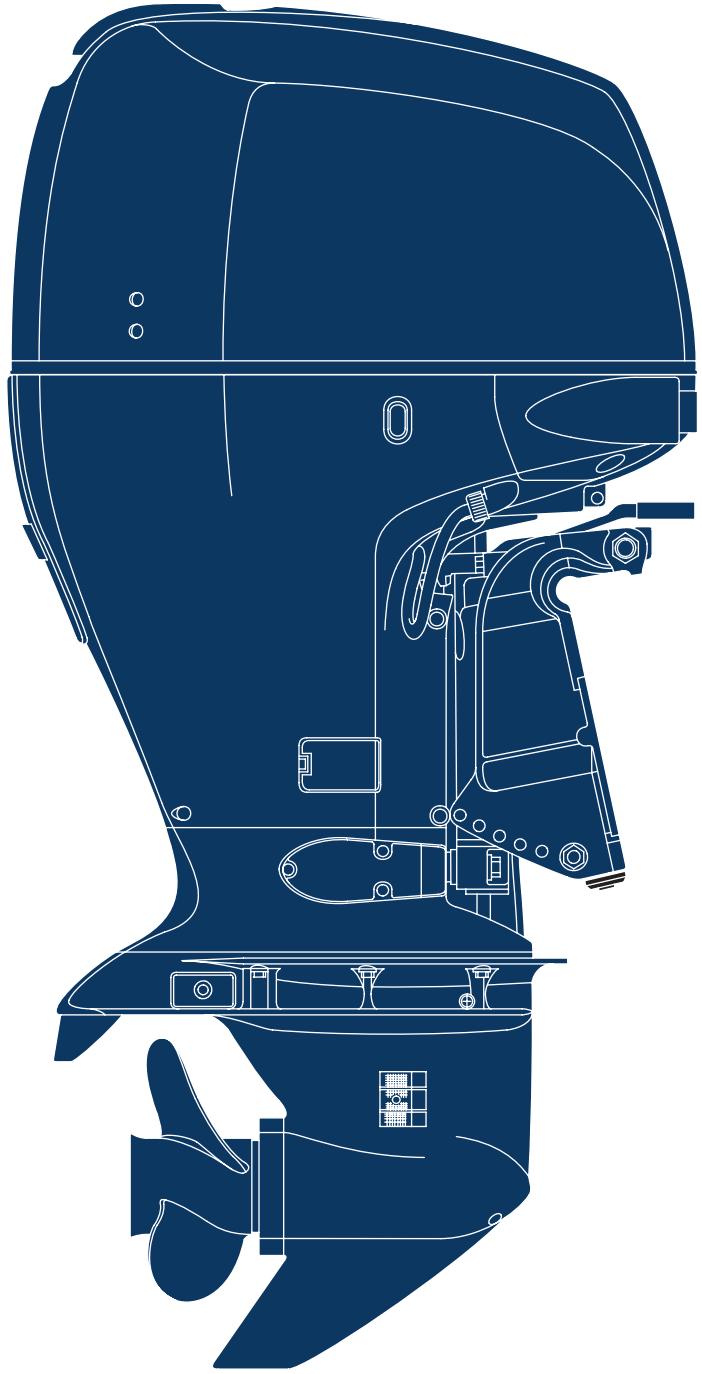
SERVICE MANUAL

TOHATSU
Outboards



4 Stroke
BFT115A
Models

OB No.62ZX100
14-01 NB

Introduction

Before reading this manual

This service manual provides information that is needed for inspection, service and repair of applicable outboard motors. For our customers' safe and comfortable use of the products for long term, it is essential to maintain the performance and quality of the outboard motors. To ensure this, the maintenance and service have to be done properly by service technicians with fundamental knowledge and skills. This manual is utilized so that our customers can always use their outboard motor with full satisfaction.
As this document contains information from the Honda Motor's Service Manual, the document contains information about models that are not sold by our company. Additionally, the model names and part numbers of the special tools mentioned in this document are the names and numbers used by Honda Motor Co., Ltd. Please alter the model names and part numbers as follows.

Change model names with "BF" to "BFT".

Example: BF* -> BFT***

Add "HCO-" at the beginning of part numbers of special tools.

Example: 07GD-0010100-OS -> HT07GD-0010100-OS

A Few Words About Safety

SERVICE INFORMATION

The service and repair information contained in this manual is intended for use by qualified, professional technicians. Attempting service or repairs without the proper training, tools, and equipment could cause injury to you and/or others. It could also damage this Honda product or create an unsafe condition.

This manual describes the proper methods and procedures for performing service, maintenance, and repairs. Some procedures require the use special tools. Any person who intends to use a replacement part, service procedure, or a tool that is not recommended by Honda must determine the risks to their personal safety and the safe operation of this product.

If you need to replace a part, use Honda Genuine parts with the correct part number or an equivalent part. We strongly recommend that you do not use replacement parts of inferior quality.

For Your Customer's Safety

Proper service and maintenance are essential to the customer's safety and the reliability of this product. Any error or oversight while servicing this product can result in faulty operation, damage to the product, or injury to others.

⚠WARNING

Improper service or repairs can create an unsafe condition that can cause your customer or others to be seriously hurt or killed.

Follow the procedures and precautions in this manual and other service materials carefully.

For Your Safety

Because this manual is intended for the professional service technician, we do not provide warnings about many basic shop safety practices (e.g., Hot parts-wear gloves). If you have not received shop safety training or do not feel confident about your knowledge of safe servicing practices, we recommend that you do not attempt to perform the procedures described in this manual.

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

⚠WARNING

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

Follow the procedures and precautions in this manual carefully.

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 anytime you hammer, drill, grind, or work around pressurized air, pressurized liquids, 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 equipment hoisted in the air. Anytime you lift this product with a hoist, make sure that the hoist hook is securely attached to the product.

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 batteries.

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

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INTRODUCTION

This manual covers the service and repair procedures for the Honda BF115D outboard motor.

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 this Honda product, other property, or the environment.

SAFETY MESSAGES

Your safety and the safety of other, 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 products. You must use your own good judgement.

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

- Safety Labels – on the product.
- 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 these products correctly and safely.

ALL INFORMATION, ILLUSTRATIONS, DIRECTIONS AND SPECIFICATIONS INCLUDED IN THIS PUBLICATION ARE BASED ON THE LATEST PRODUCT INFORMATION AVAILABLE AT THE TIME OF APPROVAL FOR PRINTING. Honda Motor Co., Ltd. RESERVES THE RIGHT TO MAKE CHANGES AT ANY TIME WITHOUT NOTICE AND WITHOUT INCURRING ANY OBLIGATION WHATSOEVER. NO PART OF THIS PUBLICATION MAY BE REPRODUCED WITHOUT WRITTEN PERMISSION. THIS MANUAL IS WRITTEN FOR PERSONS WHO HAVE ACQUIRED BASIC KNOWLEDGE OF MAINTENANCE ON Honda PRODUCTS.

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SERVICE PUBLICATION OFFICE

Date of Issue: July 2010

SERVICE RULES

- Use Honda Genuine or Honda-recommended parts and lubricants or their equivalents. Parts that do not meet Honda's design specifications may damage the unit.
- Use the special tools designed for the product.
- Install new gaskets, O-rings, etc. when reassembling.
- When torquing bolts or nuts, begin with larger-diameter or inner bolts first and tighten to the specified torque diagonally, unless a particular sequence is specified.
- Clean parts in cleaning solvent upon disassembly. Lubricate any sliding surfaces before reassembly.
- After reassembly, check all parts for proper installation and operation.
- Many screws used in this machine are self-tapping. Be aware that cross-threading or overtightening these screws will strip the threads and ruin the hole.

Use only metric tools when servicing this unit. Metric bolts, nuts, and screws are not interchangeable with non-metric fasteners. The use of incorrect tools and fasteners will damage the unit.

SYMBOLS

The symbols used throughout this manual show specific service procedures. If supplementary information is required pertaining to these symbols, it will be explained specifically in the text without the use of the symbols.

	Replace the part(s) with new one(s) before assembly.
	Use the recommend engine oil, unless otherwise specified.
	Use molybdenum oil solution (mixture of the engine oil and molybdenum grease in a ratio of 1:1).
	Use multi-purpose grease (lithium based multi-purpose grease NLGI #2 or equivalent).
	Use marine grease (water resistant urea based grease).
	Apply a locking agent. Use a medium strength locking agent unless otherwise specified.
	Apply sealant.
	Use automatic transmission fluid.
(○ x ○) (○)	Indicates the diameter, length, and quantity of metric bolts used.
page 1-1	Indicates the reference page.

ABBREVIATIONS

Throughout this manual, the following abbreviations are used to identify the respective parts or systems.

Abbreviated term	Full term
ACG	Alternator
A/F	Air Fuel Ratio
API	American Petroleum Institute
Approx.	Approximately
Assy.	Assembly
ATDC	After Top Dead Center
ATF	Automatic Transmission Fluid
ATT	Attachment
BAT	Battery
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
BARO	Barometric Pressure
CKP	Crankshaft Position
Comp.	Complete
CMP	Camshaft Position
CYL	Cylinder
DLC	Data Link Connector
EBT	Engine Block Temperature
ECT	Engine Coolant Temperature
ECM	Engine Control Module
EMT	Exhaust Manifold Temperature
EOP	Engine Oil Pressure
EX	Exhaust
F	Front or Forward
GND	Ground
HO2S	Heated Oxygen sensor
IAB	Intake Air Bypass
IAC	Idle Air Control
IAT	Intake Air Temperature
I.D.	Inside diameter
IG or IGN	Ignition
IN	Intake
INJ	Injection
L.	Left
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
O.D.	Outside Diameter
OP	Optional Part
PGM-FI	Programmed-Fuel Injection
P/N	Part Number
Qty	Quantity
R.	Right
SAE	Society of Automotive Engineers
SCS	Service Check Signal
STD	Standard
SW	Switch
TDC	Top Dead Center
TP	Throttle Position
VTEC	Variable Valve Timing & Valve Lift Electronic Control

Bl	Black	G	Green	Br	Brown	Lg	Light green
Y	Yellow	R	Red	O	Orange	P	Pink
BU	Blue	W	White	Lb	Light blue	Gr	Gray

1. GENERAL INFORMATION

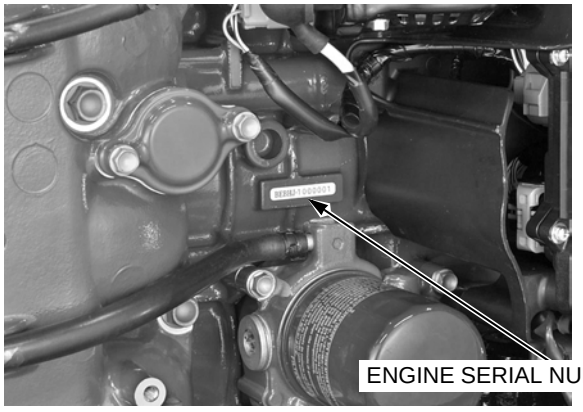
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SERIAL NUMBER LOCATION

The engine serial number is stamped on the right side of cylinder block and the product identification number is located on the right stern bracket. Always specify these numbers when inquiring about the engine or when ordering parts in order to obtain the correct parts for the outboard motor being serviced.





SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Model	BF115D						
Description code	BBHJ						
Type	LD	XD	XCD	LU	XU	LC	XC
Overall length	845 mm (33.3 in)						
Overall width	580 mm (22.8 in)						
Overall height	1,665 mm (65.6 in)	1,790 mm (70.5 in)		1,665 mm (65.6 in)	1,790 mm (70.5 in)	1,665 mm (65.6 in)	1,790 mm (70.5 in)
Dry weight (*1)	217 kg (478 lbs)	220 kg (485 lbs)	223 kg (492 lbs)	217 kg (478 lbs)	220 kg (485 lbs)	217 kg (478 lbs)	220 kg (485 lbs)
Operating weight (including oil)	225 kg (496 lbs)	228 kg (503 lbs)	231 kg (509 lbs)	225 kg (496 lbs)	228 kg (503 lbs)	225 kg (496 lbs)	228 kg (503 lbs)

*1 : With propeller mounted.
LD, XD, LU, XU, LC and XC types: Aluminum type 3.0 kg (6.6 lbs)
XCD type: Stainless type 6.0 kg (13.2 lbs)

FRAME

Model	BF115D						
Type	LD	XD	XCD	LU	XU	LC	XC
Transom height (*1)	508 mm (20.0 in)	635 mm (25.0 in)		508 mm (20.0 in)	635 mm (25.0 in)	508 mm (20.0 in)	635 mm (25.0 in)
Tilting angle	72°						
Tilting stage	Stageless						
Trim angle (*1)	– 4° to 16°						
Swivel angle	30° right and left						
Shaft length type	L	XL	XL	L	XL	L	XL
Standard rotation	○	○		○	○	○	○
Counter rotation			○				
Remote control box	(○)	(○)	(○)	(○)	(○)	(○)	(○)
Power trim/tilt	○	○	○	○	○	○	○
Tachometer	(○)	(○)	(○)	(○)	(○)	(○)	(○)
Trim meter	(○)	(○)	(○)	(○)	(○)	(○)	(○)

*1 : Transom angle is at 12°
(○): Optional part

ENGINE

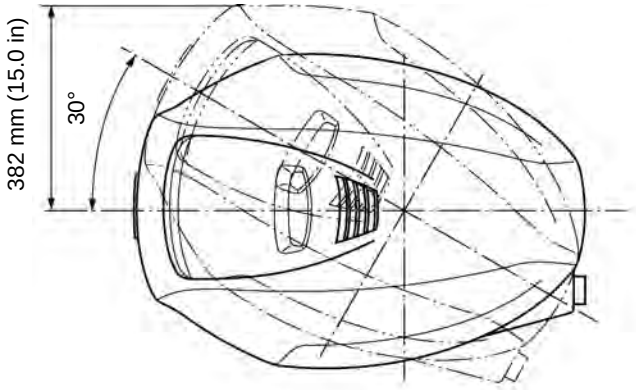
Model	BF115D
Description code	BEBHJ
Type	4-stroke, D.O.H.C., 4 cylinder
Displacement	2,354 cm^3 (143.6 cu in)
Bore × stroke	87.0 × 99.0 mm (3.43 × 3.90 in)
Rated power	84.6 kW (115 PS) at 5,250 min^{-1} (rpm)
Maximum torque	194 N·m (19.8 kgf·m, 143 lbf·ft)
Compression ratio	9.6 : 1
Fuel consumption ratio (at rated power)	315 g/kW·h
Fuel consumption ratio (at continuous maximum power)	315 g/kW·h
Cooling system	Forced water circulation by impeller pump with thermostat
Ignition system	Fully transistorized, battery ignition
Ignition timing	0° at 750 min^{-1} (rpm) B.T.D.C
Spark plug	ZFR6K−11 (NGK), KJ20DR–M11 (DENSO)
Fuel supply system	Programmed fuel injection
Fuel injection system	Electronic control
Fuel injection nozzle	Multi-point type
Fuel	Unleaded gasoline with a pump octane rating of 86 or higher
Fuel pump	Electric and mechanical plunger type
Lubrication system	Pressure lubrication by trochoid pump
Lubrication capacity	7.35 liter (7.77 US qt, 6.47 Imp qt) [Without oil filter replacement : 6.5 liter (6.87 US qt, 5.72 Imp qt)] [With oil filter replacement : 6.7 liter (7.08 US qt, 5.90 Imp qt)]
Starter system	Electric starter
Exhaust system	Underwater type

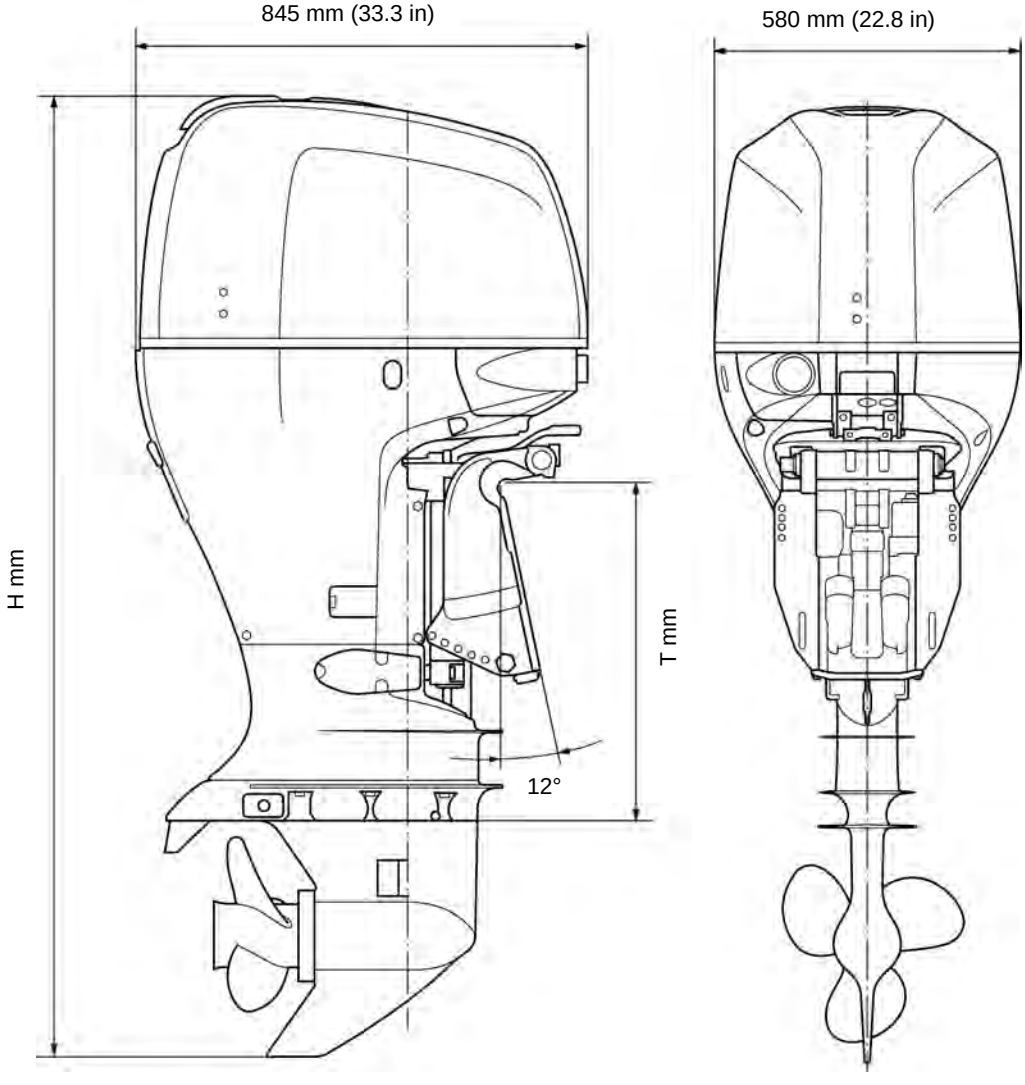
LOWER UNIT

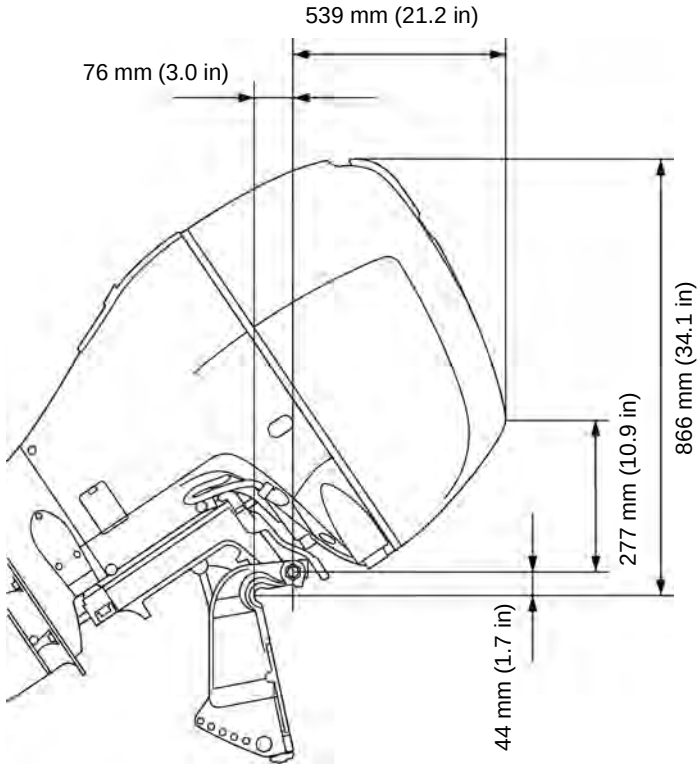
Clutch		Dog clutch (Forward – Neutral – Reverse)
Gear ratio	Forward	2.14 (30/14)
	Reverse	2.14 (30/14)
Reduction		Spiral bevel gear
Gear case oil capacity		0.98 liter (1.04 US qt, 0.86 Imp qt)
Propeller rotating direction		Clockwise (viewed from rear) : LU, XU, LD, XD, LC and XC types
		Counterclockwise (viewed from rear) : XCD type

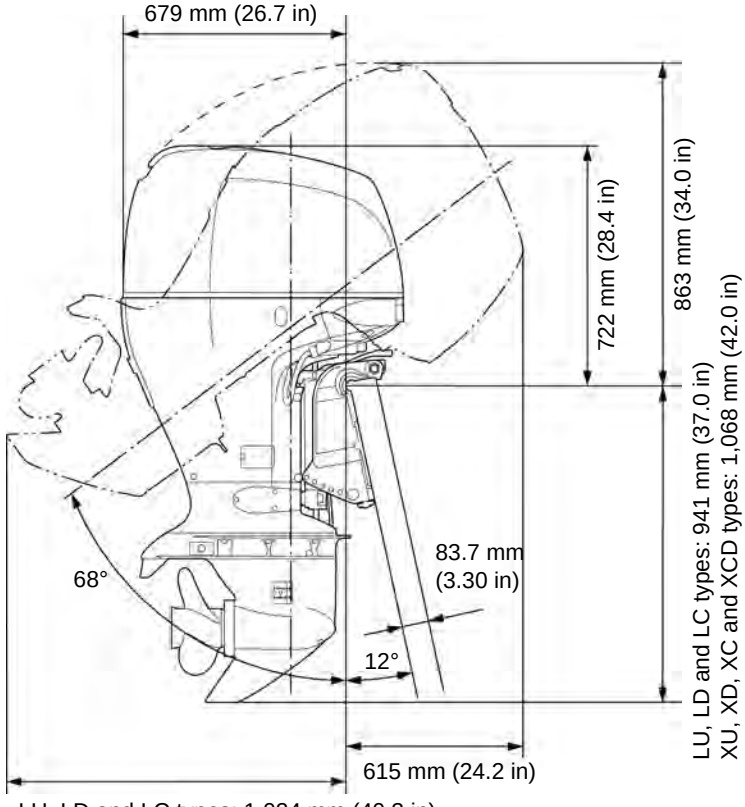
DIMENSIONAL DRAWING

Transom	H	T
LU, LD and LC types	1,665 mm (65.6 in)	508 mm (20.0 in)
XU, XD, XC and XCD types	1,790 mm (70.5 in)	635 mm (25.0 in)



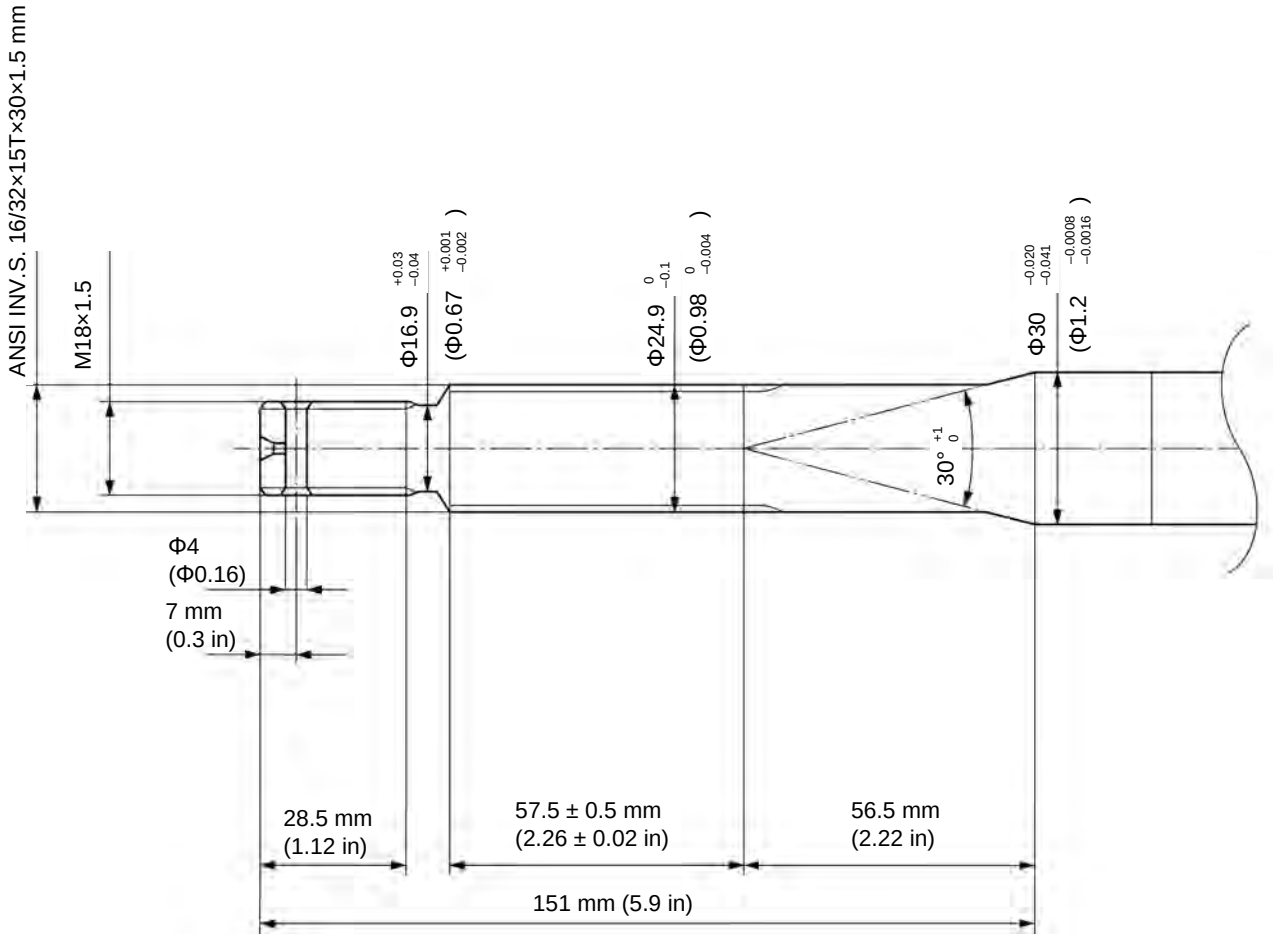






LU, LD and LC types: 1,024 mm (40.3 in)
XU, XD, XC and XCD types: 1,144 mm (45.0 in)

Propeller shaft



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MAINTENANCE STANDARDS

ENGINE

Unit: mm (in)

Part	Item		Standard	Service limit
Engine	Idle speed (in neutral)		750 ± 50 min^{-1} (rpm)	–
	Trolling speed		650 ± 50 min^{-1} (rpm)	–
	Cylinder compression		1,230 – 1,630 kPa (12.6 – 16.6 kgf/cm^2, 179 – 236 psi) at 200 min^{-1} (rpm)	930 (9.5, 135)
Ignition timing	At idle (*1)		0° BTDC at 750 min^{-1} (rpm)	–
Spark plugs	Gap		1.00 – 1.10 (0.039 – 0.043)	–
Valves	Valve clearance	IN	0.21 – 0.25	–
		EX	0.28 – 0.32	–
	Stem O.D.	IN	5.475 – 5.485 (0.2156 – 0.2159)	5.445 (0.2144)
		EX	5.450 – 5.460 (0.2146 – 0.2150)	5.420 (0.2134)
	Guide I.D.	IN/EX	5.515 – 5.530 (0.2171 – 0.2177)	5.55 (0.219)
	Guide extrusion amount	IN	15.2 – 16.2 (0.60 – 0.64)	–
		EX	15.5 – 16.5 (0.61 – 0.65)	–
	Stem-to-guide clearance	IN	0.030 – 0.055 (0.0012 – 0.0022)	0.080 (0.0031)
		EX	0.055 – 0.080 (0.0022 – 0.0031)	0.110 (0.0043)
	Seat width	IN/EX	1.25 – 1.55 (0.049 – 0.061)	2.0 (0.08)
	Seat installation height	IN	44.0 – 44.6 (1.73 – 1.76)	–
		EX	44.0 – 44.6 (1.73 – 1.76)	–
	Spring free length	IN	49.64 (1.954)	–
		EX	49.64 (1.954)	–
Rocker arms	Rocker arm I.D.	IN	17.019 – 17.035 (0.6700 – 0.6707)	–
		EX	17.012 – 17.039 (0.6698 – 0.6708)	–
	Rocker arm shaft O.D.	IN/EX	16.983 – 16.994 (0.6686 – 0.6691)	–
	Rocker arm-to-rocker arm shaft clearance	IN	0.025 – 0.052 (0.0010 – 0.0020)	0.08 (0.003)
		EX	0.018 – 0.056 (0.0007 – 0.0022)	0.08 (0.003)
Pistons	Skirt O.D.	A	86.980 – 86.990 (3.4244 – 3.4248)	86.930 (3.4224)
		B	86.970 – 86.980 (3.4240 – 3.4244)	86.920 (3.4220)
	Piston-to-cylinder clearance		0.020– 0.040 (0.0008 – 0.0016)	0.05 (0.0020)
	Pin bore I.D.		21.960 – 21.963 (0.8646 – 0.8647)	–
	Pin O.D.		21.961 – 21.965 (0.8646 – 0.8648)	21.953 (0.8643)
	Pin-to-pin bore clearance		– 0.005 – + 0.002 (– 0.0002 – + 0.0001)	0.005 (0.0002)
	Ring groove width	Top	1.230 – 1.240 (0.0484 – 0.0488)	1.25 (0.049)
		Second	1.240 – 1.250 (0.0488 – 0.0492)	1.25 (0.049)
		Oil	2.005 – 2.025 (0.0789 – 0.0797)	2.050 (0.0807)
Piston rings	Ring side clearance	Top	0.040 – 0.065 (0.0016 – 0.0026)	0.130 (0.0051)
		Second	0.050 – 0.075 (0.0020 – 0.0030)	0.130 (0.0051)
	Ring end gap	Top	0.20 – 0.35 (0.008 – 0.014)	0.60 (0.024)
		Second	0.50 – 0.65 (0.020 – 0.026)	0.75 (0.030)
		Oil	0.20 – 0.70 (0.008 – 0.028)	0.80 (0.031)
	Ring thickness	Top	1.175 – 1.190 (0.0463 – 0.0469)	–
		Second	1.175 – 1.190 (0.0463 – 0.0469)	–
Cylinder head	Warpage		–	0.05 (0.002)
	Camshaft journal I.D.		29.000 – 29.024 (1.1417 – 1.1427)	–
	Head height		103.95 – 104.05 (4.093 – 4.096)	–
	Cylinder head bolt O.D.		–	10.6 (0.42)
Cylinder block	Cylinder sleeve I.D.	A or I	87.010 – 87.020 (3.4256 – 3.4260)	87.070 (3.4279)
		B or II	87.000 – 87.010 (3.4252 – 3.4256)	87.070 (3.4279)
	Warpage		0.07 (0.003) Max	0.10 (0.004)
	Difference between upper and lower parts of sleeve I.D.		–	0.05 (0.002)

*1: With the SCS service connector connected to the service check connector.

Part	Item			Standard	Service limit
Connecting rods	Difference between upper and lower parts of connecting rod bolt O.D.			0 – 0.10 (0 – 0.004)	–
	Small end I.D.			21.970 – 21.976 (0.8650 – 0.8652)	–
	Small end-to-piston pin clearance			0.005 – 0.015 (0.0002 – 0.0006)	0.020 (0.0008)
	Big end axial clearance			0.15 – 0.35 (0.006 – 0.014)	0.40 (0.016)
	Connecting rod big end oil clearance			0.020 – 0.050 (0.0008 – 0.0020)	0.060 (0.0024)
Crankshaft	Journal O.D.	Main	No. 1, 2, 4, 5	54.984 – 55.008 (2.1647 – 2.1657)	–
			No.3	54.976 – 55.000 (2.1644 – 2.1654)	–
		Pin		48.000 – 49.976 (1.8898 – 1.9676)	–
	Journal taper (Main/Pin)			0.005 (0.0002) Max	0.010 (0.0004)
	Journal roundness (Main/Pin)			0.005 (0.0002) Max	0.010 (0.0004)
	Crankshaft runout			0.03 (0.001) Max	0.04 (0.002)
	Crankshaft main bearing oil clearance	Main	No.1, 2, 4, 5	0.017 – 0.041 (0.0007 – 0.0016)	0.050 (0.0020)
			No.3	0.025 – 0.049 (0.0010 – 0.0019)	0.055 (0.0022)
	Crankshaft axial clearance			0.10 – 0.35 (0.004 – 0.014)	0.45 (0.018)
	Thrust washer side clearance			0.10 – 0.35 (0.004 – 0.014)	0.45 (0.018)
Camshaft	Camshaft axial clearance			0.05 – 0.20 (0.002 – 0.008)	0.40 (0.016)
	Camshaft runout			0.03 (0.001) Max	0.04 (0.002)
	Journal O.D.	No. 1		28.955 – 28.970 (1.1400 – 1.1405)	–
		No. 2, 3, 4, 5		28.925 – 28.940 (1.1388 – 1.1394)	–
	Cam height		IN	32.626 – 32.931 (1.2845 – 1.2965)	–
			EX	33.927 – 34.212 (1.3357 – 1.3469)	–
	Camshaft oil clearance	No. 1		0.030 – 0.069 (0.0012 – 0.0027)	0.150 (0.0059)
		No. 2, 3, 4, 5		0.060 – 0.099 (0.0024 – 0.0039)	0.150 (0.0059)
Oil pump	Body I.D.			84.000 – 84.030 (3.3071 – 3.3083)	–
	Inner rotor-to-outer rotor clearance			0.04 – 0.16 (0.002 – 0.006)	0.20 (0.008)
	Outer rotor-to-oil pump body clearance			0.10 – 0.18 (0.004 – 0.007)	0.20 (0.008)
	Outer rotor height			12.480 – 12.500 (0.4913 – 0.4921)	–
	Pump body depth			12.520 – 12.550 (0.4929 – 0.4941)	–
	Outer rotor - to-oil body side clearance			0.020 – 0.070 (0.0008 – 0.0028)	0.120 (0.0047)
	Oil pressure [kPa (kgf/cm^2, psi)]			147 (1.5, 21.3) or more at 2,050 min^{-1} (rpm)	–
Fuel injector	Resistance (20°C/68 °F)			9.7 – 10.9 Ω	–
Fuel pump	Discharge volume (with pump operated for 2 sec.)			45 cm^3 (1.5 US oz, 1.6 lmp oz) or more	–
	Fuel pressure [kPa (kgf/cm^2, psi)]			270 – 320 (2.8 – 3.3, 40 – 47)	–
Vapor separator	Float height			28.5 – 33.5 (1.12 – 1.32)	–
Alternator	Brush length			10.5 (0.41)	8.4 (0.33)
	Slip ring O.D.			14.4 (0.57)	14.0 (0.55)
	Belt tension [N (kgf, lbf)] Measured between the pulleys with belt tension gauge.		Used belt	392 – 490 N (40 – 50 kgf, 88 – 110 lbf)	–
			New belt	490 – 588 N (50 – 60 kgf, 110 – 132 lbf) (*1)	–
	Belt deflection Measured with 98 N (10 kgf, 22 lbf) of force applied to the center of belt between the pulleys.		Used belt	10.6 – 11.1 (0.42 – 0.44)	–
			New belt	10.1 – 10.6 (0.40 – 0.42) (*1)	–
Starter motor	Brush length			12.3 (0.48)	7.0 (0.28)
	Insulation depth			0.40 – 0.50 (0.016 – 0.020)	0.20 (0.008)
	Commutator O.D.			29.4 (1.16)	28.8 (1.13)
	Commutator runout			–	0.10 (0.004)

*1: With a new belt installed.

Part	Item		Standard	Service limit
Thermostat	Begin to open	Cylinder head side	48 – 52 °C (118 °F – 126 °F)	–
		Cylinder block side	58 – 62 °C (136 °F – 144 °F)	–
	Fully open	Cylinder head side	60 °C (140 °F)	–
		Cylinder block side	70 °C (158 °F)	–
	Valve lift		more than 3.0 (0.12)	–
ECT sensor 1, 2, 3, 4	Resistance	40°C /104 °F	1.0 – 1.3 kΩ	–
		100°C/212 °F	0.1 – 0.2 kΩ	–
IAC valve	Resistance (20°C/68 °F)		10.6 – 12.6 Ω	–
A/F sensor	Resistance (20°C/68 °F)		0.86 – 1.10 Ω	–

FRAME

Unit: mm (in)

Part	Item		Standard	Service limit
Vertical shaft	Shaft O.D. (at needle bearing)		28.566 – 28.575 (1.1246 – 1.1250)	28.545 (1.1238)
	Runout		0.30 (0.012) or below	–
	Bushing I.D. (XC, XU, XD, XCD types)		22.05 – 22.10 (0.868 – 0.870)	–
Propeller shaft	Shaft O.D.	At needle bearing	30.007 – 30.020 (1.1814 – 1.1819)	29.990 (1.1807)
		At forward bevel gear (LC, LU, LD, XC, XU, XD types)	24.987 – 25.000 (0.9837 – 0.9843)	24.966 (0.9829)
		At reverse bevel gear (XCD type)	24.987 – 25.000 (0.9837 – 0.9843)	24.966 (0.9829)
	Runout		0.02 (0.001) or below	–
Propeller/gear case/extension case	Forward bevel gear backlash		0.10 – 0.30 (0.004 – 0.012)	–
	Reverse bevel gear backlash (XCD type)		0.10 – 0.35 (0.004 – 0.014)	–
	Thrust clearance adjustment (XCD type)		0.2 – 0.4 (0.008 – 0.016)	–
Power trim/tilt assembly	Lower chamber blow pressure		13,239 – 15,691 kPa (135 – 160 kgf/cm^2, 1,920 – 2,276 psi)	
	Upper chamber blow pressure		3,923 – 7,355 kPa (40 – 75 kgf/cm^2, 569 – 1,067 psi)	
Power tilt motor assembly	Brush length		9.8 (0.39)	4.8 (0.19)
	Mica depth		–	0.50 (0.020)

ENGINE & FRAME TORQUE VALUES

Use standard torque values for fasteners that are not listed in this table.

ENGINE

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Lower block bolt (11 x 95 mm)	M11 x 1.5	*1	–	–
Lower block orifice	M10 x 1.0	10	1.0	7
20 mm cylinder block sealing bolt	M20 x 1.0	34	3.5	25
22 mm cylinder block sealing bolt	M22 x 1.5	54	5.5	40
28 mm cylinder block sealing bolt	M28 x 1.5	128	13.1	94
Oil jet bolt	M8 x 0.75	16	1.6	12
Cylinder head bolt	M11 x 1.5	*2	–	–
Cylinder head sealing bolt	M20 x 1.0	45	4.6	33
Spark plug	M14 x 1.25	18	1.8	13
Connecting rod bolt	M8 x 0.75	*3	–	–

*1: Tighten the lower block bolts to 30 N·m (3.1 kgf·m, 22 lbf·ft) (Snag torque) first, then tighten them an additional 56° (Angle method).

*2: New bolt:
Tighten the new cylinder head bolts to 40 N·m (4.1 kgf·m, 30 lbf·ft) (Snag torque) first, then tighten them an additional 278° (Tighten to 90° at first, then to 90°, and to 98° in this order) (Angle method).
Used bolt:
Tighten the cylinder head bolts to 40 N·m (4.1 kgf·m, 30 lbf·ft) (Snag torque) first, then tighten them an additional 180° (Tighten to 90° at first, then to 90° in this order) (Angle method).

*3: Tighten the connection rod bolt to 20 N·m (2.0 kgf·m, 15 lbf·ft) (Snag torque) first, then tighten them an additional 90° (Angle method).

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Crankshaft pulley bolt	M16 x 1.5	250	25.5	184
Balancer chain guide bolt	M6 x 1.0	12	1.2	9
Cam chain tensioner arm pivot bolt	M8 x 1.25	22	2.2	16
Chain case bolt	M6 x 1.0	12	1.2	9
Balancer driven sprocket	M10 x 1.25	45	4.6	33
Cam sprocket bolt (IN side)	M12 x 1.25	115	11.7	85
Cam sprocket bolt (EX side)	M10 x 1.25	72	7.3	53
Camshaft holder bolt (8 x 90/8 x 110 mm)	M8 x 1.25	22	2.2	16
Camshaft collar/CMP pulse plate bolt	M14 x 1.0	40	4.1	30
Valve adjusting lock nut (IN side)	M7 x 0.75	20	2.0	15
Valve adjusting lock nut (EX side)	M7 x 0.75	14	1.4	10
Oil filter cartridge	M20 x 1.5	12	1.2	9
Oil filter holder	M22 x 1.5	49	5.0	36
Oil drain plug bolt	M12 x 1.5	23	2.3	17
Balancer holder case assembly bolt				
(8 x 50/8 x 75 mm)	M8 x 1.25	22	2.2	16
(8 x 55 mm)	M8 x 1.25	28	2.9	21
(10 x 105 mm)	M10 x 1.25	45	4.6	33
Throttle body bolt	M8 x 1.25	22	2.2	16
IAC valve bolt	M8 x 1.25	22	2.2	16
Fuel pipe bolt	M8 x 1.25	22	2.2	16
Pressure regulator nut	M18 x 1.0	27	2.8	20
Mount case bolt	M8 x 1.25	26	2.7	19
	M10 x 1.25	44	4.5	32
	M12 x 1.25	64	6.5	47
Mount case flange nut	M10 x 1.25	44	4.5	32
Direct ignition coil bolt	M6 x 1.0	12	1.2	9
Flywheel bolt	M12 x 1.0	118	12.0	87
Flywheel boss bolt	M8 x 1.25	32	3.3	24
Alternator bolt	M10 x 1.25	44	4.5	32
Alternator nut	M8 x 1.25	26	2.7	19
Alternator pulley lock nut	M14 x 1.5	110	11.2	81
Starter motor bolt	M10 x 1.25	44	4.5	32
EOP sensor	M10 x 1.25	22	2.2	16
ECT sensor 1, 2, 3	M10 x 1.25	12	1.2	9
ECT sensor 4	M12 x 1.5	18	1.8	13
A/F sensor	M18 x 1.5	42	4.3	31
Knock sensor	M12 x 1.25	31	3.2	23
MAP sensor	M5 x 0.8	3.4	0.35	2.5
ECM bolt	M6 x 1.0	5	0.51	3.7
Air flow tube clamp	–	3	0.31	2.2

OIL CASE

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Oil case bolt	M10 x 1.25	34	3.5	25

GEAR CASE

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Pinion gear nut	M18 x 1.0	142	14.5	105
Oil level check bolt	M8 x 1.25	6.5	0.7	4.8
Drain plug bolt	M8 x 1.25	6.5	0.7	4.8
Bearing holder (XCD type)	M100 x 2.0	191	19.5	141
Impeller housing bolt	M8 x 1.25	20	2.0	15
Propeller castle nut	M18 x 1.5	*1	–	–
Vertical shaft lock nut	M64 x 1.5	123	12.5	91
Water screen screw	M5 x 0.8	1	0.10	0.7
Speed sensor nipple	M8 x 1.0	*2	–	–
Propeller shaft holder bolt	M10 x 1.5	34	3.5	25

*1: If the split pin cannot be set by tightening the 18 mm castle nut to the specified torque [1.0 N·m (0.10 kgf·m, 0.7 lbf·ft)], tighten the castle nut additionally until the split pin can be set. Note that the maximum torque of the 18 mm castle nut is 44 N·m (4.5 kgf·m, 32 lbf·ft).

*2: If the sensor nipple cannot be seated on the gear case by tightening it to the specified torque [1.0 N·m (0.10 kgf·m, 0.7 lbf·ft)], tighten the sensor nipple until it is seated on the gear case.

EXTENSION/MOUNT

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Lower mount rubber nut	M12 x 1.25	83	8.5	61
Upper mount rubber nut	M12 x 1.25	83	8.5	61

STERN BRACKET

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Stern bracket nut	M25 x 2.0	34	3.5	25
Stern bracket nut	7/8 - 14 UNF	34	3.5	25
Stern bracket lower nut	M10 x 1.25	39	4.0	29
Thrust receiver nut	M10 x 1.25	39	4.0	29

POWER TRIM/TILT

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Cylinder cap	–	208	21.2	153
Rod guide	–	140	14.3	103
Manual valve	M14 x 1.5	3.4	0.35	2.5
Socket bolt A and B	–	8.3	0.85	6.1
Power tilt motor mounting bolt	1/4 - 20 UNC	4.9	0.50	3.6
Oil tank mounting bolt	–	4.9	0.50	3.6
Oil tank cap	–	2.5	0.25	1.8

OTHERS

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Neutral switch nut	M20 x 1.0	2.5	0.25	1.8
Grease fitting	M6 x 1.0	3	0.31	2.2
Starter motor B terminal nut	M8 x 1.25	11	1.1	8
Alternator B terminal nut	M6 x 1.0	8	0.82	5.9
No1. fuse (100A) screw	M5 x 0.8	3.2	0.33	2.4
Hook bracket bolt	M6 x 1.0	10	1.0	7
Fuse/relay junction box mounting bolt	M6 x 1.0	5	0.51	3.7
Fuse/relay junction box terminal bolt	M6 x 1.0	5	0.51	3.7
Under cover mounting special bolt	M6 x 1.0	10	1.0	7
Under cover mounting screw	M6 x 1.0	4.5	0.46	3.3
Cover lock cable lock nut	M6 x 1.0	3.5	0.36	2.6
Water joint cap nut	M16 x 1.0	1.1	0.11	0.8

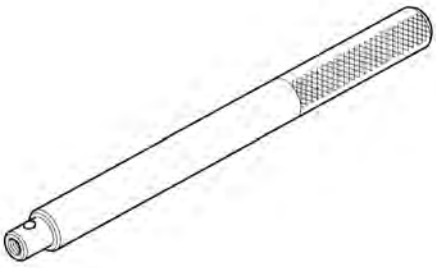
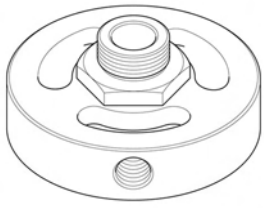
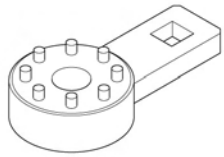
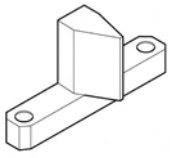
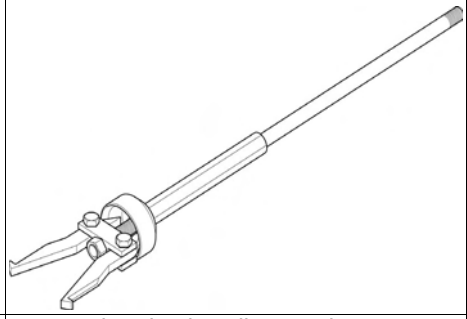
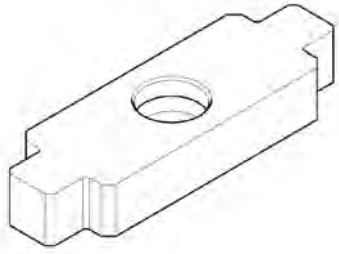
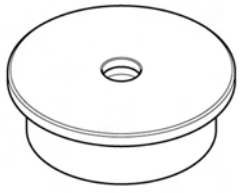
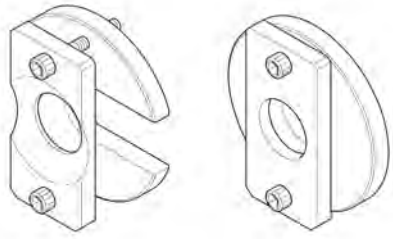
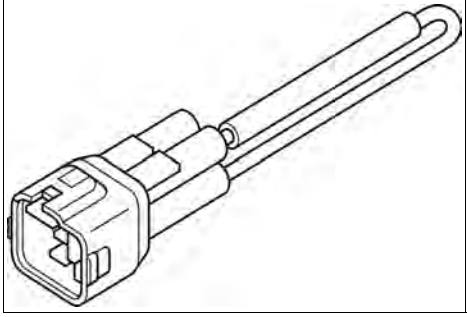
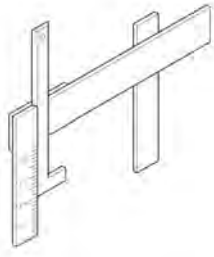
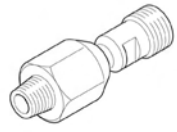
STANDARD TORQUE VALUES

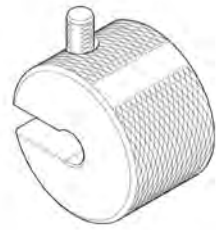
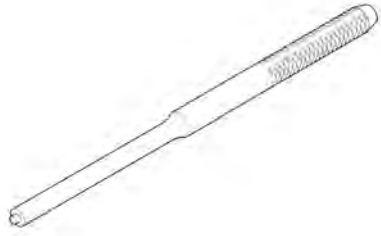
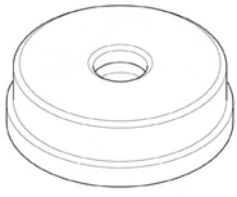
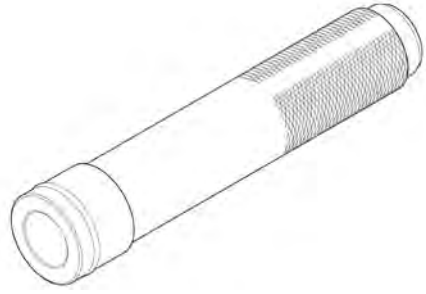
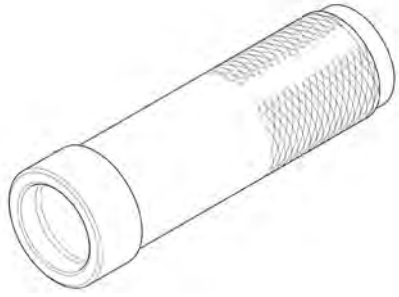
Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kgf·m	lbf·ft
Screw	5 mm	4.2	0.43	3.1
	6 mm	9	0.92	6.6
Bolt and nut	5 mm	5.2	0.53	3.8
	6 mm	10	1.0	7
	8 mm	21.5	2.2	16
	10 mm	34	3.5	25
	12 mm	54	5.5	40
Flange bolt and nut	6 mm (SH bolt)	9	0.92	6.6
	6 mm (CT bolt)	12	1.2	9
	6 mm	12	1.2	9
	8 mm	26.5	2.7	20
	10 mm	39	4.0	29

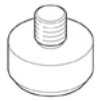
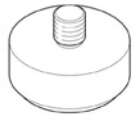
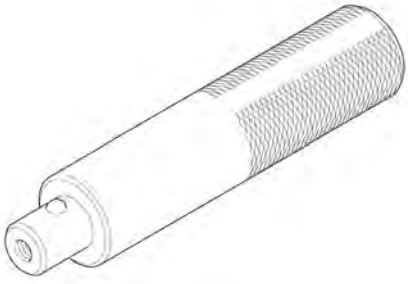
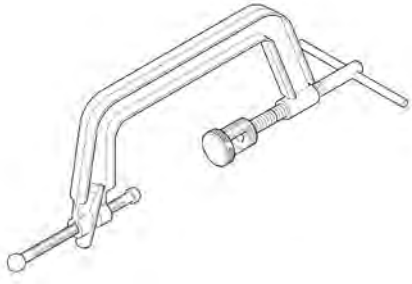
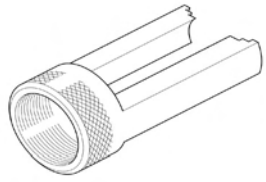
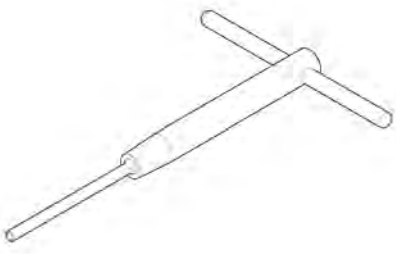
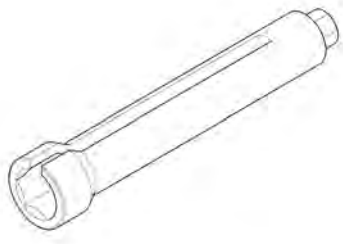
•SH bolt: Small head bolt
•CT bolt: Self-tapping bolt

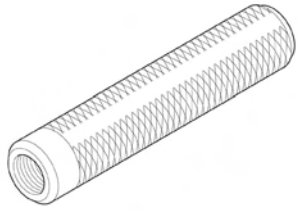
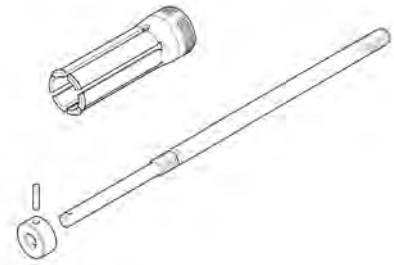
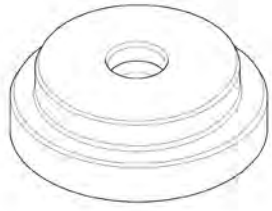
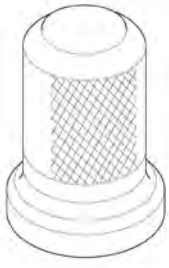
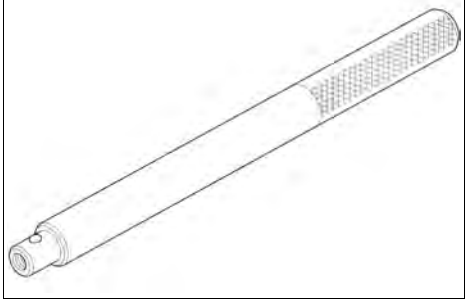
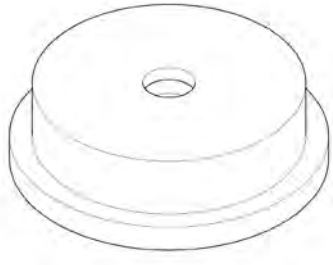
TOOLS

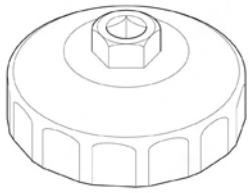
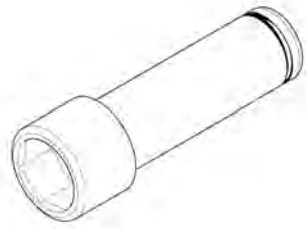
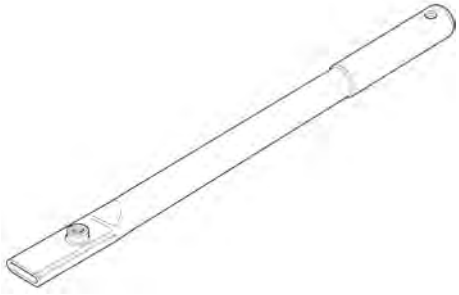
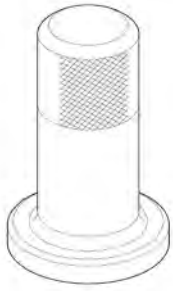
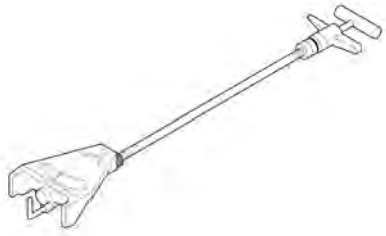
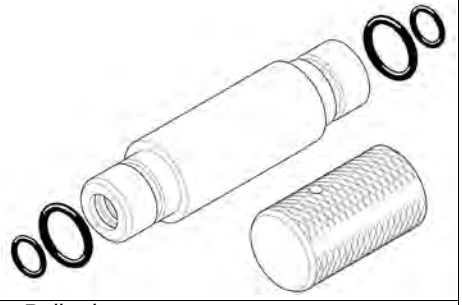
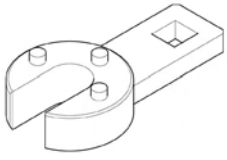
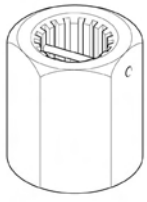
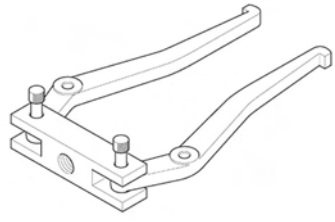
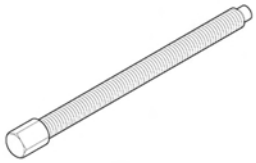
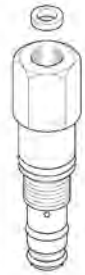
SPECIAL TOOLS

Driver, 480 mm 070GD-0010100 	Oil pressure gauge attachment 070MJ-0010101 	Trim cap wrench, 4 mm 070PA-0010100 
Ring gear holder 070PB-ZY60100 	Bearing race puller 070PC-ZY30100 	Taper bearing driver attachment 070PD-ZY60100 
Attachment, 30 x 37 mm 070PD-ZY60200 	Taper bearing installer attachment 070PF-ZY60100 	Gauge adapter, 100 mm 070PJ-ZY30100 
SCS service check connector 070PZ-ZY30100 	Float level gauge 07401-0010000 	Pressure gauge attachment 07406-0030000 

Fuel pressure gauge 07406-0040004 	Oil pressure gauge set 07506-3000001 	Remover weight 07741-0010201 
Valve guide driver, 5.35 x 9.7 07742-0010100 	Pin driver 6.0 07744-0010500 	Attachment, 32 x 35 mm 07746-0010100 
Attachment, 37 x 40 mm 07746-0010200 	Attachment, 42 x 47 mm 07746-0010300 	Attachment, 52 x 55 mm 07746-0010400 
Attachment, 62 x 68 mm 07746-0010500 	Attachment, 24 x 26 mm 07746-0010700 	Driver, 22 mm I.D. 07746-0020100 
Attachment, 15 mm I.D. 07746-0020200 	Driver, 40 mm I.D. 07746-0030100 	Pilot, 15 mm 07746-0040300 

Pilot, 20 mm 07746-0040500 	Pilot, 25 mm 07746-0040600 	Pilot, 35 mm 07746-0040800 
Driver 07749-0010000 	Valve spring compressor 07757-0010000 	Valve spring compressor attachment 07757-PJ10100 
Valve seat cutter, 45° 35 mm [IN] 07780-0010400 	Valve seat cutter, 45° 33 mm [EX] 07780-0010800 	Valve seat cutter, 32° 38.5 mm [IN] 07780-0012400 
Valve seat cutter, 32° 33 mm [EX] 07780-0012900 	Valve seat cutter, 60° 37.5 mm [IN] 07780-0014100 	Valve seat cutter, 60° 30 mm [EX] 07780-0014000 
Cutter holder, 5.5 mm 07781-0010101 	Sensor socket wrench, 22 x 150 mm 07906-PD10000 	Lock nut wrench 36 x 47.8 mm 07916-MB00002 

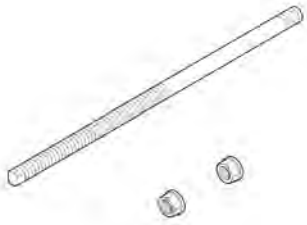
Bearing separator attachment, 18 mm 07931-4630100 	Remover handle 07936-3710100 	Bearing remover, 30 mm 07936-8890300 
Bearing driver attachment, 44 x 49.5 mm 07945-3330300 	Bearing driver attachment, 28 x 30 mm 07946-1870100 	Oil seal driver, 72 mm 07947-6340201 
Oil seal driver, 44.5 mm 07947-SB00100 	Oil seal driver attachment, 21 mm 07947-ZV00100 	Oil seal driver attachment, 27.5 x 44 mm 07948-9540000 
Driver, 280 mm 07949-3710001 	Driver shaft, B 07964-MB00200 	Attachment, 78 x 90 mm 07GAD-SD40101 

Oil filter wrench, 65 mm 07HAA-PJ70101 	Valve guide reamer, 5.5 mm 07HAH-PJ70100 	Socket wrench, 19 x 90 mm 07JAA-001020A 
Holder handle 07JAB-001020B 	oil seal driver, 65 mm 07JAD-PL90100 	Belt tension gauge 07JGG-0010101 
Holder attachment, 50 mm, offset 07MAB-PY30100 	Attachment, 52 x 55 mm 07NAD-P200100 	Stem seal driver 07PAD-0010000 
Pin wrench 6 x 35 mm 07SPA-ZW10101 	Vertical shaft holder 07SPB-ZW10200 	Puller jaws 07SPC-ZW0010Z 
Puller bolt 07SPC-ZW0011Z 	Backlash indicator attachment 07WPK-ZW50100 	Oil pressure gauge joint A 07SPJ-ZW10100 

Oil pressure gauge joint B
07SPJ-ZW10200



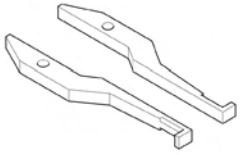
Installer shaft, 15 x 370 mm
07VMF-KZ30200



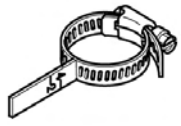
Pin spanner wrench, 110 mm
07WAA-S1G0100



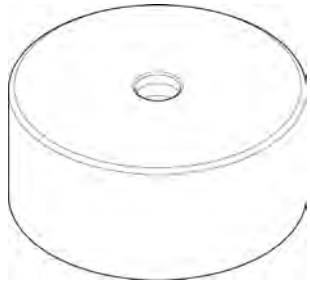
Puller jaws, 25 mm
07WPC-ZW50100



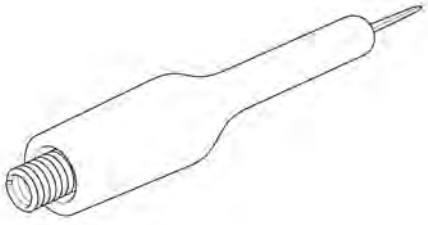
Backlash indicator tool
07SPJ-ZW0030Z



Oil seal driver attachment, 80 x 96 mm
07ZAD-PNA0100



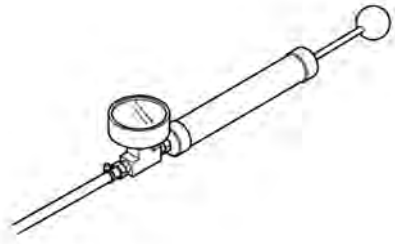
Test probe
07ZAJ-RDJA110



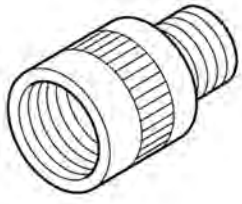
Bearing remover attachment, 37 mm
07ZMD-MBW0200



Pressure tester S-34
07APJ-001A100



Adapter
07APJ-001A300



LUBRICATION & SEAL POINT

ENGINE

Location	Material	Remarks
Main bearing bolt threads and seating surface	Engine oil	
Oil filter holder threads (Oil filter flange side)		
Oil filter cartridge O-ring		
Camshaft holder bolt threads and seating surface		
Cylinder head bolt threads and seating surface		
Crankshaft pulley bolt threads and seating surface		
CMP pulse plate bolt threads and seating surface		
Valve stem seal inner surface		
Valve adjusting screw threads		
Valve adjusting lock nut threads and seating surface		
Balancer driven sprocket bolt threads and seating surface		
Cam sprocket bolt threads and seating surface		
Oil strainer O-ring		
Flywheel mounting bolt threads and seating surface		
Flywheel boss bolt threads and seating surface		
CKP sensor O-ring		
CMP sensor O-ring		
EOP sensor O-ring		
Oil case bolt threads and seating surface		
Lower block bolt threads and seating surface		
Balancer holder case assembly bolt threads and seating surface		
Oil pump rotor chamber		30 cc
Cylinder sleeve inner surface	Use molybdenum oil solution (mixture of the engine oil and molybdenum grease in a ratio of 1:1)	
Crankshaft main bearing, journal and thrust washer contact surface		
Piston outer surface and piston rings		
Piston pin outer surface		
Connecting rod small end inner surface		
Camshaft journal and cam profile		
Rocker shaft outer surface		
Intake/exhaust valve stem guide sliding surface		
Fuel injector O-ring	Engine oil or silicone oil (Shinetsu KF 96350 CS)	
Fuel hose O-ring		
Pressure regulator O-ring		
Crankcase mating surface	Liquid sealant (Threebond® 1280B or equivalent)	
Chain case mating surface (crankcase and cylinder head surface)		
Chain case cover mating surface		
Cylinder block and lower block mating surface		
Rocker holder (No.5) mating surface		
Cylinder head and cylinder head cover packing mating surface	Liquid sealant (Threebond® 1215 or equivalent)	
Cylinder head and cylinder block mating surface (chain case side)		
ECT sensor threads and seating surface	Liquid sealant (Threebond® 1201 or 1215 or equivalent)	
Oil pan packing exhaust port sealing surface to oil pan and mounting case	Liquid sealant (Threebond® 1211 or equivalent)	
Idle port gasket sealing surface to mounting case and idle port		
Each oil seal and water seal outer circumference	Industrial parts cleaner solution (mixture of the Threebond® 2720C and water in a ratio of 1:9)	

Location	Material	Remarks
Each oil seal and water seal lip	Use marine grease (water resistant urea based grease)	
Water tube grommet inner and outer surface		
Exhaust manifold O-ring		
Exhaust guide seal part		
Cylinder head sealing bolt	Locking agent (Threebond® 1322 or equivalent)	
Spark plug tube seal lip	Soapy water	

FRAME

GEAR CASE

Location	Material	Remarks
Propeller shaft spline and threads	Use marine grease (water resistant urea based grease)	
Propeller shaft water seal (30 x 45 x 7 mm) lip and between seals		
Propeller shaft holder gear case installation part and O-ring installation part		
Propeller shaft holder O-ring		
Vertical shaft engine side spline		
Vertical shaft water seal (23 x 36 x 6 mm) lip and between seals		
Water pump housing O-ring (58.5 x 3.5 mm)		
Water pump O-ring		
Pump liner inner surface		
Water tube seal ring inner surface		
Extension case grommet inner surface		
Water tube insertion part		
Vertical shaft bushing inner surface (XC, XU, XD, XCD types)		
Shift rod water seal lip and between seals		
Shift rod holder O-ring		
Propeller shaft water seal (30 x 45 x 7 mm) outer circumference	Industrial parts cleaner solution (mixture of the Threebond® 2720C and water in a ratio of 1:9)	
Vertical shaft water seal (23 x 36 x 6 mm) outer circumference		
Shift rod water seal outer circumference		
Vertical shaft taper roller bearing (30 x 62 x 40 mm)	Hypoid gear oil SAE #90	0.98 ℓ
Gear case		
Bearing holder threads and seating surface (XCD type)		
Vertical shaft lock nut (64 mm) threads and seating surface		
Pinion gear nut (18 mm) threads and seating surface		

STERN BRACKET MOUNT

Location	Material	Remarks
Lower cylinder collar outer surface	Use marine grease (water resistant urea based grease)	
Lower cylinder bushing inner and outer surface		
Mount frame shaft and spline		
Thrust washer (34 mm)		
Swivel case liner		
Oil seal (39.5 x 52 x 6 mm) lip and outer surface		
Swivel case shaft sliding part		
Swivel case tilting shaft sliding part		
Swivel case bushing inner and outer surface		
Cylinder upper pin outer surface		
Cylinder upper bushing inner and outer surface		
Click spring roller		
Tilting bracket cam part		
Tilt stopper bushing inner and outer surface		
Tilting shaft bearing part and threads		
Thrust receiver thrust sliding part		
Tilting shaft O-ring (15.54 x 2.62 mm)		

LINKAGE

Location	Material	Remarks
Shift rod A spline	Use marine grease (water resistant urea based grease)	
Shift shaft A water seal (14 x 26 x 8 mm) lip and outer surface		
Shift shaft A water seal contact surface and spline		
Shift shaft B water seal contact surface		
Seal holder O-ring (25 x 2.4 mm)		
Seal holder O-ring groove and bearing part		
Click arm bushing inner surface		
Click arm roller part		
Shift shaft B water seal (14 x 26 x 6 mm) lip		
Shift arm link pin insertion part and click part		
Shift link bracket shift pivot insertion part and throttle rod insertion part		
Throttle arm bearing part, shift pivot insertion part and throttle link insertion part		
Shift pivot bearing part		
Throttle rod throttle body insertion part		
Throttle link throttle arm insertion part and throttle plate insertion part		
Shift link bracket throttle arm insertion part		
Throttle plate shaft part and insertion part		
Cover lock bushing A bearing part		
Shift pivot plate bracket contact part		
Shift slider pivot outer surface		
Shift link pin outer surface		
Shift shaft B water seal (14 x 26 x 6 mm) outer circumference	Industrial parts cleaner solution (mixture of the Threebond® 2720C and water in a ratio of 1:9)	

LOCKS

Location	Material	Remarks
Cover lock lever-to-lever bushing A contact part	Use marine grease (water resistant urea based grease)	
Cover lock bushing A bearing part		
Hook bracket hook damper insertion part		
Front lock insertion part, locking part and cable end insertion part		
Side lock insertion part, locking part and cable end insertion part		
Cover lock bolt tapered part and bolt shaft		
Cover open shaft bearing part and lock lever sliding part		

OTHERS

Location	Material	Remarks
Extension case oil case side seal surface	Liquid sealant (Threebond® 5222B or equivalent)	
Steering rod collar insertion part and end face sliding part	Use marine grease (water resistant urea based grease)	
Water joint cap nut seating surface	Loctite® PRISM 403	

CABLE/HARNESS ROUTING

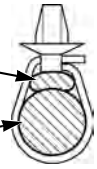
VIEWED FROM THE UPPER RIGHT REAR SIDE:

HARNESS BAND CLIP

Clamp the main wire harness and the ECT sensor 3 wire as shown.

ECT SENSOR 3 WIRE

MAIN WIRE HARNESS

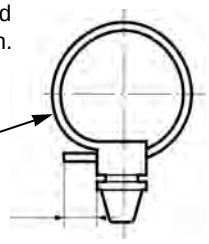


Viewed from the cylinder head cover side:

HARNESS BAND CLIP

After securing the cables and harnesses with the harness band clips, cut the end of the harness band clips so that the projected length is 5 – 10 mm (0.2 – 0.4 in) as shown.

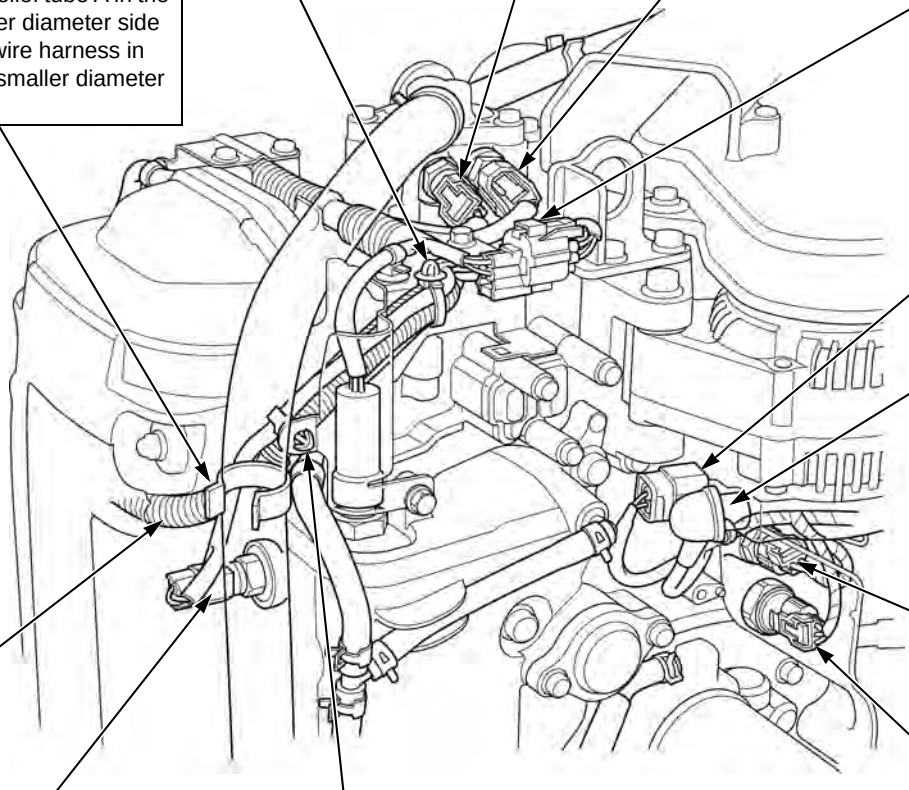
HARNESS BAND CLIP



5 - 10 mm (0.2 -0.4 in)

WATER TUBE CLAMP

Set the water relief tube A in the clamp the larger diameter side and the main wire harness in the clamp the smaller diameter side.



1 ECT SENSOR 2 2P CONNECTOR

2 ECT SENSOR 4 2P CONNECTOR

3 A/F SENSOR 4P CONNECTOR

5 ALTERNATOR 4P CONNECTOR

T1 ALTERNATOR B TERMINAL

6 ECT SENSOR 1 2P CONNECTOR

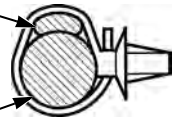
7 EOP SENSOR 3P CONNECTOR

MAIN WIRE HARNESS

8 ECT SENSOR 3 2P CONNECTOR

Clamp the main wire harness and the ECT sensor 3 wire as shown.

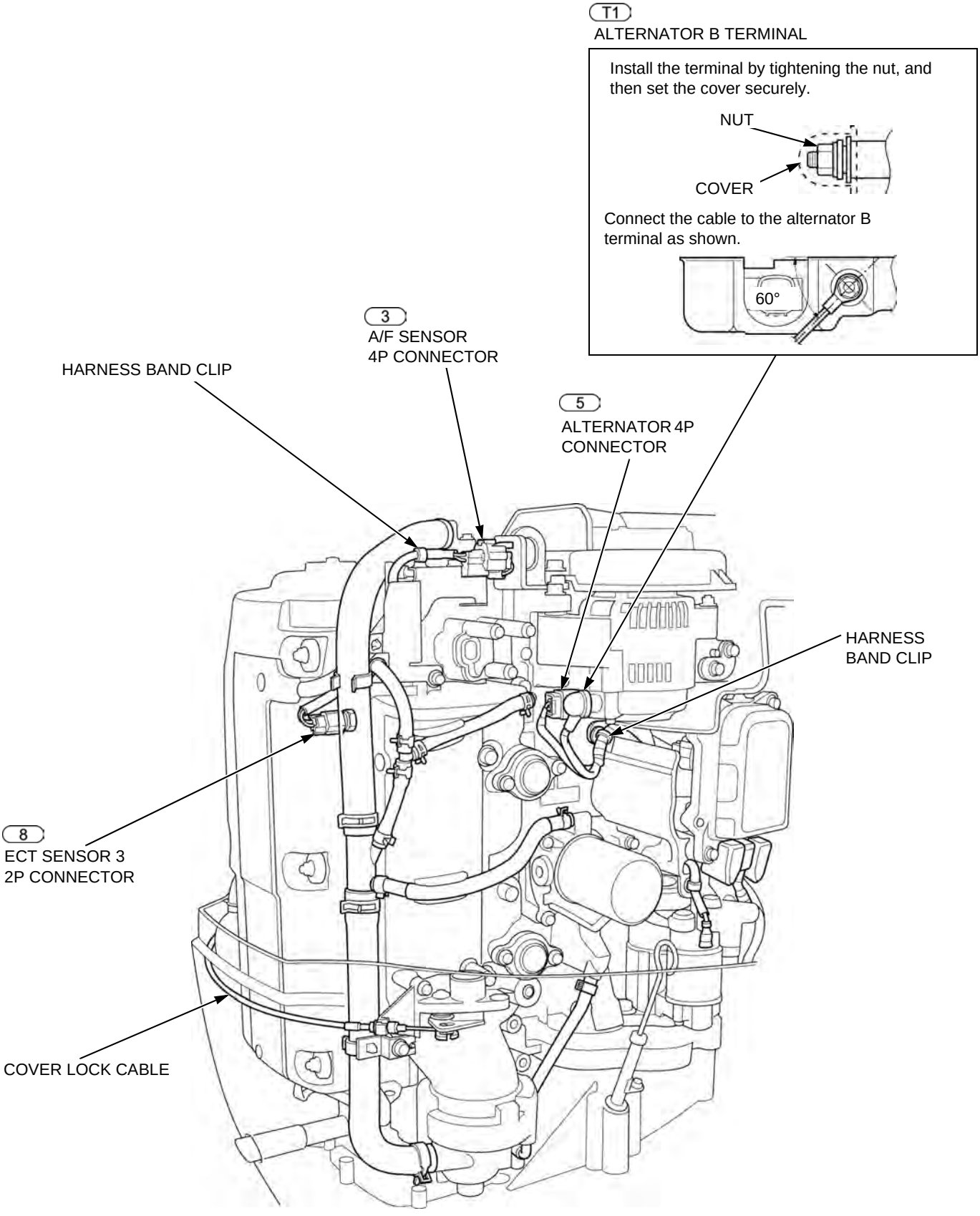
ECT SENSOR 3 WIRE



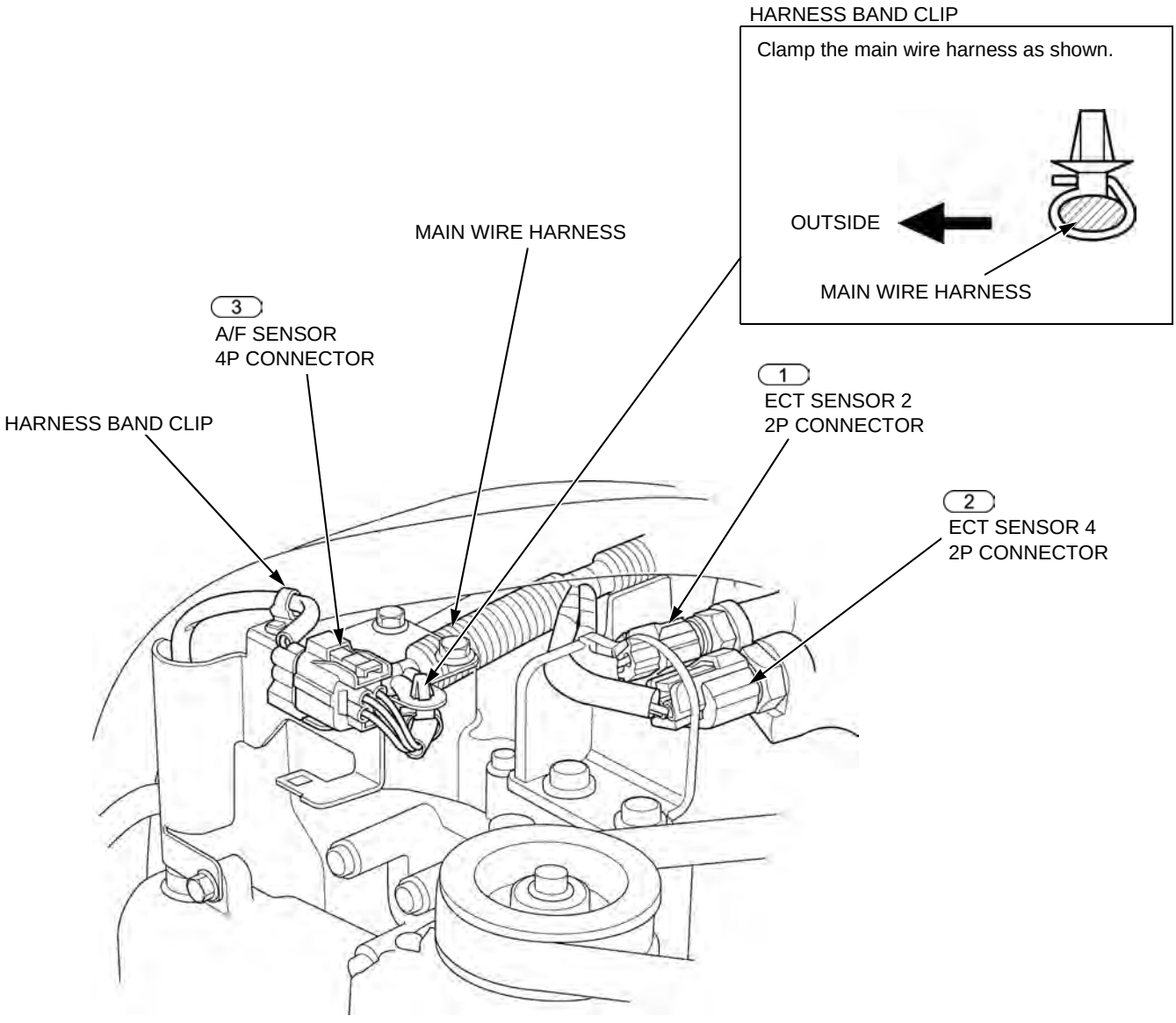
MAIN WIRE HARNESS

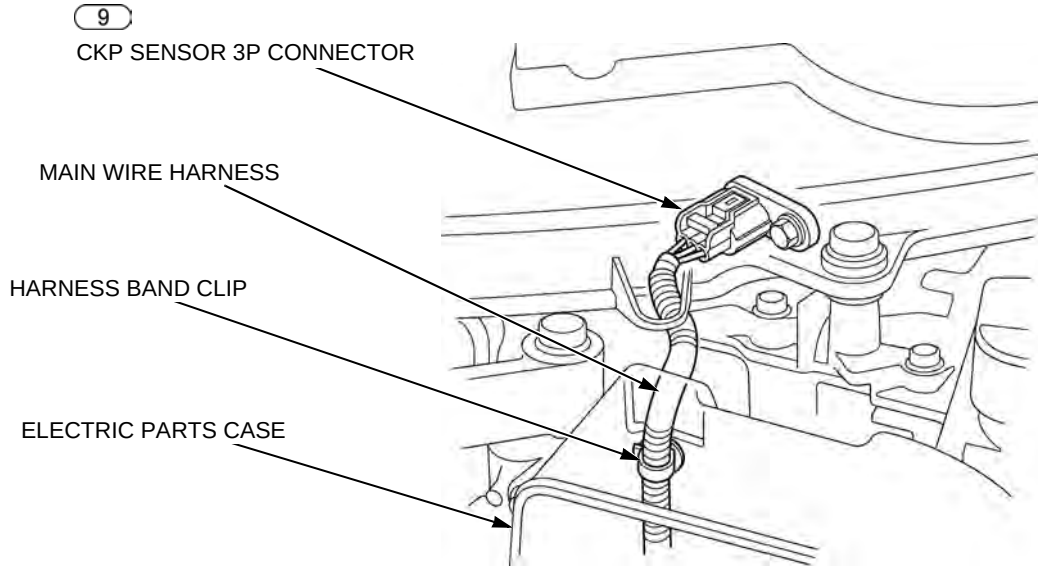
Viewed from the cylinder head cover side:

VIEWED FROM THE RIGHT SIDE:

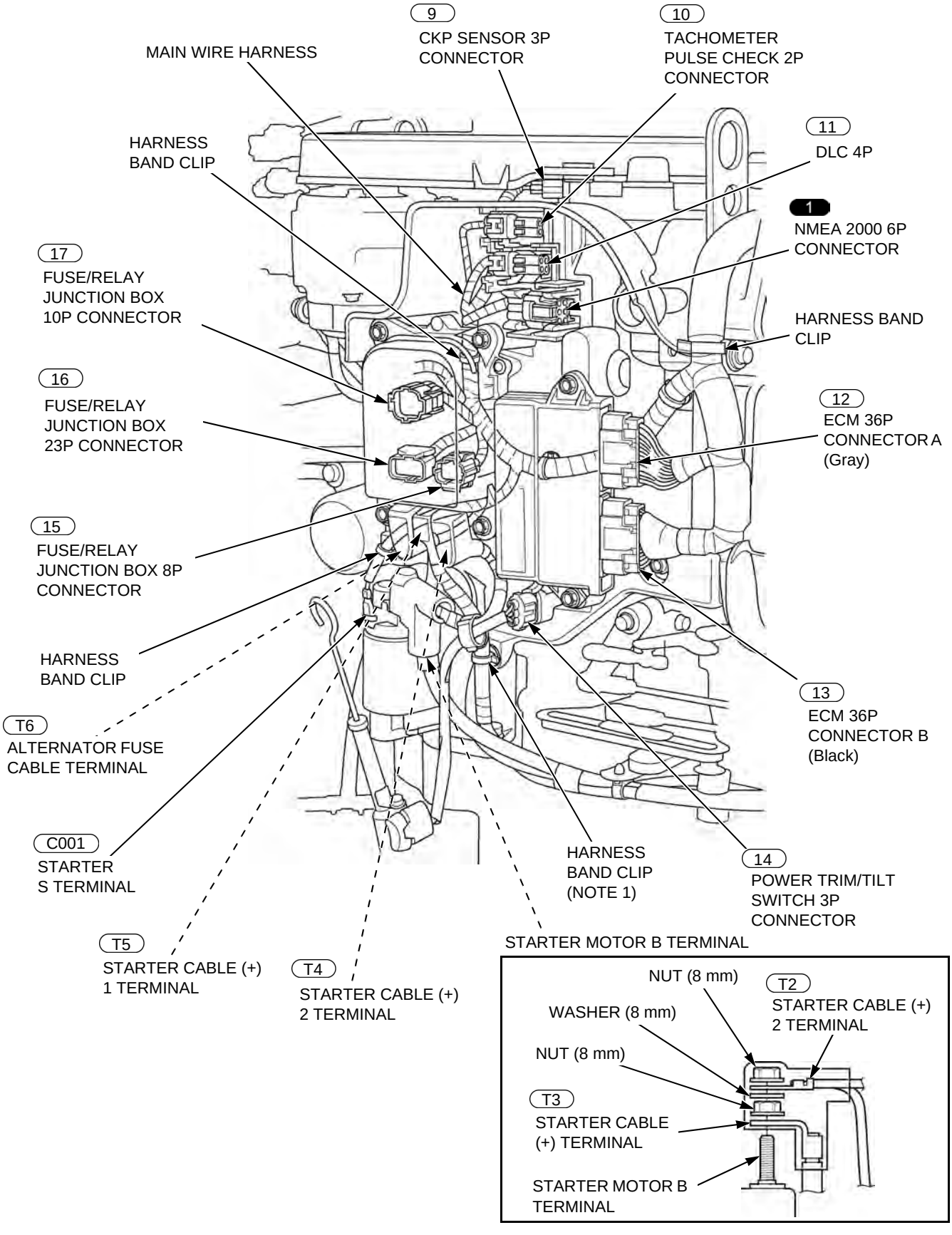


VIEWED FROM THE UPPER RIGHT SIDE:



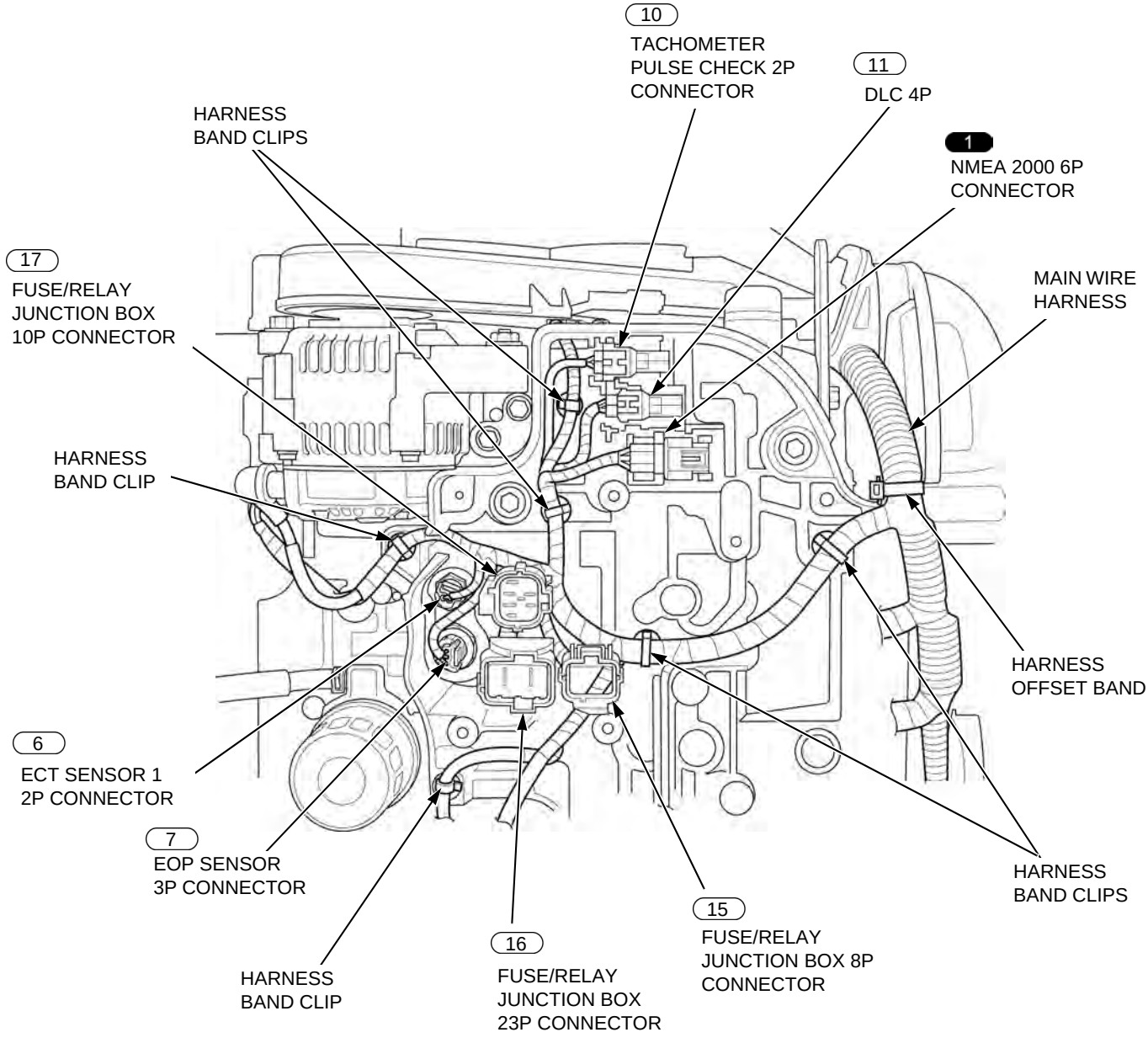


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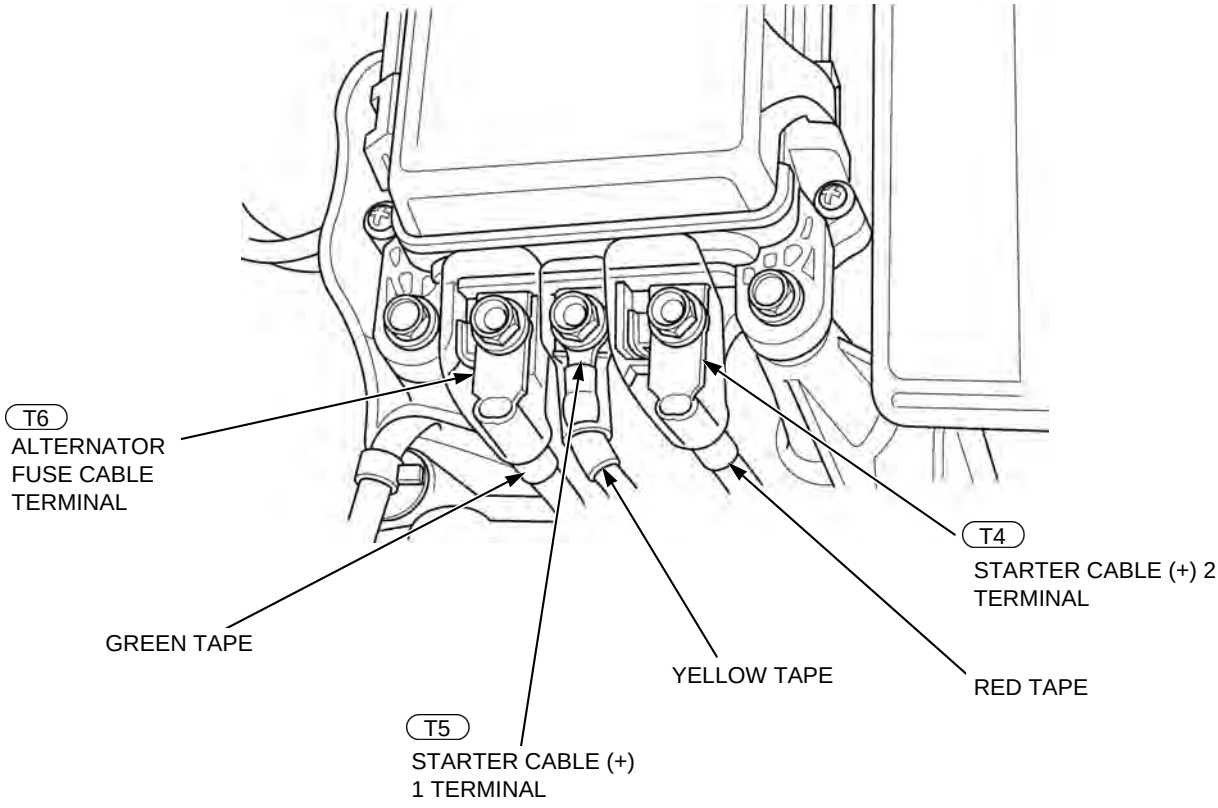


NOTE 1	Harness band clip installation	page 2-23

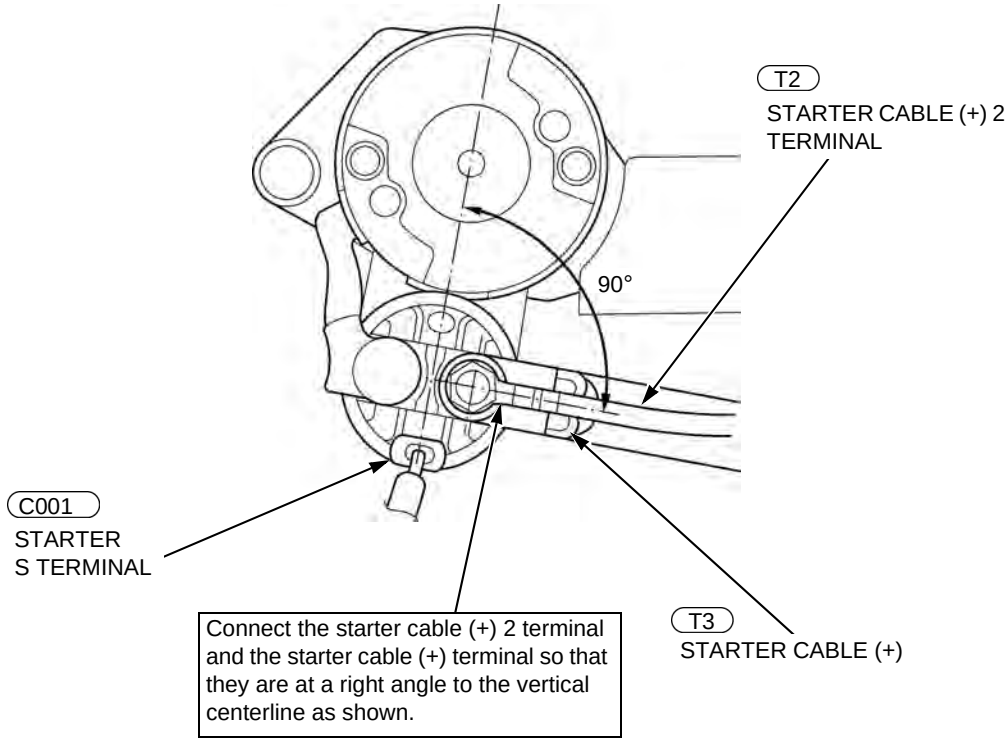
VIEWED FROM THE RIGHT SIDE



FUSE/RELAY JUNCTION BOX:



STARTER MOTOR



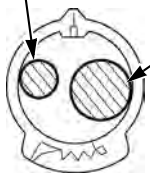
VIEWED FROM THE RIGHT FRONT SIDE

HARNESS BAND CLIP

Clamp the starter cable (+) 2 and power trim/tilt switch wire.

POWER TRIM/TILT SWITCH WIRE

STARTER CABLE (+) 2

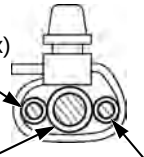


Viewed from the silencer case side:

HARNESS BAND CLIP

Clamp the starter cable (+) 1, starter cable (+) 2 and starter cable (+).

STARTER CABLE (+) 1
(To fuse/relay junction box)

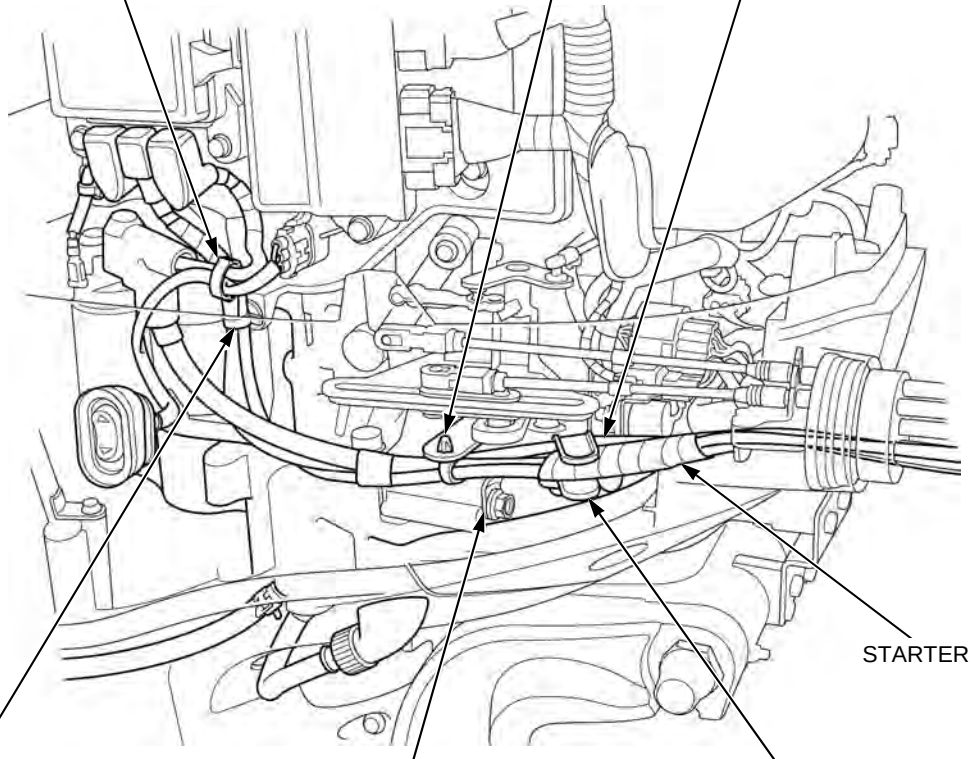


STARTER CABLE (+)
(To starter motor B terminal)

STARTER CABLE (+) 2
(To power trim/tilt relay)

Viewed from the front side:

STARTER CABLE (+) 2

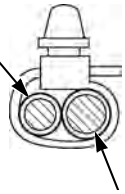


STARTER CABLES

HARNESS BAND CLIP

Clamp the starter cable (+) 1 and starter cable (+) 2.

STARTER CABLE (+) 2
(To starter motor B terminal)



STARTER CABLE (+) 1
(To fuse/relay junction box)

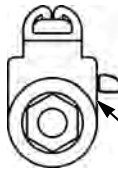
Viewed from the upper side:

GND1

STARTER CABLE GROUND TERMINAL

Connect the ground terminal by pushing it against the projection on the crankcase.

PROJECTION



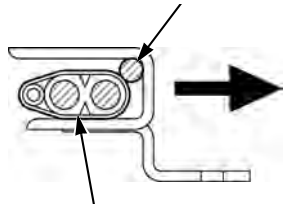
STARTER CABLE GROUND TERMINAL

Viewed from the front side:

CABLE BRACKET A

Clamp the starter cables and starter cable (+) 2.

STARTER CABLE (+) 2
(To power trim/tilt relay)

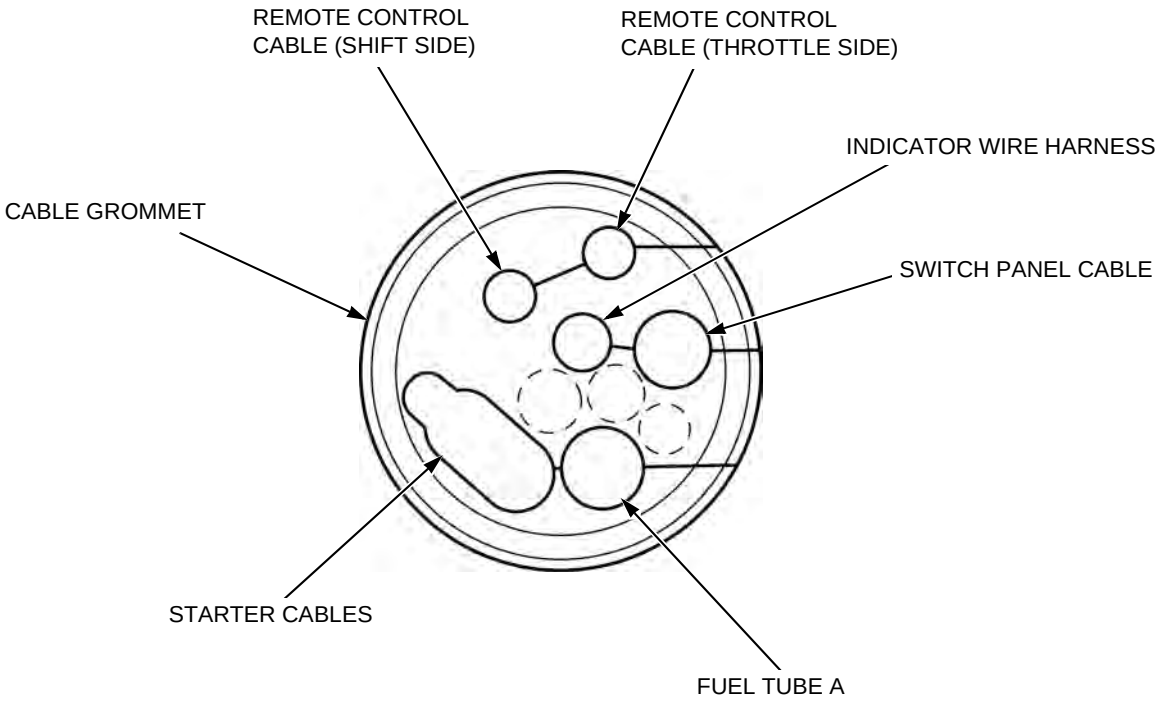


ENGINE SIDE

STARTER CABLES

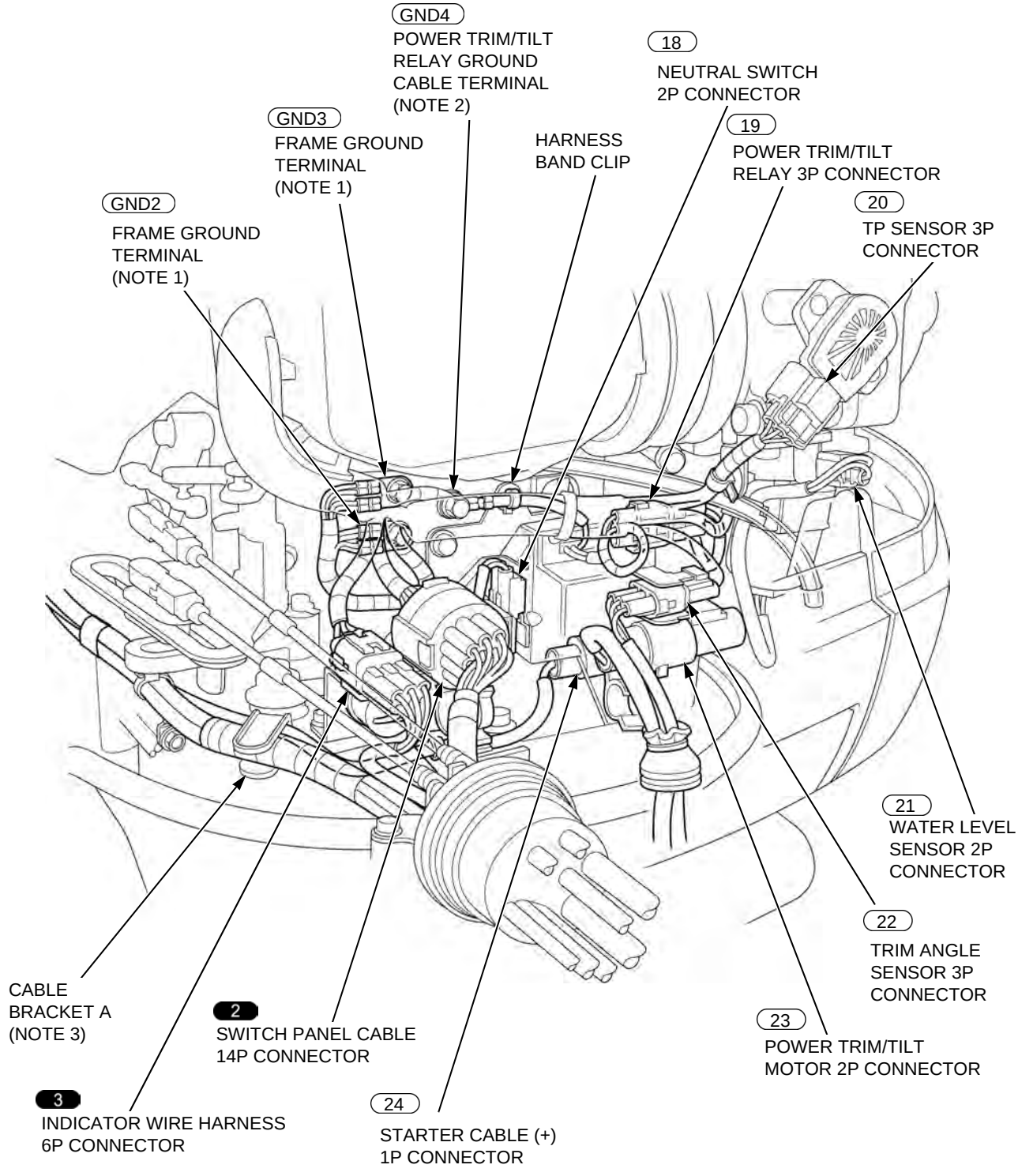
Viewed from the front side:

CABLE GROMMET:



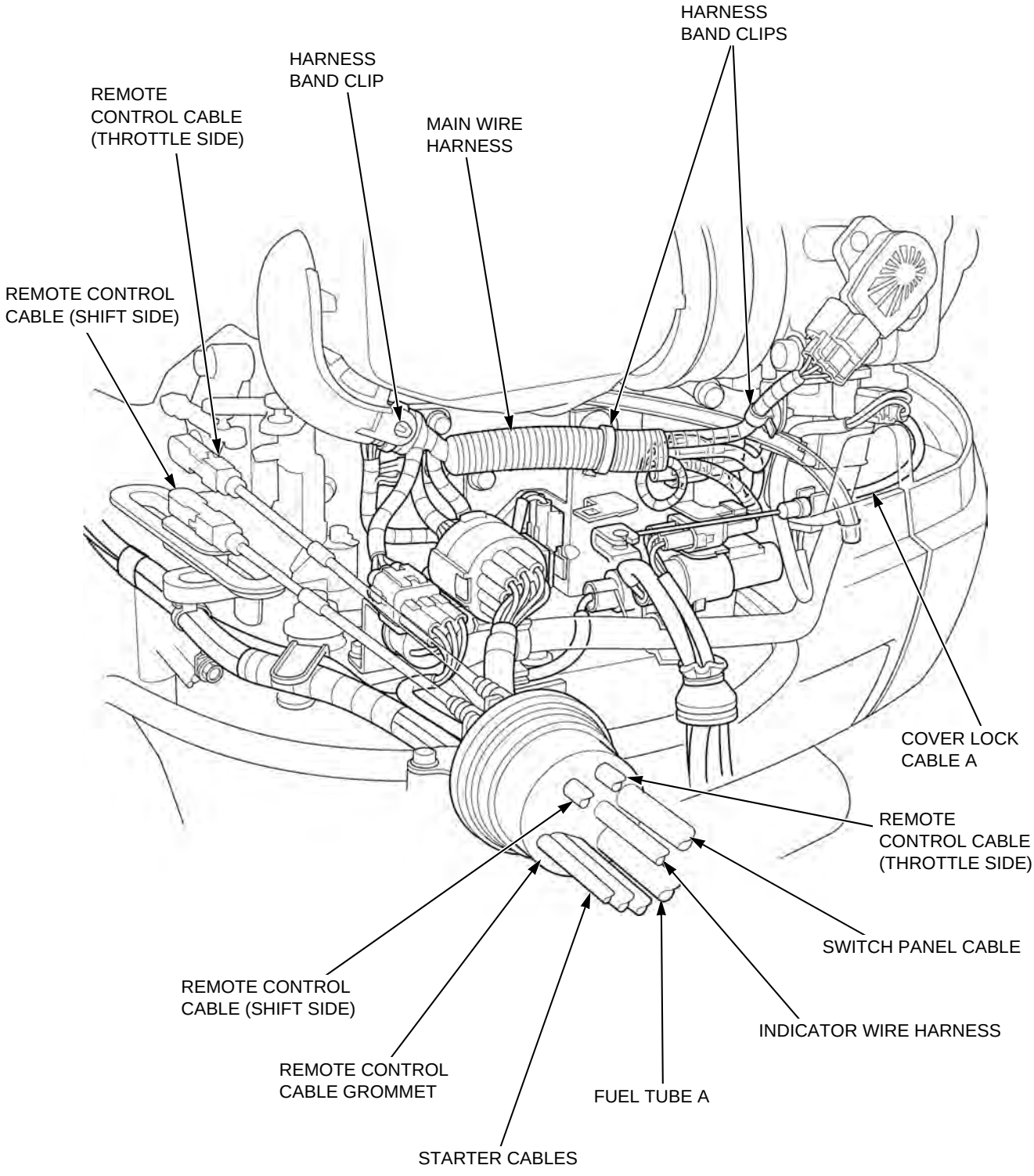
Viewed from the front side:

VIEWED FROM THE FRONT SIDE:



NOTE 1	Frame ground terminal installation	page 2-27
NOTE 2	Power trim/tilt relay ground terminal installation	page 2-27
NOTE 3	Cable bracket A (Starter cable installation)	page 2-23

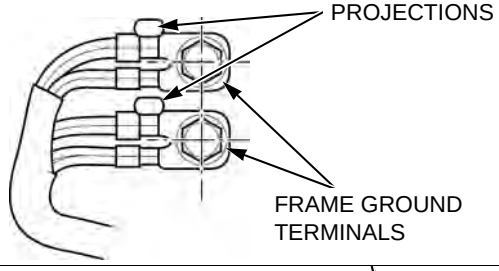
VIEWED FROM THE FRONT SIDE:



VIEWED FROM THE FRONT SIDE:

FRAME GROUND CABLE TERMINALS

- Connect the Black, Blue, Green/Red and the Green/White wires to the upper frame ground terminal.
- Connect the Black/White, Blue, Green/Black and Green wires to the lower frame ground terminal.
- Install by pushing the frame ground cable terminals against the corresponding projections on the crankcase.

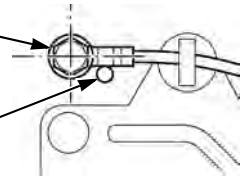


GND4

POWER TRIM/TILT RELAY GROUND CABLE TERMINAL

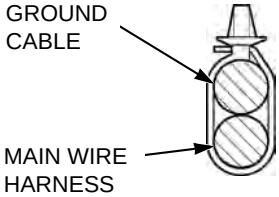
Install by pushing the ground cable terminal against the corresponding projection on the crankcase.

POWER TRIM/TILT RELAY GROUND TERMINAL

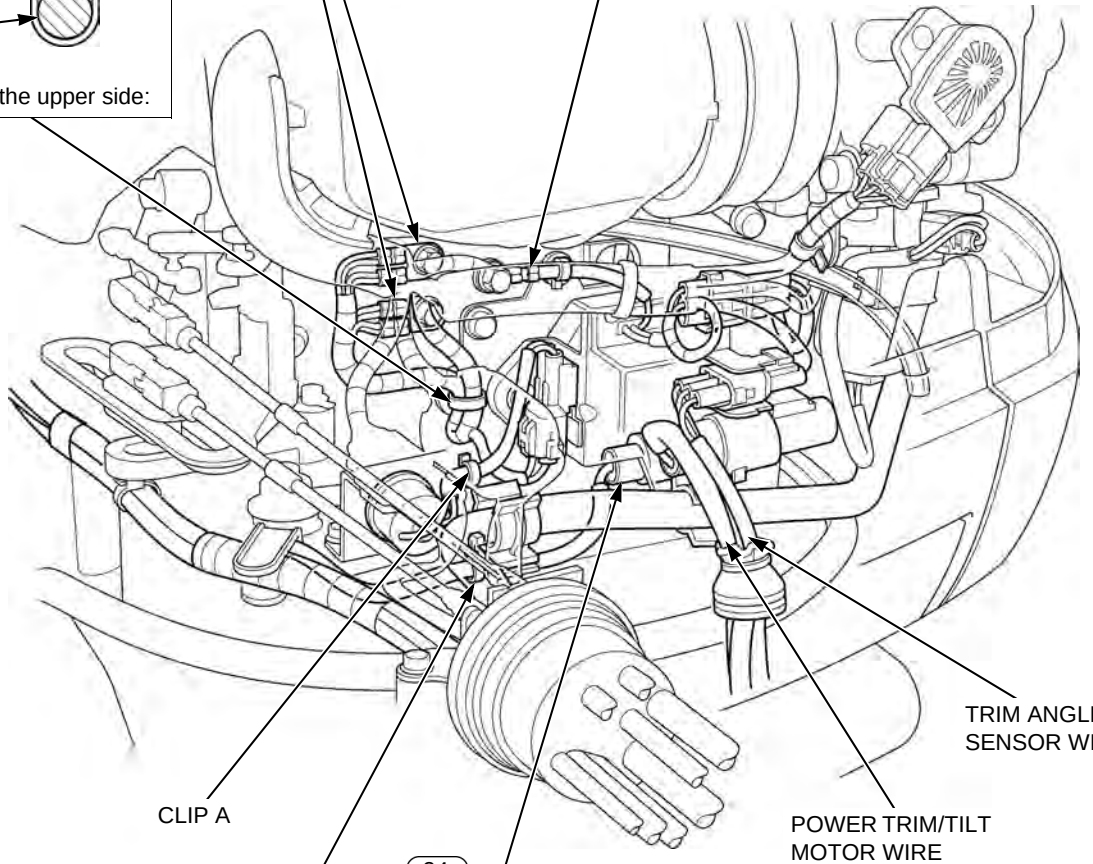


HARNESS BAND CLIP

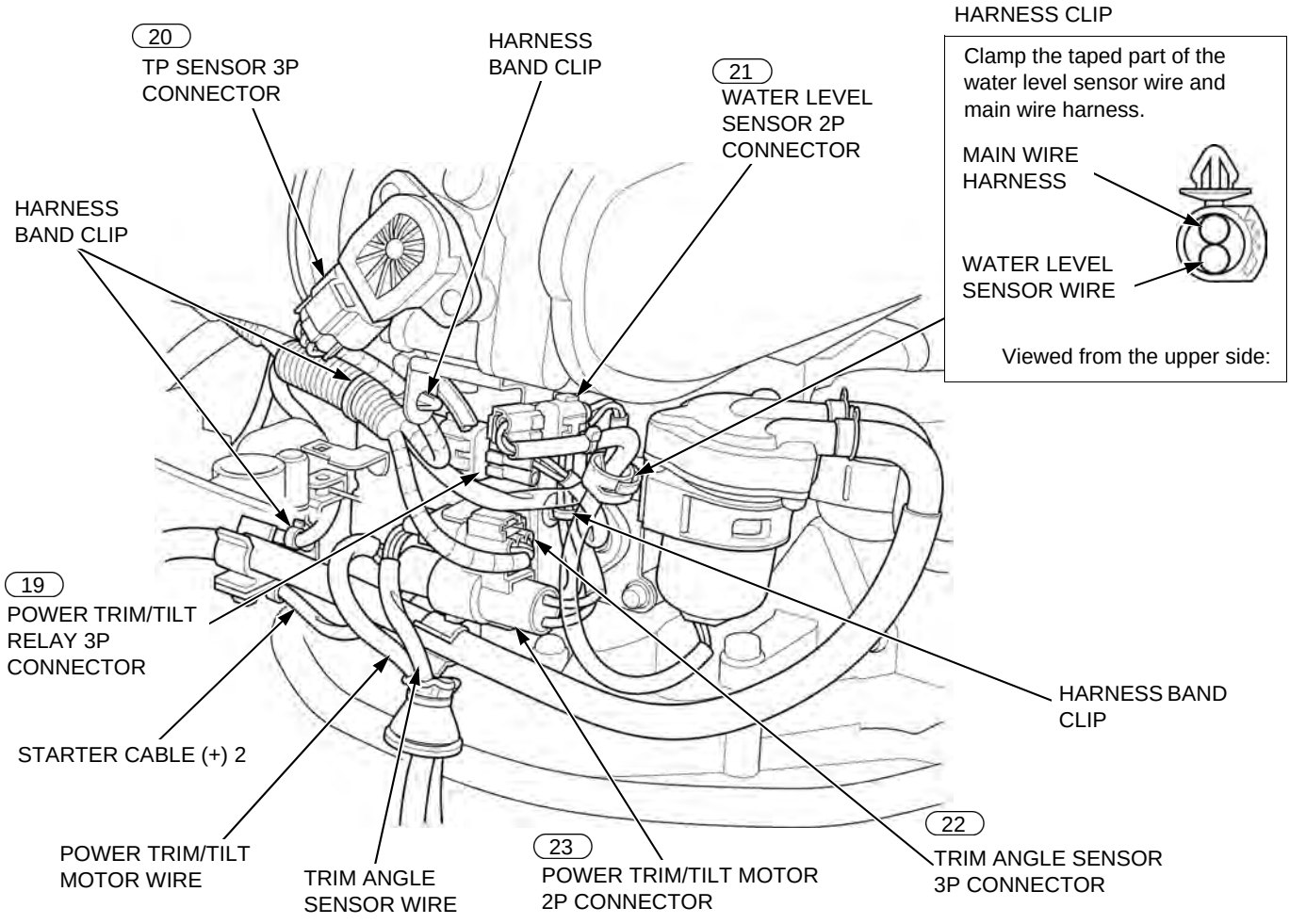
Clamp the ground cable and main wire harness.



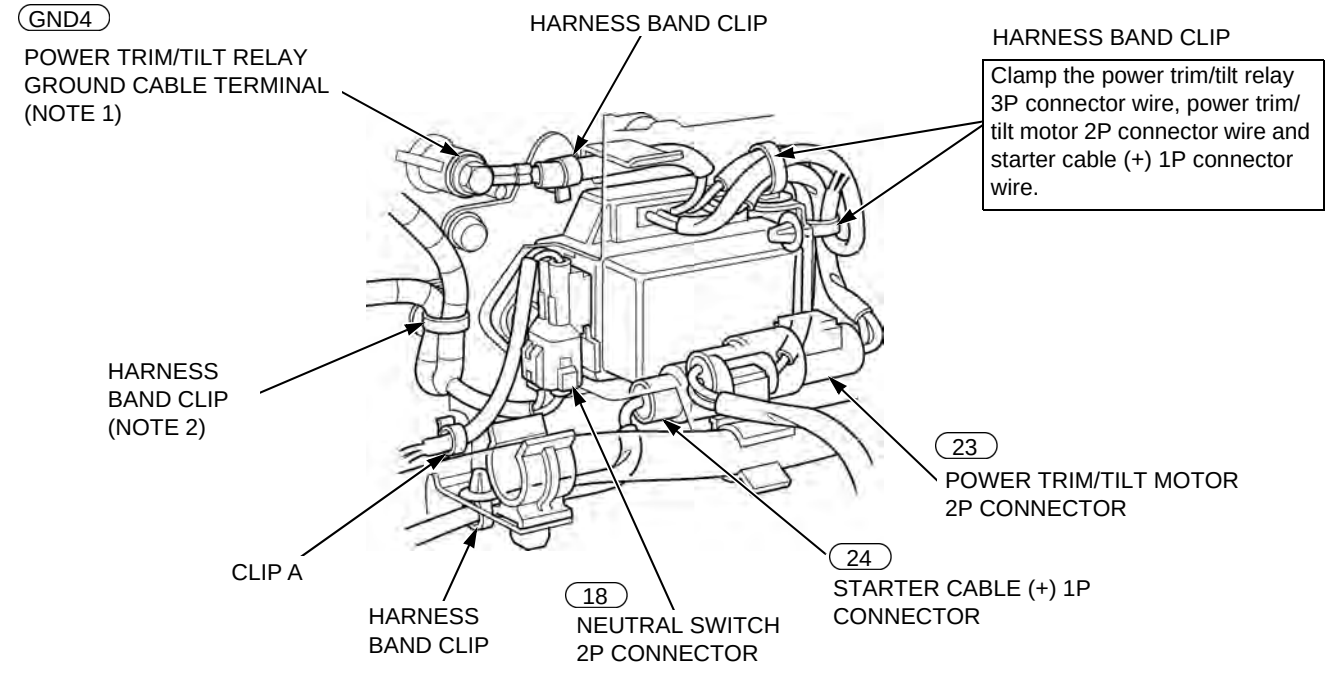
Viewed from the upper side:



VIEWED FROM THE LEFT FRONT SIDE:

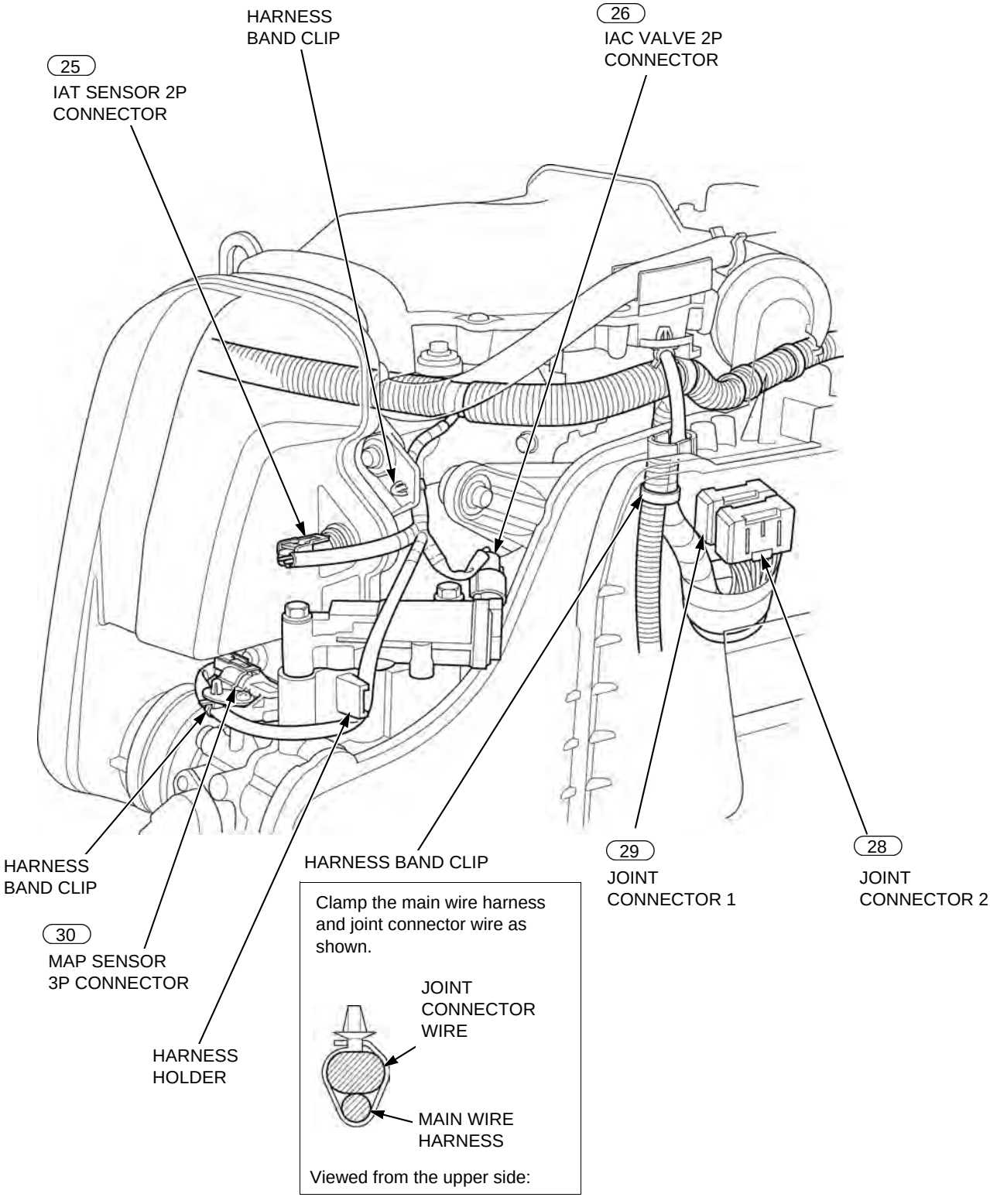


POWER TRIM/TILT RELAY:

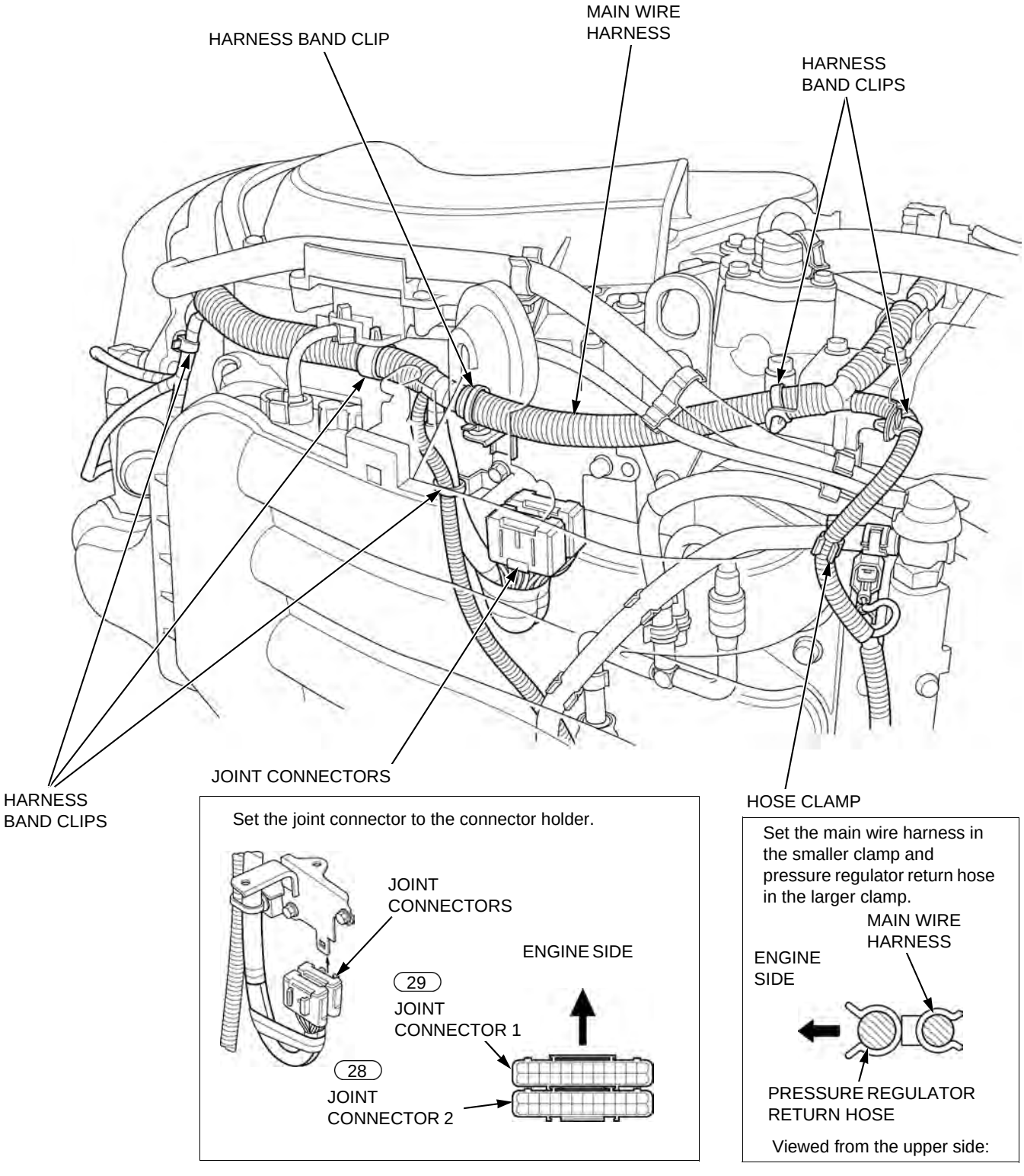


NOTE 1	Power trim/tilt relay ground cable terminal installation	page 2-27
NOTE 2	Harness band clip installation	page 2-27

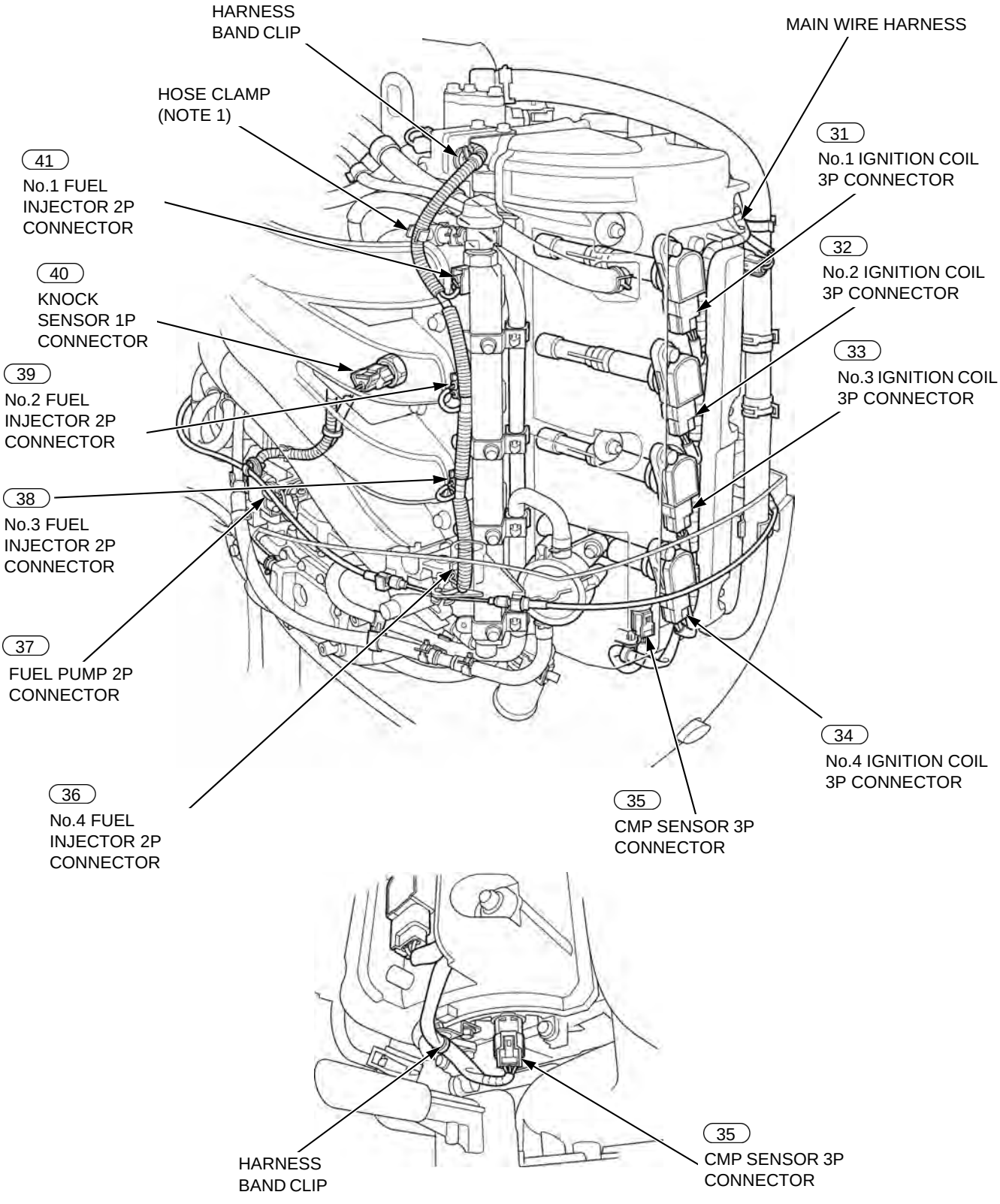
VIEWED FROM THE LEFT FRONT SIDE:



VIEWED FROM THE UPPER LEFT REAR SIDE:



VIEWED FROM THE LEFT REAR SIDE:

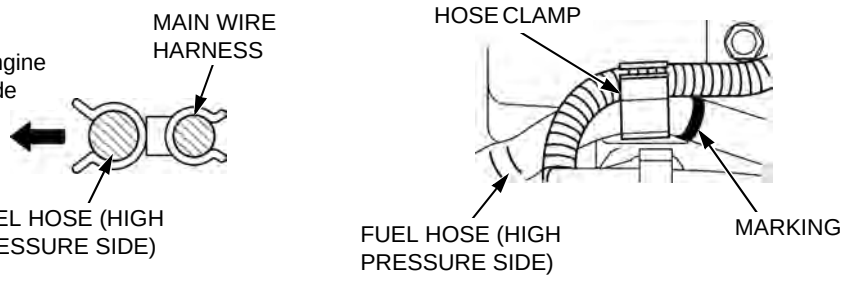


NOTE 1	Hose clamp installation	page 2-30

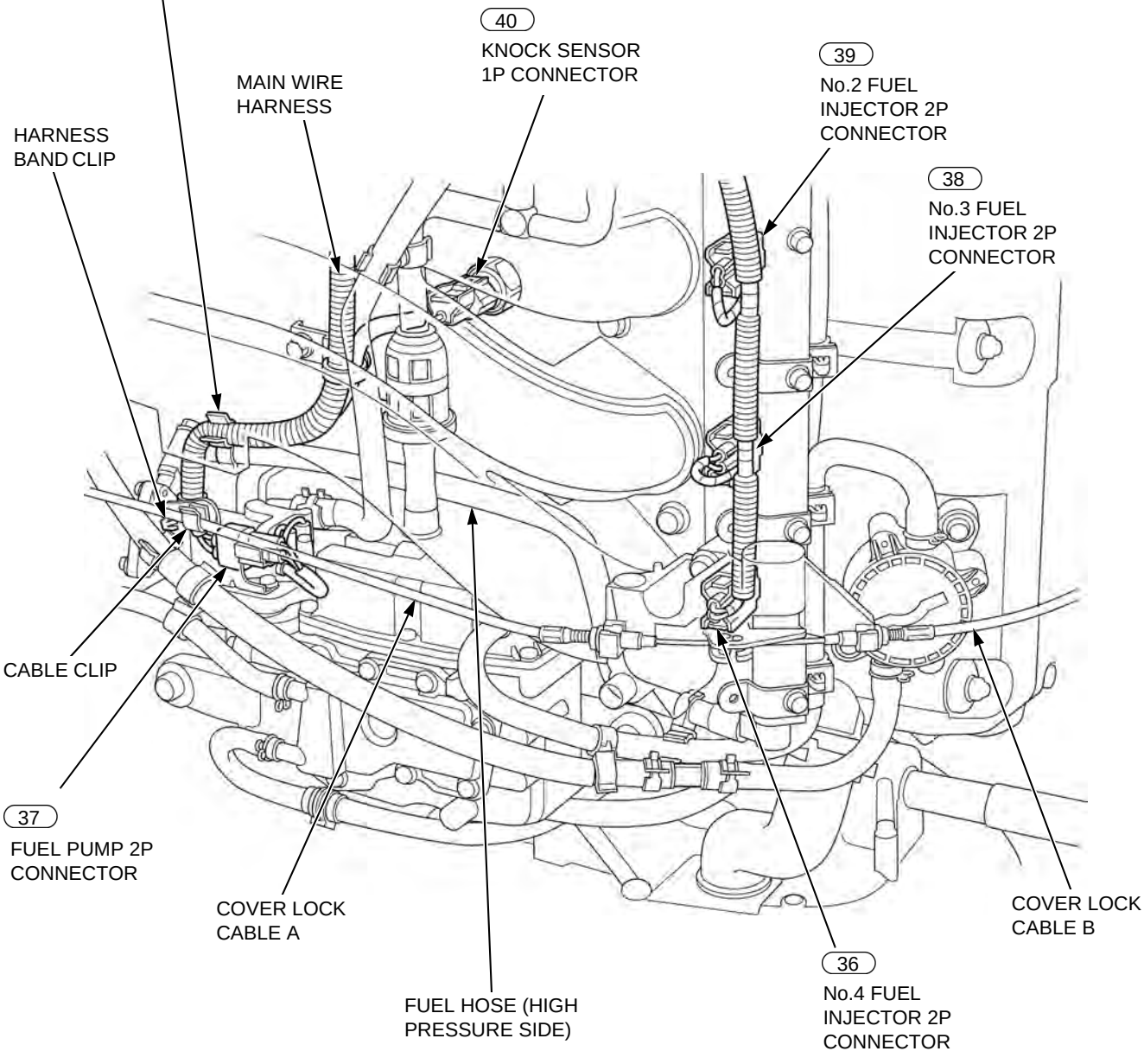
VIEWED FROM THE LOWER LEFT SIDE:

HOSE CLAMP

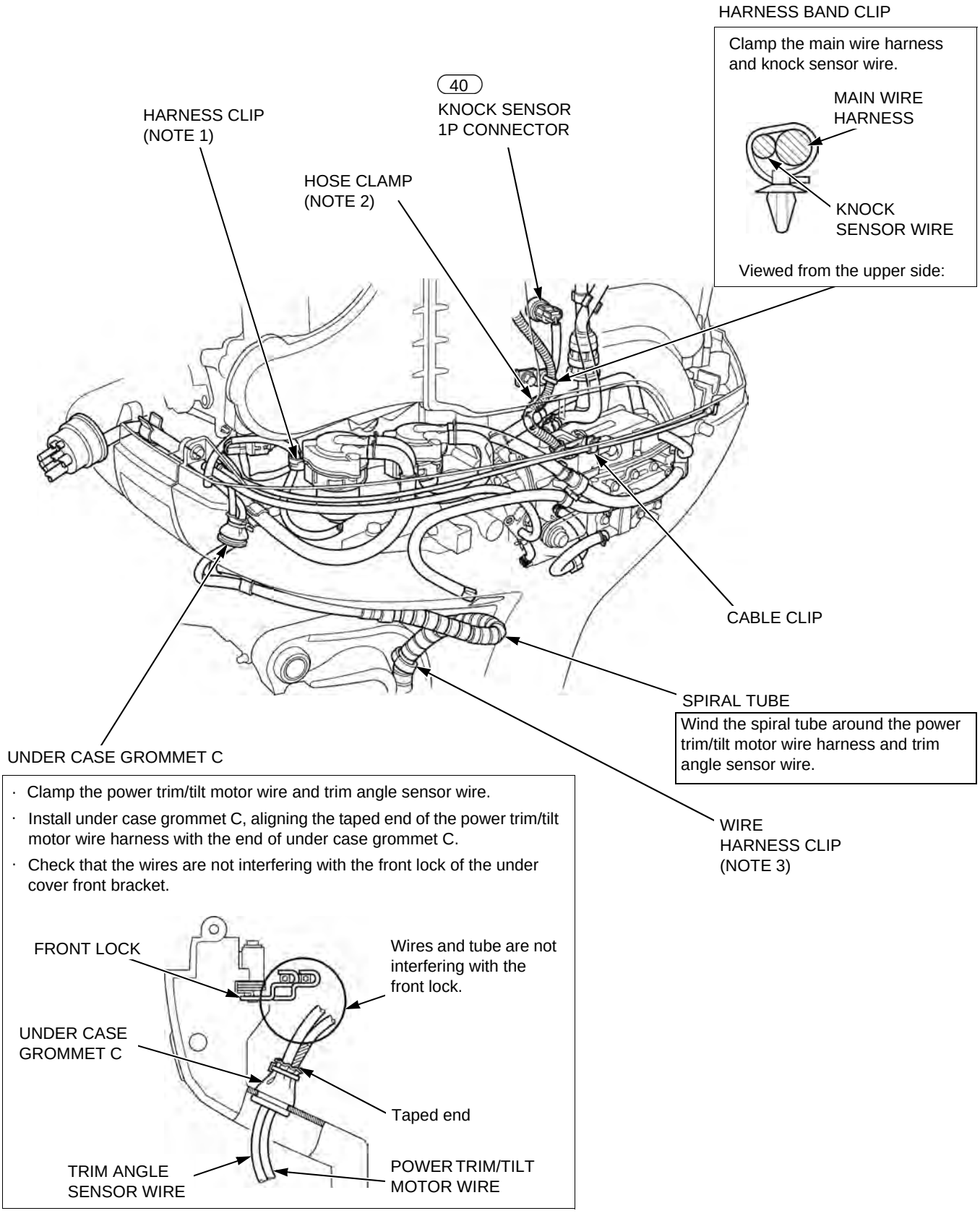
- Set the fuel hose (High pressure side) in the clamp of the larger diameter side and the main wire harness in the smaller diameter side.
- Clamp the fuel hose (High pressure side) to the left-hand side of the marked point.



Viewed from the throttle body side:



VIEWED FROM THE LOWER LEFT SIDE:

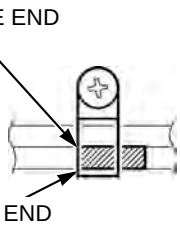


NOTE 1	Harness clip installation	page 2-28
NOTE 2	Hose clamp installation	page 2-32
NOTE 3	Wire harness clip installation	page 2-34

SWIVEL CASE:

CLIP

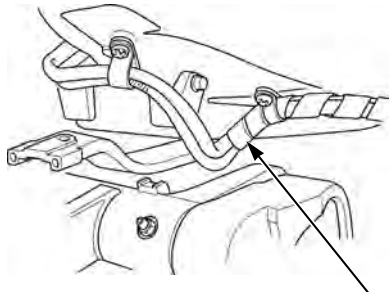
Align the tape end of the power trim/tilt motor wire harness with the clip end.



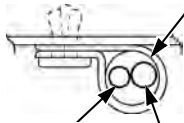
Viewed from the lower side:

CLIP

Clamp the spiral tube as shown.

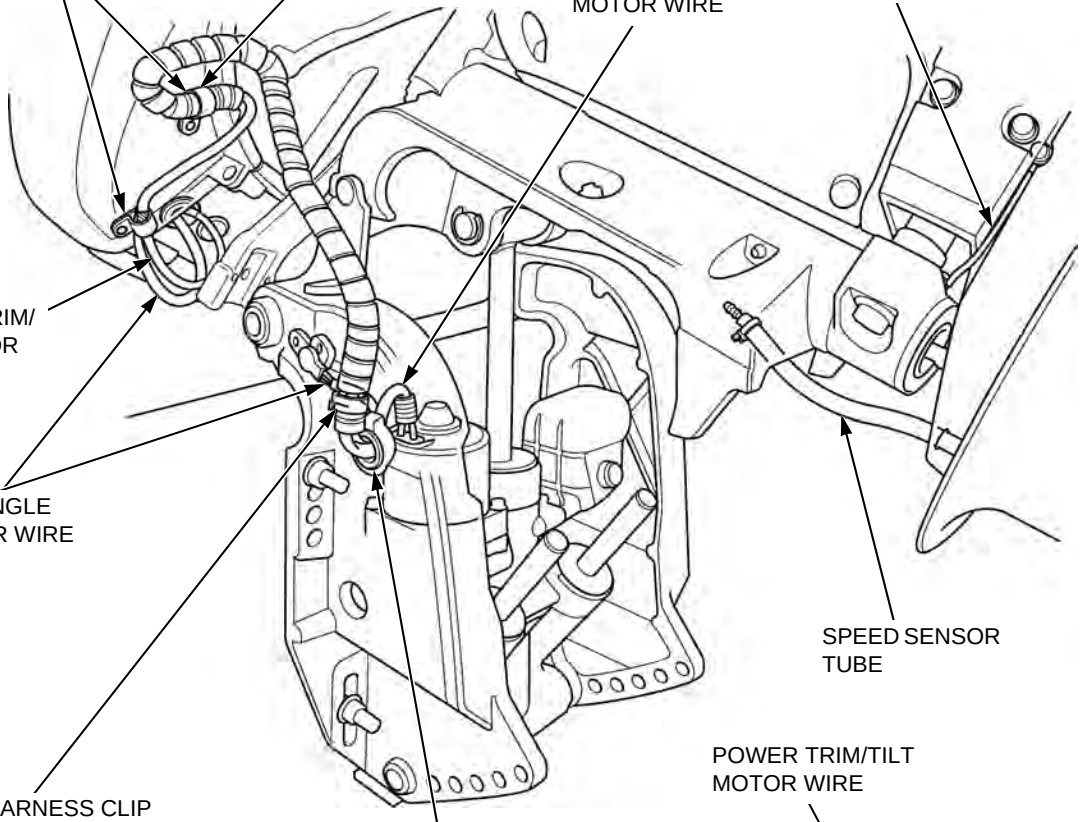


Viewed from the left side:

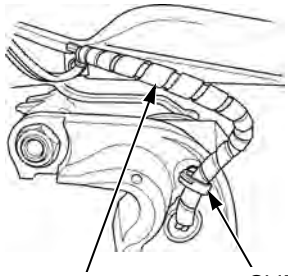


SPIRAL TUBE

Viewed from the cylinder head side:

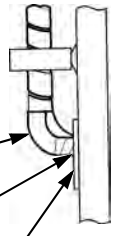


Clamp the spiral tube as shown.



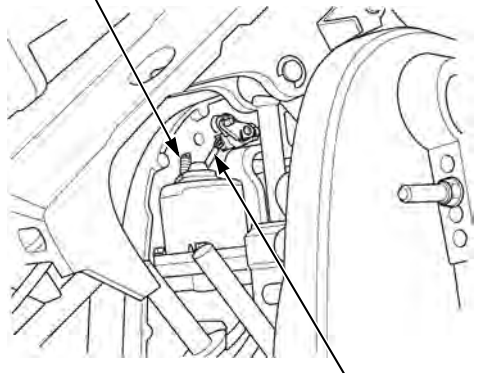
Viewed from the left side:

Align the tape end of the power trim/tilt motor wire harness with the clip end.



Viewed from the cylinder head side:

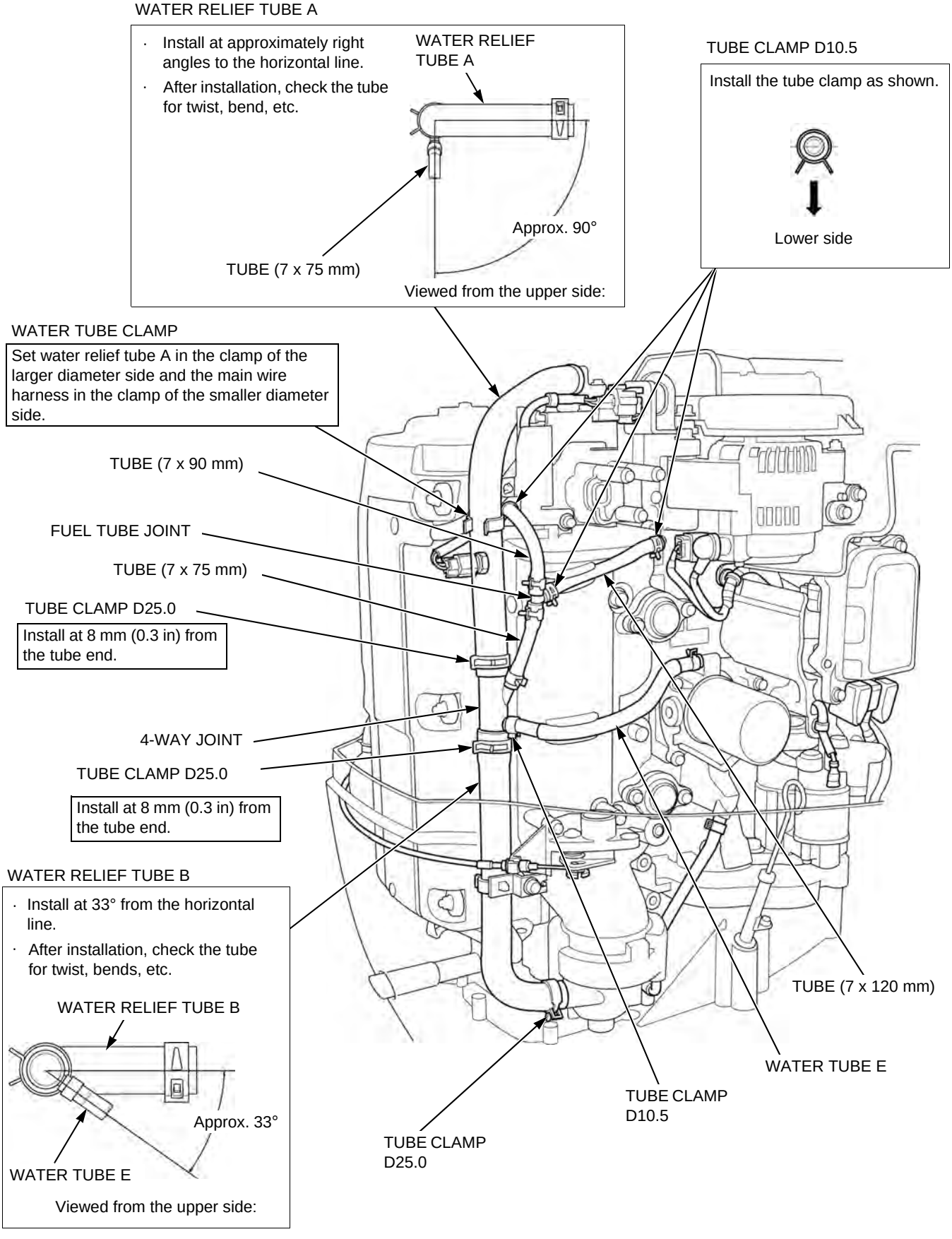
POWER TRIM/TILT MOTOR WIRE



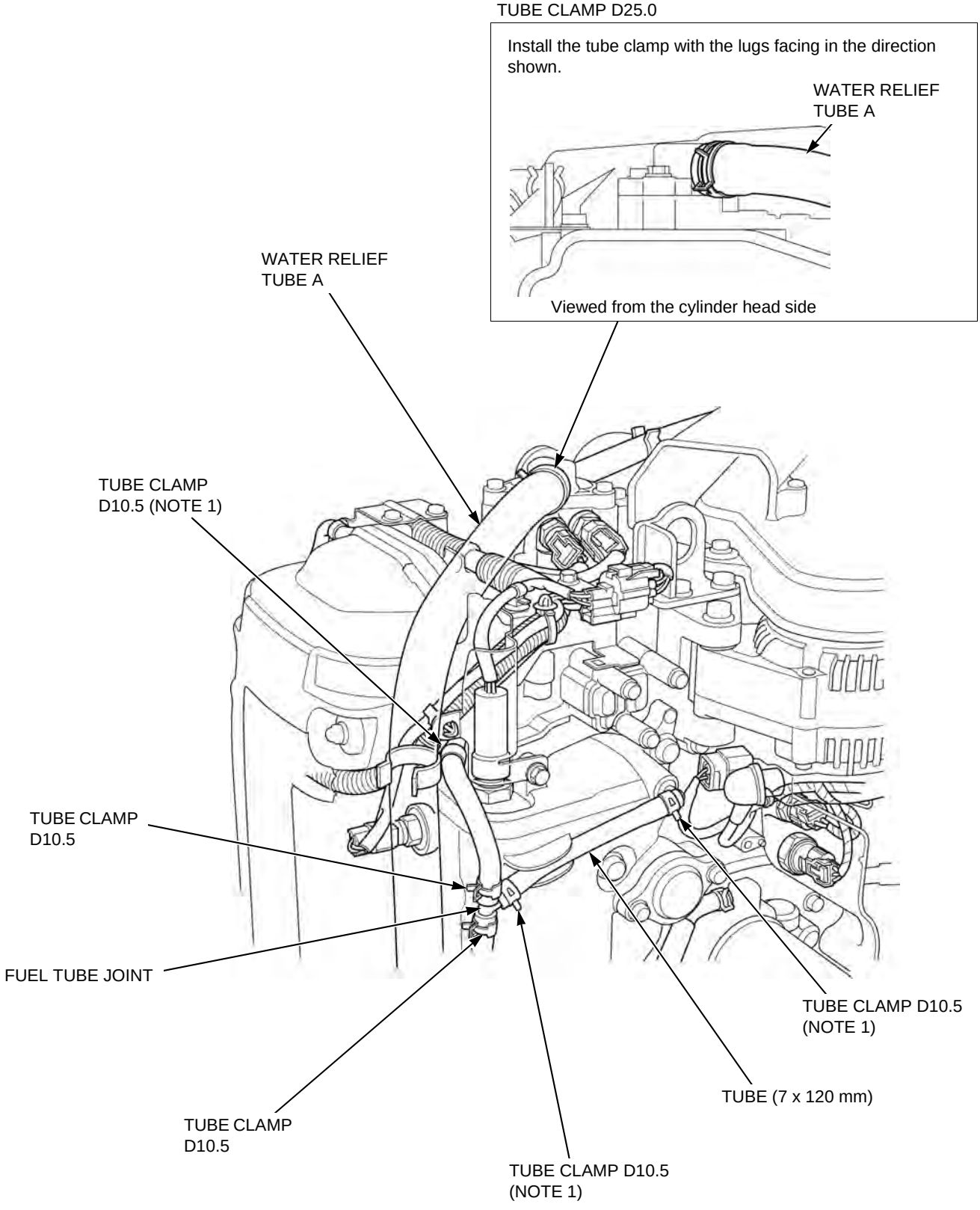
Viewed from the right side:

TUBE ROUTING

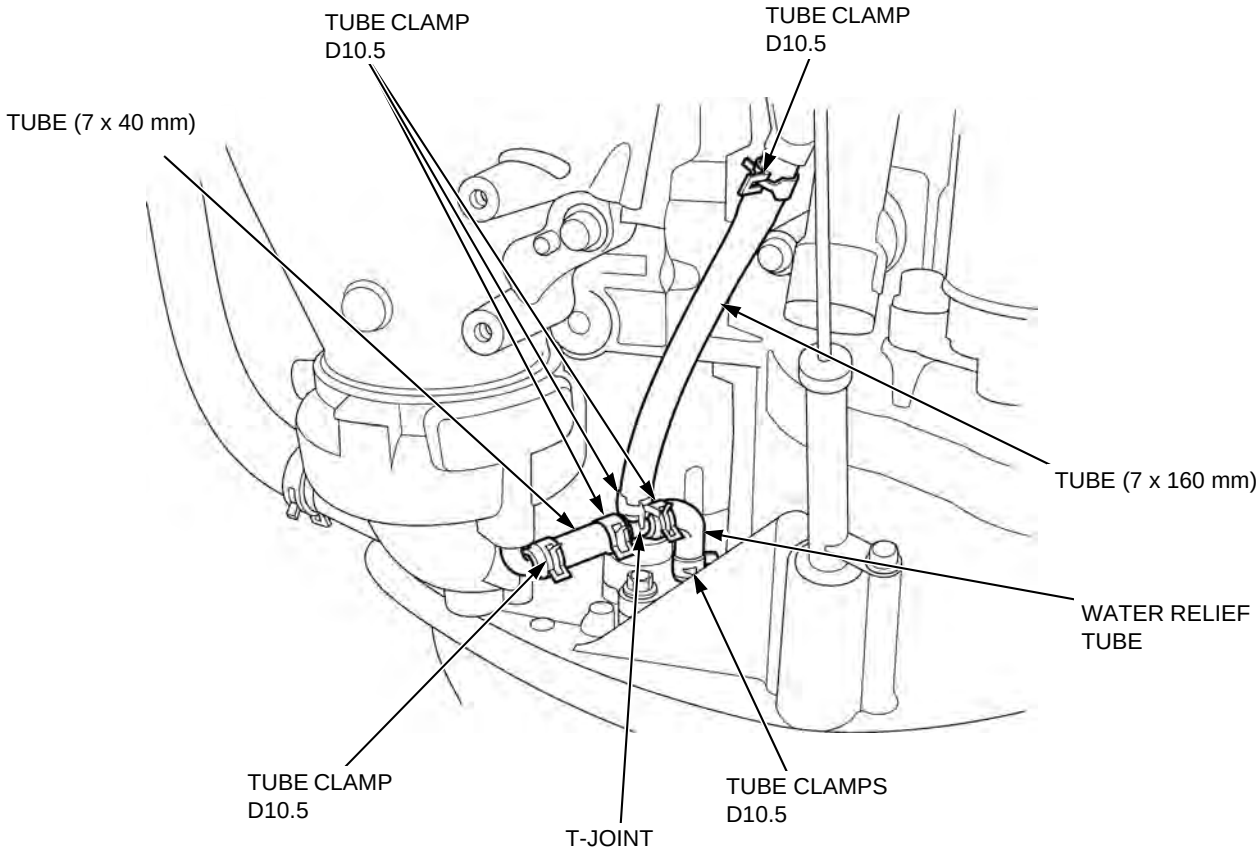
VIEWED FROM THE RIGHT SIDE:

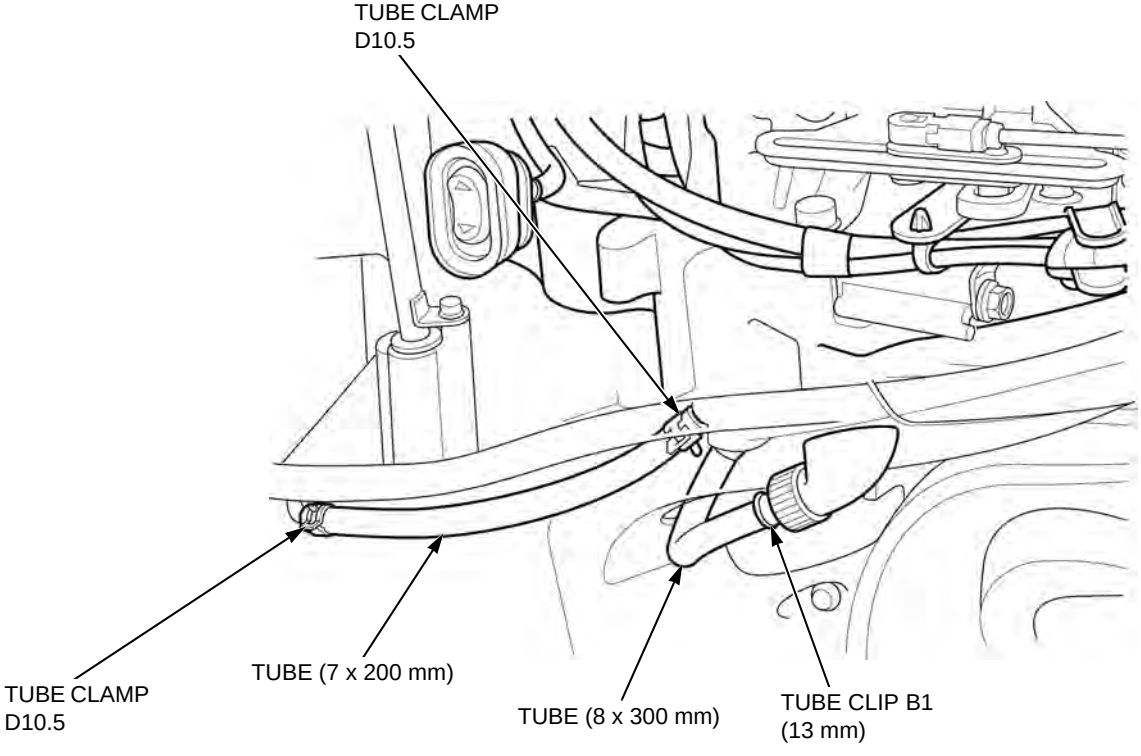


VIEWED FROM THE UPPER RIGHT SIDE:

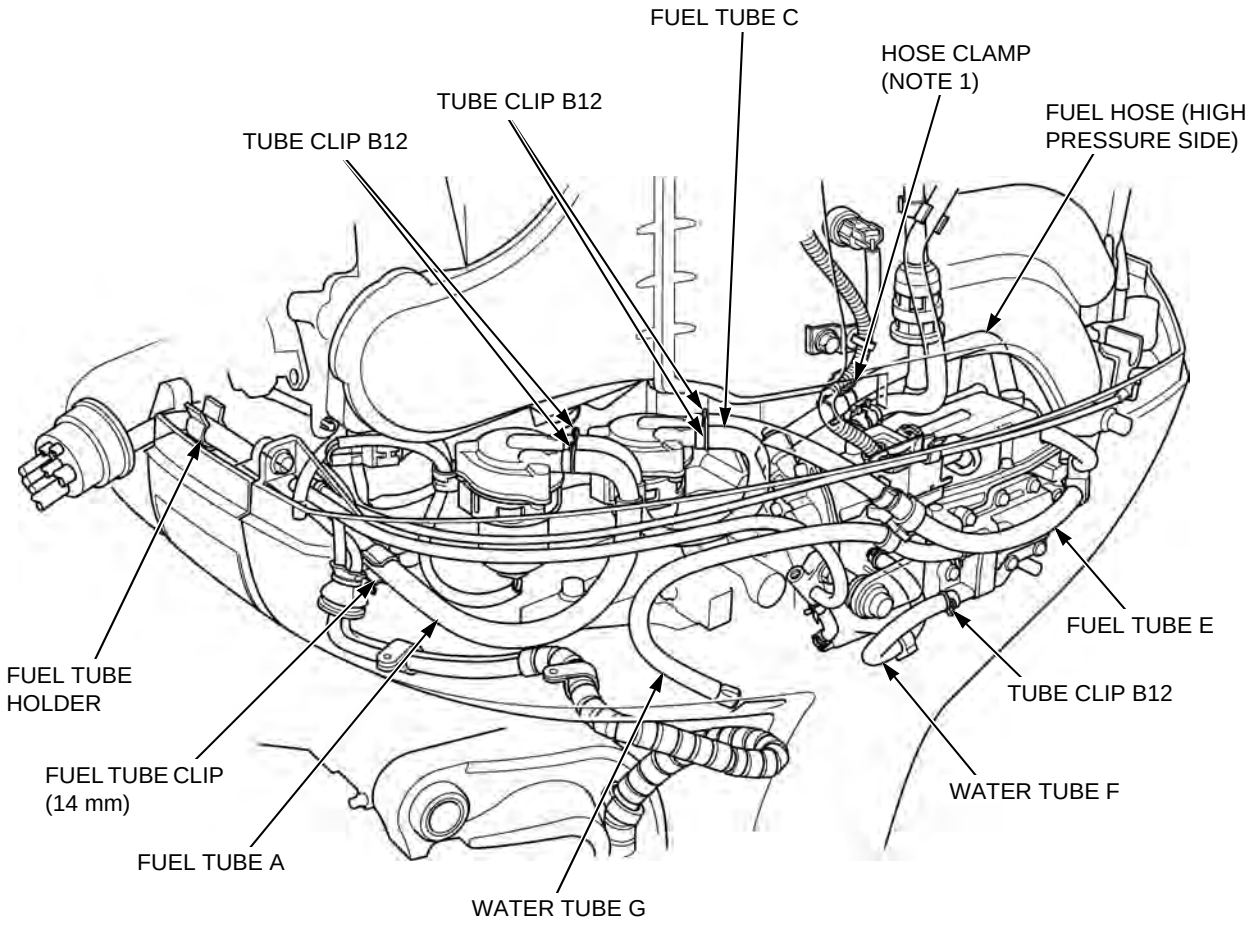


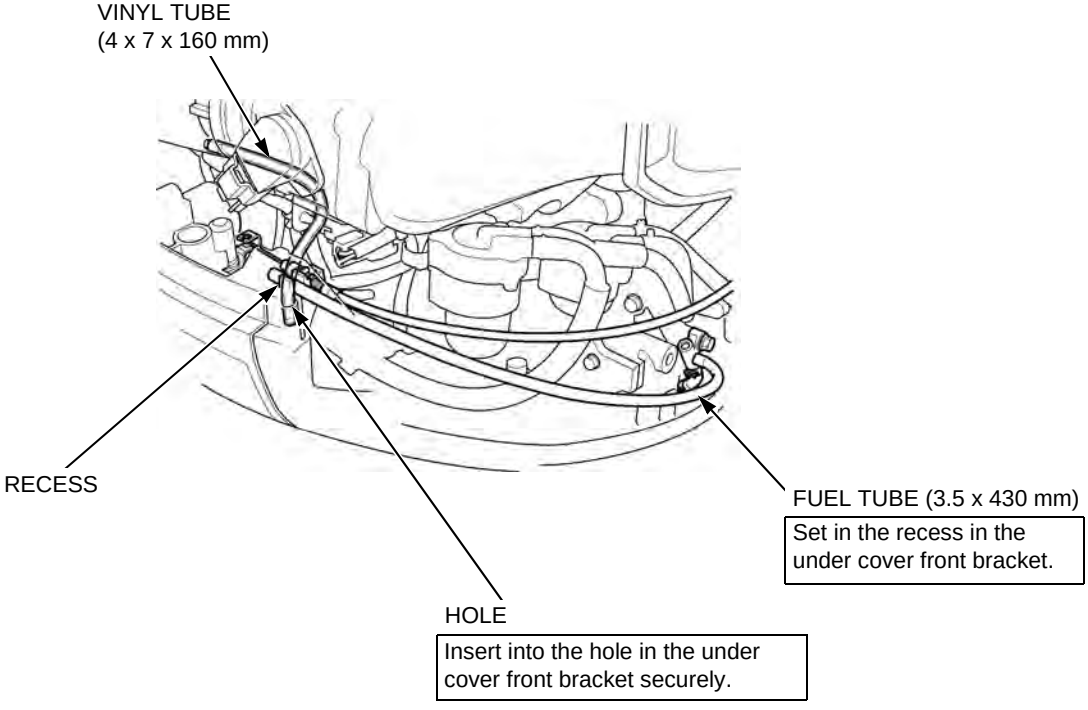
VIEWED FROM THE LOWER RIGHT SIDE:





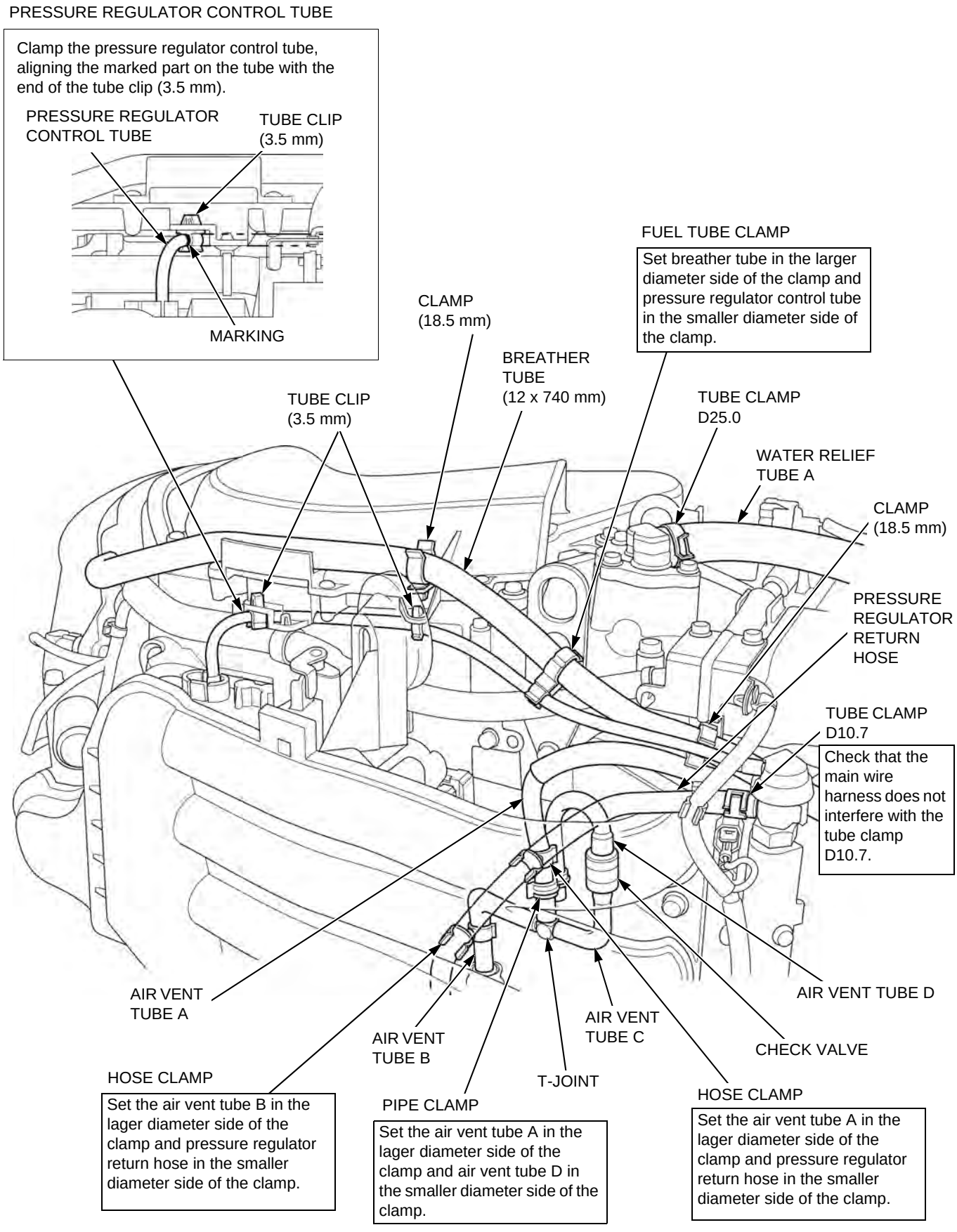
VIEWED FROM THE LOWER LEFT SIDE:



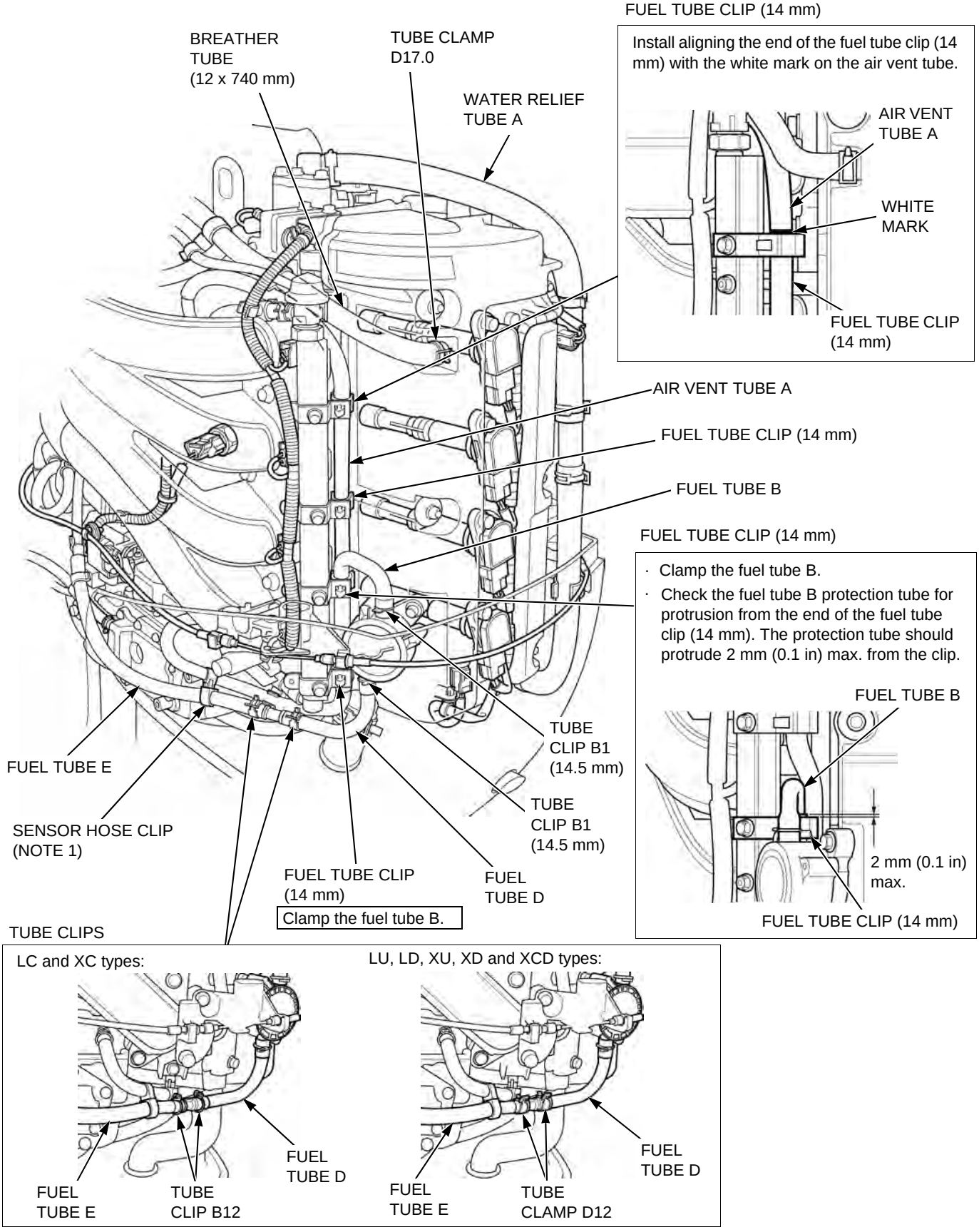


NOTE 1	Hose clamp installation	page 2-32

VIEWED FROM THE UPPER LEFT SIDE:

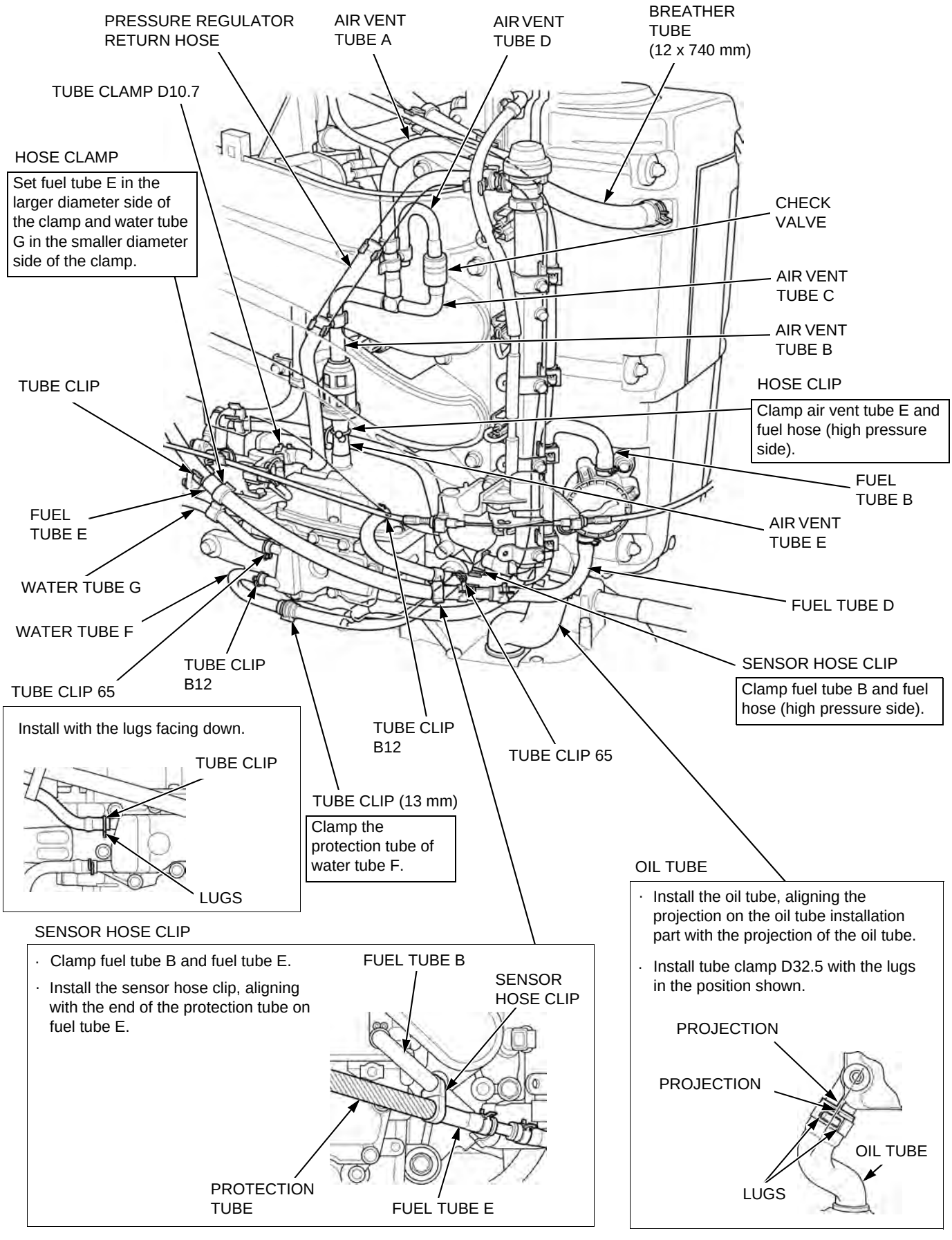


VIEWED FROM THE LEFT REAR SIDE:



NOTE 1	Hose clip installation	page 2-41

VIEWED FROM THE LEFT REAR SIDE:



MEMO

3. MAINTENANCE

MAINTENANCE SCHEDULE ····· 3-2

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WATER PUMP INSPECTION ····· 3-30

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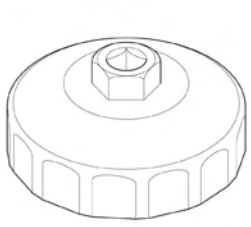
MAINTENANCE SCHEDULE

Item		REGULAR SERVICE PERIOD (2) Perform at every indicated month or operating hour interval, whichever comes first.						Refer to page
		Each use	After use	First month or 20 hrs.	Every 6 months or 100 hrs.	Every year or 200 hrs.	Every 2 years or 400 hrs.	
Engine oil	Check level	○						3-4
	Change			○	○			3-5
Engine oil filter	Replace					○		3-6
Gear case oil	Change			○	○			3-7
ACG belt	Check-adjust					○		3-8
Throttle linkage	Check-adjust			○	○			3-9
Idling speed	Check-adjust			○	○			3-13
Valve clearance	Check-adjust					○		3-15
Spark plug	Check-adjust-replace				○			3-17
Propeller and Cotter pin	Check	○						3-19
Anode metal (Outside engine)	Check	○						3-19
Anode metal (Inside engine)	Check						○ (5)	3-21
Lubrication	Grease			○ (1)	○ (1)			3-22
Water separator	Check	○						3-24
Fuel strainer (Low pressure side)	Check				○			3-24
	Replace						○	3-24
Fuel strainer (High pressure side)	Replace						○	3-26
Thermostat	Check					○		3-26
Fuel line	Check	○						3-27
	Replace	Every 2 years (If necessary)						3-27
Battery and cable connection	Check level-tightness	○						3-28
Bolts and nuts	Check-tightness			○	○			3-28
Crankcase breather tube	Check					○		3-28
Cooling water passages	Clean		○ (3)					3-29
Water pump	Check					○		3-30
Emergency stop switch	Check	○						3-30
Engine oil leak	Check	○						3-30
Each operation part	Check	○						3-31
Engine condition (4)	Check	○						3-31
Power trim/tilt	Check				○			3-31

1. Lubricate more frequently when used in salt water.
2. For professional commercial use, log hours of operation to determine proper maintenance intervals.
3. When operating in salt water, turbid or muddy water, the engine should be flushed with clean water after each use.
4. Upon starting, check for unusual engine sounds and cooling water flowing freely from the check hole.
5. When there is 1/3 or more consumption, please exchange.

TOOLS

LIST

Oil filter wrench, 65 mm 07HAA-PJ70101 	Belt tension gauge 07JGG-0010101 

ENGINE OIL LEVEL INSPECTION/OIL CHANGE

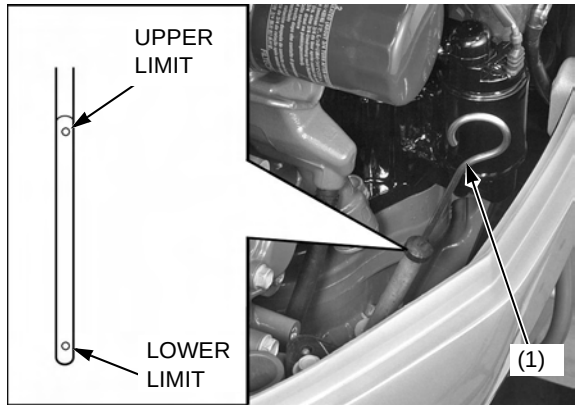
OIL LEVEL INSPECTION

Start the engine, let it warm up to the normal operating temperature, and stop the engine.

Place the outboard motor in the vertical position (with the engine level), and remove the engine cover.

Remove the dipstick (1), and wipe it clean with a shop towel.

Insert the dipstick into the oil level pipe fully, then remove it and check the oil level.
Check whether the oil is dirty or has a milky color.



If the oil level is low, remove the oil filler cap (1), and add the recommended oil to bring the oil level up to the upper level mark on the dipstick.



RECOMMENDED ENGINE OIL:
SAE 10W – 30
API Service classification SG, SH, or SJ

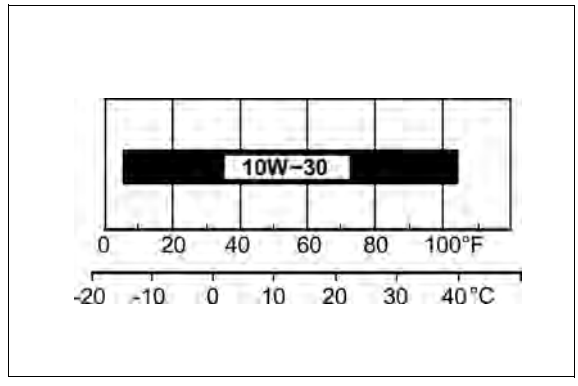
SUGGESTED ENGINE OIL:
Honda SAE 10W – 30

Replace the engine oil if it is dirty (page 3-5).

If the oil has a milky color, check the gaskets and replace them with new ones if necessary:

– Mounting case gasket (page 13-3)
– Cylinder head gasket (page 14-35)
– Oil pump body gasket (page 12-9)
– Oil case gasket (page 12-6)

Install the oil filler cap.



OIL CHANGE

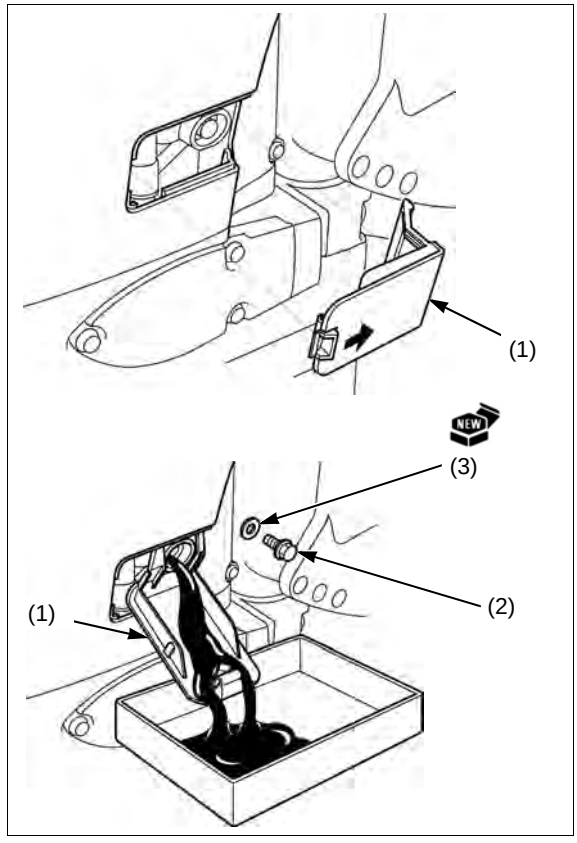
⚠CAUTION

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.

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

Place the outboard motor on a level surface and position the outboard motor vertically (with the engine level).
Remove the oil filler cap (page 3-4).

Place a suitable oil container next to the outboard motor.
Remove the drain plug cover (1) and set it to the outboard motor as shown.
Remove the oil drain plug bolt (2) and drain plug washer (3), and drain the engine oil.



Please dispose of 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 pour it down a drain.

After draining, set a new drain plug washer on the oil drain plug bolt.
Tighten the oil drain plug bolt to the specified torque.

TORQUE: 23 N·m (2.3 kgf·m, 17 lbf·ft)

Refill with the recommended engine oil up to the upper level mark on the dipstick (page 3-4).

ENGINE OIL CAPACITY:
6.5 liter (6.9 US qt, 5.7 Imp qt)
With oil filter replacement:
6.7 liter (7.1 US qt, 5.9 Imp qt)

Install the oil filler cap, dipstick and drain plug cover.

Reinstall the engine cover.

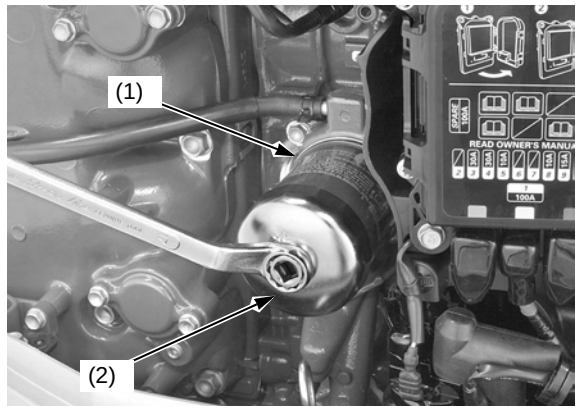
ENGINE OIL FILTER REPLACEMENT

Remove the engine cover.

Drain the engine oil as described in the oil change procedure (page 3-5).

Place a shop towel under the oil filter (1) to absorb any spilled oil, and then attach the special tool to the oil filter and remove it.

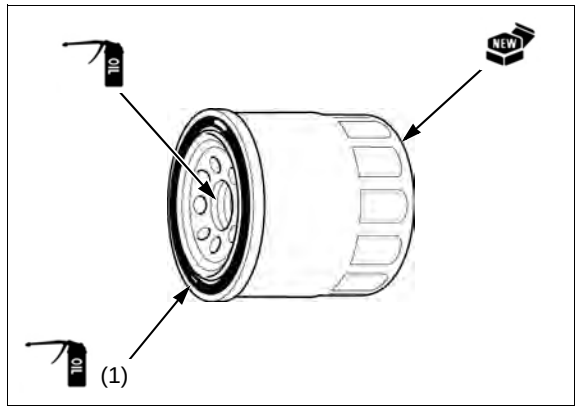
TOOL:
Oil filter wrench, 65 mm (2) 07HAA-PJ70101



Apply clean engine oil to the O-ring (1) on the inner side of a new oil filter.

Clean the filter mounting base, and coat the stud with clean engine oil.

- Use only a Honda Genuine oil filter or a filter of equivalent quality specified for your model. Using the wrong Honda filter, or a non-Honda filter that is not of equivalent quality, may cause engine damage.



Screw on the filter (1) by hand first, and then screw it in to the specified torque using the special tool used for removing the filter.

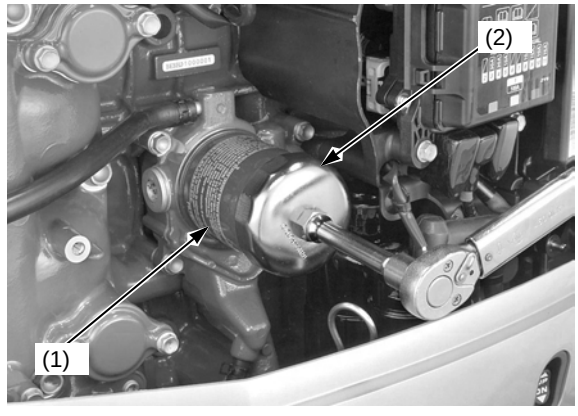
TOOL:
Oil filter wrench, 65 mm (2) 07HAA-PJ70101

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Refill the engine with the specified amount of the recommended oil as described in the oil change procedure, and start the engine to warm it up to the normal operating temperature.

Stop the engine and check for leaks from the oil filter. Check the oil level (page 3-4).

Install the engine cover.



GEAR CASE OIL CHANGE

Place the outboard motor on a level surface and position the outboard motor vertically (with the gear case level).
Tilt the outboard motor up slightly until the drain hole is at its lowest point.

Remove the oil level check bolt (1) and drain plug bolt (2), then check for metal particles on the magnet end.

If there are metal particles on the magnet end of the drain plug bolt, disassemble and inspect the gear case assembly:

– Standard rotation type (page 16-8)
– Counter rotation type (page 17-8)

If there is water in the oil, the water will flow out first when the drain plug bolt is removed, or the oil will be in milky color. If water in the gear oil is detected, perform a gear case pressure check:

– Standard rotation type (page 16-47)
– Counter rotation type (page 17-51)

Tilt the outboard motor down until it is vertical.

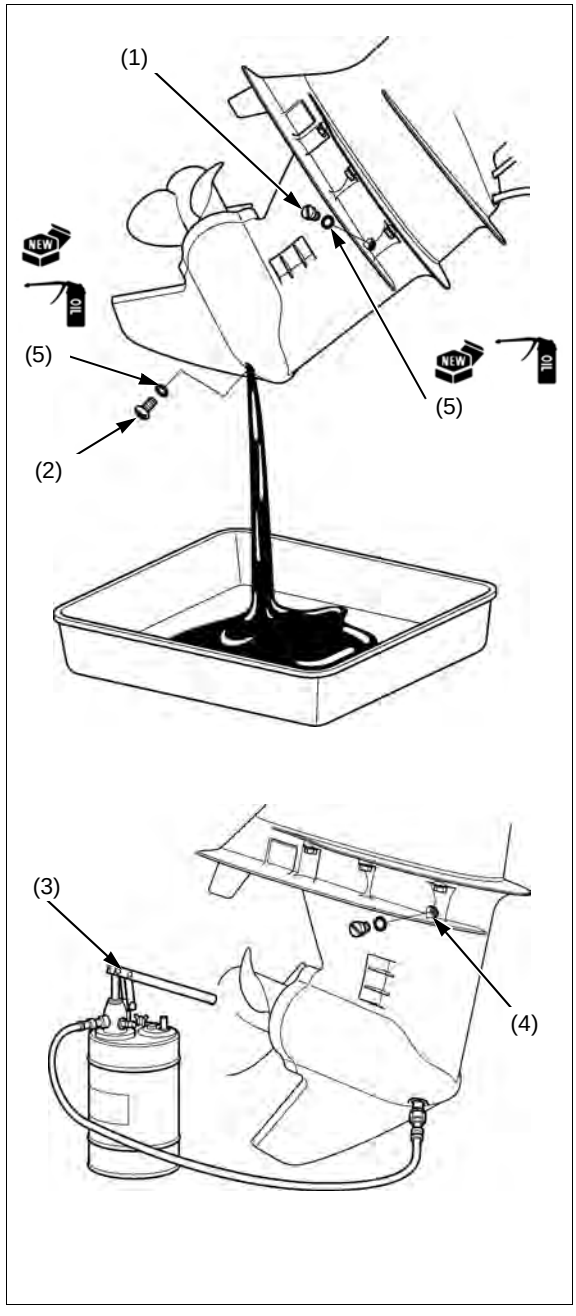
Install a commercially available gear oil pump (3) in the oil drain bolt hole, and add gear oil until it flows out from the oil level check bolt hole (4).

RECOMMENDED GEAR OIL:
MARINE SAE 90 Hypoid gear oil
API Service Classification (GL-4)

GEAR OIL CAPACITY:
0.98 liter (1.04 US qt, 0.86 Imp qt)

After adding the gear oil, apply gear oil to new O-rings (5) and install them on the oil level check bolt and drain plug bolt.
Install and tighten the bolts to the specified torque.

TORQUE: 6.5 N·m (0.66 kgf·m, 4.8 lbf·ft)



ALTERNATOR BELT INSPECTION

BELT INSPECTION

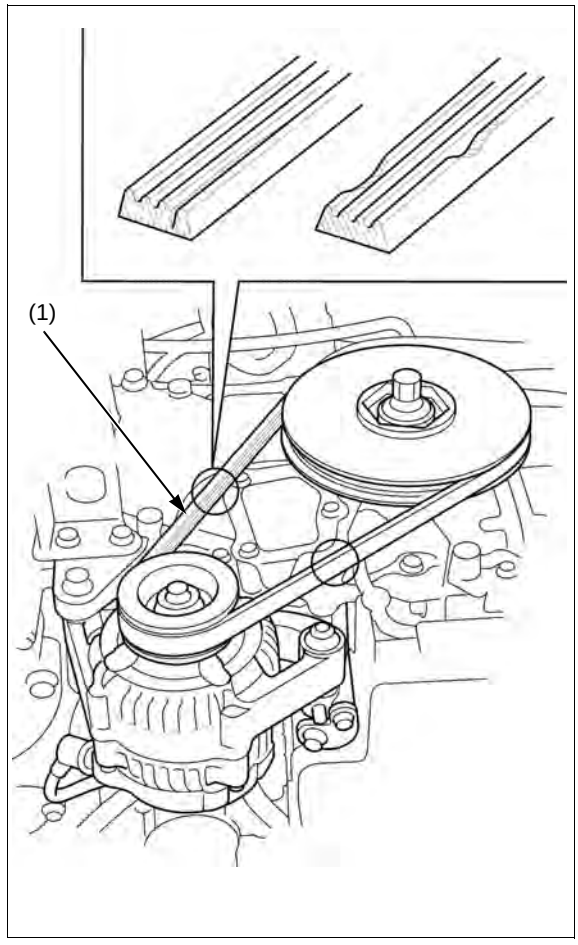
Remove the following:

– Engine cover
– Silencer duct (page 5-82)

Check the alternator belt (1) for wear and damage. Replace the belt if it is worn or damaged (page 7-5).

Check the alternator belt and the related parts for oil contamination, etc. If contaminated, clean the contaminated parts and replace the belt.

Check the alternator belt tension or deflection.



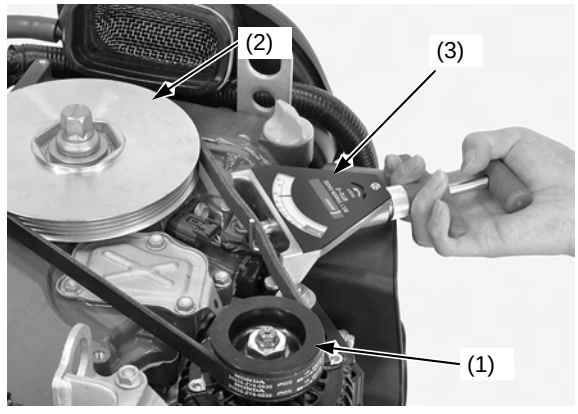
BELT TENSION INSPECTION USING BELT TENSION GAUGE

Set the special tool at the center between the alternator belt pulley (1) and crankshaft pulley (2), and measure the belt tension.

TOOL:
Belt tension gauge (3) 07JGG-0010101

BELT TENSION:
New belt 490 – 588 N (50 – 60 kgf, 110 – 132 lbf)
Used belt 392 – 490 N (40 – 50 kgf, 88 – 110 lbf)

If the belt tension is out of the specification, adjust the belt tension.



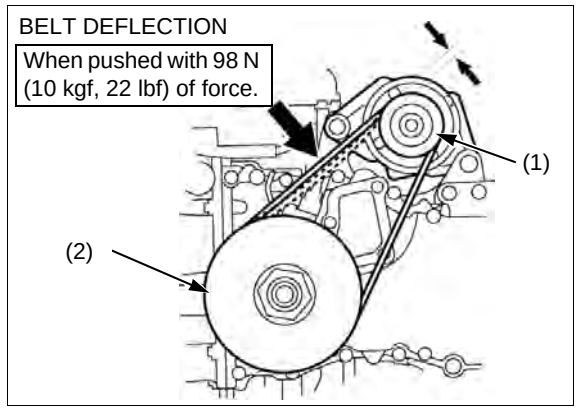
BELT DEFLECTION INSPECTION

Measure the belt deflection by pushing the alternator belt at the center between the alternator belt pulley (1) and crankshaft pulley (2) with 98 N (10 kgf, 22 lbf) of force.

BELT DEFLECTION:

New belt	**10.1 – 10.6 mm (0.40 – 0.42 in)**
Used belt	**10.6 – 11.1 mm (0.42 – 0.44 in)**

If the belt tension is out of specification, adjust the belt tension.



BELT TENSION ADJUSTMENT

1. If the belt tension or belt deflection is out of specification, loosen the bolt (1) and nut (2) and adjust the belt tension or deflection by turning the special adjuster bolt (3) right or left.
2. After adjustment, tighten the nut first, then tighten the bolt to the specified torque.

   TORQUE:

Nut:	**26 N·m (2.7 kgf·m, 19 lbf·ft)**
Bolt:	**44 N·m (4.5 kgf·m, 32 lbf·ft)**

3. After tightening the nut and bolt to the specified torque, check the alternator belt tension again.
   If the measurement is still outside the specification, repeat the step 1 and 2 again.



Install the following:

– Silencer duct (page 5-82)
– Engine cover

THROTTLE LINKAGE INSPECTION/ ADJUSTMENT

STANDARD INSPECTION/ ADJUSTMENT

Remove the following:

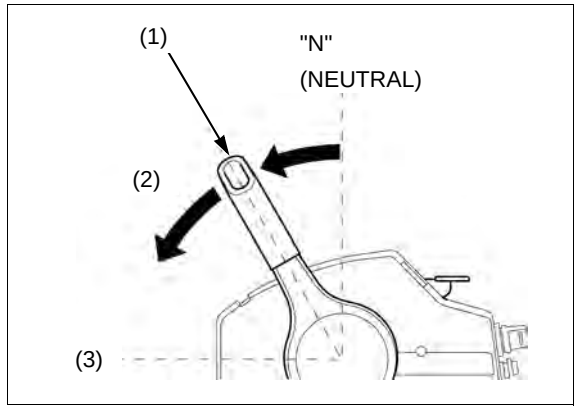
– Engine cover
– Front separate cover (page 6-3)

1. Move the remote control lever (1) to the "F" (Forward) (2) full open position (3).

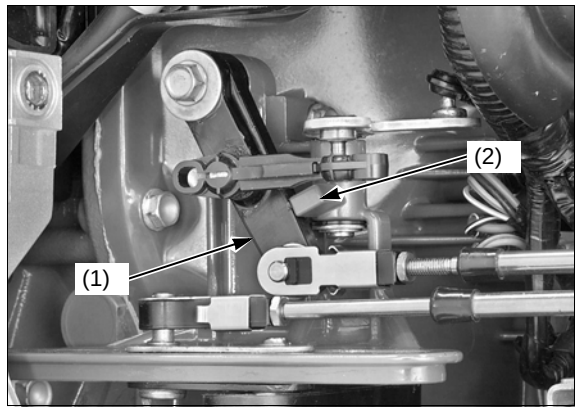
If it is hard to move the remote control lever to the "F" (Forward) position with the engine stopped, move the lever while turning the propeller or propeller shaft.

NOTICE

Do not move the remote control lever with force or damage to the gearshift system can result.

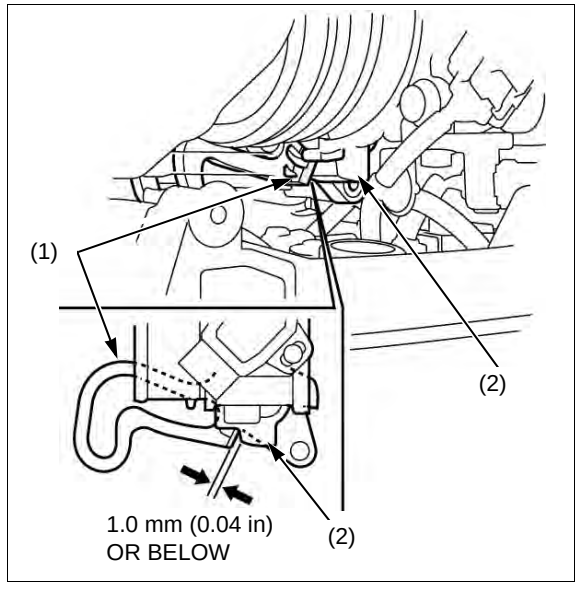


2. Check whether the throttle arm (1) is in contact with the full open position stopper (2).
   Perform the adjustment (page 3-11) if the throttle arm is not in contact with the stopper.



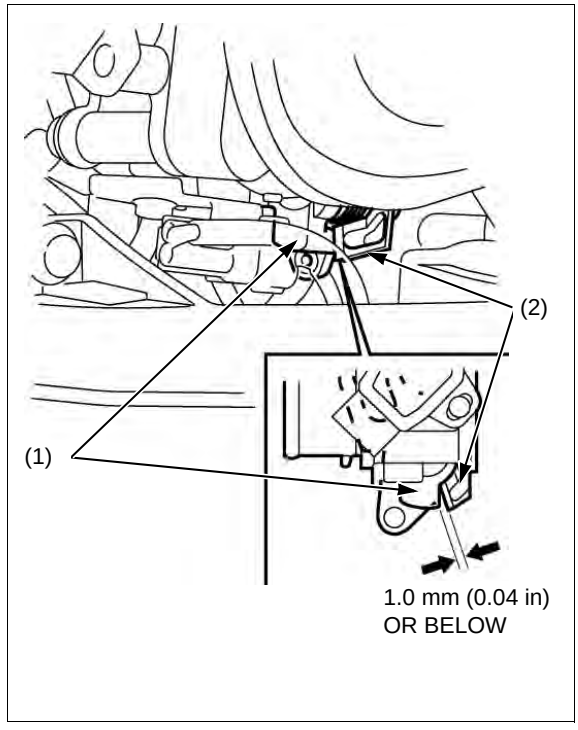
3. With the throttle arm in contact with the full open position stopper, measure the clearance between the throttle cam (1) of the throttle body assembly and full open position stopper (2). It should be 1.0 mm (0.04 in) or below.

   Perform the adjustment (page 3-11) if the clearance is larger than specified.



4. Return the remote control lever to the "N" (Neutral) position.
   Check that the throttle cam (1) of the throttle body is at the fully closed position.
   Measure the clearance between the throttle cam of the throttle body assembly and full close position stopper (2). It should be 1.0 mm (0.04 in) or below.

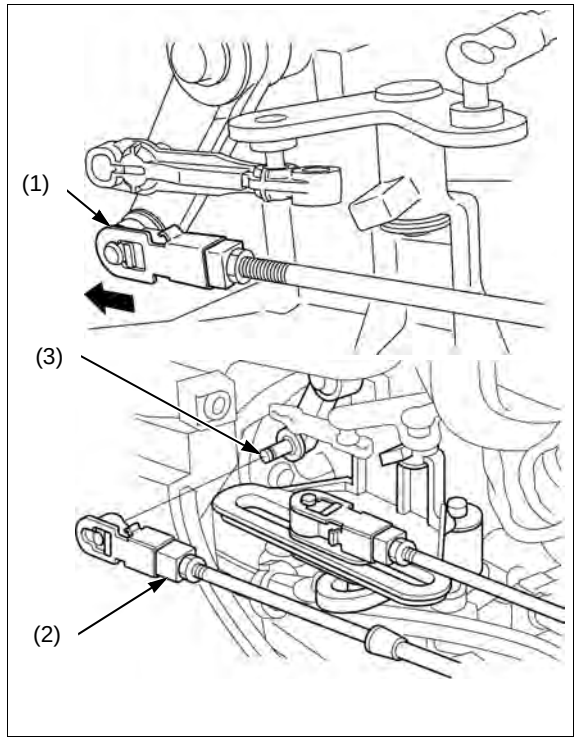
   Perform the adjustment (page 3-11) if the clearance is larger than specified.



SYMPTOM ADJUSTMENT

If the throttle arm does not fully open

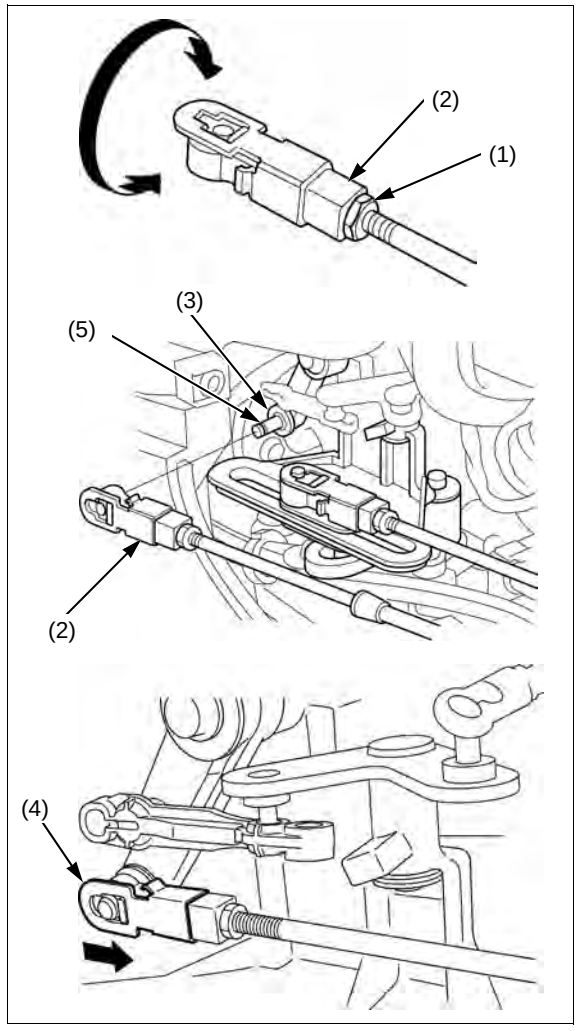
Slide the lock plate (1) backward and remove the throttle control cable (2) from the throttle arm (3).



Loosen the shift pivot lock nut (1).

Adjust the shift pivot (2) so it can be installed over the throttle arm (3) easily.

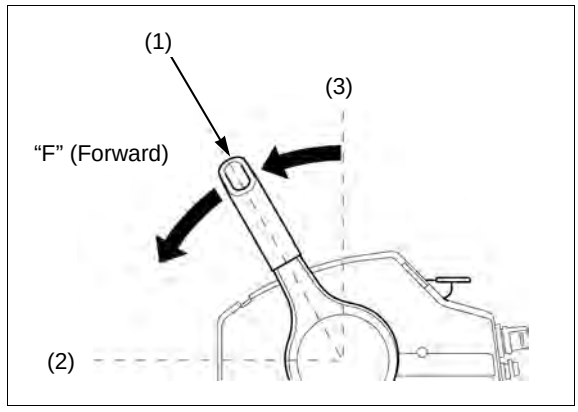
Lock the lock plate (4) by sliding it to the groove (5) of the shift link.



Move the remote control lever (1) to the "F" (Forward) full open position (2).

Check whether the throttle linkage satisfies the conditions on step 2, 3 and 4 on page 3-10.

Move the remote control lever to the "N" (Neutral) (3) position and tighten the adjusting nut.



If the throttle cam does not fully open

Remove the linkage pivot (1) of the throttle rod (2) from throttle plate (3).
Loosen the linkage pivot lock nut (4).

Turn the linkage pivot of the throttle rod until the throttle link satisfies the conditions on step 2, 3 and 4 on page 3-10.

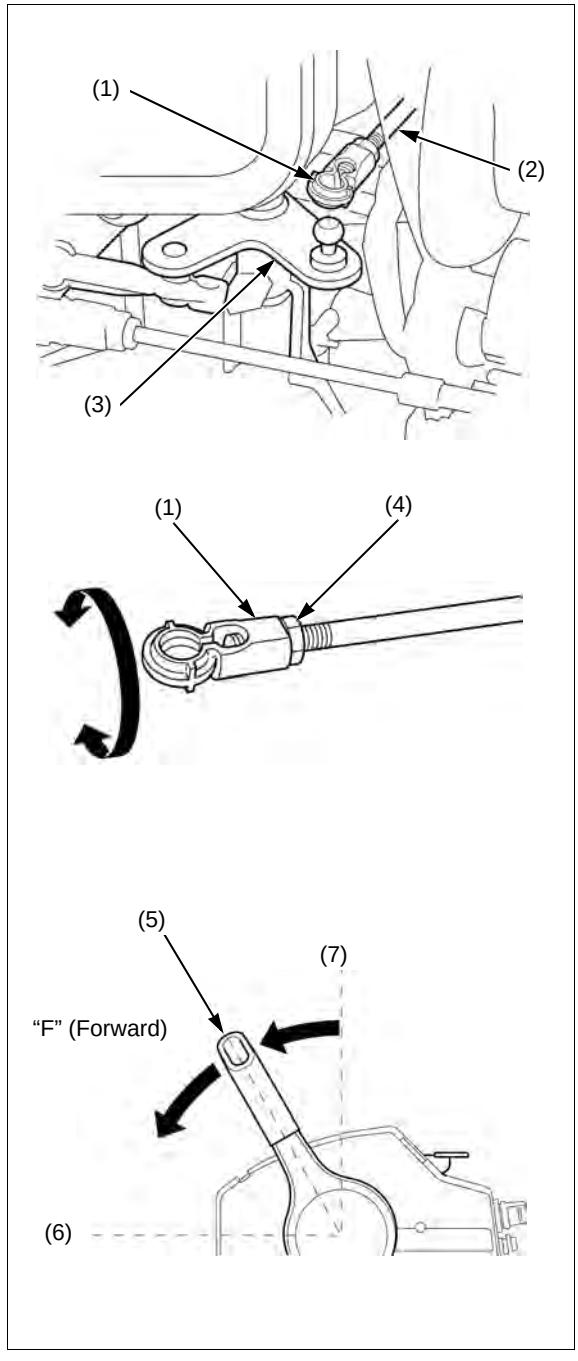
Temporarily install the linkage pivot to the throttle plate.

Move the remote control lever (5) to the "F" (Forward) full open position (6).

Check whether the throttle linkage satisfies the conditions on step 2, 3 and 4 on page 3-10.

Return the remote control lever to the "N" (Neutral) position (7) and tighten the linkage pivot lock nut.

After tightening the lock nut, check that the throttle cam side pivot of the throttle rod is not disconnected from the throttle cam.



IDLE SPEED INSPECTION/ ADJUSTMENT

INSPECTION

Check the following before starting the idle speed inspection.

- Spark plug inspection (page 3-17)
- MIL must be OFF.

Turn the combination switch OFF.

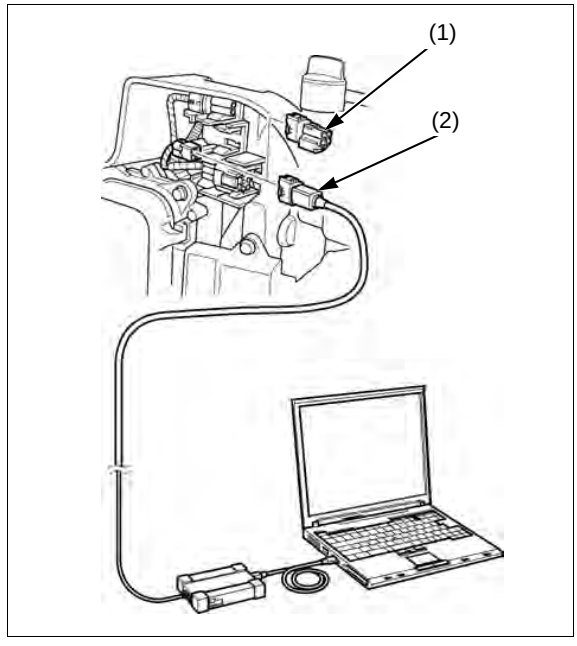
Place the outboard motor vertically (with the engine level to the ground), and set the remote control lever in the "N" (Neutral) position.

Remove the engine cover.

Set the outboard motor gear case in a test tank filled with water.

USING THE HDS

Remove the dummy connector (1) from the DLC and connect the HDS (2).



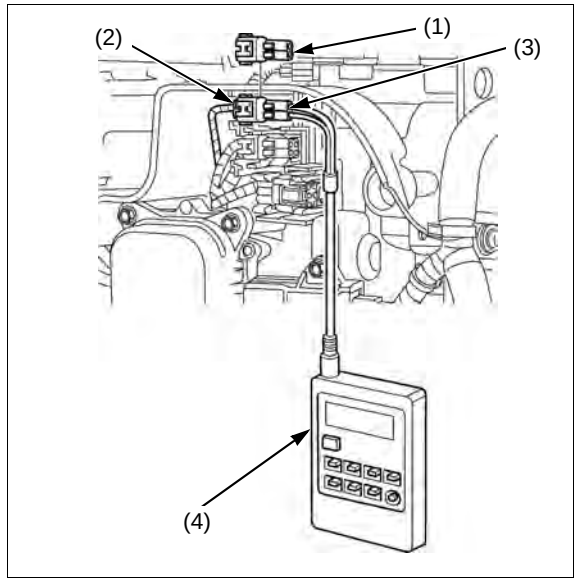
Start the engine and let it warm up sufficiently.
Wait until the engine speed stabilizes under no load, and check the idle speed.

SPECIFIED IDLE SPEED (AT NEUTRAL):
750 ± 50 min^{-1} (rpm)

- When the idle speed is out of specification, or when a problem symptom shown on the idle control system troubleshooting (page 4-7) appears, perform the adjustment as follows.

USING THE DIGITAL TACHOMETER (KOWA: KEK-8-MT600)

Remove the dummy connector (1) from the tacho pulse 2P connector (2).
Connect the connector cable (KOWA: KEK-8-MT600-ATHM) (3) to the tacho pulse 2P connector.
Connect the connector cable pin jack, that is the opposite side from the 2P connector, to the digital tachometer (KOWA: KEK-8-MT600) (4).



Start the engine.
Wait until the engine speed stabilizes under no load, and check the idle speed.

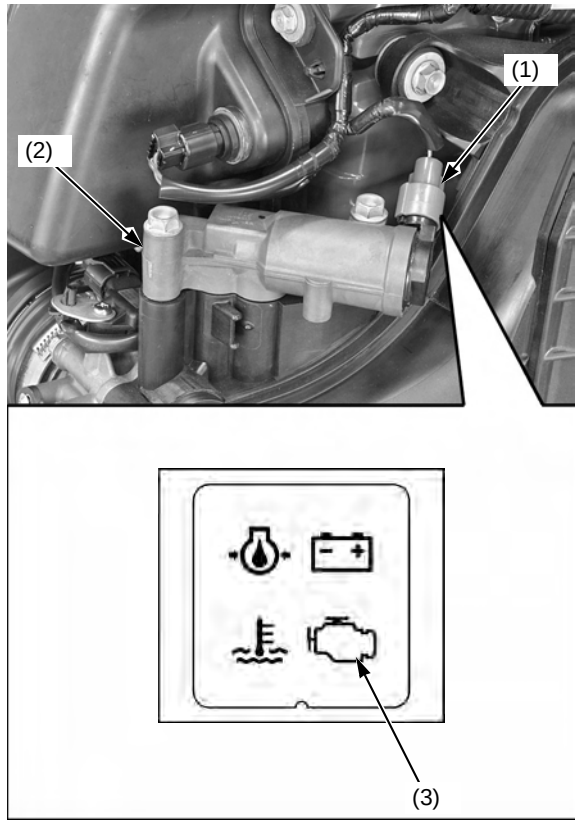
SPECIFIED IDLE SPEED (AT NEUTRAL):
750 ± 50 min^{-1} (rpm)

- When the idle speed is out of specification, or when a problem symptom shown on the idle control system troubleshooting (page 4-7) appears, perform the adjustment as follows.

ADJUSTMENT

Set the outboard motor gear case in a test tank filled with water.
Start the engine.

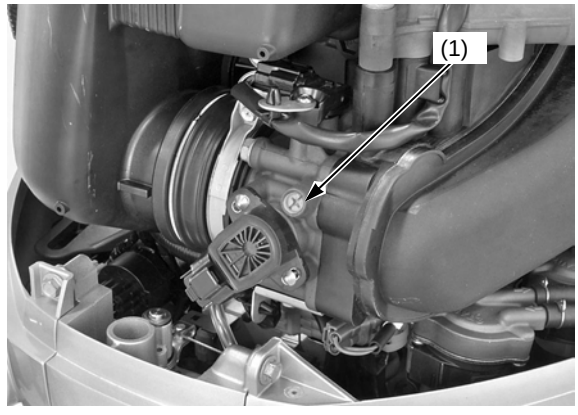
Disconnect the 2P connector (1) from the IAC valve (2). The MIL (3) should come ON and the warning buzzer should sound (intermittent sound: long beep).



Wait until the engine speed stabilizes, and then check the idle speed.

If the idle speed is out of specification, adjust by turning the idle adjusting screw (1) in or out.

BASE IDLE SPEED (AT NEUTRAL):
575 ± 30 min^{-1} (rpm) (with IAC valve connector disconnected)



After adjustment, stop the engine and apply Nippon Paint Uni-pack 200 or equivalent to the entire surface of the idle adjusting screw (1) head.

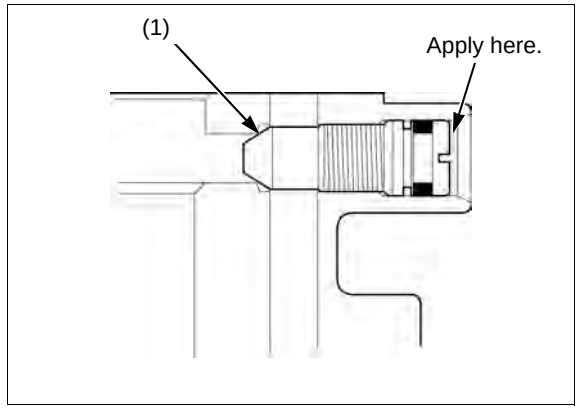
Connect the IAC valve 2P connector.

Clear the DTC (page 5-6).

Start the engine. Wait until the engine speed stabilizes under no load, and recheck the idle speed.

SPECIFIED IDLE SPEED (AT NEUTRAL):
750 ± 50 min^{-1} (rpm)

If the idle speed is out of specification, inspect and troubleshoot the idle control system (page 4-7).



VALVE CLEARANCE INSPECTION/ ADJUSTMENT

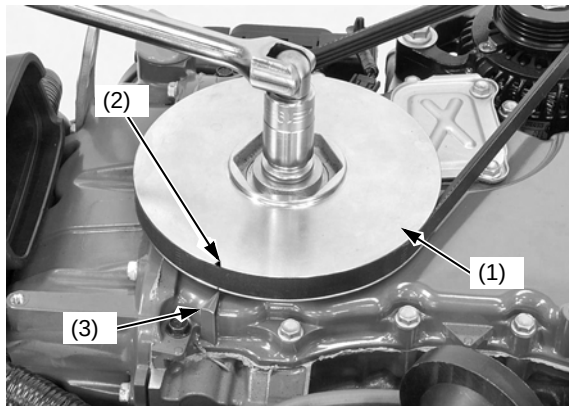
- Valve clearance inspection and adjustment must be performed with the engine cold

1. Remove the following:

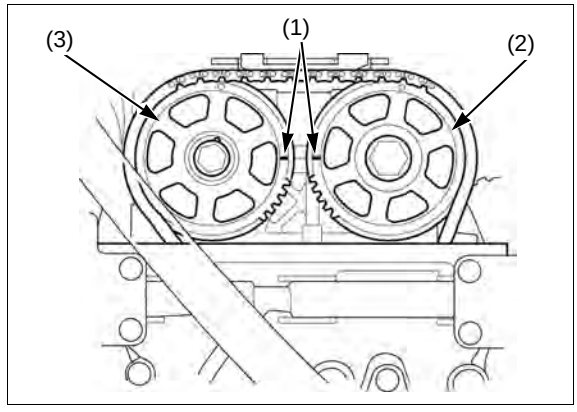
– Silencer duct (page 5-82)
– Cylinder head cover (page 14-6)

2. Manually turn the crankshaft pulley (1) clockwise, and align the cutout (2) of the crankshaft pulley with the index mark (3) of the chain case.

- Do not turn the crankshaft pulley counterclockwise.

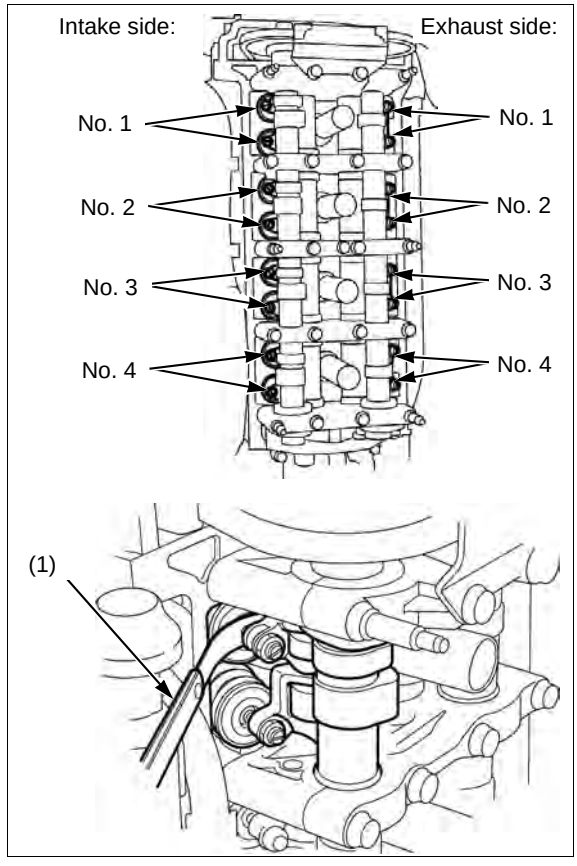


3. With the engine in the position described in step 2, check that the index lines (1) of the intake camshaft sprocket (2) and exhaust camshaft sprocket (3) are lined up as shown.
   At this position, No.1 piston is at the top dead center of its compression stroke.



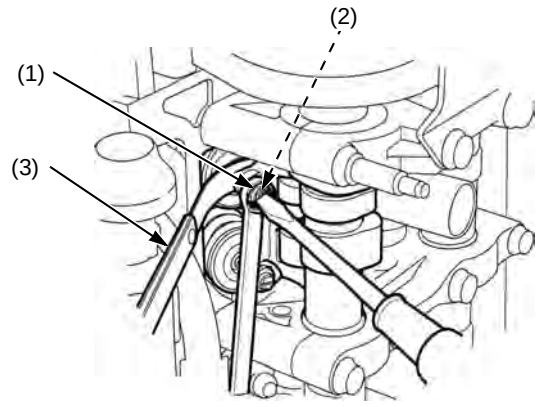
4. With the engine in the position described in step 3, check the intake and exhaust valve clearances of No.1 cylinder by inserting a feeler gauge (1) between the intake and exhaust side rocker arm adjusting screws and the valve stem ends.

VALVE CLEARANCE:
IN: 0.21 – 0.25 mm
EX: 0.28 – 0.32 mm



5. If adjustment is necessary, loosen the valve adjusting lock nut (1), and adjust the intake and exhaust valve clearance by turning the valve adjusting screw (2) right or left.
6. After adjustment, secure the adjusting screw and loosely tighten the lock nut.
7. Recheck the valve clearances using a feeler gauge (3), and tighten the valve adjusting lock nut to the specified torque.

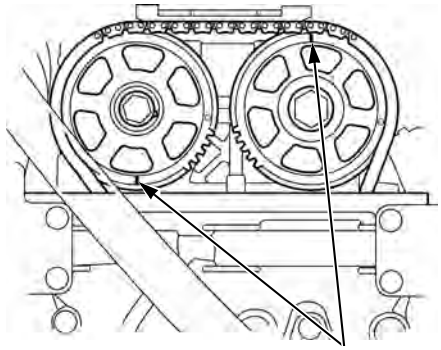
   TORQUE:
   IN: 20 N·m (2.0 kgf·m, 15 lbf·ft)
   EX: 14 N·m (1.4 kgf·m, 10 lbf·ft)



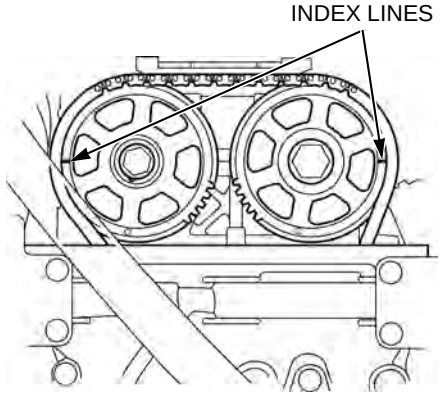
8. After adjusting the intake and exhaust valve clearance of the No. 1 cylinder, turn the crankshaft pulley clockwise by increments of 180° and bring the piston of each cylinder at the top dead center of its compression stroke.

   Repeat the procedures through step 4 to step 7 and adjust the No.3, No.4 and No.2 valve clearance.

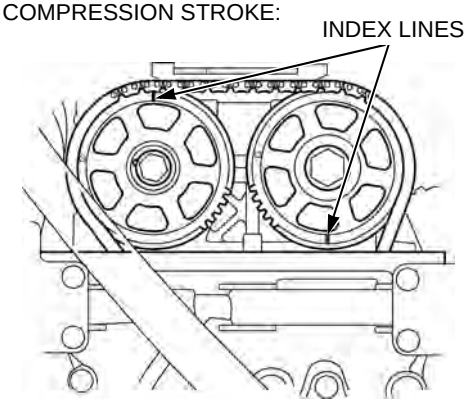
No.3 PISTON AT TOP DEAD CENTER OF COMPRESSION STROKE:



No.4 PISTON AT TOP DEAD CENTER OF COMPRESSION STROKE:



No.2 PISTON AT TOP DEAD CENTER OF COMPRESSION STROKE:

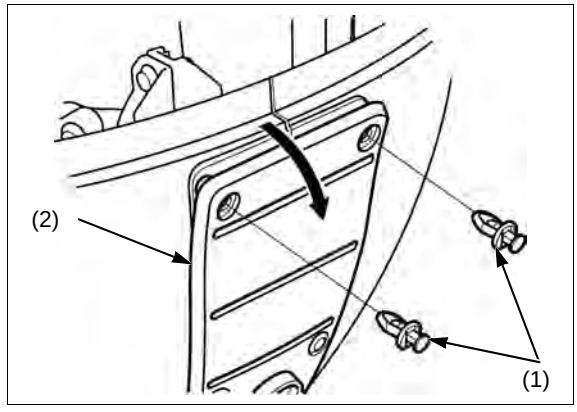


SPARK PLUG INSPECTION

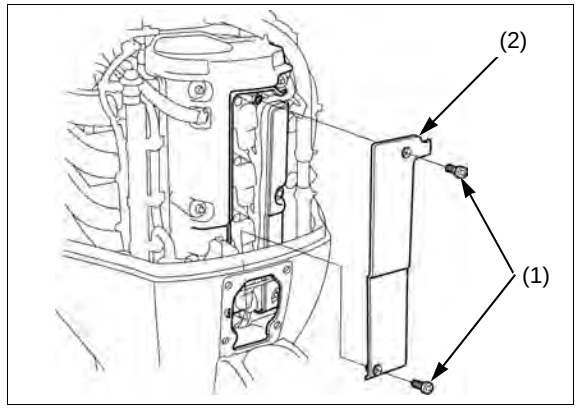
Remove the engine cover.

Remove the two mud guard clips (1) from the upper side of under cover grommet (2).

Detach the upper side of the under cover grommet.



Remove the two bolts (1) and plug hole coil cover (2).

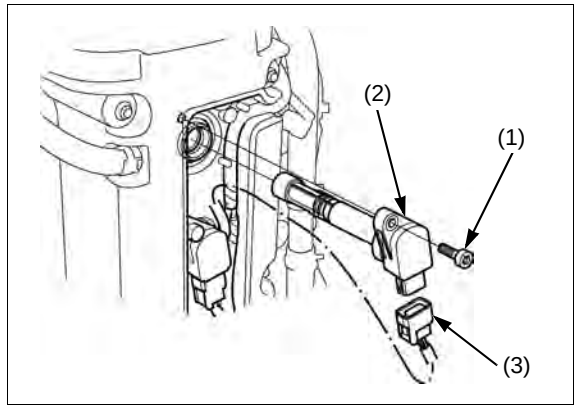


Remove the socket bolts (1) and pull out each ignition coil (2) from the corresponding spark plug.

Disconnect the ignition coil 3P connector (3) from the ignition coil.

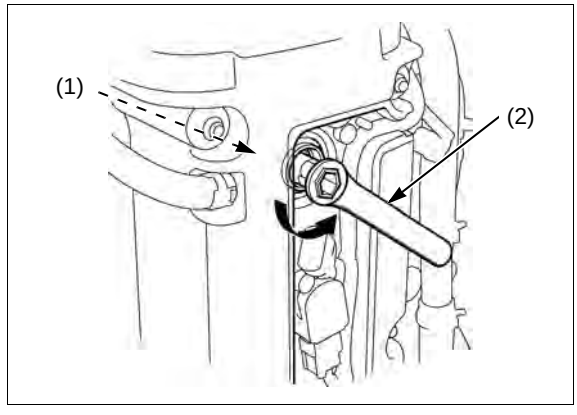
Remove the ignition coils.

- Take care not to drop the ignition coils. Do not reuse the ignition coil if dropped.



Remove the spark plugs (1) using a spark plug wrench (2).

- Before removing the spark plugs, clean any dirt or dust from around the spark plug bases to prevent foreign material from entering the engine.



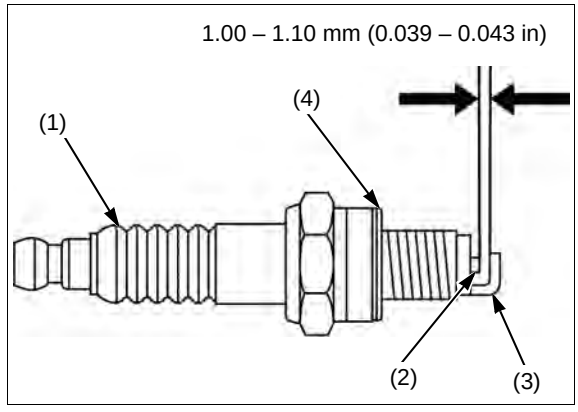
If the spark plug is dirty, clean the spark plug using a spark plug cleaner.

Visually inspect the spark plugs. Discard the plugs if the insulators (1) are cracked, chipped, or fouled.

Measure the plug gap between the center electrode (2) and side electrode (3) with a wire-type feeler gauge.

SPARK PLUG GAP:
1.00 – 1.10 mm (0.039 – 0.043 in)

RECOMMENDED SPARK PLUG:
ZFR6K-11 (NGK)
KJ20DR–M11 (DENSO)



Adjust the spark plug gap by bending the side electrode, if the gap is out of specification.

Make sure each sealing washer (4) is in good condition and replace the spark plug if necessary.
Thread the spark plugs in by hand to seat the sealing washers and prevent cross-threading.

NOTICE

A loose spark plug can become very hot and can damage the engine. Overtightening the spark plugs can damage the threads in the engine.

Tighten the spark plugs to the specified torque.

TORQUE: 18 N·m (1.8 kgf·m, 13 lbf·ft)

Install the ignition coils and tighten the socket bolts to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

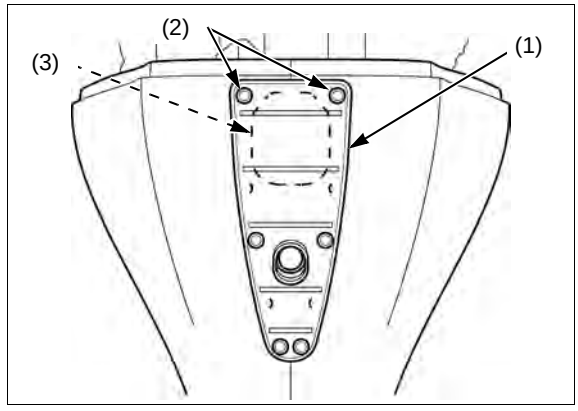
Connect the 3P connector to the ignition coil.

Install the plug hole coil cover and tighten the two bolts.

Attach the upper side of the under cover grommet (1) and install the two mud guard clips (2).

After installing the clips, make sure that the lip (3) behind the under cover grommet is securely installed on the L./R. engine under covers.

Install the engine cover.



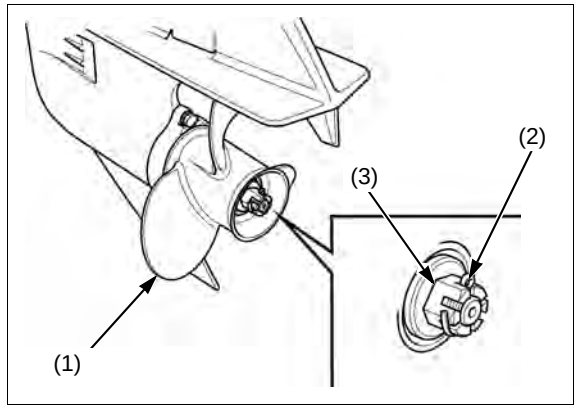
PROPELLER AND COTTER PIN INSPECTION

Check the propeller (1) for bending or damage and replace if necessary.

– Standard rotation type (page 16-6)
– Counter rotation type (page 17-6)

Make sure the split pin (2) ends are bent as shown to lock the nut (3) and replace if necessary.

– Standard rotation type (page 16-6)
– Counter rotation type (page 17-6)



ANODE METAL INSPECTION (OUTSIDE ENGINE)

GEAR CASE

Check the anode metal (1) for excessive wear or corrosion.
Replace the anode metal with a new one if it is corroded excessively:

– Standard rotation type (page 16-7)
– Counter rotation type (page 17-7)



Remove the trim tab.

– Standard rotation type (page 16-8)
– Counter rotation type (page 17-8)

Remove the corrosion as it prevents the continuity.

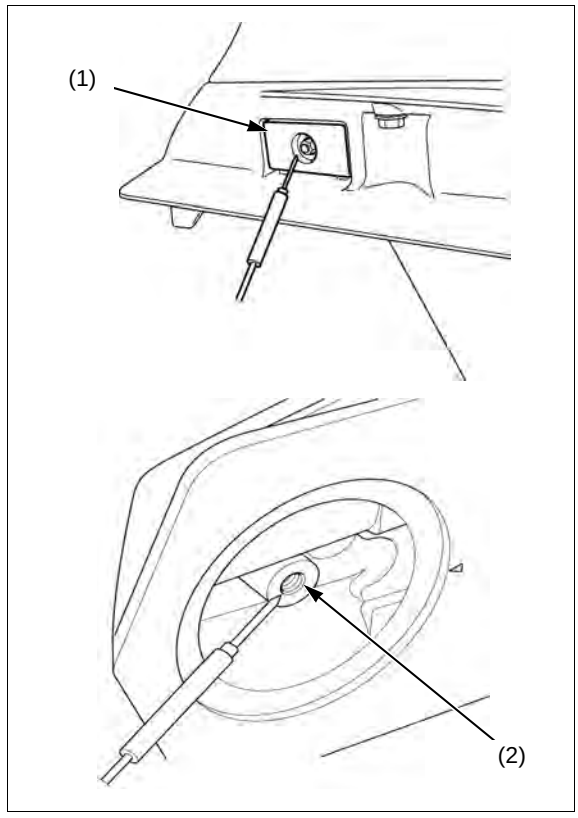
Perform continuity inspection between the anode metal (1) surface without corrosion and the bare aluminum surface of the gear case trim tab installation area (2).

If there is no continuity, remove the anode metal:

– Standard rotation type (page 16-7)
– Counter rotation type (page 17-7)

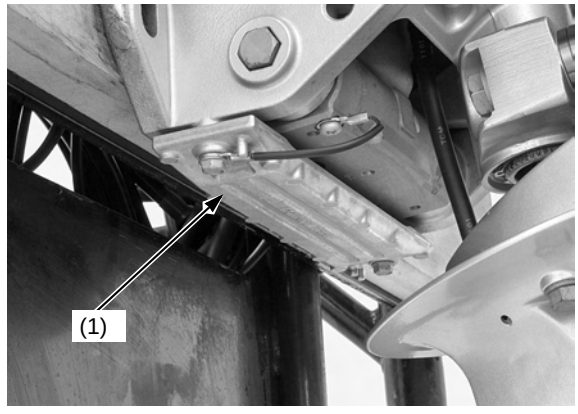
Remove the corrosion from the bolt, nut, anode metal, and anode metal installation surface.

Install the anode metal and recheck the continuity.
If there is no continuity, replace the anode metal with a new one and recheck.



STERN BRACKET

Check the anode metal (1) for excessive wear or corrosion.
Replace the anode metal with a new one if it is corroded excessively (page 19-4).



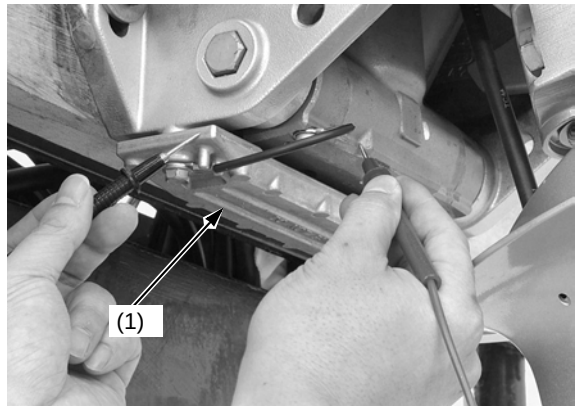
Check the continuity between the anode (1) and stern bracket or power trim/tilt.

Remove the corrosion as it prevents the continuity.

Perform continuity inspection between the anode metal surface without corrosion and bare aluminum surface of the stern bracket, or the power trim/tilt.

If there is no continuity, remove the anode metal (page 19-4) and remove the corrosion from the bolt, anode metal, and anode metal installation surface.

Install the anode metal (page 19-11) and recheck the continuity.
If there is no continuity, replace the anode metal with a new one and recheck.

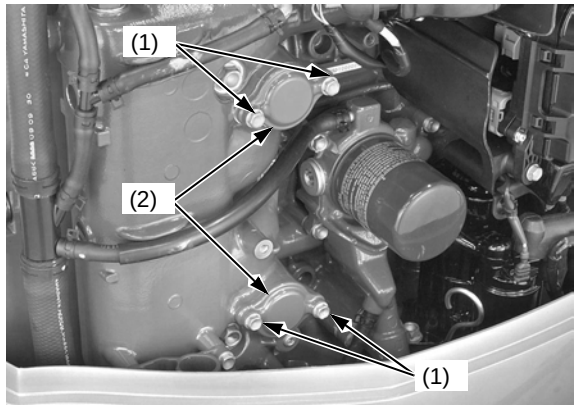


ANODE METAL INSPECTION (INSIDE ENGINE)

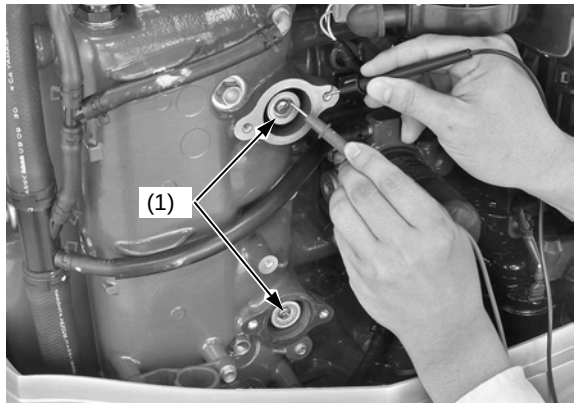
EXHAUST MANIFOLD

Remove the engine cover.

Remove the four bolts (1) and two exhaust manifold covers (2).



Check the anode metal (1) for excessive wear or corrosion and replace if necessary.



NOTICE

If the anode metal is worn to less than 2/3 of its original length, replace it with a new one.

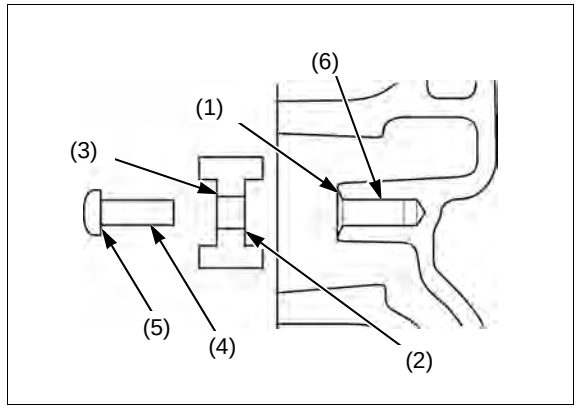
Check the continuity between the anode metal and exhaust manifold.

Remove the corrosion as it prevents the continuity.

Perform the continuity inspection between the anode metal surface without corrosion and the bare aluminum surface of the exhaust manifold.

If there is no continuity, remove the exhaust manifold anode metal (page 5-112) and remove the corrosion of the following parts using a sandpaper.

- Exhaust manifold (anode attaching area) (1)
- Anode metal (exhaust manifold attaching area) (2)
- Anode metal (screw head attaching area) (3)
- Screw (male screw area) (4)
- Screw (Anode metal attaching area) (5)



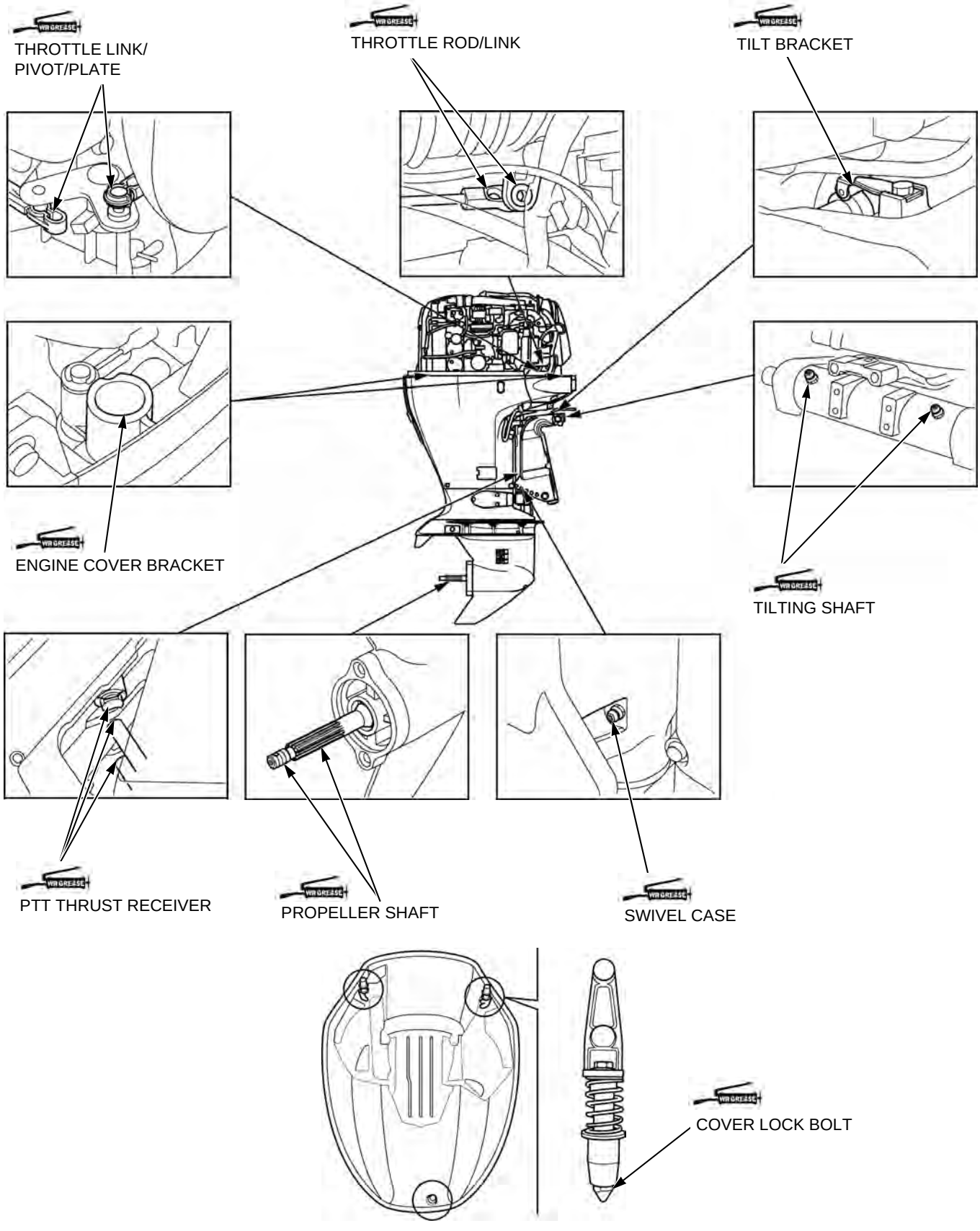
Clean the exhaust manifold (female nut area) (6) using a M6 x 1.0 tap.

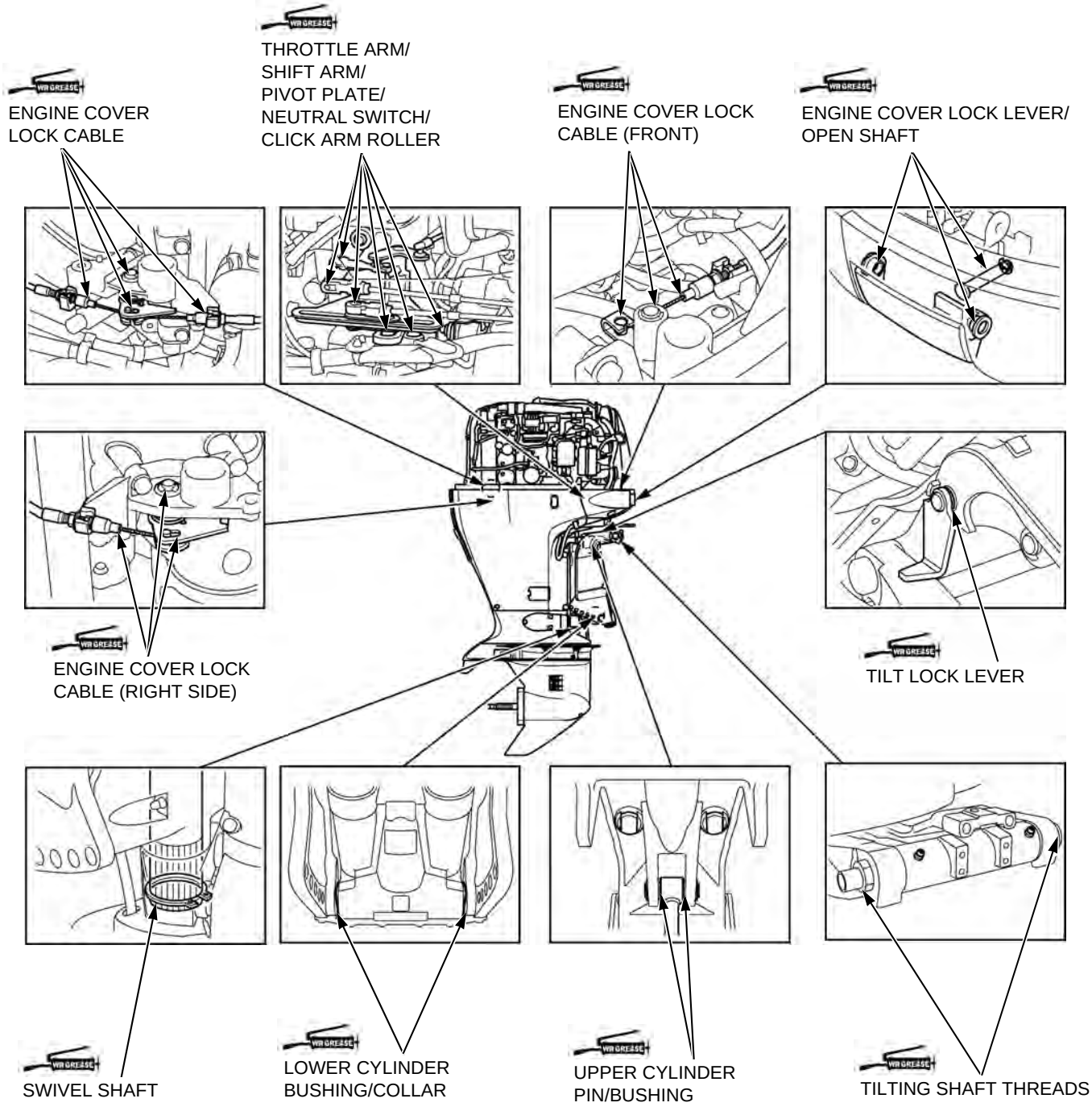
Install the anode metal (page 5-112) and recheck the continuity.
If there is no continuity, replace the anode metal with a new one and recheck.

Install the engine cover.

LUBRICATION

Apply marine grease to the following parts:



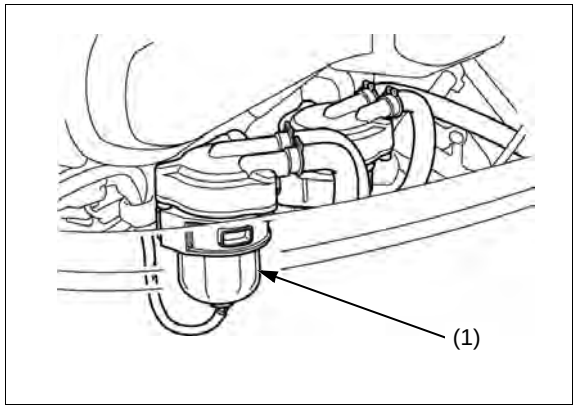

ENGINE COVER LOCK CABLE
THROTTLE ARM/ SHIFT ARM/ PIVOT PLATE/ NEUTRAL SWITCH/ CLICK ARM ROLLER
ENGINE COVER LOCK CABLE (FRONT)
ENGINE COVER LOCK LEVER/ OPEN SHAFT
ENGINE COVER LOCK CABLE (RIGHT SIDE)
TILT LOCK LEVER
SWIVEL SHAFT
LOWER CYLINDER BUSHING/COLLAR
UPPER CYLINDER PIN/BUSHING
TILTING SHAFT THREADS

WATER SEPARATOR INSPECTION

Remove the engine cover.

Check the water separator (1) for water accumulation or sediment. If water or sediment is found, or the water filled alert buzzer sounds, remove the water separator and perform the inspection (page 5-138).

Install the engine cover.



FUEL STRAINER (LOW PRESSURE SIDE) INSPECTION/REPLACEMENT

⚠ WARNING

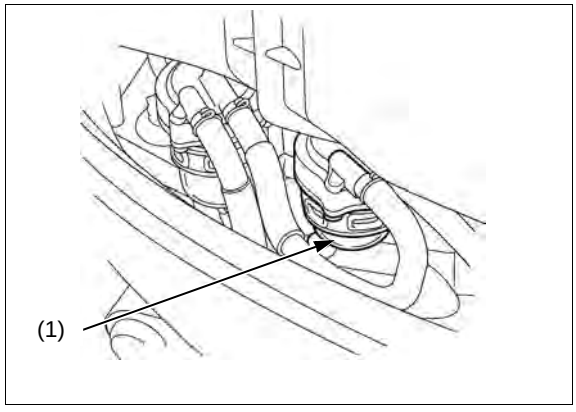
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- Keep heat, sparks, and flame away.
- Wipe up spills immediately.
- Handle fuel only outdoors.

INSPECTION

Remove the engine cover.

Visually check the fuel strainer (low pressure side) (1) for water or foreign material in the cup.
Check the fuel strainer for contamination.

If there is water or foreign material in the cup, disassemble and clean the cup.

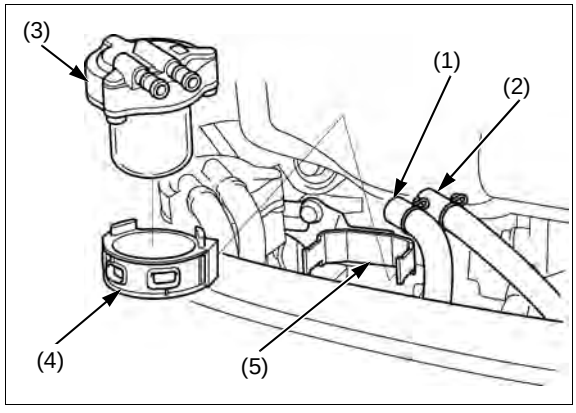


REPLACEMENT

Clamp fuel tubes C (1) and E (2) with commercially available hose clamps, and disconnect them from the fuel strainer (3).

Remove the fuel strainer with the suspension (4) from the strainer bracket (5).

Remove the fuel strainer from the suspension.

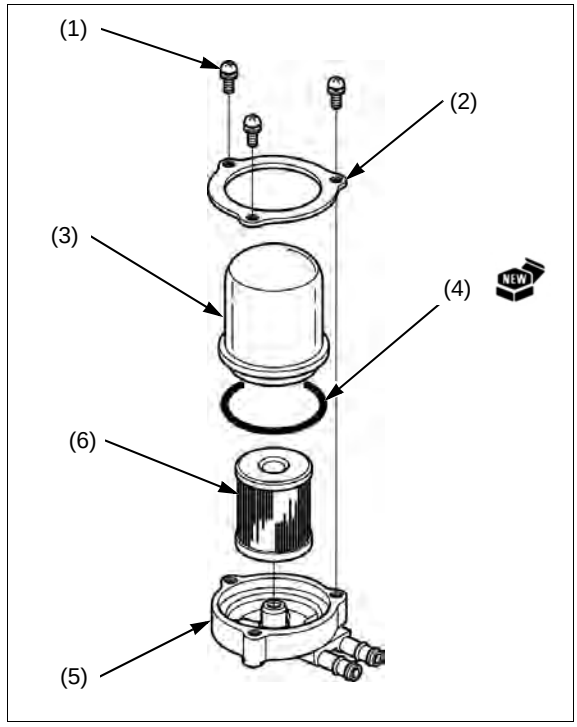


Remove the three screws (1), plate (2), strainer cup (3) and O-ring (4) from the strainer body (5).

Clean the water or sediment in the cup, and if necessary, replace the strainer (6).

Install a new O-ring.
Install the strainer body and plate to the strainer cup, then tighten the three screws to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

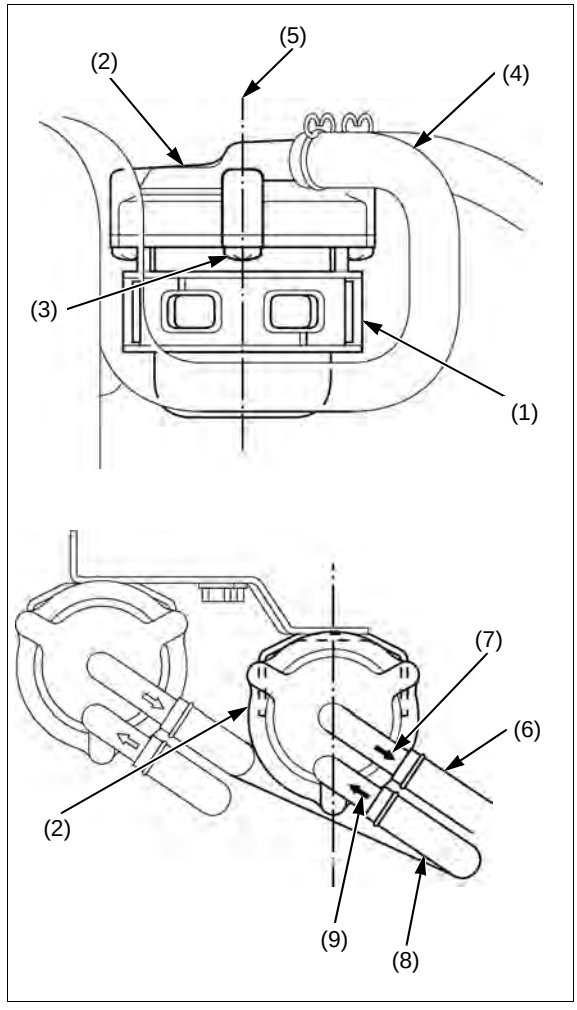


Install the suspension (1) on the fuel strainer (2).

Align the center of the screw (3) at the fuel tube C (4) side with the center line (5) of the suspension as shown.

Connect the fuel tube E (6) to the outlet mark (7) side of the fuel strainer and fuel tube C (8) to the inlet mark (9) side.

Install the engine cover.



FUEL STRAINER (HIGH PRESSURE SIDE) INSPECTION/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.
- Handle fuel only outdoors.

- Disconnect the battery cable from the battery negative (–) terminal before relieving the fuel pressure.
- Replace the sealing washer when the service check bolt is loosened or removed.
- Catch the gasoline draining from the strainer to avoid contaminating the engine parts with gasoline.

Replace the fuel strainer (high pressure side) at the replacement interval shown or in the following case.

– Regular replacement period of every 2 years or 400 operating hours.
– When the fuel pressure does not reach 270 – 320 kPa (2.8 – 3.3 kgf/cm^2, 40 – 47 psi) with the pressure regulator control tube disconnected from the pressure regulator, check the following. If the they are normal, replace the fuel strainer (high pressure side).
  – Fuel pump (High pressure side) (page 5-130)
  – Pressure regulator (page 5-129)

Remove the L. engine under cover (page 6-4).

Relieve the fuel pressure (page 5-79).

Place a rag or a shop towel over the strainer cover (1) and remove the three screws (2) and strainer cover.

Remove the packing (3), strainer (4) and spring (5).
Check for damage or contamination and replace if necessary.

Apply engine oil to a new O-ring (6) and install it to the strainer cover.

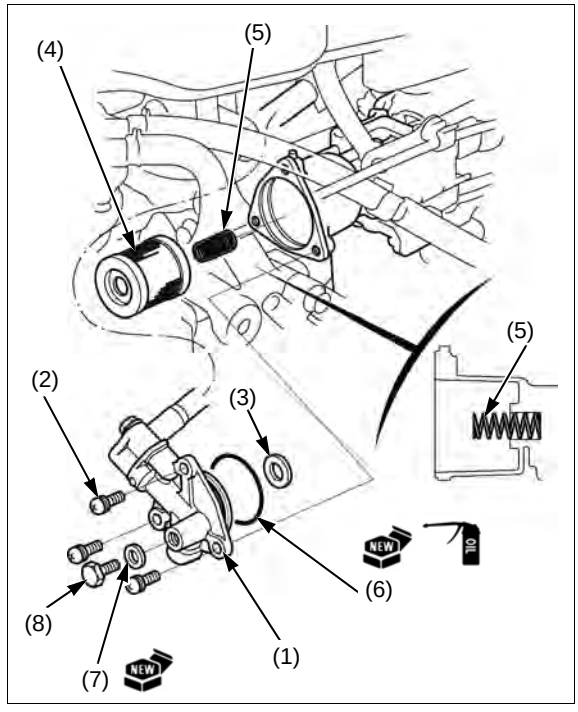
Install the packing, strainer and strainer cover, then tighten the three screws to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

Replace the sealing washer (7), and tighten the service check bolt (8) to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Install the removed parts in the reverse order of removal.



THERMOSTAT INSPECTION

Remove the thermostat and perform the inspection (page 11-15).

FUEL LINE INSPECTION/ 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.
- Handle fuel only outdoors.

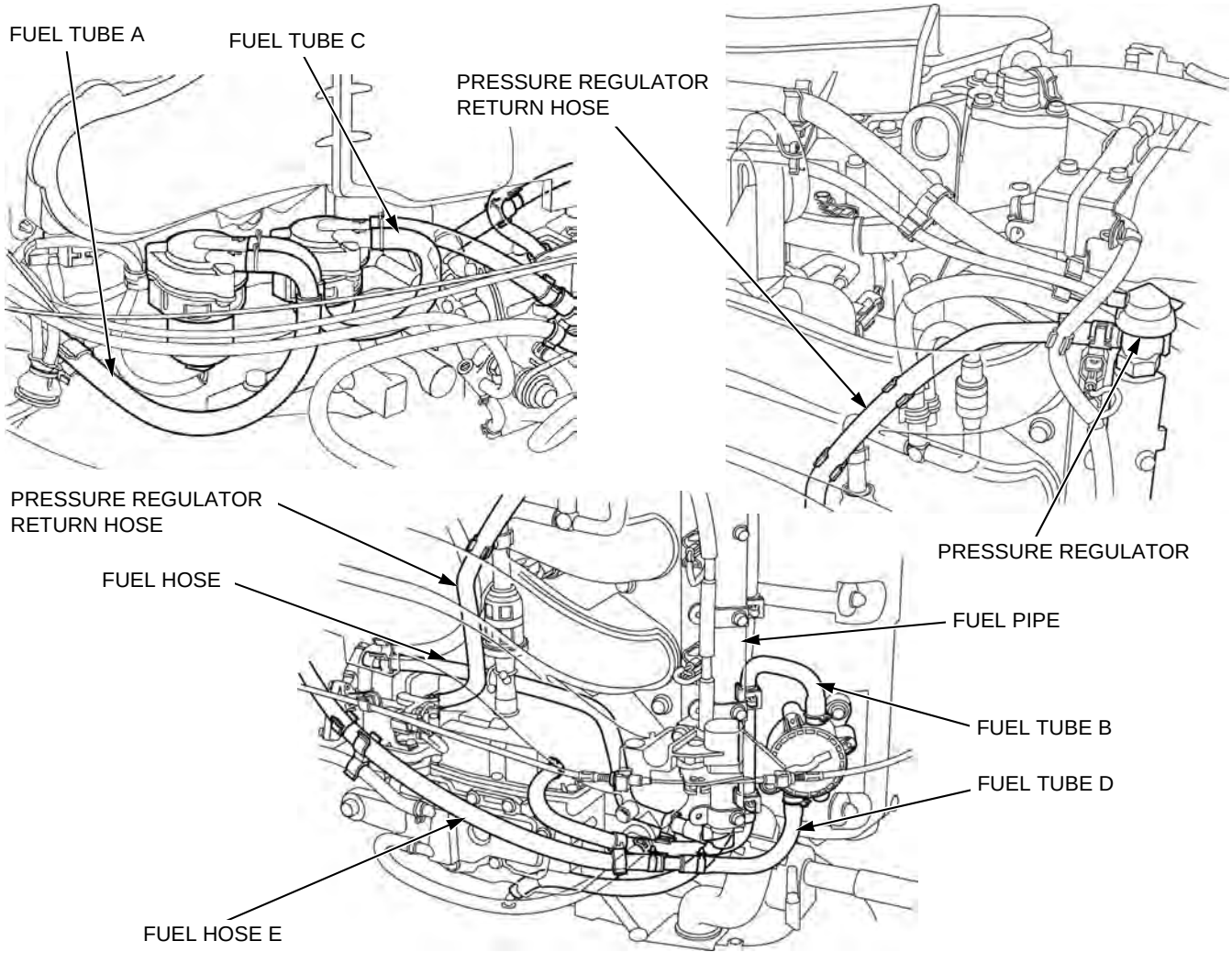
Check the fuel line, fuel hose and fuel tubes for damage, fuel leakage, corrosion, and other abnormalities. Check that the hoses and tubes are not interfering with the neighboring parts.

Turn the combination switch ON to operate the fuel pump (High pressure side) and check for fuel leakage.

Replace the hose or tube if there is damage, fuel leakage, corrosion, etc.

Replace the following fuel tube (or hose) as necessary:

– Water separator line (page 5-99)
– Fuel pump (Low pressure side) line (page 5-80)
– Fuel injector/pressure regulator line (page 5-91)
– Fuel pump (High pressure side) line (page 5-101)
– Vapor separator line (page 5-101)



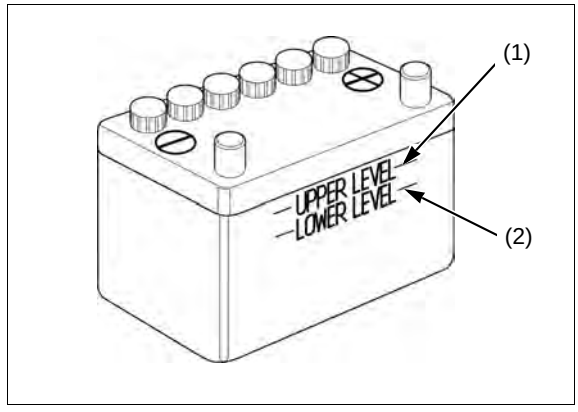
BATTERY AND CABLE CONNECTION

⚠WARNING

A battery can explode if you do not follow the proper procedure, causing serious injury to anyone nearby.
Follow all procedures carefully and keep sparks and open flames away from the battery.
The battery contains sulfuric acid (electrical) which is highly corrosive and poisonous.
Getting electrolyte in your eyes or on your skin can cause serious burns.
Wear protective clothing and eye protection when working on or a near battery.
Swallowing electrolyte can cause fatal poisoning if immediate action is not taken.

- Battery handling differs according to the type of battery. Refer to the battery manufacturer's instructions.

Check whether the battery fluid is between the upper (1) and lower levels (2), and check the vent hole in each battery cap for clogging.
If the battery fluid is near or below the lower level, add distilled water to the upper level.



Check that the battery cables are connected securely.
If the battery terminals are contaminated or corroded, remove the battery cables and clean the terminals.

⚠WARNING

Battery posts, terminals, and related accessories contain lead and lead compounds. Wash your hands after handling.

NUTS, BOLTS, FASTENERS

Check that all chassis nuts and bolts are tightened to their correct torque values (page 2-4).
Check that all safety clips, hose clamps and cable stays are in place and properly secured.

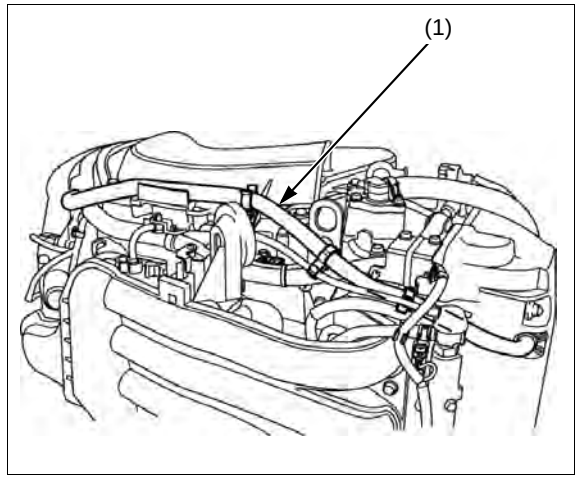
CRANKCASE BREATHER INSPECTION

Remove the engine cover.

Check if the crankcase breather tube (1) is bent or damaged.

Replace the crankcase breather tube if necessary.

Install the engine cover.

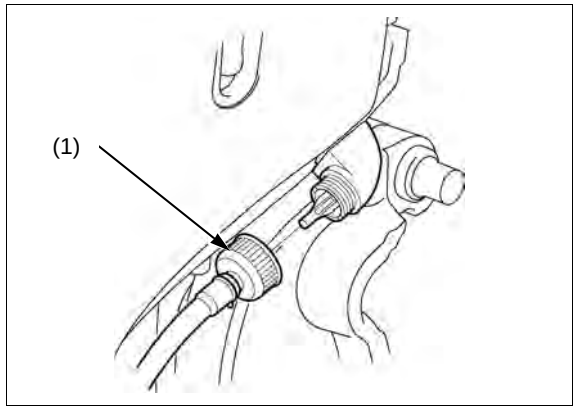


WATER PASSAGE CLEANING

NOTICE

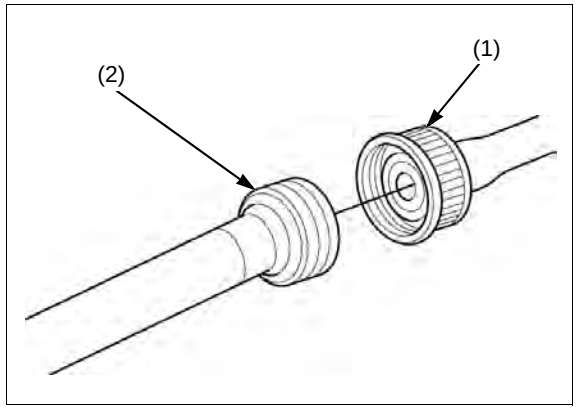
- *Do not run the motor when flushing with a garden hose or the motor may be damaged.*
- *For safety, remove the emergency stop switch clip so the engine cannot be started while you are standing near the propeller.*

Disconnect the flush plug cap (1).



Screw the flush plug cap (1) onto a commercially available garden hose (2).

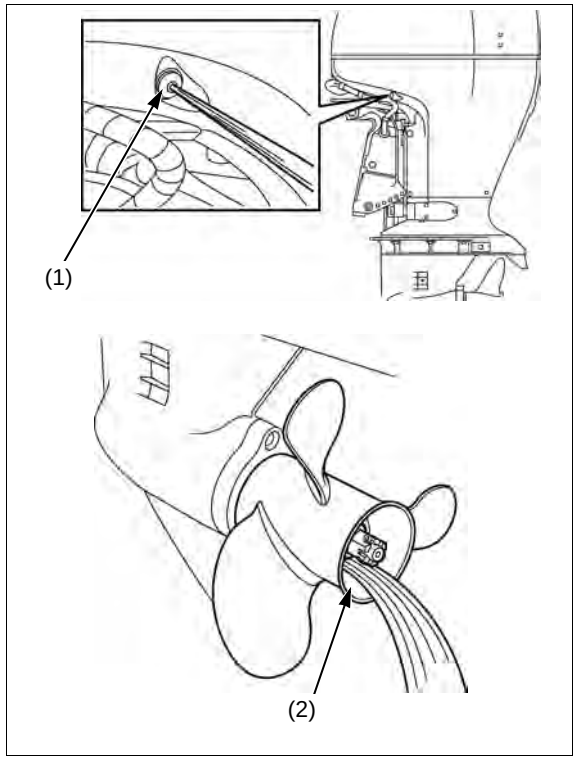
Turn on the fresh water supply.



Flush the outboard motor for at least 10 minutes.

Check that the water flows from the cooling system inspection hole (1) and drain hole (2).

After flushing, disconnect the garden hose and reconnect the flush plug cap.

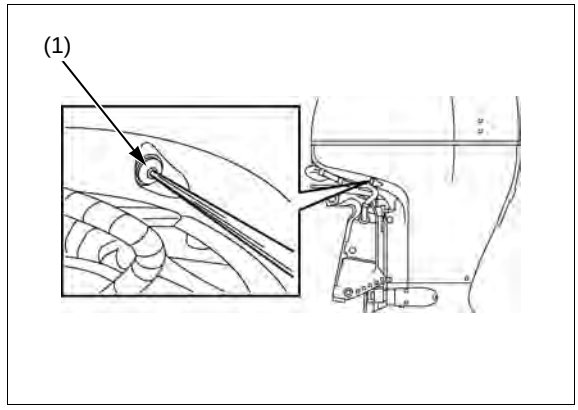


WATER PUMP INSPECTION

Place the outboard motor in a test tank or connect an external water supply to the water inlet.

Start the engine and idle the engine in neutral.
Water should flow from the cooling system inspection hole (1) while the engine is running.

If water does not flow while the engine is running, inspect the water pump (page 11-7).

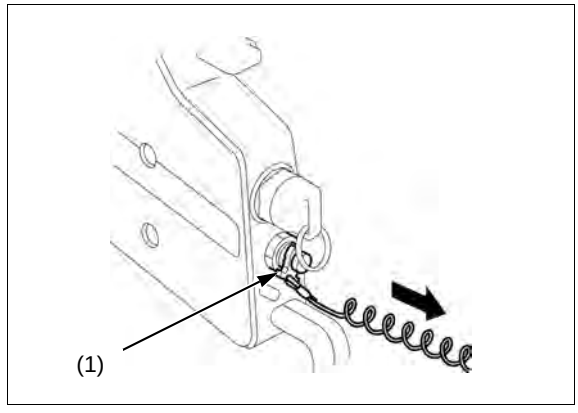


EMERGENCY STOP SWITCH INSPECTION

Make sure that the clip (1) is set at the emergency stop switch.

Start the engine and idle the engine in neutral.
The engine should stop when the clip is removed.

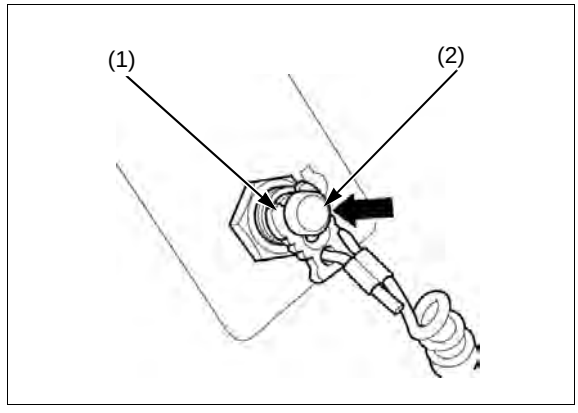
If there is a problem with the system, check the emergency stop switch.



Set the clip (1) to the emergency stop switch.

Start the engine and idle the engine in neutral.
The engine should stop when the engine stop switch (2) is pushed.

If there is a problem with the system, check the emergency stop switch.



ENGINE OIL LEAK INSPECTION

Remove the engine cover.

Check that the engine oil in not leaking from the following locations.

– Cylinder head cover/cylinder head mating surface
– Cylinder head/cylinder block mating surface
– Cylinder block/oil case mating surface
– Chain case installation surface
– Engine/mounting case mating surface
– Oil tube connection area

Install the engine cover.

EACH OPERATION PART INSPECTION

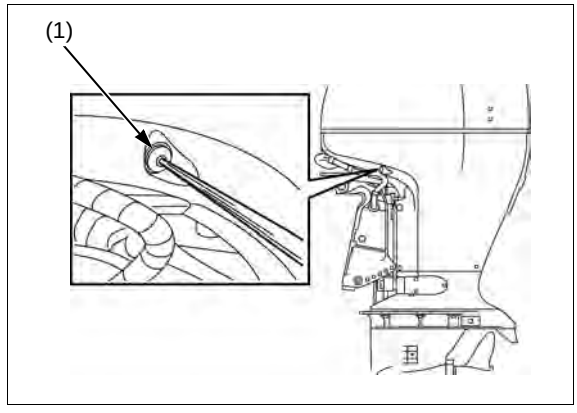
Check each component for proper operation.

– Check the steering component for smooth operation without excessive play when fully turned to right and left.
– Check the shift control cable/throttle control cable for smooth operation without excessive play.

ENGINE CONDITION INSPECTION

Start the engine and idle the engine in neutral.
Check the engine starting condition and engine sound.

Water should flow from the cooling system inspection hole (1) while the engine is running.



POWER TRIM/TILT INSPECTION

Set the swivel case to the uppermost position.

Make sure that the power trim/tilt has no ATF leaks.

If the ATF leaks, replace or repair the faulty part (s) (page 19-25).

MEMO

4. TROUBLESHOOTING

BEFORE TROUBLESHOOTING ····· 4-2

ENGINE TROUBLESHOOTING ····· 4-2

FUSE/ELECTRIC POWER LINE TROUBLESHOOTING ····· 4-13

ALERT SYSTEM/WARNING SYSTEM TROUBLESHOOTING ····· 4-17

FRAME TROUBLESHOOTING ····· 4-24

BEFORE TROUBLESHOOTING

- Use a known-good battery for troubleshooting.
- Check that the connectors are connected securely.
- Check for sufficient fresh fuel in the fuel tank.
- Check that the emergency stop switch clip is set securely.
- Read the circuit tester's operation instructions carefully, and observe the instructions during inspection.
- When a commercially available circuit tester is used for inspection, use the special tool [Tester probe (Male) 07ZAJ-RDJ110], and take care not to apply excessive force to the connector terminal.
- Switch the tester lead polarities to check the circuit, including a diode (see below). The circuit is normal if there is continuity in one direction but not the other. If there is continuity in both directions or in neither direction, the circuit is abnormal.
  – Indicator light
  – Regulator/rectifier
  – Power tilt relay
  – Fuse/relay junction box

ENGINE TROUBLESHOOTING

ENGINE DOES NOT START OR ENGINE STALLS

ENGINE DOES NOT START

1. Electrical power system inspection

Turn the combination switch ON.
Check that the MIL and warning buzzer sound.

Does the MIL come ON for 2 seconds and warning buzzer sound twice?

YES – GO TO STEP 2.

NO – Perform fuse/electrical power system troubleshooting (page 4-13).

2. Alert system inspection

Check the warning buzzer sound.

Does the warning buzzer sound twice and then keep sounding?

YES – Perform alert system/warning system troubleshooting (page 4-17).

NO – GO TO STEP 3.

3. Starting system inspection

Check that the starter motor operates properly.

Does the starter motor turn?

YES – GO TO STEP 4.

NO – Perform starting system troubleshooting (page 9-3).

4. Engine idle speed inspection

Adjust by turning the idle adjusting screw in or out.
Start the engine.

Does engine start?

YES – Improper idle adjusting screw adjustment. Adjust the idle speed (page 3-13).

NO – GO TO STEP 5.

5. Spark Plug Inspection

Remove and inspect spark plugs.

Is the spark plug wet?

YES –
- Incorrect spark plug heat range
- Incorrect spark plug gap
- Restriction or blockage between the silencer case and cylinder head
- Improper vapor separator float height

NO – GO TO STEP 6.

6. Spark Test

Perform the spark test with each ignition coil (page 8-4).

Is there normal spark?

YES – GO TO STEP 7.

NO – Perform ignition system troubleshooting (page 8-3).

7. Cylinder Compression

Check the cylinder compression (page 14-44).

Is the compression normal?

YES – GO TO STEP 8.

NO –
- Incorrect valve clearance
- Valve stuck open
- Cylinder/piston ring wear
- Blown cylinder head gasket
- Burned valve
- Incorrect cam chain tensioner adjustment

8. Vapor separator inspection

Loosen the vapor separator drain screw and check whether fuel flows out.

Does the fuel flow properly?

YES – GO TO STEP 9.

NO –
- Clogged, bent or damaged fuel tube
- Closed fuel tank vent knob
- Primer valve leak
- Faulty primer valve
- Clogged fuel strainer (Low pressure side)
- Clogged water separator
- Faulty fuel pump (Low pressure side)
- Clogged vapor separator air vent tube or filter
- Faulty vapor separator

9. Fuel Pump (High pressure side) Inspection

You should hear the pump hum when the combination switch is turned "ON".

Is the hum heard?

YES – GO TO STEP 10.

NO – Perform fuel pump (high pressure side) system inspection (page 5-130).

10. Fuel Flow Inspection

Inspect the fuel flow (page 5-130).

Is the fuel flow within specification?

YES – GO TO STEP 11.

NO –
- Clogged, bent or damaged fuel hose
- Clogged fuel strainer (High pressure side)
- Faulty fuel pump

11. Fuel injector inspection

Inspect the fuel injector (page 5-134).

Is the fuel injector normal?

YES – GO TO STEP 12.

NO –
- Repair the open or short circuit in the fuel injector wire
- Faulty fuel injector

12. IAC valve inspection

Inspect the IAC valve (page 5-138).

Is the IAC valve normal?

YES – Replace the ECM with a new one and recheck.

NO – Replace the IAC valve with a new one and recheck.

ENGINE STARTS BUT STALLS SOON

1. Alert system inspection

Turn the combination switch ON.
Check the warning buzzer sound.

Does the warning buzzer sound twice and then keep sounding?

YES – Perform alert system/warning system troubleshooting (page 4-17).

NO – GO TO STEP 2.

2. Engine idle speed inspection

Adjust by turning the idle adjusting screw in or out.
Start the engine.

Does engine stall?

YES – GO TO STEP 3.

NO – Improper idle adjusting screw adjustment. Adjust the idle speed (page 3-13).

3. Spark Plug Inspection

Remove and inspect spark plugs.

Is the spark plug wet?

YES –
- Incorrect spark plug heat range
- Incorrect spark plug gap
- Restriction or blockage between the silencer case and cylinder head
- Improper vapor separator float height

NO – GO TO STEP 4.

4. Spark Test

Perform the spark test with each ignition coil (page 8-4).

Is there normal spark?

YES – GO TO STEP 5.

NO – Perform ignition system troubleshooting (page 8-3).

5. Intake air leak inspection

Check for secondary air leak between the silencer case and cylinder head.

Is there an air leak?

YES –
- Loose IAC valve and/or throttle body mounting bolt
- Leaking or damaged throttle body and/or IAC valve gasket
- Loose IAT sensor
- Leaking or damaged IAT sensor O-ring
- Loose intake manifold and/or injector base mounting bolt
- Leaking or damaged intake manifold gasket
- Leaking or damaged injector base gasket
- Leaking or damaged fuel injector seal ring

NO – GO TO STEP 6.

6. Fuel Flow Inspection

Inspect the fuel flow (page 5-130).

Is the fuel flow within specification?

YES – GO TO STEP 7.

NO –
- Clogged, bent or damaged fuel tube
- Clogged fuel strainer (Low pressure side) (page 3-24)
- Clogged water separator (page 3-24)
- Faulty fuel pump (Low pressure side)
- Clogged vapor separator air vent tube or filter
- Faulty vapor separator (page 5-133)
- Clogged, bent or damaged fuel feed hose
- Clogged fuel strainer (High pressure side) (page 3-26)
- Faulty fuel pump (high pressure side)

7. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 8.

NO – Faulty pressure regulator

8. Fuel injector inspection

Inspect the fuel injector (page 5-134).

Is the fuel injector normal?

YES – GO TO STEP 9.

NO – • Repair the open or short circuit fuel injector wire
• Faulty fuel injector

9. IAC valve inspection

Replace the IAC valve with a new one and start the engine.

Does engine stall?

YES – Replace the ECM with a new one and recheck.

NO – Faulty original IAC valve

ENGINE SOMETIMES MISFIRES OR TENDS TO STALL

1. Spark Plug Inspection

Remove and inspect the spark plugs.

Is the spark plug wet?

YES – • Incorrect spark plug heat range
• Incorrect spark plug gap
• Restriction or blockage between the silencer case and cylinder head
• Improper vapor separator float height

NO – GO TO STEP 2.

2. Spark Test

Perform the spark test with each ignition coil (page 8-4).

Is there normal spark?

YES – GO TO STEP 3.

NO – Perform ignition system troubleshooting (page 8-3).

3. Fuel Flow Inspection

Inspect the fuel flow (page 5-130).

Is the fuel flow within specification?

YES – GO TO STEP 4.

NO – • Clogged, bent or damaged fuel tube
• Clogged fuel strainer (Low pressure side) (page 3-24)
• Clogged water separator (page 3-24)
• Faulty fuel pump (Low pressure side)
• Clogged vapor separator air vent tube or filter
• Faulty vapor separator (page 5-133)
• Clogged, bent or damaged fuel feed hose
• Clogged fuel strainer (High pressure side) (page 3-26)
• Faulty fuel pump (high pressure side)

4. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 5.

NO – Faulty pressure regulator

5. Fuel injector inspection

Inspect the fuel injector (page 5-134).

Is the fuel injector normal?

YES – GO TO STEP 6.

NO – • Repair the open or short circuit fuel injector wire
• Faulty fuel injector

6. IAC valve inspection

Replace the IAC valve with a new one and start the engine.

Does engine sometimes misfire or tend to stall?

YES – Replace the ECM with a new one and recheck.

NO – Faulty original IAC valve

ENGINE DOES NOT RUN SMOOTHLY

ENGINE IDLE SPEED IS HIGHER THAN SPECIFIED AFTER WARMING UP

1. Alert system inspection

Turn the combination switch ON.
Check the warning buzzer sound.

Does the warning buzzer sound twice and then keep sounding?

YES – Perform alert system/warning system troubleshooting (page 4-17).

NO – GO TO STEP 2.

2. Engine idle speed inspection

Adjust by turning the idle adjusting screw in or out (page 3-13).

Does the engine speed become normal?

YES – Improper original idle adjusting screw adjustment

NO – GO TO STEP 3.

3. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 4.

NO – Faulty pressure regulator

4. IAC valve inspection

Replace the IAC valve with a new one and start the engine.

Is the engine idle speed normal?

YES – Faulty original IAC valve

NO – Replace the ECM with a new one and recheck.

TROLLING SPEED IS HIGHER THAN SPECIFIED AFTER WARMING UP

1. Alert system inspection

Turn the combination switch ON.
Check the warning buzzer sound.

Does the warning buzzer sound twice and then keep sounding?

YES – Perform alert system/warning system troubleshooting (page 4-17).

NO – GO TO STEP 2.

2. Engine idle speed inspection

Adjust by turning the idle adjusting screw in or out (page 3-13).

Does the trolling speed become normal?

YES – Improper original idle adjusting screw adjustment

NO – GO TO STEP 3.

3. Neutral switch inspection

Inspect the neutral switch (page 10-19).

Is the neutral switch normal?

YES – GO TO STEP 4.

NO – Replace the neutral switch with a new one and recheck.

4. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 5.

NO – Faulty pressure regulator

5. IAC valve inspection

Replace the IAC valve with a new one and start the engine.
Warm up the engine and check the trolling speed.

Is the engine trolling speed normal?

YES – Faulty original IAC valve

NO – Replace the ECM with a new one and recheck.

TROLLING SPEED IS LOWER THAN SPECIFIED AFTER WARMING UP

1. Alert system inspection

Turn the combination switch ON.
Check the warning buzzer sound.

Does the warning buzzer sound twice and then keep sounding?

YES – Perform alert system/warning system troubleshooting (page 4-17).

NO – GO TO STEP 2.

2. Engine idle speed inspection

Adjust by turning the idle adjusting screw in or out (page 3-13).

Does the engine speed and/trolling speed become normal?

YES – Improper original idle adjusting screw adjustment

NO – GO TO STEP 3.

3. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 4.

NO – Faulty pressure regulator

4. IAC valve inspection

Replace the IAC valve with a new one and start the engine.
Warm up the engine and check the trolling speed.

Is the engine trolling speed normal?

YES – Faulty original IAC valve

NO – Replace the ECM with a new one and recheck.

ENGINE SPEED IS UNSTABLE DURING IDLE AND TROLLING

1. Alert system inspection

Turn the combination switch ON.
Check the warning buzzer sound.

Does the warning buzzer sound twice and then keep sounding?

YES – Perform alert system/warning system troubleshooting (page 4-17).

NO – GO TO STEP 2.

2. Engine idle speed inspection

Adjust by turning the idle adjusting screw in or out (page 3-13).

Does the engine speed and/trolling speed become normal?

YES – Improper original idle adjusting screw adjustment

NO – GO TO STEP 3.

3. Spark Test

Perform the spark test with each ignition coil (page 8-4).

Is there normal spark?

YES – GO TO STEP 4.

NO – Perform ignition system troubleshooting (page 8-3).

4. Spark Plug Inspection

Remove and inspect the spark plugs.

Is the spark plug wet?

YES –
- Incorrect spark plug heat range
- Incorrect spark plug gap
- Restriction or blockage between the silencer case and cylinder head
- Improper vapor separator float height

NO – GO TO STEP 5.

5. Fuel Flow Inspection

Inspect the fuel flow (page 5-130).

Is the fuel flow within specification?

YES – GO TO STEP 6.

NO –
- Clogged, bent or damaged fuel tube
- Clogged fuel strainer (Low pressure side) (page 3-24)
- Clogged water separator (page 3-24)
- Faulty fuel pump (Low pressure side)
- Clogged vapor separator air vent tube or filter
- Faulty vapor separator (page 5-133)
- Clogged, bent or damaged fuel feed hose
- Clogged fuel strainer (High pressure side) (page 3-26)
- Faulty fuel pump (high pressure side)

6. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 7.

NO – Faulty pressure regulator

7. Neutral switch inspection

Inspect the neutral switch (page 10-19).

Is the neutral switch normal?

YES – GO TO STEP 8.

NO – Replace the neutral switch with a new one and recheck.

8. Fuel injector inspection

Inspect the fuel injector (page 5-134).

Is the fuel injector normal?

YES – GO TO STEP 9.

NO – • Repair the open or short circuit fuel injector wire
• Faulty fuel injector

9. IAC valve inspection

Replace the IAC valve with a new one and start the engine.

Is the engine idle/trolling speed normal?

YES – Faulty original IAC valve

NO – Replace the ECM with a new one and recheck.

ENGINE SPEED DOES NOT INCREASE

1. Throttle link/ control cable inspection

Inspect the throttle link/control cables (page 3-9).

Is the adjustment correct?

YES – GO TO STEP 2.

NO – Improper throttle cable adjustment (page 3-9).

2. Propeller inspection

Match the propeller.

Is the propeller correct?

YES – GO TO STEP 3.

NO – Propeller mismatched

3. Fuel Flow Inspection

Inspect the fuel flow (page 5-130).

Is the fuel flow within specification?

YES – GO TO STEP 4.

NO – • Clogged, bent or damaged fuel tube
• Clogged fuel strainer (Low pressure side) (page 3-24)
• Clogged water separator (page 3-24)
• Faulty fuel pump (Low pressure side)
• Clogged vapor separator air vent tube or filter
• Faulty vapor separator (page 5-133)
• Clogged, bent or damaged fuel feed hose
• Clogged fuel strainer (High pressure side) (page 3-26)
• Faulty fuel pump (high pressure side)

4. Pressure regulator inspection

Check the fuel pressure and record it (page 5-129).

Disconnect the pressure regulator control tube.
Check the fuel pressure.

Is the fuel pressure higher with the control tube disconnected?

YES – GO TO STEP 5.

NO – Faulty pressure regulator

5. Valve clearance inspection

Inspect the valve clearance (page 3-15).

Is the valve clearance correct?

YES – GO TO STEP 6.

NO – Improper valve clearance adjustment (page 3-15).

6. Fuel injector inspection

Inspect the fuel injector (page 5-134).

Is the fuel injector normal?

YES – Replace the ECM with a new one and recheck.

NO – • Repair the open or short circuit fuel injector wire
• Faulty fuel injector

ENGINE SPEED DOES NOT STABILIZE WHEN RUNNING AT HIGH SPEED AND ENGINE SPEED IS NOT AS HIGH AS IT USED TO BE WHEN RUNNING WITH THE THROTTLE FULLY OPEN

1. Throttle link/ control cable inspection

Inspect the throttle link/control cables (page 3-9).

Is the adjustment correct?

YES – GO TO STEP 2.

NO – Improper throttle cable adjustment (page 3-9).

2. Fuel Flow Inspection

Inspect the fuel flow (page 5-130).

Is the fuel flow within specification?

YES – GO TO STEP 3.

NO – • Clogged, bent or damaged fuel tube
• Clogged fuel strainer (Low pressure side) (page 3-24)
• Clogged water separator (page 3-24)
• Faulty fuel pump (Low pressure side)
• Clogged vapor separator air vent tube or filter
• Faulty vapor separator (page 5-133)
• Clogged, bent or damaged fuel feed hose
• Clogged fuel strainer (High pressure side) (page 3-26)
• Faulty fuel pump (high pressure side)

3. Fuel inspection

Check to see if the fuel deteriorated or contaminated.

Is the fuel deteriorated or contaminated?

YES – Refuel with fresh fuel with the correct octane rating.

NO – GO TO STEP 4.

4. Intake air system inspection

Check for restriction or blockage of the air intake system.

Is the intake airway restricted?

YES – Clear the restriction.

NO – GO TO STEP 5.

5. Cylinder Compression

Check the cylinder compression (page 14-44).

Is the compression normal?

YES – Replace the ECM with a new one and recheck.

NO – GO TO STEP 6.

6. Valve clearance inspection

Inspect the valve clearance (page 3-15).

Is the valve clearance correct?

YES – Perform a leak down test before removing components.

NO – Incorrect valve clearance adjustment

ENGINE SPEED INCREASES EXCESSIVELY

1. Propeller inspection

Check the propeller for bend or damage.

Is the propeller normal?

YES – GO TO STEP 2.

NO – • Propeller mismatched
• Faulty propeller

2. Outboard motor installation inspection

Inspect the outboard motor installation (Transom height/tilt angle).

Is the outboard motor installed correctly?

NO – Faulty outboard motor installation.

ENGINE SPEED DOES NOT DECREASE

1. Throttle link/ control cable inspection

Inspect the throttle link/control cables (page 3-9).

Is the adjustment correct?

YES – GO TO STEP 2.

NO – Improper throttle cable adjustment (page 3-9).

2. Throttle body inspection

Check the throttle shaft of the throttle body.

Does the throttle shaft move smoothly?

YES – GO TO STEP 3.

NO – Check the throttle body and clean it (page 5-136).

3. Engine idle speed inspection

Adjust by turning the idle adjusting screw (page 3-13).

Does the engine speed decrease?

YES – Improper original idle adjusting screw adjustment.

NO – GO TO STEP 4.

4. Intake air leak inspection

Check for secondary air leak between the silencer case and cylinder head.

Is there an air leak?

YES – • Loose IAC valve and/or throttle body mounting bolt
• Leaking or damaged throttle body and/or IAC valve gasket
• Loose IAT sensor
• Leaking or damaged IAT sensor O-ring
• Loose intake manifold and/or injector base mounting bolt
• Leaking or damaged intake manifold gasket
• Leaking or damaged injector base gasket
• Leaking or damaged fuel injector seal ring

NO – GO TO STEP 5.

5. IAC valve inspection

Replace the IAC valve with a new one and start the engine.

Is the engine idle/trolling speed normal?

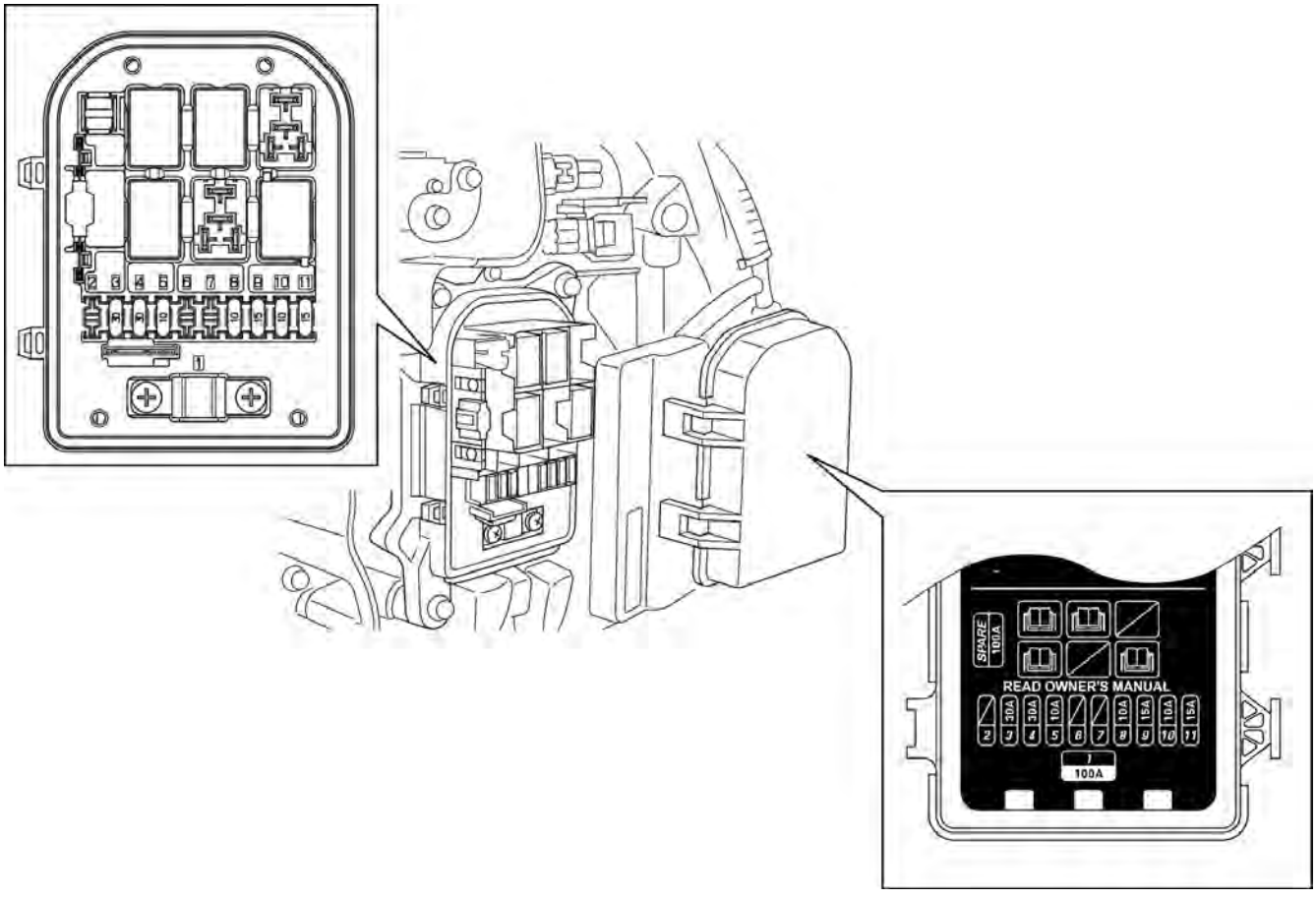
YES – Faulty original IAC valve

NO – Replace the ECM with a new one and recheck.

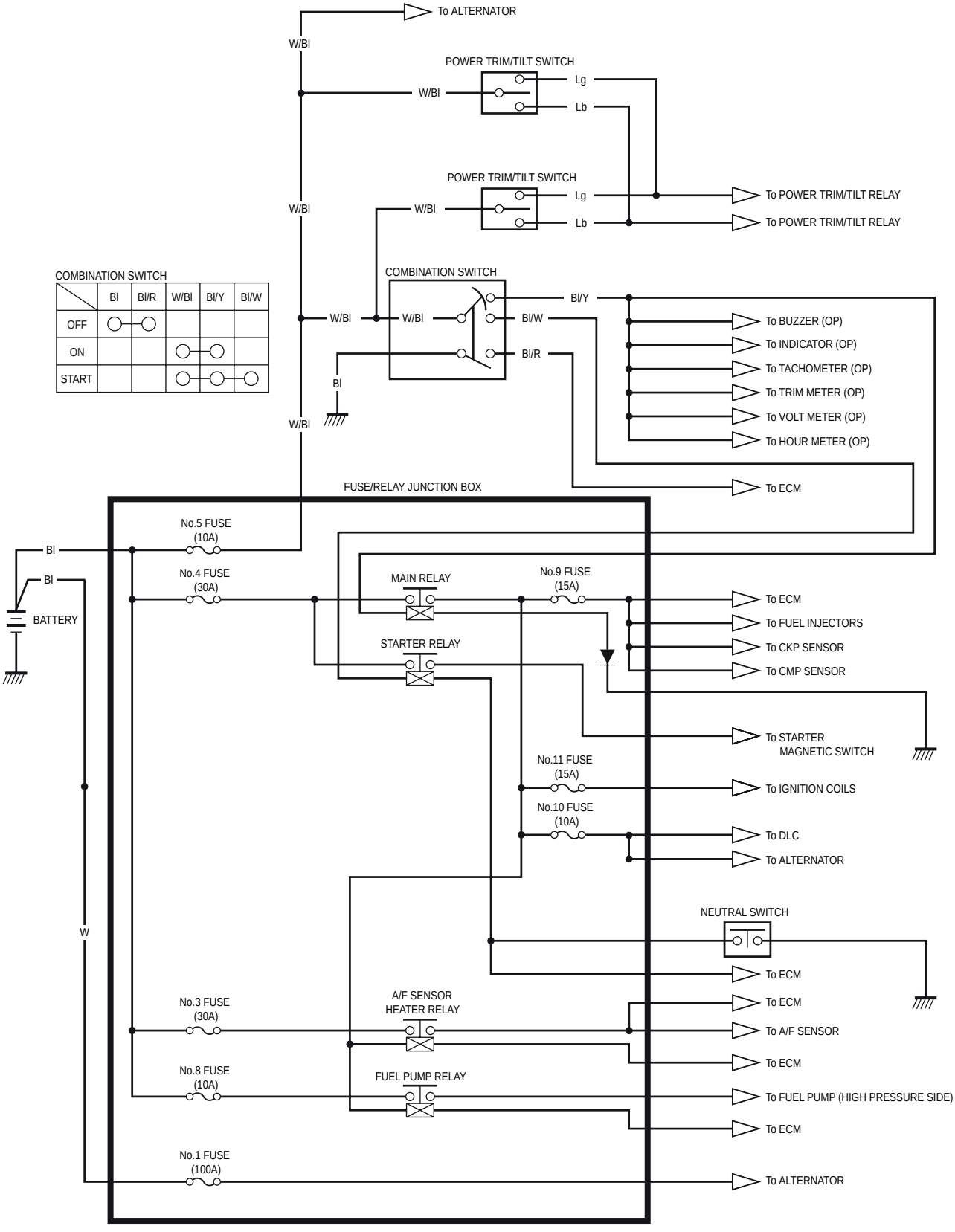
FUSE/ELECTRIC POWER LINE TROUBLESHOOTING

FUSE BOX CONNECTION TABLE

Fuse No.	Amps.	Component (s) or Circuit (s) Protected
1	100 A	Alternator (Charging terminal)
3	30 A	A/F sensor heater relay
4	30 A	ECM (Power supply), Fuel injectors, CKP sensor, CMP sensor, Alternator, DLC, Direct ignition coils, Main relay, Starter relay, A/F sensor heater relay, Fuel pump relay
5	10 A	Alternator, Power trim/tilt switch, Combination switch, Main relay, Starter relay, Warning buzzer, Oil indicator light, Overheat indicator light, MIL, Alternator indicator light
8	10 A	Fuel pump (High pressure side)
9	15 A	ECM (Power supply), Fuel injectors, CKP sensor, CMP sensor
10	10 A	Alternator, DLC
11	15 A	Direct ignition coils



FUSE LOAD CHART



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

MIL AND WARNING BUZZER DOES NOT OPERATE

1. Fuse inspection

Turn the combination switch OFF.

Check for blown No.4, No.5, and No.9 fuses.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 2.

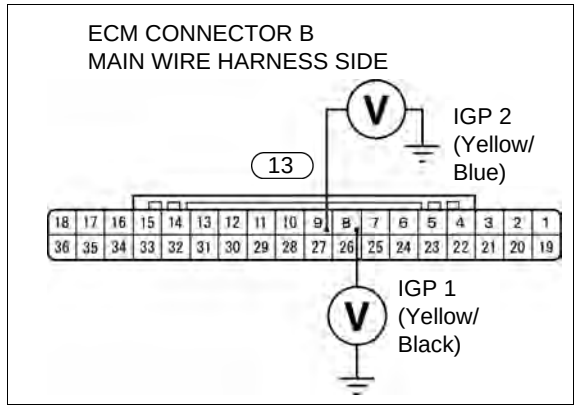
2. ECM power line inspection

Install the No.4, No.5 and No.9 fuses in the fuse/relay junction box.

Disconnect ECM connector B (13).

Turn the combination switch ON.
Measure the voltage between the main wire harness side No.8 (Yellow/Black) terminal of ECM connector B (13) and engine ground.

Measure the voltage between the main wire harness side No.9 (Yellow/Blue) terminal of ECM connector B (13) and engine ground.



Does battery voltage present?

YES – GO TO STEP 3.

NO – GO TO STEP 4.

3. ECM ground line inspection

Turn the combination switch OFF.

Disconnect the ECM connector A (12).

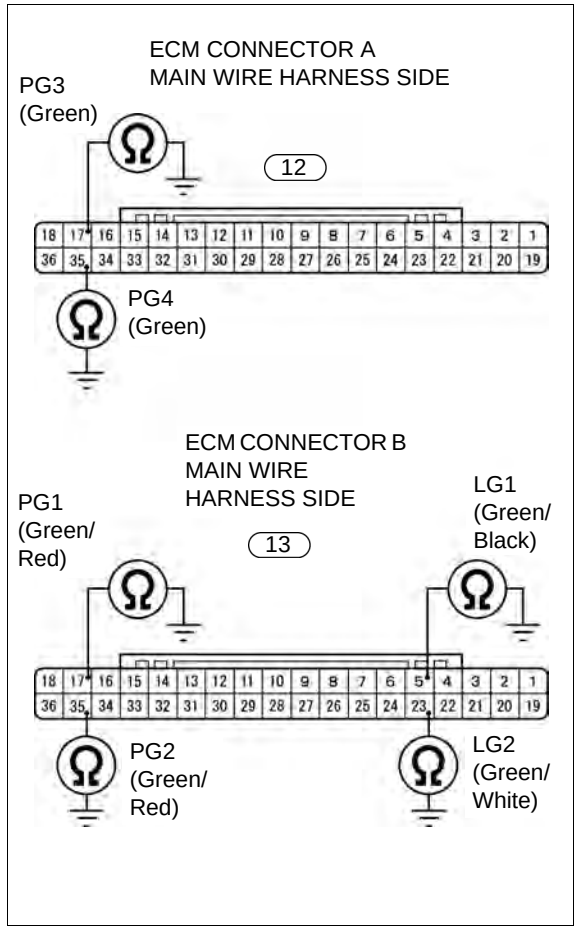
Check for continuity between the ECM connector A (12) main wire harness side No.17 (Green) terminal, No.35 (Green) terminal and engine ground.

Check for continuity between the ECM connector B (13) main wire harness side No.5 (Green/Black) terminal, No.17 (Green/Red) terminal, No.23 (Green/White) terminal, No.35 (Green/Red) terminal and engine ground.

Is there continuity?

YES – Replace the ECM with a new one and recheck.

NO – Repair open in the wire harness between the ECM and engine ground.



4. Main relay inspection

Inspect the main relay (page 10-13).

Is the main relay normal?

YES – GO TO STEP 5.

NO – Replace the main relay with a new one and recheck.

5. Fuse/relay junction box inspection

Inspect the maine relay circuit into the fuse/relay junction box (page 10-16).

Is the fuse/relay junction box normal?

YES – Repair open in the main wire harness.

NO – Replace the fuse/relay junction box and recheck.

ALERT SYSTEM/WARNING SYSTEM TROUBLESHOOTING

- Perform the MIL initial check before starting the engine.
  The warning buzzer can sound when the starter motor speed is extremely low, but the alert system/warning system is normal if the buzzer stops sounding after starting the engine.
  When the warning buzzer keeps sounding after MIL initial check, refer to the following symptom chart and perform the necessary troubleshooting.
  If the symptom is not shown in the following symptom chart, perform a function test according to the following procedure:
  – FUNCTION TEST USING THE HDS (page 4-18)
  – FUNCTION TEST WITHOUT USING THE HDS (page 4-19)

SYMPTOM CHART

Condition	Indicator light				Warning buzzer
	Oil indicator light (Green)	Overheat indicator light (Red)	MIL (Red)	Alternator indicator light (Red)	
Combination switch ON (MIL initial check)	● (for 2 sec.)	● (for 2 sec.)	● (for 2 sec.)	●	Sounds twice
2 sec. after turning the combination switch ON	○	○	○	●	Stop
Normal operation	●	○	○	○	Stop
Low oil pressure (page 4-22)	○	○	○	○	Continuous sound
Overheat (page 4-21)	●	●	○	○	Continuous sound
MIL faulty (page 4-23)	● *1	○ *2	●	○	Intermittent sound (Long beep)
Abnormal charging (page 4-23)	●	○	○	●	Intermittent sound (Long beep)
Water inside water separator/fuel strainer (page 4-23)	●	○	○	○	Intermittent sound (Short beep)

● : ON ○ : OFF

When two or more problems occur at the same time, the warnings for both problems are indicated together.
The prolonged buzzer sound takes precedence over the short buzzer sound.
Example: When problems occur with overheat and abnormal charging at the same time, the oil indicator light and the alternator indicator light all come on, and the buzzer sounds continuously.
*1: The oil indicator light blinks when a problem with the EOP sensor or MAP sensor occurs at the same time as a MIL malfunction.
*2: The overheat indicator light blinks when a problem with the ECT sensor occurs at the same time as a MIL malfunction.

FUNCTION TEST USING THE HDS

1. Fuse inspection

Turn the combination switch OFF.

Check the No.10 fuse in the fuse/relay junction box.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 2.

2. Buzzer inspection

Turn the combination switch OFF and connect the HDS (page 5-7).

Test the warning buzzer using the HDS.

Does the buzzer sound?

YES – GO TO STEP 3.

NO –
- Inspect the warning buzzer.
- Inspect the combination switch.
- Repair the open or short circuit in the main wire harness.
- Replace the ECM with a new one and recheck.

3. Alternator indicator light inspection

Test the alternator indicator light using the HDS.

Does the alternator indicator light blink?

YES – GO TO STEP 4.

NO –
- Inspect the indicator light.
- Repair the open circuit in the main wire harness.
- Replace the ECM with a new one and recheck.

4. MIL inspection

Test the MIL using the HDS.

Does the MIL blink?

YES – GO TO STEP 5.

NO –
- Inspect the indicator light.
- Repair the open or short circuit in the main wire harness.
- Replace the ECM with a new one and recheck.

5. Overheat indicator light inspection

Test the overheat indicator light using the HDS.

Does the overheat indicator light blink?

YES – GO TO STEP 6.

NO –
- Inspect the indicator light.
- Repair the open or short circuit in the main wire harness.
- Replace the ECM with a new one and recheck.

6. Oil indicator light inspection

Test the oil indicator light using the HDS.

Does the oil indicator light blink?

YES – Indicator light/warning buzzer is normal.

NO –
- Inspect the indicator light.
- Repair the open or short circuit in the main wire harness.
- Replace the ECM with a new one and recheck.

FUNCTION TEST WITHOUT USING THE HDS

1. Fuse inspection

Turn the combination switch OFF.

Check the No.10 fuse in the fuse/relay junction box.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 2.

2. Indicator light/warning buzzer inspection

Turn the combination switch OFF.

Disconnect the ECM connector A (12) and ECM connector B (13).
Turn the combination switch ON.

Do the indicator lights and warning buzzer operate?

YES –
- Repair the short circuit in the main wire harness.
- Inspect the warning buzzer
- Inspect the indicator light(s)

NO – GO TO STEP 3.

3. Buzzer inspection

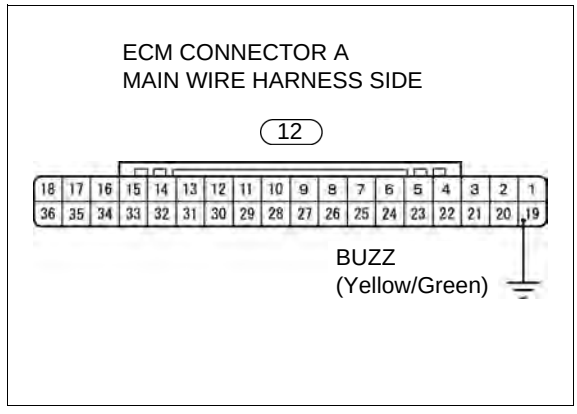
Turn the combination switch OFF.

Short the No.19 terminal (Yellow/Green) of the ECM connector A (12) main wire harness side connector to engine ground using a jumper wire.
Turn the combination switch ON.

Does the warning buzzer sound?

YES – GO TO STEP 4.

NO –
- Inspect the warning buzzer.
- Inspect the combination switch.
- Repair the open circuit in the main wire harness.
- Replace the ECM with a new one and recheck.



4. Alternator indicator light inspection

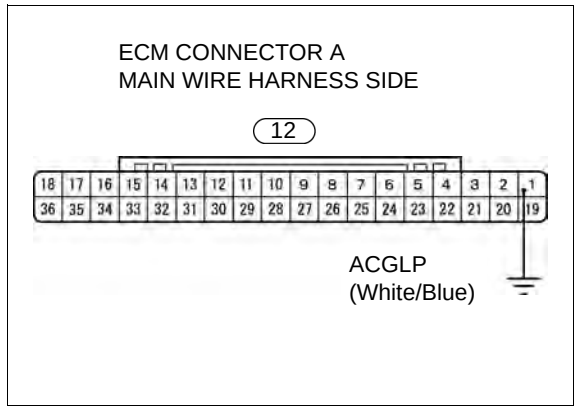
Turn the combination switch OFF.

Short the No.1 terminal (White/Blue) of the ECM connector A (12) main wire harness side connector to engine ground using a jumper wire.
Turn the combination switch ON.

Does the alternator indicator light come ON?

YES – GO TO STEP 5.

NO –
- Inspect the indicator light
- Repair the open circuit in the main wire harness
- Replace the ECM with a new one and recheck



5. MIL inspection

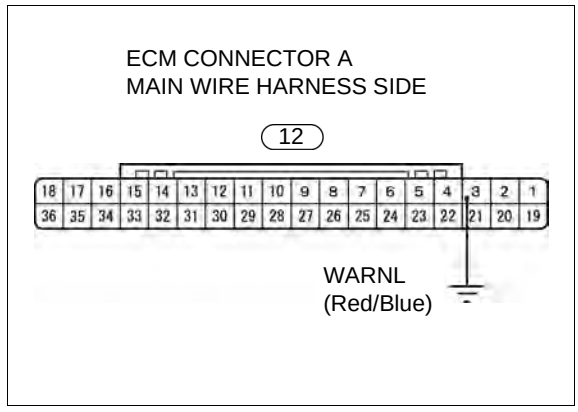
Turn the combination switch OFF.

Short the No.3 terminal (Red/Blue) of the ECM connector A (12) main wire harness side connector to engine ground using a jumper wire.
Turn the combination switch ON.

Does the MIL come ON?

YES – GO TO STEP 6.

NO – • Inspect the indicator light.
• Repair the open circuit in the main wire harness.
• Replace the ECM with a new one and recheck.



6. Overheat indicator light inspection

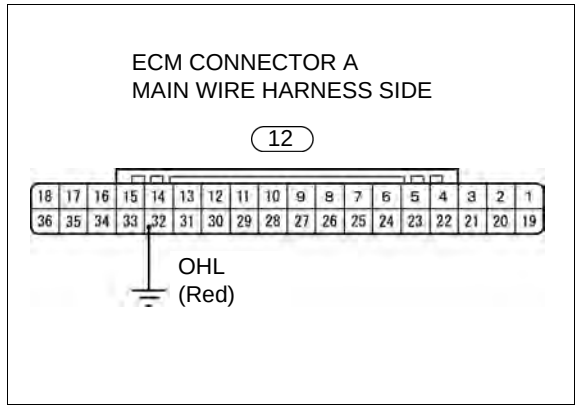
Turn the combination switch OFF.

Short the No.32 terminal (Red) of the ECM connector A (12) main wire harness side connector to engine ground using a jumper wire.
Turn the combination switch ON.

Does the overheat indicator light come ON?

YES – GO TO STEP 7.

NO – • Inspect the indicator light.
• Repair the open circuit in the main wire harness.
• Replace the ECM with a new one and recheck.



7. Oil indicator light inspection

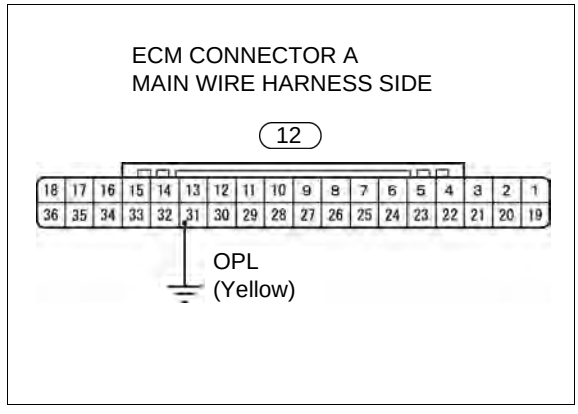
Turn the combination switch OFF.

Short the No.31 terminal (Yellow) of the ECM connector A (12) main wire harness side connector to engine ground using a jumper wire.
Turn the combination switch ON.

Does the oil indicator light go off?

YES – Indicator light/warning buzzer is normal.

NO – • Inspect the indicator light.
• Repair the open circuit in the main wire harness.
• Replace the ECM with a new one and recheck.



WARNING BUZZER SOUNDS CONTINUOUSLY

- The warning buzzer can sound when the starter motor speed is extremely low, but the alert system/warning system is normal if the buzzer stops sounding after starting the engine.

THE OVERHEAT INDICATOR LIGHT COMES ON OR BLINKS

1. **MIL inspection**

   Check to see if the MIL stays on.

   Does the MIL stay ON?

   YES – Perform PGM-FI troubleshooting (page 5-6).

   NO – GO TO STEP 2.

2. **Outboard motor installation inspection**

   Inspect the outboard motor installation (transom height/tilt angle).

   Is the outboard motor installation correct?

   YES – GO TO STEP 3.

   NO – Faulty outboard motor installation

3. **Water screen inspection**

   Stop the engine and check the water screen.

   Is it blocked with foreign material?

   YES – Remove the foreign material.

   NO – GO TO STEP 4.

4. **Cooling water inspection**

   Check the cooling water with the engine idling.

   Is the water flowing through the check port steadily?

   YES – GO TO STEP 5.

   NO –
   - Faulty water pump
   - Blocked or damaged water passage

5. **Engine cool down procedure**

   Put the outboard motor into gear for a few minutes and let the engine cool down at idle speed.

   Does the overheat indicator light go OFF and the buzzer stop sounding?

   YES – Temporary failure (disappears)

   NO – GO TO STEP 6.

6. **Thermostat inspection**

   Stop the engine and inspect the thermostat (page 11-15).

   Is the thermostat normal?

   YES – Replace the ECM with a new one and recheck.

   NO – Replace the thermostat with a new one and recheck.

THE OVERHEAT INDICATOR LIGHT GOES OFF AND OIL INDICATOR LIGHT GOES OFF OR BLINKS

1. MIL inspection

Check to see if the MIL stays on.

Does the MIL stay ON?

YES – Perform PGM-FI troubleshooting (page 5-6).

NO – GO TO STEP 2.

2. Oil level inspection

Stop the engine and check the oil level.

Is the oil level at the proper level?

YES – GO TO STEP 3.

NO – Adjust the oil level.

3. Oil indicator light inspection

Let the engine idle.
Check the oil indicator light and buzzer.

Does the oil indicator light come ON and warning buzzer stop sounding?

YES – Temporary failure (disappears)

NO – GO TO STEP 4.

4. Oil Pressure inspection

Turn the combination switch OFF.

Clear the DTC.
– Using the HDS (page 5-6)
– Without using the HDS (page 5-6)

Check the oil pressure (page 12-13).

Is the oil pressure within specification?

YES – Replace the ECM with a new one and recheck.

NO –
- Oil strainer is clogged.
- Faulty oil pump
- Oil passage is clogged.
- Oil filter cartridge is clogged.

THE OVERHEAT INDICATOR LIGHT GOES OFF AND OIL INDICATOR LIGHT COMES ON

1. Overheat indicator light and oil indicator light inspection

Inspect the overheat indicator light and oil indicator light.
– Using the HDS (page 4-18)
– Without using the HDS (page 4-19)

Are they normal?

YES – Replace the ECM with a new one and recheck.

NO – Replace or repair the faulty part.

WARNING BUZZER SOUNDS INTERMITTENTLY (LONG BEEP)

1. MIL inspection

Check to see if the MIL stays on.

Does the MIL stay ON?

YES – Perform PGM-FI troubleshooting (page 5-6).

NO – GO TO STEP 2.

2. Alternator indicator light inspection

Check to see if the alternator indicator light stays on.

Does the alternator indicator light stay ON?

YES – Perform charging system troubleshooting (page 7-4).

NO – Check the indicator light:
- Using the HDS (page 4-18)
- Without using the HDS (page 4-19)
- If indicator light is normal, replace the ECM with a new one and recheck

WARNING BUZZER SOUNDS INTERMITTENTLY (SHORT BEEP)

1. Water separator/fuel strainer (Low pressure side) inspection

Turn the combination switch OFF.
Check the water separator and fuel strainer (low pressure side).

Is there water in the cup?

YES – Remove the water and clean the cup of the water separator and fuel strainer.

NO – GO TO STEP 2.

2. Water level sensor inspection

Disconnect the water level sensor 2P connector (21) and turn the combination switch ON.

Does the warning buzzer sound the intermittent short term sound?

YES – Repair the shorted wire between ECM and water level sensor. If the wires are normal, replace the ECM with a new one and recheck.

NO – Inspect the water level sensor (page 5-138).

FRAME TROUBLESHOOTING

HARD TO SHIFT

1. Shift control cable inspection

Check the shift control cable for corrosion.

Is the control cable normal?

YES – GO TO STEP 2.

NO – Replace the shift control cable.

2. Shift control cable adjustment

Adjust the shift control cable (page 20-16).

Check the shift control lever of the remote control box for proper operation.

Does the remote control box operate properly?

YES – Improper cable adjustment

NO – GO TO STEP 3.

3. Shift link/link rod inspection

Check the following to see if they are bent or deformed.

– Shift link
– Shift link rod

Are they normal?

YES – GO TO STEP 4.

NO – Replace the faulty part (s).

4. Shift shaft/shift shaft gear inspection

Check shift shaft A and B to see if they are bent or deformed.
Check shift shaft A and B gear teeth for wear or damage.

Are they normal?

YES – GO TO STEP 5.

NO – Replace the faulty part (s).

5. Shift rod inspection

Check the shift rod to see if it is bent or damaged.

Is it normal?

YES – Gear case problem (clutch shifter and propeller shaft are corroded).

NO – Replace the shift rod with a new one and recheck.

POWER TRIM/TILT DOES NOT MOVE

1. Power trim/tilt motor inspection

Turn the combination switch ON.
Operate the power trim/tilt switch and check the power tilt motor sound.

Do you hear the motor sound?

YES – GO TO STEP 2.

NO – Perform "POWER TRIM/TILT MOTOR DOES NOT OPERATE" troubleshooting (page 4-26).

2. Manual valve inspection

Check the manual valve for looseness.

Is the manual valve loose?

YES – Tighten the manual valve to the specified torque: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

NO – GO TO STEP 3.

3. Oil leak inspection

Check for oil leakage from the power trim/tilt.

Is there oil leakage?

YES – Replace the O-ring and oil seal at the leaking point (when the manual valve O-ring or piston rod (cylinder cap) oil seal is leaking, replace it as an assembly).

NO – GO TO STEP 4.

4. Oil level inspection

Check the oil level with each rod fully extended (page 19-31).

Is the oil level within specification?

YES – GO TO STEP 5.

NO – Fill the oil to the specified level and recheck.

5. Air bleed inspection

Check for air in the system.

Is there air in the system?

YES – Bleed the air from the system (page 19-37).

NO – Faulty power trim/tilt
Repair the faulty part by referring to the "POWER TRIM/TILT QUICK REFERENCE CHART (page 4-27).

POWER TRIM/TILT DOES NOT HOLD POSITION

1. Manual valve inspection

Check the manual valve for looseness.

Is the manual valve loose?

YES – Tighten the manual valve to the specified torque: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

NO – GO TO STEP 2.

2. Oil leak inspection

Check for oil leakage from the power trim/tilt.

Is there oil leakage?

YES – Replace the O-ring and oil seal at the leaking point (when the manual valve O-ring or piston rod (cylinder cap) oil seal is leaking, replace it as an assembly).

NO – GO TO STEP 3.

3. Hydraulic pressure inspection

Check the hydraulic pressure (page 19-39).

Is the hydraulic pressure within the specification?

YES – GO TO STEP 4.

NO – Replace the motor or pump assembly and recheck.

4. Oil level inspection

Check the oil level with each rod fully extended (page 19-31).

Is the oil level within specification?

YES – GO TO STEP 5.

NO – Fill the oil to the specified level and recheck.

5. Air bleed inspection

Check for air in the system.

Is there air in the system?

YES – Bleed the air from the system (page 19-37).

NO – Faulty power trim/tilt
Repair the faulty part by referring to the "POWER TRIM/TILT QUICK REFERENCE CHART (page 4-27).

POWER TRIM/TILT MOTOR DOES NOT OPERATE

1. **Power trim/tilt motor inspection**

   Connect the battery to the power tilt motor and check whether the motor operates (page 19-48).

   Does the motor turn?

   YES – GO TO STEP 2.

   NO – GO TO STEP 4.

2. **Power tilt relay inspection**

   Check the power tilt relay (page 10-17).

   Is the power tilt relay normal?

   YES – GO TO STEP 3.

   NO – Replace the power tilt relay with a new one and recheck.

3. **Power tilt switch inspection**

   Check the power tilt switch (page 19-50).

   Is the power tilt switch normal?

   YES – Repair the open/short in the main wire harness.

   NO – Replace the power tilt switch with a new one and recheck.

4. **Power trim/tilt motor continuity inspection**

   Check for continuity at the motor (page 19-48).

   Is there continuity?

   YES – GO TO STEP 5.

   NO – Repair or replace the motor.

5. **Overheat inspection**

   Check the motor for overheating.

   Is the motor overheated?

   YES – Cool down the motor and recheck.

   NO – GO TO STEP 6.

6. **Breaker inspection**

   Check the breaker inside the motor (page 19-48).

   Is the breaker normal?

   YES – GO TO STEP 7.

   NO – Replace the breaker with a new one.

7. **Oil leak inspection**

   Check for oil leaking into the motor.

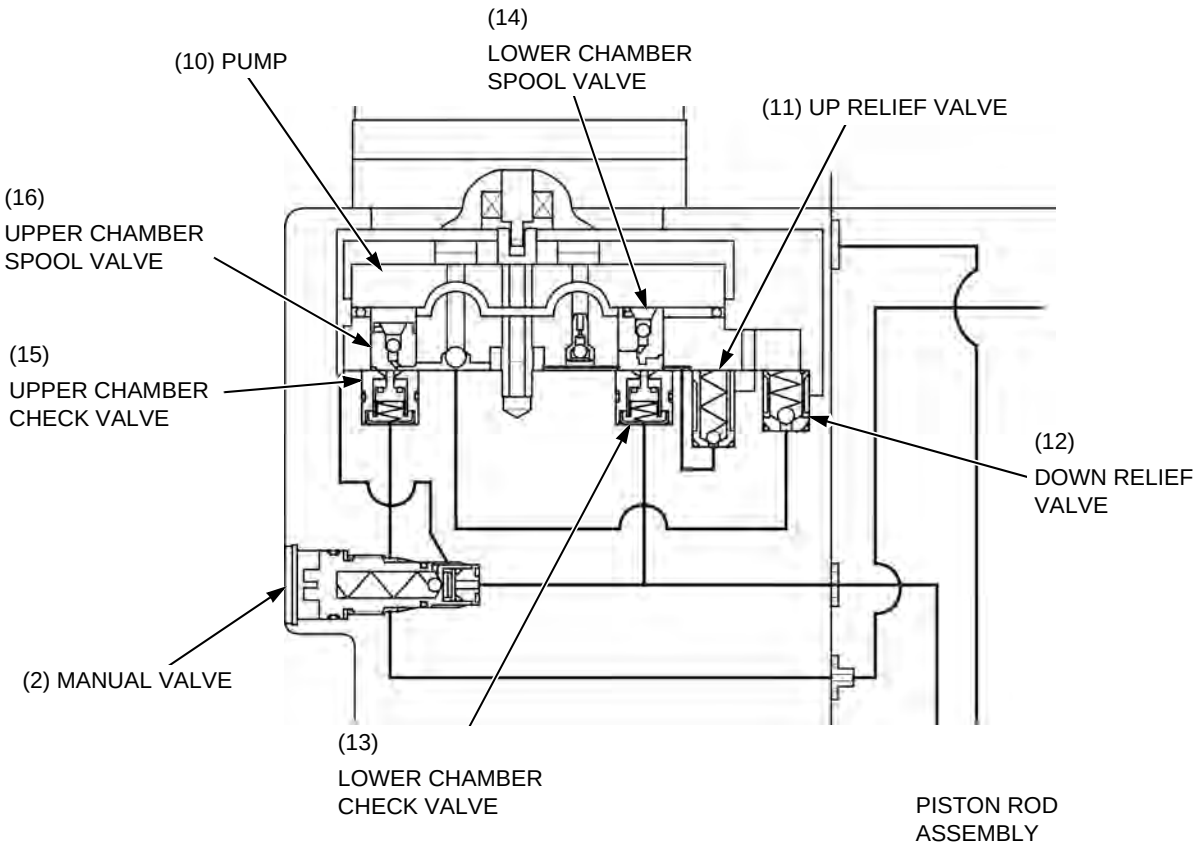
   Is oil inside?

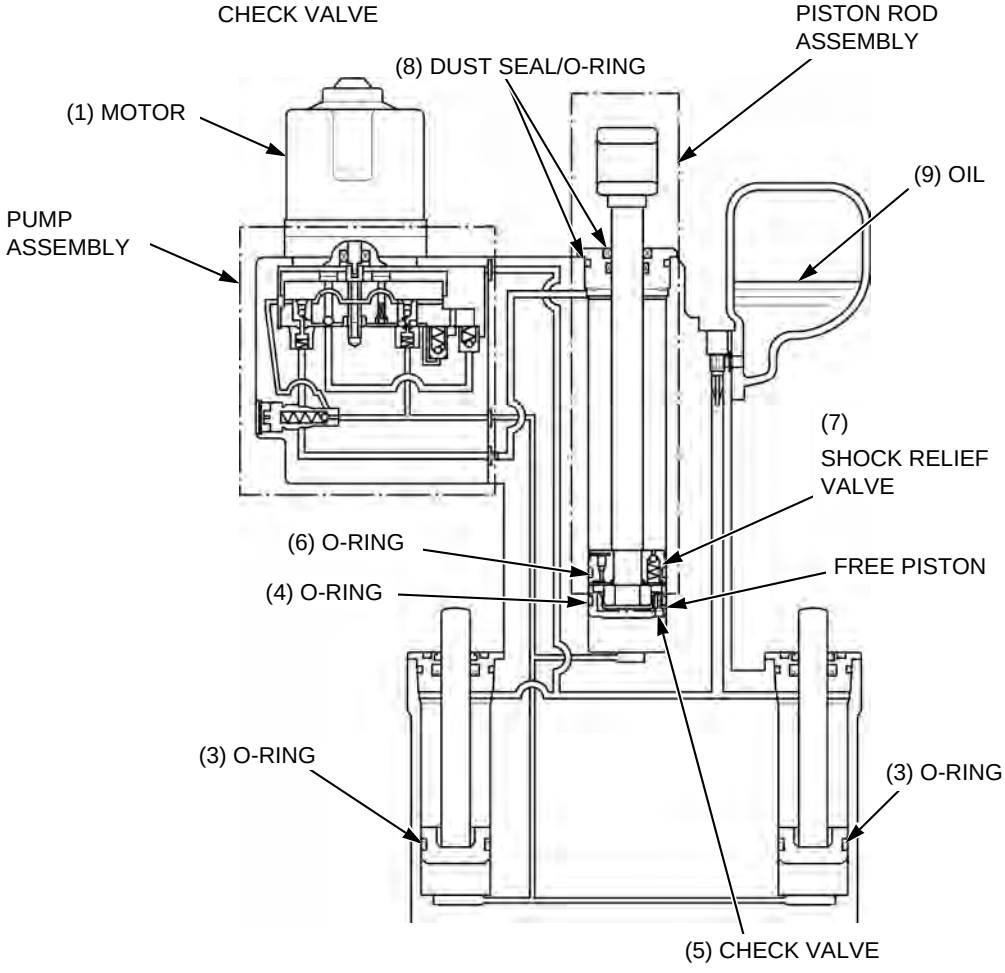
   YES – Replace the motor with a new one (page 19-25) and recheck.

   NO – Disassemble the motor and replace the faulty part(s) (page 19-48).

POWER TRIM/TILT QUICK REFERENCE CHART

Symptom				Pressure check		Check point	Check/repair method
Does not tilt up	Does not tilt down	Does not hold		Lower chamber hydraulic pressure lower than specification or pressure drops.	Upper chamber hydraulic pressure lower than specification or pressure drops.		
		Lowers	Extends				
○	○			○	○	(1) Motor	Check according to the motor check procedure.
○	○	○	○	○	○	(2) Manual valve	Check that the manual valve is installed securely. Replace if it is damaged. Check the O-ring for damage and replace if necessary. If there is no damage, clean the O-ring and install it on the manual valve properly.
○	○	○		○		(3) O-ring	Check the O-ring for damage and replace if necessary. If there is no damage, clean the O-ring and reinstall it properly.
○		○		○		(4) O-ring	
○		○		○		(5) Check valve	Check the ball seat for damage or foreign material. The check valve cannot be replaced as an individual part. Replace the free piston assembly if the check valve is defective.
	○		○		○	(6) O-ring	Check the O-ring for damage and replace if necessary. If there is no damage, clean the O-ring and reinstall it properly.
	○		○		○	(7) Shock relief valve	Check the ball seat for damage or foreign material. The shock valve cannot be replaced as an individual part. Replace the piston rod assembly if the shock valve is defective.
	○		○		○	(8) Dust seal/ O-ring	Check the dust seal and O-ring for damage. The dust seal and O-ring cannot be replaced as individual parts. Replace the piston rod assembly if the dust seal or O-ring are defective.
○	○					(9) Oil	Check the oil level and add the oil if necessary.
○	○			○	○	(10) Pump	Do not disassemble the pump assembly. If any of the following parts are defective, replace the pump assembly.
○				○		(11) Up relief valve	
	○				○	(12) Down relief valve	
○	○	○		○		(13) Lower chamber check valve	
○	○	○		○		(14) Lower chamber spool valve	
○	○		○		○	(15) Upper chamber check valve	
○	○		○		○	(16) Upper chamber spool valve	


(14)
LOWER CHAMBER
SPOOL VALVE
(10) PUMP
(11) UP RELIEF VALVE
(16)
UPPER CHAMBER
SPOOL VALVE
(15)
UPPER CHAMBER
CHECK VALVE
(12)
DOWN RELIEF
VALVE
(2) MANUAL VALVE
(13)
LOWER CHAMBER
CHECK VALVE


PISTON ROD
ASSEMBLY
(8) DUST SEAL/O-RING
(1) MOTOR
(9) OIL
PUMP
ASSEMBLY
(7)
SHOCK RELIEF
VALVE
(6) O-RING
FREE PISTON
(4) O-RING
(3) O-RING
(3) O-RING
(5) CHECK VALVE

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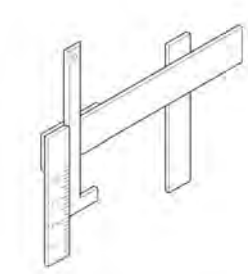
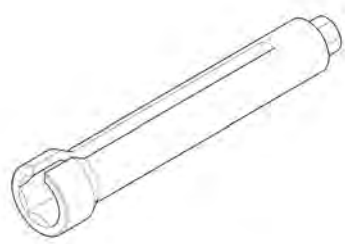
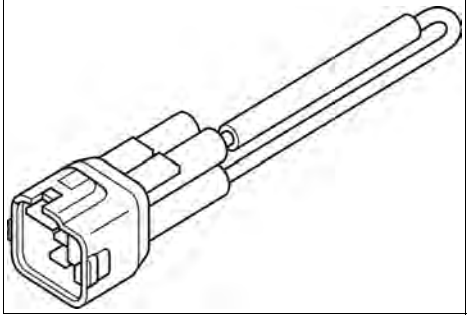
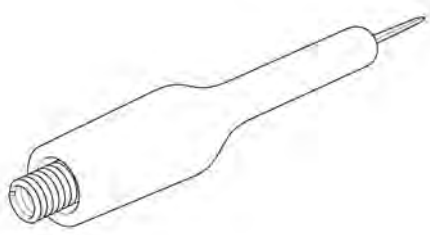
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TOOLS

LIST

Float level gauge 07401-0010000 	Fuel pressure gauge 07406-0040004 	Sensor socket wrench, 22 x 150 mm 07906-PD10000 
SCS service check connector 070PZ-ZY30100 	Test probe 07ZAJ-RDJA110 	

SERVICE PRECAUTIONS

GENERAL TROUBLESHOOTING

Before troubleshooting

- First, check the MIL.
- Be sure to turn the combination switch OFF before disconnecting and connecting the connectors.
- Clear the DTCs after inspection.
  – DTC (with the HDS: page 5-6)
  – MIL (without the HDS: page 5-6)

PERMANENT FAILURE

When there is a problem in the system, the MIL will blink and go off when the engine is turned off.
When there is a permanent failure, the MIL will blink again when the engine is started again, as the problem still exists.
Most permanent failures will be indicated when the combination switch is turned on and engine is started, while others are indicated only under certain conditions.
MIL will blink constantly until the problem part is fixed or replaced.

INTERMITTENT FAILURE

When there is an intermittent failure, the MIL will not blink again when the engine is restarted.
The ECM stores the problem code in its memory.
An intermittent failure is often associated with a loose connector or poor contact in the circuit.

Opens and Shorts

An open or a short are common electrical terms. An open is a break in a wire or at a connection. A short is an accidental connection of a wire to ground or to another wire. This usually means something will not work at all. With an ECM, an open or short may cause something to work, just not the way it is supposed to.

FUEL LINE SERVICE

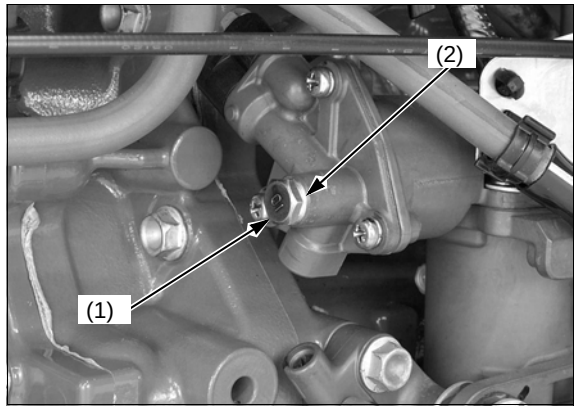
⚠WARNING

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.
- Handle fuel only outdoors.

Disconnect the battery cable from the battery negative (–) terminal.

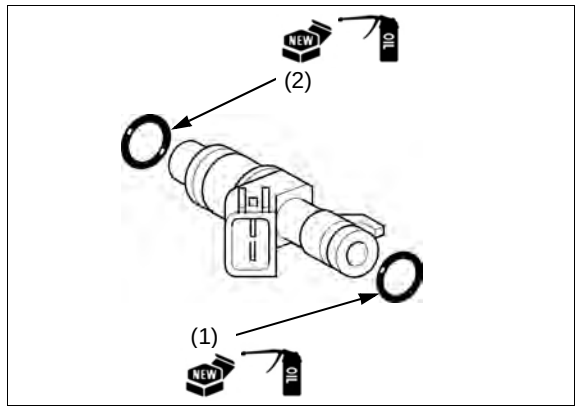
Before removing and installing the fuel line, relieve the fuel pressure by loosening the service check bolt (1) as described in "How to relieve fuel pressure" (page 5-79).

Replace the sealing washer (2) during reassembly.



Replace the O-ring (7.47 × 3.6 mm) (1) and O-ring (7.45 × 3.61 mm) (2) with new ones when the fuel line is removed/installed or replaced.

- Install the O-rings in their proper locations.
- Apply engine oil to the O-rings before installation.
- Avoid using vegetable oil and alcohol based lubricants.



CHECK AFTER OPERATION

Check the parts for secure installation and the bolts, screws, and other fasteners for secure tightening.

Connect the battery cable to the battery negative (–) terminal.

FUEL LEAK CHECK

Turn the combination switch ON (but do not turn the starter) after connecting the fuel lines. The fuel pump (high pressure side) should operate for approximately 2 seconds and the fuel pressure in the high pressure side fuel line should rise. Repeat this operation 2 or 3 times and check for fuel leakage.

WHEN THE BOAT IS EQUIPPED WITH RADIO EQUIPMENT/D-GPS

The ECM and its wires are designed to be unaffected by radio waves. However, the ECM can malfunction when it senses an extremely powerful electric wave. Note the following to avoid malfunction of the ECM.

- Install the antenna and the body of the radio equipment at least 50 cm (20.0 in) away from the ECM, remote control cable, remote control box, NMEA interface cable, and network cable.
- Antenna wire must not be too long. Do not route the antenna wire along the main wire harness and other cables/wires.
- Do not mount high output power radio equipment on the boat. (The maximum output power of the radio equipment should be 10 W.)
- Install the D-GPS antenna and the body unit at least 3 m away from the engine.
- Connect the D-GPS antenna ground wire to ground.

SYSTEM DESCRIPTION

SELF-DIAGNOSIS SYSTEM

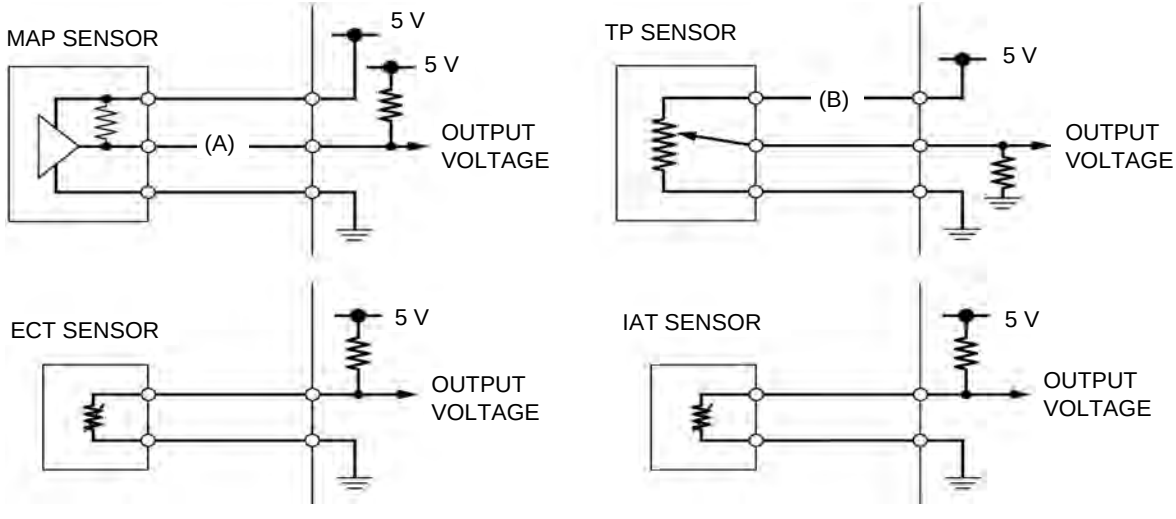
The ECM has a self-diagnosis function that memorizes the failure code and turns the MIL ON when it detects an abnormality with the input/output system.

FAIL-SAFE FUNCTION

The PGM-FI system is provided with a fail-safe function to provide minimum running capability even when there is trouble in the system. When any abnormality is detected by the self-diagnosis function, running capability is maintained by pre-programed value in the simulated program map. When any abnormality is detected in the MAP sensor or CKP sensor, the fail-safe function stops the engine to protect it from damage.

DTC (Diagnostic Trouble Code)

- The DTC is composed of a main code and a sub code, and it is displayed as a hyphenated number when retrieved from the ECM with the HDS.
  The digits in front of the hyphen are the main code; they indicate the component or function failure.
  The digits behind the hyphen are the sub code, they detail the specific symptom of the component or function failure.
  For example, in the case of the TP sensor:
  – DTC 07 – 1 = (TP sensor voltage) – (lower than the specified value)
  – DTC 07 – 2 = (TP sensor voltage) – (higher than the specified value).
- The MAP, ECT, TP, and IAT sensor diagnosis will be made according to the voltage output of the affected sensor.
  If a failure occurs, the ECM determines the Function Failure, compares the sensor voltage output to the standard value, and then outputs the corresponding DTC to the HDS.
  For example:
  – If the output voltage line (A) on the MAP sensor is open, the ECM detects the output voltage is about 5 V, then the DTC 3-2 (MAP sensor circuit high voltage) will be displayed.
  – If the input voltage line (B) on the TP sensor is open, the ECM detects the output voltage is 0 V, then the DTC 7-1 (TP sensor circuit low voltage) will be displayed.



DTC READOUT

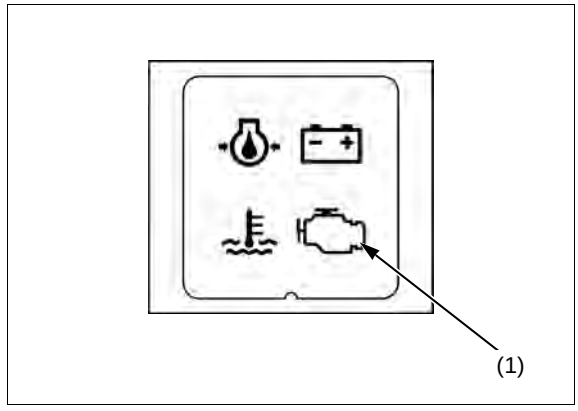
Turn the combination switch ON; the MIL will stay on for a few seconds, then go off.

Start the engine and check the MIL (1).

- If the engine will not start, turn the starter motor for more than 10 seconds and check the MIL.

If the MIL stays on or blinks, read the following:

– DTC (with the HDS: page 5-7)
– MIL (without the HDS: page 5-7)



CLEARING DTC

How to clear the DTC with HDS

Connect the HDS to the DLC (page 5-7).

Clear the DTC with the HDS while the engine is stopped.

To clear the DTC without the HDS, refer to the following procedure.

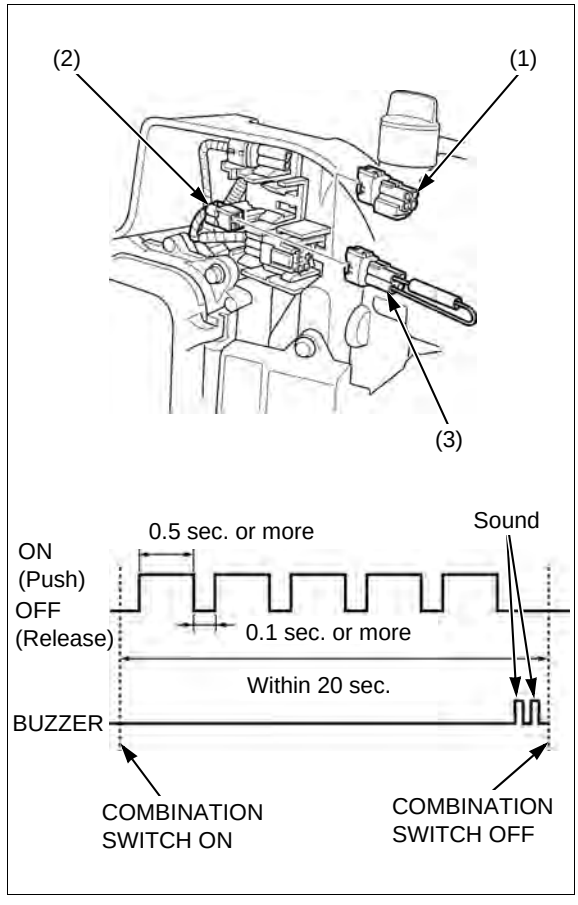
How to clear the DTC with SCS service check connector

1. Turn the combination switch OFF.
2. Remove the dummy connector (1), and short the wire terminals of the DLC (2) using the special tool.

   TOOL:
   SCS service check connector (3) **070PZ-ZY30100**
3. Turn the combination switch ON.

- Perform steps 4 though 6 within 20 seconds.

4. Turn the emergency stop switch ON (push for 0.5 sec. or more) and OFF (release for 0.1 sec. or more).
   Repeat the procedure five times.
5. Check that the buzzer sounds twice.
   The MIL should stay ON.
6. Turn the combination switch OFF. (DTC clear procedure completes.)



READING DTC WITH THE HDS

- The HDS can readout the DTC, freeze data, current data, and other ECM conditions.

Turn the combination switch OFF.

Remove the dummy connector (1) from the DLC (2). Connect the HDS (3) to the DLC.

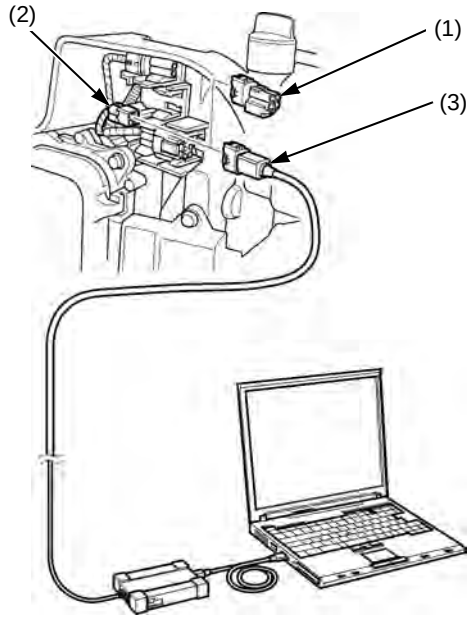
Turn the combination switch ON and check the DTC and freeze data.

- Freeze data indicates the engine conditions when the first malfunction was detected.

Read the DTC and freeze data and follow the troubleshooting index (page 5-15).

After troubleshooting, perform repairs as needed and perform the "FINAL PROCEDURE (AFTER TROUBLESHOOTING)" (page 5-8).

With Dr. H shown:



READING DTC WITH THE MIL

Turn the combination switch OFF.

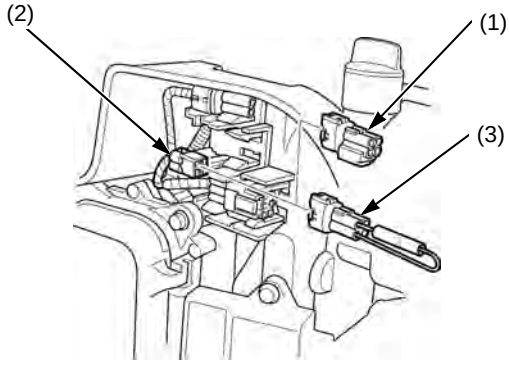
Remove the dummy connector (1) from the DLC (2) and short the DLC terminals using the special tool.

TOOL:
SCS service check connector (3) 070PZ-ZY30100

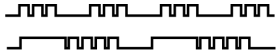
Turn the combination switch ON; read and note the MIL blinks and refer to the troubleshooting index (page 5-53).

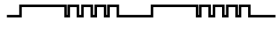
- If the ECM has any DTC in its memory, the MIL will start blinking.
- The MIL has two types of blinks, a long blink and a short blink. One long blink is the equivalent of ten short blinks. For example, when two long blinks are followed by five short blinks, the MIL is 25 (two long blinks = 20 blinks, plus five short blinks).
- When multiple problems occur simultaneously, the MIL repeatedly indicates them by blinking separate codes, one after another.

After troubleshooting, perform repairs as needed and perform the "FINAL PROCEDURE (AFTER TROUBLESHOOTING)" (page 5-8).



Single problem:

 See DTC 3

 See DTC 14

Multiple problems:

 See DTC 3 and 4

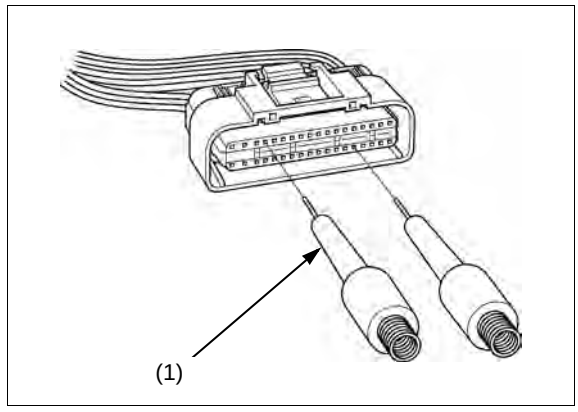
 See DTC 3 and 14

INSPECTION AT ECM CONNECTOR

- Always clean around and keep any foreign material away from the ECM connector before disconnecting it.
- A faulty PGM-FI system is often related to poorly connected or corroded terminals. Check those connections before proceeding.
- In testing at the ECM connector (wire harness side) terminal, always use the test probe. Insert the test probe into the connector terminal, and then attach the digital multimeter probe to the test probe.

TOOL:

Test probe (1)	**07ZAJ-RDJA110**

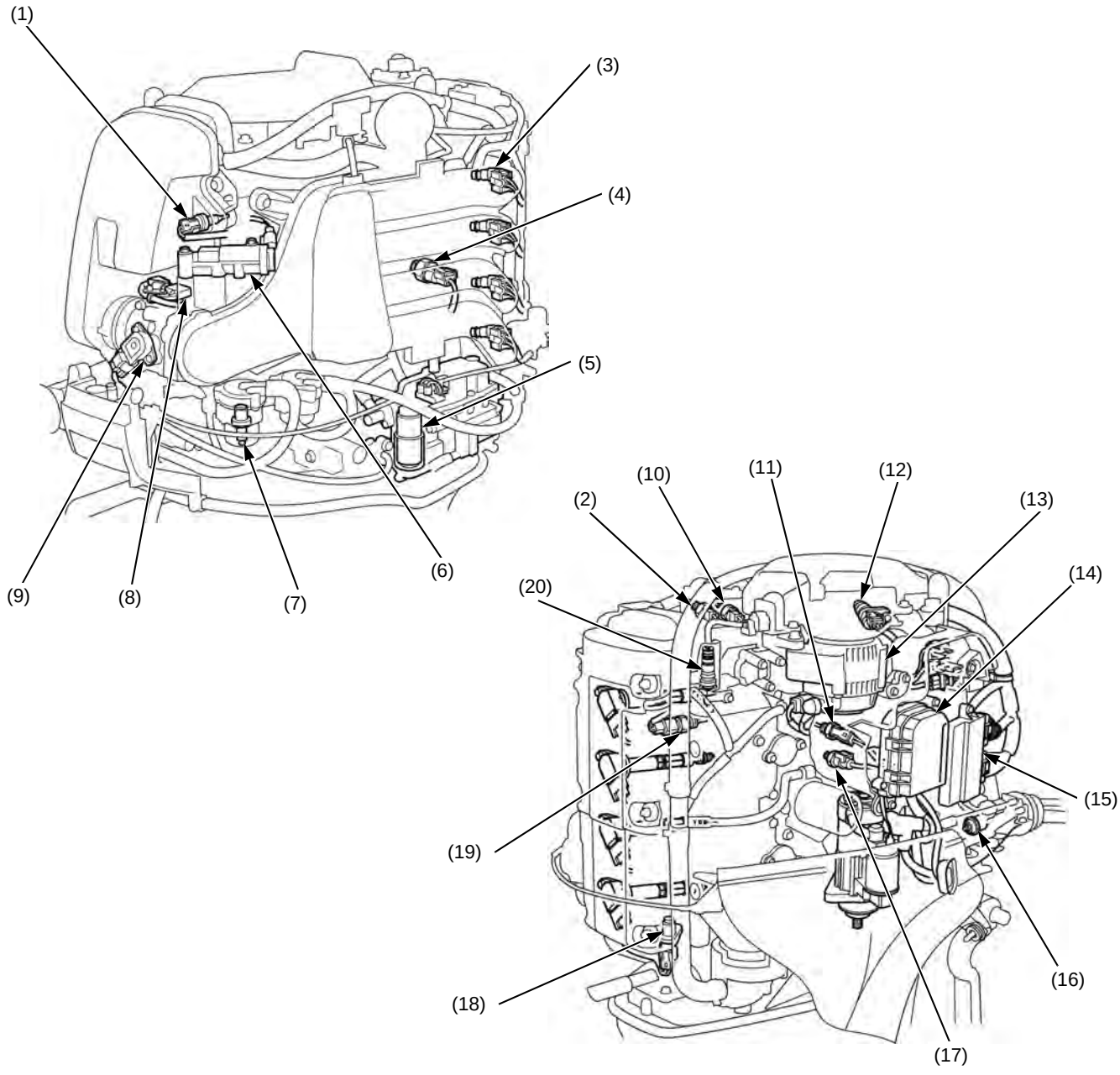


FINAL PROCEDURE (AFTER TROUBLESHOOTING)

Clear the DTCs from the ECM using the procedures shown on page 5-6.

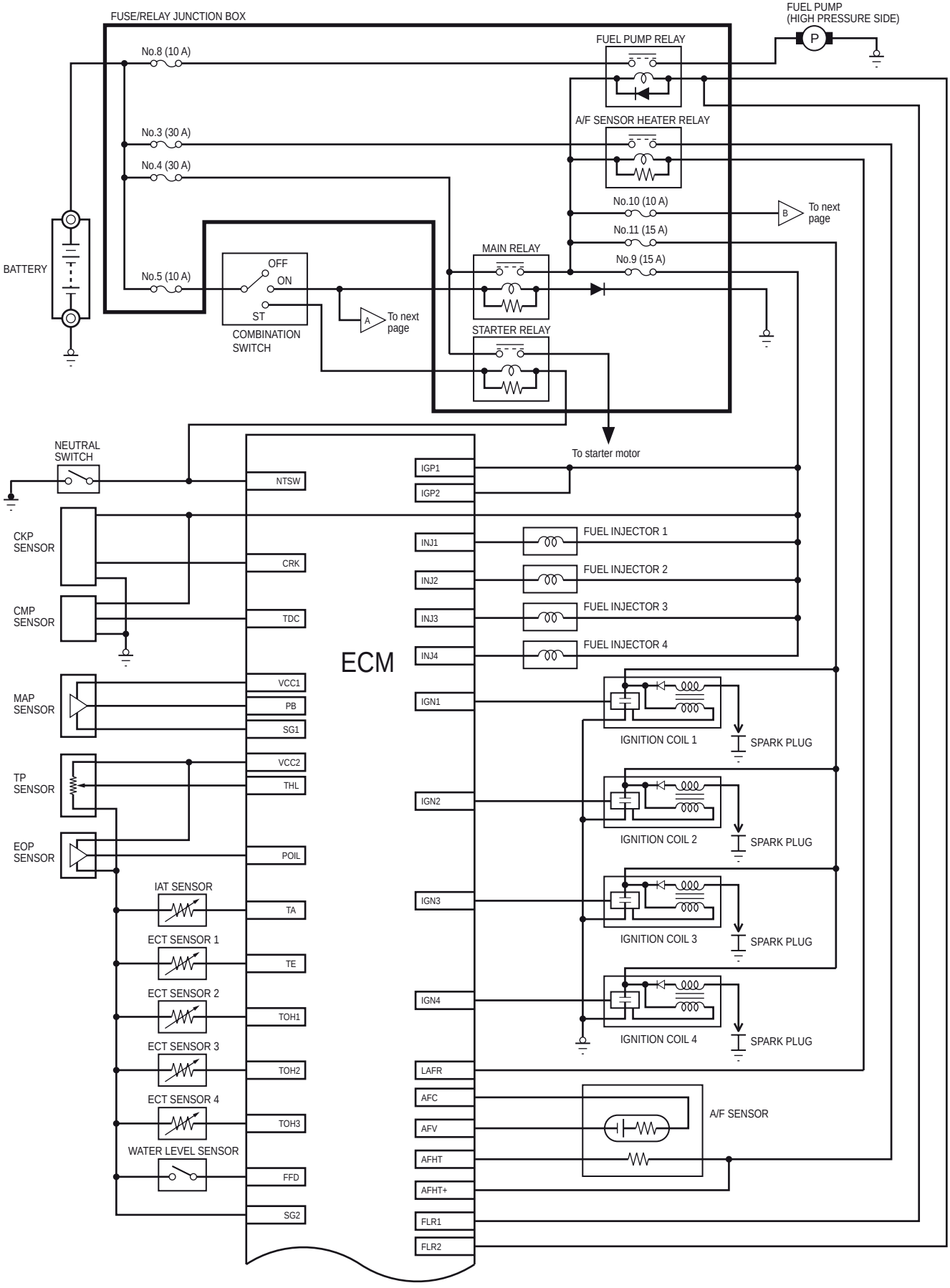
Disconnect the SCS service check connector from the DLC and connect the dummy connector.
Note that the MIL stays ON while the SCS service check connector is connected to the DLC.

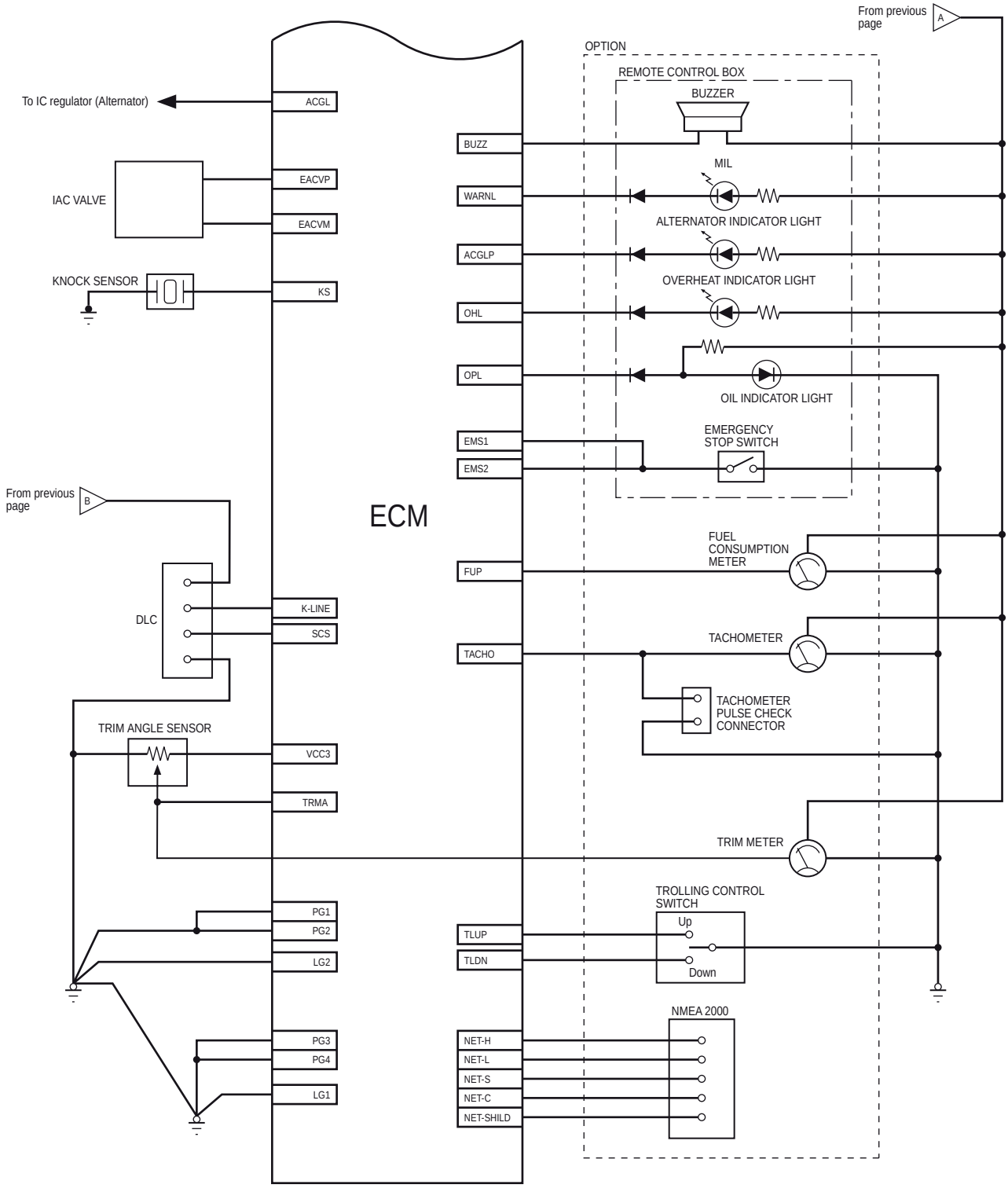
SYSTEM LOCATION



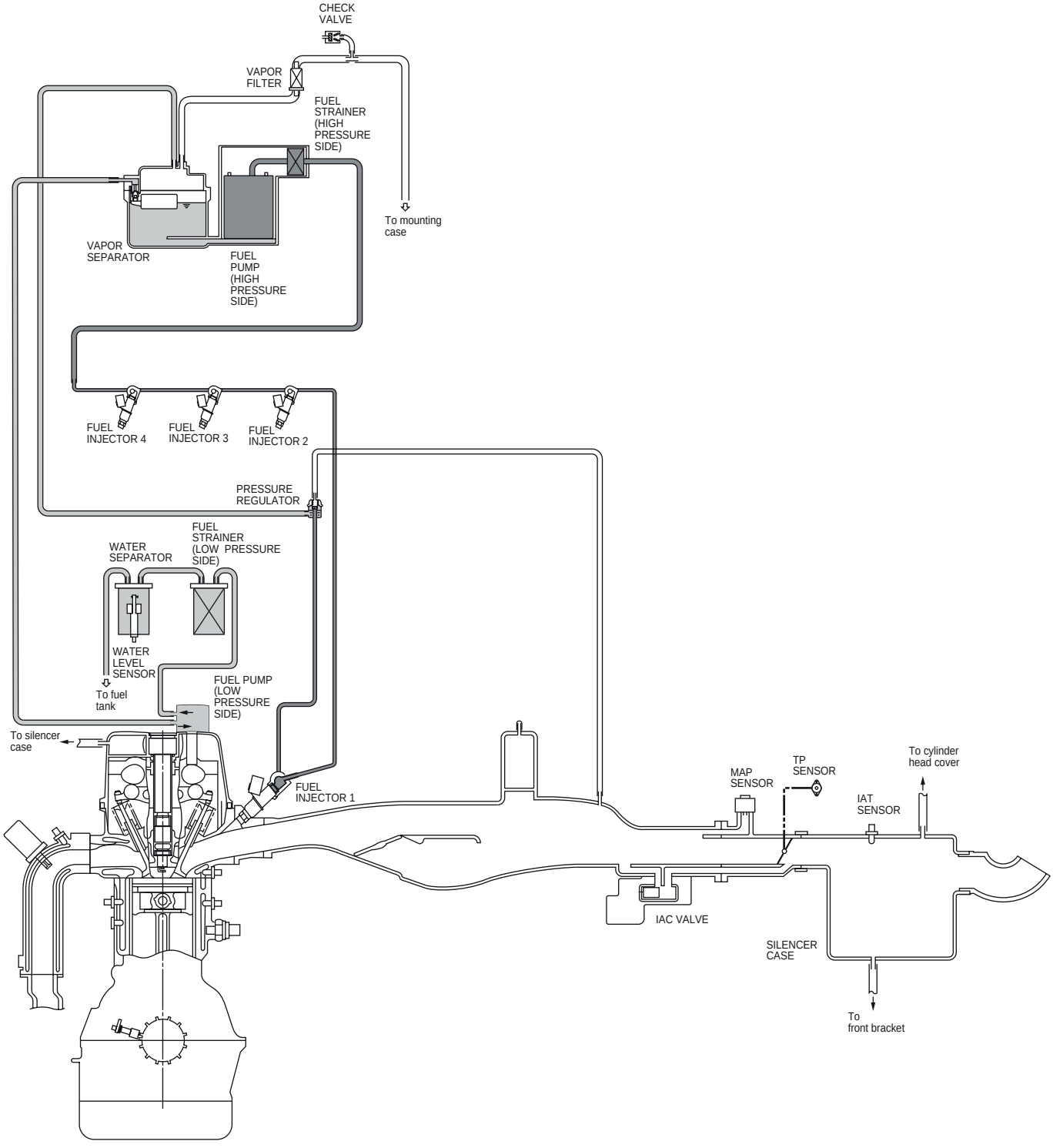
(1) IAT sensor
(2) ECT sensor 2
(3) Injector
(4) Knock sensor
(5) Fuel pump
(6) IAC valve
(7) Water separator/water level sensor
(8) MAP sensor
(9) TP sensor
(10) ECT sensor 4
(11) ECT sensor 1
(12) CKP sensor
(13) Alternator
(14) Fuse/relay junction box
(15) ECM
(16) Neutral switch
(17) EOP sensor
(18) CMP sensor
(19) ECT sensor 3
(20) A/F sensor

CIRCUIT DIAGRAM



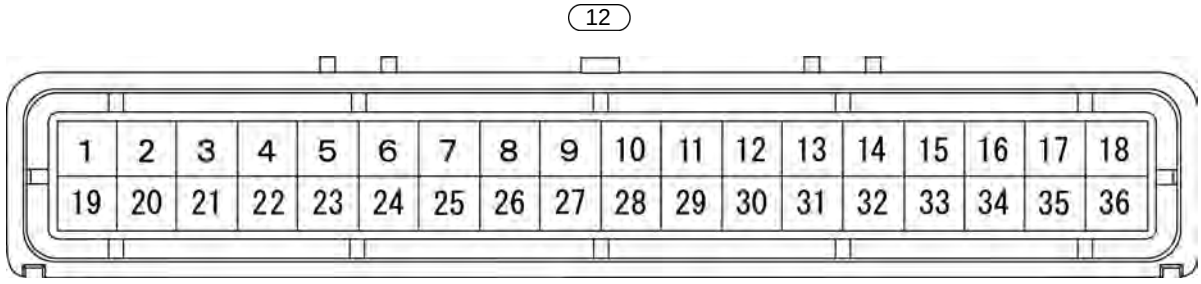

From previous page
A
OPTION
REMOTE CONTROL BOX
BUZZER
To IC regulator (Alternator)
ACGL
BUZZ
MIL
IAC VALVE
EACVP
WARNL
EACVM
ALTERNATOR INDICATOR LIGHT
ACGLP
KNOCK SENSOR
OVERHEAT INDICATOR LIGHT
KS
OHL
OPL
OIL INDICATOR LIGHT
EMERGENCY STOP SWITCH
EMS1
EMS2
From previous page
B
ECM
FUEL CONSUMPTION METER
FUP
DLC
K-LINE
SCS
TACHOMETER
TACHO
TACHOMETER PULSE CHECK CONNECTOR
TRIM ANGLE SENSOR
VCC3
TRMA
TRIM METER
TROLLING CONTROL SWITCH
PG1
PG2
Up
TLUP
LG2
TLDN
Down
NMEA 2000
PG3
NET-H
PG4
NET-L
NET-S
LG1
NET-C
NET-SHILD

PIPING CONNECTIONS



ECM TERMINAL ARRANGEMENT

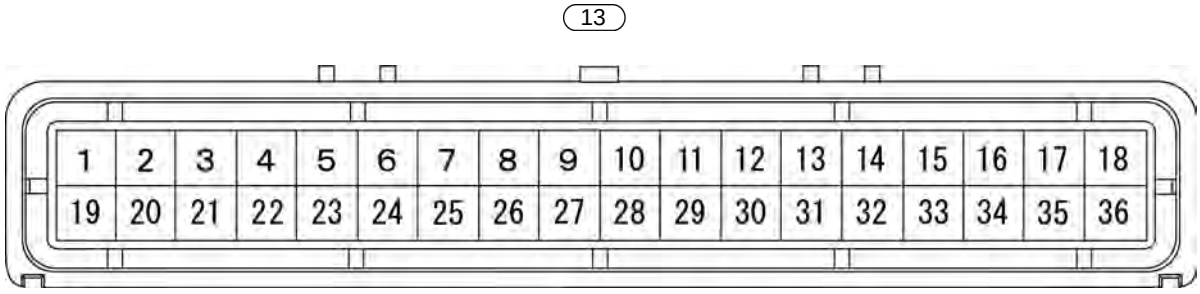
ECM CONNECTOR A (GRAY)



ECM side connector (viewed from the terminal side)

Terminal No.	Terminal mark	Name	Content/Signal
1	ACGLP	Alternator indicator light	Alternator indicator light signal output
2	LAFR	A/F sensor heater relay	A/F sensor heater relay driver
3	WARNL	MIL	MIL output
4	TACHO	Tachometer	Tachometer pulse signal output
5	-	–	–
6	TRMA	Trim angle sensor	Trim angle sensor input
7	TE	ECT sensor 1	ECT sensor 1 input
8	THL	TP sensor	TP sensor input
9	PB	MAP sensor	MAP sensor input
10	POIL	EOP sensor	EOP sensor input
11	K-LINE	Communication signal	Serial communication signal input/output
12	IGN2	No.2 ignition coil	No.2 ignition coil signal output
13	FLR1	Fuel pump relay 1	Fuel pump relay 1 driver
14	FLR2	Fuel pump relay 2	Fuel pump relay 2 driver
15	IGN1	No.1 ignition coil	No.1 ignition coil signal output
16	-	–	–
17	PG3	Power ground 3	Power ground 3
18	AFHT	A/F sensor heater	A/F sensor heater driver
19	BUZZ	Warning buzzer	Warning buzzer driver
20	CRK	CKP sensor	CKP sensor input
21	-	–	–
22	TOH1	ECT sensor 2	ECT sensor 2 input
23	TA	IAT sensor	IAT sensor input
24	TDC	CMP sensor	CMP sensor input
25	TOH3	ECT sensor 4	ECT sensor 4 input
26	TOH2	ECT sensor 3	ECT sensor 3 input
27	AFC	A/F sensor (C)	A/F sensor (C) input
28	AFV	A/F sensor (V)	A/F sensor (V) input
29	-	–	–
30	IGN3	No.3 ignition coil	No.3 ignition coil signal output
31	OPL	Oil indicator light	Oil indicator light driver
32	OHL	Overheat indicator light	Overheat indicator light driver
33	IGN4	No.4 ignition coil	No.4 ignition coil signal output
34	FUP	Fuel consumption meter	Fuel consumption volume signal output
35	PG4	Power ground 4	Power ground 4
36	AFTH+	A/F sensor heater (+)	A/F sensor heater (+) input

ECM CONNECTOR B (BLACK)



ECM side connector (viewed from the terminal side)

Termi-nal No.	Terminal mark	Name	Content/Signal
1	NET-H	NMEA 2000 CAN HI	NMEA 2000 CAN HI output
2	NET-S	NMEA 2000 12V power source	NMEA 2000 12V power input
3	NET-C	NMEA 2000 ground	NMEA 2000 ground
4	-	–	–
5	LG1	Logic ground 1	Logic ground 1
6	VCC1	Sensor power 1	Sensor power 5 V output 1
7	VCC2	Sensor power 2	Sensor power 5 V output 2
8	IGP1	ECM power source 1	ECM main power 12 V input 1
9	IGP2	ECM power source 2	ECM main power 12 V input 2
10	-	–	–
11	TLUP	Trolling switch Up	Trolling switch Up input
12	TLDN	Trolling switch Down	Trolling switch Down input
13	INJ4	No.4 injector	No.4 injector driver
14	INJ3	No.3 injector	No.3 injector driver
15	INJ2	No.2 injector	No.2 injector driver
16	INJ1	No.1 injector	No.1 injector driver
17	PG1	Power ground 1	Power ground 1
18	EACVP	IAC valve (+)	IAC valve (+) driver
19	NET-L	NMEA 2000 CAN LO	NMEA 2000 CAN LO output
20	NET-SHILD	NMEA 2000 shield	NMEA 2000 shield
21	-	–	–
22	VCC3	Sensor power 3	Sensor power 5 V output 3
23	LG2	Logic ground 2	Logic ground 2
24	SG1	Sensor ground 1	Sensor ground 1
25	SG2	Sensor ground 2	Sensor ground 2
26	-	–	–
27	NTSW	Neutral switch	Neutral switch input
28	FFD	Water level sensor	Water level sensor input
29	KS	Knock sensor	Knock sensor input
30	EMS1	Emergency stop switch 1	Emergency stop switch input 1
31	EMS2	Emergency stop switch 2	Emergency stop switch input 2
32	-	–	–
33	SCS	Service check signal	Service check signal input
34	ACGL	Alternator indicator light	Alternator indicator light signal input
35	PG2	Power ground 2	Power ground 2
36	EACVM	IAC valve (–)	IAC valve (–) driver

DTC TROUBLESHOOTING

DTC INDEX

DTC	MIL	Detected component	Probable cause	Ref. page
0 or does not communicate	MIL does not come ON/ blink 	ECM	• Loose or poor contact of the connector • Faulty indicator light • Open circuit in MIL wire • Open circuit in ECM power/ground cable • Faulty ECM	4-15
0 or does not communicate	MIL stay ON 	ECM	• SCS service check connector activated • Short circuit in DLC wire • Short circuit in MIL wire • Short circuit in sensor power circuit • Faulty ECM	5-19
0-2 0-5 0-8	ON 	ECM (Internal failure)	• Faulty ECM	5-22
3-1	ON 	MAP sensor (voltage too low)	• Loose or poor contact of the connector • Short circuit in MAP sensor wire (PB) • Open circuit in MAP sensor wire (VCC1) • Faulty MAP sensor	5-22
3-2	ON 	MAP sensor (voltage too high)	• Loose or poor contact of the connector • Open circuit in MAP sensor wire (PB) • Open circuit in MAP sensor wire (VCC1) • Open circuit in MAP sensor wire (SG1) • Faulty MAP sensor	5-23
4-1	ON 	CKP sensor (no pulse)	• Loose or poor contact of the connector • Open or short circuit in CKP sensor wire (CRK) • Open circuit in CKP sensor wire (IGP2) • Open circuit in CKP sensor wire (LG1) • Faulty CKP sensor	5-25
4-2	ON 	CKP sensor (abnormal pulse)	• Loose or poor contact of the connector • Faulty CKP sensor • CKP sensor is not installed properly	5-26
6-1	ON 	ECT sensor 1 (voltage too low)	• Loose or poor contact of the connector • Short circuit in ECT sensor 1 wire (TE) • Faulty ECT sensor 1	5-27
6-2	ON 	ECT sensor 1 (voltage too high)	• Loose or poor contact of the connector • Open circuit in ECT sensor 1 wire (TE) • Open circuit in ECT sensor 1 wire (SG2) • Faulty ECT sensor 1	5-28

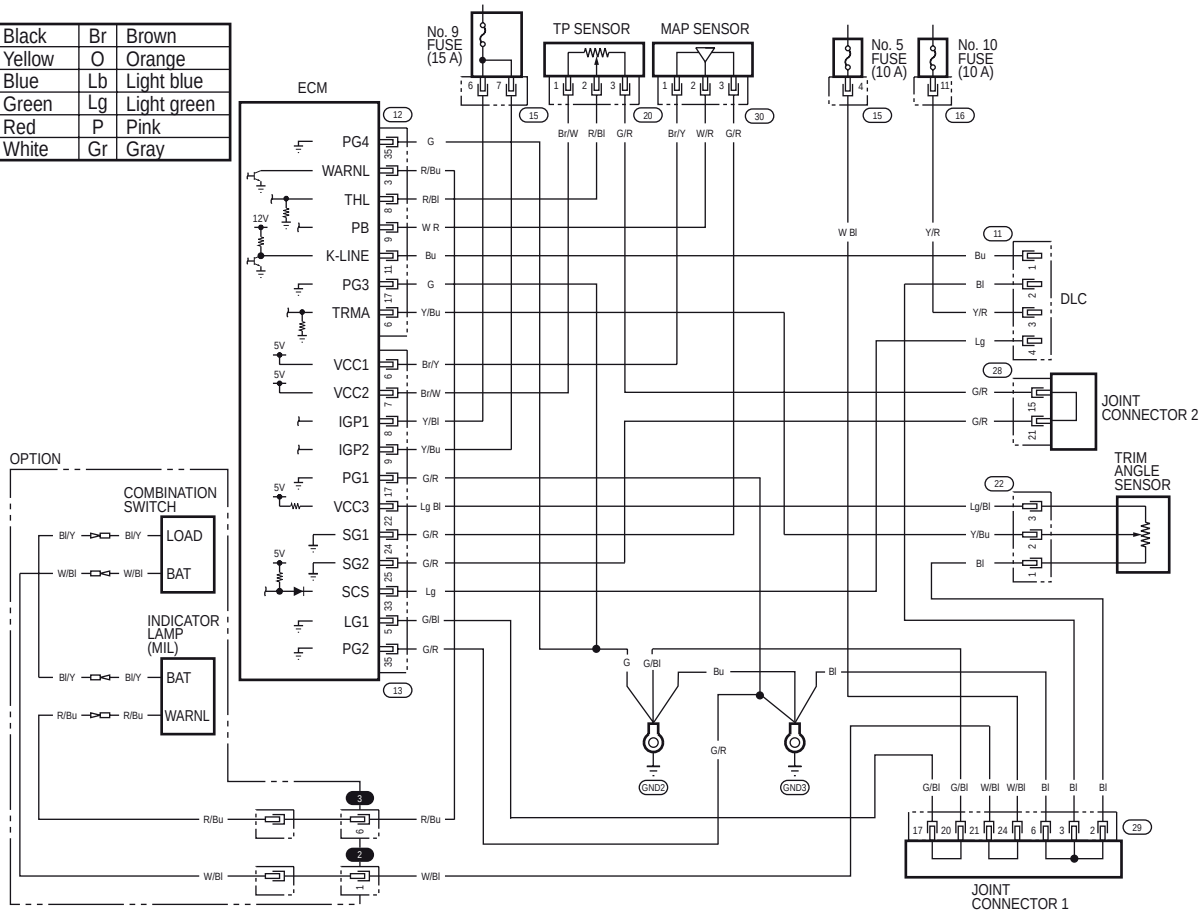
DTC	MIL	Detected component	Probable cause	Ref. page
7-1	ON 	TP sensor (voltage too low)	• Loose or poor contact of the connector • Open or short circuit in TP sensor wire (THL) • Open circuit in TP sensor wire (VCC2) • Faulty TP sensor	5-29
7-2	ON 	TP sensor (voltage too high)	• Loose or poor contact of the connector • Open circuit in TP sensor wire (SG2) • Faulty TP sensor	5-30
8-1	ON 	CMP sensor (no pulse)	• Loose or poor contact of the connector • Open or short circuit in CMP sensor wire (TDC) • Open circuit in CMP sensor wire (IGP2) • Open circuit in CMP sensor wire (LG1) • Faulty CMP sensor	5-31
8-2	ON 	CMP sensor (abnormal pulse)	• Loose or poor contact of the connector • Faulty CMP sensor • CMP sensor is not installed properly	5-32
10-1	ON 	IAT sensor (voltage too low)	• Loose or poor contact of the connector • Short circuit in IAT sensor wire (TA) • Faulty IAT sensor	5-33
10-2	ON 	IAT sensor (voltage too high)	• Loose or poor contact of the connector • Open circuit in IAT sensor wire (TA) • Open circuit in IAT sensor wire (SG2) • Faulty IAT sensor	5-34
14-1	ON 	IAC valve (abnormal current)	• Loose or poor contact of the connector • Open or short circuit in IAC valve wire (EACVP) • Open or short circuit in IAC valve wire (EACVM) • Faulty IAC valve	5-35
22-1	ON 	EOP sensor (voltage too low)	• Loose or poor contact of the connector • Short circuit in EOP sensor wire (POIL) • Open circuit in EOP sensor wire (VCC2) • Faulty EOP sensor	5-36
22-2	ON 	EOP sensor (voltage too high)	• Loose or poor contact of the connector • Open circuit in EOP sensor wire (POIL) • Open circuit in EOP sensor wire (VCC2) • Open circuit in EOP sensor wire (SG2) • Faulty EOP sensor	5-37
23-1	ON 	Knock sensor (abnormal detection)	• Loose or poor contact of the connector • Open or short circuit in knock sensor wire (KS) • Faulty knock sensor	5-39

DTC	MIL	Detected component	Probable cause	Ref. page
41-3	ON 	A/F sensor heater (abnormal high current or low current)	• Loose or poor contact of the connector • Open or short circuit in A/F sensor heater wire (LAFR) • Open circuit in A/F sensor heater wire (AFHT+) • Open or short circuit in A/F sensor heater wire (AFHT) • Faulty A/F sensor heater • Faulty A/F sensor heater relay	5-40
41-4	ON 	A/F sensor heater (abnormal current)	• Loose or poor contact of the connector • Short circuit in A/F sensor heater wire (AFHT) and A/F sensor wire (AFC) • Short circuit in A/F sensor heater wire (AFHT) and A/F sensor wire (AFV) • Short circuit in A/F sensor heater wire (AFHT+) and A/F sensor wire (AFC) • Short circuit in A/F sensor heater wire (AFHT+) and A/F sensor wire (AFV) • Open or short circuit in A/F sensor heater wire (LAFR) • Open circuit in A/F sensor heater wire (AFHT+) • Open or short circuit in A/F sensor heater wire (AFHT) • Faulty A/F sensor heater • Faulty A/F sensor heater relay	5-42
48-5	ON 	A/F sensor (open circuit in A/F sensor wire (AFV/AFC))	• Loose or poor contact of the connector • Open circuit in A/F sensor wire (AFV) • Open circuit in A/F sensor wire (AFC)	5-44
48-6	ON 	A/F sensor (short circuit in A/F sensor wire (AFV))	• Loose or poor contact of the connector • Short circuit in A/F sensor wire (AFV)	5-45
48-7	ON 	A/F sensor (short circuit in A/F sensor wire (AFC))	• Loose or poor contact of the connector • Short circuit in A/F sensor wire (AFC)	5-46
140-1	ON 	ECT sensor 2 (voltage too low)	• Loose or poor contact of the connector • Short circuit in ECT sensor 2 wire (TOH1) • Faulty ECT sensor 2	5-47
140-2	ON 	ECT sensor 2 (voltage too high)	• Loose or poor contact of the connector • Open circuit in ECT sensor 2 wire (TOH1) • Open circuit in ECT sensor 2 wire (SG2) • Faulty ECT sensor 2	5-48
141-1	ON 	ECT sensor 3 (voltage too low)	• Loose or poor contact of the connector • Short circuit in ECT sensor 3 wire (TOH2) • Faulty ECT sensor 3	5-49

DTC	MIL	Detected component	Probable cause	Ref. page
141-2	ON 	ECT sensor 3 (voltage too high)	• Loose or poor contact of the connector • Open circuit in ECT sensor 3 wire (TOH2) • Open circuit in ECT sensor 3 wire (SG2) • Faulty ECT sensor 3	5-50
143-1	ON 	ECT sensor 4 (voltage too low)	• Loose or poor contact of the connector • Short circuit in ECT sensor 4 wire (TOH3) • Faulty ECT sensor 4	5-51
143-2	ON 	ECT sensor 4 (voltage too high)	• Loose or poor contact of the connector • Open circuit in ECT sensor 4 wire (TOH3) • Open circuit in ECT sensor 4 wire (SG2) • Faulty ECT sensor 4	5-52

MIL IS ON BUT DTC IS 0 OR DOES NOT COMMUNICATE

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. DLC power/GND line open circuit inspection

Turn the combination switch OFF and disconnect the HDS.

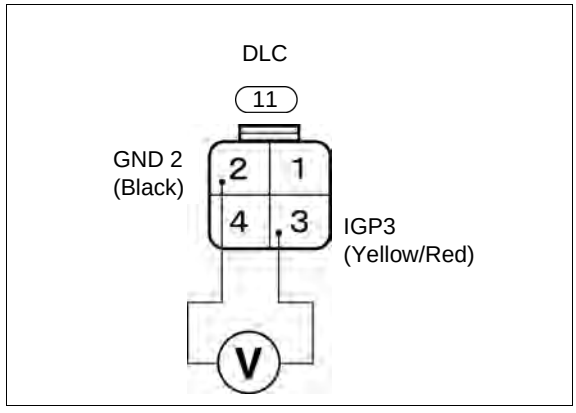
Turn the combination switch ON.

Measure the voltage at the DLC (11) No.3 (Yellow/Red) terminal and No.2 (Black) terminal.

Is battery voltage present?

YES – GO TO STEP 2.

NO – • Repair open in the Yellow/Red wire.
• Repair open in the Black wire.
• If main wire harness is normal, inspect the No.10 fuse circuit in the fuse/relay junction box (page 10-14).



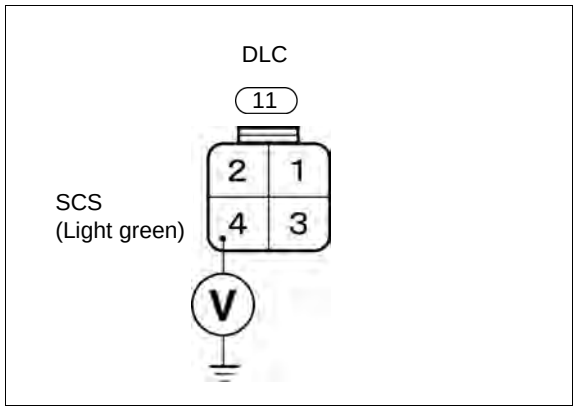
2. DLC signal line short circuit inspection

Measure the voltage between the DLC (11) No.4 (Light green) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair short in the Light green wire.



3. MIL ON line short circuit inspection

Turn the combination switch OFF.

Disconnect ECM connector A (12).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – GO TO STEP 4.

NO – Repair short in the main wire harness between the ECM and the MIL.

4. MAP sensor power line short circuit inspection 1

Turn the combination switch OFF.

Connect ECM connector A (12).

Disconnect the MAP sensor 3P connector (30).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – Replace the MAP sensor.

NO – GO TO STEP 5.

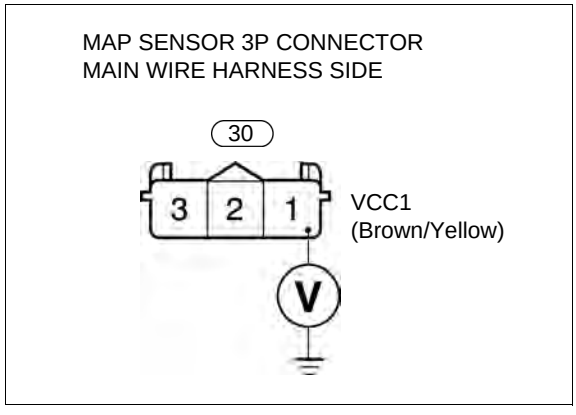
5. MAP sensor power line short circuit inspection 2

Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.1 (Brown/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 6.

NO – Repair short in the Brown/Yellow wire.



6. TP sensor power line short circuit inspection 1

Turn the combination switch OFF.
Disconnect the TP sensor 3P connector (20).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – Replace the TP sensor.

NO – GO TO STEP 7.

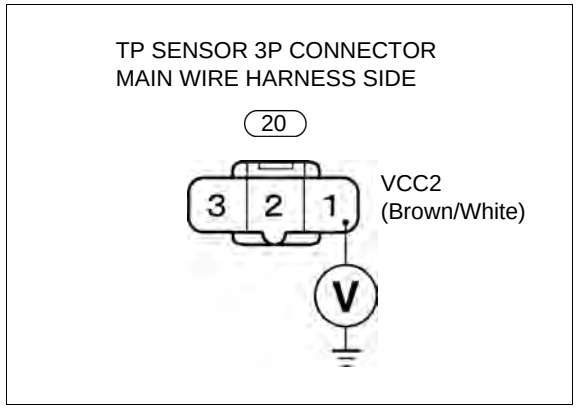
7. TP sensor power line short circuit inspection 2

Measure the voltage between the TP sensor 3P connector (20) main wire harness side No.1 (Brown/White) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 8.

NO – Repair short in the Brown/White wire.



8. Trim angle sensor power line short circuit inspection 1

Turn the combination switch OFF.
Disconnect the trim angle sensor 3P connector (22).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – Replace the trim angle sensor.

NO – GO TO STEP 9.

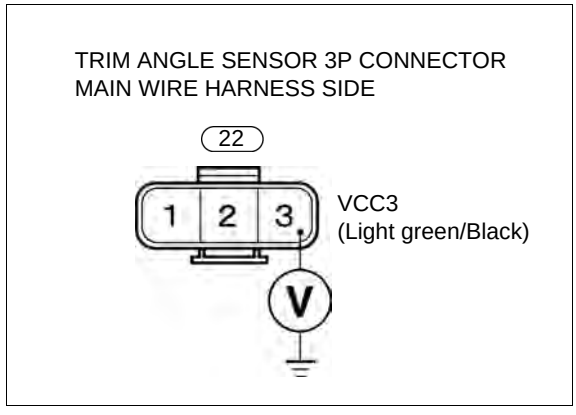
9. Trim angle sensor power line short circuit inspection 2

Measure the voltage between the trim angle sensor 3P connector (22) main wire harness side No.3 (Light green/Black) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECM with a new one and recheck.

NO – Repair short in the Light green/Black wire.



DTC 0-2, 0-5, 0-8 (INTERNAL FAILURE OF ECM)

1. Reproduction test

Turn the combination switch ON and wait for more than one second.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

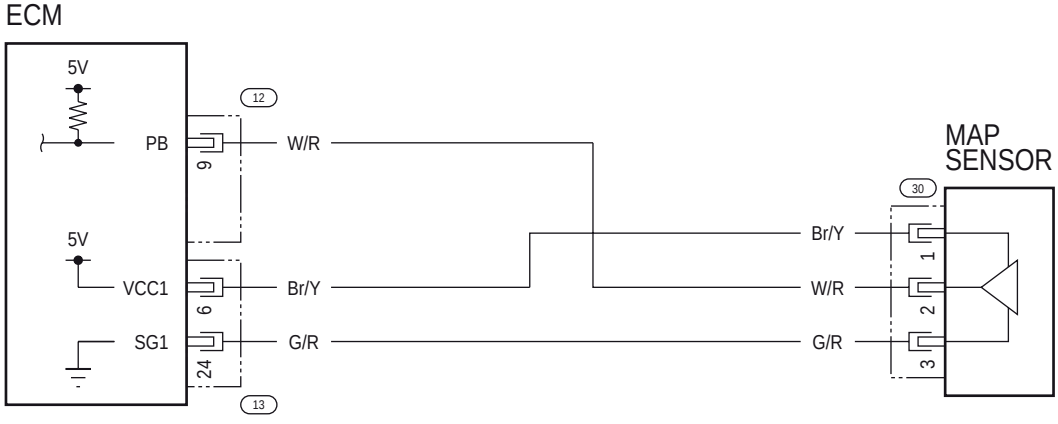
Start the engine and recheck the DTC using the HDS.

Does the DTC 0-2, 0-5, 0-8 appear?

YES – Replace the ECM with a new one and recheck

NO – Temporary failure (code does not reappear)

DTC 3-1, 3-2 (MAP SENSOR VOLTAGE TOO LOW OR TOO HIGH)



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

DTC 3-1 (MAP SENSOR VOLTAGE IS TOO LOW)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the MAP sensor 3P connector (30), ECM connector A (12), and ECM connector B (13), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the MAP sensor voltage using the HDS.

Is the measurement within 0.23 – 4.49 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. MAP sensor signal line short circuit inspection

Turn the combination switch OFF and disconnect the MAP sensor 3P connector (30).

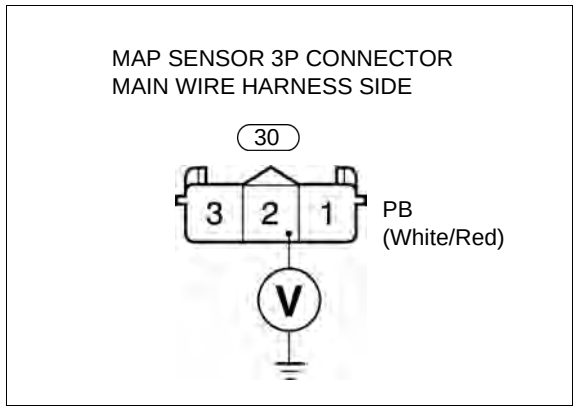
Turn the combination switch ON.

Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.2 (White/Red) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair short in the White/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



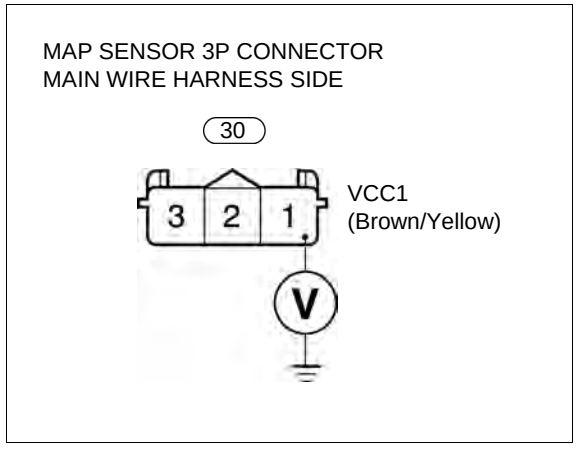
3. MAP sensor power line open circuit inspection

Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.1 (Brown/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the MAP sensor with a new one and recheck.

NO – Repair open in the Brown/Yellow wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 3-2 (MAP SENSOR VOLTAGE IS TOO HIGH)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the MAP sensor 3P connector (30), ECM connector A (12), and ECM connector B (13), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the MAP sensor voltage using the HDS.

Is the measurement within 0.23 – 4.49 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. MAP sensor power line open circuit inspection

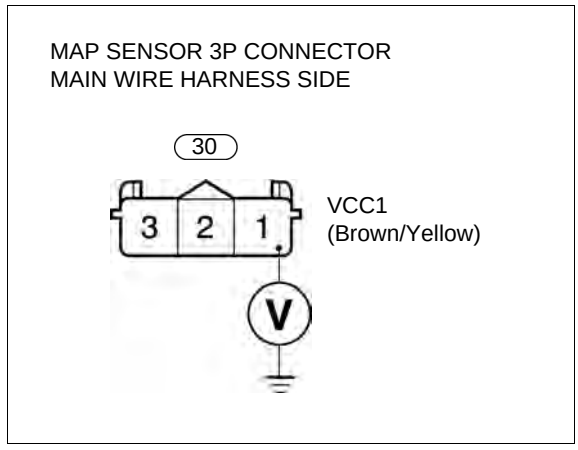
Turn the combination switch OFF and disconnect the MAP sensor 3P connector (30).

Turn the combination switch ON.
Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.1 (Brown/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair open in the Brown/Yellow wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



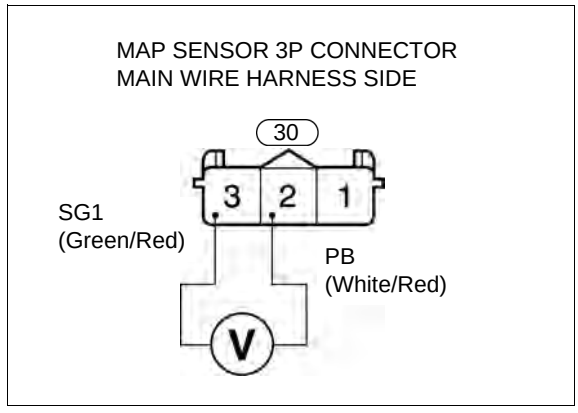
3. MAP sensor signal/GND line open circuit inspection

Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.2 (White/Red) terminal and No.3 (Green/Red) terminal.

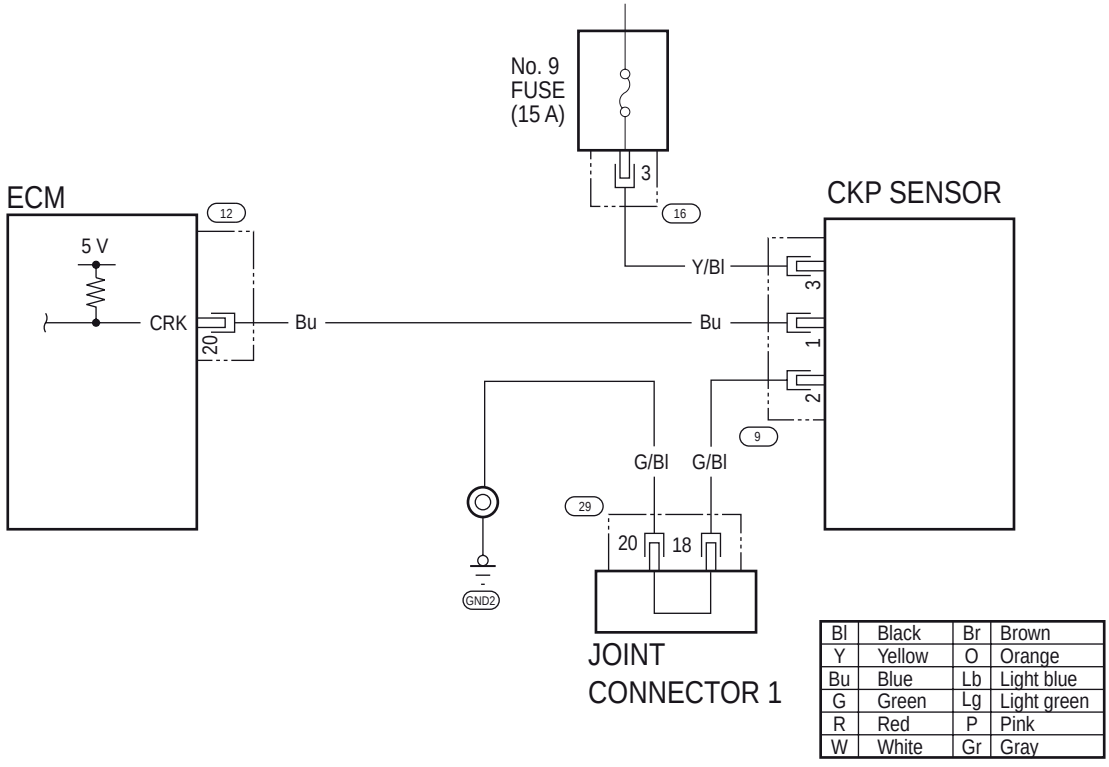
Is the measurement within 4.75 – 5.25 V?

YES – Replace the MAP sensor with a new one and recheck.

NO –
- Repair open in the White/Red wire.
- Repair open in the Green/Red wire.
- If the main wire harness is normal, replace the ECM with a new one, and recheck



DTC 4-1, 4-2 (NO CKP SENSOR PULSE OR ABNORMAL CKP SENSOR PULSE)



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

DTC 4-1 (NO CKP SENSOR PULSE)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the CKP sensor 3P connector (9), ECM connector A (12), and joint connector 1 (29), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and check the DTC using the HDS.

Does the DTC 4-1 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. CKP sensor power line open circuit inspection

Turn the combination switch OFF and disconnect the CKP sensor 3P connector (9).

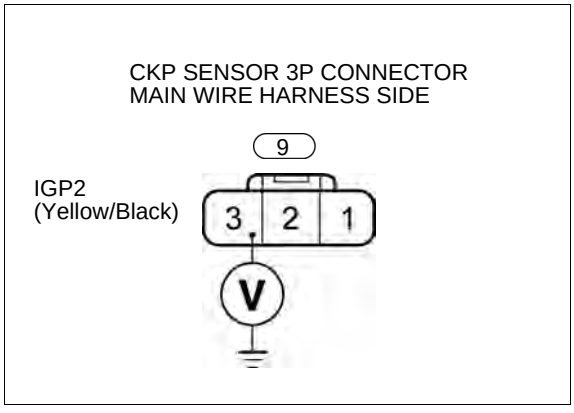
Turn the combination switch ON.

Measure the voltage between the CKP sensor 3P connector (9) main wire harness side No.3 (Yellow/Black) terminal and engine ground.

Does battery voltage exist?

YES – GO TO STEP 3.

NO – Repair open in the Yellow/Black wire. If main wire harness is normal, inspect the No.9 fuse circuit in the fuse/relay junction box (page 10-14).



3. CKP sensor signal line open or short circuit/ GND line open circuit inspection

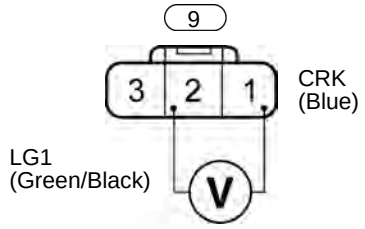
Measure the voltage between the CKP sensor 3P connector (9) main wire harness side No.1 (Blue) terminal and No.2 (Green/Black) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the CKP sensor with a new one and recheck.

NO – • Repair open or short in the Blue wire.
• Repair open in the Green/Black wire.
• If the main wire harness is normal, replace the ECM with a new one, and recheck.

CKP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



DTC 4-2 (ABNORMAL CKP SENSOR PULSE)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the CKP sensor 3P connector (9), ECM connector A (12), and joint connector 1 (29), and then reconnect them.

Clear the DTC (page 5-6).

• Continue the procedure if the DTC does not clear.

Start the engine and check the DTC using the HDS.

Does the DTC 4-2 appear?

YES – GO TO STEP 2.

NO – Temporary failure (disappears)

2. CKP sensor installation inspection

Turn the combination switch OFF.

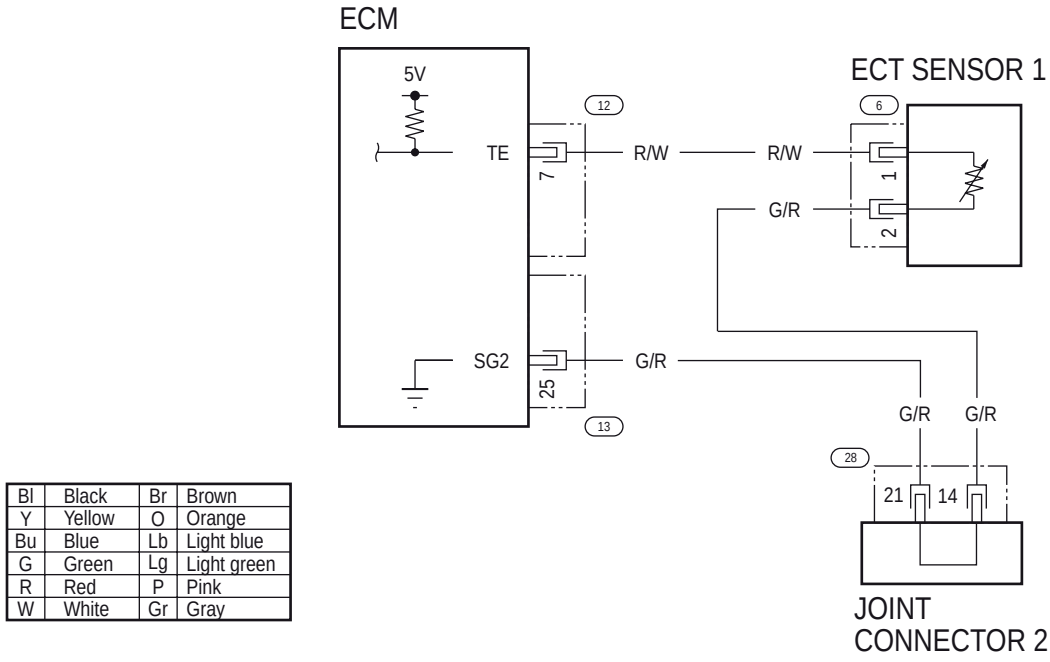
Check the installation of the CKP sensor (page 5-118).

Is the CKP sensor installation correct?

YES – Replace the CKP sensor with a new one and recheck. If the CMP sensor is replaced, but DTC 4-2 still appears, replace the ECM with a new one and recheck.

NO – Install the CKP sensor properly, and recheck.

DTC 6-1, 6-2 (ECT SENSOR 1 VOLTAGE IS TOO LOW OR TOO HIGH)



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

DTC 6-1 (ECT SENSOR 1 VOLTAGE IS TOO LOW)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 1 (2P) connector (6), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 1 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 1 signal line short circuit inspection

Turn the combination switch OFF and disconnect the ECT sensor 1 (2P) connector (6).

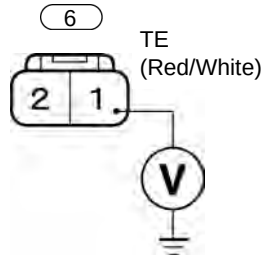
Turn the combination switch ON.
Measure the voltage between the ECT sensor 1 (2P) connector (6) main wire harness side No.1 (Red/White) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 1 with a new one and recheck.

NO – Repair short in the Red/White wire. If the main wire is normal, replace the ECM with a new one and recheck.

ECT SENSOR 1 (2P) CONNECTOR
MAIN WIRE HARNESS SIDE



DTC 6-2 (ECT SENSOR 1 VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 1 (2P) connector (6), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 1 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 1 signal/GND line open circuit inspection

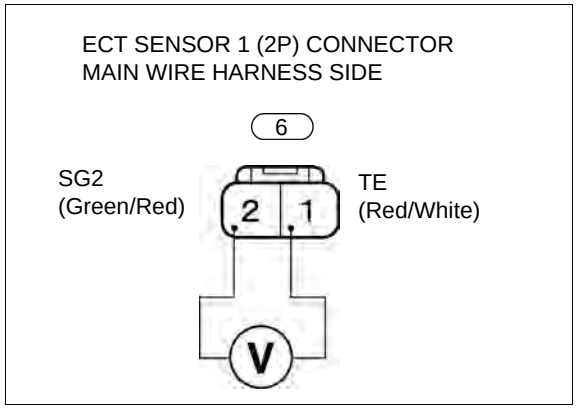
Turn the combination switch OFF and disconnect the ECT sensor 1 (2P) connector (6).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 1 (2P) connector (6) main wire harness side No.1 (Red/White) terminal and No.2 (Green/Red) terminal.

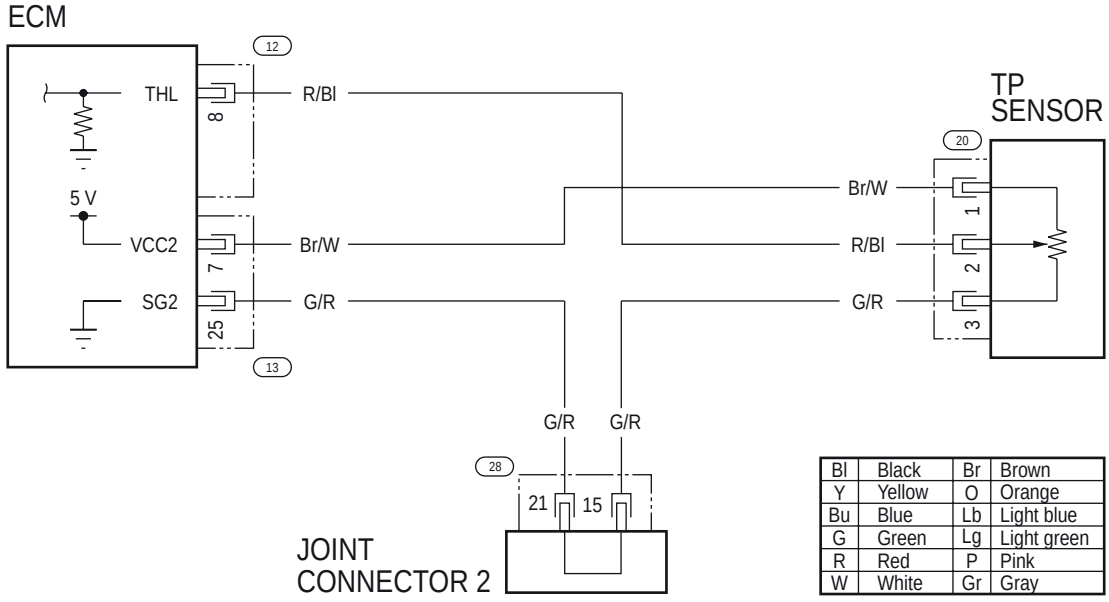
Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 1 with a new one and recheck.

NO – Repair open in the Red/White wire or Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 7-1, 7-2 (TP SENSOR VOLTAGE IS TOO LOW OR TOO HIGH)



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

DTC 7-1 (TP SENSOR VOLTAGE IS TOO LOW)

- When the DTC code 7-1 and 22-1 or 22-2 are indicated at the same time, the power line (VCC2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the TP sensor 3P connector (20), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.

Measure the TP sensor voltage using the HDS.

Is the measurement within 0.23 – 4.89 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. TP sensor power/signal line open circuit inspection

Turn the combination switch OFF and disconnect the TP sensor 3P connector (20).

Turn the combination switch ON.

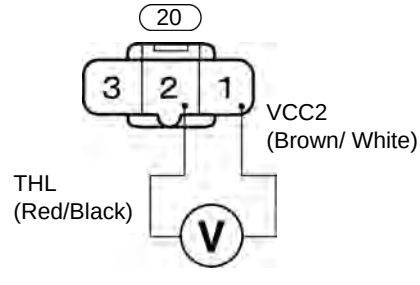
Measure the voltage between the TP sensor 3P connector (20) main wire harness side No.1 (Brown/White) terminal and No.2 (Red/Black) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – • Repair open in the Brown/White wire.
• Repair open in the Red/Black wire.
• If the main wire harness is normal, replace the ECM with a new one, and recheck.

TP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



3. TP sensor signal line short circuit inspection

Turn the combination switch OFF.
Disconnect ECM connector A (12).

Check for continuity between the TP sensor 3P connector (20) main wire harness side No.2 (Red/Black) terminal and engine ground.

Is there continuity?

YES – Repair short in the Red/Black wire.

NO – Replace the throttle body with a new one and recheck.

DTC 7-2 (TP SENSOR VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.
Disconnect the TP sensor 3P connector (20), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the TP sensor voltage using the HDS.

Is the measurement within 0.23 – 4.89 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. TP sensor inspection

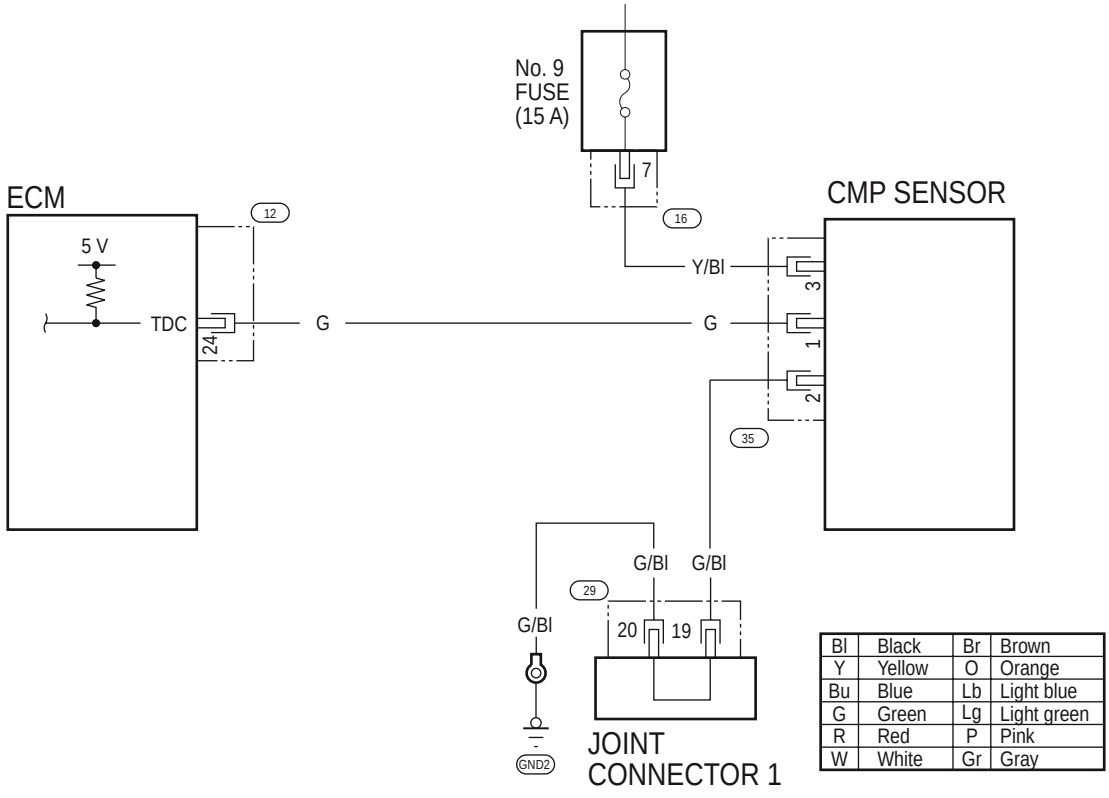
Turn the combination switch ON and measure the TP sensor voltage using the HDS.

Is the measurement within 4.49 – 4.85 V when the throttle is fully open and within 0.44 – 0.56 V when the throttle is fully closed?

YES – Replace the ECM with a new one and recheck.

NO – Repair the open circuit in the Green/Red wire. If the main wire harness is normal, replace the throttle body with a new one and recheck.

DTC 8-1, 8-2 (NO CMP SENSOR PULSE OR ABNORMAL CMP SENSOR PULSE)



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

DTC 8-1 (NO CMP SENSOR PULSE)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the CMP sensor 3P connector (35), ECM connector A (12), and joint connector 1 (29), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and check the DTC using the HDS.

Does the DTC 8-1 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. CMP sensor power line open circuit inspection

Turn the combination switch OFF and disconnect the CMP sensor 3P connector (35).

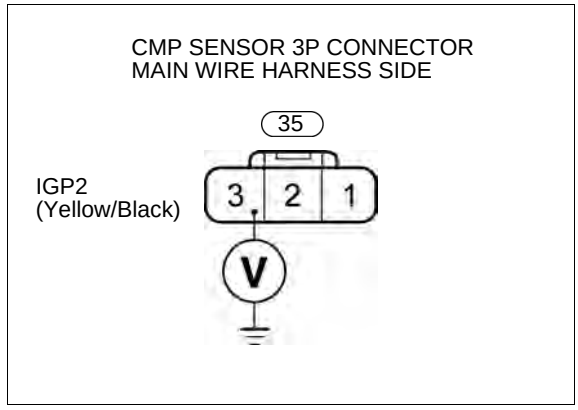
Turn the combination switch ON.

Measure the voltage between the CMP sensor 3P connector (35) main wire harness side No.3 (Yellow/Black) terminal and engine ground.

Does battery voltage exist?

YES – GO TO STEP 3.

NO – Repair open in the Yellow/Black wire. If main wire harness is normal, inspect the No.9 fuse circuit in the fuse/relay junction box (page 10-14).



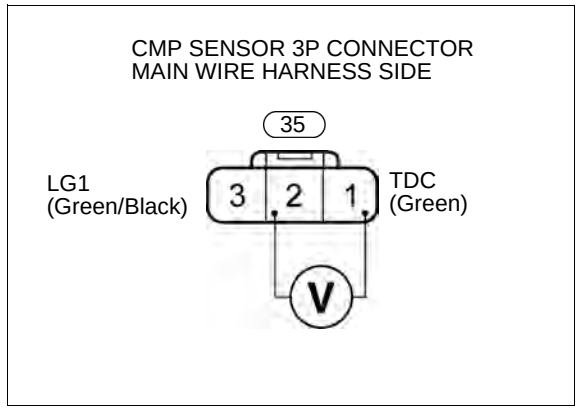
3. CMP sensor signal line open or short circuit/ GND line open circuit inspection

Measure the voltage between the CMP sensor 3P connector (35) main wire harness side No.1 (Green) terminal and No.2 (Green/Black) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the CMP sensor with a new one and recheck.

NO –
- Repair open or short in the Green wire.
- Repair open in the Green/Black wire.
- If the main wire harness is normal, replace the ECM with a new one, and recheck.



DTC 8-2 (ABNORMAL CMP SENSOR PULSE)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the CMP sensor 3P connector (35), ECM connector A (12), and joint connector 1 (29), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and check the DTC using the HDS.

Does the DTC 8-2 appear?

YES – GO TO STEP 2.

NO – Temporary failure (disappears)

2. CMP sensor installation inspection

Turn the combination switch OFF.

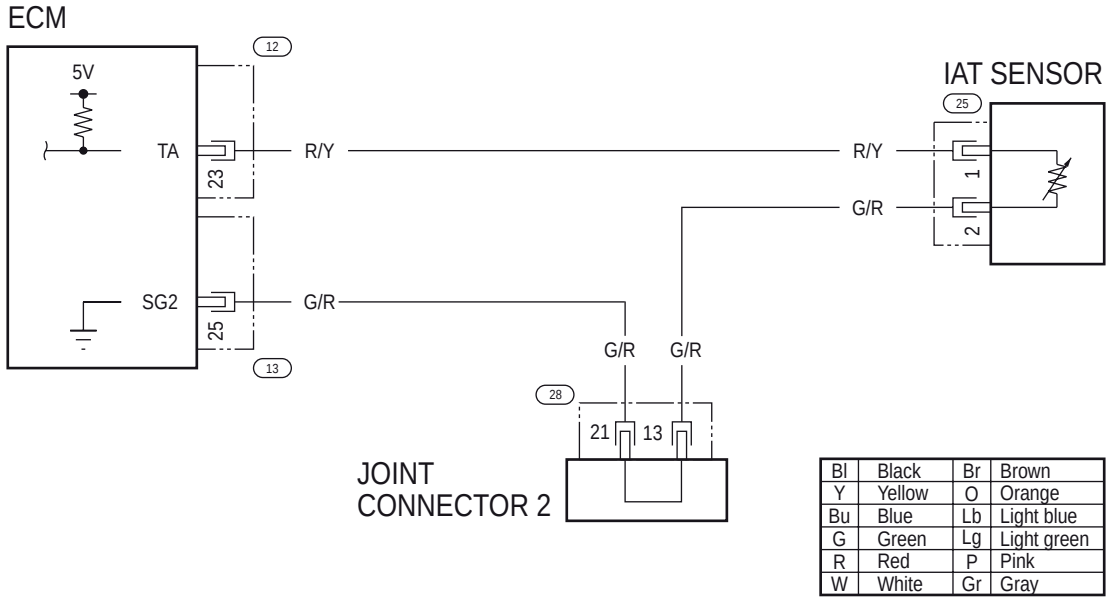
Check the installation of the CMP sensor (page 5-119).

Is the CMP sensor installation correct?

YES – Replace the CMP sensor with a new one and recheck. If the CMP sensor is replaced, but DTC 8-2 still appears, replace the ECM with a new one and recheck.

NO – Install the CMP sensor properly, and recheck.

DTC 10-1, 10-2 (IAT SENSOR VOLTAGE IS TOO LOW OR TOO HIGH)



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

DTC 10-1 (IAT SENSOR VOLTAGE IS TOO LOW)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the IAT sensor 2P connector (25), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the IAT sensor voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. IAT sensor signal line short circuit inspection

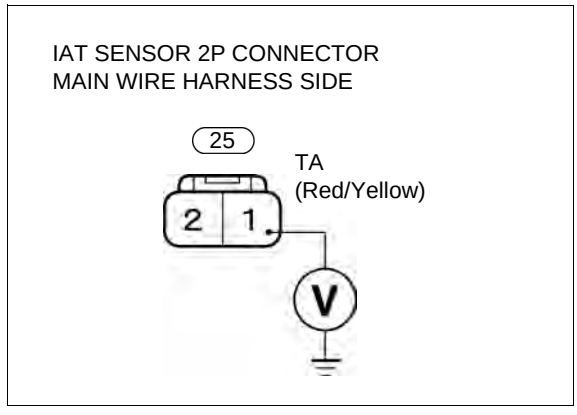
Turn the combination switch OFF and disconnect the IAT sensor 2P connector (25).

Turn the combination switch ON.
Measure the voltage between the IAT sensor 2P connector (25) main wire harness side No.1 (Red/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the IAT sensor with a new one and recheck.

NO – Repair short in the Red/Yellow wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 10-2 (IAT SENSOR VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the IAT sensor 2P connector (25), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the IAT sensor voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. IAT sensor signal line open circuit inspection

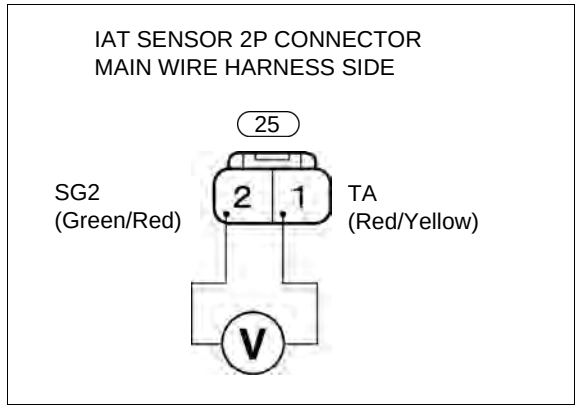
Turn the combination switch OFF and disconnect the IAT 2P connector (25).

Turn the combination switch ON.
Measure the voltage between the IAT sensor 2P connector (25) main wire harness side No.1 (Red/Yellow) terminal and No.2 (Green/Red) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the IAT sensor with a new one and recheck.

NO – Repair open in the Red/Yellow wire or Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 14-1 (ABNORMAL IAC VALVE CURRENT)



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the IAC valve 2P connector (26) and ECM connector B (13), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and check the DTC using the HDS.

Does the DTC 14-1 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. IAC valve inspection

Turn the combination switch OFF.

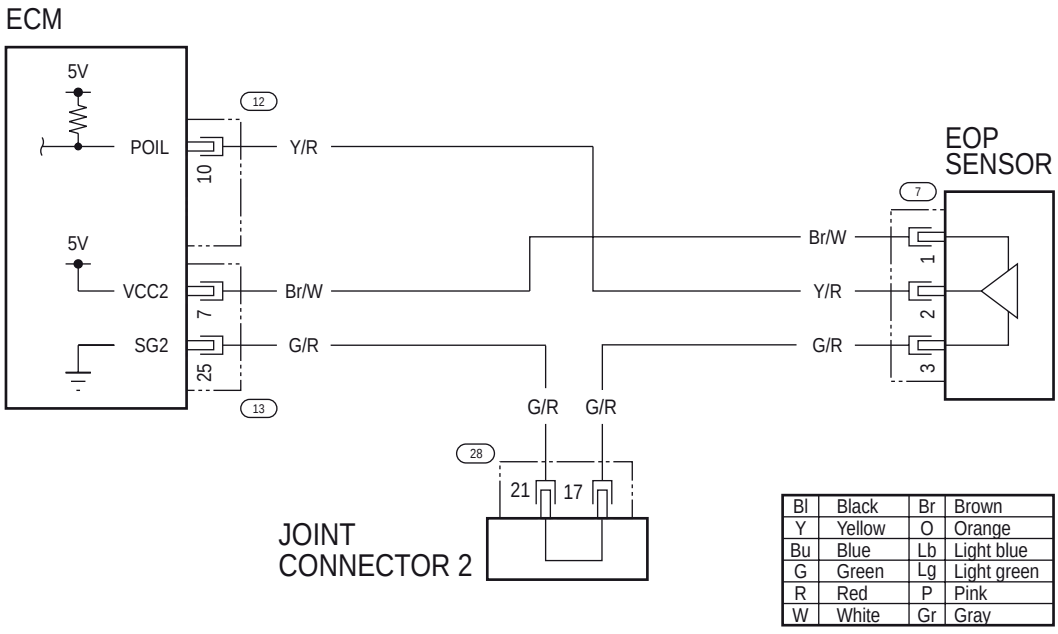
Inspect the IAC valve (page 5-138).

Is the IAC valve normal?

YES – Repair open or short in the Green/White wire or Black wire between the ECM and IAC valve. If main wire harness is normal, replace the ECM with a new one and recheck.

NO – Replace the IAC valve with a new one and recheck.

DTC 22-1, 22-2 (EOP SENSOR VOLTAGE TOO LOW OR TOO HIGH)



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

DTC 22-1 (EOP SENSOR VOLTAGE IS TOO LOW)

- When the DTC code 7-1 and 22-1 or 22-2 are indicated at the same time, the power line (VCC2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the EOP sensor 3P connector (7), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the EOP sensor voltage using the HDS.

Is the measurement within 0.30 – 4.70 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. EOP sensor signal line short circuit inspection

Turn the combination switch OFF and disconnect the EOP sensor 3P connector (7).

Turn the combination switch ON.

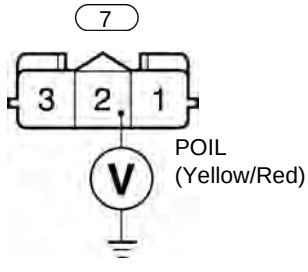
Measure the voltage between the EOP sensor 3P connector (7) main wire harness side No.2 (Yellow/Red) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair short in the Yellow/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.

EOP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



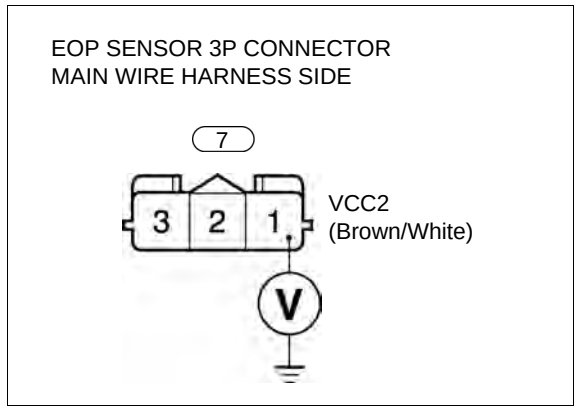
3. EOP sensor power line open circuit inspection

Measure the voltage between the EOP sensor 3P connector (7) main wire harness side No.1 (Brown/White) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the EOP sensor with a new one and recheck.

NO – Repair open in the Brown/White wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 22-2 (EOP SENSOR VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.
- When the DTC code 7-1 and 22-1 or 22-2 are indicated at the same time, the power line (VCC2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the EOP sensor 3P connector (7), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the EOP sensor voltage using the HDS.

Is the measurement within 0.30 – 4.70 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. EOP sensor power line open circuit inspection

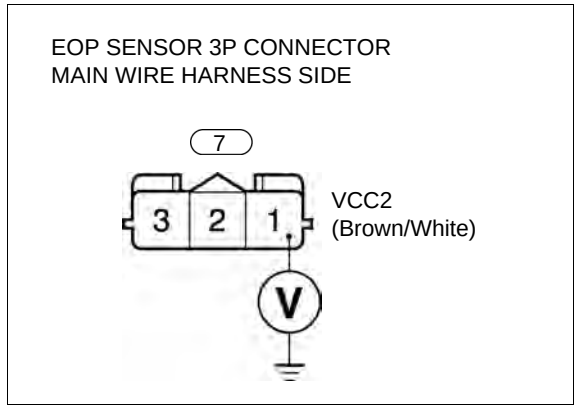
Turn the combination switch OFF and disconnect the EOP sensor 3P connector (7).

Turn the combination switch ON.
Measure the voltage between the EOP sensor 3P connector (7) main wire harness side No.1 (Brown/White) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair open in the Brown/White wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



3. EOP sensor signal/GND line open circuit inspection

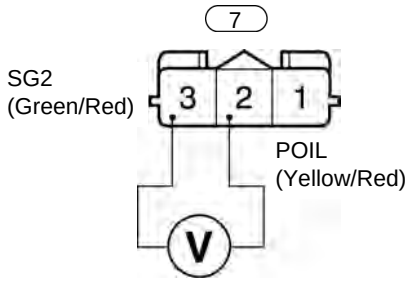
Measure the voltage between the EOP sensor 3P connector (7) main wire harness side No.2 (Yellow/Red) terminal and No.3 (Green/Red) terminal.

Is the measurement within 4.75 – 5.25 V?

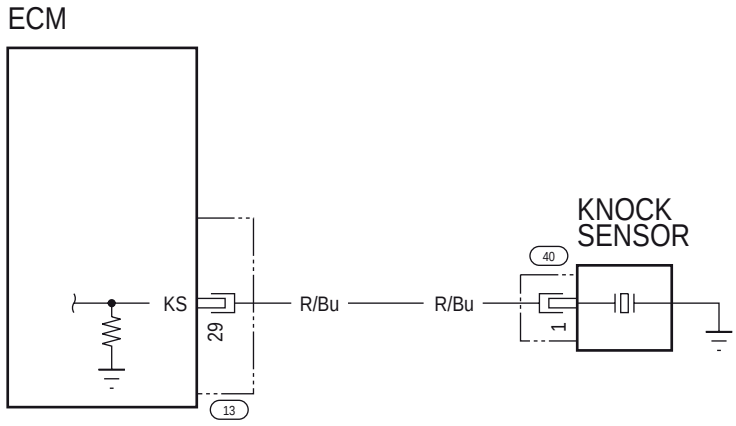
YES – Replace the EOP sensor with a new one and recheck.

NO –
- Repair open in the Yellow/Red wire.
- Repair open in the Green/Red wire.
- If the main wire harness is normal, replace the ECM with a new one, and recheck.

EOP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



DTC 23-1 (ABNORMAL KNOCK SENSOR DETECTION)



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the knock sensor 1P connector (40) and ECM connector B (13), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).
Increase the engine speed gradually and run it at 3,000 – 4,000 min^{-1} (rpm) for 10 seconds.

Recheck the DTC with the HDS.

Does the DTC 23-1 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. Knock sensor line open or short circuit inspection

Turn the combination switch OFF.

Disconnect the knock sensor 1P connector (40) and ECM connector B (13).

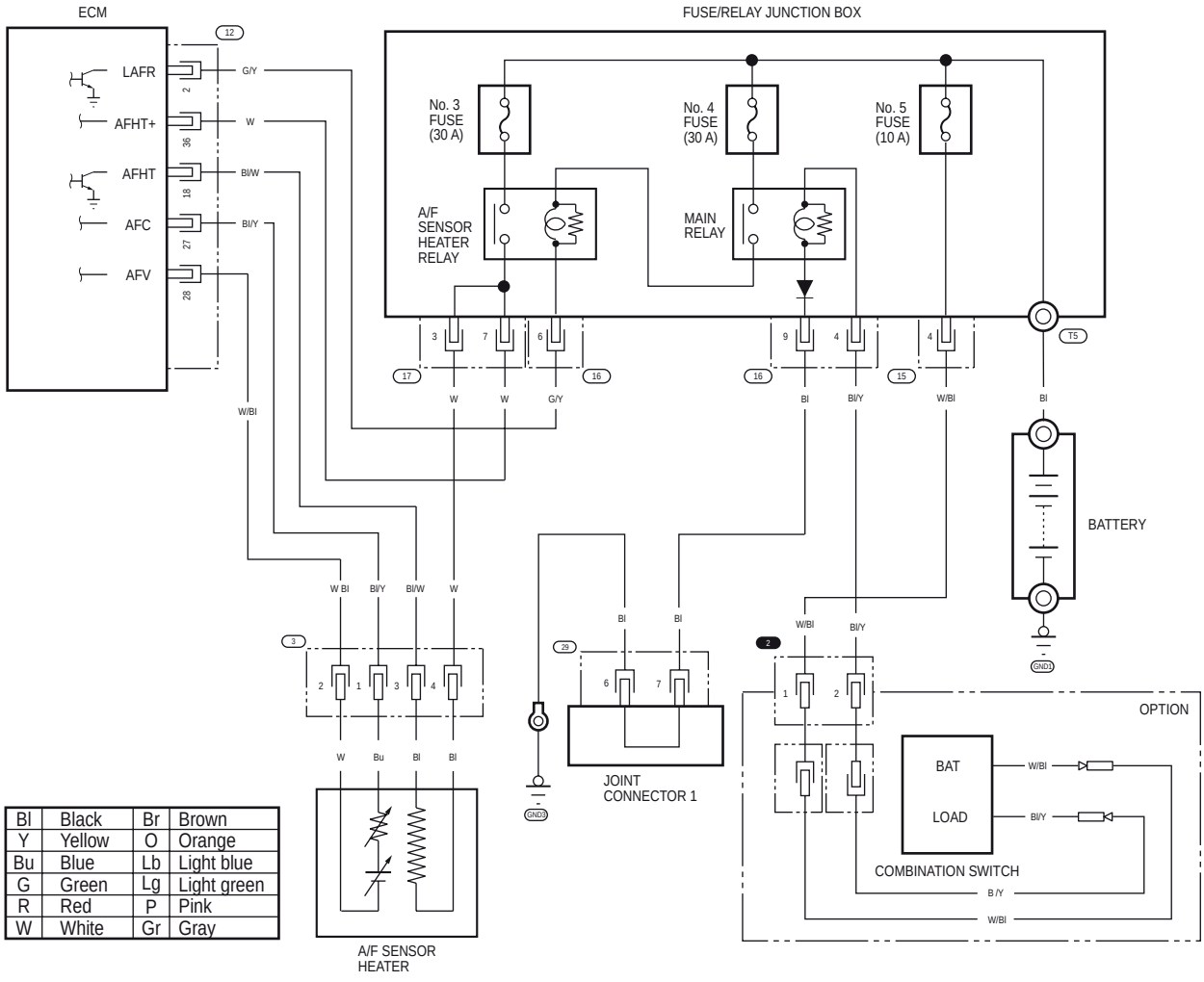
Check for open and short circuit between the knock sensor 1P connector (40) main wire harness side No.1 (Red/Blue) terminal and ECM connector B (13) No.29 (Red/Blue) terminal.

Is the knock sensor line normal?

YES – Replace the knock sensor with a new one and recheck. If the knock sensor is replaced, but DTC 23-1 still appears, replace the ECM with a new one and recheck.

NO – Repair open or short in the Red/Blue wire.

DTC 41-3, 41-4 (ABNORMAL A/F SENSOR HEATER CURRENT)



DTC 41-3 (ABNORMAL A/F SENSOR HEATER HIGH CURRENT OR LOW CURRENT)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3), fuse/relay junction box 23P connector (16), fuse/relay junction box 10P connector (17), and ECM connector A (12), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).

Check the DTC using the HDS.

Does the DTC 41-3 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. Fuse inspection

Turn the combination switch OFF.

Check for blown No.3 fuse.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 3.

3. A/F sensor heater inspection

Turn the combination switch OFF.

Inspect the A/F sensor heater (page 5-139).

Is the A/F sensor heater normal?

YES – GO TO STEP 4.

NO – Replace the A/F sensor with a new one and recheck.

4. A/F sensor heater relay inspection

Inspect the A/F sensor heater relay (page 10-13).

Is the A/F sensor heater relay normal?

YES – GO TO STEP 5.

NO – Replace the A/F sensor heater relay with a new one and recheck.

5. Fuse/relay junction box inspection

Inspect the A/F sensor heater relay circuit in the fuse/relay junction box (page 10-14).

Is the fuse/relay junction box normal?

YES –
- Repair open in the White wire between the fuse/relay junction box and A/F sensor.
- Repair open in the White wire between the ECM and fuse/relay junction box.
- Repair open or short in the Black/White wire between the ECM and A/F sensor.
- Repair open or short in the Green/yellow wire between the ECM and fuse/relay junction box.
- If the wire harness is normal, replace the ECM with a new one and recheck.

NO – Replace the fuse/relay junction box with a new one and recheck.

DTC 41-4 (ABNORMAL CURRENT)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3), fuse/relay junction box 23P connector (16), fuse/relay junction box 10P connector (17), and ECM connector A (12), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).

Check the DTC using the HDS.

Does the DTC 41-4 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. Fuse inspection

Turn the combination switch OFF.

Check for blown No.3 fuse.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 3.

3. A/F sensor heater inspection

Turn the combination switch OFF.

Inspect the A/F sensor heater (page 5-139).

Is the A/F sensor heater normal?

YES – GO TO STEP 4.

NO – Replace the A/F sensor with a new one and recheck.

4. A/F sensor heater relay inspection

Inspect the A/F sensor heater relay (page 10-13).

Is the A/F sensor heater relay normal?

YES – GO TO STEP 5.

NO – Replace the A/F sensor heater relay with a new one and recheck.

5. Fuse/relay junction box inspection

Inspect the A/F sensor heater relay circuit in the fuse/relay junction box (page 10-14).

Is the fuse/relay junction box normal?

YES – GO TO STEP 6.

NO – Replace the fuse/relay junction box with a new one and recheck.

6. A/F sensor line short circuit inspection

Disconnect the ECM connector A (12).

Check for continuity between the following terminals.

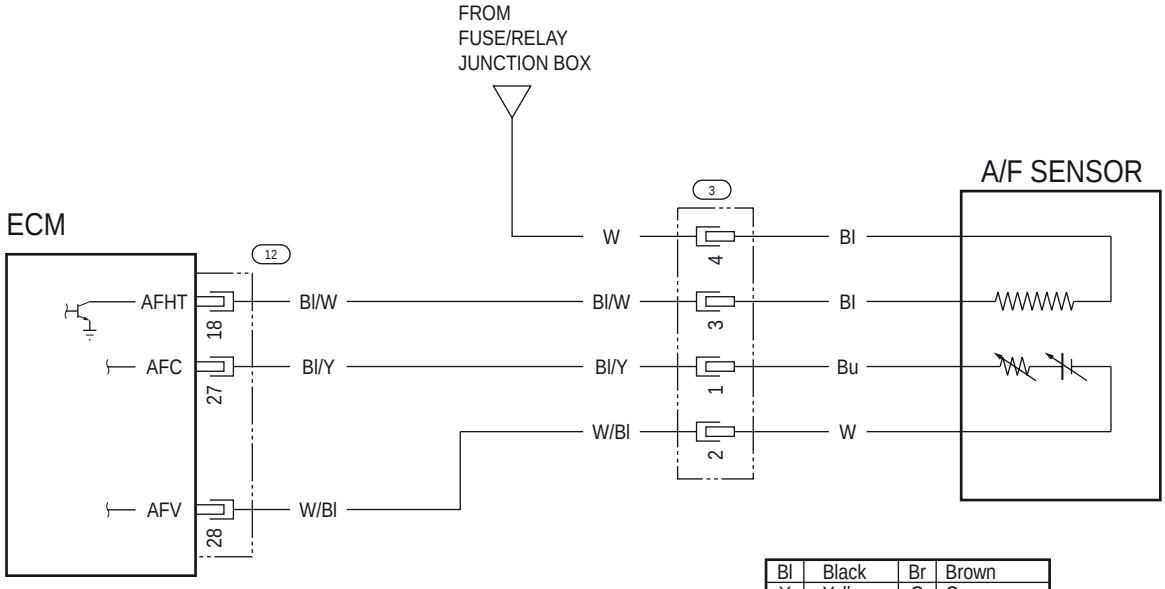
– A/F sensor 4P connector (3) main wire harness side No.1 (Black/yellow) terminal and ECM connector A (12) main wire harness side No.18 (Black/White) terminal
– A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and ECM connector A (12) main wire harness side No.18 (Black/White) terminal
– A/F sensor 4P connector (3) main wire harness side No.1 (Black/yellow) terminal and ECM connector A (12) main wire harness side No.36 (White) terminal
– A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and ECM connector A (12) main wire harness side No.36 (White) terminal

Is there continuity?

YES –
- Repair short in the Black/yellow wire and Black/White wire between the ECM and A/F sensor.
- Repair short in the White/Black wire and Black/White wire between the ECM and A/F sensor.
- Repair short in the Black/yellow wire and White wire between the ECM and A/F sensor.
- Repair short in the White/Black wire and White wire between the ECM and A/F sensor.

NO –
- Repair open in the White wire between the fuse/relay junction box and A/F sensor.
- Repair open in the White wire between the ECM and fuse/relay junction box.
- Repair open or short in the Black/White wire between the ECM and A/F sensor.
- Repair open or short in the Green/Yellow wire between the ECM and fuse/relay junction box.
- If the wire harness is normal, replace the A/F sensor with a new one and recheck.
- If the A/F sensor is replaced, but DTC 41-4 still appears, replace the ECM with a new one and recheck.

DTC 48-5, 48-6, 48-7 (ABNORMAL A/F SENSOR CURRENT)



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

DTC 48-5 (OPEN CIRCUIT IN A/F SENSOR WIRE (AFV/AFC))

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3) and ECM connector A (12), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).
Then run the engine at 3,000 min^{-1} (rpm) for 1 minute.

Recheck the DTC with the HDS.

Does the DTC 48-5 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. A/F sensor line open circuit inspection

Turn the combination switch OFF.
Disconnect the A/F sensor 4P connector (3) and ECM connector A (12).

Check for open circuit between the A/F sensor 4P connector (3) main wire harness side No.1 (Black/Yellow) terminal and ECM connector A (12) main wire harness side No.27 (Black/Yellow) terminal.

Check for open circuit between the A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and ECM connector A (12) main wire harness side No.28 (White/Black) terminal.

Is the A/F sensor line open?

YES – Repair open in the Black/Yellow wire or White/Black wire.

NO – Replace the A/F sensor with a new one and recheck. If the A/F sensor is replaced, but DTC 48-5 still appears, replace the ECM with a new one and recheck.

DTC 48-6 (SHORT CIRCUIT IN A/F SENSOR (AFV))

1. Symptom reproduction test

Turn the combination switch OFF.
Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).
Then run the engine at 3,000 min^{-1} (rpm) for 1 minute.

Recheck the DTC with the HDS.

Does the DTC 48-6 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. A/F sensor AFV line short circuit inspection

Turn the combination switch OFF.
Disconnect the A/F sensor 4P connector (3) and ECM connector A (12).

Check for continuity between the A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and engine ground.

Is there continuity?

YES – Repair short in the White/Black wire between the ECM and A/F sensor.

NO – Replace the A/F sensor with a new one and recheck. If the A/F sensor is replaced, but DTC 48-6 still appears, replace the ECM with a new one and recheck.

DTC 48-7 (SHORT CIRCUIT IN A/F SENSOR (AFC))

1. Symptom reproduction test

Turn the combination switch OFF.
Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).
Then run the engine at 3,000 min^{-1} (rpm) for 1 minute.

Recheck the DTC with the HDS.

Does the DTC 48-7 appear?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. A/F sensor AFC line short circuit inspection

Turn the combination switch OFF.
Disconnect the A/F sensor 4P connector (3) and ECM connector A (12).

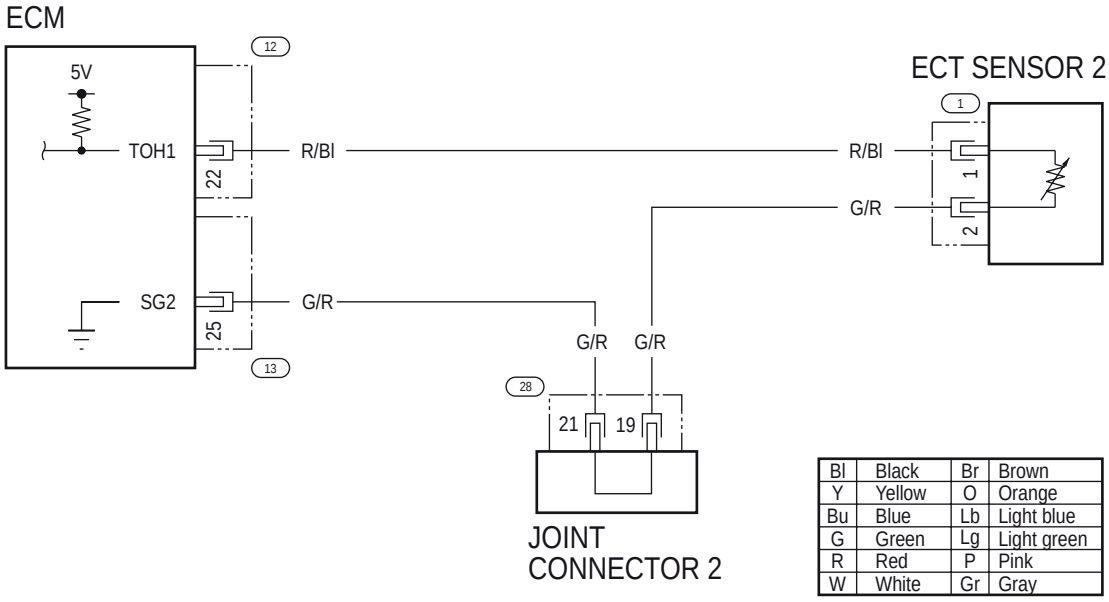
Check for continuity between the A/F sensor 4P connector (3) main wire harness side No.1 (Black/Yellow) terminal and engine ground.

Is there continuity?

YES – Repair short in the Black/Yellow wire between the ECM and A/F sensor.

NO – Replace the A/F sensor with a new one and recheck. If the A/F sensor is replaced, but DTC 48-7 still appears, replace the ECM with a new one and recheck.

DTC 140-1, 140-2 (ECT SENSOR 2 VOLTAGE IS TOO LOW OR TOO HIGH)



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

DTC 140-1 (ECT SENSOR 2 VOLTAGE IS TOO LOW)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 2 (2P) connector (1), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 2 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 2 signal line short circuit inspection

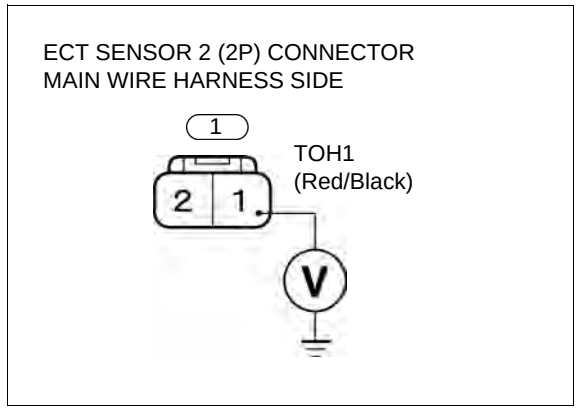
Turn the combination switch OFF and disconnect the ECT sensor 2 (2P) connector (1).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 2 (2P) connector (1) main wire harness side No.1 (Red/Black) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 2 with a new one and recheck.

NO – Repair short in the Red/Black wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 140-2 (ECT SENSOR 2 VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 2 (2P) connector (1), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 2 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 2 signal/GND line open circuit inspection

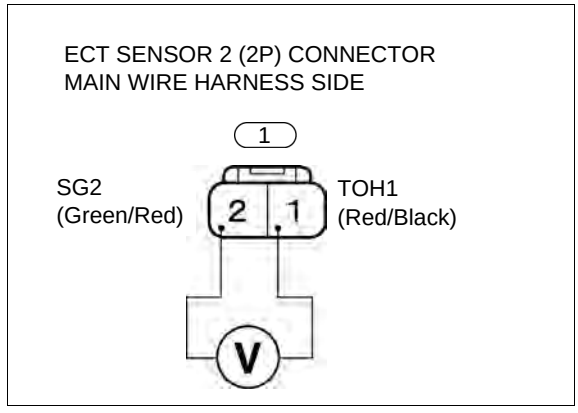
Turn the combination switch OFF and disconnect the ECT sensor 2 (2P) connector (1).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 2 (2P) connector (1) main wire harness side No.1 (Red/Black) terminal and No.2 (Green/Red) terminal.

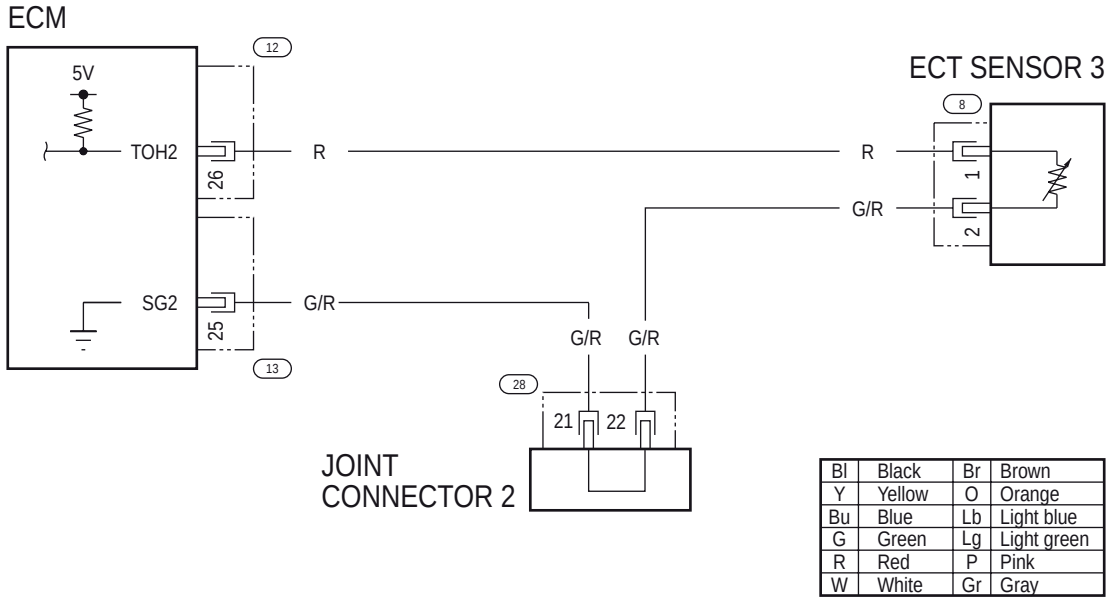
Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 2 with a new one and recheck.

NO – Repair open in the Red/Black wire or Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 141-1, 141-2 (ECT SENSOR 3 VOLTAGE IS TOO LOW OR TOO HIGH)



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

DTC 141-1 (ECT SENSOR 3 VOLTAGE IS TOO LOW)

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 3 (2P) connector (8), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 3 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 3 signal line short circuit inspection

Turn the combination switch OFF and disconnect the ECT sensor 3 (2P) connector (8).

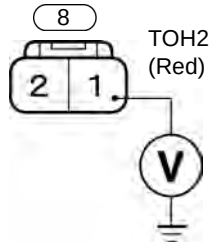
Turn the combination switch ON.
Measure the voltage between the ECT sensor 3 (2P) connector (8) main wire harness side No.1 (Red) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace ECT sensor 3 with a new one and recheck.

NO – Repair short in the Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.

ECT SENSOR 3 (2P) CONNECTOR
MAIN WIRE HARNESS SIDE



DTC 141-2 (ECT SENSOR 3 VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 3 (2P) connector (8), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 3 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 3 signal/GND line open circuit inspection

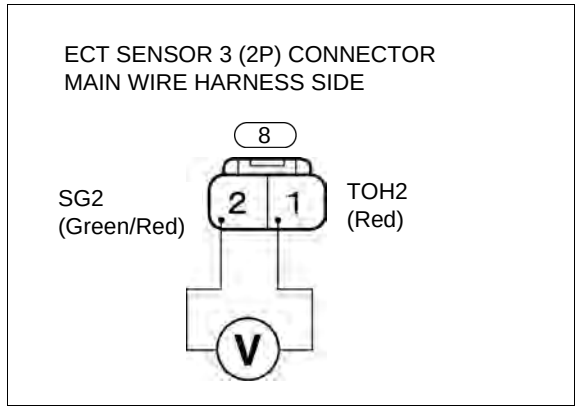
Turn the combination switch OFF and disconnect the ECT sensor 3 (2P) connector (8).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 3 (2P) connector (8) main wire harness side No.1 (Red) terminal and No.2 (Green/Red) terminal.

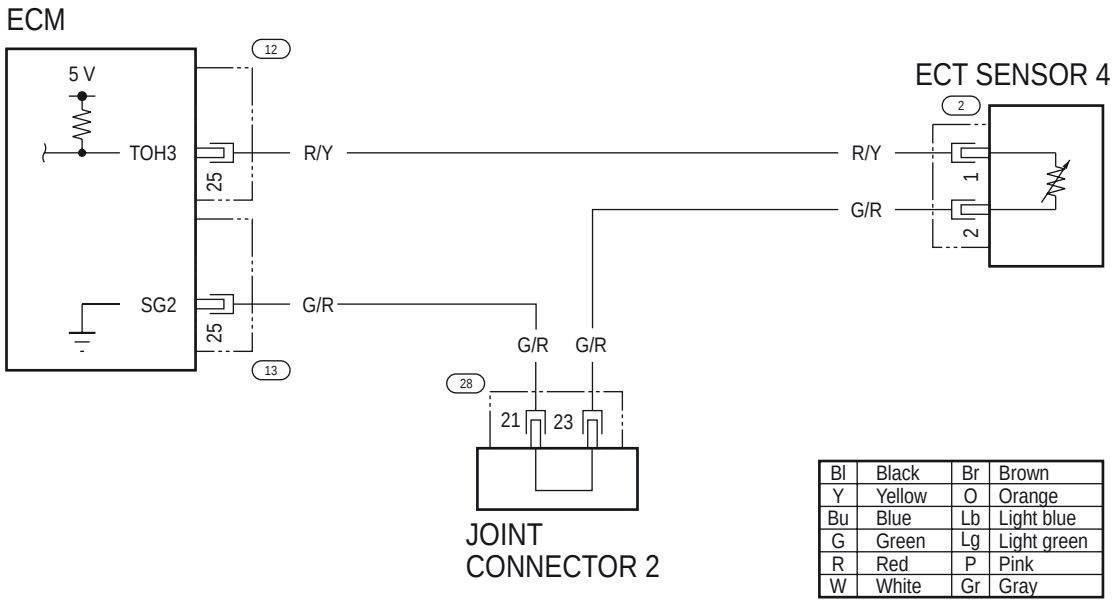
Is the measurement within 4.75 – 5.25 V?

YES – Replace ECT sensor 3 with a new one and recheck.

NO – Repair open in the Red wire or Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



DTC 143-1, 143-2 (ECT SENSOR 4 VOLTAGE IS TOO LOW OR TOO HIGH)



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

DTC 143-1 (ECT SENSOR 4 VOLTAGE IS TOO LOW)

1. Symptom reproduction test

Turn the combination switch OFF.
Disconnect the ECT sensor 4 (2P) connector (2), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 4 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 4 signal line short circuit inspection

Turn the combination switch OFF and disconnect the ECT sensor 4 (2P) connector (2).

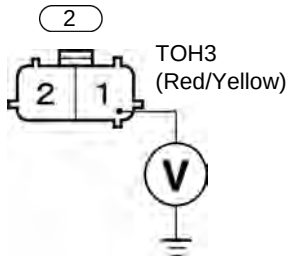
Turn the combination switch ON.
Measure the voltage between the ECT sensor 4 (2P) connector (2) main wire harness side No.1 (Red/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – Replace ECT sensor 4 with a new one and recheck.

NO – Repair short in the Red/Yellow wire. If the main wire harness is normal, replace the ECM with a new one and recheck.

ECT SENSOR 4 (2P) CONNECTOR
MAIN WIRE HARNESS SIDE



DTC 143-2 (ECT SENSOR 4 VOLTAGE IS TOO HIGH)

- When the DTC code 6-2, 7-2, 10-2, 22-2, 140-2, 141-2, and 143-2 are indicated at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 4 (2P) connector (2), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

- Continue the procedure if the DTC does not clear.

Turn the combination switch ON.
Measure the ECT sensor 4 voltage using the HDS.

Is the measurement within 0.08 – 4.92 V?

YES – Temporary failure (code does not reappear)

NO – GO TO STEP 2.

2. ECT sensor 4 signal/GND line open circuit inspection

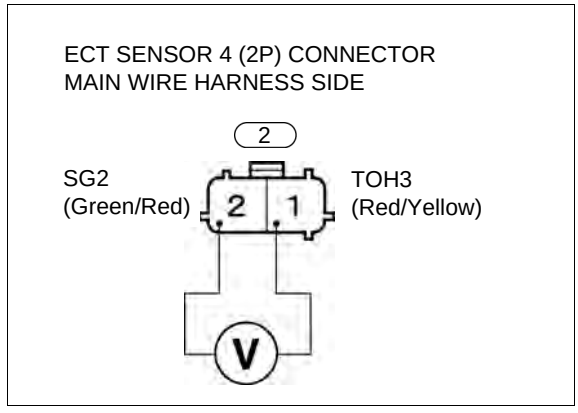
Turn the combination switch OFF and disconnect the ECT sensor 4 (2P) connector (2).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 4 (2P) connector (2) main wire harness side No.1 (Red/Yellow) terminal and No.2 (Green/Red) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – Replace ECT sensor 4 with a new one and recheck.

NO – Repair open in the Red/Yellow wire or Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



MIL TROUBLESHOOTING

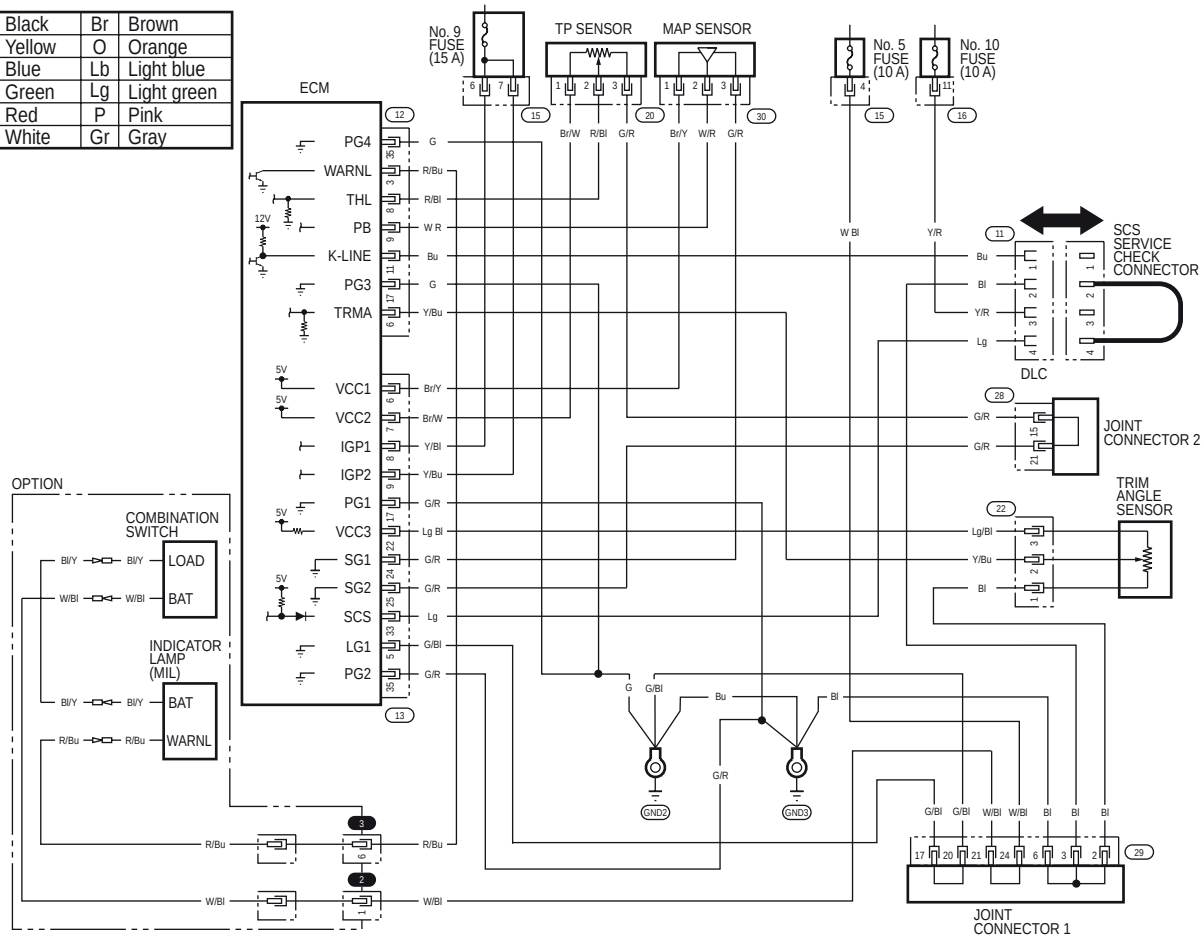
MIL INDEX

MIL		Detected component	Probable cause	Ref. page
No. of blinks	Condition			
MIL does not blink	Detected component 	ECM	• Loose or poor contact of the connector • Faulty indicator light • Open circuit in MIL wire • Open circuit in ECM power/ground cable • Faulty ECM	4-15
Stays ON	ON 	ECM	Normal with the SCS service check connector installed - If engine condition continues without the MIL blinking, check the following: • Short circuit in DLC wire • Short circuit in MIL wire • Short circuit in sensor power circuit • Faulty ECM	5-55
3	Blink 	MAP sensor (voltage too low or too high)	• Loose or poor contact of the connector • Open or short circuit in MAP sensor wire • Faulty MAP sensor	5-58
4	Blink 	CKP sensor (no pulse or abnormal pulse)	• Loose or poor contact of the connector • Open or short circuit in CKP sensor wire • Faulty CKP sensor • CKP sensor is not installed properly	5-59
6	Blink 	ECT sensor 1 (voltage too low or too high)	• Loose or poor contact of the connector • Open or short circuit in ECT sensor 1 wire • Faulty ECT sensor 1	5-61
7	Blink 	TP sensor (voltage too low or too high)	• Loose or poor contact of the connector • Open and short circuit in TP sensor wire • Faulty TP sensor	5-62
8	Blink 	CMP sensor (no pulse or abnormal pulse)	• Loose or poor contact of the connector • Open or short circuit in CMP sensor wire • Faulty CMP sensor • CMP sensor is not installed properly	5-64
10	Blink 	IAT sensor (voltage too low or too high)	• Loose or poor contact of the connector • Open and short circuit in IAT sensor wire • Faulty IAT sensor	5-66
14	Blink 	IAC valve (abnormal current)	• Loose or poor contact of the connector • Open and short circuit in IAC valve wire • Faulty IAC valve	5-67
22	Blink 	EOP sensor (voltage too low or too high)	• Loose or poor contact of the connector • Open and short circuit in EOP sensor wire • Faulty EOP sensor	5-68

MIL		Detected component	Probable cause	Ref. page
No. of blinks	Condition			
23	Blink 	Knock sensor (abnormal detection)	• Loose or poor contact of the connector • Open and short circuit in knock sensor wire • Faulty knock sensor	5-70
24	Blink 	ECT sensor 2 (voltage too low or too high)	• Loose or poor contact of the connector • Open and short circuit in ECT sensor 2 wire • Faulty ECT sensor 2	5-71
25	Blink 	ECT sensor 3 (voltage too low or too high)	• Loose or poor contact of the connector • Open and short circuit in ECT sensor 3 wire • Faulty ECT sensor 3	5-72
27	Blink 	ECT sensor 4 (voltage too low or too high)	• Loose or poor contact of the connector • Open and short circuit in ECT sensor 4 wire • Faulty ECT sensor 4	5-73
41	Blink 	A/F sensor heater (abnormal current)	• Loose or poor contact of the connector • Open and short circuit in A/F sensor heater wire • Faulty A/F sensor heater • Faulty A/F sensor heater relay	5-74
48	Blink 	A/F sensor (abnormal current)	• Loose or poor contact of the connector • Open and short circuit in A/F sensor wire • Faulty A/F sensor	5-77

MIL TURNS ON BUT DOES NOT BLINK WITH SCS SERVICE CHECK CONNECTOR CONNECTED

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. DLC signal line short circuit inspection

Turn the combination switch OFF and remove the SCS service check connector (1) from DLC (11) (2).

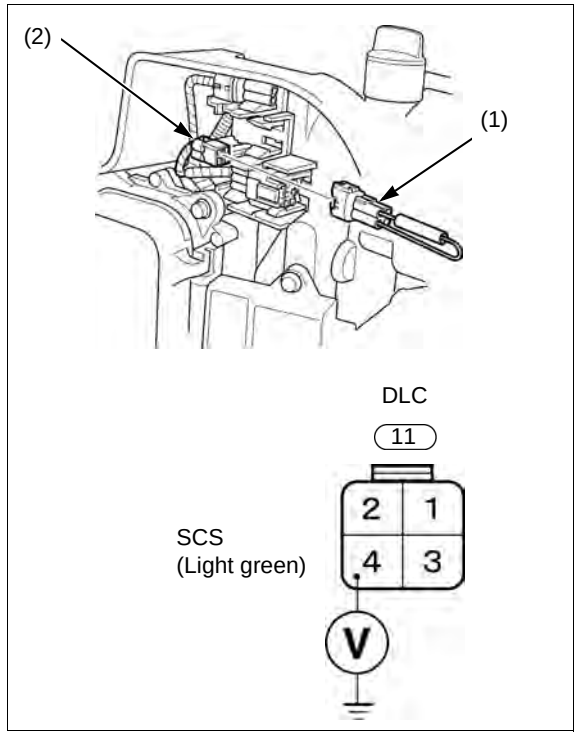
Turn the combination switch ON.

Measure the voltage between the DLC (11) No.4 (Light green) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 2.

NO – Repair short in the Light green wire.



2. MIL ON line short circuit inspection

Turn the combination switch OFF.
Disconnect the ECM connector A (12).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – GO TO STEP 3.

NO – Repair short in the main wire harness between the ECM and the MIL.

3. MAP sensor power line short circuit inspection 1

Turn the combination switch OFF.
Connect ECM connector A (12).
Disconnect the MAP sensor 3P connector (30).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – Replace the MAP sensor.

NO – GO TO STEP 4.

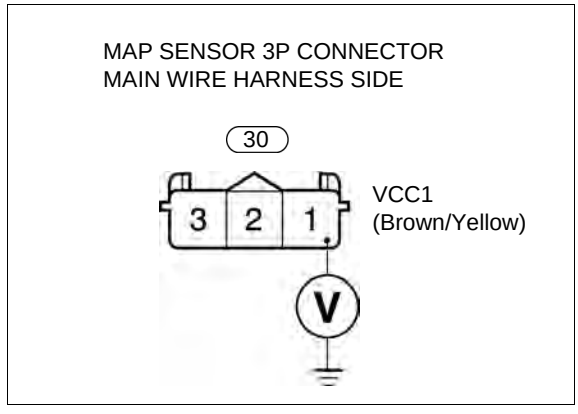
4. MAP sensor power line short circuit inspection 2

Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.1 (Brown/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 5.

NO – Repair short in the Brown/Yellow wire.



5. TP sensor power line short circuit inspection 1

Turn the combination switch OFF.
Disconnect the TP sensor 3P connector (20).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – Replace the TP sensor.

NO – GO TO STEP 6.

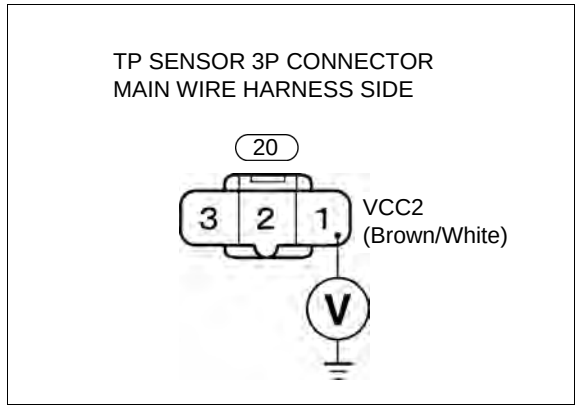
6. TP sensor power line short circuit inspection 2

Measure the voltage between the TP sensor 3P connector (20) main wire harness side No.1 (Brown/White) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 7.

NO – Repair short in the Brown/White wire.



7. Trim angle sensor power line short circuit inspection 1

Turn the combination switch OFF.
Disconnect the trim angle sensor 3P connector (22).

Turn the combination switch ON and check the MIL.

Does the MIL go OFF?

YES – Replace the trim angle sensor.

NO – GO TO STEP 8.

8. Trim angle sensor power line short circuit inspection 2

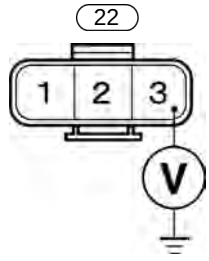
Measure the voltage between the trim angle sensor 3P connector (22) main wire harness side No.3 (Light green/Black) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

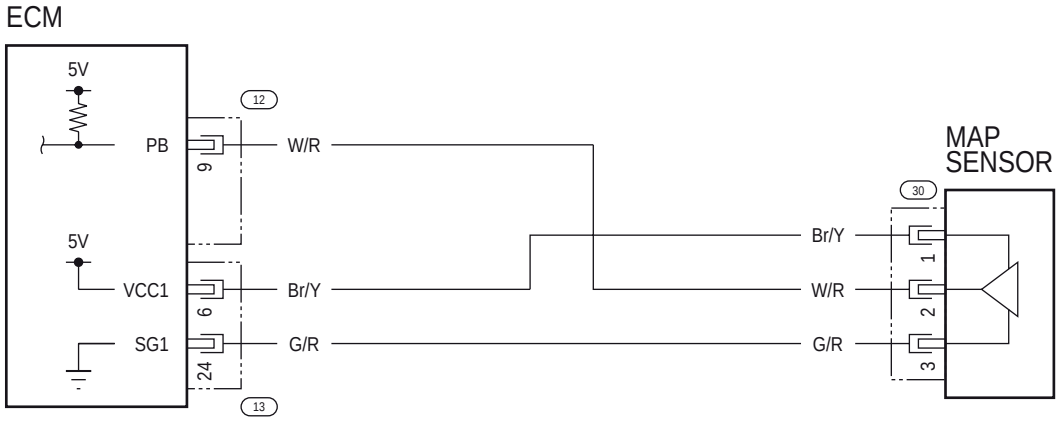
YES – Replace the ECM with a new one and recheck.

NO – Repair short in the Light green/Black wire.

TRIM ANGLE SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



MIL BLINKS 3 (MAP SENSOR)



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the MAP sensor 3P connector (30), ECM connector A (12), and ECM connector B (13), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine.

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 3?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. MAP sensor power line open circuit inspection

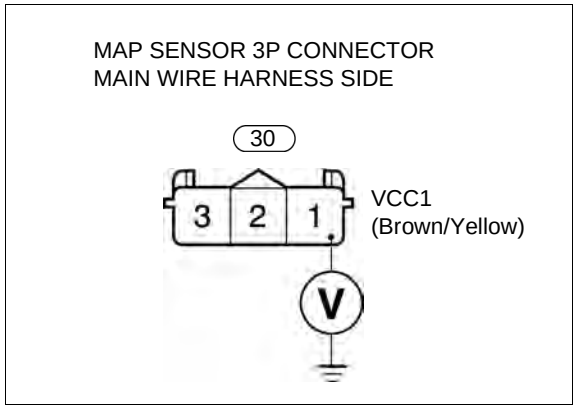
Turn the combination switch OFF and disconnect the MAP sensor 3P connector (30).

Turn the combination switch ON.
Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.1 (Brown/Yellow) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair open in the Brown/Yellow wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



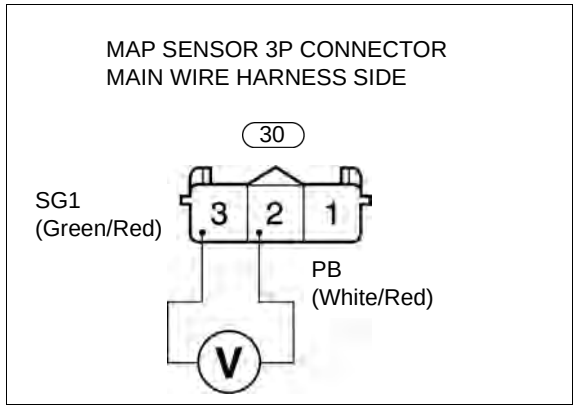
3. MAP sensor signal open or short circuit/GND line open circuit inspection

Measure the voltage between the MAP sensor 3P connector (30) main wire harness side No.2 (White/Red) terminal and No.3 (Green/Red) terminal.

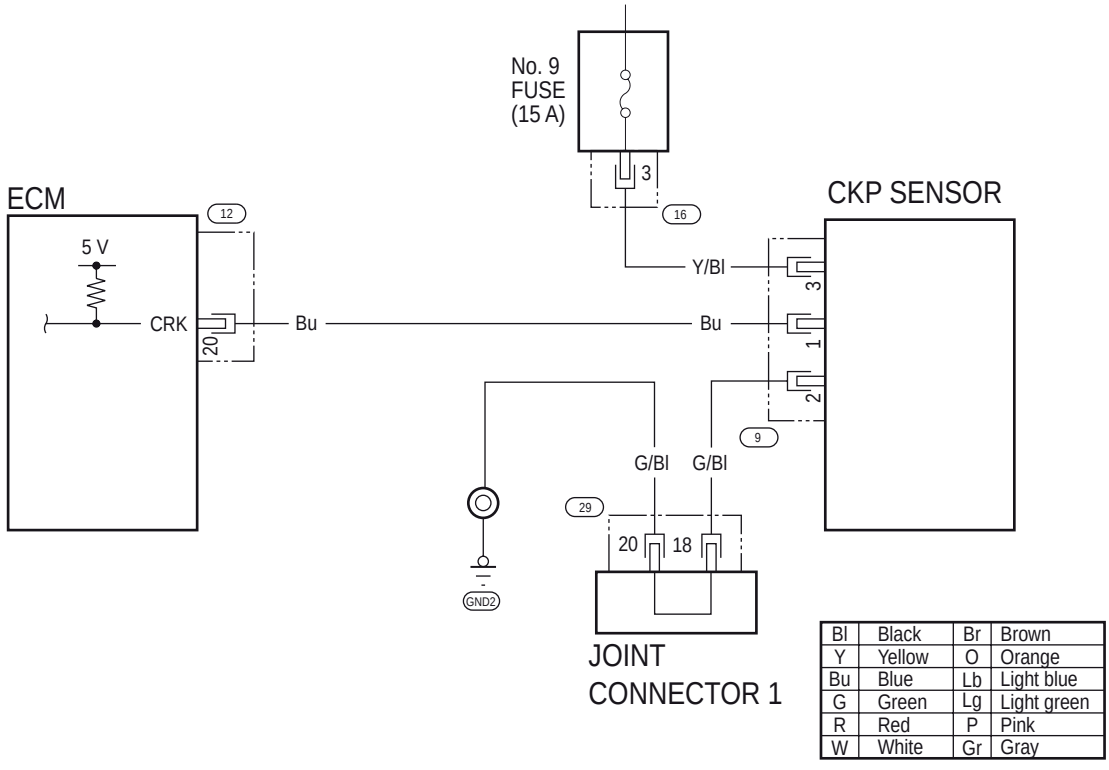
Is the measurement within 4.75 – 5.25 V?

YES – Replace the MAP sensor with a new one and recheck.

NO – • Repair open or short in the White/Red wire.
• Repair open in the Green/Red wire.
• If the main wire harness is normal, replace the ECM with a new one, and recheck.



MIL BLINKS 4 (CKP SENSOR)



1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the CKP sensor 3P connector (9), ECM connector A (12), and joint connector 1 (29), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine.
Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 4?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. CKP sensor power line open circuit inspection

Turn the combination switch OFF and disconnect the CKP sensor 3P connector (9).

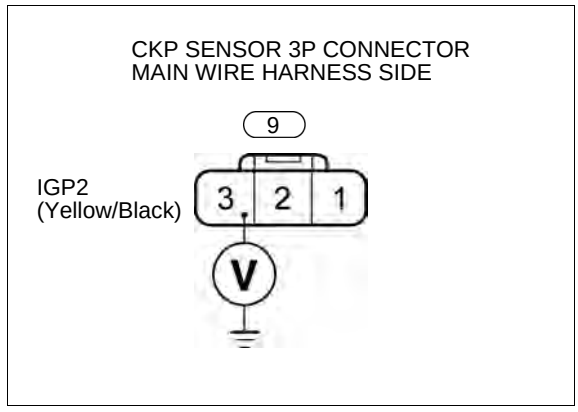
Turn the combination switch ON.

Measure the voltage between the CKP sensor 3P connector (9) main wire harness side No.3 (Yellow/Black) terminal and engine ground.

Does battery voltage exist?

YES – GO TO STEP 3.

NO – Repair open in the Yellow/Black wire. If main wire harness is normal, inspect the No.9 fuse circuit in the fuse/relay junction box (page 10-14).



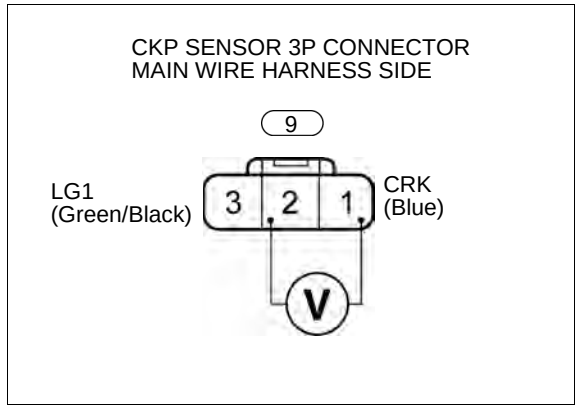
3. CKP sensor signal line open or short circuit/ GND line open circuit inspection

Measure the voltage between the CKP sensor 3P connector (9) main wire harness side No.1 (Blue) terminal and No.2 (Green/Black) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 4.

NO –
- Repair open or short in the Blue wire
- Repair open in the Green/Black wire
- If the main wire harness is normal, replace the ECM with a new one, and recheck.



4. CKP sensor installation inspection

Turn the combination switch OFF.

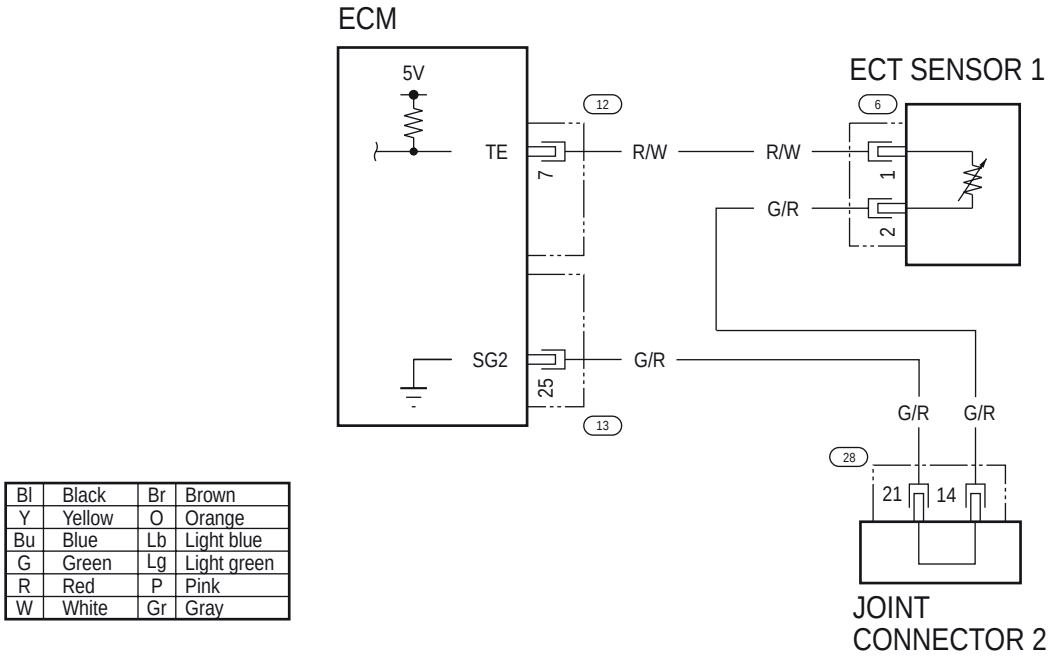
Check the installation of the CKP sensor (page 5-118).

Is the CKP sensor installation correct?

YES – Replace the CKP sensor with a new one and recheck. If the CKP sensor is replaced, but MIL blinks 4, replace the ECM with a new one and recheck.

NO – Install the CKP sensor properly, and recheck.

MIL BLINKS 6 (ECT SENSOR 1)



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

- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 1 (2P) connector (6), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 6?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. ECT sensor 1 signal line open or short circuit/ GND line open circuit inspection

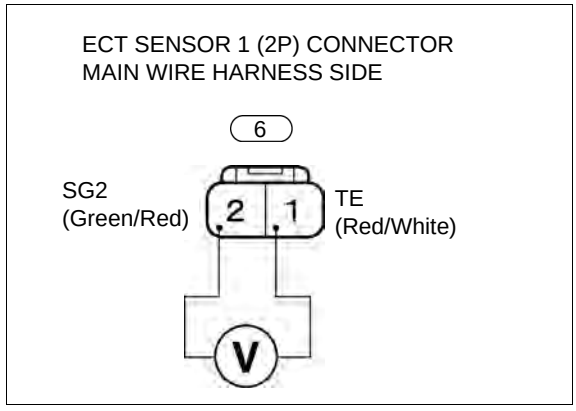
Turn the combination switch OFF and disconnect the ECT sensor 1 (2P) connector (6).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 1 (2P) connector (6) main wire harness side No.1 (Red/White) terminal and No.2 (Green/Red) terminal.

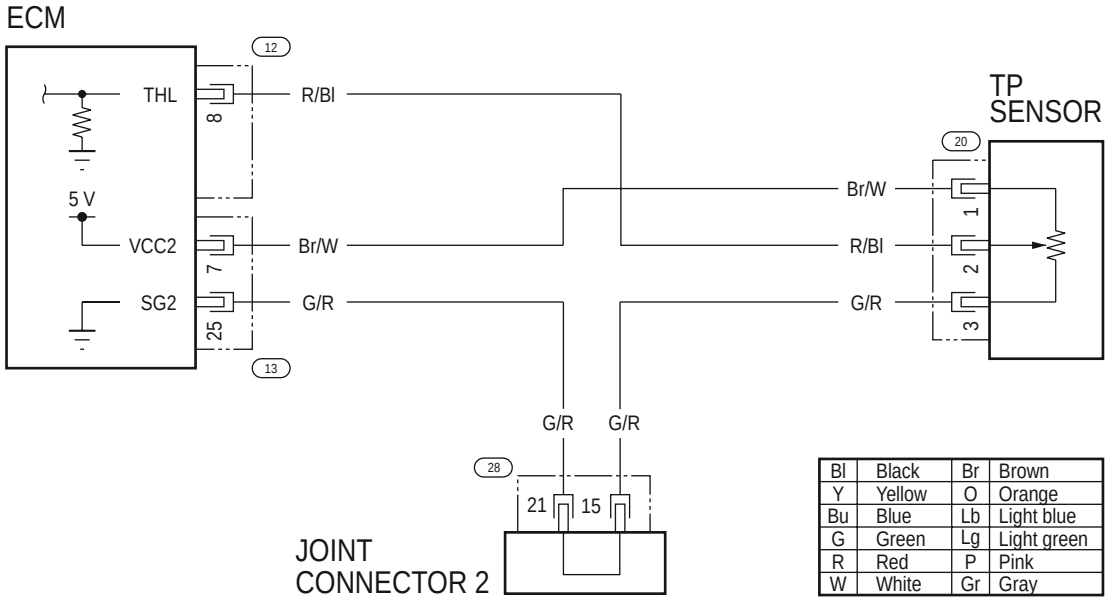
Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 1 with a new one and recheck.

NO – Repair open or short in the Red/White wire or open circuit in the Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



MIL BLINKS 7 (TP SENSOR)



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

- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.
- When the MIL blinks 7 and 22 at the same time, the power line (VCC2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the TP sensor 3P connector (20), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine.

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 7?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. TP sensor power/GND line open circuit inspection

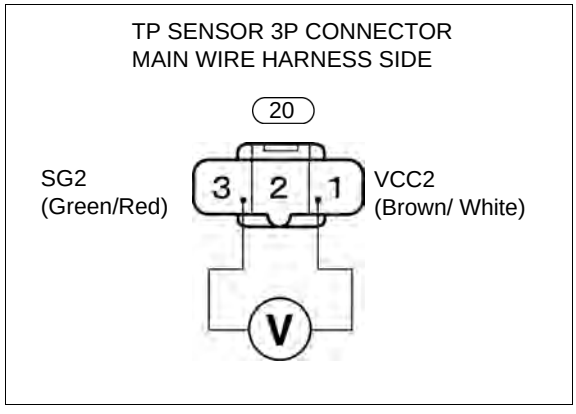
Turn the combination switch OFF and disconnect the TP sensor 3P connector (20).

Turn the combination switch ON.
Measure the voltage between the TP sensor 3P connector (20) main wire harness side No.1 (Brown/White) terminal and No.3 (Green/Red) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair open in the Brown/White wire or Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



3. TP sensor signal line open or short circuit inspection

Turn the combination switch OFF.

Disconnect the ECM connector A (12).

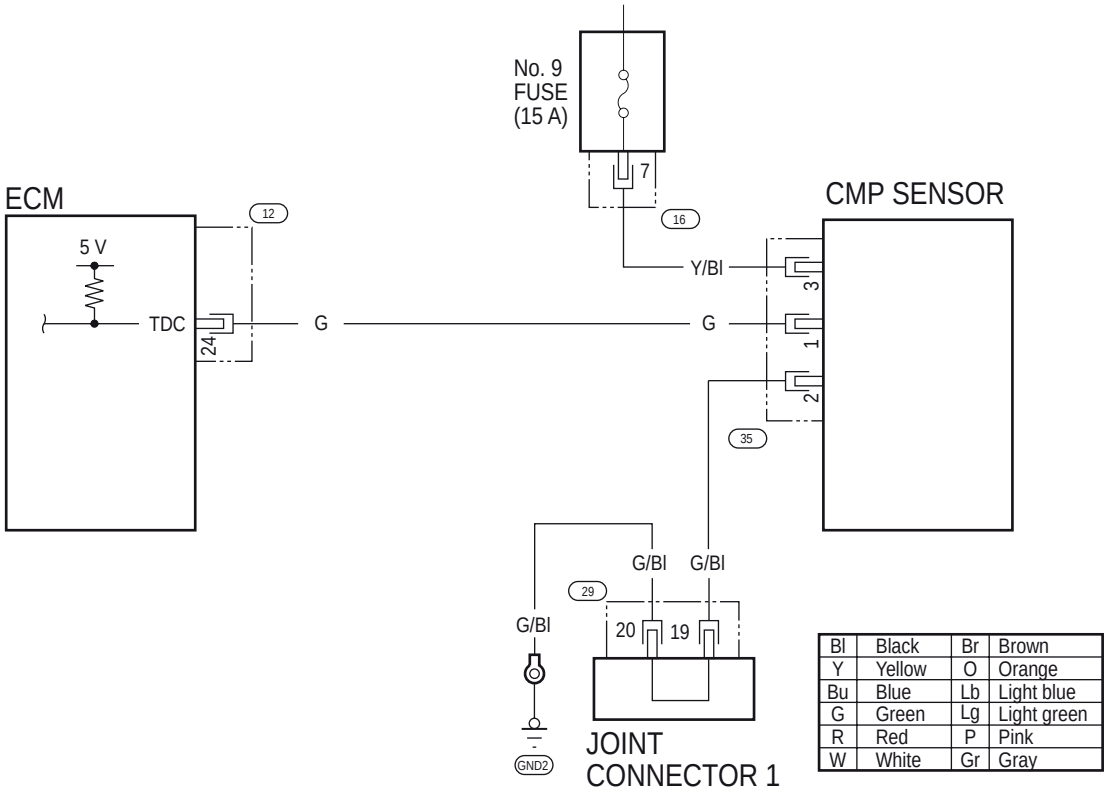
Check for open and short circuit between the TP sensor 3P connector (20) main wire harness side No.2 (Red/Black) terminal and ECM connector A (12) main wire harness side No.8 (Red/Black) terminal.

Is the signal line open or short?

YES – Repair open or short in the Red/Black wire.

NO – Replace the throttle body with a new one and recheck.

MIL BLINKS 8 (CMP SENSOR)



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the CMP sensor 3P connector (35), ECM connector A (12), and joint connector 1 (29), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine.
Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 8?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. CMP sensor power line open circuit inspection

Turn the combination switch OFF and disconnect the CMP sensor 3P connector (35).

Turn the combination switch ON.

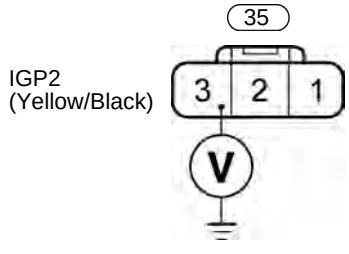
Measure the voltage between the CMP sensor 3P connector (35) main wire harness side No.3 (Yellow/Black) terminal and engine ground.

Does battery voltage exist?

YES – GO TO STEP 3.

NO – Repair open in the Yellow/Black wire. If main wire harness is normal, inspect the No.9 fuse circuit in the fuse/relay junction box (page 10-14).

CMP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



3. CMP sensor signal line open or short circuit/ GND line open circuit inspection

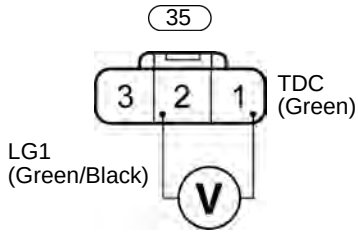
Measure the voltage between the CMP sensor 3P connector (35) main wire harness side No.1 (Green) terminal and No.2 (Green/Black) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 4.

NO – • Repair open or short in the Green wire
• Repair open in the Green/Black wire
• If the main wire harness is normal, replace the ECM with a new one, and recheck.

CMP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



4. CMP sensor installation inspection

Turn the combination switch OFF.

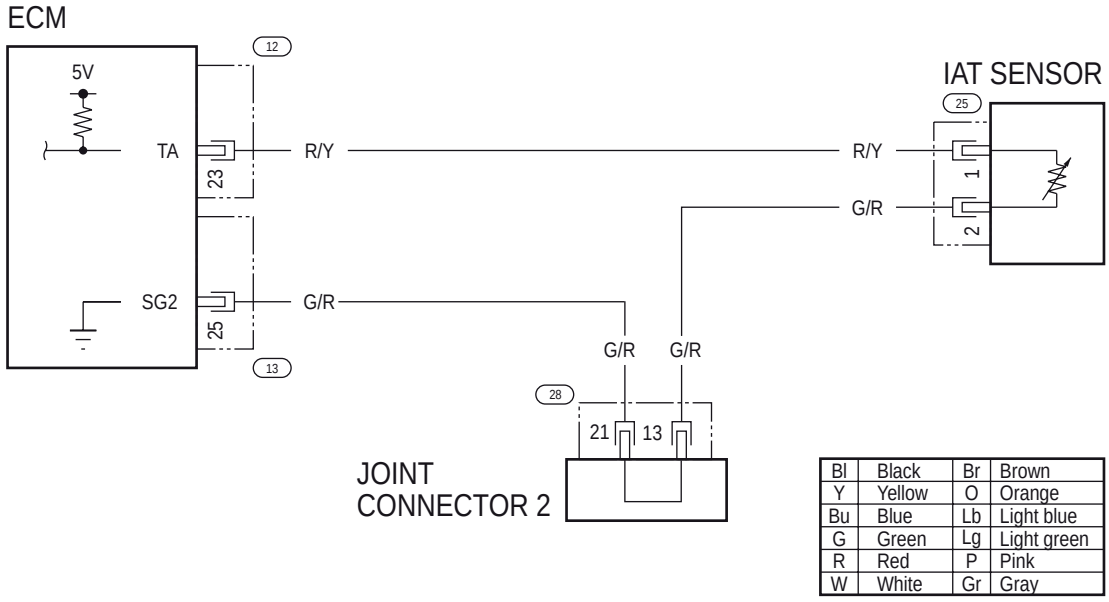
Check the installation of the CMP sensor (page 5-119).

Is the CMP sensor installation correct?

YES – Replace the CMP sensor with a new one and recheck. If the CMP sensor is replaced, but MIL blinks 8, replace the ECM with a new one and recheck.

NO – Install the CMP sensor properly, and recheck.

MIL BLINKS 10 (ONE LONG BLINK AND NO SHORT BLINK) IAT SENSOR



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

- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the IAT sensor 2P connector (25), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 10 (one long blink)?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. IAT sensor signal open or short circuit/GND line open circuit inspection

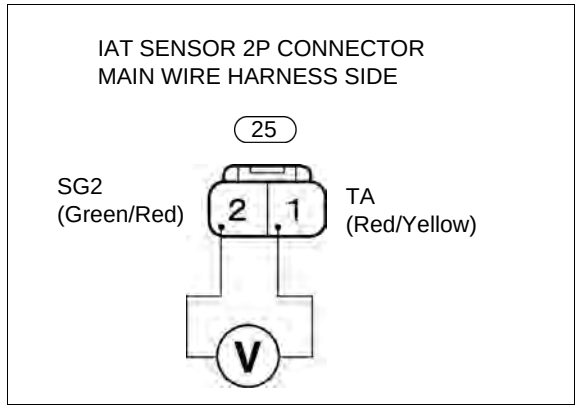
Turn the combination switch OFF and disconnect the IAT sensor 2P connector (25).

Turn the combination switch ON.
Measure the voltage between the IAT sensor 2P connector (25) main wire harness side No.1 (Red/Yellow) terminal and No.2 (Green/Red) terminal.

Is the measurement within 4.75 – 5.25 V?

YES – Replace the IAT sensor with a new one and recheck.

NO –
- Repair open or short in the Red/Yellow wire
- Repair open in the Green/Red wire
- If the main wire harness is normal, replace the ECM with a new one, and recheck.



MIL BLINKS 14 (ONE LONG BLINK AND 4 SHORT BLINKS) IAC VALVE



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the IAC valve 2P connector (26), ECM connector B (13) and then reconnect them.

Clear the DTC (page 5-6).

Start the engine.
Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 14?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. IAC valve inspection

Turn the combination switch OFF.

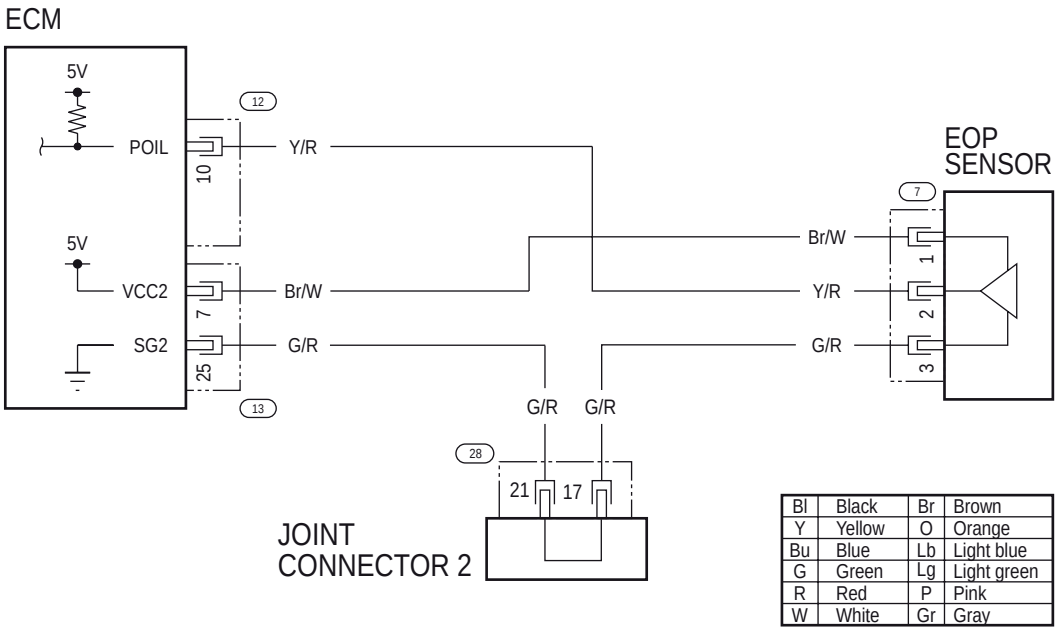
Inspect the IAC valve (page 5-138).

Is the IAC valve normal?

YES – Repair open or short in the Green/White wire or Black wire between the ECM and IAC valve. If the main wire harness is normal, replace the ECM with a new one and recheck.

NO – Replace the IAC valve with a new one and recheck.

MIL BLINKS 22 (2 LONG BLINKS AND 2 SHORT BLINKS) EOP SENSOR



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

- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.
- When the MIL blinks 7 and 22 at the same time, the power line (VCC2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the EOP sensor 3P connector (7), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 22?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. EOP sensor power line open circuit inspection

Turn the combination switch OFF and disconnect the EOP sensor 3P connector (7).

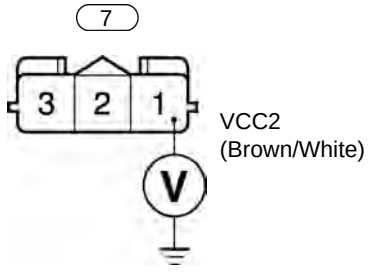
Turn the combination switch ON.
Measure the voltage between the EOP sensor 3P connector (7) main wire harness side No.1 (Brown/White) terminal and engine ground.

Is the measurement within 4.75 – 5.25 V?

YES – GO TO STEP 3.

NO – Repair open in the Brown/White wire. If the main wire harness is normal, replace the ECM with a new one and recheck.

EOP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



3. EOP sensor signal line open or short circuit/ GND line open circuit inspection

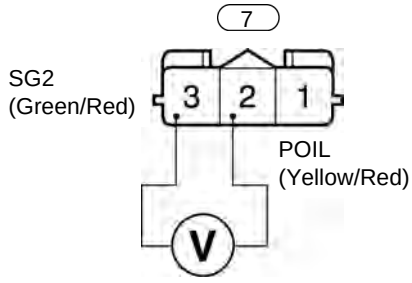
Measure the voltage between the EOP sensor 3P connector (7) main wire harness side No.2 (Yellow/Red) terminal and No.3 (Green/Red) terminal.

Is the measurement within 4.75 – 5.25 V?

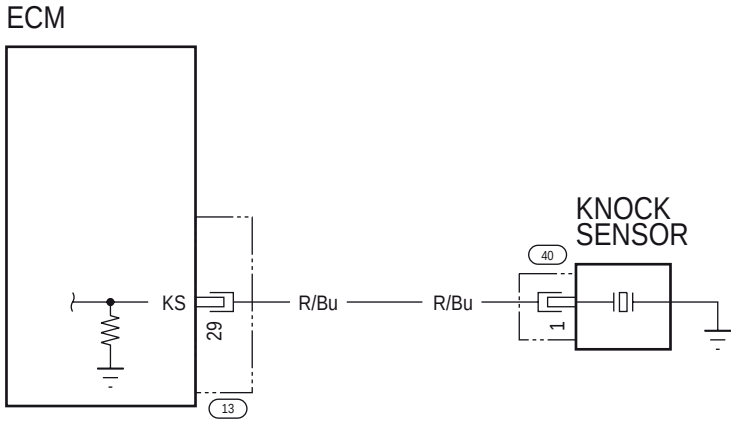
YES – Replace the EOP sensor with a new one and recheck.

NO –
- Repair open or short in the Yellow/Red wire
- Repair open in the Green/Red wire.
- If the main wire harness is normal, replace the ECM with a new one, and recheck.

EOP SENSOR 3P CONNECTOR
MAIN WIRE HARNESS SIDE



MIL BLINKS 23 (2 LONG BLINKS AND 3 SHORT BLINKS) KNOCK SENSOR



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the knock sensor 1P connector (40) and ECM connector B (13), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).
Increase the engine speed gradually and run it at 3,000 – 4,000 min^{-1} (rpm) for 10 seconds.

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 23?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. Knock sensor line open or short circuit inspection

Turn the combination switch OFF.

Disconnect the knock sensor 1P connector (40) and ECM connector B (13).

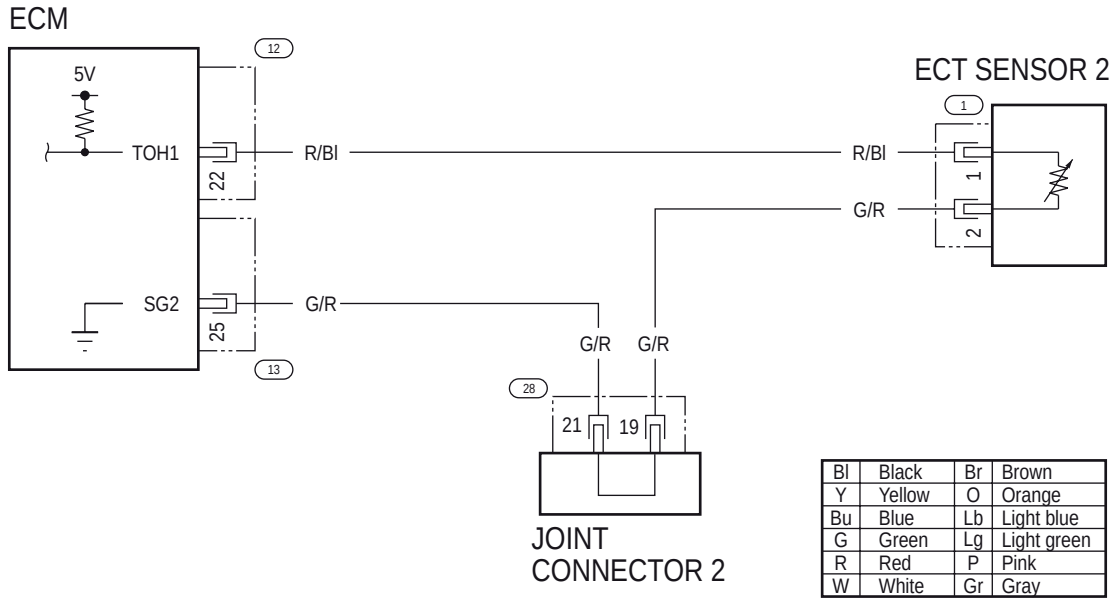
Check for open and short circuit between the knock sensor 1P connector (40) main wire harness side No.1 (Red/Blue) terminal and ECM connector B (13) No.29 (Red/Blue) terminal.

Is the knock sensor line open or short?

YES – Repair open or short in the Red/Blue wire.

NO – Replace the knock sensor with a new one and recheck. If the knock sensor is replaced, but MIL blinks 23, replace the ECM with a new one and recheck.

MIL BLINKS 24 (2 LONG BLINKS AND 4 SHORT BLINKS)
ECT SENSOR 2



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

- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 2 (2P) connector (1), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 24?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. ECT sensor 2 signal line open or short circuit/ GND line open circuit inspection

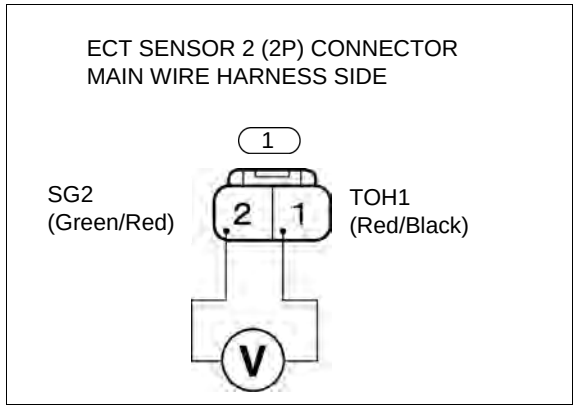
Turn the combination switch OFF and disconnect the ECT sensor 2 (2P) connector (1).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 2 (2P) connector (1) main wire harness side No.1 (Red/Black) terminal and No.2 (Green/Red) terminal.

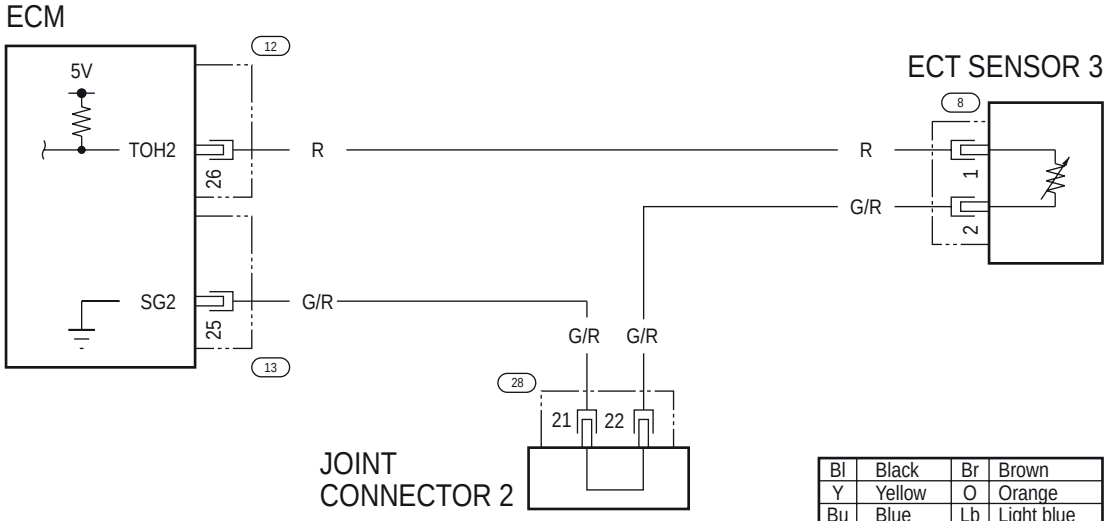
Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 2 with a new one and recheck.

NO – Repair open or short in the Red/Black wire or open in the Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



MIL BLINKS 25 (2 LONG BLINKS AND 5 SHORT BLINKS)
ECT SENSOR 3



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

- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 3 (2P) connector (8), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 25?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. ECT sensor 3 signal line open or short circuit/ GND line open circuit inspection

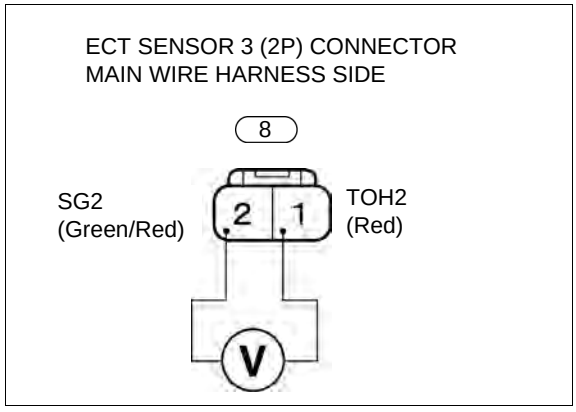
Turn the combination switch OFF and disconnect the ECT sensor 3 (2P) connector (8).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 3 (2P) connector (8) main wire harness side No.1 (Red) terminal and No.2 (Green/Red) terminal.

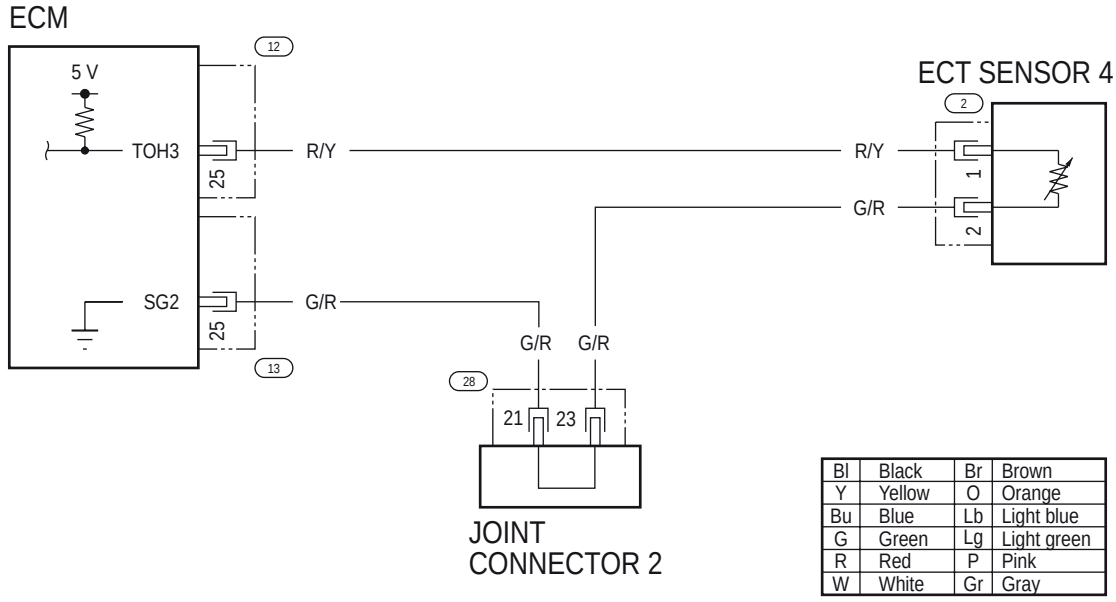
Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 3 with a new one and recheck.

NO – Repair open or short in the Red wire or open in the Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



MIL BLINKS 27 (2 LONG BLINKS AND 7 SHORT BLINKS) ECT SENSOR 4



- When the MIL blinks 6, 7, 10, 22, 24, 25, and 27 at the same time, the ground line (SG2) is open.

1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the ECT sensor 4 (2P) connector (2), ECM connector A (12), ECM connector B (13), and joint connector 2 (28), and then reconnect them.

Clear the DTC (page 5-6).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 27?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. ECT sensor 4 signal line open or short circuit/ GND line open circuit inspection

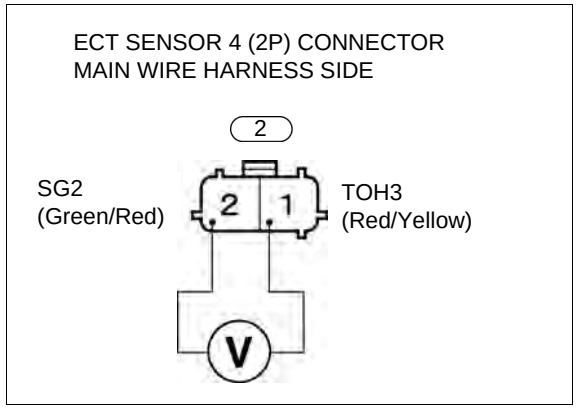
Turn the combination switch OFF and disconnect the ECT sensor 4 (2P) connector (2).

Turn the combination switch ON.
Measure the voltage between the ECT sensor 4 (2P) connector (2) main wire harness side No.1 (Red/Yellow) terminal and No.2 (Green/Red) terminal.

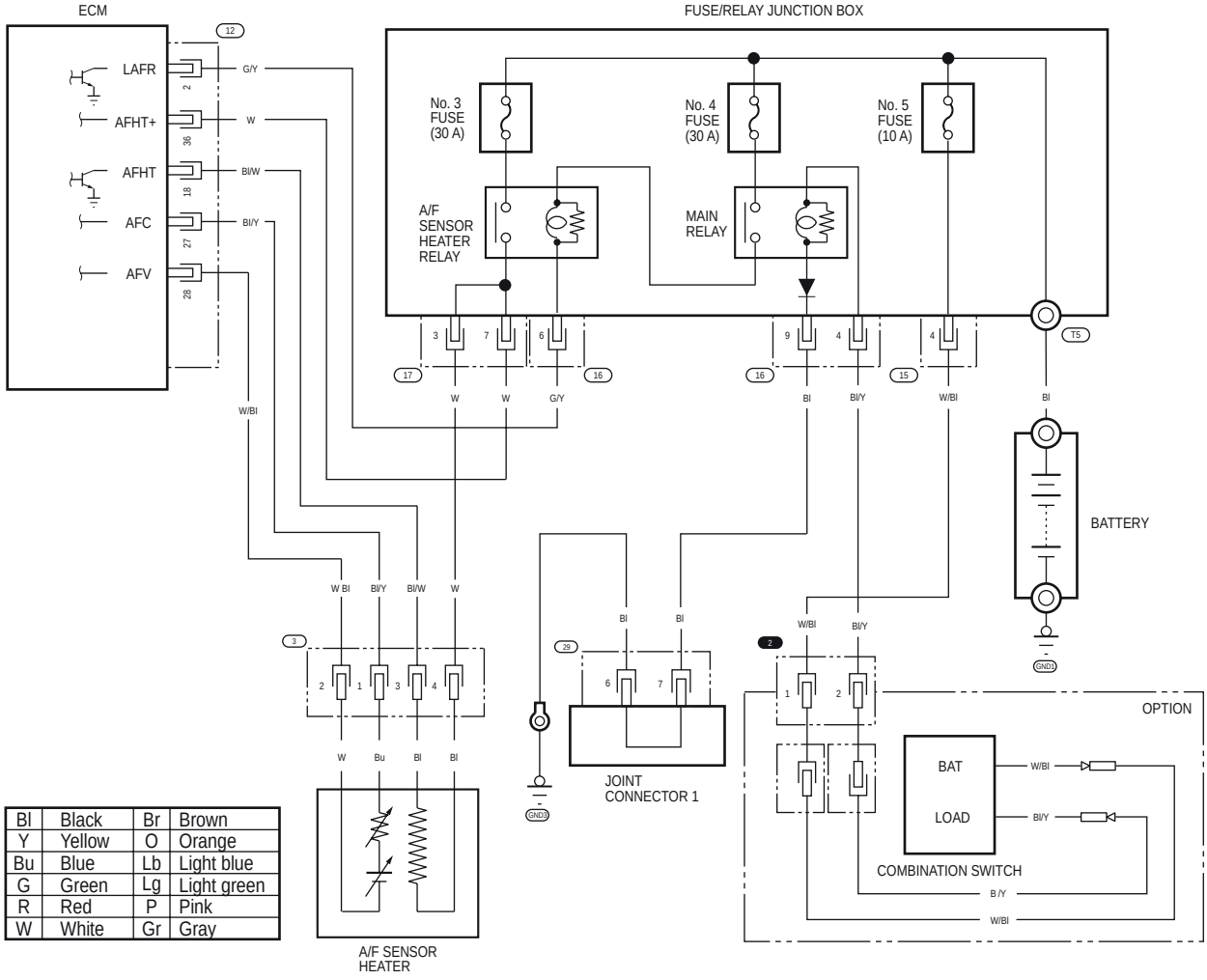
Is the measurement within 4.75 – 5.25 V?

YES – Replace the ECT sensor 4 with a new one and recheck.

NO – Repair open or short in the Red/Yellow wire or open in the Green/Red wire. If the main wire harness is normal, replace the ECM with a new one and recheck.



MIL BLINKS 41 (4 LONG BLINKS AND ONE SHORT BLINK)
A/F SENSOR HEATER



1. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3), fuse/relay junction box 23P connector (16), fuse/relay junction box 10P connector (17), and ECM connector A (12), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 41?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. Fuse inspection

Turn the combination switch OFF.

Check for blown No.3 fuse.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 3.

3. A/F sensor heater inspection

Turn the combination switch OFF.

Inspect the A/F sensor heater (page 5-139).

Is the A/F sensor heater normal?

YES – GO TO STEP 4.

NO – Replace the A/F sensor with a new one and recheck.

4. A/F sensor heater relay inspection

Inspect the A/F sensor heater relay (page 10-13).

Is the A/F sensor heater relay normal?

YES – GO TO STEP 5.

NO – Replace the A/F sensor heater relay with a new one and recheck.

5. Fuse/relay junction box inspection

Inspect the A/F sensor heater relay circuit in the fuse/relay junction box (page 10-14).

Is the fuse/relay junction box normal?

YES – GO TO STEP 6.

NO – Replace the fuse/relay junction box with a new one and recheck.

6. A/F sensor line short circuit inspection

Disconnect the ECM connector A (12).

Check for continuity between the following terminals.

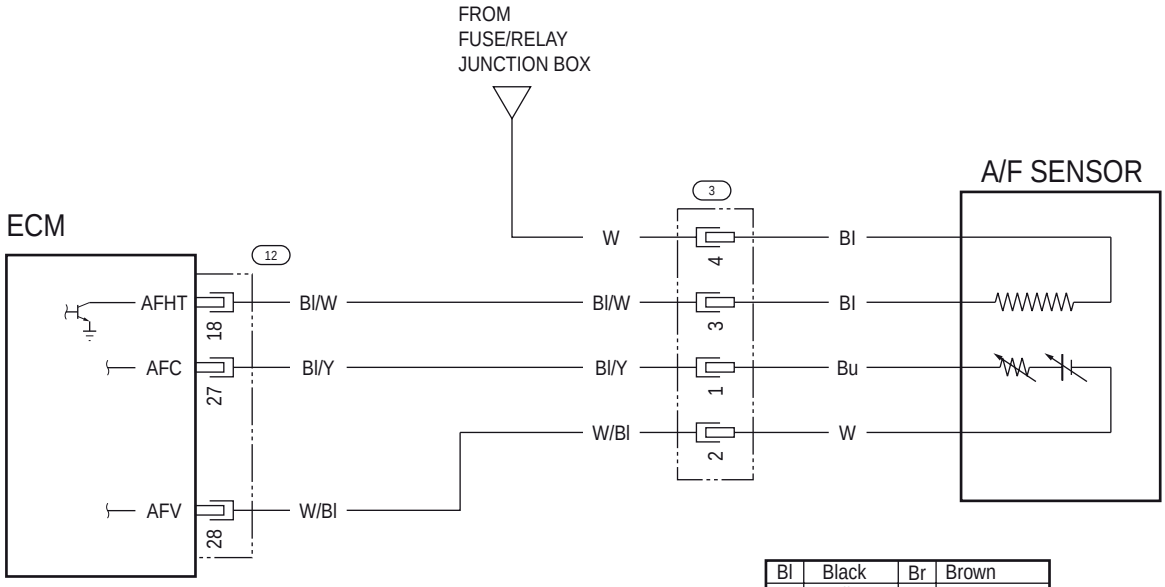
– A/F sensor 4P connector (3) main wire harness side No.1 (Black/yellow) terminal and ECM connector A (12) main wire harness side No.18 (Black/White) terminal
– A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and ECM connector A (12) main wire harness side No.18 (Black/White) terminal
– A/F sensor 4P connector (3) main wire harness side No.1 (Black/yellow) terminal and ECM connector A (12) main wire harness side No.36 (White) terminal
– A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and ECM connector A (12) main wire harness side No.36 (White) terminal

Is there continuity?

YES – • Repair short in the Black/yellow wire and Black/White wire between the ECM and A/F sensor.
• Repair short in the White/Black wire and Black/White wire between the ECM and A/F sensor.
• Repair short in the Black/yellow wire and White wire between the ECM and A/F sensor.
• Repair short in the White/Black wire and White wire between the ECM and A/F sensor.

NO – • Repair open in the White wire between the fuse/relay junction box and A/F sensor.
• Repair open in the White wire between the ECM and fuse/relay junction box.
• Repair open or short in the Black/White wire between the ECM and A/F sensor.
• Repair open or short in the Green/Yellow wire between the ECM and fuse/relay junction box.
• If the wire harness is normal, replace the A/F sensor with a new one and recheck.
• If the A/F sensor is replaced, but MIL blinks 41, replace the ECM with a new one and recheck.

MIL BLINKS 48 (4 LONG BLINKS AND 8 SHORT BLINKS) A/F SENSOR



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. Symptom reproduction test

Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3) and ECM connector A (12), and then reconnect them.

Clear the DTC (page 5-6).

Start the engine and let it run at 3,000 min^{-1} (rpm) for 5 minutes or more under no load until the engine temperature is over 85 °C (185 °F).
Then run the engine at 3,000 min^{-1} (rpm) for 1 minute.

Turn the combination switch OFF and connect the SCS service check connector.
Turn the combination switch ON and check the number of blinks of the MIL.

Does the MIL blink 48?

YES – GO TO STEP 2.

NO – Temporary failure (code does not reappear)

2. A/F sensor line open or short circuit inspection

Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3) and ECM connector A (12).

Check for open or short circuit between the A/F sensor 4P connector (3) main wire harness side No.1 (Black/Yellow) terminal and ECM connector A (12) main wire harness side No.27 (Black/Yellow) terminal.

Check for open or short circuit between the A/F sensor 4P connector (3) main wire harness side No.2 (White/Black) terminal and ECM connector A (12) main wire harness side No.28 (White/Black) terminal.

Is the A/F sensor line open or short?

YES – Repair open or short in the Black/Yellow wire or White/Black wire.

NO – Replace the A/F sensor with a new one and recheck. If the A/F sensor is replaced, but MIL blinks 48, replace the ECM with a new one and recheck.

FUEL PRESSURE RELIEVING

⚠WARNING

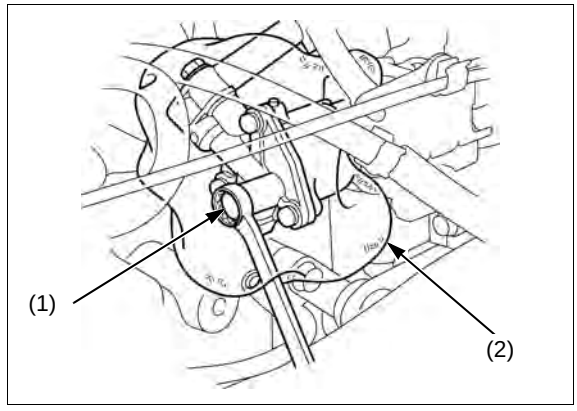
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- Keep heat, sparks, and flame away.
- Wipe up spills immediately.
- Handle fuel only outdoors.

- Disconnect the battery cable from the battery negative (–) terminal before relieving the fuel pressure.
- Replace the sealing washer when the service check bolt is loosened or removed.

Remove the L. engine under cover (page 6-4).

Set a wrench on the service check bolt (1) on the vapor separator and place a shop towel or equivalent material (2) over the service check bolt.

Loosen the service check bolt approximately one turn slowly to relieve the fuel pressure.



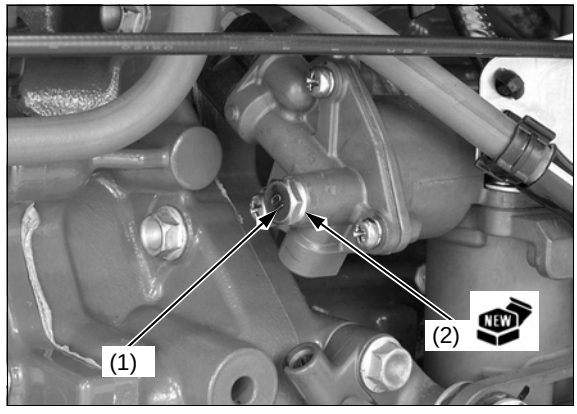
After relieving the fuel pressure, remove the service check bolt (1) and replace the sealing washer (2) with a new one.

Install and tighten the service check bolt to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Install the L. engine under cover (page 6-4).

Connect the battery cable from the battery negative (–) terminal.



FUEL PUMP (LOW PRESSURE SIDE) REMOVAL/INSTALLATION

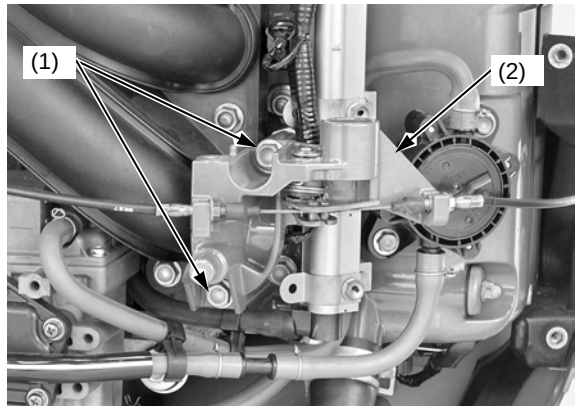
⚠WARNING

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.
- Handle fuel only outdoors.

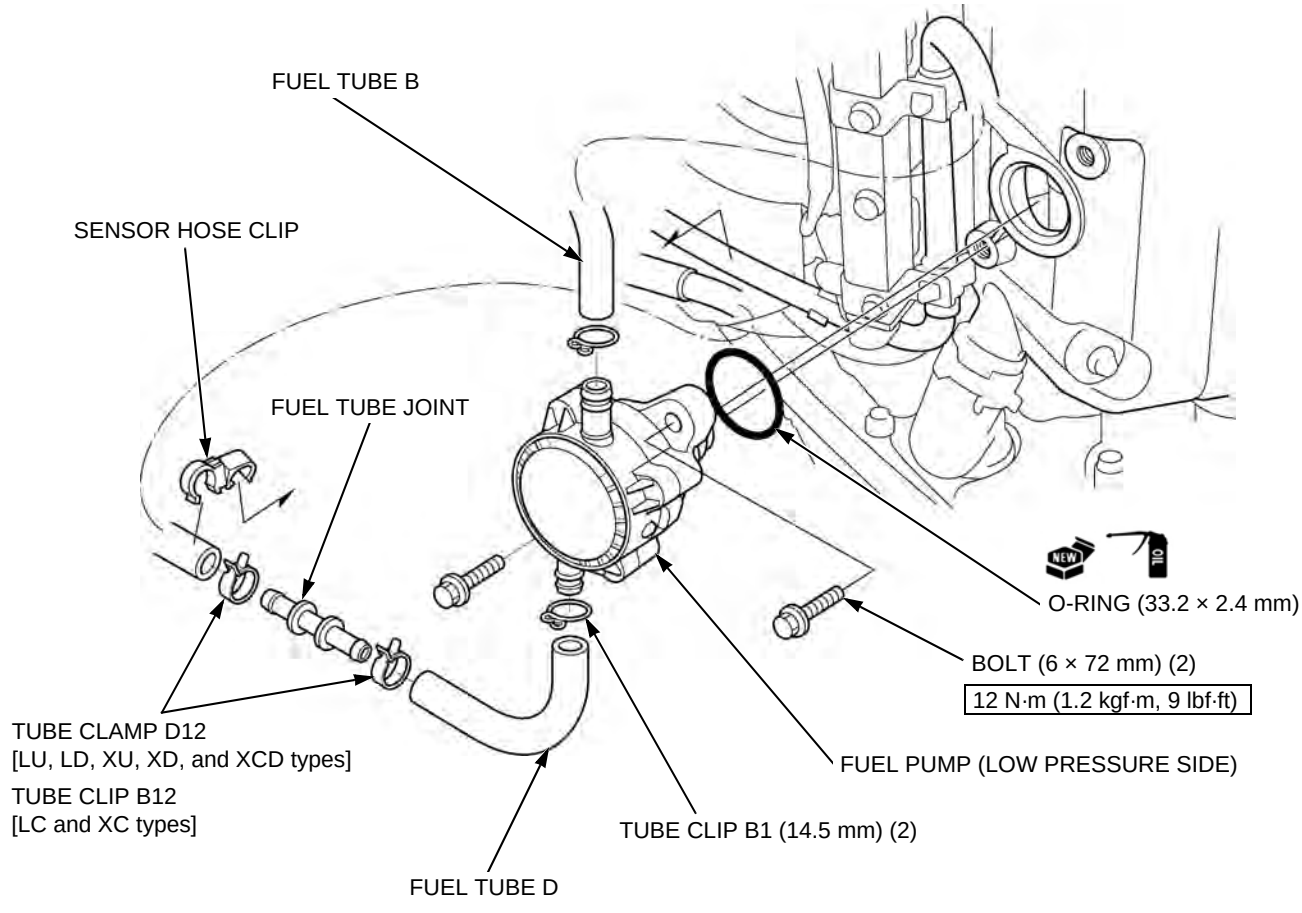
REMOVAL

Remove the L. engine under cover (page 6-4).

Remove the two bolts (1) and slide the L. side cover bracket (2).



- Clamp the fuel tube B and D before disconnecting them from the fuel pump, using commercially available tube clips.

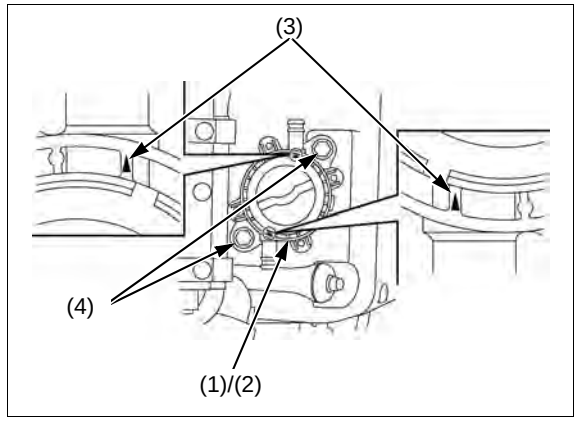


INSTALLATION

Apply engine oil to a new O-ring (1) and install it to the fuel pump (2).

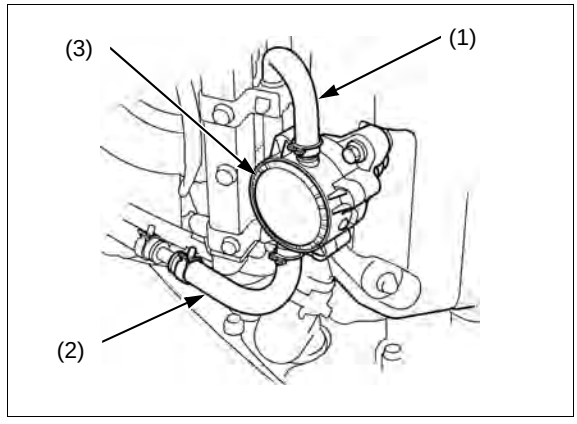
Position the fuel pump marks (3) as shown, then install and tighten the bolts (4) to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



Connect the fuel tube B (1) and fuel tube D (2) to the fuel pump (3).

Install the L. engine under cover (page 6-4).



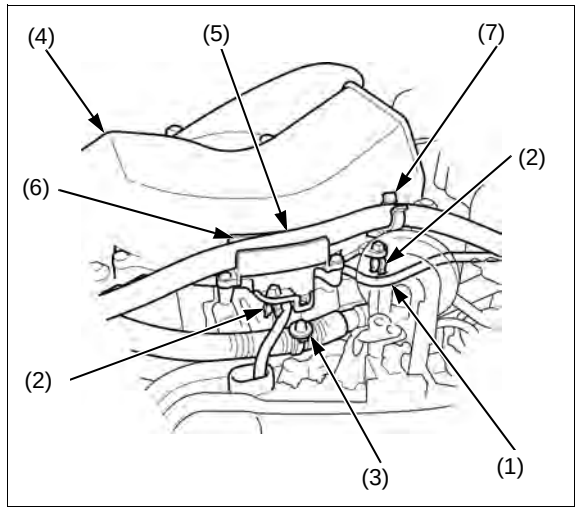
SILENCER DUCT REMOVAL/ INSTALLATION

Remove the engine cover.

Release the pressure regulator control tube (1) from the two tube clips (2).

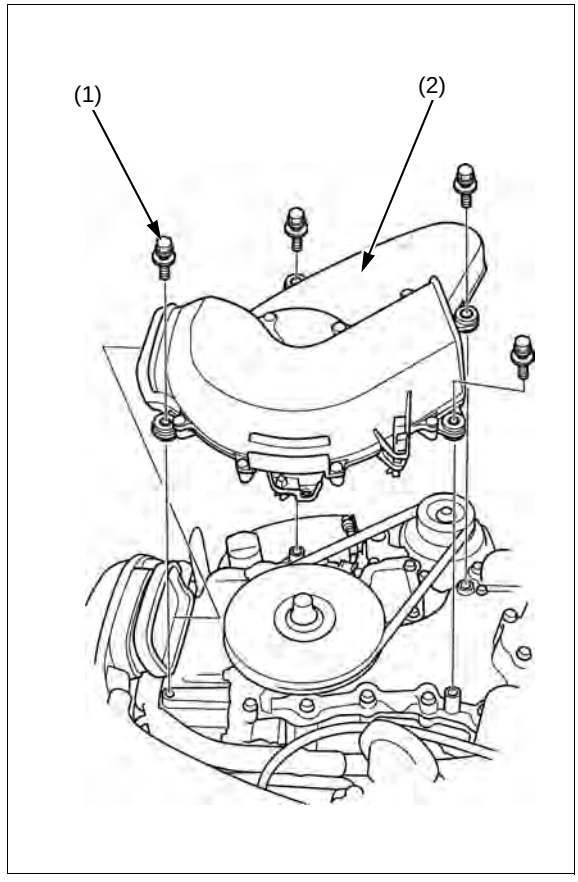
Release the harness band clip (3) of the main wire harness from the silencer duct (4).

Release the breather tube (5) from the silencer duct groove (6) and clamp (7).



Remove the four bolts (1) and silencer duct (2).

Installation is in the reverse order of removal.



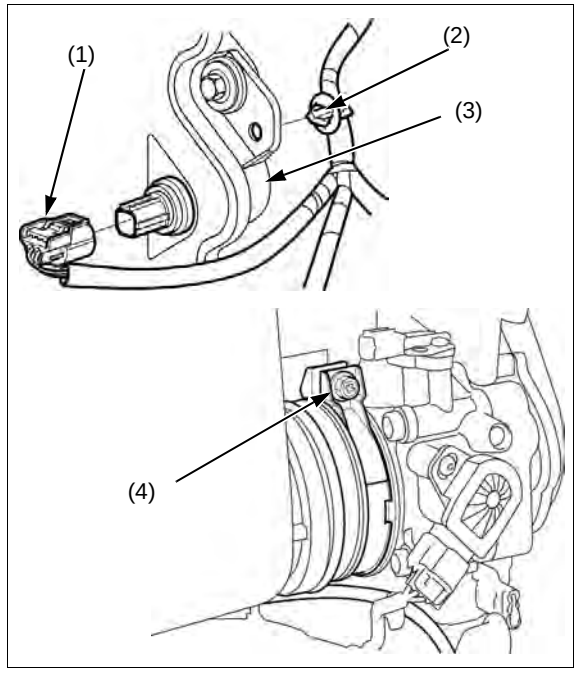
SILENCER CASE REMOVAL/ INSTALLATION

REMOVAL

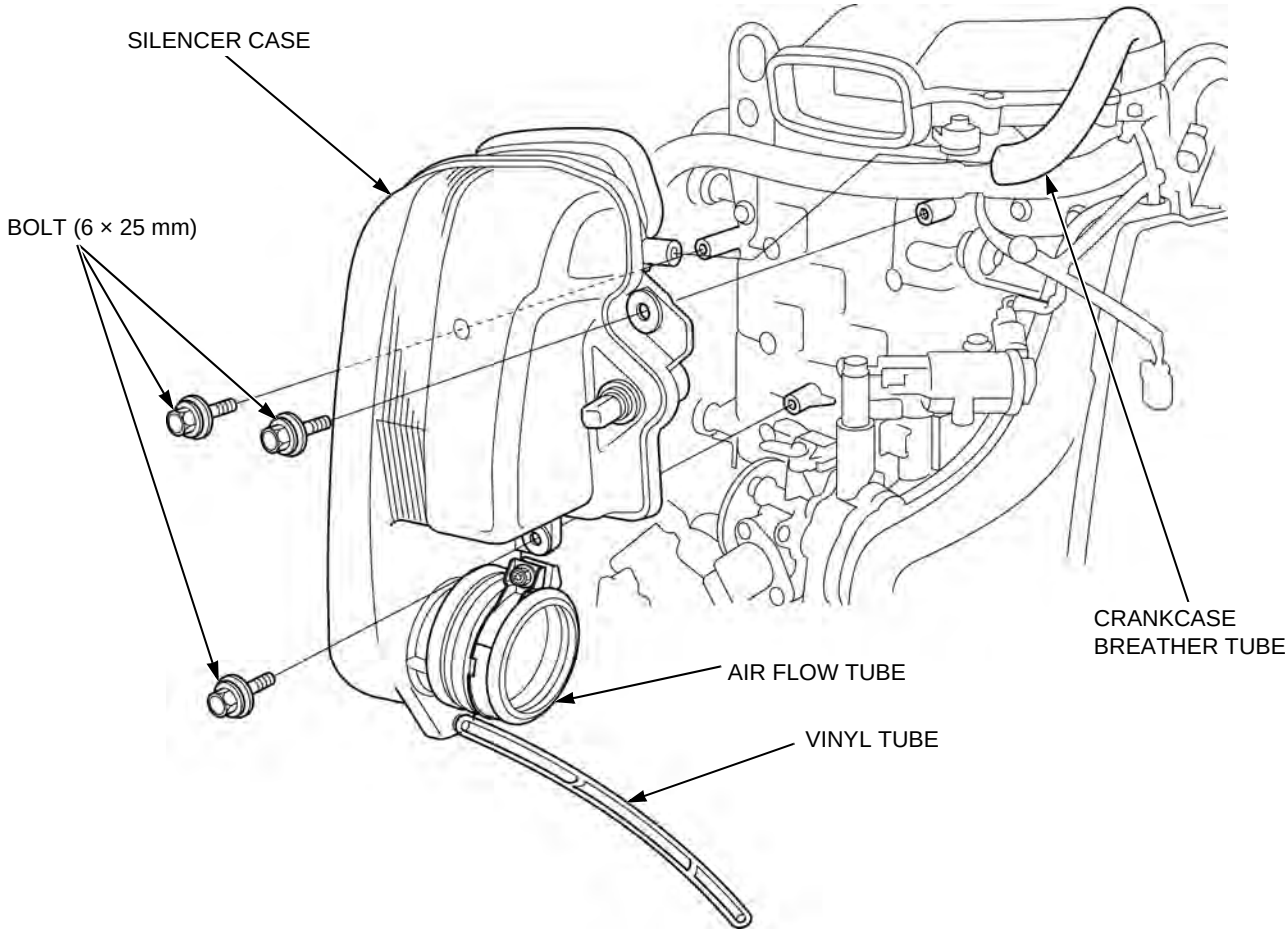
Remove the engine cover.

Disconnect the IAT sensor 2P connector (1) and release the harness band clip (2) from the silencer case (3).

Loosen the air flow clamp screw (4).



Disconnect the crankcase breather tube from the silencer case.



INSTALLATION

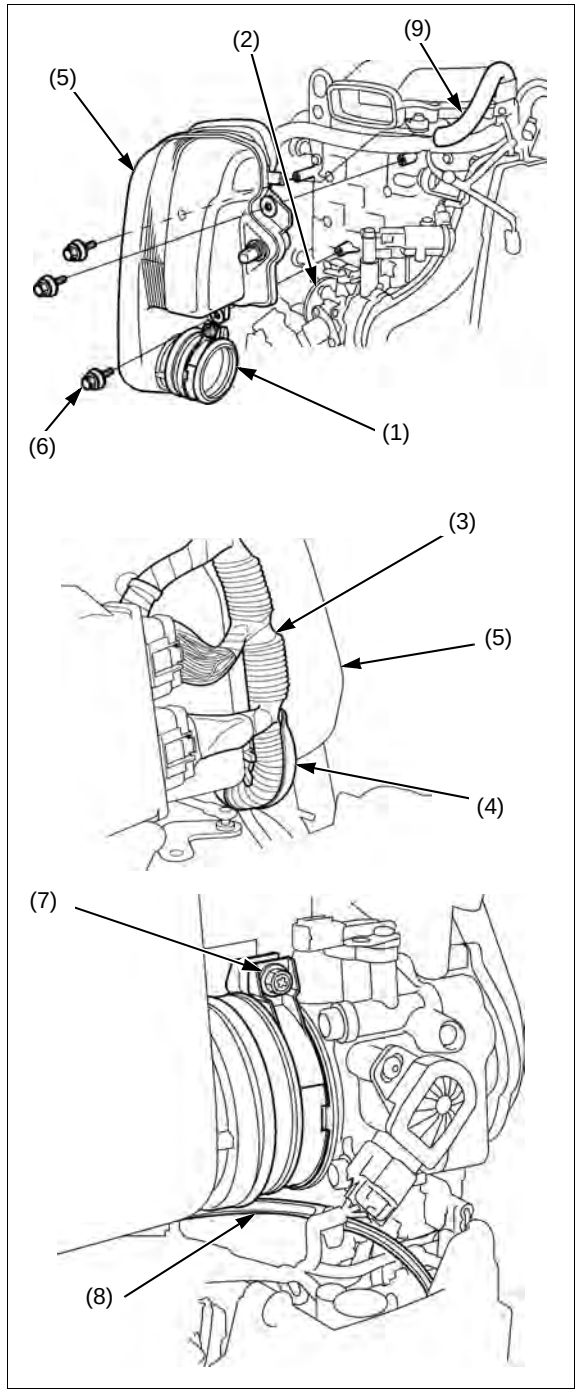
Connect the air flow tube (1) to the throttle body (2) and set the wire harness (3) into the groove (4) in the left lower side of silencer case (5).

Install and tighten the three bolts (6).

- Be careful not to pinch the wire harness.

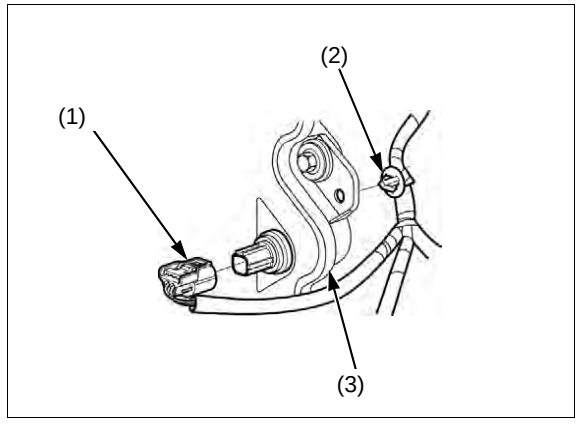
Tighten the air flow tube clamp screw (7).

Connect the vinyl tube (8) and crankcase breather tube (9) to the silencer case.



Connect the IAT sensor 2P connector (1) and install the harness band clip (2) to the silencer case (3).

Install the engine cover.

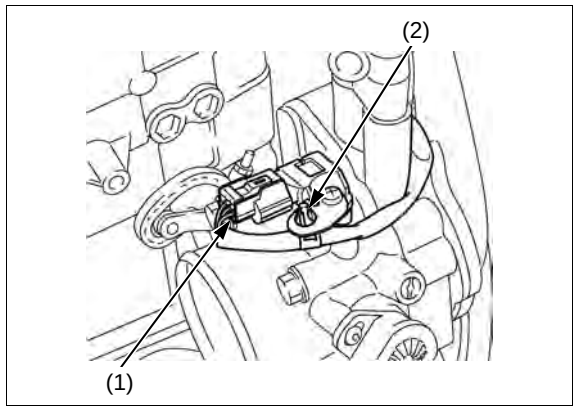


THROTTLE BODY REMOVAL/ INSTALLATION/CLEANING

REMOVAL

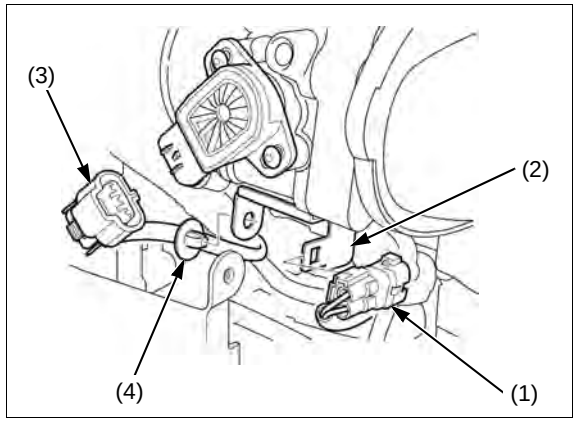
Remove the silencer case (page 5-83).

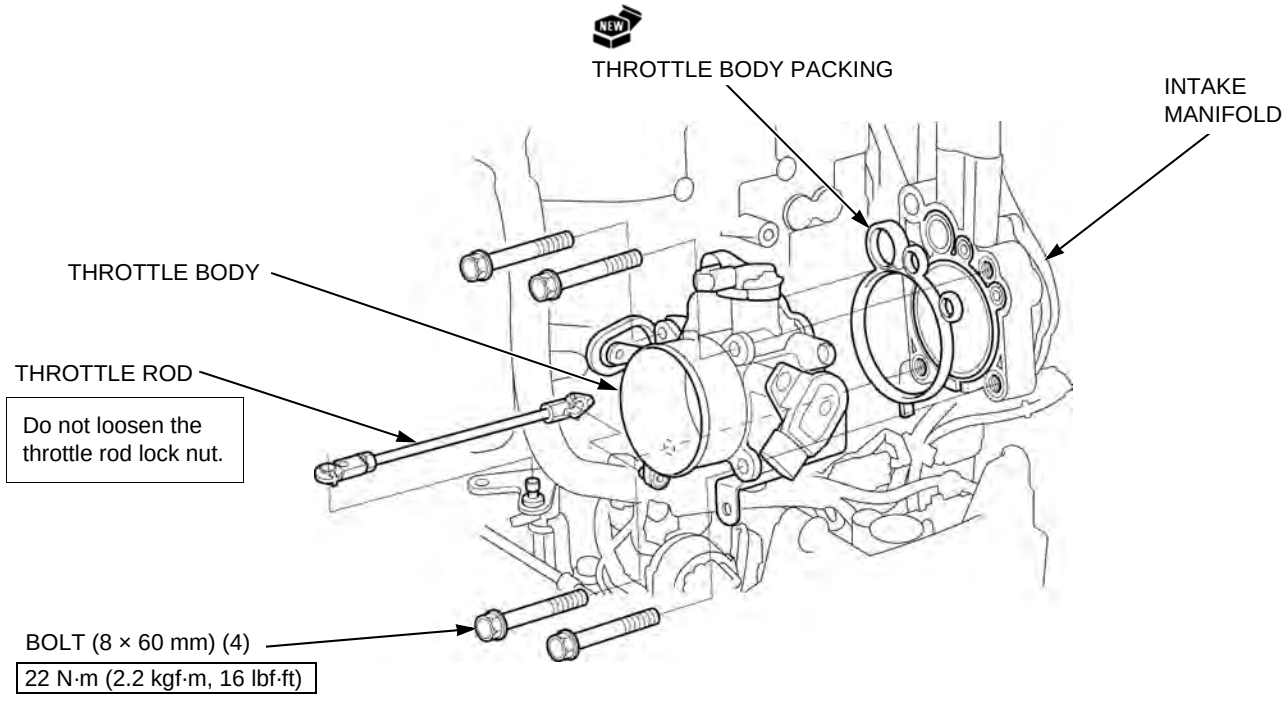
Disconnect the MAP sensor 3P connector (1) and release the harness band clip (2).



Release the water level sensor 2P connector (1) from the sensor wire bracket (2).

Disconnect the TP sensor 3P connector (3) and release the harness band clip (4) from the sensor wire bracket.



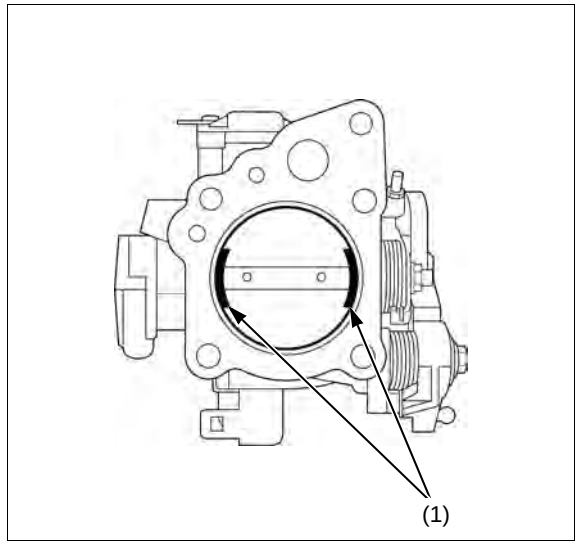


CLEANING

Wipe off carbon or any other dirt or stain with soft dry shop towels sprayed with carburetor cleaner, and clean the throttle valve and bore.

NOTICE

- *The inside of the throttle body is coated with molybdenum. Do not wipe the molybdenum coated area (1) of throttle valve.*

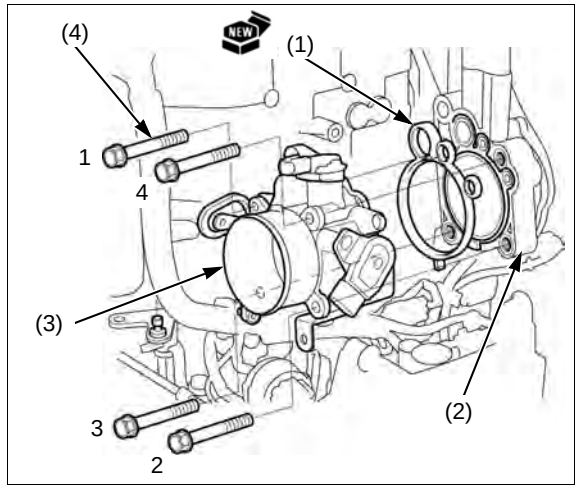


INSTALLATION

Install a new throttle body packing (1) to the intake manifold (2).

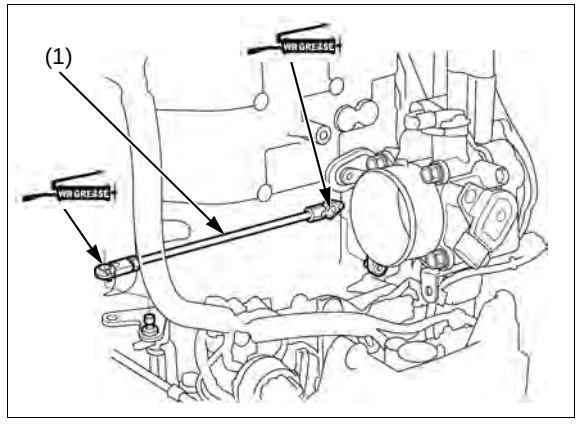
Install the throttle body (3) and tighten the four bolts (4) to the specified torque in the numbered order in two or three steps.

TORQUE: 22 N·m (2.2 kgf·m, 16 lbf·ft)

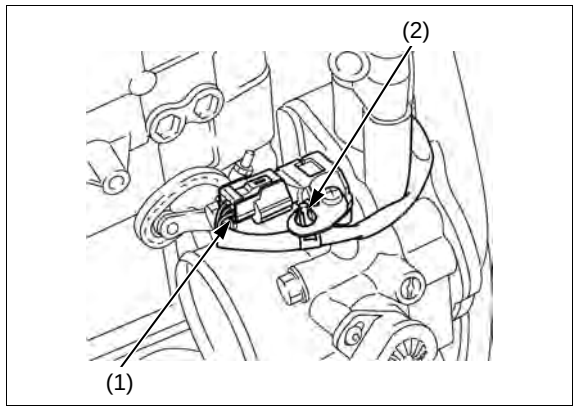


Apply marine grease to the throttle body insertion area and throttle plate insertion area of the throttle rod (1). Install the throttle rod in the direction as shown.

- Do not loosen the throttle rod lock nut.



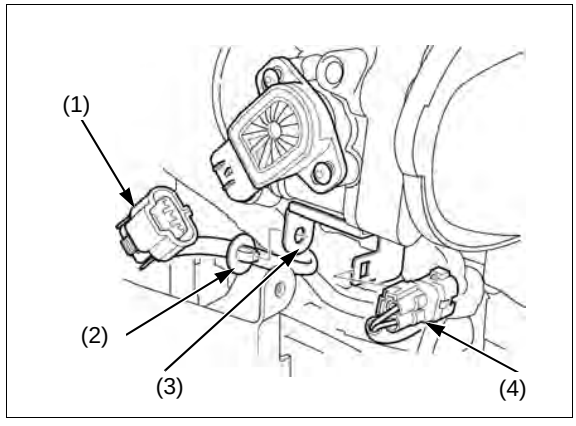
Connect the MAP sensor 3P connector (1) and install the harness band clip (2).



Connect the TP sensor 3P connector (1) and install the harness band clip (2) to the sensor wire bracket (3).

Install the water level sensor 2P connector (4) to the sensor wire bracket.

Install the silencer case (page 5-83).



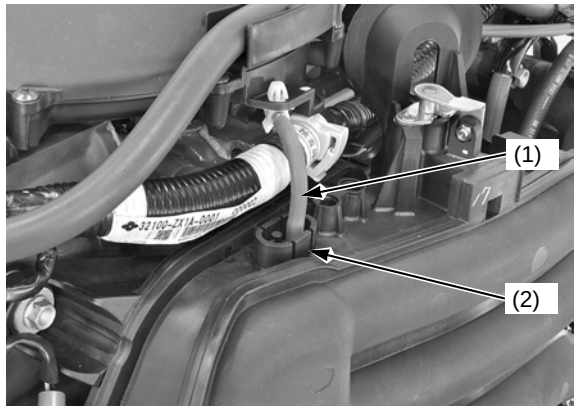
INTAKE MANIFOLD REMOVAL/ INSTALLATION

REMOVAL

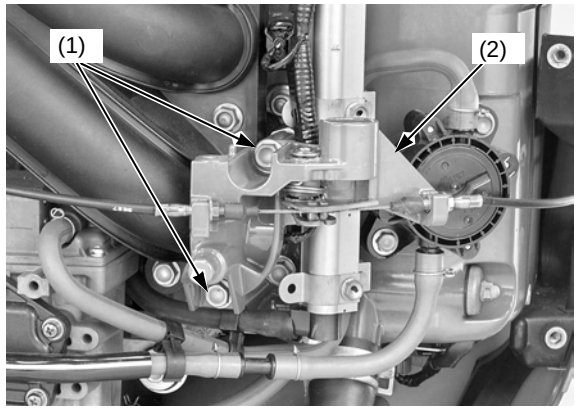
Remove the following:

– L. engine under cover (page 6-4)
– Throttle body (page 5-85)

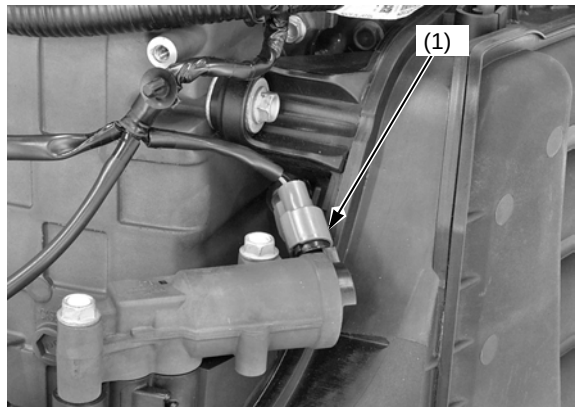
Disconnect the pressure regulator control tube (1) from the intake manifold joint (2).



Remove the two bolts (1) and slide the L. side cover bracket (2).



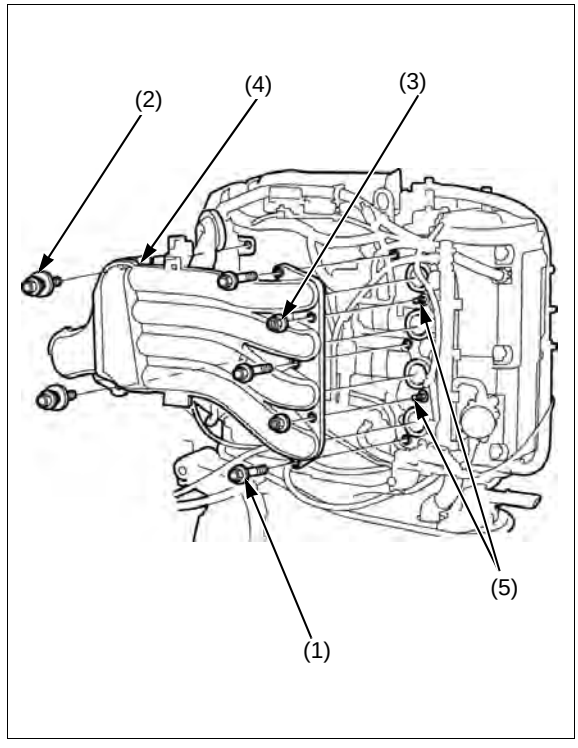
Disconnect the IAC valve 2P connector (1).



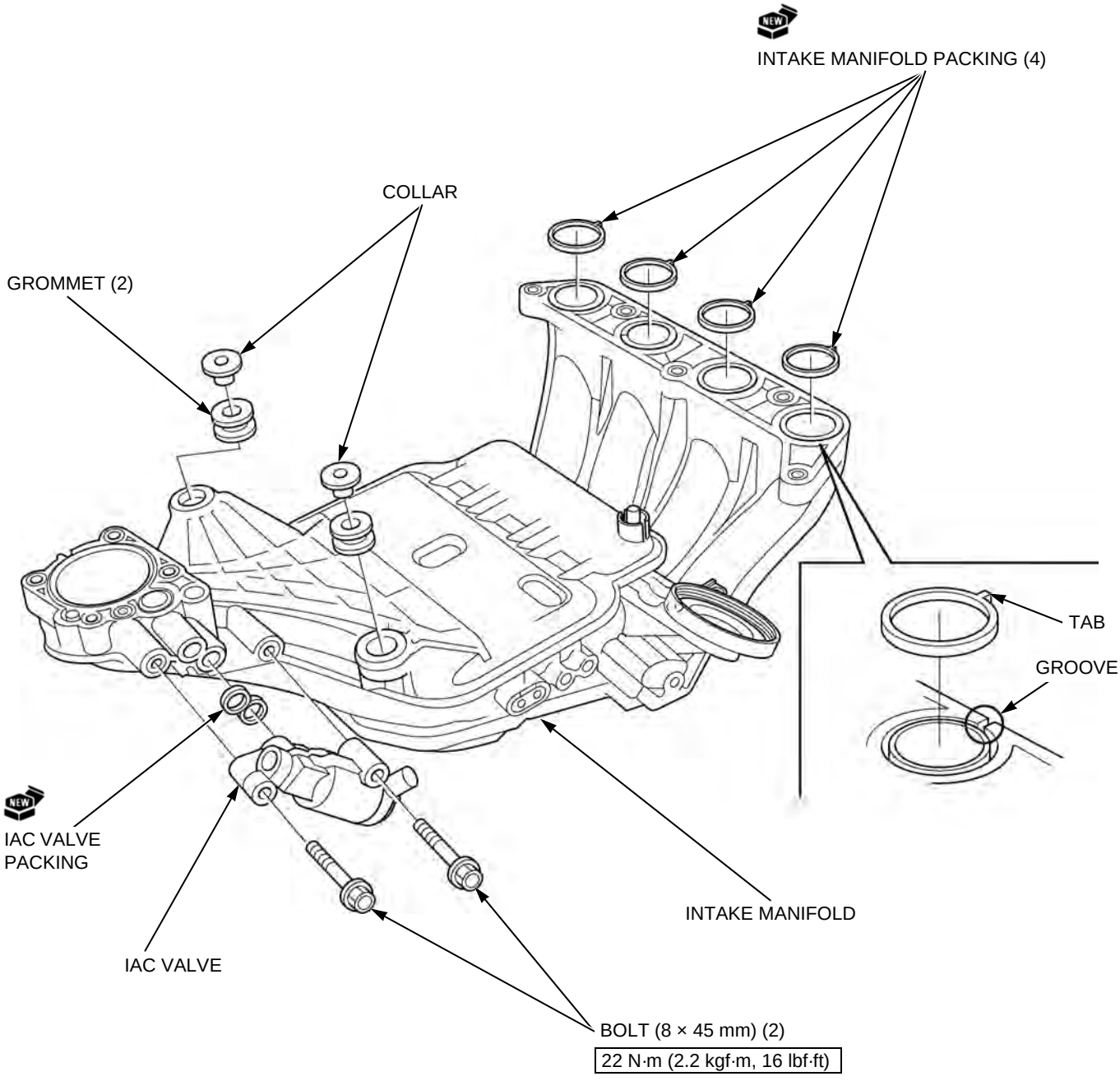
Remove the three bolts (8 × 35 mm) (1), two bolts (8 × 35 mm) (2), two nuts (3) and intake manifold (4).

- If the stud bolt (5) became loose during intake manifold removal, tighten them so that the stud bolt height above the injector base surface is as specified.

  STANDARD: 31 mm (1.2 in)



EXPLODED VIEW

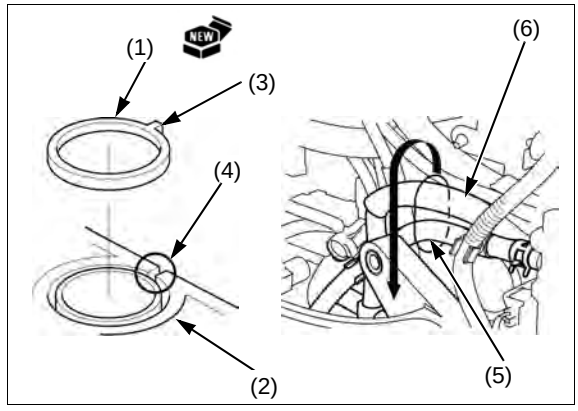


INSTALLATION

Install the four new intake manifold packings (1) to the intake manifold (2) by aligning the tabs (3) of the packings with the grooves (4) of the intake manifold.

Install the intake manifold to the engine.

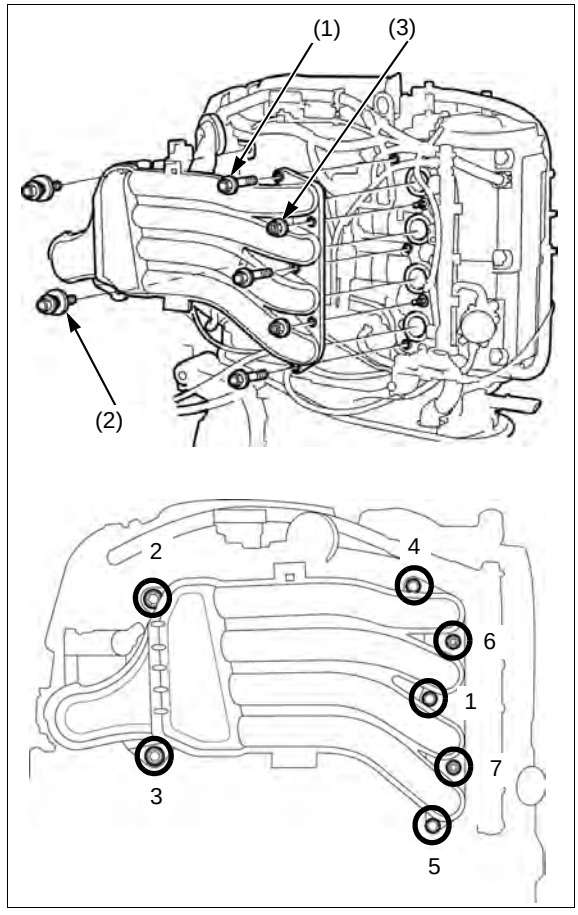
- Take care not to pinch the pressure regulator return hose (5) and air vent tube (6) with the upper side of intake manifold.



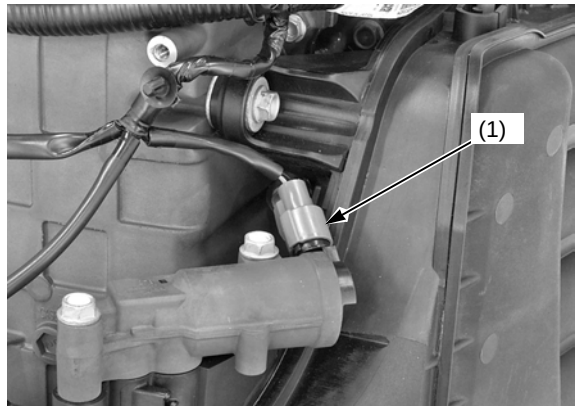
Install the three bolts (8 × 35 mm) (1), two bolts (8 × 35 mm) (2) and two nuts (3).

Tighten the bolts and nuts to the specified torque in the numbered order in two or three steps.

TORQUE: 26 N·m (2.7 kgf·m, 19 lbf·ft)



Connect the IAC valve 2P connector (1).



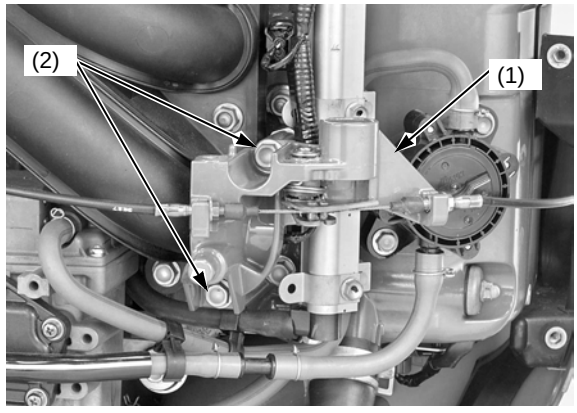
Connect the pressure regulator control tube (1) to the intake manifold joint (2).



Install the L. side cover bracket (1) and tighten the two bolts (2).

Install the following:

– Throttle body (page 5-85)
– L. engine under cover (page 6-4)



FUEL INJECTORS/FUEL PRESSURE REGULATOR REMOVAL/ INSTALLATION

⚠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.
- Handle fuel only outdoors.

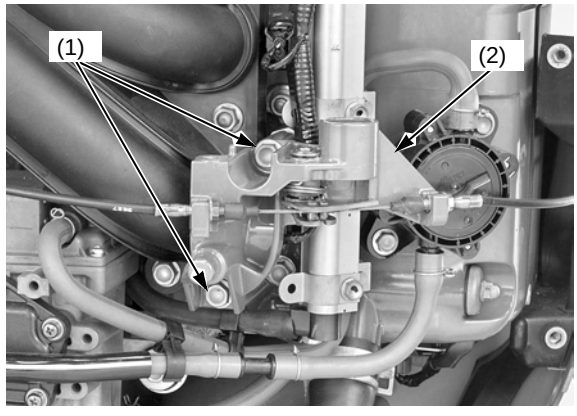
REMOVAL

Disconnect the battery cable from the battery negative (–) terminal.

Remove the L. engine under cover (page 6-4).

Relieve the fuel pressure (page 5-79).

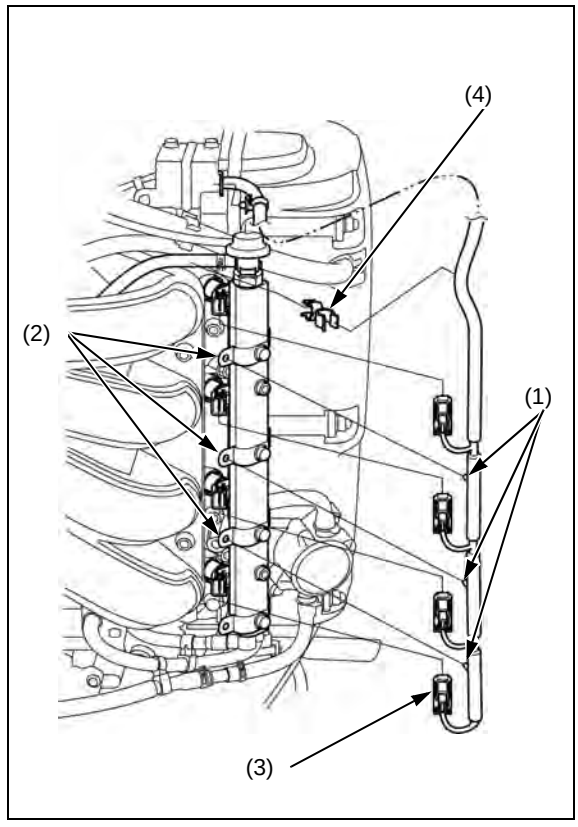
Remove the two bolts (1) and slide the L. side cover bracket (2).



Release the clips (1) of the main wire harness from the clip brackets (2).

Disconnect the four fuel injector 2P connectors (3).

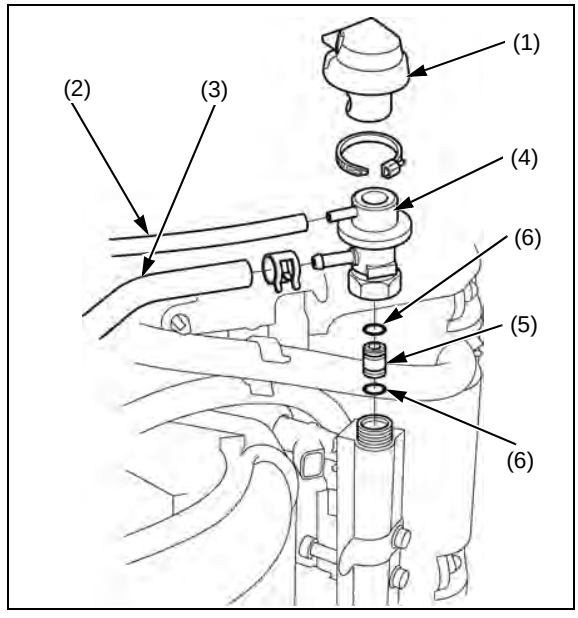
Remove the hose clamp (4).



Remove the regulator cap (1).

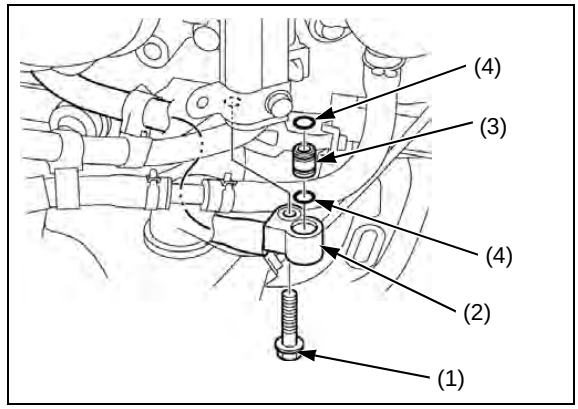
Disconnect the pressure regulator control tube (2) and pressure regulator return tube (3) from the pressure regulator (4).

Remove the pressure regulator, joint pipe (5) and two O-rings (6).



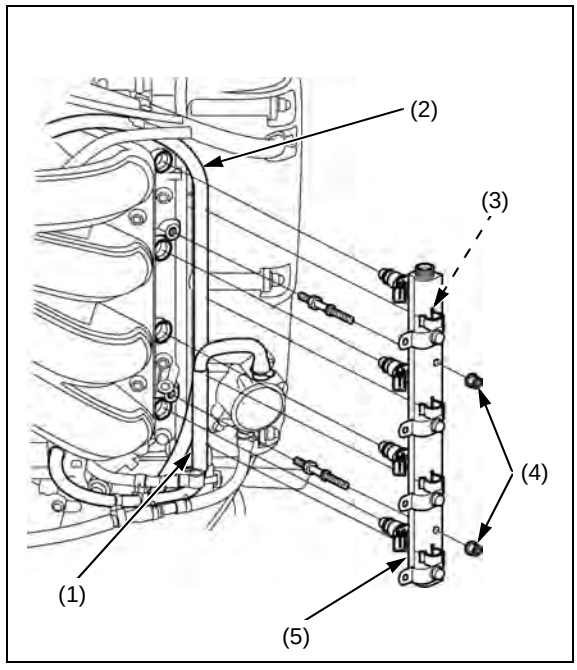
Remove the bolt (1) and fuel hose (2).

Remove the joint pipe (3) and two O-rings (4).

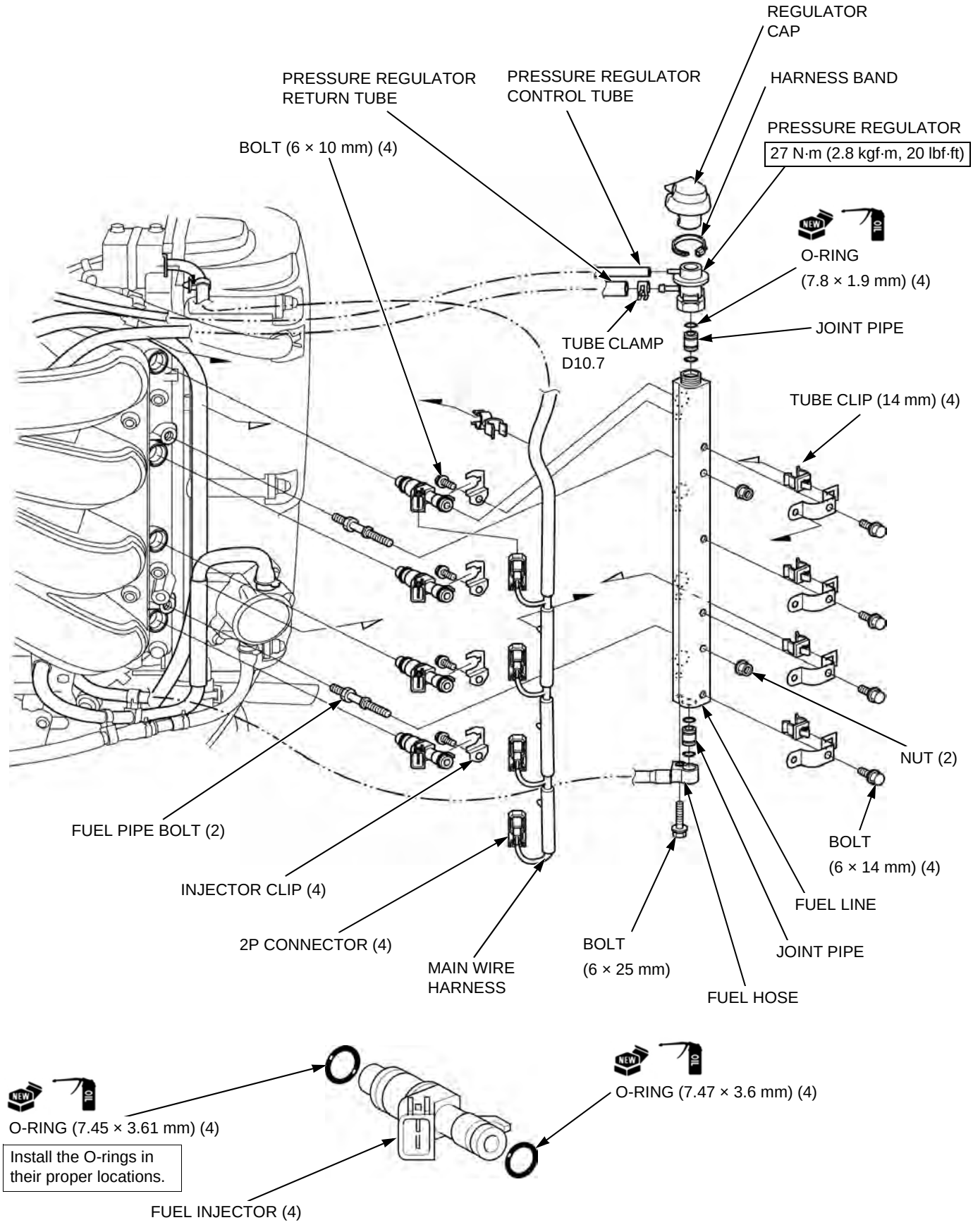


Release the fuel tube B (1) and air vent tube (2) from the four 14 mm tube clips (3).

Remove the two nuts (4) and fuel line (5).



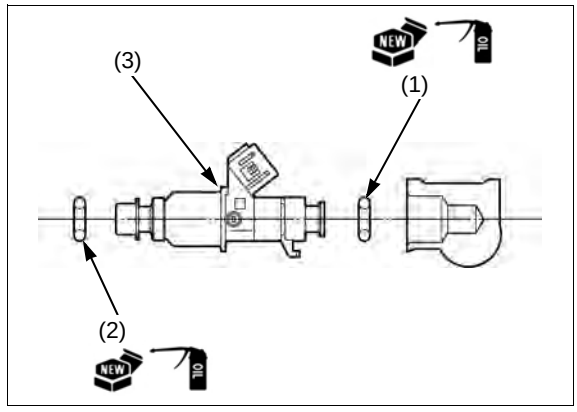
EXPLODED VIEW



INSTALLATION

Apply engine oil to the new O-ring (7.47 × 3.6 mm) (1) and O-ring (7.45 × 3.61 mm) (2) and install them into the grooves of the fuel injector (3).

- Be sure to install the O-rings in their correct locations.

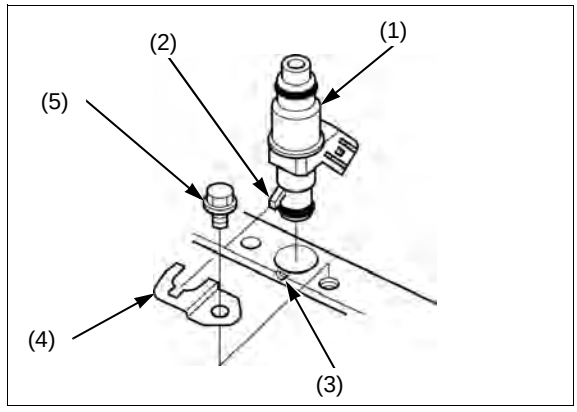


Install the fuel injectors (1) by aligning their tabs (2) with the grooves (3) of the fuel pipe.

NOTICE

Insert the fuel injectors straight into the fuel pipe. Do not insert them into the fuel pipe slanted, and do not insert them with force. Damage to the O-rings can occur.

Install injector clips (4) and tighten the bolts (5) to the fuel pipes.

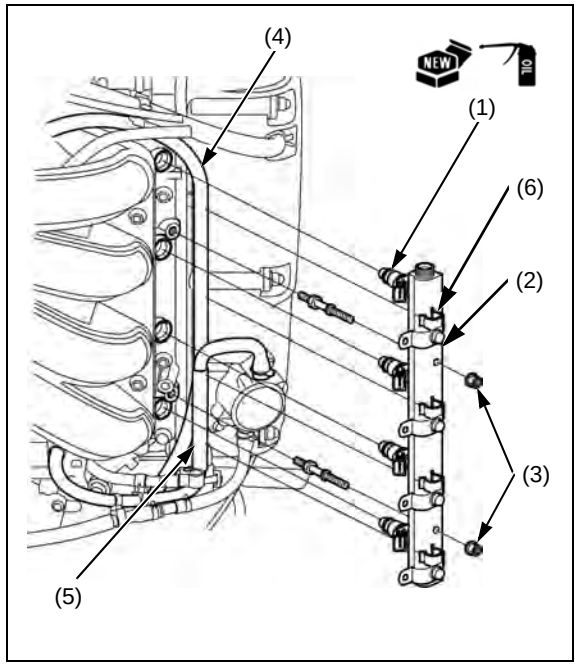


NOTICE

To prevent damage to the O-ring, install the injectors in the fuel pipe first, then install them in the injector bases.

Apply engine oil to the new O-rings (1) and install the fuel line (2), then tighten the two nuts (3).

Set the air vent tube (4) and fuel tube B (5) to the four 14 mm tube clips (6).



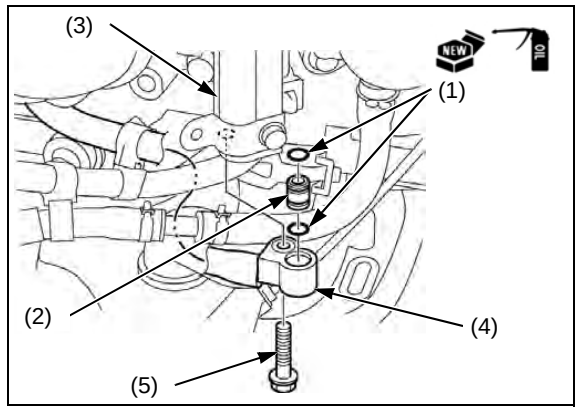
Apply engine oil to two new O-rings (1) and install them to the joint pipe (2).

Insert the joint pipe until it is seated on the fuel line (3).

Install the fuel hose (4) to the fuel line and tighten the bolt (5).

NOTICE

To prevent fuel leaks, make sure the fuel pipe joint and fuel hose are fixed to the fuel line securely before tightening the bolt.



Apply engine oil to two new O-rings (1) and install them to the joint pipe (2).

Insert the joint pipe until it is seated on the fuel line (3).

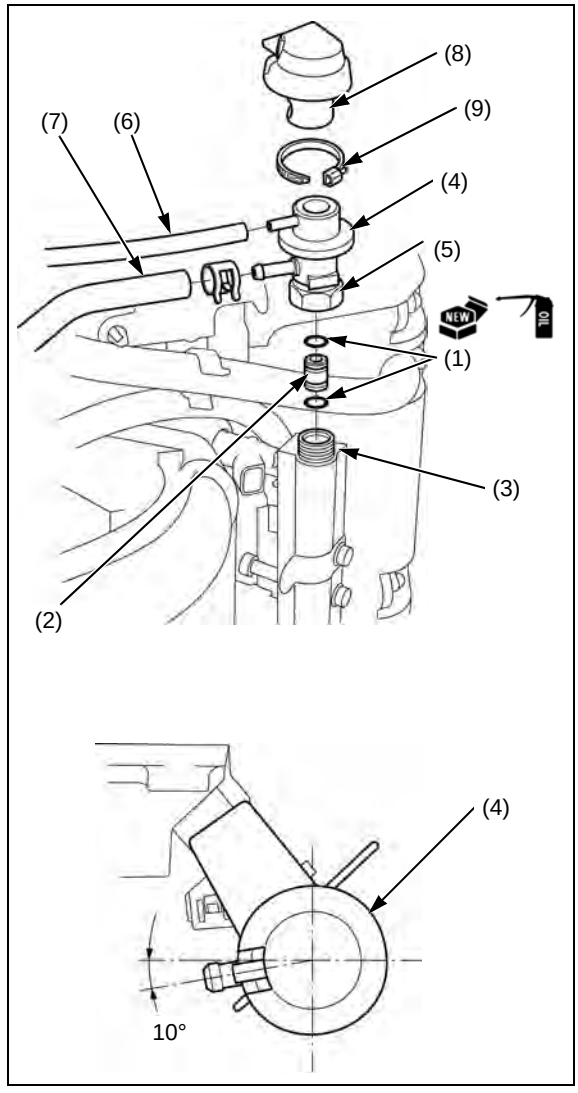
Install the pressure regulator (4) to the fuel line in the specified angle as shown.

Install and tighten the holding nut (5) to the specified torque.

TORQUE: 27 N·m (2.8 kgf·m, 20 lbf·ft)

Connect the pressure regulator control tube (6) and pressure regulator return hose (7) to the pressure regulator.

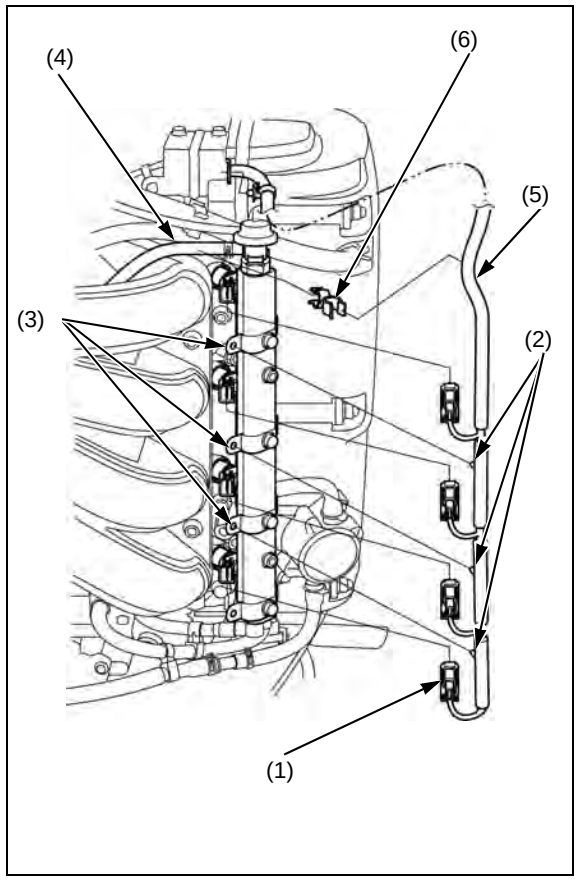
Install the regulator cap (8) and secure it with the harness band (9).



Connect the four fuel injector 2P connectors (1).

Install the main wire harness clips (2) to the clip brackets (3).

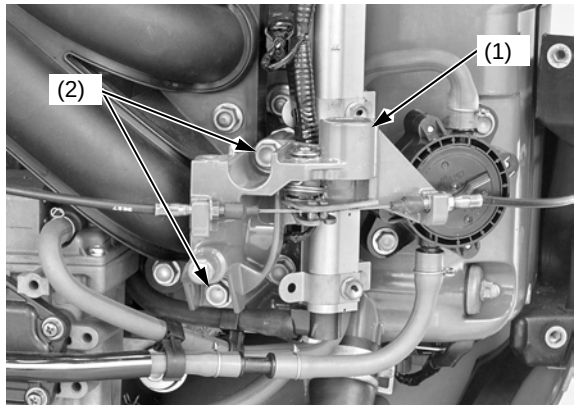
Secure the pressure regulator return hose (4) and main wire harness (5) with the hose clamp (6).



Install the L. side cover bracket (1) and tighten the two bolts (2).

Install the L. engine under cover (page 6-4).

Connect the battery negative (-) terminal.



INJECTOR BASE REMOVAL/ INSTALLATION

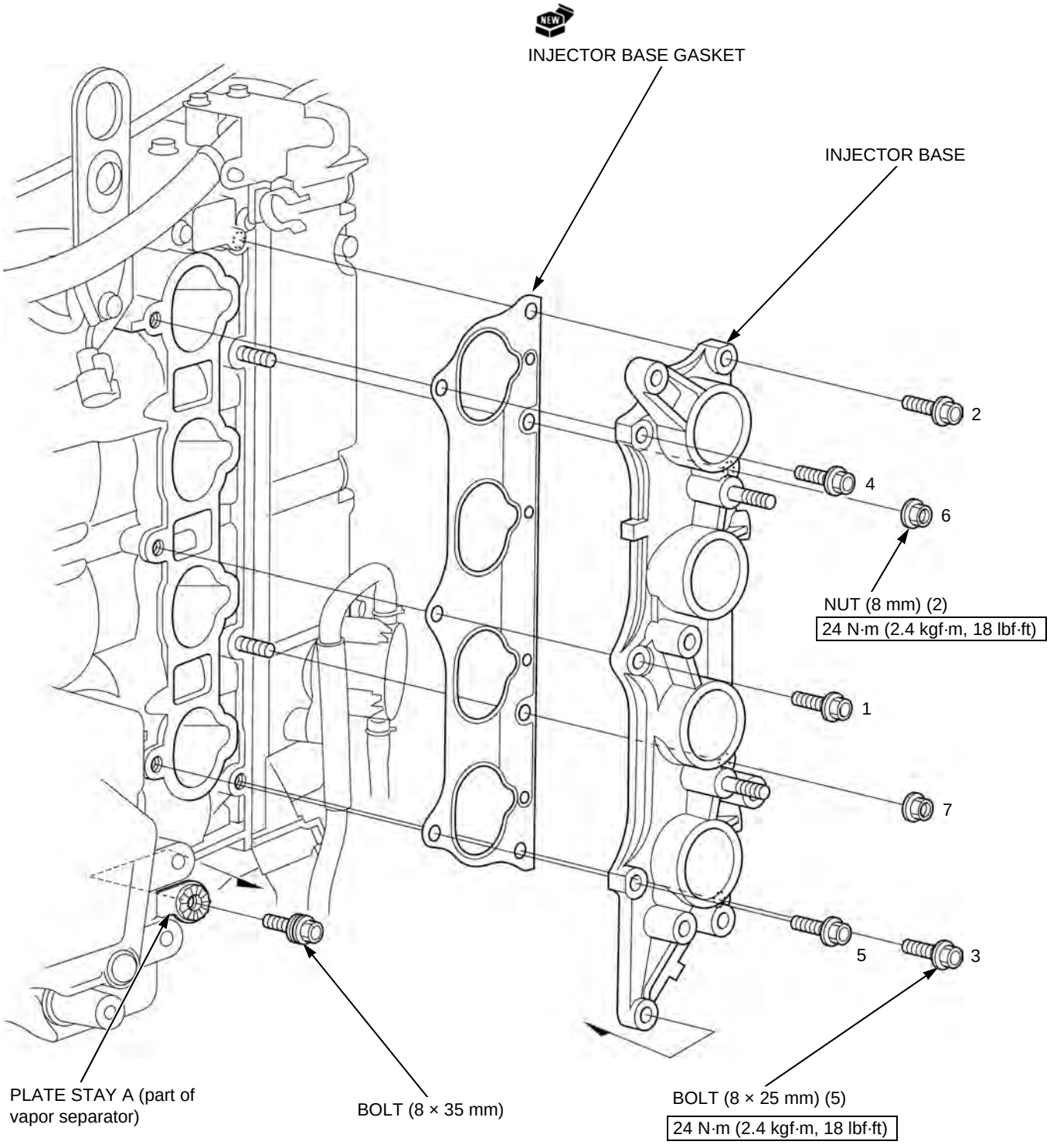
Remove the intake manifold (page 5-87).

Remove the fuel line assembly (page 5-91).

Installation is in the reverse order or removal.

Tighten the five bolts (8 × 25 mm) and two nuts (8 mm) to the specified torque in the numbered order in two or three steps.

Tighten the bolt (8 × 35 mm) securely.



WATER SEPARATOR/WATER LEVEL SENSOR REMOVAL/INSTALLATION

⚠WARNING

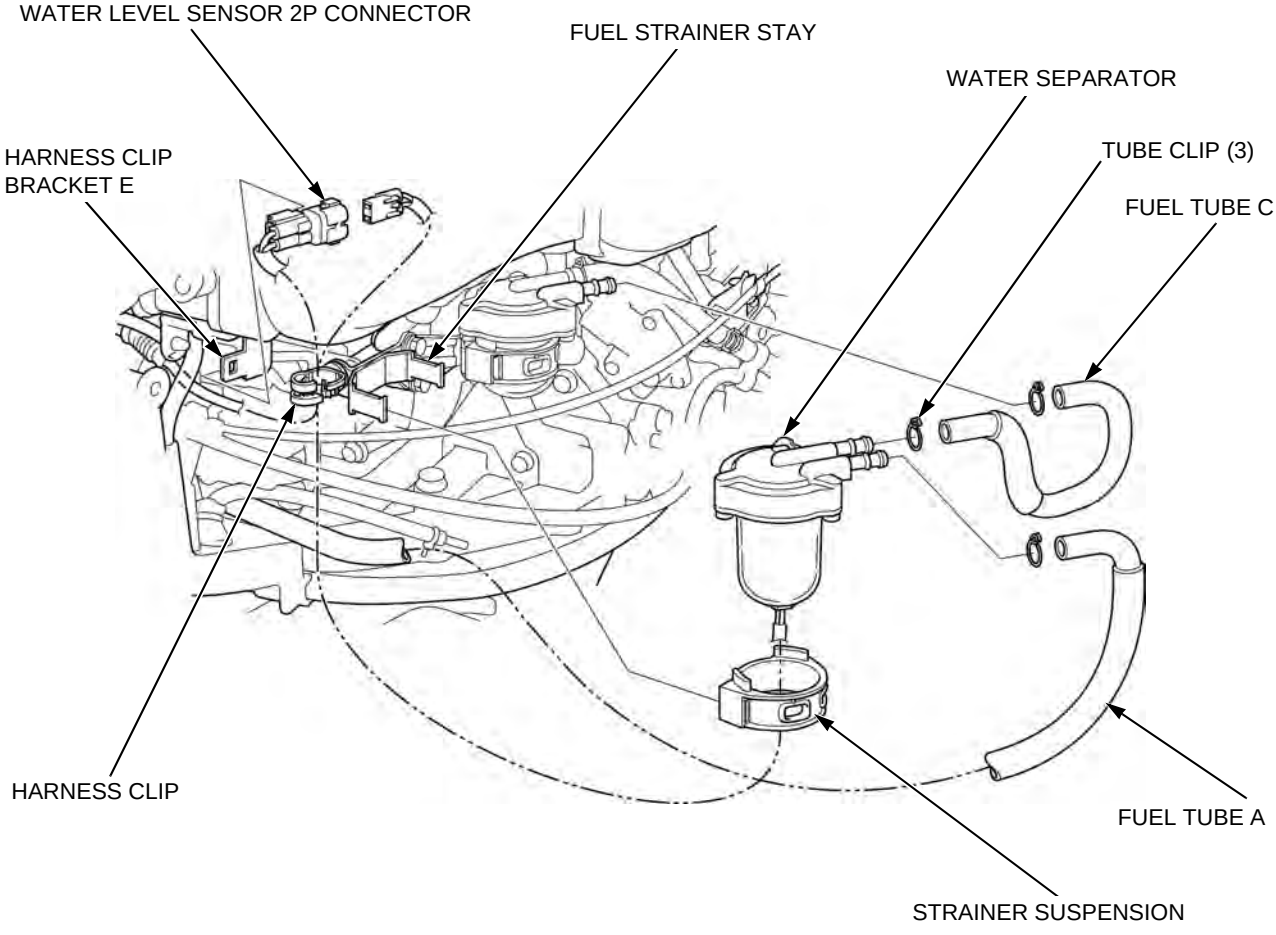
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- Keep heat, sparks, and flame away.
- Wipe up spills immediately.
- Handle fuel only outdoors.

REMOVAL

Remove the L. engine under cover (page 6-4).

Release the water level sensor wires from the harness clip.
Remove the water level sensor 2P connector from the harness clip bracket E and disconnect it.

Clamp the fuel tubes using commercially available hose clamps and disconnect them from the water separator.



INSTALLATION

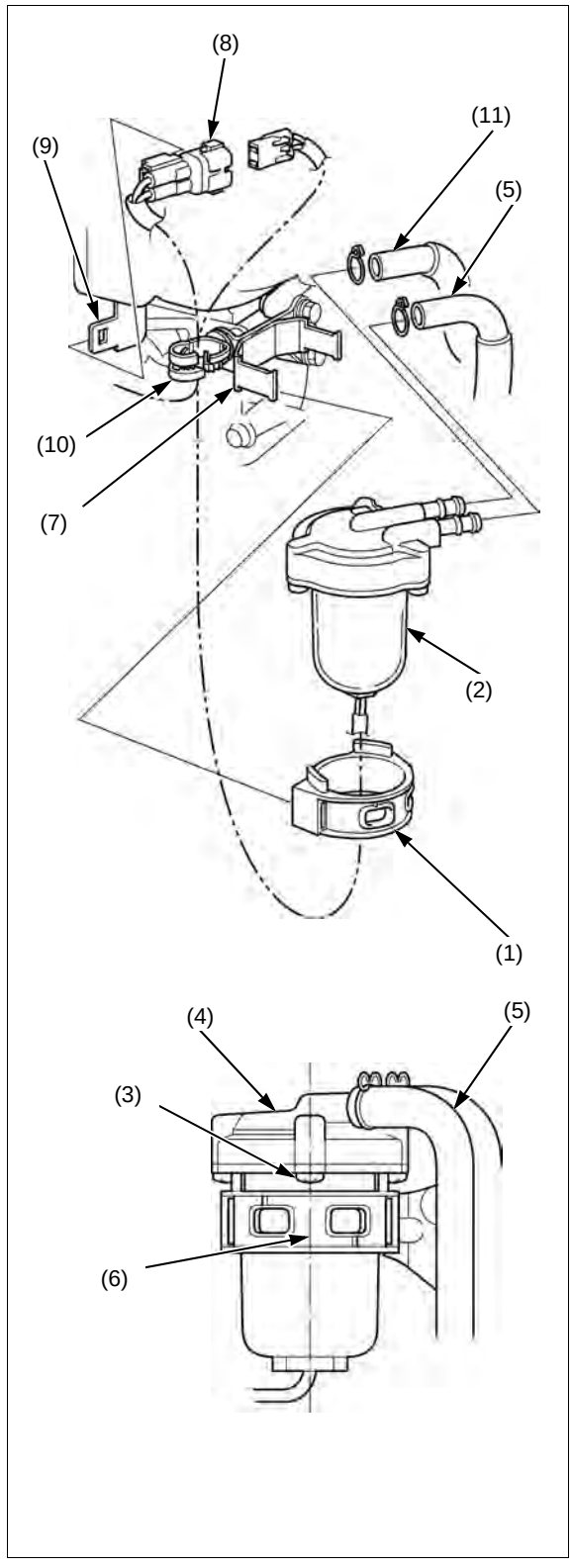
Install the suspension (1) to the water separator (2) and align the screw (3) of the water separator body (4) on the fuel tube A (5) side with the center line (6) of the suspension as shown.

Install the water separator to the fuel strainer stay (7).

Connect the water separator/water level sensor 2P connector (8) and install it to the harness clip bracket E (9).
Clamp the water level sensor wires with the harness clip (10).

Connect the fuel tube C (11) and fuel tube A to the water separator.

Install the L. engine under cover (page 6-4).



FUEL PUMP (HIGH PRESSURE SIDE)/ VAPOR SEPARATOR REMOVAL/ INSTALLATION

⚠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.
- Handle fuel only outdoors.

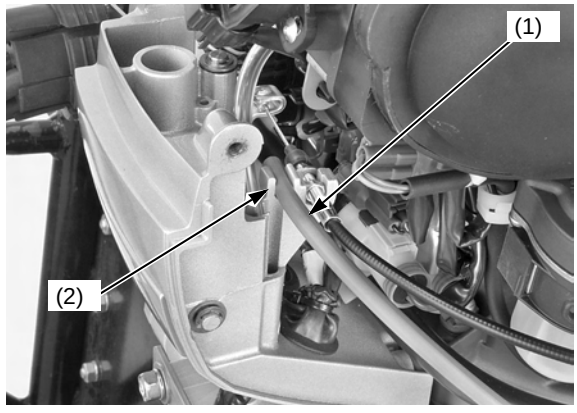
Disconnect the battery cable from the battery negative (–) terminal.

Remove the L. engine under cover (page 6-4).

Relieve the fuel pressure (page 5-79).

REMOVAL

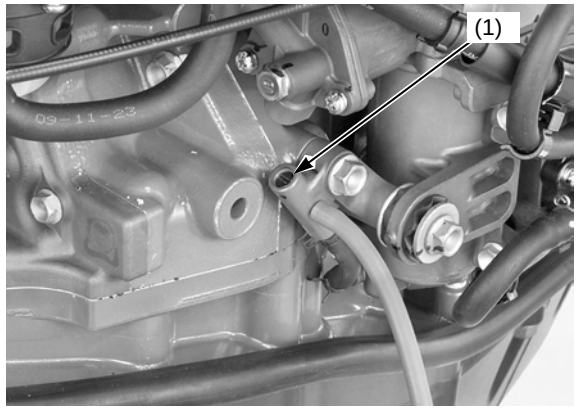
Release the vapor separator drain tube (1) from the clamp (2) on the under cover front bracket.



Loosen the water separator drain screw (1) and drain the fuel in the vapor separator.

After draining, tighten the vapor separator drain screw to the specified torque.

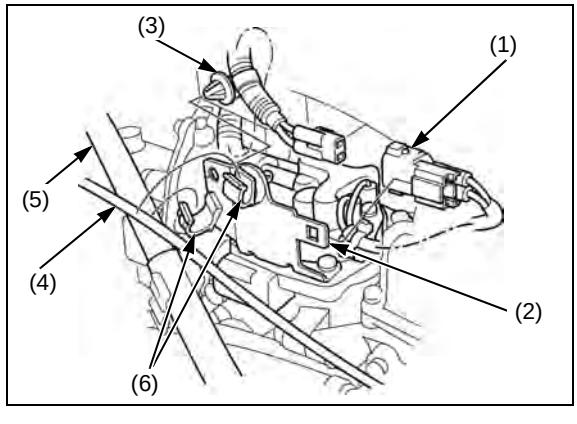
TORQUE: 1.5 N·m (0.15 kgf·m, 1.1 lbf·ft)



Release the high pressure side fuel pump 2P connector (1) from the connector bracket (2) and disconnect it.

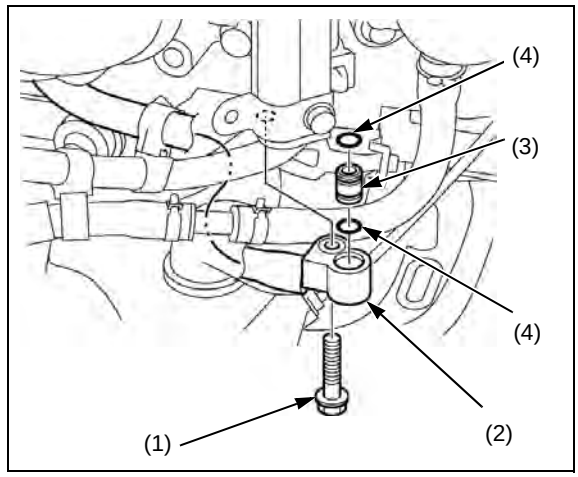
Release the harness band clip (3) from the connector bracket.

Release the cover lock cable (4) and fuel tube (5) from the clamps (6).

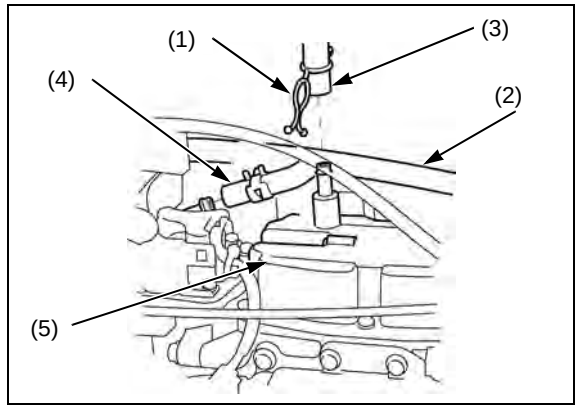


Remove the bolt (1) and fuel hose (2).

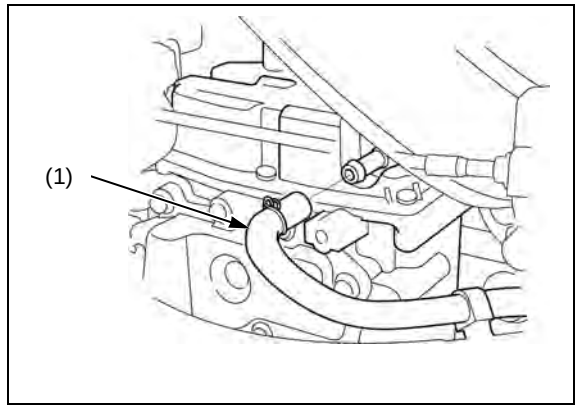
Remove the joint pipe (3) and two O-rings (4).



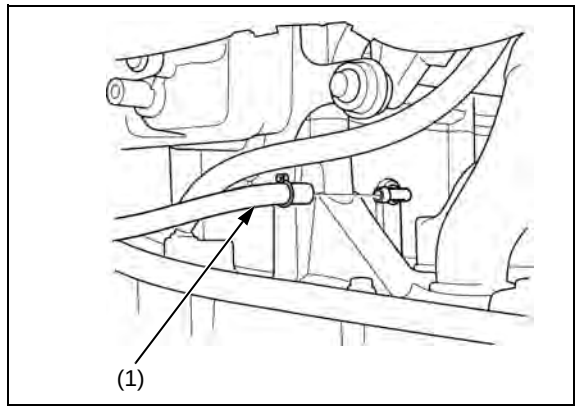
Release the hose clip (1) from the fuel hose (2) and disconnect the air vent tube E (3) and pressure regulator return hose (4) from the vapor separator (5).



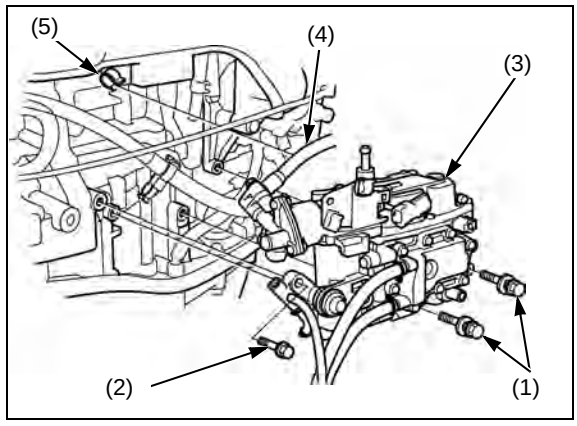
Disconnect the fuel tube B (1) (from the low pressure side fuel pump) from the vapor separator.



Disconnect the water tube F (1) from the mounting case.



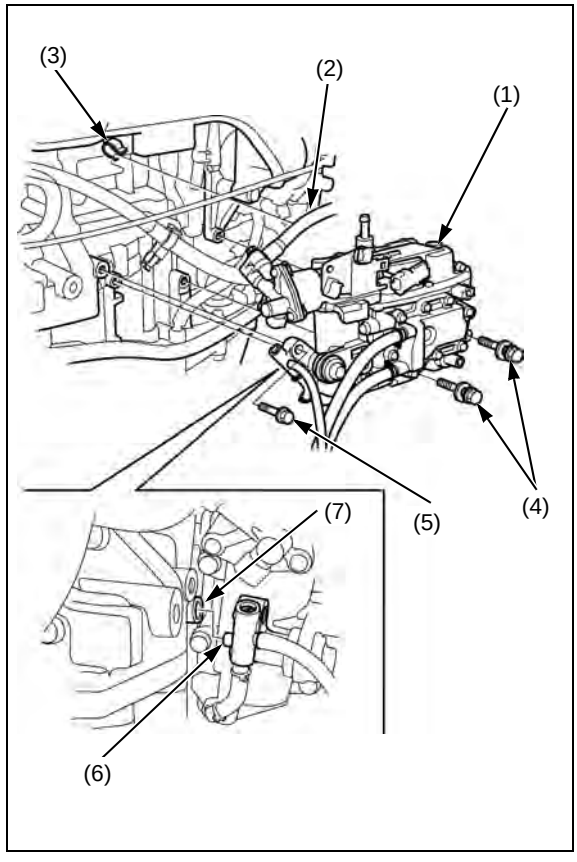
Remove the two bolts (8 × 35 mm) (1), bolt (8 × 30 mm) (2) and vapor separator (3) by releasing the fuel hose (high pressure side) (4) from the hose clip (5).



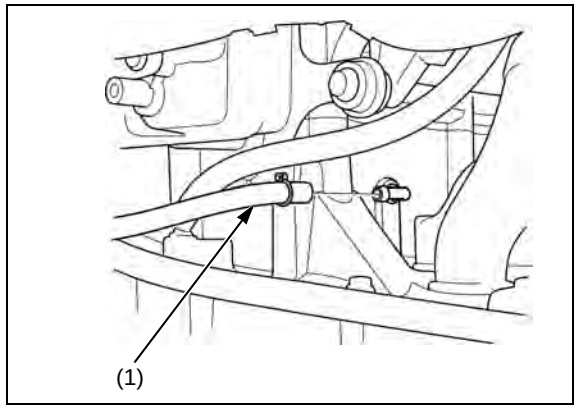
INSTALLATION

Install the vapor separator (1) to the engine by installing the fuel hose (high pressure side) (2) to the hose clip (3).
Loosely install the two bolts (8 × 35 mm) (4) and bolt (8 × 30 mm) (5).

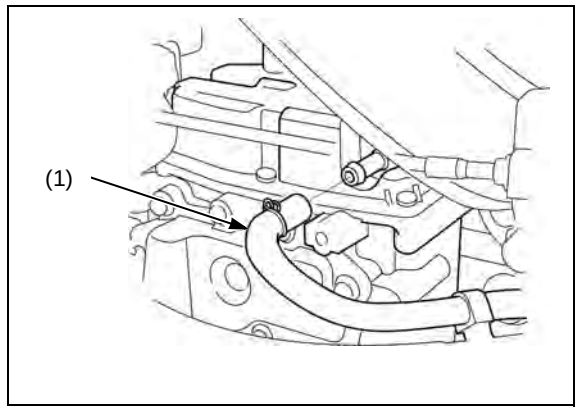
Align the boss (6) of the vapor separator stay with the hole (7) of the engine.



Connect the water tube F (1) to the mounting case.

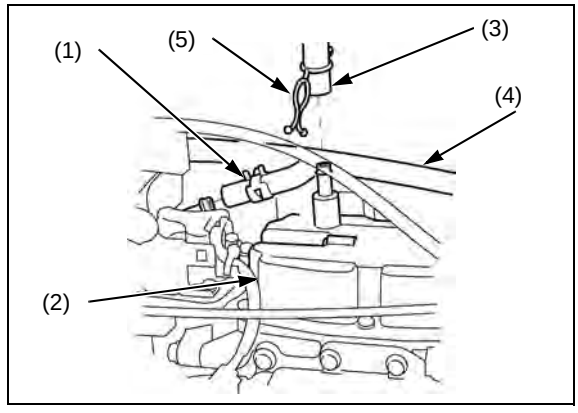


Connect the fuel tube B (1) to the vapor separator.



Connect the pressure regulator return hose (1) to the vapor separator (2).

Connect the air vent tube E (3) to the vapor separator, then clamp the air vent tube E and fuel hose (4) with the hose clip (5).



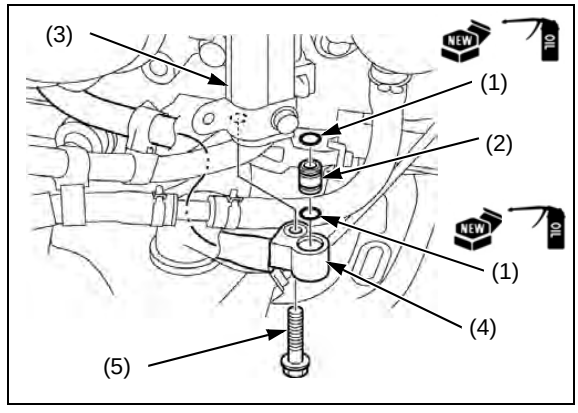
Apply engine oil to two new O-rings (1) and install them to the joint pipe (2).

Insert the joint pipe until it is seated on the fuel line (3).

Install the fuel hose (4) to the fuel line and tighten the bolt (5).

NOTICE

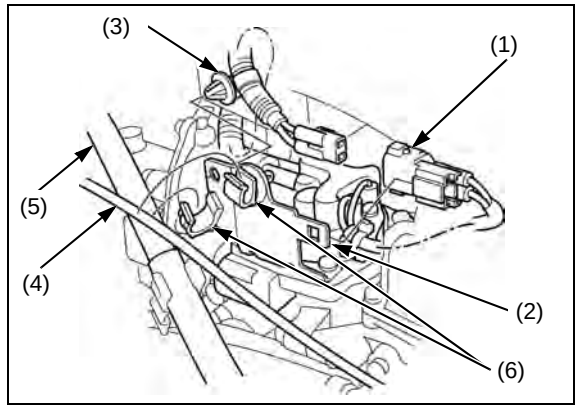
To prevent fuel leaks, make sure the fuel pipe joint and fuel hose are fixed to the fuel line securely before tightening the bolt.



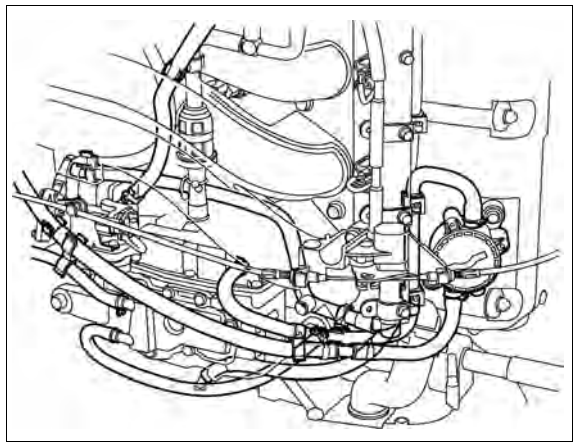
Connect the fuel pump 2P connector (1) and install it to the connector bracket (2).

Install the harness band clip (3) to the connector bracket as shown.

Set the cover lock cable (4) and fuel tube D (5) to the clamps (6).



Check the tubes that they are connected correctly (page 2-35).

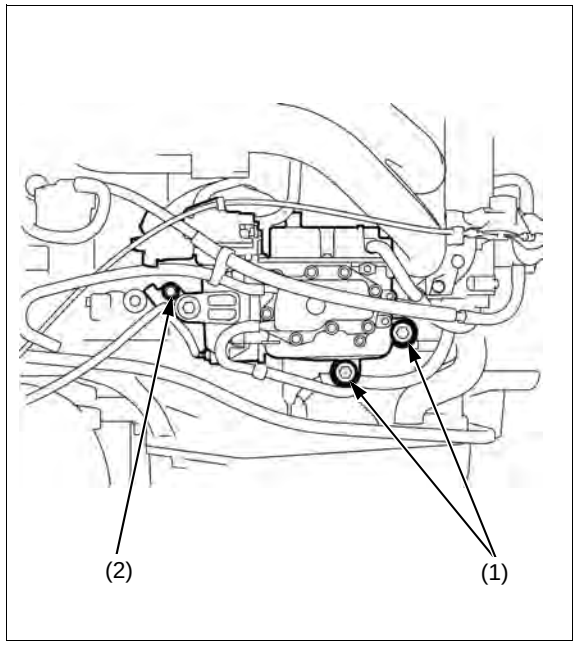


After checking the hose connection, tighten the two bolts (8 × 35 mm) (1) and bolt (8 × 30 mm) (2) to the specified torque.

TORQUE: 26 N·m (2.7 kgf·m, 19 lbf·ft)

Install the L. engine under cover (page 6-4).

Connect the battery negative (–) terminal.

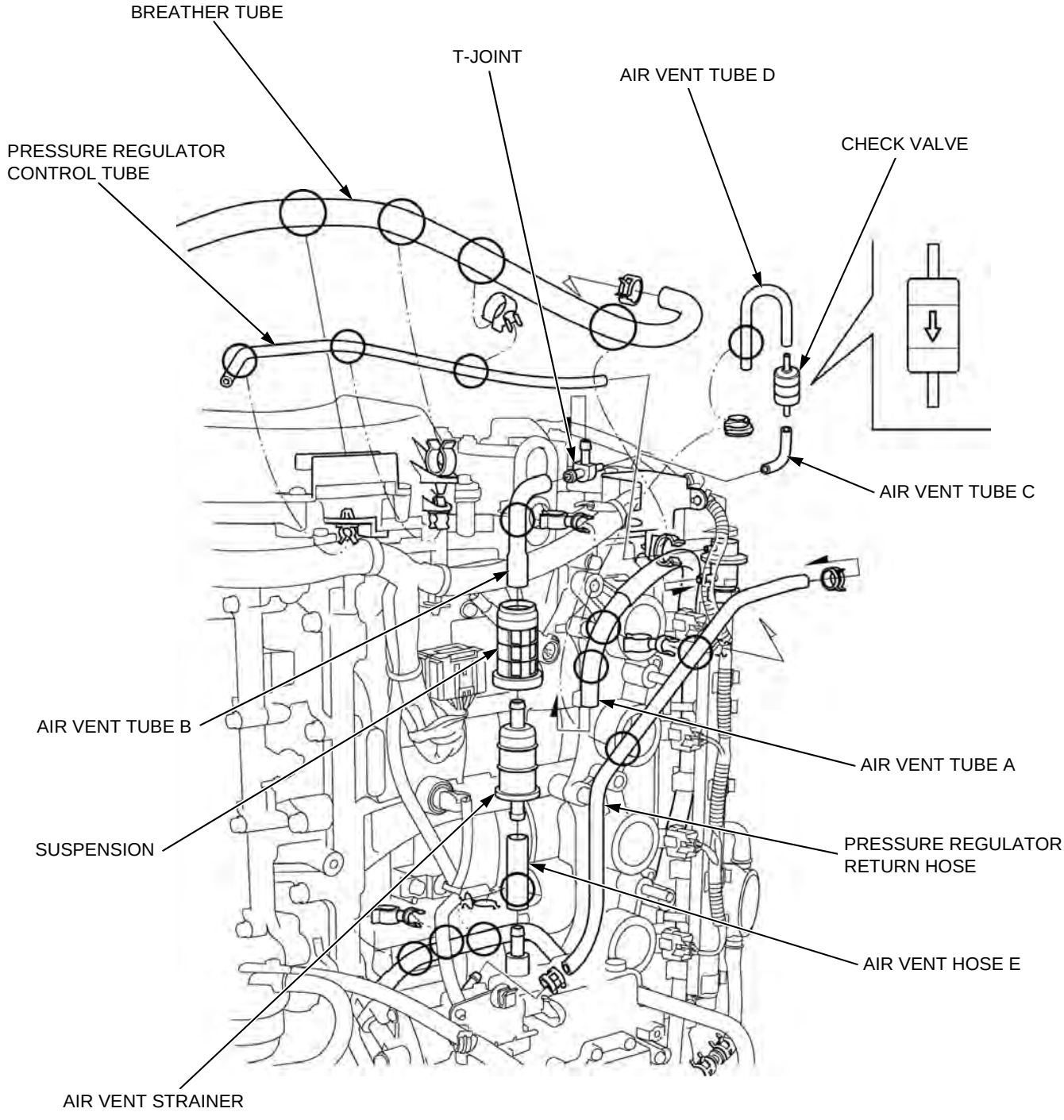


AIR VENT STRAINER/AIR VENT TUBE REMOVAL/INSTALLATION

Remove the intake manifold (page 5-87).

- Check the tubes for deterioration or cracks and replace if necessary.
- After installation, check the tube clamps for correct installation (page 2-35).

Installation is in the reverse order of removal.



EXHAUST MANIFOLD REMOVAL/ INSTALLATION

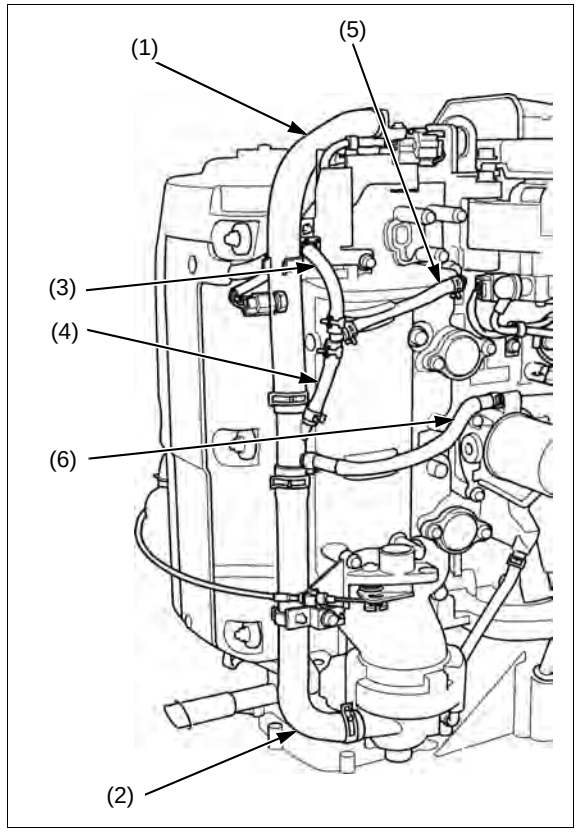
REMOVAL

Remove the following:

– L./R. side cover bracket (page 6-18)

Disconnect the following water tubes:

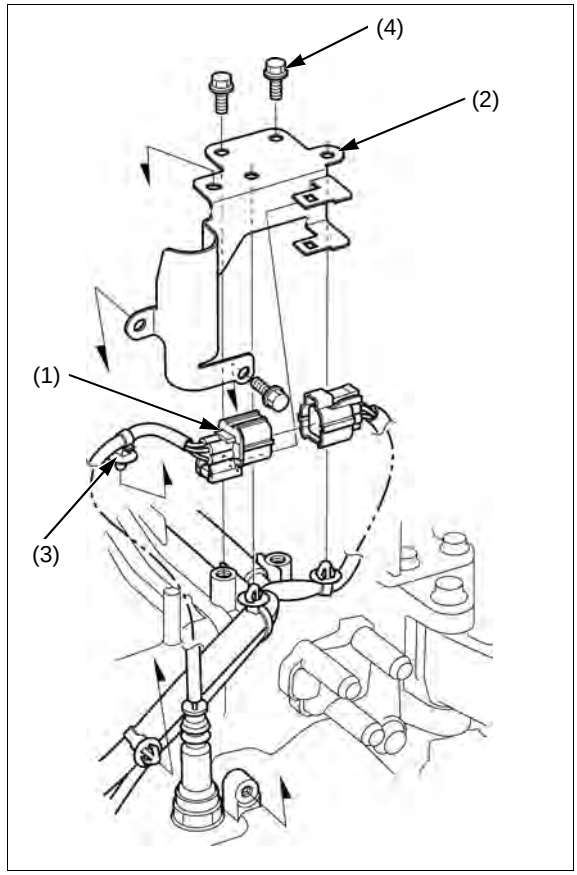
– Water relief tube A (1)
– Water relief tube B (2)
– Tube (7 × 90 mm) (3)
– Tube (7 × 75 mm) (4)
– Tube (7 × 120 mm) (5)
– Water tube E (6)



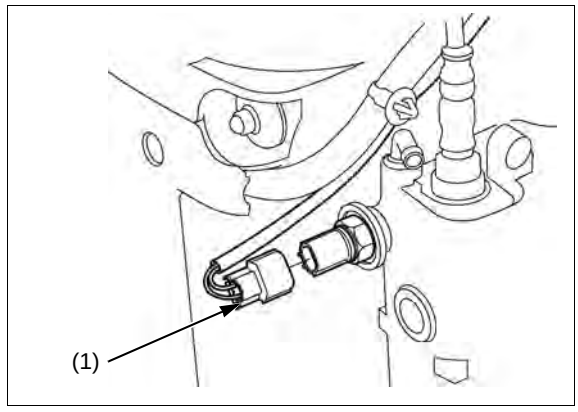
Disconnect the A/F sensor 4P connector (1) and remove it from the connector bracket (2).

Release the four harness band clips (3) from the connector bracket.

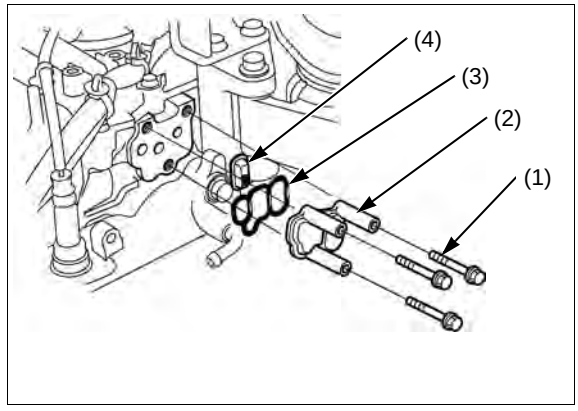
Remove the three bolts (4) and connector bracket.



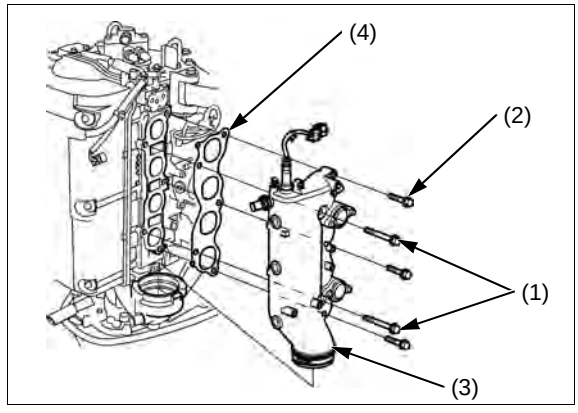
Disconnect the ECT sensor 3 (2P) connector (1).



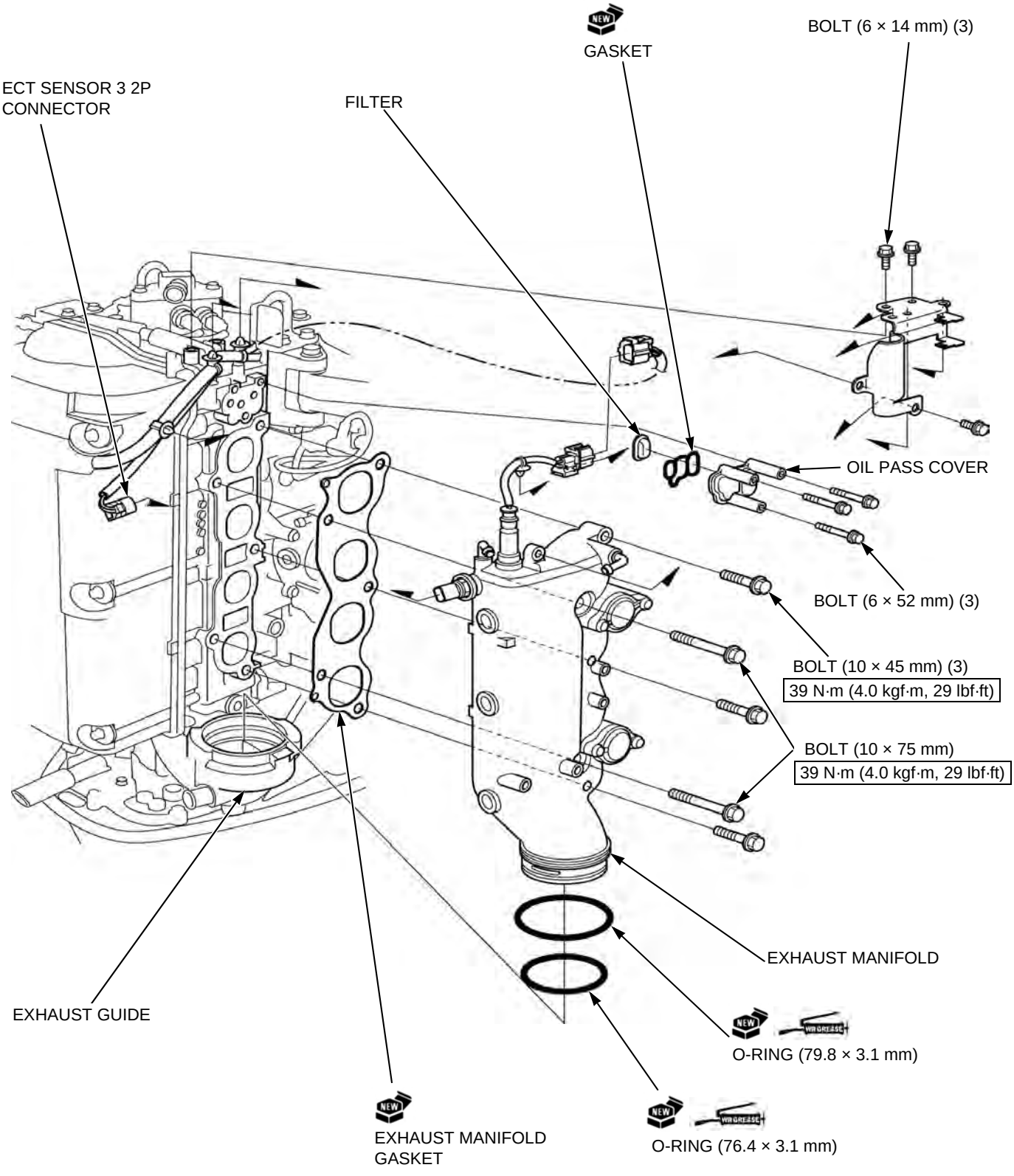
Remove the three bolts (1), oil pass cover (2), gasket (3) and filter (4).



Remove the two bolts (10 × 75 mm) (1), three bolts (10 × 45 mm) (2), exhaust manifold (3) and exhaust manifold gasket (4).



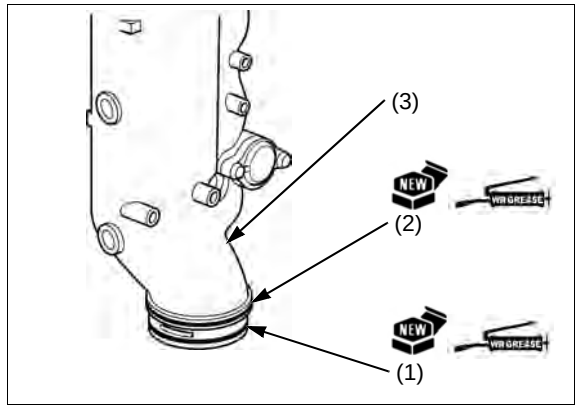
EXPLODED VIEW



INSTALLATION

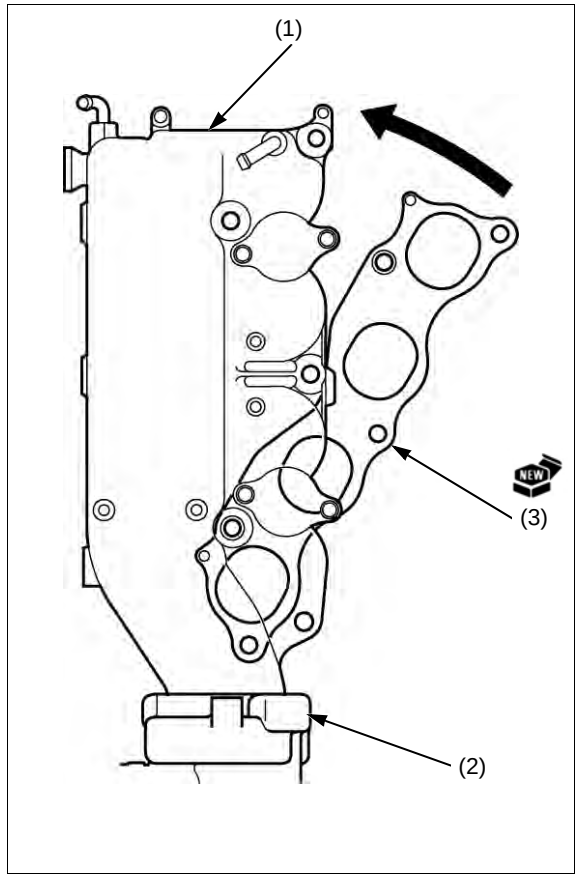
Apply marine grease to the exhaust manifold installation area of the exhaust guide.

Apply marine grease to new O-ring (76.4 × 3.1 mm) (1) and O-ring (79.8 × 3.1 mm) (2) and install them to the exhaust manifold (3).



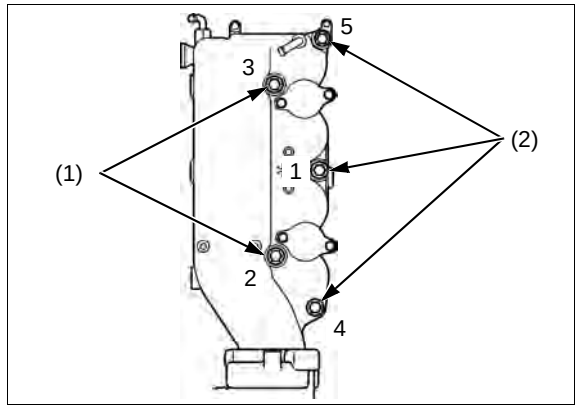
Set the exhaust manifold (1) on the exhaust guide (2).

Install a new exhaust manifold gasket (3) to the exhaust manifold.

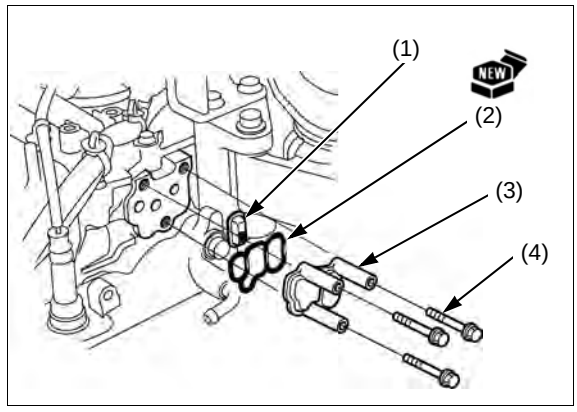


Install the two bolts (10 × 75 mm) (1) and three bolts (10 × 45 mm) (2), then tighten them to the specified torque in the numbered order in two or three steps.

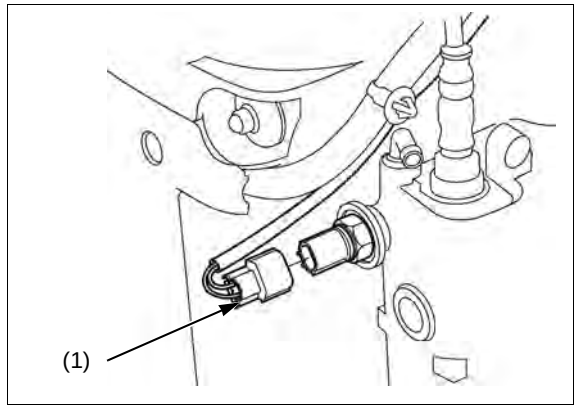
TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)



Install the filter (1), new gasket (2) and oil pass cover (3), then tighten the three bolts (4).



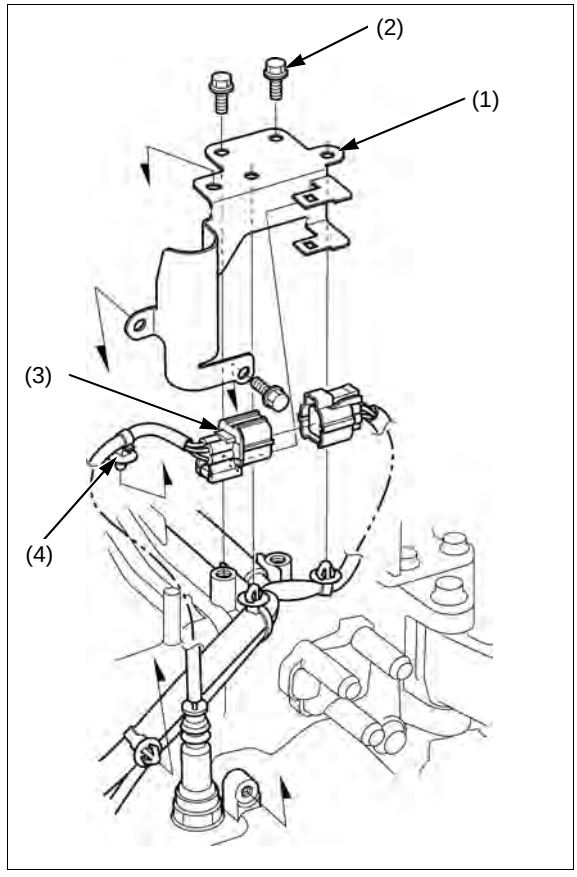
Connect the ECT sensor 3 (2P) connector (1).



Install the connector bracket (1) and tighten the three bolts (2).

Connect the A/F sensor 4P connector (3) and install it to the connector bracket.

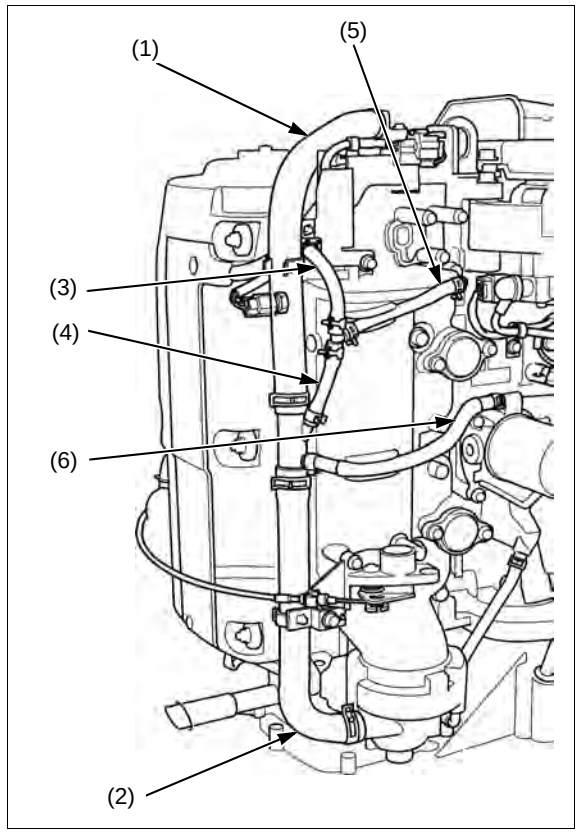
Install the four harness band clips (4) to the connector bracket.



Connect the following water tubes:

– Water relief tube A (1)
– Water relief tube B (2)
– Tube (7 × 90 mm) (3)
– Tube (7 × 75 mm) (4)
– Tube (7 × 120 mm) (5)
– Water tube E (6)

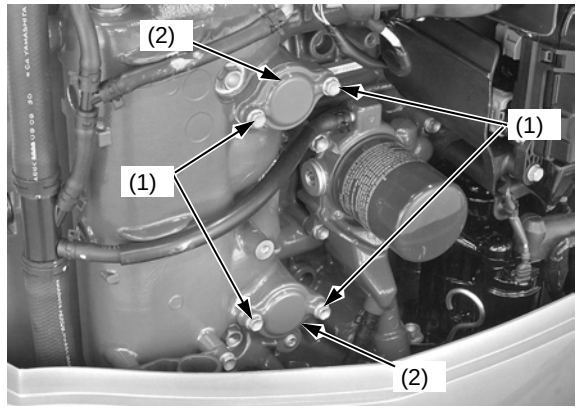
Install the L./R. side cover bracket (page 6-18).



EXHAUST MANIFOLD ANODE REMOVAL/INSTALLATION

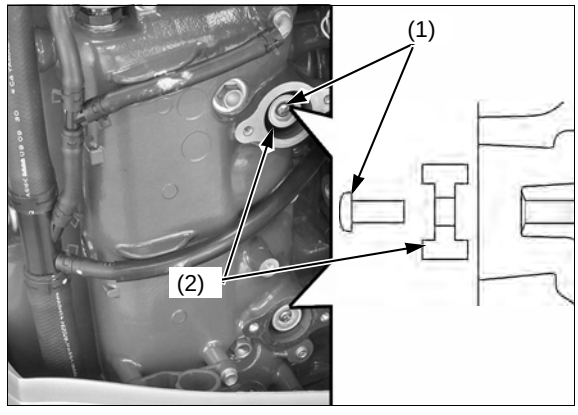
Remove the engine cover.

Remove the four bolts (1) and two exhaust manifold covers (2).



Remove the two screws (1) and two anode metals (2).

Installation is in the reverse order of removal.

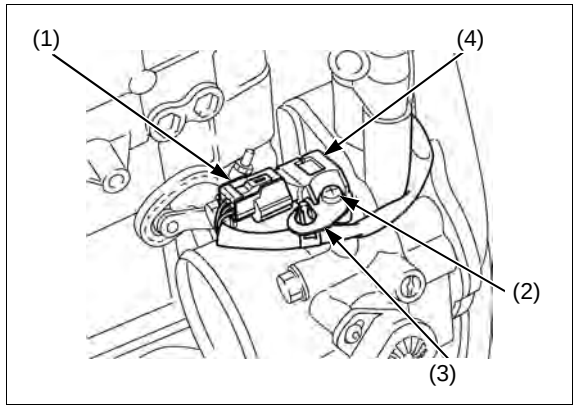


MAP SENSOR REMOVAL/ INSTALLATION

Remove the silencer case (page 5-83).

Disconnect the MAP sensor 3P connector (1).

Remove the screw (2), harness clamp holder (3) and MAP sensor (4).



Remove the O-ring (1).

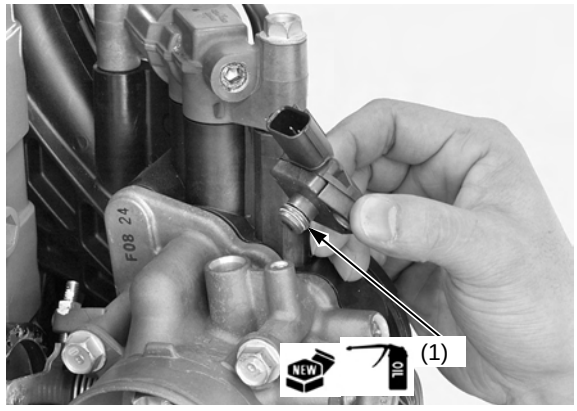
Apply engine oil to a new O-ring and install it to the MAP sensor.

Install the MAP sensor and harness clamp holder to the throttle body, then install and tighten the screw to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

Connect the MAP sensor 3P connector.

Install the silencer case (page 5-83).

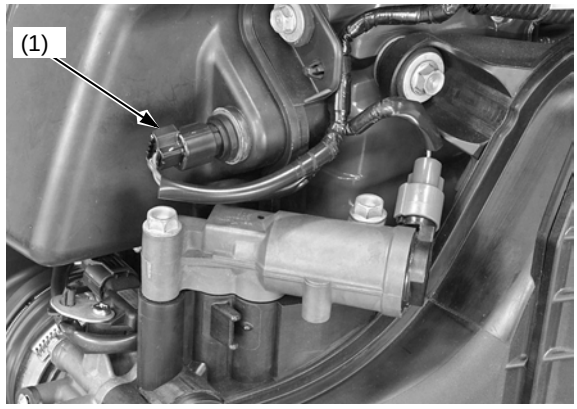


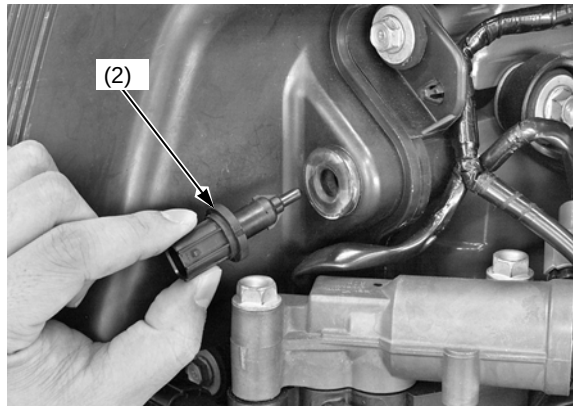
IAT SENSOR REMOVAL/ INSTALLATION

Remove the engine cover.

Disconnect the 2P connector (1) and remove the IAT sensor (2).

Installation is in the reverse order of removal.



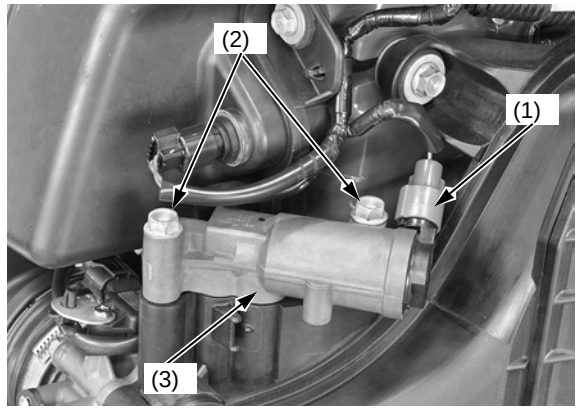


IAC VALVE REMOVAL/INSTALLATION

Remove the engine cover.

Disconnect the IAC valve 2P connector (1).

Remove the two bolts (2) and IAC valve (3).



Remove the IAC valve packing (1).

Install a new IAC valve packing.

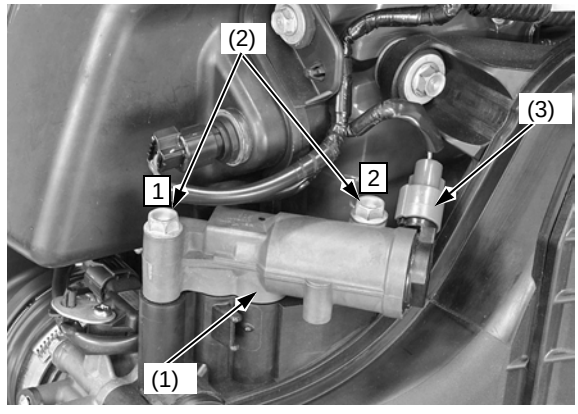


Install the IAC valve (1) to the intake manifold and tighten the bolts (2) to the specified torque in the numbered order in two or three steps.

TORQUE: 22 N·m (2.2 kgf·m, 16 lbf·ft)

Connect the IAC valve 2P connector (3).

Install the engine cover.



A/F SENSOR REMOVAL/ INSTALLATION

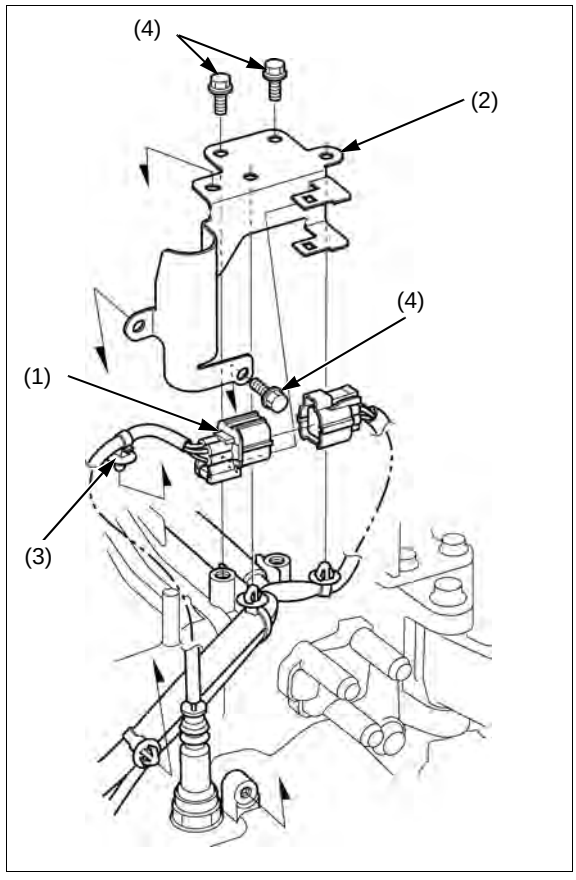
REMOVAL

Remove the engine cover.

Disconnect the A/F sensor 4P connector (1) and remove it from the connector bracket (2).

Remove the four harness band clips (3) from the connector bracket.

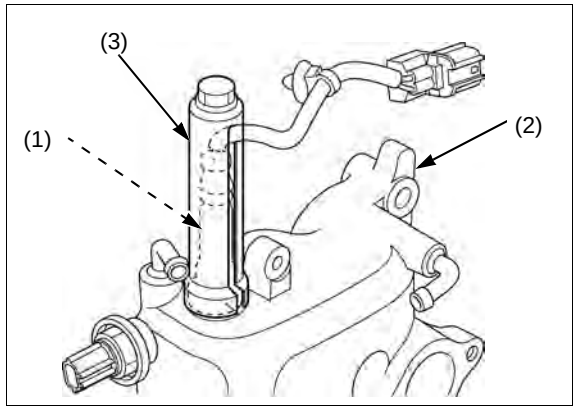
Remove the three bolts (4) and connector bracket.



Remove the A/F sensor (1) from the exhaust manifold (2), using a special tool.

TOOL:

Sensor socket wrench, 22 x 150 mm (3)	**07906-PD10000**



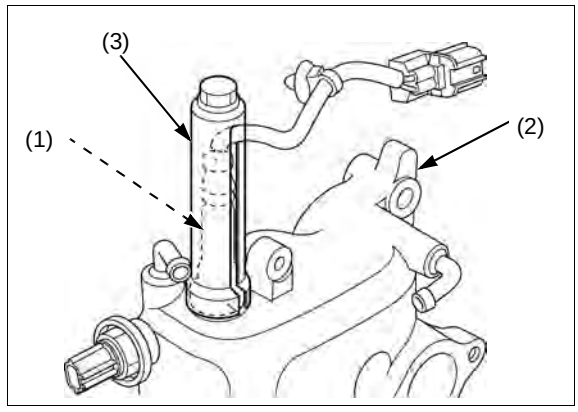
INSTALLATION

Install the A/F sensor (1) to the exhaust manifold (2).

Tighten the A/F sensor to the specified torque using a special tool.

TOOL:
Sensor socket wrench, 22 x 150 mm (3) **07906-PD10000**

TORQUE: 42 N·m (4.3 kgf·m, 31 lbf·ft)

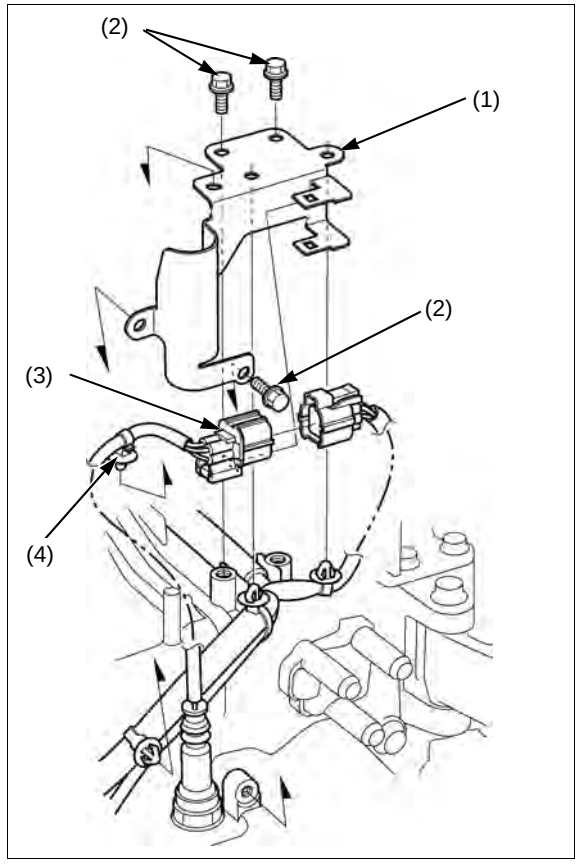


Install the connector bracket (1) and tighten the three bolts (2).

Connect the A/F sensor 4P connector (3) and install it to the connector bracket.

Install the four harness band clips (4) to the connector bracket.

Install the engine cover.



ECT SENSOR 1 REMOVAL/ INSTALLATION

Remove the fuse/relay junction box (page 10-3).

Disconnect the ECT sensor 1 (2P) connector (1).

Remove the ECT sensor 1 (2) and O-ring (3).

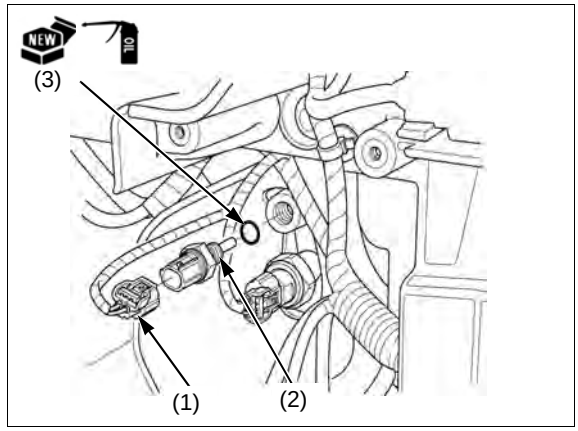
Apply engine oil to a new O-ring and install it to the ECT sensor 1.

Install and tighten the ECT sensor 1 to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Connect the ECT sensor 1 (2P) connector.

Install the fuse/relay junction box (page 10-3).

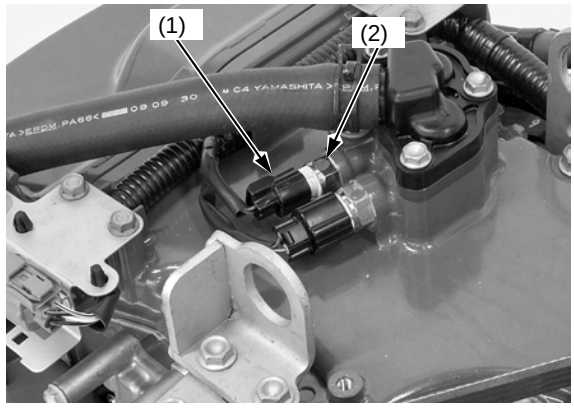


ECT SENSOR 2 REMOVAL/ INSTALLATION

Remove the engine cover.

Disconnect the ECT sensor 2 (2P) connector (1).

Remove the ECT sensor 2 (2).



Remove the O-ring (1).

Apply engine oil to a new O-ring and install it to the ECT sensor 2 (2).

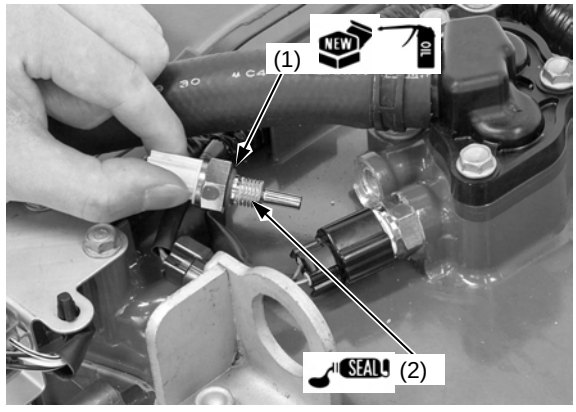
Apply liquid sealant (Threebond® 1201 or 1215 or equivalent) to the threads and seating surface of the ECT sensor 2.

Install the ECT sensor 2 to the chain case and tighten it to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Connect the ECT sensor 2 (2P) connector.

Install the engine cover.

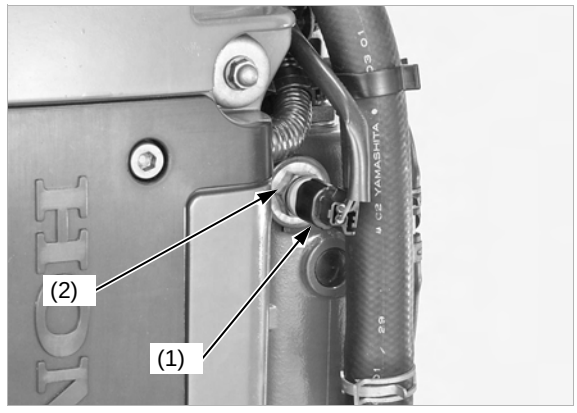


ECT SENSOR 3 REMOVAL/ INSTALLATION

Remove the engine cover.

Disconnect the ECT sensor 3 (2P) connector (1).

Remove the ECT sensor 3 (2).



Remove the O-ring (1).

Apply engine oil to a new O-ring and install it to the ECT sensor 3 (2).

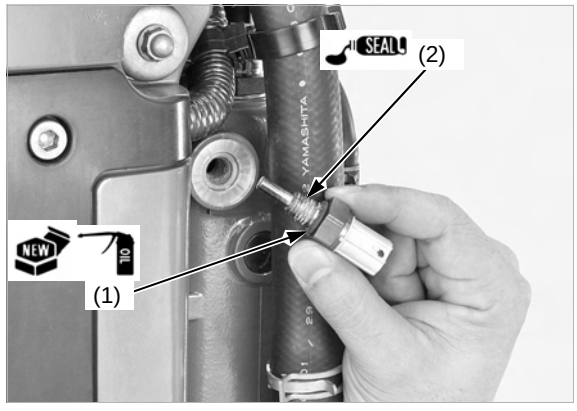
Apply liquid sealant (Threebond® 1201 or 1215 or equivalent) to the threads and seating surface of the ECT sensor 3.

Install the ECT sensor 3 to the exhaust manifold and tighten it to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Connect the ECT sensor 3 (2P) connector.

Install the engine cover.

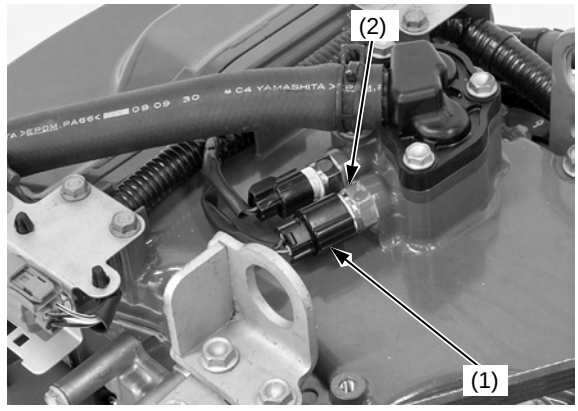


ECT SENSOR 4 REMOVAL/ INSTALLATION

Remove the engine cover.

Disconnect the ECT sensor 4 (2P) connector (1).

Remove the ECT sensor 4 (2).



Remove the O-ring (1).

Apply engine oil to a new O-ring and install it to the ECT sensor 4 (2).

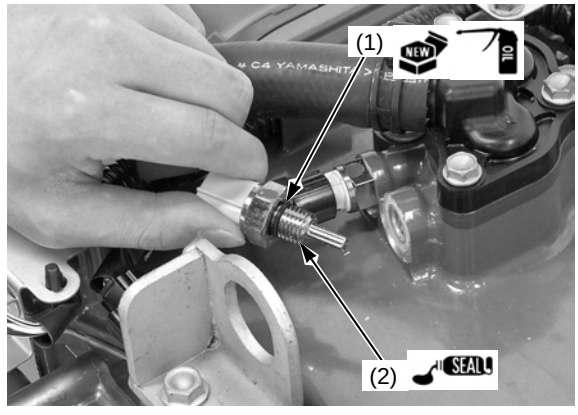
Apply liquid sealant (Threebond® 1201 or 1215 or equivalent) to the threads and seating surface of the ECT sensor 4.

Install the ECT sensor 4 to the chain case and tighten it to the specified torque.

TORQUE: 18 N·m (1.8 kgf·m, 13 lbf·ft)

Connect the ECT sensor 4 (2P) connector.

Install the engine cover.



CKP SENSOR REMOVAL/ INSTALLATION

Remove the silencer duct (page 5-82).

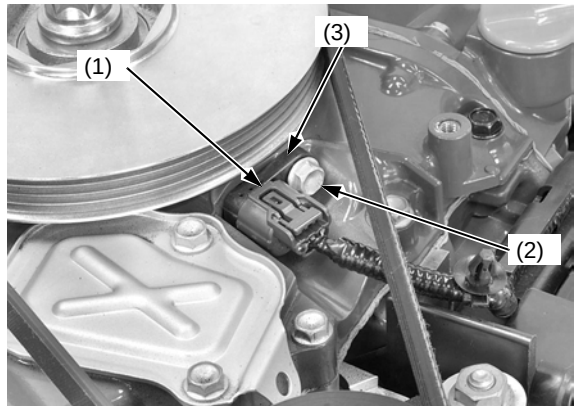
Disconnect the CKP sensor 3P connector (1).

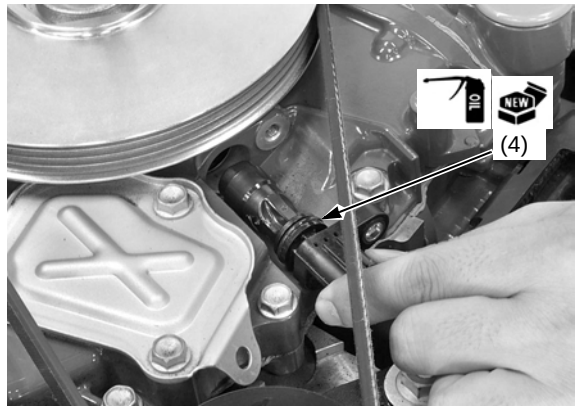
Remove the bolt (2), CKP sensor (3) and O-ring (4).

Apply engine oil to a new O-ring and install it to the CKP sensor.

Install the CKP sensor and tighten the bolt.
Connect the CKP sensor 3P connector.

Install the silencer duct (page 5-82).





CMP SENSOR REMOVAL/ INSTALLATION

Remove the following:

– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)

Disconnect the CMP sensor 3P connector (1).

Remove the bolt (2), CMP sensor (3) and O-ring (4).

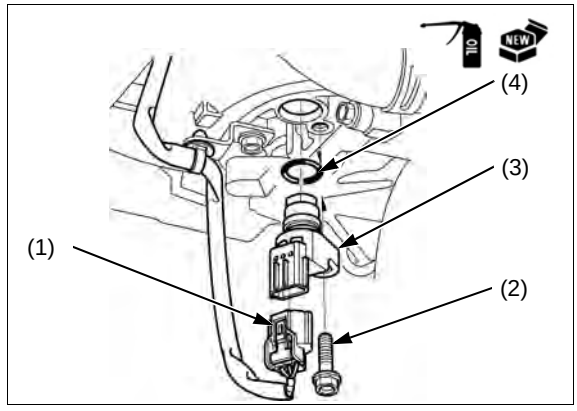
Apply engine oil to a new O-ring and install it to CMP sensor.

Install the CMP sensor and tighten the bolt.

Connect the CMP sensor 3P connector.

Install the following:

– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)



KNOCK SENSOR REMOVAL/ INSTALLATION

Remove the intake manifold (page 5-87).

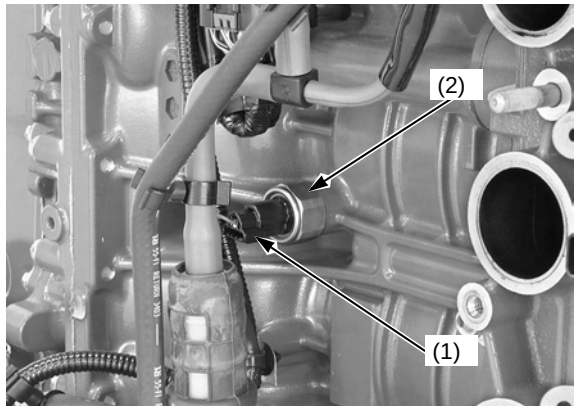
Disconnect the knock sensor 1P connector (1) and remove the knock sensor (2).

Install the knock sensor and tighten it to the specified torque.

TORQUE: 31 N·m (3.2 kgf·m, 23 lbf·ft)

Connect the knock sensor 1P connector.

Install the intake manifold (page 5-87).



EOP SENSOR REMOVAL/ INSTALLATION

Remove the fuse/relay junction box (page 10-3).

Disconnect the EOP sensor 3P connector (1).
Remove the EOP sensor (2) and O-ring (3).

Apply engine oil to a new O-ring and install it to EOP sensor.

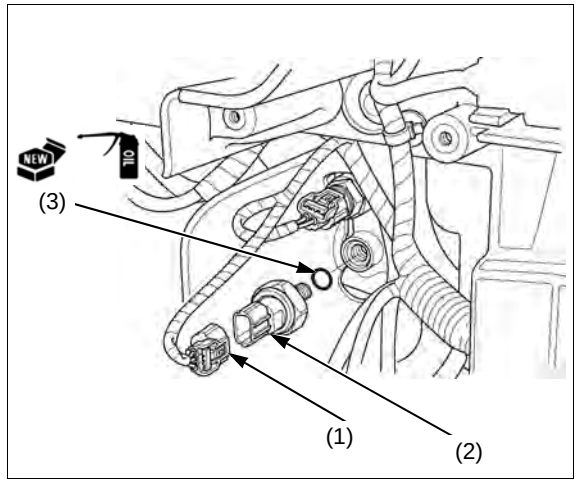
Install the EOP sensor and tighten it to the specified torque.

TORQUE: 22 N·m (2.2 kgf·m, 16 lbf·ft)

- Always use the torque wrench when tightening the EOP sensor and do not tighten it more than the specified torque. It will cause damage to the cylinder block.

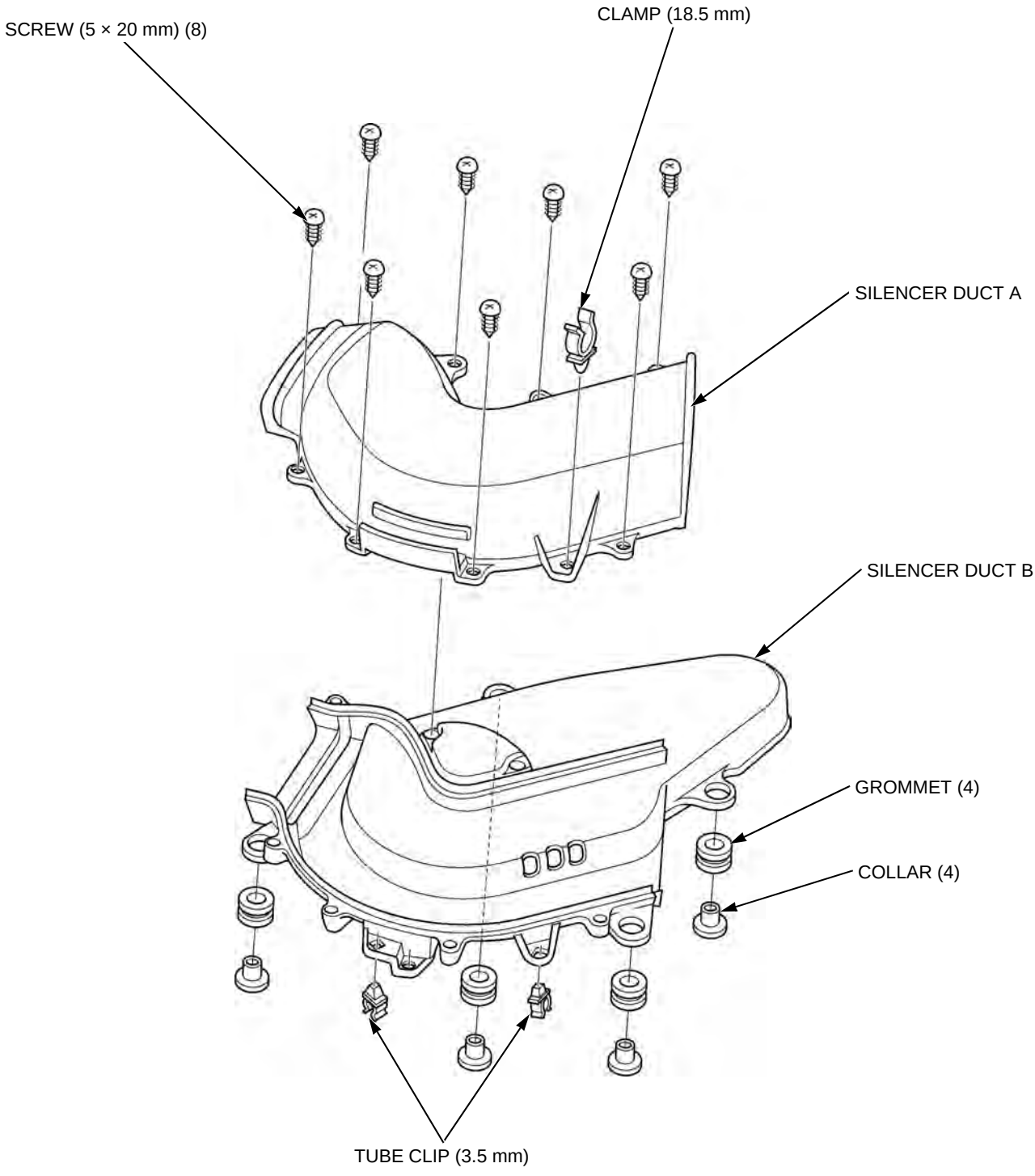
Connect the EOP sensor 3P connector.

Install the fuse/relay junction box (page 10-3).



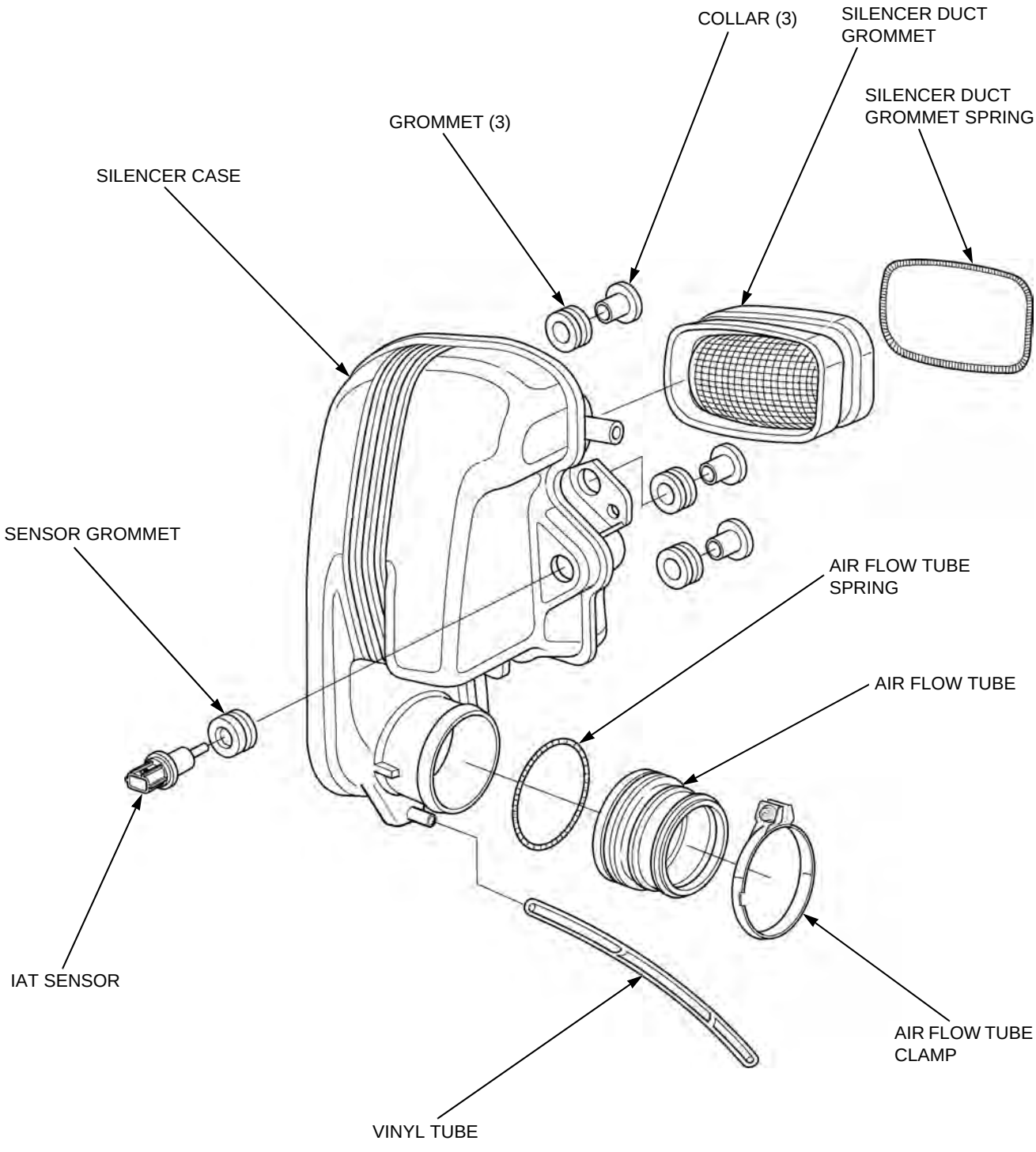
SILENCER DUCT DISASSEMBLY/ ASSEMBLY

Remove the silencer duct (page 5-82).



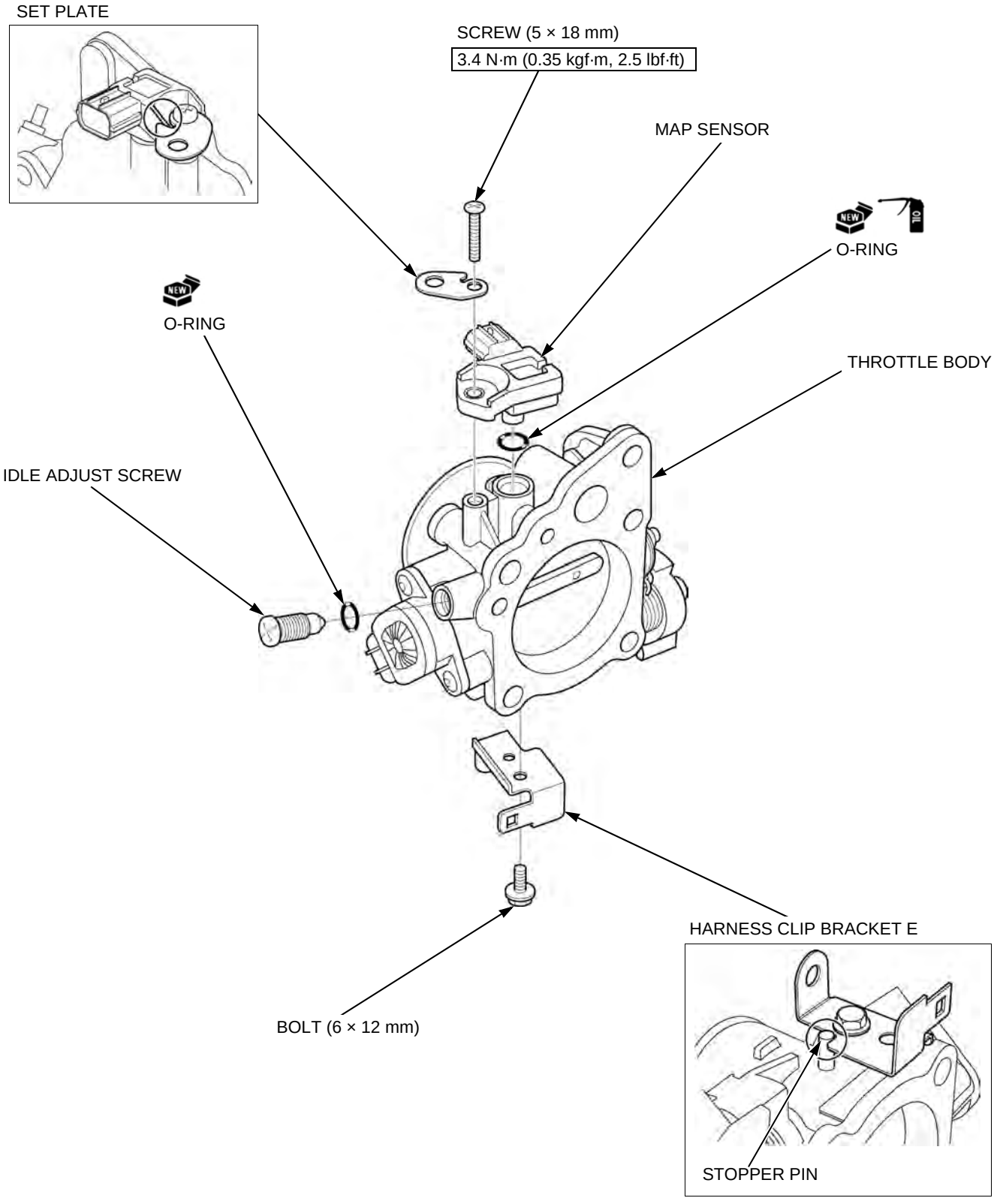
SILENCER CASE DISASSEMBLY/ ASSEMBLY

Remove the silencer case (page 5-83).



THROTTLE BODY DISASSEMBLY/ ASSEMBLY

Remove the throttle body (page 5-85).



WATER SEPARATOR DISASSEMBLY/ CLEANING/ASSEMBLY

Remove the water separator (page 5-99).

Remove the three screws (1), set plate (2), water separator cup (3) and O-ring (4) from the water separator body (5).

Remove the baffle plate (6) from the water separator body.

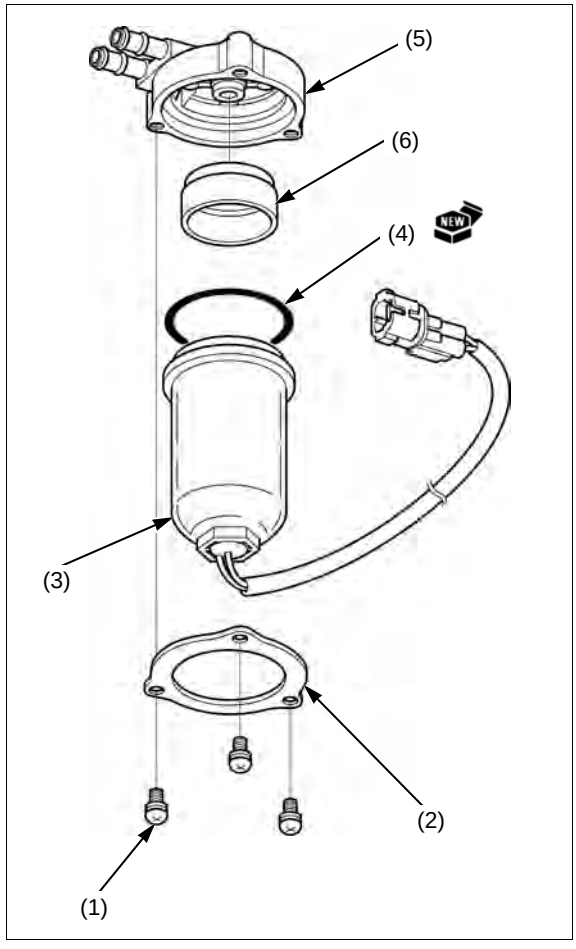
Clean off the dust or water inside the water separator cup.

Set the baffle plate into the water separator body.

Install a new O-ring to the water separator cup.
Install the water separator body and tighten the three screws to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

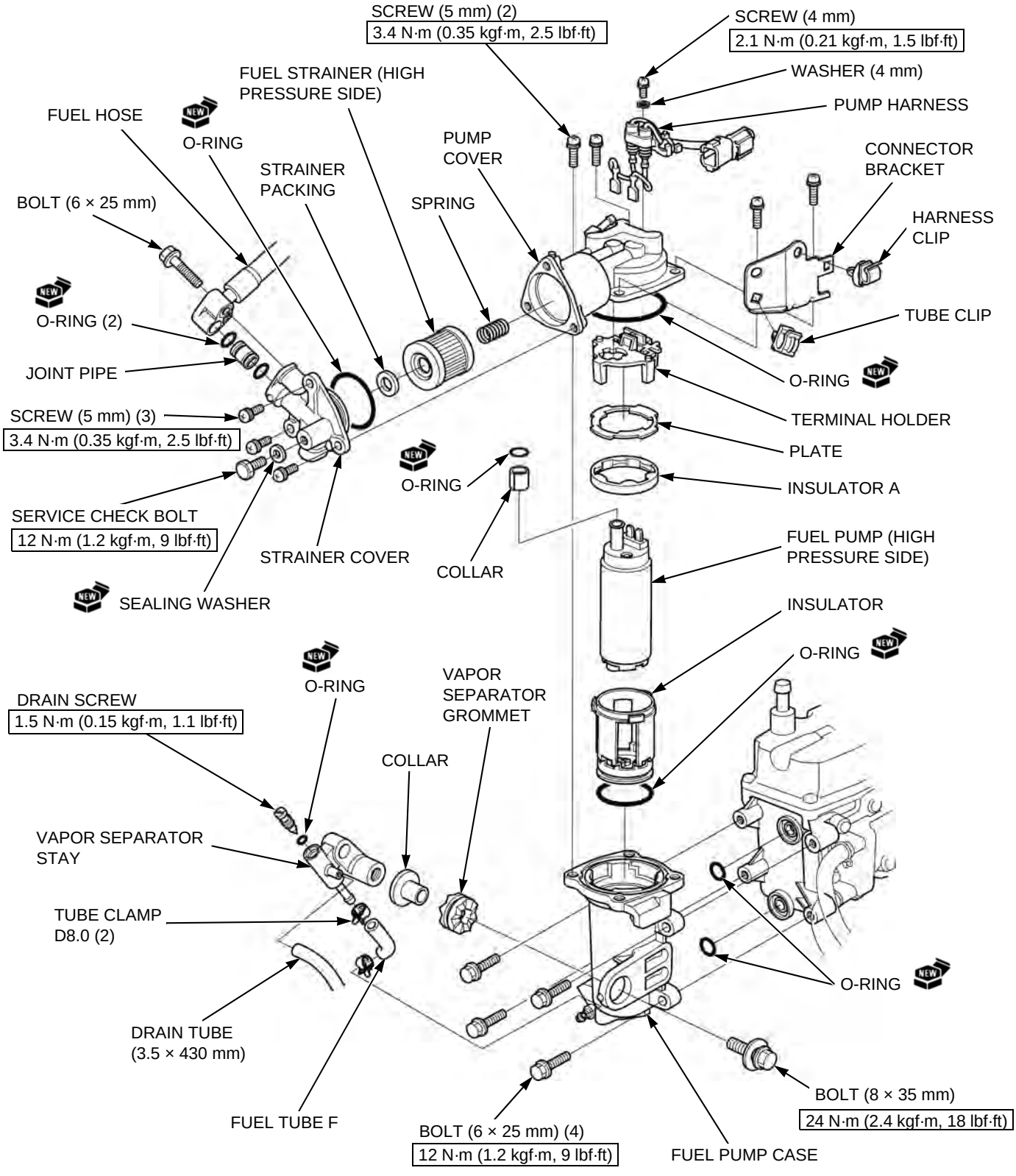
Install the water separator (page 5-99).



FUEL PUMP (HIGH PRESSURE SIDE)/ FUEL STRAINER DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

Remove the fuel pump (high pressure side)/vapor separator (page 5-101).

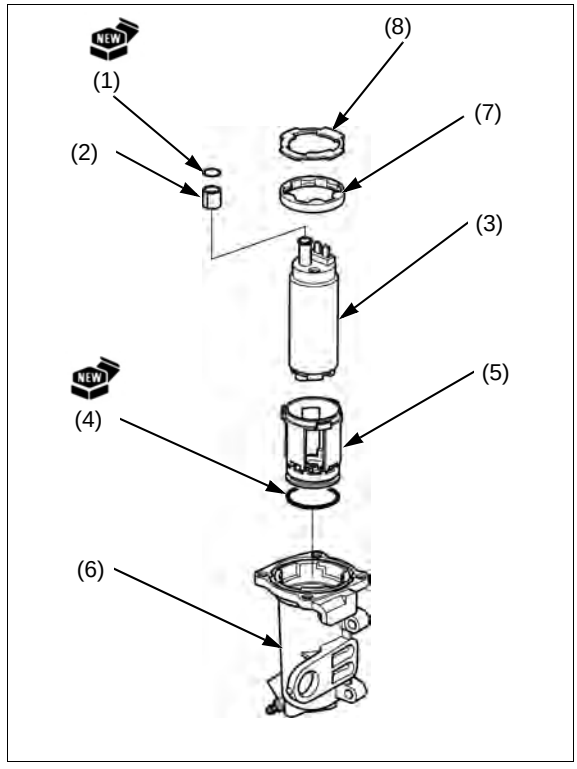


ASSEMBLY

Install a new O-ring (1) and collar (2) to the fuel pump (3).
Install a new O-ring (4) to the pump holder (5).

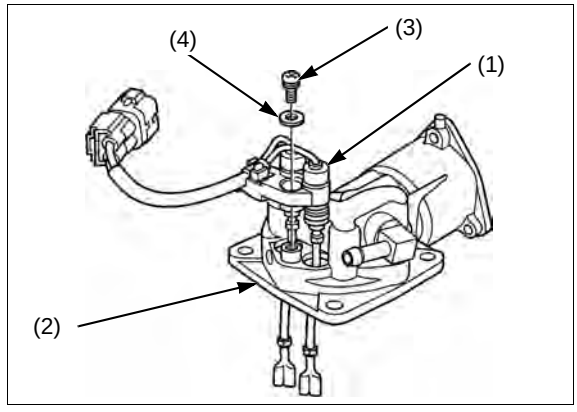
Install the following parts to the fuel pump case (6).

– Pump holder
– Fuel pump
– Insulator A (7)
– Plate (8)

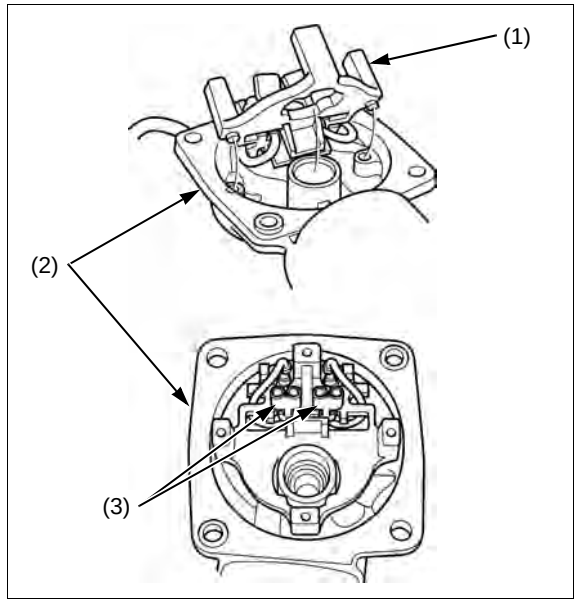


Install the pump harness (1) to the pump cover (2).
Install the screw (3) with the washer (4) and tighten it to the specified torque.

TORQUE: 2.1 N·m (0.21 kgf·m, 1.5 lbf·ft)

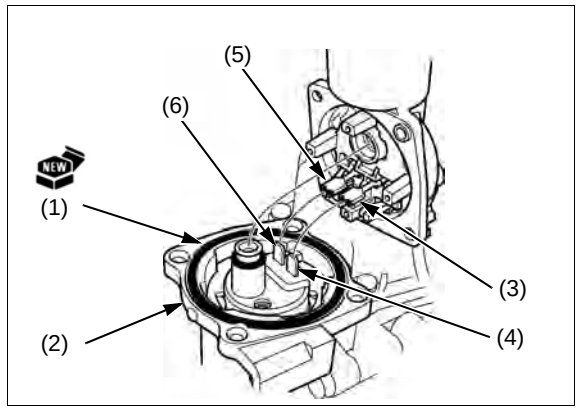


Install the terminal holder (1) to the pump cover (2).
Set the pump harness terminals (3) as shown.



Install a new O-ring (1) to the fuel pump case (2).

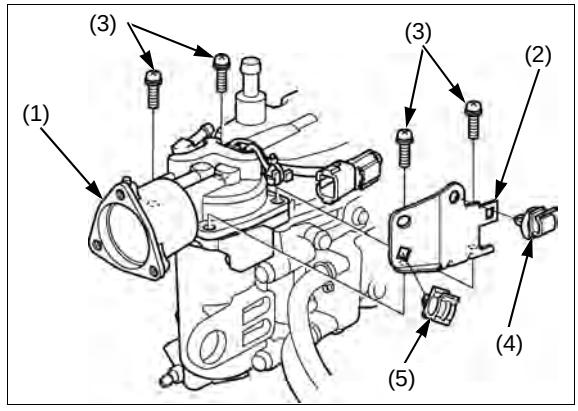
Connect the Blue/Yellow terminal (3) to the fuel pump positive (+) terminal (4).
Connect the Black terminal (5) to the fuel pump negative (-) terminal (6).



Install the pump cover (1) and connector bracket (2).
Install and tighten the four screws (3) to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

Install the harness clip (4) and tube clip (5) to the connector bracket.



Set the spring (1) to the pump cover (2).

Apply engine oil to a new O-ring (3) and install it to the strainer cover (4).

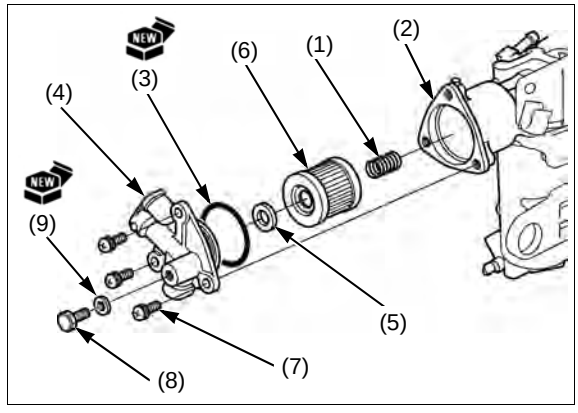
Install the strainer packing (5) to the fuel strainer (6).
Set the fuel strainer to the strainer cover.

Install the strainer cover to the pump cover and tighten the three screws (7) to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

Install the service check bolt (8) with a new sealing washer (9) and tighten it to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



Install two new O-rings (1) to the vapor separator (2).

Install the fuel pump (high pressure side)/fuel strainer assembly (3) to the vapor separator.
Install the four bolts (6 × 25 mm) (4) and tighten them to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

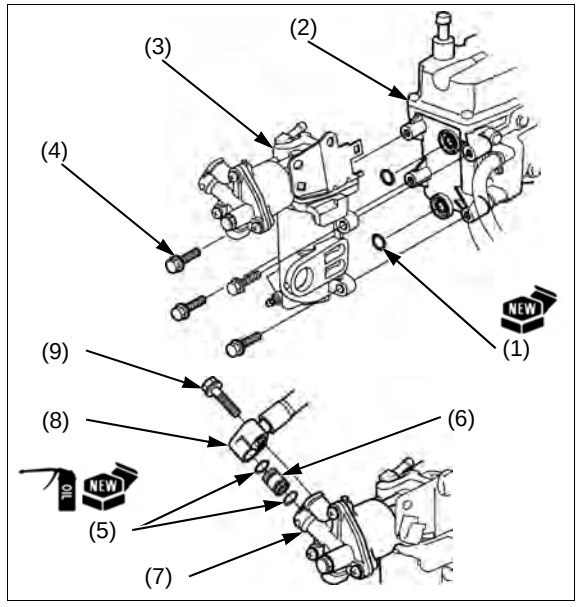
Apply engine oil to two new O-rings (5) and install them to the joint pipe (6).
Install the joint pipe until it is seated on the strainer cover (7).

Set the fuel hose (8) on the strainer cover and tighten the bolt (6 × 25 mm) (9).

NOTICE

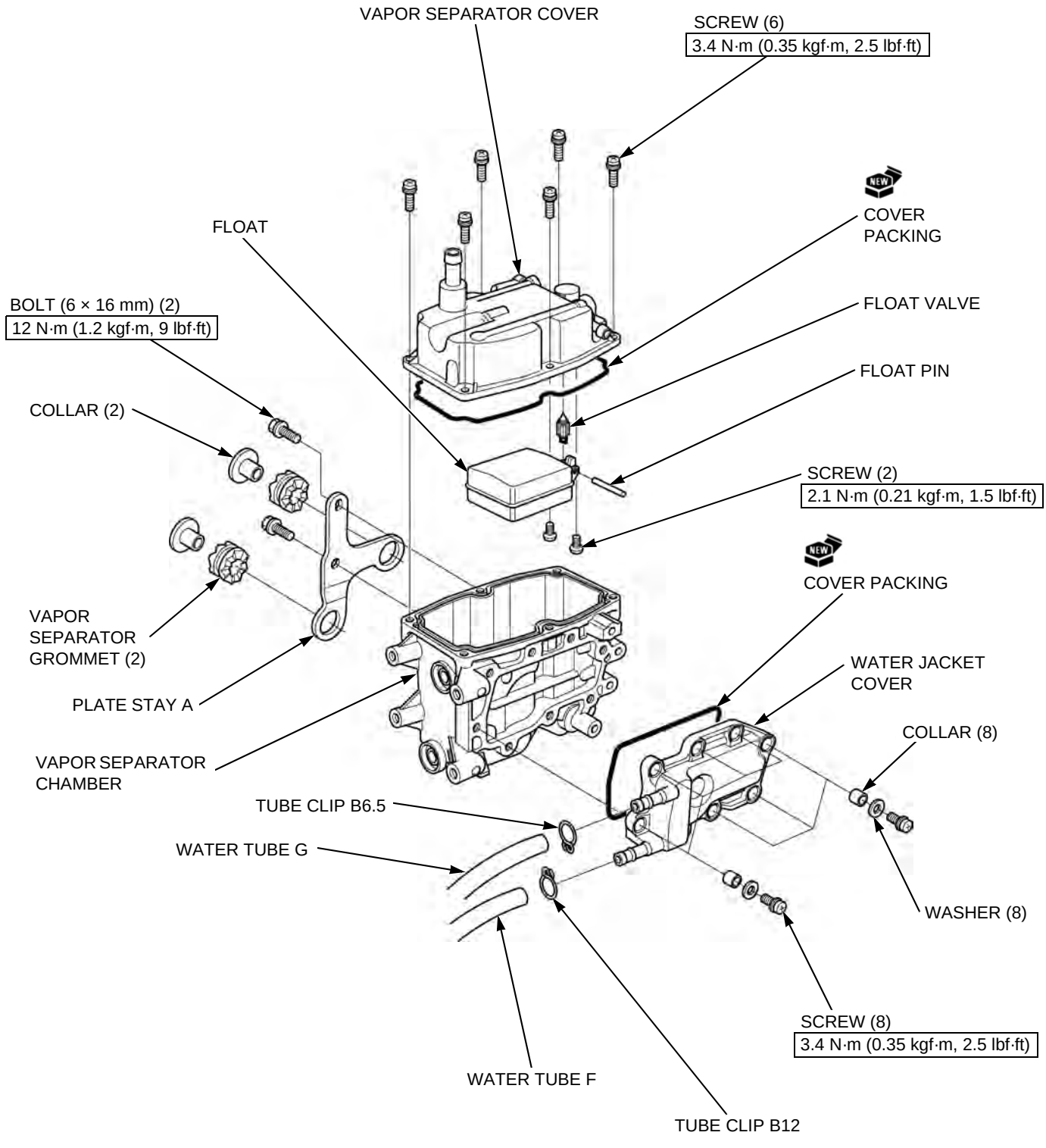
Make sure the fuel hose joint and fuel hose are seated on the strainer cover before tightening the bolt.

Install the fuel pump (high pressure side)/vapor separator (page 5-103).



VAPOR SEPARATOR DISASSEMBLY/ ASSEMBLY

Remove the fuel pump (high pressure side) (page 5-101).



FUEL PRESSURE MEASUREMENT

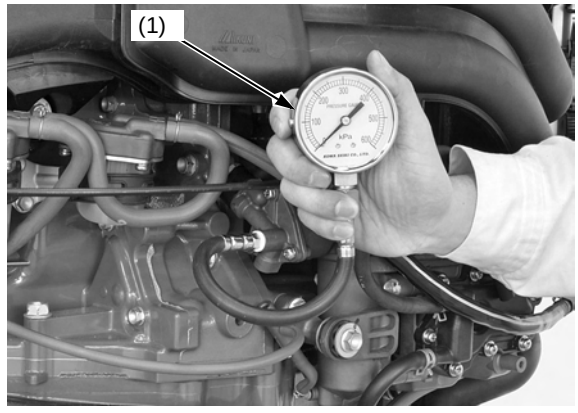
⚠WARNING

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.
- Handle fuel only outdoors.

Relieve the fuel pressure (page 5-79).

Remove the service check bolt and set the special tool in the threaded bolt hole.

TOOL:
Fuel pressure gauge (1) 07406-0040004

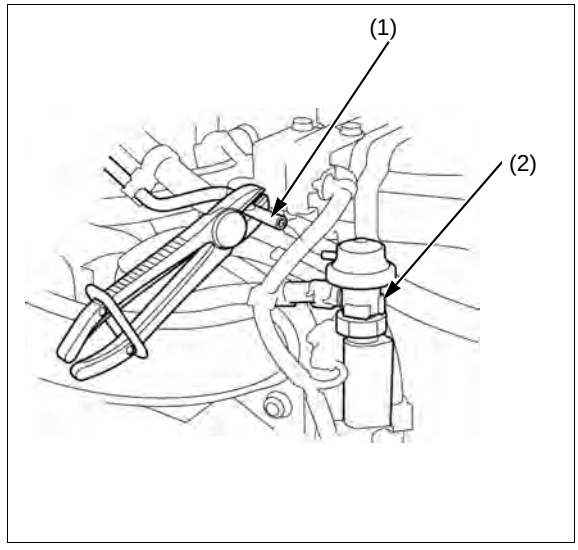


Disconnect the pressure regulator control tube (1) from the pressure regulator (2) and clamp the tube.

Remove the propeller:
– Standard rotation type (page 16-6)
– Counter rotation type (page 17-6)

Set the outboard motor gear case in a test tank filled with water. Start the engine and measure the fuel pressure at idle.

Standard fuel pressure
[At idle speed of 750 ± 50 min^{-1} (rpm)]:
270 – 320 kpa (2.8 – 3.3 kgf/cm^2, 40 – 47 psi)



When the fuel pressure is out of the specified standard pressure, check the following:

- When fuel pressure is higher than standard pressure:
  – Check fuel return hose and fuel line for clogging (page 3-27).
  – Check the pressure regulator for proper operation (page 5-129).
- When fuel pressure is lower than standard pressure:
  – Check the pressure regulator for proper operation (page 5-129).
  – Check the high pressure side fuel pump for proper operation (page 5-130).
  – Check the high pressure side fuel strainer for an obstruction (page 3-26).
  – Check the fuel hose and fuel line for leaking (page 3-27).

After measuring fuel pressure, install the service check bolt (page 5-79).

Connect the pressure regulator control tube to the pressure regulator.

FUEL PRESSURE REGULATOR INSPECTION

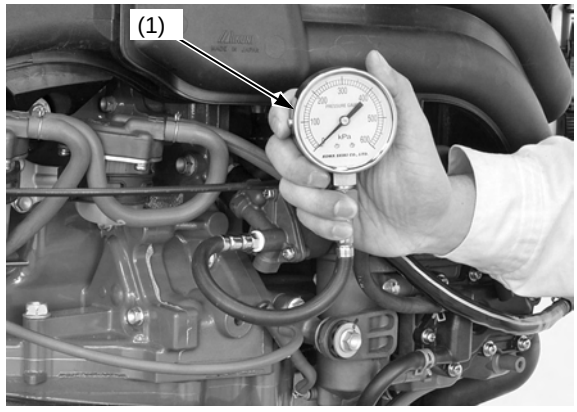
⚠WARNING

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.
- Handle fuel only outdoors.

Relieve the fuel pressure (page 5-79).

Remove the service check bolt and set the special tool in the threaded bolt hole.

TOOL:
Fuel pressure gauge (1) 07406-0040004



Check that the pressure regulator control tube (1) is not bent, disconnected, or damaged.

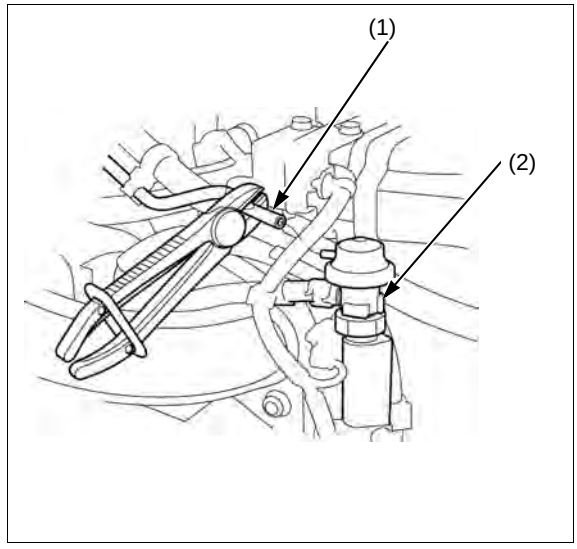
Remove the propeller:
– Standard rotation type (page 16-6)
– Counter rotation type (page 17-6)

Set the gear case in a test tank filled with water and start the engine.

With the engine idling, disconnect the control tube from the pressure regulator (2) and clamp the control tube.

Check the fuel pressure. It should be higher than the pressure measured with the control tube connected.

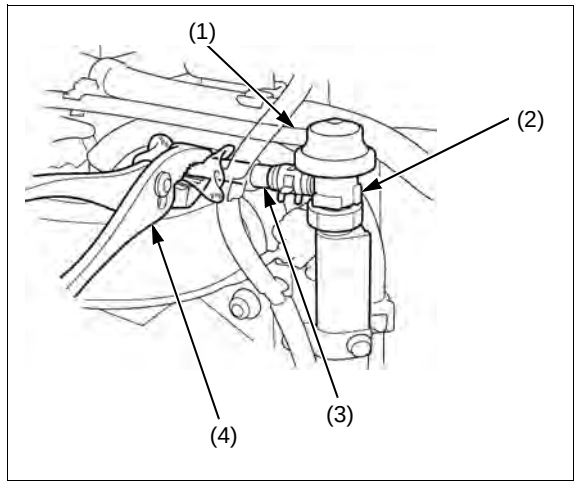
Standard fuel pressure
[At idle speed of 750 ± 50 min^{-1} (rpm)]:
270 – 320 kpa (2.8 – 3.3 kgf/cm^2, 40 – 47 psi)



If the fuel pressure does not rise, connect the control tube (1) to the pressure regulator (2).
Pinch the pressure regulator return hose (3) that goes from the pressure regulator to the vapor separator 2 or 3 times lightly, and measure the fuel pressure again.

If the measurement is out of the specified standard pressure, replace the pressure regulator.

- Protect the pressure regulator return hose by winding a shop towel or equivalent around the hose, and lightly pinch the hose with the pliers (4).



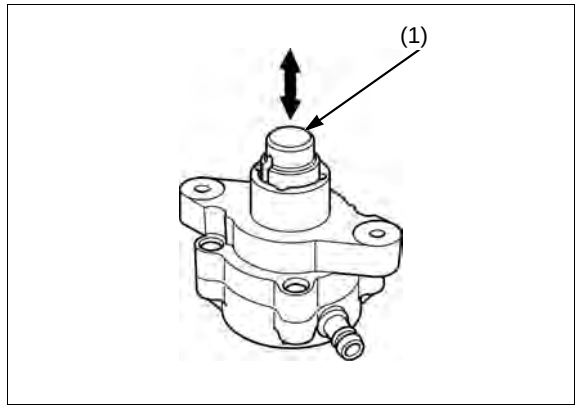
FUEL PUMP (LOW PRESSURE SIDE) INSPECTION

Remove the fuel pump (low pressure side) (page 5-80).

Push the fuel pump plunger (1) and make sure the plunger moves smoothly.

If the plunger is stiff, replace the fuel pump (low pressure side).

Install the fuel pump (low pressure side) (page 5-80).



FUEL PUMP (HIGH PRESSURE SIDE) INSPECTION

DISCHARGE VOLUME INSPECTION

⚠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.
- Handle fuel only outdoors.

- Use a known-good battery for the inspection.

Disconnect the pressure regulator return hose (1) and connect a hose (2) that is equivalent to the return hose to the pressure regulator.
Place a suitable container (3) under the hose as shown.

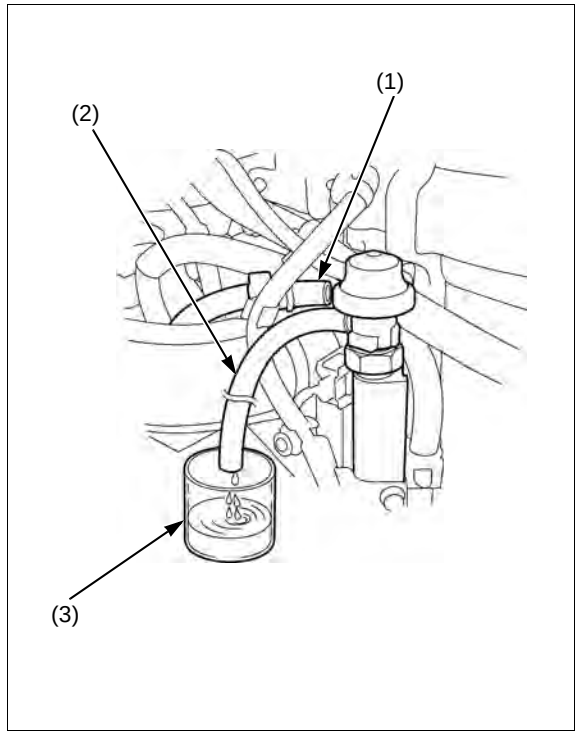
Turn the combination switch ON.
Operate the fuel pump for approximately 2 seconds and measure the fuel discharge volume.

Discharge volume
45 cm^3 (1.5 US oz, 1.6 Imp oz) or more

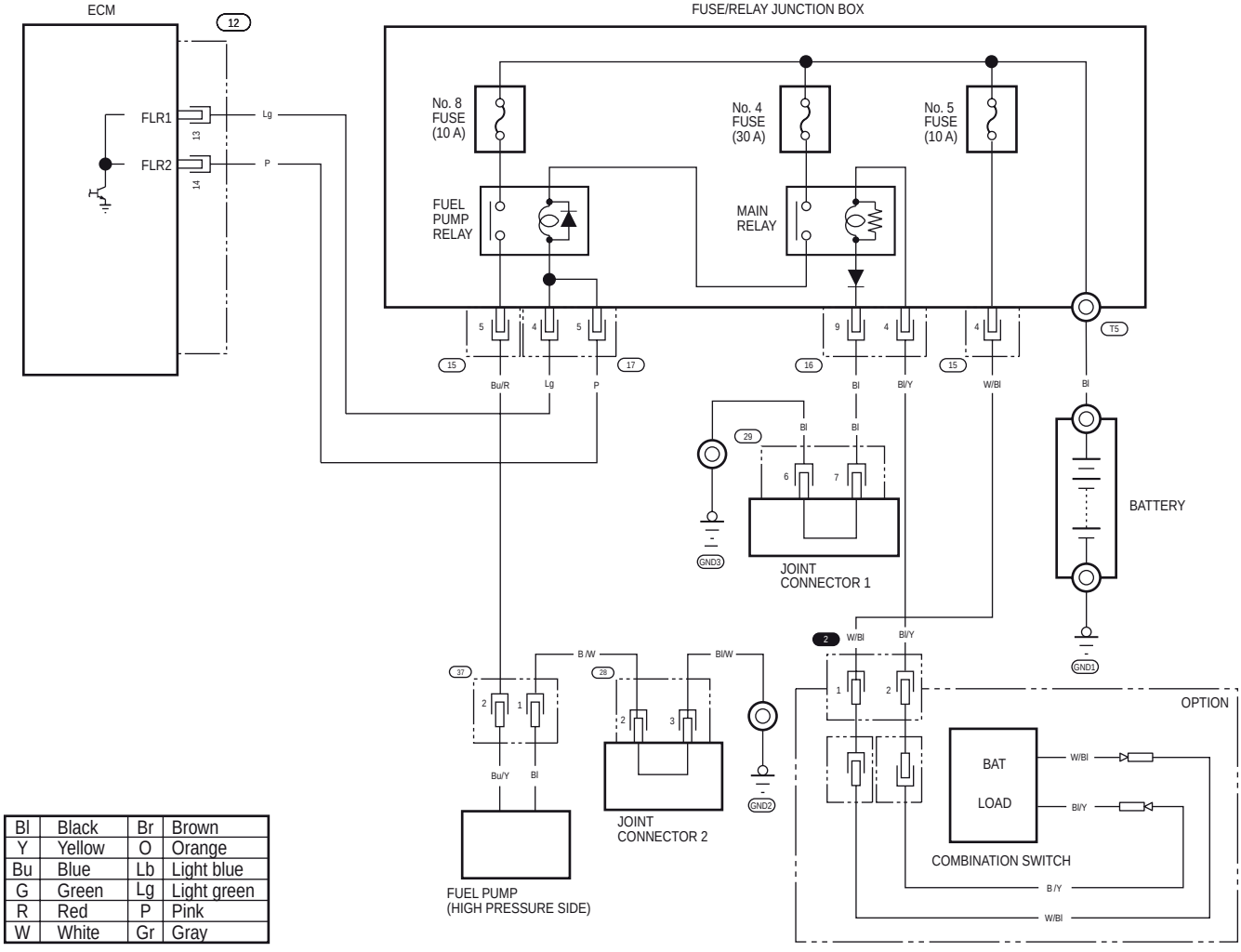
If the discharge volume is less than the specified value, or no fuel is discharged, check the following.

– Open circuit or poor contact of the main wire harness
– Clogged fuel filter (high pressure side) (page 3-26)
– Clogged fuel hose/line (page 3-27)
– Pressure regulator operation (page 5-129)

If the fuel pump does not operate when the combination switch is turned ON, inspect the fuel pump circuit (page 5-131).



CIRCUIT INSPECTION



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. Fuse inspection

Turn the combination switch OFF.

Check for blown No.8 fuse.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 2.

2. Fuel pump power/ground line open circuit inspection

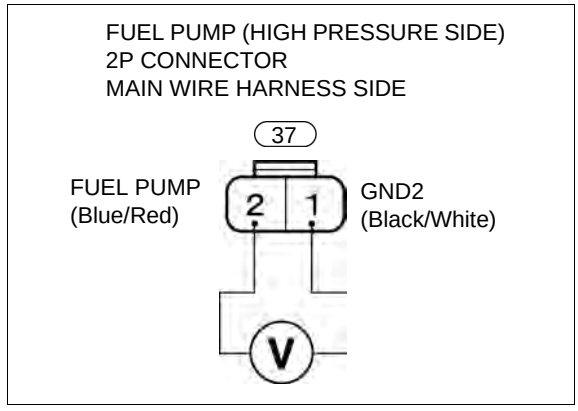
Turn the combination switch OFF and disconnect the fuel pump (High pressure side) 2P connector (37).

Turn the combination switch ON.
Measure the battery voltage between the fuel pump (High pressure side) 2P connector (37) main wire harness side No.2 (Blue/Red) terminal and No.1 (Black/White) terminal.

Is there battery voltage for a few seconds?

YES – Replace the fuel pump (High pressure side) with a new one and recheck.

NO – GO TO STEP 3.



3. Fuel pump relay Inspection

Turn the combination switch OFF.

Inspect the fuel pump relay (page 10-14).

Is the fuel pump relay normal?

YES – GO TO STEP 4.

NO – Replace the fuel pump relay with a new one and recheck.

4. Fuse/relay junction box inspection

Turn the combination switch OFF.

Inspect the fuel pump relay circuit in the fuse/relay junction box (page 10-14).

Is the fuse/relay junction box normal?

YES – GO TO STEP 5.

NO – Replace the fuse/relay junction box with a new one and recheck.

5. Fuel pump relay line Inspection

Install the fuel pump relay and fuse/relay junction box.
Disconnect the ECM connector A (12).

Turn the combination switch ON.

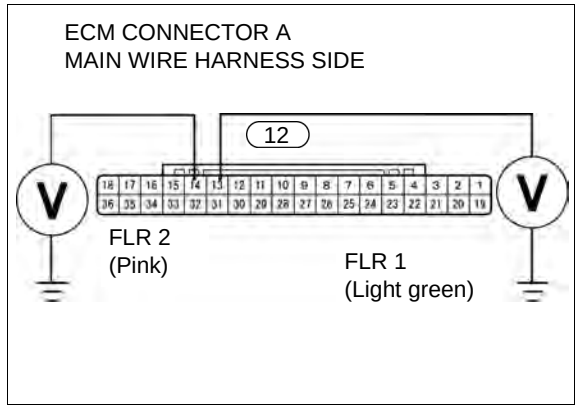
Measure the voltage as follows:

– ECM connector A (12) main wire harness side No.13 (Light green) terminal and engine ground
– ECM connector A (12) main wire harness side No.14 (Pink) terminal and engine ground

Is battery voltage present?

YES – • Repair the open in the Blue/Red wire harness between the fuse/relay junction box and fuel pump (High pressure side).
• Repair the open in the Black/White wire harness between the fuel pump (High pressure side) and engine ground.
• If wire harness is normal, replace the ECM with a new one and recheck.

NO – Repair the open or short in the Light green wire or Pink wire.



VAPOR SEPARATOR INSPECTION

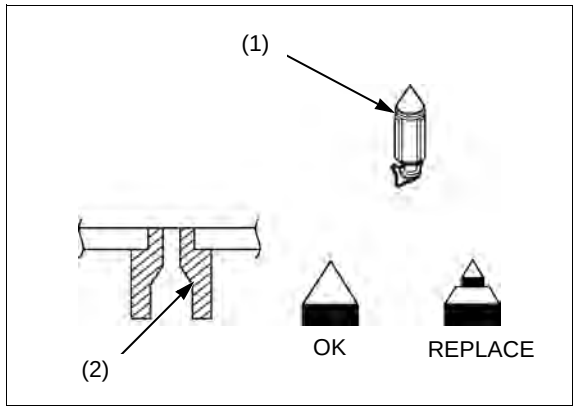
FLOAT VALVE

Disassemble the vapor separator (page 5-127).

If gasoline overflows from the vapor separator, perform the following check.

Remove the float valve (1) from the float.

Check the float valve tip and valve seat (2) for wear and damage.
Replace the float valve or the vapor separator cover if necessary (page 5-127).



FLOAT HEIGHT

If gasoline overflows from the vapor separator, perform the following check.

Check the float (1) for damage or deformation.
Check that there is no gasoline inside the float.
The float valve (2) and float must be installed on the vapor separator cover (3) properly.

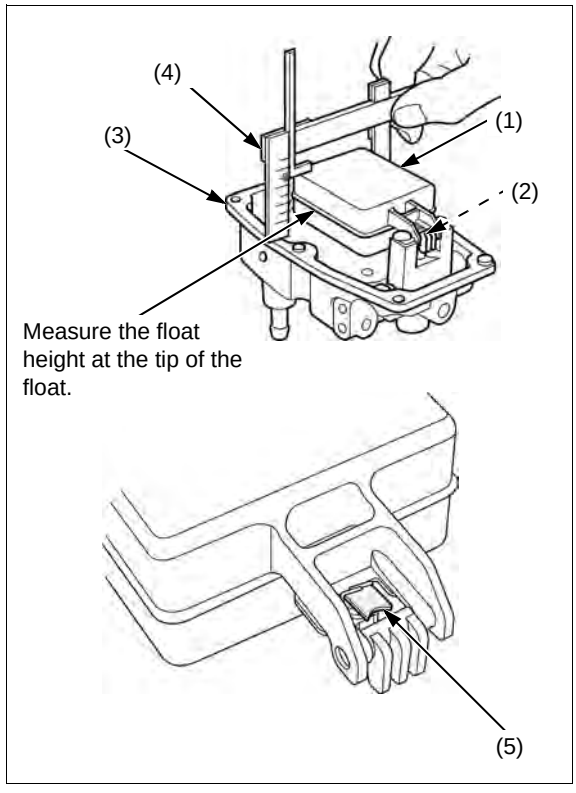
Place the cover as shown and measure the distance between the float and cover (i.e. float height) at the tip of the float.

TOOL:
Float level gauge (4) 07401-0010000

Float height: 28.5 – 33.5 mm (1.12 – 1.32 in)

If the float height is out of the specification, adjust the float height by bending the brass float tab (5) slowly with care not to damage the float.

Check float operation.



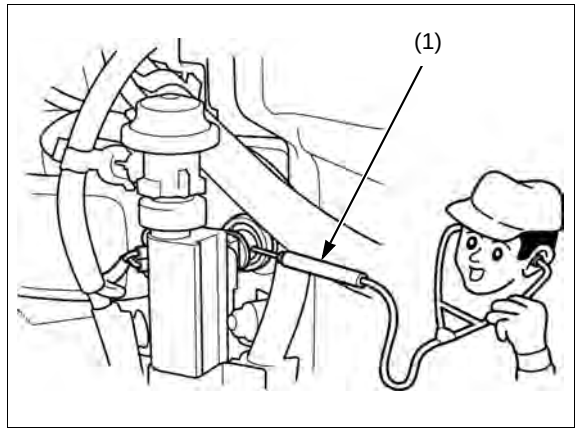
FUEL INJECTOR INSPECTION

OPERATION INSPECTION

- If engine does not start, refer to "ENGINE DOES NOT START" (page 4-2).

Start the engine and let it idle.

Confirm the fuel injector operates with a sounding rod or stethoscope (1).



If the fuel injector does not operate, check the following:

– Fuel injector inspection (page 5-134)
– Circuit inspection (page 5-135)

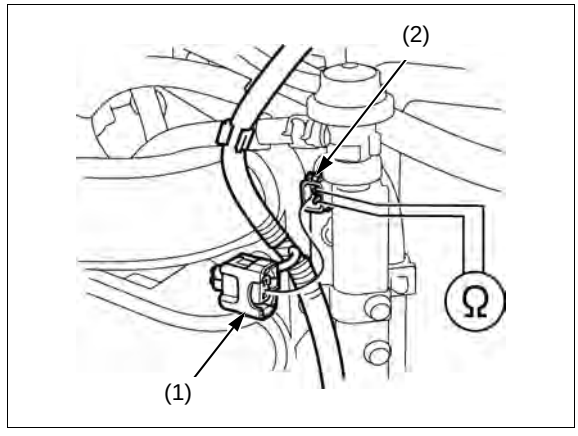
If circuit inspection and fuel injector inspection are normal, replace the ECM with a new one and recheck.

FUEL INJECTOR INSPECTION

Remove the L. side cover bracket (page 6-18).

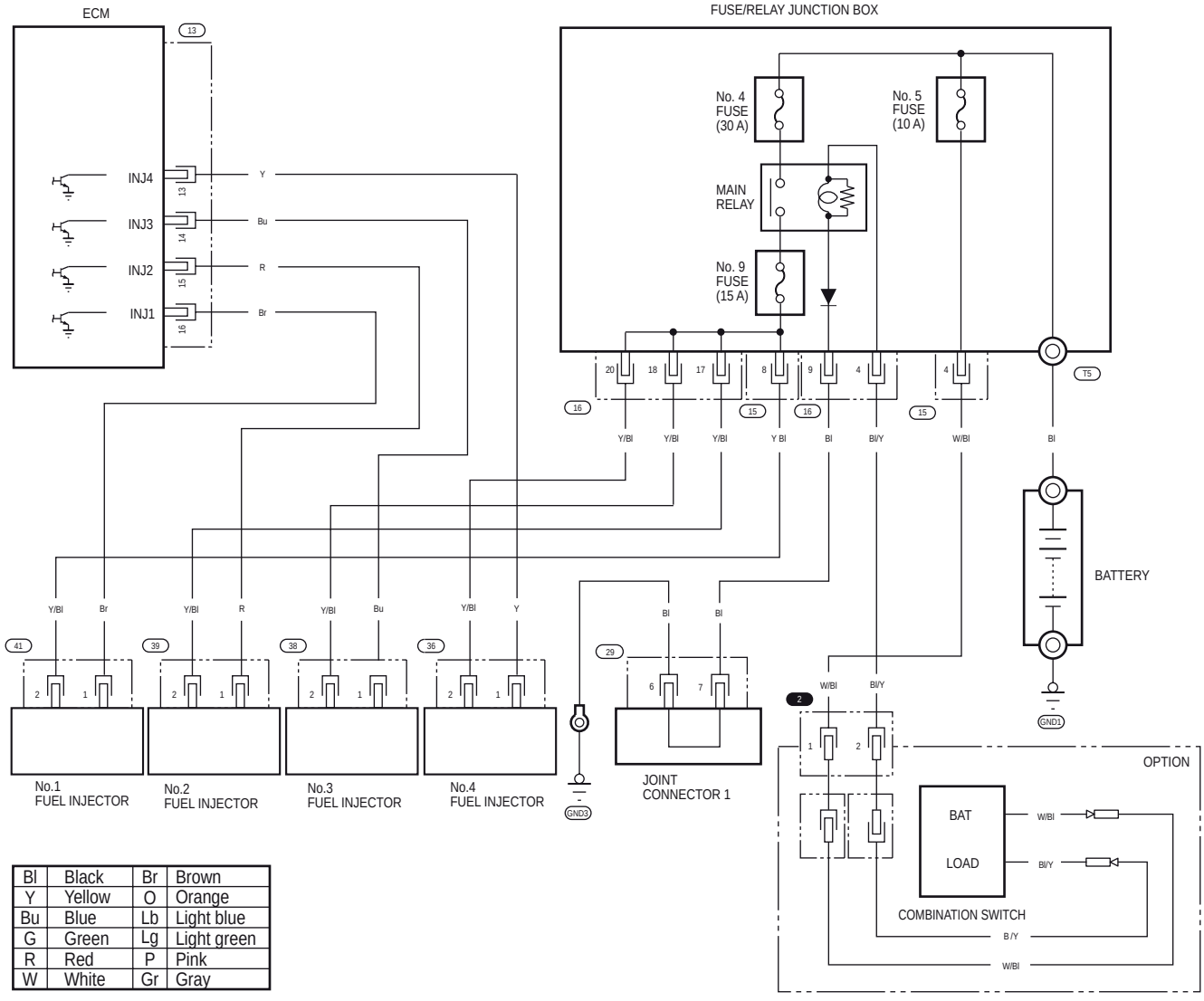
Turn the combination switch OFF and disconnect the fuel injector 2P connector (1).

Measure the resistance between the fuel injector (2) terminals.



Resistance: 9.7 – 10.9 Ω (at 20 °C/68 °F)

CIRCUIT INSPECTION



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. Fuel injector power line open circuit inspection

Turn the combination switch OFF and disconnect the fuel injector 2P connectors (36), (38), (39), and (41).

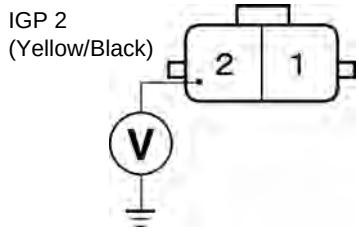
Turn the combination switch ON.
Measure the battery voltage between each fuel injector 2P connector main wire harness side No.2 (Yellow/Black) terminal and ground.

Is battery voltage present?

YES – GO TO STEP 2.

NO – Repair open in the Yellow/Black wire. If main wire harness is normal, inspect the No.9 fuse circuit in the fuse/relay junction box (page 10-14).

FUEL INJECTOR 2P CONNECTOR
MAIN WIRE HARNESS SIDE



2. Fuel injector signal line open or short circuit Inspection

Turn the combination switch OFF.

Disconnect the ECM connector B (13).

Check for open or short circuit between each fuel injector 2P connector main wire harness side No.1 terminal and ECM connector B (13) main wire harness side terminal.

Are there any shorts or opens?

YES – Repair the open or short circuit in Brown or Red or Blue or Yellow wire between the fuel injector and ECM.

NO – Circuit is normal.

THROTTLE BODY INSPECTION

Remove the silencer case (page 5-83).

- Do not adjust the throttle stop screw (1) as it is factory preset.

Check that the throttle valve turns smoothly when the throttle cam (2) is turned.

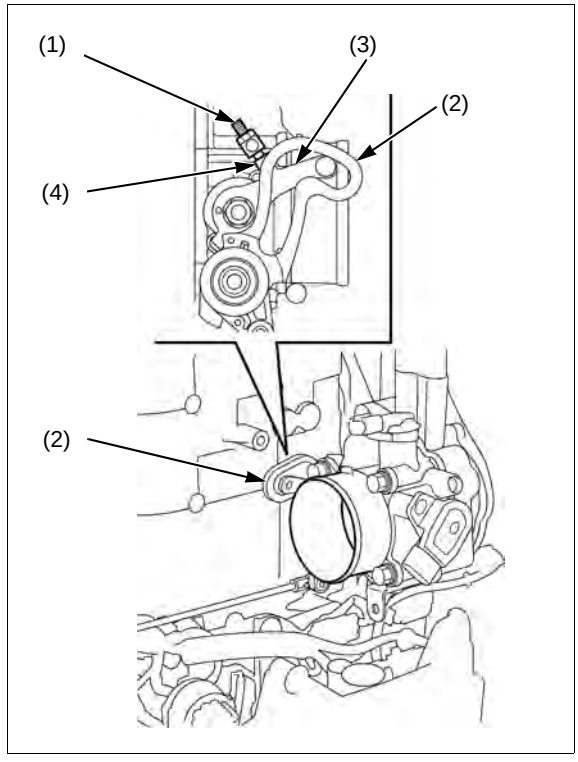
Check that there is no looseness on the throttle valve shaft when turning the throttle lever (3).

Make sure there is no clearance between the throttle stop screw and the throttle valve lever stopper (4).

Check for dirt or stains on the throttle valve and the throttle body bore.

If the throttle valve and bore have dirt or stains, clean the throttle body (page 5-86).

Install the silencer case (page 5-83).



ECT SENSOR 1/2/3/4 INSPECTION

Remove the following:

– ECT sensor 1 (page 5-116)
– ECT sensor 2 (page 5-117)
– ECT sensor 3 (page 5-117)
– ECT sensor 4 (page 5-118)

Heat the coolant with an electric heating element. Suspend the sensor (1) in heated coolant and check the continuity through the sensor as the coolant heats up.

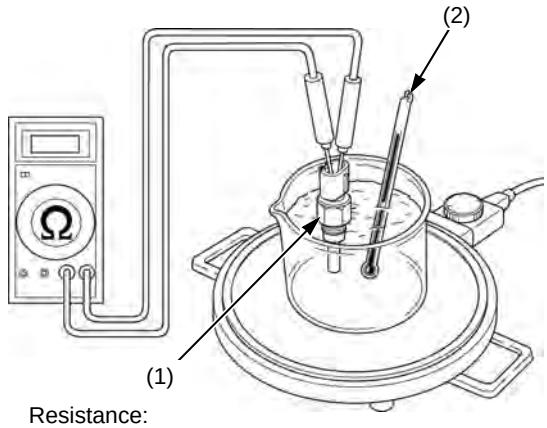
- Wear insulated gloves and adequate eye protection. Keep flammable materials away from the burner.
- Soak the sensor in coolant up to its threads with at least 40 mm (1.57 in) from the bottom of the pan to the bottom of the switch.
- Keep temperature constant for 3 minutes before testing. A sudden change of temperature will result in incorrect readings. Do not let the thermometer (2) or sensor touch the pan.

Temperature	40 °C (104 °F)	100 °C (176 °F)
Resistance	1.0 – 1.3 kΩ	0.1 – 0.2 kΩ

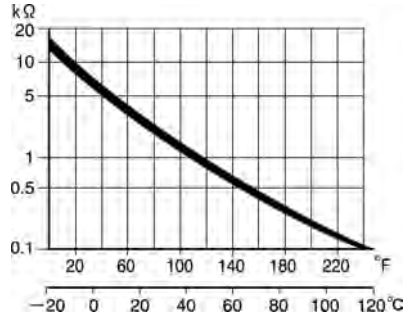
Replace the sensor if it is out of specifications.

Install the following:

– ECT sensor 1 (page 5-116)
– ECT sensor 2 (page 5-117)
– ECT sensor 3 (page 5-117)
– ECT sensor 4 (page 5-118)



Resistance:



Coolant temperature:

IAT SENSOR INSPECTION

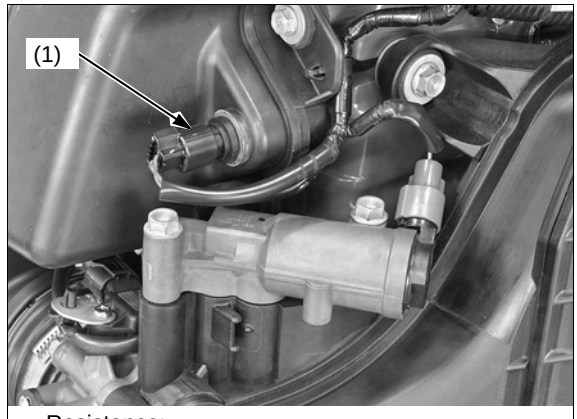
Remove the engine cover.

Disconnect the IAT sensor 2P connector (1).

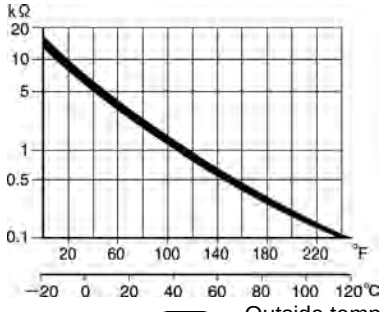
Measure the resistance at the sensor side connector (25) terminals.

Check that the resistance is within specifications in each outside temperature range.

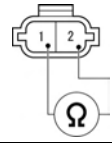
Install the engine cover.



Resistance:



Outside temperature:



WATER LEVEL SENSOR INSPECTION

Remove the water separator (page 5-99).

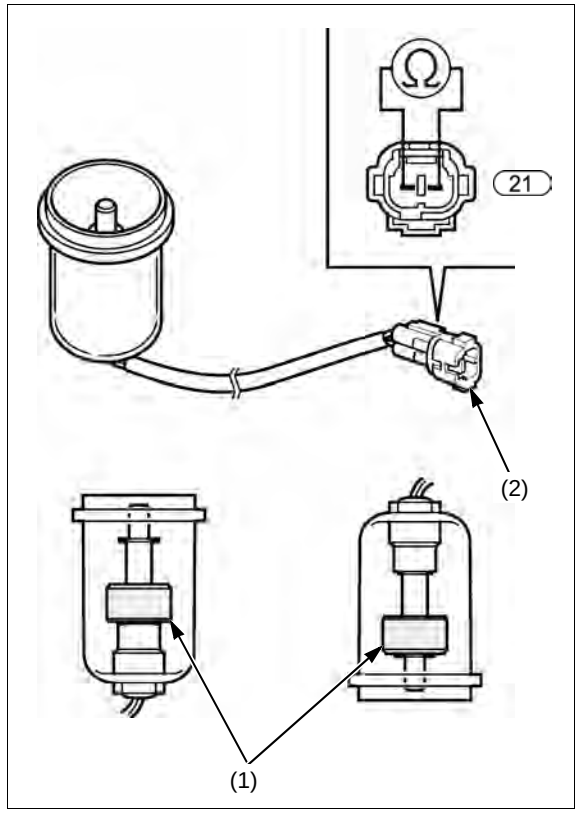
Check that the float (1) of the water level sensor moves up and down smoothly with the separator cup removed.

Check for continuity between the water level sensor 2P connector (21) (2) terminals in each float position.

- There should be no continuity when the sensor is level (the float is down).
- There should be continuity when the sensor is upside down (the float is up).

If the water level sensor is faulty, replace the water separator.

Install the water separator (page 5-99).

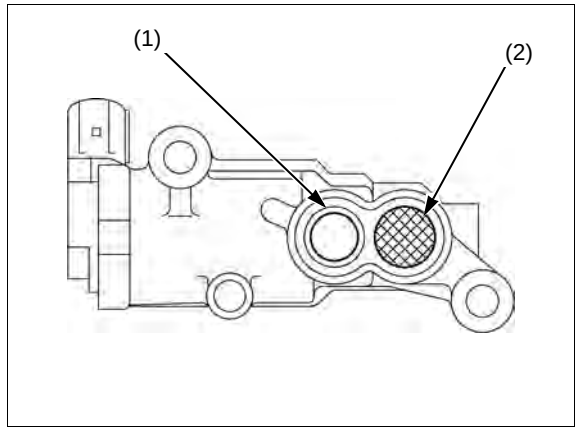


IAC VALVE INSPECTION

Remove the IAC valve (page 5-114).

Check for carbon deposits on the IAC valve hole (1) and filter (2).

If the IAC valve is dirty, clean the IAC valve hole and filter.

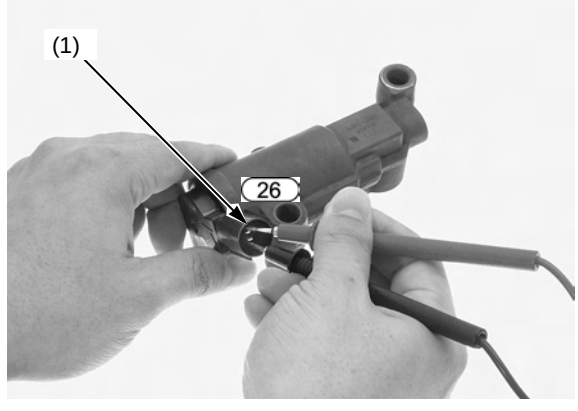


Measure the resistance between the IAC valve side No.1 terminal and No.2 terminal of the IAC valve 2P connector (26) (1).

Resistance: 10.6 – 12.6 Ω (at 20 °C/68 °F)

If the resistance is not as specified, replace the IAC valve.

Install the IAC valve (page 5-114).



A/F SENSOR HEATER INSPECTION

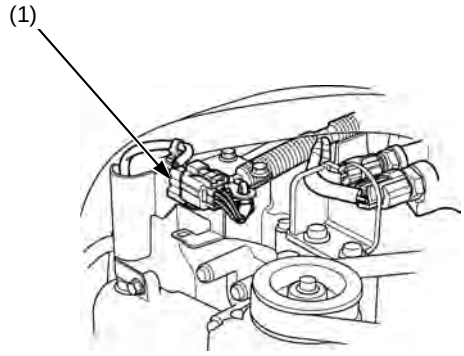
Turn the combination switch OFF.

Disconnect the A/F sensor 4P connector (3) (1).

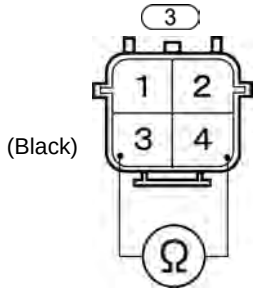
Measure the resistance between the No.3 (Black) and No.4 (Black) terminals of the A/F sensor.

Resistance: 0.86 – 1.10 Ω (at 20 °C/68 °F)

If the resistance is not as specified, replace the A/F sensor.



A/F SENSOR 4P CONNECTOR
SENSOR SIDE



MEMO

6. ENGINE COVER/COVER LOCK

COMPONENT LOCATION ····· 6-2

FRONT SEPARATE COVER REMOVAL/ INSTALLATION ····· 6-3

L. ENGINE UNDER COVER REMOVAL/ INSTALLATION ····· 6-4

R. ENGINE UNDER COVER REMOVAL/ INSTALLATION ····· 6-10

COVER LOCK CABLE REMOVAL/ INSTALLATION ····· 6-15

SIDE COVER BRACKET REMOVAL/ INSTALLATION ····· 6-18

UNDER COVER FRONT BRACKET REMOVAL/INSTALLATION ····· 6-18

POWER TILT SWITCH REMOVAL/ INSTALLATION ····· 6-19

HOOK BRACKET REMOVAL/ INSTALLATION ····· 6-20

ENGINE COVER AIR GUIDE REMOVAL/ INSTALLATION ····· 6-20

SIDE COVER BRACKET DISASSEMBLY/ ASSEMBLY ····· 6-21

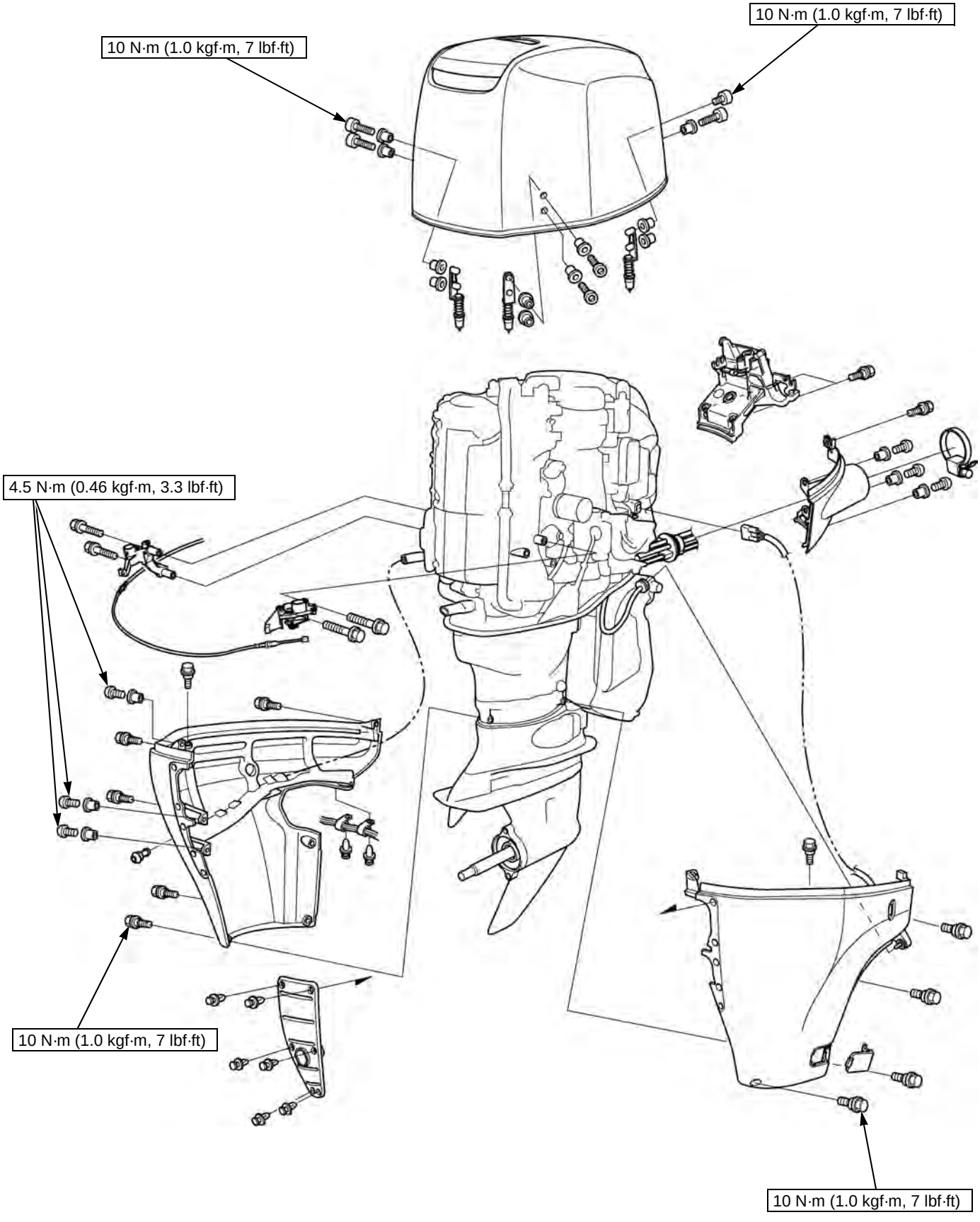
UNDER COVER FRONT BRACKET DISASSEMBLY/ASSEMBLY ····· 6-22

HOOK BRACKET DISASSEMBLY/ ASSEMBLY ····· 6-25

HOOK BRACKET ADJUSTMENT ····· 6-26

UNDER COVER SEAL B REPLACEMENT ····· 6-27

COMPONENT LOCATION



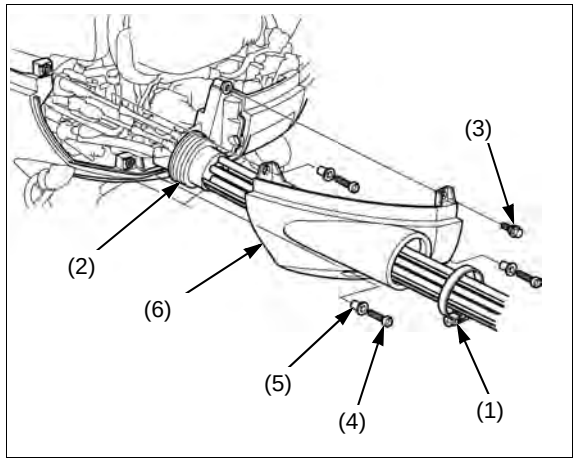
FRONT SEPARATE COVER REMOVAL/ INSTALLATION

REMOVAL

Remove the engine cover.

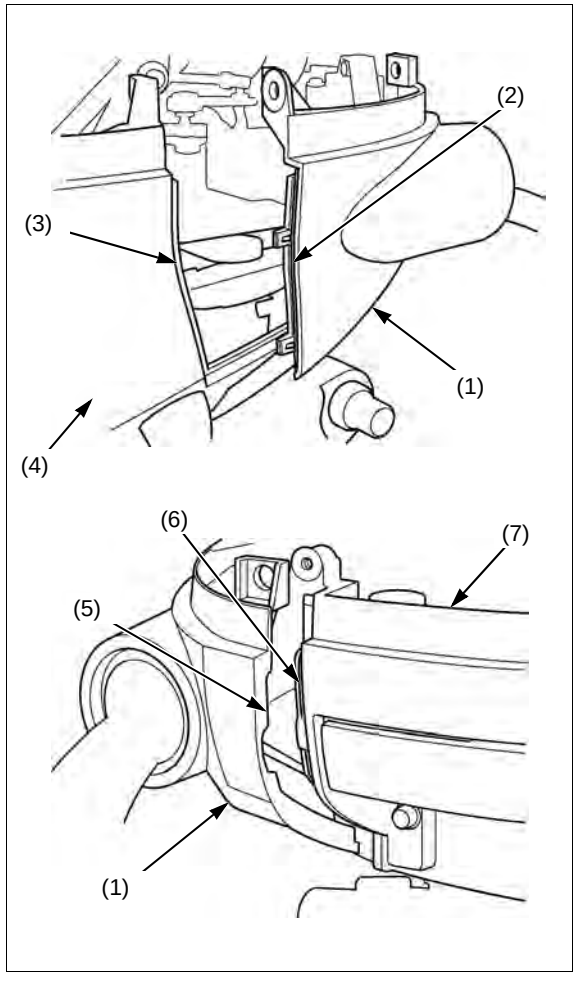
Loosen the under case grommet band (1) and remove it from the under case grommet (2).

Remove the special bolt (6 x 17 mm) (3), three screws (6 x 25 mm) (4), three collars (5) and front separate cover (6).



INSTALLATION

Install the front separate cover (1) by aligning its rear (R. engine under cover side) groove (2) with the tab (3) of the R. engine under cover (4) and aligning its front (under cover front bracket side) tab (5) with the groove (6) of the under cover front bracket (7).



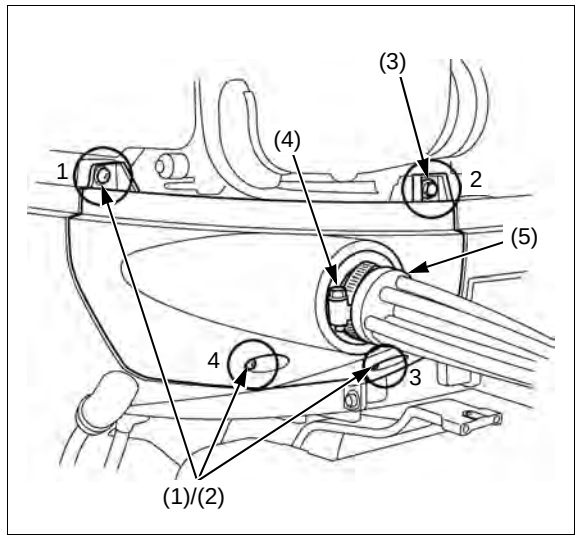
Install the three collars (1), then loosely install the three screws (6 x 25 mm) (2) and special bolt (6 x 17 mm) (3).

- Be sure that the special bolt flange is positioned in the case bolt hole.

Tighten the screws and special bolt in the numbered order in several steps.

Install the under case grommet band (4) to the under case grommet (5) and tighten the band securely.
Install the engine cover.

- Be sure that the fuel tube A is not pinched.

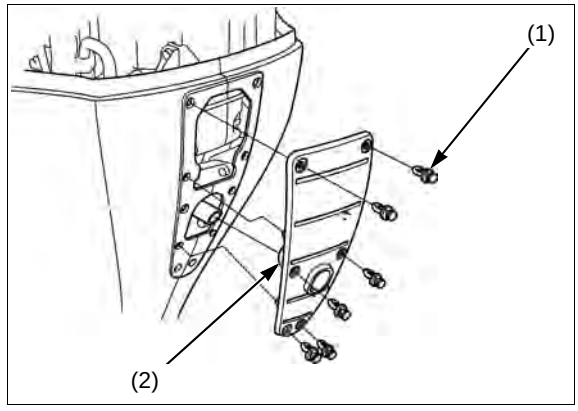


L. ENGINE UNDER COVER REMOVAL/ INSTALLATION

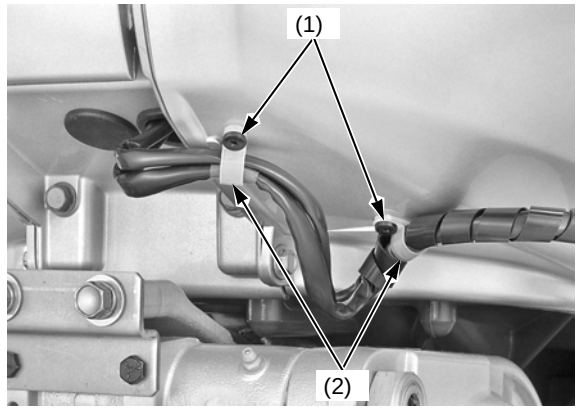
REMOVAL

Remove the engine cover.

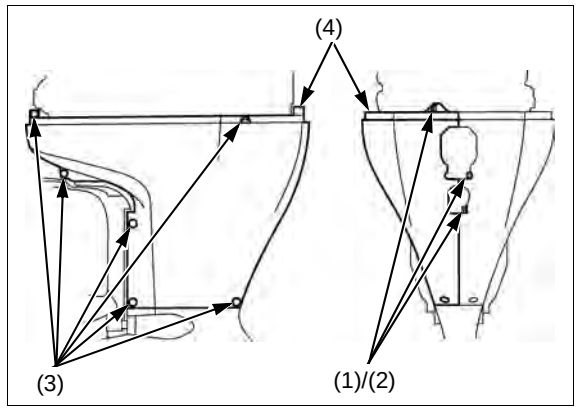
Remove the six mud guard clips (1) and under cover grommet (2).



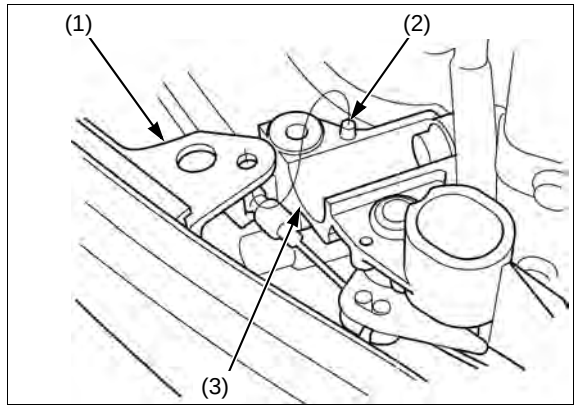
Loosen the two rivet screws (1) and remove the two harness clips (2).



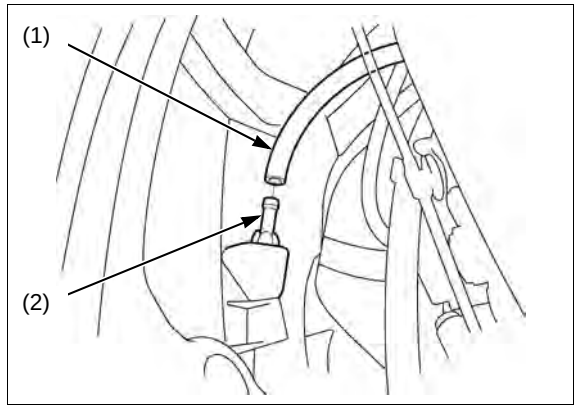
Remove the three screws (6 x 25 mm) (1), collars (2), and six special bolts (6 x 17 mm) (3) from the L. engine under cover (4).



Release the L. engine under cover (1) from the boss (2) of the L. side cover bracket (3).

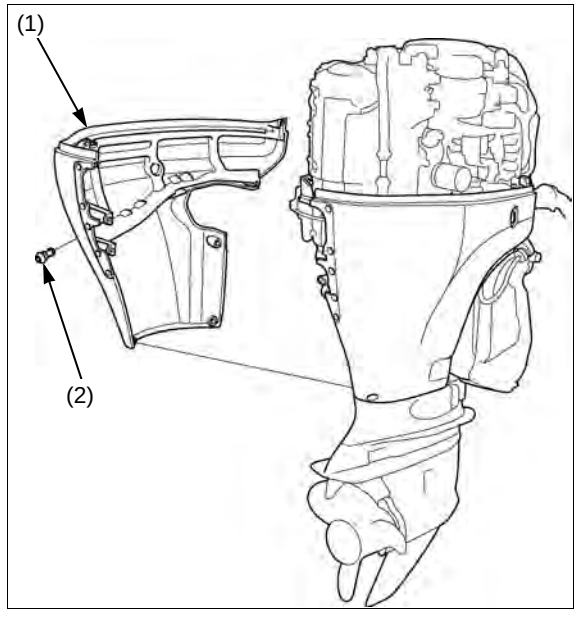


Open the L. engine under cover and disconnect the hose (1) from the water check grommet (2).



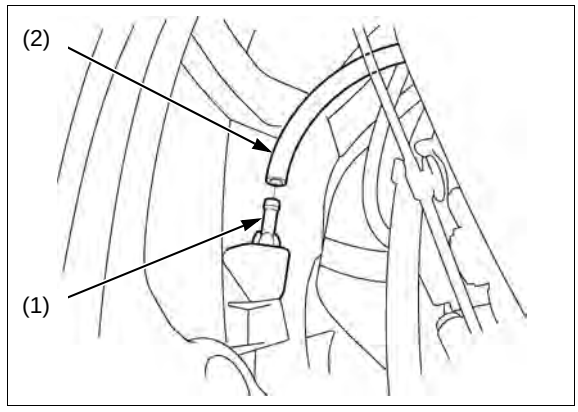
Remove the L. engine under cover (1).

Remove the water check grommet (2).

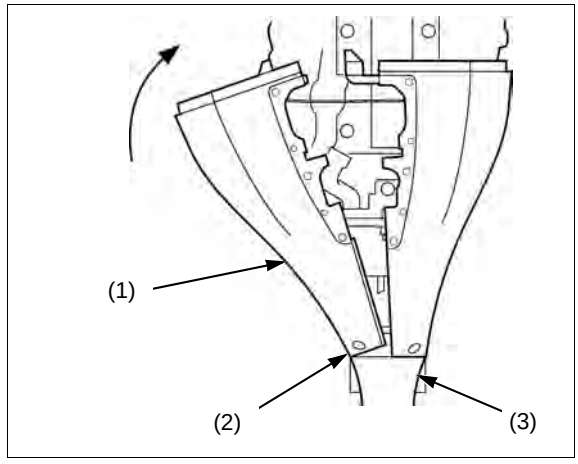


INSTALLATION

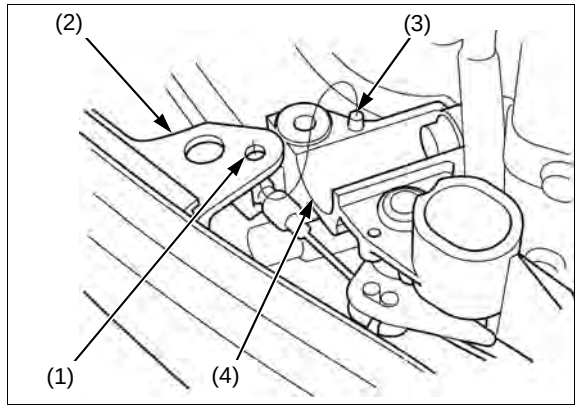
Install the water check grommet (1) from the outside of the L. engine under cover.
Connect the hose (2) to the water check grommet.



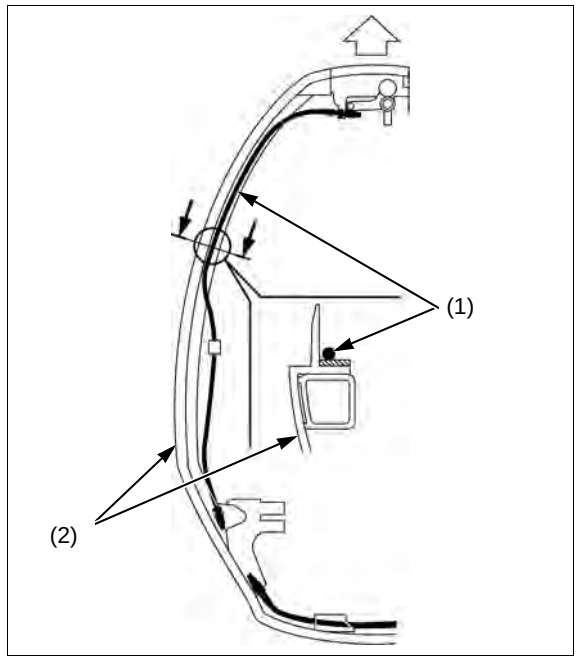
Install the L. engine under cover (1) by aligning its lower side (2) with the extension case (3).



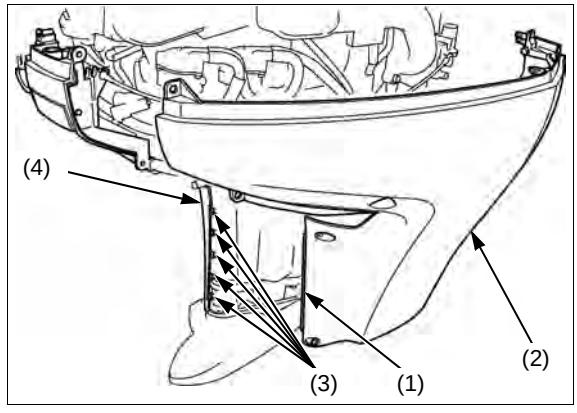
Install the hole (1) of the L. engine under cover (2) onto the boss (3) of the L. side cover bracket (4).



Check that the cover lock cable A (1) is positioned on the L. engine under cover (2) as shown.

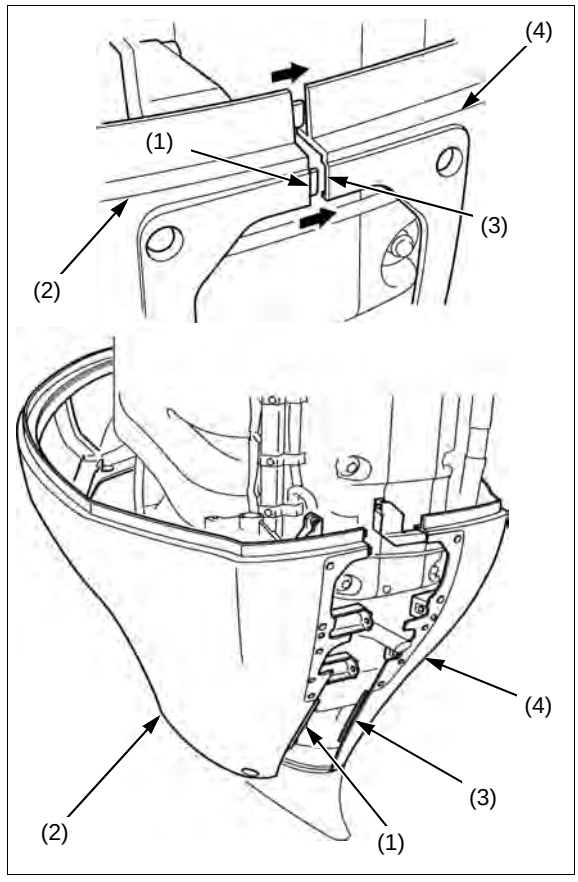


Install the tab (1) of the front side (swivel case side) of L. engine under cover (2) into the grooves (3) of the R. engine under cover (4).



Install the tabs (1) of the rear side (cylinder head cover side) of L. engine under cover (2) into the grooves (3) of the R. engine under cover (4).

- Be sure that all tabs and grooves are completely aligned with each other.



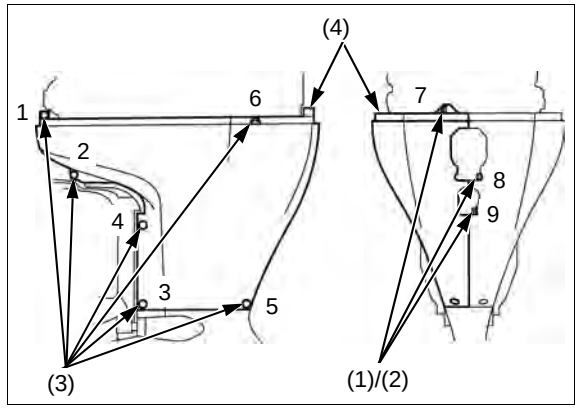
Install the three collars (1), then loosely install the three screws (6 x 25 mm) (2) and six special bolts (6 x 17 mm) (3) to the L. engine under cover (4).

- Be sure that the special bolt flange is positioned in the case bolt hole.

Tighten the three screws and six special bolts to the specified torque in the numbered order in several steps.

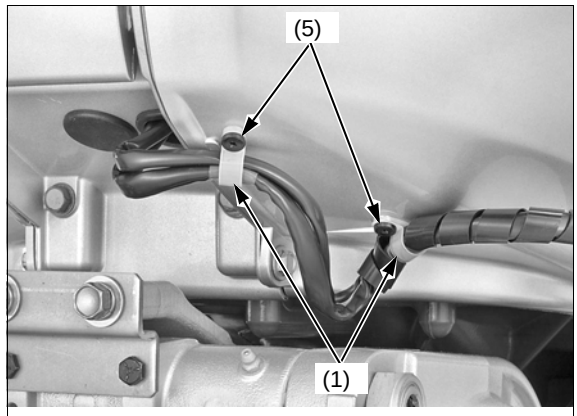
TORQUE:
Screws: 4.5 N·m (0.46 kgf·m, 3.3 lbf·ft)
Special bolts: 10 N·m (1.0 kgf·m, 7 lbf·ft)

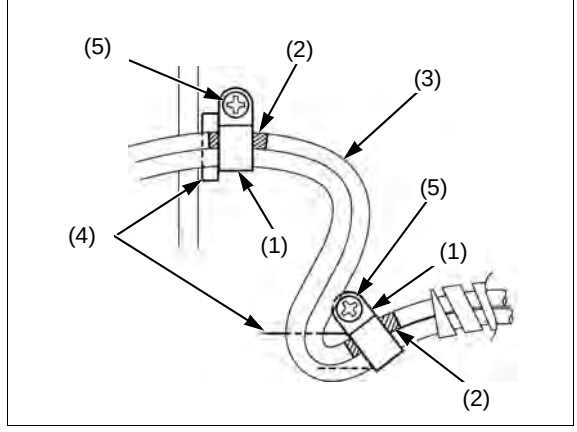
- Be sure that all tabs and grooves are completely aligned with each other.



Check that the harness clips (1) and harness tapes (2) of the power tilt motor wire (3) are aligned.

Position the clips while aligning their edges with the L. engine under cover projections (4), then install and tighten the two rivet screws (5).

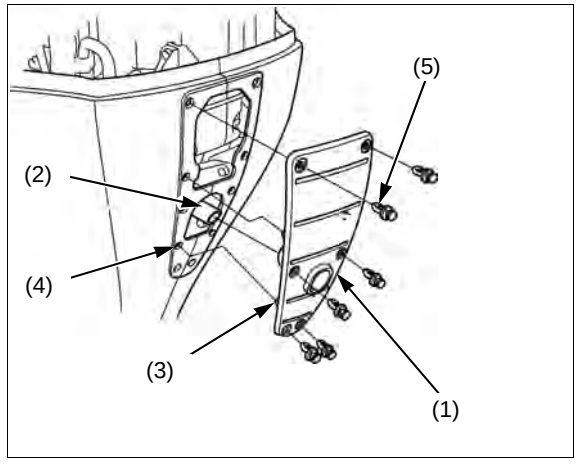




Install the under cover grommet (1) onto the idle exhaust port (2).

Install the four under cover grommet bosses (3) into the engine under cover holes (4) securely.

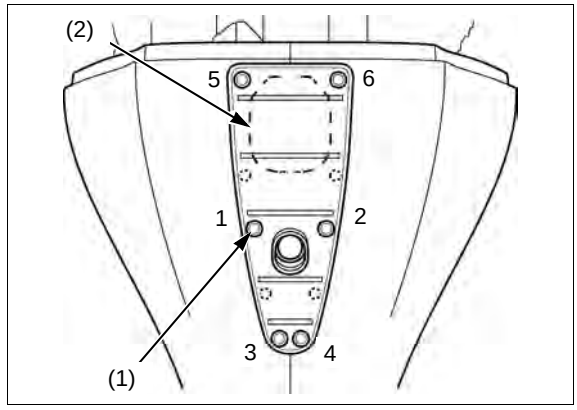
Set the six mud guard clips (5) by aligning the clip holes of under cover grommet and engine under covers.



Push in the heads of the mud guard clips (1) completely in the numbered order.

Check that the lip (2) behind the under cover grommet is completely set on the engine under covers.

- Be sure that the under cover grommet is fully seated on the engine under covers.

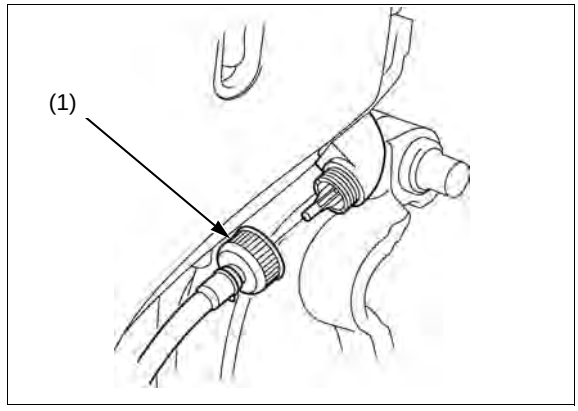


R. ENGINE UNDER COVER REMOVAL/ INSTALLATION

REMOVAL

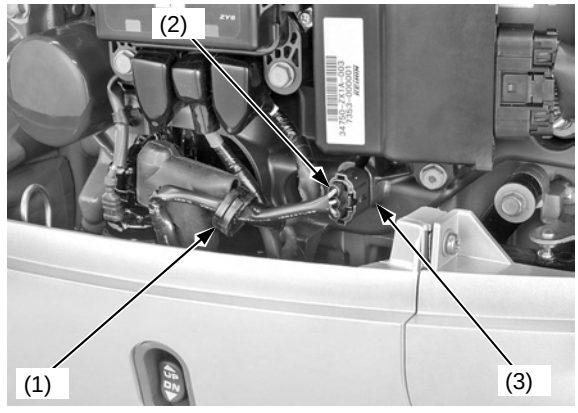
Remove the front separate cover (page 6-3).

Disconnect the flush plug cap (1) from the R. engine under cover.

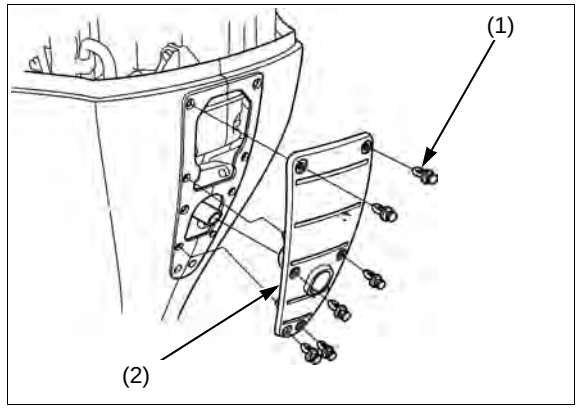


Release the wire harness clip (1) and remove the power tilt switch 3P connector (2) from the electric parts case (3).

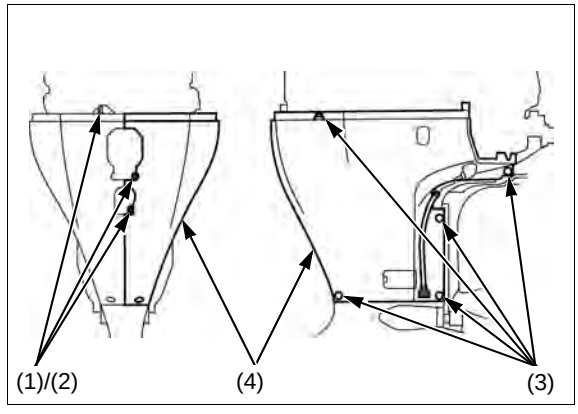
Disconnect the power tilt switch 3P connector.



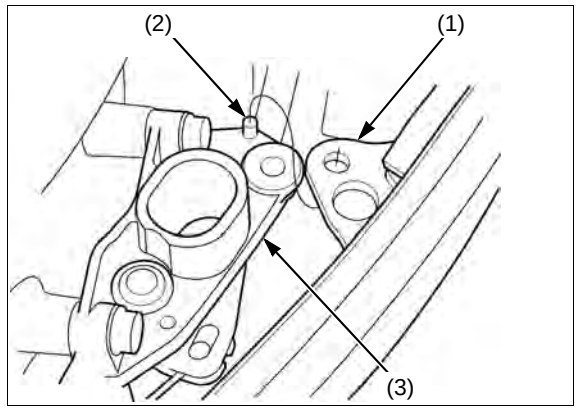
Remove the six mud guard clips (1) and under cover grommet (2).



Remove the three screws (6 x 25 mm) (1), collars (2), and five special bolts (6 x 17 mm) (3) from the R. engine under cover (4).

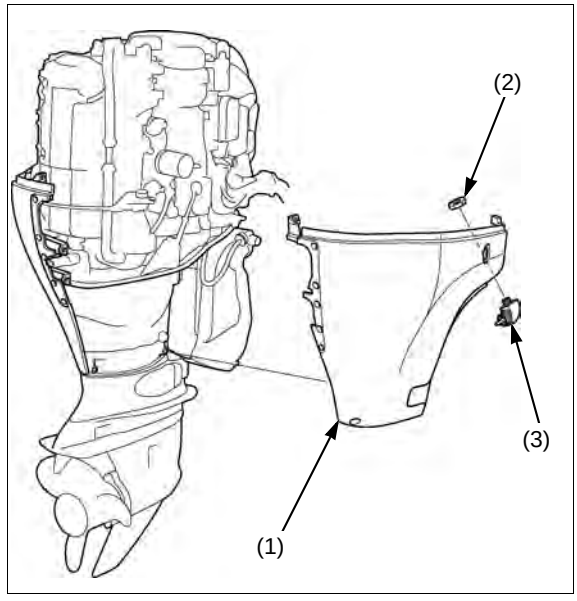


Release the R. engine under cover (1) from the boss (2) of the R. side cover bracket (3).



Remove the R. engine under cover (1).

Remove the nut (2) and water joint cap (3).

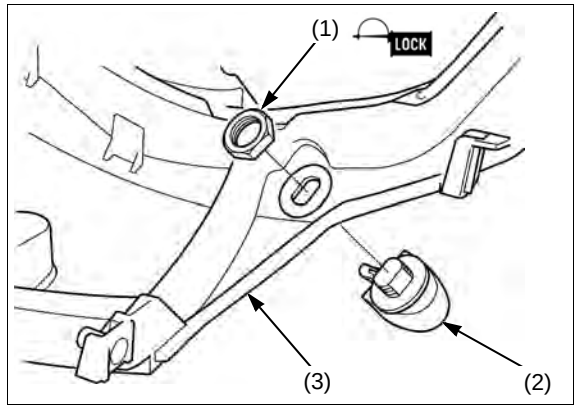


INSTALLATION

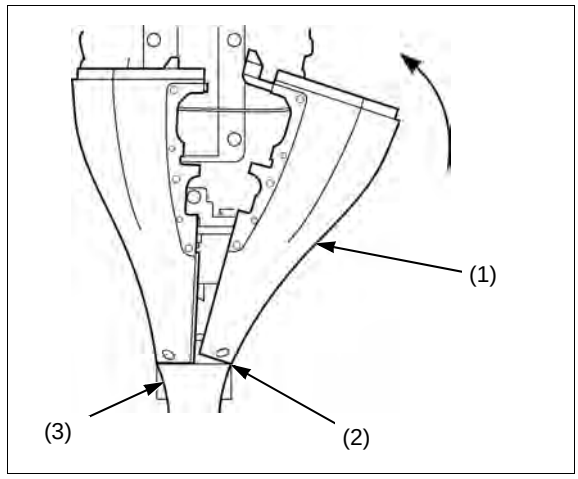
Apply locking agent (Loctite® PRISM 403 or equivalent) to the seating surface of the nut (1).

Install the water joint cap (2) to the R. engine under cover (3) in the direction as shown.
Install and tighten the nut to the specified torque.

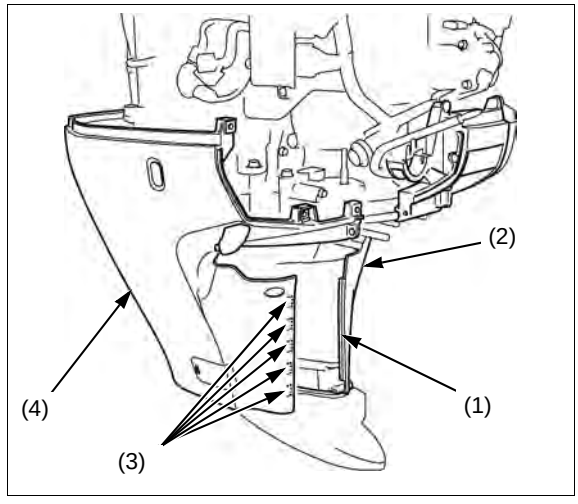
TORQUE: 1.1 N·m (0.11 kgf·m, 0.8 lbf·ft)



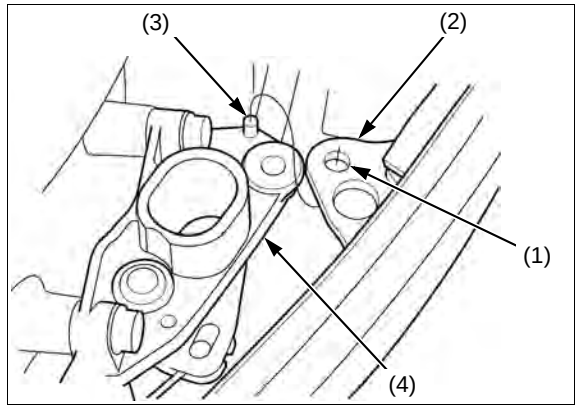
Position the power tilt switch wire on the upper side of the R. engine under cover and pull the hose with the flush plug cap out of the R. engine under cover.
Install the R. engine under cover (1) by aligning its lower side (2) with the extension case (3).



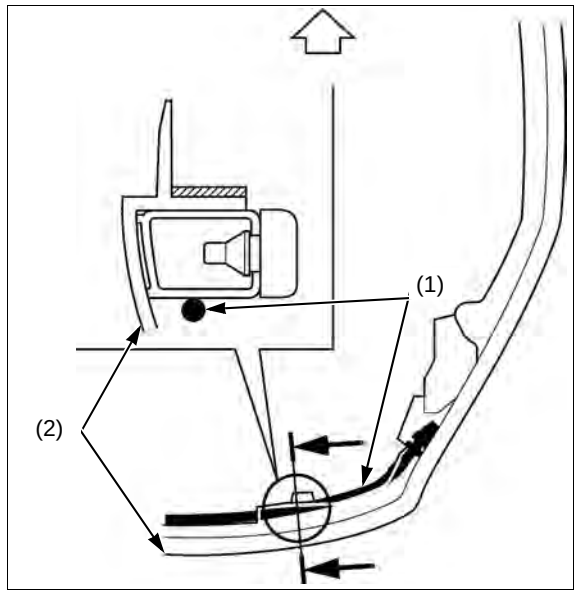
Install the tab (1) of the front side (swivel case side) of L. engine under cover (2) into the grooves (3) of the R. engine under cover (4).



Install the hole (1) of the R. engine under cover (2) onto the boss (3) of the R. side cover bracket (4).

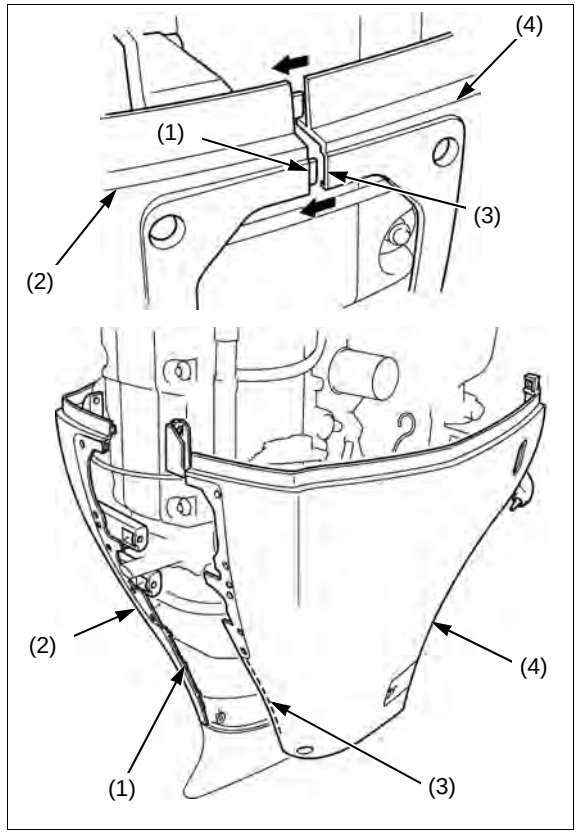


Check that the cover lock cable B (1) is positioned under the R. engine under cover (2) as shown.



Install the tabs (1) of the rear side (cylinder head cover side) of L. engine under cover (2) into the grooves (3) of the R. engine under cover (4).

- Be sure that all tabs and grooves are completely aligned with each other.



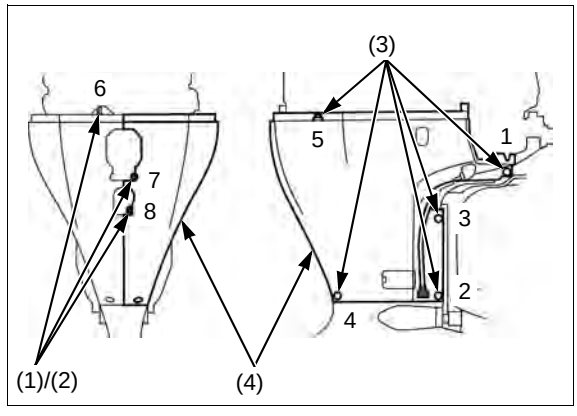
Install the three collars (1), then loosely install the three screws (2) and five special bolts (3) to the R. engine under cover (4).

- Be sure that the special bolt flange is positioned in the case bolt hole.

Tighten the three screws and five special bolts to the specified torque in the numbered order in several steps.

TORQUE:
Screws: 4.5 N·m (0.46 kgf·m, 3.3 lbf·ft)
Special bolts: 10 N·m (1.0 kgf·m, 7 lbf·ft)

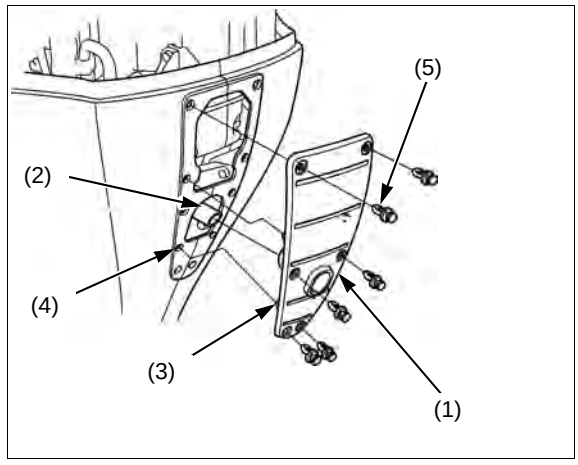
- Be sure that all tabs and grooves are completely aligned with each other.



Install the under cover grommet (1) onto the idle exhaust port (2).

Install the four under cover grommet bosses (3) into the engine under cover holes (4) securely.

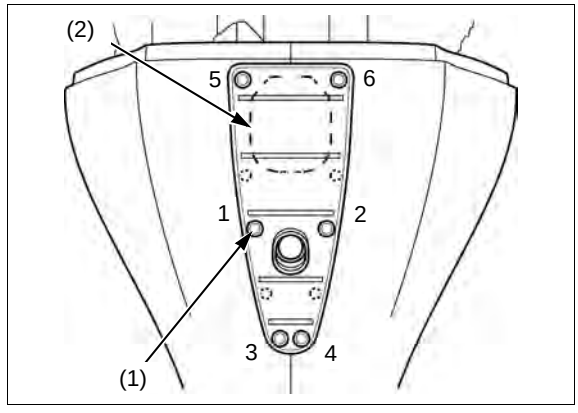
Set the six mud guard clips (5) by aligning the clip holes of under cover grommet and engine under covers.



Push in the heads of the mud guard clips (1) completely in the numbered order.

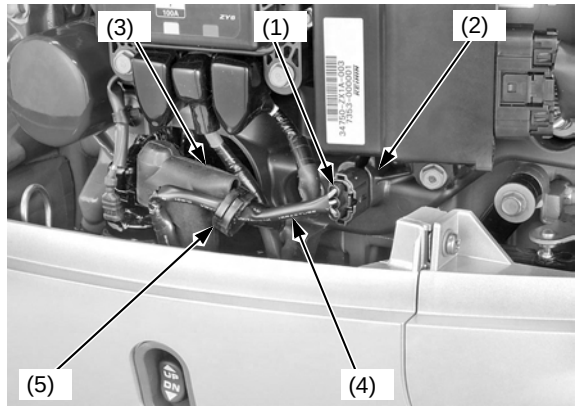
Check that the lip (2) behind the under cover grommet is completely set on the engine under covers.

- Be sure that the under cover grommet is fully seated on the engine under covers.



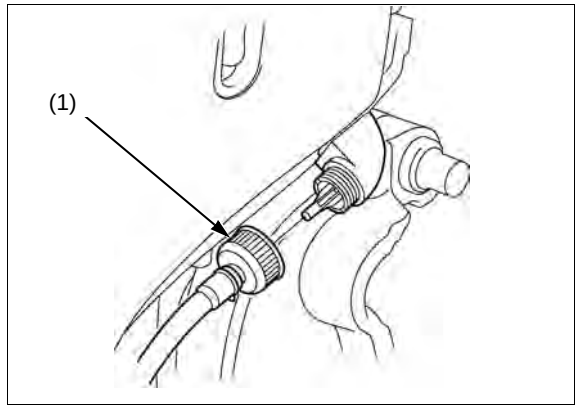
Connect the power tilt switch 3P connector (1).

Install the power tilt switch 3P connector to the electric parts case (2).
Secure the starter cable (3) and power tilt switch wire (4) with the harness clip (5).



Install and tighten the flush plug cap (1) to the R. engine under cover.

Install the front separate cover (page 6-3).



COVER LOCK CABLE REMOVAL/ INSTALLATION

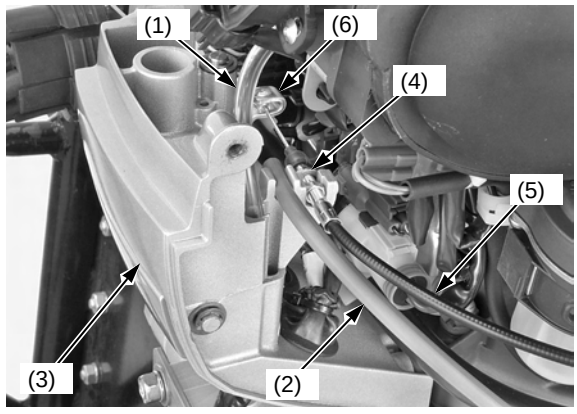
REMOVAL

Remove the following:

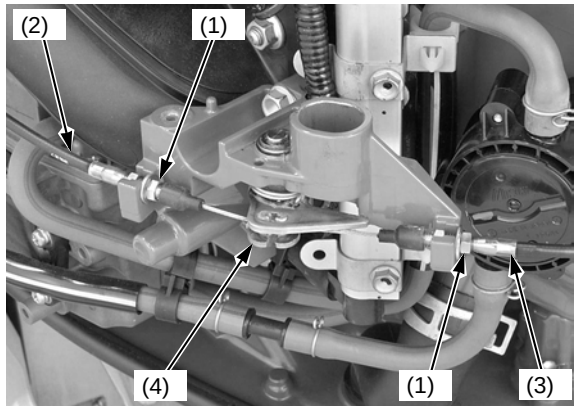
- Engine cover
- Front separate cover (page 6-3)
- L. engine under cover (page 6-4)
- R. engine under cover (page 6-10)

Remove the vinyl tube (1) and fuel tube (2) from the under cover front bracket (3).

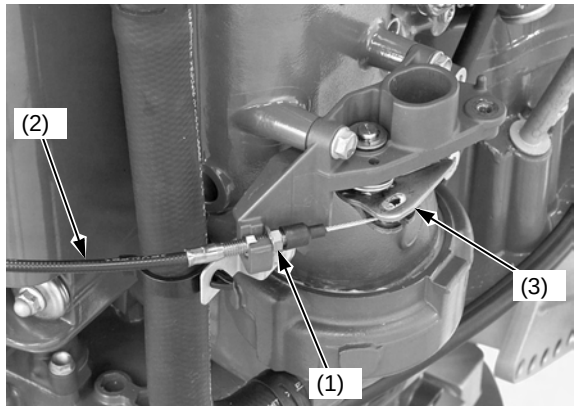
Loosen the lock nut (4) of the cover lock cable A (5) and disconnect the cable from the front lock (6).



Loosen the lock nuts (1) of the cover lock cable A (2) and cover lock cable B (3), then disconnect the cables from the L. side lock (4).

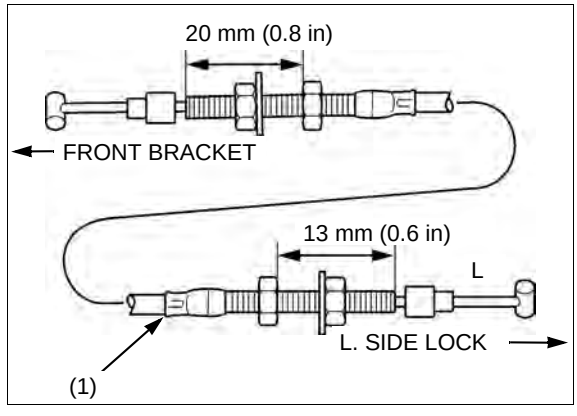


Loosen the lock nut (1) of the cover lock cable B (2) and disconnect the cable from the R. side lock (3).



INSTALLATION/ADJUSTMENT

Set the adjusting nut position of cover lock cable A (1) (longer cable) to the measurement as shown.

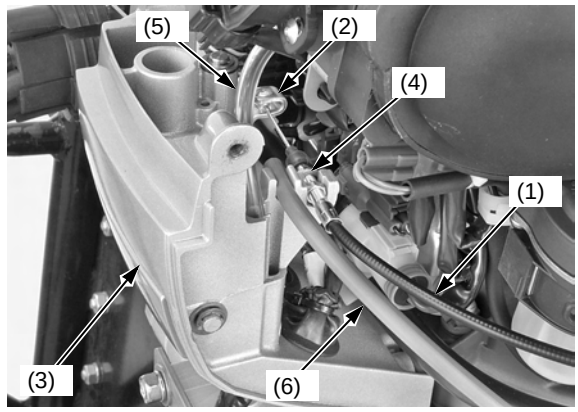


Insert the inner cable end of cover lock cable A (1) into the front lock arm (2).
Install cover lock cable A to the under cover front bracket (3), and tighten the washer side lock nut (4) to the specified torque.

TORQUE: 3.5 N·m (0.36 kgf·m, 2.6 lbf·ft)

- After tightening the lock nut, check that the adjusting nut position is not changed from the previous step. If changed, readjust the cable.

Install the vinyl tube (5) and fuel tube (6) to the under cover front bracket.



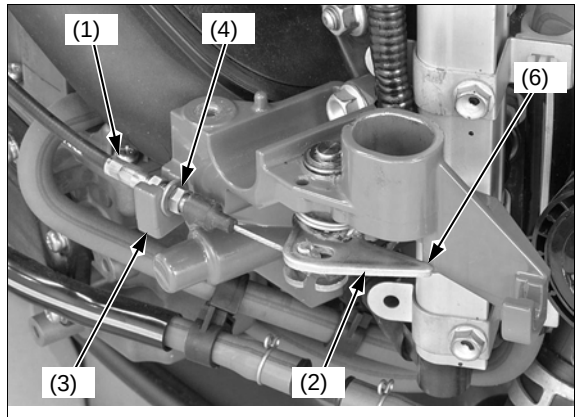
Insert the inner cable end of cover lock cable A (1) into the L. side lock (2).
Install cover lock cable A to the L. side cover bracket (3), and tighten the washer side lock nut (4) to the specified torque.

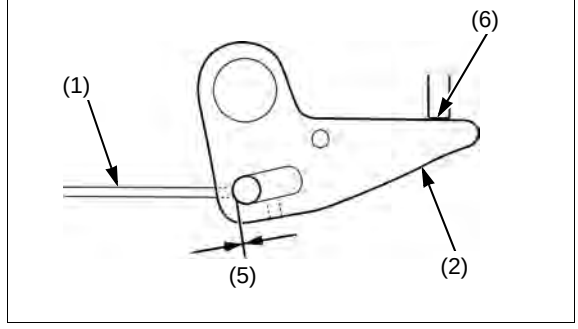
TORQUE: 3.5 N·m (0.36 kgf·m, 2.6 lbf·ft)

- After tightening the lock nut, check that the adjusting nut position is not changed from the previous step. If changed, readjust the cable.

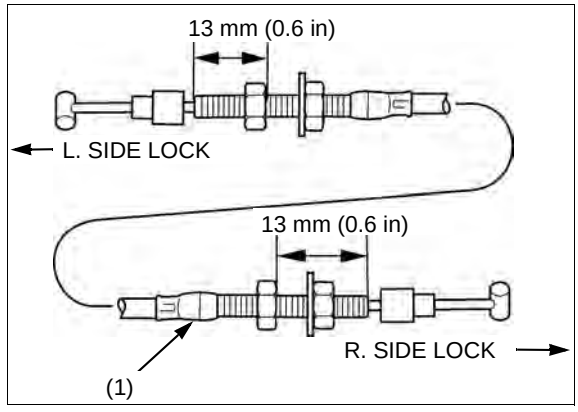
There should be no clearance (5) between the hole of the L. side lock and cable end of the cover lock cable A, and check that the L. side lock is contacting the stopper (6) of the L. side cover bracket.

Readjust the cable if there is clearance.





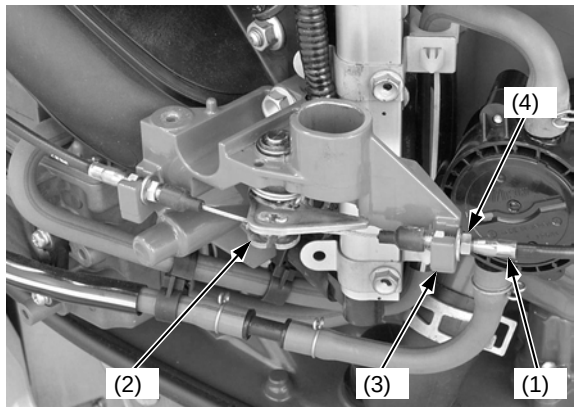
Set the adjusting nut position of cover lock cable B (1) (shorter cable) to the measurement as shown.



Insert the inner cable end of cover lock cable B (1) into the L. side lock (2).
Install cover lock cable B to the L. side cover bracket (3), and tighten the washer side lock nut (4) to the specified torque.

TORQUE: 3.5 N·m (0.36 kgf·m, 2.6 lbf·ft)

- After tightening the lock nut, check that the adjusting nut position is not changed from the previous step. If changed, readjust the cable.



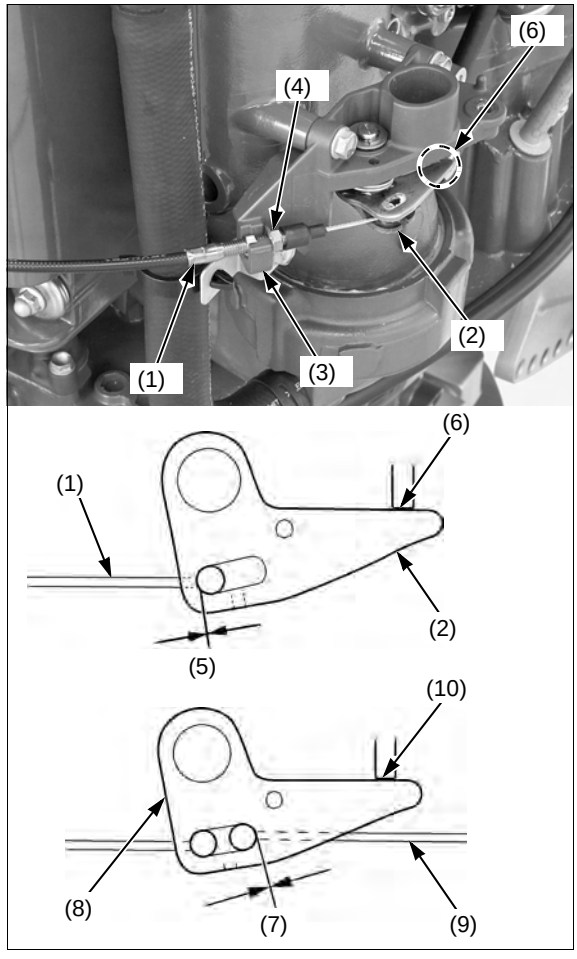
Insert the inner cable end of cover lock cable B (1) into the R. side lock (2).
Install cover lock cable B to the R. side cover bracket (3), and tighten the washer side lock nut (4) to the specified torque.

TORQUE: 3.5 N·m (0.36 kgf·m, 2.6 lbf·ft)

- After tightening the lock nut, check that the adjusting nut position is not changed from the previous step. If changed, readjust the cable.

There should be no clearance (5) between the hole of the R. side lock and cable end of the cover lock cable B, and check that the R. side lock is contacting the stopper (6) of the R. side cover bracket.
There should be no clearance (7) between the hole of the L. side lock (8) and cable end of the cover lock cable B (9), and recheck that the L. side lock is contacting the stopper (10) of the L. side cover bracket.

Readjust the cable if there is clearance.



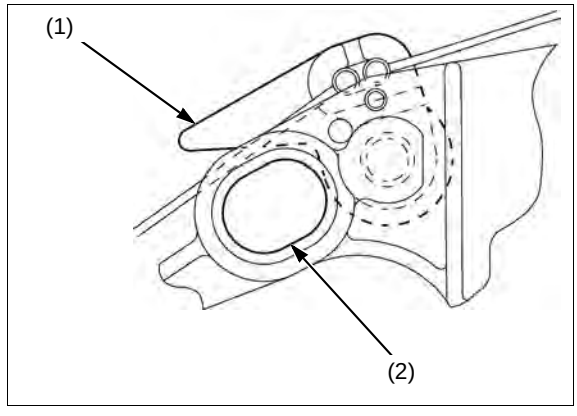
After installing the cables, operate the cover lock levers and check that the front lock and L./R. side locks operates smoothly.

Also check that the front lock and side lock (1) is not visible from each cover lock bolt insertion hole (2) of the under cover front bracket and L./R. side cover bracket, when operating the levers, viewed from straight above the holes.

Readjust the cables if the front lock and/or side lock is visible.

Install the following:

– L. engine under cover (page 6-6)
– R. engine under cover (page 6-11)
– Front separate cover (page 6-3)
– Engine cover



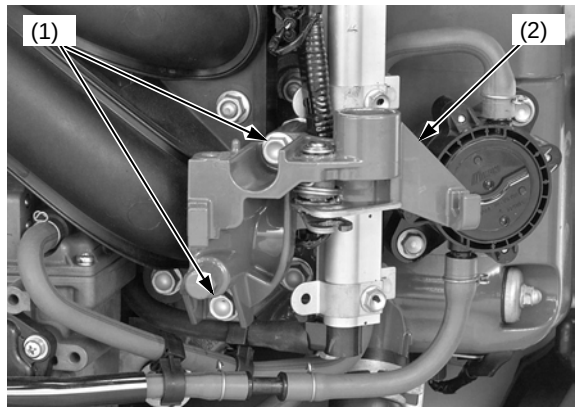
SIDE COVER BRACKET REMOVAL/ INSTALLATION

L. SIDE COVER BRACKET

Remove the cover lock cable A and B (page 6-15).

Remove the two flange bolts (1) and L. side cover bracket (2).

Installation is in the reverse order of removal.

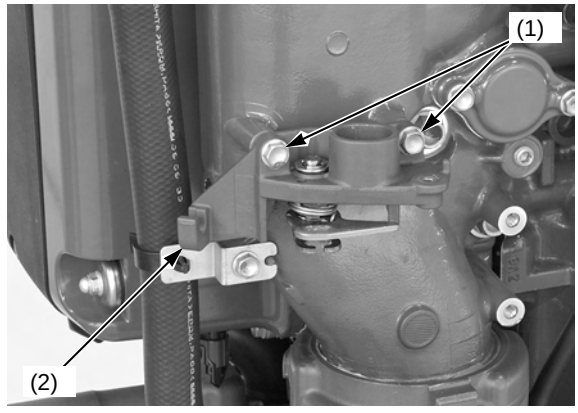


R. SIDE COVER BRACKET

Remove the cover lock cable A and B (page 6-15).

Remove the two flange bolts (1) and R. side cover bracket (2).

Installation is in the reverse order of removal.



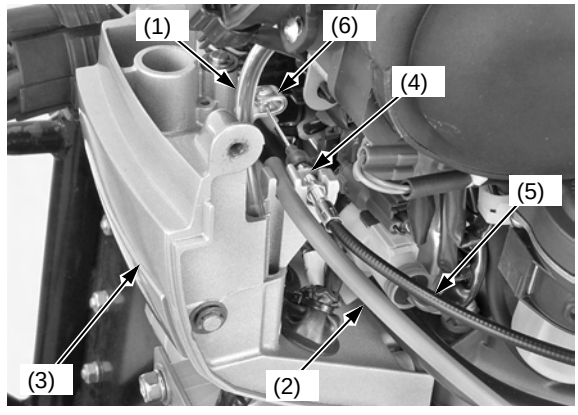
UNDER COVER FRONT BRACKET REMOVAL/INSTALLATION

Remove the following:

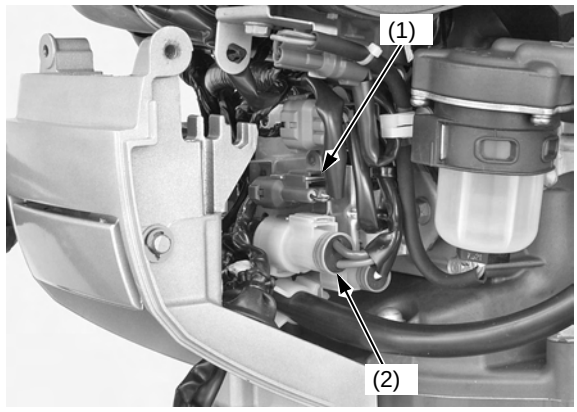
- Engine cover
- Front separate cover (page 6-3)
- L. engine under cover (page 6-4)
- R. engine under cover (page 6-10)
- Shift control cable (page 20-3)
- Throttle control cable (page 20-6)

Remove the vinyl tube (1) and fuel tube (2) from the under cover front bracket (3).

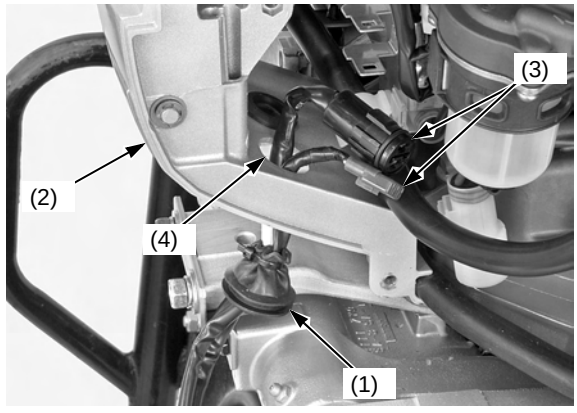
Loosen the lock nut (4) of the cover lock cable A (5) and disconnect the cable from the front lock (6).



Remove the trim angle sensor 3P connector (1) and power tilt motor 2P connector (2) from the connector bracket A.
Disconnect the trim angle sensor 3P connector and power tilt motor 2P connector.

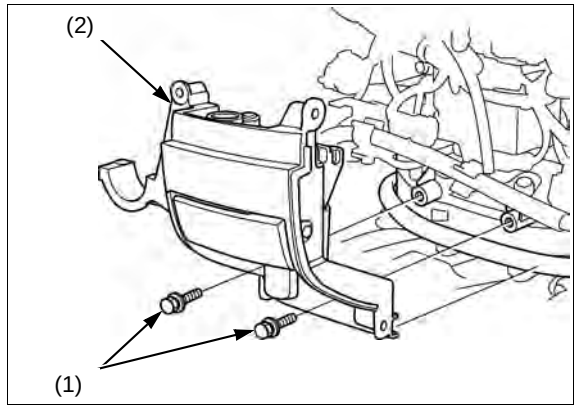


Release the under case grommet C (1) from the under cover front bracket (2) toward out side as shown.
Pull out the connectors (3) from the under cover front bracket hole (4).



Remove the two washer bolt (1) and under cover front bracket (2).

Installation is in the reverse order of removal.

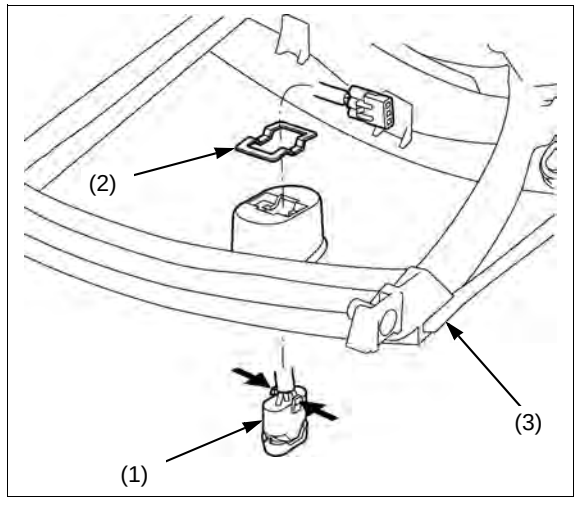


POWER TILT SWITCH REMOVAL/ INSTALLATION

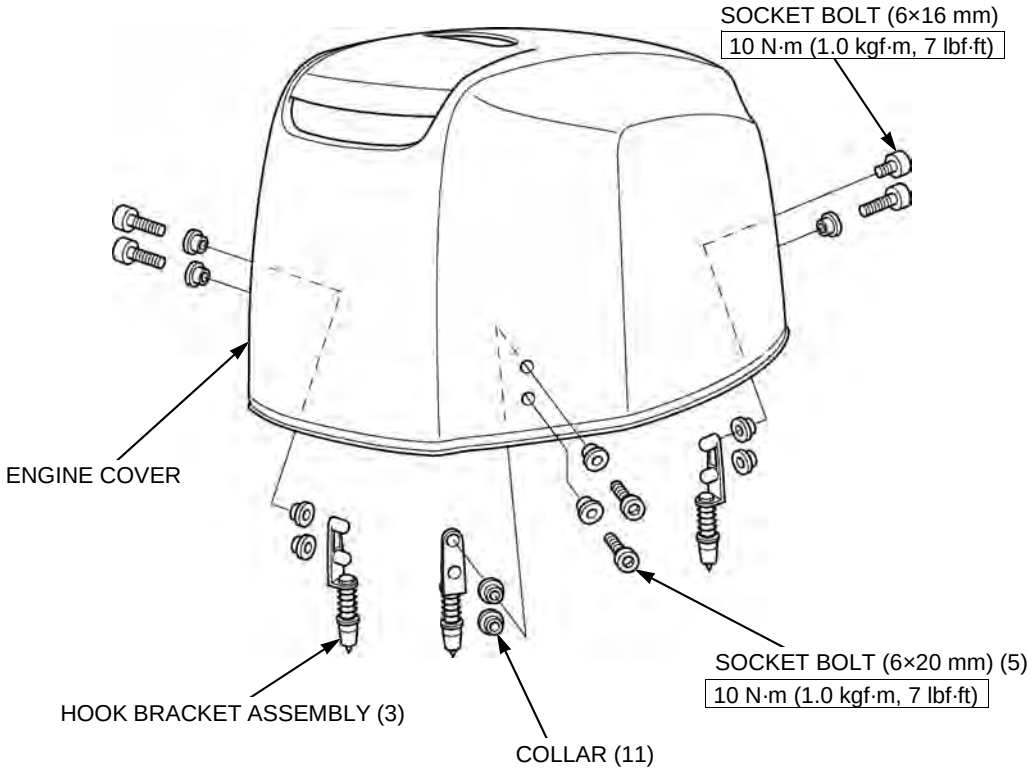
Remove the R. engine under cover (page 6-10).

Remove the power tilt switch (1) from the holder (2) and R. engine under cover (3) by pressing the tabs inward.

Installation is in the reverse order of removal.



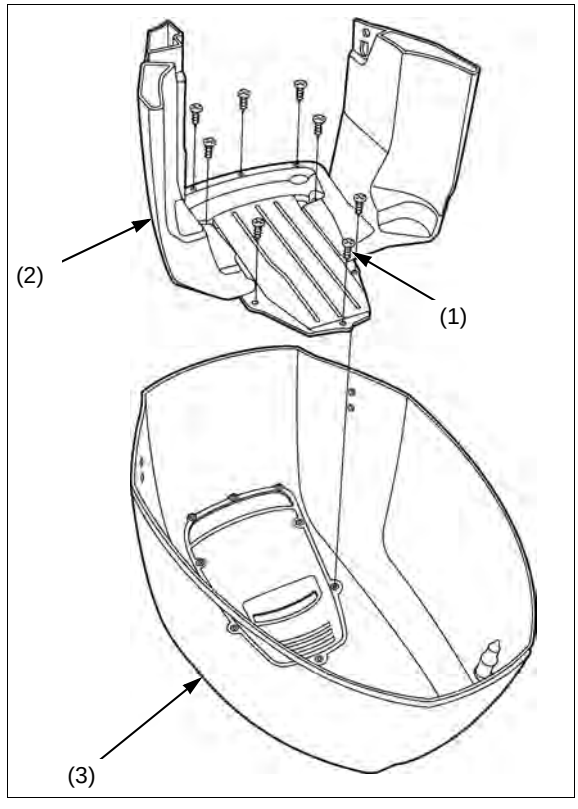
HOOK BRACKET REMOVAL/ INSTALLATION



ENGINE COVER AIR GUIDE REMOVAL/ INSTALLATION

Remove the right and left hook bracket assembly (page 6-20).

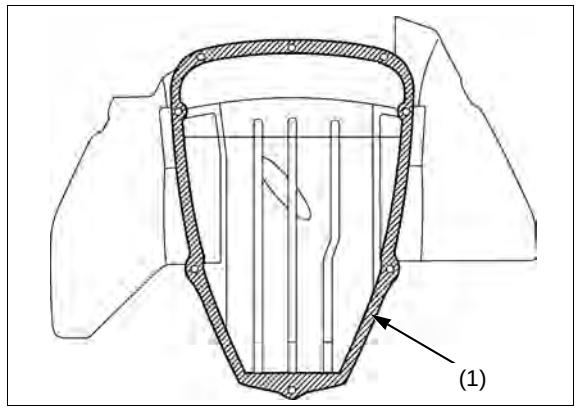
Remove the eight screws (1) and engine cover air guide (2) from the engine cover (3).



Clean the mating surfaces of the engine cover and engine cover air guide.

Apply sealant (SHINETSU-SILICONE KE45 or equivalent) to the specified area (1) of the engine cover air guide.

Installation is in the reverse order of removal.



SIDE COVER BRACKET DISASSEMBLY/ASSEMBLY

L. SIDE COVER BRACKET

Remove the L. side cover bracket (page 6-18).

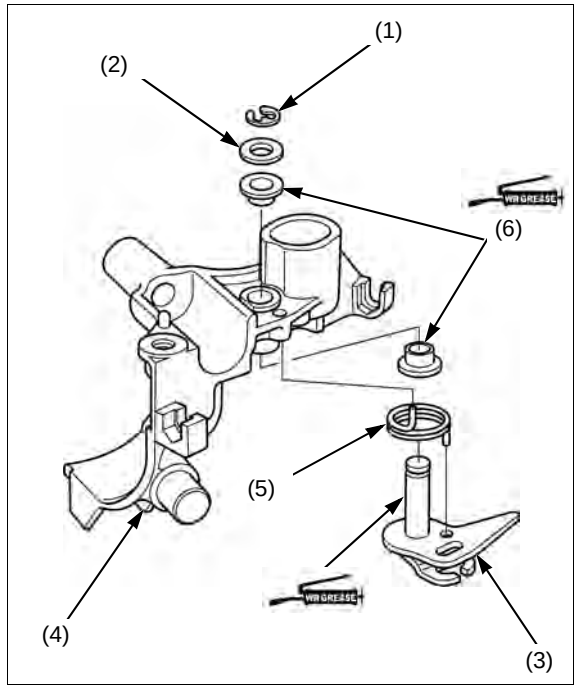
Remove the E-ring (1) and washer (2) from the side lock (3).

Remove the side lock from the L. side cover bracket (4) by pulling down the side lock, while releasing the cover lock hook spring (5) from the L. side cover bracket hole. Remove the cover lock hook spring from the side lock.

Remove the two cover lock bushings A (6).
Check the cover lock bushings A for damage and replace them if necessary.

Apply marine grease to the cover lock bushings A whole surface and shaft area of the side lock.

Assembly is in the reverse order of disassembly.



R. SIDE COVER BRACKET

Remove the R. side cover bracket (page 6-18).

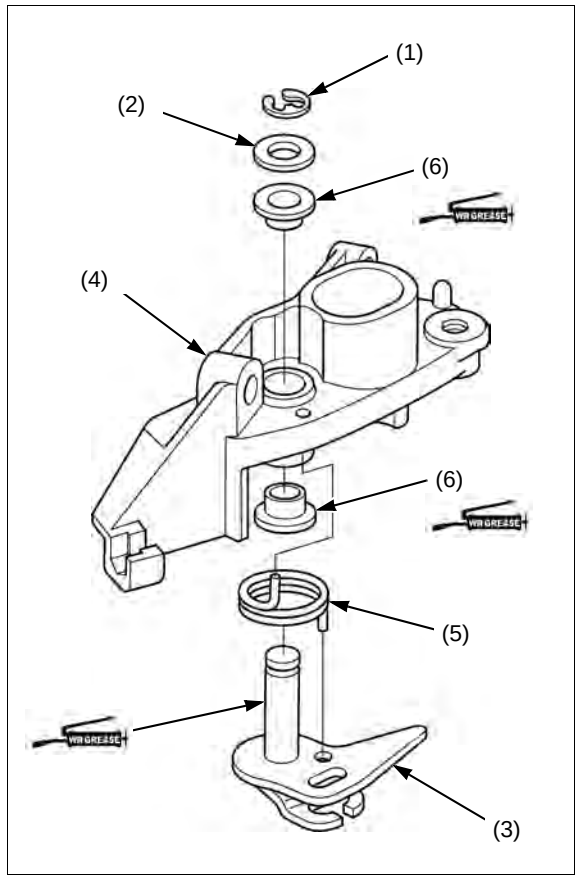
Remove the E-ring (1) and washer (2) from the side lock (3).

Remove the side lock from the R. side cover bracket (4) by pulling down the side lock, while releasing the cover lock hook spring (5) from the R. side cover bracket hole. Remove the cover lock hook spring from the side lock.

Remove the two cover lock bushings A (6).
Check the cover lock bushings A for damage and replace them if necessary.

Apply marine grease to the cover lock bushings A whole surface and shaft area of side lock.

Assembly is in the reverse order of disassembly.



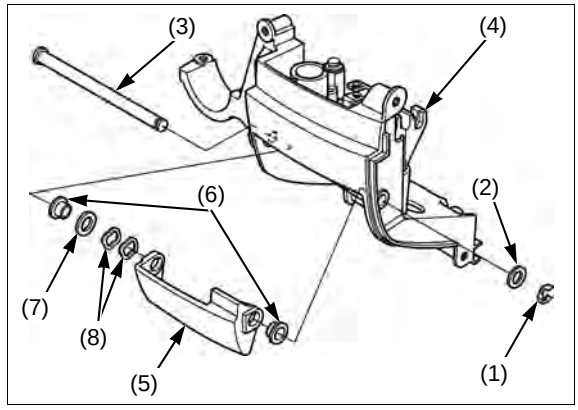
UNDER COVER FRONT BRACKET DISASSEMBLY/ASSEMBLY

DISASSEMBLY

Remove the under cover front bracket (page 6-18).

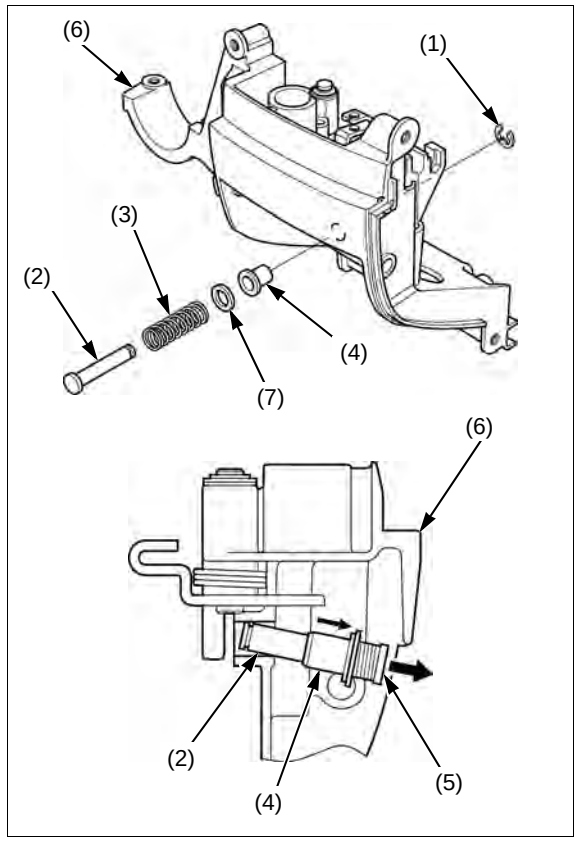
Remove the E-ring (1) and washer (8 mm) (2) from the lock front shaft (3).

Pull out the lock front shaft from the under cover front bracket (4).
Remove the cover lock lever (5), two cover lock bushings A (6), washer (10 mm) (7) and two wave washers (8).



Remove the E-ring (1) from the cover open shaft (2). Compress the lock lever return spring (3) by sliding the cover lock bushing B (4), then slightly lean the shaft as shown, so the shaft head (5) does not come in contact with the under cover front bracket (6).

Remove the cover lock bushing B, washer (7) and lock lever return spring from the cover open shaft.

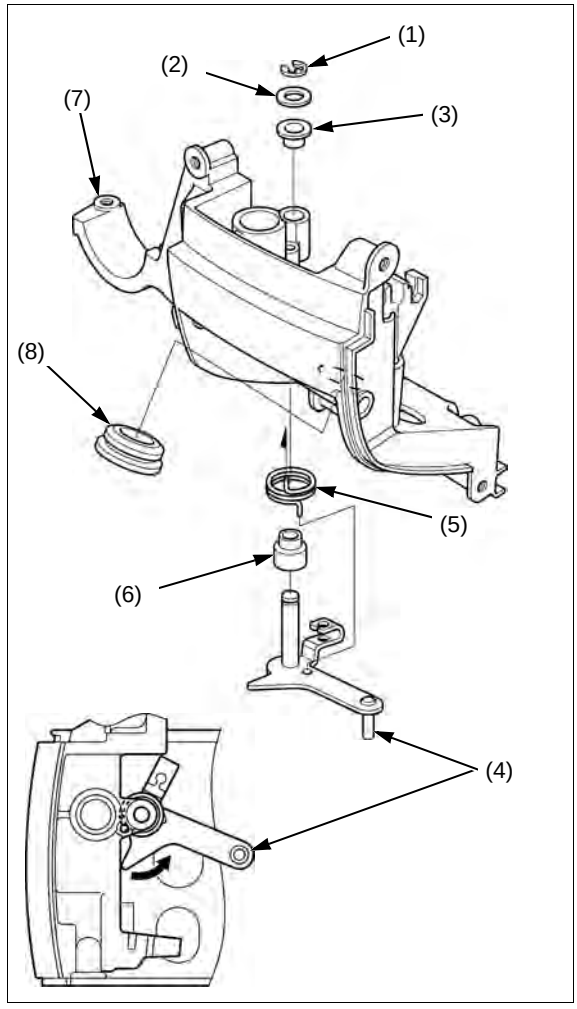


Remove the E-ring (1), washer (2), cover lock bushing A (3) from the front lock (4).

Release the cover lock spring (5) from the under cover front bracket hole by pulling down the front lock. Remove the cover lock bushing (6) from the under cover front bracket (7) and slide it toward the front lock side.

Turn the front lock as shown, then slightly lean the front lock and remove it from the under cover front bracket. Remove the cover lock bushing and cover lock hook spring from the front lock.

Remove the bracket cap (8).



ASSEMBLY

Install the bracket cap (1).

Apply marine grease to the shaft area of the front lock (2) and cover lock bushing (3) whole surface.

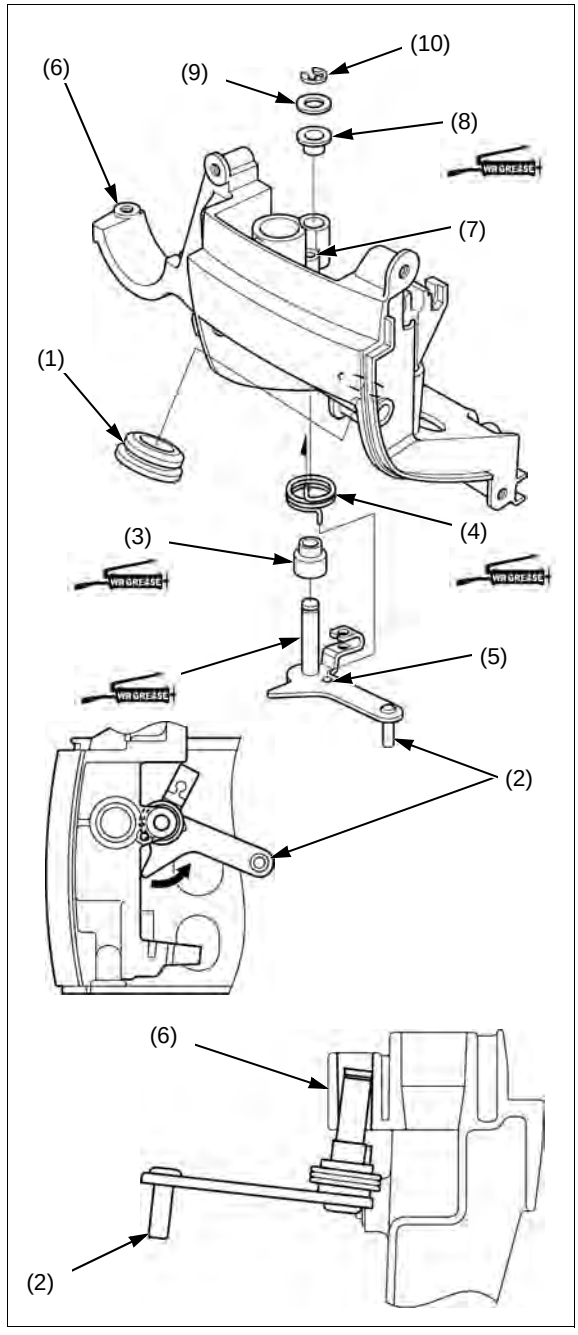
Apply marine grease to the cover lock hook spring (4) whole surface and install it into the front lock hole (5).

Turn the front lock as shown, then slightly lean the front lock and install it into the under cover front bracket (6).

Insert the other end of the cover lock hook spring into the under cover front bracket hole (7).

Apply marine grease to the cover lock bushing A (8) whole surface and install it into the under cover front bracket.

Install the washer (9) and E-ring (10) to the front lock.

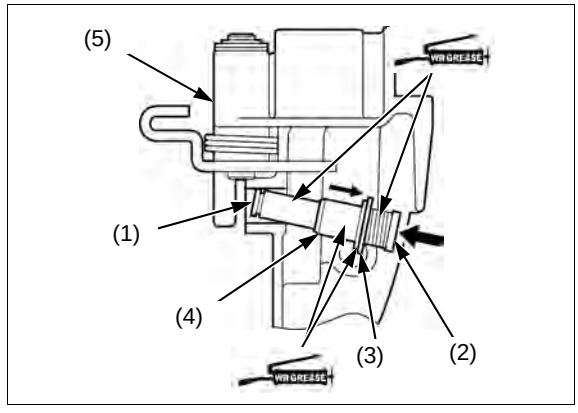


Apply marine grease to the whole surfaces of cover open shaft (1), lock lever return spring (2), washer (3) and cover lock bushing B (4).
Install the lock lever return spring, washer and cover lock bushing B to the cover open shaft.
Compress the lock lever return spring by sliding the cover lock bushing B as shown.

Slightly lean the cover open shaft as shown and install it into the under cover front bracket (5).

Install the cover lock bushing B into the under cover front bracket.

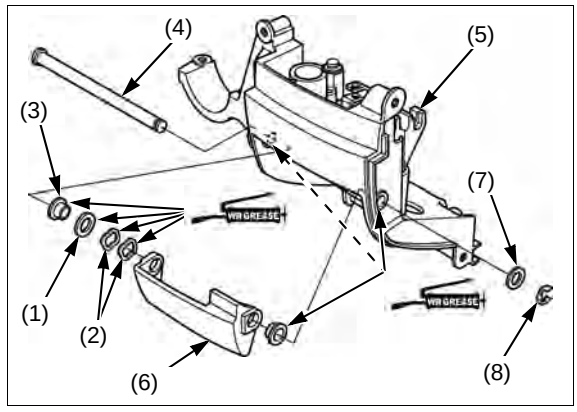
Install the E-ring to the cover open shaft.



Apply marine grease to the whole surfaces of the washer (10 mm) (1), two wave washers (2), two cover lock bushings A (3) and lock front shaft (4) sliding surface of under cover front bracket (5).

Set the two cover lock bushings A, washer (10 mm) and two wave washers to the cover lock lever (6) and install it to the under cover front bracket.

Install the lock front shaft.
Install the washer (8 mm) (7) and E-ring (8) to the lock front shaft.



HOOK BRACKET DISASSEMBLY/ASSEMBLY

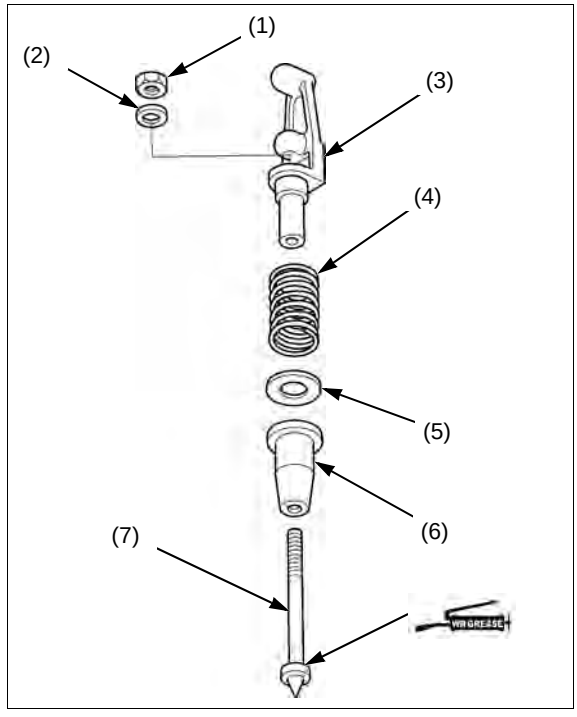
Remove the hook bracket assembly (page 6-20).

Remove the following:

– Nut (1)
– Washer (2)
– Hook bracket (3)
– Spring (4)
– Washer (5)
– Hook damper (6)
– Cover lock bolt (7)

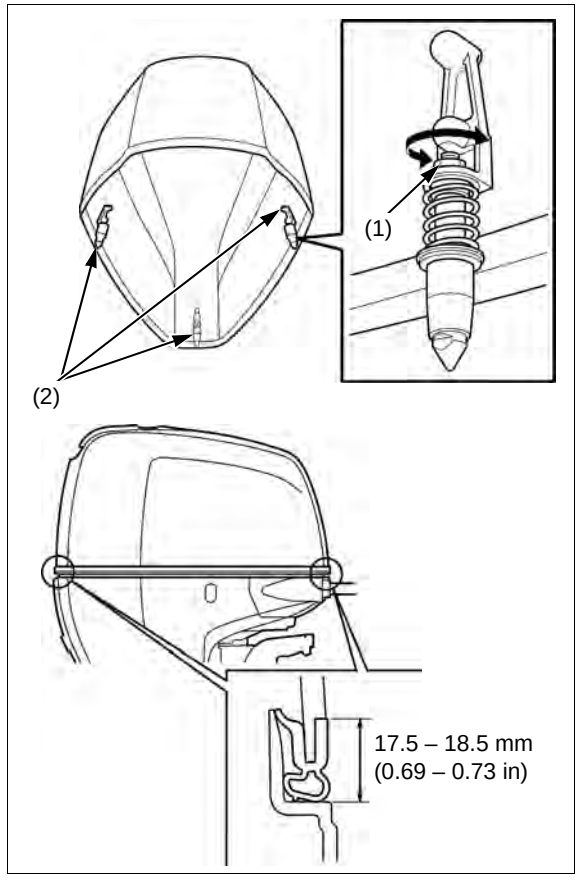
Apply marine grease to the cover lock bolt threads and seating surface.

Assembly is in the reverse order of disassembly.



HOOK BRACKET ADJUSTMENT

Turn the nut (1) and adjust the hook bracket (2) height until the clearance between the engine under cover and engine cover is 17.5 – 18.5 mm (0.69 – 0.73 in).



UNDER COVER SEAL B REPLACEMENT

Remove the extension case (1).

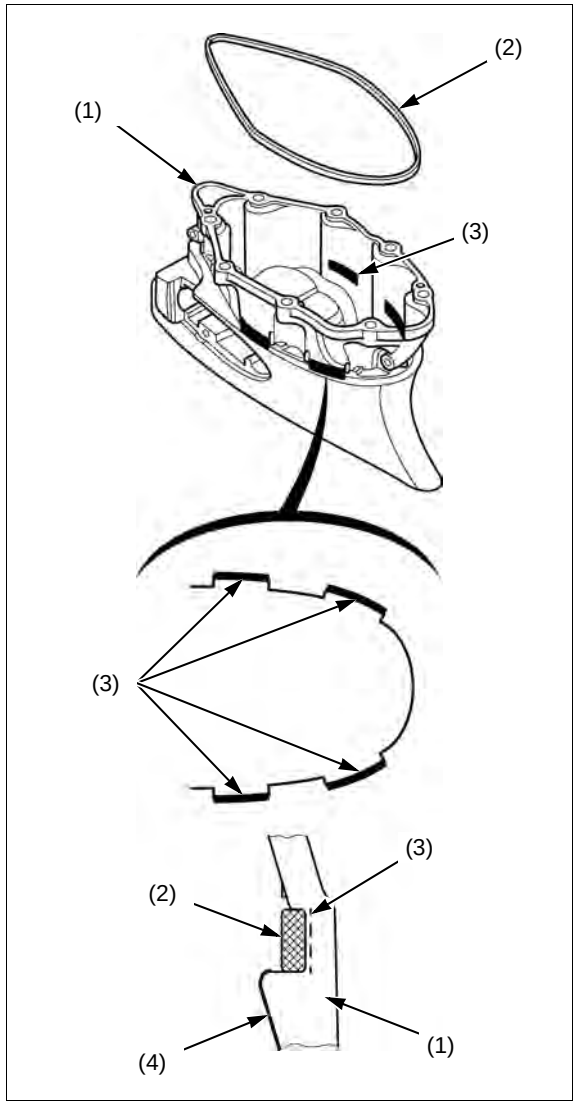
– Standard rotation type (page 16-12)
– Counter rotation type (page 17-12)

Remove the under cover seal B (2).

Clean the seal installation surface of extension case.
Apply adhesive (Threebond® 1530C or equivalent) to the specified area (3) as shown.

Install the under cover seal B.
Allow the adhesive to dry for approximately 1 – 2 hours.

- Allow the adhesive to dry completely (approximately 24 hours) before running the outboard motor.
- Do not let the adhesive to stick out side of the specified area (4).



MEMO

7. CHARGING SYSTEM

SYSTEM LOCATION 7-2

SYSTEM DIAGRAM 7-2

TOOLS 7-3

CHARGING SYSTEM TROUBLESHOOTING 7-4

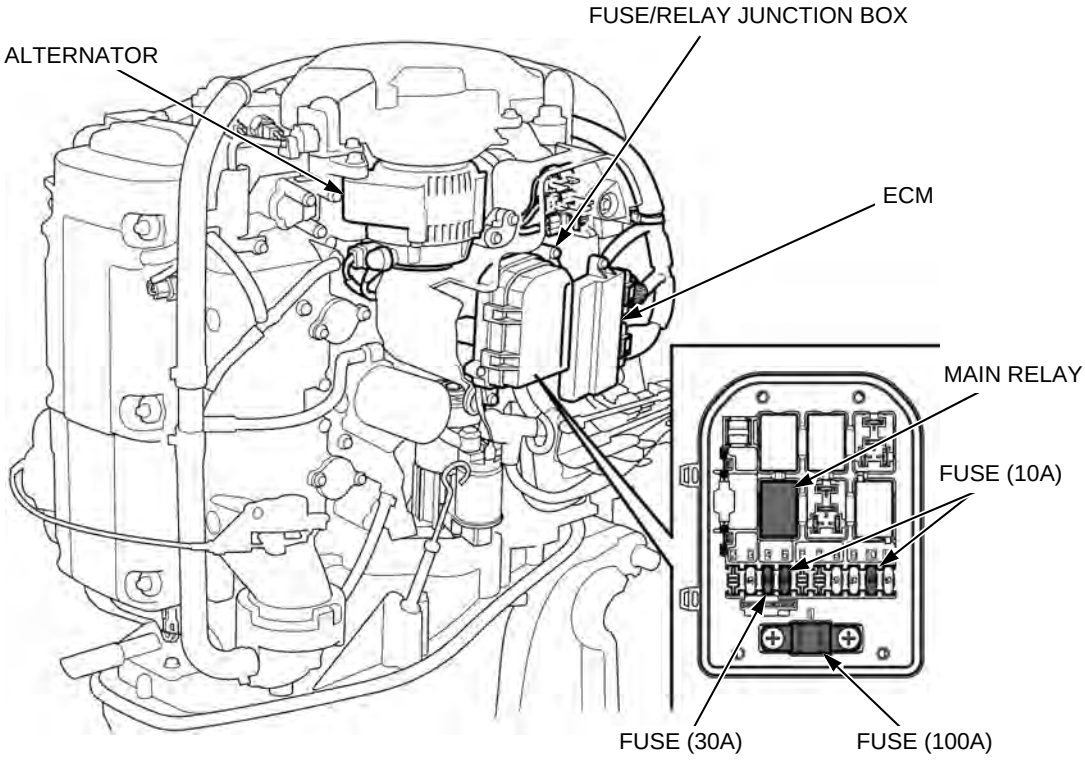
ALTERNATOR REMOVAL/ INSTALLATION 7-5

ALTERNATOR BRACKET REMOVAL/ INSTALLATION 7-7

ALTERNATOR DISASSEMBLY/ ASSEMBLY 7-8

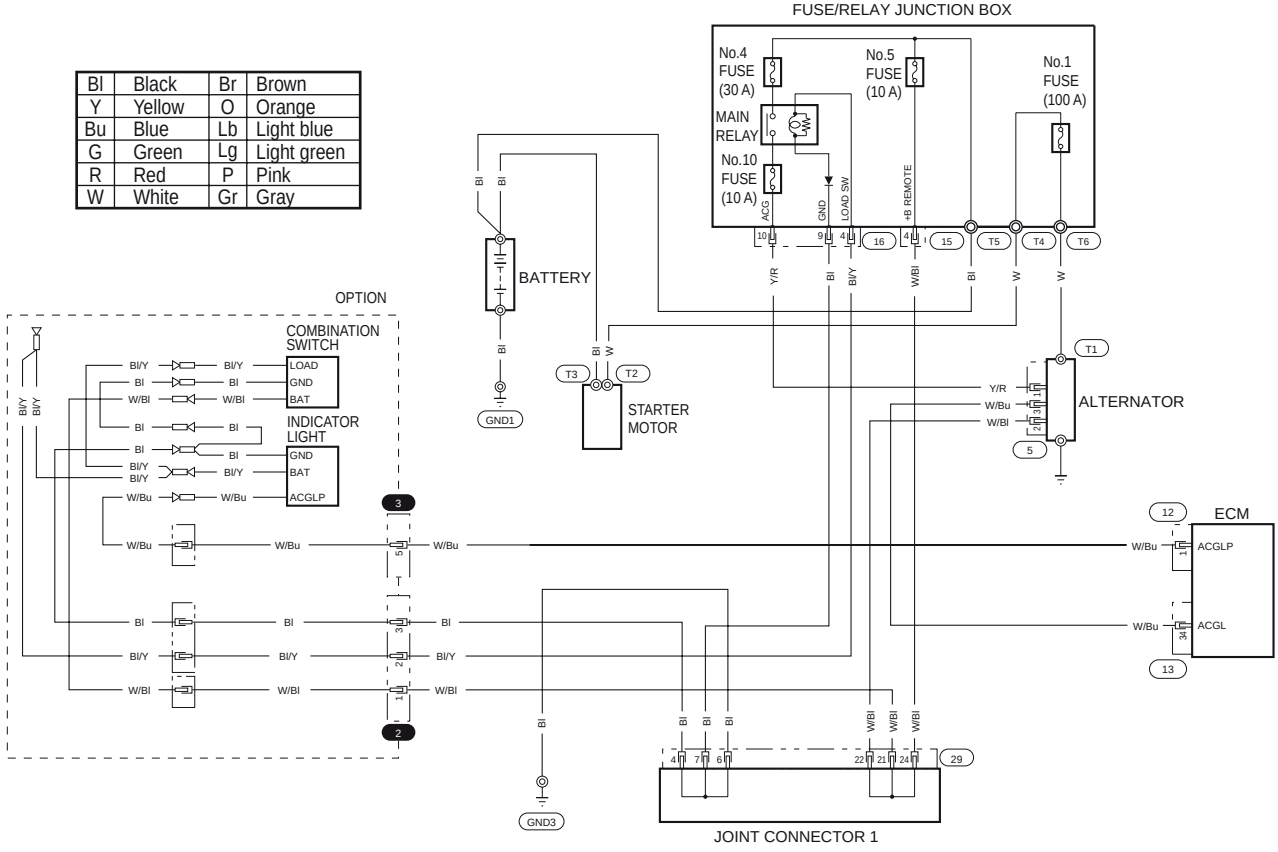
ALTERNATOR INSPECTION 7-20

SYSTEM LOCATION



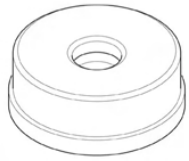
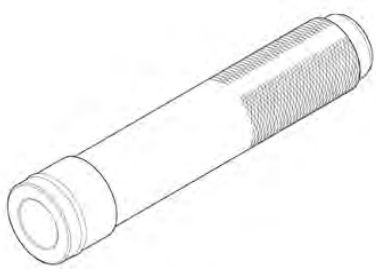
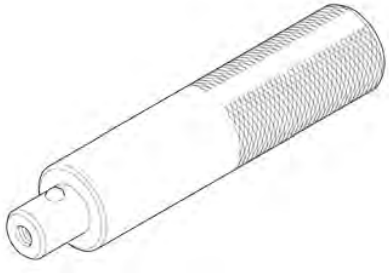
SYSTEM DIAGRAM

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



TOOLS

LIST

Attachment, 37 x 40 mm 07746-0010200 	Attachment, 52 x 55 mm 07746-0010400 	Attachment, 24 x 26 mm 07746-0010700 
Driver, 22 mm I.D. 07746-0020100 	Attachment, 15 mm I.D. 07746-0020200 	Pilot, 15 mm 07746-0040300 
Driver 07749-0010000 		

CHARGING SYSTEM TROUBLESHOOTING

BATTERY IS DAMAGED OR WEAK

1. Battery test

Remove the battery.

Check the battery condition using the commercially available battery tester.

Is the battery in good condition?

YES – GO TO STEP 2.

NO – Faulty battery

2. Fuse inspection

Check No.1 fuse (100 A) and No.10 fuse (10 A).

Is it normal?

YES – GO TO STEP 3.

NO – Battery connected incorrectly or reverse polarity.
- Check for short in the main wire harness
- Incorrect load by referring to the fuse load chart (page 4-14)
- Replace the blown fuse

3. Load Inspection

Check whether an excessive load is connected.

Is the load normal?

YES – GO TO STEP 4.

NO – Remove the load and recheck.

4. Alternator terminal inspection

Check the alternator B terminal and 4P connector (5) terminal for looseness and damage.

Is it normal?

YES – GO TO STEP 5.

NO – Connect the terminal and/or connector securely.

5. Alternator wire inspection

Check for open in the alternator wires.

Are they normal?

YES – GO TO STEP 6.

NO – Repair the open in the alternator wires.

6. Alternator belt inspection

Check the alternator belt for looseness and damage (page 3-8).

Is it normal?

YES – GO TO STEP 7.

NO – Adjust or replace the alternator belt (page 7-5).

7. Alternator inspection

Inspect the alternator (page 7-20).

Is it normal?

YES – Replace the IC regulator with a new one and recheck.

NO – Replace the faulty part (s).

ALTERNATOR REMOVAL/ INSTALLATION

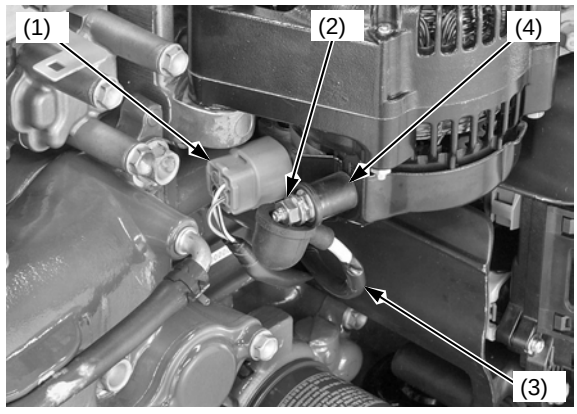
REMOVAL

Disconnect the battery negative (–) cable.

Remove the silencer duct (page 5-82).

Disconnect the 4P connector (1) from the alternator.

Remove the nut (2) and alternator fuse cable (3) from the alternator B terminal (4).

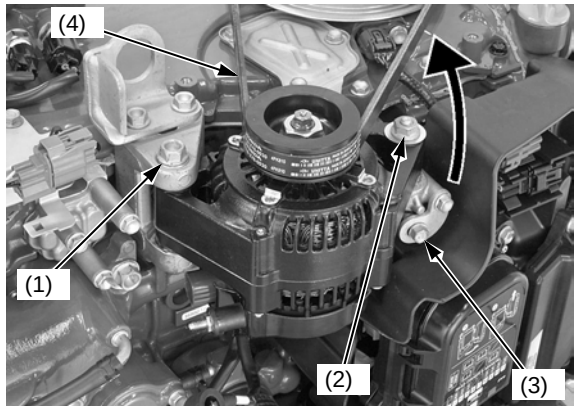


Loosen the bolt (1) and nut (2).

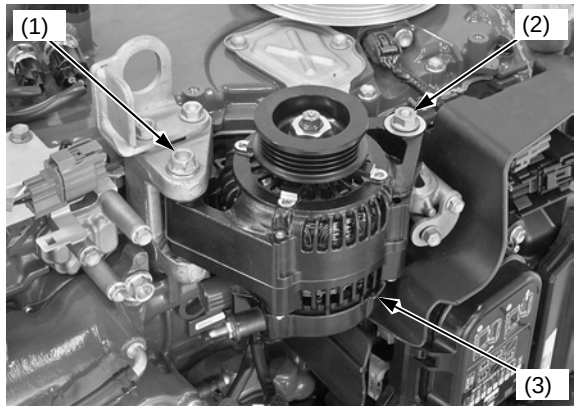
Loosen the special adjuster bolt (3).

Move the alternator to the engine side as far as it goes, and remove the alternator belt (4).

- Do not contaminate the alternator belt with oil and grease after removal.
- Do not bend the alternator belt. Store the belt by hanging it on the wall.



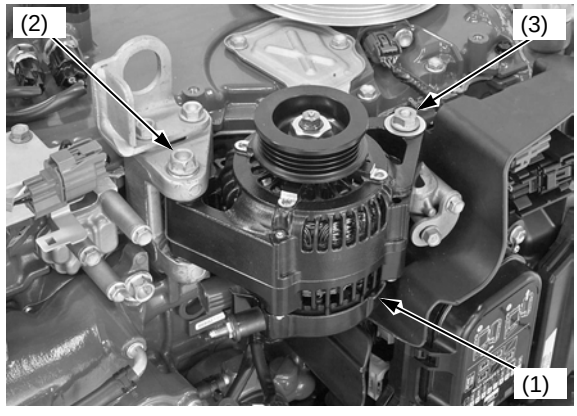
Remove the bolt (1), nut (2) and alternator (3).



INSTALLATION

Install the alternator (1) and loosely tighten the bolt (2).

Loosely install the nut (3).



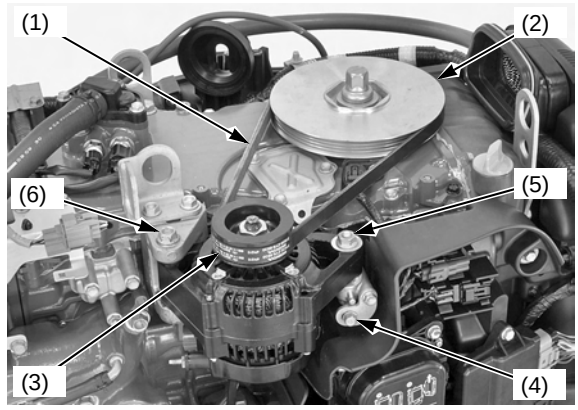
Install the alternator belt (1) to the crankshaft pulley (2), then alternator pulley (3).
Adjust the belt tension by turning the special adjuster bolt (4) (page 3-9).

- Do not turn the crankshaft pulley counterclockwise.

After adjusting the belt tension, tighten the nut (5) first, then the bolt (6) to the specified torque.

TORQUE:
Nut: 26 N·m (2.7 kgf·m, 19 lbf·ft)
Bolt: 44 N·m (4.5 kgf·m, 32 lbf·ft)

After tightening the nut and bolt, recheck the belt tension (page 3-8).



Set the alternator fuse cable (1) to the alternator B terminal (2) in the specified angle as shown.
Install and tighten the nut (3) to the specified torque.

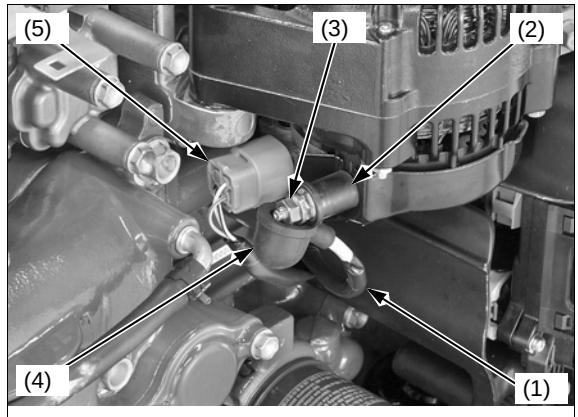
TORQUE: 8 N·m (0.82 kgf·m, 5.9 lbf·ft)

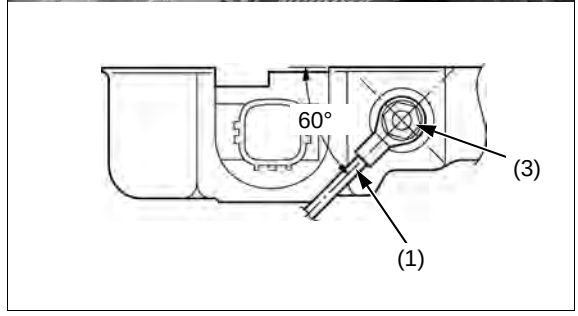
Install the terminal cover (4) to the alternator B terminal.

Connect the alternator 4P connector (5).

Install the silencer duct (page 5-82).

Connect the battery negative (–) cable.



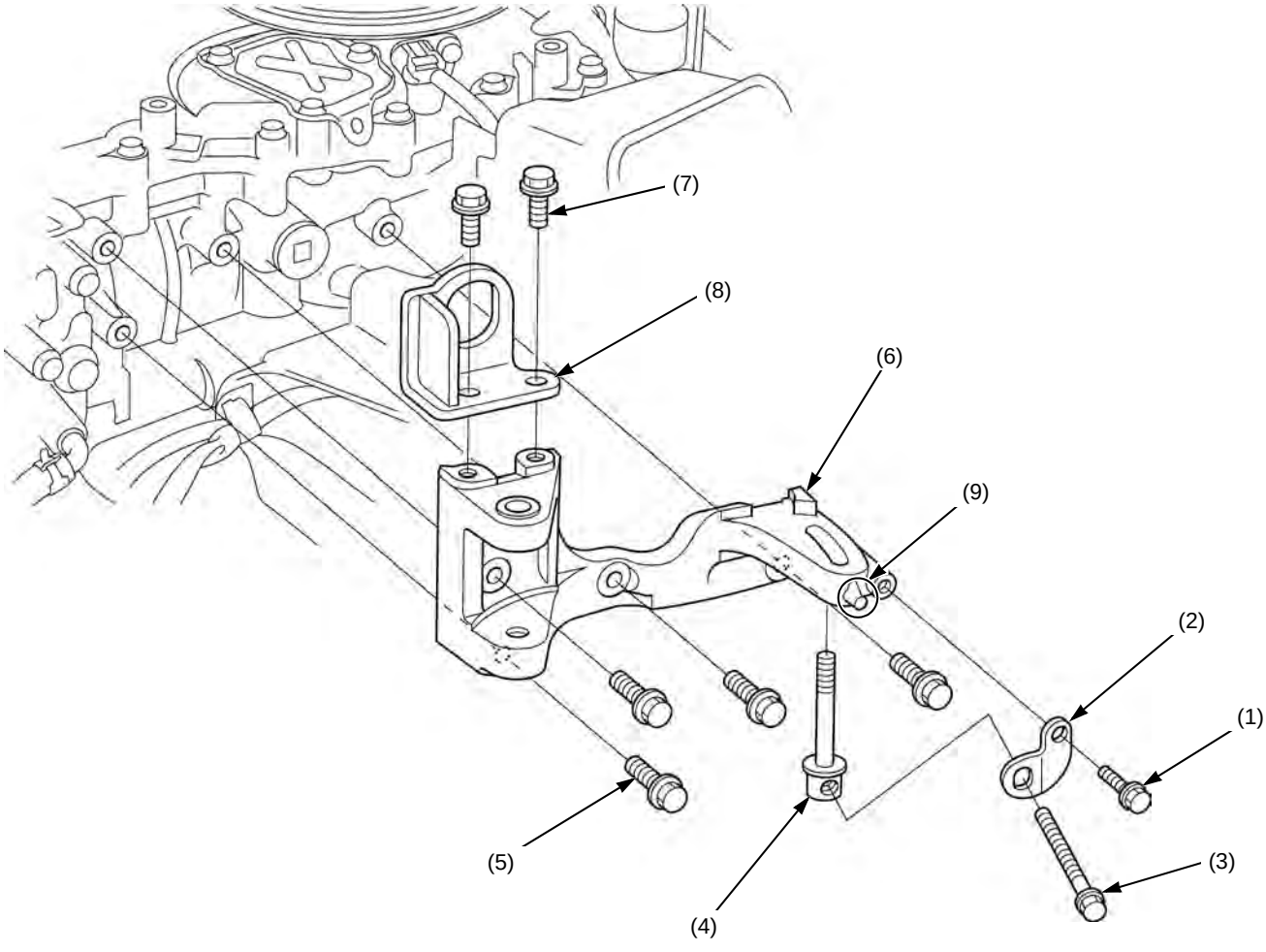


ALTERNATOR BRACKET REMOVAL/ INSTALLATION

Remove the flange bolt (6 × 16 mm) (1) and alternator stay (2).
Remove the special adjuster bolt (3) and tensioner bolt (4).
Remove the four bolts (8 × 28 mm) (5) and alternator bracket (6).
Remove the two bolts (8 × 20 mm) (7) and engine hanger B (8).

Installation is in the reverse order of removal.

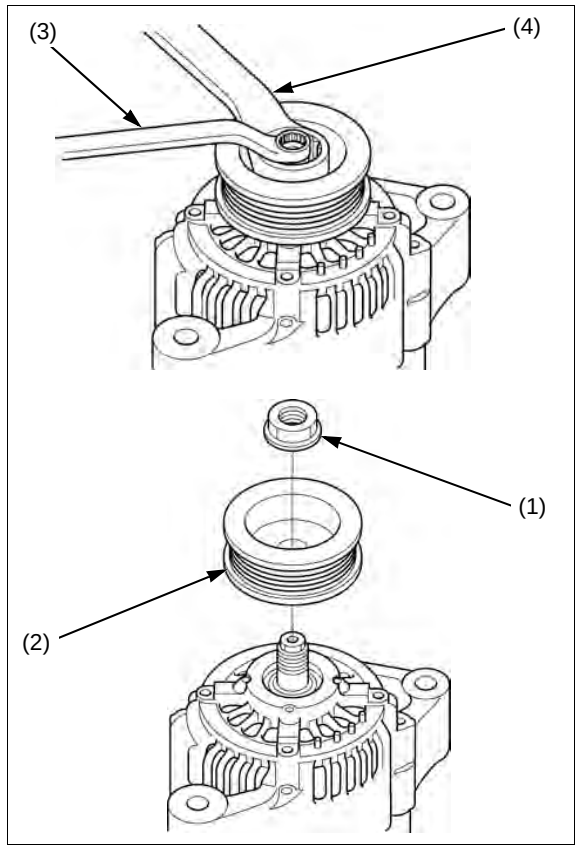
Tighten the bolts (6 × 16 mm) while pushing the alternator stay against the projection (9) of the alternator bracket.



ALTERNATOR DISASSEMBLY/ ASSEMBLY

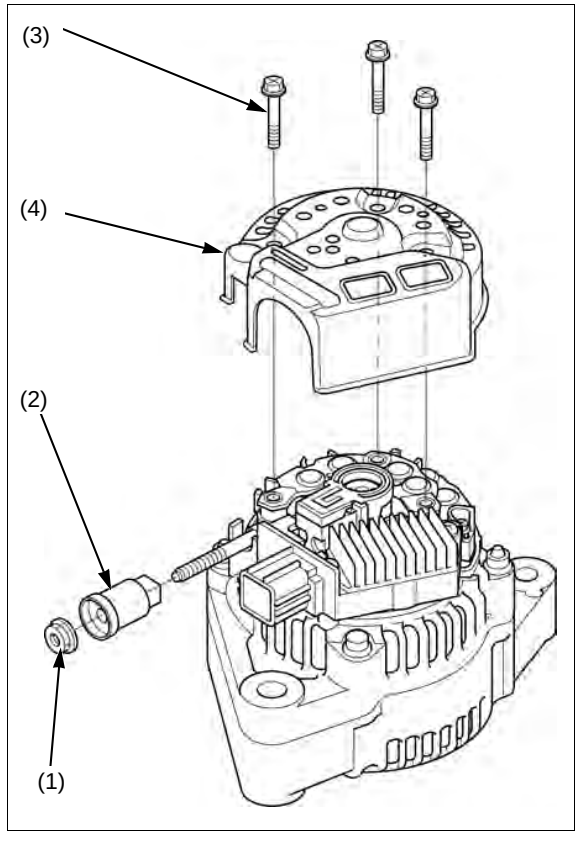
DISASSEMBLY

Remove the lock nut (1) and alternator pulley (2) using the two offset wrenches (10 mm (3) and 22 mm (4)) as shown.



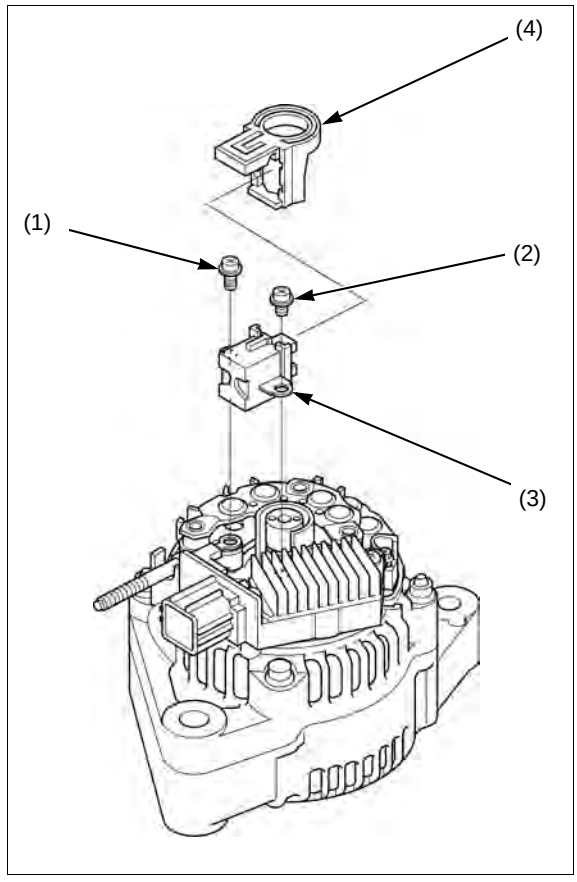
Remove the nut (1) and insulator bushing (2) from the alternator B terminal.

Remove the three rear end cover bolts (3) and rear end cover (4).

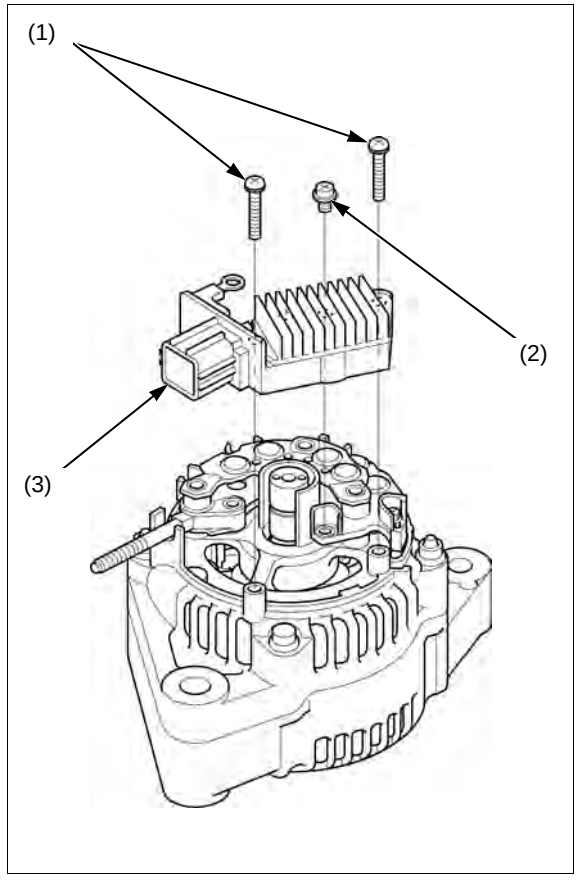


Remove the screw (4 x 8 mm) (1), screw (4 x 6 mm) (2), and brush holder (3).

Remove the brush holder insulator (4) from the brush holder.



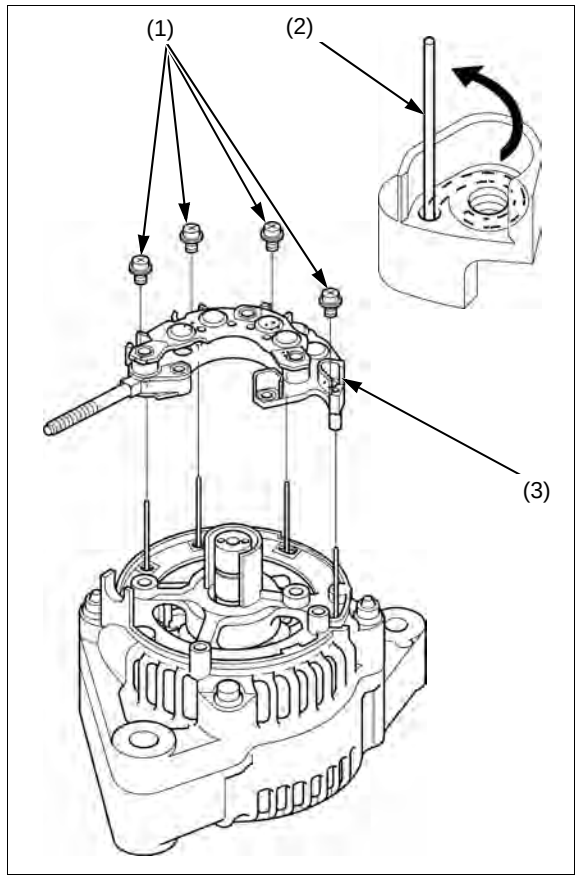
Remove the two screws (4 x 25 mm) (1), screw (4 x 6 mm) (2) and IC regulator (3).



Remove the four screws (1).

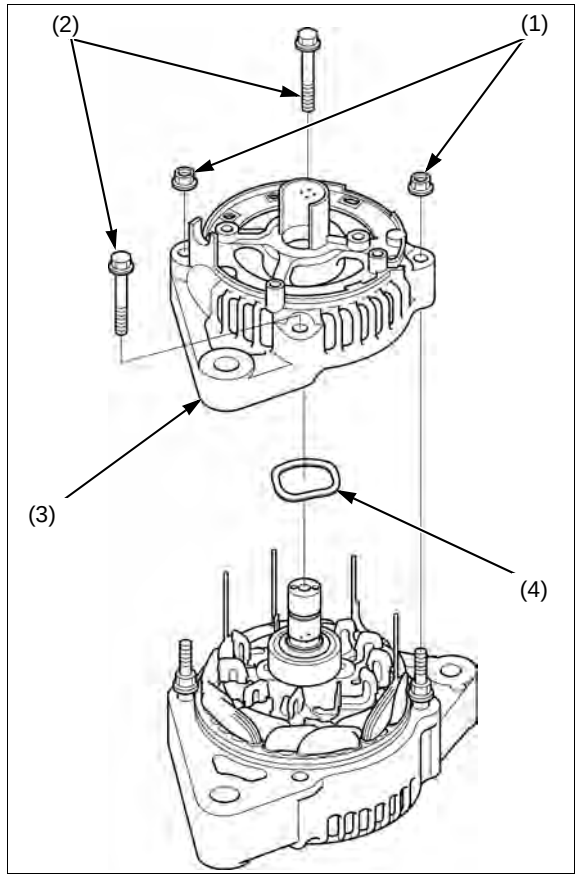
Straighten the four wires (2) as shown and remove the rectifier (3).

- Replace the stator with a new one, if the wires are broken around the rectifier holes.



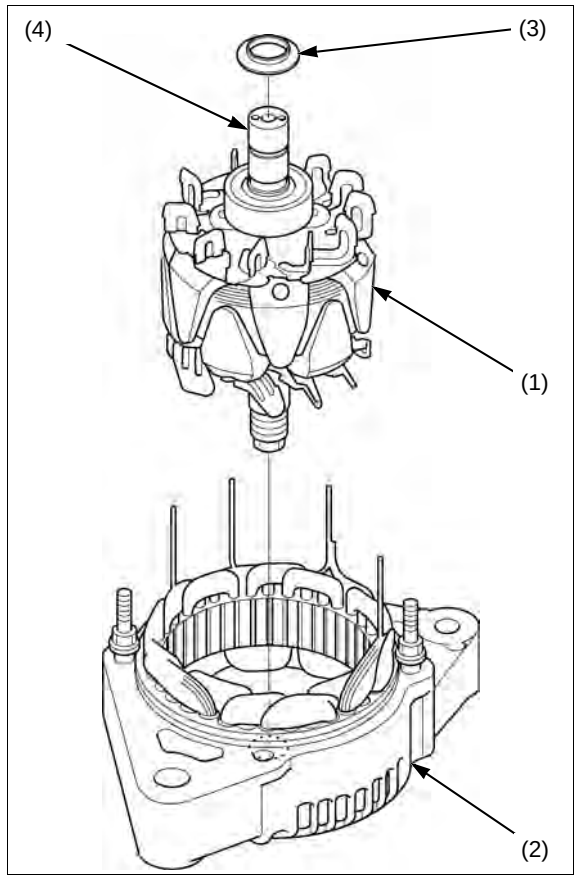
Remove the two nuts (1), two rear housing bolts (2) and rear housing (3).

Remove the wave washer (4).



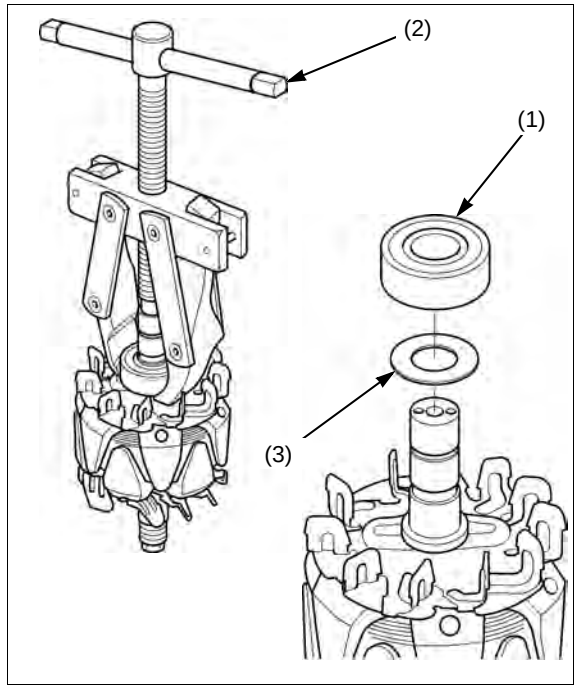
Remove the rotor (1) from the stator (drive end frame) (2).

Remove the bearing cover (3) from the rotor shaft (4).



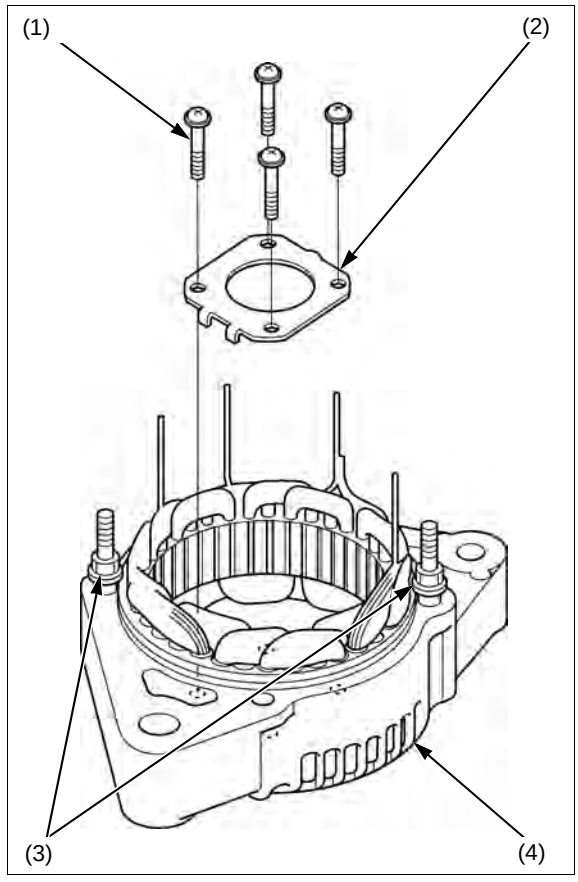
Before removing the rear bearing (1), check the bearing for abnormal play and replace if necessary.

Remove the rear bearing from the rotor using a commercially available bearing puller (2).
Remove the washer (3) from the rotor.



Remove the four screws (1) and bearing retainer plate (2).

Remove the two stud bolts (3) from the stator (4).



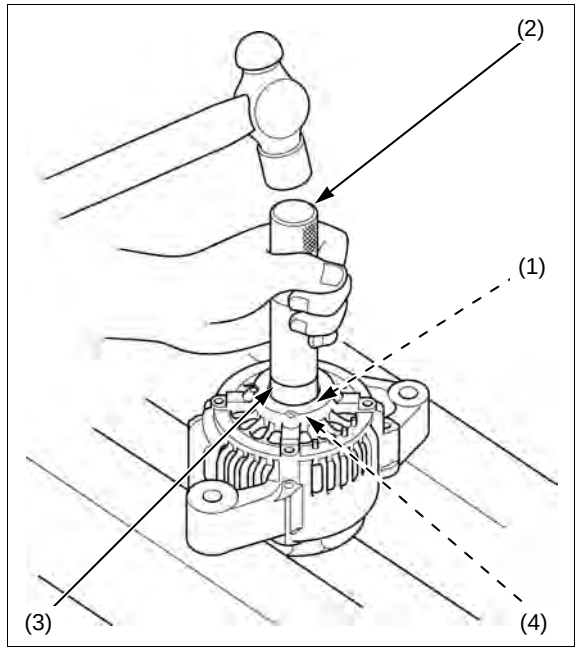
Before removing the front bearing (1), check the bearing for abnormal play and replace if necessary.

Support the stator housing in a vise, and drive out the front bearing using the special tools.

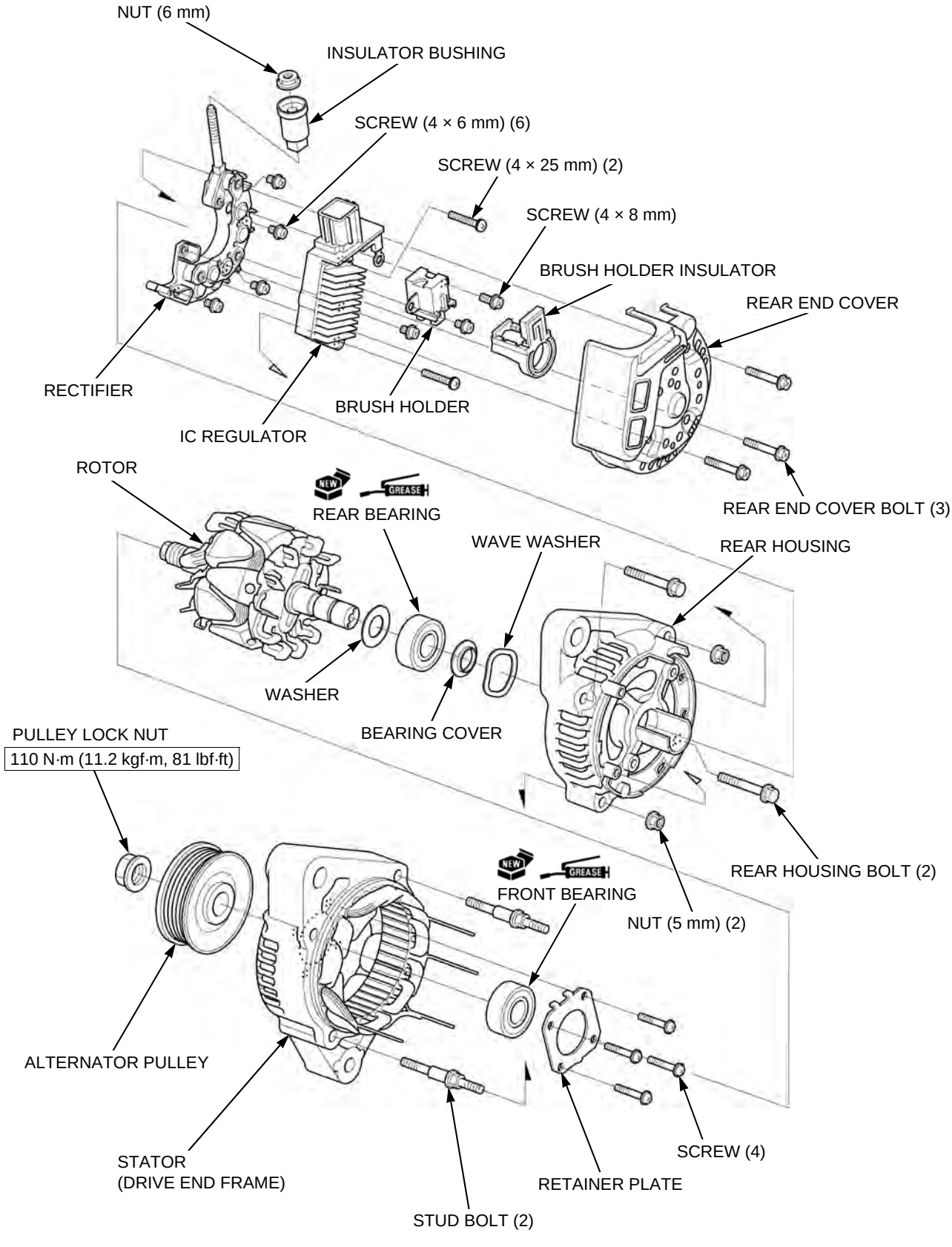
TOOLS:

Driver (2)	**07749-0010000**
Attachment, 24 × 26 mm (3)	**07746-0010700**
Pilot, 15 mm (4)	**07746-0040300**

Check the alternator parts (page 7-20).



EXPLODED VIEW



ASSEMBLY

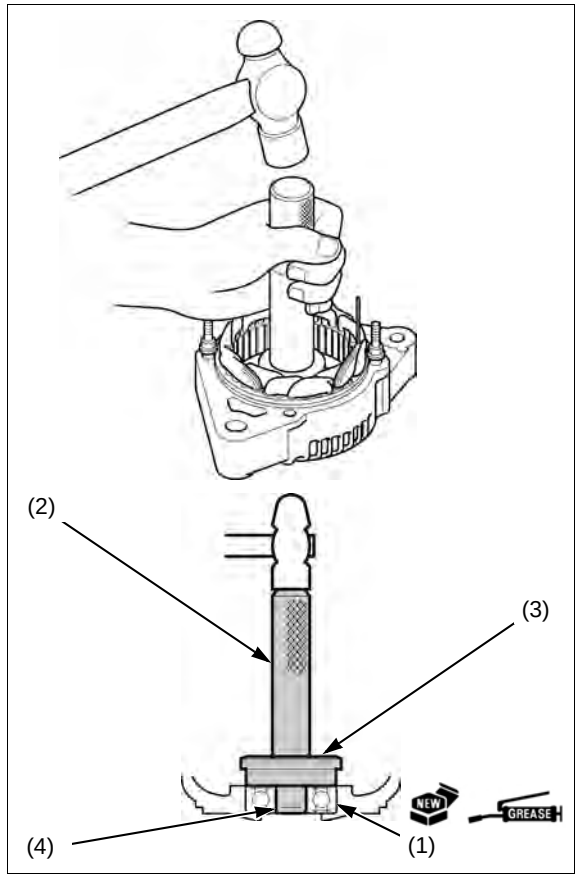
If the front bearing is removed, replace with a new bearing (1).

Apply grease to the outer circumference of the bearing.

Install a new front bearing in the stator (drive end frame) using the special tool as shown.

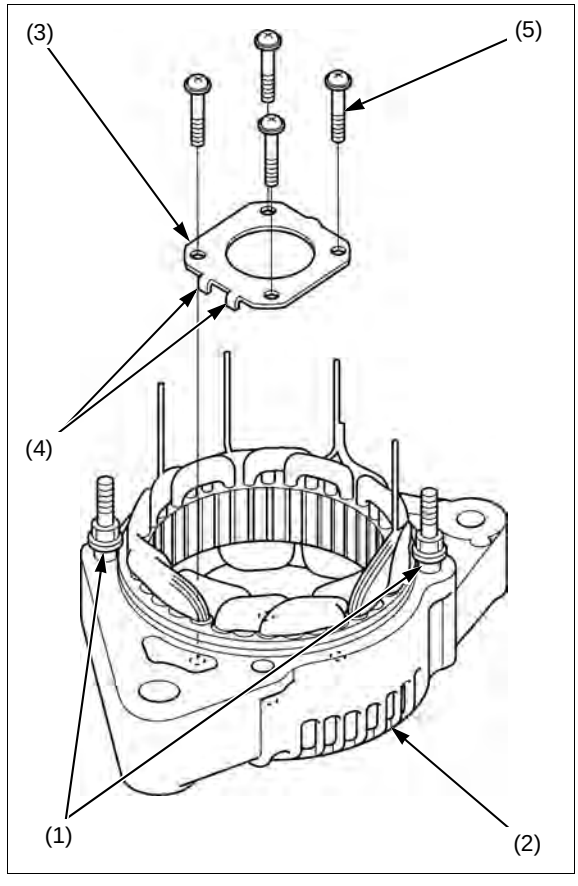
TOOLS:

Driver (2)	**07749-0010000**
Attachment, 37 x 40 mm (3)	**07746-0010200**
Pilot, 15 mm (4)	**07746-0040300**



Install the two stud bolts (1) to the stator (drive end frame) (2),

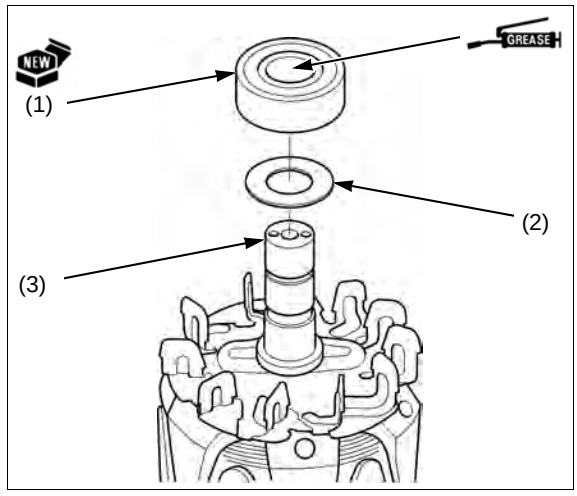
Install the front bearing retainer (3) with its tabs (4) facing the front bearing side and tighten the four screws (5).



If the rear bearing (1) is removed, replace it with a new one.

Install the washer (2) to the rotor shaft (3).

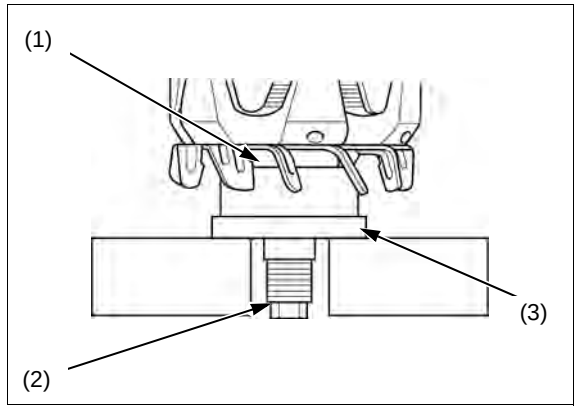
Apply grease to the inner surface of new bearing and install it to the rotor shaft.



Attach the special tool to the front bearing (1) side of the rotor shaft (2), then set the rotor to a hydraulic press.

TOOL:

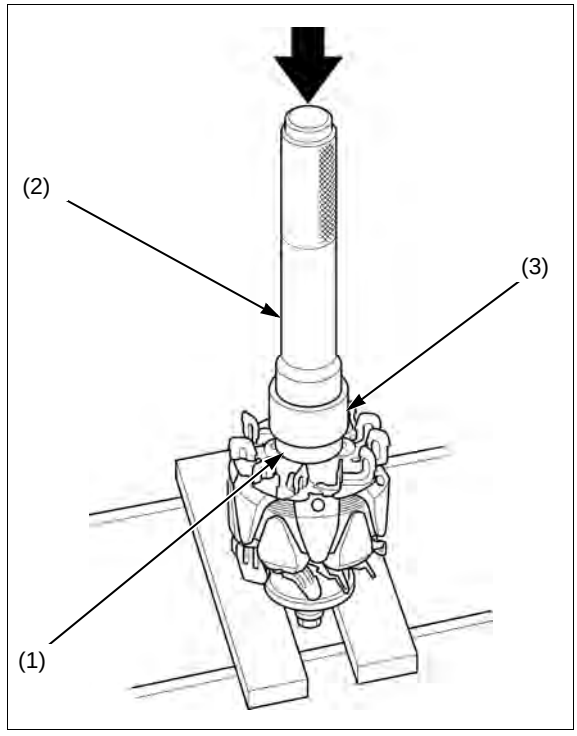
Attachment, 52 × 55 mm (3)	**07746-0010400**



Attach the special tool to the rear bearing (1) side and install the rear bearing and bearing cover to the rotor, using a hydraulic press.

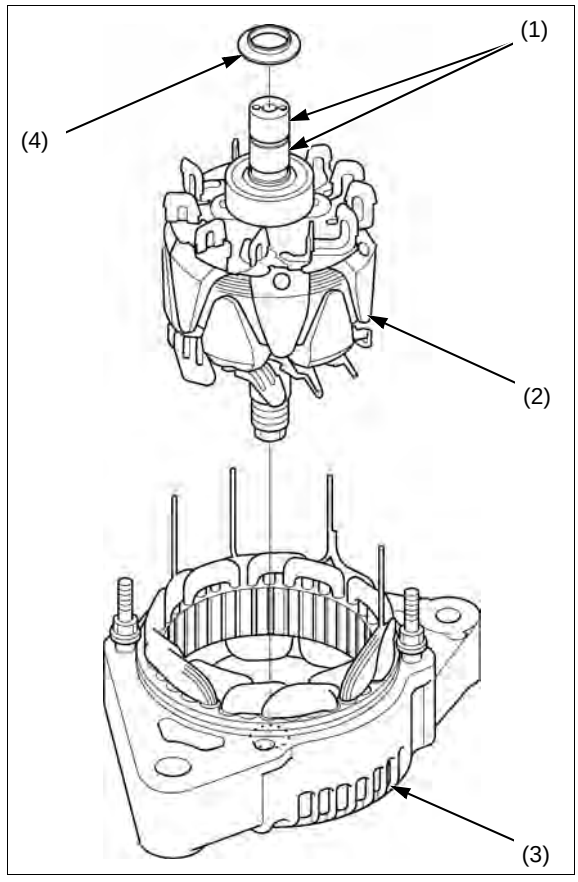
TOOLS:

Driver, 22 mm I.D. (2)	**07746-0020100**
Attachment, 15 mm I.D. (3)	**07746-0020200**



Clean the grease or oil from the slip ring (1) of the rotor using a shop towel.

Install the rotor (2) to the stator (drive end frame) (3). Install the bearing cover (4) onto the rotor shaft.



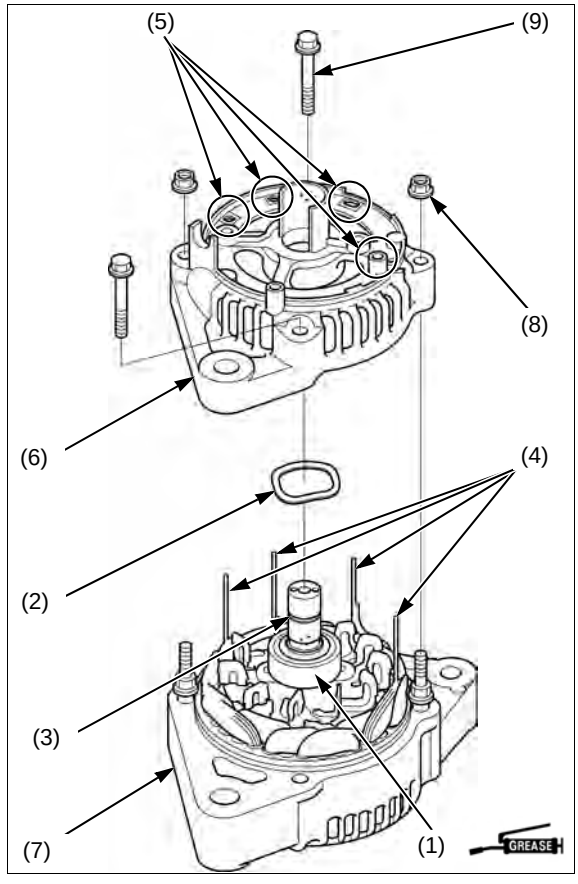
Apply grease to the outer circumference of the rear bearing (1).

Install the wave washer (2) to the rotor shaft (3).

- Be sure that the wave washer is positioned within the bearing circumference.

Route the four wires (4) through the rear housing holes (5), then install the rear housing (6) to the stator (drive end frame) (7).

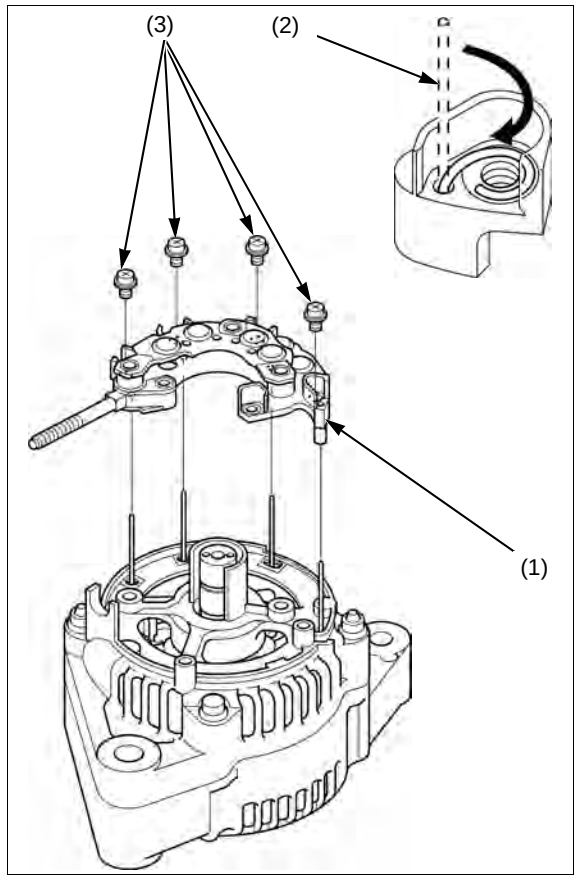
Install and tighten the two nuts (8) and two rear housing bolts (9).



Install the rectifier (1) and bend the wires (2) toward the rectifier and around the screw holes as shown.

Install and tighten the four screws (3).

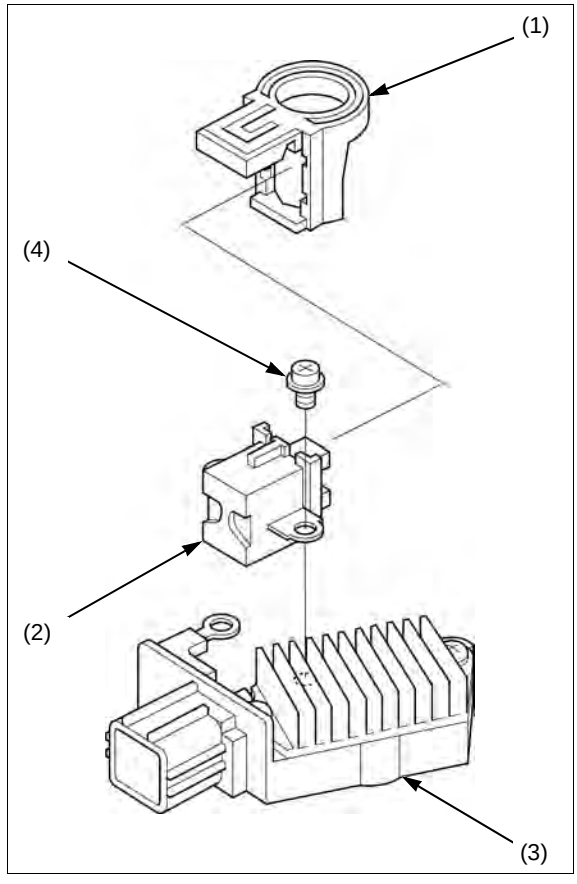
- Replace the stator with a new one, if the wires are broken around the rectifier holes.



Install the brush holder insulator (1) to the brush holder (2).

Install the IC regulator (3) and loosely tighten the screw (4 x 6 mm) (4).

- Tighten the screw so that the brush holder does not move.

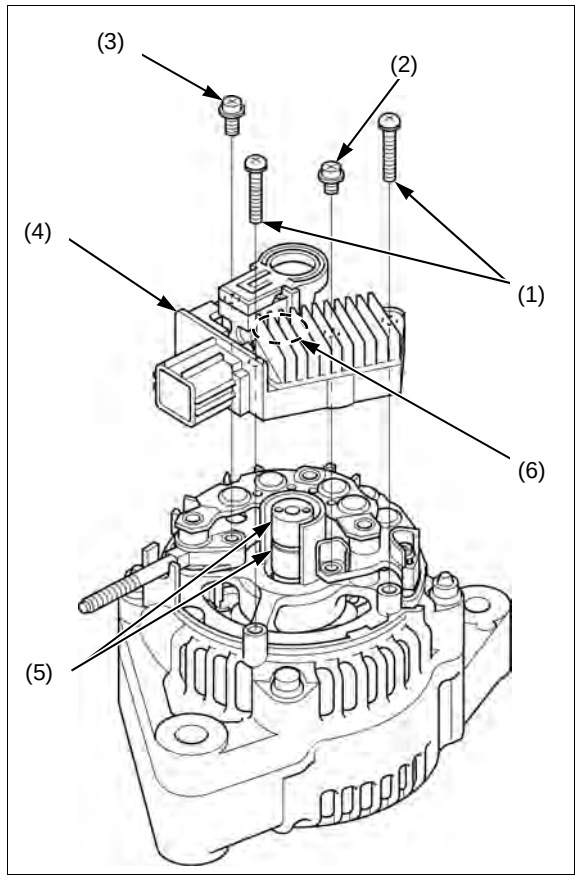


Tighten the two screws (4 × 25 mm) (1), screw (4 × 6 mm) (2) and screw (4 × 8 mm) (3) while slightly pushing the brush of IC regulator/brush holder (4) against the slip ring (5) of the rotor shaft.

Tighten the screw (4 × 6 mm) (6), which was installed in the previous step.

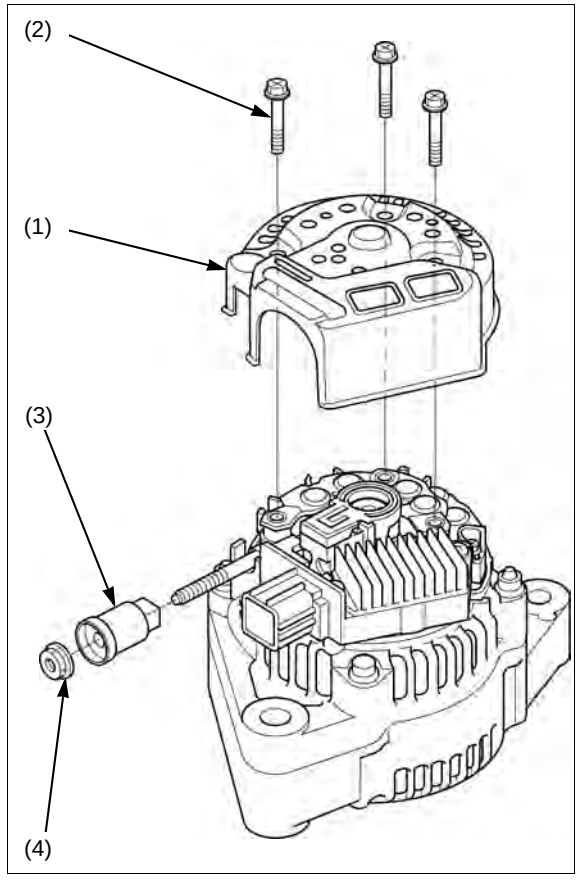
NOTICE

Take care not to damage the rotor shaft slip rings with the brush holder during installation.



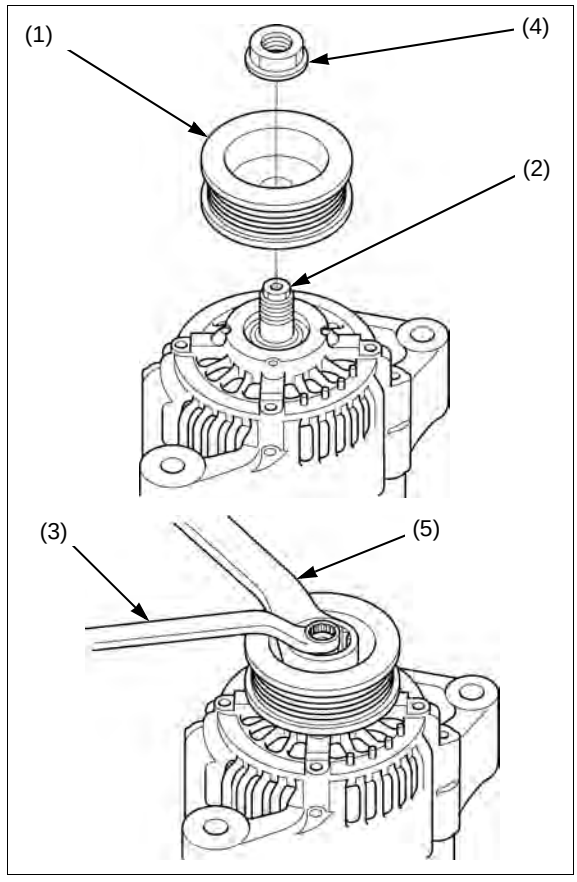
Install the rear end cover (1) and tighten the three bolts (2).

Install the insulator bushing (3) and tighten the nut (4).



Install the alternator pulley (1) and hold the rotor shaft (2) using a 10 mm wrench (3), then tighten the alternator pulley lock nut (4) using a 22 mm torque wrench (5).

TORQUE: 110 N·m (11.2 kgf·m, 81 lbf·ft)



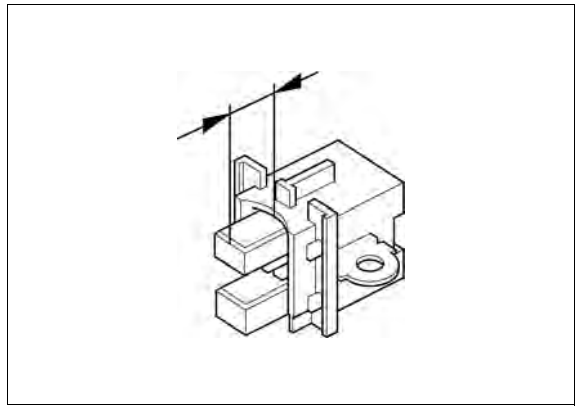
ALTERNATOR INSPECTION

BRUSH HOLDER ASSEMBLY

Measure the brush length.

STANDARD: 10.5 mm (0.41 in)
SERVICE LIMIT: 8.4 mm (0.33 in)

If the measurement is less than the service limit, replace the brush holder assembly.

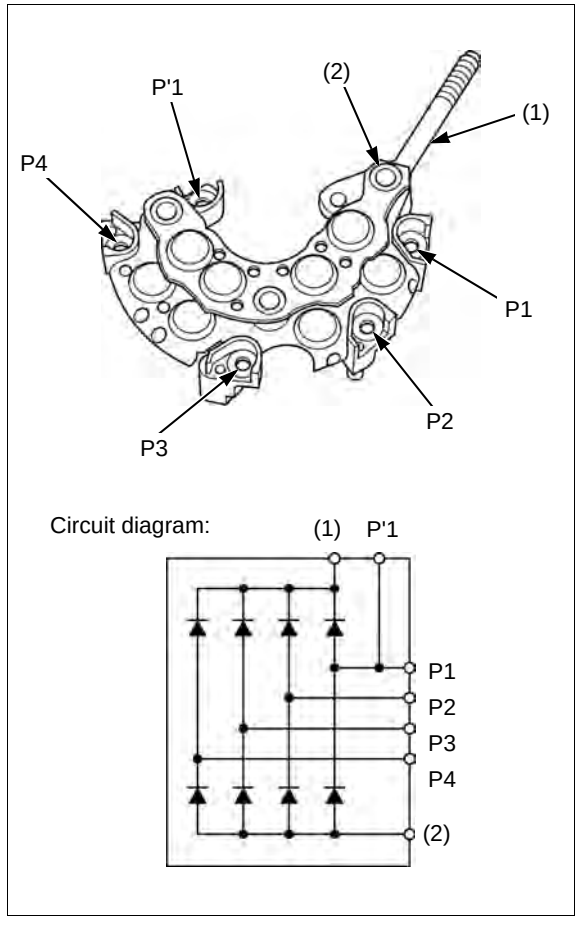


RECTIFIER ASSEMBLY

- Inspect the rectifier by removing it from the stator.

Check for continuity between the B terminal (1) and respective P terminals (P1, P2, P3, and P4), and between the E terminal (2) and respective P terminals (P1, P2, P3, and P4). Check for continuity in two directions by reversing the test leads.

There should be continuity only in one direction.
Replace the rectifier if necessary.



ROTOR

Check that there is continuity between the slip rings (1).

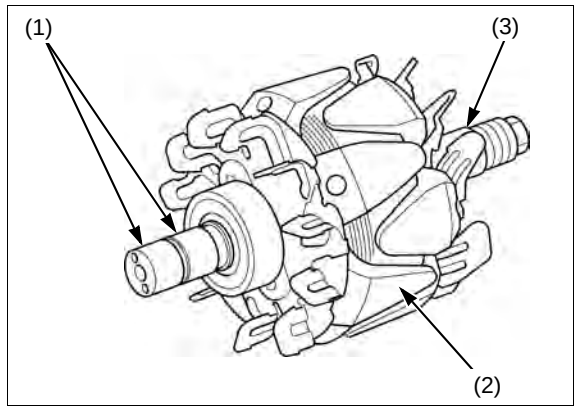
Check that there is no continuity between a slip ring and rotor (2), and between a slip ring and rotor shaft (3).

Replace the rotor if it is abnormal.

Measure the slip ring O.D.

STANDARD: 14.4 mm (0.57 in)
SERVICE LIMIT: 14.0 mm (0.55 in)

If the measurement is less than the service limit, replace the rotor.



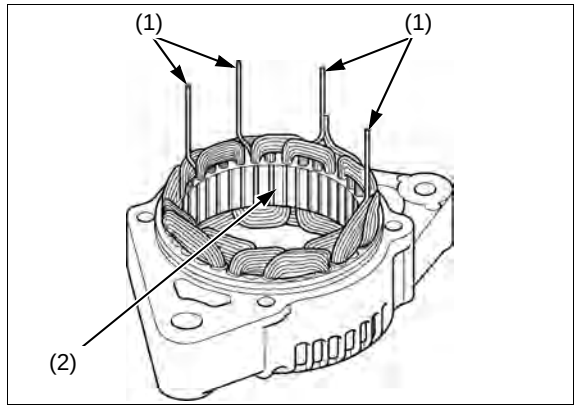
STATOR

- Inspect the stator by removing it from the alternator.

Check that there is continuity between the wires (1).

Check that there is no continuity between each wire and stator core (2).

Replace the stator if necessary.



MEMO

8. IGNITION SYSTEM

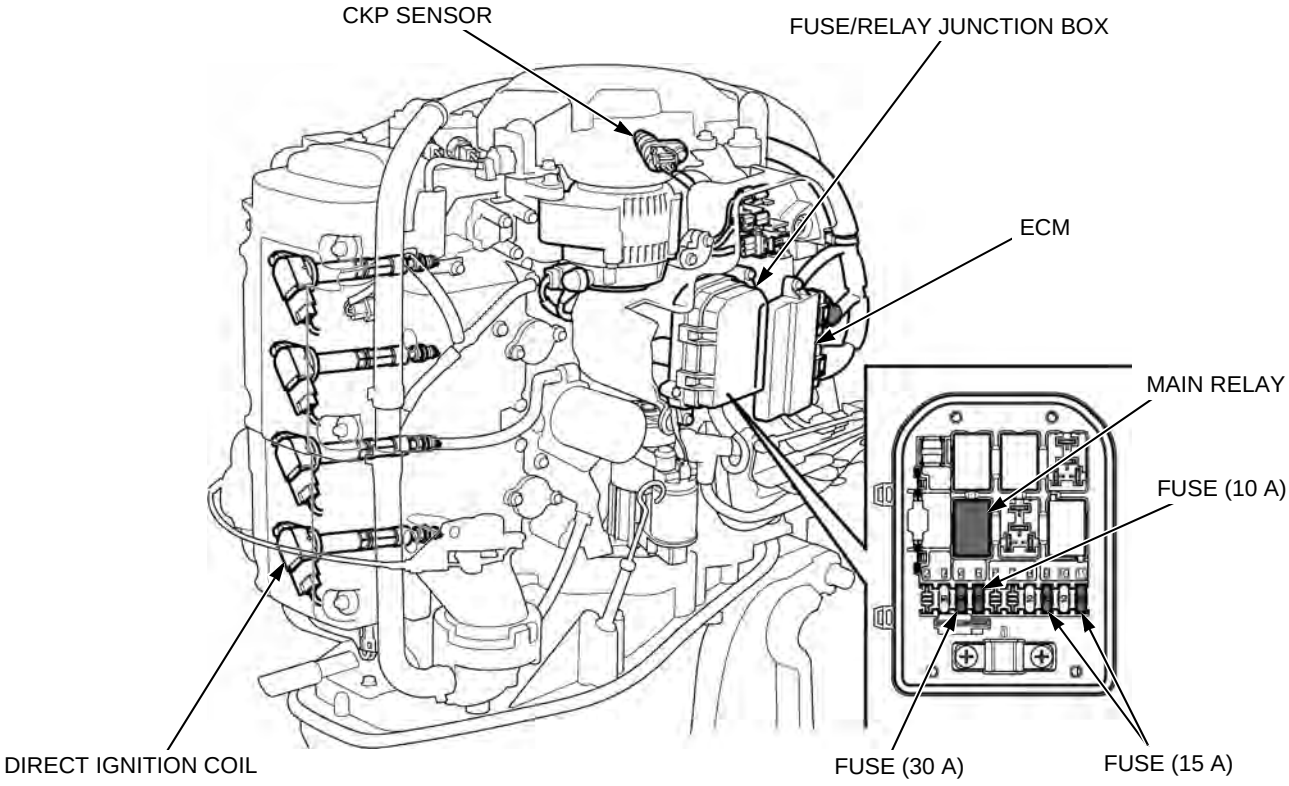
SYSTEM LOCATION 8-2

SYSTEM DIAGRAM 8-2

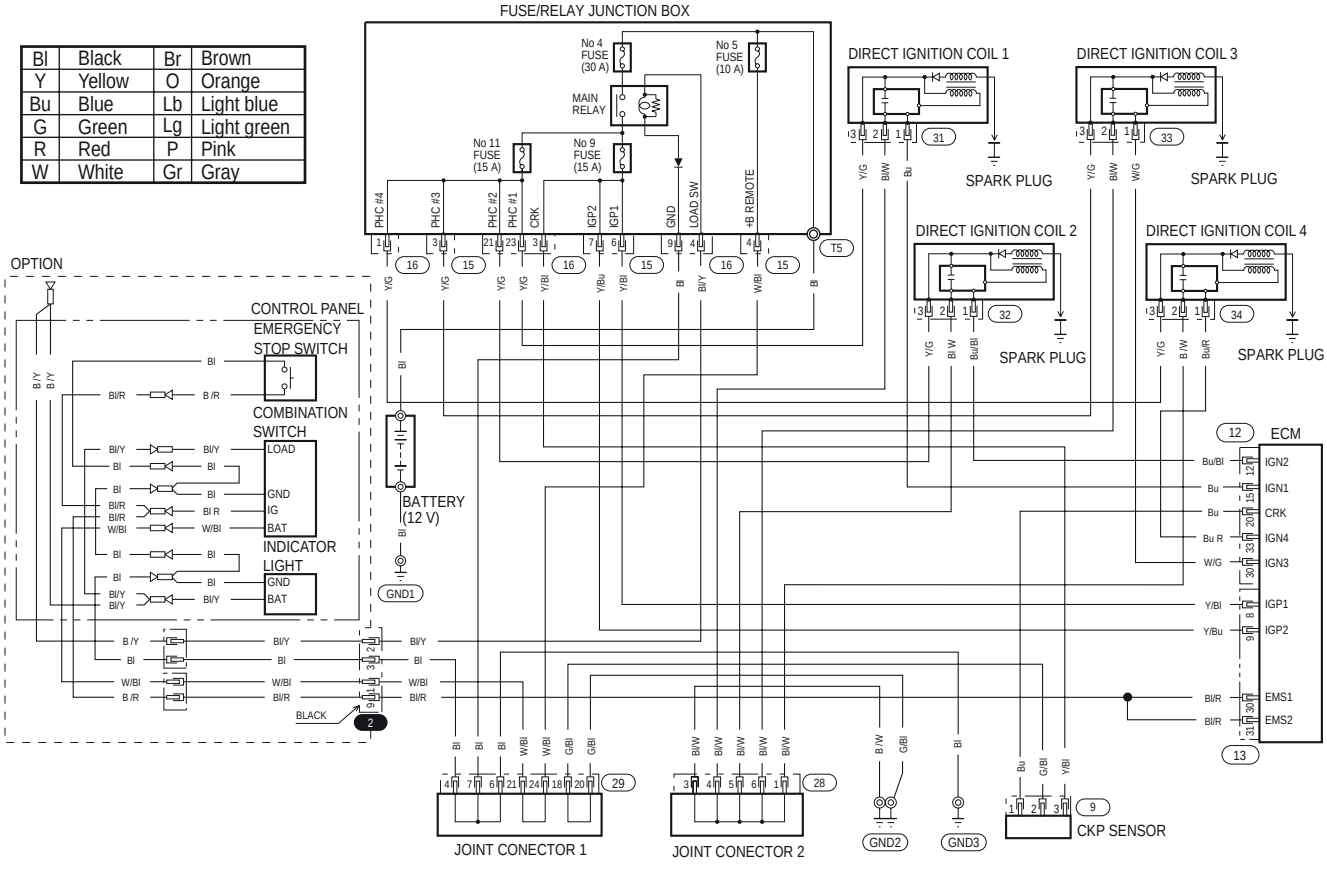
IGNITION SYSTEM TROUBLESHOOTING 8-3

SPARK TEST 8-4

SYSTEM LOCATION



SYSTEM DIAGRAM



IGNITION SYSTEM TROUBLESHOOTING

NO SPARK (S)

1. MIL inspection

Turn the combination switch ON and check that the MIL stays ON.

Does the MIL stay ON?

YES – PGM-FI troubleshooting (page 5-6).

NO – GO TO STEP 2.

2. Emergency stop switch clip inspection

Check the emergency stop switch clip.

Is the emergency stop switch clip connected?

YES – GO TO STEP 3.

NO – Set the clip securely.

3. Direct ignition coil inspection

Temporarily exchange the direct ignition coil with a known good direct ignition coil and perform the spark test.

Is there spark?

Sparks– Faulty original direct ignition coil

One plug has no spark – GO TO STEP 4.

All plugs have no sparks – GO TO STEP 5.

4. Direct ignition coil signal line open circuit inspection

Turn the combination switch OFF.
Disconnect the ECM connector A (12).

Check for open or short circuit between the direct ignition coil 3P connector main wire harness side No.1 terminal and ECM connector A (12) terminal of the same colors.

Is the circuit normal?

YES – GO TO STEP 6.

NO – Repair open or short in the main wire harness between the ECM and direct ignition coil.

5. Fuse inspection

Check for a blown No.11 (15 A) fuse.

Is the fuse blown?

YES – Replace the blown fuse and check for short in the main wire harness or incorrect load by referring to the fuse load chart (page 4-14).

NO – GO TO STEP 6.

6. Direct ignition coil power/ground line open circuit inspection

Turn the combination switch OFF.
Disconnect the direct ignition coil 3P connector (31) (32) (33) (34).

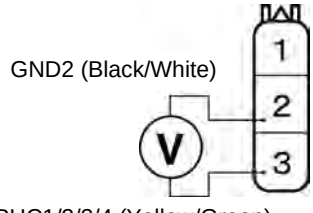
Turn the combination switch ON.
Measure the voltage at the direct ignition coil 3P connector (31) (32) (33) (34) main wire harness side No.2 (Black/White) terminal and No.3 (Yellow/Green) terminal.

Does battery voltage exist?

YES – GO TO STEP 7.

NO – Repair open in the Yellow/Green wire or Black/White wire.

DIRECT IGNITION COIL 3P CONNECTOR
MAIN WIRE HARNESS SIDE



7. Emergency stop switch signal line short circuit inspection

Disconnect the ECM connector A (12) and B (13).
Disconnect the switch panel cable 14P connector (2).

Check for continuity between the ECM connector B (13) main wire harness side No.30 (Black/Red) terminal, No.31 (Black/Red) terminal and engine ground.

Is there continuity?

YES – Repair short in the main wire harness between the remote control box and ECM.

NO – Replace the ECM with a new one and recheck.

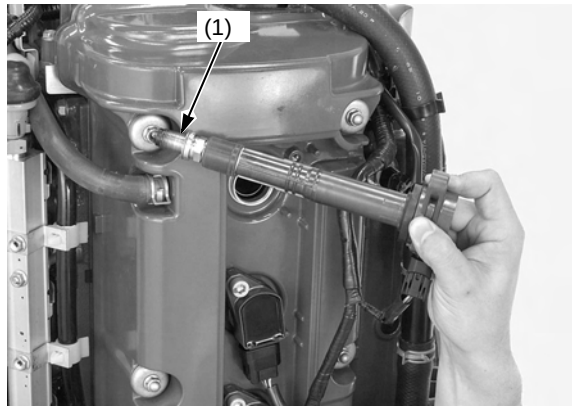
SPARK TEST

- Inspect the following before doing a spark test:
  – Faulty spark plug
  – Loose spark plug cap or direct ignition coil 3P connector connection
  – Water in the direct ignition coil cap (leaking the direct ignition coil secondary voltage)

Remove the direct ignition coil (page 3-17).
Connect the direct ignition coil 3P connector.

Connect a known-good spark plug (1) to the direct ignition coil and ground the spark plug to the cylinder head cover mounting nut.

Crank the engine with the starter motor and check whether sparks jump across the electrodes.



9. STARTING SYSTEM

SYSTEM LOCATION 9-2

SYSTEM DIAGRAM 9-2

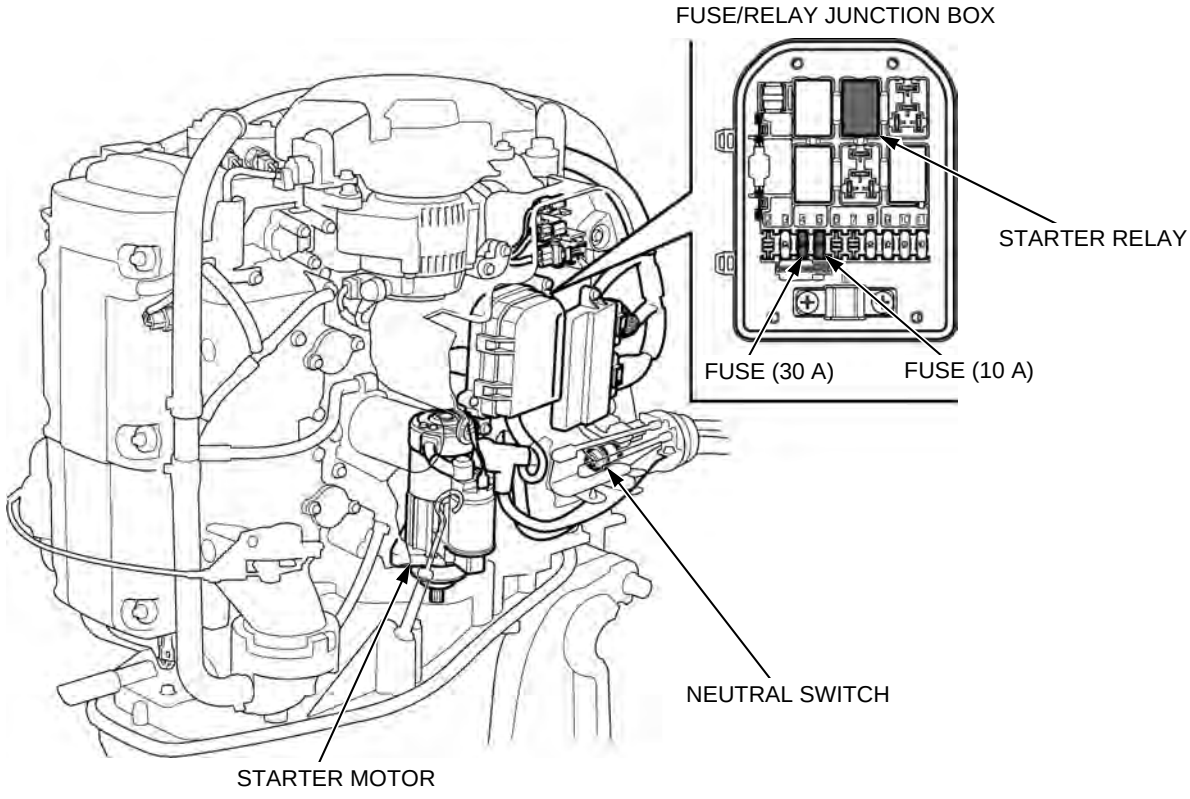
STARTING SYSTEM TROUBLESHOOTING 9-3

STARTER MOTOR REMOVAL/ INSTALLATION 9-5

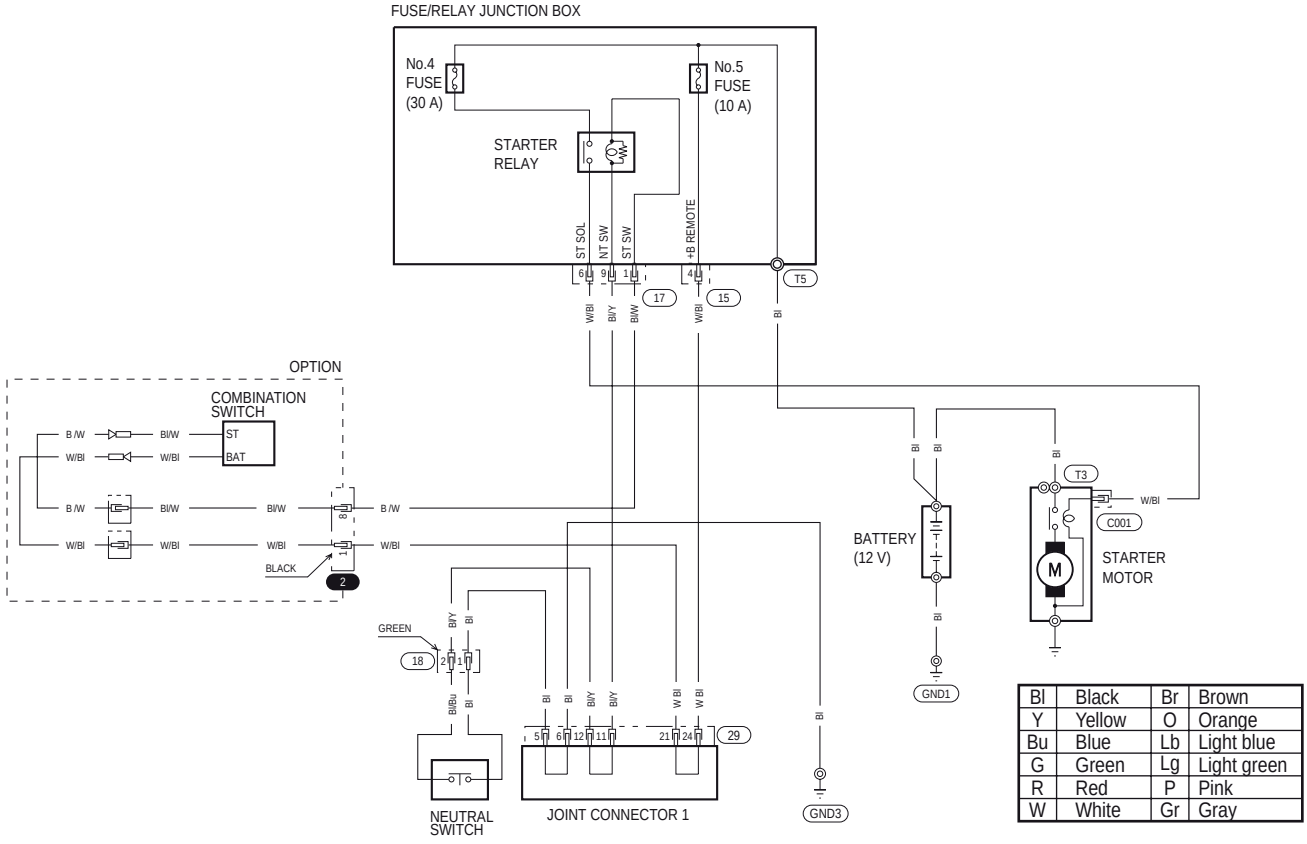
STARTER MOTOR DISASSEMBLY/ ASSEMBLY 9-6

STARTER MOTOR INSPECTION 9-15

SYSTEM LOCATION



SYSTEM DIAGRAM



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

STARTING SYSTEM TROUBLESHOOTING

STARTER MOTOR DOES NOT TURN

1. Standard inspection

Check the following:

– Battery condition
– Burned No.4 (30 A) fuse

Are the above items in good condition?

YES – GO TO STEP 2.

NO – Replace or repair the malfunctioning part (s).

2. Starter relay operation inspection

Turn the combination switch to the START position.
Check the operation of the starter relay switch.

Does the starter relay switch click?

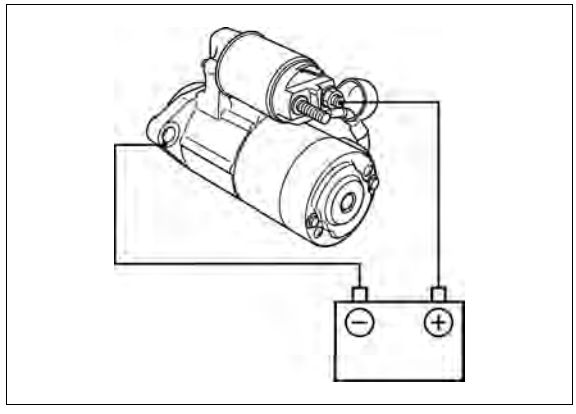
YES – GO TO STEP 3.

NO – GO TO STEP 4.

3. Starter motor inspection

Turn the combination switch OFF.
Remove the starter motor (page 9-5).

Apply battery voltage to the starter motor directly and check the operation (A large amount of current flows, so do not use a thin wire).



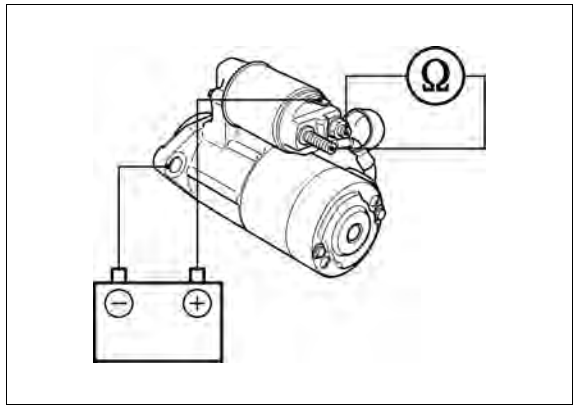
Does the starter motor turn?

YES – • Poorly connected starter motor cable
• Faulty starter magnetic switch

NO – Inspect the starter motor (page 9-15).

4. Starter magnetic switch inspection

Apply battery voltage to the starter magnetic switch S terminal and starter motor body.
Check for continuity at the starter motor B terminal and starter motor M terminal.



Is there continuity by connecting the battery?

YES – GO TO STEP 5.

NO – Faulty starter magnetic switch

5. Starter relay switch coil line open circuit inspection

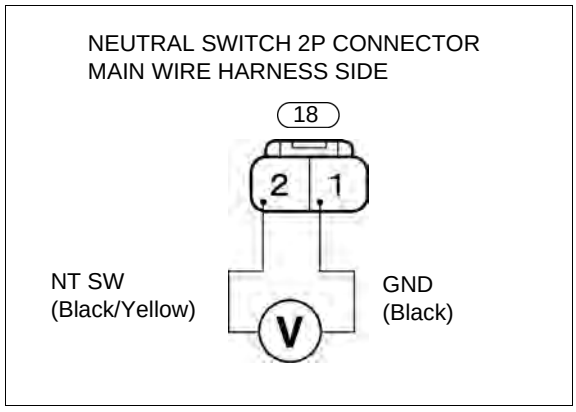
Disconnect the neutral switch 2P connector (18).

Turn the combination switch to the START position. Measure the voltage at the neutral switch 2P connector (18) main wire harness side No.2 (Black/yellow) terminal and No.1 (Black) terminal.

Does battery voltage exist?

YES – Faulty neutral switch.

NO – GO TO STEP 6.



6. Combination switch open circuit inspection

Turn the combination switch OFF.

Disconnect the switch panel cable 14P connector (2).

Turn the combination switch to START position.

Check for the continuity at the switch panel cable 14P connector (2) combination switch side No.1 (White/Black) terminal and No.8 (Black/White) terminal.

Is there continuity?

YES – GO TO STEP 7.

NO – • Repair the open circuit in the combination switch wire.
• Replace the combination switch with a new one and recheck.

7. Starter relay inspection

Inspect the starter relay (page 10-13).

Is the starter relay normal?

YES – GO TO STEP 8.

NO – Replace the starter relay with a new one and recheck.

8. Fuse/relay junction box inspection

Inspect the fuse/relay junction box starter relay circuit (page 10-14).

Is the fuse/relay junction box normal?

YES – Repair the open circuit in the main wire harness.

NO – Replace the fuse/relay junction box with a new one and recheck.

STARTER MOTOR TURNS SLOWLY

- Low battery voltage
- Poorly connected battery cable terminal
- Poorly connected starter motor cable
- Faulty starter motor
- Poorly connected battery ground cable
- Incorrect engine oil viscosity

STARTER MOTOR TURNS, BUT ENGINE DOES NOT TURN

- Faulty starter overrunning clutch
- Damaged or faulty starter planetary gear

STARTER RELAY SWITCH "CLICKS", BUT ENGINE DOES NOT TURN

- Crankshaft does not turn due to engine problems

STARTER MOTOR REMOVAL/ INSTALLATION

Disconnect the battery negative (–) terminal.

Remove the electric parts case (page 10-5).

Disconnect starter motor S terminal (1) from the starter solenoid (2).

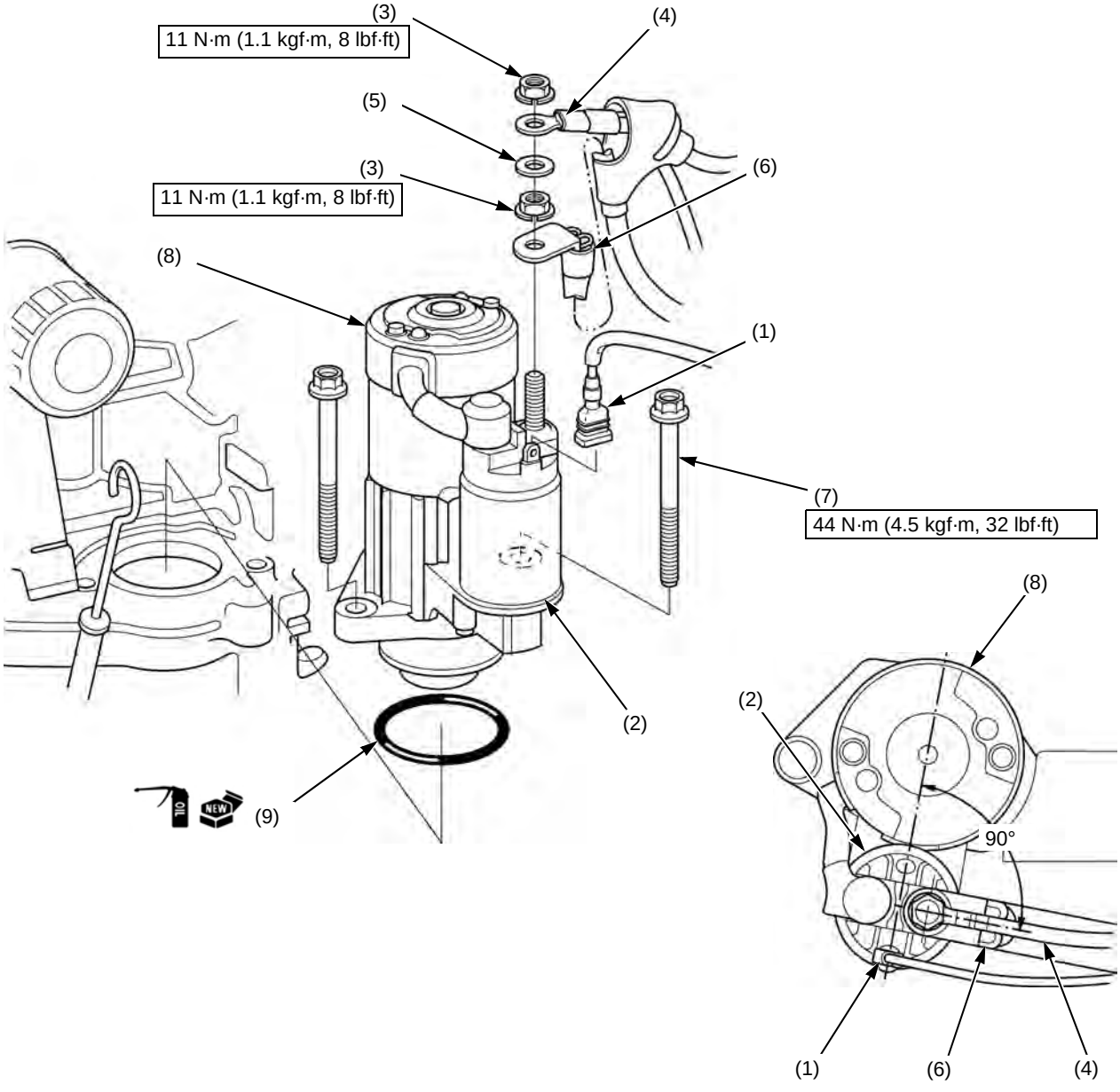
Remove the two nuts (3), alternator fuse cable (4), washer (5) and starter cable (6) from the starter solenoid.

Remove the two bolts (10 x 90 mm) (7) and starter motor (8).

Remove the O-ring (59.4 x 3.1 mm) (9) from the starter motor.

Installation is in the reverse order of removal.

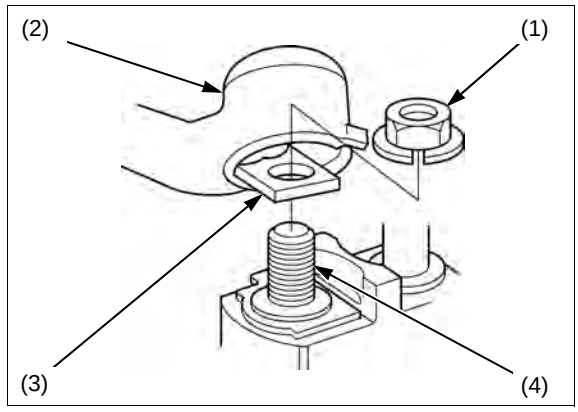
- Replace the O-ring with a new one and coat it with engine oil.
- Install the starter cable and alternator fuse cable as shown direction.



STARTER MOTOR DISASSEMBLY/ ASSEMBLY

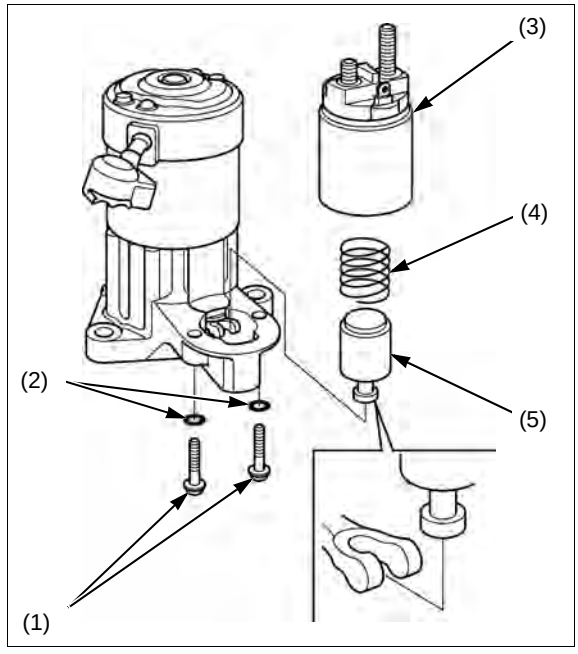
DISASSEMBLY

Remove the nut (1) by pulling off the terminal cover (2) and disconnect the motor wire (3) from the M terminal (4).



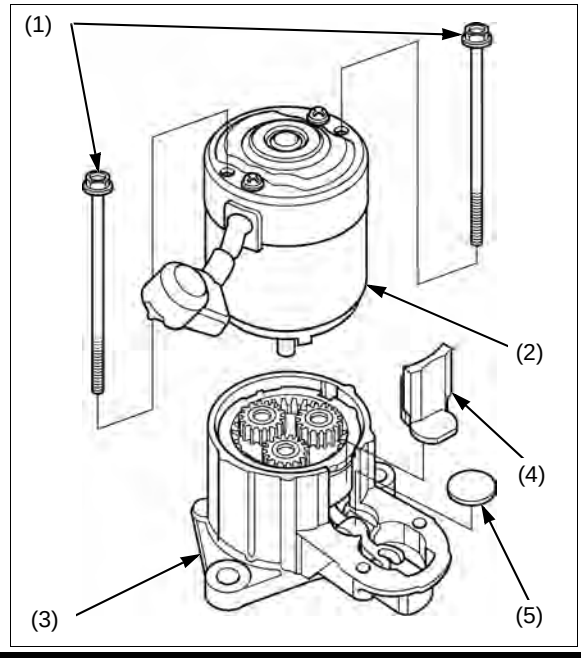
Remove the two screws (1) and two O-rings (2).

Remove the starter solenoid (3), spring (4) and plunger (5).

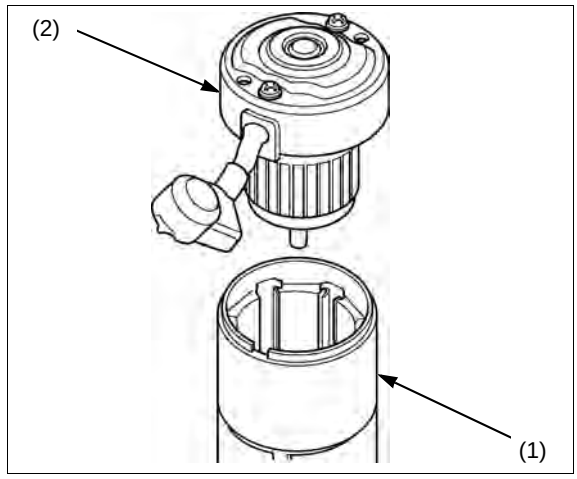


Remove the two bolts (1) and yoke/rear bracket (2) from the front bracket (3).

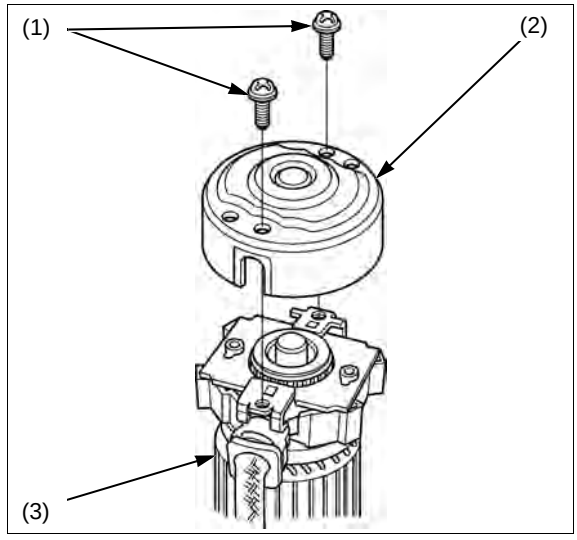
Remove the packing (4) and plate (5).



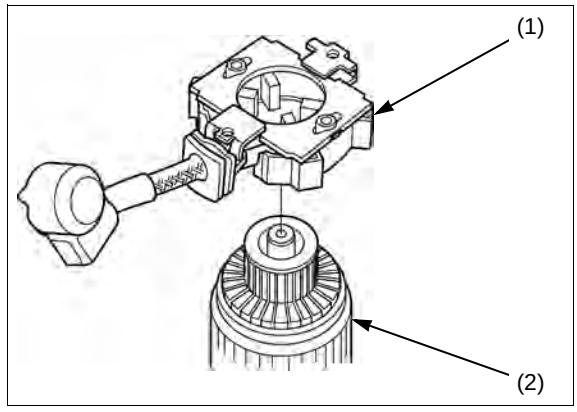
Remove the yoke (1) from the armature/rear bracket assembly (2).



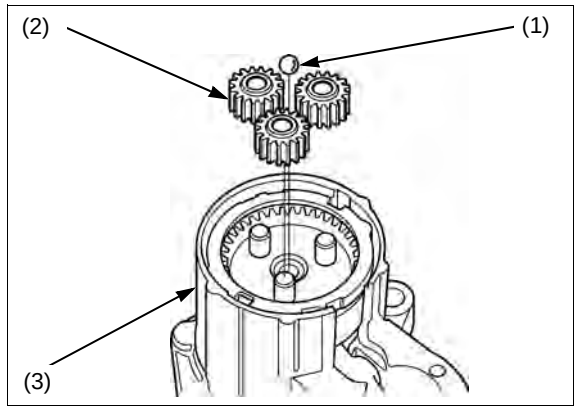
Remove the two screws (1) and rear bracket (2) from the armature (3).



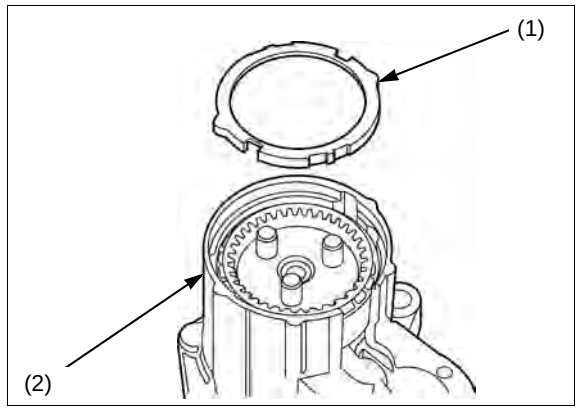
Remove the brush holder (1) from the armature (2).



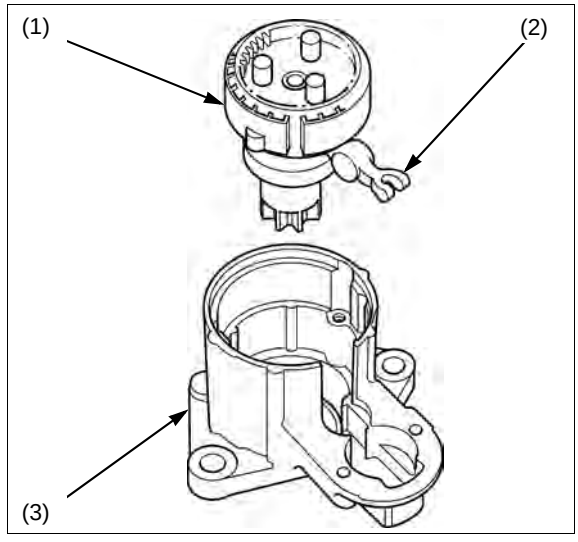
Remove the steel ball (1) and three planetary gears (2) from the front bracket (3).



Remove the packing (1) from the front bracket (2).



Remove the overrunning clutch (1) and clutch fork (2) from the front bracket (3).



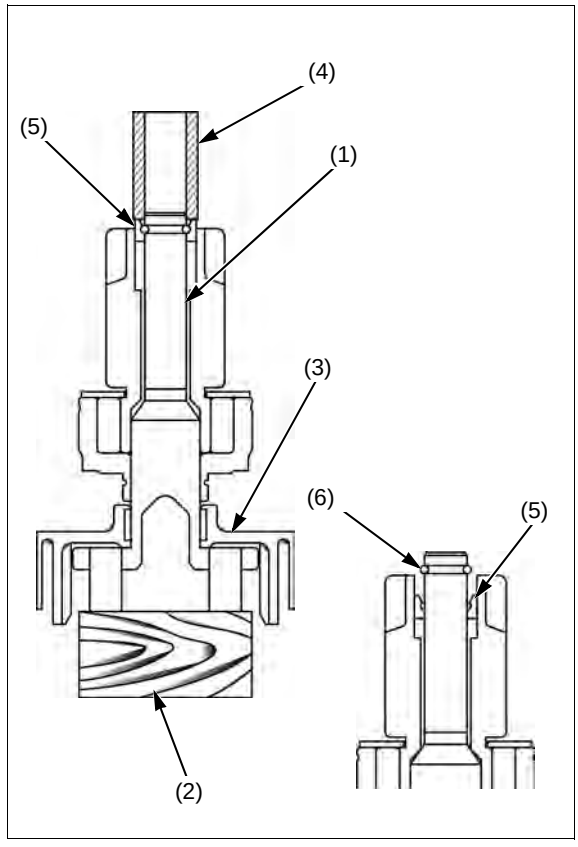
Secure the gear shaft (1) by placing a wood block (2) under the gear shaft assembly, taking care not to touch the internal gear (3).

Prepare a pipe (4) of the following dimensions.

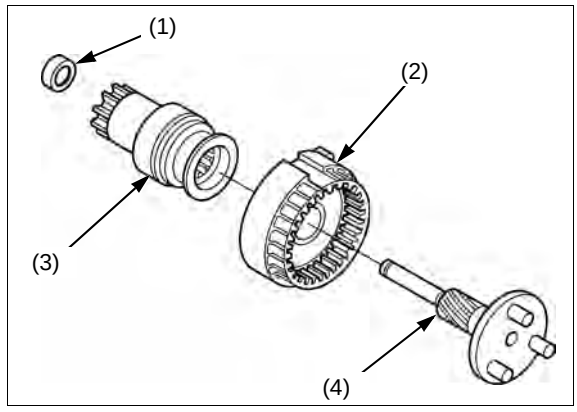
- I.D.: approx. 11 mm (0.4 in)
  O.D.: approx. 15 mm (0.6 in)
  LENGTH: approx. 20 mm (0.8 in)

Set the pipe on the gear shaft stopper (5) and drop the gear shaft stopper into the overrunning clutch by tapping on the pipe.

Remove the snap ring (6) using a screwdriver or equivalent tool.

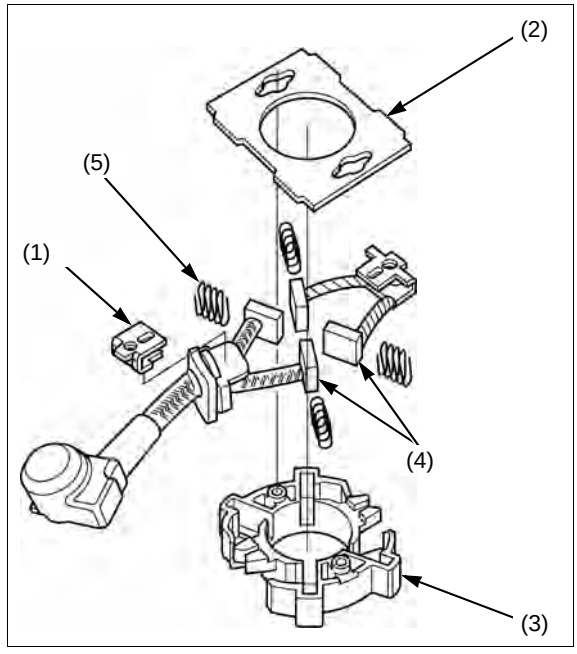


Remove the gear shaft stopper (1), internal gear (2) and overrunning clutch (3) from the gear shaft (4).



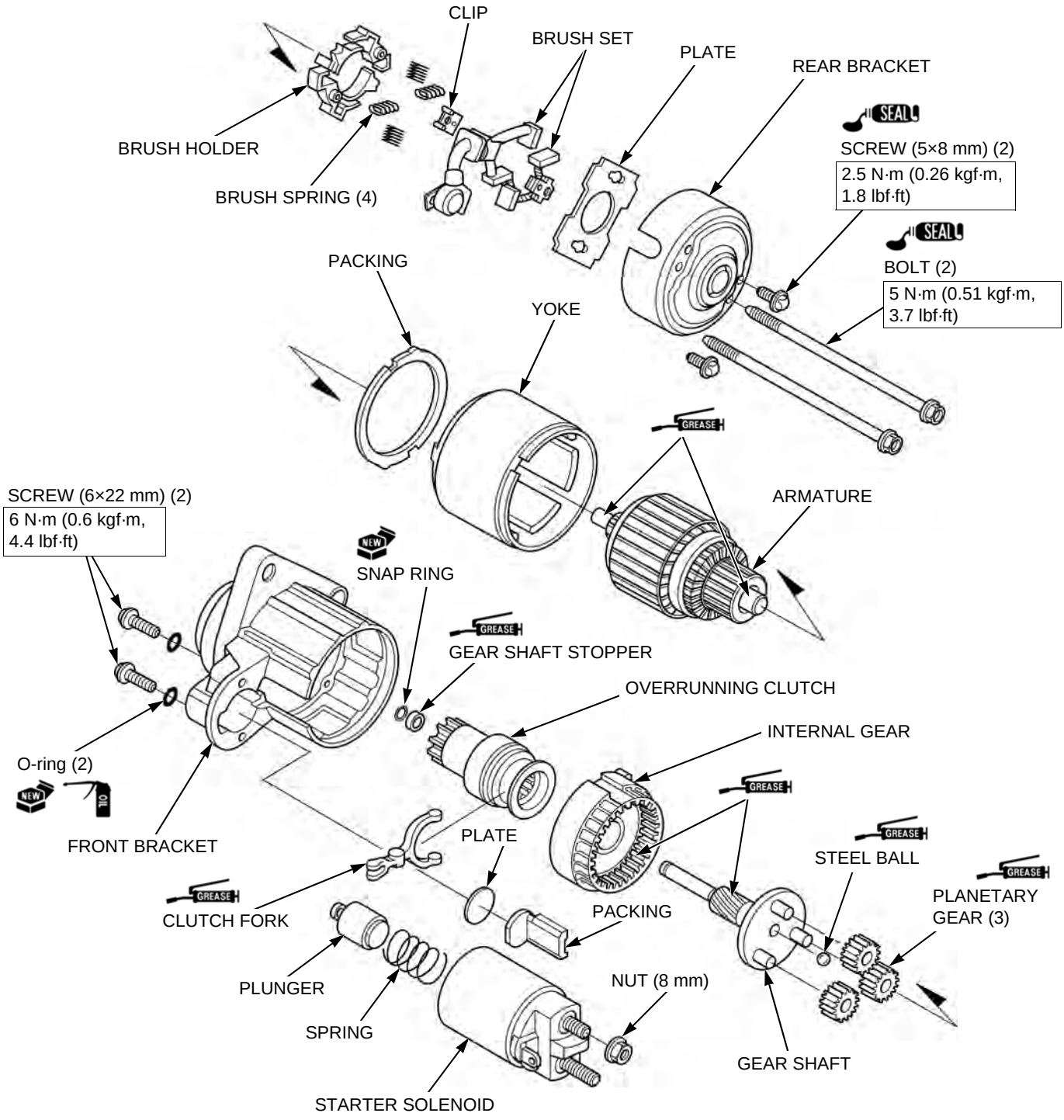
Remove the clip (1) and plate (2) from the brush holder (3)

Remove the brush sets (4) and four brush springs (5).



EXPLODED VIEW

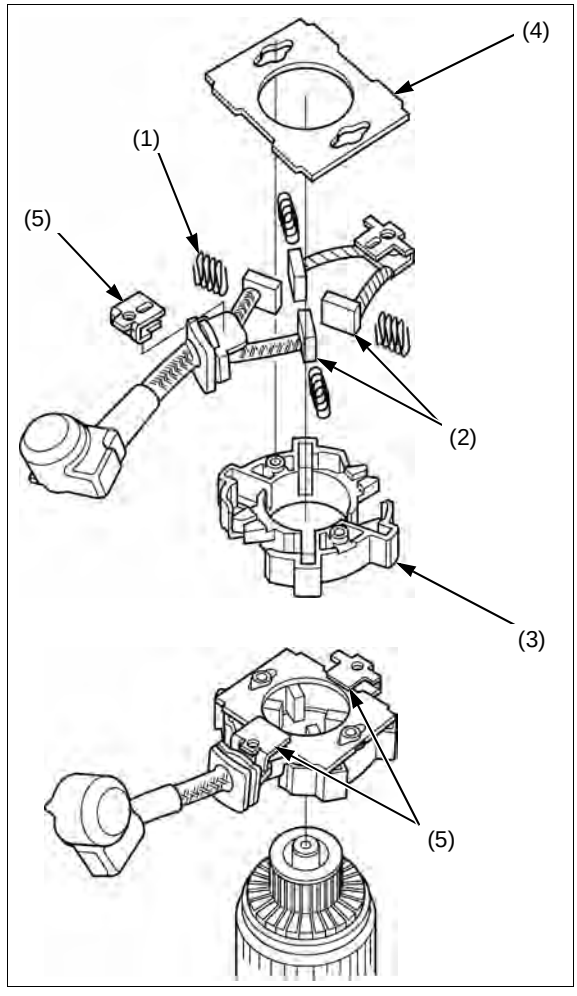
After assembling the starter motor, apply a sufficient amount of water resisting sealant (Sumitomo 3M Padding Sealer #8533 or equivalent) to the mating sections of each part (page 9-14).



ASSEMBLY

Set the four brush springs (1) and brush sets (2) into the brush holder (3).

Install the plate (4) on the brush holder and secure it with the clip (5).

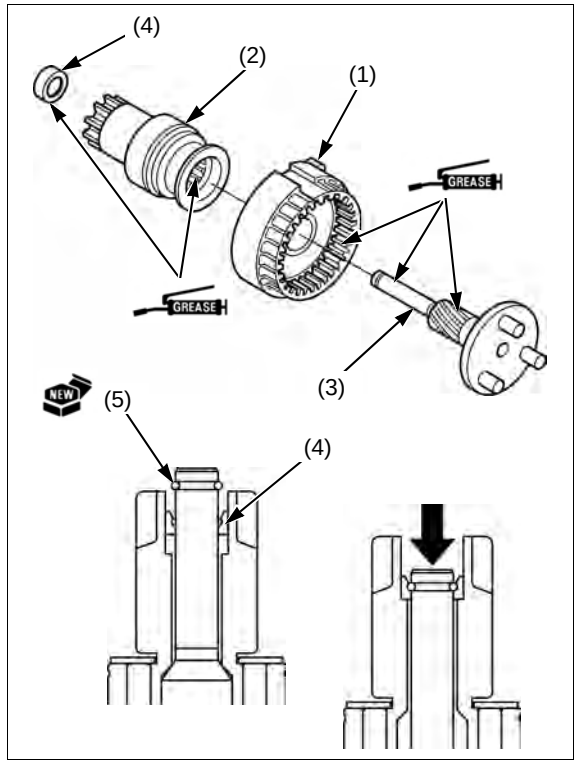


Apply grease to the internal gear (1), inner wall of the overrunning clutch (2), gear shaft (3) outer surface, and whole surface of the gear shaft stopper (4).

Assemble the overrunning clutch, gear shaft, and the gear shaft stopper with the internal gear.

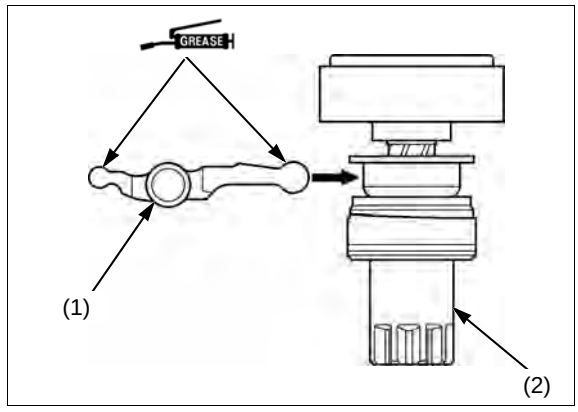
Install a new snap ring (5).

Holding the overrunning clutch, push the gear shaft into the overrunning clutch. Push the gear shaft stopper up to set the snap ring in the groove of the gear shaft stopper securely.



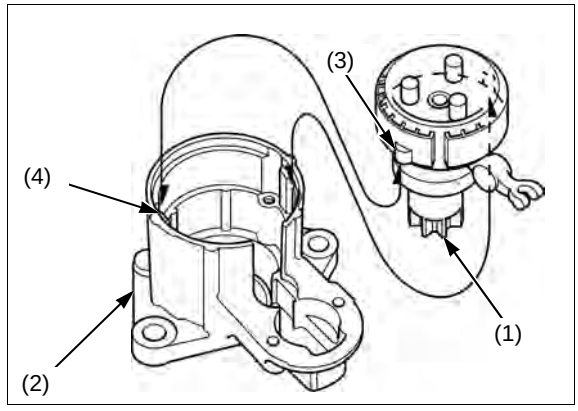
Apply grease to the sliding surface of the clutch fork (1).

Set the clutch fork in the indicated position of the overrunning clutch groove (2) as shown.



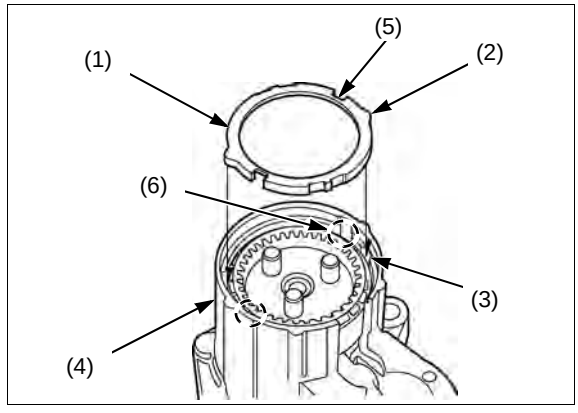
Install the overrunning clutch (1) assembly on the front bracket (2).

- Install the overrunning clutch by aligning the projections (3) on the outer surface of the ring gear with the grooves (4) in the front bracket.



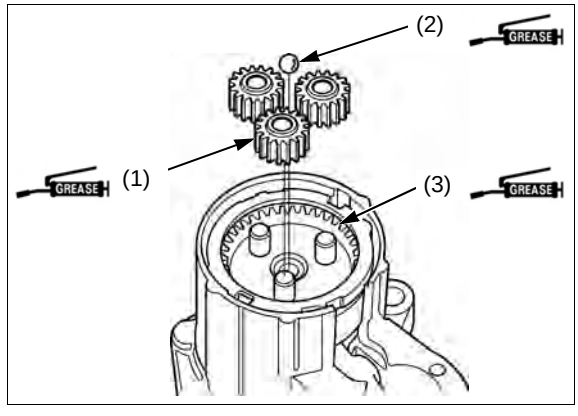
Install the packing (1).

- Install the packing by aligning the projections (2) on the packing with the grooves (3) in the front bracket (4), and aligning the notches (5) on the packing with the bolt hole (6) in the front bracket.



Apply grease to the planetary gears (1), steel ball (2), and internal gear (3).

Install the planetary gears, steel ball, and internal gear.



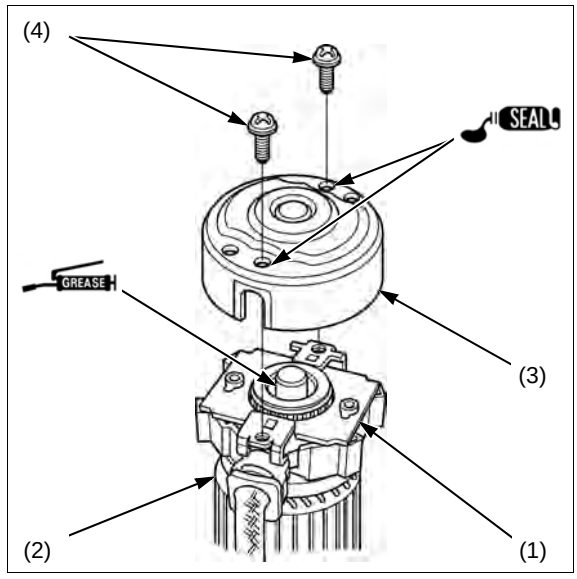
Install the brush holder (1) onto the armature (2).

Apply grease to the armature shaft.

Install the rear bracket (3).

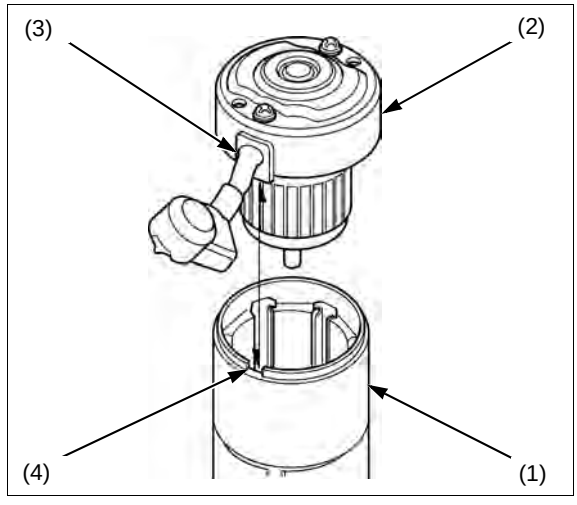
Apply water resisting sealant (Sumitomo 3M Padding Sealer #8533 or equivalent) to the seating surface of each screw (4).
Install and tighten the two screws to the specified torque.

TORQUE: 2.5 N·m (0.26 kgf·m, 1.8 lbf·ft)



Check the inner wall of the yoke (1) for foreign material.

Install the armature/rear bracket assembly (2) by aligning the grommet (3) with the cutout (4) in the yoke.

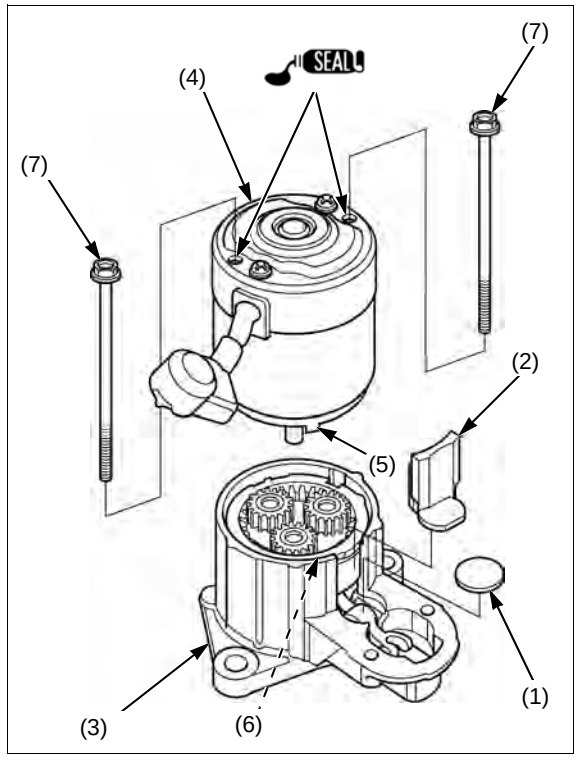


Install the plate (1) and packing (2) on the front bracket (3).

Install the yoke/rear bracket assembly (4) by aligning the projection (5) on the yoke with the cutout (6) in the front bracket.

Apply water resisting sealant (Sumitomo 3M Padding Sealer #8533 or equivalent) to the seating surface of each bolt (7).
Install and tighten the two bolts to the specified torque.

TORQUE: 5 N·m (0.51 kgf·m, 3.7 lbf·ft)



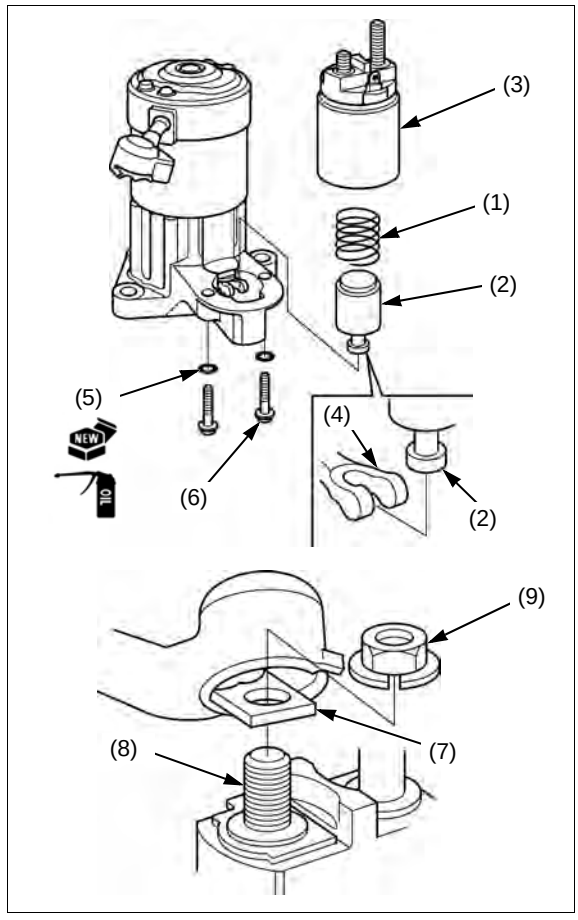
Install the spring (1) and plunger (2) to the starter solenoid (3), then assemble the plunger and clutch fork (4) as shown.

Apply engine oil to new O-rings (5) and install them onto the screws (6).

Install and tighten the two screws to the specified torque.

TORQUE: 6 N·m (0.6 kgf·m, 4.4 lbf·ft)

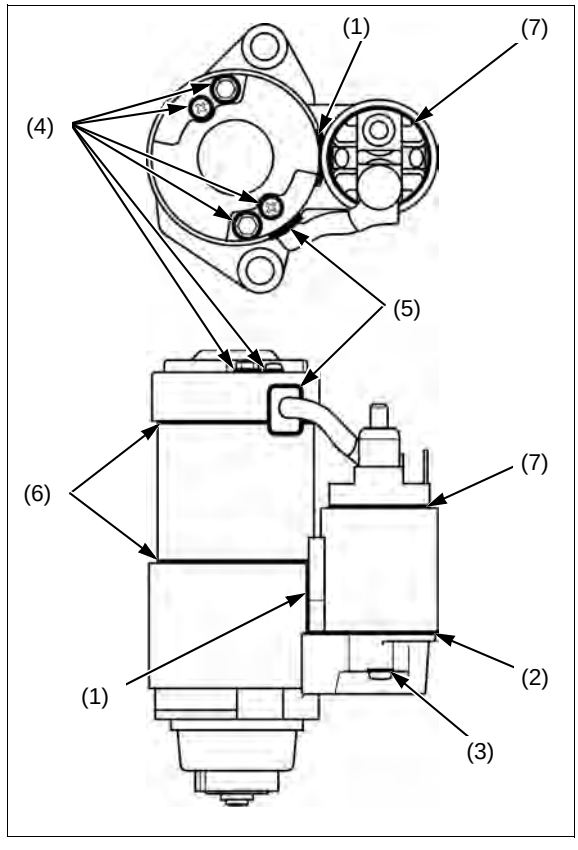
Connect the motor wire (7) to the M terminal (8) and tighten the nut (9).



WATER RESISTING SEALANT APPLICATION POINTS

After the assembling the starter motor, apply a sufficient amount of water-resisting sealant (Sumitomo 3M Padding Sealer 8533 or equivalent) to the mating surfaces as shown.

- Packing/front bracket mating section (1)
- Starter solenoid/front bracket mating section (2)
- Starter solenoid mounting screw (3)
- Screw/ bolt and rear bracket mating sections (4)
- Wire, grommet and rear bracket (5)
- Engagement sections with yoke (6)
- Starter solenoid case caulking section (7)

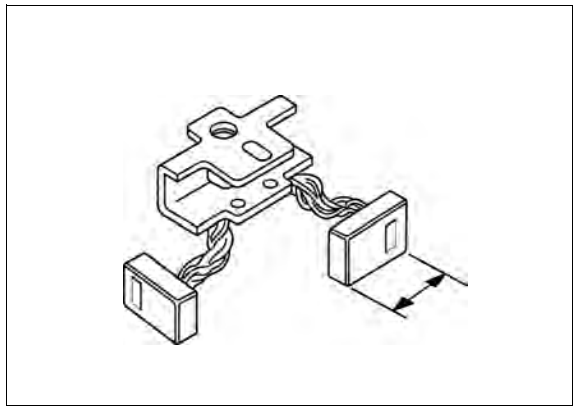


STARTER MOTOR INSPECTION

BRUSH LENGTH

Measure the brush length. If brush length is less than the service limit, replace the brushes as a set.

STANDARD: 12.3 mm (0.48 in)
SERVICE LIMIT: 7.0 mm (0.28 in)

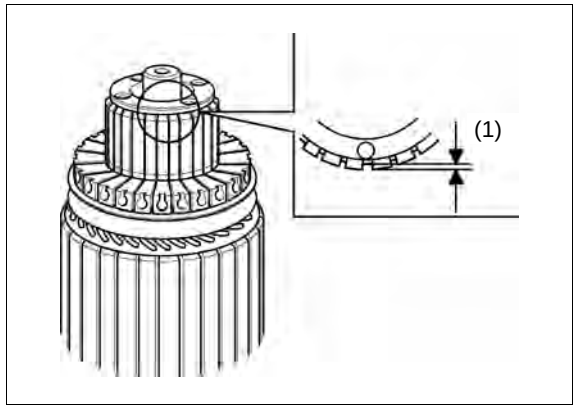


MICA DEPTH

Measure the mica depth (1).

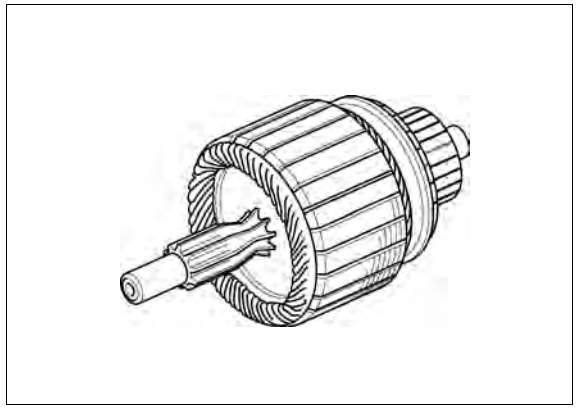
STANDARD: 0.40 – 0.50 mm (0.016 – 0.020 in)
SERVICE LIMIT: 0.20 mm (0.008 in)

If the grooves are clogged or mica depth is less than the service limit, recut the grooves using a hacksaw blade or a small file.



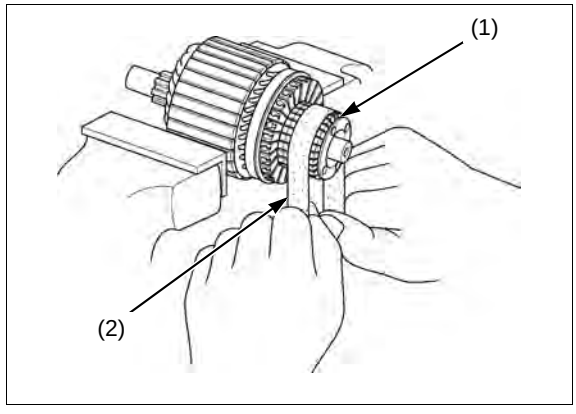
ARMATURE

Check the armature and shaft gear for wear and damage.



Check the commutator (1) for damage, dust, dirt, and metal particles.

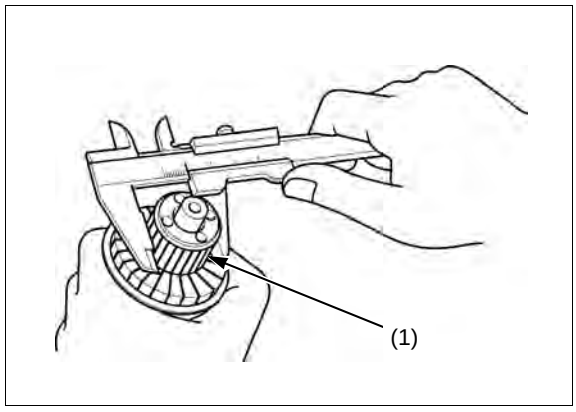
If there is stain, irregularity, and/or evidence of burning, clean with emery paper (2) #500 or #600.



Measure the commutator (1) O.D.

STANDARD: 29.4 mm (1.16 in)
SERVICE LIMIT: 28.8 mm (1.13 in)

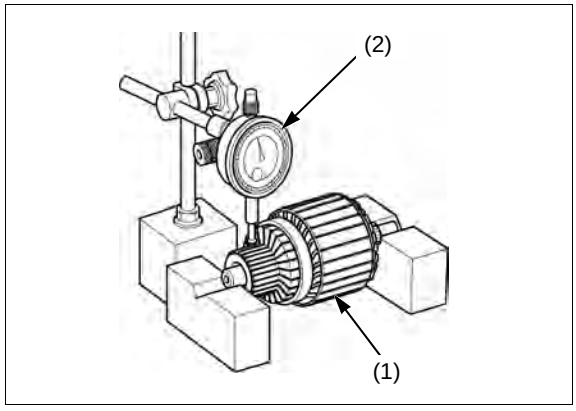
If the measurement is less than the service limit, replace the armature with a new one.



Measure commutator (1) runout using a dial gauge (2).

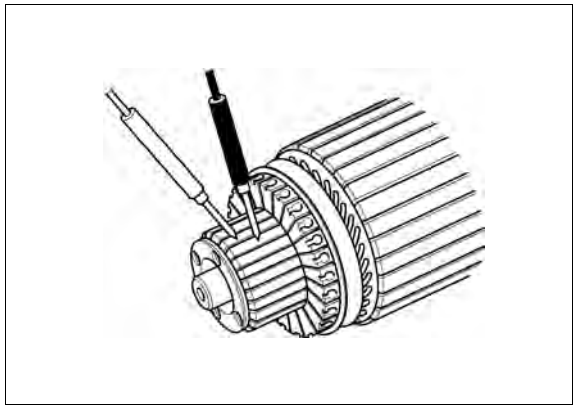
SERVICE LIMIT: 0.1 mm (0.004 in)

If the measurement is more than the service limit, replace the armature with a new one.



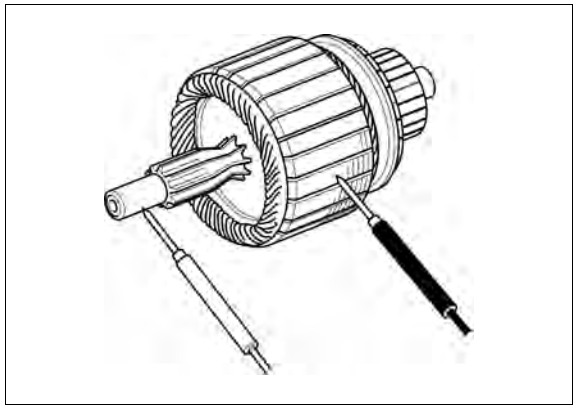
Check for continuity between each segment.

If an open circuit exists between any two segments, replace the armature.



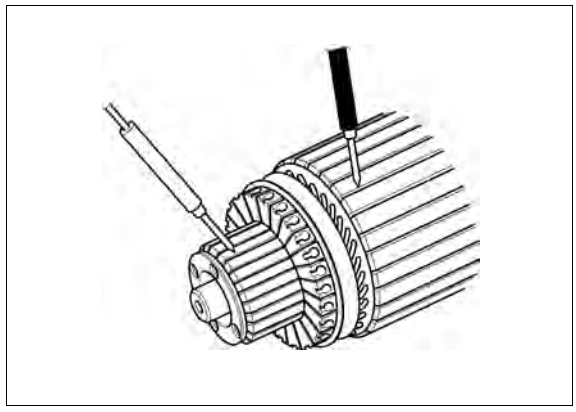
Check for continuity between the armature and armature shaft.

If there is no continuity, replace the armature.



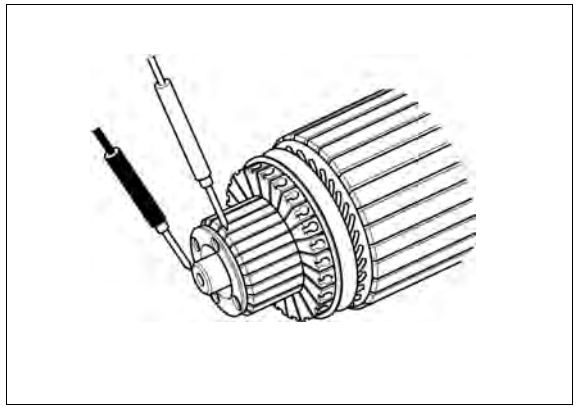
Check for continuity between the commutator and armature coil core.

If continuity exists, replace the armature.



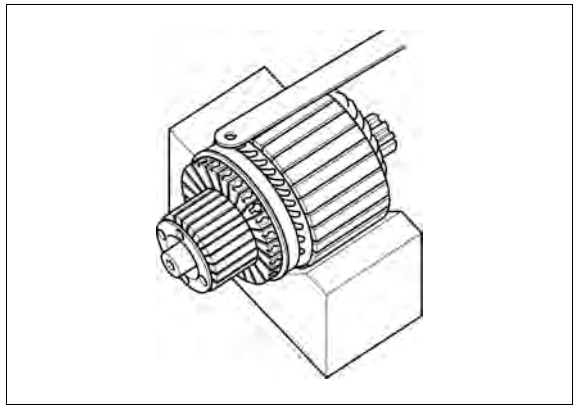
Check for continuity between the commutator and armature shaft.

If there is continuity, replace the armature.



Place the armature in an armature tester (commercially available).

Hold a hacksaw blade close to the armature core. If the blade is attracted to the core or vibrates when the core is turned, the armature is shorted. Replace the armature.

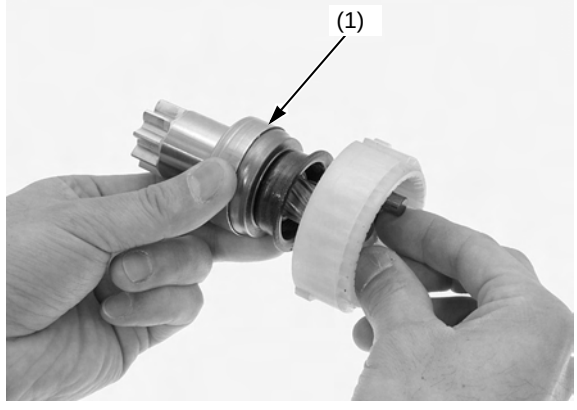


OVERRUNNING CLUTCH

Check the overrunning clutch (1) for smooth axial movement.

Clean and apply grease to the spline, if necessary.

If the overrunning clutch does not move smoothly after cleaning or coated with grease, replace the overrunning clutch.

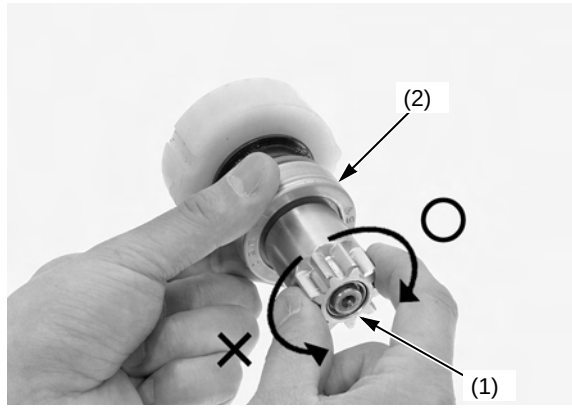


Turn the gear shaft assembly (1) by holding the overrunning clutch (2). The gear shaft assembly should turn only clockwise.

If the clutch turns freely in both directions or if it does not turn at all, replace the overrunning clutch.

Check the pinion gear teeth for wear and damage and replace if necessary.

If the pinion gear is worn or damaged, the flywheel ring gear must be inspected.



10. OTHER ELECTRICAL

SYSTEM LOCATION 10-2

FUSE/RELAY JUNCTION BOX REMOVAL/ INSTALLATION 10-3

ECM REMOVAL/INSTALLATION 10-4

ELECTRIC PARTS CASE REMOVAL/ INSTALLATION 10-5

SWITCH PANEL CABLE/INDICATOR WIRE HARNESS REMOVAL/INSTALLATION 10-6

STARTER CABLE REMOVAL/ INSTALLATION 10-9

POWER TILT RELAY/CONNECTOR BRACKET A REMOVAL/ INSTALLATION 10-11

RELAY REMOVAL/INSTALLATION 10-13

MAIN/STARTER/A/F SENSOR HEATER RELAY INSPECTION 10-13

FUEL PUMP RELAY INSPECTION 10-14

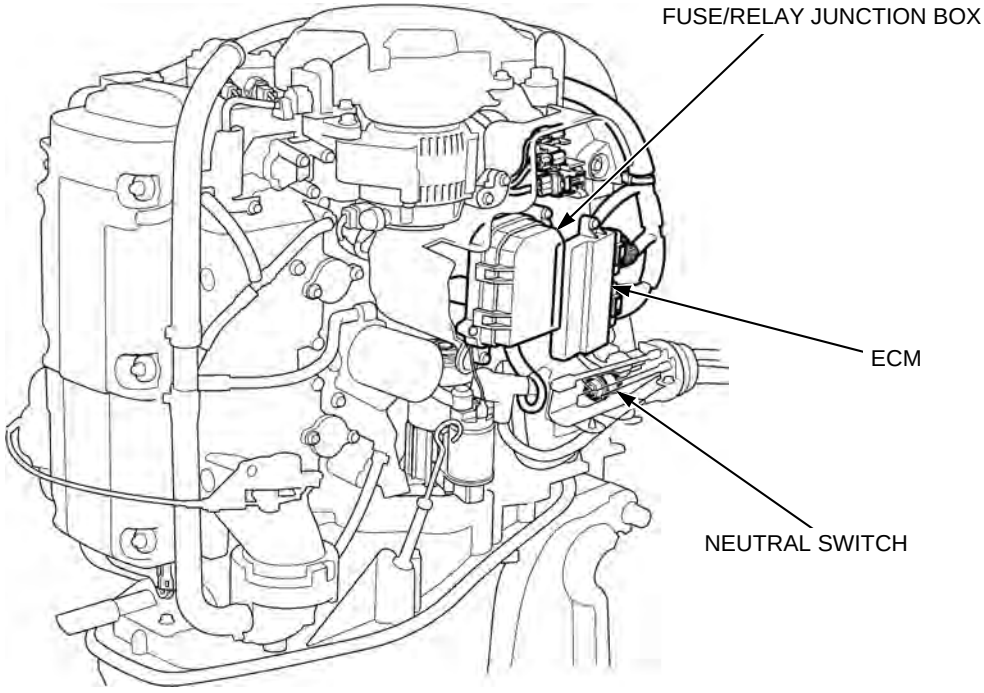
FUSE/RELAY JUNCTION BOX INSPECTION 10-14

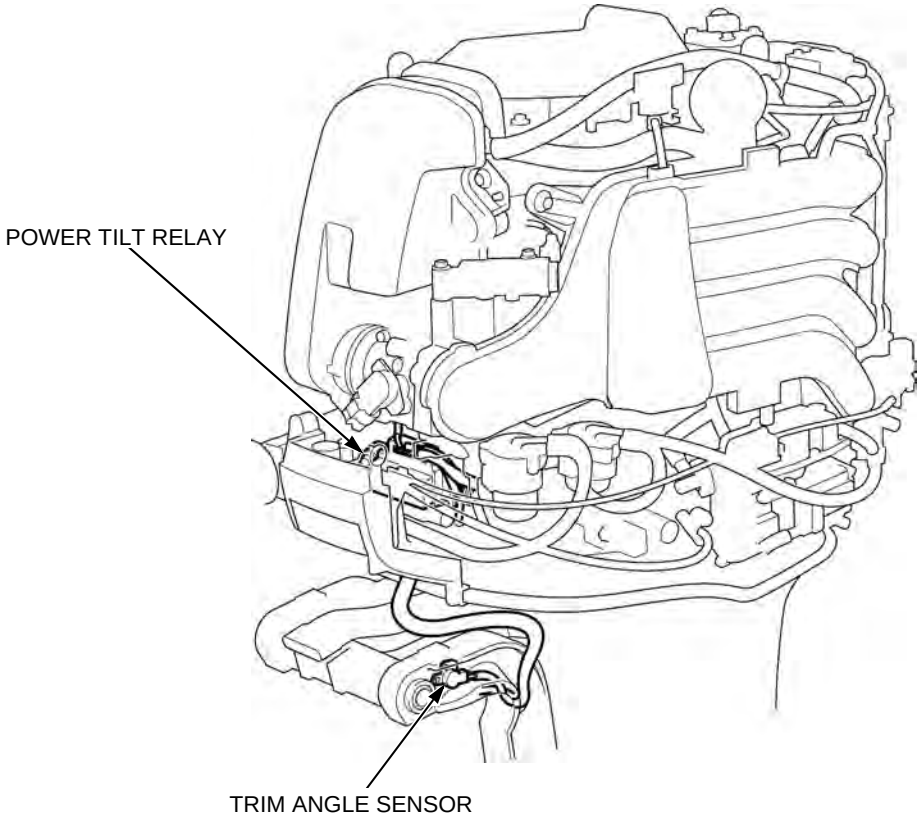
POWER TILT RELAY INSPECTION 10-17

TRIM ANGLE SENSOR INSPECTION 10-18

NEUTRAL SWITCH INSPECTION 10-19

SYSTEM LOCATION

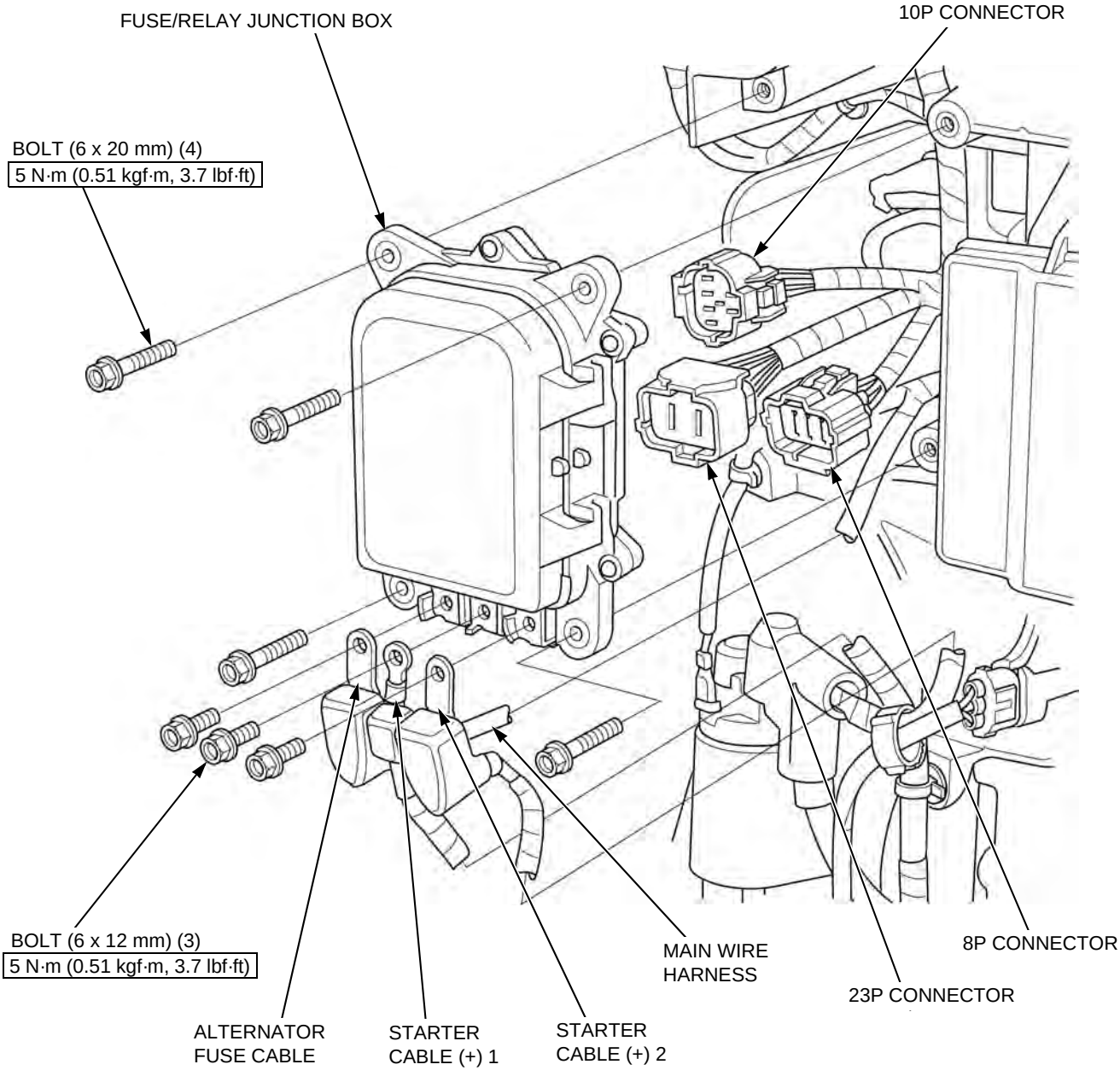




FUSE/RELAY JUNCTION BOX REMOVAL/INSTALLATION

Disconnect the battery negative (–) cable, then the positive (+) cable from the battery.

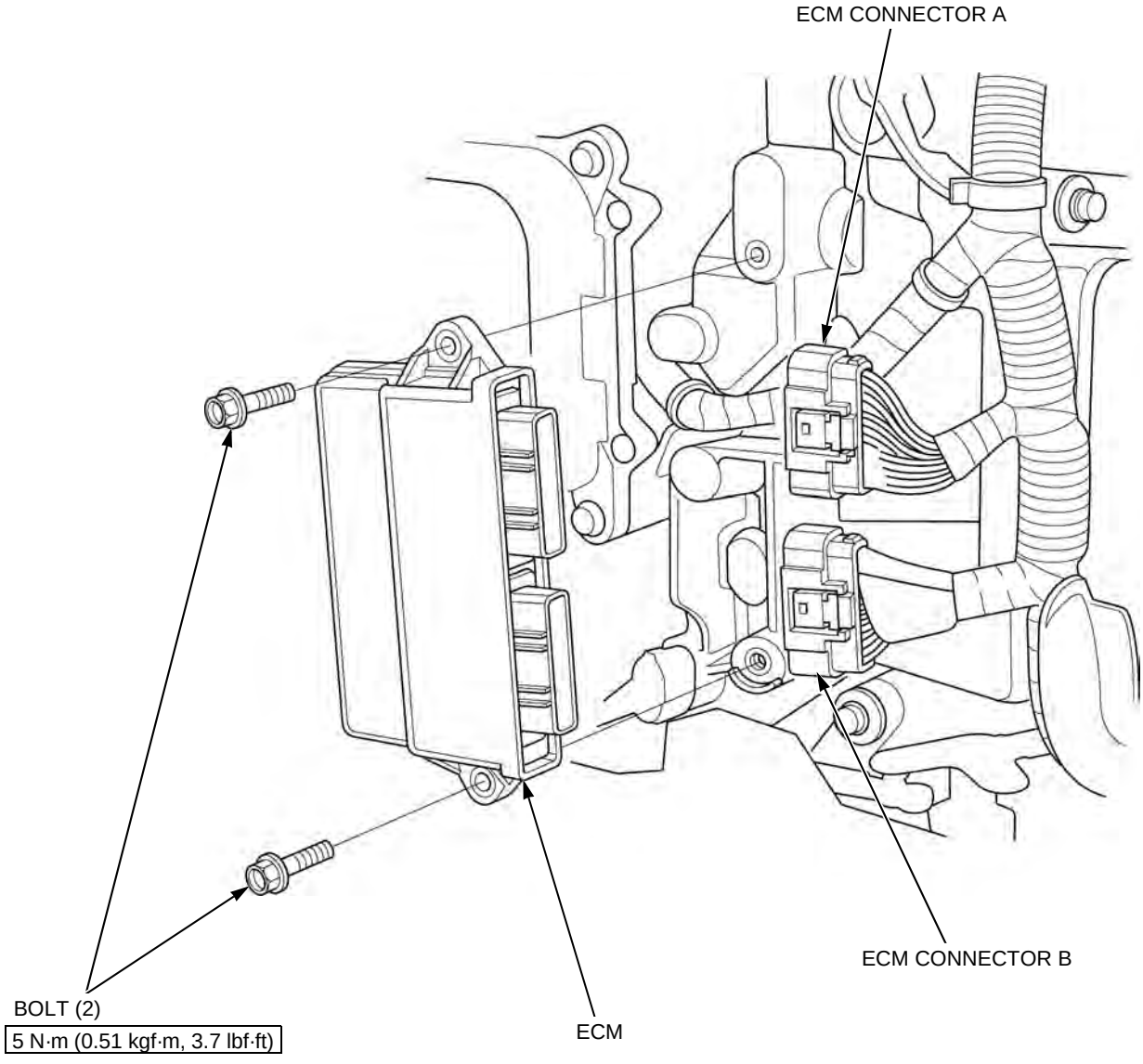
Remove the engine cover.



ECM REMOVAL/INSTALLATION

Disconnect the battery negative (–) cable, then the positive (+) cable from the battery.

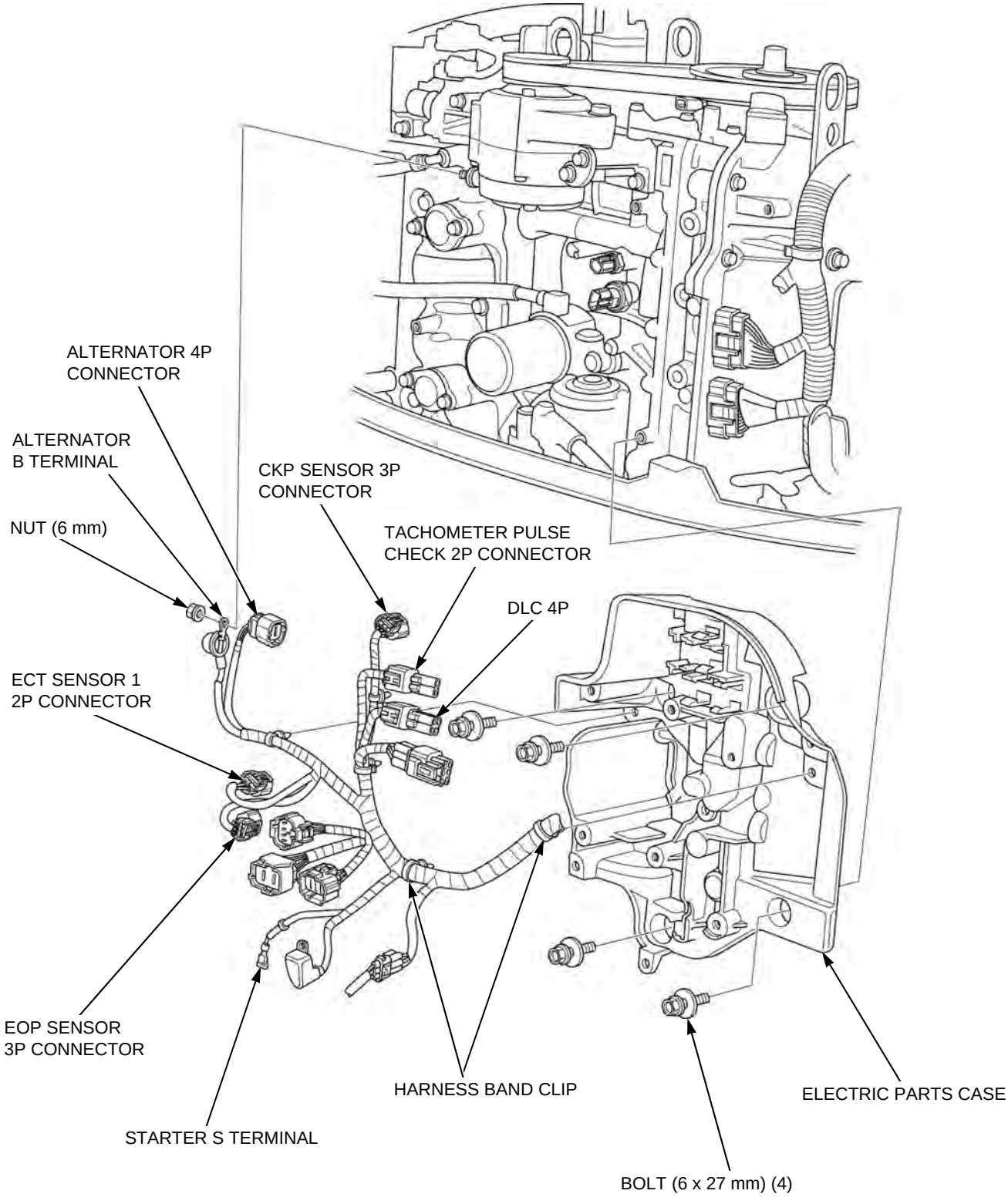
Remove the engine cover.



ELECTRIC PARTS CASE REMOVAL/ INSTALLATION

Remove the following:

– Fuse/relay junction box (page 10-3)
– ECM (page 10-4)



SWITCH PANEL CABLE/INDICATOR WIRE HARNESS REMOVAL/ INSTALLATION

REMOVAL

Disconnect the battery negative (–) cable, then the positive (+) cable from the battery.

Remove the following:

– Front separate cover (page 6-3)
– Shift control cable pivot (page 20-3)
– Throttle control cable pivot (page 20-6)

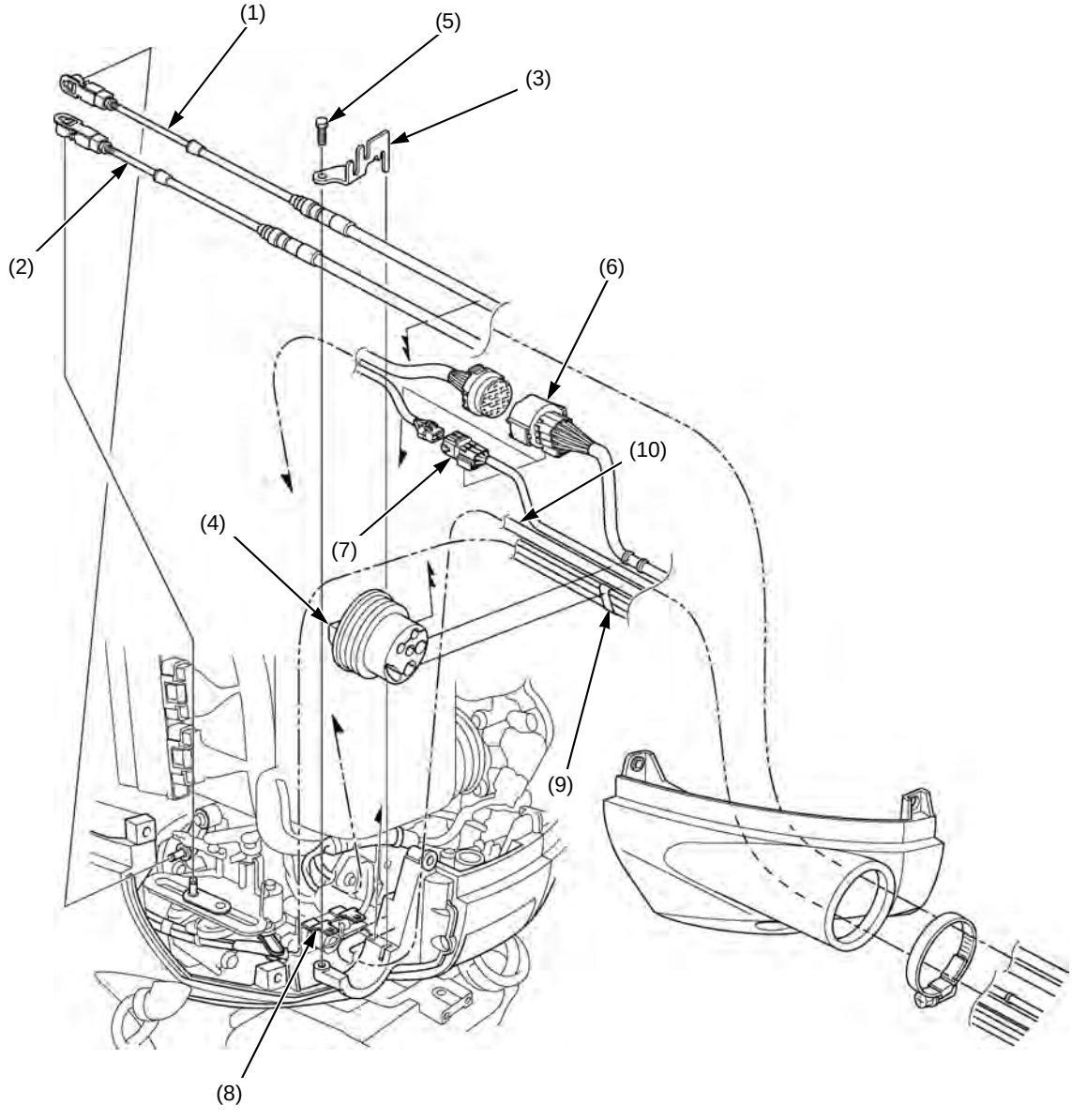
Remove the throttle control cable (1) and shift control cable (2) from the remote cable plate (3) and remote control cable grommet (4).

Remove the bolt (5) and remote control cable plate.

Remove the 14P connector (6) of the switch panel cable and 6P connector (7) of the indicator wire harness from the neutral switch bracket (8), then disconnect them.

Remove the 14P connector of the switch panel cable and 6P connector of the indicator wire harness from the remote control cable grommet.

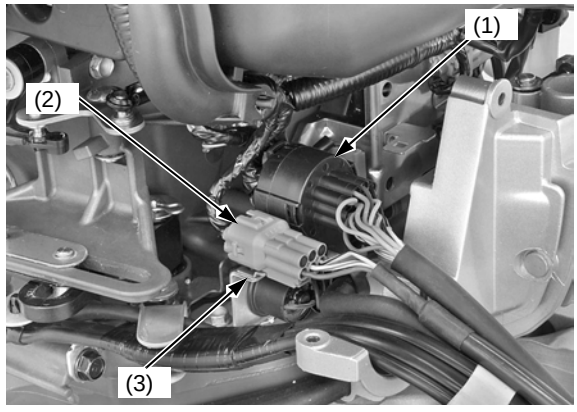
Remove the stater cable (9) and fuel tube A (10) from the remote control cable grommet.



INSTALLATION

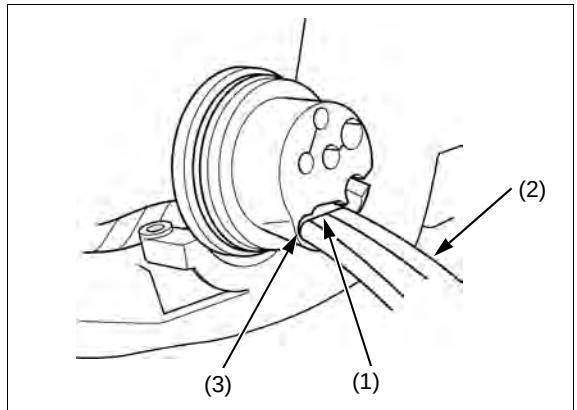
- Be careful not to press the fuel tube A with the remote control cable grommet.

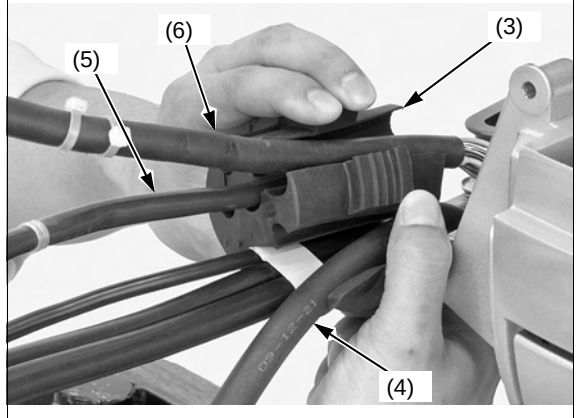
Connect the 14P connector (1) of the switch panel cable and 6P connector (2) of the indicator wire harness, then install them to the neutral switch bracket (3).

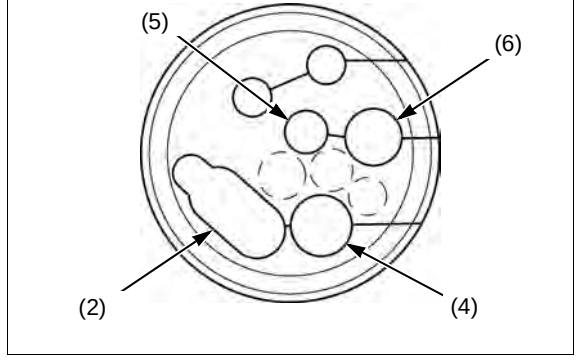


Make sure the white tape (1) on the starter cable (2) aligns with the edge of the remote control cable grommet (3).

Pass the fuel tube A (4), indicator wire harness (5), switch panel wire harness (6) into the remote control cable grommet.

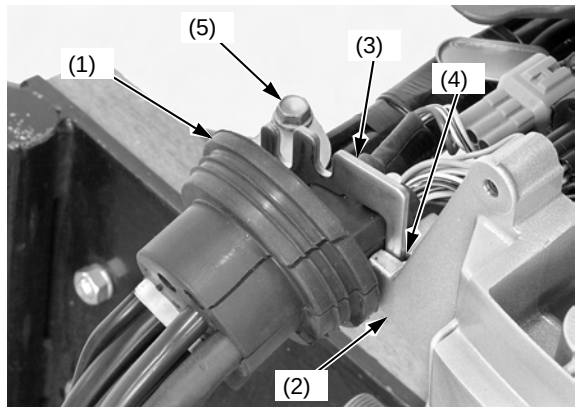






Install the remote control cable grommet (1) while aligning the front under cover bracket (2) end surface.

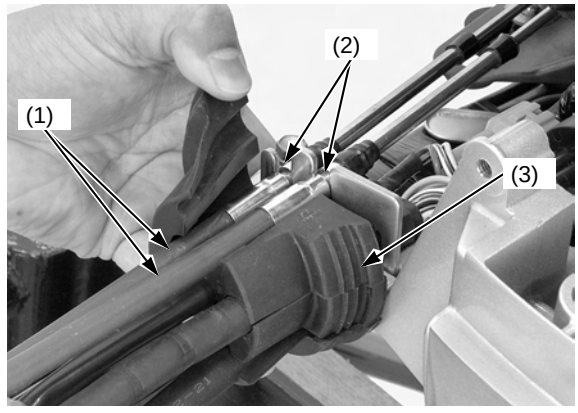
Install the remote control cable plate (3) to the groove (4) of the front under cover bracket, then tighten the bolt (5).



Install the following:

– Shift control cable pivot (page 20-3)
– Throttle control cable pivot (page 20-6)

Install the remote control cables (1) by aligning their grooves with the grooves (2) of the cable plate, then set them to the remote control grommet (3).



Adjust the following:

– Shift control cable (page 20-16)
– Throttle control cable (page 3-9)

Install the front separate cover (page 6-3).

STARTER CABLE REMOVAL/ INSTALLATION

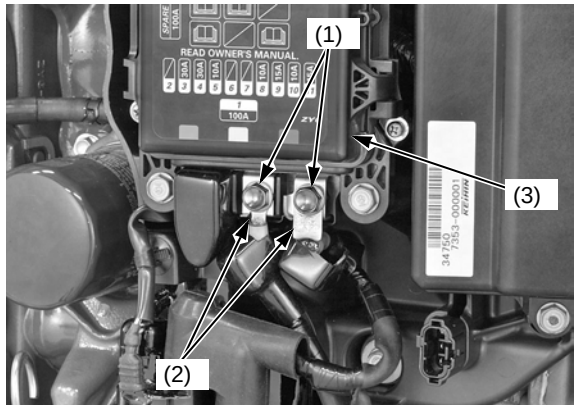
REMOVAL

Disconnect the battery negative (–) cable, then the positive (+) cable from the battery.

Remove the following:

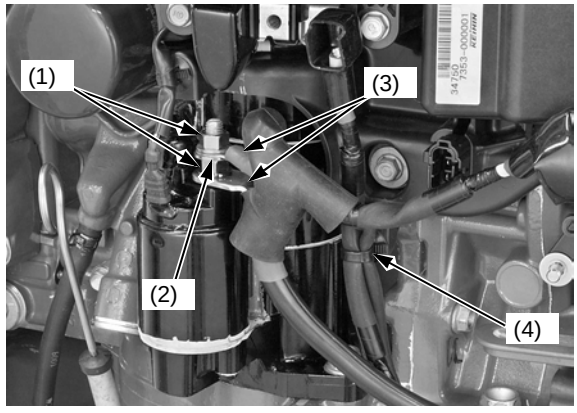
– Under cover front bracket (page 6-18)
– Switch panel cable/indicator wire harness (page 10-6)

Remove the two bolts (1) and starter cables (+) (2) from the fuse/relay junction box (3).



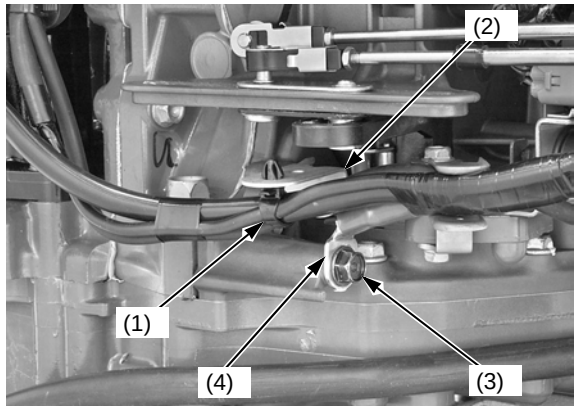
Remove the two nuts (1), washer (2) and starter cables (+) (3) from the starter B terminal.

Remove the harness band clip (4) from the electric parts case.



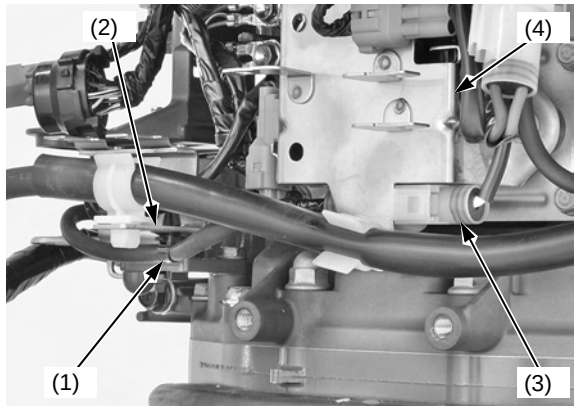
Remove the harness band clip (1) from the cable bracket B (2).

Remove the bolt (3) and ground terminal (4) of the starter cable (–).



Remove the harness band clip (1) from the neutral switch bracket (2).

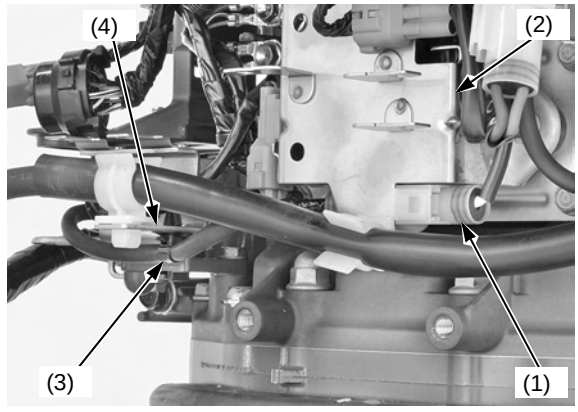
Remove the starter cable (+) 1P connector (3) from the connector bracket A (4) and disconnect it.



INSTALLATION

Connect the starter cable (+) 1P connector (1) and install it to the connector bracket A (2).

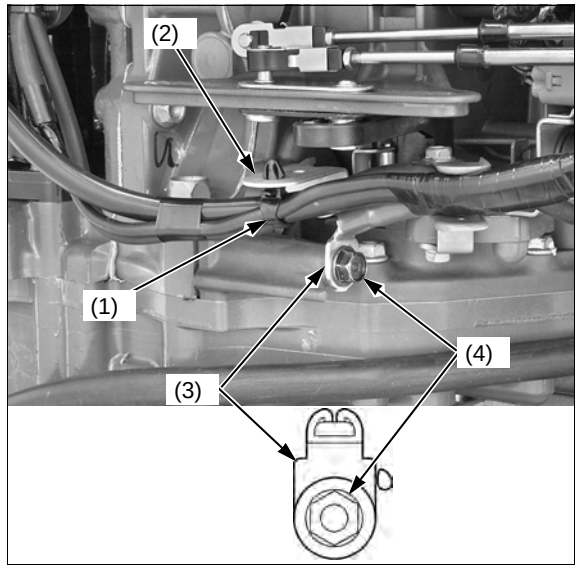
Install the harness band clip (3) to the neutral switch bracket (4).



Install the harness band clip (1) to the cable bracket B (2).

Set the ground terminal (3) of the starter cable (–) as shown and tighten the bolt (4) to the specified torque.

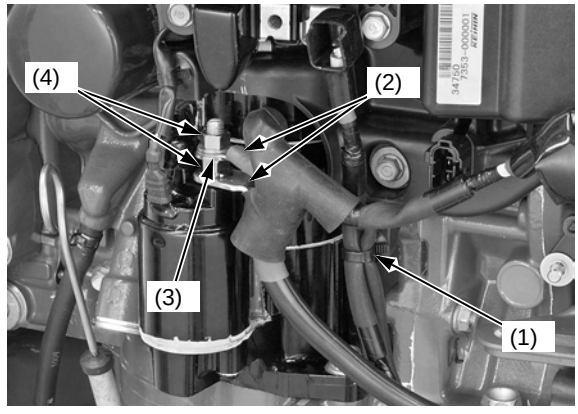
TORQUE: 26 N·m (2.7 kgf·m, 19 lbf·ft)



Install the harness band clip (1) to the electric parts case.

Install the starter cable (+) (2), washer (3) and two nuts (4) to the starter B terminal, then tighten the nuts to the specified torque.

TORQUE: 11 N·m (1.1 kgf·m, 8 lbf·ft)

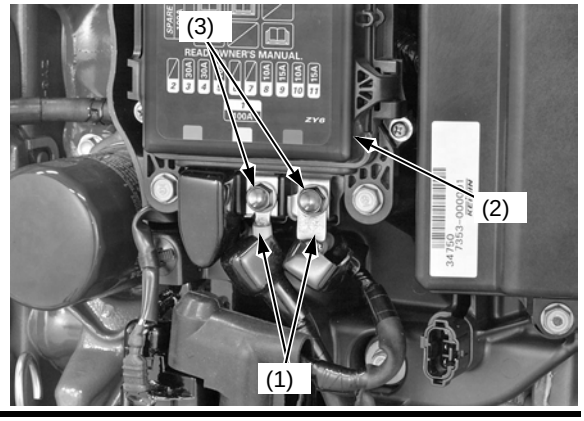


Set the starter cables (+) (1) to the fuse/relay junction box (2) and tighten the bolts (3) to the specified torque.

TORQUE: 5 N·m (0.51 kgf·m, 3.7 lbf·ft)

Install the following:

– Under cover front bracket (page 6-18)
– Switch panel cable/indicator wire harness (page 10-6)



POWER TILT RELAY/CONNECTOR BRACKET A REMOVAL/INSTALLATION

Disconnect the battery negative (–) cable, then the positive (+) cable from the battery.

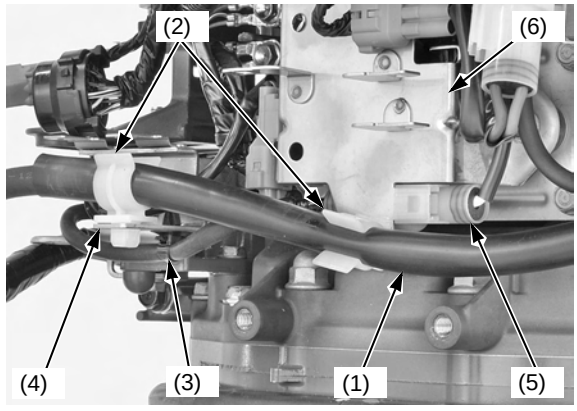
Remove the following:

– Under cover front bracket (page 6-18)
– Switch panel cable/indicator wire harness (page 10-6)

Disconnect the fuel tube A (1) from the drain tube holders (2).

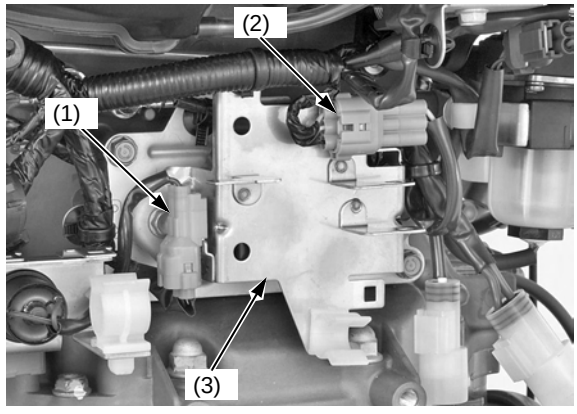
Remove the harness band clip (3) from the neutral switch bracket (4).

Remove the starter cable (+) 1P connector (5) from the connector bracket A (6) and disconnect it.

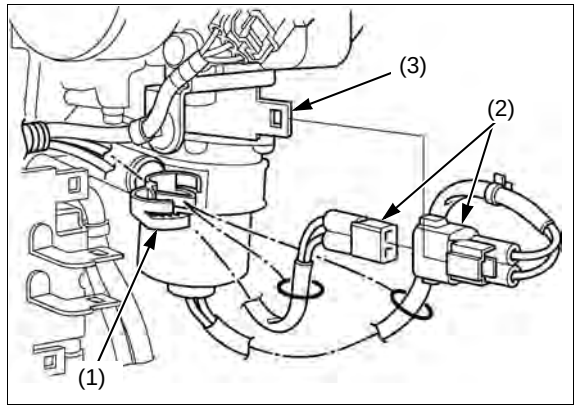


Remove the neutral switch 2P connector (1) and power tilt relay 3P connector (2) from the connector bracket A (3).

Disconnect the power tilt relay 3P connector.



Release the clamp (1) of the wire clip and remove the water level sensor 2P connector (2) from the harness clip bracket E (3).



Remove the bolt (6 x 12 mm) (1) and ground terminal (2) of the power tilt relay.

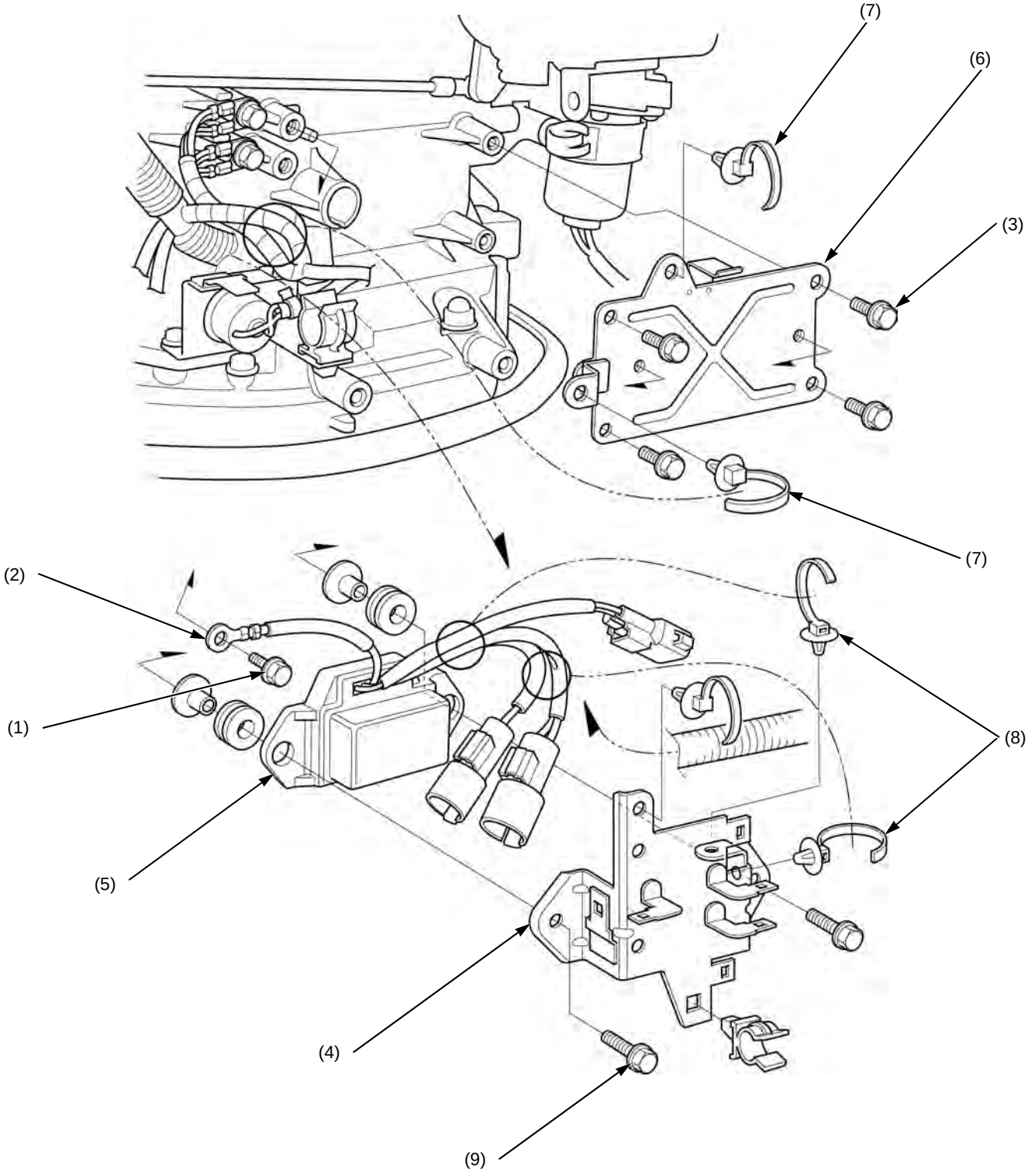
Remove the four bolts (6 x 14 mm) (3).
Remove the connector bracket A (4), power tilt relay (5) and relay bracket (6) as a set.

Remove the two wire clips (7) from the relay bracket.

Remove the two wire clips (8) from the connector bracket A.

Remove the two bolts (6 x 22 mm) (9) and power tilt relay.

Installation is in the reverse order of removal.



RELAY REMOVAL/INSTALLATION

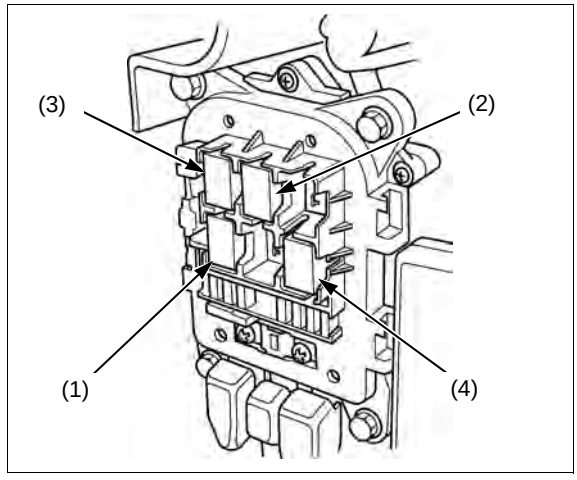
Disconnect the battery negative (–) cable, then the positive (+) cable from the battery.

Remove the engine cover and fuse/relay junction box cover.

Remove the following:

– Main relay (1)
– Starter relay (2)
– A/F sensor heater relay (3)
– Fuel pump relay (4)

Installation is in the reverse order of removal.



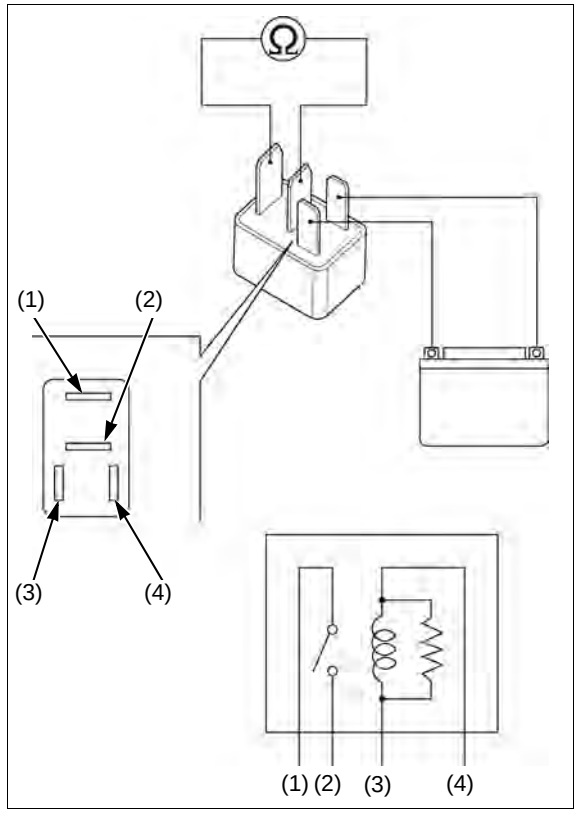
MAIN/STARTER/A/F SENSOR HEATER RELAY INSPECTION

Remove the relay from the fuse/relay junction box (page 10-13).

Connect the ohmmeter to the relay terminal C (1) and terminal D (2).

Connect the battery positive (+) cable to the relay terminal A (3) and battery negative (–) cable to terminal B (4).

There should be continuity while the battery is connected to the relay terminals, and there should be no continuity while the battery is disconnected.



FUEL PUMP RELAY INSPECTION

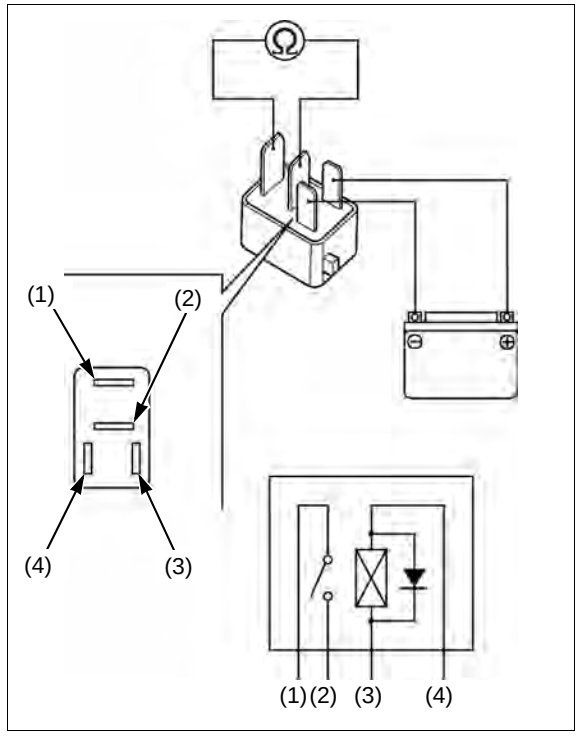
Remove the fuel pump relay from the fuse/relay junction box (page 10-13).

Connect the ohmmeter to the fuel pump relay terminal C (1) and terminal D (2).

Connect the battery positive (+) cable to the fuel pump relay terminal A (3) and battery negative (–) cable to terminal B (4).

- When connecting the fuel pump relay terminals, do not interchange the battery positive (+) cable and battery negative (–) cable.

There should be continuity while the battery is connected to the relay terminals, and there should be no continuity while the battery is disconnected.



FUSE/RELAY JUNCTION BOX INSPECTION

BLOCK FUSE INSPECTION

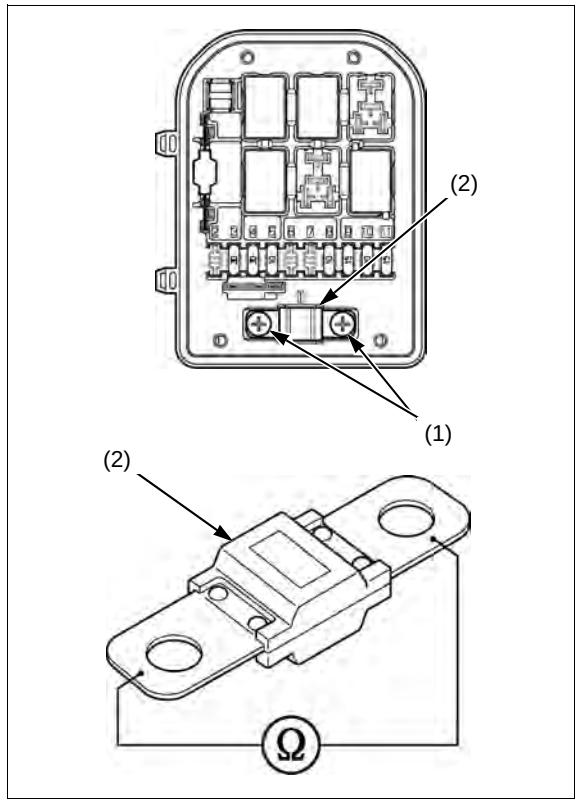
Disconnect the negative (–) and positive (+) cables from battery.

Remove the engine cover and fuse/relay junction box cover.

Remove the screws (1) and No.1 fuse (2) from fuse/relay junction box and check for continuity.

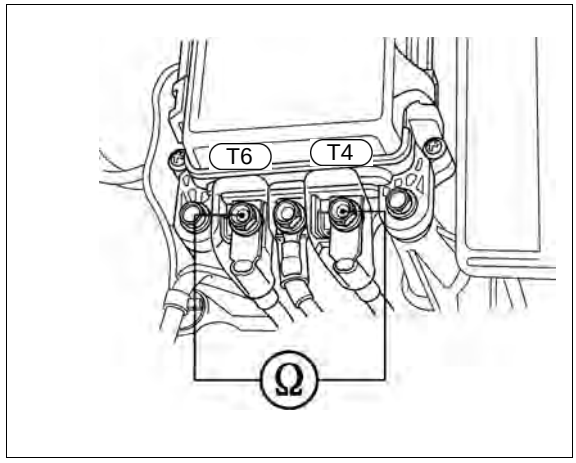
If there is no continuity, replace the No.1 fuse.
If there is continuity, install the No.1 fuse to fuse/relay junction box and tighten the screws to the specified torque.

TORQUE: 3.2 N·m (0.33 kgf·m, 2.4 lbf·ft)



Check for continuity between the (T4) terminal and (T6) terminal of fuse/relay junction box.

If the fuse is normal but there is no continuity between the terminals, replace the fuse/relay junction box with a new one.

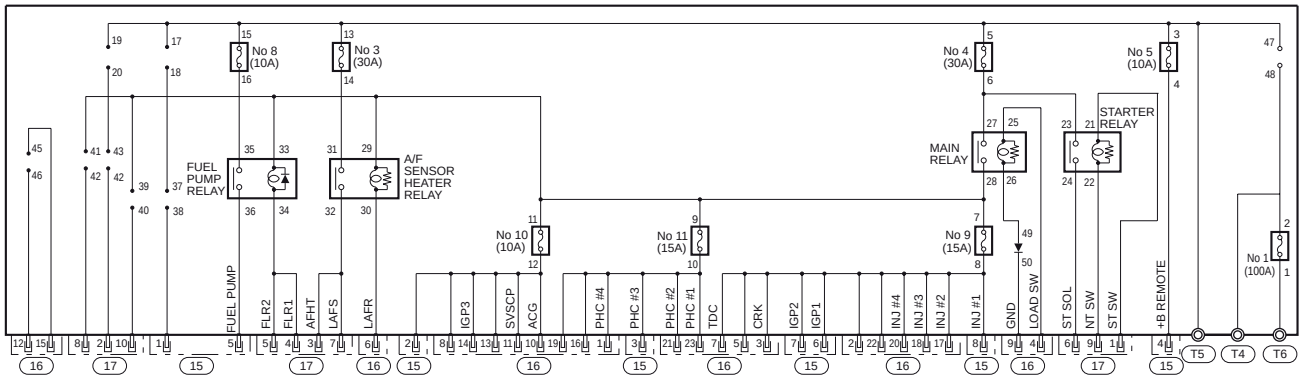


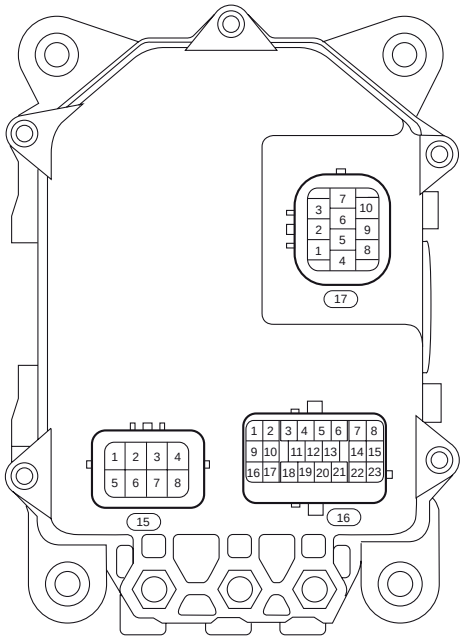
BLADE FUSE INSPECTION

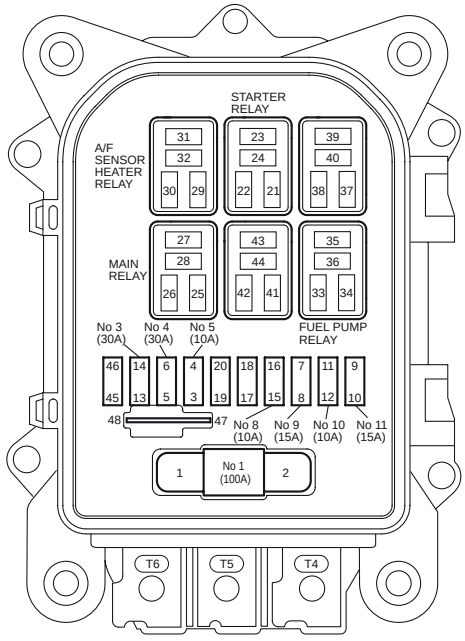
Remove the fuses from fuse/relay junction box and check for blown fuses.

If the fuses are normal, install the fuses to fuse/relay junction box and check for continuity between the terminals in each connectors as shown in the table.

FUSE/RELAY JUNCTION BOX







Check terminals
No.1 fuse No.1 terminal and (T6) terminal
No.1 fuse No.2 terminal and (T4) terminal
No.3 fuse No.13 terminal and (T5) terminal
No.3 fuse No.14 terminal and A/F sensor heater relay No.31 terminal
No.4 fuse No.5 terminal and (T5) terminal
No.4 fuse No.6 terminal and starter relay No.23 terminal
No.4 fuse No.6 terminal and main relay No.27 terminal
No.5 fuse No.3 terminal and (T5) terminal
No.5 fuse No.4 terminal and fuse/relay junction box 8P connector (15) No.4 terminal
No.8 fuse No.15 terminal and (T5) terminal
No.8 fuse No.16 terminal and fuel pump relay No.35 terminal
No.9 fuse No.7 terminal and main relay No.28 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 8P connector (15) No.8 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 23P connector (16) No.17 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 23P connector (16) No.18 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 23P connector (16) No.20 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 8P connector (15) No.6 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 8P connector (15) No.7 terminal

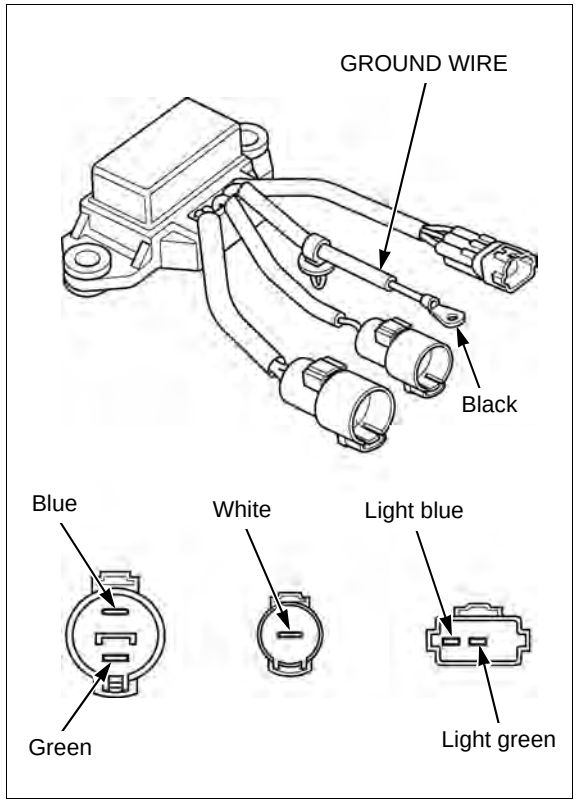
Check terminals
No.9 fuse No.8 terminal and fuse/relay junction box 23P connector (16) No.3 terminal
No.9 fuse No.8 terminal and fuse/relay junction box 23P connector (16) No.7 terminal
No.10 fuse No.11 terminal and main relay No.28 terminal
No.10 fuse No.12 terminal and fuse/relay junction box 23P connector (16) No.10 terminal
No.10 fuse No.12 terminal and fuse/relay junction box 23P connector (16) No.11 terminal
No.10 fuse No.12 terminal and fuse/relay junction box 23P connector (16) No.14 terminal
No.11 fuse No.9 terminal and main relay No.28 terminal
No.11 fuse No.10 terminal and fuse/relay junction box 23P connector (16) No.23 terminal
No.11 fuse No.10 terminal and fuse/relay junction box 23P connector (16) No.21 terminal
No.11 fuse No.10 terminal and fuse/relay junction box 8P connector (15) No.3 terminal
No.11 fuse No.10 terminal and fuse/relay junction box 23P connector (16) No.1 terminal
Starter relay No.21 terminal and fuse/relay junction box 10P connector (17) No.1 terminal
Starter relay No.22 terminal and fuse/relay junction box 10P connector (17) No.9 terminal
Starter relay No.24 terminal and fuse/relay junction box 10P connector (17) No.6 terminal
Main relay No.25 terminal and fuse/relay junction box 23P connector (16) No.4 terminal
Main relay No.28 terminal and A/F sensor heater relay No.29 terminal
Main relay No.28 terminal and fuel pump relay No.33 terminal
A/F sensor heater relay No.30 terminal and fuse/relay junction box 23P connector (16) No.6 terminal
A/F sensor heater relay No.32 terminal and fuse/relay junction box 10P connector (17) No.7 terminal
A/F sensor heater relay No.32 terminal and fuse/relay junction box 10P connector (17) No.3 terminal
Fuel pump relay No.34 terminal and fuse/relay junction box 10P connector (17) No.4 terminal
Fuel pump relay No.34 terminal and fuse/relay junction box 10P connector (17) No.5 terminal
Fuel pump relay No.36 terminal and fuse/relay junction box 8P connector (15) No.5 terminal

POWER TILT RELAY INSPECTION

- Disconnect the power tilt relay connectors, and remove the relay from the outboard motor to check.

Check for continuity between the following terminals.

Between Green and Black	Continuity
Between Blue and Black	Continuity
Between Green and White	No continuity
Between Blue and White	No continuity



Connect a battery as shown. There must be continuity/ no continuity between the terminals shown.

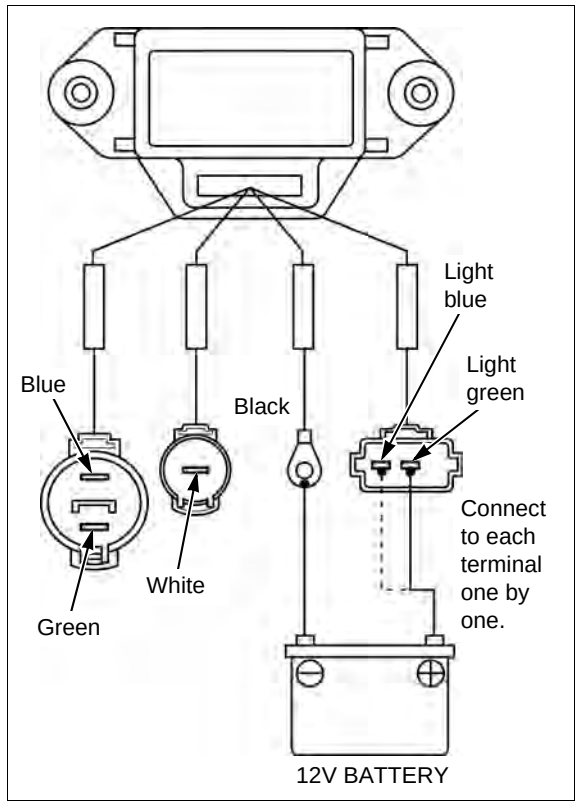
- Use a known-good battery for the test.

Positive (+) battery terminal connected to Light green terminal:

Between Green and Black	No continuity
Between Blue and Black	Continuity
Between Green and White	Continuity
Between Blue and White	No continuity

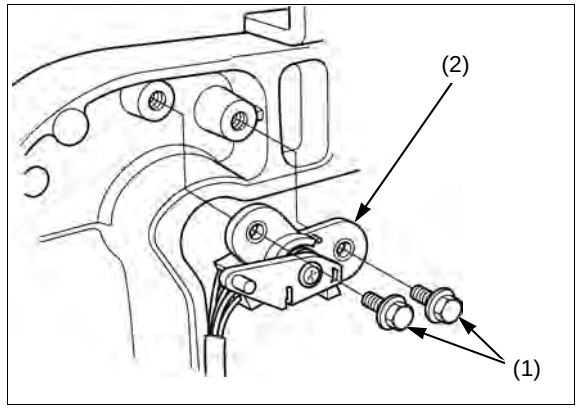
Positive (+) battery terminal connected to Light blue terminal:

Between Green and Black	Continuity
Between Blue and Black	No continuity
Between Green and White	No continuity
Between Blue and White	Continuity



TRIM ANGLE SENSOR INSPECTION

Remove the two trim angle sensor mounting bolts (1) and make the trim angle sensor (2) free.

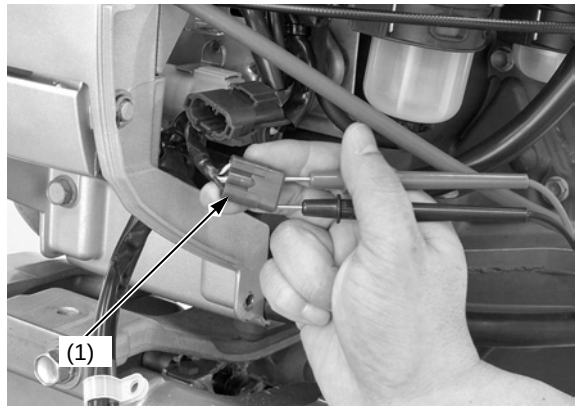


Remove the L. engine under cover (page 6-4).

Remove the trim angle sensor 3P connector (1) from the connector bracket and disconnect it.

Attach the tester leads to the trim angle sensor connectors and measure the resistance.

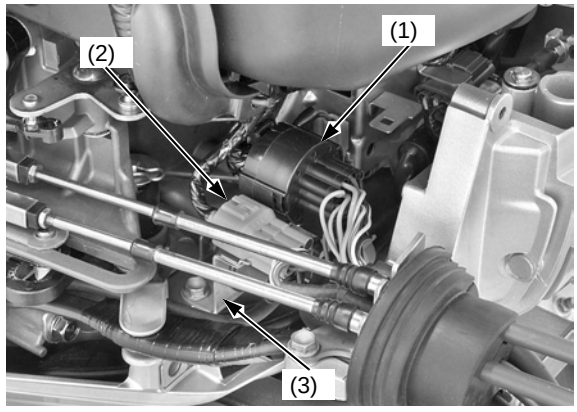
Resistance between Light green/ Black and Black	4.0 – 6.0 kΩ
Resistance between Yellow/Blue and Black	2.7 – 4.3 kΩ



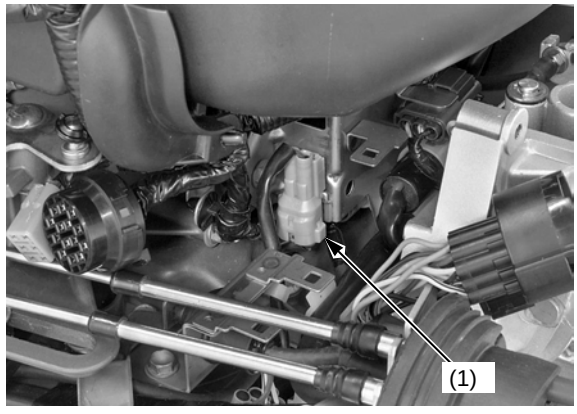
NEUTRAL SWITCH INSPECTION

Remove the front separate cover (page 6-3).

Remove the switch panel cable 14P connector (1) and indicator wire harness 6P connector (2) from the neutral switch bracket (3), then disconnect them.



Remove the neutral switch 2P connector (1) from the connector bracket A and disconnect it.



Attach the tester leads to the two terminals at the neutral switch.

Continuity should exist between the each position as follows:

SWITCH PUSHED (Shift lever in "N")	Continuity
SWITCH RELEASED (Shift lever in "F" or "R")	No continuity

Replace the neutral switch if there is any abnormality.



MEMO

11. COOLING SYSTEM

COMPONENT LOCATION ····· 11-2

TOOLS ····· 11-3

WATER LINE DESCRIPTION ····· 11-4

THERMOSTAT REMOVAL/ INSTALLATION ····· 11-5

WATER RELIEF TUBE REMOVAL/ INSTALLATION ····· 11-6

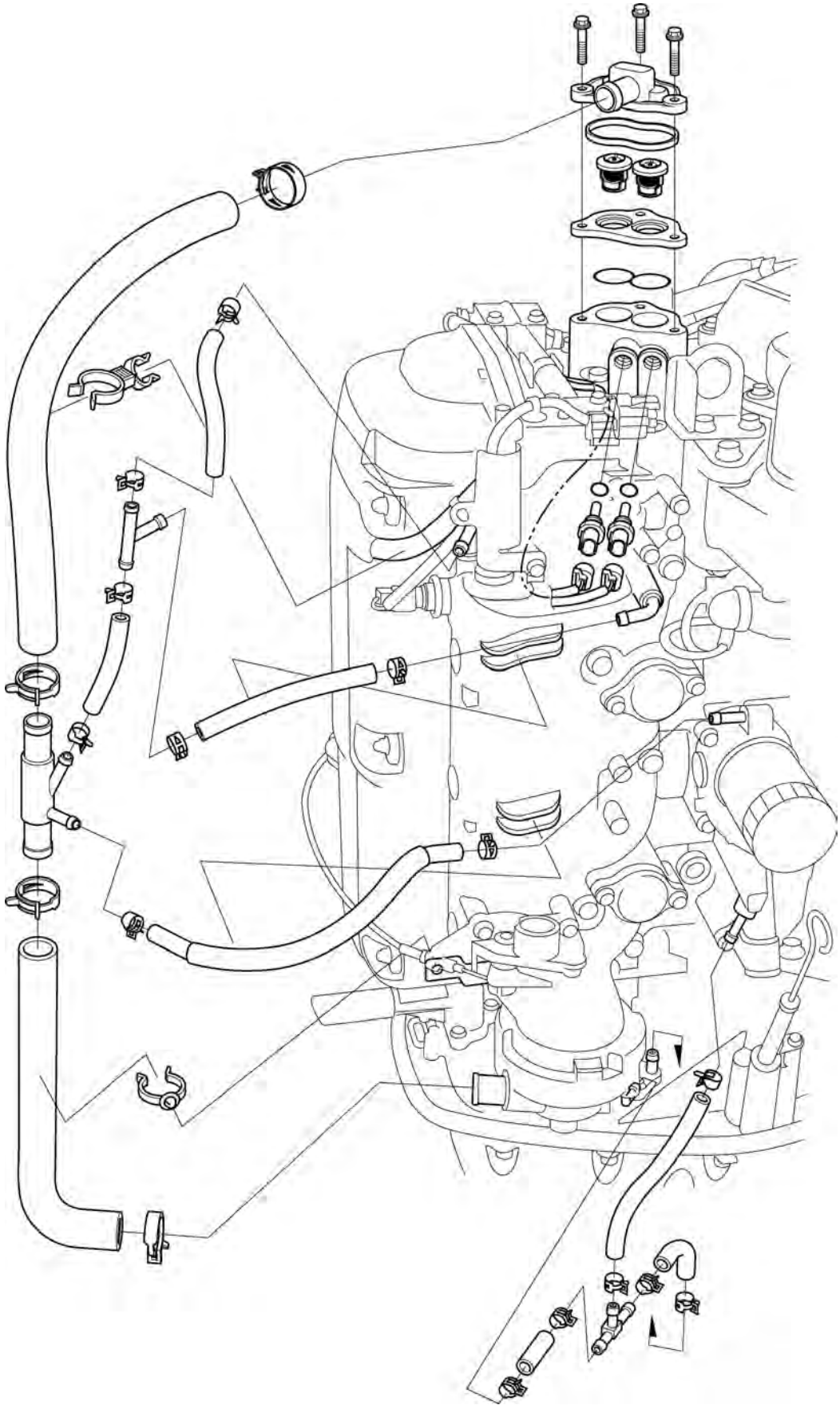
WATER PUMP REMOVAL/ INSTALLATION ····· 11-7

RELIEF VALVE DISASSEMBLY/ ASSEMBLY ····· 11-13

FLUSH VALVE DISASSEMBLY/ ASSEMBLY ····· 11-14

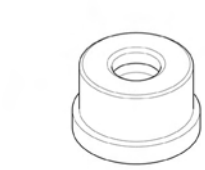
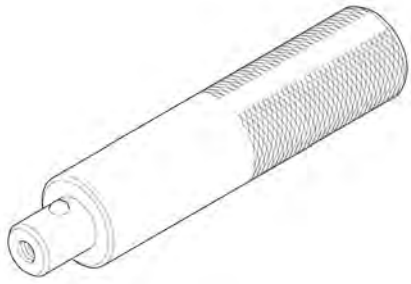
THERMOSTAT INSPECTION ····· 11-15

COMPONENT LOCATION

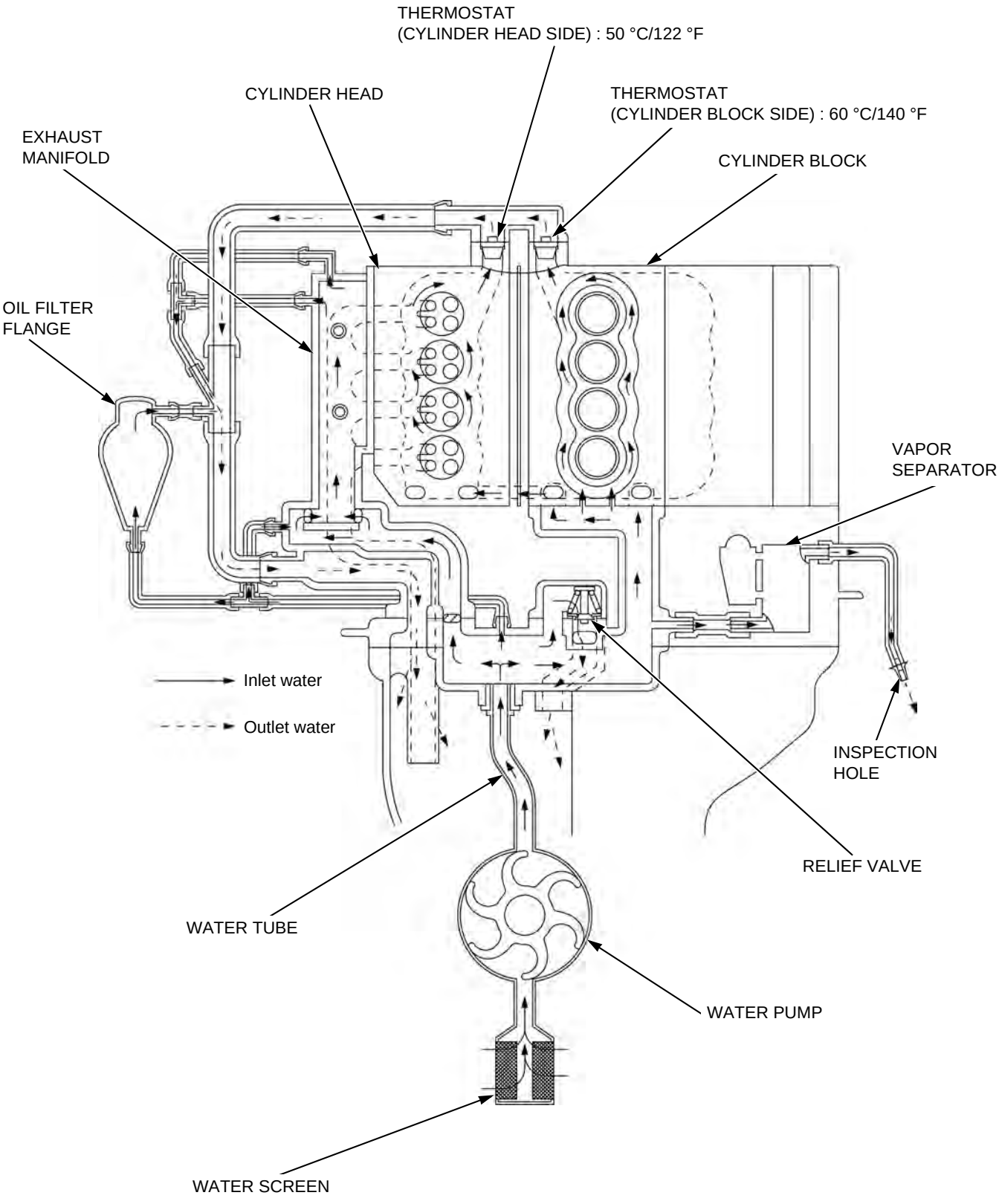


TOOLS

LIST

Attachment, 32 x 35 mm 07746-0010100 	Driver 07749-0010000 

WATER LINE DESCRIPTION



THERMOSTAT REMOVAL/INSTALLATION

Remove the engine cover.

Disconnect the water relief tube A (1) from the thermostat cover (2).

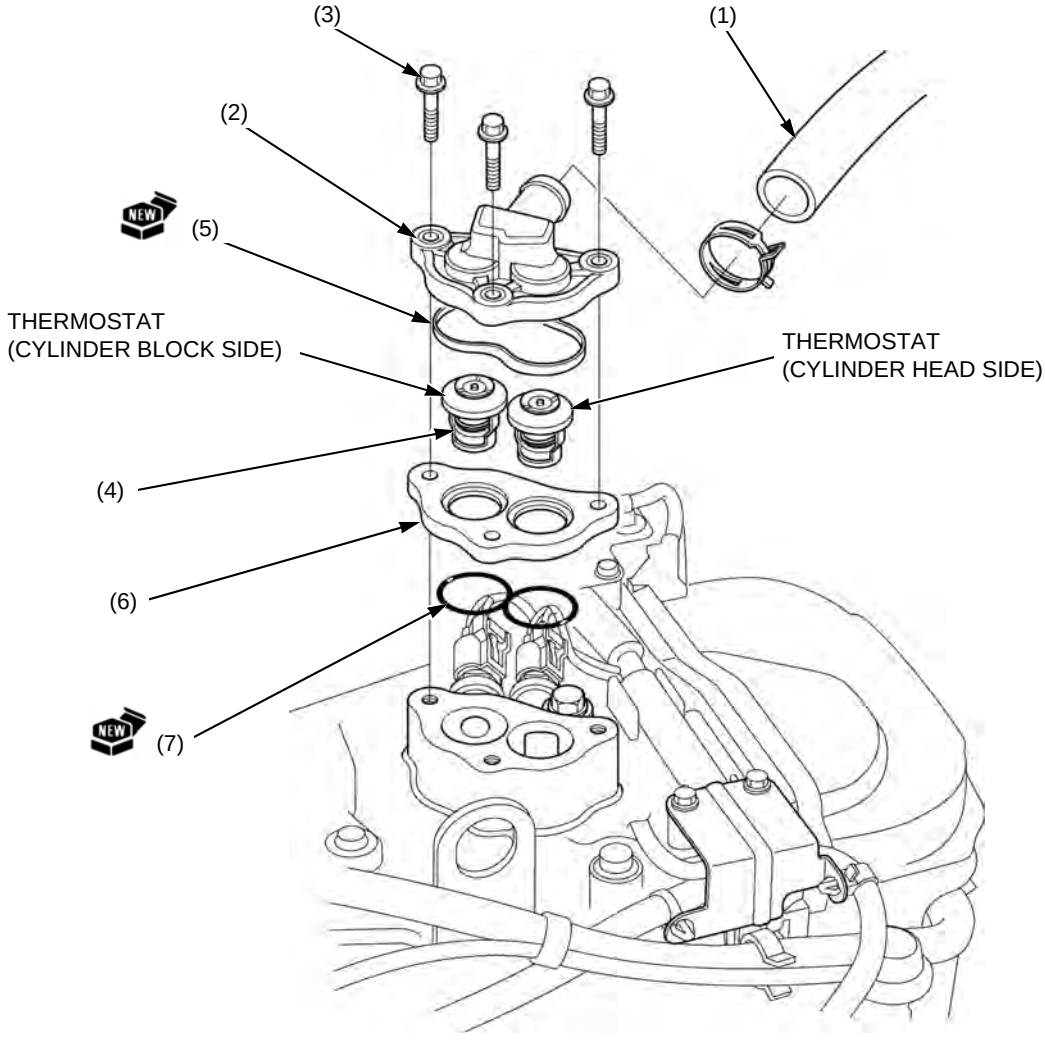
Remove the following:

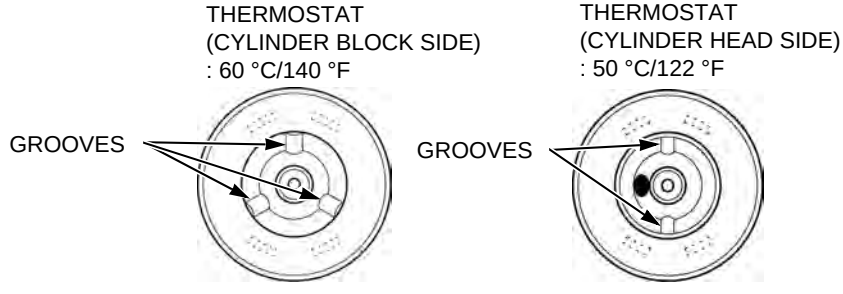
– Three bolts (6 x 22 mm) (3)
– Thermostat cover
– Two thermostats (4)
– Thermostat cover packing (5)
– Thermostat cover spacer (6)
– Thermostat spacer packing (7)

Replace the thermostat cover packing and thermostat spacer packing with new ones.

Installation is in the reverse order of removal.

• Install the thermostats in their proper locations.





WATER RELIEF TUBE REMOVAL/INSTALLATION

Remove the following:

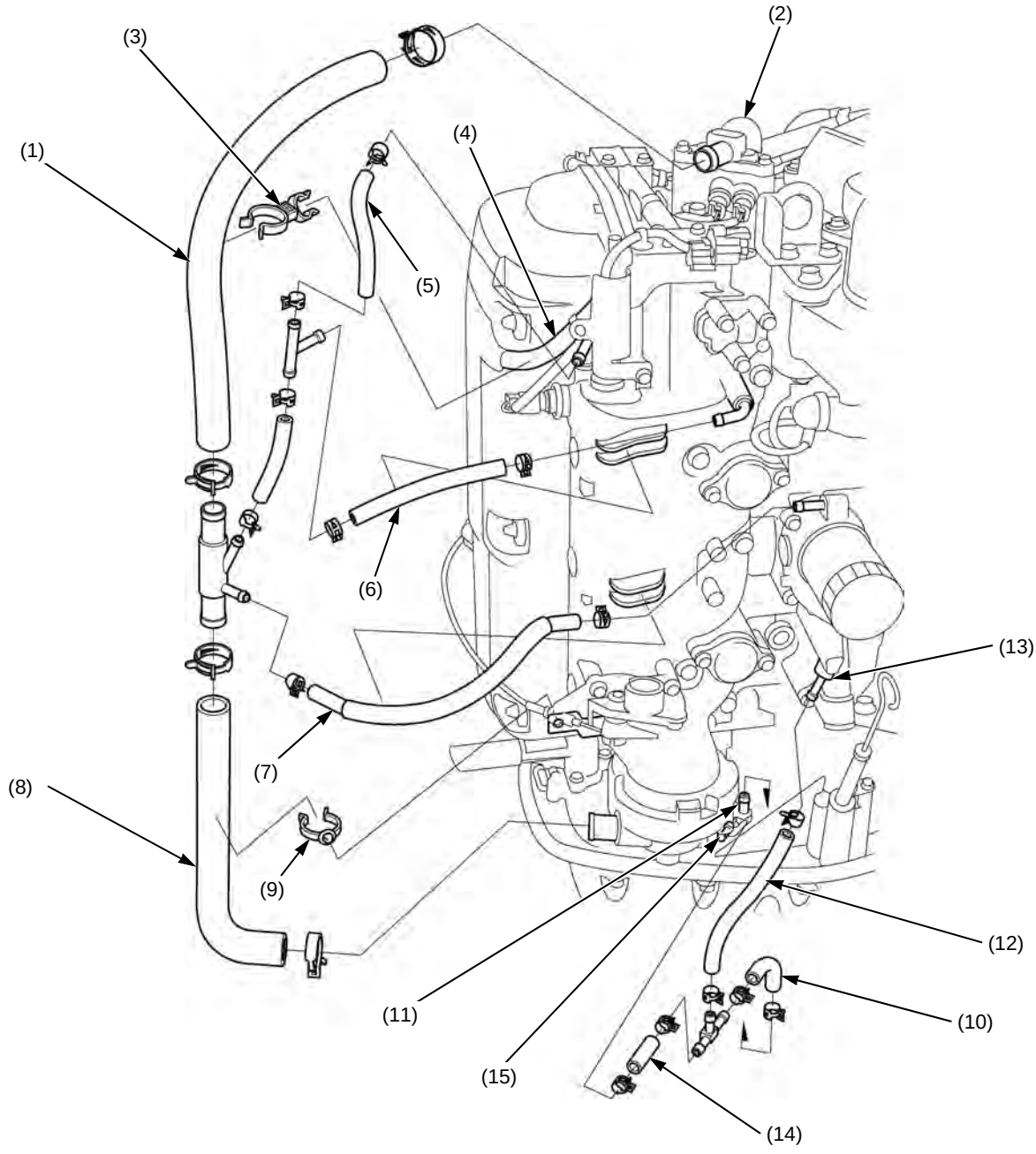
– Engine cover
– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)

Disconnect the water relief tube A (1) from the thermostat cover (2).
Remove the water tube clamp (3) from the water relief tube A and main wire harness (4).

Disconnect the tube (7 x 90 mm) (5), tube (7 x 120 mm) (6) and water tube E (7) from the engine side.
Release the water relief tube B (8) from the water tube clamp B (9).

Disconnect the water relief tube C (10) from the relief valve cover (11).
Disconnect the tube (7 x 160 mm) (12) from the oil filter flange (13).
Disconnect the tube (7 x 40 mm) (14) from the exhaust guide (15).

Installation is in the reverse order of removal.



WATER PUMP REMOVAL/ INSTALLATION

REMOVAL

Remove the following:

– Propeller
  – Standard rotation type (page 16-6)
  – Counter rotation type (page 17-6)
– Gear case
  – Standard rotation type (page 16-8)
  – Counter rotation type (page 17-8)

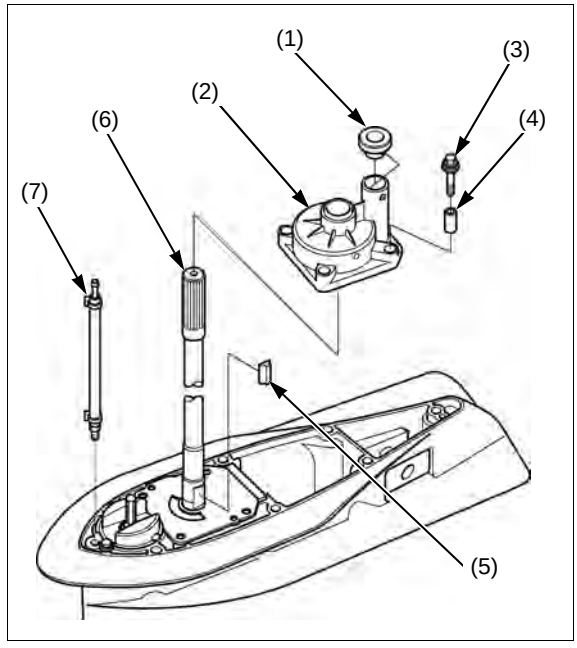
Remove the water tube seal ring (1) from the impeller housing (2)

Remove the four bolts (8 x 60 mm) (3), four distance collars (4), and impeller housing.

Remove the special key (5) from the vertical shaft (6).

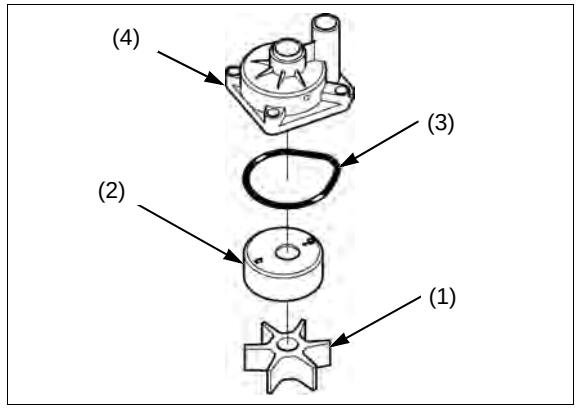
- Check the special key and key groove of the vertical shaft for wear; replace them if necessary.

Remove the speed sensor tube (7).



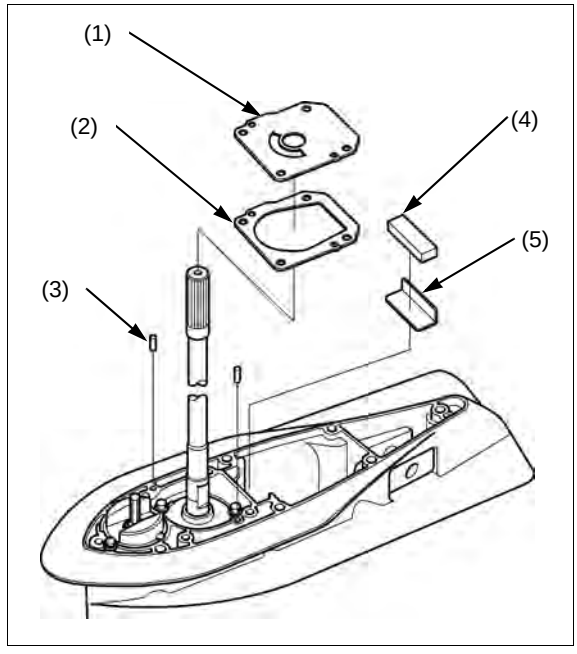
Remove the pump impeller (1), pump liner (2) and water pump O-ring (3) from the impeller housing (4).

Check the impeller housing for deformation; replace it if necessary.
Check the impeller for cracks, wear, or damage; replace it if necessary.
Check the pump liner for cracks or wear; replace it if necessary



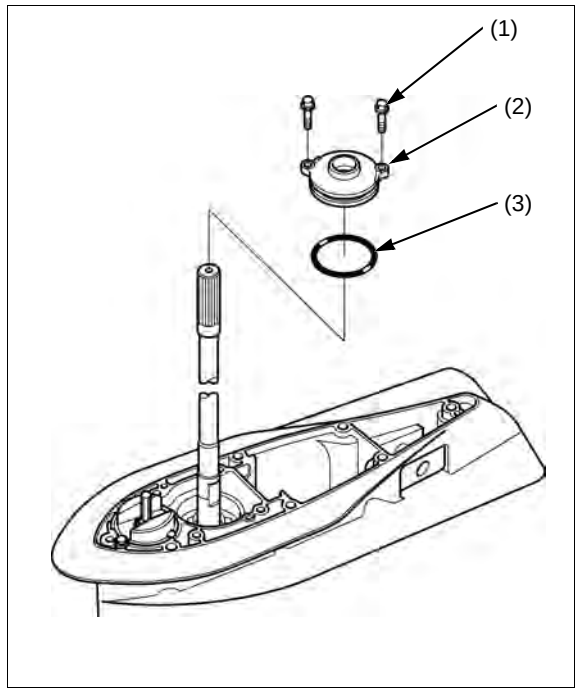
Remove the following:

– Impeller cover (1)
– Impeller gasket (2)
– Two dowel pins (3)
– Gear case grommet (4)
– Rubber setting plate (5)

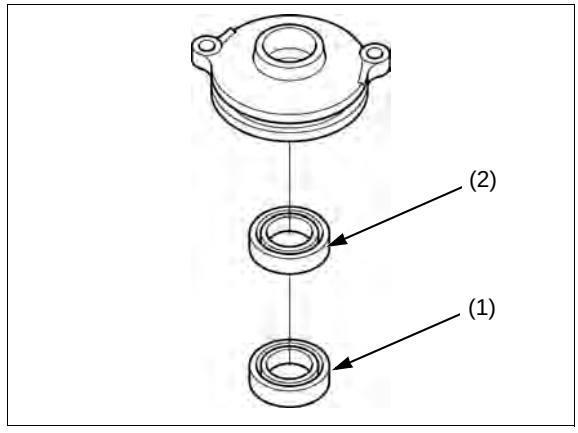


Remove the two bolts (1) and water seal housing (2)

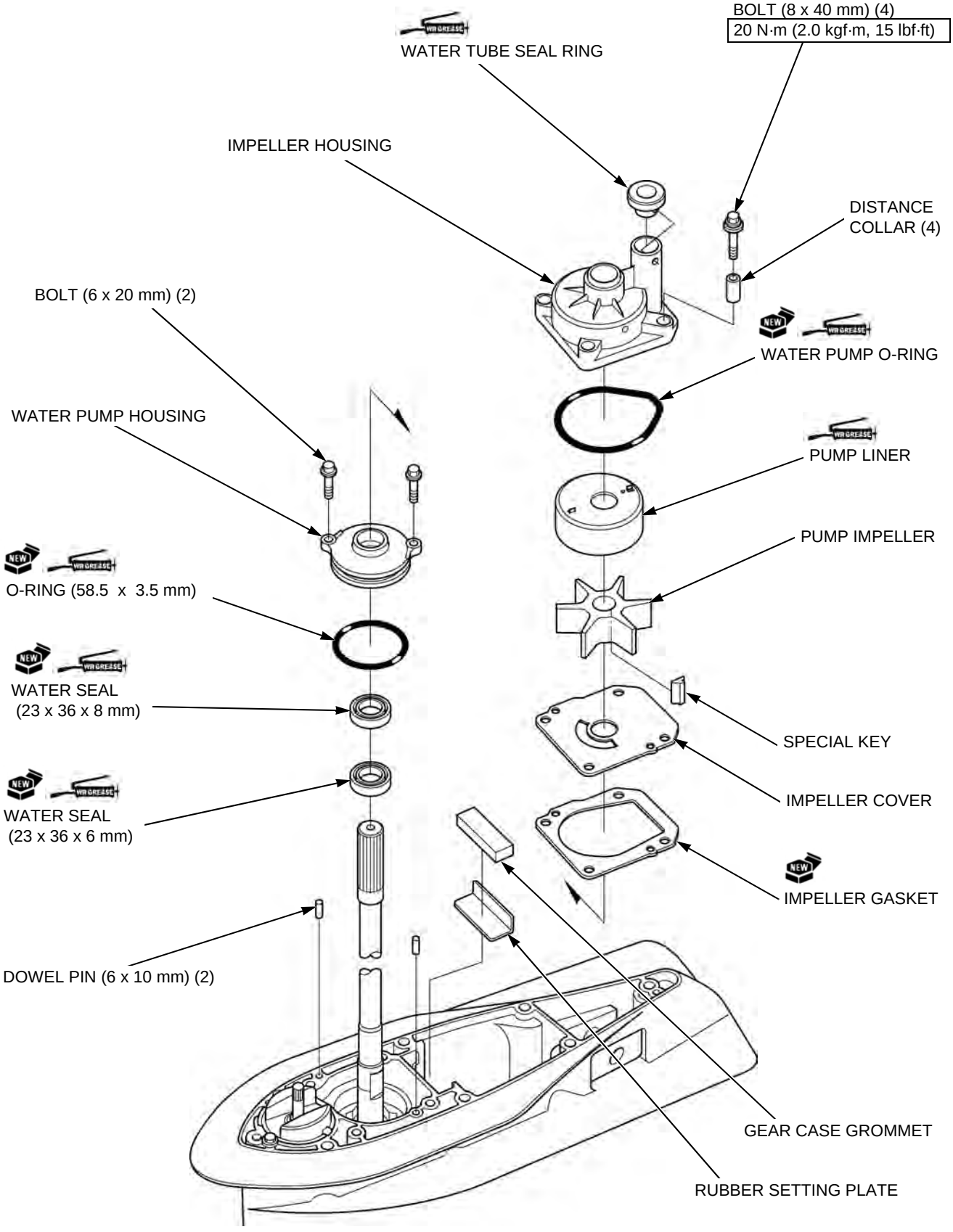
Remove the O-ring (58.5 x 3.5 mm) (3) from the water seal housing.



Remove the water seal (23 x 36 x 6 mm) (1) and water seal (23 x 36 x 8 mm) (2) using a commercially available oil seal remover.



EXPLODED VIEW



INSTALLATION

Apply soapy water to the circumference of the new water seals and marine grease to the water seals mating surface.

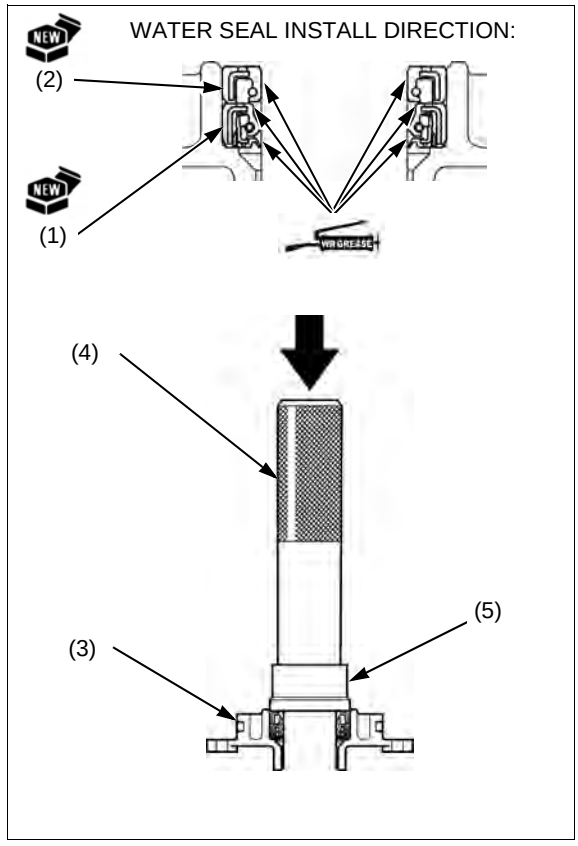
Drive the water seal (23 x 36 x 8 mm) (1) and water seal (23 x 36 x 6 mm) (2) into the water pump housing (3) using the special tools.
Note the installation direction of the water seals.

- The water seal (23 x 36 x 8 mm) is Brown, water seal (23 x 36 x 6 mm) is black, be careful not to confuse them.

TOOLS:

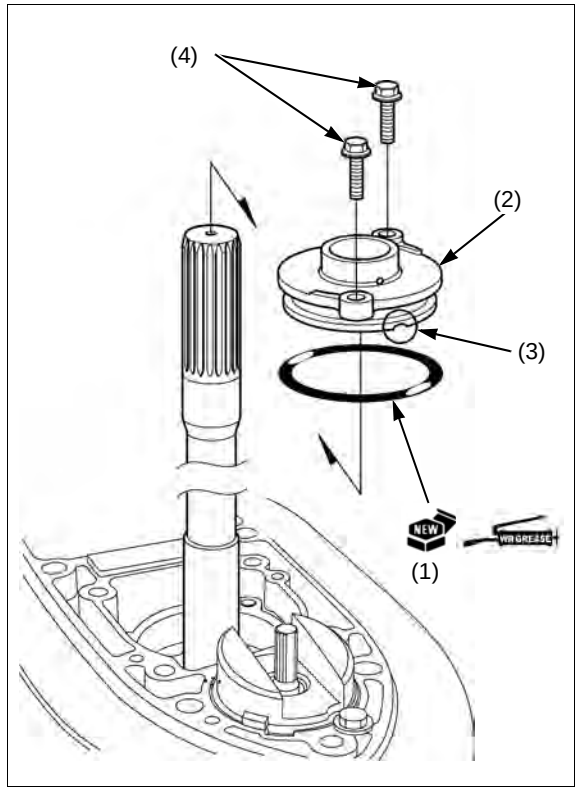
Driver (4)	**07749-0010000**
Attachment, 32 x 35 mm (5)	**07746-0010100**

After installing the water seal, apply marine grease to the water seal lips.



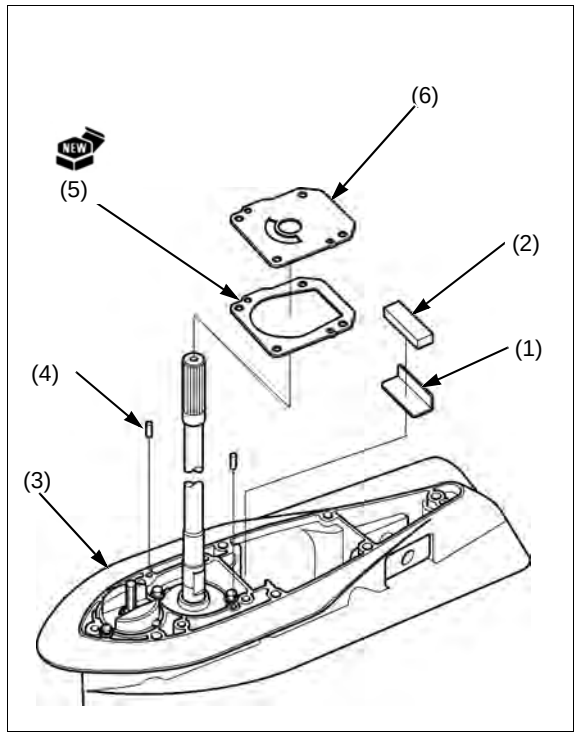
Apply marine grease to a new O-ring (58.5 x 3.5 mm) (1) and install it to the water seal housing (2).

Install the water seal housing with its cut out (3) facing the forward direction as shown.
Install and tighten the two bolts (4).



Install the rubber setting plate (1) and gear case grommet (2) to the gear case (3).

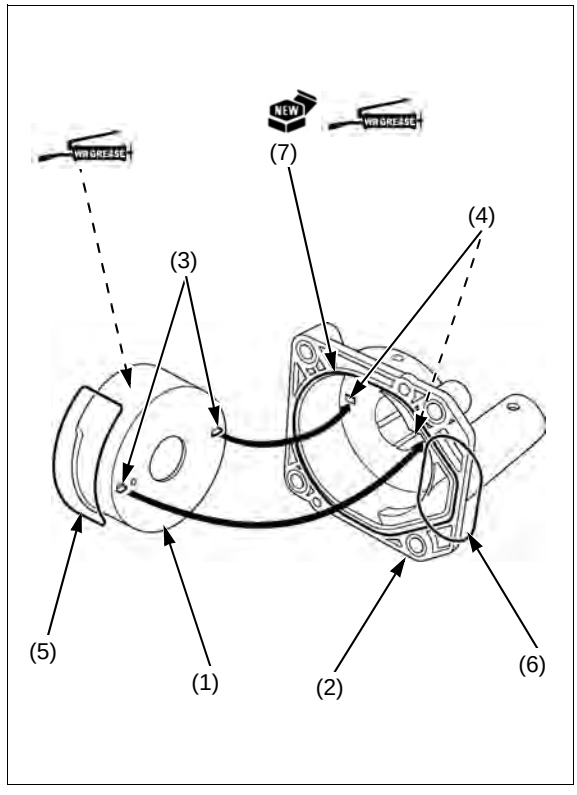
Install the two dowel pins (4), a new impeller gasket (5) and impeller cover (6).



Apply marine grease to the pump liner (1) inner surface.

Install the pump liner into the impeller housing (2) by aligning the two projections (3) on the pump liner with the two grooves (4) in the impeller housing.
Be sure that the cutout (5) of the pump liner is in alignment with the water inlet hole (6) of the impeller housing.

Apply marine grease to a new water pump O-ring (7) and install it into the impeller housing.



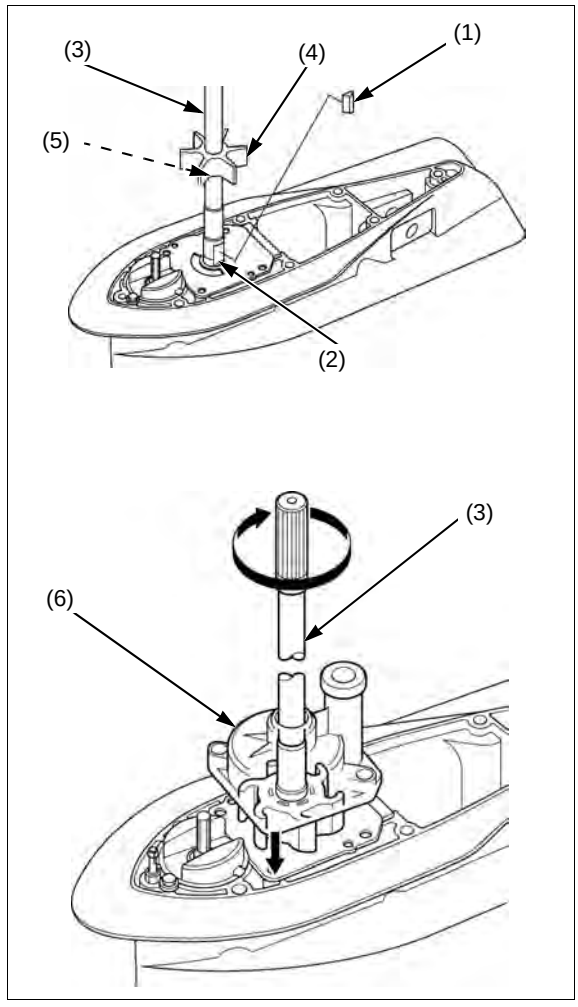
Set the special key (1) to the groove (2) in the vertical shaft (3).

Install the pump impeller (4) by aligning the key groove (5) in the pump impeller with the special key.

Install the impeller housing (6) while turning the vertical shaft clockwise.

NOTICE

Be sure to turn the vertical shaft clockwise.



Install the four distance collars (1) on the impeller housing (2) and tighten the four bolts (8 x 40 mm) (3) to the specified torque.

TORQUE: 20 N·m (2.0 kgf·m, 15 lbf·ft)

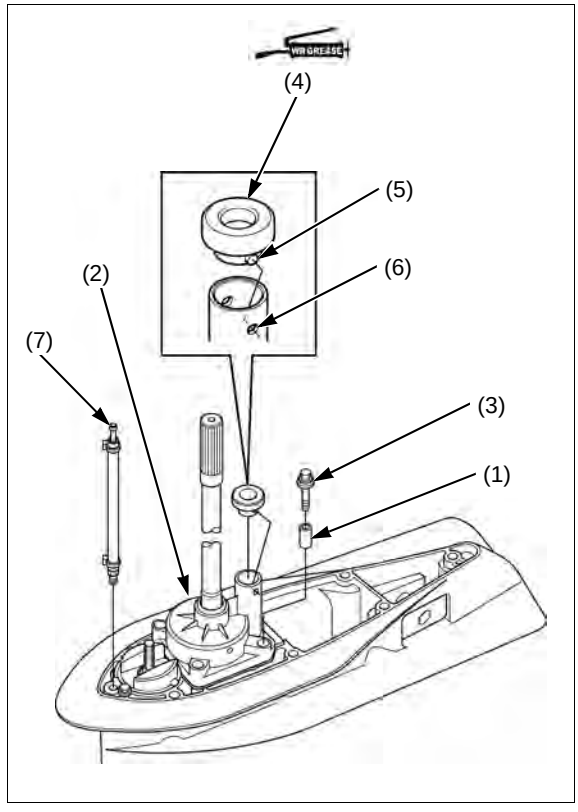
Apply marine grease to the inner wall of the water tube seal ring (4).
Install the water tube seal ring by aligning the projection (5) with the hole (6) in the housing.

Install the speed sensor tube (7).

Perform the gear case pressure check after assembly:
– Standard rotation type (page 16-47)
– Counter rotation type (page 17-51)

Install the following:

– Gear case
  – Standard rotation type (page 16-8)
  – Counter rotation type (page 17-8)
– Propeller
  – Standard rotation type (page 16-6)
  – Counter rotation type (page 17-6)



RELIEF VALVE DISASSEMBLY/ ASSEMBLY

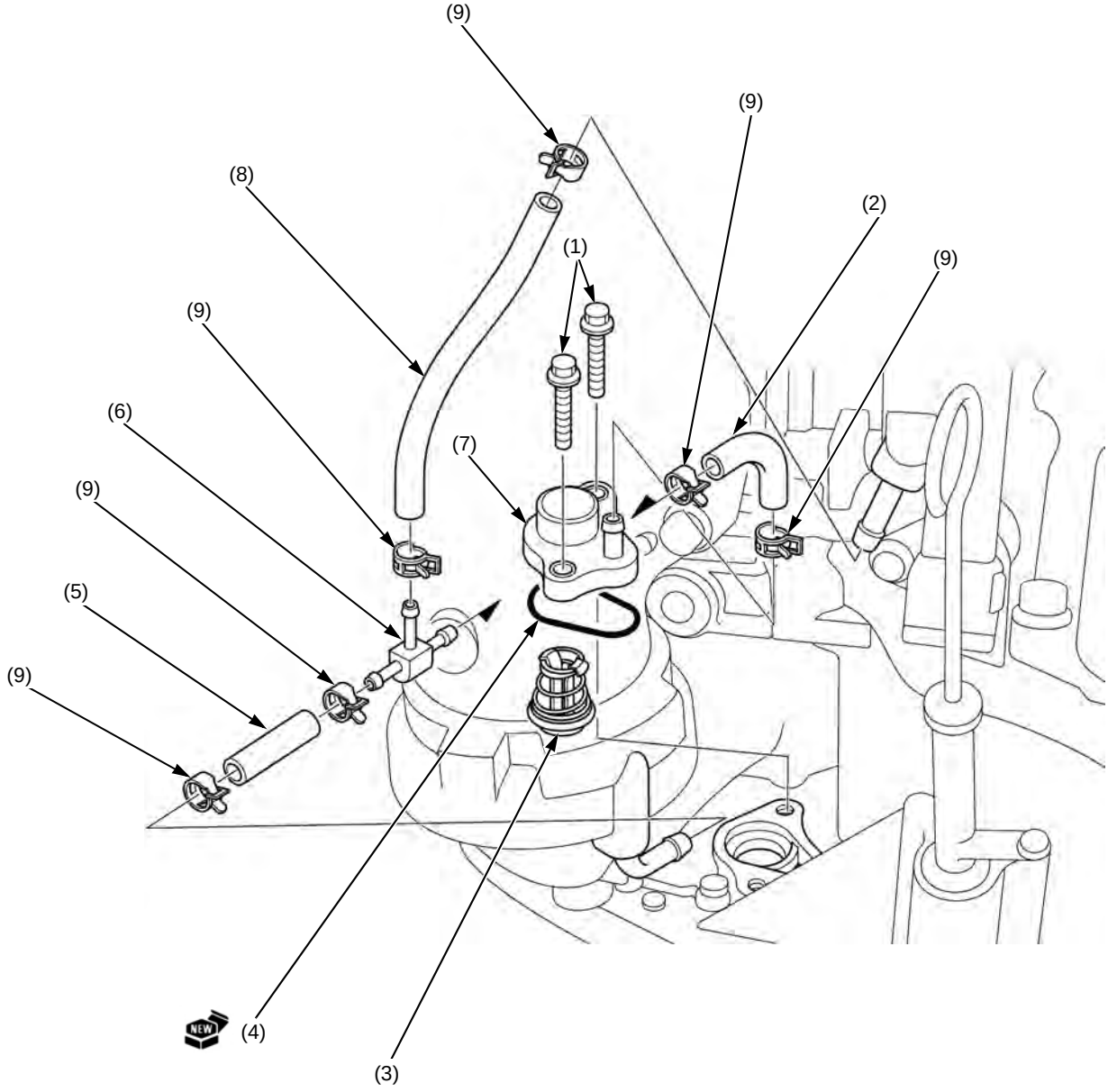
Remove the R. engine under cover (page 6-10).

Remove the following:

– Bolt (6 x 22 mm) (1)
– Water relief tube C (2)
– Relief valve (3)
– Relief valve cover O-ring (4)
– Tube (7 x 40 mm) (5)
– T-joint (6)
– Relief valve cover (7)
– Tube (7 x 160 mm) (8)
– Six tube clamps D10.5 (9)

Replace the relief valve cover O-ring with a new one.

Installation is in the reverse order of removal.



FLUSH VALVE DISASSEMBLY/ ASSEMBLY

Remove the following:

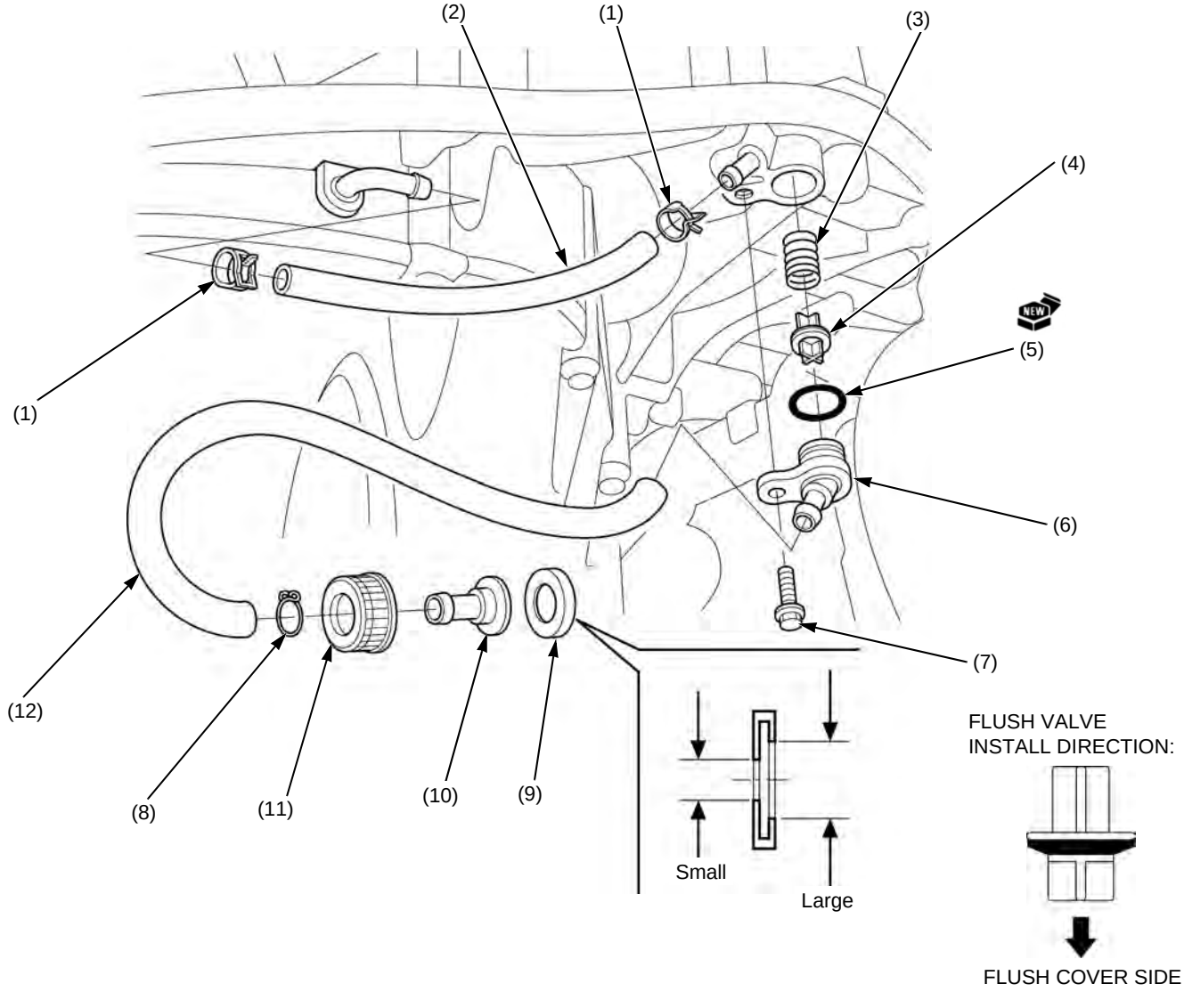
– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)

Remove the following:

– Two tube clamps D10.5 (1)
– Tube (7 x 200 mm) (2)
– Flush valve spring (3)
– Flush valve (4)
– O-ring (16 mm) (5)
– Flush valve cover (6)
– Bolt (6 x 16 mm) (7)
– Tube clip B1 (8)
– Water seal (9)
– Water hose joint A (10)
– Flush plug cap (11)
– Tube (8 x 300 mm) (12)

Replace the O-ring (16 mm) with a new one.

Installation is in the reverse order of removal.



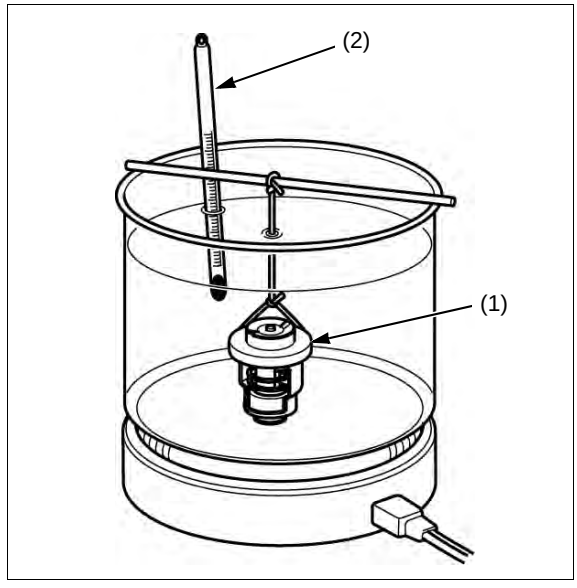
THERMOSTAT INSPECTION

Remove the thermostat (page 11-5).

Immerse the thermostat (1) in water.

Heat the water and observe the operation of the thermostat as the water temperature increases.

Measure the water temperature when the thermostat starts opening.
Don't let the thermometer (2) or the thermostat touch the container; this may cause a false reading.



CYLINDER HEAD SIDE:
START OPENING: 48 °C - 52 °C (118 °F - 126 °F)
FULLY OPEN: 60 °C (140 °F)

CYLINDER BLOCK SIDE:
START OPENING: 58 °C - 62 °C (136 °F - 144 °F)
FULLY OPEN: 70 °C (158 °F)

Measure the lift height when the thermostat is fully open.

CYLINDER HEAD SIDE:
LIFT HEIGHT: More than 3.0 mm (0.12 in)

CYLINDER BLOCK SIDE:
LIFT HEIGHT: More than 3.0 mm (0.12 in)

MEMO

12. LUBRICATION SYSTEM

COMPONENT LOCATION ····· 12-2

LUBRICATION SYSTEM DIAGRAM ····· 12-3

TOOLS ····· 12-4

OIL FILTER FLANGE REMOVAL/ INSTALLATION ····· 12-5

OIL CASE/WATER TUBE REMOVAL/ INSTALLATION ····· 12-6

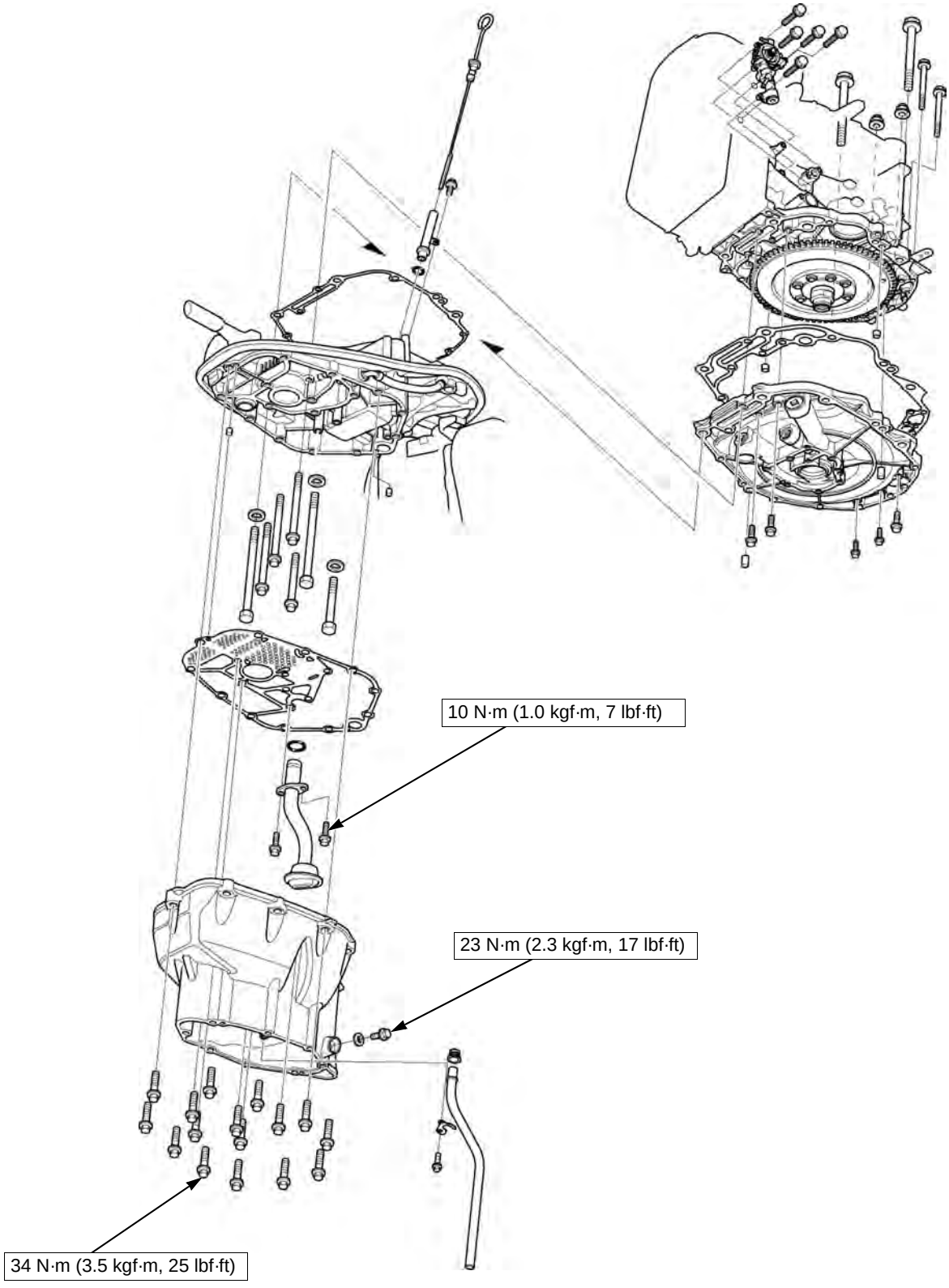
OIL PUMP REMOVAL/ INSTALLATION ····· 12-9

OIL PUMP DISASSEMBLY/ ASSEMBLY ····· 12-10

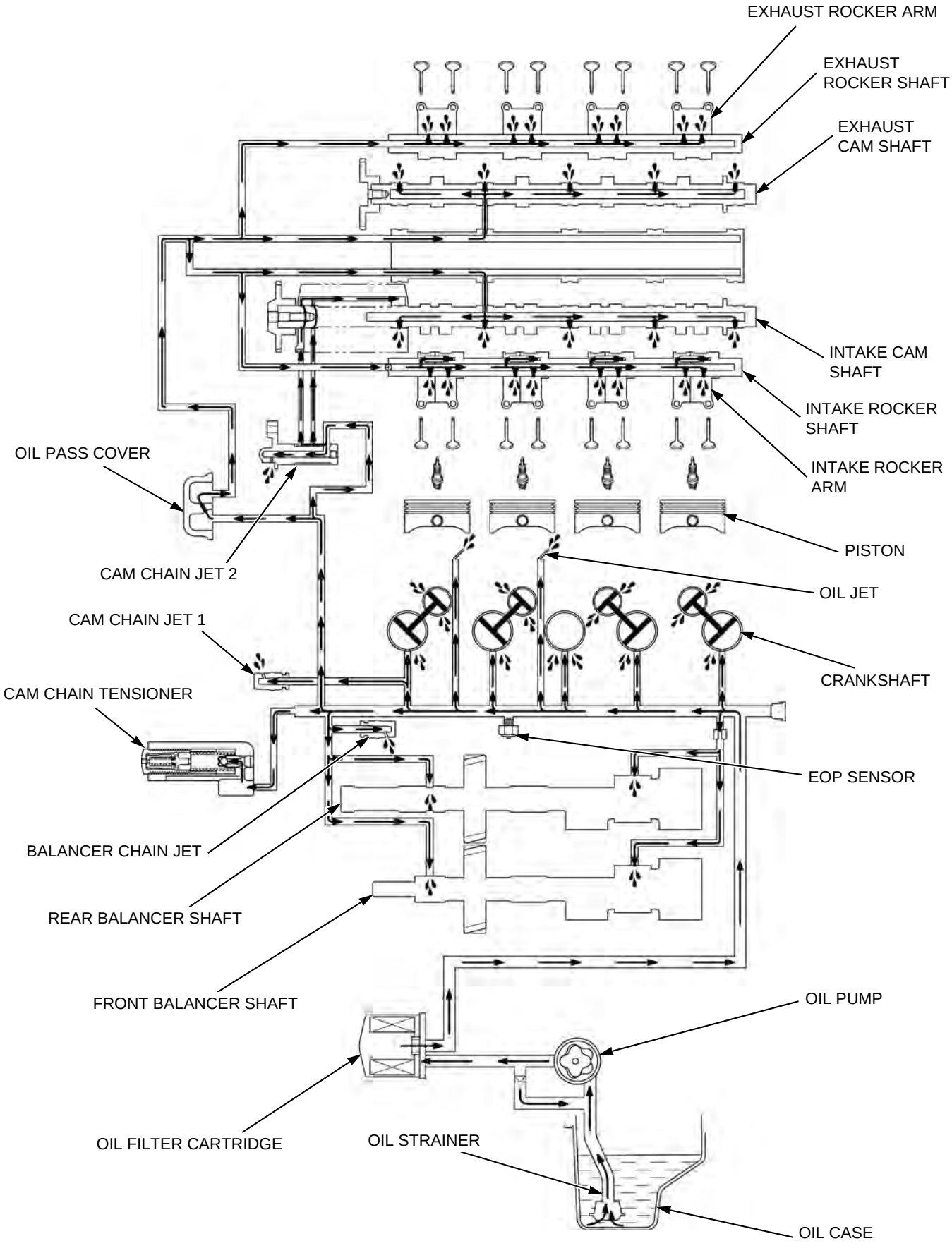
OIL PRESSURE TEST ····· 12-13

OIL PUMP INSPECTION ····· 12-14

COMPONENT LOCATION

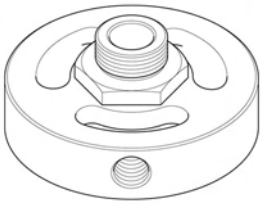
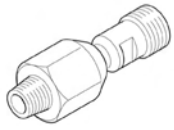
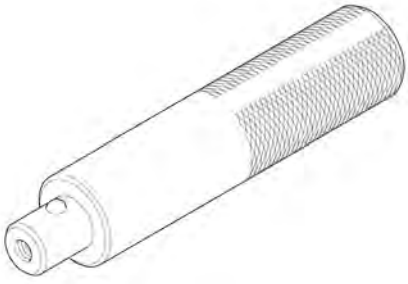
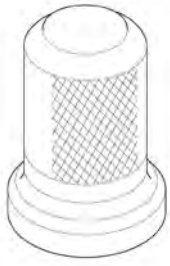


LUBRICATION SYSTEM DIAGRAM



TOOLS

LIST

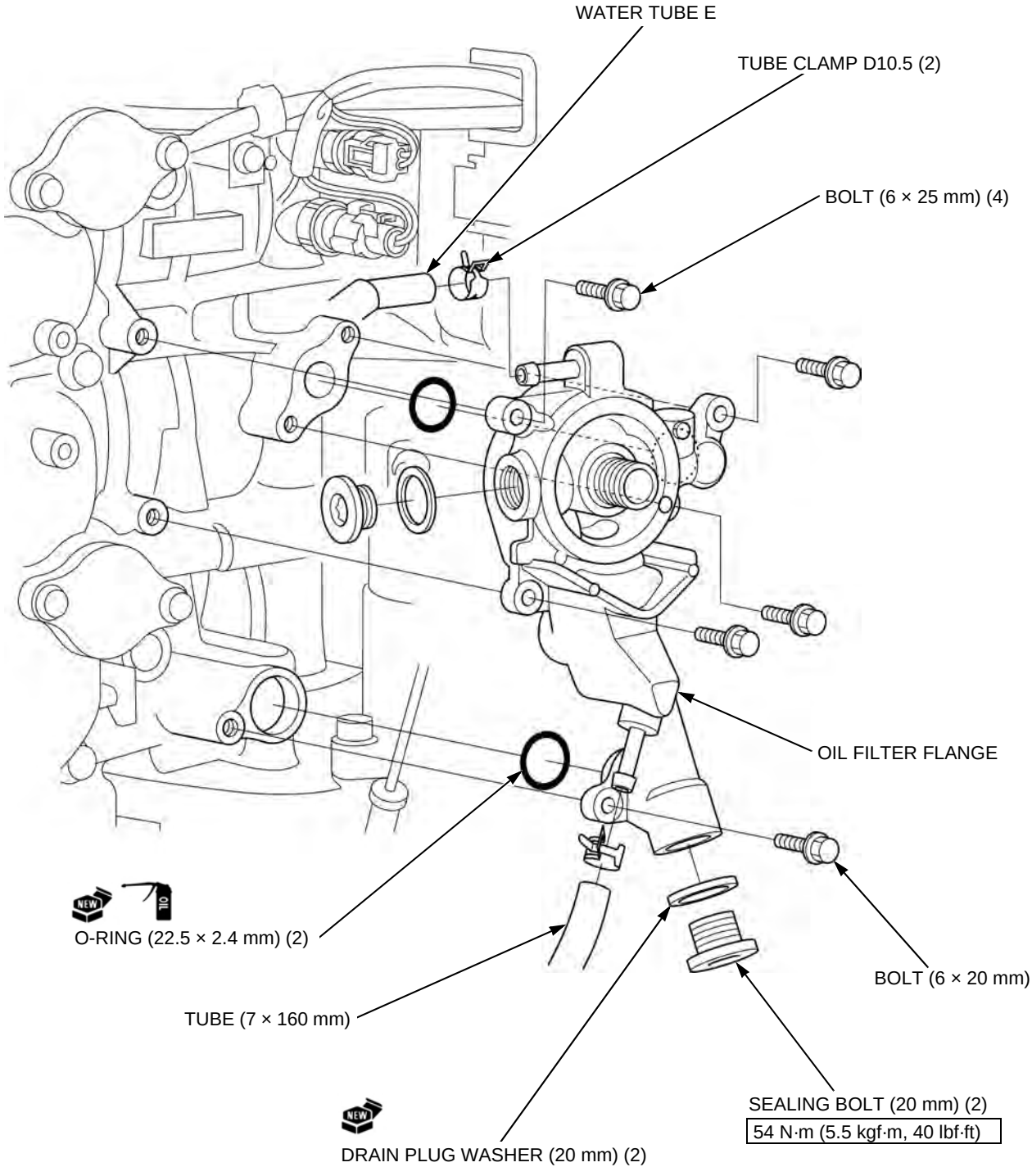
Oil pressure gauge attachment 070MJ-0010101 	Pressure gauge attachment 07406-0030000 	Oil pressure gauge set 07506-3000001 
Driver 07749-0010000 	Oil seal driver, 44.5 mm 07947-SB00100 	Oil seal driver, 72 mm 07947-6340201 

OIL FILTER FLANGE REMOVAL/INSTALLATION

Remove the following:

– Electric parts case (page 10-5)
– Remove the oil filter (page 3-6)

Installation is in the reverse order of removal.



OIL CASE/WATER TUBE REMOVAL/ INSTALLATION

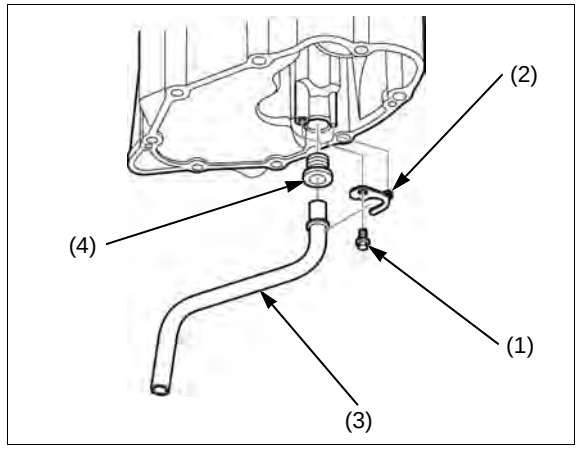
REMOVAL

Drain the engine oil (page 3-5).

Remove the following:

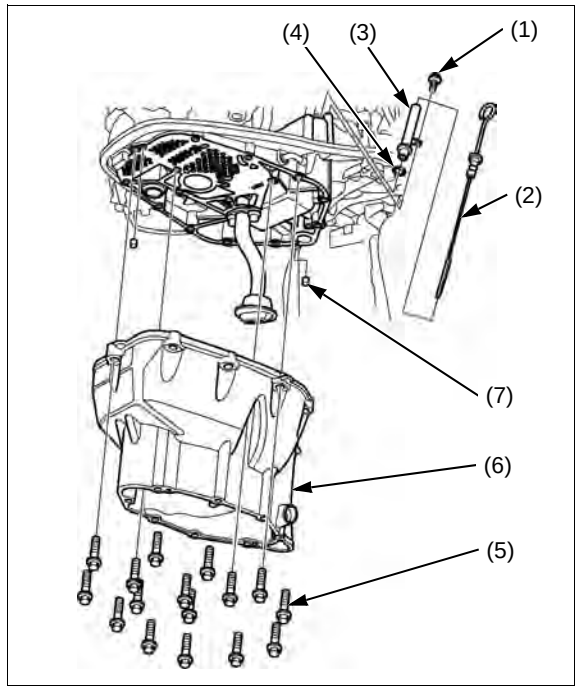
– Gear case
  – Standard rotation type (page 16-8)
  – Counter rotation type (page 17-8)
– Extension case
  – Standard rotation type (page 16-12)
  – Counter rotation type (page 17-12)

Remove the bolt (1) and water tube set plate (2).
Remove the water tube (3) and water tube grommet (4).

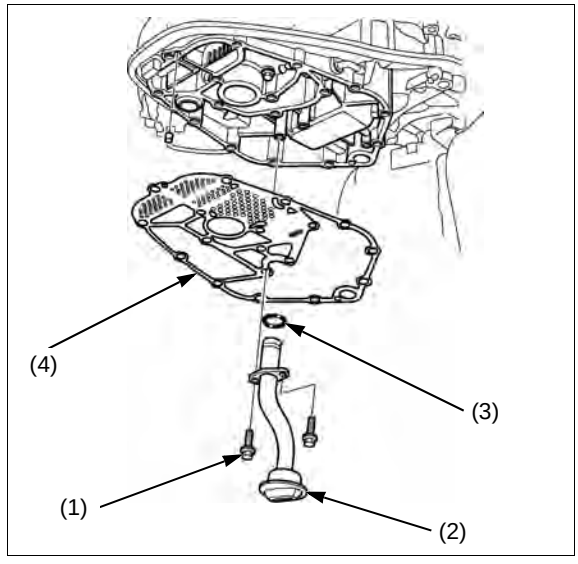


Remove the bolt (6 × 12 mm) (1), oil level gauge (2), oil level pipe (3) and O-ring (4).

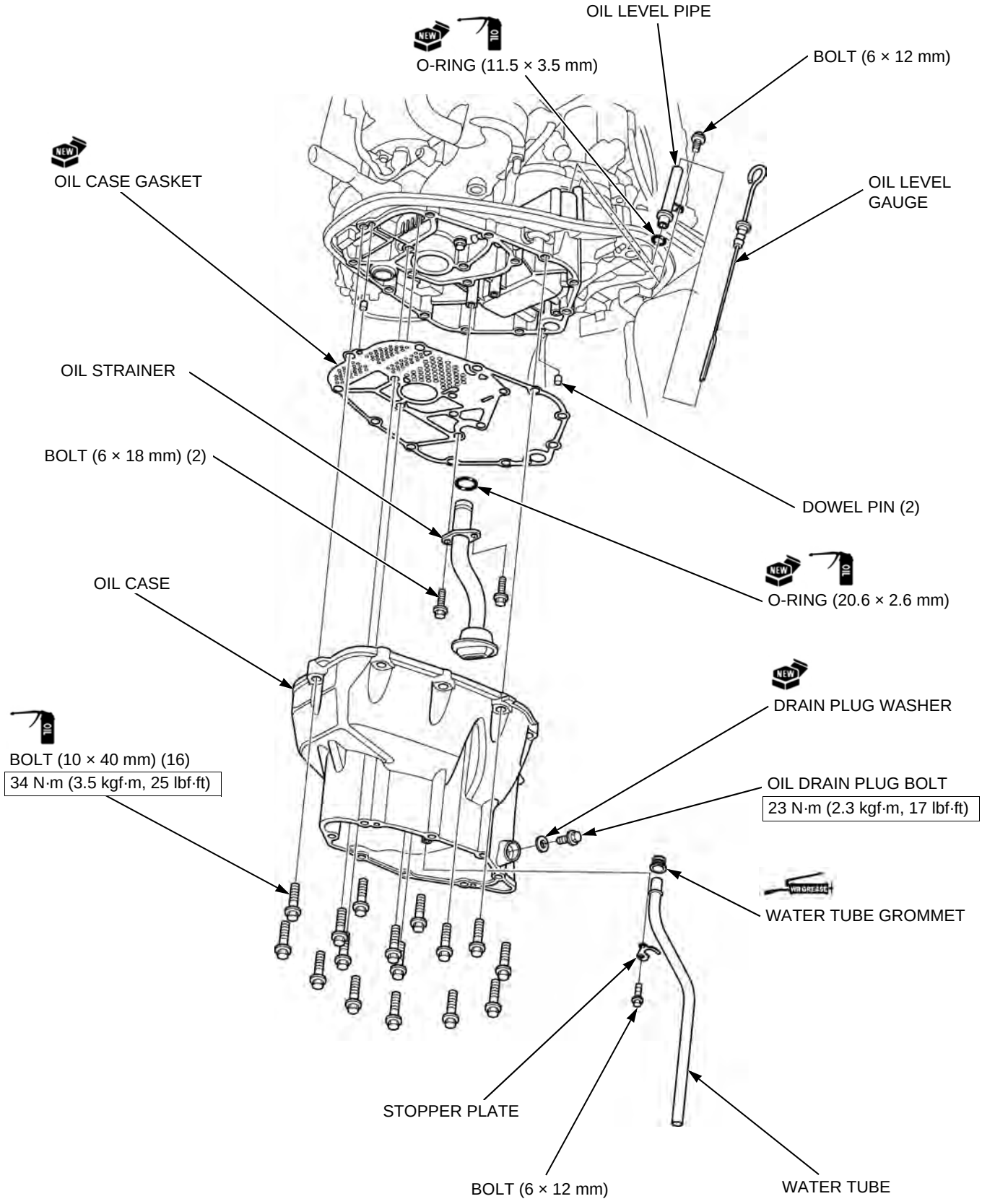
Remove the sixteen bolts (10 × 40 mm) (5), oil case (6) and two dowel pins (7).



Remove the two bolts (1), oil strainer (2), O-ring (3) and oil case gasket (4).



EXPLODED VIEW



INSTALLATION

Apply engine oil to a new O-ring (1), and install it to the oil strainer (2).

Apply 1.0 – 5.0 mm (0.04 – 0.20 in) bead of liquid sealant (ThreeBond® #1211 or equivalent) to the upper and lower area of a new oil case gasket (3) as shown.

NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

Install the oil case gasket and oil strainer, then tighten the two bolts (6 × 18 mm) (4).

Apply engine oil to the threads and seating surfaces of the sixteen bolts (10 × 40 mm) (5).
Install the two dowel pins (6) to the oil case (7), then tighten the sixteen bolts to the specified torque.

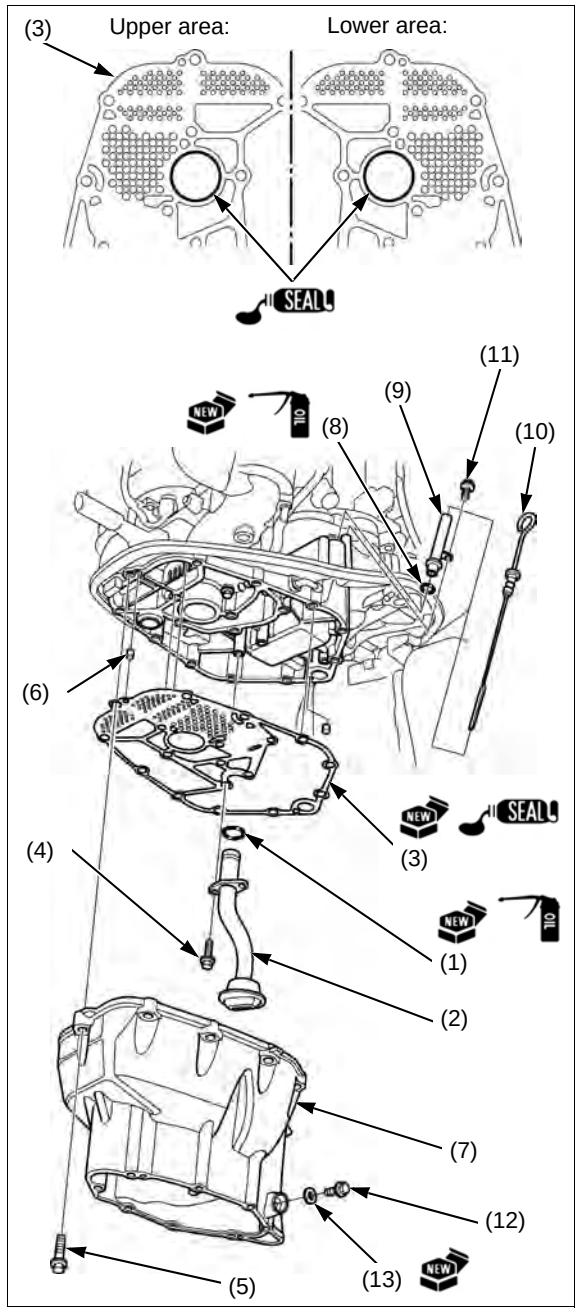
TORQUE: 34 N·m (3.5 kgf·m, 25 lbf·ft)

Apply engine oil to a new O-ring (8) and install it to the oil level pipe (9).

Install the oil level pipe and oil level gauge (10), then tighten the bolt (6 × 12 mm) (11).

Install the oil drain plug bolt (12) with a new sealing washer (13) and tighten it to the specified torque.

TORQUE: 23 N·m (2.3 kgf·m, 17 lbf·ft)



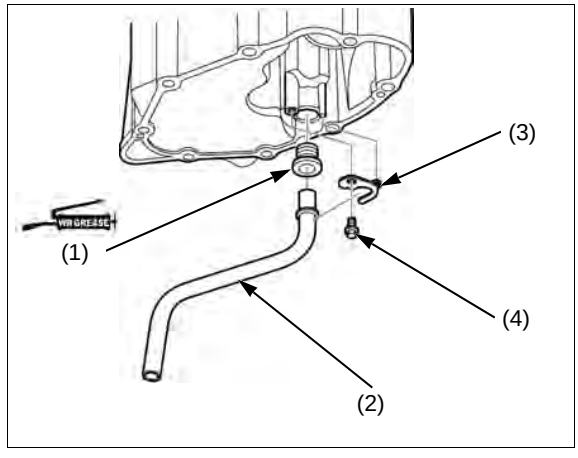
Apply marine grease to the water tube grommet (1) outer surface and install it to the water tube (2).

Install the water tube with the stopper plate (3) and tighten the bolt (4).

Install the following:

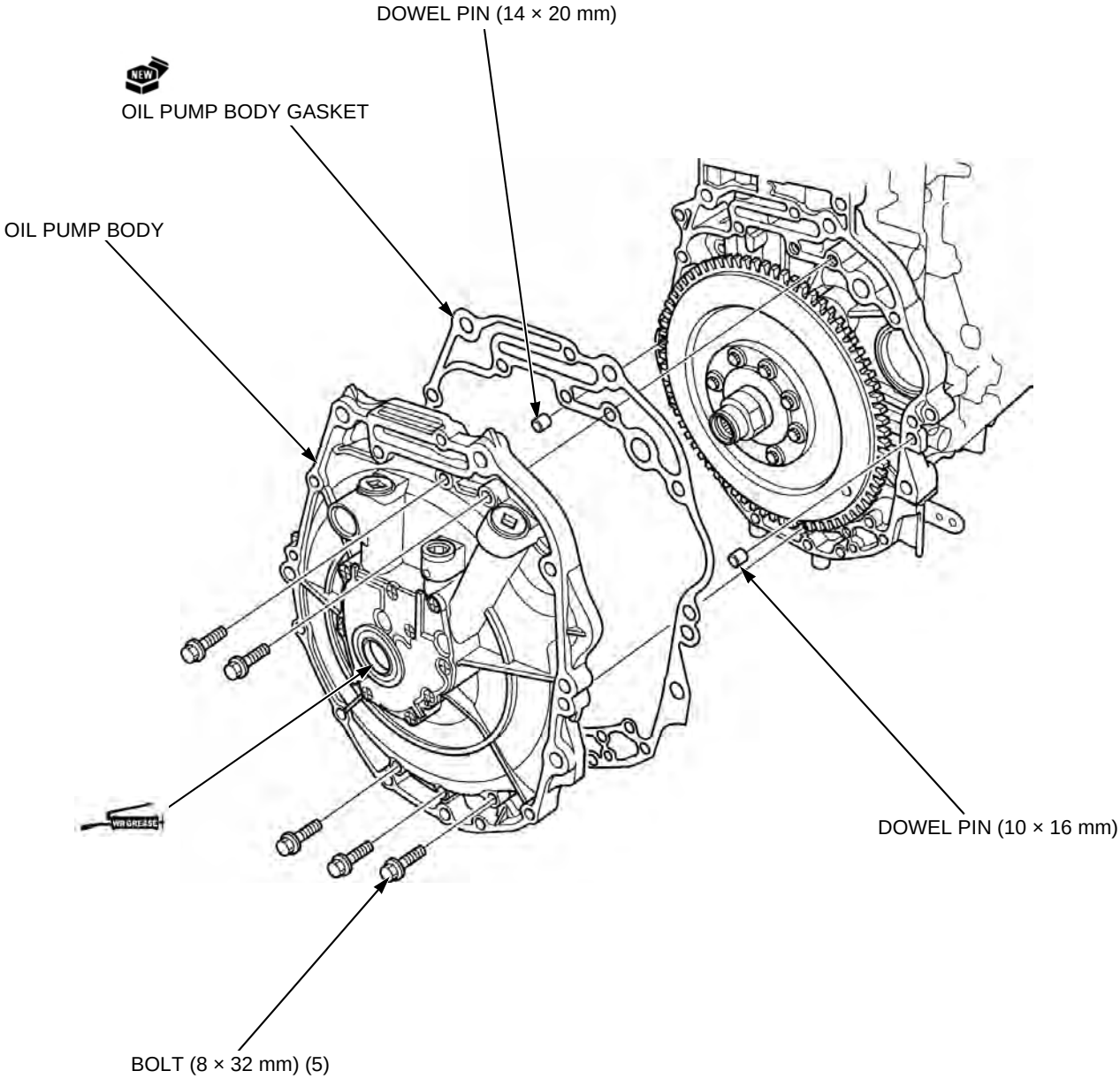
– Extension case
  – Standard rotation type (page 16-12)
  – Counter rotation type (page 17-12)
– Gear case
  – Standard rotation type (page 16-8)
  – Counter rotation type (page 17-8)

Refill the engine oil (page 3-5).



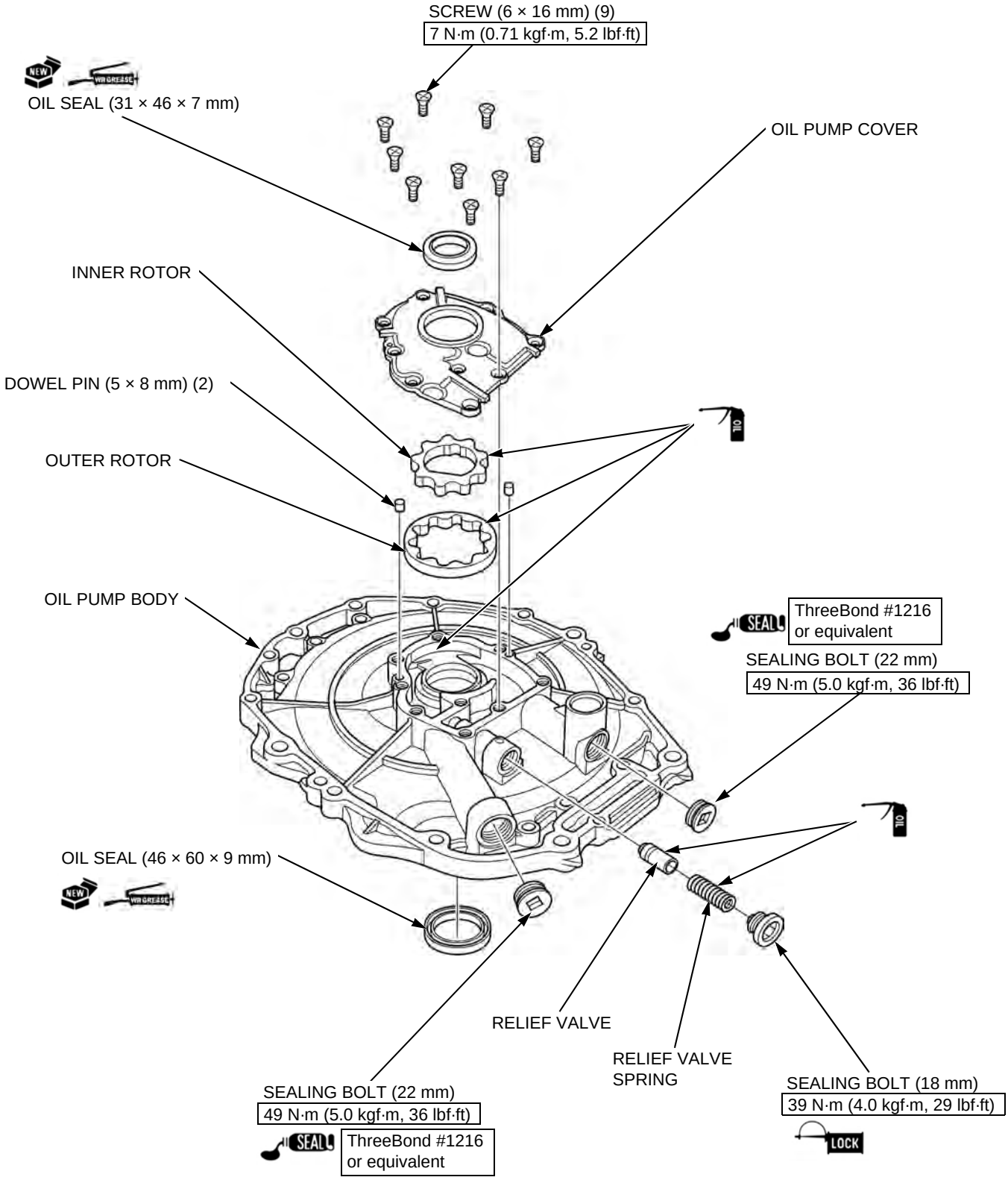
OIL PUMP REMOVAL/INSTALLATION

Remove the engine (page 13-3).



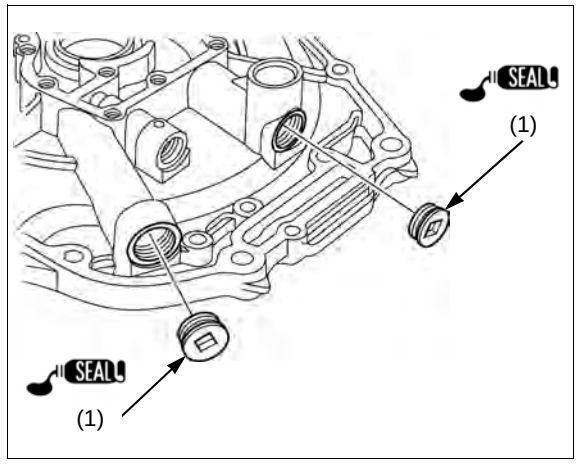
OIL PUMP DISASSEMBLY/ASSEMBLY

DISASSEMBLY



ASSEMBLY

Apply liquid sealant (Threebond® 1216 or equivalent) to the threads of the two sealing bolts (1).



NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

Install and tighten the sealing bolts to the specified torque.

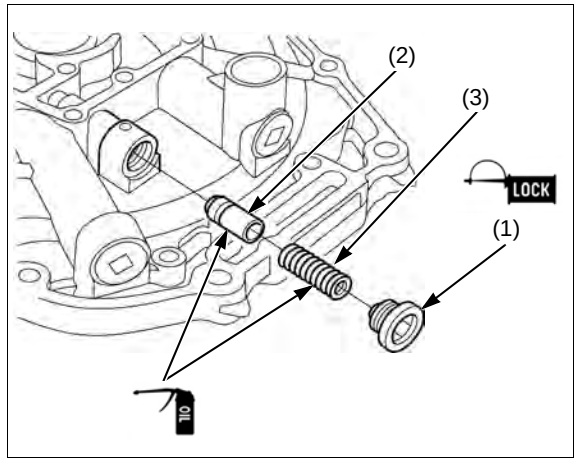
TORQUE: 49 N·m (5.0 kgf·m, 36 lbf·ft)

Apply locking agent to the threads of the sealing bolt (1).

Check the relief valve (2) surface for damage.
Apply engine oil to the relief valve and valve spring (3).

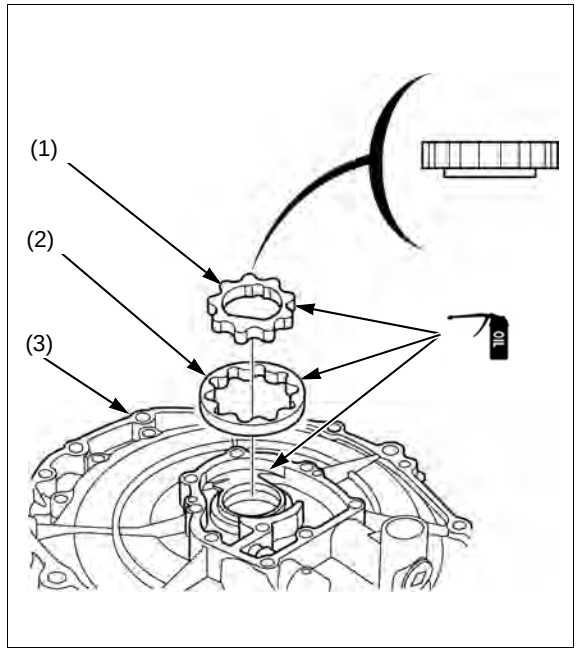
Install the relief valve and valve spring, then tighten the sealing bolt to the specified torque.

TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)



Clean the inner rotor (1) and outer rotor (2) and apply engine oil.

Apply engine oil to the oil pump body (3) and install the inner and outer rotor in the same direction as noted during disassembly.

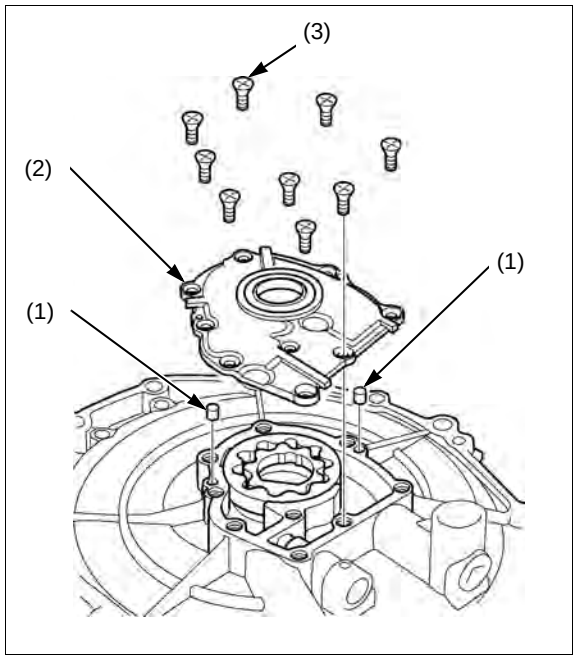


Install the two dowel pins (1) to the oil pump body.

Install the oil pump cover (2) and tighten the nine screws (3) to the specified torque.

TORQUE: 7 N·m (0.71 kgf·m, 5.2 lbf·ft)

After assembly, check that the rotors rotate smoothly.



Install the oil seal (46 × 60 × 9 mm) (1) until the depth from the oil pump body surface is 27.4 – 28.0 mm (1.08 – 1.10 in) (2) as shown, using the special tools.

TOOLS:

Driver (3)	**07749-0010000**
Oil seal driver, 72 mm (4)	**07947-6340201**

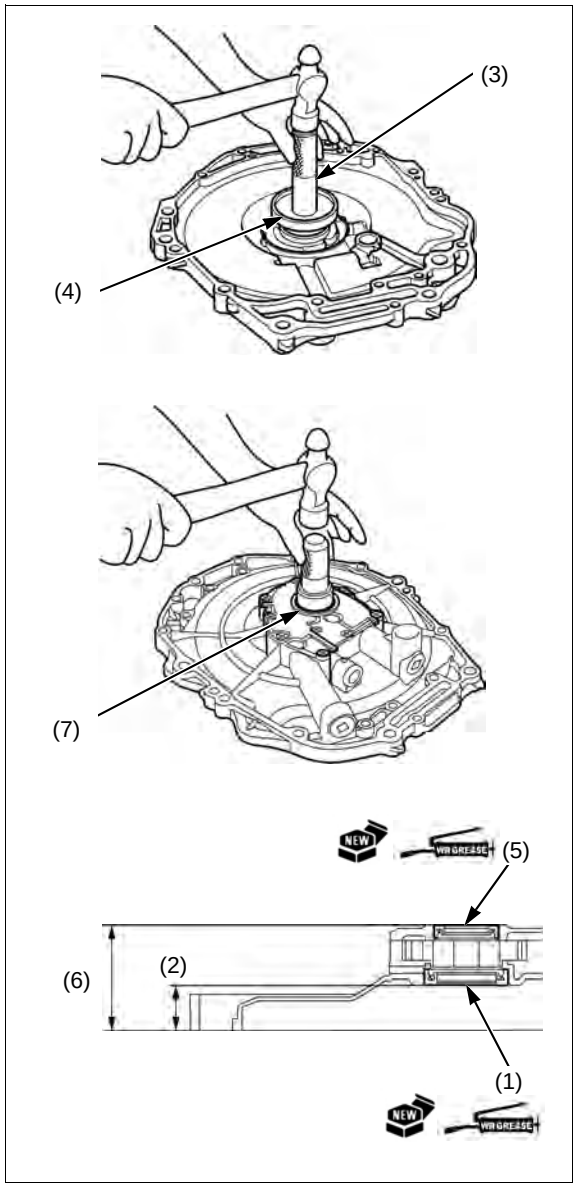
Install the oil seal (31 × 46 × 7 mm) (5) until the depth from the oil pump body surface is 63.9 – 64.5 mm (2.52 – 2.54 in) (6), using the special tool.

TOOL:

Oil seal driver, 44.5 mm (7)	**07947-SB00100**

Apply marine grease to the lips of each oil seal.

Install the oil pump (page 12-9).



OIL PRESSURE TEST

Remove the oil filter (page 3-6).

Check the condition of the O-ring (1) of the special tool and install it to the oil filter flange (2).
Tighten the special tool to the specified torque.

TOOL:
Oil pressure gauge attachment (3) **070MJ-0010101**

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Install and tighten the special tool to the specified torque.

TOOL:
Pressure gauge attachment (4) **07406-0030000**

TORQUE: 8.3 N·m (0.85 kgf·m, 6.1 lbf·ft)

Install the special tool.

TOOL:
Oil pressure gauge set (5) **07506-3000001**

Install the oil filter (page 3-6).

Check the engine oil level (page 3-4).

Remove the propeller.

– Standard rotation type (page 16-6)
– Counter rotation type (page 17-6)

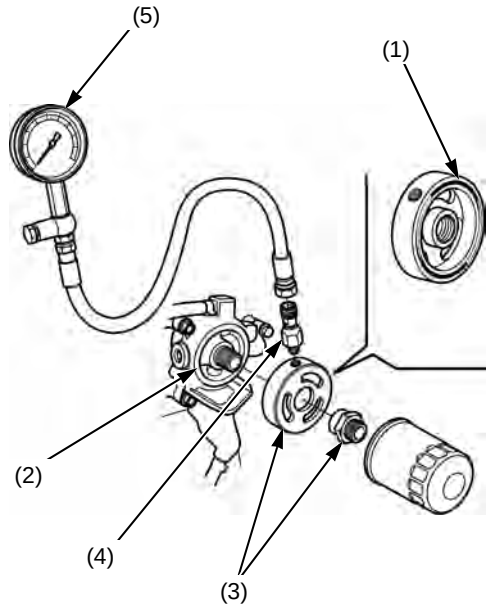
Run the outboard in a test tank with the water level at least 4 inches above the anti-ventilation plate. Allow the engine to warm up to normal operating temperature, and then measure the oil pressure.

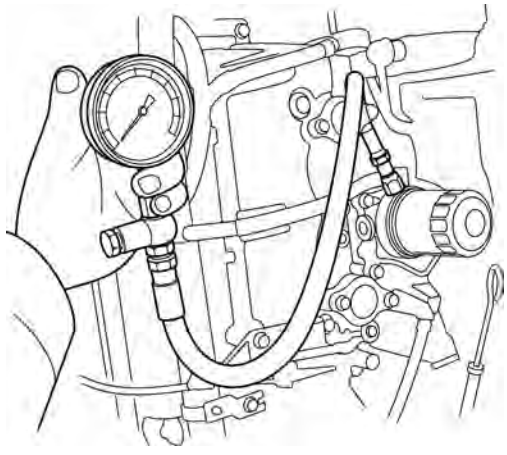
OIL PRESSURE (Pressure check at 2050 min^{-1} (rpm) in neutral:
147 kPa (1.5 kgf/cm^2, 21 psi) or higher

If the oil pressure is lower than the specified value, inspect the oil pump rotor and body for wear (page 12-14).

Remove the special tools.

Install the oil filter (page 3-6).



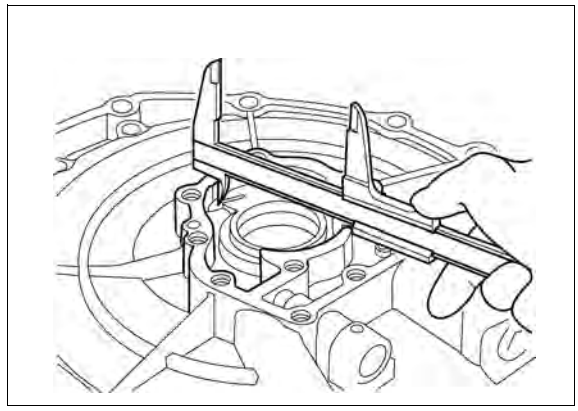


OIL PUMP INSPECTION

OIL PUMP BODY I.D.

Measure the oil pump body I.D.

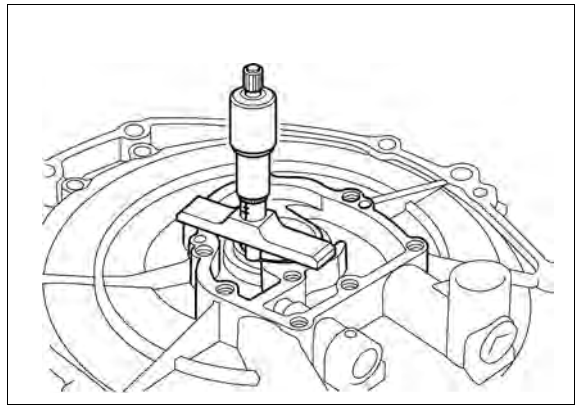
STANDARD:
84.000 – 84.030 mm (3.3071 – 3.3083 in)



OIL PUMP BODY DEPTH

Measure the oil pump body depth.

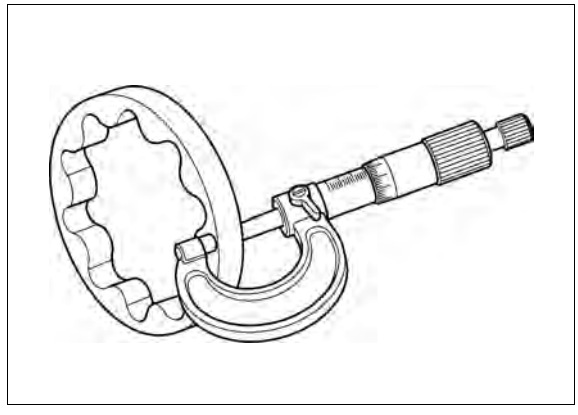
STANDARD:
12.520 – 12.550 mm (0.4929 – 0.4941 in)



OUTER ROTOR HEIGHT

Measure the outer rotor height.

STANDARD:
12.480 – 12.500 mm (0.4913 – 0.4921 in)

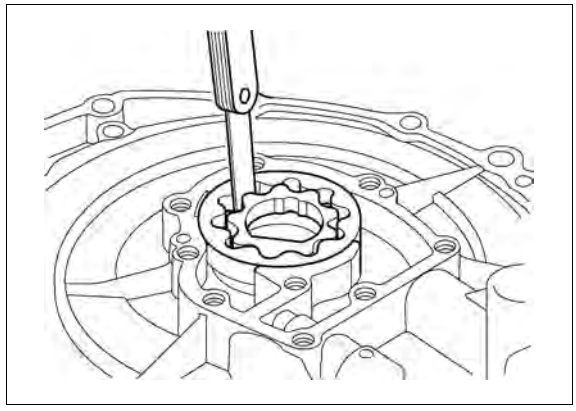


INNER ROTOR-TO-OUTER ROTOR CLEARANCE

Measure the inner rotor-to-outer rotor clearance.

STANDARD:
0.04 – 0.16 mm (0.002 – 0.006 in)
SERVICE LIMIT:
0.20 mm (0.008 in)

Replace the inner rotor and outer rotor as a set (page 12-10) if the measurement exceeds the service limit.

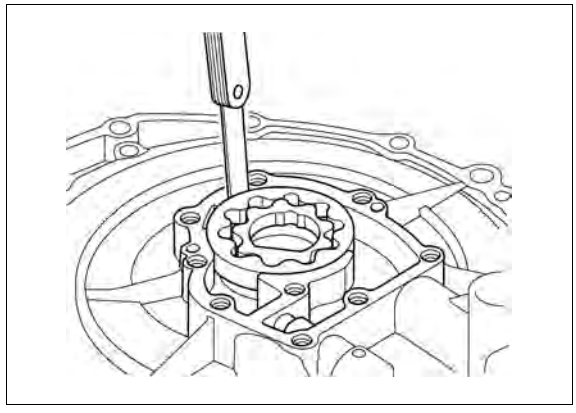


OUTER ROTOR-TO-PUMP BODY CLEARANCE

Measure the outer rotor-to-pump body clearance.

STANDARD:
0.10 – 0.18 mm (0.004 – 0.007 in)
SERVICE LIMIT:
0.20 mm (0.008 in)

Replace the outer rotor and oil pump body as a set (page 12-10) if the measurement exceeds the service limit.

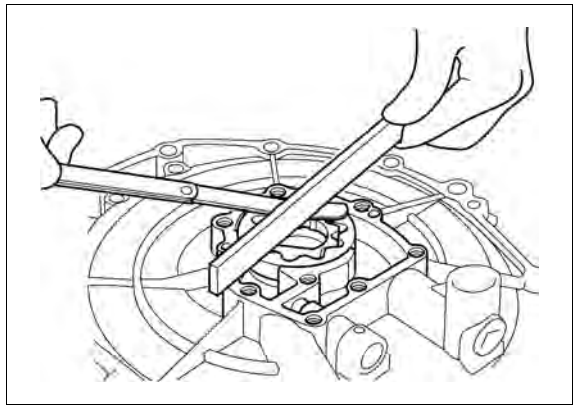


OUTER ROTOR-TO-OIL PUMP BODY SIDE CLEARANCE

Measure the outer rotor-to-oil pump body side clearance.

STANDARD:
0.02 – 0.07 mm (0.001 – 0.003 in)
SERVICE LIMIT:
0.12 mm (0.005 in)

Replace the outer rotor and oil pump body as a set (page 12-10) if the measurement exceeds the service limit.



MEMO

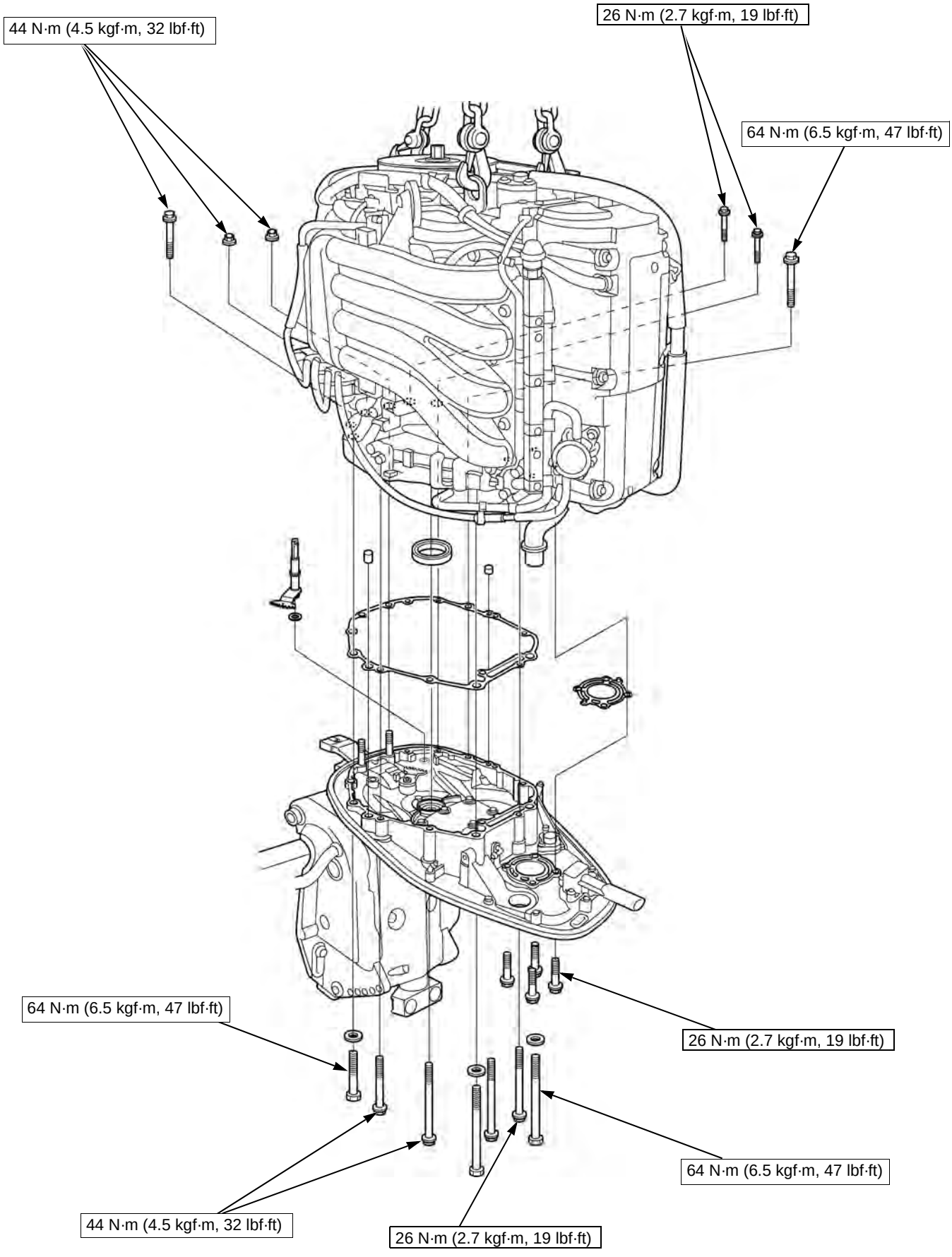
13. ENGINE REMOVAL/INSTALLATION

COMPONENT LOCATION ····· 13-2

ENGINE REMOVAL ····· 13-3

ENGINE INSTALLATION ····· 13-6

COMPONENT LOCATION



ENGINE REMOVAL

⚠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.
- Handle fuel only outdoors.

Disconnect the negative (–) and positive (+) cables from the battery.

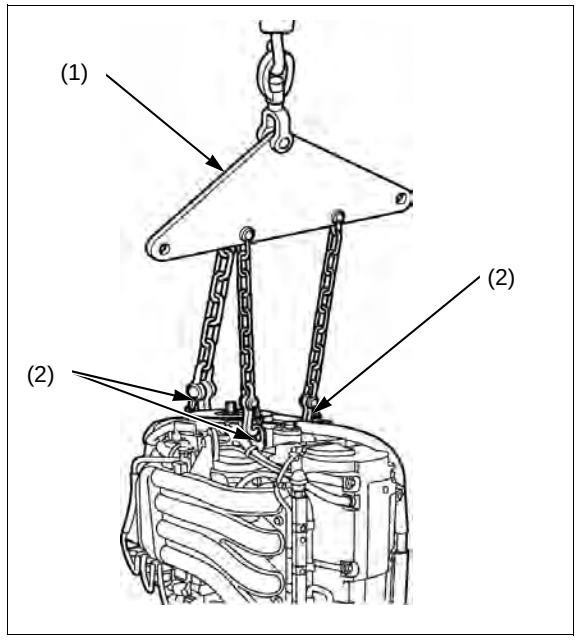
Shift the remote control lever to the N (neutral) position.

Remove the following:

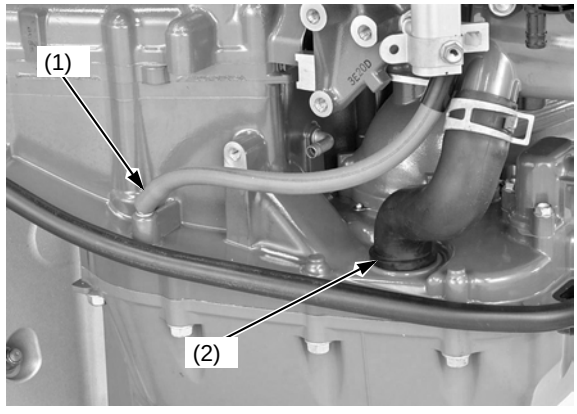
– L./R. side cover bracket (page 6-18)
– Under cover front bracket (page 6-18)
– Starter cable (page 10-9)
– Power tilt relay/connector bracket A (page 10-11)
– Fuel pump (high pressure side)/vapor separator (page 5-101)
– Oil case/water tube (page 12-6)
– Shift link bracket (page 20-7)
– Seal holder (page 20-12)
– Water relief tube (page 11-6)
– Starter motor (page 9-5)

Relieve the fuel pressure (page 5-79).

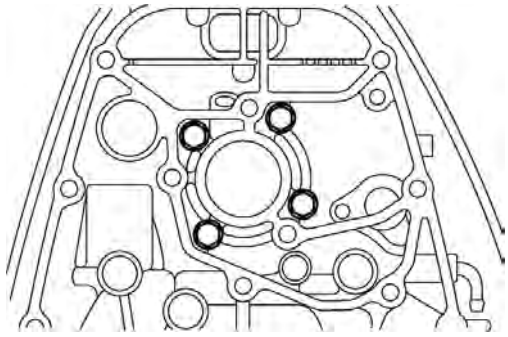
Attach the engine chains (1) to the engine hangers (2).



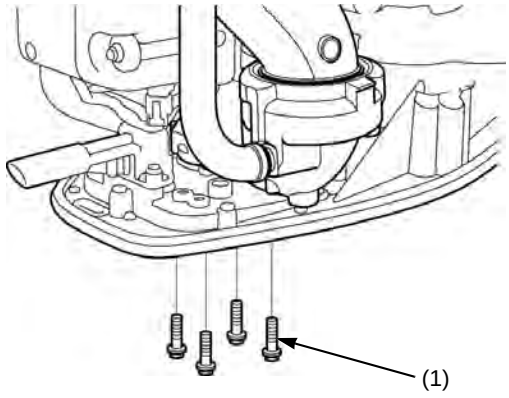
Disconnect the air vent tube (1) and oil tube (2) from the mounting case.



Remove the four bolts (8 × 30 mm) (1) that secure the exhaust guide from the under side of the mounting case.



Viewed from the under side of the mounting case:

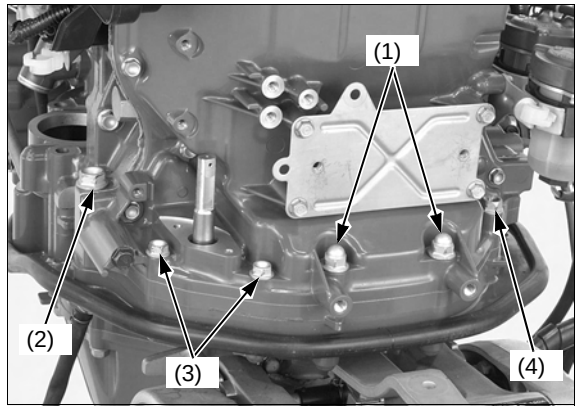


Remove the following fasteners:

- Two cap nuts (1)
- Bolt (12 x 83 mm) (2)
- Two bolts (8 x 55 mm) (3)
- Bolt (10 x 70 mm) (4)

NOTICE

- *Be sure that the hanger chains are hooked on the three engine hangers securely.*



Remove the following bolts from the under side of the mounting case (1).

- Bolt (8 × 100 mm) (2)
- Bolt (10 × 80 mm) (3)
- Two bolts (10 × 110 mm) (4)
- Hex bolt (12 × 70 mm) (5)
- Two hex bolts (12 × 130 mm) (6)
- Three washers (12 mm) (7)

Lift up the engine assembly slowly with a hoist, and remove the engine from the engine mounting case.

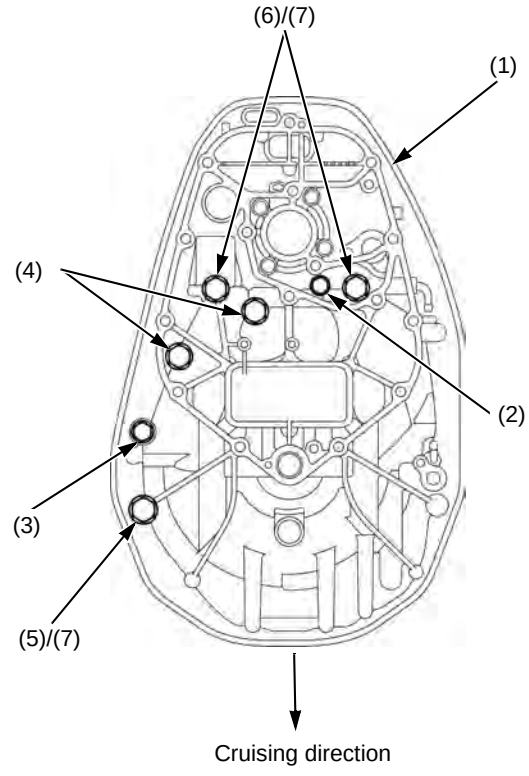
NOTICE

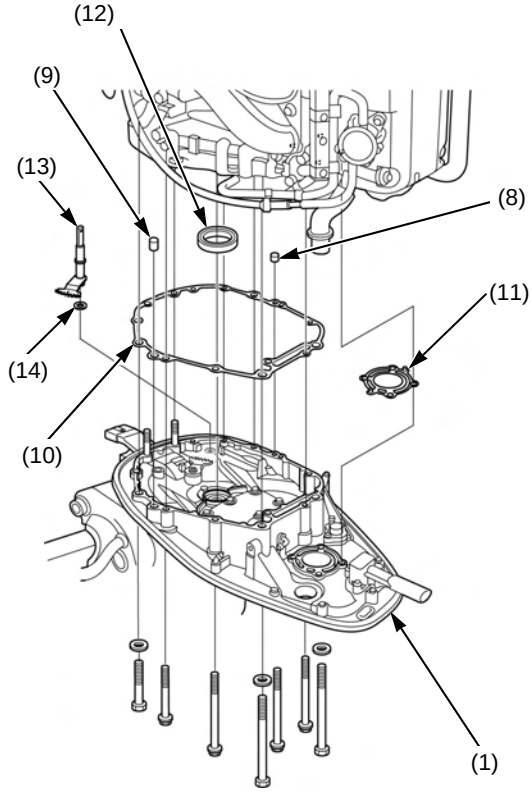
When lifting the engine assembly, take care to keep it level.

Remove the following:

– Dowel pin (10 × 16 mm) (8)
– Dowel pin (14 × 20 mm) (9)
– Mounting case gasket (10)
– Exhaust gasket (11)
– Oil pump rubber (12)
– Shift shaft B (13)
– Shift shaft washer (14)

Viewed from the under side of the mounting case:

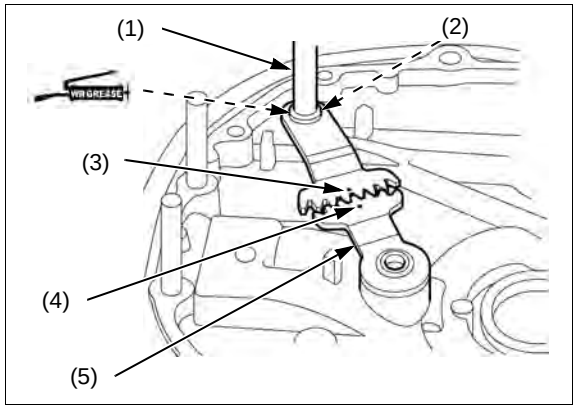




ENGINE INSTALLATION

Apply marine grease to the shift shaft B (1) installation area of mounting case.

Set the shift shaft washer (2) under the shift shaft B. Install the shift shaft B by aligning its punch mark (3) with the punch mark (4) on shift shaft A (5).



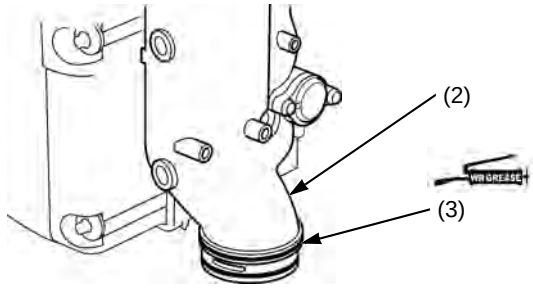
NOTICE

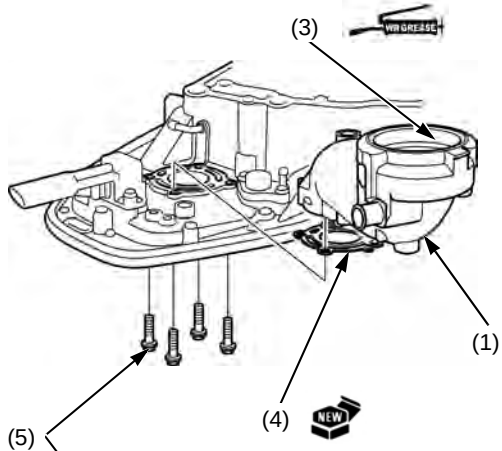
- *Do not install the engine assembly without aligning the punch marks. Take care not to let the punch marks get out of alignment during the engine installation.*
- *Proper shifting cannot be made unless the punch marks are aligned.*

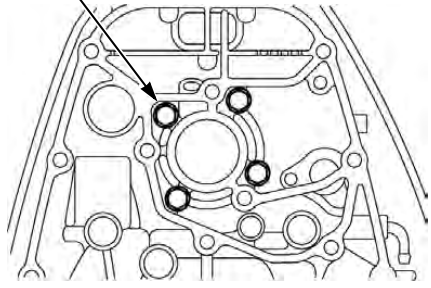
Remove the exhaust guide (1) from the exhaust manifold (2) of the engine.

Apply marine grease to the sealing area (3) of the exhaust manifold and exhaust guide.

Install a new exhaust guide gasket (4) and exhaust guide to the mounting case, and loosely install the four bolts (5).

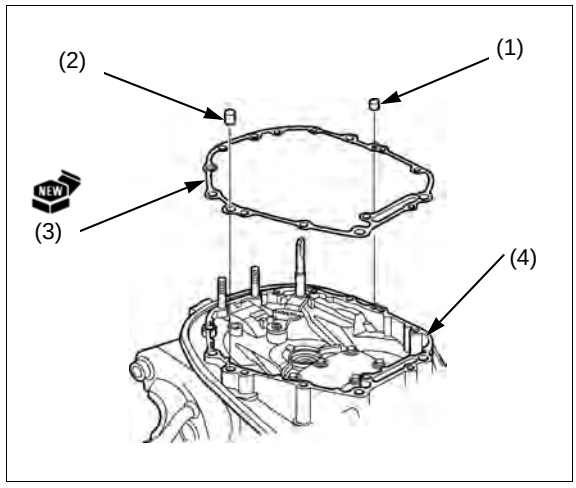






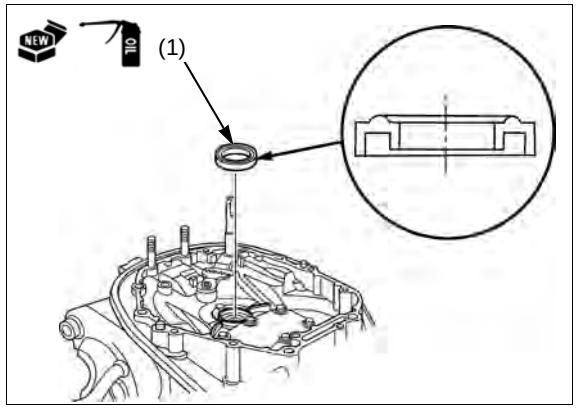
Viewed from the under side of the mounting case:

Install the dowel pin (10 × 16 mm) (1), dowel pin (14 × 20 mm) (2) and new mounting case gasket (3) to the mounting case (4).



Apply engine oil to a new oil pump rubber (1) and install it to the mounting case.

- Install the oil pump rubber in the correct direction as shown.

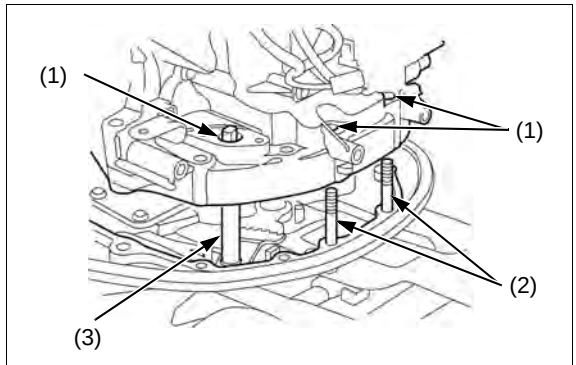


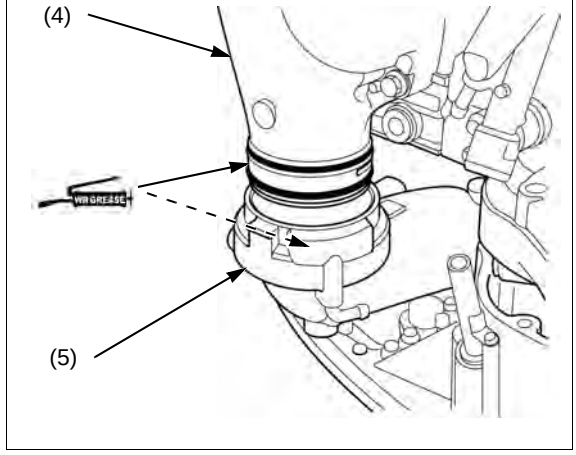
Lower the engine assembly slowly while aligning its holes (1) with the stud bolts (2) and shift shaft B(3).

Lower the engine assembly slowly onto the mounting case while aligning the exhaust manifold (4) with the exhaust guide (5).

NOTICE

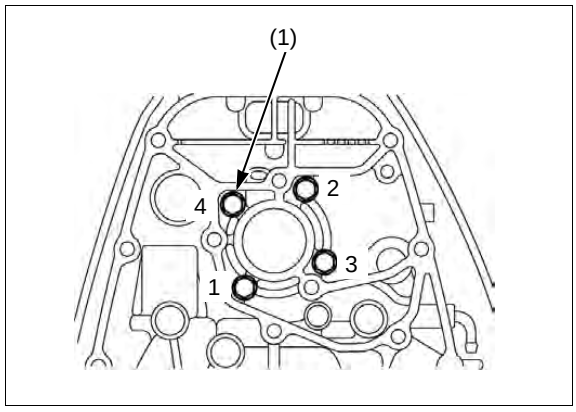
- *Be careful not to damage the stud bolt threads or stepped part of the shift shaft B.*
- *Lower the engine assembly slowly while holding the engine vertically.*





Tighten the four exhaust guide bolts (1) from the under side of the mounting case in the numbered order in two or three steps to the specified torque.

TORQUE: 26 N·m (2.7 kgf·m, 19 lbf·ft)



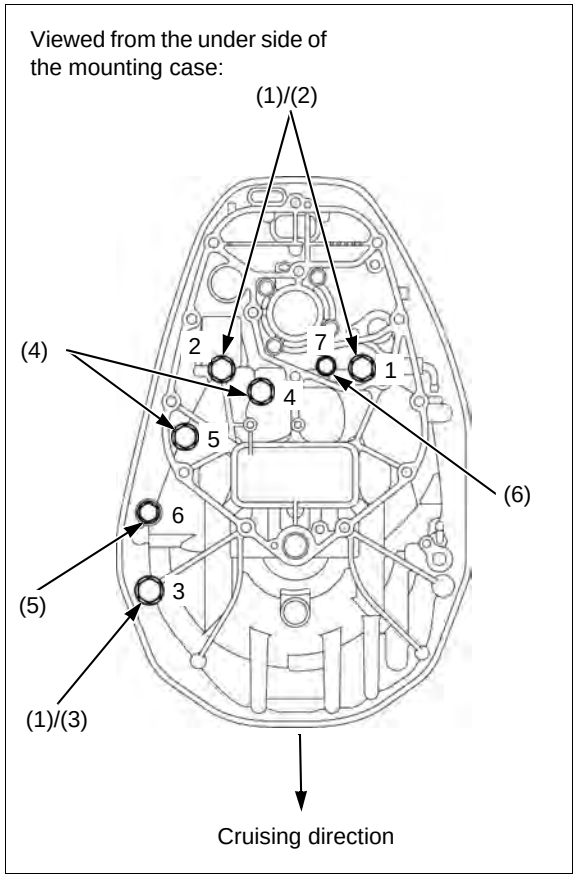
Install the three washers (12 mm) (1) to the two bolts (12 × 130 mm) (2) and bolt (12 × 70 mm) (3).
Tighten the bolts from the under side of the mounting case in the numbered order to the specified torque.

TORQUE:

64 N·m (6.5 kgf·m, 47 lbf·ft):
Two hex bolts (12 × 130 mm) (2)
Hex bolt (12 × 70 mm) (3)

44 N·m (4.5 kgf·m, 32 lbf·ft):
Two bolts (10 × 110 mm) (4)
Bolt (10 × 80 mm) (5)

26 N·m (2.7 kgf·m, 19 lbf·ft)
Bolt (8 × 100 mm) (6)



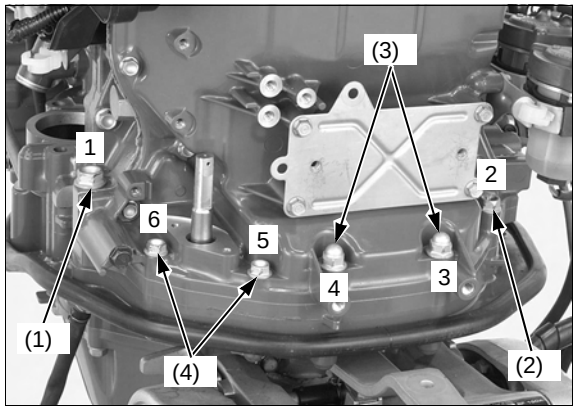
Loosely install the bolts and nuts.
Tighten the bolts from the upper side of the engine in the numbered order in two or three steps to the specified torque.

TORQUE:

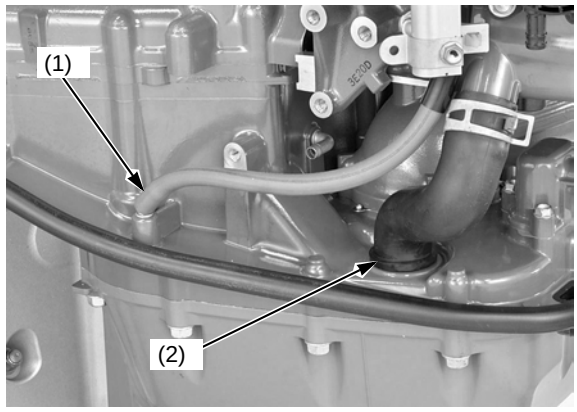
64 N·m (6.5 kgf·m, 47 lbf·ft):
Bolt (12 × 83 mm) (1)

44 N·m (4.5 kgf·m, 32 lbf·ft):
Bolt (10 × 70 mm) (2)
Two nuts (10 mm) (3)

26 N·m (2.7 kgf·m, 19 lbf·ft)
Two bolts (8 × 55 mm) (4)



Connect the air vent tube (1) and oil tube (2) to the mounting case.



Install the following:

- Starter motor (page 9-5)
- Water relief tube (page 11-6)
- Seal holder (page 20-12)
- Shift link bracket (page 20-7)
- Oil case/water tube (page 12-6)
- Fuel pump (high pressure side)/vapor separator (page 5-101)
- Power tilt relay/connector bracket A (page 10-11)
- Starter cable (page 10-9)
- Under cover front bracket (page 6-18)
- L./R. side cover brackets (page 6-18)

MEMO

14. CYLINDER HEAD

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CRANKSHAFT PULLEY/CAM CHAIN REMOVAL/INSTALLATION ····· 14-11

CAMSHAFT/ROCKER ARM REMOVAL/ INSTALLATION ····· 14-26

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ROCKER ARM DISASSEMBLY/ ASSEMBLY ····· 14-38

CYLINDER HEAD DISASSEMBLY/ ASSEMBLY ····· 14-39

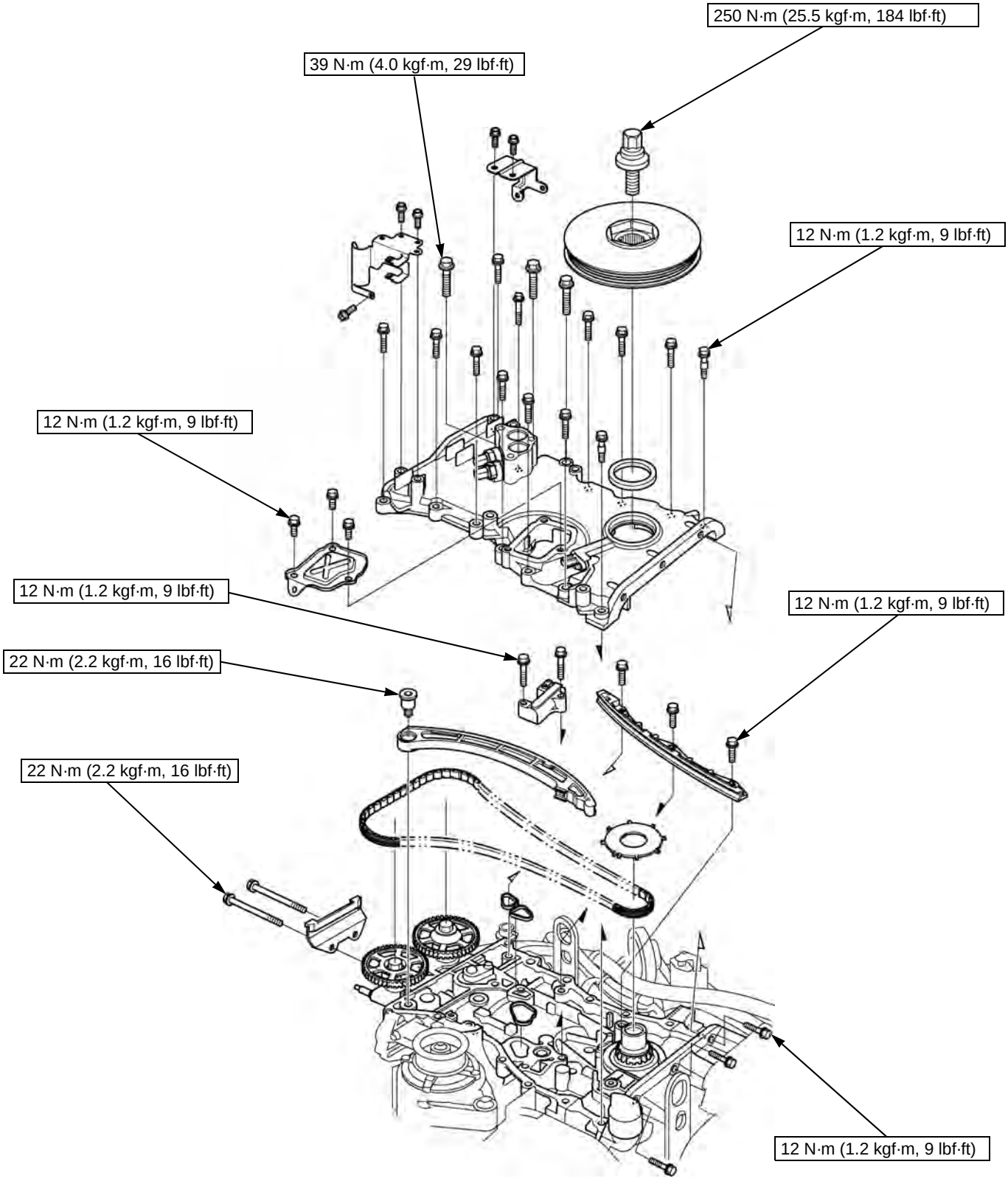
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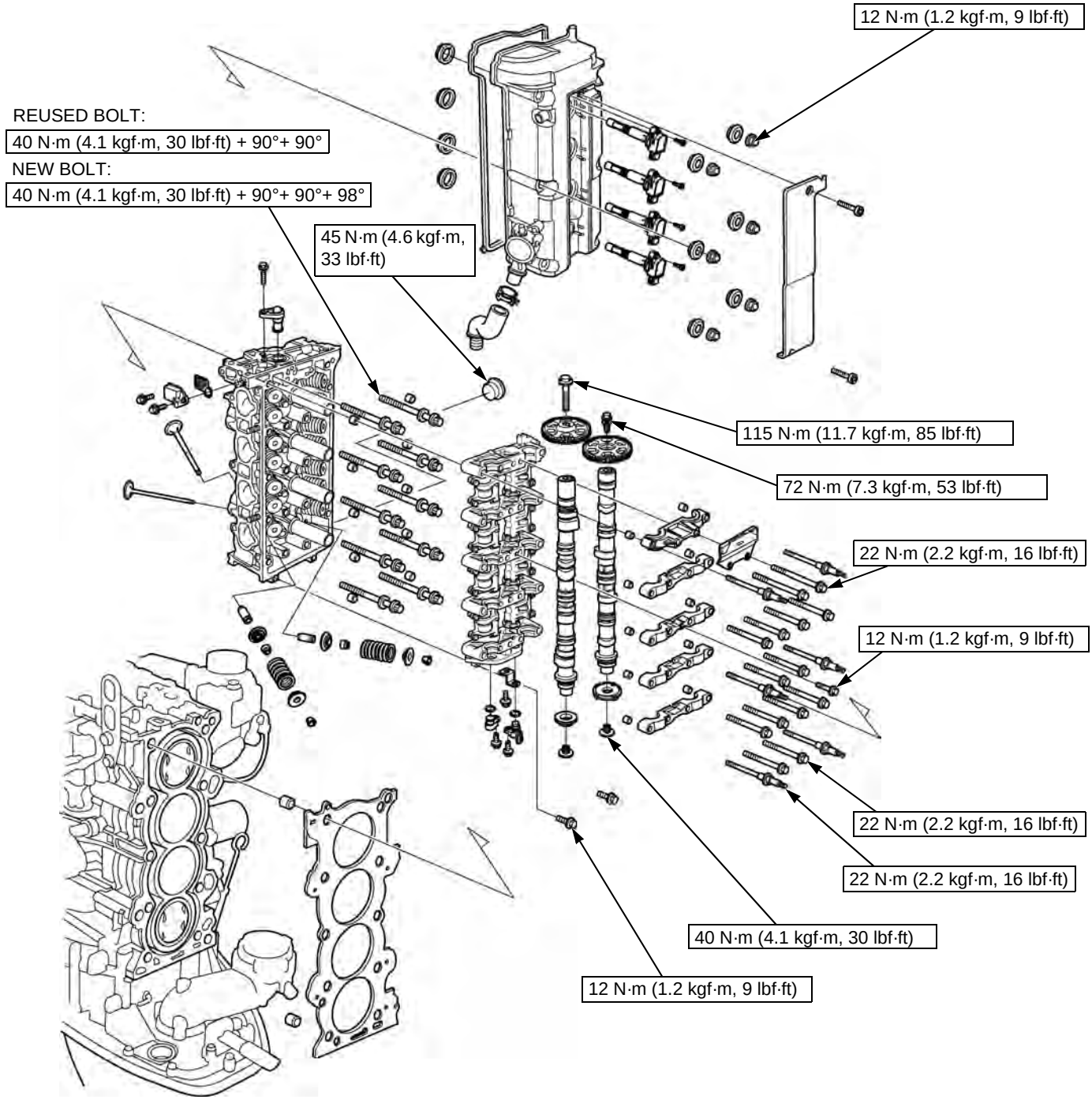
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VALVE GUIDE REPLACEMENT ····· 14-52

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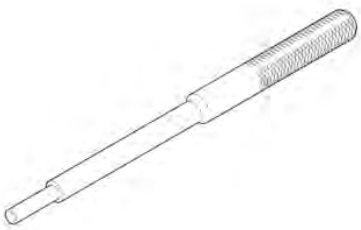
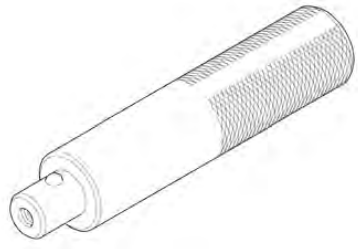
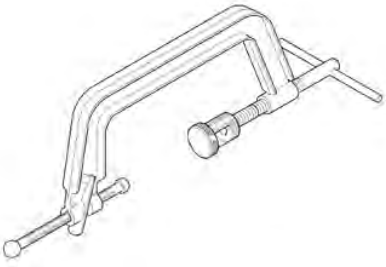
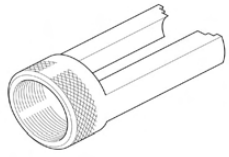
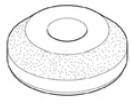
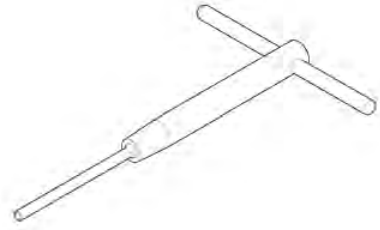
COMPONENT LOCATION

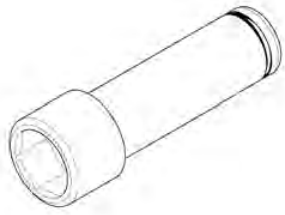
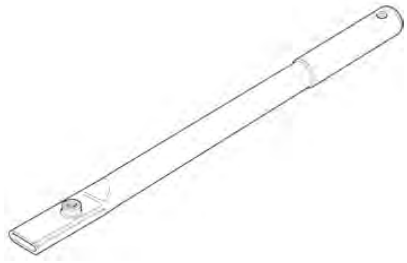



12 N·m (1.2 kgf·m, 9 lbf·ft)
REUSED BOLT:
40 N·m (4.1 kgf·m, 30 lbf·ft) + 90°+ 90°
NEW BOLT:
40 N·m (4.1 kgf·m, 30 lbf·ft) + 90°+ 90°+ 98°
45 N·m (4.6 kgf·m, 33 lbf·ft)
115 N·m (11.7 kgf·m, 85 lbf·ft)
72 N·m (7.3 kgf·m, 53 lbf·ft)
22 N·m (2.2 kgf·m, 16 lbf·ft)
12 N·m (1.2 kgf·m, 9 lbf·ft)
22 N·m (2.2 kgf·m, 16 lbf·ft)
22 N·m (2.2 kgf·m, 16 lbf·ft)
40 N·m (4.1 kgf·m, 30 lbf·ft)
12 N·m (1.2 kgf·m, 9 lbf·ft)

TOOLS

LIST

Valve guide driver 5.35×9.7 07742-0010100 	Attachment 52 × 55 mm 07746-0010400 	Driver 07749-0010000 
Valve spring compressor 07757-0010000 	Valve spring compressor attachment 07757-PJ10100 	Valve seat cutter, 45° 35 mm [IN] 07780-0010400 
Valve seat cutter, 45° 33 mm [EX] 07780-0010800 	Valve seat cutter, 32° 38.5 mm [IN] 07780-0012400 	Valve seat cutter, 32° 33 mm [EX] 07780-0012900 
Valve seat cutter, 60° 30 mm [EX] 07780-0014000 	Valve seat cutter, 60° 37.5 mm [IN] 07780-0014100 	Cutter holder, 5.5 mm 07781-0010101 

Valve guide reamer, 5.525 mm 07HAH-PJ70100 	Socket wrench 19 × 90 07JAA-001020A 	Holder handle 07JAB-001020B 
Holder attachment, 50 mm, offset 07MAB-PY30100 	Stem seal driver 07PAD-0010000 	

CYLINDER HEAD COVER REMOVAL/ INSTALLATION

REMOVAL

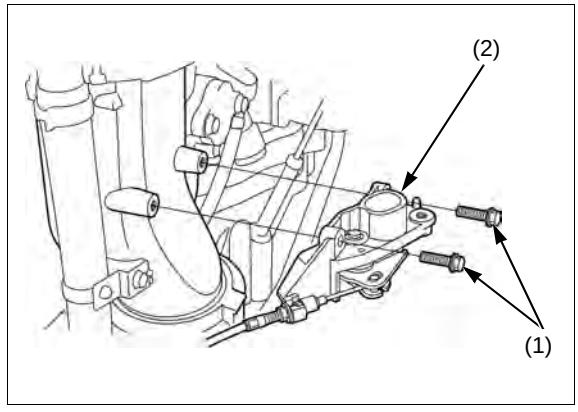
Disconnect the battery negative (–) cable.

Shift the remote control lever in the N (neutral) position.

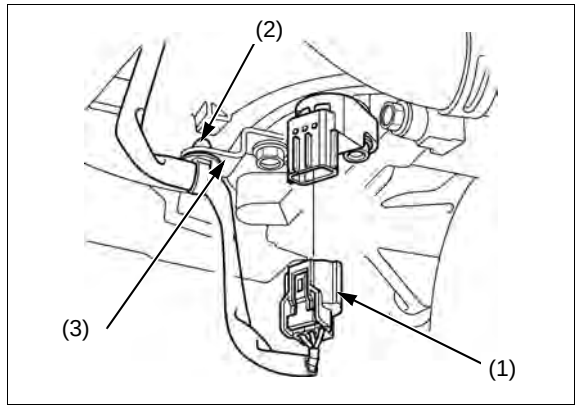
Remove the following:

– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)
– Direct ignition coils (page 3-17)

Remove the two bolts (1) and R. side cover bracket (2).

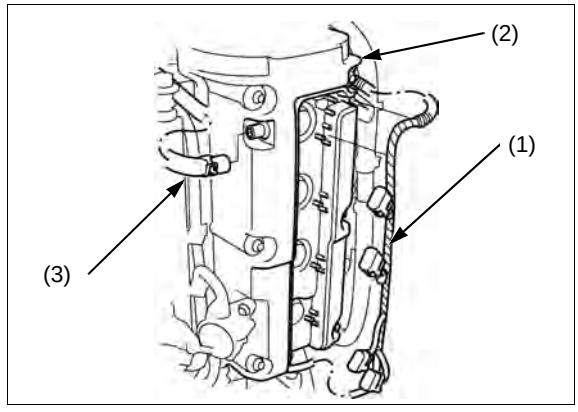


Disconnect the CMP sensor 3P connector (1).
Release the harness band clip (2) from the clip bracket F (3).



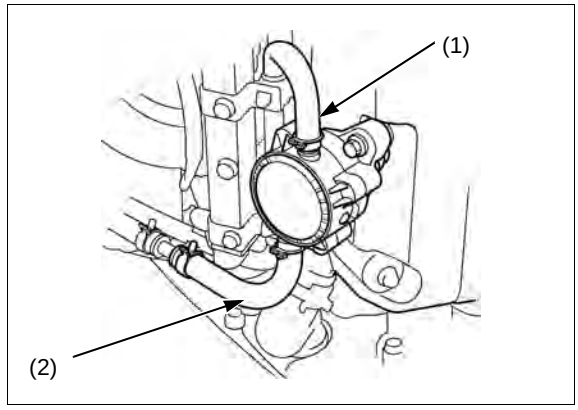
Release the main wire harness (1) from the cylinder head cover (2).

Disconnect the crankcase breather tube (3).

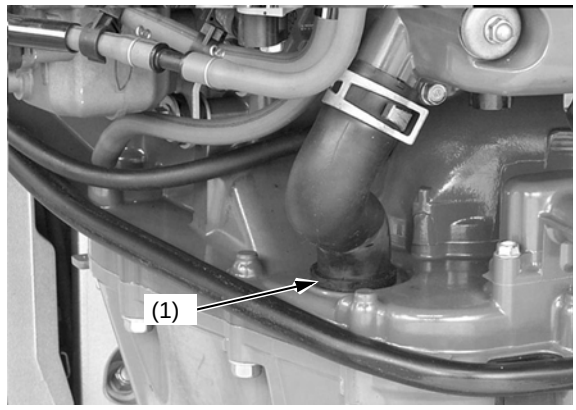


Disconnect the fuel tube B (1) and fuel tube D (2) from the fuel pump (low pressure side).

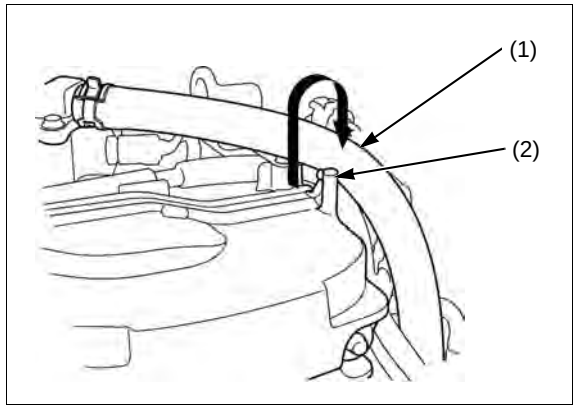
- Clamp the fuel tubes before disconnecting them.



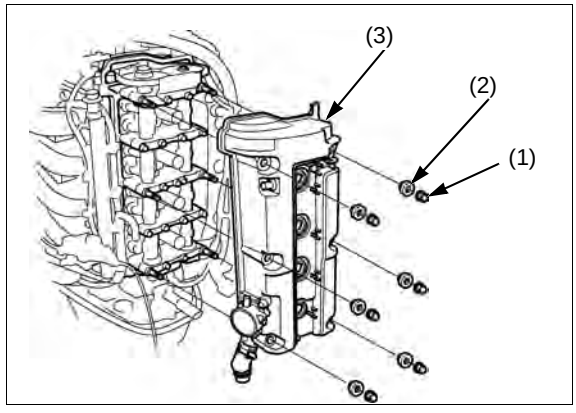
Disconnect the mount case side oil tube (1).



Move the water relief tube A (1) from the cylinder head cover boss (2) to the exhaust manifold side.



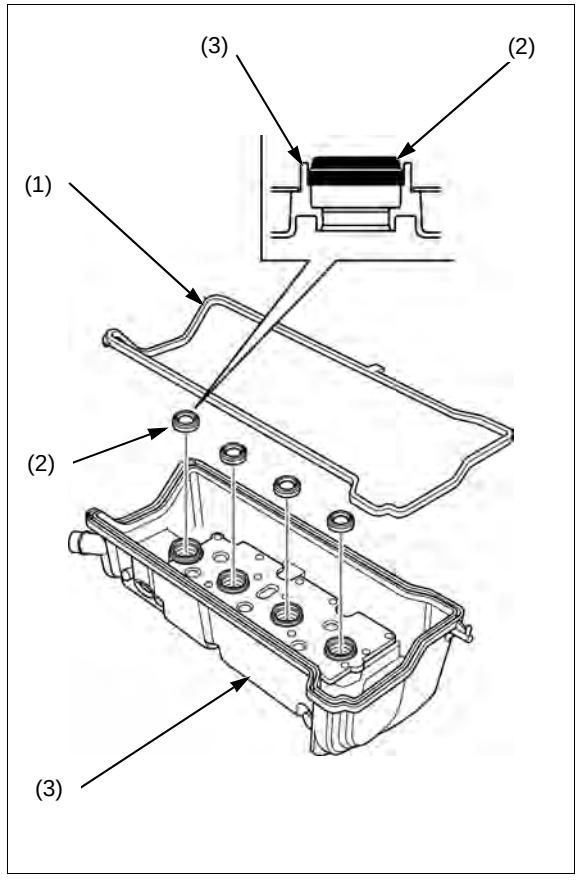
Remove the six nuts (1), six cylinder head cover washers (2) and cylinder head cover (3).



INSTALLATION

Check the cylinder head cover packing (1) and spark plug tube seal (2) for oil leaks, deterioration or damage, and replace them if necessary.

Install the cylinder head cover packing and spark plug tube seal to the cylinder head cover (3).

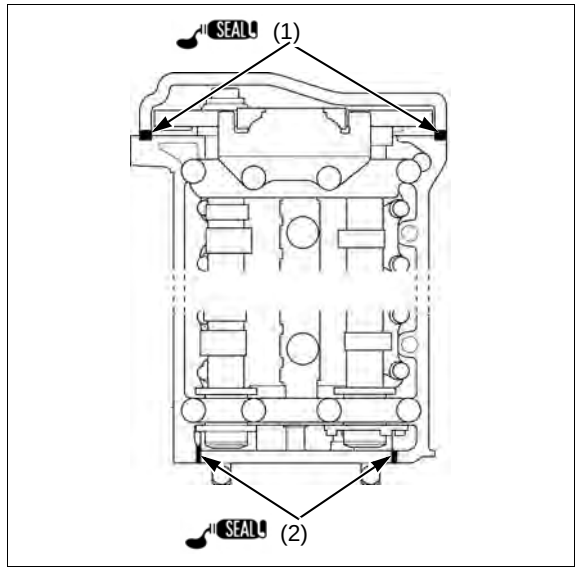


Clean the cylinder head mating surfaces with a shop towel or equivalent material.

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1280B or equivalent) to the chain case mating surface (1), and 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1215 or equivalent) to the No. 5 rocker shaft holder mating surface (2) of the cylinder head.

NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*



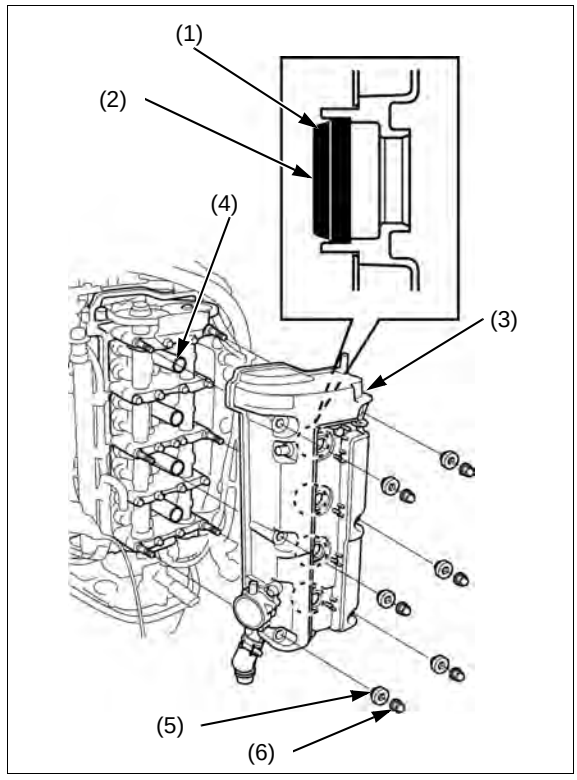
Apply soapy water to the lips (1) of the spark plug tube seal (2).

Install the cylinder head cover (3) to the cylinder head by aligning the spark plug tube (4) with the spark plug tube seal.

- Be careful not to damage the spark plug tube seal and do not allow the seal lip to turn inside out.
- Wipe off the excess soapy water.

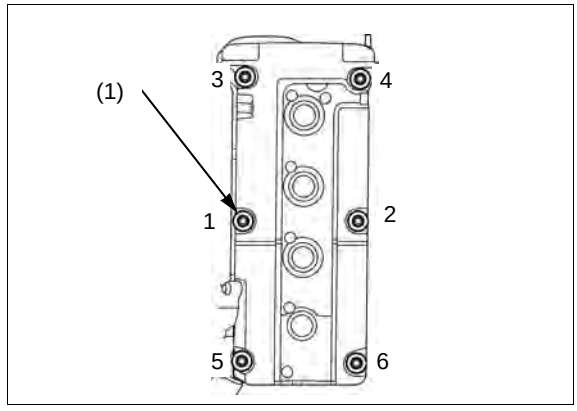
After installing the cylinder head cover, slightly move it several times to let the cylinder head cover packing and spark plug tube seal to seat properly.

Install the six cylinder head cover washers (5) and loosely install the six nuts (6).

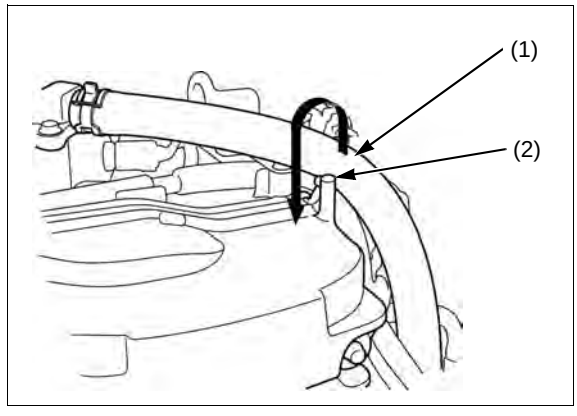


Tighten the nuts (1) to the specified torque in the numbered order in two or three steps.

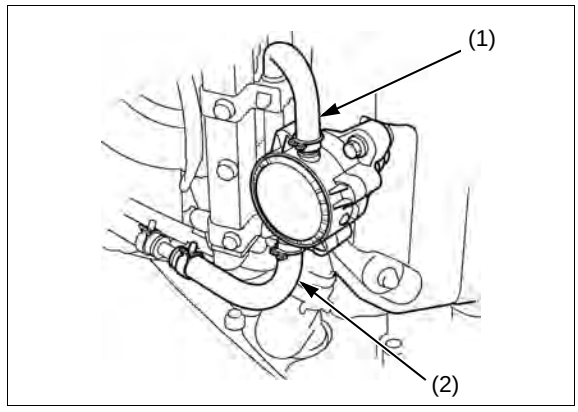
TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



Move the water relief tube A (1) to the front side (cylinder head side) of the cylinder head cover boss (2).

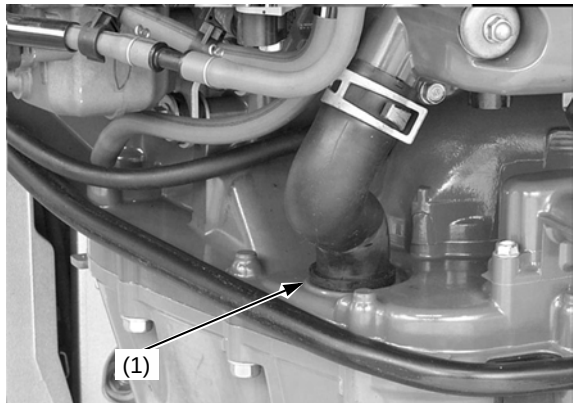


Connect the fuel tube B (1) and fuel tube D (2) to the fuel pump (low pressure side).



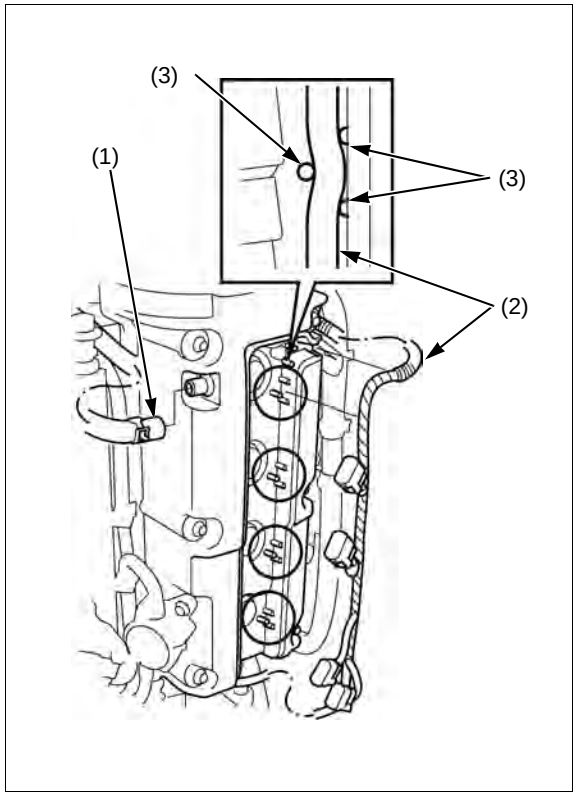
Connect the oil tube (1).

- Be sure that the oil tube is connected to the mount case securely.

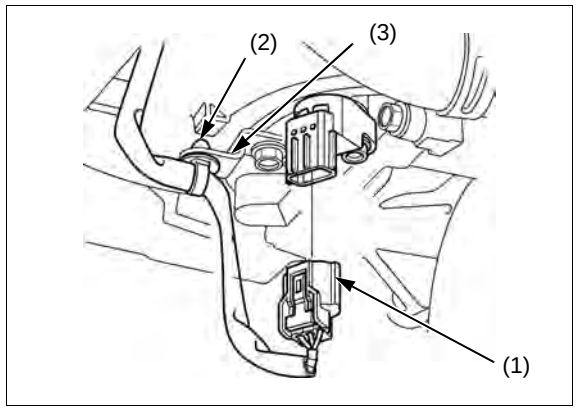


Connect the crankcase breather tube (1).

Set the main wire harness (2) to the cylinder head cover bosses (3).



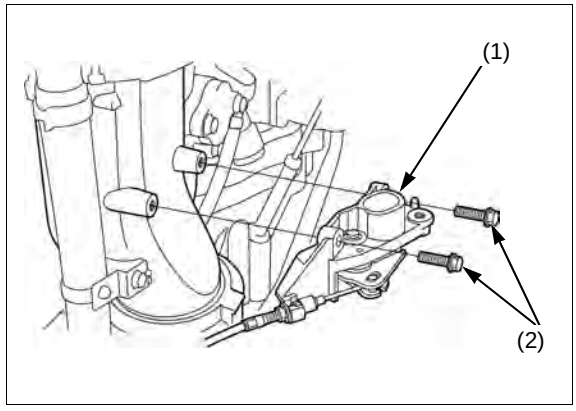
Connect the CMP sensor 3P connector and install the harness band clip (2) to the clip bracket F (3).



Install the R. side cover bracket (1) and tighten the bolts (2).

Install the following:

– Direct ignition coils (page 3-17)
– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)



CRANKSHAFT PULLEY/CAM CHAIN REMOVAL/INSTALLATION

REMOVAL

Disconnect the battery negative (–) cable.

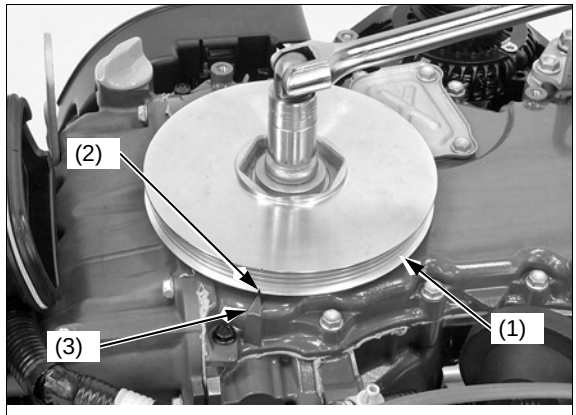
Make sure the remote control lever is in "N" (neutral) position.

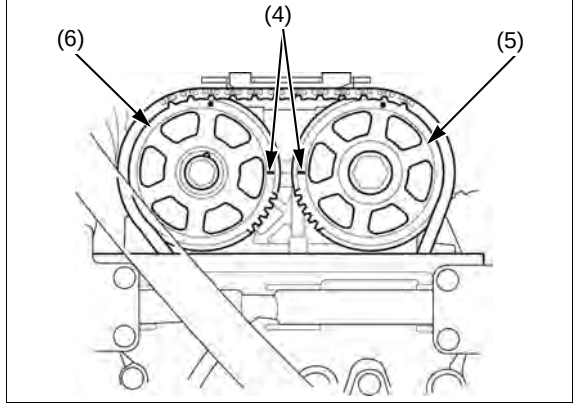
Remove the following:

– Alternator belt (page 7-5)
– Thermostat (page 11-5)
– Engine hanger B (page 7-7)
– Cylinder head cover (page 14-6)

Turn the crankshaft pulley (1) clockwise so that the cut-out (2) of the crankshaft pulley lines up with the pointer (3).

Make sure that the marks (4) of intake cam sprocket (5) and exhaust cam sprocket (6) are lined up as shown. In this position, the No. 1 piston is at TDC.

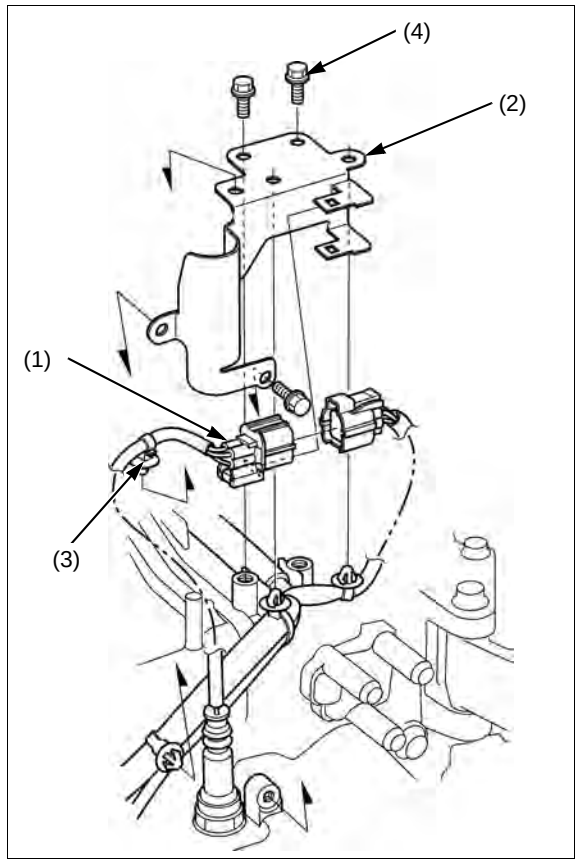




Remove the A/F sensor 4P connector (1) from the harness clip bracket C (2) and disconnect it.

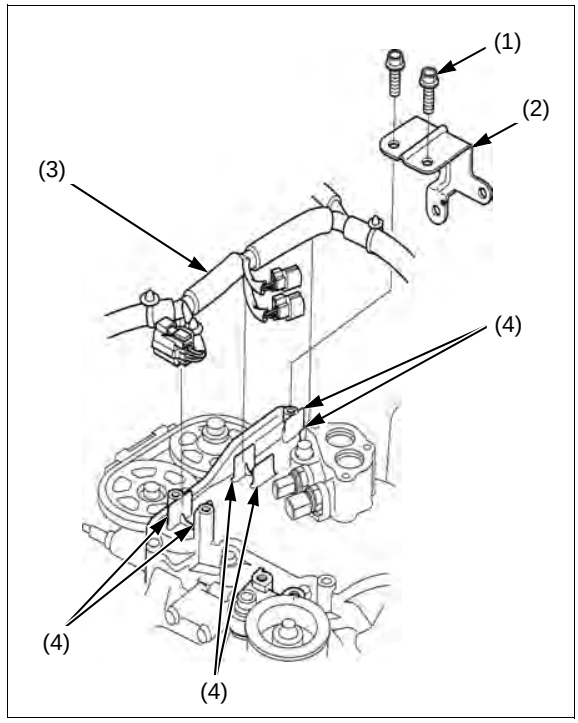
Remove the harness band clip (3) from the harness clip bracket C.

Remove the three bolts (4) and harness clip bracket C.

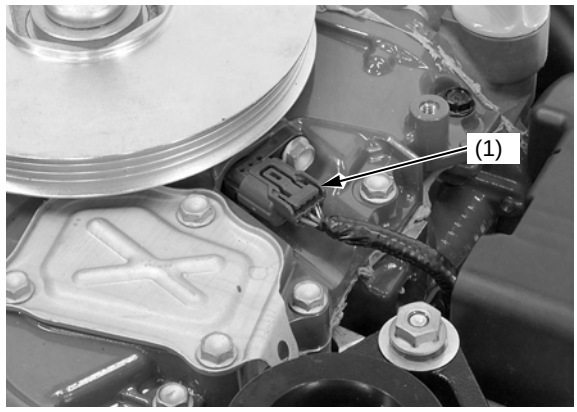


Remove the two bolts (1) and harness clip bracket B (2).

Release the main wire harness (3) from the tabs (4) of the chain case.



Disconnect the CKP sensor 3P connector (1).



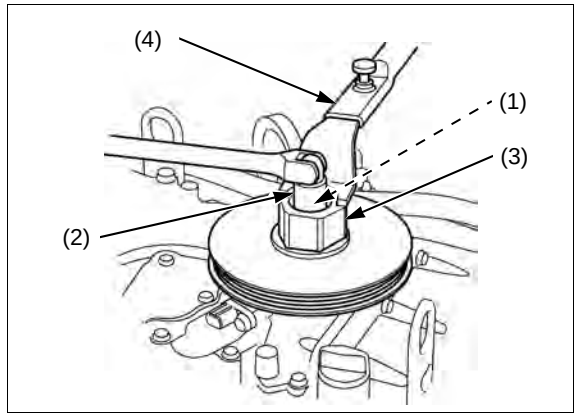
Loosen the crankshaft pulley bolt (1) using the special tools as shown.

NOTICE

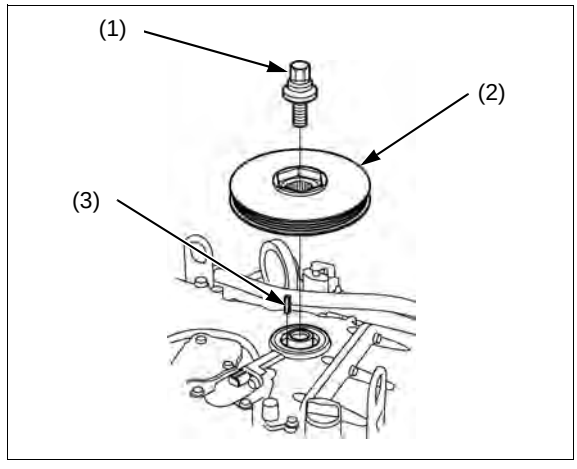
- *Do not use an impact wrench. Remove the bolt while holding the crankshaft pulley with the special tool.*
- *Do not turn the crankshaft counterclockwise.*

TOOLS:

Socket wrench 19 × 90 (2)	**07JAA-001020A**
Holder attachment, 50 mm, offset (3)	**07MAB-PY30100**
Holder handle (4)	**07JAB-001020B**



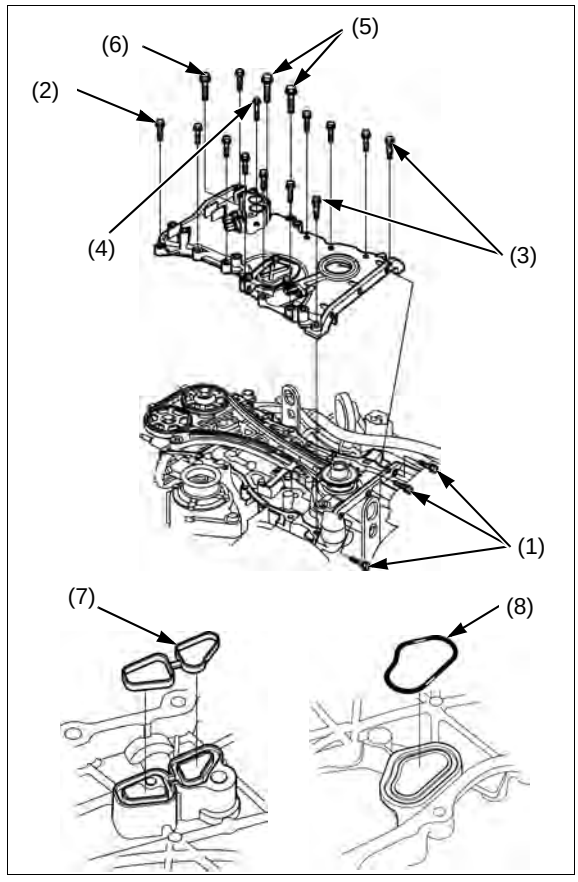
Remove the crankshaft pulley bolt (1), crankshaft pulley (2) and key (3).



Remove the following bolts from the chain case.

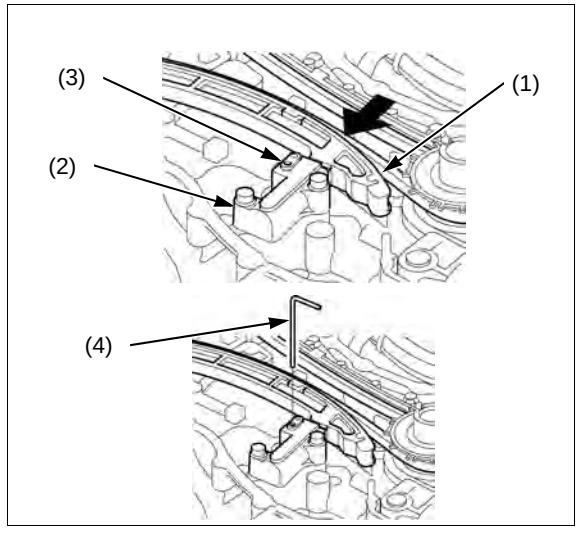
- Three bolts (6 × 25 mm) (1)
- Ten bolts (6 × 28 mm) (2)
- Two bolts (6 × 31 mm) (3)
- Bolt (SH) (6 × 38 mm) (4)
- Two bolts (10 × 43 mm) (5)
- Bolt (10 × 70 mm) (6)

Remove the chain case packing (7) and chain case O-ring (8) from the chain case.

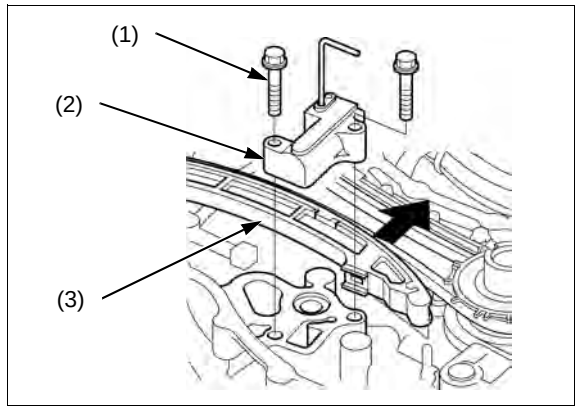


Push the cam chain tensioner arm (1) toward cam chain tensioner (2) side so that the plate and lock holes (3) are aligned, and insert a 1.5 mm O.D. pin (4) into the holes.

- Do not remove the 1.5 mm O.D. pin until the cam chain tensioner is reinstalled.

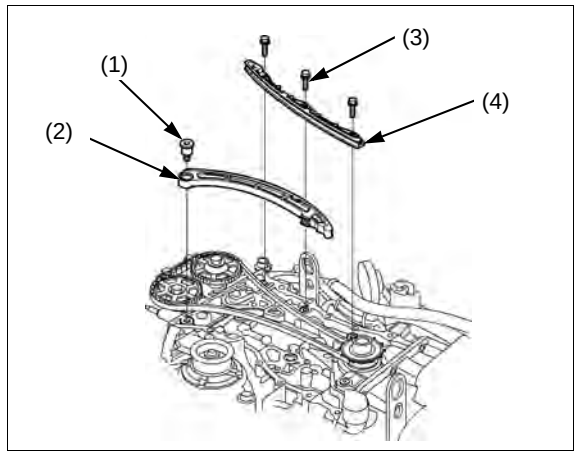


Remove the two bolts (1) and cam chain tensioner (2) by pushing the cam chain tensioner arm (3) toward the cam chain side.

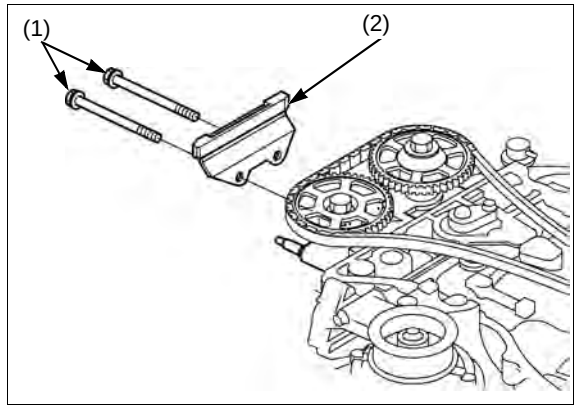


Remove the tensioner pivot bolt (1) and cam chain tensioner arm (2).

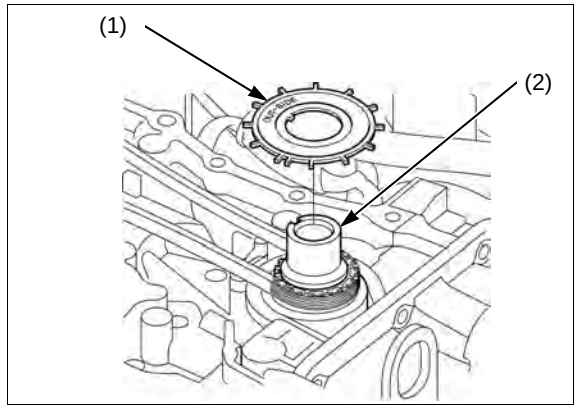
Remove the three bolts (3) and cam chain guide (4).



Remove the two bolts (1) and cam chain guide B (2).

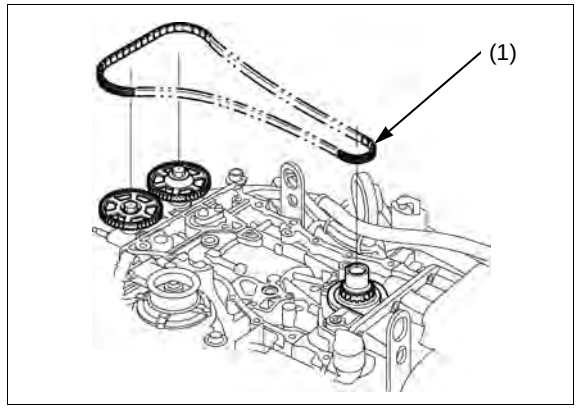


Remove the crank pulser plate (1) from the crankshaft (2).



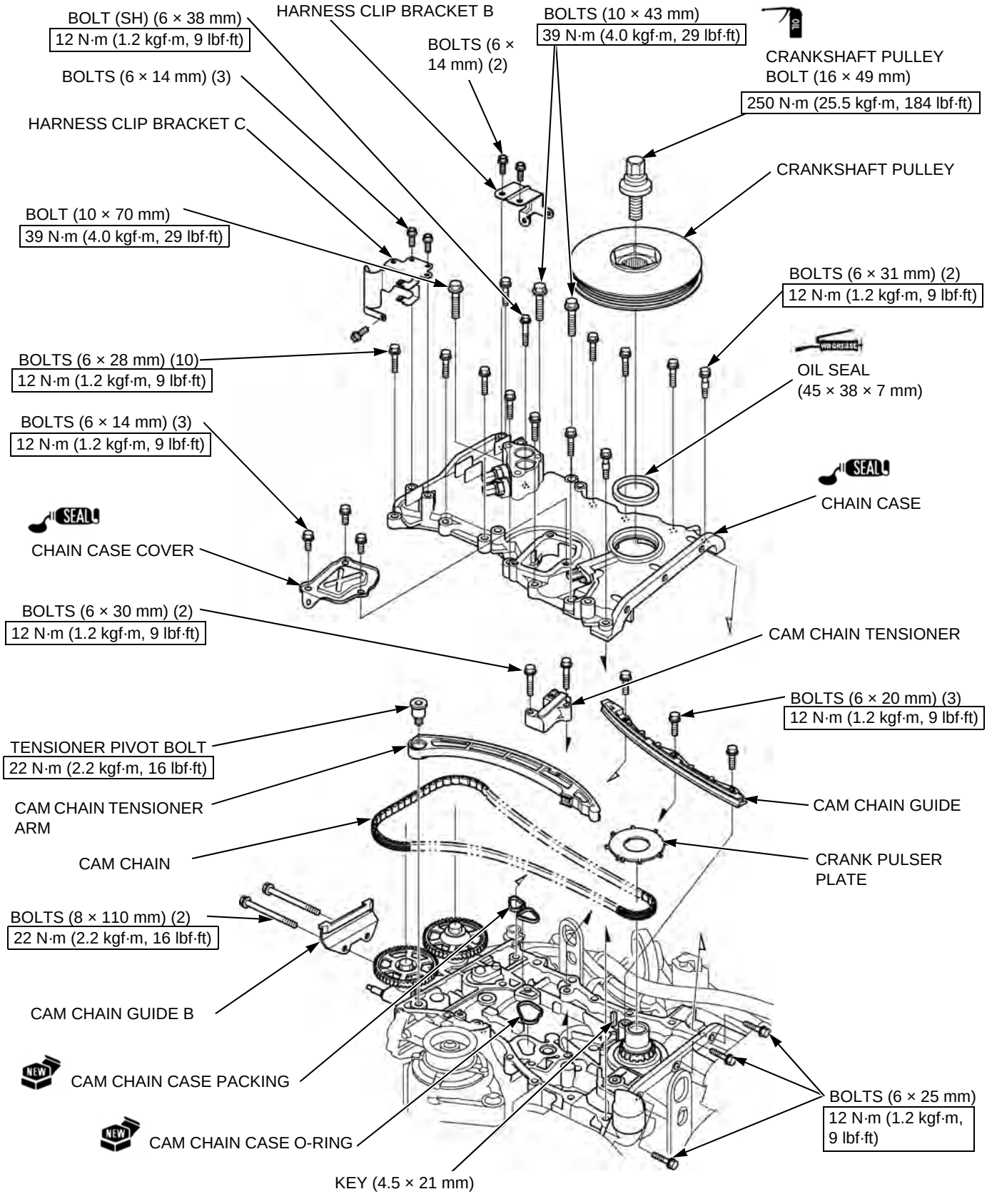
Remove the cam chain (1).

- Keep the cam chain away from the magnetic object.



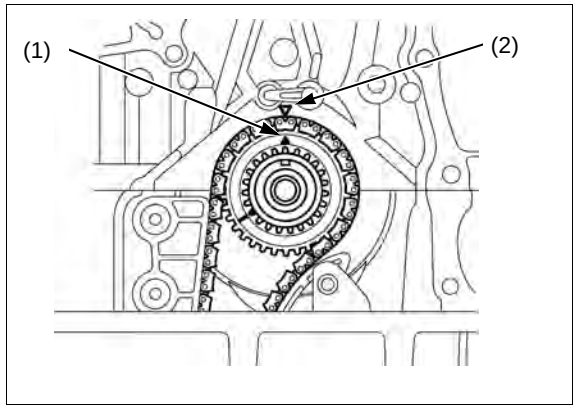
EXPLODED VIEW

- Check for oil leaks from the crankshaft oil seal and replace if necessary.



INSTALLATION

Align the crankshaft sprocket mark (1) with the pointer (2) on the cylinder block.

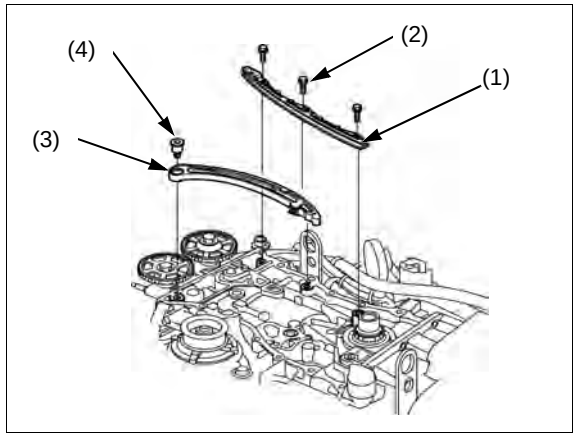


Install the cam chain guide (1), then install and tighten the three bolts (2) to the specified torque.

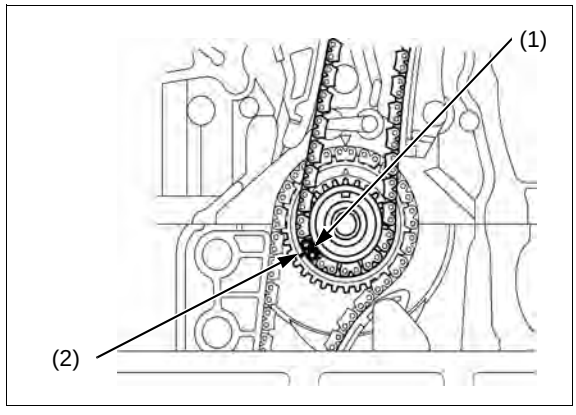
TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Install the cam chain tensioner arm (3), then install and tighten the tensioner pivot bolt (4) to the specified torque.

TORQUE: 22 N·m (2.2 kgf·m, 16 lbf·ft)



Set the cam chain by aligning a color plate (1) with the index mark (2) of the crankshaft sprocket.



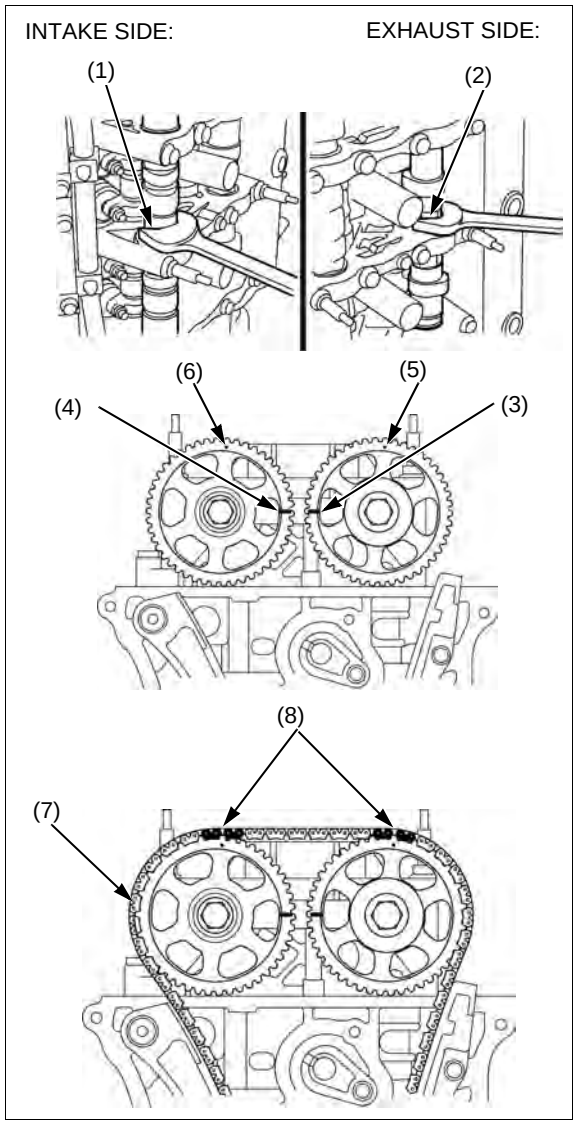
Hold the hexagonal parts of the intake camshaft (1) and exhaust camshaft (2) with a wrench or equivalent tool, then align the intake cam sprocket mark (3) and exhaust cam sprocket mark (4) as shown.
At this position, the No. 1 piston is at top dead center on compression stroke.

Make sure that the intake cam sprocket punch mark (5) and exhaust cam sprocket punch mark (6) is positioned as shown.

Install the cam chain (7) so that the punch marks of the cam sprockets are positioned between the corresponding color plates (8) (2 places) as shown.

- To adjust the camshaft position, turn the camshaft by holding the hexagonal parts of both the intake and exhaust camshafts with the wrench or equivalent tool as shown.
- Make sure that the crankshaft side color plate is aligned with the index mark of the crankshaft sprocket.

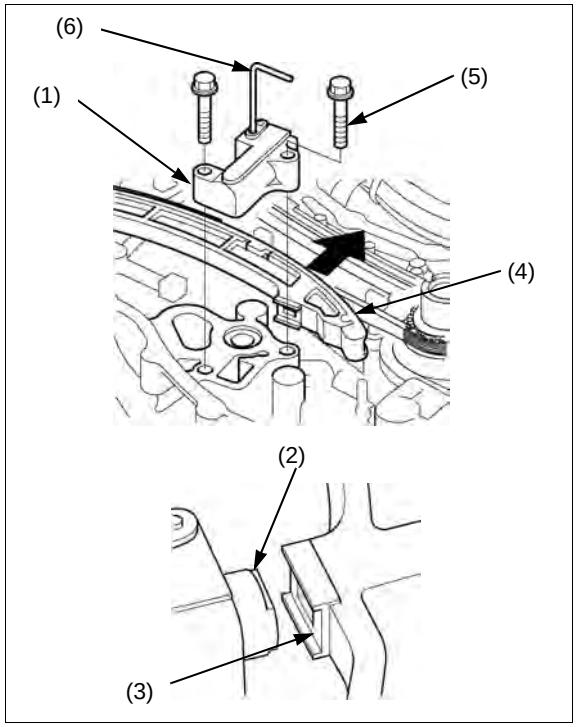
Check that the crankshaft sprocket and camshaft sprockets are in alignment with the No.1 piston at top dead center on compression stroke.



Install the cam chain tensioner (1) by aligning its cutouts (2) with the recess (3) in the cam chain tensioner arm (4) while pushing it toward the cam chain side.
Install and tighten the two bolts (5) to the specified torque.

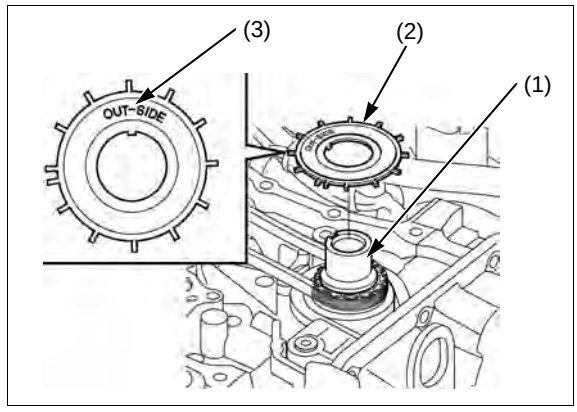
TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Remove the 1.5 mm O.D. pin (6).



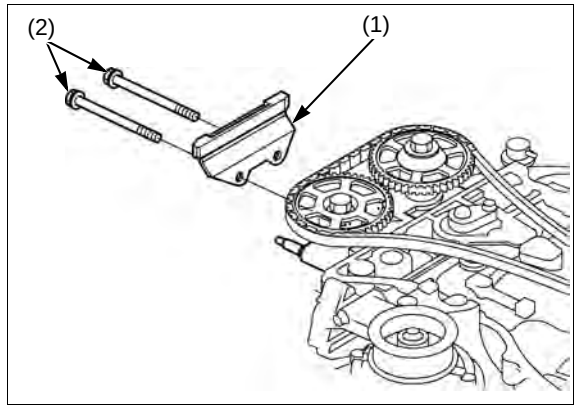
Wipe off the oil and clean the crankshaft (1) outer surface using a shop towel.

Install the crank pulser plate (2) with the "OUT-SIDE" mark (3) facing out.

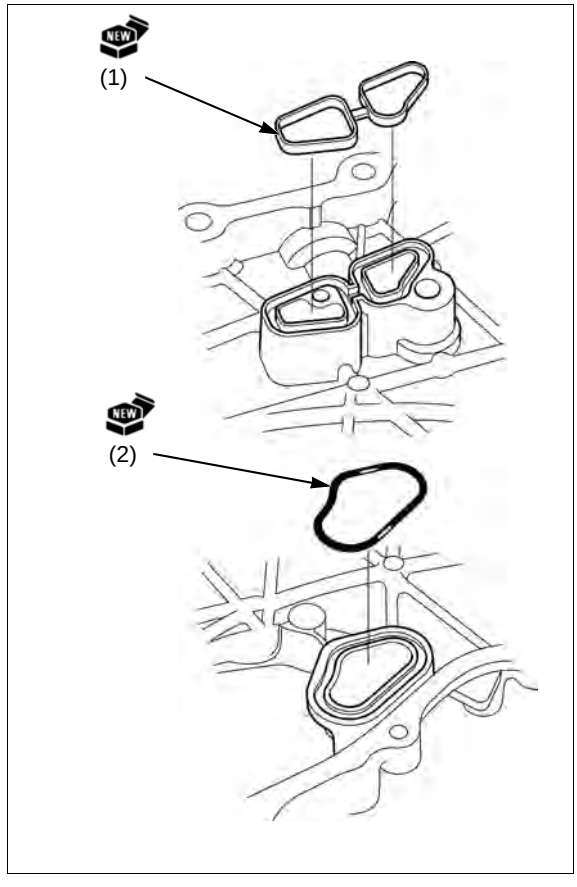


Install the cam chain guide B (1) and tighten the two bolts (2) to the specified torque.

TORQUE: 22 N·m (2.2 kgf·m, 16 lbf·ft)



Install a new chain case packing (1) and chain case O-ring (2) to the chain case.



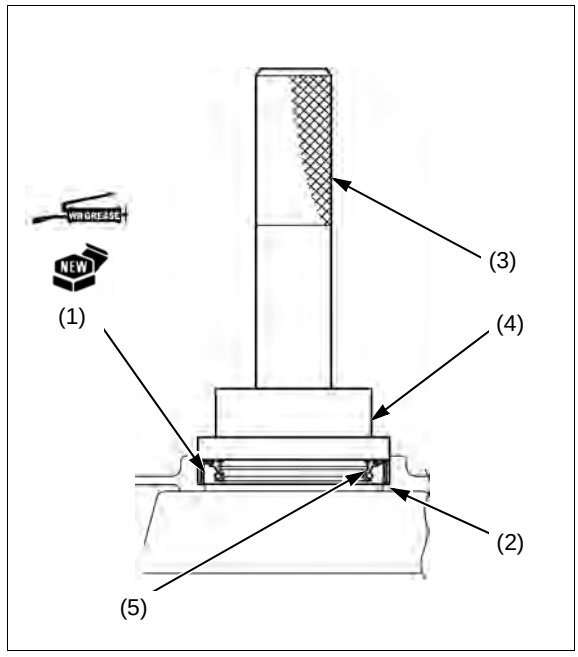
Apply soapy water to a new crankshaft oil seal (43 × 58 × 7 mm) (1) outer surface.

Drive in the oil seal until it is fully seated on the cam chain case (2) using the special tools.

TOOLS:

Driver (3)	**07749-0010000**
Attachment, 52 × 55 mm (4)	**07746-0010400**

Apply grease to the oil seal lips (5) after installation.

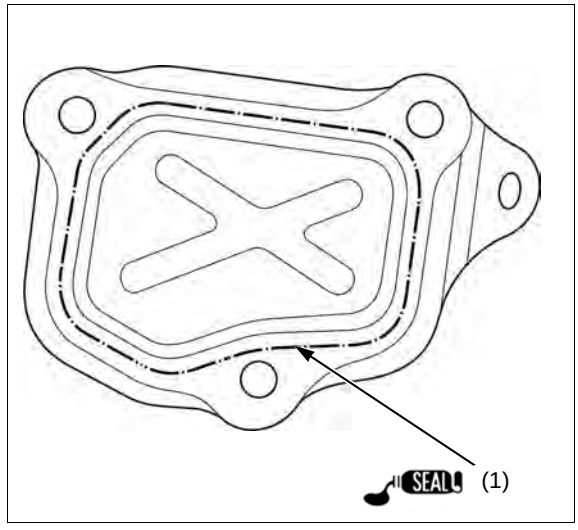


Clean the chain case cover and chain case mating surface.

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1280B or equivalent) to the specified area (1) of chain case cover.

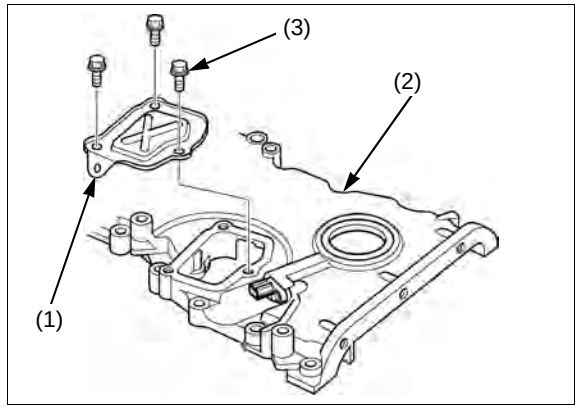
NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*
- *Do not apply sealant in the O-ring groove.*



Install the chain case cover (1) to the chain case (2), then install and tighten the three bolts (6×14 mm) (3) to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

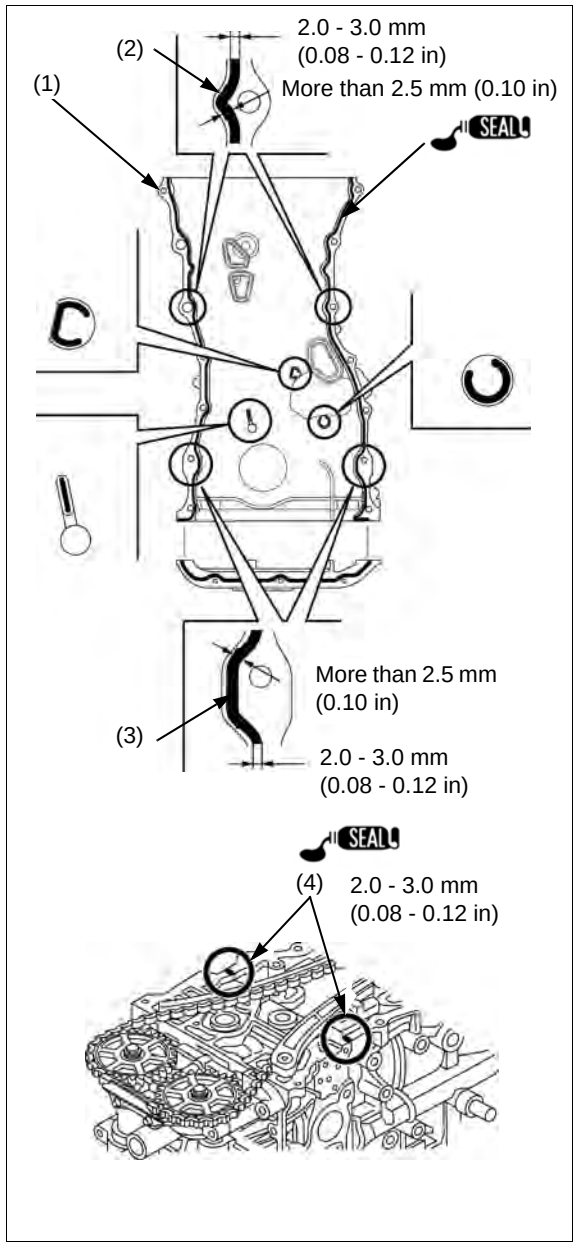


Clean the cylinder block, cylinder head and chain case mating surface.

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1280B or equivalent) to the specified area of chain case (1).

Apply larger bead (more than 2.5 mm (0.10 in) thick) to the specified area (2) and (3).

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1215 or equivalent) to the cylinder head gasket mating area (4) between the cylinder head and cylinder block, then install the chain cover.



NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

Set the chain case (1) against the crankcase side (2) and install it to the cylinder block (3).

Loosely install the two bolts (6 × 31 mm) (4).

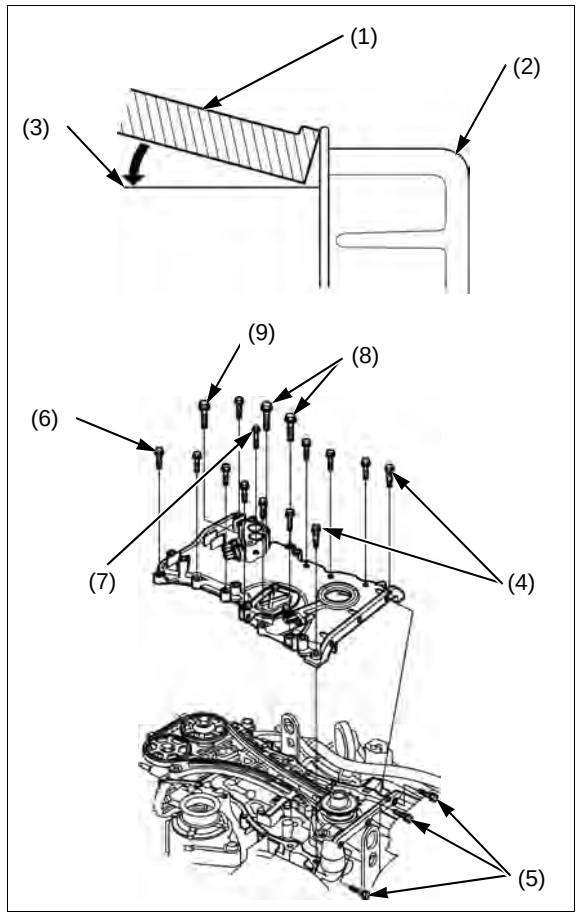
Loosely install the other bolts and tighten them to the specified torque in two or three steps.

TORQUE:

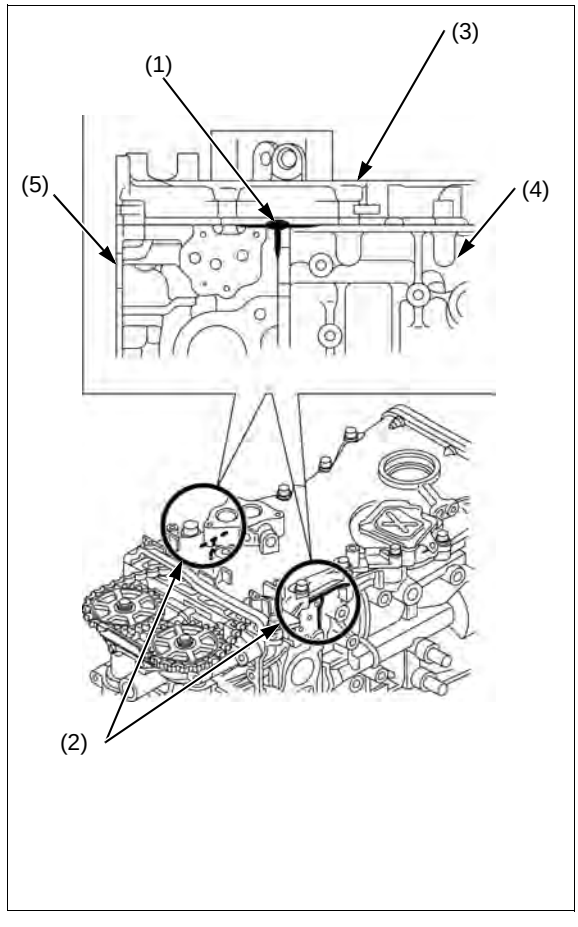
12 N·m (1.2 kgf·m, 9 lbf·ft) :
THREE BOLTS (6 × 25 mm) (5)
TEN BOLTS (6 × 28 mm) (6)
TWO BOLTS (6 × 31 mm) (4)
BOLT (SH) (6 × 38 mm) (7)

39 N·m (4.0 kgf·m, 29 lbf·ft) :
TWO BOLTS (10 × 43 mm) (8)
BOLT (10 × 70 mm) (9)

- Do not slide the chain case when installing it. It will cause uneven application of the liquid sealant.
- Be careful not to drop the O-ring and chain case packing.



After installing the chain case, push the excess sealant (1) into the T-shaped mating surfaces (2) of chain case (3), cylinder block (4) and cylinder head (5) on both sides.



Be sure to degrease, clean, or lubricate the following parts before installation.

Crankshaft pulley bolt (1)

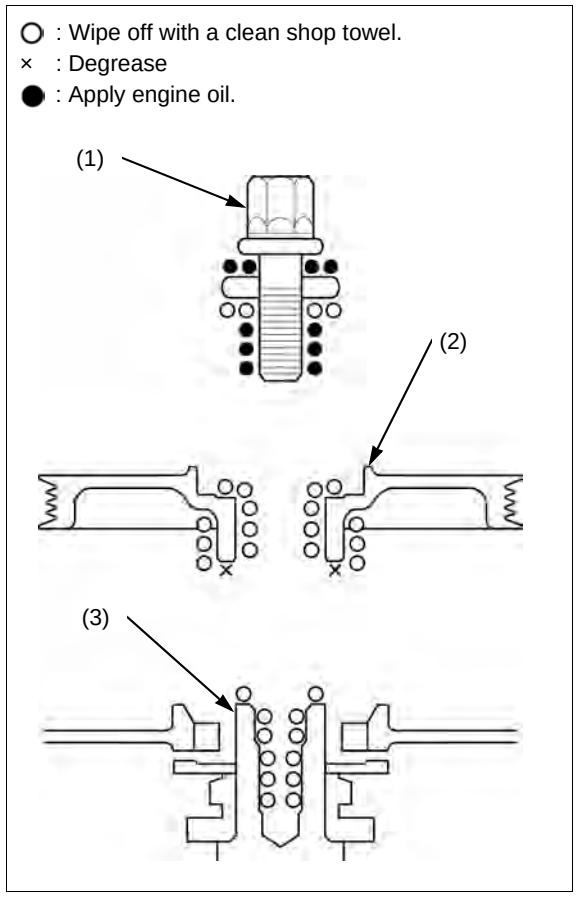
- Degrease the entire surface of the bolt-washer (especially the washer and crankshaft pulley mating surface) with a clean shop towel.
- Apply engine oil to the flanged part of the bolt and washer mating surface.
- Apply engine oil to the threaded part of the bolt.
- Do not apply engine oil to the washer and crankshaft pulley mating surface.

Crankshaft pulley (2)

- Remove oil from the bottom of the crankshaft pulley boss using a degreasing cleaning agent.
- Degrease the bolt-washer mounting surface on the crankshaft pulley using a clean shop towel.
- Do not contaminate the belt installation parts with oil.

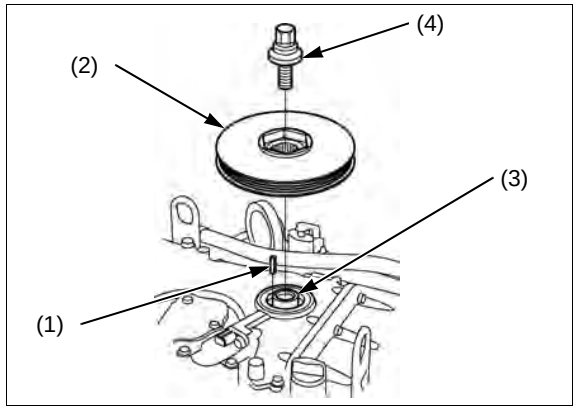
Crankshaft (3)

- Spray a degreasing cleaning agent over a clean shop towel, and wipe the entire surface of the crankshaft to remove oil thoroughly.
- Do not let the oil seals and other rubber parts get sprayed or contaminated with the degreasing cleaning agent.
- Do not spray the degreasing cleaning agent directly over the crankshaft. Be sure to wipe the crankshaft with a clean shop towel sprayed with the degreasing cleaning agent.



Install the key (1) and crankshaft pulley (2) to the crankshaft (3) and loosely install the crankshaft pulley bolt (4).

- Be careful not to let the key fall into the chain case.



Tighten the crankshaft pulley bolt (1) to the specified torque using the special tools.

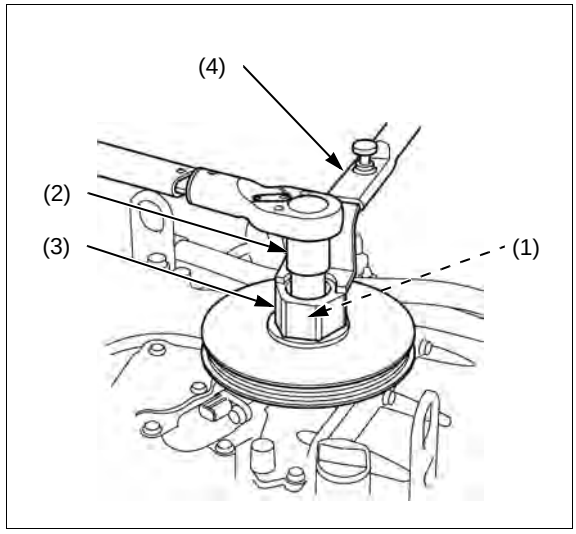
TOOLS:

Socket wrench 19 × 90 (2)	**07JAA-001020A**
Holder attachment, 50 mm, offset (3)	**07MAB-PY30100**
Holder handle (4)	**07JAB-001020B**

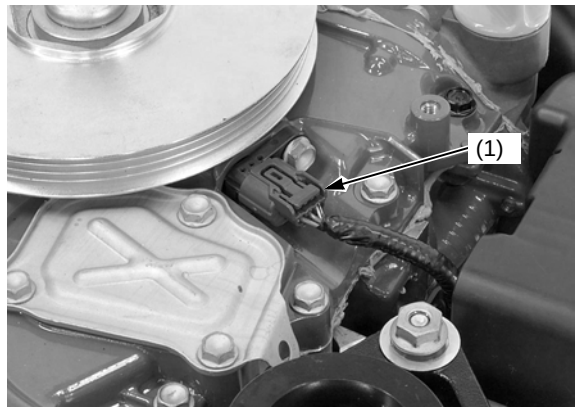
TORQUE: 250 N·m (25.5 kgf·m, 184 lbf·ft)

NOTICE

- *Do not use an impact wrench. Tighten the bolt while holding the crankshaft pulley with the special tool.*
- *Do not turn the crankshaft counterclockwise.*

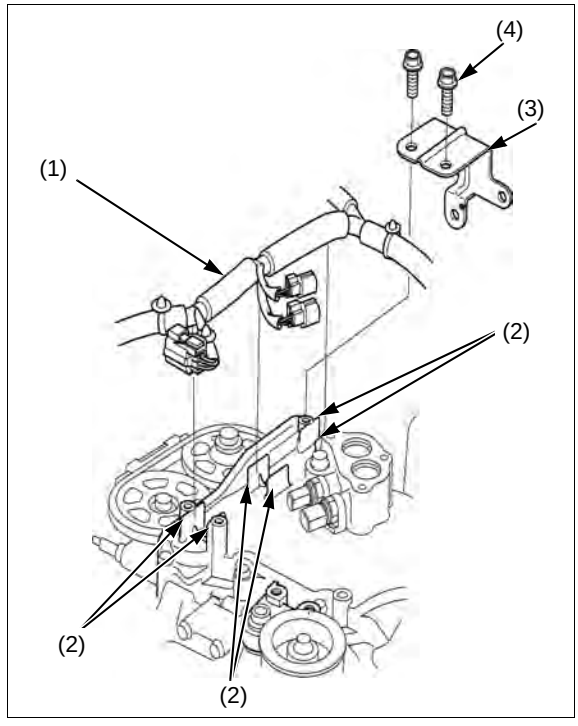


Connect the CKP sensor 3P connector (1).



Set the main wire harness (1) between the tabs (2).

Install the harness clip bracket B (3) and tighten the two bolts (4).



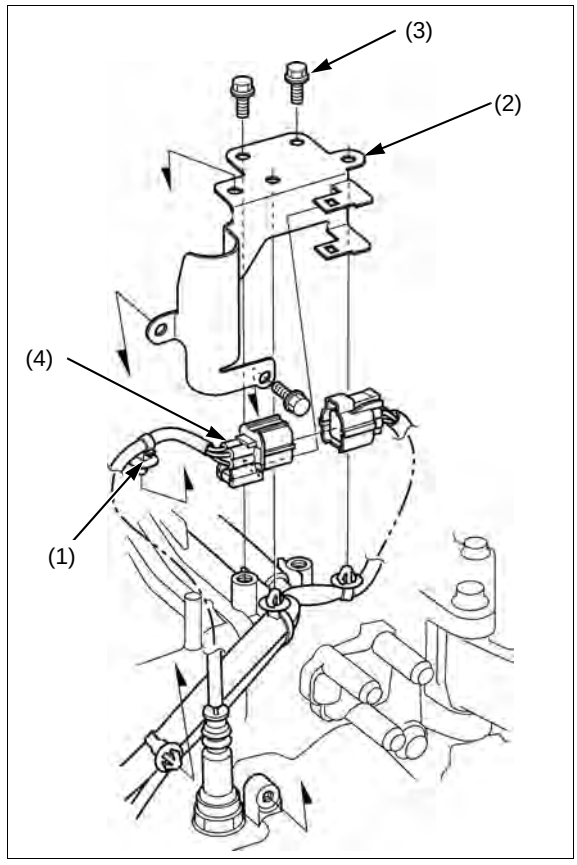
Install the four harness band clips (1) to the harness clip bracket C (2).

Set the harness clip bracket C and tighten the three bolts (3).

Connect the A/F sensor 4P connector (4) and install it to the harness clip bracket C.

Install the following:

– Cylinder head cover (page 14-6)
– Engine hanger B(page 7-7)
– Thermostat (page 11-5)
– Alternator belt (page 7-5)



CAMSHAFT/ROCKER ARM REMOVAL/ INSTALLATION

REMOVAL

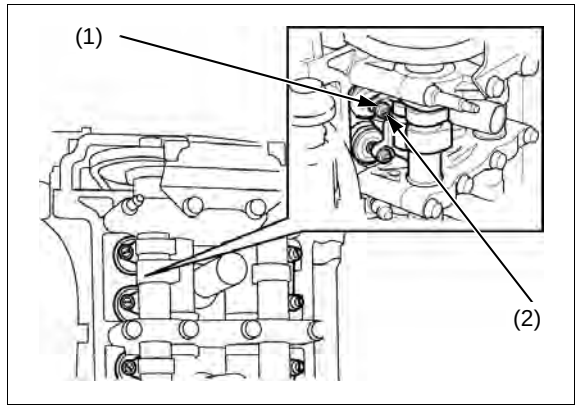
Disconnect the battery negative (–) cable.

Make sure the remote control lever is in "N" (neutral) position.

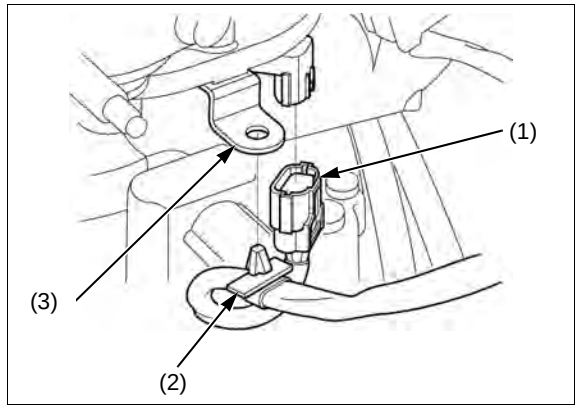
Turn the crankshaft and set the No. 1 piston at top dead center of compression stroke (page 3-15).

Remove the crankshaft pulley/cam chain (page 14-11).

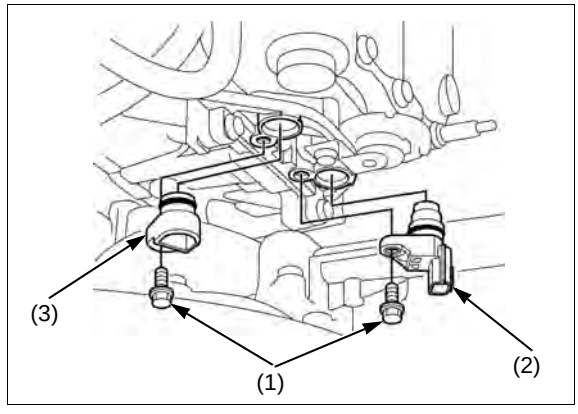
Loosen all the lock nuts (1) and then loosen all the valve adjusting screws (2) fully.



Disconnect the CMP sensor 3P connector (1) and remove the harness band clip (2) from the clip bracket F (3).

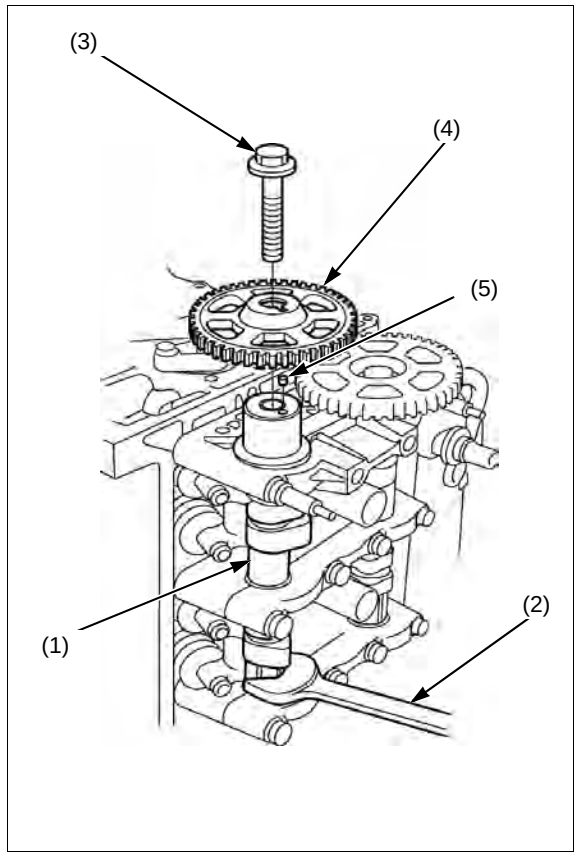


Remove the two bolts (1), CMP sensor (2) and CMP hole plug (3).



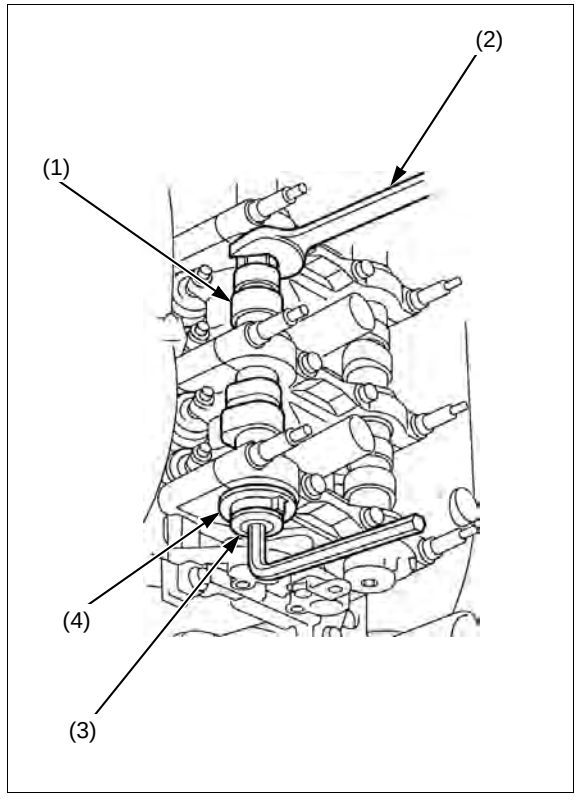
Hold the hexagonal part of intake camshaft (1) with a wrench (2) or equivalent tool.

Remove the VTC flange bolt (3), intake camshaft sprocket (4) and dowel pin (5).



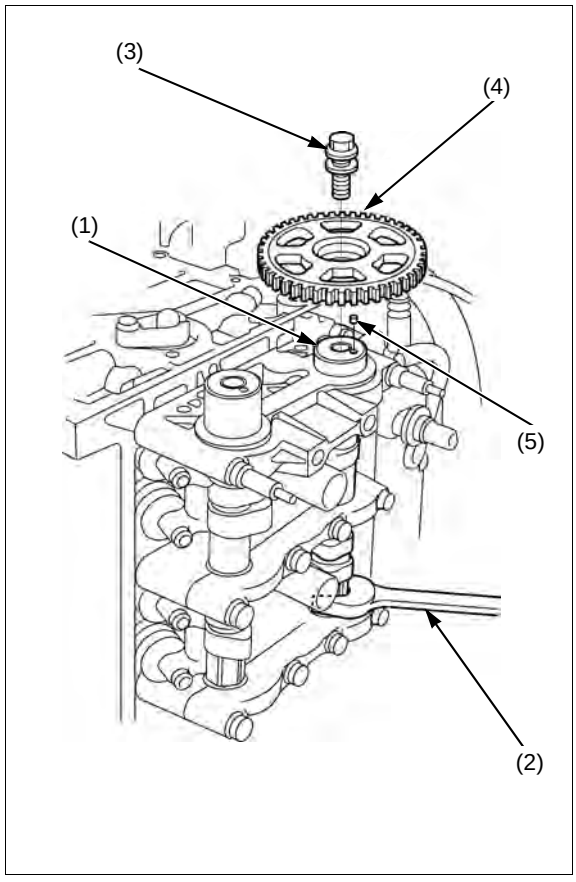
Hold the hexagonal part of intake camshaft (1) with a wrench (2) or equivalent tool.

Remove the sealing bolt (3) and camshaft collar (4).



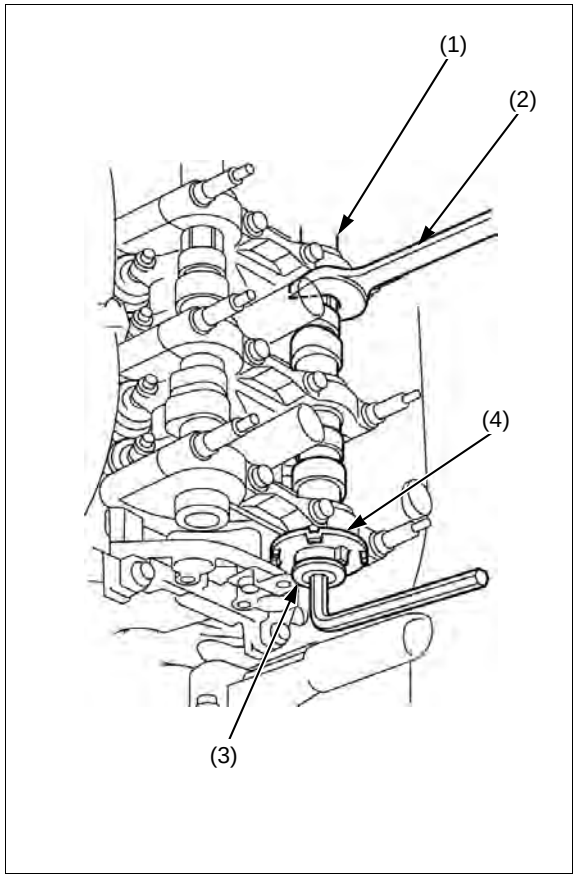
Hold the hexagonal part of exhaust camshaft (1) with a wrench (2) or equivalent tool.

Remove the bolt (3), exhaust camshaft sprocket (4) and dowel pin (5).

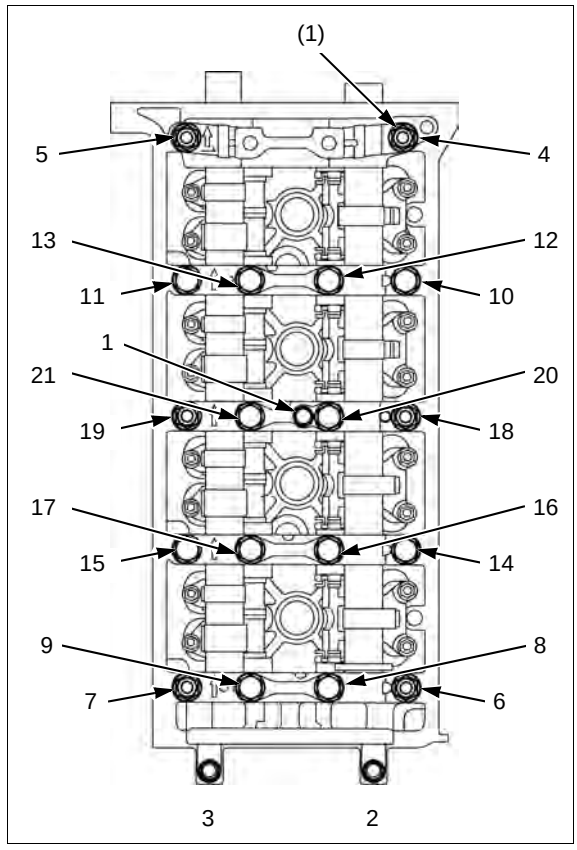


Hold the hexagonal part of exhaust camshaft (1) with a wrench (2) or equivalent tool.

Remove the sealing bolt (3) and CMP pulse plate (4).

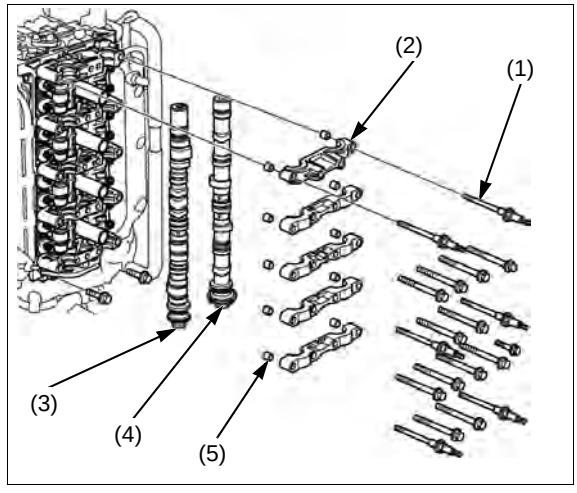


Loosen the twenty-one camshaft holder bolts (1) in the numbered sequence in two or three steps.



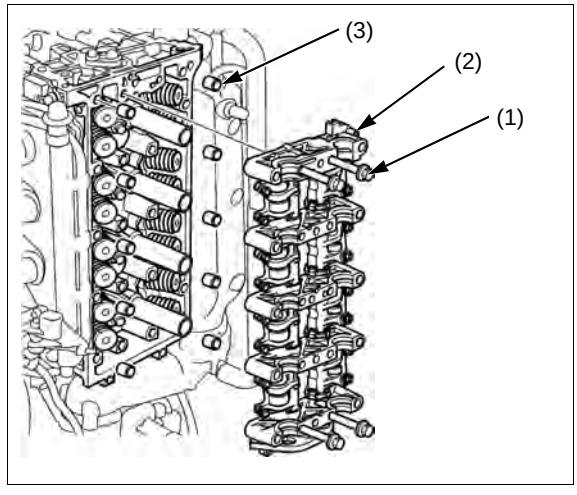
Remove the following:

- Twenty-one bolts (1)
- Five camshaft holders (2)
- Intake camshaft (3)
- Exhaust camshaft (4)
- Ten dowel pins (5)

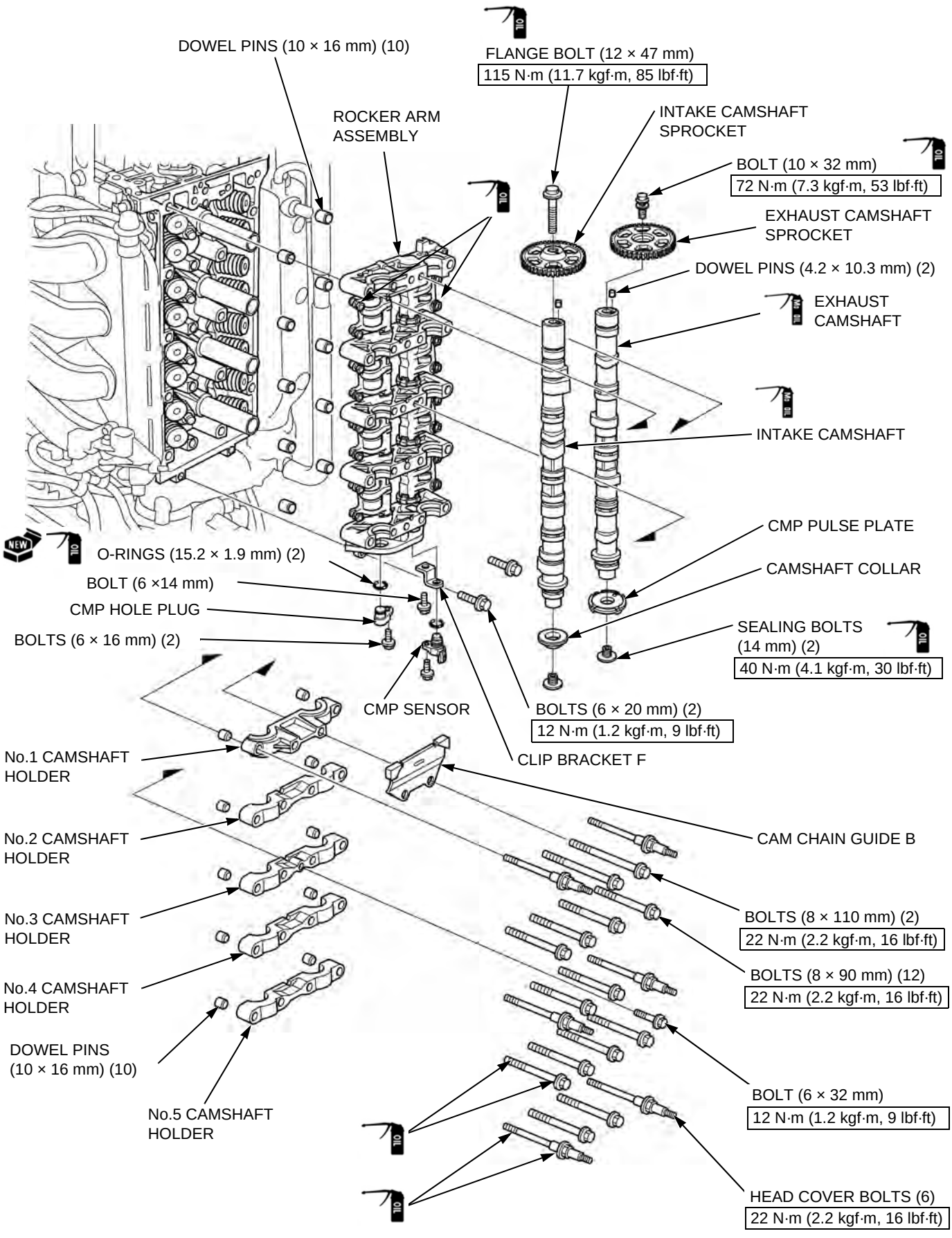


Install the four bolts (1) in the positions as shown and remove the rocker arm assembly (2) from the cylinder head.

Remove the ten dowel pins (3).



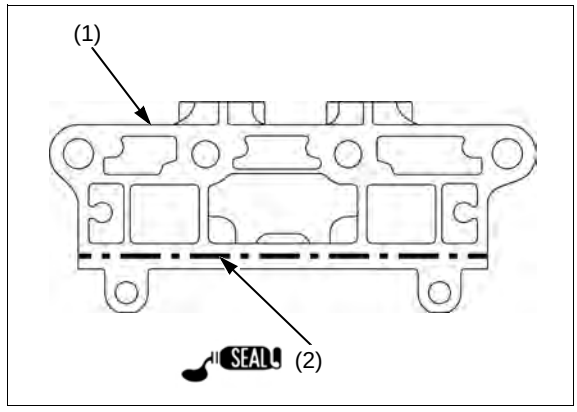
EXPLODED VIEW



INSTALLATION

Completely degrease the No. 5 rocker shaft holder (1) mating surface with cylinder head, using a degreasing agent.

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1280B or equivalent) to the specified area (2) of No. 5 rocker shaft holder.

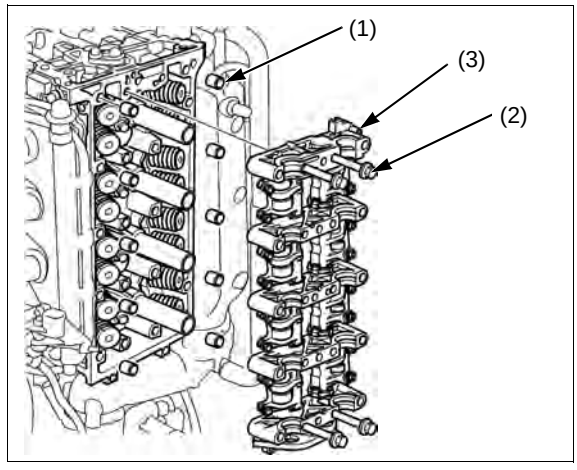


NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

Install the ten dowel pins (1) to the cylinder head.

Install the four bolts (2) in the positions as shown and install the rocker arm assembly (3) to the cylinder head.

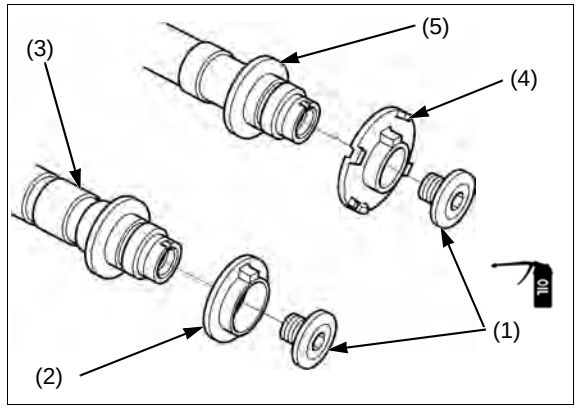


Apply engine oil to the threads and seating surfaces of the two sealing bolts (1).

Install the camshaft collar (2) to the intake camshaft (3).
Install the CMP pulse plate (4) to the exhaust camshaft (5).
Install and tighten the both sealing bolts to the specified torque.

TORQUE: 40 N·m (4.1 kgf·m, 30 lbf·ft)

- When tightening the bolts, hold the hexagonal parts of camshafts with a wrench or equivalent tool.
- Be careful not to damage the camshaft journal surfaces and cam lobes.

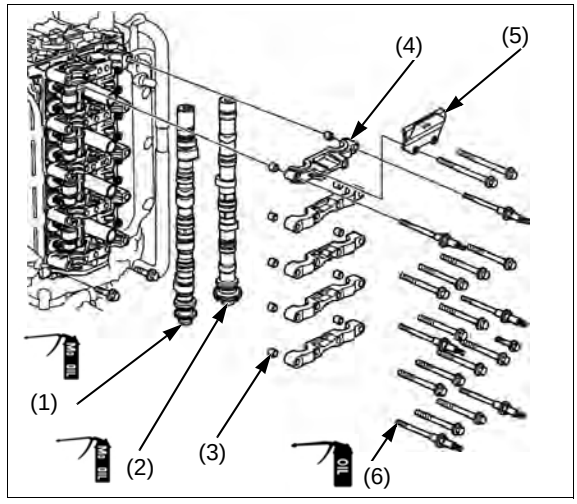


Apply molybdenum disulfide oil to the camshaft journals and cam lobes.
Apply engine oil to the threads and seating surfaces of each bolt.

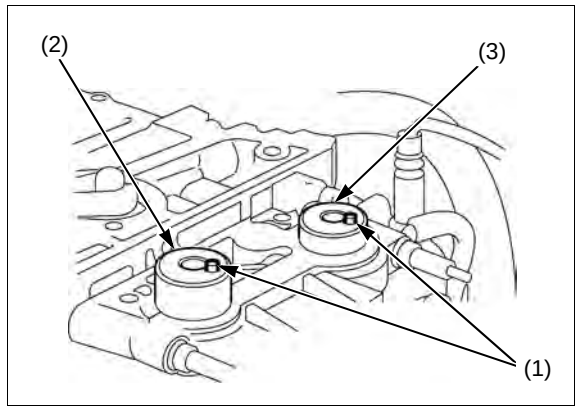
Install the intake camshaft (1), exhaust camshaft (2), ten dowel pins (3), five camshaft holders (4) and cam chain guide B (5).

Loosely install the following bolts (6):

– Two bolts (8 x 110 mm)
– Twelve bolts (8 x 90 mm)
– Bolt (6 x 32 mm)
– Two bolts (6 x 20 mm)
– Six head cover bolts



Check that the dowel pins (1) of intake camshaft (2) and exhaust camshaft (3) are positioned as shown.

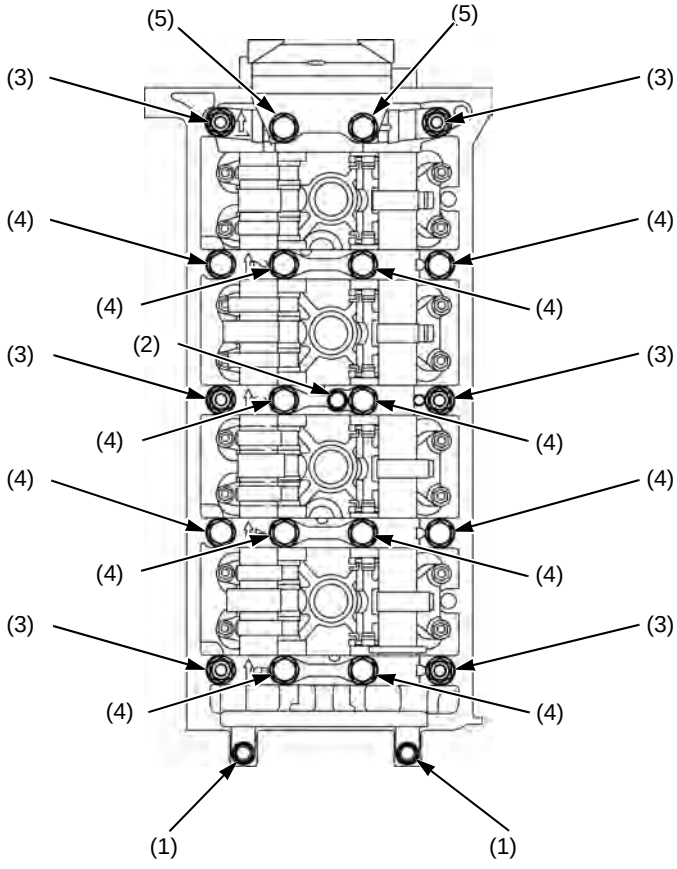


Tighten the bolts (1) to the specified torque in the numbered sequence in two or three steps.

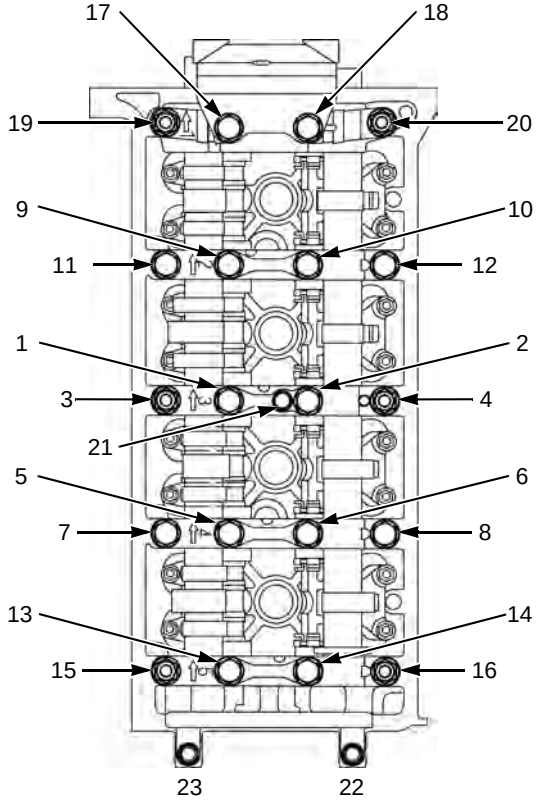
TORQUE:

12 N·m (1.2 kgf·m, 9 lbf·ft) :
Two bolts (6 × 20 mm) (1)
Bolt (6 × 32 mm) (2)
22 N·m (2.2 kgf·m, 16 lbf·ft) :
Six head cover bolts (3)
Twelve bolts (8 × 90 mm) (4)
Two bolts (8 × 110 mm) (5)

BOLT INSTALLATION POSITION:



BOLT TIGHTENING SEQUENCE:

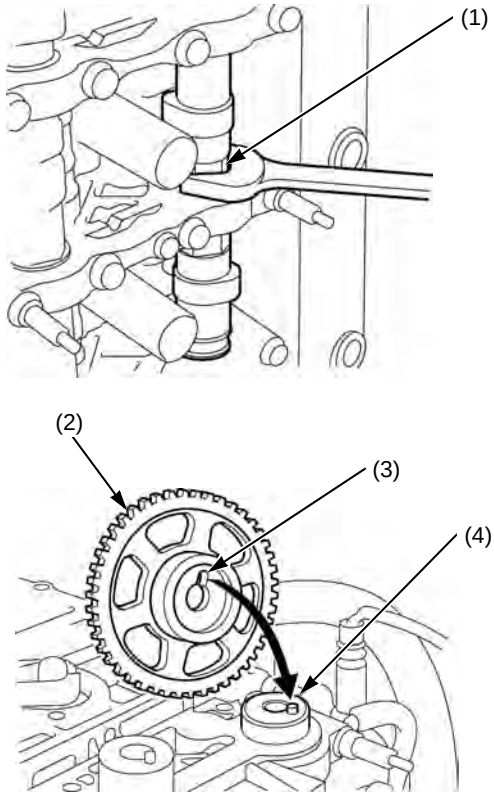


Hold the hexagonal part of exhaust camshaft (1) with a wrench or equivalent tool.

Install the exhaust camshaft sprocket (2) by aligning its groove (3) with the dowel pin (4) of the exhaust camshaft.

Apply engine oil to the threads and seating surface of the bolt and tighten it to the specified torque.

TORQUE: 72 N·m (7.3 kgf·m, 53 lbf·ft)

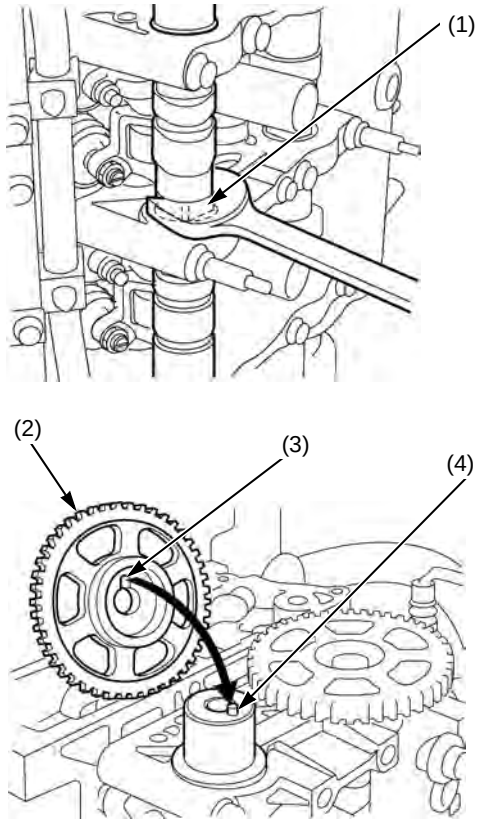


Hold the hexagonal part of intake camshaft (1) with a wrench or equivalent tool.

Install the intake camshaft sprocket (2) by aligning its groove (3) with the dowel pin (4) of the intake camshaft.

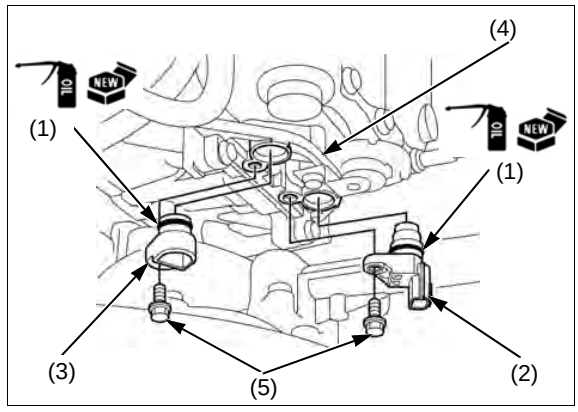
Apply engine oil to the threads and seating surface of the bolt and tighten it to the specified torque.

TORQUE: 115 N·m (11.7 kgf·m, 85 lbf·ft)



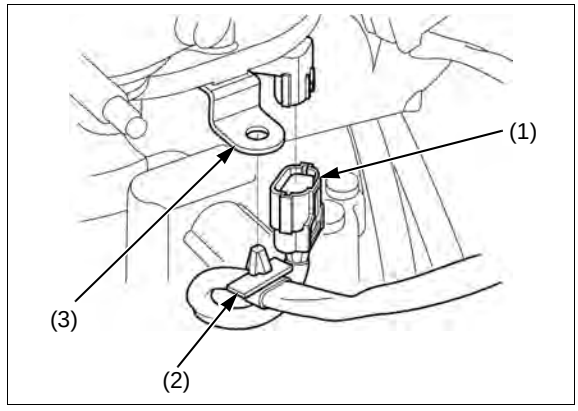
Apply engine oil to new O-rings (1) and install them to the CMP sensor (2) and CMP hole plug (3).

Install the CMP sensor and CMP hole plug to the No.5 rocker shaft holder (4) and tighten the two bolts (5).



Connect the CMP sensor 3P connector (1) and install the harness band clip (2) to the clip bracket F (3).

Install the crankshaft pulley/cam chain (page 14-11).



CYLINDER HEAD REMOVAL/ INSTALLATION

REMOVAL

- Remove the cylinder head when the engine is cold.
- Be careful not to damage the gasket mating surfaces of cylinder head and cylinder block.

Turn the crankshaft and set the No. 1 piston at top dead center of compression stroke (page 3-15).

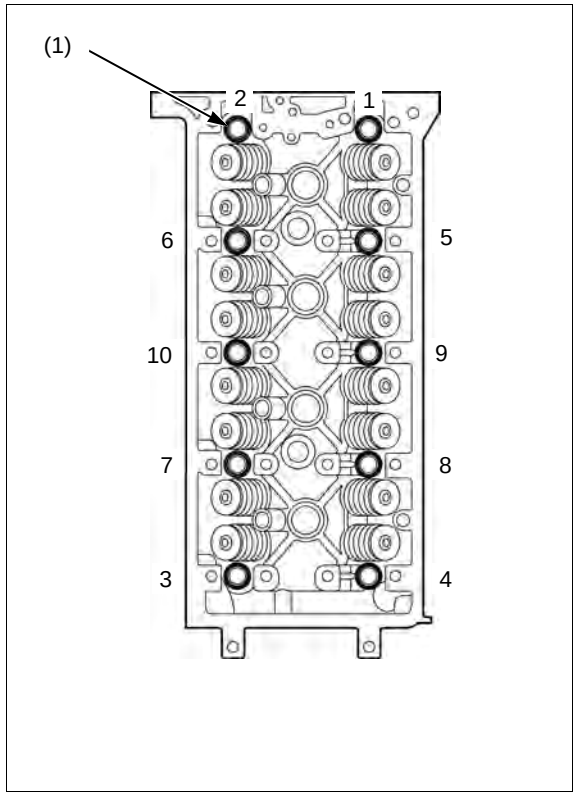
Disconnect the battery negative (–) cable.

Make sure the remote control lever is in "N" (neutral) position.

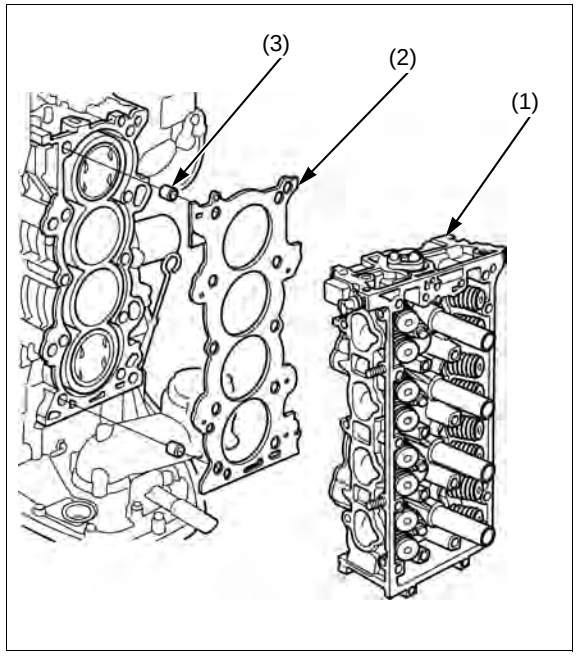
Remove the following:

– Fuel pump (high pressure side)/Vapor separator (page 5-101)
– Injector base (page 5-98)
– Exhaust manifold (page 5-107)
– Camshaft/rocker arm (page 14-26)

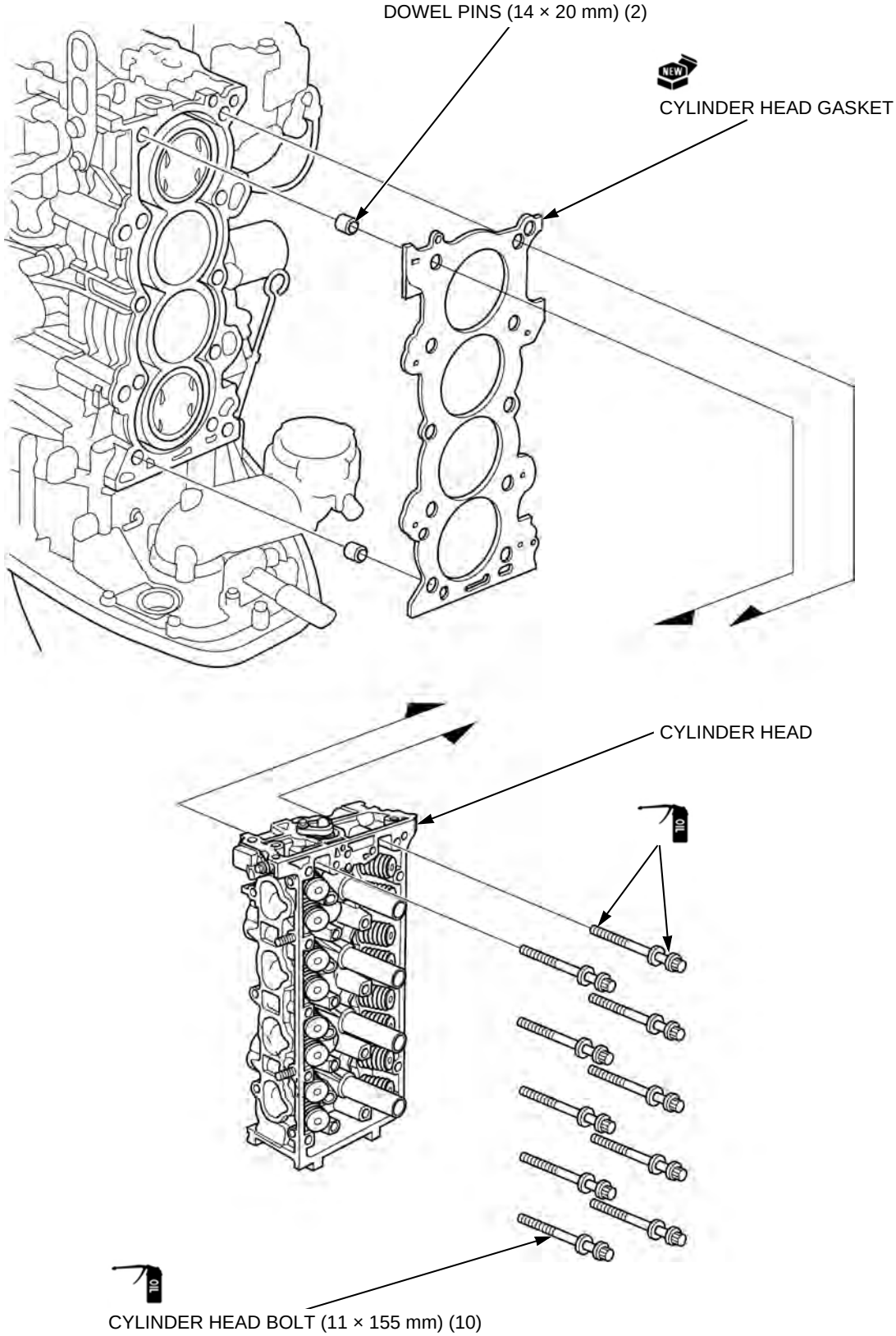
Loosen the ten bolts (1) in the numbered sequence in two or three steps.



Remove the cylinder head (1), cylinder head gasket (2) and two dowel pins (3).



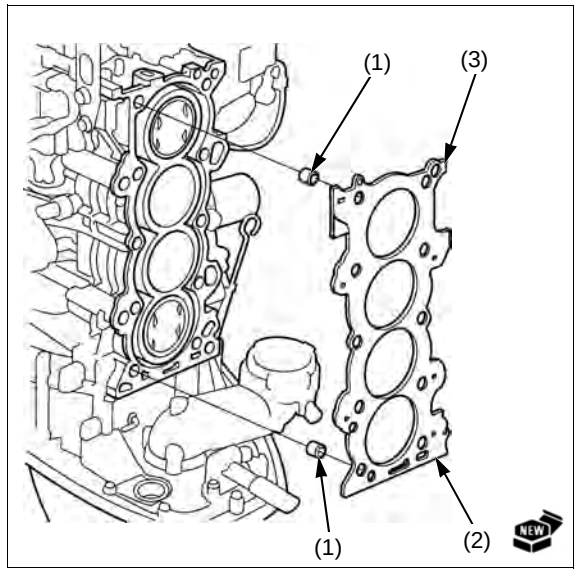
EXPLODED VIEW



INSTALLATION

Turn the crankshaft and set the No. 1 piston at top dead center of compression stroke (page 3-15).

Clean the cylinder head and cylinder block mating surfaces.
Install the two dowel pins (1) to the cylinder block.
Install a new cylinder head gasket (2) with its tab (3) positioned as shown.



Install the cylinder head onto the cylinder block by aligning the dowel pin holes.

Apply engine oil to the threads and seating surface of each bolt.
Install and tighten the ten bolts (1) to the specified torque in the numbered sequence in two or three steps.

TORQUE: 40 N·m (4.1 kgf·m, 30 lbf·ft)

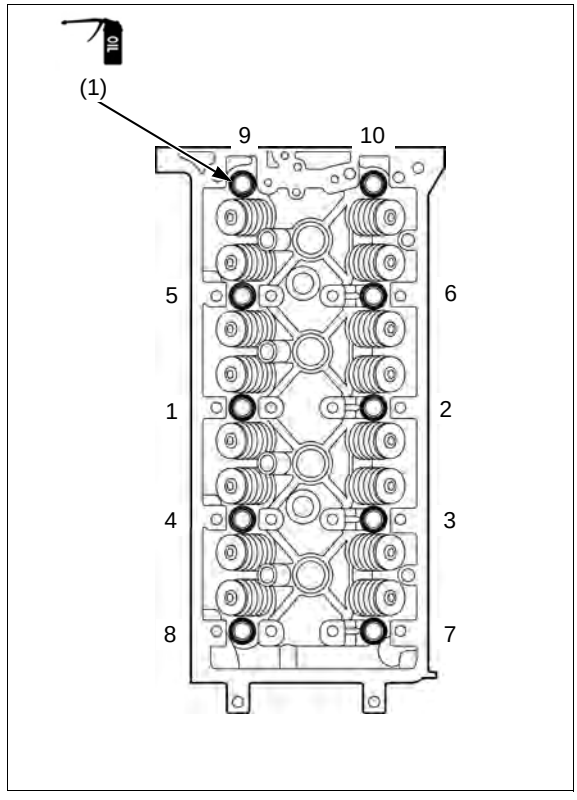
Using a torque angle gauge (commercially available), continue tightening the bolts in two more steps by 90°.

If the bolts are replaced with new ones, further tighten them by 98°.

TIGHTENING ANGLE:
+ 90°+ 90° (When reusing the bolts)
+ 90°+ 90°+ 98° (When replacing the bolts)

Install the following:

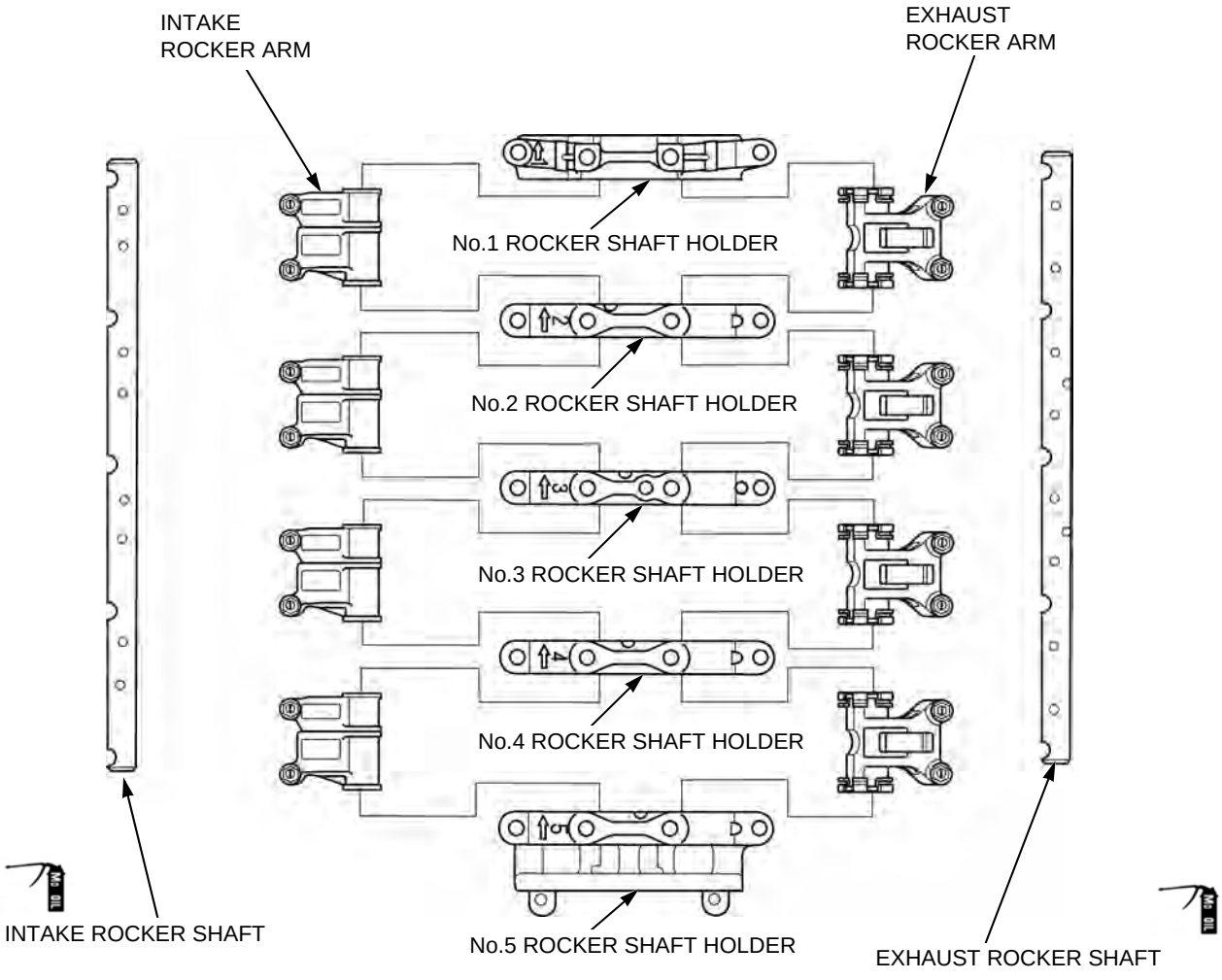
– Camshaft/rocker arm (page 14-31)
– Injector base (page 5-98)
– Exhaust manifold (page 5-107)
– Vapor separator/Fuel pump (high pressure side) (page 5-101)



ROCKER ARM DISASSEMBLY/ ASSEMBLY

- Identify parts before they are removed so they can be reinstalled in their original locations.
- Check the rocker arm contacting surface of camshaft for wear or damage.

Apply molybdenum disulfide oil to the intake and exhaust rocker shaft whole surfaces.



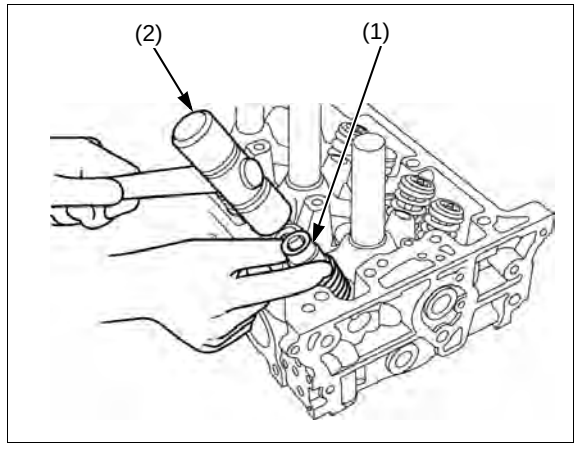
CYLINDER HEAD DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

Remove the cylinder head (page 14-35).

Use an appropriate tool (1) that matches the diameter of the valve spring retainer.
Attach the tool to the retainer and lightly tap the tool with a plastic hammer (2) to separate the valve keepers from the retainer.

- Tap at right angles with each valve stem head. Be careful not to bend the valve.



Change the attachment of the special tool as shown.

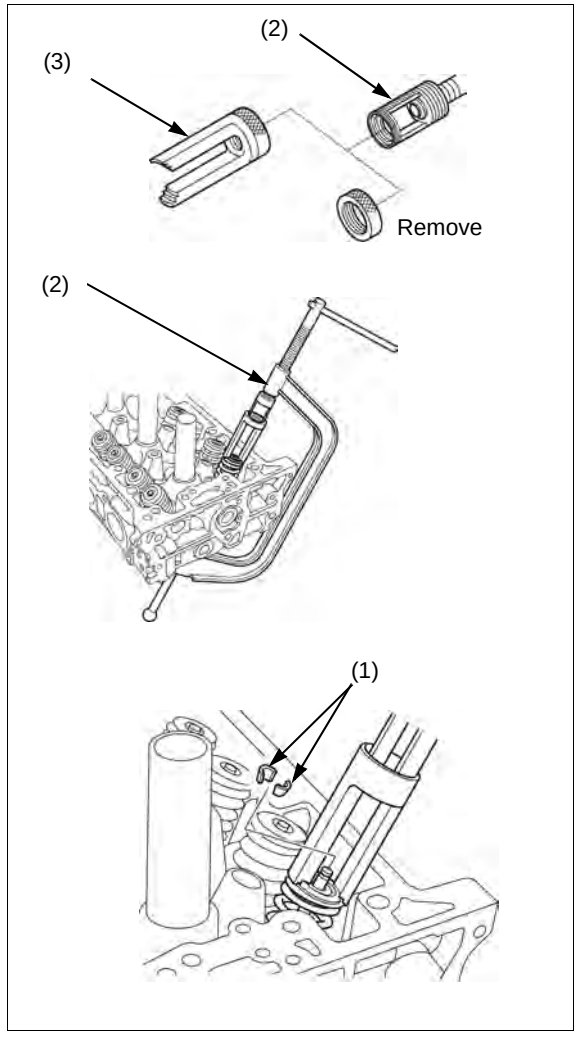
Compress the valve springs and remove the valve keepers (1) using the special tools.

TOOLS:

Valve spring compressor (2)	**07757-0010000**
Valve spring compressor attachment (3)	**07757-PJ10100**

- Take care not to let the special tools contact the cylinder head.
- Identify the valve keepers so they can be reinstalled in their original locations.

Remove the remaining valve keepers.

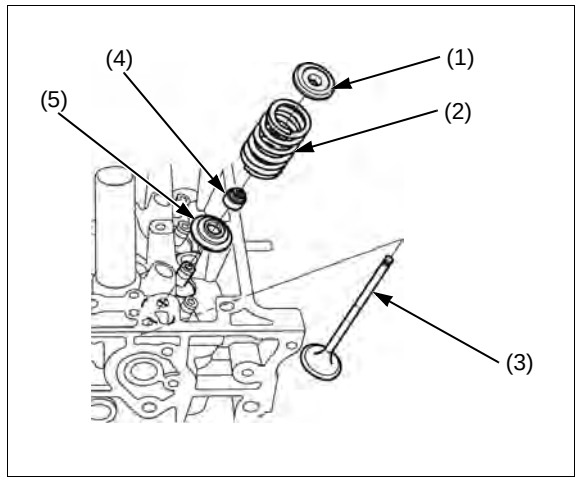


Remove the valve spring retainer (1), valve spring (2), valve (3), valve stem seal (4) and valve spring seat (5).

Check the valve heads for chipping and excessive carbon deposits. Clean or replace the valves if necessary.

- Identify each part so they can be reinstalled in their original locations.

Inspect the cylinder head (page 14-45).



EXPLODED VIEW

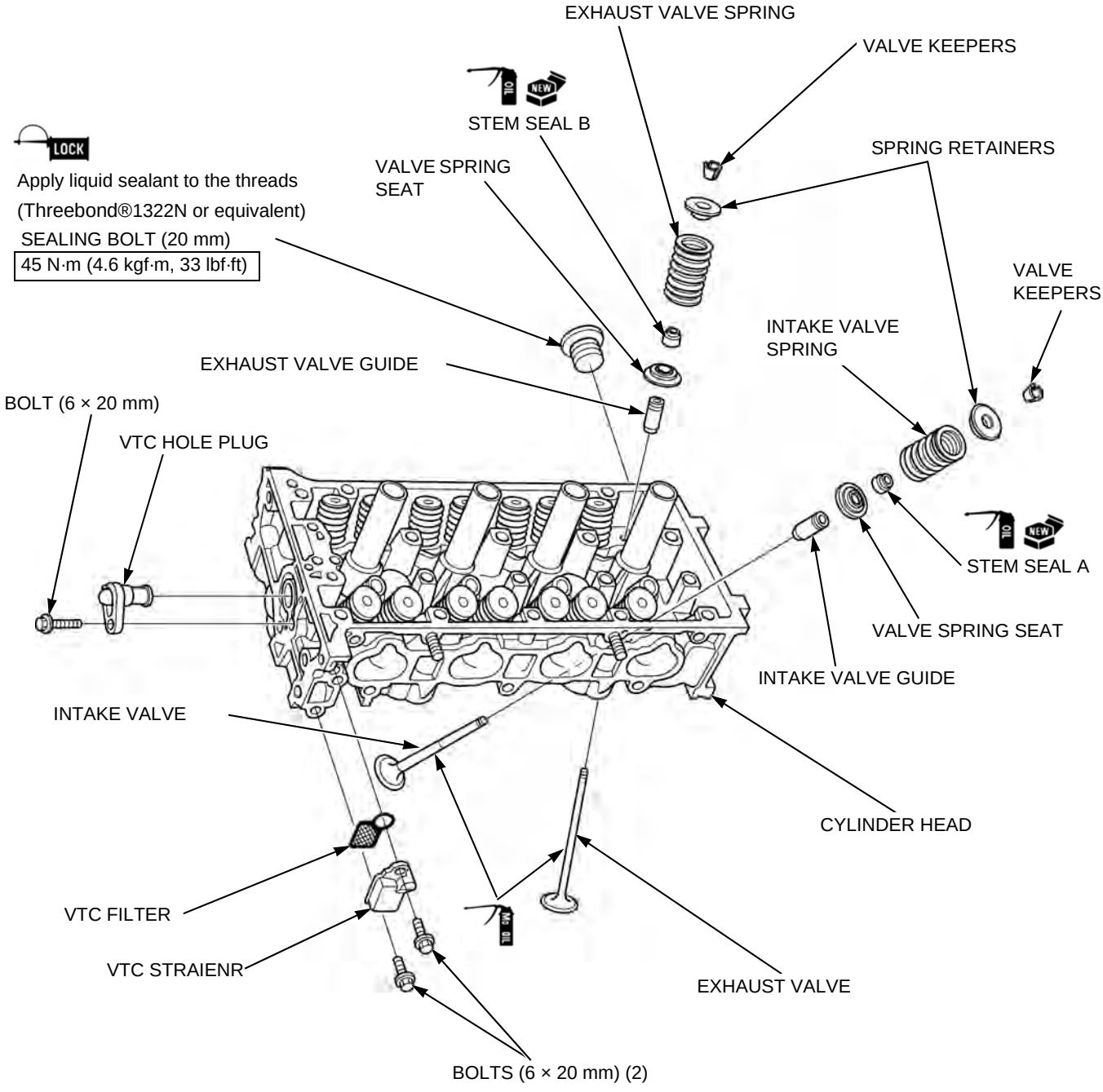
Apply oil to the following parts during assembly.

Engine oil:

- Valve stem seals (inner surface)

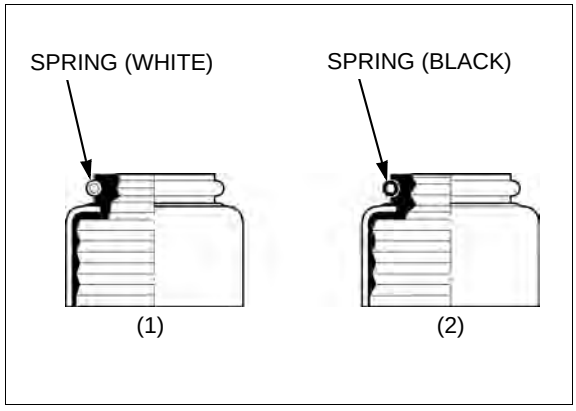
Molybdenum disulfide oil:

- Valve stem (sliding surface)



ASSEMBLY

Note that valve stem seal A (intake side) (1) and B (exhaust side) (2) are different. Do not confuse them.



Install the valve spring seat.

Apply engine oil to the new valve stem seal (1) inner surface.

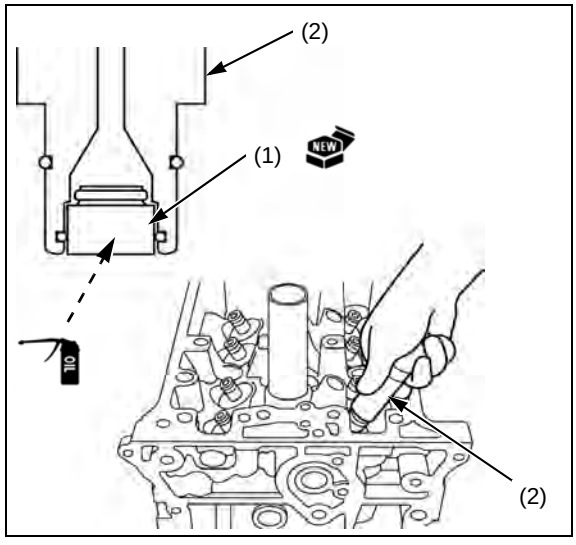
Set the new valve stem seal in the special tool, and push it straight into the valve guide by hand.

TOOL:

Stem seal driver (2)	**07PAD-0010000**

- Use the 5.5 mm side of special tool.

Apply molybdenum disulfide oil to the valve stem sliding surface and insert the valve into the valve guide.



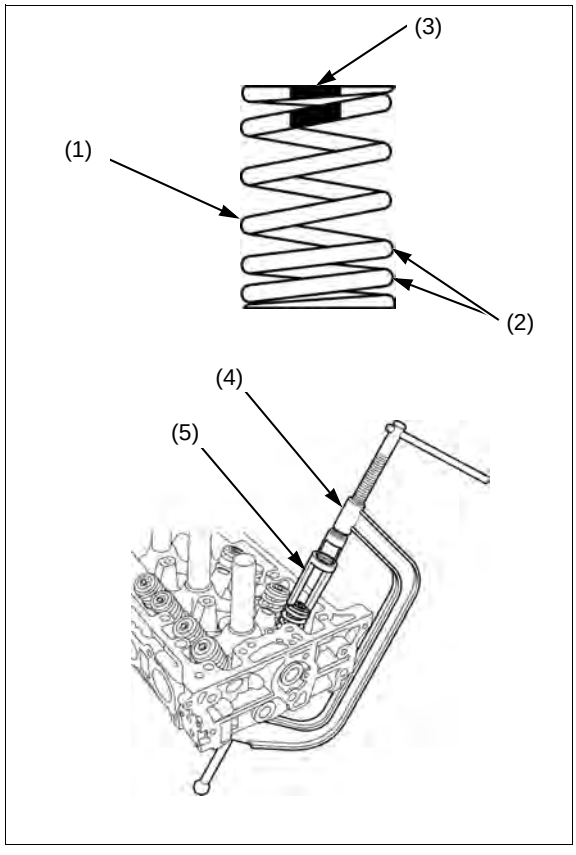
Install the valve spring (1) and valve spring retainer.

- Install the valve spring with its narrow pitched side (2) facing the valve spring seat and painted side (3) facing the retainer.

Using the special tools, compress the valve spring and set the two valve keepers in the groove in the valve stems securely.

TOOL:

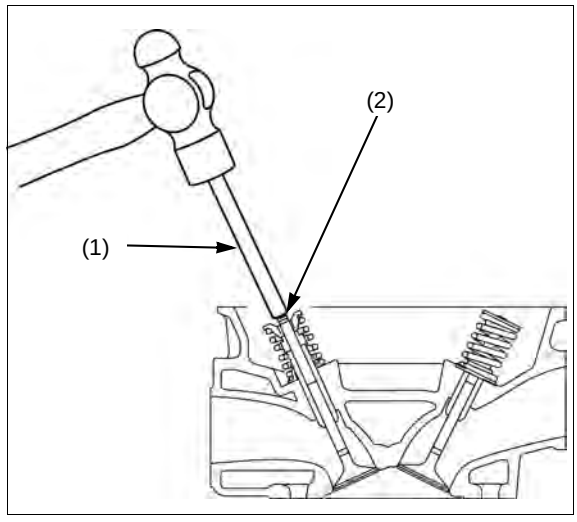
Valve spring compressor (4)	**07757-0010000**
Valve spring compressor attachment (5)	**07757-PJ10100**



Using an appropriate tool (1), lightly tap the end of each valve stem (2) two or three times with a plastic hammer to ensure proper seating of the valve and valve keepers.

- Tap the valve stem only along its axis so you do not bend the stem.

Install the cylinder head (page 14-37).



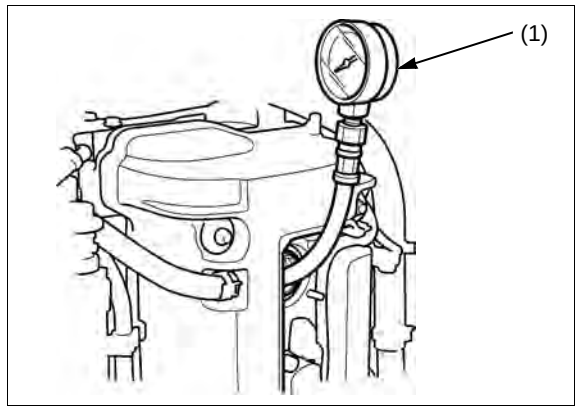
CYLINDER COMPRESSION TEST

Set the remote control lever in the "N" (neutral) position.

Remove the emergency stop switch clip.

Remove the No. 1 spark plug (page 3-17).

Install a compression gauge (commercially available) (1) in the No.1 plug hole.



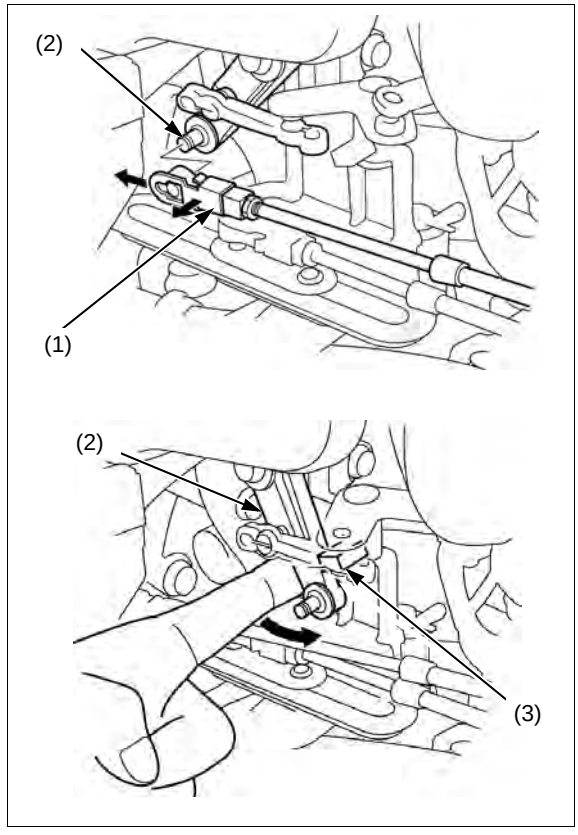
Disconnect the throttle control cable (1) from the throttle arm (2).

Set the throttle to the fully open position by pushing the throttle arm against the stopper (3) as shown.

Set the combination switch in the START position and turn the starter motor until the maximum reading is obtained. Measure the cylinder compression.

CYLINDER COMPRESSION (Pressure check at 200 min^{-1} (rpm) with wide open throttle):
1,230 – 1,630 kPa (12.6 – 16.6 kgf/cm^2, 179 – 236 psi)

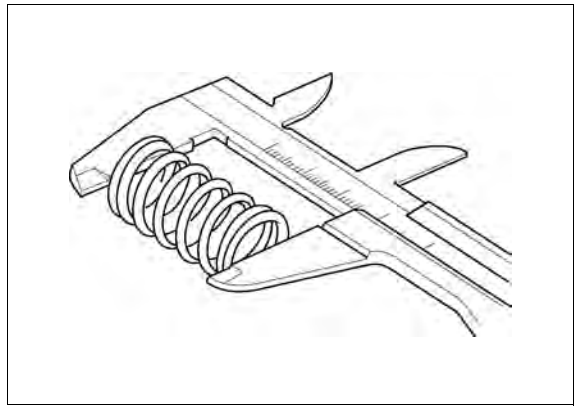
Check the compression on all cylinders.



CYLINDER HEAD INSPECTION

VALVE SPRING FREE LENGTH

Measure the free length of the valve springs.



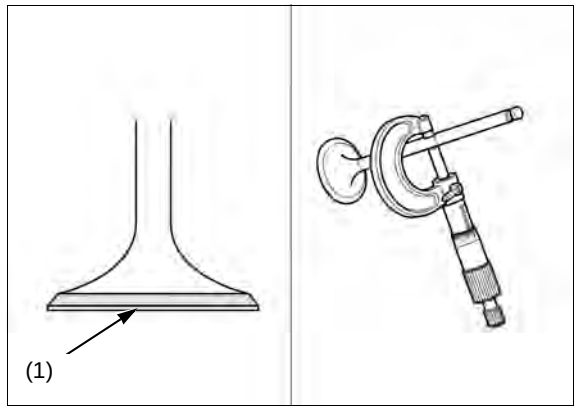
STANDARD:
IN: 49.64 mm (1.954 in)
EX: 49.64 mm (1.954 in)

VALVE FACE/STEM O.D.

Inspect each valve face (1) for pitting, wear, or irregularities.

Inspect each valve stem for bending or abnormal stem wear. Replace the valve if necessary (page 14-39).

Measure and record each valve stem O.D.

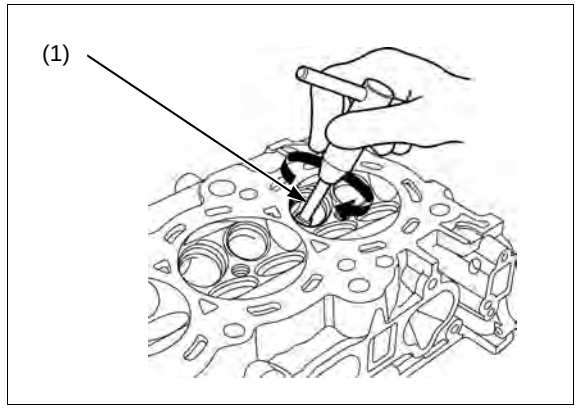


STANDARD:
IN: 5.475 – 5.485 mm (0.2156 – 0.2159 in)
EX: 5.450 – 5.460 mm (0.2146 – 0.2150 in)
SERVICE LIMIT:
IN: 5.445 mm (0.2144 in)
EX: 5.420 mm (0.2134 in)

Replace the valves if their O.D. is smaller than the service limit (page 14-39).

VALVE GUIDE I.D.

Using the valve guide reamer (special tool), ream the valve guides to remove any carbon deposits before measuring.

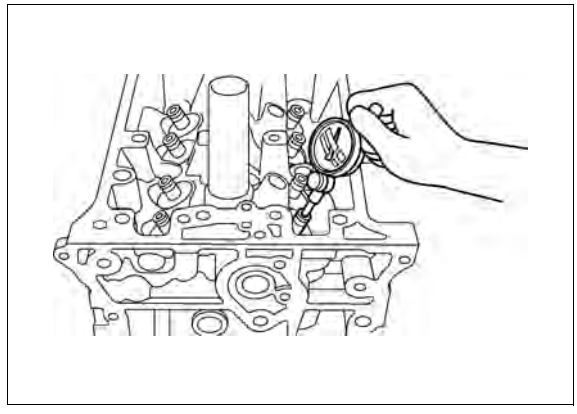


NOTICE

Turn the special tool (valve guide reamer, 5.525 mm) clockwise, never turn it counterclockwise. Continue to turn it clockwise as you lift it from the valve guide.

TOOL:
Valve guide reamer, 5.525 mm (1) 07HAH-PJ70100

Measure and record each valve guide I.D.



STANDARD:
IN/EX: 5.515 – 5.530 mm (0.2171 – 0.2177 in)
SERVICE LIMIT:
IN/EX: 5.55 mm (0.219 in)

Replace the guides if they are over the service limit (page 14-52).

- Check the stem-to-guide clearance if the valve guide is replaced.

VALVE STEM-TO-VALVE GUIDE CLEARANCE

Subtract each valve stem O.D. from the corresponding valve guide I.D.

STANDARD:
IN: 0.030 – 0.055 mm (0.0012 – 0.0022 in)
EX: 0.055 – 0.080 mm (0.0022 – 0.0031 in)
SERVICE LIMIT:
IN: 0.080 mm (0.0031 in)
EX: 0.110 mm (0.0043 in)

If the stem-to-guide clearance exceeds the service limit, determine if the new guide with standard dimensions would bring the clearance within tolerance. If so, replace any guide as necessary and ream to fit (page 14-52). If the stem-to-guide clearance exceeds the service limit with new guides, replace the valves as well.

- Recondition the valve seats whenever the valve guides are replaced (page 14-54).

VALVE SEAT WIDTH

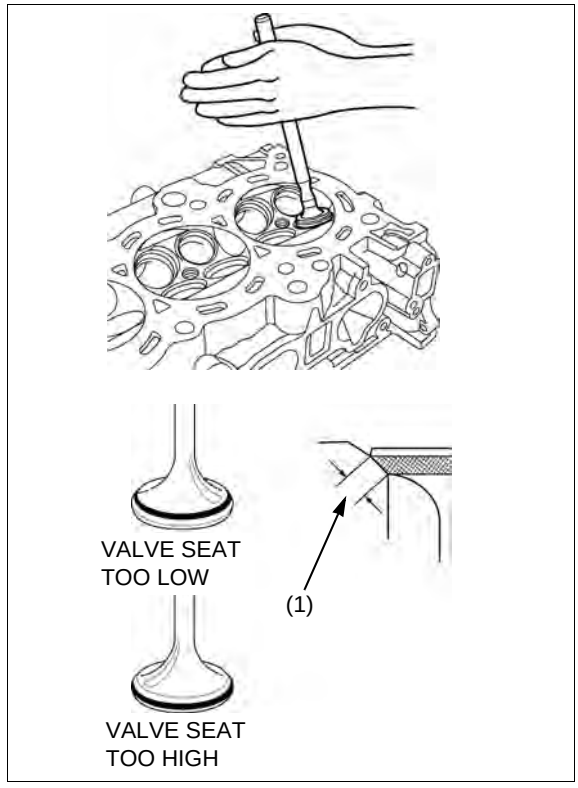
Thoroughly clean the combustion chambers and valve seats to remove carbon deposits. Apply a light coat of Prussian Blue compound or erasable felt-tipped marker ink to the valve faces.

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 transferred marking compound will show any area of the seat that is not concentric.

Measure the valve seat width (1).

STANDARD:
IN/EX: 1.25 – 1.55 mm (0.049 – 0.061 in)
SERVICE LIMIT:
IN/EX: 2.0 mm (0.08 in)

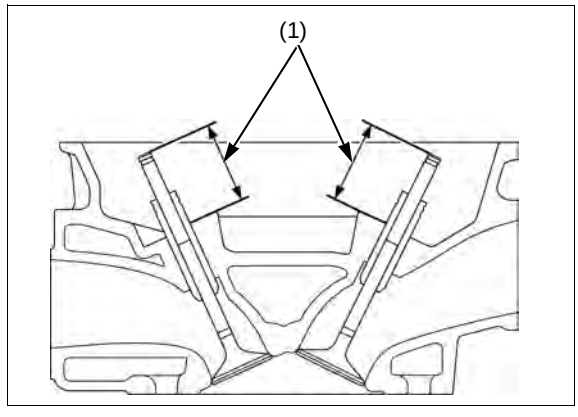
If the valve seat width is under the standard, or over the service limit, or if the valve seat is too high/low, recondition the valve seat (page 14-54).



VALVE INSTALLATION HEIGHT

Measure the valve installation height (1).

STANDARD:
IN: 44.00 – 44.60 mm (1.732 – 1.756 in)
EX: 44.00 – 44.60 mm (1.732 – 1.756 in)

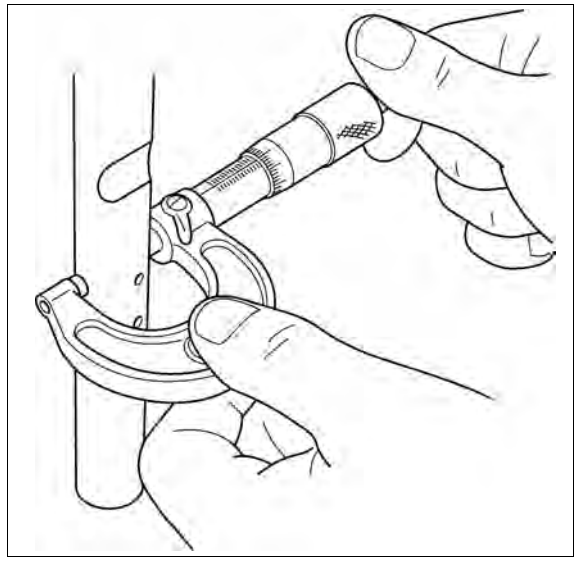


ROCKER SHAFT O.D.

Measure and record the rocker shaft O.D. at each rocker arm sliding area.

STANDARD:
IN/EX: 16.983 – 16.994 mm (0.6686 – 0.6691 in)

Replace the rocker shaft if its O.D. is smaller than the service limit (page 14-38).

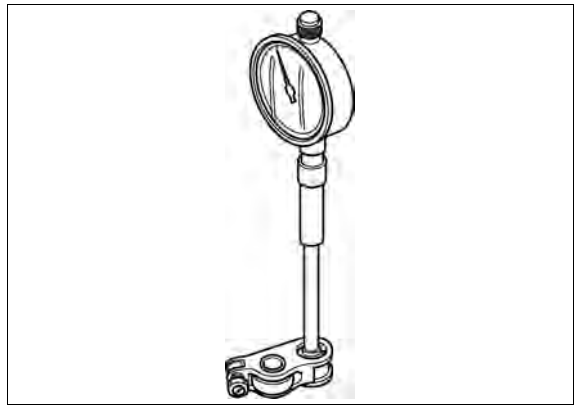


ROCKER ARM I.D.

Measure and record each rocker arm I.D.

STANDARD:
IN: 17.019 – 17.035 mm (0.6700 – 0.6707 in)
EX: 17.012 – 17.039 mm (0.6698 – 0.6708 in)

Replace the rocker arms if their I.D. is larger than the service limit (page 14-38).



ROCKER SHAFT-TO-ROCKER ARM CLEARANCE

Subtract each rocker shaft O.D. from the corresponding rocker arm I.D.

STANDARD:
IN: 0.025 – 0.052 mm (0.0010 – 0.0020 in)
EX: 0.018 – 0.056 mm (0.0007 – 0.0022 in)
SERVICE LIMIT:
IN: 0.080 mm (0.003 in)
EX: 0.080 mm (0.003 in)

If the rocker shaft-to-rocker arm clearance exceeds the service limit, replace the rocker arm and recheck.

If the rocker shaft-to-rocker arm clearance still exceeds the service limit, replace the rocker shaft (page 14-38).

CAM LOBE HEIGHT

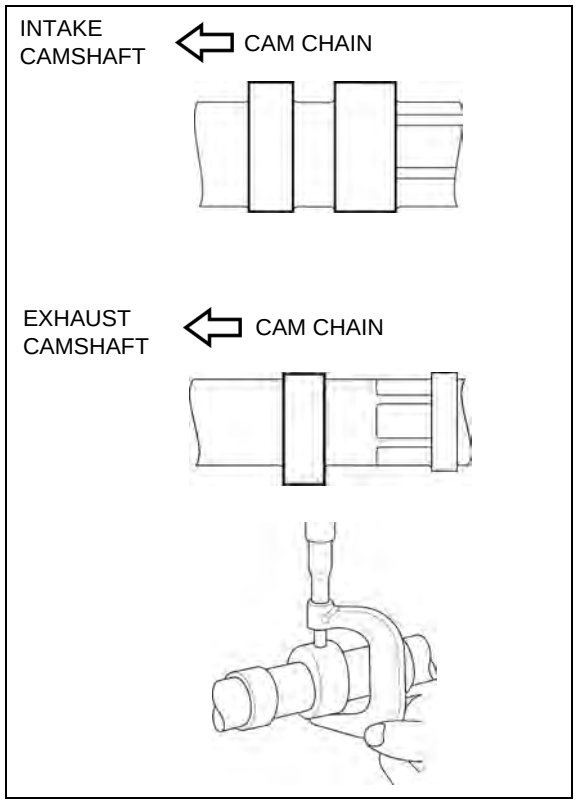
Wipe the camshaft clean, then inspect the cam lobes and journals for damage.

Clean the bearing and check the bearing for damage.

Measure cam lobe height.

STANDARD:

IN: 32.626 – 32.931 mm (1.2845 – 1.2965 in)
EX: 33.927 – 34.212 mm (1.3357 – 1.3469 in)

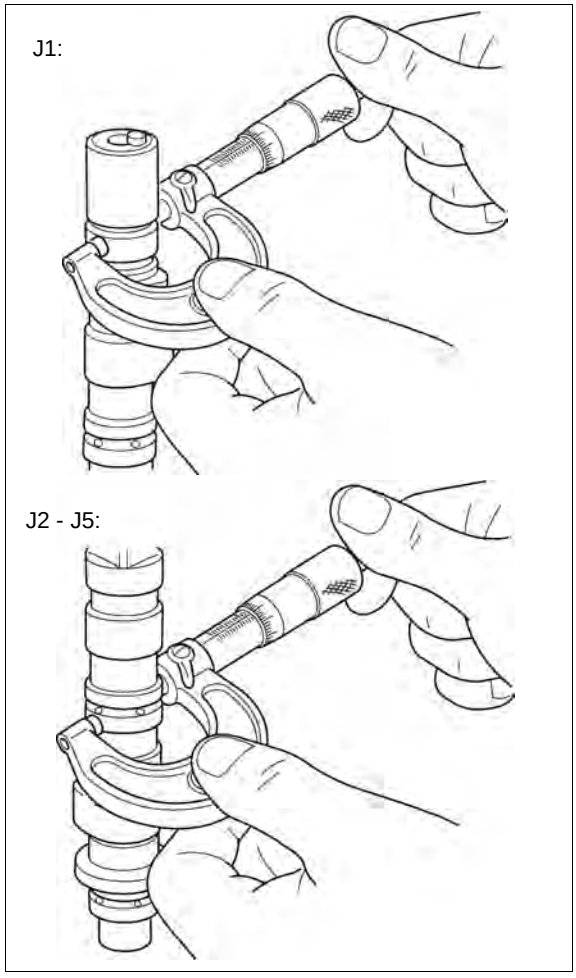


CAMSHAFT JOURNAL O.D.

Measure the camshaft journal O.D.

STANDARD:

J1: 28.955 – 28.970 mm (1.1400 – 1.1405 in)
J2 - J5: 28.925 – 28.940 mm (1.1388 – 1.1394 in)

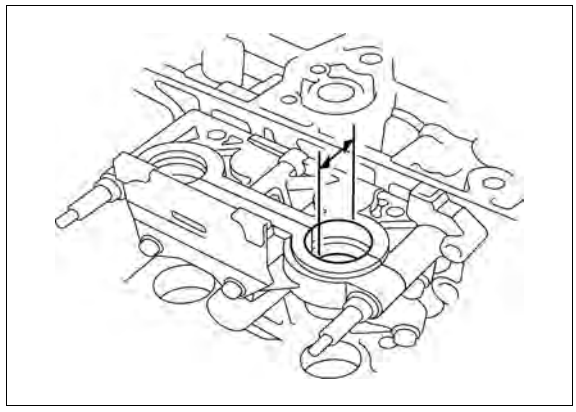


CAMSHAFT JOURNAL I.D.

Install each journal onto the cylinder head and tighten them to the specified torque.

Measure the I.D. of each camshaft journal.

STANDARD:
29.000 – 29.024 mm (1.1417 – 1.1427 in)



CAMSHAFT OIL CLEARANCE

Clean off any oil from the camshafts, camshaft holders and rocker shaft holders. Check each journal for excessive wear or damage.

Install the rocker shaft holders, camshafts and camshaft holders and tighten the bolts to the specified torque (page 14-31).

Remove the camshaft holder and camshaft, then set a plastigauge (1) on each journal as shown.

- Set the plastigauge in the axial direction on each journal.
- Position the plastigauge away from the oil passage.

Reinstall the camshaft holders and tighten the bolts to the specified torque (page 14-31).

- Do not turn the camshaft during inspection.

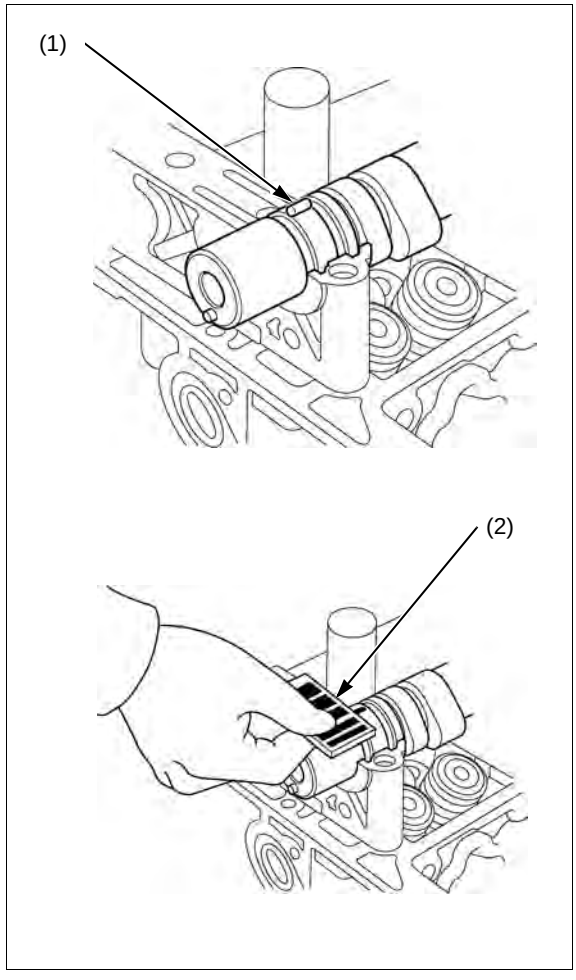
Remove the camshaft holder and measure the width of the pressed part of the plastigauge using a scale (2) printed on the bag of the plastigauge.

STANDARD:
No.1: 0.030 – 0.069 mm (0.0012 – 0.0027 in)
No.2 - No.5: 0.060 – 0.099 mm (0.0024 – 0.0039 in)
SERVICE LIMIT:
No.1: 0.15 mm (0.006 in)
No.2 - No.5: 0.15 mm (0.006 in)

- Measure the widest part of the plastigauge.

If the measurement exceeds the service limit, replace the camshaft holder, rocker shaft holder and the cylinder head as a set. Recheck the camshaft oil clearance.

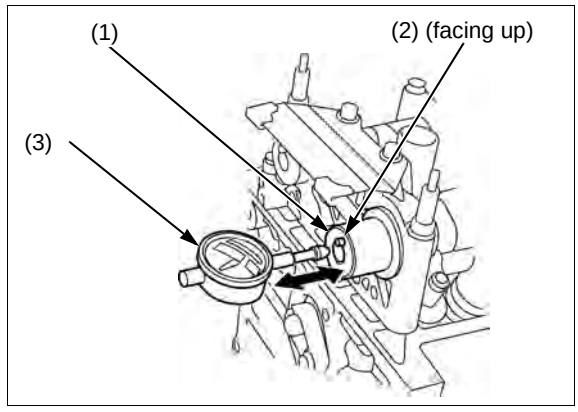
If the measurement still exceeds the service limit, replace the camshaft (page 14-26).



CAMSHAFT AXIAL CLEARANCE

Install the rocker shaft holders, camshafts and camshaft holders and tighten the bolts to the specified torque (page 14-31).

Put the camshaft (1) at top dead center of the compression stroke of the No. 1 piston (with the dowel pin (2) facing up) and set a dial indicator (3). Check the camshaft axial play by pushing and pulling the camshaft as shown.



STANDARD:
0.05 – 0.20 mm (0.002 – 0.008 in)
SERVICE LIMIT:
0.4 mm (0.02 in)

If the measurement exceeds the service limit, replace the camshaft (page 14-26).

Install a new camshaft and recheck the axial play. If the measurement still exceeds the service limit, replace the cylinder head (page 14-39).

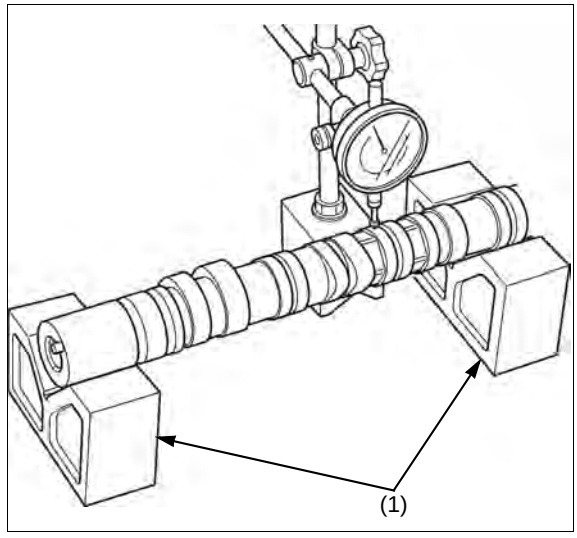
CAMSHAFT RUNOUT

Place V blocks (1) or equivalent under the journal at both ends of the camshaft.

Set a dial indicator and measure the camshaft runout by turning the camshaft.

STANDARD: 0.030 mm (0.0012 in) Max
SERVICE LIMIT: 0.040 mm (0.0016 in)

Replace the camshaft if the measurement exceeds the service limit (page 14-26).



CYLINDER HEAD WARPAGE

Remove carbon deposits from the combustion chamber.

Clean off any gasket material from the cylinder head surface.

Check the cylinder head for warpage using a straight edge (1) and a feeler gauge (2).

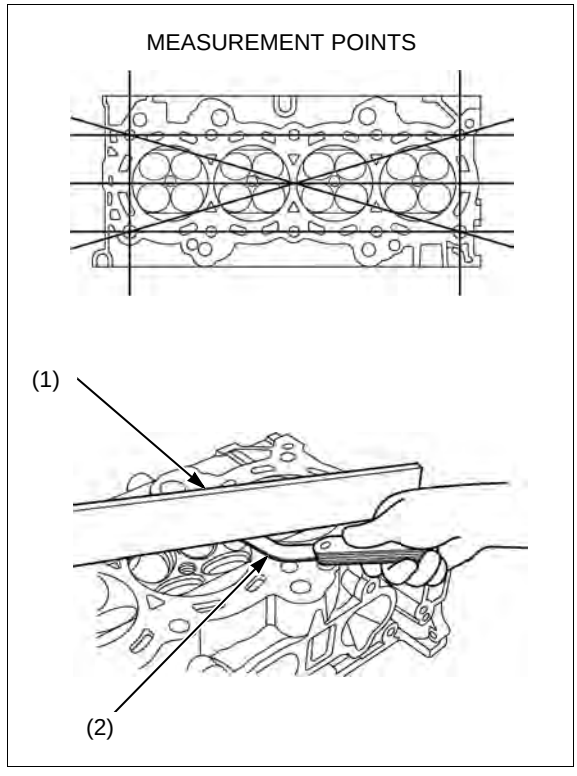
SERVICE LIMIT: 0.05 mm (0.002 in)

If the measurement exceeds the service limit, recondition the cylinder head surface.

- Reconditioning must be made within the standard value of the cylinder head height.

Cylinder head reconditioning procedure:

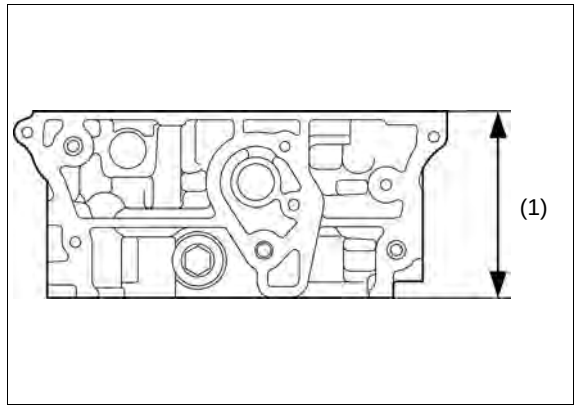
Apply Prussian blue compound to the level block to identify the warpage. Using a fine oil stone, grind the cylinder head in a figure "8" pattern with the warped part being the center of the ground part. Or use a lapping machine to recondition the cylinder head.



CYLINDER HEAD HEIGHT

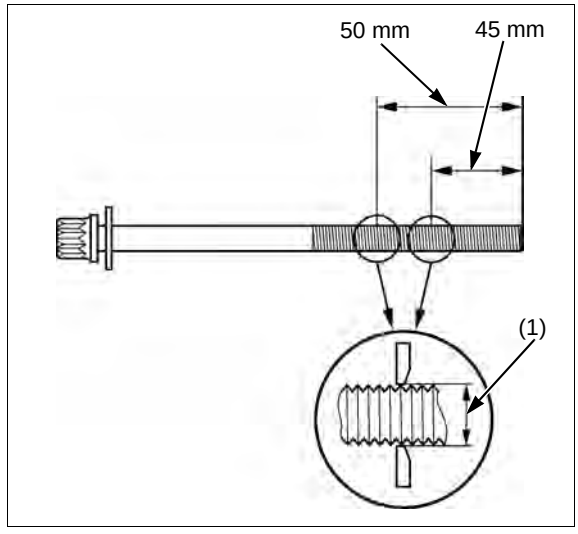
Measure the cylinder head height (1).

STANDARD:
103.95 – 104.05 mm (4.093 – 4.096 in)



CYLINDER HEAD BOLT (11 × 155 mm)

Measure the bolt O.D. at the two points as shown.



STANDARD: 10.6 mm (0.417 in)

Replace the cylinder head bolt if its O.D. is smaller than the service limit.

Measure the O.D. of all cylinder head bolts.

VALVE GUIDE REPLACEMENT

Chill the replacement valve guides in the freezer section of a refrigerator for about an hour.

Use a hot plate or oven to heat the cylinder evenly to 150 °C (300 °F). Check the temperature with a temperature indicating stick (available at a welding supply store) or equivalent.

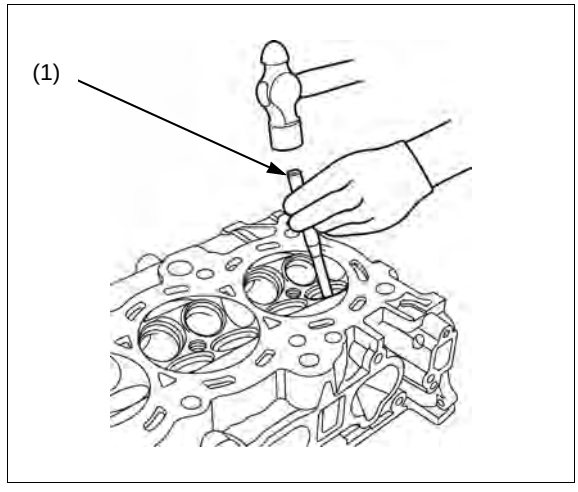
NOTICE

- *Do not use a torch to heat the cylinder head; warpage of the cylinder head may result.*
- *Do not get the head hotter than 150 °C (300 °F); excessive heat may loosen the valve seats.*

Remove the heated cylinder head from the hot plate, and support it with wooden blocks. Wear heavy gloves to protect your hands.

Drive the valve guide out of the combustion chamber side using the special tool.

- Be careful not to damage the cylinder head mating surface.



TOOL:

Valve guide driver, 5.35 × 9.7 (1)	**07742-0010100**

Allow the cylinder head to cool to room temperature. Clean and inspect the valve guide bores in the cylinder head.

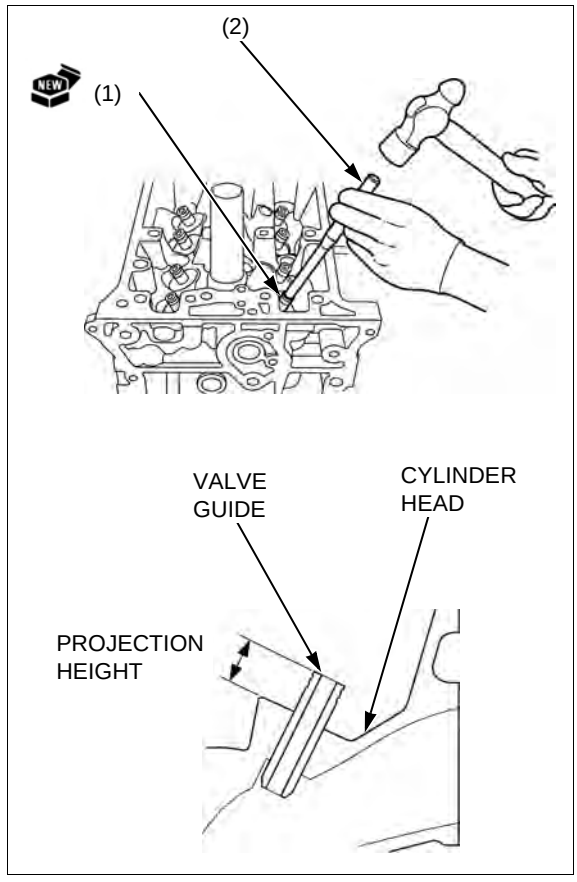
Use a hot plate or oven to heat the cylinder head evenly to 150 °C (300 °F). Check the temperature with a temperature indicating stick or equivalent.

Install new valve guides (1) from the valve spring side of the cylinder head.

Drive each valve guide to the specified height, measured from the top of the valve guide to the cylinder head as shown.

TOOL:
Valve guide driver, 5.35 × 9.7 (2) 07742-0010100

Valve guide installation height:
IN: 15.20 – 16.20 mm (0.598 – 0.638 in)
EX: 15.50 – 16.50 mm (0.610 – 0.650 in)



After installation, ream the new valve guide from the combustion chamber side, using the special tool.

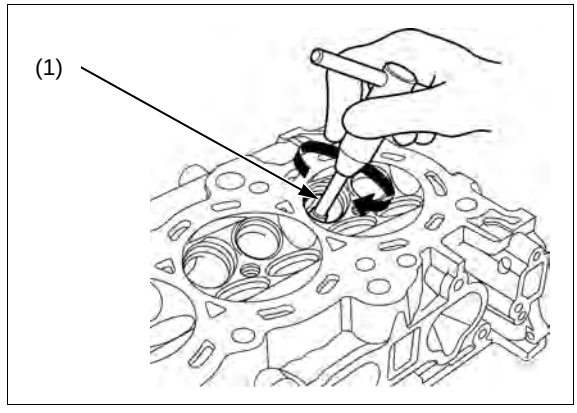
Coat the reamer and valve guide with cutting oil.

Rotate the reamer clockwise through the valve guide for the full length of the reamer.

Continue to rotate the reamer clockwise while removing it from the valve guide.

NOTICE

Turn the special tool (valve guide reamer, 5.525 mm) clockwise, never turn it counterclockwise. Continue to turn it clockwise as you lift it from the valve guide.

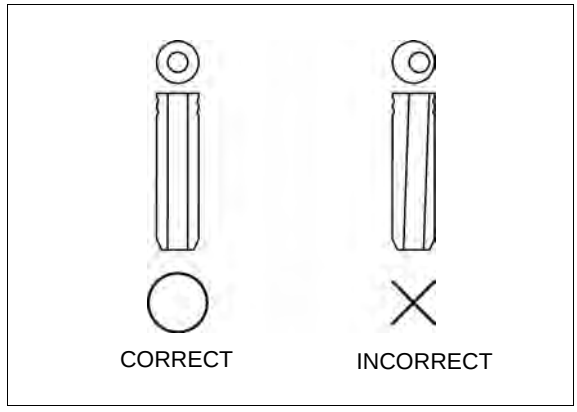


TOOL:
Valve guide reamer, 5.525 mm (1) 07HAH-PJ70100

Thoroughly clean the cylinder head to remove any cutting residue.

Check the valve guide bore; it should be straight, round and centered in the valve guide, insert the valve and check operation. If the valve does not operate smoothly, the guide may have been bent during installation.
Replace the valve guide (page 14-52) if it is bent or damaged.

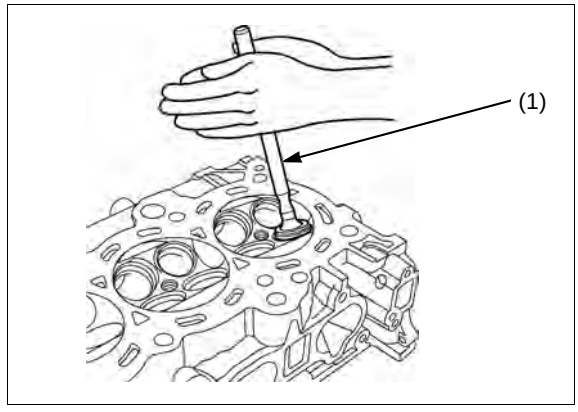
Check the Valve Stem-to-Valve Guide Clearance (page 14-46).



VALVE SEAT RECONDITIONING

Clean the intake and exhaust valves thoroughly to remove carbon deposits.

Apply a light coat of Prussian Blue to each valve seats. Tap the valve against the valve seat several times without rotating the valve, to check for proper valve seat contact using a commercially available valve lapper (1).

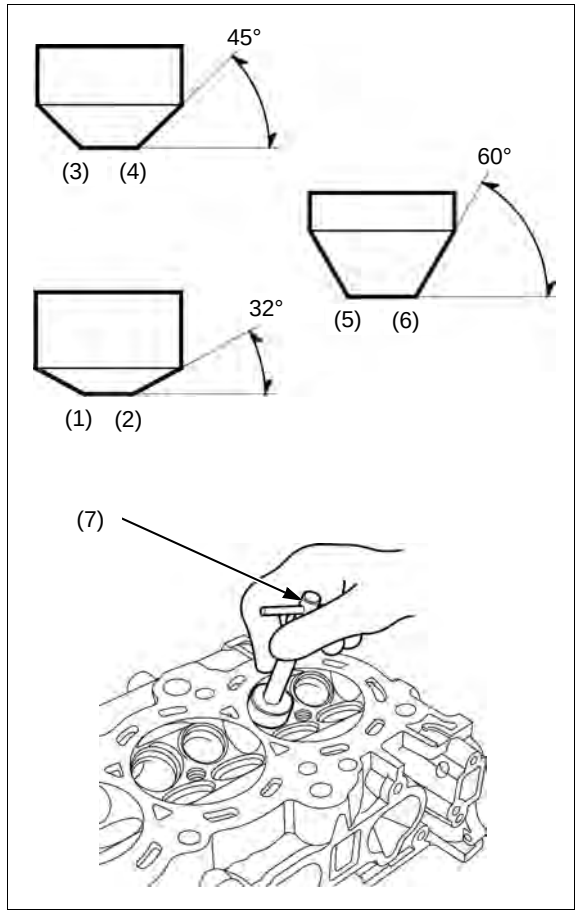


Using a 45° cutter, remove enough material to produce a smooth and concentric seat. Follow the valve seat cutter manufacturer's instructions.

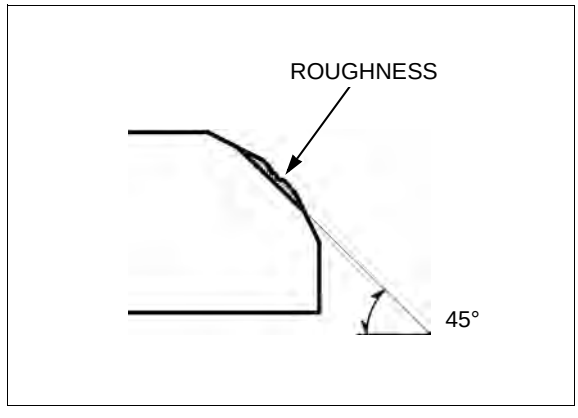
Turn the cutter clockwise, never counterclockwise. Continue to turn the cutter as you lift it from the valve seat.

TOOLS:

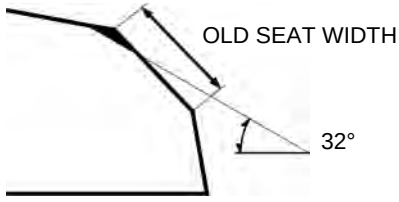
Valve seat cutter, 32° 38.5 mm [IN] (1)	**07780-0012400**
Valve seat cutter, 32° 33 mm [EX] (2)	**07780-0012900**
Valve seat cutter, 45° 35 mm [IN] (3)	**07780-0010400**
Valve seat cutter, 45° 33 mm [EX] (4)	**07780-0010800**
Valve seat cutter, 60° 37.5 mm [IN] (5)	**07780-0014100**
Valve seat cutter, 60° 30 mm [EX] (6)	**07780-0014000**
Cutter holder, 5.5 mm (7)	**07781-0010101**



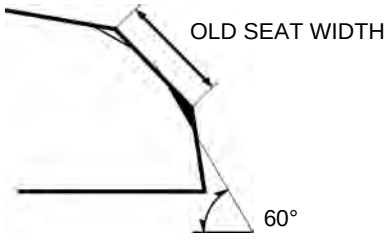
Use a 45° cutter, remove the roughness or irregularities from the seat.



Using 32° cutter, remove the top edge of the existing valve seat material.



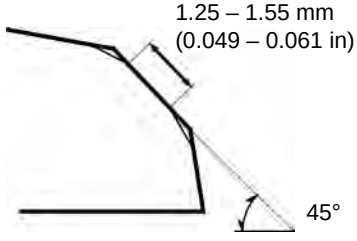
Using 60° cutter, remove the bottom edge of the old seat.



Use 45° cutter and cut the seat to the proper width.

STANDARD:

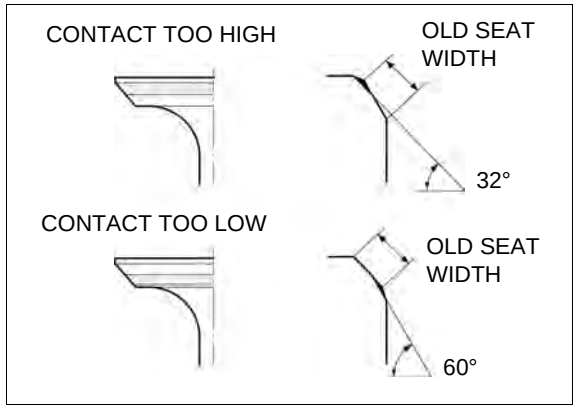
IN/EX: 1.25 – 1.55 mm (0.049 – 0.061 in)



After resurfacing the seats, inspect for even valve seating (page 14-46).

If the contact area is too high on the valve, the seat must be lowered using a 32° flat cutter, then adjust the width using the 45° cutter.

If the contact area is too low on the valve, the seat must be raised using a 60° inner cutter, then adjust the width using the 45° cutter.

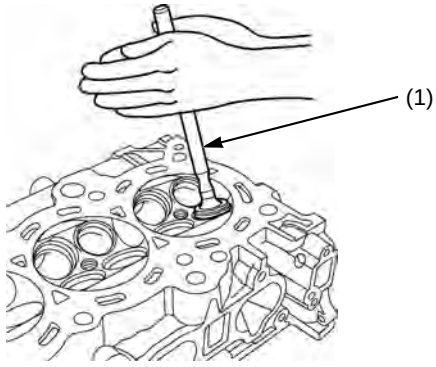


After cutting the seat, apply lapping compound to the valve face and lap the valve using a commercially available valve lapper (1).

- Excessive lapping pressure may deform or damage the seat.
- Change the angle of lapping tool frequently to prevent uneven seat wear.
- Lapping compound can cause damage if it enters between the valve stem and guide.

After lapping, wash any residual compound off the cylinder head and valve.

Recheck the seat contact (page 14-46) after lapping.



COMPONENT LOCATION 15-2

TOOLS 15-4

FLYWHEEL REMOVAL/INSTALLATION ... 15-5

CRANKCASE/BALANCER REMOVAL/ INSTALLATION 15-8

CYLINDER BLOCK/CRANKSHAFT/ PISTON DISASSEMBLY/ASSEMBLY 15-15

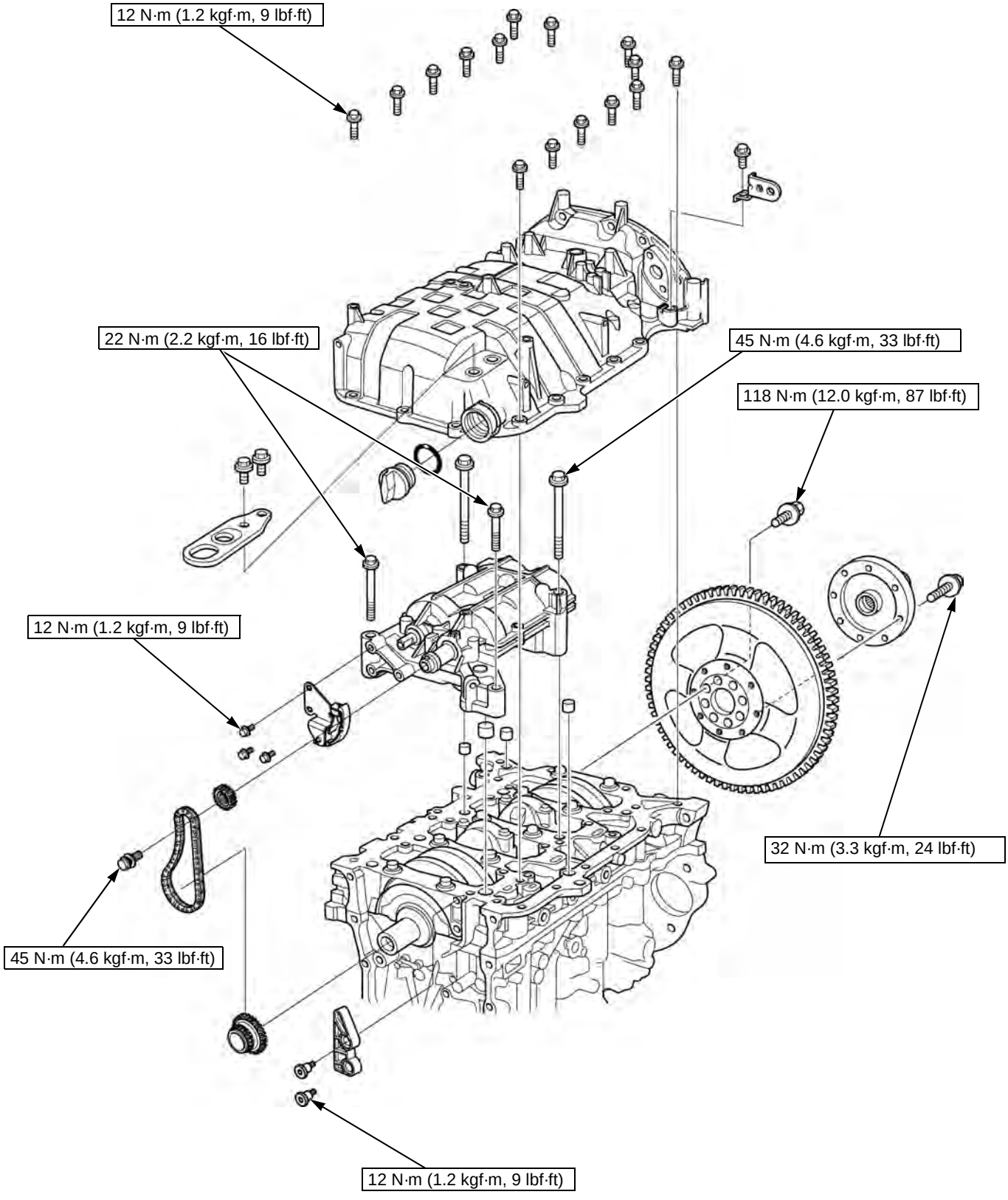
BALANCER CASE DISASSEMBLY/ ASSEMBLY 15-30

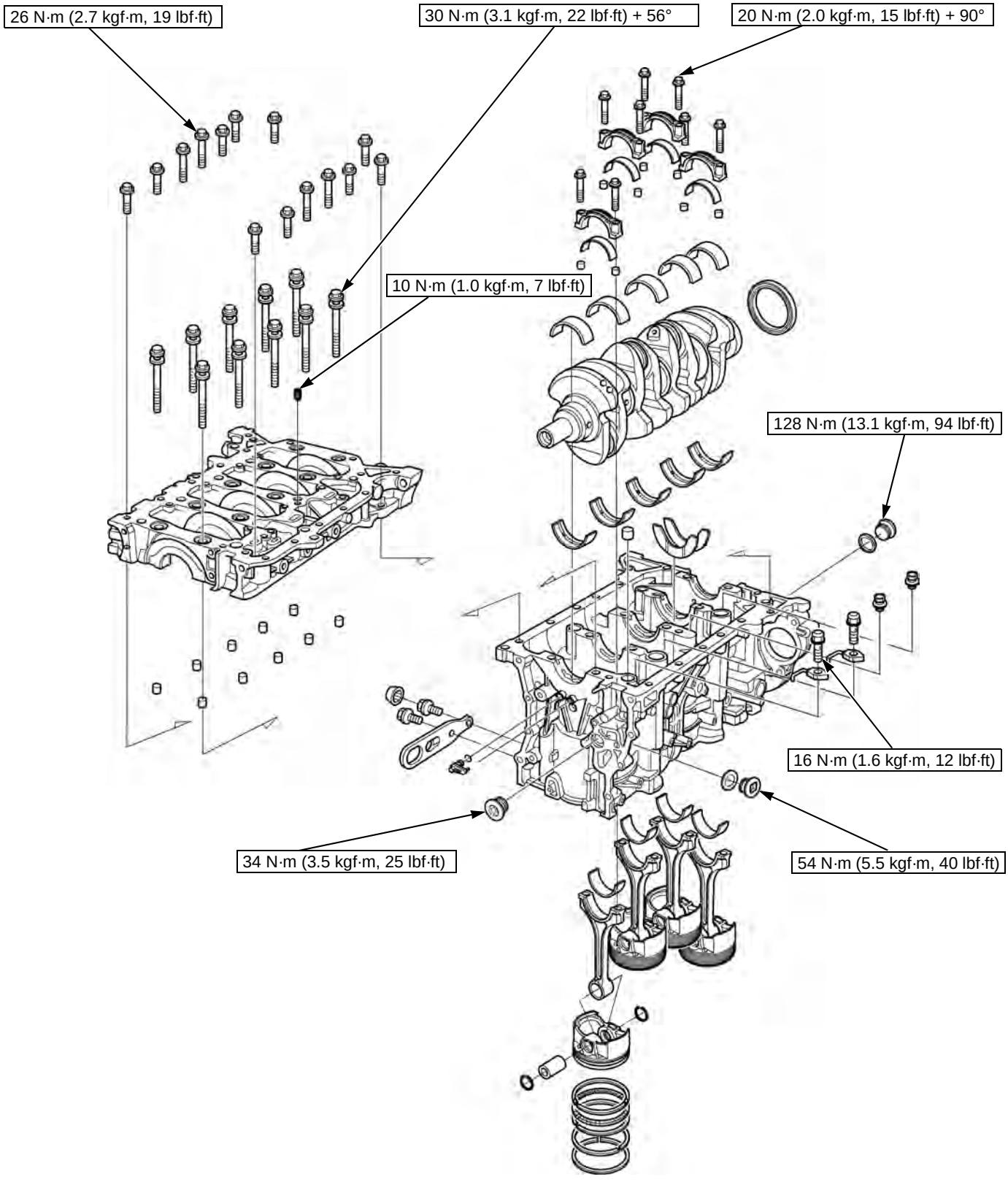
FLYWHEEL INSPECTION 15-32

CRANKSHAFT/PISTON/CYLINDER BLOCK INSPECTION 15-32

BEARING SELECTION 15-43

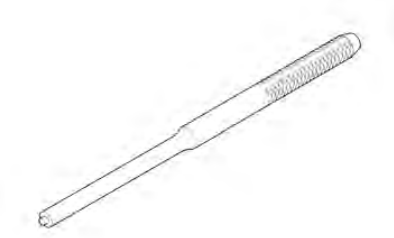
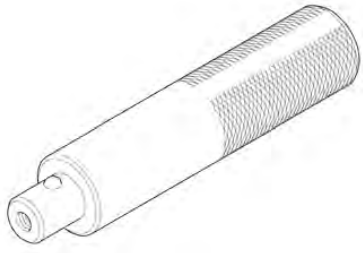
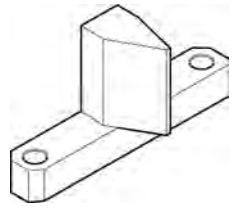
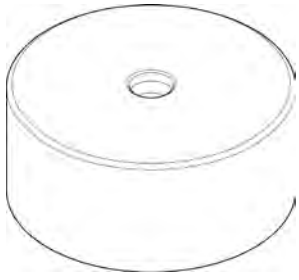
COMPONENT LOCATION




26 N·m (2.7 kgf·m, 19 lbf·ft)
30 N·m (3.1 kgf·m, 22 lbf·ft) + 56°
20 N·m (2.0 kgf·m, 15 lbf·ft) + 90°
10 N·m (1.0 kgf·m, 7 lbf·ft)
128 N·m (13.1 kgf·m, 94 lbf·ft)
16 N·m (1.6 kgf·m, 12 lbf·ft)
34 N·m (3.5 kgf·m, 25 lbf·ft)
54 N·m (5.5 kgf·m, 40 lbf·ft)

TOOLS

LIST

Pin driver, 6.0 07744-0010500 	Driver 07749-0010000 	Ring gear holder 070PB-ZY60100 
Oil seal driver attachment, 80 × 96 mm 07ZAD-PNA0100 		

FLYWHEEL REMOVAL/INSTALLATION

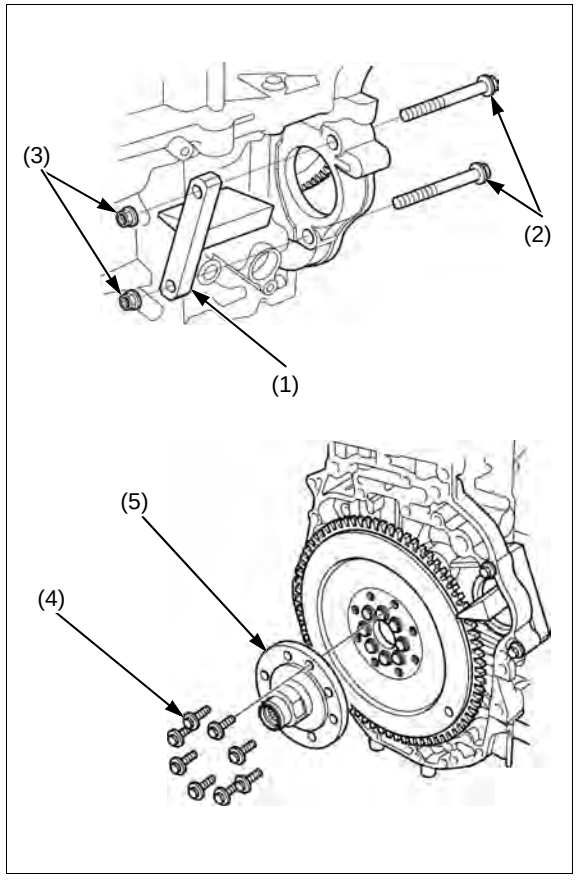
REMOVAL

Remove the oil pump (page 12-9).

Set the special tool (1) on the starter motor mounting position and tighten the suitable bolts (2) and nuts (3).

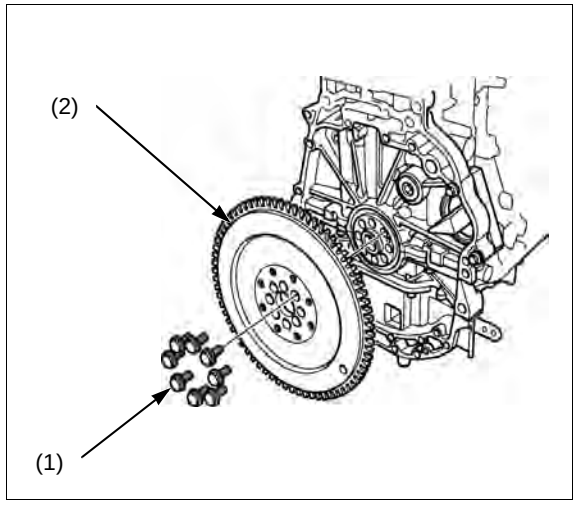
TOOL:
Ring gear holder (1) 070PB-ZY60100

Remove the eight special bolts (4) and flywheel boss (5).

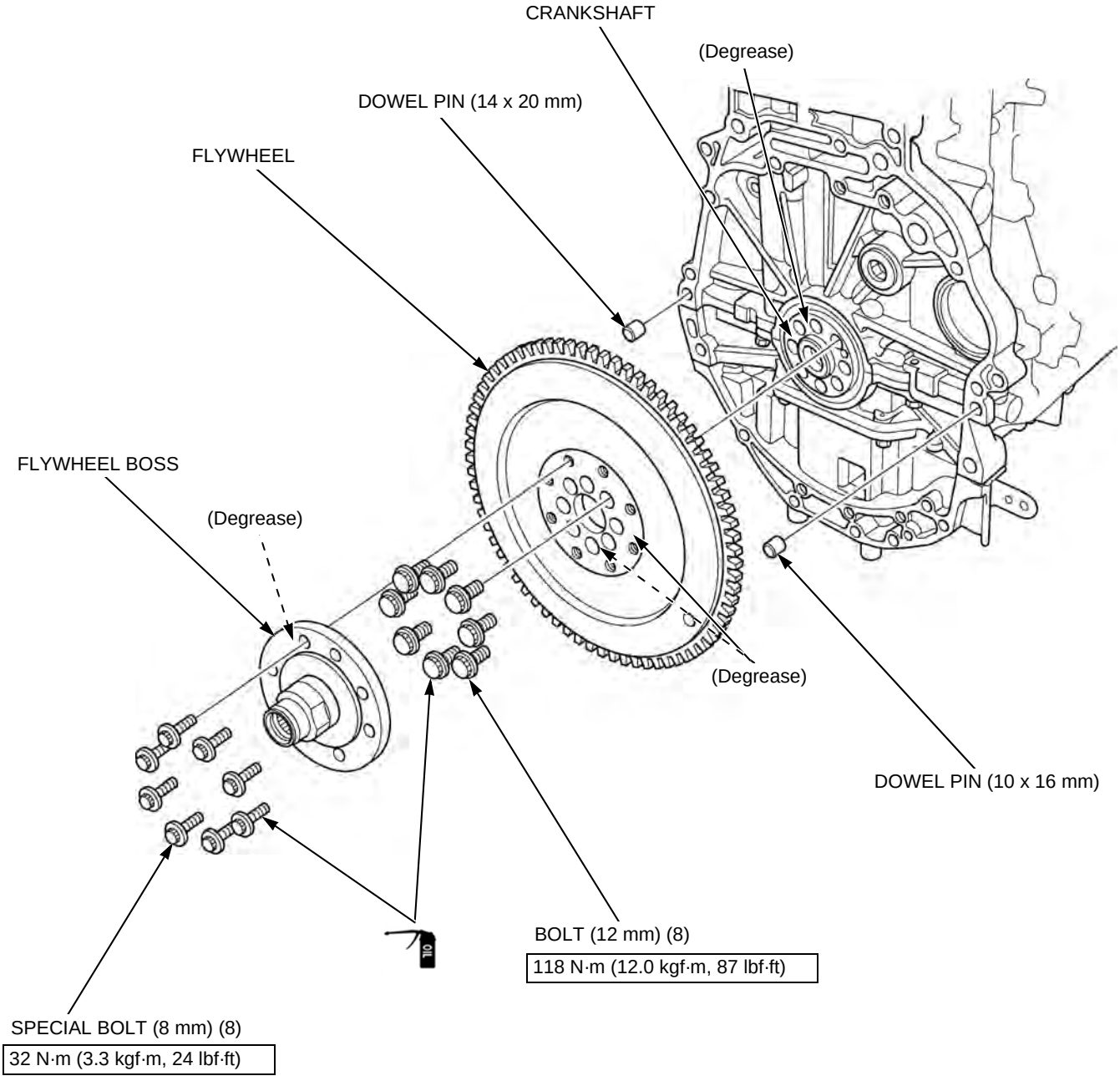


Remove the eight bolts (1) and flywheel (2).

Inspect the flywheel (page 15-32).



EXPLODED VIEW



INSTALLATION

Clean the mating surfaces between the crankshaft (1) and flywheel (2) with a degreasing cleaning agent, then set the flywheel on the crankshaft.

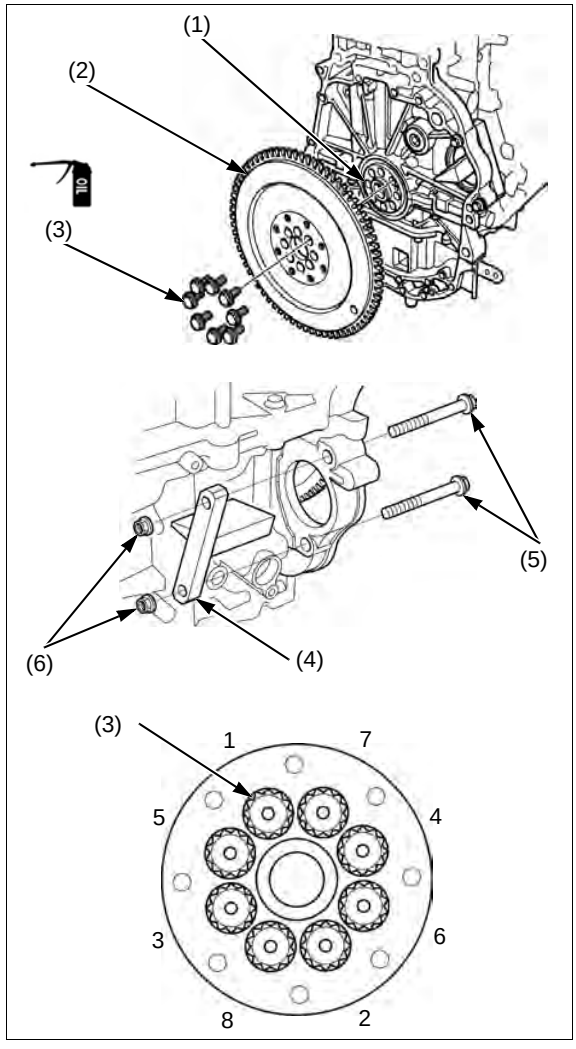
Apply engine oil to the threads and seating surfaces of the eight bolts (12 mm) (3).

Hand tighten the eight bolts.
Install the special tool (4) on the starter motor mounting position and tighten the two suitable bolts (5) and nuts (6).

TOOL:
Ring gear holder (4) 070PB-ZY60100

Tighten the bolts in the numbered sequence shown.
Tighten them in two or three steps to the specified torque.

TORQUE: 118 N·m (12.0 kgf·m, 87 lbf·ft)



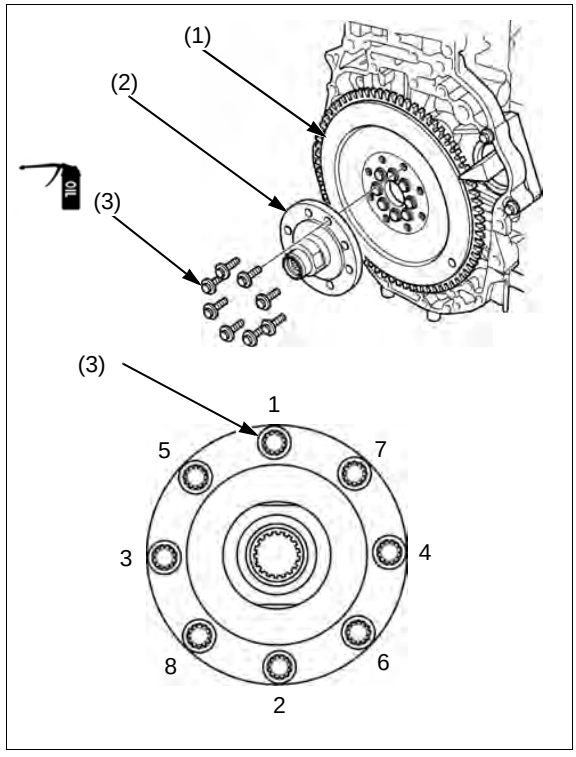
Clean the mating surfaces between the flywheel (1) and flywheel boss (2) with a degreasing cleaning agent, then set the flywheel boss on the flywheel.

Apply engine oil to the threads and seating surfaces of the eight special bolts (3).

Tighten the bolts in the numbered sequence shown.
Tighten them in two or three steps to the specified torque.

TORQUE: 32 N·m (3.3 kgf·m, 24 lbf·ft)

Install the oil pump (page 12-9).



CRANKCASE/BALANCER REMOVAL/ INSTALLATION

REMOVAL

Remove the following:

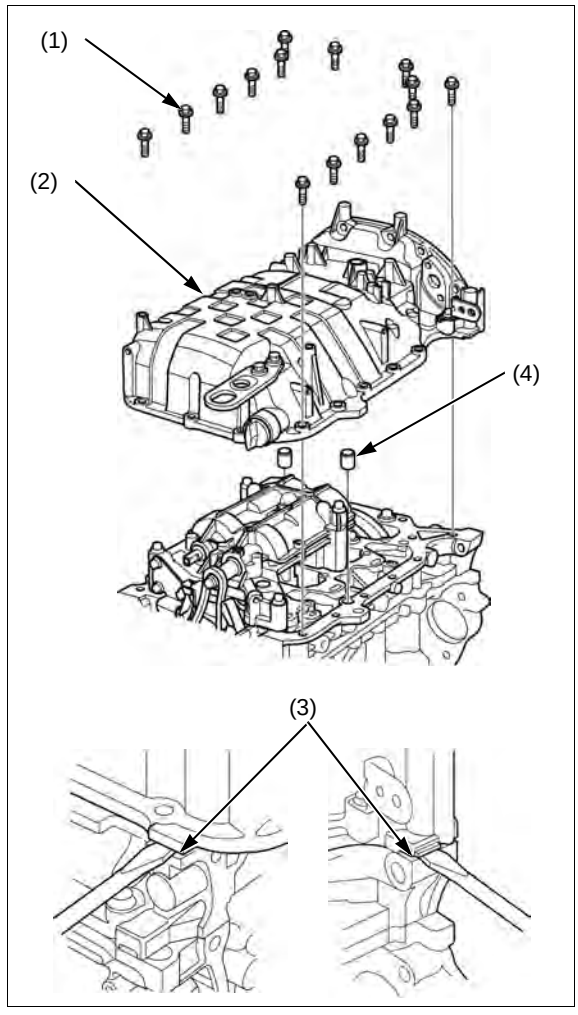
– Main wire harness
– Intake manifold (page 5-87)
– Crankshaft pulley/cam chain (page 14-11)
– Flywheel (page 15-5)
– Fuel strainer (page 3-24)
– Water separator (page 5-99)

Remove the fifteen bolts (6×25 mm) (1) from the crankcase (2).

Insert a screwdriver into the recesses (3) of the crankcase and raise the crankcase little by little.

- Be careful not to damage the crankcase and cylinder block mating surfaces.

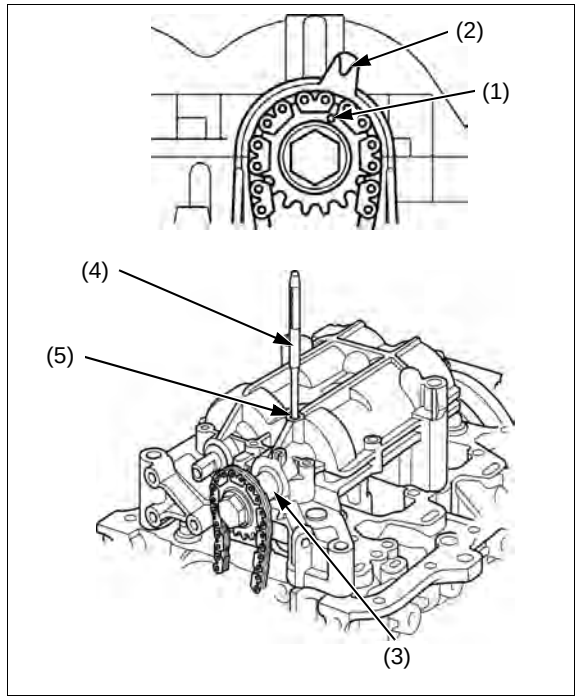
Remove the two dowel pins (13×20 mm) (4) from the cylinder block.



Align the punch mark (1) of driven sprocket with the index mark (2) of balancer case.

Hold the rear balancer shaft (3) by inserting a special tool (4) into the shaft through the maintenance hole (5).

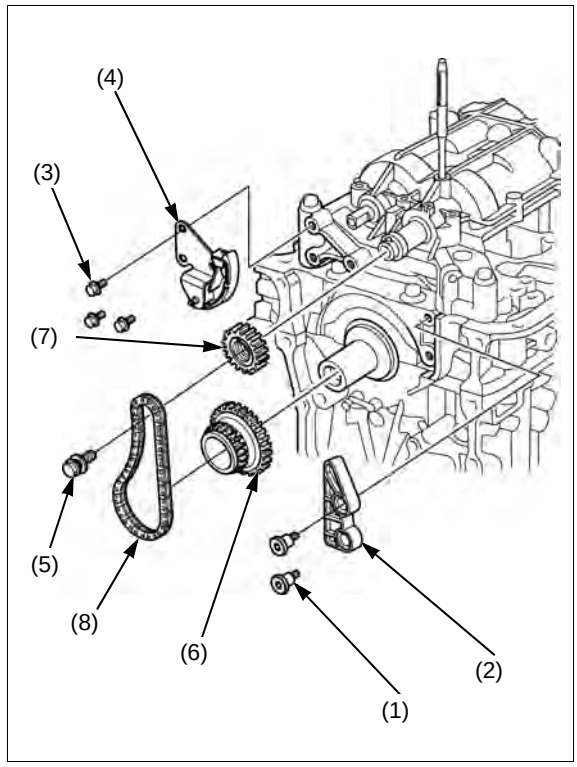
TOOL:
Pin driver 6.0 (4) **07744-0010500**



Remove the two chain guide bolts (1) and balancer chain guide (2).

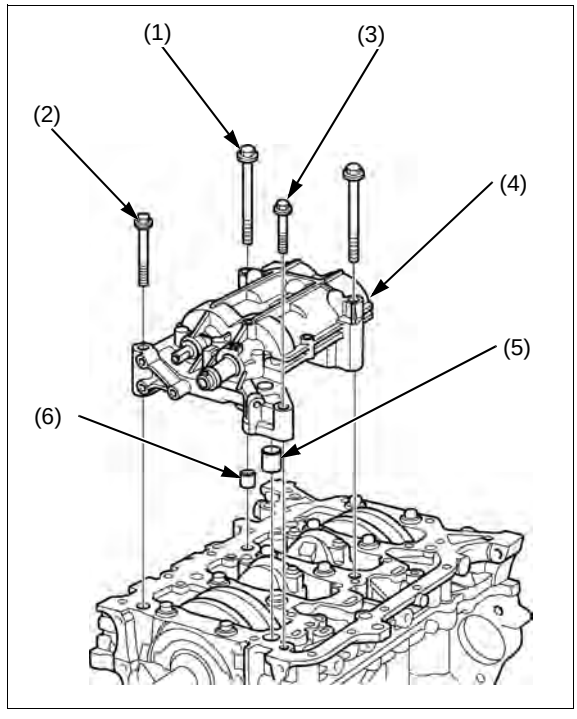
Remove the three bolts (6 × 14 mm) (3) and balancer chain tensioner (4).

Remove the bolt (10 × 30 mm) (5), crankshaft sprocket (6), driven sprocket (7) and balancer chain (8).

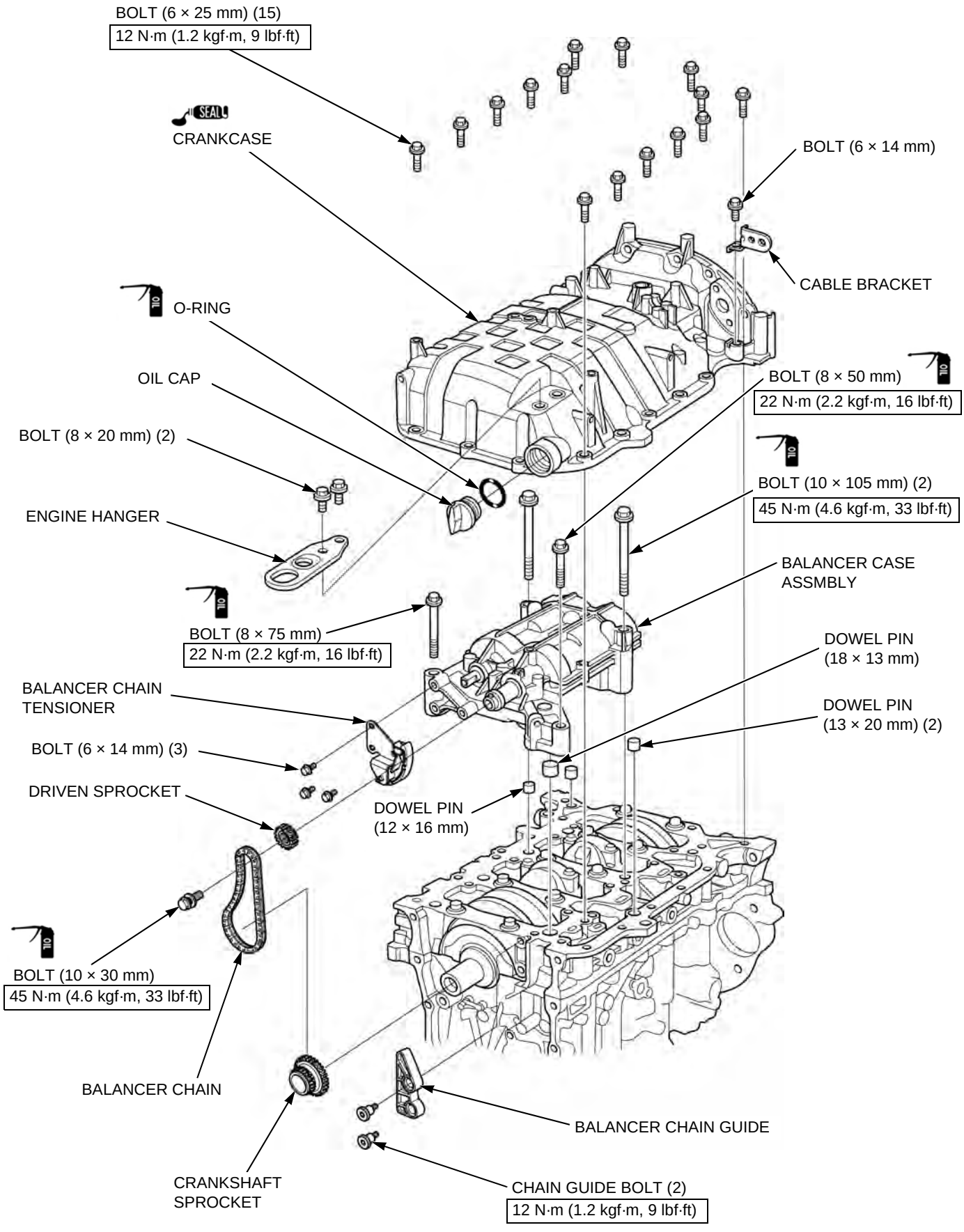


Remove the two bolts (10 × 105 mm) (1), bolt (8 × 75 mm) (2), and bolt (8 × 50 mm) (3).

Remove the balancer case assembly (4), dowel pin (18 × 13 mm) (5) and dowel pin (12 × 16 mm) (6).



EXPLODED VIEW



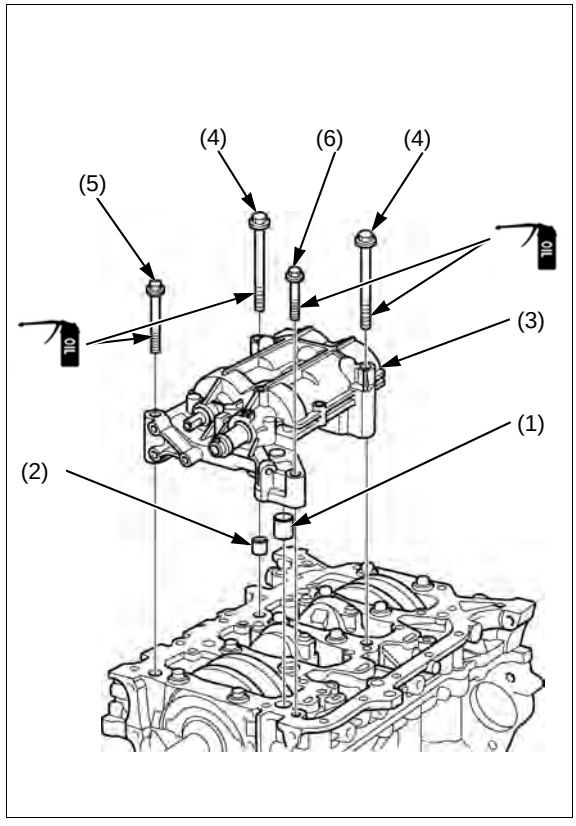
INSTALLATION

Install the dowel pin (18 × 13 mm) (1), dowel pin (12 × 16 mm) (2) and balancer case assembly (3) to the cylinder block.

Apply engine oil to the threads and seating surface of the bolts and tighten them to the specified torque.

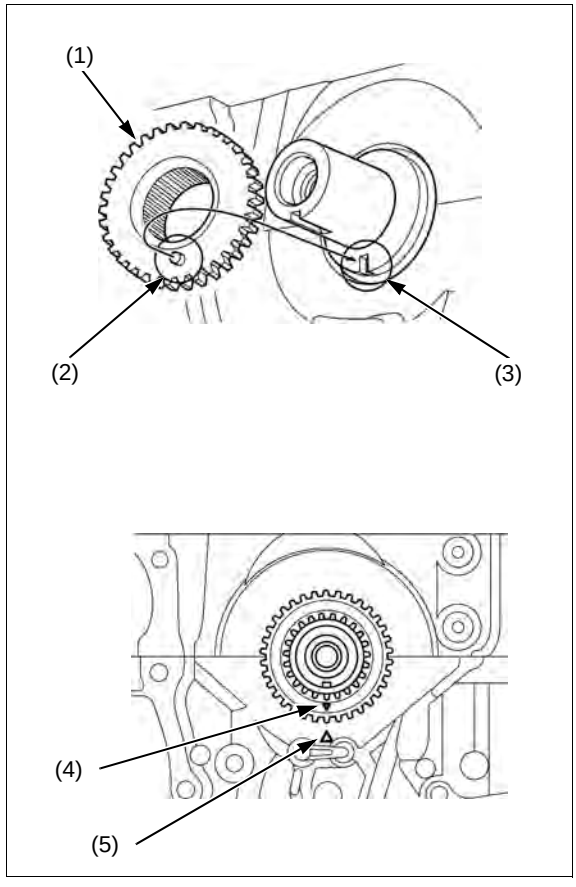
TORQUE:

45 N·m (4.6 kgf·m, 33 lbf·ft) :
TWO BOLTS (10 × 105 mm) (4)
22 N·m (2.2 kgf·m, 16 lbf·ft) :
BOLT (8 × 75 mm) (5)
BOLT (8 × 50 mm) (6)



Install the crankshaft sprocket (1) by aligning its boss (2) with the groove (3) of the crankshaft.

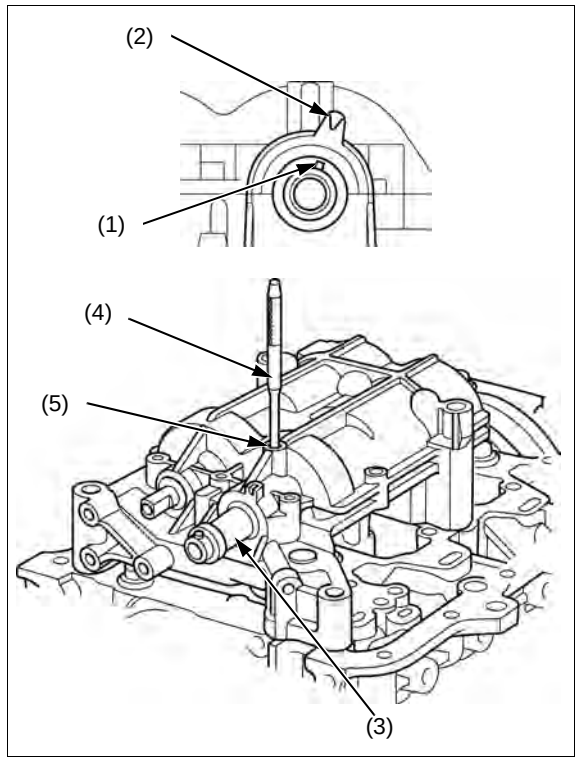
Check that the index mark (4) of the crankshaft sprocket is lined up with the triangle mark (5) of the cylinder block.



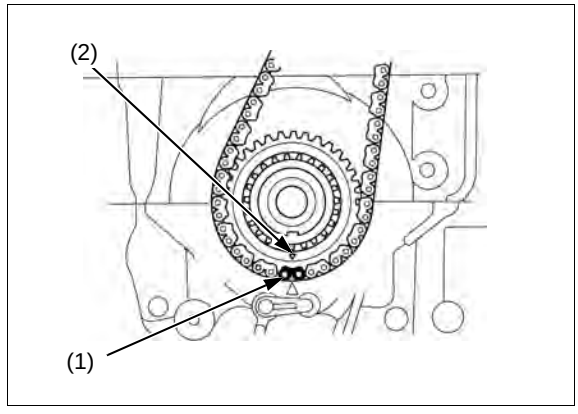
Align the rear balancer shaft boss (1) with the index mark (2) of balancer case.

Hold the rear balancer shaft (3) by inserting a special tool (4) into the shaft through the maintenance hole (5).

TOOL:
Pin driver 6.0 (4) 07744-0010500



Install the balancer chain to the crankshaft sprocket by aligning its color plate (one place) (1) with the index mark (2) of crankshaft sprocket.



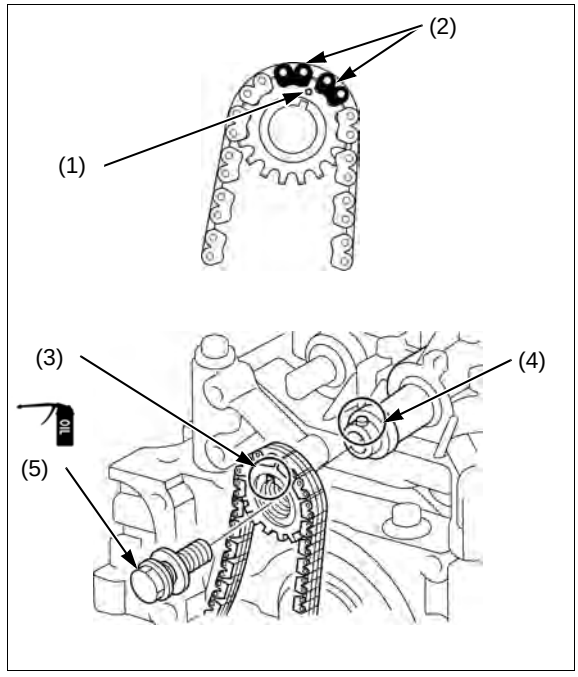
Set the driven sprocket to the balancer chain by positioning its punch mark (1) between the color plates (two places) (2) of balancer chain.

Install the driven sprocket by aligning its groove (3) with the boss (4) of the rear balancer shaft.

Apply engine oil to the threads and seating surface of the bolt (5) and tighten it to the specified torque.

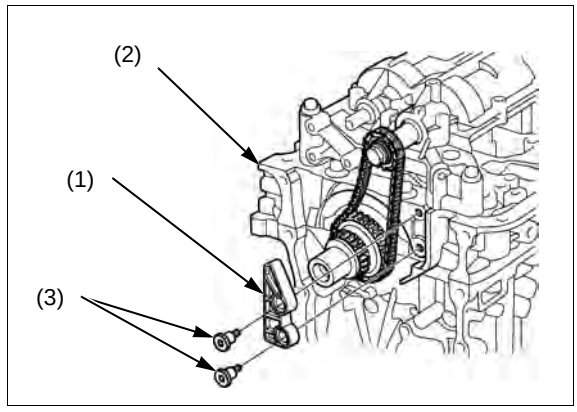
TORQUE: 45 N·m (4.6 kgf·m, 33 lbf·ft)

After installation, remove the special tool from the balancer case assembly.

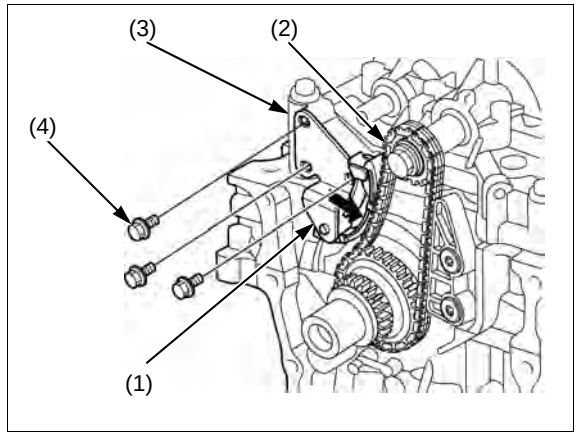


Install the balancer chain guide (1) to the cylinder block (2) and tighten the two chain guide bolts (3) to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



Push the balancer chain tensioner (1) against the balancer chain (2) and install it to the rear balancer holder (3).
Install and tighten the three bolts (4).

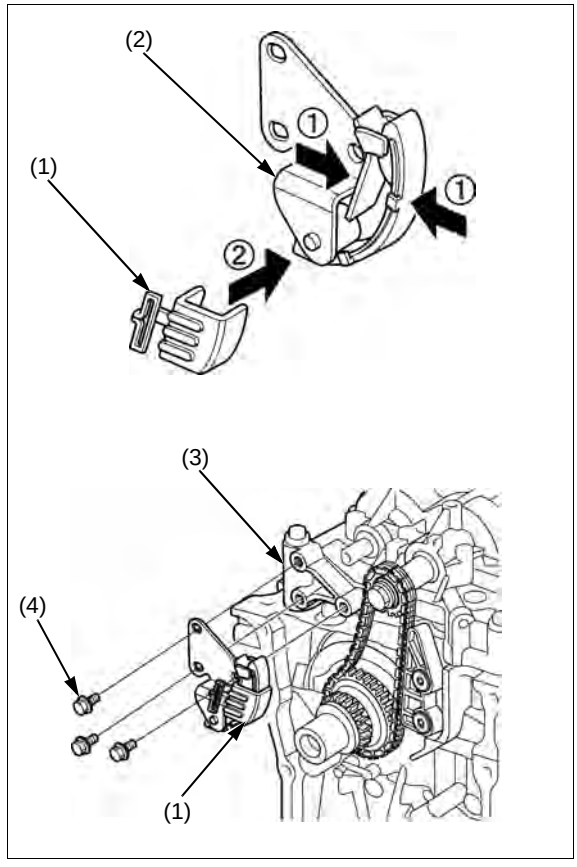


WHEN REPLACING THE BALANCER CHAIN TENSIONER WITH NEW ONE:

Install the set clip (1), which is included in the new balancer chain tensioner, to the balancer chain tensioner (2).

Install the balancer chain tensioner to the rear balancer holder (3) and tighten the three bolts (4).

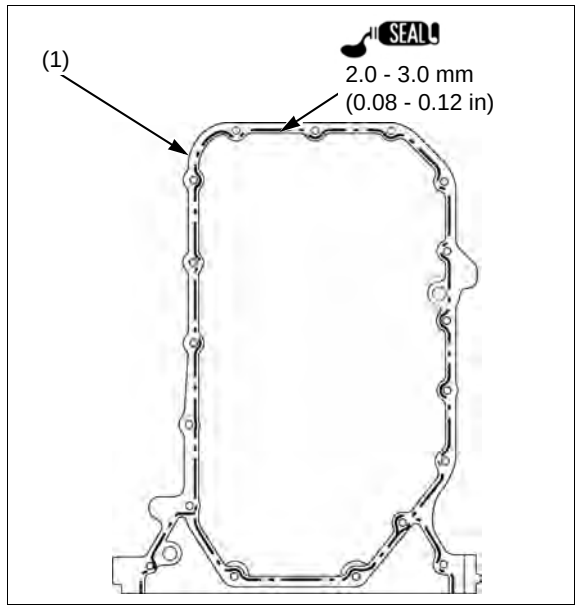
After installation, remove the set clip from the balancer chain tensioner.



Install the crankshaft pulley/cam chain (page 14-17).

Clean the crankcase and lower block mating surfaces thoroughly with degreasing agent.

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1280B or equivalent) to the crankcase mating surface (1).



NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

Install the two dowel pins (13 × 20 mm) (1) to the cylinder block.

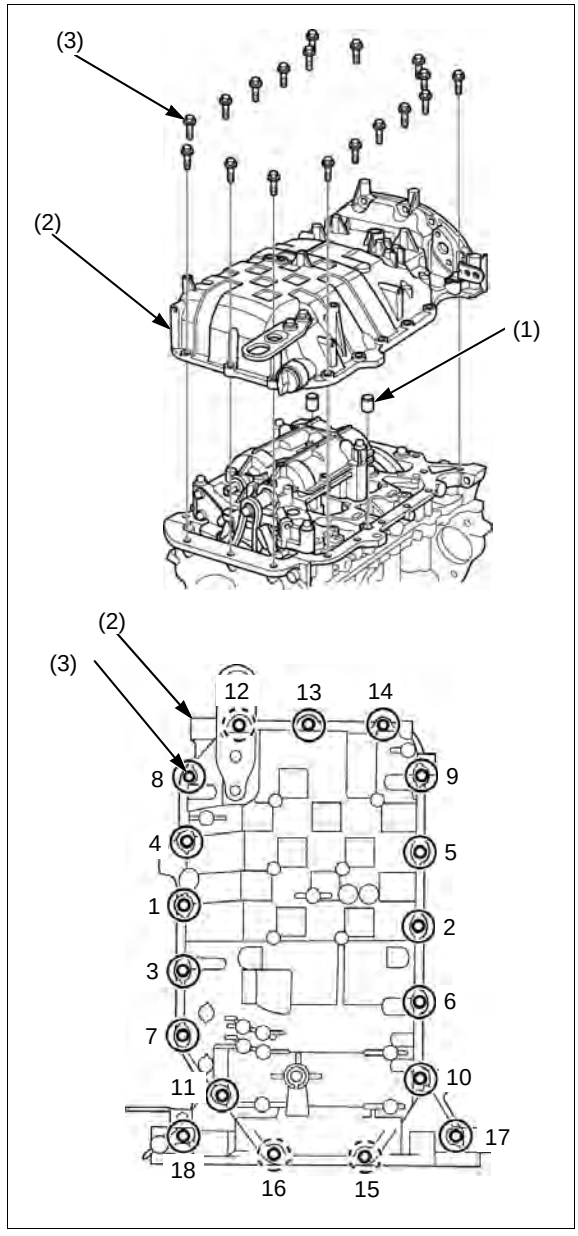
Install the crankcase (2) to the cylinder block and temporarily install the eighteen bolts (3).

Tighten the bolts in the numbered sequence shown. Tighten them in two or three steps to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

Install the following:

– Water separator (page 5-98)
– Fuel strainer (page 3-24)
– Flywheel (page 15-7)
– Intake manifold (page 5-87)
– Main wire harness



CYLINDER BLOCK/CRANKSHAFT/ PISTON DISASSEMBLY/ASSEMBLY

CYLINDER BLOCK/CRANKSHAFT DISASSEMBLY

Remove the following:

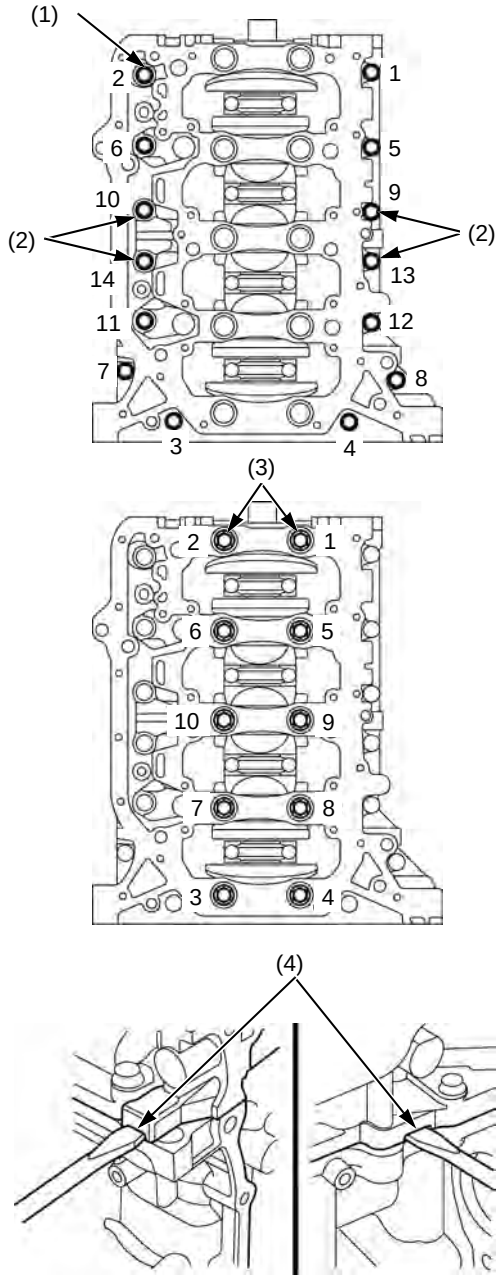
– Cylinder head (page 14-35)
– Crankcase/balancer (page 15-8)
– Oil filter flange (page 12-5)
– Knock sensor (page 5-119)
– EOP sensor (page 5-119)
– ECT sensor 1 (page 5-116)
– Alternator bracket (page 7-7)

Loosen the ten bolts (8 × 35 mm) (1) and four bolts (8 × 50 mm) (2) in two or three steps in the numbered sequence shown.

Loosen the ten bolts (11 × 95 mm) (3) in two or three steps in the numbered sequence shown.

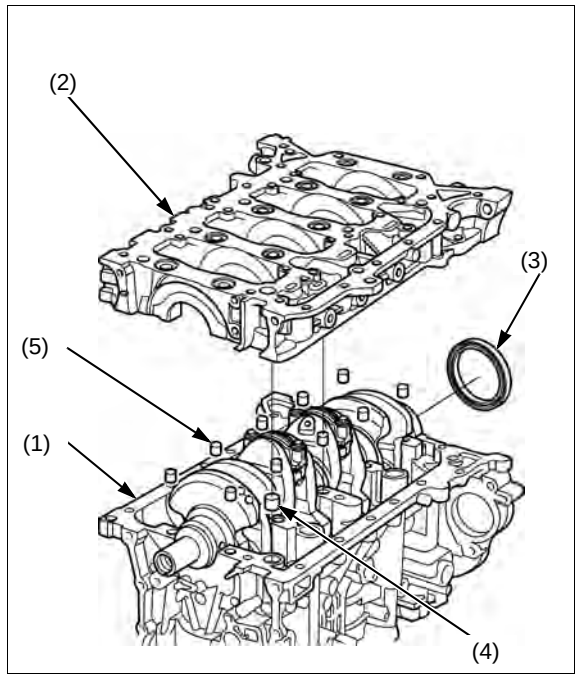
Insert a screwdriver into the recesses (4) of the lower block and raise the lower block little by little.

• Be careful not to damage the lower block and cylinder block mating surfaces.



Remove the following parts from the cylinder block (1):

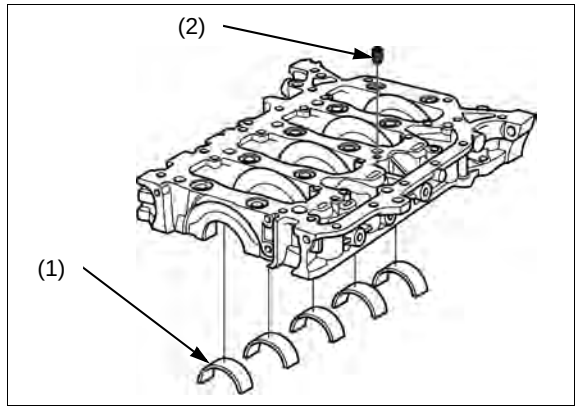
– Lower block (2)
– Oil seal (3)
– Dowel pin (18 × 22 mm) (4)
– Ten dowel pins (13 × 14 mm) (5)



Remove the five lower main bearings (1) from the lower block.

• Check the lower main bearings for damage and replace if necessary.

Remove the lower block orifice (2) from the lower block and clean it with a cleaning solvent.

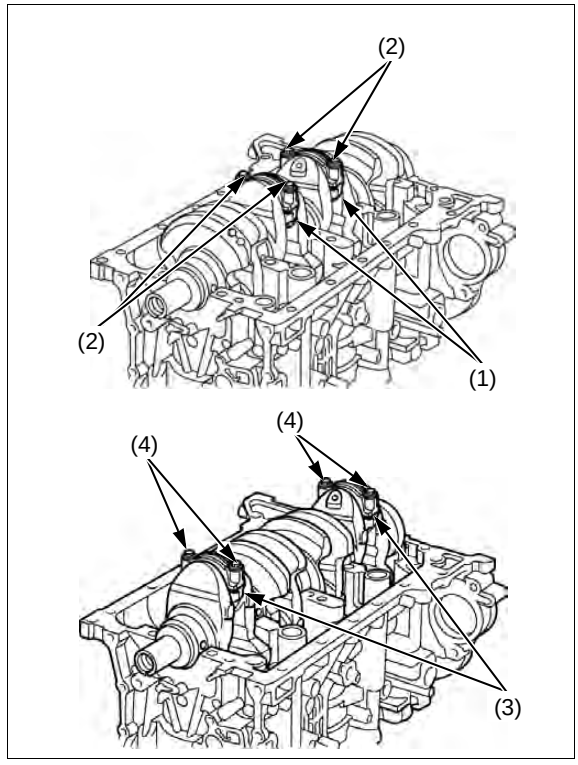


Check that the No.2 and No.3 cylinders (1) are at the bottom dead center.

Loosen the connecting rod bolts (2) until they can be turned by hand.

Turn the crankshaft until the No.1 and No.4 cylinders (3) are at the bottom dead center.

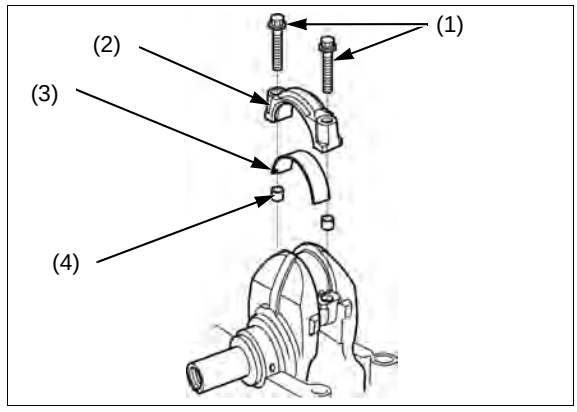
Loosen the connecting rod bolts (4).



Remove the connecting rod bolts (1) and connecting rod caps (2) of each cylinder.

- Store the removed parts separately for each cylinder.

Remove the connecting rod bearings (3) and dowel pins (4) of each cylinder.



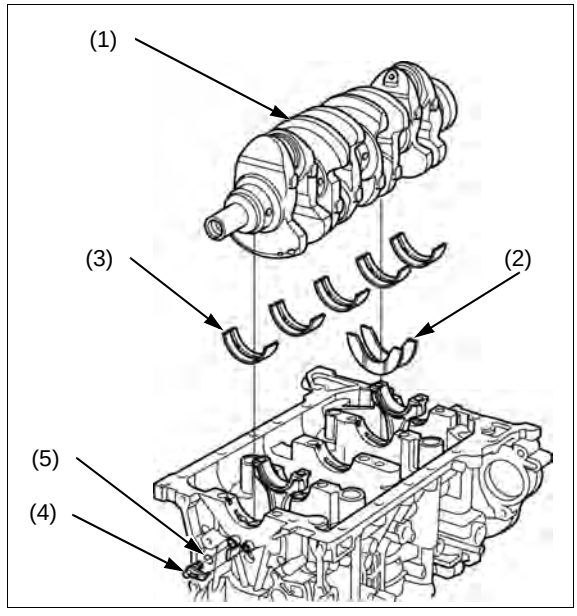
Remove the crankshaft (1) and two thrust washers (2), taking care not to damage the journal.

Remove the five upper main bearings (3).

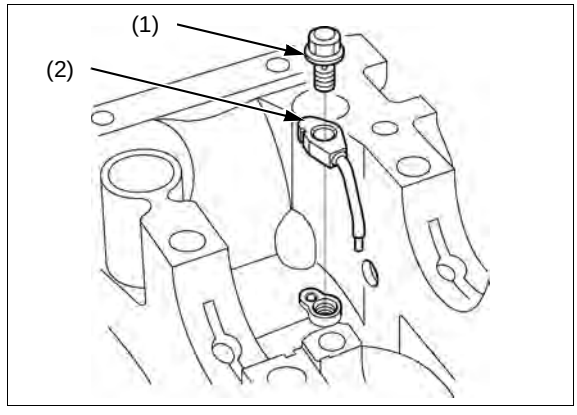
- Check the main bearings for damage and replace if necessary.
- Be careful not to damage the cylinder inner surface by connecting rod when removing the crankshaft.

Remove the oil jet orifice (4) and O-ring (5) from the cylinder block, then clean the orifice with a cleaning solvent.

Inspect the crankshaft (page 15-32).



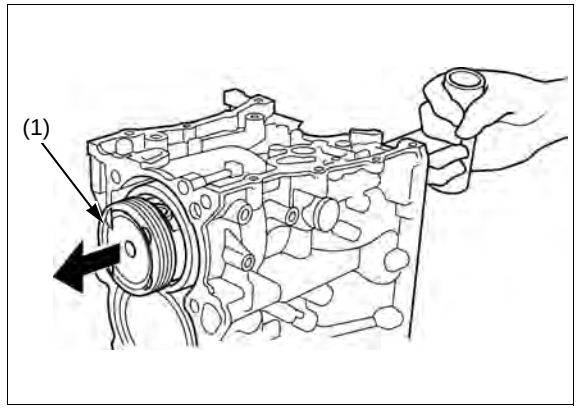
Remove the two oil jet bolts (1) and two oil jet bodies (2) from the No.1 and No.2 cylinder.



Remove the piston/connecting rod assembly (1) from the cylinder by pushing the connecting rod with the handle of a hammer, taking care not to damage the cylinder with the connecting rod.

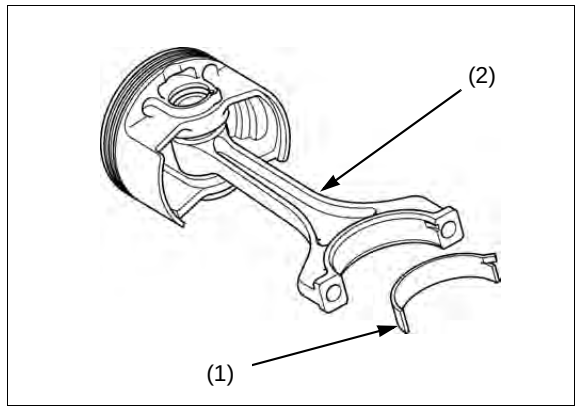
- Before removing the piston assembly, remove the carbon deposits from the cylinder with care not to damage the piston head.
- Store the removed piston assembly components separately for each cylinder.

Inspect the cylinder block (page 15-32).



Remove the connecting rod bearing (1) from the connecting rod (2).

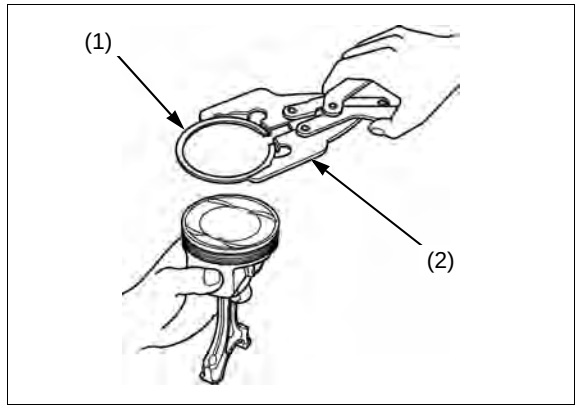
- Check the connecting rod bearing for damage (scores, scratches, etc.) and replace it with a new one if necessary.



PISTON DISASSEMBLY

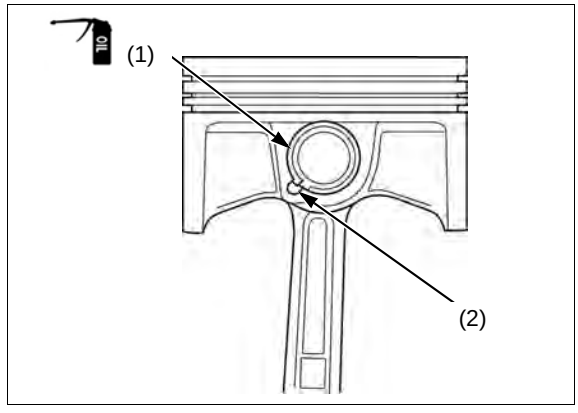
Remove the piston ring (1) using a piston ring expander (commercially available) (2).

- Store the removed connecting rod bearing and piston ring with its piston.
- Do not expand the piston ring excessively as it can break easily.



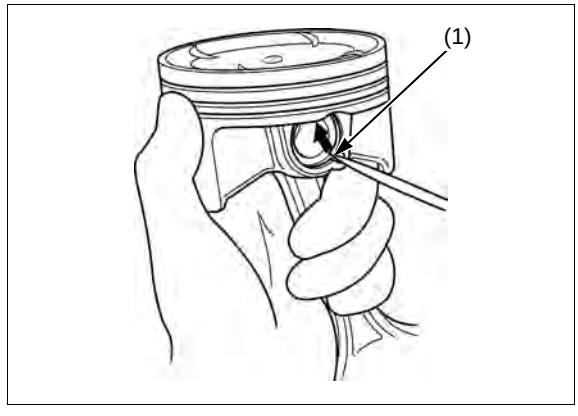
Apply engine oil to the piston pin clip (1) and turn them in the ring grooves until the end gaps are lined up with the cutouts (2) in the piston pin holes.

- Do not damage the piston pin clip installation groove.



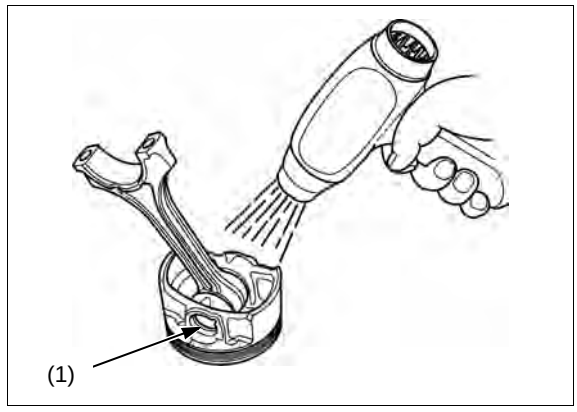
Remove both piston pin clips (1). Start at the cutout in the piston pin holes.

- Wear eye protection as the piston pin clips can pop out.

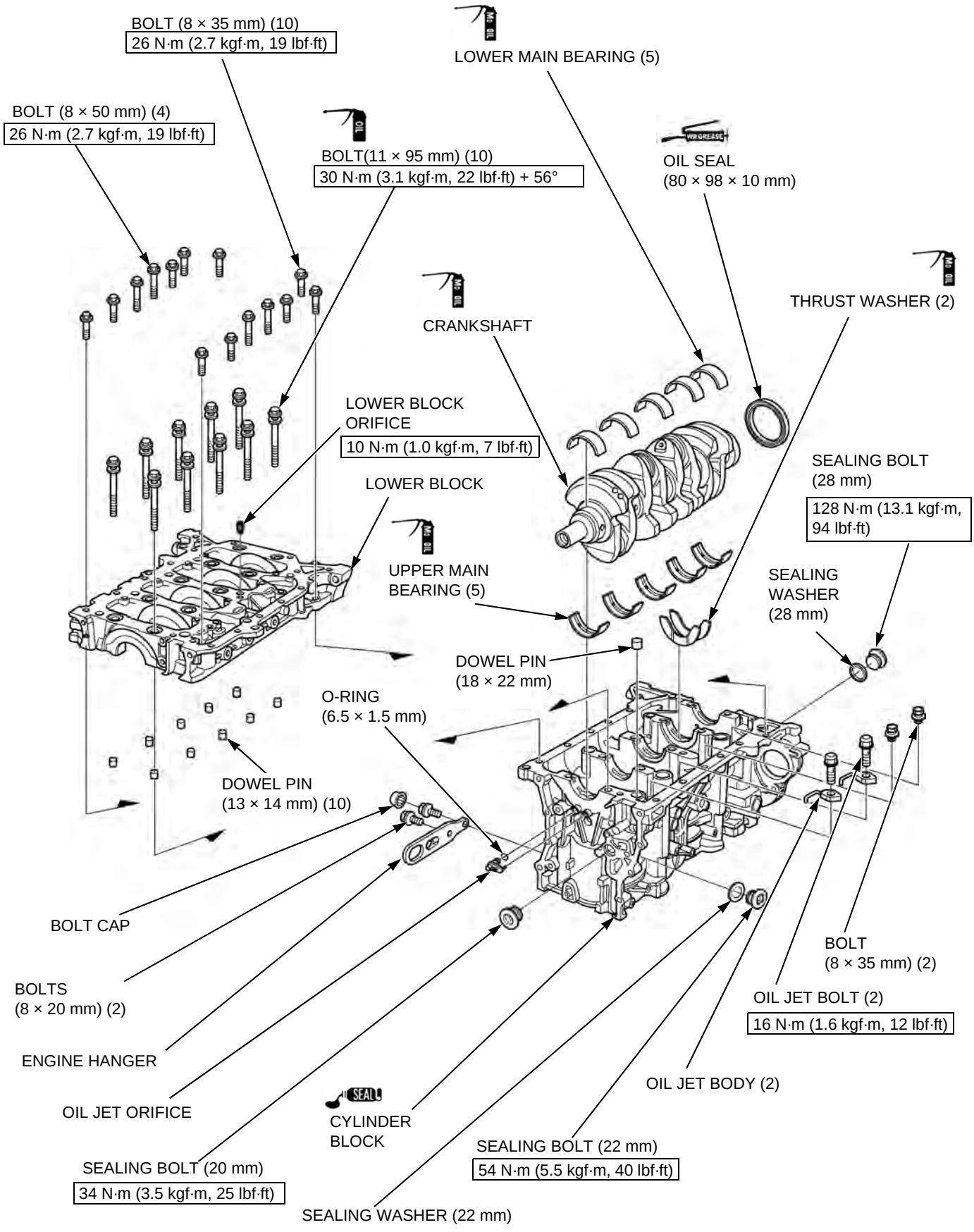


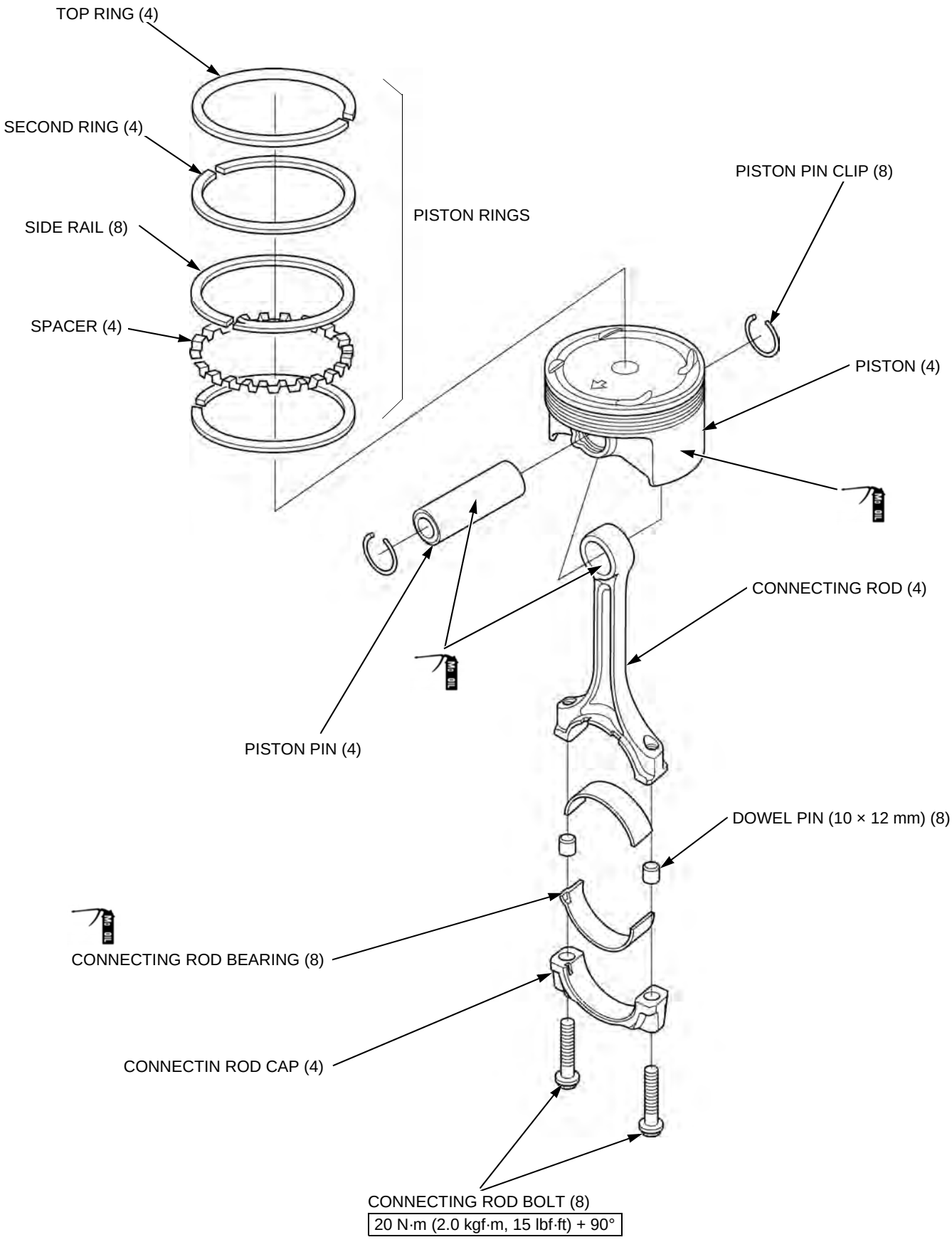
Wearing heavy gloves, heat the piston and connecting rod assembly to approximately 70 °C (158 °F), and then remove the piston pin (1).

Check the piston parts (page 15-32).



EXPLODED VIEW

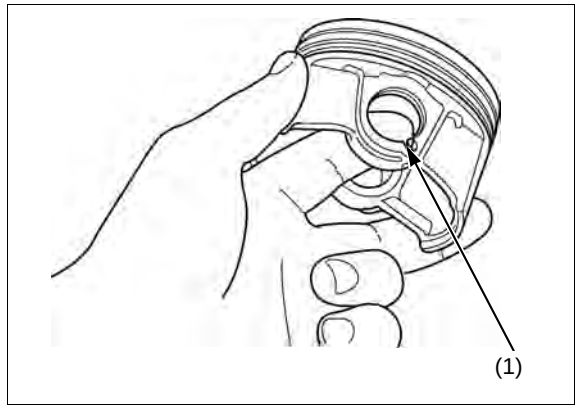



TOP RING (4)
SECOND RING (4)
SIDE RAIL (8)
SPACER (4)
PISTON RINGS
PISTON PIN CLIP (8)
PISTON (4)
CONNECTING ROD (4)
PISTON PIN (4)
DOWEL PIN (10 × 12 mm) (8)
CONNECTING ROD BEARING (8)
CONNECTIN ROD CAP (4)
CONNECTING ROD BOLT (8)
20 N·m (2.0 kgf·m, 15 lbf·ft) + 90°

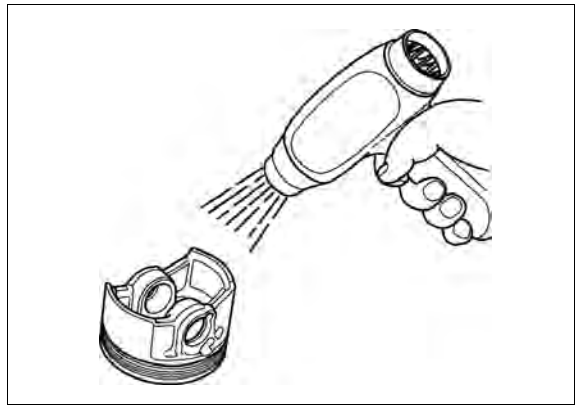
PISTON ASSEMBLY

Install the piston pin clip (1) on one side only.

- Wear eye protection as the piston pin clips can pop out during installation.
- Make sure the piston pin clip does not align with the cutout in the piston pin bore.



Put on heavy gloves, then using a heat gun, heat the piston to approximately 70 °C (158 °F).

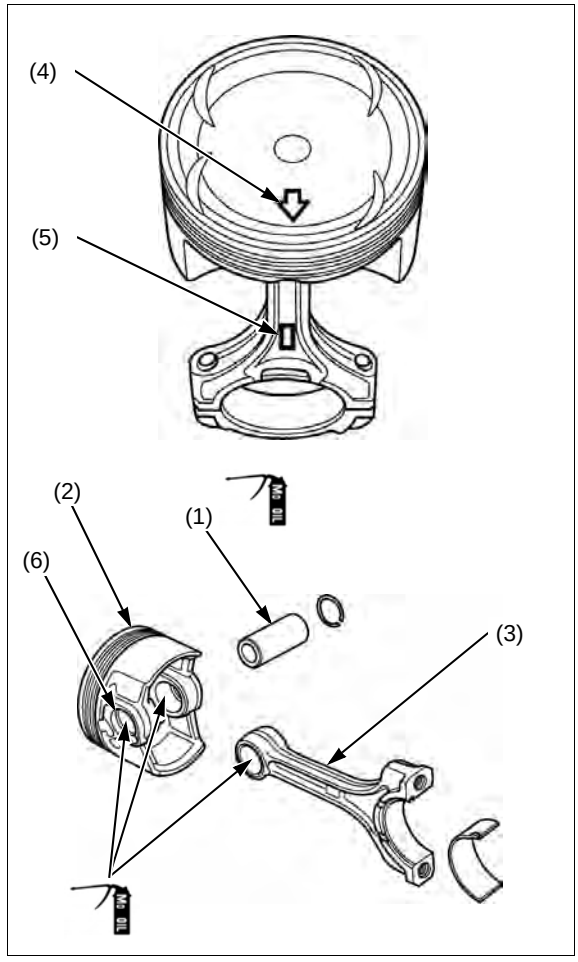


Apply molybdenum disulfide oil to the piston pin (1) outer surface, pin holes in the piston (2), and to the connecting rod (3) small end.

Install the piston pin so that the "⇦" mark (4) on the piston head points to the same direction as the model mark (5) on the connecting rod.

Install another piston pin clip (6) to the opposite side.

- Wear eye protection as the piston pin clips can pop out.
- Make sure the piston pin clip does not align with the cutout in the piston pin bore.



Install the piston rings in the ring grooves of the piston (1) with the marks on the top ring (2) and second ring (3) facing up.

NOTICE

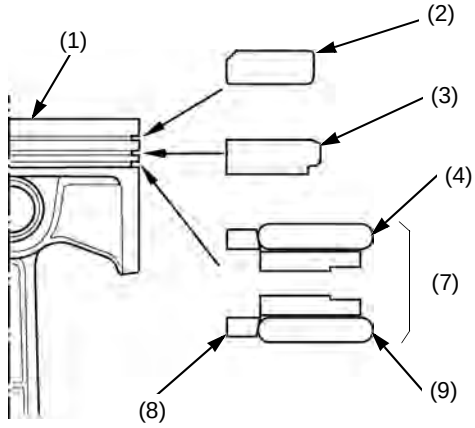
- *Clean the ring grooves thoroughly before installing the piston rings.*
- *Install the piston rings with care not to break the piston rings. Take care not to score or scratch the piston.*
- *Do not confuse the top ring and the second ring. The top ring is glossy while the second ring can be identified by its dark color.*

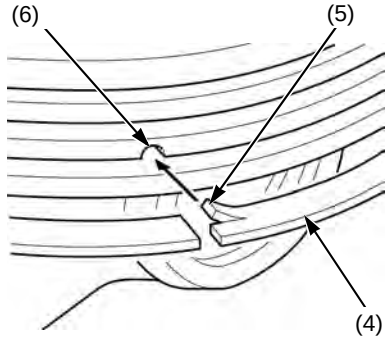
Install the side rail (top side) (4) by aligning the lug (5) of the side rail (top side) with the positioning groove (6) in the ring groove.

NOTICE

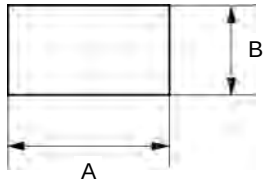
- *To install the oil rings (7), install the spacer (8) first, then install the side rail (skirt side) (9).*
- *Be sure that the lug of the side rail (top side) sits in the positioning groove securely.*

After installing the piston rings, check for smooth movement of each ring. (except top side rail)





DIMENSIONS OF PISTON RING



TOP RING

A: 3.1 mm (0.12 in)

B: 1.2 mm (0.05 in)

SECOND RING

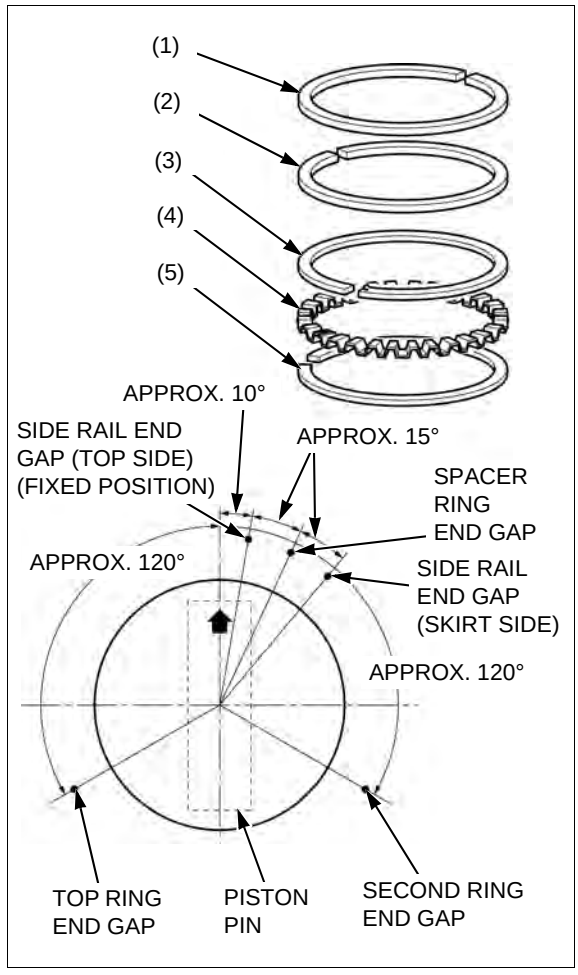
A: 3.4 mm (0.13 in)

B: 1.2 mm (0.05 in)

Stagger the piston ring end gaps as shown (top ring) (1), second ring (2), side rail (top side) (3), spacer (4), and side rail (skirt side) (5).

NOTICE

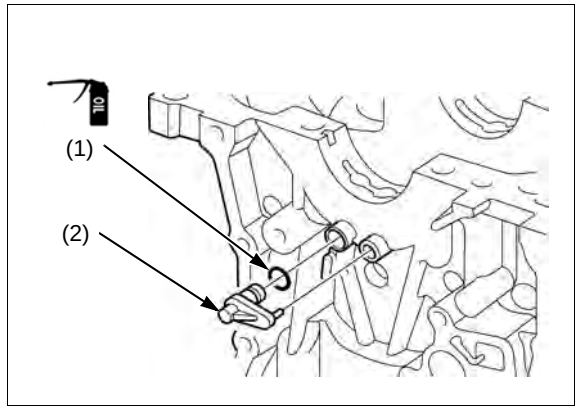
Do not align with the piston pin, and avoid the direction that makes a right angle with the piston pin.



CYLINDER BLOCK/CRANKSHAFT ASSEMBLY

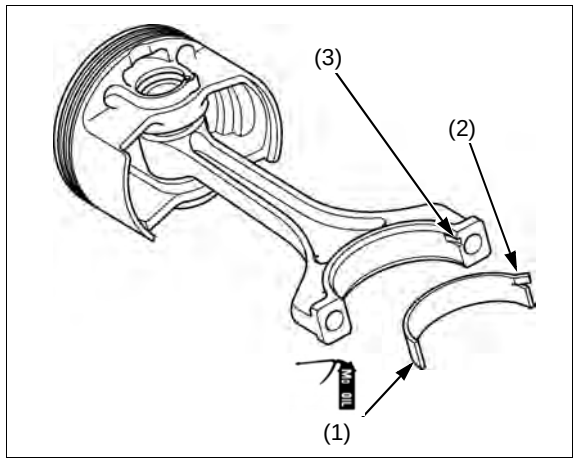
Apply engine oil to the new O-ring (1) and install it to the oil jet orifice (2).

Install the oil jet orifice to the cylinder block.



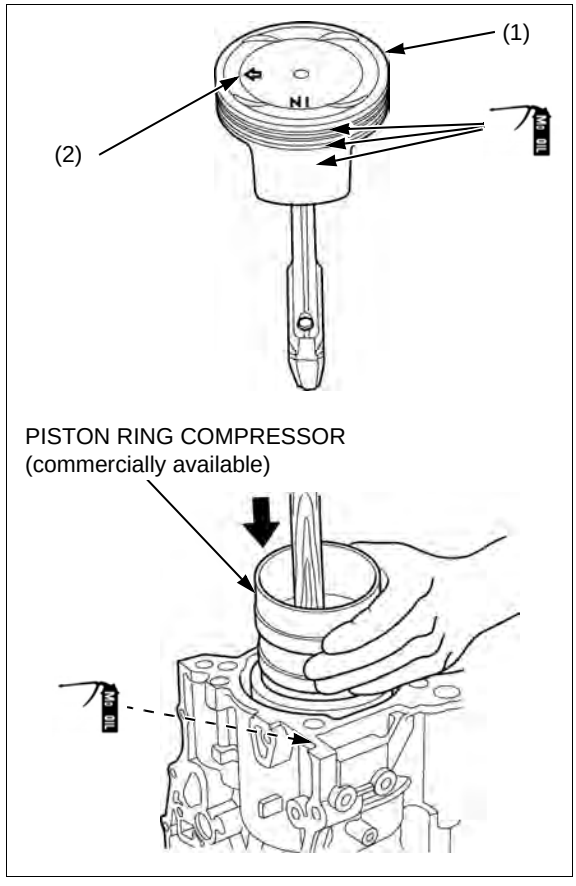
Apply molybdenum disulfide oil to the connecting rod bearing surface (1).

Install the connecting rod bearing to the connecting rod by aligning the tab (2) of the connecting rod bearing with the groove (3) of the connecting rod.



Apply molybdenum disulfide oil to the piston (1) outer surface, piston rings, oil rings and cylinder sleeve inner surface.

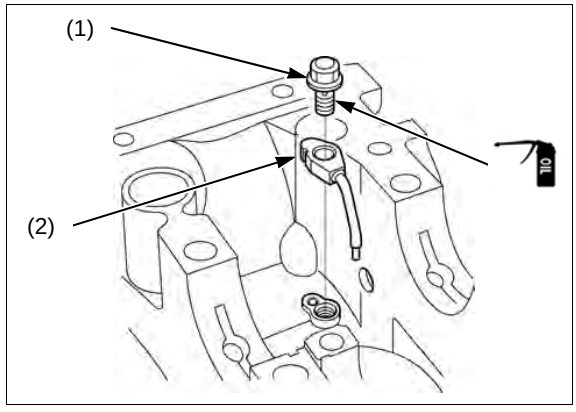
Install the piston with the arrow mark (2) facing the cam chain side of the engine. Using a piston ring compressor (commercially available), position the piston in the cylinder block, and tap it in using the wooden handle of a hammer.



Apply engine oil to the threads and seating surface of the oil jet bolts (1).

Install the oil jet body (2) to No.1 and No.2 cylinders and tighten the oil jet bolts to the specified torque.

TORQUE: 16 N·m (1.6 kgf·m, 12 lbf·ft)

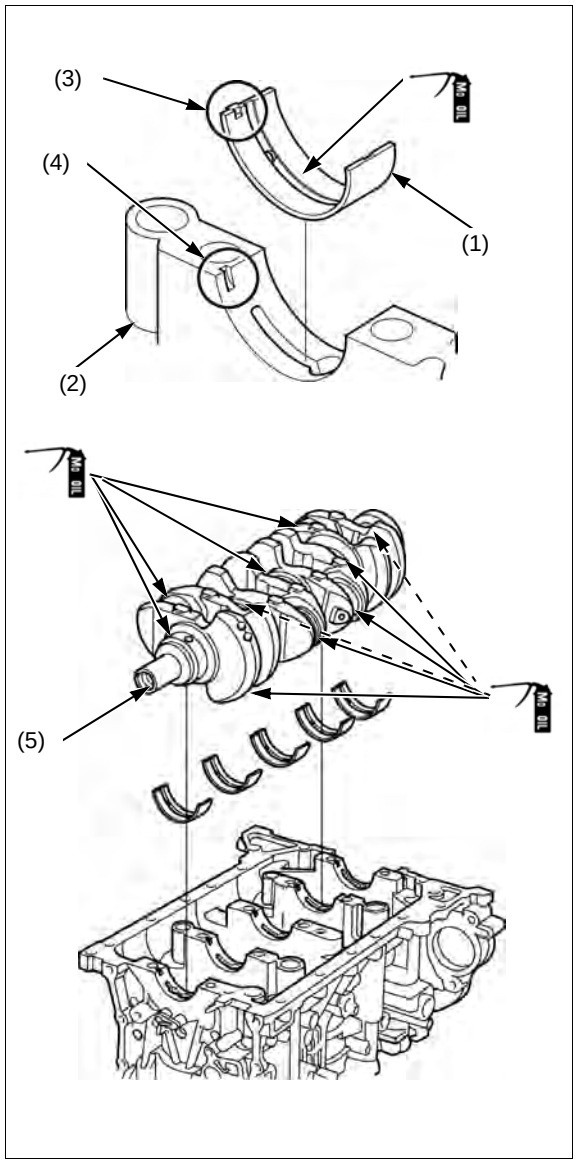


Install the connecting rod bearing (1) to the connecting rod (2) by aligning the tab (3) of the connecting rod bearing with the groove (4) of the connecting rod.

Apply molybdenum disulfide oil to the connecting rod bearing surface.

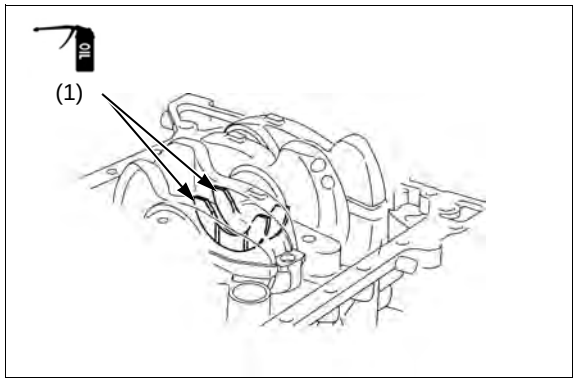
Apply molybdenum disulfide oil to the crankshaft main journal, crank pin, thrust washer contacting surfaces.

Install the crankshaft (5) to the cylinder block as shown.



Apply engine oil to the thrust washers (1) and install them to the cylinder block No.4 journal.

- Install the thrust washers with their oil grooves facing out as shown.



Install the connecting rod bearing (1) to the connecting rod cap (2) by aligning the tab (3) of the connecting rod bearing with the groove (4) of the connecting rod cap.

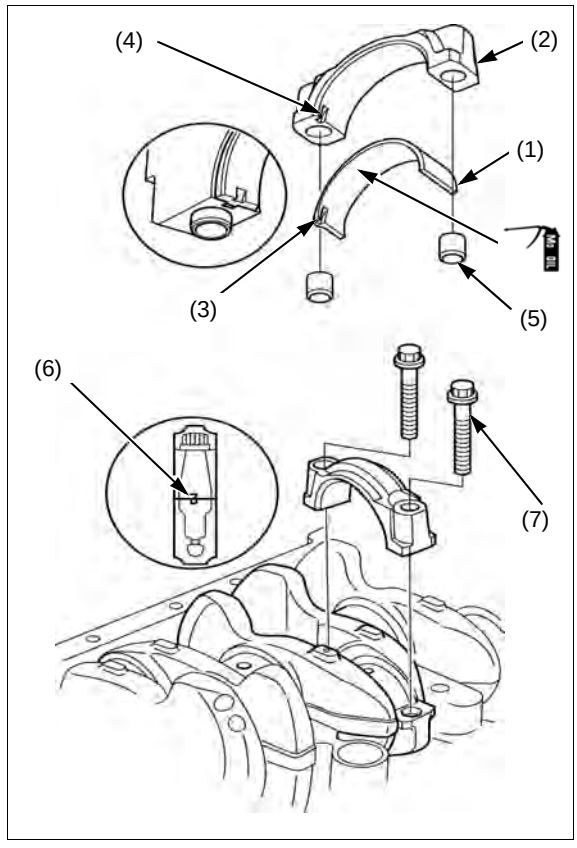
Install the two dowel pins (5).

Apply molybdenum disulfide oil to the connecting rod bearing surface.

Install the connecting rod caps of No.2 and No.3 cylinders.

- Install the connecting rod caps by aligning the code letter with the number (6) on the counter part.

Install the connecting rod bolts (7).



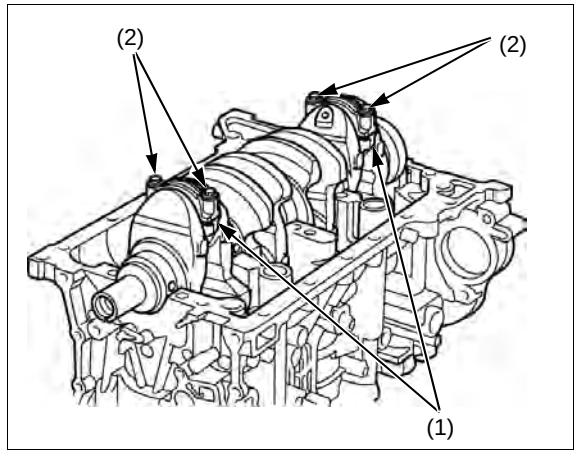
Turn the crankshaft until the No.1 and No.4 cylinders (1) are at the bottom dead center.

Install the No.1 and No.4 connecting rod caps using the same procedure as No.2 and No.3 caps.

Tighten the connecting rod bolts (2) to the specified torque, then tighten them to an additional 90°.

TORQUE: 20 N·m (2.0 kgf·m, 15 lbf·ft) + 90°

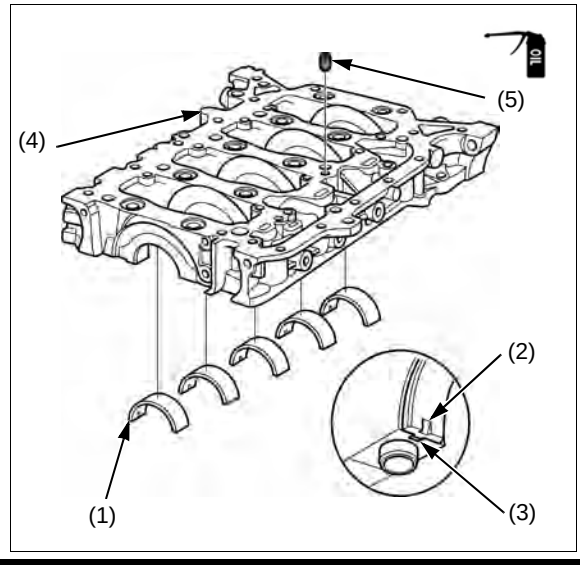
Turn the crankshaft until the No.2 and No.3 cylinders are at the bottom dead center, then tighten the No.2 and No.3 bolts using the same procedure as No.1 and No.4 bolts.



Install the five main bearings (1) by aligning their tabs (2) with the grooves (3) of the lower block (4).

Apply engine oil to the threads of the lower block orifice (5) and install it to the lower block.
Tighten the orifice to the specified torque.

TORQUE: 10 N·m (1.0 kgf·m, 7 lbf·ft))



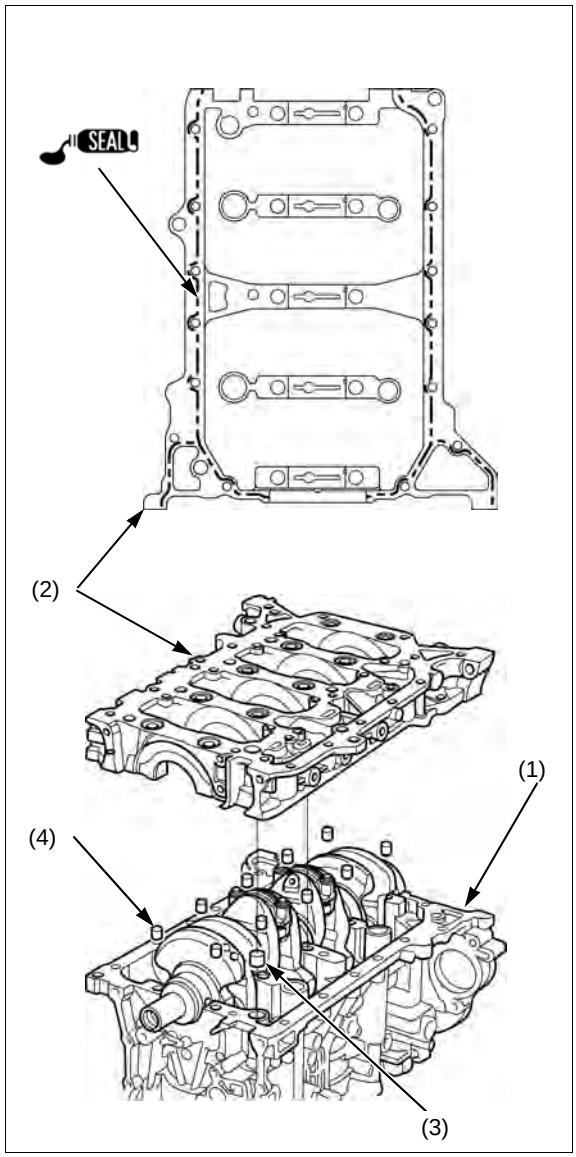
Clean the crankcase (1) and lower block (2) mating surfaces thoroughly with degreasing agent.

Apply 2.0 – 3.0 mm (0.08 – 0.12 in) bead of liquid sealant (Threebond® 1280B or equivalent) to the indicated area of lower block mating surface.

NOTICE

- *To prevent leaks, do not install the parts if 5 minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the old residue.*
- *After assembly, wait at least 30 minutes before filling the engine with oil.*

Install the dowel pin (18 × 22 mm) (3), ten dowel pins (13 × 14 mm) (4) to the cylinder block.
Install the lower block to the cylinder block.



Apply engine oil to the threads and seating surface of the ten bolts (1) and install them.

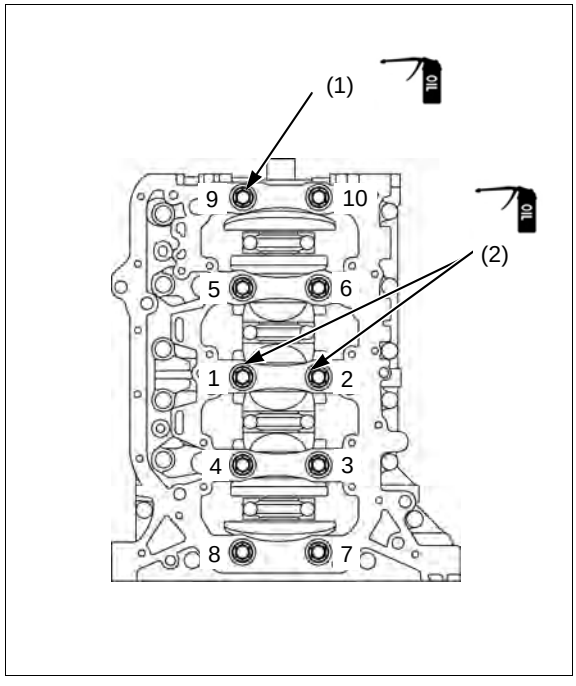
Tighten the two No.3 journal mounting bolts (2) in two or three steps to the specified torque.

TORQUE: 70 N·m (7.1 kgf·m, 52 lbf·ft)

After tightening them to the specified torque, completely loosen them.

Tighten the ten bolts in the numbered sequence shown. Tighten them in two or three steps to the specified torque, then tighten them to an additional 56°.

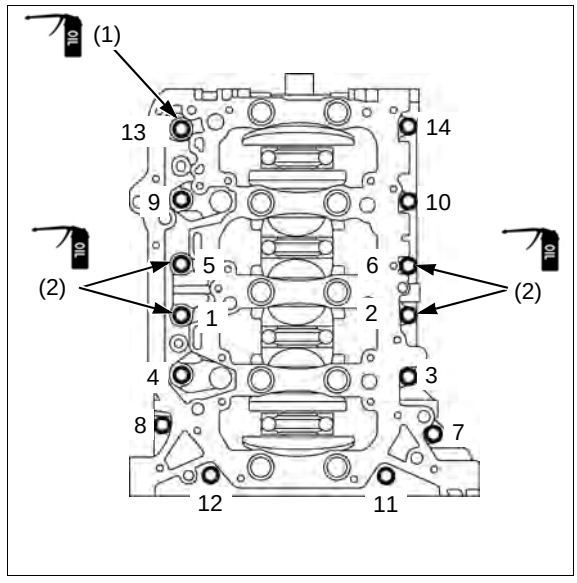
TORQUE: 30 N·m (3.1 kgf·m, 22 lbf·ft)+ 56°



Apply engine oil to the threads and seating surface of the ten bolts (8 × 35 mm) (1) and four bolts (8 × 50 mm) (2), then install them.

Tighten the ten bolts in the numbered sequence shown. Tighten them in two or three steps to the specified torque.

TORQUE: 26 N·m (2.7 kgf·m, 19 lbf·ft)



Apply soapy water to the new oil seal (80 × 98 × 10 mm) (1) outer surface.

Apply marine grease to the oil seal lips.

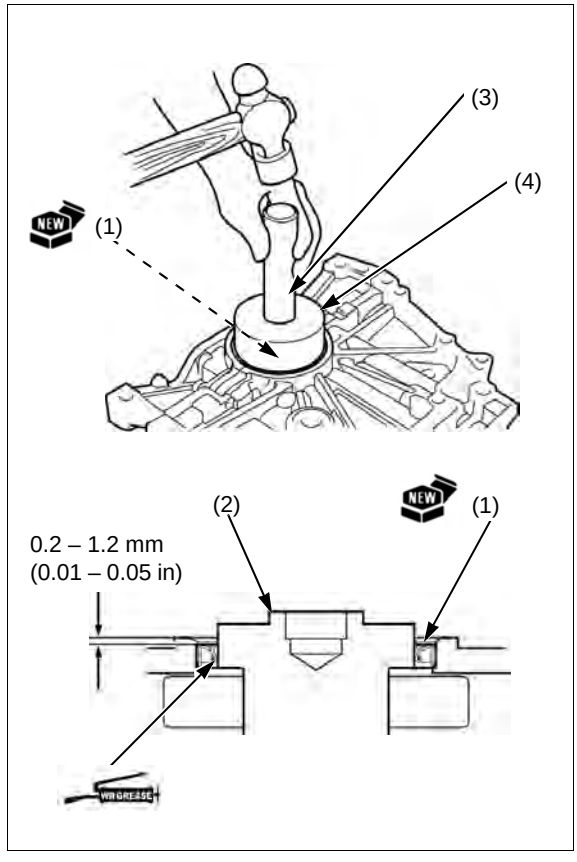
Install the oil seal to the crankshaft (2) in the direction as shown, using the special tools until its upper surface is 0.2 - 1.2 mm (0.01 - 0.05 in) below the cylinder block top surface.

TOOLS:

Driver (3)	**07749-0010000**
Oil seal driver attachment, 80 × 96 mm (4)	**07ZAD-PNA0100**

Install the following:

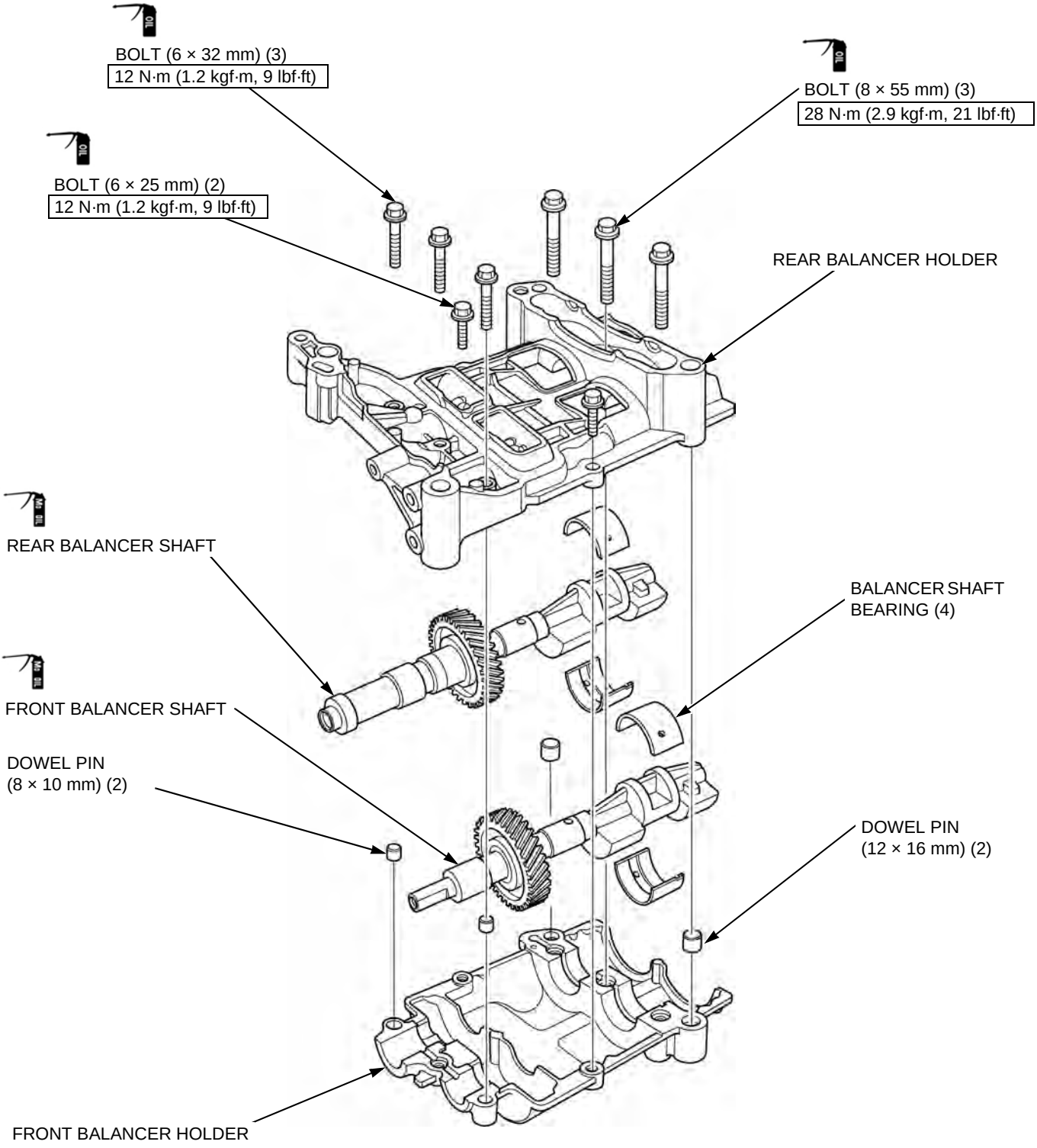
– Crankcase/balancer (page 15-8)
– Cylinder head (page 14-35)
– Oil filter flange (page 12-5)
– Knock sensor (page 5-119)
– EOP sensor (page 5-119)
– ECT sensor 1 (page 5-116)
– Alternator bracket (page 7-7)



BALANCER CASE DISASSEMBLY/ ASSEMBLY

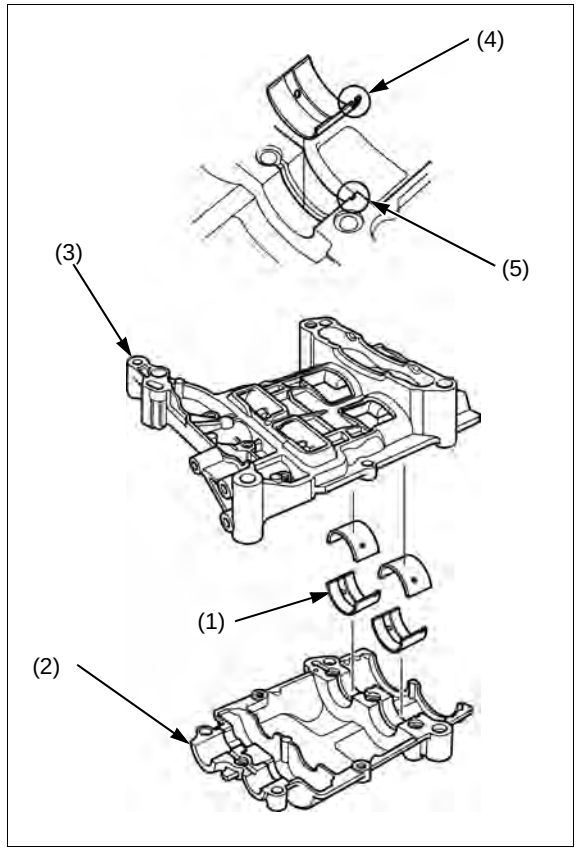
DISASSEMBLY

Remove the balancer case (page 15-8).



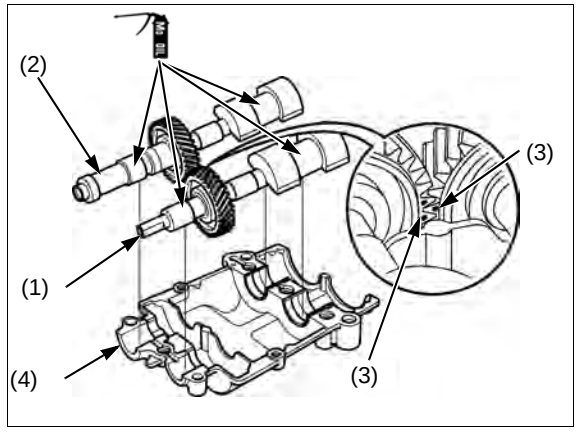
ASSEMBLY

Install the four balancer shaft bearings (1) to the front balancer holder (2) and rear balancer holder (3) by aligning the tab (4) of the bearing with the groove (5) of the holders.



Apply molybdenum disulfide oil to the balancer shaft journal surface.

Engage the front balancer shaft (1) and rear balancer shaft (2) by aligning the punch marks (3) as shown.
Install the balancer shafts to the front balancer holder (4).



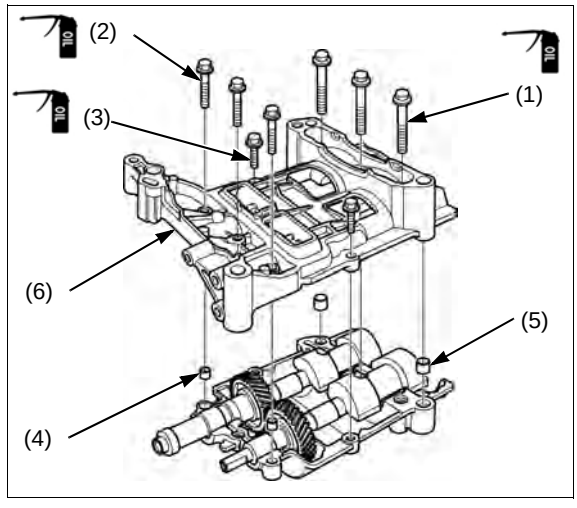
Apply engine oil to the threads and seating surfaces of the three bolts (8 × 55 mm) (1), three bolts (6 × 32 mm) (2) and two bolts (6 × 25 mm) (3).

Install the two dowel pins (8 × 10 mm) (4), two dowel pins (12 × 16 mm) (5), and rear balancer holder (6).
Install and tighten the bolts to the specified torque.

TORQUE:

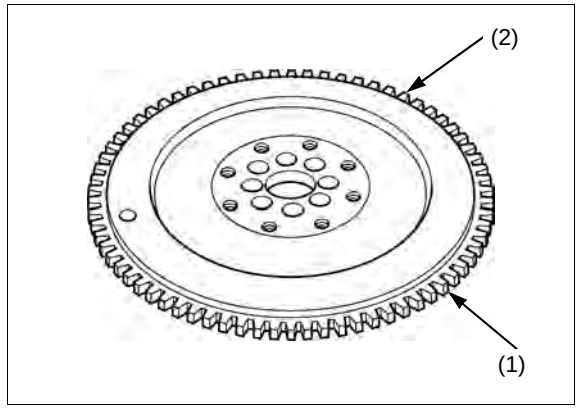
28 N·m (2.9 kgf·m, 21 lbf·ft) :
THREE BOLTS (8 × 55 mm) (1)
12 N·m (1.2 kgf·m, 9 lbf·ft) :
THREE BOLTS (6 × 32 mm) (2)
TWO BOLTS (6 × 25 mm) (3)

Install the balancer case (page 15-11).



FLYWHEEL INSPECTION

Inspect the ring gear (1) of the flywheel (2) for wear or damage.
If it is worn or damaged, inspect the starter motor pinion gear (page 9-15).



CRANKSHAFT/PISTON/CYLINDER BLOCK INSPECTION

PISTON SKIRT O.D.

Check the piston outer surface for damage (scores, scratches, etc.), warpage and cracks.

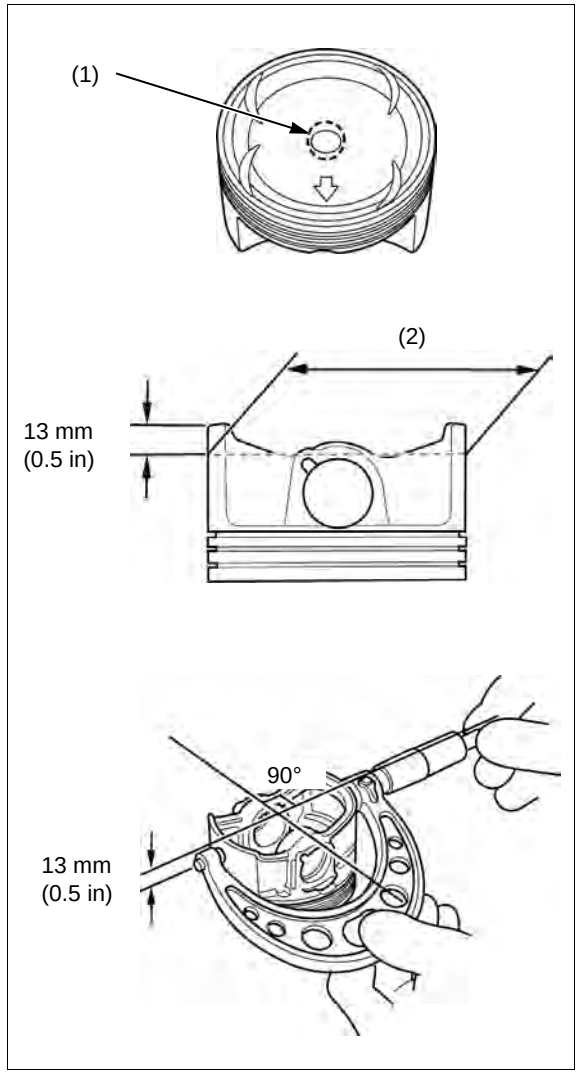
Note the identification code (1) on the piston top.

Measure and record the piston O.D. (2) at a point 13 mm (0.5 in) from the bottom, and 90° to the piston pin bore.

IDENTIFICATION CODE: Not marked (PISTON A)
STANDARD:
86.980 – 86.990 mm (3.4244 – 3.4248 in)
SERVICE LIMIT:
86.930 mm (3.4224 in)

IDENTIFICATION CODE: B mark (PISTON B)
STANDARD:
86.970 – 86.980 mm (3.4240 – 3.4244 in)
SERVICE LIMIT:
86.920 mm (3.4220 in)

Replace the piston if the measurement is less than the service limit (page 15-15).



CYLINDER SLEEVE I.D.

Check the cylinder sleeve inner surface for damage (scores, scratches, etc.).

Measure and record the cylinder I.D. at three levels in both X and Y axis. Take the maximum reading to determine the cylinder wear.

Note the identification codes (1) as shown.

IDENTIFICATION CODE: A or I

STANDARD:

87.010 – 87.020 mm (3.4256 – 3.4260 in)

SERVICE LIMIT:

87.070 mm (3.4279 in)

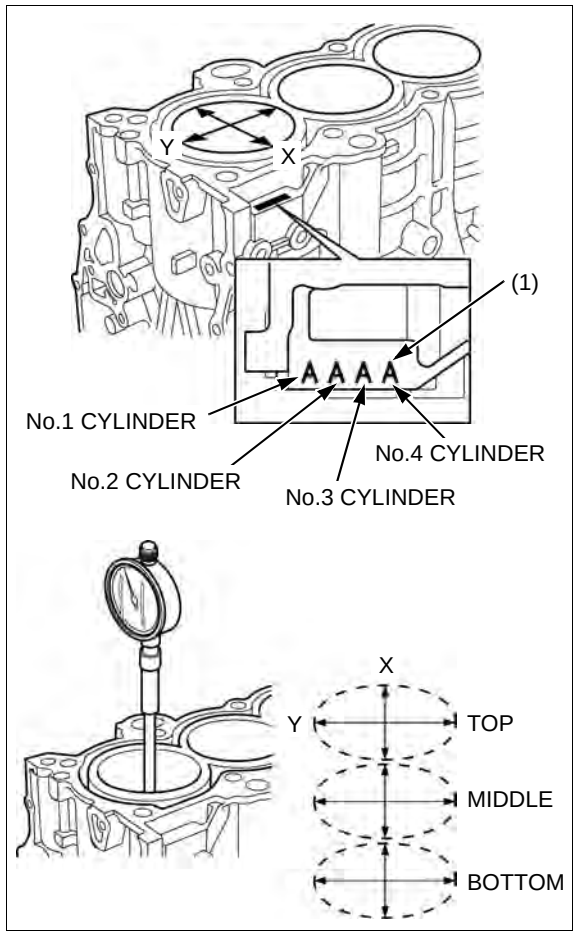
IDENTIFICATION CODE: B or II

STANDARD:

87.000 – 87.010 mm (3.4252 – 3.4256 in)

SERVICE LIMIT:

87.070 mm (3.4279 in)



DIFFERENCE BETWEEN UPPER AND LOWER PARTS OF SLEEVE I.D.

Measure and record the cylinder I.D. at three levels in both X and Y axis. Calculate the difference between upper and lower parts of sleeve I.D.

SERVICE LIMIT:

0.05 mm (0.002 in)

PISTON-TO-CYLINDER CLEARANCE

Subtract each piston skirt O.D. from the corresponding cylinder sleeve I.D.

STANDARD:

0.020 – 0.040 mm (0.0008 – 0.0016 in)

SERVICE LIMIT:

0.050 mm (0.002 in)

Replace the cylinder block if the measurement exceeds the service limit (page 15-15).

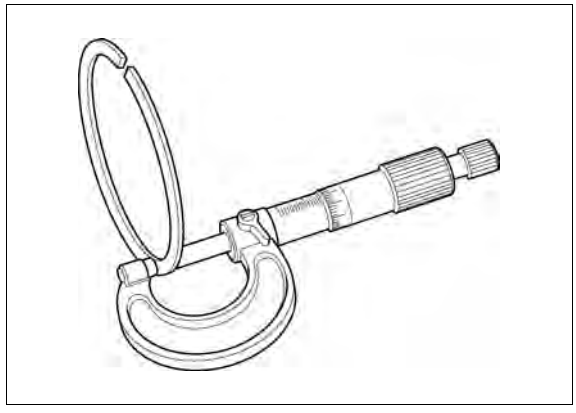
PISTON RING THICKNESS

Check the piston ring and oil ring for damage.
Always replace the oil ring spacer and side rails as a set.

Measure the piston ring thickness.

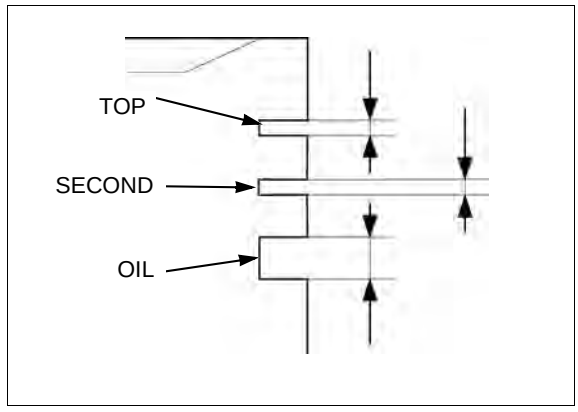
STANDARD:

TOP	**1.175 – 1.190 mm (0.0463 – 0.0469 in)**
SECOND	**1.175 – 1.190 mm (0.0463 – 0.0469 in)**



PISTON RING GROOVE WIDTH

Measure the piston ring groove width.

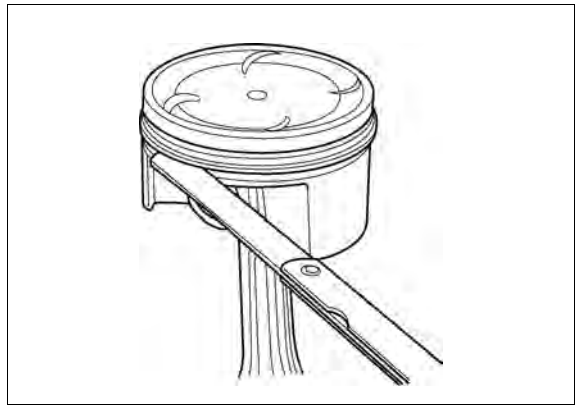


STANDARD:
- **TOP: 1.230 – 1.240 mm (0.0484 – 0.0488 in)**
- **SECOND: 1.240 – 1.250 mm (0.0488 – 0.0492 in)**
- **OIL: 2.005 – 2.025 mm (0.0789 – 0.0797 in)**

SERVICE LIMIT:
- **TOP: 1.25 mm (0.049 in)**
- **SECOND: 1.25 mm (0.049 in)**
- **OIL: 2.05 mm (0.081 in)**

PISTON RING SIDE CLEARANCE

Install the piston rings onto the piston so it is almost flush with the piston outer surface. Measure the piston ring side clearance.



STANDARD:
- **TOP: 0.040 – 0.065 mm (0.0016 – 0.0026 in)**
- **SECOND: 0.050 – 0.075 mm (0.0020 – 0.0030 in)**

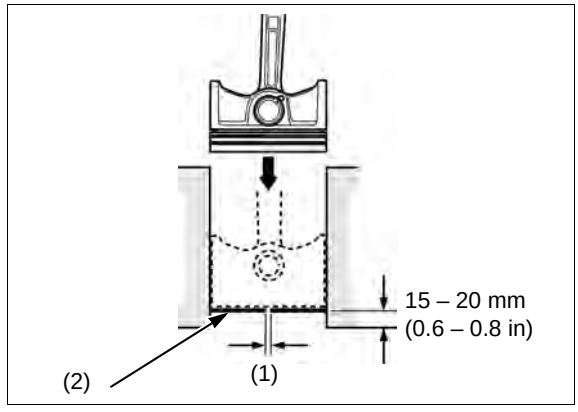
SERVICE LIMIT:
- **TOP: 0.13 mm (0.005 in)**
- **SECOND: 0.13 mm (0.005 in)**

If the measurement exceeds the service limit, replace the piston ring with new one (page 15-18) and recheck.

If the measurement still exceeds the service limit, also replace the piston with new one (page 15-15).

PISTON RING END GAP

Measure the piston ring end gap (1) 15 – 20 mm (0.6 – 0.8 in) from the cylinder bottom.
Before measurement, be sure to set the ring (2) in the cylinder squarely using the piston.



STANDARD:
- **TOP: 0.20 – 0.35 mm (0.008 – 0.014 in)**
- **SECOND: 0.50 – 0.65 mm (0.020 – 0.026 in)**
- **OIL: 0.20 – 0.70 mm (0.008 – 0.028 in)**

SERVICE LIMIT:
- **TOP: 0.6 mm (0.024 in)**
- **SECOND: 0.75 mm (0.030 in)**
- **OIL: 0.8 mm (0.031 in)**

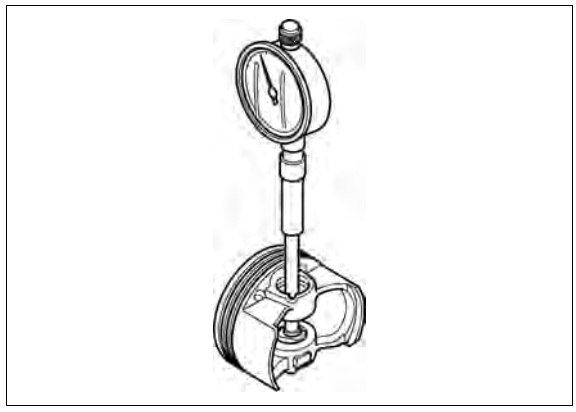
If the measurement exceeds the service limit, replace the piston ring with new one (page 15-18) and recheck.

If the measurement still exceeds the service limit, also inspect the cylinder sleeve I.D. (page 15-33).

PISTON PIN BORE I.D.

Measure the piston pin bore I.D.at the both sides of the piston. Take the largest measurement to determine the piston pin bore I.D.

STANDARD:
21.960 – 21.963 mm (0.8646 – 0.8647 in)

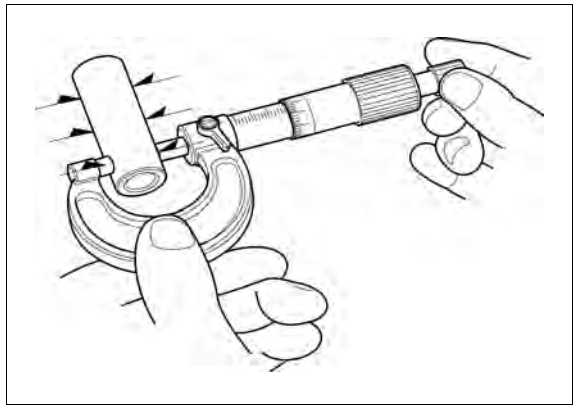


PISTON PIN O.D.

Check the piston pin outer surface for damage.

Measure the piston pin O.D. at the top, middle and bottom of the piston pin. Take the smallest measurement to determine the piston pin O.D.

STANDARD:
21.961 – 21.965 mm (0.8646 – 0.8648 in)
SERVICE LIMIT:
21.953 mm (0.8643 in)

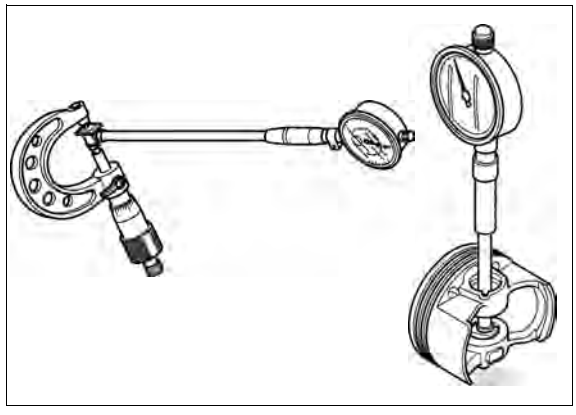


PISTON PIN-TO-PIN BORE CLEARANCE

Set the cylinder gauge at the piston pin O.D. and zero the cylinder gauge.

Insert the cylinder gauge in the piston pin holes at the both sides of the piston and measure the piston pin-to pin bore clearance. Take the largest measurement to determine the clearance.

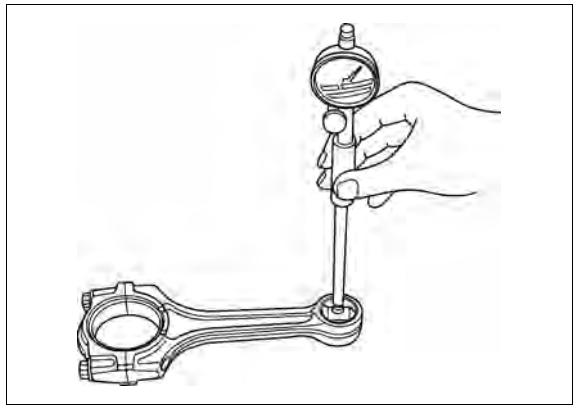
STANDARD:
-0.005 – +0.002 mm (-0.0002 – +0.0001 in)
SERVICE LIMIT:
0.005 mm (0.0002 in)



CONNECTING ROD SMALL END I.D.

Measure the connecting rod small end I.D.

STANDARD:
21.970 – 21.976 mm (0.8650 – 0.8652 in)



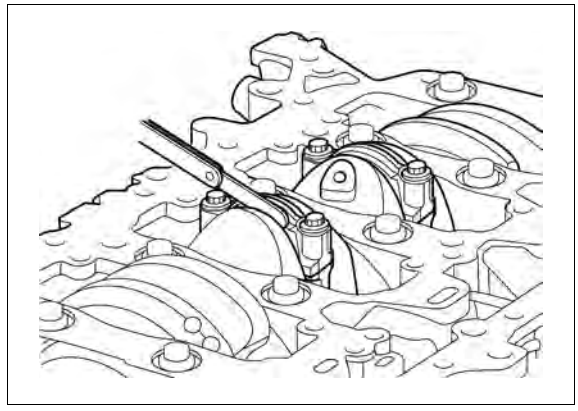
CONNECTING ROD SMALL END-TO-PISTON PIN CLEARANCE

Subtract each piston pin O.D. from the corresponding connecting rod small end I.D.

STANDARD:
0.005 – 0.015 mm (0.0002 – 0.0006 in)
SERVICE LIMIT:
0.020 mm (0.0008 in)

CONNECTING ROD BIG END AXIAL CLEARANCE

Measure the connecting rod big end axial clearance.



STANDARD:
0.15 – 0.35 mm (0.006 – 0.014 in)
SERVICE LIMIT:
0.40 mm (0.016 in)

If the clearance exceeds the service limit, replace the connecting rod and connecting rod cap with new ones as a set (page 15-15) and recheck.

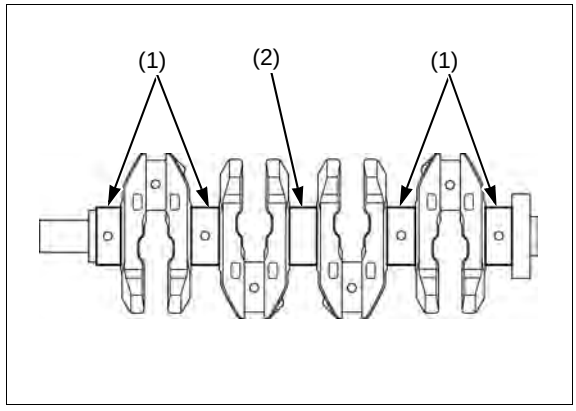
If the measurement still exceeds the service limit, replace the crankshaft with a new one (page 15-15).

CRANKSHAFT MAIN JOURNAL O.D.

Measure the crankshaft main journal O.D.

STANDARD:

No. 1, 2, 4, 5 (1):	**54.984 – 55.008 mm (2.1647 – 2.1657 in)**
No. 3 (2):	**54.976 – 55.000 mm (2.1644 – 2.1654 in)**

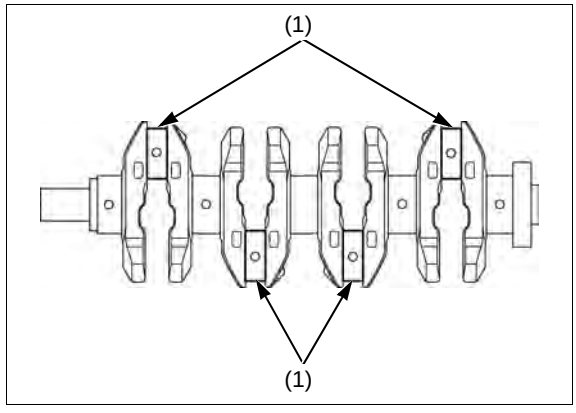


CRANK PIN O.D.

Measure the crank pin (1) O.D.

STANDARD:

47.976 – 48.000 mm (1.8888 – 1.8898 in)



CRANKSHAFT JOURNAL (MAIN/ CRANK PIN JOURNALS) ROUNDNESS/TAPER

Measure and record the crank pin journal and crankshaft main journal O.D. in both A and B axis.
Calculate the difference between the measurements to determine the roundness.

STANDARD:

0.005 mm (0.0002 in) Max

SERVICE LIMIT:

0.010 mm (0.0004 in)

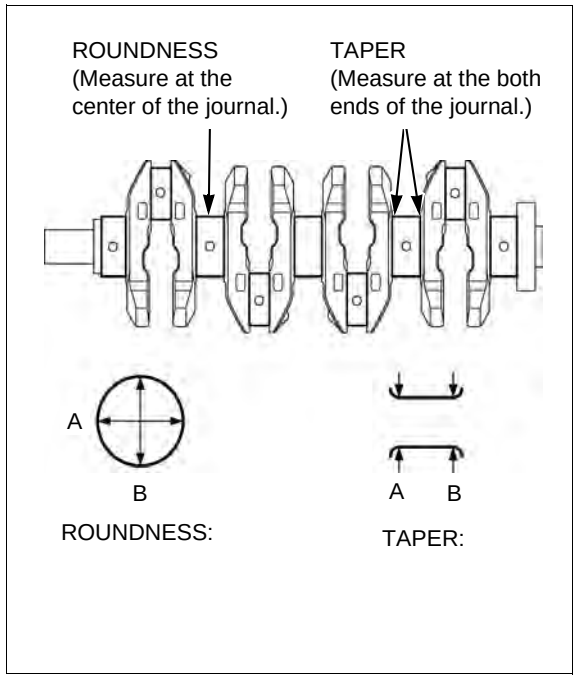
Measure and record the crank pin journal and crankshaft main journal O.D. in A and B points.
Calculate the difference between the measurements to determine the taper.

STANDARD:

0.005 mm (0.0002 in) Max

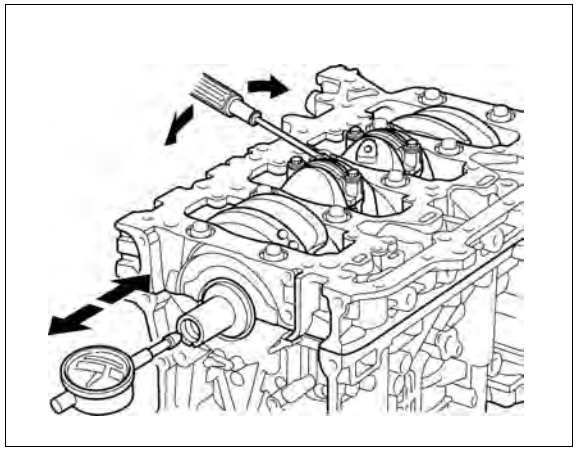
SERVICE LIMIT:

0.010 mm (0.0004 in)



CRANKSHAFT AXIAL CLEARANCE

Measure the crankshaft axial clearance.



STANDARD:

0.10 – 0.35 mm (0.004 – 0.014 in)

SERVICE LIMIT:

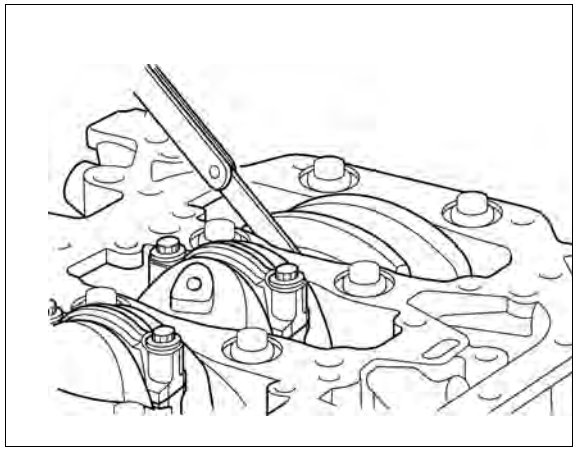
0.45 mm (0.018 in)

If the measurement exceeds the service limit, check the thrust washers and the thrust surface of the cylinder block. Replace the thrust washers with new ones (page 15-15) and recheck.

If the measurement still exceeds the service limit, replace the crankshaft (page 15-15).

THRUST WASHER SIDE CLEARANCE

Measure the clearance between the thrust washers and crankshaft at the No.4 main journal.



STANDARD:

0.10 – 0.35 mm (0.004 – 0.014 in)

SERVICE LIMIT:

0.45 mm (0.018 in)

If the measurement exceeds the service limit, check the thrust washers and the thrust surface of the cylinder block. Replace the thrust washers with new ones (page 15-15) and recheck.

If the measurement still exceeds the service limit, replace the crankshaft (page 15-15).

CRANKSHAFT RUNOUT

Install the No.1 main bearing (1) and No.5 main bearing (2) to the cylinder block (3).

Install the crankshaft (4) to the cylinder block.

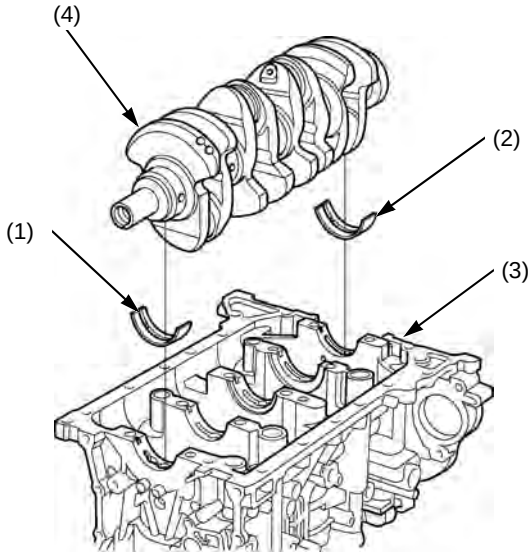
Measure the crankshaft runout.

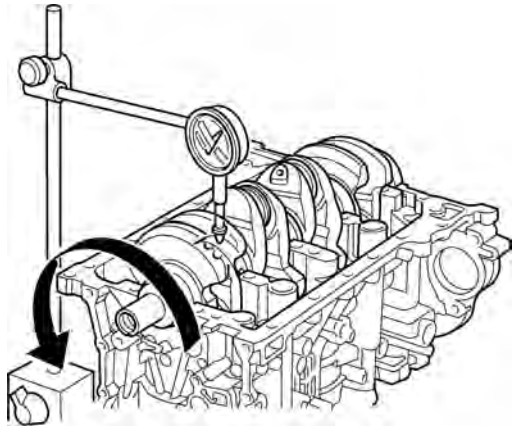
STANDARD:

0.030 mm (0.0012 in) Max

SERVICE LIMIT:

0.040 mm (0.0016 in)





MATING SURFACE WITH CYLINDER HEAD WARPAGE

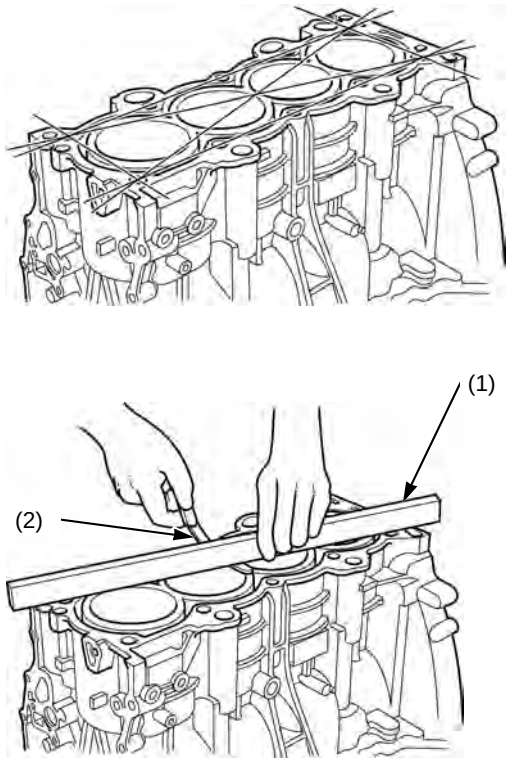
Take care not to damage (scores, scratches, etc.) the mating surface with the gasket.

Measure the surface warpage using a straight edge (1) and a feeler gauge (2) as shown.

STANDARD:
0.07 mm (0.003 in) Max
SERVICE LIMIT:
0.10 mm (0.004 in)

If the measurement exceeds the service limit, replace the cylinder block (page 15-15).

MEASUREMENT POINTS



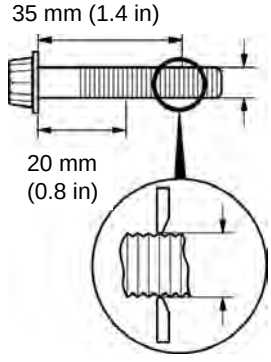
CONNECTING ROD BOLT

Measure the bolt O.D. at the two points as shown and calculate the difference between the measurements.

STANDARD:
0 – 0.10 mm (0 – 0.004 in)

If the difference exceeds the standard value, replace the connecting rod bolt (page 15-15).

Measure the O.D. of all connecting rod bolts.



CRANKSHAFT MAIN BEARING OIL CLEARANCE

To check main bearing-to-journal oil clearance, remove the lower block, crankshaft, and main bearings (page 15-15).

Clean each main journal and main bearings and check for wear or damage.

Install the main bearings, crankshaft and lower block to the cylinder block, and tighten the bolts to the specified torque (page 15-24).

Remove the lower block and main bearings and place one strip of plastigauge (1) across each main journal.

- Set the plastigauge in the axial direction.
- Avoid the oil passage in the bearing journal to set the plastigauge.

Reinstall the main bearings, crankshaft and lower block to the cylinder block, and tighten the bolts to the specified torque (page 15-24).

- Do not turn the crankshaft during this check.

Remove the lower block and main bearings and measure the pressured width (2) of the plastigauge using the scale (3) printed on the plastigauge's bag.

STANDARD:

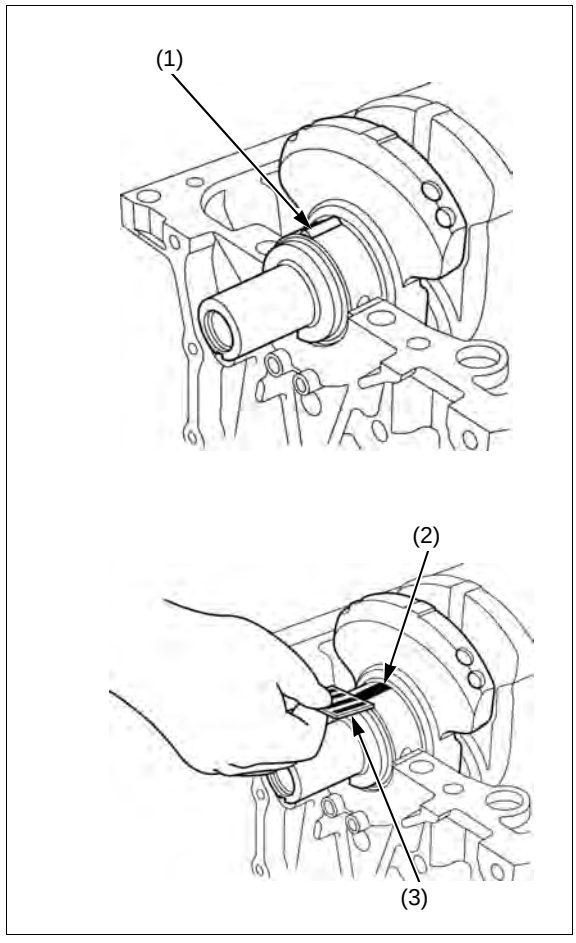
No.1, 2, 4, 5:	**0.017 – 0.041 mm (0.0007 – 0.0016 in)**
No.3:	**0.025 – 0.049 mm (0.0010 – 0.0019 in)**

SERVICE LIMIT:

No.1, 2, 4, 5:	**0.05 mm (0.0020 in)**
No.3:	**0.055 mm (0.0022 in)**

- Take the largest width on the plastigauge.

If the measurement exceeds the service limit, replace the bearings by referring to crankshaft main bearing selection table (page 15-45) and measure the oil clearance again.
If the measurement still exceeds the service limit, replace the crankshaft with a new one (page 15-15) and recheck.



CONNECTING ROD BEARING OIL CLEARANCE

To check connecting rod bearing-to-crank pin oil clearance, remove the connecting rod bearing caps, crankshaft, and connecting rod bearings (page 15-15).

Clean each crank pin and connecting rod bearing and check for wear or damage.
Set the crankshaft to the cylinder block, install the connecting rod caps and tighten the connecting rod bolts to the specified torque (page 15-24).

Remove the bearing caps and place one strip of plastigauge (1) across each crank pin.

- Set the plastigauge in the axial direction.
- Avoid the oil passage in the crank pin when setting the plastigauge.

Reinstall the connecting rod caps and tighten the connecting rod bolts to the specified torque (page 15-24).

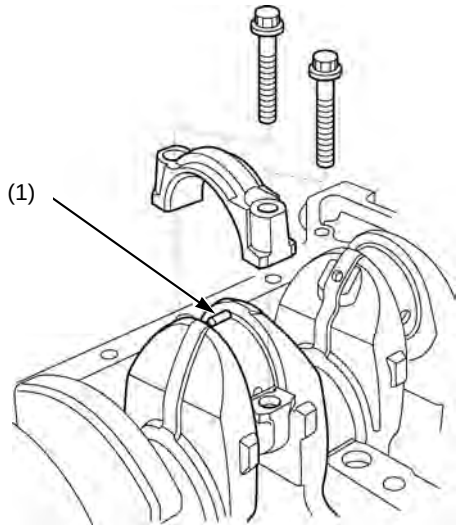
- Tighten the connecting rod bolt with care not to turn the crankshaft and/or the connecting rod.

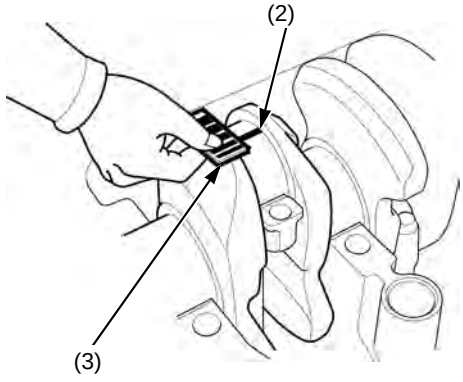
Remove the connecting rod cap and measure the pressured width (2) of the plastigauge using the scale (3) printed on the plastigauge's bag.

- Take the largest width on the plastigauge.

STANDARD:
0.020 – 0.050 mm (0.0008 – 0.0020 in)
SERVICE LIMIT:
0.060 mm (0.0024 in)

If the measurement exceeds the service limit, replace the bearings by referring to connecting rod bearing selection table (page 15-43) and measure the oil clearance again.
If the measurement still exceeds the service limit, replace the crankshaft with a new one (page 15-15) and recheck.





BEARING SELECTION

CONNECTING ROD BEARING

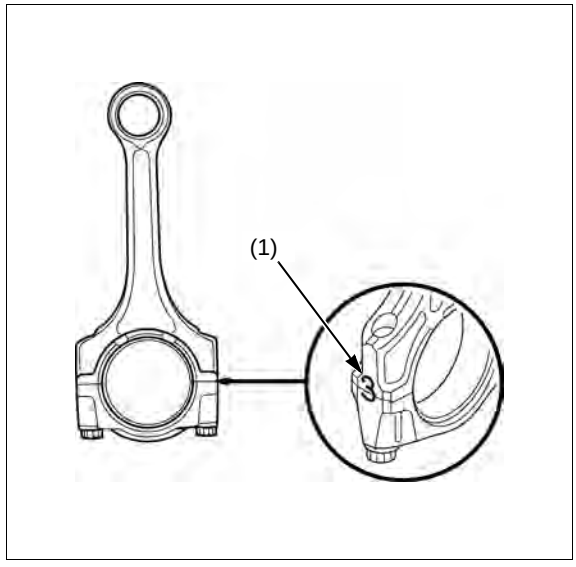
- When replacing the connecting rod bearing, check the crank pin code letter and the connecting rod code number, and select the correct bearing by referring to the bearing selection table.
- If the code letters and/or numbers are not clear, clean the areas with a cleaning solvent and check again. Do not scrub with a stiff wire brush or scraper to clean.

Check the connecting rod code numbers (1) and record them.

- The connecting rod code numbers are for the No.1 and the subsequent number journals when viewed from the cam chain side.

Connecting rod: 51.00 mm (2.008 in)

Code number	Tolerance ranges
1 or I	±0.000 – +0.006 mm (±0.0000 – +0.0002 in)
2 or II	+0.006 – +0.012 mm (+0.0002 – +0.0005 in)
3 or III	+0.012 – +0.018 mm (+0.0005 – +0.0007 in)
4 or IIII	+0.018 – +0.024 mm (+0.0007 – +0.0009 in)

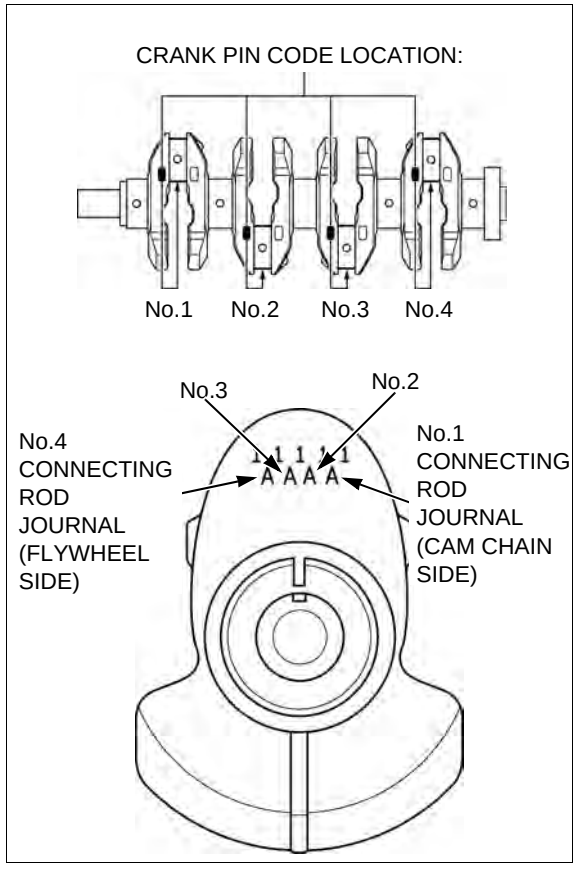


Check the crank pin code letters and record them.

- The crank pin code letters are for the No.1 and the subsequent number journals when viewed from crankshaft pulley side.

Crank pin: 48.00 mm (1.8898 in)

Code number	Tolerance ranges
A	±0.000 – -0.006 mm (±0.0000 – -0.0002 in)
B	-0.006 – -0.012 mm (-0.0002 – -0.0005 in)
C	-0.012 – -0.018 mm (-0.0005 – -0.0007 in)
D	-0.018 – -0.024 mm (-0.0007 – -0.0009 in)



Select the correct bearing by referring to the crank pin code letter and the connecting rod code number.

Connecting rod bearing selection table

Crank pin code letter	Connecting rod code number			
	1 or I	2 or II	3 or III	4 or IIII
	Bearing I.D. color			
A	Pink	Pink/ Yellow	Yellow/ Green	Green
B	Yellow	Yellow/ Green	Green/ Brown	Brown
C	Green	Green/ Brown	Brown/ Black	Black
D	Brown	Brown/ Black	Black/ Blue	Blue

Connecting rod bearing center thickness: 1.5 mm (0.06 in)

Mark	Color	Tolerance ranges
F	Pink	-0.005 – -0.002 mm (-0.00020 – -0.00008 in)
E	Yellow	-0.002 – +0.001 mm (-0.00008 – +0.00004 in)
D	Green	+0.001 – +0.004 mm (+0.00004 – +0.00016 in)
C	Brown	+0.004 – +0.007 mm (+0.00016 – +0.00028 in)
B	Black	+0.007 – +0.010 mm (+0.00028 – +0.00039 in)
A	Blue	+0.010 – +0.013 mm (+0.00039 – +0.00051 in)

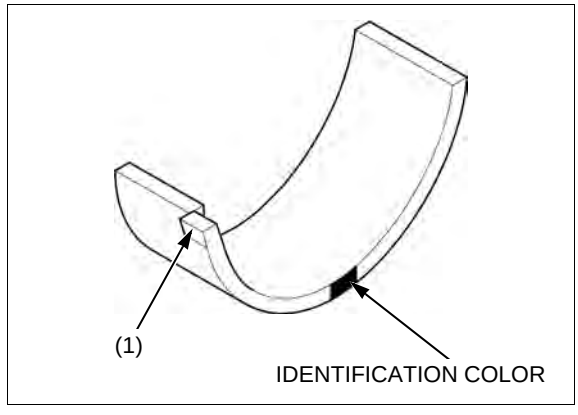
New connecting rod bearings are available in seven sizes, identified by color, in increments of 0.003 mm (0.0001 in).

Note that the bearings are selected so that the oil clearance is in the range between 0.020 – 0.050 mm (0.0008 – 0.0020 in).

Apply molybdenum disulfide oil to the entire surface of the bearings.
Align the bearing lug (1) with the cutout in the connecting rod or cap, and install with care not to damage the sliding surface.

Be sure to measure the oil clearance after installing the selected bearing(s) (page 15-42).

- Be sure to measure the connecting rod bearing oil clearance after selecting the bearing by referring to the selection table.
- If the two bearing I.D. colors are shown on the selection table, use a bearing of the respective colors.



CRANKSHAFT MAIN BEARING

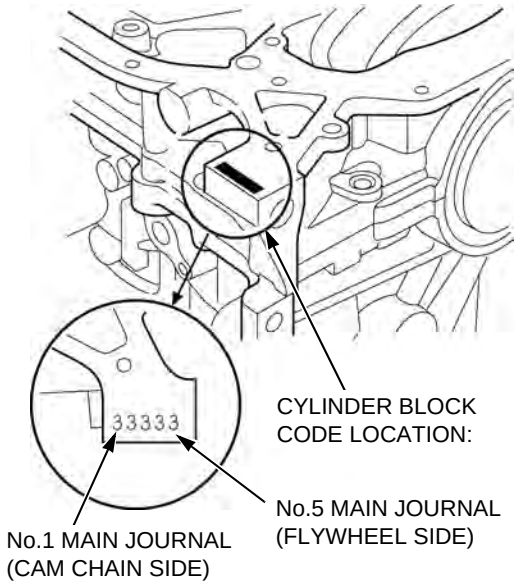
- When replacing the main bearing, check the crankshaft main journal code number and the cylinder block I.D. code letter or number, and select the correct bearing by referring to the bearing selection table.
- If the code letter and/or number is not clear, clean the area with a cleaning solvent and check again. Do not scrub with a stiff wire brush or scraper to clean.

Check the cylinder block I.D. code letters or numbers and record them.

- The cylinder block I.D. code letters or numbers are for the No.1 and the subsequent number journals when viewed from the left side code.

Cylinder block I.D.: 59.00 mm (2.323 in)

Code number	Tolerance ranges
1 or A or I	±0.000 – +0.006 mm (±0.0000 – +0.0002 in)
2 or B or II	+0.006 – +0.012 mm (+0.0002 – +0.0005 in)
3 or C or III	+0.012 – +0.018 mm (+0.0005 – +0.0007 in)
4 or D or IIII	+0.018 – +0.024 mm (+0.0007 – +0.0009 in)



Check the crankshaft main journal code numbers and record them.

- The crankshaft main journal code numbers are for the No.1 and subsequent number journals when viewed from the crankshaft pulley side.

Crankshaft main journal O.D. 55.00 mm (2.165 in)

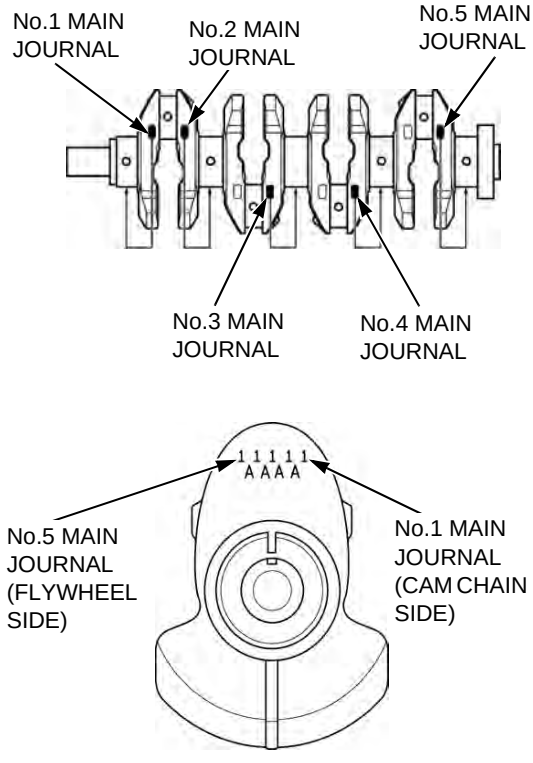
No. 1, 2, 4, 5 crankshaft main journal

Code	Tolerance ranges
1	+0.008 – +0.004 mm (+0.0003 – +0.0002 in)
2	+0.004 – ±0.000 mm (+0.0002 – ±0.0000 in)
3	±0.000 – -0.004 mm (±0.0000 – -0.0002 in)
4	-0.004 – -0.008 mm (-0.0002 – -0.0003 in)
5	-0.008 – -0.012 mm (-0.0003 – -0.0005 in)
6	-0.012 – -0.016 mm (-0.0005 – -0.0006 in)

No. 3 crankshaft main journal

Code	Tolerance ranges
1	±0.000 – -0.004 mm (±0.0000 – -0.0002 in)
2	-0.004 – -0.008 mm (-0.0002 – -0.0003 in)
3	-0.008 – -0.012 mm (-0.0003 – -0.0005 in)
4	-0.012 – -0.016 mm (-0.0005 – -0.0006 in)
5	-0.016 – -0.020 mm (0.0006 – 0.0008 in)
6	-0.020 – -0.024 mm (0.0008 – 0.0009 in)

CRANKSHAFT MAIN JOURNAL CODE LOCATION:



Select the correct bearing by referring to the cylinder block I.D. code letter or number and the crankshaft main journal code number.

Crankshaft main bearing selection table

Crankshaft main journal code number	Cylinder block I.D. code number or letter			
	1 or A or I	2 or B or II	3 or C or III	4 or D or IIII
	Bearing I.D. color			
1	Pink	Pink/Yellow	Yellow	Green
2	Pink/Yellow	Yellow	Green	Green/Brown
3	Yellow	Green	Green/Brown	Brown
4	Green	Green/Brown	Brown	Black
5	Green/Brown	Brown	Black	Black/Blue
6	Brown	Black	Black/Blue	Blue

IDENTIFICATION TABLE
Main bearing center thickness: 2.0 mm (0.079 in)

Code	Color	Tolerance ranges
F	Pink	-0.006 – -0.003 mm (-0.0002 – -0.0001 in)
E	Yellow	-0.003 – ±0.000 mm (-0.0001 – ±0.0000 in)
D	Green	±0.000 – +0.003 mm (±0.0000 – +0.001 in)
C	Brown	+0.003 – +0.006 mm (+0.001 – +0.002 in)
B	Black	+0.006 – +0.009 mm (+0.002 – +0.004 in)
A	Blue	+0.009 – +0.012 mm (+0.004 – +0.005 in)

New main bearings are available in six sizes, identified by color, in increments of 0.003 mm (0.0001 in).

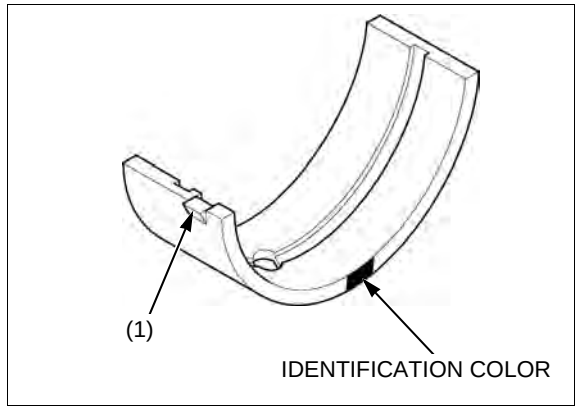
Note that the bearings are selected so that the No. 1, 2, 4, 5 journal oil clearance is in the range between 0.017 – 0.041 mm (0.0007 – 0.0016 in) and that the No. 3 journal oil clearance is in the range between 0.025 – 0.049 mm (0.0010 – 0.0019 in).

Apply molybdenum disulfide oil to the crankshaft mating surface. Do not apply to the cylinder block and lower block mating surface.

Align the bearing lug (1) with the grooves in the lower block and cylinder block, and assemble carefully not to damage the sliding surface.

After installing the selected bearing(s), measure the oil clearance (page 15-41).

- Be sure to measure the connecting rod bearing oil clearance after selecting the bearing by referring to the selection table.
- If the two bearing I.D. colors are shown on the selection table, use a bearing of the respective colors.



16. GEAR CASE (STANDARD ROTATION)

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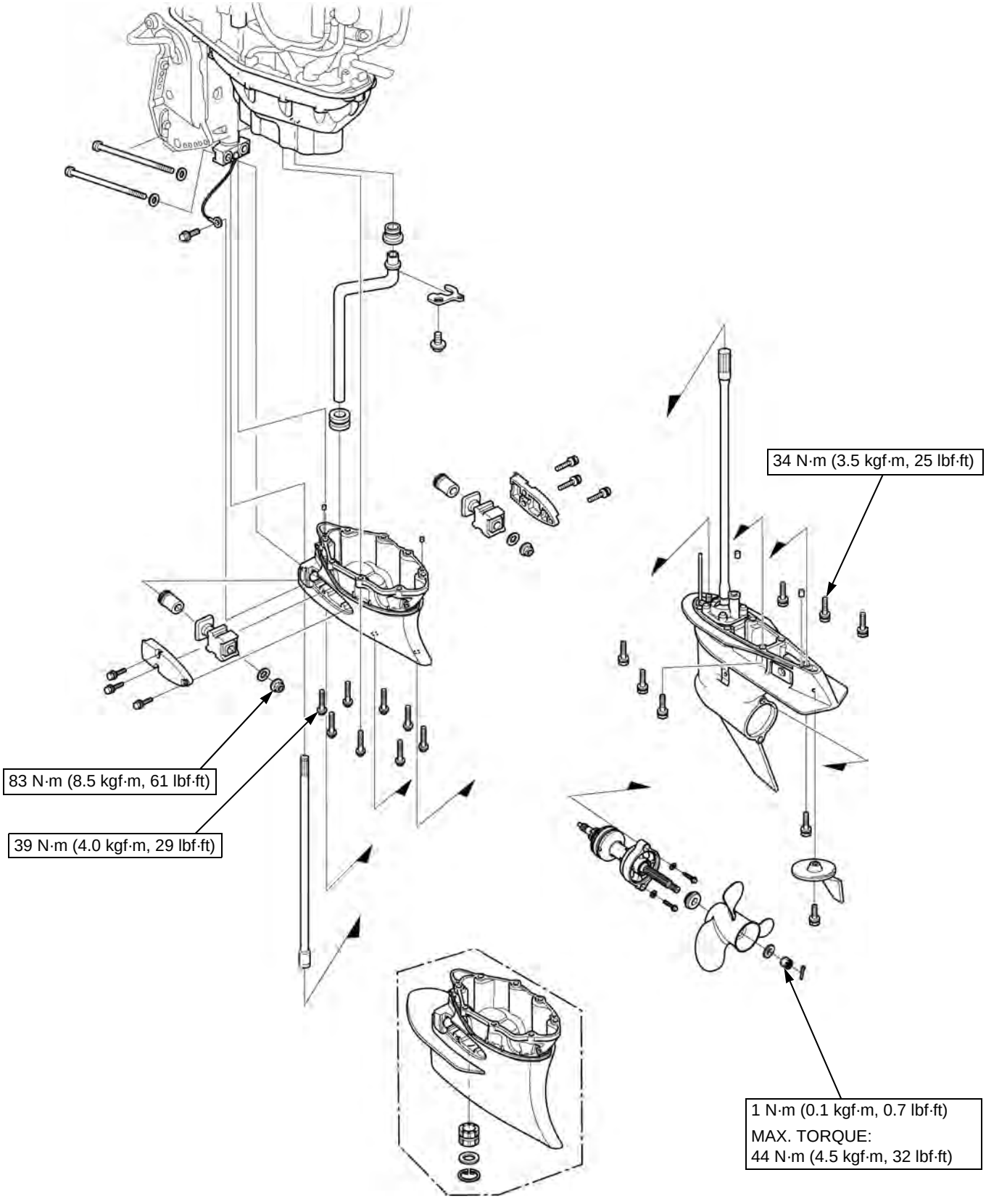
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INSPECTION ····· 16-50

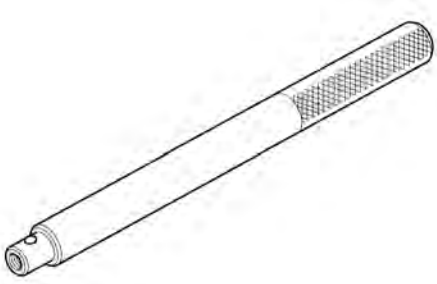
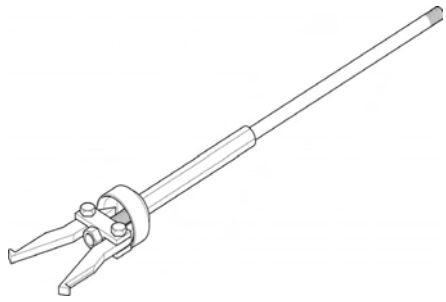
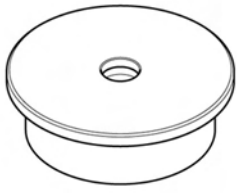
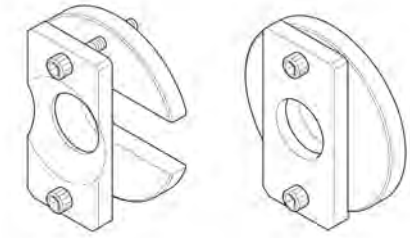
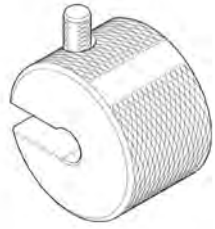
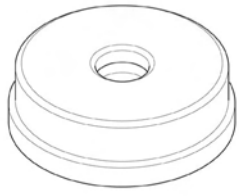
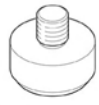
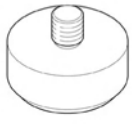
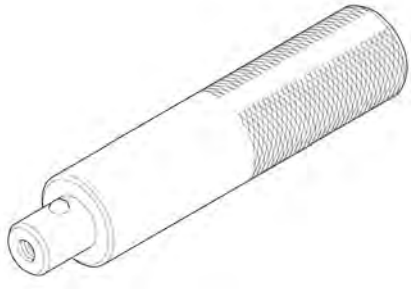
GEAR CASE BEARING
REPLACEMENT ····· 16-50

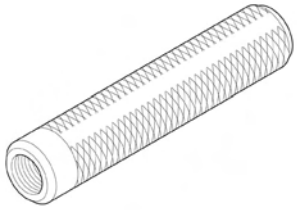
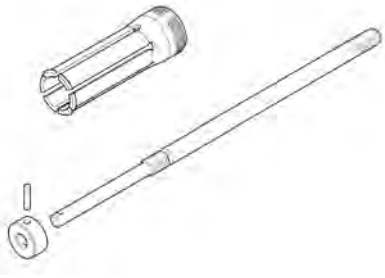
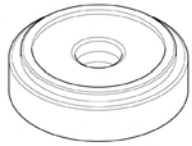
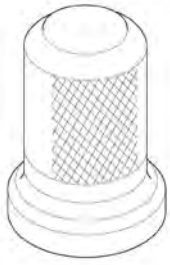
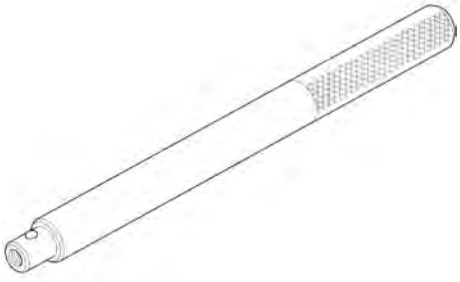
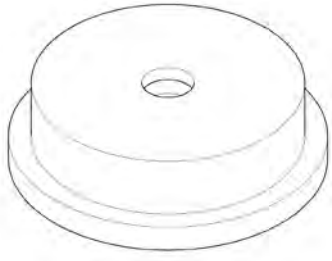
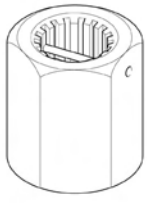
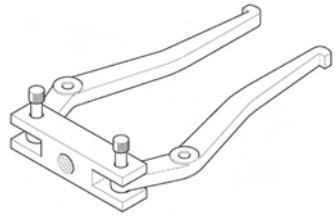
COMPONENT LOCATION

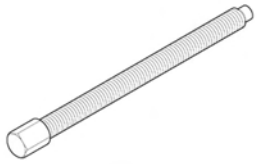
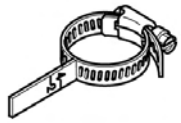
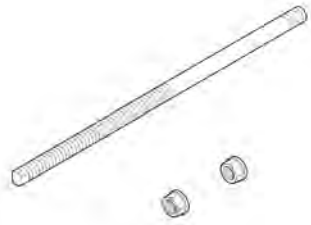
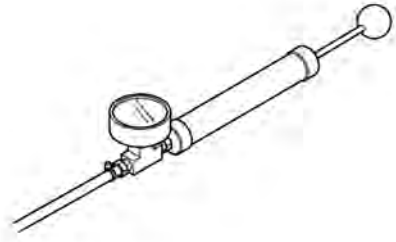
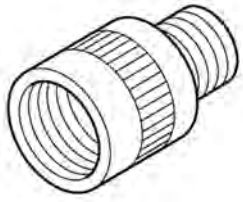


TOOLS

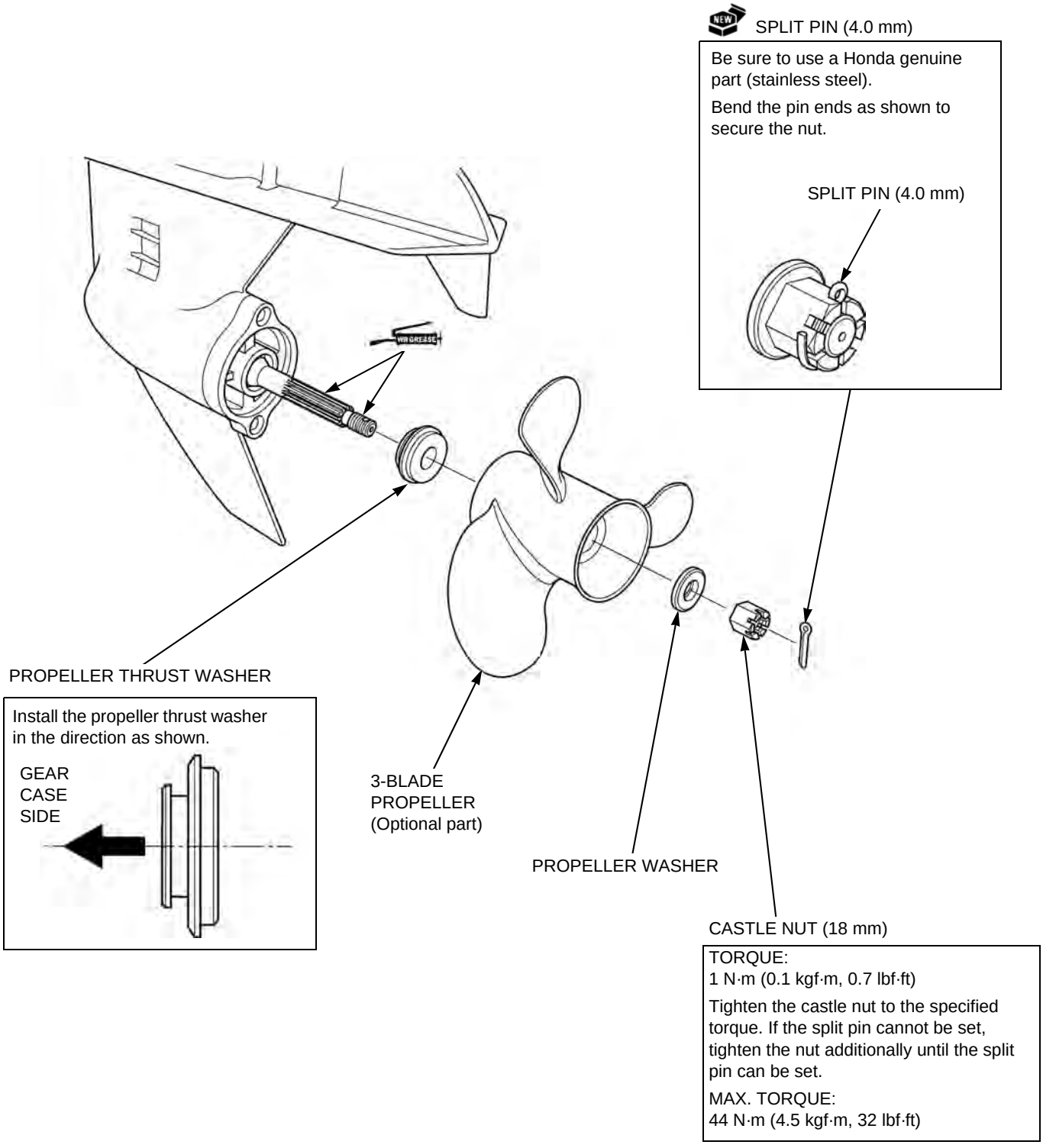
LIST

Driver, 480 mm 070GD-0010100 	Bearing race puller 070PC-ZY30100 	Attachment, 30 x 37 mm 070PD-ZY60200 
Taper bearing installer attachment 070PF-ZY60100 	Gauge adapter, 100 mm 070PJ-ZY30100 	Remover weight 07741-0010201 
Attachment, 42 x 47 mm 07746-0010300 	Attachment, 62 x 68 mm 07746-0010500 	Pilot, 25 mm 07746-0040600 
Pilot, 35 mm 07746-0040800 	Driver 07749-0010000 	Lock nut wrench 36 x 47.8 mm 07916-MB00002 

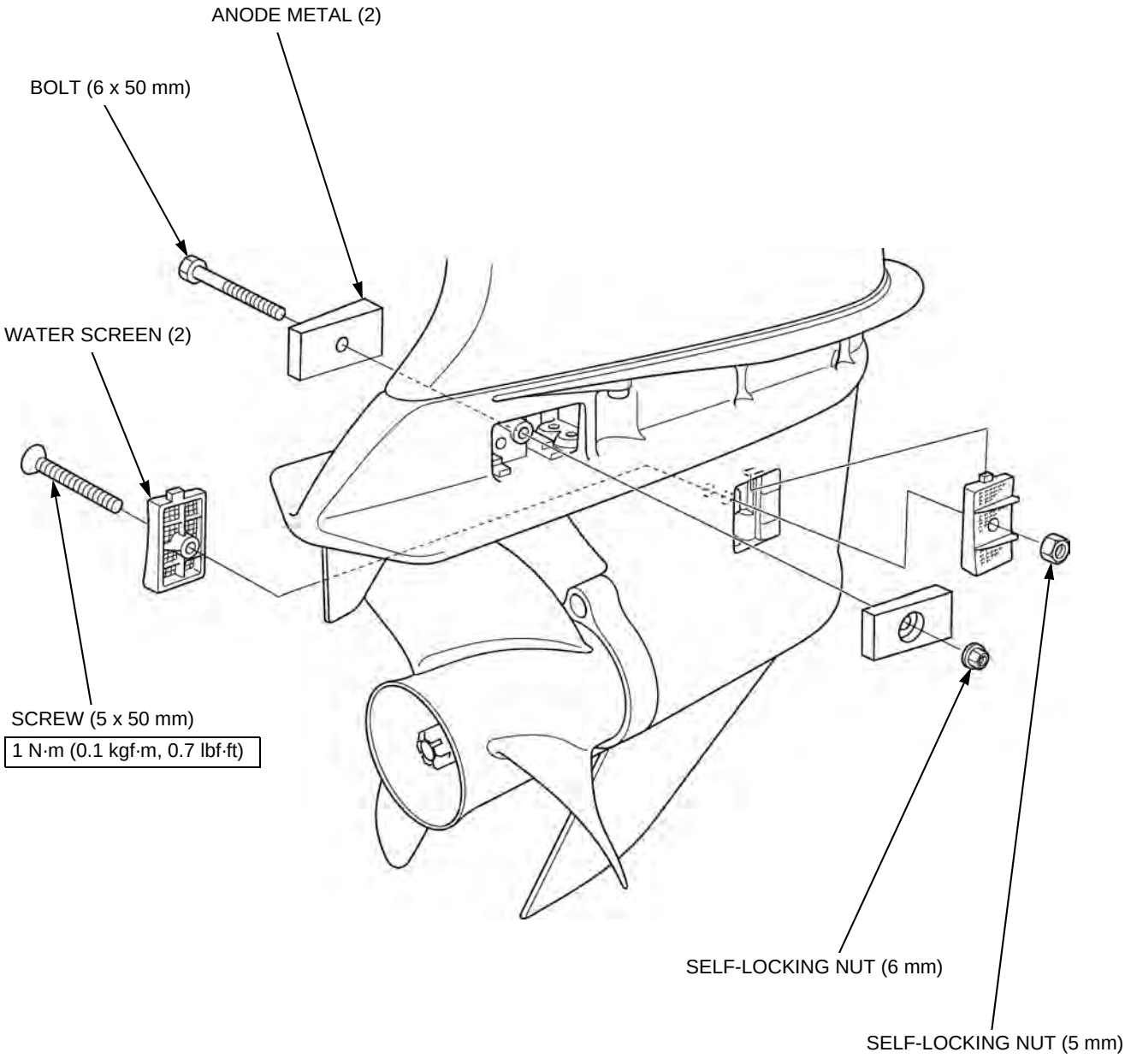
Remover handle 07936-3710100 	Bearing remover, 30 mm 07936-8890300 	Bearing driver attachment, 44 x 49.5 mm 07945-3330300 
Oil seal driver, 44.5 mm 07947-SB00100 	Oil seal driver attachment, 21 mm 07947-ZV00100 	Oil seal driver attachment, 27.5 x 44 mm 07948-9540000 
Driver, 280 mm 07949-3710001 	Driver shaft, B 07964-MB00200 	Attachment, 78 x 90 mm 07GAD-SD40101 
Attachment, 52 x 55 mm 07NAD-P200100 	Vertical shaft holder 07SPB-ZW10200 	Puller jaws 07SPC-ZW0010Z 

Puller bolt 07SPC-ZW0011Z 	Backlash indicator tool 07SPJ-ZW0030Z 	Installer shaft, 15 x 370 mm 07VMF-KZ30200 
Backlash indicator attachment 07WPK-ZW50100 	Bearing remover attachment, 37 mm 07ZMD-MBW0200 	Pressure tester S-34 07APJ-001A100 
Adapter 07APJ-001A300 		

PROPELLER REMOVAL/ INSTALLATION



ANODE METAL/WATER SCREEN REMOVAL/INSTALLATION



GEAR CASE REMOVAL/INSTALLATION

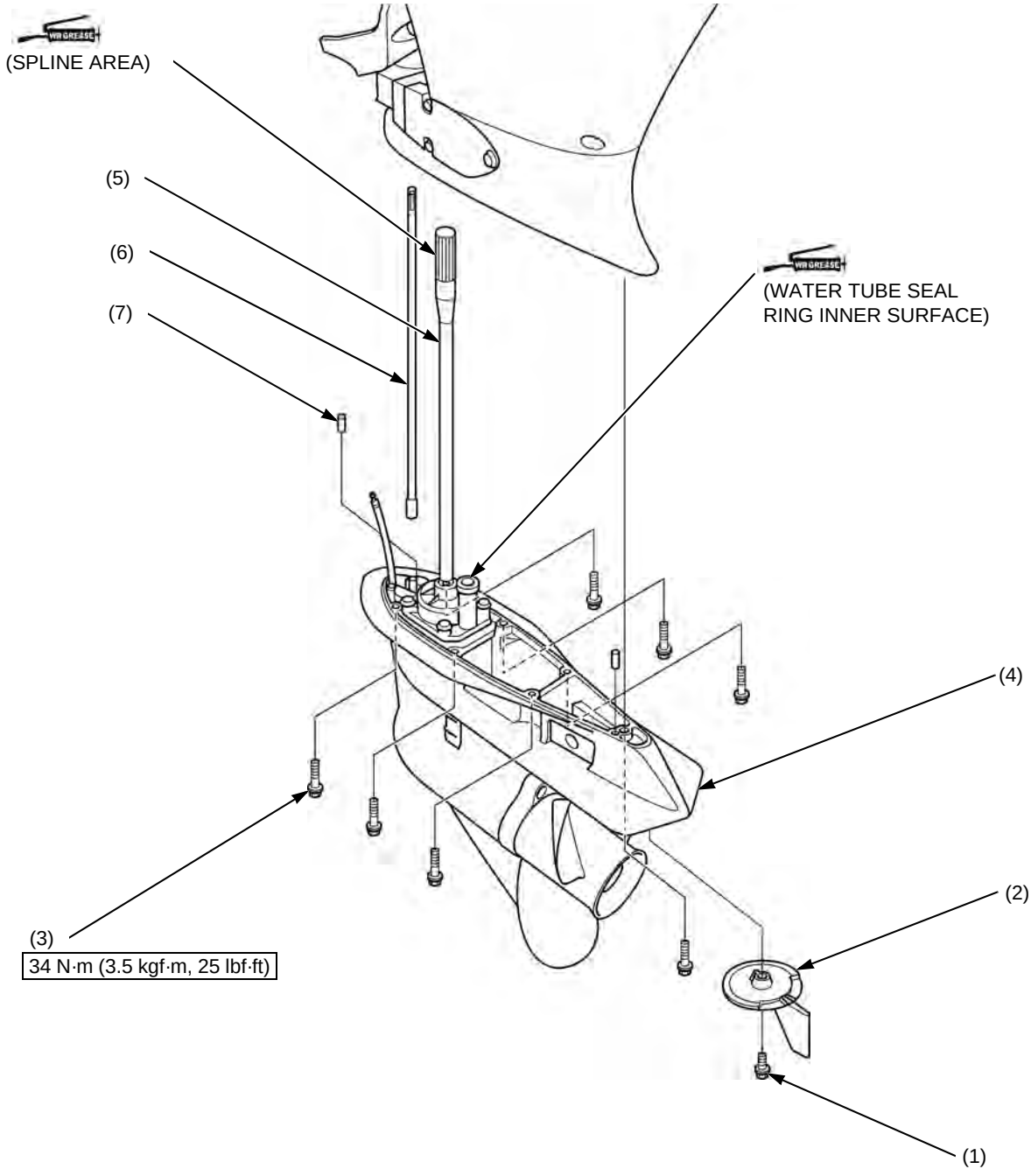
REMOVAL

Set the remote control lever in the "N" (Neutral) position.
Tilt up the motor to the uppermost position.

Remove the bolt (10 × 32 mm) (1) and trim tab (2).
Remove the seven bolts (10 × 40 mm) (3) while supporting the gear case (4).

Remove the gear case with care not to damage the vertical shaft (5).
Remove the shift rod A (6) and two dowel pins (7).

After removing the gear case, tilt down the motor to the lowermost position.

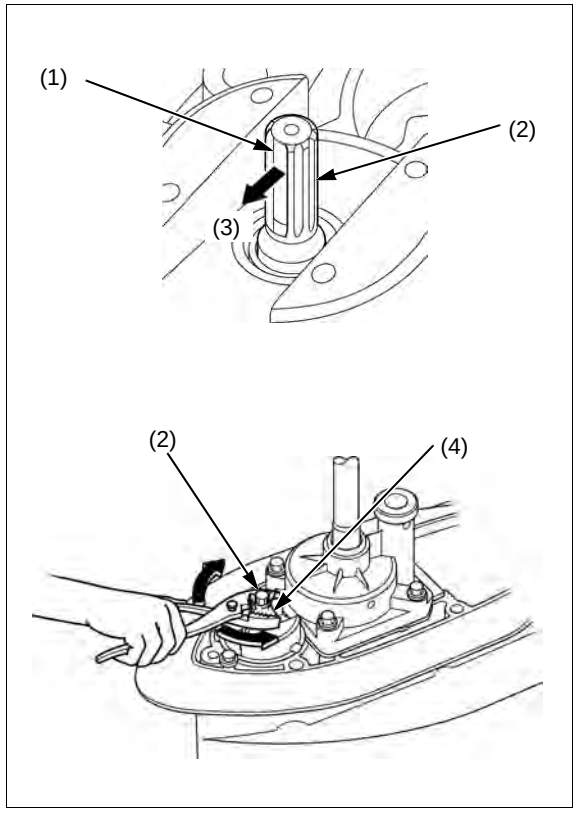


INSTALLATION

Set the remote control lever in the "N" (Neutral) position.

Check that the cutout (1) of the shift rod (2) spline faces the cruising direction (3) (this position is "N" (Neutral)).

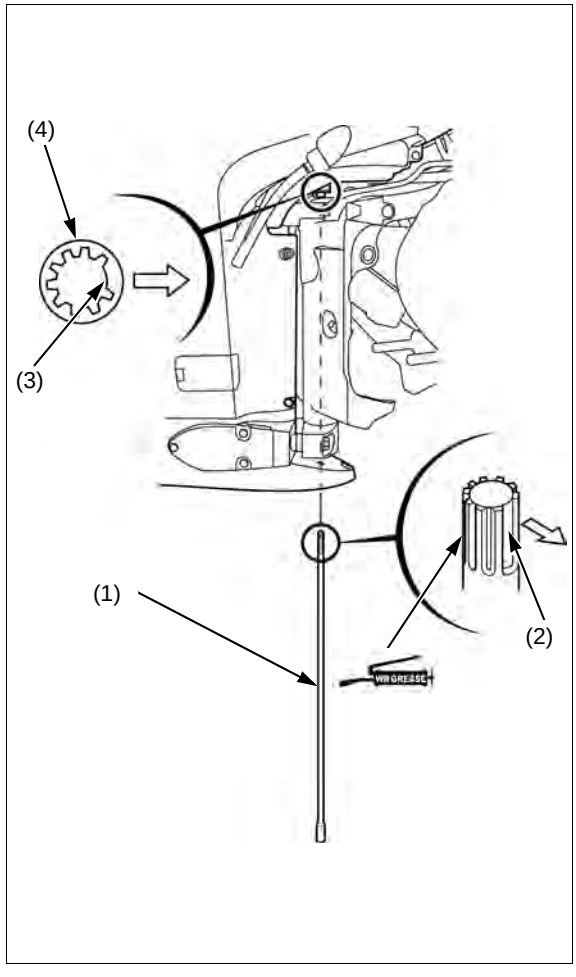
If the cutout of the spline is not in the cruising direction, protect the spline with a shop towel (4) and turn the shift rod right or left with a wrench until the cutout faces toward the cruising direction.



Tilt up the motor to the uppermost position.

Apply marine grease to the spline area of the shift rod A (1).

Install the shift rod A by aligning its spline groove (2) with the spline projection (3) of the shift shaft A (4).



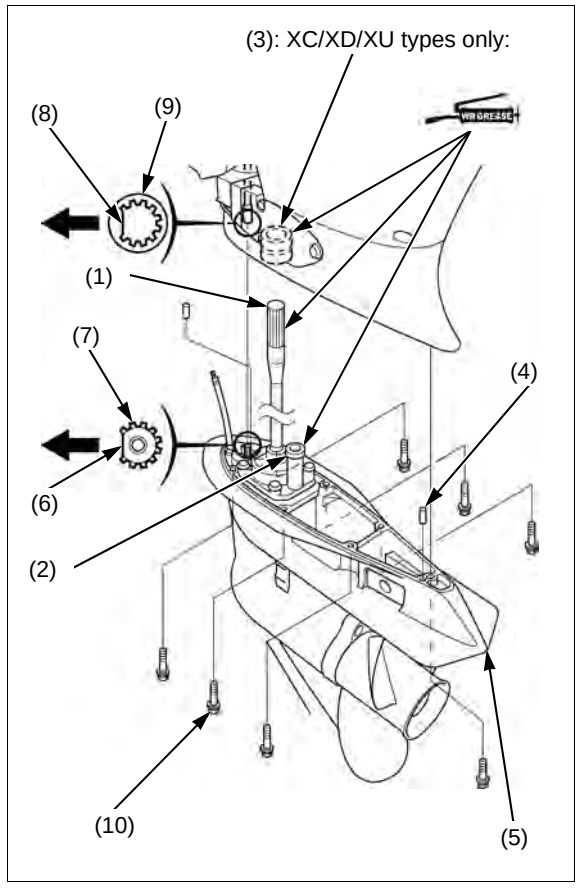
Apply marine grease to the vertical shaft (1) spline area and water tube seal ling (2).

Apply marine grease to the vertical shaft bushing (3) inner surface. (XC, XD and XU types only)

Install the two dowel pins (4) to the gear case (5).

Install the gear case by aligning the spline cutout (6) of the shift rod (7) with the spline projection (8) of the shift rod A (9).
Loosely install the seven bolts (10).
Tilt down the motor to the lowermost position.
Tighten the seven bolts to the specified torque.

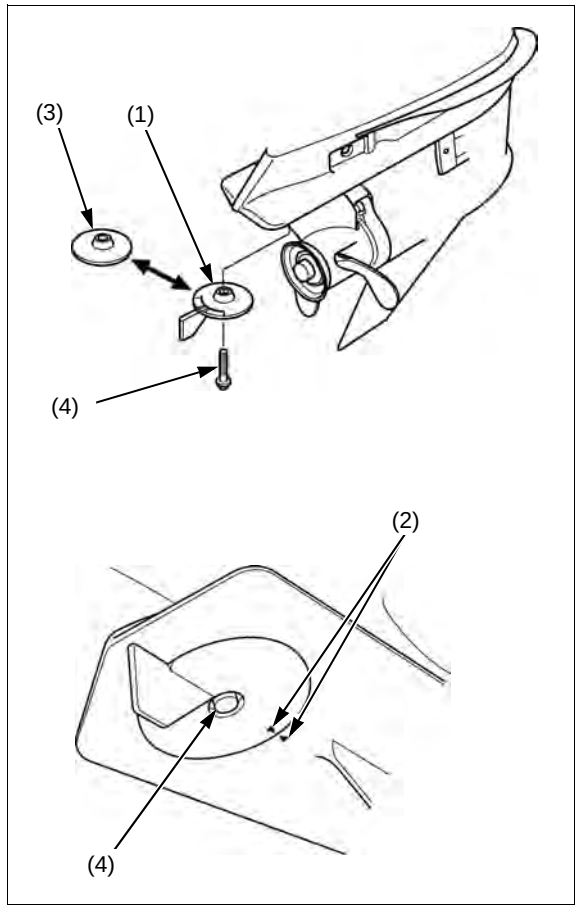
TORQUE: 34 N·m (3.5 kgf·m, 25 lbf·ft)



Install the trim tab (1) by aligning the "△" marks (2). (single motor type)
Install the gear case cover (3). (dual motor type)

Install and tighten the bolt (4).

After installing the gear case, adjust the shift control cable (page 20-16).



VERTICAL SHAFT BUSHING REMOVAL/INSTALLATION (XC, XD and XU type only)

Remove the gear case (page 16-8).

Remove the internal circlip (1), washer (2) and vertical shaft bushing (3).

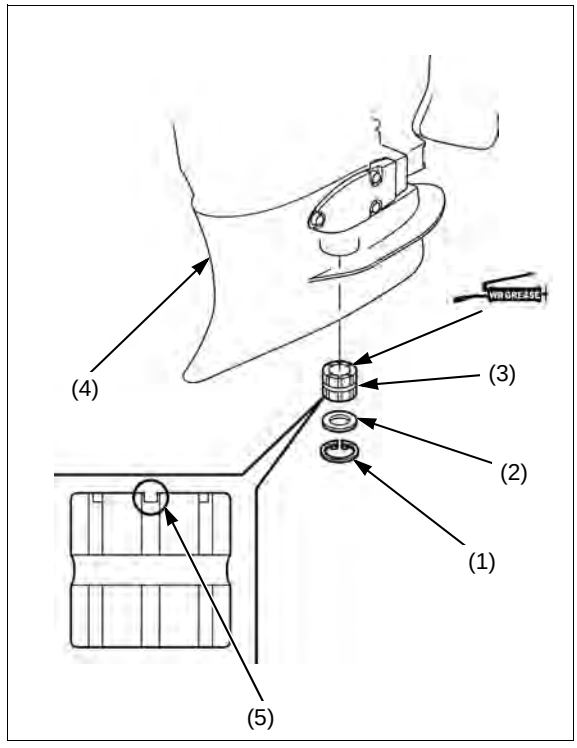
Inspect the vertical shaft bushing (page 16-50) and replace if necessary.

Install the vertical shaft bushing to the extension case (4) with its groove (5) facing up.

Apply marine grease to the vertical shaft bushing inner surface.

Install the washer and internal circlip.

Install the gear case (page 16-9).



EXTENSION CASE REMOVAL/ INSTALLATION

REMOVAL

Remove the following:

– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)
– Gear case (page 16-8)

Remove the three bolts (8 × 30 mm) (1) and lower mount housing (2).

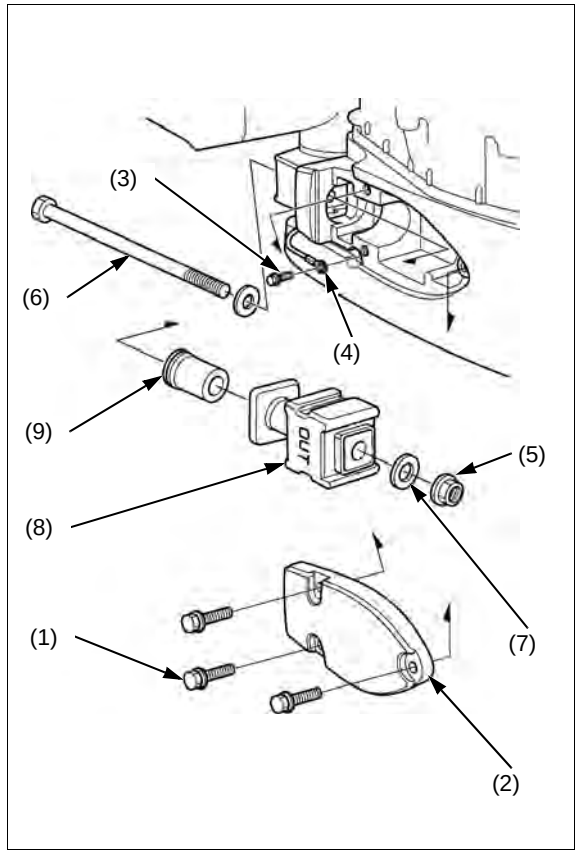
Remove the bolt (6 × 12 mm) (3) and ground terminal (4).

Remove the self-locking nut (5), bolt (12 × 225 mm) (6) and two washers (7).

Slightly move the extension case and remove the lower rubber mount (8) and lower mount collar (9).

Remove the same parts described above from the opposite side of the extension case, except the bolt and ground terminal.

- Support the outboard motor securely in order to prevent the upper mount from being damaged when the lower rubber mount is removed from the extension case, which may cause an excessive load on the upper mount.



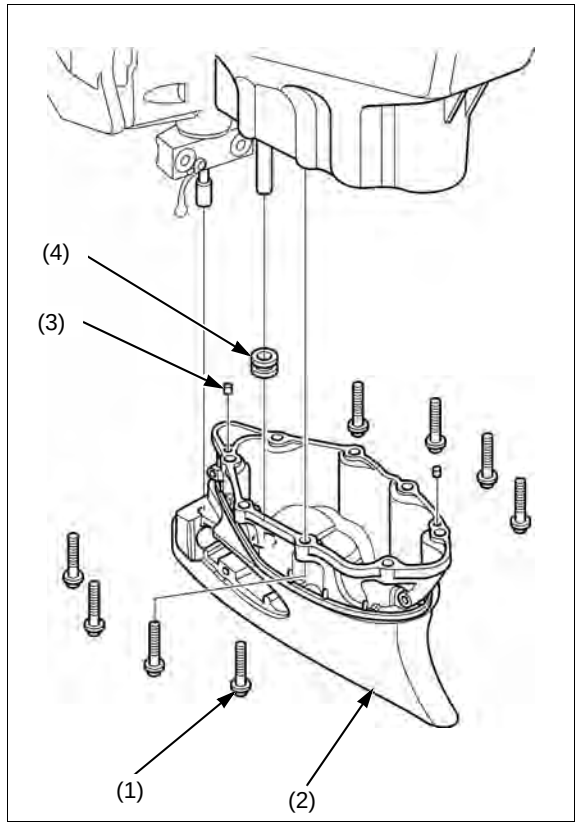
Remove the eight bolts (1) and extension case (2).

NOTICE

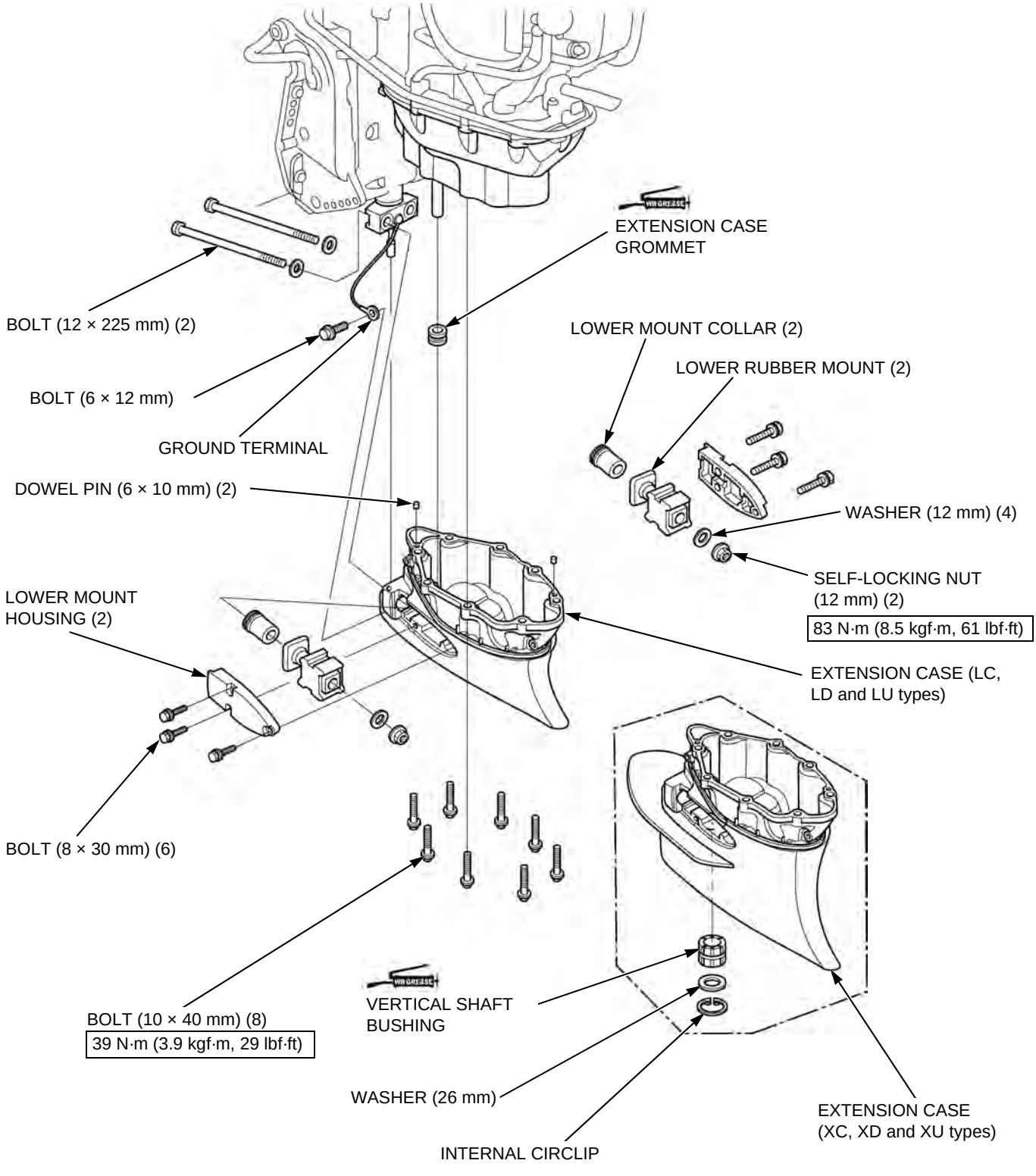
Take care not to drop the extension case.

Remove the two dowel pins (3) from the extension case.

Remove the extension case grommet (4).



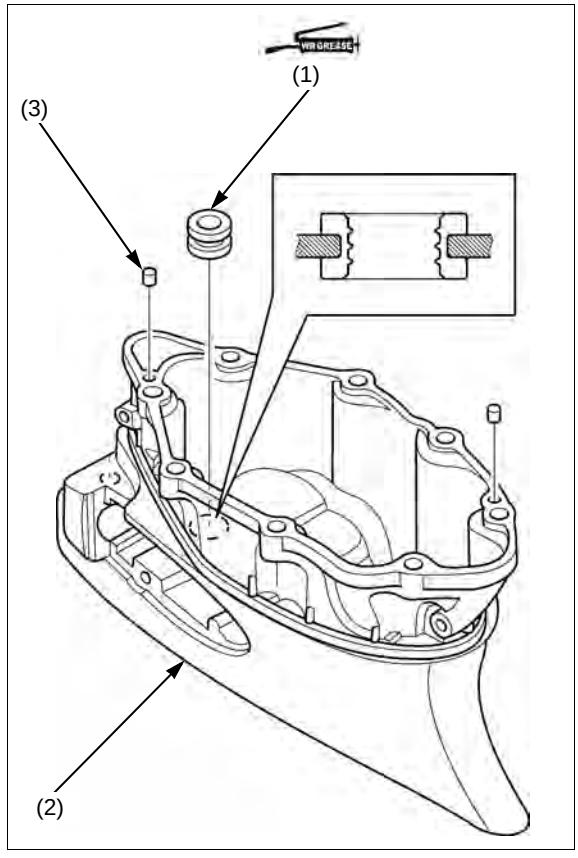
EXPLODED VIEW



INSTALLATION

Apply marine grease to the extension case grommet (1) inner surface and install it to the extension case (2) as shown.

Install the two dowel pins (3) to the extension case.

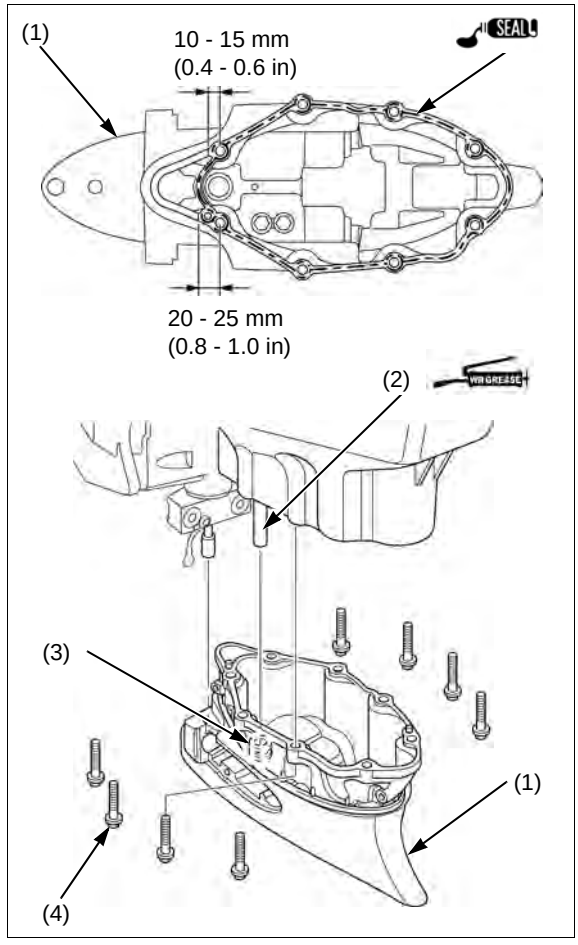


Clean the mating surfaces of the extension case (1) and oil case using a degreasing agent.

Apply liquid sealant (Threebond® 5222B or equivalent) to the specified area of extension case as shown.

Apply marine grease to the tip of the water tube (2).
Install the extension case by aligning the water tube with the extension case grommet (3).
Install and tighten the eight bolts (4) to the specified torque.

TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)



Install the lower rubber mount (1) and lower mount collar (2) while holding the extension case.

- Install the lower mount collar with the smaller diameter side toward the lower rubber mount.
- Install the lower rubber mount with the "OUT" mark toward out.

Install the bolt (12 × 225 mm) (3), two washers (4) and tighten the self-locking nut (5) to the specified torque.

TORQUE: 83 N·m (8.5 kgf·m, 61 lbf·ft)

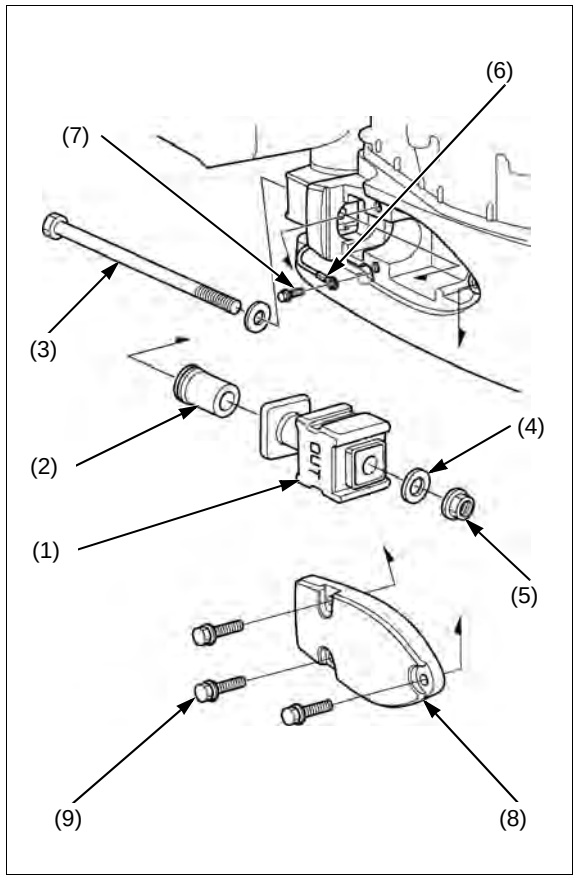
Install the ground terminal (6) and tighten the bolt (6 × 12 mm) (7).

Install the lower mount housing (8) and tighten the three bolts (9).

Install the same parts described above to the opposite side of the extension case, except the bolt and ground terminal.

Install the following:

– Gear case (page 16-9)
– L. engine under cover (page 6-6)
– R. engine under cover (page 6-11)

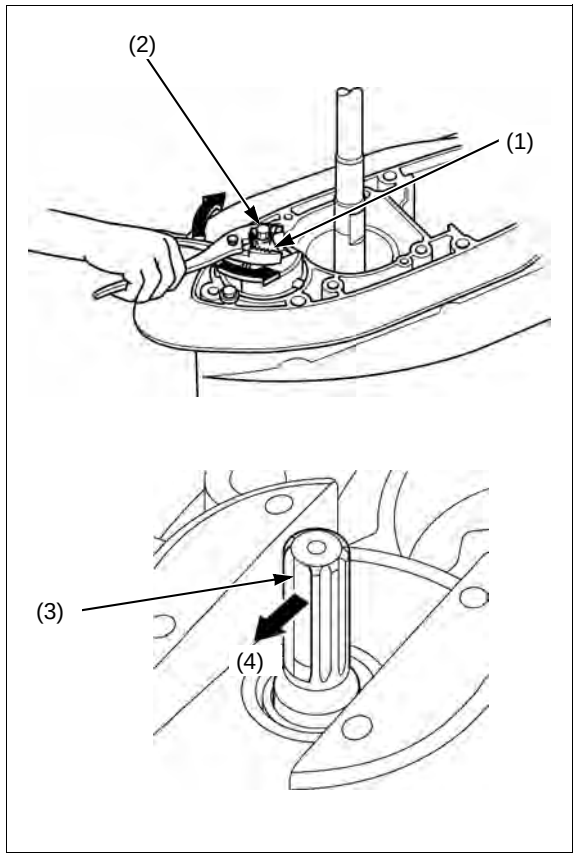


SHIFT ROD REMOVAL/INSTALLATION

REMOVAL

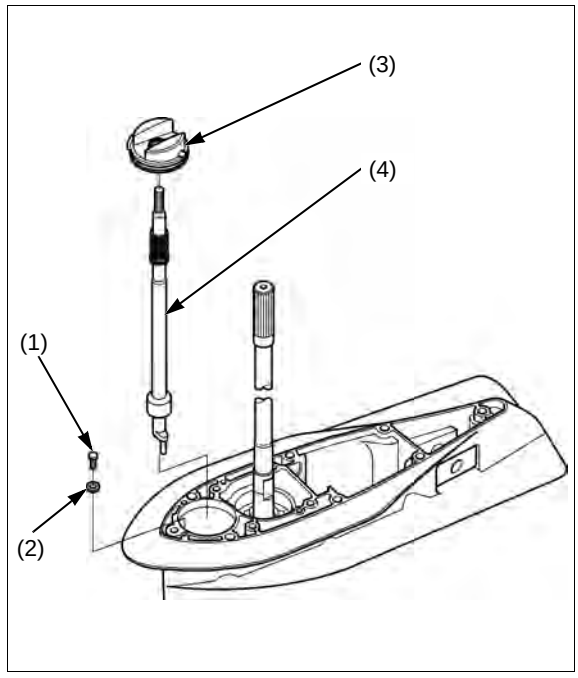
Remove the water pump (page 11-7).

Wrap a shop towel (1) around the shift rod (2) spline, and use pliers to turn the shift rod in the shown direction (cutout (3) of the shift rod spline is facing toward the cruising direction (4)).

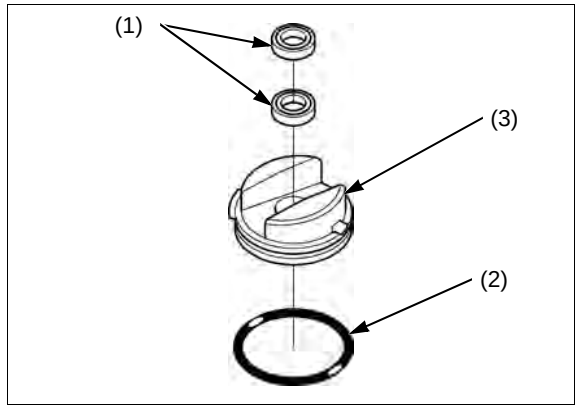


Remove the bolt (1) and washer (2).

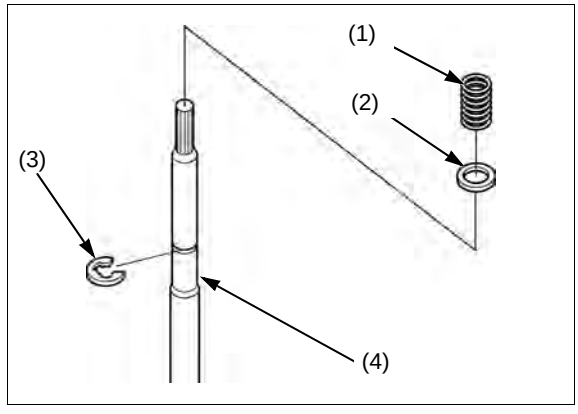
Remove the shift rod holder (3) and shift rod (4).



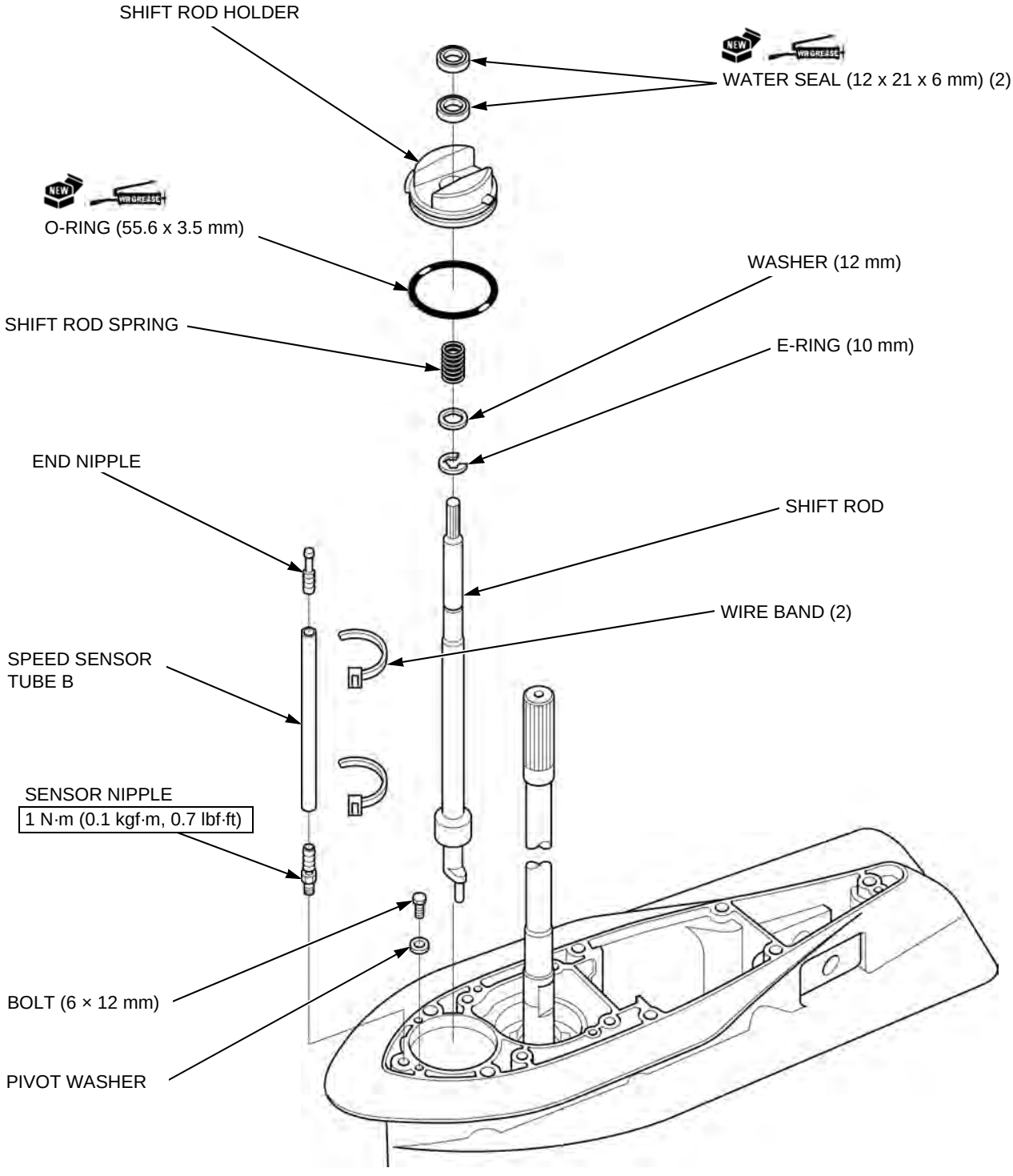
Remove the two water seals (1) and O-ring (2) from the shift rod holder (3).



Remove the shift rod spring (1), washer (2) and E-ring (3) from the shift rod (4).



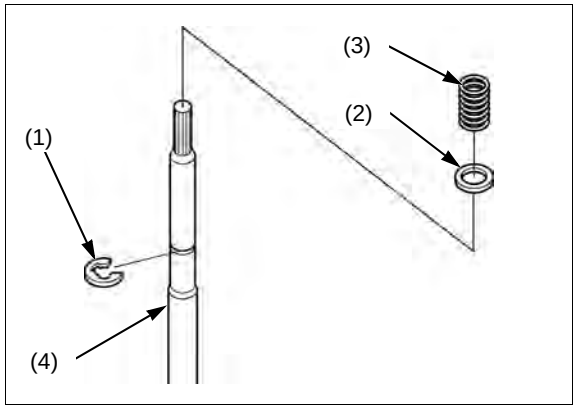
EXPLODED VIEW



INSTALLATION

Install the E-ring (1), washer (2), and shift rod spring (3) onto the shift rod (4).

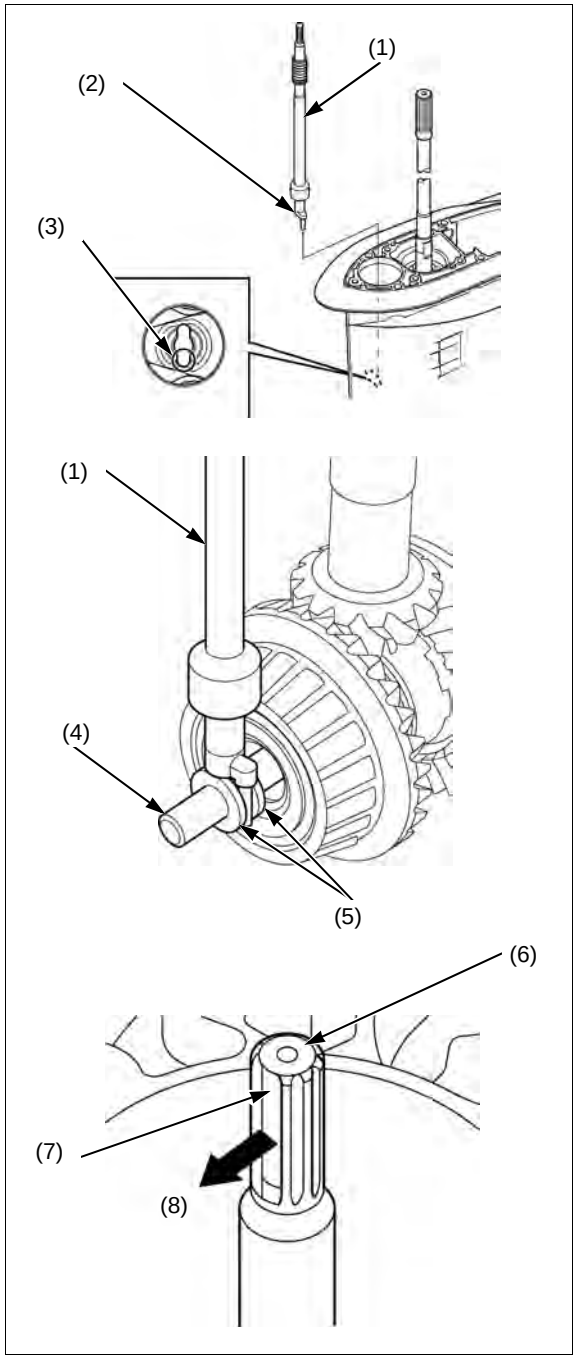
- Do not reuse the E-ring if it is deformed or deteriorated.
- Check that the E-ring is set in the groove in the shift rod securely.



Insert the shift rod (1) into the gear case by aligning the cam (2) of the shift rod with the "A" point (3) of the gear case as shown.
Install the shift rod onto the shift slider (4) by aligning the cam of the shift rod with the groove (5) in the shift slider.

- Check that there is no marking in the shift rod end (6).

After installing the shift rod, position the shift rod in the "N" (Neutral) position and check that the cutout in the spline (7) faces the cruising direction (8).



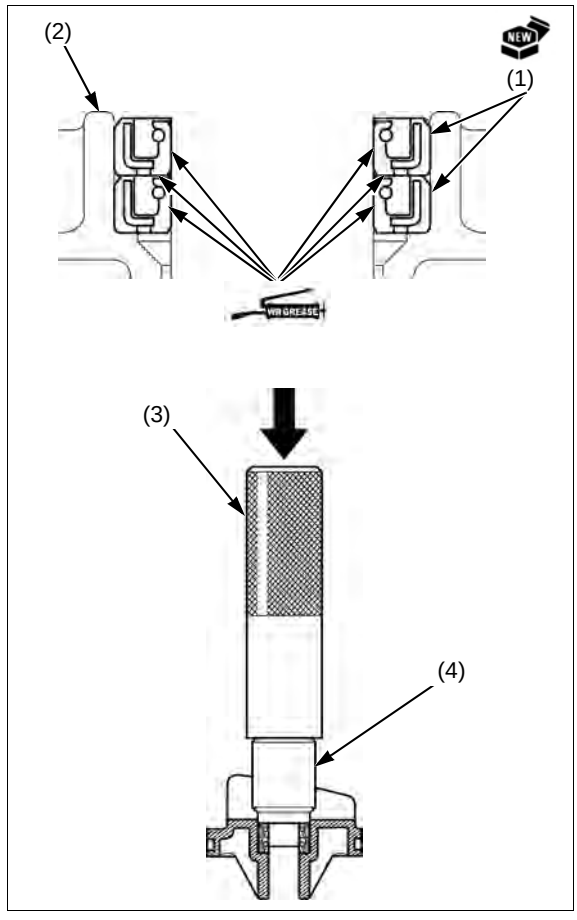
Apply marine grease to the mating surfaces and soapy water to the circumference of the new water seals (1).

Drive the water seals into the shift rod holder (2) using the special tools in the correct direction as shown.

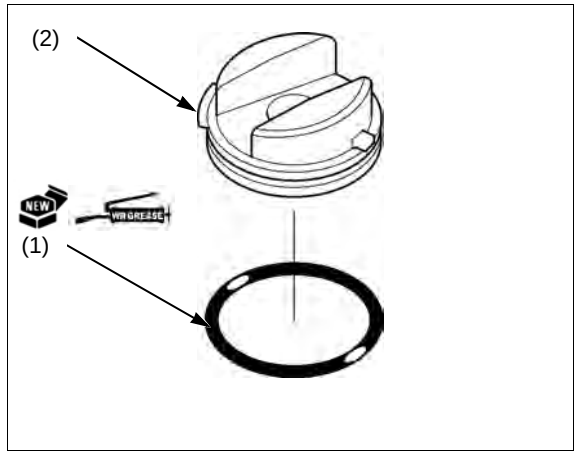
TOOL:

Driver (3)	**07749-0010000**
Oil seal driver attachment, 21 mm (4)	**07947-ZV00100**

After installation, apply marine grease to the water seal lips.



Apply marine grease to a new O-ring (1) and install it to the shift rod holder (2).

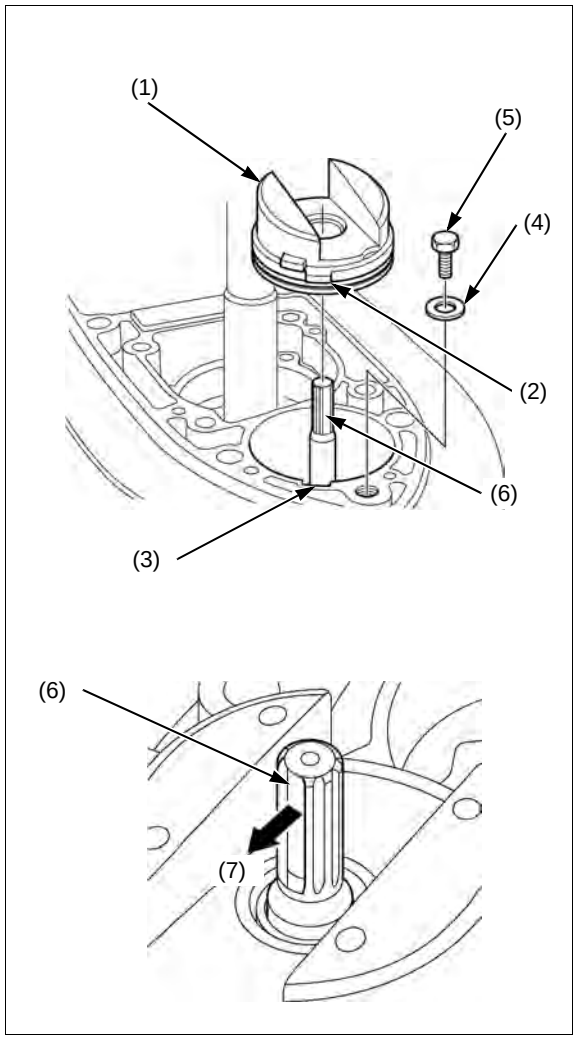


Install the shift rod holder (1) into the gear case by aligning the projection (2) of the shift rod holder with the recess (3) of the gear case.

Install the washer (4) and tighten the bolt (5).

After installation, check that the cutout (6) in the shift rod splines is in the cruising direction (7).

Install the water pump (page 11-10).



PROPELLER SHAFT HOLDER REMOVAL/INSTALLATION

Remove the following:

- Propeller (page 16-6)
- Gear case (page 16-8)
- Shift rod (page 16-15)

Remove the two bolts (1) and two washers (2).
Insert a screwdriver or equivalent tool into the recess (3) in the propeller shaft holder (4) and remove the propeller shaft holder from the gear case (5).

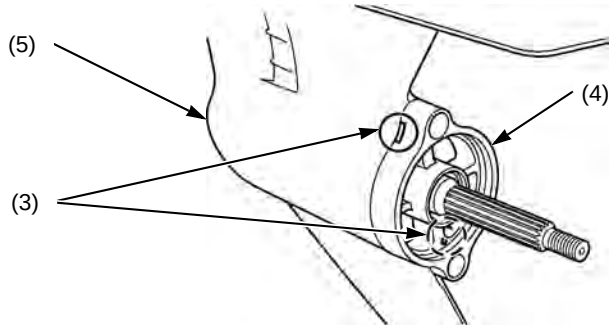
Replace the O-ring (6) with a new one and coat the O-ring with marine grease.

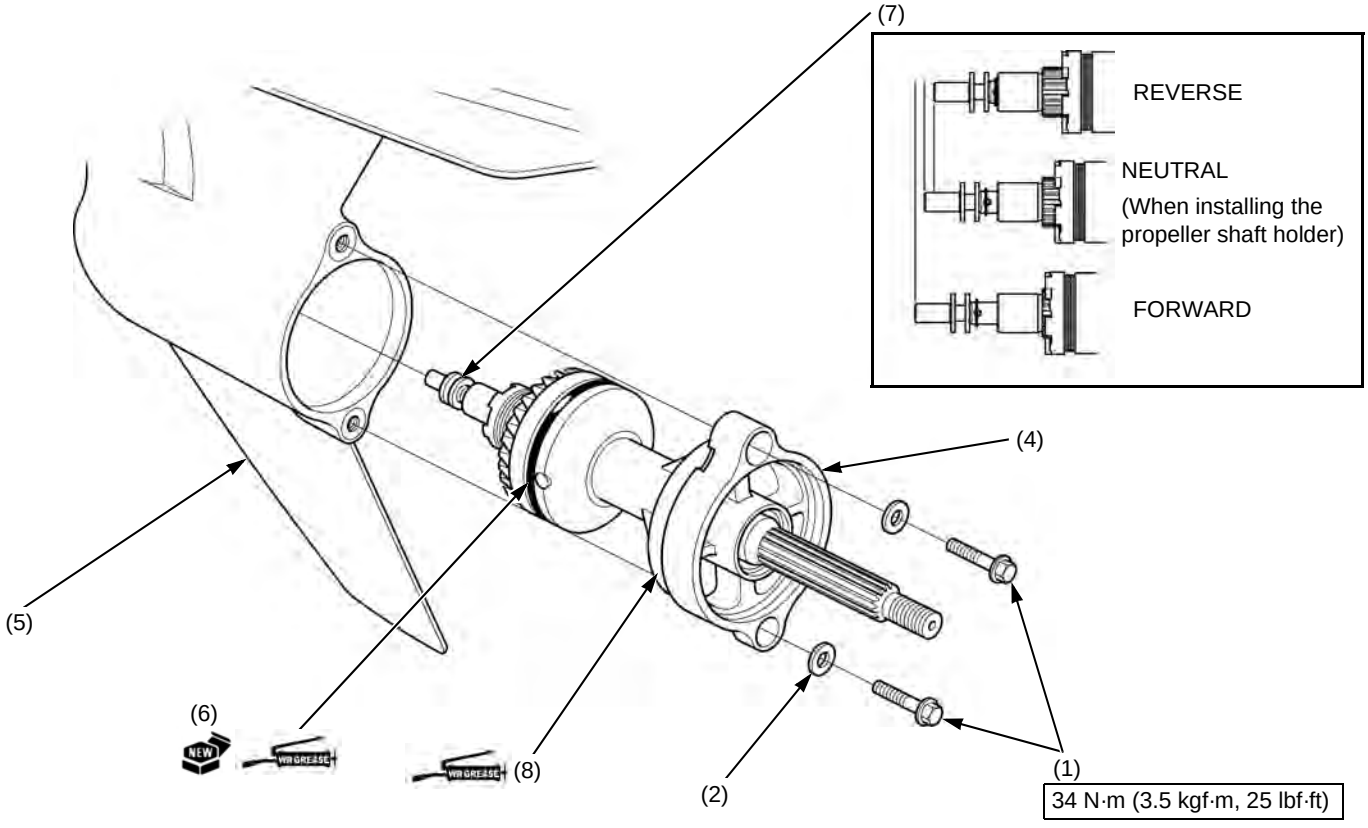
At installation, check that the shift slider (7) of the propeller shaft holder is set in the Neutral position.

Apply marine grease to the gear case insertion area (8) of propeller shaft holder.

Installation is in the reverse order of removal.

Perform the gear case pressure check (page 16-47).



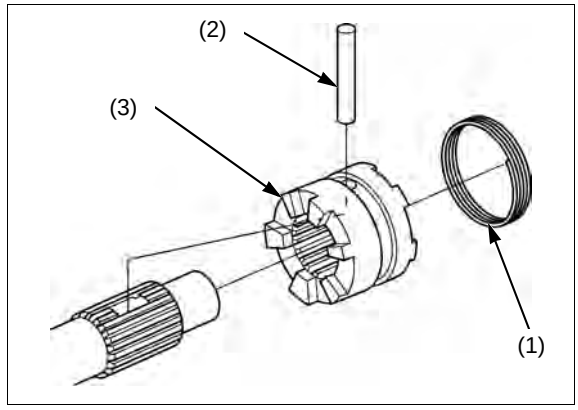


SHIFT SLIDER/BEARING HOLDER/ PROPELLER SHAFT REMOVAL/ INSTALLATION

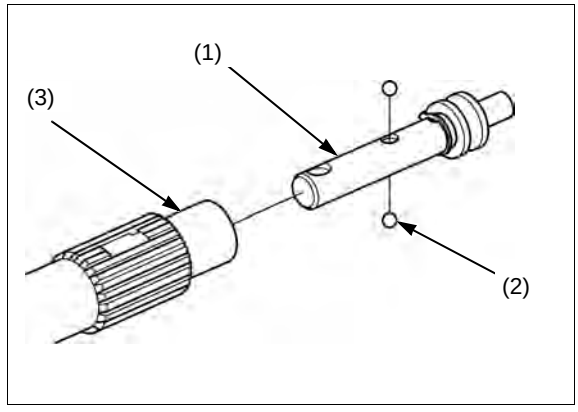
SHIFT SLIDER REMOVAL

Remove the propeller shaft holder (page 16-21).

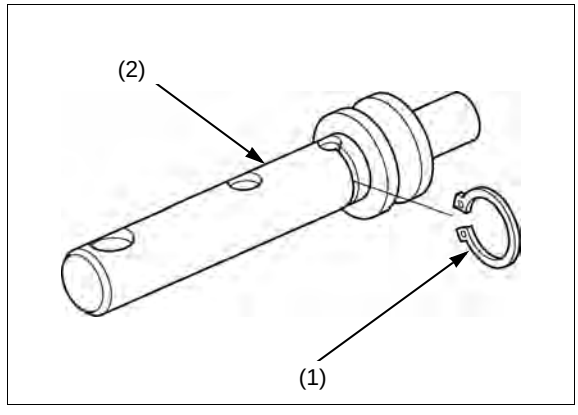
Remove the cross pin ring (1), shifter pin (2) and clutch shifter (3).



Remove the shift slider (1) and two steel balls (#7) (2) from the propeller shaft (3), being careful not to lose the steel balls.

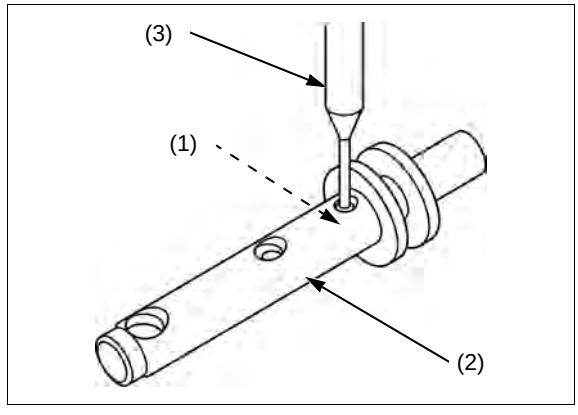


Remove the circlip (1) from the shift slider (2).



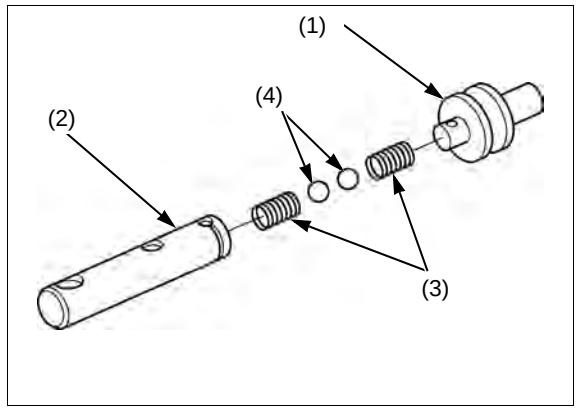
Remove the roller (1) from the shift slider (2) using a commercially available pin driver (3).

- Take care not to let the shift plate, shift springs and steel balls (#9) pop out of the shift slider during removal of the roller.



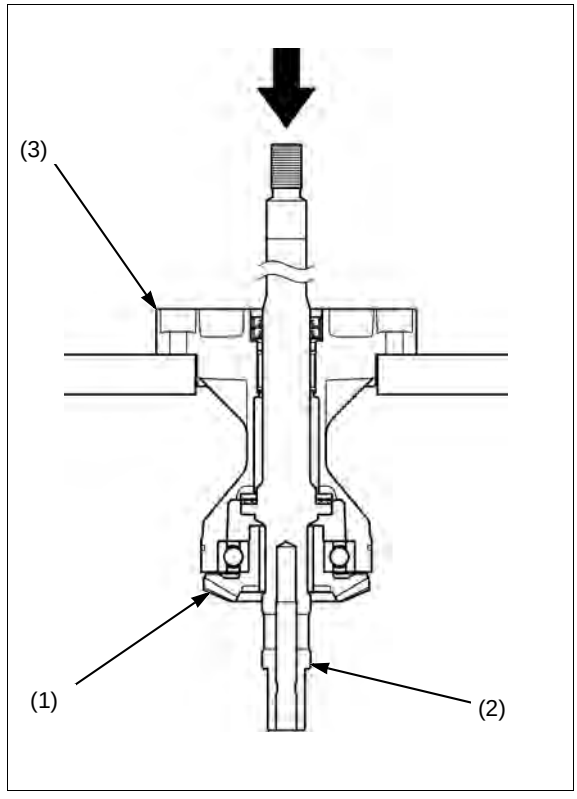
Remove the shift plate (1) from the shift slider (2), then remove the two shift springs (3) and two steel balls (#9) (4).

- Take care not to let the shift springs and steel balls (#9) pop out of the shift slider during removal of the shift plate.



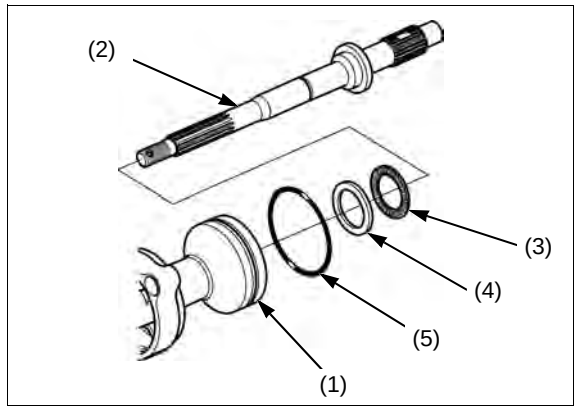
PROPELLER SHAFT REMOVAL

Remove the reverse bevel gear assembly (1) and propeller shaft (2) from the propeller shaft holder (3) using a hydraulic press as shown.

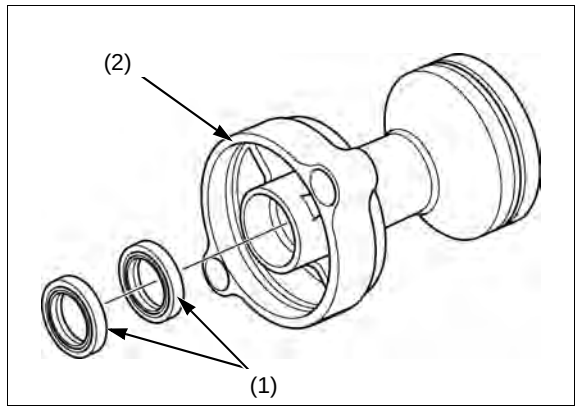


Remove the following parts from the propeller shaft holder (1):

– Propeller shaft (2)
– Thrust bearing (3)
– Thrust bearing washer (4)
– O-ring (5)



Remove the two water seals (1) from the propeller shaft holder (2) using a commercially available oil seal remover.

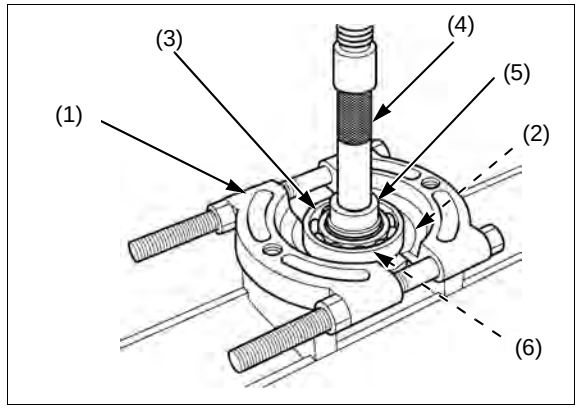


Set a commercially available universal bearing puller (1) between the reverse bevel gear (2) and bearing (3).

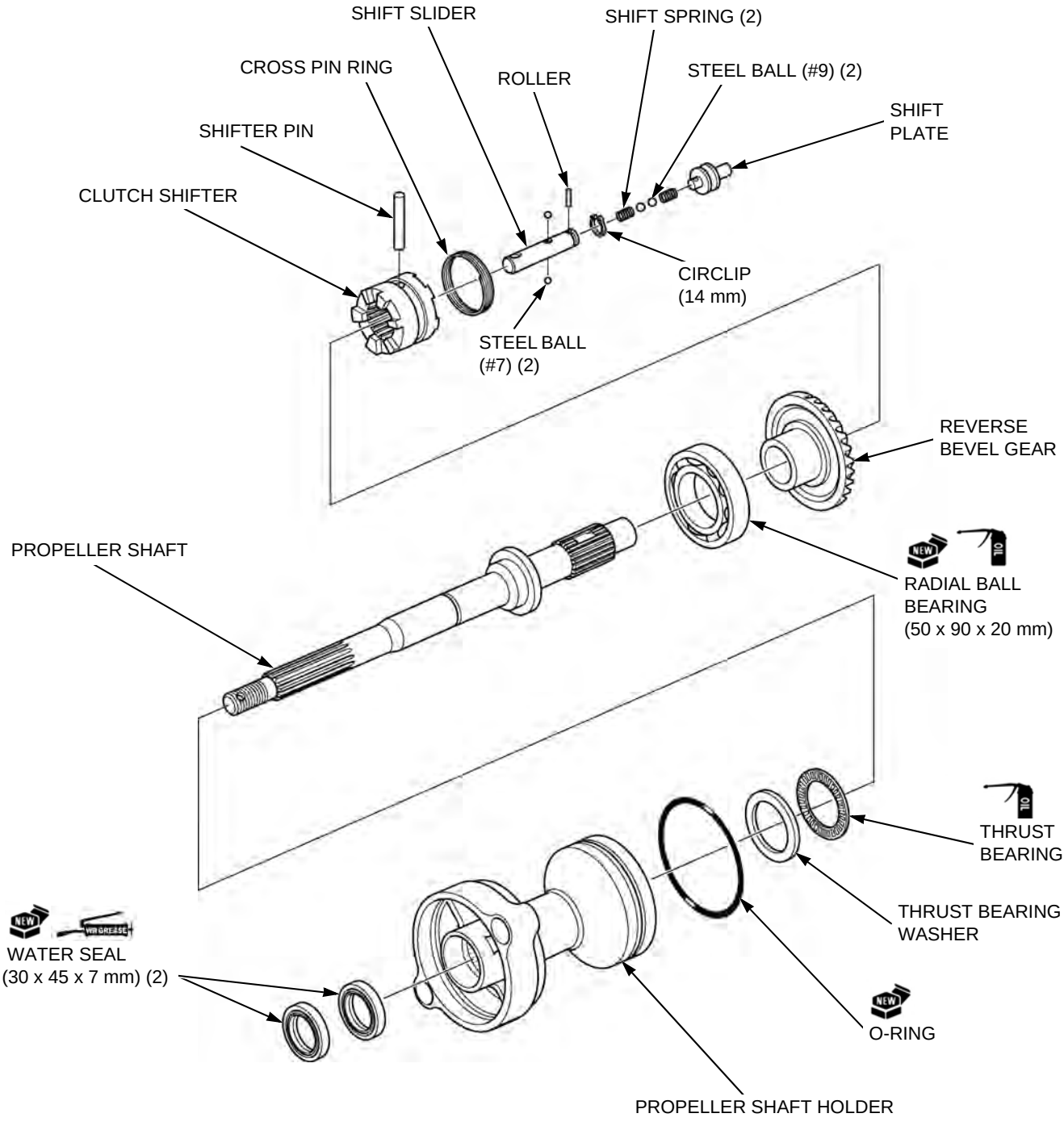
Remove the bearing from the reverse bevel gear using the special tools and hydraulic press.

TOOLS:

Driver (4)	**07749-0010000**
Attachment, 42 × 47 mm (5)	**07746-0010300**
Pilot, 35 mm (6)	**07746-0040800**



EXPLODED VIEW



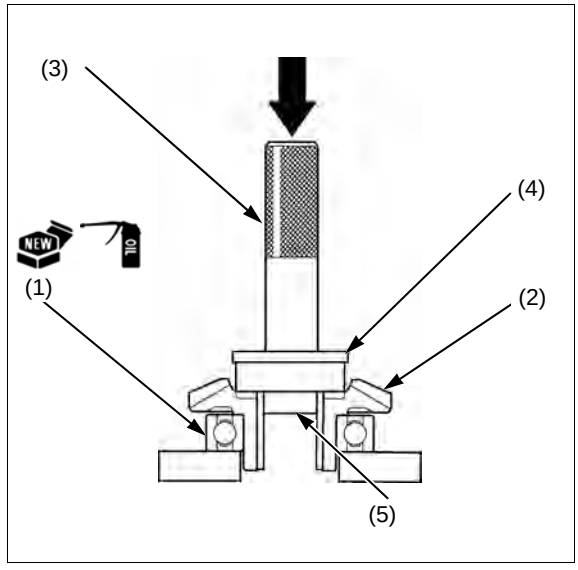
PROPELLER SHAFT INSTALLATION

Apply gear oil to the circumference of a new bearing (1).

Install the bearing to the reverse bevel gear (2) using the special tools and hydraulic press.

TOOLS:

Driver (3)	**07749-0010000**
Attachment, 62 × 68 mm (4)	**07746-0010500**
Pilot, 35 mm (5)	**07746-0040800**



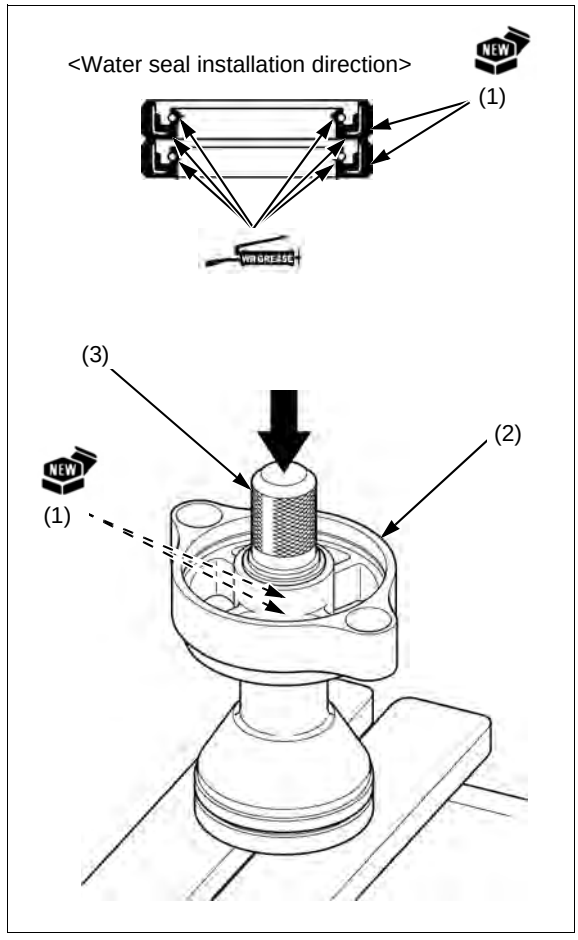
Apply soapy water to the outer circumference and marine grease to the mating surfaces of new water seals (1).

Install the water seals into the propeller shaft holder (2) in the direction as shown, using the special tool.

TOOL:

Oil seal driver, 44.5 mm (3)	**07947-SB00100**

After installation, apply marine grease to the lips of the water seals.



Apply gear oil to the circumference of the thrust bearing (1).

Soak the propeller shaft holder (2) in a container filled with oil with its reverse bevel gear installation side (3) facing down as shown.

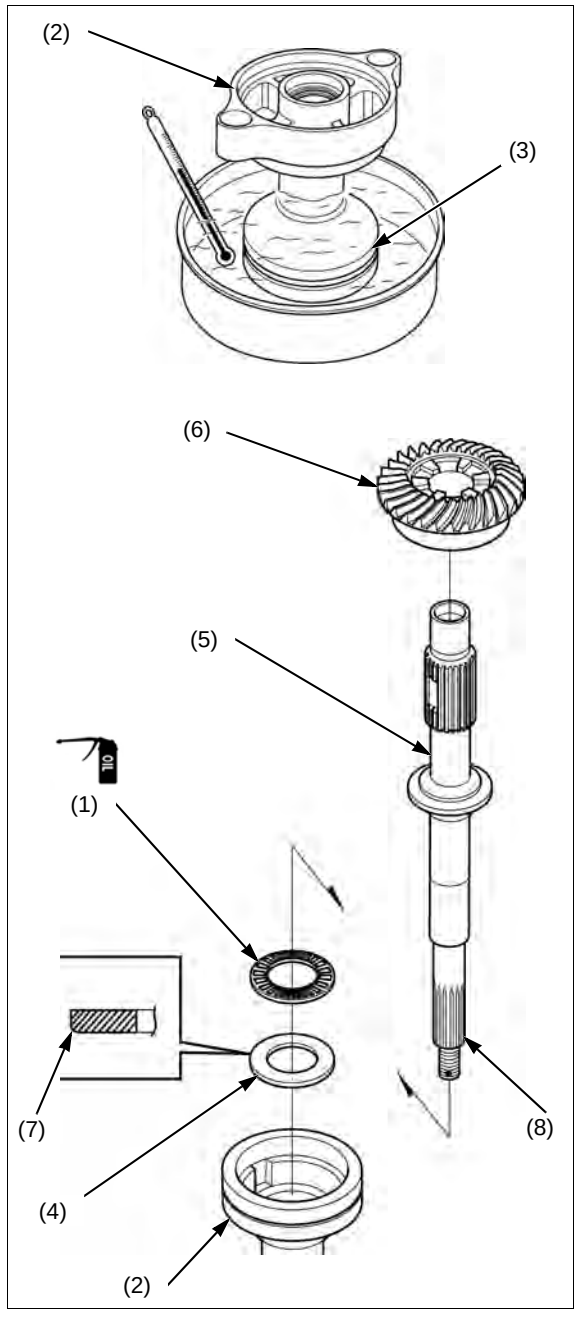
Heat the oil to 80 – 90°C (176 – 194°F).

- Do not heat the oil above 90°C (194°F).
- Be sure to wear gloves during the procedure.

After entire propeller shaft holder becomes hot, remove it out of the container.
Quickly install the thrust bearing washer (4), thrust bearing, propeller shaft (5) and reverse bevel gear assembly (6) to the propeller shaft holder in this order.

- Install the thrust bearing washer with its chamfered side (7) facing the propeller shaft holder.
- Check that there is no groove at the spline (8) of the propeller installation area of the propeller shaft. If there is a groove, this propeller shaft is for counter rotation type.

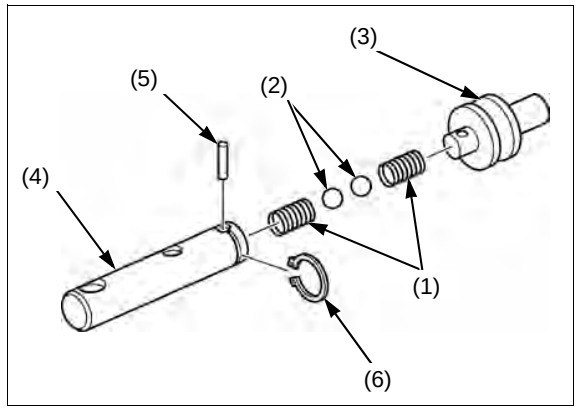
Wait until the propeller shaft holder is adequately cooled down.



SHIFT SLIDER INSTALLATION

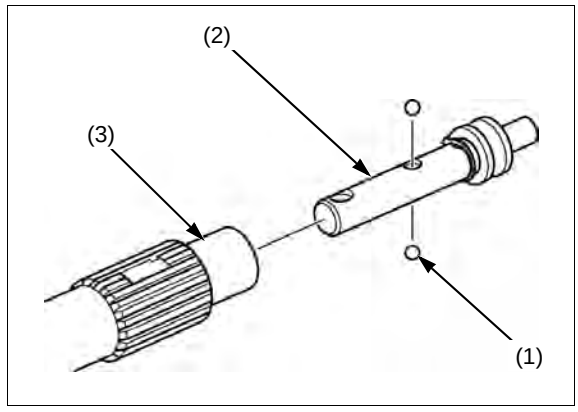
Install a shift spring (1), two steel balls (#9) (2), the other shift spring and shift plate (3) into the shift slider (4) in this order.

Install the roller (5) by aligning the hole in the shift slider with the hole in the shift plate, then install the circlip (6).

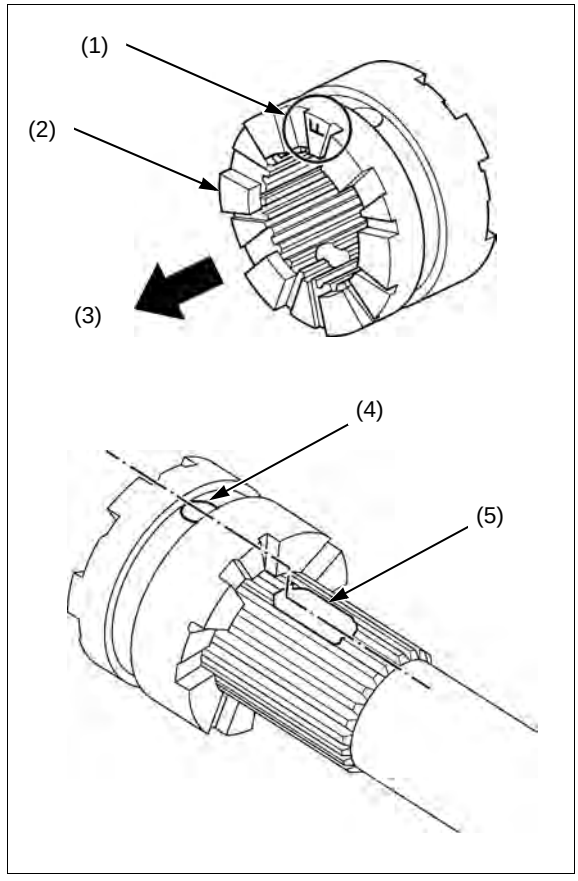


Set the two steel balls (#7) (1) in the steel ball installation holes of the shift slider (2), and push the shift slider slowly into the propeller shaft (3).

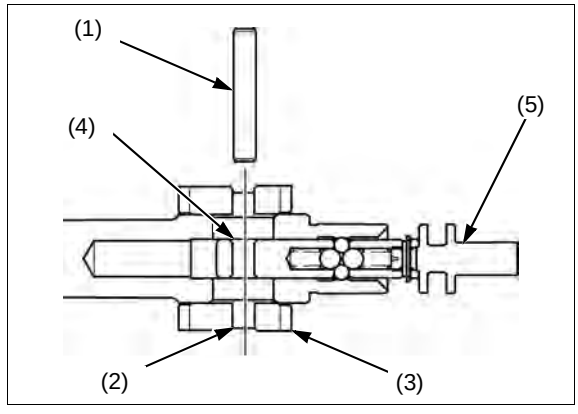
- Push the shift slider into the propeller shaft with care not to allow the steel balls (#7) to pop out.



With the F mark (1) of the clutch shifter (2) toward the forward bevel gear (cruising direction) (3), install the clutch shifter onto the propeller shaft while aligning the shifter pin installation hole (4) with the long hole of the propeller shaft (5).

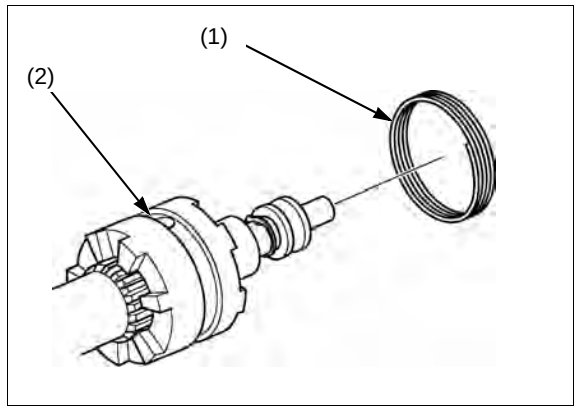


Install the shifter pin (1) while aligning the hole (2) of the clutch shifter (3) with the hole (4) of the shift slider (5).



Install the cross pin ring (1) onto the clutch shifter (2).

- Check that the coils of the cross pin ring do not overlap with each other.

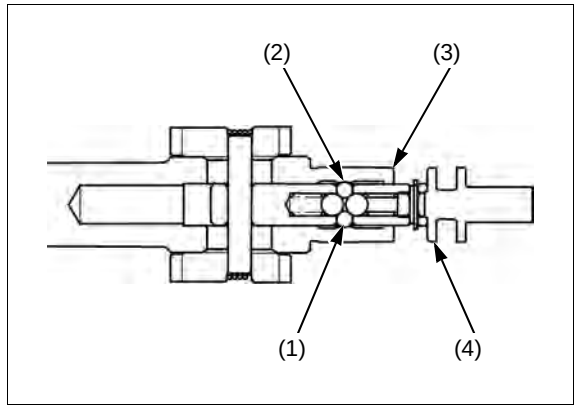


Check that the steel balls (#7) (1) are positioned in the groove (2) of the propeller shaft (3) as shown.

NOTICE

Note that the shift rod cannot be installed unless the shift slider (4) is in the correct position. Set the shift slider on the position as shown.

Install the propeller shaft holder (page 16-21).



VERTICAL SHAFT REMOVAL/ INSTALLATION

REMOVAL

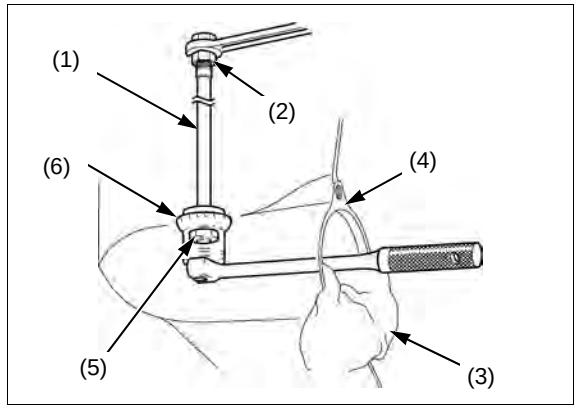
Remove the propeller shaft holder (page 16-21).

Attach the special tool to the vertical shaft (1) end (flywheel boss installation side).

TOOL:
Vertical shaft holder (2) 07SPB-ZW10200

Place a shop towel (3) or equivalent material as shown to protect the gear case (4).

Holding the vertical shaft with the special tool as shown, remove the pinion gear nut (5) and pinion gear (6) from the vertical shaft.

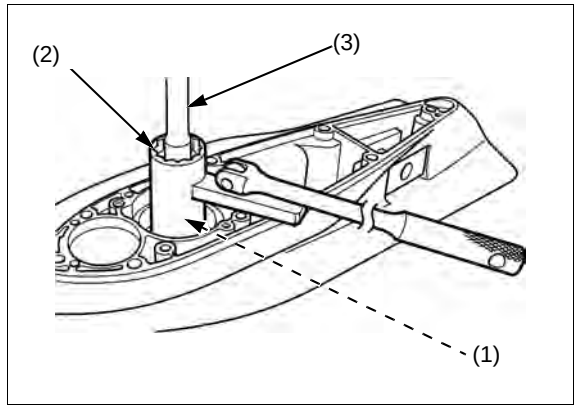


Remove the lock nut (1) using the special tool.

TOOL:
Lock nut wrench, 36 × 47.8 mm (2) 07916-MB00002

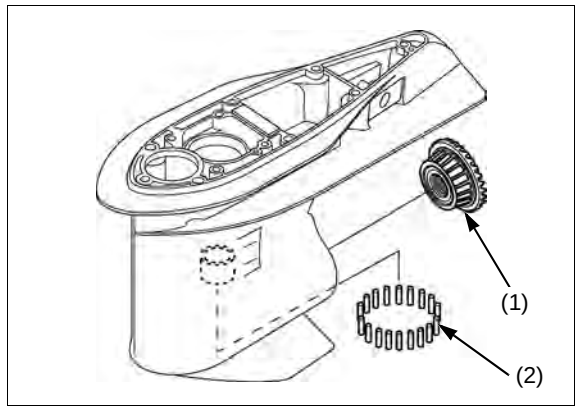
Remove the vertical shaft (3).

- Be careful not to drop the needle bearing (rollers) when removing the vertical shaft.



Remove the forward bevel gear/taper bearing (1).

Remove the eighteen needle bearing rollers (2).

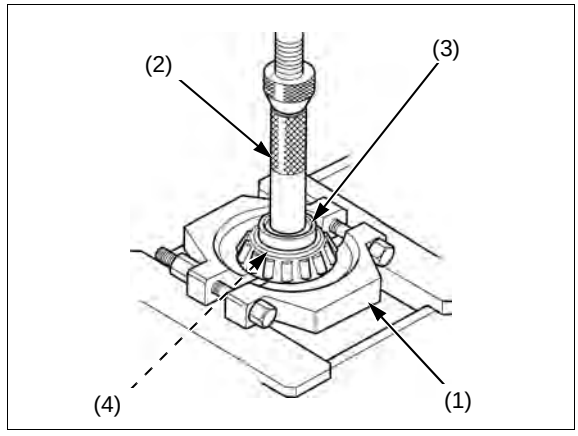


Set a commercially available universal bearing puller (1) between the taper bearing (inner race) and forward bevel gear.

Remove the taper bearing (inner race) from the forward bevel gear using the special tools and hydraulic press.

TOOLS:

Driver (2)	**07749-0010000**
Bearing driver attachment, 44 × 49.5 mm (3)	**07945-3330300**
Pilot, 25 mm (4)	**07746-0040600**

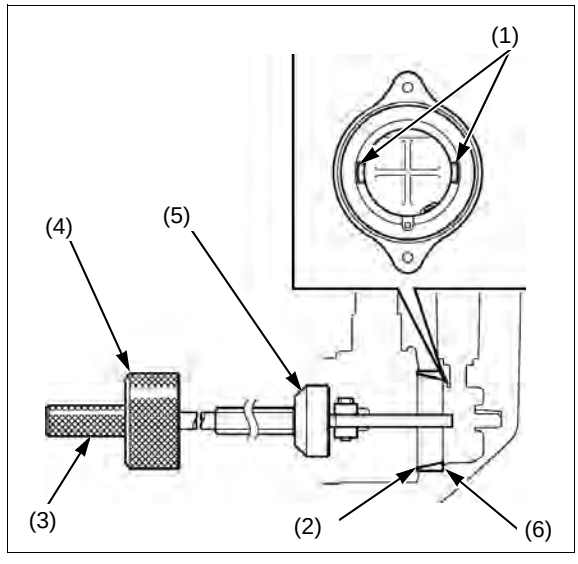


Positioning the special tool in the groove (1) of the gear case as shown, remove the taper bearing (outer race) (2).

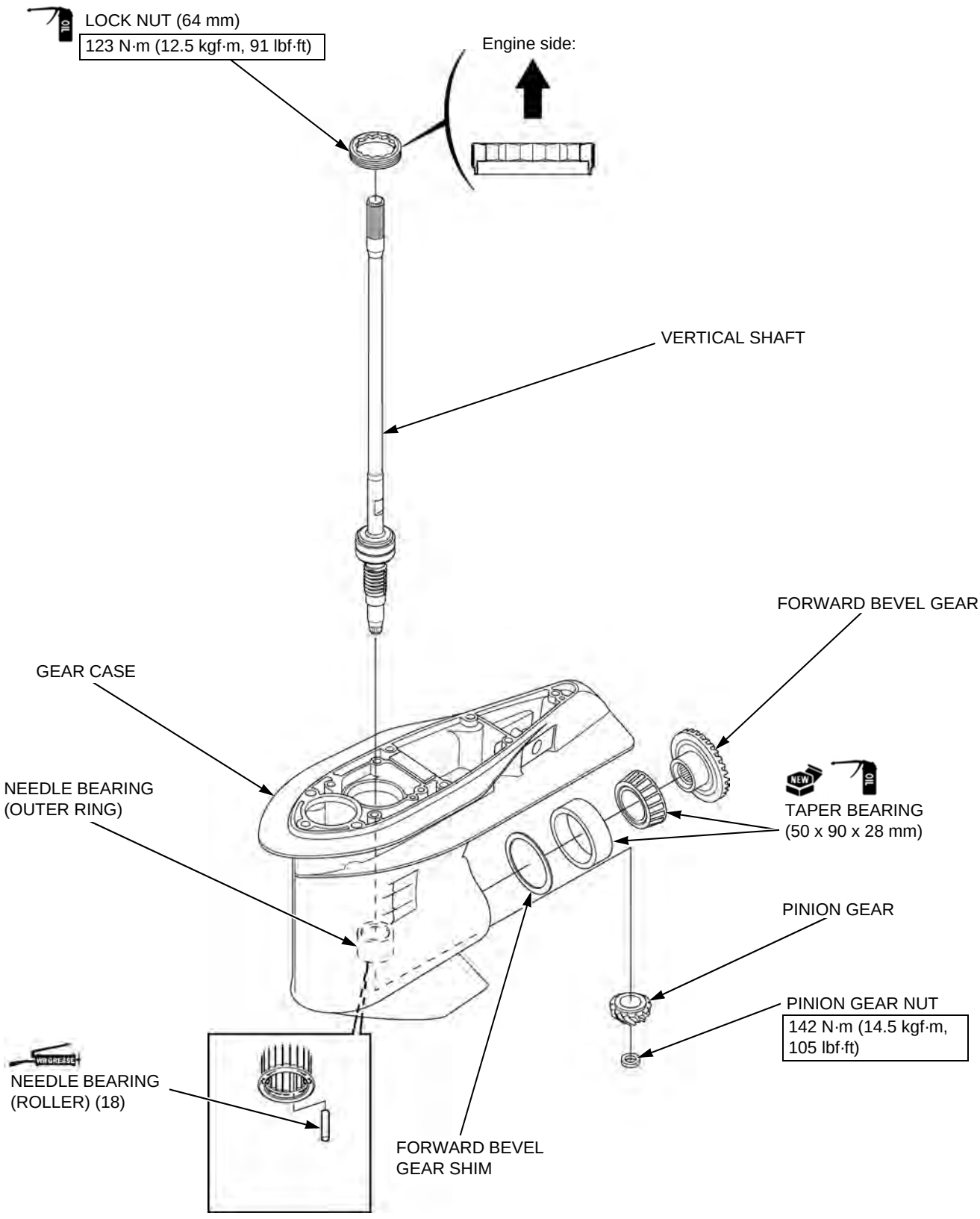
TOOLS:

Remover handle (3)	**07936-3710100**
Remover weight (4)	**07741-0010201**
Bearing race puller (5)	**070PC-ZY30100**

Remove the forward bevel gear shim (6) from the gear case.



EXPLODED VIEW



INSTALLATION

- When the gear case or the taper bearing have been replaced with new ones, perform shim adjustment and select the appropriate shim accordingly (page 16-38).

Soak the gear case (1) in a container (2) filled with oil with its bearing installation side facing down as shown.

Heat the oil to 80 – 90°C (176 – 194°F).

- Do not heat the oil above 90°C (194°F).
- Be sure to wear gloves during the procedure.

After entire gear case becomes hot, remove it out of the container.

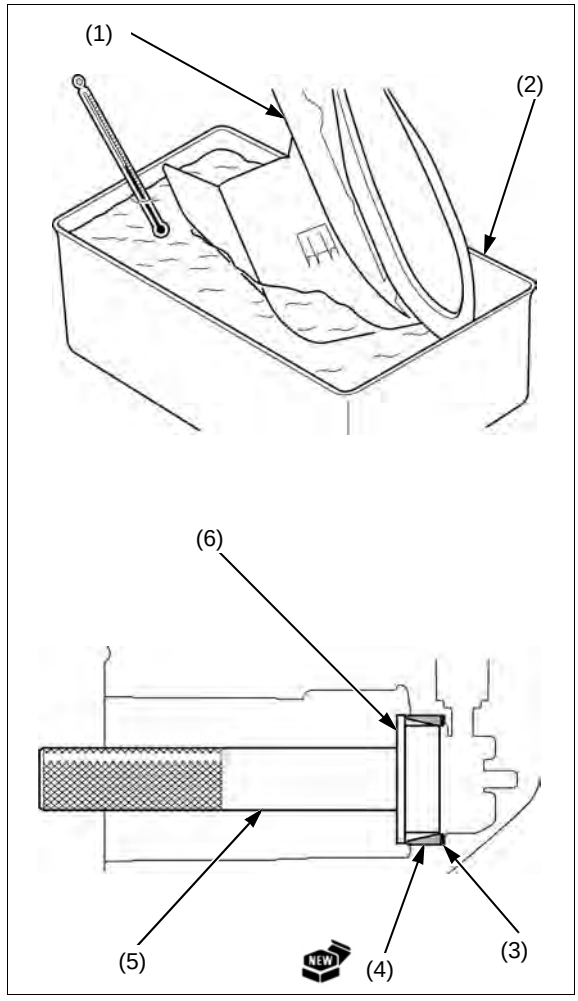
Install the shim (3) into the gear case.

Install a new taper bearing (outer race) (4) into the gear case using the special tools.

- Install the taper bearing (outer race) with its larger I.D. side facing out.

TOOLS:

Driver, 480 mm (5)	**070GD-0010100**
Taper bearing installer attachment (6)	**070PF-ZY60100**



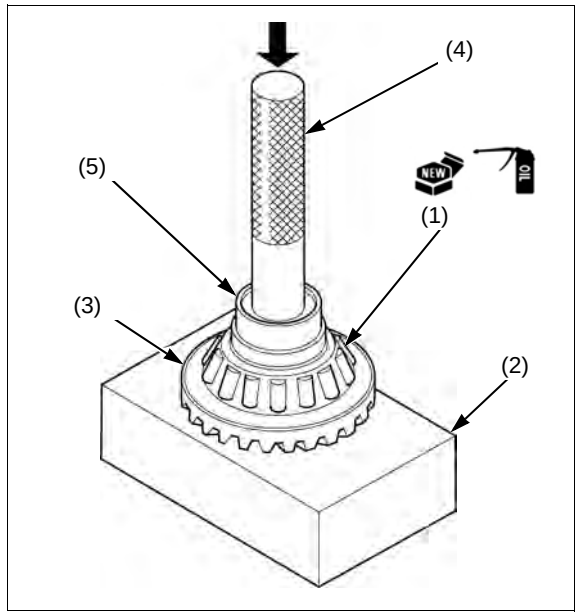
Apply gear oil to the inner circumference and roller area of a new taper bearing (inner race) (1).

Place a wood block (2) under the forward bevel gear (3).

Install the taper bearing (inner race) onto the forward bevel gear using the special tools and hydraulic press.

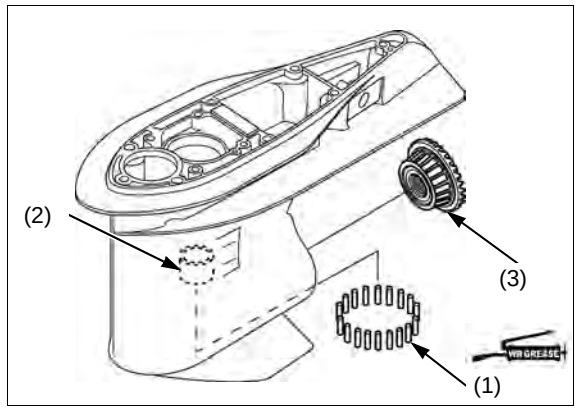
TOOLS:

Driver (4)	**07749-0010000**
Attachment, 52 × 55 mm (5)	**07NAD-P200100**



Apply marine grease to the needle bearing rollers (1) and install them into the needle bearing outer ring (2).

Install the forward bevel gear/taper bearing (3).

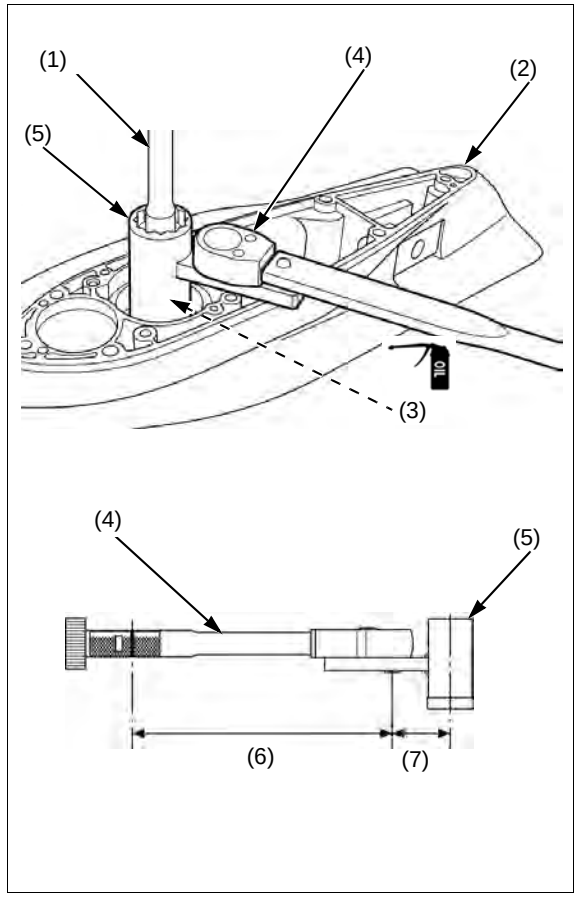


Install the vertical shaft (1) into the gear case (2).

Apply gear oil to the threads and seating surface of the lock nut (3).
Tighten the lock nut to the specified torque using the special tool and a torque wrench (4).

TOOL:
Lock nut wrench, 36 × 47.8 mm (5) 07916-MB00002

TORQUE: 123 N·m (12.5 kgf·m, 91 lbf·ft)



NOTICE

To tighten the lock nut, read the torque as follows.

Formula:

Torque wrench reading =

[A x B] / [A + C]

A: Torque wrench effective length [m (ft)] (6)

B: Specified torque [N·m (kgf·m, lbf·ft)]

C: Lock nut wrench effective length [m (ft)] (7)

Example:

Torque wrench reading using a torque wrench with an effective length of 0.4 m (1.31 ft) and lock nut wrench with an effective length of 0.05 (0.164)

Torque wrench reading =

[0.4 (1.31) x 123 (12.5, 91)]

/ [0.4 (1.31)] + [0.05 (0.164)]

= 109 [N·m (11.1 kgf·m, 80 lbf·ft)]

A: Torque wrench effective length = 0.4 m (1.31 ft)

B: Specified torque = 123 N·m (12.5 kgf·m, 91 lbf·ft)

C: Lock nut wrench effective length = 0.05 (0.164)

I.e. torque wrench reading is 109 N·m (11.1 kgf·m, 80 lbf·ft).

Wipe the tapered part (1) of the vertical shaft (2) and pinion gear (3) with a shop towel and degreasing cleaning solvent.

Attach the special tool to the end (flywheel boss installation side) of the vertical shaft as shown.

TOOL:
Vertical shaft holder (4) 07SPB-ZW10200

Place a shop towel (5) in the gear case (6) as shown to protect it.

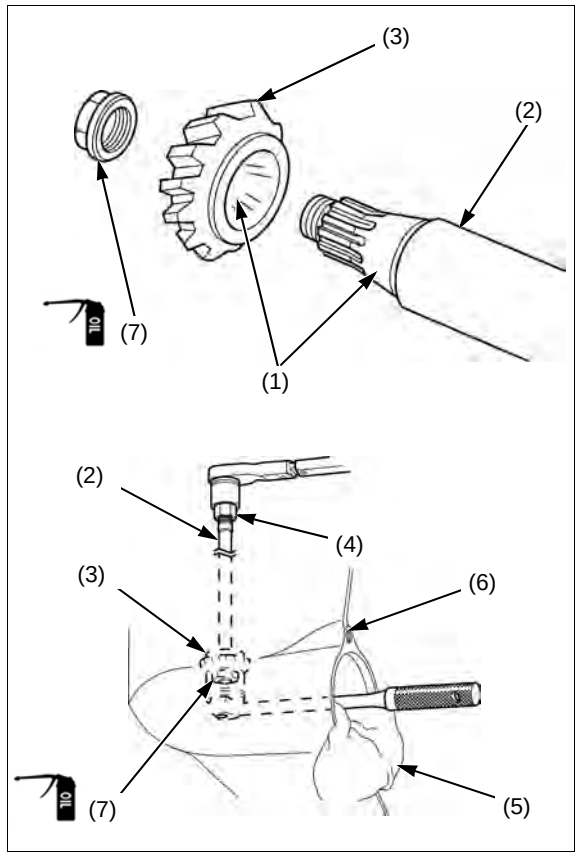
Apply gear oil to the threads and seating surface of the pinion gear nut (7), and install the pinion gear and pinion gear nut onto the vertical shaft.

- Before installing the pinion gear, make sure that the forward bevel gear/taper bearing is positioned in the gear case correctly.

Holding the vertical shaft using the special tool as shown, tighten the pinion gear nut to the specified torque.

TORQUE: 142 N·m (14.5 kgf·m, 105 lbf·ft)

Install the propeller shaft holder (page 16-21).

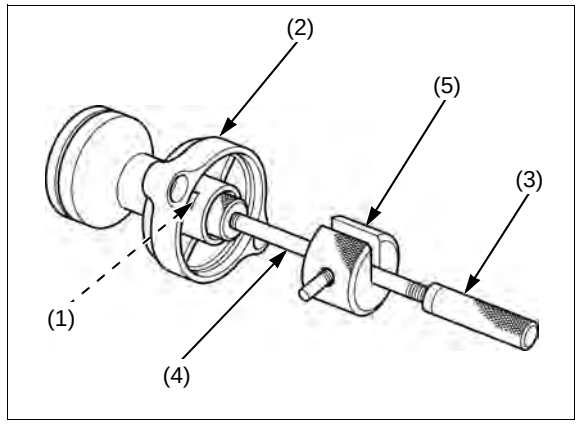


PROPELLER SHAFT HOLDER DISASSEMBLY/ASSEMBLY

DISASSEMBLY

Remove the needle bearing (30 x 37 x 26 mm) (1) from the propeller shaft holder (2) using the special tools.

TOOLS:
Remover handle (3) 07936-3710100
Bearing remover, 30 mm (4) 07936-8890300
Remover weight (5) 07741-0010201



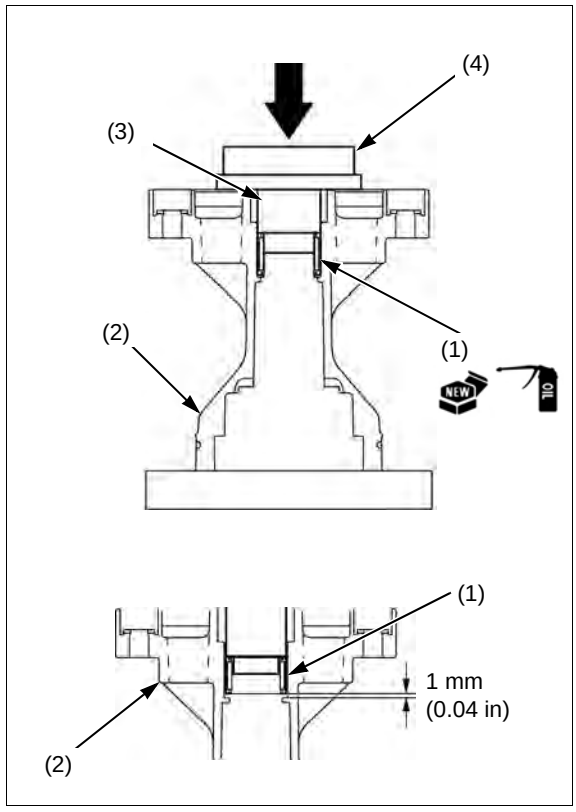
ASSEMBLY

Apply gear oil to the outer circumference of a new needle bearing (30 x 37 x 26 mm) (1).

Install the needle bearing into the propeller shaft holder (2) until the specified depth, using the special tools and hydraulic press.

- Install the bearing with its marked side facing the special tool.

TOOLS:
Attachment, 30 × 37 mm (3) 070PD-ZY60200
Attachment, 62 × 68 mm (4) 07746-0010500

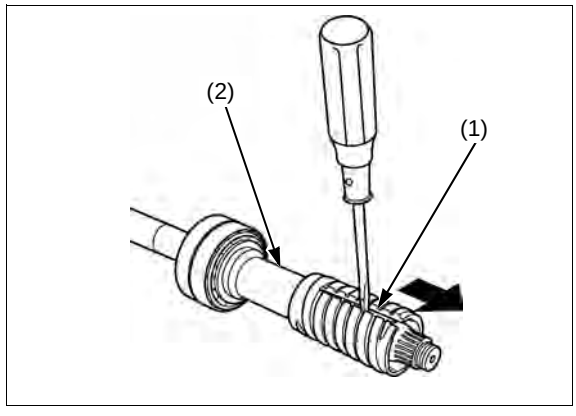


VERTICAL SHAFT DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

Remove the oil slinger (1) from the vertical shaft (2) by expanding the cut in the oil slinger with a screwdriver or equivalent.

- Do not expand the slinger more than necessary, or it will be damaged.

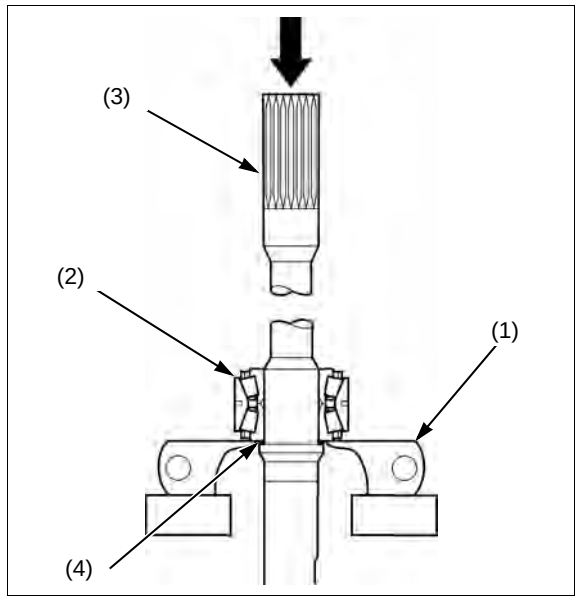


Check the taper roller bearing for abnormal sound and play.
Replace the inner race and outer race as a set if necessary.

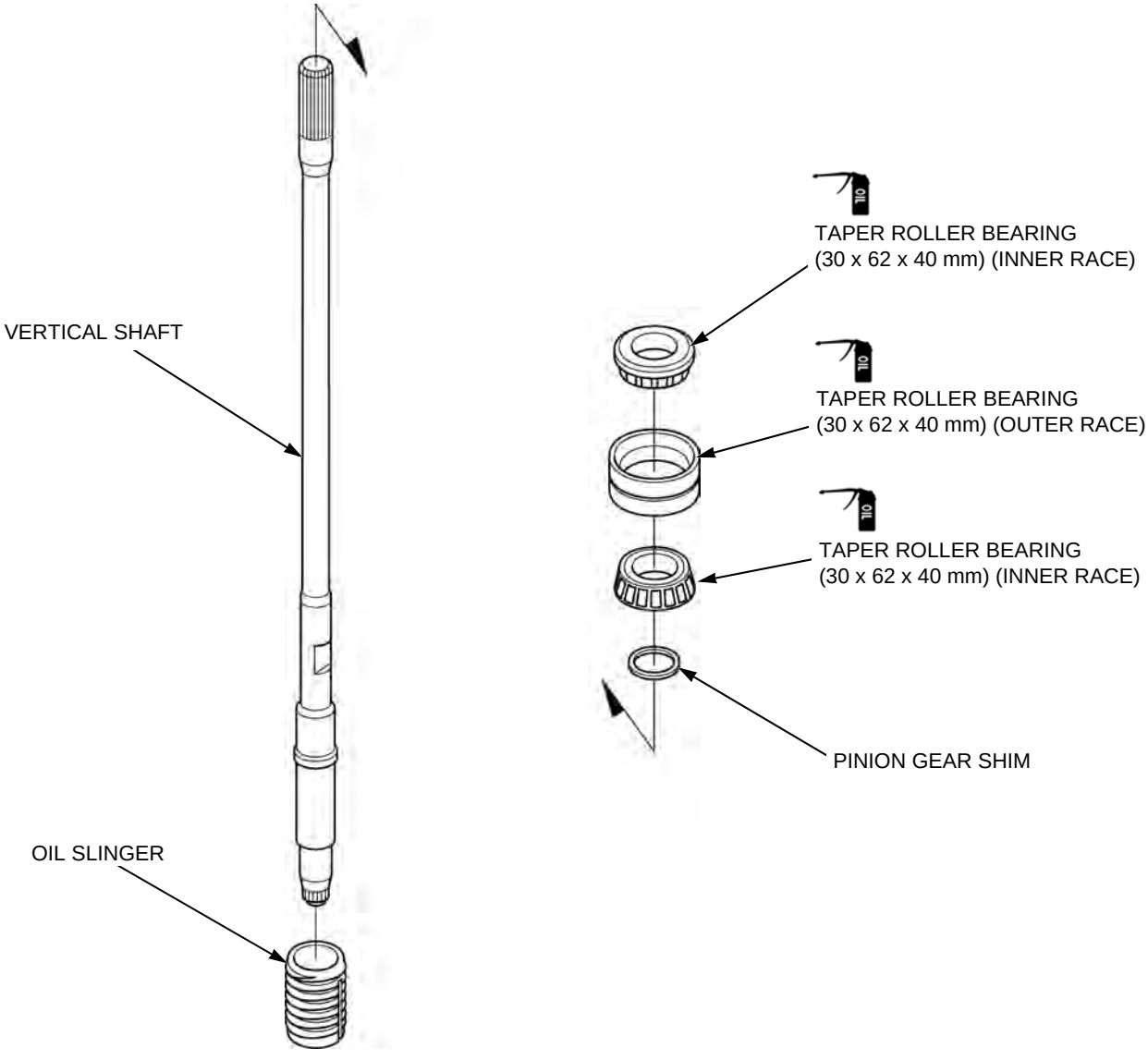
Set a commercially available universal bearing puller (1) under the taper roller bearing (inner race) (2) and set the vertical shaft (3) on the hydraulic press with the flywheel boss installation side facing up.

Remove the taper roller bearing from the vertical shaft using a hydraulic press.

Remove the pinion gear shim (4) from the vertical shaft.



EXPLODED VIEW



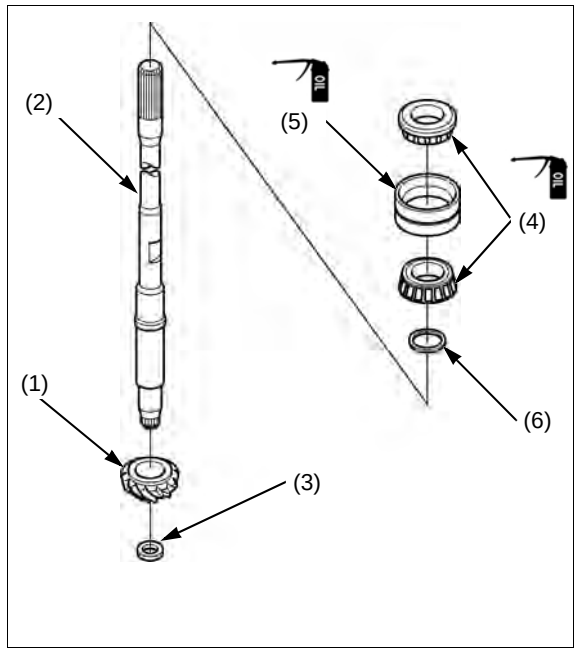
ASSEMBLY

Set the pinion gear (1) onto the vertical shaft (2), and loosely tighten the pinion gear nut (3) by hand.

Apply gear oil to the inner wall of the taper roller bearing inner races (4), rollers and outer circumference of the outer race (5).
Assemble the inner races and outer race.

Install the pinion gear shim (6) and taper roller bearing onto the vertical shaft.

- When the gear case, vertical shaft or taper roller bearing is replaced with a new one, perform the shim adjustment and select the appropriate shim accordingly (page 16-38).
- Set the taper roller bearing with the side on which the "E" dimension was measured during shim adjustment toward the pinion gear (page 16-38).



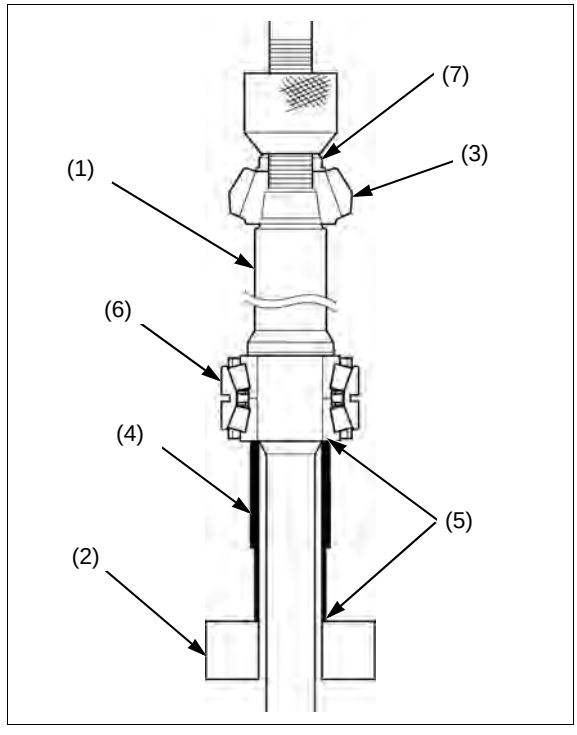
Install the special tool onto the vertical shaft (1) and set the vertical shaft on the hydraulic press (2) with the pinion gear (3) side facing up as shown.

TOOL:
Driver shaft, B (4) 07964-MB00200

- Check that the ends (5) of the special tool are set on the taper roller bearing (6) inner race and hydraulic press table securely.
- Do not damage the threads at the end of the vertical shaft (pinion gear nut (7) installation part).

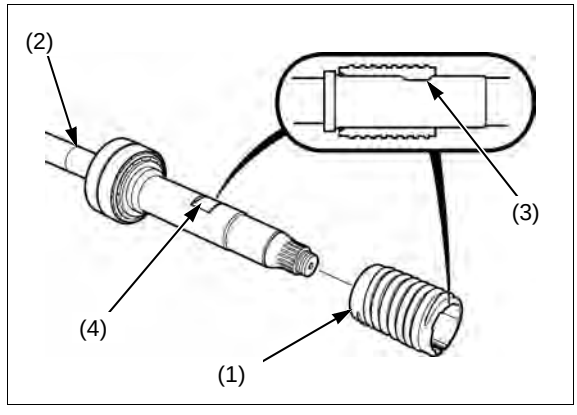
Install the taper roller bearing onto the vertical shaft using the hydraulic press.

Remove the pinion gear nut and pinion gear from the vertical shaft.



Install the oil slinger (1) onto the vertical shaft (2) by aligning the projection (3) on the inside of the oil slinger with the recess (4) on the pinion gear installation side of the vertical shaft.

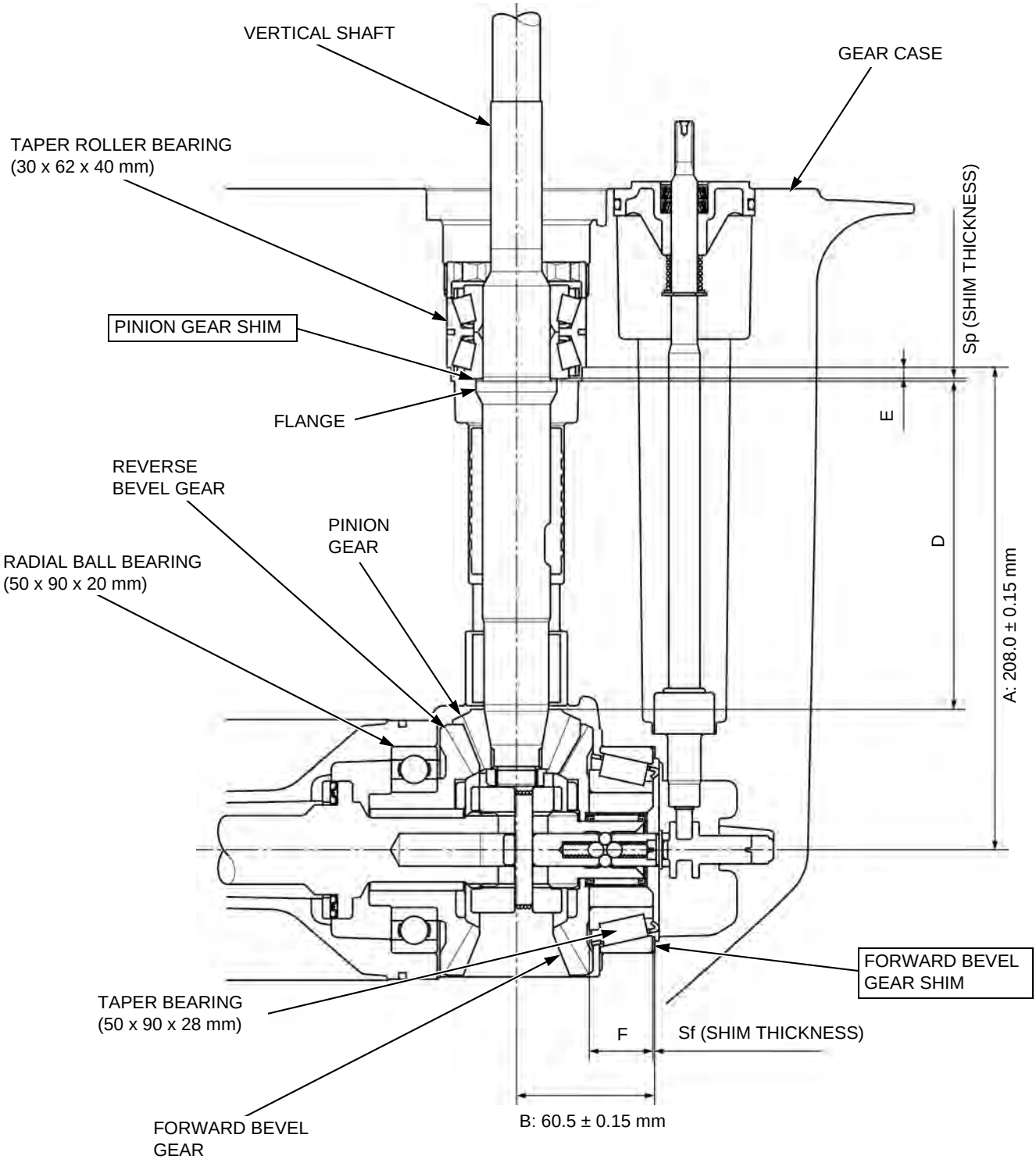
- Do not expand the slinger more than necessary, or it will be damaged.



SHIM SELECTION

- Use shims to adjust the position of each gear so that they engage properly. Perform shim adjustment if the backlash of a gear is outside the specification or after replacing the gear case, vertical shaft, gear or bearing with a new one.

SHIM LOCATIONS



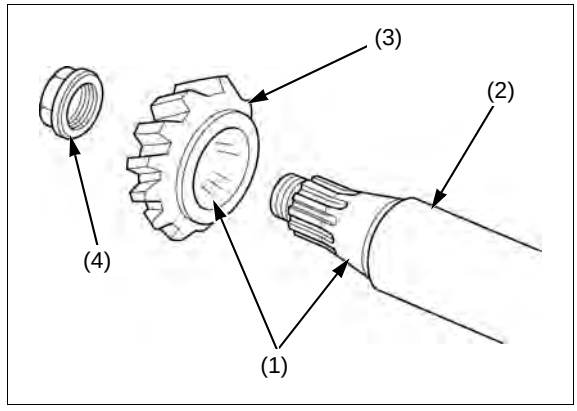
PINION GEAR SHIM

Clean the tapered surfaces (1) of the vertical shaft (2) and pinion gear (3) thoroughly using a shop towel and degreasing cleaning agent.

Install the pinion gear onto the vertical shaft.
Tighten the pinion gear nut (4) to the specified torque using the special tool.

TOOL:
Vertical shaft holder 07SPB-ZW10200

TORQUE: 142 N·m (14.5 kgf·m, 105 lbf·ft)



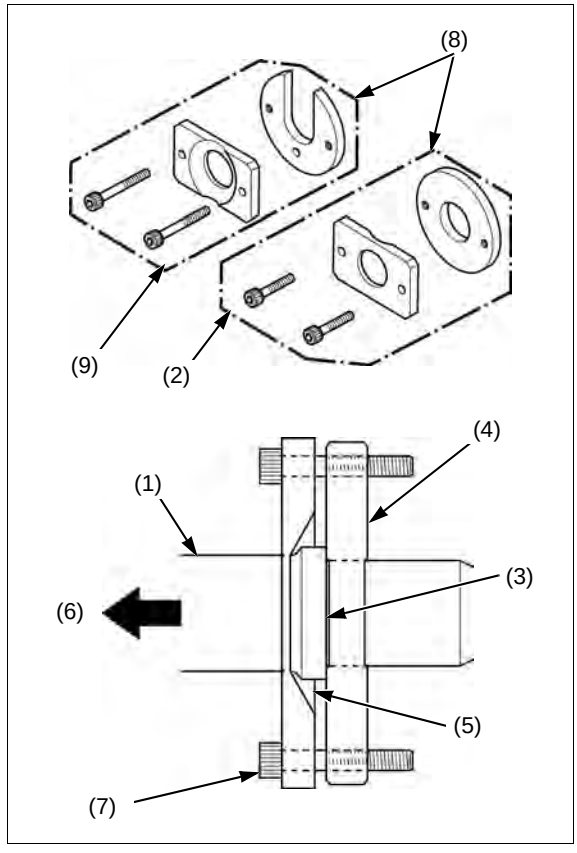
Remove the taper roller bearing if it is mounted on the vertical shaft (1) (page 16-35).

Set the special tools (taper roller bearing side) (2) onto the both sides of vertical shaft flange (3) with their tool No. mark side (4) and taper side (5) facing the opposite side of pinion gear direction (6) as shown.
Tighten the bolts (7) by hand.

TOOL:
Gauge adapter, 100 mm (8) 070PJ-ZY30100

- Do not confuse the pinion gear side (9) and the taper roller bearing side of the special tool.
- Take care not to score or scratch the measurement side (i.e. opposite side from the surface where the tool No. is stamped).
- Do not tighten the bolts with a wrench.

After installing the tools, check that there is no looseness in the tool.

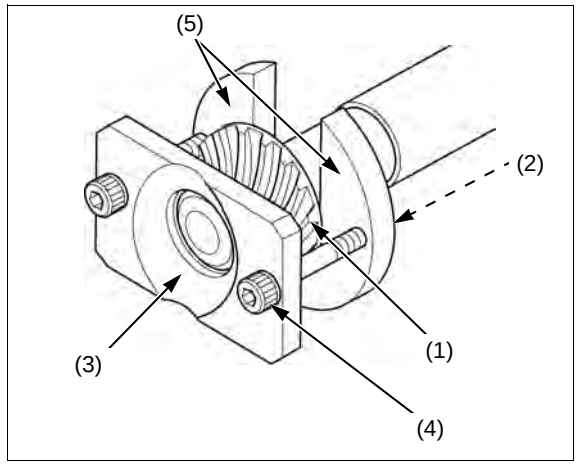


Set the special tools (pinion gear side) onto the both sides of pinion gear (1) with their tool No. mark side (2) and taper side (3) facing the opposite side of pinion gear as shown.
Tighten the bolts (4) by hand.

- Do not confuse the pinion gear side and the taper roller bearing side of the special tool.
- Take care not to score or scratch the measurement side (i.e. opposite side from the surface where the tool No. is stamped) (5).
- Do not tighten the bolts with a wrench.

Check that the tool of the pinion gear nut side is not raised on the nut.

After installing the tools, check that there is no looseness in the tool.

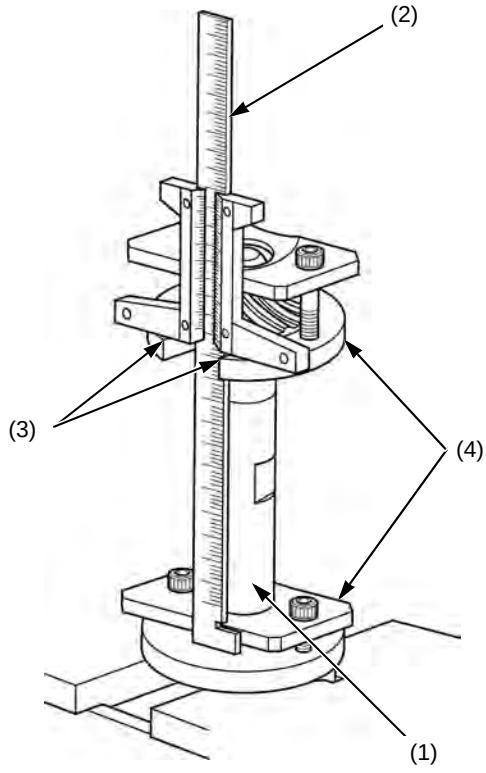


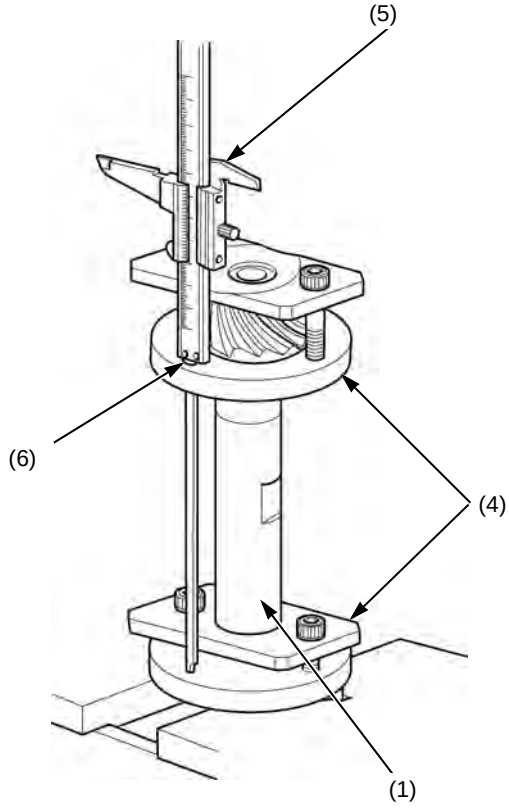
Hold the vertical shaft (1) upright with the pinion gear facing up.

Set a commercially available depth gauge (2) in the groove (3) of the pinion gear side special tool (4) as shown. Measure the length (D) from the pinion gear end to the end of the vertical shaft flange and record the measurement.

If using a vernier caliper (5), set it in the small hole (6) of the special tool as shown.

MEASUREMENT D:

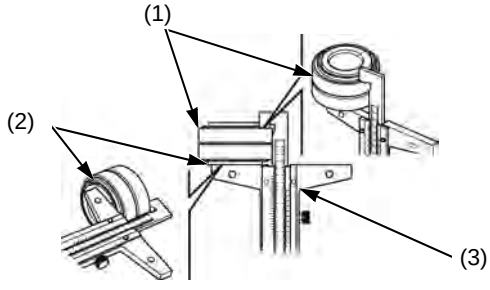


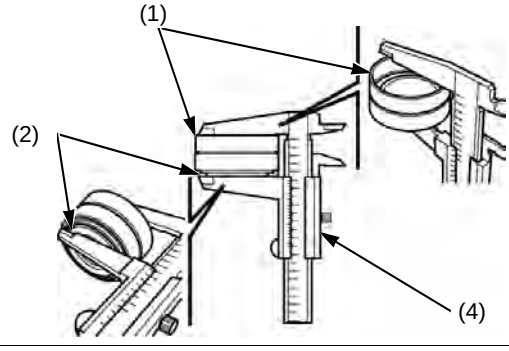


Assemble the outer race (1) and inner race (2) of the taper roller bearing, and turn the outer race two or three turns to seat the bearings.

If using a depth gauge (3), measure the bearing height (E') from the outer race end to the inner race end as shown, and record the measurement.
If using a vernier caliper (4), remove one side of the inner race and measure the bearing height (E').

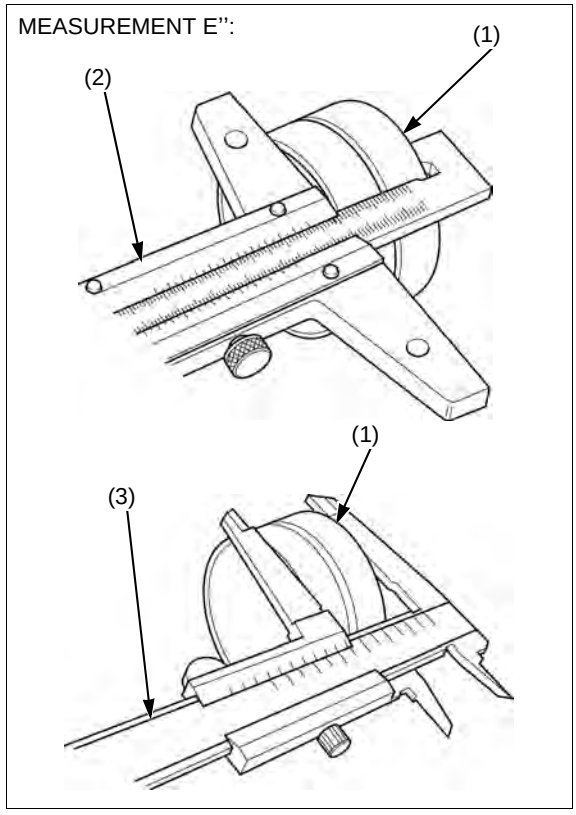
MEASUREMENT E':





Measure the height (E'') of the taper roller bearing outer race (1) using a depth gauge (2) or vernier caliper (3), and record it.

MEASUREMENT E'':



Calculate the length from the inner race end to the outer race end (E) by determining the gap between the measurements E' and E'' using the following formula.

Formula: E= E' - E''

Example:
When measurement (E') from the outer race end to the inner race end is 34.90 mm (1.374 in), and outer race height (E'') is 29.65 mm (1.167 in):

E= 34.90 - 29.65 = 5.25
The gap (E) from the inner race end to the outer race end is 5.25 mm (0.207 in).

Determine the tolerance and record it using the measurement (D), calculation (E) and the following formula.

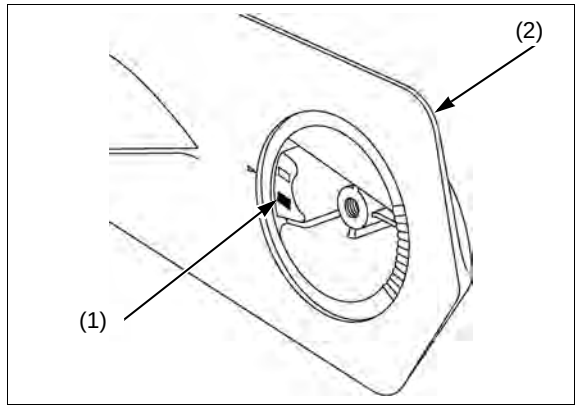
Formula: Tolerance = D + E - 147.2

Example:
When measurement (D) from the pinion gear end to the end of the vertical shaft flange is 141.90 mm (5.587 in), and calculation (E) from the inner race end to the outer race end is 5.25 mm (0.207 in):

141.90 + 5.25 - 147.2 = -0.05
The tolerance is -0.05 mm (-0.002 in).

Remove the trim tab (page 16-8).

Record the engagement mark (1) located on the trim tab installation part of the gear case (2).



Cross reference the engagement mark and tolerance calculated in the previous step, and refer to the pinion gear shim selection table to determine the required thickness of the shim (Sp).

Pinion gear shim selection table

Unit: mm

		Calculation value													
		-0.31 – -0.25	-0.25 – -0.20	-0.20 – -0.15	-0.15 – -0.10	-0.10 – -0.05	-0.05 – 0	0 – +0.05	+0.05 – +0.10	+0.10 – +0.15	+0.15 – +0.20	+0.20 – +0.25	+0.25 – +0.30	+0.30 – +0.35	+0.35 – +0.41
Gear case engagement mark	A	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	-
	B	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10
	C	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15
	D	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20
	E	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25
	F	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30

Select the shims from the pinion gear shims of different thickness to obtain the required thickness (Sp) by combining the shims.

Pinion gear shim type table

Shim type	Thickness
Shim A	0.10 mm
Shim B	0.15 mm
Shim C	0.30 mm
Shim D	0.50 mm

Install the trim tab to the gear case (page 16-9).

HOW TO READ SHIM SELECTION TABLE

When the engagement mark on the gear case housing is C and tolerance is -0.05 mm (-0.002 in), the shim selection table shows that the required shim thickness is 0.55 mm (0.022 in). (See the table shown below).

Pinion gear shim selection table

Unit: mm

		Calculation value						
		-0.31 – -0.25	-0.25 – -0.20	-0.20 – -0.15	-0.15 – -0.10	-0.10 – -0.05	-0.05 – 0	0 – +0.05
Gear case engagement mark	A	0.70	0.65	0.60	0.55	0.50	0.45	0.40
	B	0.75	0.70	0.65	0.60	0.55	0.50	0.45
	C	0.80	0.75	0.70	0.65	0.60	0.55	0.50
	D	0.85	0.80	0.75	0.70	0.65	0.60	0.55
	E	0.90	0.85	0.80	0.75	0.70	0.65	0.60
	F	0.95	0.90	0.85	0.80	0.75	0.70	0.65

HOW TO SELECT SHIM COMBINATION

To obtain 0.55 mm (0.022 in) of shim thickness, combine one gear shim A, one gear shim B, and one gear shim C, or combine four gear shim A and one gear shim B.

FORWARD BEVEL GEAR SHIM

Assemble the outer race (1) and inner race (2) of a new taper bearing, and turn the outer race two or three turns to seat the bearing.

If using a depth gauge (3), measure the bearing height (F) from the outer race end to the inner race end as shown, and record the measurement.
If using a vernier caliper (4), place the assembled taper bearing on the smooth side of the gauge adapter special tool (or flat, hard surface).
Press the outer race down over the inner race and measure the bearing height (F) (5).

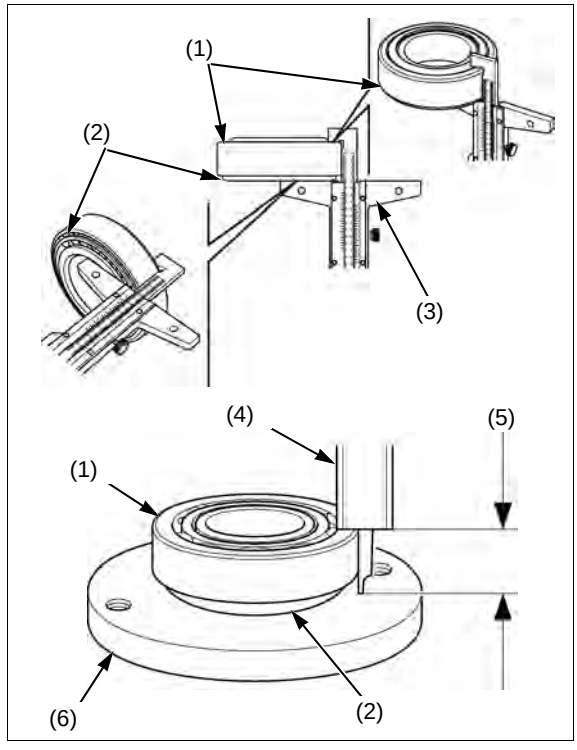
TOOL:
Gauge adapter, 100 mm (6) 070PJ-ZY30100

Calculate the tolerance using the measurement F obtained in the previous step and the following formula.

Formula: Tolerance = F - 28.00

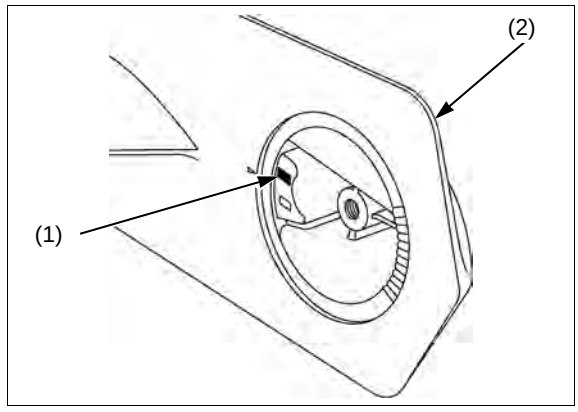
Example:
When measurement (F) from the outer race end to the inner race end is 28.05 mm (1.104 in):

Tolerance = 28.05 - 28.00 = 0.05
The tolerance is 0.05 mm (0.002 in).



Remove the trim tab (page 16-8).

Record the engagement mark (1) located on the trim tab installation part of the gear case (2).



Cross reference the engagement mark and tolerance calculated in the previous step, and refer to the forward bevel gear shim selection table to determine the required thickness of the shim (Sf).

Forward bevel gear shim selection table

Unit: mm

		Calculation value	
		0 – +0.05	+0.05 – +0.10
Gear case engagement mark	1	0.45	0.40
	2	0.40	0.35
	3	0.35	0.30
	4	0.30	0.25
	5	0.25	0.20
	6	0.20	0.15

Refer to 16-43 for information on how to read the shim selection table and shim combination.

Select the shims from the forward bevel gear shims of different thickness to obtain the required thickness (Sf) by combining the shims.

Forward bevel gear shim type table

Shim type	Thickness
Shim A	0.10 mm
Shim B	0.15 mm
Shim C	0.30 mm
Shim D	0.50 mm

Install the trim tab on the gear case (page 16-9).

After shim selection, inspect the forward bevel gear backlash (page 16-45).

BACKLASH INSPECTION

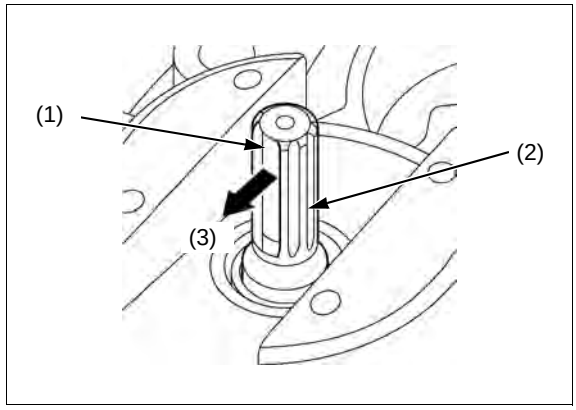
FORWARD BEVEL GEAR BACKLASH

Backlash adjustment must be made after adjustment of each gear shim (page 16-38).

Install the following parts except the water pump.

– Vertical shaft (page 16-29)
– Propeller shaft holder (page 16-21)
– Shift rod (page 16-15)

Check that the shift rod of the gear case is in the "N" (Neutral) position.
The cutout (1) of the shift rod (2) spline area should face the cruising direction (3).



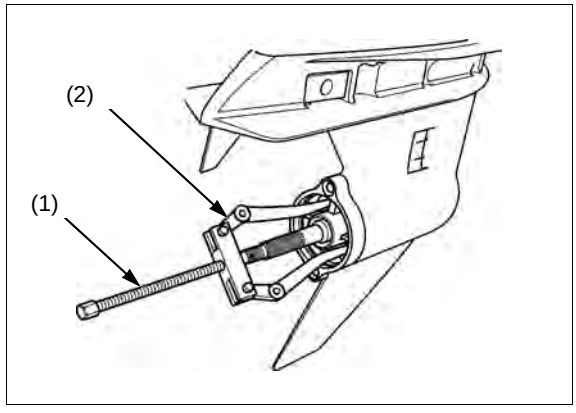
Hold the propeller shaft securely with the special tool, and tighten the puller bolt of the special tool to the specified torque.

TOOLS:

Puller bolt (1)	**07SPC-ZW0011Z**
Puller jaws (2)	**07SPC-ZW0010Z**

TORQUE: 5 N·m (0.51 kgf·m, 3.7 lbf·ft)

Turn the vertical shaft clockwise 5 – 10 times to seat the bearings.



Attach the special tool to the vertical shaft (1) as shown, adjust the dial indicator (2) so its needle is at the line "2" of the backlash indicator tool.

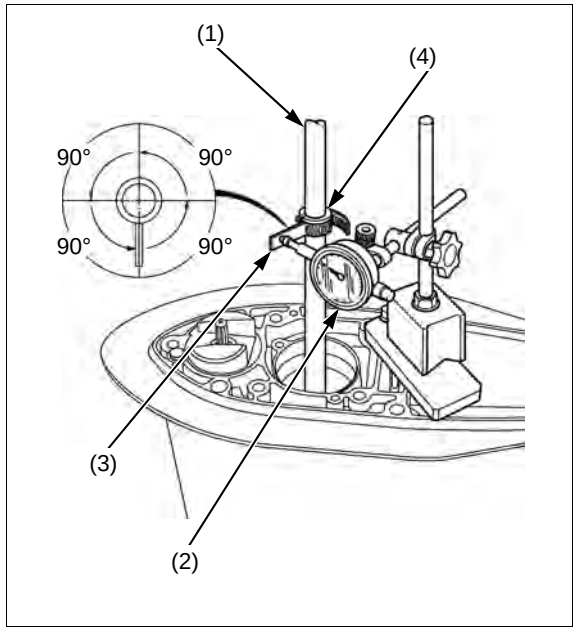
TOOLS:

Backlash indicator tool (3)	**07SPJ-ZW0030Z**
Backlash indicator attachment (4)	**07WPK-ZW50100**

Turn the vertical shaft lightly right and left and record the dial indicator reading.

Measure the backlash at four points (by turning the vertical shaft in increments of 90°) in the same manner.

- When measuring the backlash, do not turn the propeller shaft by turning the vertical shaft.



Obtain the forward bevel gear backlash using the dial indicator runout and the following formula.

Formula:
Backlash = Dial gauge runout ÷ 0.86

Example:
When dial gauge runout is 0.175 mm (0.0069 in),
Backlash =
0.175 mm (0.0069 in) ÷ 0.86 = 0.20 mm (0.008 in)

STANDARD VALUE:
0.10 – 0.30 mm (0.004 – 0.012 in)

If the backlash is too large compared to the standard value, increase the forward bevel gear shim thickness and recheck the backlash.

If the backlash is too small compared to the standard value, reduce the forward bevel gear shim thickness and recheck the backlash.

- Be sure to use the special tool when removing the bearings in order to readjust the backlash.

Install the water pump (page 11-10).

After installing the water pump, perform the gear case pressure inspection (page 16-47).

GEAR CASE PRESSURE INSPECTION

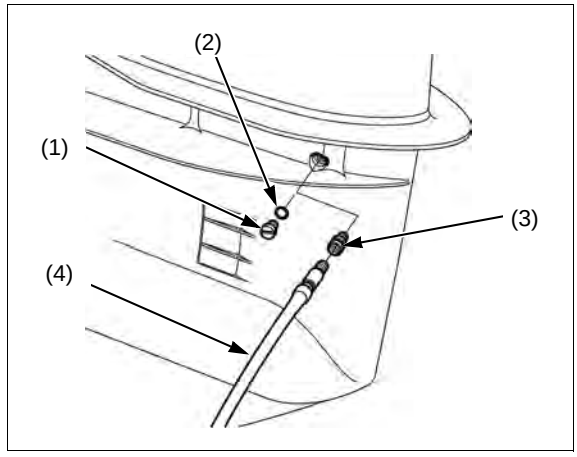
- Perform the gear case pressure check and check for pressure leakage after disassembling and reassembling the gear case.
- In principle, the pressure check should be made on the gear case before filling it with gear oil and before installing it on the outboard motor. However, the check can be made with the gear case filled with gear oil.

Remove the oil check bolt (1) and O-ring (2).

Install the adapter (special tool) (3) in the oil check bolt hole.
Attach the hose end of the pressure tester S-34 (special tool) (4) to the adapter.
Do not screw in the adapter and hose end with force.

TOOLS:

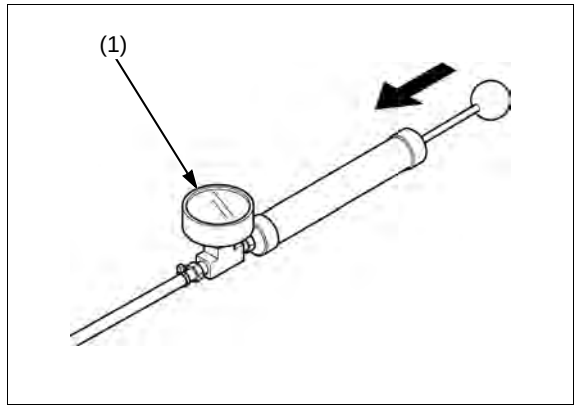
Pressure tester S-34	**07APJ-001A100**
Adapter	**07APJ-001A300**



While watching pressure tester gauge (1), apply the specified air pressure to the gear case by pumping the handle slowly.

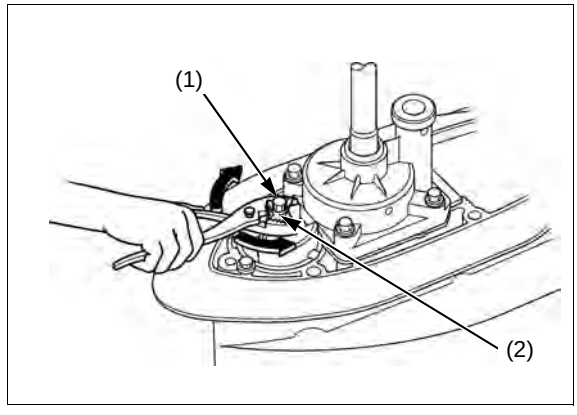
- Do not apply excessive air pressure.

AIR PRESSURE:
29 kPa (0.3 kgf/cm^2, 4.3 psi)

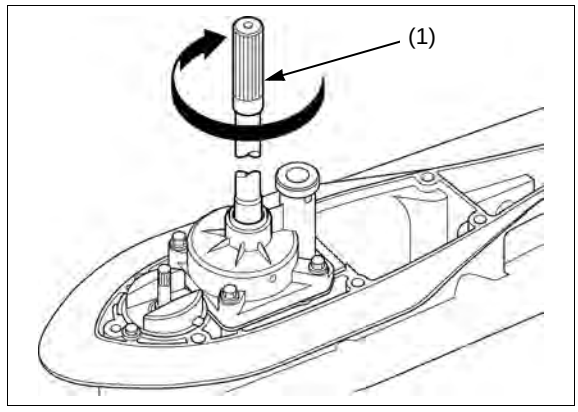


While applying the specified air pressure to the gear case, move the shift rod (1) right and left five or six times using pliers.

- Wrap a shop towel (2) around the shift rod spline to move the shift rod with pliers.



While applying the specified air pressure to the gear case, turn the vertical shaft (1) five or six turns clockwise.

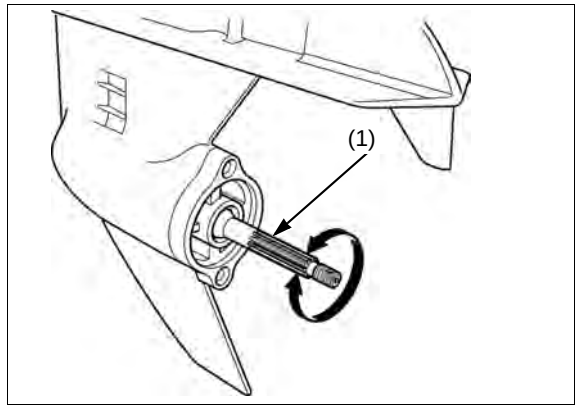


NOTICE

Be sure to turn the vertical shaft clockwise, or damage to the water pump impeller can occur.

While applying the specified air pressure to the gear case, turn the propeller shaft (1) right and left two or three turns.

Leave the gear case for five minutes and check that the air pressure is maintained.



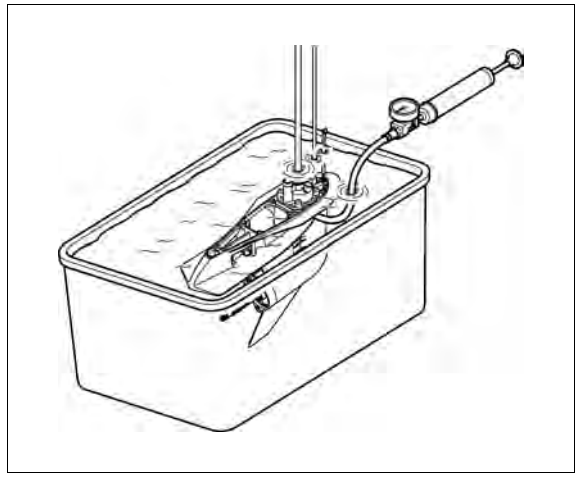
If the air pressure drops, place the gear case in a container filled with water. Apply the specified air pressure to the gear case again, move the shift rod, vertical shaft and propeller shaft, and locate the point where the air is leaking.

Remove the gear case from the water and replace the water seal or O-ring where the air is leaking.

After replacing the water seal or O-ring, perform the pressure check again and be sure that air is not leaking.

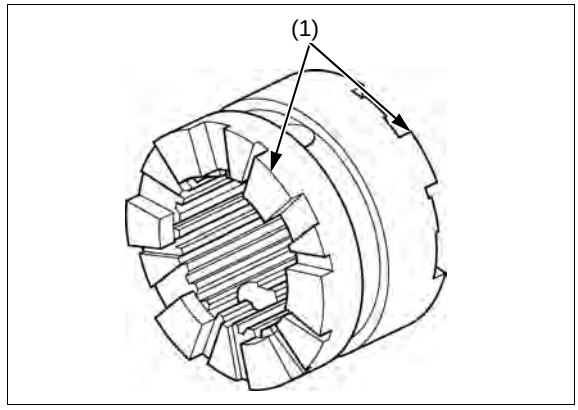
Remove the gear case pressure tester and the adapter from the gear case.
Install a new O-ring onto the oil check bolt, and tighten the oil check bolt to the specified torque.

TORQUE: 6.5 N·m (0.66 kgf·m, 4.8 lbf·ft)



CLUTCH SHIFTER INSPECTION

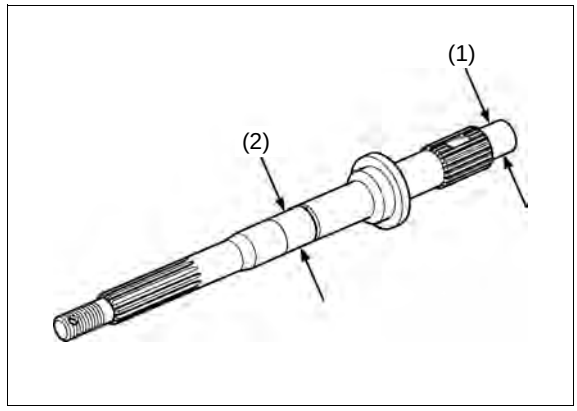
Check the clutch parts (1) on the forward and reverse sides for wear and damage.



PROPELLER SHAFT INSPECTION

PROPELLER SHAFT O.D.

Measure the O.D. of the propeller shaft at the forward bevel gear area (1) and needle bearing area (2).



STANDARD:

At forward bevel gear:	**24.987 – 25.000 mm (0.9837 – 0.9843 in)**
At needle bearing:	**30.007 – 30.020 mm (1.1814 – 1.1819 in)**

SERVICE LIMIT:

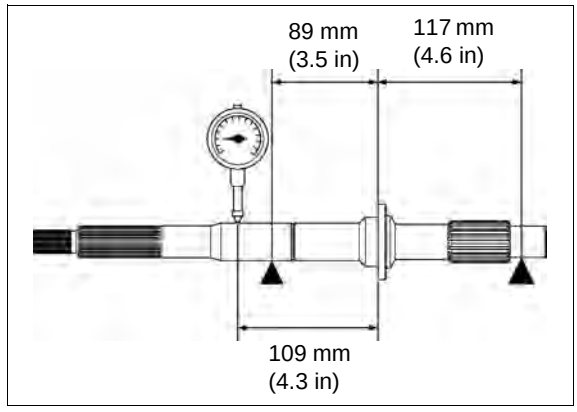
At forward bevel gear:	**24.966 mm (0.9829 in)**
At needle bearing:	**29.990 mm (1.1807 in)**

If the measurement is less than the service limit, replace the propeller shaft with a new one.

PROPELLER SHAFT RUNOUT

Support each journal with V-blocks as shown.

Set the dial indicator and measure the propeller shaft runout while turning the shaft.

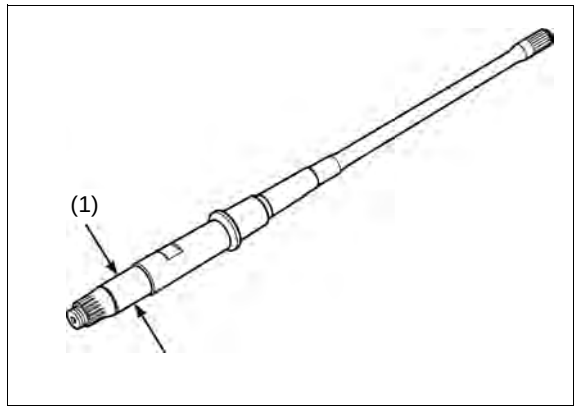


STANDARD: 0.02 mm (0.001 in) or below

VERTICAL SHAFT INSPECTION

VERTICAL SHAFT O.D.

Measure the O.D. of the vertical shaft at the needle bearing area (1).



STANDARD: 28.566 – 28.575 mm (1.1246 – 1.1250 in)
SERVICE LIMIT: 28.545 mm (1.1238 in)

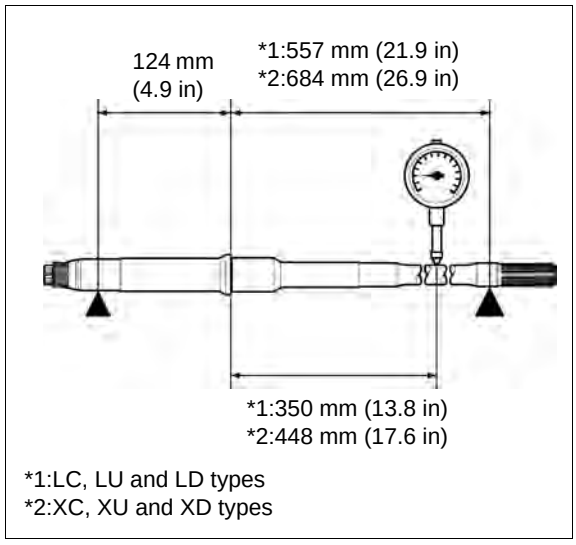
If the measurement is less than the service limit, replace the vertical shaft with a new one on assembly.

VERTICAL SHAFT RUNOUT

Support each journal with V-blocks as shown.

Set the dial indicator and measure the vertical shaft runout while turning the shaft.

STANDARD: 0.30 mm (0.012 in) or below



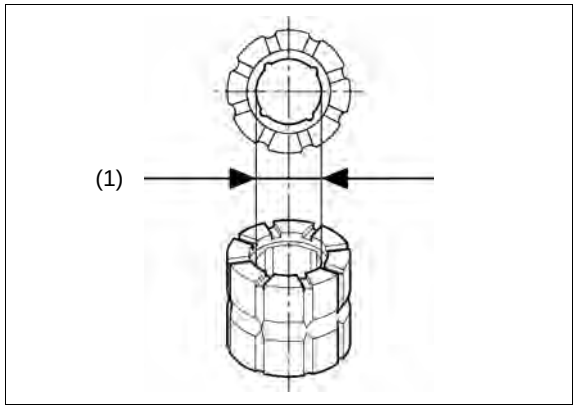
*1:LC, LU and LD types
*2:XC, XU and XD types

VERTICAL SHAFT BUSHING INSPECTION

VERTICAL SHAFT BUSHING I.D.

Measure the vertical shaft bushing (1) I.D.

STANDARD: 22.05 – 22.10 mm (0.868 – 0.870 in)



GEAR CASE BEARING REPLACEMENT

NEEDLE BEARING

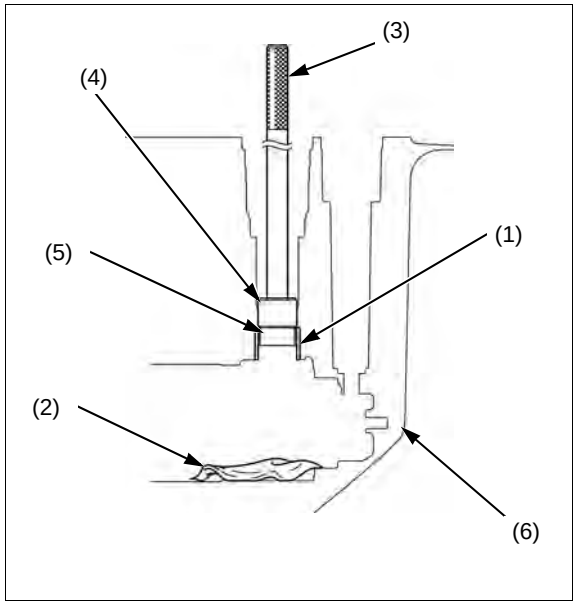
Set the special tools on the needle bearing (28.575 x 44.45 x 31.75 mm) (1), and place a shop towel (2) or equivalent material under the needle bearing as shown.

TOOLS:

Driver, 280 mm (3)	**07949-3710001**
Bearing remover attachment, 37 mm (4)	**07ZMD-MBW0200**
Pilot, 35 mm (5)	**07746-0040800**

Remove the needle bearing from the gear case (6).

- Remove the needle bearing with care not to damage the gear case.



Apply gear oil to the outer circumference of a new needle bearing (28.575 x 44.45 x 31.75 mm) (1).

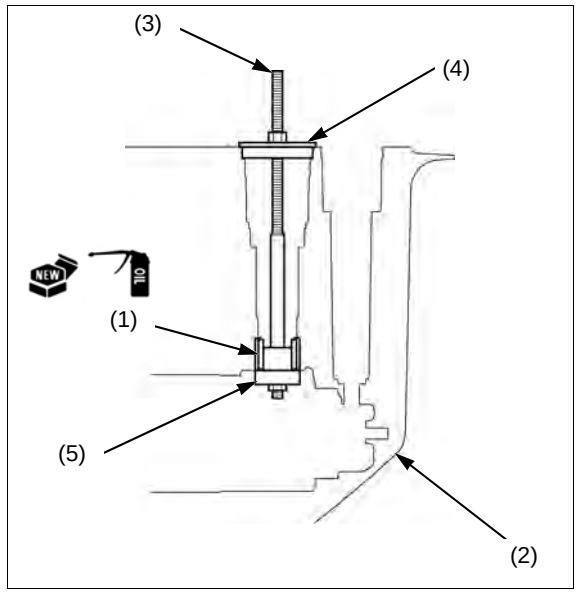
Install the needle bearing into the gear case (2) using the special tools.

- Install the needle bearing with the stamped side facing down (facing the special tool side).

TOOLS:

Installer shaft, 15 x 370 mm (3)	**07VMF-KZ30200**
Attachment, 78 x 90 mm (4)	**07GAD-SD40101**
Oil seal driver attachment, 27.5 x 44 mm (5)	**07948-9540000**

After installation, check that the bottom surface of the needle bearing is flush with the bottom of the gear case.



MEMO

17. GEAR CASE (COUNTER ROTATION)

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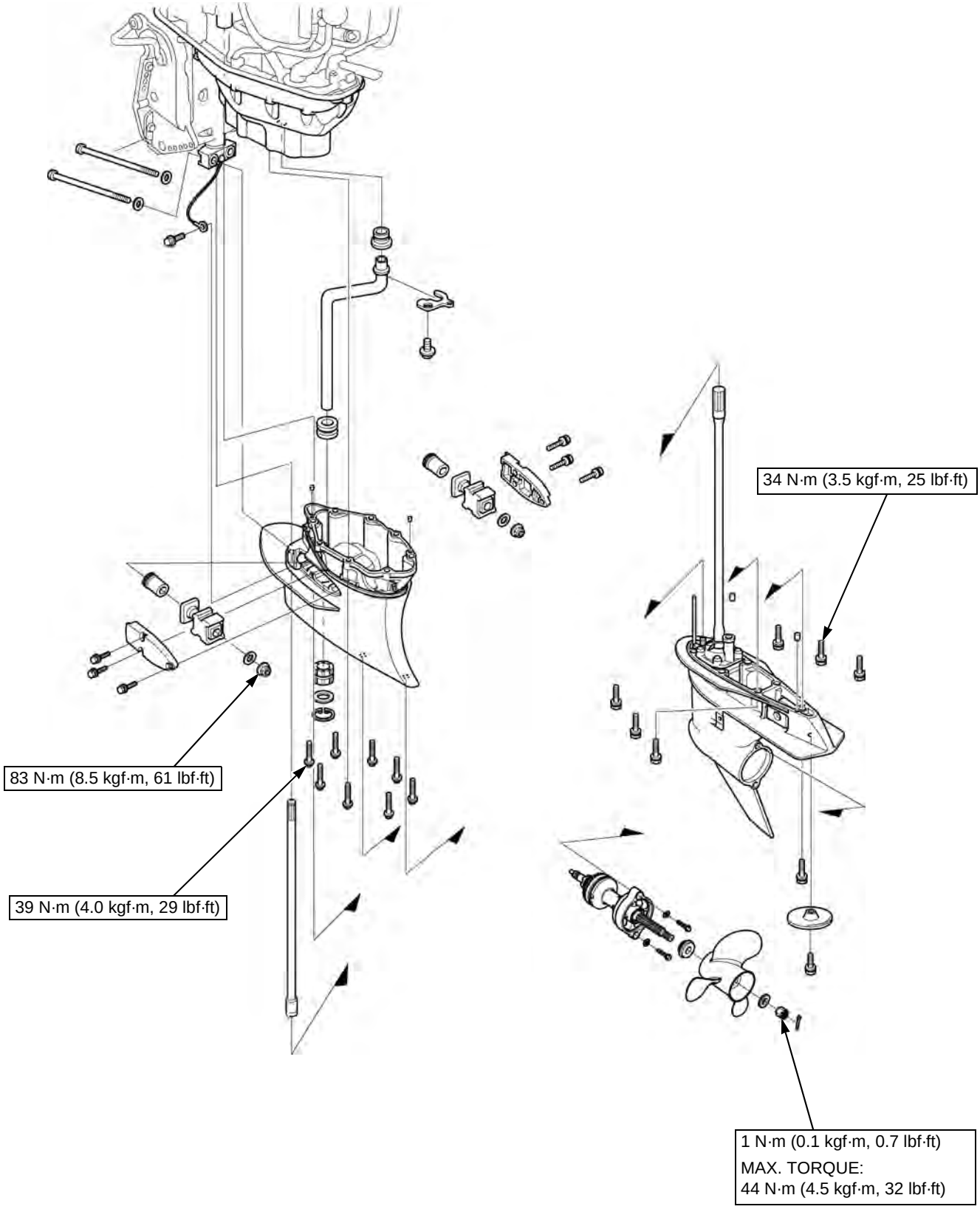
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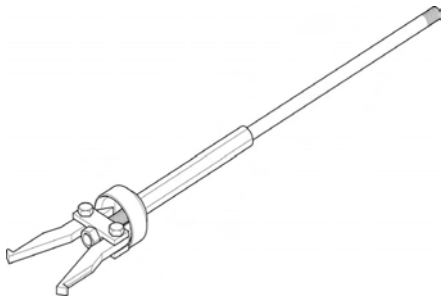
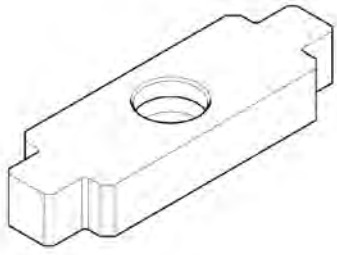
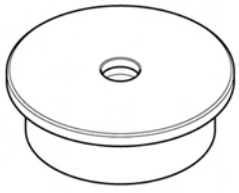
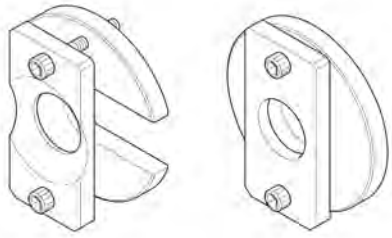
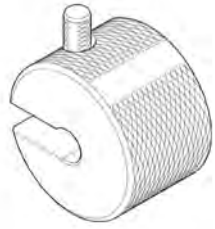
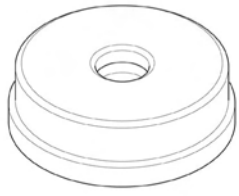
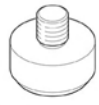
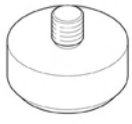
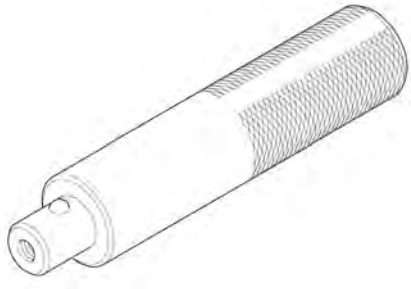
GEAR CASE BEARING
REPLACEMENT ····· 17-55

COMPONENT LOCATION

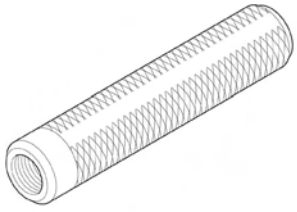
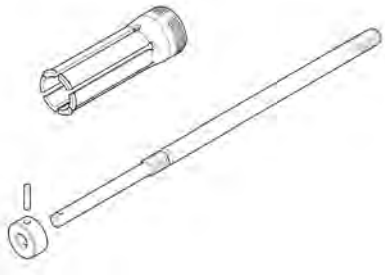
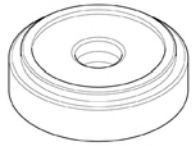
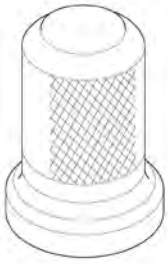
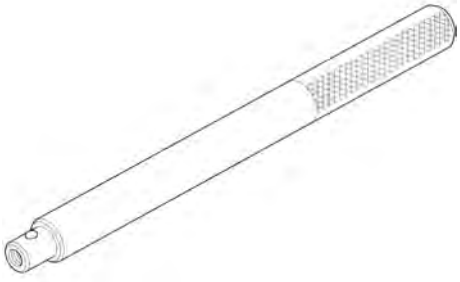
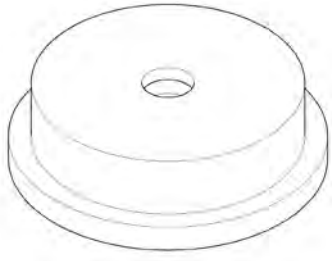
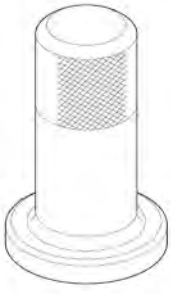
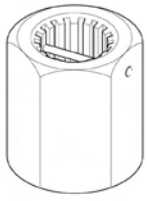
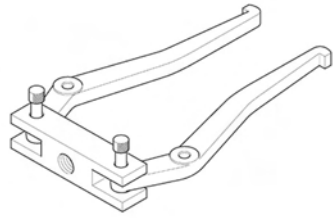


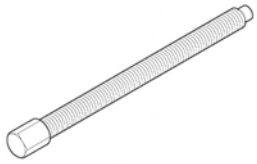
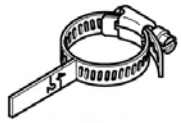
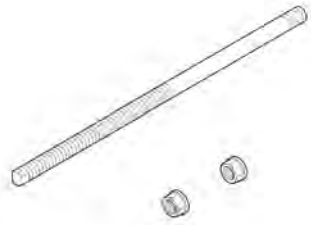
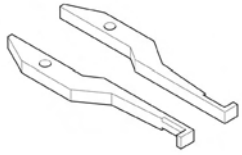
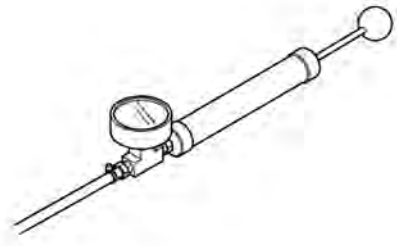
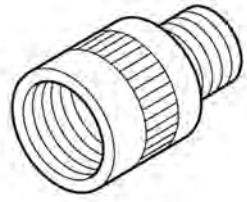
TOOLS

LIST

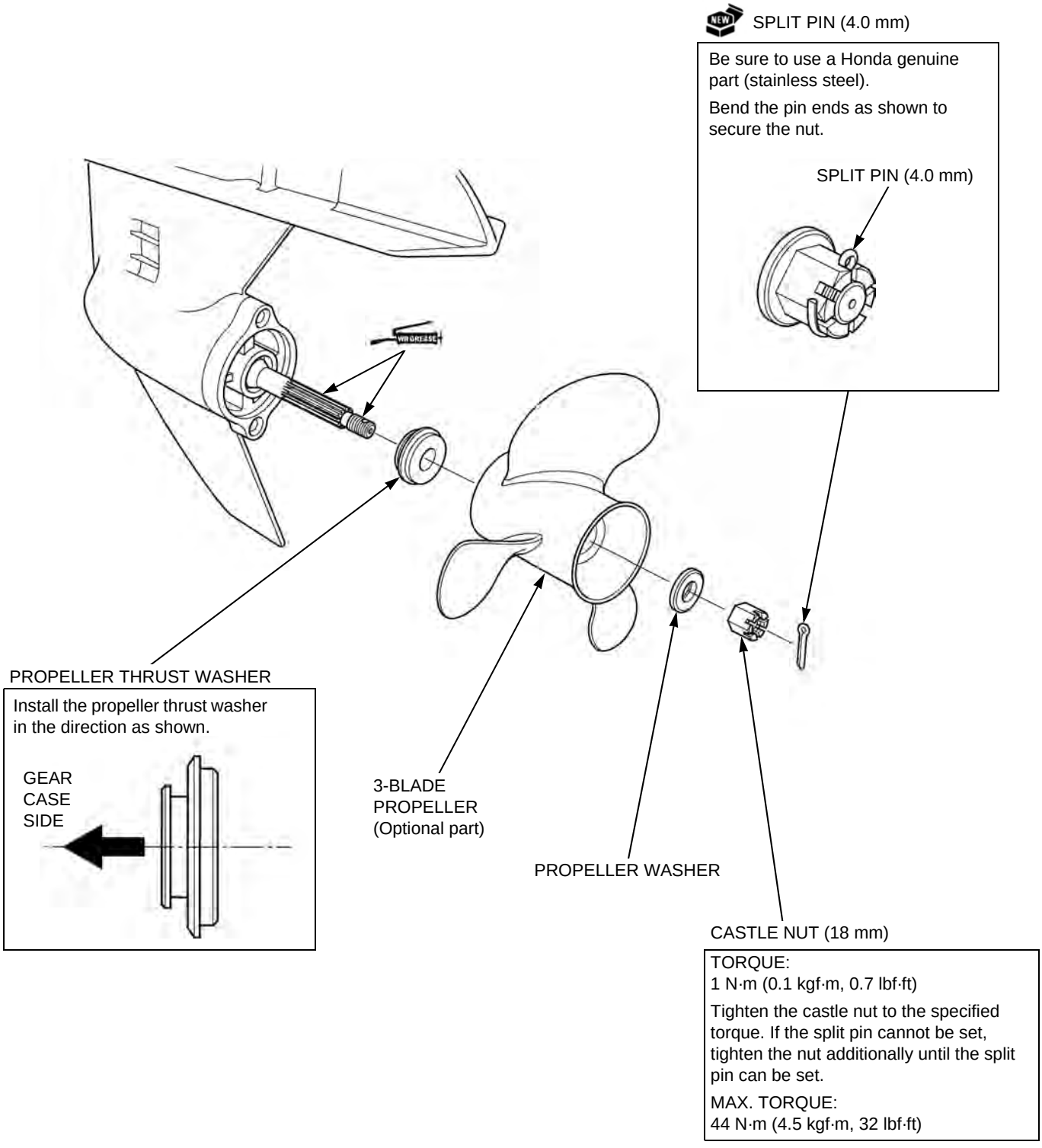
Bearing race puller 070PC-ZY30100 	Taper bearing driver attachment 070PD-ZY60100 	Attachment, 30 x 37 mm 070PD-ZY60200 
Taper bearing installer attachment 070PF-ZY60100 	Gauge adapter, 100 mm 070PJ-ZY30100 	Remover weight 07741-0010201 
Attachment, 52 × 55 mm 07746-0010400 	Attachment, 62 x 68 mm 07746-0010500 	Pilot, 25 mm 07746-0040600 
Pilot, 35 mm 07746-0040800 	Driver 07749-0010000 	Lock nut wrench 36 x 47.8 mm 07916-MB00002 

GEAR CASE (COUNTER ROTATION)

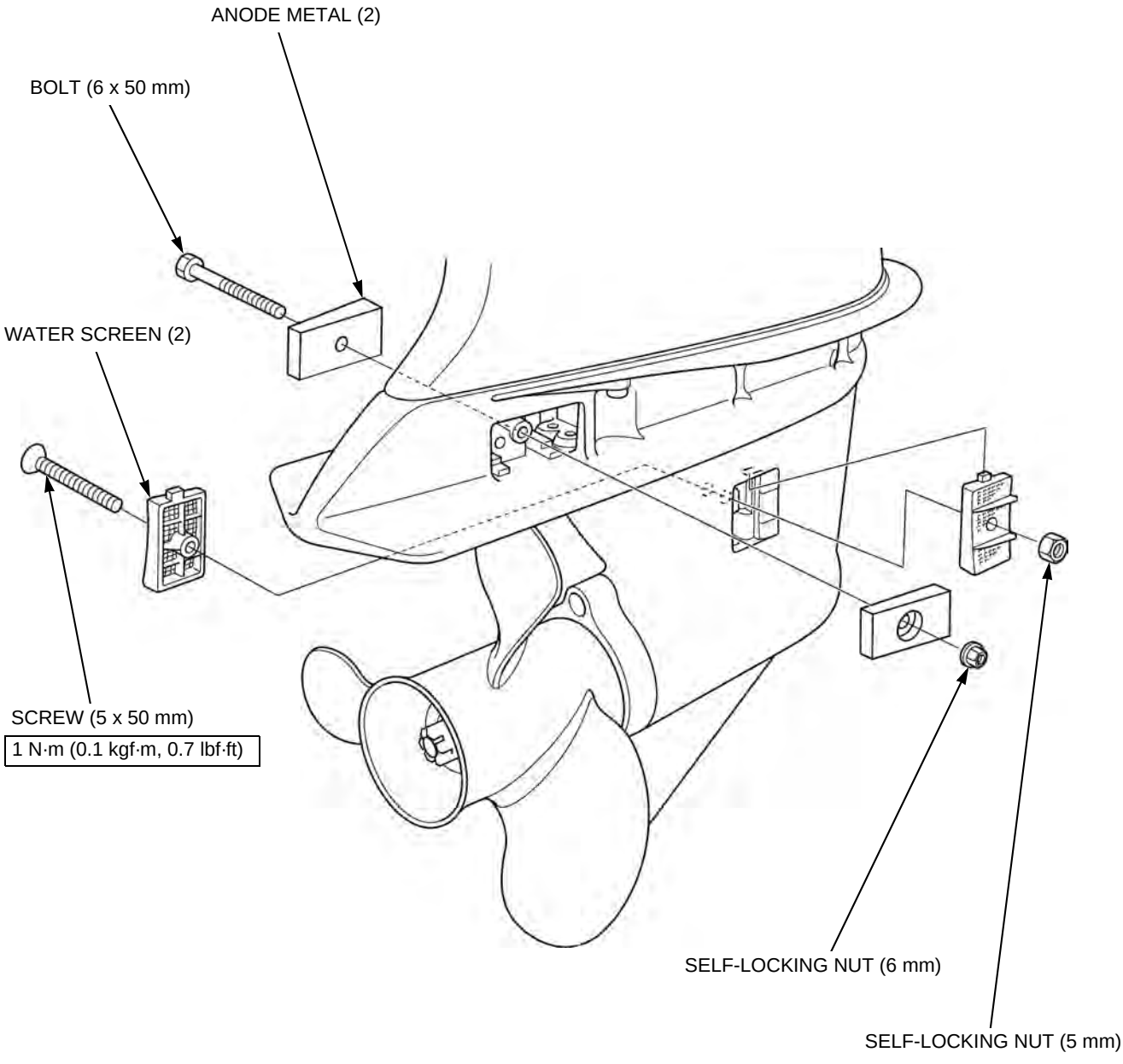
Remover handle 07936-3710100 	Bearing remover, 30 mm 07936-8890300 	Bearing driver attachment, 44 x 49.5 mm 07945-3330300 
Oil seal driver, 44.5 mm 07947-SB00100 	Oil seal driver attachment, 21 mm 07947-ZV00100 	Oil seal driver attachment, 27.5 x 44 mm 07948-9540000 
Driver, 280 mm 07949-3710001 	Driver shaft, B 07964-MB00200 	Attachment, 78 x 90 mm 07GAD-SD40101 
Oil seal driver, 65 mm 07JAD-PL90100 	Vertical shaft holder 07SPB-ZW10200 	Puller jaws 07SPC-ZW0010Z 

Puller bolt 07SPC-ZW0011Z 	Backlash indicator tool 07SPJ-ZW0030Z 	Installer shaft, 15 x 370 mm 07VMF-KZ30200 
Pin spanner wrench, 110 mm 07WAA-S1G0100 	Puller jaws, 25 mm 07WPC-ZW50100 	Backlash indicator attachment 07WPK-ZW50100 
Bearing remover attachment, 37 mm 07ZMD-MBW0200 	Pressure tester S-34 07APJ-001A100 	Adapter 07APJ-001A300 

PROPELLER REMOVAL/ INSTALLATION



ANODE METAL/WATER SCREEN REMOVAL/INSTALLATION



GEAR CASE REMOVAL/INSTALLATION

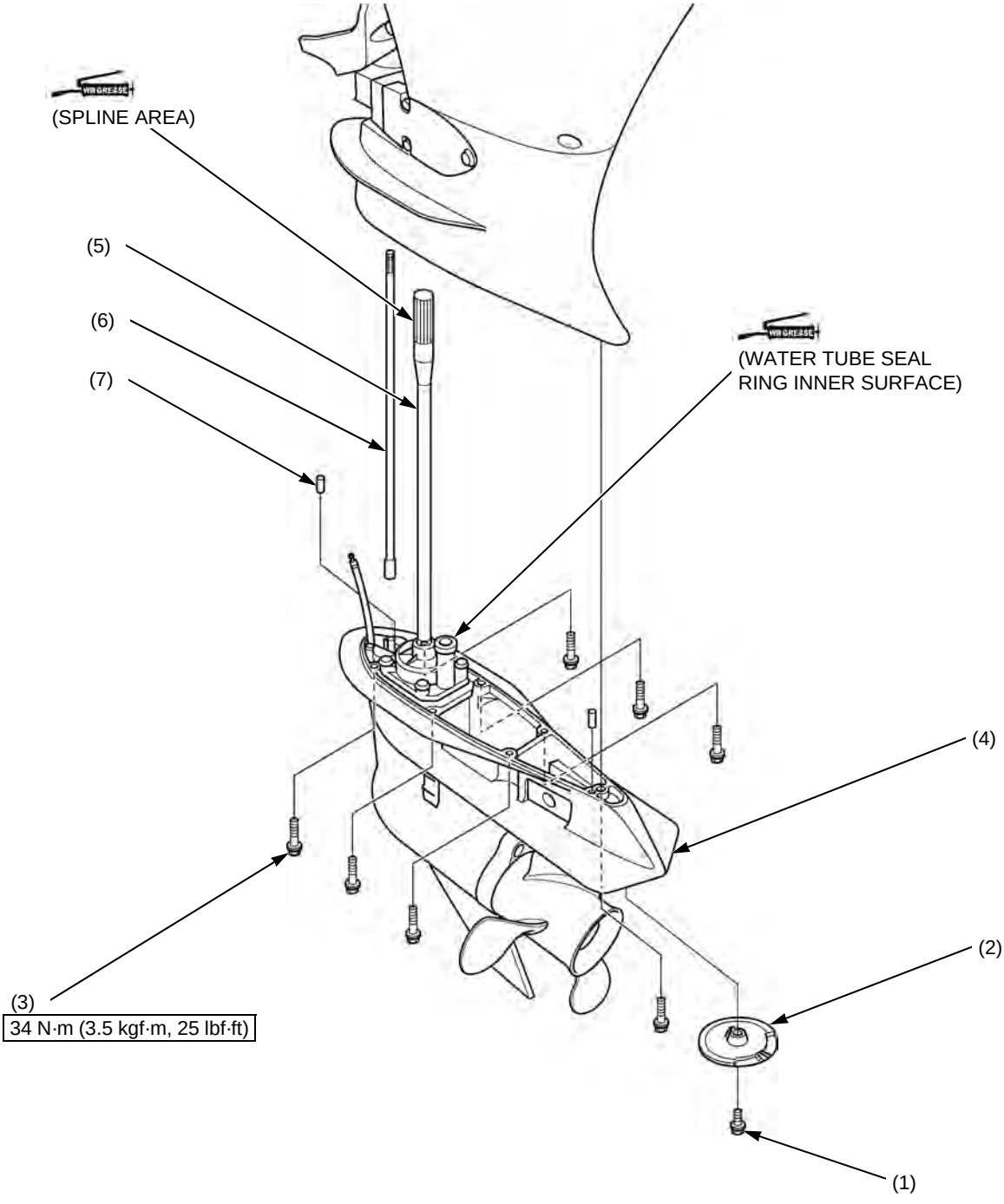
REMOVAL

Set the remote control lever in the "N" (Neutral) position.
Tilt up the motor to the uppermost position.

Remove the bolt (10 × 32 mm) (1) and gear case cover (2).
Remove the seven bolts (10 × 40 mm) (3) while supporting the gear case (4).

Remove the gear case with care not to damage the vertical shaft (5).
Remove the shift rod A (6) and two dowel pins (7).

After removing the gear case, tilt down the motor to the lowermost position.

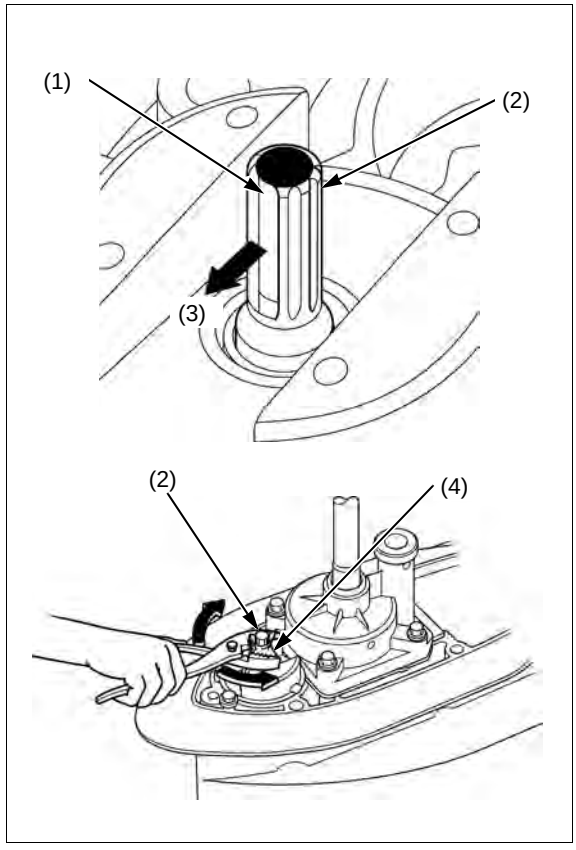


INSTALLATION

Set the remote control lever in the "N" (Neutral) position.

Check that the cutout (1) of the shift rod (2) spline faces the cruising direction (3) (this position is "N" (Neutral)).

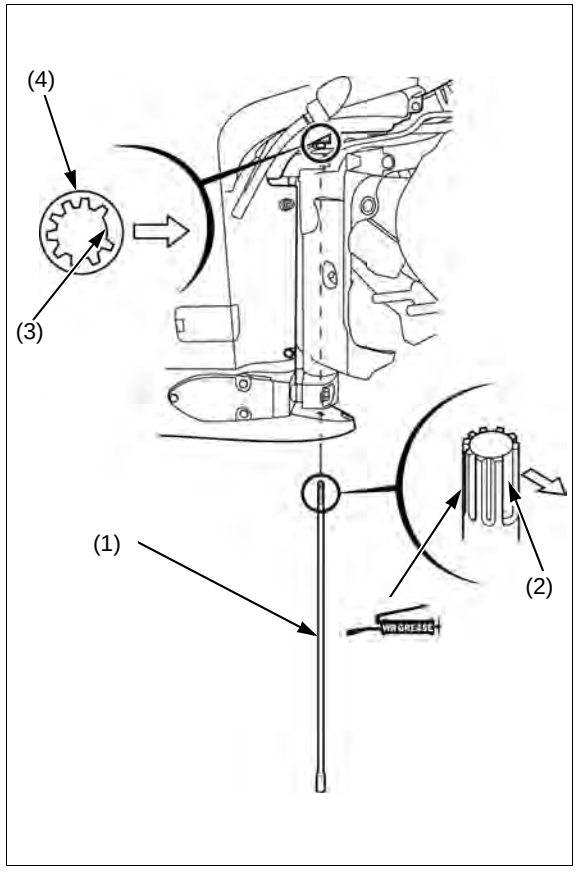
If the cutout of the spline is not in the cruising direction, protect the spline with a shop towel (4) and turn the shift rod right or left with a wrench until the cutout faces toward the cruising direction.



Tilt up the motor to the uppermost position.

Apply marine grease to the spline area of the shift rod A (1).

Install the shift rod A by aligning its spline groove (2) with the spline projection (3) of the shift shaft A (4).

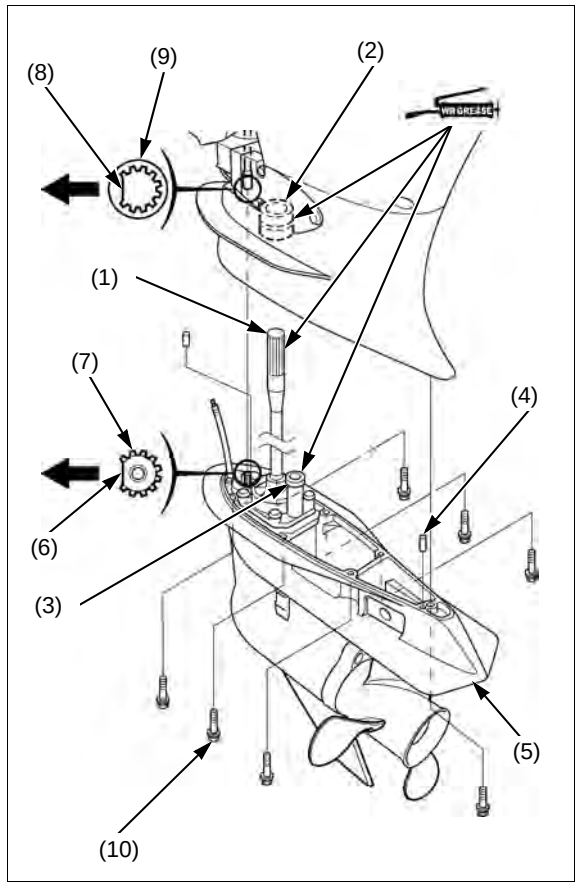


Apply marine grease to the vertical shaft (1) spline area, vertical shaft bushing (2) inner surface and water tube seal ling (3).

Install the two dowel pins (4) to the gear case (5).

Install the gear case by aligning the spline cutout (6) of the shift rod (7) with the spline projection (8) of the shift rod A (9).
Loosely install the seven bolts (10).
Tilt down the motor to the lowermost position.
Tighten the seven bolts to the specified torque.

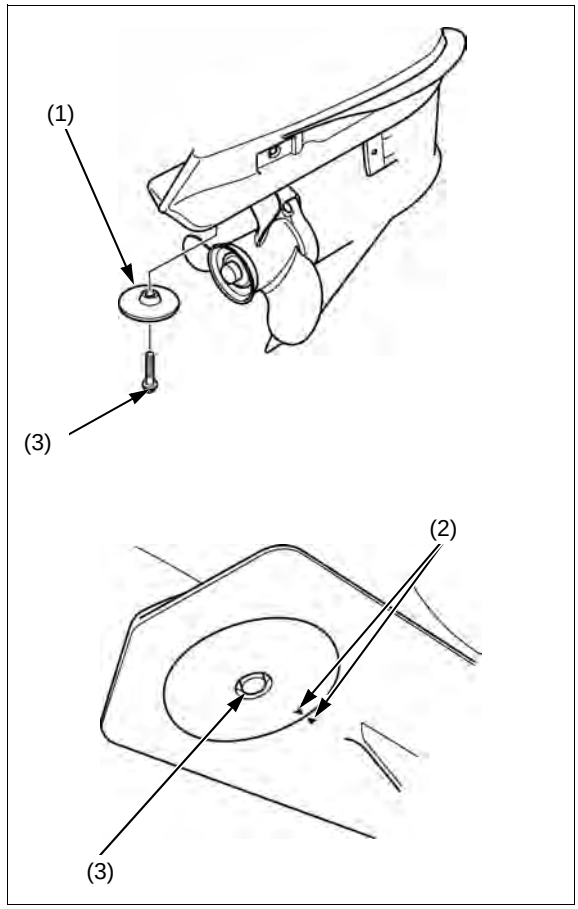
TORQUE: 34 N·m (3.5 kgf·m, 25 lbf·ft)



Install the gear case cover (1) by aligning the "△" marks (2).

Install and tighten the bolt (3).

After installing the gear case, adjust the shift control cable (page 20-16).



VERTICAL SHAFT BUSHING REMOVAL/INSTALLATION

Remove the gear case (page 17-8).

Remove the internal circlip (1), washer (2) and vertical shaft bushing (3).

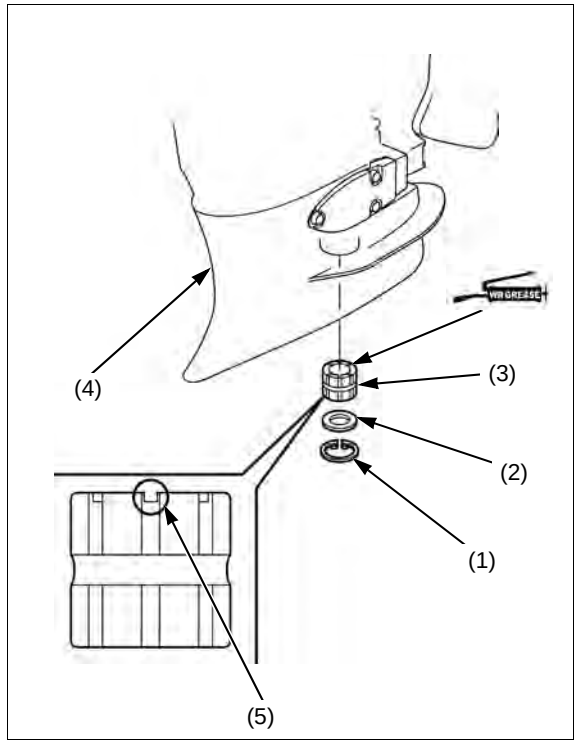
Inspect the vertical shaft bushing (page 17-54) and replace if necessary.

Install the vertical shaft bushing to the extension case (4) with its groove (5) facing up.

Apply marine grease to the vertical shaft bushing inner surface.

Install the washer and internal circlip.

Install the gear case (page 17-9).



EXTENSION CASE REMOVAL/ INSTALLATION

REMOVAL

Remove the following:

– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)
– Gear case (page 17-8)

Remove the three bolts (8 × 30 mm) (1) and lower mount housing (2).

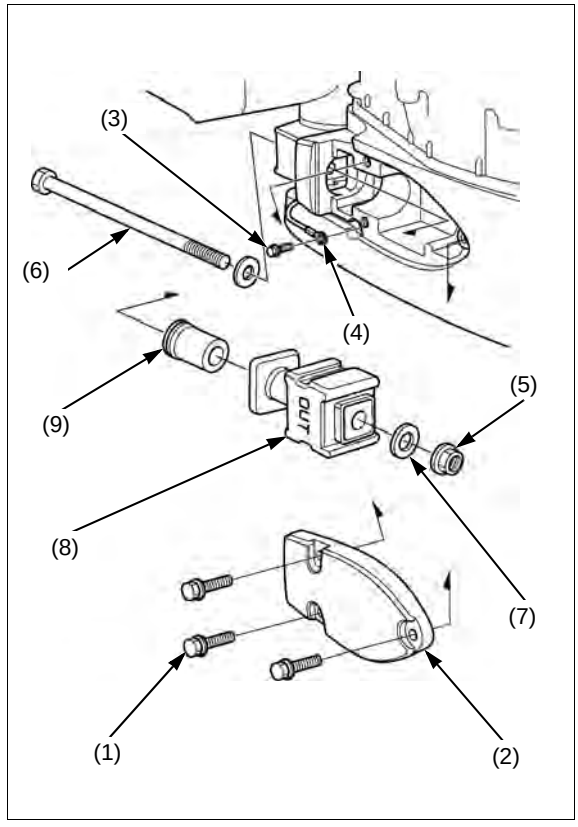
Remove the bolt (6 × 12 mm) (3) and ground terminal (4).

Remove the self-locking nut (5), bolt (12 × 225 mm) (6) and two washers (7).

Slightly move the extension case and remove the lower rubber mount (8) and lower mount collar (9).

Remove the same parts described above from the opposite side of the extension case, except the bolt and ground terminal.

- Support the outboard motor securely in order to prevent the upper mount from being damaged when the lower rubber mount is removed from the extension case, which may cause an excessive load on the upper mount.



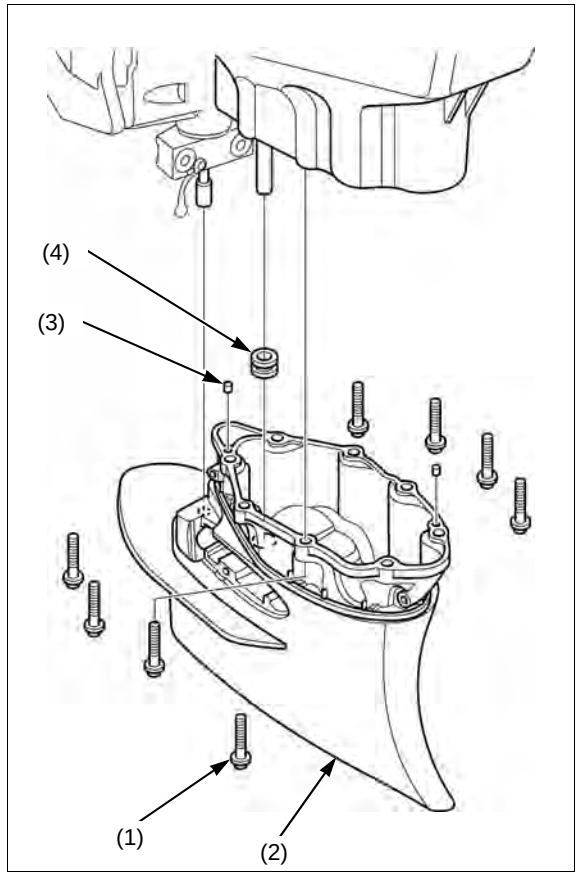
Remove the eight bolts (1) and extension case (2).

NOTICE

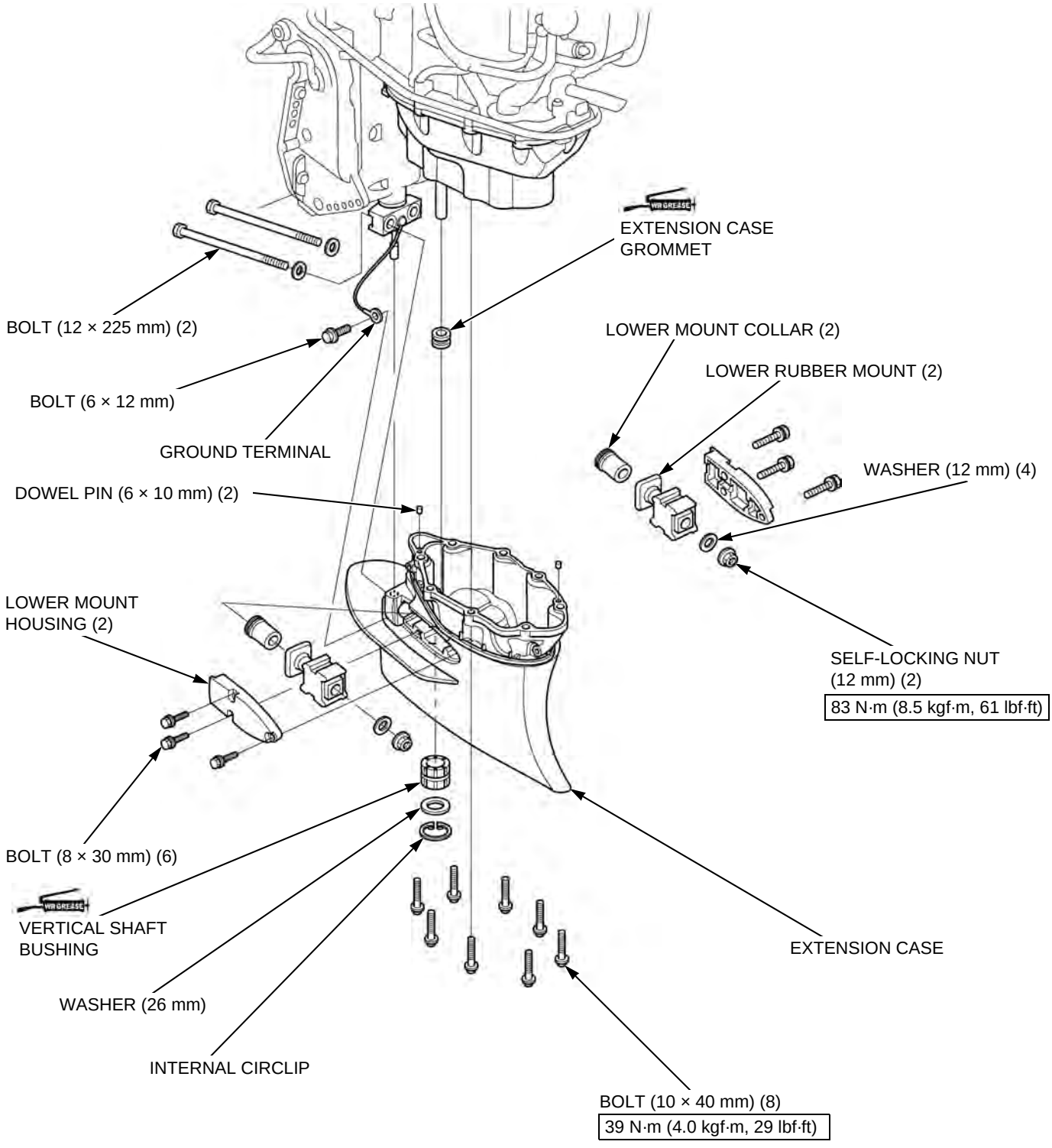
Take care not to drop the extension case.

Remove the two dowel pins (3) from the extension case.

Remove the extension case grommet (4).



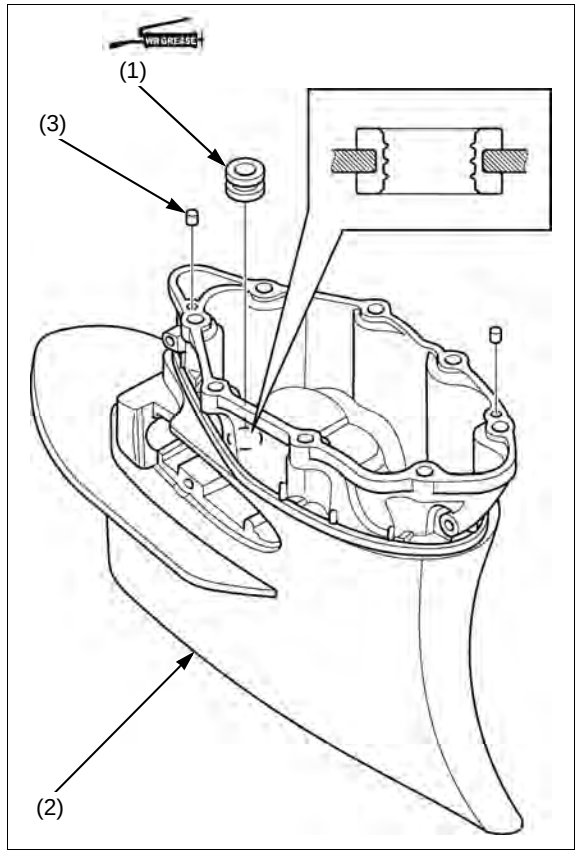
EXPLODED VIEW



INSTALLATION

Apply marine grease to the extension case grommet (1) inner surface and install it to the extension case (2) as shown.

Install the two dowel pins (3) to the extension case.

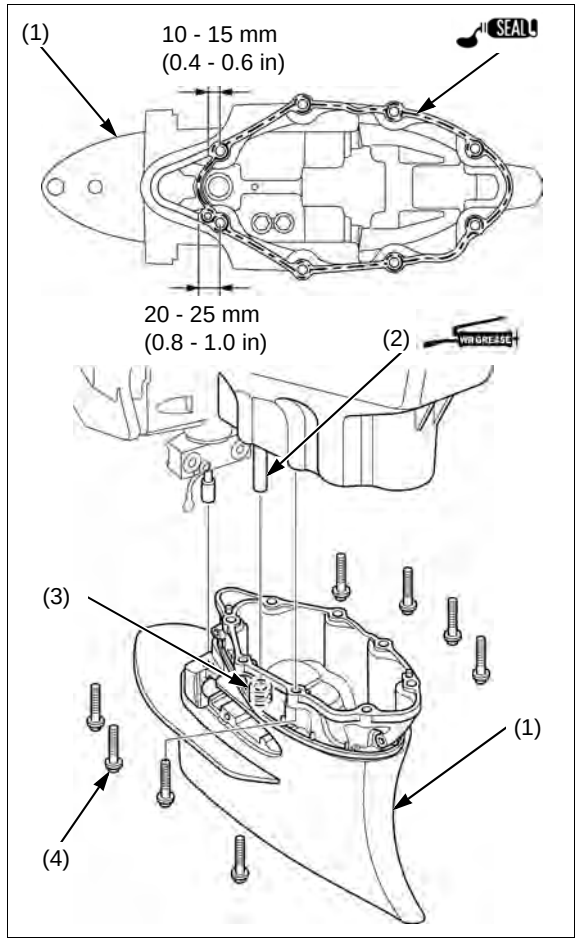


Clean the mating surfaces of the extension case (1) and oil case using a degreasing agent.

Apply liquid sealant (Threebond® 5222B or equivalent) to the specified area of extension case as shown.

Apply marine grease to the tip of the water tube (2).
Install the extension case by aligning the water tube with the extension case grommet (3).
Install and tighten the eight bolts (4) to the specified torque.

TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)



Install the lower rubber mount (1) and lower mount collar (2) while holding the extension case.

- Install the lower mount collar with the smaller diameter side toward the lower rubber mount.
- Install the lower rubber mount with the "OUT" mark toward out.

Install the bolt (12 × 225 mm) (3), two washers (4) and tighten the self-locking nut (5) to the specified torque.

TORQUE: 83 N·m (8.5 kgf·m, 61 lbf·ft)

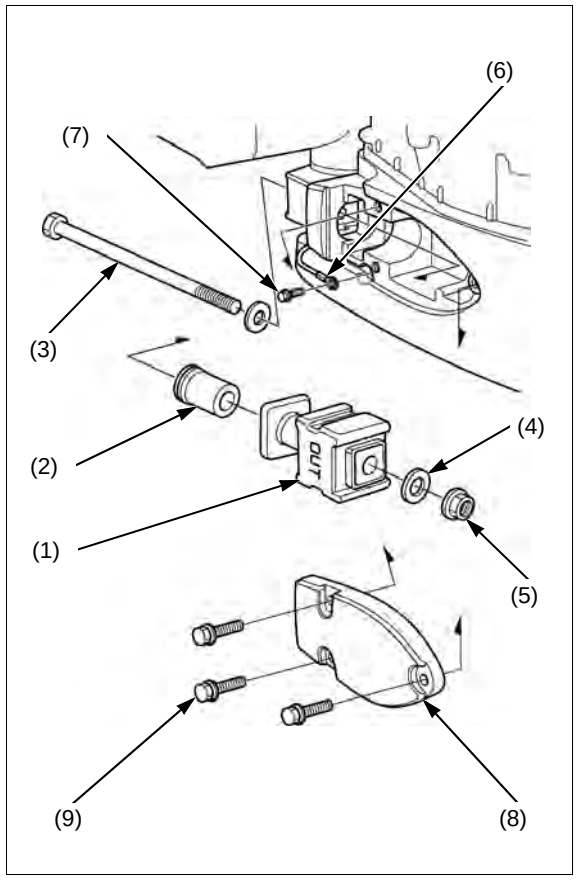
Install the ground terminal (6) and tighten the bolt (6 × 12 mm) (7).

Install the lower mount housing (8) and tighten the three bolts (8 × 30 mm) (9).

Install the same parts described above to the opposite side of the extension case, except the bolt and ground terminal.

Install the following:

– Gear case (page 17-9)
– L. engine under cover (page 6-6)
– R. engine under cover (page 6-11)

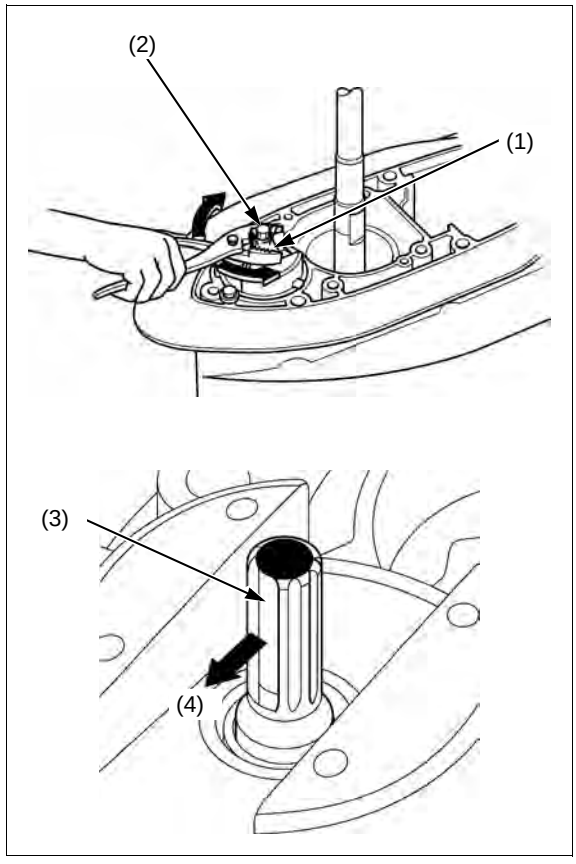


SHIFT ROD REMOVAL/INSTALLATION

REMOVAL

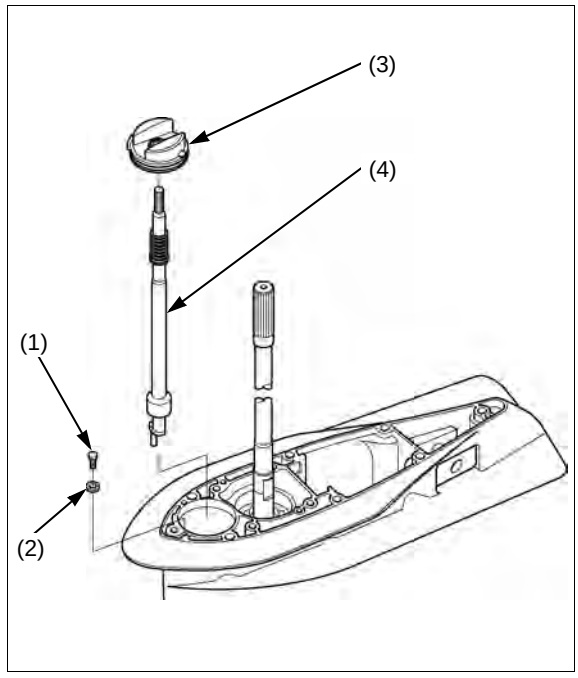
Remove the water pump (page 11-7).

Wrap a shop towel (1) around the shift rod (2) spline, and use pliers to turn the shift rod in the shown direction (cutout (3) of the shift rod spline is facing toward the cruising direction (4)).

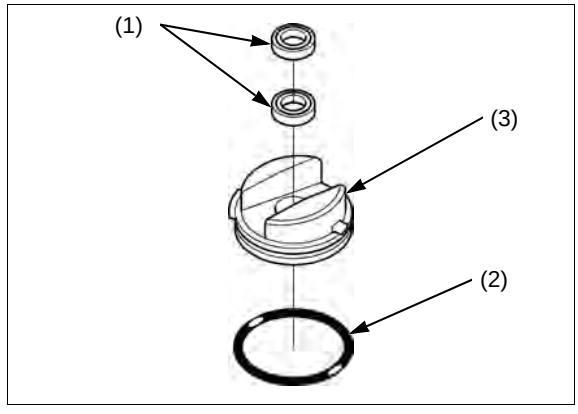


Remove the bolt (1) and washer (2).

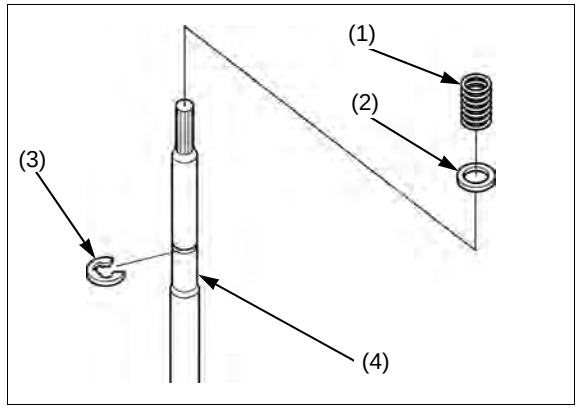
Remove the shift rod holder (3) and shift rod (4).



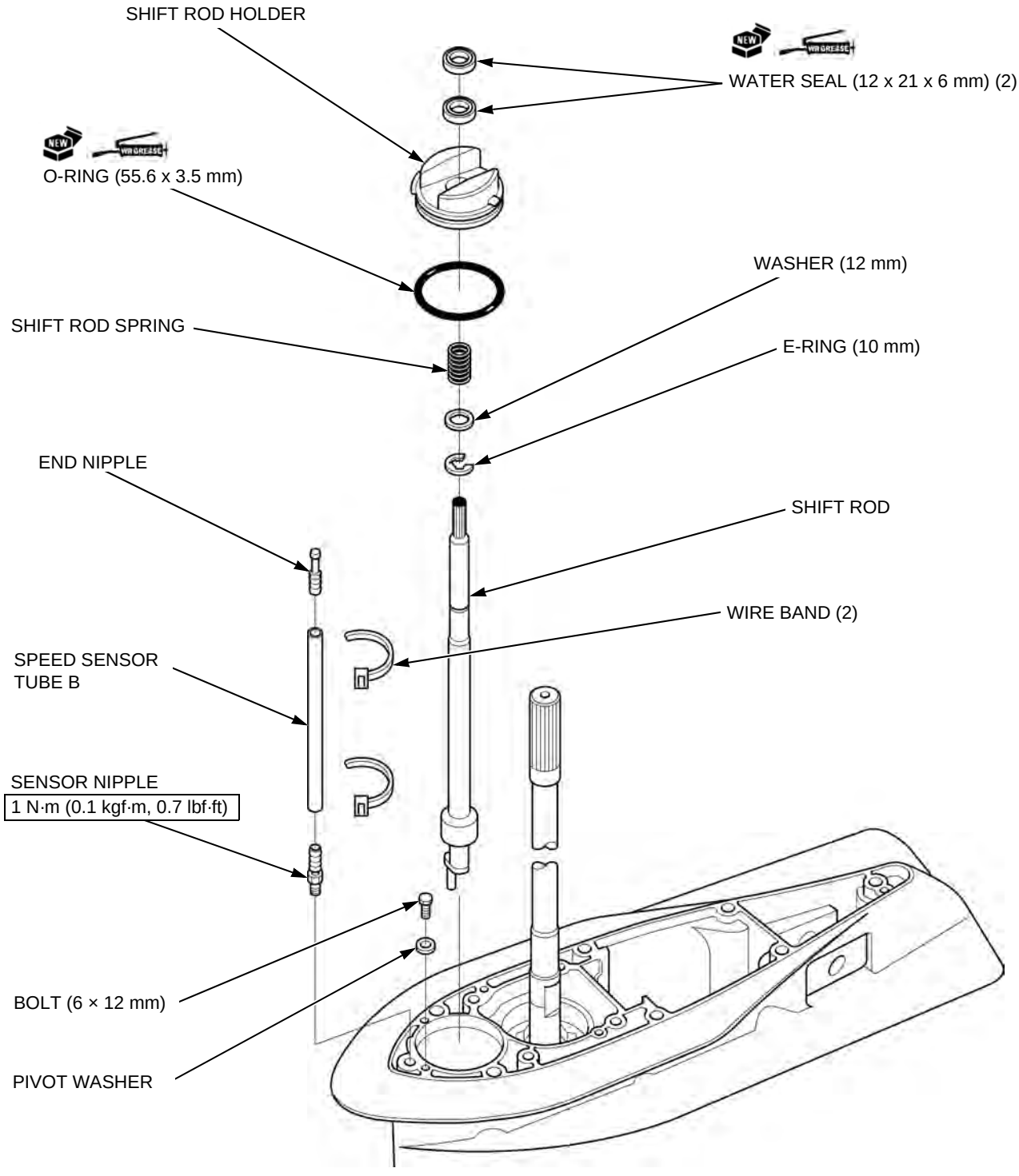
Remove the two water seals (1) and O-ring (2) from the shift rod holder (3).



Remove the shift rod spring (1), washer (2) and E-ring (3) from the shift rod (4).



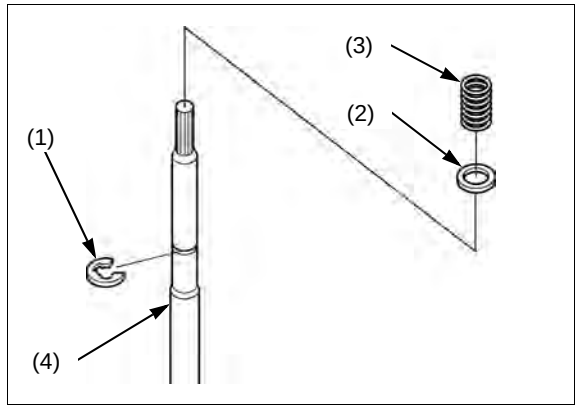
EXPLODED VIEW



INSTALLATION

Install the E-ring (1), washer (2), and shift rod spring (3) onto the shift rod (4).

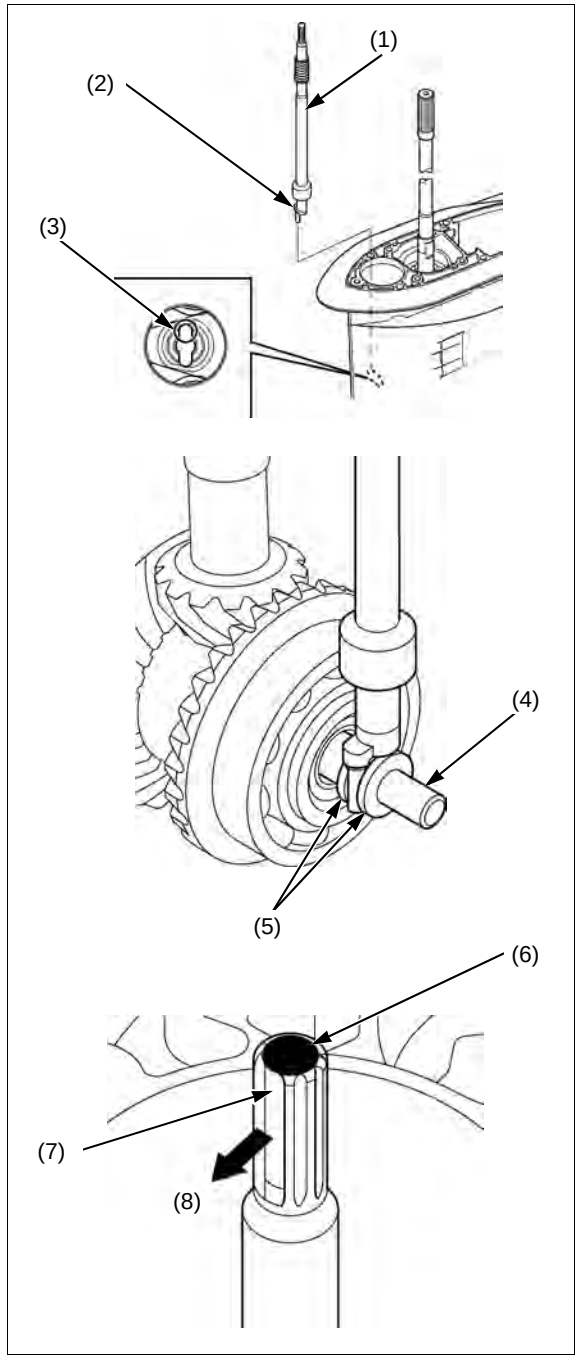
- Do not reuse the E-ring if it is deformed or deteriorated.
- Check that the E-ring is set in the groove in the shift rod securely.



Insert the shift rod (1) into the gear case by aligning the cam (2) of the shift rod with the "A" point (3) of the gear case as shown.
Install the shift rod onto the shift slider (4) by aligning the cam of the shift rod with the groove (5) in the shift slider.

- Check that there is a marking (6) in the shift rod end.

After installing the shift rod, position the shift rod in the "N" (Neutral) position and check that the cutout in the spline (7) faces the cruising direction (8).



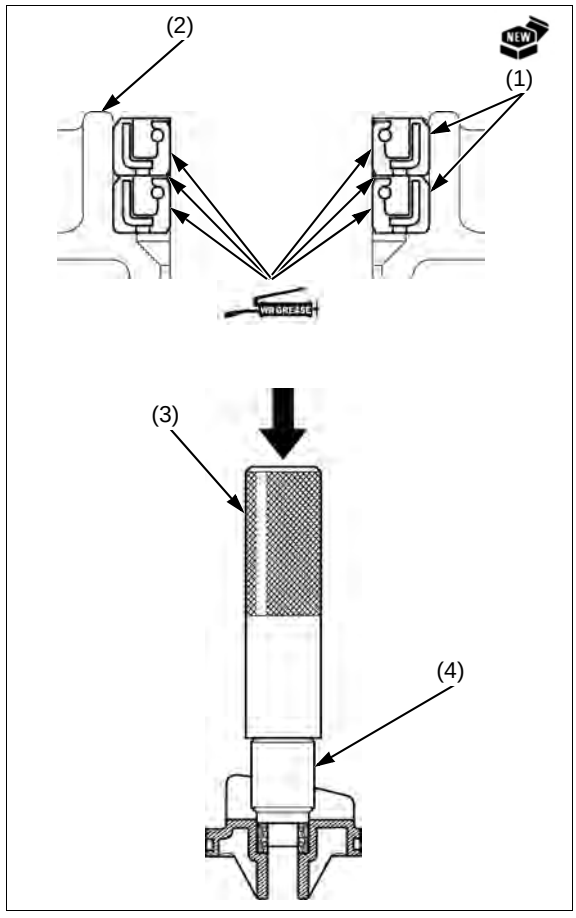
Apply marine grease to the mating surfaces and soapy water to the circumference of the new water seals (1).

Drive the water seals into the shift rod holder (2) using the special tools in the correct direction as shown.

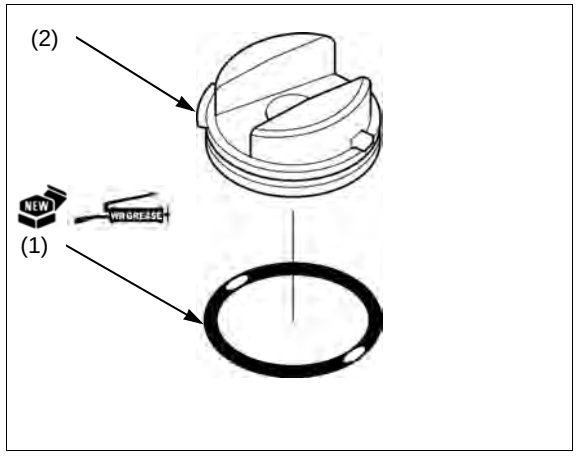
TOOL:

Driver (3)	**07749-0010000**
Oil seal driver attachment, 21 mm (4)	**07947-ZV00100**

After installation, apply marine grease to the water seal lips.



Apply marine grease to a new O-ring (1) and install it to the shift rod holder (2).

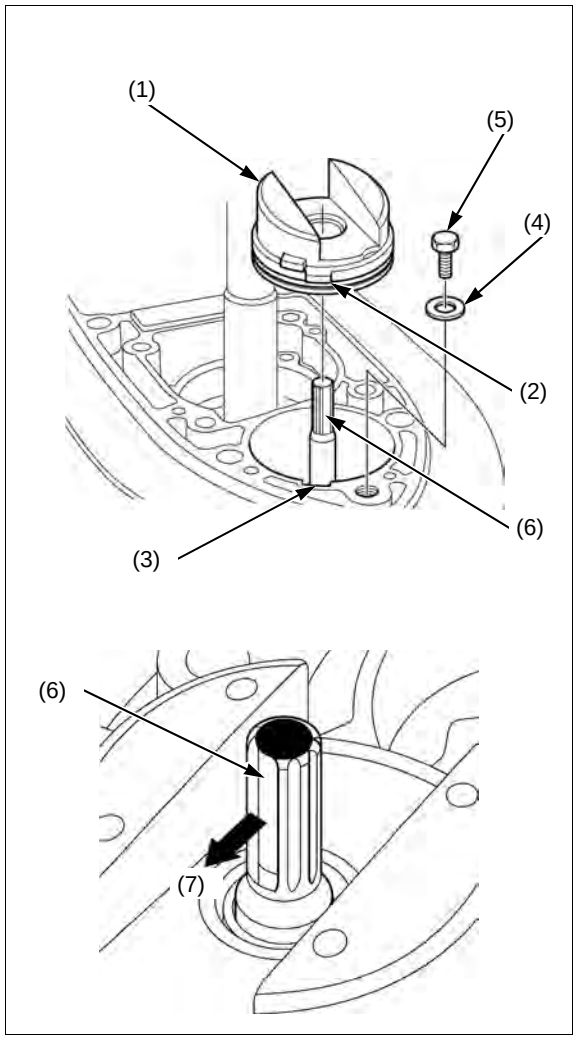


Install the shift rod holder (1) into the gear case by aligning the projection (2) of the shift rod holder with the recess (3) of the gear case.

Install the washer (4) and tighten the bolt (5).

After installation, check that the cutout (6) in the shift rod splines is in the cruising direction (7).

Install the water pump (page 11-10).



PROPELLER SHAFT HOLDER REMOVAL/INSTALLATION

Remove the following:

– Propeller (page 17-6)
– Gear case (page 17-8)
– Shift rod (page 17-15)

Remove the two bolts (1) and two washers (2).
Insert a screwdriver or equivalent tool into the recess (3) in the propeller shaft holder (4) and remove the propeller shaft holder from the gear case (5).

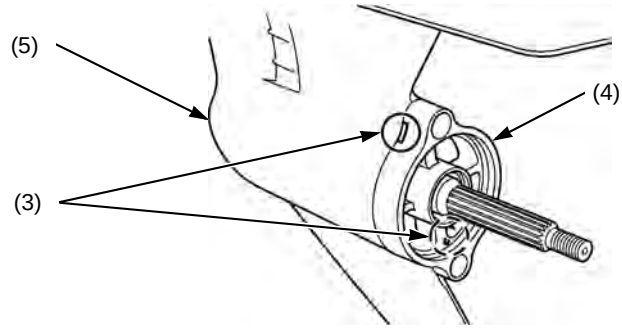
Replace the O-ring (6) with a new one and coat the O-ring with marine grease.

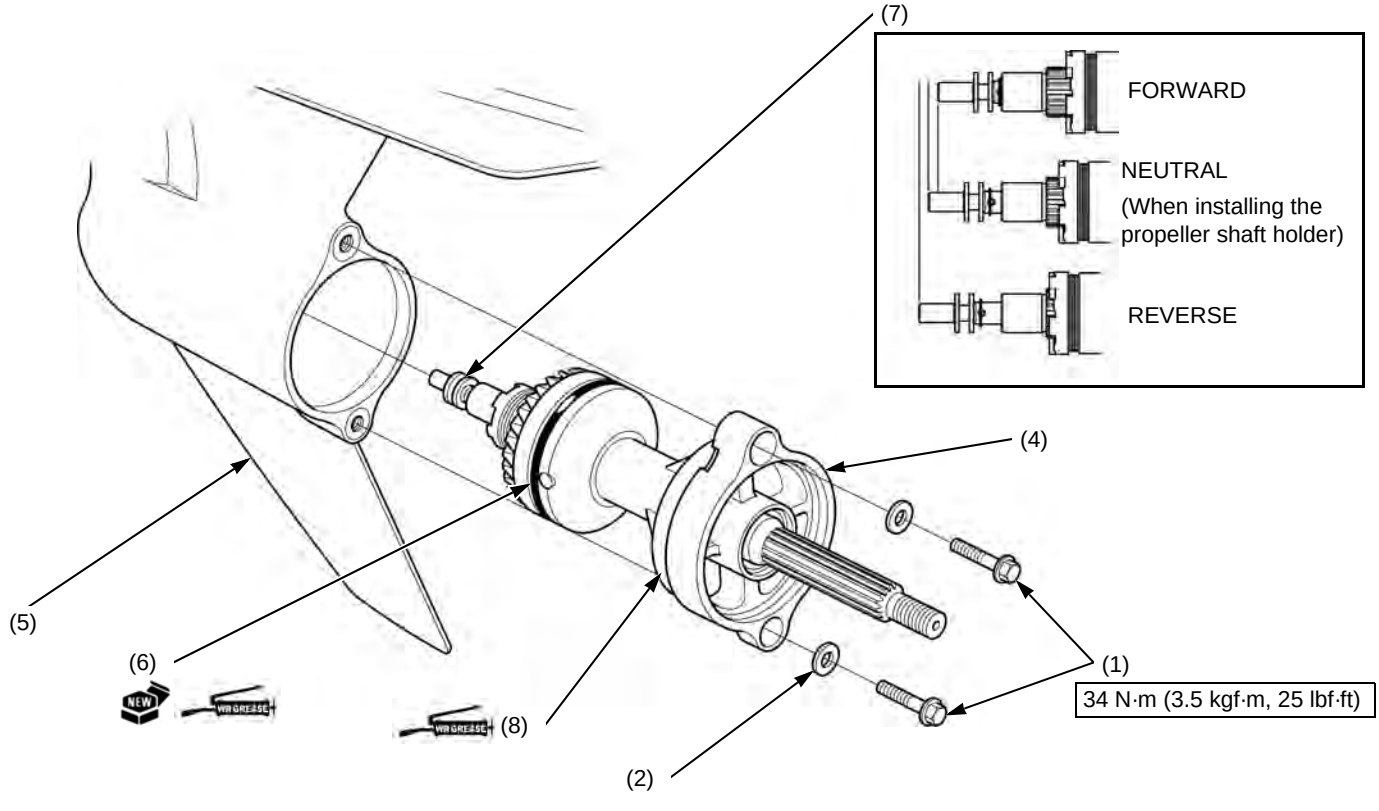
At installation, check that the shift slider (7) of the propeller shaft holder is set in the Neutral position.

Apply marine grease to the gear case insertion area (8) of propeller shaft holder.

Installation is in the reverse order of removal.

Perform the gear case pressure check (page 17-51).



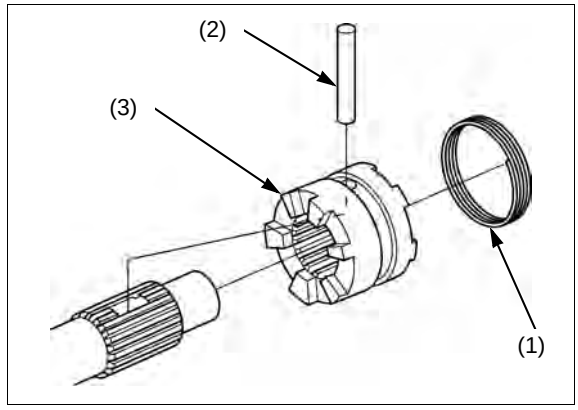


SHIFT SLIDER/BEARING HOLDER/ PROPELLER SHAFT REMOVAL/ INSTALLATION

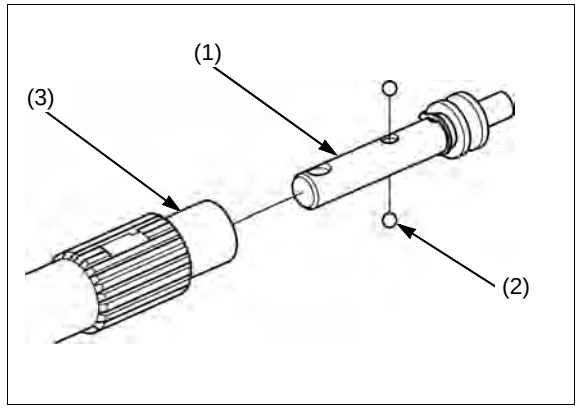
SHIFT SLIDER REMOVAL

Remove the propeller shaft holder (page 17-21).

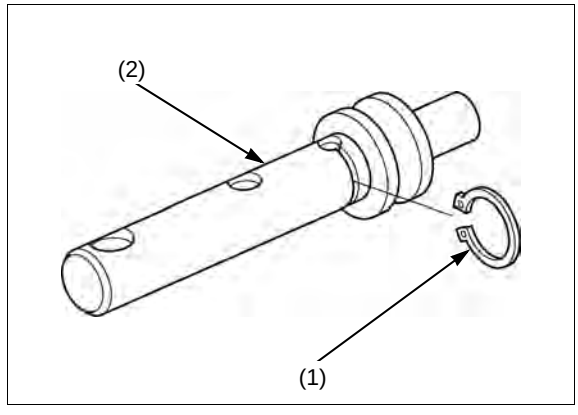
Remove the cross pin ring (1), shifter pin (2) and clutch shifter (3).



Remove the shift slider (1) and two steel balls (#7) (2) from the propeller shaft (3), being careful not to lose the steel balls.

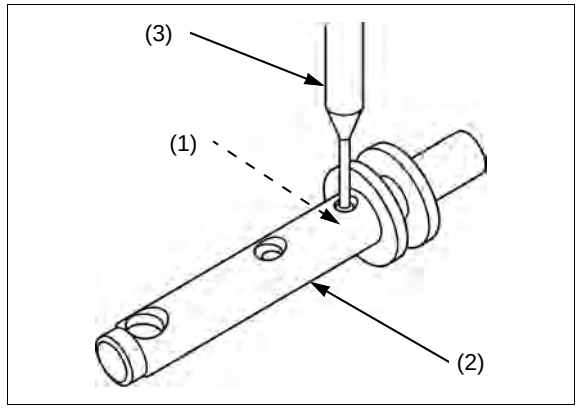


Remove the circlip (1) from the shift slider (2).



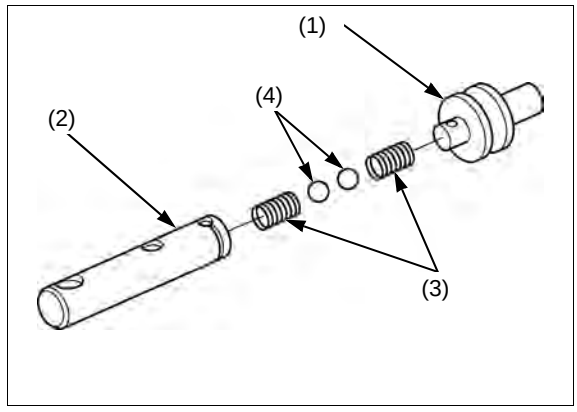
Remove the roller (1) from the shift slider (2) using a commercially available pin driver (3).

- Take care not to let the shift plate, shift springs and steel balls (#9) pop out of the shift slider during removal of the roller.



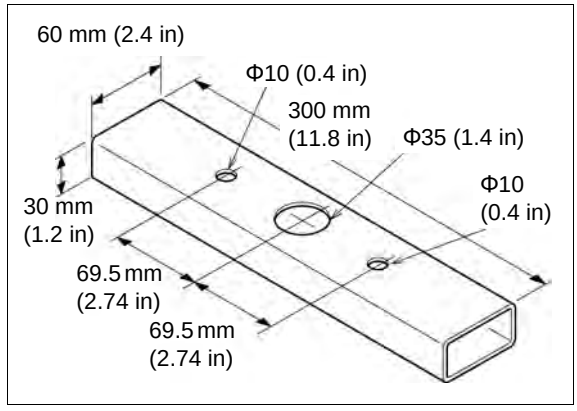
Remove the shift plate (1) from the shift slider (2), then remove the two shift springs (3) and two steel balls (#9) (4).

- Take care not to let the shift springs and steel balls (#9) pop out of the shift slider during removal of the shift plate.



PROPELLER SHAFT REMOVAL

Prepare the fixing tool with the dimensions shown.



Position the propeller shaft holder (1) onto the fixing tool (2) and secure the holder with bolts (3).

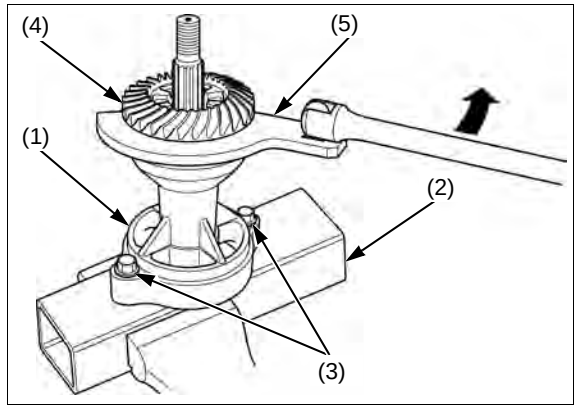
Hold the fixing tool with a vise.

- Avoid holding the propeller shaft holder directly in a vise. Use the fixing tool to hold it in a vise.

Loosen the bearing holder (4) using the special tool as shown.

TOOL:
Pin spanner wrench, 110 mm (5) 07WAA-S1G0100

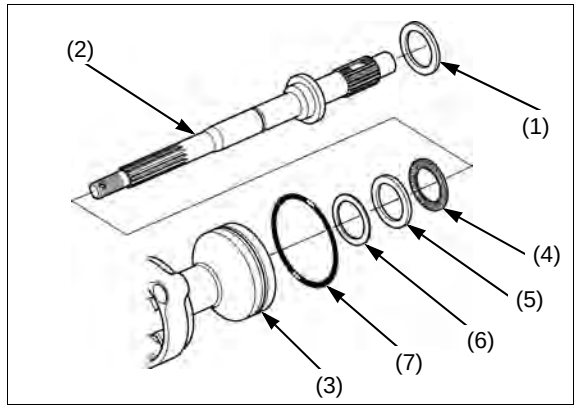
Remove the bearing holder from the propeller shaft holder.



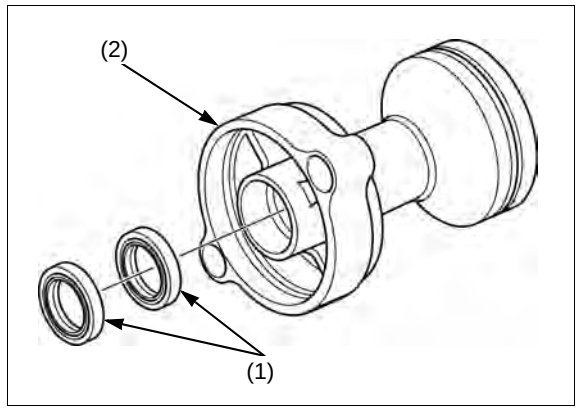
Remove the thrust bearing washer (1) from the propeller shaft (2).

Remove the following parts from the propeller shaft holder (3):

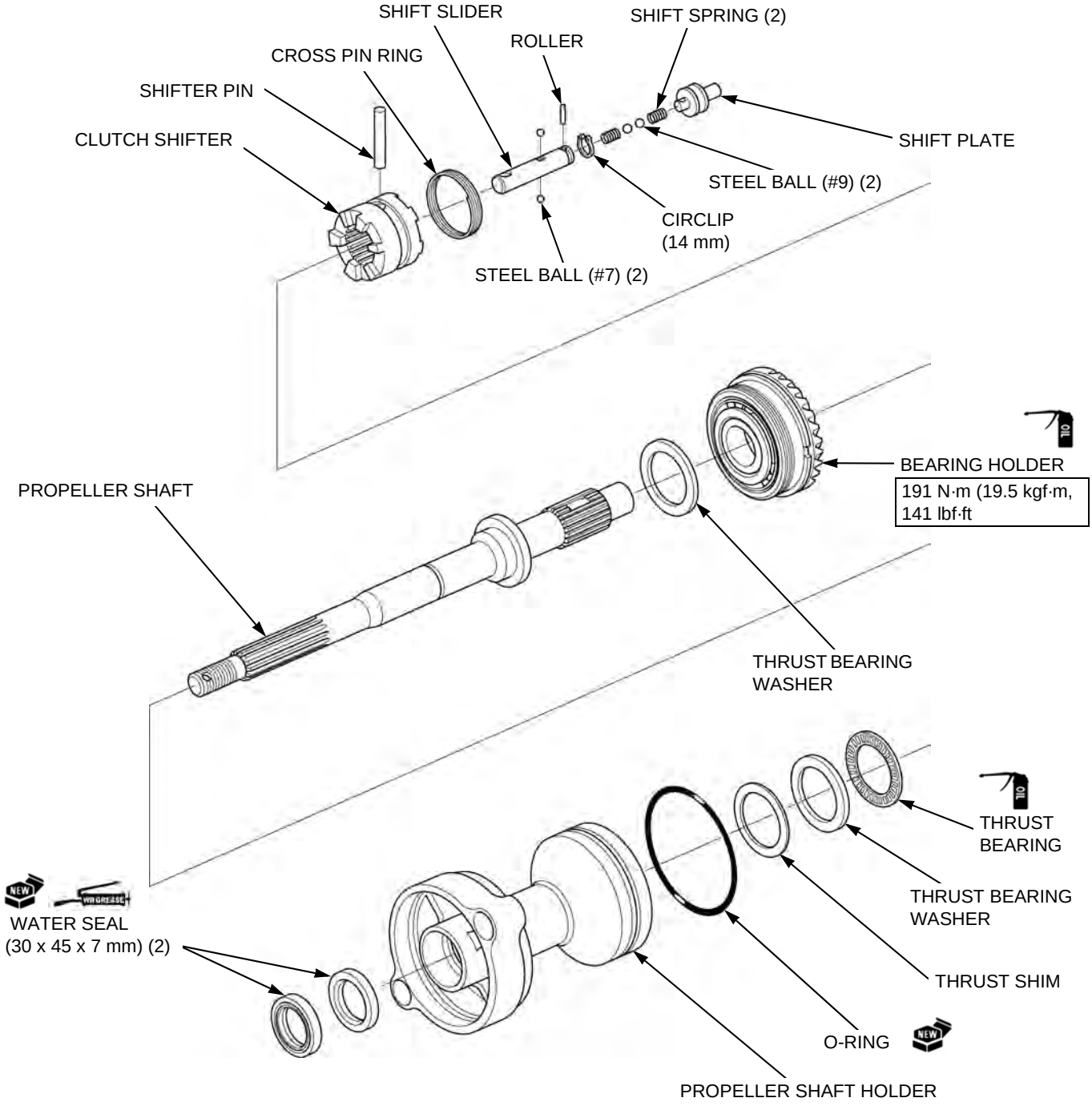
– Propeller shaft
– Thrust bearing (4)
– Thrust bearing washer (5)
– Thrust shim (6)
– O-ring (7)



Remove the two water seals (1) from the propeller shaft holder (2) using a commercially available oil seal remover.



EXPLODED VIEW



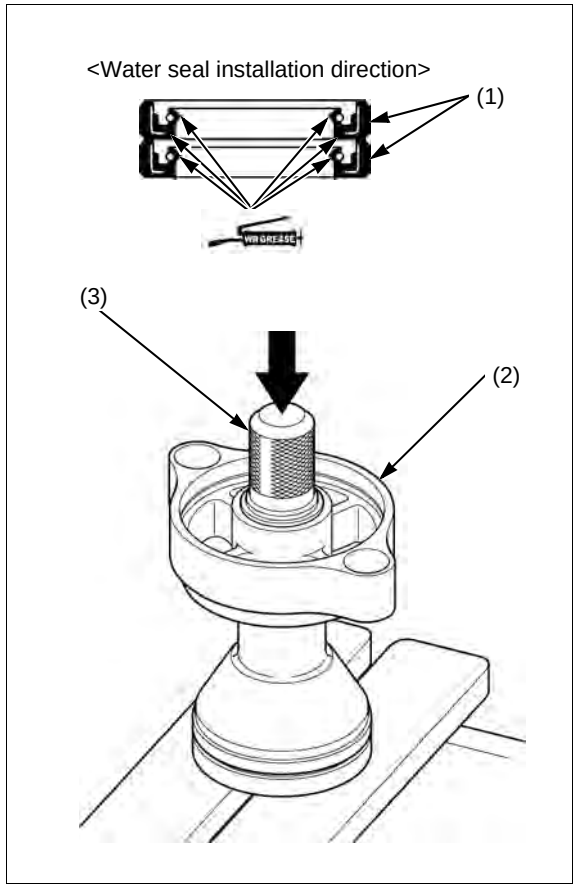
PROPELLER SHAFT INSTALLATION

Apply soapy water to the outer circumference and marine grease to the mating surfaces of new water seals (1).

Install the water seals into the propeller shaft holder (2) in the direction as shown, using the special tool.

TOOL:
Oil seal driver, 44.5 mm (3) 07947-SB00100

After installation, apply marine grease to the lips of the water seals.

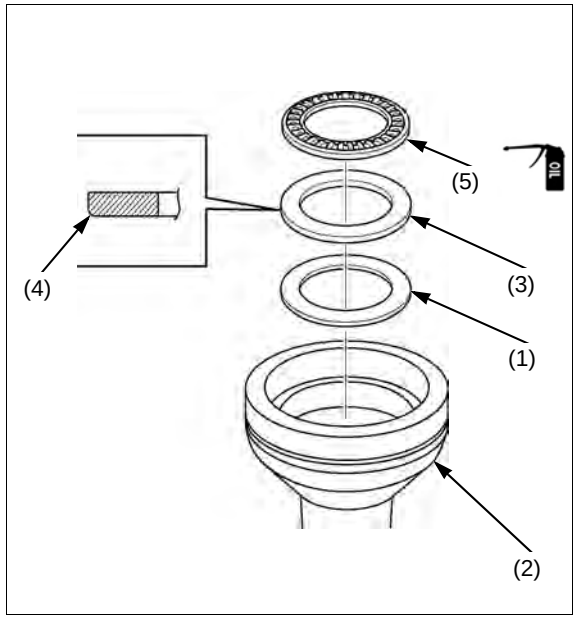


Install the shim (1) on the propeller shaft holder (2).

- When the forward bevel gear shim has been replaced, inspect the propeller shaft thrust clearance, and adjust the thrust shim if necessary (page 17-47).

Install the thrust bearing washer (3) with its chamfered side (4) facing the propeller shaft holder.

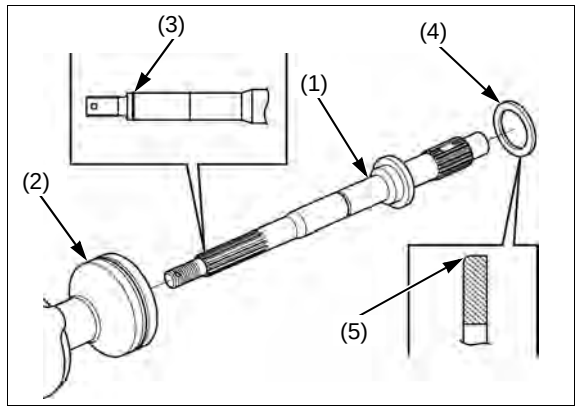
Apply gear oil to the whole surface of the thrust bearing (5) and install it onto the thrust bearing washer.



Install the propeller shaft (1) into the propeller shaft holder (2).

- Check that there is a groove (3) on the propeller shaft. If there is no groove, this propeller shaft is for standard rotation type.

Install the thrust bearing washer (4) with its chamfered side (5) facing the propeller shaft holder side.



Apply gear oil to the threads and seating surface of the bearing holder (1).

Set the bearing holder on the propeller shaft holder (2). Loosely tighten the bearing holder on the propeller shaft holder by hand.

Attach the fixing tool (3), which was used during removal, on the propeller shaft holder and secure with the bolts (4).

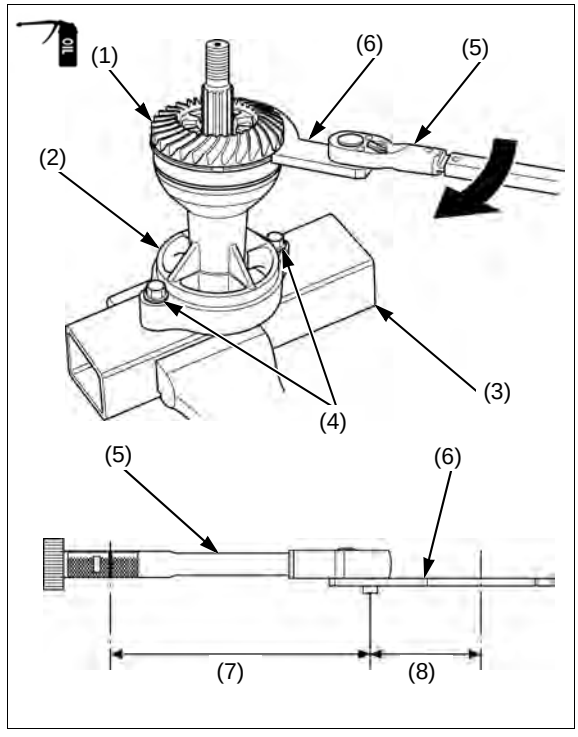
Hold the fixing tool with a vise.

- Avoid holding the propeller shaft holder directly in a vise. Use the fixing tool to hold it in a vise.

Tighten the bearing holder to the specified torque using the special tool and a torque wrench (5) as shown.

TOOL:
Pin spanner wrench, 110 mm (6) 07WAA-S1G0100

TORQUE: 191 N·m (19.5 kgf·m, 141 lbf·ft)



NOTICE

To tighten the bearing holder, read the torque as follows.

Formula:

Torque wrench reading =[A x B] / [A + C]

A: Torque wrench effective length [m (ft)] (7)

B: Specified torque [N·m (kgf·m, lbf·ft)]

C: Pin spanner wrench effective length [m (ft)] (8)

Example:

Torque wrench reading using a torque wrench with an effective length of 0.4 m (1.31 ft) and pin spanner wrench with an effective length of 0.1 m (0.33 ft)

Torque wrench reading =
[0.4 (1.31) x 191 (19.5, 141)] / [0.4 (1.31)] + [0.1 (0.33)]
= 153 [N·m (15.6 kgf·m, 113 lbf·ft)]

A: Torque wrench effective length = 0.4 m (1.31 ft)

B: Specified torque = 191 N·m (19.5 kgf·m, 141 lbf·ft)

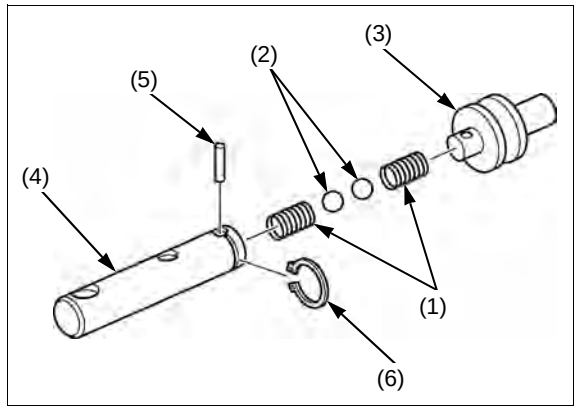
C: Pin spanner wrench effective length = 0.1 m (0.33 ft)

I.e. torque wrench reading is 153 N·m (15.6 kgf·m, 113 lbf·ft).

SHIFT SLIDER INSTALLATION

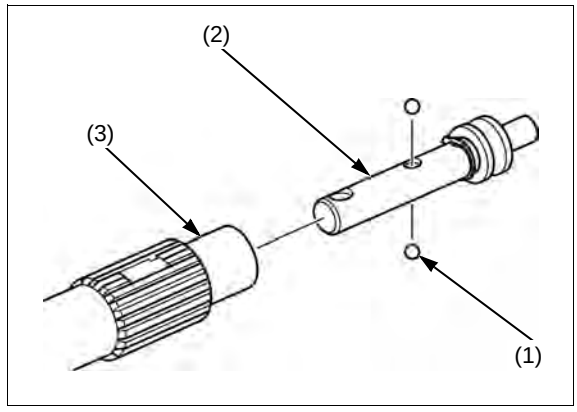
Install a shift spring (1), two steel balls (#9) (2), the other shift spring and shift plate (3) into the shift slider (4) in this order.

Install the roller (5) by aligning the hole in the shift slider with the hole in the shift plate, then install the circlip (6).

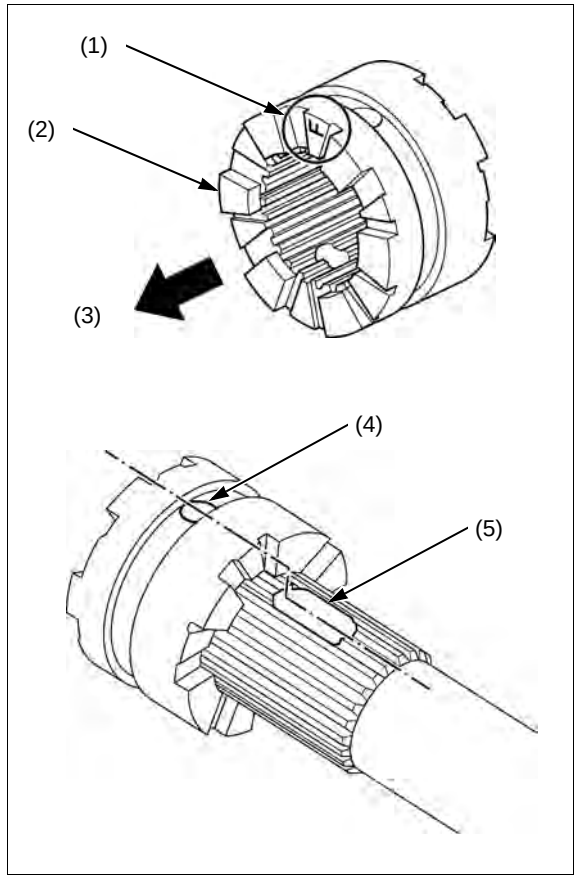


Set the two steel balls (#7) (1) in the steel ball installation holes of the shift slider (2), and push the shift slider slowly into the propeller shaft (3).

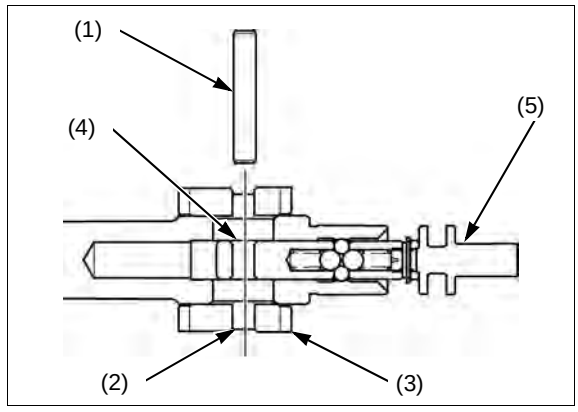
- Push the shift slider into the propeller shaft with care not to allow the steel balls (#7) to pop out.



With the F mark (1) of the clutch shifter (2) toward the reverse bevel gear (cruising direction) (3), install the clutch shifter onto the propeller shaft while aligning the shifter pin installation hole (4) with the long hole of the propeller shaft (5).

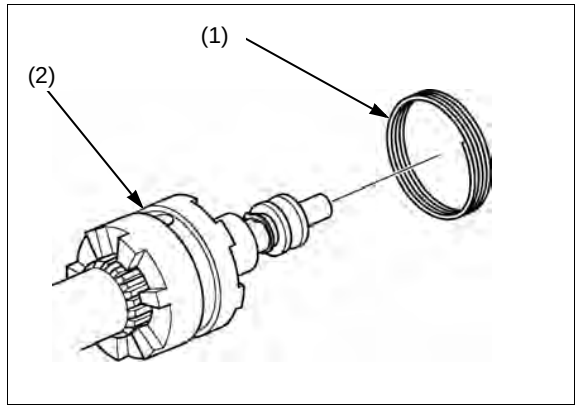


Install the shifter pin (1) while aligning the hole (2) of the clutch shifter (3) with the hole (4) of the shift slider (5).



Install the cross pin ring (1) onto the clutch shifter (2).

- Check that the coils of the cross pin ring do not overlap with each other.

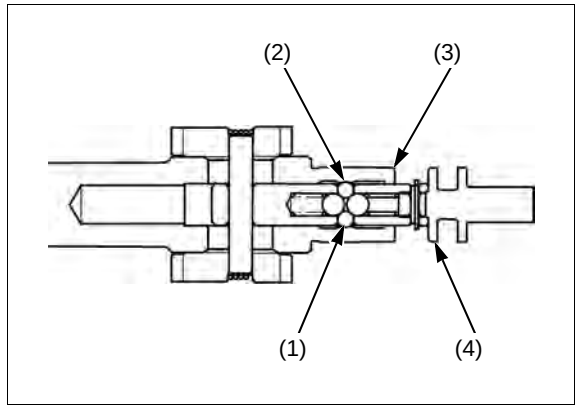


Check that the steel balls (#7) (1) are positioned in the groove (2) of the propeller shaft (3) as shown.

NOTICE

Note that the shift rod cannot be installed unless the shift slider (4) is in the correct position. Set the shift slider on the position as shown.

Install the propeller shaft holder (page 17-21).



VERTICAL SHAFT REMOVAL/ INSTALLATION

REMOVAL

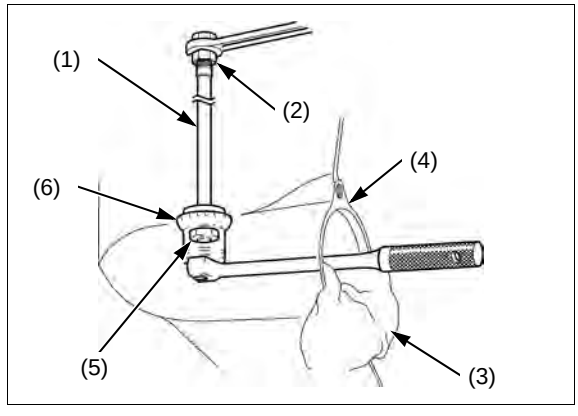
Remove the propeller shaft holder (page 17-21).

Attach the special tool to the vertical shaft (1) end (flywheel boss installation side).

TOOL:
Vertical shaft holder (2) 07SPB-ZW10200

Place a shop towel (3) or equivalent material as shown to protect the gear case (4).

Holding the vertical shaft with the special tool as shown, remove the pinion gear nut (5) and pinion gear (6) from the vertical shaft.

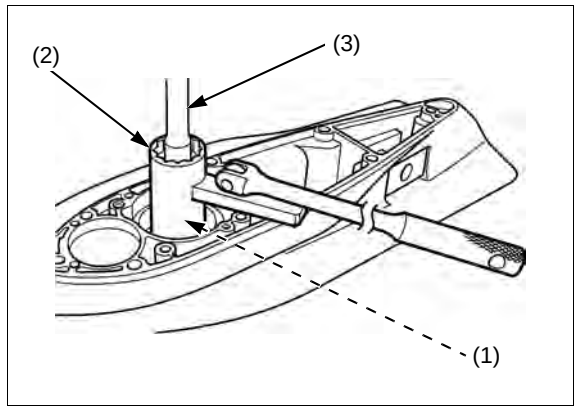


Remove the lock nut (1) using the special tool.

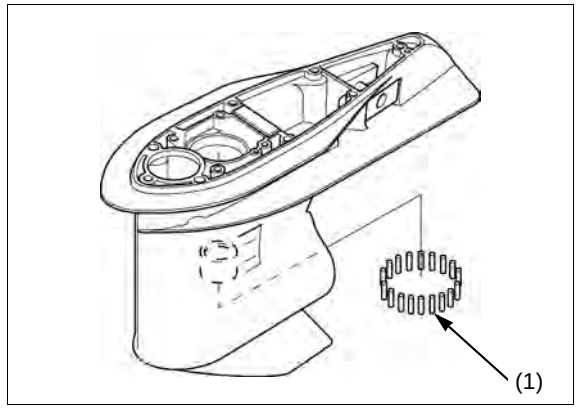
TOOL:
Lock nut wrench, 36 × 47.8 mm (2) 07916-MB00002

Remove the vertical shaft (3).

- Be careful not to drop the needle bearing (rollers) when removing the vertical shaft.



Remove the eighteen needle bearing rollers (1).



Replace the puller jaws (1) of the special tool as shown.

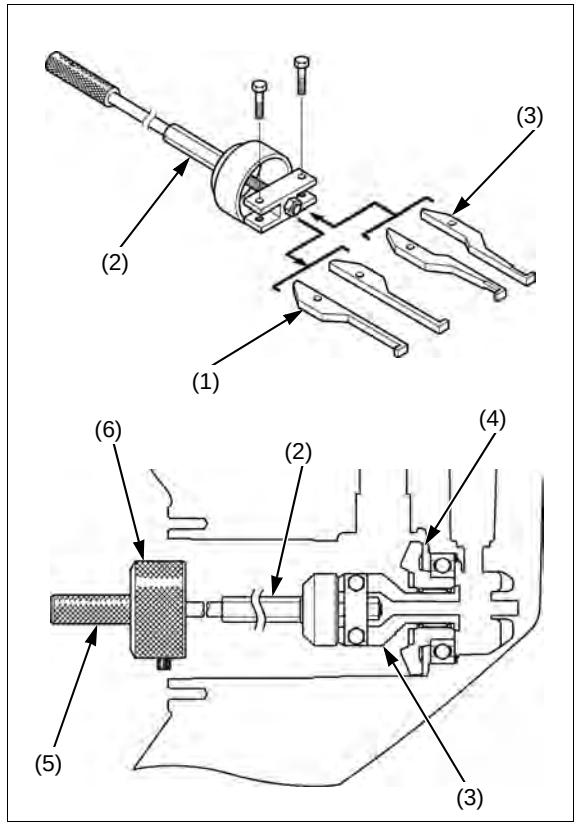
TOOLS:

Bearing race puller (2)	**070PC-ZY30100**
Puller jaws, 25 mm (3)	**07WPC-ZW50100**

Remove the reverse bevel gear (4) using the special tools as shown.

TOOLS:

Remover handle (5)	**07936-3710100**
Remover weight (6)	**07741-0010201**

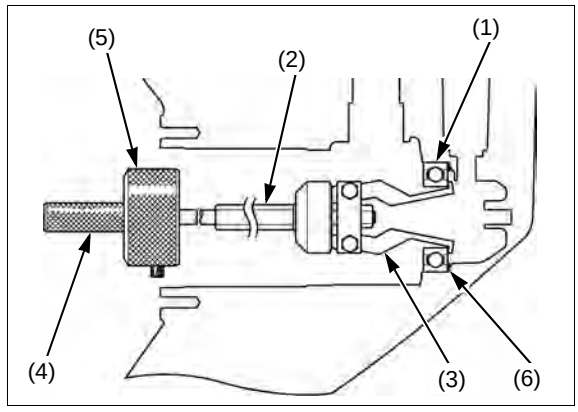


If the ball bearing (1) remains in the gear case side, remove it using the bearing race puller (2) with the replaced puller jaws (3) used in previous step and the following special tools.

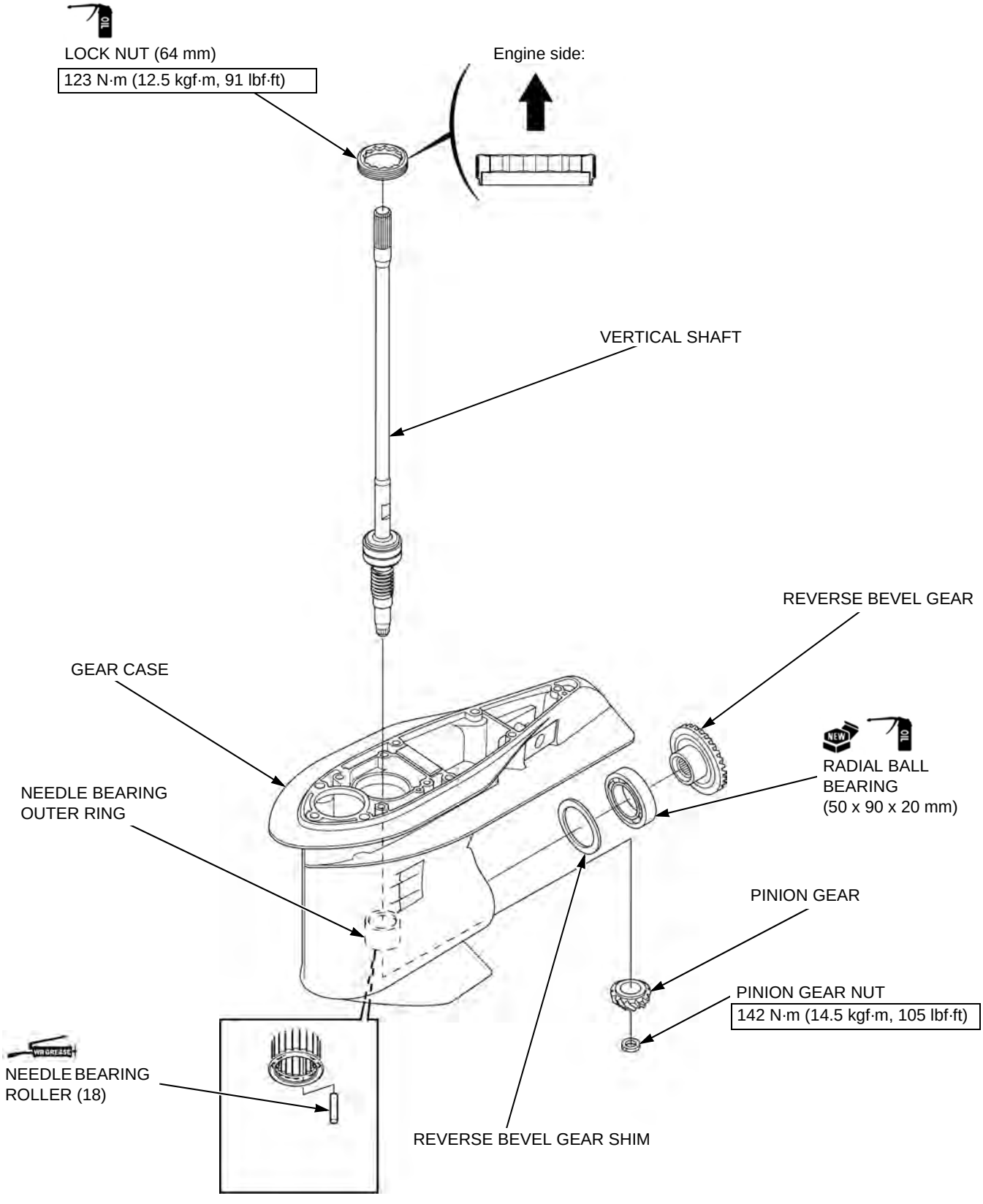
TOOLS:

Remover handle (4)	**07936-3710100**
Remover weight (5)	**07741-0010201**

Remove the reverse bevel gear shim (6) from the gear case.



EXPLODED VIEW



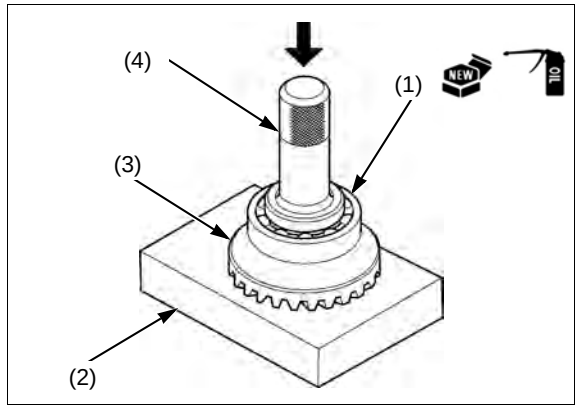
INSTALLATION

Apply gear oil to the circumference of a new ball bearing (1).

Place a wood block (2) under the reverse bevel gear (3).

Drive the ball bearing to the reverse bevel gear using the special tool and a hydraulic press as shown.

TOOL:
Oil seal driver, 65 mm (4) 07JAD-PL90100



Soak the gear case (1) in the container (2) filled with oil with the bearing installation side down.

Heat the oil to 80 °C – 90 °C (176 °F – 194 °F) (2).

NOTICE

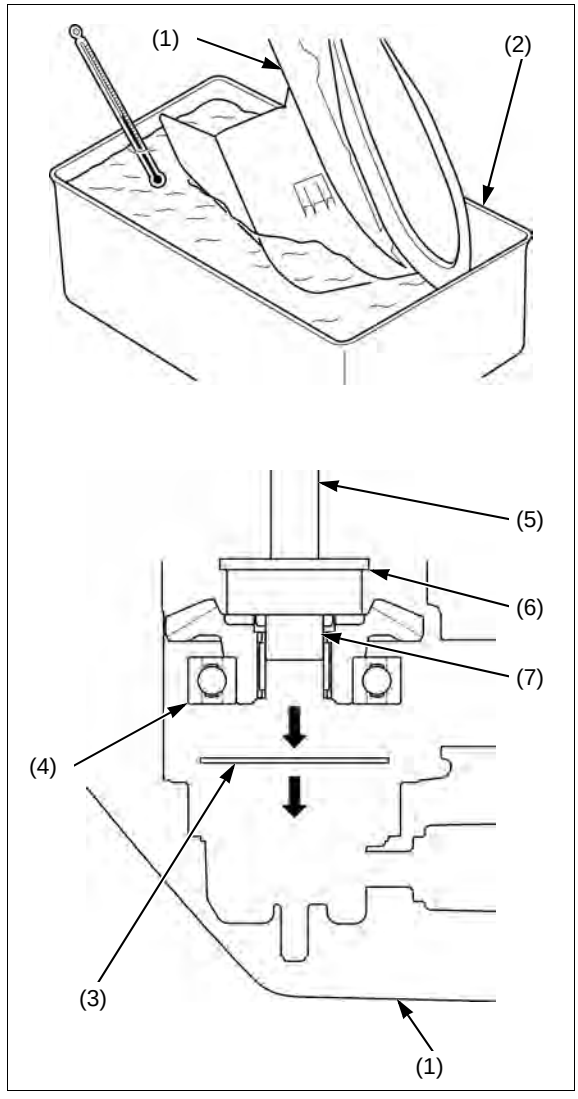
- Do not heat the oil above 90 °C (194 °F).
- Be sure to wear the gloves during the operation.

After entire bearing installation side of the gear case becomes hot, remove the gear case from the container and install the reverse bevel gear shim (3) into the gear case.
Install the reverse bevel gear/bearing (4) onto the gear case using the special tool as shown.

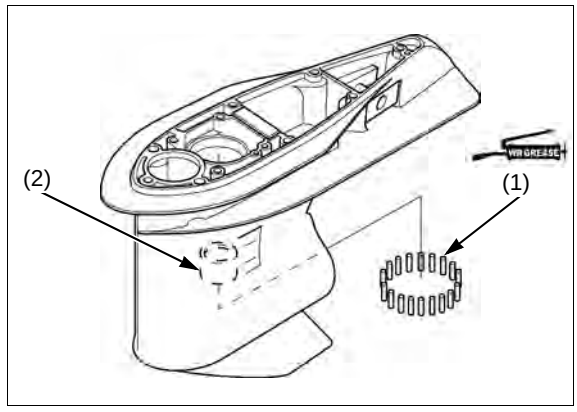
NOTICE

- *When the gear case or bearing is replaced with a new one, perform shim adjustment and select the appropriate shim accordingly (page 17-40).*
- *Do not apply the force of 8,826 N (900 kgf, 1984 lbf) or above during installation.*
- *Install the reverse bevel gear/bearing assembly while the gear case is hot.*

TOOLS:
Driver, 280 mm (5) 07949-3710001
Attachment, 52 x 55 mm (6) 07746-0010400
Pilot, 25 mm (7) 07746-0040600



Apply marine grease to the needle bearing rollers (1) and install them into the needle bearing outer ring (2).



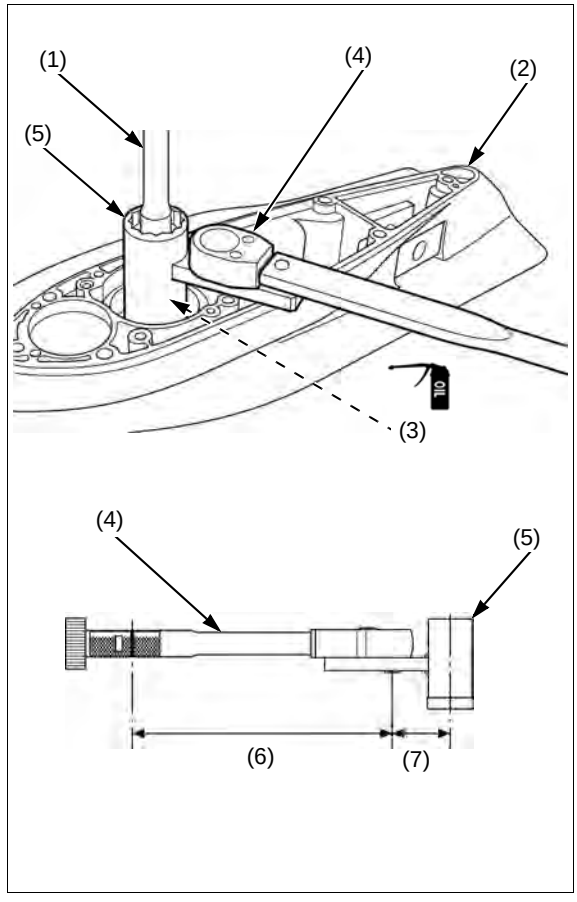
Install the vertical shaft (1) into the gear case (2).

- Be careful not to drop the needle bearing rollers.

Apply gear oil to the threads and seating surface of the lock nut (3).
Tighten the lock nut to the specified torque using the special tool and a torque wrench (4).

TOOL:
Lock nut wrench, 36 × 47.8 mm (5) 07916-MB00002

TORQUE: 123 N·m (12.5 kgf·m, 91 lbf·ft)



NOTICE

To tighten the lock nut, read the torque as follows.

Formula:

Torque wrench reading =

[A x B] / [A + C]

A: Torque wrench effective length [m (ft)] (6)

B: Specified torque [N·m (kgf·m, lbf·ft)]

C: Lock nut wrench effective length [m (ft)] (7)

Example:

Torque wrench reading using a torque wrench with an effective length of 0.4 m (1.31 ft) and lock nut wrench with an effective length of 0.05 (0.164)

Torque wrench reading =

[0.4 (1.31) x 123 (12.5, 91)]

/ [0.4 (1.31)] + [0.05 (0.164)]

= 109 [N·m (11.1 kgf·m, 80 lbf·ft)]

A: Torque wrench effective length = 0.4 m (1.31 ft)

B: Specified torque = 123 N·m (12.5 kgf·m, 91 lbf·ft)

C: Lock nut wrench effective length = 0.05 (0.164)

I.e. torque wrench reading is 109 N·m (11.1 kgf·m, 80 lbf·ft).

Wipe the tapered part (1) of the vertical shaft (2) and pinion gear (3) with a shop towel and degreasing cleaning solvent.

Attach the special tool to the end (flywheel boss installation side) of the vertical shaft as shown.

TOOL:
Vertical shaft holder (4) 07SPB-ZW10200

Place a shop towel (5) in the gear case (6) as shown to protect it.

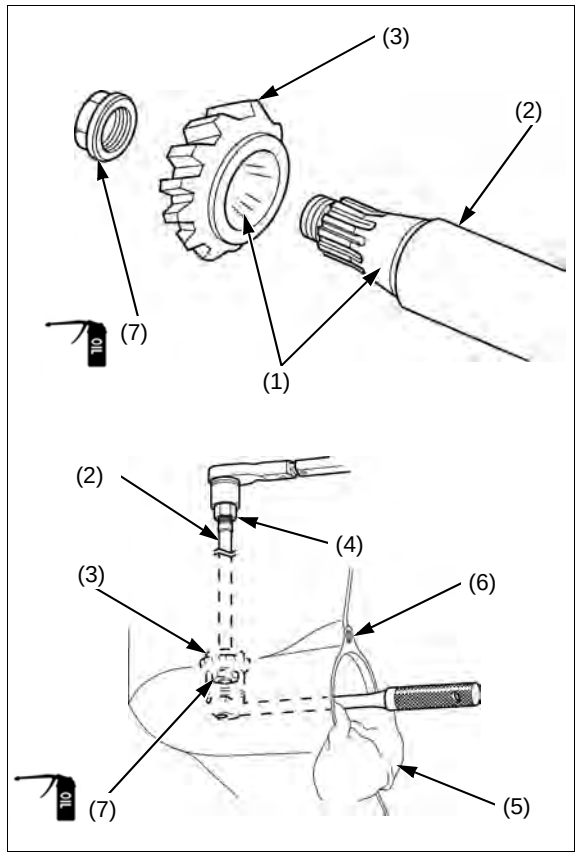
Apply gear oil to the threads and seating surface of the pinion gear nut (7), and install the pinion gear and pinion gear nut onto the vertical shaft.

- Before installing the pinion gear, make sure that the reverse bevel gear/taper bearing is positioned in the gear case correctly.

Holding the vertical shaft using the special tool as shown, tighten the pinion gear nut to the specified torque.

TORQUE: 142 N·m (14.5 kgf·m, 105 lbf·ft)

Install the propeller shaft holder (page 17-21).



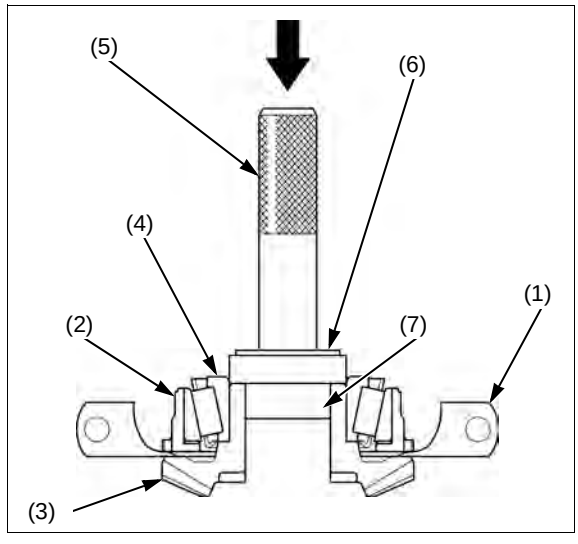
BEARING HOLDER DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

Attach a commercially available universal bearing puller (1) between the bearing holder (2) and the forward bevel gear (3).

Remove the forward bevel gear from the taper bearing (inner race) (4) using the special tools and hydraulic press.

TOOLS:
Driver (5) 07749-0010000
Bearing driver attachment, 44 x 49.5 mm (6) 07945-3330300
Pilot, 35 mm (7) 07746-0040800

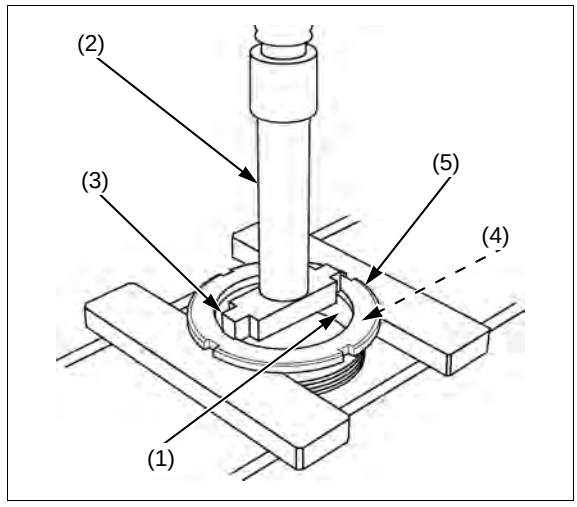


Remove the taper bearing (outer race) (1) using the special tools and hydraulic press.

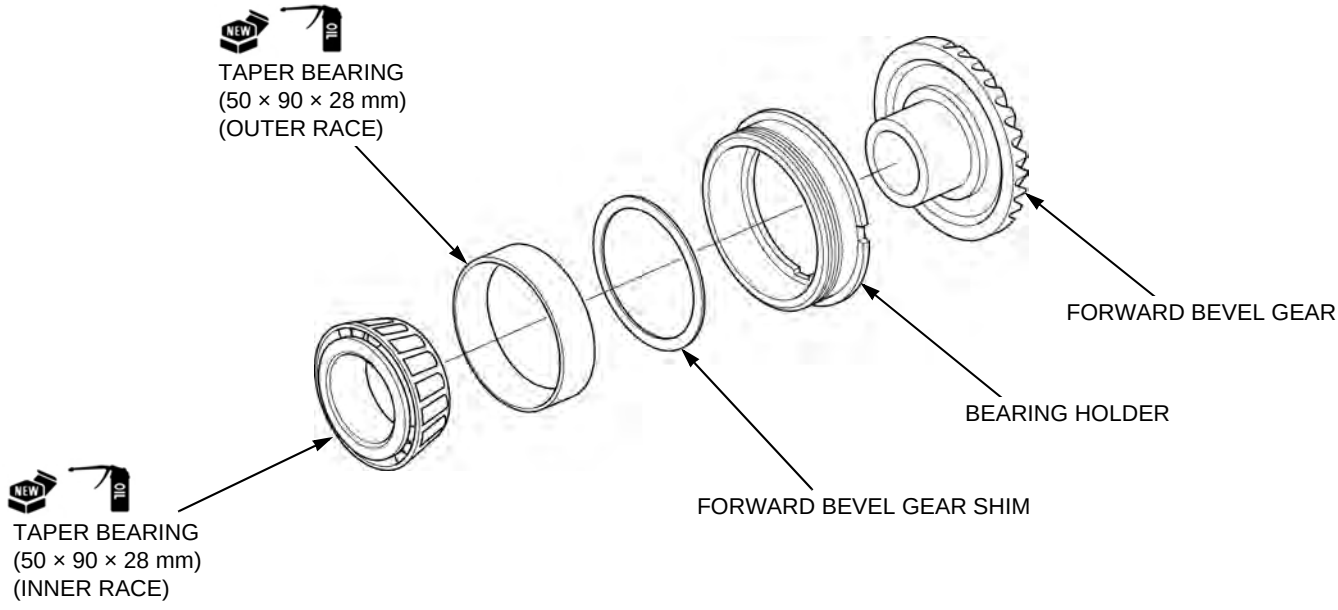
TOOLS:

Driver (2)	**07749-0010000**
Taper bearing driver attachment (3)	**070PD-ZY60100**

Remove the forward bevel gear shim (4) from the bearing holder (5).



EXPLODED VIEW



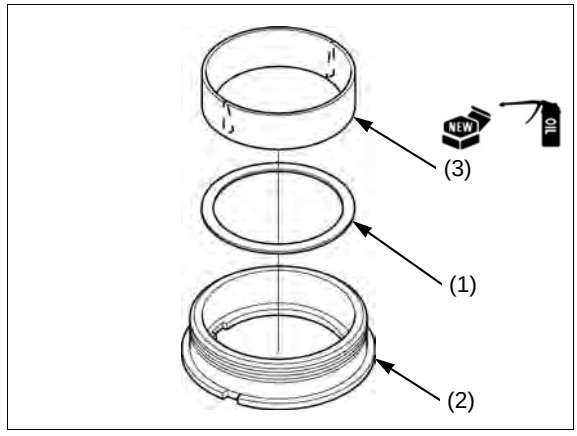
ASSEMBLY

Install the forward bevel gear shim (1) onto the bearing holder (2).

- When the gear case or taper bearing is replaced with a new one, perform shim adjustment and select the appropriate shim accordingly (page 17-40).

Apply gear oil to the circumference of a new taper bearing (outer race) (3).

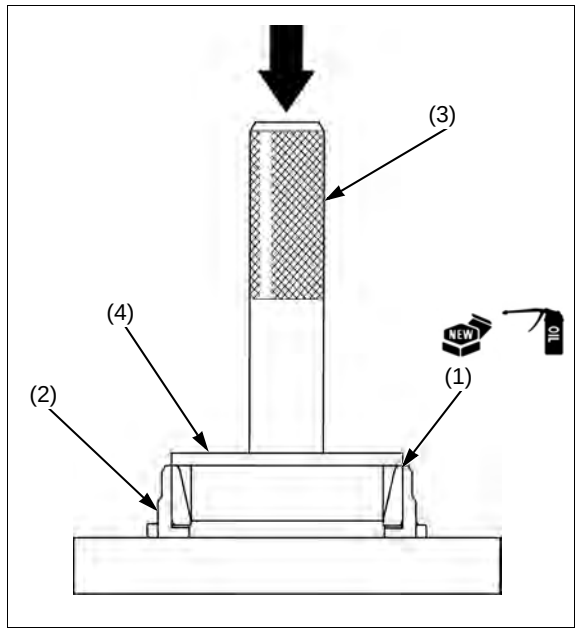
- Install the taper bearing (outer race) with the smaller I.D. side toward the shim.



Install the taper bearing (outer race) (1) into the bearing holder (2) using the special tools and a hydraulic press as shown.

TOOLS:

Driver (3)	**07749-0010000**
Taper bearing installer attachment (4)	**070PF-ZY60100**



Place a wood block (1) under the forward bevel gear (2).

Place the bearing holder (3) onto the forward bevel gear.

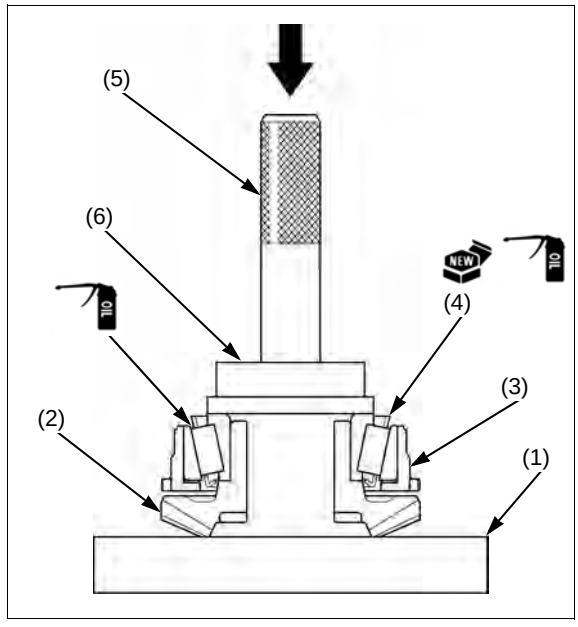
Apply gear oil to the inner wall of a new taper bearing (inner race) (4).

Install the taper bearing (inner race) into the forward bevel gear using the special tool and hydraulic press.

- Install by applying gear oil between the inner and outer races of the taper bearing.

TOOLS:

Driver (5)	**07749-0010000**
Attachment, 62 × 68 (6)	**07746-0010500**



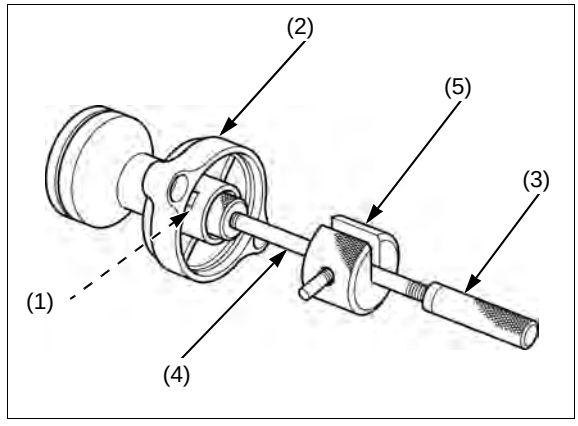
PROPELLER SHAFT HOLDER DISASSEMBLY/ASSEMBLY

DISASSEMBLY

Remove the needle bearing (30 x 37 x 26 mm) (1) from the propeller shaft holder (2) using the special tools.

TOOLS:

Remover handle (3)	**07936-3710100**
Bearing remover, 30 mm (4)	**07936-8890300**
Remover weight (5)	**07741-0010201**



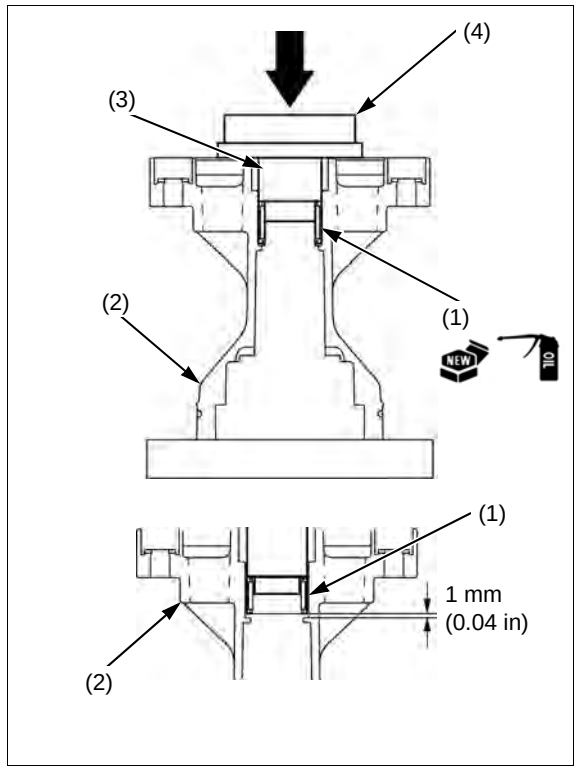
ASSEMBLY

Apply gear oil to the outer circumference of a new needle bearing (30 x 37 x 26 mm) (1).

Install the needle bearing into the propeller shaft holder (2) until the specified depth, using the special tools and hydraulic press.

- Install the bearing with its marked side facing the special tool.

TOOLS:
Attachment, 30 × 37 mm (3) 070PD-ZY60200
Attachment, 62 × 68 mm (4) 07746-0010500

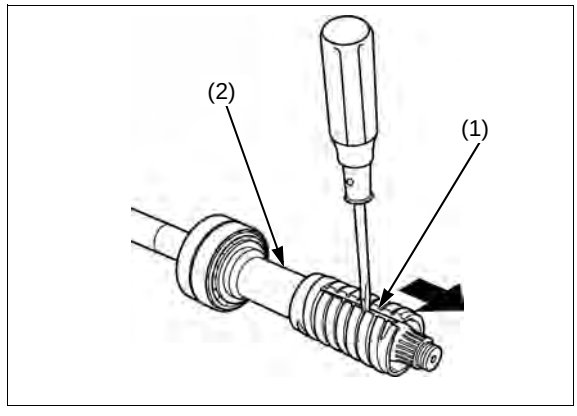


VERTICAL SHAFT DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

Remove the oil slinger (1) from the vertical shaft (2) by expanding the cut in the oil slinger with a screwdriver or equivalent.

- Do not expand the slinger more than necessary, or it will be damaged.

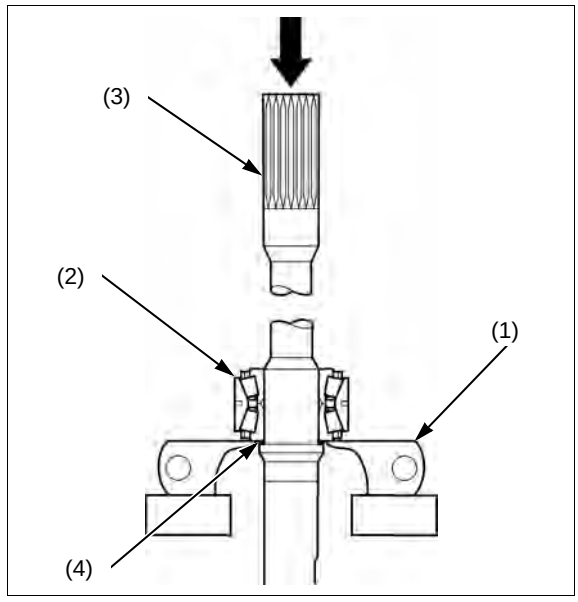


Check the taper roller bearing for abnormal sound and play.
Replace the inner race and outer race as a set if necessary.

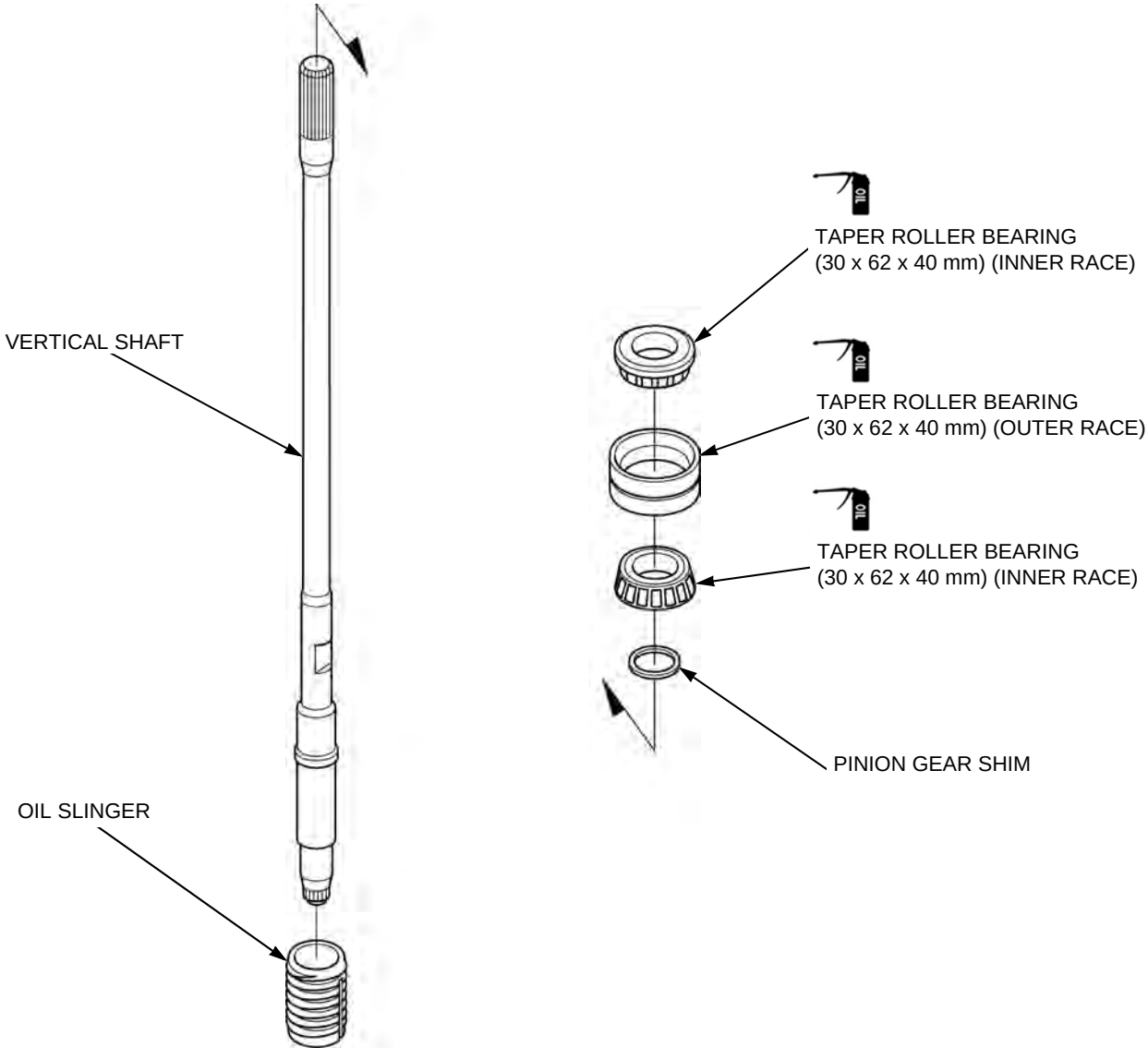
Set a commercially available universal bearing puller (1) under the taper roller bearing (inner race) (2) and set the vertical shaft (3) on the hydraulic press with the flywheel boss installation side facing up.

Remove the taper roller bearing from the vertical shaft using a hydraulic press.

Remove the pinion gear shim (4) from the vertical shaft.



EXPLODED VIEW



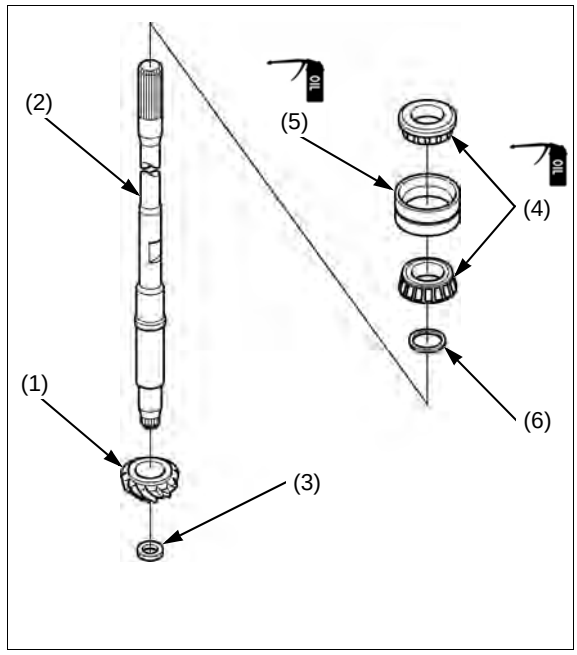
ASSEMBLY

Set the pinion gear (1) onto the vertical shaft (2), and loosely tighten the pinion gear nut (3) by hand.

Apply gear oil to the inner wall of the taper roller bearing inner races (4), rollers and outer circumference of the outer race (5).
Assemble the inner races and outer race.

Set the pinion gear shim (6) and taper roller bearing onto the vertical shaft.

- When the gear case, vertical shaft or taper roller bearing is replaced with a new one, perform the shim adjustment and select the appropriate shim accordingly (page 17-40).
- Set the taper roller bearing with the side on which the "E" dimension was measured during shim adjustment toward the pinion gear.



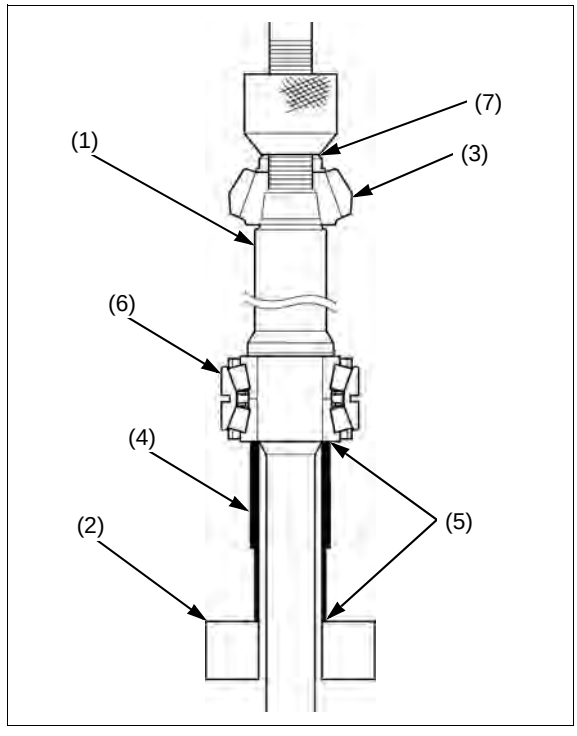
Install the special tool onto the vertical shaft (1) and set the vertical shaft on the hydraulic press (2) with the pinion gear (3) side facing up as shown.

TOOL:
Driver shaft, B (4) 07964-MB00200

- Check that the ends (5) of the special tool are set on the taper roller bearing (6) inner race and hydraulic press table securely.
- Do not damage the threads at the end of the vertical shaft (pinion gear nut (7) installation part).

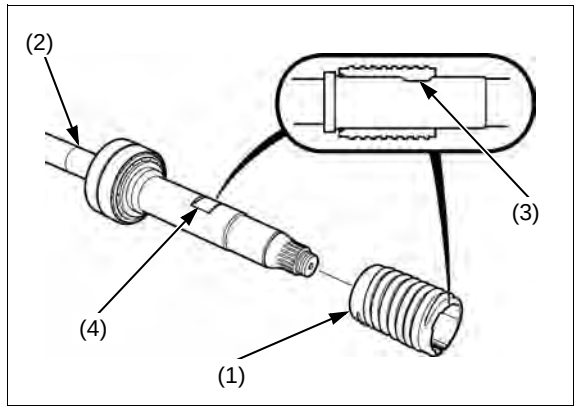
Install the taper roller bearing onto the vertical shaft using the hydraulic press.

Remove the pinion gear nut and pinion gear from the vertical shaft.



Install the oil slinger (1) onto the vertical shaft (2) by aligning the projection (3) on the inside of the oil slinger with the recess (4) on the vertical shaft.

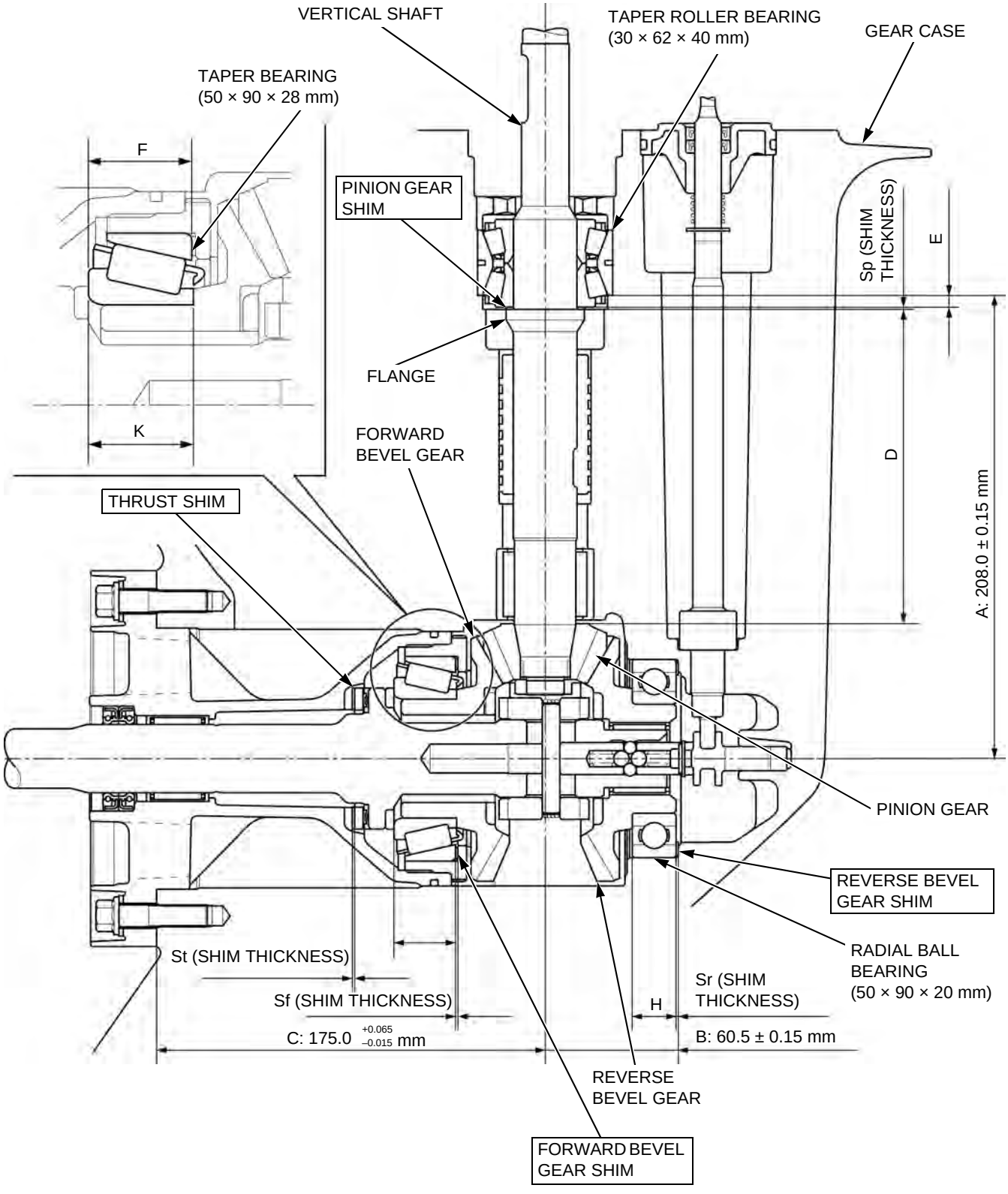
- Do not expand the slinger more than necessary, or it will be damaged.



SHIM SELECTION

- Use shims to adjust the position of each gear so that they engage properly. Perform shim adjustment if the backlash of a gear is outside the specification or after replacing the gear case, vertical shaft, gear or bearing with a new one.

SHIM LOCATIONS



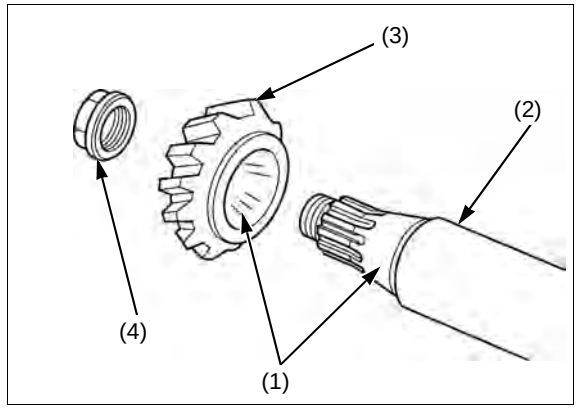
PINION GEAR SHIM

Clean the tapered surfaces (1) of the vertical shaft (2) and pinion gear (3) thoroughly using a shop towel and degreasing cleaning agent.

Install the pinion gear onto the vertical shaft.
Tighten the pinion gear nut (4) to the specified torque using the special tool.

TOOL:
Vertical shaft holder 07SPB-ZW10200

TORQUE: 142 N·m (14.5 kgf·m, 105 lbf·ft)



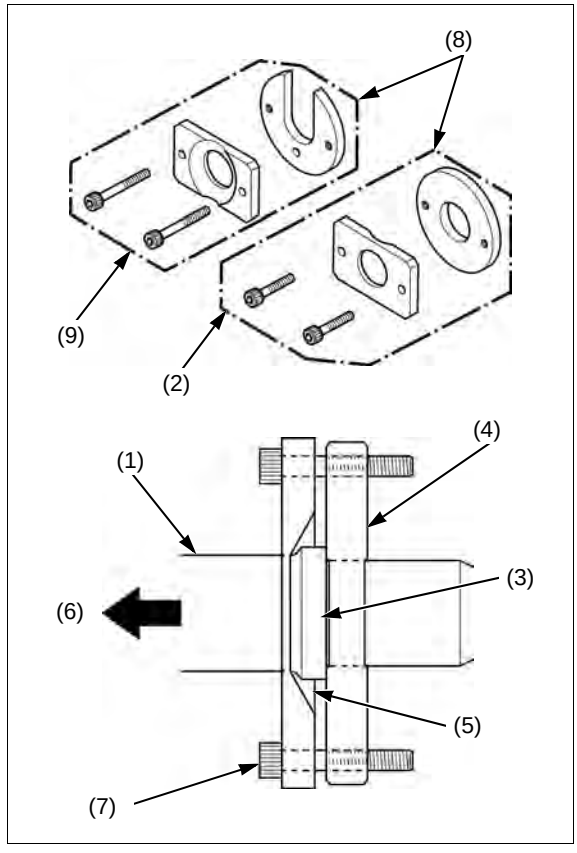
Remove the taper roller bearing if it is mounted on the vertical shaft (1) (page 17-37).

Set the special tools (taper roller bearing side) (2) onto the both sides of vertical shaft flange (3) with their tool No. mark side (4) and taper side (5) facing the opposite side of pinion gear direction (6) as shown.
Tighten the bolts (7) by hand.

TOOL:
Gauge adapter, 100 mm (8) 070PJ-ZY30100

- Do not confuse the pinion gear side (9) and the taper roller bearing side of the special tool.
- Take care not to score or scratch the measurement side (i.e. opposite side from the surface where the tool No. is stamped).
- Do not tighten the bolts with a wrench.

After installing the tools, check that there is no looseness in the tool.

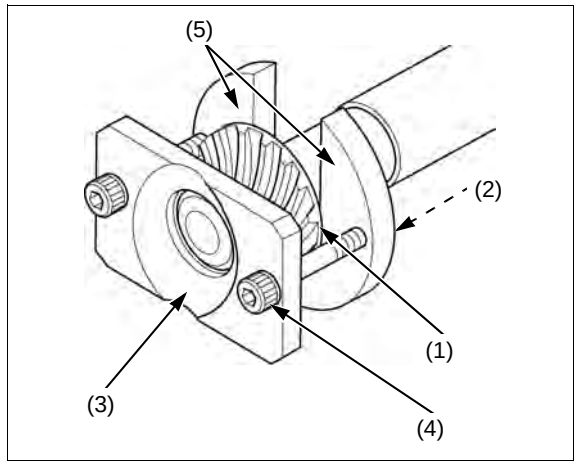


Set the special tools (pinion gear side) onto the both sides of pinion gear (1) with their tool No. mark side (2) and taper side (3) facing the opposite side of pinion gear as shown.
Tighten the bolts (4) by hand.

- Do not confuse the pinion gear side and the taper roller bearing side of the special tool.
- Take care not to score or scratch the measurement side (i.e. opposite side from the surface where the tool No. is stamped) (5).
- Do not tighten the bolts with a wrench.

Check that the tool of the pinion gear nut side is not raised on the nut.

After installing the tools, check that there is no looseness in the tool.

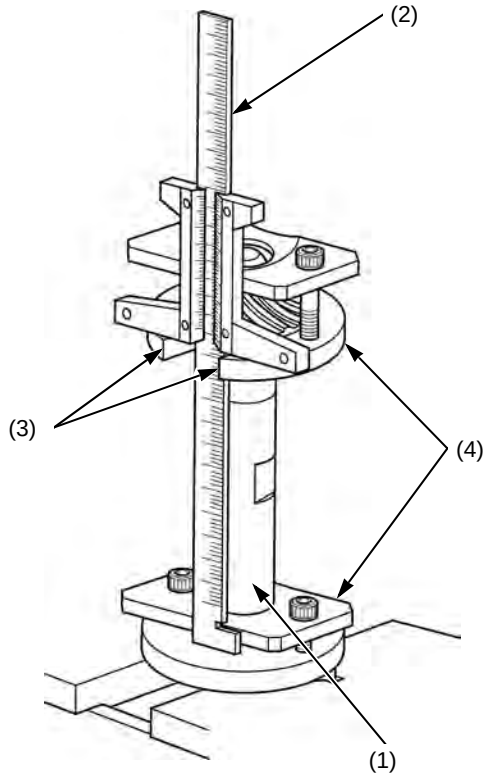


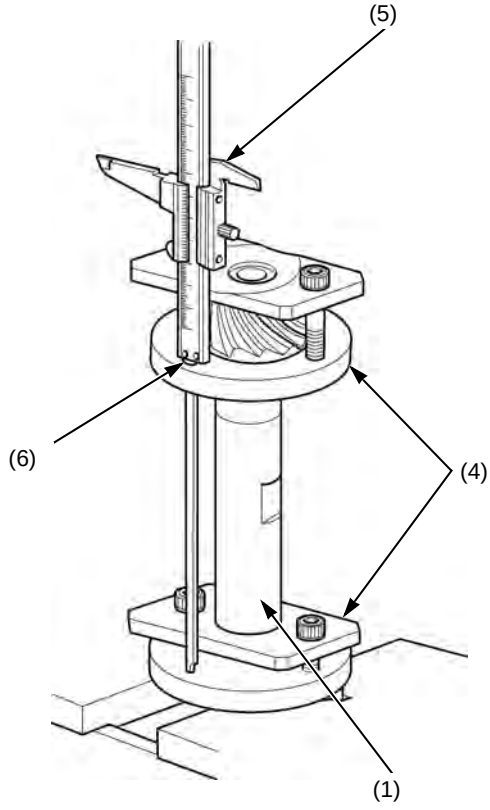
Hold the vertical shaft (1) upright with the pinion gear facing up.

Set a commercially available depth gauge (2) in the groove (3) of the pinion gear side special tool (4) as shown. Measure the length (D) from the pinion gear end to the end of the vertical shaft flange and record the measurement.

If using a vernier caliper (5), set it in the small hole (6) of the special tool as shown.

MEASUREMENT D:

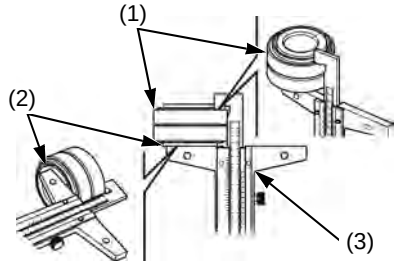


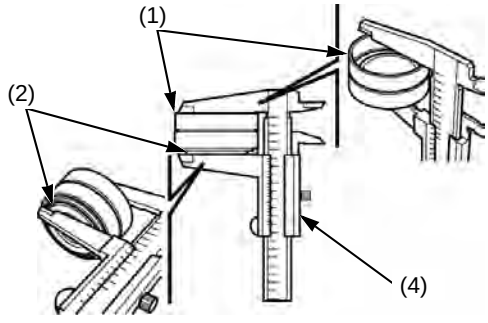


Assemble the outer race (1) and inner race (2) of the taper roller bearing, and turn the outer race two or three turns to seat the bearings.

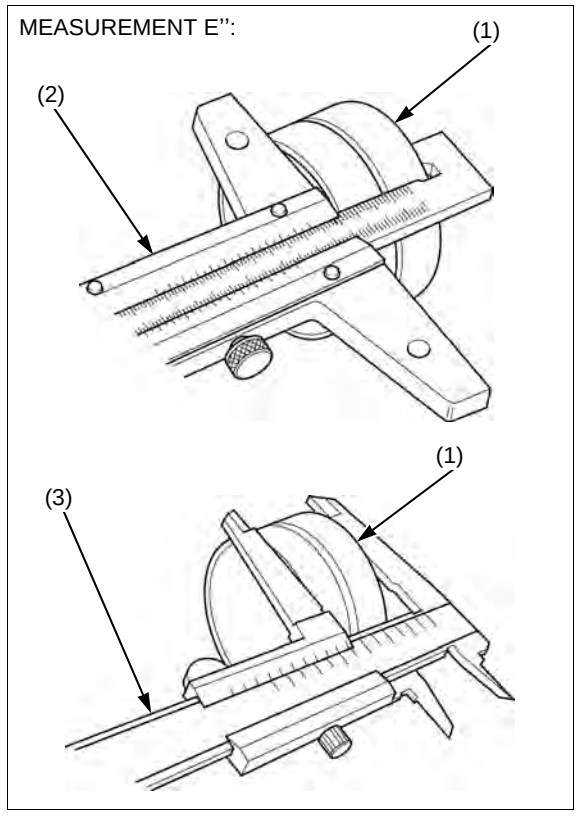
If using a depth gauge (3), measure the bearing height (E') from the outer race end to the inner race end as shown, and record the measurement.
If using a vernier caliper (4), remove one side of the inner race and measure the bearing height (E').

MEASUREMENT E':





Measure the height (E'') of the taper roller bearing outer race (1) using a depth gauge (2) or vernier caliper (3), and record it.



Calculate the length from the inner race end to the outer race end (E) by determining the gap between the measurements E' and E'' using the following formula.

Formula: E= E' - E''

Example:
When measurement (E') from the outer race end to the inner race end is 34.90 mm (1.374 in), and outer race height (E'') is 29.70 mm (1.169 in):

E= 34.90 - 29.70 = 5.20
The gap (E) from the inner race end to the outer race end is 5.20 mm (0.205 in).

Determine the tolerance and record it using the measurement (D), calculation (E) and the following formula.

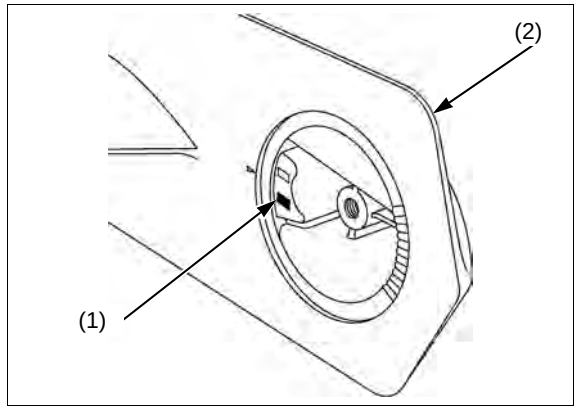
Formula: Tolerance = D + E - 147.2

Example:
When measurement (D) from the pinion gear end to the end of the vertical shaft flange is 141.80 mm (5.583 in), and calculation (E) from the inner race end to the outer race end is 5.20 mm (0.205 in):

141.80 + 5.20 - 147.2 = -0.20
The tolerance is -0.20 mm (-0.008 in).

Remove the gear case cover (page 17-8).

Record the engagement mark (1) located on the gear case (2).



Cross reference the engagement mark and tolerance calculated in the previous step, and refer to the pinion gear shim selection table to determine the required thickness of the shim (Sp).

Pinion gear shim selection table

Unit: mm

		Calculation value													
		-0.31 – -0.25	-0.25 – -0.20	-0.20 – -0.15	-0.15 – -0.10	-0.10 – -0.05	-0.05 – 0	0 – +0.05	+0.05 – +0.10	+0.10 – +0.15	+0.15 – +0.20	+0.20 – +0.25	+0.25 – +0.30	+0.30 – +0.35	+0.35 – +0.41
Gear case engagement mark	A	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	-
	B	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10
	C	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15
	D	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20
	E	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25
	F	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30

Select the shims from the pinion gear shims of different thickness to obtain the required thickness (Sp) by combining the shims.

Pinion gear shim type table

Shim type	Thickness
Shim A	0.10 mm
Shim B	0.15 mm
Shim C	0.30 mm
Shim D	0.50 mm

HOW TO READ SHIM SELECTION TABLE

When the engagement mark on the gear case housing is C and the tolerance is -0.05 mm (-0.002 in), the shim selection table shows that the required shim thickness is 0.55 mm (0.022 in). (See the table shown below).

Pinion gear shim selection table

Unit: mm

		Calculation value						
		-0.31 – -0.25	-0.25 – -0.20	-0.20 – -0.15	-0.15 – -0.10	-0.10 – -0.05	-0.05 – 0	0 – +0.05
Gear case engagement mark	A	0.70	0.65	0.60	0.55	0.50	0.45	0.40
	B	0.75	0.70	0.65	0.60	0.55	0.50	0.45
	C	0.80	0.75	0.70	0.65	0.60	0.55	0.50
	D	0.85	0.80	0.75	0.70	0.65	0.60	0.55
	E	0.90	0.85	0.80	0.75	0.70	0.65	0.60
	F	0.95	0.90	0.85	0.80	0.75	0.70	0.65

HOW TO SELECT SHIM COMBINATION

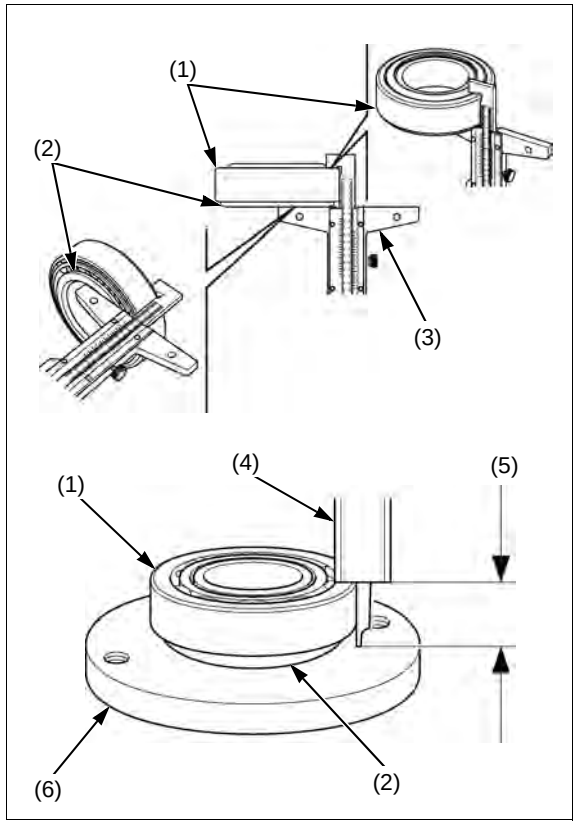
To obtain 0.55 mm (0.022 in) of shim thickness, combine one gear shim A, one gear shim B, and one gear shim C, or combine four gear shim A and one gear shim B.

FORWARD BEVEL GEAR SHIM

Assemble the outer race (1) and inner race (2) of a new taper bearing (50 × 90 × 28 mm), and turn the outer race two or three turns to seat the bearing.

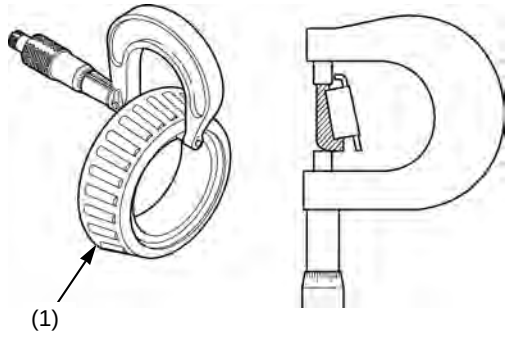
If using a depth gauge (3), measure the bearing height (F) from the outer race end to the inner race end as shown, and record the measurement.
If using a vernier caliper (4), place the assembled taper bearing on the smooth side of the gauge adapter special tool (or flat, hard surface).
Press the outer race down over the inner race and measure the bearing height (F) (5).

TOOL:
Gauge adapter, 100 mm (6) 070PJ-ZY30100



Remove the taper roller bearing inner race (1) from the outer race.
Measure the inner race height (K) of the bearing as shown, and record the measurement.

MEASUREMENT K:



Calculate the tolerance using the measurement F, K and following formula.

Formula: Tolerance = F - K

Example:
When measurement (F) is 28.05 mm (1.104 in) and measurement (K) is 28.00 mm (1.102 in):

Tolerance = 28.05 - 28.00 = 0.05
The tolerance is 0.05 mm (0.002 in).

Cross reference the tolerance calculated in the previous step and forward bevel gear shim selection table to determine the required thickness of the shim (Sf).

Forward bevel gear shim selection table (Counter rotation type)

Unit: mm

Tolerance	Shim thickness
0 – +0.05	0.45
+0.05 – +0.10	0.40
+0.10 – +0.15	0.35

Refer to page 17-44 for information on how to read the shim selection table and shim combination.

Select the shims from the forward bevel gear shims of different thickness to obtain the required thickness (Sf) by combining the shims.

Forward bevel gear shim type table

Shim type	Thickness
Shim A	0.10 mm
Shim B	0.15 mm
Shim C	0.30 mm
Shim D	0.50 mm

After shim selection, inspect the propeller shaft thrust clearance (page 17-51).

REVERSE BEVEL GEAR SHIM

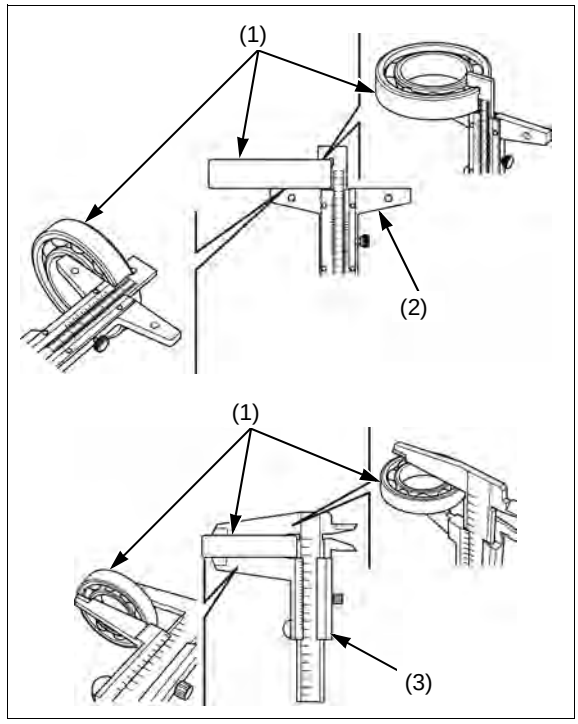
Measure the bearing height (H) of a new ball bearing (1) using a depth gauge (2) or vernier caliper (3) as shown, and record the measurement.

Calculate the tolerance using the measurement H obtained in the previous step and the following formula.

Formula: Tolerance = H - 20.00

Example:
When measurement (H) is 19.95 mm (0.785 in):

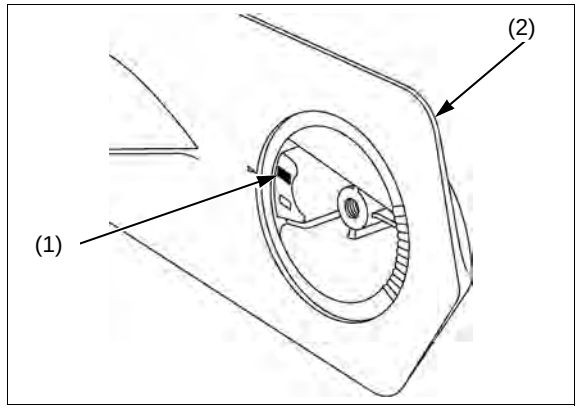
Tolerance = 19.95 - 20.00 = -0.05
The tolerance is -0.05 mm (-0.002 in).



Remove the gear case cover (page 17-8).

Record the engagement mark (1) located on the gear case (2).

Cross reference the engagement mark and tolerance calculated in the previous step, and refer to the reverse bevel gear shim selection table to determine the required thickness of the shim (Sr).



Reverse bevel gear shim selection table (Counter rotation type)

Unit: mm

		Calculation value	
		-0.12 – -0.05	-0.05 – 0
Gear case engagement mark	1	0.65	0.60
	2	0.60	0.55
	3	0.55	0.50
	4	0.50	0.45
	5	0.45	0.40
	6	0.40	0.35

Refer to page 17-44 for information on how to read the shim selection table and shim combination.

Select the shims from the reverse bevel gear shims of different thickness to obtain the required thickness (Sr) by combining the shims.

Reverse bevel gear shim type table

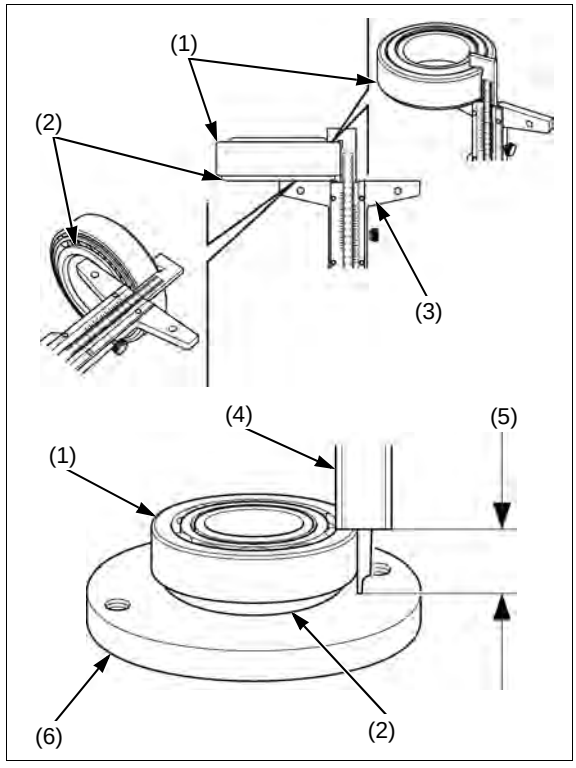
Shim type	Thickness
Shim A	0.10 mm
Shim B	0.15 mm
Shim C	0.30 mm
Shim D	0.50 mm

PROPELLER SHAFT THRUST SHIM

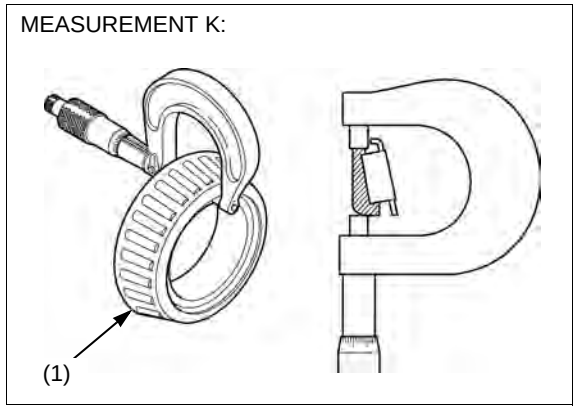
Assemble the outer race (1) and inner race (2) of a new taper bearing (50 × 90 × 28 mm), and turn the outer race two or three turns to seat the bearing.

If using a depth gauge (3), measure the bearing height (F) from the outer race end to the inner race end as shown, and record the measurement.
If using a vernier caliper (4), place the assembled taper bearing on the smooth side of the gauge adapter special tool (or flat, hard surface).
Press the outer race down over the inner race and measure the bearing height (F) (5).

TOOL:
Gauge adapter, 100 mm (6) 070PJ-ZY30100



Remove the taper roller bearing inner race (1) from the outer race.
Measure the inner race height (K) of the bearing as shown, and record the measurement.



Calculate the tolerance using the measurement F, K and following formula.

Formula: Tolerance = F - K

Example:
When measurement (F) is 28.05 mm (1.104 in) and measurement (K) is 28.00 mm (1.102 in):

Tolerance = 28.05 - 28.00 = 0.05
The tolerance is 0.05 mm (0.002 in).

Cross reference the tolerance calculated in the previous step and thrust shim selection table to determine the required thickness of the shim (St).

Propeller shaft thrust shim selection table (Counter rotation type)

Unit: mm

		Calculation value		
		0 – +0.05	+0.05 – +0.10	+0.10 – +0.15
Bearing height (F)	28.00 − 28.05	0.75	0.70	0.65
	28.05 − 28.10	0.70	0.65	0.60

Refer to page 17-44 for information on how to read the shim selection table and shim combination.

Select the shims from the thrust shims of different thickness to obtain the required thickness (St) by combining the shims.

Propeller shaft thrust shim type table

Shim type	Thickness
Shim A	0.10 mm
Shim B	0.15 mm
Shim C	0.30 mm
Shim D	0.50 mm

BACKLASH INSPECTION

FORWARD BEVEL GEAR BACKLASH

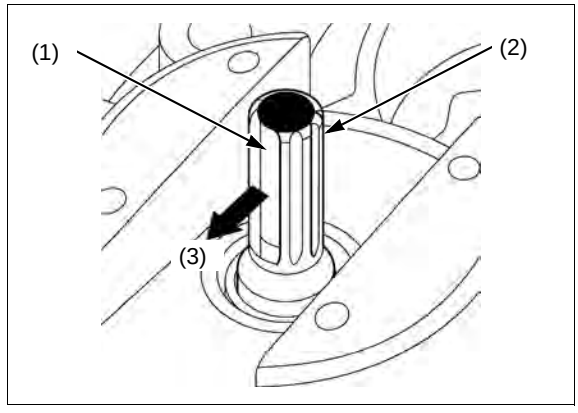
Backlash adjustment must be made after adjustment of each gear shim (page 17-40).

Install the following parts except the water pump.

– Vertical shaft (page 17-32)
– Propeller shaft holder (page 17-21)
– Shift rod (page 17-18)

Check that the shift rod of the gear case is in the "N" (Neutral) position.

The cutout (1) of the shift rod (2) spline area should face the cruising direction (3).

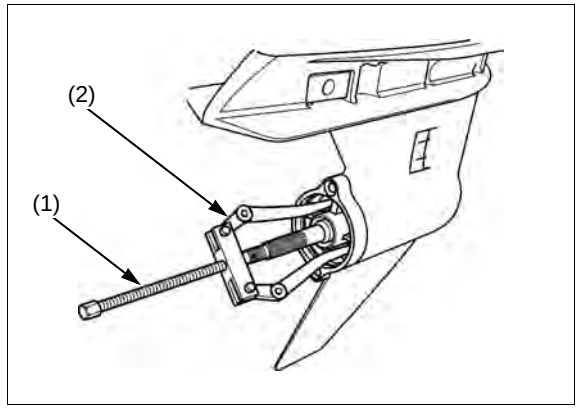


Hold the propeller shaft securely with the special tool as shown, and tighten the puller to the specified torque.

TOOLS:
Puller bolt (1) 07SPC-ZW0011Z
Puller jaws (2) 07SPC-ZW0010Z

TORQUE: 5 N·m (0.51 kgf·m, 3.7 lbf·ft)

Turn the vertical shaft five to ten turns clockwise to fit the taper bearing.



Attach the special tool to the vertical shaft (1) as shown, adjust the dial indicator (2) so its needle is at the line "2" of the backlash indicator tool.

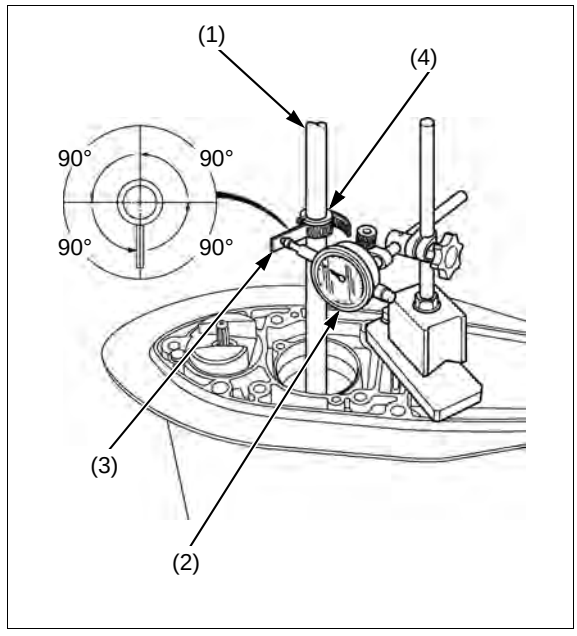
TOOLS:

Backlash indicator tool (3)	**07SPJ-ZW0030Z**
Backlash indicator attachment (4)	**07WPK-ZW50100**

Turn the vertical shaft lightly right and left and record the dial indicator reading.

Measure the backlash at four points (by turning the vertical shaft in increments of 90°) in the same manner.

- When measuring the backlash, do not turn the propeller shaft by turning the vertical shaft.



Obtain the forward bevel gear backlash using the dial indicator runout and the following formula.

Formula:
Backlash = Dial gauge runout ÷ 0.86

Example:
When dial gauge runout is 0.175 mm (0.0069 in),
Backlash =
0.175 mm (0.0069 in) ÷ 0.86 = 0.20 mm (0.008 in)

STANDARD VALUE:
0.10 – 0.30 mm (0.004 – 0.012 in)

If the backlash is too large compared to the standard value, increase the forward bevel gear shim thickness and recheck the backlash.

If the backlash is too small compared to the standard value, reduce the forward bevel gear shim thickness and recheck the backlash.

- Be sure to use the special tool when removing the bearings in order to readjust the backlash.
- After adjusting the forward bevel gear shim, perform the propeller shaft thrust clearance inspection/ adjustment (page 17-51).

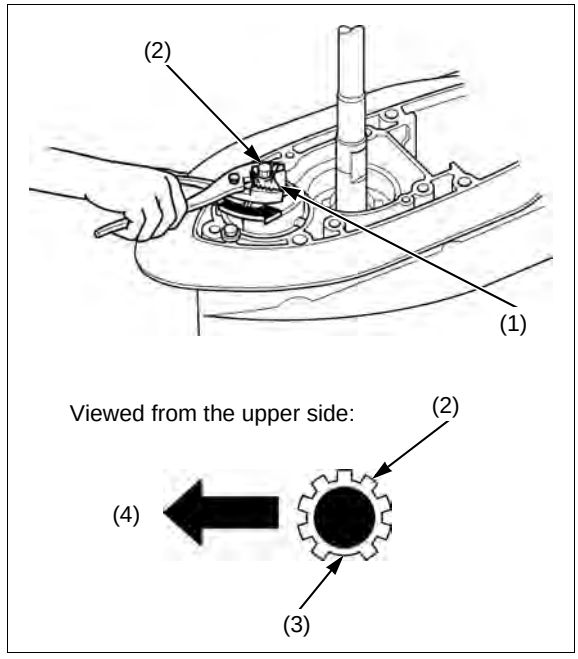
REVERSE BEVEL GEAR BACKLASH

Backlash adjustment must be made after adjustment of each gear shim (page 17-40).

Install the following parts except the water pump.

– Vertical shaft (page 17-32)
– Propeller shaft holder (page 17-21)
– Shift rod (page 17-18)

Wrap a shop towel (1) around the shift rod (2) spline, and use pliers to turn the shift rod in the direction shown (cutout (3) of the shift rod spline is toward the left side of the cruising direction (4)).



Attach the special tool to the vertical shaft (1) as shown, adjust the dial indicator (2) so its needle is at the line "2" of the backlash indicator tool.

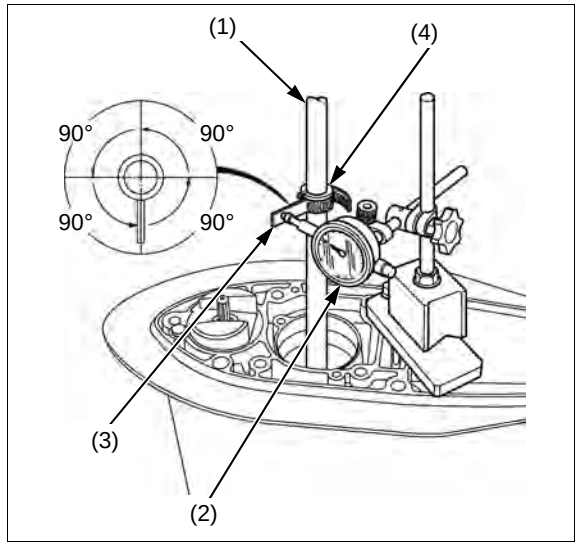
TOOLS:

Backlash indicator tool (3)	**07SPJ-ZW0030Z**
Backlash indicator attachment (4)	**07WPK-ZW50100**

Turn the vertical shaft lightly right and left and record the dial indicator reading.

Measure the backlash at four points (by turning the vertical shaft in increments of 90°) in the same manner.

- When measuring the backlash, do not turn the propeller shaft by turning the vertical shaft.



Obtain the reverse bevel gear backlash using the dial indicator runout and the following formula.

Formula:
Backlash = Dial gauge runout ÷ 0.86

Example:
When dial gauge runout is 0.175 mm (0.0069 in),
Backlash =
0.175 mm (0.0069 in) ÷ 0.86 = 0.20 mm (0.008 in)

STANDARD VALUE:
0.10 – 0.35 mm (0.004 – 0.014 in)

If the backlash is too large compared to the standard value, increase the reverse bevel gear shim thickness and recheck the backlash.

If the backlash is too small compared to the standard value, reduce the reverse bevel gear shim thickness and recheck the backlash.

- Be sure to use the special tool when removing the bearings in order to readjust the backlash.

THRUST CLEARANCE INSPECTION

- Always inspect the propeller shaft thrust clearance when adjusting the backlash.
- Always adjust the propeller shaft thrust clearance when forward bevel gear shim is replaced with new ones.

Check that the bearing holder is securely tightened to the specified torque on the propeller shaft holder (1) (page 17-25).
Check that the clutch shifter and shift slider are not installed (page 17-22).

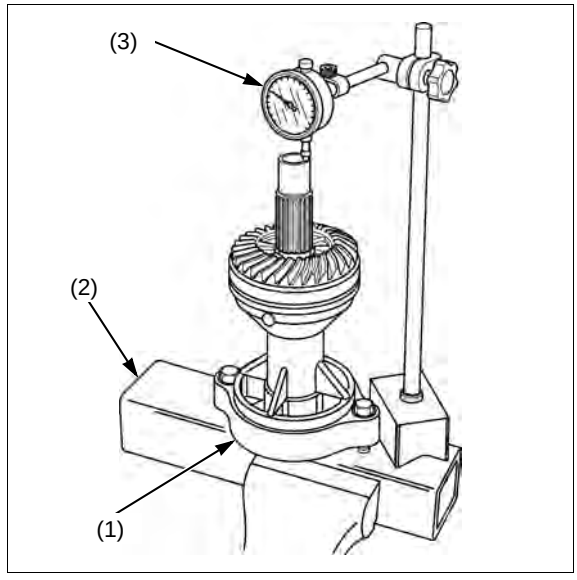
Fix the propeller shaft holder on the fixing tool (2) securely using the bolts as shown.

Set the dial indicator (3) perpendicularly so that its tip contacts the end of the propeller shaft.

Move the propeller shaft up and down and read the runout of the dial indicator. It must be within the specified range.

THRUST CLEARANCE:
0.2 – 0.4 mm (0.008 – 0.016 in)

If the clearance is too large, increase the thrust shim thickness and recheck the thrust clearance.
If the clearance is too small, reduce the thrust shim thickness and recheck the thrust clearance.



GEAR CASE PRESSURE INSPECTION

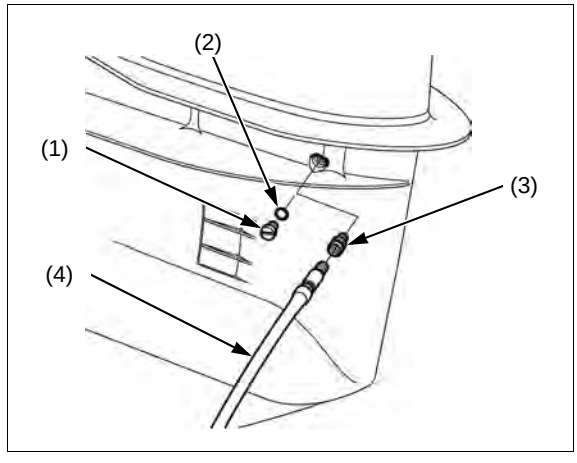
- Perform the gear case pressure check and check for pressure leakage after disassembling and reassembling the gear case.
- In principle, the pressure check should be made on the gear case before filling it with gear oil and before installing it on the outboard motor. However, the check can be made with the gear case filled with gear oil.

Remove the oil check bolt (1) and O-ring (2).

Install the adapter (special tool) (3) into the oil check bolt hole.
Attach the hose end of the pressure tester S-34 (special tool) (4) to the adapter.
Do not screw in the adapter and hose end with force.

TOOLS:

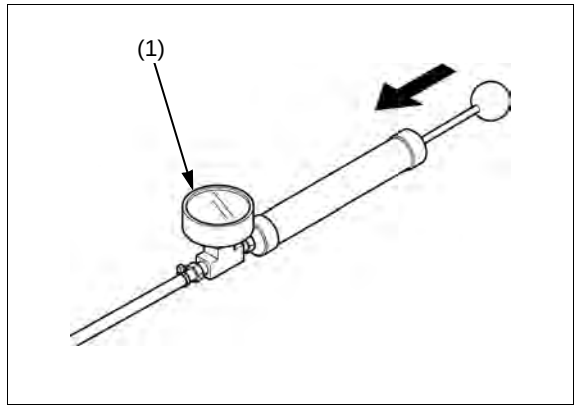
Pressure tester S-34	**07APJ-001A100**
Adapter	**07APJ-001A300**



While watching pressure tester gauge (1), apply the specified air pressure to the gear case by pumping the handle slowly.

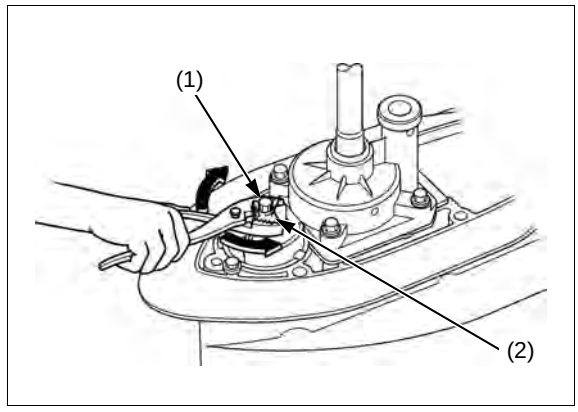
- Do not apply excessive air pressure.

AIR PRESSURE:
29 kPa (0.3 kgf/cm^2, 4.3 psi)



While applying the specified air pressure to the gear case, move the shift rod (1) right and left five or six times using pliers.

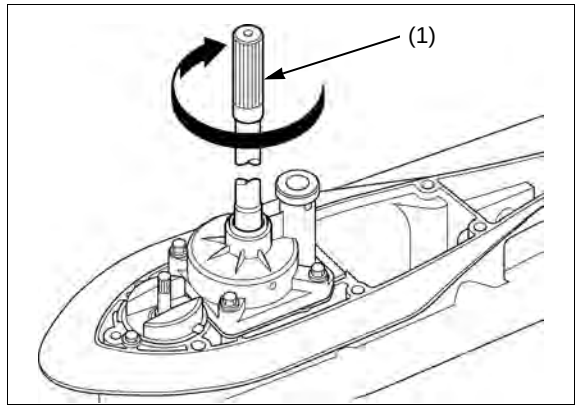
- Wrap a shop towel (2) around the shift rod spline to move the shift rod with pliers.



While applying the specified air pressure to the gear case, turn the vertical shaft (1) five or six turns clockwise.

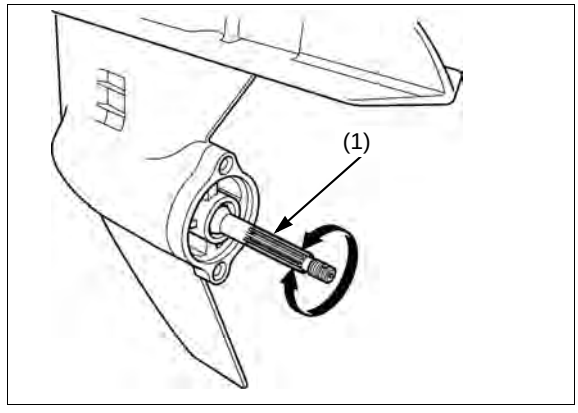
NOTICE

Be sure to turn the vertical shaft clockwise, or damage to the water pump impeller can occur.



While applying the specified air pressure to the gear case, turn the propeller shaft (1) right and left two or three turns.

Leave the gear case for five minutes and check that the air pressure is maintained.



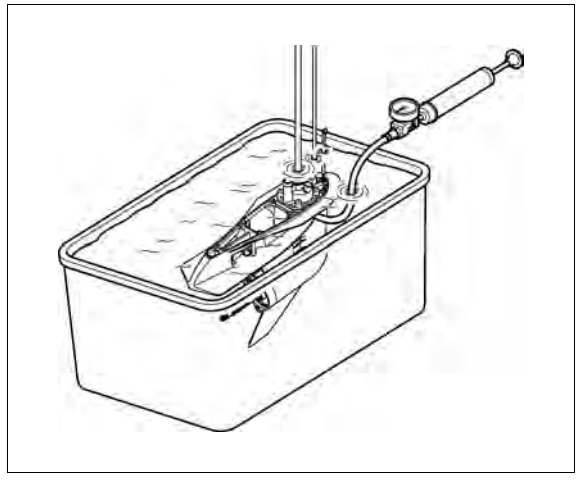
If the air pressure drops, place the gear case in a container filled with water. Apply the specified air pressure to the gear case again, move the shift rod, vertical shaft and propeller shaft, and locate the point where the air is leaking.

Remove the gear case from the water and replace the water seal or O-ring where the air is leaking.

After replacing the water seal or O-ring, perform the pressure check again and be sure that air is not leaking.

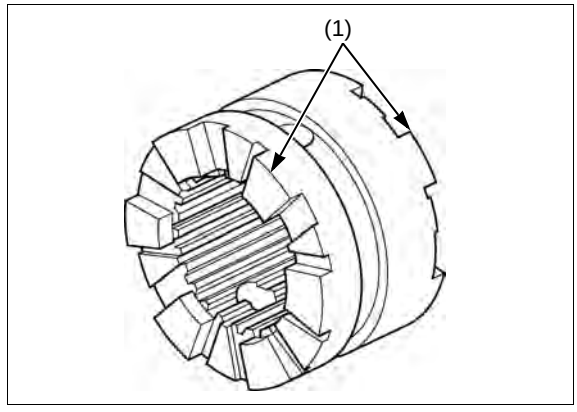
Remove the gear case pressure tester and the adapter from the gear case.
Install a new O-ring onto the oil check bolt, and tighten the oil check bolt to the specified torque.

TORQUE: 6.5 N·m (0.66 kgf·m, 4.8 lbf·ft)



CLUTCH SHIFTER INSPECTION

Check the clutch parts (1) on the forward and reverse sides for wear and damage.



PROPELLER SHAFT INSPECTION

PROPELLER SHAFT O.D.

Measure the O.D. of the propeller shaft at the reverse bevel gear area (1) and needle bearing area (2).

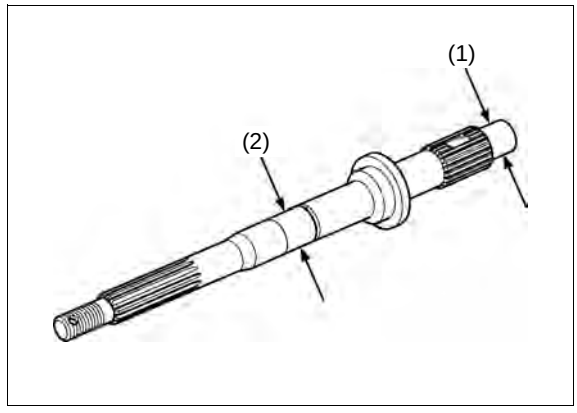
STANDARD:

At reverse bevel gear:	**24.987 – 25.000 mm (0.9837 – 0.9843 in)**
At needle bearing:	**30.007 – 30.020 mm (1.1814 – 1.1819 in)**

SERVICE LIMIT:

At reverse bevel gear:	**24.966 mm (0.9829 in)**
At needle bearing:	**29.990 mm (1.1807 in)**

If the measurement is less than the service limit, replace the propeller shaft with a new one.

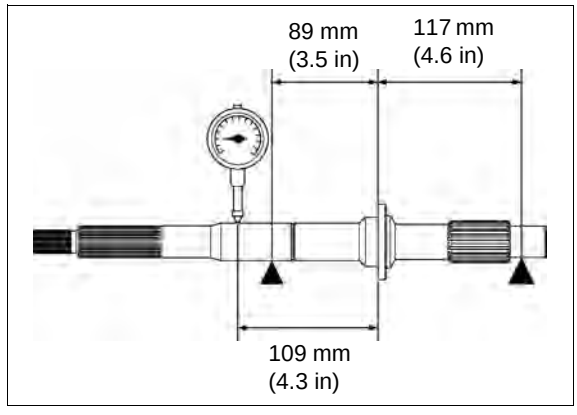


PROPELLER SHAFT RUNOUT

Support each journal with V-blocks as shown.

Set the dial indicator and measure the propeller shaft runout while turning the shaft.

STANDARD: 0.02 mm (0.001 in) or below



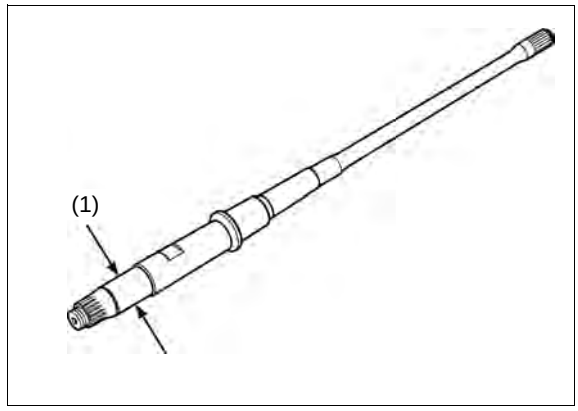
VERTICAL SHAFT INSPECTION

VERTICAL SHAFT O.D.

Measure the O.D. of the vertical shaft at the needle bearing area (1).

STANDARD: 28.566 – 28.575 mm (1.1246 – 1.1250 in)
SERVICE LIMIT: 28.545 mm (1.1238 in)

If the measurement is less than the service limit, replace the vertical shaft with a new one.

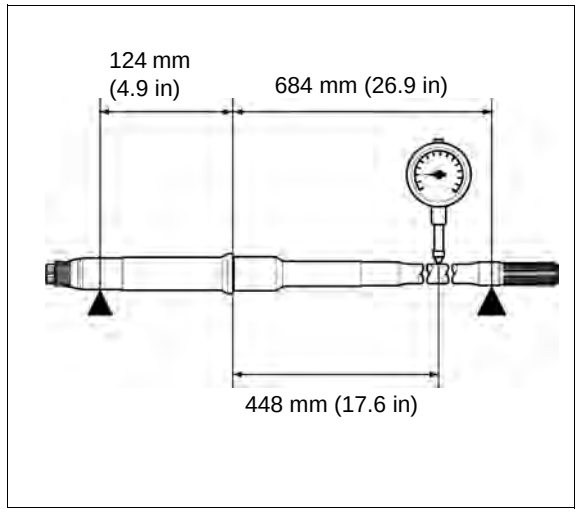


VERTICAL SHAFT RUNOUT

Support each journal with V-blocks as shown.

Set the dial indicator and measure the vertical shaft runout while turning the shaft.

STANDARD: 0.30 mm (0.012 in) or below

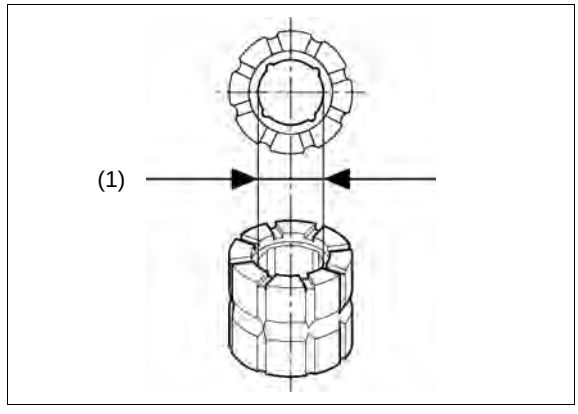


VERTICAL SHAFT BUSHING INSPECTION

VERTICAL SHAFT BUSHING I.D.

Measure the vertical shaft bushing (1) I.D.

STANDARD: 22.05 – 22.10 mm (0.868 – 0.870 in)



GEAR CASE BEARING REPLACEMENT

NEEDLE BEARING

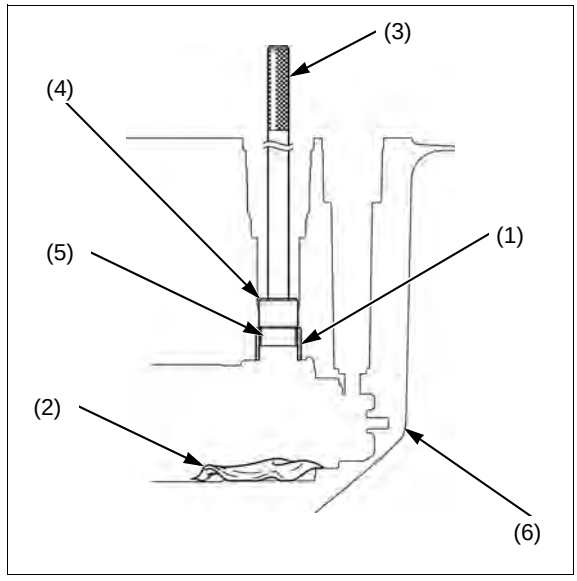
Set the special tools on the needle bearing (28.575 x 44.45 x 31.75 mm) (1), and place a shop towel (2) or equivalent material under the needle bearing as shown.

TOOLS:

Driver, 280 mm (3)	**07949-3710001**
Bearing remover attachment, 37 mm (4)	**07ZMD-MBW0200**
Pilot, 35 mm (5)	**07746-0040800**

Remove the needle bearing from the gear case (6).

- Remove the needle bearing with care not to damage the gear case.



Apply gear oil to the outer circumference of a new needle bearing (28.575 x 44.45 x 31.75 mm) (1).

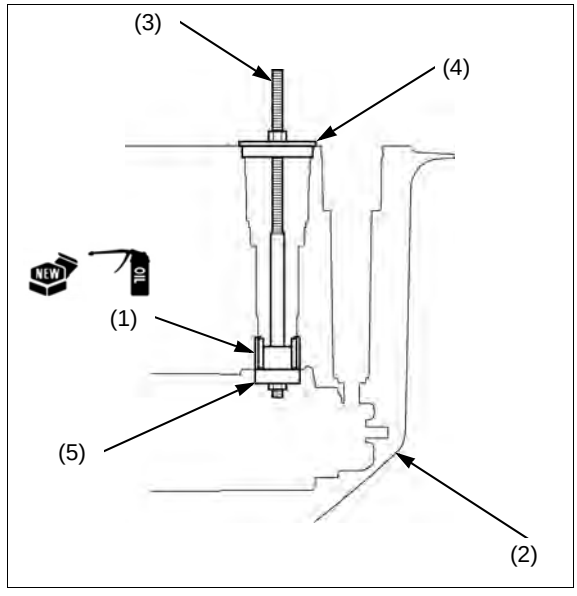
Install the needle bearing into the gear case (2) using the special tools.

- Install the needle bearing with the stamped side facing down (facing the special tool side).

TOOLS:

Installer shaft, 15 x 370 mm (3)	**07VMF-KZ30200**
Attachment, 78 x 90 mm (4)	**07GAD-SD40101**
Oil seal driver attachment, 27.5 x 44 mm (5)	**07948-9540000**

After installation, check that the bottom surface of the needle bearing is flush with the bottom of the gear case.



MEMO

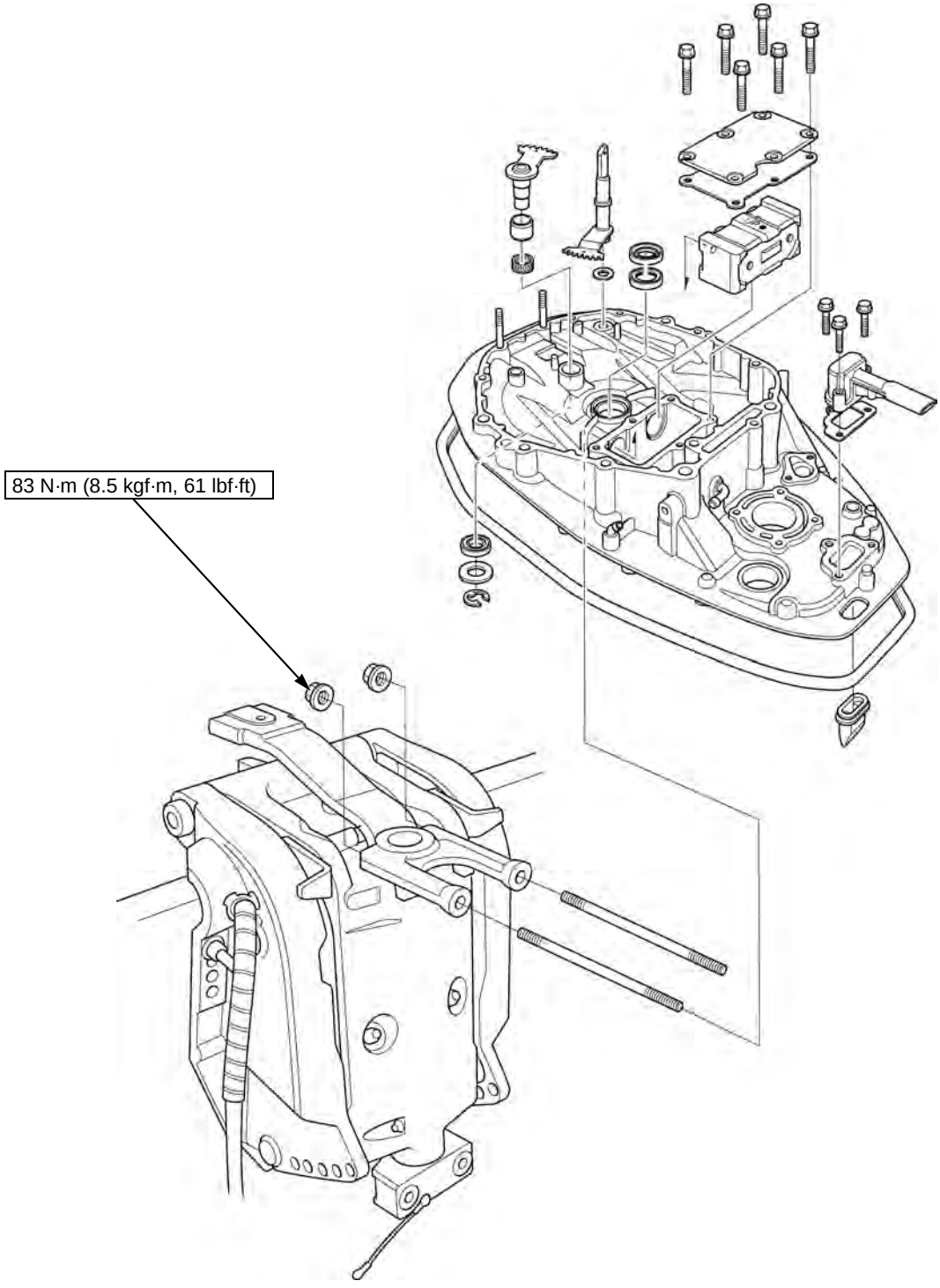
COMPONENT LOCATION ····· 18-2

TOOLS ····· 18-3

MOUNTING CASE REMOVAL/ INSTALLATION ····· 18-4

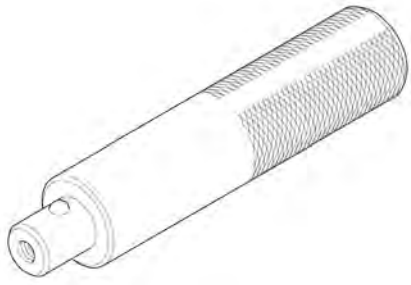
MOUNTING CASE DISASSEMBLY/ ASSEMBLY ····· 18-5

COMPONENT LOCATION



TOOLS

LIST

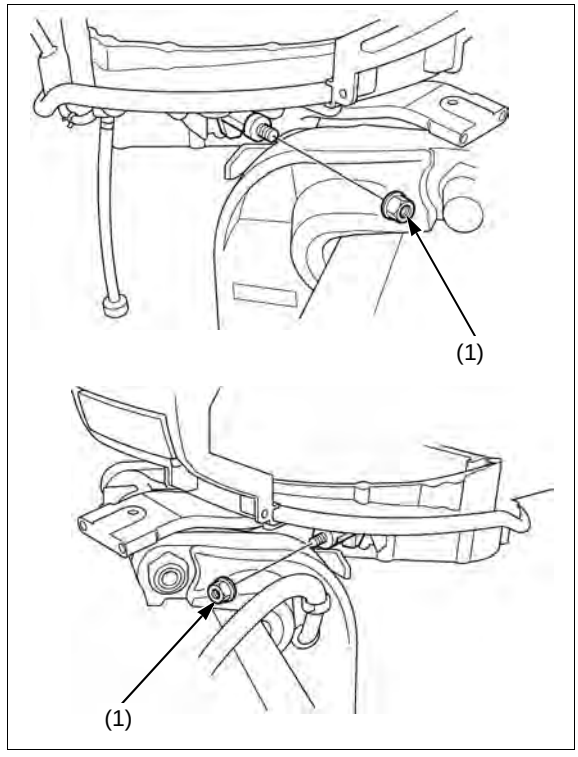
Attachment, 32 × 35 mm 07746-0010100 	Attachment, 24 × 26 mm 07746-0010700 	Pilot, 20 mm 07746-0040500 
Attachment, 28 × 30 mm 07946-1870100 	Driver 07749-0010000 	

MOUNTING CASE REMOVAL/ INSTALLATION

Place the outboard motor on a level surface so it is in the vertical position.

Remove the engine (page 13-3).

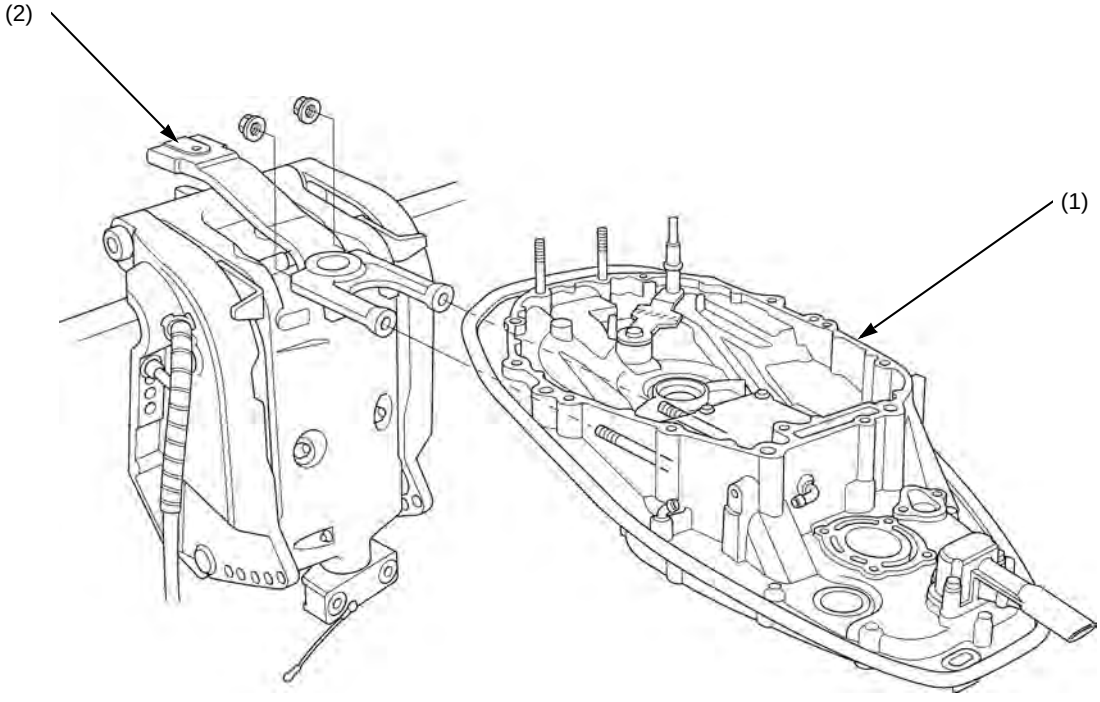
Swivel the outboard motor right and left, then remove the two nuts (1).



Remove the mounting case (1) from the mounting frame (2).

Installation is in the reverse order of removal.

TORQUE: 83 N·m (8.5 kgf·m, 61 lbf·ft)

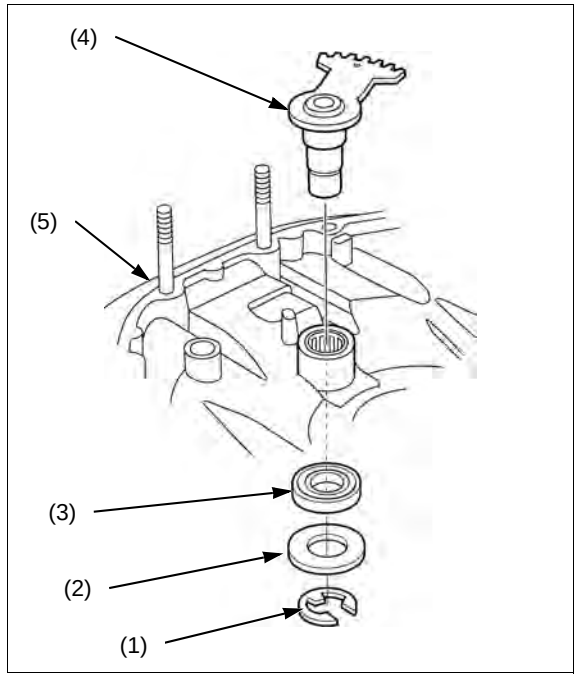


MOUNTING CASE DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

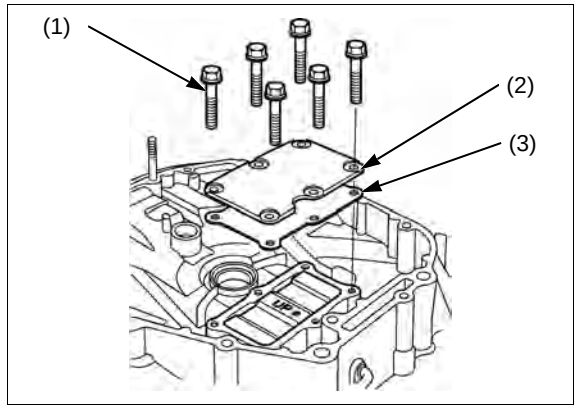
Remove the mounting case (page 18-4).

Remove the E-ring (1), washer (2), water seal (3) and shift shaft A (4) from the mounting case (5).



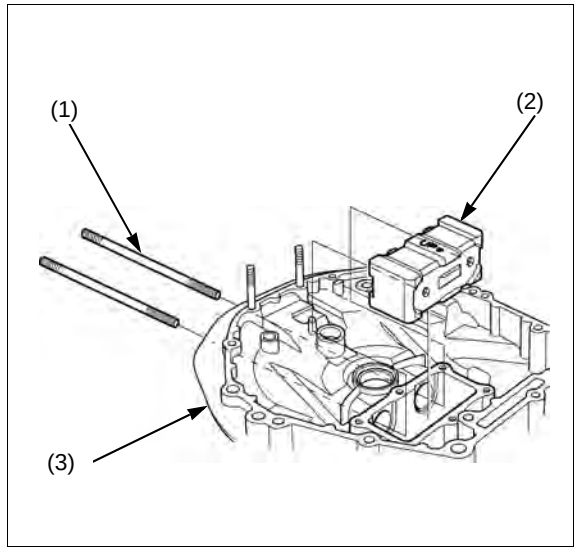
Remove the six bolts (1).

Remove the upper mount holder (2) and upper mount holder gasket (3).

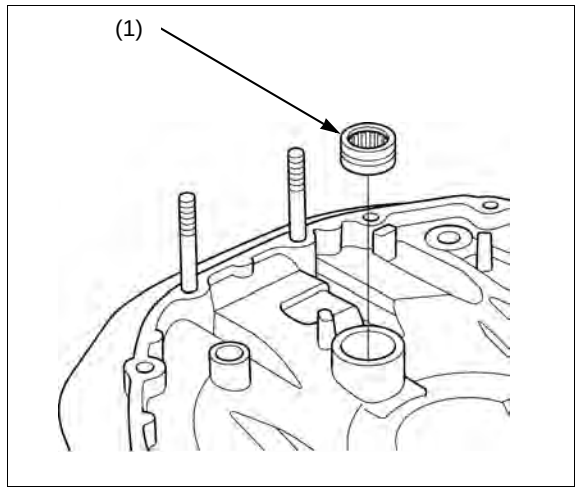


Remove the two stud bolts (1).

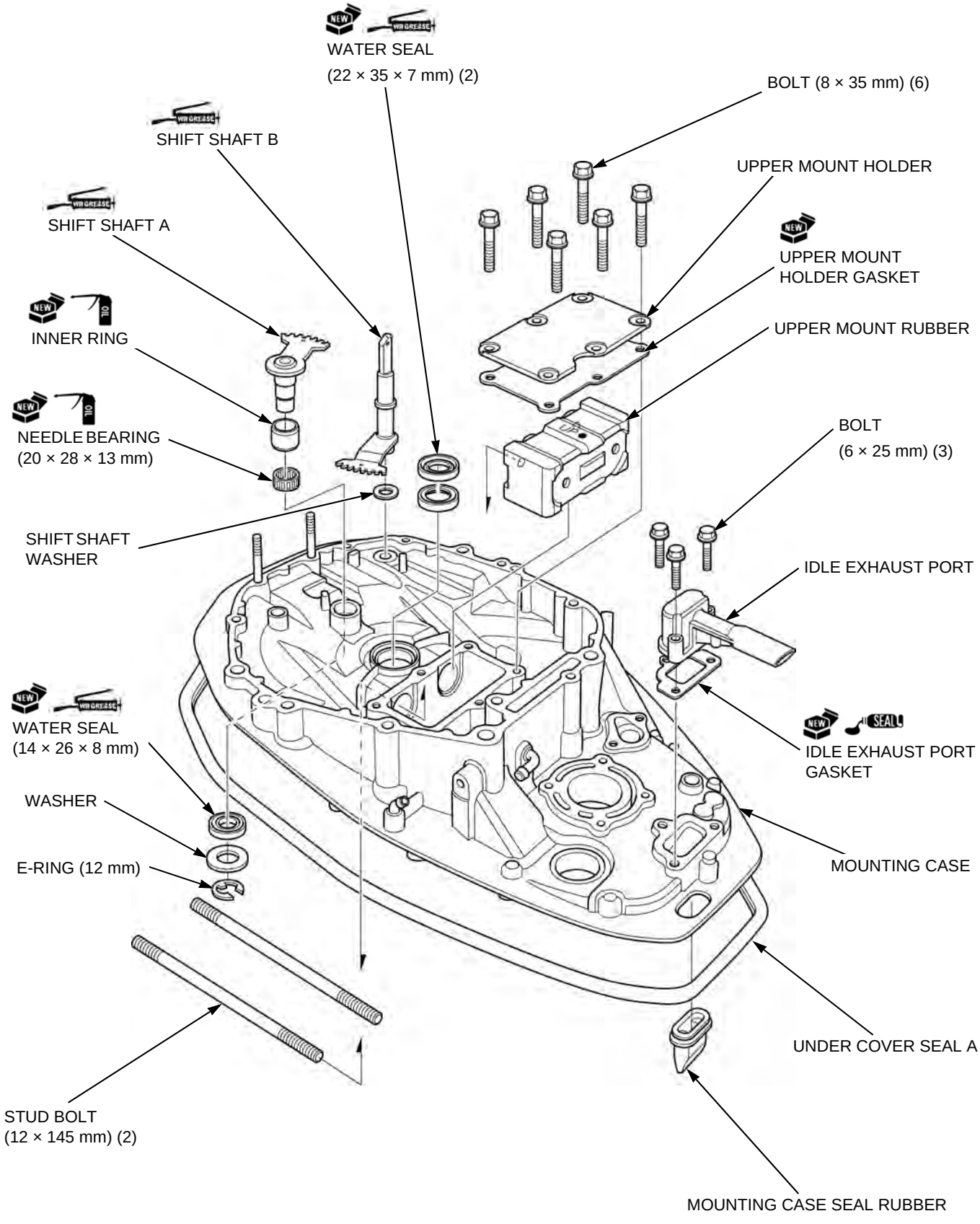
Remove the upper rubber mount (2) from the mounting case (3).



Apply heat around the needle bearing (1) installation area of the mounting case, and remove the needle bearing from the mounting case.



EXPLODED VIEW



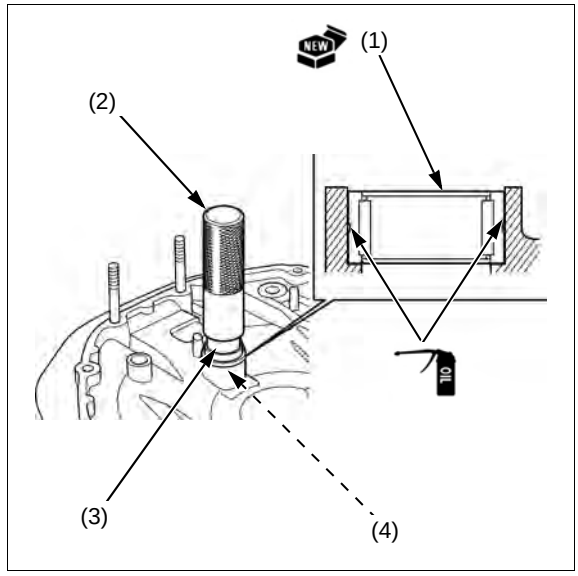
ASSEMBLY

Apply engine oil to the outer circumference of a new needle bearing (1).

Install the needle bearing in the mounting case using the special tools as shown.

TOOLS:

Driver (2)	**07749-0010000**
Attachment, 28 × 30 mm (3)	**07946-1870100**
Pilot, 20 mm (4)	**07746-0040500**



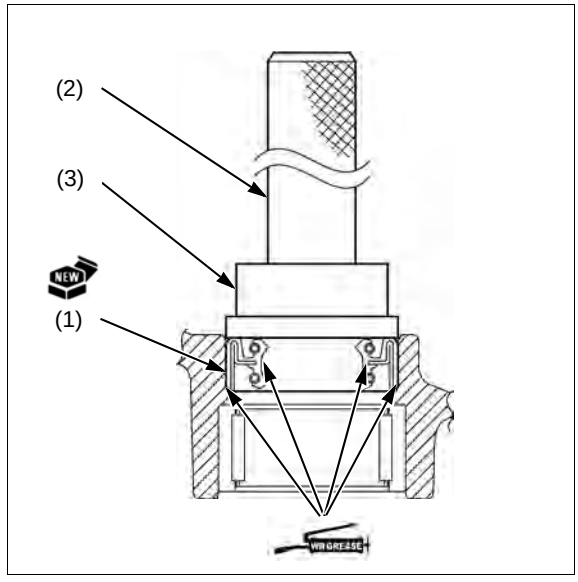
Apply marine grease to the outer circumference of a new water seal (14 × 26 × 8 mm) (1).

Install the water seal in the mounting case using the special tools as shown, noting the installation direction.

TOOLS:

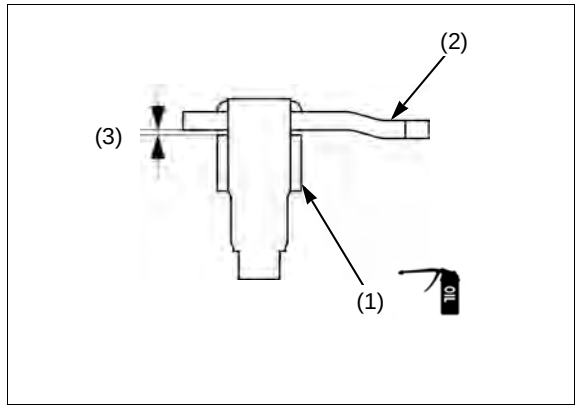
Driver (2)	**07749-0010000**
Attachment, 24 × 26 mm (3)	**07746-0010700**

After installation, apply 2 – 4 g of marine grease to the lips and nearby surface of the water seals.



Apply engine oil to the inner surface of a new inner ring (1).

Using a press, install the inner ring to the shift shaft A (2) so that the distance between the inner ring face and shift shaft A surface is 1.0 mm (0.04 in) (3) as shown.



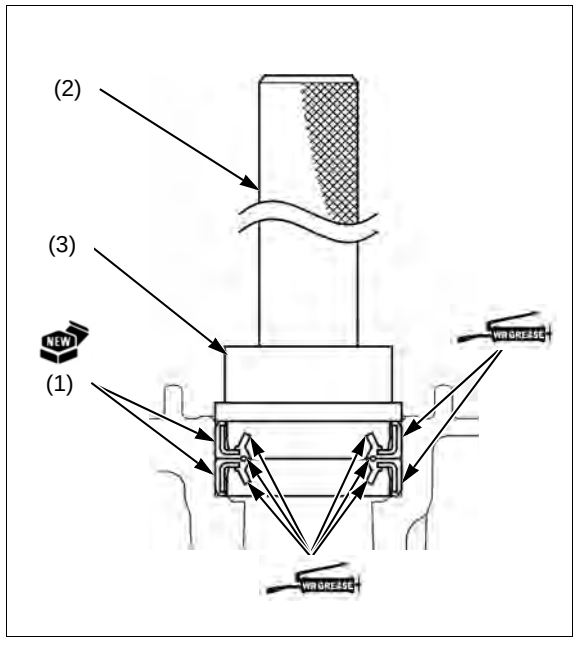
Apply marine grease to the circumference of two new water seals (22 × 35 × 7 mm) (1).

Install the water seals in the mounting case using the special tools as shown, noting the installation direction.

TOOL:

Driver (2)	**07749-0010000**
Attachment, 32 × 35 mm (3)	**07746-0010100**

After installation, apply 2 – 4 g of marine grease to the lips and nearby surface of the water seals.

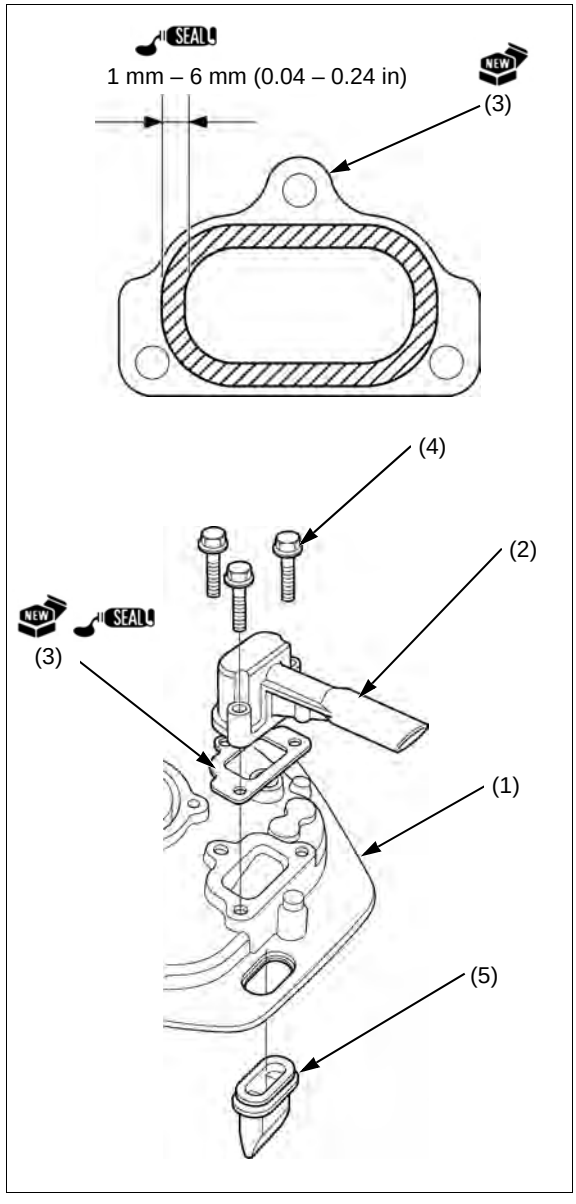


Clean the mating surfaces between the mounting case (1) and idle exhaust port (2).

Apply a bead [Φ1 mm – 6 mm (0.04 – 0.24 in)] of the liquid gasket (ThreeBond® #1211B or equivalent) to both sides of a new idle exhaust port gasket (3) as shown.

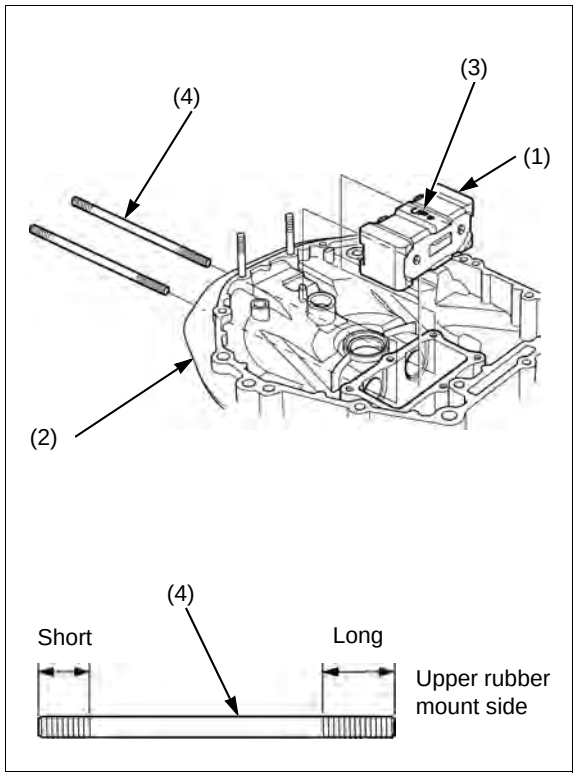
Install the idle exhaust port gasket, idle exhaust port and three bolts (4).

Install the mounting case seal rubber (5) to the mounting case.

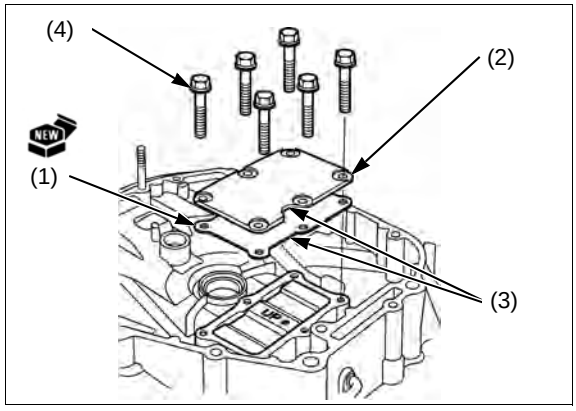


Install the upper rubber mount (1) to the mounting case (2) with its "UP" mark (3) facing up.

Install the two stud bolts (4) with its longer thread side facing the upper rubber mount.



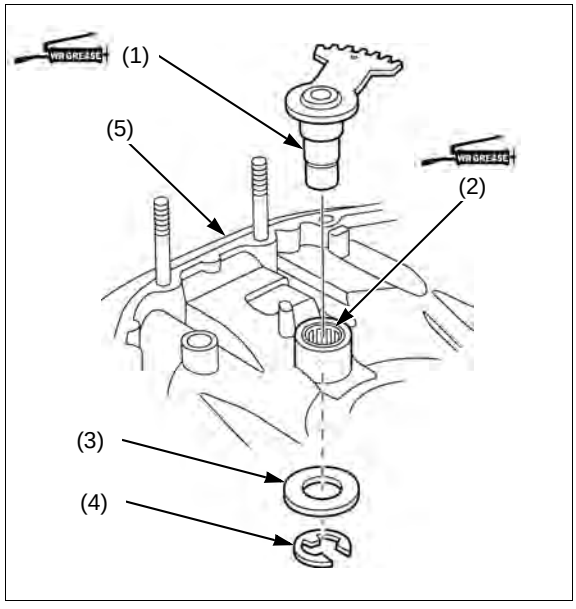
Install a new upper mount holder gasket (1) and upper mount holder (2) with their cutouts (3) positioned as shown, and tighten the six bolts (4).



Apply marine grease to the outer surface of the shift shaft A (1) and needle bearing (2) inner surface.

Install the shift shaft A, washer (3) and E-ring (4) to the mounting case (5).

Install the mounting case (page 18-4).



COMPONENT LOCATION ····· 19-2

TOOLS ····· 19-3

POWER TRIM/TILT/SWIVEL CASE/STERN BRACKET REMOVAL/INSTALLATION ····· 19-4

SWIVEL CASE/MOUNT FRAME DISASSEMBLY/ASSEMBLY ····· 19-16

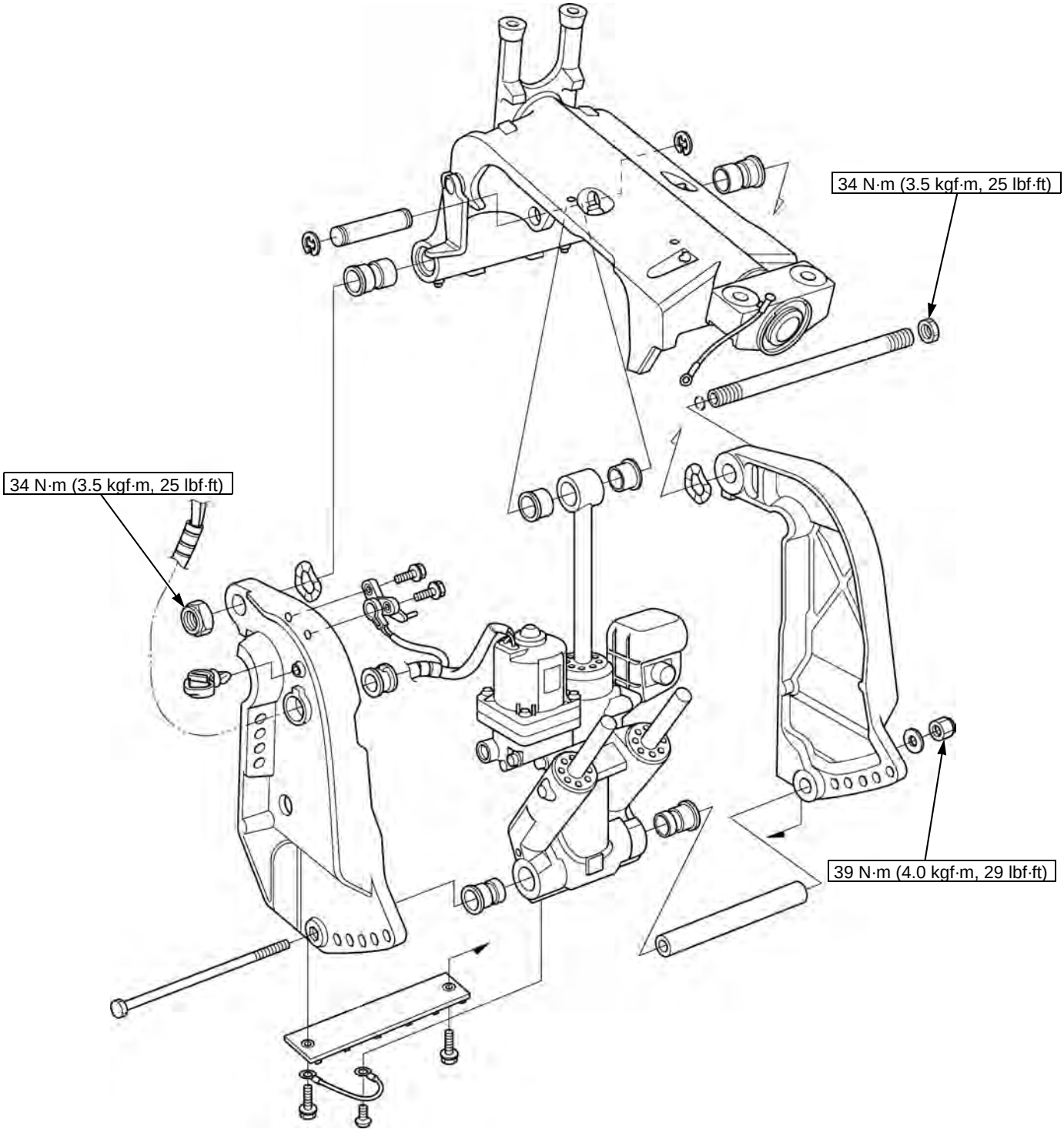
POWER TRIM/TILT DISASSEMBLY/ ASSEMBLY ····· 19-25

POWER TILT MOTOR DISASSEMBLY/ ASSEMBLY ····· 19-43

POWER TILT MOTOR INSPECTION ····· 19-48

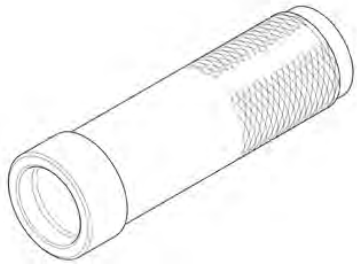
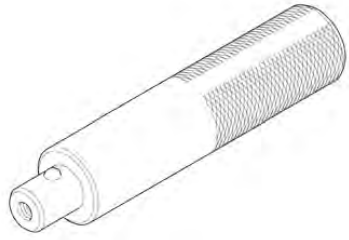
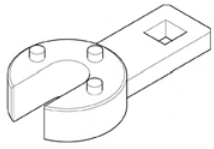
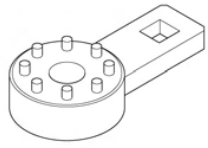
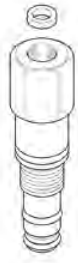
POWER TILT SWITCH INSPECTION ····· 19-50

COMPONENT LOCATION



TOOLS

LIST

Attachment, 52 × 55 mm 07746-0010400 	Driver, 40 mm I.D. 07746-0030100 	Driver 07749-0010000 
Bearing separator attachment, 18 mm 07931-4630100 	Pin wrench, 6 × 35 mm 07SPA-ZW10101 	Trim cap wrench, 4 mm 070PA-0010100 
Oil pressure gauge joint A (Upper chamber side) 07SPJ-ZW10100 	Oil pressure gauge joint B (Lower chamber side) 07SPJ-ZW10200 	

POWER TRIM/TILT/SWIVEL CASE/ STERN BRACKET REMOVAL/ INSTALLATION

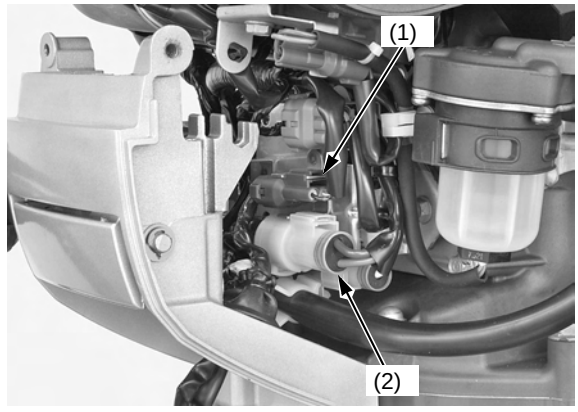
REMOVAL

Remove the following:

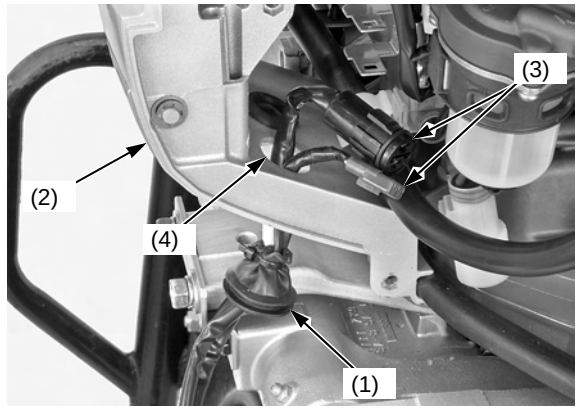
– Engine cover
– Switch panel cable/indicator wire (page 10-6)
– L. engine under cover (page 6-4)
– R. engine under cover (page 6-10)
– Gear case
  – Standard rotation type (page 16-8)
  – Counter rotation type (page 17-8)

Place the outboard motor on a level surface so it is in the vertical position.

Remove the trim angle sensor 3P connector (1) and power tilt motor 2P connector (2) from the connector bracket A (3).
Disconnect the trim angle sensor 3P connector and power tilt motor 2P connector.



Remove the under case grommet C (1) from the under cover front bracket (2) toward the out side as shown.
Pull out the connectors (3) from the hole (4) of the under cover front bracket.

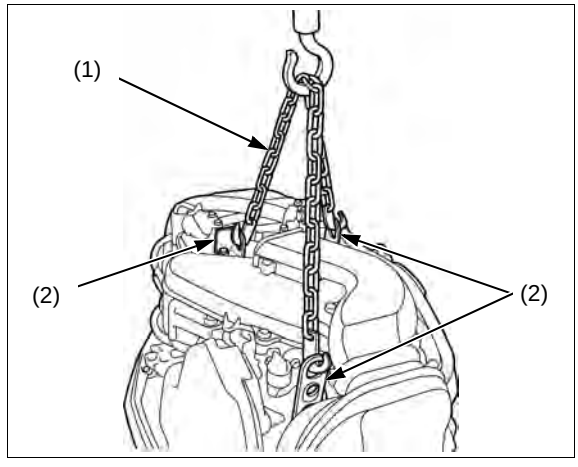


Hook the engine hanger chains (1) to the three engine hangers (2).

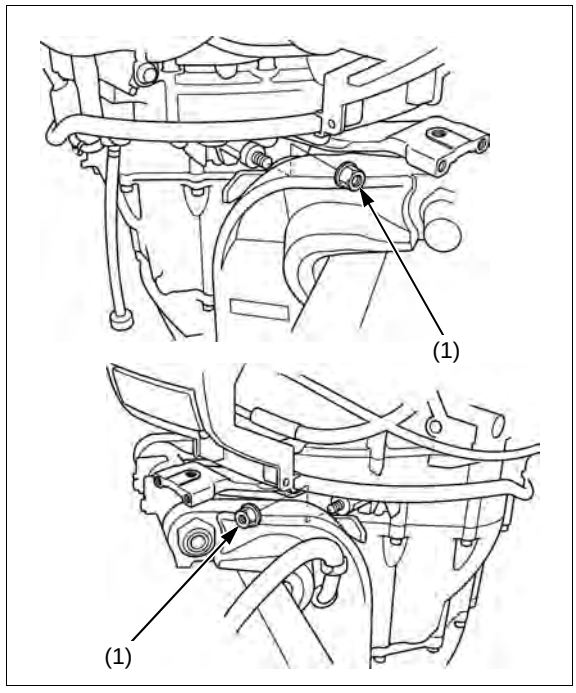
Remove the lower rubber mount.

– Standard rotation type (page 16-12)
– Counter rotation type (page 17-12)

• Check that the outboard motor is not lifted off.



Turn the outboard motor right and left, then remove the two self-locking nuts (1).



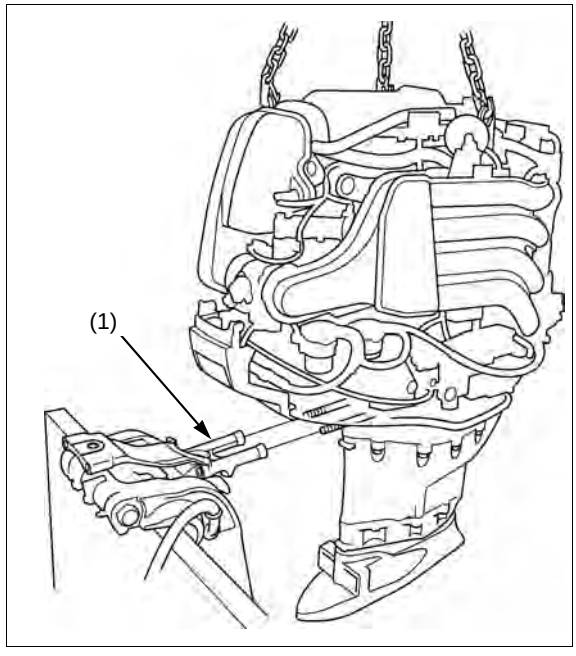
Check that the engine and mount case mating surfaces are level to the ground.
Holding the outboard motor, remove the stern bracket/swivel case assembly (1) from the outboard motor.

If it is hard to remove the stern bracket/swivel case assembly, adjust the engine position by raising and lowering the outboard motor slowly with the hoist.

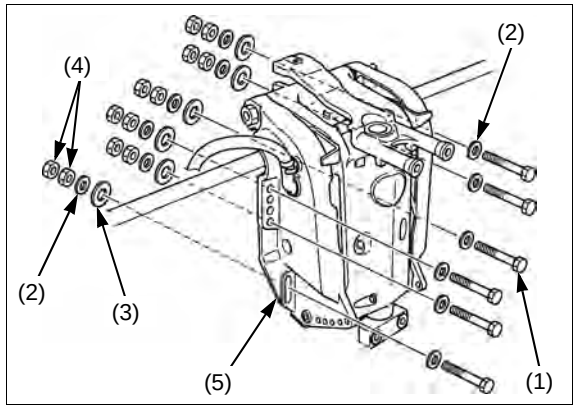
- Be careful not to raise the outboard motor stand off the ground while raising the outboard motor with the hoist.
- Be careful not to damage the threads of the two stud bolts when removing the stern bracket/swivel case assembly from the outboard motor.

After removing the stern bracket/swivel case assembly, lower the outboard motor slowly.
Store the outboard motor with the extension case set on the ground.

- If it is necessary to store the outboard motor by laying it on its side, drain the engine oil, drain the fuel from the vapor separator and install the L./R. engine under covers.
- Then, lay the outboard motor on a urethane foam sheet or blanket with the intake manifold side facing down.



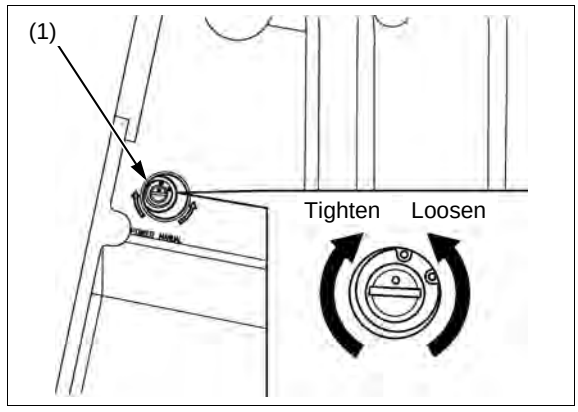
Remove the six bolts (1), twelve small washers (2), six large washers (3), twelve nuts (4) and stern bracket (5).



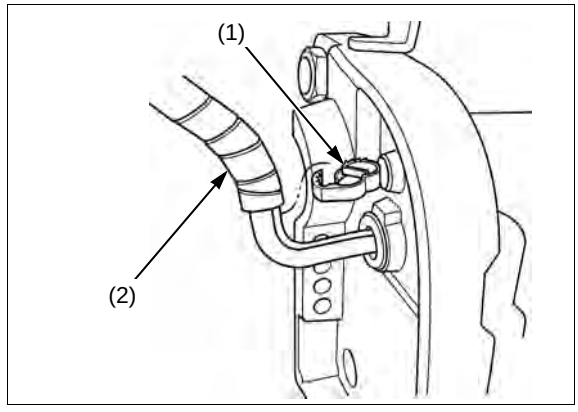
Loosen the manual valve (1) fully and set the swivel case in the uppermost position, using the tilt stopper.

Tighten the manual valve to the specified torque with the swivel case in the uppermost position.

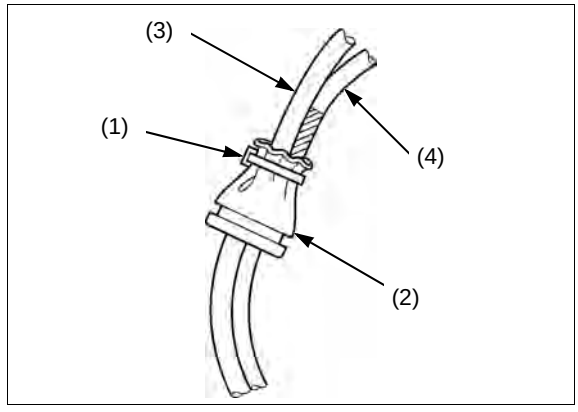
TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)



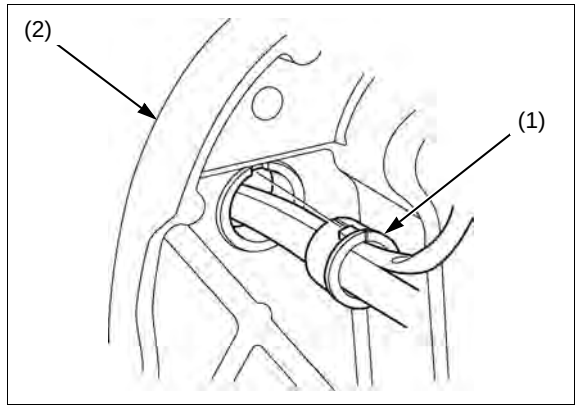
Open the wire harness clip (1) and release the trim angle sensor wire and power tilt motor wire.
Remove the spiral tube (2) from the trim angle sensor wire and power tilt motor wire.



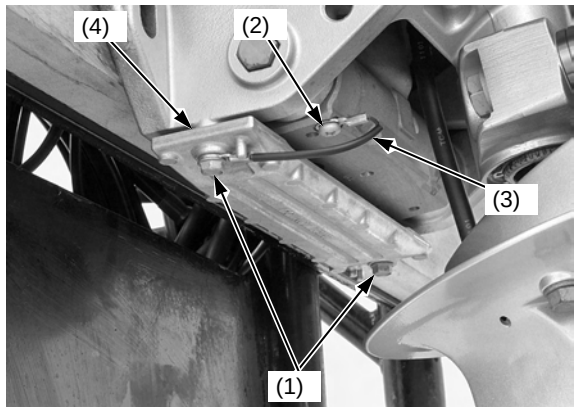
Remove the wire band (1) from the under case grommet C (2) and release the trim angle sensor wire (3) and power tilt motor wire (4).



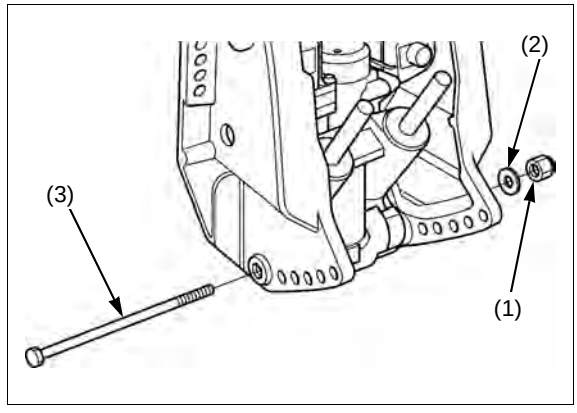
Remove the motor wire bushing (1) from the L. stern bracket (2).



Remove the two bolts (1), screw (2), ground cable (3) and anode metal (4).

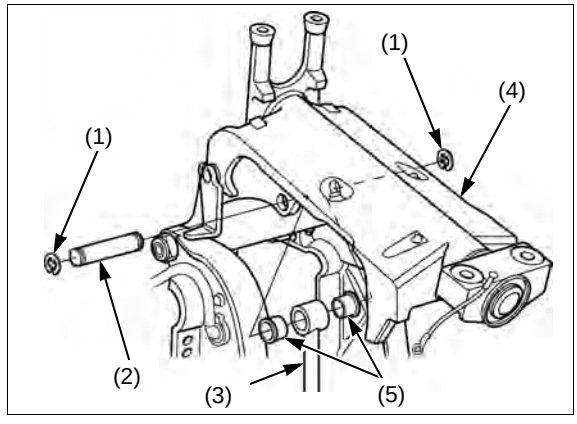


Remove the self-locking nut (1), washer (2) and bolt (3).

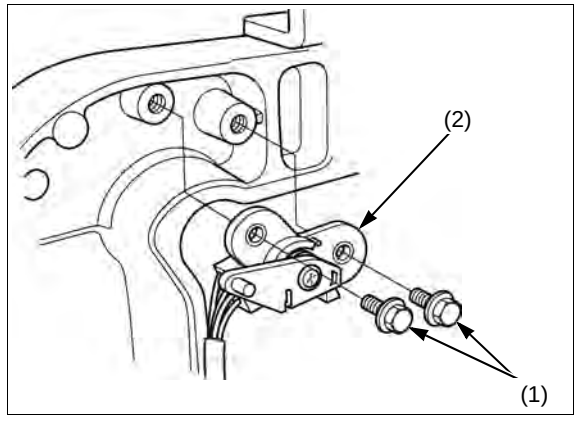


Remove the two E-rings (1) from the upper cylinder pin (2).
Remove the upper cylinder pin and pull off the piston rod (3) of the power trim/tilt from the swivel case (4).

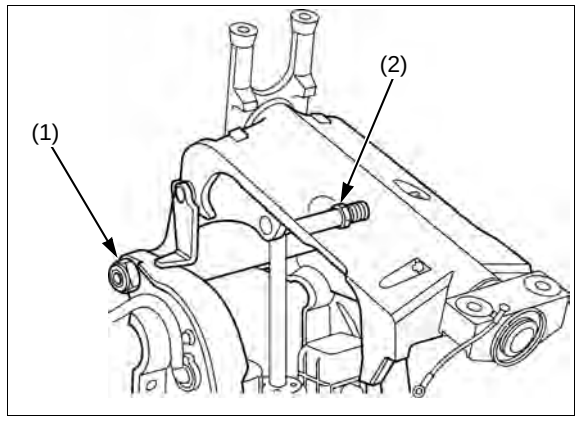
Remove the two upper cylinder bushings (5).



Remove the two bolts (1) and trim angle sensor (2).



Loosen the self-locking nut (25 × 2.0 mm) (1) or self-locking nut (7/8-14 UNF) (2).

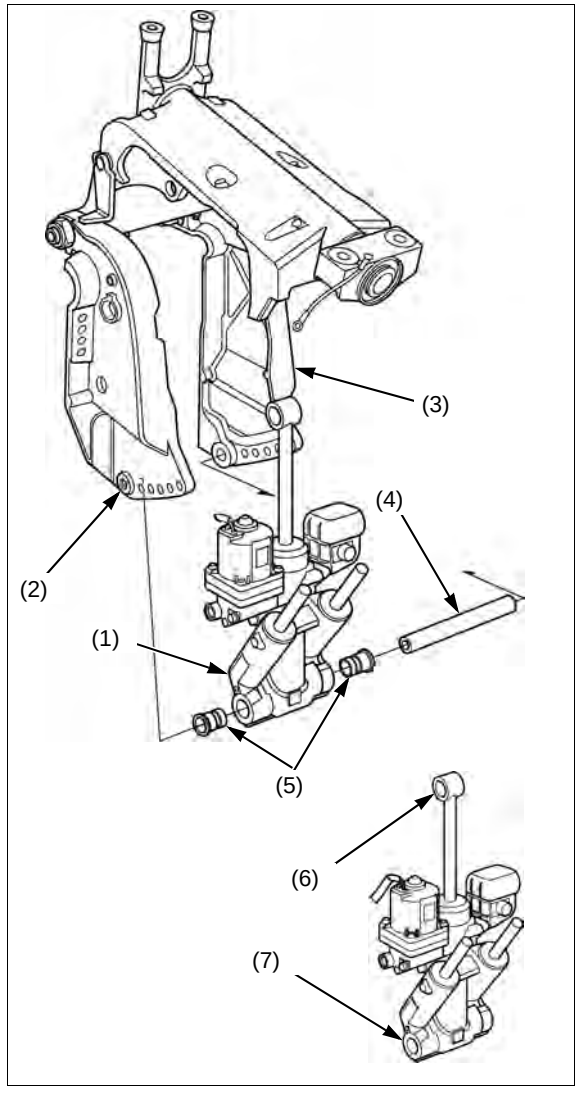


While holding the power trim/tilt (1) by hand, spread the L./R. stern bracket (2)/(3) and remove the lower cylinder collar (4).

Pull out the wire and tube from the L. stern bracket hole and remove the power trim/tilt.

Remove the two lower cylinder bushings (5).

- If it is hard to remove the power trim/tilt, loosen the self-locking nut again.
- Do not push in the piston rod after removing the power trim/tilt.
  If the piston rod is pushed down, extend the piston rod fully and hold it in the position.
- After removal store the power trim/tilt vertically with the upper cylinder bushing installation area (6) facing up.
  Never store the power trim/tilt by laying it on its side or with the lower cylinder bushing installation area (7) facing up.



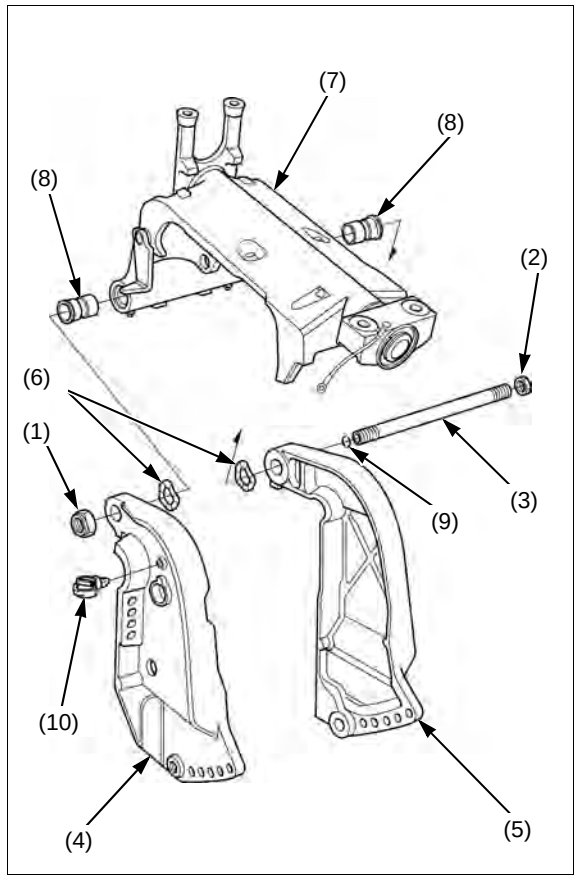
Remove the self-locking nut (25 × 2.0 mm) (1) or the self-locking nut (7/8-14 UNF) (2) from the tilting shaft (3).

Remove the tilting shaft, L./R. stern bracket (4)/(5), two wave washers (6) and swivel case (7).

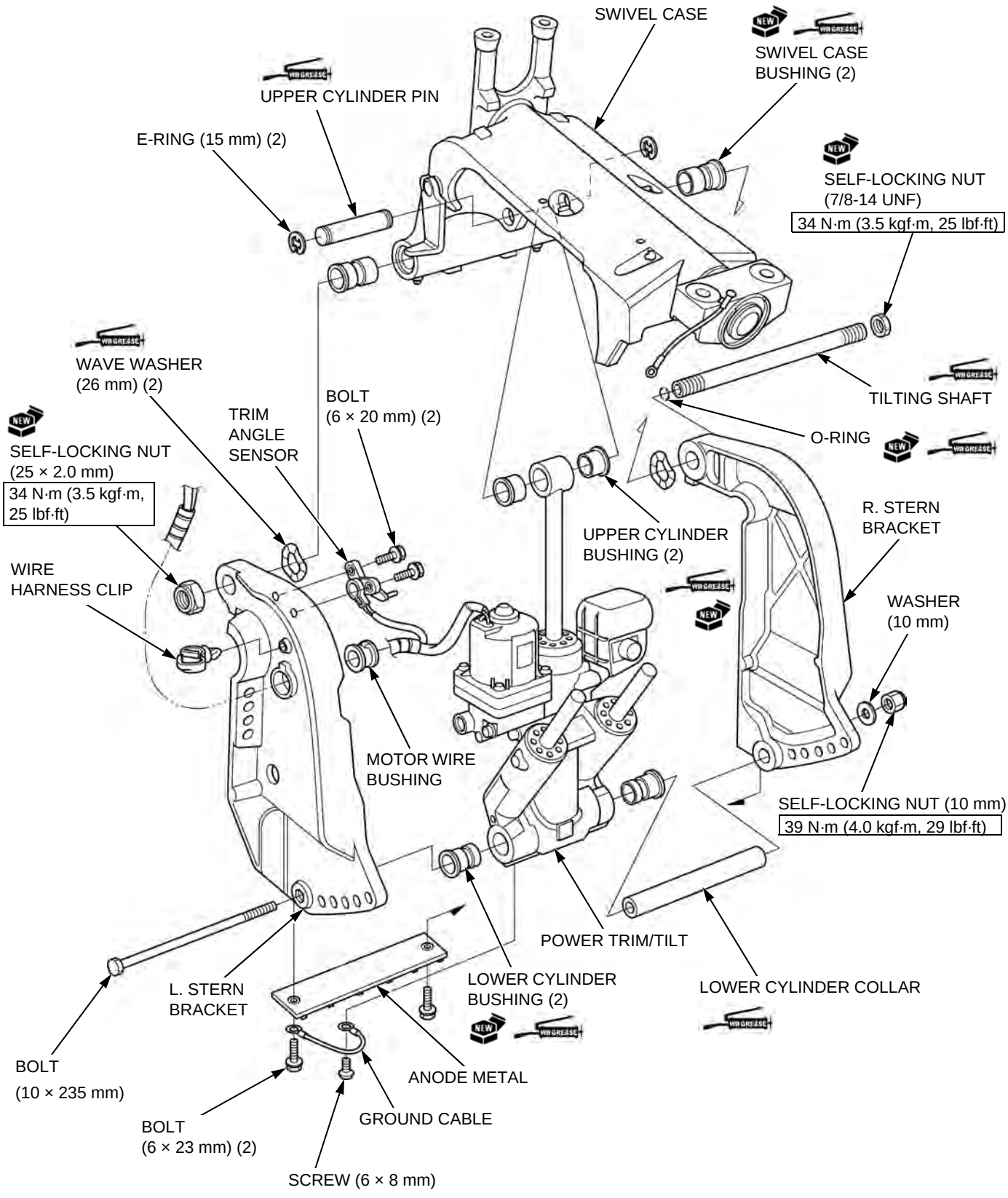
Remove the two swivel case bushings (8).

Remove the O-ring (9) from the inside of the tilting shaft.

Remove the wire harness clip (10) from the L. stern bracket.



EXPLODED VIEW



INSTALLATION

- Check that the piston rod of the power trim/tilt is in the fully extended position.

Install the wire harness clip (1) to the L. stern bracket (2).

Apply marine grease to the inner wall and circumference of new swivel case bushings (3) and install them to the swivel case (4).

Apply marine grease to the new O-ring (5) whole surface and install it into the inner groove of the tilting shaft (6).
Apply marine grease to the following area:

– Bearing part and threads of the tilting shaft
– Tilting shaft installation part of swivel case
– Tilting shaft installation part of L. stern bracket
– Tilting shaft installation part of R. stern bracket (7)

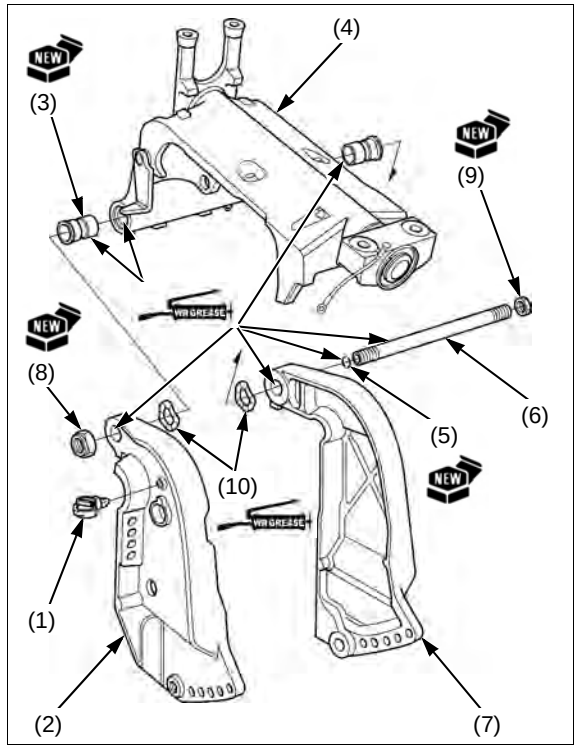
Loosely install the new self-locking nut (25 × 2.0 mm) (8) or self locking nut (7/8-14 UNF) (9) to the tilting shaft.

Apply marine grease to the whole surface of two wave washers (10).
Install the stern bracket and a wave washer to the side which you have installed the self-locking nut.

- If you have installed the self-locking nut (7/8-14 UNF) first, install the R. stern bracket to the tilting shaft.

Insert the tilting shaft into the swivel case and install the wave washer and stern bracket.

Loosely install the new self-locking nut (25 × 2.0 mm) or self locking nut (7/8-14 UNF) to the tilting shaft and spread the L./R. stern bracket.

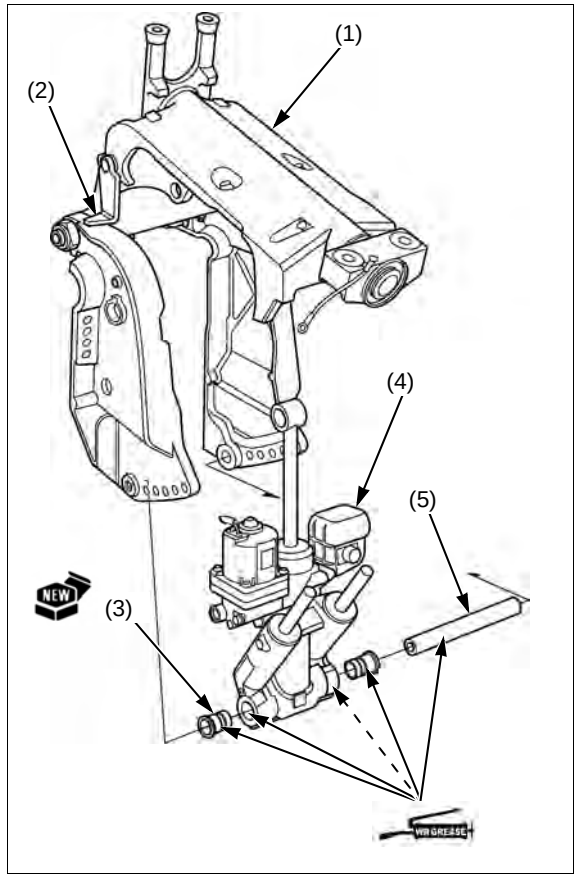


Raise the swivel case (1) to the uppermost position and hold it in position with the tilt stopper (2).

Apply marine grease to the inner wall and circumference of new lower cylinder bushings (3) and install them into the power trim/tilt (4).
Apply marine grease to the lower cylinder collar (5) whole surface and install it into the power trim/tilt.

Route the trim angle sensor wire and power tilt motor wire into the L. stern bracket hole.

Install the lower cylinder collars, which have been mounted in the power trim/tilt, between the L. and R. stern brackets.

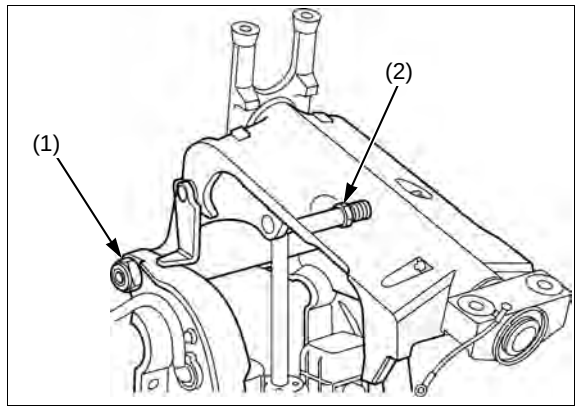


Tighten the self-locking nut (25 × 2.0 mm) (1) or self-locking nut (7/8-14 UNF) (2) to the specified torque.

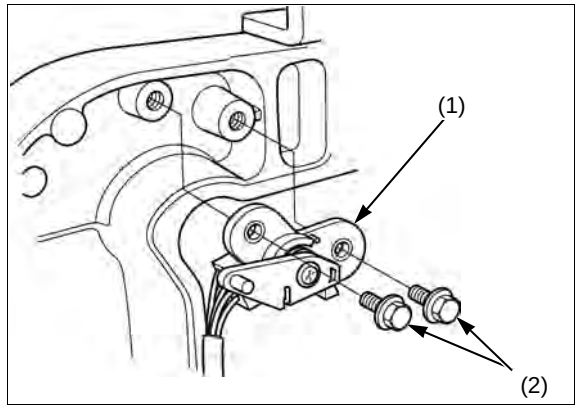
TORQUE: 34 N·m (3.5 kgf·m, 25 lbf·ft)

Tighten the self-locking nut (25 × 2.0 mm) or self-locking nut (7/8-14 UNF) of the other side to the specified torque.

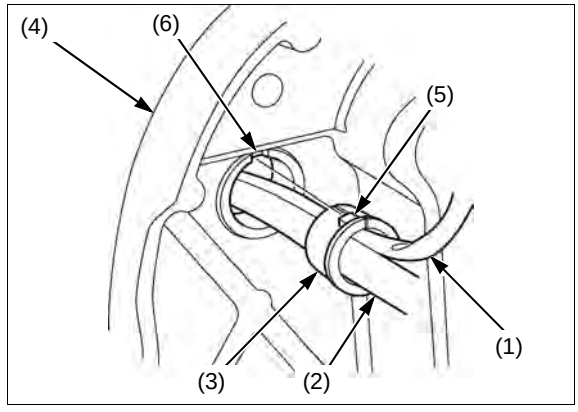
TORQUE: 34 N·m (3.5 kgf·m, 25 lbf·ft)



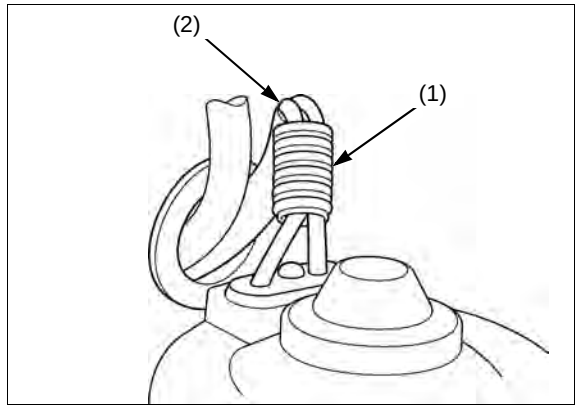
Install the trim angle sensor (1) and tighten the two bolts (2) securely.



Position the trim angle sensor wire (1) and power tilt motor wire (2) in the motor wire bushing (3) as shown.
Install the motor wire bushing into the L. stern bracket (4) by aligning its boss (5) with the groove (6) of the bracket.

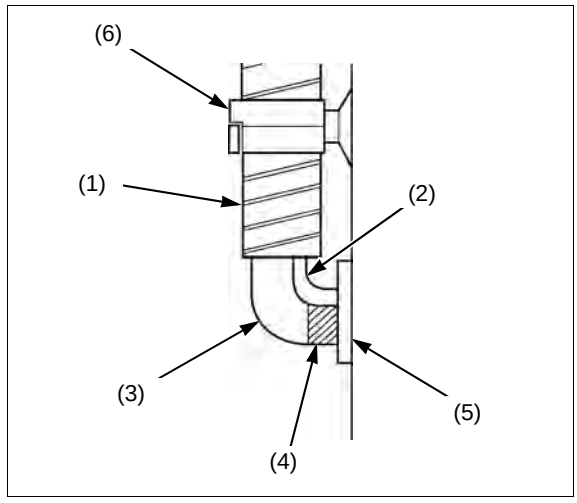


Check that the corrugated tube (1) of the power tilt motor wire (2) stands straight up as shown.



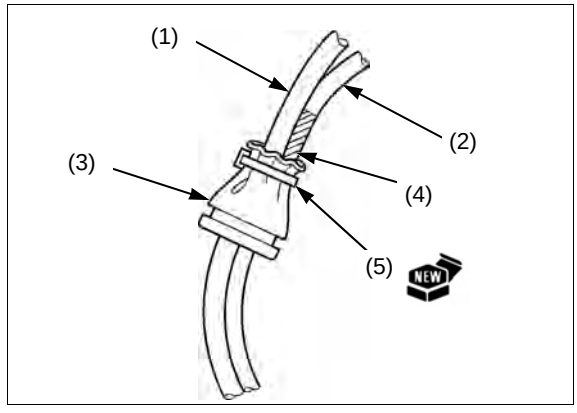
Install the spiral tube (1) around the trim angle sensor wire (2) and power/tilt motor wire (3).

Align the taped end (4) of the power/tilt motor wire with the end of the motor wire bushing (5) and install.
Clamp the trim angle sensor wire and power/tilt motor wire with the wire harness clip (6).



Pass the trim angle sensor wire (1) and power/tilt motor wire (2) through the under case grommet C (3).

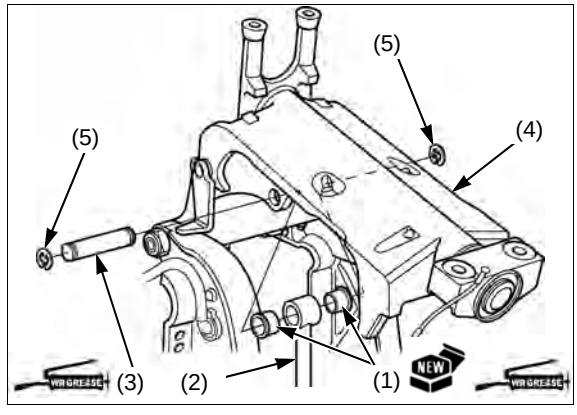
Align the taped end (4) of the power/tilt motor wire with the end of the under case grommet C, and fasten the new wire band (5) as shown.
After fastening the wire band, cut the excess part of the wire band so that the remaining projected length is 5 – 10 mm (0.2 – 0.4 in).



Apply marine grease to the inner wall and circumference of new upper cylinder bushings (1) and install them to the piston rod (2) of the power trim/tilt.

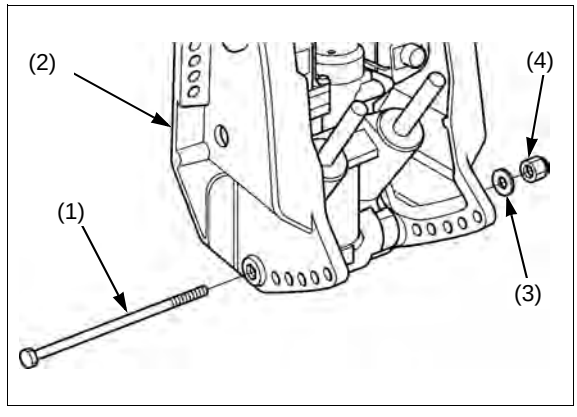
Apply marine grease to the upper cylinder pin (3) whole surface.

Install the upper cylinder pin by aligning the piston rod hole with the swivel case (4) holes.
Install the two E-rings (5) to the upper cylinder pin.

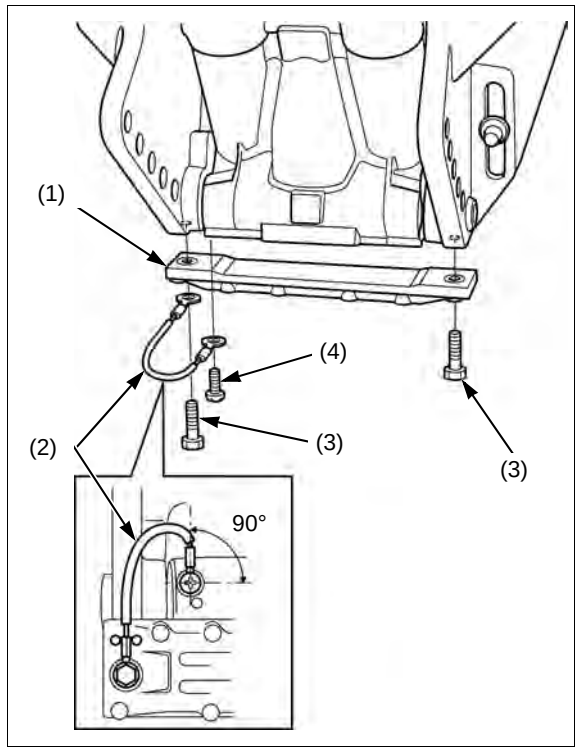


Install the bolt (1) from the L. stern bracket (2) side and install the washer (3).
Install and tighten the self-locking nut (4) to the specified torque.

TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)



Inspect the anode metal (1) for corrosion and replace if necessary.
Install the anode metal and ground cable (2) and tighten the two bolts (3).
Set the ground cable in the specified angle as shown, and tighten the screw (4).

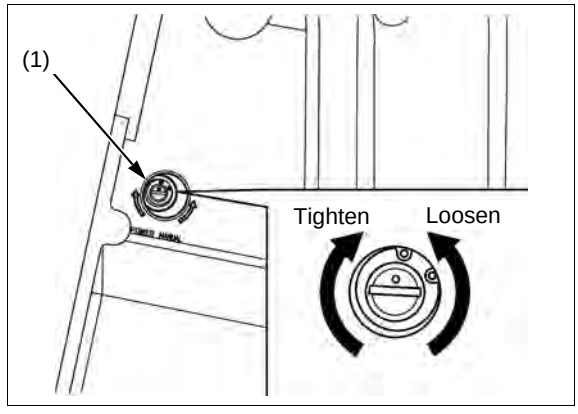


Loosen the manual valve (1) fully.
Raise the swivel case assembly a little, unlock the tilt stopper and lower the swivel case assembly to the lowermost position.

With the swivel case assembly in its lowermost position, tighten the manual valve to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

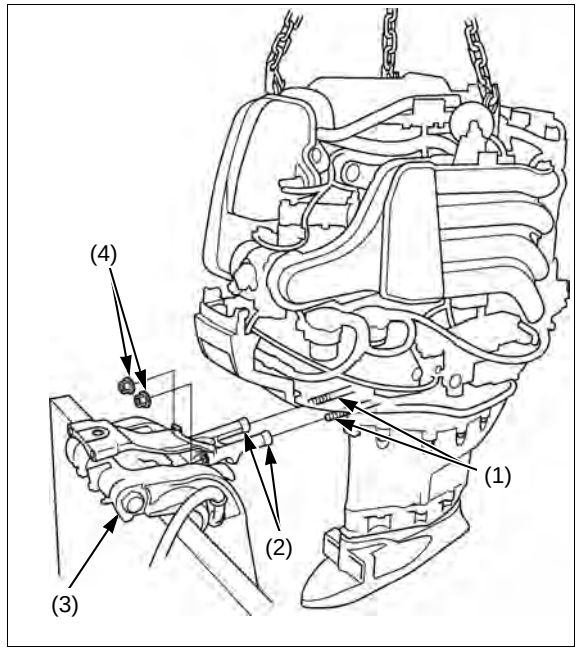
Install the swivel case/stern bracket to the boat.
Install the mounting case (page 18-4).



Lift up the outboard motor using the engine hanger until the stud bolts (1) are aligned with the mount frame holes (2) of the stern bracket/swivel case (3).

Move the stern bracket/swivel case assembly, which is attached to the outboard motor stand, slowly toward the outboard motor.
Insert the stud bolts into the mount frame holes and tighten the two self-locking nuts (4) to the specified torque.

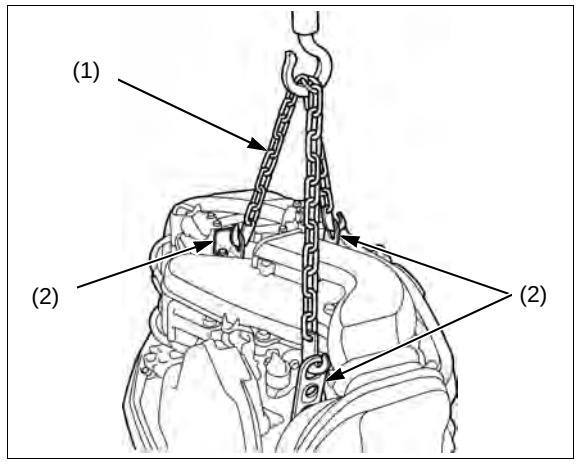
TORQUE: 83 N·m (8.5 kgf·m, 61 lbf·ft)



Install the lower rubber mount.

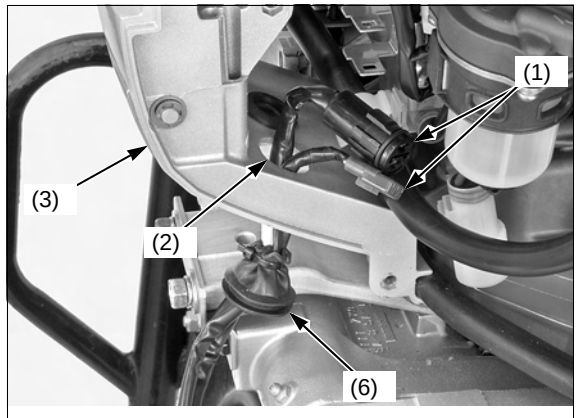
– Standard rotation type (page 16-14)
– Counter rotation type (page 17-14)

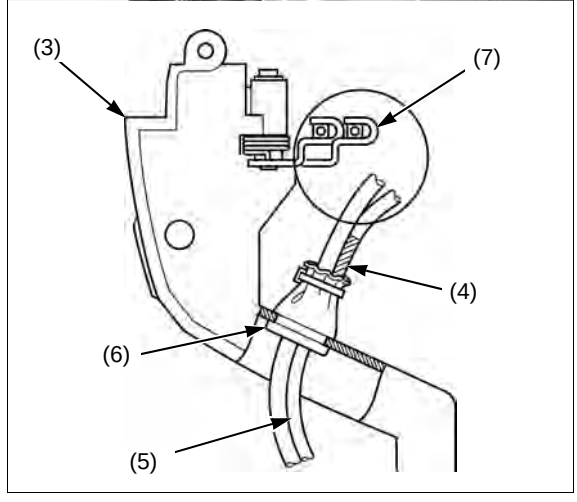
Remove the chains (1) from the three engine hangers (2).



Route the connectors (1) into the hole (2) of the under cover front bracket (3).
Check that the taped end (4) of the power/tilt motor wire (5) are aligned with the end of the under case grommet C (6).
Set the groove of the under case grommet C to the under cover front bracket securely.

Move the front lock (7) by hand and check that the wires and tube do not interfere with the front lock.

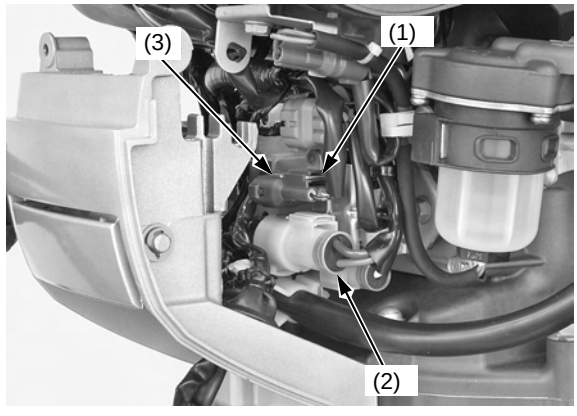




Connect the trim angle sensor 3P connector (1) and power tilt motor 2P connector (2).
Install the trim angle sensor 3P connector to the upper side of the connector bracket A (3) and power tilt motor 2P connector to the lower side.

Install the following:

– Gear case
  – Standard rotation (page 16-8)
  – Counter rotation (page 17-8)
– L. engine under cover (page 6-6)
– R. engine under cover (page 6-11)
– Switch panel cable/indicator wire (page 10-6)
– Engine cover



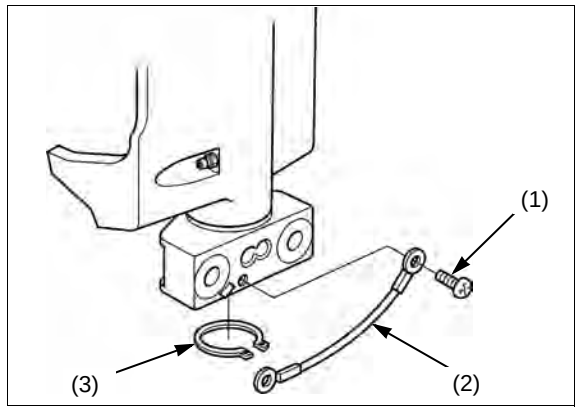
SWIVEL CASE/MOUNT FRAME DISASSEMBLY/ASSEMBLY

DISASSEMBLY

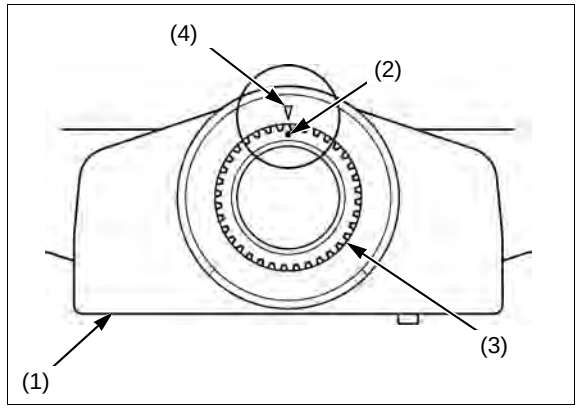
Remove the swivel case/stern bracket (page 19-4).

Remove the screw (1) and ground cable (2).

Remove the external circlip (3).



Before disassembling the lower mount center housing (1), put a mark (2) on the mount frame (3) so it is aligned with the "△" mark (4) on the lower mount center housing.



Apply heat to the lower mount center housing (1), using a commercially available heat gun (2) or equivalent.

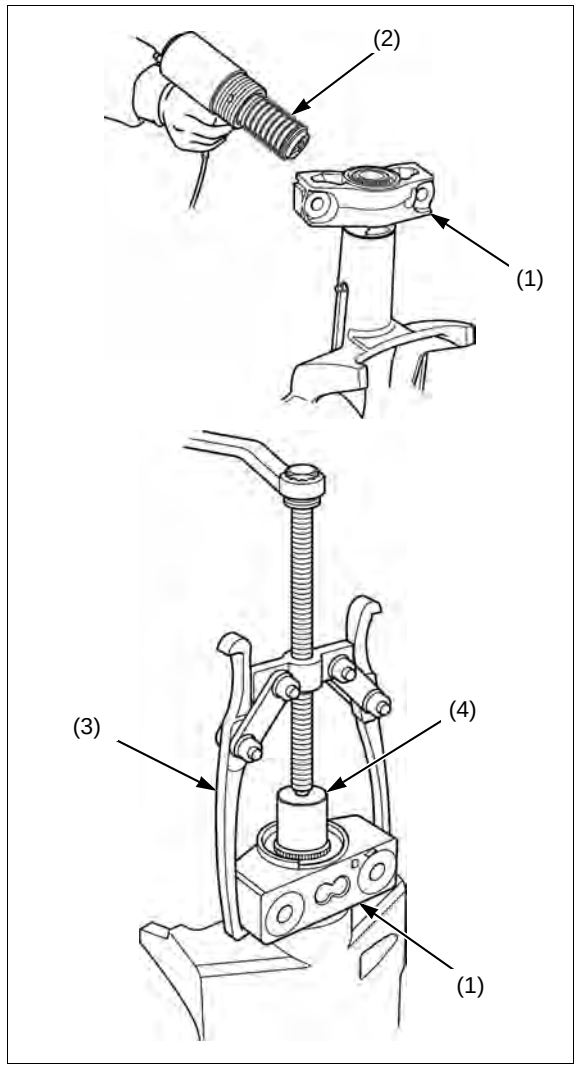
NOTICE

Overheating the lower mount center housing may cause damage to the painted surfaces.

Remove the lower mount center housing by using the special tool with a commercially available bearing puller (3).

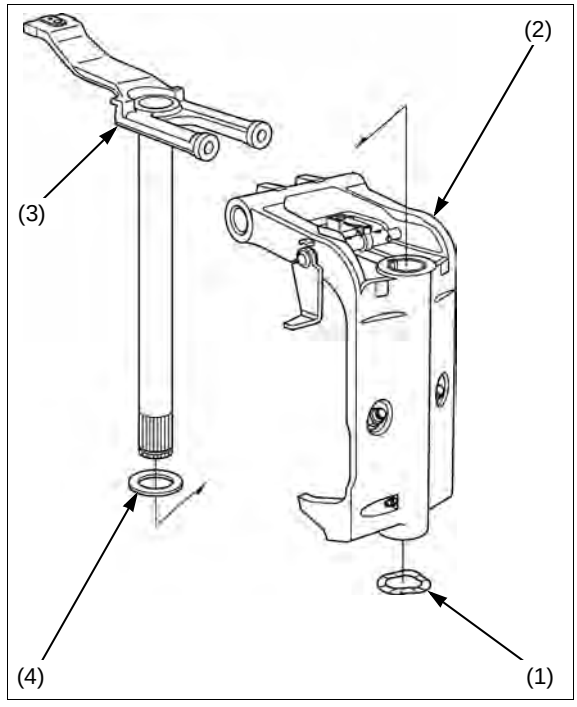
TOOL:

Bearing separator attachment, 18 mm (4)	**07931-4630100**



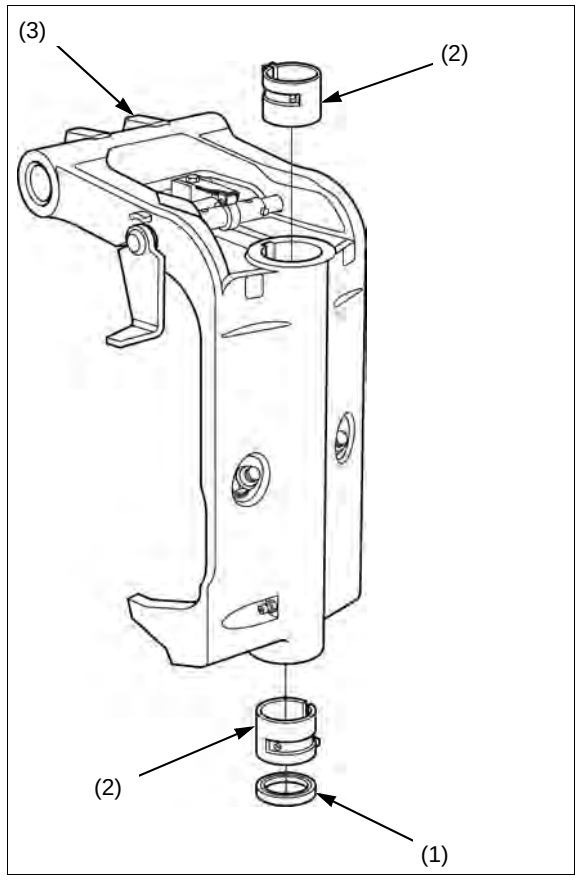
Remove the wave washer (1) from the swivel case (2).

Remove the mount frame (3) and thrust washer (4) from the swivel case.



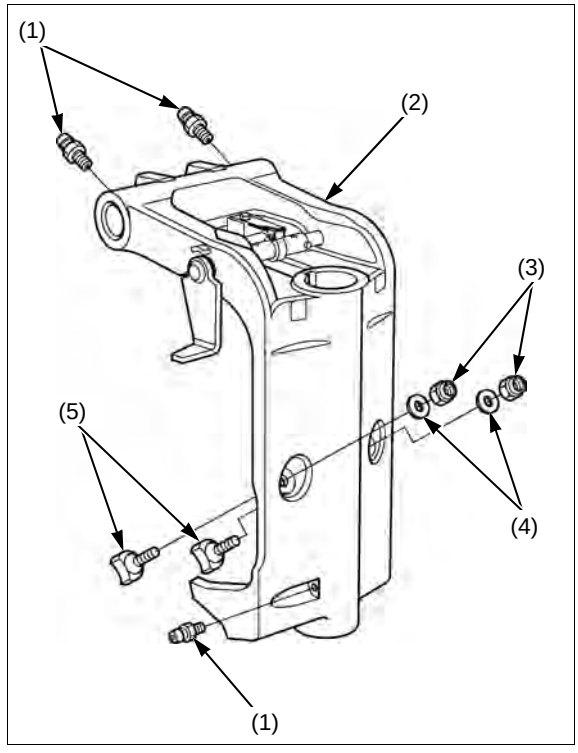
Remove the oil seal (1).

Remove the two swivel case liners (2) from the swivel case (3).



Remove the three grease fittings (1) from the swivel case (2).

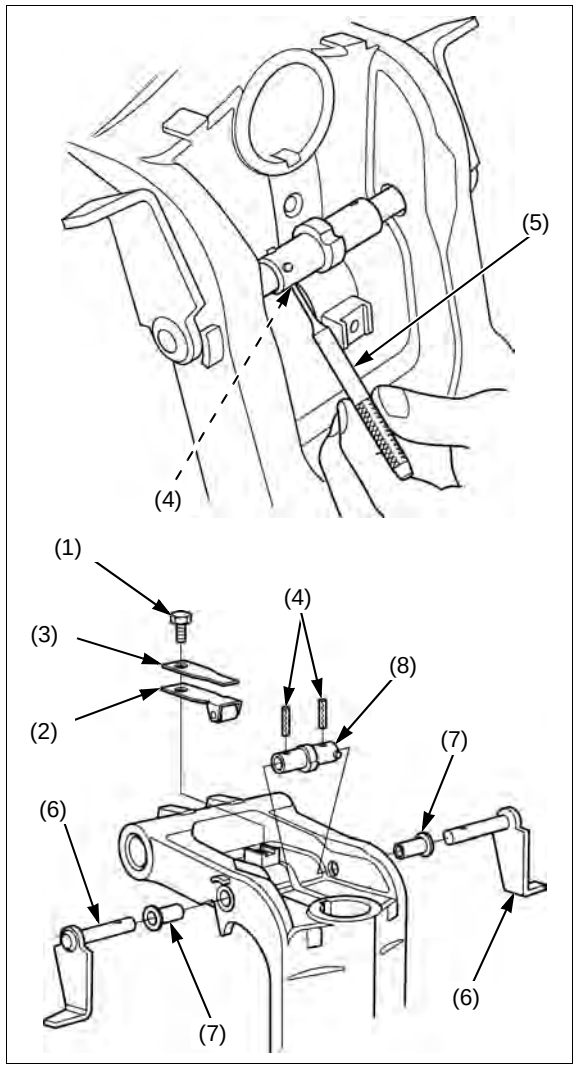
Remove the two self-locking nuts (3), two washers (4) and two thrust receivers (5) from the swivel case.



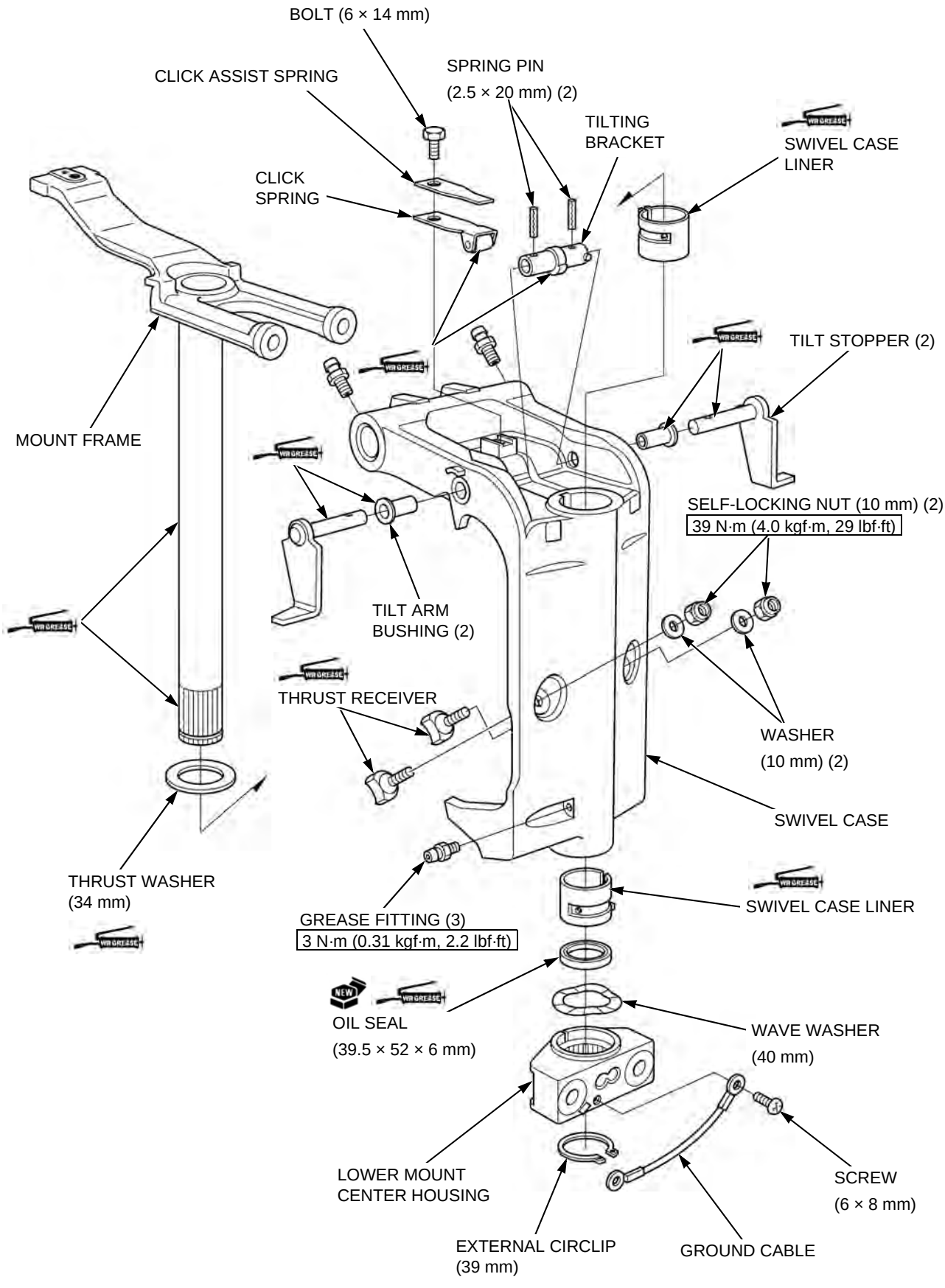
Remove the bolt (1), click spring (2) and click assist spring (3).

Drive out the spring pin (4) from the tilting bracket, using a commercially available pin driver (5).
Remove the spring pin on the other side in the same manner.

Remove the two tilt stoppers (6), two tilt arm bushings (7) and tilting bracket (8).



EXPLODED VIEW

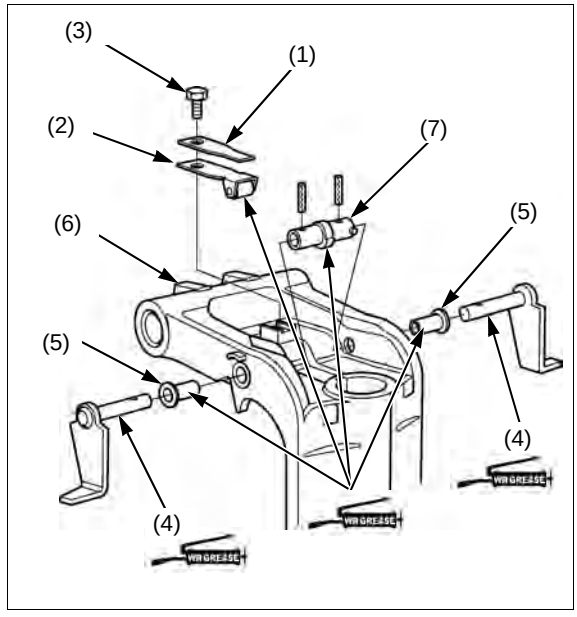


ASSEMBLY

Install the click assist spring (1) and click spring (2), then tighten the bolt (3).
Apply marine grease to the click spring roller surface.

Apply marine grease to the two tilt stoppers (4) and tilt arm bushings (5).

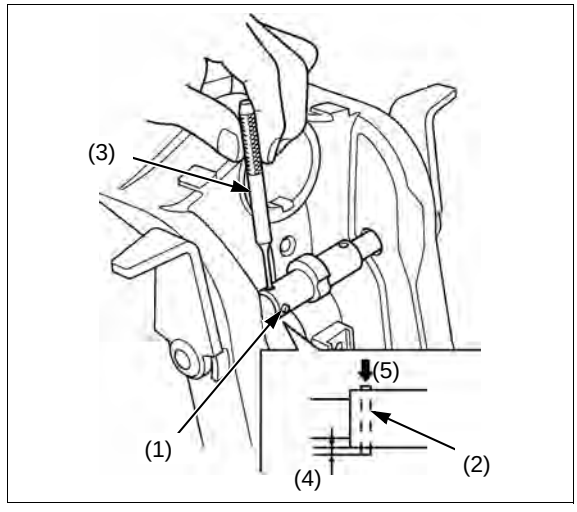
Install the tilt arm bushings and tilt stoppers to the swivel case (6).
Set the tilting bracket (7) to the tilt stoppers.



Insert the L./R. tilt stopper shafts into the tilting bracket so that the boss (1) of the bracket is facing right and upward direction, when viewed from the mount frame installation hole side of the swivel case.

Drive in the spring pin (2) using a commercially available pin driver (3) until the extrusion length of the pin is 1 – 2 mm (0.04 – 0.08 in) (4) at the opposite side of the driven side (5).

- Do not drive in the spring pin more than necessary, as it will prevent the tilt stopper operation.



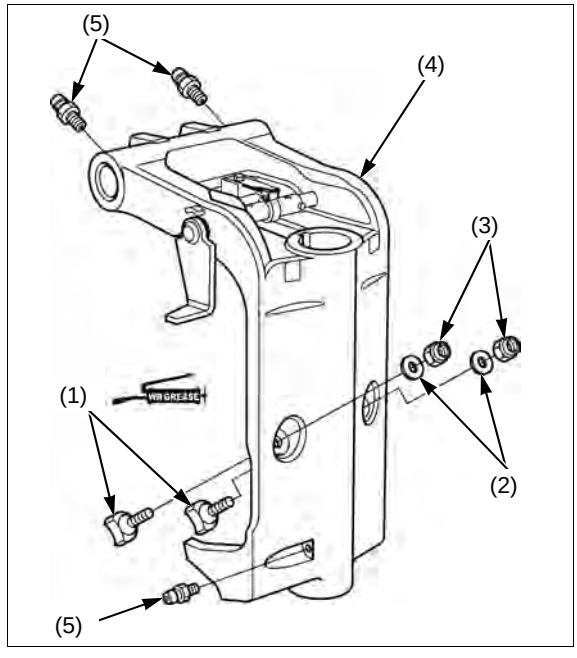
Install the two thrust receivers (1), two washers (2) and two self-locking nuts (3) to the swivel case (4), then tighten the nuts to the specified torque.

TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)

Install and tighten the three grease fittings (5) to the specified torque.

TORQUE: 3 N·m (0.31 kgf·m, 2.2 lbf·ft)

Apply marine grease to the thrust receiver sliding surfaces.



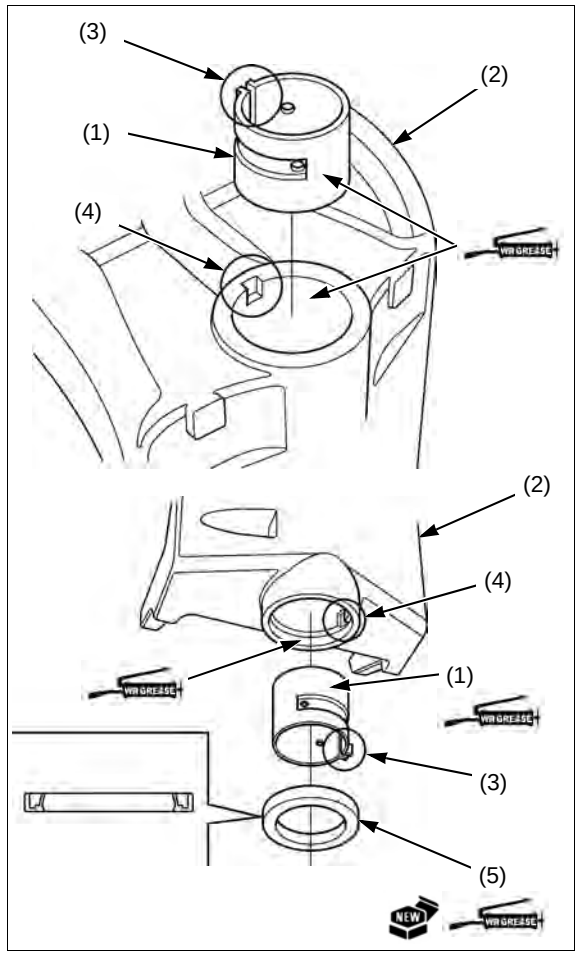
Apply marine grease to the swivel case liner (1) whole surface.

Install the two swivel case liners into the swivel case (2) by aligning its tabs (3) with the case grooves (4).

Apply marine grease to the lips and circumference of a new oil seal (5).
Install the oil seal into the lower side of the swivel case in the direction as shown, using the special tools.

TOOLS:

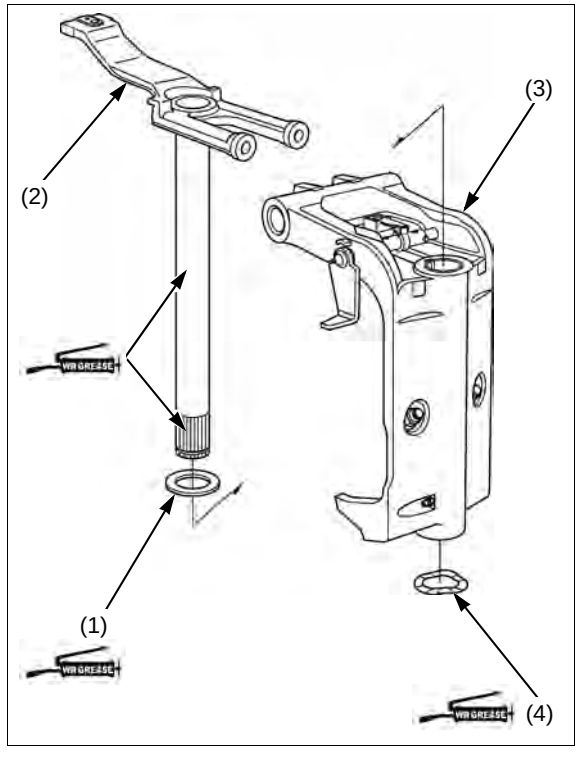
Driver	**07749-0010000**
Attachment, 52 × 55 mm	**07746-0010400**



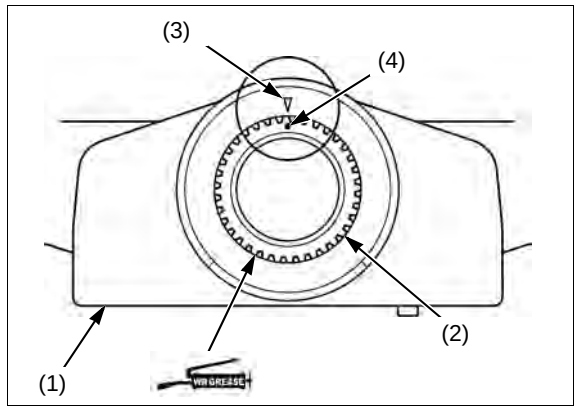
Apply marine grease to the thrust washer (1) whole surface and install it to the mount frame (2).
Apply marine grease to the mount frame shaft whole surface and install the mount frame into the swivel case (3).

- Install the mount frame with care not to push the swivel case liner out of the swivel case.

Apply marine grease to the wave washer (4) whole surface and install it to the mount frame.



Apply grease to the splines of the lower mount center housing (1).
Install the lower mount center housing on the mount frame (2) by aligning its "△" mark (3) with the mark (4) on the mount frame that had been made during disassembly.



Apply heat to the lower mount center housing (1), using a commercially available heat gun.

NOTICE

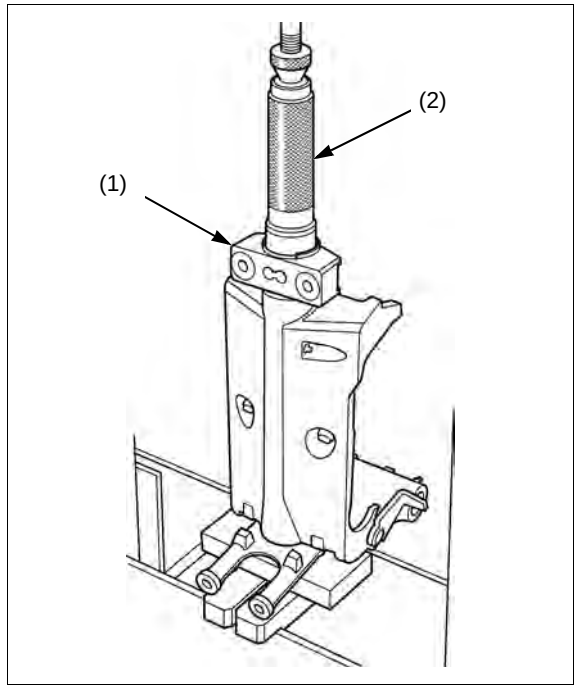
Overheating the lower mount center housing may cause damage to the painted surfaces.

Set the swivel case/mount frame to the hydraulic press.

Set the special tool onto the lower mount center housing as shown, press the lower mount center housing until it seats on the swivel case.

TOOL:
Driver, 40 mm I.D. (2) **07746-0030100**

Remove the special tool and swivel case from the hydraulic press.



Check that the mount frame turns smoothly and that the external circlip can be installed.

If the circlip can be installed but the mount frame does not turn smoothly, perform the following procedure.

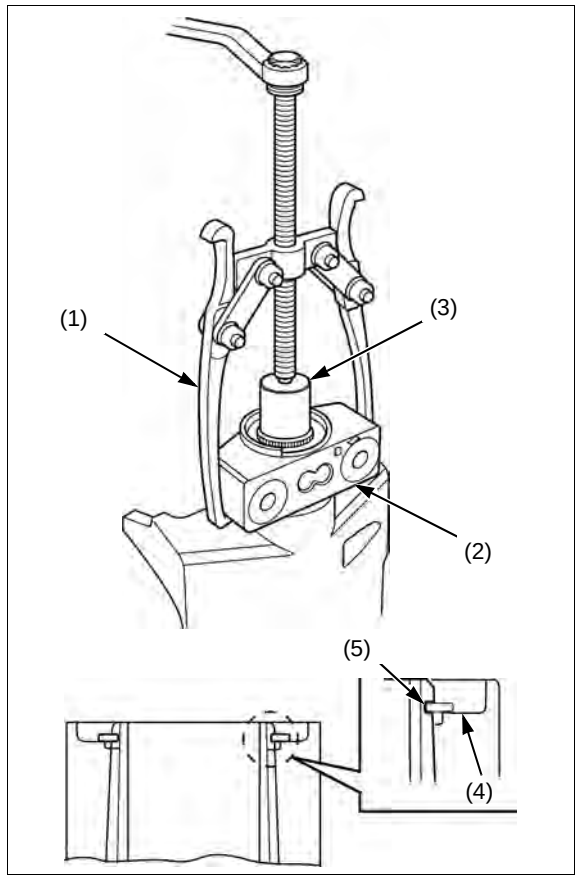
Set the special tool and a commercially available bearing puller (1) to the lower mount center housing (2).

TOOL:
Bearing separator attachment, 07931-4630100
18 mm (3)

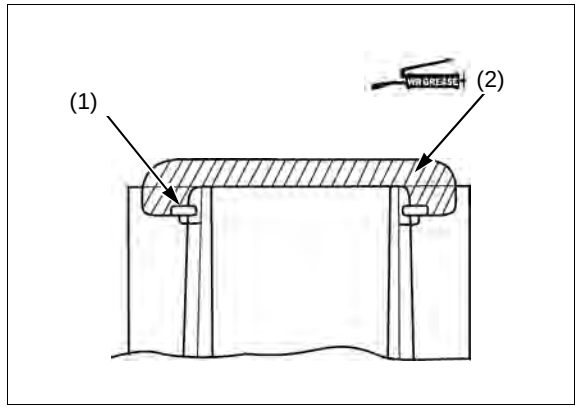
Pull the lower mount center housing until its top surface (4) is flush with the circlip groove (5) of the mount frame.

Remove the special tool and bearing puller.

Recheck that the mount frame turns smoothly and that the external circlip can be installed.



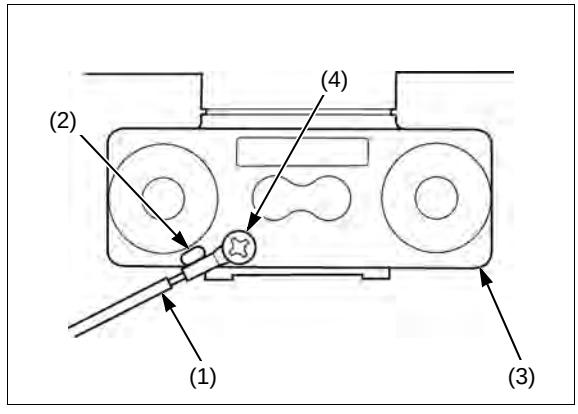
Install the external circlip (1) into the groove and apply marine grease to the specified area (2).



Position the ground cable (1) against the stopper (2) of the lower mount center housing (3), then install and tighten the screw (4).

After assembling the swivel case, add marine grease through the grease fittings using a grease gun.

Install the swivel case/stern bracket (page 19-11).



POWER TRIM/TILT DISASSEMBLY/ ASSEMBLY

DISASSEMBLY

- Do not overtighten the cylinder when holding the power trim/tilt with a vise. Do not hold the cylinder with a vise except the specified area (page 19-27).
- Do not disassemble the pump assembly. If it is faulty, replace it as an assembly.
- Do not use a shop towel, cloth or gloves during disassembly.
- Use the recommended automatic transmission fluid (ATF).
  Recommended ATF: Genuine Honda Automatic Transmission Fluid (ATF), DEXRON® or equivalent.
- Do not reuse the drained ATF.
- Clean the removed parts in fresh 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 and oil seals.
- Be careful not to damage the sliding surface of the piston rod during removal.

Remove the swivel case/stern bracket (page 19-4).

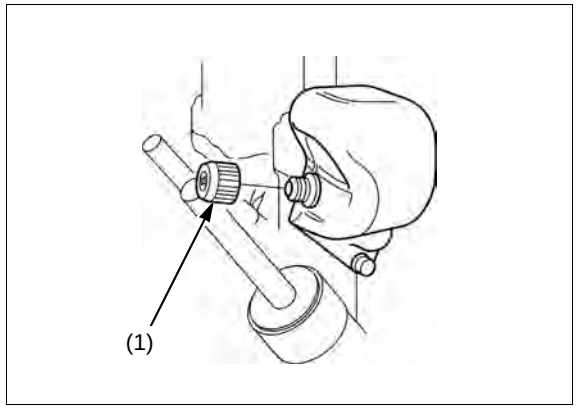
Check that the piston rod of the power trim/tilt is in the fully extended position.

If not, connect the power tilt motor 2P connector and operate the power tilt motor until the piston rod reach the fully extended position.

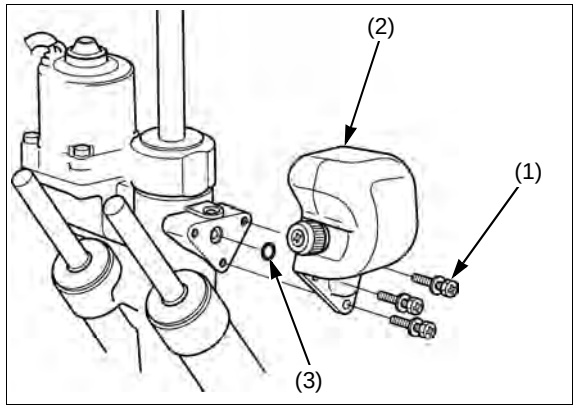
Remove the oil tank cap (1), and drain the ATF from the oil tank.

- Do not drain the ATF by pushing the piston rod in.

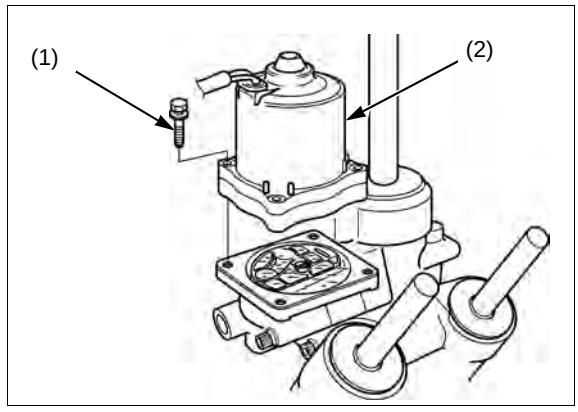
Loosely install the oil tank cap on the oil tank.



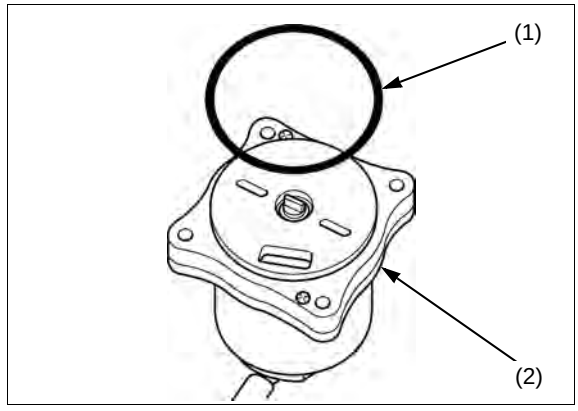
Remove the three bolts (1), oil tank (2) and O-ring (3) from the cylinder.



Remove the four bolts (1) and power tilt motor (2).

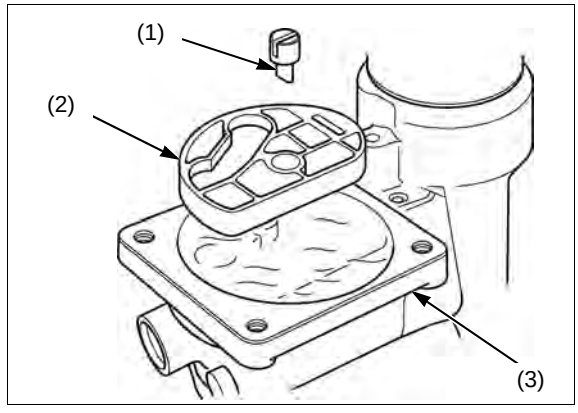


Remove the O-ring (1) from the power tilt motor (2).



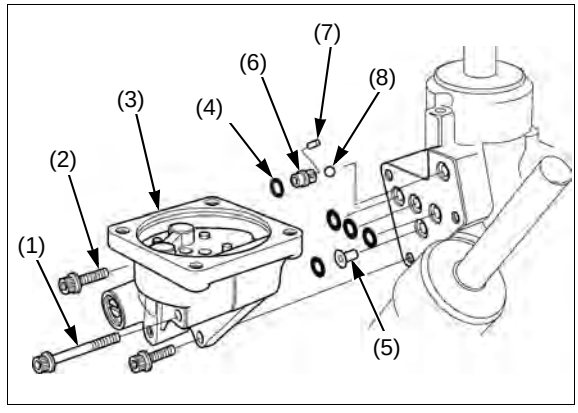
Remove the drive joint (1) and filter B (2) from the pump assembly (3).

Check the mesh of the filter B for blockage and tear.
If it is torn, replace it with a new one.
If it is clogged with dust and dirt, blow the mesh with air to remove the blockage, being careful not to damage the mesh.



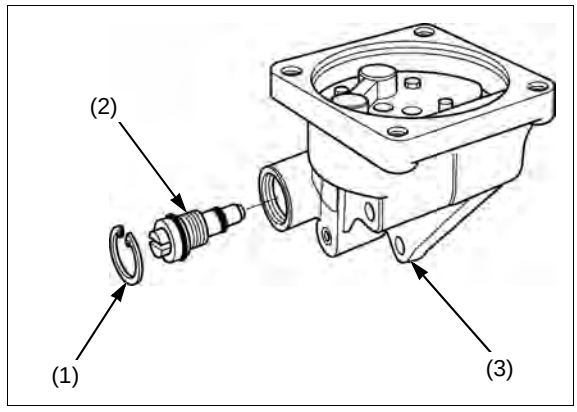
Remove the following:

- Socket bolt A (1)
- Two socket bolts B (2)
- Pump assembly (3)
- Five O-rings (4)
- Orifice collar (5)
- Reservoir valve (6)
- Pin (7)
- Steel ball (8)



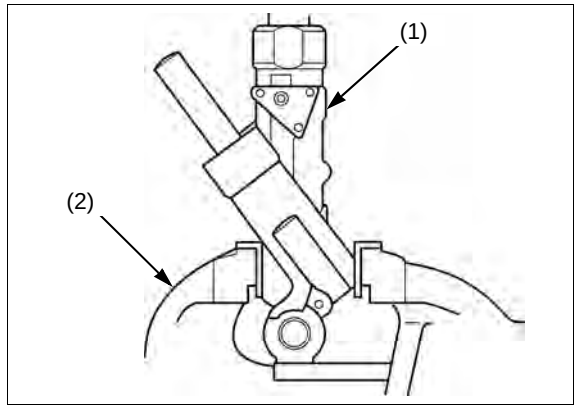
Remove the internal circlip (1) and manual valve (2) from the pump assembly (3).

Check the manual valve for wear or damage and replace it if necessary.



Hold the cylinder (1) in a vise (2) with shop towel or soft jaws as shown.

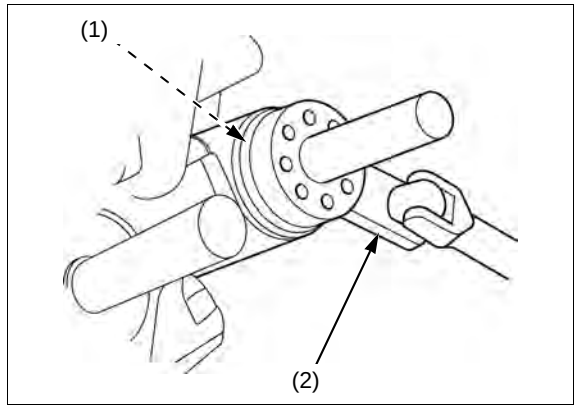
- Do not tighten the vise excessively, as it can damage the cylinder.



Make sure that the left and right piston rods B are in the fully extended position.

Loosen the rod guide (1) using the special tool as shown.

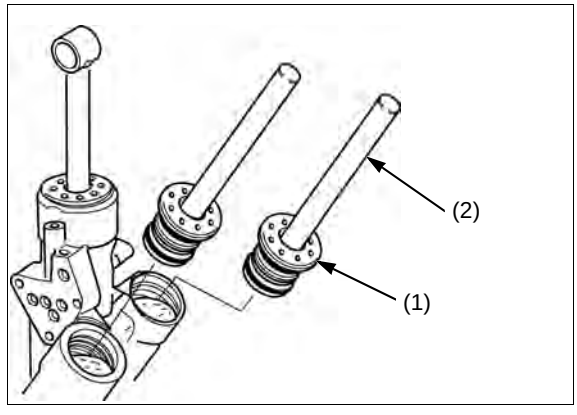
TOOL:
Trim cap wrench, 4 mm (2) 070PA-0010100



Remove the rod guides (1) and piston rods B (2) from the cylinders slowly.

Remove the rod guide from the piston rod B.

Drain the ATF from the cylinders.

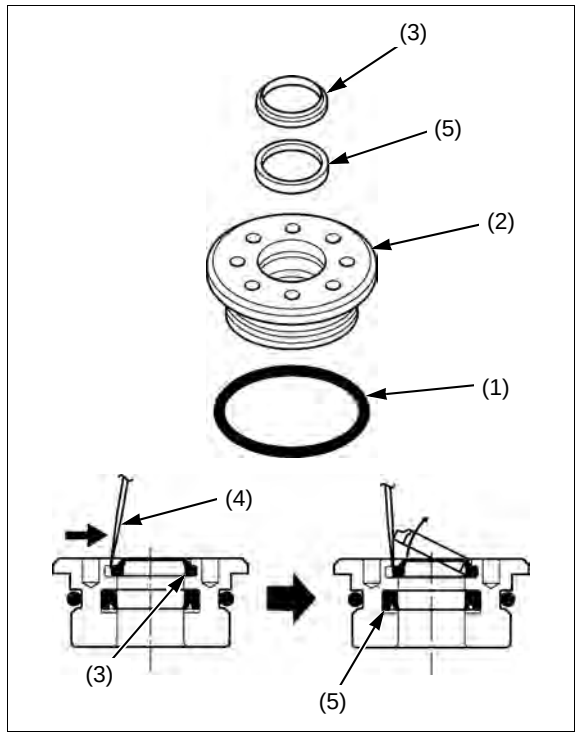


Remove the O-ring (1) from the rod guide (2).

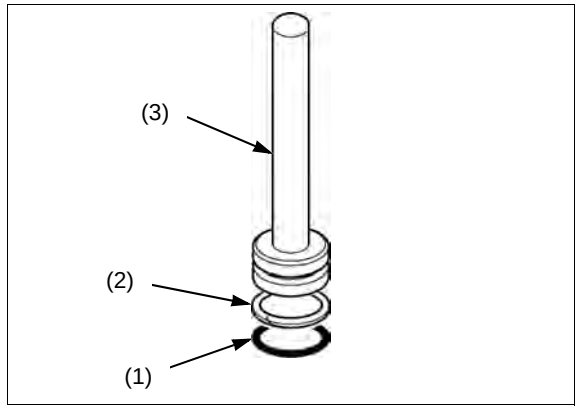
Remove the dust seal (3) using a sharp-end screwdriver (4) or equivalent tool.

Remove the oil seal (5) from the rod guide in the same manner.

- Be careful not to damage the oil seal installation surface of the rod guide.
  Replace the rod guide with a new one, if damaged.



Remove the O-ring (1) and backup ring (2) from the piston rod B (3).

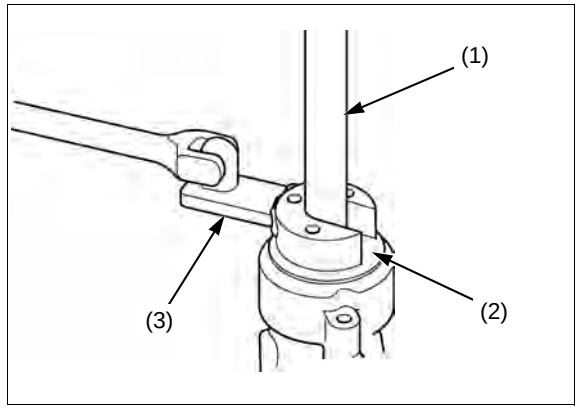


Hold the cylinder in a vise (page 19-27).

Make sure that the piston rod (1) is in the fully extended position.

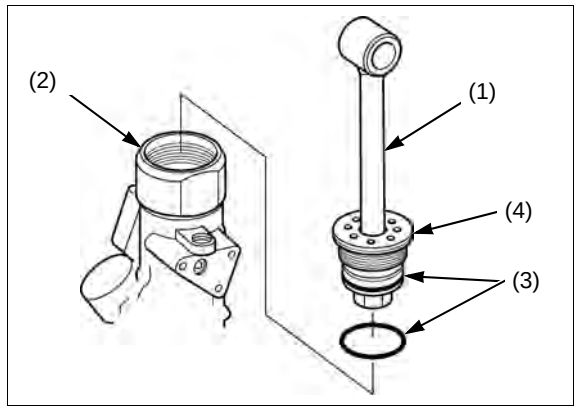
Loosen the cylinder cap (2) using the special tool.

TOOL:
Pin wrench, 6 × 35 mm (3) 07SPA-ZW10101



Remove the piston rod (1) from the cylinder (2).

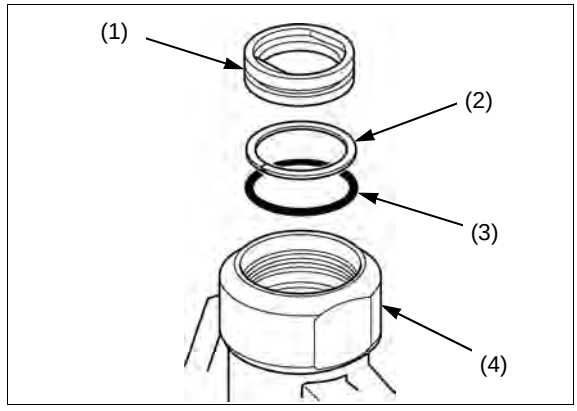
Remove the two O-rings (3) from the cylinder cap/ piston rod (4).



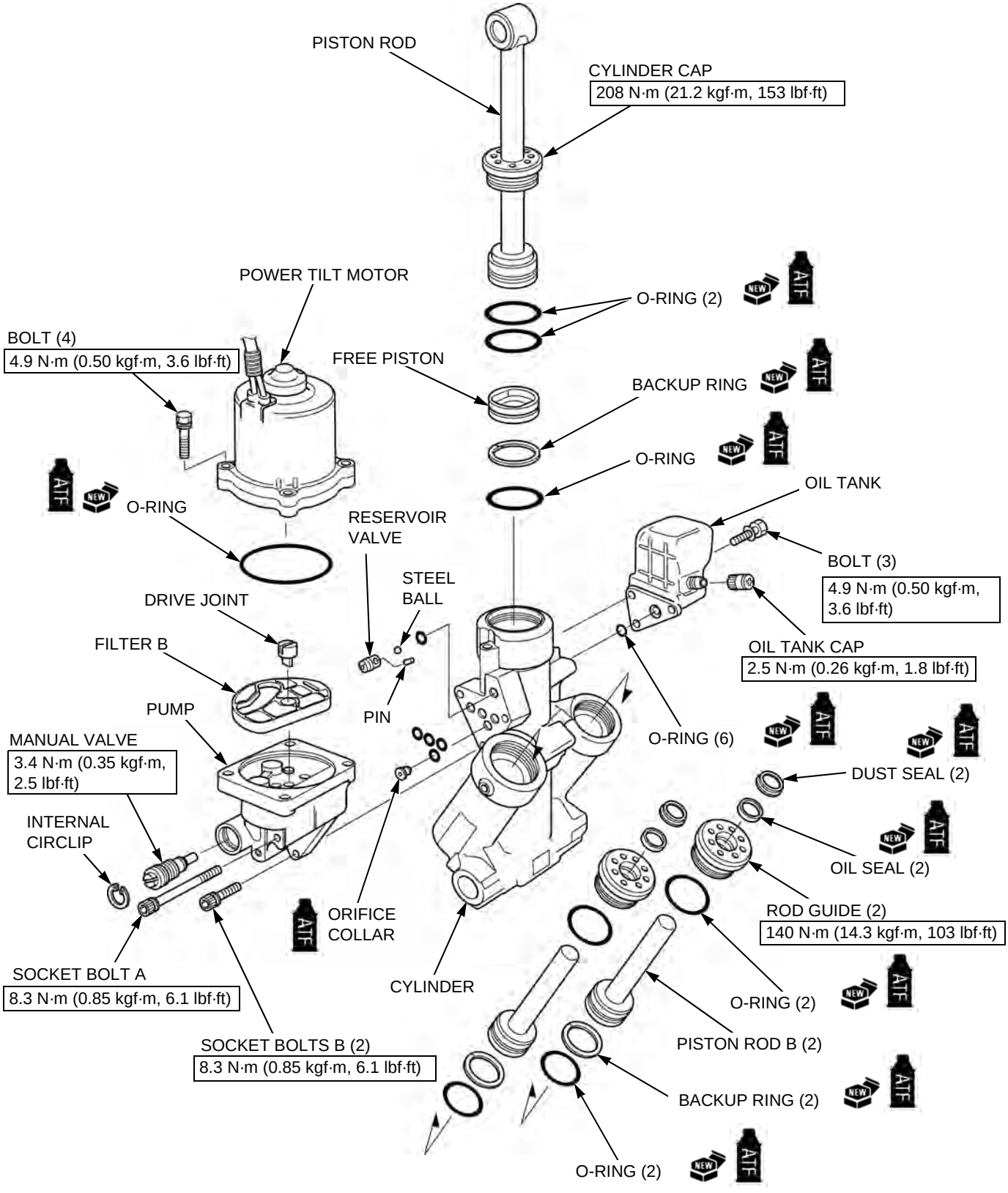
Remove the free piston (1), backup ring (2) and O-ring (3) from the cylinder (4).

Check the sliding surface of the free piston and backup ring surface for wear or damage, replace it if necessary.

Drain the ATF from the cylinder.



EXPLODED VIEW

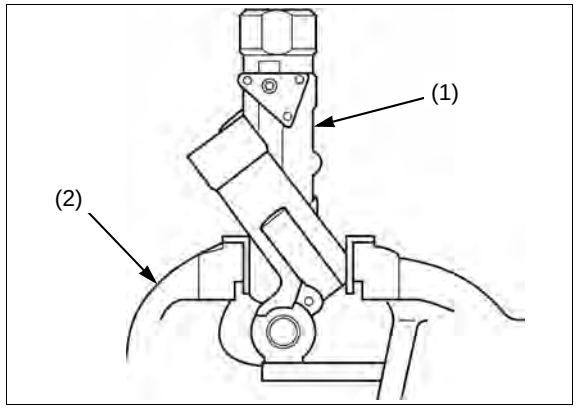


INSTALLATION

- Do not reuse O-rings and oil seals.
- Do not use a shop towel or equivalent cloth, and do not wear gloves during this operation.
- Do not reuse the drained ATF.
- When operation is made by holding the cylinder in a vise, do not tighten the vise excessively.
- Add ATF slowly.
- Assemble the power trim/tilt with the piston rod and piston rod B fully extended. Do not push in the piston rod and piston rod B.
- Do not allow dust, dirt, and other foreign material to enter the cylinder and the pump during assembly.
- After assembly, coat the joints or mating sections of the parts and the sections where the paint came off with rust preventive paint of the same color.

Clean the parts with the fresh ATF and blow each port with compressed air to remove dust and dirt. Check that the parts are clean before assembly.

Hold the cylinder (1) in a vise (2) with shop towel or soft jaws as shown.



NOTICE

Do not tighten the vise excessively, as it can damage the cylinder.

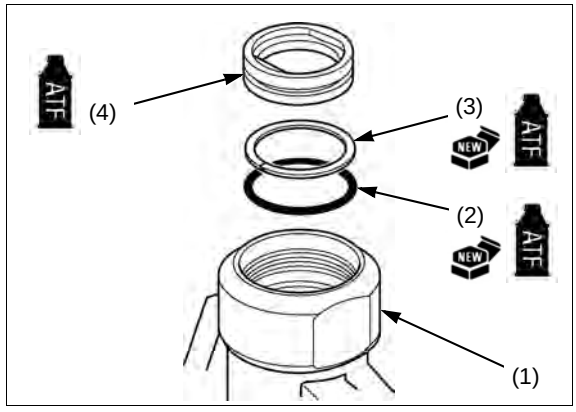
Pour approximately 30 cm^3 (1.0 fl oz) of ATF into the piston rod chamber of the cylinder (1).

RECOMMENDED OIL:

Genuine Honda Automatic Transmission Fluid (ATF) DEXRON®, or equivalent

Apply ATF to a new O-ring (2) and new backup ring (3).

Install the backup ring and O-ring on the free piston (4).

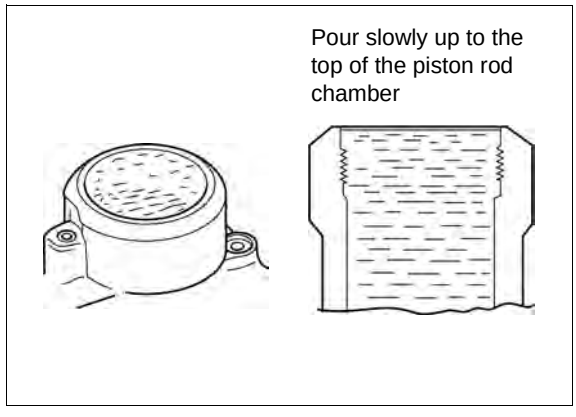


NOTICE

Install the backup ring on the free piston with care not to break it.

Apply ATF to the circumference of the free piston and push it in the piston rod chamber slowly until it bottoms out.

After fully installing the free piston, pour the fresh ATF slowly up to the top of the piston rod chamber of the cylinder.



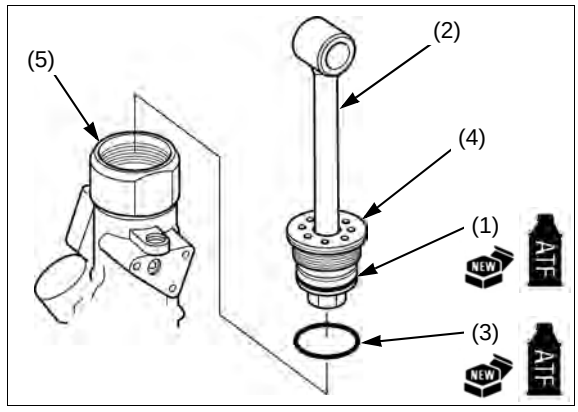
Apply ATF to a new O-ring (1) and Install it on the bottom of the piston rod (2).

Apply ATF to a new O-ring (3) and Install it on the cylinder cap (4).

With the piston rod fully extended, install the piston rod slowly into the cylinder (5).

Loosely tighten the cylinder cap.

- Do not push the piston rod into the cylinder when installing it.



Tighten the cylinder cap (1) to the specified torque using the special tool and a torque wrench (2) as shown.

TOOL:
Pin wrench, 6 × 35 mm (3) 07SPA-ZW10101

TORQUE: 208 N·m (21.2 kgf·m, 153 lbf·ft)

NOTICE

To tighten the cylinder cap with the 6 mm pin wrench, read the torque as follows.

Formula:

Torque wrench (2) reading =[A x B] / [A + C]

A: Torque wrench effective length [m (ft)] (4)

B: Specified torque [N·m (kgf·m, lbf·ft)]

C: Pin wrench effective length [m (ft)] (5)

Example:

Torque wrench reading using a torque wrench with an effective length of 0.4 m (1.31 ft) and pin wrench with an effective length of 0.06 m (0.20 ft)

Torque wrench reading =

[0.4 (1.31) x 208 (21.2, 153)] / [0.4 (1.31)] + [0.06 (0.20)]

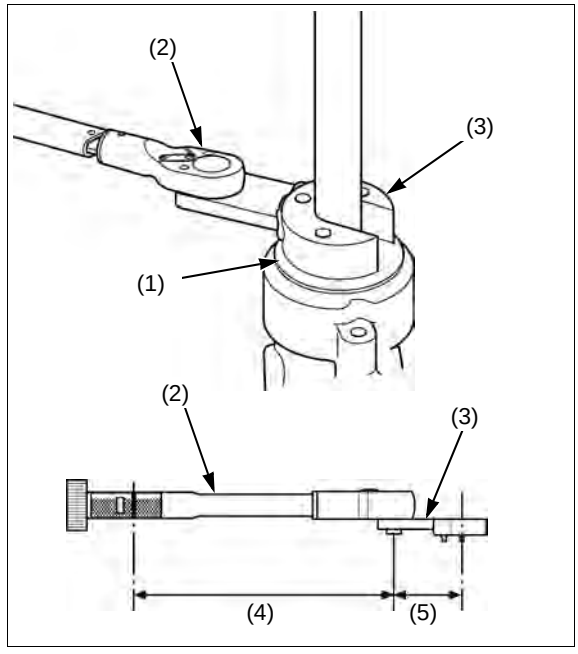
= 181 [N·m (18.5 kgf·m, 133 lbf·ft)]

A: Torque wrench effective length = 0.4 m (1.31 ft)

B: Specified torque = 208 N·m (21.2 kgf·m, 153 lbf·ft)

C: Pin wrench effective length = 0.06 m (0.20 ft)

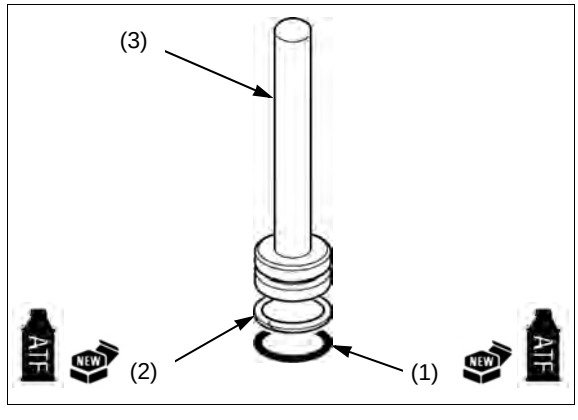
I.e. torque wrench reading is 181 N·m (18.5 kgf·m, 133 lbf·ft).



Apply ATF to a new O-ring (1), new backup ring (2) and install them on the piston rod B (3).

NOTICE

Install the backup ring on the piston rod with care not to break it.



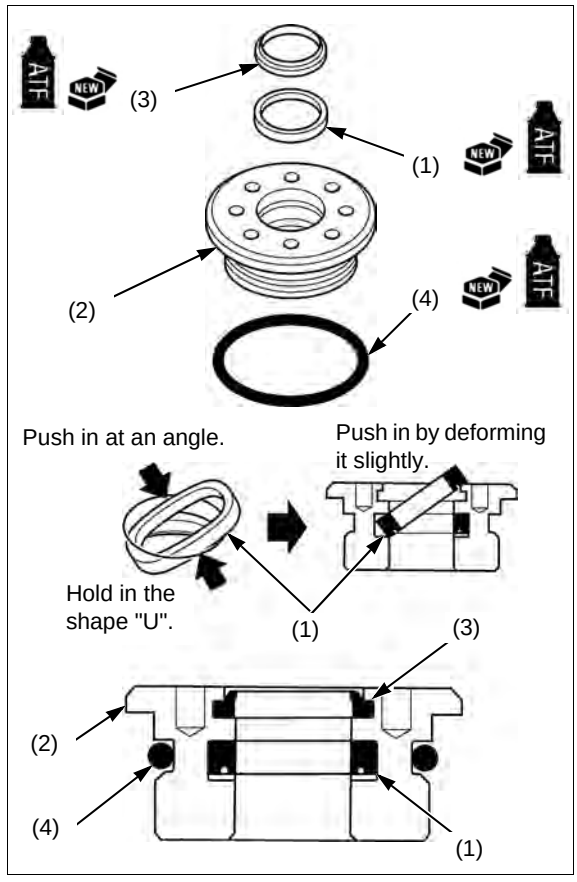
Apply ATF to a new oil seal (1).

Holding the oil seal in the shape of a "U" with your fingers, install it in the lower groove in the rod guide (2), taking care not to damage the oil seal.

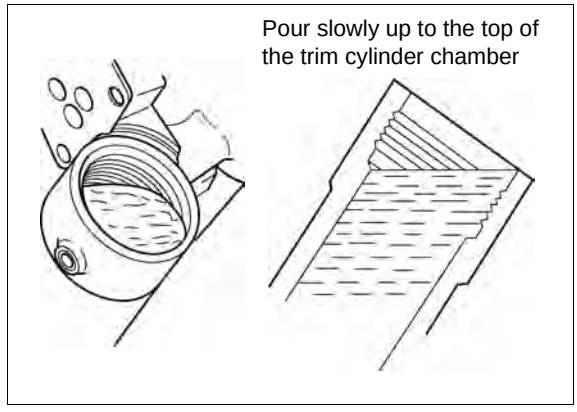
Apply ATF to a new dust seal (3).

Holding the dust seal in the shape of a "U" with your fingers, install it in the upper groove in the rod guide, taking care not to damage the dust seal.

Apply ATF to a new O-ring (4) and install it on the rod guide.



Pour fresh ATF in the right and left trim cylinder chambers up to the top of the trim cylinder chamber.



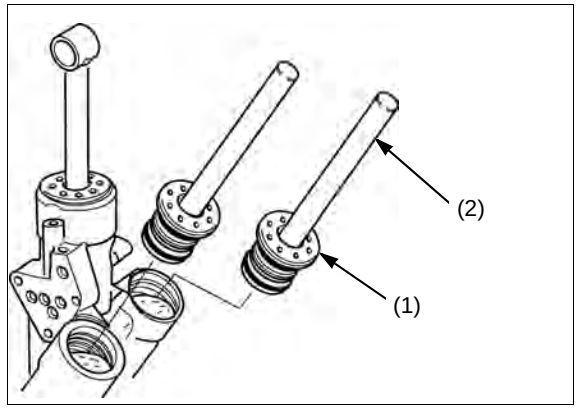
Install the rod guide (1) on piston rod B (2).
Extend the piston rod fully and hold it in position.

Set one piston rod B in the left cylinder chamber and one in the right cylinder chamber.

- Do not install either piston rod B by pushing it into the trim cylinder.

Holding each piston rod B in place, loosely tighten the rod guides on the cylinders.

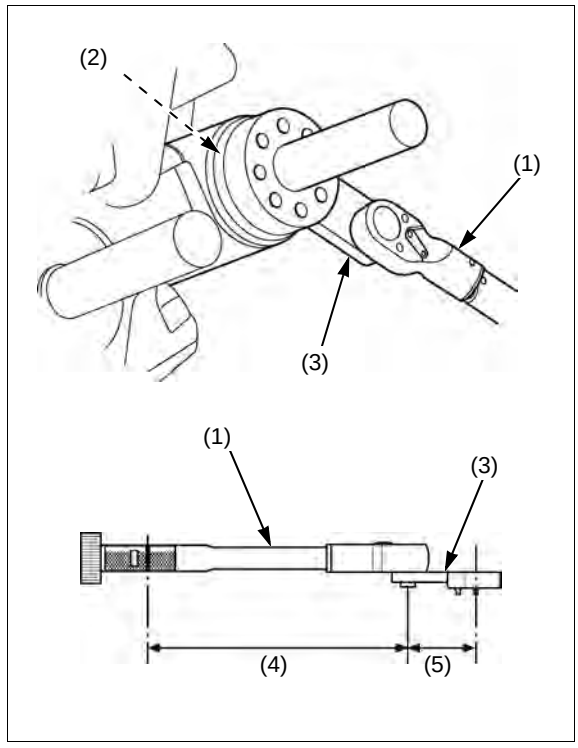
- Do not install either piston rod B by pushing it into the trim cylinder.



Using the special tool and a torque wrench (1), tighten the left and right rod guides (2) to the specified torque as shown.

TOOL:
Pin wrench, 4 mm (3) 070PA-0010100

TORQUE: 140 N·m (14.3 kgf·m, 103 lbf·ft)



NOTICE

To tighten the rod guide with the pin wrench, 4 mm, read the torque as follows.

Formula:

Torque wrench (1) reading =[A x B] / [A + C]

A: Torque wrench effective length [m (ft)] (4)

B: Specified torque [N·m (kgf·m, lbf·ft)]

C: Pin wrench effective length [m (ft)] (5)

Example:

Torque wrench reading using a torque wrench with an effective length of 0.4 m (1.31 ft) and pin wrench with an effective length of 0.06 m (0.20 ft)

Torque wrench reading =

[0.4 (1.31) x 140 (14.3, 103)] / [0.4 (1.31)] + [0.06 (0.20)]

= 122 [N·m (12.4 kgf·m, 90 lbf·ft)]

A: Torque wrench effective length = 0.4 m (1.31 ft)

B: Specified torque = 140 N·m (14.3 kgf·m, 103 lbf·ft)

C: Pin wrench effective length = 0.06 m (0.20 ft)

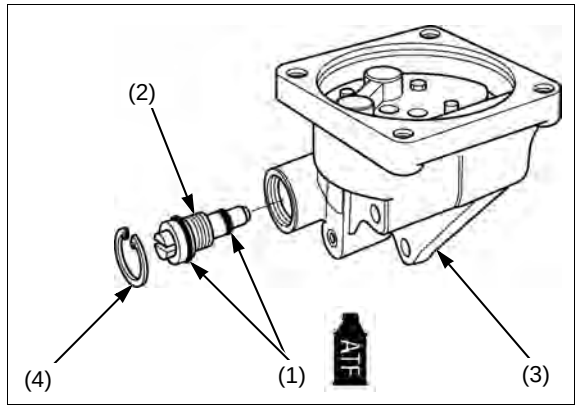
I.e. torque wrench reading is 122 N·m (12.4 kgf·m, 90 lbf·ft).

Apply ATF to the manual valve O-rings (1).

Install the manual valve (2) to the pump (3) and tighten it to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

Install the internal circlip (4).



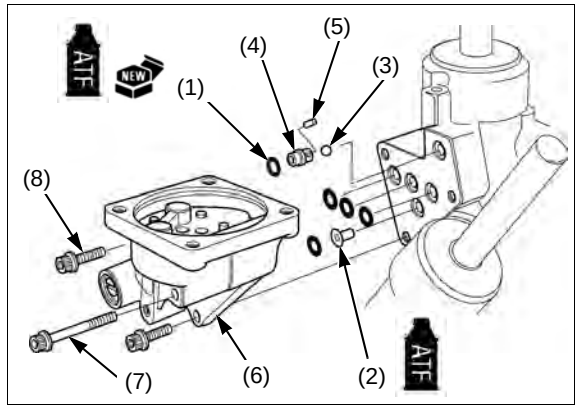
Apply ATF to five new O-rings (1) and orifice collar (2).

Install the steel ball (3) into the reservoir valve (4) and set the pin (5).
Install the reservoir valve into the cylinder.

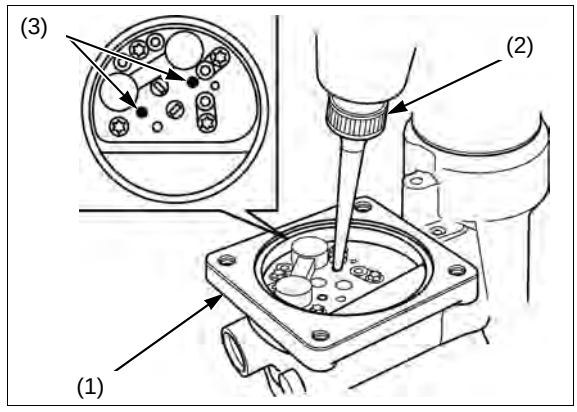
Install the five O-rings and orifice collar in the cylinder and install the pump (6) on the cylinder.

Install and tighten the socket bolts A (7) and two socket bolts B (8) to the specified torque.

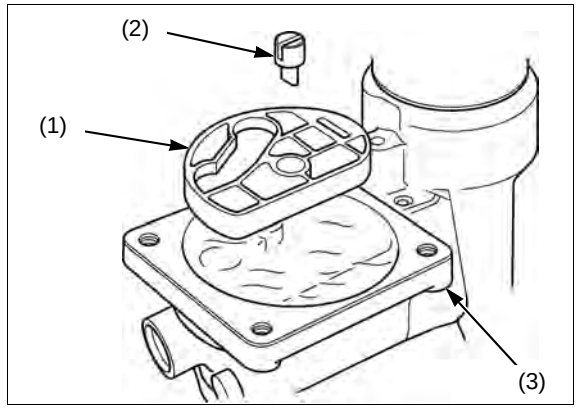
TORQUE: 8.3 N·m (0.85 kgf·m, 6.1 lbf·ft)



Fill the pump (1) fully with fresh ATF using an oil bottle (2) or equivalent by pouring the ATF into the holes (3) alternately, removing the air inside the pump until it is completely filled up.



Check the filter B (1) for dust or tear in the mesh.
Install the filter B and drive joint (2) on the pump (3).

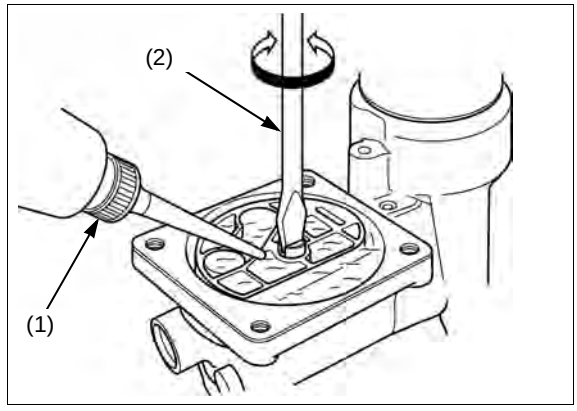


After installation, remove the air bubbles with the oil bottle (1) or an equivalent tool if necessary.

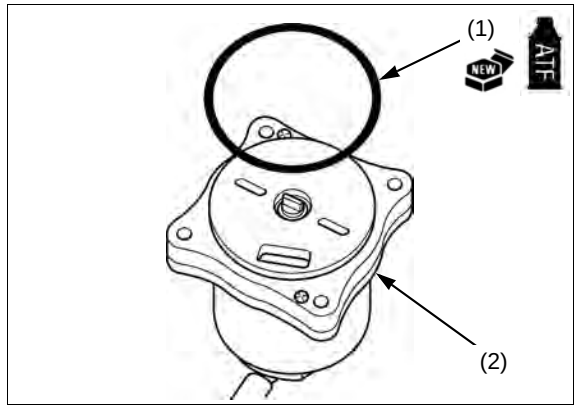
Turn the drive joint right and left several times using a screwdriver (2) and remove the air bubbles until no more bubbles come out of the pump.

- Be sure to remove the air bubbles, or it will cause air in the system.

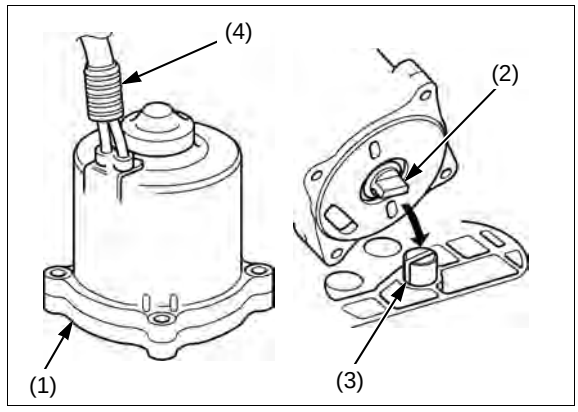
After removing the air bubbles, fill the pump fully with ATF again.



Apply ATF to a new O-ring (1) and install it on the power tilt motor (2).

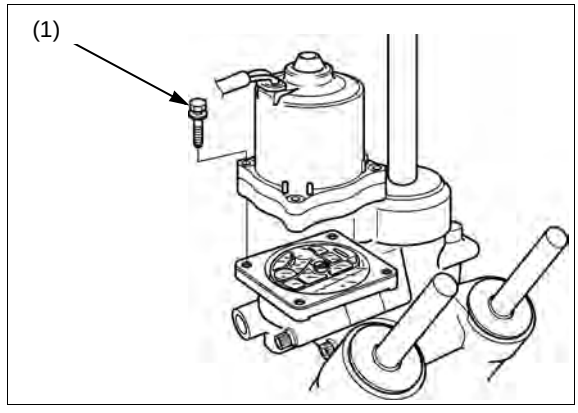


Install the power tilt motor (1) on the pump by aligning the projection (2) on the motor with the cutout (3) in the drive joint with the motor wire (4) facing toward the manual valve side.



Install and tighten the four bolts (1) to the specified torque.

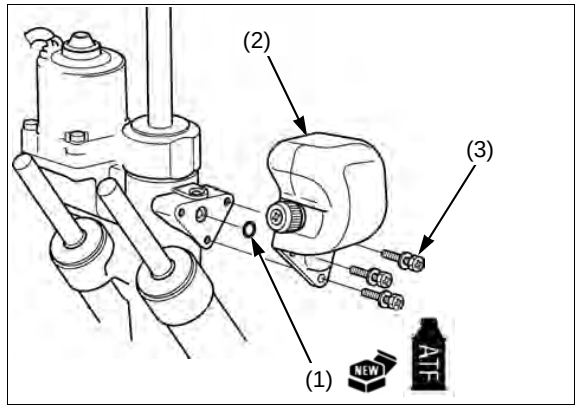
TORQUE: 4.9 N·m (0.50 kgf·m, 3.6 lbf·ft)



Apply ATF to a new O-ring (1) and install it on the cylinder.

Install the oil tank (2) on the cylinder and tighten the three bolts (3) to the specified torque.

TORQUE: 4.9 N·m (0.50 kgf·m, 3.6 lbf·ft)



Remove the oil tank cap (1). Pour flesh ATF to the upper limit (2) of the oil tank filler port.

OIL CAPACITY:
0.68 liter (0.72 US qt, 0.6 Imp qt)

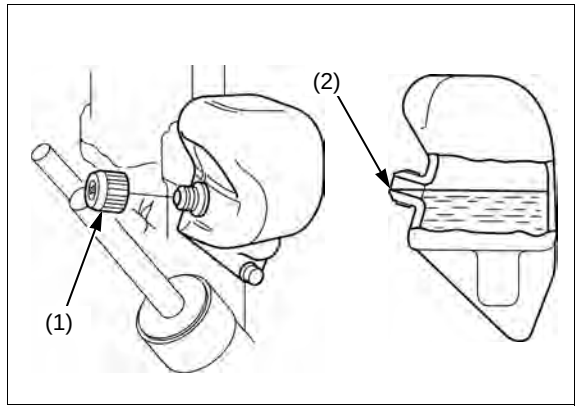
NOTICE

Do not overfill with ATF; that will damage the oil seal of the motor when each rod is compressed.

After filling the oil tank with ATF, bleed air from the power tilt/trim (without mounting on the outboard motor) (page 19-37).

Install the oil tank cap and tighten it to the specified torque.

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



AIR BLEEDING

- Bleed air from the unit whenever the power trim/tilt is assembled.
- Perform the following procedure to bleed air:

1. Bleed air without mounting the unit on the outboard motor.
2. Check hydraulic pressure (page 19-39).
3. Bleed air after mounting the unit on the outboard motor.

Power trim/tilt not mounted on the outboard motor

1. Connect each cable to operate the power trim/tilt.

– Connect the positive (+) and negative (–) starter cables.
– Connect the power tilt motor 2P connector to the power tilt relay.
– Be sure that the starter cables are connected to the battery.

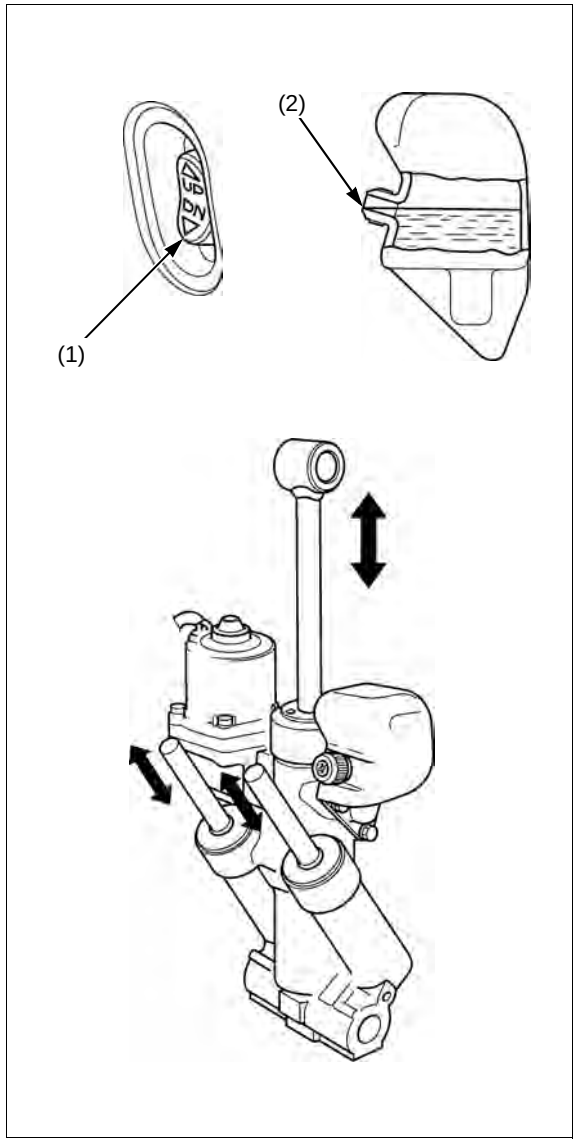
2. Hold the power trim/tilt vertically.
3. Push the "DN" side of the power tilt switch (1) to compress each rod fully.
4. Push the "UP" side of the power tilt switch to extend each rod fully.
5. Remove the oil tank cap with each rod extended fully. Check if the ATF is at the upper limit (2) of the filler port.
   If ATF does not flow out of the filler port, add ATF until it flows out.

- Check the fluid level with the rods fully extended. Note that ATF will spurt out when the oil tank cap is removed with the rods fully compressed.

6. After adding ATF, repeat the procedure from step 3 through 5 two or three times to bleed air from the unit.
7. Be sure that the rods fully extend and compress during the step 6 operation.

   When the rods fully extend and compress fully, perform the hydraulic pressure check (page 19-39).

   If the rods do not compress fully, perform the following procedure.



8. With the rods extended fully, push the "UP" side of the power tilt switch (1) until relief valve opens again. Push the "DN" side of the power tilt switch, and be sure that the rods compress.

   If the rods extend and compress fully, go to the hydraulic pressure check (page 19-39).

9. If the rods do not compress after the step 8 operation, push the "DN" side of the power tilt switch while pushing the piston rod B (2), and check if the rods compress.

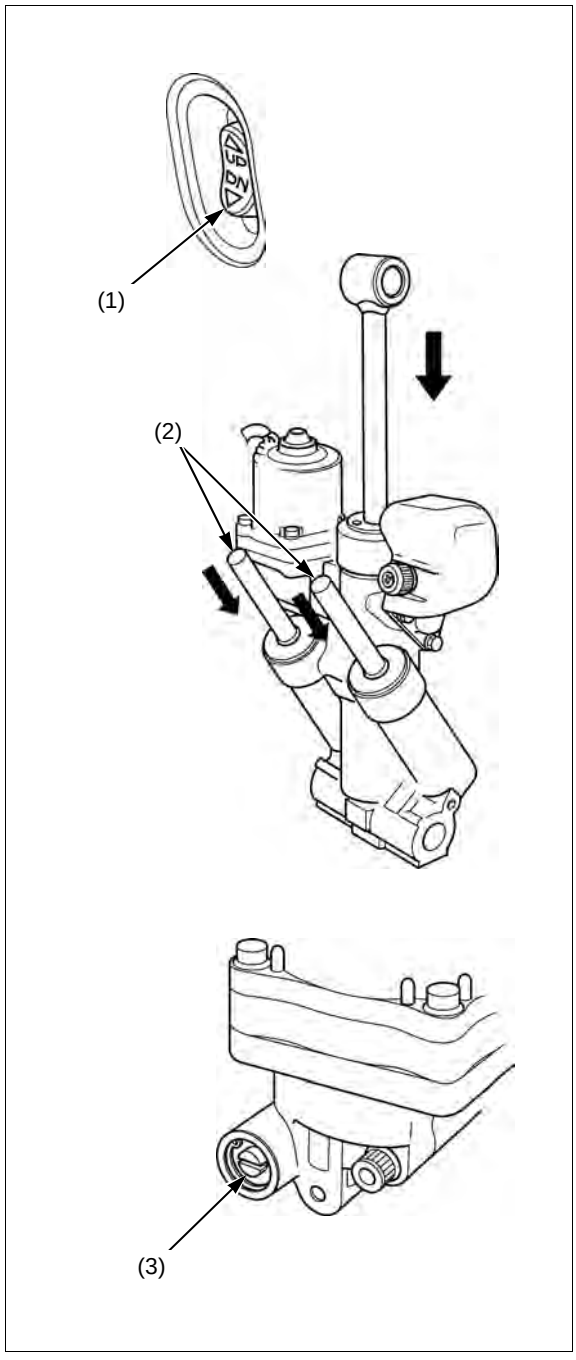
   If the rods extend and compress fully, go to the hydraulic pressure check (page 19-39).

10. If the rods still do not compress after the step 9 operation, loosen the manual valve (3) and compress each rod. Tighten the manual valve securely again. Push the "UP" side of the power tilt switch to extend the rods fully, then push the "DN" side of the switch and check whether the rods compress fully.

    If the rods extend and compress fully, go to the hydraulic pressure check (page 19-39).

11. If the rods do not compress after the above operations, perform the following.

– Disassemble and assemble the power trim/tilt (page 19-25).
– Bleed air with the power trim/tilt not mounted on the outboard motor (page 19-37).



HYDRAULIC PRESSURE CHECK

After bleeding air from the power trim/tilt without installing on the outboard motor and checking each rod for proper compression, perform the following operation in the same manner as bleeding air without installing on the outboard motor.

– Be sure each rod is extended fully.
– Check the hydraulic pressure both at the upper and lower chambers.

Lower chamber hydraulic pressure

Remove the internal circlip (1) and manual valve (2) from the power trim/tilt.

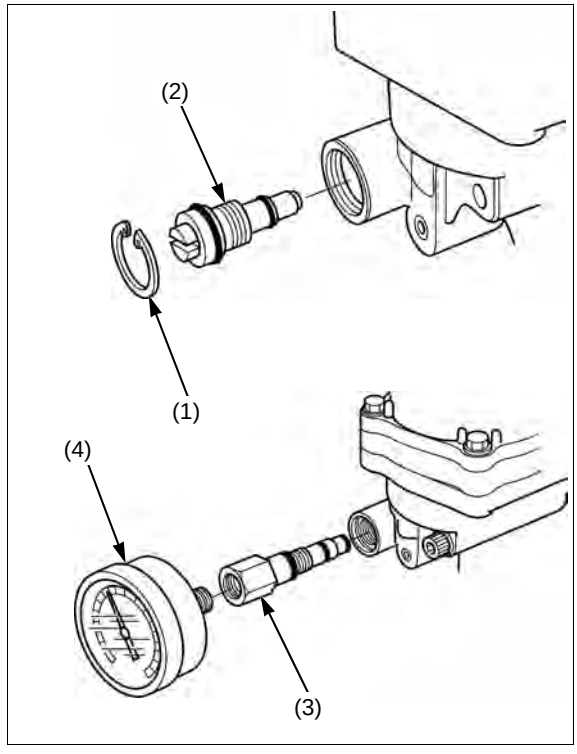
- A small amount of oil will flow out when the manual valve is removed. Catch it with a container.

Install the special tool to the manual valve installation area as shown and tighten it to the specified torque.

TOOL:
Oil pressure gauge joint B (3) 07SPJ-ZW10200

TORQUE: 9 N·m (0.92 kgf·m, 6.6 lbf·ft)

Attach a commercially available pressure gauge (PF 1/4) (4) which measures 18,633 kPa (190 kgf/cm^2, 2,702 psi) or above to the special tool (oil pressure gauge joint B).



Remove the oil tank cap (1) and check if the ATF is at the upper limit of the filler port (2).

Push the "DN" side of the power tilt switch (3) to compress each rod fully.

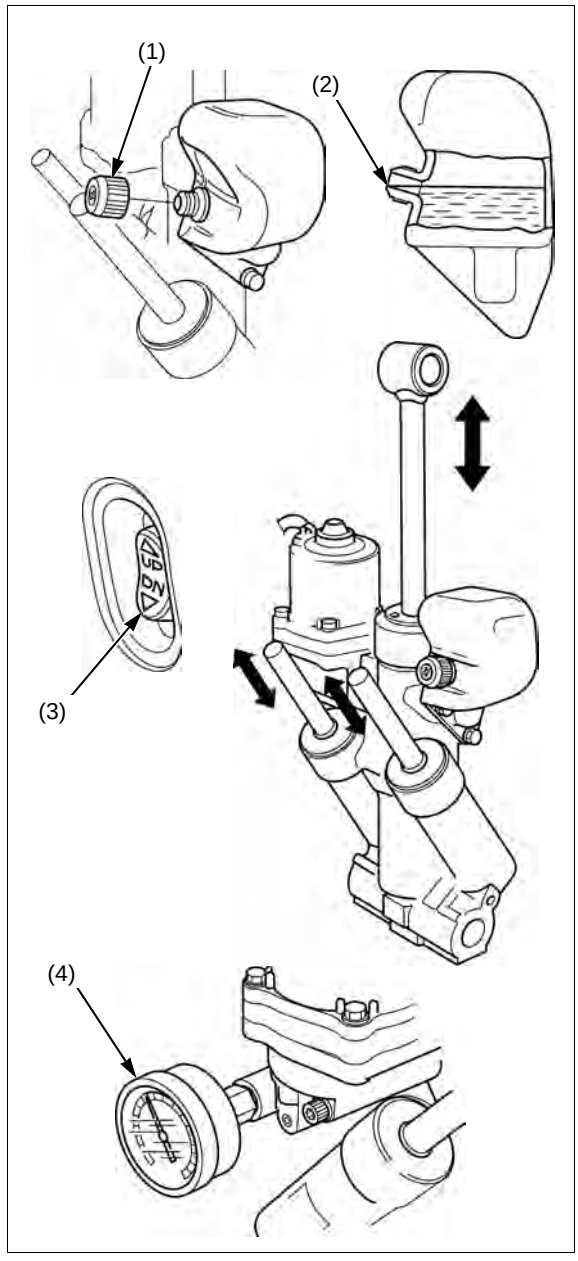
Push the "UP" side of the power tilt switch to extend each rod fully again, and read the pressure gauge (4) to measure the lower chamber hydraulic pressure.

LOWER CHAMBER HYDRAULIC PRESSURE:
13,239 – 15,691 kPa
(135 – 160 kgf/cm^2, 1,920 – 2,276 psi)

If a sharp pressure drop is observed, check the power tilt motor for a damaged oil seal.

If the hydraulic pressure is lower than the specified pressure, check for oil leaks.

Measure the upper chamber hydraulic pressure (page 19-40).



Upper chamber hydraulic pressure

After measuring the lower chamber hydraulic pressure, remove the special tools (oil pressure gauge joint B and oil pressure gauge) with each rod fully extended.

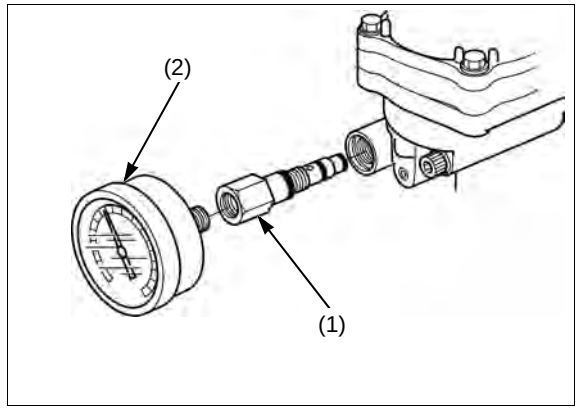
- A small amount of oil will flow out when the manual valve is removed. Catch it with a container.

Install the special tool to the manual valve installation area as shown and tighten it to the specified torque.

TOOL:
Oil pressure gauge joint A (1) 07SPJ-ZW10100

TORQUE: 9 N·m (0.92 kgf·m, 6.6 lbf·ft)

Attach a commercially available pressure gauge (PF 1/4) (2) which measures 18,633 kPa (190 kgf/cm^2, 2,702 psi) or above to the special tool (oil pressure gauge joint A).



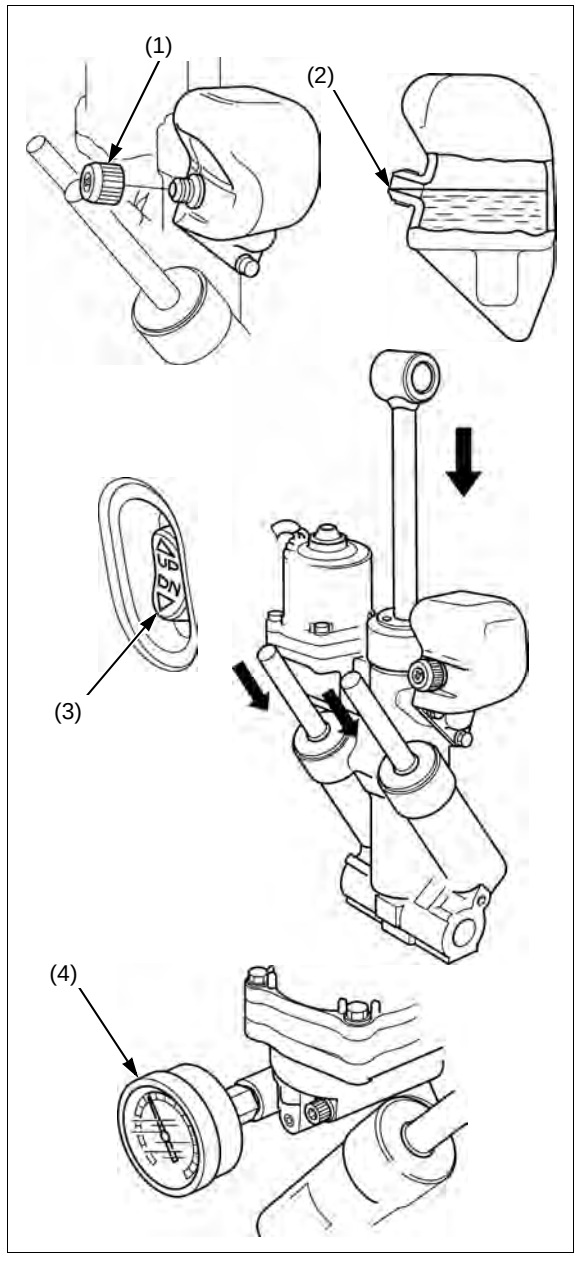
Remove the oil tank cap (1) and check if the ATF is at the upper limit of the filler port (2).

Push the "DN" side of the power tilt switch (3) to compress each rod fully, and read the pressure gauge (4) to measure the upper chamber hydraulic pressure.

UPPER CHAMBER HYDRAULIC PRESSURE:
3,923 – 7,355 kPa
(40 – 75 kgf/cm², 569 – 1,067 psi)

If a sharp pressure drop is observed, check the power tilt motor for a damaged oil seal.

If the hydraulic pressure is lower than the specified pressure, check for oil leaks.



After checking, push the "UP" side of the power tilt switch. With each rod extended fully, remove the special tools (oil pressure gauge and oil pressure gauge joint A).

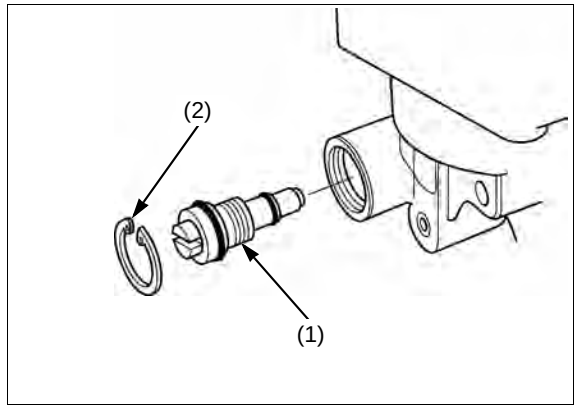
- A small amount of oil will flow out when the special tool is removed. Catch it with a container.

Instal the manual valve (1) to the pump and tighten it to the specified torque.

TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

Install the internal circlip (2).

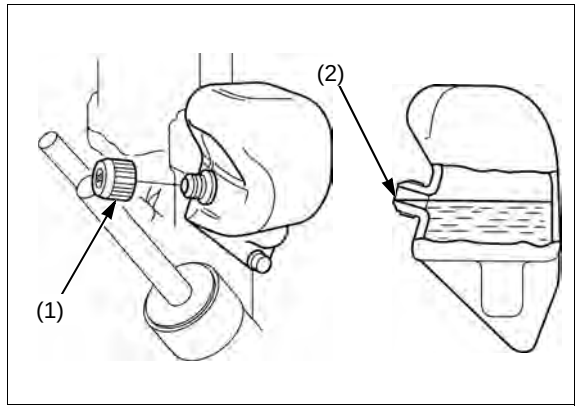
Recheck the ATF level.



Air bleeding with the power trim/tilt on the outboard motor

- Perform the following procedure after bleeding air without mounting the power trim/tilt on the outboard motor and after checking the hydraulic pressure.

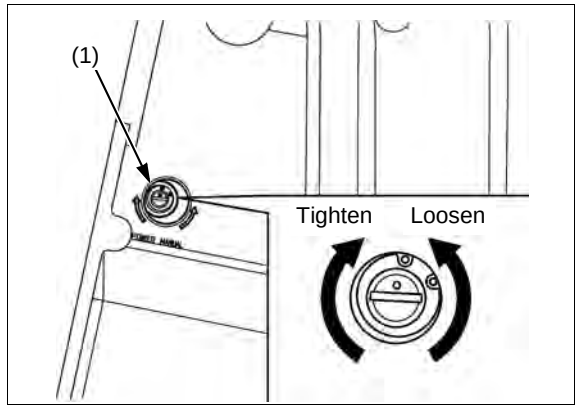
1. Install the power trim/tilt on the outboard motor securely.
2. Push the "UP" side of the power tilt switch, and raise the outboard motor to the uppermost position.
3. Remove the oil tank cap (1), and check whether the ATF is at the upper limit (2) of the oil filler port. Add ATF if necessary.



4. Lower the outboard motor slowly to the lowermost position by loosening the manual valve (1).
5. Tighten the manual valve to the specified torque.

   TORQUE: 3.4 N·m (0.35 kgf·m, 2.5 lbf·ft)

6. Hold the outboard motor in the lowermost position for five minutes.
7. Then, push the "UP" side of the power tilt switch, and raise the outboard motor to the uppermost position. Hold the outboard motor in this position for five minutes. After five minutes, check the fluid level in the oil tank.
8. Repeat the procedure from step 4 through 7 five times.



POWER TILT MOTOR DISASSEMBLY/ ASSEMBLY

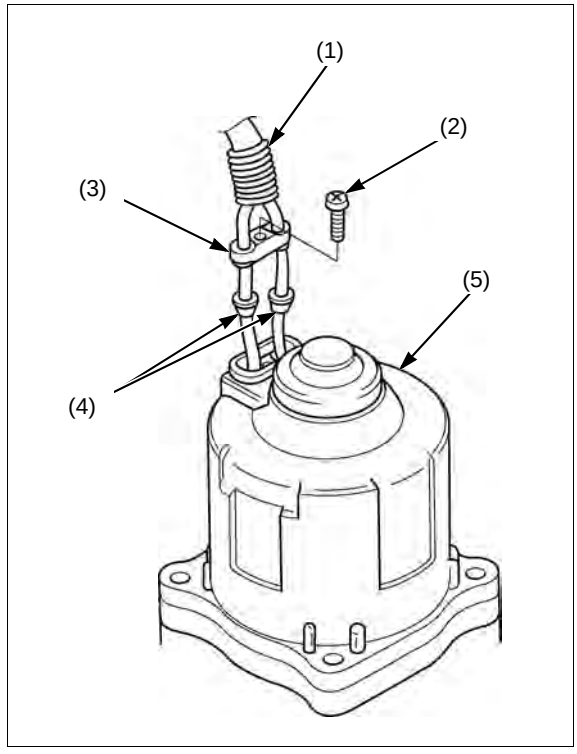
DISASSEMBLY

Untape the corrugated tube (1), and pull the tube to the connector side.

Remove the screw (2).
Pull out the wire holder (3) and the two grommets (4) from the yoke (5), and move them to the tube side.

NOTICE

Pull out the grommets with care not to damage them.

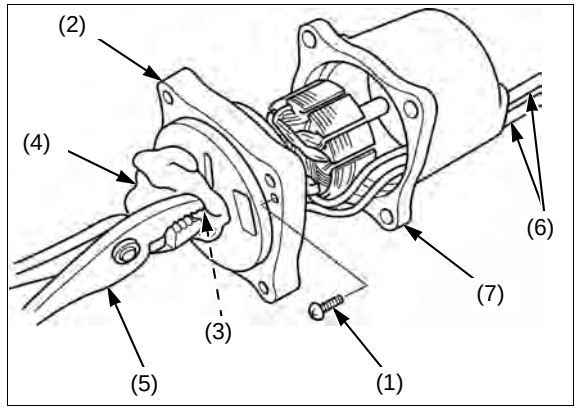


Remove the two screws (1) from the front bracket (2).

Wrap the armature shaft (3) with a shop towel (4) or equivalent material to protect, and hold the shaft with pliers (5).

Pushing the two motor wires (6) toward the yoke (7), remove the armature/front bracket from the yoke.

- Do not allow the commutator to become contaminated with oil or grease.



Pull the brushes (1) from the brush holder A (2) and B (3).

Disconnect the motor wire (Blue wire) terminal (4) from the breaker (5) while holding the breaker with a screwdriver.

NOTICE

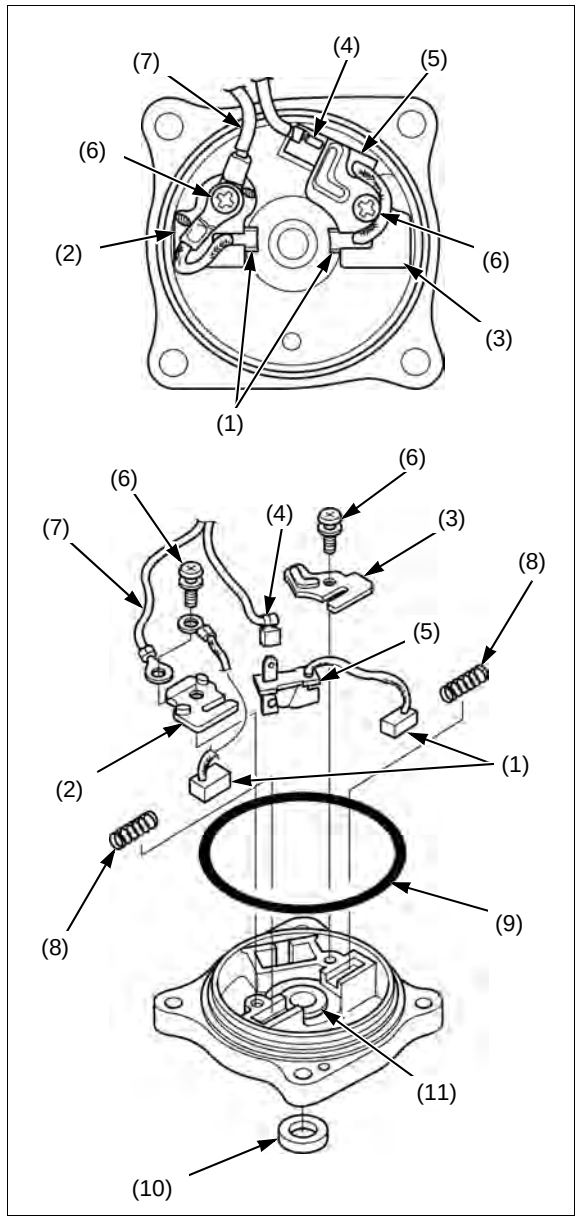
- *Do not disconnect the Blue wire terminal without holding the breaker, or it can cause damage to the breaker. Be sure to disconnect the terminal while holding the breaker.*
- *Take care not to touch the bimetal part of the breaker during removal.*

Remove the two screws (6), motor wire (Green wire) (7), brush holders A and B, brush, two brush springs (8) and breaker.

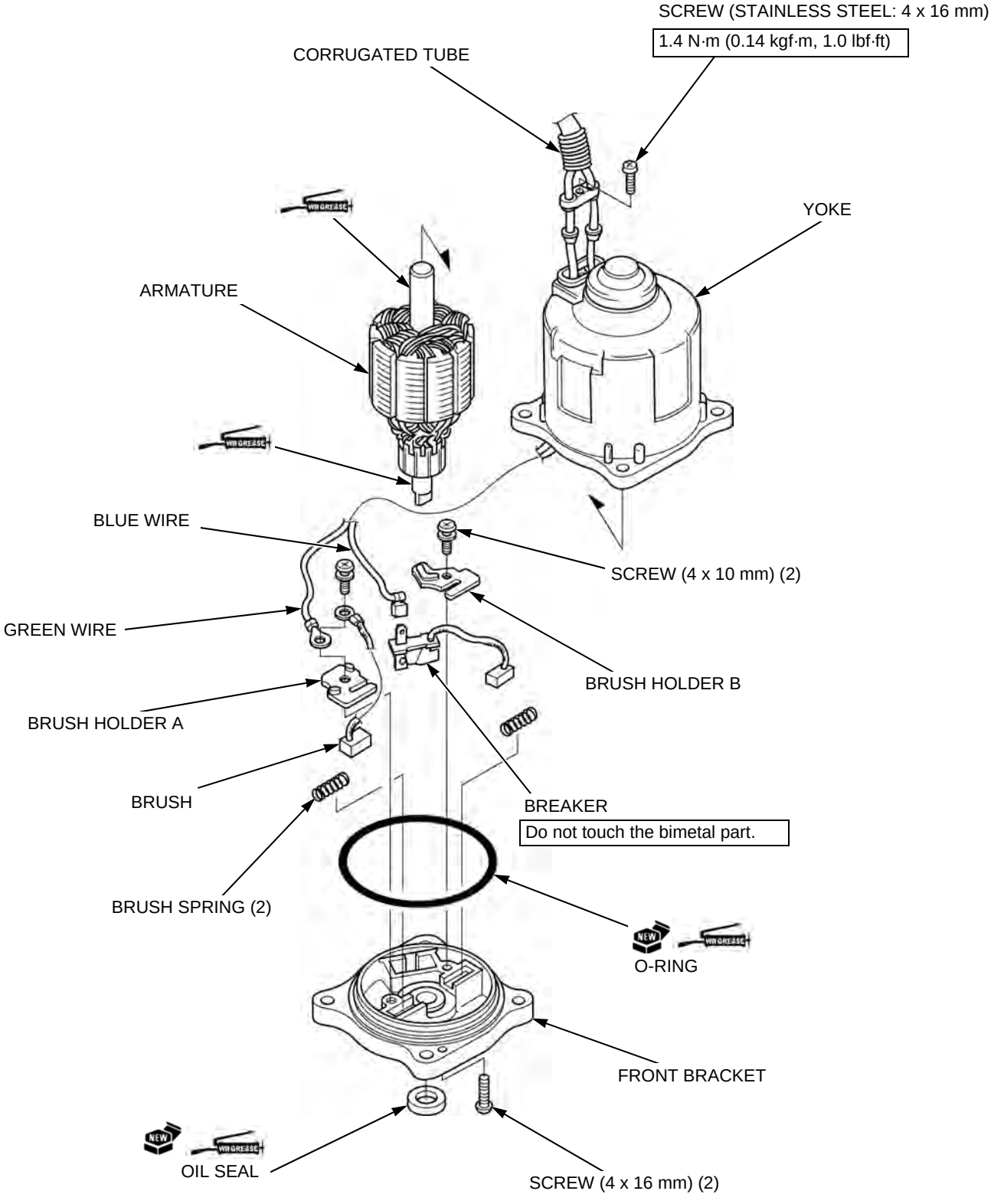
Remove the O-ring (9) from the front bracket groove.

Check the oil seal (10) for damage or wear.
Replace the oil seal with a new one if necessary.

Check the metal part (11) of the front bracket for damage and wear.
Replace the front bracket assembly if necessary.



EXPLODED VIEW



ASSEMBLY

Apply marine grease to the oil seal lips.

Apply marine grease to a new O-ring (1) and install it to the front bracket (2) groove.

Set the brush holder A (3) and motor wire (Green wire) terminal (4), then install the brush terminal (5) and loosely tighten the screw (6).
Be sure that the motor wire (Green wire) terminal and the brush assembly wire terminal contact the respective projections (7) on brush holder A, and then tighten the screw.

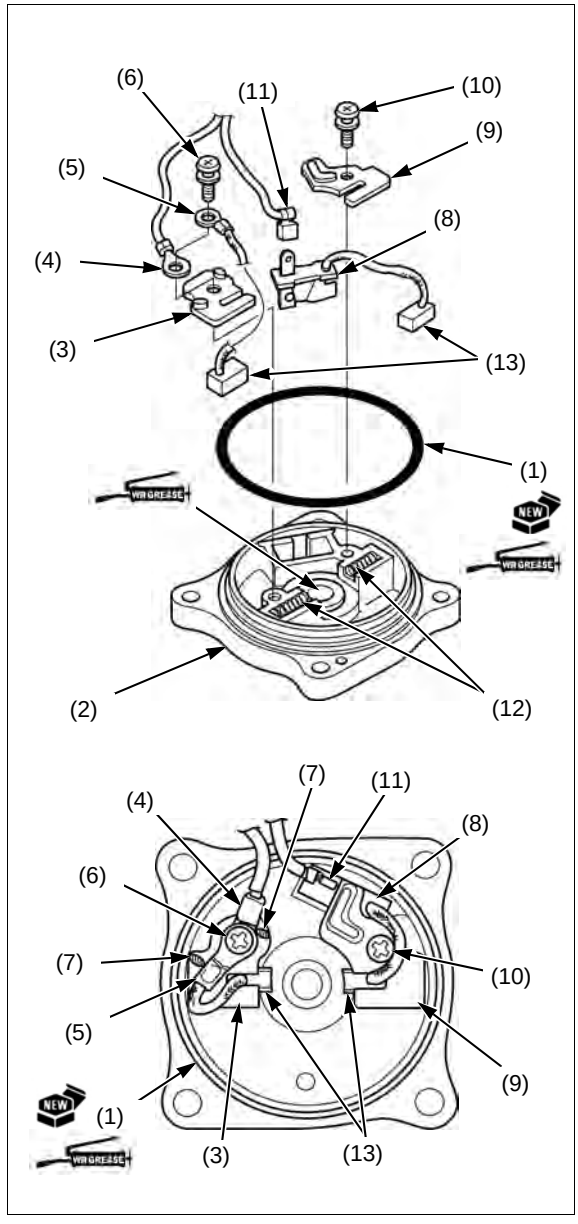
Install the breaker (8) and brush holder B (9), and tighten the screw (10).

NOTICE

Do not touch the bimetal part of the breaker.

Connect the motor wire (Blue wire) terminal (11) to the breaker.

Install the two springs (12) in the place under the brush holders A and B.
Set the two brushes (13) on the brush holders.

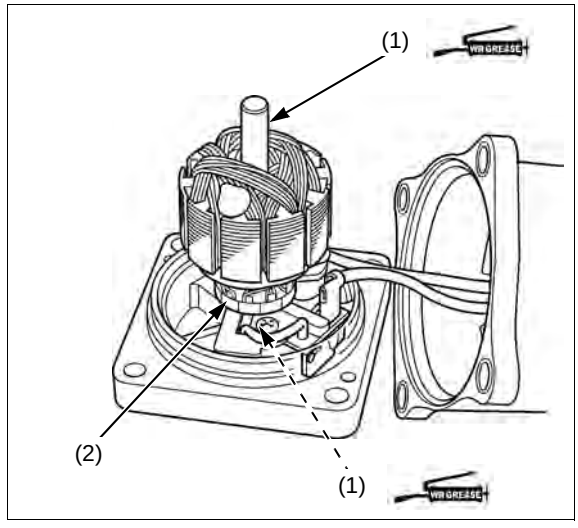


Apply marine grease to the sliding surface of the armature shaft (1).

- Take care that the commutator surface (2) is not contaminated with grease.

Install the armature on the front bracket while pushing the brush terminal into the holder.

- Be careful not to damage the brushes when installing the armature into the front bracket.



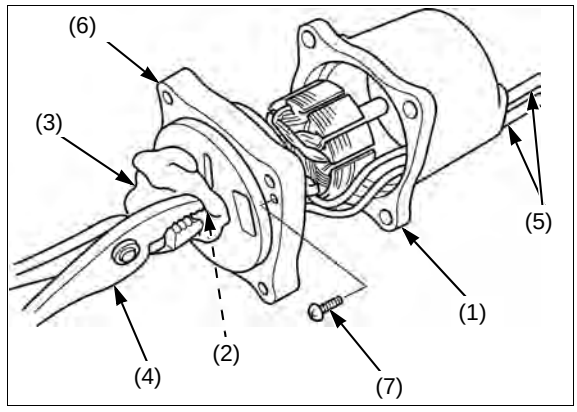
- Make sure that there is no washer, etc. on the magnet in the yoke (1).

Wrap the armature shaft (2) with a shop towel (3) or equivalent material, and hold the shaft with pliers (4).

Pulling the two motor wires (5) of the yoke side slowly, install the armature/front bracket (6) on the yoke.

If it is hard to install the armature/front bracket in the yoke, check whether the metal of the yoke (i.e. where the armature shaft is installed) is out of position and repeat.

After installation, check that the armature turns smoothly and tighten the two screws (7).

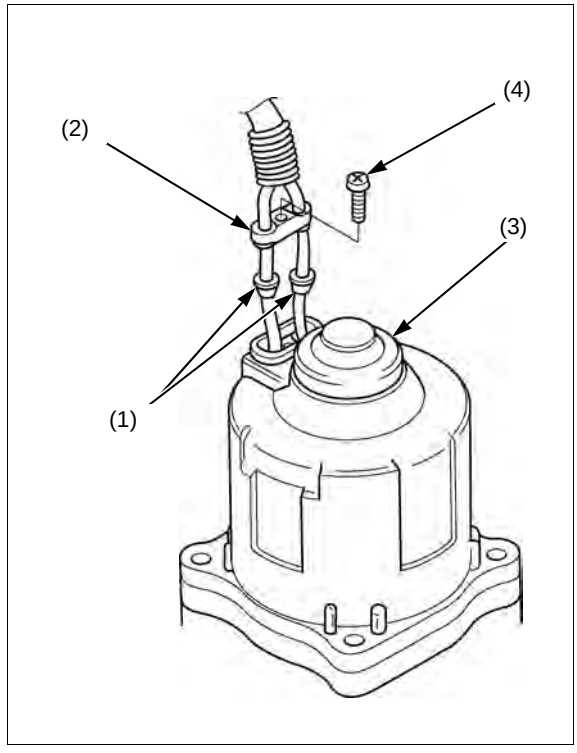


After tightening the two screws, connect the motor 2P connector and check whether the motor turns. If the motor does not turn, disassemble the power tilt motor again, and check whether the motor wire (Blue wire) terminal is disconnected.

Install the two grommets (1) and wire holder (2) on the yoke (3).

Tighten the screw (stainless steel screw) (4) to the specified torque. Do not overtighten it.

TORQUE: 1.4 N·m (0.14 kgf·m, 1.0 lbf·ft)

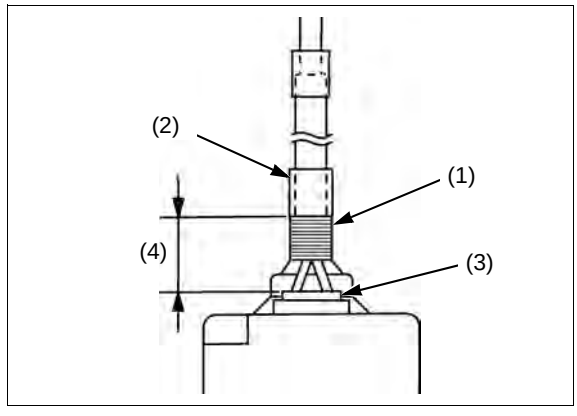


Tape the corrugated tube (1) with heat resisting tape (2) so that the distance from the wire holder end (3) to the tube end is 30 mm (1.2 in) or less (4) as shown.

- Wrap the heat resisting tape 2 - 3 times around the tube.

Install the power tilt motor to the power trim/tilt (page 19-36).

Bleed air from the power trim/tilt without mounting on the outboard motor (page 19-37).



POWER TILT MOTOR INSPECTION

OPERATION INSPECTION

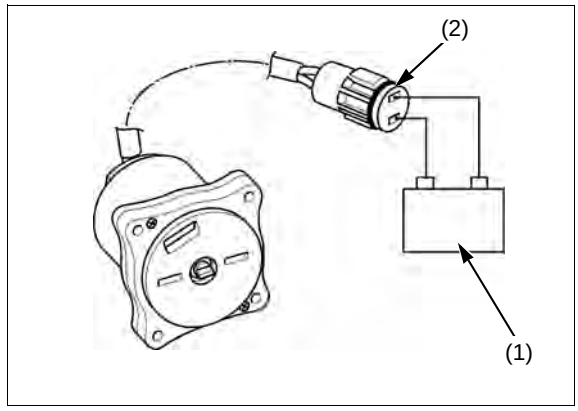
Connect a battery (1) to the 2P connector terminals (2) and check that the motor turns.

Connect the battery in reverse and check that the motor turns in the opposite direction.

NOTICE

Connect the battery, being very careful not to cause a short-circuit.

Disassemble and inspect the components of the motor if there is any abnormality.

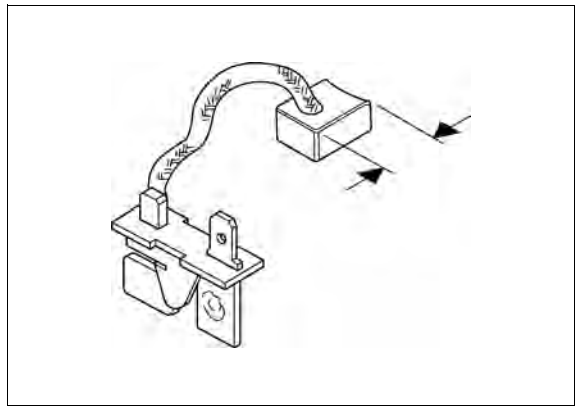


BRUSH LENGTH

Measure the brush length.

STANDARD: 9.8 mm (0.39 in)
SERVICE LIMIT: 4.8 mm (0.19 in)

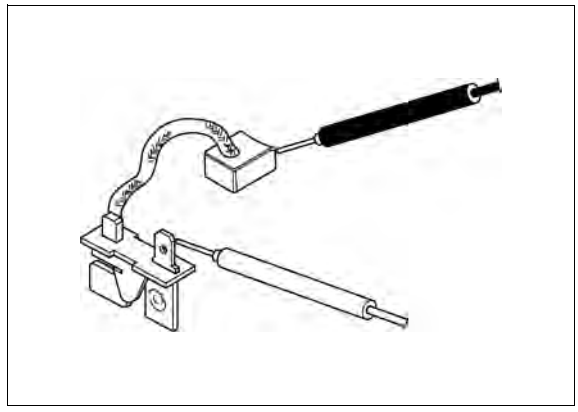
If brush length is less than the service limit, replace the brush assembly.



BREAKER

Check for continuity between the brush and terminal.

If there is no continuity, replace the brush assembly.



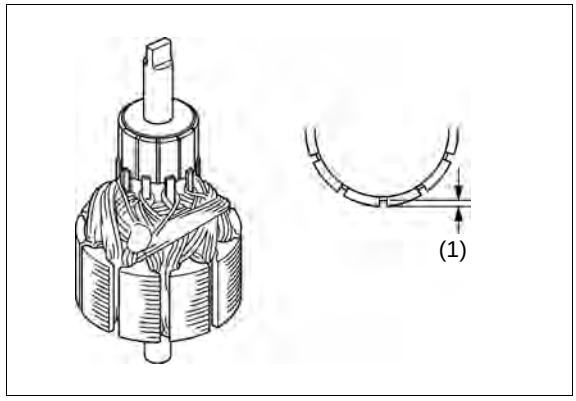
MICA DEPTH

Check the grooves of the commutator and measure the mica depth.

SERVICE LIMIT: 0.50 mm (0.020 in) (1)

If the grooves are clogged or mica depth is less than the service limit, recut the grooves using a hacksaw blade or a small file.

If the mica depth is still less than the service limit, replace the armature.

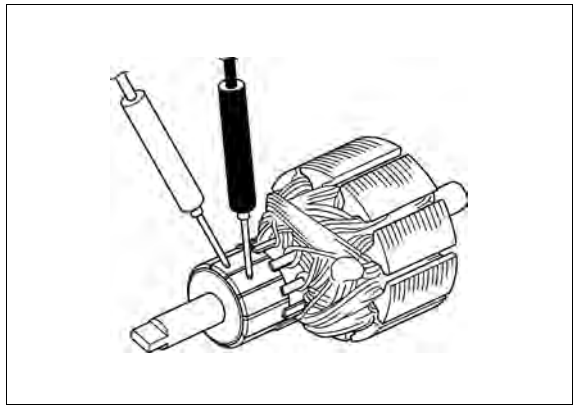


ARMATURE

- Use an armature tester, if available.

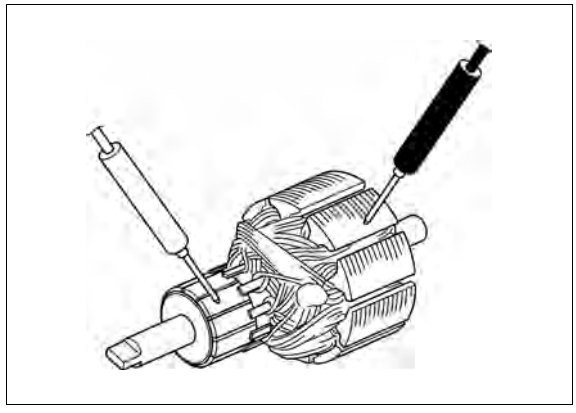
Check for continuity between each segment.

If an open circuit exists between any two segments, replace the armature.



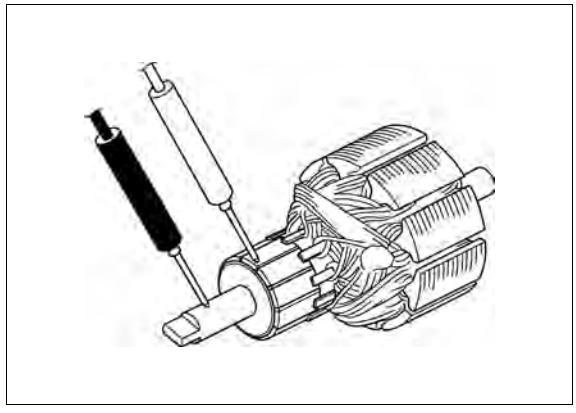
Check for continuity between the commutator and armature coil core.

If there is continuity, replace the armature.



Check for continuity between the commutator and armature shaft.

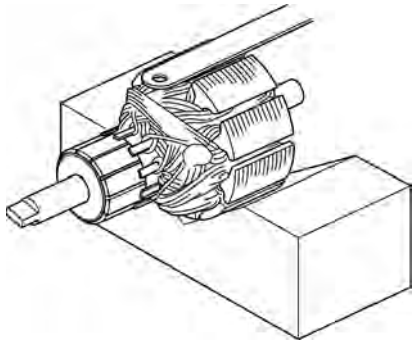
If there is continuity, replace the armature.



Place the armature on an armature tester (commercially available.)

Hold a hacksaw blade close to the armature core.

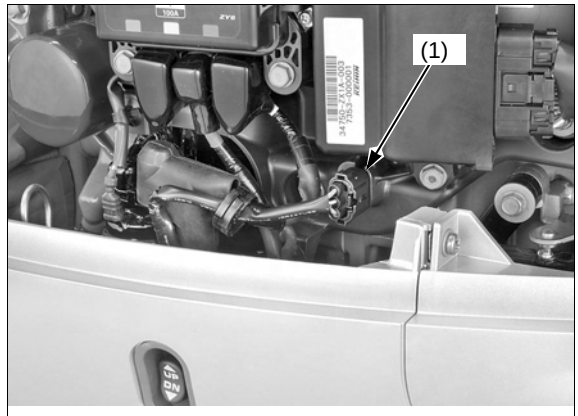
If the blade is attracted to the core or vibrates when the core is turned, the armature is shorted. Replace the armature.

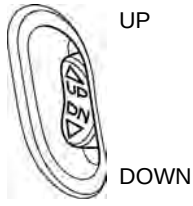


POWER TILT SWITCH INSPECTION

Disconnect the power tilt switch 3P connector (1).

Attach the tester lead to each terminal and check for continuity.
When the switch is pushed "UP" or "DN", there should be continuity between the terminals marked with a circle in the table below.





	Lg	W/Bl	Lb
UP	○—○		
DOWN		○—○	

○—○ :Continuity

20. CONTROLS

COMPONENT LOCATION ····· 20-2

SHIFT CONTROL CABLE REMOVAL/ INSTALLATION ····· 20-3

THROTTLE CONTROL CABLE REMOVAL/INSTALLATION ····· 20-6

SHIFT LINK BRACKET REMOVAL/ INSTALLATION ····· 20-7

SHIFT ARM/NEUTRAL SWITCH REMOVAL/INSTALLATION ····· 20-8

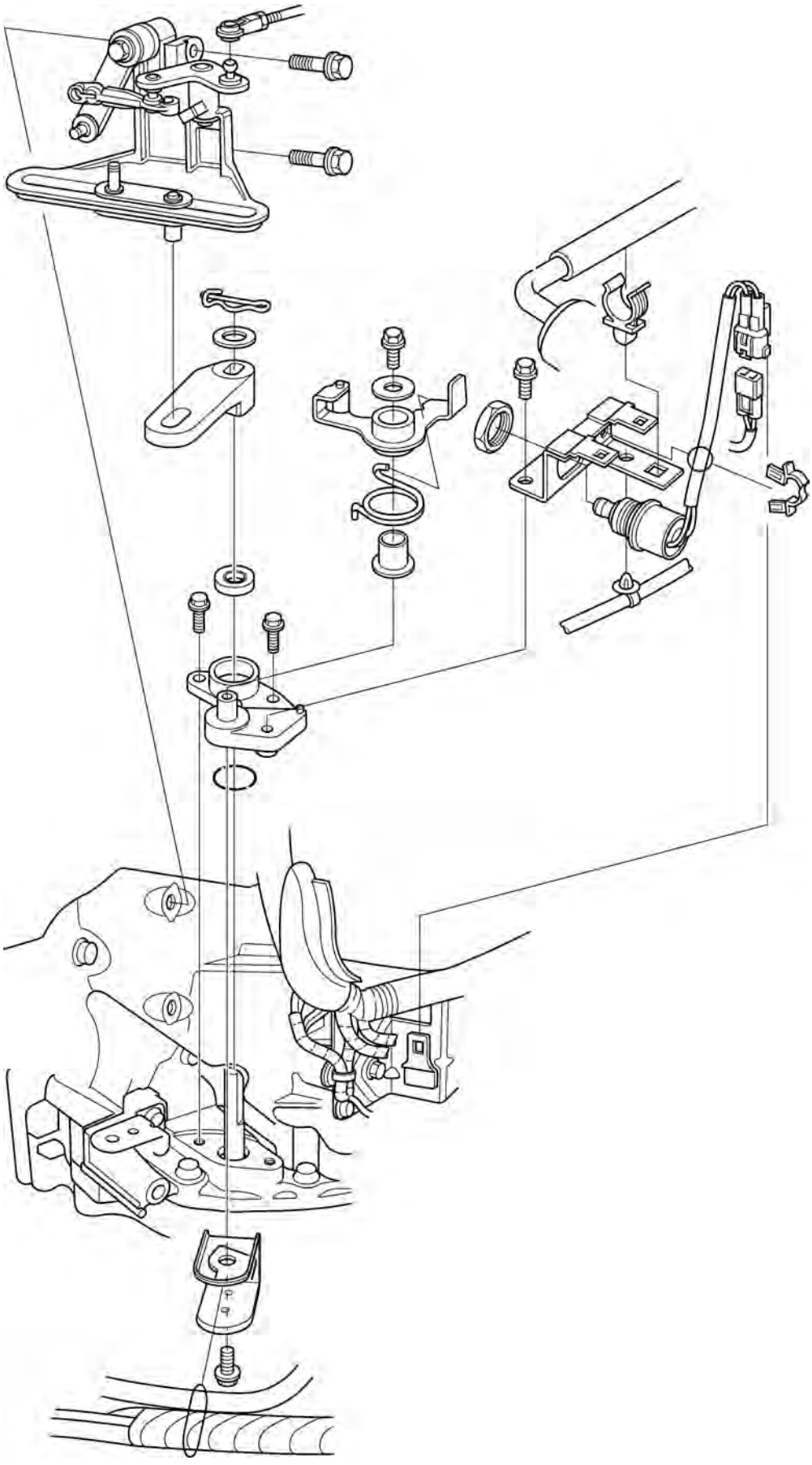
SEAL HOLDER REMOVAL/ INSTALLATION ····· 20-12

SHIFT LINK BRACKET DISASSEMBLY/ASSEMBLY ····· 20-15

SHIFT CONTROL CABLE INSPECTION/ADJUSTMENT ····· 20-16

SHIFT SHAFT B ALIGNMENT ····· 20-18

COMPONENT LOCATION



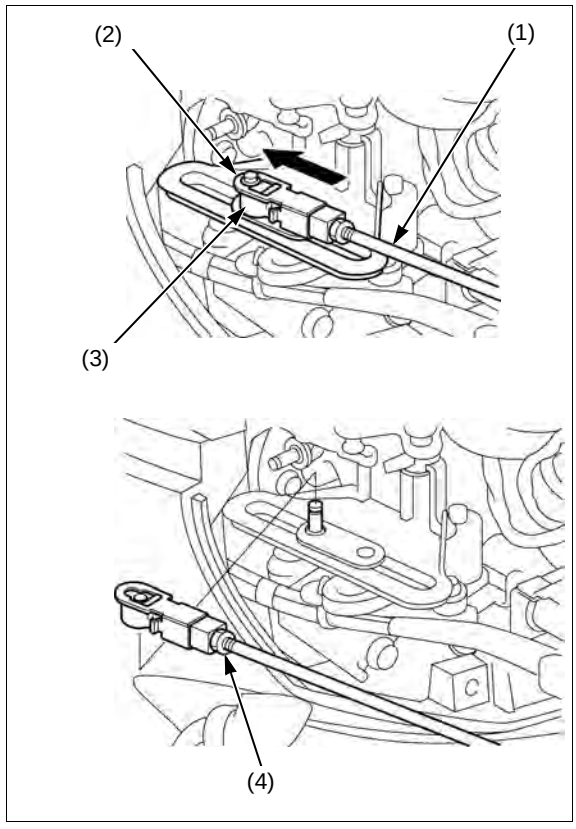
SHIFT CONTROL CABLE REMOVAL/ INSTALLATION

REMOVAL

Remove the front separate cover (page 6-3).

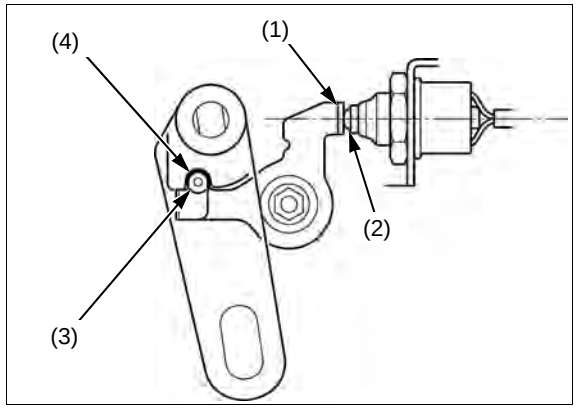
Remove the shift control cable (1) by sliding the lock plate (2) of the shift pivot (3) as shown.

Loosen the shift pivot lock nut (4) and remove the shift pivot.



INSTALLATION

- Before installing the cable to the outboard motor, check the following.
  – Before connecting the cable to the outboard motor, be sure that the cable is connected to the remote control box side securely.
  – Be sure that the click arm end (1) aligns with the neutral switch end (2) as shown. (Note that the click arm roller (3) must be set in the shift arm groove (4) securely.)



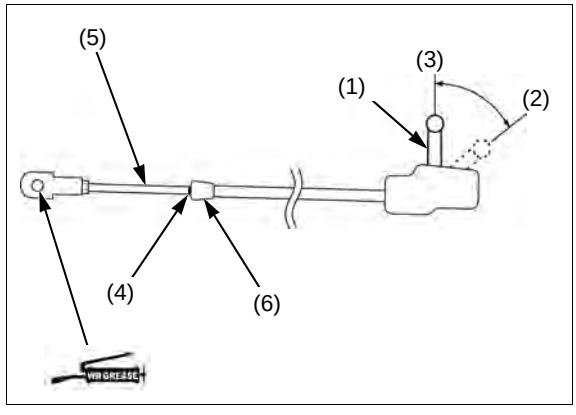
1. Apply marine grease to the mating surface of the shift pivot.

   Set the shift control cable to the shift pivot.

2. Move the remote control lever (1) fully to the "F" (Forward) side (2).

   Return the lever to the "N" (Neutral) position (3) slowly.

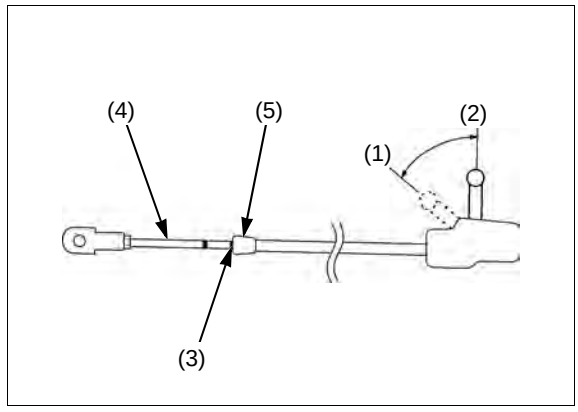
3. With the lever returned to the "N" (Neutral) position, draw Mark (A) (4) on the inner cable (5) at the end of cable outer seal (6).



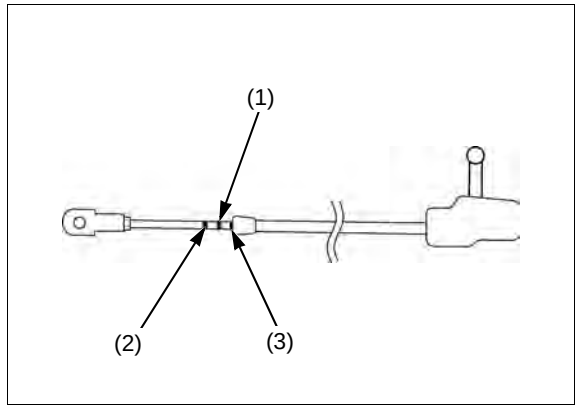
4. Move the remote control lever fully to the "R" (Reverse) side (1).

   Return the lever to the "N" (Neutral) position (2) slowly.

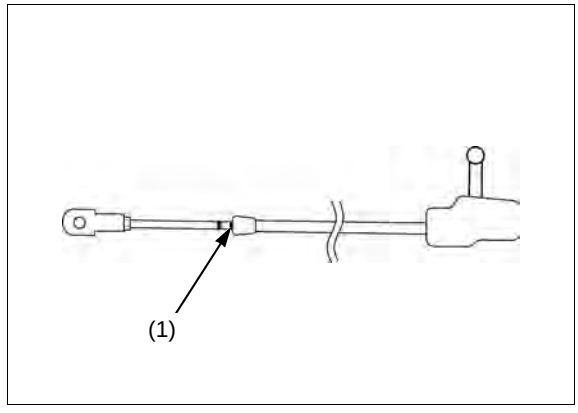
5. With the lever returned to the "N" (Neutral) position, draw Mark (B) (3) on the inner cable (4) at the end of cable outer seal (5).



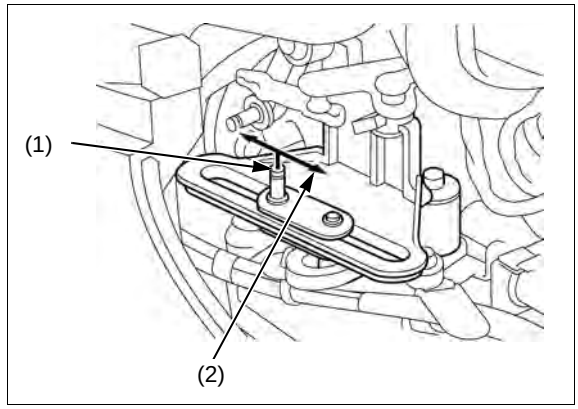
6. Draw Mark (C) (1) at the mid point between the mark (A) (2) and mark (B) (3) on the inner cable.



7. Align mark (C) (1) with the cable outer seal end.



8. Push the shift link pin (1) lightly and set the shift link to the center of the play (2) as shown.



9. With the shift control cable (1) in the condition described in step 7, connect the shift pivot (2) to the shift link pin (3) while turning the shift pivot so that the shift pivot sets on the shift pin smoothly.

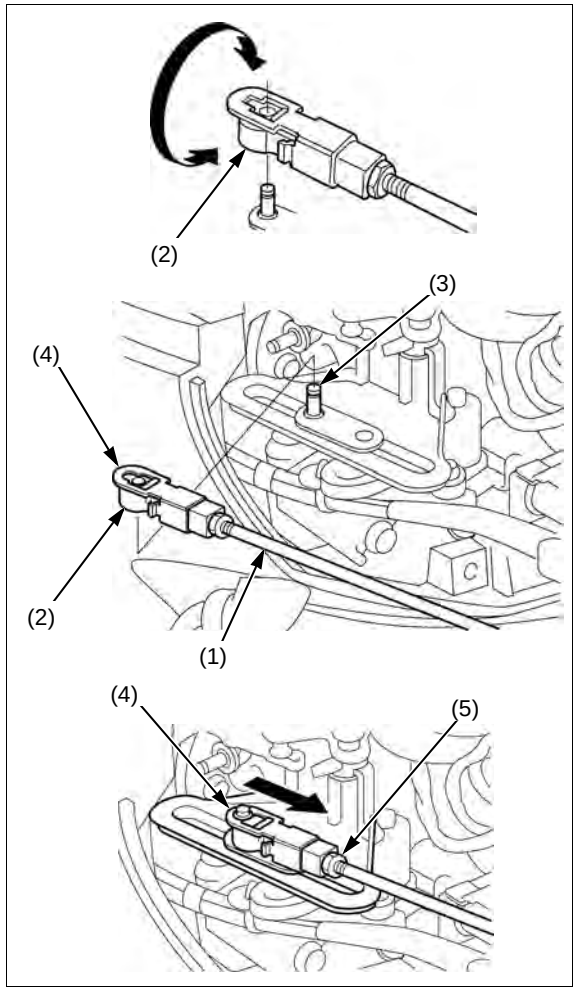
   Take care not to move mark (C) and outer seal end out of alignment. Hold the shift link at the center of the play.

   Lock the lock plate (4) by sliding it into the groove of the shift link pin.

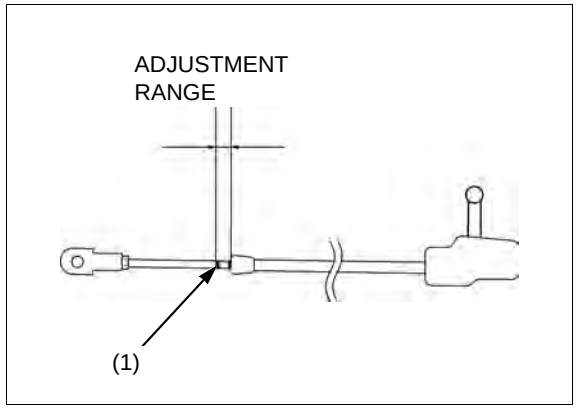
   Tighten the shift pivot lock nut (5).

10. After connecting the cable, move the remote control lever back and forth and check for proper shifting.

- If it is hard to put the remote control lever in the "F" (Forward) or "R" (Reverse) position with the engine stopped, shift the gear while turning the propeller or propeller shaft.
- Do not shift the gear with force, or damage to the shift system can result.



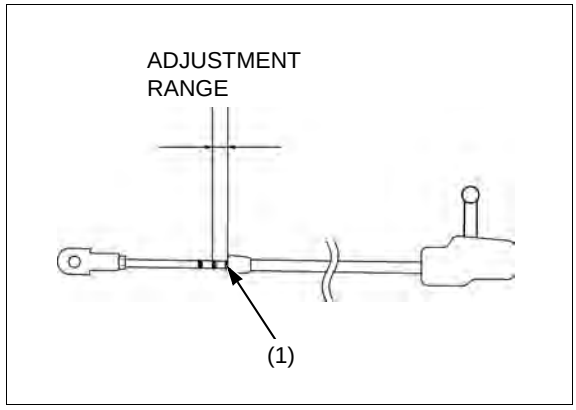
11. If the gear is not in neutral by moving the remote control lever from the "F" (Forward) to the "N" (Neutral) position, remove the shift control cable and move the inner cable toward the mark (A) (1). Repeat the procedure from the step 8.



12. If the gear is not in neutral by moving the remote control lever from the "R" (Reverse) to the "N" (Neutral) position, remove the shift control cable and move the inner cable toward the mark (B) (1). Repeat the procedure from the step 8.

13. After adjustment, check operation of the lever in each position. If it cannot be put in neutral correctly, perform steps 11 or 12 again.

After installation, inspect the shift control cable (page 20-16).



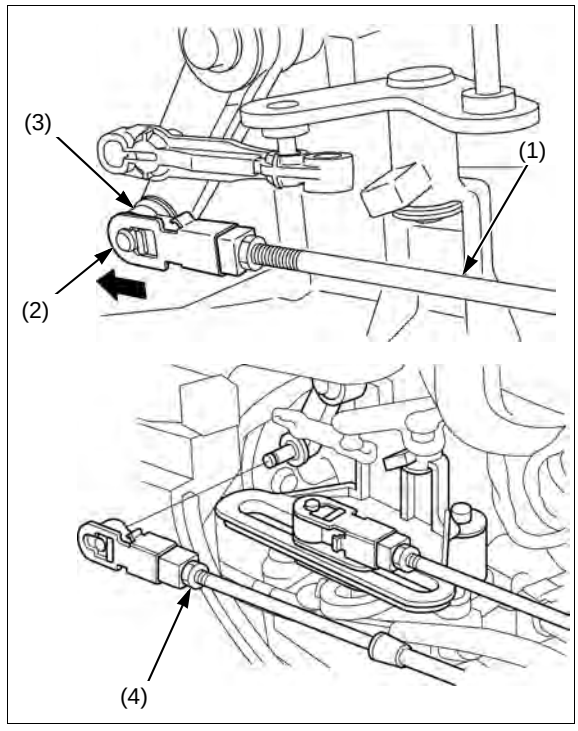
THROTTLE CONTROL CABLE REMOVAL/INSTALLATION

REMOVAL

Remove the front separate cover (page 6-3).

Remove the shift control cable (1) by sliding the lock plate (2) of the shift pivot (3) as shown.

Loosen the shift pivot lock nut (4) and remove the shift pivot from the throttle control cable.



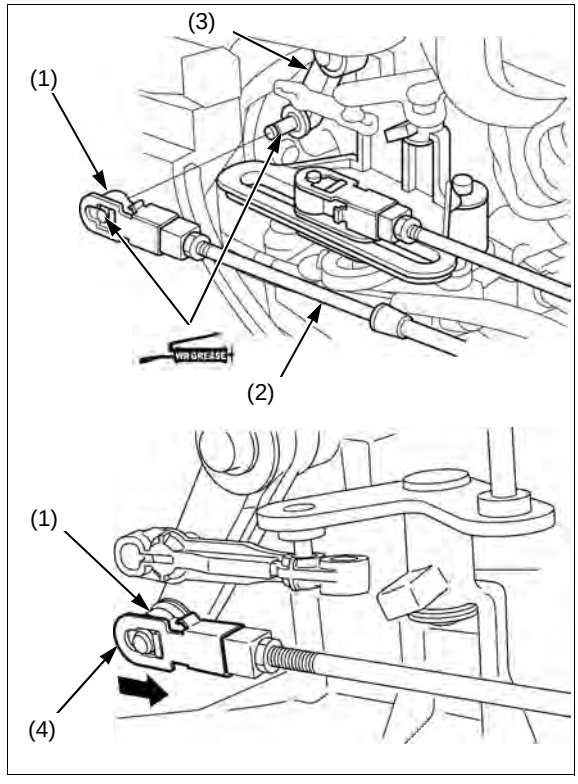
INSTALLATION

Before installing the cable to the outboard motor, check that the cable is connected to the remote control box side properly.

Apply marine grease to the mating surface of the throttle arm link pin and shift pivot bearing area.
Install the shift pivot (1) to the throttle control cable (2).

Install the shift pivot to the throttle arm (3).
Lock the lock plate (4) by sliding it into the groove of the throttle arm.

After installation, inspect and adjust the throttle link (page 3-9).



SHIFT LINK BRACKET REMOVAL/ INSTALLATION

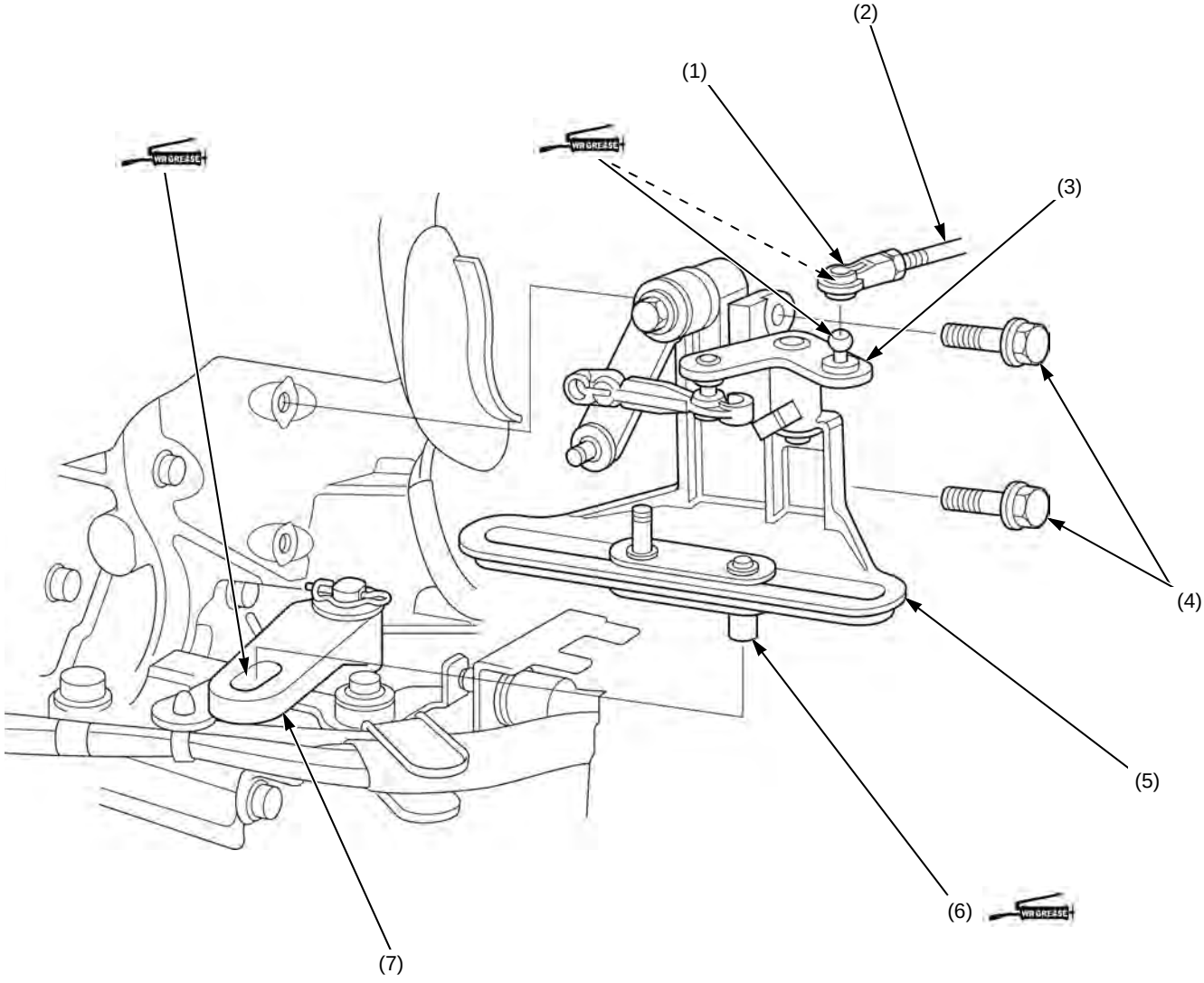
Remove the following:

- Front separate cover (page 6-3)
- Shift control cable (page 20-3)
- Throttle control cable (page 20-6)
- Switch panel cable/indicator wire harness (page 10-6)

Remove the linkage pivot (1) of the throttle rod (2) from the throttle plate (3).

Remove the two bolts (4).
Remove the shift link bracket (5) by releasing the link pin (6) from the shift arm (7).

Installation is in the reverse order of removal.



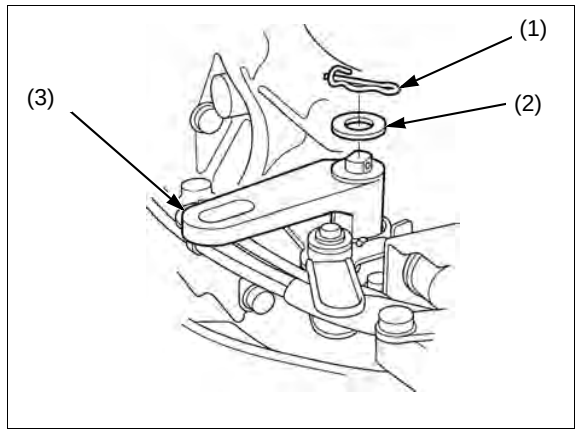
SHIFT ARM/NEUTRAL SWITCH REMOVAL/INSTALLATION

REMOVAL

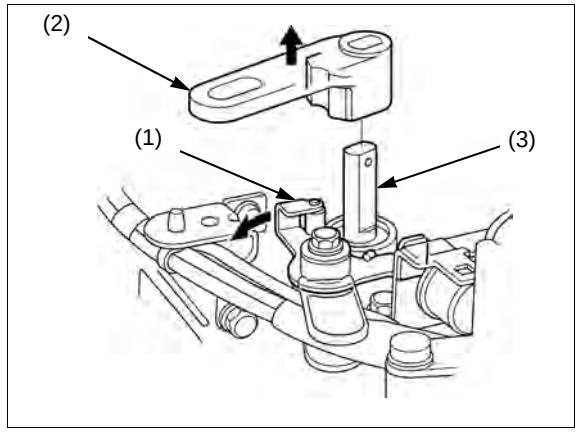
Move the remote control lever to the "N" (Neutral) position.

Remove the shift link bracket (page 20-7).

Remove the snap pin (1) and washer (2) from the shift arm (3).

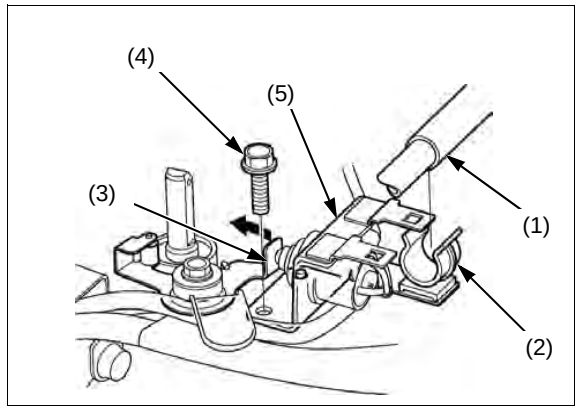


Pull the click arm (1) as shown direction and hold it, then remove the shift arm (2) from the shift shaft B (3).



Release the fuel tube A (1) from the holder (2).

Pull the click arm (3) as shown direction and hold it, then remove the bolt (4) and neutral switch bracket (5).

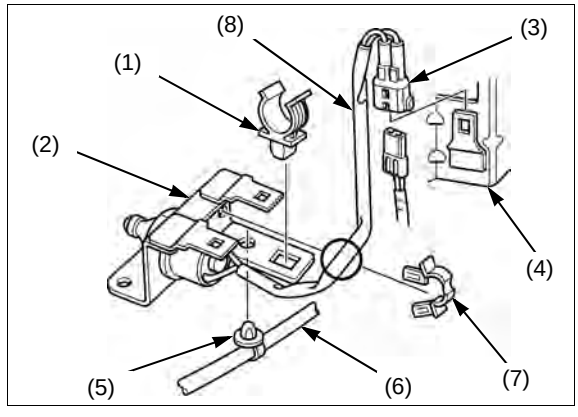


Remove the fuel tube holder (1) from the neutral switch bracket (2).

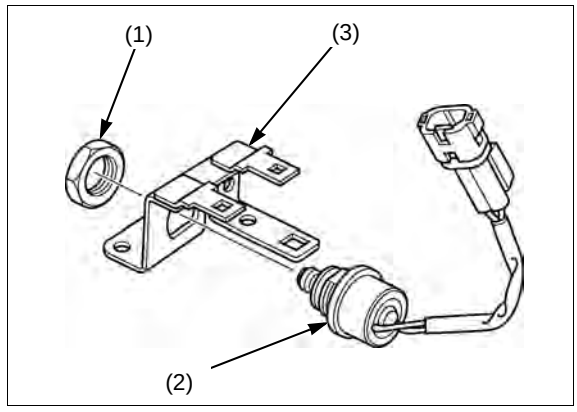
Remove the neutral switch 2P connector (3) from the connector bracket A (4) and disconnect it.

Remove the wire clip (5) of the starter cable (6) from the neutral switch bracket.

Remove the clip A (7) and release the neutral switch wire (8).



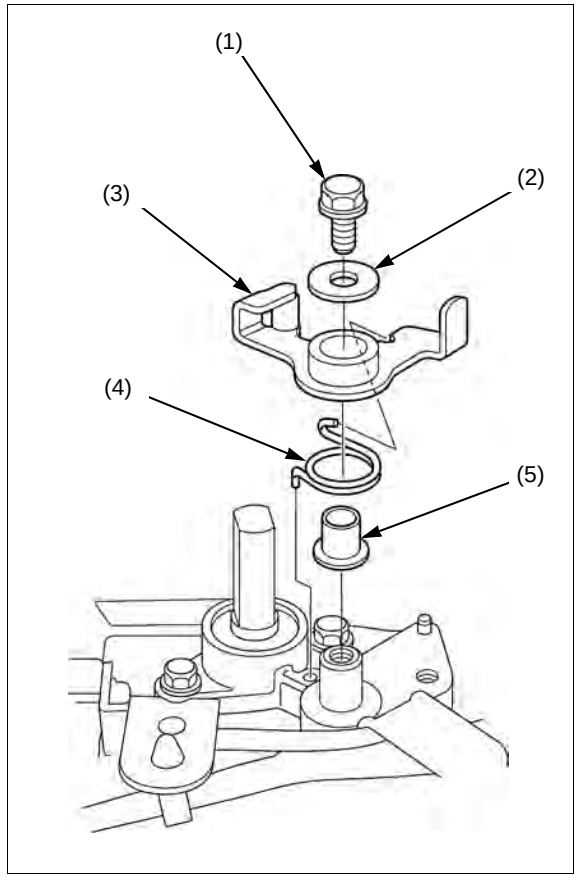
Remove the nut (1) and neutral switch (2) from the neutral switch bracket (3).



Remove the following:

– Bolt (1)
– Washer (2)
– Click arm (3)
– Click spring (4)
– Click arm bushing (5)

Check the click arm for wear or damage; replace it if necessary.

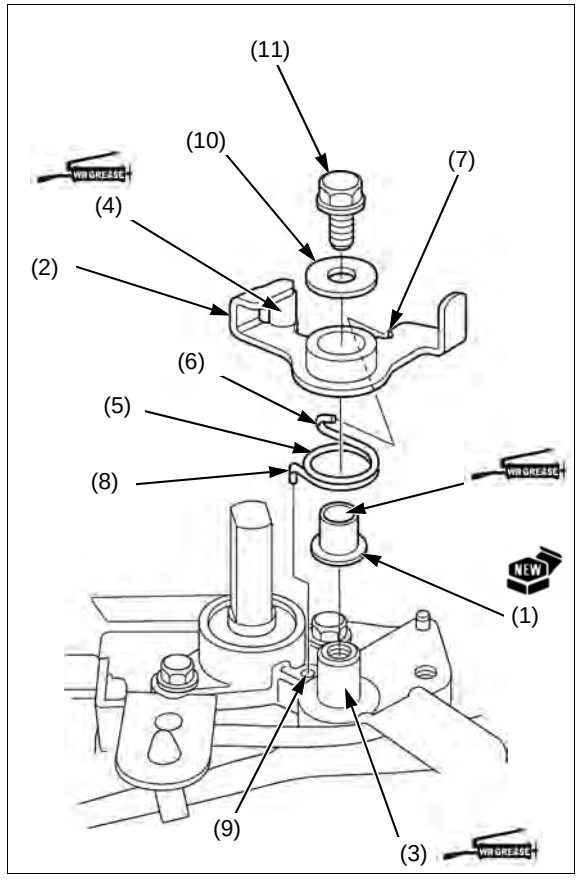


INSTALLATION

Apply marine grease to a new click arm bushing (1) inner surface and install it to the click arm (2).

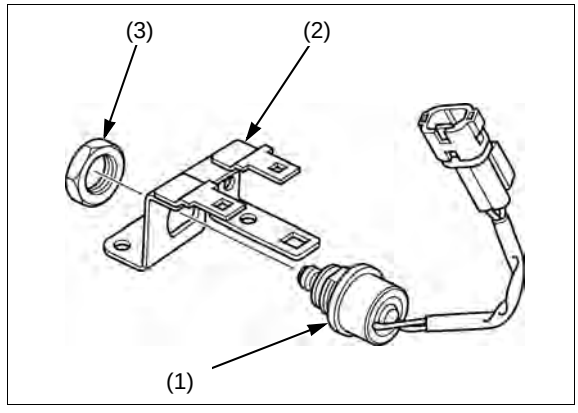
Apply marine grease to the shaft area (3) of the seal holder and roller area (4) of the click arm.

Install the click spring (5) to the click arm by aligning the hook A (6) of the click spring with the groove (7) of the click arm.
Install the click spring hook B (8) into the hole (9) of the seal holder, then set the washer (10) and tighten the bolt (11).



Install the neutral switch (1) to the neutral switch bracket (2) and tighten the nut to the specified torque.

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

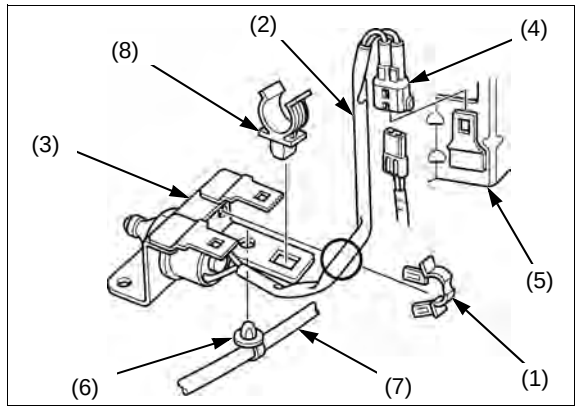


Set the clip A (1) to the neutral switch wire (2) and install it to the neutral switch bracket (3).

Connect the neutral switch 2P connector (4) and install it to the connector bracket A (5).

Install the wire clip (6) of the starter cable (7) to the neutral switch bracket.

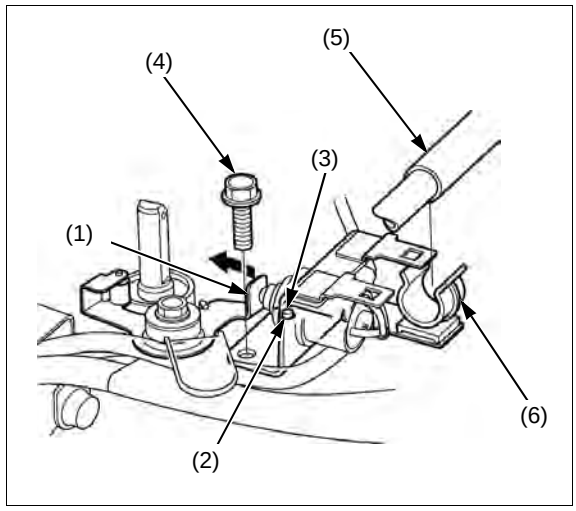
Install the fuel tube holder (8) to the neutral switch bracket.



Pull the click arm (1) as shown direction and hold it, then install the neutral switch bracket by aligning the hole (2) with the projection (3) on the seal holder.

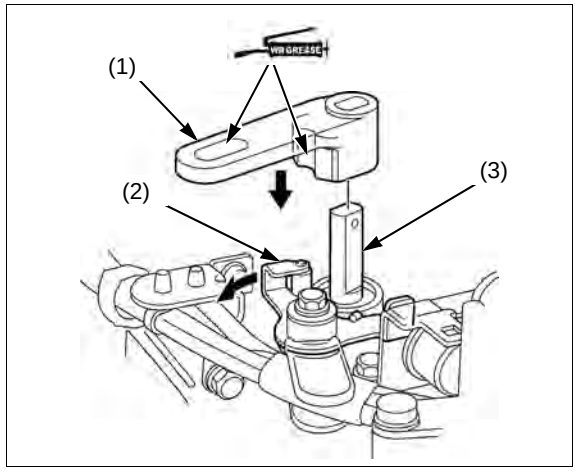
Install and tighten the bolt (4).

Install the fuel tube A (5) to the fuel tube holder (6).



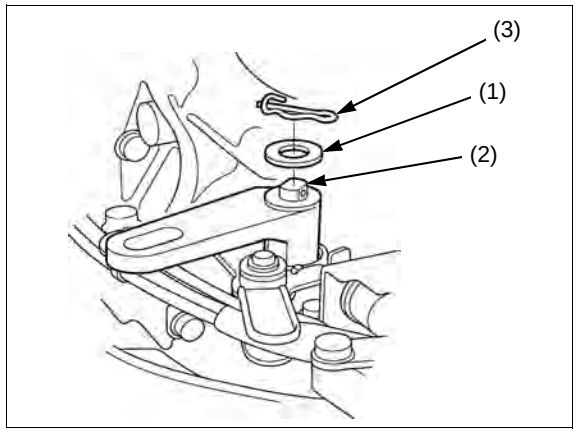
Apply marine grease to the link pin inserting area and roller contact area of the shift arm (1).

Pull the click arm (2) as shown direction and hold it, then install the shift arm to the shift shaft B (3).



Set the washer (1) to the shift shaft B (2) and install the snap pin (3) to the shift shaft B.

Install the shift link bracket (page 20-7).



SEAL HOLDER REMOVAL/ INSTALLATION

REMOVAL

Remove the following:

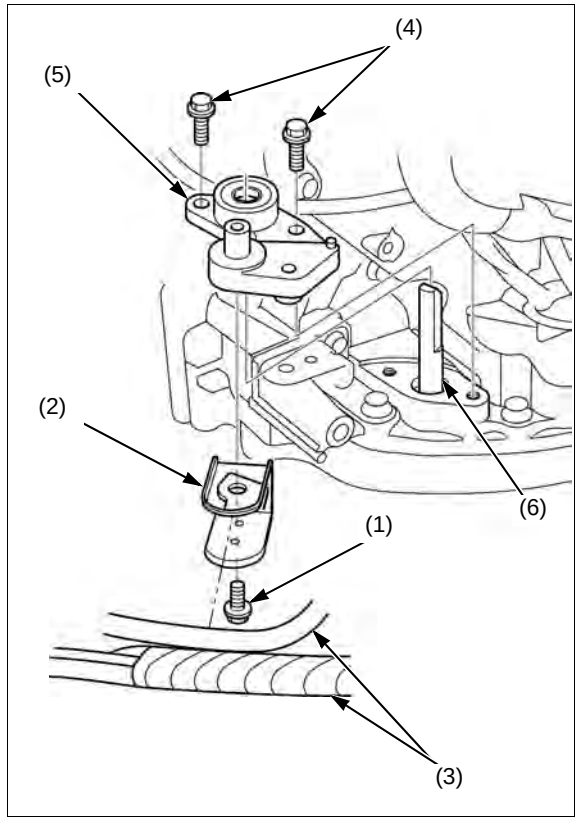
– Shift arm/neutral switch (page 20-8)
– R. engine under cover (page 6-10)

Remove the bolt (6 x 14 mm) (1) and cable bracket A (2).

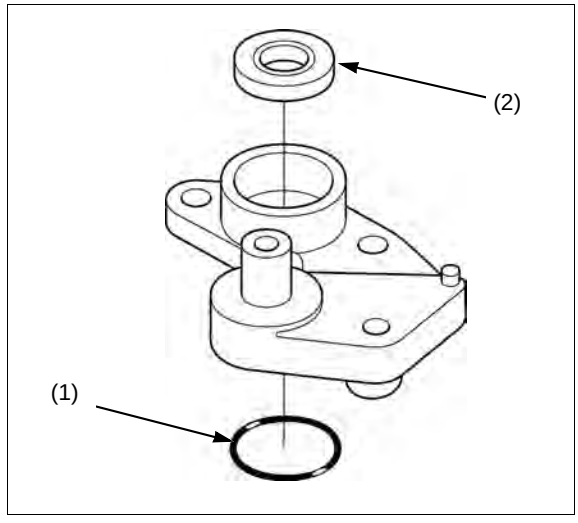
Remove the starter cables (3) from the cable bracket A.

Remove the two bolts (6 x 20 mm) (4) and seal holder (5).

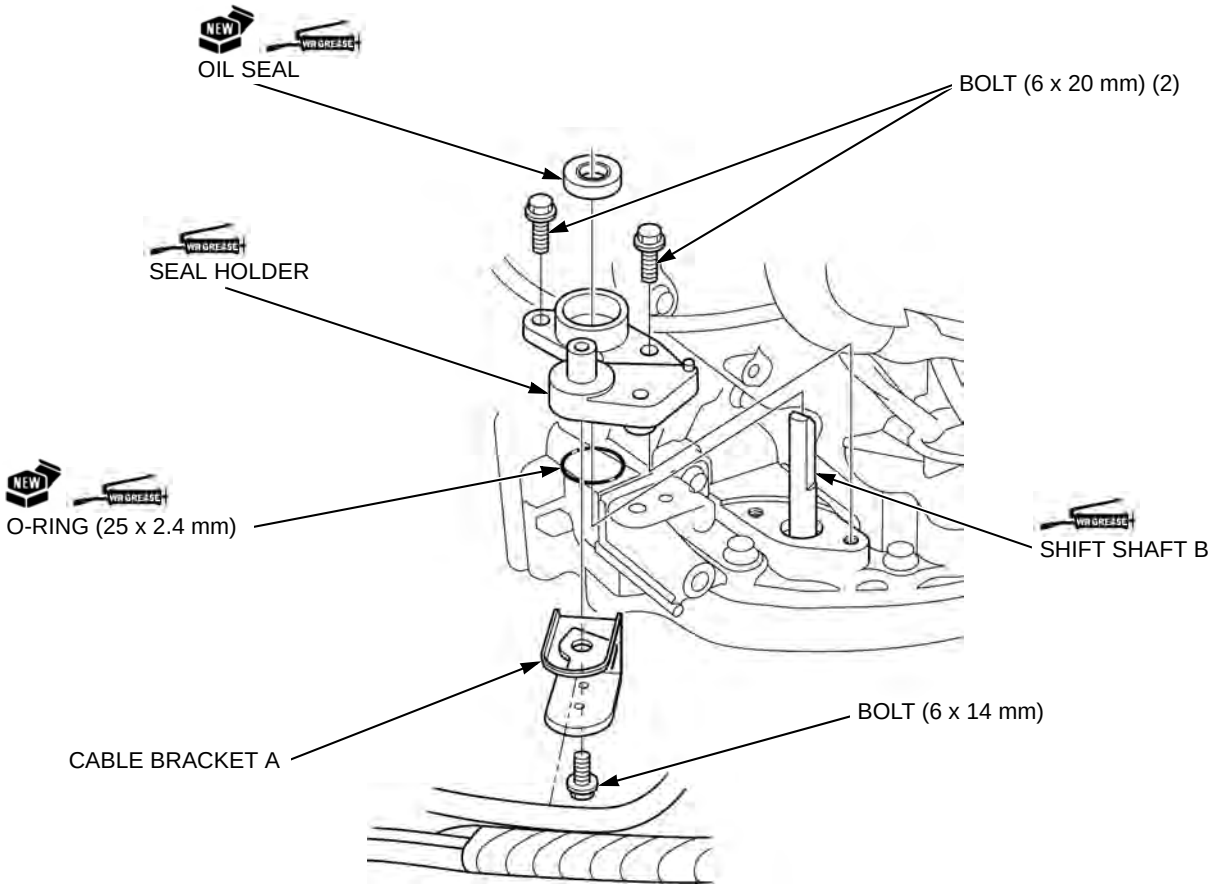
- When removing the seal holder, hold the shift shaft B (6) to prevent it from being disengaged from shift shaft A.
- If disengage, adjust the shift shaft B alignment (page 20-18).
- If assembled with incorrect alignment, shifting operation will fail.



Remove the O-ring (1) and oil seal (2) from the seal holder.



EXPLODED VIEW

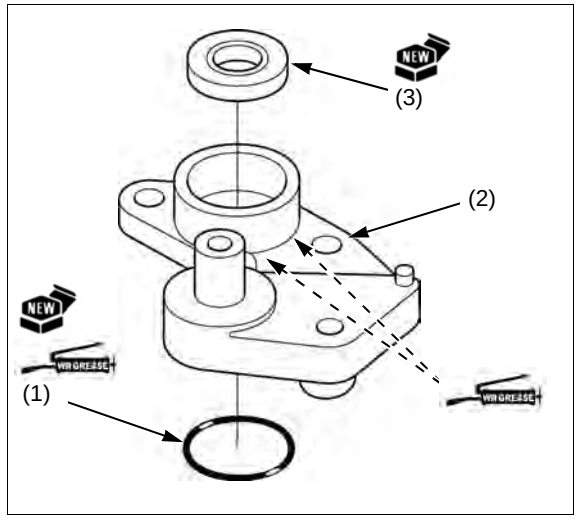


INSTALLATION

Apply marine grease to a new O-ring (1) outer surface.

Apply marine grease to the O-ring installation area of the seal holder (2) and shift shaft B bearing area.
Apply soapy water to a new Oil seal (3) outer surface.

Install the oil seal and O-ring to the seal holder.



Install the cable bracket A (1) to the seal holder (2) and tighten the bolt (6 x 14 mm) (3).

Attach a piece of tape (4) around the flange area of shift shaft B (5) as shown.

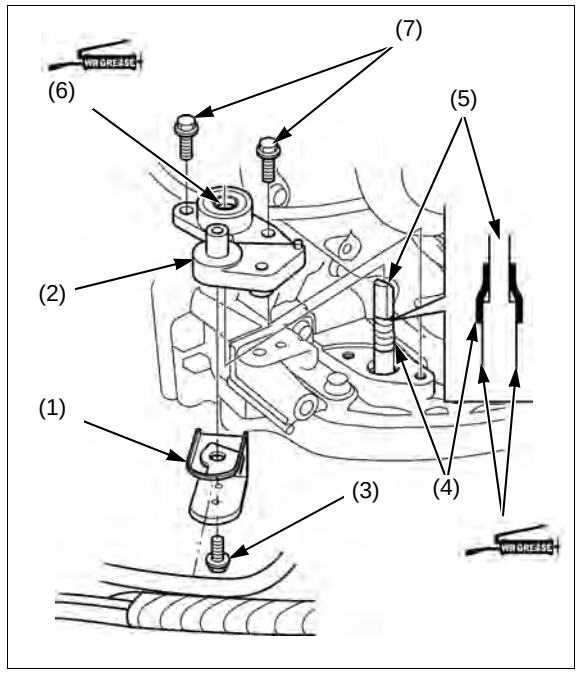
Apply marine grease to the oil seal lips (6) of the seal holder.

Install the seal holder onto the shift shaft B slowly and tighten the two bolts (6 x 20 mm) (7).

- When installing the seal holder, hold the shift shaft B (6) to prevent it from being disengaged from shift shaft A.
- If disengage, adjust the shift shaft B alignment (page 20-18).
- If assembled with incorrect alignment, shifting operation will fail.

Remove the sealing tape from the shift shaft B.

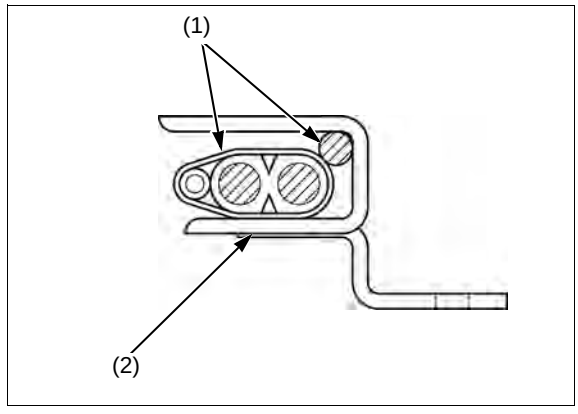
- When removing the tape, check that the oil seal lip is not turned inside out.



Install the starter cables (1) to the cable bracket A (2) as shown.

Install the following:

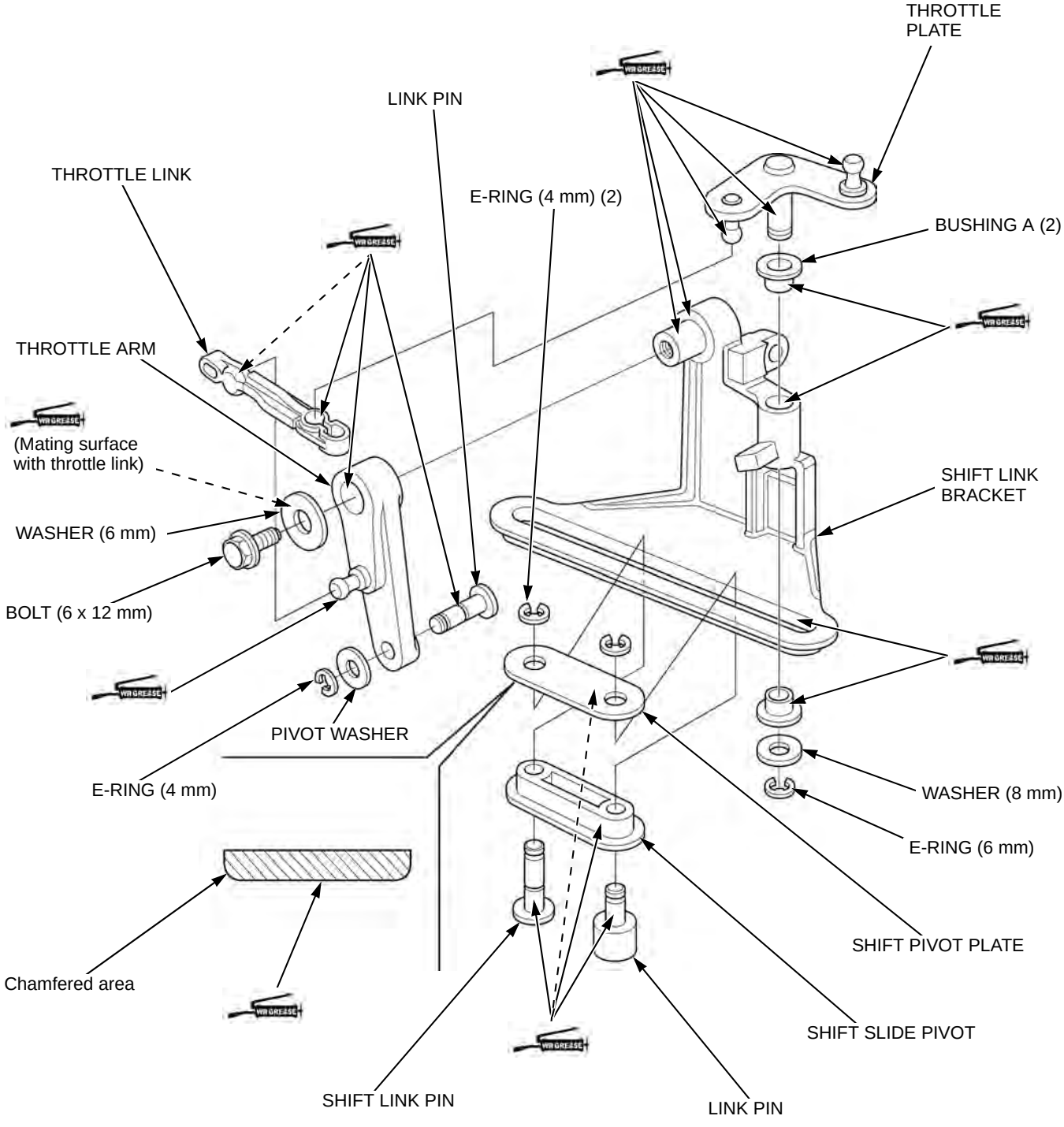
– Shift arm/neutral switch (page 20-10)
– R. engine under cover (page 6-11)



SHIFT LINK BRACKET DISASSEMBLY/ ASSEMBLY

Remove the shift link bracket (page 20-7).

Installation is in the reverse order of removal.



SHIFT CONTROL CABLE INSPECTION/ ADJUSTMENT

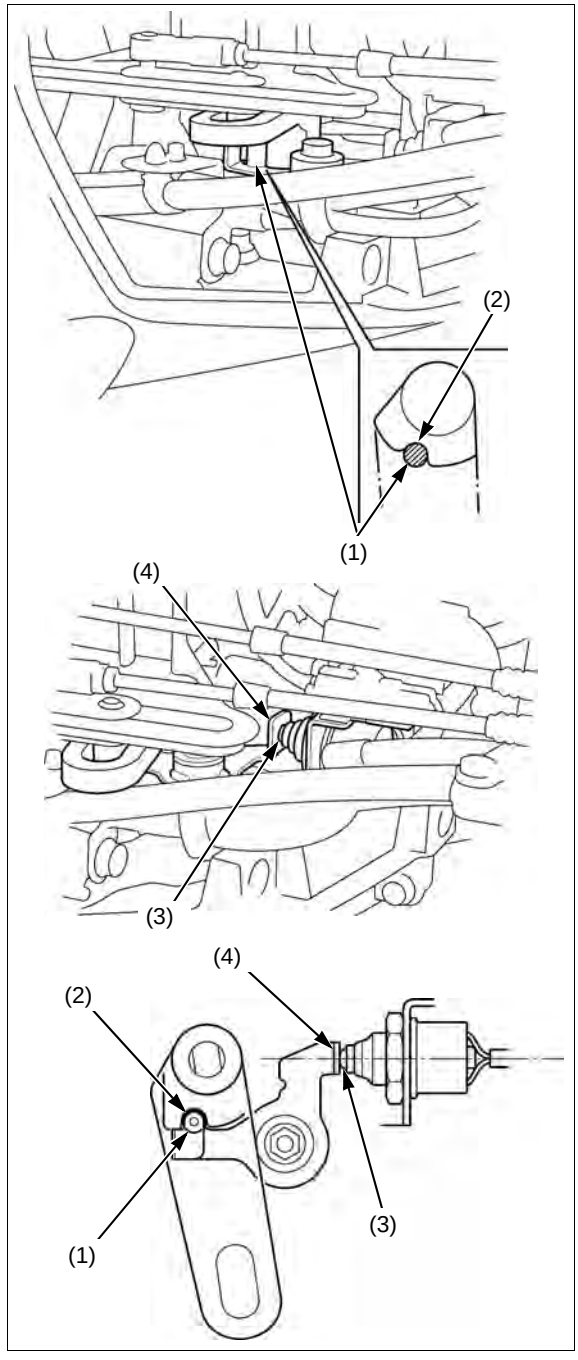
INSPECTION

Remove the front separate cover (page 6-3).

Move the remote control lever to the "N" (Neutral) position.

Make sure that the roller (1) of the click arm is in the groove (2) of the shift arm.
Make sure that the neutral switch tip area (3) is pushing the click arm flat area (4).
If the roller is not in the groove, adjust the shift control cable (page 20-17).

If the neutral switch tip area is not pushing the click arm flat area, check the click arm for wear or damage; replace it if necessary (page 20-8).



ADJUSTMENT

Move the remote control lever to the "N" (Neutral) position.

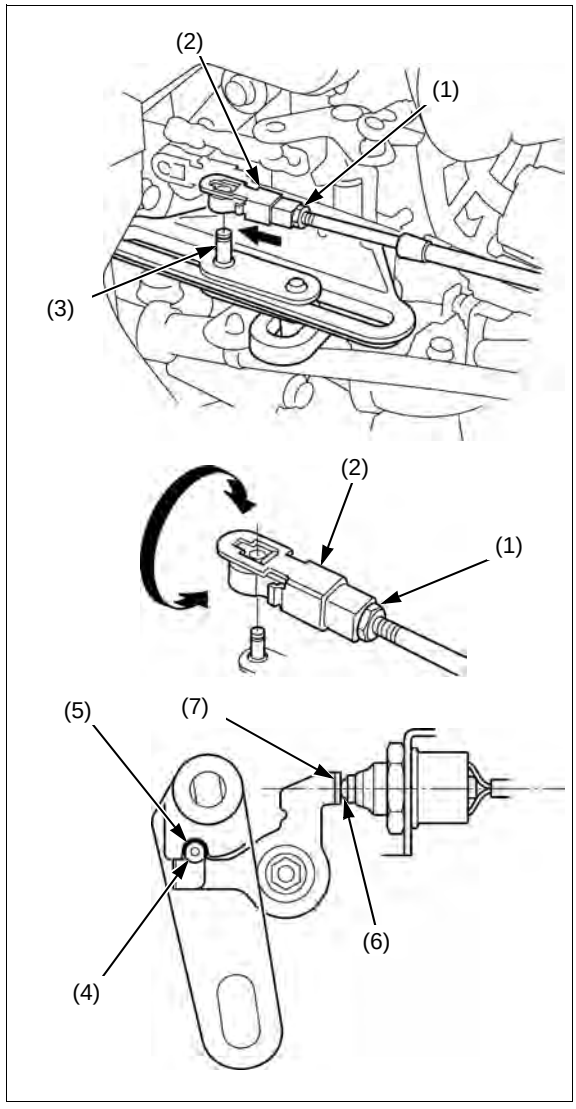
Loosen the lock nut (1) of the remote control cable (shift side) and remove the shift pivot (2) from the shift link pin (3).

Make sure that the roller (4) of the click arm is in the groove (5) of the shift arm.

Turn the shift pivot so that the shift pivot sets on the shift pin smoothly.

Set the shift pivot to the shift link pin and move the remote control lever several times, then move the remote control lever to the "N" (Neutral) position.
Make sure that the roller of the click arm is in the groove of the shift arm and neutral switch tip area (6) is pushing the click arm flat area (7).
After checking, tighten the lock nut.
If the roller is not in the groove, readjust the shift control cable.

Install the front separate cover (page 6-3).



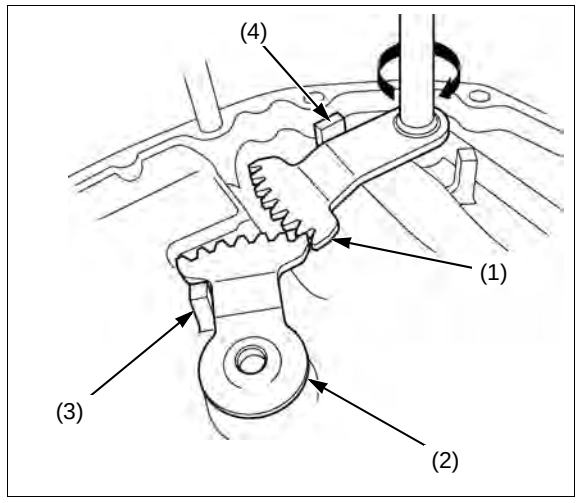
SHIFT SHAFT B ALIGNMENT

Remove the following:

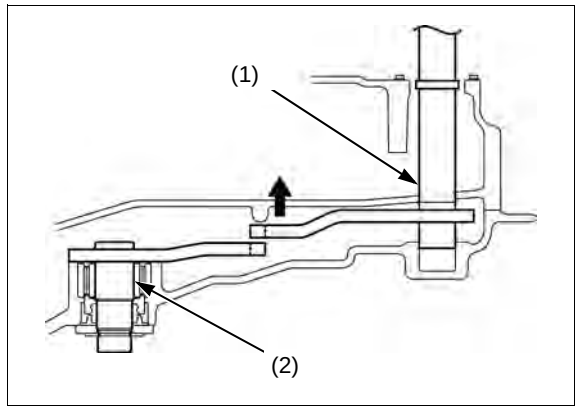
– Seal holder (page 20-12)
– Gear case
  – Standard rotation type (page 16-8)
  – Counter rotation type (page 17-8)

Turn the shift shaft B (1) clockwise until the shift shaft A (2) touches the stopper (3) in the mounting case as shown.

- If the shift shaft B touches the stopper (4) before shift shaft A touches the stopper, lift up the shift shaft B and turn it counterclockwise until it engages with the shift shaft A. Then turn shift shaft B clockwise until shift shaft A touches the stopper.



Pull the shift shaft B (1) upward slowly while holding the shift shaft A (2) in contact with the stopper in the mounting case.



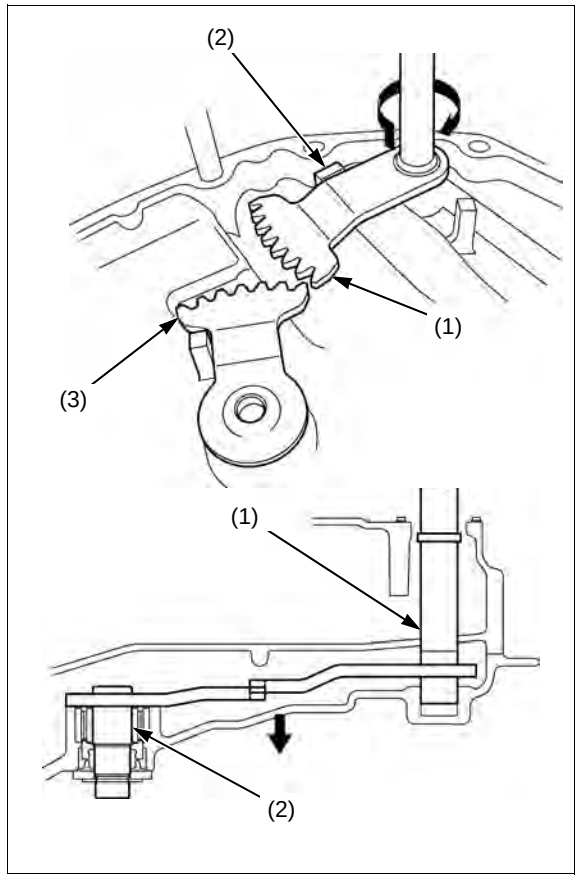
With raised shift shaft B (1), turn it clockwise until it touches the stopper (2) in the mounting case, then lower the shift shaft B slowly and engage its gear with the gear of the shift shaft A (3).

- Be careful not to move the shift shaft A when engaging the gears.

After alignment, check for proper shifting operation.

Install the following:

– Gear case
  – Standard rotation type (page 16-9)
  – Counter rotation type (page 17-9)
– Seal holder (page 20-13)



21. TECHNICAL FEATURES

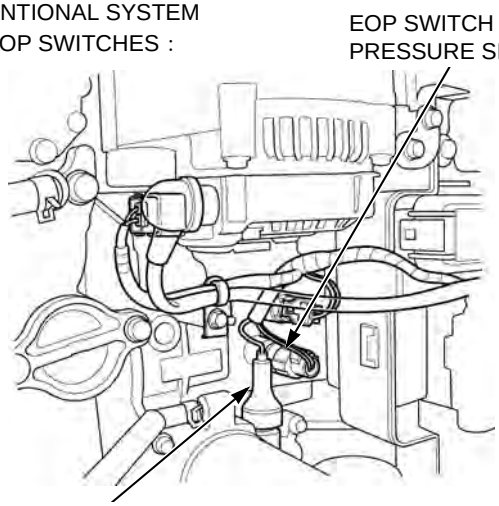
OIL PRESSURE ALERT SYSTEM·····21-2

OIL PRESSURE ALERT SYSTEM

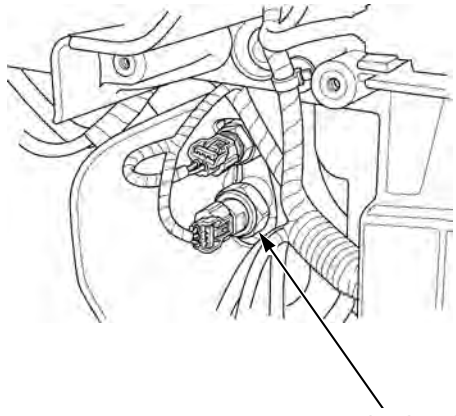
SYSTEM DESCRIPTION

This model utilizes an oil pressure alert system with the EOP sensor, which detects the oil pressure linearly, instead of a conventional system that uses two EOP switches (high pressure side/low pressure side).
This system enables more accurate control of pressure alert, depending on the engine speed and engine temperature, which realizes an enhanced reliability of the whole system.

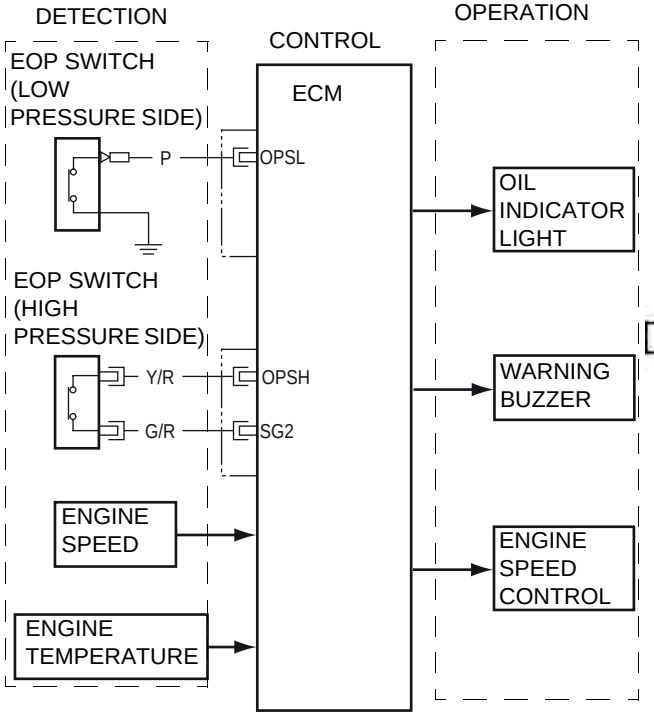
CONVENTIONAL SYSTEM WITH EOP SWITCHES :



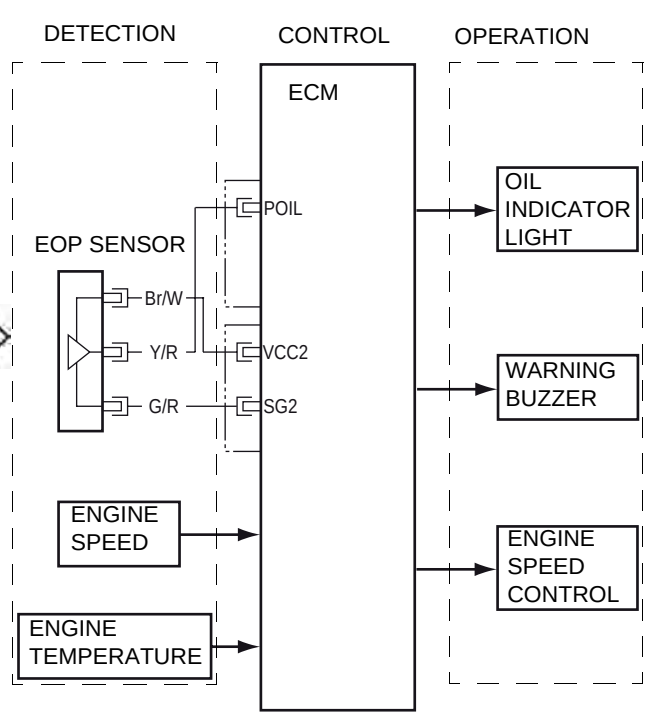
NEW SYSTEM WITH EOP SENSOR:



CONVENTIONAL SYSTEM



NEW SYSTEM

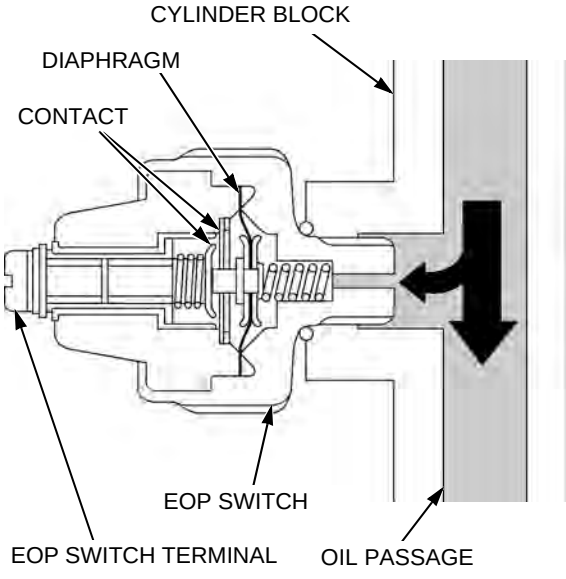


EOP SENSOR

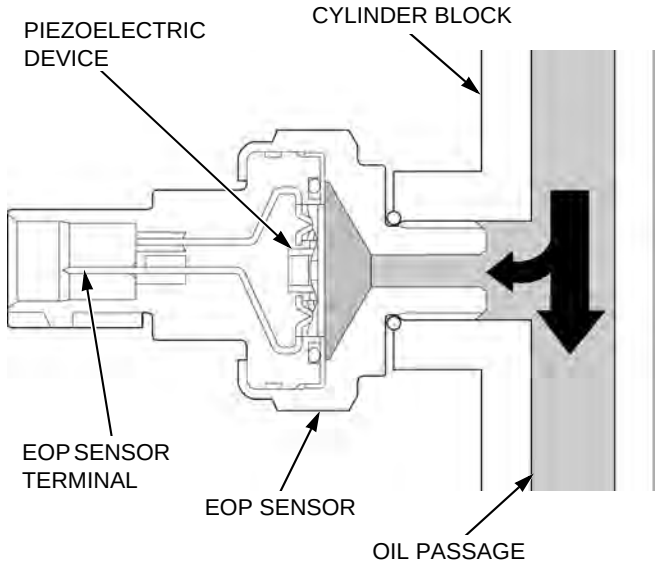
A conventional EOP switch is an ON/OFF pressure switch, which includes a mechanical contact, that turns ON when the oil pressure is below a specified value and turns OFF when the pressure is above a specified value.

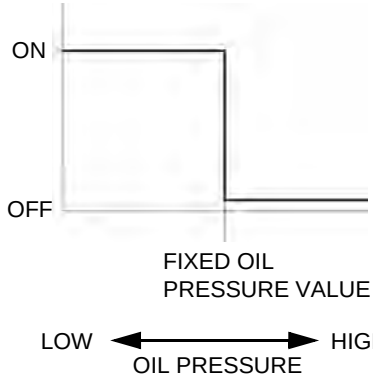
The EOP sensor includes a piezoelectric device which converts the electronic signals into voltage, which ranges from 0 to 5 V, and transmits to the ECM. The electronic resistance of the piezoelectric device changes in accordance with the oil pressure, sending smaller signal when the oil pressure is low and larger signal when the oil pressure is high.

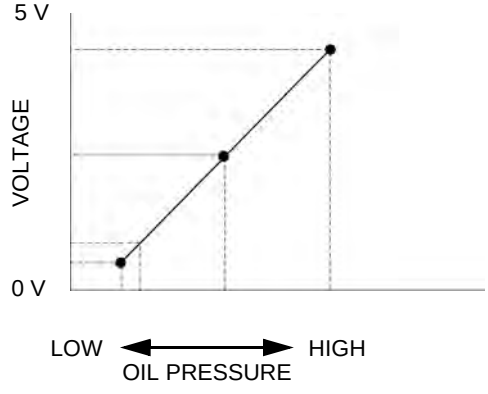
CONVENTIONAL SYSTEM WITH EOP SWITCHES :



NEW SYSTEM WITH EOP SENSOR:



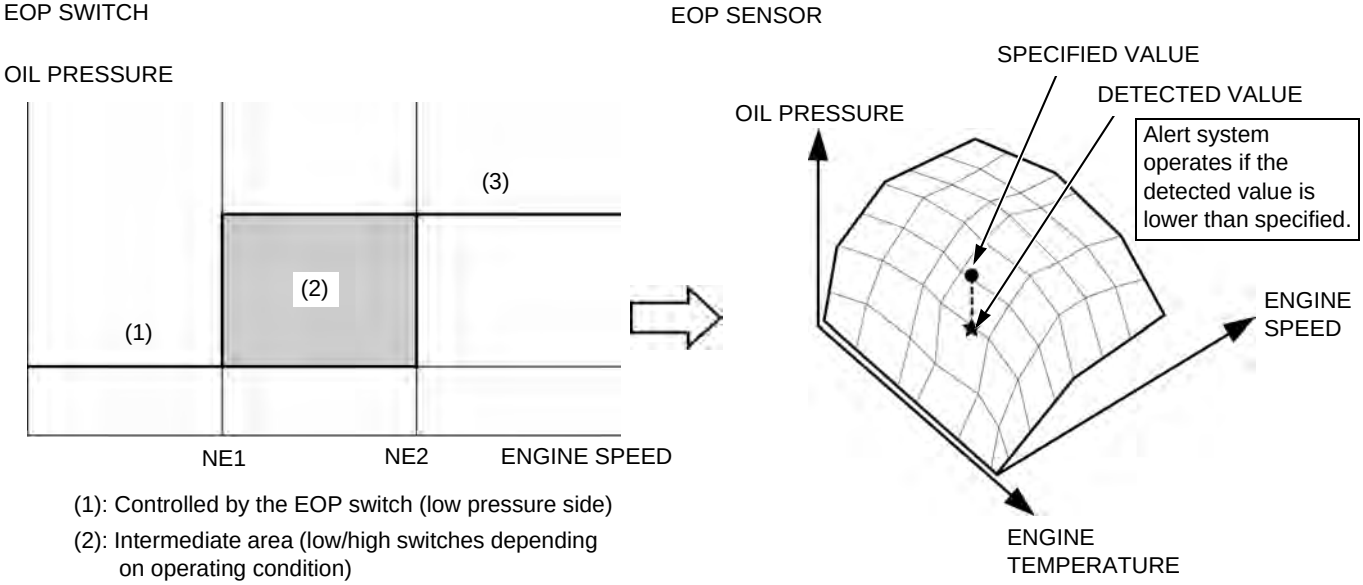




ABNORMAL OIL PRESSURE DETECTION

In a conventional system, the ECM uses two EOP switches (low/high pressure) in order to detect an abnormal oil pressure according to the operating condition that varies with the engine speed and engine temperature.

On this newly introduced oil pressure alert system, the ECM detects linear change of oil pressure by the EOP sensor, constantly compares the constantly changing detected value with the normal value depending on engine speed and temperature, in order to find an abnormal oil pressure.



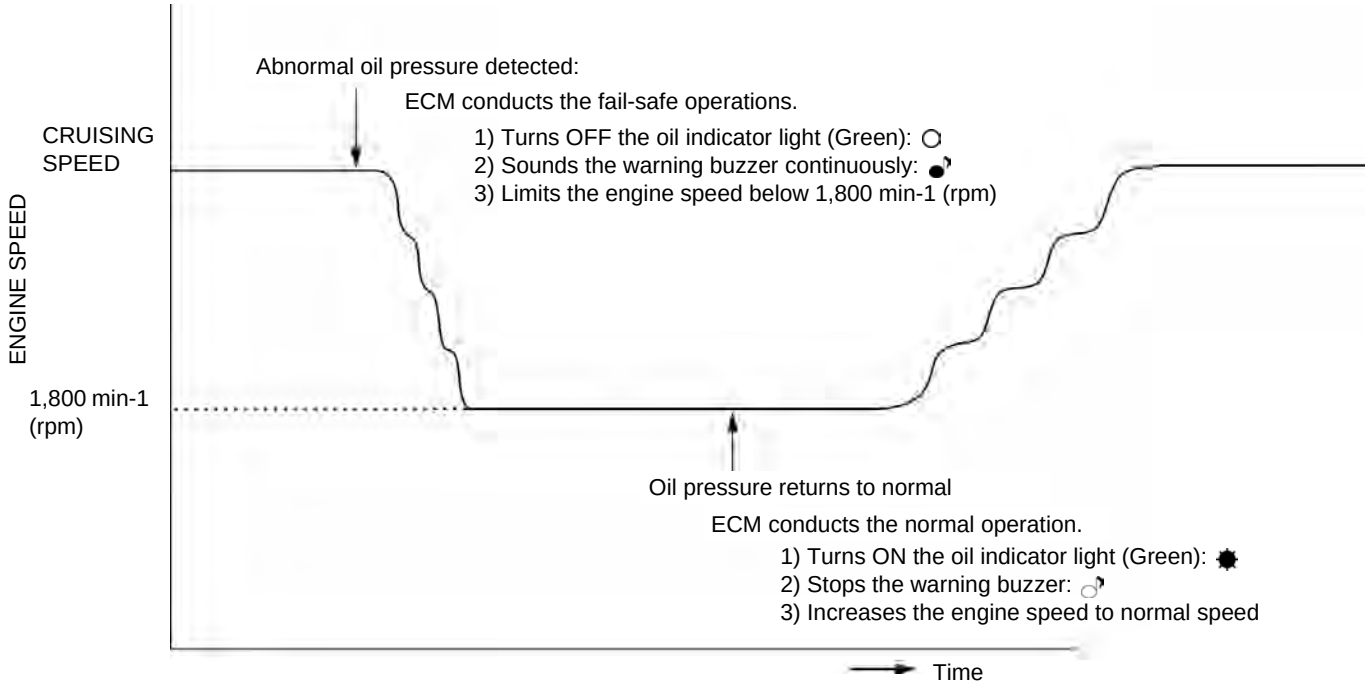
(1): Controlled by the EOP switch (low pressure side)
(2): Intermediate area (low/high switches depending on operating condition)
(3): Controlled by the EOP switch (high pressure side)

FAIL-SAFE OPERATION WHEN ABNORMAL OIL PRESSURE IS DETECTED

When the ECM detects an abnormal oil pressure, it conducts the following fail-safe operations.

1. Turns OFF the oil indicator light (Green)
2. Sounds the warning buzzer continuously
3. Limits the engine speed below 1,800 min^{-1} (rpm)

When the abnormal oil pressure is cleared, the ECM will turn ON the oil indicator light (Green) and stops the warning buzzer, then gradually increases the engine speed to normal operating speed.



22. WIRING DIAGRAMS

HOW TO READ A WIRING DIAGRAM & RELATED INFORMATION ····· 22-2

WIRING DIAGRAMS ····· 22-5

SYSTEM DIAGRAM ····· 22-6

CONNECTOR GENERAL LAYOUT DRAWING ····· 22-7

HOW TO READ A WIRING DIAGRAM & RELATED INFORMATION

The wiring diagram, connector general layout drawing, connector drawings, and the symbols used in troubleshooting are explained in this section.

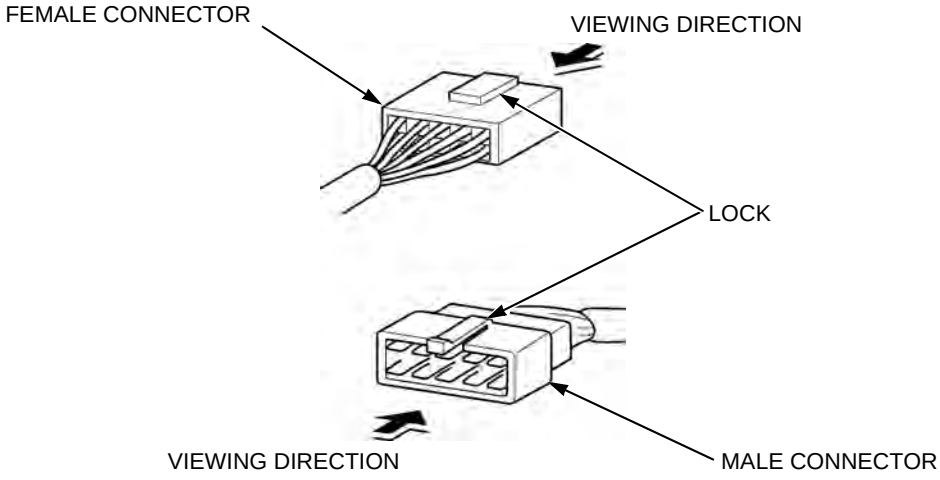
HOW TO READ CONNECTOR DRAWINGS

Connector drawings show the terminal arrangement, terminal No., number of pins, and the shape of terminal (male or female).

Both the male and female connectors are shown for the common connectors, while only the main wire harness side connectors are shown for the dedicated connectors.

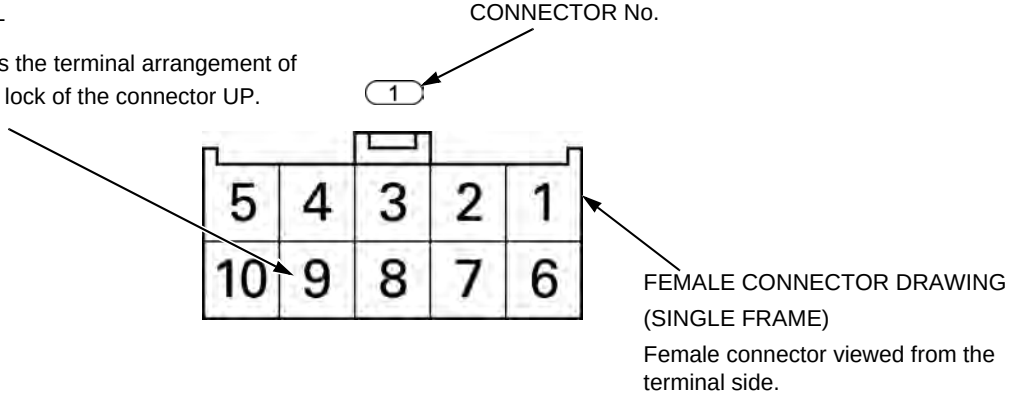
The double frame connectors represent the male connectors and the single frame connectors represent the female connectors.

Both the male and female connectors are shown by viewing them from the terminal side.



TERMINAL ARRANGEMENT

The connector drawing shows the terminal arrangement of the (1) connector with the lock of the connector UP.

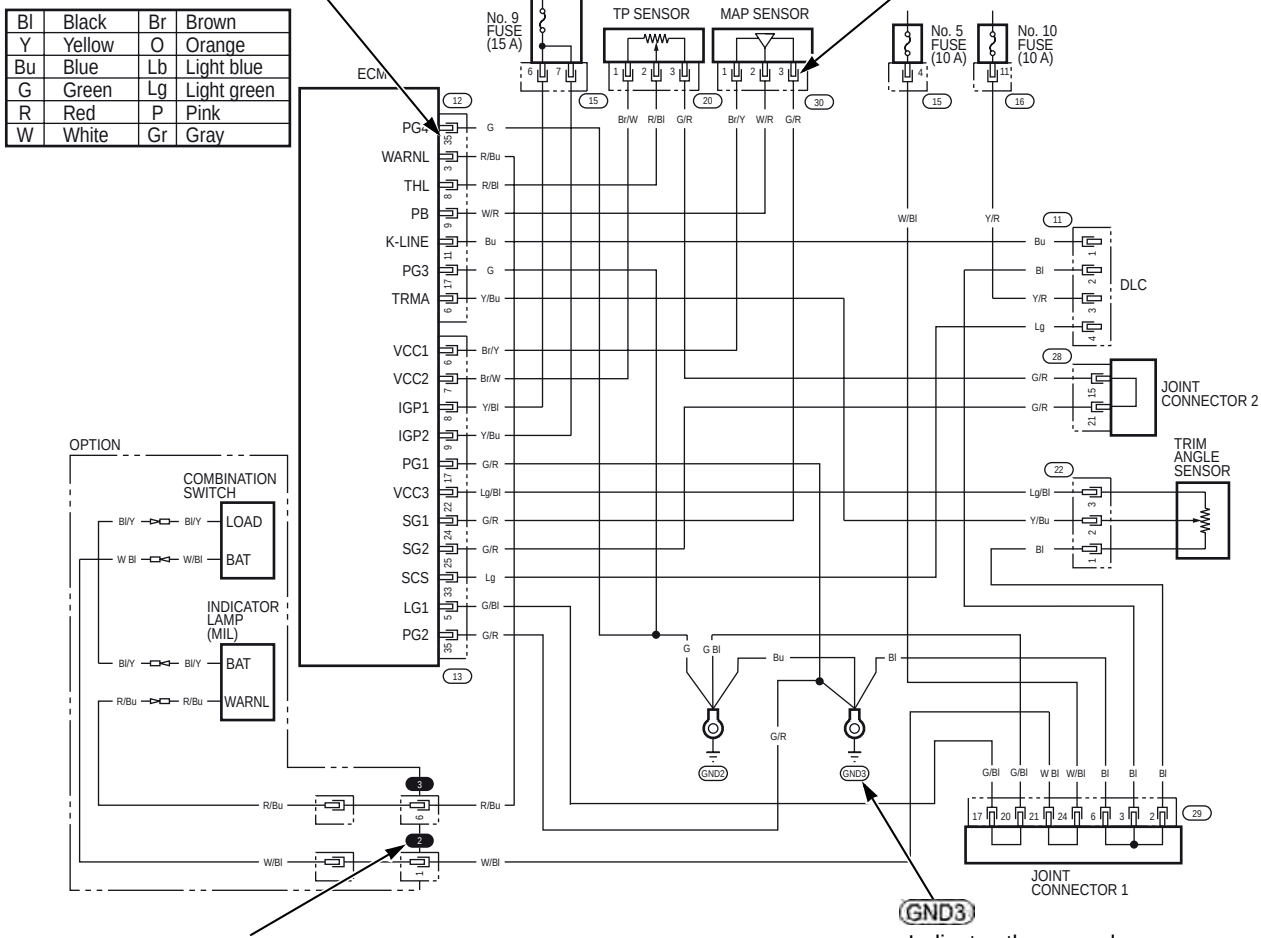


HOW TO READ A WIRING DIAGRAM

SYMBOL OF TERMINAL

It shows the shape of each terminal to identify whether it is a male or female terminal.

TERMINAL No.



CONNECTOR/TERMINAL No.

Every connector and terminal has a number to help the users find the location and shape of the connector and the terminal arrangement by referring to the “Connector general layout drawing” and/or the “Connector drawing.” All the connector/terminal numbers shown in this Service Manual are either of those shown in this section.

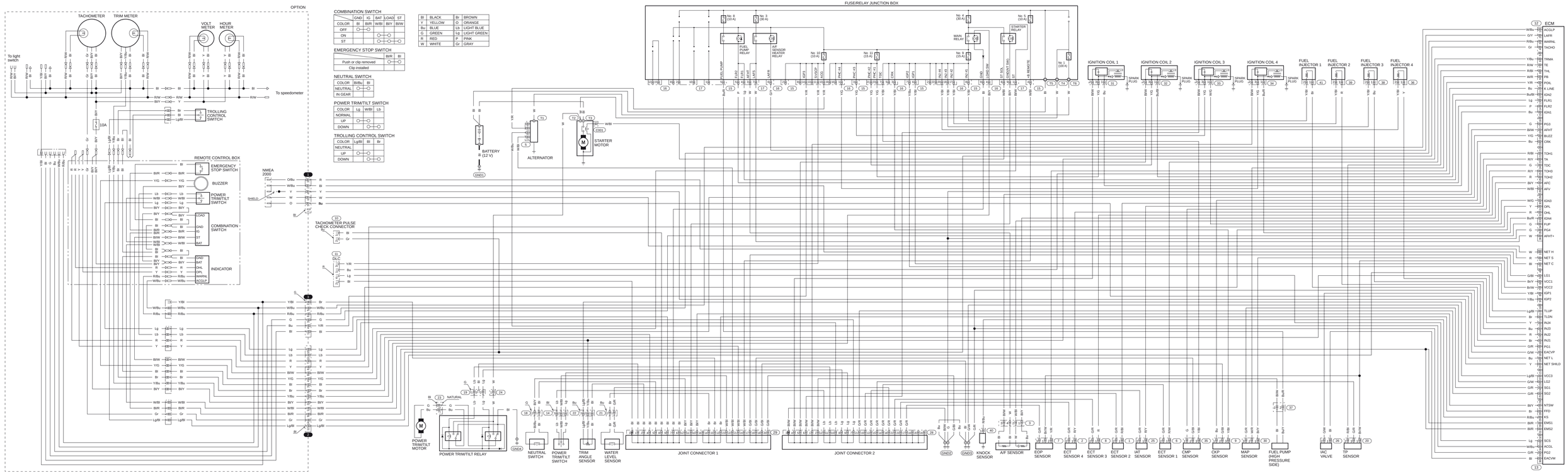
- (1) : Connector that joins a harness to a harness (Circled No. in black background)
- (1) : Connector that connects to electrical equipment (Circled No. in white background)
- (C1) : Connector (Circled C followed with No. in white background)
- (T1) : Terminal (Circled T followed with No. in white background)
- (GND1) : Ground (Circled GND followed with No. in white background)

GND3

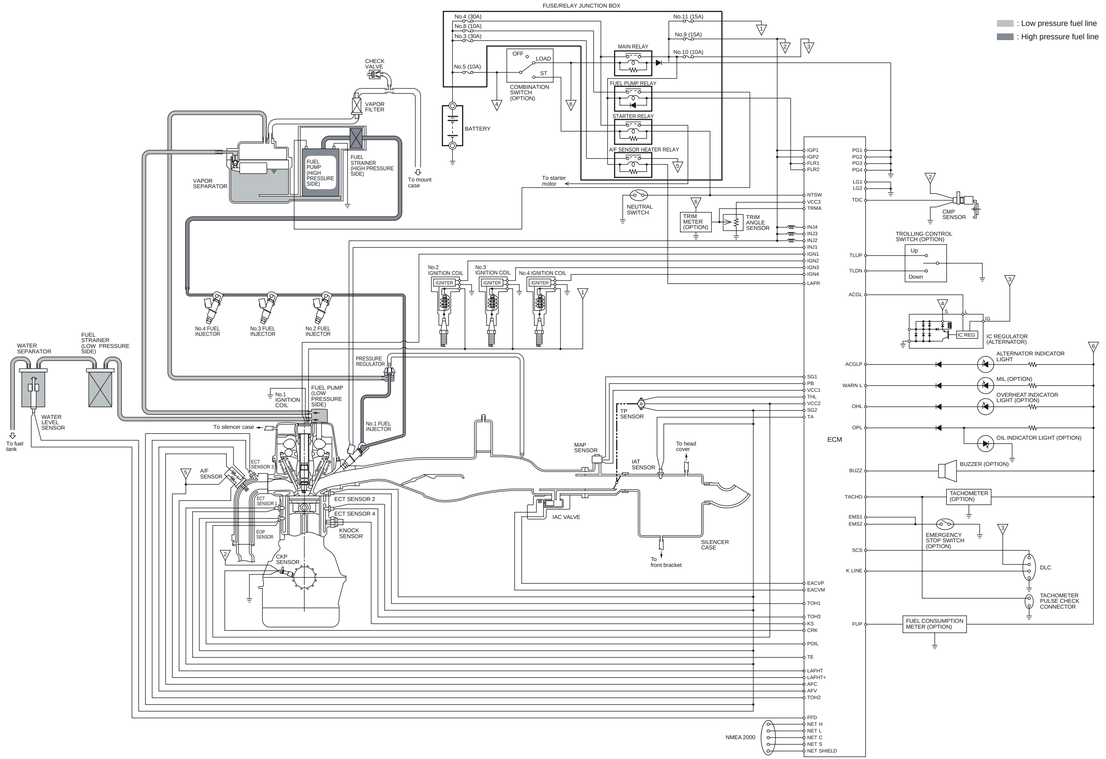
Indicates the ground.
(Circled GND followed with No. in white background)

MEMO

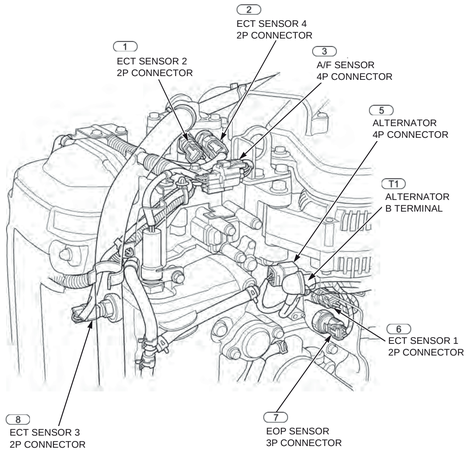
WIRING DIAGRAMS



SYSTEM DIAGRAM



CONNECTOR GENERAL LAYOUT DRAWING



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



Main wire harness side

Terminal number	Wire color
1	R/Bl
2	G/R

2



Main wire harness side

Terminal number	Wire color
1	R/Y
2	G/R

3



Main wire harness side

Terminal number	Wire color
1	Bl/Y
2	W/Bl
3	Bl/W
4	W

3



A/F sensor side

Terminal number	Wire color
1	Bu
2	W
3	Bl
4	Bl

5



Main wire harness side

Terminal number	Wire color
1	Y/R
2	W/Bl
3	W/Bu
4	–

Alternator B terminal

Terminal number	Wire color
T1	W

6



Main wire harness side

Terminal number	Wire color
1	R/W
2	G/R

7



Main wire harness side

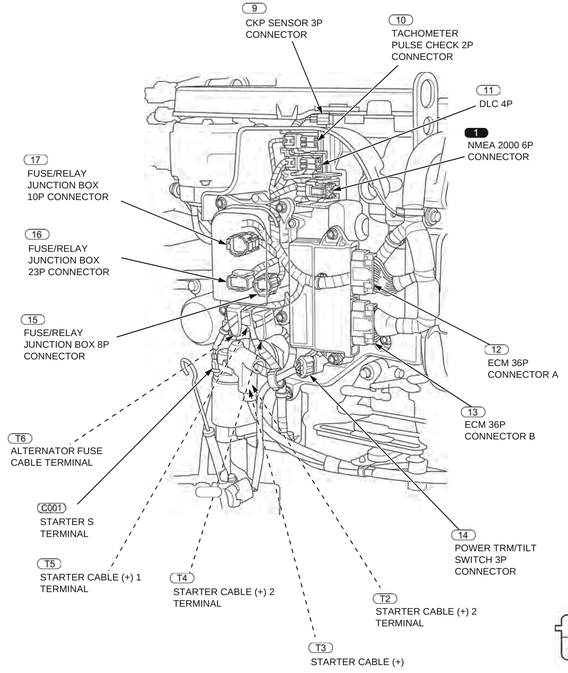
Terminal number	Wire color
1	Br/W
2	Y/R
3	G/R

8



Main wire harness side

Terminal number	Wire color
1	R
2	G/R



9



Main wire harness side

Terminal number	Wire color
1	Bu
2	G/Bl
3	Y/Bl

10



Main wire harness side

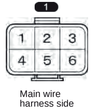
Terminal number	Wire color
1	Bl
2	Gr

11



Main wire harness side

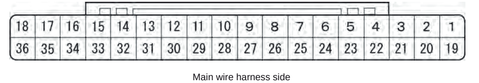
Terminal number	Wire color
1	Bu
2	Bl
3	Y/R
4	Lg



Main wire harness side

Terminal number	Wire color
1	–
2	Bl
3	R
4	Y
5	Bu
6	W

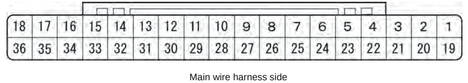
12



Main wire harness side

Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color
1	W/Bu	10	Y/R	19	Y/G	28	W/Bl
2	G/Y	11	Bu	20	Bu	29	–
3	R/Bu	12	Bu/Bl	21	–	30	W/G
4	Gr	13	Lg	22	R/Bl	31	Y
5	–	14	P	23	R/Y	32	R
6	Y/Bu	15	Bu	24	G	33	Bu/R
7	R/W	16	–	25	R/Y	34	G
8	R/Bl	17	G	26	R	35	G
9	W/R	18	Bl/W	27	Bl/Y	36	W

13



Main wire harness side

Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color
1	W	10	–	19	Bu	28	Br
2	R	11	Lg/Bl	20	Y	29	R/Bu
3	Bl	12	Br	21	–	30	Bl/R
4	–	13	Y	22	Lg/Bl	31	Bl/R
5	G/Bl	14	Bu	23	G/W	32	–
6	Br/Y	15	R	24	G/R	33	Lg
7	Br/W	16	Br	25	G/R	34	W/Bu
8	Y/Bl	17	G/R	26	–	35	G/R
9	Y/Bu	18	G/W	27	Bl/Y	36	Bl

14



Main wire harness side

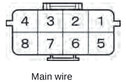
Terminal number	Wire color
1	Lg
2	W/Bl
3	Lb



Power Trm/tilt switch side

Terminal number	Wire color
1	Lg
2	W/Bl
3	Lb

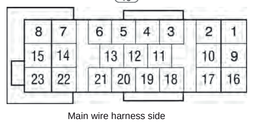
15



Main wire harness side

Terminal number	Wire color
1	–
2	–
3	Y/G
4	W/Bl
5	Bu/R
6	Y/Bl
7	Y/Bu
8	Y/Bl

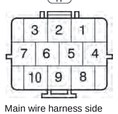
16



Main wire harness side

Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color
1	Y/G	9	Bl	17	Y/Bl
2	–	10	Y/R	18	Y/Bl
3	Y/Bl	11	Y/R	19	–
4	Bl/Y	12	–	20	Y/Bl
5	–	13	–	21	Y/G
6	G/Y	14	Y/R	22	–
7	Y/Bl	15	–	23	Y/G
8	–	16	–		

17



Main wire harness side

Terminal number	Wire color
1	Bl/W
2	–
3	W
4	Lg
5	P
6	W/Bl
7	W
8	–
9	Bl/Y
10	–

Starter cable (+) 2 terminal

Terminal number	Wire color
T2	W

Starter cable (+) 1 terminal

Terminal number	Wire color
T5	Bl

Starter cable (+)

Terminal number	Wire color
T3	Bl

Alternator fuse cable terminal

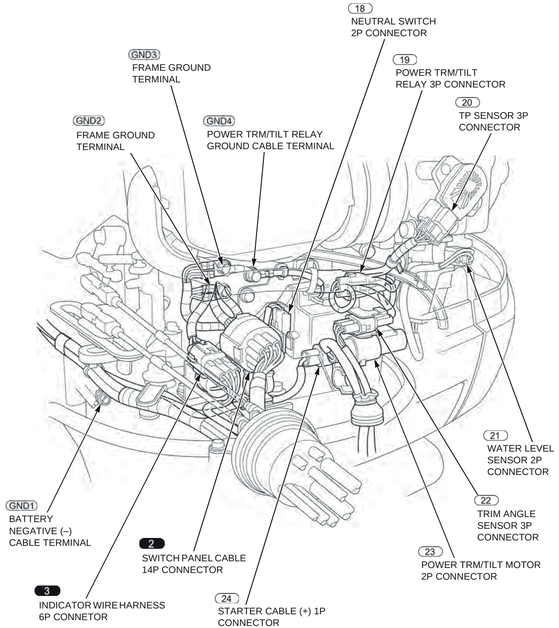
Terminal number	Wire color
T6	W

Starter cable (+) 2 terminal

Terminal number	Wire color
T4	W

Starter S terminal

Terminal number	Wire color
C001	W/Bl



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

Battery negative (–) cable terminal

Terminal number	Wire color
GND1	Bl

Ground cable tarminals

Terminal number	Wire color
GND2	Bl/W
	Bu
	G/Bl
	G
GND3	Bl
	Bu
	G/W
	G/R

Power trm/tilt relay ground cable terminal

Terminal number	Wire color
GND4	Bl



Main wire harness side

Terminal number	Wire color
1	Bl
2	Bl/Y



Neutral switch side

Terminal number	Wire color
1	Bl
2	Bl/Bu



Main wire harness side

Terminal number	Wire color
1	Lb
2	Lg
3	Bl



Power trm/tilt relay side

Terminal number	Wire color
1	Lb
2	Lg
3	-



Main wire harness side

Terminal number	Wire color
1	Br/W
2	R/Bl
3	G/R



Main wire harness side

Terminal number	Wire color
1	G/R
2	Br



Water level sensor side

Terminal number	Wire color
1	G/R
2	Br



Main wire harness side

Terminal number	Wire color
1	Bl
2	Y/Bu
3	Lg/Bl



Trim angle sensor side

Terminal number	Wire color
1	Bl
2	Y/Bu
3	Lg/Bl



Power trm/tilt relay side

Terminal number	Wire color
1	G
2	Bu



Power trm/tilt motor side

Terminal number	Wire color
1	G
2	Bu



Stater cable side

Terminal number	Wire color
1	W



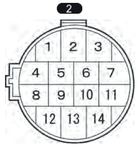
Power trim/tilt relay side

Terminal number	Wire color
1	W



Main wire harness side

Terminal number	Wire color
1	W/Bl
2	Bl/Y
3	Bl
4	Y/G
5	Y/Bu
6	Y
7	R
8	Bl/W
9	Bl/R
10	Lg
11	Lb
12	Lg/Bl
13	Br
14	Gr



Switch panel cable side

Terminal number	Wire color
1	W/Bl
2	Bl/Y
3	Bl
4	Y/G
5	Y/Bu
6	Y
7	R
8	Bl/W
9	Bl/R
10	Lg
11	Lb
12	Lg/Bl
13	Br
14	Gr



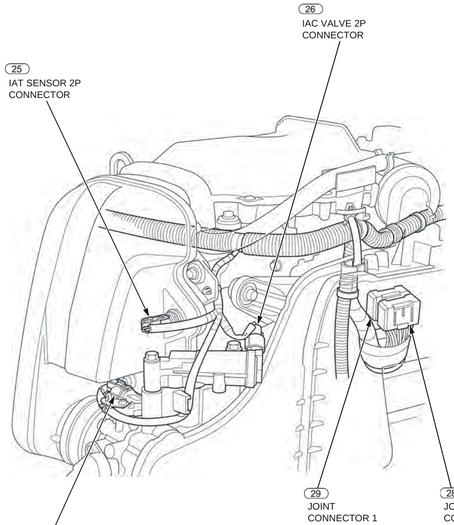
Main wire harness side

Terminal number	Wire color
1	Bl
2	Br
3	G
4	Y/R
5	W/Bu
6	R/Bu



Indicator wire harness side

Terminal number	Wire color
1	Bl
2	Y/Bl
3	G
4	Bu
5	W/Bu
6	R/Bu





Main wire harness side

Terminal number	Wire color
1	R/Y
2	G/R



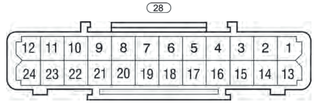
Main wire harness side

Terminal number	Wire color
1	Bl
2	G/W



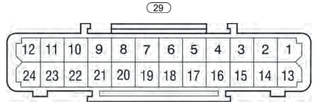
Main wire harness side

Terminal number	Wire color
1	Br/Y
2	W/R
3	G/R



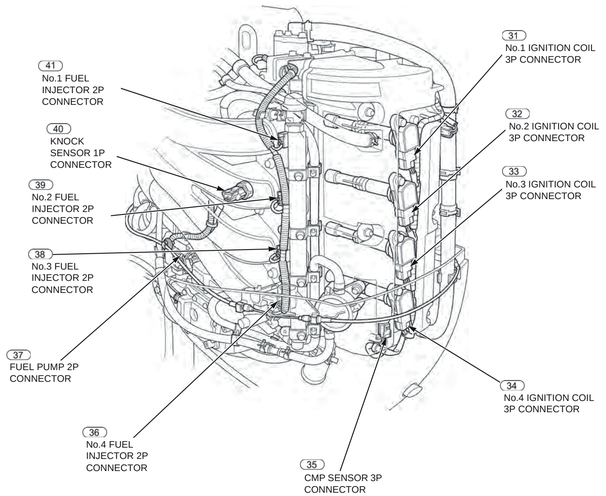
Main wire harness side

Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color
1	Bl/W	7	Lg	13	G/R	19	G/R
2	Bl/W	8	Lg	14	G/R	20	–
3	Bl/W	9	Lg	15	G/R	21	G/R
4	Bl/W	10	Lb	16	–	22	G/R
5	Bl/W	11	Lb	17	G/R	23	G/R
6	Bl/W	12	Lb	18	G/R	24	–



Main wire harness side

Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color	Terminal number	Wire color
1	Bl	7	Bl	13	Br	19	G/Bl
2	Bl	8	Bl	14	Br	20	G/Bl
3	Bl	9	Bl	15	Br	21	W/Bl
4	Bl	10	Bl/Y	16	–	22	W/Bl
5	Bl	11	Bl/Y	17	G/Bl	23	W/Bl
6	Bl	12	Bl/Y	18	G/Bl	24	W/Bl



31



Main wire harness side

Terminal number	Wire color
1	Bu
2	Bl/W
3	Y/G

32



Main wire harness side

Terminal number	Wire color
1	Bu/Bl
2	Bl/W
3	Y/G

33



Main wire harness side

Terminal number	Wire color
1	W/G
2	Bl/W
3	Y/G

34



Main wire harness side

Terminal number	Wire color
1	Bu/R
2	Bl/W
3	Y/G

35



Main wire harness side

Terminal number	Wire color
1	G
2	G/Bl
3	Y/Bl

36



Main wire harness side

Terminal number	Wire color
1	Y
2	Y/Bl

37



Main wire harness side

Terminal number	Wire color
1	Bl/W
2	Bu/R

38



Main wire harness side

Terminal number	Wire color
1	Bu
2	Y/Bl

39



Main wire harness side

Terminal number	Wire color
1	R
2	Y/Bl

40



Main wire harness side

Terminal number	Wire color
1	R/Bu

41



Main wire harness side

Terminal number	Wire color
1	Br
2	Y/Bl

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TOHATSU
Outboards

SERVICE MANUAL

4 Stroke
BFT115A
Models

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14-01 NB
Printed in Japan