pivot.



- 6) Apply grease to the throttle grip installation surface of the tiller handle and friction block. Install the friction block by aligning the grooves of the throttle friction block with the bosses of the tiller handle as shown.
- 7) Install the throttle cable pin on the cable pivot with the projected length at both ends of the pin equal as shown.



- 8) Apply grease to the inside of the throttle grip pipe, inside of the friction grip, both ends of the throttle cable pin, handle pipe and both side of the friction pad. Set the throttle friction pad on the grip pipe.
- 9) Install the grip pipe on the tiller handle by slowly turning it clockwise.
- 10) Tighten the throttle friction grip against the throttle friction block aligning the cutout of the friction pad with the boss of the friction block.
- 11) Tighten the 6 x 12 mm flange bolt securely.
- 12) Pull the throttle cable end of the engine side fully, and install the grip rubber with the "▲" mark facing toward up.



4. STARTER SWITCH

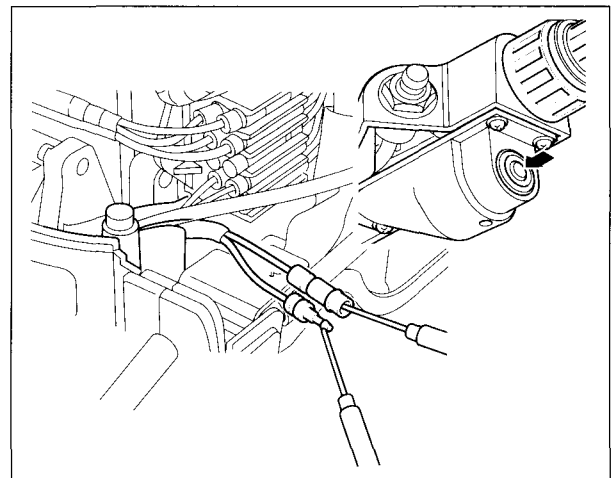
a. INSPECTION

- The starter switch test can be performed with the switch installed on the tiller handle.

Check for continuity between the terminals.

There should be continuity between the terminals when the switch pushed and no continuity with the switch free.

Replace if necessary.

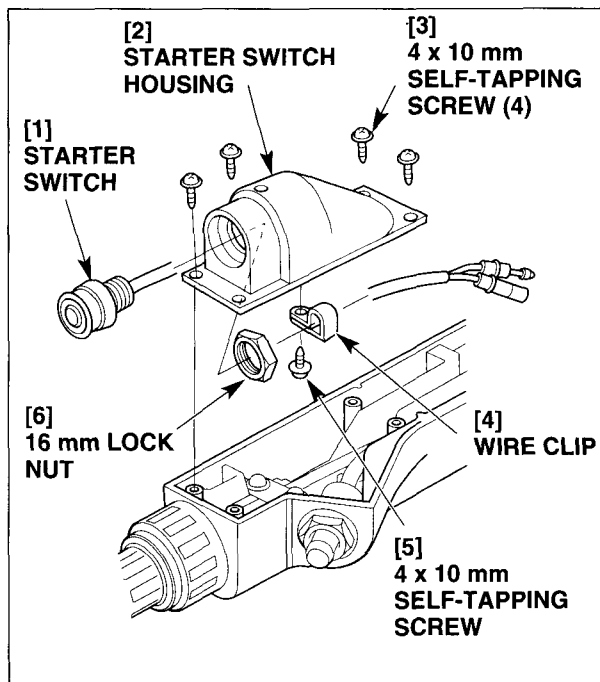


b. REPLACEMENT

- 1) Remove the 4 x 10 mm self-tapping screw and wire clip.
- 2) Remove the 16 mm lock nut and remove the starter switch from the starter switch housing.
- 3) Install a new starter switch and tighten the 16 mm lock nut to the specified torque.

TORQUE: 1.5 N•m (0.15 kgf•m, 1.1 lbf•ft)

- 4) Set the wire clip in the place and secure it with the 4 x 10 mm self-tapping screw.



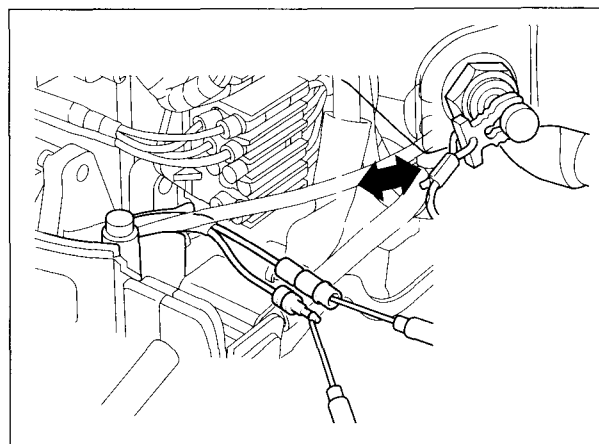
5. EMERGENCY STOP SWITCH

a. INSPECTION

- The emergency stop switch test can be performed with the switch installed on the tiller handle.

Check for continuity between the terminals according to the table below.

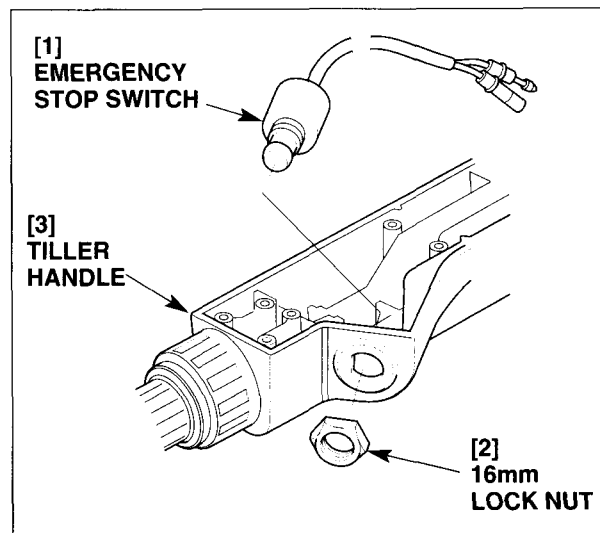
Clip engaged.	There should be no continuity.
Clip disengaged.	There should be continuity.
Clip engaged and button pushed.	There should be continuity.



b. REPLACEMENT

- 1) Remove the 16 mm lock nut and remove the emergency stop switch. Replace if necessary.
- 2) Install a new emergency stop switch and tighten the 16 mm lock nut to the specified torque.

TORQUE: 1.5 N•m (0.15 kgf•m, 1.1 lbf•ft)



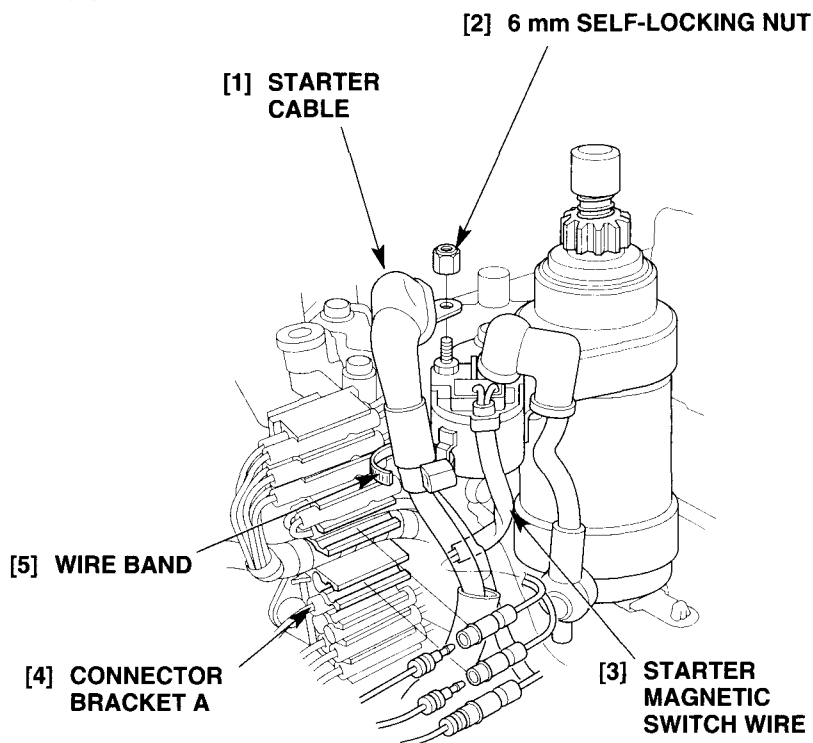
- | | |
|--|----------------------------|
| 1. STARTER MOTOR | 5. IGNITION CONTROL MODULE |
| 2. STARTER CABLE (Type with 12A charge coil) | 6. CONNECTOR BRACKET A |
| 3. CHARGE WIRE (Type with 6A charge coil) | 7. IGNITION COIL |
| 4. NEUTRAL SWITCH/INDICATOR | 8. REGULATOR/RECTIFIER |

1. STARTER MOTOR

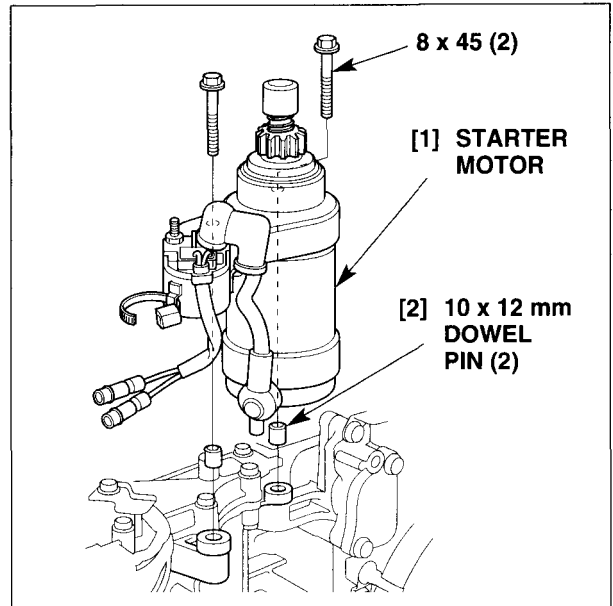
a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-2).
 - recoil starter (P. 7-2).
 - flywheel (P. 9-2)
- 2) Disconnect the cable terminals from the battery, before starter motor removal.
 - Disconnect the negative (–) terminal first, then disconnect the positive (+) terminal.
- 3) Tiller handle type: Open the wire band on the starter magnetic switch.

Remote control type: Open the wire band on the starter magnetic switch and remove the control box wire harness (P. 15-3)
- 4) Remove the 6 mm self-locking nut and disconnect the starter cable from the starter magnetic switch.
- 5) Pull the starter magnetic switch wire connectors from the connector bracket A and disconnect the connectors.

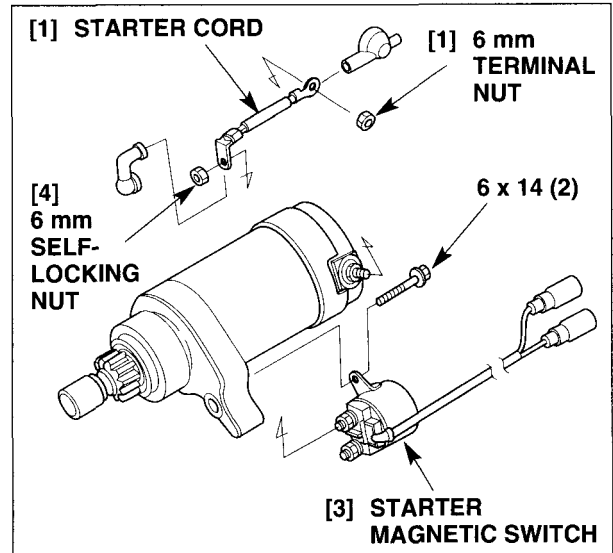


- 6) Remove the two 8 x 45 mm flange bolts and remove the starter motor and two 10 x 12 mm dowel pins.

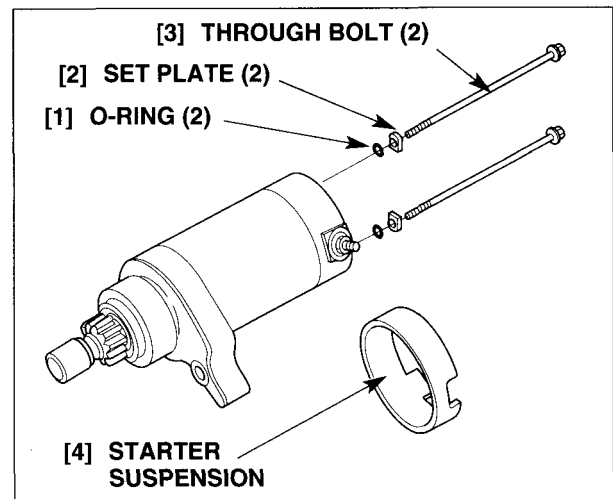


b. DISASSEMBLY

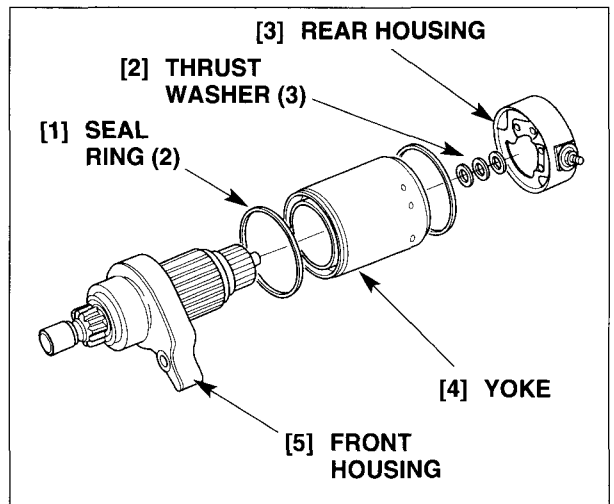
- 1) Pull off the terminal covers, remove the 6 mm self-locking nut, 6 mm terminal nut and disconnect the starter cord from the starter magnetic switch and brush terminal.
 - See page 16-5 for starter magnetic switch inspection.
- 2) Remove the two 6 x 14 mm flange bolts, then remove the starter magnetic switch.



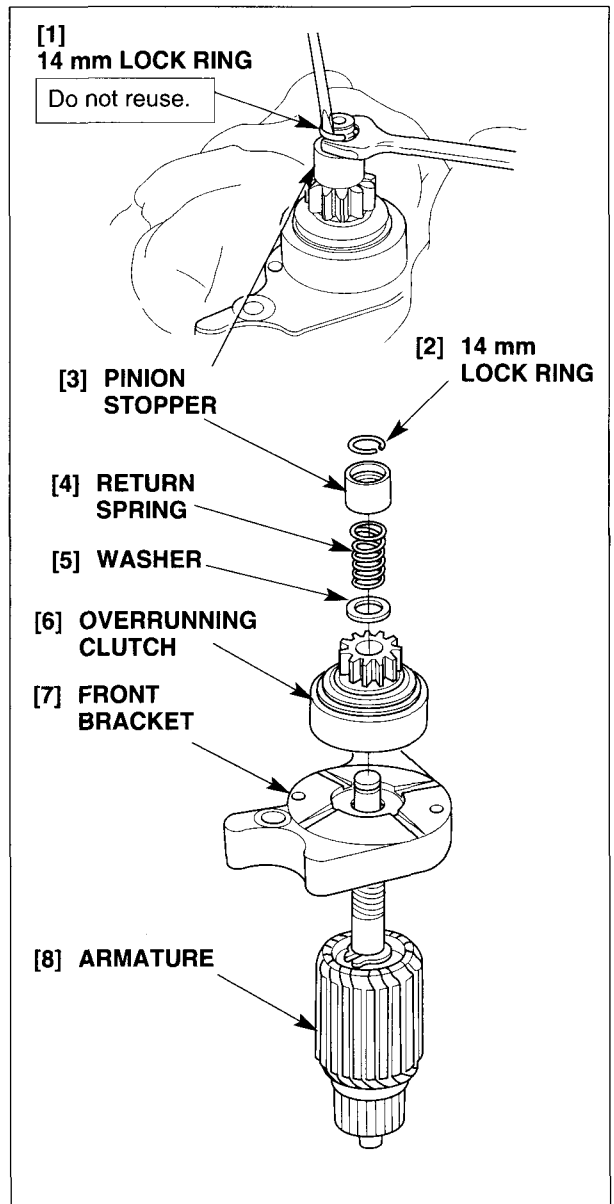
- 3) Remove the starter suspension.
- 4) Remove the through bolts, set plates and O-rings.



- 5) Remove the rear housing with the brush holder attached, thrust washers, seal rings and yoke.



- 6) Hold the front bracket/armature assembly upright in a vice as shown.
- 7) Push down the pinion stopper using a spanner and pry off the 14 mm lock ring using a screw-driver.
- 8) Remove the return spring, washer, overrunning clutch and front bracket from the armature.



- 9) Remove the 6 mm washer nut, 6 mm washer and insulator collar.
- 10) Remove the brush holder from the rear housing, then disassemble the brush holder.

c. INSPECTION

• BRUSH

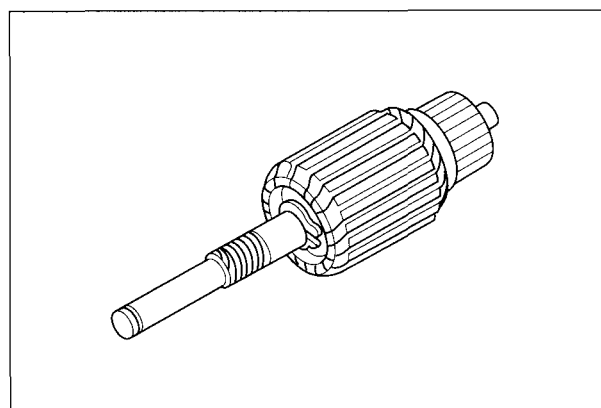
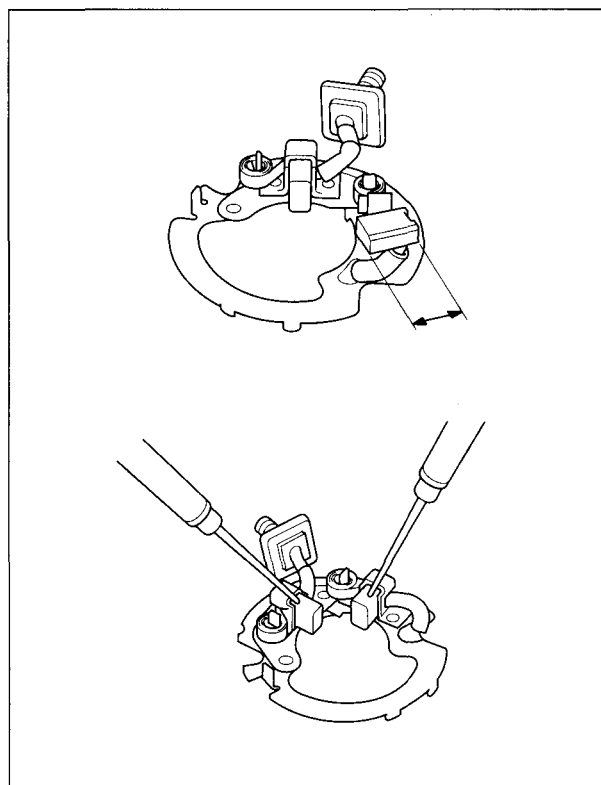
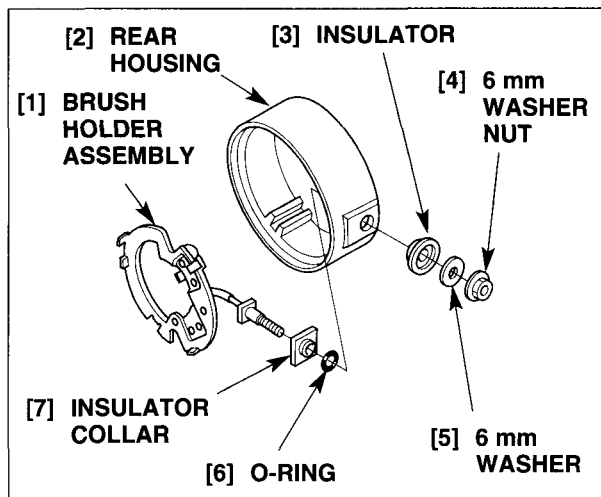
- 1) Measure the brush length.
 - If the brush length is less than the service limit, replace the brush holder assembly.

Standard	Service limit
12.5 mm (0.49 in)	8.5 mm (0.33 in)

- 2) Check for continuity between the brushes. There should be no continuity between the brushes. If necessary, replace the brush holder as an assembly.

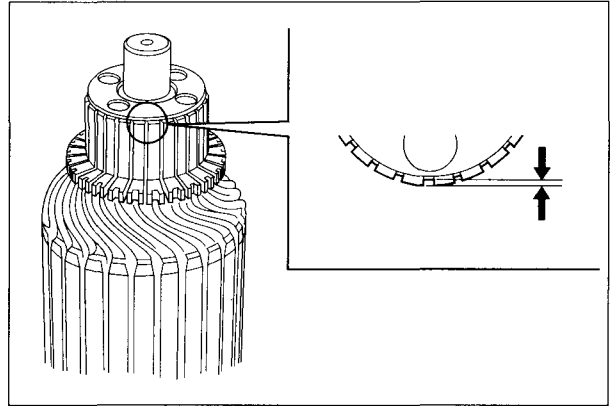
• ARMATURE

- 1) Check the armature for wear or damage. Check the over-running clutch installation section of the shaft for wear or damage. Replace if necessary.
- 2) Visually inspect the commutator surface for dust, rust or other damage. If necessary, wipe it with a clean lint-free cloth or dress with a fine emery cloth.

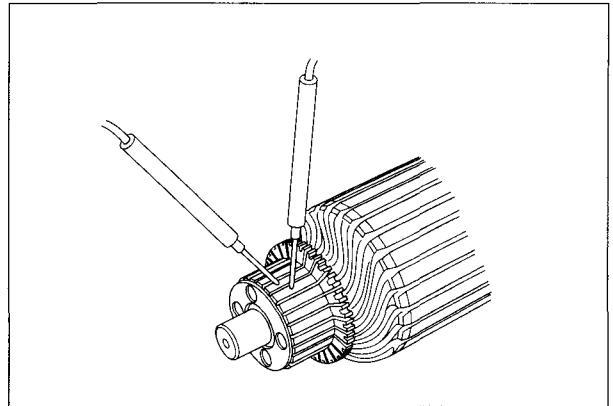


- 3) Measure the mica depth. If the grooves are clogged, clean the grooves and measure the depth again. If the measurement is less than the service limit, replace the armature.

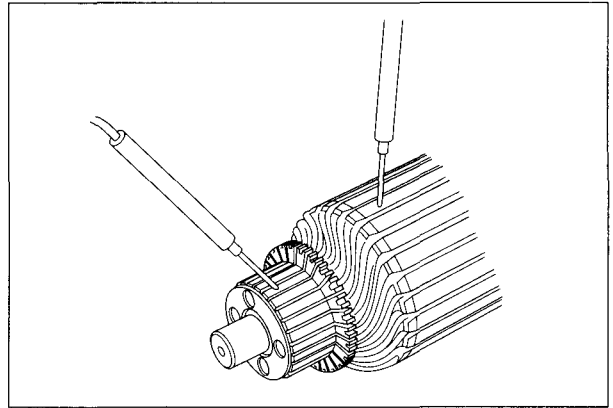
Service limit	0.2 mm (0.01 in)
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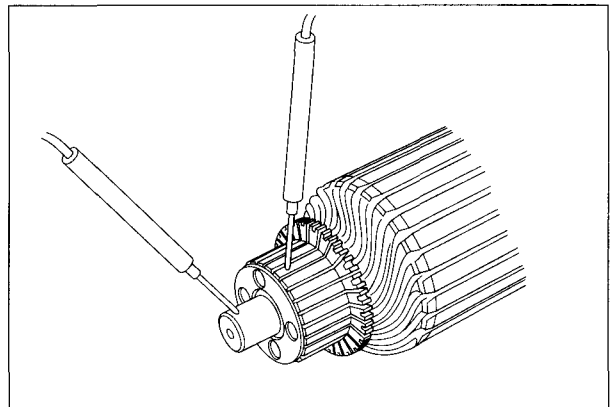
- 4) Check for continuity between each segment. If an open circuit exists between any two segments, replace the armature.



- 5) Check for continuity between the commutator and armature coil core. If continuity exists, replace the armature.



- 6) Check for continuity between the commutator and armature shaft. If there is continuity, replace the armature.



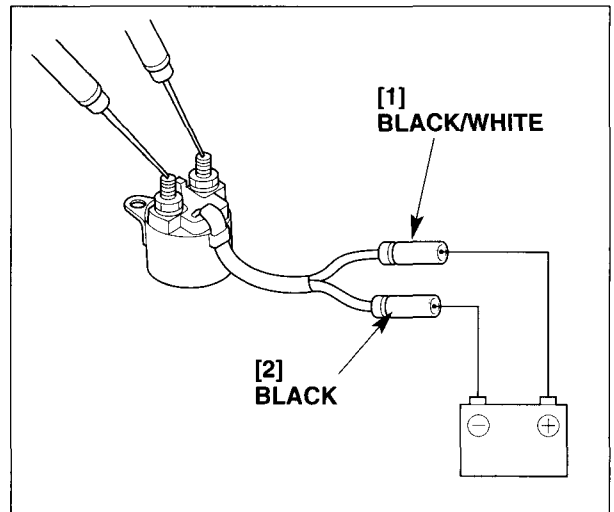
• STARTER MAGNETIC SWITCH

- This test can be performed with the starter magnetic switch installed on the starter motor.
- Be sure the battery is in good condition before performing this test.

Connect a 12 V battery to the magnetic switch terminals as shown.

There should be continuity between the battery and starter motor terminals.

There should be no continuity when the battery is disconnected.

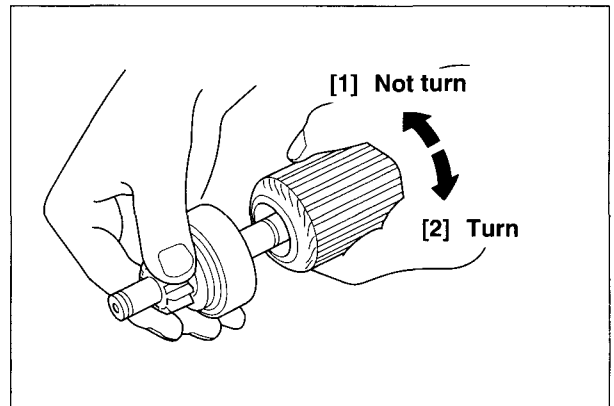


• OVERRUNNING CLUTCH

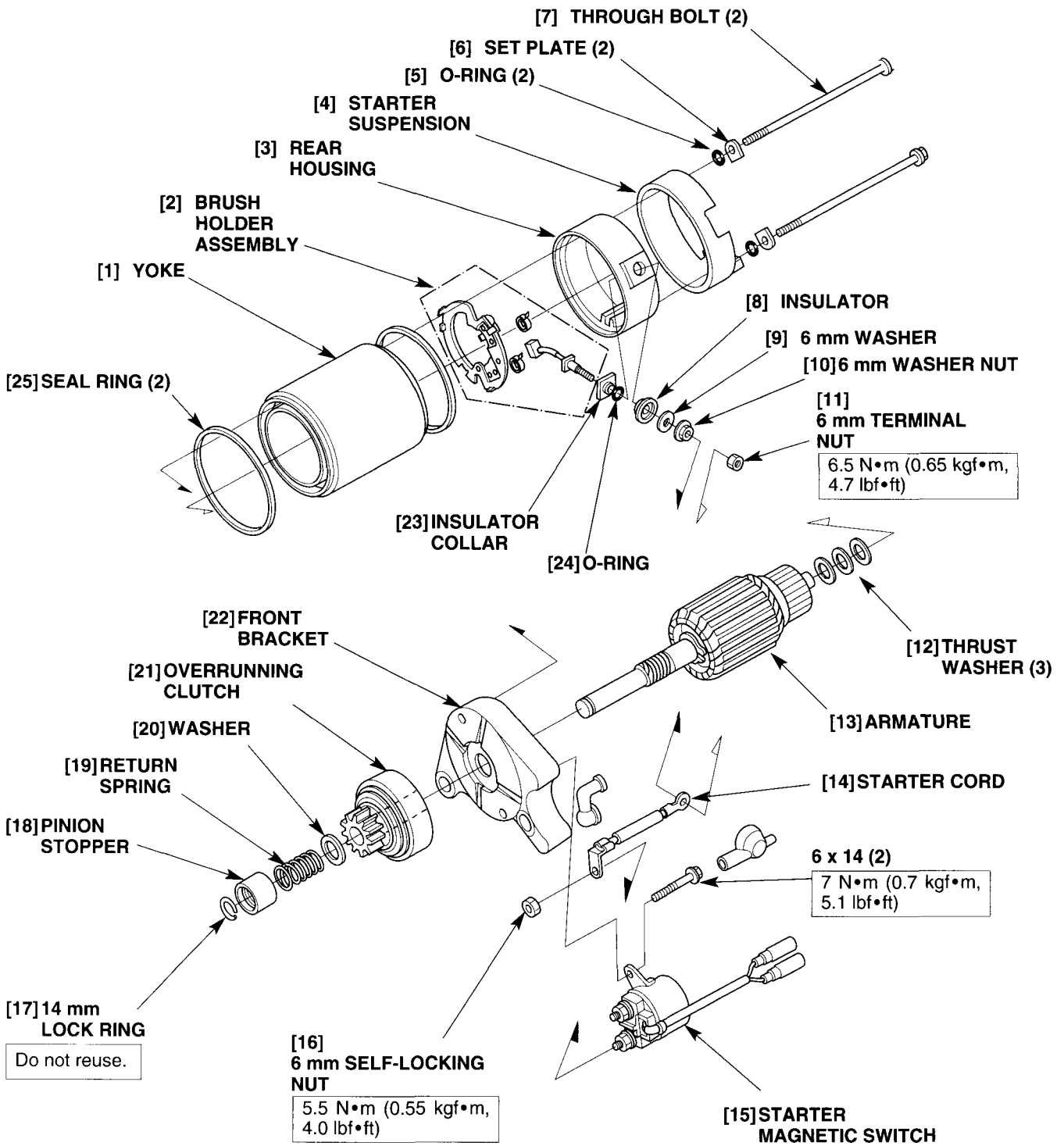
- 1) Check the pinion gear for wear or damage and replace if necessary.

If the pinion gear is worn or damaged, the flywheel ring gear must be inspected.

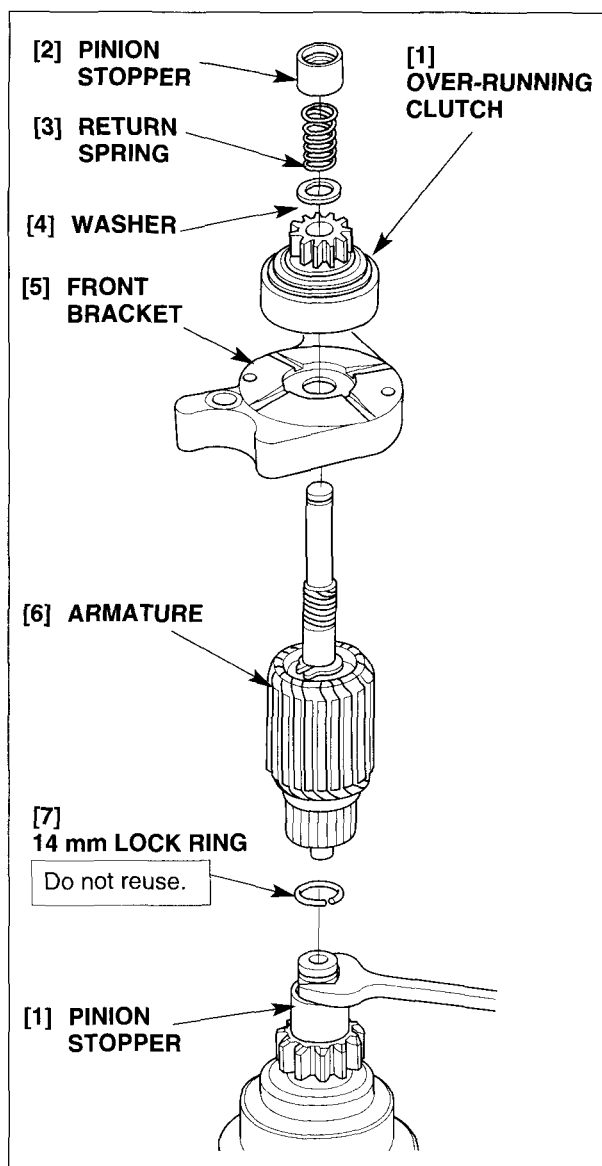
- 2) Check the overrunning clutch for smooth axial movement. Apply gear oil or replace the overrunning clutch if necessary.
- 3) Check the overrunning clutch operation by holding the armature and turning the overrunning clutch. The overrunning clutch should turn counterclockwise freely and should not turn clockwise viewed from overrunning clutch side.



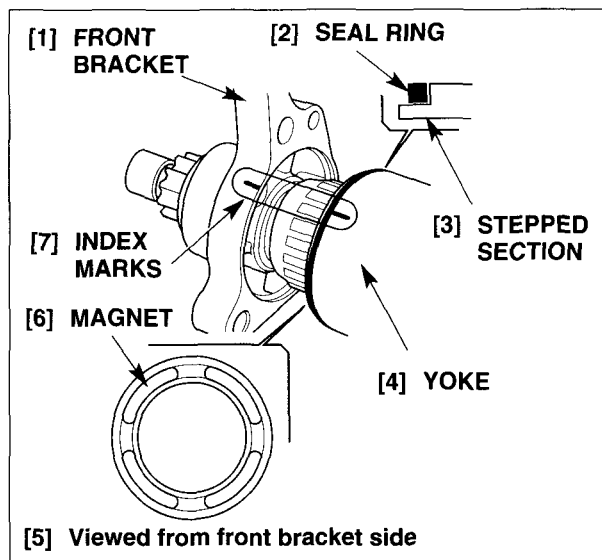
d. ASSEMBLY



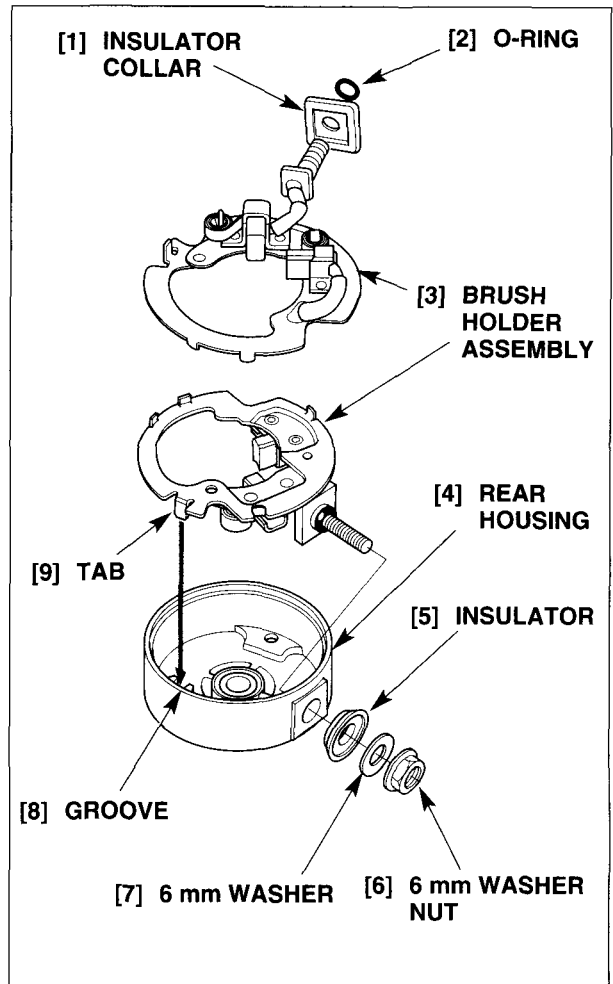
- 1) Apply grease to the armature shaft, bearing and seal lip of the front bracket, and sliding surface of the overrunning clutch.
- 2) Install the front bracket onto the armature.
- 3) Install the overrunning clutch, washer, return spring and pinion stopper.
- 4) Hold the armature upright and push down the pinion stopper using an offset wrench and install the stopper ring.



- 5) Make sure that the seal ring is in good condition, replace if necessary. Install the seal ring onto the yoke.
 - Set the seal ring onto the stepped section of the yoke properly taking care not to pinch with the yoke and front bracket.
- 6) Make sure that there is no obstruction on the magnets. Install the yoke noting the installation direction as shown and align the index mark on the yoke with the index mark on the front bracket.



- 7) Install the brushes and brush springs in the brush holder.
- 8) Apply oil to the O-ring and install the insulator collar and O-ring to the brush holder.
- 9) Install the brush holder to the rear housing by aligning the tab of the brush holder with groove of the rear housing as shown.
- 10) Install the insulator and 6 mm washer and tighten the 6 mm washer nut securely.

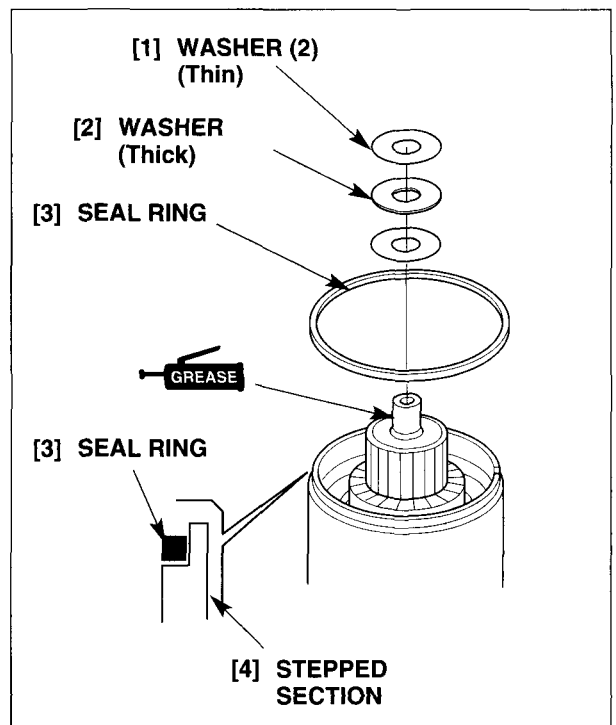


- 11) Apply grease to the armature shaft. Install the washers onto the armature shaft.

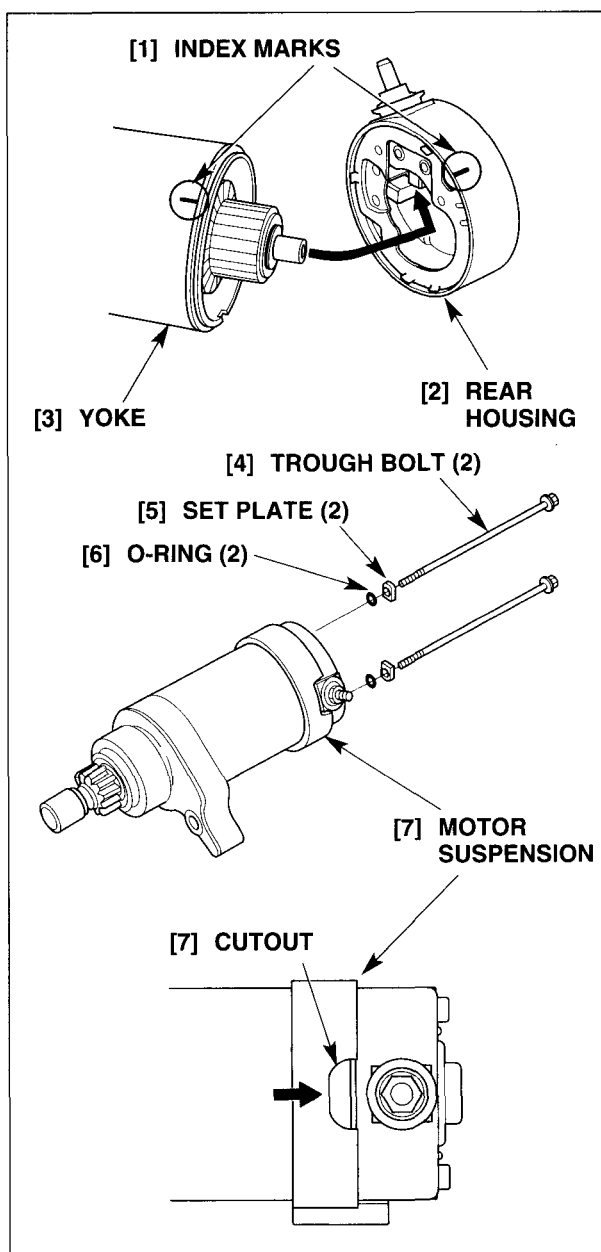
Note the washers installation position.

- 12) Make sure that the seal ring is in good condition, replace if necessary. Install the seal ring.

Set the seal ring onto the stepped section of the yoke properly taking care not to pinch with the yoke and rear housing.

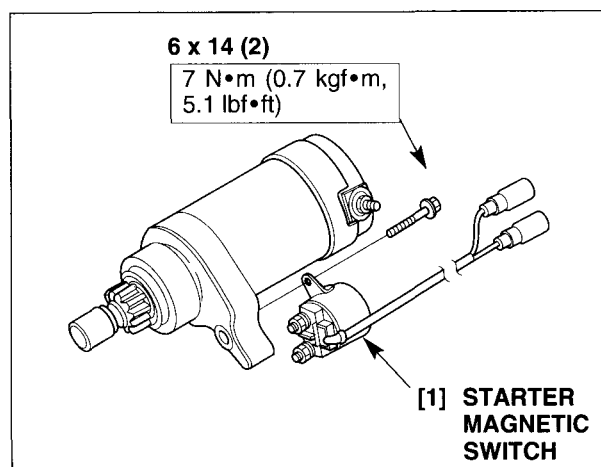


- 13) Install the rear bracket and align the index mark on the rear housing with the index mark on the yoke.
- 14) Install the starter suspension onto the yoke.
- 15) Apply oil to new O-rings and install the set plate and the O-ring to each through bolt.
- 16) Tighten the through bolts securely.
- 17) Set the starter suspension by aligning the cutout of the suspension with the terminal as shown.



- 18) Install the starter magnetic switch and tighten the 6 x 14 mm flange bolts to the specified torque.

TORQUE: 7 N•m (0.7 kgf•m, 5.1 lbf•ft)



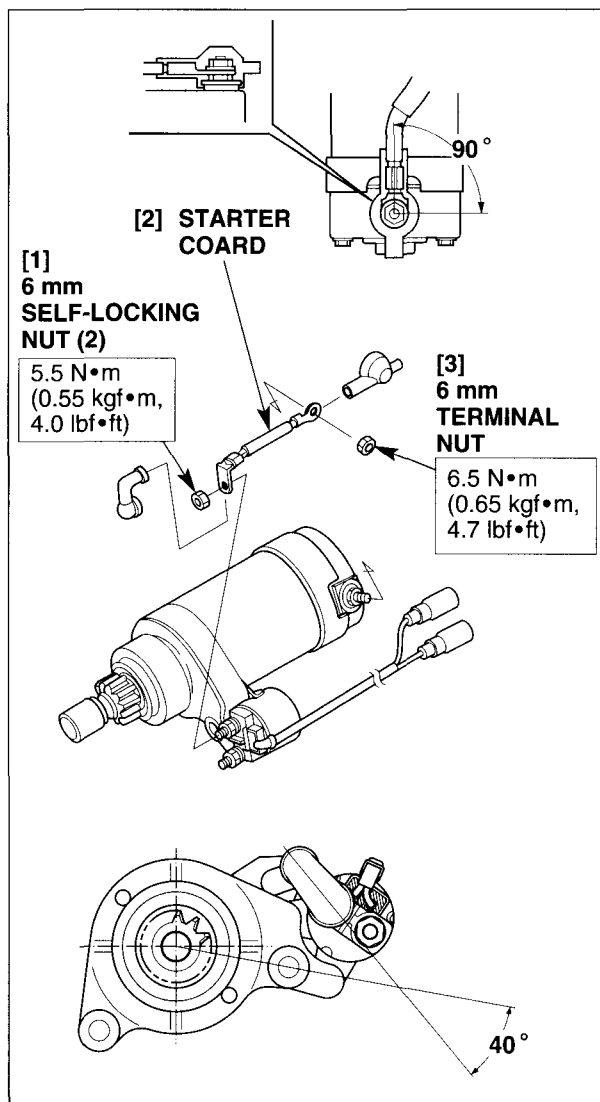
19) Install the starter cord between the brush terminal and starter magnetic switch terminal and loosely install the 6 mm self-locking nut and 6 mm terminal nut.

20) Adjust the starter cord terminal direction and tighten the 6 mm terminal nut to the specified torque.

TORQUE: 6.5 N·m (0.65 kgf·m, 4.7 lbf·ft)

21) Tighten the 6 mm self-locking nut on the starter magnetic switch to the specified torque.

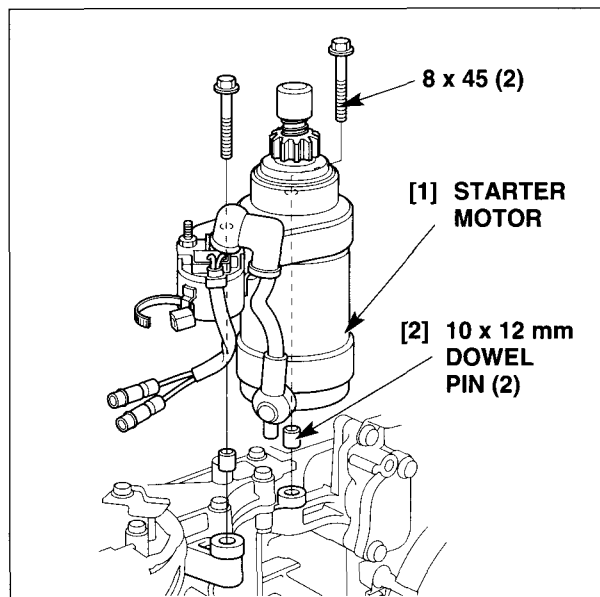
TORQUE: 5.5 N·m (0.55 kgf·m, 4.0 lbf·ft)



e. INSTALLATION

1) Install the 10 x 12 mm dowel pin onto the crankcase cover.

2) Install the starter motor and tighten the 8 x 45 mm flange bolts securely.



3) Route the starter magnetic switch wire and connect the connectors, and set them to the connector bracket A.

- See page 3-31 (Tiller handle type) or P3-33 (Remote control type).

4) Connect the starter cable to the starter magnetic switch and adjust the terminal direction so that the starter cable contacts to the clamp bracket on the starter magnetic switch body as shown.

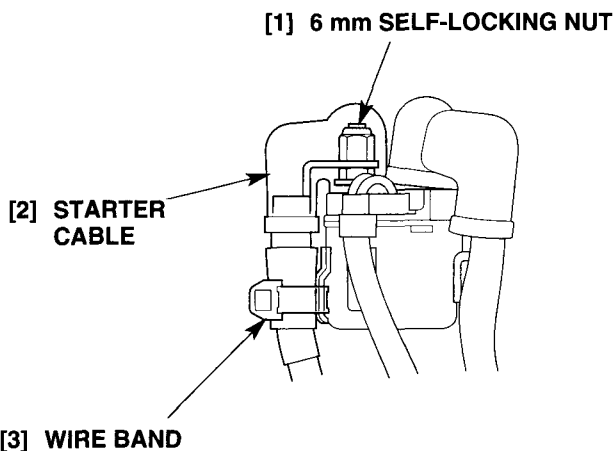
5) Tighten the self-locking nut to the specified torque.

TORQUE: 5.5 N•m (0.55 kgf•m, 4.0 lbf•ft)

6) Secure the battery cable, charge wire and control box wire harness (Remote control type only) with the cable band on the starter magnetic switch.

7) Install the removed parts in the reverse order of removal:

- flywheel (P. 9-11).
- recoil starter (P. 7-9).
- left engine under cover (P. 5-3).
- engine cover (P. 5-1).



[1] 6 mm SELF-LOCKING NUT
5.5 N•m (0.55 kgf•m, 4.0 lbf•ft)

[3] WIRE BAND

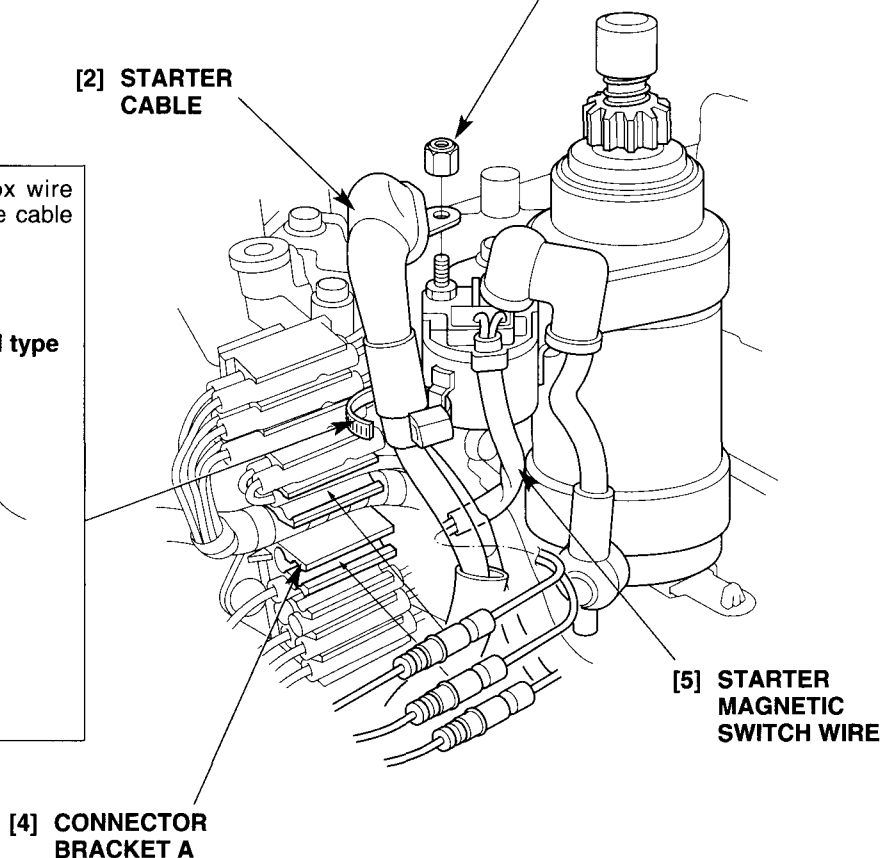
Secure battery cable and control box wire harness (Remote control type) with the cable band on the starter magnetic switch.

[3]-1
Tiller handle type

[3]-2
Remote control type

[3]-3
CONTROL
BOX WIRE
HARNESS

[3]-4
STARTER CABLE

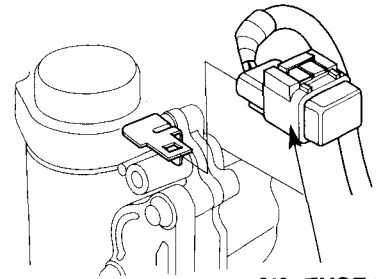


2. STARTER CABLE

(Type with electric starter)

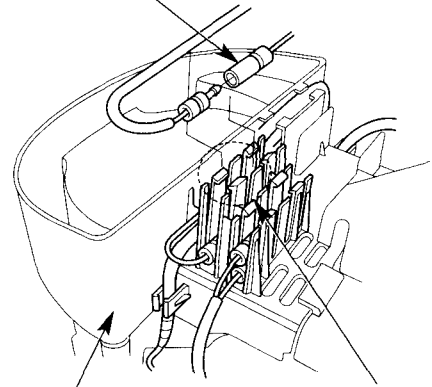
a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
- 2) Remove the fuse holder from the fuse holder bracket.
- 3) Pull off the white wire (fuse line) connectors from the holder on the starter case B, and disconnect them.
- 4) Open the three wire band clips and remove the spiral protectors.
- 5) Open the wire band on the starter magnetic switch.
- 6) Remove the 6 mm self-locking nut and disconnect the starter cable from the starter magnetic switch.
- 7) Remove the 6 x 12 mm flange bolt and disconnect the battery ground terminal.



[1] FUSE HOLDER

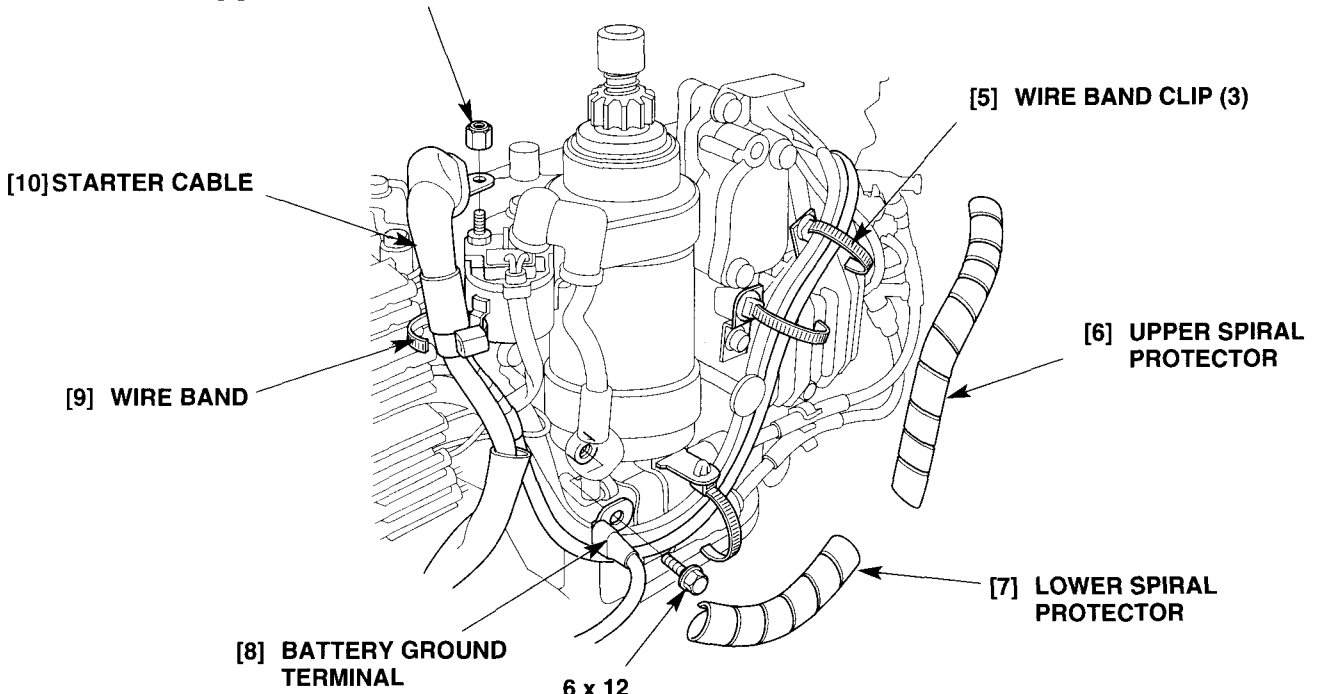
[2] WHITE WIRE
(From fuse holder)



[3] STARTER CASE B

[4] HOLDER

[4] 6 mm SELF-LOCKING NUT



[10] STARTER CABLE

[5] WIRE BAND CLIP (3)

[9] WIRE BAND

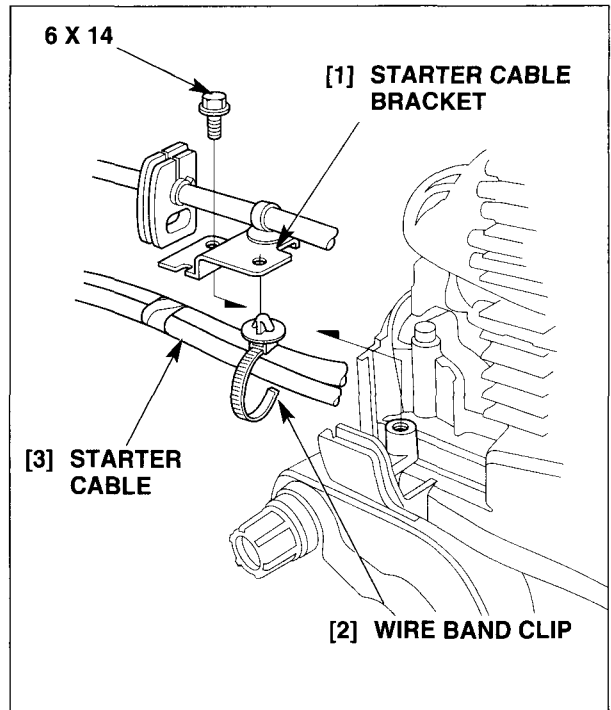
[6] UPPER SPIRAL
PROTECTOR

[8] BATTERY GROUND
TERMINAL

[7] LOWER SPIRAL
PROTECTOR

6 x 12

- 8) Remove the 6 x 14 mm flange bolt and starter cable bracket.
- 9) Open the wire band and remove the starter cable.

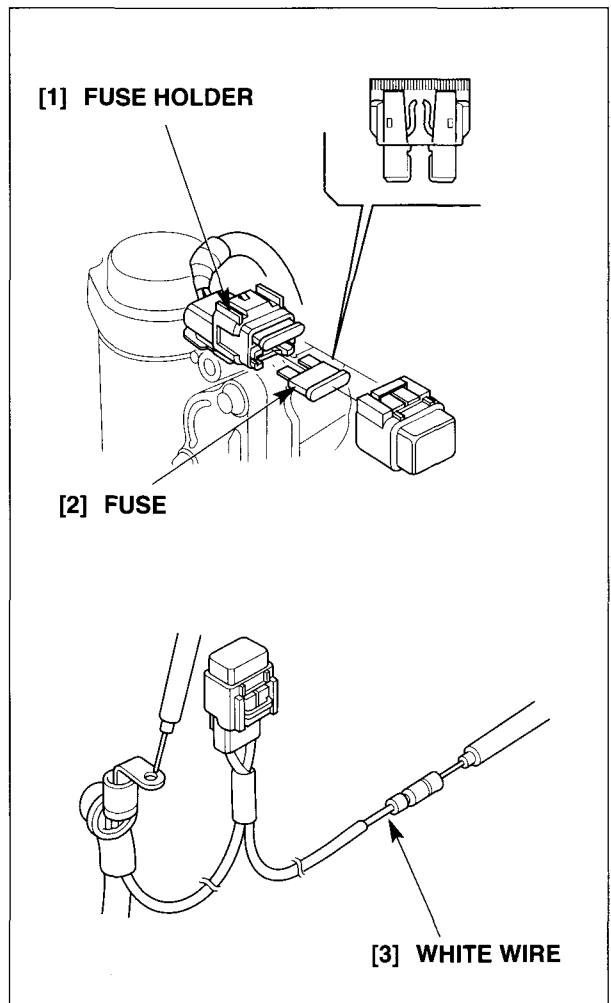


b. INSPECTION

- Before inspection or replacement, disconnect the battery cable from the battery.

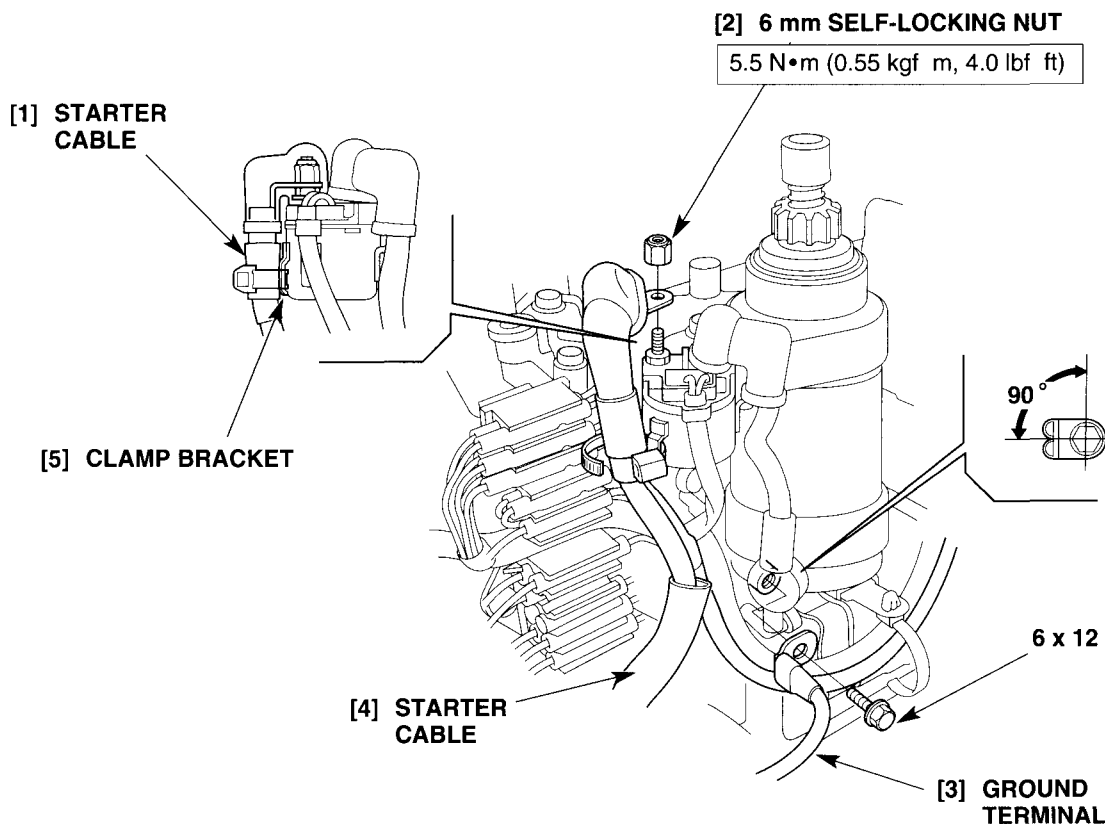
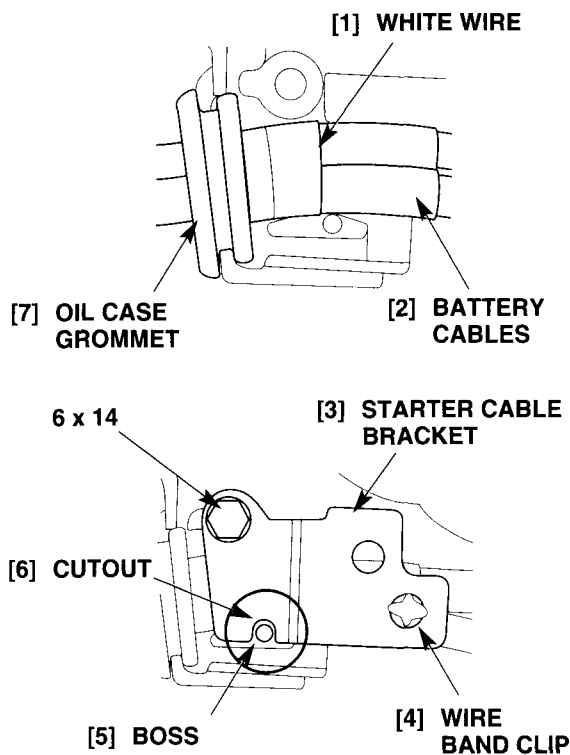
• FUSE AND FUSE HOLDER

- 1) Remove the fuse from the fuse holder and check for continuity between the terminals.
 - There should be continuity, replace if necessary.
- 2) Install the fuse to the fuse holder.
- 3) Check for continuity between the white wire connector and battery positive terminal.
 - There should be continuity.

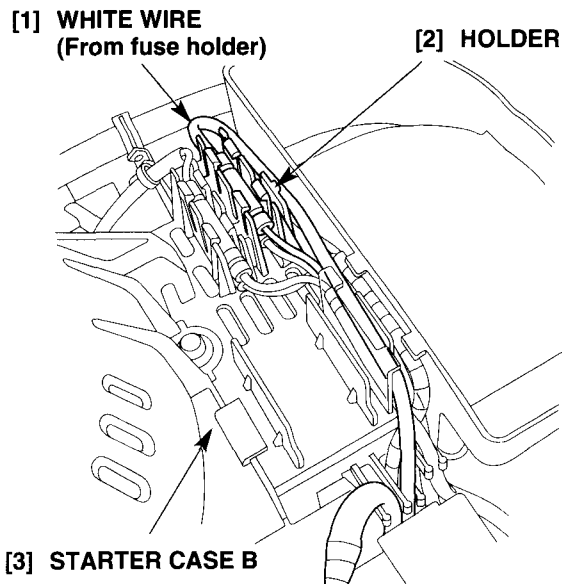


c. INSTALLATION

- 1) Install the oil case grommet to the starter cable and align the inside of the grommet with the white tape on the starter cable, and install them onto the oil case.
- 2) Secure the starter cable with the wire band clip and install the starter cable bracket by aligning the cutout with the boss on the oil case and tighten the 6 x 14 mm flange bolt securely.
- 3) Route the starter cable.
- 4) Tighten the ground terminal to the cylinder block using the 6 x 12 mm flange bolt.
- 5) Connect the starter cable to the starter magnetic switch and adjust the terminal direction so that the starter cable contacts to the clamp bracket on the starter magnetic switch body as shown.
- 6) Tighten the self-locking nut to the specified torque.
TORQUE: 5.5 N•m (0.55 kgf m, 4.0 lbf ft)
- 7) Secure the starter cable and control box wire harness (Remote control type only) with the cable band on the starter magnetic switch.



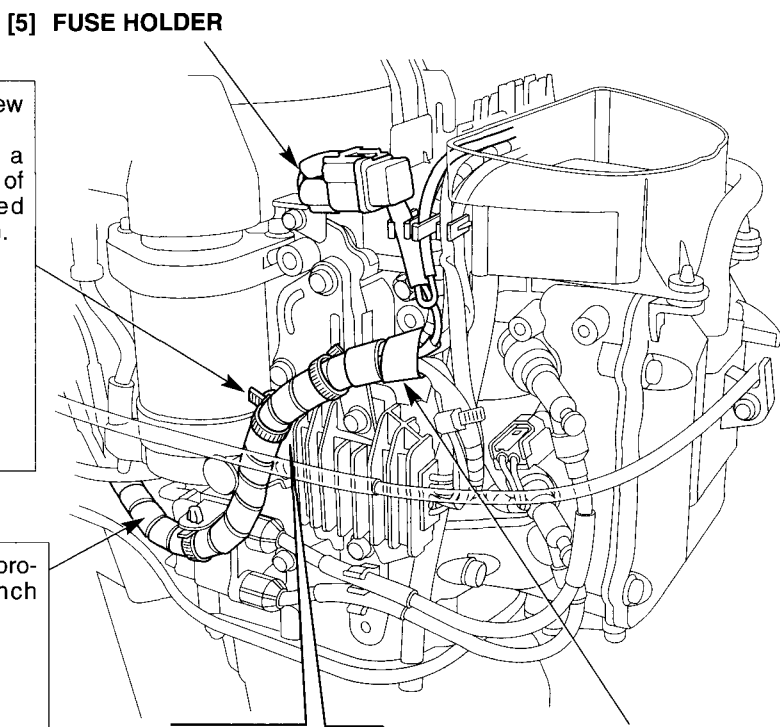
- 8) Connect the white wire connectors and set them to the connector holder on the starter case B.
 - Refer to page 3-31 (Tiller handle type) or 3-33 (Remote control type) for wire and connector locations.
- 9) See the fuse holder to the fuse holder bracket.
- 10) Route the charge wire (fuse line) along the main wire harness as shown and wrap the wires with the spiral protectors. Secure the them with the wire band clips.
- 11) Reinstall the removed parts in the reverse order of removal.



[4] WIRE BAND CLIP (3)

- Replace the wire band with new one, if it has been cut.
- After securing the wires with a new wire band, cut the end of the wire band as projected length is about 15 mm (0.6 in).

15 mm (0.6 in)



[9] SPIRAL PROTECTOR (LOWER)

Wrap the wires with the spiral protector starting from the branch point of the main harness.

[9]-1 MAIN WIRE HARNESS

[9]-2 SPIRAL PROTECTOR

[6] SPIRAL PROTECTOR (UPPER)

The starting point of winding must be 5 - 20 mm (0.2 - 0.8 in) away from the lower spiral protector.

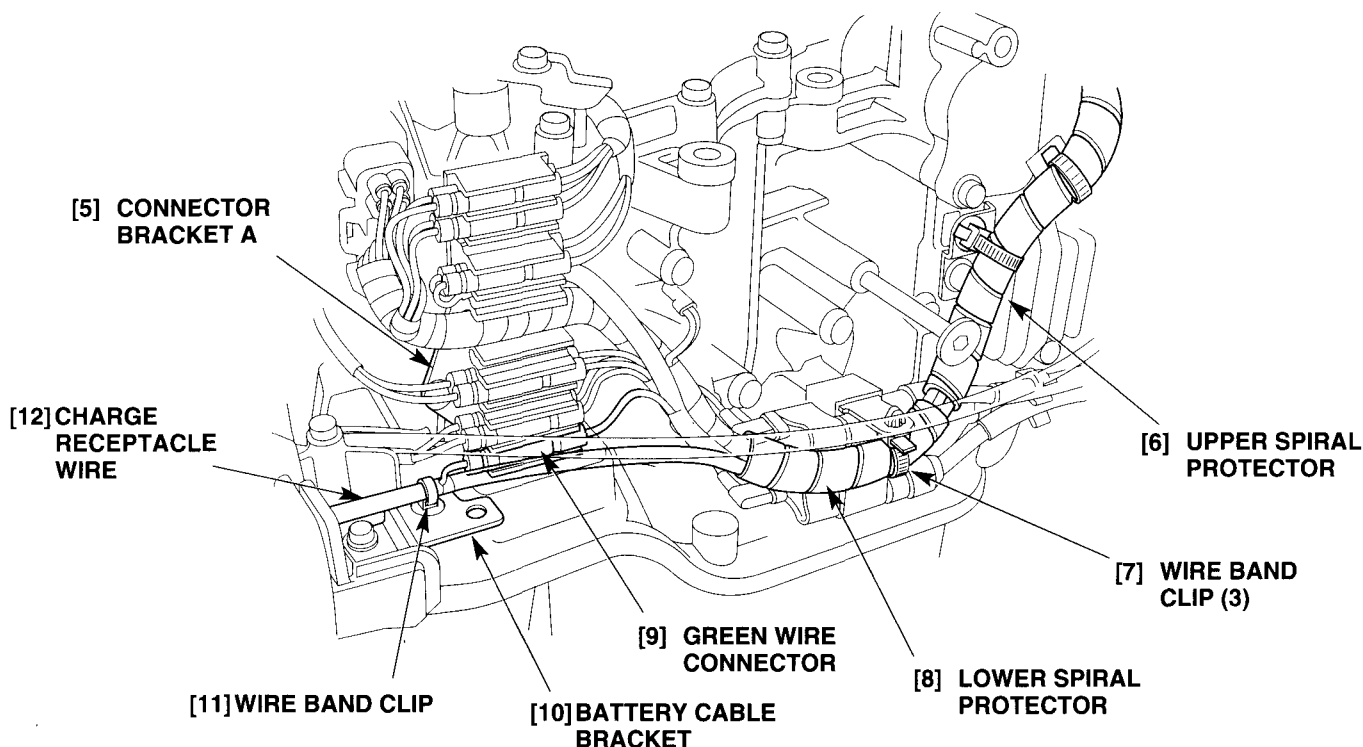
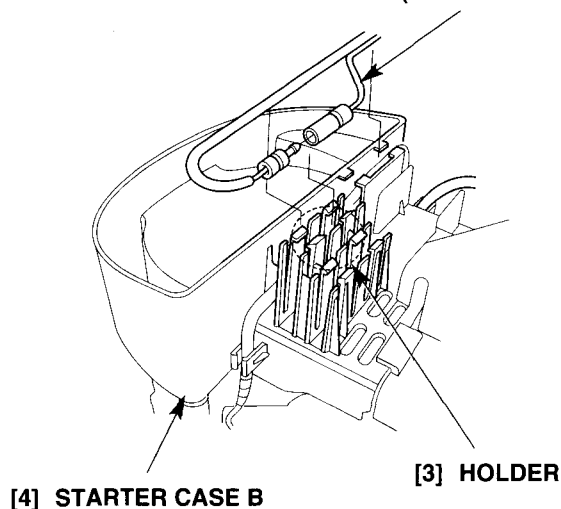
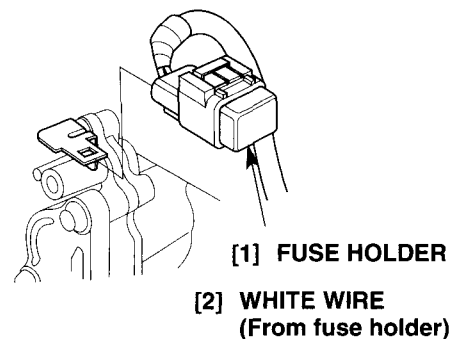
[7] Make sure that there is clearance between the wire harness and engine side stopper.

3. CHARGE RECEPTACLE WIRE

(Type with 6A charge coil)

a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
- 2) Remove the fuse holder from the fuse holder bracket.
- 3) Pull off the white wire (main fuse line) connectors from the holder on the starter case B, and disconnect them.
- 4) Open the three wire bands and remove the spiral protectors.
- 5) Pull off the white wire connector from the connector bracket A and disconnect the connector.
- 6) Open the wire band clip on the battery cable bracket



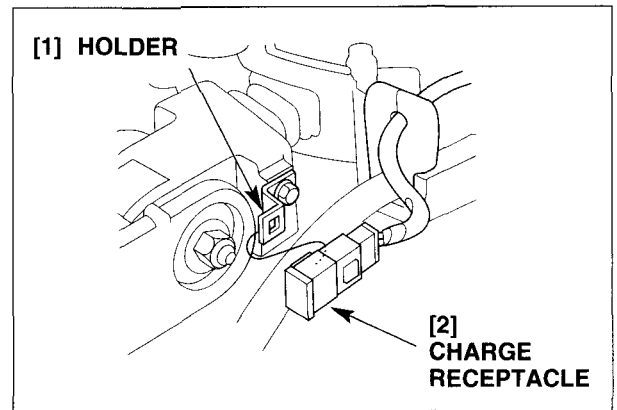
- 8) Remove the charge receptacle from the holder at the tiller handle and remove the charge receptacle wire.

b. INSPECTION

- Before inspection or replacement, disconnect the battery cable from the battery.

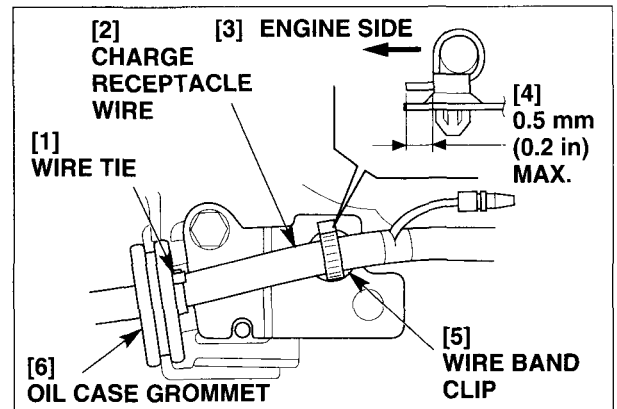
• FUSE AND FUSE HOLDER

See page 16-14 for inspection of the fuse and fuse holder.

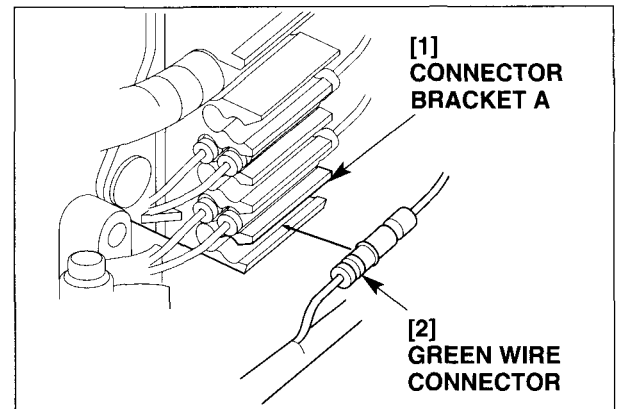


c. INSTALLATION

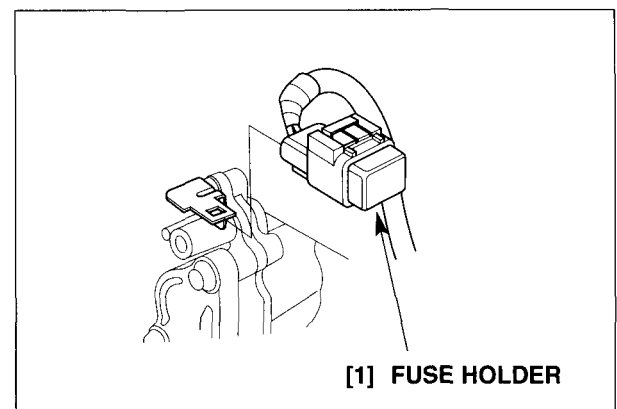
- 1) Install the oil case grommet to the charge receptacle wire and align the inside of the grommet with the wire tie on the wire, and install them onto the oil case.
- 2) Secure the charge receptacle wire with the wire band clip



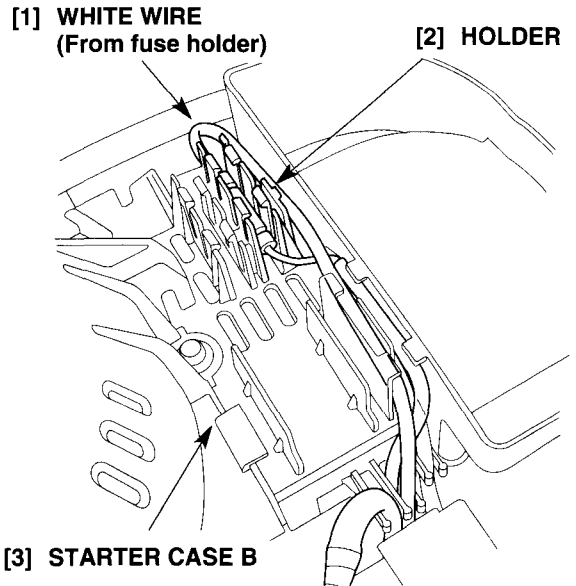
- 3) Route the charge receptacle wire along the main wire harness
- 4) Connect the green wire connectors and set them to the connector bracket A.



- 5) Set the fuse holder to the fuse holder bracket and secure the wires as shown.



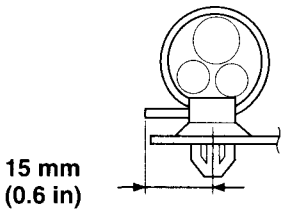
- 6) Connect the white wire connectors and set them to the connector holder on the starter case B.
- 7) Route the charge receptacle wire as shown and wrap the wires with the spiral protectors, then secure them with the wire band clips.



[5] FUSE HOLDER

[4] WIRE BAND CLIP (3)

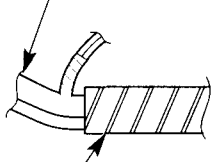
- Replace the wire band with new one, if it has been cut.
- After securing the wires with a new wire band, cut the end of the wire band as projected length is about 15 mm (0.6 in).



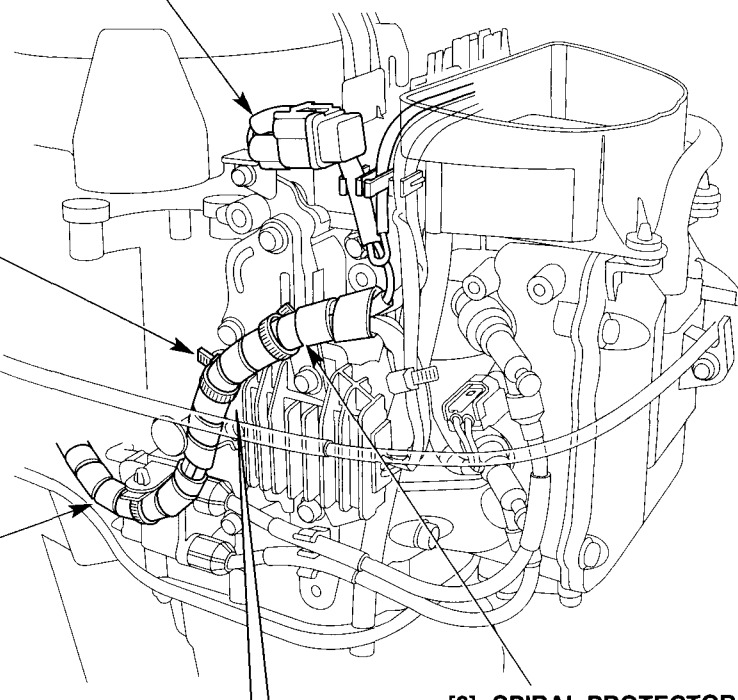
[9] SPIRAL PROTECTOR (LOWER)

Wrap the main wire harness and charge wire starting at the sprit point of the main wire harness as shown.

[9]-1 MAIN WIRE HARNESS



[9]-2 SPIRAL PROTECTOR



[6] SPIRAL PROTECTOR (UPPER)

The starting point of winding must be 5 - 20 mm (0.2 - 0.8 in) away from the lower spiral protector.

- [7] Make sure that there is clearance between the wire harness and engine side stopper.

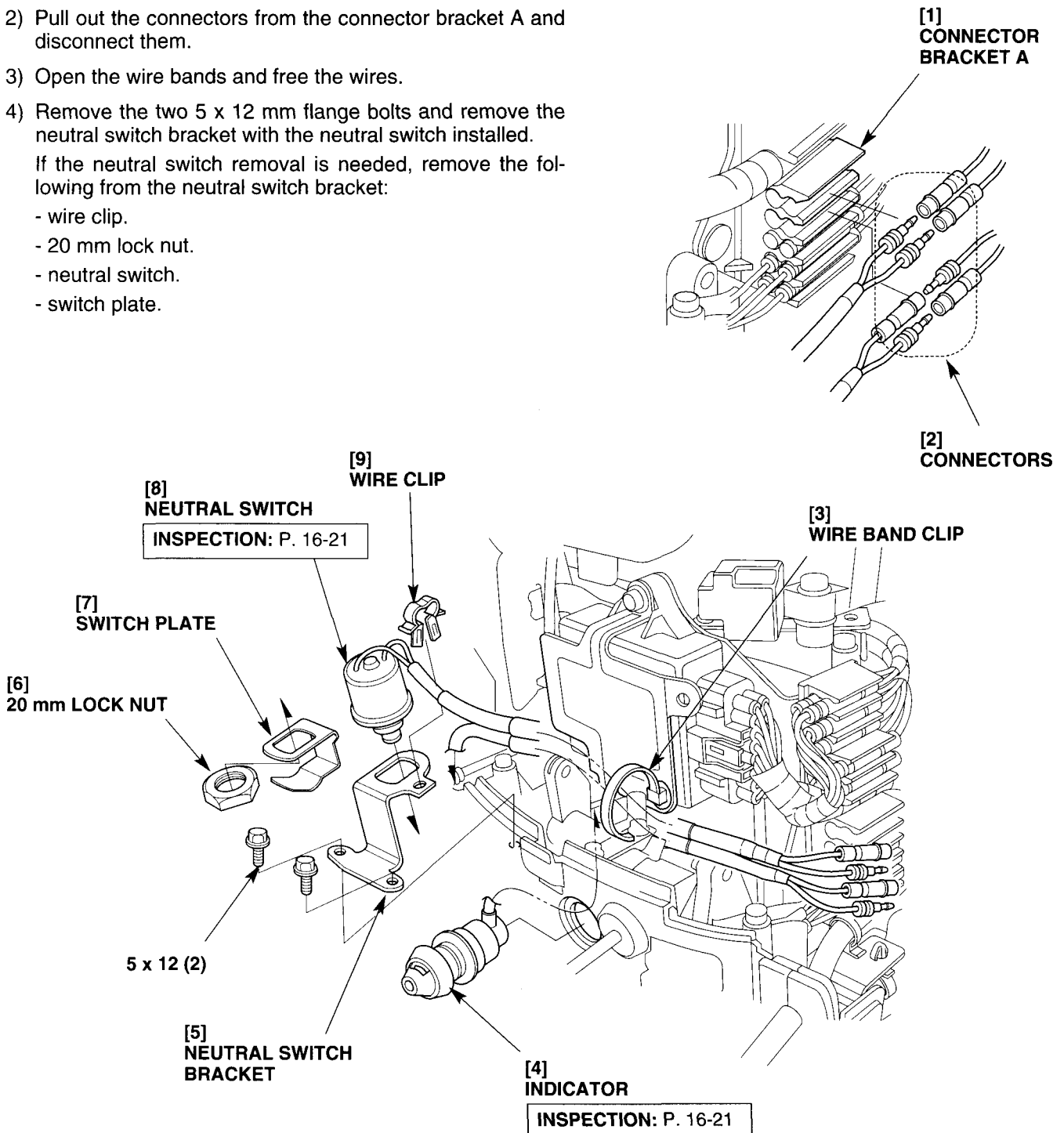
4. NEUTRAL SWITCH/INDICATOR

a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
 - neutral start cable (P. 7-1).
 - recoil starter (P. 7-2).
 - silencer cover (P. 8-1).
- 2) Pull out the connectors from the connector bracket A and disconnect them.
- 3) Open the wire bands and free the wires.
- 4) Remove the two 5 x 12 mm flange bolts and remove the neutral switch bracket with the neutral switch installed.

If the neutral switch removal is needed, remove the following from the neutral switch bracket:

 - wire clip.
 - 20 mm lock nut.
 - neutral switch.
 - switch plate.



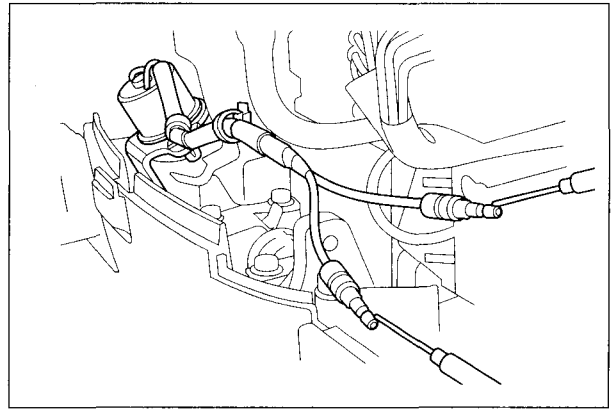
b. INSPECTION

• **NEUTRAL SWITCH (Type with electric starter)**

Check for continuity between the terminals.

There should be continuity with the switch pushed (gearshift in NEUTRAL).

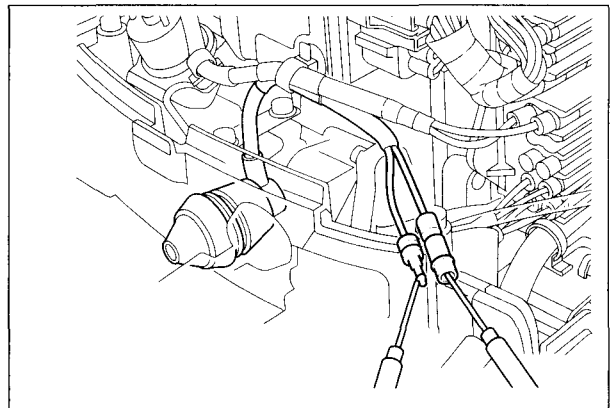
There should be no continuity with the switch released (gearshift in FORWARD or REVERSE).



• **INDICATOR (Tiller handle type)**

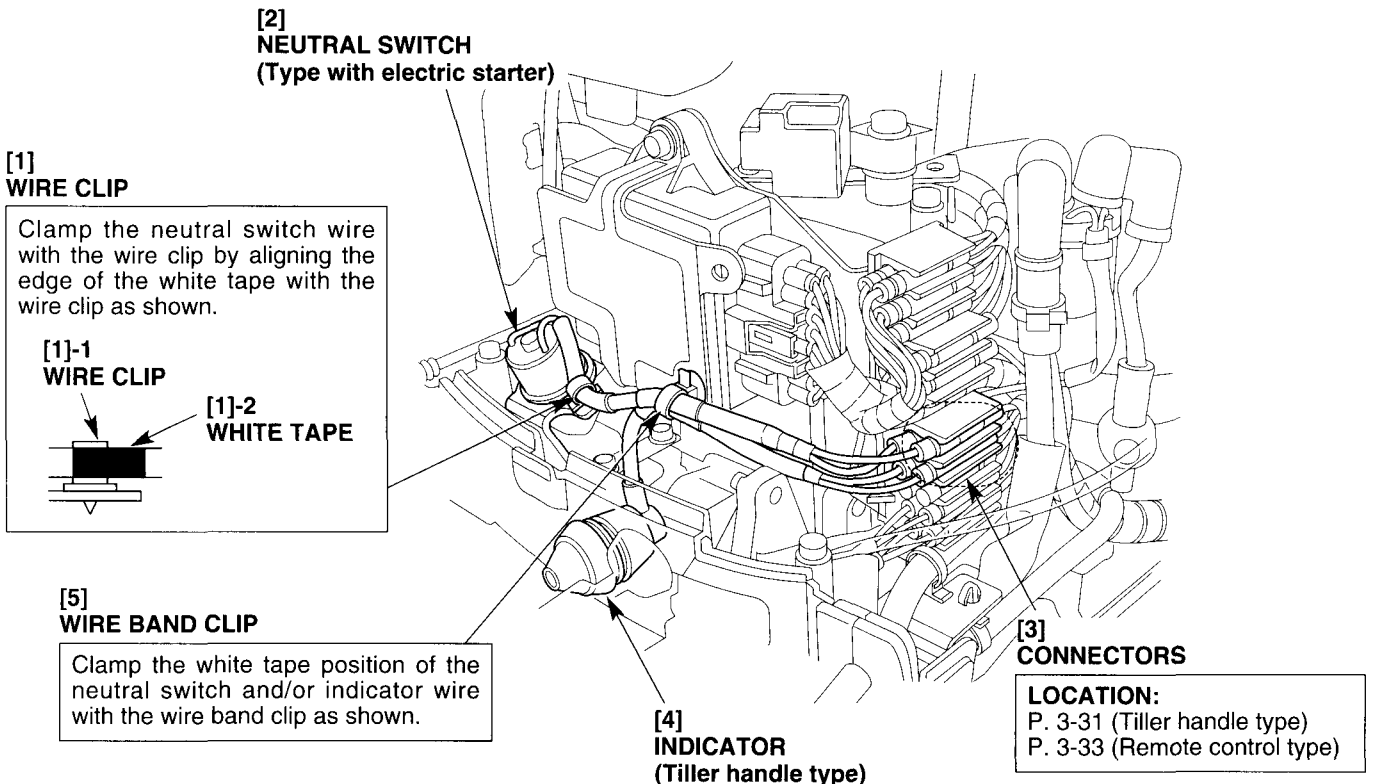
The indicator should turn on when connecting a 12V battery (+) terminal to the Orange terminal and (-) to the Black terminal.

• Be sure the battery is in good condition before performing the test



c. INSTALLATION

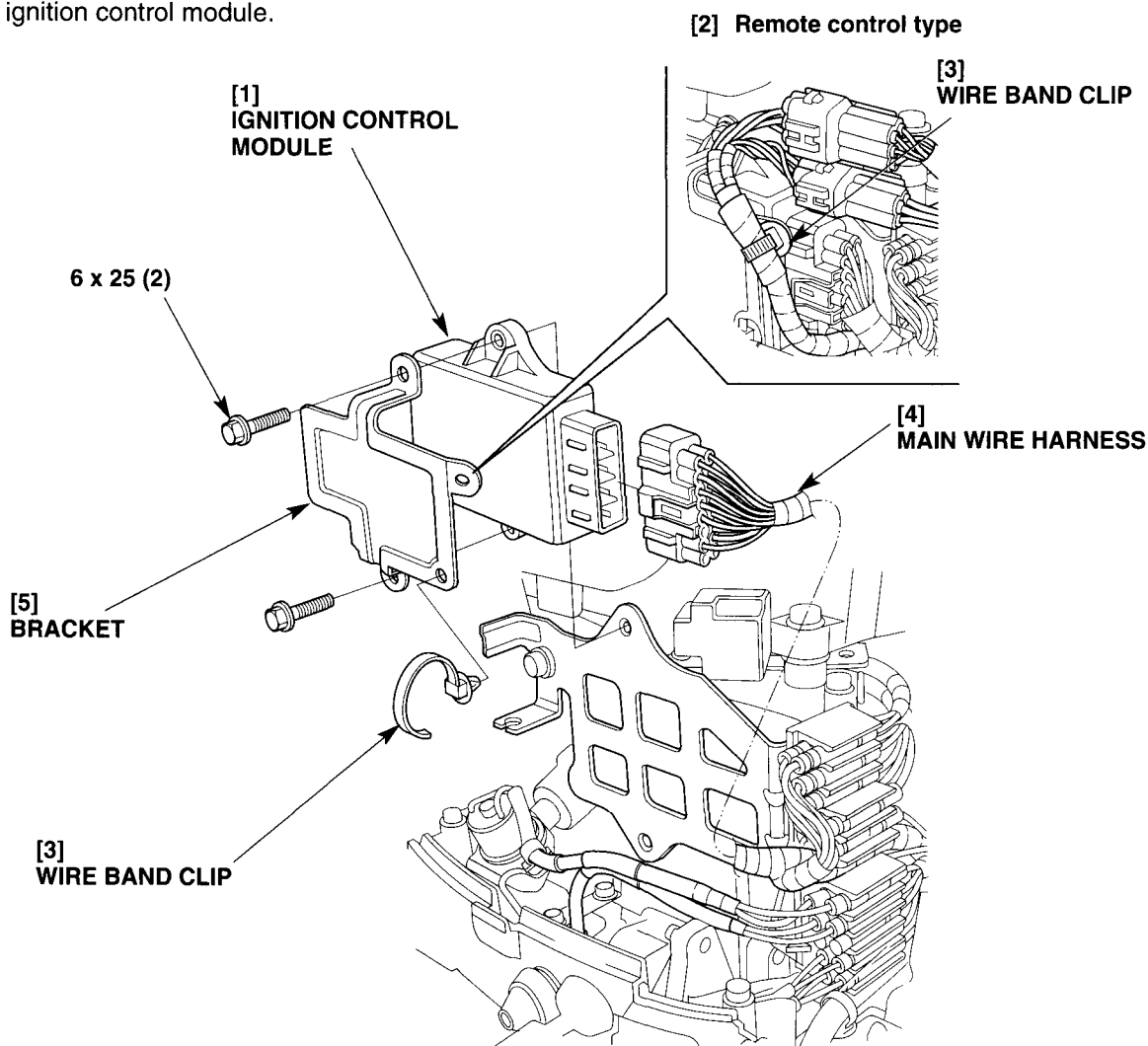
Installation procedure is the reverse order of removal.



5. IGNITION CONTROL MODULE

a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
 - neutral start cable (P. 7-1).
 - recoil starter (P. 7-2).
 - silencer cover (P. 8-1).
- 2) Open the wire band clip and free the neutral switch wire (Type with electric starter) and/or indicator wire (Tiller handle type).
- 3) Remote control type only: Open the wire band clip and free the main wire harness (connected to the control box wire harness).
- 4) Disconnect the engine control module connector.
- 5) Remove the two 6 x 25 mm flange bolts, and remove the bracket and ignition control module.

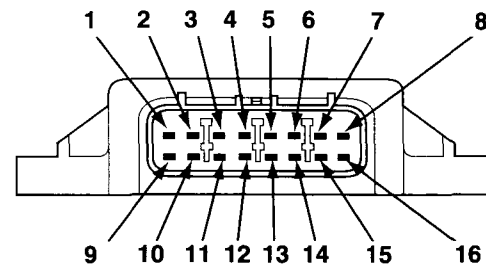


b. INSPECTION

Measure the resistance between the terminals and be sure that the measurements conform to the ranges shown in the table on next page.

- Use a tester that is equivalent to or higher than the performance specified;
Internal resistance: 20 k Ω/VDC, 9 k Ω/VAC
- Be careful not to touch the metallic part of the tester probe with your body, otherwise correct resistance value cannot be obtained

- Read the tester manufacturer's operation instructions carefully before operation with a tester. Follow the instructions of the Service Manual. Be sure the tester's battery is fully charged and check the meter before using the tester.
- Use a R x 1 scale of an commercially available multimeter, and meter shows current flow from negative (-) to positive (+). The meter shows current flowing one way and not other the diode is good.

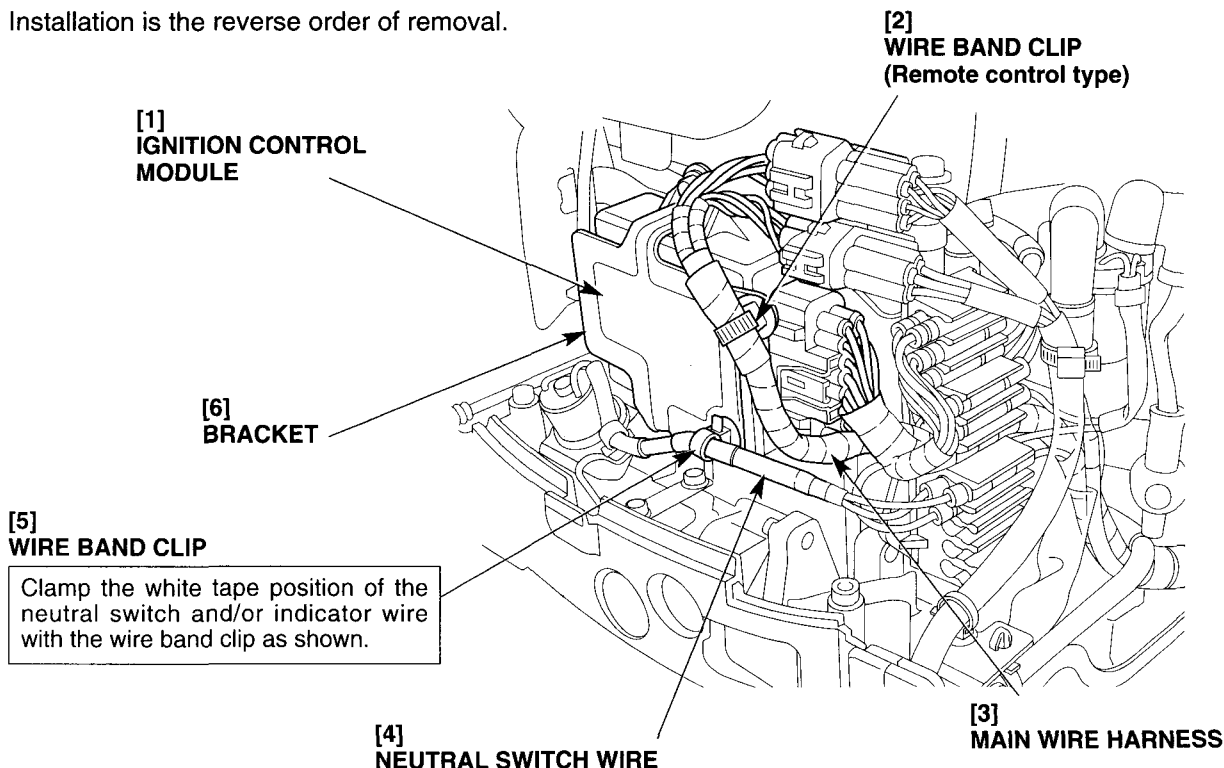


Unit: kΩ

		[1] Tester probe (+) (RED)															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
[2] Tester probe (-) (BLACK)	1	∞	∞	100 - 500	12 - 50	6 - 24	12 - 50	22 - 90	70 - 300	6 - 24	13 - 60	13 - 60	100 - 400	25 - 100	6 - 24	10 - 40	
	2	30 - 150	∞	400 - ∞	100 - 400	60 - 300	70 - 300	150 - ∞	150 - ∞	60 - 300	100 - 500	100 - 500	400 - ∞	100 - 1,000	60 - 300	70 - 300	
	3	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
	4	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
	5	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
	6	12 - 50	∞	∞	15 - 60	1.7 - 6.8	4.4 - 18	7.5 - 30	45 - 200	0	2 - 9	2.2 - 9.5	8.5 - 34	8.5 - 34	0	2 - 8	
	7	22 - 90	∞	∞	27 - 110	7.5 - 30	4.4 - 18	14 - 60	50 - 200	4.5 - 18	8 - 34	8.5 - 32	15 - 60	15 - 60	4.4 - 18	7 - 28	
	8	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
	9	30 - 150	∞	∞	40 - 200	5 - 20	2 - 8	8 - 32	17 - 70	4.2 - 17	6.5 - 26	6.5 - 26	16 - 70	15 - 60	2 - 8	5 - 20	
	10	11 - 44	∞	∞	15 - 60	1.7 - 7	0	4.4 - 18	7.5 - 30	45 - 200	2.2 - 9	2.4 - 10	8.5 - 34	8.5 - 34	0	1.8 - 8	
	11	50 - 200	∞	∞	70 - 300	15 - 60	6 - 24	13 - 60	8 - 32	70 - 300	6 - 24	15 - 60	70 - 300	7.5 - 30	6 - 24	10 - 40	
	12	50 - 200	∞	∞	70 - 300	13 - 60	6.5 - 28	13 - 60	8 - 32	70 - 300	6 - 24	15 - 60	70 - 300	7.5 - 30	6 - 24	10 - 40	
	13	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
	14	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
	15	11 - 44	∞	∞	15 - 60	1.7 - 7	0	4.4 - 18	7.5 - 30	45 - 200	0	2.2 - 9.5	2.2 - 9	15 - 60	8 - 32	1.8 - 8	
	16	17 - 70	∞	∞	20 - 80	5 - 20	2.6 - 11	7 - 28	11 - 45	45 - 200	2.6 - 11	5.5 - 22	5.5 - 22	20 - 80	12 - 50	2.6 - 11	

c. INSTALLATION

Installation is the reverse order of removal.

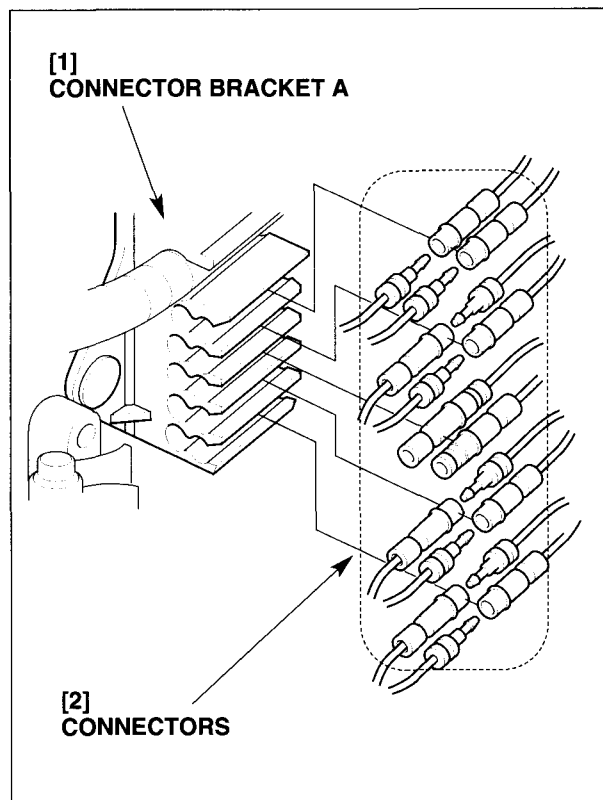


6. CONNECTOR BRACKET A

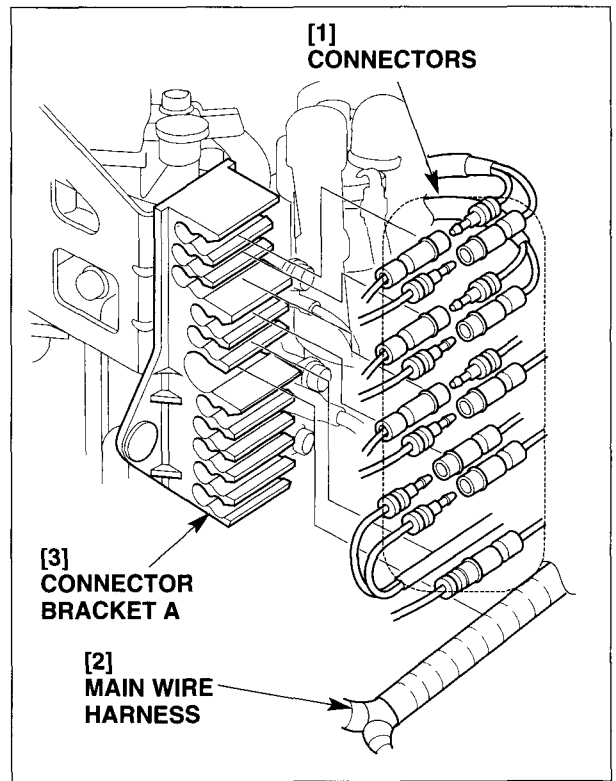
a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
 - neutral start cable (P. 7-1).
 - recoil starter (P. 7-2).
 - ignition control module (P. 16-22).

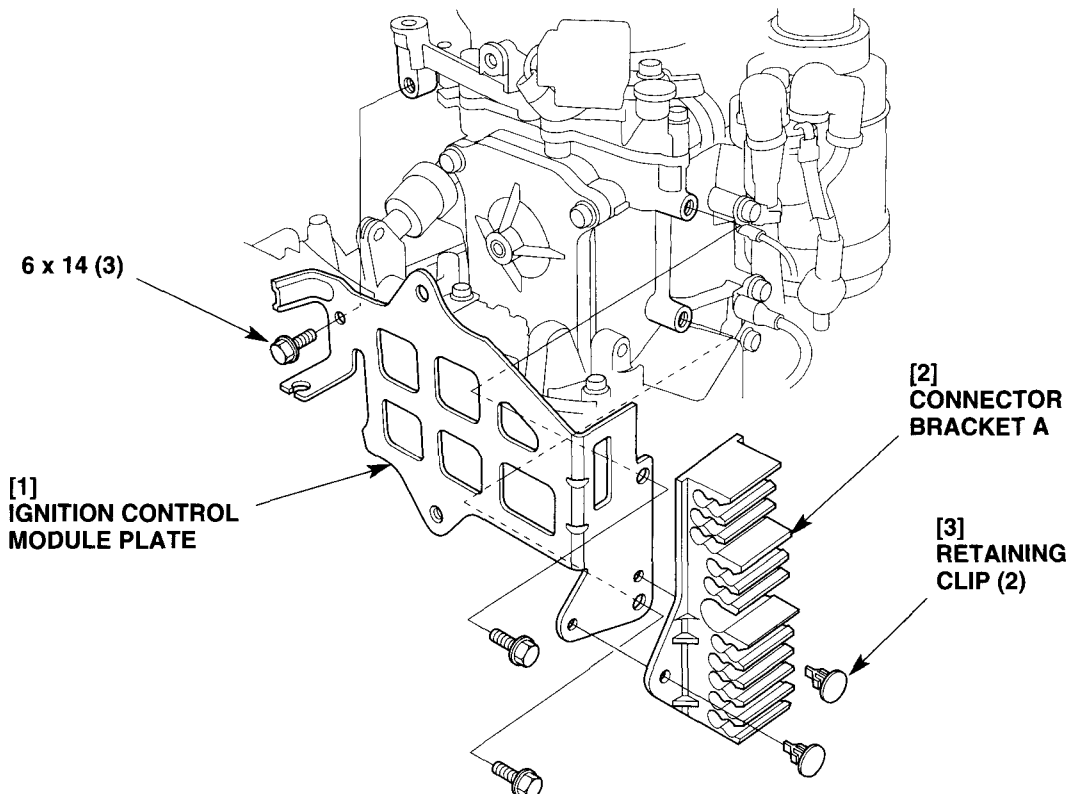
 - 2) Pull out the following connectors and wires from the connector bracket A, and disconnect the connectors.
 - Remote control type:
 - neutral switch wire (Type with electric starter).
 - regulator/rectifier wire.
 - Tiller handle type:
 - tachometer pulse (Type with electric starter)
 - neutral switch wire (Type with electric starter).
 - starter switch wire (Type with electric starter).
 - emergency stop witch wire.
 - indicator wire.
- Refer to page 3-31 (Tiller handle type) or 3-33 (Remote control type) for connector location.



- 3) Pull out the following connectors and wires from the connector bracket A, and disconnect the connectors.
- charge coil wire.
 - exciter coil wire.
 - SE thermal valve heater wire (Type with electric starter).
 - regulator/rectifier wire.
 - main wire harness.
 - starter magnetic switch wire (Type with electric starter).
- Refer to page 3-31 (Tiller handle type) or 3-33 (Remote control type) for connector location.



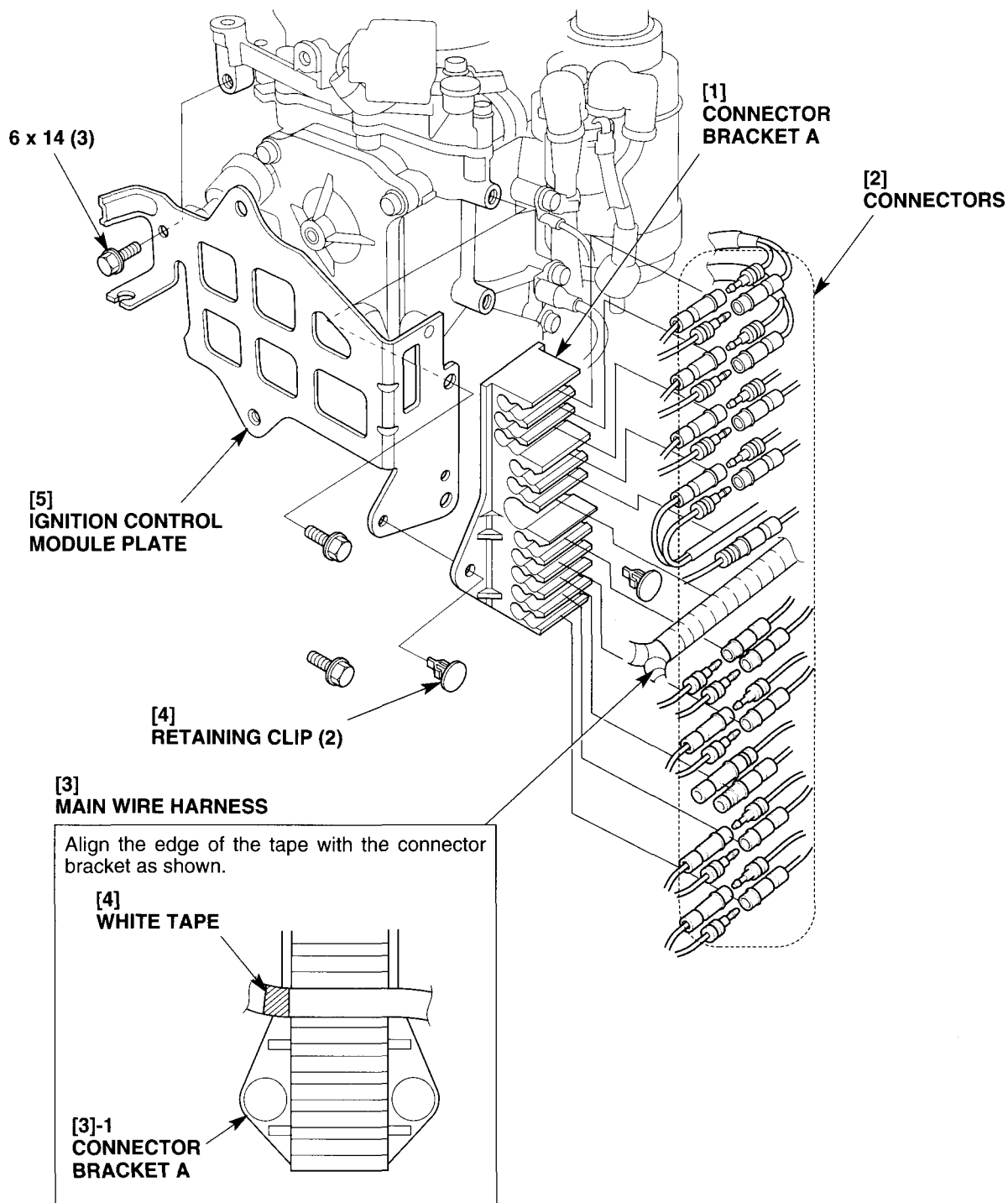
- 4) Remove the three 6 x 14 mm flange bolts and ignition control module plate with the connector bracket A attached.
- 5) Remove the retaining clip and connector bracket.



b. INSTALLATION

Installation is the reverse order of removal.

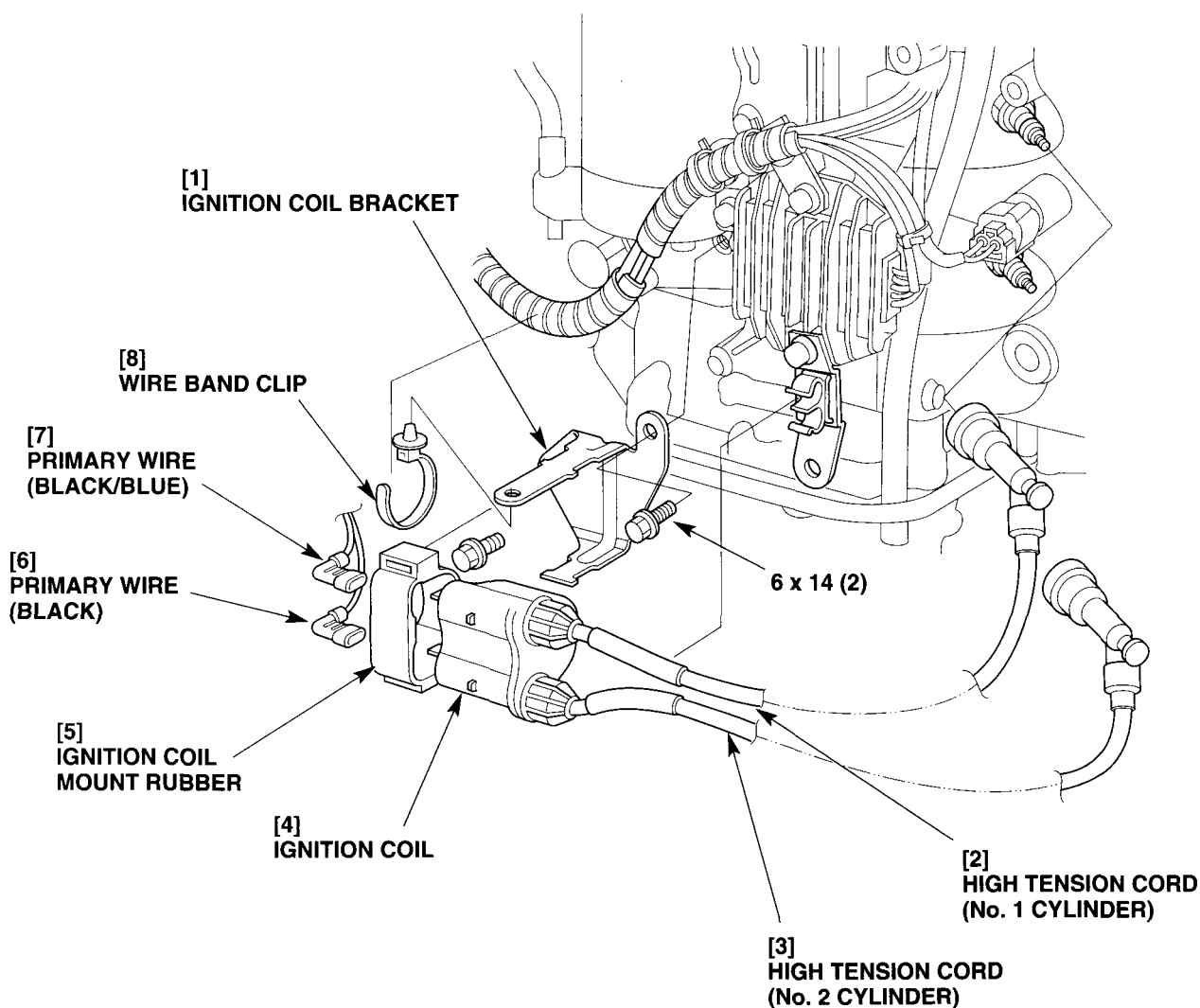
- Refer to page 3-31 (Tiller handle type) or 3-33 Remote control type) for connector location.



7. IGNITION COIL

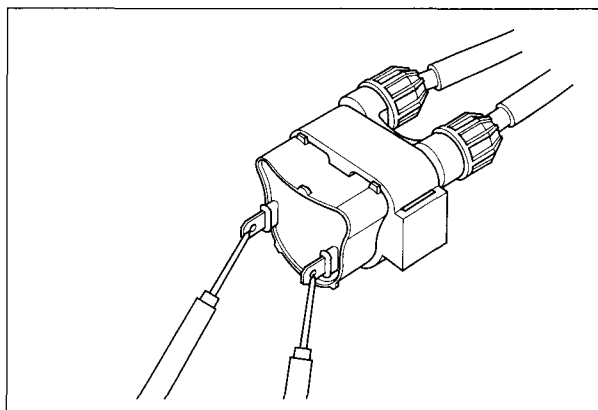
a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
- 2) Open the wire band clip and free the wires with the spiral protector attached.
- 3) Disconnect the spark plug caps from the spark plugs.
- 4) Disconnect the ignition coil primary wires from the ignition coil and remove the ignition coil.
- 5) Remove the 6 x 14 mm flange bolts and ignition coil bracket.



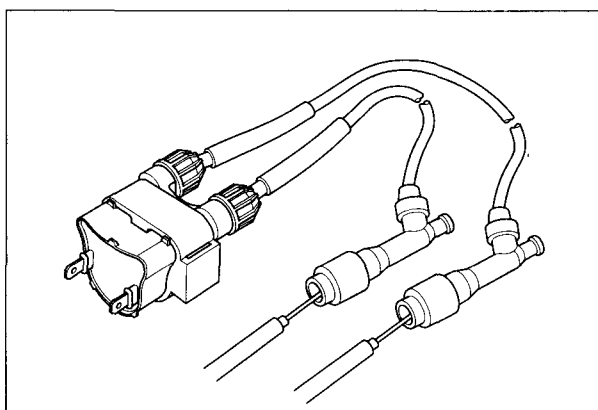
b. INSPECTION

- 1) Check the high tension cords for cracked or damaged insulation, replace if necessary.
- 2) Measure the resistance of the primary coil by touching ohmmeter leads to the ignition coil's primary terminals.



Standard resistance	0.8 - 1.0 Ω
---------------------	-------------

- 3) Measure the resistance of the secondary side of the coil by touching ohmmeter leads to the spark plug caps.

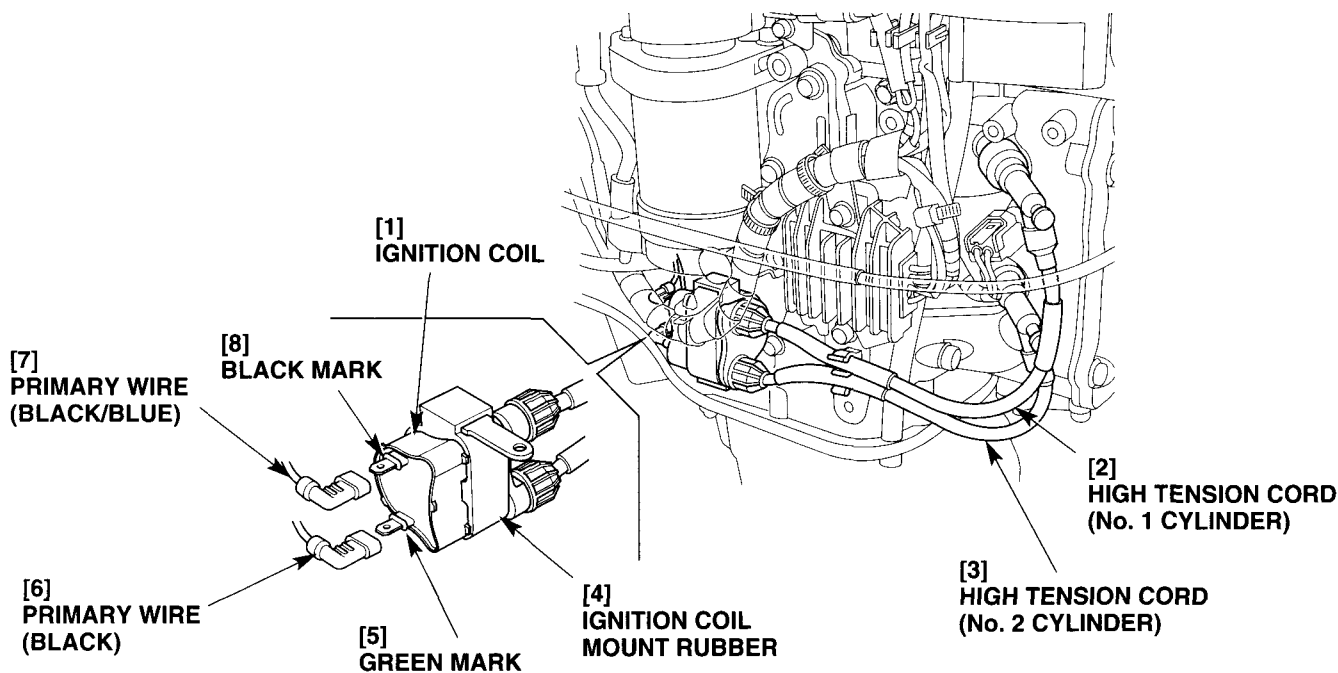


Standard resistance	23.0 - 34.8 k Ω
---------------------	-----------------

c. INSTALLATION

Installation is the reverse order of removal.

- Connect the ignition coil primary wires to the ignition coil terminal as shown.



8. REGULATOR/RECTIFIER

a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
- 2) Pull out the wires from the holder on the starter case B and disconnect the connectors.
- 3) Pull out the connectors from the connector bracket A and disconnect the connectors.

[1] Type with 12A charge coil

[2] Type with 6A charge coil

[3] REGULATOR/
RECTIFIER WIRE

[3] REGULATOR/
RECTIFIER WIRE

[4] HOLDER

[4] HOLDER

[5] STARTER CASE B

[5] STARTER CASE B

[6] REGULATOR/
RECTIFIER WIRE
(GRAY, GRAY)

[7] REGULATOR/
RECTIFIER WIRE

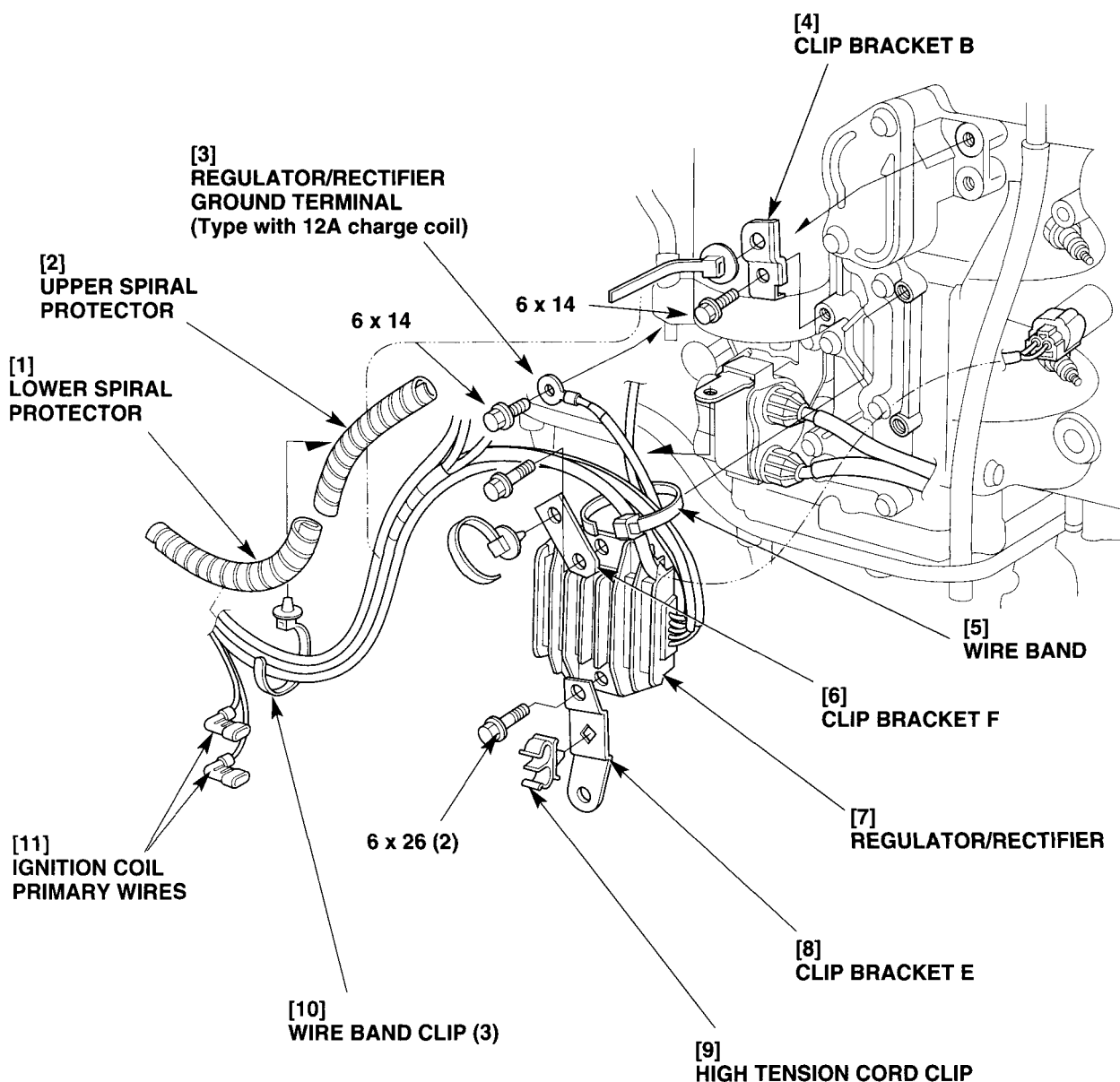
(Type with 6A charge coil: GREEN
Type with 12 A charge coil: WHITE/BLACK)

[8] REGULATOR/
RECTIFIER WIRE
(WHITE/BLACK)

[10] CONNECTOR
BRACKET A

[9] Remote control type

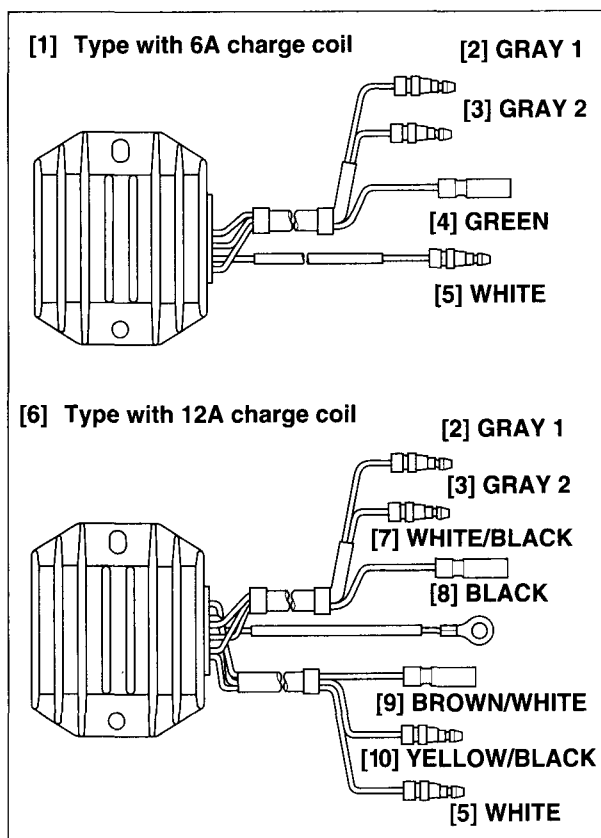
- 4) Open the three wire band clips and wire band, and free the wires.
- 5) Remove the upper and lower spiral protectors from the wires.
- 6) Pull off the high tension cords from the high tension cord clip.
- 7) Remove the two 6 x 26 mm flange bolts and regulator/rectifier.



b. INSPECTION

Measure the resistance between the terminals and be sure that the measurements conform to the ranges shown in the table below.

- Use a tester that is equivalent to or higher than the performance specified;
Internal resistance: 20 k Ω/VDC, 9 k Ω/VAC
- Be careful not to touch the metallic part of the tester probe with your body, otherwise correct resistance value cannot be obtained
- Read the tester manufacturer's operation instructions carefully before operation with a tester. Follow the instructions of the Service Manual. Be sure the tester's battery is fully charged and check the meter before using the tester.
- Use a R x 1 scale of an commercially available multimeter, and meter shows current flow from negative (-) to positive (+). The meter shows current flowing one way and not other the diode is good.



• **Type with 6A charge coil**

Unit: k Ω

		[1] Tester probe (+)			
		[2] Gray 1	[3] Gray 2	[4] White	[5] Green
[6] Tester probe (-)	[2] Gray 1	∞	∞	∞	∞
	[3] Gray 2	∞	∞	∞	∞
	[4] White	2 - 40	2 - 40	1 - 20	1 - 20
	[5] Green	0.5 - 10	0.5 - 10	1 - 20	1 - 20

• **Type with 12A charge coil**

Unit: k Ω

		[1] Tester probe(+)						
		[2] Gray 1	[3] Gray2	[4] White	[5] White/black	[6] Black	[7] Yellow/black	[8] Brown/white
[9] Tester probe (-)	[2] Gray 1	∞	∞	∞	∞	∞	∞	∞
	[3] Gray 2	∞	∞	∞	∞	∞	∞	∞
	[4] White	2 - 40	2 - 40	0	1 - 20	∞	∞	∞
	[5] White/black	2 - 40	2 - 40	0	1 - 20	∞	∞	∞
	[6] Black	0.5 - 10	0.5 - 10	1 - 20	1 - 20	∞	∞	∞
	[7] Yellow/black	∞	∞	∞	∞	∞	∞	0.5 - 10
	[8] Brown/white	∞	∞	∞	∞	∞	∞	∞

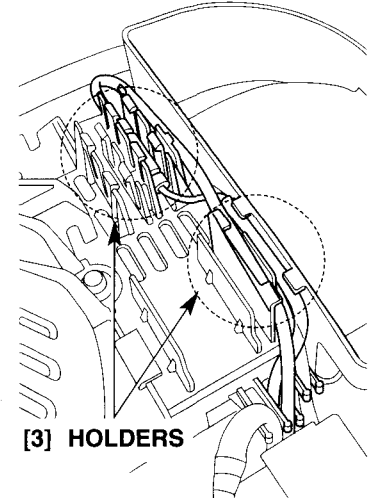
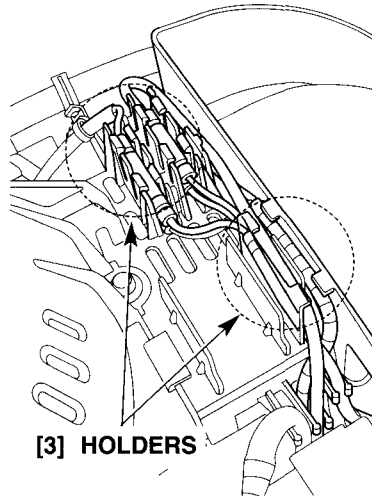
c. INSTALLATION

Installation is the reverse order of removal.

- Connect the connectors and set the connectors and wires to the holder on the starter case B. See page 2-36 for connector and wire locations.

[1] Type with 12A charge coil

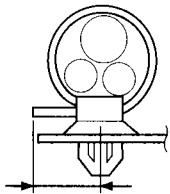
[2] Type with 6A charge coil



[8] WIRE BAND CLIP (3)

- Replace the wire band with new one, if it has been cut.
- After securing the wires with a new wire band, cut the end of the wire band as projected length is about 15 mm (0.6 in).

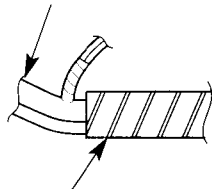
15 mm
(0.6 in)



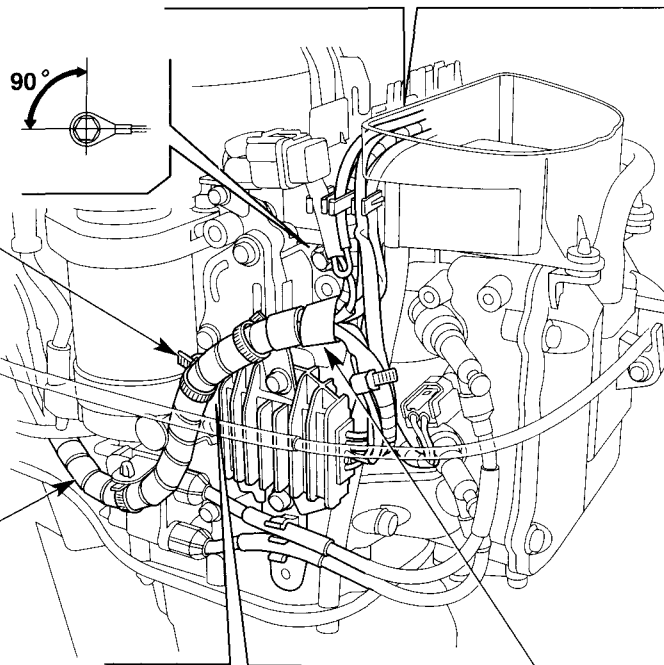
[7] SPIRAL PROTECTOR (LOWER)

Wrap the wires with the spiral protector starting from the branch point of the main harness.

[7]-1
MAIN WIRE HARNESS



[7]-2
SPIRAL PROTECTOR



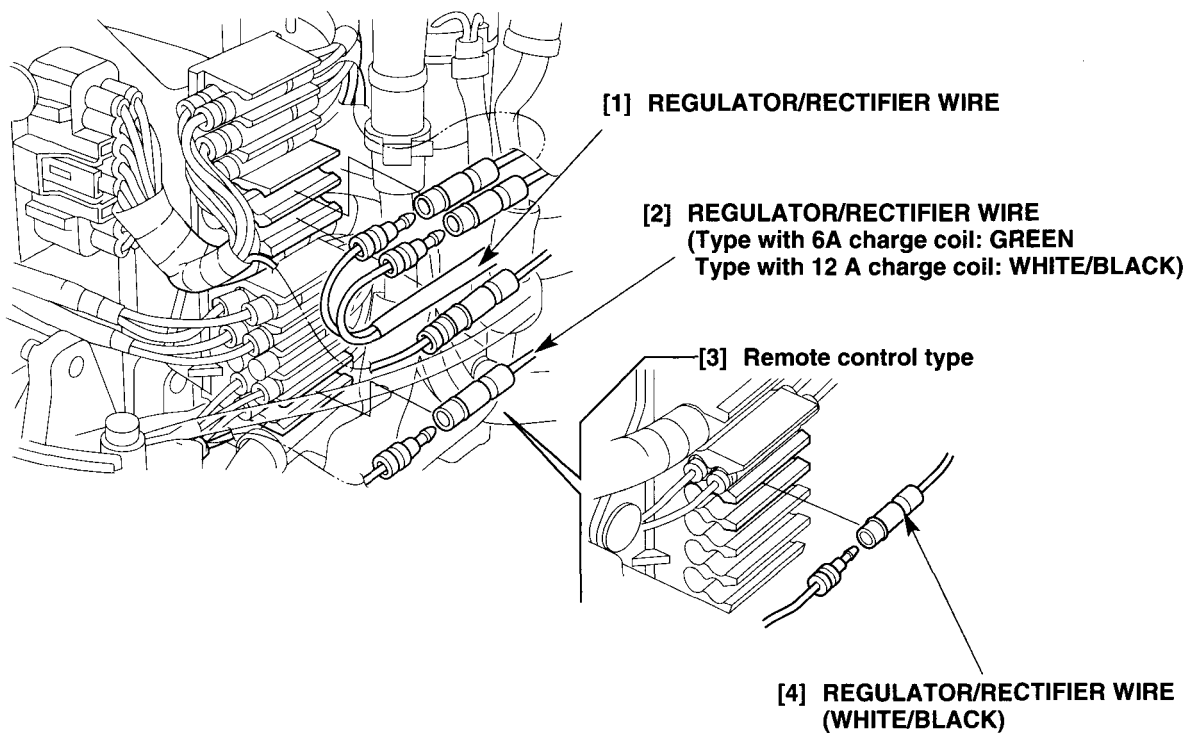
[4] SPIRAL PROTECTOR (UPPER)

The starting point of winding must be 5 - 20 mm (0.2 - 0.8 in) away from the lower spiral protector.

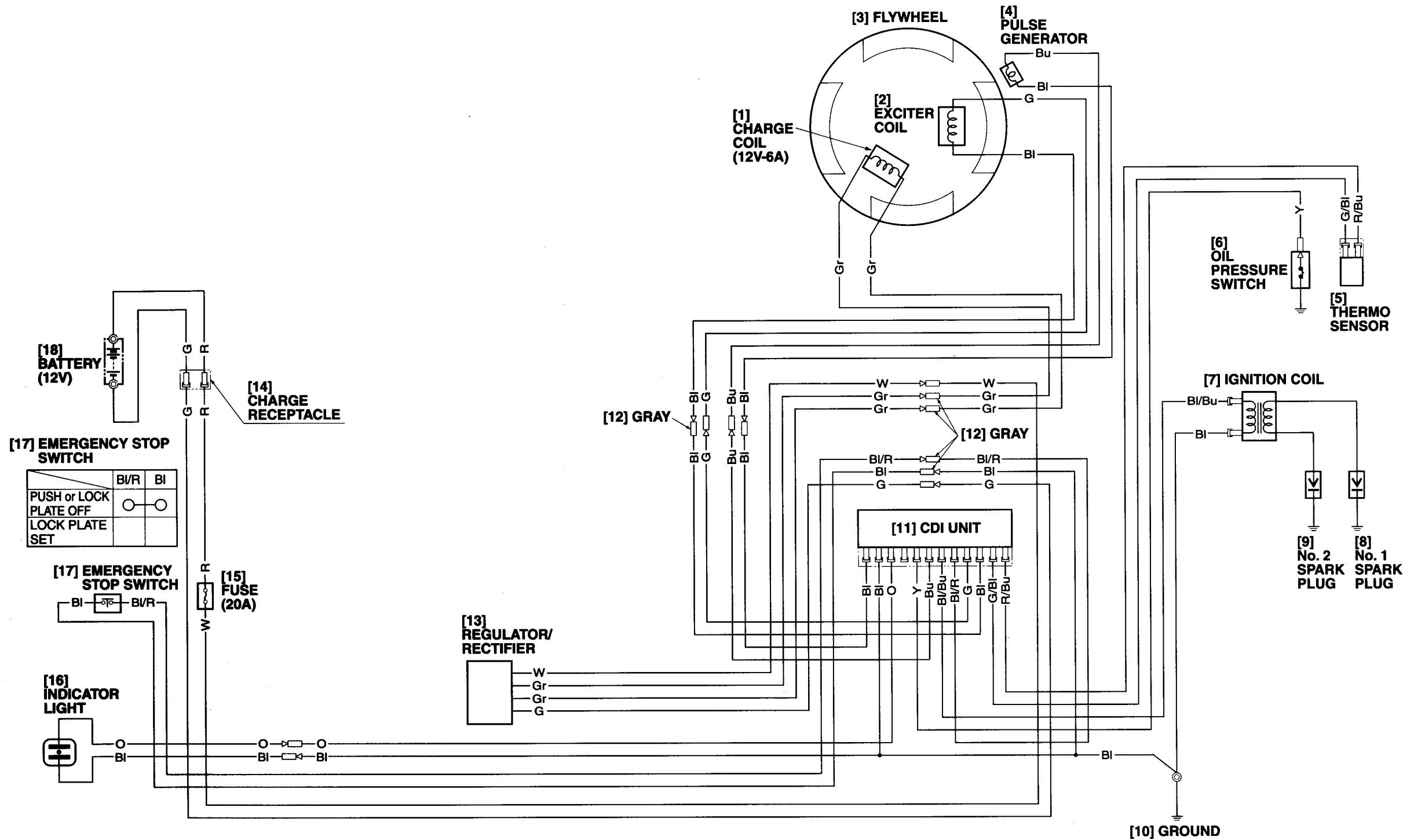
[6] ENGINE SIDE STOPPER

[5] Make sure that there is clearance between the wire harness and engine side stopper.

- Connect the connectors and set the connectors and wires to the connector bracket A. See page 2-31 (Tiller handle type) or 2-33 (Remote control type) for connector locations.

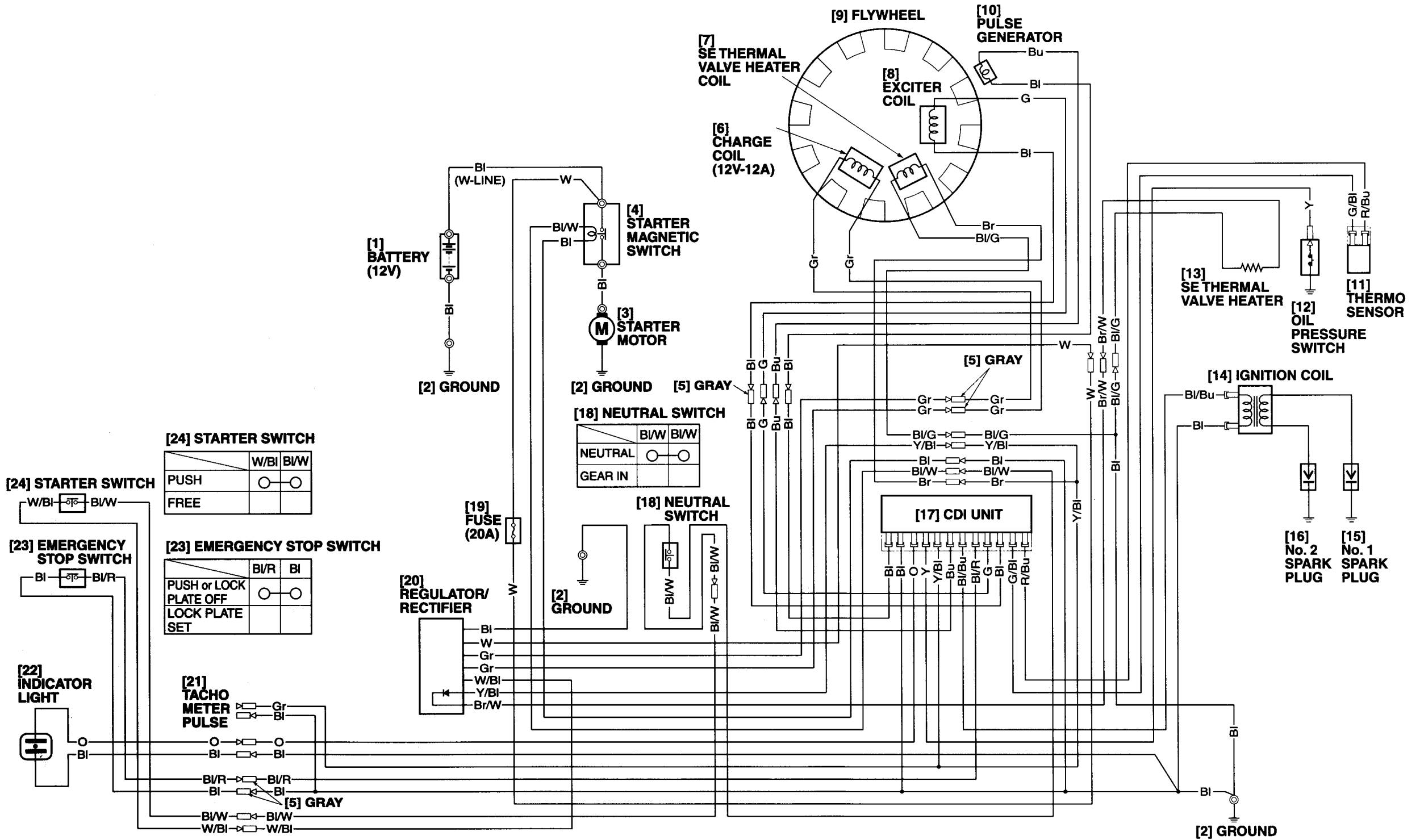


TILLER HANDLE TYPE (Type wit 6A charge coil)



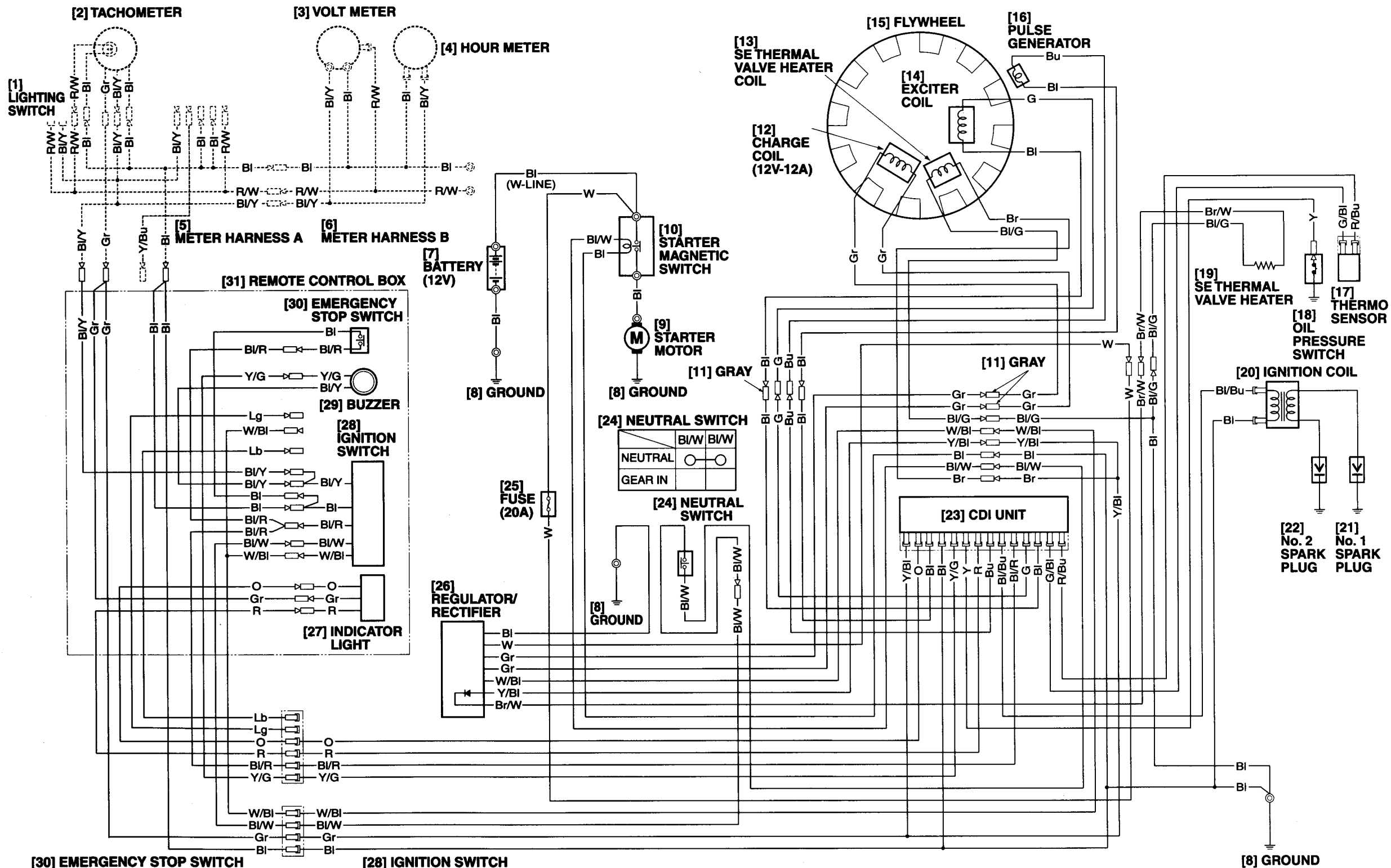
Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

TILLER HANDLE TYPE (Type wit 12A charge coil)



BI	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

REMOTE CONTROL TYPE



[30] EMERGENCY STOP SWITCH

	B/R	BI
PUSH or LOCK PLATE OFF	○	○
LOCK PLATE SET		

[28] IGNITION SWITCH

	E	IG	BAT	LOAD	ST
	BI	B/R	W/BI	BI/Y	BI/W
OFF	○	○			
ON			○	○	
START			○	○	○

BI	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

PREFACE

This manual covers the construction, function and servicing procedures of the Honda BF15D and BF20D, Outboard Motors. (Power tilt and Gas assisted tilt type)

For service information which is not covered in this supplement, please refer to the base shop manual, part number 66ZY000.

All information contained in this manual is based on the latest product information available at the time of printing. We reserve the right to make changes at any time without notice.


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As you read this manual, you will find information that is preceded by a **NOTICE** symbol. The purpose of this message is to help prevent damage to the outboard motor, other property, or the environment.

SAFETY MESSAGES

Your safety, and the safety of others, are very important. To help you make informed decisions, we have provided safety messages and other safety information throughout this manual. Of course, it is not practical or possible to warn you about all the hazards associated with servicing these outboard motors. You must use your own good judgment.

You will find important safety information in a variety of forms, including:

- **Safety Messages** – preceded by a safety alert  symbol and one of three signal words, DANGER, WARNING, or CAUTION.

These signal words mean:

▲ DANGER You WILL be KILLED or SERIOUSLY HURT if you don't follow instructions.

▲ WARNING You CAN be KILLED or SERIOUSLY HURT if you don't follow instructions.

▲ CAUTION You CAN be HURT if you don't follow instructions.

- **Instructions** – how to service this outboard motor correctly and safely.

Honda Motor Co., Ltd
Service Publication Office

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1. SPECIFICATIONS

BF15D•BF20D

1. SPECIFICATIONS	2. DIMENSIONAL DRAWINGS
-------------------	-------------------------

1. SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Model	BF15D					
Description Code	BALJ					
Type	SHG	SRT	LHG	LHT	LRT	XRT
Overall length	650 mm (25.6 in)	640 mm (25.2 in)			650 mm (25.6 in)	
Overall width	350 mm (13.8 in)					
Overall height	1,110 mm (43.7 in)		1,240 mm (48.8 in)			1,380 mm (54.3 in)
Dry weight (With propeller mounted)	57.0 kg (126 lb)	58.0 kg (128 lb)	58.5 kg (129 lb)	60.5 kg (133 lb)	59.5 kg (131 lb)	62.0 kg (137 lb)
Operating weight	58.4 kg (129 lb)	59.4 kg (131 lb)	59.9 kg (132 lb)	61.9 kg (136 lb)	60.9 kg (134 lb)	63.4 kg (140 lb)
Transom height	433 mm (17.0 in)		563 mm (22.2 in)			703 mm (27.7 in)
Transom angle	4 stage adjustment (8° , 12° , 16° , 20°)					
Tilting angle	68°					
Swivel angle	45° right and left					

Model	BF20D		
Description Code	BALJ		
Type	SHG	SHT	SRT
Overall length	650 mm (25.6 in)		640 mm (25.2 in)
Overall width	350 mm (13.8 in)		
Overall height	1,110 mm (43.7 in)		
Dry weight (With propeller mounted)	57.0 kg (126 lb)	58.5 kg (129 lb)	58.0 kg (128 lb)
Operating weight	58.4 kg (129 lb)	59.9 kg (132 lb)	59.4 kg (131 lb)
Transom height	433 mm (17.0 in)		
Transom angle	4 stage adjustment (8° , 12° , 16° , 20°)		
Tilting angle	68°		
Swivel angle	45° right and left		

Model	BF20D				
Description Code	BAMJ				
Type	LG	LHG	LHT	LRT	XRT
Overall length	650 mm (25.6 in)			640 mm (25.2 in)	
Overall width	350 mm (13.8 in)				
Overall height	1,240 mm (48.8 in)				1,380 mm (54.3 in)
Dry weight (With propeller mounted)	55.5 kg (122 lb)	58.5 kg (129 lb)	60.5 kg (133 lb)	59.5 kg (131 lb)	62.0 kg (136 lb)
Operating weight	56.9 kg (125 lb)	59.9 kg (132 lb)	61.9 kg (136 lb)	60.9 kg (134 lb)	63.4 kg (140 lb)
Transom height	563 mm (22.2 in)				703 mm (27.7 in)
Transom angle	4 stage adjustment (8° , 12° , 16° , 20°)				
Tilting angle	68°				
Swivel angle	45° right and left				

Types of Honda BF15D/BF20D Outboard Motors

It may be necessary to refer to this chart for reference purposes when reading this manual.

Model	Type	Shaft length	Tiller handle	Remote control	Electric starter	Recoil starter	Charge coil	Power tilt	Gas-assisted tilt	Starting enrichment system
BF15D	SHG	S	●		●	●	12A		●	Automatic
	SRT	S		●	●	●	12A	●		Automatic
	LHG	L	●		●	●	12A		●	Automatic
	LHT	L	●		●	●	12A	●		Automatic
	LRT	L		●	●	●	12A	●		Automatic
	XRT	UL		●	●	●	12A	●		Automatic
BF20D	LG	L	●			●	6 A		●	Manual
	SHG	S	●		●	●	12A		●	Automatic
	SHT	S	●		●	●	12A	●		Automatic
	SRT	S		●	●	●	12A	●		Automatic
	LHG	L	●		●	●	12A		●	Automatic
	LHT	L	●		●	●	12A	●		Automatic
	LRT	L		●	●	●	12A	●		Automatic
	XRT	UL		●	●	●	12A	●		Automatic

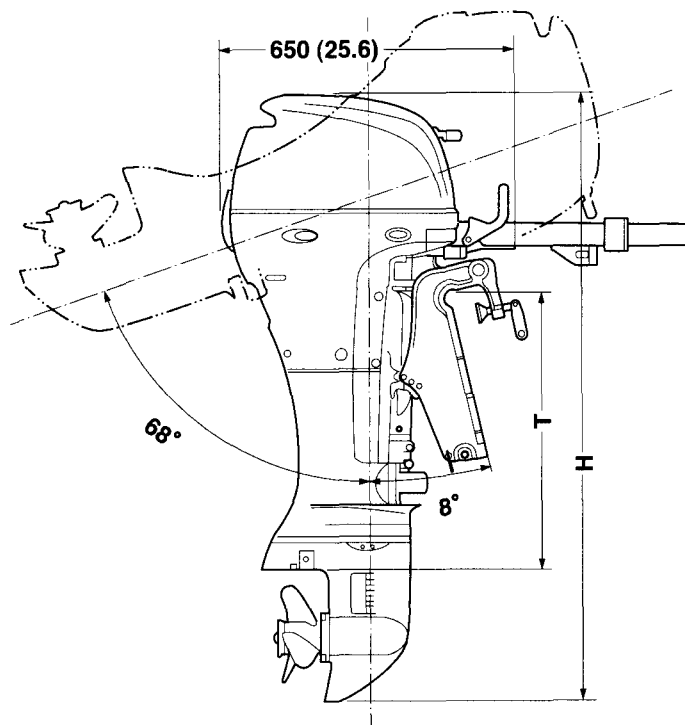
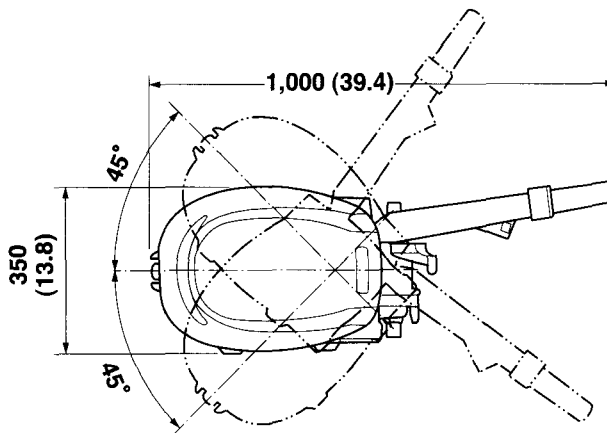
S: Short shaft L: Long shaft UL: Extra long shaft

2. DIMENSIONAL DRAWINGS

• Tiller Handle Type

Unit: mm (in)

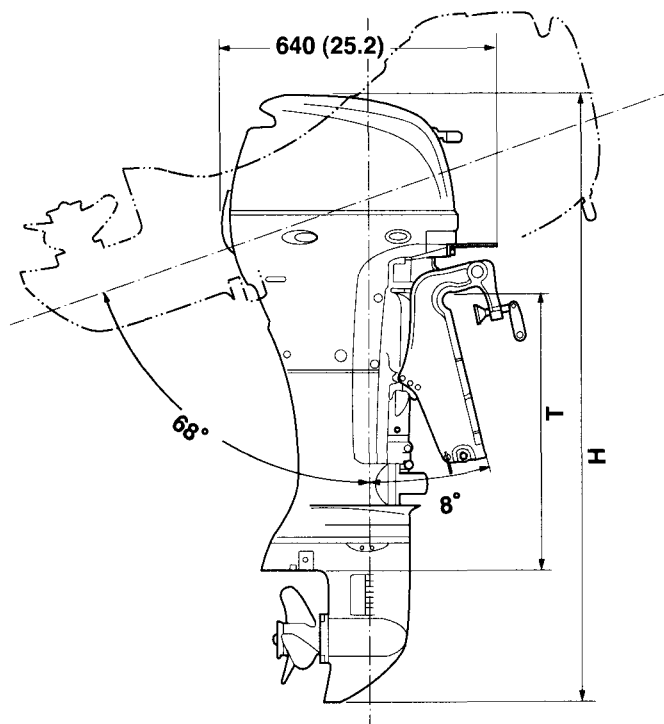
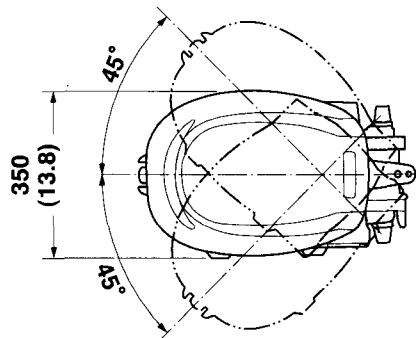
[1] Type	H	T
S	1,110 (43.7)	433 (17.0)
L	1,240 (48.8)	563 (22.2)
UL	1380 (54.3)	703 (27.7)



• Remote Control Type

Unit: mm (in)

[1] Type	H	T
S	1,110 (43.7)	433 (17.0)
L	1,240 (48.8)	563 (22.2)
UL	1380 (54.3)	703 (27.7)



1. TORQUE VALUES
2. TROUBLESHOOTING

3. CABLE & HARNESS ROUTING
4. LUBRICATION POINTS

1. TORQUE VALUES

• Gas Assisted Tilt

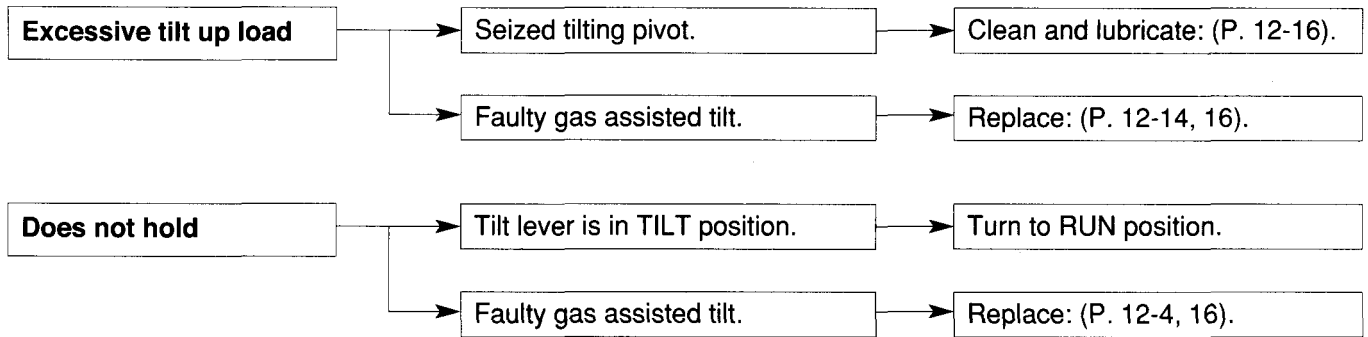
Item	Thread dia. x pitch	Torque		
		N•m	kgf•m	lbf•ft
Tilt lever nut	M6 x 1.0	12	1.2	9

• Power Tilt

Item	Thread dia. x pitch	Torque		
		N•m	kgf•m	lbf•ft
Upper joint metal lock nut	M10 x 1.25	41.5	4.2	30
Oil hole cap bolt	3/8-16UNC	1.1	0.11	0.80
Oil tank bolt	M5 x 0.8	4.4	0.45	3.3
Outer tube	M46 x 1.5	152	15.5	112
Gear pump socket bolt	M5 x 0.8	5	0.5	3.6
Spool valve cap	M22 x 1.0	22	2.2	16
Manual valve	M12 x 1.75	1.7	0.17	1.2

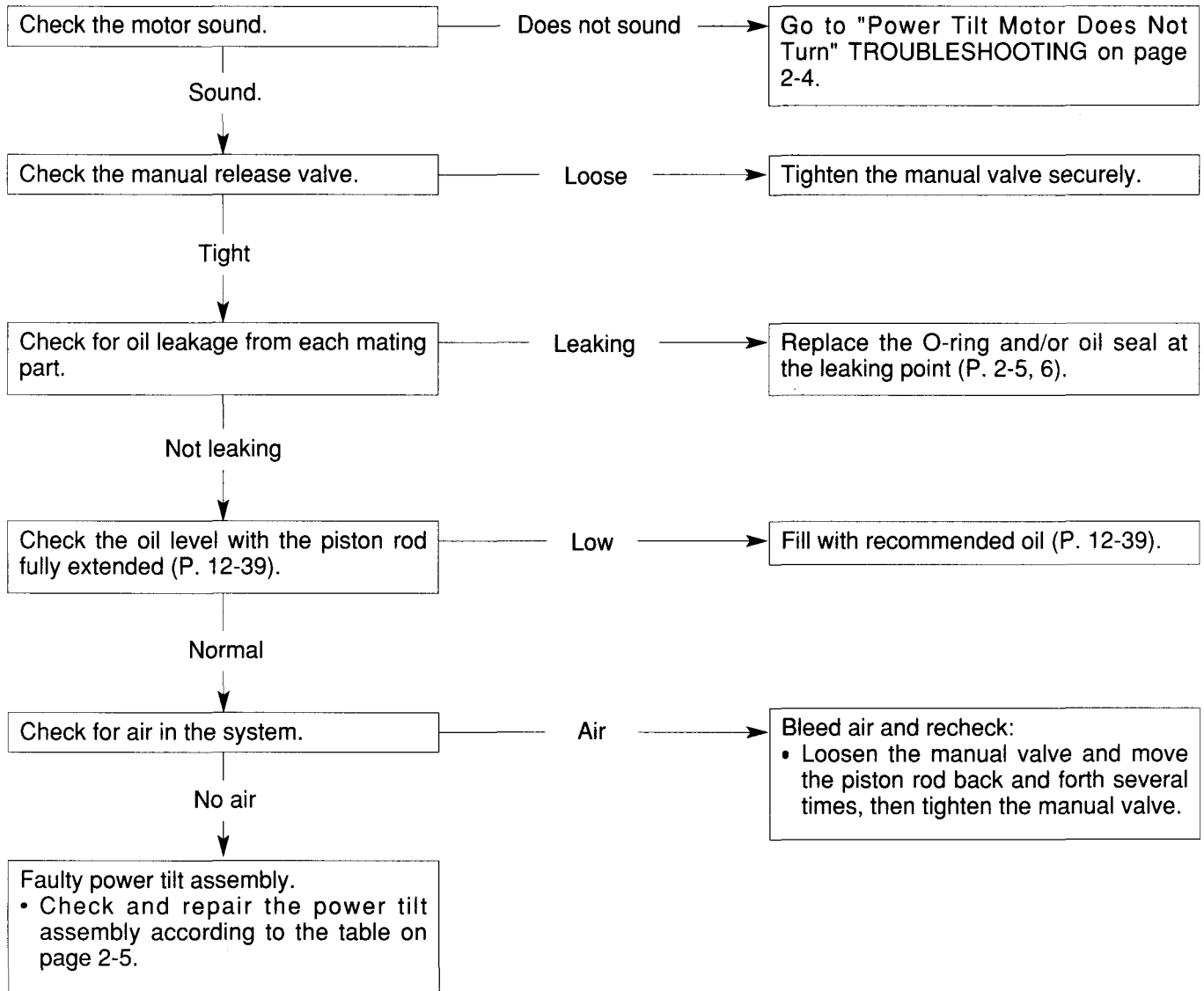
2. TROUBLESHOOTING

a. GAS ASSISTED TILT

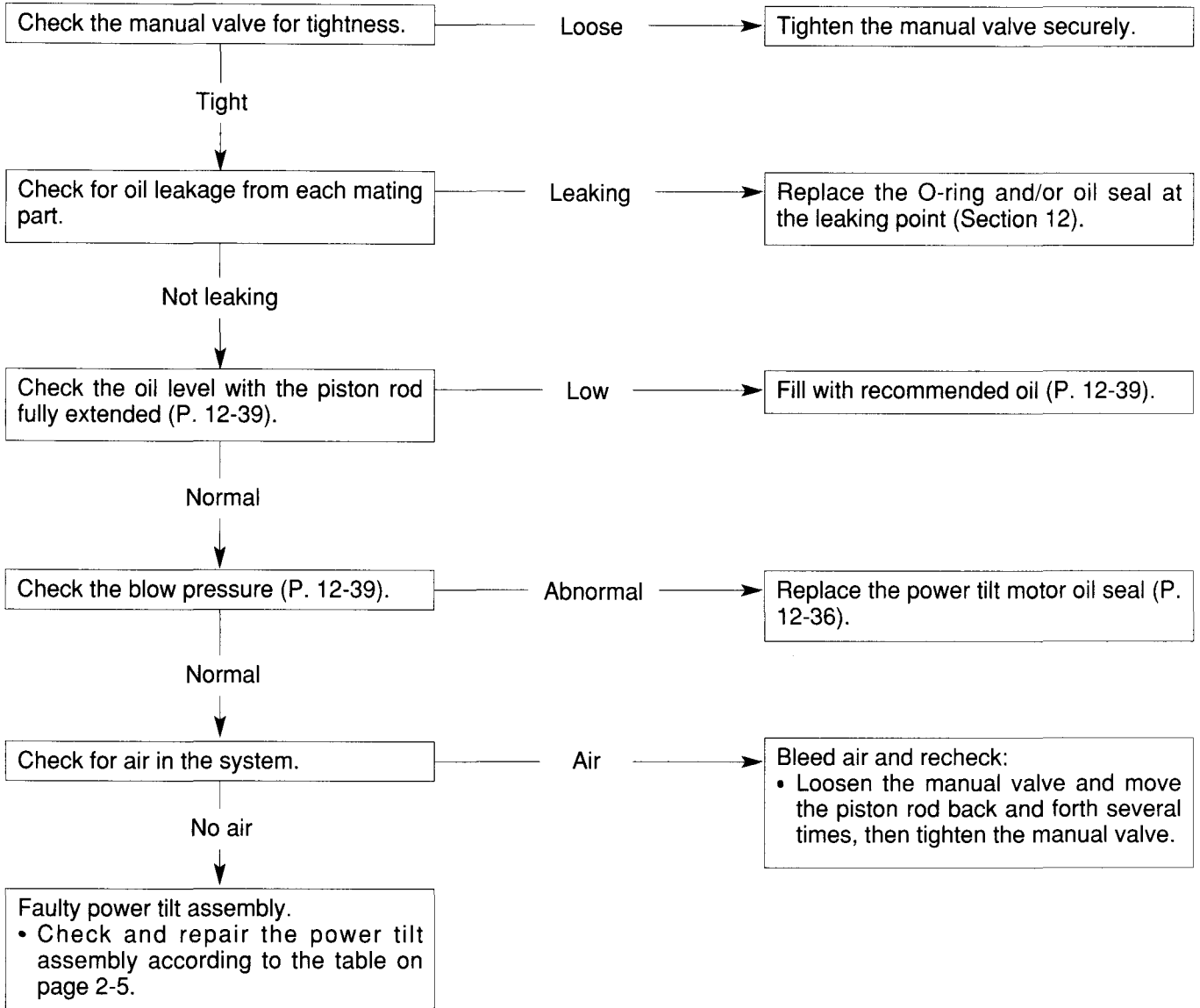


b. POWER TILT

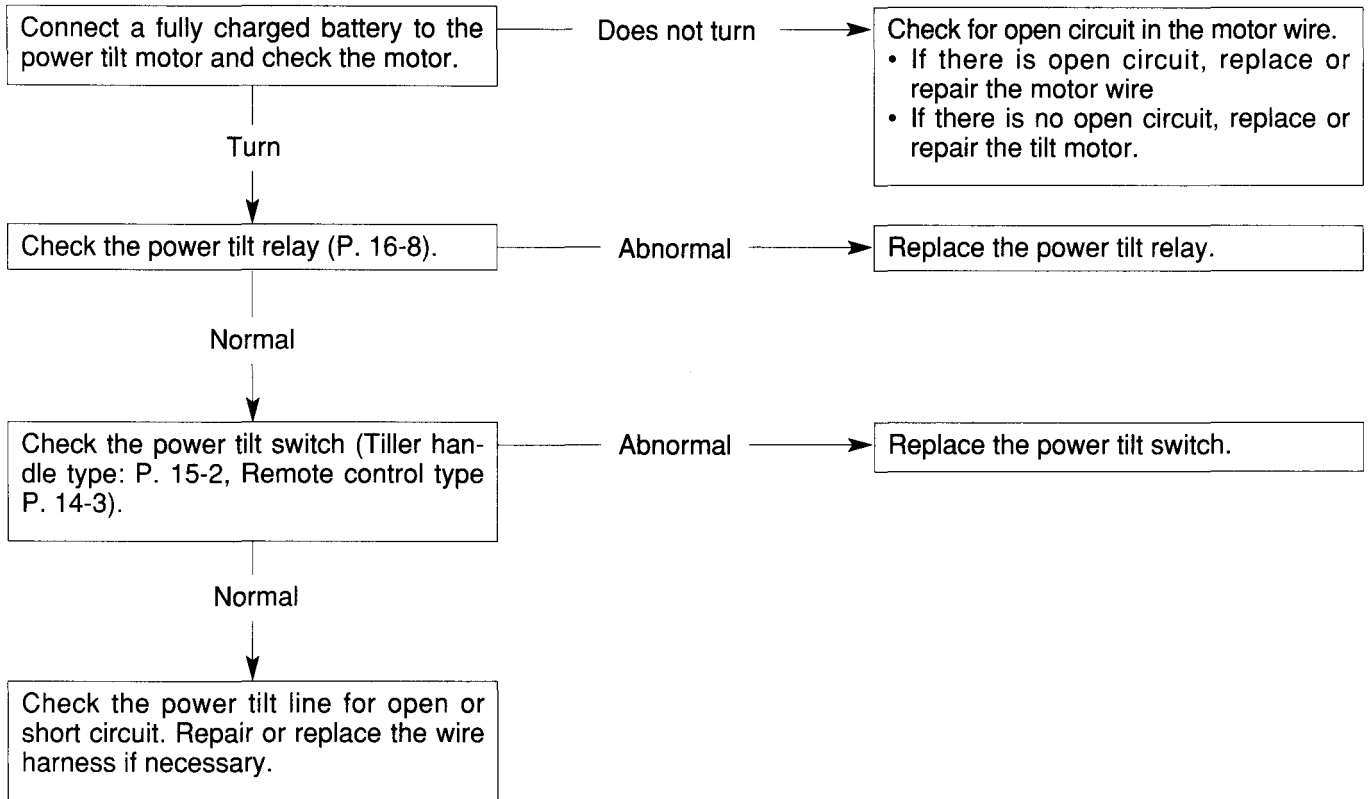
• Power Tilt Does Not Move



• Power Tilt Does Not Hold



• Power Tilt Motor Does Not Turn



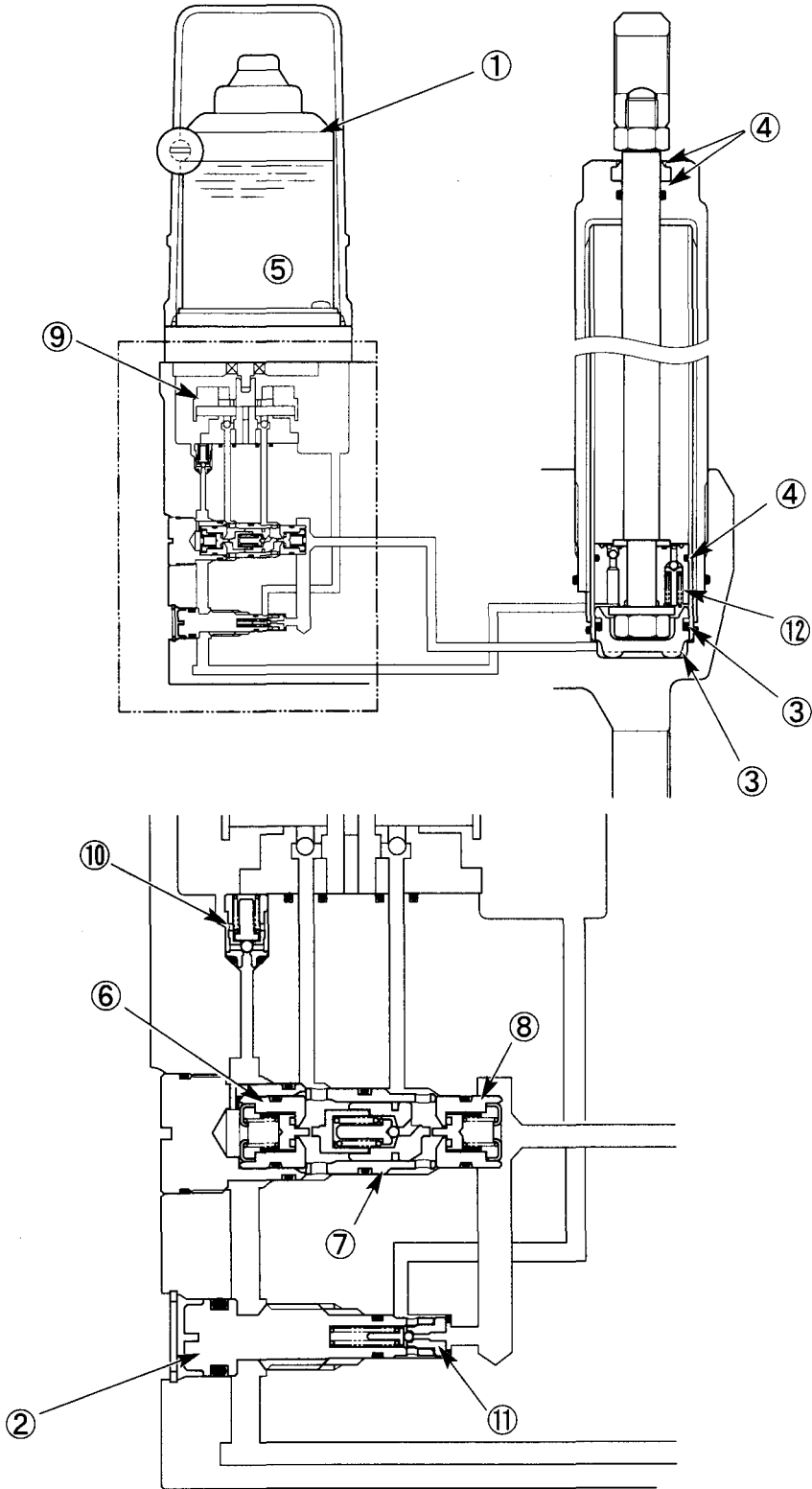
• Faulty Power Tilt Assembly

Quick Reference Chart

Symptom				Pressure		Check point See page 2-6	Check/repair method
Does not tilt up	Does not tilt down.	Does not hold		Lower chamber blow pressure low or drops	Upper chamber blow pressure low or drops		
		Contracted side	Extended side				
○	○	—	—	○	○	① Motor	Check the motor
○	○	○	○	○	○	② Manual valve	Check the manual valve for tightening, damage or foreign material. Check the O-ring for damage, replace if necessary. Replace the manual valve if necessary.
○	—	○	—	○	—	③ Free piston, O-ring, backup ring	Check the O-ring and backup ring for damage, replace if necessary. Replace the piston rod assembly if necessary.
—	○	—	○	—	○	④ Piston rod, O-ring, dust seal	Check the O-ring, dust seal for damage, replace if necessary.
○	○	—	—	○	○	⑤ Oil (ATF)	Check the oil level and add if necessary
○	○	—	○	—	○	⑥ Upper chamber check valve	Check the check valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
○	○	○	○	○	○	⑦ Spool valve (with built-in upper relief valve)	Check the valve for damage, wear or foreign material. Clean and reassemble the spool valve properly. Do not disassemble the spool valve, either as the upper relief valve is built in the spool valve.
—	○	—	○	—	○	⑧ Lower chamber check valve	Check the check valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
○	○	—	—	○	○	⑨ Gear pump	Replace the gear pump assembly
—	○	—	○	—	○	⑩ Down relief valve	Check the valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
○	—	○	—	○	—	⑪ Thermal valve (in the manual valve)	Check the check valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
○	○	—	○	—	○	⑫ Shock relief valve (in the piston)	Check the relief valve for damage, wear or foreign material.

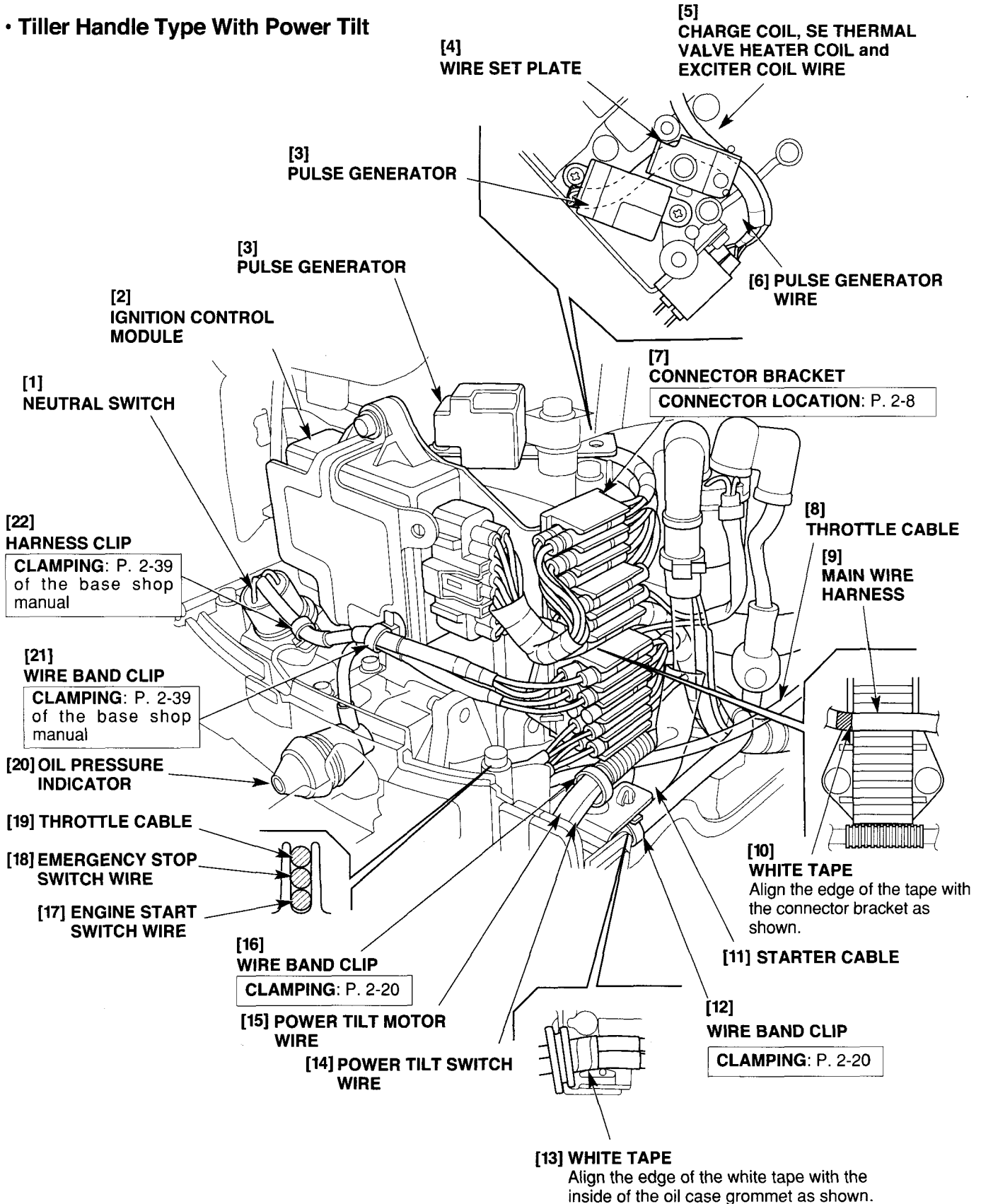
BF15D•BF20D

Check Points



3. CABLE & HARNESS ROUTING

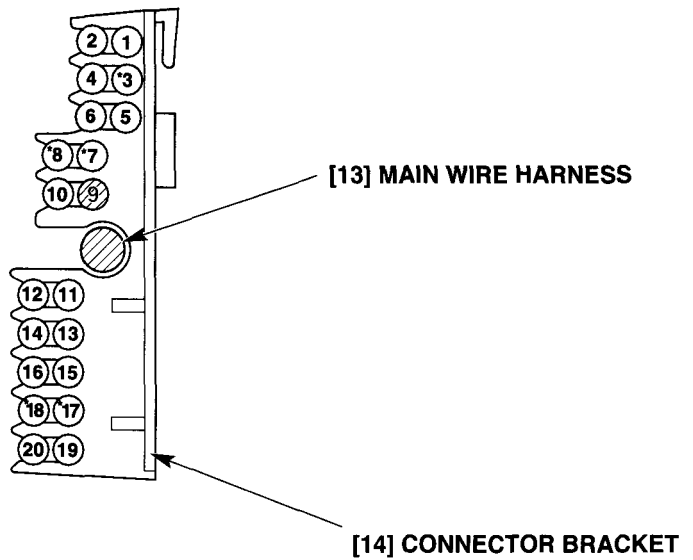
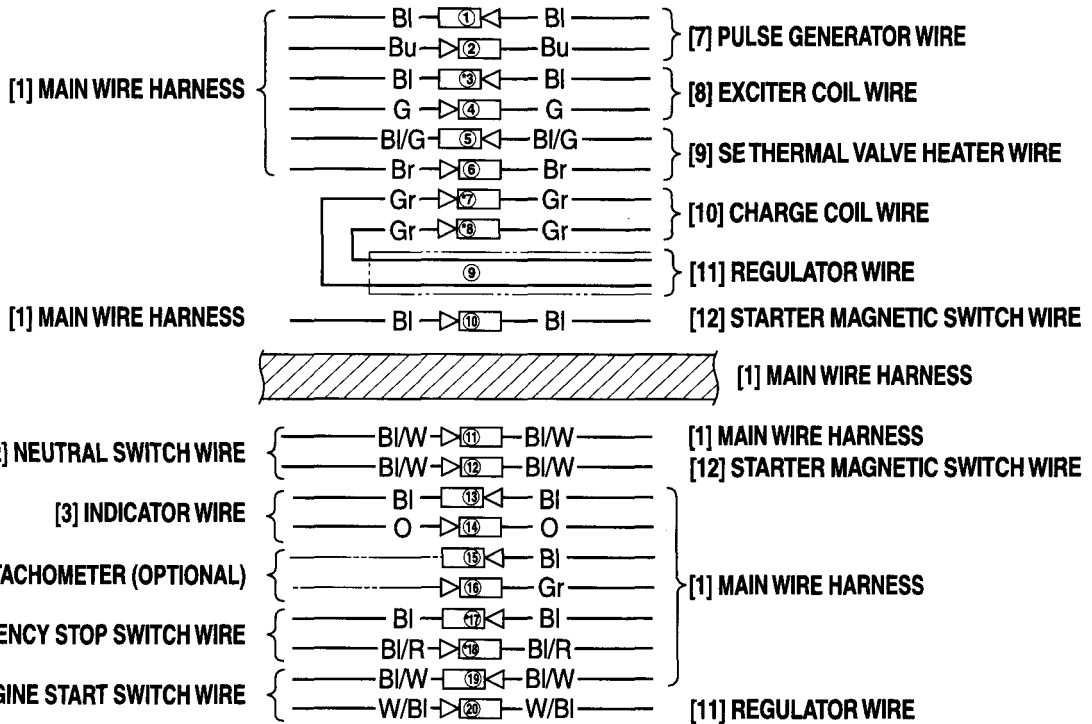
• Tiller Handle Type With Power Tilt



CONNECTOR LOCATION

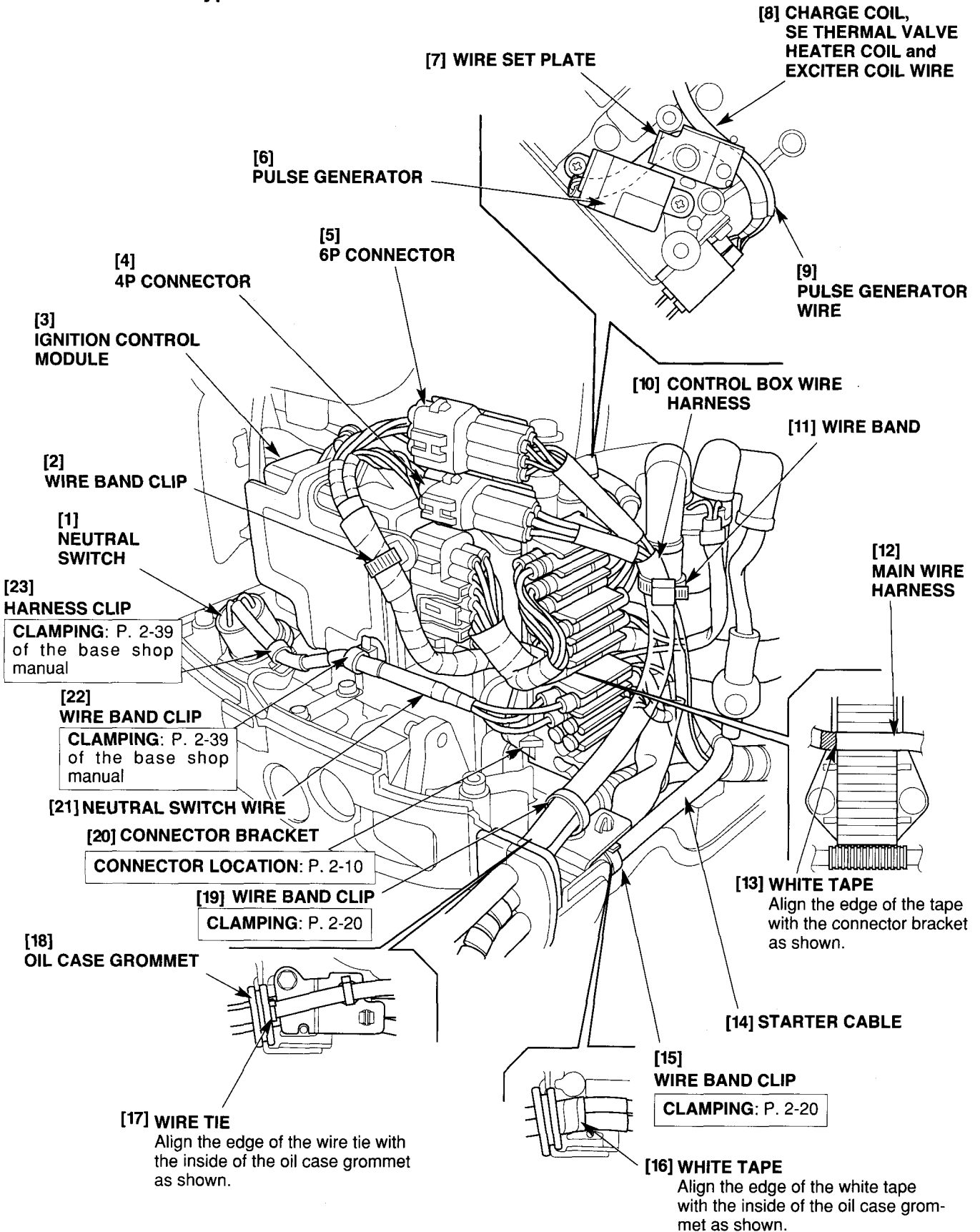
• Tiller Handle Type With Power Tilt

*: Gray insulator



Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

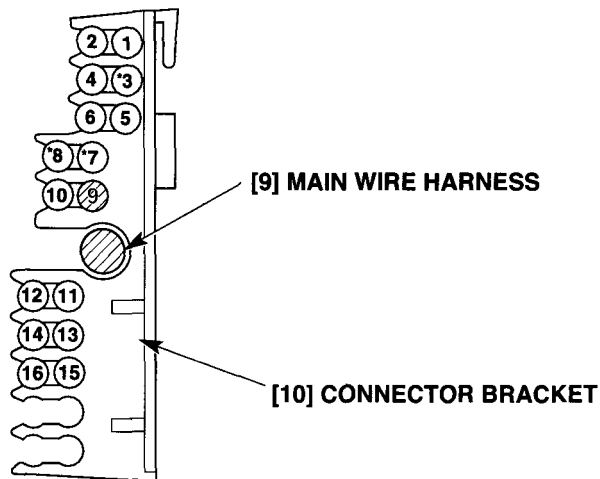
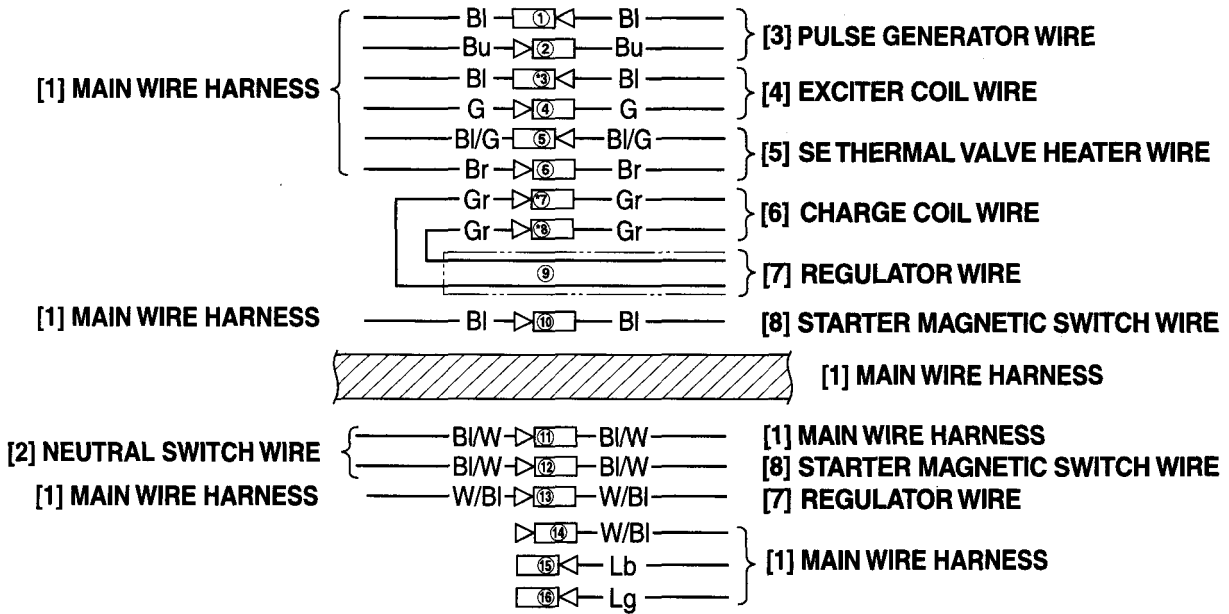
• Remote Control Type With Power Tilt



CONNECTOR LOCATION

• Remote Control Type With Power Tilt

*: Gray insulator



Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

• Tiller Handle Type With Power Tilt

[1] **STARTER CABLE**

Set the starter cable with contacting to the clip bracket as shown.

[2] **CLIP BRACKET**

[3] **ENGINE GROUND TERMINAL**

[17] **WIRE BAND**

[16] **STARTER CABLE**

[4] **STARTER CABLE (CHARGE LINE)**

[5] **MAIN WIRE HARNESS**

[6] **BLACK/BLUE WIRE TERMINAL**
Connect to the black mark terminal of the ignition coil.

[15] **THROTTLE CABLE**

[7] **WIRE BAND CLIP**

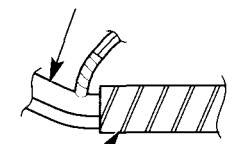
CLAMPING: P. 2-20

[14] **POWER TILT MOTOR WIRE**

[8] **SPIRAL PROTECTOR**

Wrap the main wire harness and charge wire starting from the branch point of the main wire harness as shown.

[8]-1 **MAIN WIRE HARNESS**



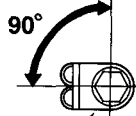
[8]-2 **SPIRAL PROTECTOR**

[13] **POWER TILT SWITCH WIRE**

[9] **IGNITION COIL**

[12] **WIRE BAND CLIP**

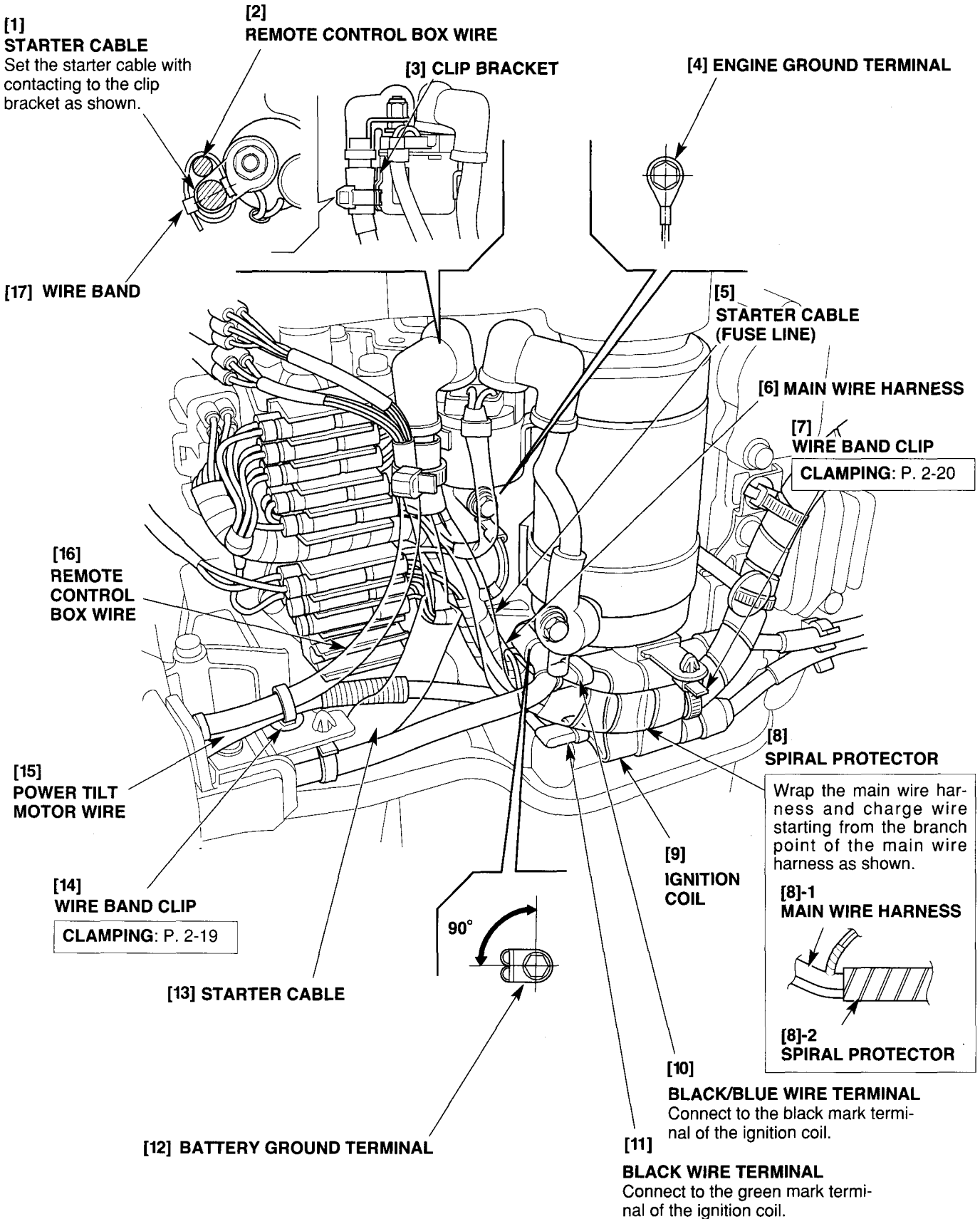
CLAMPING: P. 2-19



[10] **BLACK WIRE TERMINAL**
Connect to the green mark terminal of the ignition coil.

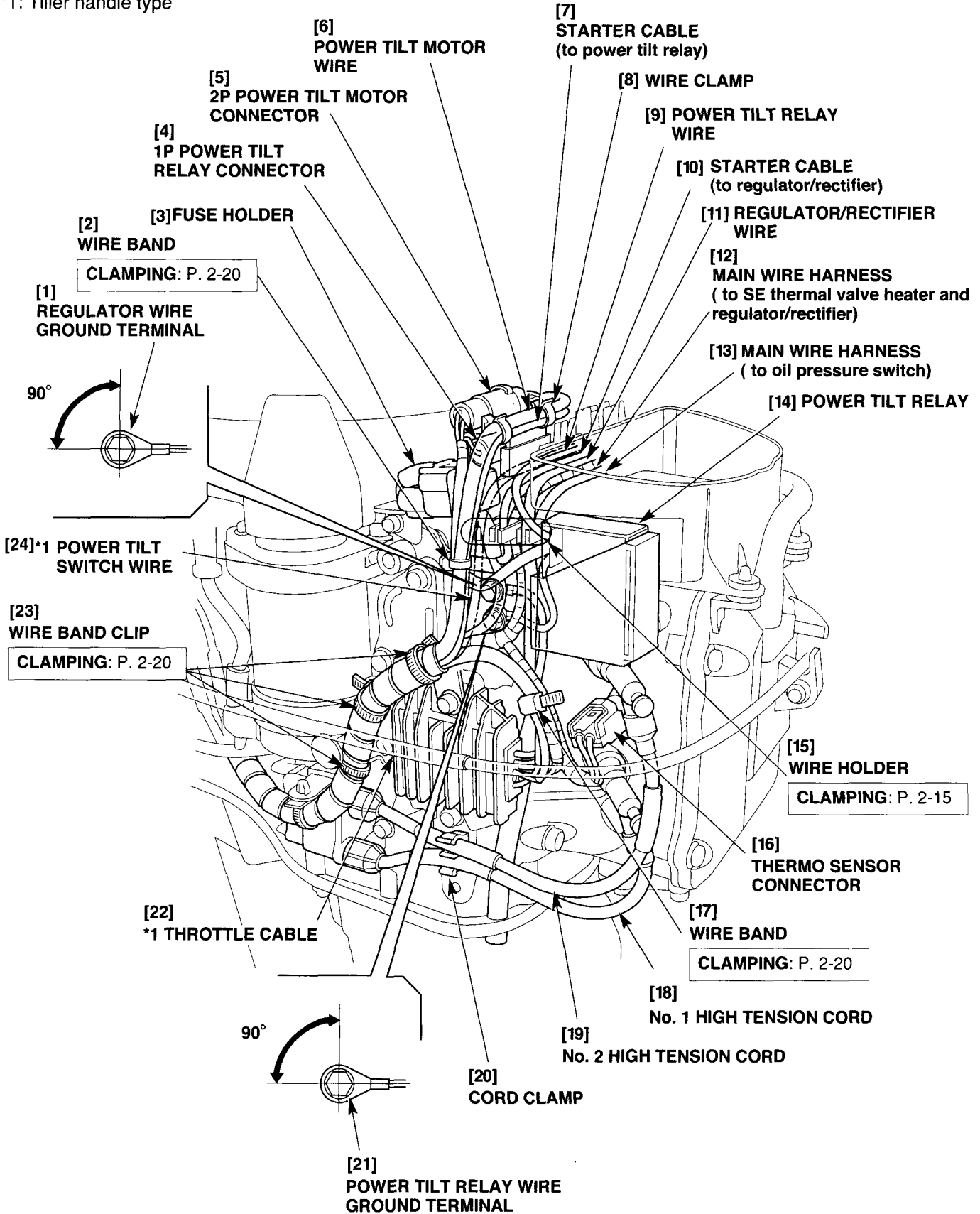
[11] **BATTERY GROUND TERMINAL**

• Remote Control Type With Power Tilt

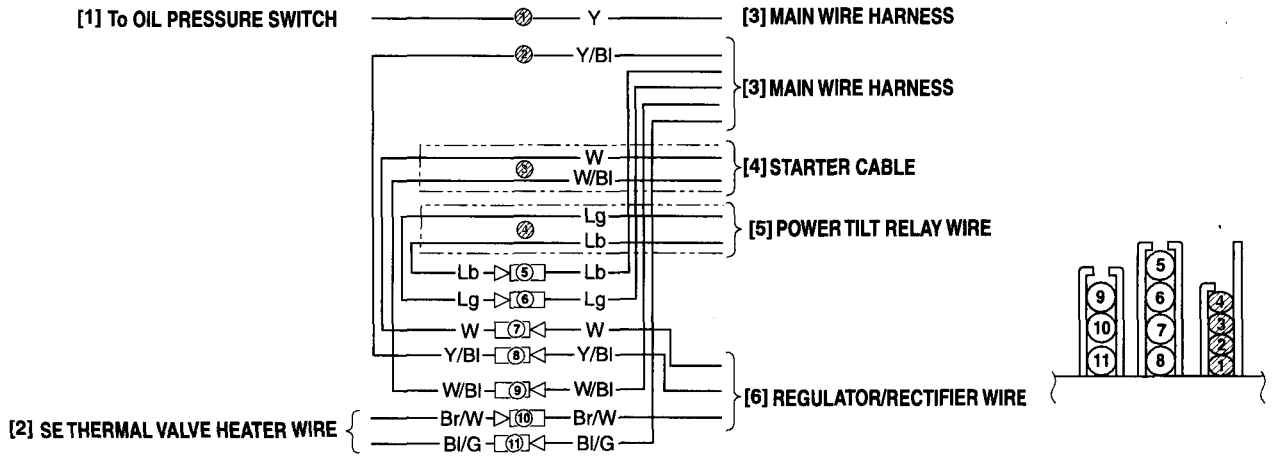


• Type With Power Tilt

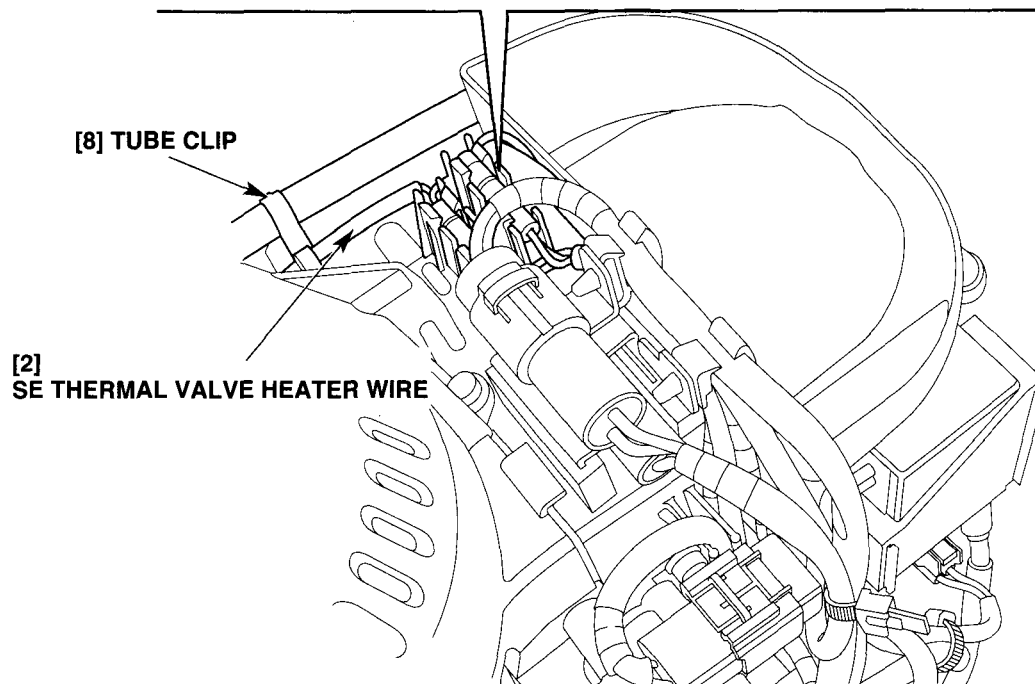
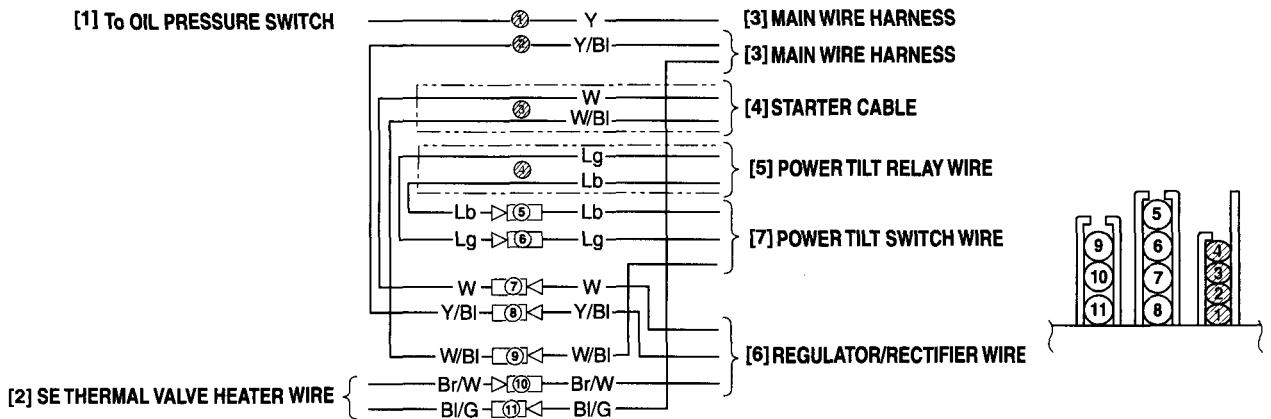
*1: Tiller handle type



• Type With Power Tilt
Remote Control Type

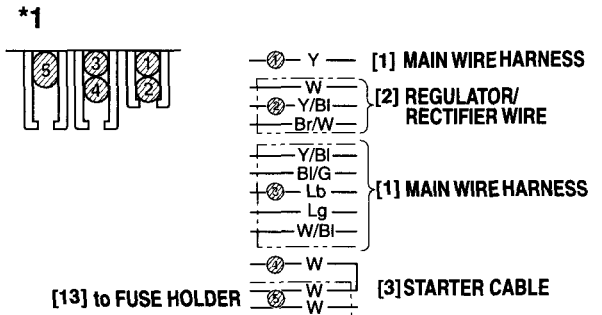
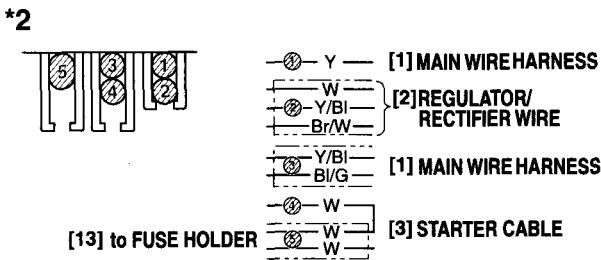
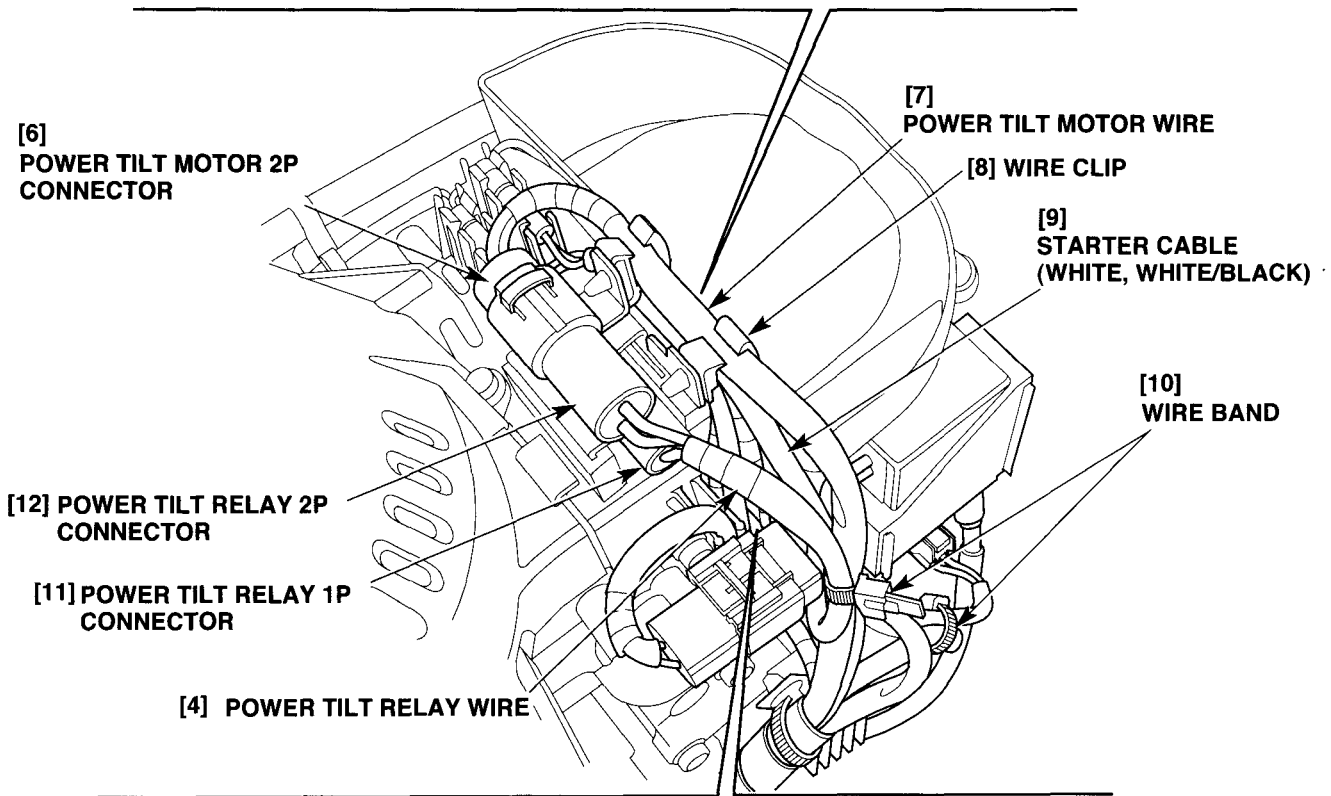
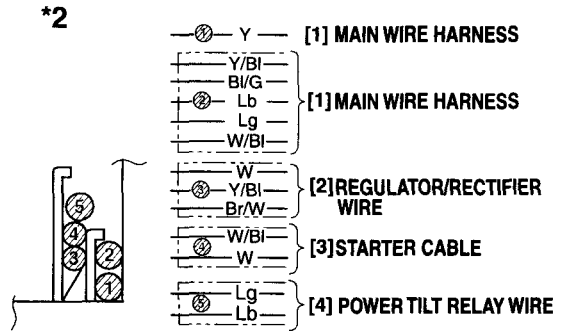
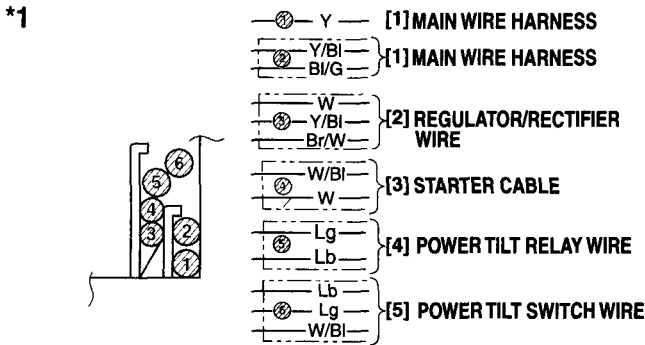


Tiller Handle Type

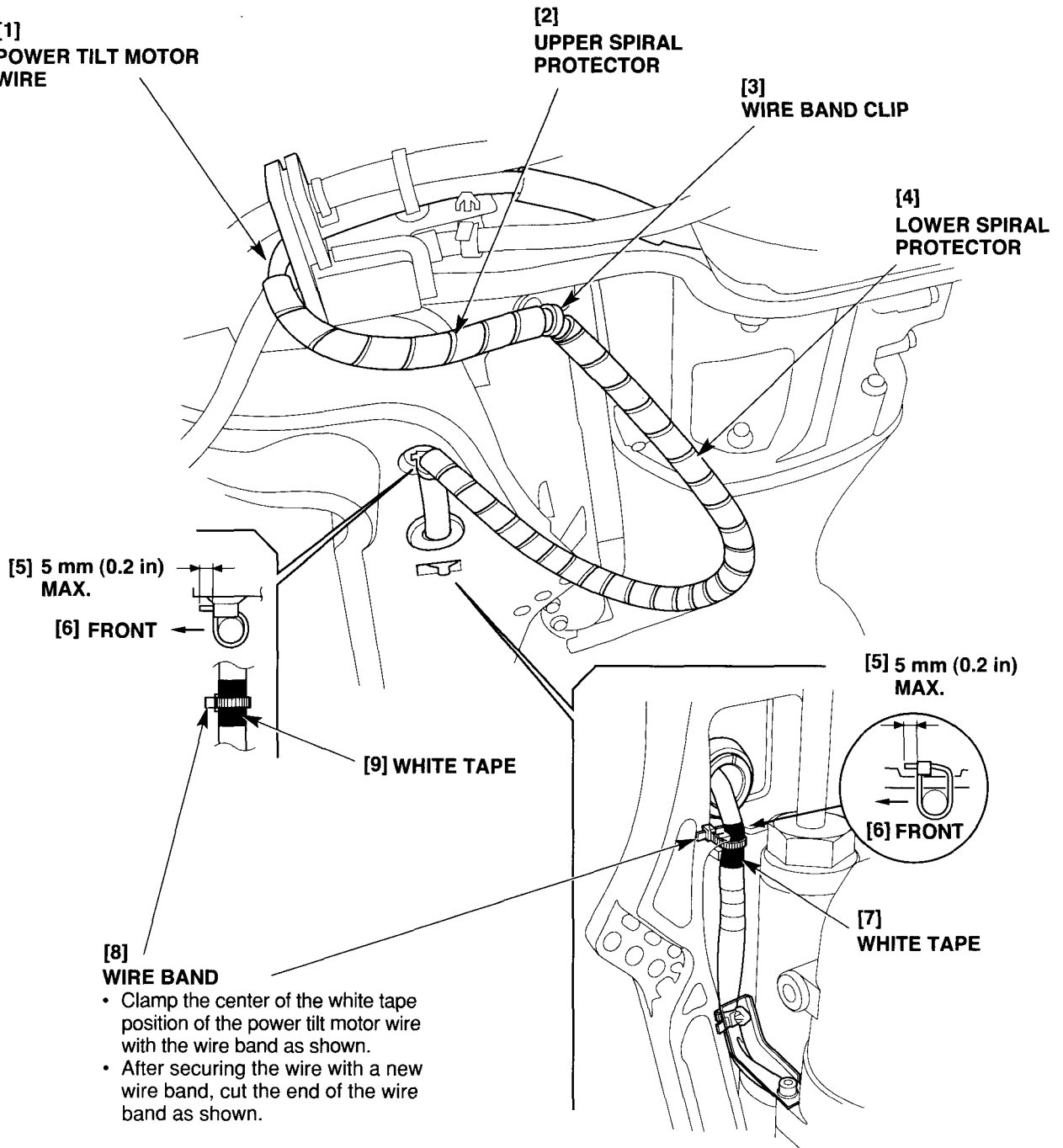


• Type With Power Tilt

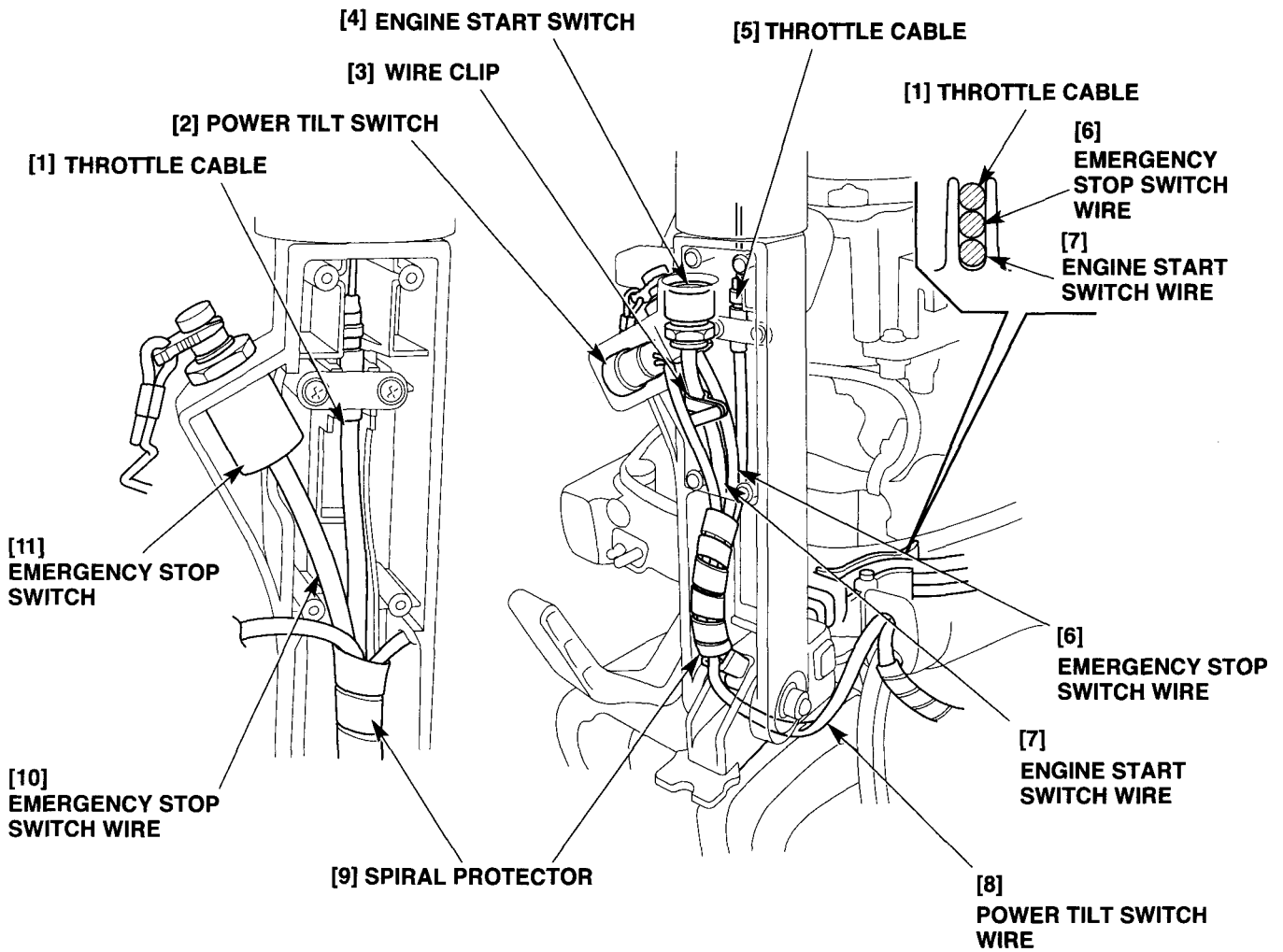
- *1: Tiller handle type
- *2: Remote control type



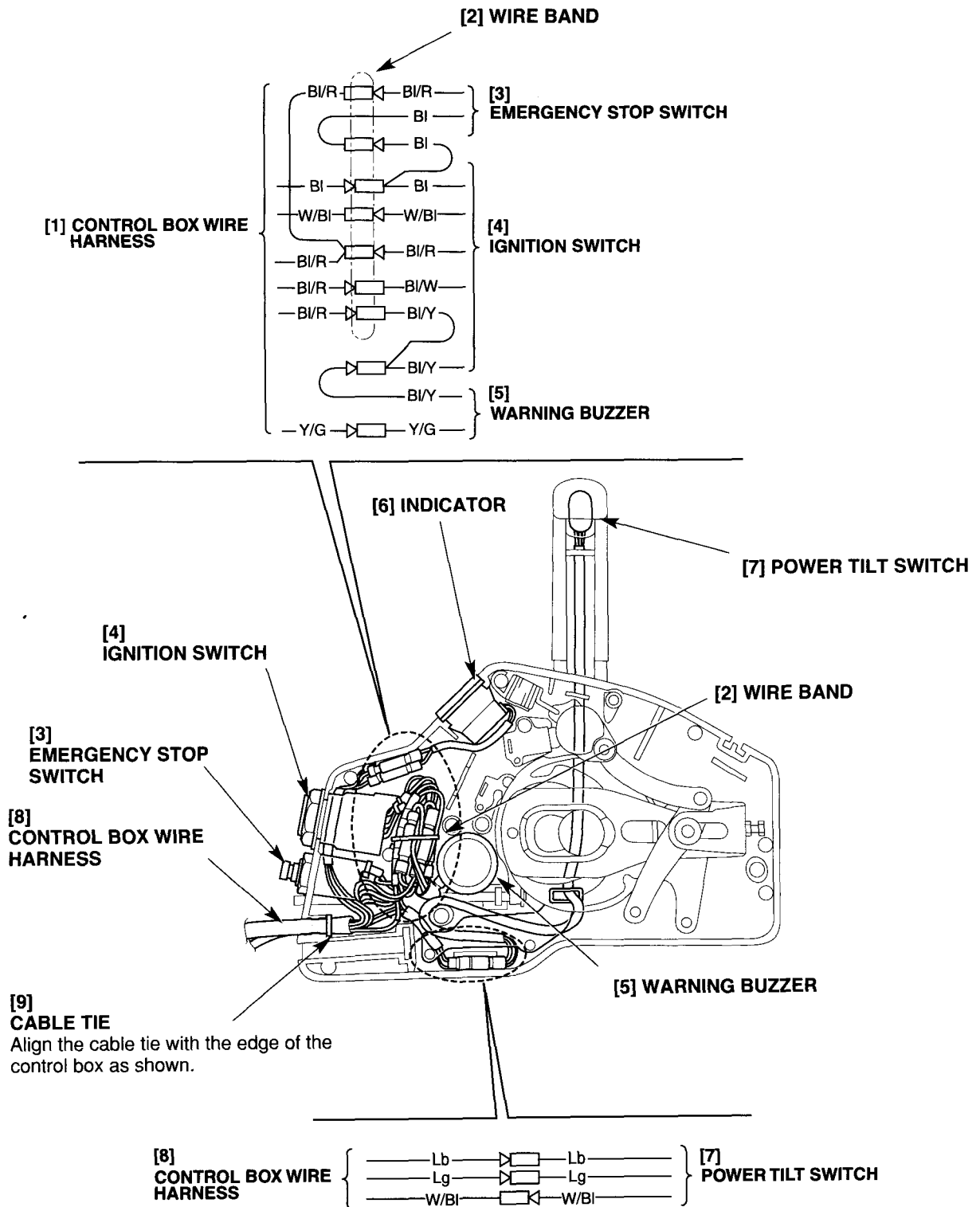
• Type With Power Tilt



• Tiller Handle Type With Power Tilt



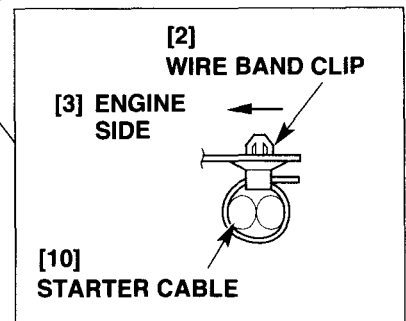
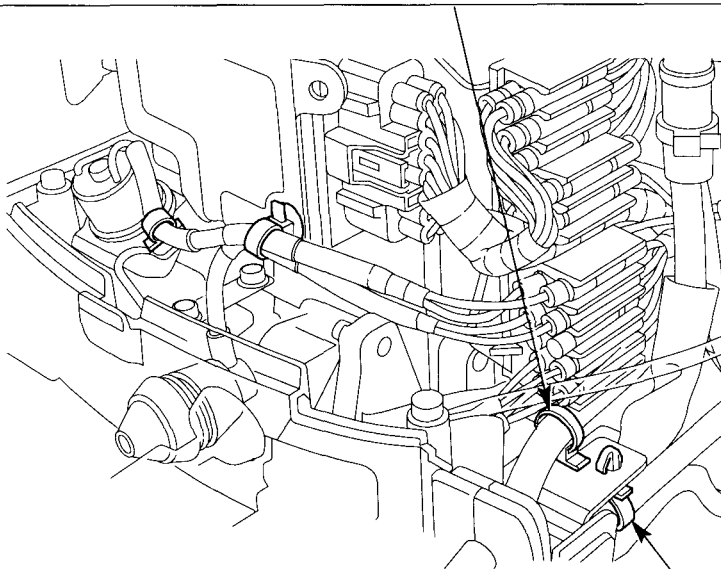
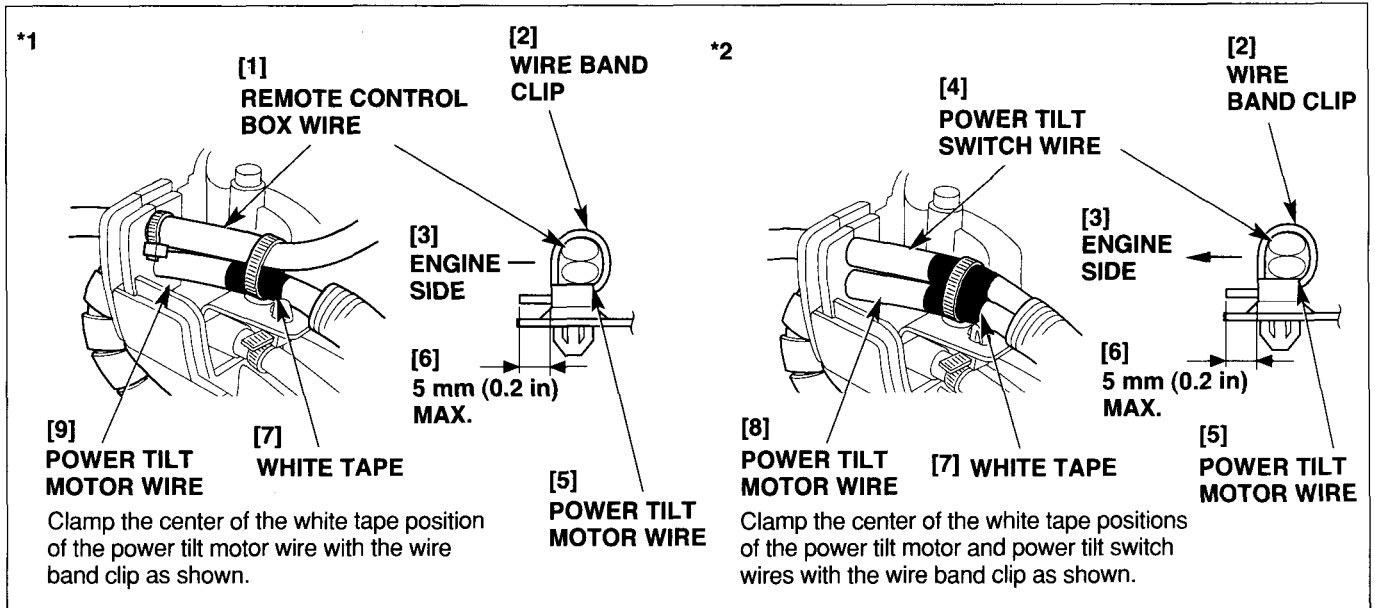
• Remote Control Box (Type With Power Tilt)



• WIRE CLAMPING

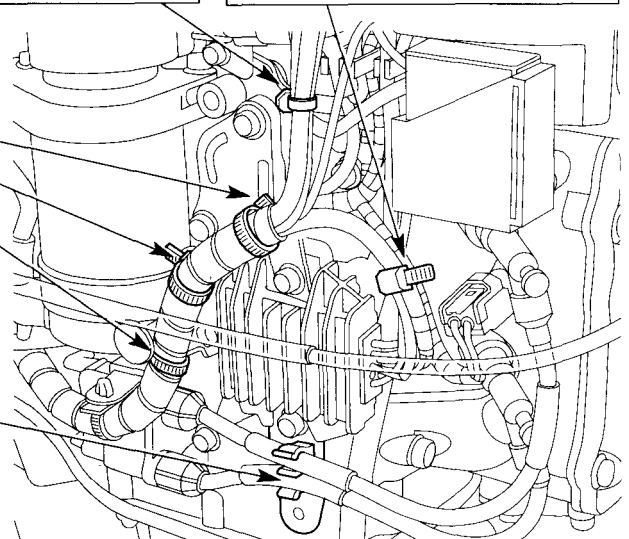
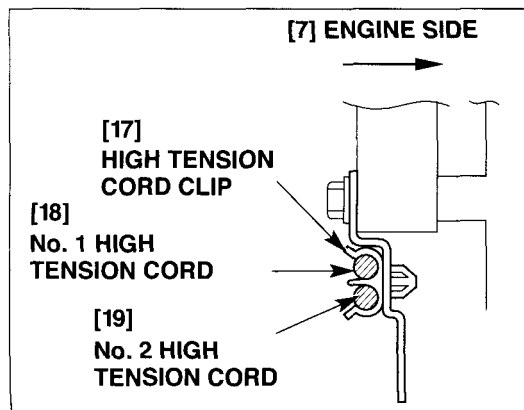
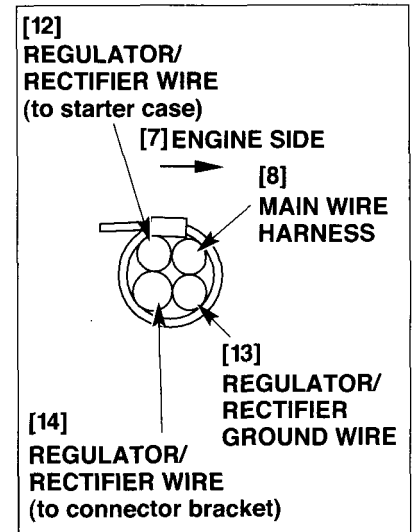
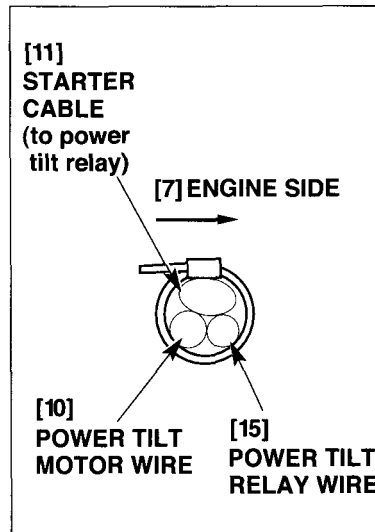
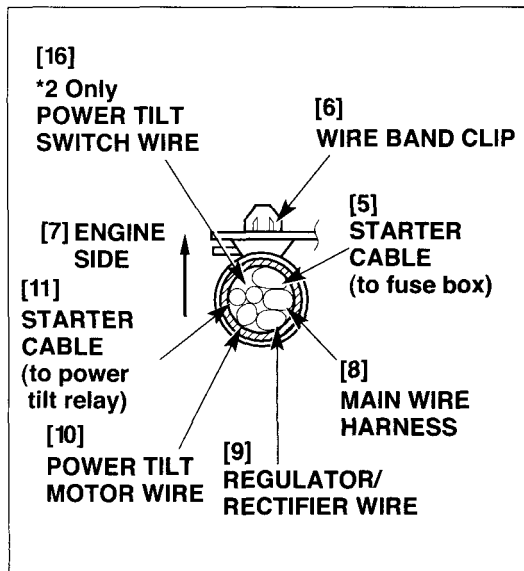
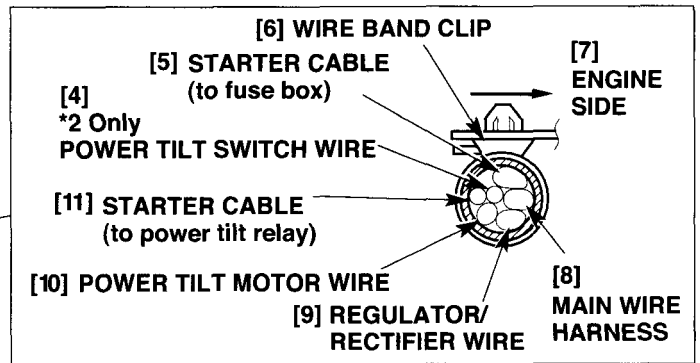
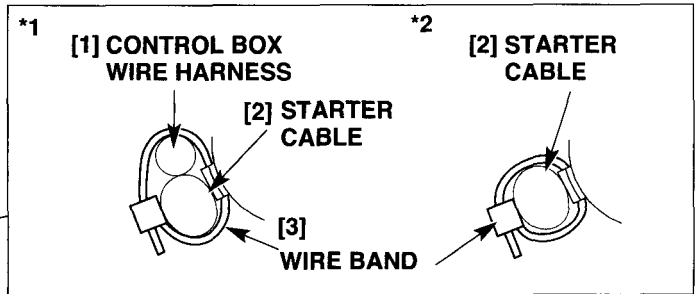
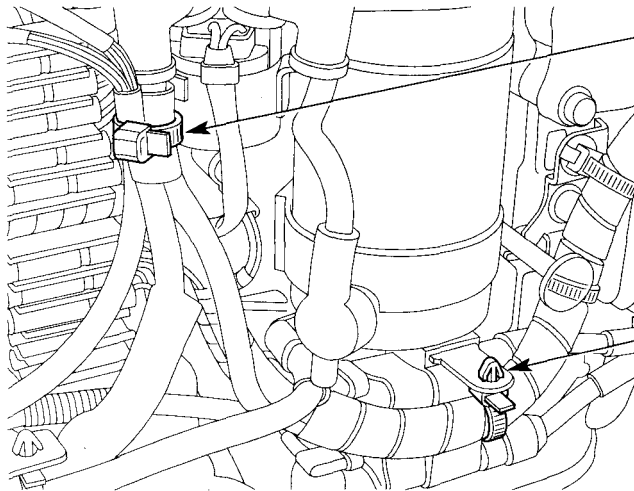
*1: Remote control type with power tilt

*2: Tiller handle type with power tilt



*1: Remote control type

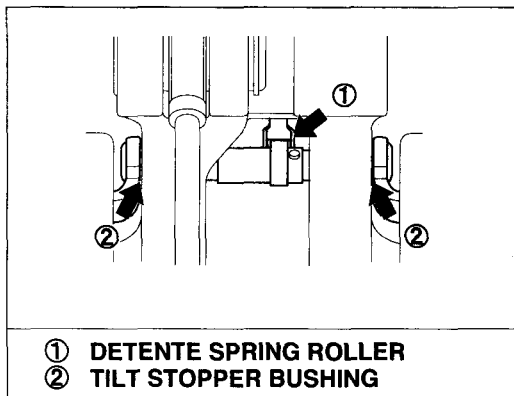
*2: Tiller handle type



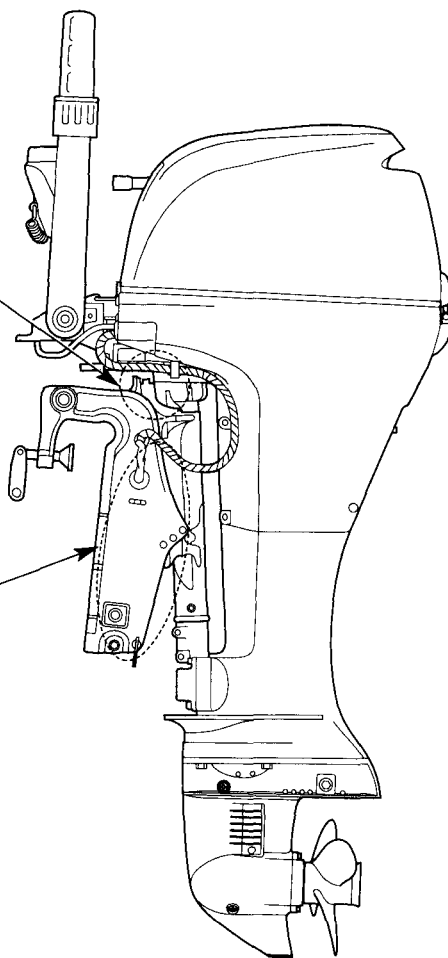
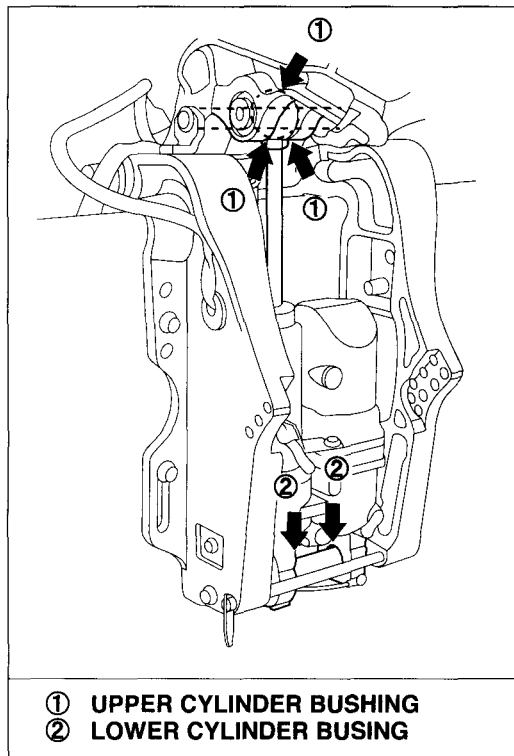
4. LUBRICATION POINTS

• POWER TILT, GAS ASSISTED TILT

[1]



[2]



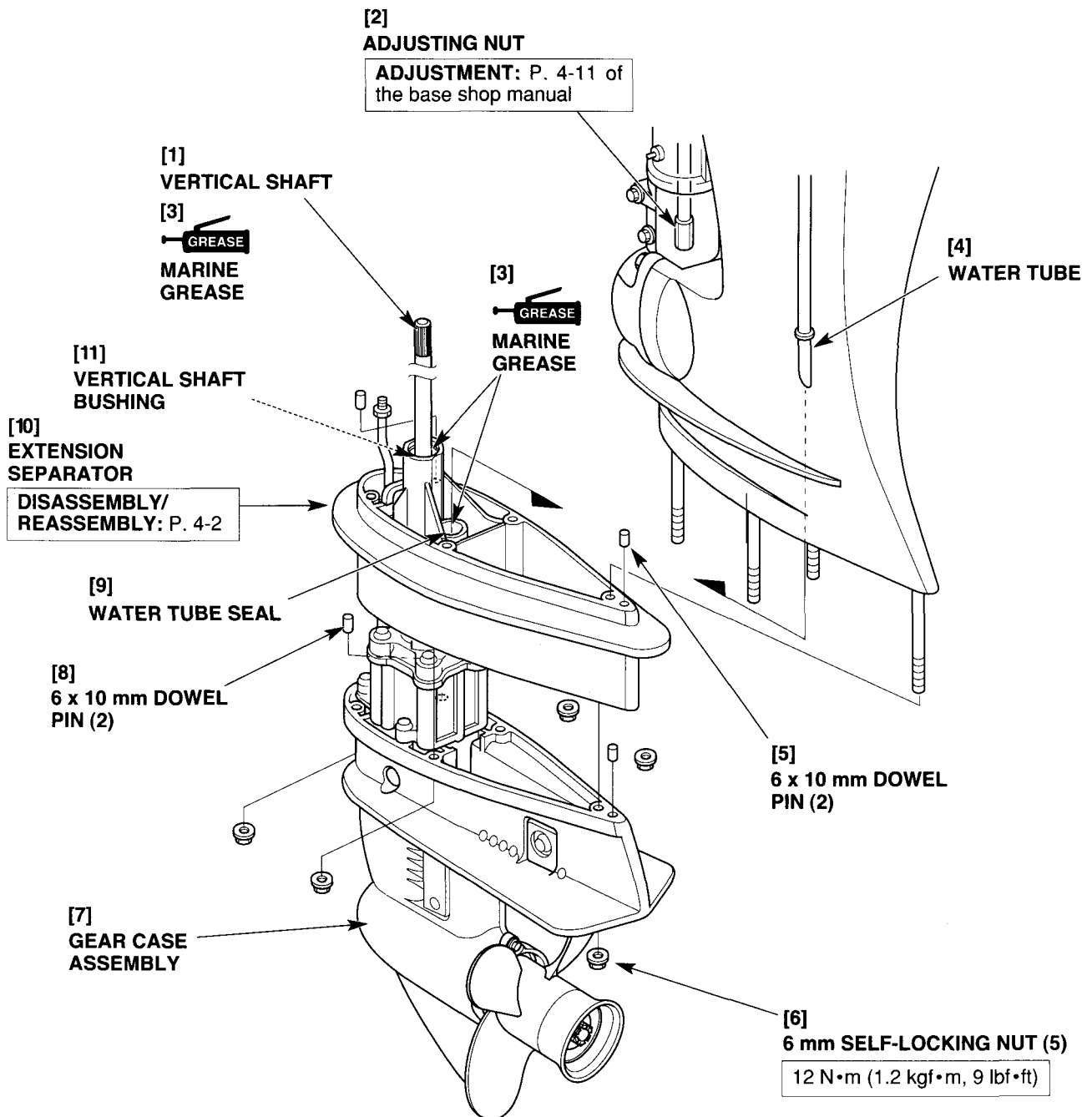
- 1. GEAR CASE ASSEMBLY
- 2. EXTENSION SEPARATOR

- 3. WATER PUMP

1. GEAR CASE ASSEMBLY

a. REMOVAL/INSTALLATION

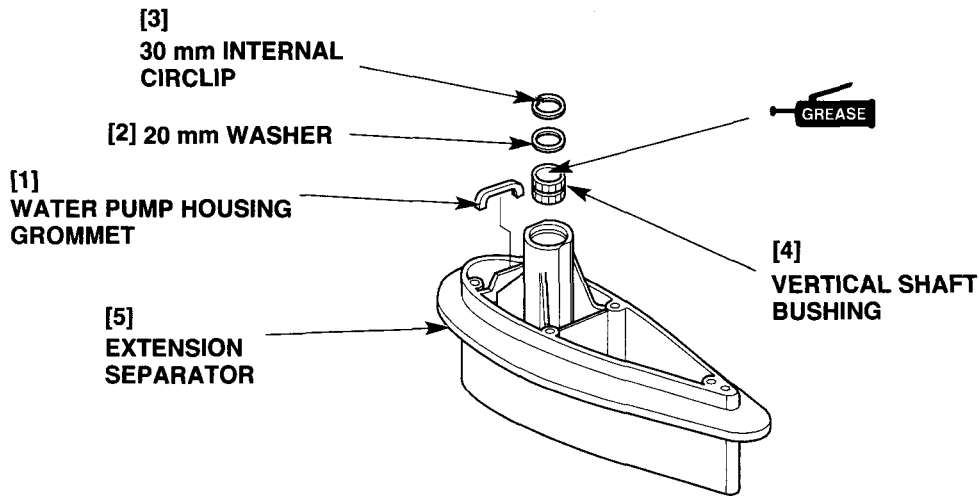
• UL Type



2. EXTENSION SEPARATOR

a. DISASSEMBLY/REASSEMBLY

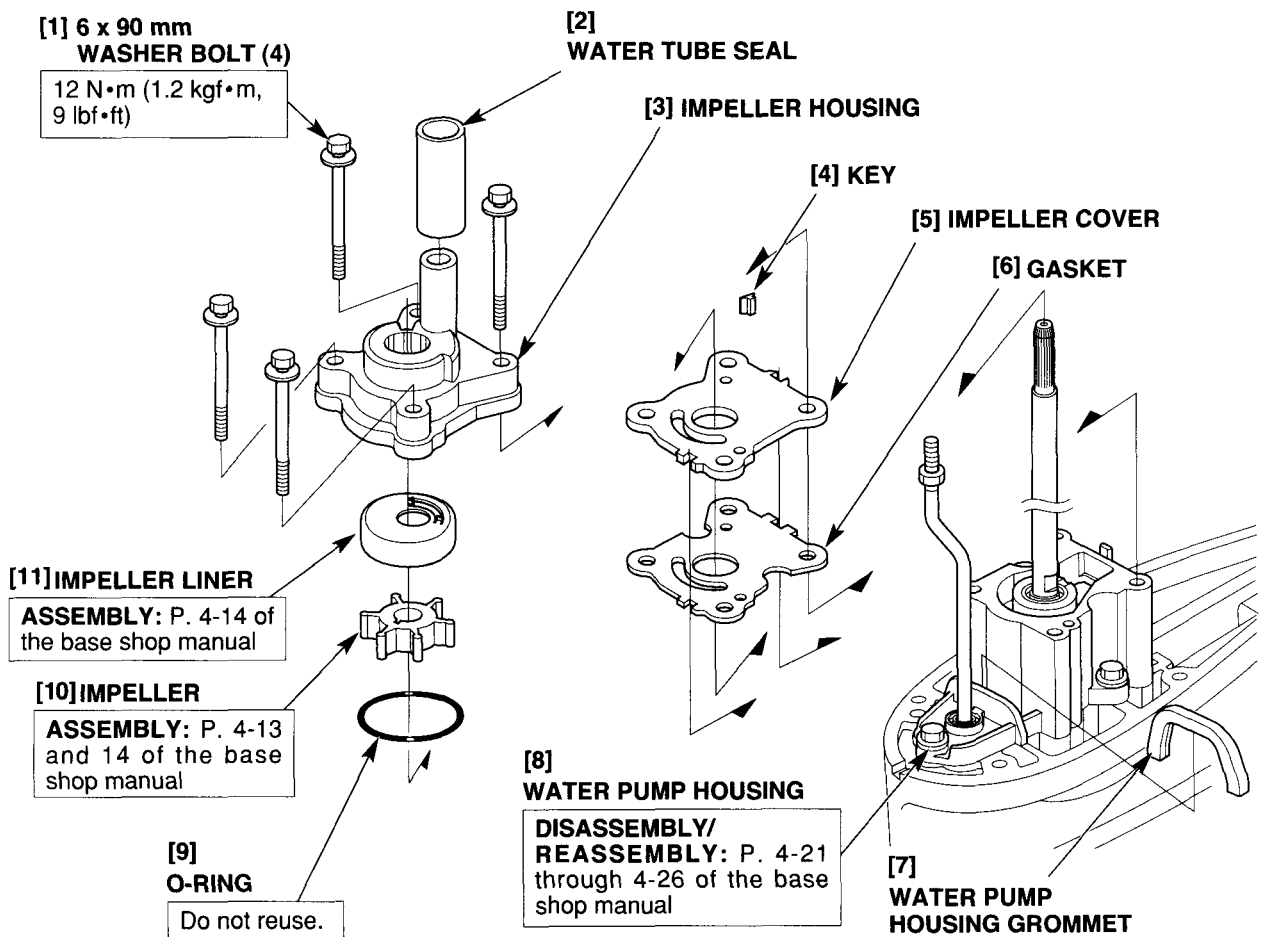
• UL Type



3. WATER PUMP

a. DISASSEMBLY/REASSEMBLY

• UL Type



1. STARTER CASE B

3. STARTER CASE B

• Type With Power Tilt

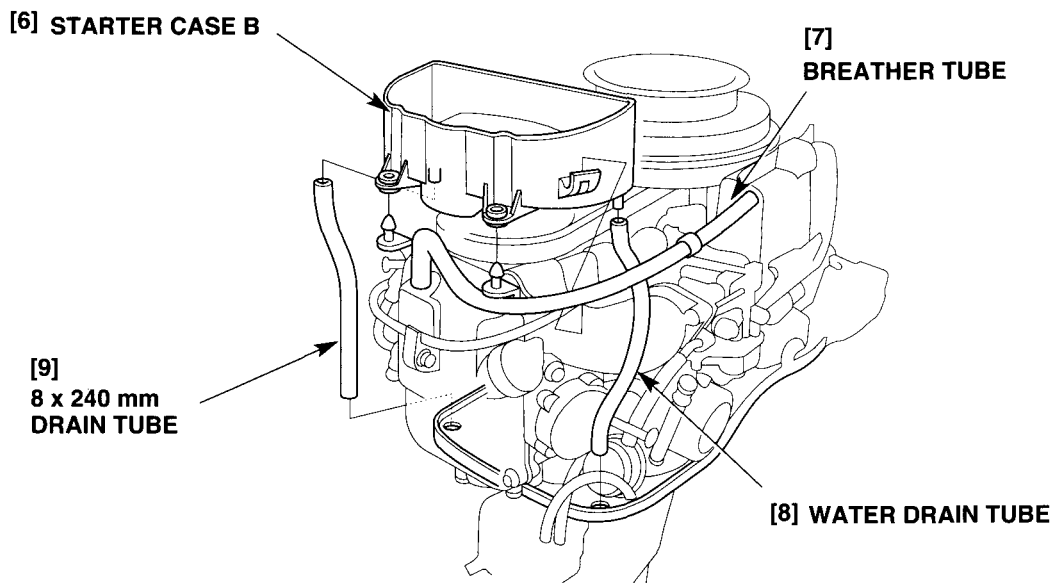
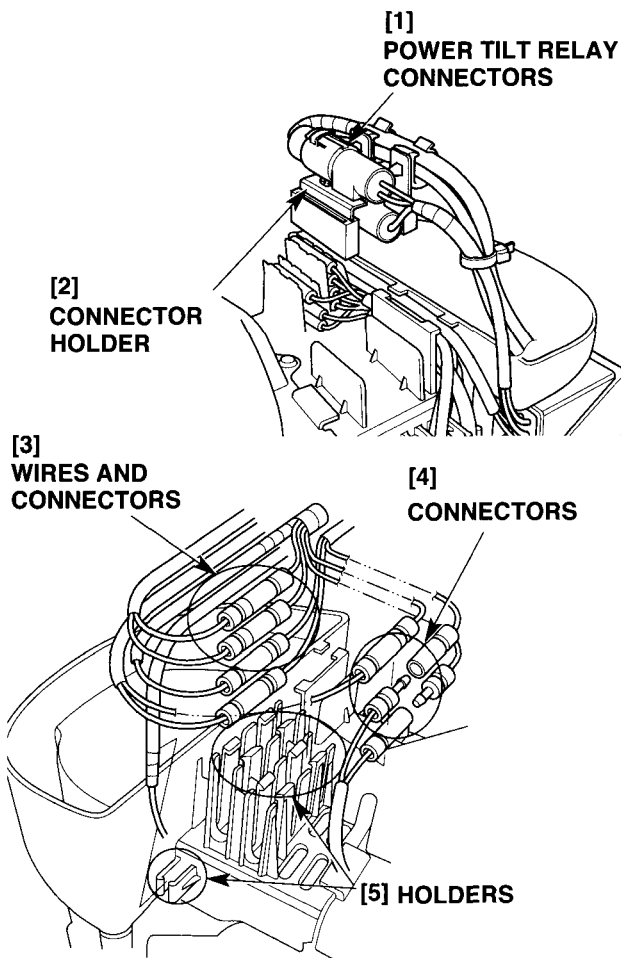
a. REMOVAL

- 1) Remove the following:
 - engine cover (P. 5-1 of the base shop manual).
 - left engine under cover (P. 5-2 of the base shop manual).
 - right engine under cover (P. 5-3 of the base shop manual).
 - recoil starter (P. 7-2 of the base shop manual).
- 2) Remove the power tilt relay connectors and connector holder as a set with the connectors connected as shown.
- 3) Pull out the connectors and wires from the holder on the starter case B
- 4) Pull off the breather tube from the clamp on the starter case B and remove it. Disconnect the breather tube from the cylinder head cover.
- 5) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.

b. INSTALLATION

Installation is the reverse order of removal.

- See pages 2-14, and 15 for wires and connectors clamping.



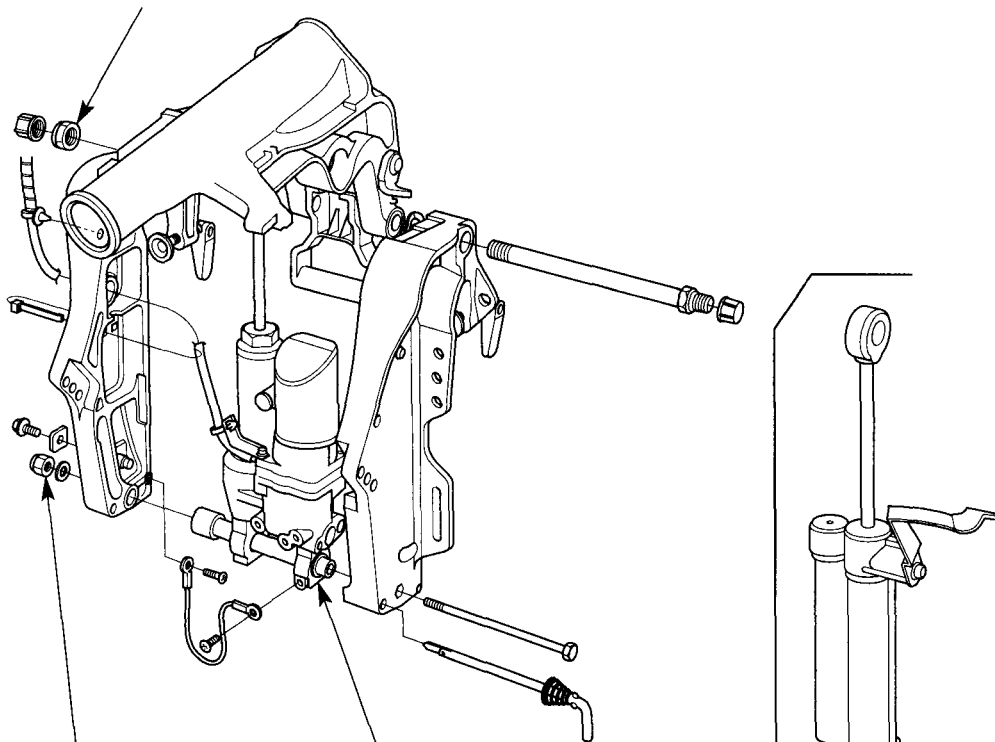
12. OIL CASE/MOUNT FRAME/STERN BRACKET/ POWER TILT/GAS ASSISTED TILT

BF15D•BF20D

- 1. STERN BRACKET
- 2. SWIVEL CASE

- 3. GAS ASSISTED DAMPER
- 4. POWER TILT ASSEMBLY

[1]
7/8-14 UNF SELF-LOCKING NUT
Do not reuse. Tighten to 40 N•m
(4.1 kgf•m, 30 lbf•ft) then turn
back 1/2 turn.



[4]
8 mm SELF-LOCKING NUT
21 N•m (2.1 kgf•m, 15 lbf•ft)

[3] POWER TILT ASSY.

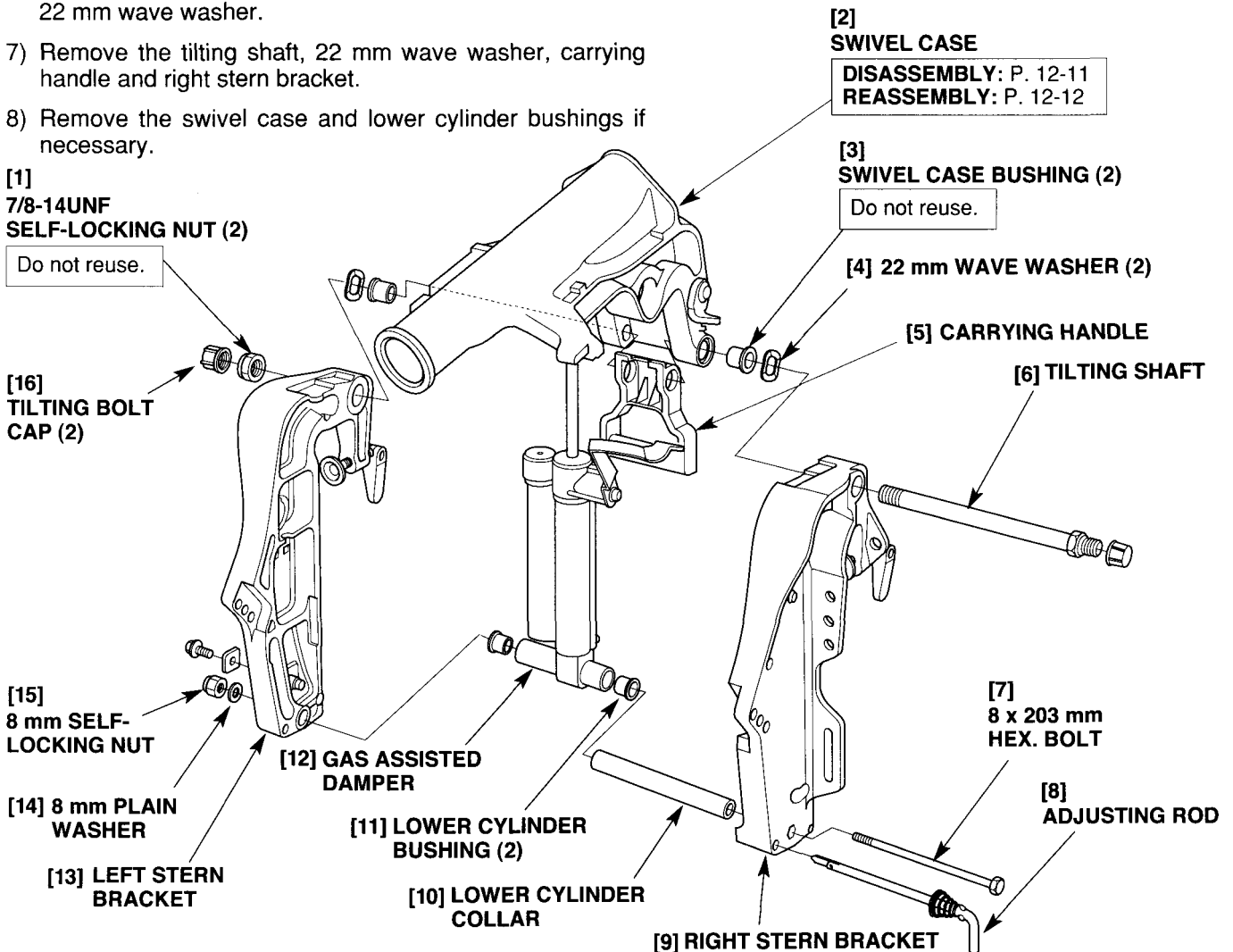
[2] GAS ASSISTED TILT ASSY.

1. STERN BRACKET

• GAS ASSISTED TILT


a. DISASSEMBLY

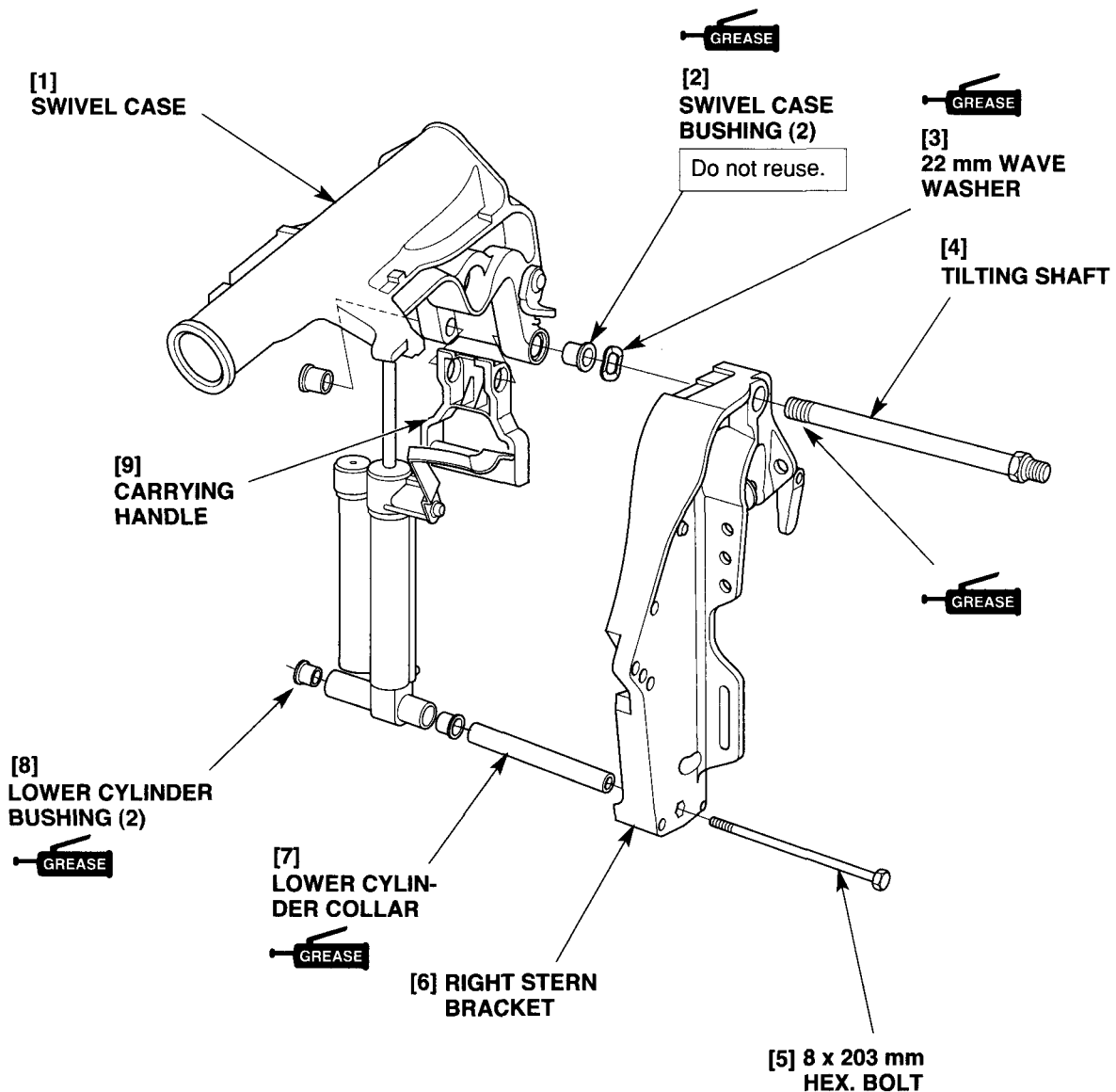
- 1) Remove the engine (see section 8 of the base shop manual), then remove the following:
 - oil case (P. 12-2).
 - friction adjusting lever (P. 12-4).
 - mount frame (P. 12-6).
- 2) Move the tilt lever to free position to release the gas assisted damper.
- 3) Remove the adjusting rod.
- 4) Remove the tilting bolt cap and loosen the 7/8-14UNF self-locking nut, then remove the 8 mm self-locking nut, 8 mm plain washer and 8 x 203 mm hex. bolt.
- 5) Remove the 7/8-14UNF self-locking nut and discard it. Replace the self-locking nut with new one when reassembly.
- 6) Remove the left stern bracket, lower cylinder collar and 22 mm wave washer.
- 7) Remove the tilting shaft, 22 mm wave washer, carrying handle and right stern bracket.
- 8) Remove the swivel case and lower cylinder bushings if necessary.



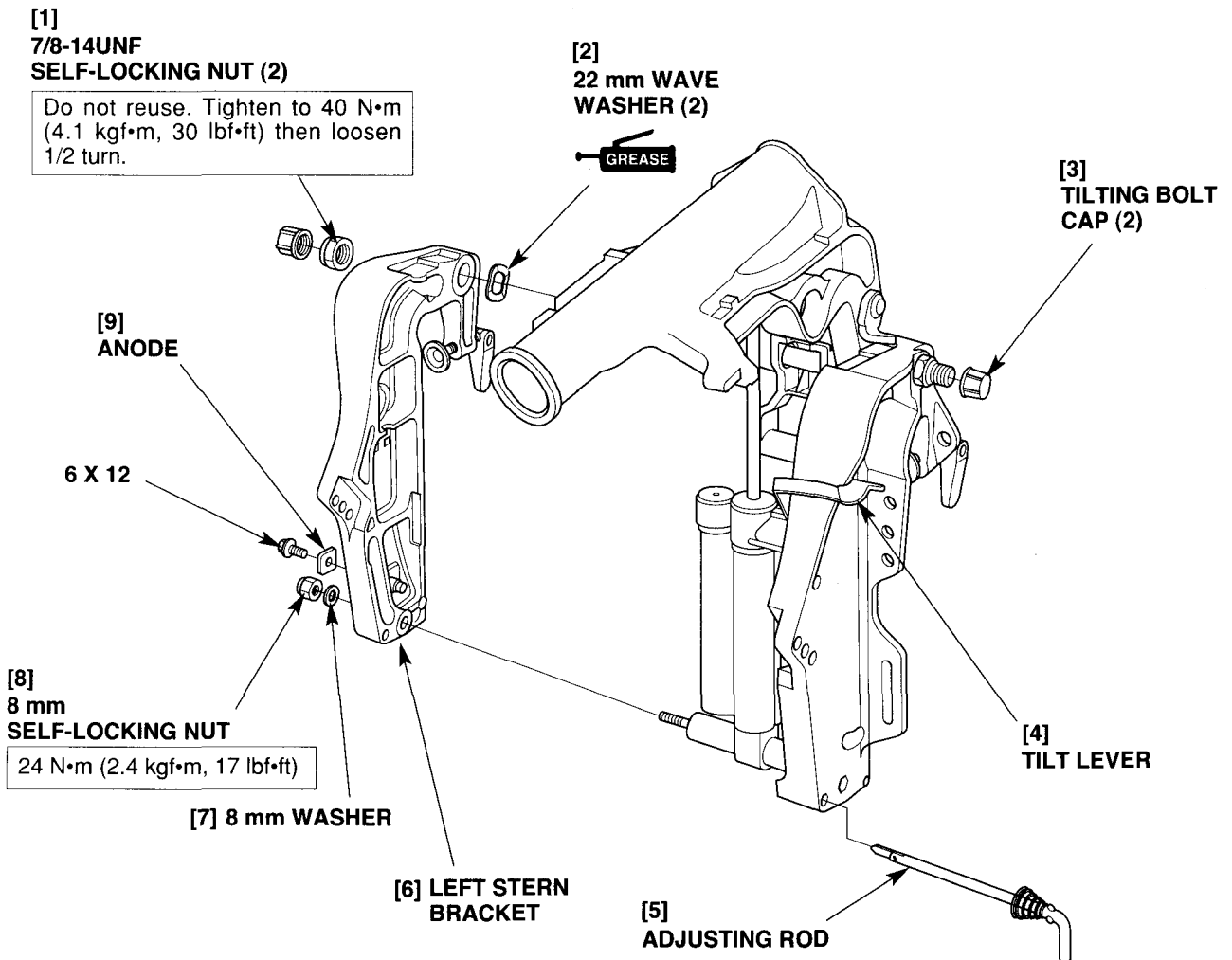
b. REASSEMBLY

- 1) Apply marine grease to new swivel case bushings and install them to the swivel case.
- 2) Apply marine grease to new lower cylinder bushings and lower cylinder collar, then install them to the gas assisted dumper lower mount.
- 3) Apply marine grease to the threads of the tilting shaft, mounting hole and wave washers.
- 4) Install the right stern bracket, carrying handle, and 22 mm wave washer, and install the tilting bolt.
- 5) Install the 8 x 203 mm hex. bolt.

 : Apply marine grease.



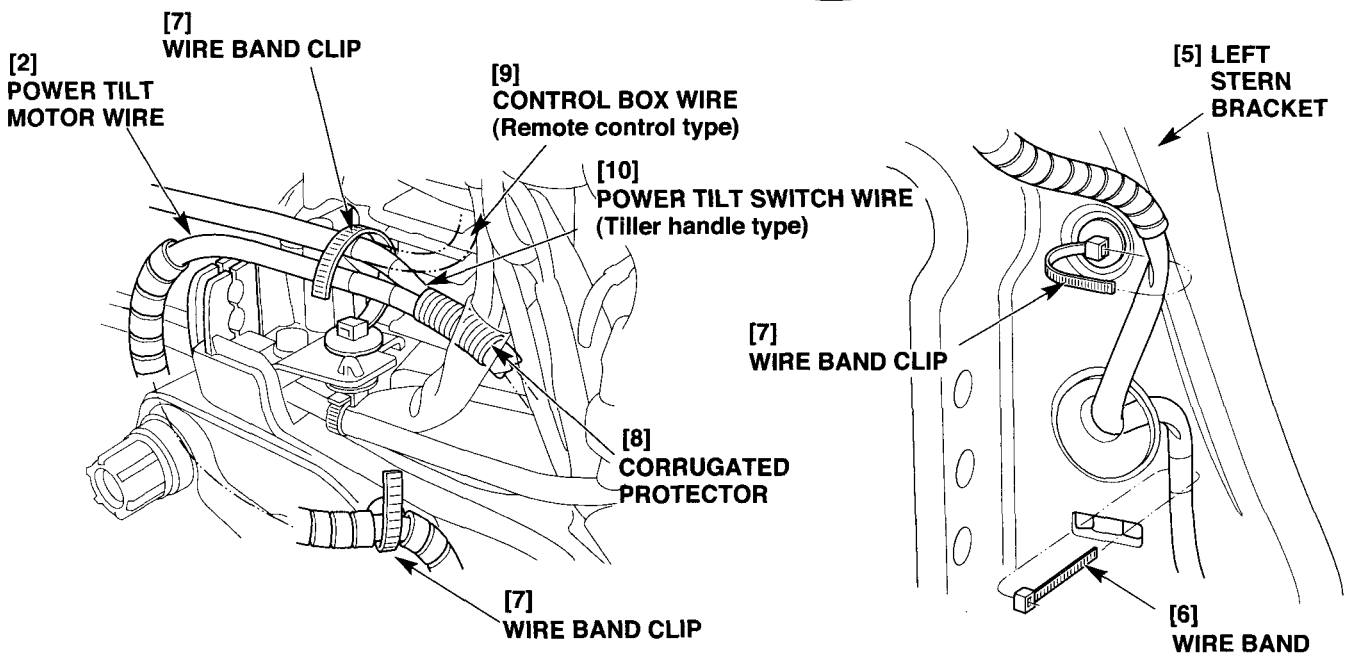
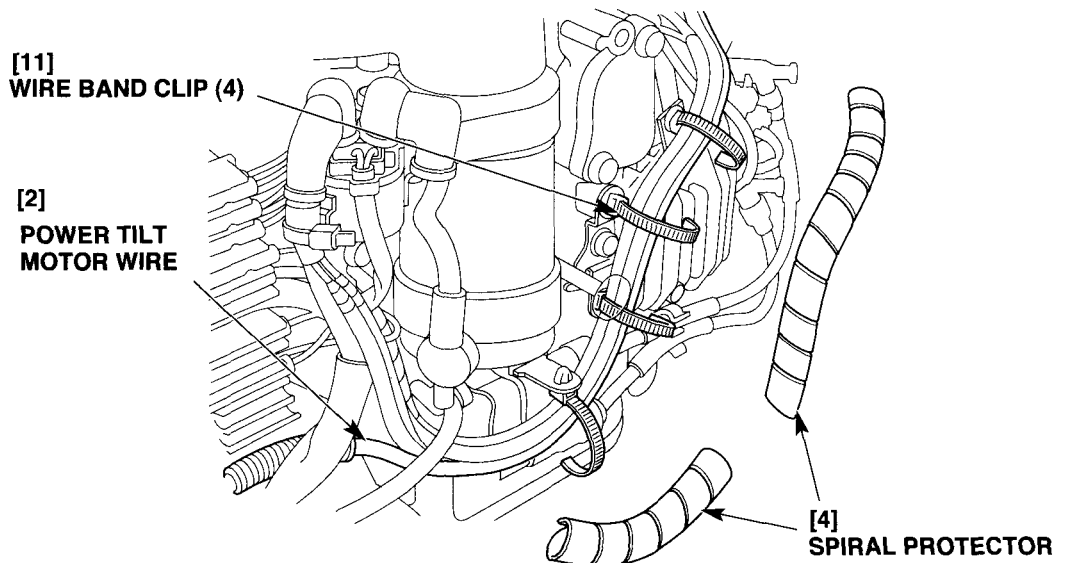
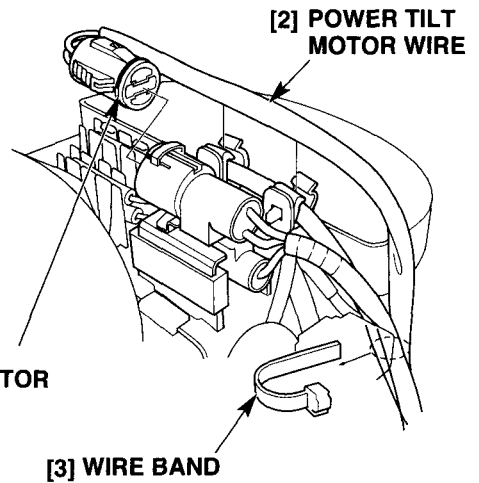
- 6) Apply grease to the 22 mm wave washer and install the wave washer and right stern bracket.
- 7) Loosely install a new 7/8-14UNF self-locking nut.
- 8) Install the 8 mm washer and 8 mm self-locking nut. Tighten the 8 mm self-locking nut to the specified torque.
TORQUE: 21 N • m (2.1 kgf • m, 15 lbf • ft)
- 9) Tighten the 7/8-14UNF self-locking nut to 40 N • m (4.1 kgf • m, 30 lbf • ft) then loosen 1/2 turn.
- 10) Install the adjusting rod and tilting bolt caps.
- 11) Install the anode and tighten the 6 x 12 mm flange bolt securely if the anode removed.
- 12) Move the tilt lever to tilt position and make sure that the swivel case moves free.
- 13) Install the removed parts in the reverse order of removal.



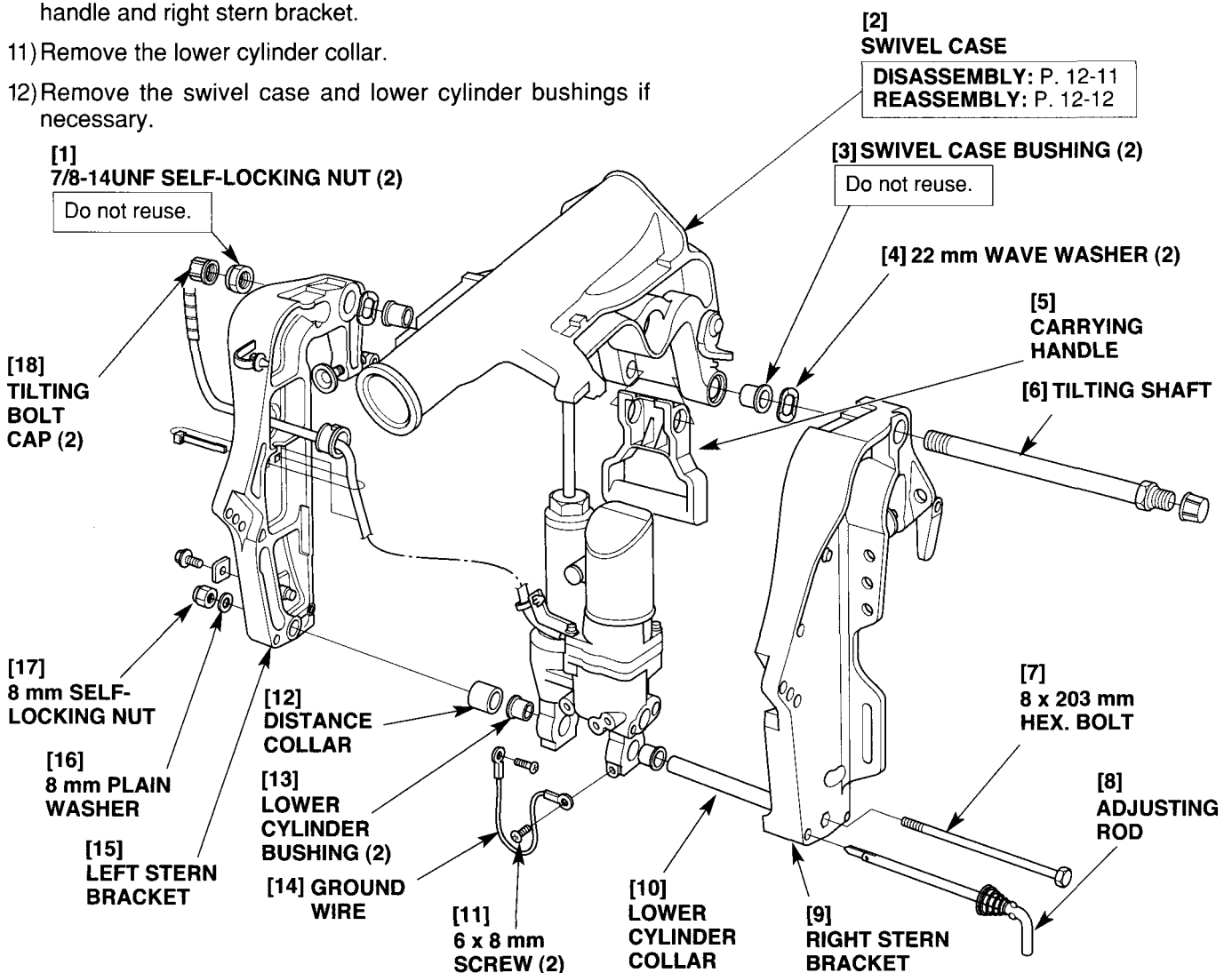
• POWER TILT

a DISASSEMBLY

- 1) Remove the power tilt motor wire from the motor:
 - Open the wire bands.
 - Open the wire band clips.
 - Remove the spiral protectors.
 - Remove the corrugated protector (Tiller handle type).



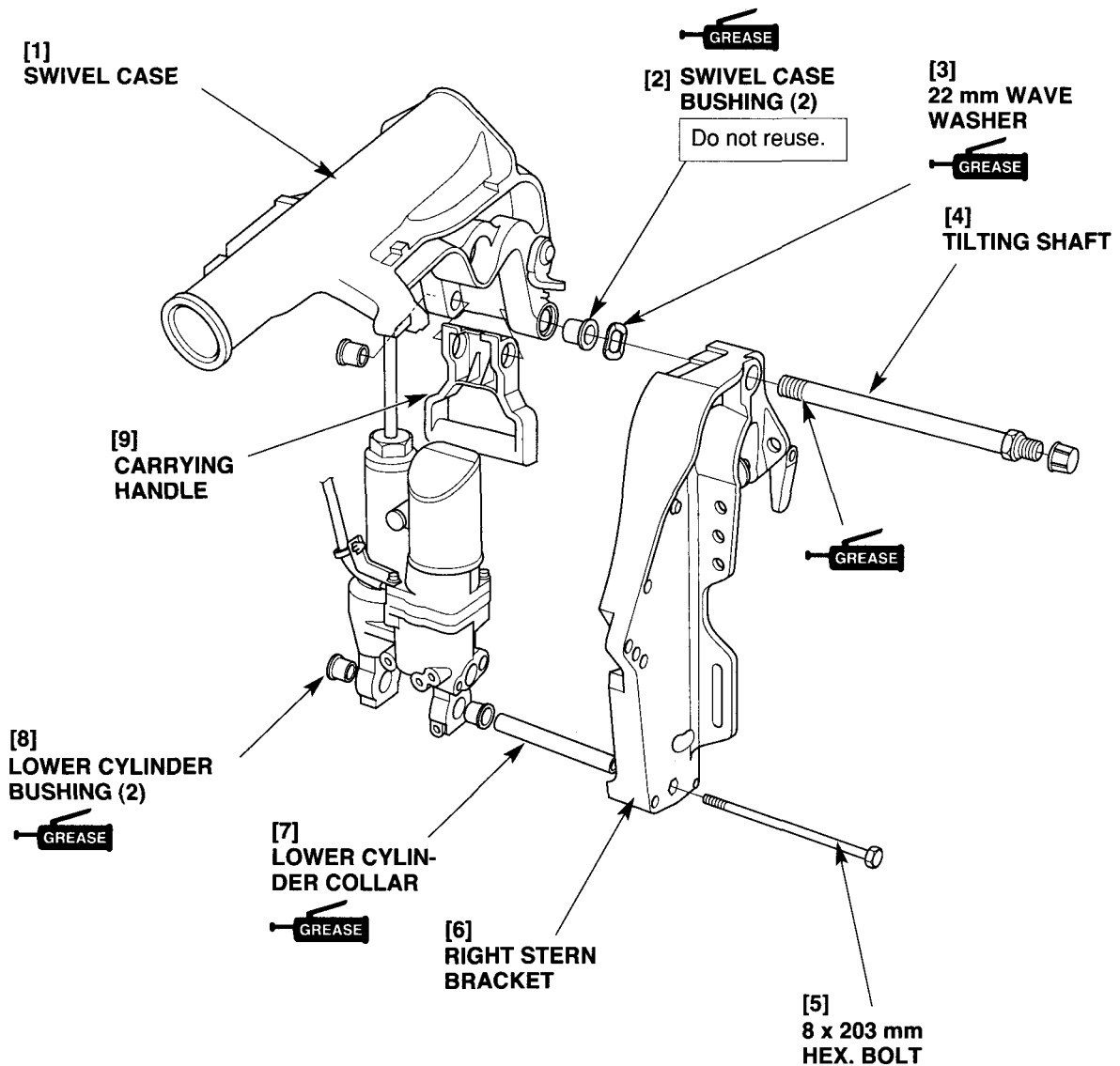
- 2) Remove the engine (see Section 8) , then remove the following:
 - oil case (P. 12-1).
 - friction adjusting lever (P. 12-3).
 - mount frame (P. 12-5).
- 3) Open the wire band and wire band clip and free the motor wire from the right stern bracket.
- 4) Remove the 6 x 8 mm screws and ground wire.
- 5) Turn the manual valve counterclockwise fully and rise the swivel case completely.
- 6) Remove the adjusting rod.
- 7) Remove the tilting bolt cap and loosen the 7/8-14UNF self-locking nut, then remove the 8 mm self-locking nut, 8 mm plain washer.
- 8) Remove the 7/8-14UNF self-locking nut.
- 9) Remove the left stern bracket, distance collar and 22 mm wave washer.
- 10) Remove the tilting shaft, 22 mm wave washer, carrying handle and right stern bracket.
- 11) Remove the lower cylinder collar.
- 12) Remove the swivel case and lower cylinder bushings if necessary.



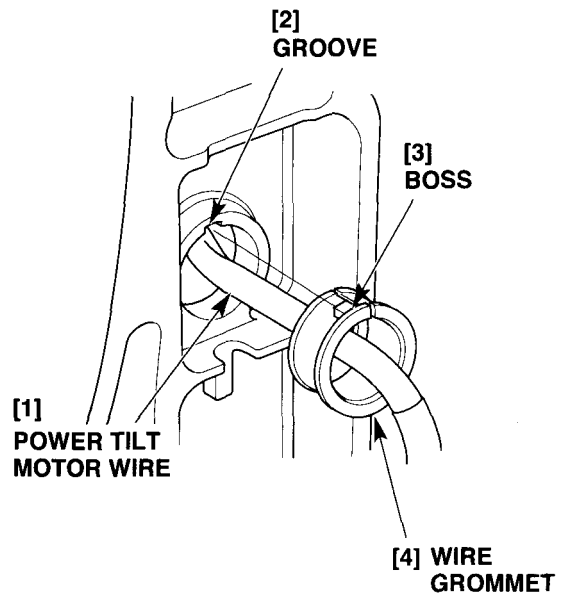
b. REASSEMBLY

- 1) Apply marine grease to new swivel case bushings and install them to the swivel case.
- 2) Apply marine grease to new lower cylinder bushings and lower cylinder collar, then install them to the gas assisted dumper lower mount.
- 3) Apply marine grease to the threads of the tilting shaft, mounting hole and wave washers.
- 4) Install the right stern bracket, carrying handle, and 22 mm wave washer, and install the tilting bolt.
- 5) Install the 8 x 203 mm hex. bolt.

 : Apply marine grease.

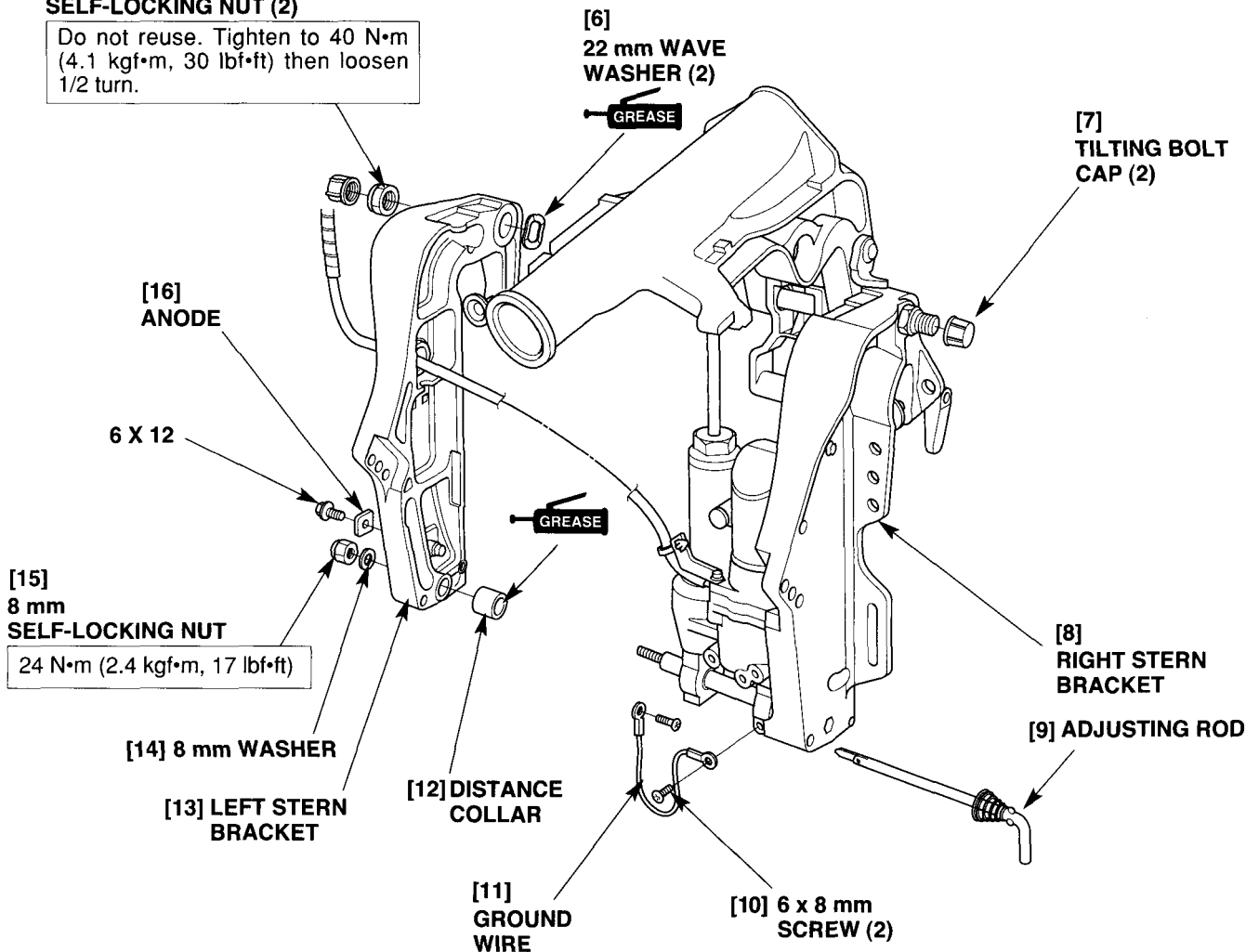


- 6) Set the motor wire grommet to the motor wire and install them to the left stern bracket by aligning the boss of the grommet with the groove of the left stern bracket
- 7) Apply grease to the 22 mm wave washer and distance collar, then install the wave washer, distance collar and right stern bracket.
- 8) Loosely install a new 7/8-14UNF self-locking nut.
- 9) Install the 8 mm washer and 8 mm self-locking nut. Tighten the 8 mm self-locking nut to the specified torque.
TORQUE: 21 N•m (2.1 kgf•m, 15 lbf•ft)
- 10) Tighten the 7/8-14UNF self-locking nut to 40 N•m (4.1 kgf•m, 30 lbf•ft) then loosen 1/2 turn.
- 11) Install the adjusting rod and tilting bolt caps.
- 12) Install the anode and tighten the 6 x 12 mm flange bolt securely if the anode removed.
- 13) Make sure that the swivel case moves free.



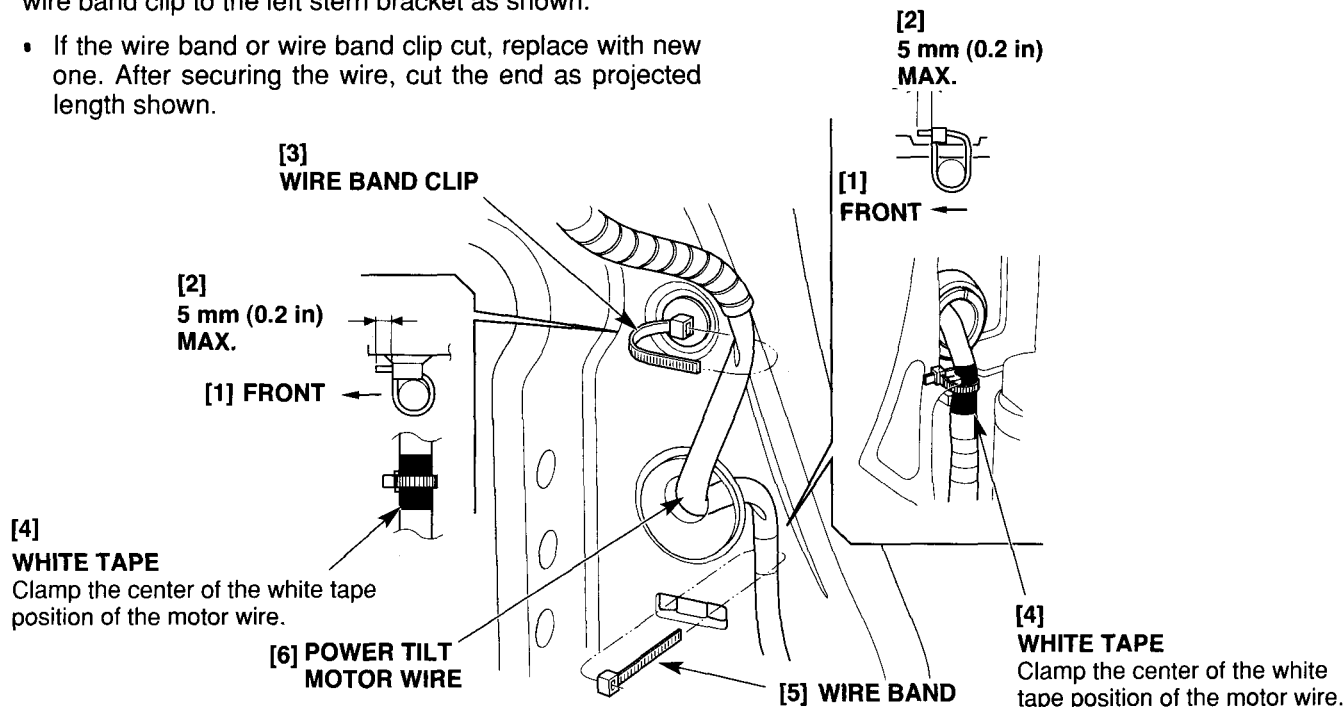
**[5]
7/8-14UNF
SELF-LOCKING NUT (2)**

Do not reuse. Tighten to 40 N•m (4.1 kgf•m, 30 lbf•ft) then loosen 1/2 turn.



14) Secure the power tilt motor wire with the wire band and wire band clip to the left stern bracket as shown.

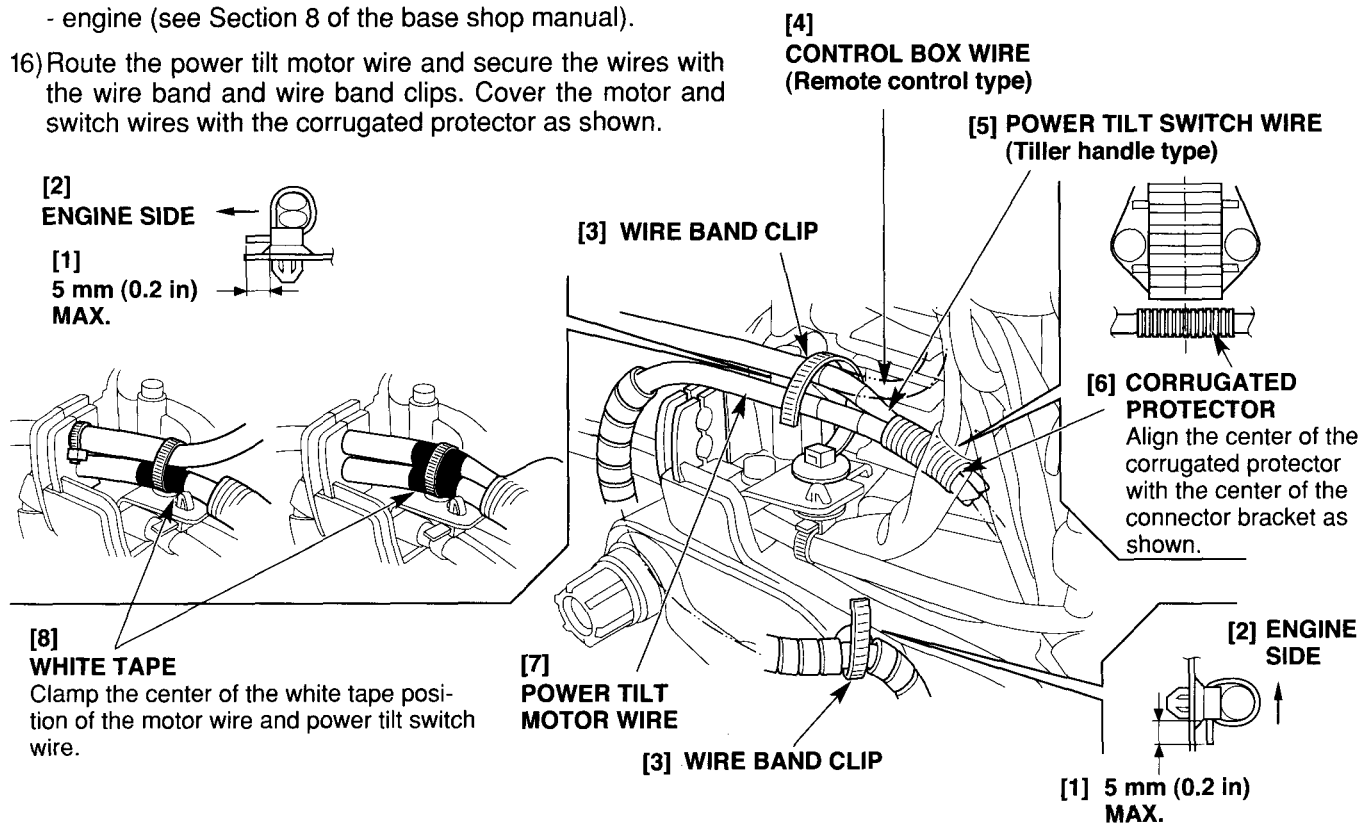
- If the wire band or wire band clip cut, replace with new one. After securing the wire, cut the end as projected length shown.



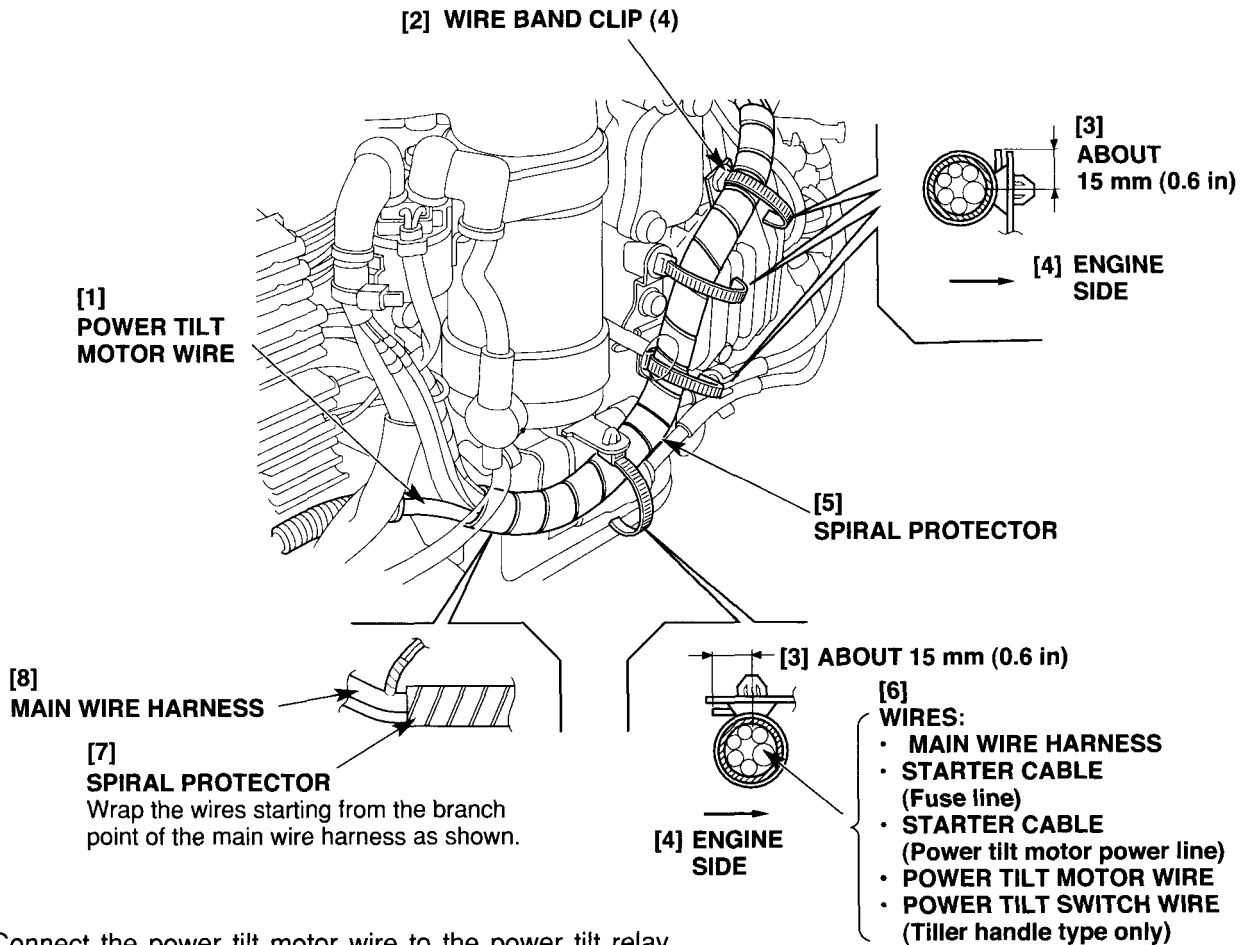
15) Install the following in the reverse order of removal:

- oil case (P. 12-1 of the base shop manual).
- friction adjusting lever (P. 12-3 of the base shop manual).
- mount frame (P. 12-5 of the base shop manual).
- engine (see Section 8 of the base shop manual).

16) Route the power tilt motor wire and secure the wires with the wire band and wire band clips. Cover the motor and switch wires with the corrugated protector as shown.

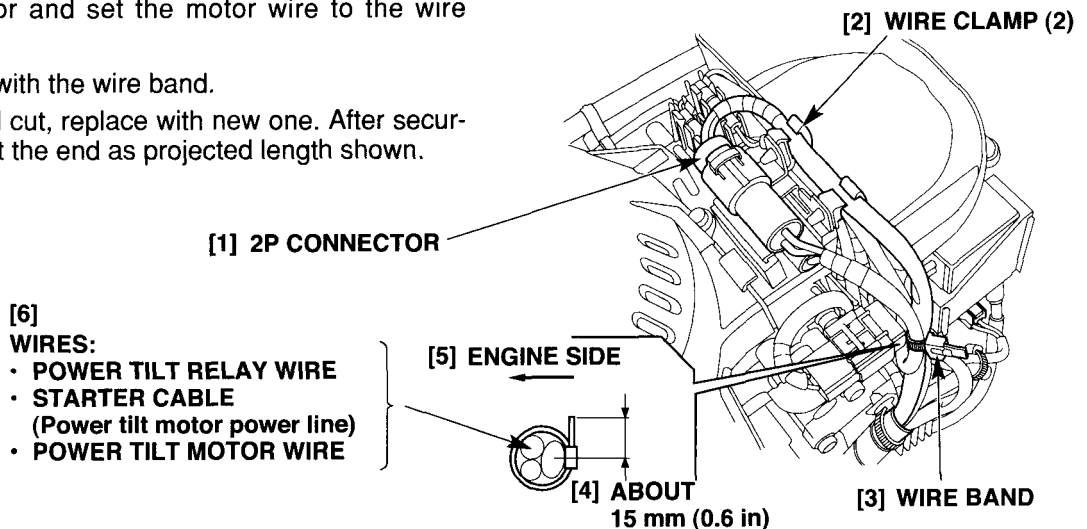


- 16) Route the power tilt motor wire along the main wire harness as shown and wrap the wires with the upper and lower spiral protectors as shown.
- 17) Secure the wires with the wire band clips.
- If the wire band clip cut, replace with new one. After securing the wire, cut the end as projected length



18) Connect the power tilt motor wire to the power tilt relay wire 2P connector and set the motor wire to the wire clamps.

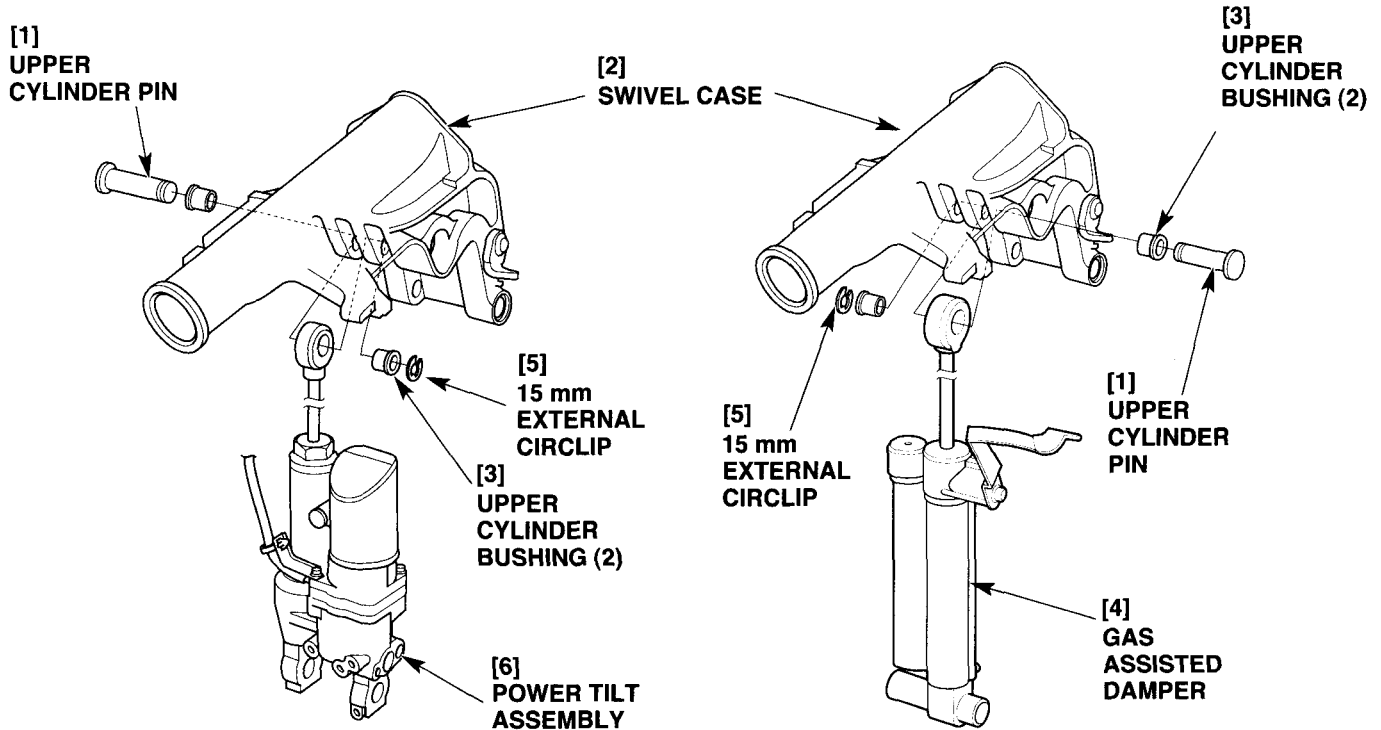
- 19) Secure the wires with the wire band.
- If the wire band cut, replace with new one. After securing the wire, cut the end as projected length shown.



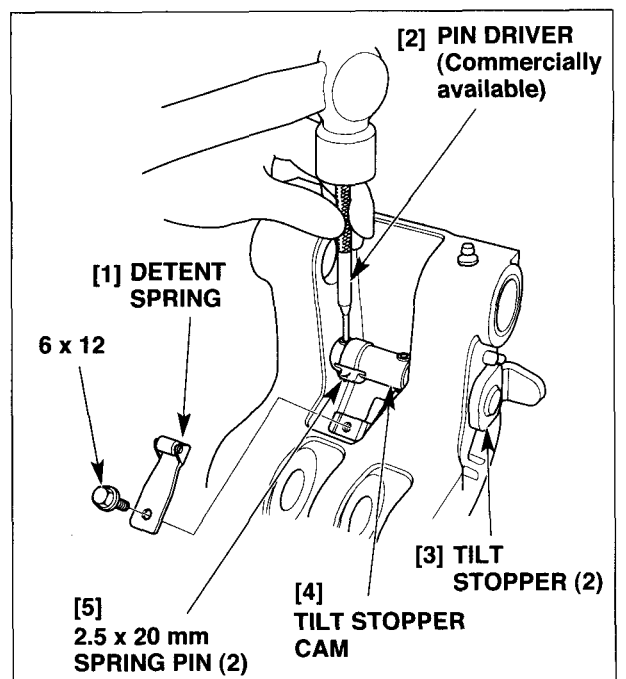
2. SWIVEL CASE

a. DISASSEMBLY

- 1) Remove the 15 mm external circlip.
- 2) Remove the upper cylinder pin and separate the gas assisted damper or power tilt assembly from the swivel case.
- 3) Remove the upper cylinder bushings if necessary.

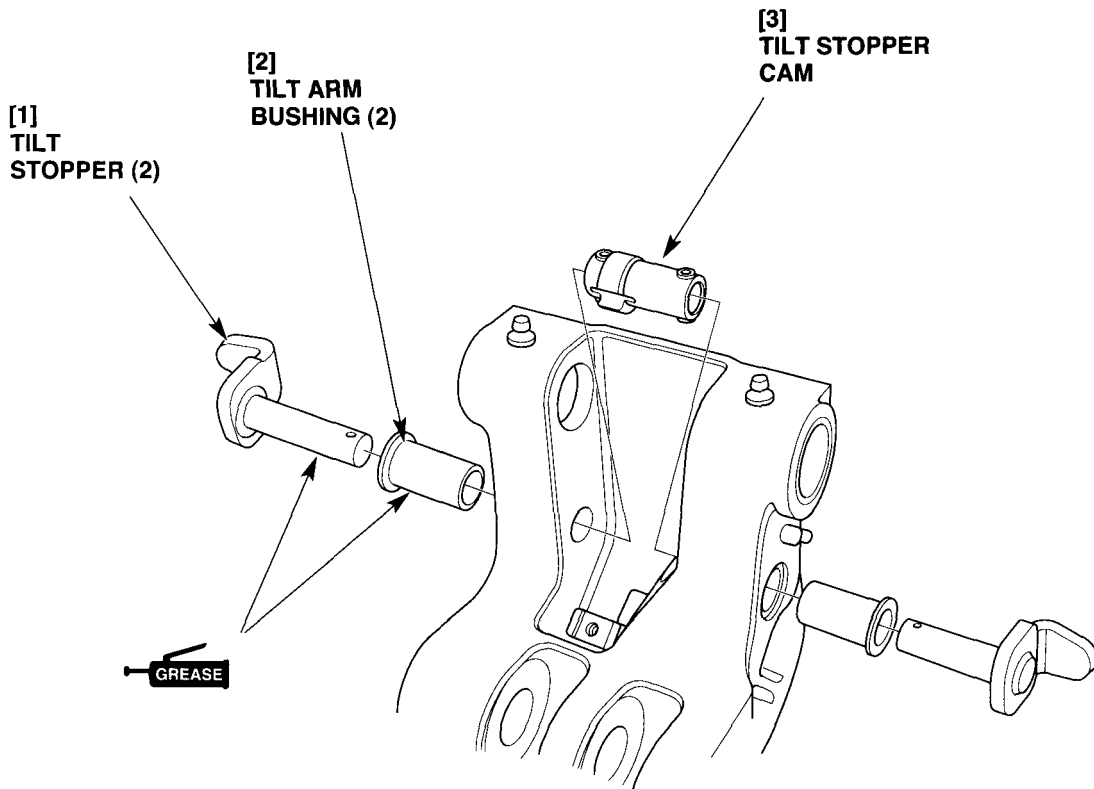


- 4) Remove the 6 x 12 mm flange bolt and detente spring.
- 5) Drive out the 2.5 x 20 mm spring pins using commercially available pin driver.
- 6) Remove the tilt stoppers and tilt stopper cam.
- 7) Remove the tilt arm bushings.

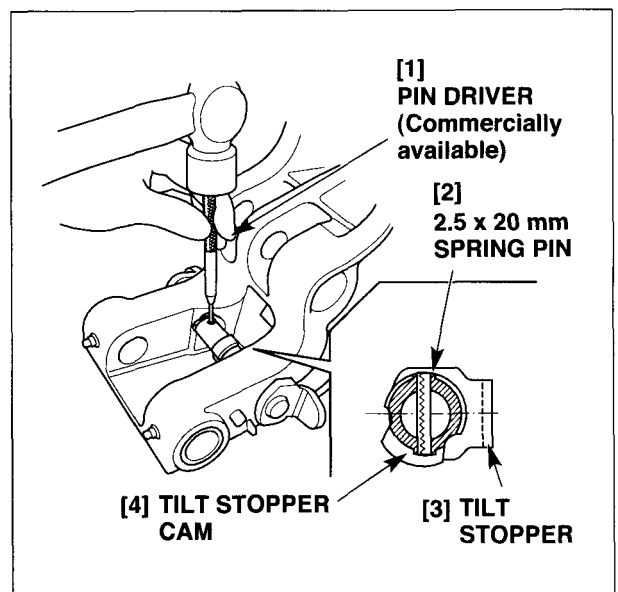


b. REASSEMBLY

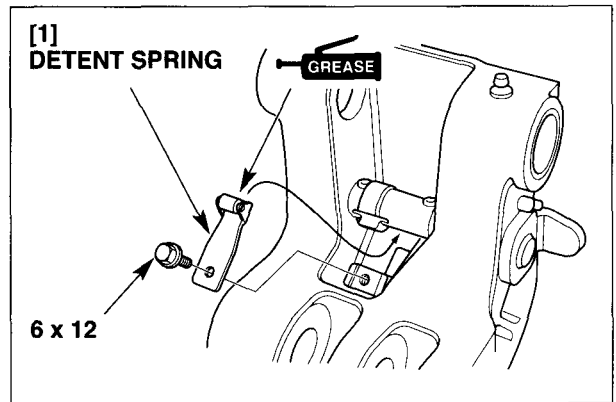
- 1) Apply marine grease to the tilt arm bushings and install them.
- 2) Apply marine grease to the shaft of the tilt stopper, then install the tilt stopper cam and tilt stoppers.



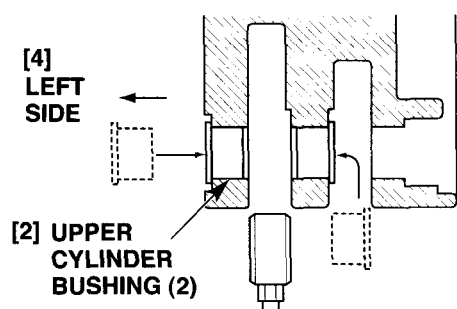
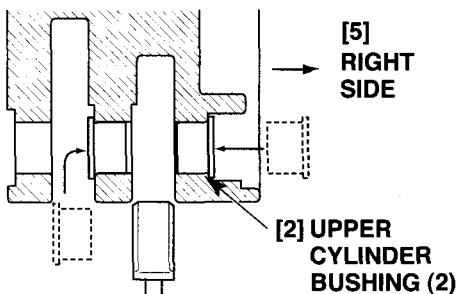
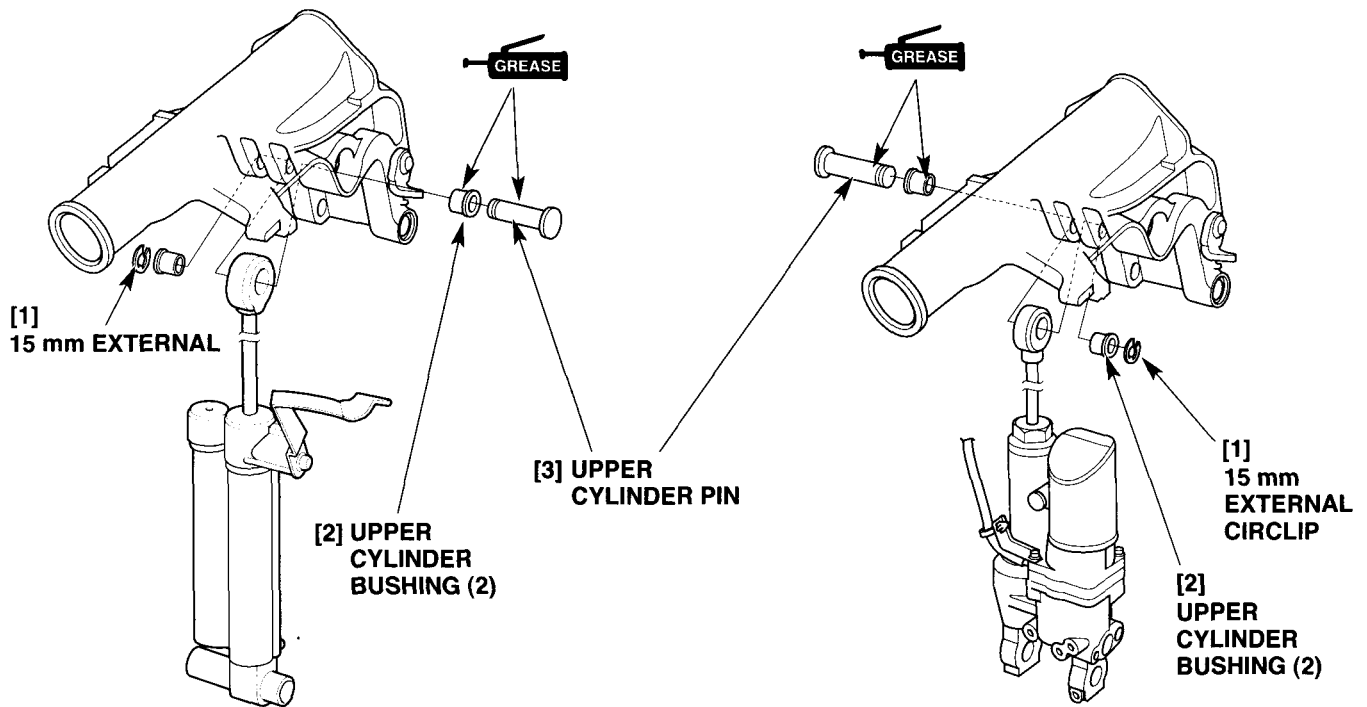
- 3) Align the pin hole so that the tilt stopper and tilt stopper cam as shown and drive the 2.5 x 20 mm spring pin using a commercially available pin driver until the pin end aligns with the tilt stopper cam as shown.



- 4) Install the detente spring and tighten the 6 x 12 mm flange bolt securely. Apply grease to the roller of the detente spring.



- 5) Apply marine grease to the upper cylinder bushings and install them to the swivel case as shown.
6) Install the gas assisted damper with the tilt lever facing to the right side or power tilt assembly with the power tilt motor facing to the right side, then install the upper cylinder pin and secure it with the 15 mm external circlip.



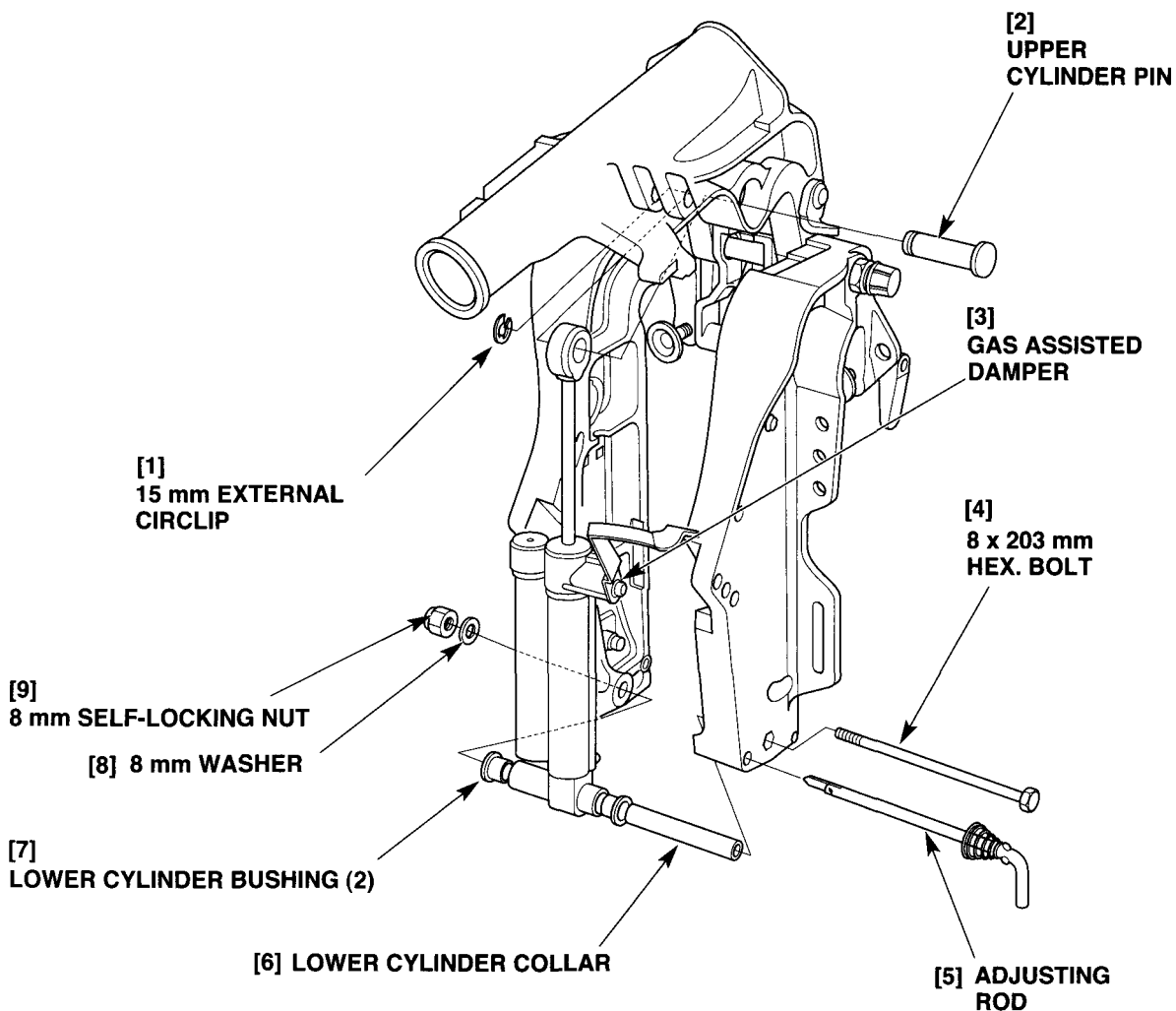
3. GAS ASSISTED DAMPER

a. REMOVAL

- 1) Remove the adjusting rod.
- 2) Remove the 8 mm self-locking nut, 8 mm plain washer and 8 x 203 mm hex. bolt.
- 3) Remove the 15 mm external circlip and pull out the upper cylinder pin.
- 4) Remove the gas assisted damper from the swivel case.
- 5) Remove the lower cylinder collar and lower cylinder bushings.

NOTICE

After removing the gas-assisted damper, store it upright with the upper cylinder pin mounting part toward up. Do not store the gas-assisted damper by laying it on its side or with the lower cylinder bushing installation part toward up.

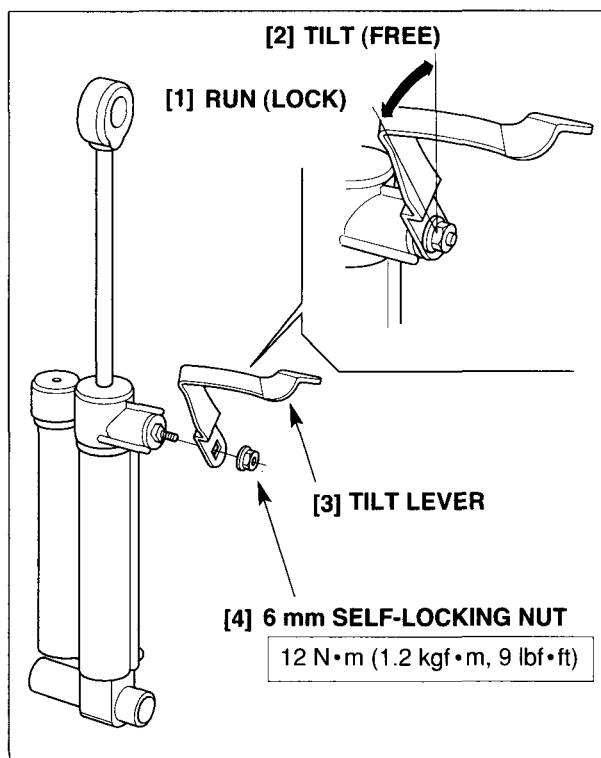


b. TILT LEVER REPLACEMENT

- Before removing the tilt lever, set the tilt lever to the run position
- Install the tilt lever by aligning the mounting hole of the lever with the tilt lever shaft as shown.

NOTICE

Store the gas-assisted damper upright with the upper cylinder pin mounting part toward up. Do not store the gas-assisted damper by laying it on its side or with the lower cylinder bushing installation part toward up.



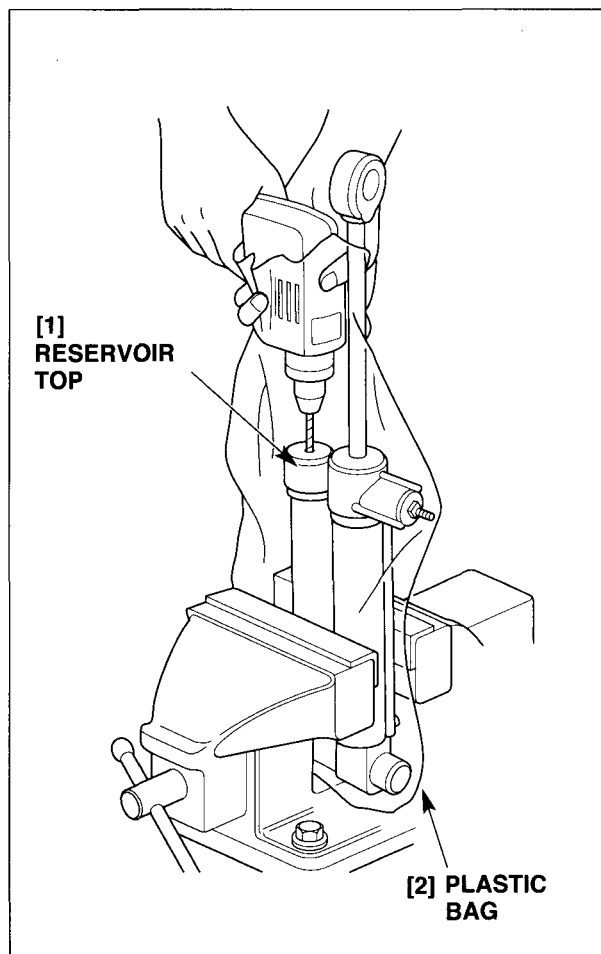
c. DISPOSAL

- 1) Set the tilt lever in the "TILT" position with the piston rod fully extended, then remove the tilt lever.
- 2) Center punch the reservoir end to mark the drilling point.
- 3) Wrap the damper inside a plastic bag and support the damper in a vice as shown.
- 4) Through the open end of the plastic bag, insert a drill motor with a sharp 2 - 3 mm (5/64 - 1/8 in) drill bit.

CAUTION

- The gas assisted damper contains nitrogen gas and oil under heigh pressure. Do not drill any farther reservoir top, or you may drill into the oil chamber; oil escaping under high pressure may cause serious personal injury.
- Do not use a dull drill bit which could cause a build-up of excessive heat and pressure inside the damper, leading to explosion and severe personal injury.
- Always wear eye protection to avoid getting metal shaving in your eyes when the gas pressure is released. The plastic bag is only intended to shield you from the escaping gas.


- 5) Hold the bag around the drill motor and briefly run the drill motor inside the bag; this will inflate the bag with air from the drill motor and keep the bag from getting caught in the bit when you start.

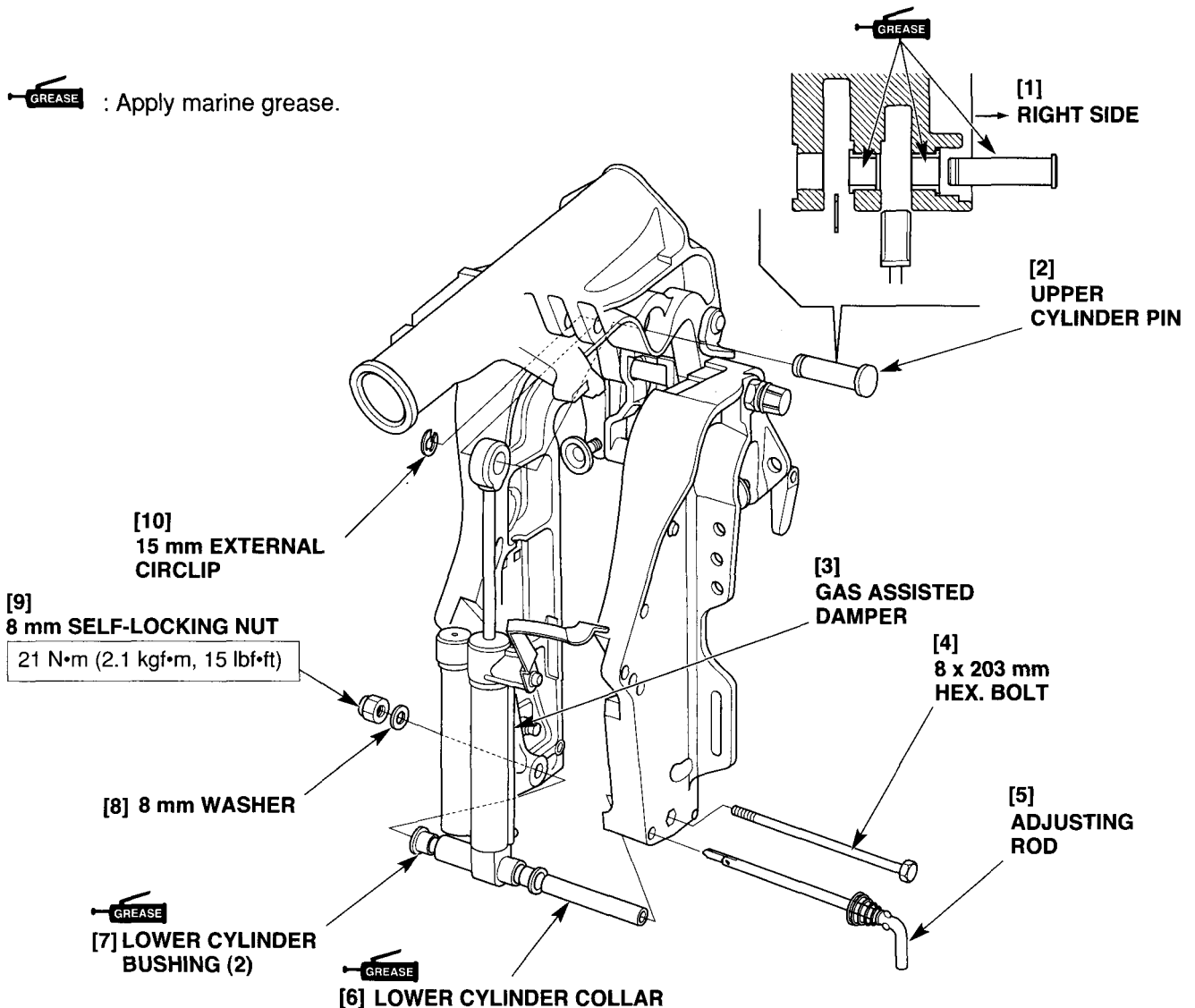


d. INSTALLATION

- 1) Install new lower cylinder bushings if they are removed.
- 2) Apply marine grease to the lower cylinder bushings and lower cylinder collar, then install the lower cylinder collar to the gas assisted dumper lower mount.
- 3) Apply marine grease to the swivel case bushings.
- 4) Install the gas assisted damper to the swivel case.
 - Set the piston rod in the fully extended position before installation.
- 5) Install the upper cylinder pin through the right side of the swivel case as shown and secure it with the 15 mm external circlip.
- 6) Set the gas assisted damper to the lower mounting hole and install the 8 x 203 mm hex. bolt and 8 mm washer.
- 7) Tighten the 8 mm self-locking nut to the specified torque.

TORQUE: 21 N·m (2.1 kgf·m, 15 lbf·ft)

 : Apply marine grease.



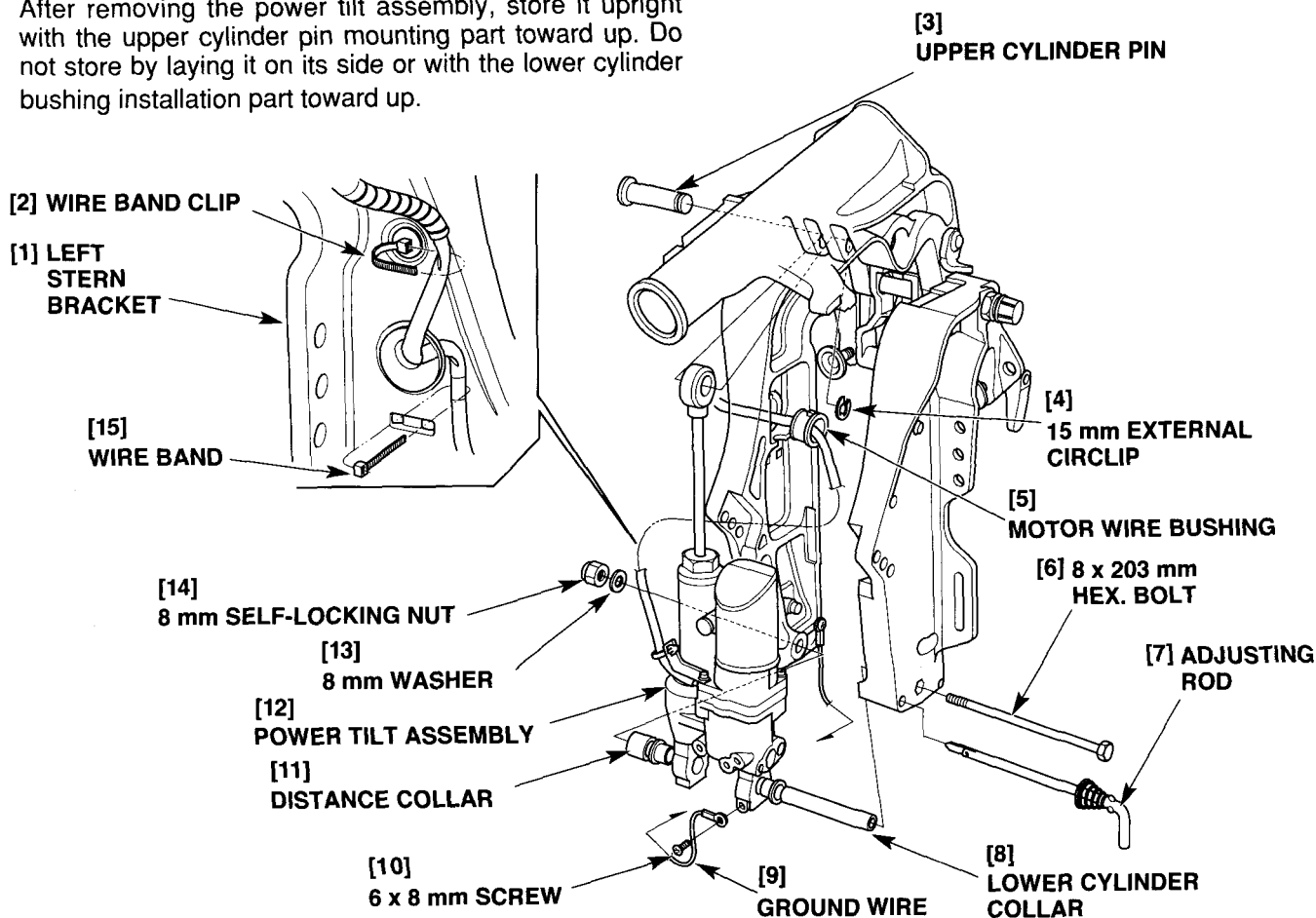
4. POWER TILT ASSEMBLY

a. REMOVAL

- 1) Remove the following:
 - remove the motor wire from the motor (P. 13-9)
 - engine (section 8).
 - oil case (P. 12-1).
 - friction adjusting lever (Tiller handle type only P. 12-3).
 - mount frame (P. 12-5).
- 2) Open the wire band and wire band clip and free the motor wire from the right stern bracket, then pull the motor wire from the left stern bracket with the motor wire bushing.
- 3) Remove the 6 x 8 mm screw and ground wire from the power tilt assembly.
- 4) Remove the adjusting rod.
- 5) Remove the 8 mm self-locking nut and 8 mm plain washer.
- 6) Remove the distance collar and lower cylinder collar.
- 7) Tilt up the swivel case, and remove the 15 mm external circlip and upper cylinder pin and remove the power tilt assembly.

NOTICE

After removing the power tilt assembly, store it upright with the upper cylinder pin mounting part toward up. Do not store by laying it on its side or with the lower cylinder bushing installation part toward up.



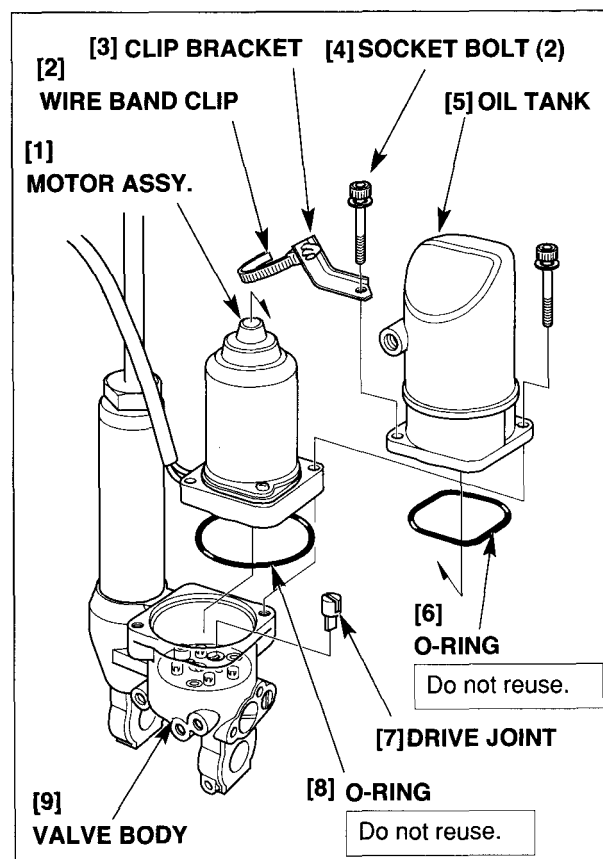
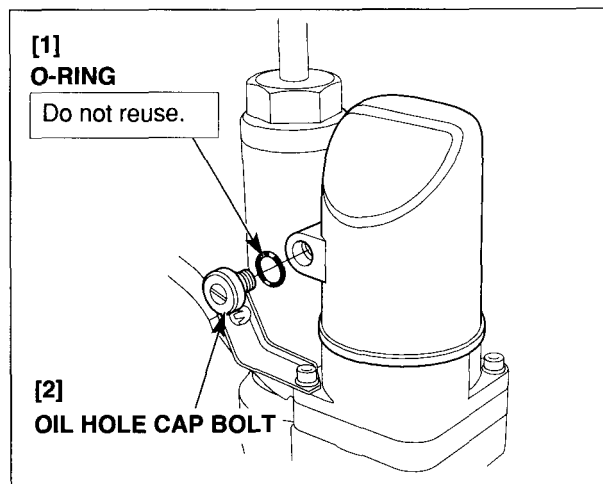
b. DISASSEMBLY

NOTICE

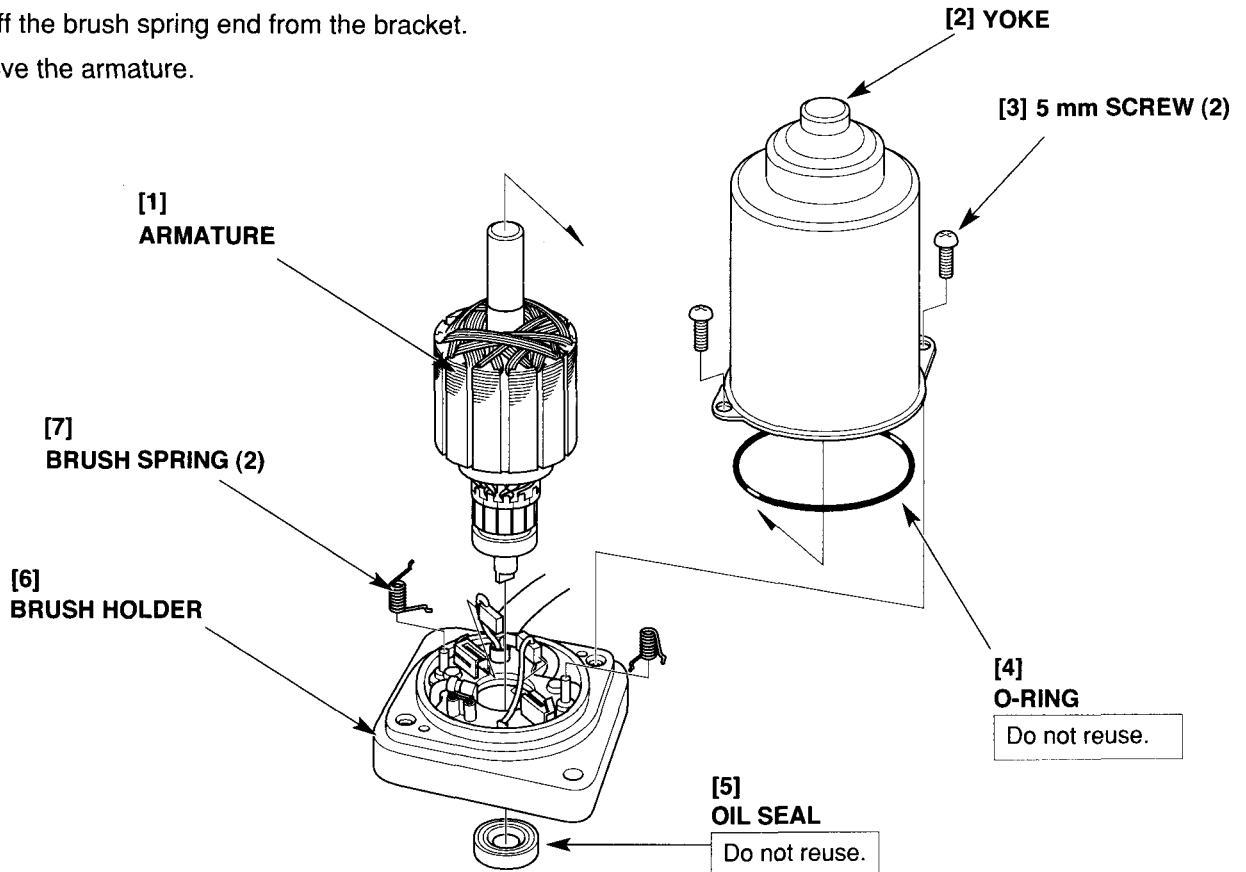
- Do not disassemble the gear pump assembly. If it is faulty, replace it as an assembly.
- Do not use a shop towel, cloth, gloves, etc.
- Do not reuse the drained automatic transmission fluid (ATF).
- Do not hold at the outer tube when holding the power tilt assembly in a vise during operation.
- Clean the removed parts in fresh automatic transmission fluid (ATF), and blow each port of the parts with compressed air. Set the parts neatly in a suitable container with care not to contaminate them with dust and dirt.
- Do not reuse the O-rings.
- Remove each valve and sleeve with care not to damage the sliding surface of the parts.

• POWER TILT MOTOR

- 1) Connect the power tilt motor 2P connector and operate the power tilt motor assembly until the piston rod extends fully.
- 2) Loosen the manual valve fully.
- 3) Remove the oil hole cap bolt and drain the ATF in the oil tank through the bolt hole.
- 4) Remove the O-ring from the oil hole cap bolt and discard it. Replace the O-ring with a new one on reassembly.
 - Do not drain the ATF by pushing in the piston rod.
- 5) Open the wire band clip and free the motor wire.
- 6) Remove the two socket bolts and washers, and remove the oil tank and power tilt motor assembly.
- 7) Drain the ATF from the valve body.
- 8) Remove the two O-rings from the power tilt motor assembly and discard them. Replace the O-rings with new ones when reassembly.
- 9) Remove the drive joint from the gear pump assembly.



- 10) Remove the 5 mm screws, yoke and O-ring.
- 11) Pull off the brush spring end from the bracket.
- 12) Remove the armature.



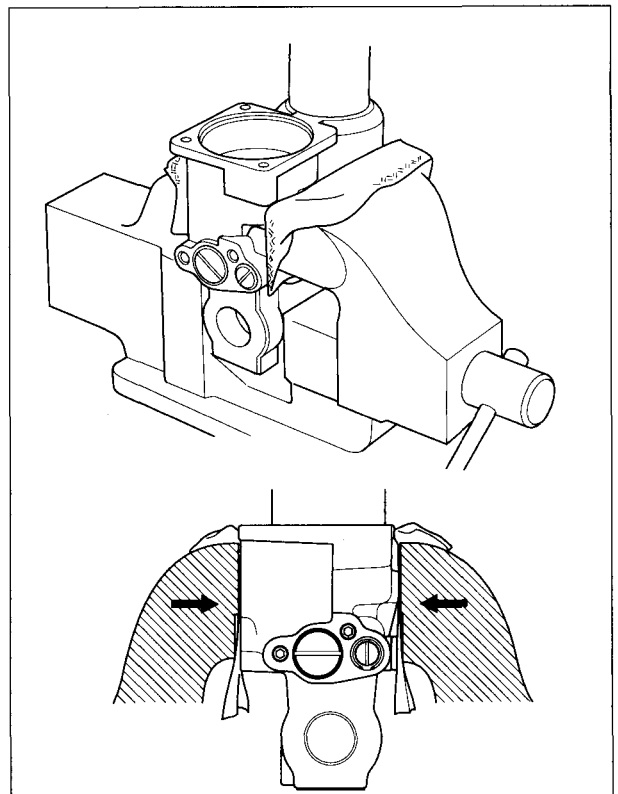
• CYLINDER, PISTON ROD

- 1) Hold the valve body in a vise with shop towel or soft jaws as shown.

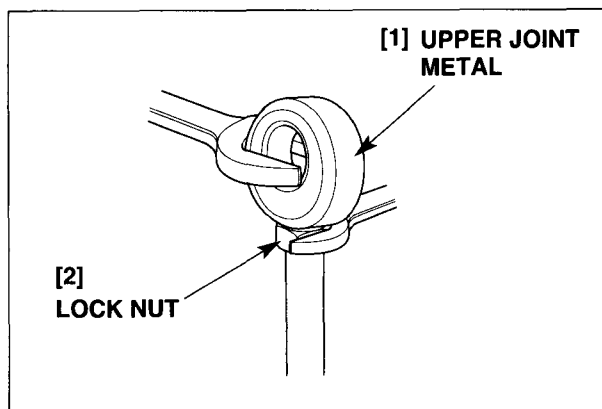
NOTICE

Take care not to tighten the vise too tight as it damages the valve body

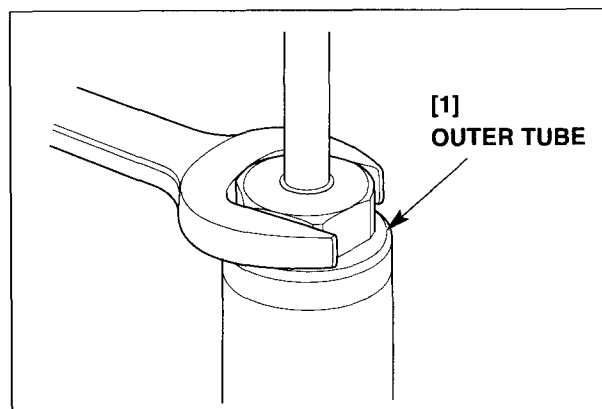
- If it is need to disassemble the valve body, loosen the spool vale (P. 12-23).



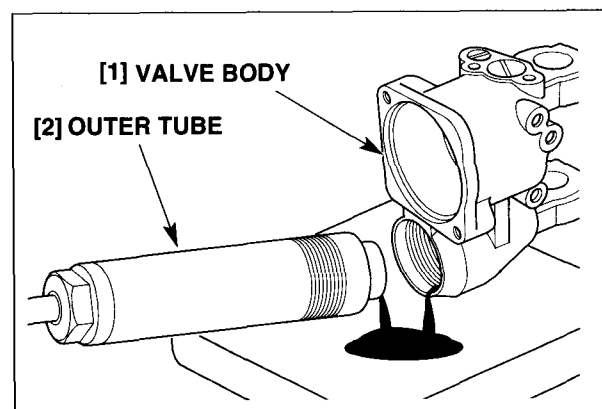
- 2) Loosen the lock nut, then remove the upper joint metal and lock nut.



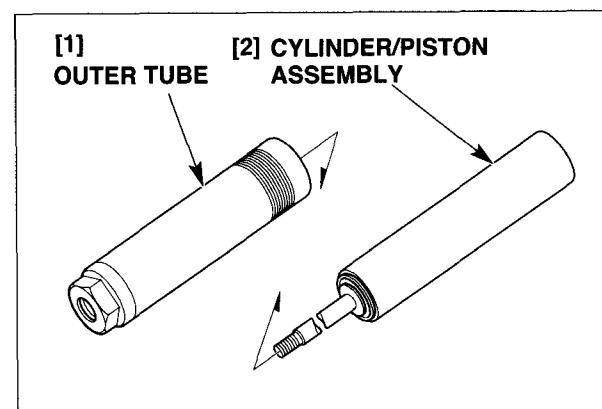
- 3) Loosen the outer tube, then remove the valve body from the vise.



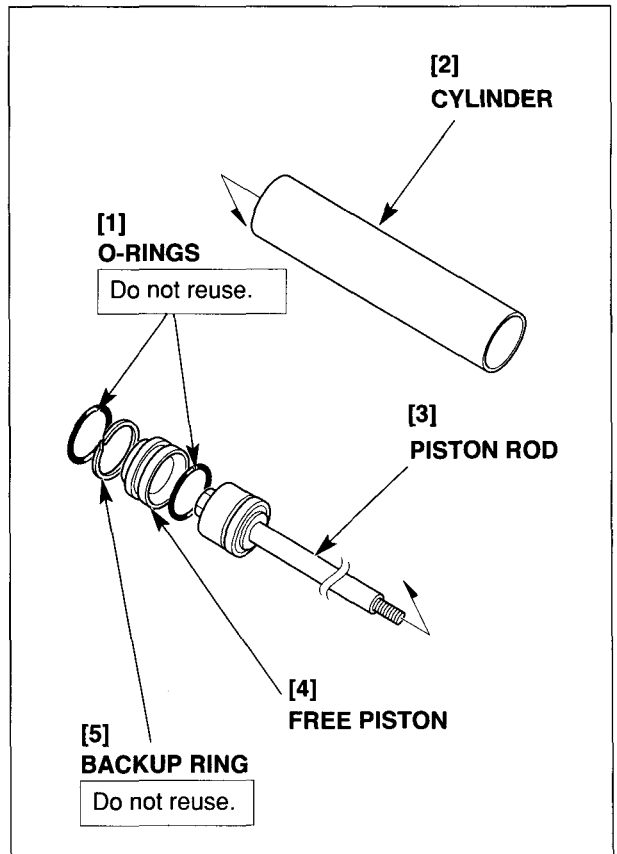
- 4) Loosen the outer tube slowly. Drain the residual ATF from the outer tube and valve body and remove the outer tube from the valve body.



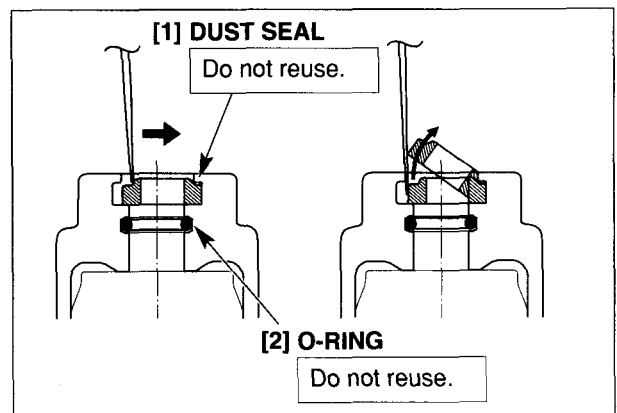
- 5) Remove the cylinder/piston assembly from the outer tube.



- 6) Remove the piston rod and free piston from the cylinder.
- 7) Remove the O-ring from the piston rod and discard it. Replace the O-ring with a new one when reassembly.
- 8) Remove the backup ring and O-ring from the free piston and discard them. Replace the backup ring and O-ring as a set when reassembly.

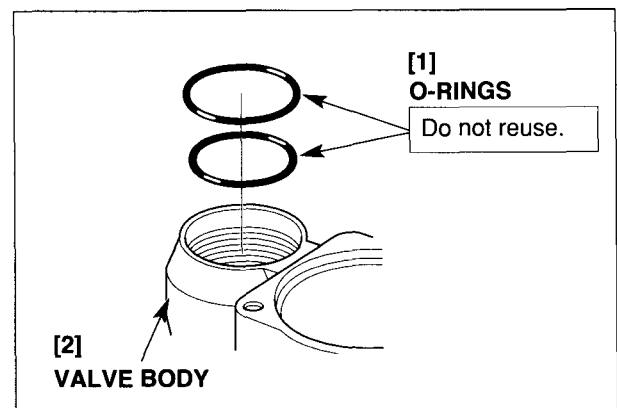


- 9) Remove the dust seal and O-ring from the outer tube and discard them. Replace the O-ring and dust seal with new one when reassembly.

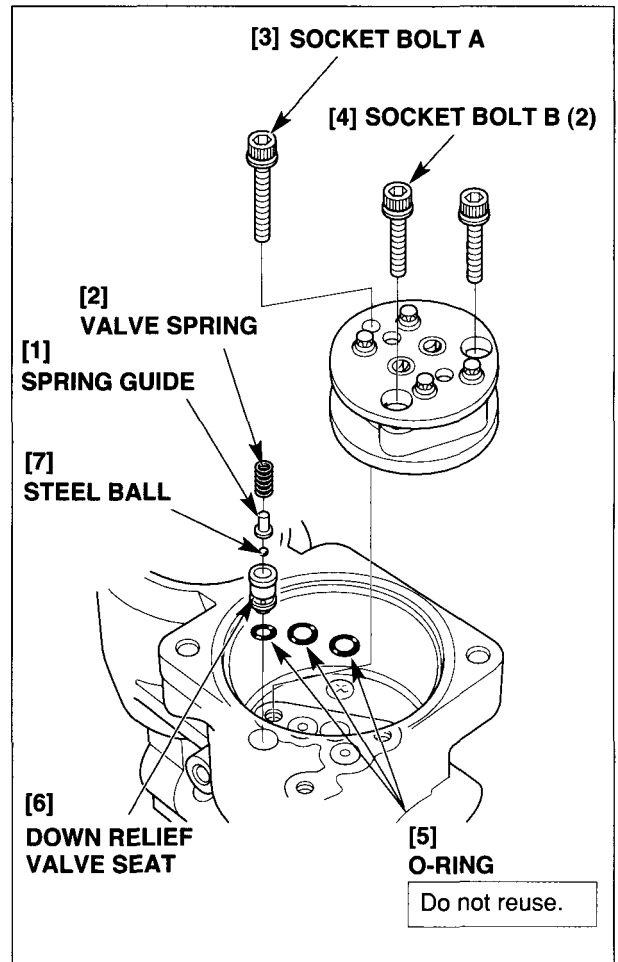


• VALVE BODY

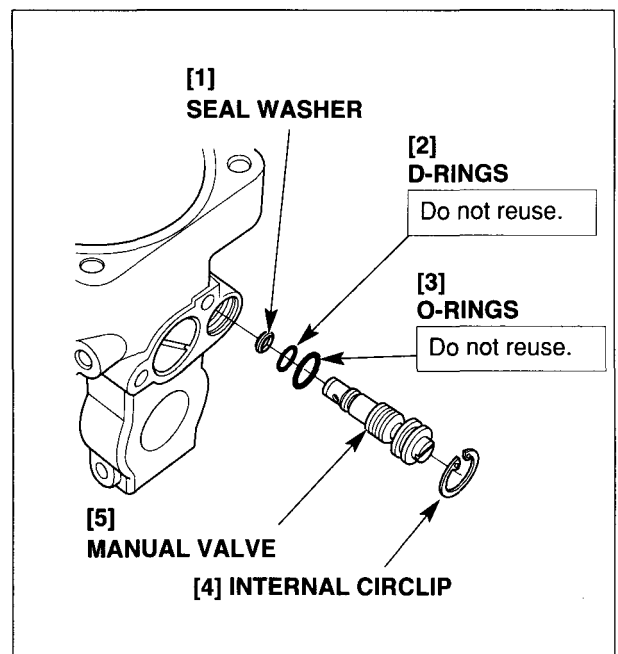
- 1) Remove the two O-rings from the valve body and discard them. Replace the O-rings with the new ones when reassembly.



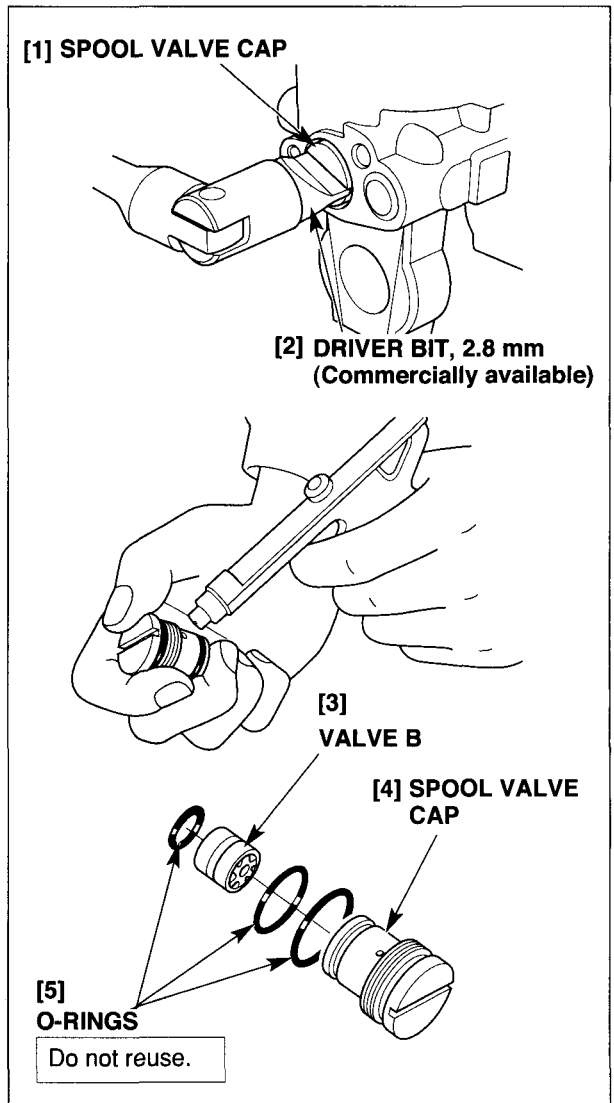
- 2) Remove the socket bolts and gear pump assembly.
 - Do not disassemble the gear pump assembly. If it is faulty, replace it as an assembly.
- 3) Remove the two O-rings, valve spring, spring guide, steel ball and the down relief valve seat from the valve body. Remove the O-ring from the down relief valve seat. Discard the O-rings, replace the O-rings with new ones when reassembly.



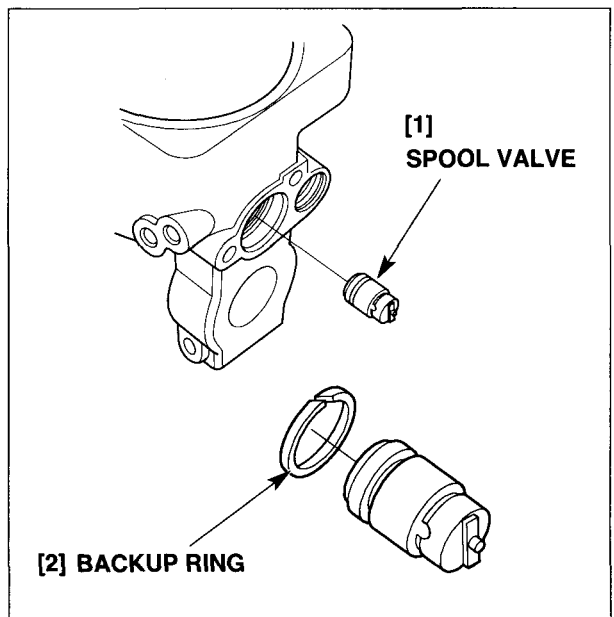
- 4) Remove the internal circlip, and remove the manual valve and seal washer.
- 5) Remove the O-ring and D-ring, and discard them. Replace with new ones when reassembly.



- 6) Remove the spool valve cap using a commercially available driver bit 2.8 mm.
- 7) Apply small squirt of air pressure to the oil hole in the spool valve cap to remove the valve B. Remove the valve B from the spool valve cap.
- 8) Remove the O-rings from the spool valve cap and valve B and discard them. Replace the O-rings with the new ones on reassembly.



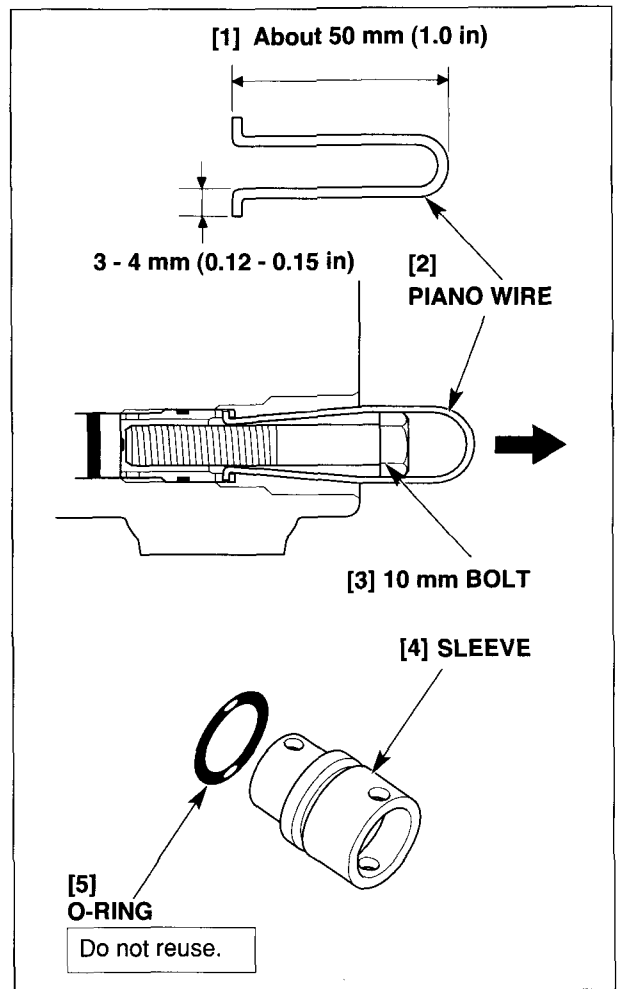
- 9) Remove the spool valve from the valve body
Check the backup ring on the spool valve for damage and scratches. Replace the backup ring if it is damaged or scratched.



10) Process a piece of piano wire of 1.5 mm in diameter as shown.

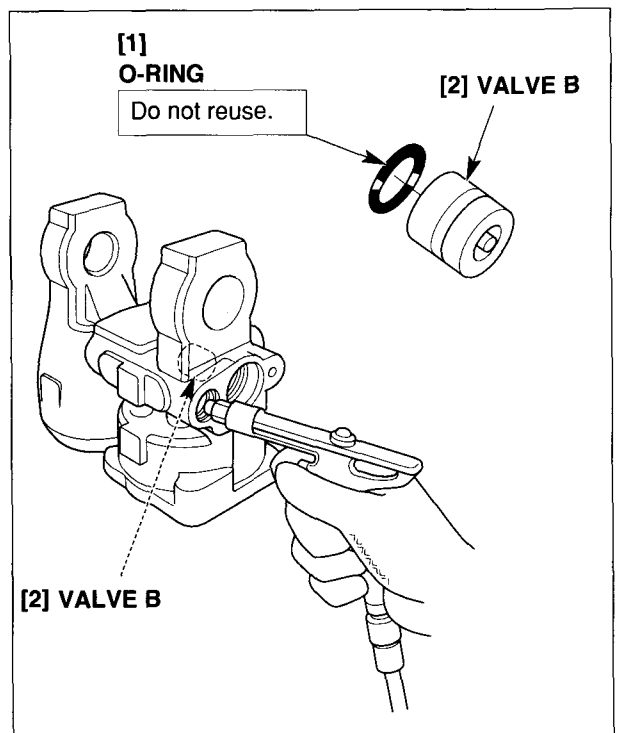
11) Set the processed wire in the holes in both sides of the sleeve as shown, and secure the wire by inserting the 10 mm bolt into the sleeve. Remove the sleeve from the valve body by pulling the wire with care not to damage the valve body.

Remove the O-ring from the sleeve and discard it. Replace the O-ring with a new one on reassembly.



12) Set the valve body as shown. Apply small squirt of air pressure to the manual valve installation hole to remove the valve B. Remove the valve B from the valve body

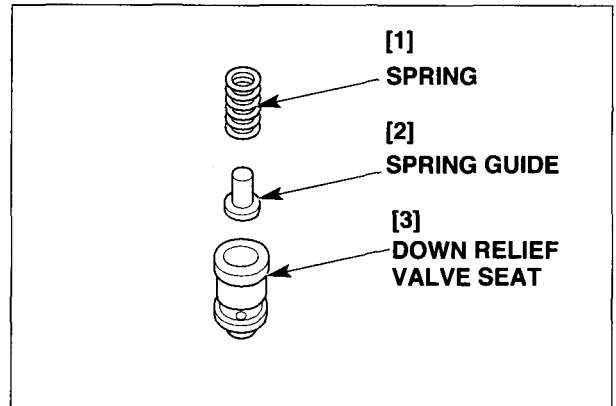
13) Remove the O-ring from the valve comp. B. Replace the O-ring with a new one on reassembly.



c. INSPECTION

• DOWN RELIEF VALVE SEAT

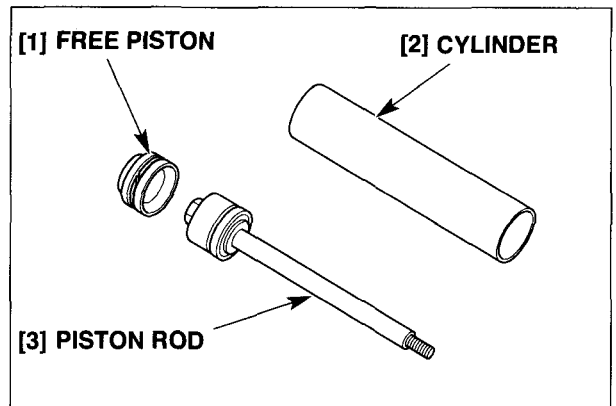
Check the down relief valve seat, spring guide and spring for wear or damage. Replace the down relief valve seat, spring guide or spring if damaged or worn.



• CYLINDER, PISTON, FREE PISTON

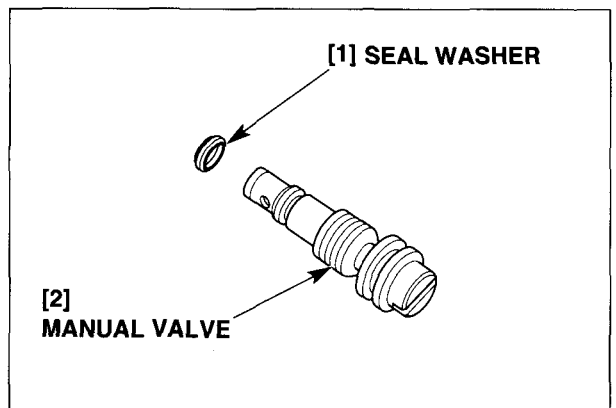
Check the piston rod for damage and bent. Replace the piston rod with a new one if necessary.

Check the inner and outer surfaces of the cylinder for damage and scratch. Replace the cylinder with a new one if it is damaged or scratched.



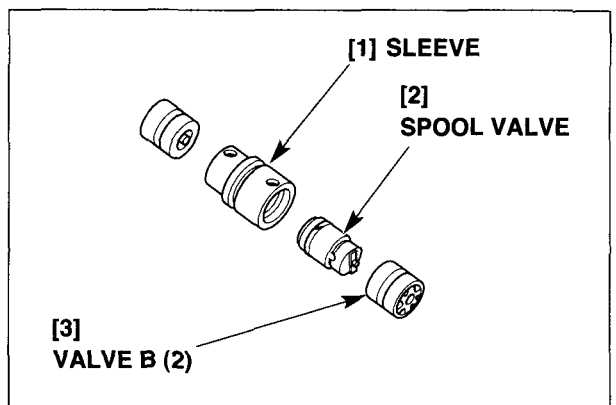
• MANUAL VALVE SEALING CUP

Check the manual valve and seal washer for wear or damage and deterioration. Replace if it is damaged or deteriorated.



• SPOOL VALVES

Check the sliding surface of the valve B, spool valve, sleeve for damage, scratch and wear, replace if necessary.



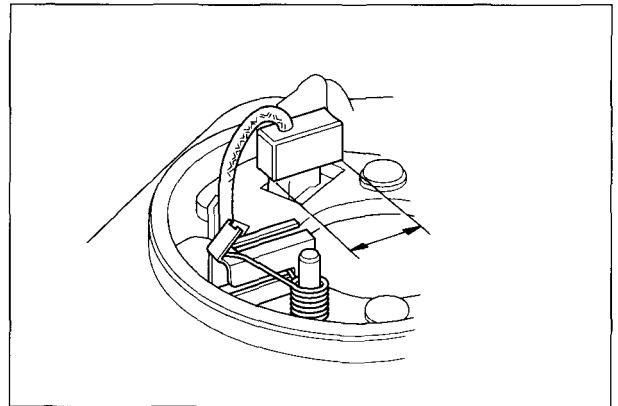
• **POWER TILT MOTOR**

• **Brush**

Measure the brush length.

If the brush length is less than the service limit, replace the brush holder assembly.

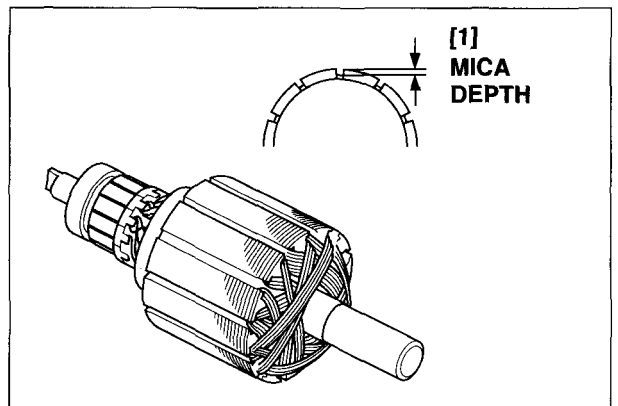
Standard	Service limit
10 mm (0.4 in)	6 mm (0.2 in)



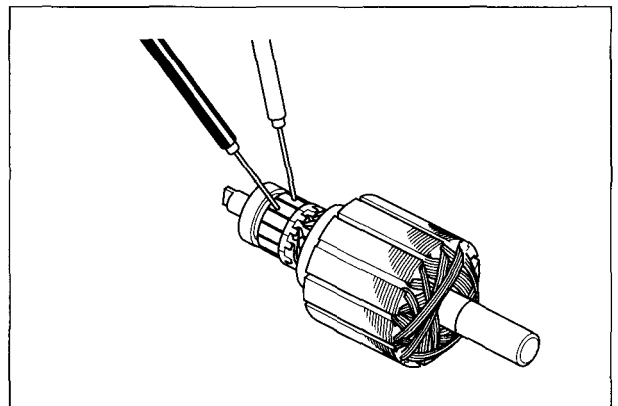
• **Armature**

- 1) Check the armature for wear or damage. Replace if necessary.
- 2) Visually inspect the commutator surface for dust, rust or other damage. If necessary, wipe it with a clean lint-free cloth or dress with a fine emery cloth.
- 3) Measure the mica depth. If the grooves are clogged, clean the grooves and measure the depth again. If the measurement is less than the service limit, replace the armature.

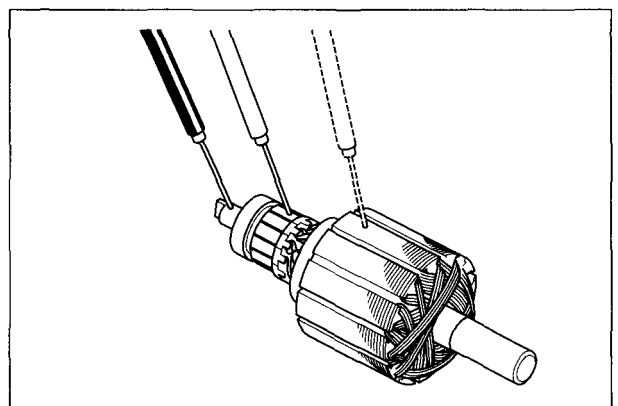
Service limit	0.8 mm (0.03 in)
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- 4) Check the bearing for play. Replace the armature if it has excessive play or abnormal noise.
- 5) Check for continuity between each segment. If an open circuit exists between any two segment, replace the armature.



- 6) Check for continuity between the commutator and armature coil core. If continuity exists, replace the armature.
- 7) Check for continuity between the commutator and armature shaft. If there is continuity, replace the armature.



d. REASSEMBLY

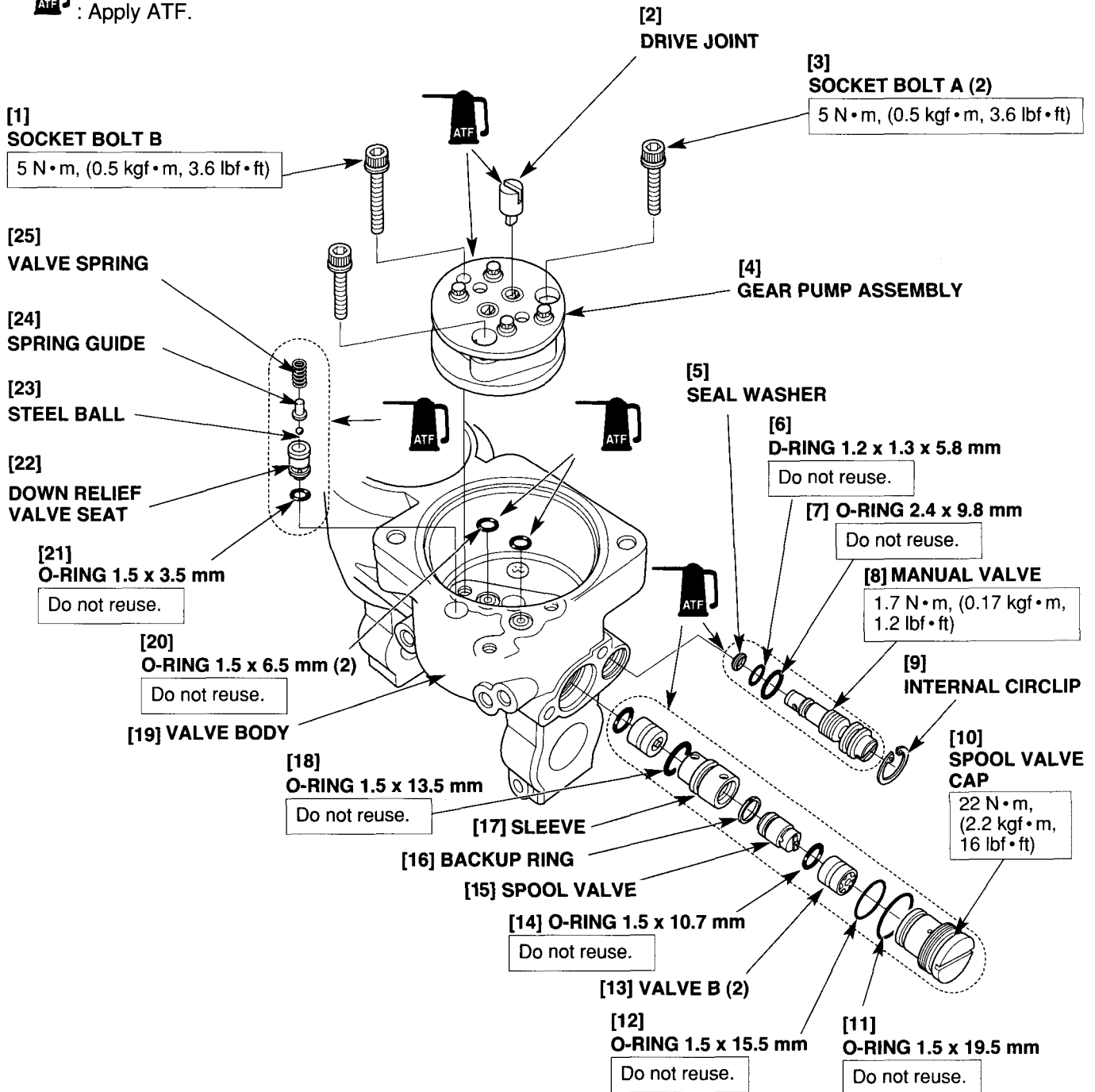
• VALVE BODY

NOTICE

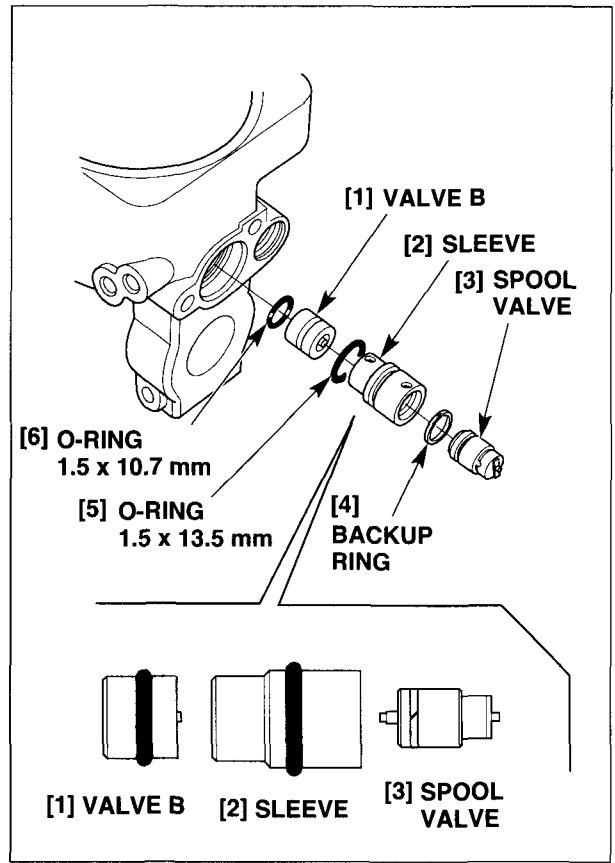
- Do not reuse the O-ring.
- Do not use a shop towel, cloth, gloves, etc when reassembly.
- Assemble the parts with care not to let the foreign particles and dirt enter the valve body and gear pump assembly.



: Apply ATF.

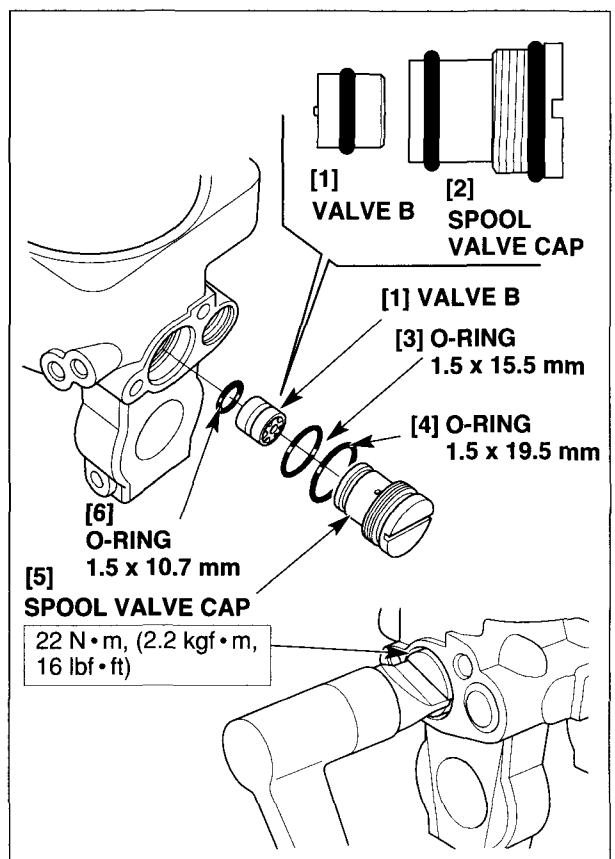


- 1) Clean the parts in the fresh ATF, and blow each port of the parts with compressed air. Check that the parts are free from contamination with dust and dirt before reassembly.
- 2) Apply the ATF to a new O-ring, and install it on the valve B.
- 3) Apply the ATF to the valve B and install the valve B in the valve body noting the installation direction.
- 4) Apply the ATF to a new O-ring, and install it on the sleeve.
- 5) Set the new backup ring on the spool valve and apply the ATF to the outer surface of the spool valve.
- 6) Install the spool valve in the sleeve noting the installation direction.
- 7) Apply the ATF to the sleeve, and install the sleeve in the valve body noting the installation direction.



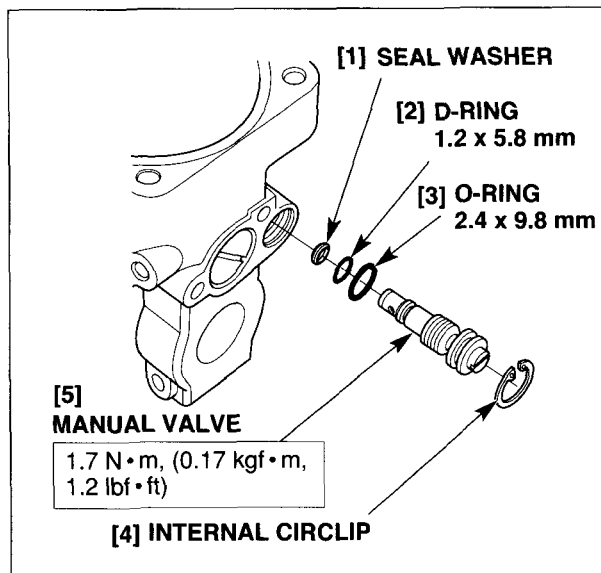
- 8) Apply the ATF to a new O-ring, and install it on the valve B.
- 9) Apply the ATF to the valve B and install it in the spool valve cap noting the installation direction.
- 10) Apply the ATF to the new O-rings, and install the O-rings on the spool valve cap.
- 11) Tighten the spool valve cap to the specified torque using the commercially available driver bit 2.8 mm.

TORQUE: 22 N•m (2.2 kgf•m, 16 lbf•ft)



- 12) Apply the ATF to the sealing washer, and set it in the valve body at right angles. Be careful not to set it at an inclined angle, which can lead to the collapsed sealing washer.
- 13) Apply the ATF to new O-ring and D-ring, and install them on the manual valve.
- 14) Tighten the manual valve to the specified torque, and set the internal circlip in the groove in the valve body securely.

TORQUE: 1.7 N•m (0.17 kgf•m, 1.2 lbf•ft)

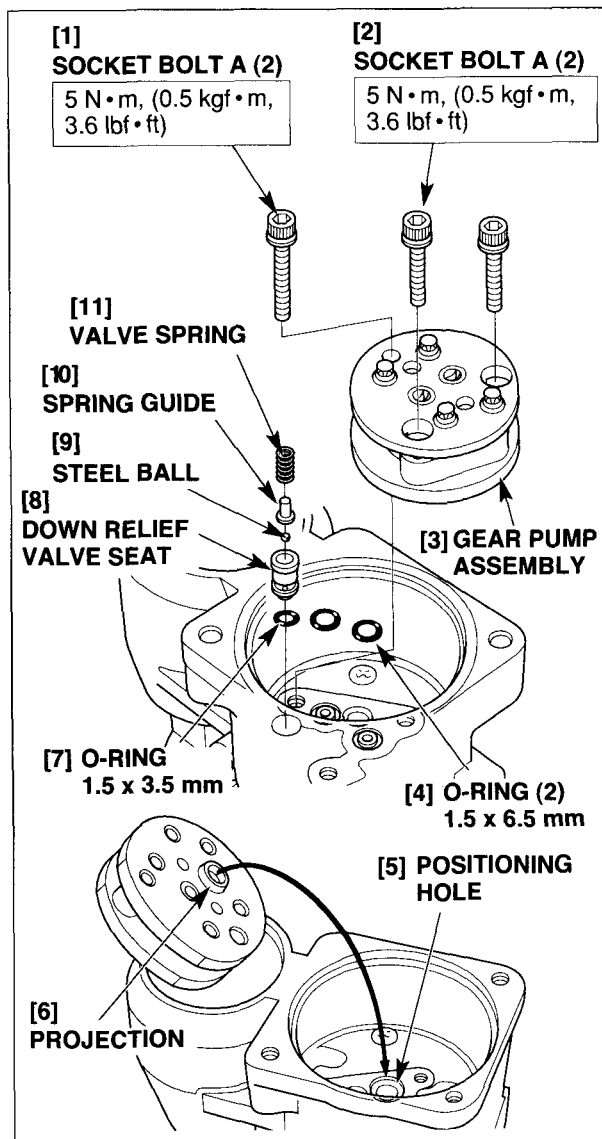


- 15) Apply the ATF to a new O-ring, and install it on the down relief valve seat.
- 16) Apply the ATF to the down relief valve seat and install it in the valve body
- 17) Install the steel ball, spring guide and the valve spring in the down relief valve seat.
- 18) Apply the ATF to the two new O-rings and install the O-rings in the valve body in the positions shown.

- 19) Install the gear pump assembly in the valve body by aligning the projection at the bottom of the gear pump assembly with the positioning hole in the valve body with care not to let the O-rings come out of position in the valve body

- 20) Tighten the socket bolts to the specified torque.

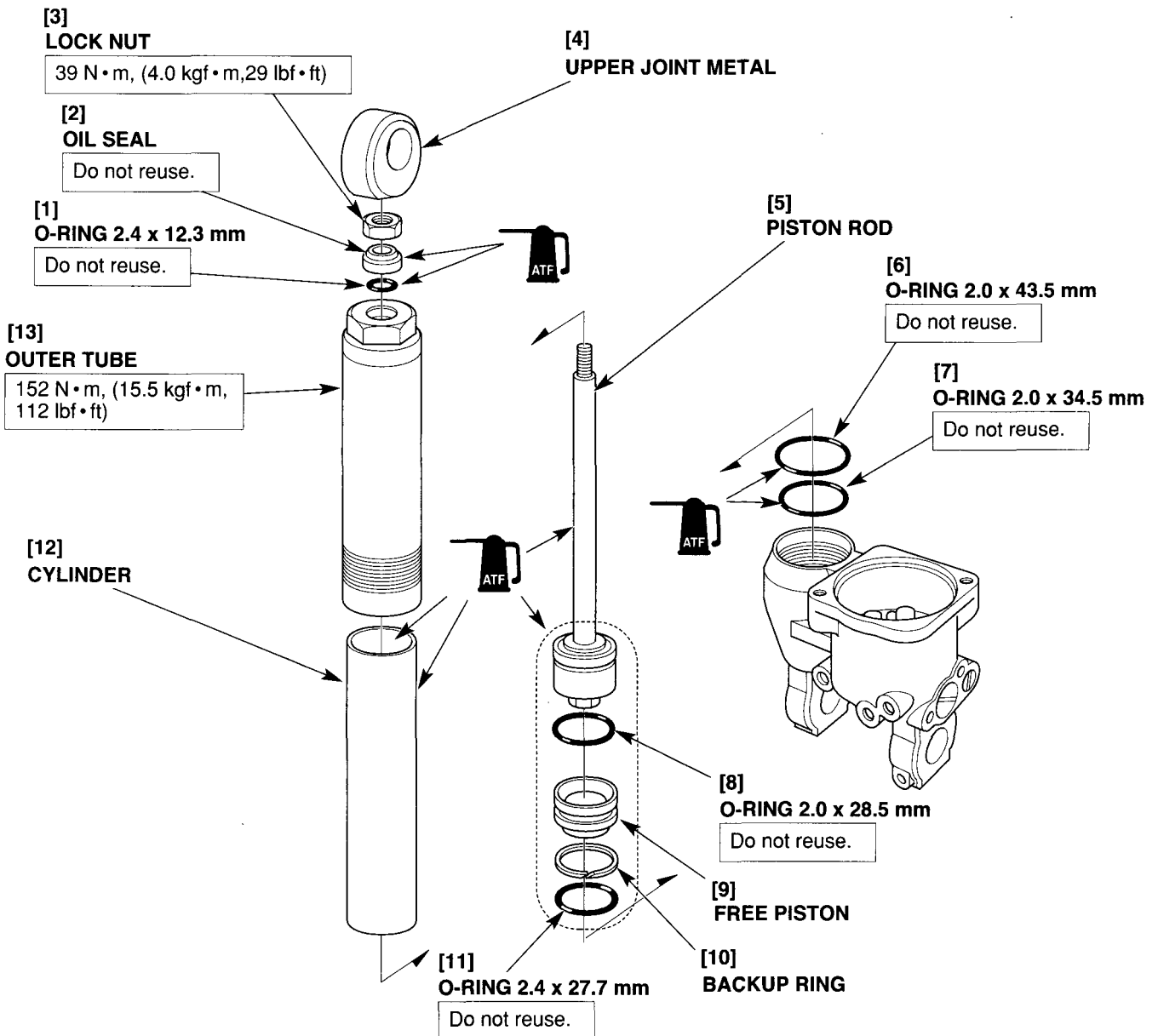
TORQUE: 5 N•m (0.5 kgf•m, 1.3 lbf•ft)



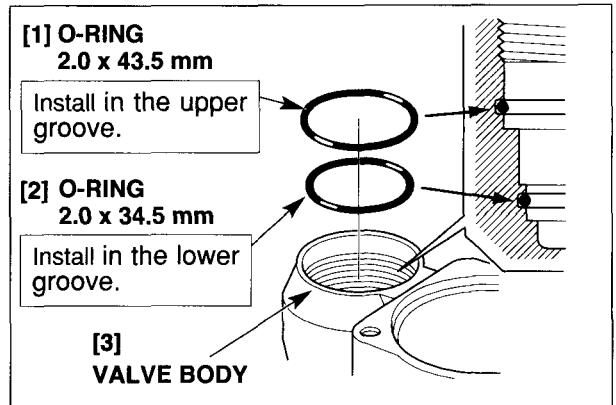
• CYLINDER, PISTON

NOTICE

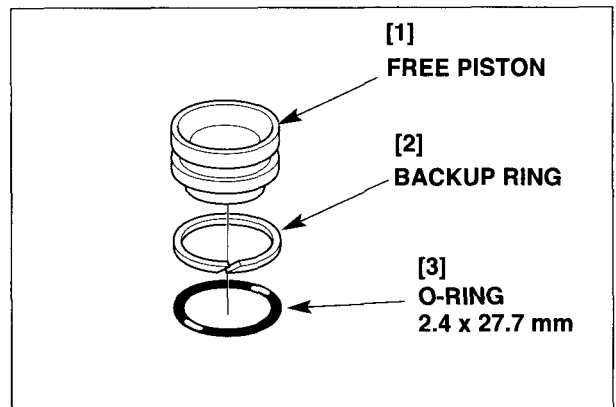
- Do not reuse the O-ring.
 - Do not use a shop towel, cloth, gloves, etc when reassembly.
 - Assemble the parts with care not to let the foreign particles and dirt enter the valve body and gear pump assembly.
- 1) Clean the parts in the fresh ATF. Check that the parts are free from contamination with dust and dirt before reassembly.



- 2) Apply the ATF to two new O-rings, and install the O-rings in the valve body
 - Install the smaller O-ring in the lower groove and the larger O-ring in the upper groove of the valve body



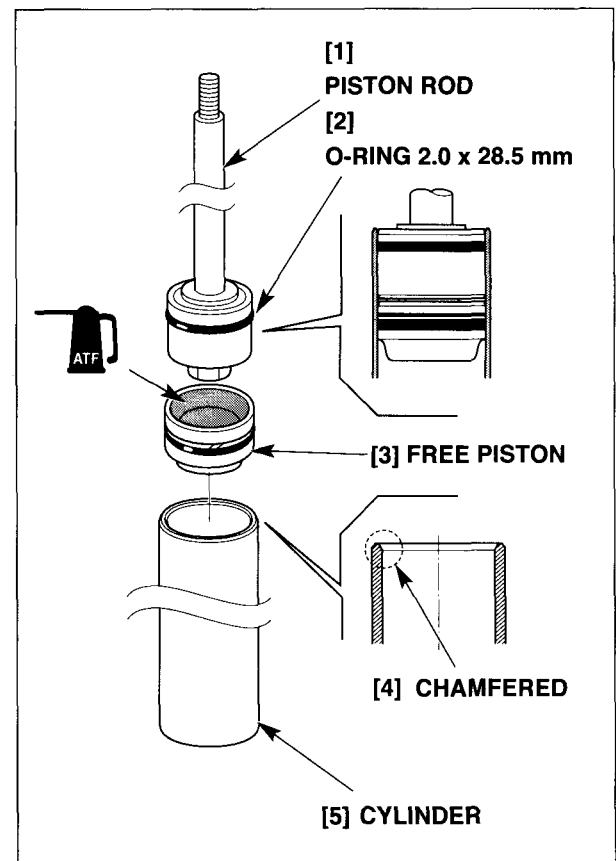
- 3) Apply the ATF to a new O-ring and backup ring, and install them on the free piston.



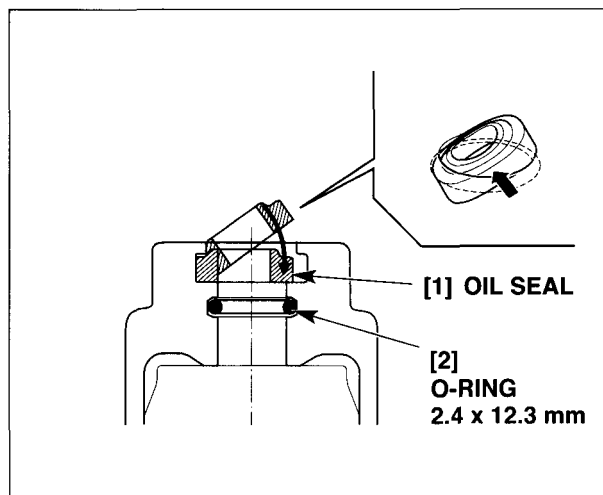
- 4) Apply the ATF to a new O-ring and install it on the piston rod.
- 5) Apply the ATF to the inner wall of the cylinder.
- 6) Install the free piston in the cylinder and pour the fresh ATF to the free piston.
- 7) Install the piston rod in the cylinder from the chamfered ends at the inside of the cylinder and push in the piston rod until the piston rod end aligns with the cylinder end as shown.

NOTICE

Take care not to damage the free piston O-ring and backup ring and the piston rod O-ring.



- 8) Apply the ATF to a new O-ring, and install it in the lower groove in the outer tube.
- 9) Apply the ATF to the new oil seal. Holding the oil seal with the fingers so that it shapes "U" and install it in the upper groove in the outer tube.

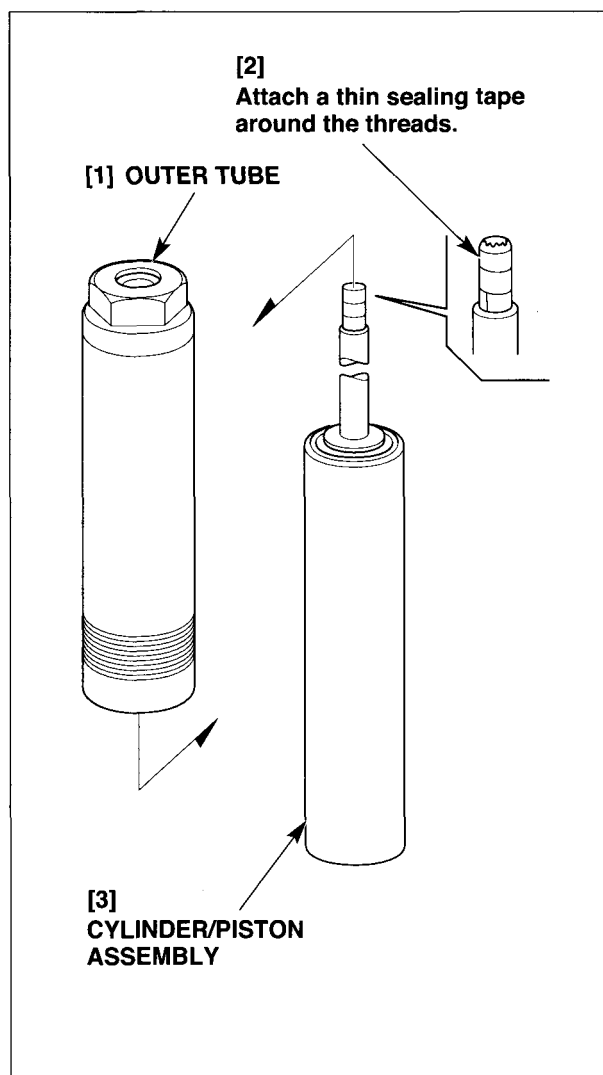


- 10) Attach a thin sealing tape around the threads at the end of the piston rod.

- 11) Install the cylinder/piston assembly in the outer tube.

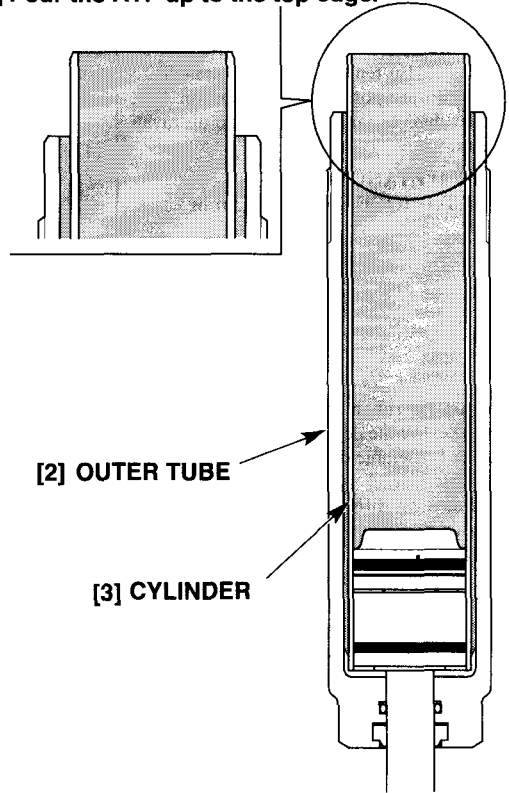
- When it is hard to install the piston rod end in the outer tube, apply the ATF to the piston rod end, then insert the piston rod into the outer tube by turning the outer tube.
- Take care not to push the piston rod into the cylinder with force.
- When the piston rod is pushed into the cylinder with force, push in the free piston in the cylinder as full as it goes with the threaded part of the piston rod facing down and by holding the outer tube and cylinder securely.

- 12) After installation, remove the sealing tape from the threads at the end of the piston rod.



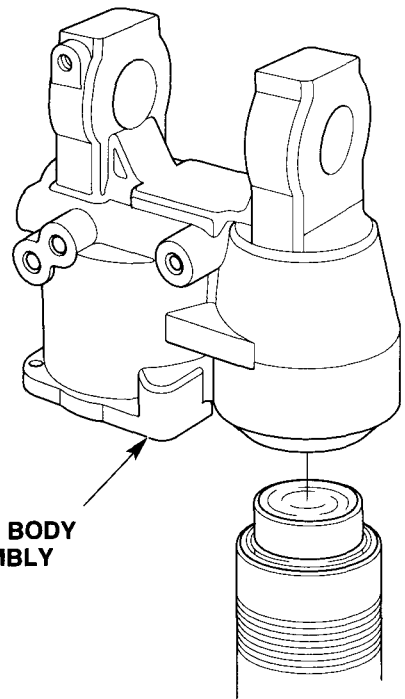
- 13) Turn the piston rod of the outer tube/piston rod assembly upside down and check whether the piston rod is extended fully.
- 14) Pour the fresh ATF into the cylinder and outer tube up to the top edge of the cylinder and outer tube.

[1] Pour the ATF up to the top edge.



- 15) Install the valve body on the outer tube that had been filled with the ATF in the previous step 14, and tighten the valve body
- Install the valve body with care not to spill the ATF in the outer tube/piston rod assembly.

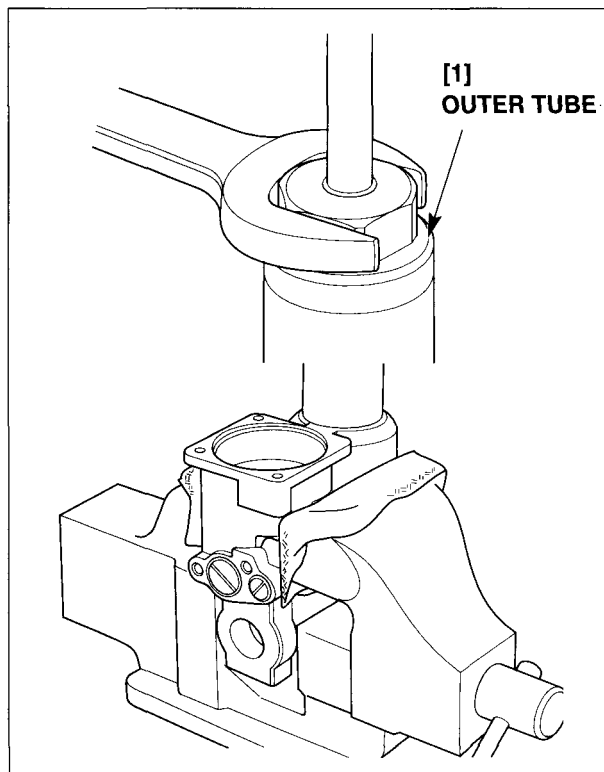
[1] VALVE BODY ASSEMBLY



16) Hold the valve body in a vise as shown taking care not to tighten the vise too tight as it damages the valve body

17) Tighten the outer tube to the specified torque.

TORQUE: 152 N·m (15.5 kgf·m, 112 lbf·ft)



• POWER TILT MOTOR

NOTICE

- Do not reuse the O-ring.
- Do not use a shop towel, cloth, gloves, etc when reassembly.

[1] ARMATURE

- Remove the burrs at the armature shaft with a fine emery paper before assembly.
- Take care not to damage the oil seal during assembly.

[7] BRUSH SPRING (2)

[6] BRUSH HOLDER

[5] OIL SEAL

- Do not reuse. Replace with new one.
- Install with the lips facing out (i.e. gear pump assembly side).

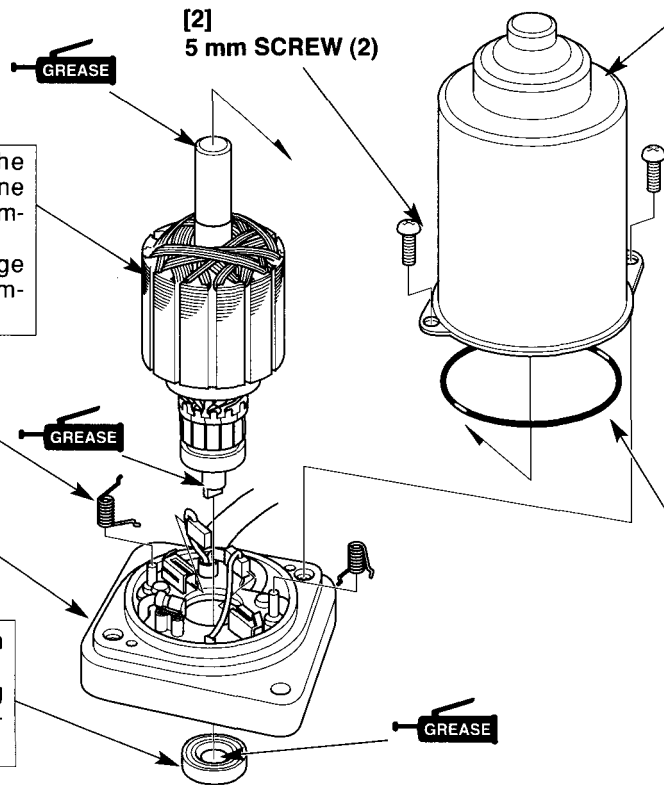
[2] 5 mm SCREW (2)

[3] YOKE

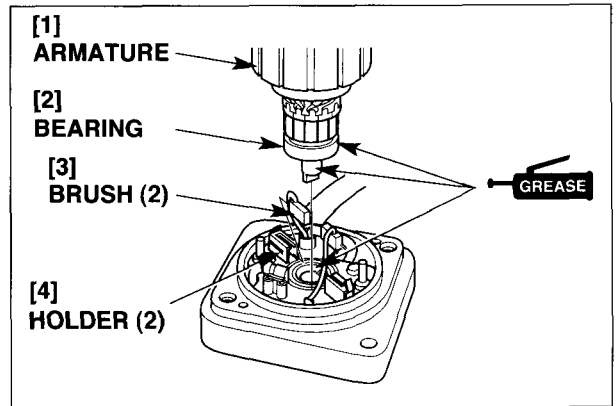
- Make sure there is no metallic part (e.g. washer, etc.) the magnets before installation.
- After installing the yoke, lightly tap on the outer surface of the yoke with a plastic hammer (for snug fitting of the armature bearing).

[4] O-RING

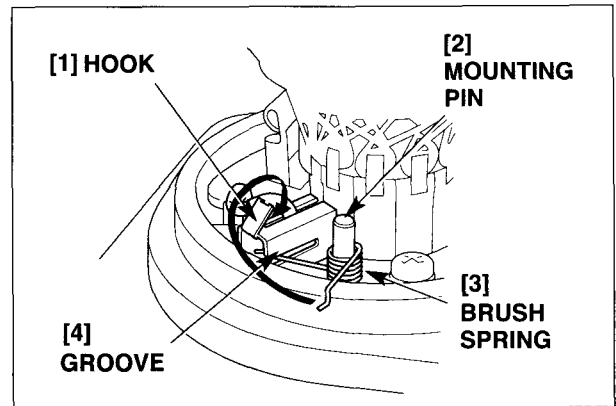
- Do not reuse. Replace with new one.



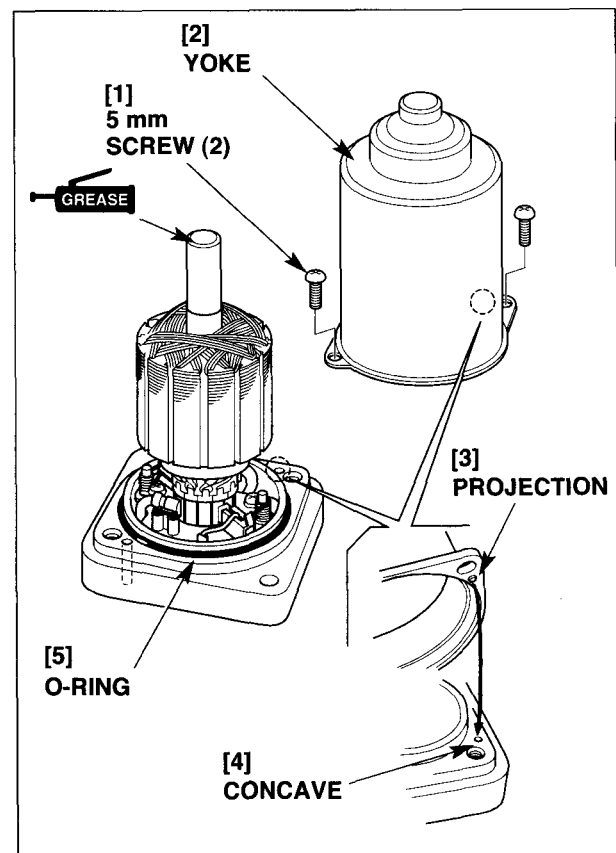
- 1) Set the brushes on the each holder.
- 2) Apply grease to the bearing and oil seal lip and install the armature.
 - Remove the burrs at the armature shaft with a fine emery paper before assembly.
 - Take care not to damage the oil seal during assembly.



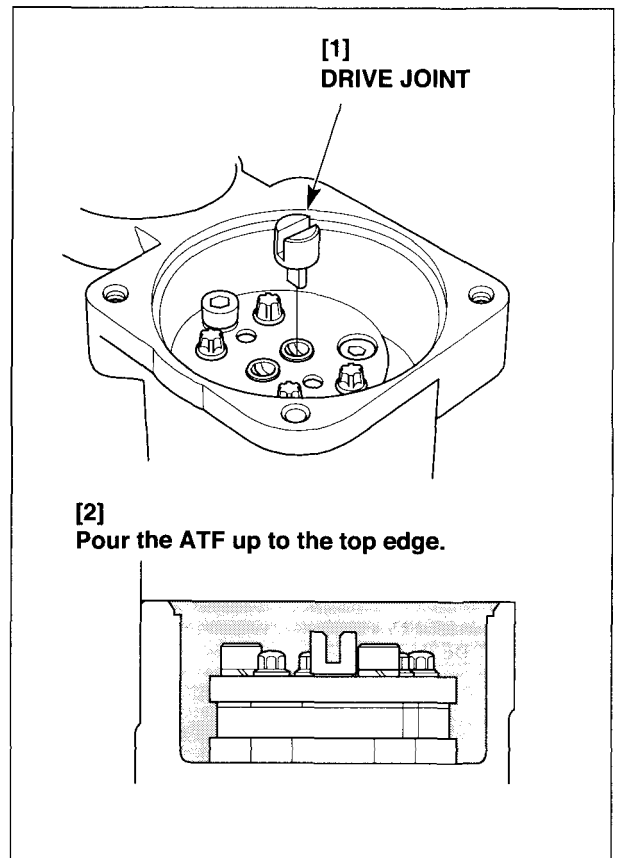
- 3) Set the brush springs over the mounting pins of the brush holder.
- 4) Set the lower straight part of the brush spring in the groove of the brush holder.
- 5) Set the upper straight part of the brush spring on the hook of the brush holder.



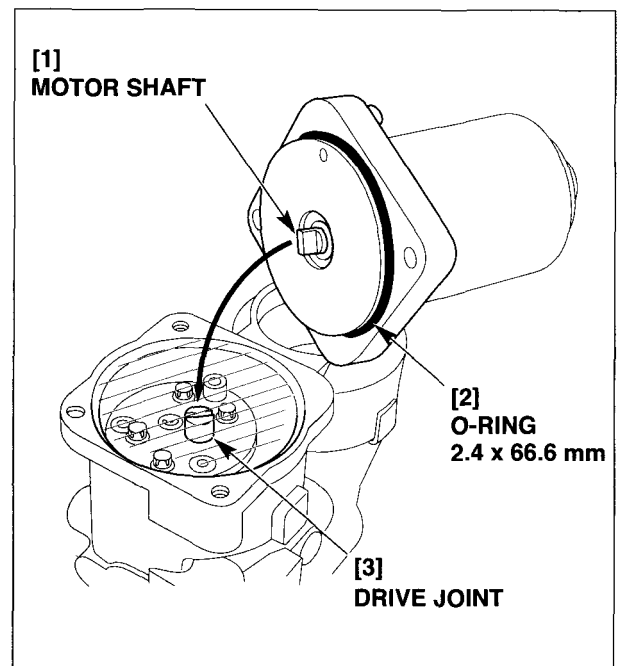
- 6) Set a new O-ring on the brush holder.
- 7) Make sure there is no metallic part (e.g. washer, etc.) the magnets before installation.
- 8) Holed the armature shaft and install the yoke by aligning its projection with the concave in the brush holder.
- 9) Tighten the two screws securely. After tightening, be sure there is no lifting between the yoke and brush holder.
- 10) After assembly, lightly tap on the outer surface of the yoke with a plastic hammer (for snug fitting of the armature bearing).



- 11) Loosen the manual valve by turning it 3 turns or more.
- 12) Install the drive joint in the position of the gear pump assembly as shown.
- 13) Fill the gear pump chamber with the fresh ATF up to the upper edge of the chamber. If the ATF in the valve body contains air bubbles, remove the air bubbles using an oil bottle or equivalent tool.
 - Do not pour the ATF into the valve body gear pump chamber quickly. Pour the fluid slowly.
 - Trapped air in the system causes faulty operation. Remove the air bubbles in the fluid securely.

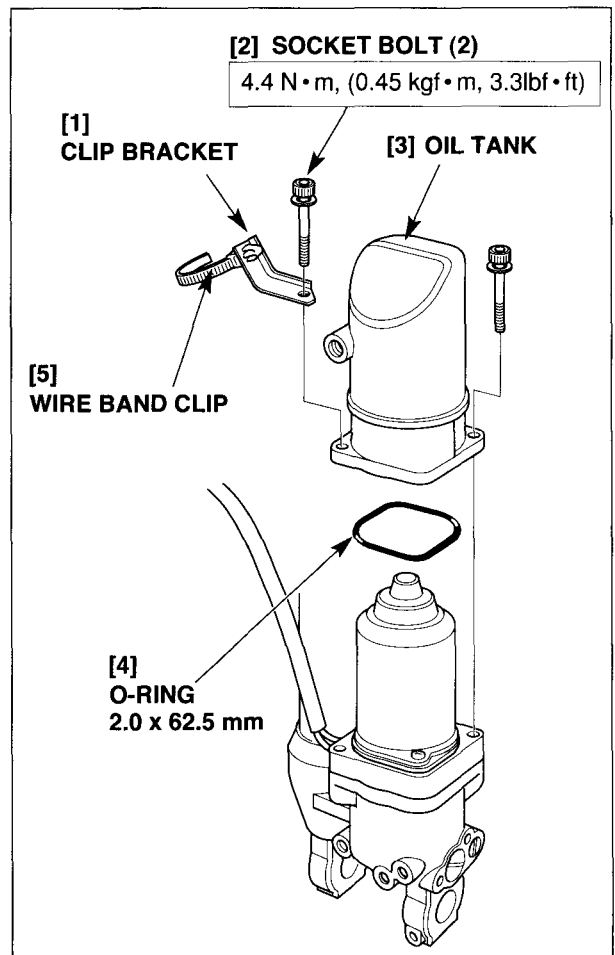


- 14) Apply the ATF to a new O-ring, and install it on the power tilt motor assembly.
- 15) Install the power tilt motor assembly on the valve body so that the power tilt motor wire is at the outer tube side and align the motor shaft with the groove of the drive joint as shown.



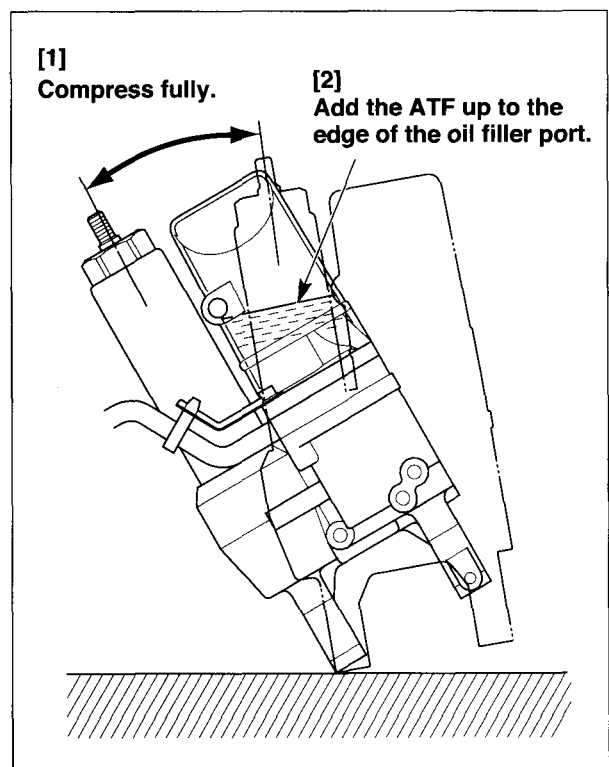
- 16) Apply the ATF to a new O-ring, and install it on the power tilt motor assembly.
- 17) Install the oil tank on the power tilt motor assembly so that the oil hole cap bolt mounting hole is at the motor wire side.
- 18) Set the wire band clip on the clip bracket, and secure the motor wire.
- 19) Tighten the two socket bolts to the specified torque.

TORQUE: 4.4 N • m (0.45 kgf • m, 3.3 lbf • ft)

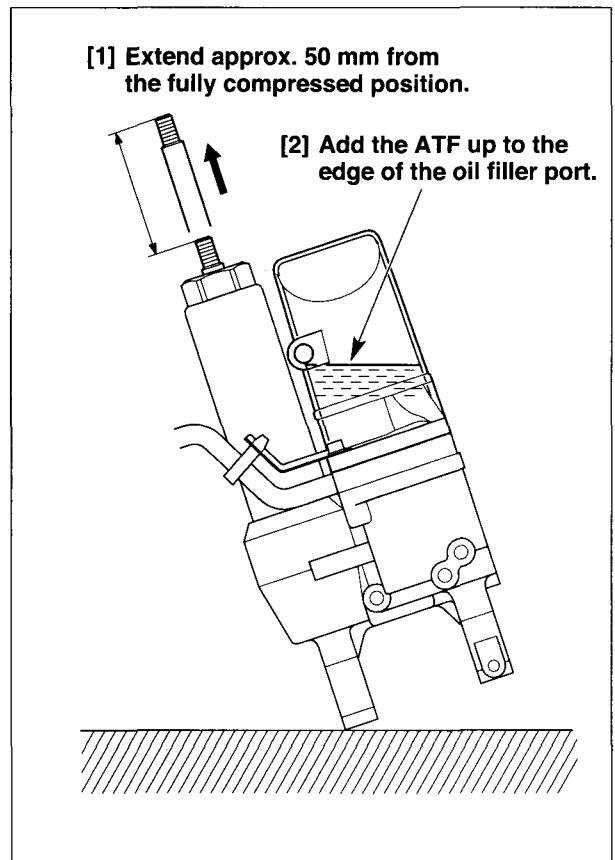


f. ATF FILLING

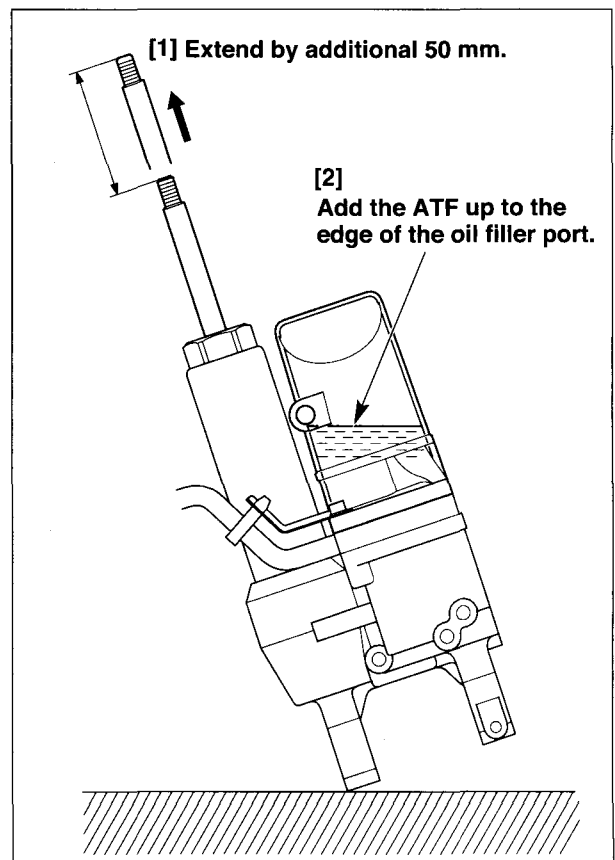
- 1) Using a syringe or equivalent tool, add approximately 30 cm³ (1.01 US oz, 1.06 Imp oz) of the ATF slowly through the oil filler port of the oil tank.
- 2) After adding the fluid, tighten the manual valve securely.
 - Wipe up the spilled ATF thoroughly.
 - Be sure that the oil hole cap bolt is not tightened.
- 3) Connect a fully charged battery, power tilt relay, power tilt switch and motor so that the power tilt assembly can operate.
- 4) To bleed air in the ATF, lean the power tilt assembly to the left, viewed from the oil filler port side, several times slowly at an angle of 10° to 30° as shown.
- 5) Push the "DN" side of the power tilt switch and compress the piston rod fully.
- 6) Using a syringe or equivalent tool, add the ATF slowly until the fluid flows out of the oil filler port of the oil tank.



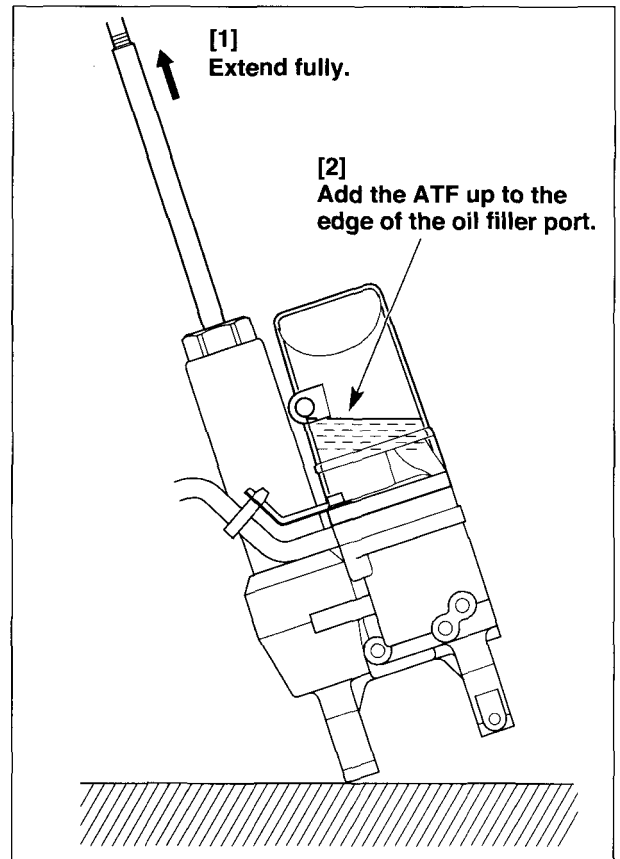
- 7) Lean the power tilt assembly to the side as shown with the piston rod fully compressed. Push the "UP" side of the power tilt switch and extend the piston rod approximately 50 mm (2 in) from the end of the piston rod.
- 8) With the power tilt assembly inclined to the side, add the ATF to the oil tank slowly until the fluid flows out of the oil filler port by using a syringe or equivalent tool.



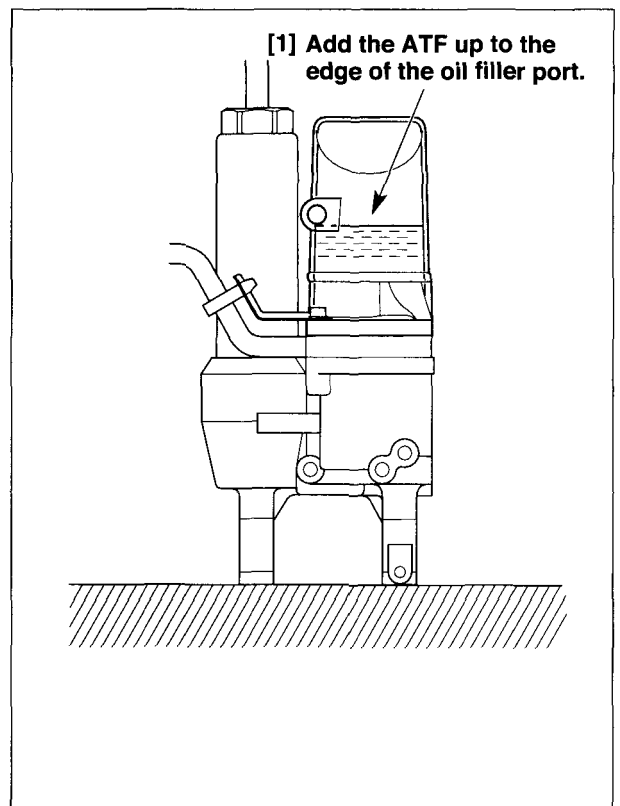
- 9) Push the "UP" side of the power tilt switch with the power tilt assembly inclined to the side, and extend the piston rod by additional 50 mm from the end of the piston rod.
- 10) With the power tilt assembly inclined to the side, add the ATF to the oil tank slowly until the fluid flows out of the oil filler port by using a syringe or equivalent tool.



- 11) With the power tilt assembly inclined to the side, push the "UP" side of the power tilt switch and extend the piston rod as full as it goes.
- 12) With the power tilt assembly inclined to the side, add the ATF to the oil tank slowly until the fluid flows out of the oil filler port by using a syringe or equivalent tool.



- 13) Set the power tilt assembly upright. Using a syringe or equivalent tool, catch the ATF flowing out of the oil filler port of the oil tank until the fluid level is at the edge of the filler port.
- 14) Check whether the ATF level is at the edge of the filler port.

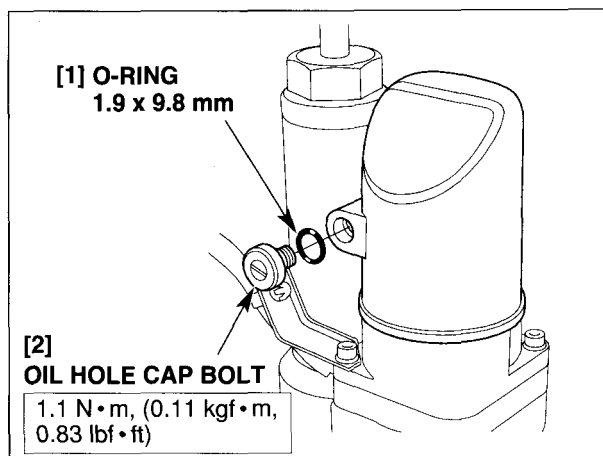


15) Install the new O-ring on the oil hole cap bolt and tighten the oil hole cap bolt to the specified torque.

TORQUE: 1.1 N·m (0.11 kgf·m, 0.83 lbf·ft)

16) Push the "UP" side and "DN" side of the power tilt switch, and check whether the piston rod moves smoothly.

17) Disconnect the motor connector, battery, power tilt relay and switch.



g. UPPER JOINT METAL INSTALLATION

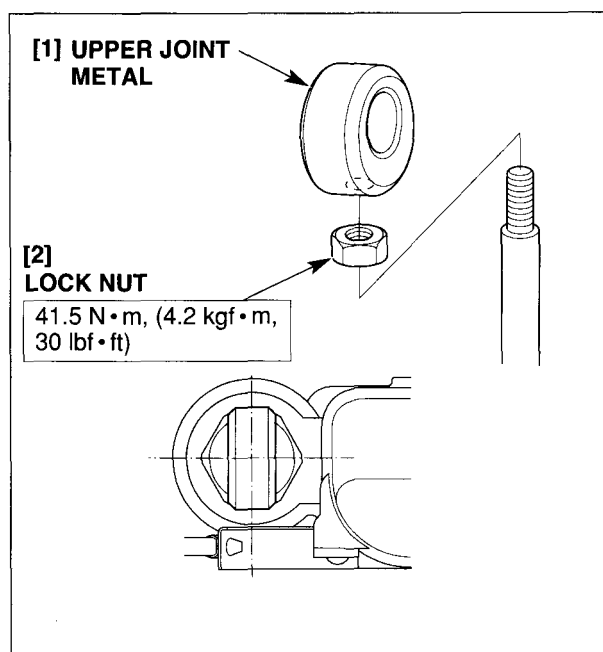
1) Install the lock nut and upper joint metal against the piston rod.

- Be sure that the piston rod end is not protruding from the upper joint metal.

2) Holding the upper joint metal, tighten the hex. nut to the specified torque.

TORQUE: 41.5 N·m (4.2 kgf·m, 30 lbf·ft)

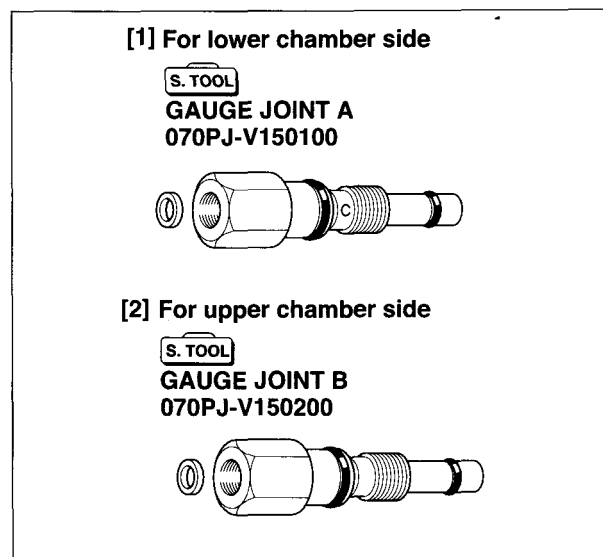
3) Set the upper joint metal at the installation angle shown.



h. BLOW PRESSURE INSPECTION

After assembling the power tilt assembly, perform the blow pressure inspection. Install the power tilt assembly after the blow pressure inspection.

- Extend the piston rod of the power tilt assembly fully After operating (moving up and down) the piston rod several times.
- Remove the power tilt assembly if it is mounted (P. 12-17).
- Connect each engine side cable and motor 2P connector so that the power tilt assembly can operate while it is isolated from the outboard motor.
- Check the ATF level in the power tilt assembly oil tank. It must be at the specified level (P. 13-39).
- Perform the cylinder upper chamber side and lower chamber side blow pressure inspection using the special tools.



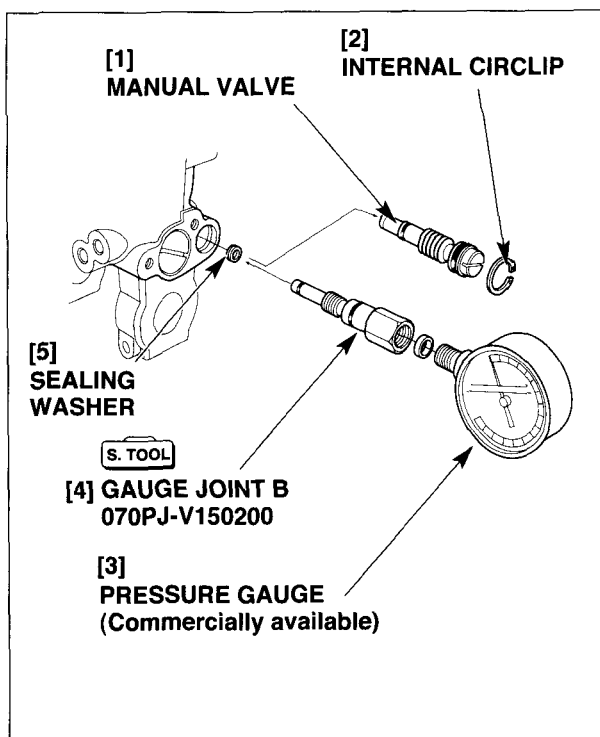
• LOWER CHAMBER SIDE BLOW PRESSURE

- 1) Remove the internal circlip, manual valve and sealing washer from the valve body. Install the special tool (gauge joint body B) and the sealing washer, and tighten the special tool to the specified torque.

TORQUE: 1.7 N·m (0.17 kgf·m, 1.2 lbf·ft)

NOTICE

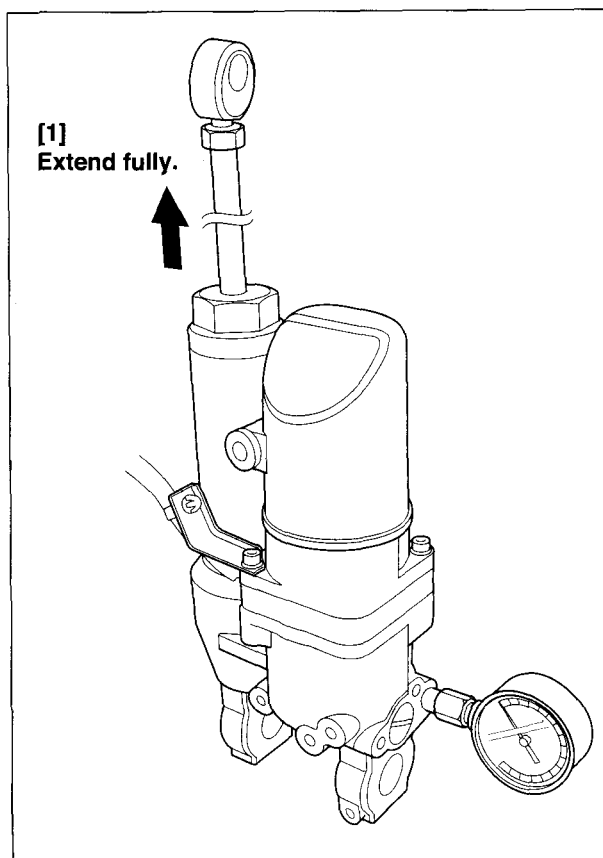
- Be sure to remove the manual valve with the piston rod fully extended, or the ATF spurts out.
 - A small amount of the ATF flows out after removing the valve. Install the special tool quickly.
 - Install the sealing washer securely not to let it collapse in the valve body.
- 2) Attach a commercially available pressure gauge to the special tool that is set in the valve body.
 - Use the pressure gauge which measures 50 Mpa (500 kgf/cm², 7,000 psi) or above .
 - Be sure that the ATF level in the oil tank is at the specified level (P. 13-39).



- 3) Push the "DN" side of the power tilt switch and compress the piston rod fully.
- 4) Push the "UP" side of the power tilt switch again. With the piston rod extended fully, measure the lower chamber blow pressure by reading the pressure gauge.

BLOW PRESSURE (Lower chamber side)	4.26 - 5.00 MPa (43.5 - 51.0 kgf/cm ² , 619 - 725 psi)
---------------------------------------	---

- If the blow pressure is out of the specified range, check each part of the power tilt assembly for oil leakage.
- If there is no oil leakage but the blow pressure drops below the specified pressure quickly, the power tilt motor assembly can be faulty. Replace the motor assembly with a new one and measure the blow pressure again.
- After measuring the lower chamber blow pressure, measure the upper chamber blow pressure.



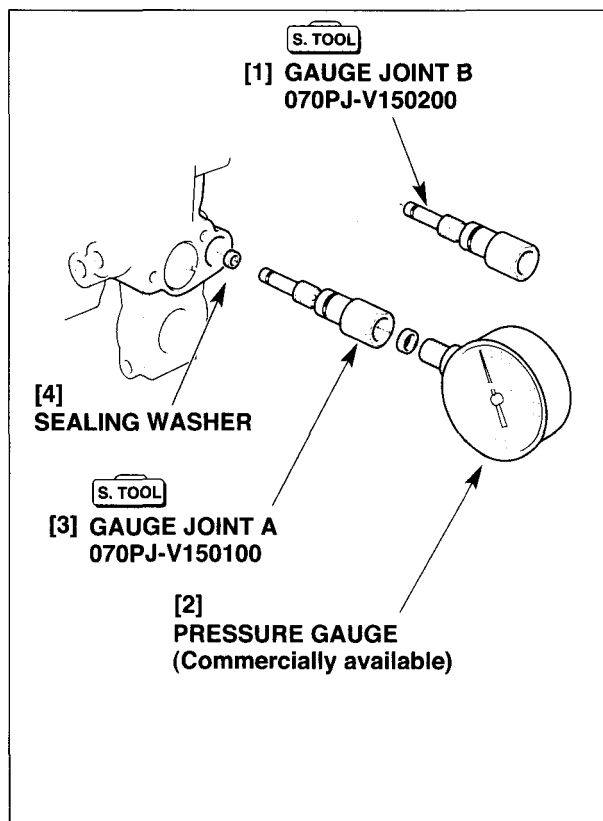
• UPPER CHAMBER BLOW PRESSURE

- 1) Remove the gauge joint body B that is for measurement of the lower chamber blow pressure from the valve body. Install the gauge joint body A that is for measurement of the upper chamber blow pressure in the valve body. Tighten the special tool to the specified torque.

TORQUE: 1.7 N·m (0.17 kgf·m, 1.2 lbf·ft)

NOTICE

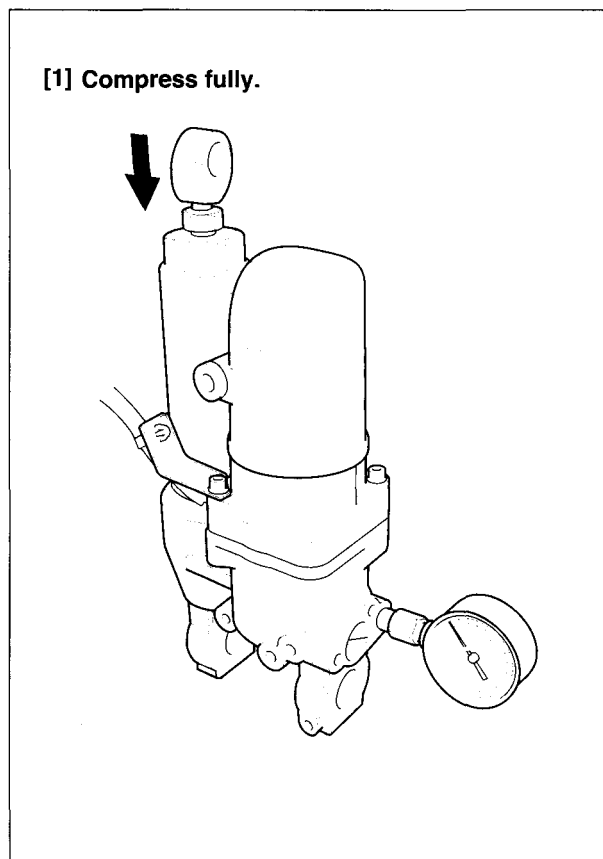
- Be sure to remove the special tool with the piston rod fully extended, or the automatic transmission fluid spurts out.
 - A small amount of the ATF flows out after removing the gauge joint body B. Install the gauge joint body quickly.
 - Install the sealing washer securely not to let it collapse in the valve body.
- 2) Attach a commercially available pressure gauge to the special tool that is set in the valve body.
 - Use the pressure gauge which measures 50 Mpa (500 kgf/cm², 7,000 psi) or above.
 - Be sure that the ATF level in the oil tank is at the specified level (P. 13-39).



- 3) Push the "DN" side of the power tilt switch and compress the piston rod fully. With the piston rod compressed fully, measure the upper chamber blow pressure by reading the pressure gauge.

BLOW PRESSURE (Upper chamber side)	3.74 - 4.73 MPa (38.2 - 48.3 kgf/cm ² , 543 - 687 psi)
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- If the blow pressure is out of the specified range, check each part of the power tilt assembly for oil leakage.
- If there is no oil leakage but the blow pressure drops below the specified pressure quickly, the power tilt motor assembly can be faulty. Replace the motor assembly with a new one and measure the blow pressure again.



- 4) Push the "UP" side of the power tilt switch and extend the piston rod fully.
- 5) Remove the special tool and pressure gauge from the valve body. Install the sealing washer, manual valve and the internal circlip in the valve body.

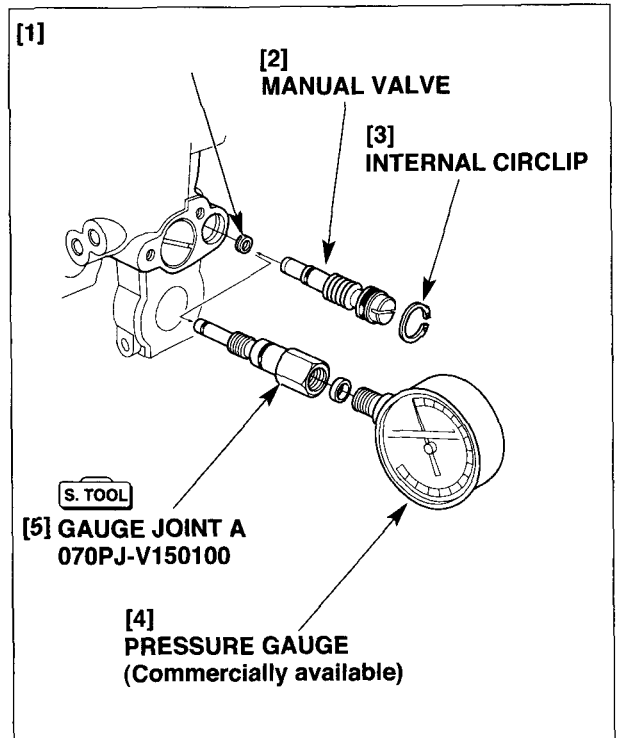
NOTICE

- Be sure to remove the special tool with the piston rod fully extended, or the ATF spurts out.
- A small amount of the ATF flows out after removing the tool. Install the manual valve quickly.
- Install the sealing washer securely not to let it collapse in the valve body.

- 6) Tighten the manual valve to the specified torque.

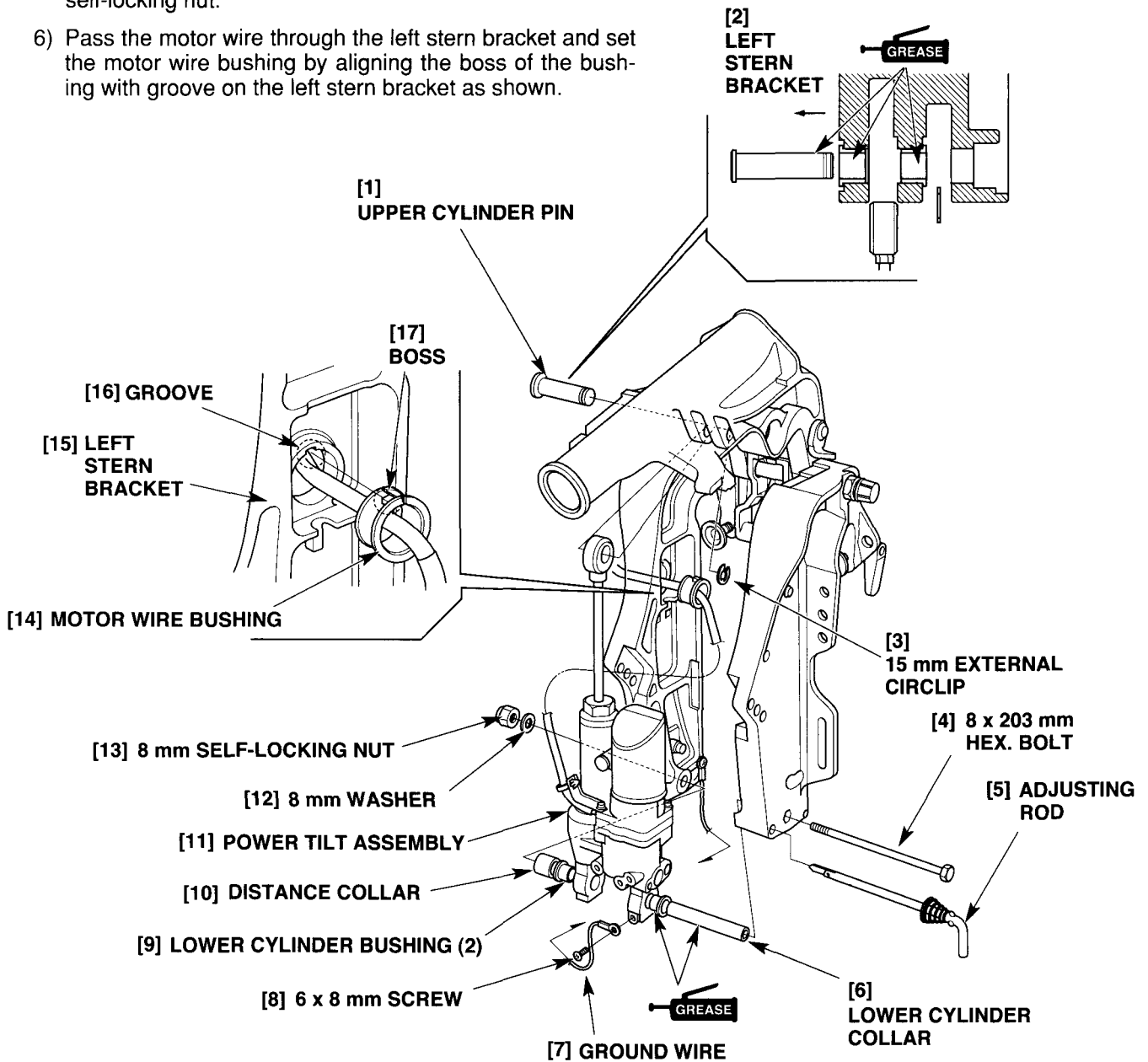
TORQUE: 1.7 N·m (0.17 kgf·m, 1.2 lbf·ft)

- 7) With the piston rod fully extended, check whether the ATF level is at the edge of the filler port of the oil tank (P. 13-55). If the oil level is low, add the fluid (ATF) up to the edge of the filler port.
- 8) Install the power tilt assembly (P. 13-39).

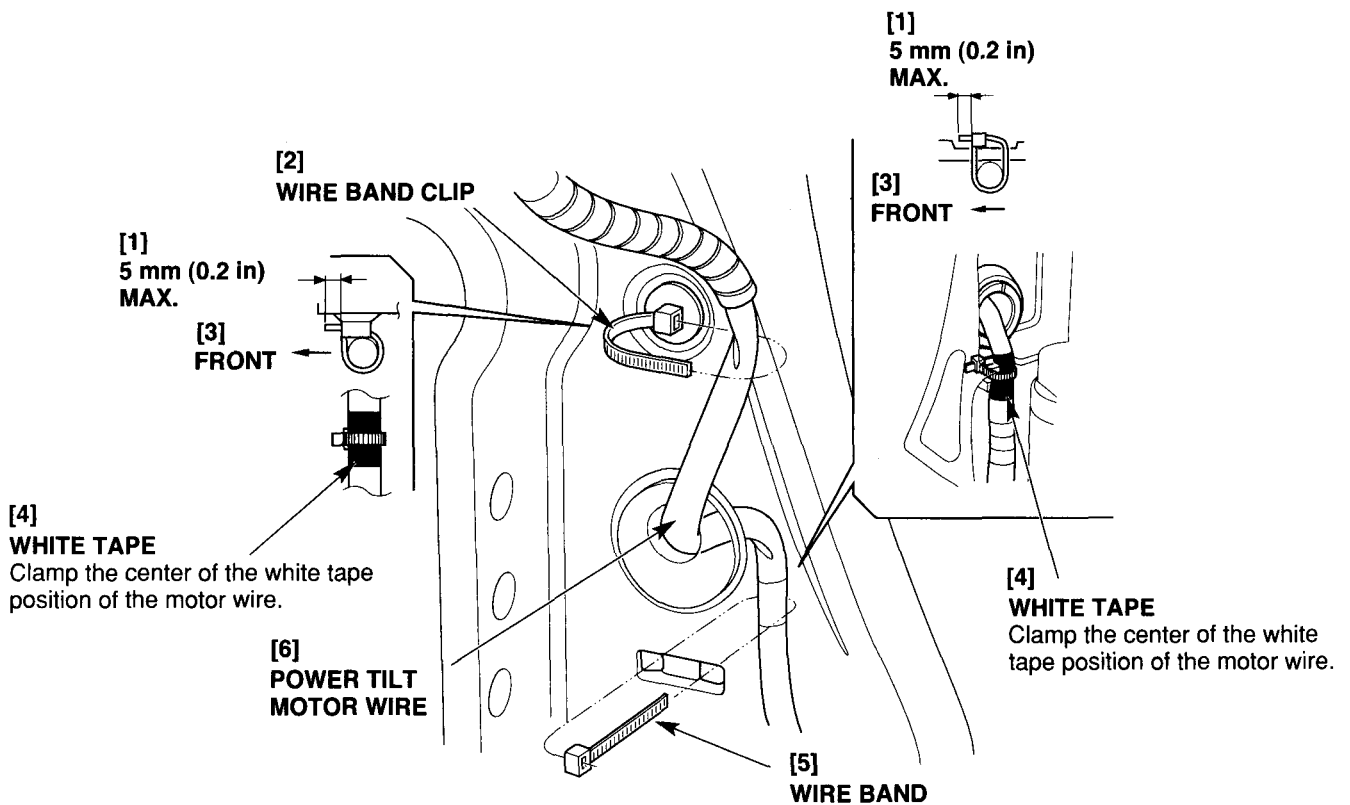
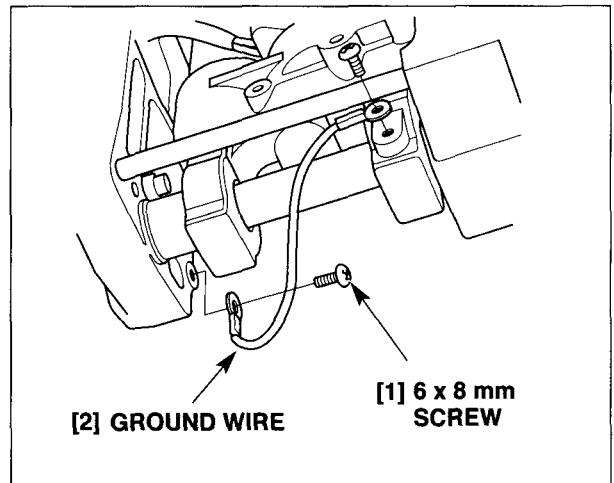


i. INSTALLATION

- 1) Apply marine grease to upper cylinder bushing.
- 2) Set the power tilt assembly to the swivel case as shown and install the upper cylinder pin and secure the 15 mm external circlip.
- 3) Apply grease to the lower cylinder bushings and lower cylinder collar, and install them on the power tilt assembly.
- 4) Install the distance collar on the lower cylinder collar and set the lower mount of the power tilt assembly between the stern bracket.
- 5) Install the 8 x 203 mm hex. bolt, 8 mm washer and 8 mm self-locking nut.
- 6) Pass the motor wire through the left stern bracket and set the motor wire bushing by aligning the boss of the bushing with groove on the left stern bracket as shown.



- 6) Connect the ground wire to the power tilt assembly by tightening the 6 x 8 mm screw.
- 7) Secure the motor wire with the wire band and wire band clip as shown.



- 8) After assembly, check the power tilt operation. Loosen the manual valve and check the manual tilting operation.
 - Clicking sound can be heard when the outboard motor is tilted up fast with the manual valve set in the TILT position. Note that this is normal. When the tilt up speed is fast, the sound is mechanically produced as the free piston failed to synchronize with the piston movement.

1. CONTROL BOX WIRE HARNESS

2. REMOTE CONTROL BOX

1. CONTROL BOX WIRE HARNESS

a. REMOVAL/INSTALLATION

1) Remove the engine cover.

• Type with power tilt

[1] WIRE BAND CLIP

[2] 4P CONNECTOR

[3] 6P CONNECTOR

[4] MAIN WIRE HARNESS

[5] WIRE BAND CLIP

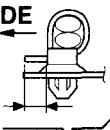
[6] WIRE BAND

ASSEMBLY:

Align the wire tie of the control box wire harness with the oil case grommet and clamp the center of the white tape position of the power tilt motor wire and control box wire harness securely.

[1]-1

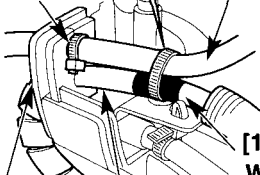
ENGINE SIDE



[1]-7
5 mm (0.2 in)
MAX.

[1]-2
CONTROL
BOX WIRE
HARNESS

[1]-6 WIRE TIE



[1]-5
OIL CASE
GROMMET

[1]-4
POWER TILT
MOTOR WIRE

[1]-3
WHITE
TAPE

[12] CONTROL BOX WIRE HARNESS

[11] POWER TILT MOTOR WIRE

[10] OIL CASE GROMMET

6 x 14

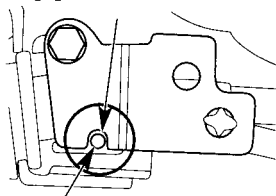
[9]

STARTER CABLE PLATE

ASSEMBLY:

Align the cutout with the pin on the oil case.

[9]-1 CUTOUT



[9]-2 PIN

[8]

WIRE BAND CLIP

[7]

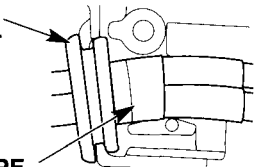
BATTERY CABLE

ASSEMBLY:

Align the white tape of the battery cable with the oil case grommet.

[7]-1

OIL CASE
GROMMET



[7]-2

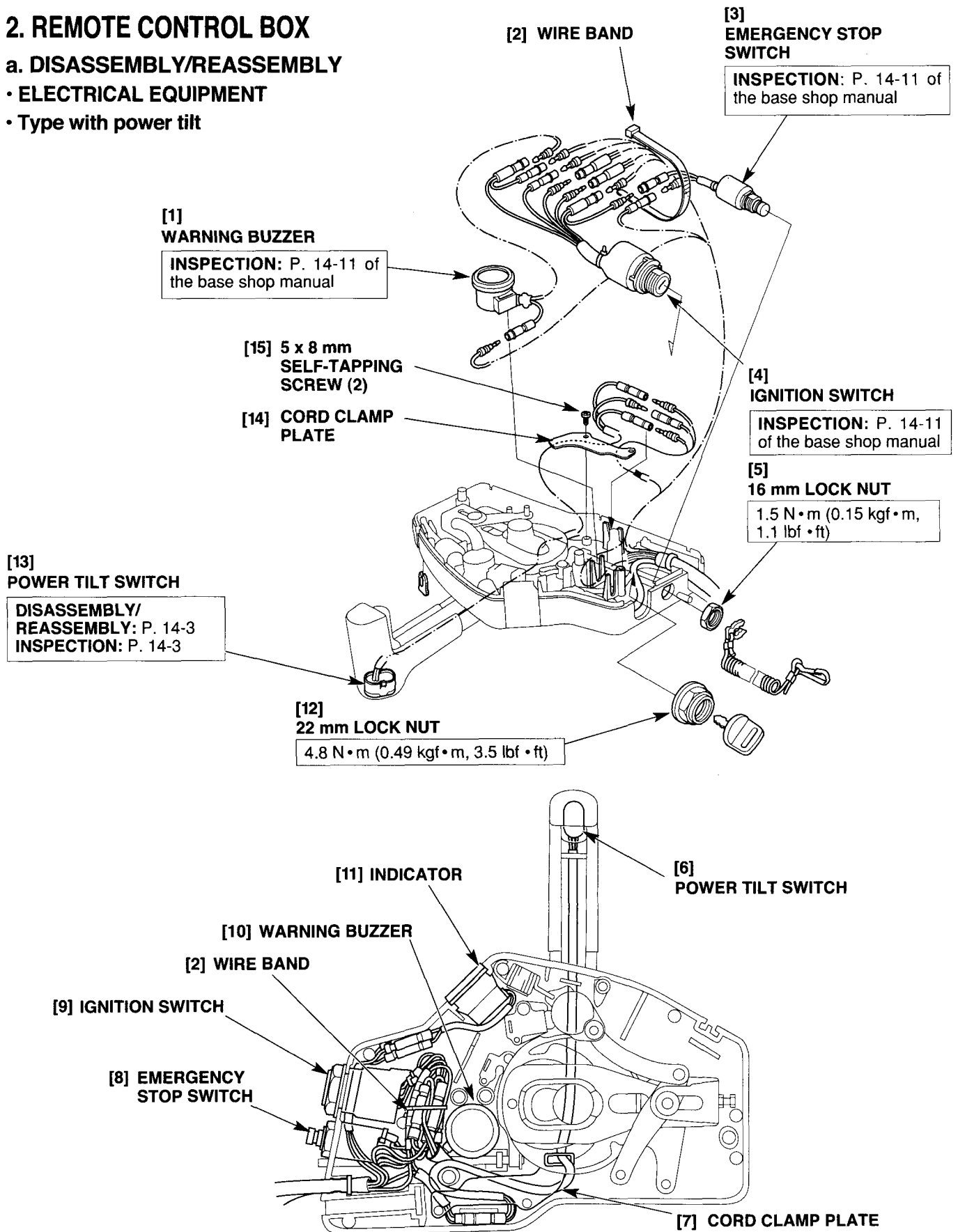
WHITE TAPE

2. REMOTE CONTROL BOX

a. DISASSEMBLY/REASSEMBLY

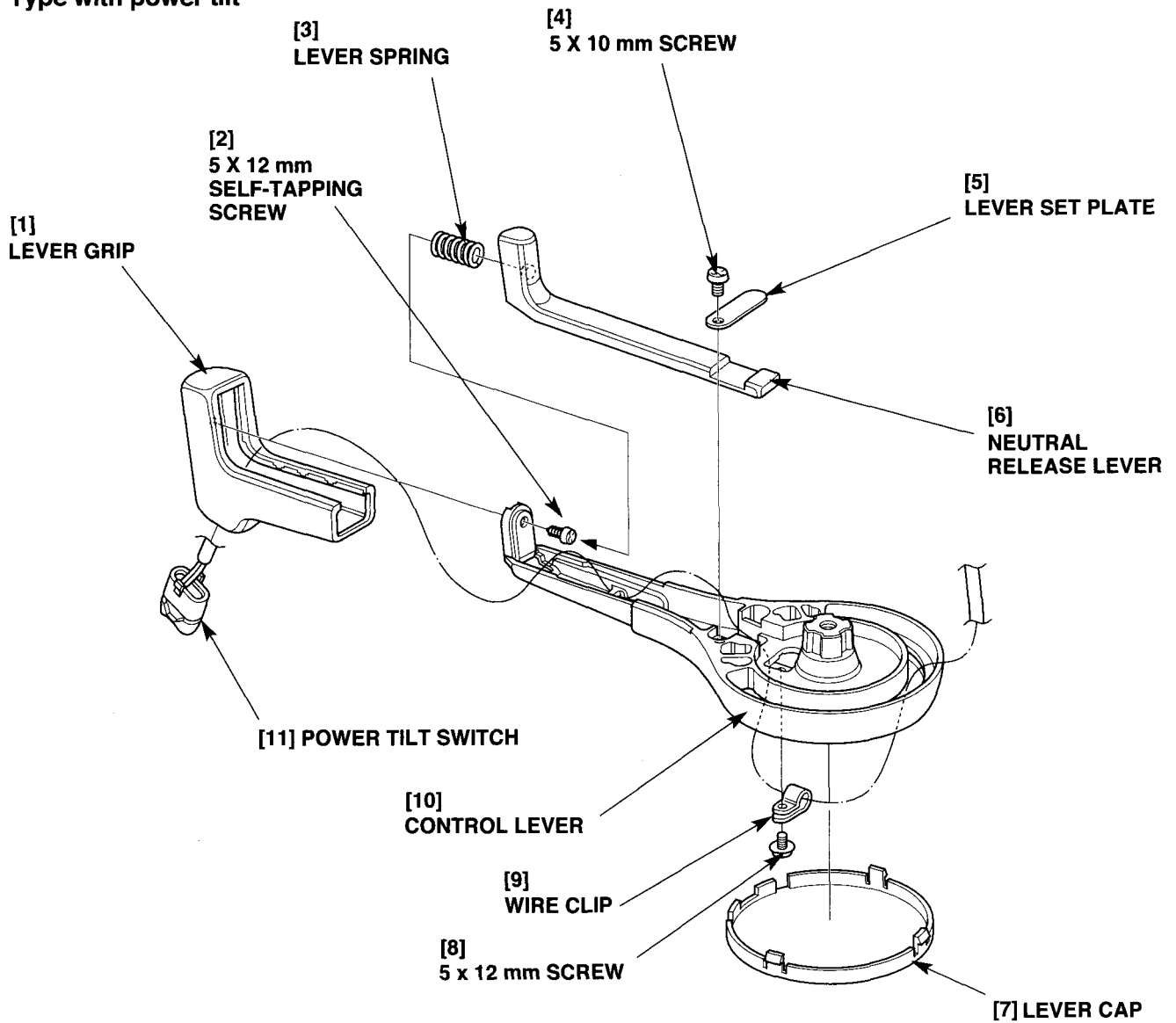
• ELECTRICAL EQUIPMENT

• Type with power tilt



• CONTROL LEVER

• Type with power tilt



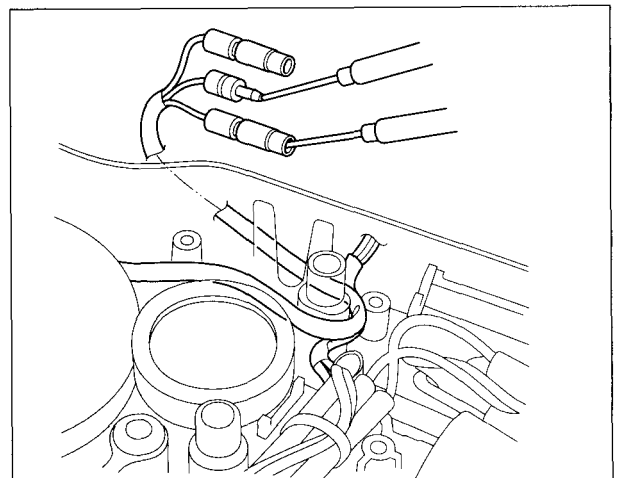
b. INSPECTION

• POWER TILT SWITCH

Check for continuity between the terminals according to the table below.

There should be continuity between ○—○.

Collar	Light green	White/black	Light blue
UP	○—○	○	
Neutral			
DOWN		○—○	○

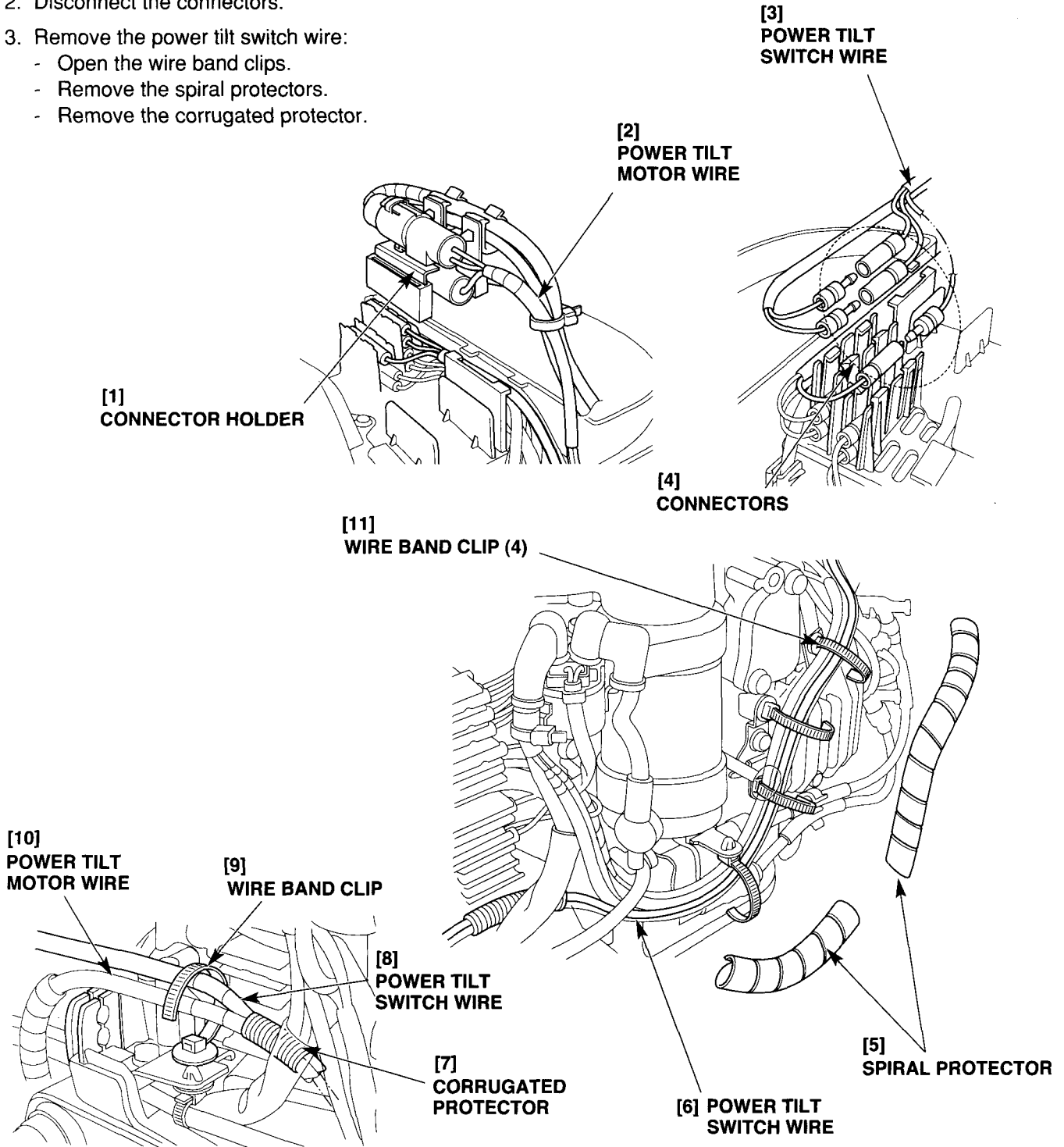


1. POWER TILT SWITCH

1. POWER TILT SWITCH

a. SWITCH WIRE REMOVAL

1. Remove the power tilt relay connectors with the connector holder attached.
2. Disconnect the connectors.
3. Remove the power tilt switch wire:
 - Open the wire band clips.
 - Remove the spiral protectors.
 - Remove the corrugated protector.



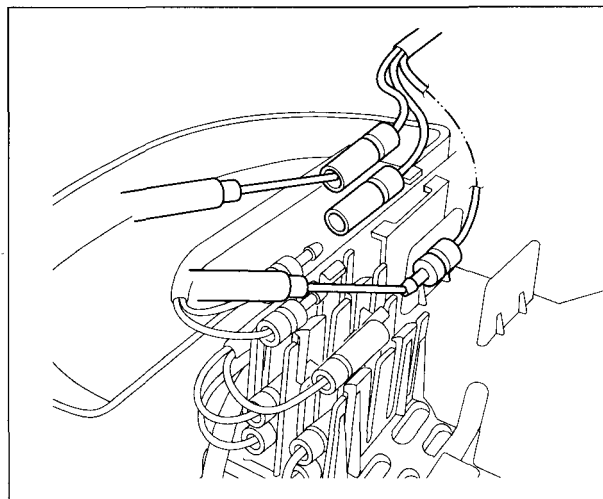
a. INSPECTION

- The power tilt switch test can be performed with the switch installed on the tiller handle.

Check for continuity between the terminals according to the table below.

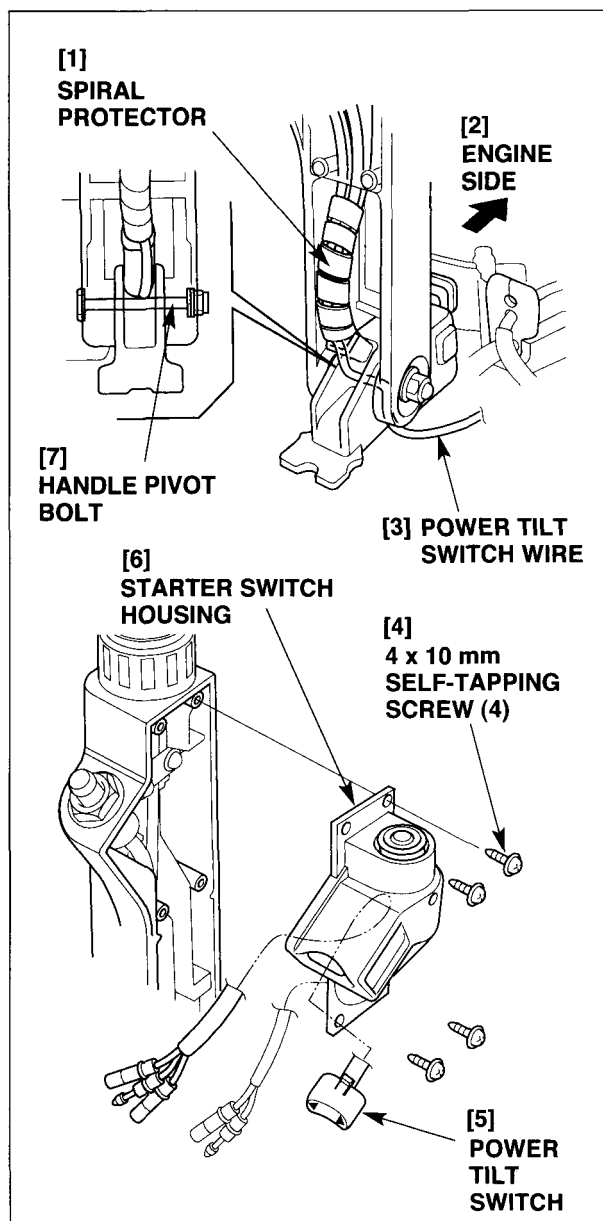
There should be continuity between ○—○.

Collar Position	Light green	White/black	Light blue
UP	○—○	○—○	
Neutral			
DOWN		○—○	○—○



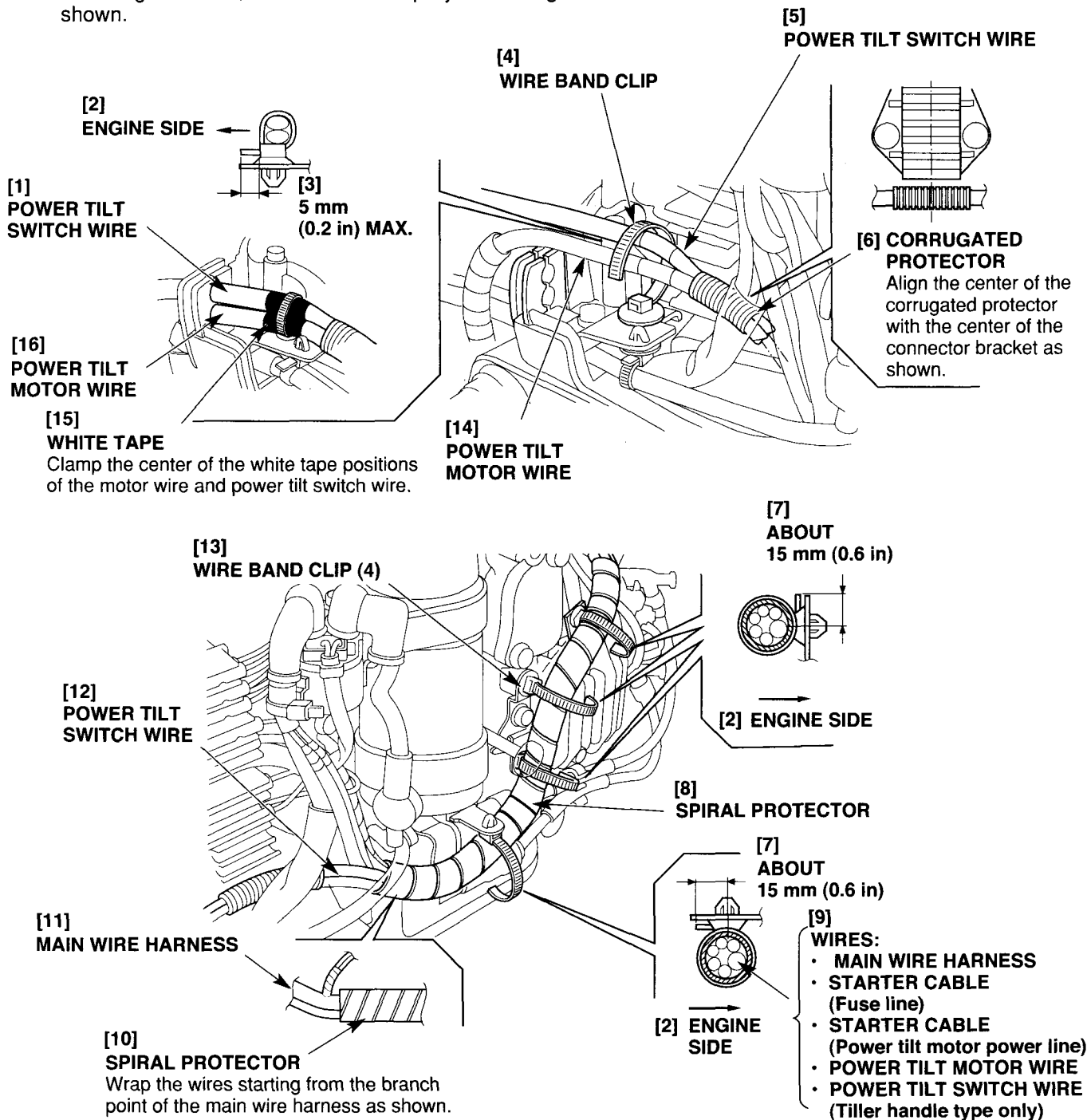
b. REPLACEMENT

- 1) Remove the spiral protector, then pull out the switch wires tacking care not to damage.
- 2) Remove the 4 x 10 mm self-tapping screws and starter switch housing.
- 3) Remove the power tilt switch from the starter switch housing.
- 4) Install a new power tilt switch.
- 5) Install the starter switch housing and tighten the 4 x 10 mm self-tapping screws.
- 6) Route the switch wire over the pivot bolt as shown.
- 7) Lap the spiral protector around the throttle cable and switch wires as shown.

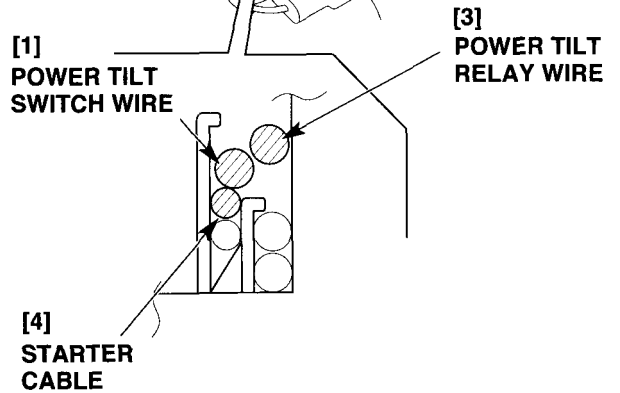
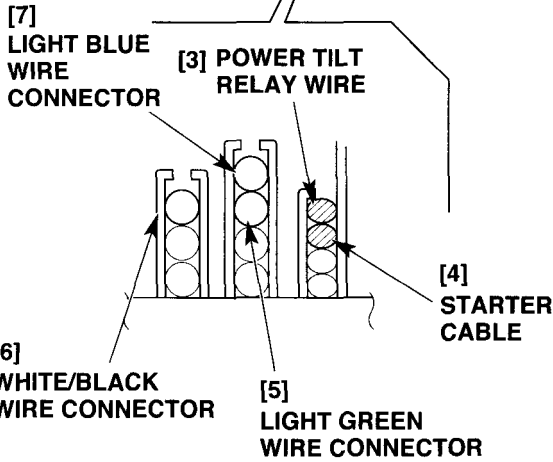
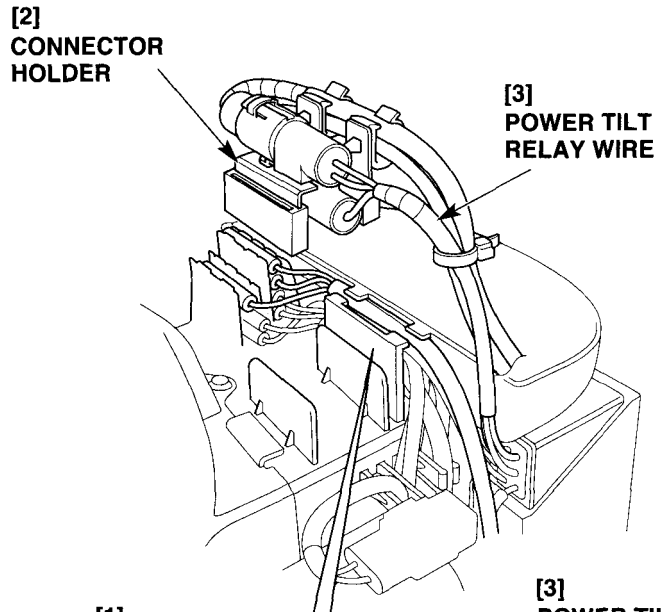
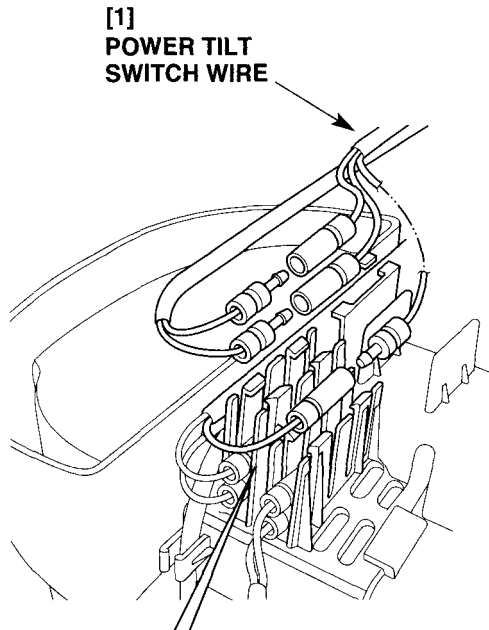


d. SWITCH WIRE INSTALLATION

- 1) Route the power tilt motor wire and secure the wires with the wire band and wire band clips. Cover the motor and switch wires with the corrugated protector as shown.
- 2) Route the power tilt motor wire along the main wire harness as shown and wrap the wires with the upper and lower spiral protectors as shown.
- 3) Secure the wires with the wire band clips.
 - If the wire band clip cut, replace with new one. After securing the wire, cut the end as projected length shown.



- 4) Connect the power tilt switch wire connectors to the starter cable and power tilt relay wire and set them to the holders.
- 5) Install the power tilt motor wire connectors with the connector holder attached to the starter case B.
- 6) Install the left engine under cover and engine cover.



1. STARTER CABLE

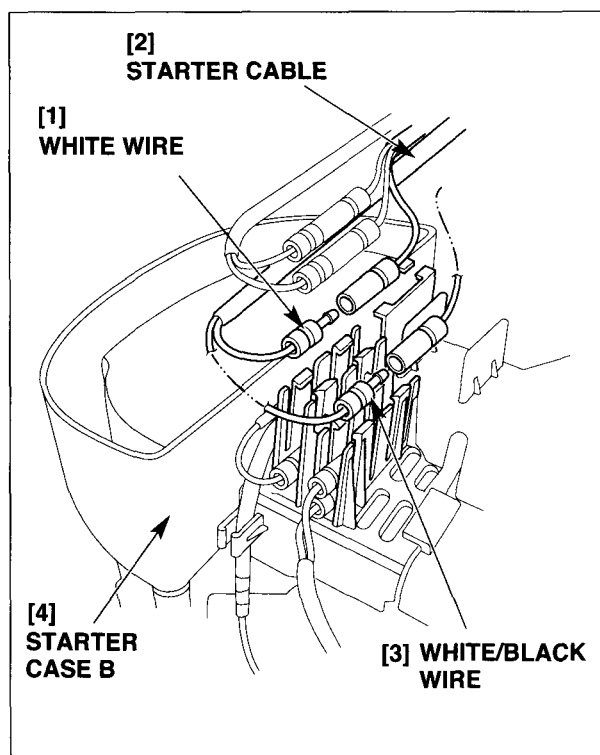
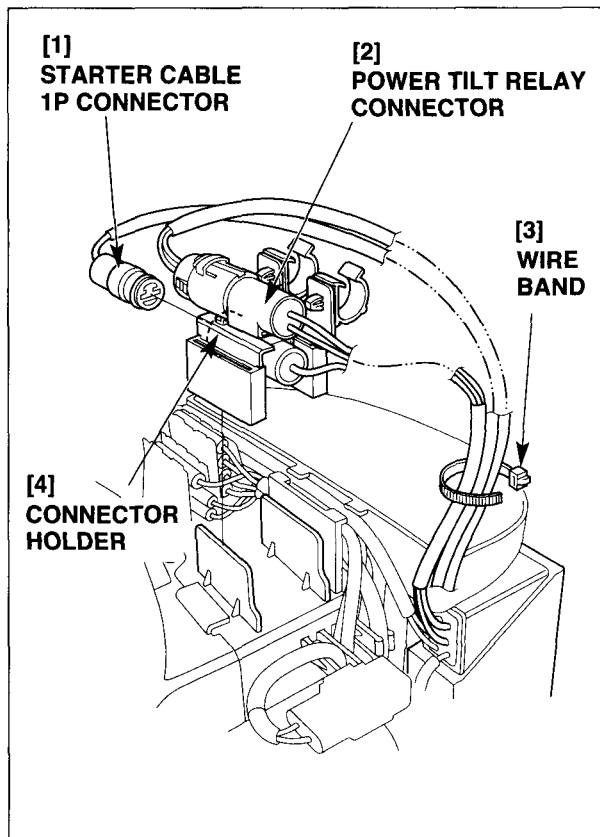
2. POWER TILT RELAY

1. STARTER CABLE

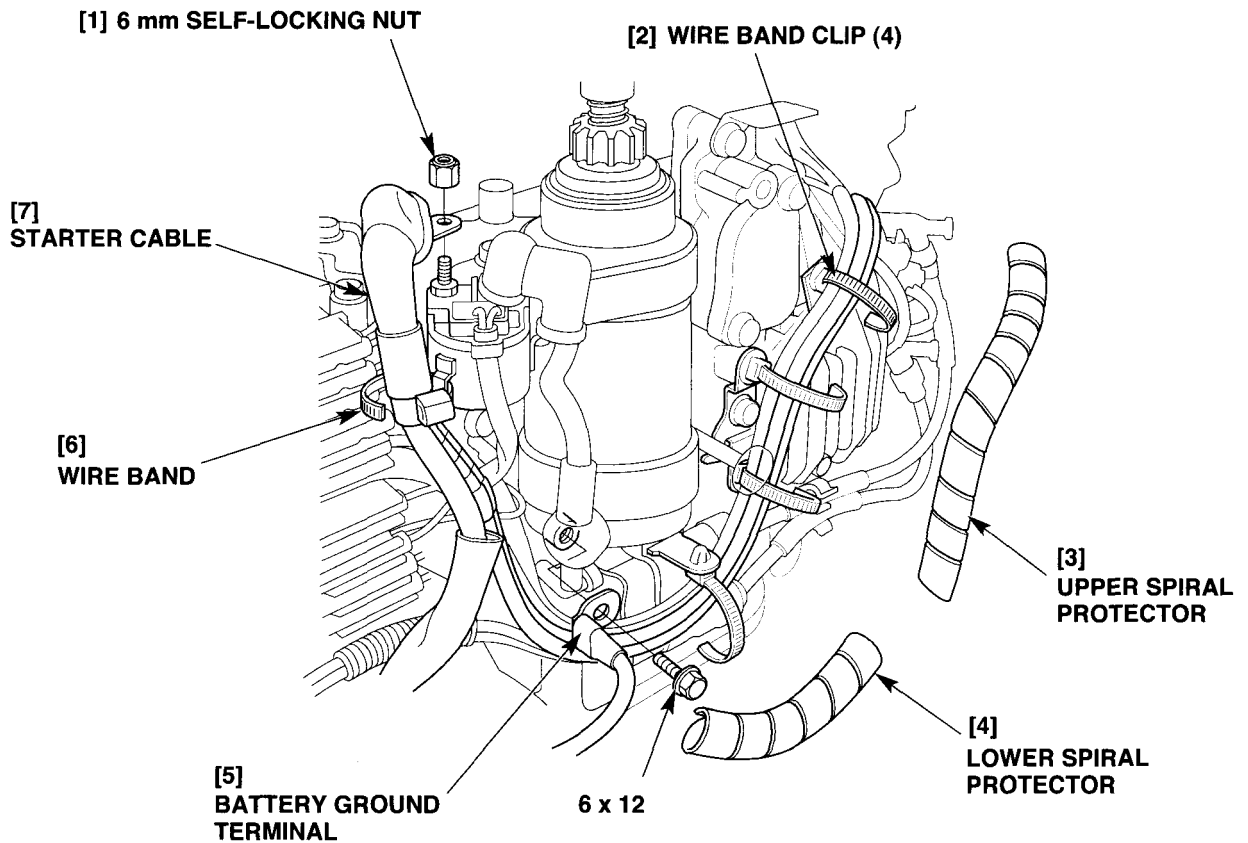
• Type With Power Tilt

a. REMOVAL

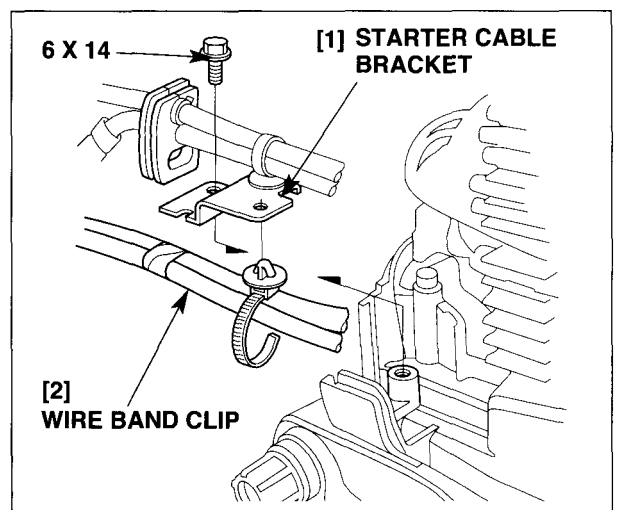
- 1) Remove the following:
 - engine cover (P. 5-1).
 - left engine under cover (P. 5-3).
- 2) Unfasten the wire band, and remove the power tilt relay wire connectors with the connector holder attached from the starter case B.
- 3) Disconnect the 1P connector and remove the connector from the connector holder.
- 4) Remove the fuse holder from the fuse holder bracket.
- 5) Pull the starter cable connectors from the holder on the starter case B, and disconnect the white and white/black wire connectors..



- 6) Open the four wire band clips and remove the spiral protectors.
- 7) Open the wire band on the starter magnetic switch.
- 8) Remove the 6 mm self-locking nut and disconnect the starter cable from the starter magnetic switch.
- 9) Remove the 6 x 12 mm flange bolt and disconnect the battery ground terminal.

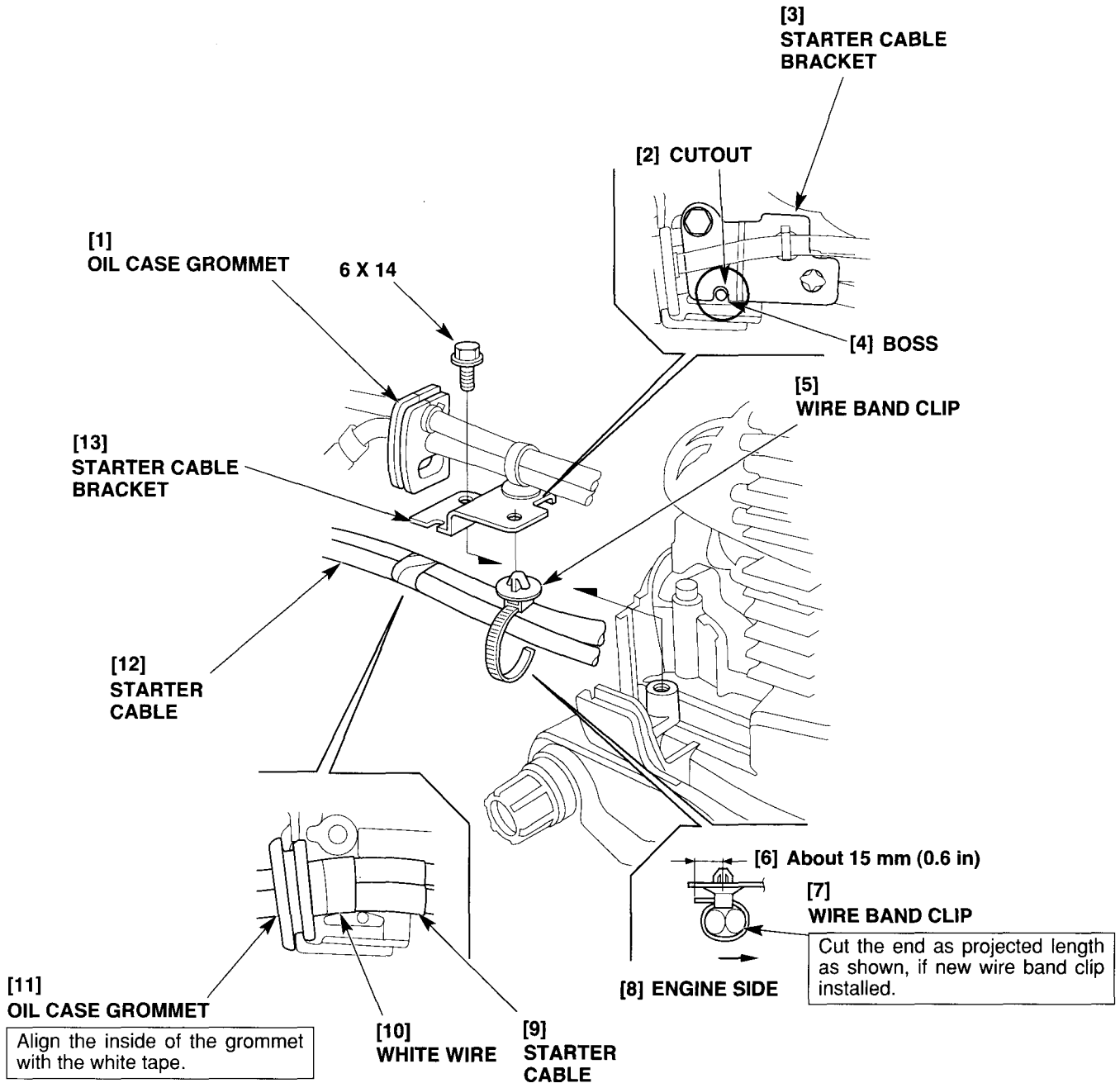


- 10) Remove the 6 x 14 mm flange bolt and starter cable bracket.
- 11) Open the wire band and remove the starter cable.

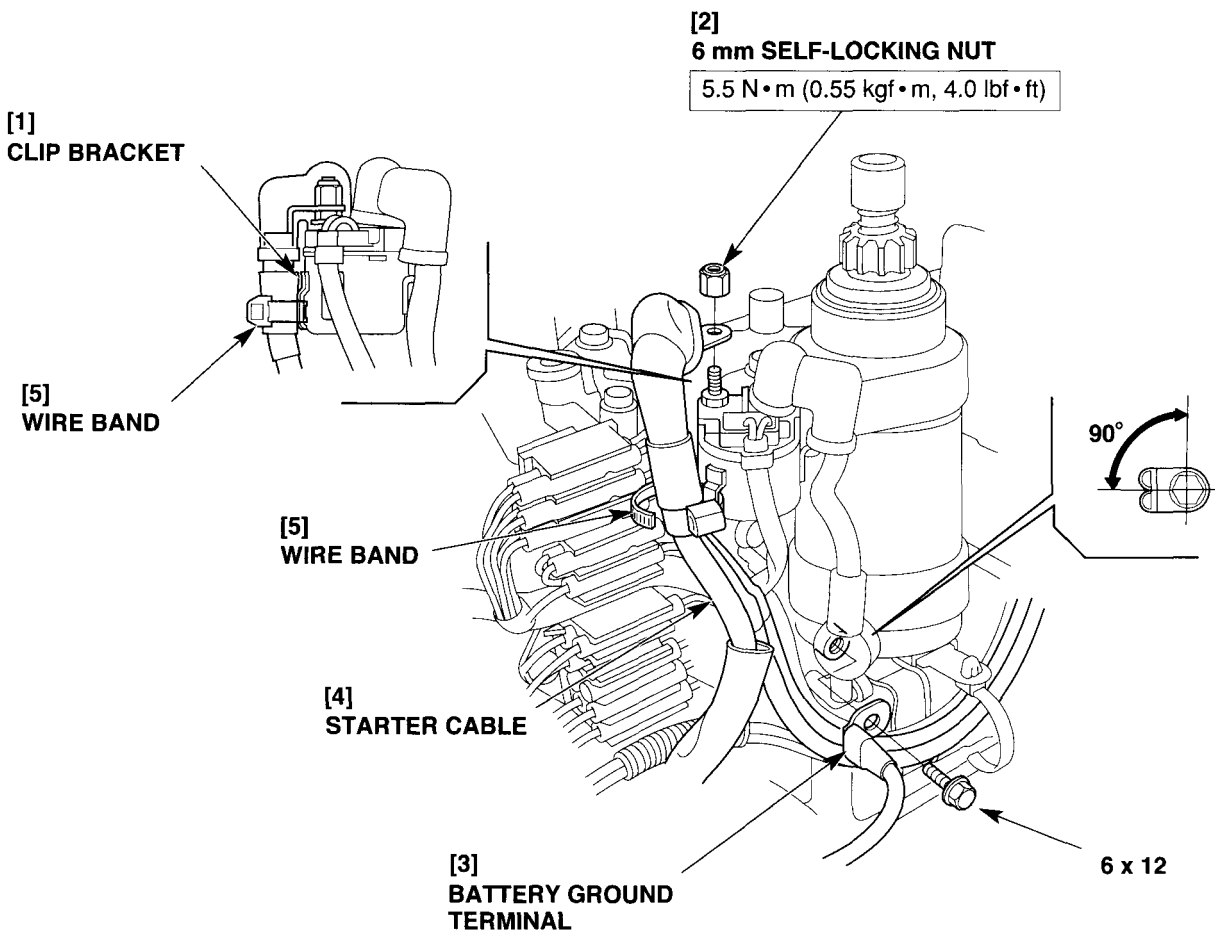


b. INSTALLATION

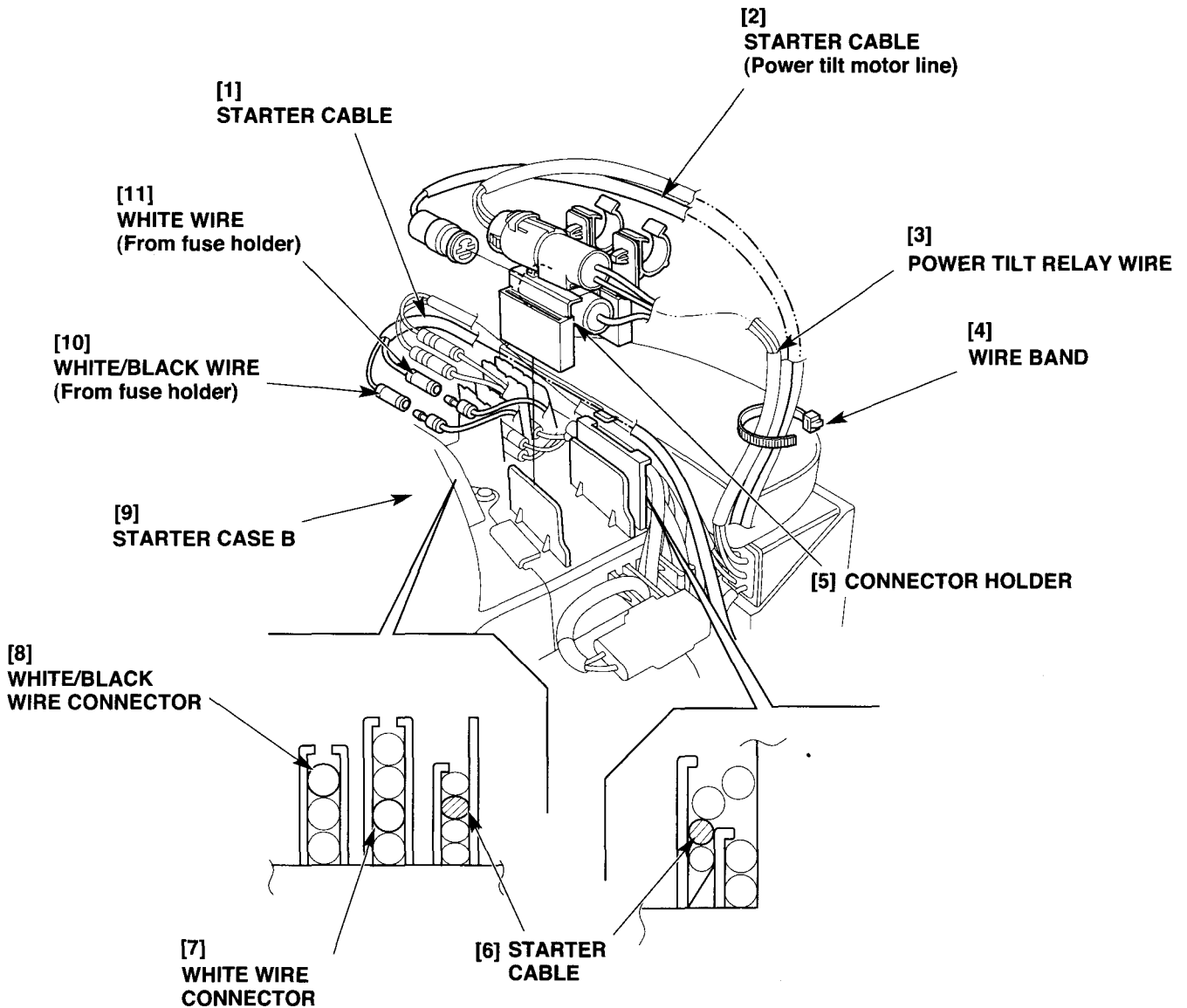
- 1) Install the oil case grommet to the starter cable and align the inside of the grommet with the white tape on the starter cable, and install them onto the oil case.
- 2) Secure the starter cable with the wire band clip and install the starter cable bracket by aligning the cutout with the boss on the oil case and tighten the 6 x 14 mm flange bolt securely.
- 3) Route the starter cable.
- 4) Tighten the ground terminal to the cylinder block using the 6 x 12 mm flange bolt.



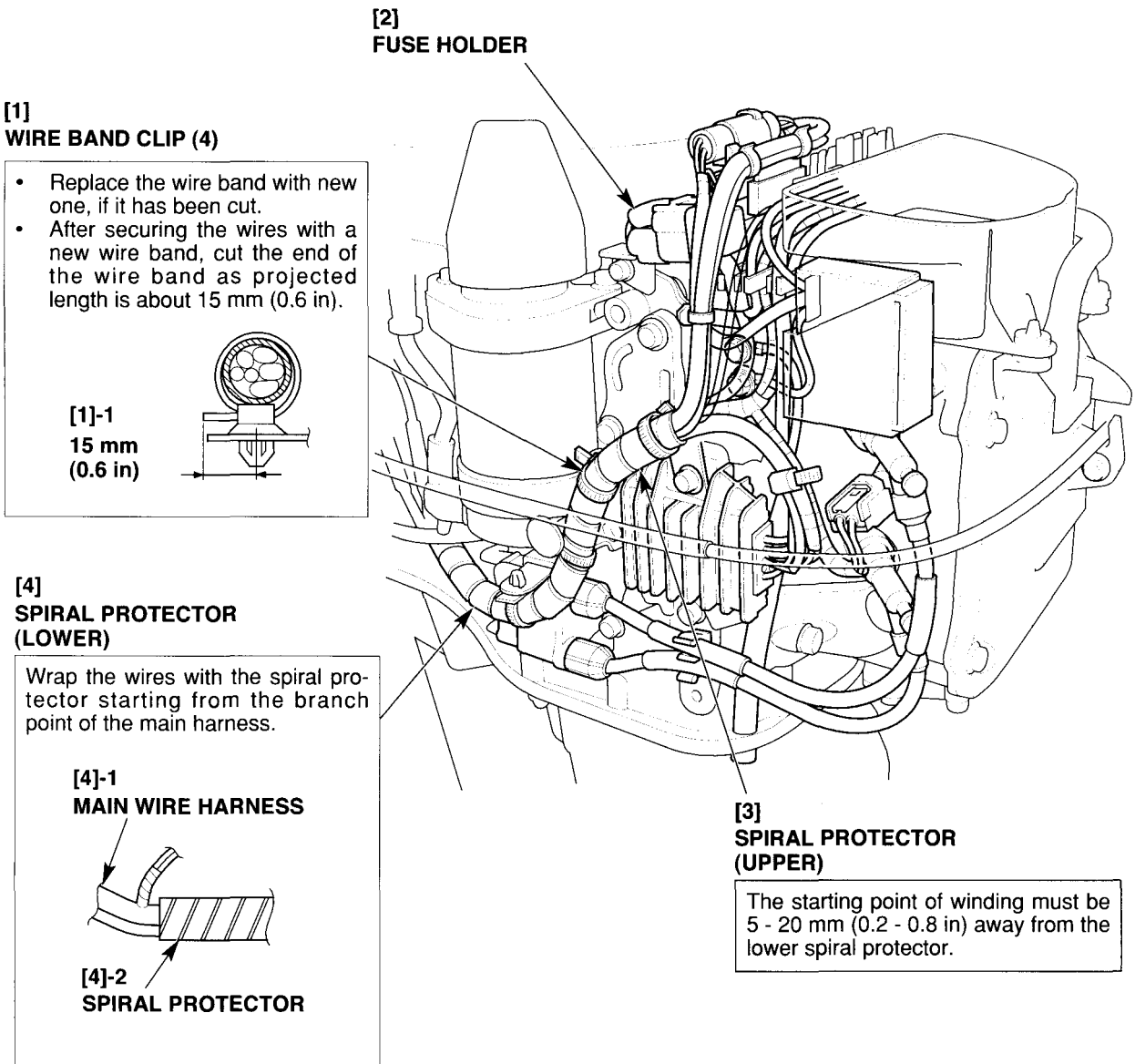
- 5) Connect the starter cable to the starter magnetic switch and adjust the terminal direction so that the starter cable contacts to the clamp bracket on the starter magnetic switch body as shown.
- 6) Tighten the self-locking nut to the specified torque.
TORQUE: 5.5 N•m (0.55 kgf Åm, 4.0 lbf Åft)
- 7) Secure the starter cable and control box wire harness (Remote control type only) with the cable band on the starter magnetic switch.



- 8) Connect the white wire connectors and set them in the connector holder on the starter case B.
 - See page 2-14 and 2-15.
- 9) Install the power tilt relay wire connectors with the connector holder on the starter case B.



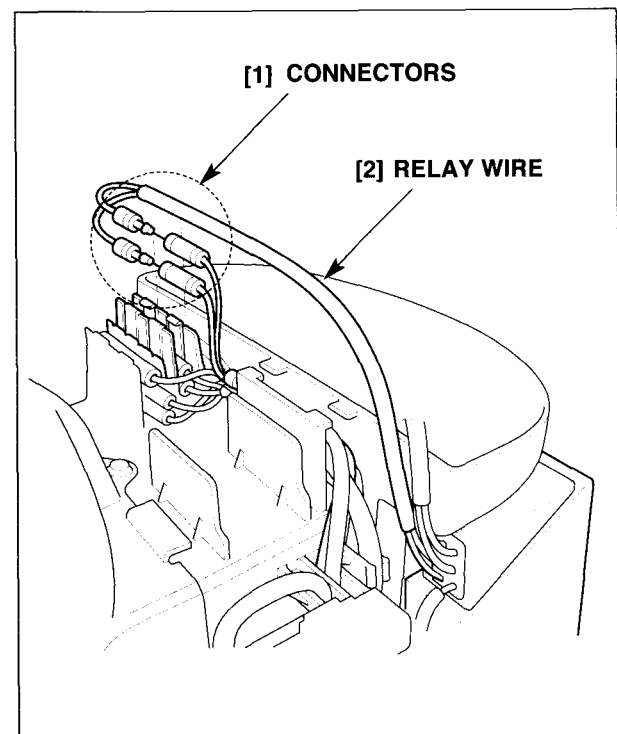
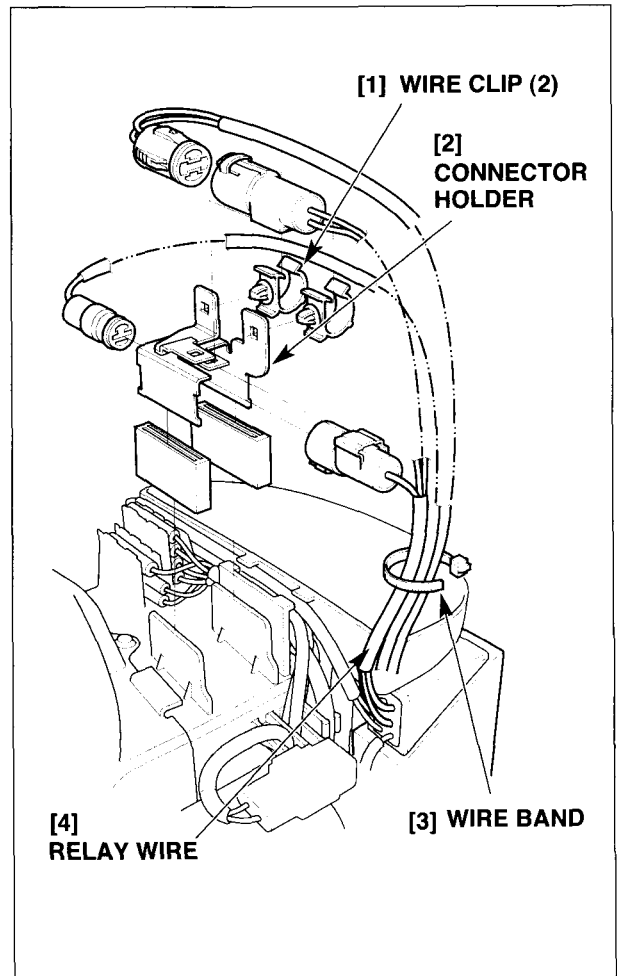
- 10) Set the fuse holder to the fuse holder bracket.
- 11) Route the charge wire (fuse line) along the main wire harness as shown and wrap the wires with the spiral protectors. Secure the them with the wire band clips.
- 12) Reinstall the removed parts in the reverse order of removal.



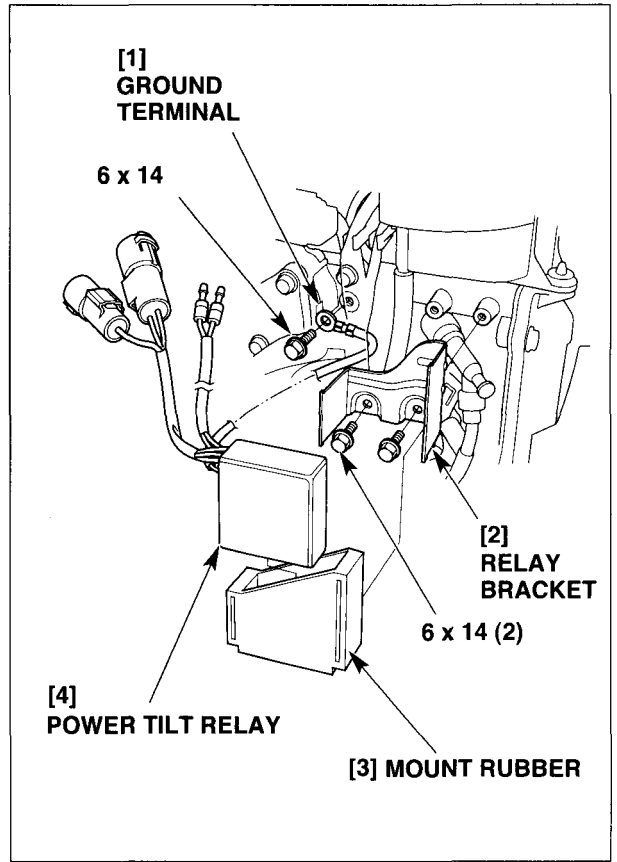
2. POWER TILT RELAY

a. REMOVAL

- 1) Remove the following:
- engine cover (P. 5-1 of the base shop manual).
 - 2) Open the wire band and free the wires.
 - 3) Remove the wires from the wire clip on the connector holder. Pull the connector holder from the starter case B with the mounting rubbers attached.
 - 4) Disconnect the power tilt relay 2P and 1P connectors.
-
- 5) Disconnect the power tilt relay connectors from the power tilt switch wire (Tiller handle type) or main wire harness (Remote control type).



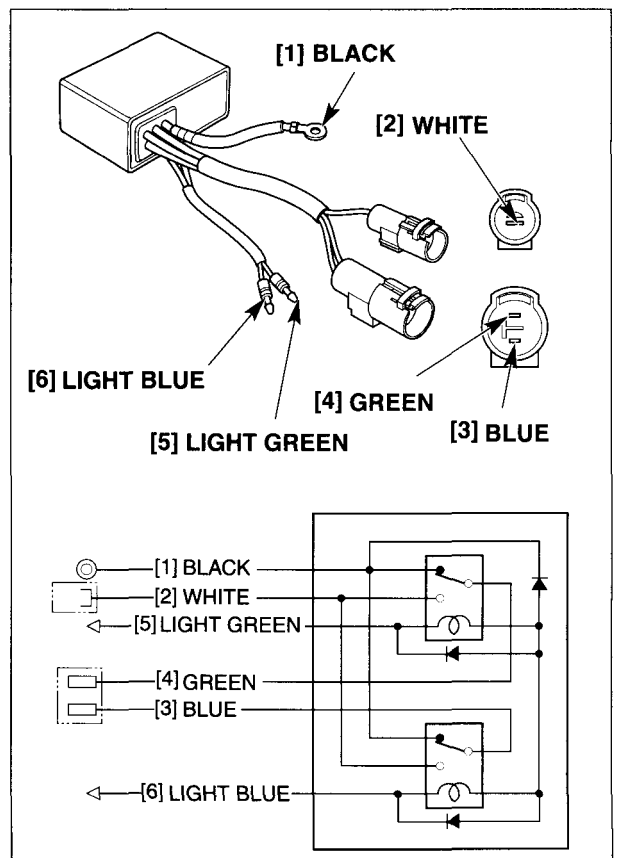
- 6) Remove the 6 x 12 mm flange bolt and disconnect the power tilt relay ground terminal from the engine.
- 7) Remove the power tilt relay.
- 8) Remove the 6 x 14 mm flange bolts and power tilt relay bracket.



b. INSPECTION

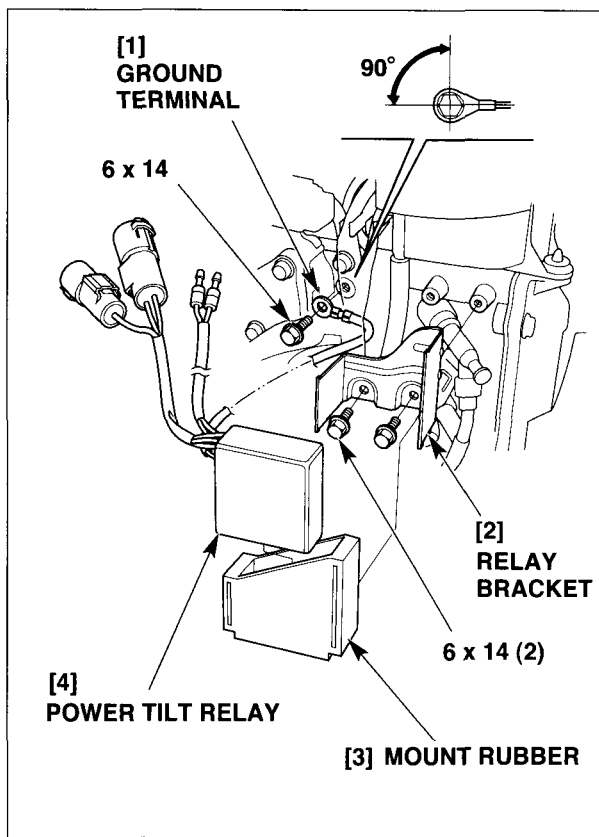
Check for continuity between the terminals:

- Connect the battery to the Light blue (+) and Black (-) terminals. There should be continuity between the White and Blue terminals.
- Connect the battery to the Light green (+) and Black (-) terminals. There should be continuity between the White and Green terminals.

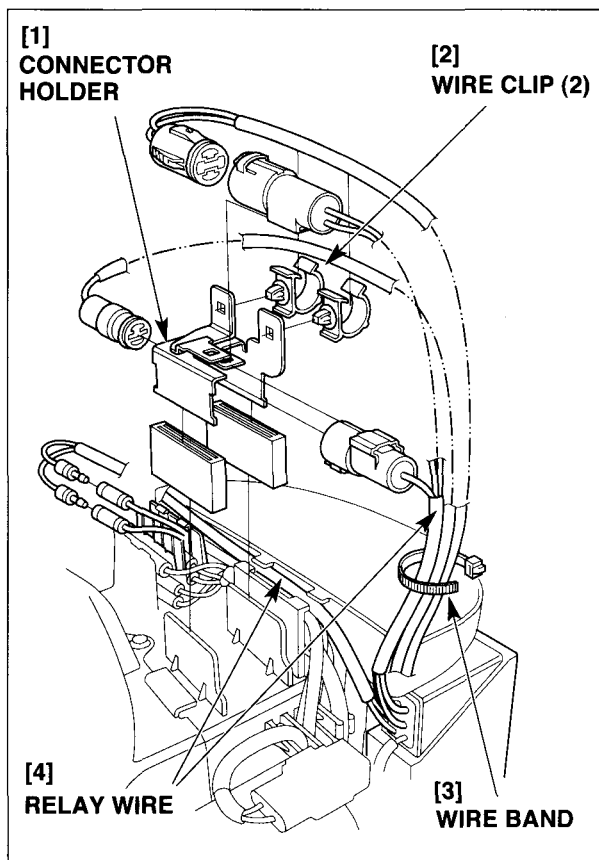


c. INSTALLATION

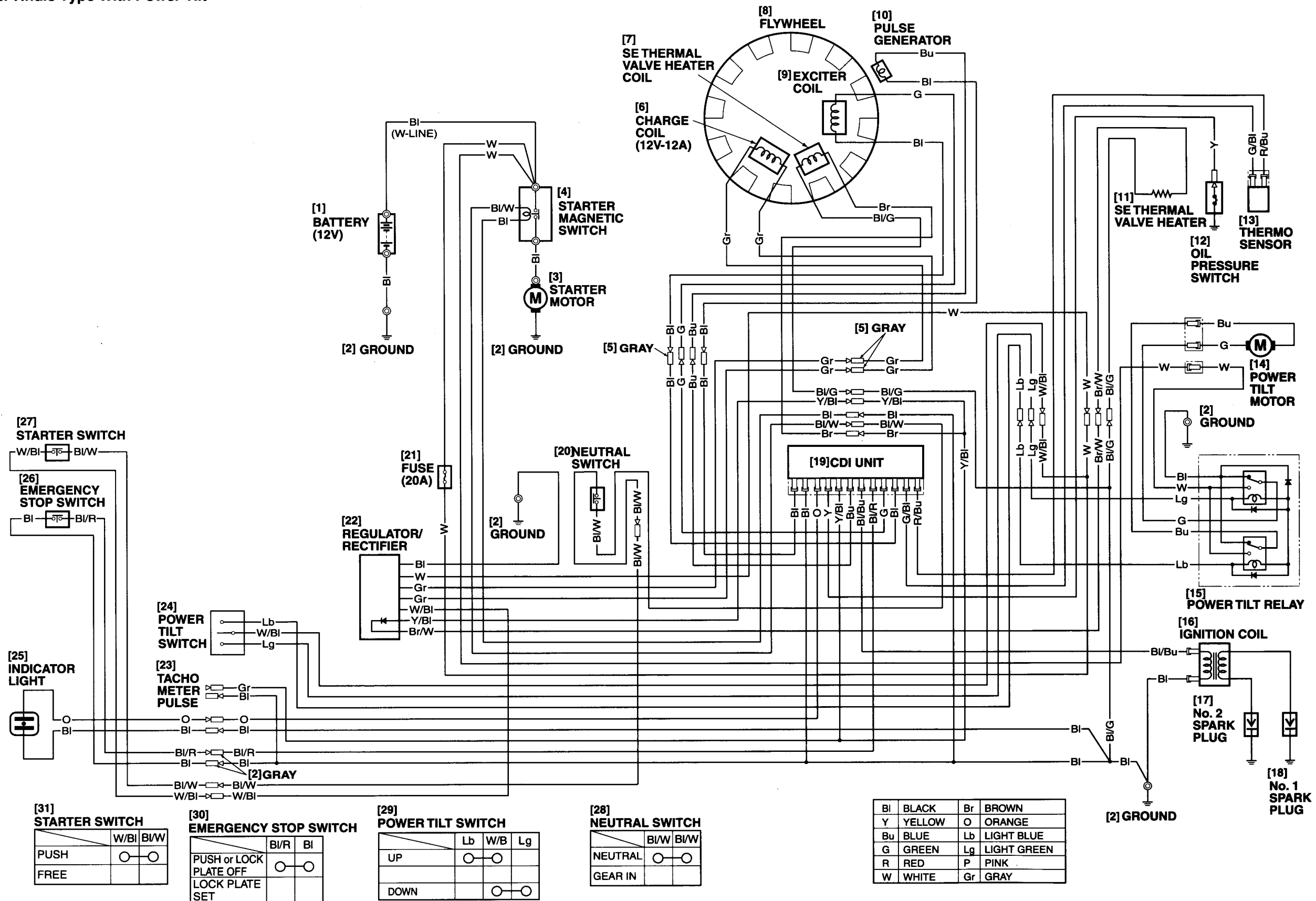
- 1) Install the relay bracket with the 6 x 12 mm flange bolts.
- 2) Install the power tilt relay to the mount rubber and install them to the relay bracket.
- 3) Adjust the relay ground terminal direction and tighten the 6 x 12 mm flange bolt securely.



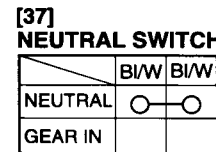
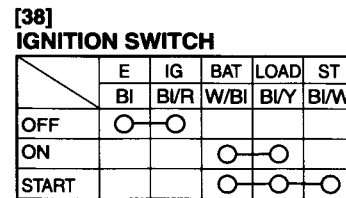
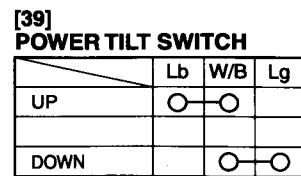
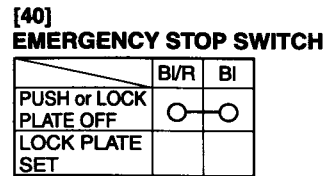
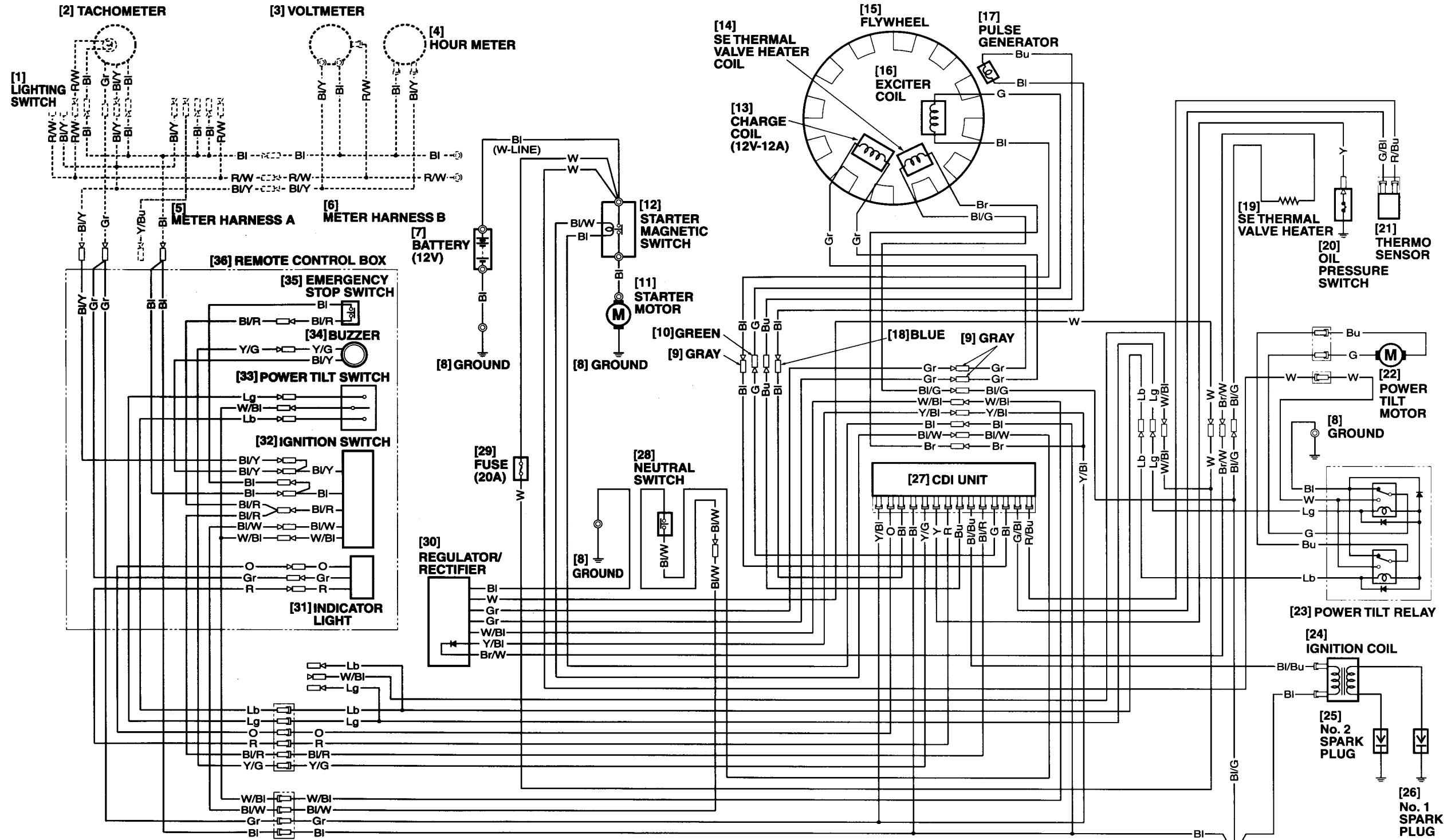
- 4) Route the power tilt relay wires and connect the connectors.
- 5) Install the connector holder to the starter case B with the mounting rubbers.
- 6) Clamp the wires with the wire clips.
- 7) Secure the wire with the wire band.
- 8) Install the removed parts in the reverse order of removal.



Tiller Hndle Type With Power Tilt



Remote Control Type With Power Tilt



BI	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

[8] GROUND

OUTBOARD MOTOR

Power Equipment

News No. P/P-158	Issue Date Apr. 2003
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SOME PARTS OF CHANGES

Applicable Information	Publication No.	Applicable Page
BF15D/BF20D	66ZY000	2-29, 6-18, 6-19, 6-20

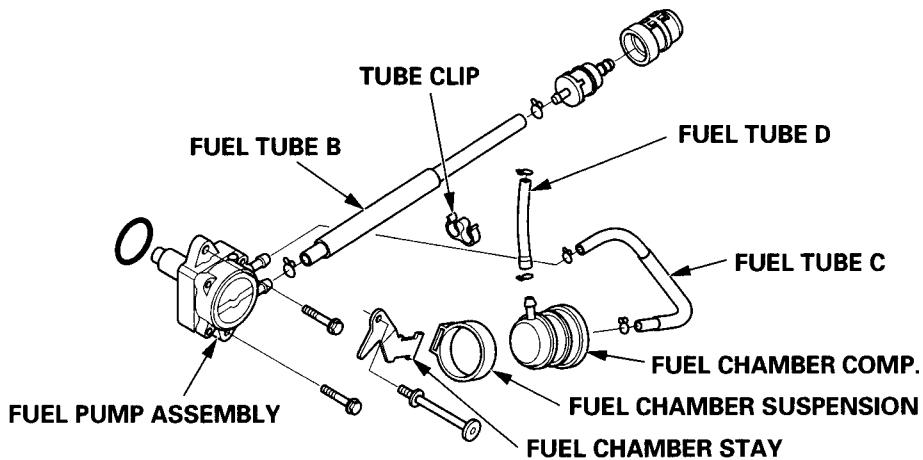
CHANGE LOCATIONS

- The installation position of the fuel pump has been changed 180 degrees.
- The installation angle of the fuel chamber comp. has been changed.
- Followed by the above changes, the fuel tubes and some other parts have been changed.
- * **Frame No. 1004589 products and the subsequent ones need a different kind of fuel chamber suspension. Also, the installation method of the fuel chamber comp. has been changed.**

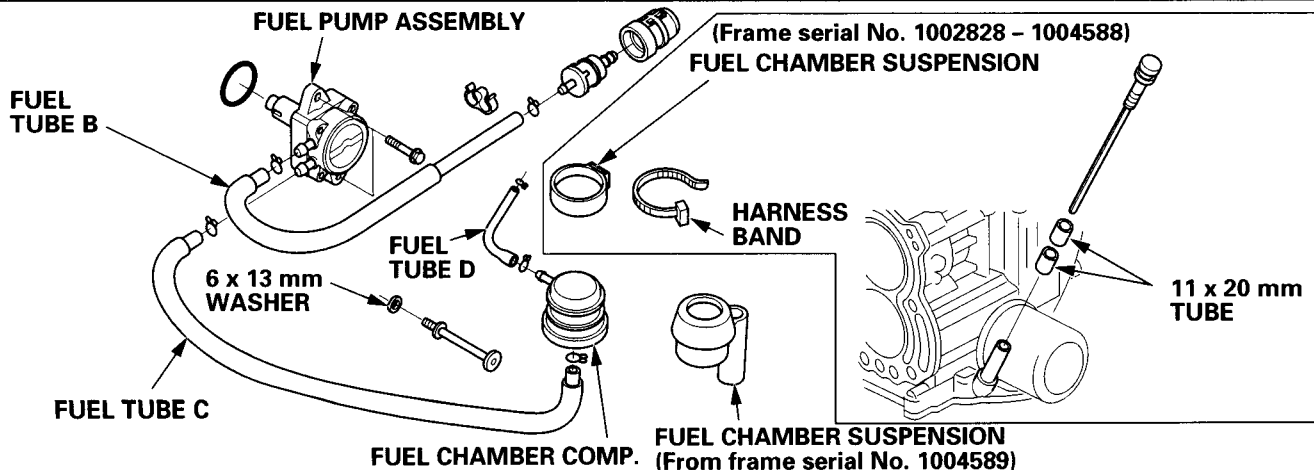
ASSOCIATED MACHINES

Model	Frame serial number
BF15D	1002828 -
BF20D	1002875 -

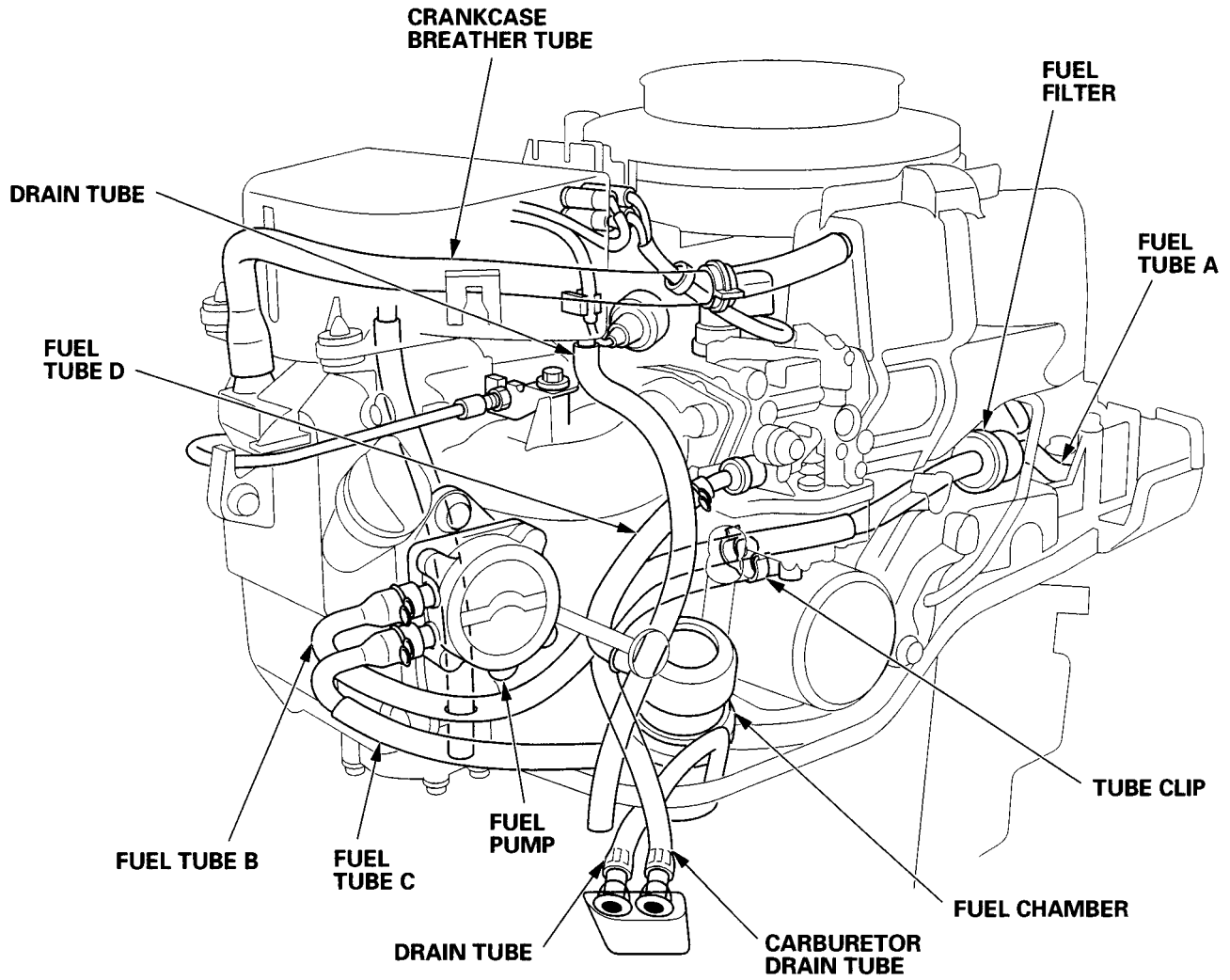
Before Modification



After Modification



TUBE ROUTING



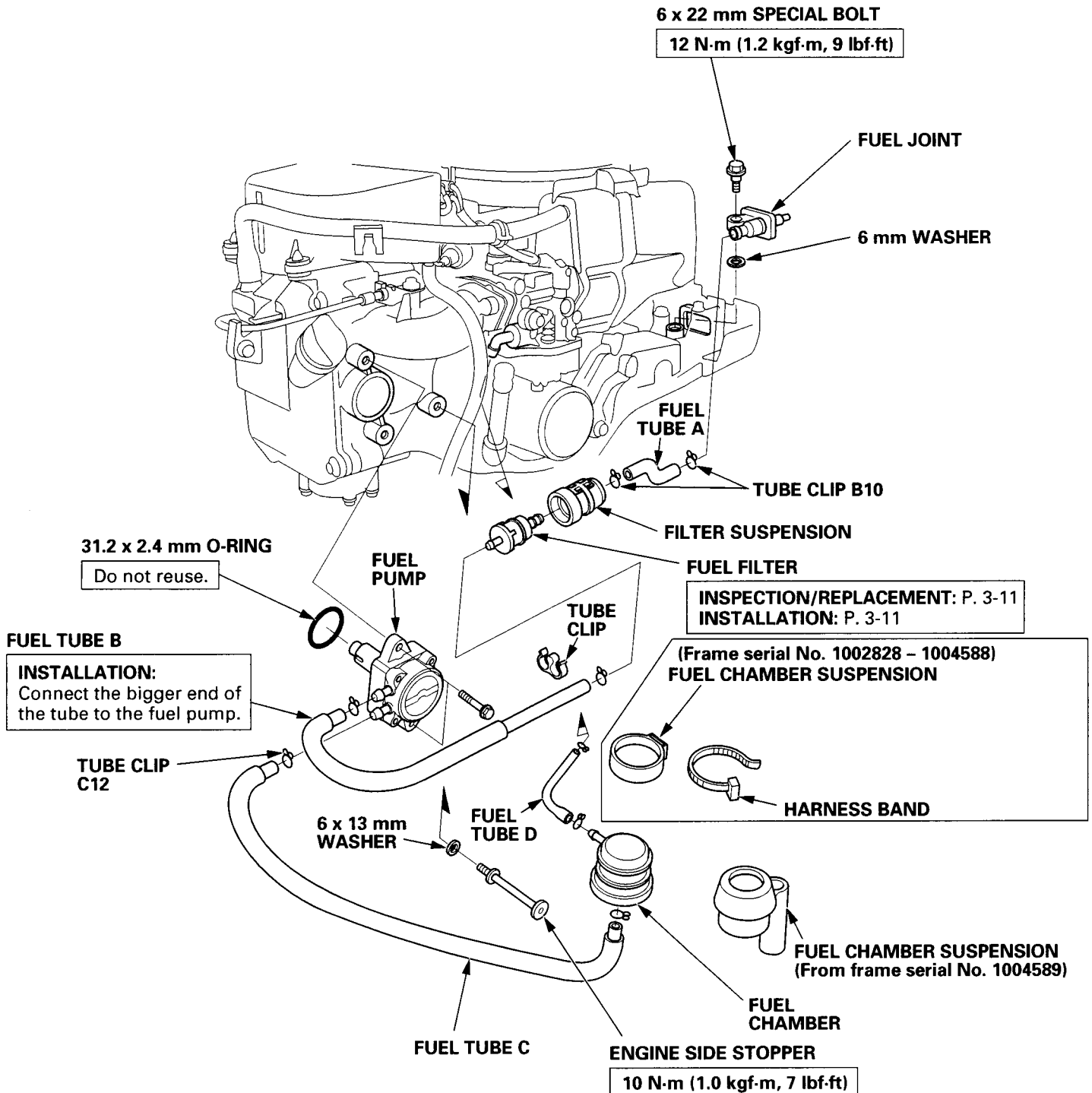
FUEL PUMP/FUEL FILTER

REMOVAL/INSTALLATION

⚠ WARNING

- The use of products causing fire is prohibited.
- Before installing each fuel tube, check it for wear and deterioration. Replace, if necessary.
- After installing each fuel tube, check that its connection does not leak gas.

- 1) Remove the engine cover (P. 5-1) and right engine under cover (P. 5-2).
- 2) Remove the tube clip used to put together the fuel tube B and carburetor drain tube.

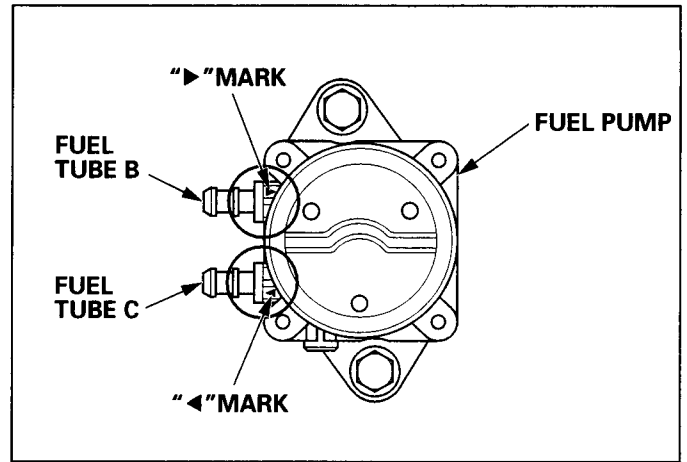


• FUEL PUMP

Installation:

- 1) Install the new 31.2 x 2.4 mm O-ring onto the fuel pump. Install the fuel pump into the cylinder head.
- 2) Connect the fuel tube B from the fuel filter to the fuel pump connection with "►" mark.
- 3) Connect the fuel tube C from the fuel chamber to the fuel pump connection with "◄" mark.

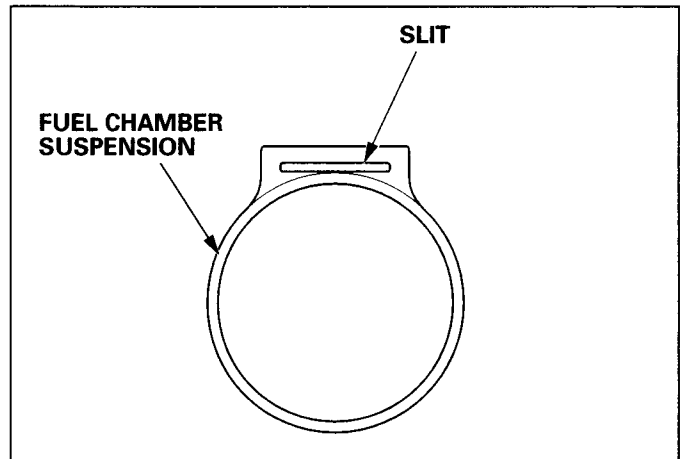
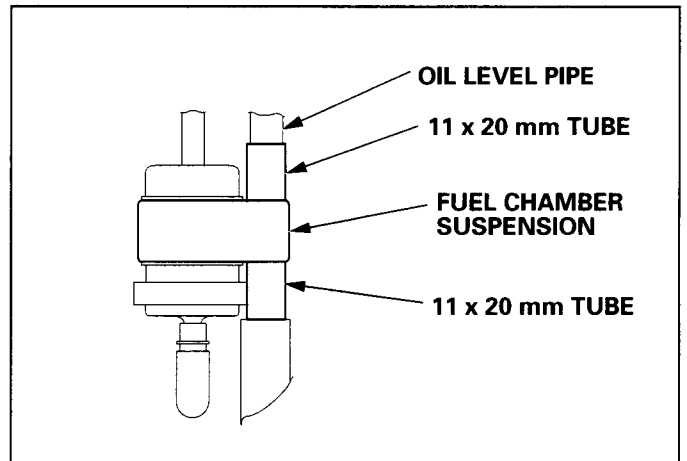
TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



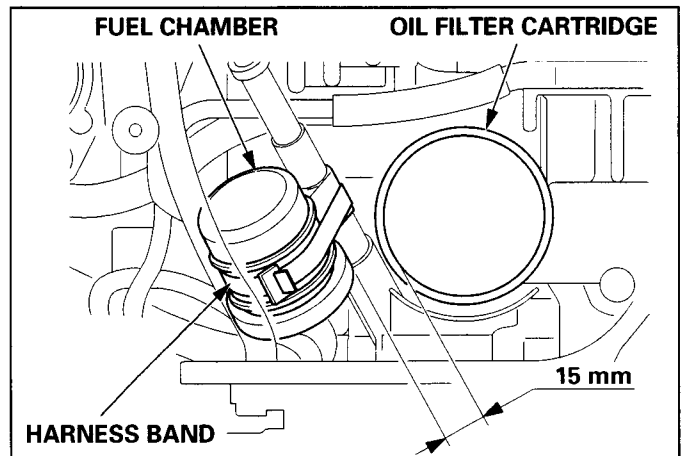
• FUEL CHAMBER

Installation: Frame No. 1002828-1004588

- 1) Pull out the oil level gauge.
- 2) Apply soapy water to the inside of one of the 11 x 20 mm tubes and attach the tube to the oil level pipe. Keep pushing the tube until it reaches the pipe end.
- 3) Apply soapy water to the slit of the fuel chamber suspension and attach the suspension to the oil level pipe. Keep pushing the suspension until it reaches the 11 x 20 mm tube.
- 4) Similarly, attach the other 11 x 20 mm tube to the oil level pipe.



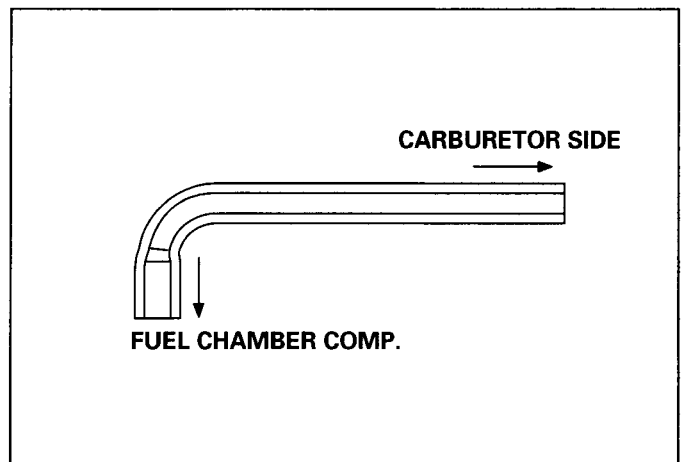
- 5) Adjust the position of the fuel chamber so that there will be about 15 mm clearance between the fuel chamber and the oil filter cartridge. Fix the fuel chamber using the harness band and trim the excess harness band.
- 6) Put the oil level gauge back.



• FUEL TUBE D

Installation:

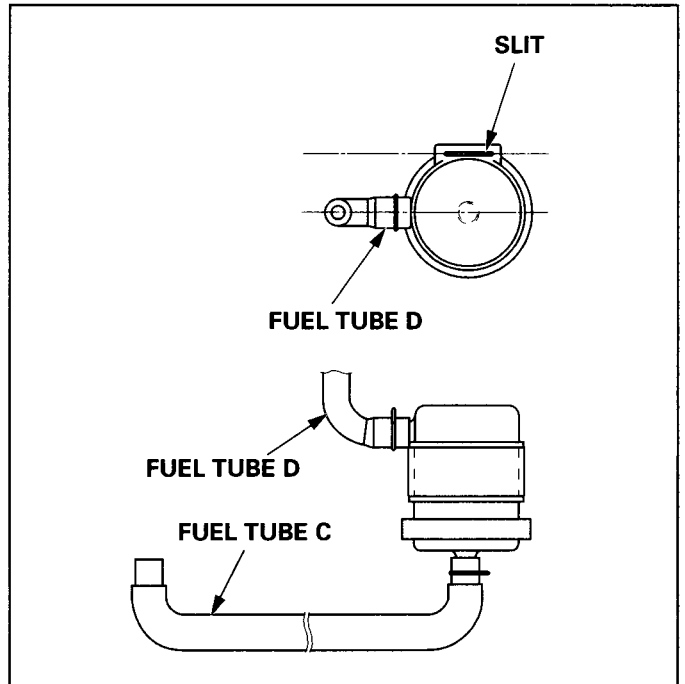
Install the bigger end of the tube into the fuel chamber and install the smaller end of the tube into the carburetor side.



• FUEL CHAMBER SUSPENSION

Installation:

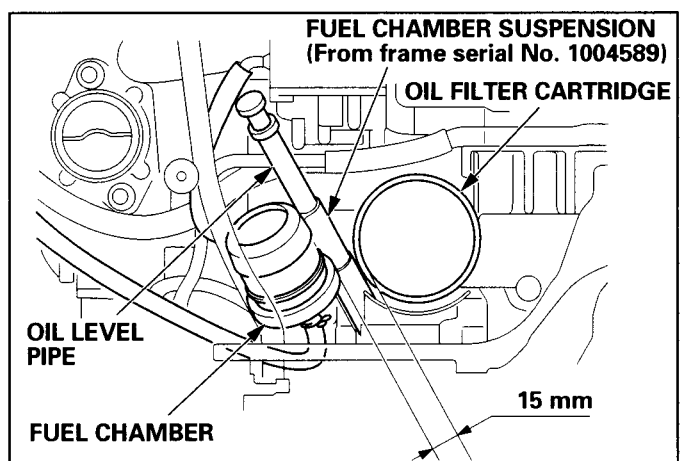
Install the fuel chamber suspension into the fuel chamber as shown so that the slit will be parallel to the connection of the fuel tube D.



• FUEL CHAMBER

Installation: From frame serial No. 1004589

Apply soapy water to the connection of the fuel chamber suspension into the oil level pipe.
Install the fuel chamber into the oil level pipe so that there will be about 15 mm clearance between the fuel chamber and the oil filter cartridge.



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