YAMAHA

F300A
FL300A
F350A
FL350A

SERVICE MANUAL

6BJ-28197-3K-11

NOTICE

This manual has been prepared by Yamaha primarily for use by Yamaha dealers and their trained mechanics when performing maintenance procedures and repairs to Yamaha equipment. It has been written to suit the needs of persons who have the Bronze Technical Certificate of YTA (Yamaha Technical Academy) marine or the equivalent basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Yamaha has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Yamaha dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

Important information

Particularly important information is distinguished in this manual by the following notations:

⚠ The Safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the machine operator, a bystander, or a person inspecting or repairing the outboard motor.

CAUTION:

A CAUTION indicates special precautions that must be taken to avoid damage to the outboard motor.

NOTE:

A NOTE provides key information to make procedures easier or clearer.

F300A, FL300A, F350A, FL350A
SERVICE MANUAL

2nd Edition, January 2013

Printed in China

Contents

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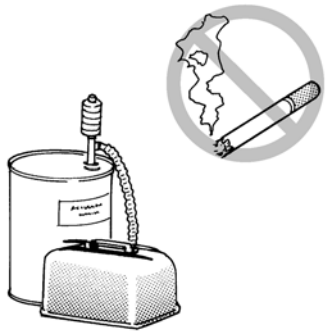
General information

Safety while working

To prevent an accident or injury and to ensure quality service, follow the safety procedures provided below.

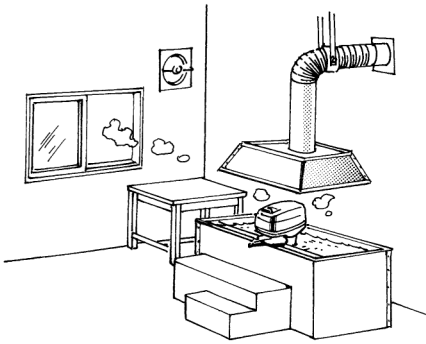
Fire prevention

Gasoline is highly flammable.
Keep gasoline and all flammable products away from heat, sparks, and open flames.


S69J1010

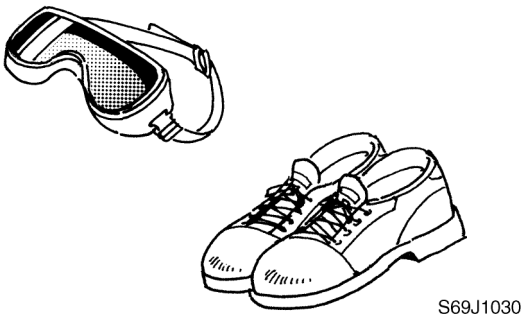
Ventilation

Gasoline vapor and exhaust gas are heavier than air and extremely poisonous. If inhaled in large quantities they may cause loss of consciousness and death within a short time. When test running an engine indoors (e.g., in a water tank) be sure to do so where adequate ventilation can be maintained.


S69J1020

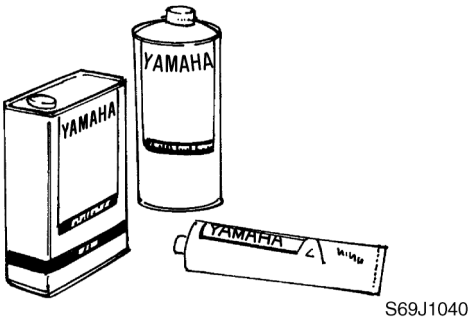
Self-protection

Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.


S69J1030

Part, lubricant, and sealant

Use only genuine Yamaha parts, lubricants, and sealants or those recommended by Yamaha, when servicing or repairing the outboard motor.



S69J1040

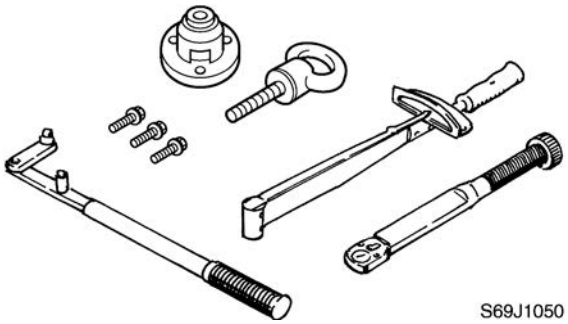
Under normal conditions, the lubricants mentioned in this manual should not harm or be hazardous to your skin. However, you should follow these precautions to minimize any risk when working with lubricants.

1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water after contact with a lubricant or lubricant soiled clothing has been made.
5. To protect your skin, apply a protective cream to your hands before working on the outboard motor.

6. Keep a supply of clean, lint-free cloths for wiping up spills, etc.

Special service tool

Use the recommended special service tools to protect parts from damage. Use the right tool in the right manner—do not improvise.



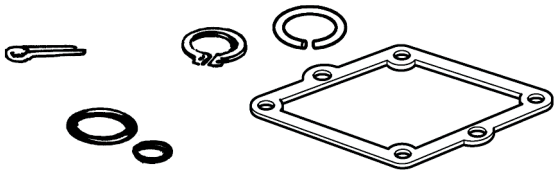
S69J1050

Tightening torque

Follow the tightening torque specifications provided throughout the manual. When tightening nuts, bolts, and screws, tighten the large sizes first, and tighten fasteners starting in the center and moving outward.

Non-reusable part

Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.

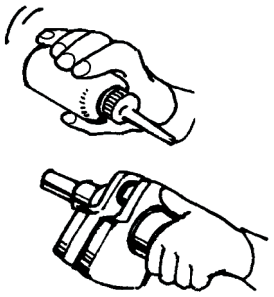


S69J1060

Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.

2. Apply engine oil to the contact surfaces of moving parts before assembly.



S69J1070

3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.

4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.

5. Check that moving parts operate normally after assembly.

How to use this manual

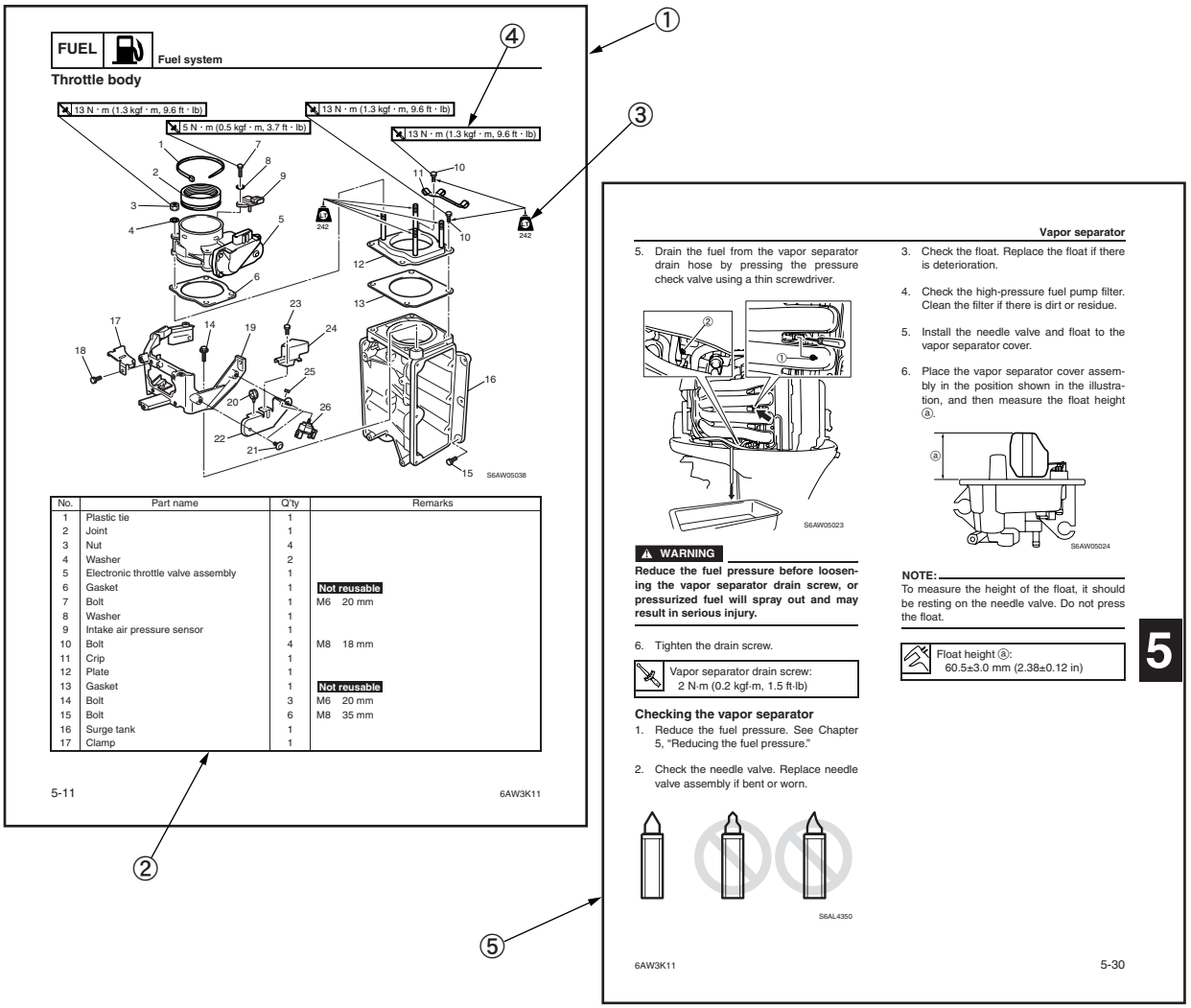
Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the information below as a guide for effective and quality service.

- Parts are shown and detailed in an exploded diagram and are listed in the component list (see ① in the figure below for an example page).
- The component list consists of part names and quantities, as well as bolt and screw dimensions (see ② in the figure below).
- Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and lubrication point (see ③ in the figure below).
- Tightening torque specifications are provided in the exploded diagrams (see ④ in the figure below for an example), and in the related detailed instructions. Some torque specifications are listed in stages as torque figures or angles in degrees.
- Separate procedures and illustrations are used to explain the details of removal, checking, and installation where necessary (see ⑤ in the figure below for an example page).

NOTE:

For troubleshooting procedures, see Chapter 4, “Troubleshooting.”

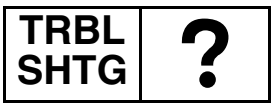


Symbol

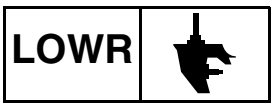
The symbols below are designed to indicate the content of a chapter.

General information

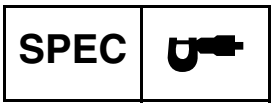
Troubleshooting



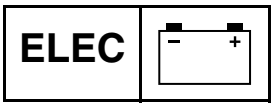
Lower unit



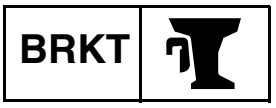
Specification



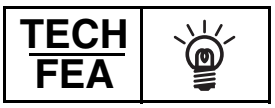
Electrical system



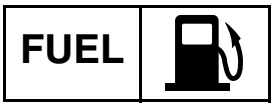
Bracket unit



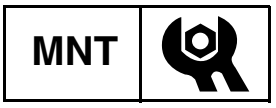
Technical features and description



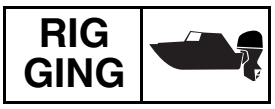
Fuel system



Maintenance

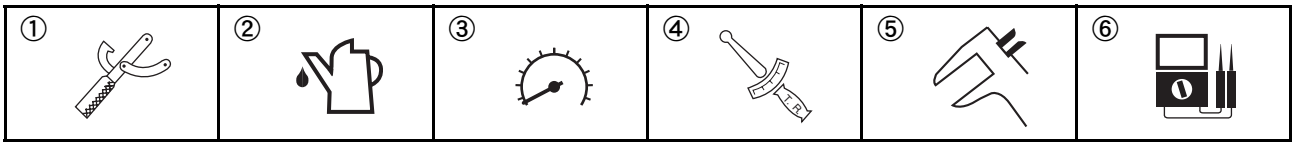


Rigging information



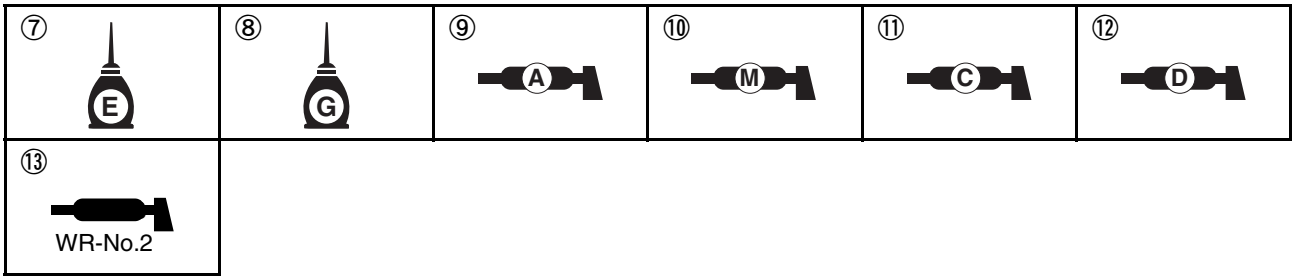
Power unit

Symbols ① to ⑥ indicate specific data.



① Special service tool
② Specified oil or fluid
③ Specified engine speed
④ Specified tightening torque
⑤ Specified measurement
⑥ Specified electrical value (resistance, voltage, electric current)

Symbols ⑦ to ⑬ in an exploded diagram and text indicate the grade of lubricant and the lubrication point.



⑦ Apply Yamaha 4-stroke motor oil
⑧ Apply gear oil
⑨ Apply water resistant grease (Yamaha grease A)
⑩ Apply molybdenum disulfide grease
⑪ Apply low temperature resistant grease (Yamaha grease C)
⑫ Apply corrosion resistant grease (Yamaha grease D)
⑬ Apply WR-No.2 grease

Symbols ⑭ to ㉓ in an exploded diagram and text indicate the type of sealant or locking agent and the application point.

⑭ 1208B	⑮ 1207D	⑯ 1322	⑰ 1386B	⑱ 1104J	⑲ LT 518
⑳ LT 271	㉑ LT 242	㉒ LT 572	㉓ SS		

⑭ Apply ThreeBond 1208B
⑮ Apply ThreeBond 1207D
⑯ Apply ThreeBond 1322
⑰ Apply ThreeBond 1386B
⑱ Apply ThreeBond 1104J
⑲ Apply LOCTITE 518 (red)
⑳ Apply LOCTITE 271 (red)
㉑ Apply LOCTITE 242 (blue)
㉒ Apply LOCTITE 572 (white)
㉓ Apply silicon sealant

Abbreviation

The following abbreviations are used in this service manual.

Abbreviation	Description
ABYC	American Boat and Yacht Council
AFT	Aft end
API	American Petroleum Institute
AWG	American Wire Gauge
BOW	Bow end
CA	Crank Angle
CCA	Cold Cranking Ampere
C/E	Check Engine
DN	Down side
ECM	Electronic Control Module
EN	European Norm (European standard)
ENG	Engine
ETV	Electronic Throttle Valve
EX	Exhaust
EXH	Exhaust
ID	Identification
IDM	Ionic current Detection Module
IEC	International Electro-technical Commission
IN	Intake
INT	Intake
ION	Ionic Current
ISC	Idle Speed Control
LPS	Lever Position Sensor
M.E.S.	Multi Engine System
OCV	Oil Control Valve
PCV	Pressure Control Valve
PON	Pump Octane Number = (RON + Motor Octane Number)/2

Abbreviation	Description
PORT	Port side
PTT	Power Trim and Tilt
RON	Research Octane Number
R.C.	Remote Control (Digital Electronic Control)
SAE	Society of Automotive Engineers
SM	Service Manual
SPS	Shift Position Sensor
STBD	Starboard side
STERN	Stern side
TDC	Top Dead Center
TPS	Throttle Position Sensor
UP	Upside
VCT	Variable Camshaft Timing
W/F	Water in Fuel
YDIS	Yamaha Diagnostic System

Model features

General feature

F300A/FL300A and F350A/FL350A OVERALL FEATURES;

- Electronic fuel injection, 60° V8, DOHC, 32-valves, VCT, 5,330 cm^3 (325.2 cu. in) engine
- Use of common components between F150 and F350
- Electro deposition treatment for durability
- Easy startability and drivability
- Low noise and vibration
- Low emission in compliance with EPA 2008, CARB 3 STARS and EU1 regulations
- Digital Electronic Control system and 6Y8 Multifunction Meters for easy rigging and precision control

A Power unit

- VCT (for intake valve)
- Flywheel installed with 6 bolts
- Crankshaft with drive sprocket
- Forged piston with molybdenum coating
- Crankcase cooler, fuel cooler
- Vapor gas treatment system
- Modularized fuel system components
- Dual exhaust passages and divided exhaust manifold
- One piece top cowl with large water separator and roller locks
- Exclusive engine lifting eye
- Simple rigging grommet

B Electrical

- Electronic Fuel Injection (Multi-point and Sequential injection)
- Digital Electronic Control and gauge system
- New YDIS 1.30 version
- Tilt-up limiter settings by YDIS 1.30
- Sequential direct ignition
- Ionic current detection module for knock control
- Water-cooled Rectifier Regulator and isolator
- Water detection alert system
- Multi-engine system for alert mode and auto engine speed synchronization
- Adjusting trolling speed function

C Bracket unit

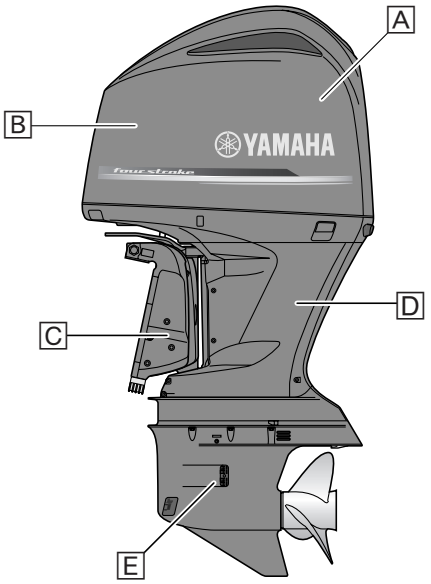
- Large clamp bracket with 6 mounting holes.
- New PTT unit to deal with additional power
- Selectable 3 full tilt-up positions

D Upper case

- Dual idle silencers
- Oil pan capacity 8.0 L (8.45 US qt, 7.04 lmp qt)
- Water-wall cooling system around muffler

E Lower unit

- Dual water inlets and large water pump
- Flat key for water pump impeller. Big drive unit
- Large exclusive propeller (Saltwater series XL)
- Reliable thrust receiver structure
- Drive shaft free play reduction structure
- Exhaust pressure reduction and prop damper cooling system (same as F250)



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Model designation

F 350 A E T X

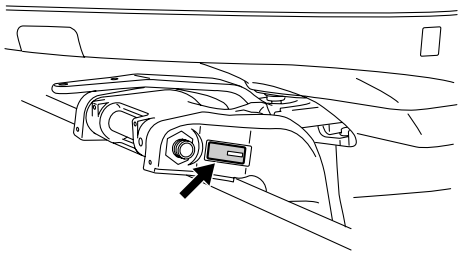
① ② ③ ④ ⑤ ⑥

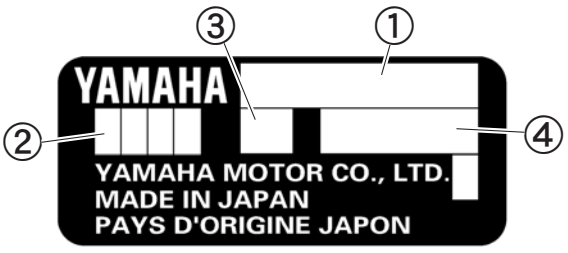
①	Model Description	F : 4-stroke regular rotation FL: 4-stroke counter rotation
②	Prop Shaft Horsepower	300: 300 HP 350: 350 HP
③	Product Generation	A: A and up
④	Functions	E: Electric starter
⑤		T: Power trim and tilt
⑥	Transom Height	X: UL (25 in) U: SUL (30 in)

Serial number

The outboard motor serial number is stamped on a label attached to the port clamp bracket.

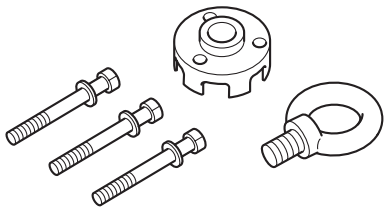
Model name	Approved model code	Starting serial No.
F300AET	6BJ	1000001–
FL300AET	6BK	1000001–
F350AET	6AW	1000001–
FL350AET	6AX	1000001–



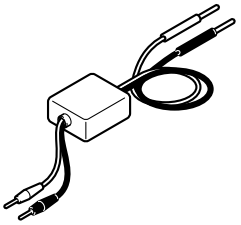


① Model name
② Approved model code
③ Transom height
④ Serial number

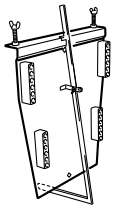
Special service tool



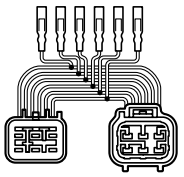
Engine lifting eye
90890-06820



Peak voltage adapter B
90890-03172

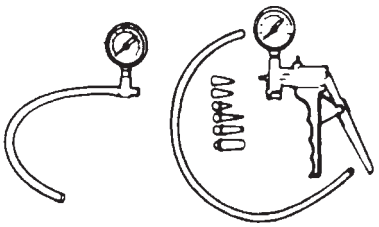


Drilling plate
90890-06783

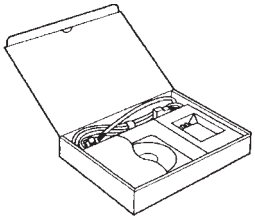


Test harness (6 pins)
90890-06872

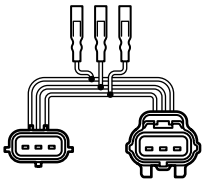
YDIS (CD-ROM, Ver. 1.30)
60V-WS853-04



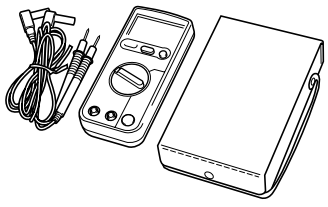
Vacuum/pressure pump gauge set
90890-06756



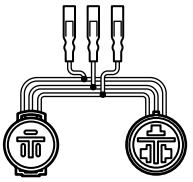
YDIS (KIT)
60V-85300-04



Test harness (3 pins)
90890-06869



Digital circuit tester
90890-03174



Test harness (3 pins)
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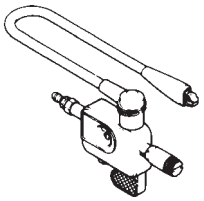
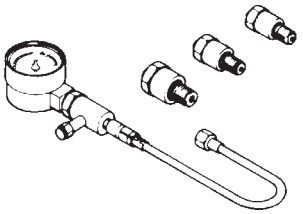
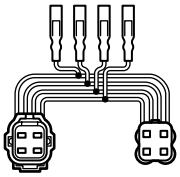


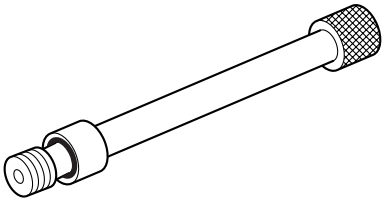
Ignition tester
90890-06754



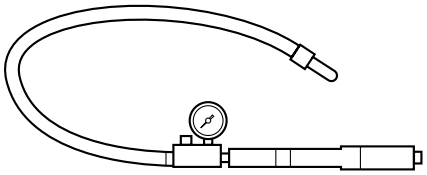
Compression gauge
90890-03160



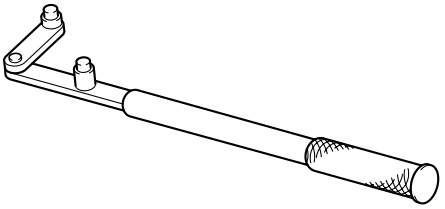
Test harness (4 pins)
90890-06878



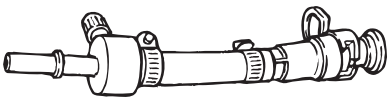
Compression gauge extension
90890-06563



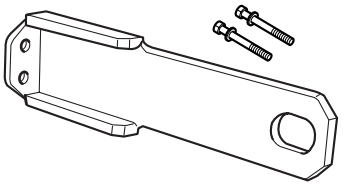
Leakage tester
90890-06840



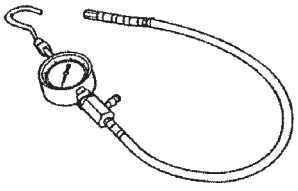
Flywheel holder
90890-06522



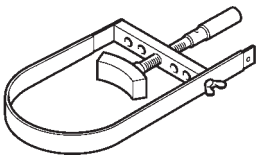
Fuel pressure gauge adapter
90890-06842



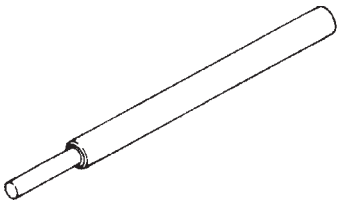
Balance hangar
90890-06822



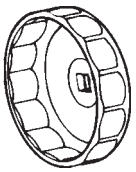
Fuel pressure gauge
90890-06786



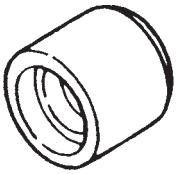
Sheave holder
90890-01701



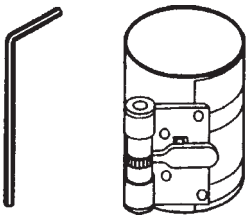
Valve guide remover
90890-06801



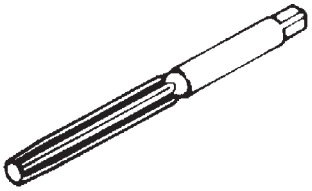
Oil filter wrench
90890-06830



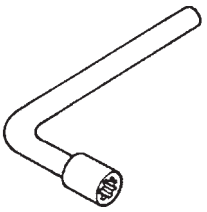
Valve guide installer
90890-06810



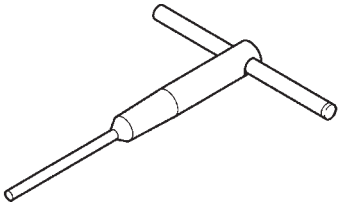
Piston ring compressor
90890-05158



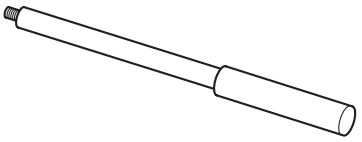
Valve guide reamer
90890-06804



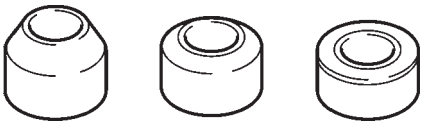
Shift rod push arm
90890-06052



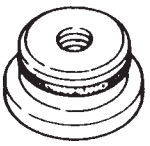
Valve seat cutter holder
90890-06316



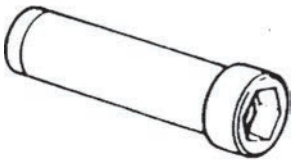
Driver rod L3
90890-06652



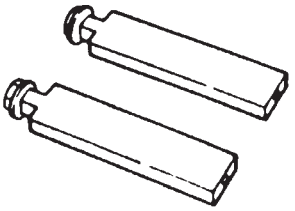
Valve seat cutter
90890-06324, 90890-06325, 90890-06326,
90890-06816, 90890-06817



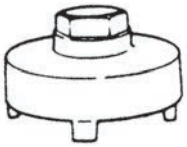
Needle bearing attachment
90890-06607, 90890-06653, 90890-06654



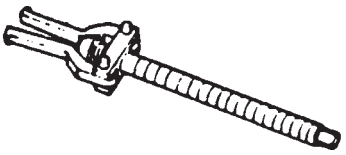
Ring nut wrench extension 2
90890-06784



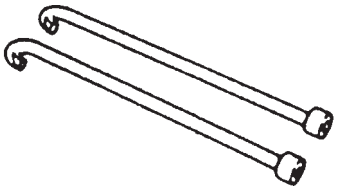
Stopper guide stand
90890-06538



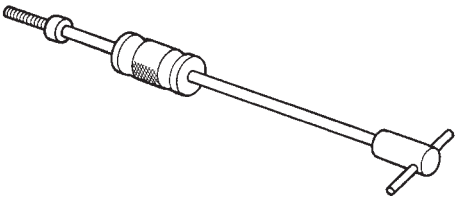
Ring nut wrench 2
90890-06823



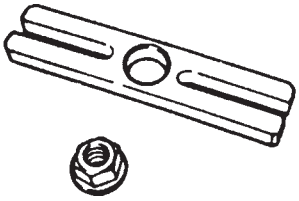
Bearing puller assembly
90890-06535



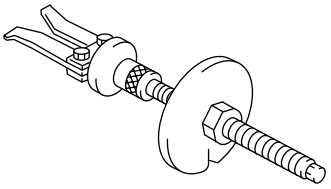
Bearing housing puller claw L
90890-06502



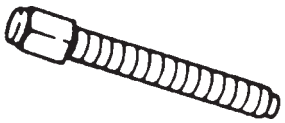
Slide hammer
90890-06531



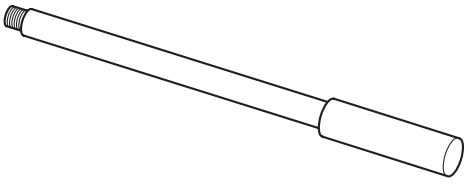
Stopper guide plate
90890-06501



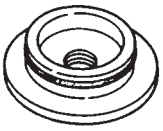
Bearing outer race puller assembly
90890-06523



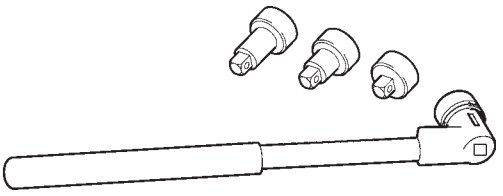
Center bolt
90890-06504



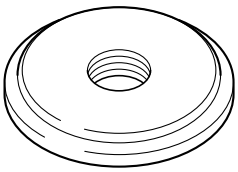
Driver rod LL
90890-06605



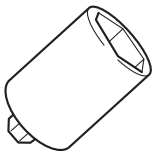
Ball bearing attachment
90890-06632



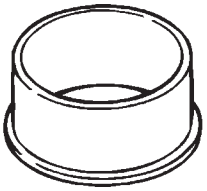
Pinion nut holder
90890-06715



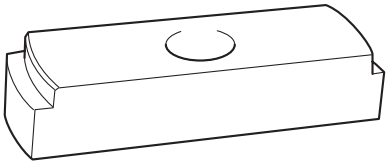
Bearing outer race attachment
90890-06622, 90890-06628



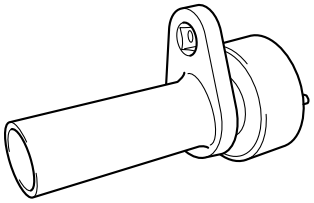
Socket adapter
90890-06831



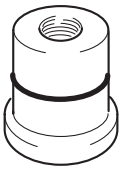
Bearing inner race attachment
90890-06640, 90890-06659, 90890-06662



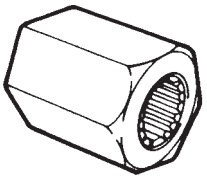
Holder guide
90890-06834



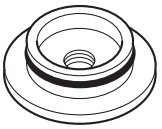
Ring nut wrench
90890-06833



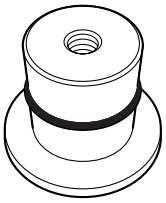
Needle bearing attachment
90890-06665



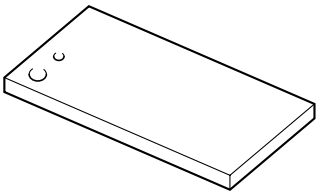
Drive shaft holder 8
90890-06832



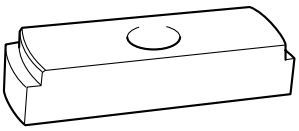
Needle bearing attachment
90890-06839



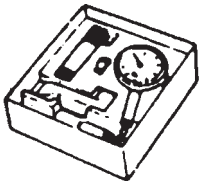
Needle bearing attachment
90890-06664



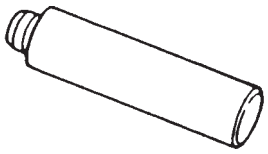
Magnet base plate
90890-07003



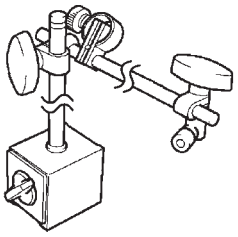
Stopper guide plate
90890-06667



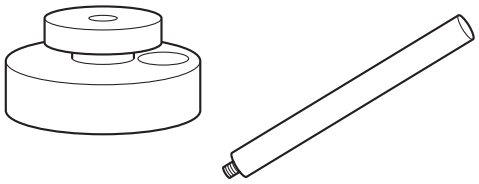
Dial gauge set
90890-01252



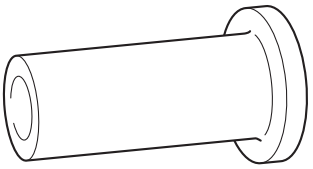
Driver rod LS
90890-06606



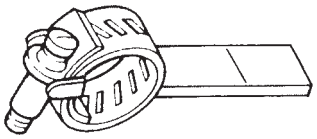
Magnet base B
90890-06844



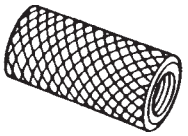
Pinion shimming gauge
90890-06835



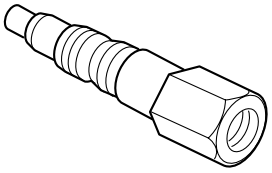
Ring nut extension
90890-06666



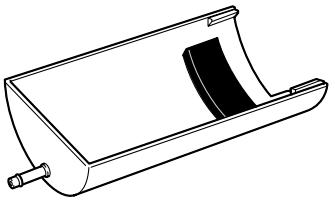
Backlash indicator
90890-06836



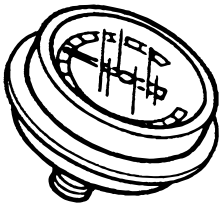
Puller head
90890-06514



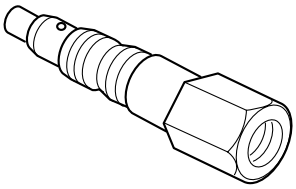
UP-relief fitting
90890-06838



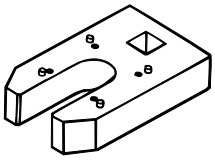
Oil filter tray
90890-06845



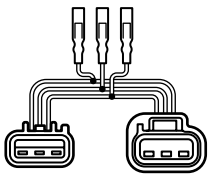
Hydraulic pressure gauge
90890-06776, 90890-06800



Down-relief fitting
90890-06774



Cylinder-end screw wrench
90890-06837



Test harness (3 pins)
90890-06791

Specification

Model data

Dimension and Weight

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Dimension					
Overall length	mm (in)	1,029 (40.5)			
Overall width	mm (in)	633 (24.9)			
Overall height					
(X)	mm (in)	2,006 (79.0)			
(U)	mm (in)	2,133 (84.0)			
Boat transom height					
(X)	mm (in)	635 (25.0)			
(U)	mm (in)	762 (30.0)			
Weight					
(without propeller)					
(X)	kg (lb)	365.0 (804)			
(U)	kg (lb)	373.0 (822)			

Performance

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Maximum output	kW (HP)	220.7 (300) at 5,500 r/min		257.4 (350) at 5,500 r/min	
Full throttle operating range	r/min	5,000–6,000			
Maximum fuel consumption	L (US gal, Imp gal)/hr	103.2 (27.3, 22.7) at 6,000 r/min		120.0 (31.7, 26.4) at 6,000 r/min	
Engine idle speed	r/min	600–700			

Power unit

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Type		4-stroke, DOHC V			
Cylinder quantity		8			
Total displacement	cm^3 (cu. in)	5,330 (325.2)			
Bore × stroke	mm (in)	94.0 × 96.0 (3.70 × 3.78)			
Compression ratio		9.6 : 1			
Control system		Digital Electronic Control			
Starting system		Electric			
Fuel system		Fuel injection			
Ignition control system		TCI			
Advance type		Micro computer			
Maximum generator output	V, A	12, 50			
Spark plug		LFR6A-11 (NGK)			
Firing order		1–8–4–3–6–5–7–2 (Normal operation)			
Cooling system		Water			
Exhaust system		Propeller boss			
Lubrication system		Wet sump			

Fuel and oil

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Fuel type		Regular unleaded gasoline		Premium unleaded gasoline	
Fuel minimum rating	RON	91		94	
	PON	85		89	
Engine oil		4-stroke motor oil			
Engine oil grade(*1)	API	SE, SF, SG, SH, SJ, or SL			
	SAE	5W-30, 10W-30, 10W-40 or 20W-40			
Engine oil capacity (oil pan capacity)					
Without oil filter	L (US qt, Imp qt)	7.8 (8.24, 6.86)			
With oil filter	L (US qt, Imp qt)	8.0 (8.45, 7.04)			
Gear oil type		Hypoid gear oil			
Gear oil grade(*2)	API	GL-5			
	SAE	90, 80W-90			
Gear oil quantity	cm^3 (US oz, Imp oz)	1,520 (51.4, 53.5)	1,310 (44.3, 46.1)	1,520 (51.4, 53.5)	1,310 (44.3, 46.1)

(*1) If the recommended engine oil grades are not available, use engine oil with an SAE classification of 15W-40, 20W-40, or 20W-50 and an API classification of SH, SJ, or SL.
(*2) Meeting both API and SAE requirements

Electrical

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Recommended battery(*1)					
Minimum cold cranking amps CCA/EN	A	670			
Minimum rated capacity 20HR/IEC	Ah	110			

(*1) See “Rigging recommendations” (3-25) for other types of batteries.

Bracket unit

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Trim angle (at 12° boat transom)	Degree	–3 to 15			
Tilt-up angle	Degree	70			
Steering angle	Degree	32 + 32			

Lower unit

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Gear shift positions		F-N-R			
Gear ratio		1.73 (26/15)			
Reduction gear type		Spiral bevel gear			
Clutch type		Dog clutch			
Propeller shaft type		Spline			
Propeller direction (aft view)		Clock-wise	Counter clockwise	Clock-wise	Counter clockwise
Propeller mark		X	XL	X	XL

Power unit technical data

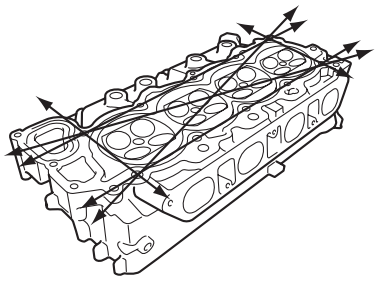
Power unit

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Minimum compression pressure(*1)	kPa (kgf/cm^2, psi)	740 (7.4, 107.3)			
Oil pressure(*2) at 600–700 r/min	kPa (kgf/cm^2, psi)	480 (4.8, 69.6)			
Oil pressure sensor input voltage (reference data)	V	5.0			
Oil pressure output voltage at 600–700 r/min (reference data)	V	3.0			
Amount of adding engine oil (at periodic maintenance)					
Without oil filter	L (US qt, Imp qt)	6.3 (6.66, 5.54)			
With oil filter	L (US qt, Imp qt)	6.5 (6.87, 5.72)			

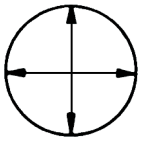
(*1) Measuring conditions:
Ambient temperature is 20 °C (68 °F), Digital Electronic Control is in the neutral position, and spark plugs removed from all cylinders.
The figures are for reference only.

(*2) For details of the checking method, see “Checking the oil pressure” (7-2).
The figures are for reference only.

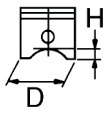
Cylinder head

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Warpage limit  (lines indicate straightedge position)	mm (in)	0.1 (0.0039)			
Camshaft cap inside diameter	mm (in)	25.000–25.021 (0.9843–0.9851)			

Cylinder

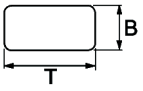
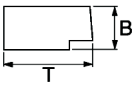
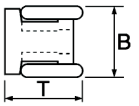
Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Bore size 	mm (in)	94.000–94.017 (3.7008–3.7014)			

Piston

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Piston diameter (D) 	mm (in)	93.921–93.941 (3.6977–3.6985)			
Measuring point (H)	mm (in)	11.5 (0.45)			
Piston clearance(*1)	mm (in)	0.075–0.080 (0.0030–0.0031)			
Piston ring groove					
Top ring	mm (in)	1.22–1.25 (0.048–0.049)			
Second ring	mm (in)	1.22–1.24 (0.048–0.049)			
Oil ring	mm (in)	2.51–2.53 (0.099–0.100)			

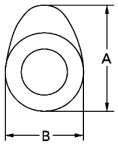
(*1) The figures are for reference only.

Piston ring

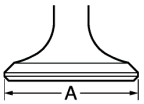
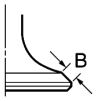
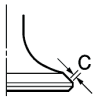
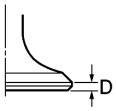
Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Top ring					
Dimension B 	mm (in)	1.170–1.185 (0.046–0.047)			
Dimension T	mm (in)	2.80–3.00 (0.110–0.118)			
End gap(*1)	mm (in)	0.20–0.30 (0.008–0.012)			
Side clearance	mm (in)	0.03–0.08 (0.001–0.003)			
2nd piston ring					
Dimension B 	mm (in)	1.17–1.19 (0.046–0.047)			
Dimension T	mm (in)	3.70–3.90 (0.146–0.154)			
End gap(*1)	mm (in)	0.30–0.45 (0.012–0.018)			
Side clearance	mm (in)	0.03–0.07 (0.001–0.003)			
Oil ring					
Dimension B 	mm (in)	2.40–2.47 (0.094–0.097)			
Dimension T	mm (in)	2.30–2.70 (0.091–0.106)			
End gap(*1)	mm (in)	0.15–0.60 (0.006–0.024)			
Side clearance	mm (in)	0.04–0.13 (0.002–0.005)			

(*1) The figures are for reference only.

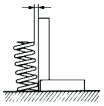
Camshaft

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Intake (A) 	mm (in)	45.95–46.05 (1.809–1.813)			
Exhaust (A)	mm (in)	45.35–45.45 (1.785–1.789)			
Intake and exhaust (B)	mm (in)	35.95–36.05 (1.415–1.419)			
Camshaft journal diameter	mm (in)	24.96–24.98 (0.9826–0.9834)			
Camshaft runout limit	mm (in)	0.03 (0.0012)			

Valve

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Valve clearance (cold)					
Intake	mm (in)	0.20 ± 0.03 (0.008 ± 0.001)			
Exhaust	mm (in)	0.34 ± 0.03 (0.013 ± 0.001)			
Head diameter (A) 					
Intake	mm (in)	36.4–36.6 (1.43–1.44)			
Exhaust	mm (in)	31.4–31.6 (1.24–1.24)			
Face width (B) 					
Intake	mm (in)	2.35–2.78 (0.092–0.110)			
Exhaust	mm (in)	2.14–3.28 (0.084–0.130)			
Seat contact width (C) 					
Intake	mm (in)	1.10–1.40 (0.043–0.055)			
Exhaust	mm (in)	1.40–1.70 (0.055–0.067)			
Margin thickness (D) 					
Intake	mm (in)	0.50–0.90 (0.020–0.035)			
Exhaust	mm (in)	0.90–1.30 (0.035–0.051)			
Stem diameter					
Intake	mm (in)	5.477–5.492 (0.2156–0.2162)			
Exhaust	mm (in)	5.464–5.479 (0.2151–0.2157)			
Guide inside diameter					
Intake and exhaust	mm (in)	5.504–5.522 (0.2167–0.2174)			
Stem-to-guide clearance					
Intake	mm (in)	0.012–0.045 (0.0005–0.0018)			
Exhaust	mm (in)	0.025–0.058 (0.0010–0.0023)			
Stem runout limit	mm (in)	0.01 (0.0004)			

Valve spring

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Free length 	mm (in)	44.20 (1.740)			
Tilt limit	mm (in)	1.2 (0.05)			

Valve lifter

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Valve lifter outside diameter	mm (in)	32.982–32.997 (1.2985–1.2991)			
Valve lifter-to-cylinder head clearance	mm (in)	0.020–0.055 (0.0008–0.0022)			

Valve shim

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Valve shim thickness (in 0.020 mm increments)	mm (in)	2.320–2.960 (0.0913–0.1165)			

Connecting rod

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Big end inside diameter	mm (in)	53.025–53.045 (2.0876–2.0884)			
Big end side clearance(*1)	mm (in)	0.14–0.31 (0.006–0.012)			
Crankpin oil clearance	mm (in)	0.025–0.055 (0.0010–0.0022)			
Big end bearing thickness					
Green	mm (in)	1.496–1.502 (0.0587–0.0591)			
Blue	mm (in)	1.505–1.511 (0.0593–0.0595)			
Red	mm (in)	1.514–1.520 (0.0596–0.0598)			

(*1) The figures are for reference only.

Crankshaft

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Crankshaft journal diameter	mm (in)	62.972–62.992 (2.4792–2.4800)			
Crankpin diameter	mm (in)	49.980–50.000 (1.9677–1.9685)			
Runout limit	mm (in)	0.03 (0.0012)			

Crankcase

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Crankshaft journal oil clearance (J1, J3)	mm (in)	0.026–0.051 (0.0010–0.0020)			
Crankshaft journal oil clearance (J2, J4)	mm (in)	0.038–0.063 (0.0015–0.0025)			
Crankshaft journal oil clearance (J5)	mm (in)	0.032–0.057 (0.0013–0.0022)			
Upper crankcase main bearing thickness					
Yellow	mm (in)	2.488–2.494 (0.0980–0.0982)			
Green	mm (in)	2.494–2.500 (0.0982–0.0984)			
Brown	mm (in)	2.500–2.506 (0.0984–0.0987)			
Black	mm (in)	2.506–2.512 (0.0987–0.0989)			
Blue	mm (in)	2.512–2.518 (0.0989–0.0991)			
Lower crankcase main bearing thickness					
Yellow	mm (in)	2.488–2.494 (0.0980–0.0982)			
Green	mm (in)	2.494–2.500 (0.0982–0.0984)			
Brown	mm (in)	2.500–2.506 (0.0984–0.0987)			
Black	mm (in)	2.506–2.512 (0.0987–0.0989)			
Blue	mm (in)	2.512–2.518 (0.0989–0.0991)			
Thrust bearing thickness (J3)	mm (in)	1.907–1.957 (0.0751–0.0770)			

Thermostat

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Opening temperature	°C (°F)	58–62 (136–144)			
Fully open temperature	°C (°F)	70 (158)			
Valve open lower limit	mm (in)	5.0 (0.20)			

Electrical technical data

Ignition and ignition control system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Spark plug gap	mm (in)	1.0–1.1 (0.039–0.043)			
Pulser coil resistance(*1) (W/R – B)					
at 20 °C (68 °F)	Ω	459–561			
Pulser coil air gap	mm (in)	0.7–1.5 (0.0276–0.0591)			
IDM input voltage (R/Y – Ground)	V	12			
Air temperature sensor resistance(*1)					
at 20 °C (68 °F)	kΩ	2.21–2.69			
at 80 °C (176 °F)	kΩ	0.32			
Engine temperature sensor resistance(*1) (B/Y – B)					
at 20 °C (68 °F)	kΩ	54.2–69.0			
at 98 °C (208 °F)	kΩ	3.12–3.48			
Thermoswitch ON temperature	°C (°F)	90–96 (194–205)			
Thermoswitch OFF temperature	°C (°F)	76–90 (169–194)			

(*1) The figures are for reference only.

ETV control system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
TPS output voltage(*1)					
with throttle valve fully closed					
TPS 1	V	0.32–0.68			
TPS 2	V	2.32–2.68			
with throttle valve fully open					
TPS 1	V	4.30–4.70			
TPS 2	V	4.50–4.80			
Throttle valve opening angle(*1)					
with control lever fully closed	Degree	4.2			
with control lever fully open	Degree	83.6			

(*1) The figures are for reference only.

VCT control system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
OCV resistance					
at 20 °C (68 °F)	Ω	6.7–7.7			

Fuel control system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Fuel injector resistance(*1) at 20 °C (68 °F)	Ω	11.5–12.5			
Low-pressure fuel pump resistance(*1) at 20 °C (68 °F)	Ω	0.76			
High-pressure fuel pump resistance(*1) at 20 °C (68 °F)	Ω	0.63			
Vapor shut-off valve resistance at 20 °C (68 °F)	Ω	30.0–34.0			

(*1) The figures are for reference only.

Starter motor

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Type		Sliding gear			
Output	kW	2.00			
Cranking time limit	Second	30			
Brushes					
Standard length	mm (in)	18.0 (0.71)			
Wear limit	mm (in)	11.0 (0.43)			
Commutator					
Standard diameter	mm (in)	32.0 (1.26)			
Wear limit	mm (in)	31.4 (1.24)			

Shift actuator

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Shift actuator resistance(*1) (Br – B) at 20 °C (68 °F)	Ω	1.7			

(*1) The figures are for reference only.

Charging system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Fuse	A	60A		(*1)	
Stator assembly output peak voltage(*2) (G – G)					
at cranking (unloaded)	V	6.2			
at 1,500 r/min (unloaded)	V	39.1			
at 3,500 r/min (unloaded)	V	87.4			
Stator coil resistance(*2) (G – G)					
at 20 °C (68 °F)	Ω	0.1416–0.2124			
Rectifier Regulator output peak voltage(*2) (R – Ground)					
at 1,500 r/min (loaded)	V	13.0			
at 3,500 r/min (loaded)	V	13.0			

(*1) 60A (6AW 1001014–)
(6AX 1000440–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

(*2) The figures are for reference only.

PTT system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
PTT sensor output voltage(*1) (P – B)					
at full tilt-up position	V	3.72–4.02			
at full trim-down position	V	0.85–1.15			
Fluid type		ATF Dexron II			
Motor brushes					
Standard length	mm (in)	11.9 (0.47)			
Wear limit	mm (in)	7.5 (0.30)			
Motor commutator					
Standard diameter	mm (in)	23.65 (0.93)			
Wear limit	mm (in)	21.00 (0.83)			

(*1) The figures are for reference only.

Fuel system technical data

Fuel system

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Fuel pressure(*1)					
at engine start switch to "ON" With in 5 seconds	kPa (kgf/cm^2, psi)	300 (3.0, 43.5)			
at engine idle speed	kPa (kgf/cm^2, psi)	260 (2.6, 37.7)			
Canister holding pressure	kPa (kgf/cm^2, psi)	19.6 (0.196, 2.8)			
Fuel filter assembly holding pressure					
Fuel inlet positive pressure	kPa (kgf/cm^2, psi)	200 (2.0, 29.0)			
Fuel outlet negative pressure	kPa (kgf/cm^2, psi)	80 (0.8, 11.6)			
Low-pressure fuel pump assembly holding pressure					
Fuel inlet positive pressure	kPa (kgf/cm^2, psi)	200 (2.0, 29.0)			
Float height					
Water detection position	mm (in)	45 (1.77)			
Vapor separator float height	mm (in)	60.5 ± 3.0 (2.38 ± 0.12)			

(*1) The figures are for reference only.

PTT unit technical data

PTT unit

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Hydraulic pressure					
Down	MPa (kgf/cm^2)	10.6–14.0 (108–143)			
Up	MPa (kgf/cm^2)	14.6–19.0 (149–194)			

Lower unit technical data

Lower unit

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Holding pressure	kPa (kgf/cm^2, psi)	68.6 (0.7, 9.9)			

Gear backlash

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Pinion-to-forward gear	mm (in)	0.20–0.63 (0.0079–0.0248)	0.13–0.61 (0.0051–0.0240)	0.20–0.63 (0.0079–0.0248)	0.13–0.61 (0.0051–0.0240)
Pinion-to-reverse gear	mm (in)	0.42–1.01 (0.0165–0.0398)	0.40–0.94 (0.0157–0.0370)	0.42–1.01 (0.0165–0.0398)	0.40–0.94 (0.0157–0.0370)

Shim

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Pinion shim	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50			
Forward gear shim	mm	2.00, 2.03, 2.06, 2.09, 2.12, 2.15	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	2.00, 2.03, 2.06, 2.09, 2.12, 2.15	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Reverse gear shim	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	2.00, 2.03, 2.06, 2.09, 2.12, 2.15	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	2.00, 2.03, 2.06, 2.09, 2.12, 2.15

Propeller shaft

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Propeller shaft free play	mm (in)	—	0.25–0.35 (0.0098–0.0138)	—	0.25–0.35 (0.0098–0.0138)
Propeller shaft shim	mm	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Runout limit	mm (in)	0.02 (0.0008)			

Drive shaft

Item	Unit	Model			
		F300A	FL300A	F350A	FL350A
Runout limit	mm (in)	1.0 (0.04)			

Special tightening torque

Fuel system

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Filter cup		—	5	0.5	3.7
Intake manifold bolt	1st	M6	12	1.2	8.9
	2nd				
	1st	M8	18	1.8	13.3
	2nd				
Intake silencer bolt		M6	7	0.7	5.2
ETV assembly nut		—	13	1.3	9.6
Air pressure sensor bolt		M6	5	0.5	3.7
Throttle damper plate bolt		M8	13	1.3	9.6
Joint pipe screw		ϕ5	4	0.4	3.0
Pump case screw		ϕ5	4	0.4	3.0
Low-pressure fuel pump bracket screw		ϕ5	4	0.4	3.0
Canister mounting bolt		M6	5	0.5	3.7
Canister bracket bolt		M6	5	0.5	3.7
Fuel cooler bolt		M6	5	0.5	3.7
Pressure regulator screw		ϕ6	5	0.5	3.7
Float chamber cover screw		ϕ4	2	0.2	1.5
Float chamber cover inner plate screw		ϕ4	2	0.2	1.5
Float pin screw		ϕ4	2	0.2	1.5
Vapor separator drain screw		—	2	0.2	1.5

Power unit

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Pulser coil screw		ϕ5	2.9	0.3	2.1
Flywheel magnet bolt	1st	M10	40	4.0	29.5
	2nd		90°		
Spark plug		M14	28	2.8	20.7
Ignition coil bolt		M6	9	0.9	6.6
Cover screw		ϕ5	2	0.2	1.5
Water-separator duct screw		ϕ5	2	0.2	1.5
Lock plate screw		ϕ5	4	0.4	3.0
PTT motor lead bolt		M6	4	0.4	3.0
Power unit mounting bolt (35 mm)	1st	M10	28	2.8	20.7
	2nd		42	4.2	31.0
Power unit mounting bolt (140 mm)	1st	M10	42	4.2	31.0
	2nd		42	4.2	31.0
Starter motor bolt		M8	19	1.9	14.0
Starter motor harness nut		—	11	1.1	8.1
Starter relay bolt		M6	4	0.4	3.0
Negative terminal bolt		M6	4	0.4	3.0

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Rectifier Regulator bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Anode screw (Rectifier Regulator)		M4	3	0.3	2.2
PTT relay lead nut		—	5	0.5	3.7
PTT relay bolt		M6	7	0.7	5.2
IDM bolt		M6	7	0.7	5.2
Timing belt tensioner bolt		M10	39	3.9	28.8
Timing belt pulley bolt		M10	39	3.9	28.8
Timing belt pulley stay bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
Anode cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Anode plug		M22	24	2.4	17.7
Exhaust joint bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
Exhaust joint nut	1st	—	14	1.4	10.3
	2nd		28	2.8	20.7
Exhaust joint bolt		M6	12	1.2	8.9
Exhaust joint stud bolt		M8	14	1.4	10.3
Plug		M18	55	5.5	40.6
Camshaft cap bolt	1st	M7	8	0.8	5.9
	2nd		17	1.7	12.5
Driven sprocket bolt		M10	60	6.0	44.3
VCT bolt		M12	60	6.0	44.3
VCT cap		M27	32	3.2	23.6
Cylinder head cover bolt	1st	M6	8	0.8	5.9
	2nd		8	0.8	5.9
Cylinder head bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
	1st	M11	27	2.7	19.9
	2nd		54	5.4	39.8
	3rd		Loosen completely		
	4th		27	2.7	19.9
	5th		48	4.8	35.4
	6th		90°		
Connecting rod cap bolt	1st	M9	23	2.3	17.0
	2nd		43	4.3	31.7
	3rd		90°		
Crankcase bolt	1st	M10	40	4.0	29.5
	2nd		90°		
	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
Crankcase cover bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Crankcase cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Oil filter		UNF 3/4	18	1.8	13.3
Oil filter mounting plug		UNF 3/4	49	4.9	36.1
Oil filter cap joint bolt		M6	12	1.2	8.9
Oil pressure sensor		1/8	18	1.8	13.3
Engine temperature sensor		M10	15	1.5	11.1
Anode bolt (thermostat cover)		M5	7	0.7	5.2
Anode (thermostat cover)		M5	7	0.7	5.2
Thermostat cover bolt		M6	12	1.2	8.9
Thermostat cover housing bolt		M6	7	0.7	5.2
Cover bolt		M6	12	1.2	8.9

Lower unit (regular rotation model)

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Gear oil check screw	—	9	0.9	6.6
Gear oil drain screw	—	9	0.9	6.6
Cooling water inlet cover screw	ϕ5	3	0.3	2.2
Cooling water inlet cover bolt	M5	3	0.3	2.2
Drive shaft nut	—	40	4.0	141.6
Pinion nut	—	162	16.2	119.5
Ring nut (drive shaft)	—	177	17.7	130.5
Ring nut (propeller shaft)	—	192	19.2	141.6
Lower case mounting bolt	M10	47	4.7	34.7
Lower case mounting nut (U-transom model)	—	47	4.7	34.7
Cap bolt	M10	42	4.2	31.0
Anode bolt	M10	42	4.2	31.0
Propeller nut	—	54	5.4	39.8

Lower unit (counter rotation model)

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Gear oil check screw	—	9	0.9	6.6
Gear oil drain screw	—	9	0.9	6.6
Cooling water inlet cover screw	ϕ5	3	0.3	2.2
Cooling water inlet cover bolt	M5	3	0.3	2.2
Drive shaft nut	—	40	4.0	141.6
Pinion nut	—	162	16.2	119.5
Ring nut (drive shaft)	—	177	17.7	130.5
Ring nut (propeller shaft)	—	192	19.2	141.6
Lower case mounting bolt	M10	47	4.7	34.7
Lower case mounting nut (U-transom model)	—	47	4.7	34.7
Cap bolt	M10	42	4.2	31.0
Anode bolt	M10	42	4.2	31.0
Propeller nut	—	54	5.4	39.8

Bracket unit

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Hose joint adapter screw	ϕ6	5	0.5	3.7
Shift-actuator bolt	M8	26	2.6	19.2
Shift-actuator bracket bolt	M8	26	2.6	19.2
Engine oil drain bolt	M14	27	2.7	19.9
Relief valve	—	44	4.4	32.5
Oil strainer bolt	M6	10	1.0	7.4
Exhaust manifold bolt	M8	20	2.0	14.8
Oil pan bolt	M8	20	2.0	14.8
Muffler bolt	M8	20	2.0	14.8
Oil pan bolt	M10	42	4.2	31.0
Upper case bolt	M8	20	2.0	14.8
	M10	42	4.2	31.0
PCV	—	9	0.9	6.6
Upper mount nut	—	96	9.6	70.8
Lower mount nut	—	72	7.2	53.1
Bracket bolt (upper mount)	M10	54	5.4	39.8
Bracket bolt (lower mount)	M10	54	5.4	39.8
Trim stopper nut	—	36	3.6	26.6
Self-locking nut	—	22	2.2	16.2
Friction plate screw	ϕ6	4	0.4	3.0
Grease nipple	—	3	0.3	2.2

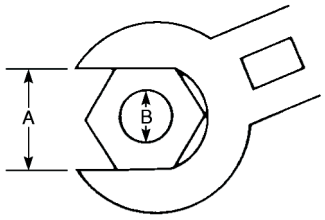
PTT unit

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Reservoir cap	—	2	0.2	1.5
Manual valve	—	4	0.4	3.0
Gear pump bolt	M4	5	0.5	3.7
	M5	7	0.7	5.2
Up-relief valve plug	—	6	0.6	4.4
Cap (port plug)	—	4	0.4	3.0
Shaft stopper bolt	M6	4	0.4	3.0
Trim cylinder end screw	—	172	17.2	126.9
Reservoir bolt	M5	4	0.4	3.0
PTT motor bolt	M6	5	0.5	3.7
Tilt cylinder end screw	—	257	25.7	189.6

General tightening torque

This chart specifies tightening torques for standard fasteners with a standard ISO thread pitch. Tightening torque specifications for special components or assemblies are provided in applicable sections of this manual. To avoid warpage, tighten multi-fastener assemblies in a crisscross fashion and progressive stages until the specified torque is reached. Unless otherwise specified, torque specifications require clean, dry threads. Components should be at room temperature.

Nut (A)	Bolt (B)	General torque specifications		
		N·m	kgf·m	ft·lb
8 mm	M5	5	0.5	3.7
10 mm	M6	8	0.8	5.9
12 mm	M8	18	1.8	13.3
14 mm	M10	36	3.6	26.6
17 mm	M12	43	4.3	31.7



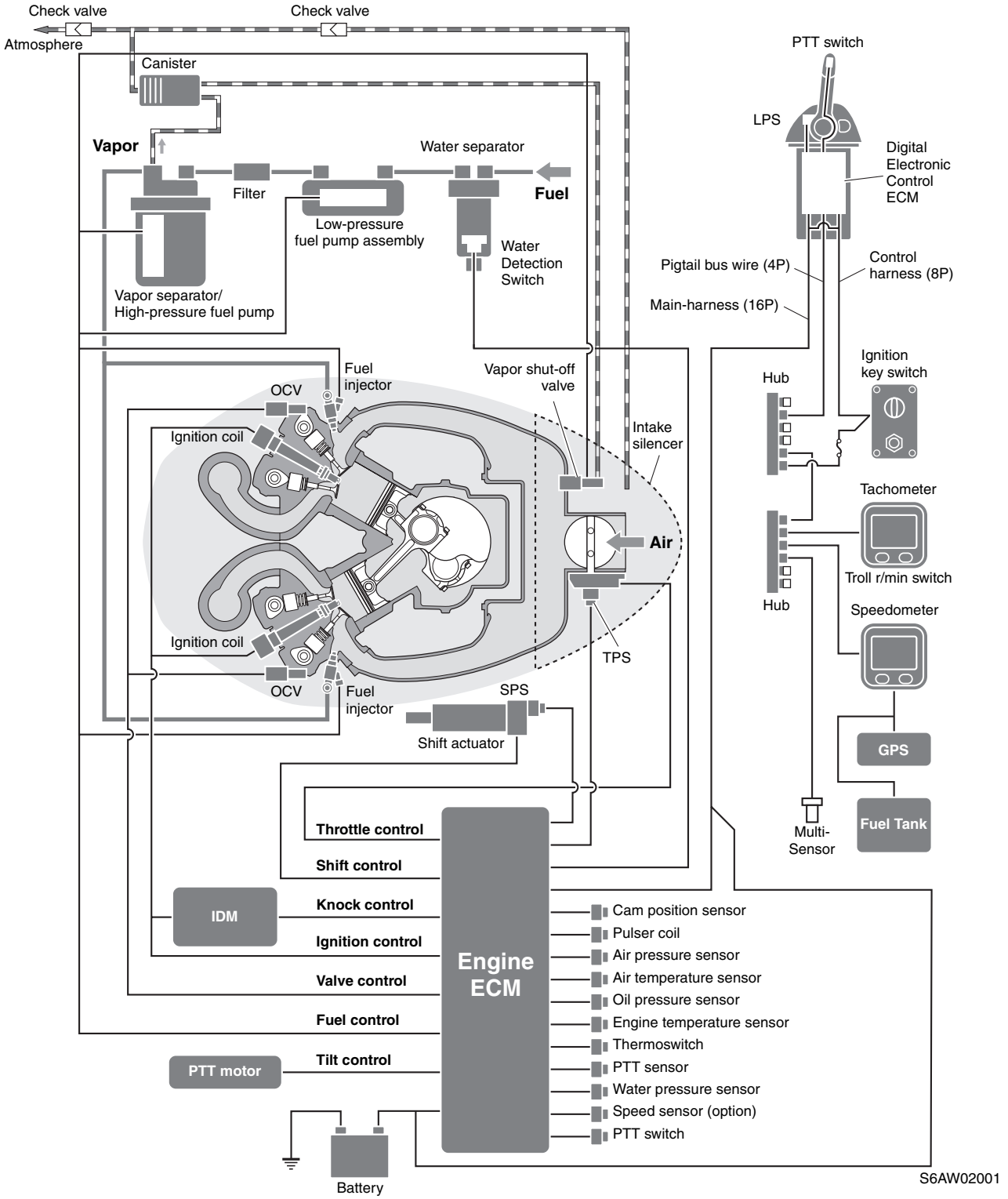
S69J2150

Technical features and description

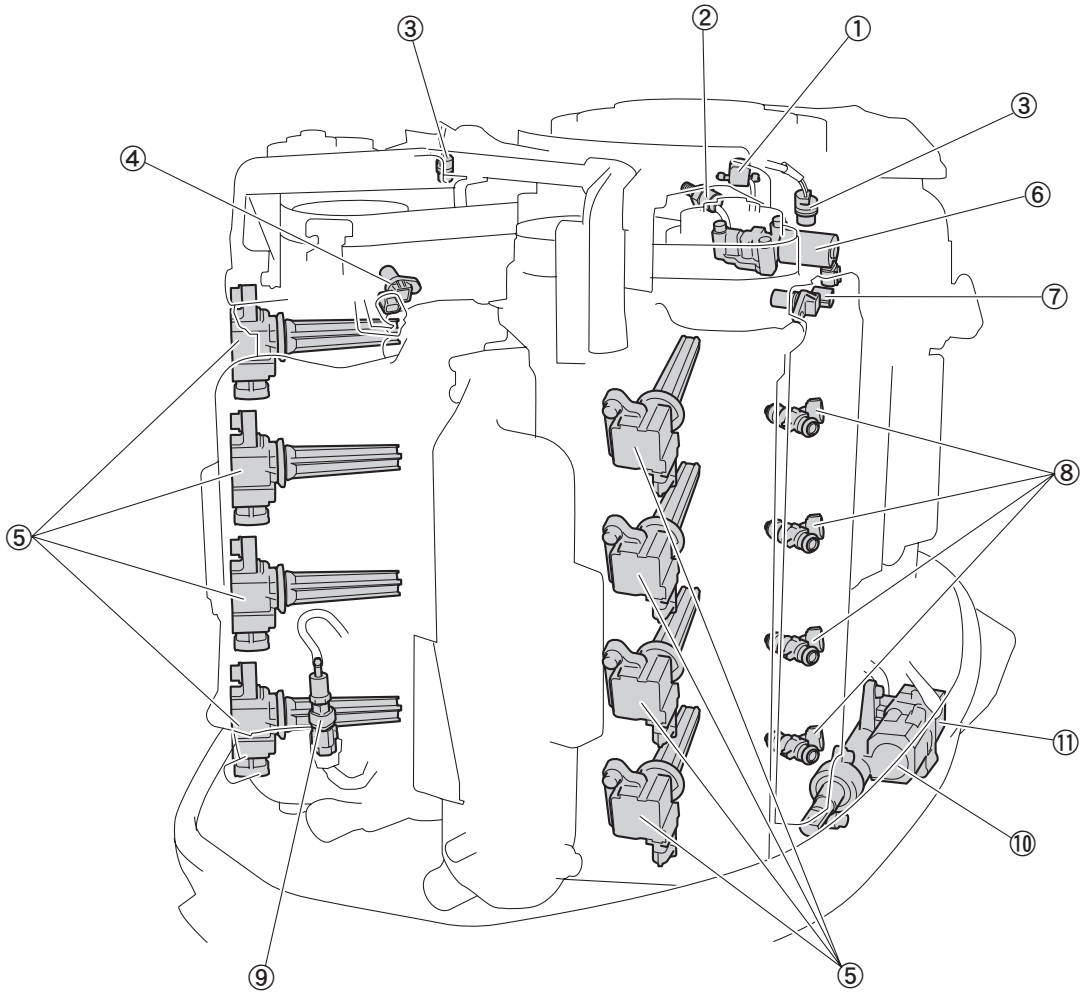
Electronic control system

The F300/FL300 and F350/FL350 are controlled by engine ECM in various aspects including; fuel injection amount, ignition timing, intake valve opening and closing timings, electronically controlled throttle valve opening, and the engine speed reduction in case of overheat and low oil pressure. Appropriate air/fuel ratio and ignition timing are assured in every engine operating condition to maintain dependable engine start, stable trolling, sharp acceleration, high output power, improved fuel economy, and low exhaust emissions.

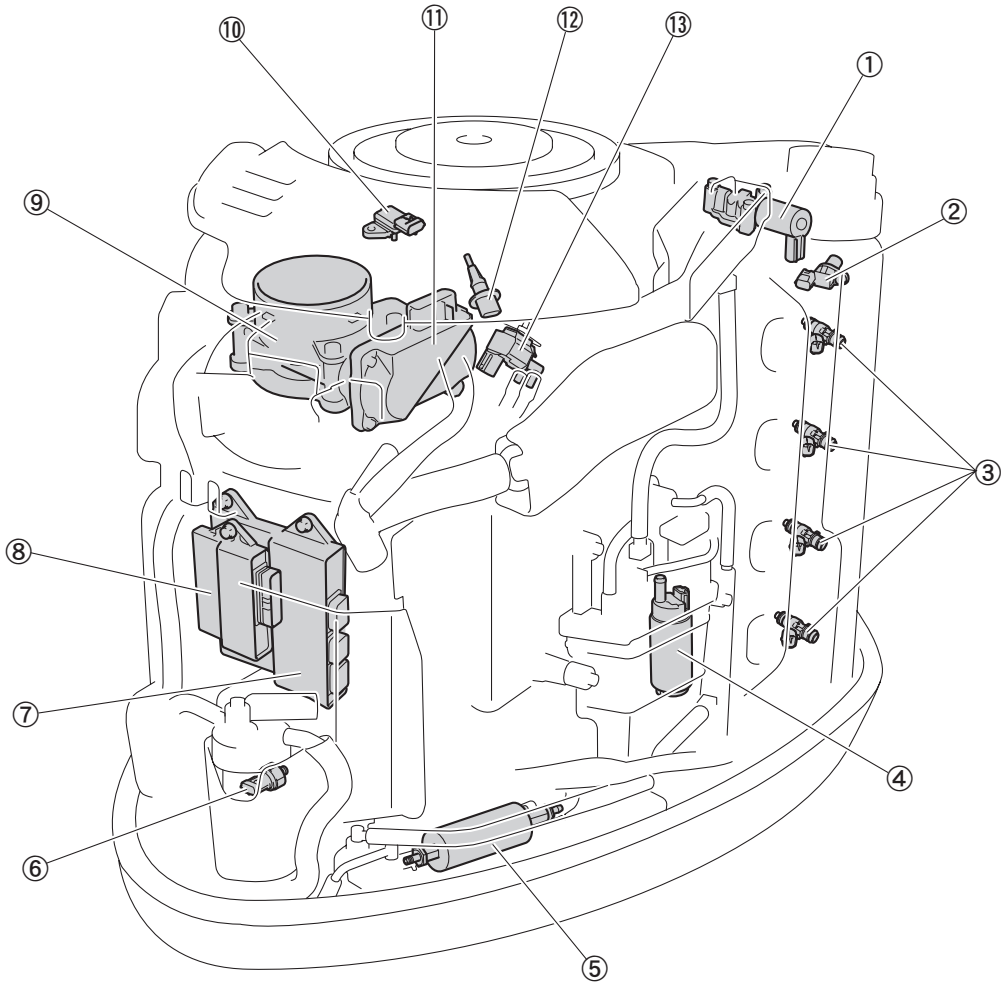
Electronic control module system diagram



Engine ECM component



① Pulser coil
② Engine temperature sensor
③ Thermoswitch (PORT and STBD)
④ Cam position sensor (PORT EX)
⑤ Ignition coil (PORT and STBD)
⑥ OCV (STBD)
⑦ Cam position sensor (STBD IN)
⑧ Fuel injector (STBD)
⑨ Water pressure sensor
⑩ SPS 1, 2
⑪ Shift actuator



S6AW02003

① OCV (PORT)
② Cam position sensor (PORT IN)
③ Fuel injector (PORT)
④ High-pressure fuel pump
⑤ Low-pressure fuel pump
⑥ Oil pressure sensor
⑦ Engine ECM
⑧ IDM
⑨ Throttle body
⑩ Air pressure sensor
⑪ TPS 1, 2
⑫ Air temperature sensor
⑬ Vapor shut-off valve

Sensor, switch and actuator

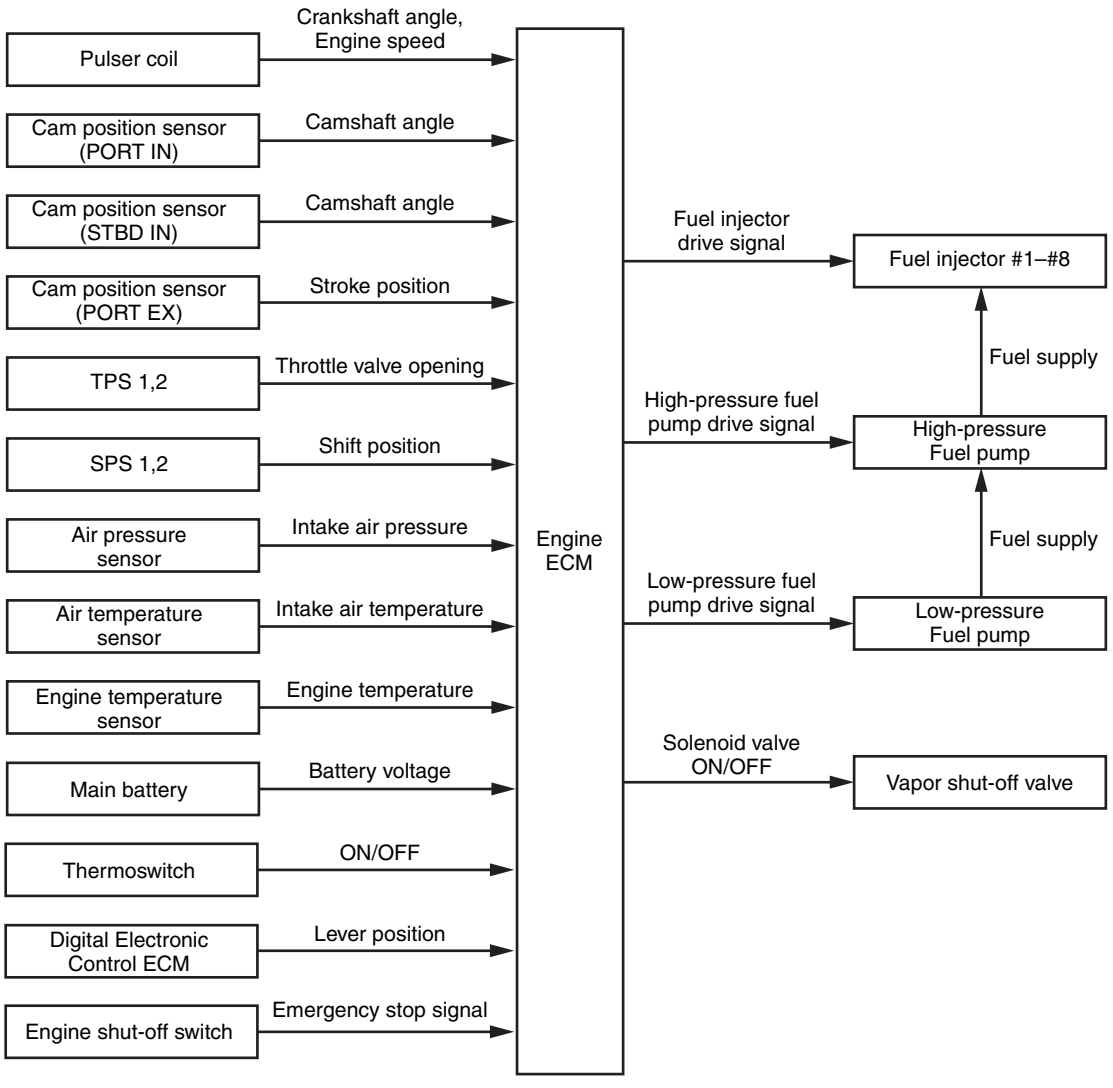
Engine ECM	• Transmits the signals received from each sensor to the Digital Electronic Control ECM to notify the present values (the current status), and receives the command values from the Digital Electronic Control ECM. And then, performs precision control regarding the fuel injection, ignition timing, knocking, VCT, electronically-controlled throttle valve opening, and the engine speed in accordance with each command value received, to keep the engine in the optimized conditions.
	• Permits the engine start after carrying out the mutual authentication with Digital Electronic Control ECM.
Pulser coil	• Detects the engine speed.
	• Detects the crankshaft angle and the position of the pistons. (Cannot distinguish exhaust stroke from compression stroke.)
	• Identify each group of cylinders (#1 and #6, #2 and #3, #4 and #7, #5 and #8).
	• Utilizes the detected signals for controlling the fuel injection, ignition timing, knocking, VCT, electronically controlled throttle valve opening, and the engine speed.
Cam position sensor (PORT EX)	• Identifies the stroke. (example: Distinguishes the compression stroke TDC from the exhaust stroke TDC)
	• Identifies the stroke each cylinder is in, based on the signals from both the pulser coil and the cam position sensor (PORT EX).
	• Applies the detected signals to VCT control.
Cam position sensor (STBD IN)	Detects the ignition advance angle on the starboard cam for VCT control.
Cam position sensor (PORT IN)	Detects the ignition advance angle on the port cam for VCT control.
TPS 1	Detects the electronically controlled throttle valve opening.
TPS 2	
SPS 1	Detects the actual shift position on the outboard motor.
SPS 2	
Shift actuator	Drives the motor according to the engine ECM command for engaging or disengaging the gearshift.
Air pressure sensor	Detects the intake air pressure for controlling the ignition timing and the fuel injection amount.
Air temperature sensor	Detects the intake temperature for compensating the ignition timing.
Engine temperature sensor	Compensates the ignition timing and the fuel injection amount.
Oil pressure sensor	Detects the oil pressure and apply it to the alert of low oil pressure and the engine speed restriction control.
Thermoswitch	Outputs the alert signal in case of overheat, and restricts the engine speed once the overheat alert is activated.
IDM	Detects the ION signal generated at the spark plug, the ignition coil and/or the lead wire, and sends it to engine ECM as the knock signal.
Digital Electronic Control ECM	Performs mutual authentication by sending the operator's demand for the shift position and the throttle valve opening to engine ECM in the form of digital signals.
Neutral switch	Detects the neutral position.
Engine shut-off switch	Activates the engine emergency stop function in urgent situations by compulsory cutting out the spark plug ignition.
Fuel injector #1–#8	Gives optimal amount of fuel injection at the optimal timing based on the signals from engine ECM.

Ignition coil #1–#8	Activates the ignition at the optimal timing based on the signals from engine ECM.
Vapor shut-off valve	Controls the amount of evaporated fuel vapor to be delivered to the intake system from the vapor separator tank, based on the signals from the engine ECM.
OCV (PORT)	Advances or retards the camshaft timing based on the signals from engine ECM, by switching the oil passages through which the engine oil is delivered into the advance chamber or the retard chamber within the rotor vane housing.
OCV (STBD)	
ETV motor	Controls the throttle valve opening based on the engine ECM command.
High-pressure fuel pump	Pressurizes the fuel in the vapor separator tank, and delivers the fuel to the port and starboard fuel rails.
Low-pressure fuel pump	Supplies the fuel into in the vapor separator tank from fuel tank.
YDIS	Performs PTT tilt limiter setting and re-authentication of the Digital Electronic Control ID when the personal computer installed with applicable software is connected. It is also capable of performing quick, precise and detailed diagnosis such as active test.

Electronic fuel injection control system

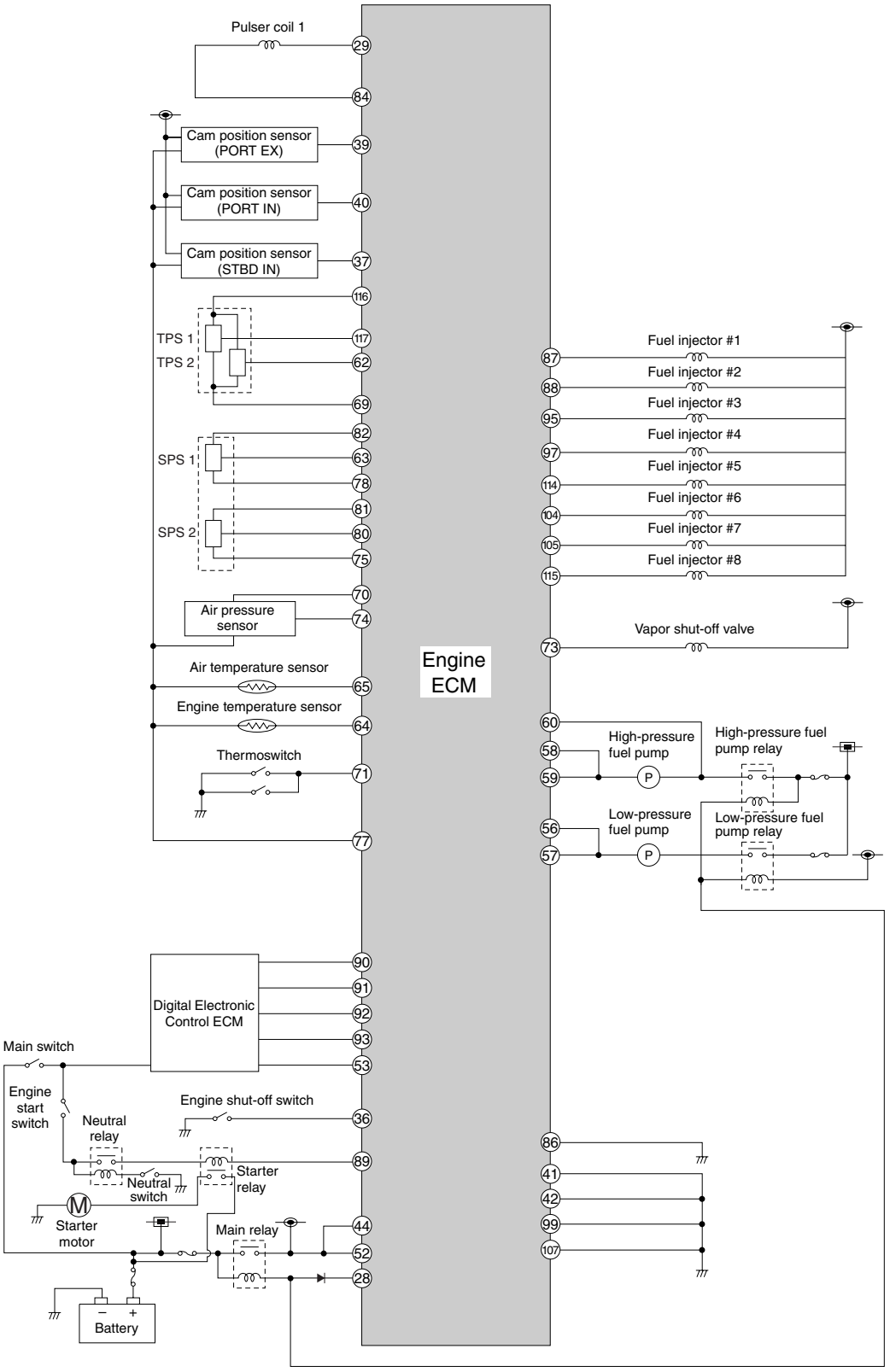
Fuel injection timing and amount on F300/FL300 and F350/FL350 are managed by the electronic fuel injection control system. High output power, improved fuel economy, and low exhaust emissions are attained by controlling the fuel injection amount (example: how long the fuel injectors are turned on) to assure the appropriate air/fuel ratio. The control is based on the intake air flow rate calculated from intake air pressure and engine speed, and the engine operating conditions indicated by the signals from each sensor are taken into account. Two types of fuel injections are carried out. One is synchronous injection in which the fuel injection always occurs at certain crankshaft angle, after the required correction is made in accordance with the signals from each sensor. The other is asynchronous injection in which the fuel is injected every time the demand for the fuel injection is identified in the signals from each sensor, regardless of the crankshaft angle.

Block diagram



S6AW02004

Circuit diagram



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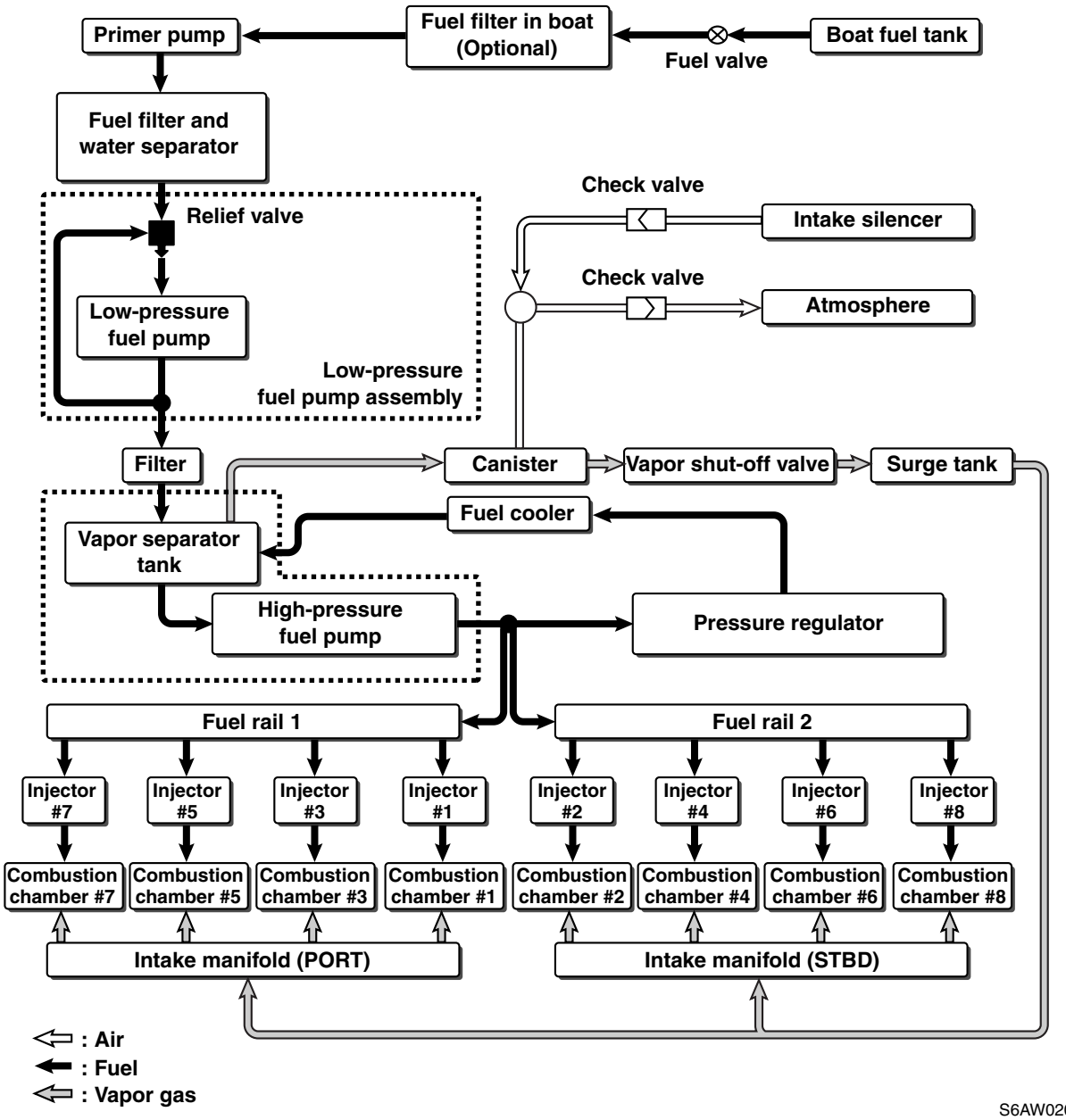
System chart

After flowing through the fuel filter, fuel is supplied to the vapor separator tank via the filter by the low-pressure fuel pump. Once the fuel in the vapor separator exceeds the specified amount, the excessive fuel is not delivered to the vapor separator tank. Then the excessive fuel flows to the relief valve. Pressurized by the high-pressure fuel pump located inside the vapor separator tank, the fuel is delivered to the fuel rail each provided on starboard and port banks, and injected into the combustion chamber by the injectors. When the fuel pressure rises above the specified level, the fuel at the pressure regulator is returned to the vapor separator tank via the fuel cooler to maintain the constant fuel pressure. Vapor shut-off valve is closed while the engine is at rest or when cranking the engine, preventing the fuel vapor gas from entering into the intake manifold. After the engine start, vapor shut-off valve is opened and closed repeatedly for controlling the amount of fuel vapor gas entering into the surge tank. While the shut-off valve is closed, the fuel vapor gas is absorbed by the activated carbon in the canister. Part of the fuel vapor gas is discharged into the open air.

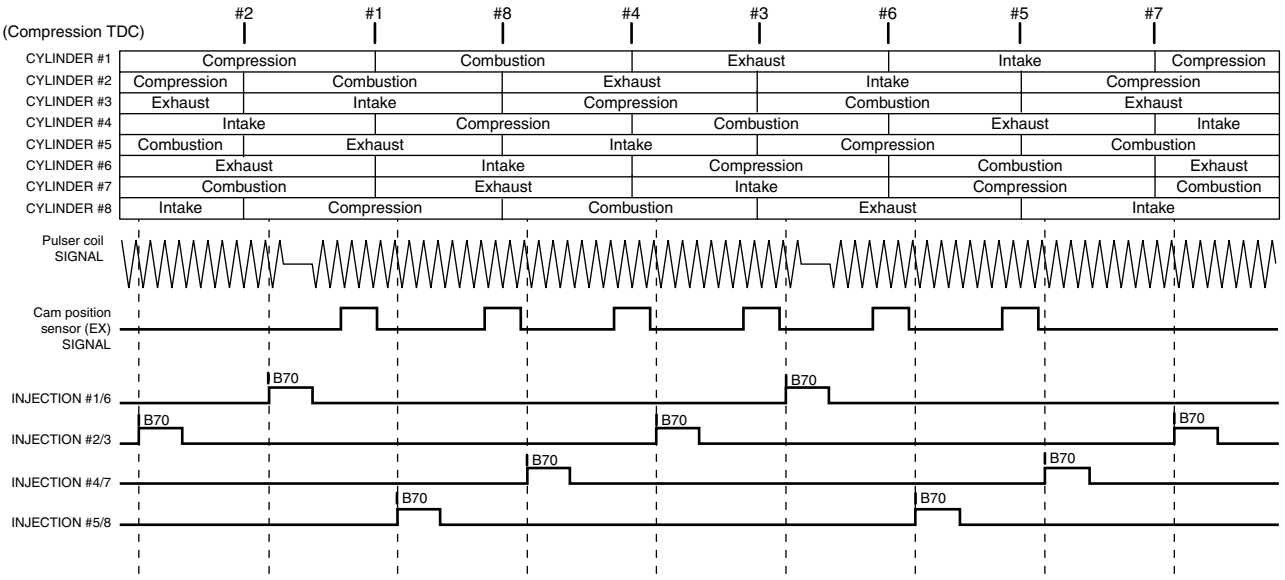


S6AW02006

Fuel injection control

Synchronous injection	Simultaneous injection for a group of cylinders at engine start-up	The fuel injection timing control applicable to the start-up mode after the cylinder identification is completed by the pulser coil. Fuel injectors are turned on simultaneously for each cylinder group (#1/6, #2/3, #4/7, and #5/8), synchronized at the crankshaft angle signal reference point (BTDC 430° CA) or at BTDC 70° CA in reference to the exhaust TDC.
	Sequential injection in normal operation	The fuel injection timing control applicable to the normal mode after the cylinder identification is completed by the cam position sensor (EX). Fuel injectors are turned on for each cylinder according to the injection completion timing setting determined in reference to the exhaust TDC.
	Group injection in normal operation	The fuel injection timing control applicable to the normal mode before the cylinder discrimination is completed by the cam position sensor (EX). Fuel injectors are turned on in reference to the exhaust (compression) TDC when only the cylinder group identification is completed and the engine is not in the start-up mode. The fuel injectors for a group of cylinders are turned on simultaneously. Fuel is injected two times in every two rotations of crankshaft.
	Synchronous injection without cylinder discrimination	The fuel injection timing control applicable to the start-up mode before the cylinder identification is completed by the pulser coil. When the cylinder identification is not completed, fuel injectors are turned on simultaneously at all cylinders based on the injection data of the injection control to be applied before the cylinder identification.
Asynchronous injection	Asynchronous injection at acceleration	When the increment of throttle opening gets larger than the set value in the course of acceleration, for instance, the fuel is injected immediately and simultaneously at all cylinders, rather than synchronizing with the engine rotation signal transmitted by the pulser coil. This prevents the lean air/fuel ratio, and assures the sharp throttle response in acceleration.

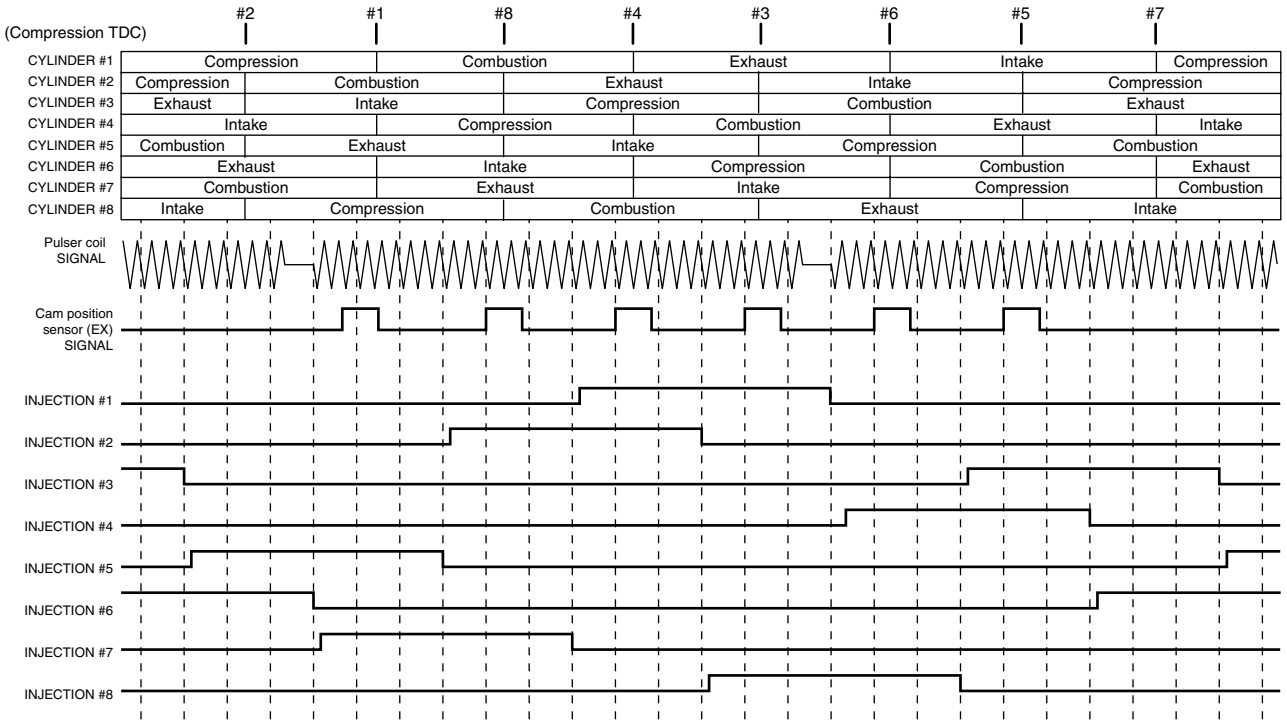
Simultaneous injection of group cylinders upon starting



Starting injection start timing
(standard position BTDC 70°)

S6AW02007

Normal sequential injection



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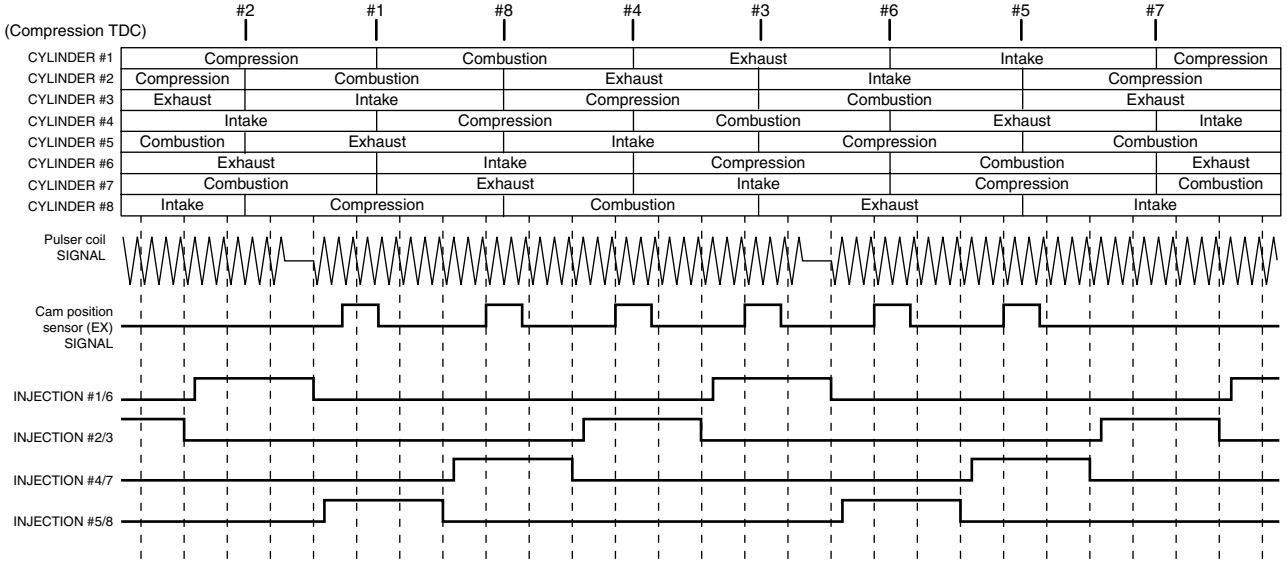
Normal group injection



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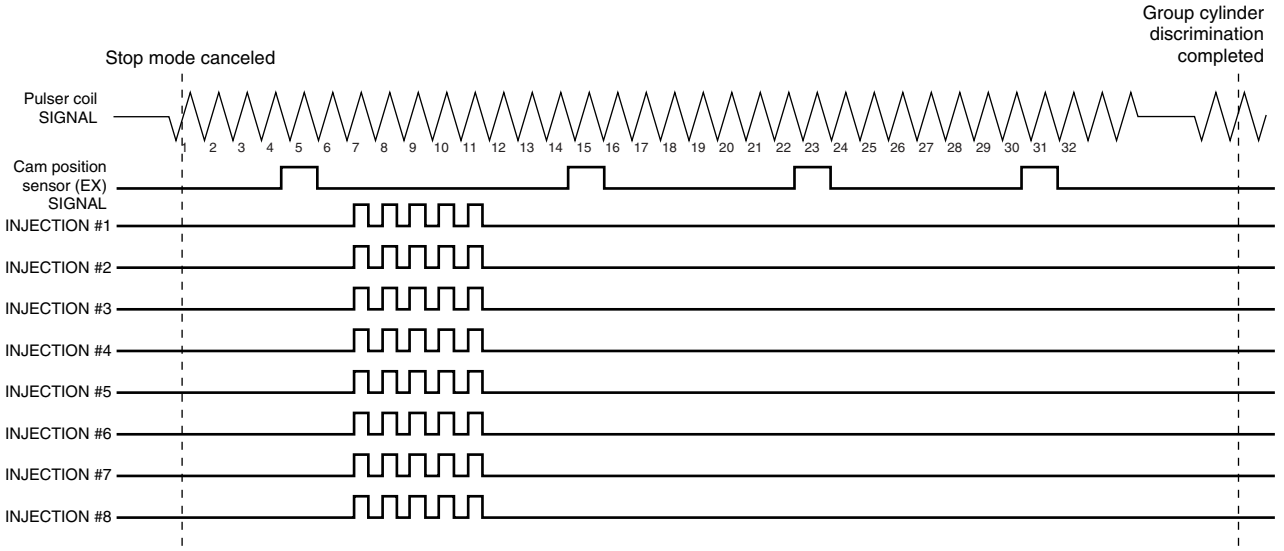
Indiscriminate cylinder simultaneous injection



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Ignition timing control system

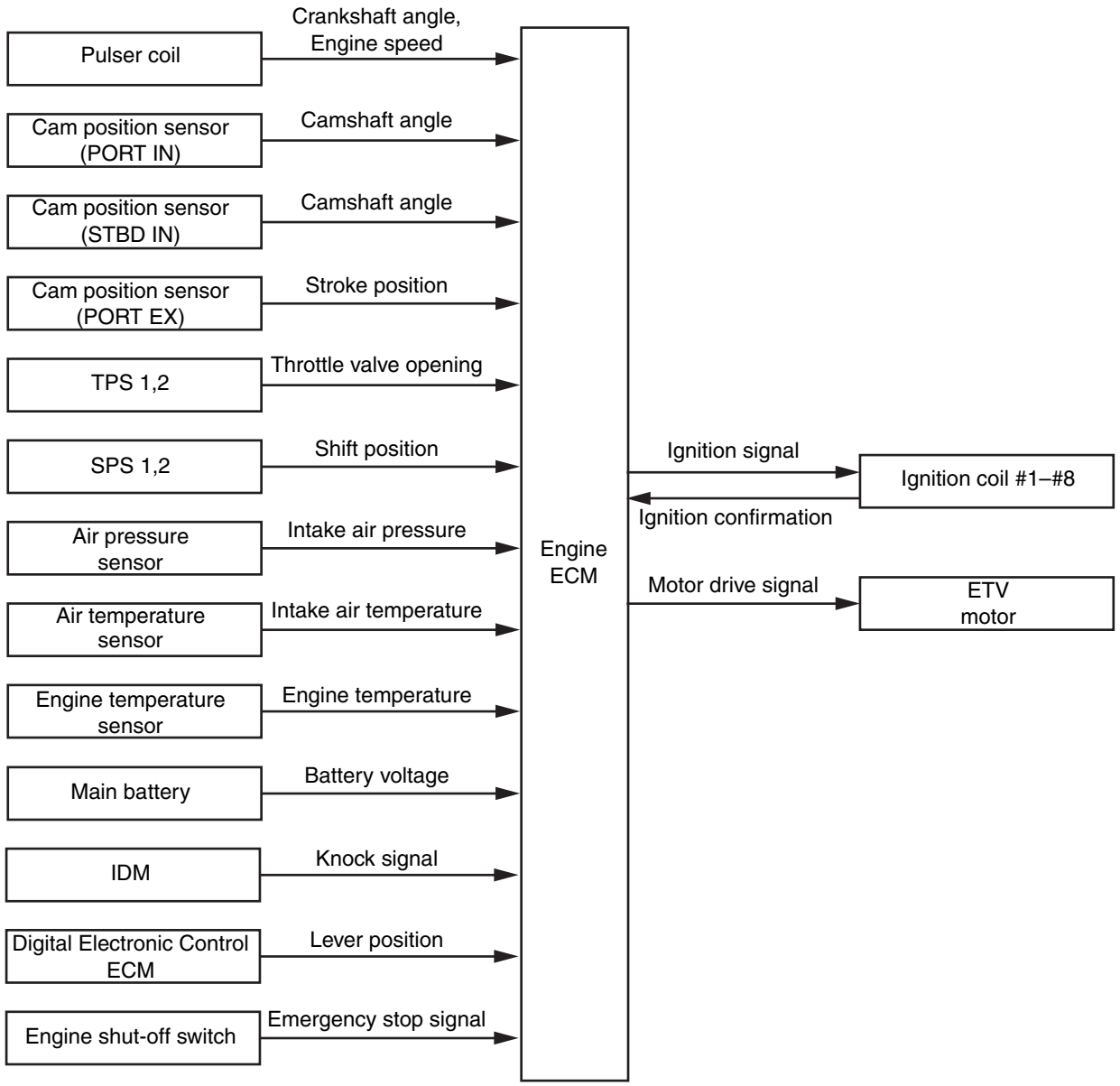
Ignition timing and the duration of ignition coil energization on F300/FL300 and F350/FL350 are managed by the ignition timing control system. High output power, improved fuel economy, and low exhaust emissions are attained by controlling the ignition timing and the duration of ignition coil energization, in response to engine operating conditions. The control is based on the signals from each sensor and the map data selected in compatible with the octane number of the fuel.

Ignition timing is computed as described below:
Basic ignition timing computation → Computation for compensation → Ignition timing restriction → Computing the duration of energization → Knock retard compensation → Ignition

Basic ignition timing computation	Optimal ignition timing is selected from the map data in accordance with the signals from each sensor.	
Computation for compensation	Ignition timing is advanced or retarded in response to the engine operating conditions determined by the signals from each sensor.	
	• Compensation for stable idle speed	As the idle speed drops, ignition timing is advanced to make it stable. Ignition timing is retarded as the idle speed gets higher.
	• Compensation for start-up operation	Engine startability is improved by applying the advanced ignition timing at the engine start-up. Subsequently, the ignition timing is controlled to go back to the standard angle gradually.
	• Compensation for acceleration	Ignition timing is temporarily retarded at acceleration to improve the throttle response.
	• Shift-cut-out compensation	Shift-cutout compensation angle of zero degree CA is applied in the low speed mode, or at the time of shift-cutout where the ignition timing retard control is invalid. When the conditions for shift-cutout control are met, 1° CA is added to the ignition timing at every updating cycle until it reaches the shift-cutout compensation angle. Otherwise, 1° CA is subtracted from the ignition timing at every updating cycle until it reaches zero degree CA.
	• Dashpot compensation	Dashpot ignition timing compensation angle zero degree CA is applied in the engine start-up/stop modes, when idle operation criteria is not met, or start-up compensation angle is not zero degree CA. Initial value of the compensation angle is applied while the dashpot sustaining control is in effect. Otherwise, 1° CA will be subtracted gradually in every progressive reducing cycle of compensation angle.

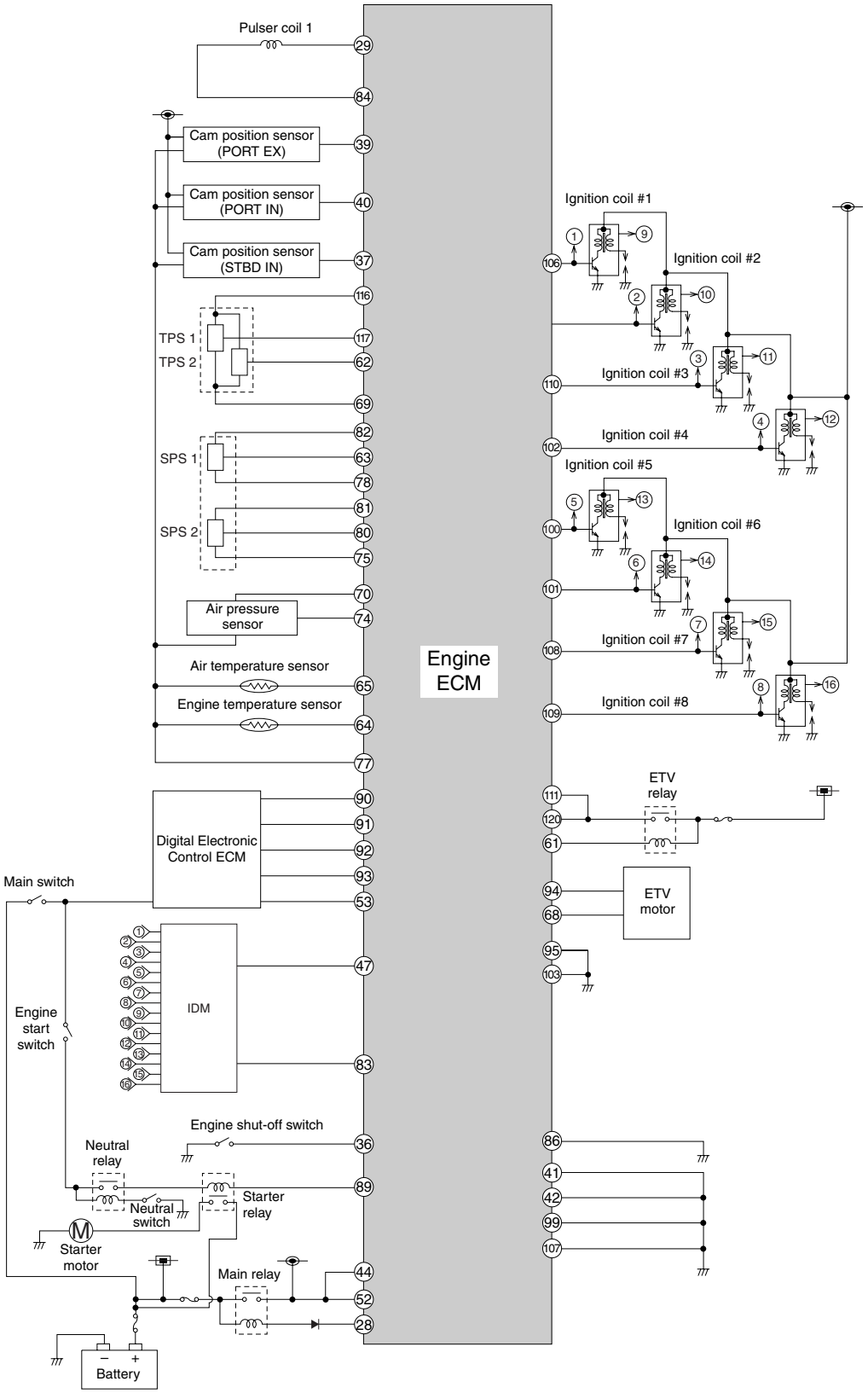
Ignition timing restriction	• Dashpot restriction	Dashpot ignition timing restriction angle ATDC 30° CA is applied in the engine start-up/stop modes, when idle operation criteria is not met, or start-up compensation angle is not zero degree CA. Initial value of the dashpot restriction angle is applied when the crankshaft rotational speed exceeds the reverse rotational speed for initiating the dashpot operation. Otherwise, 1° CA will be subtracted gradually in every progressive reducing cycle of dashpot ignition timing restriction angle until it reaches ATDC 30° CA.
	• Engine temperature restriction	Optimal ignition timing is selected from the map data depending on the cooling water temperature detected by the engine temperature sensor.
	• Ignition timing upper and lower limits restriction	Limit values for advancing and retarding the ignition timing are computed by the map data in accordance with the engine speed detected by the pulser coil.
Computing the duration of energization	The duration of ignition coil energization is controlled based on the engine speed and the supply voltage to the ignition coil.	
Knock retard compensation	Once the knocking take place, the ignition timing is compensated by the signals from IDM.	

Block diagram



S6AW02011

Circuit diagram



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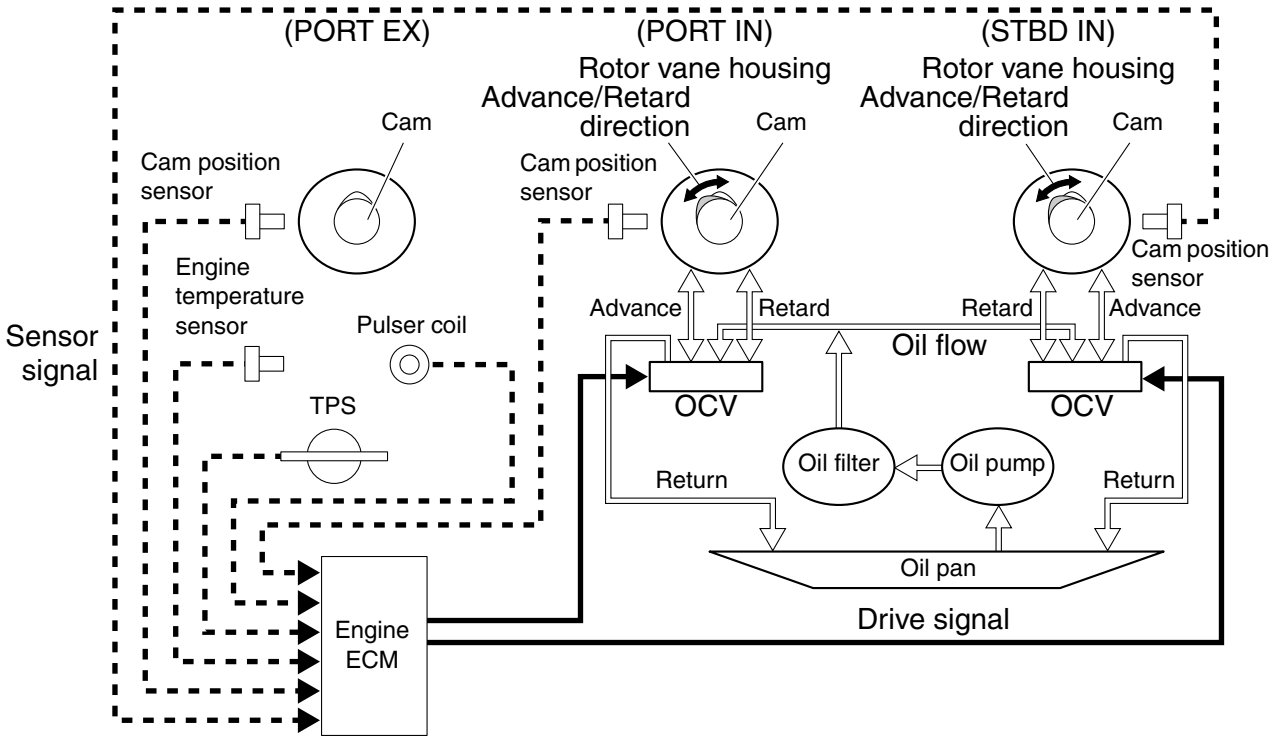
VCT control system

Intake valve opening and closing timings on F300/FL300 and F350/FL350 are managed by the VCT control system. Engine ECM optimizes the intake valve opening/closing timing by operating the OCV depending on the engine speed and the electronically-controlled throttle valve opening.
High output power is attained by improving the air filling efficiency in the combustion chamber in every engine operating condition.

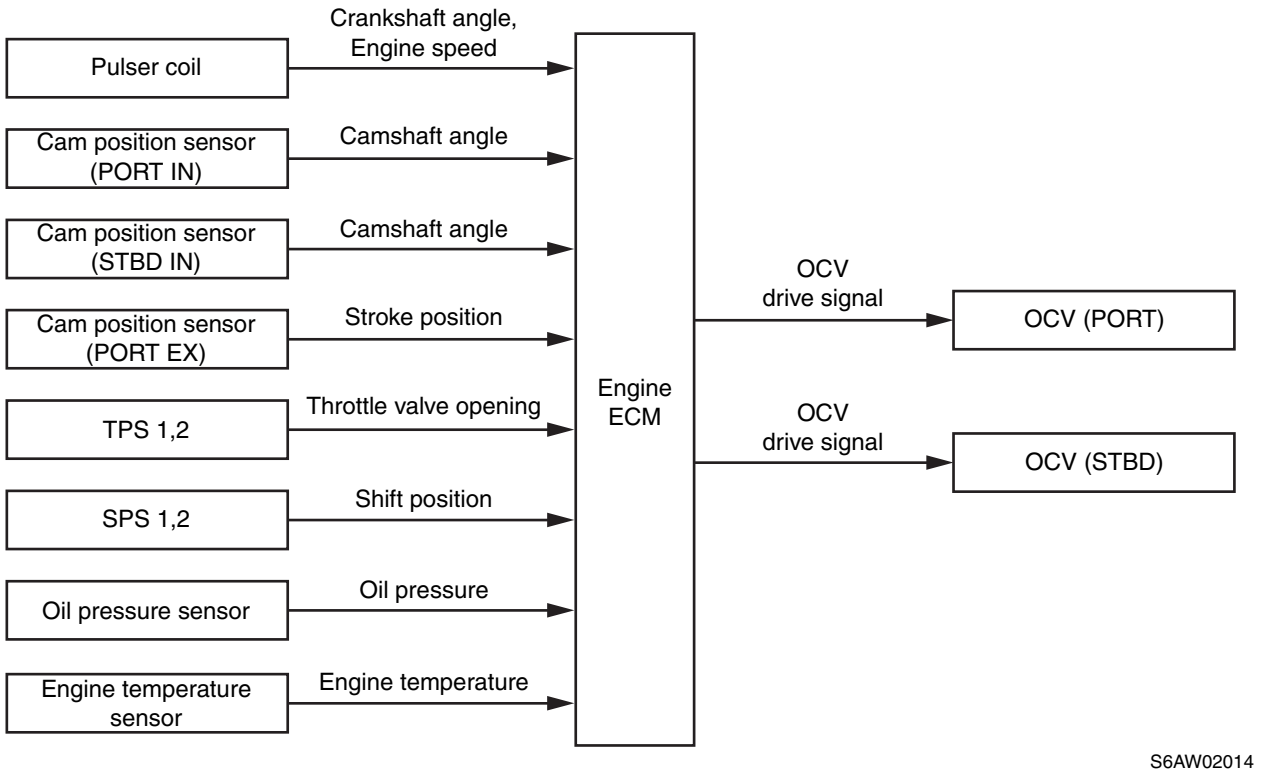
VCT control system diagram



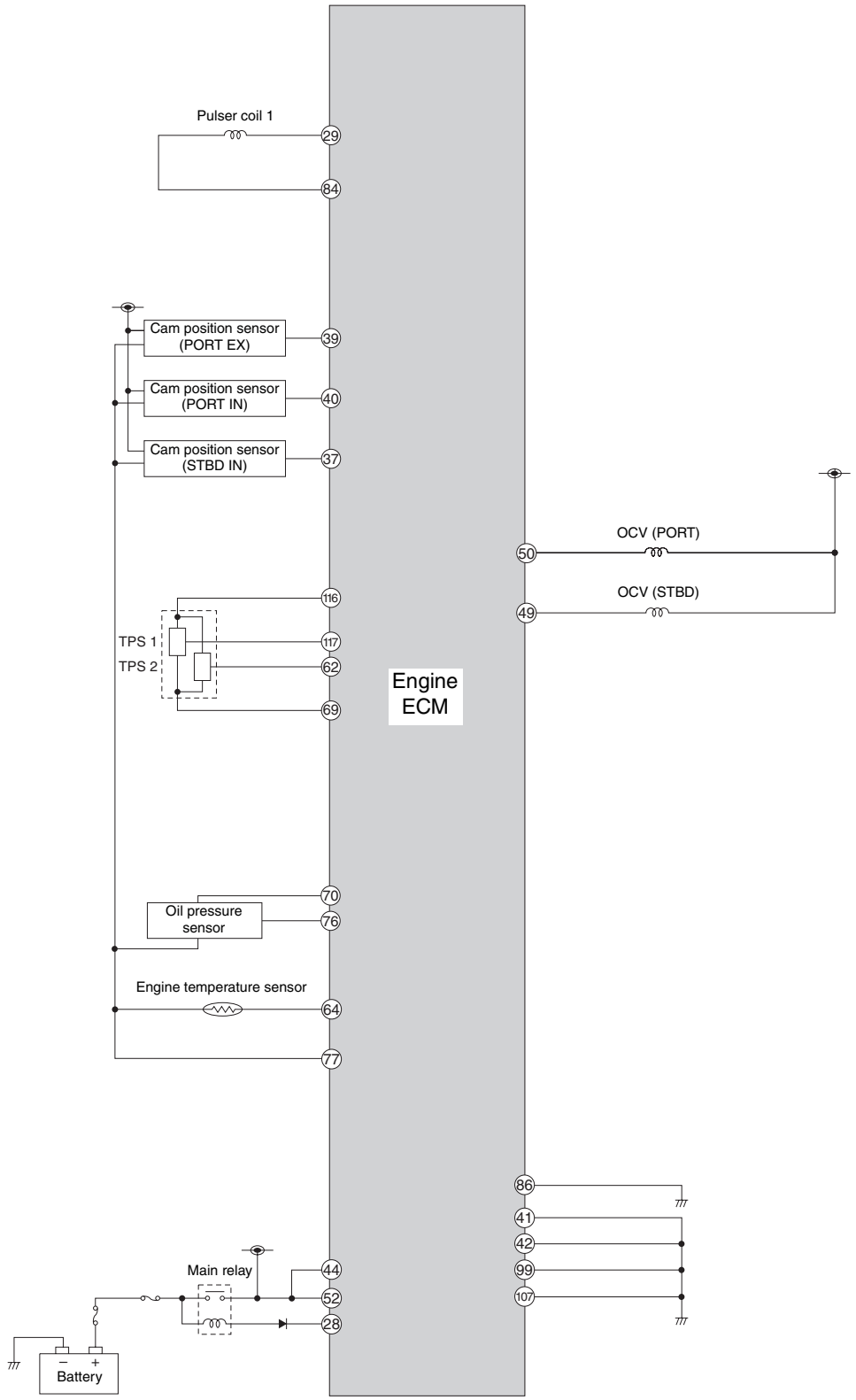
S6AW02013

Engine ECM determines the intake valve opening/closing timing suitable for the current engine operating conditions based on the engine speed, electronically-controlled throttle valve opening and engine temperature. Engine ECM also detects the actual ignition advance by means of exhaust and intake cam position sensors, and performs feed back control with OCV to make it closer to the target ignition advance position. Receiving the signal from engine ECM, the OCV delivers the engine oil to the advance chamber or to the retard chamber located in the rotor vane housing, by switching the oil passage leading to each chamber. Then, the rotor vane is driven by the engine oil pressure, advancing or retarding the angle of the camshaft integrated with the rotor vane.

Block diagram



Circuit diagram



S6AW02015

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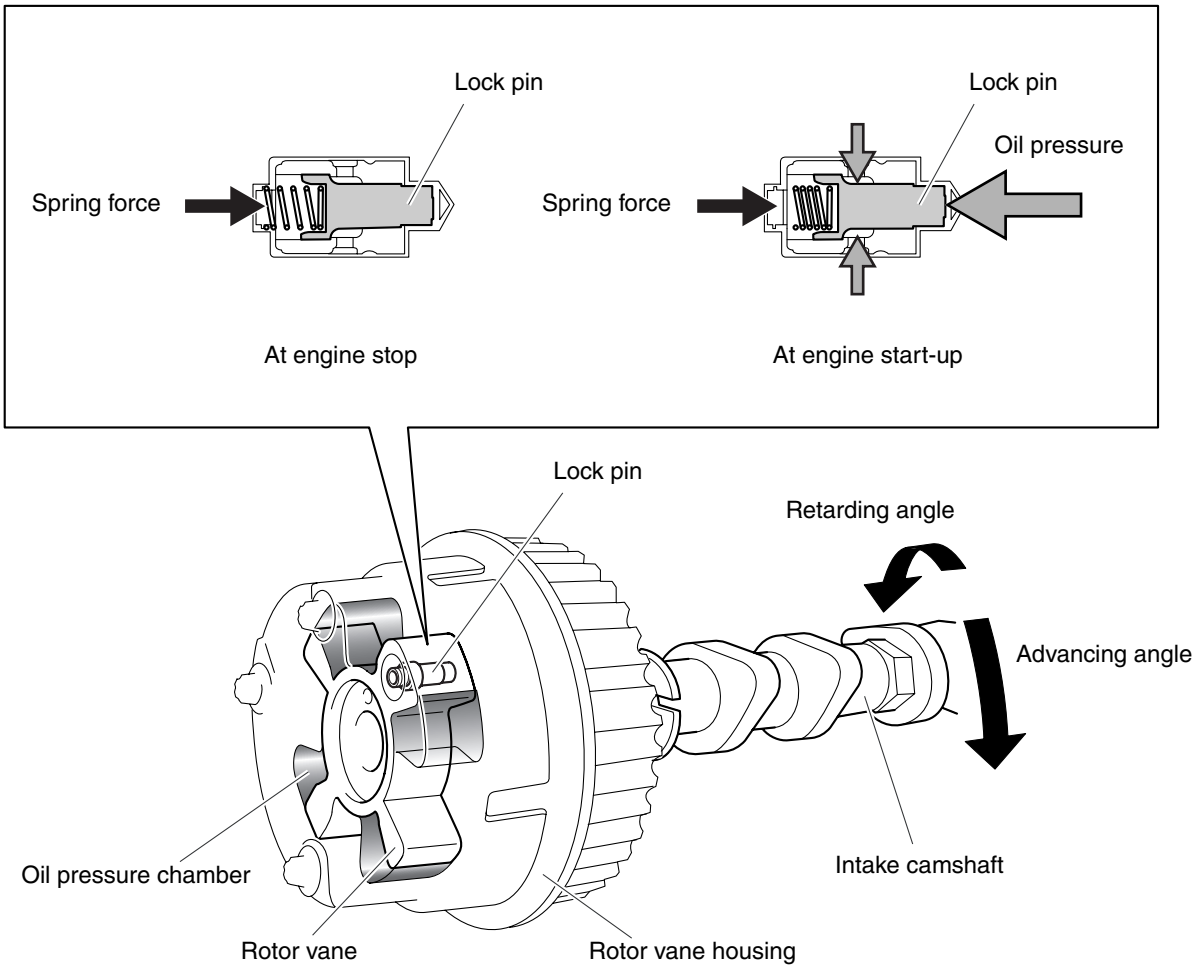
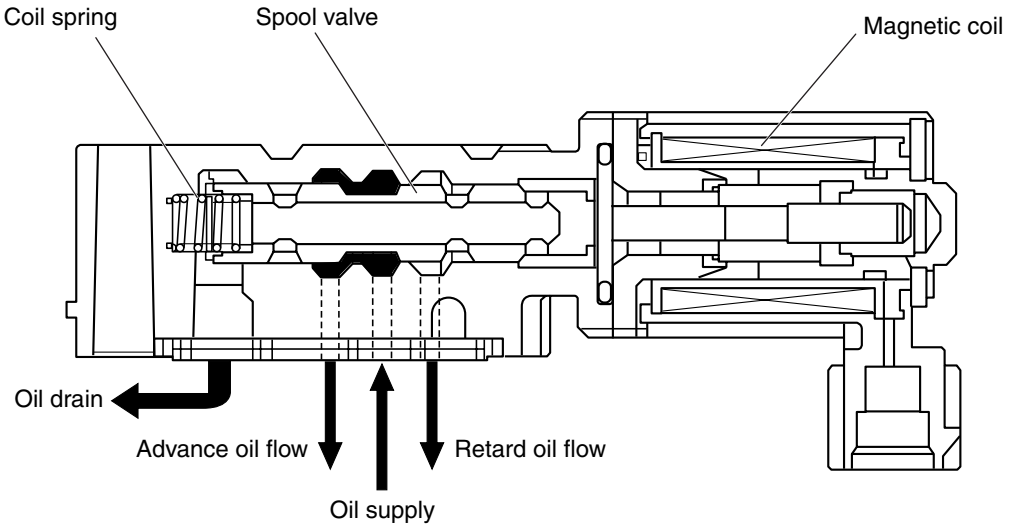
Construction and operation of the VCT unit

The VCT unit consists of a rotor vane and a rotor vane housing. Engine ECM operates the OCV according to the signals from each sensor. The OCV continuously varies the intake camshaft phase by controlling the oil pressure in the two oil pressure chambers (the advance chamber and the retard chamber) each of which is comprised of the housing and the vane, to move the vane relative to the housing in its circumferential direction. The intake valve opening and closing timing are optimized through this process. At engine start-up when the engine oil pressure is low, the rotor vane is locked to the housing by a lock pin. As engine speed increases after the start-up, the oil pressure rises to exert the control oil pressure on the lock pin. Consequently, the lock pin spring is compressed to release the lock pin.



Construction and operation of the OCV

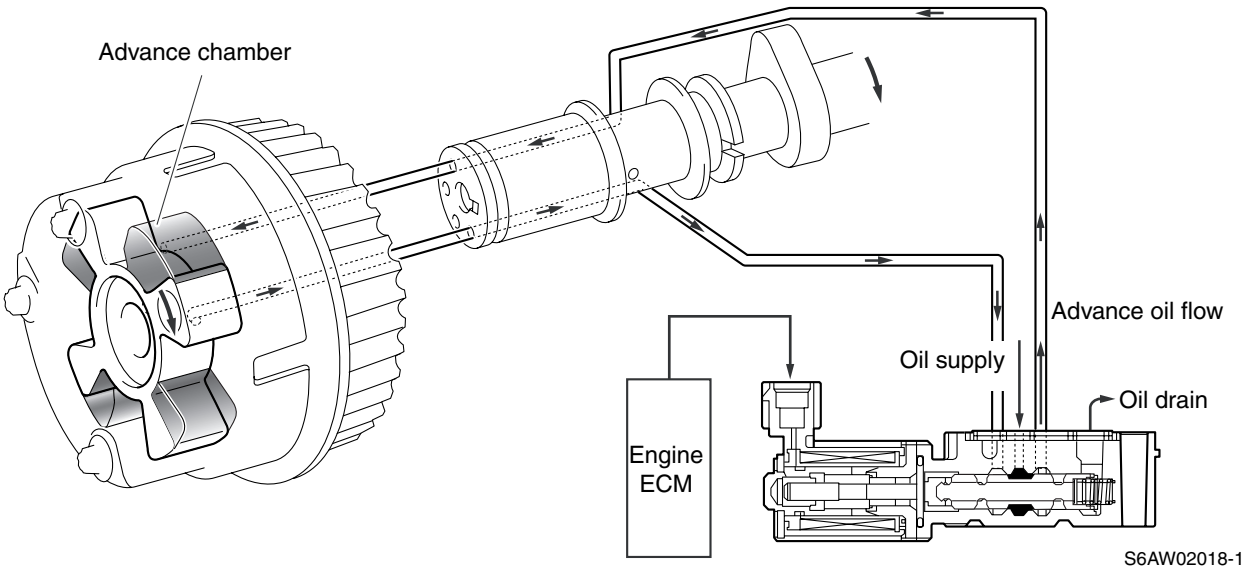
The OCV shifts the spool valve position according to the signals from engine ECM for switching the oil passage leading to the VCT unit, so that the optimized cam timing is maintained at any time.



S6AW02017

Advance timing

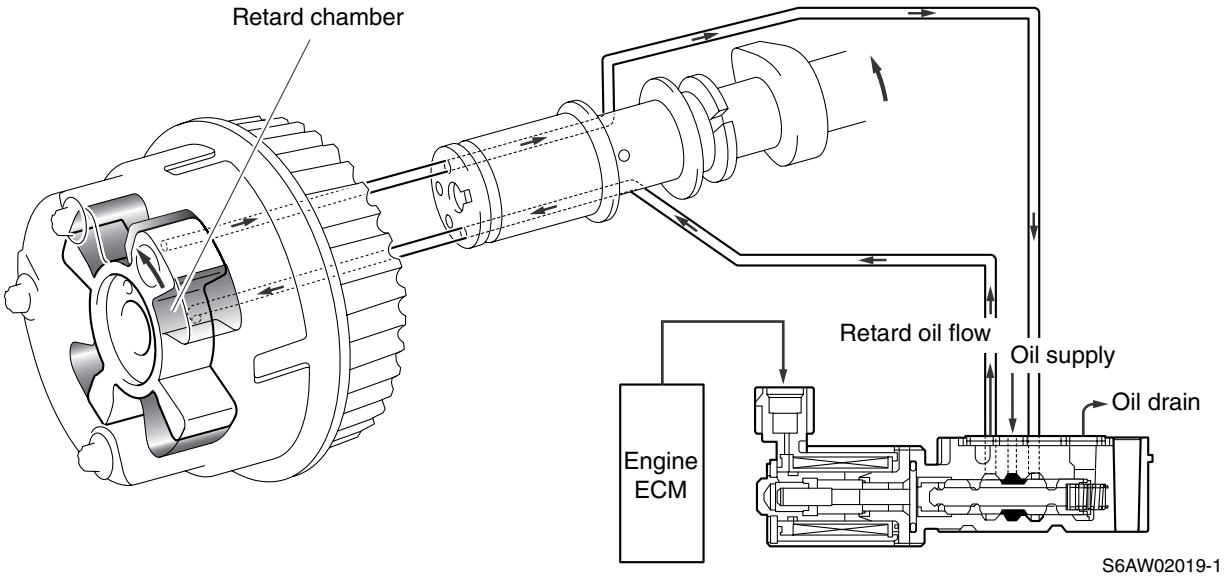
OCV is activated according to the signals from engine ECM, for shifting the spool valve position toward the coil spring. Engine oil is supplied to the passage leading to the advance chamber. As the engine oil pressure is exerted on the advance angle oil pressure chamber, the rotor vane is turned to the side of advanced angle. This makes the intake cam shaft rotate toward the advanced angle, as the intake cam shaft is fastened to the rotor vane by the bolts. The engine oil in the retard angle oil pressure chamber returns to the oil pan through the spool valve.



S6AW02018-1

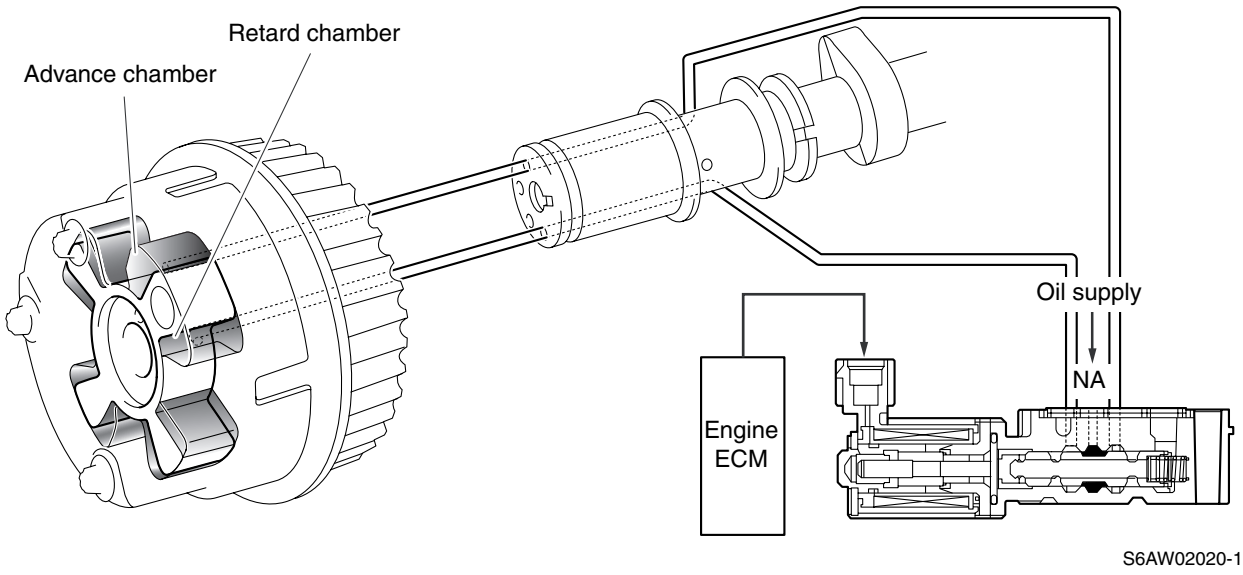
Retard timing

OCV is activated in accordance with the signals from engine ECM, for shifting the spool valve position toward the magnet coil. Engine oil is supplied to the passage leading to the retard chamber. As the engine oil pressure is exerted on the retard oil pressure chamber, the rotor vane is turned to the side of retard angle. This makes the intake cam shaft rotate toward the retard angle, as the intake cam shaft is fastened to the rotor vane by the bolts. The engine oil in the advance angle oil pressure chamber returns to the oil pan through the spool valve.



Maintenance timing

The engine ECM calculates the target cam timing based on the engine operating conditions, and carries out the control accordingly. Once the control to the target cam timing is completed, the oil passages are shut off by the spool valve to maintain the cam timing.

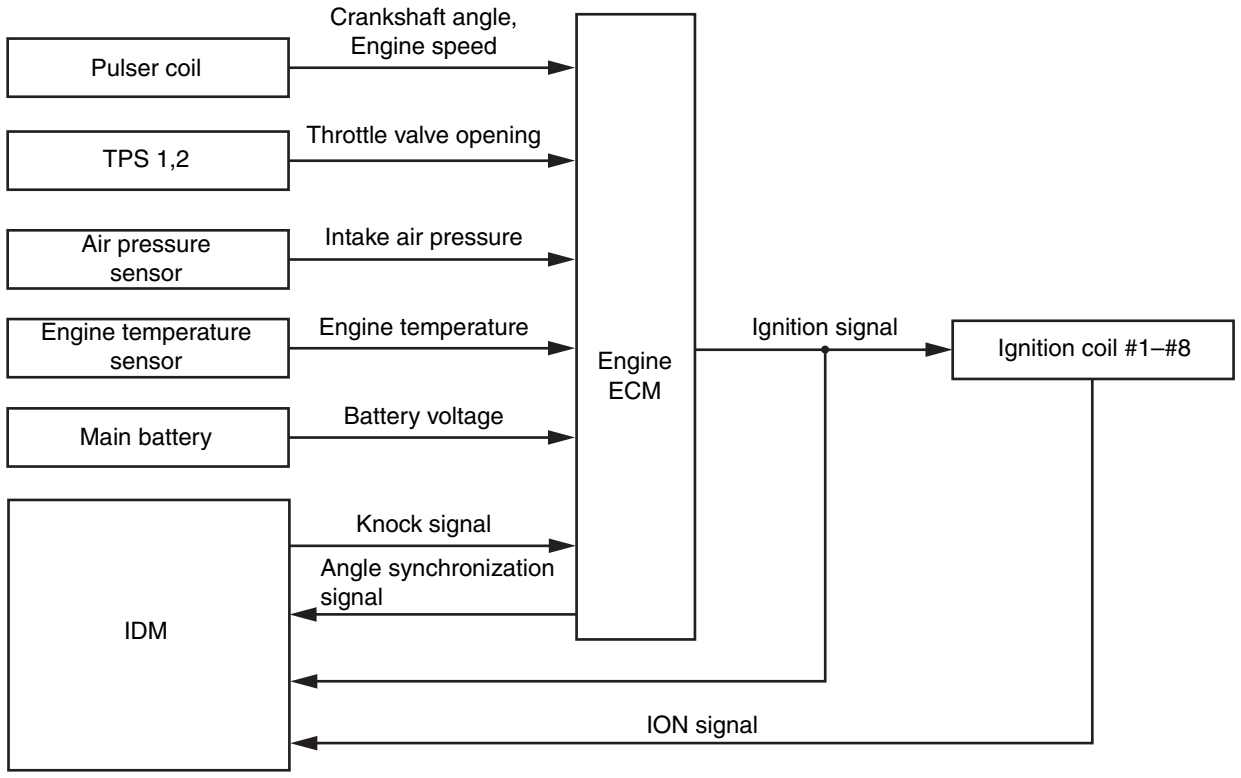


NA: Not available

Ion knock control system

IDM on F300/FL300 and F350/FL350 detects the ION signal generated by the knocking in operating engines, to determine the occurrence and the magnitude of the knocking event. Engine ECM retards the ignition timing in accordance with the knocking information transmitted by IDM to make it suppressed. Engine ECM learns the ignition timing at which the knocking occurred, and controls the ignition timing to avoid the knocking for safeguarding the engine.

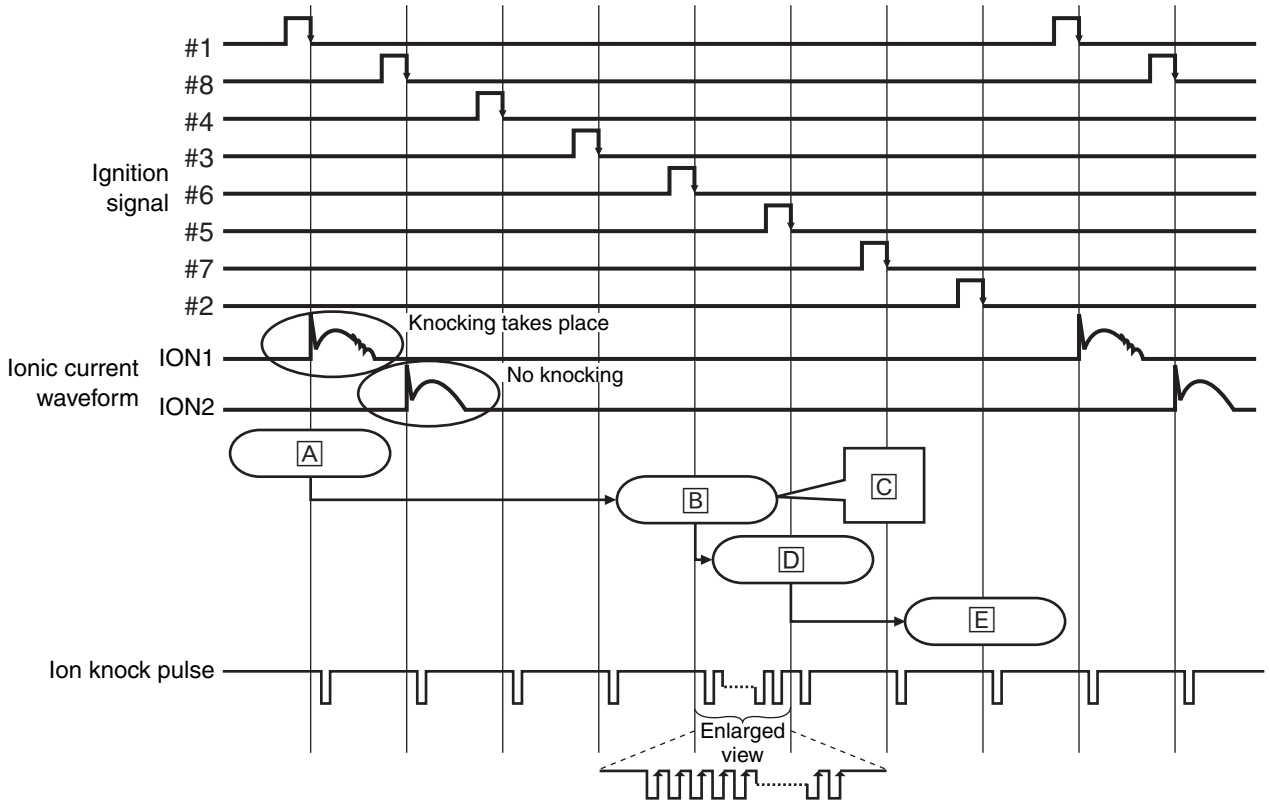
Block diagram



S6AW02021

The timing chart

This chart shows the ion knock control process from the occurrence of knocking to the completion of ignition timing retard.

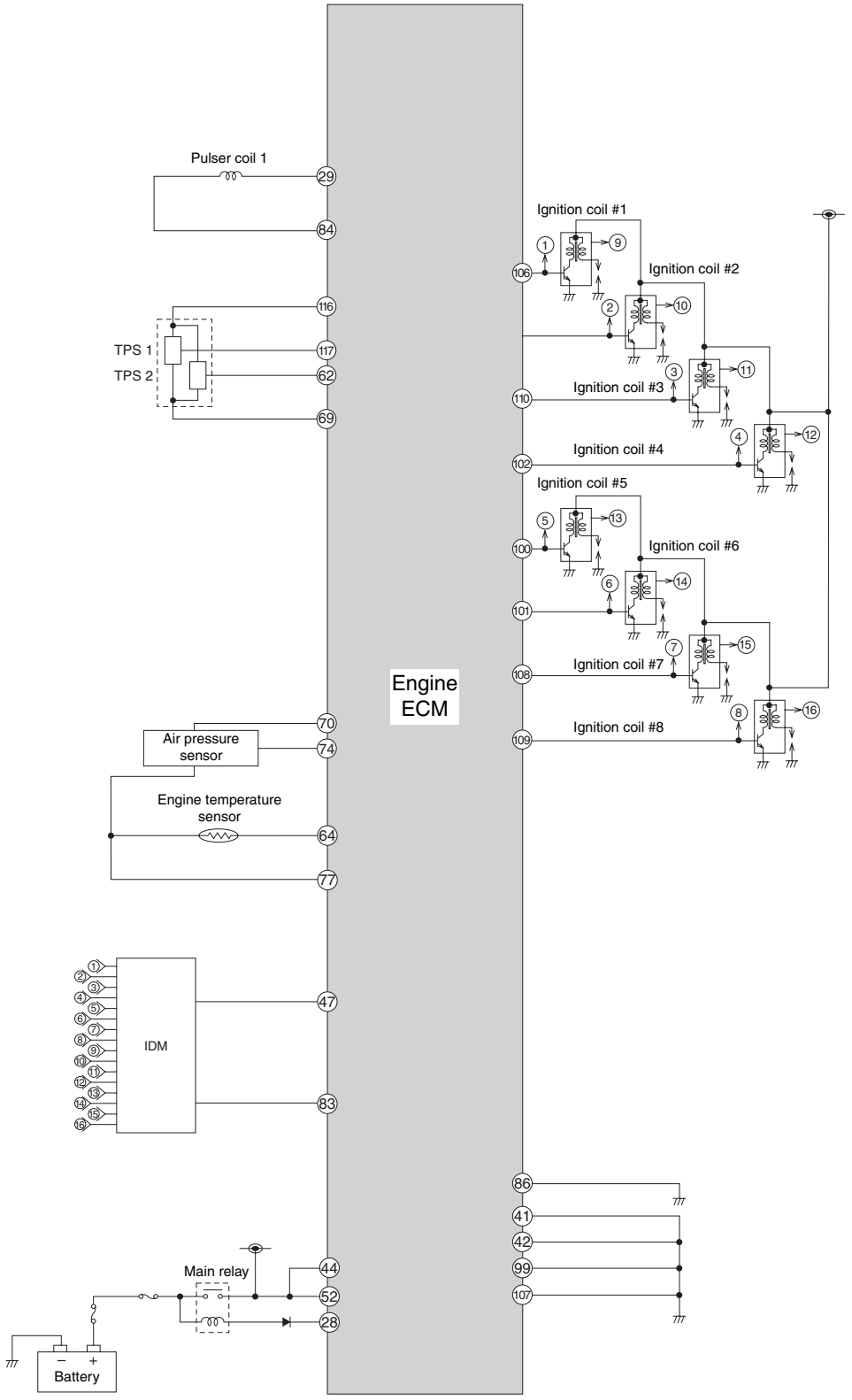


S6AW02022-1

A : Detects knocking event (IDM)
B : Sends knock signal (IDM)
C : IDM sends a signal ranging from level 1 through 9 depending on the severity of knocking.
For the pulse signal, however, at least 1 pulse signal will be sent out to detect any possible disconnection.
The pulse signal level ranges from 2 to 10.
Note that when one of the conditions listed below exists, it is defined as IDM failure mode and the pulse signal level is set to zero. No ion knock control will be performed.
- IDM failure
- IDM input ignition signal disconnected
- IDM input ION signal disconnected
- IDM input angle synchronization signal disconnected
- IDM output knock pulse line disconnected

D : Receives knock signal (Engine ECM)
E : Sends ignition retarding angle (IDM)

Circuit diagram



S6AW02023

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Engine speed control system

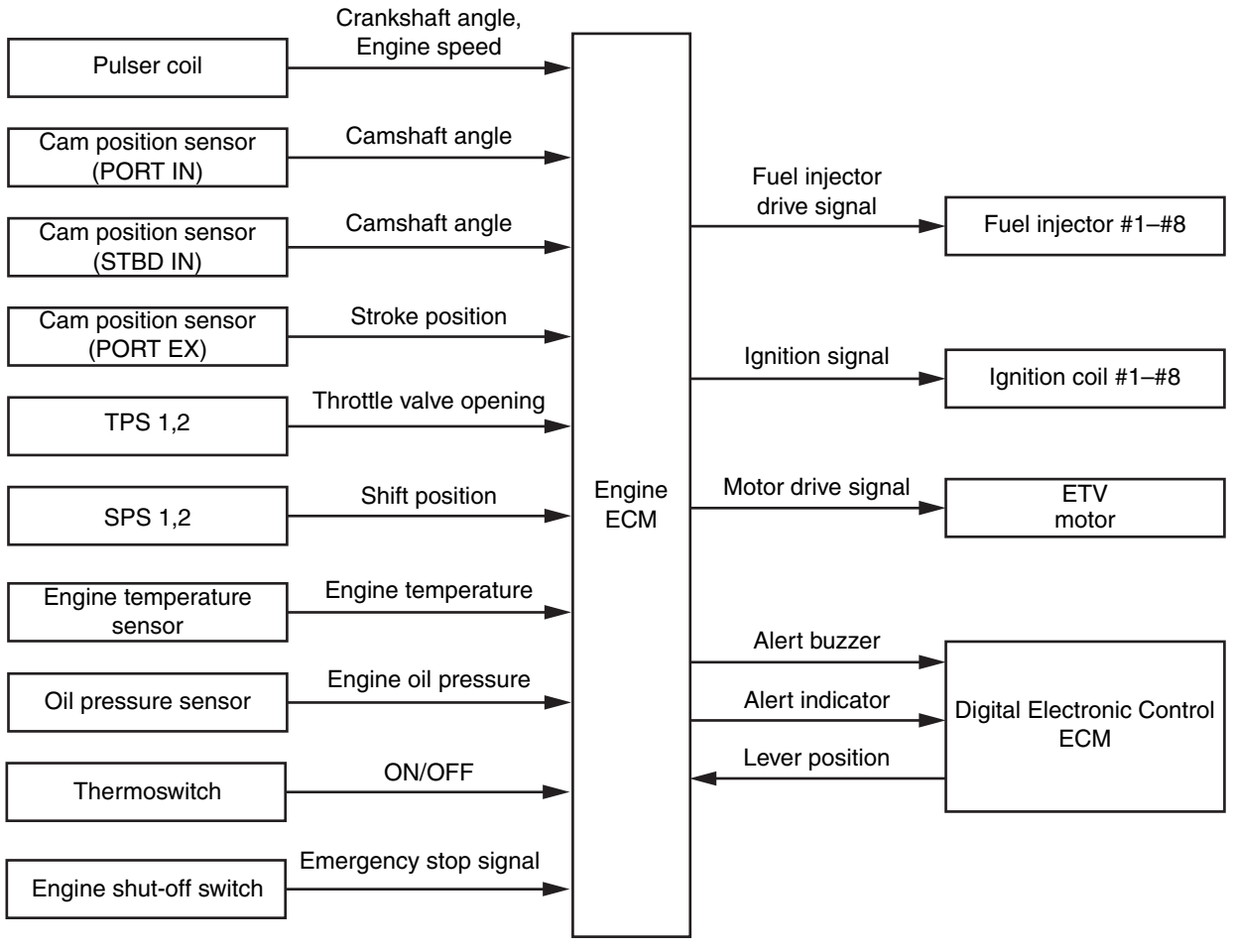
Engine speed control system on F300/FL300 and F350/FL350 reduces the engine speed in case of overheat and low oil pressure to prevent possible engine damages.

Control Name	Description	Engine condition
Overheat control	Detects the overheat event and the engine speed is controlled.	• Overheat is identified when thermoswitch is turned on and the engine temperature is at 120 °C or higher.
		• The engine ECM drops the engine speed to 2,000 r/min or lower by closing the throttle valve. It also turns on the alert buzzer and the overheat alert indicator.
Low oil pressure control	Detects the low oil pressure and the engine speed is controlled.	• Detects that the engine oil pressure is low when the oil pressure decreases to less than the specified value for the engine speed range.
		• The engine ECM drops the engine speed to 2,000 r/min or lower by closing the throttle valve. It also turns on the alert buzzer and the low oil pressure alert indicator.
M.E.S. Control	Detects the activation of M.E.S. and the engine speed is controlled.	• M.E.S switch is turned on in the event of an overheat alert or a low oil pressure alert, and the alert buzzer goes off.
		• Then, the engine ECM drops the engine speed to 2,000 r/min or lower by closing the throttle valve.
Shift-cutout control at reverse rotation	Shuts off the engine if the engine reverse rotation is detected.	• Engine reverse rotation is identified by the two parameters; presence or absence of the cam position sensor (EX) signal, and the actual advance angle of the intake cam shaft.
		• If the reverse rotation is identified, engine ECM cuts off the ignition and fuel injection to stop the engine. Gearshift is returned to the neutral position.

Control Name		Description	Engine condition	
Skip-firing control		Carries out the skip-firing control based on the criteria in the table below:		
	ETV is locked in an open position.	Controls the engine speed when ETV is determined to have got locked in an open position.	Over 1,501 r/min	Firing will be skipped in all cylinders.
			1,427–1,500 r/min	Firing will be skipped at cylinders #8, #4, #3, #6, #5, #7, and #2.
			1,356–1,426 r/min	Firing will be skipped at cylinders #8, #4, #3, #5, #7, and #2.
			1,286–1,355 r/min	Firing will be skipped at cylinders #8, #4, #3, #5, and #2.
			1,216–1,285 r/min	Firing will be skipped at cylinders #8, #3, #5, and #2.
			1,142–1,215 r/min	Firing will be skipped at cylinders #8, #3, and #5.
			1,071–1,141 r/min	Firing will be skipped at cylinders #8, and #5.
			1,001–1,070 r/min	Firing will be skipped at cylinders #8.
	When over-rev. taken place.	Controls the engine speed when over-rev. is detected.	Over 6,501 r/min	Firing will be skipped in all cylinders.
			6,415–6,500 r/min	Firing will be skipped at cylinders #8, #4, #3, #6, #5, #7, and #2.
			6,380–6,414 r/min	Firing will be skipped at cylinders #8, #4, #3, #5, #7, and #2.
			6,345–6,379 r/min	Firing will be skipped at cylinders #8, #4, #3, #5, and #2.
			6,310–6,344 r/min	Firing will be skipped at cylinders #8, #3, #5, and #2.
			6,274–6,309 r/min	Firing will be skipped at cylinders #8, #3, and #5.
			6,235–6,273 r/min	Firing will be skipped at cylinders #8, and #5.
			6,200–6,234 r/min	Firing will be skipped at cylinders #8.
	Under shift-cut-out control	Detects the activation of shift-cutout control, and controls the engine speed.	Reduces the engine speed to the extent that the gearshift can be disengaged safely.	
	Engine shut-off switch ON	Cancels the fuel injection control and the ignition control at all cylinders.		

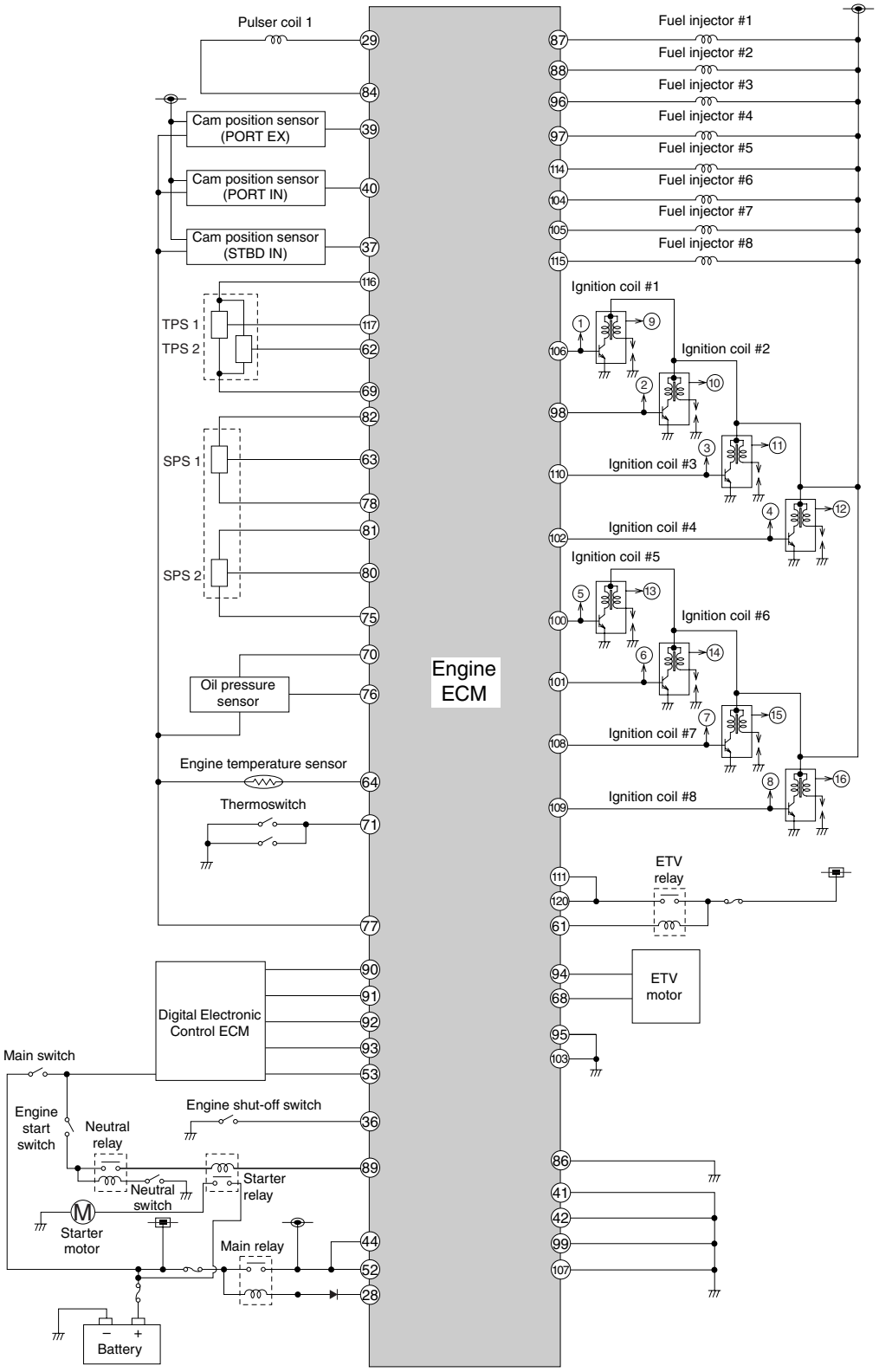
Control Name	Description	Engine condition
Throttle opening restriction control	Restricts the ETV opening based on the criteria in the table below:	
Under overheat control, low oil pressure control, or M.E.S. control	Controls the engine speed when overheat control, low oil pressure control, or M.E.S. control is detected.	• Restricts the elevation of target throttle opening when any one of the alerts is activated.
When Digital Electronic Control is failed	SPS, LPS, Abnormal communications	• Restricts the elevation of target throttle opening when the Digital Electronic Control alert and any trouble codes are appeared.
When Control lever/gear-shift conditions are inconsistent	Controls the throttle valve to the fully closed position.	• Sets the throttle valve at the fully closed position to control the engine speed until the control lever position agrees with the shift-actuator rod position.

Block diagram



S6AW02024

Circuit diagram



S6AW02025

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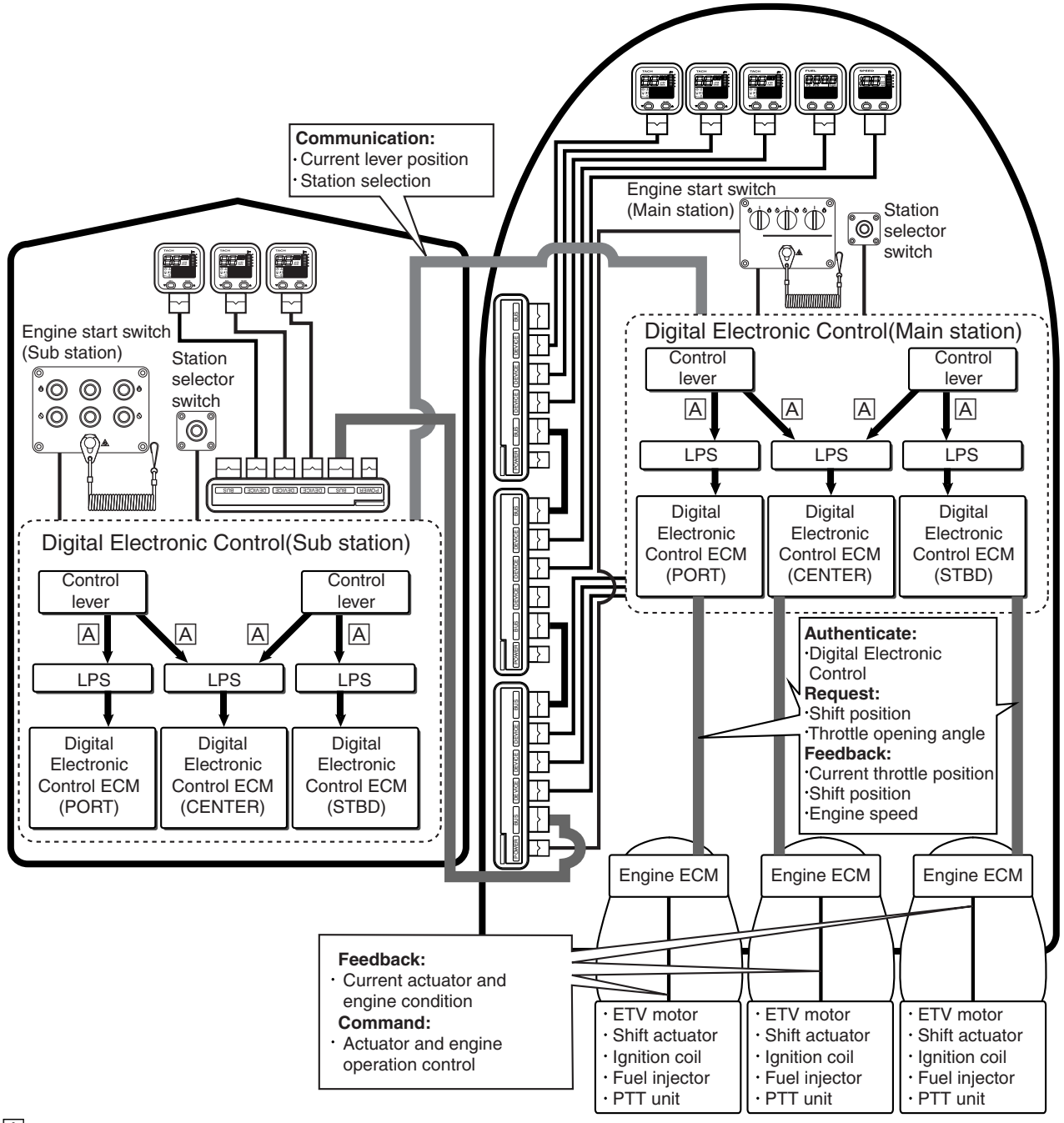
Digital Electronic Control

F300/FL300 and F350/FL350 features Digital Electronic Control that eliminates mechanical cables for controlling the throttle position and the gearshift. Actions on the control lever related to the gearshift and the throttle opening/closing are converted into the electric signals and transmitted to the engine ECM by the Digital Electronic Control ECM. Gearshift and throttle operating load is adjustable to the user's preference. Unimpeded, dependable shift-in and shift-out motions, as well as the outperforming quietness are attained by the introduction of shift-in/shift-out control system and the electric shift actuator. Authentication system is also implemented by which the mutual authentication is performed between Digital Electronic Control ECM and the ECM to assure the system security and provide anti-theft function for the outboard motor unit.

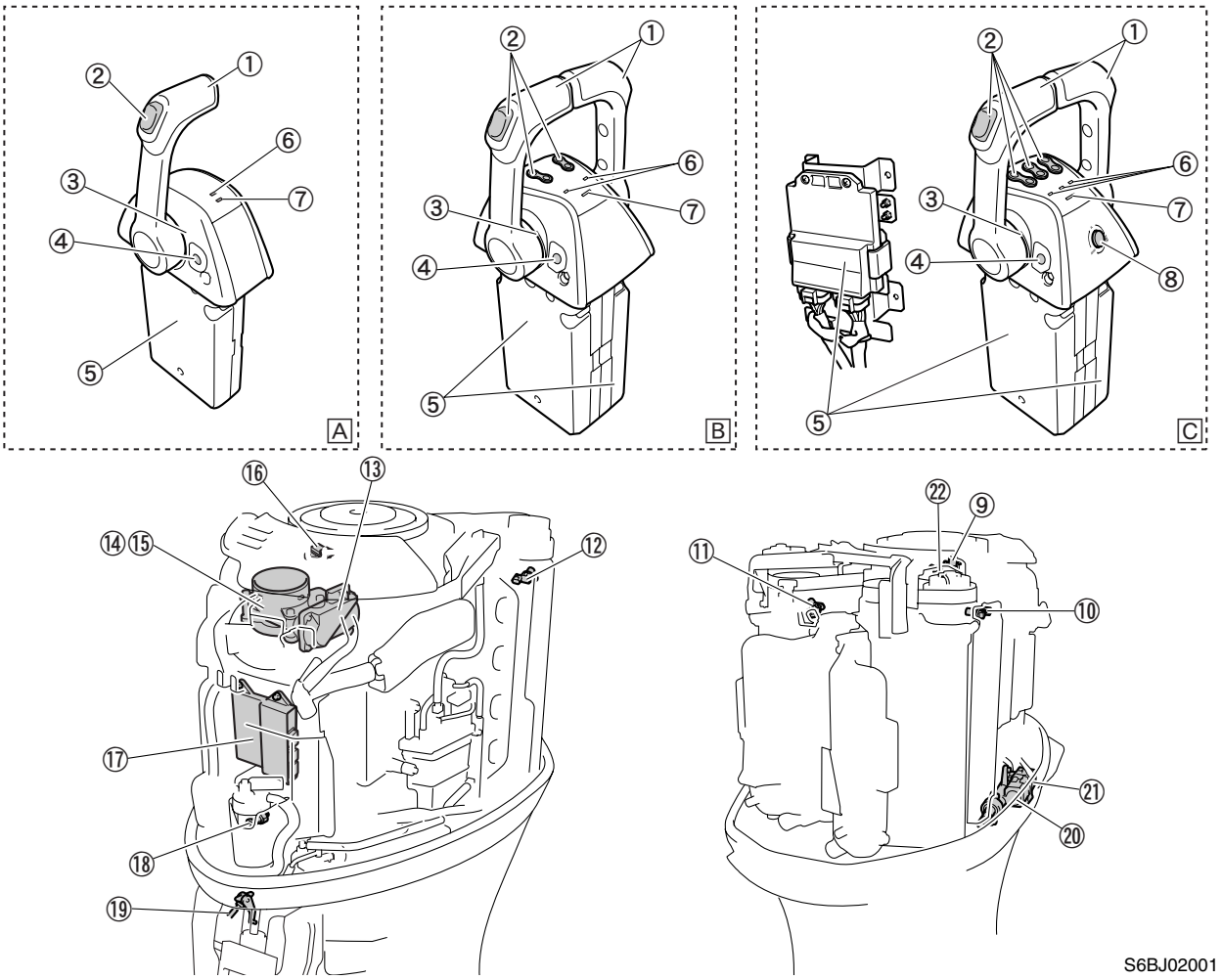
Digital Electronic Control diagram



A Actual control lever position

S6BJ02002

Digital Electronic Control component



A Single type
B Twin type
C Triple type

① Control lever
② PTT switch
③ LPS 1, 2
④ Free throttle switch
⑤ Digital Electronic Control ECM
⑥ Active indicator
⑦ Alert indicator
⑧ Engine selector switch
⑨ Pulser coil
⑩ Cam position sensor (STBD IN)
⑪ Cam position sensor (PORT EX)
⑫ Cam position sensor (PORT IN)
⑬ TPS 1, 2
⑭ ETV motor
⑮ ETV assembly
⑯ Air pressure sensor
⑰ Engine ECM
⑱ Oil pressure sensor
⑲ PTT sensor
⑳ Shift actuator
㉑ SPS 1, 2
㉒ Engine temperature sensor

Digital Electronic Control system

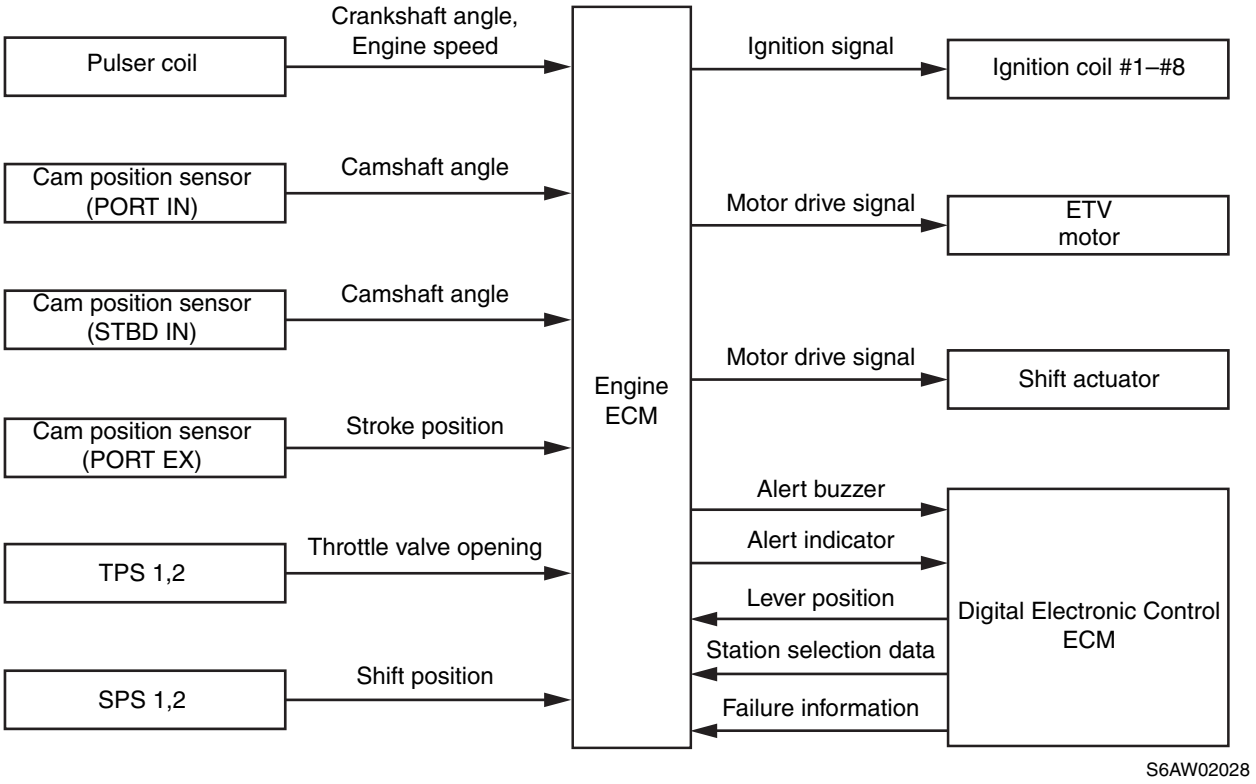
System start-up, system stop	System start-up	Turn the engine start switch from “OFF” to “ON” position for starting up the system. As the engine start switch is turned to “ON” position and the system get started, it enables the engine start-up, electronic shift control, electronic throttle control, and PTT operation at the Digital Electronic Control.
	Authentication System	Mutual authentication is performed between Digital Electronic Control ECM and the engine ECM to assure the system security and to provide the anti-theft function for the outboard motor. Authentication is carried out automatically as the engine start switch is turned to “ON” position. The engine start-up procedures, the electronic shift control and the electronic throttle control are not worked unless the Digital Electronic Control ECM and the engine ECM match with each other.
	System stop	The system stops when the engine start switch is turned “ON” to “OFF” position.
Engine start-up, engine stop	Engine start-up	Engine cranking takes place when the engine start switch is turned to “START” position (either at the main station or at the sub-station) while the battery and wiring harness connections are in normal status, the engine start switch is at “ON” position, and the shift position is determined to be in the neutral position. If the mutual authentication has failed between the Digital Electronic Control ECM and the engine ECM, the engine does not start because the ignition control and the fuel injection control are not activated. Sometimes the control lever position and the shift position do not coincide in the Digital Electronic Control. The neutral position is identified by the neutral position detecting circuit in the Digital Electronic Control ECM and the neutral switch disposed on the control lever.
	Engine stop	Engine may be stopped at either of the stations, in the same manner as the “system stop.”
Electronic shift control system	Shift-in control	Unimpeded gearshift engagement is provided by the shift actuator when the shift lever is moved from neutral to forward (or reverse).
	Shift-out control	Unimpeded gearshift disengagement is provided by the shift actuator when the shift lever is moved from forward (or reverse) to neutral.
	Shift-cutout control	In heavy load operations, trying to disengage the dog clutch from the forward gear or from the reverse gear will cause extremely high contact pressure between the clutch and the gear. The engine speed is dropped to reduce such contact pressure for easy clutch disengagement.
	Free throttle control	Throttle control can be performed without activating the gearshift by pressing the free throttle switch while both the control lever position and the shift position are in neutral.
	High speed shift-in protection control	When control lever is moved from the wide-open forward position toward wide-open reverse position, the high speed shift-in protection control hinders the gearshift operation until the engine speed is dropped to the appropriate level.

ETV control system	Standard throttle control	Throttle opening or closing motion by the control lever is converted into the electric signal by the Digital Electronic Control ECM and sent to the engine ECM as a request throttle opening value. The throttle valve is adjusted by the engine ECM to the proper opening taking account of the operating conditions.
	Variable trolling speed control	Variable trolling speed control is performed by the multi-function meter. The trolling speed is adjustable by 50 r/min increments from the idle speed up to 1,000 r/min at the highest.
	Synchronizing control	While the relative position of the two control levers falls within the synchronizing control allowable range, starboard or center engine speed is controlled to match the port engine speed.
PTT control		The engine ECM learns the tilt limit position, and sends the command to stop the outboard motor at the specified tilt limit position.
Fail-safe control		• In case the failure takes place in the Digital Electronic Control, system alert is displayed on the 6Y8 Multifunction Meter or on the Digital Electronic Control box.
		• The Digital Electronic Control ECM activates the M.E.S. control immediately after it received the M.E.S. switch information from the engine ECM.

Electronic shift control system

The electronic shift control system operates the shift-actuator based on the Digital Electronic Control communication data transmitted by the Digital Electronic Control ECM.

Block diagram



Shift-in control

Unimpeded gearshift engagement is provided by the shift actuator when the shift lever is moved from neutral to forward (or reverse).

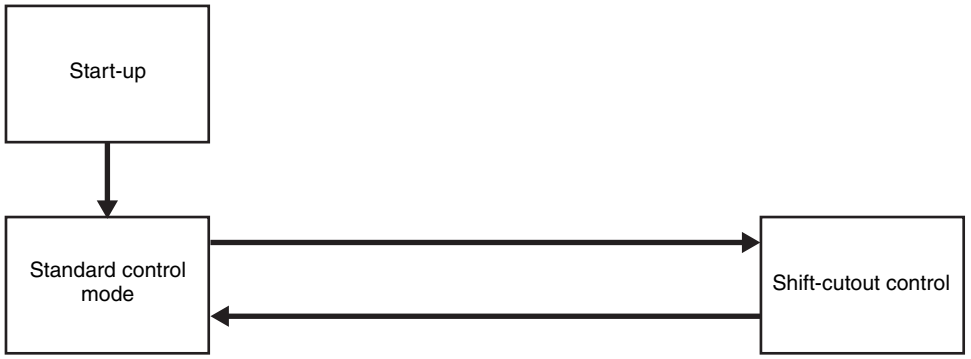
Shift-out control

Unimpeded gearshift disengagement is provided by the shift actuator when the shift lever is moved from forward (or reverse) to neutral.

Shift-cut control

When it is hard to disengage the gearshift in heavy load operations, shift-cutout control is implemented to drop the engine speed for easy disengagement. The shift-cut switch is eliminated by the introduction of the Digital Electronic Control. The shift-cut control is activated and canceled automatically when the control criteria are met.

Status transition chart



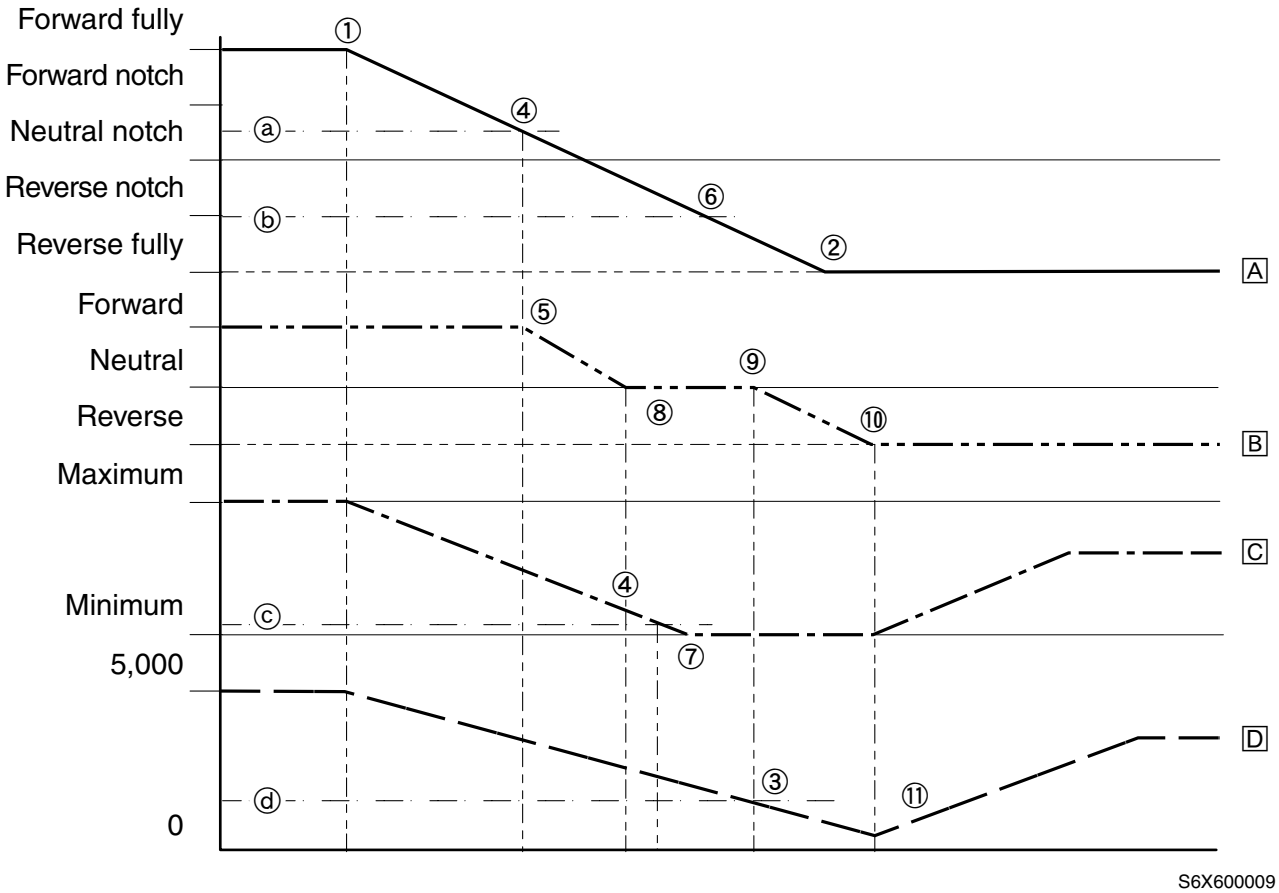
S6AW02031

Free throttle control

Free throttle mode is activated by moving the control lever to forward or reverse while keeping the free throttle switch in the pushed-in position. Continuously illuminated active indicator starts flashing on and off when the free throttle mode is activated. Check for the flashing active indicator, and release the free throttle switch. The free throttle control is also valid when the control lever is moved to the reverse side. It is canceled when the free throttle switch is turned off and the control lever is returned to the neutral position. The active indicator stops flashing and illuminates continuously.

High speed shift-in protection control

Assume that a hard control lever operation, from fully open forward position ① directly to fully open reverse position ②, for instance, was made while the engine speed is higher than the predetermined level. In such case, the Digital Electronic Control ECM prohibits the gear-shift until the engine speed comes down to the range below the point ③, in which the gear-shift is enabled. Then, shifting to neutral starts ⑤ once the control lever is moved beyond the gear-shift enabling threshold ④. Even after the control lever reaches the reverse gear-shift point ⑥, the throttle valve is kept at fully closed position ⑦ and the actual gear-shift is kept at neutral ⑧ by the engine ECM until the engine speed reaches the point ③ where the gear-shift is enabled. Once the engine speed comes down to the point ③, gear-shift operation to reverse ⑨ starts. After the gear-shift operation ⑩, the throttle opening is controlled to the position corresponding to the Digital Electronic Control lever position ⑪. Similar control process is taken when a hard operation of the control lever was made from fully open reverse position to fully open forward position.



S6X600009

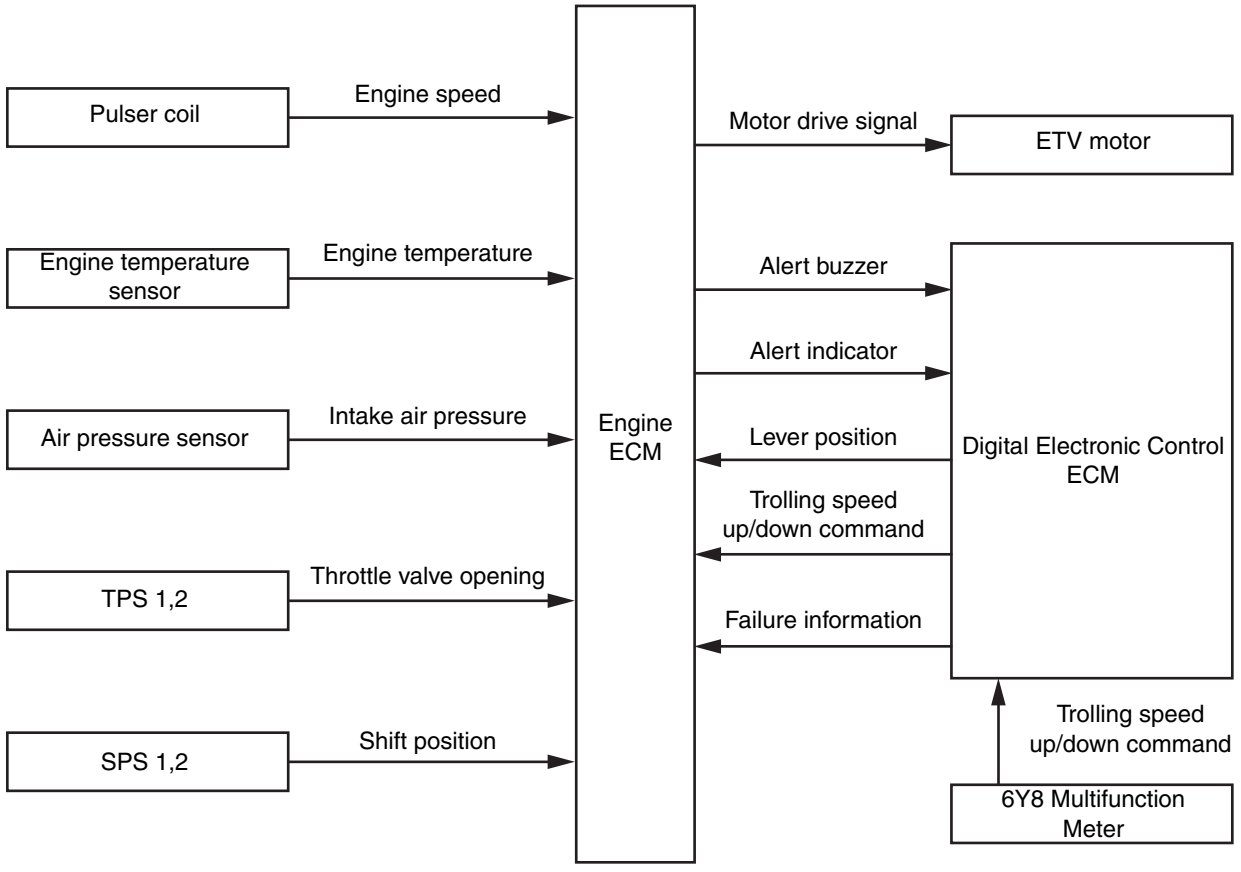
A Control lever position
B Actual control lever position
C Actual throttle opening
D Engine speed (r/min)

ⓐ Forward to neutral switching limen range
ⓑ Reverse position
ⓒ Gear-shift enabling throttle position
ⓓ Engine speed enabling gear-shift

ETV control system

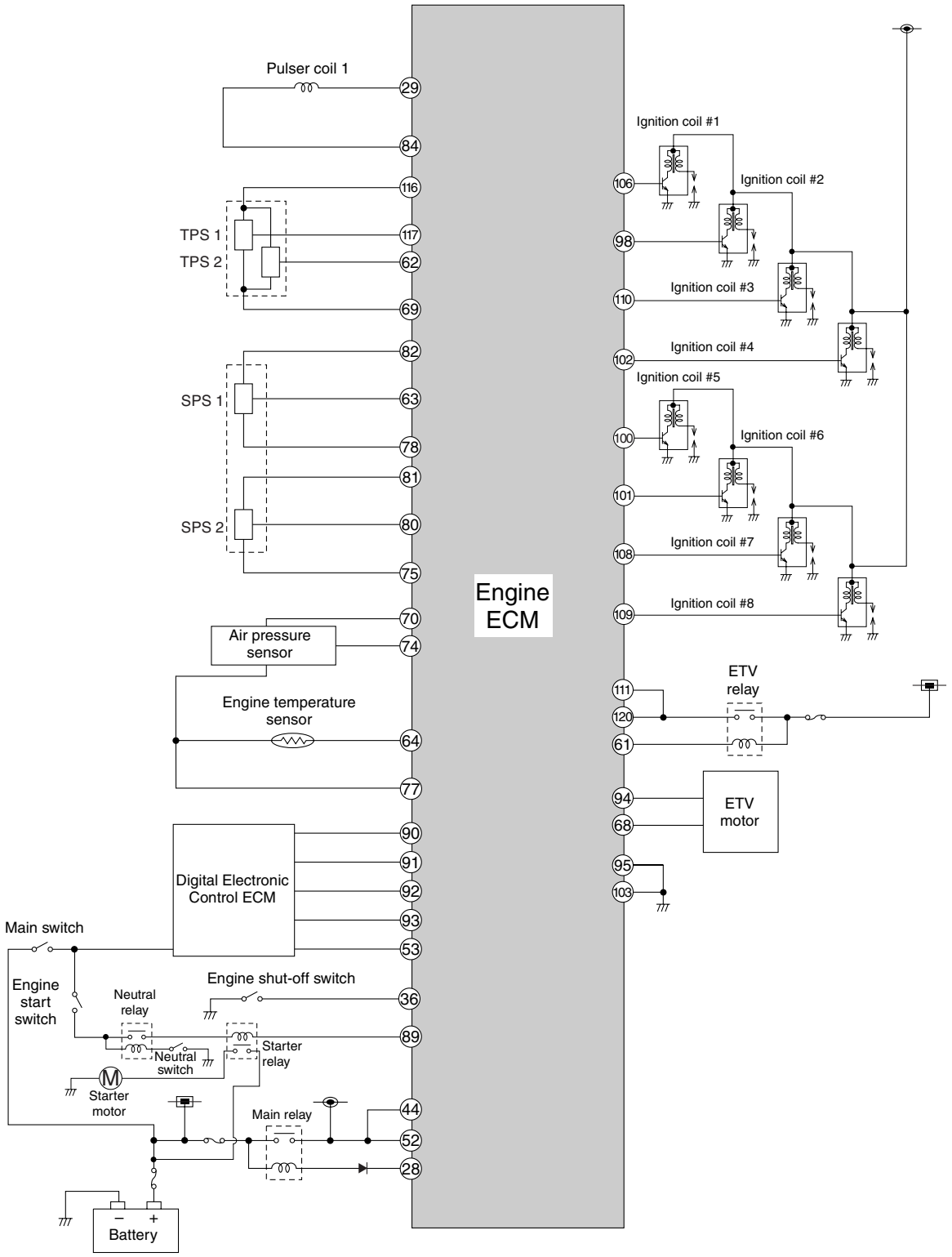
Throttle opening or closing operation by the control lever is converted into the electric signal, and the throttle valve is adjusted by the ECM to the proper opening taking account of the detected operating conditions. Electronically-controlled single throttle valve is used. Dual system (main station and sub station) is applied for both LPS and TPS inner circuits to carry out mutual monitoring against the sensor failure. If the TPS double error is detected, failure control is activated to lock the throttle valve opening at the given position, and to control the ignition timing in accordance with the throttle opening information from LPS. If the LPS double error is detected, the throttle valve is controlled to take the fully closed position, and the engine speed is kept constant regardless of the control lever movement.

Block diagram



S6AW02034

Circuit diagram



S6AW02071

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Standard throttle control

Control lever movement given by the operator is transmitted by the LPS 1, 2 disposed on the control lever to the engine ECM via the Digital Electronic Control ECM. The engine ECM in turn determines the target throttle valve opening taking account of the detected operating conditions, and drives the electronically-controlled throttle motor. The actual throttle valve opening is transmitted to ECM by TPS 1, 2. The engine ECM identifies the deviation of the actual throttle valve opening from the target, and carries out the feed back control to obtain the proper throttle valve opening.

Variable trolling speed control

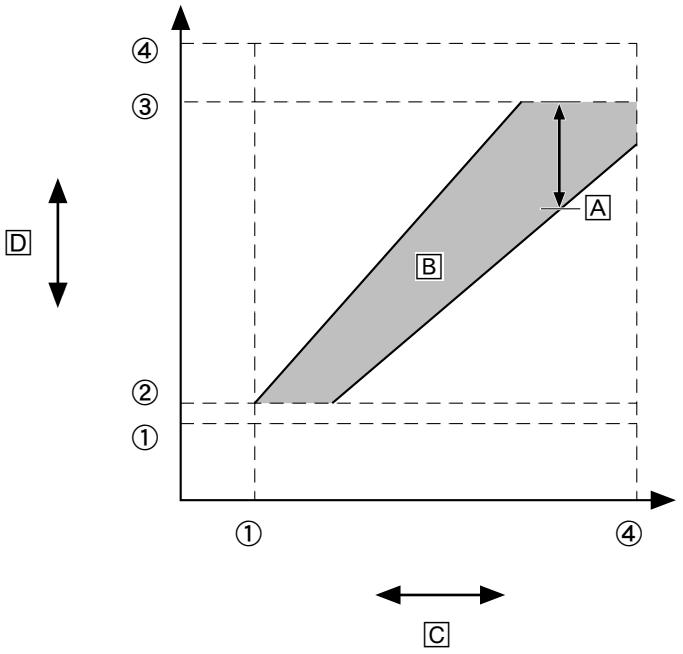
Variable trolling speed control is provided. Trolling speed is adjustable on the 6Y8 Multifunction Meter by 50 r/min increments ranging from idle speed (600 r/min) to 1,000 r/min.

Variable trolling speed control is canceled once the engine speed exceeds 3,000 r/min, and the standard control mode is resumed. It is also canceled when the shift position is returned to neutral.

Synchronizing control

This control is used to synchronize the engine speeds for the twin installation. When the relative positioning of the control levers for the twin type stays within the synchronizing control enabling value range for the specified period of time, the engine speed of the STBD outboard motor is synchronized with the engine speed of the PORT outboard motor.

The same applies to the triple outboard motor installation model. Under the synchronizing control, the center outboard motor runs at the same speed as the PORT outboard motor. For the behavior without synchronizing control, see “Digital Electronic Control service manual.” The synchronization control is canceled once the angular difference between the two control levers is out of the predetermined control range.



S6AW02035

A Angular difference of the 2 control levers
B Synchronization control activating range
C PORT lever position
D STBD lever position

① Forward fully closed
② Lower limit of the synchronization control
③ Upper limit of the synchronization control
④ Forward fully open

Conditions to carry out the synchronization control(*1) (when all the following conditions are met.)

1. Gear-shift is in forward for both the PORT and the STBD, or the center outboard motors.
2. The Digital Electronic Control lever position (STBD) falls within the synchronization control range.
3. The angular difference of the control levers falls within the synchronization control range.
4. The throttle valve opening of the STBD and the center outboard motors fall within the synchronization control range.
5. The engine speed falls within the synchronization control range for both the PORT and the STBD, or the center outboard motors.
6. The difference in engine speed between the PORT and the STBD, or the center outboard motors fall within the synchronization control range.
7. When the fail safe occurs, this synchronization control is canceled.

Conditions to synchronization control is not executed(*1) (when any of the following conditions are met.)

1. The shift position of either the PORT, or the STBD, or the center outboard motor is in neutral.
2. Shift position different between the PORT and the STBD, or the center outboard motor.
3. The Digital Electronic Control lever position (STBD) is out of the synchronization control range.
4. The angular difference of the control levers is out of the synchronization control range.
5. The throttle valve opening of the STBD, or the center outboard motor is out of the synchronization control range.
6. The engine speed of either the PORT, or the STBD, or the center outboard motor is out of the synchronization control range.
7. The difference in engine speed between the PORT and the STBD, or the center outboard motors is larger than the specified value.
8. Some failure that causes the restricted engine speed is active.

(*1) Applicable to the multiple engine installation

Triple outboard motor operation

Since the gear-shift and throttle operations are carried out by digital communication, three outboard motors are now able to be operated by the twin lever on the Digital Electronic Control box. Also, the engine selector switch enables a boat operator to change the mode of operable outboard motor among “P, C, and S mode” in which the PORT, center, and STBD outboard motors are operable, “P and S mode” in which the PORT and STBD outboard motors are operable, and “C mode” in which the center motor is operable. For details of triple outboard motor operation, see “Digital Electronic Control service manual.”

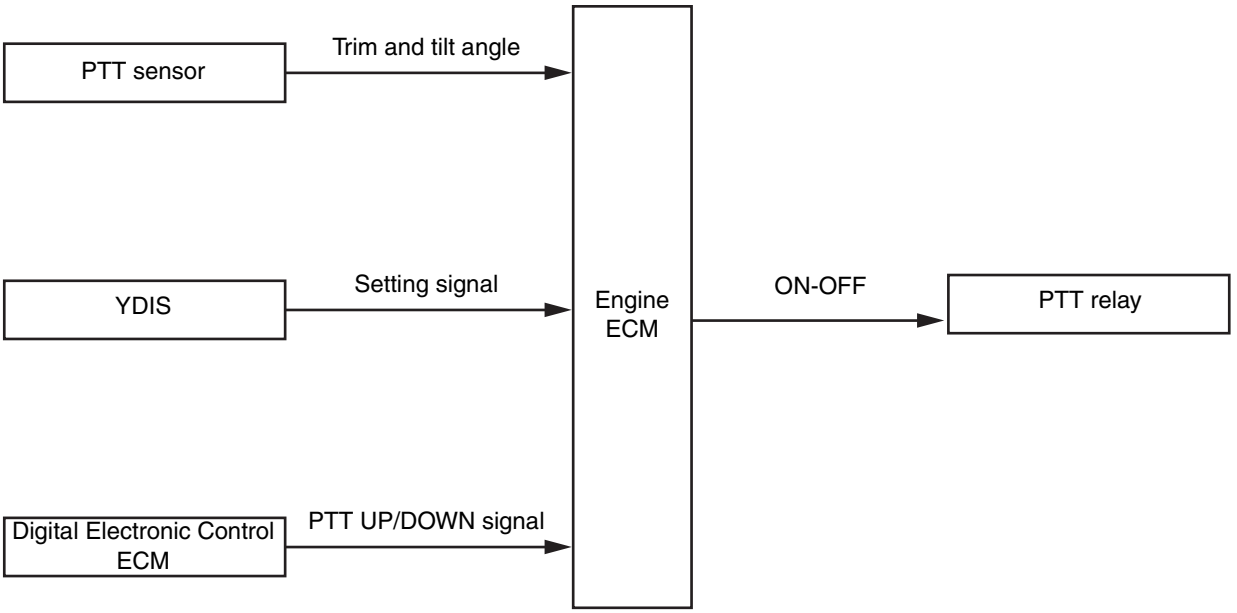
PTT control

Tilt angle limiter setting function is introduced in the PTT control. Connect a personal computer installed with YDIS (Ver. 1.30 or later) to the engine for setting the tilt limit position. This prevents the possible interference of the boat hull with the top cowling in the tilt-up position. The allowable range for setting the tilt limit position is within approx. 53 and 66 degrees. The engine ECM is responsible for the tilt limit control.

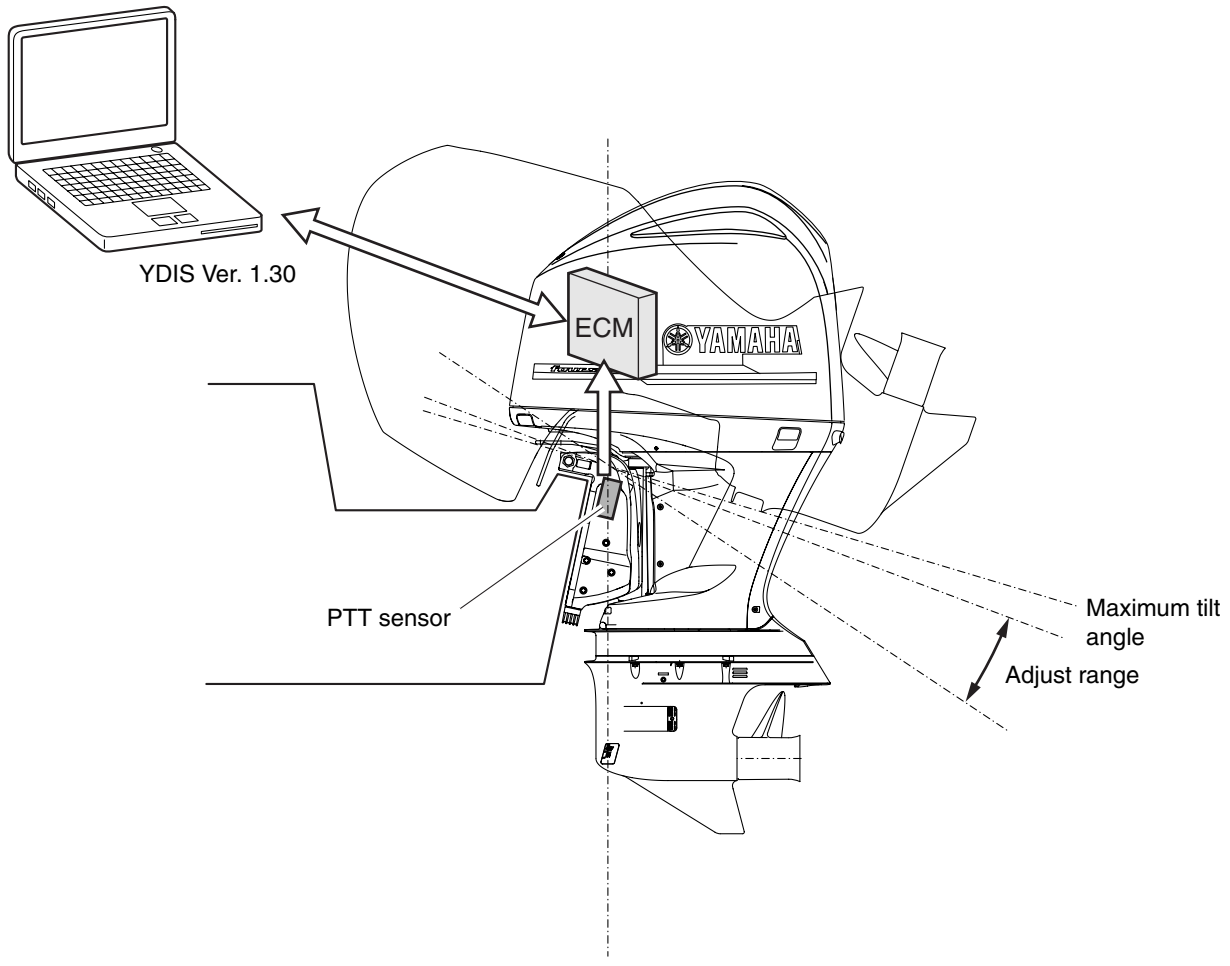
Tilt angle limiter setting is enabled when the following conditions are met:
1. ON-OFF signal of the PTT UP/DOWN switch is not being transmitted by the Digital Electronic Control ECM or the engine ECM.
2. YDIS Ver. 1.30 is connected and the tilt limiter setting operation has been completed.
3. Currently the outboard motor is positioned within the tilt limiter setting range.
4. The engine is not in operation, and the engine start switch is at “ON” position.

Tilt angle limiter setting is canceled when the following conditions are met:
1. ON-OFF signal of the PTT UP/DOWN switch is not transmitted by the Digital Electronic Control ECM or the engine ECM.
2. YDIS Ver. 1.30 is connected and the tilt limiter canceling operation has been completed.
3. The engine is not in operation, and the engine start switch is at “ON” position.
4. Trim sensor failure control is active.

Block diagram



S6AW02036



S6AW02037-1

Fail-safe control

If the electrical components malfunction, the engine ECM controls the ignition, fuel injection, VCT, and so on, as shown in the table.

Trouble code	Malfunction components	Criterion	Ignition control	Fuel injection control	VCT control	Remarks
13	Pulser coil	No signal	Back up by EX cam position sensor	Back up by EX cam position sensor.	Normal control	
24, 71, 72	Cam position sensor	Signal error (Irregular)	EX cam; Back up by pulser coil, and shifts to group ignition, and fix to BTDC 10°. IN cam; Normal control	EX cam; Back up by pulser coil, and shifts to group injection. IN cam; Normal control	Fix to fully retard position.	
124, 125,126, 127, 128	TPS	Output voltage has detected below 0.35 V, or above 4.80 V, or abnormal characteristic outputs.	Controlled by intake air pressure	Controlled by intake air pressure	Fix to fully retard position.	Fixed to specific throttle valve angle.
29	Air pressure sensor	Output voltage has detected below 0.20 V, or above 4.50 V	Controlled by throttle position	Controlled by throttle position	Normal control	Idle up (900 r/min)
15	Engine temperature sensor	Output voltage has detected below 0.18 V, or above 4.90 V	Starting; controlled by intake air temperature, Running; Controlled as 40 °C (104 °F)	Starting; controlled by intake air temperature, Running; Controlled as 40 °C (104 °F)	Fix to fully retard position.	Idle up (900 r/min)
23	Air temperature sensor	Output voltage has detected below 0.10 V, or above 4.60 V	Controlled as 40 °C (104 °F)	Controlled as 40 °C (104 °F)	Normal control	Idle up (900 r/min)
39	Oil pressure sensor	Output voltage has detected below 0.30 V, or detected above 4.80 V for 260 seconds when engine temperature is above –40 °C (–40 °F), or detected above 4.80 V when engine is stopping	Normal control	Normal control	Normal control	Idle up (900 r/min)

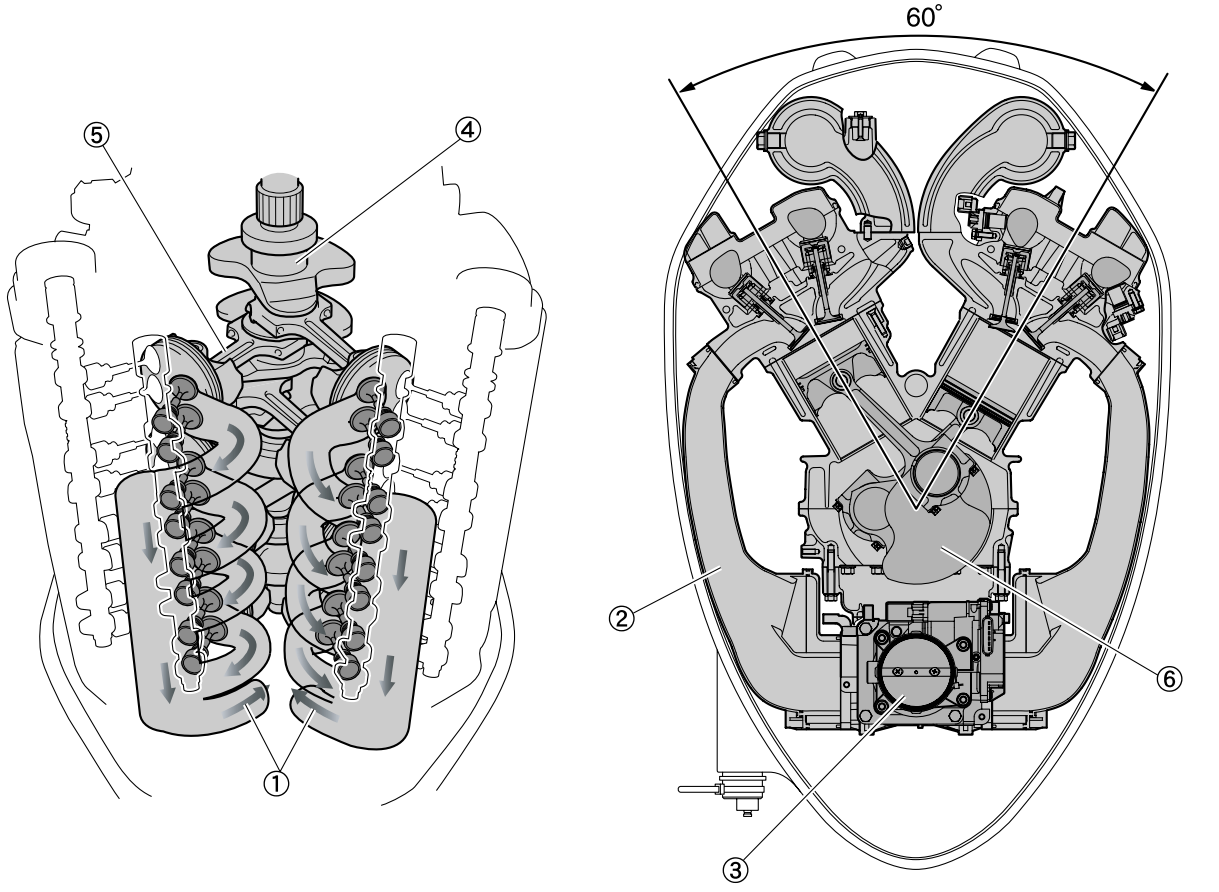
Trouble code	Malfunction components	Criterion	Ignition control	Fuel injection control	VCT control	Remarks
46	Thermoswitch	Switch is on when engine temperature is below 40 °C (104 °F), or switch is off when engine temperature is above 120 °C (248 °F)	Normal control (controlled as switch is always off)	Normal control (controlled as switch is always off)	Normal control (controlled as switch is always off)	Idle up (900 r/min), after engine has run for 74 seconds or run for 24 seconds at over 2,000 r/min, since starting
83	PTT sensor	Output voltage has detected below 0.50 V, or above 4.50 V	Normal control	Normal control	Normal control	Cancels tilt limiter control
19	Charging components	Battery voltage is below 12 V when engine speed is above 2,000 r/min	Normal control	Normal control	Normal control	Idle up (900 r/min)
73, 74	OCV	Battery voltage is below 12 V when engine speed is above 2,000 r/min	Normal control	Normal control	Normal control	Idle up (900 r/min)
85	IDM	Control unit is open or short circuit, abnormal output, damage, and so on.				
112, 113, 114, 115, 116, 117, 118, 119, 121, 122, 123, 129, 136, 137, 138, 139, 141, 142, 143, 144, 145	ETV	Motor is open or short circuit, abnormal output, damage, and so on.	Controlled by Lever Position Sensor	Normal control	Fixed to fully retard position.	Fixed to specific throttle valve angle. Fixed to 1,400 r/min
160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181	LPS	Sensor is open or short circuit, abnormal output, damage, and so on.				Fixed to specific throttle valve angle. Fixed to 1,400 r/min

Trouble code	Malfunction components	Criterion	Ignition control	Fuel injection control	VCT control	Remarks
146, 147, 148, 149, 150	SPS	Sensor is open or short circuit, abnormal output, damage, and so on.				Fixed to throttle valve angle.
153	Actuator motor	Motor is damage, and so on.				Stops shifting, fixed to 1,400 r/min
154	Actuator motor	Motor is dead lock (engine stop)				Stops shifting
155	Actuator motor	Motor is dead lock (engine running)				
183	Digital Electronic Control ECM	Digital Electronic Control ECM malfunction				
184	Digital Electronic Control ECM	Digital Electronic Control ECM malfunction				
186	Digital Electronic Control ECM	When main Digital Electronic Control ECM detects a communication error (trouble code 156,157) during operation at a main station with dual station composition.				Engine speed is fixed at idle speed with the gear-shift set at neutral.
187	Digital Electronic Control ECM					

Power unit system

Outline of system

F300/FL300 and F350/FL350 is equipped with newly developed V8 4-stroke engine having 60° V cylinder banks.
The balance weight distribution and the crank pin arrangement on the crankshaft are optimized for suppressing the vibration and noise.
Intake system features electronically-controlled single valve throttle body with long intake manifold made of resin, designed for higher intake efficiency to attain higher output power and improved fuel economy.
In-bank exhaust system contributes to the reduction of engine size.

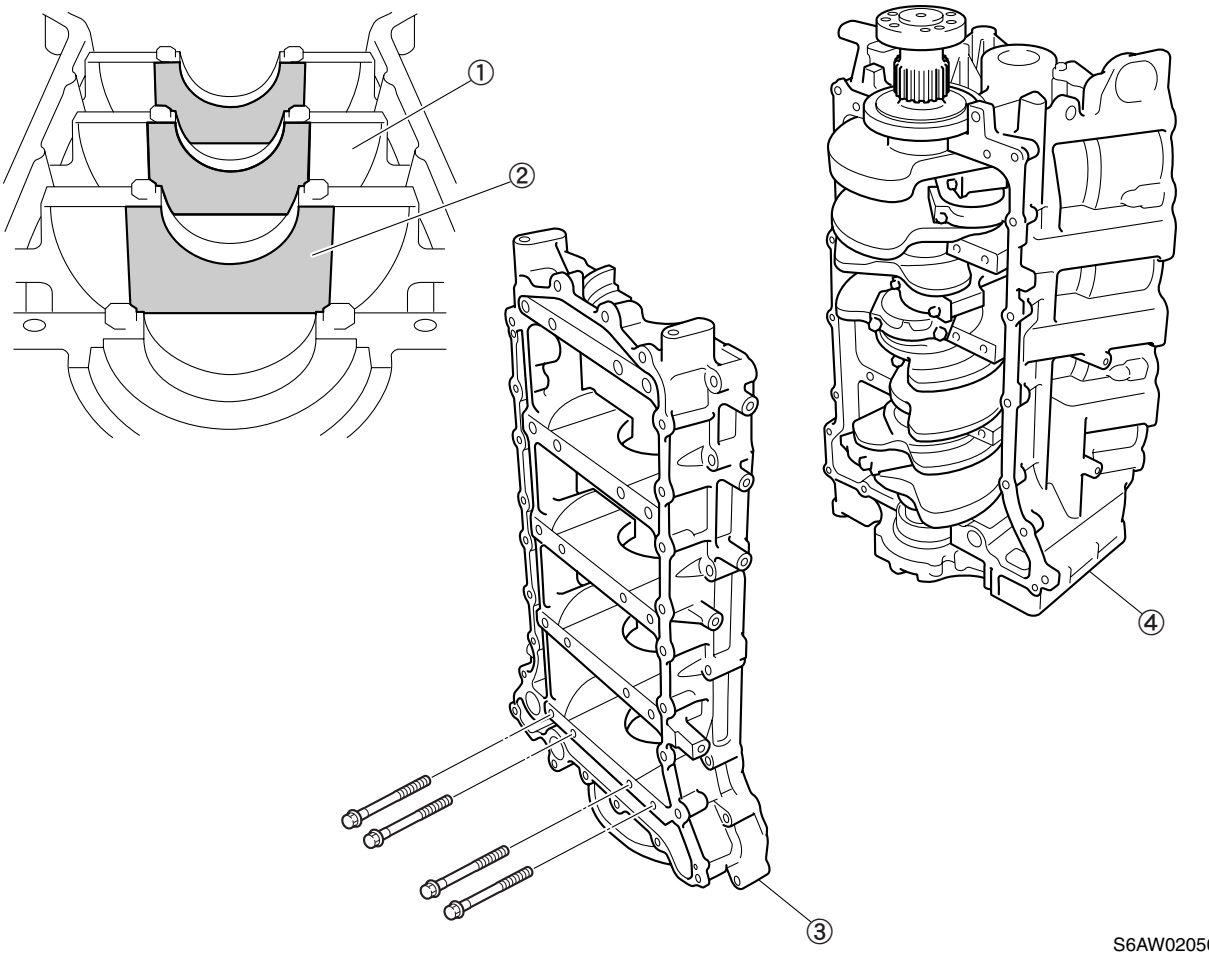


S6AW02080

① In-bank exhaust system
② Long intake manifold
③ Single type electronic throttle body assembly
④ Crank shaft
⑤ Connecting rod assembly
⑥ Balance weight

Crankcase

The crankcase is made of cast aluminum, however steel has been cast into the areas for the crankshaft bearings. By distinguishing the area that requires strength from the area that allows the use of a lighter material, both weight reduction and a stronger construction have been achieved.
The caps for the crankshaft bearings are secured with four bolts to ensure a high level of assembled rigidity.

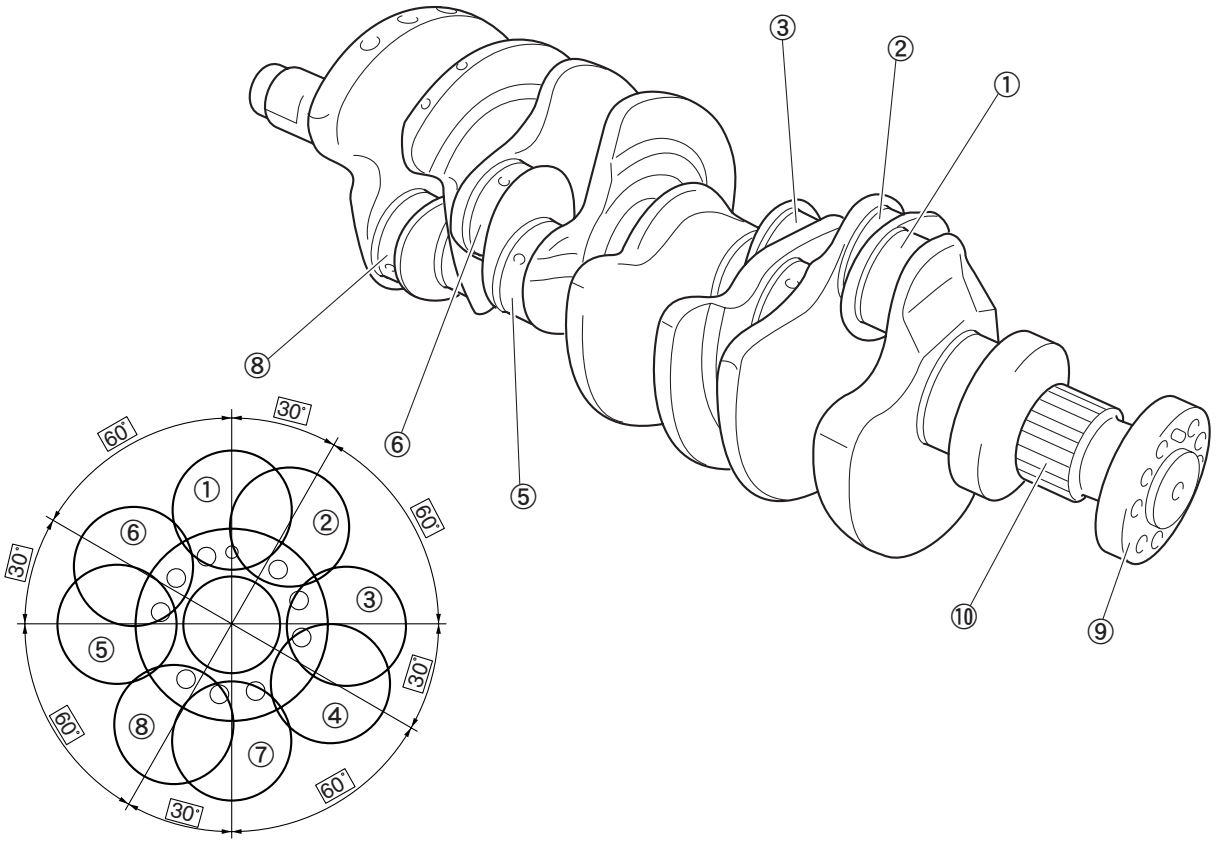


S6AW02050

① Casted aluminum
② Steel
③ Crankcase
④ Cylinder block

Crankshaft

The engine is equipped with a forged crankshaft of high strength and high rigidity having 5 journals and 8 balance weights. Optimized balance weight distribution and crank pin arrangement can effectively reduce the engine vibration and noise.
The drive sprocket and the flywheel magnet flange is integrated into the crankshaft. Simplified structure by this arrangement helps improve serviceability and reliability of the motor.

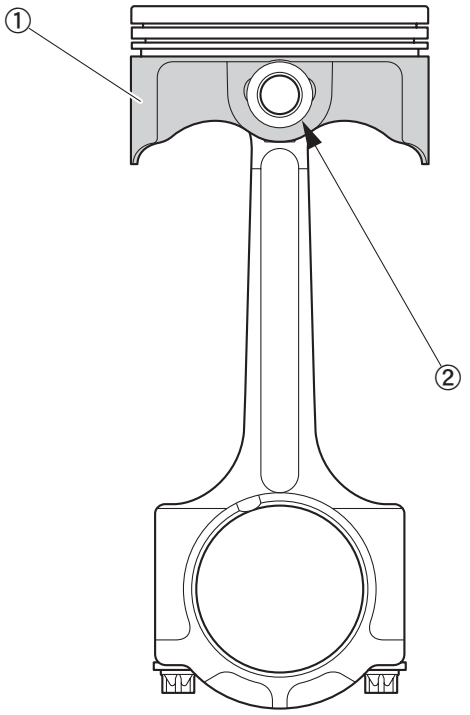


S6AW02051

① Crank pin #1
② Crank pin #2
③ Crank pin #3
④ Crank pin #4
⑤ Crank pin #5
⑥ Crank pin #6
⑦ Crank pin #7
⑧ Crank pin #8
⑨ Flywheel magnet flange
⑩ Drive sprocket

Piston and connecting rod

Light weight, highly durable aluminum pistons are mounted in the engine. Molybdenum coating applied on the piston skirts reduces the abrasion resistance on the sliding surfaces, resulting in the effective suppression of engine noise and improved fuel economy.
Piston pins are fixed to the connecting rod by the shrinkage fitting.

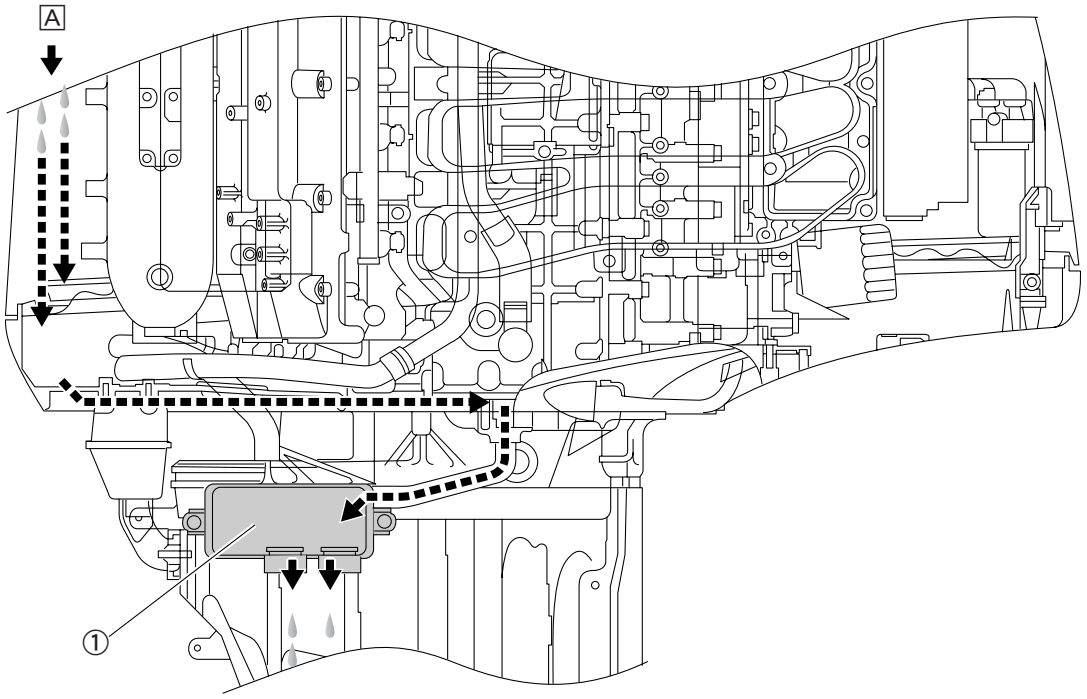


S6AW02052-1

① Molybdenum coated skirt
② Shrinkage fitting between piston pin and connecting rod

Water drain system

Water entered from the air duct of top cowl is dropped onto the bottom cowl, and accumulated in the drain box, then drains out.
This structure prevents flow back of water, which obtains the high efficiency for draining water.

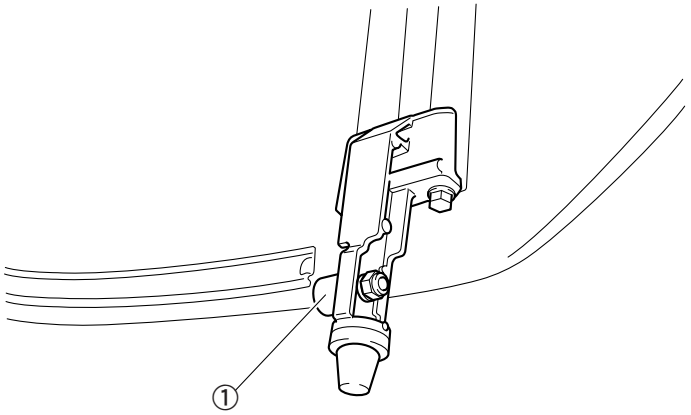


S6AW02053

A Water entered from air duct
① Water drain box

Top cowling roller lock

The roller has been used for the lock point of top cowl. This can reduce the friction of lock lever when turning the lever, and obtains easier locking or unlocking the top cowl. Therefore, the compact lock lever has been used.

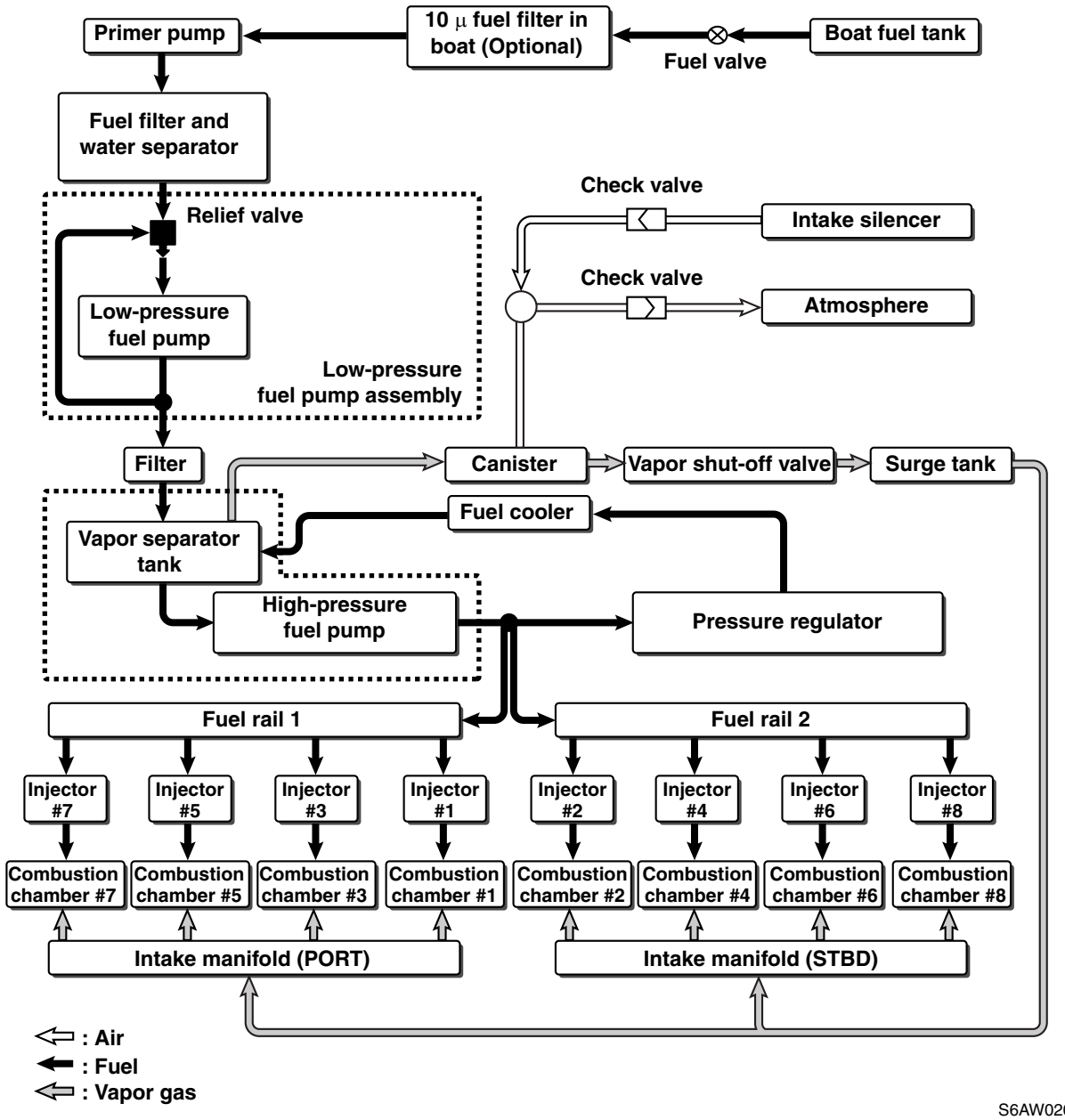


S6AW02054

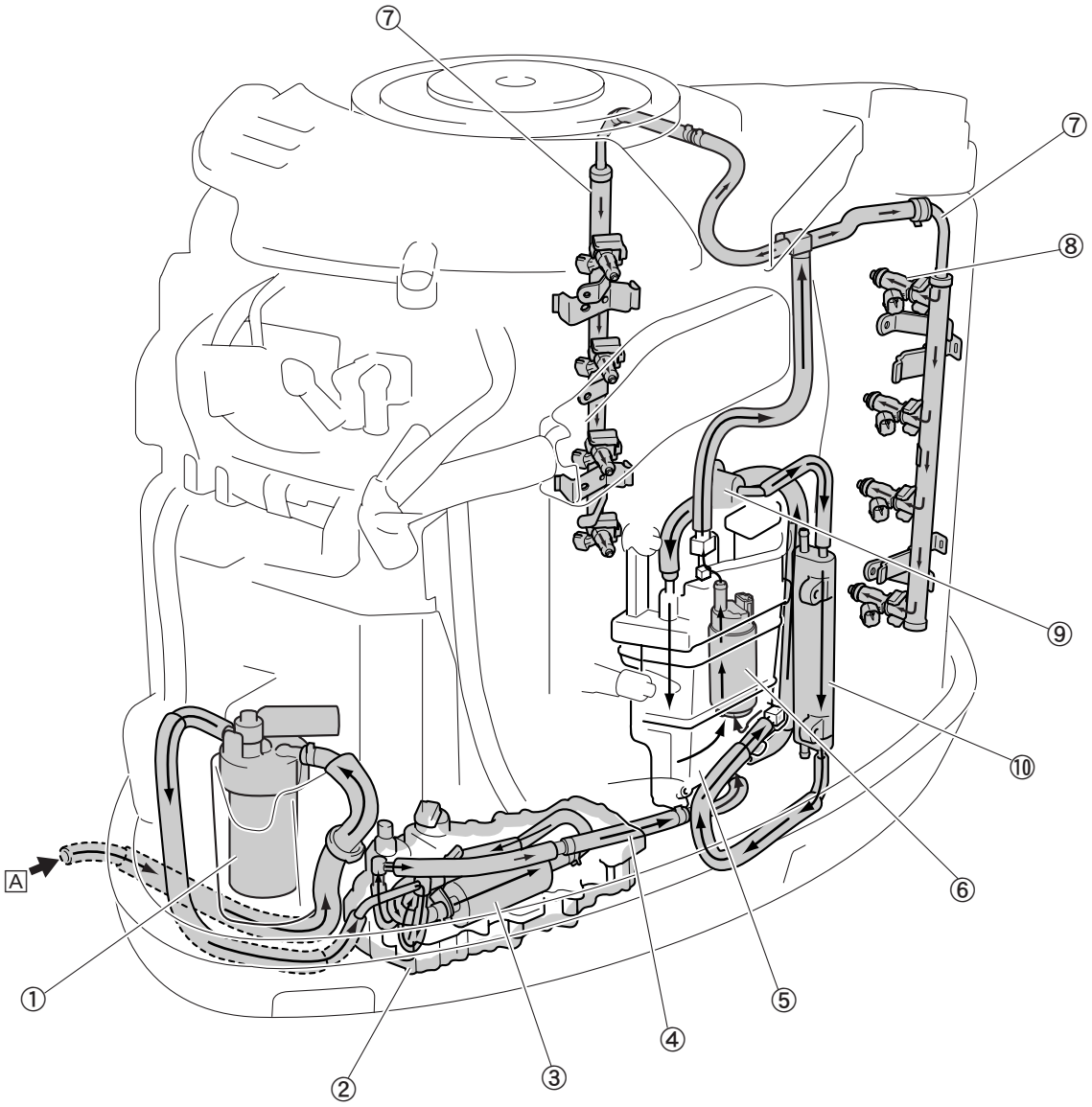
① Roller

Fuel system

The fuel system flow diagram is as follows.



S6AW02006



S6AW02074

① Fuel filter (water detection switch)
② Low-pressure fuel pump assembly
③ Low-pressure fuel pump
④ Filter
⑤ Vapor separator tank
⑥ High-pressure fuel pump
⑦ Fuel rail
⑧ Fuel injector
⑨ Pressure regulator
⑩ Fuel cooler
A From the fuel tank

Fuel rating

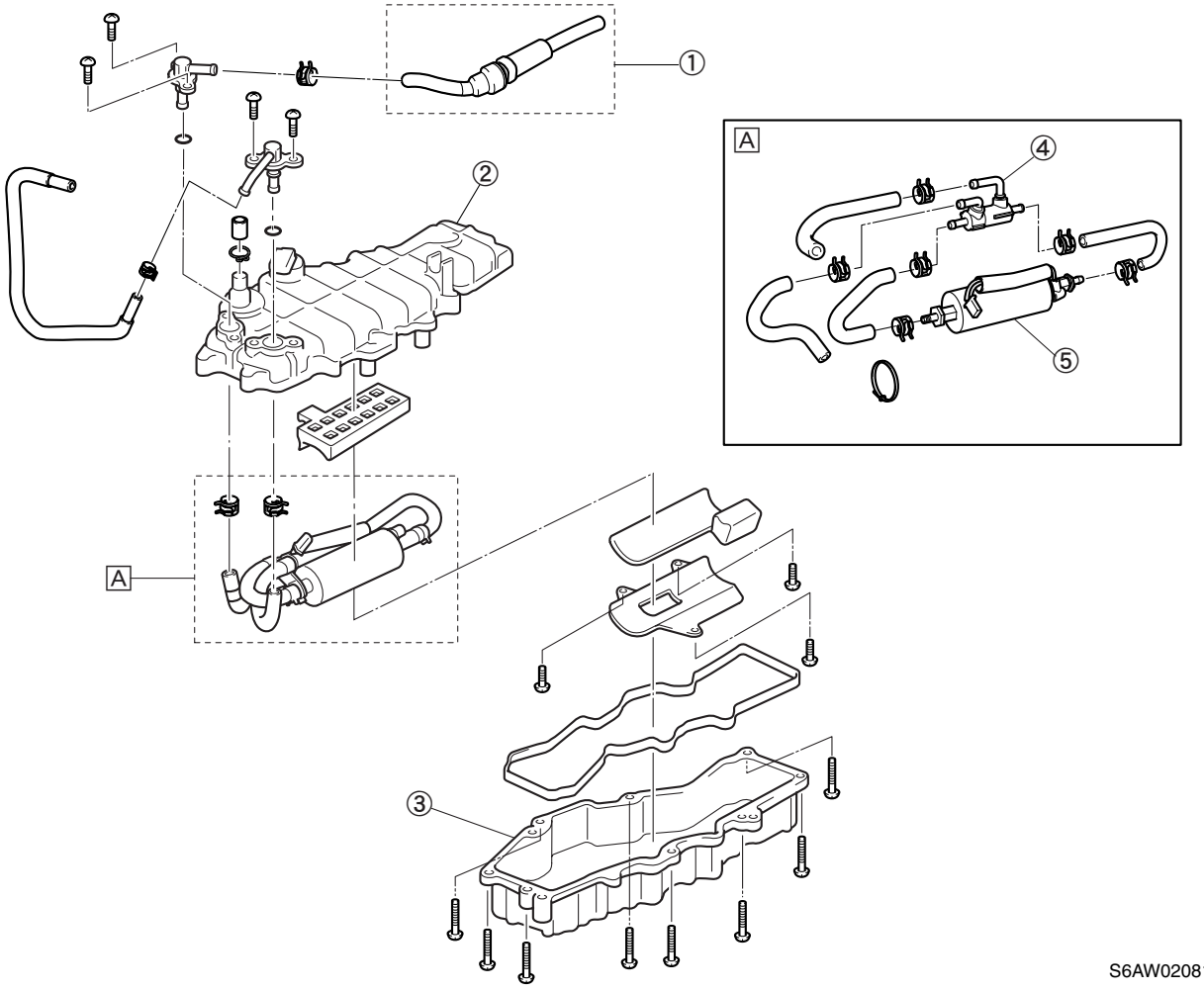
For F350/FL350, premium unleaded gasoline (minimum rating of RON94/PON89) is recommended to obtain high performance.
For F300/FL300, regular unleaded gasoline (minimum rating of RON91/PON85) is recommended.

NOTE:

The output power may be degraded if recommended fuel is not used.

Fuel supply system

Low-pressure fuel pump and the related components are packed into the low-pressure fuel pump case to form a module, avoiding the heat conduction from the engine. Vapor gas emission during the engine re-start is reduced by this arrangement.

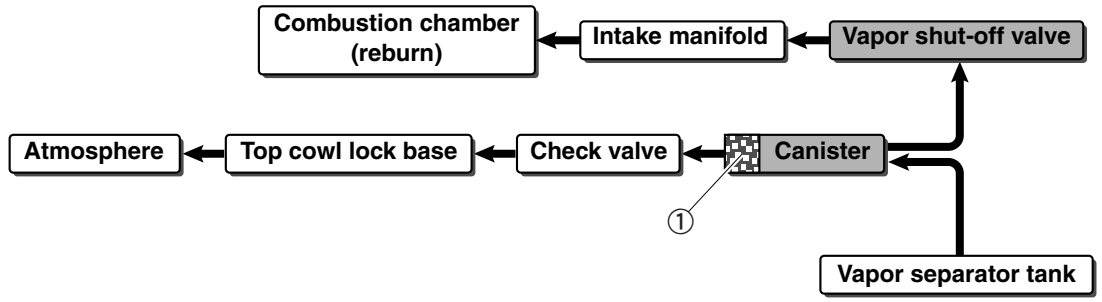


S6AW02081

① Fuel filter
② Pump cover
③ Pump case
④ Relief valve
⑤ Low-pressure fuel pump

Vapor gas treatment

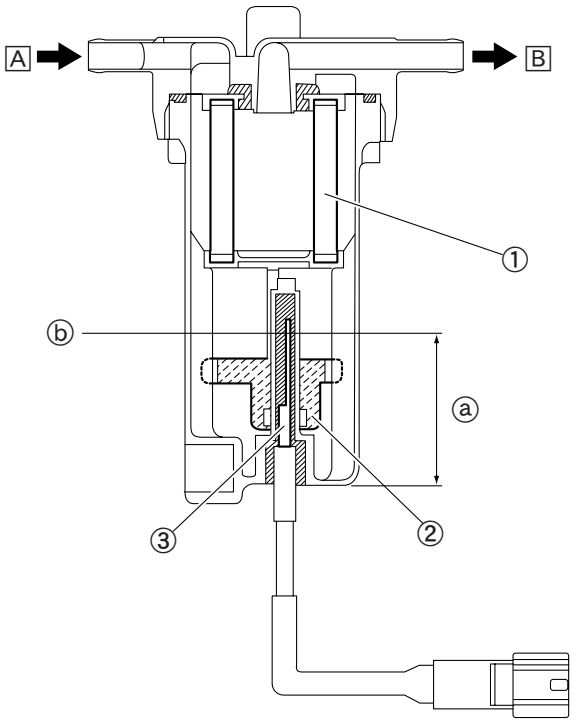
Canister and vapor shut-off valve have been incorporated to treat the vapor gas coming out from vapor separator tank, that obtains sure engine start while the engine is warm or hot. Just after the engine stopped, the cooling-water supply is immediately stopped, so the heat is conducted to the vapor separator tank from the engine unit, causing fuel to vaporize. The vapor gases are returned to the intake silencer to reburn. However, excess vapor gases are sucked into the combustion chambers when the engine is restarted, causing rich air and fuel mixture, which makes it hard to start the engine. Therefore, canister and the vapor shut-off valve have been used for surely restarting the engine when it is warm or hot so that excess vapor gases do not return into the intake silencer. Excess vapor gases are accumulated into canister, next sucked and purified by active charcoal, and finally discharged gradually into atmosphere. Vapor shut-off valve is still in the shut-off position. After the engine restarts, the vapor gases in canister are sucked into the intake manifold from vapor shutoff valve controlled by the engine ECM.



① Active charcoal

Fuel filter assembly

Fuel filter assembly is common used among other models. Large paper element has 10 micron percolation ability, and cap has 60 cm^3 (3.7 cu. in) water accumulation capacity. If water has mixed in fuel and float switch has been on, the alert indicator on 6Y8 Multifunction Meter will activate.

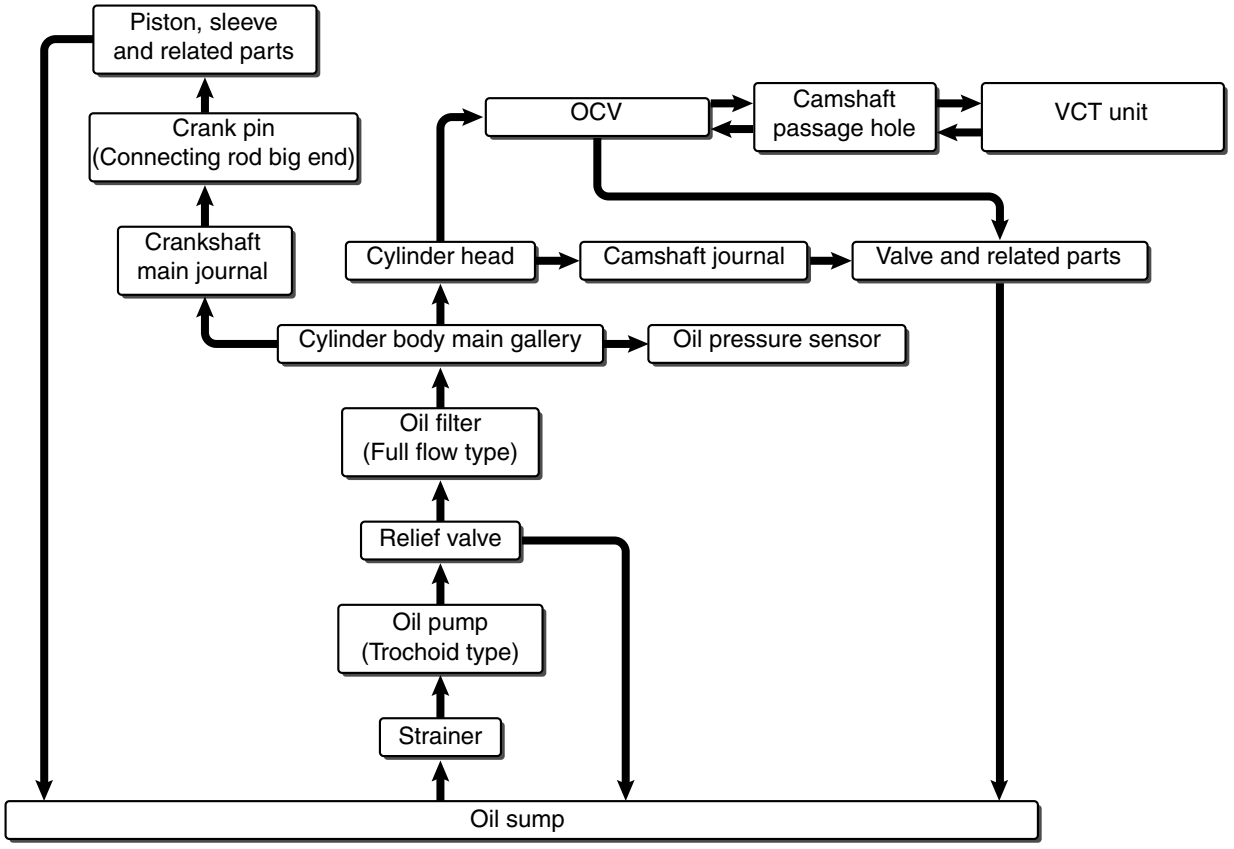


S6AW02056

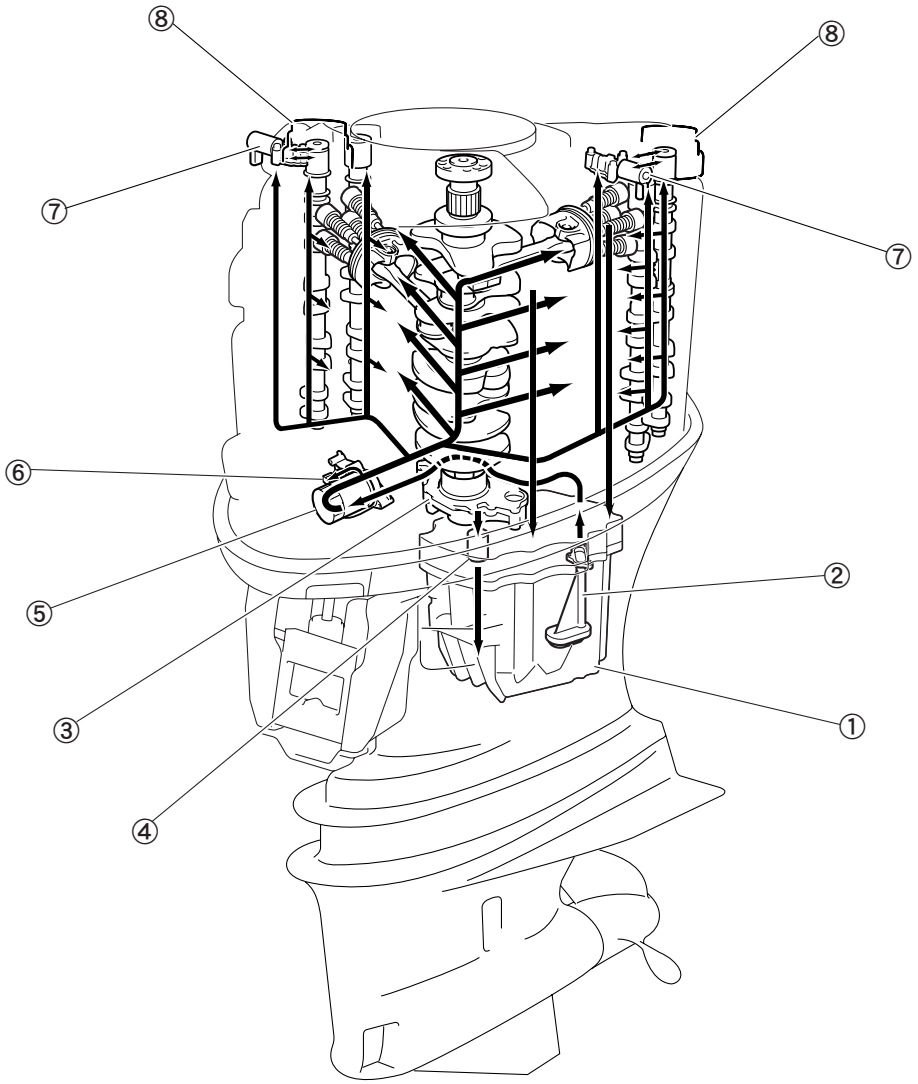
A From the fuel tank
B To the low-pressure fuel pump assembly
① Filter element
② Float
③ Water detection switch
④ Filter cup
ⓐ Maximum water level: 40 mm (1.6 in)
ⓑ Water accumulation capacity: 60 cm^3 (3.7 cu. in)

Lubrication system

The lubrication oil flow diagram is as follows.



S6AW02057

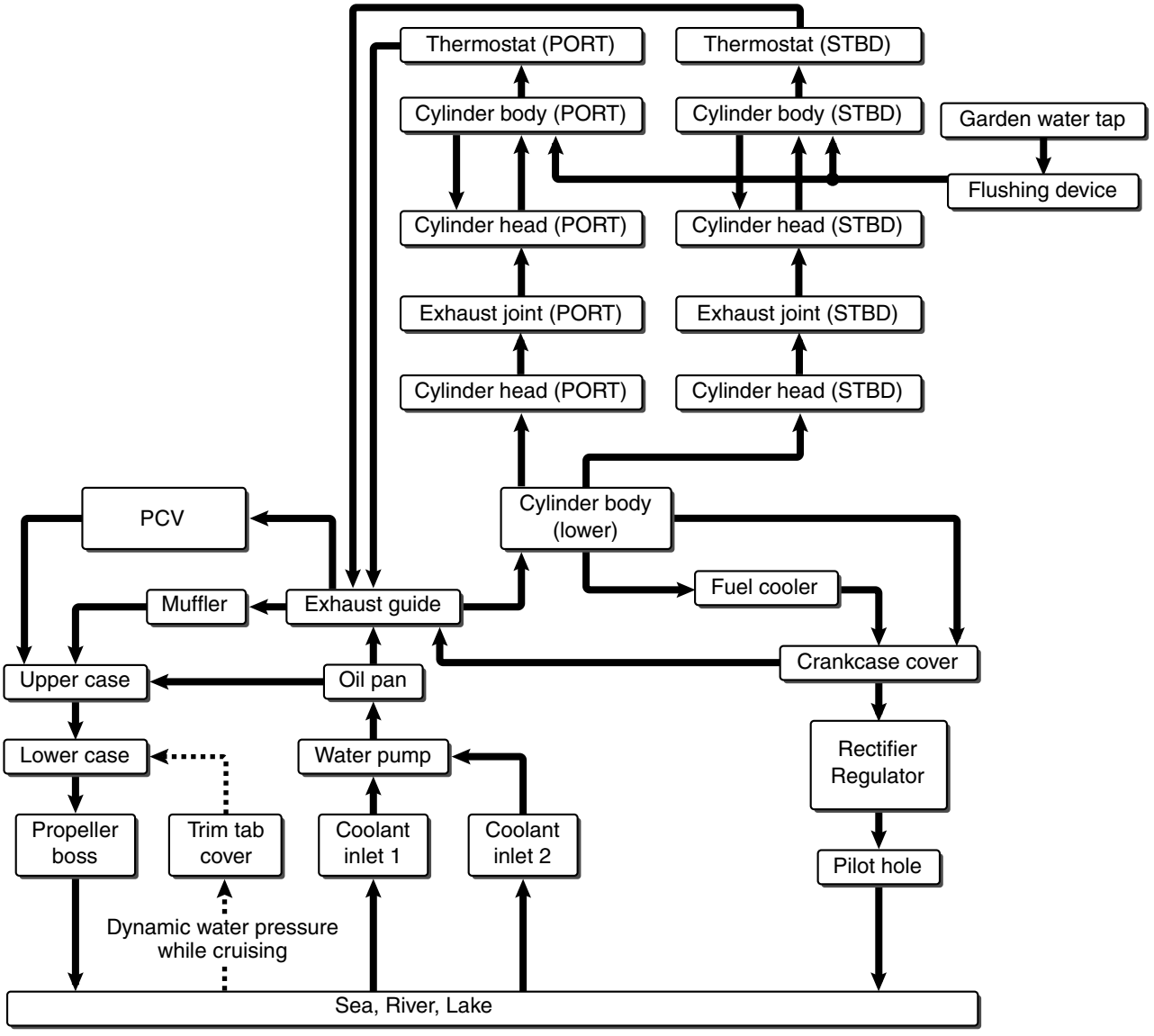


S6AW02073

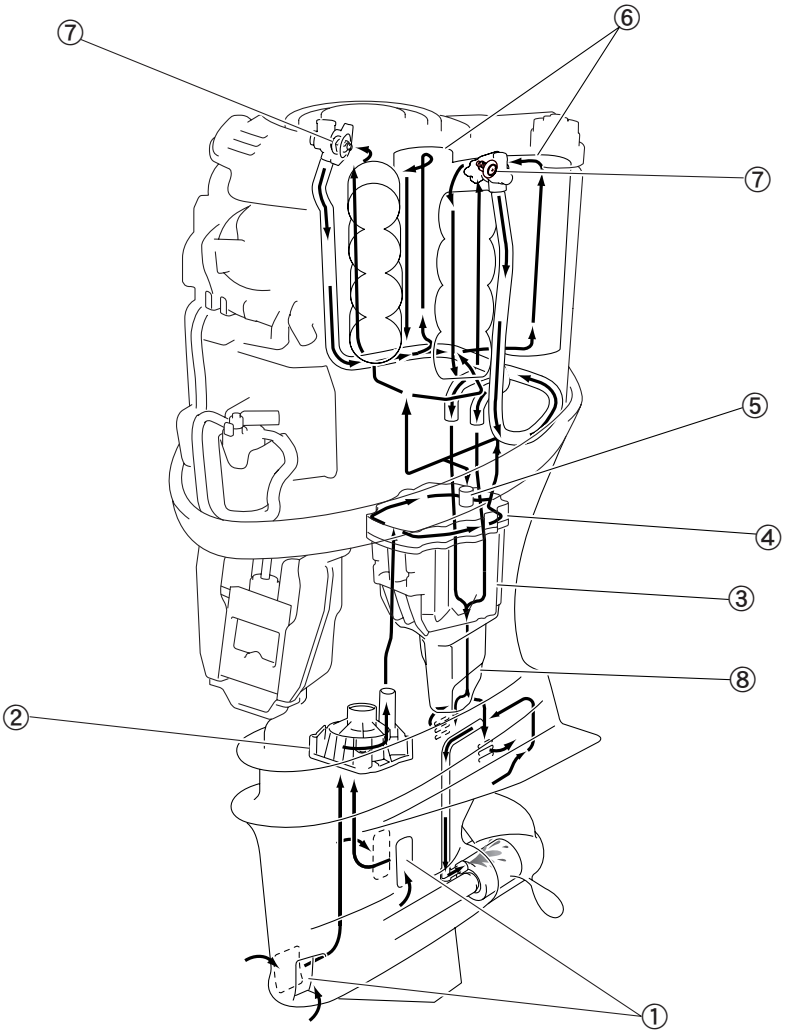
A Engine oil flow
① Oil pan
② Strainer
③ Oil pump
④ Relief valve
⑤ Oil filter
⑥ Oil pressure sensor
⑦ OCV
⑧ VCT

Cooling system

The cooling water flow diagram is as follows.



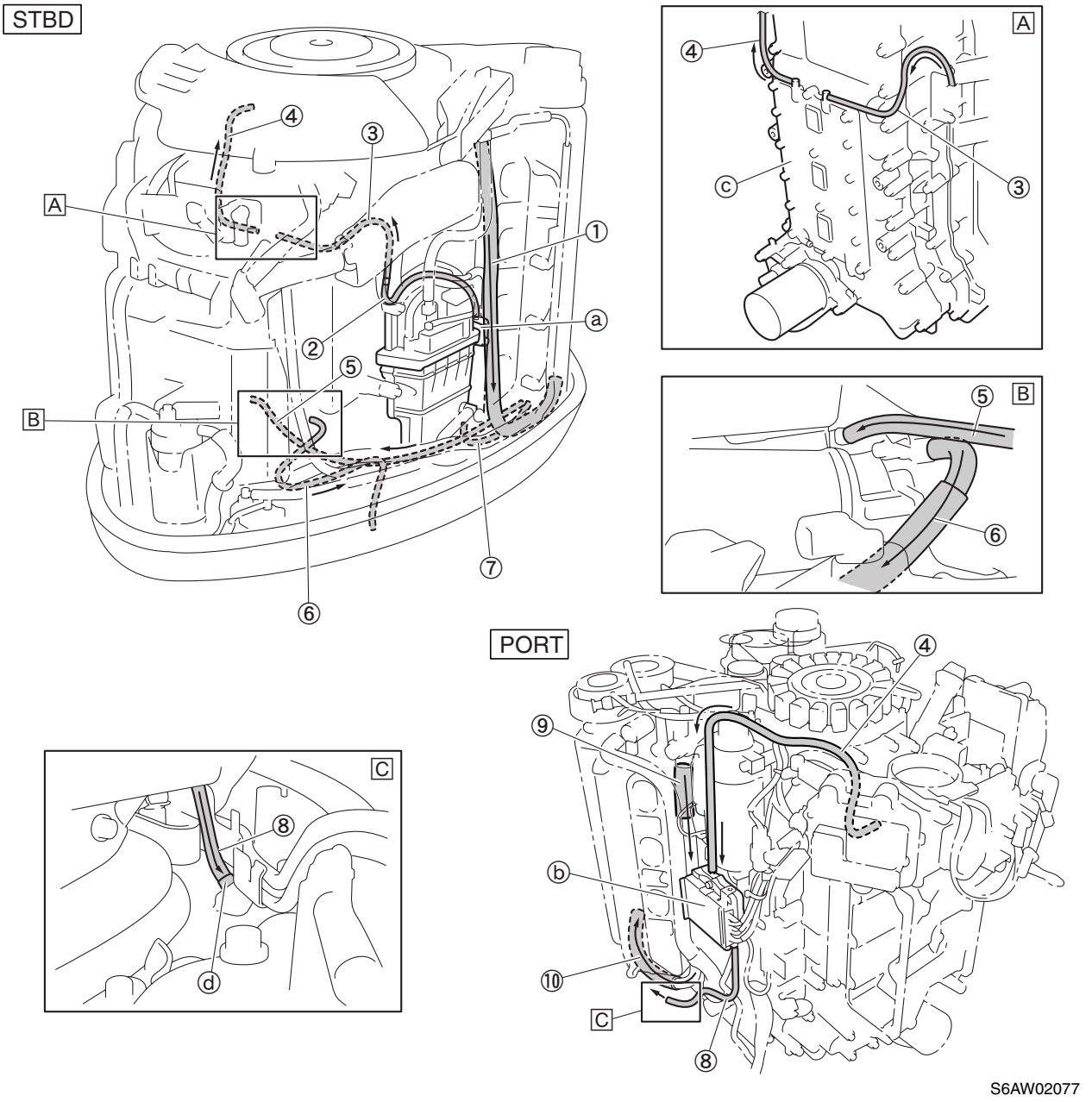
S6AW02058-1



S6AW02075

A Cooling water flow
① Cooling water inlet
② Water pump
③ Oil pan
④ Exhaust guide
⑤ PCV
⑥ Exhaust joint
⑦ Thermostat

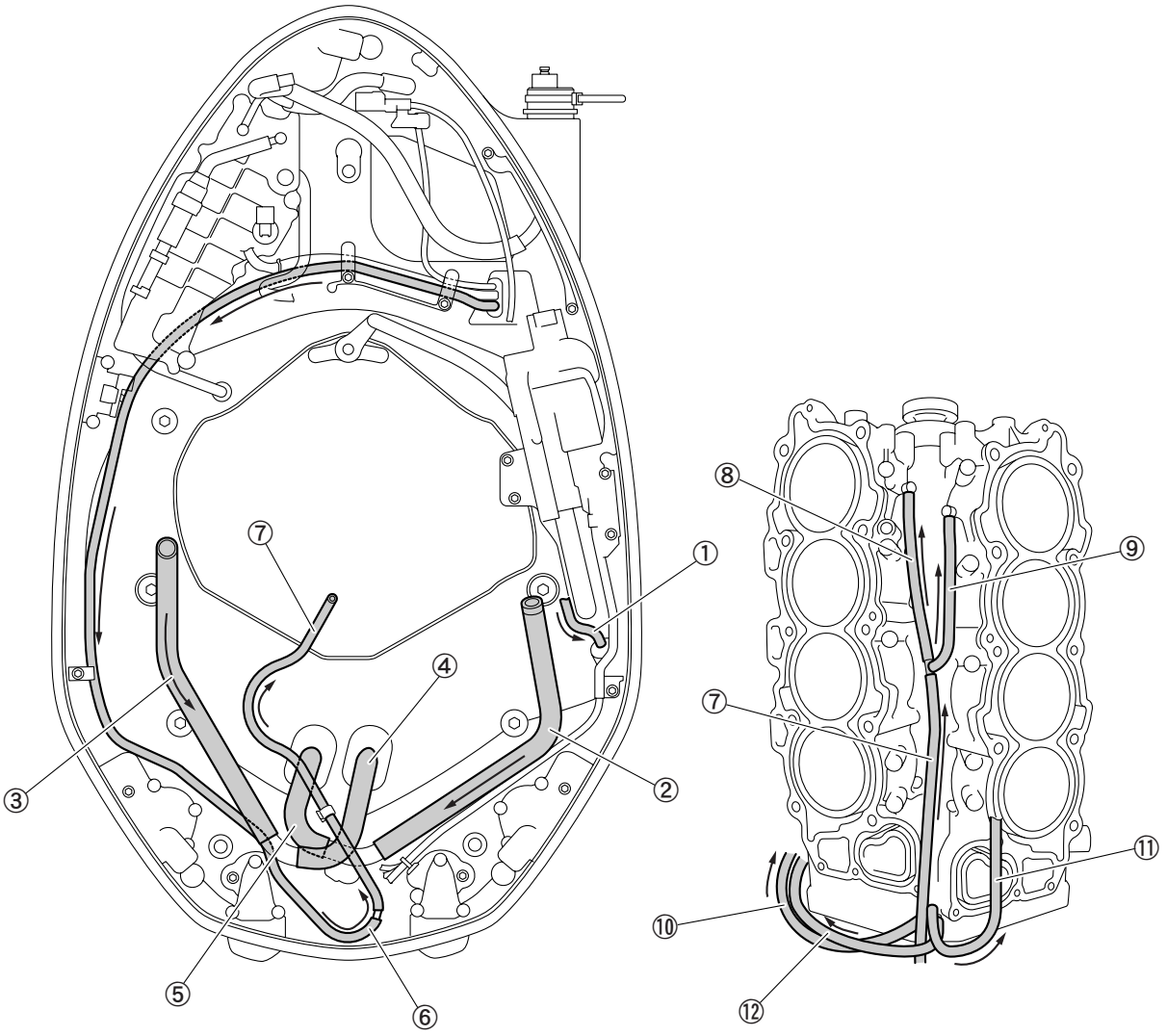
Cooling water hose



S6AW02077

① Cooling water hose (port thermostat cover-to-cooling water pipe)
② Cooling water hose (fuel cooler-to-joint)
③ Cooling water hose (joint-to-crankcase cover)
④ Cooling water hose (crankcase cover-to-Rectifier Regulator)
⑤ Cooling water hose (cylinder block-to-crankcase cover)
⑥ Cooling water hose (crankcase cover-to-bottom cowling)
⑦ Cooling water hose (cylinder block-to-fuel cooler)
⑧ Cooling water hose (Rectifier Regulator-to-cooling water pilot hole)
⑨ Cooling water hose (starboard thermostat cover-to-cooling water pipe)
⑩ Cooling water hose (cooling water pipe-to-cooling water pipe)

ⓐ Fuel cooler
ⓑ Rectifier Regulator
ⓒ Crankcase cover
ⓓ Cooling water pilot hole (on the bottom cowling)



S6AW02078-1

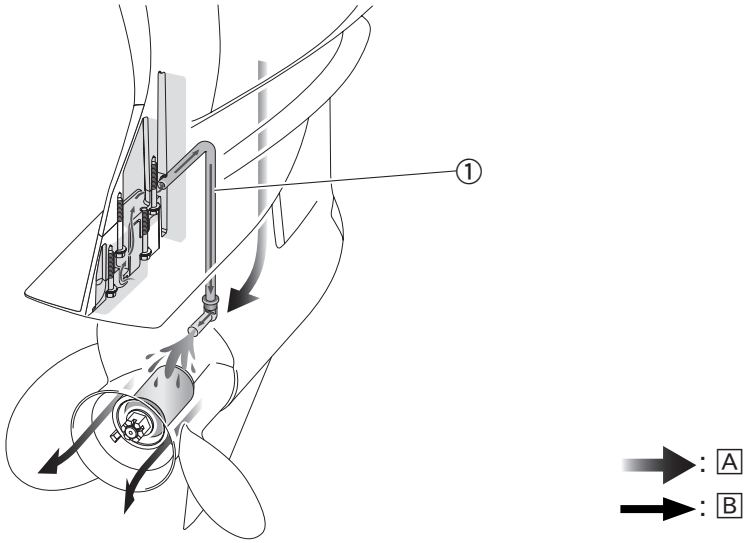
① Cooling water hose (Rectifier Regulator-to-cooling water pilot hole)
② Cooling water hose (cooling water pipe-to-cooling water pipe)
③ Cooling water hose (port thermostat cover-to-cooling water pipe)
④ Cooling water hose (cooling water pipe-to-bottom cowling)
⑤ Cooling water hose (cooling water hose-to-bottom cowling)
⑥ Flushing hose (flushing hose adapter-to-joint)
⑦ Flushing hose (joint-to-joint)
⑧ Flushing hose (joint-to-cylinder block)
⑨ Flushing hose (joint-to-cylinder block)
⑩ Cooling water hose (cylinder block-to-fuel cooler)
⑪ Cooling water hose (cylinder block-to-water pressure sensor adapter)
⑫ Cooling water hose (cylinder block-to-crankcase cover)

Propeller damper cooling

Water pipe for cooling the propeller damper is incorporated in the lower case. Water intake is located in front of the trim tab to drawn-in the water by the dynamic pressure, and the propeller damper is cooled without disturbing the exhaust gas flow. Higher output power can be generated by these features.

NOTE:

When you remove the propeller shaft housing, remove the water pipe first.

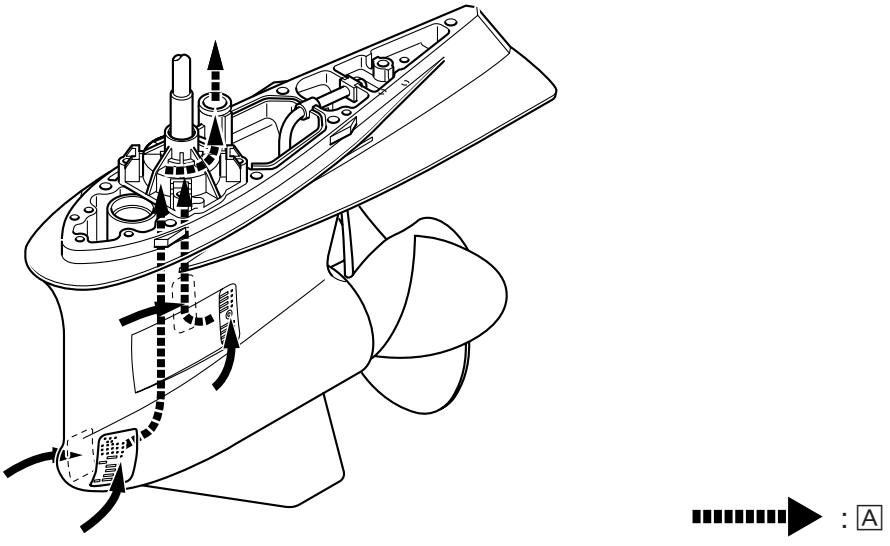


S6AW02059

A Exhaust gas flow
B Cooling water flow
① Water pipe

Dual water inlet

The second water inlets have been given onto the nose cone to obtain better cooling-water supply. Especially, the reliability of cooling-water supply has increased when cruising with super-high speed.

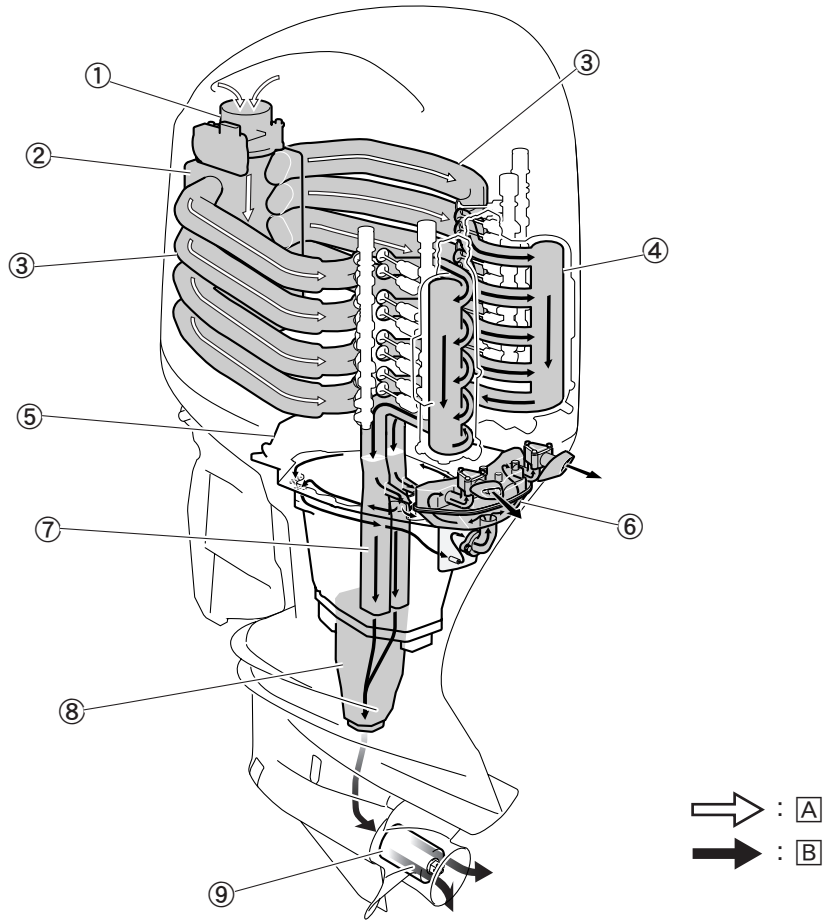


S6AW02072-1

A Cooling water flow

Intake and exhaust system

The intake and exhaust air flow diagram is as follows.



S6AW02076

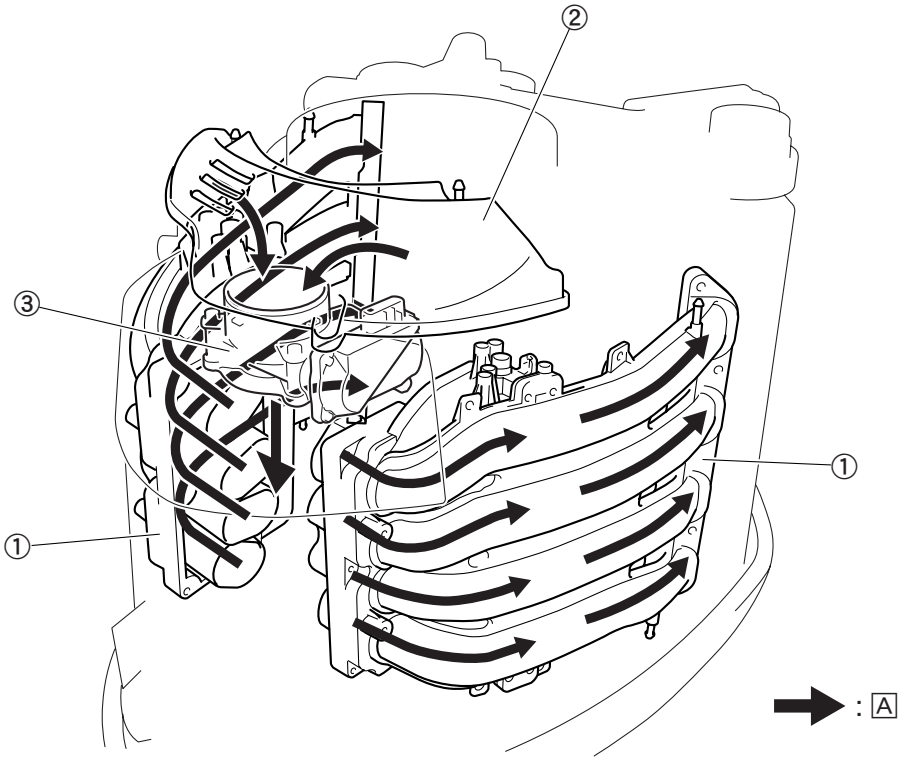
A Intake air flow
B Exhaust gas flow
① Throttle body
② Serge tank
③ Intake manifold
④ Exhaust joint
⑤ Exhaust guide
⑥ Exhaust silencer
⑦ Exhaust manifold
⑧ Muffler
⑨ Propeller

Throttle body and intake manifold

The intake system includes the big bore, single valve throttle body and the long intake manifold made of resin.

Electronically-controlled throttle valve stabilizes the combustion through the entire speed range including low speeds and high speeds. The long intake manifold effectively supplies the air into the combustion chamber for delivering ample torque in mid-speed range.

Big bore, single valve throttle body and the intake silencer for higher intake efficiency, long intake manifold made of resin for alleviating the heat conduction from the engine, and the smoothed port inner surfaces for higher filling rate of the intake air; these features contributes to the higher output power and the improved fuel economy of the engine.

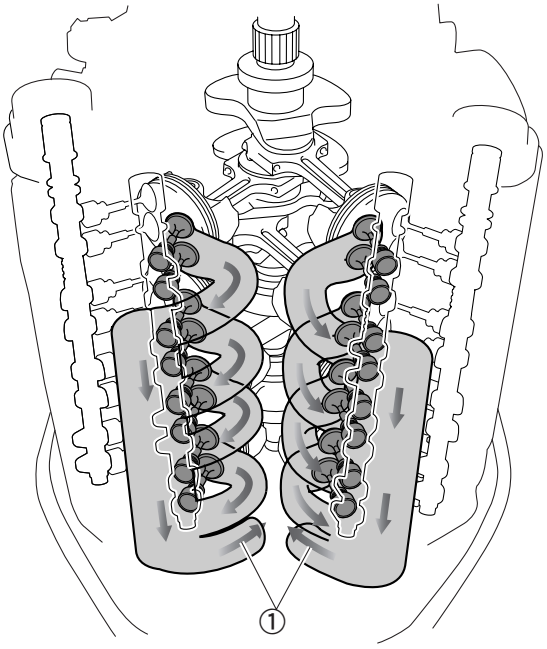


S6AW02060

A Intake air flow
① Intake manifold
② Intake silencer
③ Throttle body

In-bank exhaust system

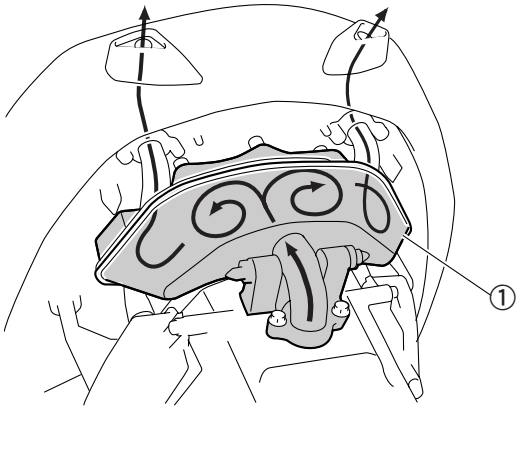
In-bank exhaust system is incorporated, in which the exhaust passages run through the space between the port and starboard cylinder banks. The engine is downsized by this arrangement. Exhaust manifold is comprised of dual exhaust passage. Simplified structure leads to the compact engine size and the improved exhaust efficiency.



A Exhaust gas flow
① Exhaust joint

Dual idle silencer

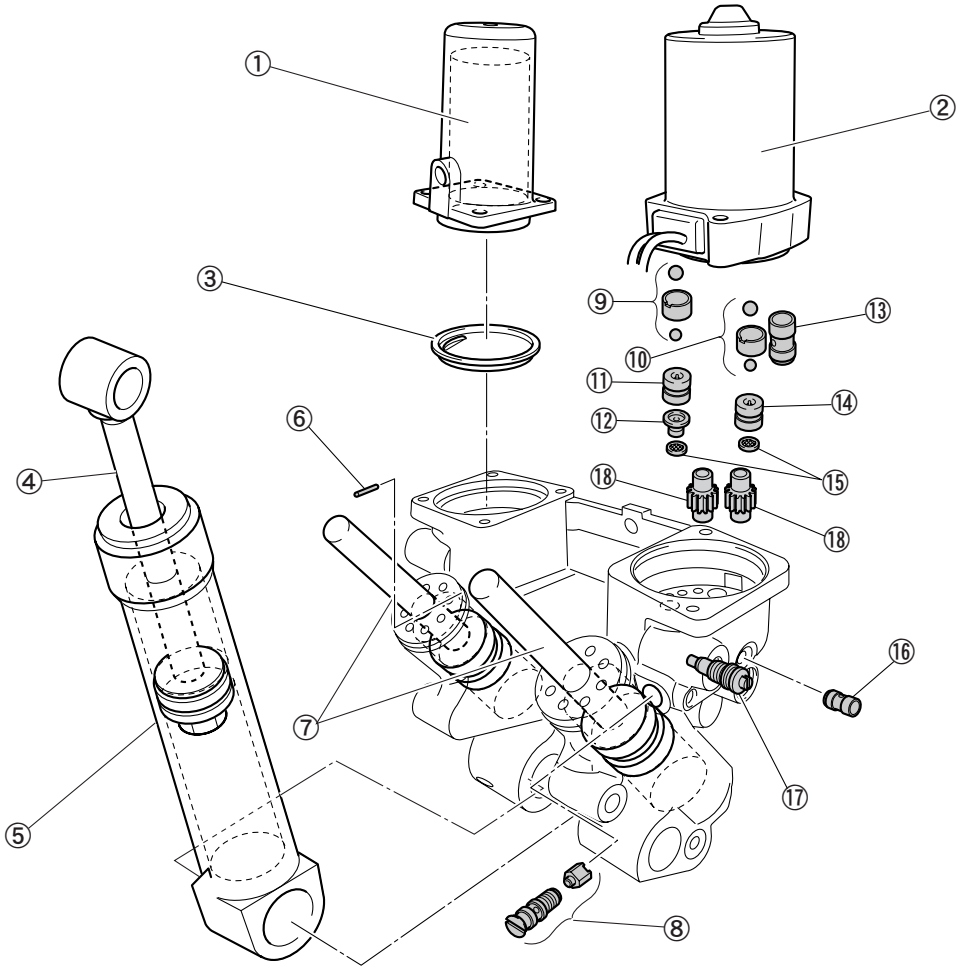
The labyrinth structure that the exhaust gases detour around the exhaust guide has been used for reducing the exhaust noise. To more reduce the exhaust sound, the large expansion chamber has been incorporated to the exterior and dual idle holes have been used.



A Exhaust gas flow
① Silencer

PTT unit

Hydraulic path is contained in the main body of the newly designed PTT unit, resulting in less number of components and the compact size of the unit. Also, the up-main valve, down-main valve, up-relief valve, and down-relief valve have been integrated into the gear pump housing. Improved serviceability and reliable operation are obtained by the consolidated design.



S6AW02082

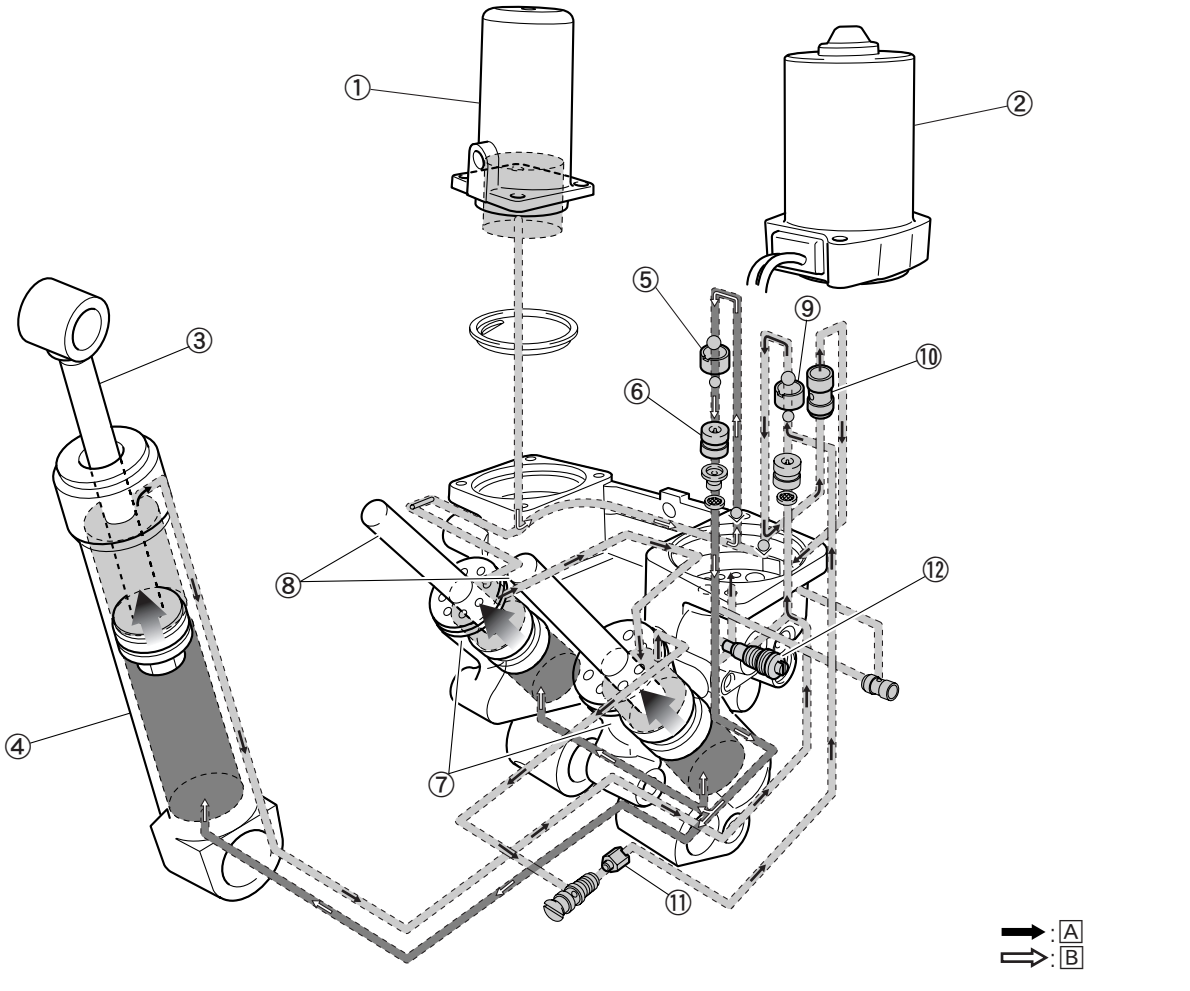
① Reservoir
② PTT motor
③ Plate
④ Tilt ram
⑤ Tilt cylinder
⑥ Pin
⑦ Trim ram
⑧ Port plug assembly
⑨ Up-shuttle piston
⑩ Down-shuttle piston
⑪ Up-main valve
⑫ Valve seat
⑬ Down-relief valve
⑭ Down-main valve
⑮ Filter
⑯ Up-relief valve
⑰ Manual valve
⑱ Gear pump

Trim-up and tilt-up function

By pressing down the PTT switch “UP” button, the gear pump is driven by the PTT motor to generate the hydraulic oil pressure.

The pressurized hydraulic oil pushes up the up-shuttle piston, flows through the up-main valve, enters into the trim cylinder lower chamber, and pushes up the trim ram. At the same time, the hydraulic oil in the trim cylinder upper chamber flows through the port plug and the down-shuttle piston, open the down-relief valve, and returns to the gear pump.

When the trim ram is pushed up to the full extent, the hydraulic oil pressure is then exerted on the tilt cylinder lower chamber to push up the tilt ram assembly. As the tilt ram assembly goes up, the hydraulic oil pressure builds up in the tilt cylinder upper chamber to push down the down-shuttle piston via the down main valve, and the hydraulic oil in the tilt cylinder upper chamber returns to the gear pump.

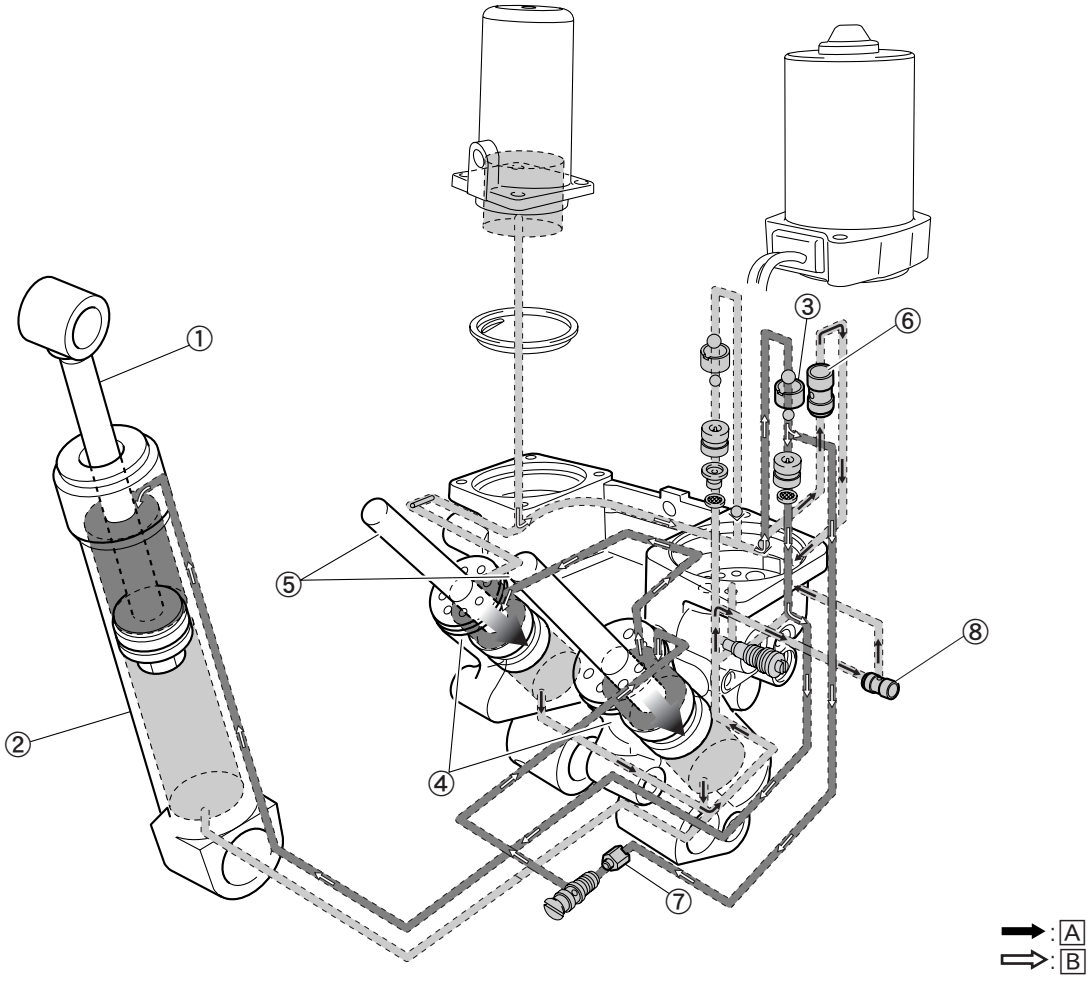


S6AW02083

① Reservoir
② PTT motor
③ Tilt ram
④ Tilt cylinder
⑤ Up-shuttle piston
⑥ Up-main valve
⑦ Trim cylinder
⑧ Trim ram
⑨ Down-shuttle valve
⑩ Down-relief valve
⑪ Port plug
⑫ Manual valve
A Return
B Send

Trim ram retraction function

To retract the trim ram, press down the PTT switch “DN” button after tilting-up the outboard motor and engaging the support lever. Hydraulic oil pressure is exerted by the gear pump to the tilt cylinder upper chamber, however, the tilt cylinder will not move downward since the tilt ram is locked by the support lever. The hydraulic oil pressure in the tilt cylinder upper chamber rises to open the down-relief valve to let the hydraulic oil released into the gear pump.
Meanwhile, the hydraulic oil is delivered into the trim cylinder upper chamber by way of the down-shuttle piston and the port plug orifice to retract the trim ram into the trim cylinder. The hydraulic oil pressure in the trim cylinder lower chamber rises as the trim ram is retracted into the trim cylinder. The increased pressure in the trim cylinder lower chamber opens the up-relief valve to release the hydraulic oil into the gear pump.

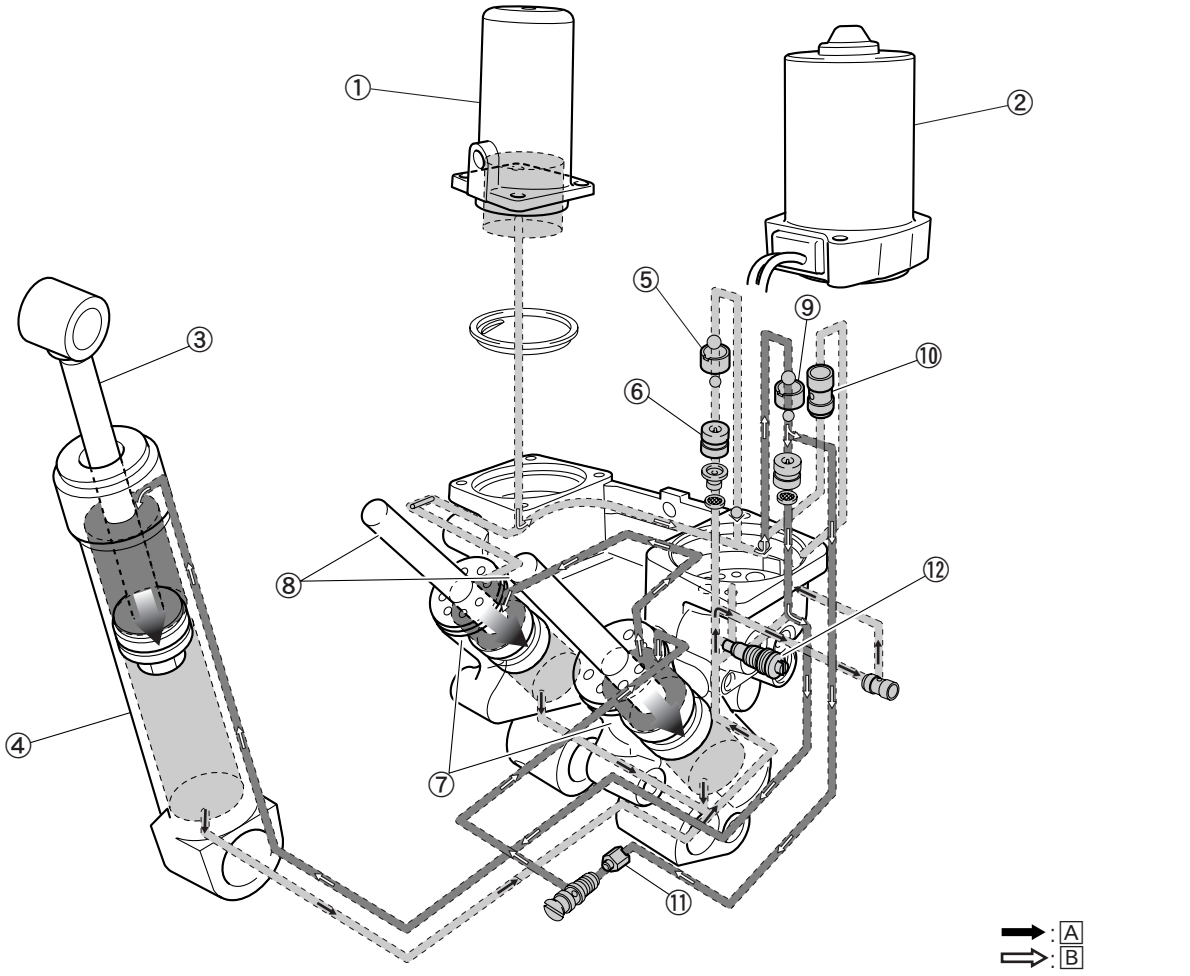


S6AW02084

① Tilt ram
② Tilt cylinder
③ Down-shuttle piston
④ Trim cylinder
⑤ Trim ram
⑥ Down-relief valve
⑦ Port plug
⑧ Up-relief valve
A Return
B Send

Trim-down and tilt-down function

By pressing down the PTT switch “DN” button, the gear pump is driven by the PTT motor to generate the hydraulic oil pressure.
The pressurized hydraulic oil enters into the tilt cylinder upper chamber to push down the tilt ram. Consequently, the hydraulic oil pressure in the tilt cylinder lower chamber rises to open the up-relief valve, and the hydraulic oil returns to the gear pump. As the tilt ram has retracted to the full extent, the hydraulic oil enters into the trim cylinder upper chamber by way of the port plug orifice to push down the trim ram.



S6AW02085

① Reservoir
② PTT motor
③ Tilt ram
④ Tilt cylinder
⑤ Up-shuttle piston
⑥ Up-main valve
⑦ Trim cylinder
⑧ Trim ram
⑨ Down-shuttle valve
⑩ Down-relief valve
⑪ Port plug
⑫ Manual valve
A Return
B Send

Stationary condition

When the PTT switch is not pressed, the gear pump will not pump the fluid, the up-main valve and the down-main valve will remain closed, and the PTT unit in the system remains constant. This will allow the tilt ram and the trim ram to maintain their positions until the PTT fluid flows through the system again.

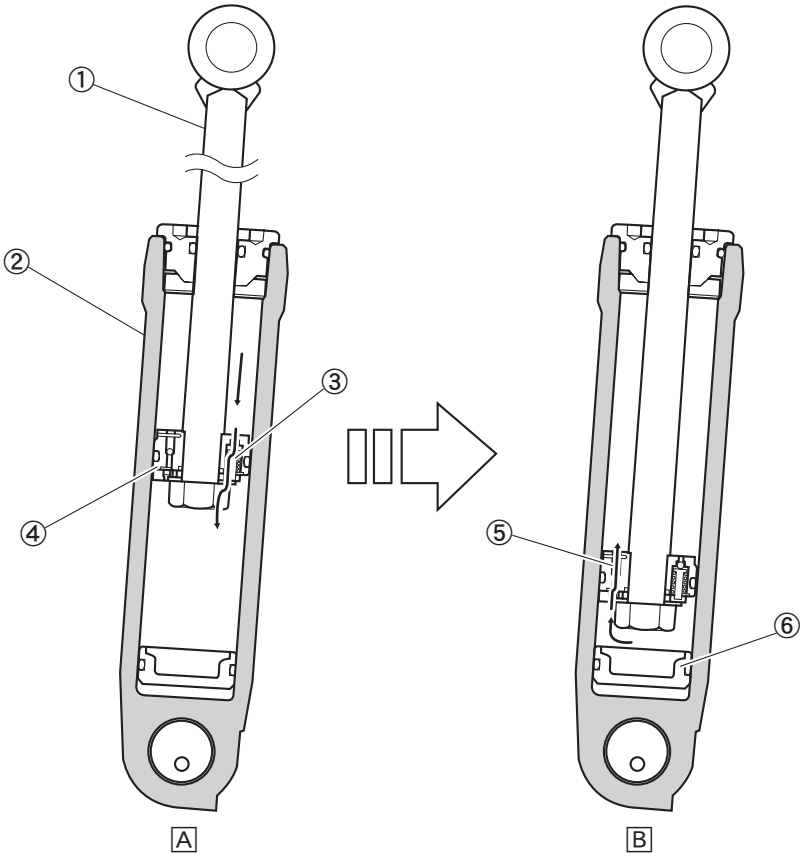
When the outboard hits something in the water

If the lower casing comes in contact with an obstacle while the boat is in operation, a sudden extension force becomes applied to the tilt ram. This force causes the fluid pressure in the tilt cylinder upper chamber to increase, and the tilt piston absorber to open and release the fluid pressure into the space between the tilt piston and the free piston. As a result, the dampening effect of the tilt piston absorber and the oil lock mechanism prevent the PTT unit from damage, before the tilt piston comes in contact with the top of the tilt cylinder.

After the collision, a force to return the outboard motor to its original position is generated due to the weight of the outboard and the thrust of the propeller.

The PTT fluid passes through the shock return valve of the tilt piston, via the free piston, and into the tilt cylinder upper chamber.

When the tilt piston comes in contact with the free piston, the tilt piston stops.



S6AW02086

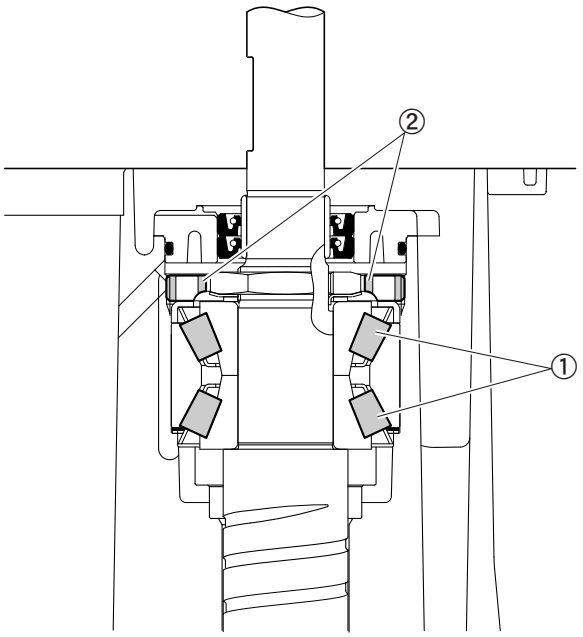
① Tilt ram
② Tilt cylinder
③ Tilt piston absorber
④ Tilt piston
⑤ Shock return valve
⑥ Free piston
A The outboard motor hit the object.
B The outboard motor returned to the original position.

Drive unit

The following design has been adopted to obtain durability and reliability.

Dual taper roller bearing

The dual taper roller bearing has been used for the drive shaft to stabilize the vertical free-play. The drive shaft assembly is secured to the lower unit with the ring nut. Consequently, the axial free play is eliminated and the pinion gear stays in the fixed position.



S6AW02079-1

① Dual taper roller bearing
② Ring nut

Rigging information

Outboard motor installation

⚠ WARNING

- **Overpowering a boat could cause severe instability. Do not install an outboard motor with more horsepower than the maximum rating on the capacity plate of the boat. If the boat does not have a capacity plate, consult the boat manufacturer.**
- **Improper mounting of the outboard motor could result in hazardous conditions such as poor handling, loss of control, or fire hazards. Consult your dealer or a Yamaha trained person experienced in proper rigging should mount the motor.**

⚠ WARNING

Too much weight on the transom can change the boat's center of gravity, buoyancy, operating balance, or performance which could cause loss of control or swamping. Consult the boat manufacturer for the maximum engine weight allowable on the transom, which is different from the overall boat capacity. Overloading the transom with a motor that is too heavy could also damage the hull, the transom, the deck, or the helm area, as well as the motor and other equipment.

⚠ WARNING

Consult the manufacturer of engine jack plates or brackets before mounting. Excessive loads could damage the plates or brackets, the boat's transom, steering system, or the engine. This could cause loss of control.

⚠ WARNING

Use a steering system for the F350 that can handle over 257.4 kW (350 HP) engine output. Engine power and steering torque can damage structural components in a steering system designed for a less powerful engine, which can result in loss of control. Refer to the steering system manufacturer for information about required components, correct assembly and wiring, and proper maintenance procedures. Do not use Yamaha's Tie Bar Kit (6E5-61301-01); it was not designed to handle 257.4 kW (350 HP).

CAUTION:

Always use the 6 mounting bolts, 150 mm (5.91 in), supplied with the engine to secure to the boat. Optional 170 mm (6.69 in) bolts are available. These bolts are specially designed for the F300, F350. Other bolts may bend or break allowing the outboard motor to detach from the boat.

CAUTION:

We recommend using genuine Yamaha propellers and attaching hardware. They are designed specially for the power characteristics of the F300, FL300, F350, FL350.

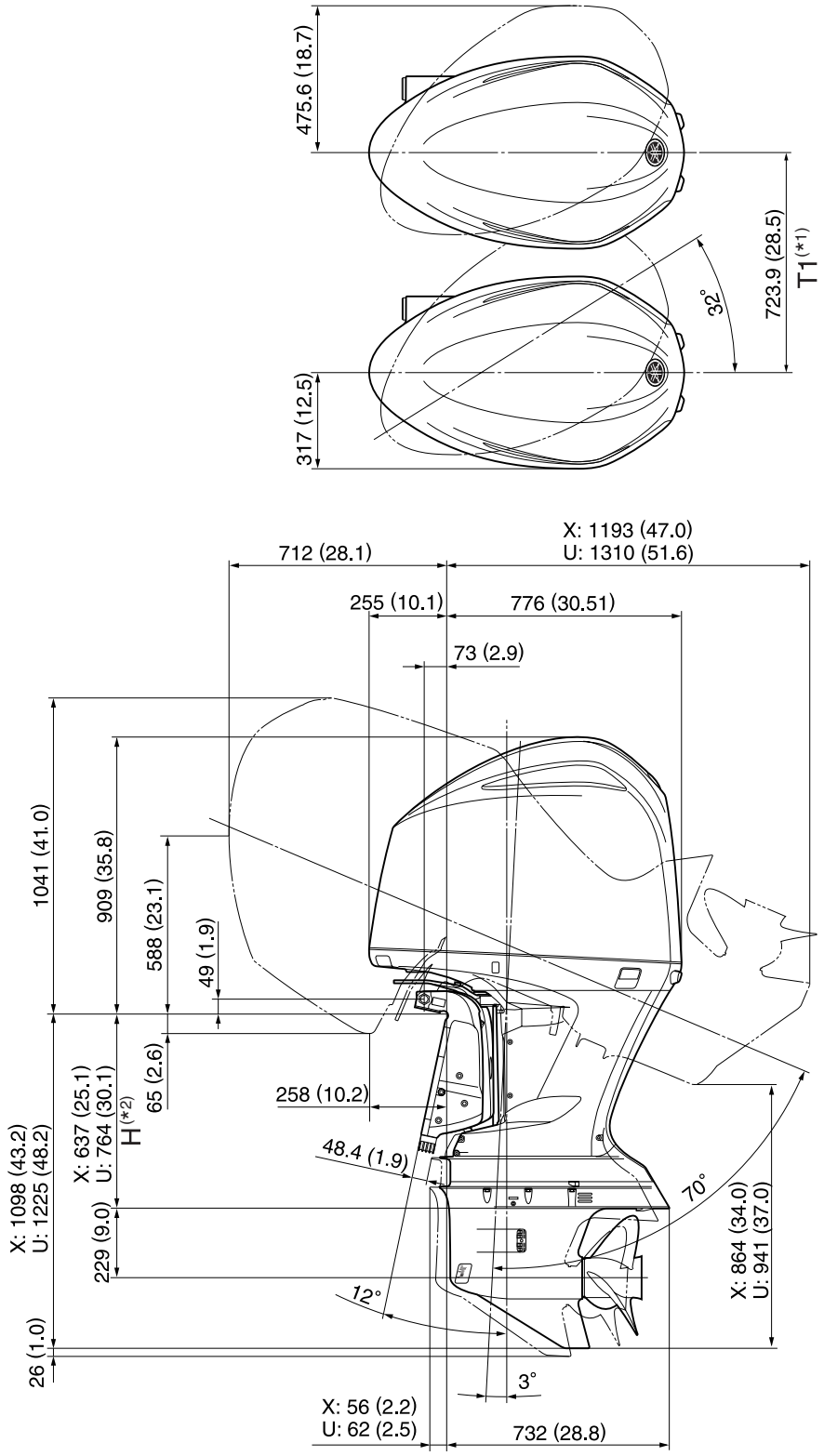
CAUTION:

The Yamaha Digital Electronic Controls and 6Y8 Multifunction Meters were specifically designed for the F300, FL300, F350, FL350. Do not use other controls or gauges.

Dimensions

Exterior

mm (in)

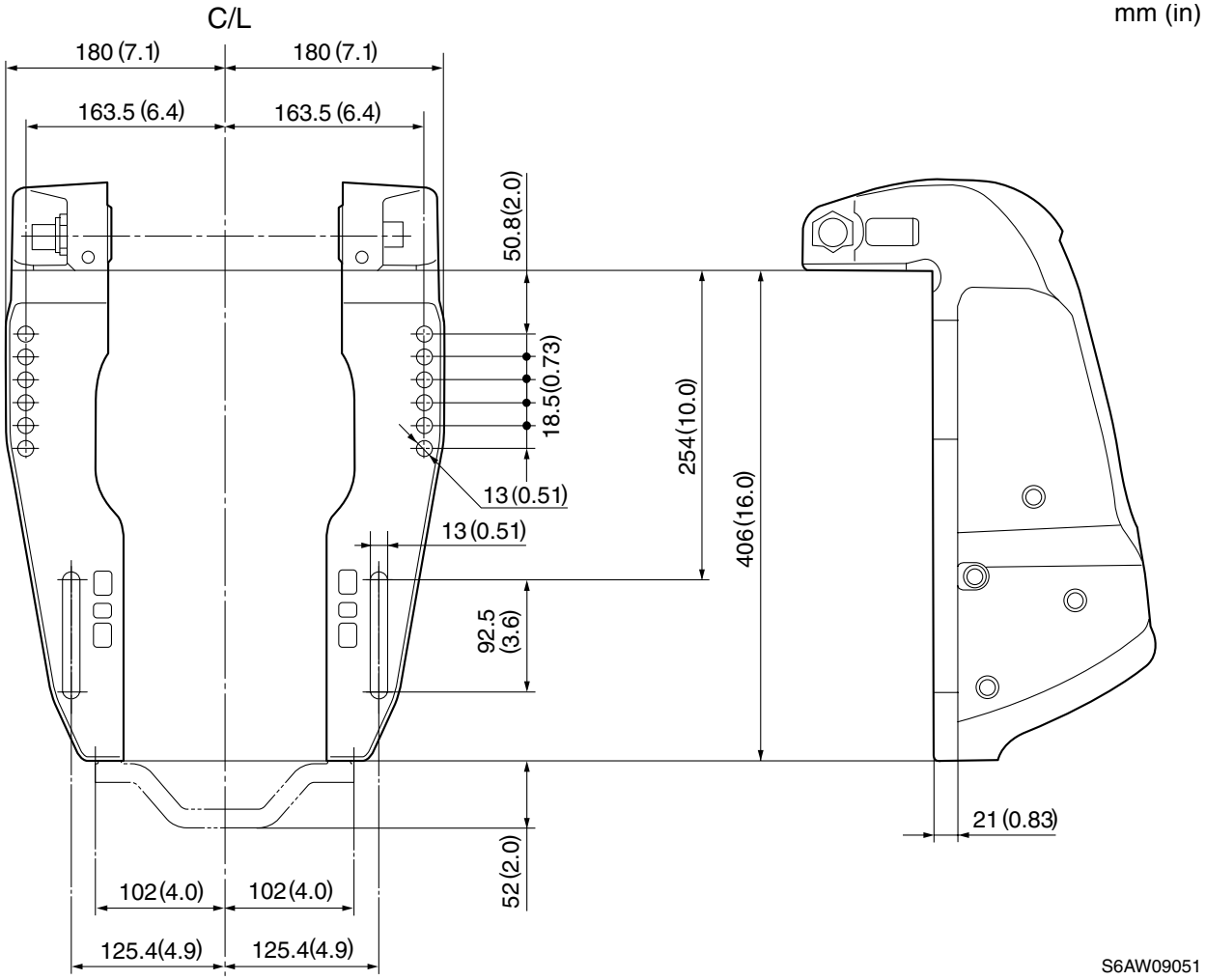


S6AW09052

(*1) Distance between the outboard motors in twin or triple installation.
(*2) Transom height

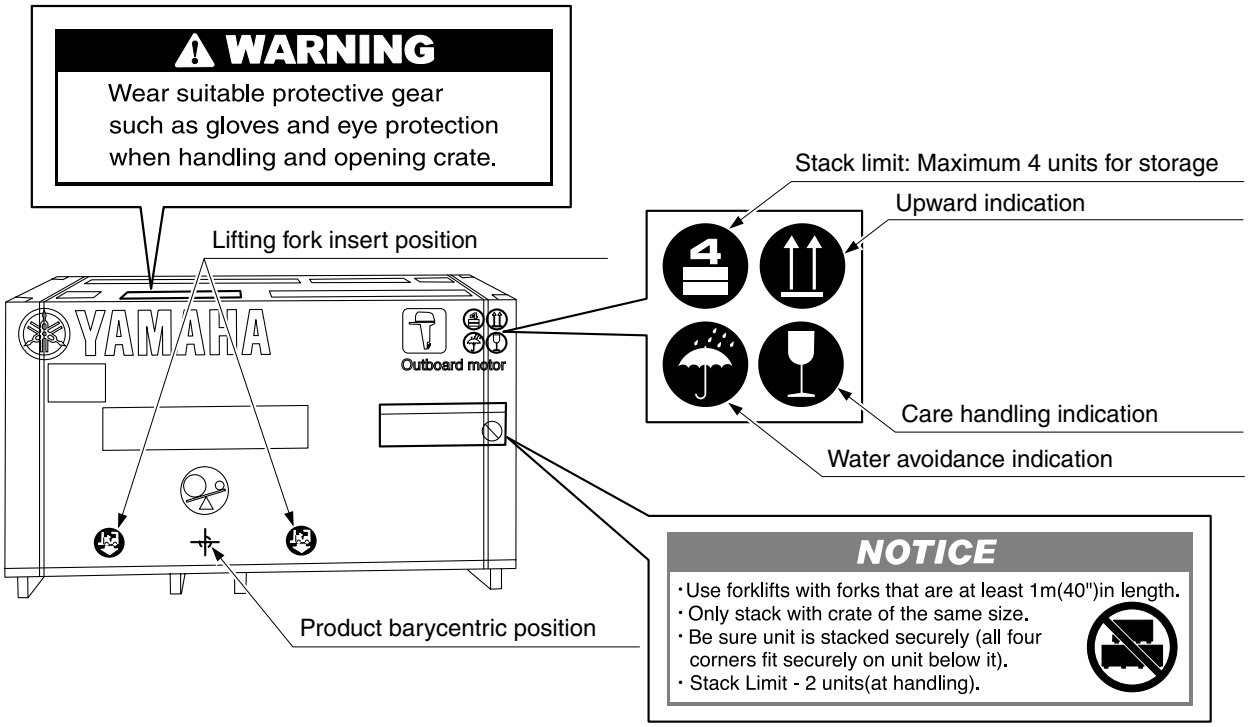
Clamp bracket

mm (in)



Crate top cover pictograph description

The following pictographs are important sign to handle the crate.
Read the notice and understand what pictographs mean to avoid a damage to the product when handling, transporting and/or keeping the crate.



S6AW09058

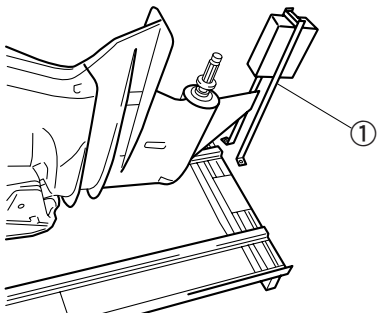
3

Uncrate procedure

1. Check for any shipping damage.
2. Remove the top cover.
3. Remove all bolts from the bottom plate, and remove the frame.

NOTE:
Be careful not to cause any damage to the outboard motor.

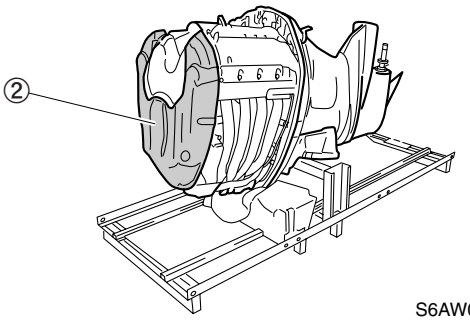
4. Remove the wrapping, and check the outboard motor for concealed damage. If any damage is found, use the concealed crate damage claim procedure.
5. Remove the skeg holder ①.



S6AW09011

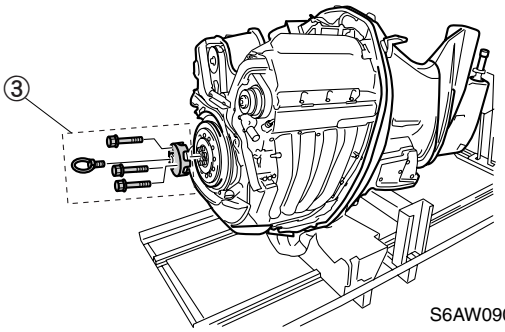
NOTE:
Remove the skeg holder first to prevent the possible damage to the outboard motor.

6. Remove the top cowl and the flywheel magnet cover ②.



S6AW09007

7. Install the engine lifting eye ③ to the flywheel magnet.



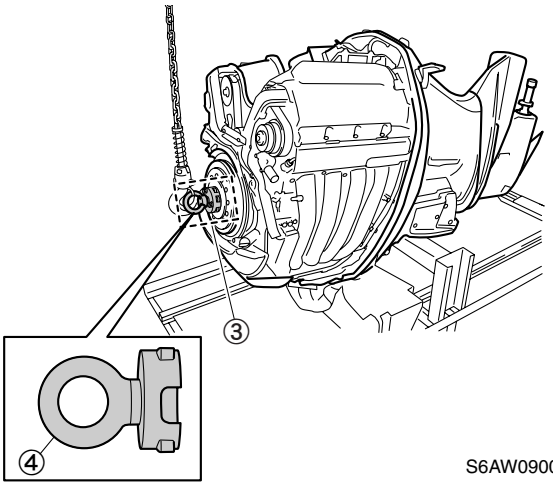
S6AW09008

CAUTION:
Always use the Yamaha-recommended engine lifting eye to lift the F300, FL300, F350, FL350 outboard motors. The Yamaha engine lifting eye and attaching bolts are designed specially for the F300, F350. Other bolts or hanging jigs may bend or break allowing the outboard motor to fall off.

NOTE:
Eye mounting bolts is M10. Use the general tightening torque for installation.

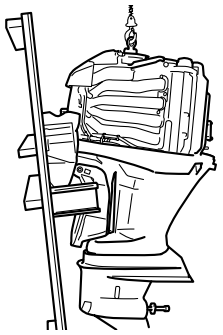
Engine lifting eye ③:
90890-06820

8. Check that the eye bolt ④ is set as shown in the illustration, and then attach the lifting harness to the engine lifting eye ③.



S6AW09009

9. Carefully lift up the motor together with the bottom frame.

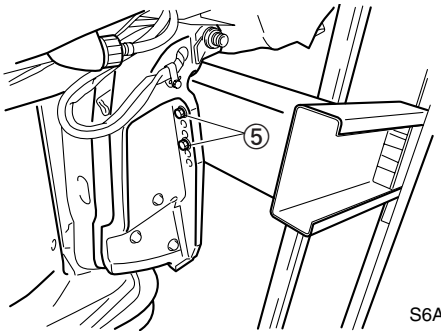


S6AW09010

CAUTION:

Do not allow the lifting hardware to interfere with other components.

10. Remove the clamp bracket bolts ⑤.



S6AW09012

NOTE:

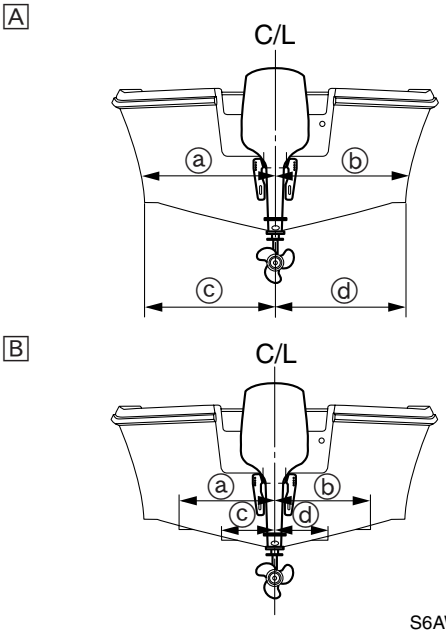
Support the frame to prevent it from falling down as the bolts are removed.

11. Remove the steering retainer, and install a hydraulic steering cylinder following the manufacture's recommendation before the outboard motor is mounted.

Mounting the outboard motor

Proper mounting of the outboard motor will mean better performance, maximum reliability, and maximum customer satisfaction. This chapter contains the specifications necessary for the outboard motor mounting, and may vary slightly depending on application.
When mounting the outboard motor, also make sure the outboard motor has the clearance to provide full movement, from both port to starboard, as well as during trim/tilt functions. Refer to the dimension items.

1. Set the outboard motor on the vertical centerline of the boat transom.



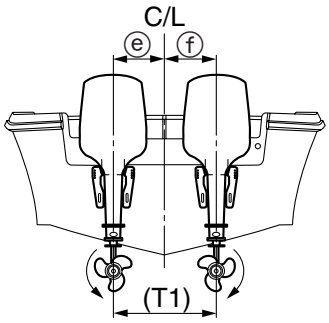
S6AW09059

A No strakes hull
B Strakes hull
C/L: Centerline of the transom.

NOTE:

Double check the measurement distance to verify that the vertical center line is straight.
The distance ⓐ and ⓑ are equal length. Also, ⓒ and ⓓ are too.

Mount twin outboard motors so the distance from the center line of each outboard motor to the center line of the boat transom are equal on both sides.

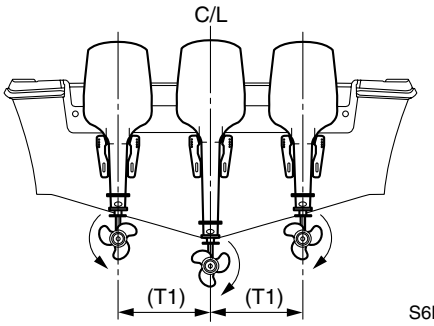


S6AW09060

C/L: Centerline of the transom.

NOTE:
- The distance ⓔ and ⓕ are equal.
- A minimum distance (T1) that is ⓔ plus ⓕ is recommended. See “Dimensions” (3-2) for the distance (T1).

For triple outboard motors installation, mount the outboard motor as shown below. If a boat has V-hull, the center outboard motor should be longer transom height than both side outboard motors.

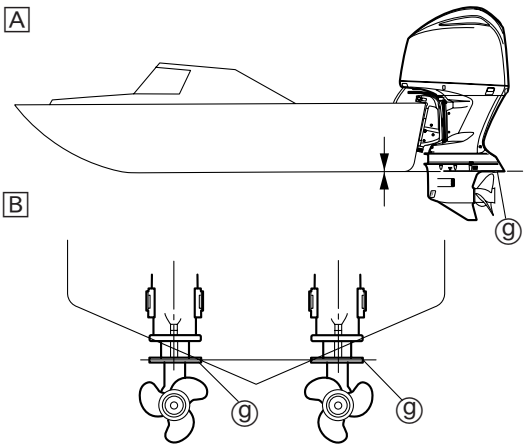


S6BJ03002

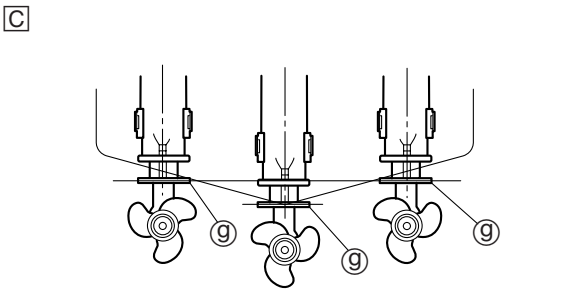
C/L: Centerline of the transom.

NOTE:
- The regular rotation model is usually used for the center outboard motor. For details, ask a boat manufacturer.
- See “Dimensions” (3-2) for the distance (T1).

2. Adjust the outboard motor so the height of the anti-cavitation plate is equal to or slightly above the bottom of the boat transom.



S6AW09061-1



S6BJ03001

A Single outboard motor
B Twin outboard motors
C Triple outboard motors
ⓖ Anti-cavitation plate

NOTE:
This mounting height information is for reference only. It is impossible to provide complete instructions for every possible boat and outboard motor combination.

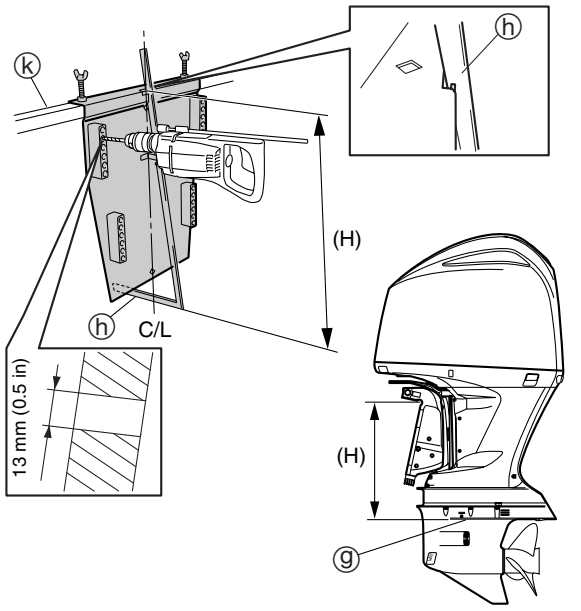
3. It is critical to properly align transom center line with running surface center line before drilling the mounting holes. Always reference alignment of drill fixture to center line marks in fixture. Never rest the fixture flat on the transom splash well until fixture alignment is true with hulls running surface (shim fixture when necessary).

   Never measure splash well to find the transom center line.

Worn or damaged fixtures should be replaced as drill bushings wear, and so on.

Adjust the scale to the transom height (H), and set it on the drilling plate. Secure the drilling plate to the boat transom by means of a screw or a vise. Drill the mounting holes in alignment with the drill-hole guide.

4. Mark the best suited 6 symmetrical mounting holes to the boat transom.
   Drill the mounting holes vertically on the boat transom using 13 mm (0.5 in) drill.

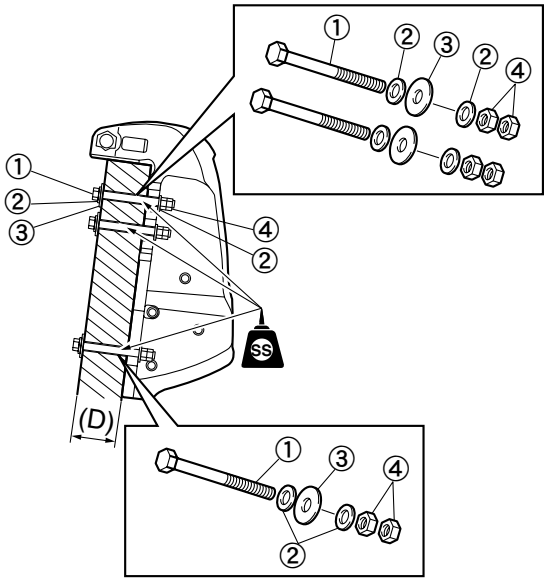


S6AW09064

ⓖ Anti-cavitation plate
ⓗ Scale
ⓚ Boat transom
C/L: Centerline of the transom.

Drilling plate:
90890-06783

5. Apply a sealant to the mounting holes and secure the outboard motor with supplied mounting hardware.



S6AW09063

① Mounting bolt
② Small washer
③ Large washer
④ Lock nut

CAUTION:

Make sure there is no clearance on the surfaces between the transom and the outboard motor bracket. Otherwise, the outboard motor bracket or boat transom may be damaged.

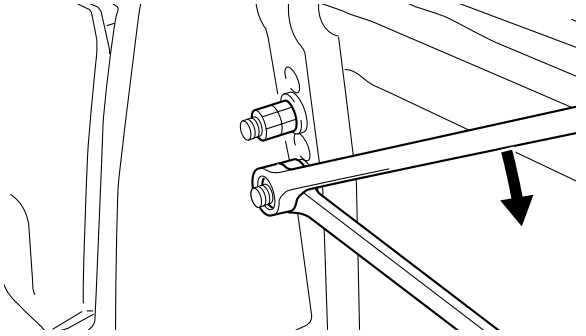
NOTE:

The second hole from the clamp bracket top is recommended for the upper mounting bolt.

Boat transom thickness (D)	110 mm (4.33 in) or less	Over 110 mm (4.33 in)
Mounting bolt	M12 × 150 mm (5.91 in)	M12 × 170 mm (6.69 in)

6. Secure the bolts, and firmly tighten the nut to the extent that the clamp bracket does not bite into the boat transom.

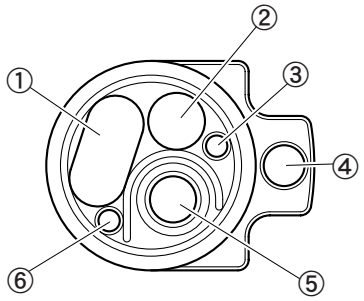
7. Firmly tighten the lock nuts as shown in the illustration.



S6AW09015

Mounting the rigging grommet

Rigging grommet description



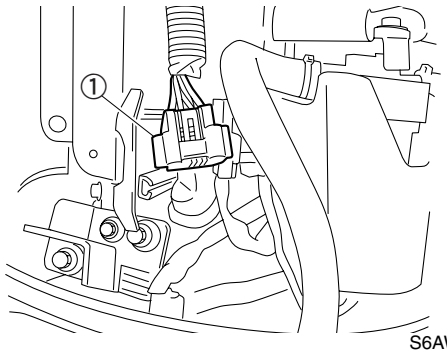
S6AW09016

① Battery cable
② Extension wire harness
③ Isolator lead (option)
④ Flushing hose (option)
⑤ Fuel hose
⑥ Speedometer hose (option)

Main harness connection on engine

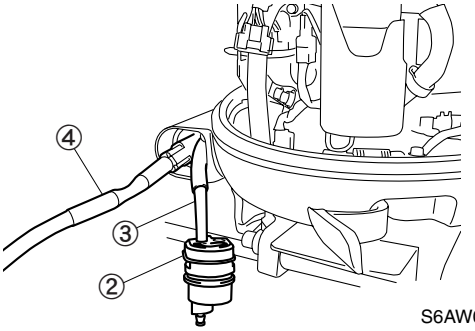
Install the main harness before installing the battery cable.

1. Remove the plastic tie to release the main harness coupler ① on the outboard motor.



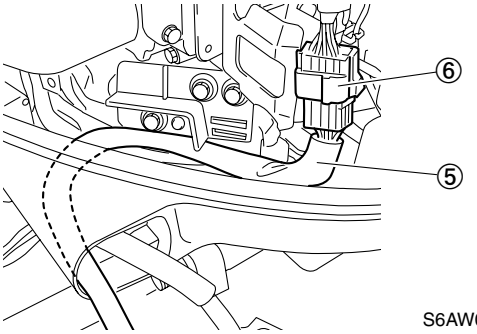
S6AW09023

2. Pull out the rigging grommet ② together with the fuel hose ③ as shown in the illustration. Insert the extension wire harness ④ into the opening on the bottom cowling.



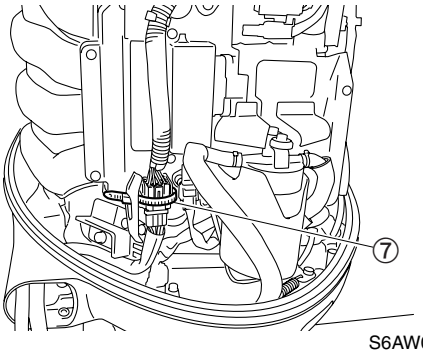
S6AW09024

3. Install the extension wire harness ⑤ as shown in the illustration. Check and eliminate any water and foreign matters inside the coupler, and connect it to the main harness coupler ⑥ on the outboard motor.



S6AW09025

4. Secure the main harness coupler ⑥ to the engine with a plastic tie ⑦.

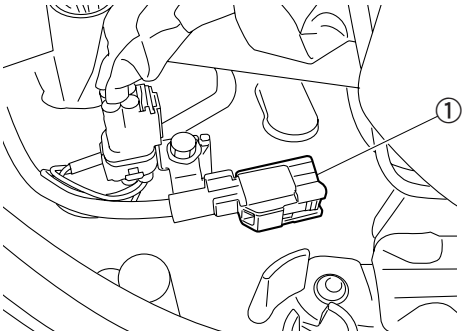


S6AW09027

Isolator lead installation (option)

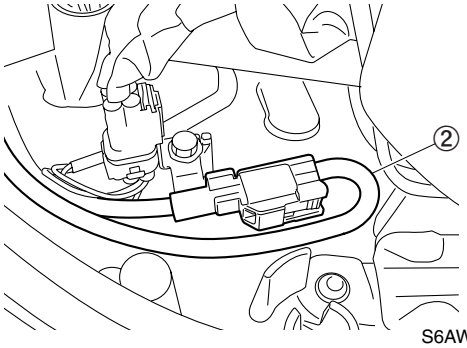
Carry out the following procedures only when the isolator lead (option) is used.

1. Remove the cap ① from the isolator coupler.



S6AW09030

2. Check and eliminate any water and foreign matters inside the isolator lead ② coupler, and connect it to the isolator coupler.



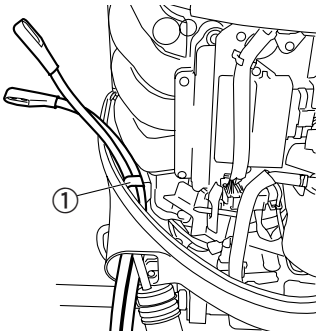
S6AW09031

Battery cable installation

⚠ WARNING

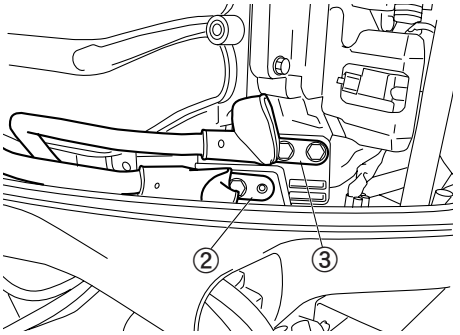
Connect the battery cables to the engine first.

1. Make sure that the extension wire harness is inserted into the opening on the bottom cowling.
2. Insert the battery cables into the bottom cowling in the manner that the positive battery cable runs below the negative battery cable. Insert them to the extent that the white tape ① goes inside the bottom cowling.



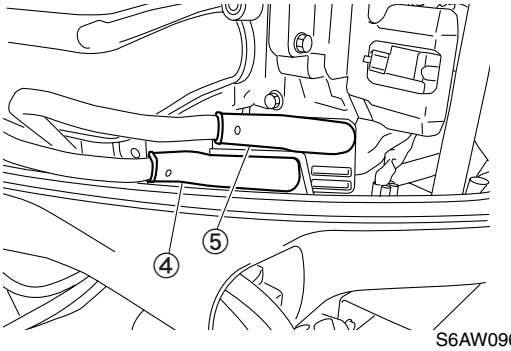
S6AW09035

3. Install the negative battery cable ② and the positive battery cable ③.



S6AW09037

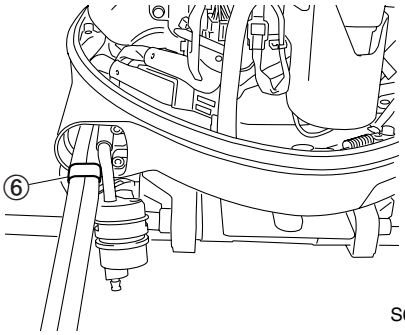
4. Apply dielectric grease to the terminals, and install the rubber caps ④ and ⑤ securely.



S6AW09038

3

5. Pull out the battery cables to the extent that the white tape ⑥ on the cables comes out of the bottom cowling.



S6AW09039

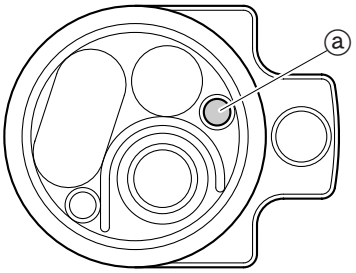
6. See “Installing the battery” (3-13) for the battery cable connections on the boat.

Speed sensor installation (option)

See “6Y8 Multifunction Meter set up manual” for the installation procedure of speed sensor.

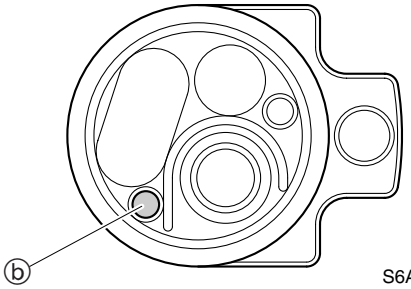
Rigging grommet installation

1. Cut out the surface film at ⓐ in the illustration if the isolator lead (option) is used.



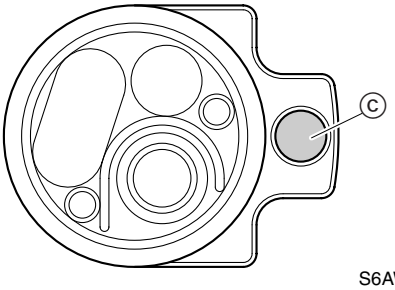
S6AW09018

2. Cut out the surface film at ⓑ in the illustration if the speed sensor (option) is used.



S6AW09020

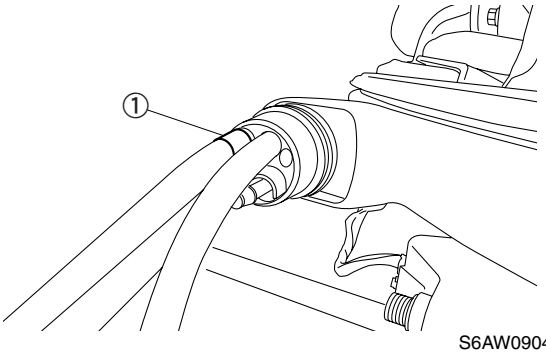
3. Cut out the surface film at ⓒ in the illustration if the flushing hose (option) is extended to the outside.



S6AW09041

4. Install each harness in the relevant position on the rigging grommet. See “Rigging grommet description” (3-9) for the detailed description of the rigging grommet.

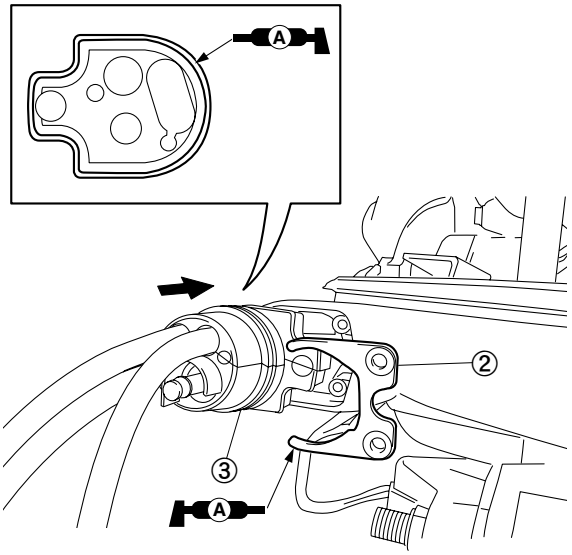
5. Pull the battery cables to the extent that the white tape ① comes out of the rigging grommet.



S6AW09046

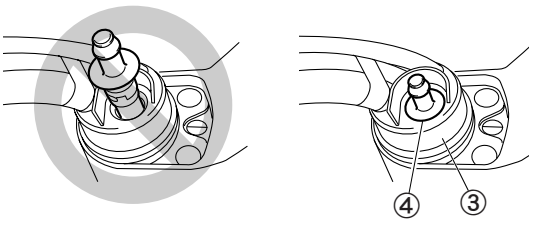
6. Check that the positive battery cable does not come in contact with the intake manifold. If it does, pull the battery cables again for adjustment, and avoid the contact.

7. Install the fitting plate ② to the rigging grommet ③. Then, insert the rigging grommet ③ into the opening on the bottom cowling.



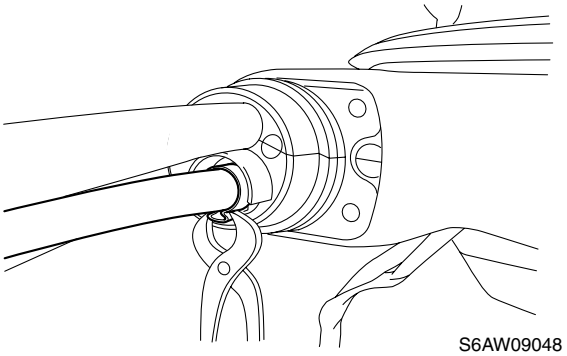
S6AW09042

8. Check that the fuel hose joint ④ is seated on the rigging grommet ③ as shown in the illustration. Correct the loose fuel hose joint ④ to the seated position.

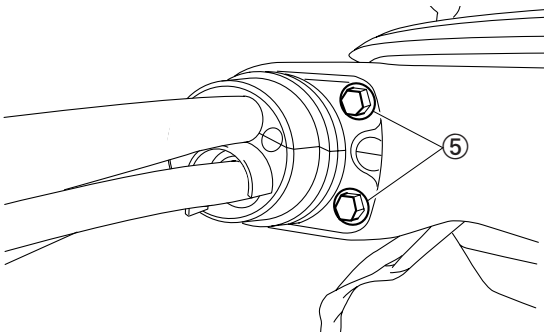


S6AW09047

9. Deeply insert the fuel hose running to the boat, and secure it firmly with a retaining clip. See “Fuel system specification” (3-25) for the recommended fuel hose size.


S6AW09048

10. Tighten the rigging grommet fastening bolt ⑤ to the specified torque.



S6AW09045

	Grommet mounting bolt: 10 N·m (1.0 kgf·m, 7.4 ft·lb)

11. Install the rigging tube retainer, and secure it with a plastic tie.

Installing the Digital Electronic Control box and switch panel

See “Digital Electronic Control service manual” for the installation procedures of Digital Electronic Control box and the switch panel.

Installing the battery

⚠ WARNING

- **Improper battery connections or cable size selection may result in a fire.**
- **When installing an isolator lead to the positive battery terminal or battery switch, over-current protection in compliance with ABYC (E-11) must be provided.**

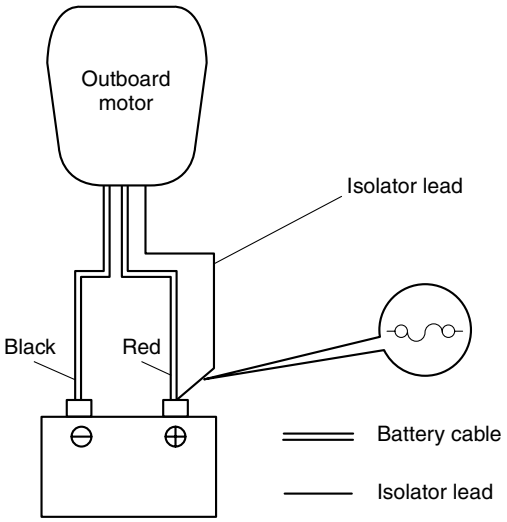
CAUTION:

If battery connections are reversed, thorough charging system testing is required, replace damaged components. See "Charging units and components" (5-42).

See "Rigging recommendations" (3-25) for the extension battery cable length.

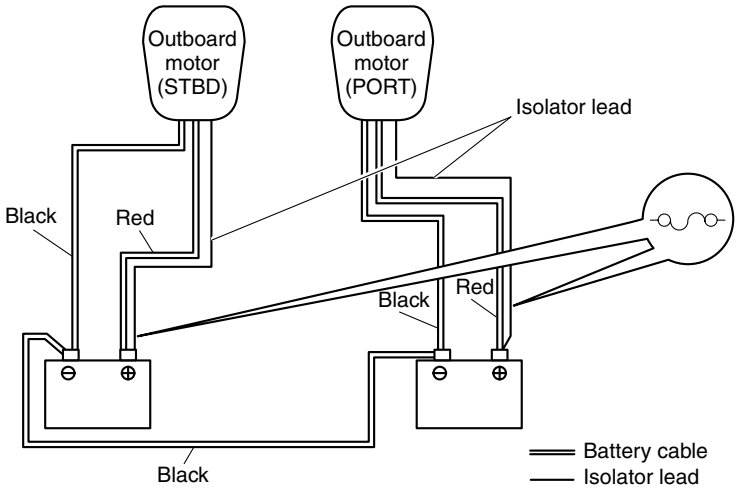
Battery wiring without house (accessory) battery

1. For engines using the optional battery isolator lead and only using one battery, connect the positive battery cable and the isolator lead to the positive battery terminal. If the battery isolator lead is left disconnected, it may come in contact with a ground connection and result in a fire.



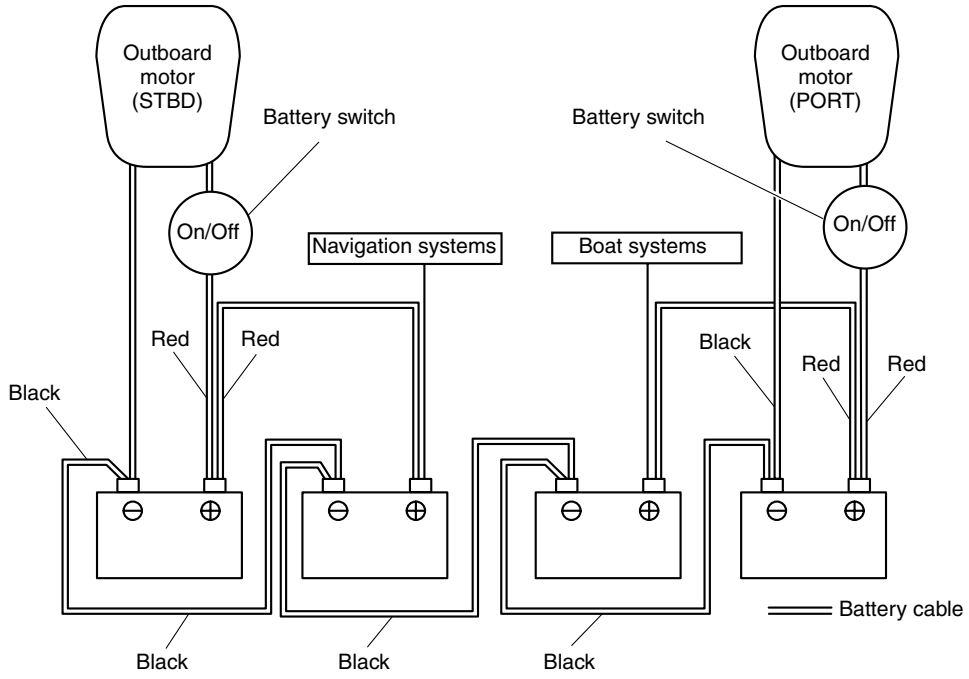
S6AW09066

2. When using a dual battery installation, a negative connecting cable must be installed between the engine battery and the house battery negative terminals. This cable must be sized equivalent to the engine battery cables or larger AWG size.



S6AW09068

3. This battery configuration requires splitting the house system load, half to each engine bank. However in the event of excessive amperage draw, isolated cranking batteries and house batteries are required.

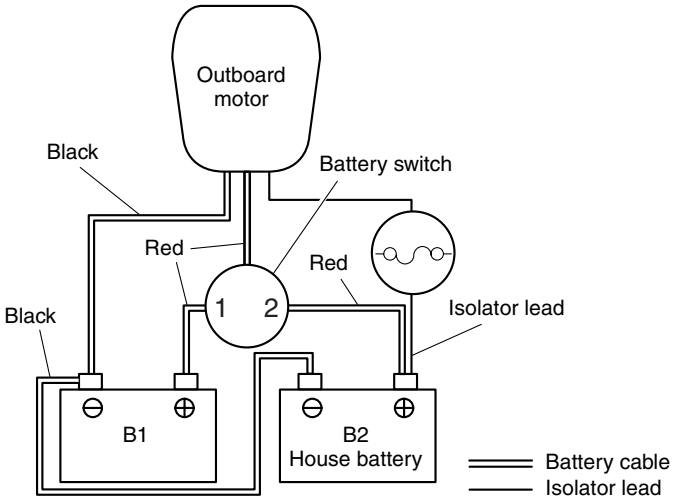


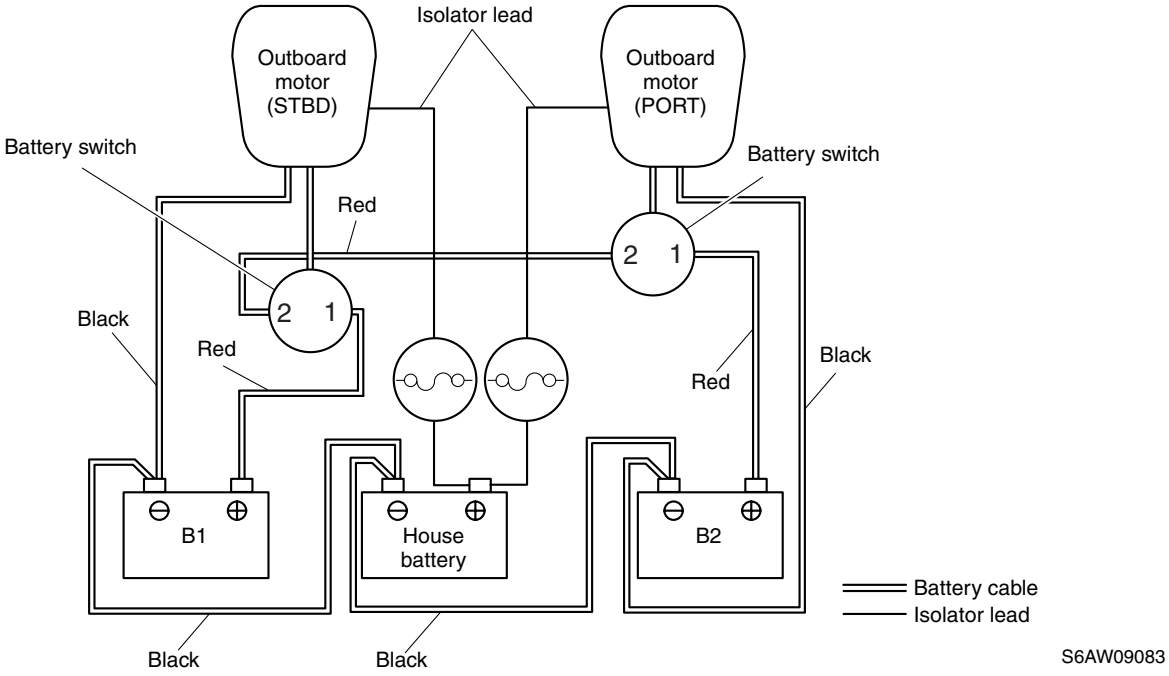
Battery wiring with house (accessory) battery

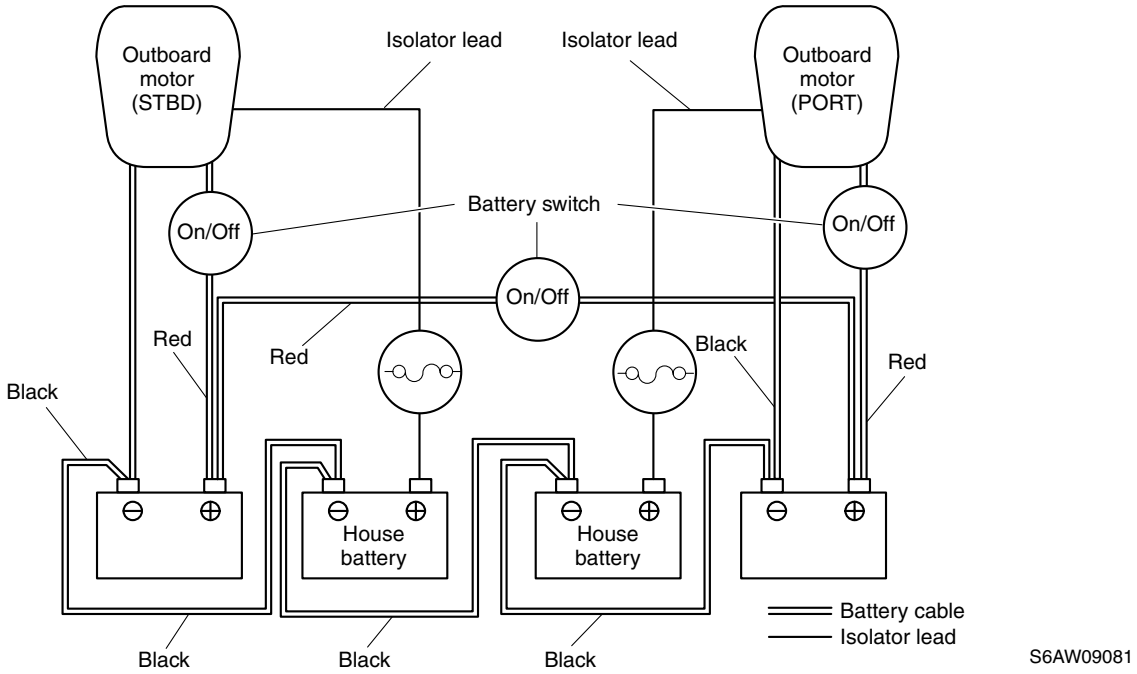
⚠ WARNING

Improper battery connections or cable size selection may result in a fire.

- **When only one battery is used for one engine, connect the positive battery cable and the isolator lead to the positive battery terminal. If the isolator lead is left unconnected, accidental contact of the isolator lead with the negative terminal of the battery can cause a short circuit which may result in a fire.**
- **When using a house battery, a negative connecting cable must be installed between the house battery and the engine battery. This cable must be sized equivalent to the engine battery cables or lager AWG cable size in accordance with ABYC specifications.**
- **Battery switches must be capable of meeting intermittent and continuous current ratings for engines and accessories.**




Isolator lead
Outboard motor (STBD)
Outboard motor (PORT)
Battery switch
Battery switch
Red
2 1
2 1
Black
Red
Red
Black
B1
House battery
B2
Battery cable
Isolator lead
Black
Black
S6AW09083


Outboard motor (STBD)
Isolator lead
Isolator lead
Outboard motor (PORT)
On/Off
Battery switch
On/Off
On/Off
Red
Red
Black
Red
Black
House battery
House battery
Battery cable
Isolator lead
Black
Black
Black
S6AW09081

Digital network system diagram

This outboard motor can only accept the exclusive Digital Network System such as “Digital Electronic Control” and “6Y8 Multifunction Meter.”
The Digital Network System allows very simple and easy rigging. It is completed by simply connecting the electrical wires.
The diagram shown here represents an example of Digital Network System configuration.
See “Digital Electronic Control service manual” for the installation procedures of Digital Electronic Control.
See “6Y8 Multifunction Meter set up manual” for the installation procedures of 6Y8 Multifunction Meter.

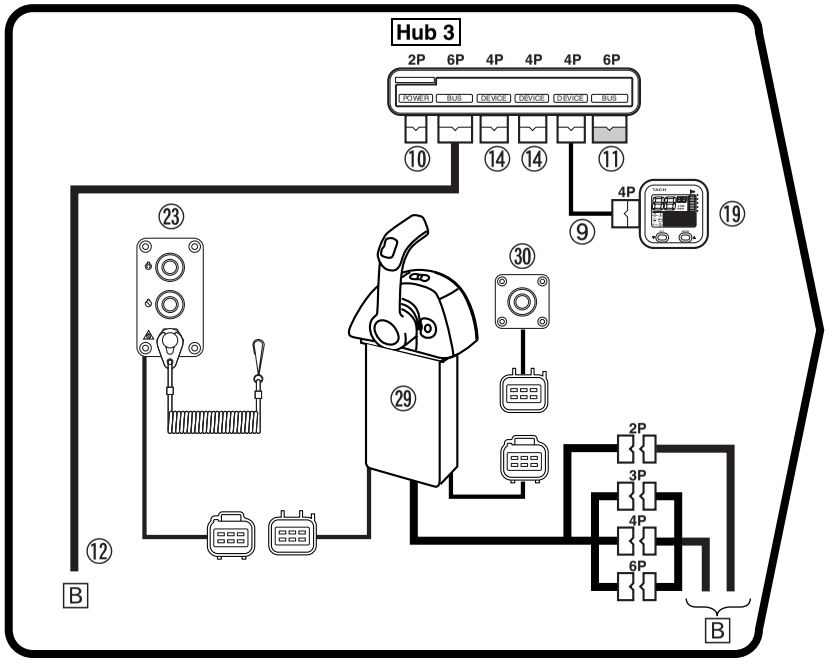
Single outboard motor application

(*1) Do not lose the 12 pin coupler plug, because it is necessary for emergency.
(*2) When installing the Speed and Fuel meter unit, the Fuel management meter unit and the Speedometer unit are not necessary, in this case install a water-proof cap ⑭ onto the open “DEVICE” connector of hub 2.
(*3) The extension wire harness is available in 4 lengths types; 7 m (23.0 ft), 8 m (26.2 ft), 10 m (32.8 ft), and 12 m (39.4 ft). Choose the one that fits your boat length.

① PTT sensor
② PTT sensor coupler (white)
③ Speed sensor (option)
④ Water pressure sensor
⑤ Engine ECM
⑥ Communication coupler
⑦ Extension wire harness coupler
⑧ Extension wire harness
⑨ Pigtail bus wire
⑩ Cap 1 (red)
⑪ In line resister
⑫ Main bus wire
⑬ Fuse (10A)
⑭ Cap 1 (white)
⑮ 2 pin coupler (red)
⑯ 4 pin coupler (white)
⑰ 6 pin coupler (gray)
⑱ 6 pin coupler (black)
⑲ Tachometer unit
⑳ Speed and Fuel meter unit
㉑ Fuel management meter unit
㉒ Speedometer unit
㉓ GPS (option)
㉔ Switch panel
㉕ 8ft power wire
㉖ Fuel tank (fuel tank sensor)
㉗ Wire lead
㉘ Digital Electronic Control box (main station)
㉙ Digital Electronic Control box (sub station)
㉚ Station selector switch

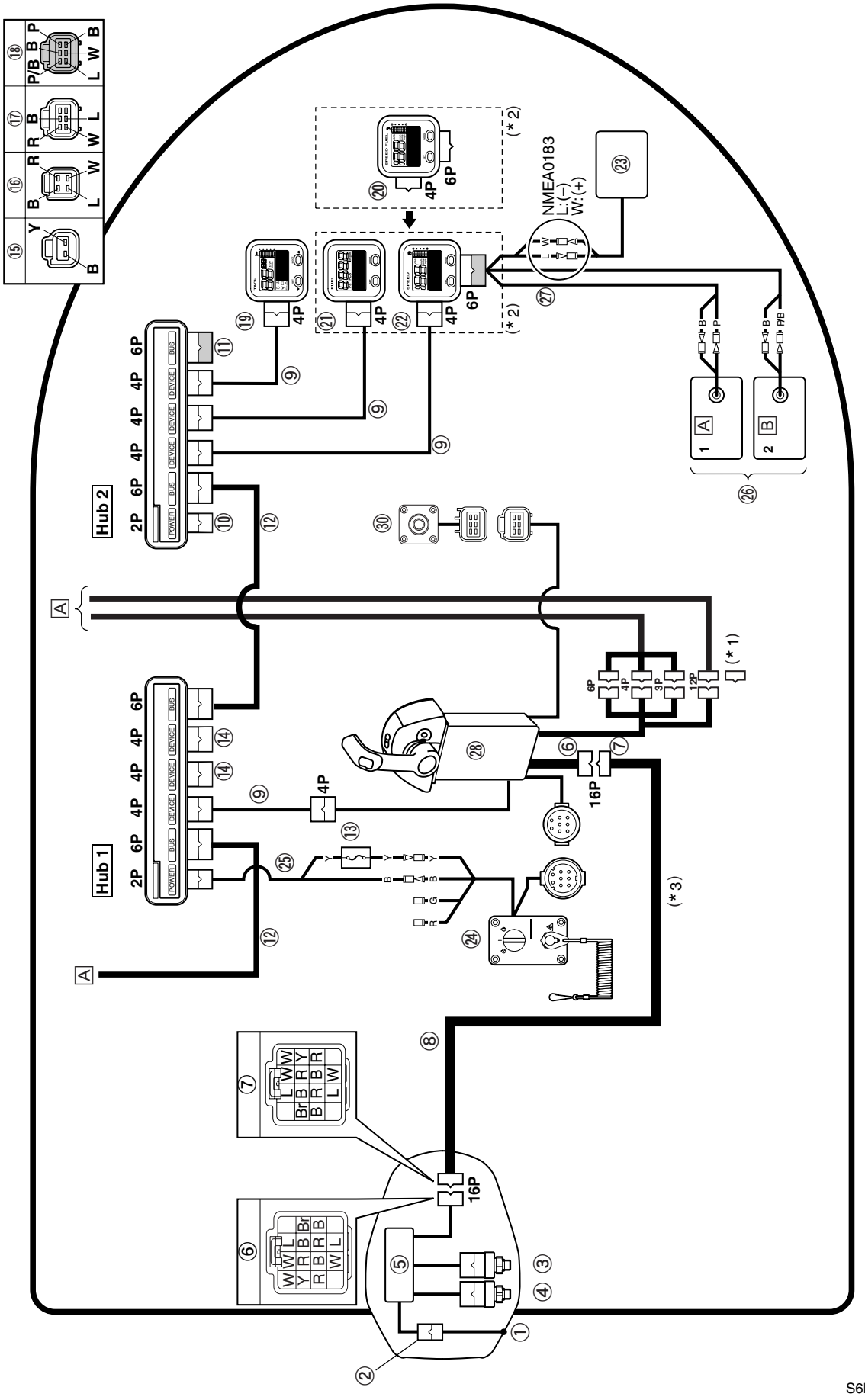
Color code

B	: Black
G	: Green
L	: Blue
P	: Pink
R	: Red
W	: White
Y	: Yellow
P/B	: Pink/Black



S6BJ03003

A To sub station
B To main station


NMEA0183
L:(–)
W:(+)
Hub 2
Hub 1
POWER
BUS
DEVICE
4P
6P
2P
16P
12P
3P
(* 1)
(* 2)
(* 3)
A
B

S6BJ03004

Twin outboard motor application

(*1) Do not lose the 12 pin coupler plug, because it is necessary for emergency.

(*2) When installing the Speed and Fuel meter unit, the Fuel management meter unit and the Speedometer unit are not necessary, in this case connect the Speed and Fuel meter unit to the “DEVICE” connector of hub 2. Always install the water-proof cap ⑭ to the open device connector.

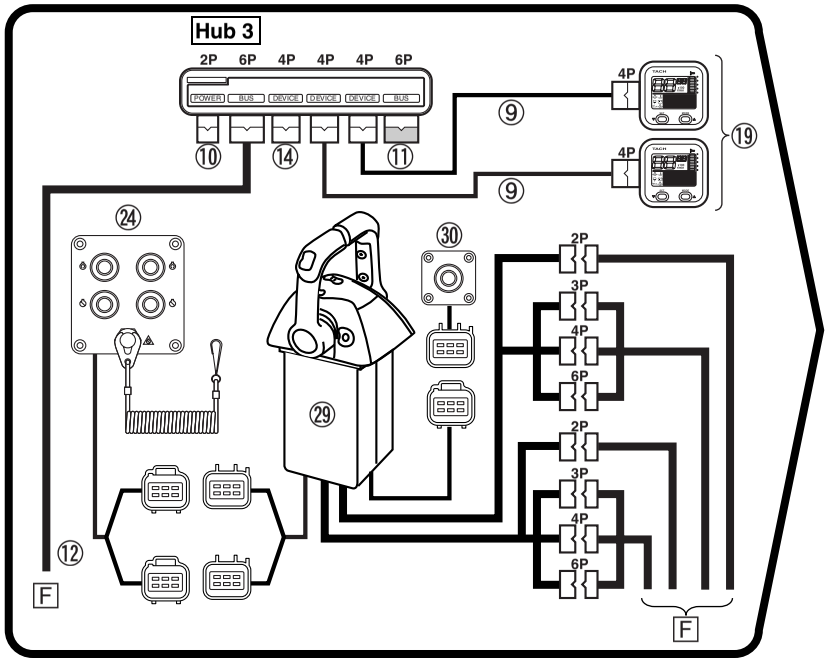
(*3) The extension wire harness is available in 4 lengths types; 7 m (23.0 ft), 8 m (26.2 ft), 10 m (32.8 ft), and 12 m (39.4 ft). Choose the one that fits your boat length.

① PTT sensor
② PTT sensor coupler (white)
③ Speed sensor (option)
④ Water pressure sensor
⑤ Engine ECM
⑥ Communication coupler
⑦ Extension wire harness coupler
⑧ Extension wire harness
⑨ Pigtail bus wire
⑩ Cap 1 (red)
⑪ In line resister
⑫ Main bus wire
⑬ Fuse (10A)
⑭ Cap 1 (white)
⑮ 2 pin coupler (red)
⑯ 4 pin coupler (white)
⑰ 6 pin coupler (gray)
⑱ 6 pin coupler (black)
⑲ Tachometer unit
⑳ Fuel management meter unit
㉑ Speedometer unit
㉒ Speed and Fuel meter unit
㉓ GPS (option)
㉔ Switch panel
㉕ 8ft power wire
㉖ Fuel tank (fuel tank sensor)
㉗ Wire lead
㉘ Digital Electronic Control box (main station)
㉙ Digital Electronic Control box (sub station)
㉚ Station selector switch

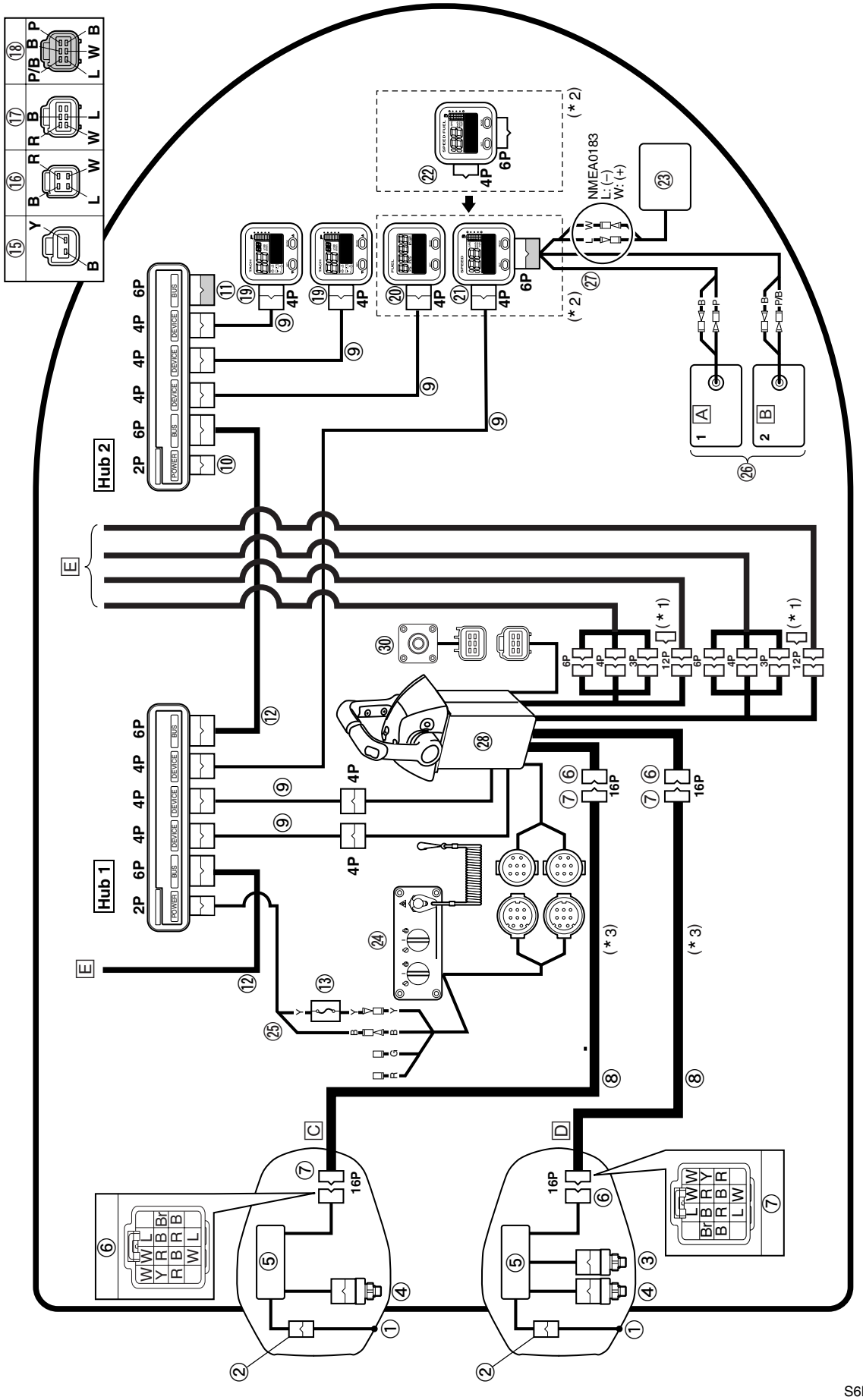
[A] Left
[B] Right
[C] PORT
[D] STBD
[E] To sub station
[F] To main station

Color code

B	: Black
G	: Green
L	: Blue
P	: Pink
R	: Red
W	: White
Y	: Yellow
P/B	: Pink/Black



S6BJ03005



S6BJ03006

Triple outboard motor application

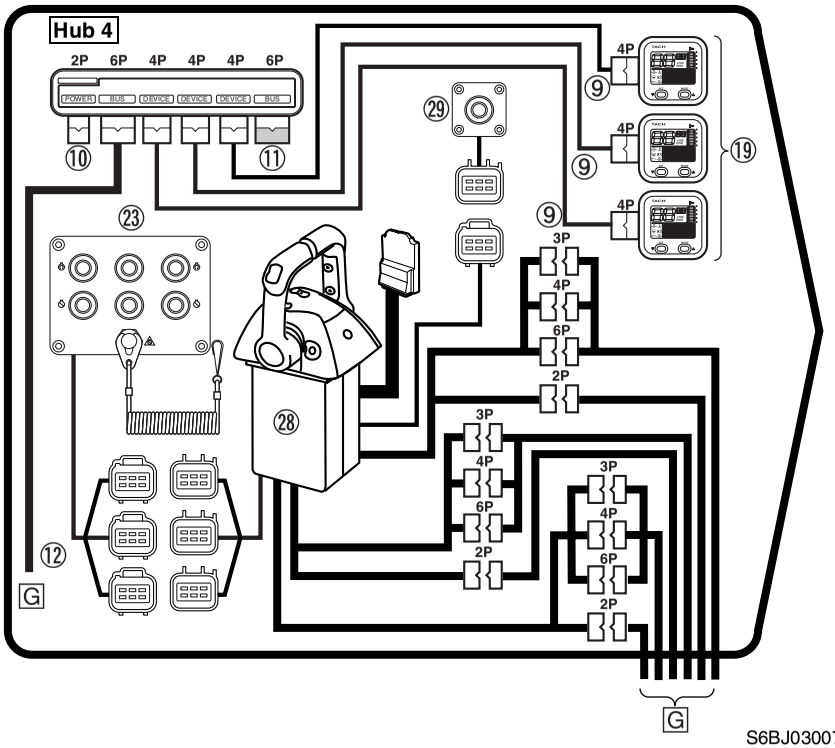
(*1) Do not lose the 12 pin coupler plug, because it is necessary for emergency.
(*2) Always install the water-proof cap ⑭ to the open device connector.
(*3) The extension wire harness is available in 4 lengths types; 7 m (23.0 ft), 8 m (26.2 ft), 10 m (32.8 ft), and 12 m (39.4 ft). Choose the one that fits your boat length.

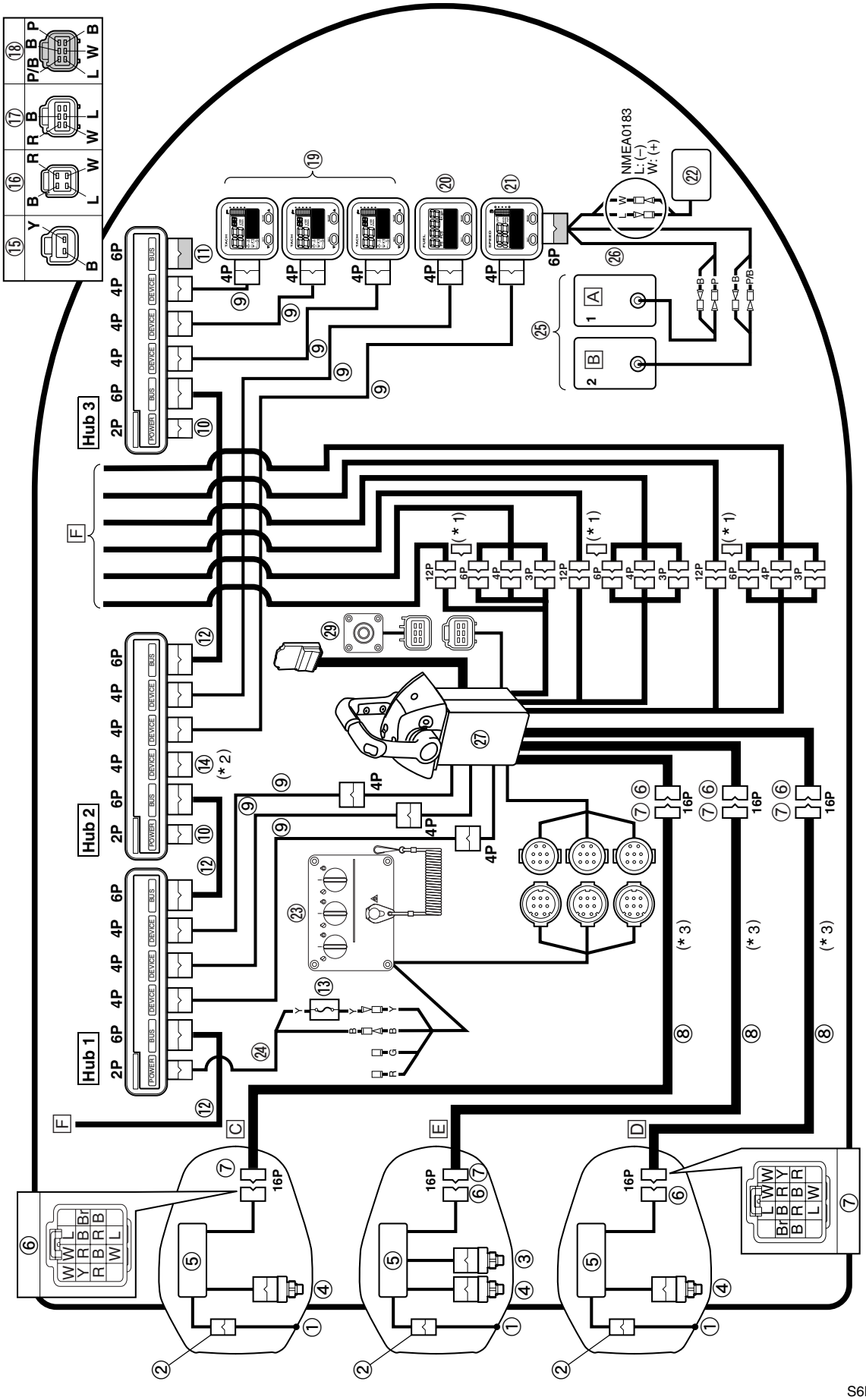
① PTT sensor
② PTT sensor coupler (white)
③ Speed sensor (option)
④ Water pressure sensor
⑤ Engine ECM
⑥ Communication coupler
⑦ Extension wire harness coupler
⑧ Extension wire harness
⑨ Pigtail bus wire
⑩ Cap 1 (red)
⑪ In line resister
⑫ Main bus wire
⑬ Fuse (10A)
⑭ Cap 1 (white)
⑮ 2 pin coupler (red)
⑯ 4 pin coupler (white)
⑰ 6 pin coupler (gray)
⑱ 6 pin coupler (black)
⑲ Tachometer unit
⑳ Fuel management meter unit
㉑ Speedometer unit
㉒ GPS (option)
㉓ Switch panel
㉔ 8ft power wire
㉕ Fuel tank (fuel tank sensor)
㉖ Wire lead
㉗ Digital Electronic Control box (main station)
㉘ Digital Electronic Control box (sub station)
㉙ Station selector switch

[A] Left
[B] Right
[C] PORT
[D] STBD
[E] Center
[F] To sub station
[G] To main station

Color code

B	: Black
G	: Green
L	: Blue
P	: Pink
R	: Red
W	: White
Y	: Yellow
P/B	: Pink/Black



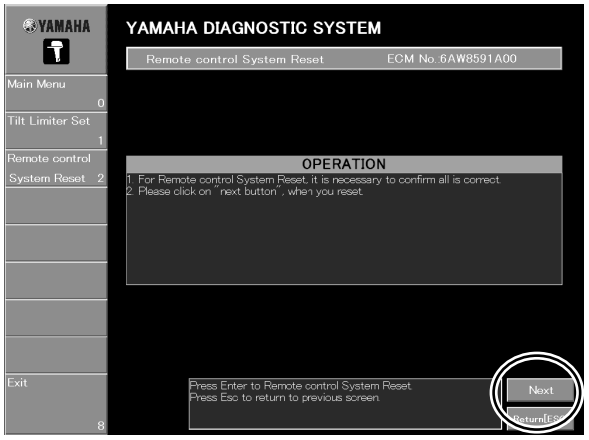

Hub 1
Hub 2
Hub 3
POWER
BUS
DEVICE
NMEA0183
L: (–)
W: (+)
(* 1)
(* 2)
(* 3)
16P
12P
6P
4P
3P
2P

S6BJ03008

Digital Electronic Control system reset

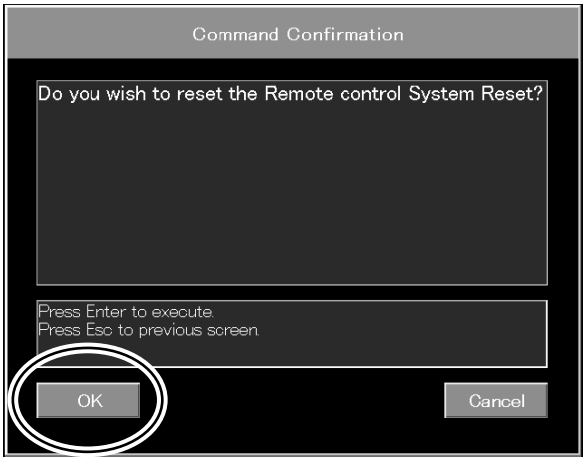
To connect the YDIS, see “YDIS” (4-1) or the YDIS (Ver. 1.30 or later) Instruction manual.

1. If the Digital Electronic Control ECM and the engine ECM are unable to identify each other, click the “Next” button or press the Enter key on your keyboard.



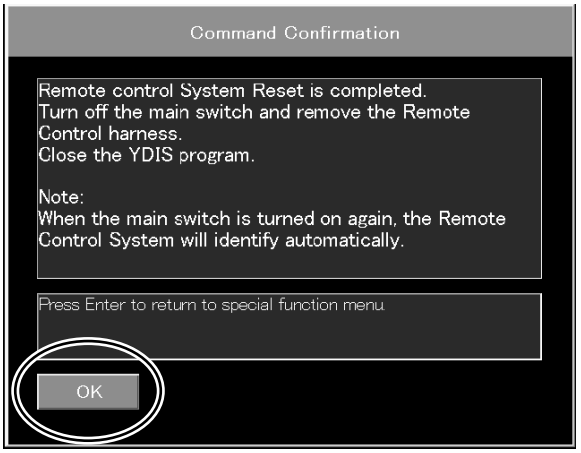
S6X604005

2. Click the “OK” button or press the Enter key on your keyboard.



S6X604006

3. Click the “OK” button or press the Enter key on your keyboard.



S6X604007

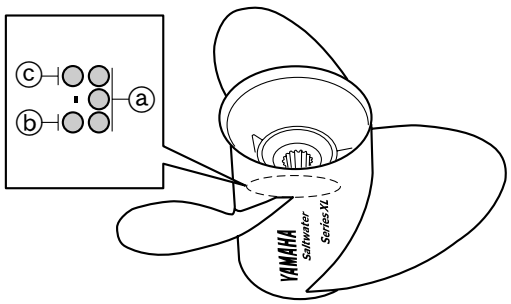
4. Turn off the engine start switch of the outboard motor, and then remove the extension wire harness of the Digital Electronic Control. When the extension wire harness is installed and engine start switch is turned on again, the outboard motor will identify the newly connected Digital Electronic Control automatically.

Propeller selection

The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

Propeller size

The size of the propeller is indicated on the propeller boss end, on the side of the propeller boss.



S6AW09089

ⓐ : Propeller diameter (in inches)
ⓑ : Propeller pitch (in inches)
ⓒ : Propeller type (propeller mark)

Selection

When the engine speed is at the full throttle operating range (5,000–6,000 r/min), the ideal propeller for the boat is one that provides maximum performance in relation to boat speed and fuel consumption.

Regular rotation model

Propeller size (in)	Material
16 1/4 x 17 - X	Stainless
16 1/4 x 19 - X	
15 1/2 x 21 - X	
15 1/4 x 23 - X	
15 1/4 x 25 - X	

Counter rotation model

Propeller size (in)	Material
16 1/4 x 17 - XL	Stainless
16 1/4 x 19 - XL	
15 1/2 x 21 - XL	
15 1/4 x 23 - XL	
15 1/4 x 25 - XL	

Rigging recommendations

Fuel system specification

Fuel hose resistance(*1)	20 kPa (0.2 kgf·cm^2, 2.9 psi)
Recommended fuel filter(*2)	RAICOR 10 μ fuel filter
Recommend fuel hose size	9 mm (3/8 in) type A1

(*1) Applicable to the fuel hose from the fuel tank outlet on the boat to the fuel filter inlet on the outboard motor.
(*2) The fuel filter installed on the boat.

Extension length recommendation of battery cable

To extend the length of battery cables, follow the requirements in the tables for your battery capacity, cable size, and atmosphere temperature.
The extension length of battery cable means the total combined length of positive and negative cables.
Select an extension battery cable and terminal which meets ABYC requirements or equivalent.
Use a stud which is best-suited to the terminal size.
Solder the connection of terminals and cables to prevent them from corroding.

CAUTION:

Exceeding the recommended extension length of battery cable may cause poor electrical system performance or damage.

Atmospheric temperature above 0 °C (32 °F)						
Battery requirements		Number of batteries in parallel	Cable specifications			
Unit	Minimum capacity		Maximum total extension length (Positive cable + Negative cable)			
			20 mm^2 AWG4	30 mm^2 AWG2	50 mm^2 AWG1/0	60 mm^2 AWG2/0
CCA/EN	670 amps	1	3.8 m (12.5 ft)	6.4 m (21.0 ft)	10.0 m (32.8 ft)	11.8 m (38.7 ft)
20HR/IEC	110 Ah					
CCA/EN	735 amps	1	4.6 m (15.1 ft)	8.0 m (26.2 ft)	12.4 m (40.7 ft)	14.4 m (47.2 ft)
20HR/IEC	115 Ah					
CCA/EN	800 amps	1	5.0 m (16.4 ft)	8.6 m (28.2 ft)	13.2 m (43.3 ft)	15.6 m (51.2 ft)
20HR/IEC	120 Ah					
CCA/EN	670 amps	2	7.2 m (23.6 ft)	12.4 m (40.7 ft)	19.0 m (62.3 ft)	22.4 m (73.5 ft)
20HR/IEC	110 Ah					
CCA/EN	735 amps	2	7.6 m (24.9 ft)	13.2 m (43.3 ft)	20.2 m (66.3 ft)	24.0 m (78.7 ft)
20HR/IEC	115 Ah					
CCA/EN	800 amps	2	7.8 m (25.6 ft)	13.4 m (44.0 ft)	20.6 m (67.6 ft)	24.2 m (79.4 ft)
20HR/IEC	120 Ah					
CCA/EN	800 amps	3		15.0 m (49.2 ft)		
20HR/IEC	120 Ah					

Atmospheric temperature above –5 °C (23 °F)						
Battery requirements		Number of batteries in parallel	Cable specifications			
Unit	Minimum capacity		Maximum total extension length (Positive cable + Negative cable)			
			20 mm^2 AWG4	30 mm^2 AWG2	50 mm^2 AWG1/0	60 mm^2 AWG2/0
CCA/EN	670 amps	1	3.7 m (12.1 ft)	6.3 m (20.7 ft)	9.7 m (31.8 ft)	11.5 m (37.7 ft)
20HR/IEC	110 Ah					
CCA/EN	735 amps	1	3.8 m (12.5 ft)	6.4 m (21.0 ft)	9.8 m (32.2 ft)	11.7 m (38.4 ft)
20HR/IEC	115 Ah					
CCA/EN	800 amps	1	3.9 m (12.8 ft)	6.5 m (21.3 ft)	10.0 m (32.8 ft)	11.8 m (38.7 ft)
20HR/IEC	120 Ah					
CCA/EN	670 amps	2	6.7 m (22.0 ft)	11.5 m (37.7 ft)	17.7 m (58.1 ft)	20.8 m (68.2 ft)
20HR/IEC	110 Ah					
CCA/EN	735 amps	2	6.8 m (22.3 ft)	11.6 m (38.1 ft)	17.9 m (58.7 ft)	20.9 m (68.6 ft)
20HR/IEC	115 Ah					
CCA/EN	800 amps	2	6.9 m (22.6 ft)	11.7 m (38.4 ft)	18.0 m (59.1 ft)	21.0 m (68.9 ft)
20HR/IEC	120 Ah					
CCA/EN	800 amps	3	7.8 m (25.6 ft)	13.3 m (43.6 ft)	20.5 m (67.3 ft)	24.1 m (79.1 ft)
20HR/IEC	120 Ah					
CCA/EN	800 amps	4	8.2 m (26.9 ft)	14.1 m (46.3 ft)	21.8 m (71.5 ft)	25.6 m (84.0 ft)
20HR/IEC	120 Ah					

Atmospheric temperature above –15 °C (5 °F)						
Battery requirements		Number of batteries in parallel	Cable specifications			
Unit	Minimum capacity		Maximum total extension length (Positive cable + Negative cable)			
			20 mm^2 AWG4	30 mm^2 AWG2	50 mm^2 AWG1/0	60 mm^2 AWG2/0
CCA/EN	670 amps	2	1.2 m (3.9 ft)	2.2 m (7.2 ft)	3.6 m (11.8 ft)	4.2 m (13.8 ft)
20HR/IEC	110 Ah					
CCA/EN	735 amps	2	2.0 m (6.6 ft)	3.4 m (11.2 ft)	5.2 m (17.1 ft)	6.4 m (21.0 ft)
20HR/IEC	115 Ah					
CCA/EN	800 amps	2	2.2 m (7.2 ft)	3.8 m (12.5 ft)	6.0 m (19.7 ft)	7.0 m (23.0 ft)
20HR/IEC	120 Ah					
CCA/EN	800 amps	3				10.2 m (33.5 ft)
20HR/IEC	120 Ah					
CCA/EN	800 amps	4				12.2 m (40.0 ft)
20HR/IEC	120 Ah					

CCA : Cold Cranking Amperage
EN : European Norm (European standard)
IEC : International Electro-technical Commission

TRBL SHTG ?

Troubleshooting

YDIS

This manual contains the model-specific information. See “YDIS Instruction manual” for detailed information.

Feature

The newly developed YDIS provides quicker detection and analysis of engine and Digital Electronic Control malfunctions.
By connecting your computer to the engine ECM of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the engine ECM on a computer’s monitor.
If this software is run on Microsoft Windows 2000 or Windows XP, the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.
In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, Data logger, and Record of engine oil exchange) can be saved on a disk or printed out.

Hardware requirement

Make sure that your computer meets the following requirements before using this software.

Computer:	IBM PC/AT compatible computer
Operating system:	Microsoft Windows 2000 or Windows XP
CPU:	
Windows 2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels) 256 or more colors SVGA (800 × 600 pixels) or more recommended, 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

NOTE:

- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
- Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
- This software will not run properly on some computers.
- When starting up this program, do not start other software applications.
- Do not use the screen saver function or the energy saving feature when using this program.
- If the ECM is changed, restart the program.
- Windows XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.

Function

- **Diagnosis**
  Displays each part name, and the engine ECM trouble codes and status when the engine start switch is turned to “ON.” This allows you to quickly specify malfunctioning parts. The trouble codes displayed are the same as those described. See “Trouble code and checking step” (4-7).

- **Diagnosis record**
  Displays each part name and the engine ECM trouble codes that have been registered. This allows you to check the outboard motor’s record of malfunctions. The trouble codes displayed are the same as those described. See “Trouble code and checking step” (4-7).

- **Engine monitor**
  Each sensor status and the engine ECM data are displayed while the engine start switch is “ON.” This enables you to find malfunctioning parts quickly. In addition, the data displayed using the Engine monitor function can be displayed in a graph.

Items: For F300/FL300, F350/FL350

Engine speed	LPS_STBD (main)	Engine temperature
Intake pressure(*1)	LPS_STBD (sub)	Intake temperature
Throttle position sensor (main)	Active Remote Control	Oil pressure(*2)
Throttle valve opening	Shift position sensor (main)	Intake cam timing (STBD)
Throttle position sensor (sub)	Shift position sensor (sub)	Intake cam timing (PORT)
Throttle request	Shift request	Trim/tilt sensor
LPS (main)	Atmospheric pressure	
LPS (sub)	Battery voltage	
LPS_PORT (main)	Fuel injection duration	
LPS_PORT (sub)	Ignition timing	

(*1) Intake air pressure
(*2) Engine oil pressure

- **Stationary test**
  Operation tests can be performed with the engine off.

Items: For F300/FL300, F350/FL350

Ignite ignition coil (#1–#8)	Oil ctrl. valve drive (STBD)(*1)	Operate electric fuel pump(*3)
Operate injector (#1–#8)	Oil ctrl. valve drive (PORT)(*2)	Operate elect. fuel feed pump(*4)

(*1) Oil control valve drive (STBD)
(*2) Oil control valve drive (PORT)
(*3) Operate high-pressure fuel pump
(*4) Operate low-pressure fuel pump

- **Active test**
  The test can be carried out while the engine is running and the shift is in the neutral position. It is not possible to carry out the test while the boat is running.

Items: For F300/FL300, F350/FL350

Drop cylinder (#1–#8)

- **Data logger**
  Displays 19 minutes of recorded data for 2 or more of the items stored in the engine ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine. You can also save the engine ECM record data on a file so that you can view and display the graph later.

Items: For F300/FL300, F350/FL350

Engine speed	Engine temperature	Throttle request
Battery voltage	Intake pressure	Shift position sensor
Throttle position sensor	Oil pressure	

- **ECM record data graph**
  When a malfunction occurs in the ETV system, 4 seconds (2 seconds before and after the malfunction) of recorded data are saved in the engine ECM. This data can be displayed on a graph using the “engine ECM record data graph” using the “YDIS” function.
  When the communication cable is used to connect a computer to the engine ECM, the engine ECM record data can be saved and viewed on the computer.
  The saved engine ECM record data can also be viewed offline.

Items: For F300/FL300, F350/FL350

Engine speed	Ref. TPS voltage (*2)	Engine stop mode with SW
Throttle request	Target TPS voltage for ISC (*3)	Engine stop lanyard switch (*4)
Throttle position sensor 1	Engine hours	Main relay (*5)
Throttle position sensor 2	Trig	ETV relay
Intake pressure	Code	Overheat warning
Battery voltage	Engine stop mode	Low oil pressure (*6)
Target TPS voltage (*1)	Engine start mode	

(*1) This item shows the target output voltage of the TPS.
This value is the control voltage that the engine ECM requires to set the target opening angle of the throttle valve.
(*2) Reference Throttle Position Sensor voltage
This item shows the criterion output voltage of the TPS.
This value is used to detect the TPS output voltage during engine operation.
(*3) Engine ECM controls the engine idle speed by using the throttle valve attached to the TPS.
This target voltage is used by the engine ECM to achieve the target opening angle of the throttle valve at the engine idle speed.
(*4) Engine shut-off switch
(*5) Main relay (ignition coil, fuel injector, VCT, engine ECM, IDM, low-pressure fuel pump, high-pressure fuel pump, vapor shut-off valve, YDIS)
(*6) Low engine oil pressure

- **Tilt limiter set**
  This function can specify the angle of tilt limiter.

- **Digital Electronic Control system reset**
  Mutual authentication is performed between Digital Electronic Control ECM and engine ECM.

- **Record of engine oil exchange**
  This function can record the history of engine oil exchange.

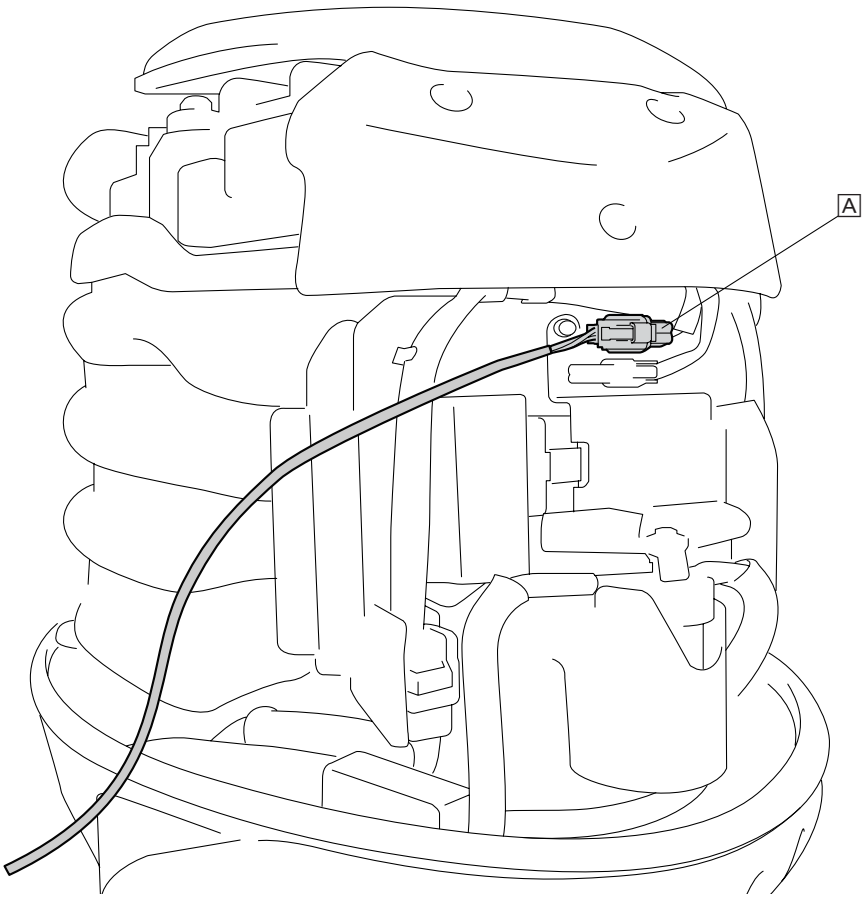
YDIS kit

No.	Item	Q'ty
①	CD-ROM (software + instruction manual)	1
②	Adapter	1
③	Communication cable	1

① ② ③

YDIS (CD-ROM, Ver. 1.30) ①:
60V-WS853-04
YDIS (KIT) ①, ②, ③:
60V-85300-04

Connecting the communication cable to the outboard motor



S6AW03001

A 3 pin communication coupler (gray)

Troubleshooting the power unit

Troubleshooting procedure

1. Before troubleshooting the outboard motor, make sure that fresh fuel of the specified type has been used.
2. Check that all electrical connections are tight and from corrosion, and that the battery is fully charged to 12 V.
3. Check the trouble code using the YDIS first, and then check the electronic control system follow the trouble code chart.
4. When a 3 digit trouble code is detected, check the data logger of the engine ECM record data graph as well.
5. If a trouble code is not detected, check the power unit according to “Troubleshooting the power unit (trouble code not detected).”
6. Before using the YDIS to check the power unit, check the engine ECM circuit. To check the engine ECM circuit, see “Checking the engine ECM circuit” (5-23).

NOTE:

- Be sure to check that the couplers and connectors are securely connected.
- When deleting the diagnosis record on the YDIS, be sure to check the time that the trouble codes were detected.
- When checking the input voltage of a part, the coupler or connector must be disconnected. As a result, the engine ECM determines that the part is disconnected and a trouble code is detected. Therefore, be sure to delete the diagnosis record after checking the input voltage.
- Since the main relay comes on for approximately 10 seconds after the engine start switch is turned to “OFF,” the power of the engine ECM cannot be turned off. Therefore, if the engine start switch is turned to “ON” within 10 seconds after it was turned to “OFF,” the trouble codes cannot be deleted.

Troubleshooting the power unit using the YDIS

1. Use the trouble codes displayed by the YDIS to check each part according to the “Trouble code and checking step” table.
2. Delete the trouble codes after checking, repairing, or replacing a part and check that the trouble codes are not detected again. If the same trouble codes are detected, the engine ECM may be faulty.
3. Check the items listed in the table, if all the items are in good condition delete the trouble code, and then check the trouble codes again. If the same trouble codes are detected again, the engine ECM is faulty.
4. A break down of the engine symptoms are described in the table below, however, multiple malfunctions that have been duplicated cannot be limited to these items. The symptoms may change according to the operating conditions and other conditions.

Trouble code table

O: Indicate

—: Not applicable

Code No.	Item	Diagnosis record (YDIS Ver. 1.30)
13	Pulser coil malfunction	O
15	Engine temp sensor malfunction (Engine temperature sensor malfunction)	O
19	Battery voltage malfunction	O
23	Intake temp sensor malfunction (Intake air temperature sensor malfunction)	O
24	Cam position sensor (EXH) malfunction	O
27	Water in fuel	O
29	Intake press sensor malfunction (Intake air pressure sensor malfunction)	O
37	Intake air passage malfunction	O
39	Oil press sensor malfunction (Engine oil pressure sensor malfunction)	O
44	Engine stop lanyard switch “ON.” (Engine shut-off switch “ON”)	—
46	Overheat thermoswitch malfunction	O
71	Cam position sensor (STBD INT) malfunction	O
72	Cam position sensor (PORT INT) malfunction	O
73	OCV (STBD) malfunction	O
74	OCV (PORT) malfunction	O
83	Trim/tilt sensor malfunction (PTT sensor malfunction)	O
85	ION detection module malfunction	O
112,113,114,115,116,117, 118,119,121,122,123,129, 136,137,138,139,141,142, 143,144,145	Electronic throttle system malfunction	O
124,125,126,127,128	Throttle position sensor malfunction	O
146,147,148,149,150,153, 154,155	Shift position sensor malfunction	O
156, 157	ENG–R.C. communication error	O
160,161,162,163,164,165, 166,167,168,169,170,171, 172,173,174,175,176,177, 178,179,180,181,183,184, 186,187	Remote control system malfunction (Digital Electronic Control)	O

The trouble codes 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 183, 184, and 186 are applicable only to the dual station model.

Trouble code and checking step

Description in < > is relevant to the twin and triple engine installation.
—: Not applicable

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
13	Pulser coil malfunction	Irregular signal	C/E	Engine does not restart.	Engine stops suddenly.	1. Measure the pulser coil air gap.	7-2
						2. Check the projections of the flywheel magnet for damage.	7-2
						3. Measure the pulser coil resistance.	5-48 a-6
						4. Check for wiring continuity between the pulser coil and engine ECM.	5-25 a-6
15	Engine temp sensor malfunction	Out of specification	C/E	Higher idle speed. Degraded acceleration performance. Declining maximum engine speed. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speed.>	—	1. Measure the engine temperature sensor input voltage.	5-50 a-6
						2. Check for wiring continuity between the engine temperature sensor and engine ECM.	5-25 a-6
						3. Measure the engine temperature sensor resistance.	5-50 a-6

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
19	Battery voltage malfunction	Below specified voltage	C/E	Engine does not restart.(*1) Shift actuator does not work.(*1)	Engine operates normally unless it is stopped. (*1) Depends on battery condition.	1. Check the battery voltage using the engine monitoring function of YDIS.	10-9
						2. Check the specific gravity.	10-13
						3. Check the main fuse.	5-3 a-8
						4. Check the battery cables and terminals for proper connection.	—
						5. Check the stator assembly output peak voltage.	5-42 a-8
						6. Measure the stator assembly resistance.	5-42 a-8
						7. Measure the Rectifier Regulator output peak voltage.	5-43 a-8
						8. Check the Rectifier Regulator for continuity.	5-43
23	Intake temp sensor malfunction	Out of specification	C/E	Higher idle speed. <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Measure the air temperature sensor input voltage.	5-48 a-6
						2. Check for wiring continuity between the air temperature sensor and engine ECM.	5-25 a-6
						3. Check for wiring continuity between the air temperature sensor and ground.	5-25 a-6
						4. Measure the air temperature sensor resistance.	5-48 a-6
						5. Check the air temperature using the engine monitoring function of YDIS.	5-48

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
24	Cam position sensor (EXH) malfunction	Out of specification	C/E	Higher idle speed. Degraded acceleration performance. Declining maximum engine speed. <Difference in engine speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Measure the cam position sensor input voltage.	5-33 a-2
						2. Check for wiring continuity between the cam position sensor and engine ECM.	5-25 a-2
						3. Check for wiring continuity between the cam position sensor and ground.	5-25 a-2
						4. Measure the cam position sensor output voltage.	5-33 a-2
						5. Check the brim of the camshaft.	7-58
27	Water in fuel	Water in fuel	W/F	Alert buzzer goes off while the shift is in neutral.	—	1. Check for water in fuel filter.	5-36
						2. Check the water detection switch for continuity.	5-36 a-4
						3. Check wiring for proper connection or damage.	5-36 a-2
29	Intake press sensor malfunction	Out of specification	C/E	Higher idle speed. Degraded acceleration performance. Declining maximum engine speed. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Measure the air pressure sensor input voltage.	5-49 a-6
						2. Check the wiring continuity between the air pressure sensor and engine ECM.	5-25 a-6
						3. Check the air temperature using the engine monitoring function of YDIS.	5-49

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
37	Intake air passage malfunction	Air leak	C/E	Higher idle speed. Cannot shift-in.(*1) Shift-cutout control.(*2) Over-revolution at fully opened throttle. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	(*1) When the engine speed is above 1,500 r/min. (*2) Control works at trolling position only.	1. Check the O-rings and gaskets of the intake manifold, surge tank, and throttle body.	6-9 6-11
						2. Check the hose between the vapor shut-off valve and surge tank.	6-14
						3. Check the throttle valve condition.	6-11
						4. Check the air presser sensor hose.	6-14
						5. Check the pressure regulator hose.	6-14
39	Oil pressure sensor malfunction	Out of specification	C/E	Higher idle speed. <Difference in idle speeds.>	—	1. Check the oil pressure using the engine monitoring function of YDIS.	7-2
						2. Measure the oil pressure sensor input and output voltage.	7-2 a-2
						3. Check for wiring continuity between the oil pressure sensor and engine ECM.	5-25 a-2
						4. Check for wiring continuity between the oil pressure sensor and ground.	5-25 a-2

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
46	Overheat thermoswitch malfunction	Irregular signal	C/E	Higher idle speed. <Difference in idle speeds.>	—	1. Measure the thermoswitch input voltage.	5-51 a-6
						2. Check for wiring continuity between the thermoswitch and engine ECM.	5-25 a-6
						3. Check for wiring continuity between the thermoswitch and ground.	5-25 a-6
						4. Measure the thermoswitch resistance.	5-51 a-6
71	Cam position sensor (STBD IN) malfunction	Irregular signal	C/E	Higher idle speed. Degraded acceleration performance. Declining maximum engine speed. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Measure the cam position sensor input voltage.	5-33 a-2
						2. Check for wiring continuity between the cam position sensor and engine ECM.	5-25 a-2
						3. Check for wiring continuity between the cam position sensor and ground.	5-25 a-2
						4. Measure the cam position sensor output voltage.	5-33 a-2
						5. Check the brim of the camshaft.	7-58

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
72	Cam position sensor (PORT IN) malfunction	Irregular signal	C/E	Higher idle speed. Degraded acceleration performance. Declining maximum engine speed. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Measure the cam position sensor input voltage.	5-33 a-2
						2. Check for wiring continuity between the cam position sensor and engine ECM.	5-25 a-2
						3. Check for wiring continuity between the cam position sensor and ground.	5-25 a-2
						4. Measure the cam position sensor output voltage.	5-33 a-2
						5. Check the brim of the camshaft.	7-58
73	OCV (STBD) malfunction	Irregular load current value	C/E	Degraded acceleration performance. Declining maximum engine speed. <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Check the OCV valve operation using the stationary test function of YDIS.	See the YDIS Instruction manual.
						2. Measure the OCV input voltage.	5-35 a-2
						3. Check for wiring continuity between the OCV and main relay.	5-35 a-2
						4. Check for wiring continuity between the OCV and engine ECM.	5-25 a-2
						5. Measure the OCV resistance.	5-35 a-2
						6. Check the filter.	10-24

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
74	OCV (PORT) malfunction	Irregular load current value	C/E	Degraded acceleration performance. Declining maximum engine speed. <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Check the OCV valve operation using the stationary test function of YDIS.	See the YDIS Instruction manual.
						2. Measure the OCV input voltage.	5-35 a-2
						3. Check for wiring continuity between the OCV and main relay.	5-35 a-2
						4. Check for wiring continuity between the OCV and engine ECM.	5-25 a-2
						5. Measure the OCV resistance.	5-35 a-2
						6. Check the filter.	10-24
83	Trim/tilt sensor malfunction	Out of specification	C/E	Tilt limiter setting canceled. Tilt limiter automatic stop does not work.	Wrong tilt position display on the Lan gauge.	1. Check the PTT sensor using the engine monitoring function of YDIS.	See the YDIS Instruction manual.
						2. Measure the PTT sensor input and output voltage.	5-61
						3. Check for wiring continuity between the PTT sensor and engine ECM.	5-25 a-10

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
85	ION detection module malfunction	Irregular signal	C/E	Degraded acceleration performance. Declining maximum engine speed. <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Malfunction of engine ECM, ignition coil, spark plug, or ignition circuit will result in this trouble code on the display.	1. Check the IDM circuit.	5-46 a-6
						2. Check the ignition spark using the stationary test function of YDIS.	5-45
						3. Check the spark plug.	10-25
						4. Measure the ignition coil input voltage.	5-45 a-6
						5. Check for wiring continuity between the ignition coil and engine ECM.	5-25 a-6
						6. Check for wiring continuity between the ignition coil and IDM.	5-46 a-6
						7. Check for wiring continuity between the ignition coil and ground.	5-25 a-6
112 114	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV circuit.	5-28
						2. Check the ETV relay and fuse.	5-3 5-28 a-2

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
113	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV operation.	5-27
						2. Check the TPS output voltage using the engine monitoring function of YDIS.	5-27
						3. Check the throttle opening angle using the engine monitoring function of YDIS.	5-27
						4. Check the ETV circuit.	5-28 a-2
						5. Check the ETV relay and fuse.	5-3 5-28 a-2
115 116	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV circuit.	5-28 a-2
						2. Check the ETV relay and fuse.	5-3 5-28 a-2
117 118	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV circuit.	5-28 a-2
						2. Check the ETV relay and fuse.	5-3 5-28 a-2

4

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
119	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV circuit.	5-28 a-2
121	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Replace the engine ECM.	7-40
122	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Replace the ETV assembly (ETV motor malfunction).	6-11
123	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV relay and fuse. 2. Check the ETV circuit.	5-3 5-28 a-2 5-28 a-2

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
124 125	Throttle position sensor malfunction	Out of specification	C/E	Unstable idle speed. Degraded acceleration performance. Declining maximum engine speed. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Check the TPS output voltage using the engine monitoring function of YDIS.	5-27
						2. Check the throttle opening angle using the engine monitoring function of YDIS.	5-27
						3. Check the ETV circuit.	5-28 a-2
124 125 126 127 128	Throttle position sensor malfunction	Out of specification	C/E	Higher idle speed Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the TPS output voltage using the engine monitoring function of YDIS.	5-27
						2. Check the throttle opening angle using the engine monitoring function of YDIS.	5-27
						3. Measure the TPS input voltage.	5-27 a-2
						4. Check the ETV operation.	5-27
						5. Check for wiring continuity between the TPS and engine ECM.	5-28 a-2
127 128	Throttle position sensor malfunction	Out of specification	C/E	Degraded acceleration performance. Declining maximum engine speed. <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Check the TPS output voltage using the engine monitoring function of YDIS.	5-27
						2. Check the throttle opening angle using the engine monitoring function of YDIS.	5-27
						3. Check the ETV circuit.	5-28 a-2

4

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
129	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Degraded acceleration performance. Declining maximum engine speed. <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	—	1. Check the TPS output voltage using the engine monitoring function of YDIS.	5-27
						2. Check the throttle opening angle using the engine monitoring function of YDIS.	5-27
						3. Check the ETV circuit.	5-28 a-2
	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the TPS output voltage using the engine monitoring function of YDIS.	5-27
						2. Check the throttle opening angle using the engine monitoring function of YDIS.	5-27
						3. Check the ETV circuit.	5-28 a-2
136 137	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV relay and fuse.	5-3 5-28 a-2
						2. Check the ETV circuit.	5-28 a-2
138 139	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the battery cables and terminals for proper connection.	—
						2. Check the ETV circuit.	5-28 a-2
						3. Check the ETV relay and fuse.	5-3 5-28 a-2

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
141	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the battery cables and terminals for proper connection.	—
						2. Check the ETV circuit.	5-28 a-2
						3. Check the ETV relay and fuse.	5-3 5-28 a-2
142	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV operation.	5-27

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
143 144	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the battery cables and terminals for proper connection.	—
						2. Check the ETV circuit.	5-28 a-2
						3. Check the ETV relay and fuse.	5-3 5-28 a-2
145	Electronic throttle system malfunction	Throttle valve malfunction	C/E	Higher idle speed. Throttle does not work. <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	Engine speed is fixed at about 1,500 r/min.	1. Check the ETV operation.	5-27
146 147	Shift position sensor malfunction	Out of specification	C/E	Engine does not restart.(*1) Alert indicator is “ON.” <Engine speeds do not synchronize.>	(*1) No cranking. Engine operates normally unless it is stopped.	1. Measure the SPS input and output voltage.	5-29 a-2
						2. Measure the shift-actuator rod stroke.	5-31
						3. Check for wiring continuity between the SPS and engine ECM.	5-31 a-2
148 149	Shift position sensor malfunction	Out of specification	C/E	Normal operation is possible. Shift actuator does not work.(*1) Alert indicator is “ON.” <Engine speeds do not synchronize.>	(*1) Trouble codes 148 and 149 occurred simultaneously.	1. Measure the SPS input and output voltage.	5-29 a-2
						2. Measure the shift-actuator rod stroke.	5-31
						3. Check for wiring continuity between the SPS and engine ECM.	5-31 a-2

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
150	Shift position sensor (Main) malfunction	Out of specification	C/E	Engine does not restart.(*1) Shift actuator does not work. Locked at around 1/2 of the intended engine speed (locked at in-gear position). Alert indicator is "ON." <Engine speeds do not synchronize.>(*2)	(*1) No cranking. (*2) Fixed engine speed on the failed engine.	1. Measure the SPS input and output voltage. 2. Measure the shift-actuator rod stroke. 3. Check for wiring continuity between the SPS and engine ECM.	5-29 a-2 5-31 5-31 a-2
	Shift position sensor (Sub) malfunction	Out of specification	C/E	Engine does not restart.(*1)(*2) Shift actuator does not work.(*3)(*4) Locked at around 1/2 of the intended engine speed (locked at in-gear position). Alert indicator is "ON." <Engine speeds do not synchronize.>(*5)	(*1) Can re-start the engine manually with shift-actuator rod set at neutral. (*2) No cranking. (*3) Shift-actuator rod is possible with manual operation. (*4) Locked at the shift-in position, as trouble occurred at the shift-in position. (*5) Fixed engine speed on the failed engine.	1. Measure the SPS input and output voltage. 2. Measure the shift-actuator rod stroke. 3. Check for wiring continuity between the SPS and engine ECM.	5-29 a-2 5-31 5-31 a-2

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Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
153	Shift position sensor malfunction	Out of specification	C/E	Engine does not restart.(*1)(*2) Unstable idling. Throttle does not work. Alert indicator is “ON.” <Engine speeds do not synchronize.>(*3)	(*1) Depending on the locked condition (shift position). (*2) No cranking. (*3) Failed engine is locked at idle speed.	1. Measure the shift-actuator rod stroke.	5-31
						2. Measure the shift actuator input voltage.	5-29 a-2
						3. Check for wiring continuity between the shift actuator and engine ECM.	5-31 a-2
						4. Measure the shift-actuator relay input voltage.	5-30
						5. Check the fuse.	5-3 a-2
						6. Check the shift-actuator relay.	5-30 a-2
						7. Check for wiring continuity between the shift-actuator relay and engine ECM.	5-31 a-2
						8. Check the shift mechanism.	5-29
						9. Check the lower unit.	8-1 8-46

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
154	Shift position sensor malfunction	Out of specification	C/E	Engine does not restart.(*1) Shift does not disengage from the shift-in position. <Engine speeds do not synchronize.>(*2)	(*1) No cranking. (*2) Failed engine does not restart.	1. Measure the shift-actuator rod stroke.	5-31
						2. Measure the shift actuator input voltage.	5-29 a-2
						3. Check for wiring continuity between the shift actuator and engine ECM.	5-31 a-2
						4. Measure the shift-actuator relay input voltage.	5-30 a-2
						5. Check the fuse.	5-3 a-2
						6. Check the shift-actuator relay.	5-30 a-2
						7. Check for wiring continuity between the shift-actuator relay and engine ECM.	5-31 a-2
						8. Check the shift mechanism.	5-29
						9. Check the lower unit.	8-1 8-46

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
155	Shift position sensor malfunction	Out of specification	C/E	Engine does not restart.(*1)(*2) Shift actuator does not work.(*3) Alert indicator is “ON.” <Engine speeds do not synchronize.>	(*1) Depending on the locked condition (shift position). (*2) No cranking. (*3) Shift actuator to the opposite, movable direction is possible.	1. Measure the SPS rod stroke.	5-31
						2. Measure the shift actuator input voltage.	5-29 a-2
						3. Check for wiring continuity between the shift actuator and engine ECM.	5-31 a-2
						4. Measure the shift-actuator relay input voltage.	5-30 a-2
						5. Check the fuse.	5-3 a-2
						6. Check the shift-actuator relay.	5-30 a-2
						7. Check for wiring continuity between the shift-actuator relay and engine ECM.	5-31 a-2
						8. Check the shift mechanism.	5-29
						9. Check the lower unit.	8-1 8-46

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
156 157	ENG–R.C. communication error	Communication error	C/E	Alert indicator is “ON.” <Engine speeds do not synchronize.>	—	1. Check the extension wire harness proper connection and damage.	5-61
						2. Check for wiring continuity between the engine ECM coupler and engine main-harness coupler.	a-8 a-10
						3. Check the Digital Electronic Control circuit.	See the Digital Electronic Control SM.
	ENG–R.C. communication	Communication error	Not displayed	Engine does not restart. Fully closed throttle. Shift-actuator rod returns to neutral. No display on Lan gauge.(*1) Alert indicator is “ON.” <Engine speeds do not synchronize.>(*2) Unable to switch the active station in the case of dual station arrangement. (trouble code 186)	Trouble codes 156 and 157 occurred simultaneously. (*1) Entire Lan gauge display is gone. (*2) Failed engine is locked at idle speed with the shift-actuator rod set at neutral position.	1. Check the extension wire harness proper connection and damage.	5-61
						2. Check for wiring continuity between the engine ECM coupler and engine main-harness coupler.	a-8 a-10
						3. Check the Digital Electronic Control circuit.	See the Digital Electronic Control SM.

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
160 161 162 163	Remote control system malfunction (Main station)	LPS Irregular signal	C/E	Higher idle speed.(*1) Degraded acceleration performance. Declining maximum engine speed.(*2) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	(*1) Unstable (*2) Throttle restricted to 1/2 opening.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.
	Remote control system malfunction (Main station)	LPS Irregular signal	C/E	Fully closed throttle. Shift-actuator rod returns to neutral. Alert indicator is "ON." <Engine speeds do not synchronize.>	When either one of the trouble codes 160 and 161, and either one of the trouble codes 162 and 163 took place simultaneously.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.
164	Remote control system malfunction (Main station)	LPS Irregular signal	C/E	Fully closed throttle. Throttle does not work. Shift-actuator rod returns to neutral position. Shift actuator is worked manually.(*1) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.>(*2)	(*1) Shift actuator is possible with manual operation. (*2) Failed engine locked at idle speed.	1. Replace the Digital Electronic Control ECM.	See the Digital Electronic Control SM.

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
165	Remote control system malfunction (Main station)	LPS Irregular signal	C/E	Fully closed throttle. Throttle does not work. Shift-actuator rod returns to neutral. Shift actuator does not work.(*1) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.>(*2)	(*1) Shift actuator is possible with manual operation. (*2) Failed engine locked at idle speed.	1. Check the LPS output voltage. 2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM. See the Digital Electronic Control SM.
166 167 168 169	Remote control system malfunction (Main station)	LPS Irregular signal	C/E	Higher idle speed.(*1) Alert indicator is "ON." Degraded acceleration performance. Declining maximum engine speed.(*2) <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	These are symptoms of the center out-board motor. (*1) Unstable (*2) Throttle restricted to 1/2 opening.	1. Check the LPS output voltage. 2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM. See the Digital Electronic Control SM.
				Fully closed throttle. Shift-actuator rod returns to neutral. Alert indicator is "ON." <Engine speeds do not synchronize.>	When either one of the trouble codes 166 and 167, and either one of the trouble codes 168 and 169 took place simultaneously. These are symptoms of the center out-board motor.	1. Check the LPS output voltage. 2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM. See the Digital Electronic Control SM.

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Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
170	Remote control system malfunction (Main station)	LPS Irregular signal	C/E	Fully closed throttle. Throttle does not work. Shift-actuator rod returns to neutral. Shift actuator does not work.(*1) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.>(*2)	(*1) Shift actuator is possible with manual operation. (*2) Failed engine locked at idle speed.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.
171 172 173 174	Remote control system malfunction (Sub station)	LPS Irregular signal	C/E	Higher idle speed.(*1) Degraded acceleration performance. Declining maximum engine speed.(*2) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	(*1) Unstable (*2) Throttle restricted to 1/2 opening.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.
				Fully closed throttle. Shift-actuator rod returns to neutral. Alert indicator is "ON." <Engine speeds do not synchronize.>	When either one of the trouble codes 171 and 172, and either one of the trouble codes 173 and 174 took place simultaneously.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
175	Remote control system malfunction (Sub station)	LPS Irregular signal	C/E	Fully closed throttle. Throttle does not work. Shift-actuator rod returns to neutral. Shift actuator does not work.(*1) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.>(*2)	(*1) Shift actuator is possible with manual operation. (*2) Failed engine locked at idle speed.	1. Replace the Digital Electronic Control ECM.	See the Digital Electronic Control SM.
176	Remote control system malfunction (Sub station)	LPS Irregular signal	C/E	Fully closed throttle. Throttle does not work. Shift-actuator rod returns to neutral. Shift actuator does not work.(*1) Alert indicator is "ON." <Difference in idle speeds.> <Engine speeds do not synchronize.>(*2)	(*1) Shift actuator is possible with manual operation. (*2) Failed engine locked at idle speed.	1. Check the LPS output voltage. 2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM. See the Digital Electronic Control SM.

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Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
177 178 179 180	Remote control system malfunction (Sub station)	LPS Irregular signal	C/E	Higher idle speed.(*1) Degraded acceleration performance. Declining maximum engine speed.(*2) Alert indicator is “ON.” <Difference in idle speeds.> <Engine speeds do not synchronize.> <Difference in maximum engine speeds.>	These are symptoms of the center outboard motor. (*1) Unstable (*2) Throttle restricted to 1/2 opening.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.
				Fully closed throttle. Shift-actuator rod returns to neutral. Alert indicator is “ON.” <Engine speeds do not synchronize.>	When either one of the trouble codes 177 and 178, and either one of the trouble codes 179 and 180 took place simultaneously. These are symptoms of the center outboard motor.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.
181	Remote control system malfunction (Sub station)	LPS Irregular signal	C/E	Fully closed throttle. Throttle does not work. Shift-actuator rod returns to neutral. Shift actuator does not work.(*1) Alert indicator is “ON.” <Difference in idle speeds.> <Engine speeds do not synchronize.>(*2)	(*1) Shift actuator is possible with manual operation. (*2) Failed engine locked at idle speed.	1. Check the LPS output voltage.	See the Digital Electronic Control SM.
						2. Check for wiring continuity between the LPS and Digital Electronic Control ECM.	See the Digital Electronic Control SM.

Trouble code	Item	Condition	Lan gauge display	Symptom	Remarks	Checking steps	Refer to page
183	Remote control system malfunction	LPS Irregular signal	C/E	Station selection is impossible. Alert indicator is “ON.”	—	1. Replace the Digital Electronic Control ECM.	See the Digital Electronic Control SM.
184	Remote control system malfunction	LPS Irregular signal	C/E	Engine selection is impossible. Alert indicator is “ON.”	—	1. Replace the Digital Electronic Control ECM.	See the Digital Electronic Control SM.
186	Remote control system malfunction (Main station)	LPS Irregular signal	Not displayed	Sub station Digital Electronic Control does not operate. The change to the sub-station Digital Electronic Control is impossible.(*1) Fully closed throttle. Shift-actuator rod returns to neutral. Alert indicator is “ON.” <Engine speeds do not synchronize.>(*2)	(*1) When main Digital Electronic Control ECM detects a communication error (trouble code 156,157) during operation at a main station with dual station composition. (*2) Failed engine is locked at idle speed with the shift-actuator rod set at neutral.	1. Turn off the engine start switch once, and turn it on again.	—
						2. Check the extension wire harness proper connection and damage.	5-61
						3. Check for wiring continuity between the engine ECM coupler and engine main-harness coupler.	a-8 a-10
						4. Check the Digital Electronic Control circuit.	See the Digital Electronic Control SM.
187	Remote control system malfunction	LPS Irregular signal	C/E	—	—	Replace the Digital Electronic Control ECM.	See the Digital Electronic Control SM.

Troubleshooting the power unit (trouble code not detected)

Troubleshooting when a trouble code is not available consists of the following 4 items.
Symptom 1: Specific trouble conditions.
Symptom 2: Trouble conditions of an area or individual part.
Cause 1: The content considered as the trouble factors of symptom 2.
Cause 2: The content considered as the trouble causes of cause 1 (described if necessary).
— : Not applicable

Symptom 1: Engine does not crank.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Starter motor does not operate.	Short, open, or loose connection in starter motor circuit.	—	Check the starter relay input voltage.	5-53 a-8
			Check the wiring harness continuity.	a-8
	Starter relay malfunction.	—	Check the starter relay.	5-53 a-8
	Main relay malfunction.	—	Check the main relay.	5-22 a-8
	Short, open, or loose connection in engine ECM circuit.	—	Check for wiring continuity between the main relay and engine ECM.	5-23 a-8
			Check for wiring continuity between the engine ECM and ground.	5-23 a-8
	Engine ECM malfunction.	—	Replace the engine ECM.	7-40
	Blown fuse.	—	Check the main fuse.	5-3
	Starter motor malfunction.	—	Disassemble and check the starter motor.	5-54
	Engine start switch malfunction.	—	Check the engine start switch.	5-52 a-8
	Neutral switch malfunction.	—	Check the neutral switch.	See the Digital Electronic Control SM.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Starter motor operates, but the engine does not crank.	Stuck piston.	—	Disassemble and check the power unit.	7-65 7-76
	Piston lock due to water or oil in the combustion chamber.			
	Salt buildup on the drive shaft and bushing.	—	Disassemble and check the upper case.	9-11
	Starter motor malfunction.	—	Disassemble and check the starter motor.	5-54

Symptom 1: Engine will not start (engine cranks).

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Discharged battery.	Battery performance decrement.	—	Check the battery electrolyte gravity	10-13
	Stator assembly malfunction.	—	Measure the stator assembly output peak voltage.	5-42 a-8
			Measure the stator assembly resistance.	5-42 a-8
	Short, open, or loose connection in charging circuit.	—	Check the battery and battery terminal continuity.	—
			Check the charging circuit wiring connection and damage.	a-8
Engine ECM does not operate.	Main relay malfunction.	—	Check the main relay.	5-22 a-8
	Blown fuse.	—	Check the fuse.	5-3 a-8
	Short, open, or loose connection in engine ECM circuit.	—	Check for wiring continuity between the main relay and engine ECM.	5-23 a-8
			Check for wiring continuity between the engine ECM and ground.	5-23 a-2
	Mismatch of engine ECM and Digital Electronic Control ECM IDs.	—	Digital Electronic Control system reset using the YDIS.	See the YDIS Instruction manual.
	Extension wire harness malfunction.	—	Check the extension wire harness continuity.	5-61

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Spark plug does not spark (all cylinders).	Short, open, or loose connection in ignition coil ground circuit.	—	Check the ignition coil input voltage.	5-45 a-6
			Check for continuity between the ignition coil and engine ECM.	5-45 a-6
			Check for wiring continuity between the ignition coil and ground.	5-45 a-6
Fuel not supplied (all cylinders).	High-pressure fuel pump does not operate.	Short, open, or loose connection in high-pressure fuel pump circuit.	Check the high-pressure fuel pump input voltage.	5-39 a-4
			Check for wiring continuity between the high-pressure fuel pump and engine ECM.	5-38 a-4
			Check for continuity between the high-pressure fuel pump and high-pressure fuel pump relay.	5-39 a-4
		Blown fuse.	Check the fuse.	5-3 a-4
		High-pressure fuel pump relay malfunction.	Check the high-pressure fuel pump relay.	5-40 a-4
		High-pressure fuel pump malfunction.	Check the high-pressure fuel pump motor resistance.	5-38 a-4
	Low-pressure fuel pump does not operate.	Short, open, or loose connection in low-pressure fuel pump circuit.	Check the low-pressure fuel pump input voltage.	5-39 a-4
			Check for wiring continuity between the low-pressure fuel pump and engine ECM.	5-38 a-4
			Check for continuity between the low-pressure fuel pump and low-pressure fuel pump relay.	5-39 a-4
		Blown fuse.	Check the fuse.	5-3 a-4
		Low-pressure fuel pump relay malfunction.	Check the low-pressure fuel pump relay.	5-40 a-4
		Low-pressure fuel pump malfunction.	Check the low-pressure fuel pump motor resistance.	5-38 a-4
	Fuel not supplied to the fuel rails.	—	Check the fuel pressure.	6-28
Vapor shut-off valve does not close.	Fixed vapor shut-off valve.	—	Check the vapor shut-off valve.	5-41 a-4

Symptom 1: Unstable engine idle speed, poor acceleration, poor performance, or limited engine speed.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Spark plug does not spark (some cylinders).	Spark plug malfunction.	—	Check the ignition spark.	5-45
			Check the spark plugs.	10-25
	Short, open, or loose connection in ignition coil circuit.	—	Check the ignition coil input voltage.	5-45 a-6
			Check for wiring continuity between the ignition coil and engine ECM.	5-45 a-6
			Check for wiring continuity between the ignition coil and ground.	5-45 a-6
	Ignition coil malfunction.	—	Change the ignition coil and check the ignition spark.	5-45
	Engine ECM malfunction.	—	Replace the engine ECM.	7-40
High-pressure fuel line malfunction (fuel pressure is low).	Pressure regulator malfunction.	—	Check the pressure regulator.	6-29
	High-pressure fuel pump malfunction.	—	Check the high-pressure fuel pump pressure.	6-28
Fuel not supplied (some cylinders).	Fuel injector malfunction.	—	Check the fuel injector operation using the stationary test function of YDIS.	See the YDIS Instruction manual.
			Check the fuel injector resistance.	5-37 a-4
	Short, open, or loose connection in fuel injector circuit.	—	Check the fuel injector input voltage.	5-37 a-4
			Check for wiring continuity between the fuel injector and main relay.	5-38 a-4
			Check for wiring continuity between the fuel injector and engine ECM.	5-25 a-4
	Clogged fuel injector filter.	—	Replace the fuel injector.	6-33
	Engine ECM malfunction.	—	Replace the engine ECM.	7-40
Low compression pressure.	Scratched piston.	—	Check the compression pressure. Disassemble and check the power unit.	7-1 7-65 7-76
	Damaged cylinder.	—		
	Damaged valve.	—		
	Valve stuck to valve guide.	—		

Symptom 1: High engine idle speed (below 1,200 r/min).

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
—	Air leakage (throttle valve–cylinder head).	—	Check the O-rings and gaskets of the intake manifold, surge tank, and throttle body.	6-9 6-11

Symptom 1: Engine stalls, unstable engine idle speed, or poor acceleration.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Incorrect intake cam timing (check using the YDIS).	VCT operation malfunction.	Stuck OCV plunger.	Check the OCV valve operation using the stationary test function of YDIS.	See the YDIS Instruction manual.
			Check the OCV plunger.	5-35
		Clogged OCV filter.	Replace the OCV filter.	10-24
		Clogged oil passage.	Check the oil passage.	2-56
		Stuck VCT.	Replace the VCT.	7-54 7-59

Symptom 1: Limited engine speed (below 2,000 r/min).

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
Buzzer comes on. Overheat alert indicator comes on. Cooling water does not discharge from the cooling water pilot hole.	Clogged cooling water inlet.	—	Check the cooling water inlet.	2-62
	Water pump malfunction.	Water pump impeller malfunction.	Check the impeller.	8-8 8-51
			Check the flat key.	8-8 8-51
		Water leakage from water pump housing.	Check the water pump housing.	8-8 8-51
			Check the insert cartridge.	8-8 8-51
			Check the outer plate cartridge.	8-8 8-51
	Clogged cooling water passage.	—	Check the cooling water passage (power unit, EX guide, and upper case).	2-58
	Thermostat malfunction.	—	Check the thermostat.	10-26
Buzzer comes on. Oil pressure alert indicator comes on.	Insufficient engine oil.	—	Add sufficient oil.	10-5
	Engine oil pressure decrease.	Oil pump malfunction.	Check the oil pressure.	7-2
		Clogged oil strainer.	Check the oil strainer.	9-19
		Clogged oil passage.	Check the oil passage (power unit and oil pump).	2-56
		Clogged oil filter.	Replace the oil filter.	10-17

Troubleshooting the PTT unit

— : Not applicable

Symptom 1: PTT unit does not operate.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
PTT motor does not operate.	Blown fuse.	—	Check the fuse.	5-3 a-10
	Loose connection of the battery terminal.	—	Check the battery terminal.	3-13
	PTT switch malfunction.	—	Check the PTT switch.	9-56 a-10
	PTT relay malfunction.	—	Check the PTT relay.	9-55 a-10
	Short, open, or loose connection of the wiring harness.	—	Check the PTT switch input voltage.	a-10
			Check the PTT relay input voltage.	a-10
			Check for wiring continuity between the PTT switch and engine ECM.	5-25
			Check for wiring continuity between the PTT relay and engine ECM.	a-10
			Check for wiring continuity between the PTT relay terminal and ground.	a-10
	PTT motor malfunction.	—	Check the PTT motor resistance.	—
			Disassemble and check the PTT motor.	9-37 a-10
	Short, open, or loose connection of the PTT motor lead.	—	Check the PTT motor input voltage.	a-10
			Check for wiring continuity between the PTT motor and PTT relay terminal.	a-10
Oil pressure does not increase.	Manual valve opened.	Manual valve malfunction.	Check the manual valve.	9-43
	Insufficient PTT fluid.	—	Add sufficient fluid.	10-25
	PTT fluid leakage.	—	Check the PTT unit for leakage.	10-25
	Clogged filter.	—	Disassemble and check the PTT unit.	2-66 9-32
	Clogged fluid passage.	—		
	PTT pump malfunction.	—	Replace the PTT pump assembly.	9-43

Symptom 1: PTT unit does not hold the outboard motor up.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
—	Manual valve opened.	Manual valve malfunction.	Check the manual valve.	9-43
—	Insufficient PTT fluid.	—	Add sufficient fluid.	10-25
—	PTT fluid leakage.	—	Check the PTT unit for leakage.	10-25
—	Clogged fluid passage.	—	Disassemble and check the PTT unit.	2-66 9-32

Troubleshooting the lower unit

— : Not applicable

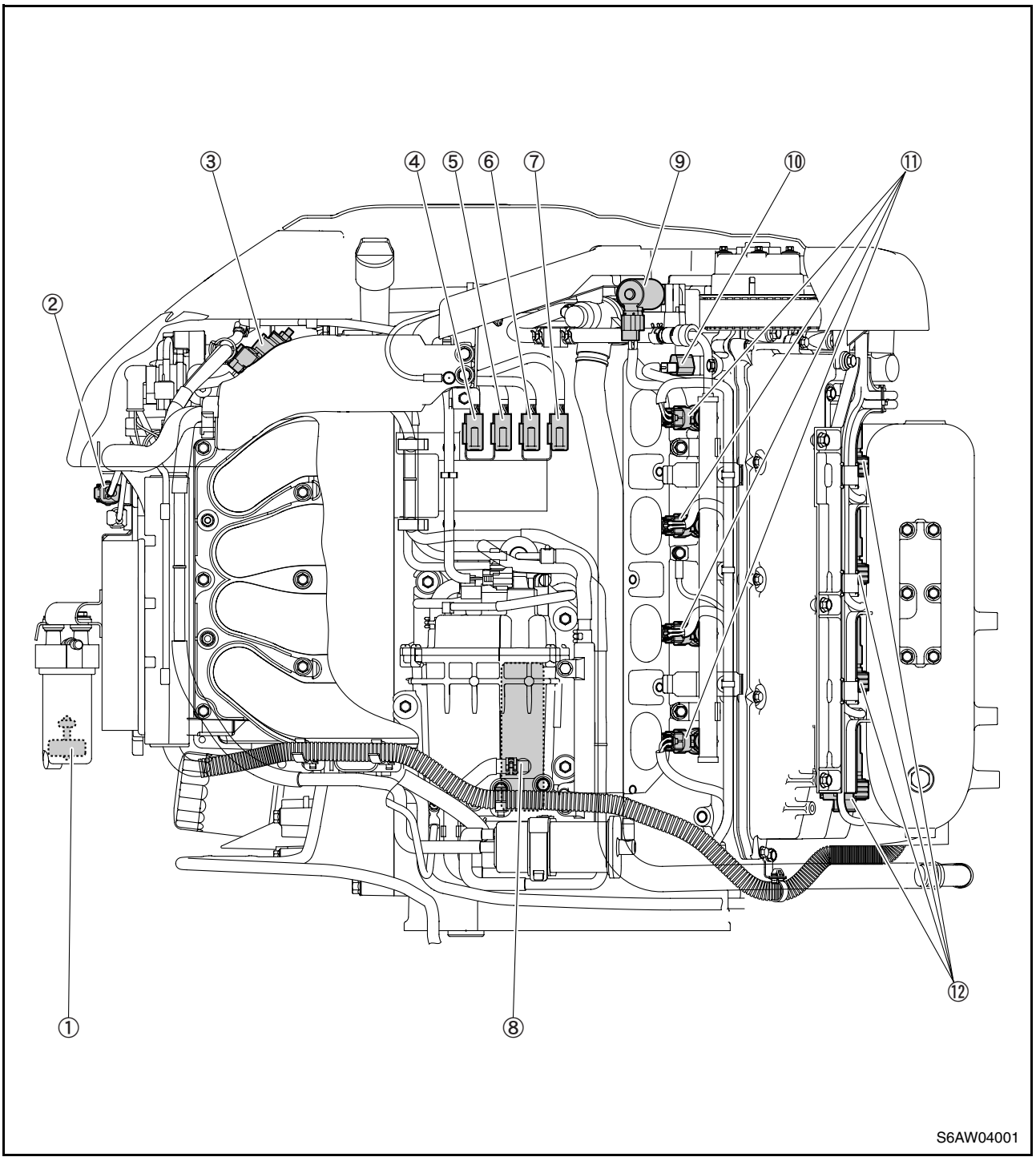
Symptom 1: Shift mechanism of the forward gear and reverse gear does not operate properly.

Symptom 2	Cause 1	Cause 2	Checking step	Refer to page
—	Shift rod operation malfunction.	Detent malfunction shift rod connection malfunction.	Check the detent. Check the shift rod connection.	8-25 8-63
—	Shift mechanism malfunction (in lower unit).	—	Disassemble and check the lower unit.	8-1 8-46

Electrical system

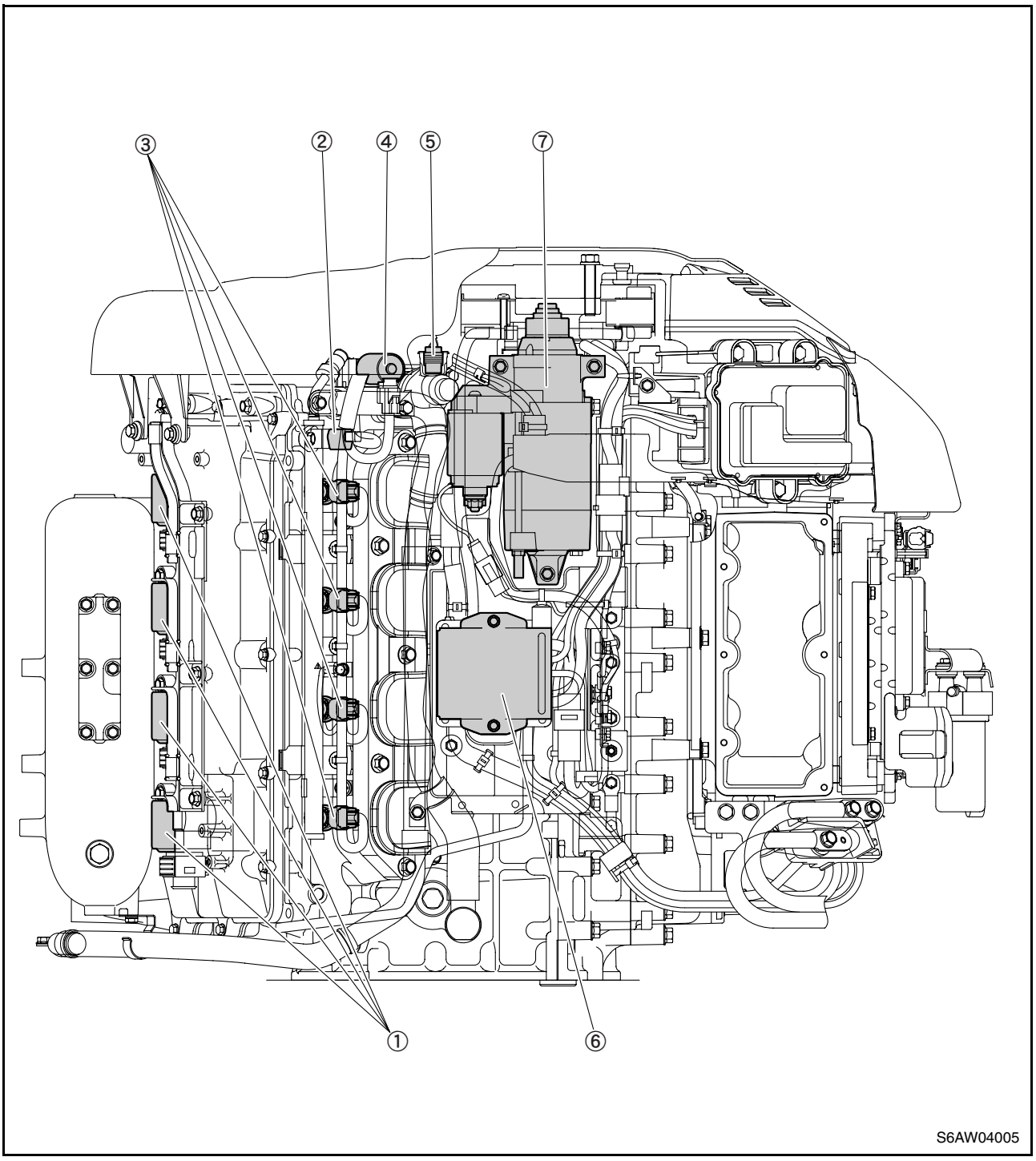
Electrical component

Port view



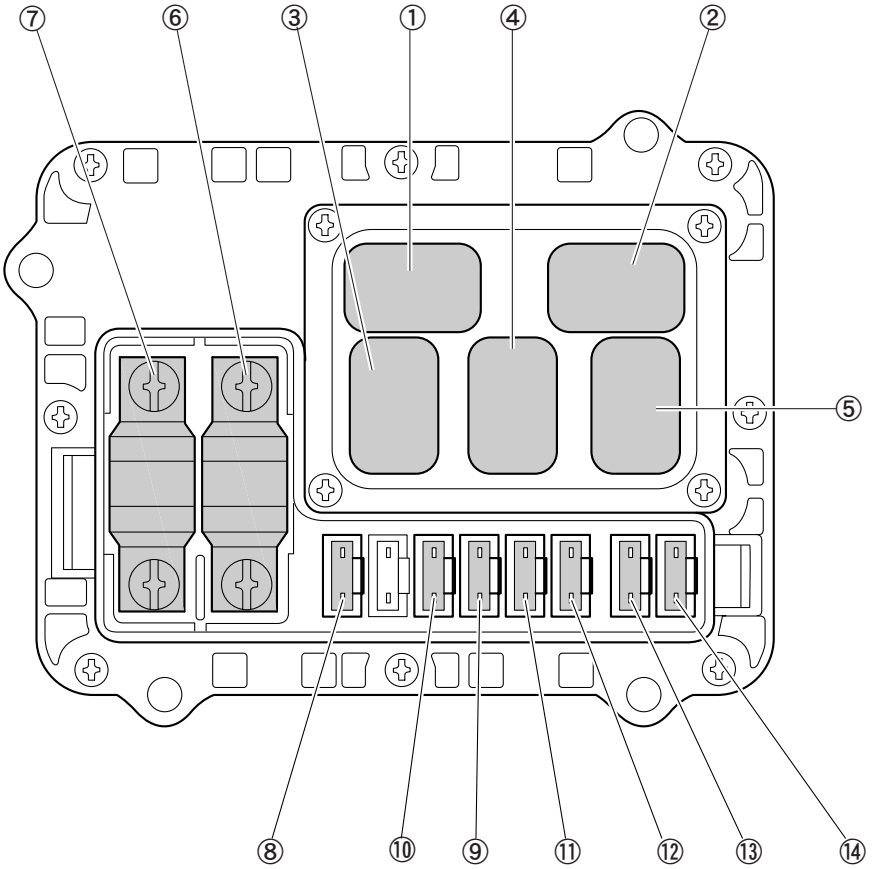
① Water detection switch (in fuel filter)
② Communication coupler (3 pins)
③ Vapor shut-off valve
④ Joint connector 2
⑤ Joint connector 1
⑥ Joint connector 3
⑦ Joint connector 6
⑧ High-pressure fuel pump
⑨ OCV (PORT)
⑩ Cam position sensor (PORT IN)
⑪ Fuel injector
⑫ Ignition coil

Starboard view



① Ignition coil
② Cam position sensor (STBD IN)
③ Fuel injector
④ OCV (STBD)
⑤ Thermoswitch (STBD)
⑥ Rectifier Regulator
⑦ Starter motor

Fuse holder

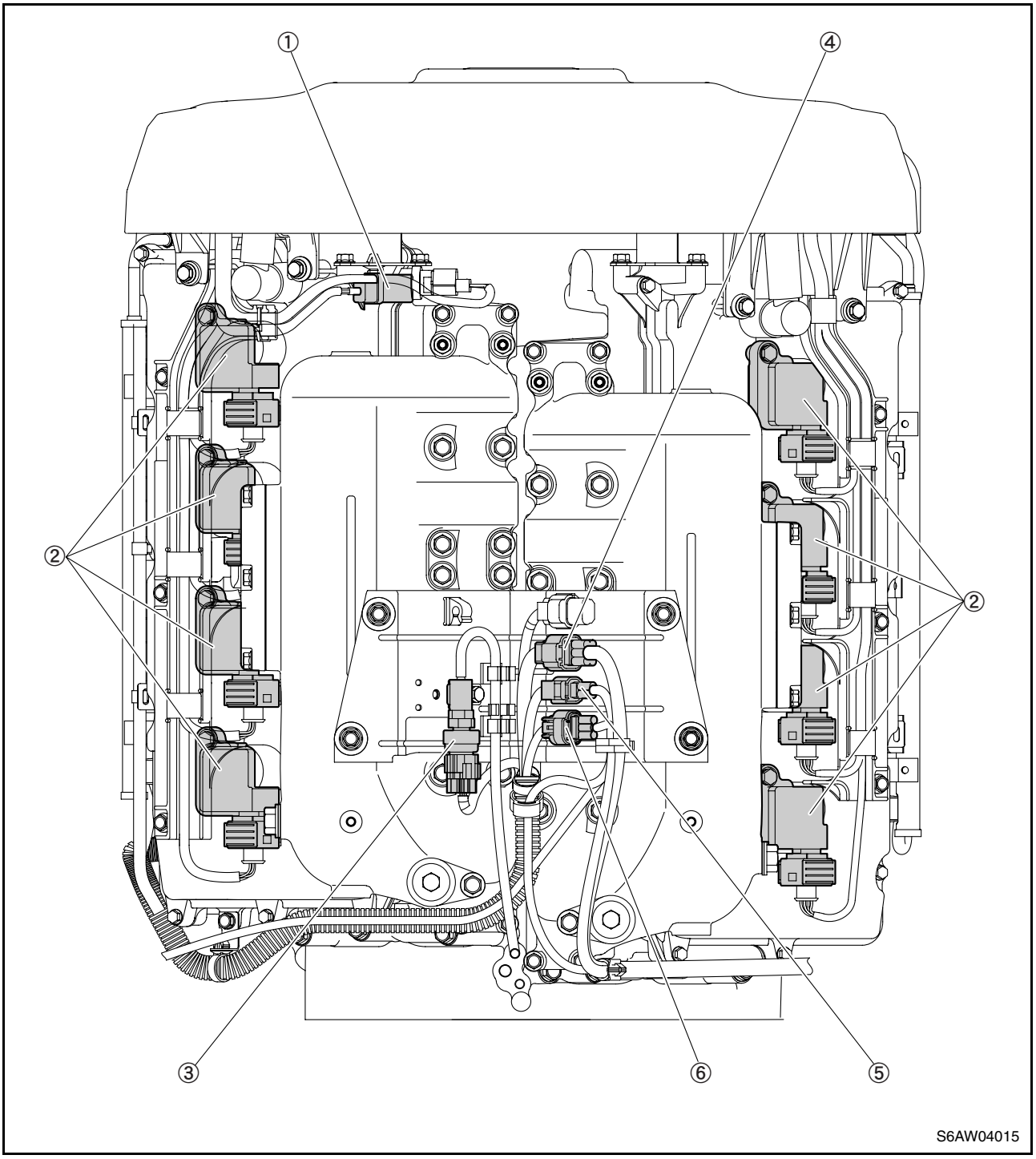


S6AW04010

① Main relay (ignition coil, VCT, fuel injector, engine ECM)
② Fuel pump relay (low-pressure)
③ Shift-actuator relay
④ ETV motor relay
⑤ Fuel pump relay (high-pressure)
⑥ Fuse (60 A) (house battery)(*1)
⑦ Fuse (60 A) (engine battery)(*1)
⑧ Fuse (10 A) (ETV)
⑨ Fuse (20A) (engine start switch, PTT switch, Digital Electronic Control ECM)
⑩ Fuse (15A) (shift actuator)
⑪ Fuse (30A) (starter relay)
⑫ Fuse (15A) (high-pressure fuel pump)
⑬ Fuse (30A) (ignition coil, VCT, fuel injector, engine ECM)
⑭ Fuse (10A) (low-pressure fuel pump)

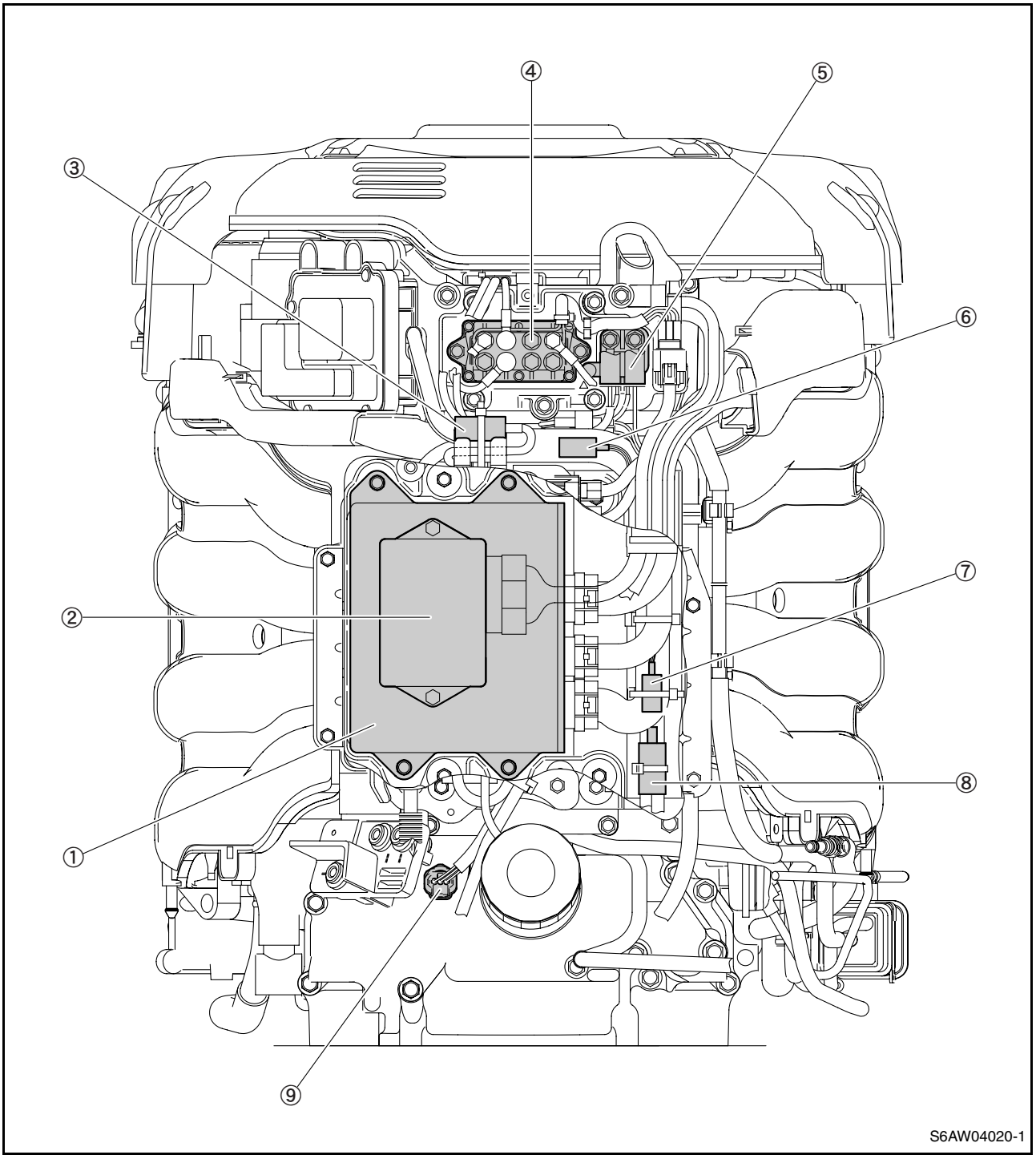
(*1) 60A (6AW 1001014–)
(6AX 1000440–)
(6BJ 1000001–)
(6BK 1000001–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

Aft view



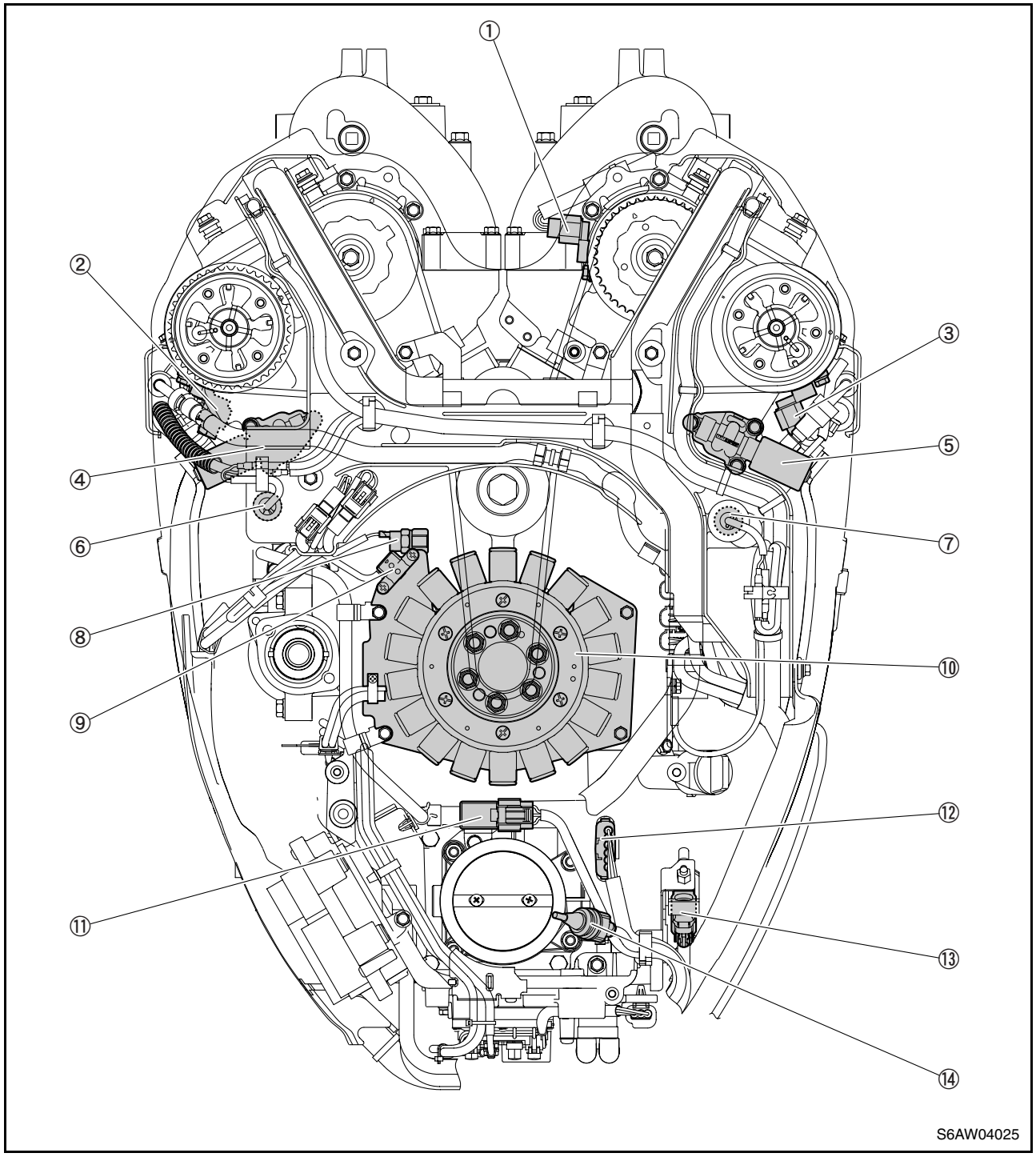
① Condenser (connect to the cam position sensor) PORT EX
② Ignition coil
③ Water pressure sensor
④ SPS coupler
⑤ Shift-actuator coupler
⑥ PTT switch coupler

Bow view



① Engine ECM
② IDM
③ Condenser (connect to the cam position sensor) STBD IN, PORT IN, PORT EX
④ PTT relay
⑤ Starter relay
⑥ Diode (connect to the PTT)
⑦ Diode (connect to the engine ECM)
⑧ Condenser (connect to the air pressure sensor)
⑨ Oil pressure sensor

Top view

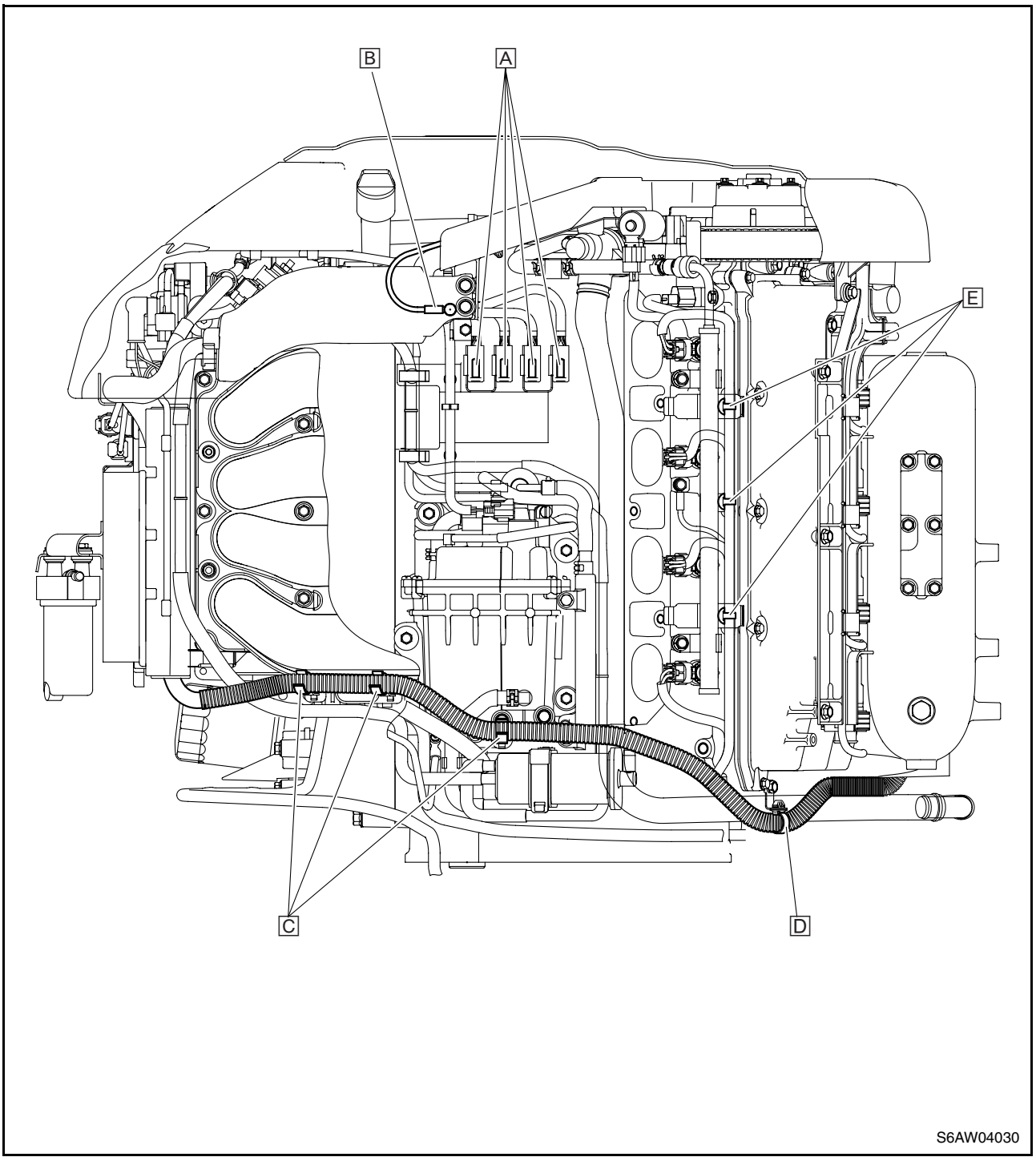


① Cam position sensor (PORT EX)
② Cam position sensor (STBD IN)
③ Cam position sensor (PORT IN)
④ OCV (STBD)
⑤ OCV (PORT)
⑥ Thermoswitch (STBD)
⑦ Thermoswitch (PORT)
⑧ Engine temperature sensor
⑨ Pulser coil
⑩ Stator assembly
⑪ Air pressure sensor
⑫ TPS coupler
⑬ Vapor shut-off valve
⑭ Air temperature sensor

5

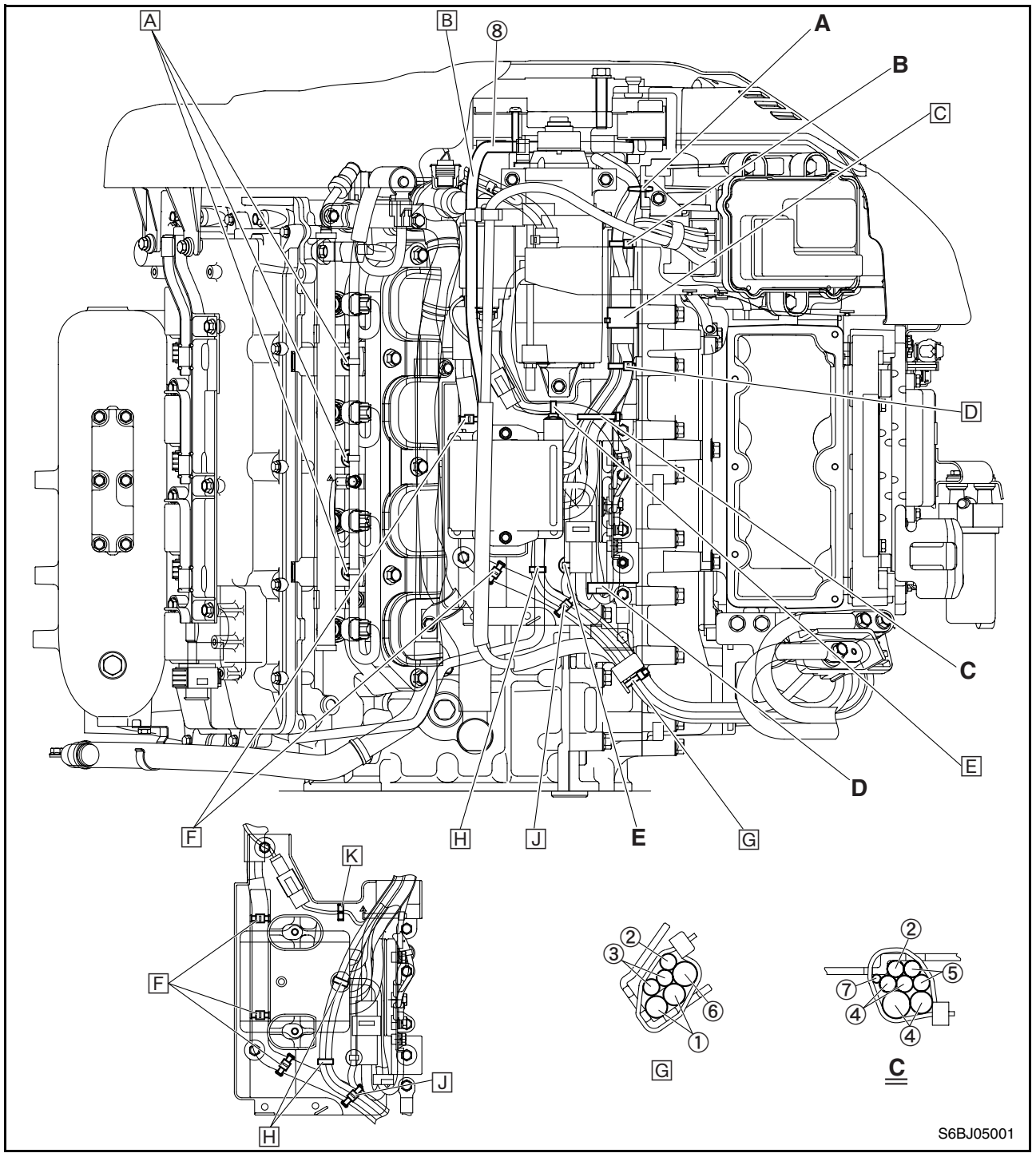
Wiring harness routing

Port view

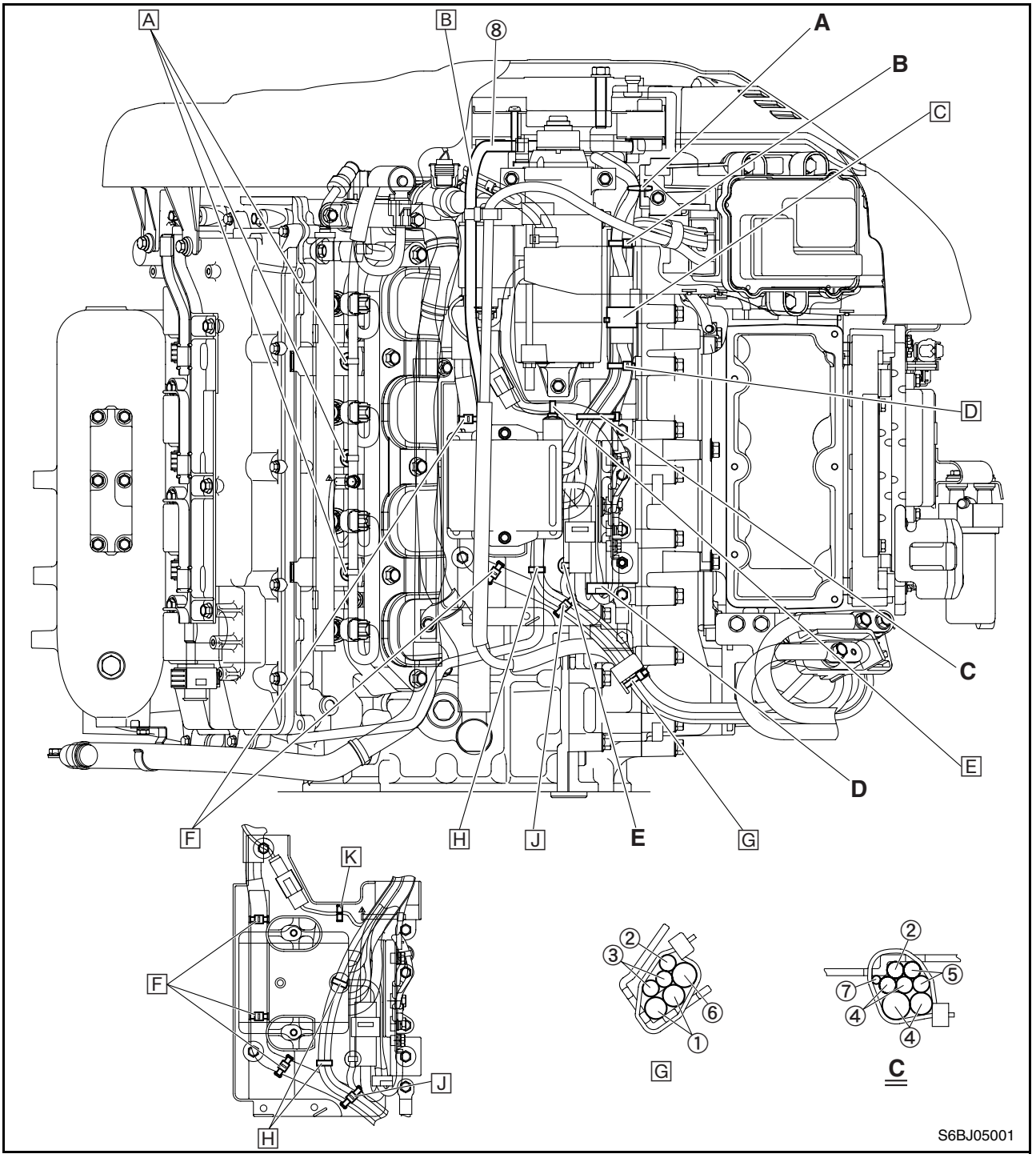


A Install the joint connectors starting order from the left; no mark, white tape, yellow tape, and brown tape.
B Install the ground lead as shown.
C Install wiring harness to the holder.
D Install the wiring harness to the stay with holder.
E Install the wiring harness to the fuel rail with holders.

Starboard view

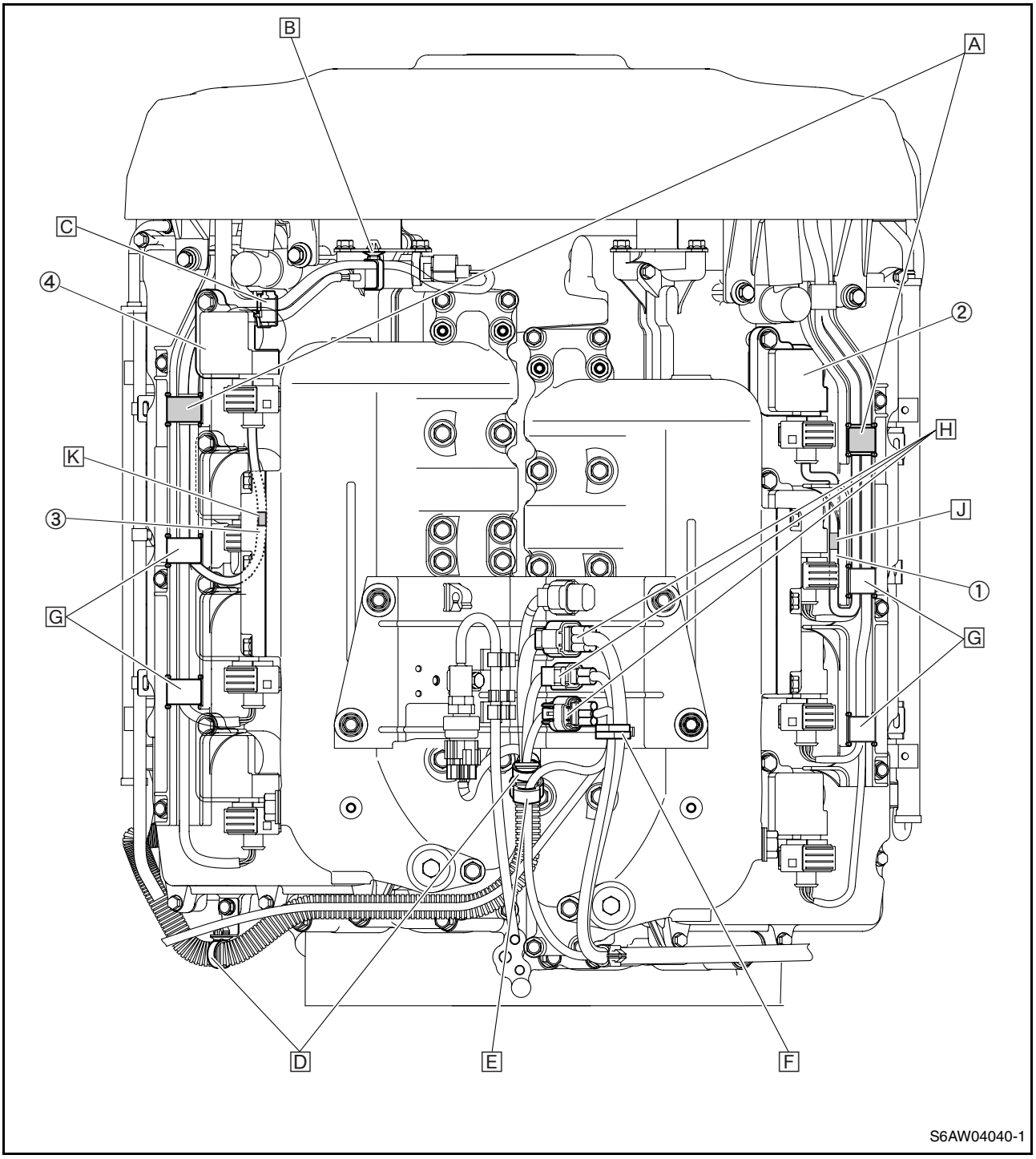


① Starter motor lead (F–J–G)
② PTT relay lead (B–D–C–E–J–G)
③ Power supply wiring harness (B–D–C–H–J–G)
④ Rectifier Regulator lead (B–D–C–D)
⑤ Stator assembly lead (A–B–D–C–D)
⑥ Ground lead (G)
⑦ Starter relay lead (B–D–C–K)



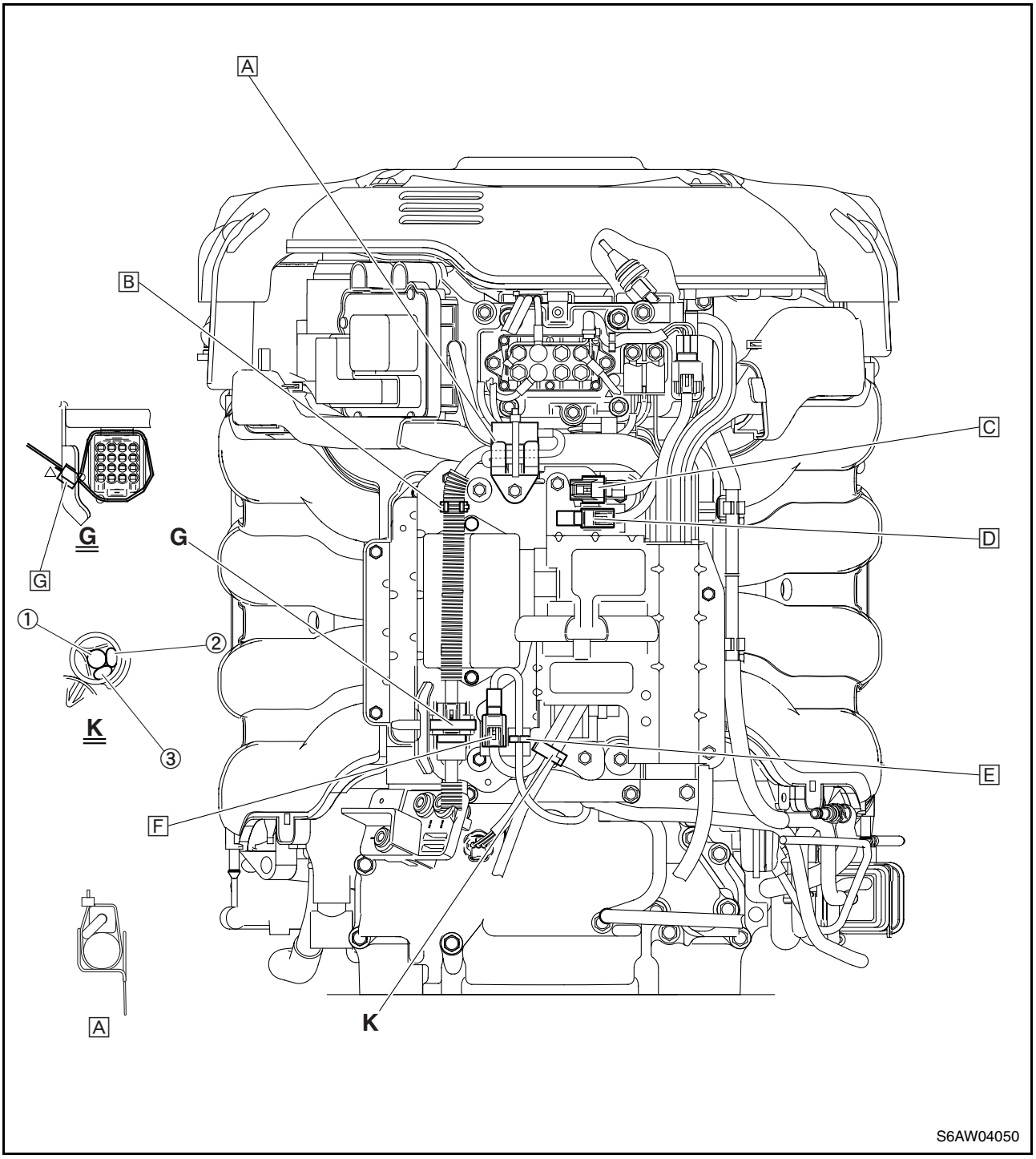
A Install the wiring harness to the fuel rail with holders.
B Route the wiring harness in front of the cooling water hose ⑧.
C Install the stator assembly coupler to the bracket.
D Fasten the power supply wiring harness and the stator assembly lead with a plastic tie.
E Install the wiring harness to the stay with a holder.
F Fasten the starter motor lead with a plastic tie.
G Fasten the wiring harness to the stay with a plastic tie.
H Install the wiring harness to the bracket with a holder.
J Fasten the wiring harness with a plastic tie.
K Install the starter motor lead to the clamp.

Aft view



A Install the wiring harness with the holder at the positioning tape.
B Install the condenser with a holder.
C Fasten a plastic tie as shown.
D Install the wiring harness with a holder.
E Install the wiring harness and PTT switch lead with a holder.
F Install the shift-actuator lead and the PTT switch lead with a holder.
G Install the ignition coil lead with a holder.
H Install the SPS, shift actuator, and PTT switch couplers into the bracket.
J Install the ignition coil lead #2 (white tape) ①, to the ignition coil #2 ②. Route the ignition coil #4 lead as shown.
K Install the ignition coil lead #1 (white tape) ③, to the ignition coil #1 ④. Route the ignition coil #3 lead as shown.

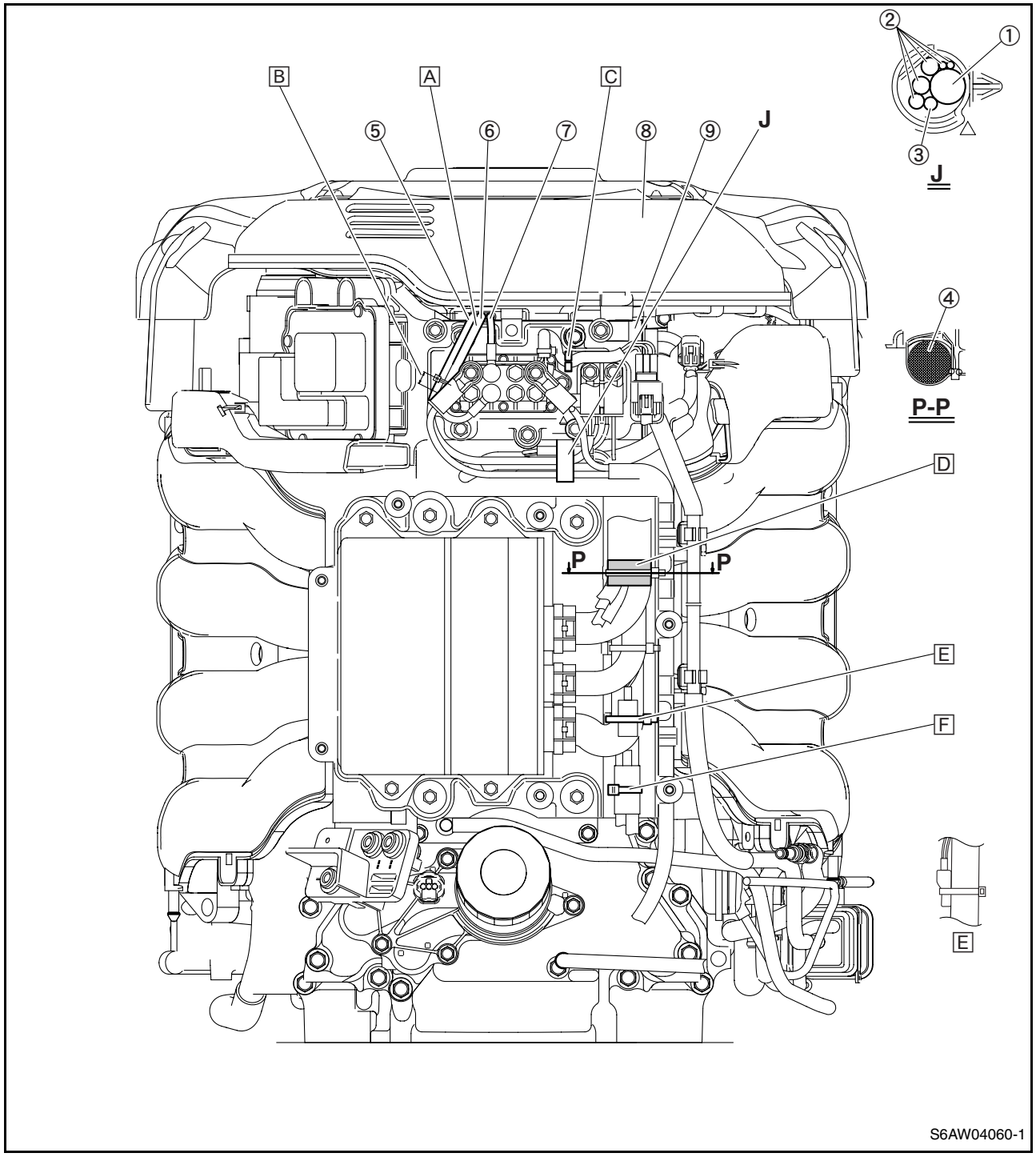
Bow view (IDM, engine ECM case)



① Water detection switch lead
② PTT sensor lead
③ Oil pressure sensor lead

A Install the condenser and the wiring harness as shown in the illustration, and fasten them.
B Install the wiring harness with the holder.
C Install the YDIS coupler to the bracket.
D Install the A/F coupler to the bracket.
E Install the water detection switch lead with the holder.
F Install the water detection switch lead to the bracket.
G Fasten the main harness coupler to the bracket with a plastic tie.

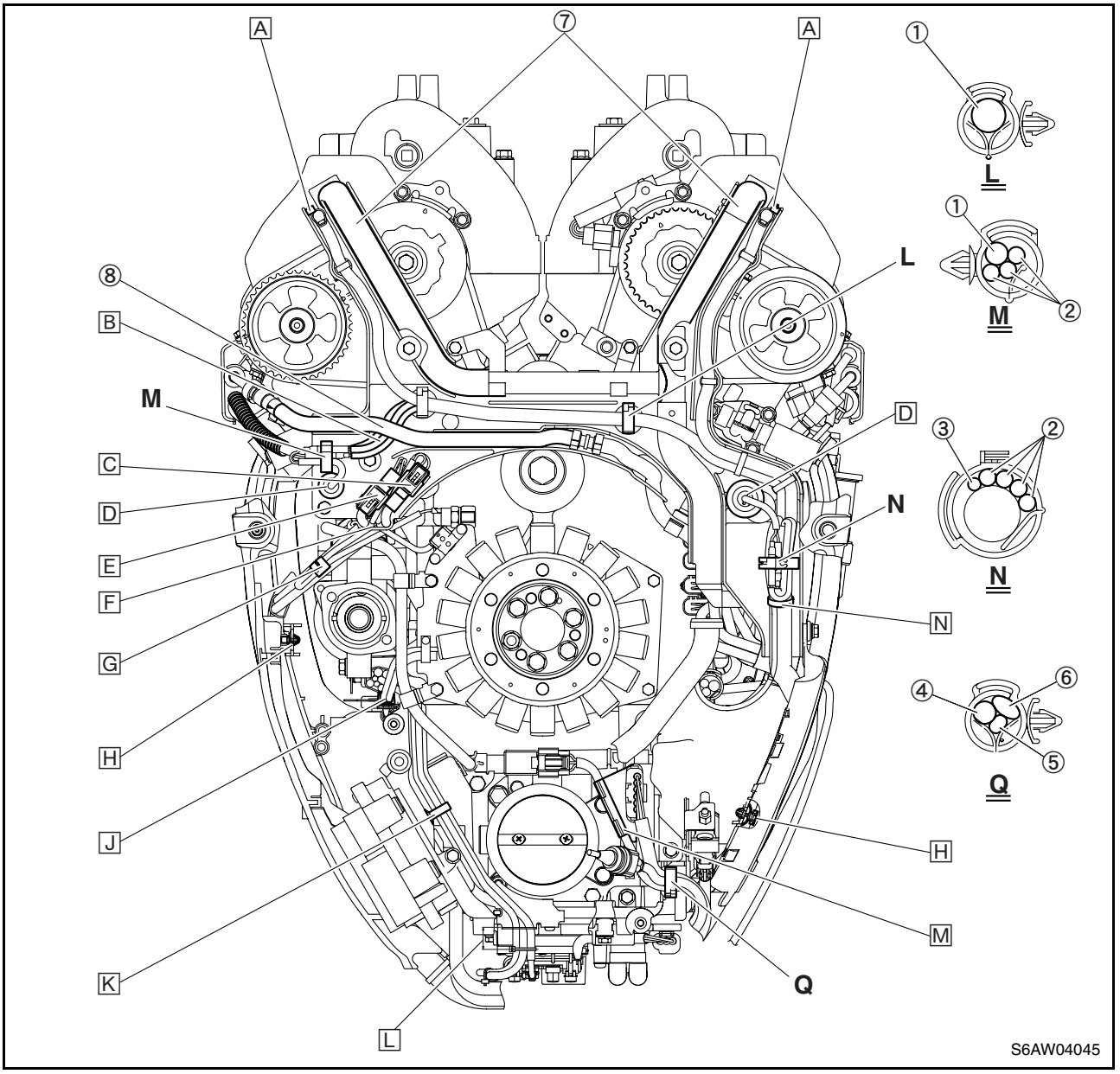
Bow view (engine ECM)



① Vapor gas hose
② Starter relay lead
③ PTT relay lead
④ Wiring harness
⑤ Starter relay lead
⑥ PTT relay lead
⑦ PTT relay lead
⑧ Intake silencer
⑨ Bracket

A Route the 3 leads in order ⑤, ⑥, ⑦ make sure that they are not pinched between the intake silencer ⑧ and the bracket ⑨.
B Fasten the plastic tie at 10 mm (0.39 in) from the tube end.
C Install the PTT relay lead in the clamp.
D Fasten the wiring harness at the positioning tape with a plastic tie.
E Fasten the wiring harness and the diode with a plastic tie, and cut off the extra length.
F Fasten the wiring harness and the condenser with a plastic tie.

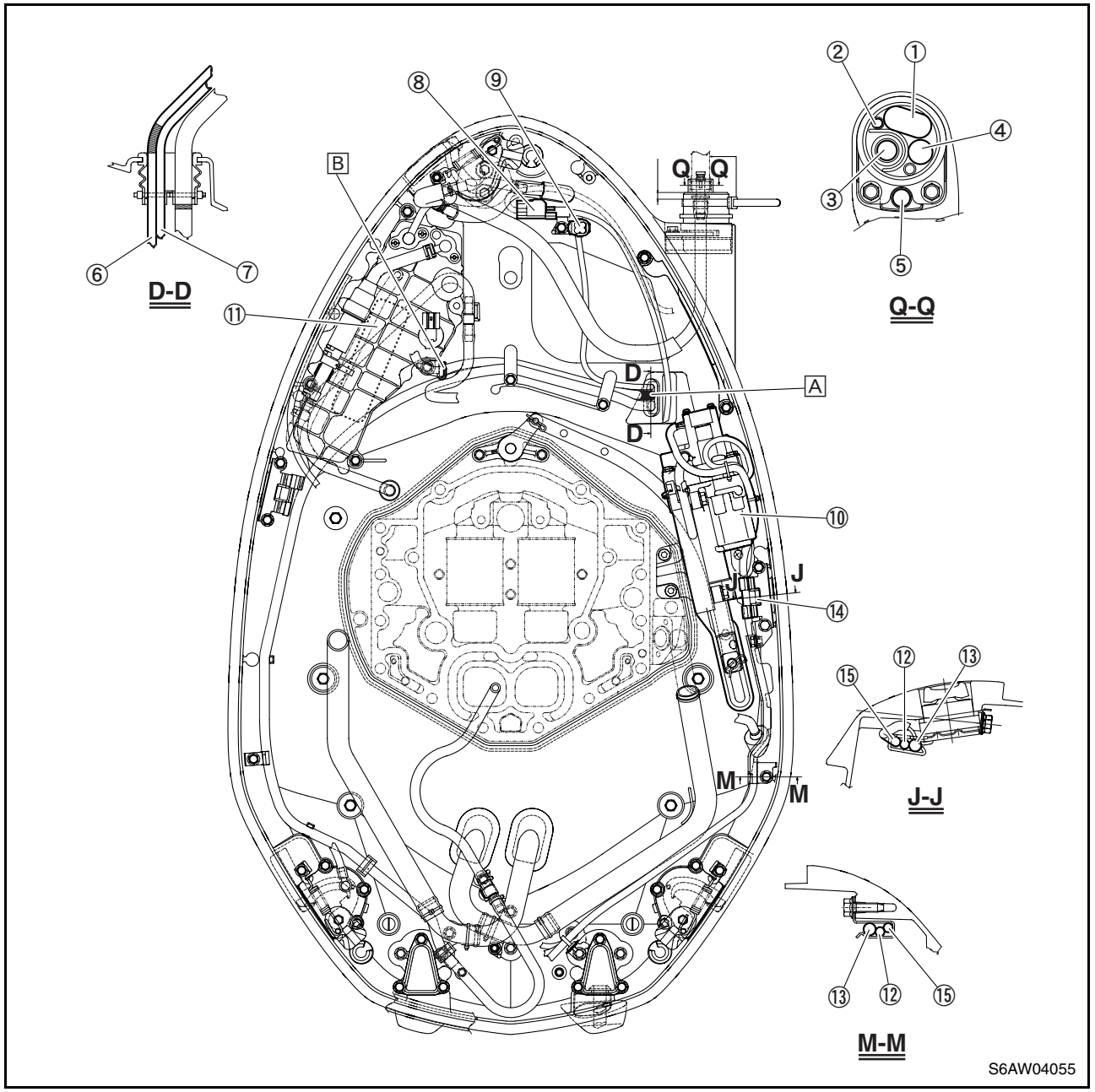
Top view



① Wiring harness
② Thermoswitch lead
③ Ground lead
④ Air temperature sensor lead
⑤ Air pressure sensor lead
⑥ ETV lead
⑦ Breather hose
⑧ High-pressure fuel hose

A Install the plastic tie in the illustrated orientation to prevent its tip from coming in contact with the breather hose ⑦.
B Run the wiring harness under the high-pressure fuel hose ⑧.
C Install the pulser coil coupler to the wiring harness guide.
D Run the thermoswitch lead through the grommet.
E Install the engine temperature sensor coupler to the wiring harness guide. Route the wiring harness under the couplers.
F Install the pulser coil lead and the thermoswitch lead to the wiring harness guide holder.
G Install the engine temperature sensor lead with holding them to the holder.
H Install the wiring harness protector in to the hole.
J Install the stator assembly lead to the holder.
K Install the sub-wiring harness holder to the bracket hole.
L Fasten the plastic tie at 15 mm (0.59 in) from the end of the clamp.
M Install the air pressure sensor lead to the plate.
N Install the wiring harness holder to the wiring harness guide.

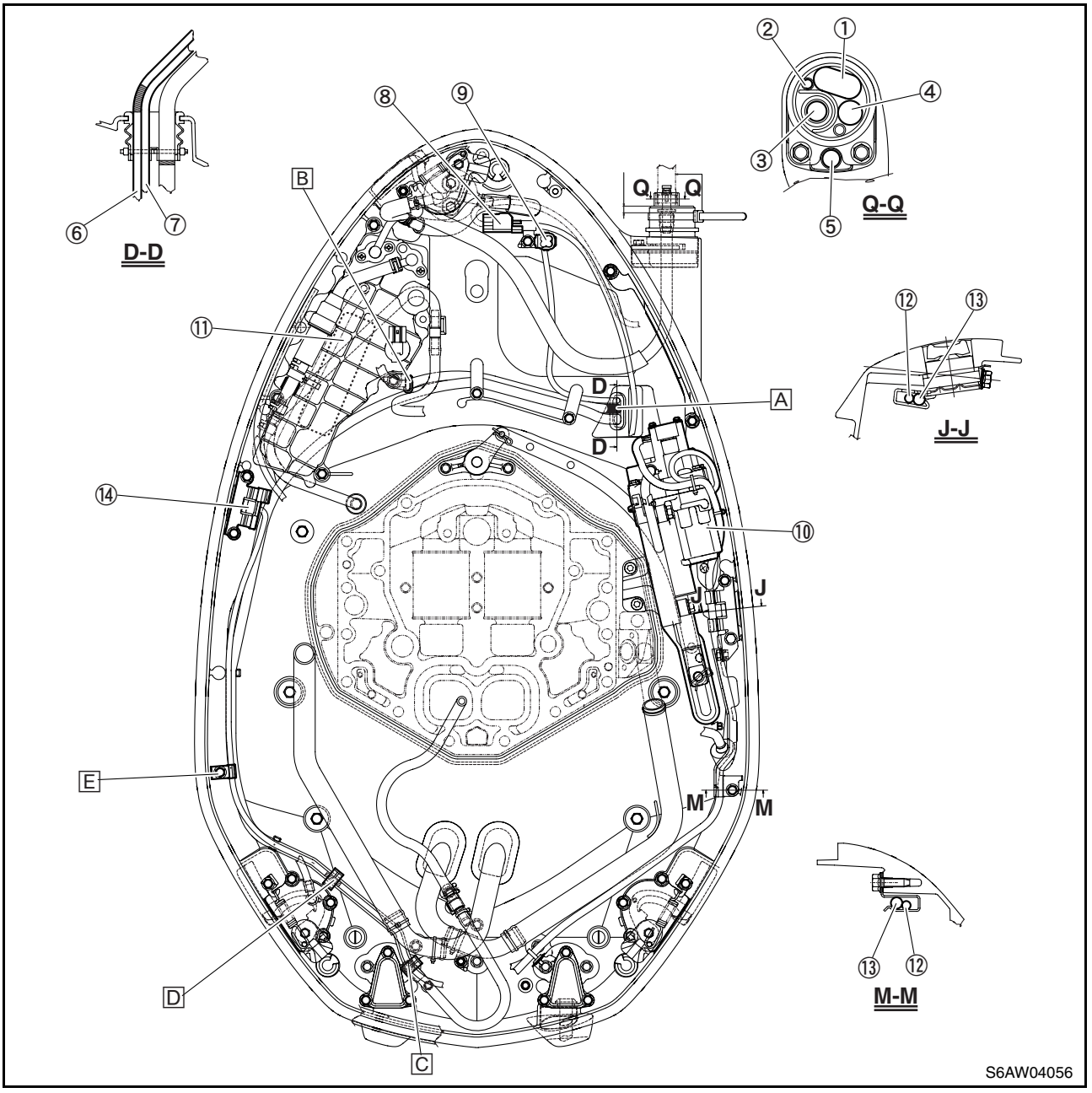
Bottom cowling (regular rotation model)



① Battery cable
② Speedometer hose (option)
③ Fuel hose
④ Extension wire harness
⑤ Flushing hose (option)
⑥ PTT sensor lead
⑦ PTT motor lead
⑧ Isolator coupler (black)
⑨ PTT sensor coupler
⑩ Shift actuator
⑪ Low-pressure fuel pump
⑫ Shift-actuator lead
⑬ SPS lead
⑭ PTT switch
⑮ PTT switch lead

[A] Align the positioning tape on the PTT motor lead to the grommet face.
[B] Install the PTT motor lead to the clamp.

Bottom cowling (counter rotation model)



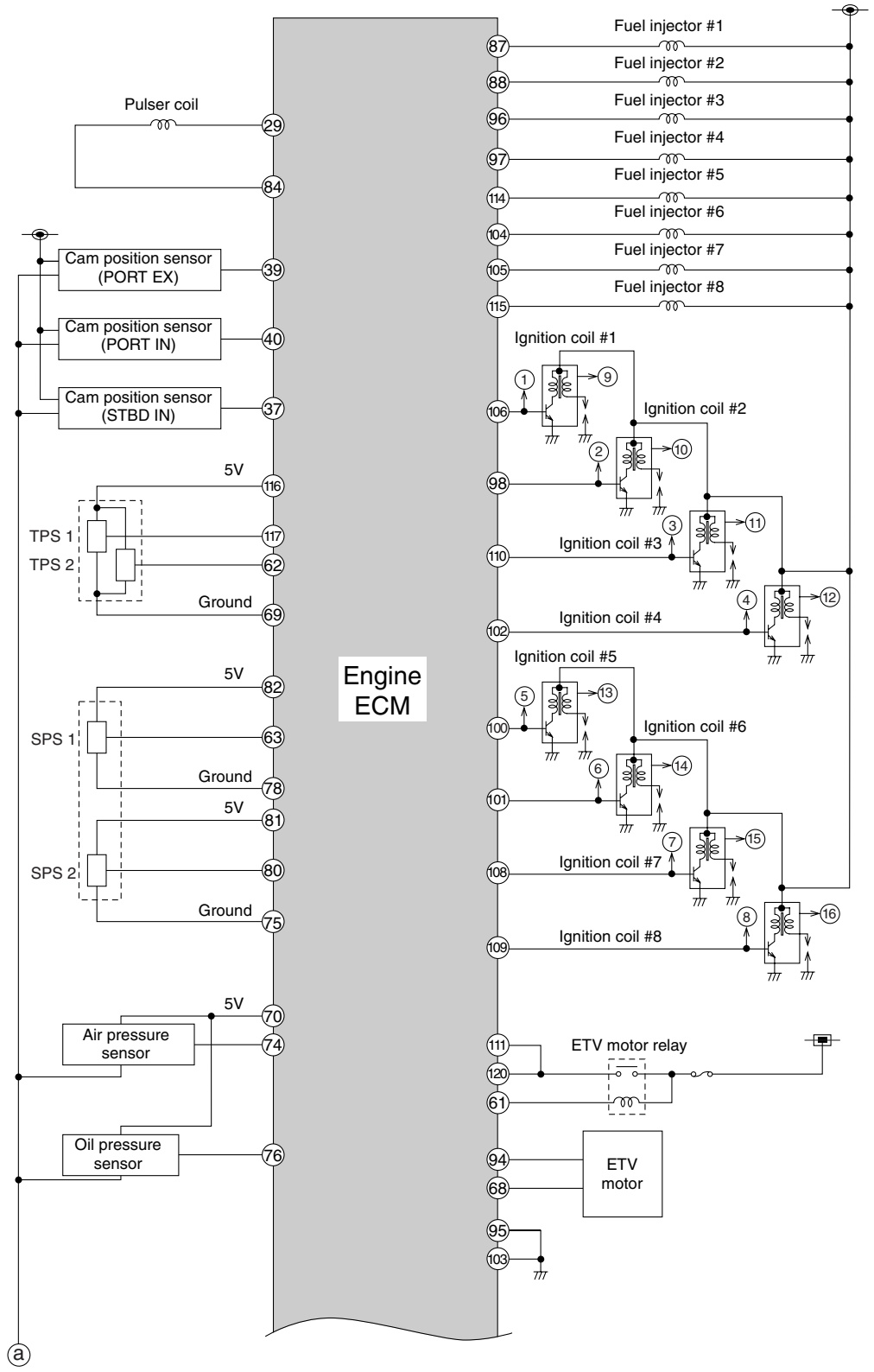
① Battery cable
② Speedometer hose (option)
③ Fuel hose
④ Extension wire harness
⑤ Flushing hose (option)
⑥ PTT sensor lead
⑦ PTT motor lead
⑧ Isolator coupler (black)
⑨ PTT sensor coupler
⑩ Shift actuator
⑪ Low-pressure fuel pump
⑫ Shift-actuator lead
⑬ SPS lead
⑭ PTT switch

[A] Align the positioning tape on the PTT motor lead to the grommet face.
[B] Install the PTT motor lead to the clamp.
[C] Fasten the PTT switch lead and the hose with the holder.
[D] Fasten the PTT switch lead and the hose with the holder at the positioning tape.
[E] Clamp the PTT switch lead.

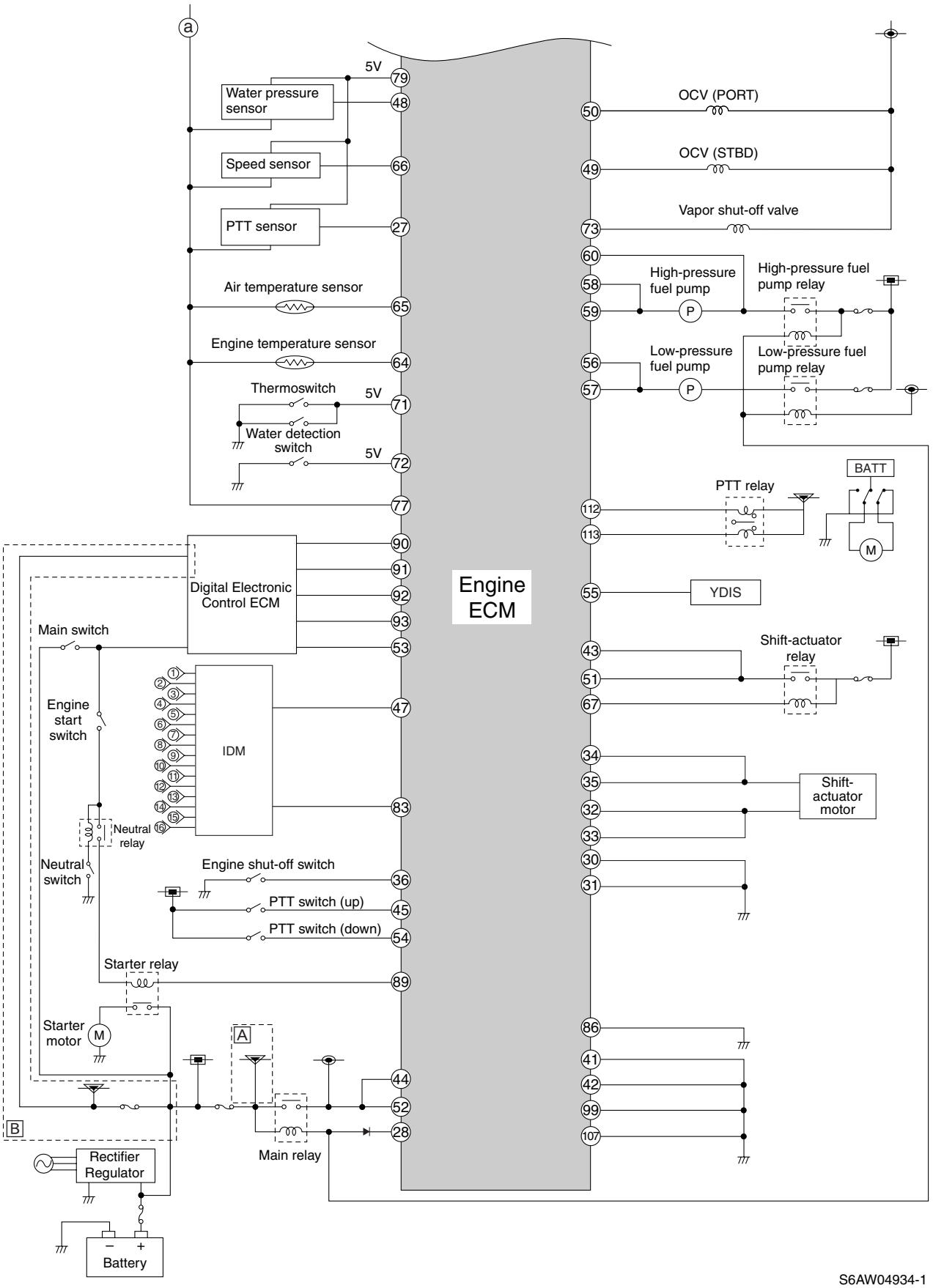
Circuit diagram

NOTE:

The circled numbers in the illustration indicate the engine ECM terminal numbers.



: Same marks are connected by each other.
: Same marks are connected by each other.

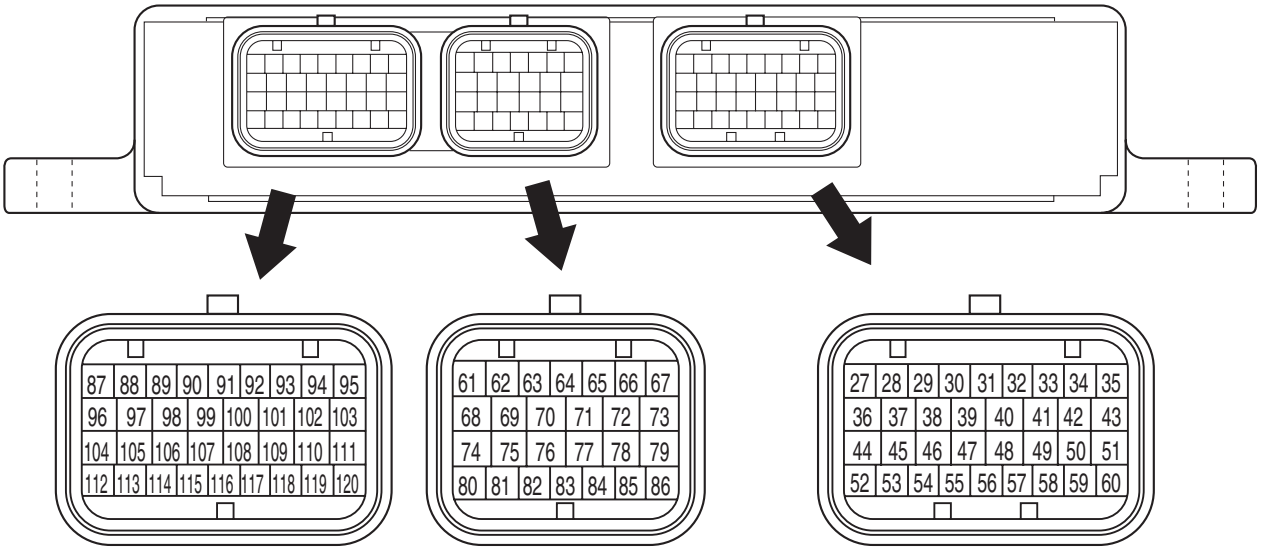


S6AW04934-1

: Same marks are connected by each other.
: Same marks are connected by each other.
: Same marks are connected by each other.

A: F350, FL350 only
B: F300, FL300 only

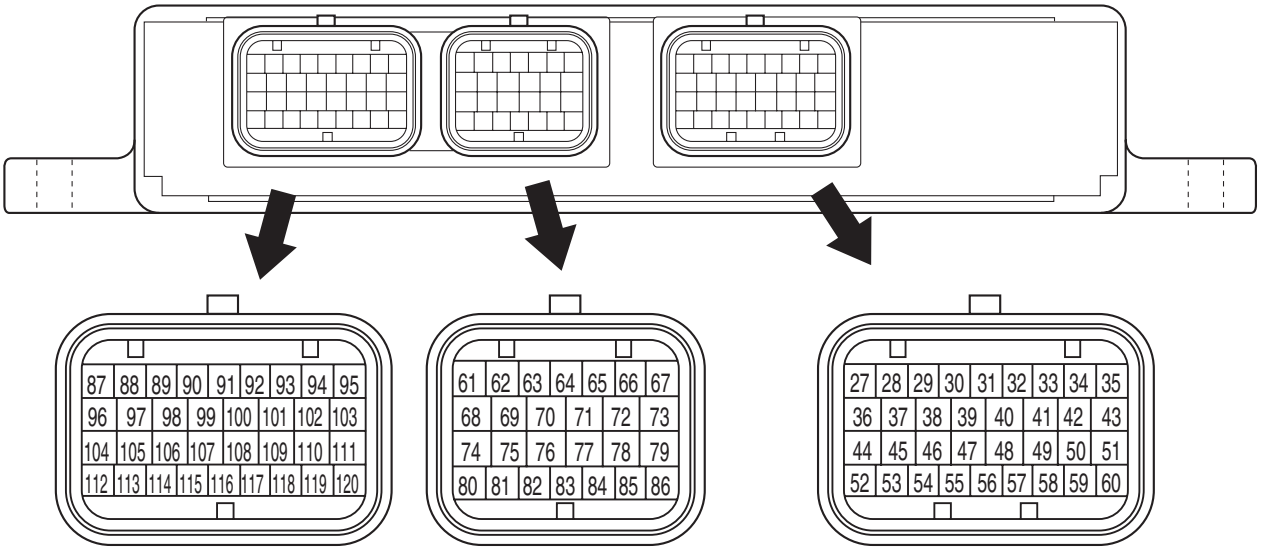
ECM coupler layout



S6AW04935

No.	Connecting part	Color
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27	PTT sensor	Pink
28	Main relay	Yellow/Green
29	Pulser coil	White/Black
30	Shift ground	Black

No.	Connecting part	Color
31	Shift ground	Black
32	Shift actuator	Green/Black
33	Shift actuator	Green/Black
34	Shift actuator	Green/Red
35	Shift actuator	Green/Red
36	Engine shut-off switch	White
37	Cam position sensor (STBD IN)	White/Black
38		
39	Cam position sensor (PORT EX)	White/Blue
40	Cam position sensor (PORT IN)	White/Green
41	Engine ECM ground	Black
42	Engine ECM ground	Black
43	Shift power source	Red/Green
44	Battery power source	Red/Yellow
45	PTT UP switch	Sky blue
46		
47	Ion knock (IDM)	Green
48	Water pressure sensor	Blue/Black
49	OCV (STBD)	Purple
50	OCV (PORT)	Purple
51	Shift power source	Red/Green
52	Battery power source	Red/Yellow
53	Wake up pulse (Digital Electronic Control)	Yellow
54	PTT DN switch	Light green
55	YDIS	White/Black



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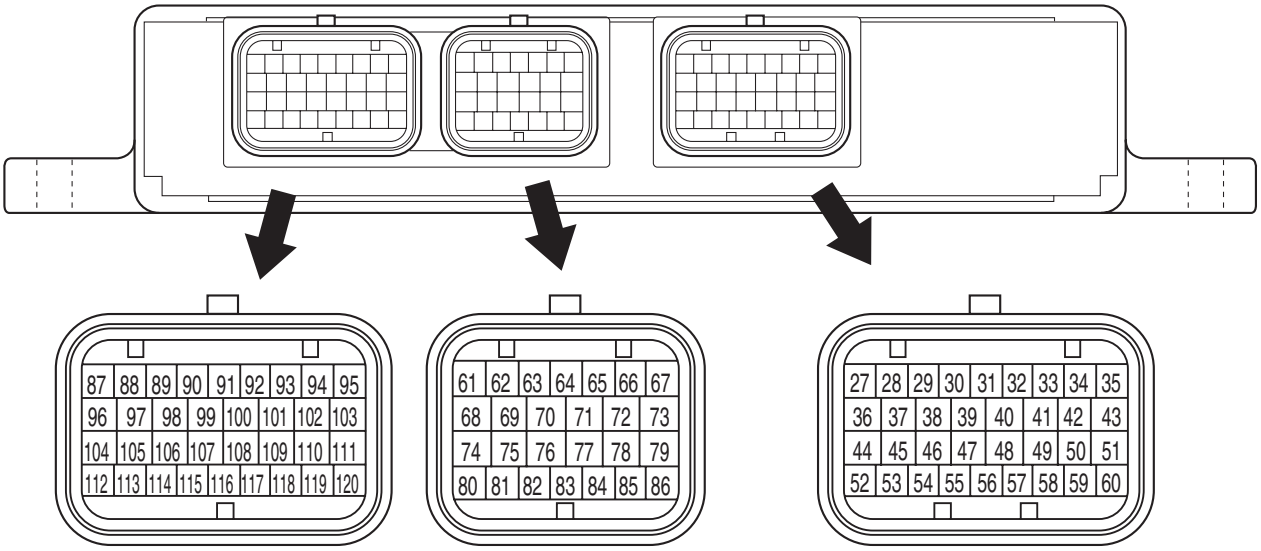
No.	Connecting part	Color
56	Low-pressure fuel pump	Blue/White
57	Low-pressure fuel pump	Blue/White
58	High-pressure fuel pump	Blue/Red
59	High-pressure fuel pump	Blue/Red
60	High-pressure fuel pump power source	Red/White
61	ETV power source	Yellow/Green
62	TPS 2	Pink/White
63	SPS 2	Pink
64	Engine temperature sensor	Red/Yellow
65	Air temperature sensor	Red/Yellow
66	Speed sensor	Blue
67	Shift power source	Yellow/Green
68	ETV motor	Green/Black
69	TPS ground	Black
70	Sensor power source 1	Orange
71	Thermoswitch	Pink
72	Water detection switch	Blue/White
73	Vapor shut-off valve	Green/Black
74	Air pressure sensor	Pink/Green
75	SPS 1 ground	Black
76	Oil pressure sensor	Pink/White
77	Sensor ground	Black
78	SPS 2 ground	Black
79	Sensor power source 2	Orange
80	SPS 1	Pink/White

No.	Connecting part	Color
81	SPS 1 power source	Orange
82	SPS 2 power source	Orange
83	Angle synchronization signal (IDM)	White/Black
84	Pulser coil ground	Black
85		
86	Ground	Black
87	Fuel injector #1	Purple/Red
88	Fuel injector #2	Purple/Black
89	Starter relay	Black
90	Digital Electronic Control 1 (H)	White
91	Digital Electronic Control 1 (L)	Blue
92	Digital Electronic Control 2 (H)	White
93	Digital Electronic Control 2 (L)	Blue
94	ETV motor	Green/Red
95	ETV ground	Black



S6AW04935

No.	Connecting part	Color
96	Fuel injector #3	Purple/Yellow
97	Fuel injector #4	Purple/Green
98	Ignition coil #2	Black/White
99	Engine ECM ground	Black
100	Ignition coil #5	Black/Blue
101	Ignition coil #6	Black/Brown
102	Ignition coil #4	Black/Green
103	ETV ground	Black
104	Fuel injector #6	Purple/White
105	Fuel injector #7	Purple/Red
106	Ignition coil #1	Black/Orange
107	Engine ECM ground	Black
108	Ignition coil #7	Black/Orange
109	Ignition coil #8	Black/White
110	Ignition coil #3	Black/Yellow
111	ETV power source	Red/Green
112	PTT relay UP	Sky blue
113	PTT relay DN	Light green
114	Fuel injector #5	Purple/Blue
115	Fuel injector #8	Purple/Black
116	TPS power source	Orange
117	TPS 1	Pink
118		
119		
120	ETV power source	Red/Green

Checking the electrical component

Checking by use of YDIS

When checking the ETV, first check for the proper communication between the Digital Electronic Control ECM and the Engine ECM by means of YDIS, followed by the checking for the sensors including TPS, SPS, and OCV.

When deleting the diagnosis record in the YDIS, be sure to check the time that the trouble codes were detected.

When checking the input voltage of a part, the coupler or connector must be disconnected. As a result, the engine ECM determines that the part is disconnected and a trouble code is detected. Therefore, be sure to delete the diagnosis record after checking the input voltage.

Since the main relay stays on for approximately 10 seconds after the start switch is turned to "OFF," the power of the engine ECM cannot be turned off. Therefore, if the start switch is turned to "ON" within 10 seconds after it was turned to "OFF," the trouble codes cannot be deleted.

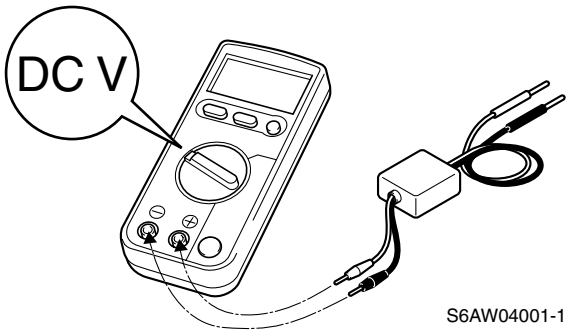
NOTE:

- Before checking the electrical components, make sure that the battery is fully charged.
- Install the proprietary YDIS software in CD-ROM to your computer. Always use the exclusive communication cable for connecting the ECM to the computer. For a description of the communication cable and CD-ROM to be used, see "YDIS" (4-1). Also, be sure to check the CD-ROM version before using it.
- To connect the YDIS, see "YDIS" (4-1) or the YDIS (version 1.30 or later) Instruction manual.

YDIS (CD-ROM, ver 1.30):
60V-WS853-04
YDIS (KIT):
60V-85300-04

Measuring the peak voltage

To check the electrical components or measure the peak voltage, use the special service tools. A faulty electrical component can be easily checked by measuring the peak voltage. The specified engine speed when measuring the peak voltage is affected by many factors such as fouled spark plugs or a weak battery. If one of these factors is present, the peak voltage cannot be measured properly.



S6AW04001-1

⚠ WARNING

When checking the peak voltage, do not touch any of the connections of the digital tester probes.

CAUTION:

When testing the voltage between the terminals of an electrical component with the digital tester, do not allow any of the leads to touch any metal parts. If touched, the electrical component can be short-circuited and be damaged.

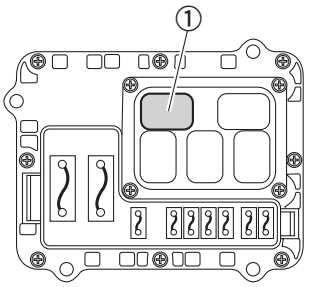
NOTE:
- Before measuring the peak voltage, check all wiring for proper connection and corrosion, and check that the battery is fully charged.
- Use the Peak voltage adapter B with the recommended digital circuit tester.
- Connect the positive pin of the Peak voltage adapter B to the positive terminal of the digital tester, and the negative pin to the negative terminal.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode.**

Digital circuit tester:
90890-03174
Peak voltage adapter B:
90890-03172

Engine control units and components

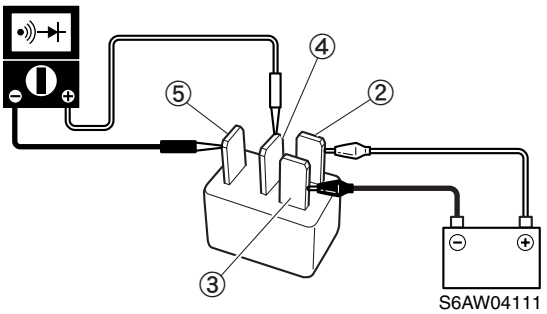
Checking the main relay

1. Remove the main relay ①.



S6AW04110

2. Connect the positive battery lead to the relay terminal ②, and the negative battery lead to the relay terminal ③ as shown, and then check for continuity between terminals ④ and ⑤. Replace the relay if there is no continuity.



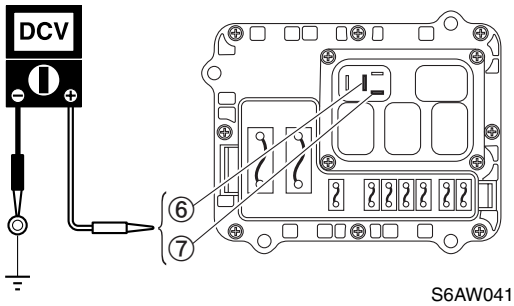
S6AW04111

CAUTION:
Do not reverse the battery leads.

Battery Lead	Relay terminal No.	
	④	⑤
Connect	○———	———○
Disconnect		

5

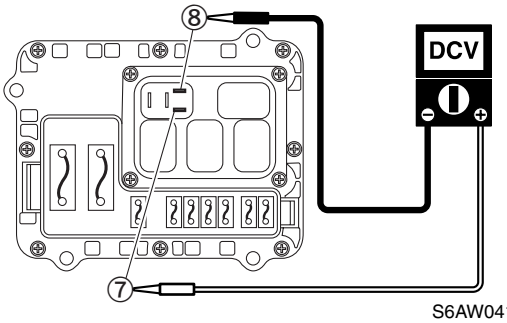
3. Measure the input voltage between the terminal ⑥ and ground, and the terminal ⑦ and ground as shown.



S6AW04112

Terminal ⑥–Ground:
Terminal ⑦–Ground:
12 V (battery voltage)

4. Turn the engine start switch to "ON," and then measure the input voltage between terminal ⑦ and ⑧ as shown.



S6AW04113

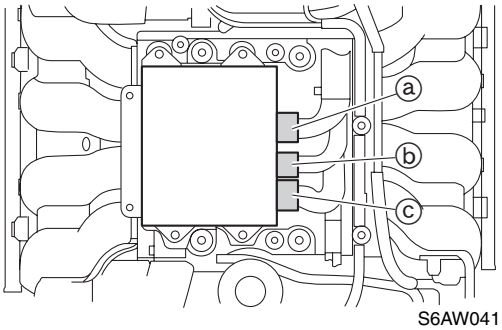
Terminal ⑦–Terminal ⑧:
12 V (battery voltage)

5. Turn the engine start switch to "OFF."

Checking the engine ECM circuit

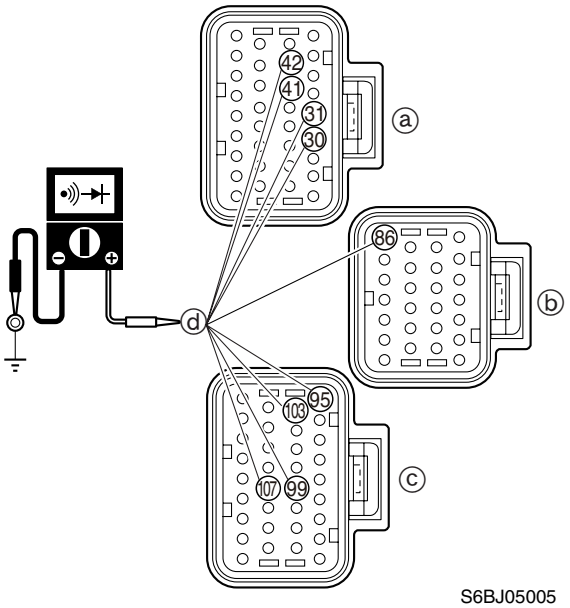
1. Remove the fuel filter.

2. Disconnect the engine ECM couplers ⓐ, ⓑ, and ⓒ.



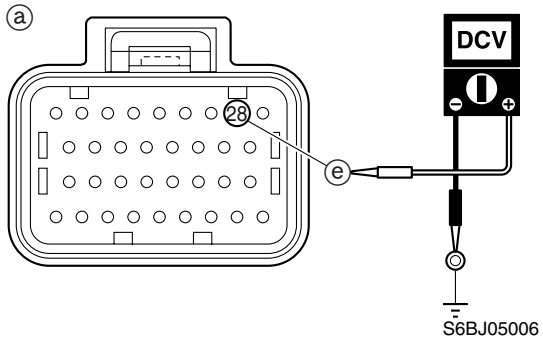
S6AW04114

3. Check for continuity between the engine ECM coupler terminals ⓓ (30, 31, 41, 42, 86, 95, 99, 103, and 107, wiring harness end) and ground. Check the wiring harness and ground if there is no continuity.



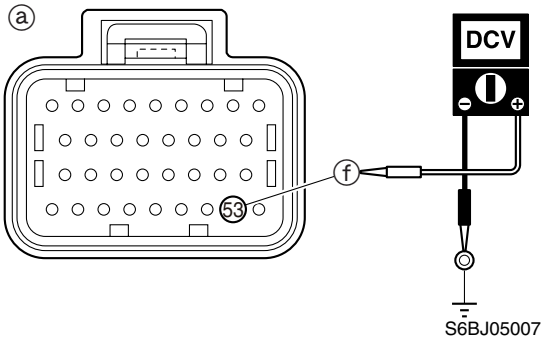
S6BJ05005

4. Measure the input voltage at engine ECM coupler ⓐ terminal ⓔ (28, wiring harness end) and ground. Check the wiring harness, fuse, relay, and diode if the measurement is lower than the specified value. To check the wiring harness, see the wiring diagram. For the location of the fuse, see "Fuse holder" (5-3). To check the relay, see "Checking the main relay" (5-22).



Terminal ⓔ 28 (Y/G)–Ground:
12 V (battery voltage)

5. Turn the engine start switch to "ON," and then measure the input voltage at engine ECM coupler terminal ⓕ (53, wiring harness end) and ground. Check the extension wire harness and Digital Electronic Control.

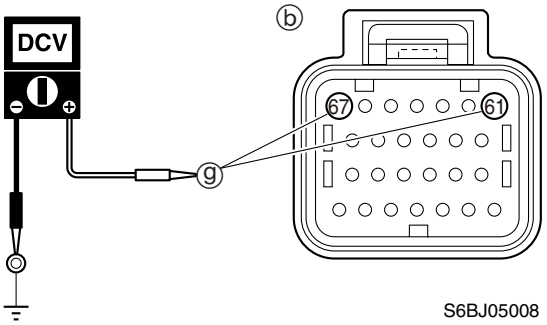


Terminal ⓕ 53 (Y)–Ground:
11.23 V (reference data)

6. Turn the engine start switch to "OFF."

7. Connect the engine ECM coupler ⓐ.

8. Turn the engine start switch to "ON," and then measure the input voltage at engine ECM coupler terminals ⓖ (61 and 67, wiring harness end) and ground. Check the fuse, relay, and wiring harness if below specification.

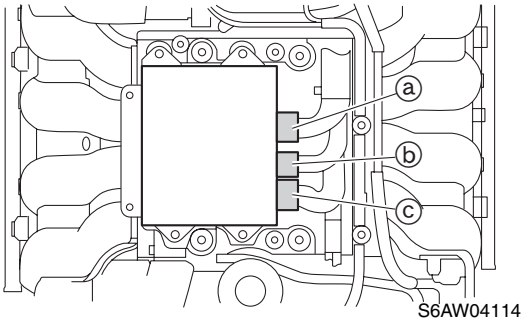


Terminal ⓖ
61 (Y/G)–Ground:
67 (Y/G)–Ground:
12 V (battery voltage)

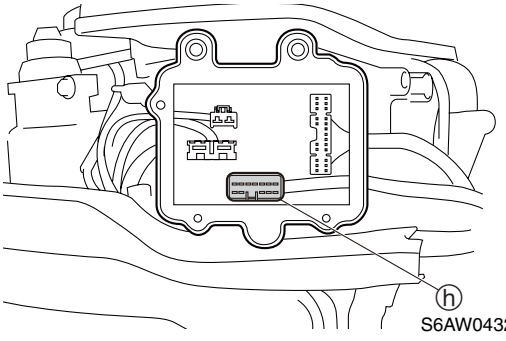
9. Turn the engine start switch to "OFF."

10. Connect the engine ECM couplers ⓑ and ⓒ.

11. Disconnect the engine ECM coupler ⓐ.

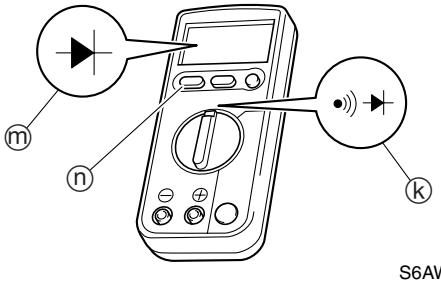


12. Disconnect the fuse holder coupler ⓗ.



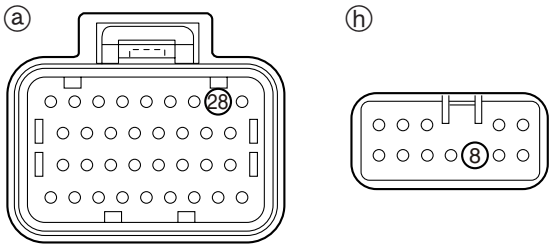
5

13. Be sure to set the measurement range ⓚ, and display the mark ⓜ by pushing the "SHIFT" switch ⓝ when checking the wiring harness continuity.



S6AW04341

14. Check the wiring harness for continuity. Replace the engine ECM protection diode, if out of specification.



S6BJ05009

NOTE:
The tester display data represents the value obtained by using Yamaha recommended tester.

Wiring harness continuity:

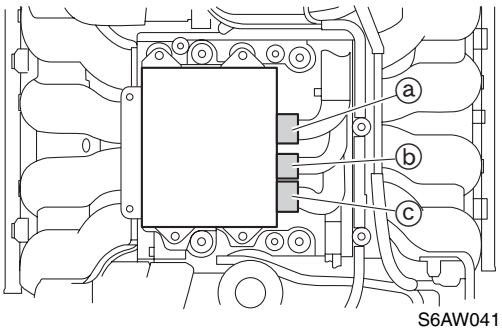
Tester probe		Display value (v)
+	–	
Coupler ⓗ 8	Coupler ⓐ 28	0.6–0.7 V (reference data)
Coupler ⓐ 28	Coupler ⓗ 8	OL (over load)

15. Connect the engine ECM and the fuse holder to the corresponding couplers.

16. Install the fuel filter.

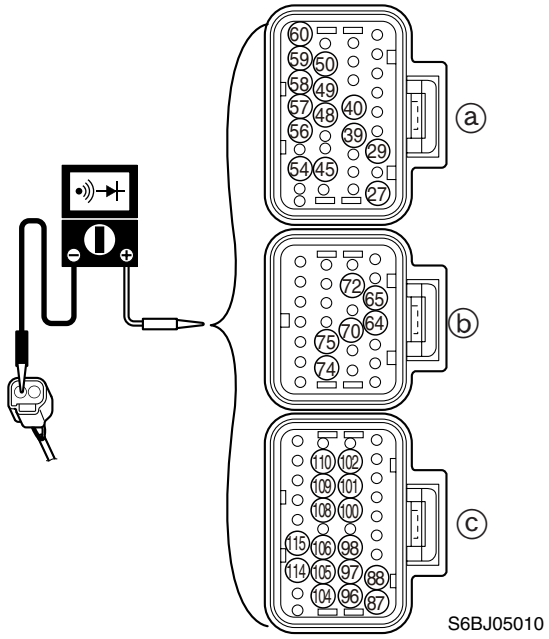
Checking the continuity between the engine ECM and each item

1. Remove the fuel filter, and then disconnect the engine ECM couplers ⓐ, ⓑ, and ⓒ.



S6AW04114

2. Check for continuity between the engine ECM and each item. Replace the wiring harness if there is no continuity.



Wiring harness continuity:

No.	Item	Color
27	PTT sensor	Pink
29	Pulser coil	White/Black
37	Cam position sensor (STBD IN)	White/Black
39	Cam position sensor (EX)	White/Blue
40	Cam position sensor (PORT IN)	White/Green
45	PTT switch UP	Sky blue
48	Water pressure sensor	Blue/Black
49	OCV (STBD)	Purple
50	OCV (PORT)	Purple
54	PTT switch down	Light green
56	Low-pressure fuel pump	Blue/White
57	Low-pressure fuel pump	Blue/White
58	High-pressure fuel pump	Blue/Red
59	High-pressure fuel pump	Blue/Red
60	High-pressure fuel pump	Red/White
64	Engine temperature	Black/Yellow
65	Air temperature sensor	Black/Yellow
70	Air pressure sensor Oil pressure sensor	Orange
72	Water detection switch	Red/White
74	Air pressure sensor	Pink/Green
75	Oil pressure sensor	Pink/Green
87	Fuel injector #1	Purple/Red
88	Fuel injector #2	Purple/Black
96	Fuel injector #3	Purple/Yellow
97	Fuel injector #4	Purple/Green
98	Ignition coil #2	Black/Blue
100	Ignition coil #5	Black/Blue
101	Ignition coil #6	Black/Brown
104	Fuel injector #6	Purple/White
105	Fuel injector #7	Purple/Red
106	Ignition coil #1	Black/Orange
108	Ignition coil #7	Black/Orange
109	Ignition coil #8	Black/Orange
114	Fuel injector #5	Purple/Blue
115	Fuel injector #8	Purple/Black

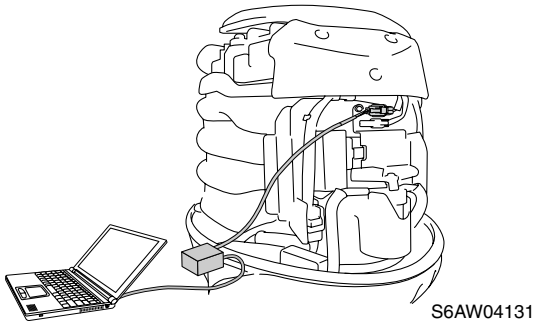
3. Check for continuity between each item coupler (wiring harness end) and ground. Check the ground connection, or replace the wiring harness if there is no continuity.

4. Connect the engine ECM coupler ⓐ, ⓑ, and ⓒ.

5

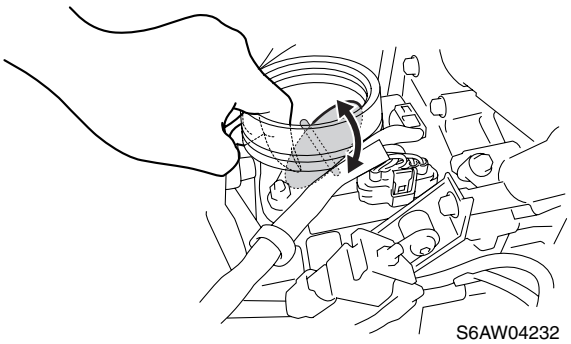
Checking the ETV and TPS

1. Connect a computer to the outboard motor and use the YDIS. To connect and operate the YDIS, see “YDIS” (4-1) and the YDIS (Ver. 1.30 or later) Instruction manual. YDIS to display “Throttle position sensor 1,” “Throttle valve opening,” and “Throttle position sensor 2.”


S6AW04131

NOTE:
TPS 1 and TPS 2 are components of the ETV, which cannot be disassembled.

2. Start the engine, warm it up, and then turn it off.
3. Remove the intake silencer.
4. Turn the engine start switch to “ON,” and set the throttle valve at fully closed position. Take measurements of TPS 1 and TPS 2 output voltage, and the throttle valve opening angle. Then, move the throttle valve manually to fully open position. Again, take measurements of TPS 1 and TPS 2 output voltage, and the throttle valve opening angle.

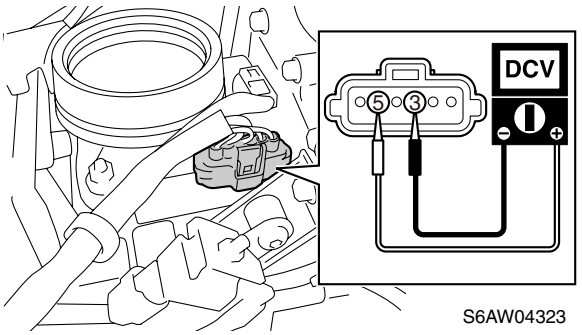

S6AW04232

NOTE:
The actual TPS output voltage and throttle valve opening angle may vary according to environmental conditions and engine temperature.

TPS output voltage and throttle valve opening angle (reference data):

Item	Fully closed	Fully open
TPS 1	0.32–0.68 V	4.30–4.70 V
TPS 2	2.32–2.68 V	4.50–4.80 V
Throttle valve opening angle	4.2°	83.6°

5. Turn the engine start switch to “OFF.”
6. Disconnect the ETV coupler.
7. Turn the engine start switch to “ON,” and then measure the TPS input voltage at the ETV coupler (wiring harness end). Check the wiring harness if measured voltage is lower than the specified range. To check the wiring harness, see “Checking the ETV and TPS circuit” (5-28).



S6AW04323

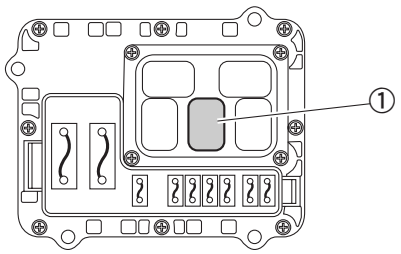
TPS input voltage (reference data):
Terminal ⑤ (O)–Terminal ③ (B):
4.5–5.5 V

8. Turn the engine start switch to “OFF.”
9. Move the throttle valve manually to check the proper movement. Replace the ETV assembly if proper movement cannot be attained.

10. Connect the ETV coupler, and install the intake silencer.

Checking the ETV motor relay

1. Remove the ETV motor relay ①.



S6AW04162

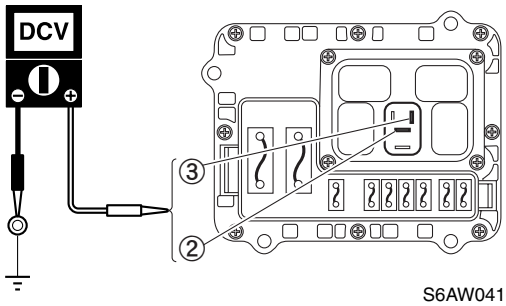
2. ETV motor relay is of the same type as the main relay. To check the relay, see "Checking the main relay" (5-22).

CAUTION:

Do not reverse the battery leads.

3. Turn the engine start switch to "ON."

4. Measure the input voltage between the terminal ② and ground, and the terminal ③ and ground as shown.



S6AW04163-a

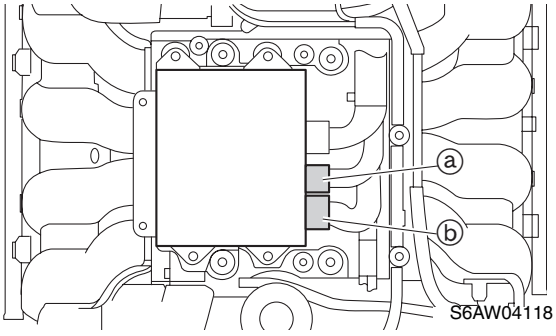
	Terminal ②–Ground: Terminal ③–Ground: 12 V (battery voltage)

5. Turn the engine start switch to "OFF," and install the ETV motor relay.

Checking the ETV and TPS circuit

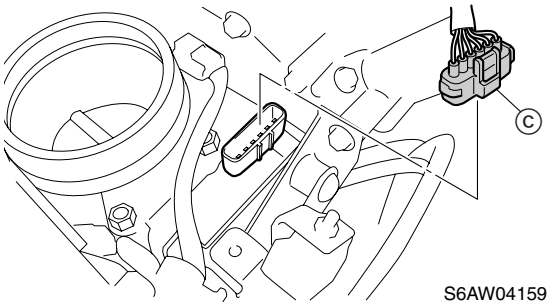
1. Remove the intake silencer and the fuel filter.

2. Disconnect the engine ECM couplers ⓐ and ⓑ.



S6AW04118

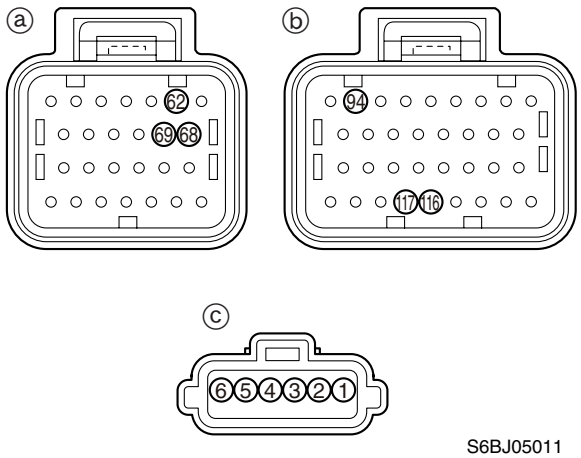
3. Disconnect the ETV coupler ⓒ.



S6AW04159

5

4. Check the wiring harness for continuity.

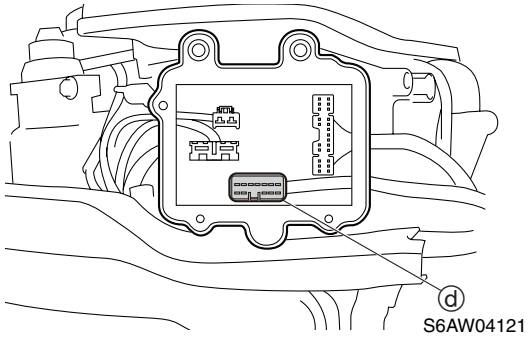


S6BJ05011

Wiring harness continuity:	
Terminal No.	
Coupler ⓐ ⓑ	Coupler ⓒ
94	1
68	2
69	3
117	4
116	5
62	6

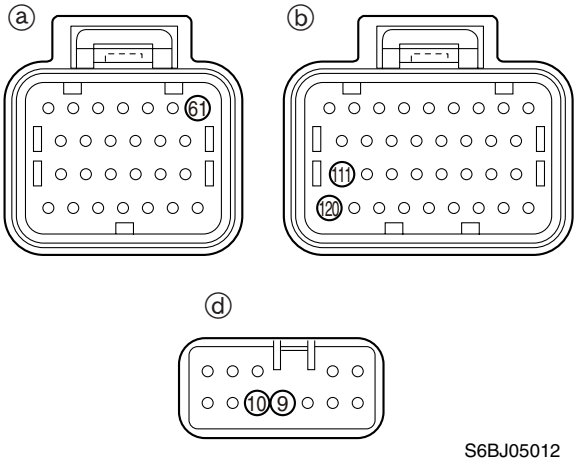
5. Connect the ETV coupler ⓒ.

6. Disconnect the fuse holder couplers ⓓ.



S6AW04121

7. Check for continuity between the wiring harnesses.



S6BJ05012

Wiring harness continuity:	
Terminal No.	
Coupler ⓐ ⓑ	Coupler ⓓ
61	9
111	10
120	10

8. Connect the engine ECM couplers ⓐ and ⓑ, as well as the fuse holder coupler ⓓ.

9. Install the fuel filter and the intake silencer.

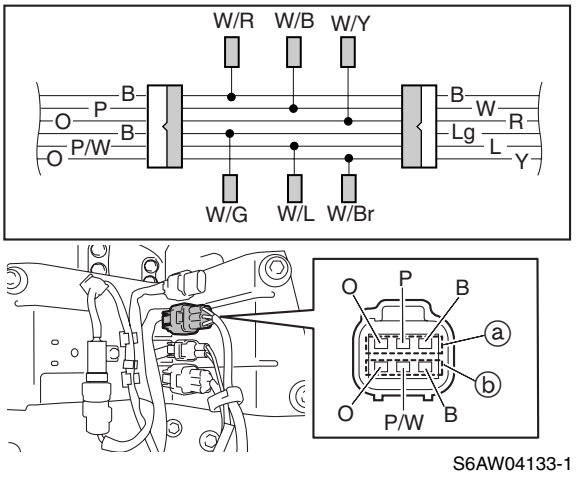
Checking the SPS

NOTE:

Remove the lower unit and check for unimpeded movement of the shift link arm before checking the SPS.

1. Disconnect the SPS coupler, and then connect it to the test harness (6 pins).

2. Turn the engine start switch to "ON." Operate the Digital Electronic Control to take measurements of input voltage at each shifting position forward, neutral, and reverse. Check the wiring harness if the measured voltage is out of the specified range. To check the wiring harness, see "Checking the SPS and the shift-actuator circuit" (5-31).



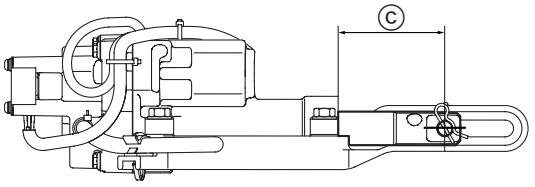
S6AW04133-1

Test harness (6 pins):
90890-06872

SPS input voltage
(reference data):

SPS 1 ⓐ:	Orange(O)–Black(B)
SPS 2 ⓑ:	Orange(O)–Black(B)
	4.75–5.25 V

3. Operate the Digital Electronic Control to take measurements of output voltage at each shifting position forward, neutral, and reverse, as well as the shift-actuator rod stroke (distance ⓒ).



S6AW04209

SPS output voltage
(reference data):

SPS 1 ⓐ: Pink(P)–Black(B)
SPS 2 ⓑ: Pink/White(P/W)–Black(B)

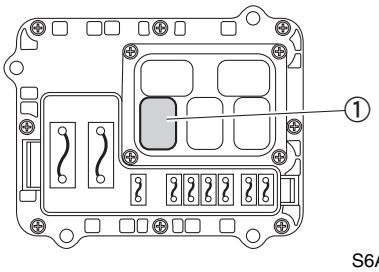
Forward	0.991 V	45 mm (1.77 in)
Neutral	2.437 V	70 mm (2.76 in)
Reverse	3.994 V	96 mm (3.78 in)

4. Turn the engine start switch to "OFF."

5. Disconnect the test harness (6 pins), and then connect the SPS coupler.

Checking the shift-actuator relay

1. Remove the shift-actuator relay ①.



S6AW04130

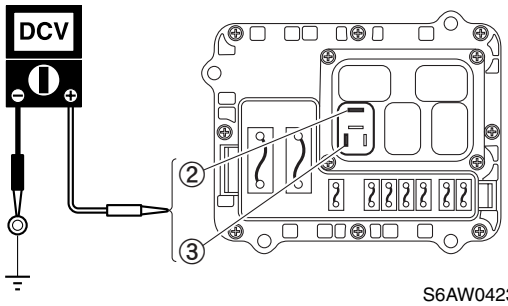
2. The shift-actuator relay and main relay are the same type of relay. To check the relay, see "Checking the main relay" (5-22).

CAUTION:

Do not reverse the battery leads.

3. Turn the engine start switch to "ON."

4. Measure the input voltage between the terminal ② and ground, and the terminal ③ and ground as shown.



S6AW04231-a

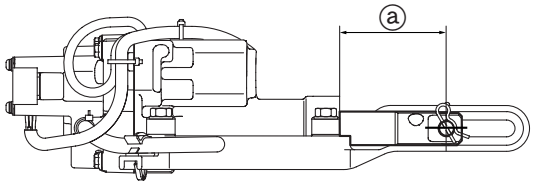
Terminal ②–Ground: Terminal ③–Ground:	12 V (battery voltage)

5. Turn the engine start switch to "OFF."

6. Install the shift-actuator relay.

Checking the shift actuator

1. Operate the Digital Electronic Control to check the shift-actuator rod stroke ⓐ at each shifting position forward, neutral, and reverse.



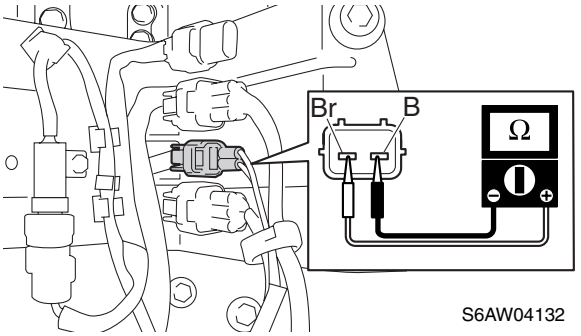
S6AW04209-1

Shift-actuator rod stroke ⓐ (reference data):

Forward	45 mm (1.77 in)
Neutral	70 mm (2.76 in)
Reverse	96 mm (3.78 in)

2. Disconnect the shift-actuator coupler.

3. Measure the resistance of the shift actuator.



S6AW04132

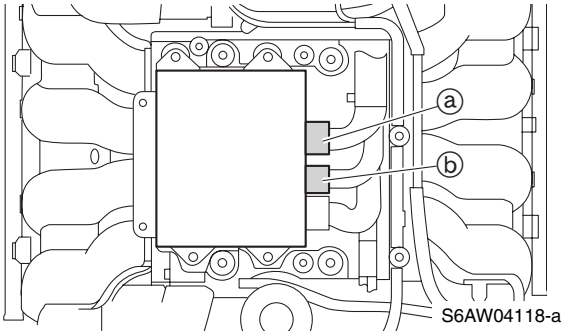
Shift actuator resistance (reference data): Brown(Br)–Black(B)	1.7 Ω at 20 °C (68 °F)

4. Install the shift-actuator coupler.

Checking the SPS and the shift-actuator circuit

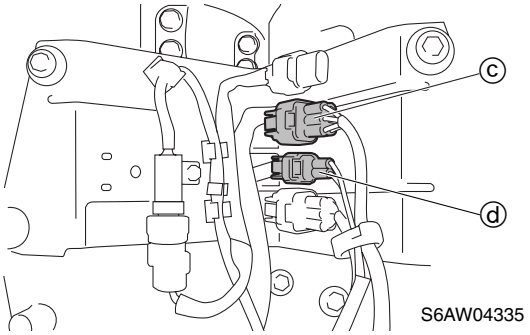
1. Remove the fuel filter.

2. Disconnect the engine ECM coupler ⓐ and ⓑ.



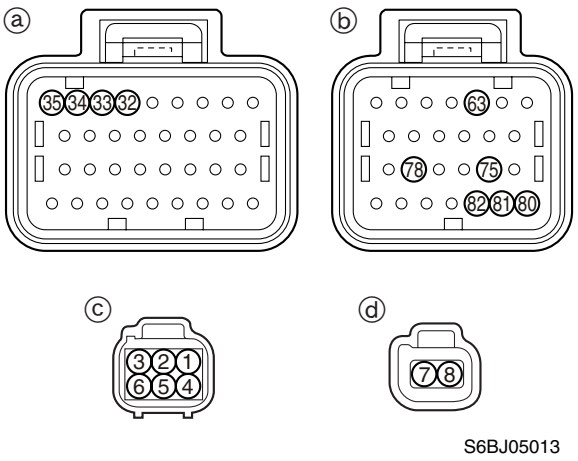
S6AW04118-a

3. Disconnect the SPS coupler ⓒ and the shift-actuator coupler ⓓ.



S6AW04335

4. Check the wiring harness for continuity.

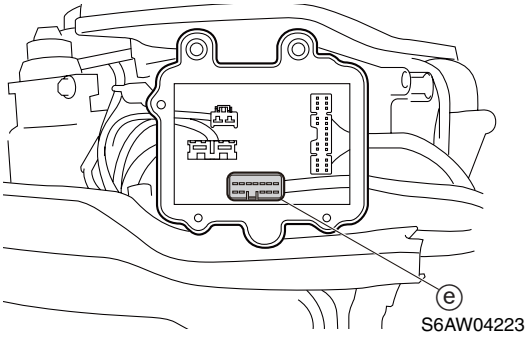


S6BJ05013

Wiring harness continuity:	
Terminal No.	
Coupler ⓒ, ⓓ	Coupler ⓐ, ⓑ
1	78
2	63
3	82
4	75
5	80
6	81
7	32, 33
8	34, 35

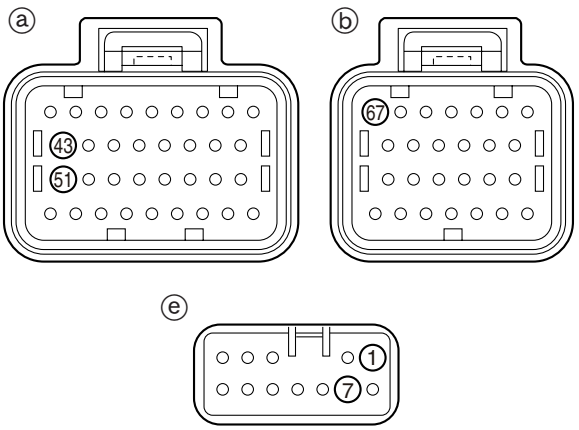
5. Connect the SPS coupler and the shift-actuator coupler.

6. Disconnect the fuse holder coupler ⓔ.



S6AW04223

7. Check the wiring harness for continuity.



S6BJ05014

Wiring harness continuity:	
Terminal No.	
Coupler ⓐ, ⓑ	Coupler ⓔ
43, 51	1
67	7

8. Connect all the engine ECM couplers and the fuse holder coupler.

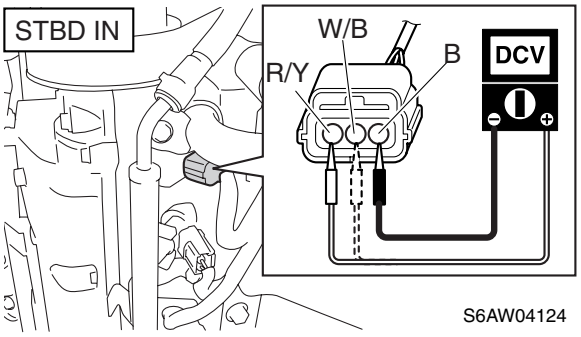
9. Install the fuel filter.

5

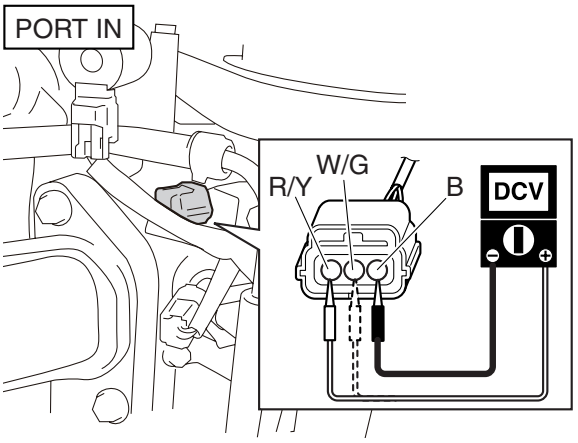
Checking the cam position sensor

1. Disconnect the cam position sensor couplers.

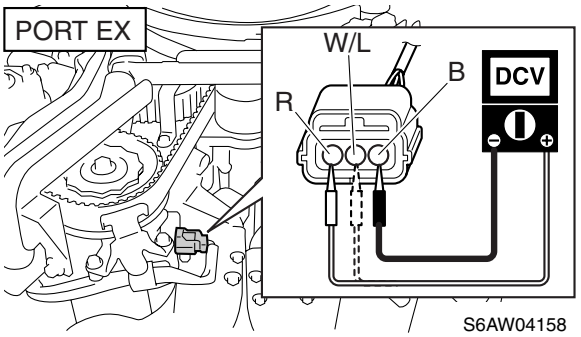
2. Turn the engine start switch to “ON,” and then measure the input voltage at the cam position sensor coupler (wiring harness end). Check the wiring harness if below specification. To check the wiring harness, see “Checking the continuity between the engine ECM and each item” (5-25).



S6AW04124



S6AW04125



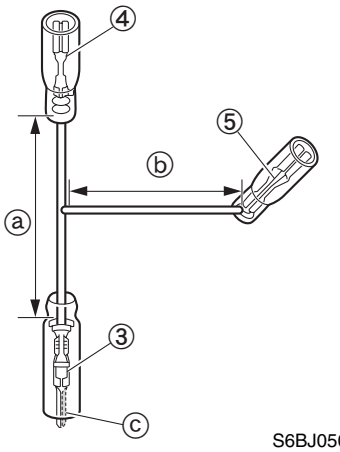
S6AW04158

Cam position sensor input voltage:
Red/Yellow (R/Y)–Black (B)
(STBD IN)(PORT IN)
Red (R)–Black (B)
(PORT EX)
12 V (battery voltage)
White/Black (W/B)–Black (B)
(STBD IN)
White/Green (W/G)–Black (B)
(PORT IN)
White/Blue (W/L)–Black (B)
(PORT EX)
4.75–5.25 V (reference data)

3. Turn the engine start switch to “OFF.”

4. Remove the cam position sensors ①.

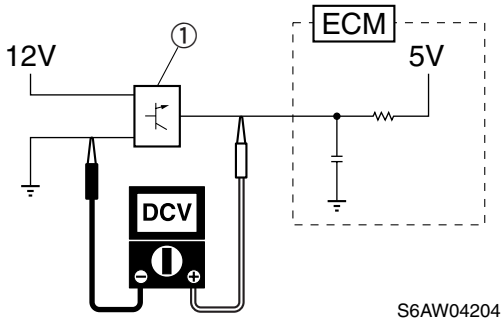
5. Make test lead as shown, and connect the cam position sensor ① and the cam position sensor coupler ② (wiring harness end) with them.



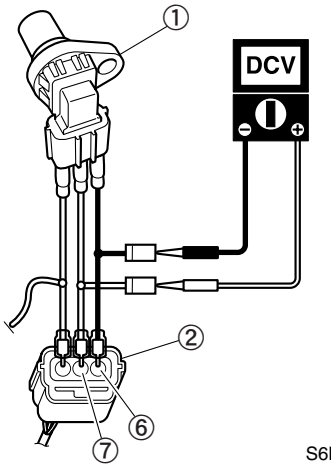
S6BJ05028

Test lead:
Terminal, male ③: 9E212-10303
Terminal, female ④: 9E212-11303
Terminal, female ⑤: (commercially available)
ⓐ = 100 mm (3.94 in)
ⓑ = 50 mm (1.97 in)
ⓒ = Cutout area

6. Connect the tester probes to the test lead.



S6AW04204

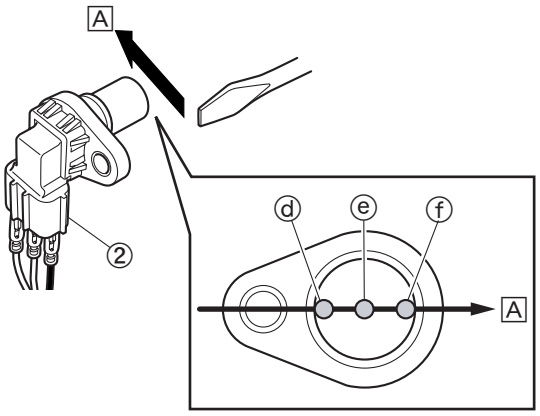


S6BJ05002

NOTE:
Be sure to connect the test lead to the corresponding terminals.

Terminal No.	⑥	⑦
STBD IN	W/B	R/Y
PORT IN	W/G	R/Y
PORT EX	W/L	R

7. Turn the engine start switch to "ON," and then measure the output voltage when moving the screwdriver close to the sensor. Replace the cam position sensor if out of specification.



S6AW04207

NOTE:
Be sure to move the screwdriver in front of the cam position sensor in direction A as shown, otherwise the correct output voltage measurement cannot be obtained.

Cam position sensor output voltage:
White/Green (W/G)–Black (B)
(PORT IN)
White/Black (W/B)–Black (B)
(STBD IN)
White/Blue (W/L)–Black (B)
(PORT EX)
(reference data)

Position	Voltage (V)
ⓓ, ⓕ	More than 4.8 V
ⓔ	Less than 1.0 V

8. Turn the engine start switch to "OFF."
9. Disconnect the wire leads.
10. Install the cam position sensors.

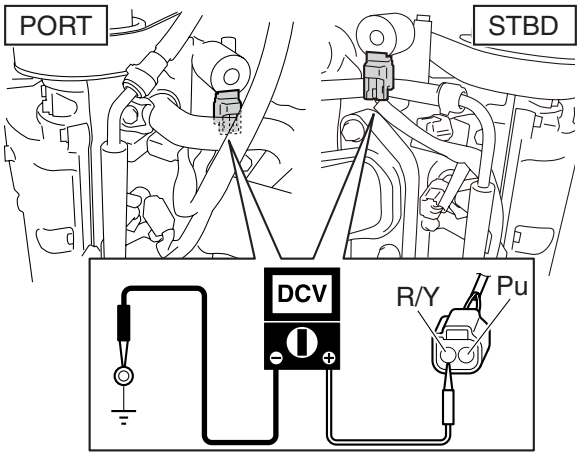
5

Checking the OCV

1. Check the operation of the OCV using the “Stationary test” of the YDIS and listen for the operating sound.

2. Disconnect the OCV couplers.

3. Turn the engine start switch to “ON,” and then measure the input voltage between the OCV coupler and ground. Check the wiring harness if below specification. To check the wiring harness, see “Checking the OCV circuit” (5-35).

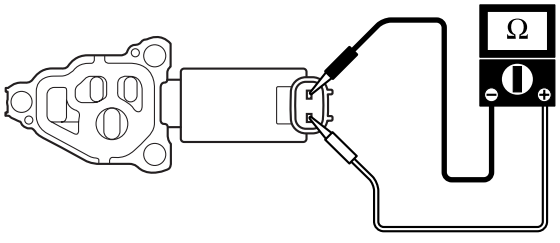


S6AW04126

OCV input voltage:
Red/Yellow (R/Y)–Ground
12 V (battery voltage)

4. Turn the engine start switch to “OFF.”

5. Measure the OCV resistance. Replace the OCV if out of specification.



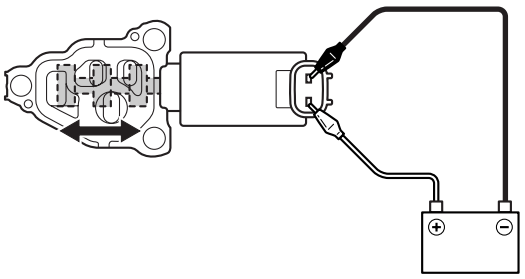
S6AW04202

OCV resistance:
6.7–7.7 Ω at 20 °C (68 °F)

6. Remove the wiring harness guide. To remove the wiring harness guide, see “Removing the wiring harness, the wiring harness guide and the flywheel magnet” (7-27).

7. Remove the OCV.

8. Connect the battery leads to the OCV terminals and check the operation of the spool valve. Replace the OCV if it does not operate.


S6AW04203

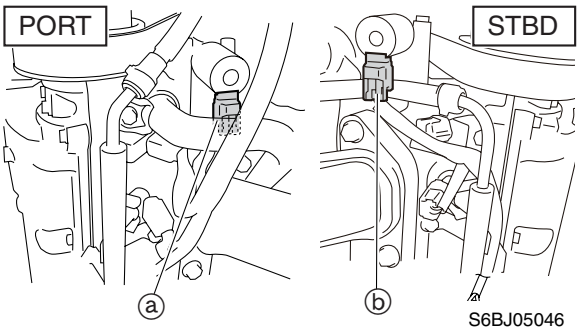
9. Disconnect the battery leads from the OCV terminals.

10. Install the OCV, and connect the OCV coupler.

11. Install the wiring harness guide.

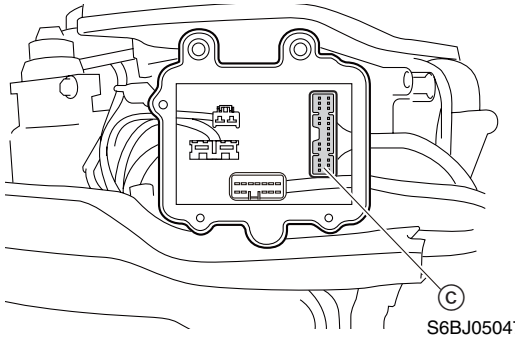
Checking the OCV circuit

1. Disconnect the OCV couplers ⓐ and ⓑ.



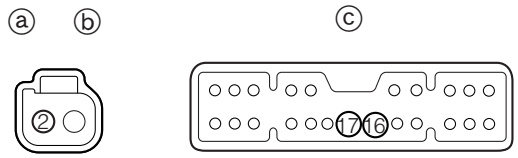
S6BJ05046

2. Disconnect the fuse holder coupler ⓒ.



S6BJ05047

3. Check the wiring harness continuity. Replace the wiring harness if there is no continuity.



S6BJ05048

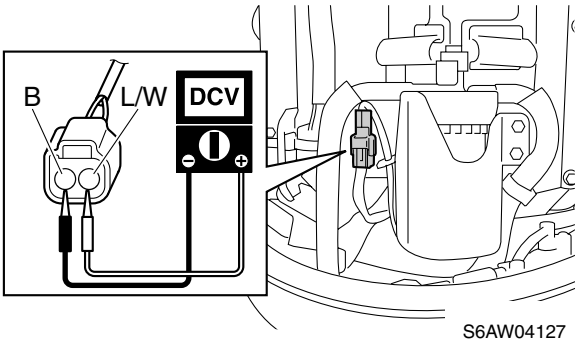
Wiring harness continuity:	
Terminal No.	
Coupler ⓐ, ⓑ	Coupler ⓒ
PORT: 2	16
STBD: 2	17

4. Check for continuity between the engine ECM and OCV. See “Checking the continuity between the engine ECM and each item” (5-25).

Checking the water detection switch

1. Disconnect the water detection switch coupler.

2. Turn the engine start switch to “ON,” and then measure the input voltage at the water detection switch coupler (wiring harness end). Check the wiring harness if out of specification. To check the wiring harness, see “Checking the continuity between the engine ECM and each item” (5-25).



S6AW04127

Water detection switch input voltage (reference data):
Blue/White (L/W)–Black (B)
4.75–5.25 V

3. Turn the engine start switch to “OFF.”

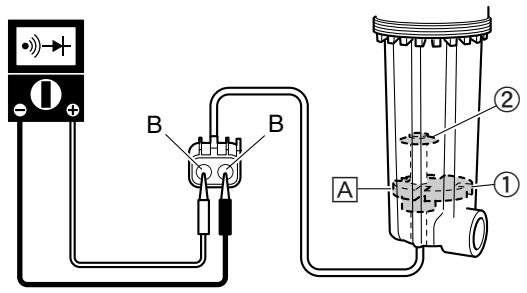
4. Remove the fuel filter cover.

5. Remove the filter cup assembly.

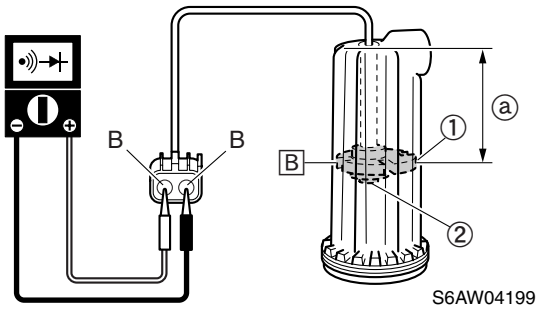
6. Before checking the water detection switch, make sure that the float ① is able to move to positions Ⓐ and Ⓑ as shown.

5

7. Check the water detection switch for continuity with the float in positions A and B.



S6AW04201



S6AW04199

NOTE:
Be sure not to remove the clip ② and float ①, otherwise the water detection switch may be damaged.

Float height:
Water detection position ⓐ:
45 mm (1.77 in)

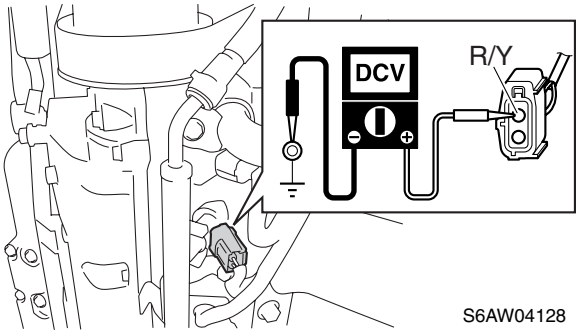
Float position	Color	
	Black (B)	Black (B)
A		
B	○	○

8. Install the filter cup assembly and connect the water detection switch coupler (blue).
9. Install the fuel filter cover.

Checking the fuel injector

NOTE:
Check all 8 cylinders.

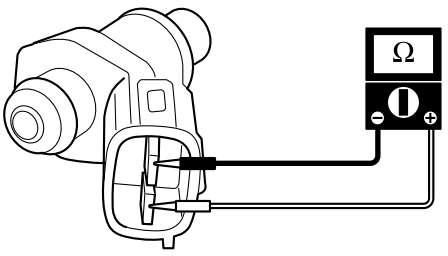
1. Check the operation of the fuel injectors using the "Stationary test" of the YDIS and listen for the operating sound.
2. Disconnect the fuel injector couplers.
3. Turn the engine start switch to "ON," and then measure the input voltage between the fuel injector coupler terminal and ground. Check the wiring harness if below specification. To check the wiring harness, see "Checking the fuel injector circuit" (5-38).



S6AW04128

Fuel injector input voltage:
Red/Yellow (R/Y)–Ground
12 V (battery voltage)

4. Turn the engine start switch to "OFF."
5. Measure the fuel injector resistance.



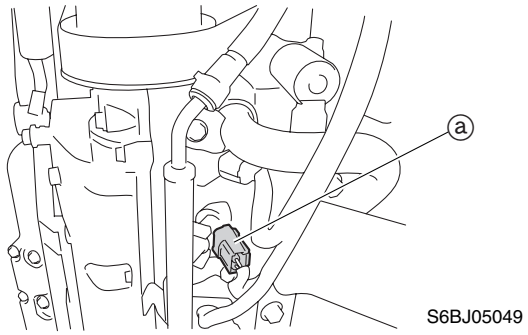
S6AW04198

Fuel injector resistance
(reference data):
11.5–12.5 Ω at 20 °C (68 °F)

6. Connect the fuel injector couplers.

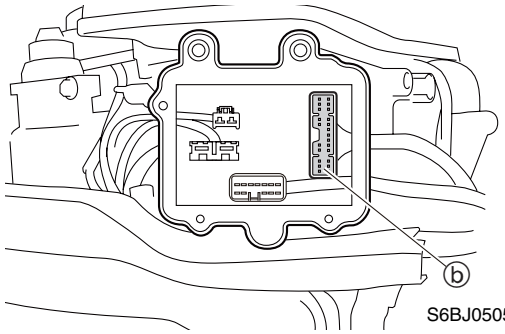
Checking the fuel injector circuit

1. Disconnect the fuel injector couplers ⓐ.



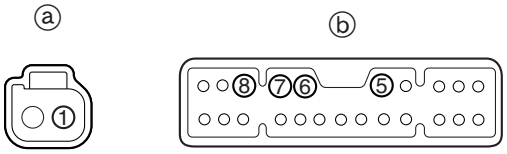
S6BJ05049

2. Disconnect the fuse holder coupler ⓑ.



S6BJ05050

3. Check the wiring harness continuity. Replace the wiring harness if there is no continuity.



S6BJ05051

Wiring harness continuity:

Injector No.	Terminal No.	
	Coupler ⓐ	Coupler ⓑ
#1, #3	1	5
#2, #4	1	6
#5, #7	1	7
#6, #8	1	8

4. Check for continuity between the engine ECM and fuel injector. See “Checking the continuity between the engine ECM and each item” (5-25).

Checking the low-pressure fuel pump and high-pressure fuel pump

1. Check the fuses for continuity. Replace if there is no continuity. For the location of the fuse, see “Fuse holder” (5-3).

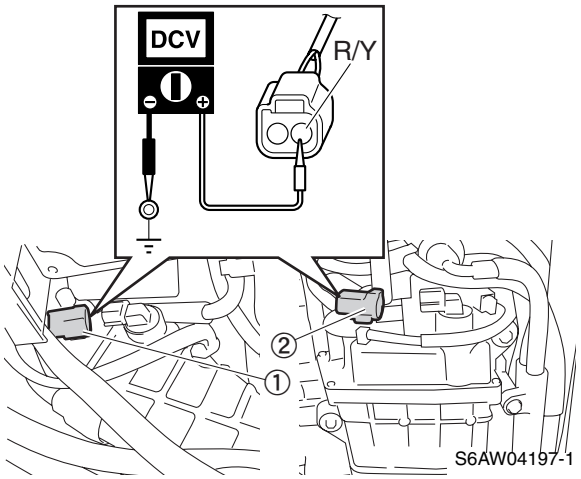
2. Check the operation of the low-pressure fuel pump and high-pressure fuel pump using the “Stationary test” of the YDIS and listen for the operating sound.

3. Remove the intake manifold (PORT).

4. Disconnect the low-pressure fuel pump coupler ① and high-pressure fuel pump coupler ②.

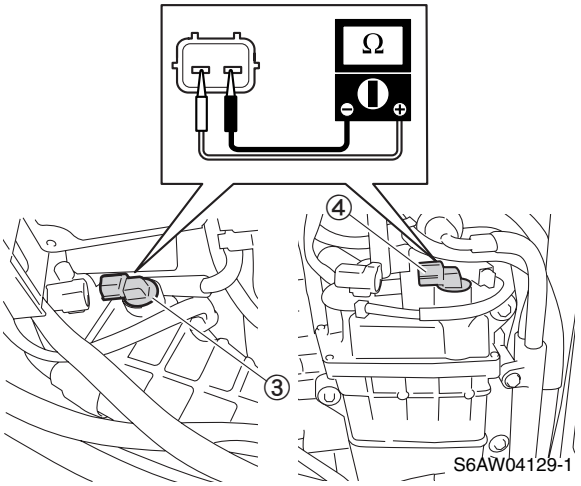
5

5. Turn the engine start switch to “ON,” and then measure the input voltage between the low-pressure fuel pump coupler terminal, high-pressure fuel pump coupler terminal, and ground. Check the wiring harness if below specification. To check the wiring harness, see “Checking the low-pressure fuel pump and high-pressure fuel pump circuit” (5-39).



Low-pressure fuel pump ① input voltage:
Red/Yellow (R/Y)–Ground
12 V (battery voltage)
High-pressure fuel pump ② input voltage:
Red/Yellow (R/Y)–Ground
12 V (battery voltage)

6. Measure the resistance of the fuel pump motors.



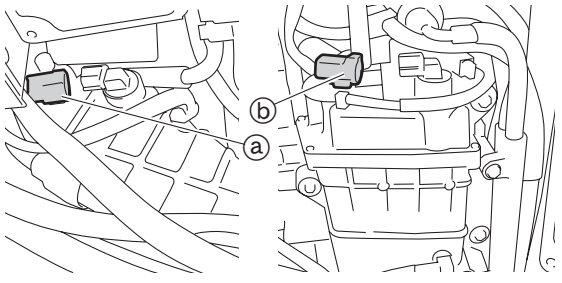
Low-pressure fuel pump ③ resistance (reference data):
0.76 Ω at 20 °C (68 °F)
High-pressure fuel pump ④ resistance (reference data):
0.63 Ω at 20 °C (68 °F)

7. Connect the low-pressure fuel pump coupler ① and high-pressure fuel pump coupler ②.

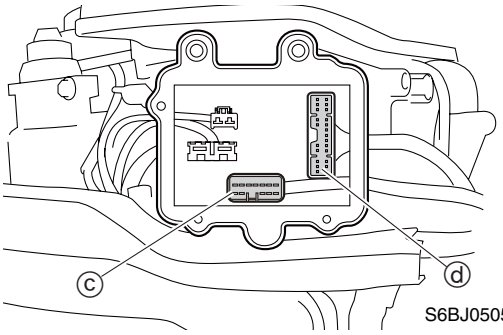
8. Install the intake manifold (PORT). To install the intake manifold (PORT), see “Installing the intake manifold” (6-9).

Checking the low-pressure fuel pump and high-pressure fuel pump circuit

1. Disconnect the low-pressure fuel pump and high-pressure fuel pump couplers ⓐ and ⓑ.



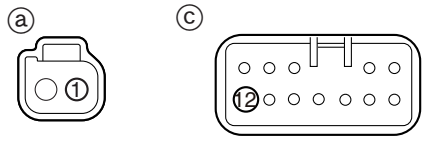
2. Disconnect the fuse holder couplers ⓒ and ⓓ.



S6BJ05053

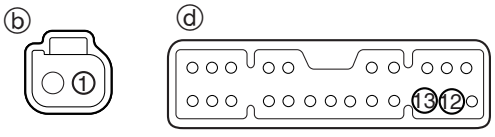
3. Check the wiring harness continuity. Replace the wiring harness if there is no continuity.

A



S6BJ05055

B



S6BJ05054

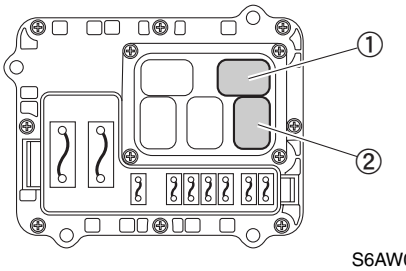
A : low-pressure fuel pump
B : high-pressure fuel pump

	Wiring harness continuity:	
Terminal No.		
	Coupler ⓐ, ⓑ	Coupler ⓒ, ⓓ
A	1	12
B	1	12, 13

4. Check for continuity between the engine ECM and low-pressure fuel pump and high-pressure fuel pump. See “Checking the continuity between the engine ECM and each item” (5-25).

Checking the low-pressure fuel pump relay and high-pressure fuel pump relay

1. Remove the low-pressure fuel pump relay ①, and high-pressure fuel pump relay ②.

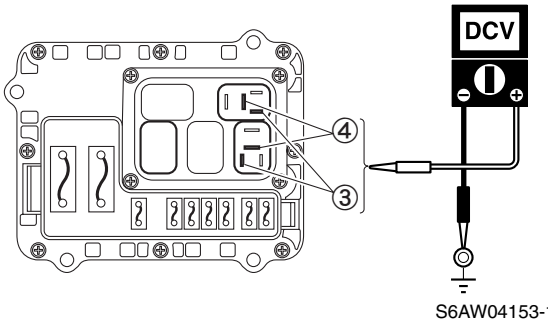


S6AW04151

2. The low-pressure fuel pump relay ① and the high-pressure fuel pump relay ② are of the same type as the main relay. To check the relay, see “Checking the main relay” (5-22).

CAUTION:
Do not reverse the battery leads.

3. Measure the input voltage between the terminals ③ and ground, and the terminals ④ and ground as shown.

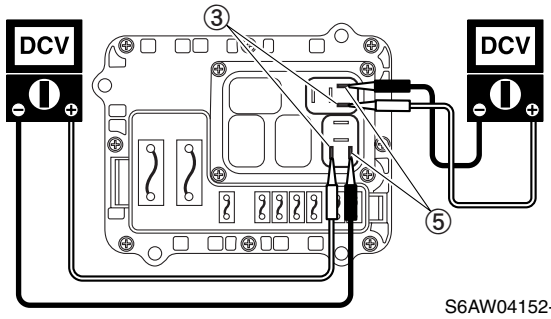


S6AW04153-1

	Terminal ③–Ground: Terminal ④–Ground: 12 V (battery voltage)

5

4. Connect the tester probes to terminals ③ and ⑤ as shown, turn the engine start switch to "ON," and then measure the voltage.



Terminal ③–Terminal ⑤:
12 V (battery voltage)

5. Turn the engine start switch to "OFF."

6. Install the low-pressure fuel pump relay and high-pressure fuel pump relay.

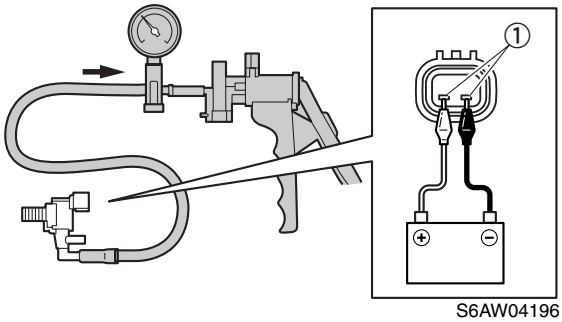
Checking the vapor shut-off valve

1. Remove the intake silencer, and then remove the vapor shut-off valve.

2. Connect the special service tool to the vapor shut-off valve as shown.

3. Apply the specified negative pressure to the vapor shut-off valve.

4. Check that the vapor shut-off valve opens and the negative pressure is released when the battery voltage is applied to the vapor shut-off valve terminals ①.



CAUTION:

Apply the battery voltage to the vapor shut-off valve terminals for a few seconds only, otherwise the vapor-shut off valve may be damaged.

Vacuum/pressure pump gauge set:
90890-06756

Specified negative pressure:
67 kPa (0.7 kgf/cm^2, 9.7 psi)

5. Measure the resistance between the vapor shut-off valve terminals ①.

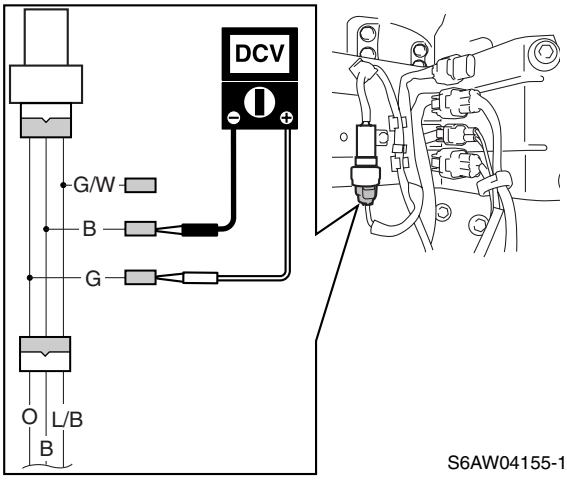
Vapor shut-off valve resistance (reference data):
30.0–34.0 Ω at 20 °C (68 °F)

6. Remove the special service tool. Install the vapor shut-off valve, and then install the intake silencer.

Checking the water pressure sensor

1. Connect the test harness (3 pins) to the water pressure sensor coupler.

2. Turn the engine start switch to "ON," and then measure the input voltage at the water pressure sensor coupler (test harness end). Check the wiring harness if the measurement is lower than the specified range. To check the wiring harness, see "Checking the continuity between the engine ECM and each item" (5-25).



Test harness (3 pins):
90890-06869

Water pressure sensor input voltage (reference data):
Orange (O)–Black (B)
4.75–5.25 V

3. Start the engine, and measure the output voltage.

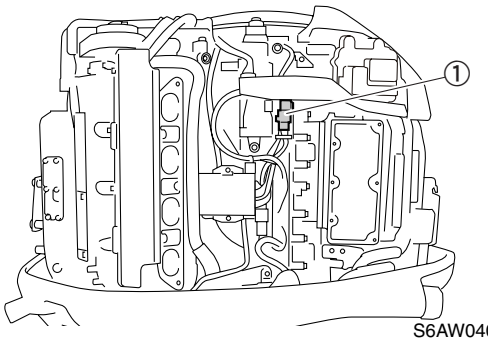
Water pressure sensor output voltage (reference data):
Blue/Black (L/B)–Black (B)
1.05 V (idle speed)

Charging units and components

Checking the stator assembly

There are 2 couplers on the stator assembly.

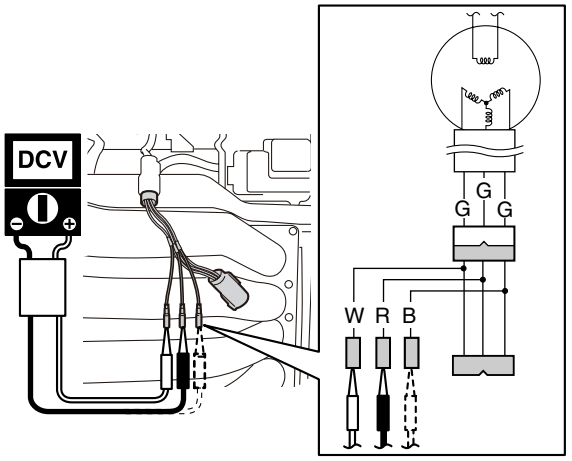
1. Remove the intake manifold (STBD).
2. Disconnect the stator assembly coupler ①, and then install the intake manifold (STBD). To install the intake manifold (STBD), see “Installing the intake manifold” (6-9).



S6AW04046

NOTE:
When installing the intake manifold (STBD) at this time, be sure to leave the stator assembly coupler on the outside of the manifold.

3. Connect the test harness (3 pins) to the stator assembly coupler.
4. Measure the stator assembly output peak voltage between all combinations of the terminals. Replace the stator assembly if below specification.



S6AW04147-1

Test harness (3 pins):
90890-06870
Peak voltage adapter B:
90890-03172

Stator assembly output peak voltage:
Green (G)–Green (G)

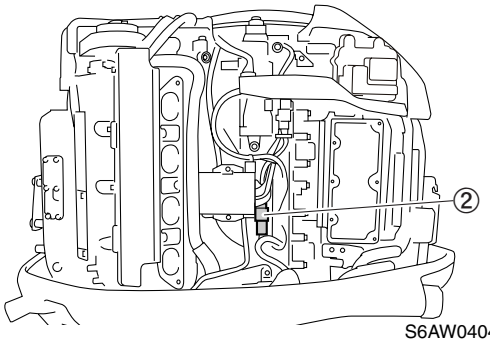
r/min	Unloaded		
	Cranking	1,500	3,500
DC V	6.2	39.1	87.4

5. Measure the stator assembly resistance.

Stator assembly resistance (reference data):
Green (G)–Green (G)
0.1416–0.2124 Ω
at 20 °C (68 °F)

5

6. Connect the test harness (3 pins) to the stator assembly coupler ②, and repeat the step 1–5 above.



S6AW04046-2

7. Remove the intake manifold (STBD).

8. Disconnect the test harness, and then connect the stator assembly coupler.

9. Install the intake manifold (STBD).
See “Installing the intake manifold” (6-9).

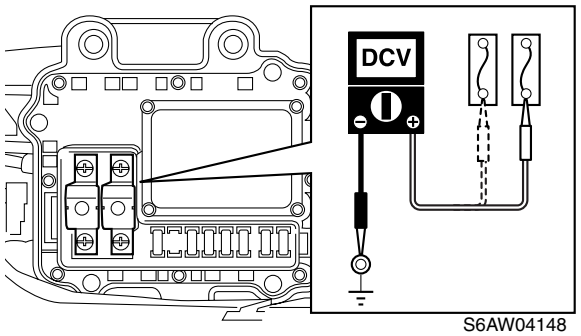
Checking the Rectifier Regulator

CAUTION:

If the battery cables are connected in reverse, the Rectifier Regulator can be damaged.

1. Remove the fuse cover.

2. Measure the Rectifier Regulator output peak voltage.



S6AW04148

NOTE:

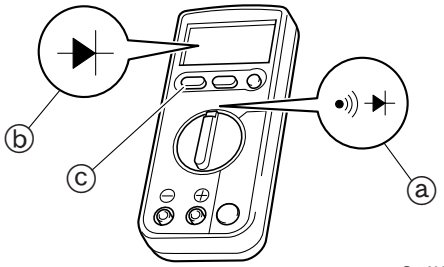
Do not use peak voltage adapter B when measuring the Rectifier Regulator output peak voltage.

Rectifier Regulator output peak voltage: Red (R)–Ground		
r/min	1,500	3,500
DC V	13.0	13.0

3. Remove the intake manifold (STBD).

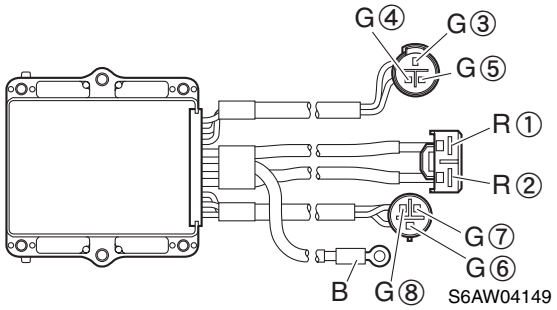
4. Remove the fuse holder, and then remove the Rectifier Regulator couplers.

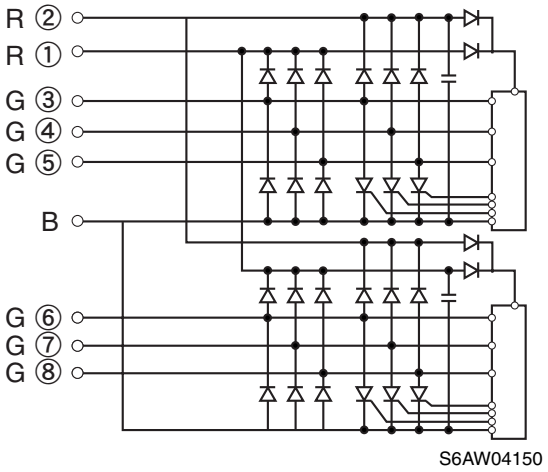
5. Be sure to set the measurement range ⓐ, and display the mark ⓑ by pushing the “SHIFT” switch ⓒ when checking the Rectifier Regulator continuity.



S6AW04195

6. Check the Rectifier Regulator for continuity. Replace if out of specification.





NOTE:
The tester display data represents the value obtained by using Yamaha recommended tester.

Continuity of the Rectifier Regulator (testing diode)

Tester probe		Display Data
+	–	V
G ③	R ①	0.42–0.46 (reference data)
G ③	R ②	
G ④	R ①	
G ④	R ②	
G ⑤	R ①	
G ⑤	R ②	
G ⑥	R ①	
G ⑥	R ②	
G ⑦	R ①	
G ⑦	R ②	
G ⑧	R ①	
G ⑧	R ②	
R ①	G ③	OL (over load)
R ①	G ④	
R ①	G ⑤	
R ①	G ⑥	
R ①	G ⑦	
R ①	G ⑧	
R ②	G ③	
R ②	G ④	
R ②	G ⑤	
R ②	G ⑥	
R ②	G ⑦	
R ②	G ⑧	

7. Connect all the Rectifier Regulator couplers, and install every components that have been removed.

5

Ignition units and components

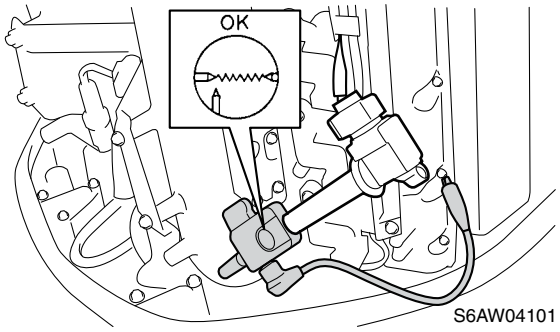
Checking the ignition spark

NOTE:
Check all 8 cylinders.

1. Remove the side covers and rear cover.
2. Remove the ignition coils.
3. Connect an ignition coil assembly to the special service tool.

Ignition tester: 90890-06754

4. Connect the YDIS to perform the ignition spark test.



⚠ WARNING

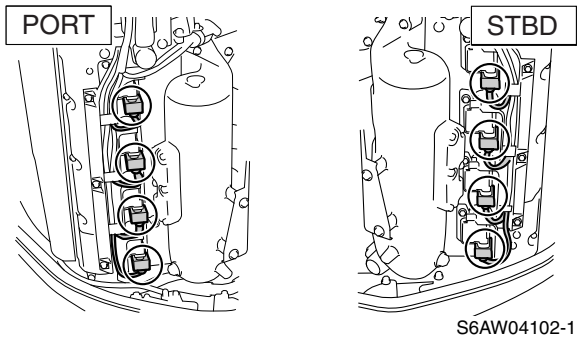
- **Do not touch any of the connections of the special service tool.**
- **Be sure to install the special service tool to the ignition coil so that sparks do not leak out.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

5. Install the ignition coils.
6. Install the side covers and rear cover.

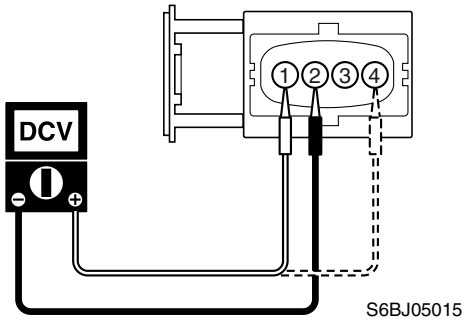
Checking the ignition coil input voltage

NOTE:
Check all 8 cylinders.

1. Remove the side covers and rear cover.
2. Disconnect the ignition coil couplers.



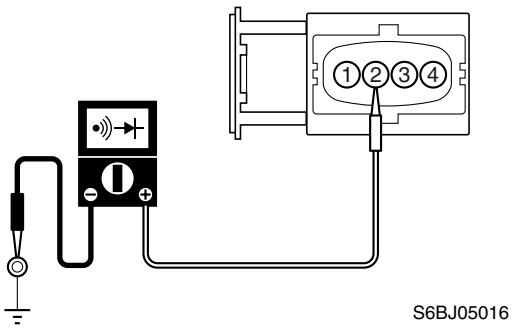
3. Turn the engine start switch to “ON,” and then measure the input voltage. Check the wiring harness if below specification. To check the wiring harness, see “Checking the continuity between the engine ECM and each item” (5-25).



Ignition coil input voltage:
Terminal ①–Terminal ②
12 V (battery voltage)
Terminal ④–Terminal ②
4.2–4.4 V (reference data)

4. Turn the engine start switch to “OFF.”

5. Check for continuity between the ignition coil coupler (wiring harness end) and ground.



S6BJ05016

6. Connect the ignition coil couplers.

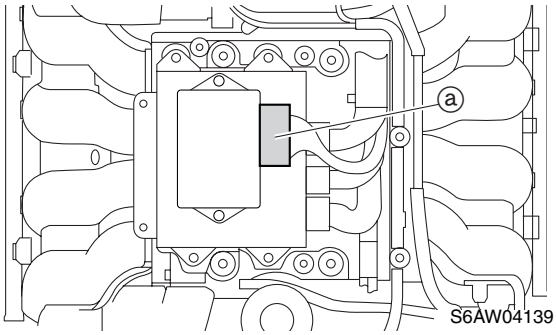
7. Install the side covers and rear cover.

Checking the IDM circuit

NOTE:
Check the spark plug and the ignition coil prior to the IDM circuit check to verify their proper functionality.

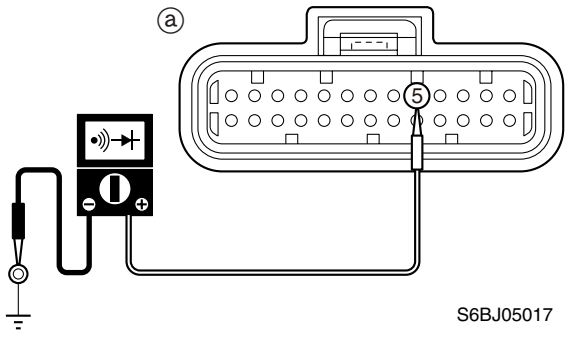
1. Remove the fuel filter.

2. Disconnect the IDM coupler ⓐ.



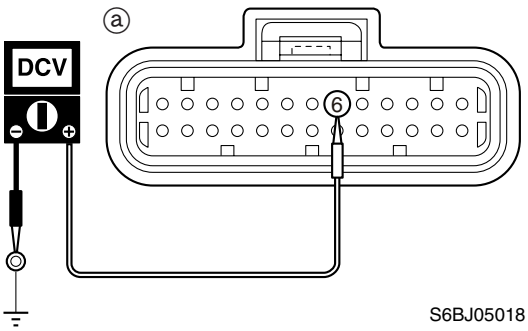
S6AW04139

3. Check for continuity between the IDM coupler terminal ⑤ (wiring harness end) and ground.



S6BJ05017

4. Turn the engine start switch to "ON." Measure the voltage between the IDM coupler terminal ⑥ (wiring harness end) and ground. Check the wiring harness if the measurement is not the specified value.

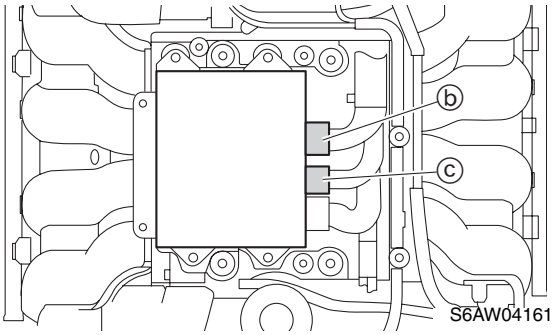


S6BJ05018

Terminal ⑥–Ground:
12 V (battery voltage)

5. Turn the engine start switch to "OFF."

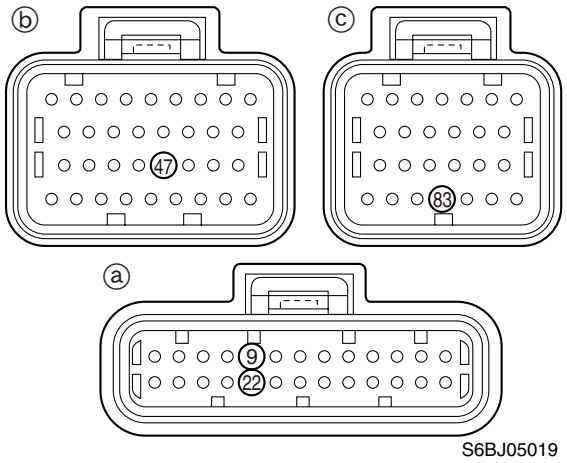
6. Disconnect the engine ECM couplers ⓑ and ⓒ.



S6AW04161

5

7. Check the wiring harness continuity. Replace the wiring harness if there is no continuity.



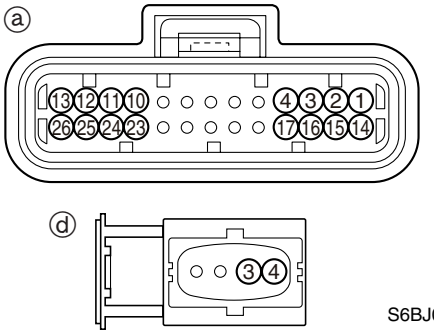
S6BJ05019

Wiring harness continuity:

IDM coupler ⓐ	Engine ECM coupler ⓑ, ⓒ
9	47
22	83

8. Disconnect the ignition coil coupler ⓓ.

9. Check the wiring harness continuity. Replace the wiring harness if the continuity is not as specified in the table.



S6BJ05020

Wiring harness continuity:

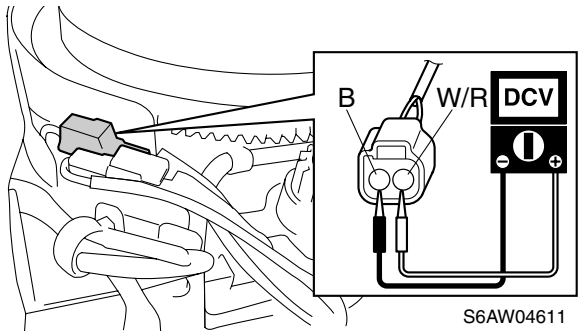
IDM coupler ⓐ	Ignition coil coupler ⓓ
1	#1: 4
2	#4: 4
3	#6: 4
4	#7: 4
10	#1: 3
11	#4: 3
12	#6: 3
13	#7: 3
14	#8: 4
15	#3: 4
16	#5: 4
17	#2: 4
23	#8: 3
24	#3: 3
25	#5: 3
26	#2: 3

10. Connect all the couplers that have been removed.

11. Install the fuel filter.

Checking the pulser coil

1. Remove the flywheel magnet cover.
2. Disconnect the pulser coil coupler.
3. Measure the pulser coil resistance.



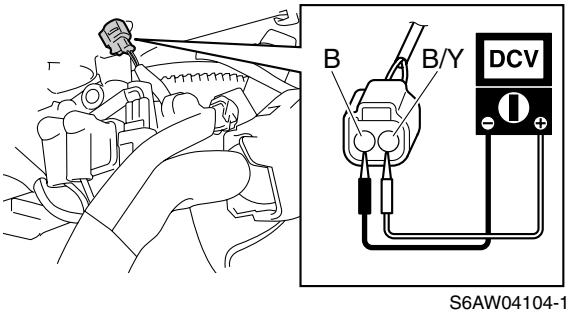
S6AW04611

Pulser coil resistance
(reference data):
White/Red (W/R)–Black (B)
459–561 Ω at 20 °C (68 °F)

4. Connect the pulser coil coupler.
5. Check the flywheel magnet projections, between the flywheel magnet projection and the pulser coil. To check the pulser coil air gap, see "Checking the pulser coil air gap" (7-2).

Checking the air temperature sensor

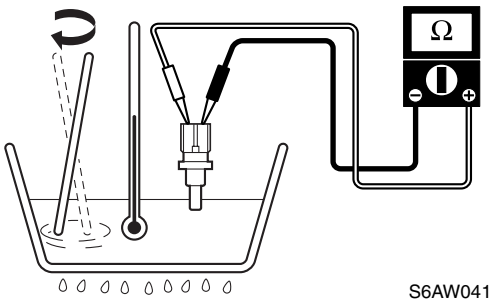
1. Remove the intake silencer 3 bolts, and then keep lift the intake silencer disconnect the air temperature sensor coupler.
2. Disconnect the air temperature sensor coupler and vacuum hose.
3. Remove the intake silencer.
4. Turn the engine start switch to "ON," and then measure the input voltage. Check the wiring harness if out of specification. To check the wiring harness, see "Checking the continuity between the engine ECM and each item" (5-25).



S6AW04104-1

Air temperature sensor input voltage
(reference data):
Black/Yellow (B/Y)–Black (B)
4.75–5.25 V

5. Turn the engine start switch to "OFF."
6. Remove the air temperature sensor.
7. Place the air temperature sensor in a container of water and slowly heat the water.



S6AW04191

8. Measure the air temperature sensor resistance. Replace if out of specification.

Air temperature sensor resistance
(reference data):
2.21–2.69 kΩ at 20 °C (68 °F)
0.32 kΩ at 80 °C (176 °F)

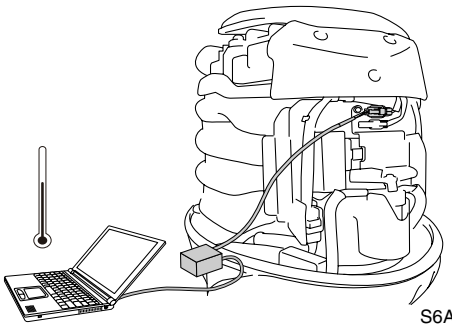
9. Install the air temperature sensor, and then connect the air temperature sensor coupler and vacuum hose.

5

10. Install the intake silencer.

11. Measure the ambient temperature.

12. Connect a computer to the outboard motor and use the YDIS to display "Intake temperature." See "YDIS" (4-1) and the YDIS (Ver. 1.30 or later) Instruction manual.


S6AW04192

13. Check that the difference between the ambient temperature and the displayed air temperature is within ± 5 °C (± 41 °F).

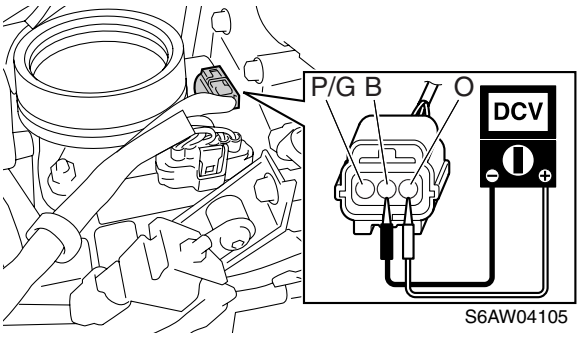
NOTE:
- Check the air temperature sensor when the engine is cold.
- When checking the air temperature sensor, remove the top cowling and do not start the engine.

Checking the air pressure sensor

1. Remove the intake silencer.

2. Disconnect the air pressure sensor coupler.

3. Turn the engine start switch to "ON," and then measure the input voltage at the air pressure sensor coupler (wiring harness end). Check the wiring harness if out of specification. To check the wiring harness, see "Checking the continuity between the engine ECM and each item" (5-25).



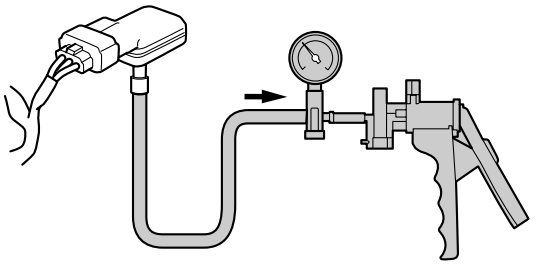
S6AW04105

Air temperature sensor input voltage (reference data):
Orange (O)–Black (B)
4.75–5.25 V

4. Turn the engine start switch to "OFF."

5. Remove the air pressure sensor, and then connect the coupler.

6. Connect the special service tool.


S6AW04190

Vacuum/pressure pump gauge set:
90890-06756

7. Turn the engine start switch to "ON."

8. Check the air pressure using the YDIS. To connect and operate the YDIS, see "YDIS" (4-1) and the YDIS (Ver. 1.30 or later) Instruction manual.

9. Apply negative pressure to the air pressure sensor slowly, and check that the displayed air pressure is varied.

NOTE:
When checking the air pressure sensor, do not start the engine.

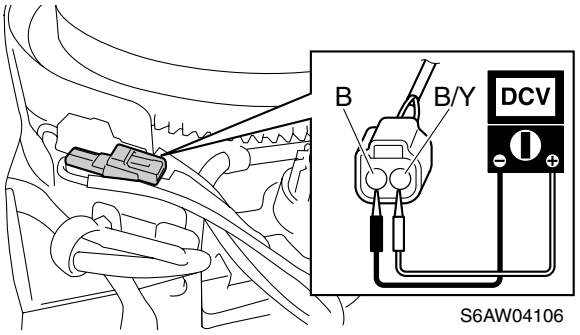
Air temperature sensor output voltage (reference data):

kPa	20	46
V	0.789	1.842

10. Disconnect the special service tool.
11. Install the air pressure sensor, and then connect the coupler.
12. Install the intake silencer.

Checking the engine temperature sensor

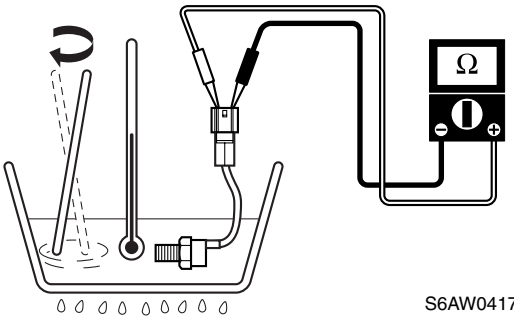
1. Disconnect the engine temperature sensor coupler.
2. Turn the engine start switch to "ON," and then measure the input voltage. Check the wiring harness if out of specification. To check the wiring harness, see "Checking the continuity between the engine ECM and each item" (5-25).



S6AW04106

Engine temperature sensor input voltage (reference data):
Black/Yellow (B/Y)–Black (B)
4.75–5.25 V

3. Turn the engine start switch to "OFF."
4. Remove the wiring harness guide. See "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).
5. Remove the engine temperature sensor.
6. Place the engine temperature sensor in a container of water and slowly heat the water.



S6AW04177

7. Measure the engine temperature sensor resistance. Replace if out of specification.

Engine temperature sensor resistance (reference data):
Black/Yellow (B/Y)–Black (B)
54.2–69.0 kΩ at 20 °C (68 °F)
3.12–3.48 kΩ at 98 °C (208 °F)

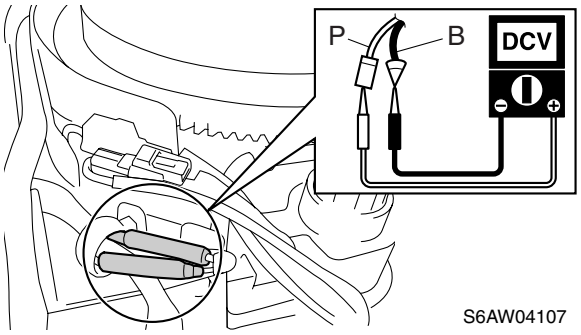
8. Install the engine temperature sensor, and then connect the engine temperature sensor coupler.
9. Install the wiring harness guide. See "Installing the wiring harness, the wiring harness guide and the flywheel magnet" (7-29).

5

Checking the thermoswitch

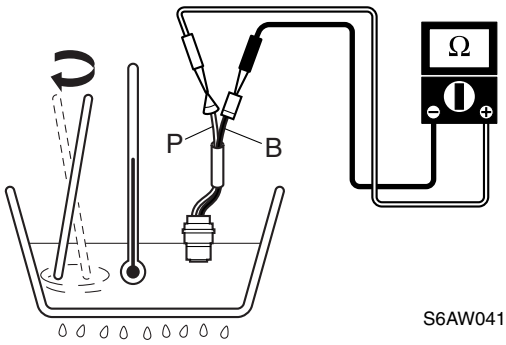
NOTE:
Check both the thermoswitches on the PORT and STBD.

1. Disconnect the thermoswitch connectors.
2. Turn the engine start switch to "ON," and then measure the input voltage at the thermoswitch connectors (wiring harness end). Check the wiring harness if blow specification.

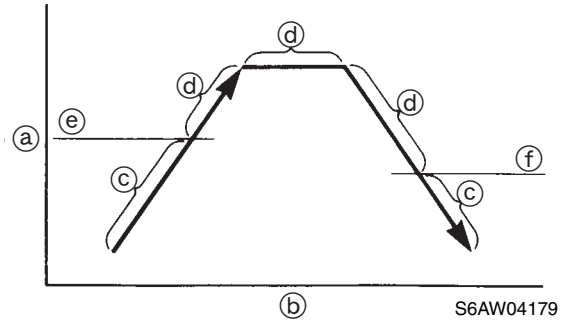


Thermoswitch input voltage:
Pink (P)–Black (B)
4.75–5.25 V

3. Turn the engine start switch to "OFF."
4. Remove the wiring harness guide. See "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).
5. Remove the thermoswitches.
6. Place the thermoswitches in a container of water and slowly heat the water.



7. Check the switch for continuity at the specified temperatures. Replace if out of specification.



ⓐ Temperature
ⓑ Time
ⓒ No continuity
ⓓ Continuity

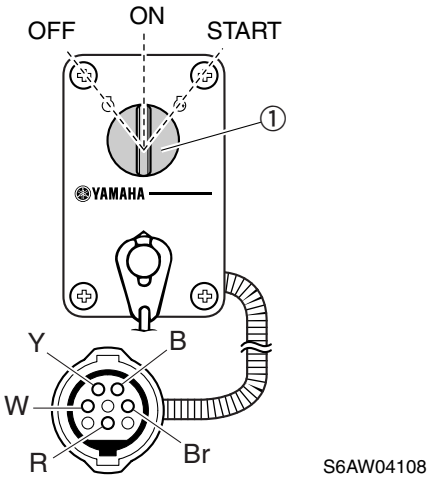
Thermoswitch continuity temperature:
Pink (P)–Black (B)
ⓔ: 90–96 °C (194–205 °F)
ⓕ: 76–90 °C (169–194 °F)

8. Install the thermoswitches, and then connect the thermoswitch connectors.
9. Install the wiring harness guide. See "Installing the wiring harness, the wiring harness guide and the flywheel magnet" (7-29).

Checking the engine start switch

1. Disconnect the 8 pins main harness coupler.

2. Check the engine start switch ① for continuity at the 8 pins main harness coupler (engine start switch end). Replace the engine start switch if there is no continuity.



S6AW04108

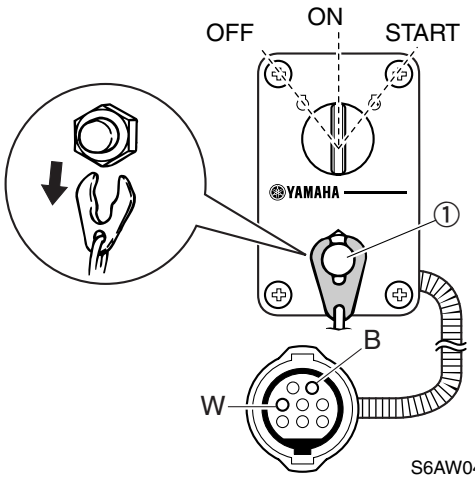
Switch Position	Color code				
	W	B	R	Y	Br
OFF	○	○			
ON			○	○	
START			○	○	○

3. Connect the 8 pins main harness coupler.

Checking the engine shut-off switch

1. Disconnect the 8 pins main harness coupler.

2. Turn the engine start switch to "ON," and then check the engine shut-off switch ① for continuity at the 8 pins main harness coupler (engine shut-off switch end). Replace the engine shut-off switch if out of specification.



S6AW04109

Switch position	Color code	
	W	B
Clip removed	○	○
Clip installed		

3. Turn the engine start switch to "OFF."

4. Connect the 8 pins main harness coupler.

5

Starting units and components

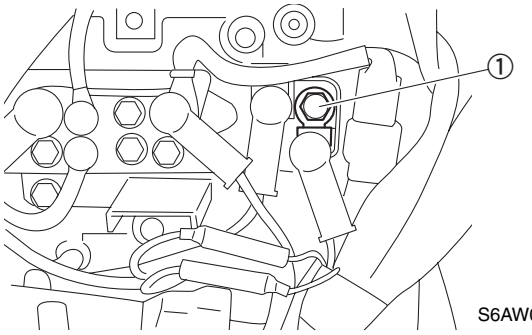
Checking the starter fuse

1. Check the fuses for continuity. Replace if there is no continuity.
   See “Fuse holder” (5-3) for the location of the fuses.

Checking the starter relay

1. Remove the junction box cover.

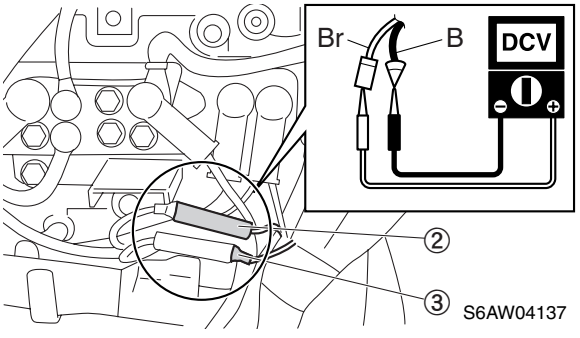
2. Measure the voltage between the starter relay terminal ① and ground.



Terminal ①–Ground:
12 V (battery voltage)

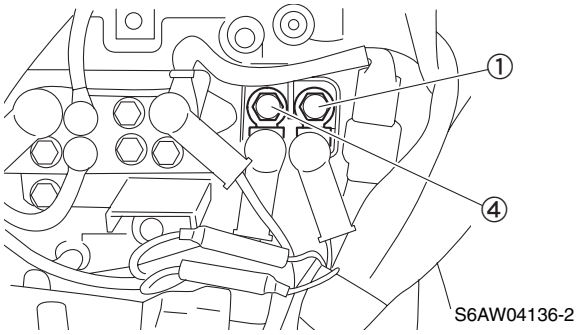
3. Disconnect the starter relay connector ② and ③, and connect the circuit tester at the wire harness end.

4. Measure the voltage after setting the start switch at “START” position.



Terminal ②–Terminal ③:
Brown (Br)–Black (B)
12 V (battery voltage)

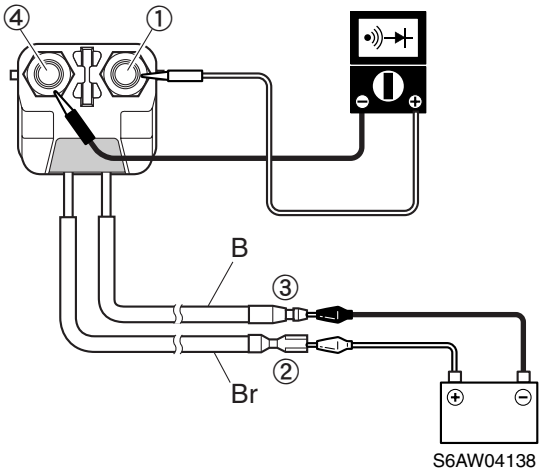
5. Disconnect the starter relay terminals ① and ④, and remove the starter relay.



CAUTION:

Always disconnect the battery negative terminal before disconnecting the starter relay terminals.

6. Connect the positive battery lead to the relay connector ②, and the negative battery lead to the relay connector ③, as shown, and then check for continuity between terminals ① and ④. Replace the relay if there is no continuity.

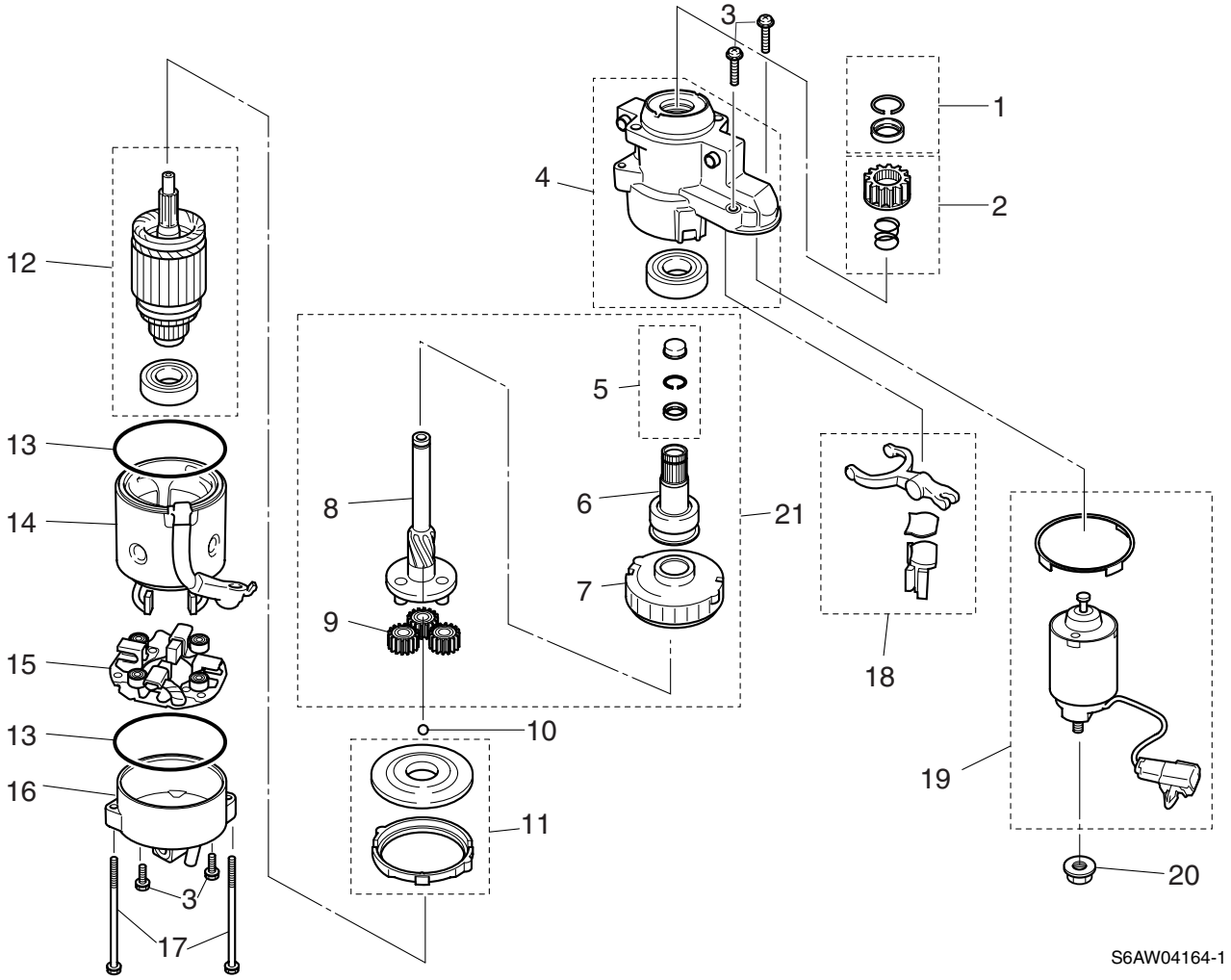


Battery Lead	Relay terminal No.	
	①	④
Connect	○	○
Disconnect		

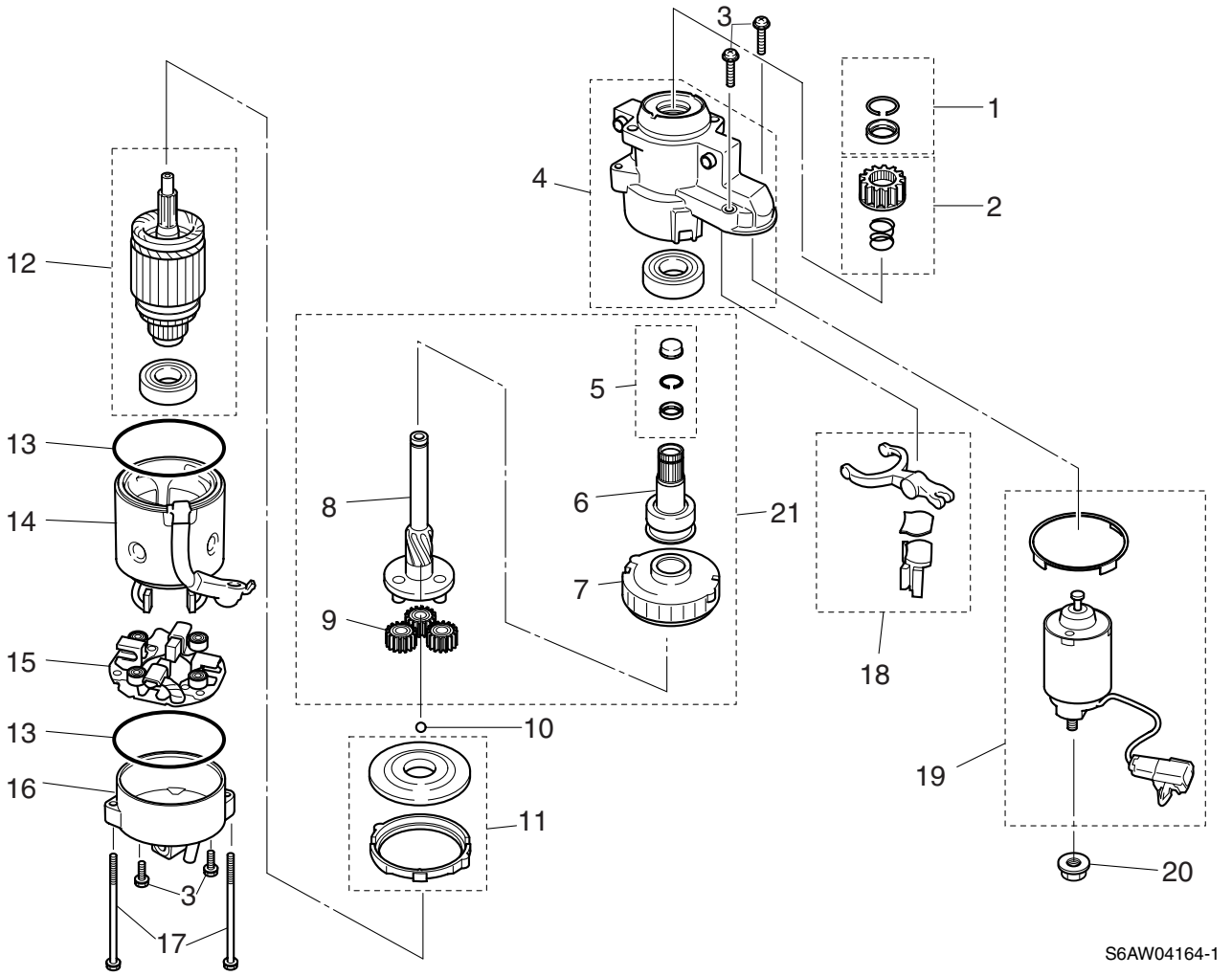
7. Install the starter relay, and connect all the wires that have been disconnected.

8. Connect the battery negative cable to the negative terminal.

Starter motor



No.	Part name	Q'ty	Remarks
1	Pinion stopper set	1	
2	Pinion set	1	
3	Screw set	1	Magnet switch screw ø6 × 25 mm Brush holder screw ø5 × 11 mm
4	Cover assembly	1	
5	Stopper set	1	
6	Clutch assembly	1	
7	Bracket	1	
8	Pinion shaft	1	
9	Planetary gear	3	
10	Ball	1	
11	Center bracket	1	**Not reusable**
12	Armature	1	
13	O-ring	2	**Not reusable**
14	Stator	1	
15	Brush holder	1	
16	Bracket	1	



No.	Part name	Q'ty	Remarks
17	Bolt	2	M6 × 150 mm
18	Lever assembly	1	
19	Magnet switch assembly	1	
20	Nut	1	
21	Starting motor gear assembly	1	

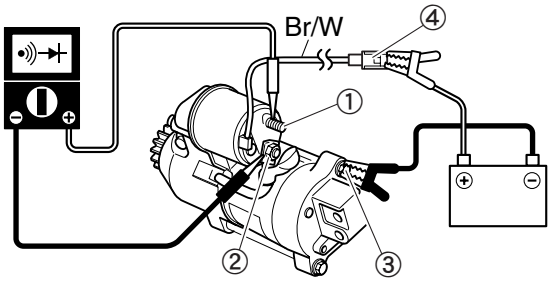
Removing the starter motor

NOTE:
Check the engine start switch, starter relay, and starter relay fuse before removing the starter motor.

1. Remove the intake manifold (STBD) and intake silencer.
2. Remove the starter motor from the power unit. See “Starter motor” (7-34).

Checking the magnet switch

1. Connect the tester probes between the magnet switch terminals ① and ② as shown.
2. Connect the negative battery cable to the starter motor body ③.
3. Connect the positive battery cable to the starter motor lead (Br/W) ④, and then check the magnet switch continuity.



S6AW04154

CAUTION:
Do not connect the starter motor lead (Br/W) to the battery for more than 1 second, otherwise the magnet switch can be damaged.

4. Check that there is continuity between the magnet switch terminals ① and ②. Replace if there is no continuity.

Battery Lead	Magnet switch terminal No.	
	①	②
Connect	○	○
Disconnect		

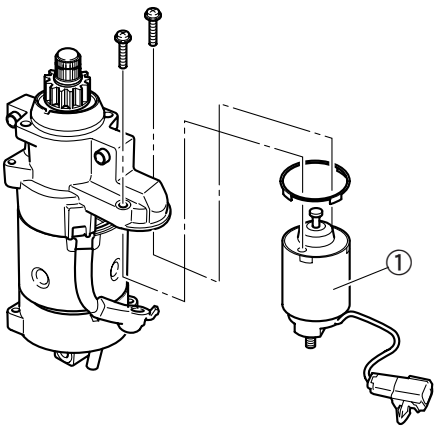
5. Disconnect the negative battery cable and positive battery cable from the battery terminals.

Checking the starter motor pinion

1. Check the pinion teeth. Replace the pinion if cracked or worn.
2. Check for smooth operation. Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

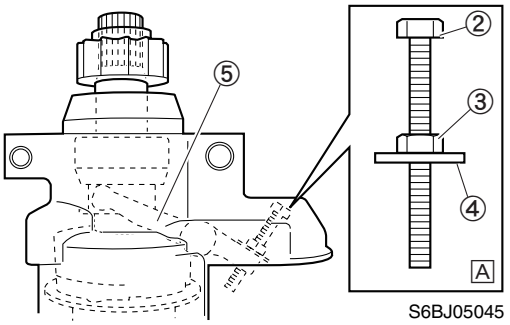
Disassembling the starter motor

1. Remove the magnet switch assembly ①.



S6BJ05039

2. To fix the lever ⑤ in the pulled-out position, use the bolt A.

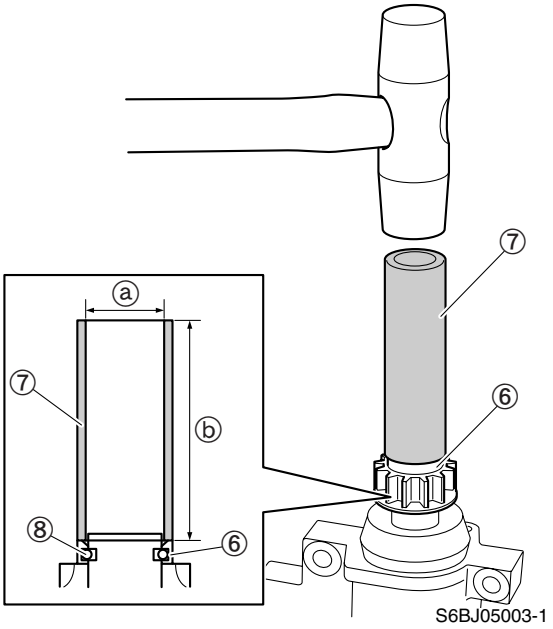


S6BJ05045

Bolt ②: M5 × 35 mm
Nut ③: M5
Washer ④
Inside diameter: 6.5 mm (0.24 in)
Outside diameter: 16.0 mm (0.63 in)

5

3. Place the pipe ⑦ on the pinion stopper ⑥. Tap the pipe ⑦ with a plastic hammer to push down the pinion stopper ⑥, and remove the clip ⑧.

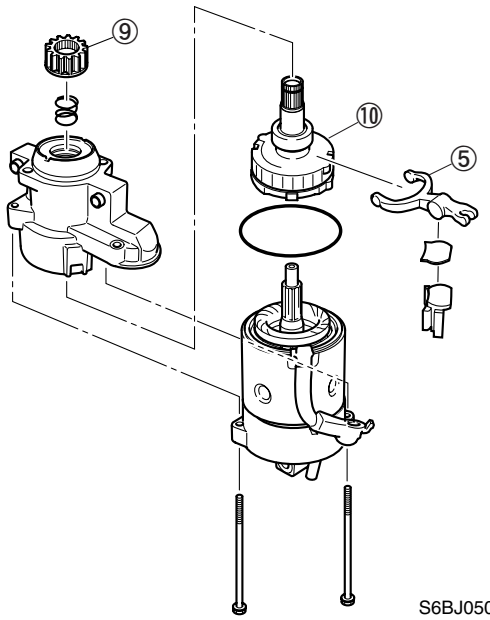


CAUTION:

Take care not to break the lever ⑤.

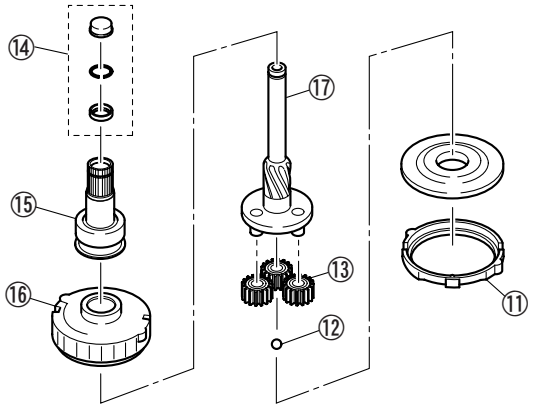
Pipe ⑦ (commercially available):
ⓐ=22 mm (0.87 in)
ⓑ=100 mm (3.94 in)

4. Remove the pinion ⑨, lever ⑤ and starting motor gear assembly ⑩.

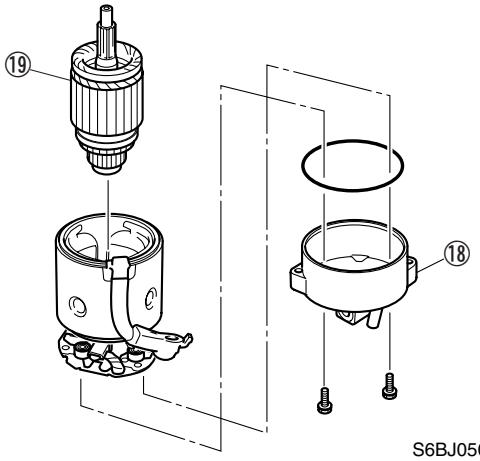


5. Remove the center bracket ⑪, ball ⑫ and planetary gear ⑬.

6. Remove the stopper set ⑭, clutch ⑮ and bracket ⑯ from the pinion shaft ⑰.



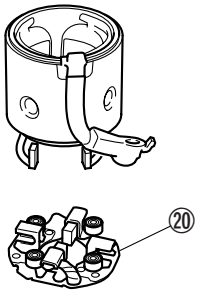
7. Remove the bracket ⑱ and armature ⑲.



CAUTION:

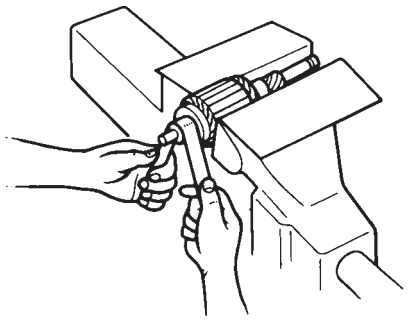
Do not scratch or damage the brushes when removing the armature.

8. Remove the brush holder ⑳.

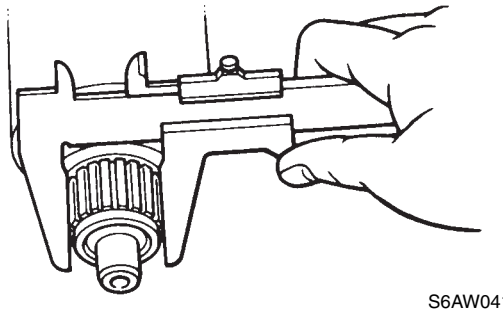


Checking the starter motor

1. Check the commutator. Clean with 600 grit sandpaper and compressed air if dirty.

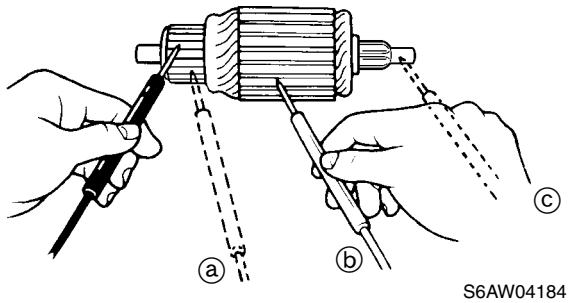

S6AW04182

2. Measure the commutator diameter. Replace the armature if below specification.


S6AW04183

Commutator standard diameter:
32.0 mm (1.26 in)
Wear limit:
31.4 mm (1.24 in)

3. Check the armature for continuity. Replace the armature if out of specifications.



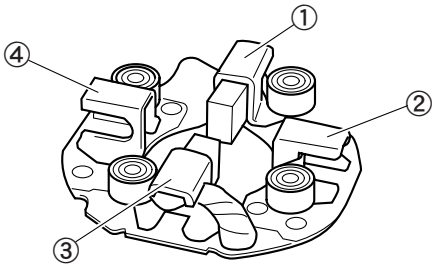
S6AW04184

Armature continuity:

Commutator segments ⓐ	Continuity
Segment–Armature core ⓑ	No continuity
Segment–Armature core ⓒ	No continuity

Checking the brush holder

1. Check the brush holder for continuity. Replace the brush holder if out of specification.



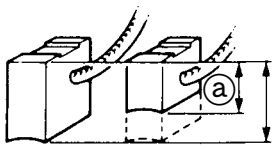
S6AW04157

Brush holder continuity:

①–③ ②–④	Continuity
①–② ①–④ ③–② ③–④	No continuity

5

2. Measure the length of each brush. Replace the brush holder assembly together with the stator assembly if the length falls out of the specified range.



S6AW04850

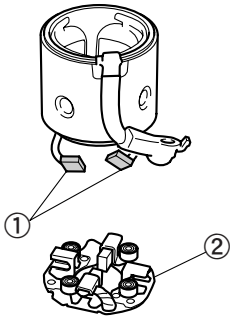
Brush standard length:
18 mm (0.71 in)
Wear limit ⓐ: 11 mm (0.43 in)

Assembling the starter motor

CAUTION:

Do not allow grease or oil to contact the commutator of the armature.

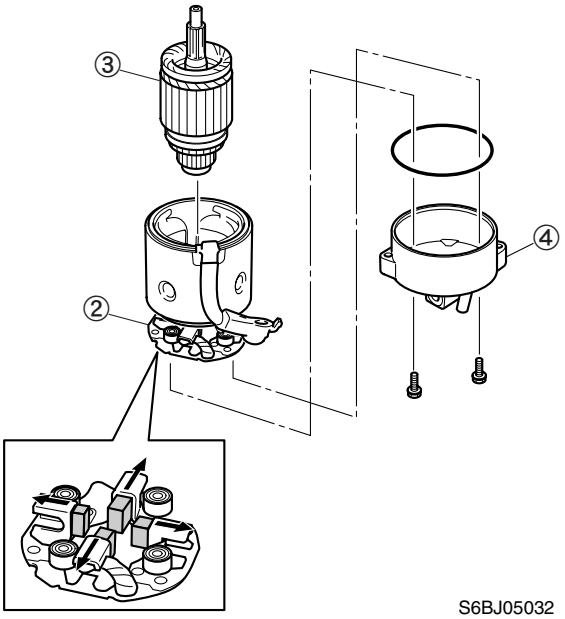
1. Install the brushes ① of the stator to the brush holder ②.



S6BJ05031

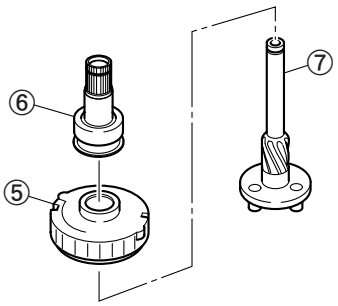
2. Push the brushes into the holders, and then install the armature ③ to the brush holder ②.

3. Install the bracket ④.



S6BJ05032

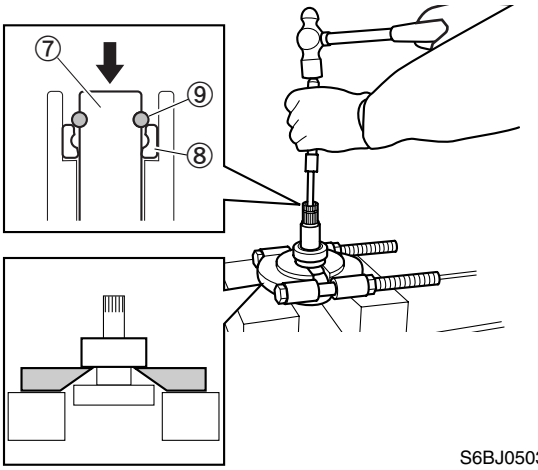
4. Install the bracket ⑤ and clutch assembly ⑥ to the pinion shaft ⑦.



S6BJ05033

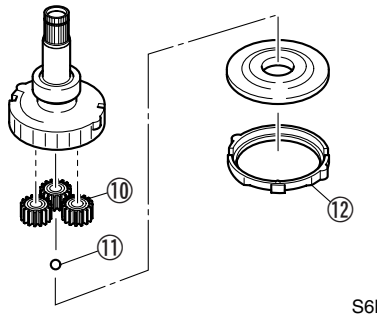
5. Install the stopper ⑧ and clip ⑨ to the pinion shaft ⑦.

6. Set the bearing separator on the bottom face of the clutch. Then, insert the clip ⑨ into the groove on the stopper ⑧ by tapping on the pinion shaft ⑦.



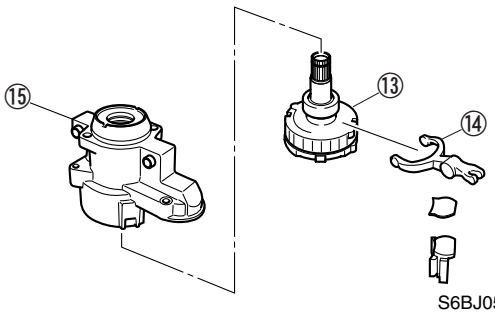
S6BJ05034

7. Install the planetary gear ⑩, ball ⑪, and center bracket ⑫.



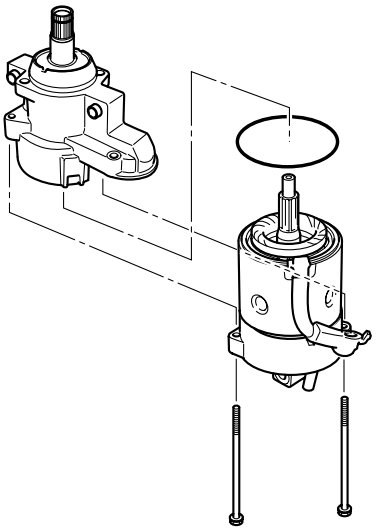
S6BJ05038

8. Install the starting motor gear assembly ⑬ and lever ⑭ in the cover ⑮.



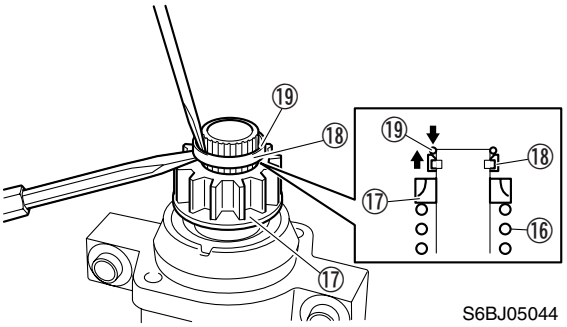
S6BJ05035

9. Assemble the starter motor body.


S6BJ05036

10. Install the spring ⑯, pinion ⑰, pinion stopper ⑱ and clip ⑲.

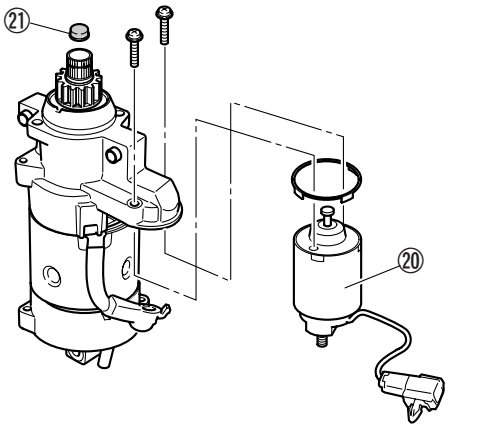
11. Insert a flat-head screwdriver between the pinion ⑰, and the pinion stopper ⑱ to raise the pinion stopper ⑱, and push in the clip ⑲.



S6BJ05044

5

12. Install the magnet switch assembly ⑳ and cap ㉑.



S6BJ05037

Installing the starter motor

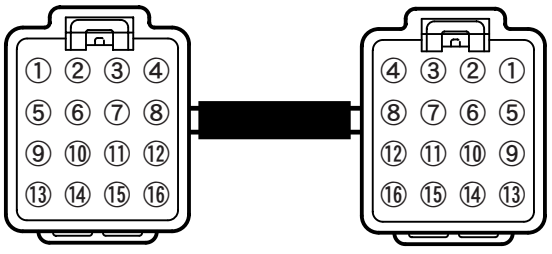
1. Install the starter motor to the power unit.

2. Install the intake manifold (STBD). To install the intake manifold (STBD), see "Installing the intake manifold" (6-9).

Outboard motor and Digital Electronic Control connection

Checking the extension wire harness

1. Check the extension wire harness continuity. Check the wire terminal numbers ① to ⑯. Replace the extension wire harness if there is no continuity.



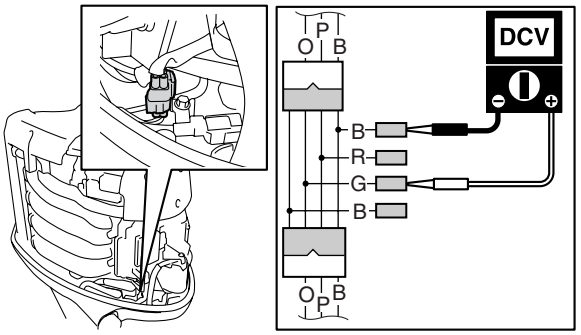
S6AW04495

PTT system

Checking the PTT sensor

1. Disconnect PTT sensor coupler and connect it to the test harness (4 pins).

2. Turn the engine start switch to "ON," and then measure the input voltage. Check the wiring harness if out of specification. To check the wiring harness, see "Checking the continuity between the engine ECM and each item" (5-25).

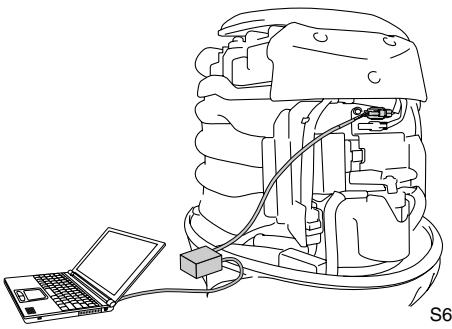


S6AW04890-1

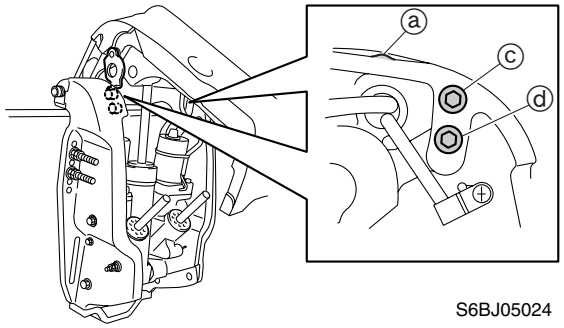
Test harness (4 pins):
90890-06878

PTT sensor input voltage
(reference data):
Orange (O)–Black (B)
4.75–5.25 V

3. Connect a computer to the outboard motor and use the YDIS. To connect and operate the YDIS, see "YDIS" (4-1) and the YDIS (Ver. 1.30 or later) Instruction manual.


S6AW04131

4. Set the outboard motor at full tilt-up position ⓐ and full trim-down position ⓑ, and then measure the output voltage at each position by using YDIS. When the full tilt-up angle is adjusted by the tilt limiter, set the outboard motor at the full tilt-up position ⓒ and ⓓ to measure the output voltage at each position.



S6BJ05024

⚠ WARNING

- **After tilting up the outboard motor, be sure to support it with the tilt support lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.**
- **Do not enter the area below the outboard motor while taking measurement.**

PTT sensor output voltage (reference data):	
Full tilt-up position ⓐ	3.72–4.02 V
ⓒ–ⓐ	3.34–3.74 V
ⓓ–ⓒ	2.96–3.34 V
Full trim-down position ⓑ	0.85–1.15 V

5. Turn the engine start switch to “OFF.”

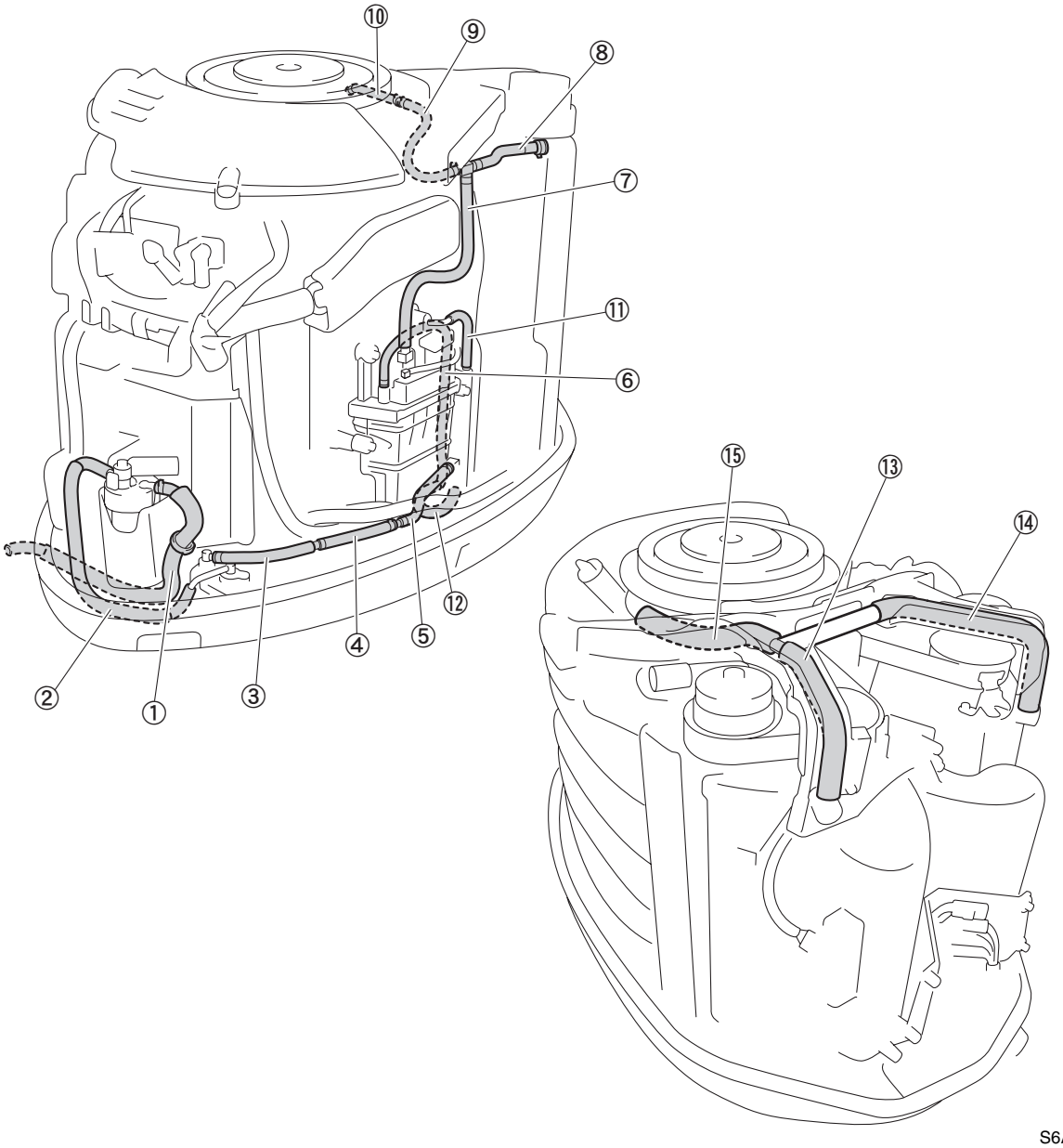
6. Disconnect test harness and connect it to PTT coupler.

5

Fuel system

Hose routing

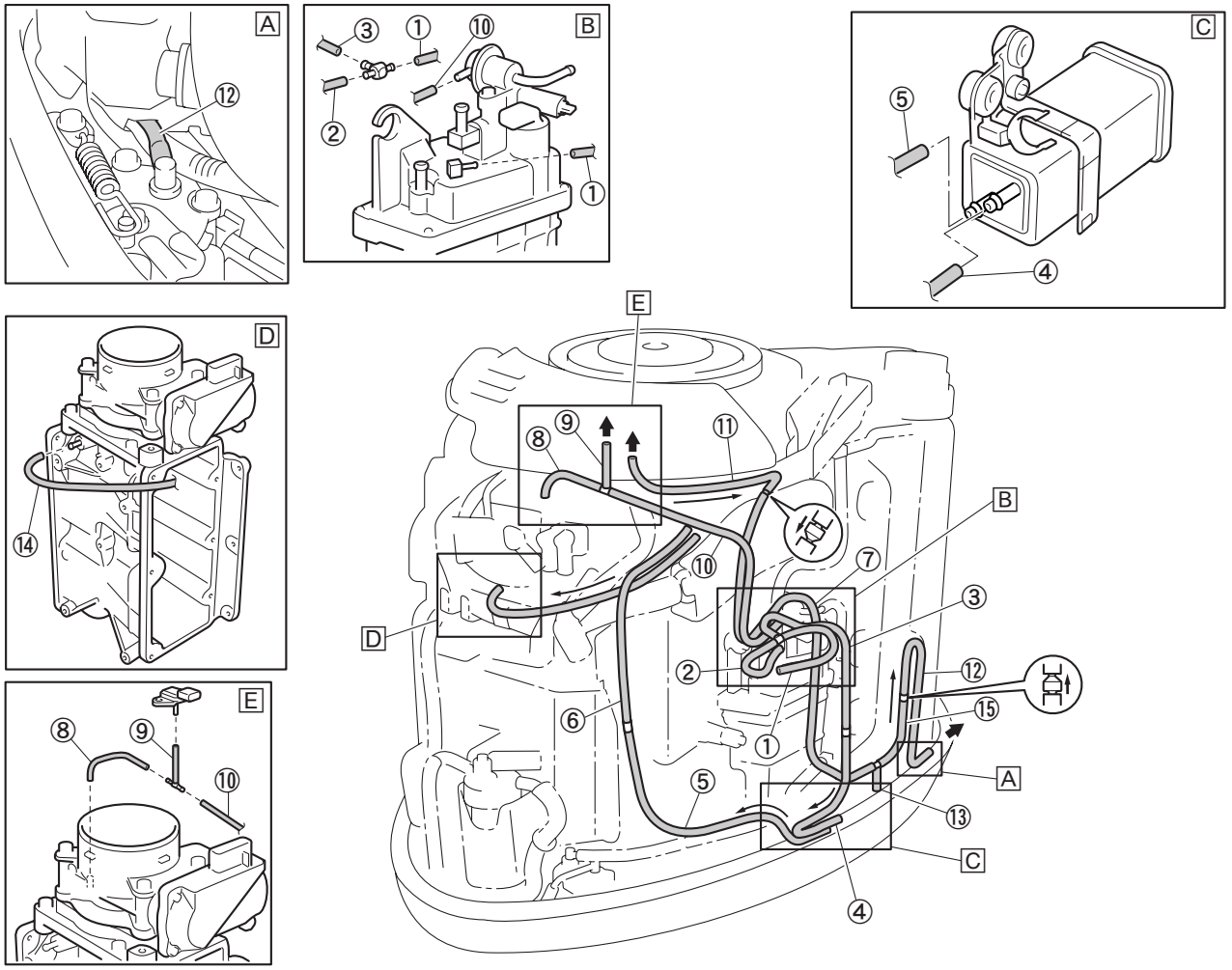
Fuel hose and blowby hose



S6AW05001

① Fuel hose (fuel joint-to-fuel filter)
② Fuel hose (fuel filter-to-low-pressure fuel pump assembly)
③ Fuel hose (low-pressure fuel pump assembly-to-filter)
④ Fuel hose (filter-to-joint)
⑤ Fuel hose (joint-to-joint)
⑥ Fuel hose (joint-to-vapor separator)
⑦ Fuel hose (vapor separator-to-joint)
⑧ Fuel hose (joint-to-quick connector)
⑨ Fuel hose (joint-to-joint)
⑩ Fuel hose (joint-to-quick connector)
⑪ Fuel hose (pressure regulator-to-fuel cooler)
⑫ Fuel hose (fuel cooler-to-vapor separator)
⑬ Blowby hose (port cylinder head cover-to-breather pipe)
⑭ Blowby hose (starboard cylinder head cover-to-breather pipe)
⑮ Blowby hose (breather pipe-to-intake silencer)

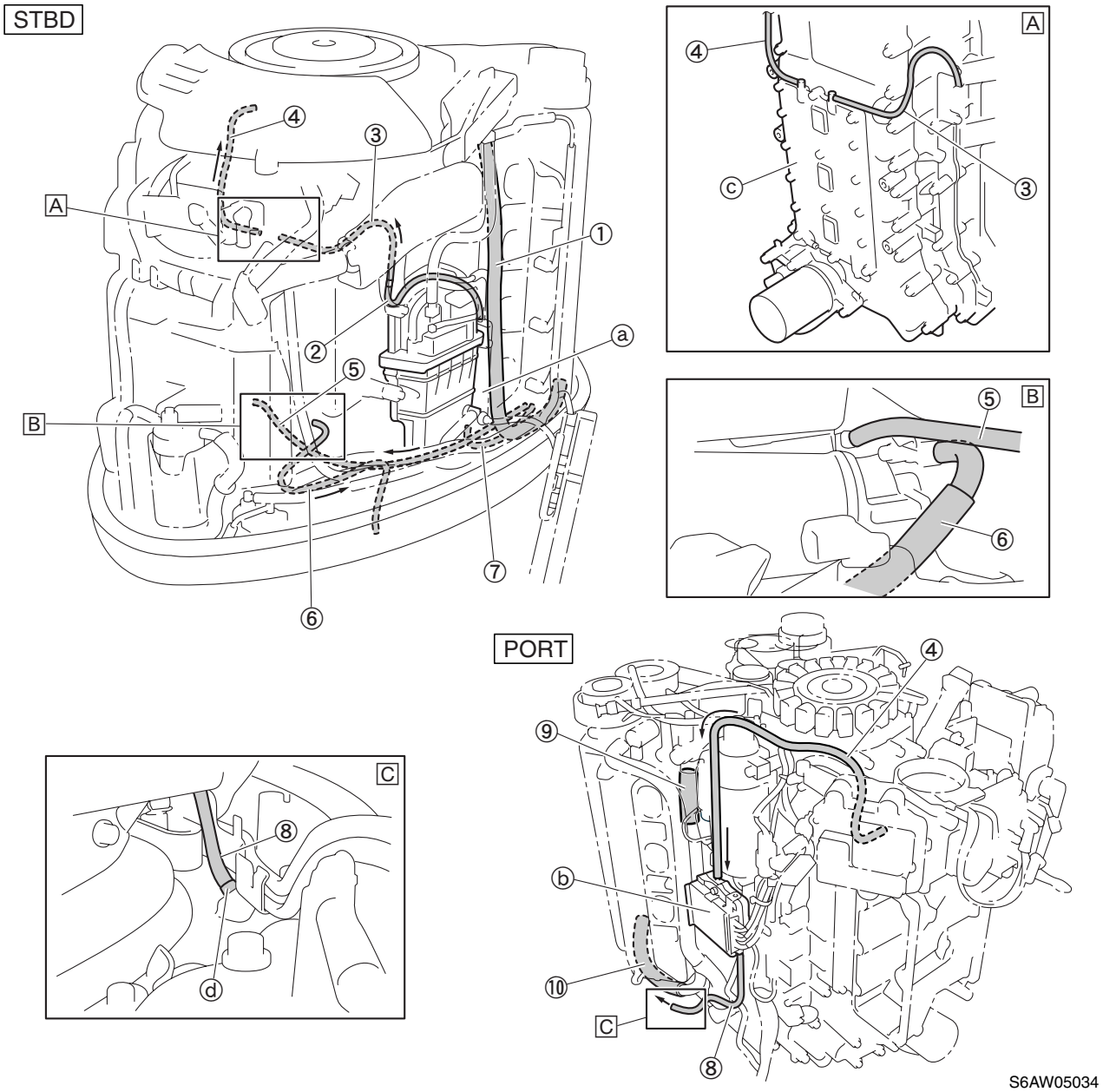
Vapor gas hose



S6AW05002

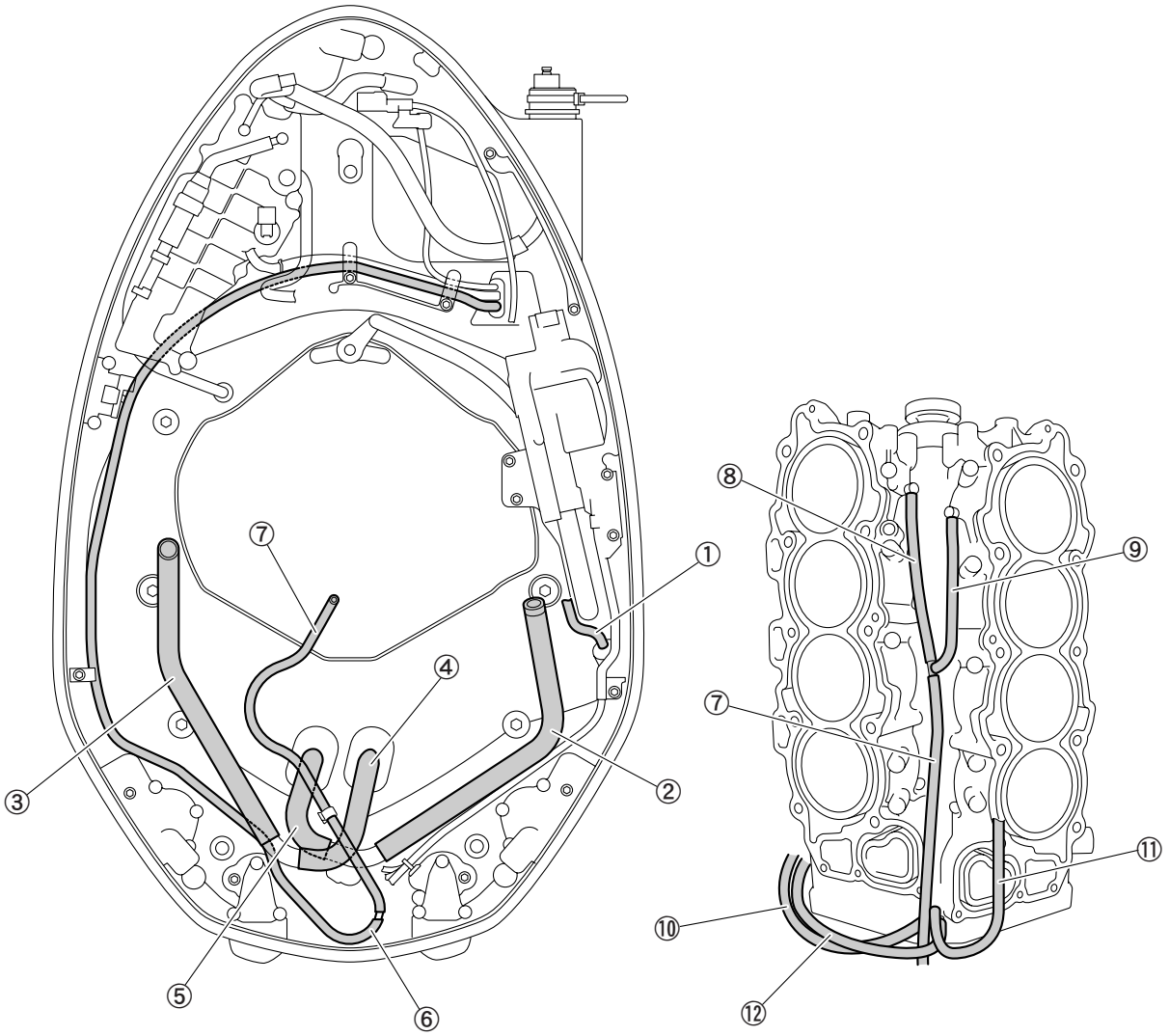
① Vapor gas hose (vapor separator-to-joint)
② Vapor gas hose (vapor separator-to-joint)
③ Vapor gas hose (joint-to-joint)
④ Vapor gas hose (joint-to-canister)
⑤ Vapor gas hose (canister-to-joint)
⑥ Vapor gas hose (joint-to-vapor shut-off valve)
⑦ Vapor gas hose (check valve-to-joint)
⑧ Vapor gas hose (joint-to-surge tank)
⑨ Vapor gas hose (air pressure sensor-to-joint)
⑩ Vapor gas hose (pressure regulator-to-joint)
⑪ Vapor gas hose (intake silencer-to-check valve)
⑫ Vapor gas hose (check valve-to-bottom cowling)
⑬ Vapor gas hose (canister-to-joint)
⑭ Vapor gas hose (vapor shut-off valve-to-surge tank)
⑮ Vapor gas hose (joint-to-check valve)

Cooling water hose



① Cooling water hose (thermostat cover-to-cooling water pipe)
② Cooling water hose (fuel cooler-to-joint)
③ Cooling water hose (joint-to-crankcase cover)
④ Cooling water hose (crankcase cover-to-Rectifier Regulator)
⑤ Cooling water hose (cylinder block-to-crankcase cover)
⑥ Cooling water hose (crankcase cover-to-bottom cowling)
⑦ Cooling water hose (cylinder block-to-fuel cooler)
⑧ Cooling water hose (Rectifier Regulator-to-cooling water pilot hole)
⑨ Cooling water hose (thermostat cover-to-cooling water pipe)
⑩ Cooling water hose (cooling water pipe-to-cooling water pipe)

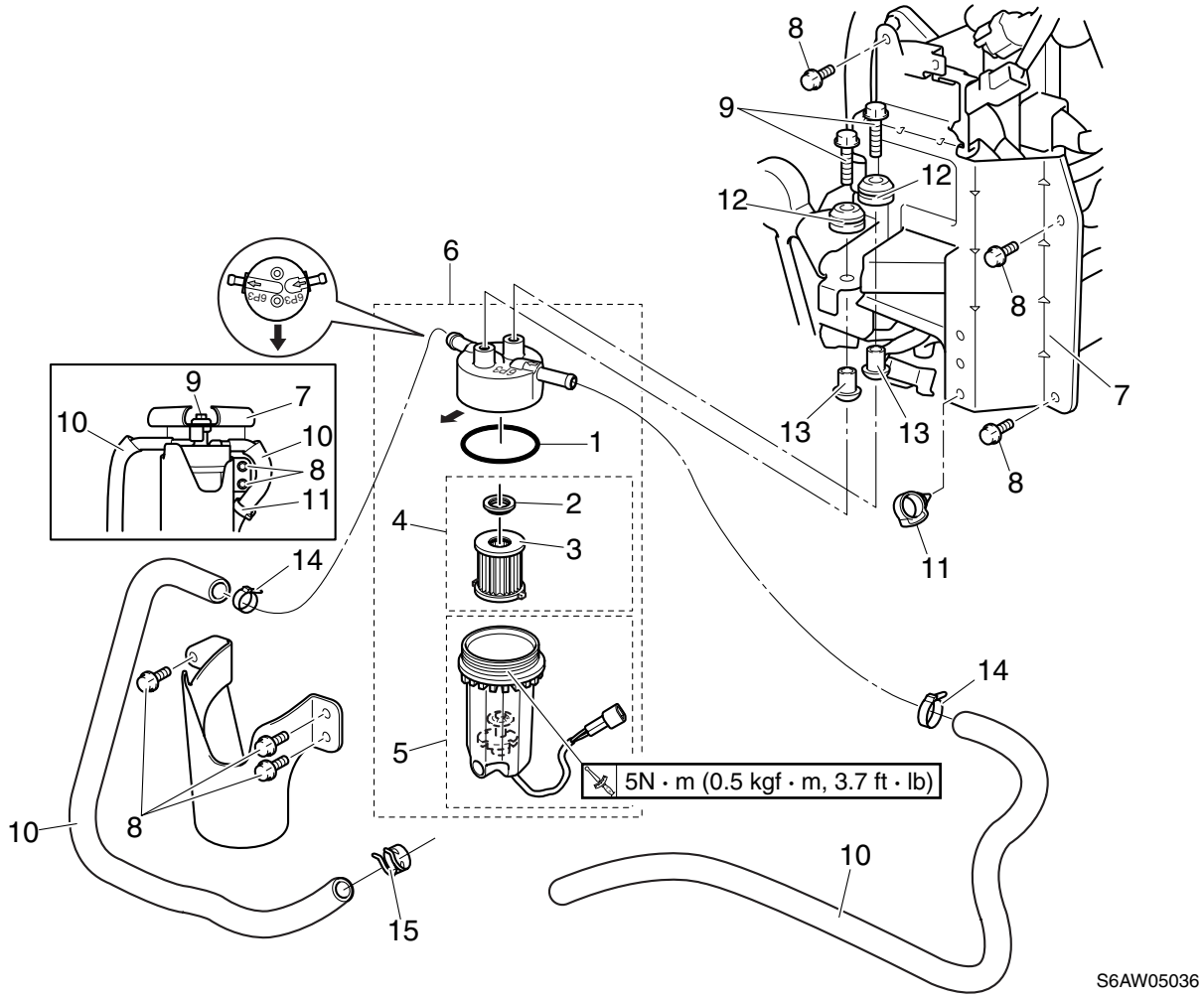
ⓐ Fuel cooler
ⓑ Rectifier Regulator
ⓒ Crankcase cover
ⓓ Cooling water pilot hole



S6AW05035-1

① Cooling water hose (Rectifier Regulator-to-cooling water pilot hole)
② Cooling water hose (cooling water pipe-to-cooling water pipe)
③ Cooling water hose (thermostat cover-to-cooling water pipe)
④ Cooling water hose (cooling water pipe-to-bottom cowling)
⑤ Cooling water hose (cooling water hose-to-bottom cowling)
⑥ Flushing hose (flushing hose adapter-to-joint)
⑦ Flushing hose (joint-to-joint)
⑧ Flushing hose (joint-to-cylinder block)
⑨ Flushing hose (joint-to-cylinder block)
⑩ Cooling water hose (cylinder block-to-fuel cooler)
⑪ Cooling water hose (cylinder block-to-water pressure sensor adapter)
⑫ Cooling water hose (cylinder block-to-crankcase cover)

Fuel filter



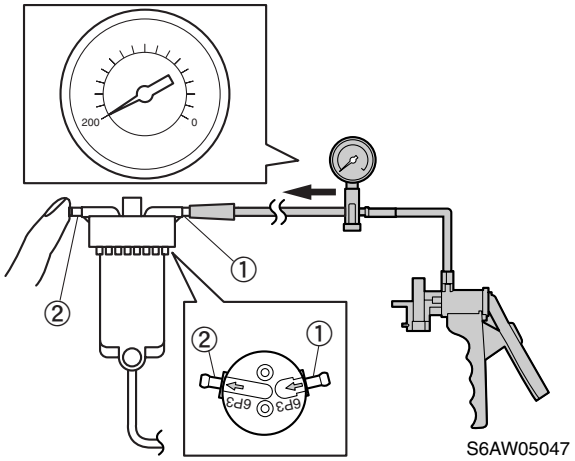
No.	Part name	Q'ty	Remarks
1	O-ring	1	**Not reusable**
2	Grommet	1	**Not reusable**
3	Filter element	1	
4	Filter element assembly	1	
5	Filter cup assembly	1	
6	Fuel filter assembly	1	
7	Bracket	1	
8	Bolt	6	M6 × 12 mm
9	Bolt	2	M6 × 14 mm
10	Fuel hose	2	
11	Clamp	1	
12	Grommet	2	
13	Collar	2	
14	Plastic tie	2	**Not reusable**
15	Clamp	1	

Checking the fuel filter assembly

1. Check for leaks in the fuel filter assembly as follows.

2. Connect a vacuum/pressure pump gauge set to the fuel inlet ①.

3. Cover the fuel outlet ② with a finger, and then apply the specified positive pressure. Replace the O-ring, fuel cup assembly, or fuel filter assembly if the specified pressure cannot be maintained for at least 15 seconds.



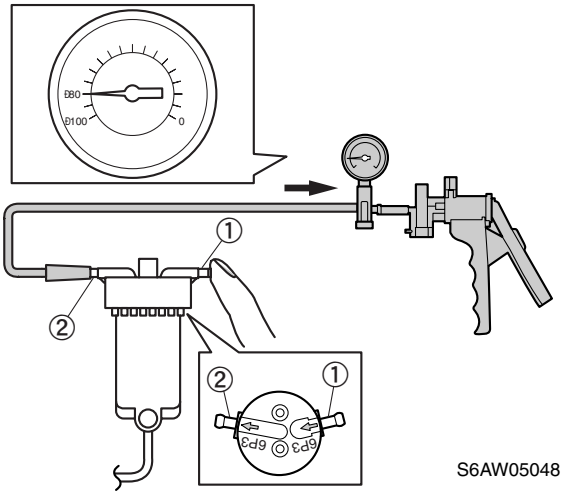
S6AW05047

NOTE:
Use a commercially available vacuum/pressure pump gauge and meter that can be pressurized 200 kPa (2.0 kgf/cm^2, 29.0 psi).

Specified positive pressure:
200 kPa (2.0 kgf/cm^2, 29.0 psi)

4. Connect the special service tool to the fuel outlet ②.

5. Cover the fuel inlet ① with a finger, and then apply the specified negative pressure. Replace the O-ring, fuel cup assembly, or fuel filter assembly if the specified pressure cannot be maintained for at least 15 seconds.



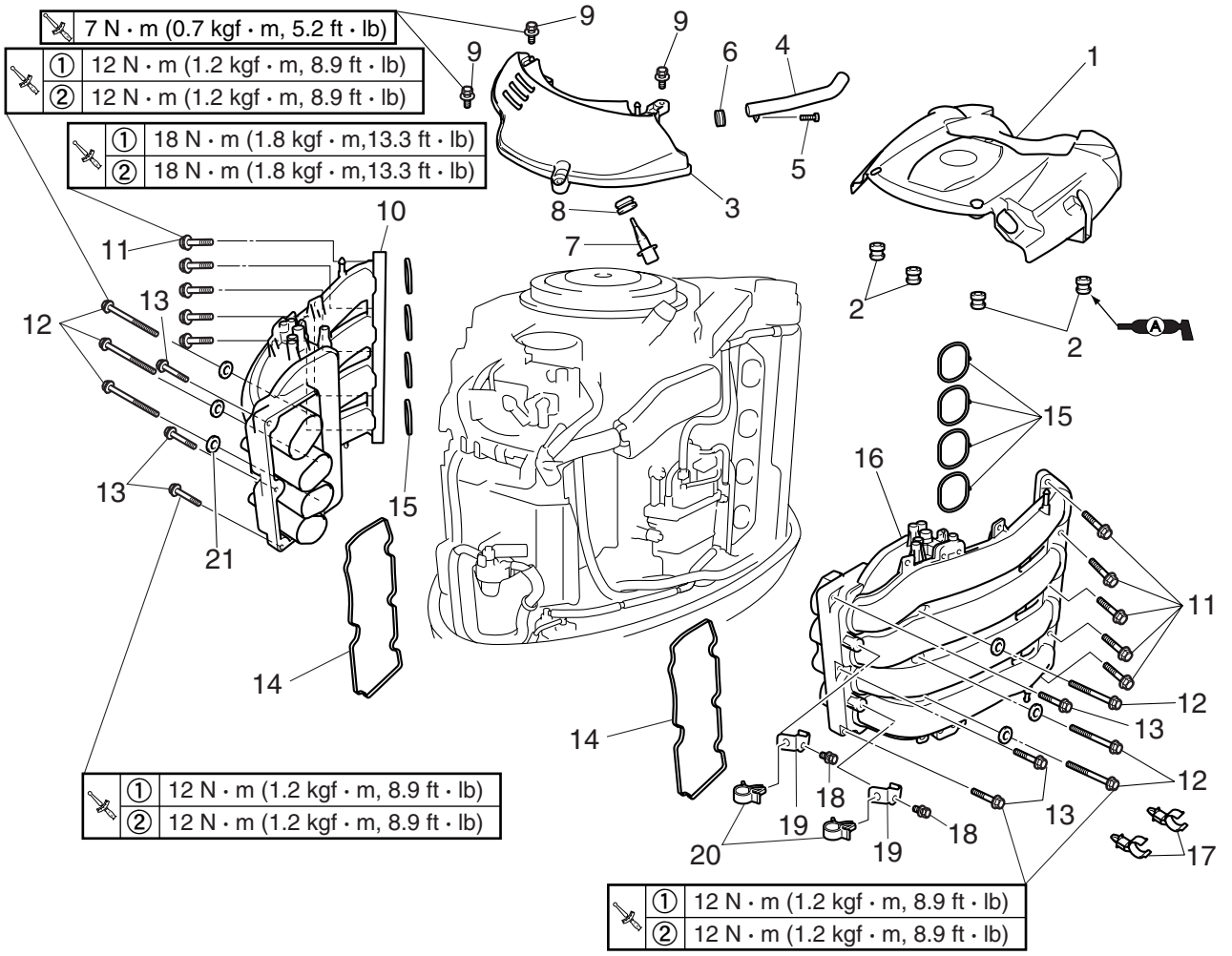
S6AW05048

Vacuum/pressure pump gauge set:
90890-06756

Specified negative pressure:
80 kPa (0.8 kgf/cm^2, 11.6 psi)

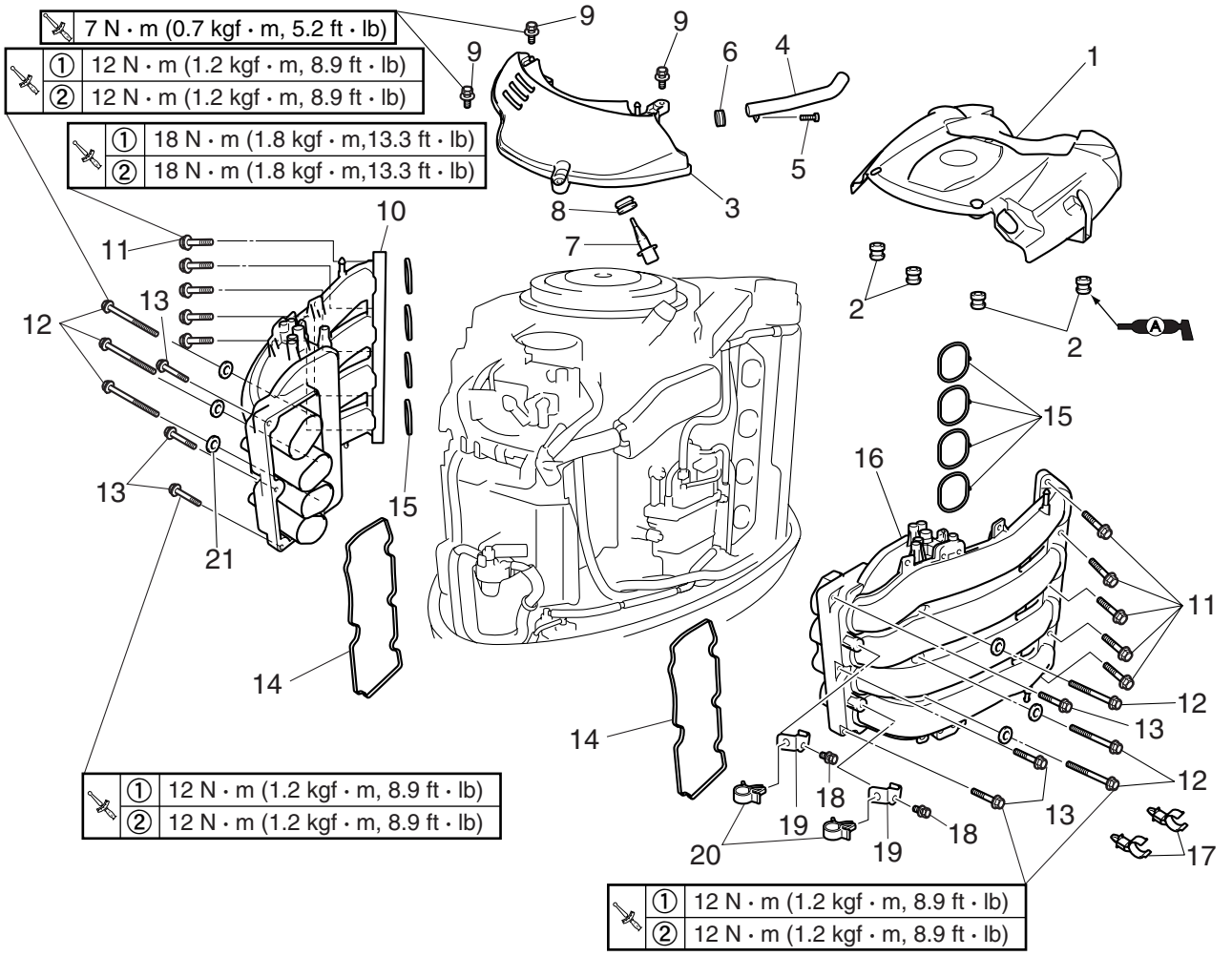
NOTE:
- To check the fuel filter element, see “Checking the fuel filter” (10-20).
- To check the water detection switch, see “Checking the water detection switch” (5-36).

Intake manifold



No.	Part name	Q'ty	Remarks
1	Flywheel magnet cover	1	
2	Grommet	4	
3	Intake silencer	1	
4	Blowby pipe	1	
5	Screw	1	ø6 × 20 mm
6	Grommet	1	
7	Air temperature sensor	1	
8	Grommet	1	
9	Bolt	3	M6 × 25 mm
10	Intake manifold (STBD)	1	
11	Bolt	10	M8 × 40 mm
12	Bolt	6	M6 × 75 mm
13	Bolt	6	M6 × 40 mm
14	Gasket	2	**Not reusable**
15	Gasket	8	**Not reusable**
16	Intake manifold (PORT)	1	
17	Clamp	2	

6



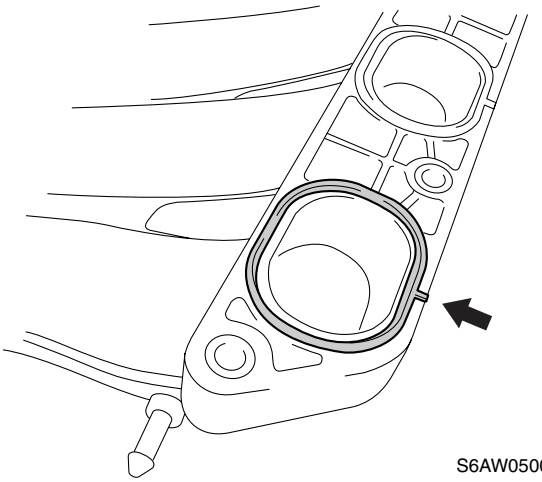
No.	Part name	Q'ty	Remarks
18	Bolt	2	M6 × 12 mm
19	Stay	2	
20	Clamp	2	
21	Washer	6	

Checking the intake manifold

1. Check the intake manifold. Replace the intake manifold if cracked or deformed.
2. Check the intake silencer. Replace the intake silencer if cracked or deformed.
3. Check the blowby hoses. Replace the blowby hoses if cracked or damaged.

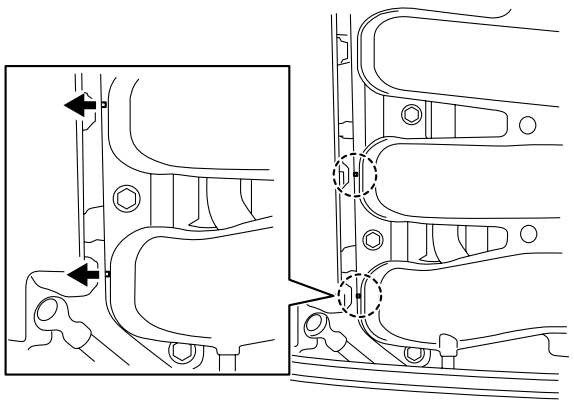
Installing the intake manifold

1. Install new gaskets onto the intake manifold. Make sure that the tab on the gasket is properly and firmly fitted into the groove on the intake manifold.



S6AW05003

2. Temporarily fasten the intake manifolds with bolts. In this process, take precautions to prevent the tab on the gasket from touching the fuel rail cover, which may result in the dislocation of gasket from the groove. Then, permanently fasten the intake manifolds with bolts.

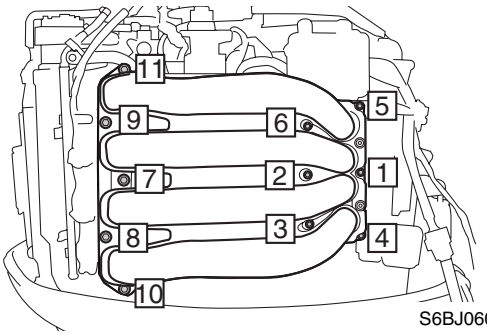


S6AW05004

NOTE:

It is recommended to remove the battery cable for easy installation of the intake manifold (STBD).

3. Tighten the intake manifold bolts to the specified torque in the sequence shown.



S6BJ06005

	Intake manifold bolt 1–6 (M6): 1st: 12 N·m (1.2 kgf·m, 8.9 ft·lb) 2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb) Intake manifold bolt 7–11 (M8): 1st: 18 N·m (1.8 kgf·m, 13.3 ft·lb) 2nd: 18 N·m (1.8 kgf·m, 13.3 ft·lb)

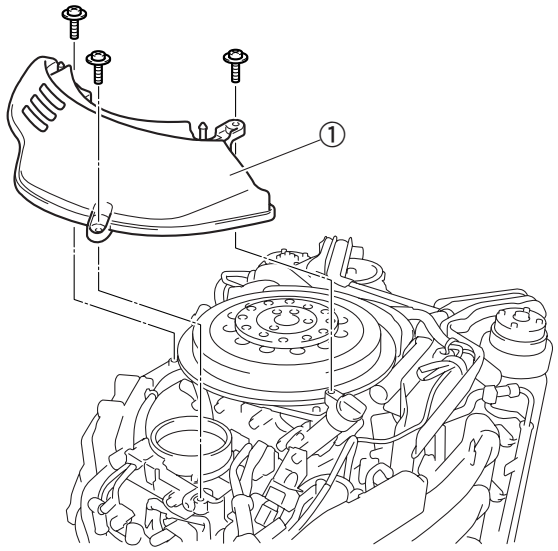
NOTE:

Use of a deep socket (commercially available) is recommended when installing or removing the intake manifold bolts (M6 × 75 mm).

6

Installing the intake silencer

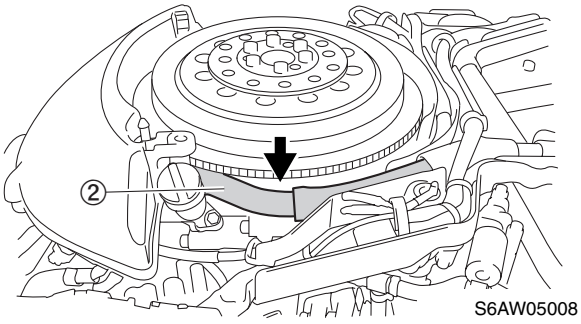
1. Install the intake silencer ①.



S6AW05007

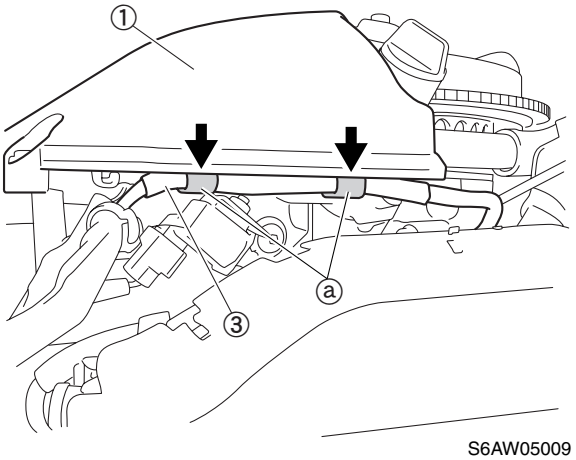
	Intake silencer bolt: 7 N·m (0.7 kgf·m, 5.2 ft·lb)

2. Connect the blowby pipe ② as shown.



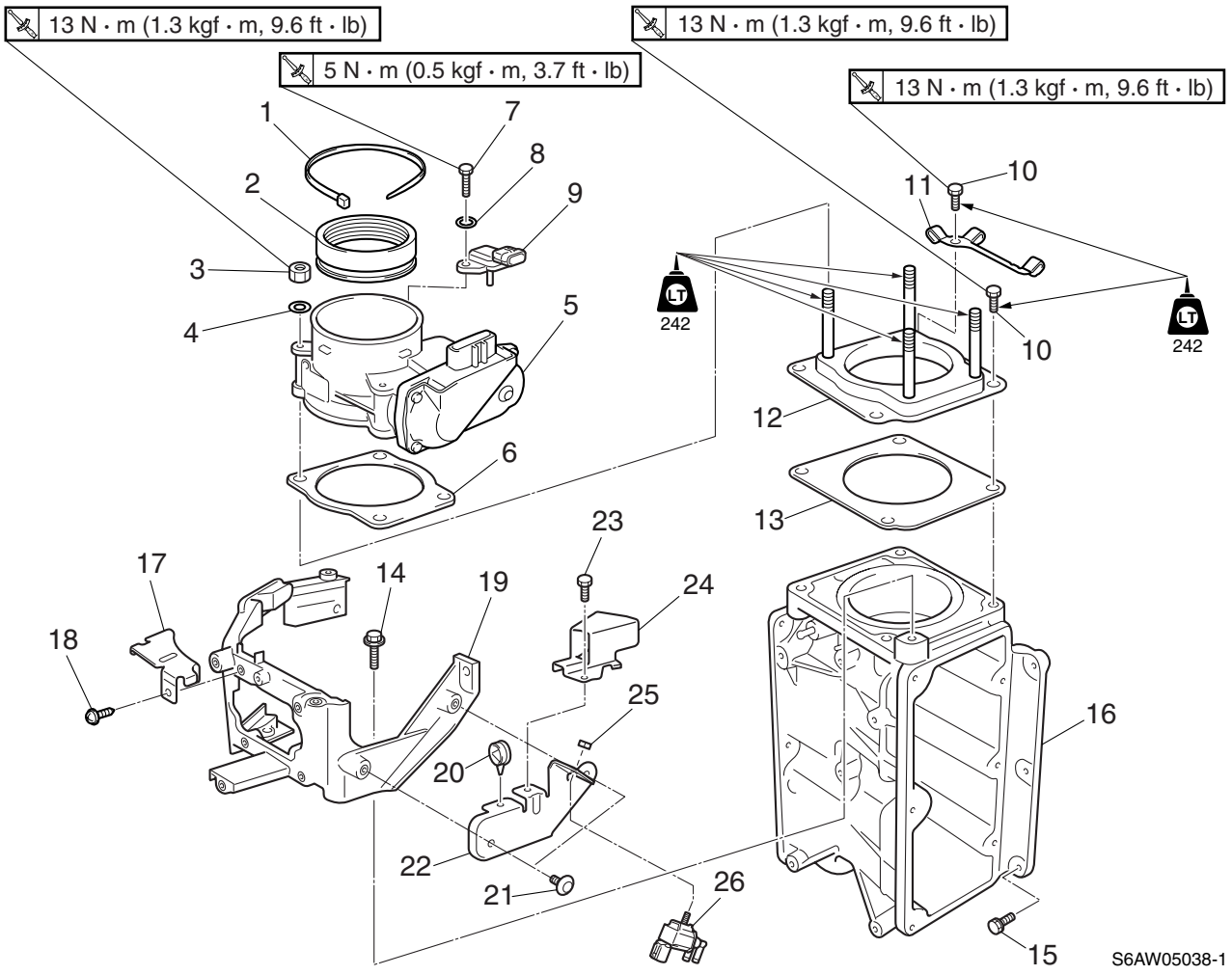
S6AW05008

3. Install the vapor hose ③ to the clamp ⓐ of the intake silencer ① as shown.

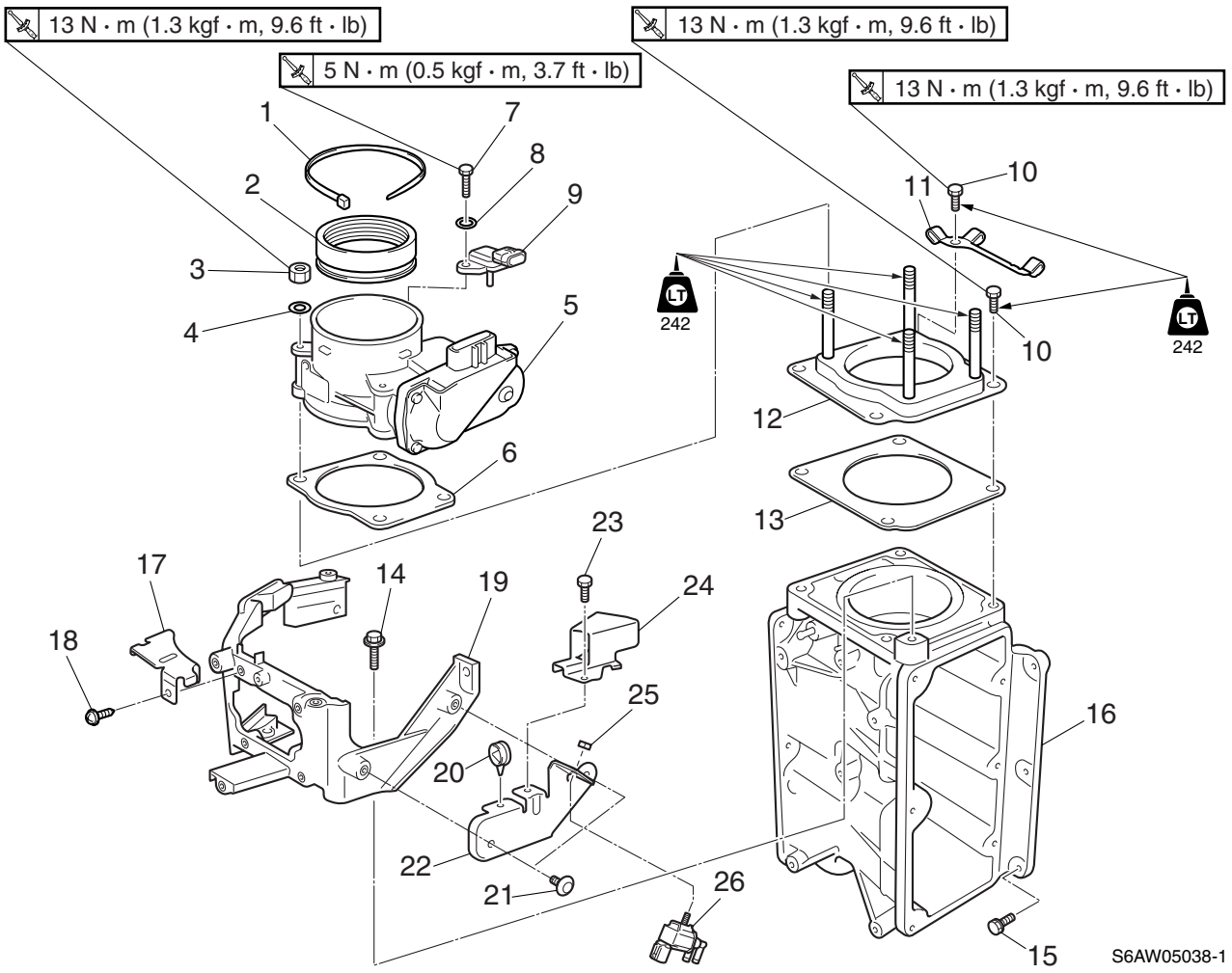


S6AW05009

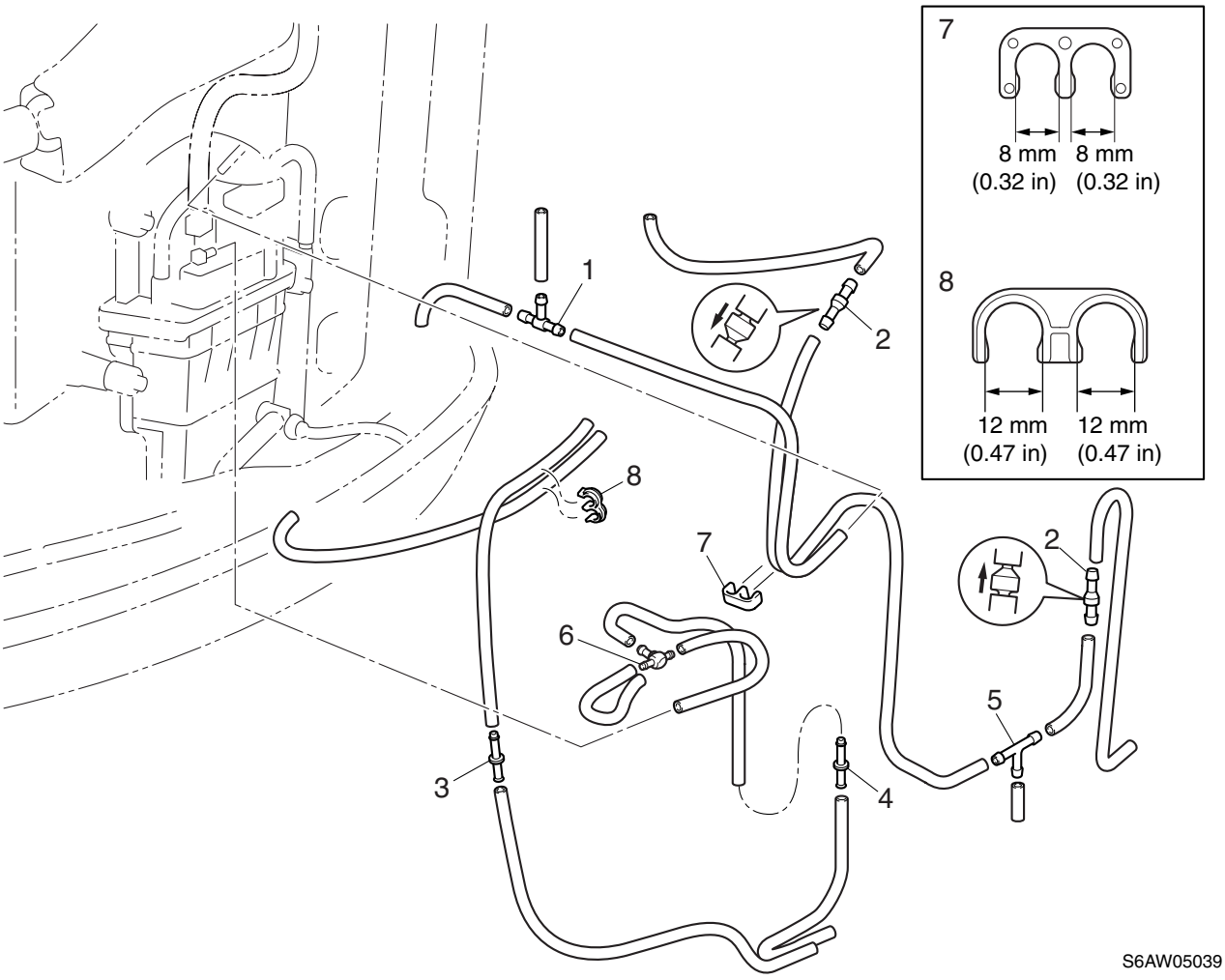
Throttle body



No.	Part name	Q'ty	Remarks
1	Plastic tie	1	
2	Joint	1	
3	Nut	4	
4	Washer	4	
5	ETV assembly	1	
6	Gasket	1	**Not reusable**
7	Bolt	1	M6 × 20 mm
8	Washer	1	
9	Air pressure sensor	1	
10	Bolt	4	M8 × 18 mm
11	Clip	1	
12	Plate	1	
13	Gasket	1	**Not reusable**
14	Bolt	2	M6 × 20 mm
15	Bolt	6	M8 × 35 mm
16	Surge tank	1	
17	Clamp	1	



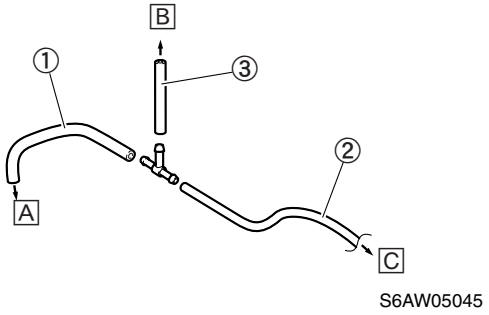
No.	Part name	Q'ty	Remarks
18	Screw	1	ø5 × 13 mm
19	Bracket	1	
20	Clamp	1	
21	Bolt	2	M6 × 14 mm
22	Holder	1	
23	Bolt	1	M6 × 14 mm
24	Cover	1	
25	Nut	1	
26	Vapor shut-off valve	1	



No.	Part name	Q'ty	Remarks
1	Joint	1	
2	Check valve	2	
3	Joint	1	ø5
4	Joint	1	ø5
5	Joint	1	
6	Joint	1	
7	Holder	1	
8	Holder	1	

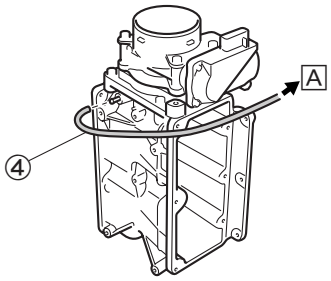
Checking the vacuum hose

1. Check hoses ①, ②, ③, and ④. Replace any hose that is cracked or damaged.



S6AW05045

A To the serge tank
B To the air pressure sensor
C To the pressure regulator

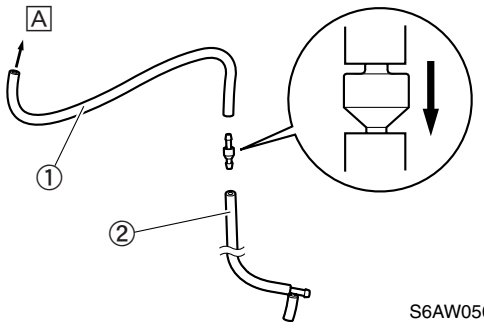


S6AW05046

A To the vapor shut-off valve

Installing the throttle body

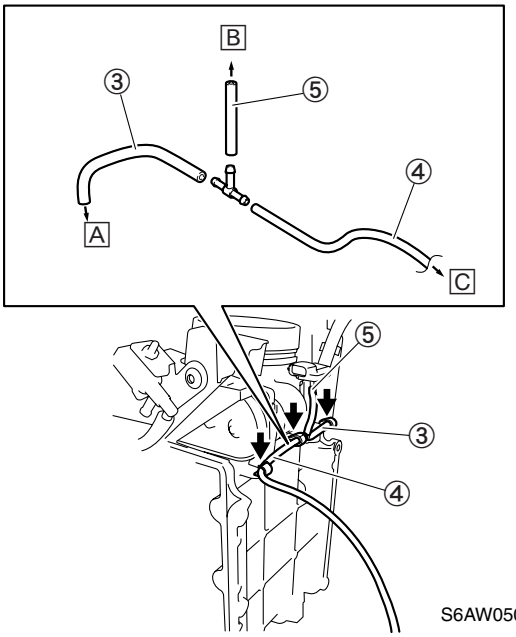
1. Connect the check valve to the hoses ① and ②.



S6AW05030

A To the intake silencer

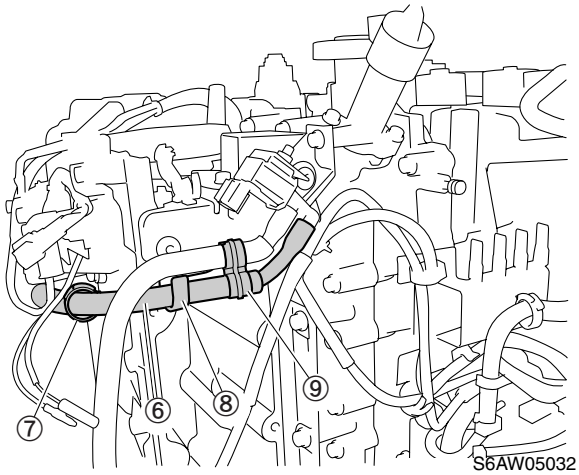
2. Connect the hoses ③, ④, and ⑤ to the joint, and connect the hose ③ to the surge tank. Install the hoses ③ and ④ with pipe clips as shown.



S6AW05031

A To the surge tank
B To the air pressure sensor
C To the pressure regulator

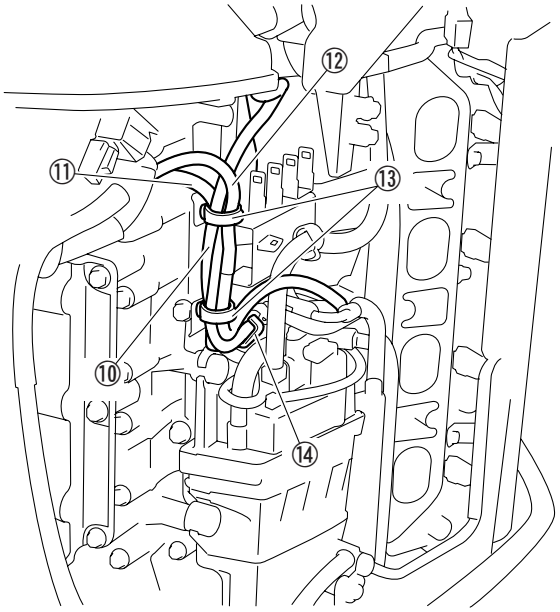
3. Connect the hose ⑥ to the surge tank and the vapor shut-off valve, and then install it to the clamp ⑦ and holder ⑧. Install the hose ⑥ and the canister hose with the holder ⑨.



S6AW05032

4. Install the throttle body.

5. Connect the hoses and fasten them.

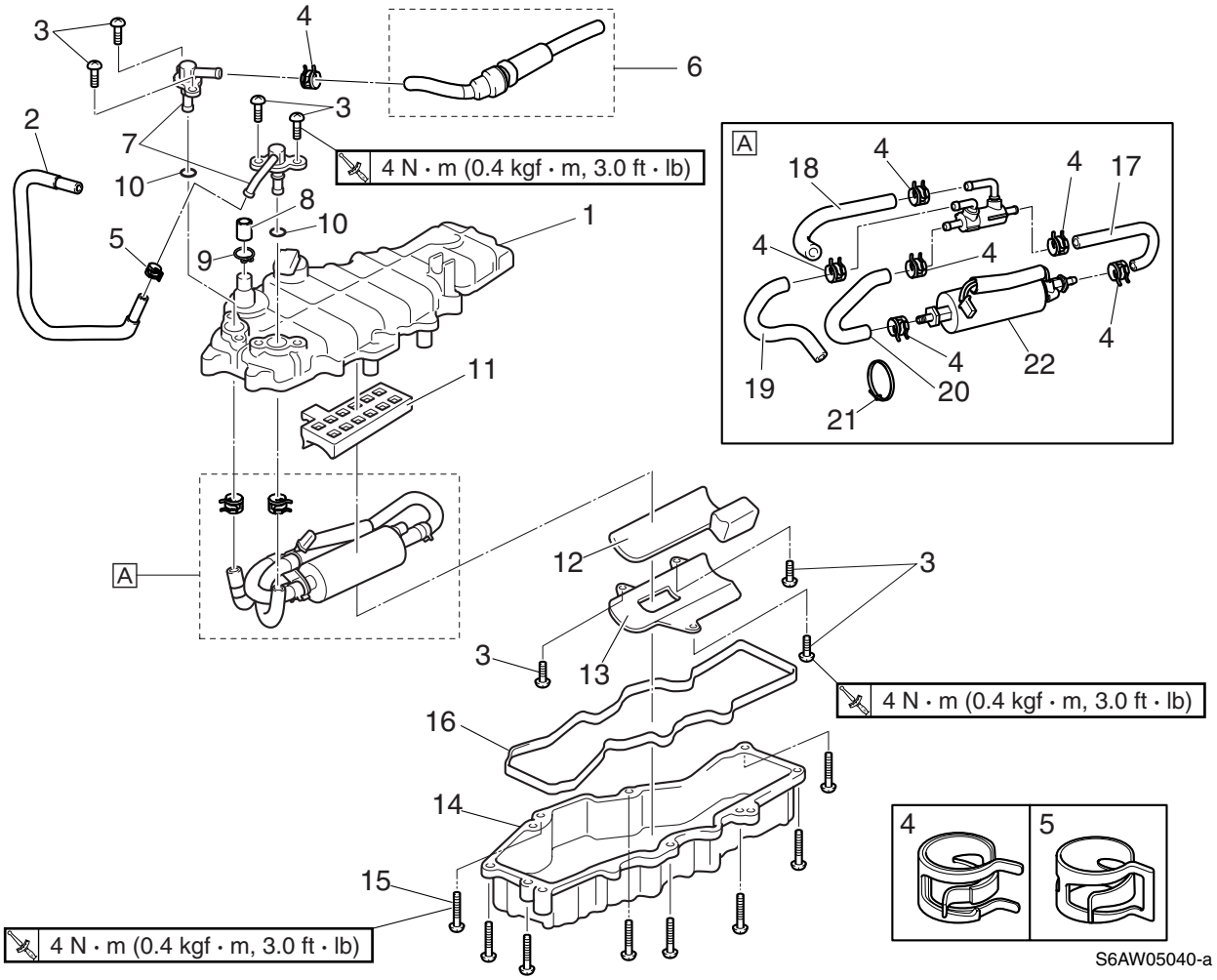


S6AW05033

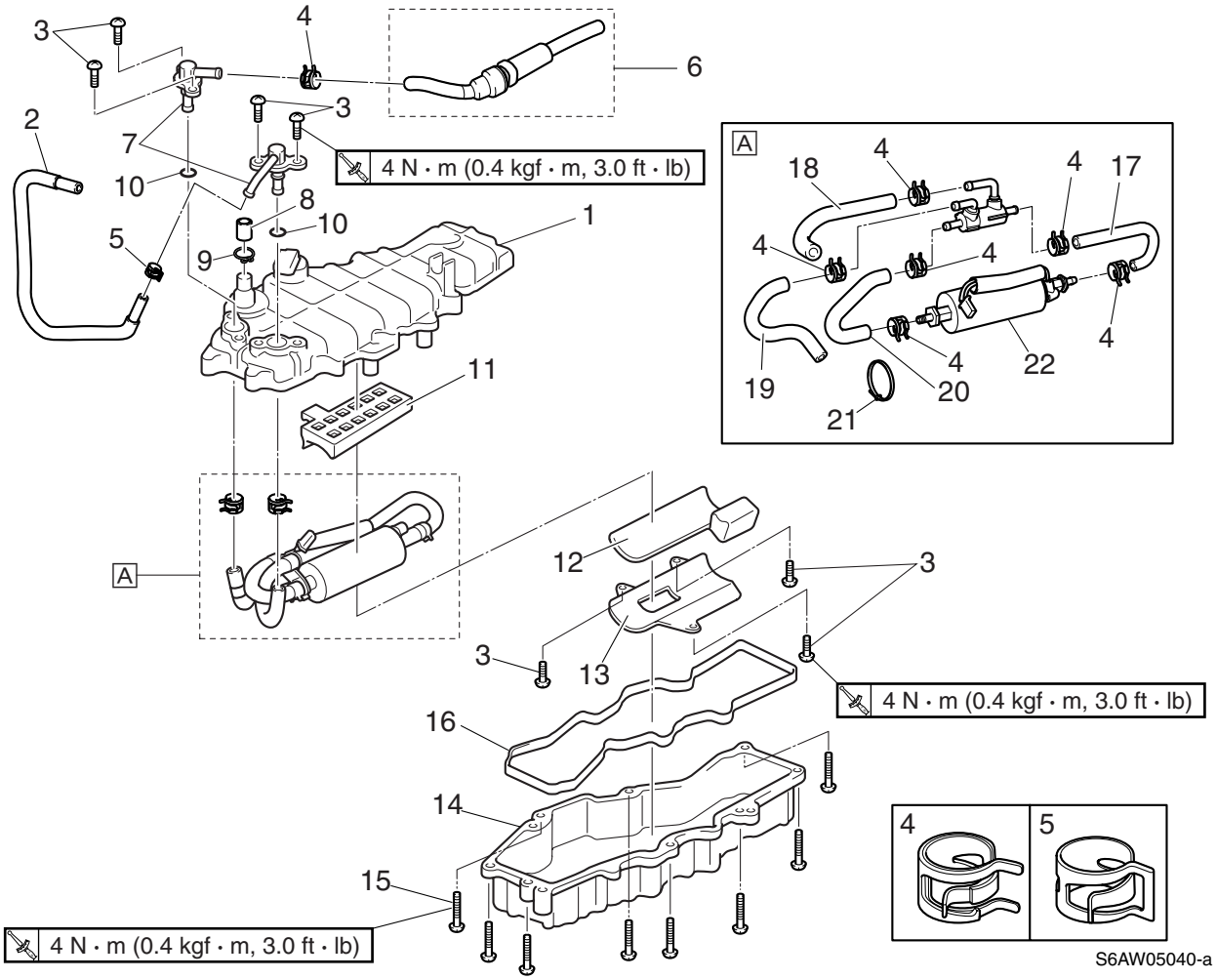
NOTE:

Install the canister hose ⑩, the pressure regulator hose ⑫, and the fuel cooler hose ⑪ in place using the clamp ⑬, and further install the canister hose ⑩ and the pressure regulator hose ⑫ in place using the holder ⑭.

Low-pressure fuel pump assembly

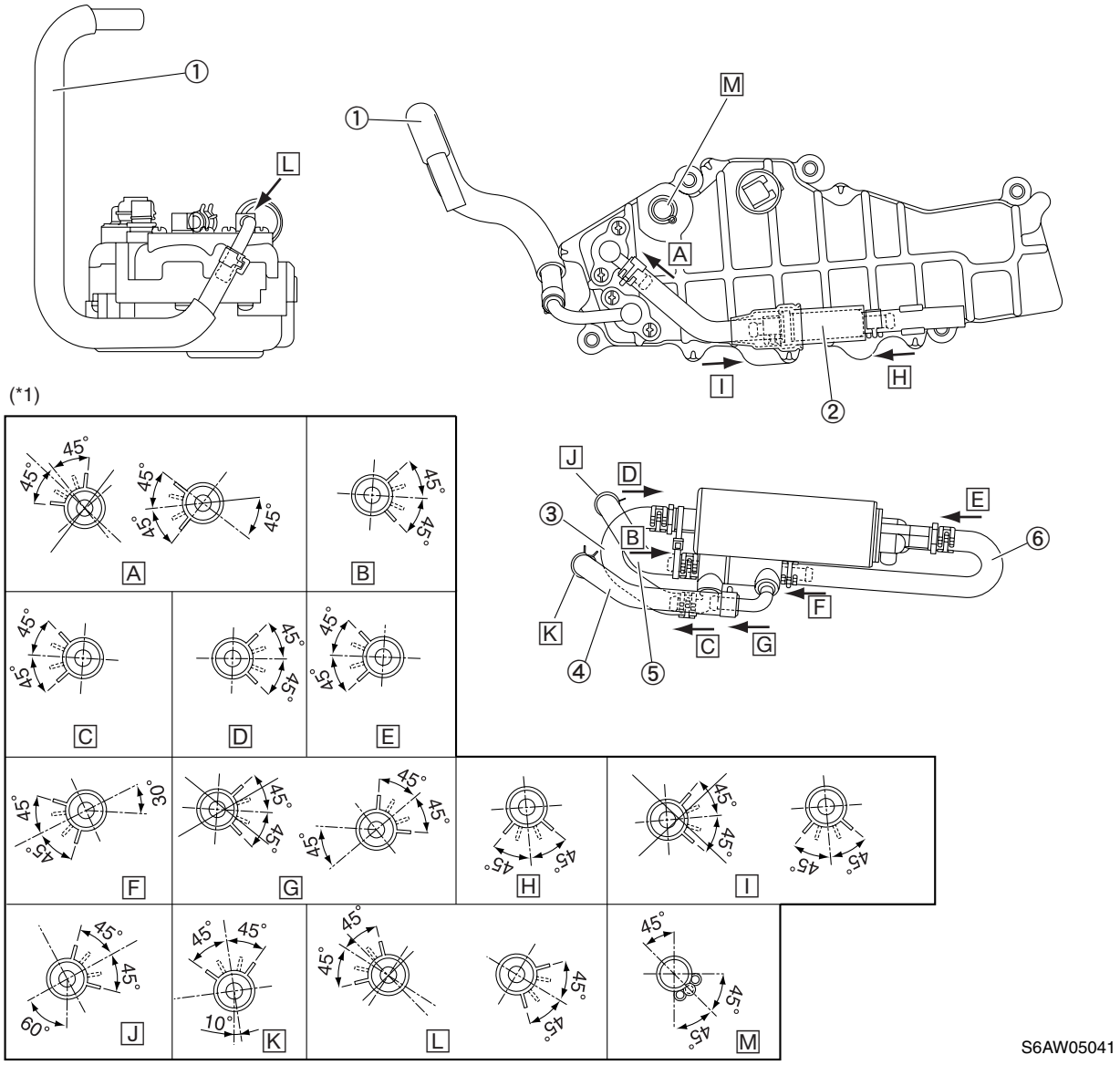


No.	Part name	Q'ty	Remarks
1	Pump cover	1	
2	Fuel hose	1	
3	Screw	7	ø5 × 10 mm
4	Clamp	8	
5	Clamp	1	
6	Fuel filter assembly	1	
7	Joint pipe	2	
8	Cap	1	
9	Clip	1	
10	O-ring	2	**Not reusable**
11	Bush	1	
12	Bush	1	
13	Bracket	1	
14	Pump case	1	
15	Screw	9	ø5 × 15 mm
16	Gasket	1	**Not reusable**
17	Fuel hose	1	



No.	Part name	Q'ty	Remarks
18	Fuel hose	1	
19	Fuel hose	1	
20	Fuel hose	1	
21	Plastic tie	1	**Not reusable**
22	Low-pressure fuel pump	1	

Low-pressure fuel pump assembly routing



(*1) The cross-sectional view A–M shows the mounting angle of the clamp when viewed in the direction of arrow.

① Fuel hose (fuel filter-to-joint pipe)
② Filter
③ Fuel hose (relief valve-to-low-pressure fuel pump)
④ Fuel hose (relief valve-to-joint pipe)
⑤ Fuel hose (joint pipe-to-relief valve)
⑥ Fuel hose (low-pressure fuel pump-to-relief valve)

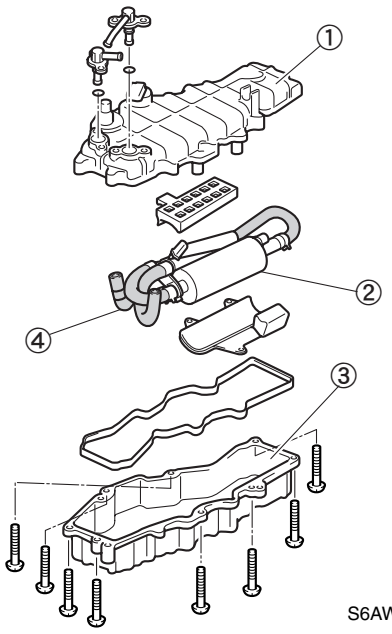
Checking the low-pressure fuel pump assembly

1. Reduce the fuel pressure. See “Reducing the fuel pressure” (6-27).
2. Drain the fuel from the vapor separator. To drain the fuel, see “Draining the fuel” (6-30).
3. Disassemble the low-pressure fuel pump assembly.
4. Check the pump cover ① and pump case ③. Replace the pump case if cracked or deformed.
5. Check the low-pressure fuel pump ②.

NOTE:

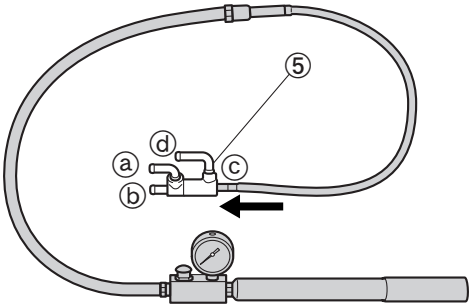
- To check the low-pressure fuel pump ②, see “Checking the low-pressure fuel pump and high-pressure fuel pump” (5-38).
- To check the fuse, see “Fuse holder” (5-3).

6. Check the fuel hoses ④. Replace the fuel hoses if cracked or damaged.

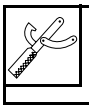


S6AW05010

7. To check the relief valve ⑤, block the fuel ports ⓑ and ⓓ, connect the special service tool to the port ⓒ, apply pressure to the port ⓒ, and check that the relief valve opens at the specified pressure. Make sure that the pressure applied to the port ⓒ is released from the port ⓐ when the relief valve opens.



S6AW05011

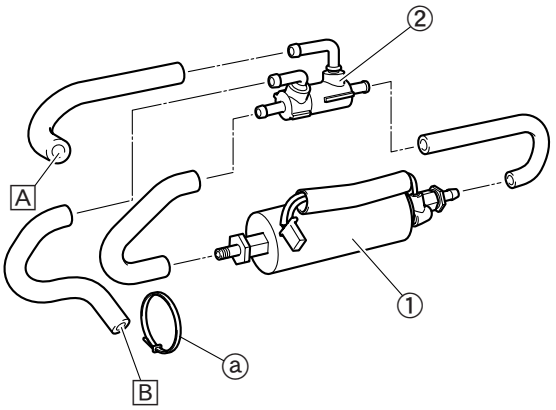


Leakage tester:
90890-06840

Specified pressure:
81.0 kPa (0.81 kgf/cm^2, 11.7 psi)

Assembling the low-pressure fuel pump assembly

1. Install each fuel hose to the low-pressure fuel pump ① and relief valve ②, and install the fuel hoses with a plastic tie ⓐ as shown.

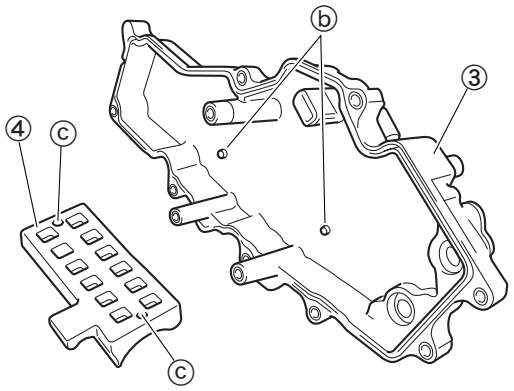


S6AW05019

A To the vapor separator tank
B From the fuel filter

NOTE:
When installing the fuel hose, see the exploded diagram (6-17).

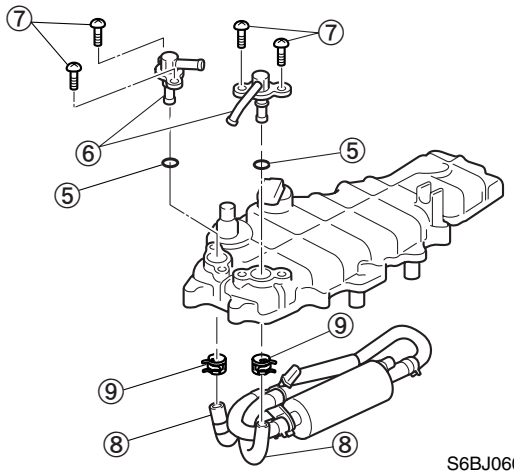
2. Install the bush ④ to the pump cover ③.



S6AW05012

NOTE:
Align the pump cover projections ⓑ with the holes ⓒ in the bush.

3. Install the new O-rings ⑤ to the joint pipes ⑥, and then tighten the joint pipe screws ⑦ to the specified torque.



S6BJ06004

	Joint pipe screw ⑦: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

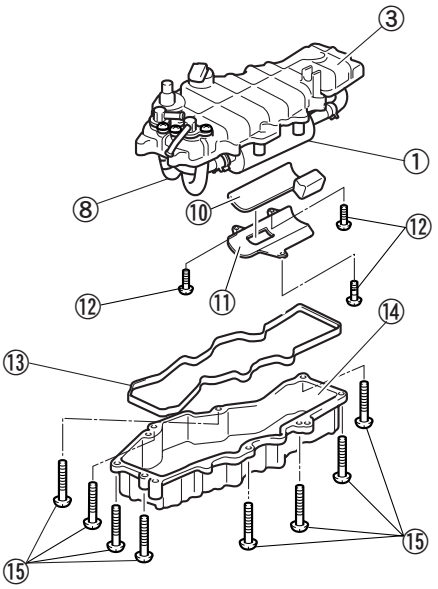
4. Connect the fuel hoses ⑧.

5. Install the clumps ⑨. See “Low-pressure fuel pump assembly routing” (6-18).

6. Install the low-pressure fuel pump ①, relief valve ②, bush ⑩ and bracket ⑪ with screws ⑫.

7. Install a new gasket ⑬ to the pump case ⑭.

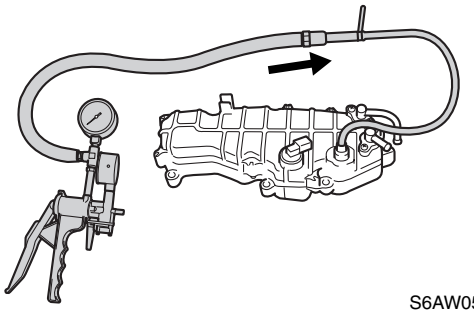
8. Tighten the pump case screws ⑮ to the specified torque.



S6AW05013-1

	Bracket screw ⑫: 4 N·m (0.4 kgf·m, 3.0 ft·lb) Pump case screw ⑮: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

9. Connect the special service tool as shown in the illustration, apply specified pressure, and make sure that there is no pressure leakage. Check again if leakage was detected.

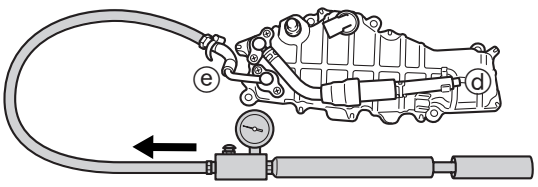


S6AW05014

Vacuum/pressure pump gauge set:
90890-06756

Specified pressure:
10 kPa (0.1 kgf/cm^2, 1.5 psi)

10. Block the port ⓓ while the fuel hose is disconnected. Connect the special service tool to the port ⓔ, apply specified pressure, and make sure there is no air leakage. If any leakage was detected, disassemble the low-pressure fuel pump assembly again, and check the fuel hose joints.

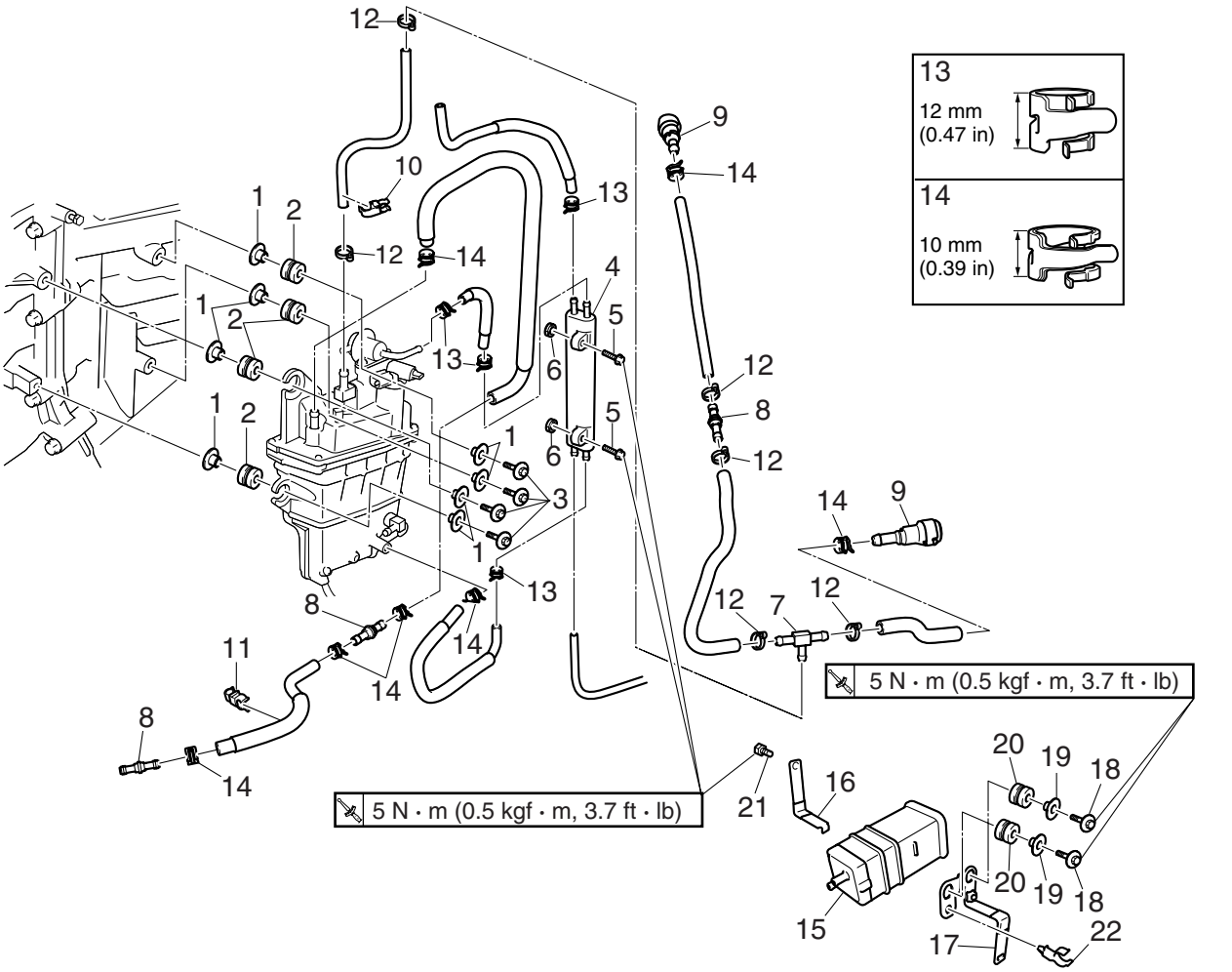


S6AW05015

Leakage tester:
90890-06840

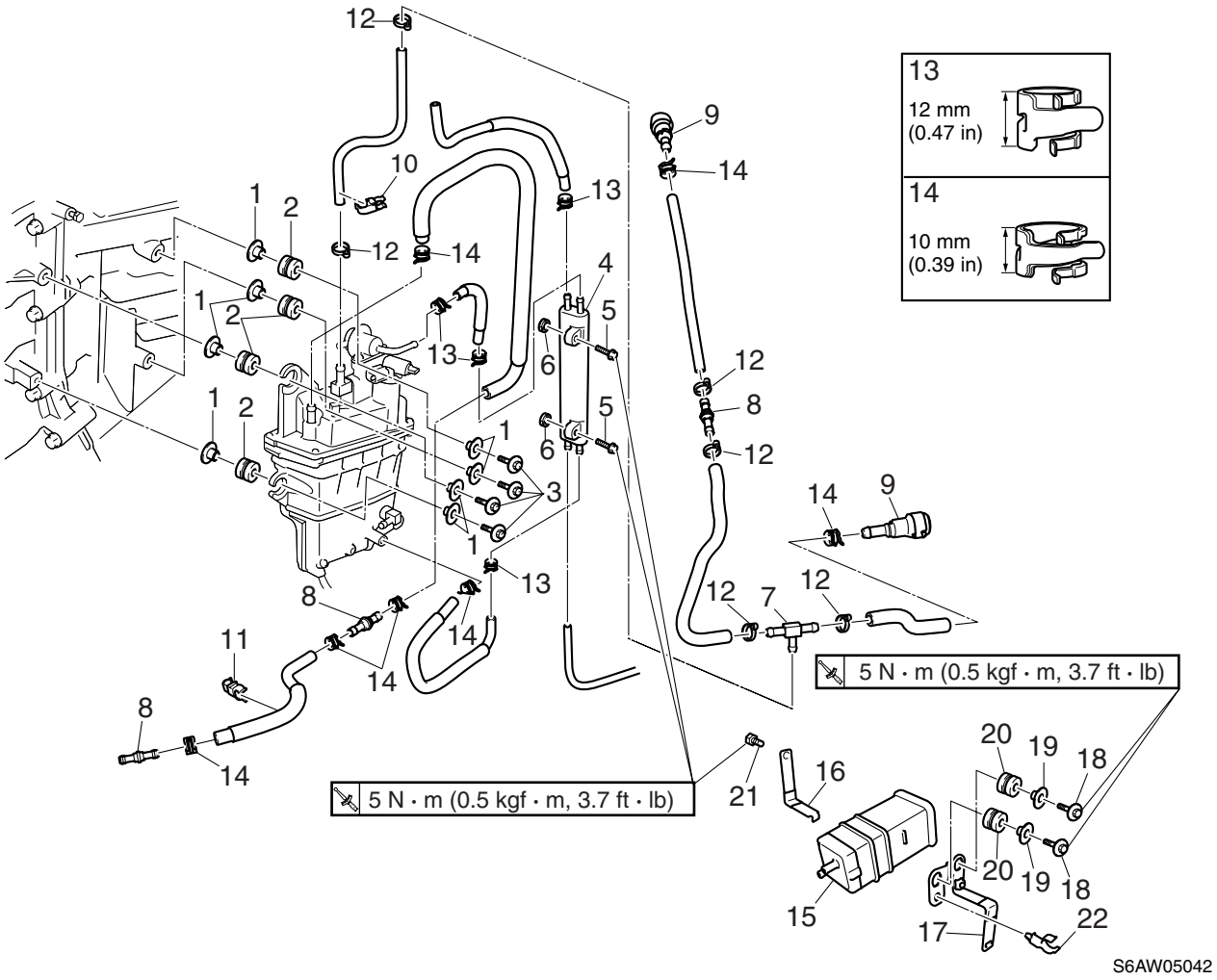
Specified pressure:
200 kPa (2.0 kgf/cm^2, 29.0 psi)

Vapor separator

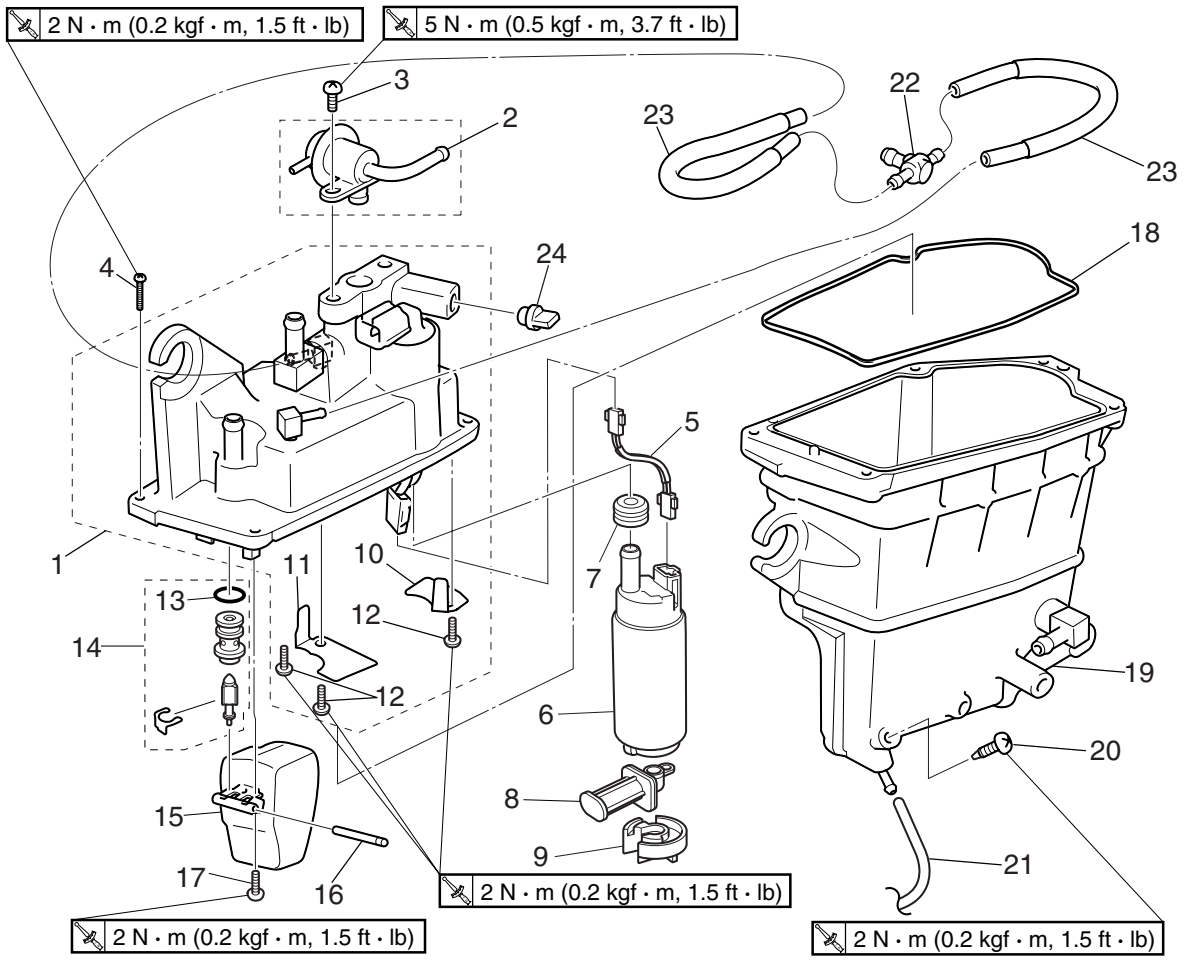


S6AW05042

No.	Part name	Q'ty	Remarks
1	Collar	8	
2	Grommet	4	
3	Bolt	4	M6 × 35 mm
4	Fuel cooler	1	
5	Bolt	2	M6 × 25 mm
6	Collar	2	
7	Joint	1	
8	Joint	3	
9	Quick connector	2	
10	Holder	1	
11	Holder	1	
12	Clamp	6	**Not reusable**
13	Clamp	4	
14	Clamp	7	
15	Canister	1	
16	Bracket	1	
17	Bracket	1	

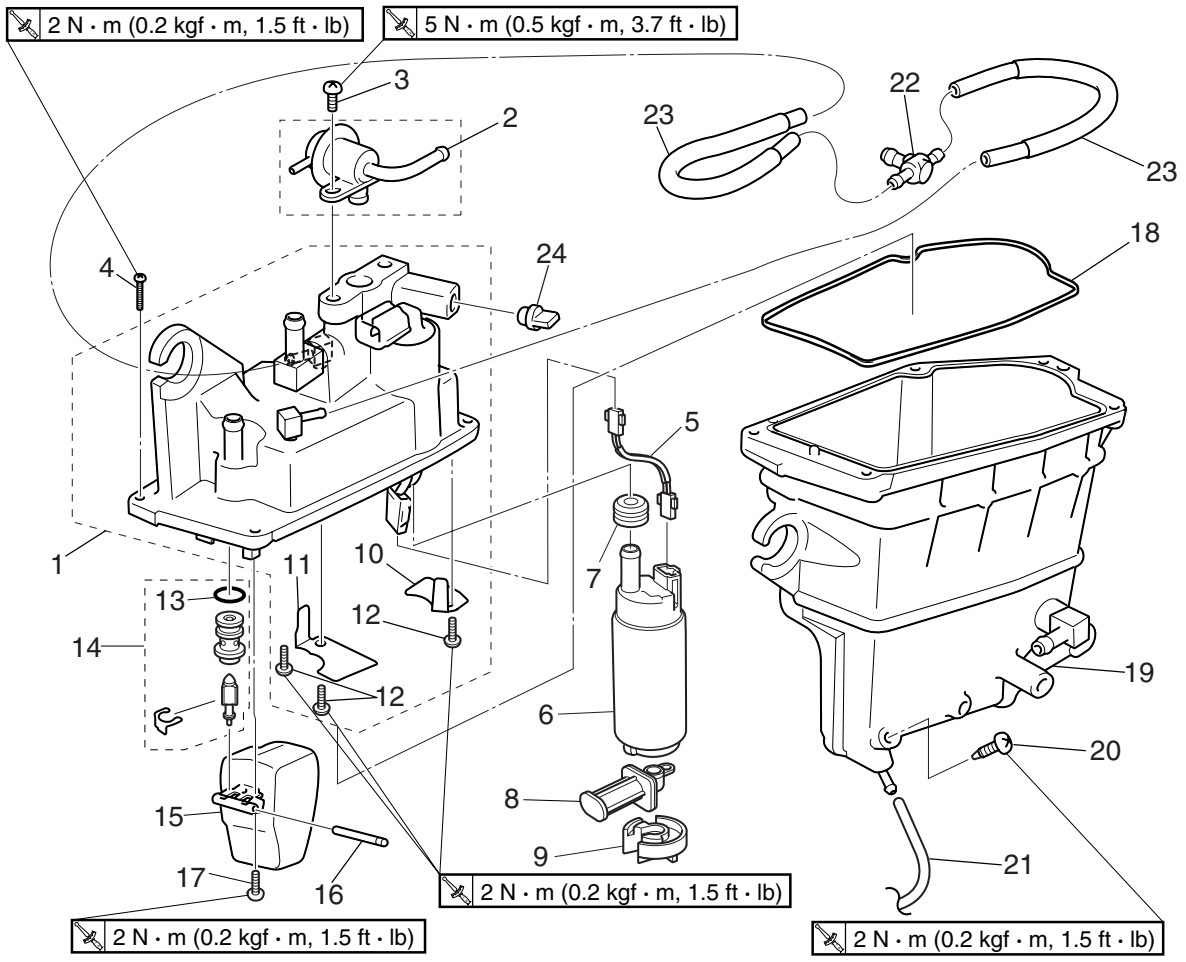


No.	Part name	Q'ty	Remarks
18	Bolt	2	M6 × 28 mm
19	Collar	2	
20	Grommet	2	
21	Bolt	1	M6 × 10 mm
22	Clamp	1	



S6AW05043

No.	Part name	Q'ty	Remarks
1	Cover assembly	1	
2	Pressure regulator	1	
3	Screw	2	ø6 × 12 mm
4	Screw	5	ø4 × 16 mm
5	Wiring harness	1	
6	High-pressure fuel pump	1	
7	Grommet	1	
8	Filter	1	
9	Filter holder	1	
10	Plate	1	
11	Plate	1	
12	Screw	3	ø4 × 8 mm
13	O-ring	1	**Not reusable**
14	Needle valve assembly	1	
15	Float	1	
16	Pin	1	
17	Screw	1	ø4 × 8 mm

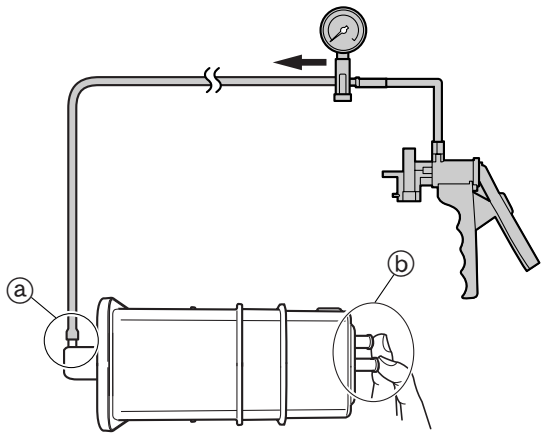


S6AW05043

No.	Part name	Q'ty	Remarks
18	Gasket	1	**Not reusable**
19	Float chamber	1	
20	Vapor separator drain screw	1	
21	Drain hose	1	
22	Joint	1	
23	Hose	2	
24	Cap	1	

Checking the canister leakage

1. Check for the possible air leakage from the canister in the following procedures.
2. Check the canister. Replace the canister if cracked.
3. Connect the special service tool to the atmospheric port ⓐ and cover the other ports ⓑ, each with a finger.



S6P24180

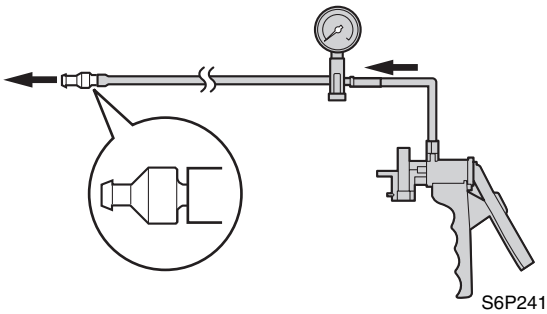
Vacuum/pressure pump gauge set:
90890-06756

4. Apply the specified positive pressure and check that there is no air leakage. Replace the canister if there is air leakage.

Specified pressure:
19.6 kPa (0.196 kgf/cm^2, 2.8 psi)

Checking the canister check valve

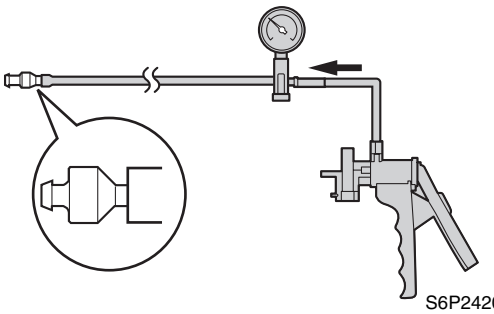
1. Connect the special service tool to the check valve port as shown.



S6P24190

Vacuum/pressure pump gauge set:
90890-06756

2. Apply positive pressure to the check valve port.
3. Check that air comes out of the opposite end of the check valve. Replace the canister check valve if no air comes out.
4. Connect the special service tool to the opposite check valve port as shown.



S6P24200

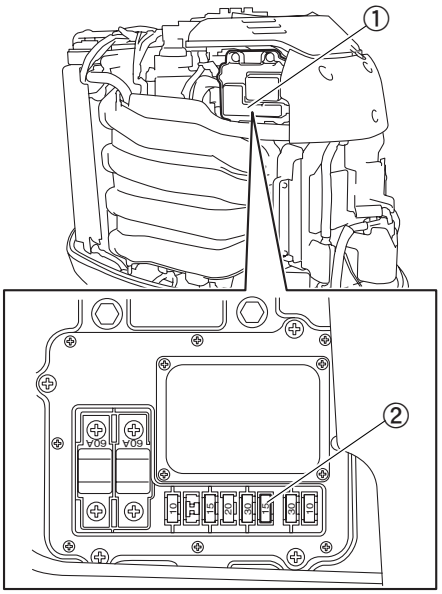
5. Apply positive pressure to the check valve port.
6. Check that no air comes out of the opposite end of the check valve. Replace the canister check valve if air comes out.

Reducing the fuel pressure

⚠ WARNING

Always reduce the fuel pressure in the high-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

1. Remove the cover ①, and then remove the high-pressure fuel pump fuse (15 A) ②.



S6AW05017-1

2. Start the engine.

NOTE:

- If the engine starts, it will stall after a few seconds.
- If the engine does not start, crank the engine 2 or 3 times.

3. After the engine stalls, crank the engine 2 or 3 times.

4. Turn the engine start switch to "OFF."

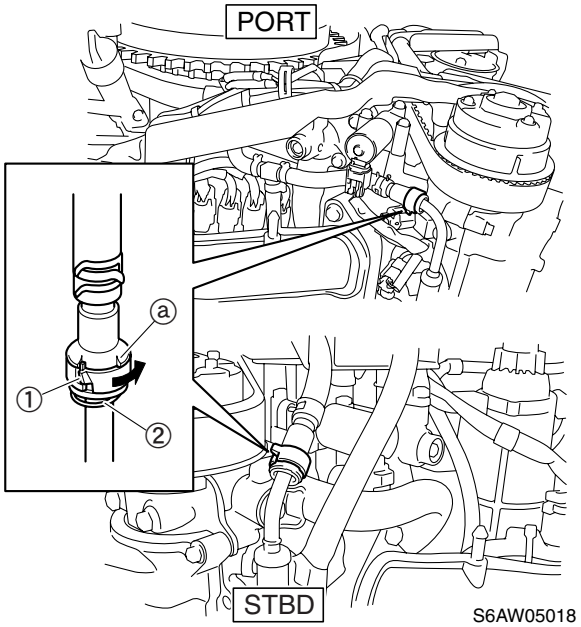
Disconnecting the quick connector

⚠ WARNING

If the quick connector is disconnected suddenly, pressurized fuel could spray out. Be sure to reduce the fuel pressure before disconnecting the quick connector.

1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-27).

2. Wrap the quick connector with a rag, and then rotate the quick connector tab ① to the stopper position ⓐ.



S6AW05018

CAUTION:

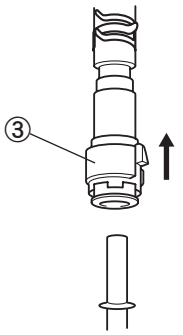
Do not rotate the quick connector tab ① past the stopper position ⓐ, otherwise it could be damaged.

NOTE:

Be careful not to lose the retainer ② after removing the fuel hose.

6

3. Disconnect the quick connector ③ from the fuel rail or vapor separator directly.



S6P24280

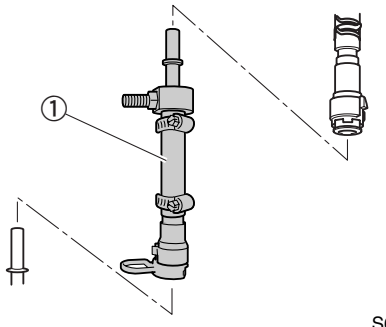
NOTE:
Cover the quick connector, fuel rail, and vapor separator with a plastic bag to prevent damage and to protect them from dirt.

Measuring the fuel pressure

1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-27).

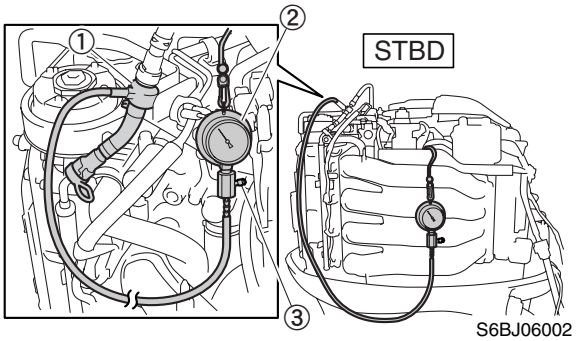
2. Disconnect the quick connector from the fuel rail. See "Disconnecting the quick connector" (6-27).

3. Connect the fuel pressure gauge adapter ① between the quick connector and fuel rail.



S6BJ06003

4. Connect the fuel pressure gauge ② to fuel pressure gauge adapter ①.



S6BJ06002

⚠ WARNING

- **Gently screw in the gauge until it is firmly connected to prevent fuel from leaking out.**
- **Before measuring the fuel pressure, make sure that the drain screw ③ is tightened securely.**
- **Do not loosen the drain screw ③ while measuring the fuel pressure. Loosening the drain screw ③ can cause fuel to spray out creating a fire hazard.**

Fuel pressure gauge adapter ①:
90890-06842
Fuel pressure gauge ②:
90890-06786

5. Turn the engine start switch to "ON," and then measure the fuel pressure within 5 seconds.

NOTE:
- The fuel pressure will decrease 5 seconds after the engine start switch is turned to "ON" because the high-pressure fuel pump will stop.
- The high-pressure fuel pump does not operate when the engine start switch is turned to "ON" again within 10 seconds after turning the switch to "OFF."

Fuel pressure (reference data):
300 kPa (3.0 kgf/cm^2, 43.5 psi)

6. Start the engine and warm up, and then measure the fuel pressure at the stable idle condition of 600–700 r/min.

Fuel pressure (reference data):
260 kPa (2.6 kgf/cm^2, 37.7 psi)
at engine idle speed

7. Reduce the fuel pressure.

8. Disconnect the special service tools.

9. Connect the quick connector.

10. After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward. And then loosen the drain screw to drain the remaining fuel from the hose and gauge.

⚠ WARNING

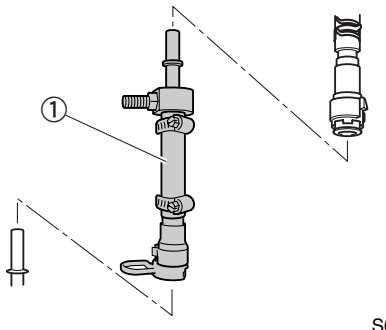
When storing the fuel pressure gauge, make sure that the drain screw is tightened securely.

Checking the pressure regulator

1. Reduce the fuel pressure. See “Reducing the fuel pressure” (6-27).

2. Disconnect the quick connector from the fuel rail. See “Disconnecting the quick connector” (6-27).

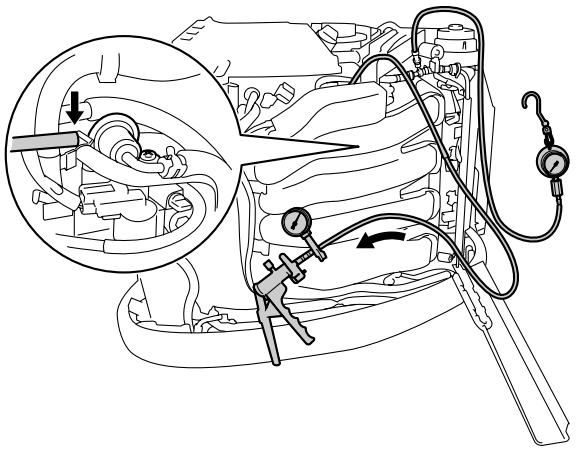
3. Connect fuel pressure gauge adapter ① between the quick connector and fuel rail.



S6BJ06003

4. Connect the fuel pressure gauge to fuel pressure gauge adapter ①.

5. Disconnect the pressure regulator hose, and then connect the special service tool to the pressure regulator.



S6AW05022

⚠ WARNING

- **Gently screw in the gauge until it is firmly connected to prevent fuel from leaking out.**
- **Before measuring the fuel pressure, make sure that the drain screw is tightened securely.**
- **Do not loosen the drain screw while measuring the fuel pressure. Loosening the drain screw can cause fuel to spray out creating a fire hazard.**

NOTE:

Clog the pressure regulator hose end as it is disconnected during the measurement.

Fuel pressure gauge:
90890-06786
Fuel pressure gauge adapter:
90890-06842
Vacuum/pressure pump gauge set:
90890-06756

6. Start the engine and let it idle.

7. Check that the fuel pressure is reduced when vacuum pressure is applied to the pressure regulator. If the fuel pressure is not reduced, replace the pressure regulator.

NOTE:
When the specified vacuum pressure is reached, the pressure regulator is operated and the fuel pressure is reduced.

8. Reduce the fuel pressure.

9. Disconnect the special service tools.

10. Connect the pressure regulator hose and quick connector.

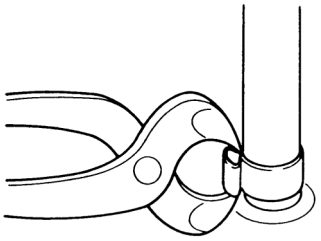
11. After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward. And then loosen the drain screw to drain the remaining fuel from the hose and gauge.

⚠ WARNING
When storing the fuel pressure gauge, make sure that the drain screw is tightened securely.

Removing the fuel hose clamp

1. Reduce the fuel pressure. See “Reducing the fuel pressure” (6-27).

2. Remove the fuel hose clamps by cutting the crimped section of the clamp.

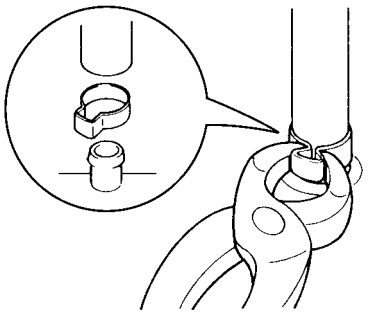


S69J4030

CAUTION:
If the fuel hose clamps are removed without cutting the crimp first, the fuel hose could be damaged.

Installing the fuel hose clamp

1. Crimp the fuel hose clamps properly to securely fasten them.



S69J4040

⚠ WARNING
Do not reuse the fuel hose clamps, always replace them with new ones, otherwise the fuel leakage may occur.

Draining the fuel

1. Reduce the fuel pressure. See “Reducing the fuel pressure” (6-27).

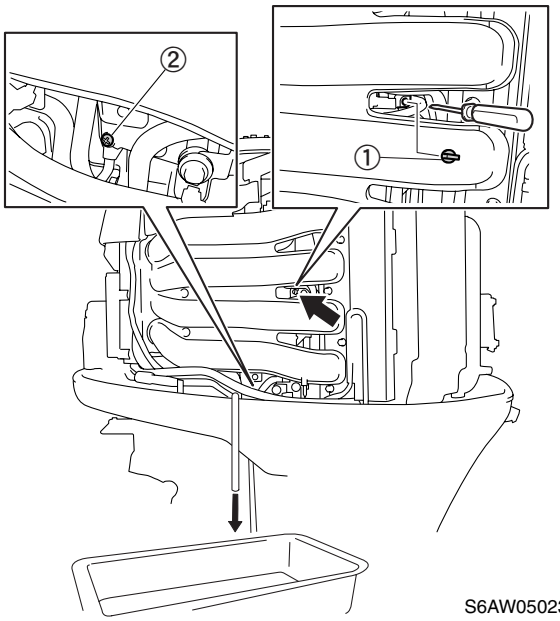
2. Remove the cap ①.

NOTE:
Remember to refit the cap ① after draining the fuel.

3. Cover the pressure check valve of the vapor separator with a rag, and then press in the pressure check valve using a thin screwdriver to release the fuel pressure.

4. Place a drain pan under the vapor separator drain hose, and then loosen the drain screw ②.

5. Drain the fuel from the vapor separator drain hose by pressing the pressure check valve using a thin screwdriver.



S6AW05023

⚠ WARNING

Reduce the fuel pressure before loosening the vapor separator drain screw, or pressurized fuel will spray out and may result in serious injury.

6. Tighten the drain screw.

Vapor separator drain screw:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

Checking the vapor separator

1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-27).

2. Disassemble the vapor separator tank, see the exploded diagram (6-22).

3. Check the needle valve. Replace needle valve assembly if bent or worn.

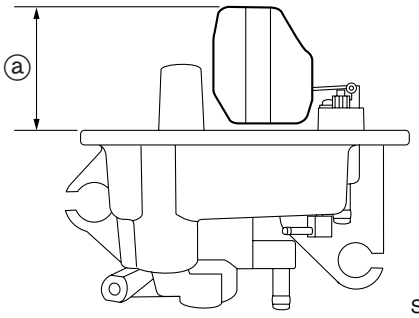

S6AL4350

4. Check the float. Replace the float if there is deterioration.

5. Check the high-pressure fuel pump filter. Clean the filter if there is dirt or residue.

6. Install the needle valve and float to the vapor separator cover.

7. Place the vapor separator cover assembly in the position shown in the illustration, and then measure the float height ⓐ.



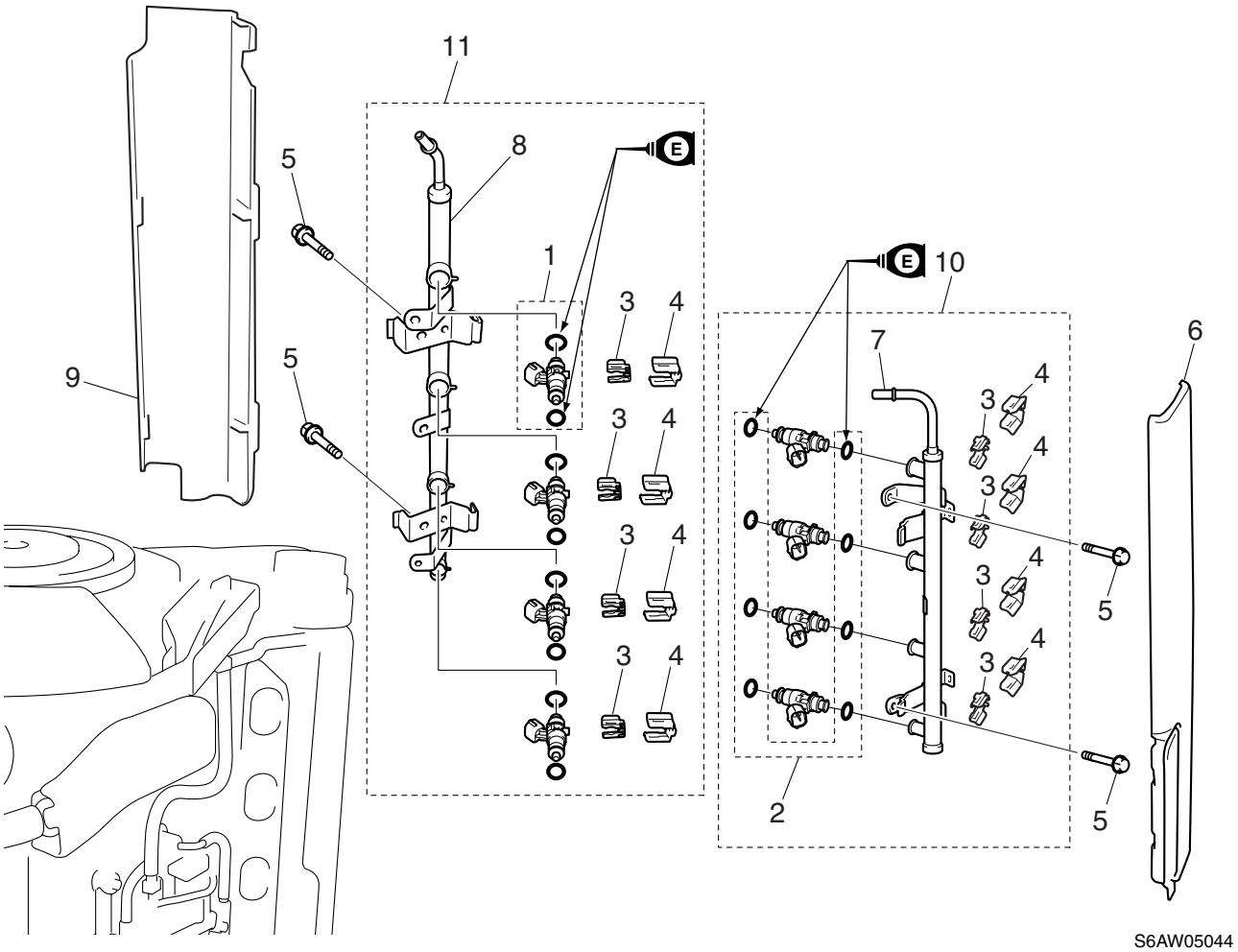
S6AW05024

NOTE:

To measure the height of the float, it should be resting on the needle valve. Do not press the float.

Float height ⓐ:
60.5 ± 3.0 mm (2.38 ± 0.12 in)

Fuel injector



S6AW05044

No.	Part name	Q'ty	Remarks
1	Fuel injector	8	
2	O-ring set	2	**Not reusable**
3	Holder	8	
4	Cap	8	
5	Bolt	4	M6 × 16 mm
6	Cover	1	
7	Fuel rail (PORT)	1	
8	Fuel rail (STBD)	1	
9	Cover	1	
10	Fuel rail assembly (PORT)	1	
11	Fuel rail assembly (STBD)	1	

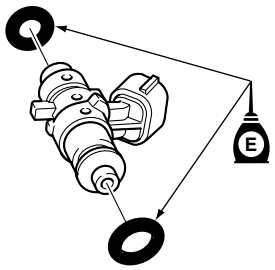
Checking the fuel rail

1. Reduce the fuel pressure. See “Reducing the fuel pressure” (6-27).

2. Check the fuel rails. Replace the fuel rail if cracked or deformed. To check the fuel injectors, see “Checking the fuel injector” (5-37).

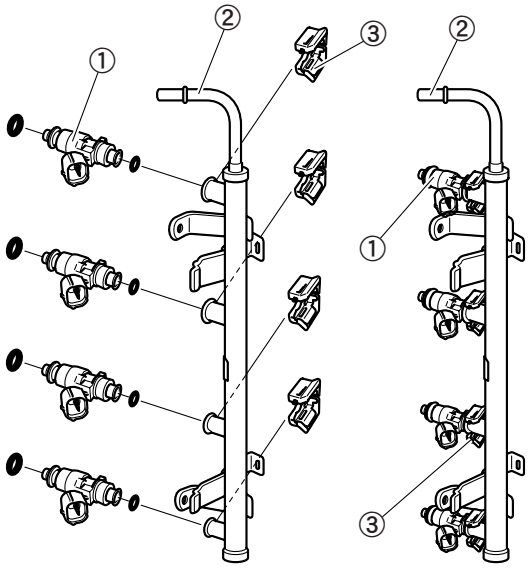
Installing the fuel injector

1. Apply engine oil to new O-rings, and then install them onto the fuel injectors.



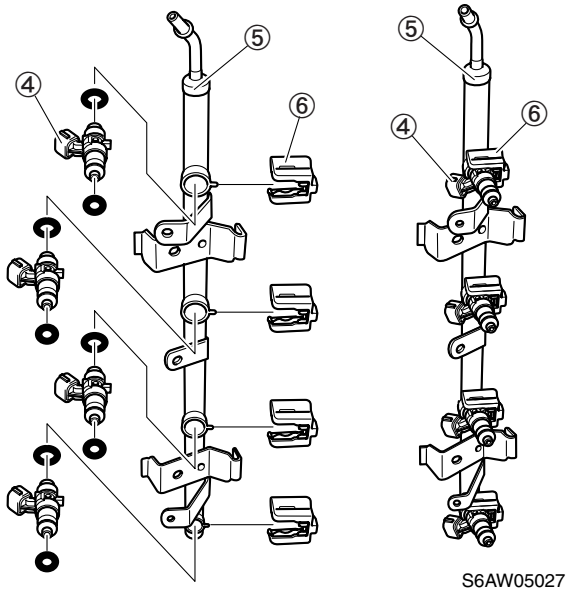
S6AW05025

2. Install the fuel injectors ① onto the port fuel rail ②, and then install the holders ③ as shown.



S6AW05026

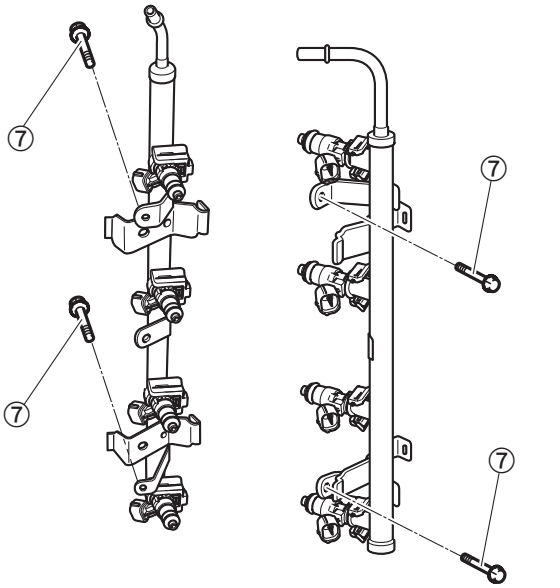
3. Install the fuel injectors ④ onto the starboard fuel rail ⑤, and then install the holders ⑥ as shown.



S6AW05027

4. Install the fuel rails onto the cylinder heads.

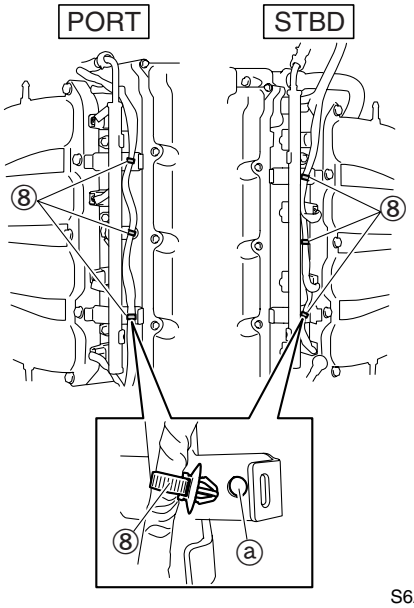
5. Tighten the bolts ⑦ equally and gradually.



S6AW05028

6. Connect the fuel injector couplers.

7. Install the wiring harness by fitting the projection of the holders ⑧ into the fuel rail stay hole ⓐ.



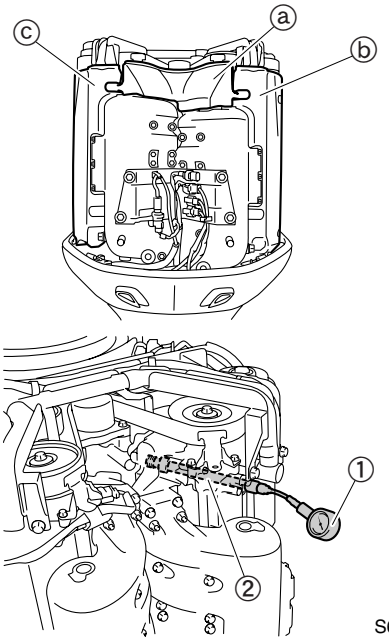
S6AW05029

Power unit

Power unit (check and adjustment)

Checking the compression pressure

1. Start the engine, run the engine until the idle speed gets stable at 600–700 r/min, and then stop the engine.
2. Remove the clip from the engine shut-off switch.
3. Disconnect all fuel injector couplers.
4. Remove the flywheel magnet cover.
5. Remove the rear cover ⓐ, cylinder head side covers ⓑ, ⓒ, all ignition coils and spark plugs, and then install the special service tools ① and ② into a spark plug hole.



S6AW06010

CAUTION:

Before removing the spark plugs, blow compressed air in the spark plug well to clear out any dirt or dust that may fall into the cylinder.

Compression gauge ①:
90890-03160
Compression gauge extension ②:
90890-06563

6. Crank the engine until the reading on the compression gauge stabilizes, and then measure the compression pressure.

NOTE:

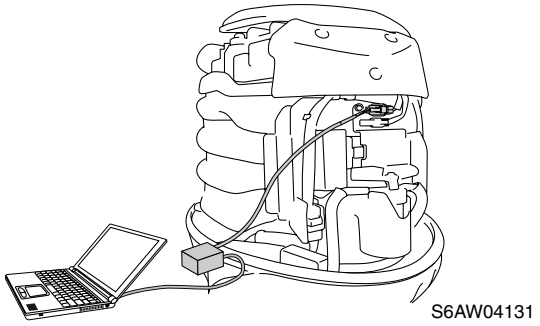
When cranking the engine, make sure that the Digital Electronic Control is in the neutral position.

Minimum compression pressure (reference data):
740 kPa (7.4 kgf/cm^2, 107.3 psi)

7. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then measure the compression pressure again.
8. If the compression pressure increases, check the pistons and piston rings. Replace if worn. To replace the pistons and piston rings, see “Assembling the power unit” (7-92).
9. If the compression pressure does not increase, check the valve clearances, valves, valve seats, cylinder head gaskets, and cylinder heads. Adjust or replace if necessary. To adjust or replace the cylinder head and cylinder head gasket, see “Cylinder head” (7-65).

Checking the oil pressure

1. Connect a computer to the outboard motor and use the YDIS. To connect and operate the YDIS, see “YDIS” (4-1) and the YDIS (Ver. 1.30 or later) Instruction manual. To display “Oil pressure.”


S6AW04131

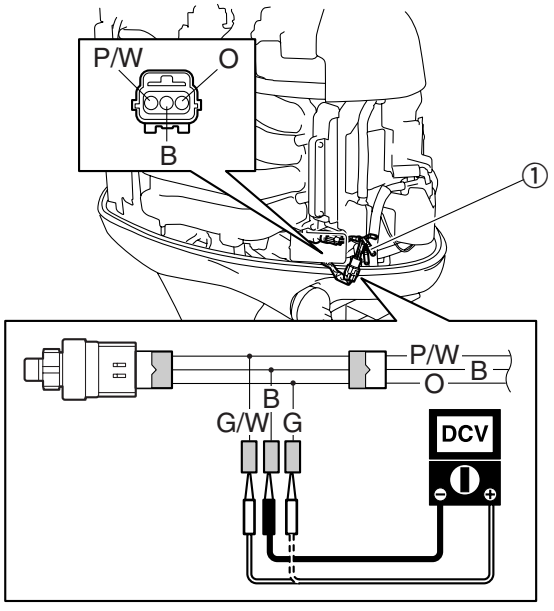
2. Start the engine, warm up the motor until the engine idle speed is stable at 600–700 r/min.

3. Check the oil pressure. If it is out of specified value, see Chapter 4, “Troubleshooting” and perform the troubleshooting again.

Oil pressure (reference data):
480 kPa (4.8 kgf/cm², 69.6 psi) at 600–700 r/min

Checking the oil pressure sensor

1. Connect the test harness (3 pins) ① to the oil pressure sensor.



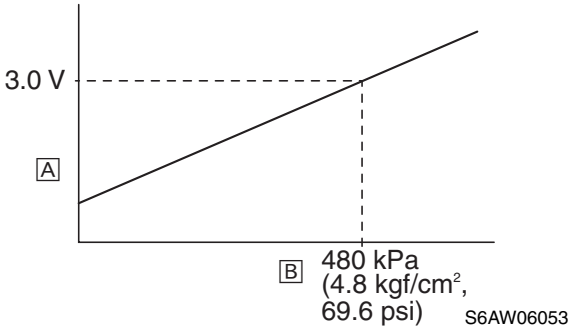
S6AW06052

Test harness (3 pins) ①:
90890-06869

2. Start the engine until the idle speed gets stable at 600–700 r/min.

3. Measure the oil pressure sensor input voltage. Check the wiring harness connection or replace the engine ECM if out of specification.

4. Measure the oil pressure sensor output voltage.



S6AW06053

A Output voltage
B Oil pressure

Oil pressure sensor input voltage (reference data):
Orange (O)–Black (B)
4.75 V–5.25 V
Oil pressure sensor output voltage (reference data):
Pink/white (P/W)–Black (B)
3.0 V at 600–700 r/min

Checking the pulser coil air gap

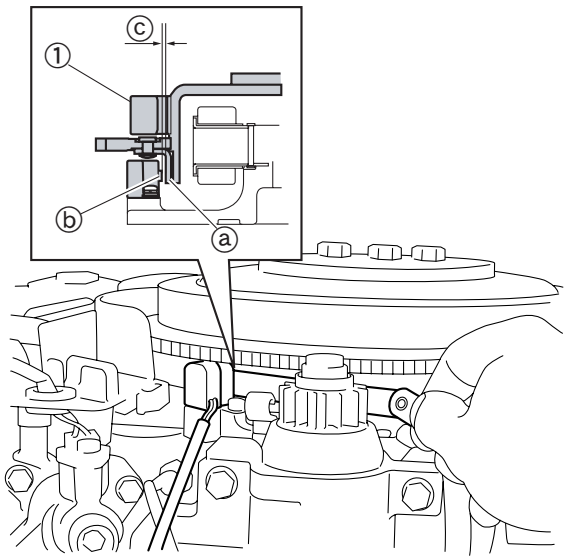
1. Turn the flywheel magnet ① clockwise to align the projection ⓐ on the flywheel magnet with the pulser coil projection ⓑ.

CAUTION:

Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.

2. Measure the pulser coil air gap ⓒ. Adjust it if out of specification.

3. Check the projections ⓐ of the flywheel magnet for damage.



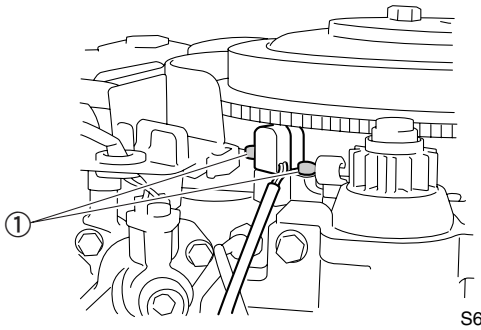
S6AW06203

Pulser coil air gap ⓒ:
0.7–1.5 mm (0.0276–0.0591 in)

Adjusting the pulser coil air gap

1. Remove the flywheel magnet. To remove the flywheel magnet, see “Removing the wiring harness, the wiring harness guide and the flywheel magnet” (7-27).

2. Loosen the pulser coil screws ①.



S6AW06205

3. Put back the flywheel magnet by tightening the removed bolts again to the specified torque.

4. Adjust the pulser coil air gap.

5. Remove the flywheel magnet, and then tighten the pulser coil screw to the specified torque.

6. Reinstall the flywheel magnet, tighten the new bolts to the specified torque.

7. Measure the pulser coil air gap. Readjust if the air gap is outside the specified range.

Pulser coil screw ①:
2.9 N·m (0.3 kgf·m, 2.1 ft·lb)
Flywheel magnet bolt:
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°

Checking the valve clearance

CAUTION:

- **Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the crankshaft or the driven sprockets when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.**

NOTE:

Measure the valve clearances when the engine is cold.

1. Reduce the fuel pressure.

NOTE:

When measuring or adjusting the valve clearances, the fuel line must be disconnected, so be sure to reduce the fuel pressure before performing the disassembly procedure. To reduce the fuel pressure, see “Reducing the fuel pressure” (6-27).

2. Remove the flywheel magnet cover, rear cover and side covers.

3. Remove the blowby hose ①.

4. Remove the bracket ②.

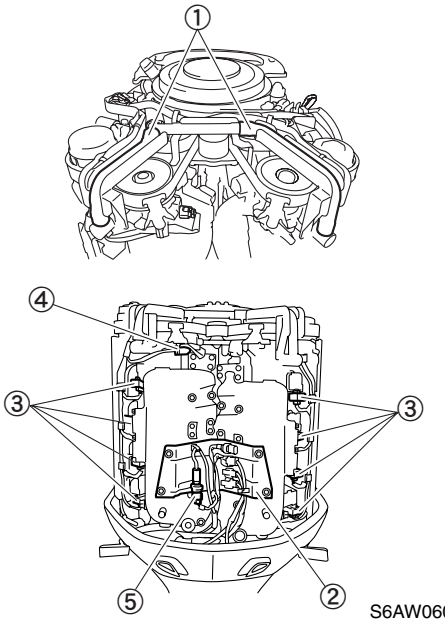
7

5. Disconnect the ignition coil couplers ③, condenser ④, and water pressure sensor ⑤.

6. Remove the wiring harness guide. To remove the wiring harness guide, see "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).

7. Remove all ignition coils and spark plugs.

8. Remove the exhaust joints.



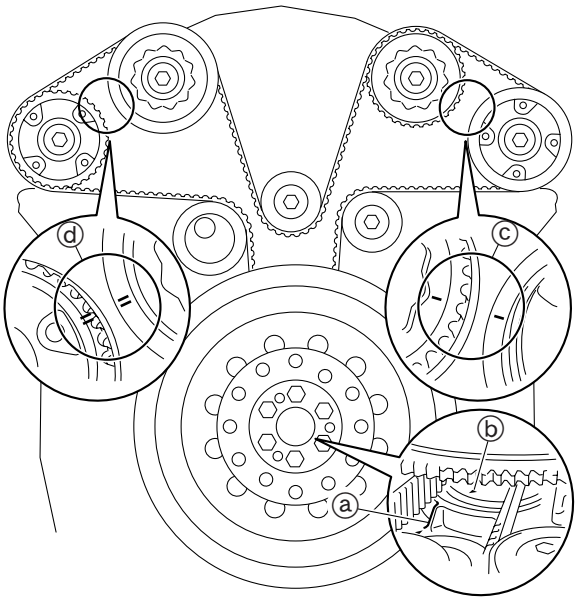
S6AW06013-a

9. Remove the cylinder head covers (PORT and STBD).

NOTE:
See the exploded diagram (7-52).

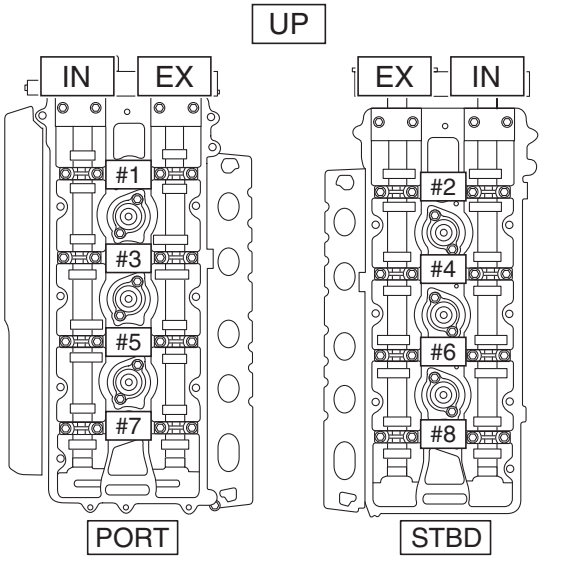
10. Turn the flywheel magnet clockwise, and align the "1TDC" mark ⓐ with the crank alignment mark ⓑ.

11. Check that the "I" marks ⓒ on the port driven sprockets are aligned, and check that the "II" marks ⓓ on the starboard driven sprockets are aligned.

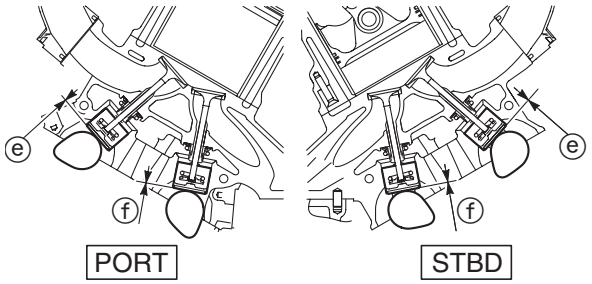


S6AW06014

12. Measure each valve clearance ⓔ and ⓕ according to steps 13–15.



S6AW06015



S6AW06016

NOTE:
Note the measurement data.

Valve clearance (cold):
Intake ⓔ:
0.20 ± 0.03 mm (0.008 ± 0.001 in)
Exhaust ⓕ:
0.34 ± 0.03 mm (0.013 ± 0.001 in)

13. Check the intake and exhaust valve clearances of the relevant cylinders.

	#1	#2	#3	#4	#5	#6	#7	#8
IN	✔	✔			✔		✔	
EX	✔		✔	✔				✔

S6AW06055

14. Then, turn the flywheel magnet clockwise by 360°, and align the "1TDC" mark ⓐ with the crank alignment mark ⓑ.

15. Check the intake and exhaust valve clearances of the relevant cylinders.

	#1	#2	#3	#4	#5	#6	#7	#8
IN			✔	✔		✔		✔
EX		✔			✔	✔	✔	

S6AW06056

16. Adjust if either of the valve clearances is out of the specified range.

Adjusting the valve clearance

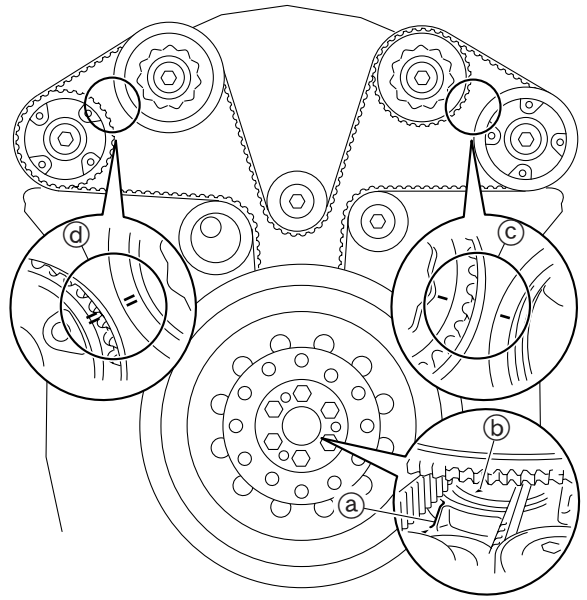
CAUTION:

- **Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the flywheel magnet or the driven sprockets when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.**

NOTE:
Check the valve clearances when the engine is cold.

1. Turn the flywheel magnet clockwise, and then align the "1TDC" mark ⓐ with the crank alignment mark ⓑ.

2. Check that the "I" marks ⓒ on the port driven sprockets are aligned, and check that the "II" marks ⓓ on the starboard driven sprockets are aligned.

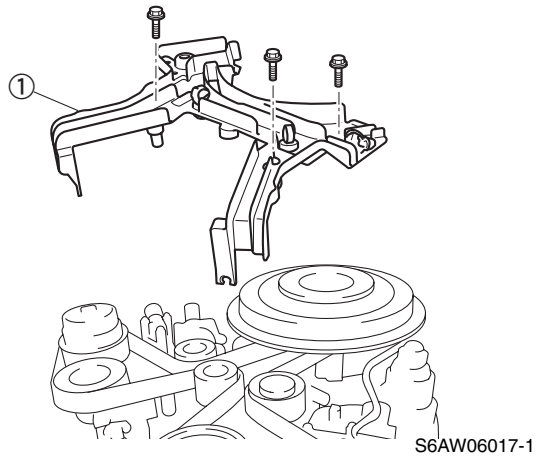


S6AW06014

3. Remove all ignition coils and spark plugs.

7

4. Remove the wiring harness guide ①.
   To remove the wiring harness guide, see "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).

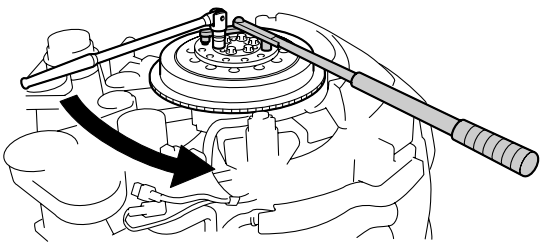


S6AW06017-1

5. Remove the exhaust joints.

6. Remove the cylinder head covers (PORT and STBD).

7. Loosen the flywheel magnet bolts.


S6AW06018

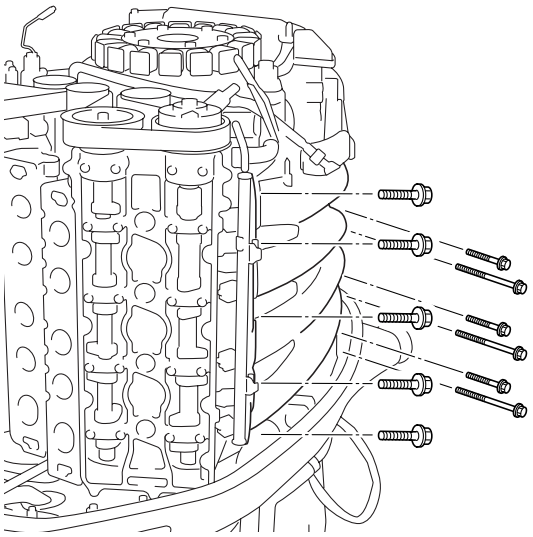
CAUTION:

Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

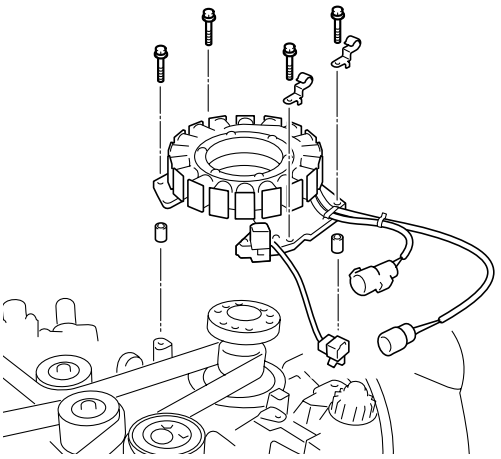
Flywheel holder: 90890-06522

8. Remove the flywheel magnet and dowel.

9. Remove the intake manifold (STBD).

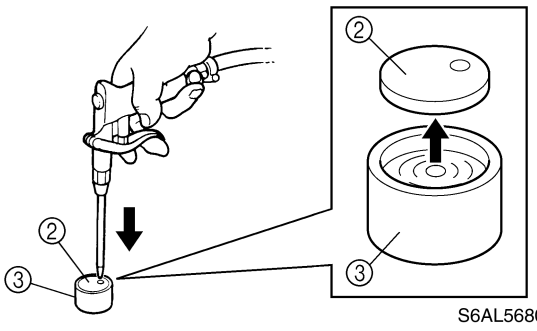

S6AW06057

10. Remove the stator assembly bolts, and then remove the stator assembly.


S6AW06054-1

11. Remove the timing belt, driven sprockets, and camshafts. To remove the timing belt, driven sprockets, and camshafts, see "Removing the timing belt, driven sprocket and camshaft" (7-54).

12. Remove the valve shim ② from the valve lifter ③ using compressed air.



S6AL5680

NOTE:
Do not mix the valve train parts. Keep them organized in their proper groups.

13. Measure the valve shim thickness using a micrometer, and then note the measurement data.

14. Select the necessary valve shim by calculating its thickness using the following formula.

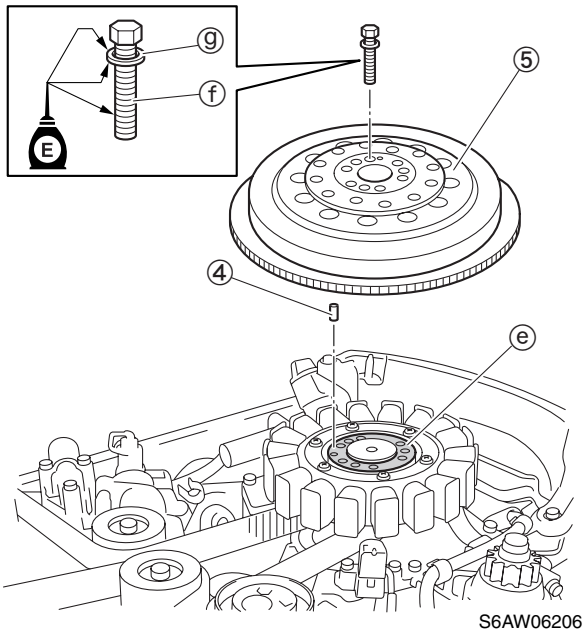
Necessary valve shim thickness = Removed valve shim thickness + Measured valve clearance – Specified valve clearance

15. Install the necessary valve shim into the valve lifter.

16. Install the camshafts, driven sprockets, and timing belt. To install the camshafts, driven sprockets, and timing belt, see “Installing the camshaft, driven sprocket, and timing belt” (7-59).

17. Install the stator assembly.

18. Install the dowel ④ and the flywheel magnet ⑤. Totally the crankshaft flange seating ⓔ and the flywheel magnet seating must be cleaned and degrease before installation. Apply some engine oil to the threads of the flywheel magnet bolts ⓕ and the washers ⓖ.

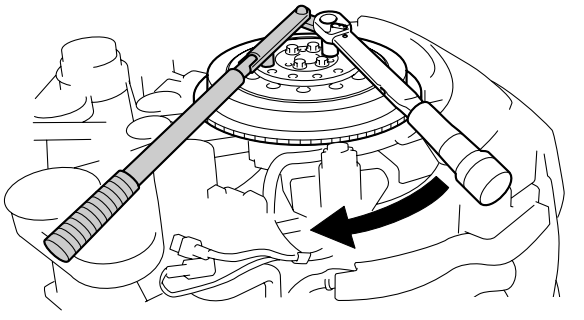


S6AW06206

CAUTION:
Do not reuse the flywheel magnet bolts, always replace it with a new one.

19. Install the intake manifold (STBD).

20. Tighten the flywheel magnet bolts to the specified torque.


S6AW06059

CAUTION:
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

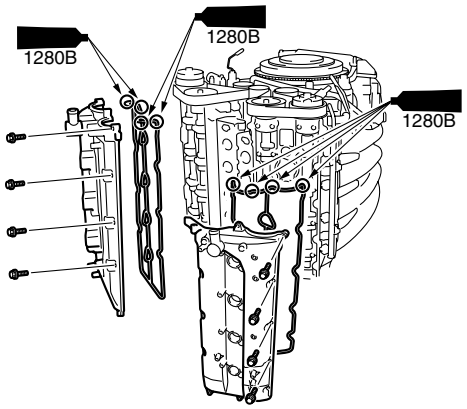
Flywheel holder: 90890-06522

Flywheel magnet bolt:
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°

21. Measure each valve clearance and adjust again if out of specification.

Valve clearance (cold):
Intake:
0.20 ± 0.03 mm (0.008 ± 0.001 in)
Exhaust:
0.34 ± 0.03 mm (0.013 ± 0.001 in)

22. Install the cylinder head covers (PORT and STBD), and then tighten the bolts to the specified torque in 2 stages.

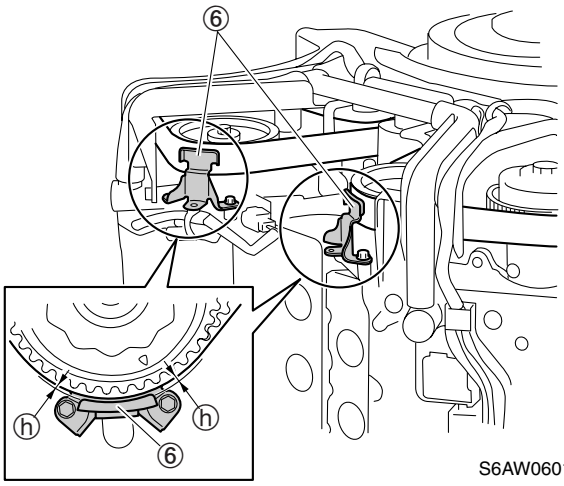


S6AW06060

NOTE:
- Apply sealant to the edge of the cylinder head cover gasket before installation.
- Tighten the cylinder head cover bolts to the same torque in both stages.
- See the exploded diagram (7-52).

Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

23. Install the timing belt guides ⑥, and then adjust the timing belt guide clearance ⓗ.



S6AW06019

Timing belt guide clearance ⓗ:
1.0 ± 0.5 mm (0.04 ± 0.02 in)

24. Install the wiring harness guide. To install the wiring harness guide, see “Installing the wiring harness, the wiring harness guide and the flywheel magnet” (7-29).

25. Install the spark plugs and ignition coils.

Spark plug:
28 N·m (2.8 kgf·m, 20.7 ft·lb)
Ignition coil bolt:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

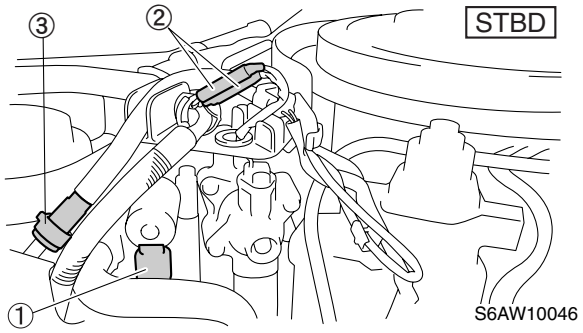
26. Install all parts removed during disassembly.

27. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

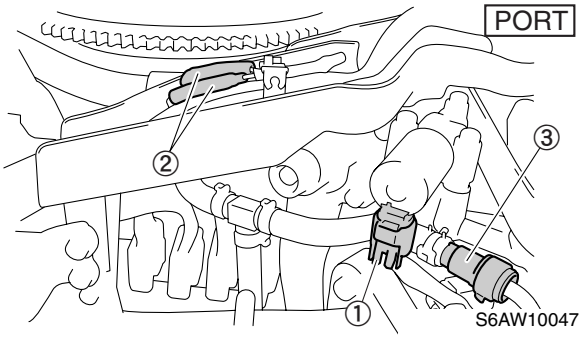
CAUTION:
Incorrect assembly of the flywheel magnet cover may result in the interference with the timing belt.

Checking the thermostat

1. Reduce the fuel pressure. To reduce the fuel pressure, see “Reducing the fuel pressure” (6-27).
2. Remove the flywheel magnet cover.
3. Disconnect the OCV couplers ①.
4. Disconnect the thermoswitch connectors ②.
5. Disconnect the quick connectors ③. To disconnect the quick connector, see “Disconnecting the quick connector” (6-27).



S6AW10046

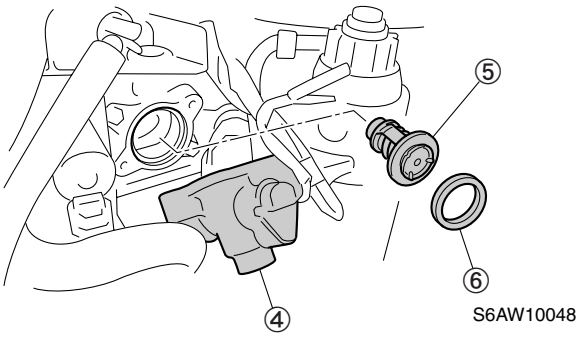


S6AW10047

⚠ WARNING

It is dangerous if the quick connectors are disconnected suddenly since pressurized fuel will spray out. Be sure to reduce the fuel pressure before disconnecting the quick connectors.

6. Remove the thermostat covers ④ and thermostats ⑤ (PORT and STBD).

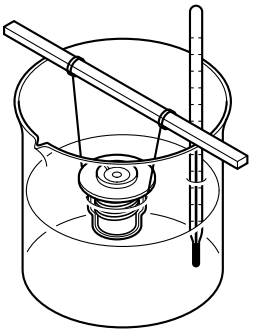


S6AW10048

CAUTION:

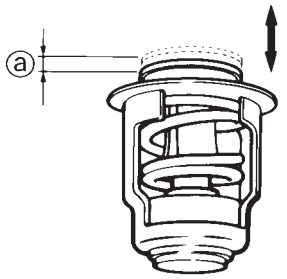
Do not reuse the gaskets ⑥, always replace them with new ones.

7. Suspend the thermostat in a container of water.
8. Place a thermometer in the water and slowly heat the water.


S6AW10049

7

9. Measure the thermostat valve opening ⓐ at the specified water temperatures. Replace the thermostat if out of specification.



S6AW10050

Water temperature	Valve opening ⓐ
58–62 °C (136–144 °F)	0.05 mm (0.0020 in) (valve begins to lift)
above 70 °C (158 °F)	more than 5.0 mm (0.20 in)

10. Install the thermostats and thermostat covers (PORT and STBD).

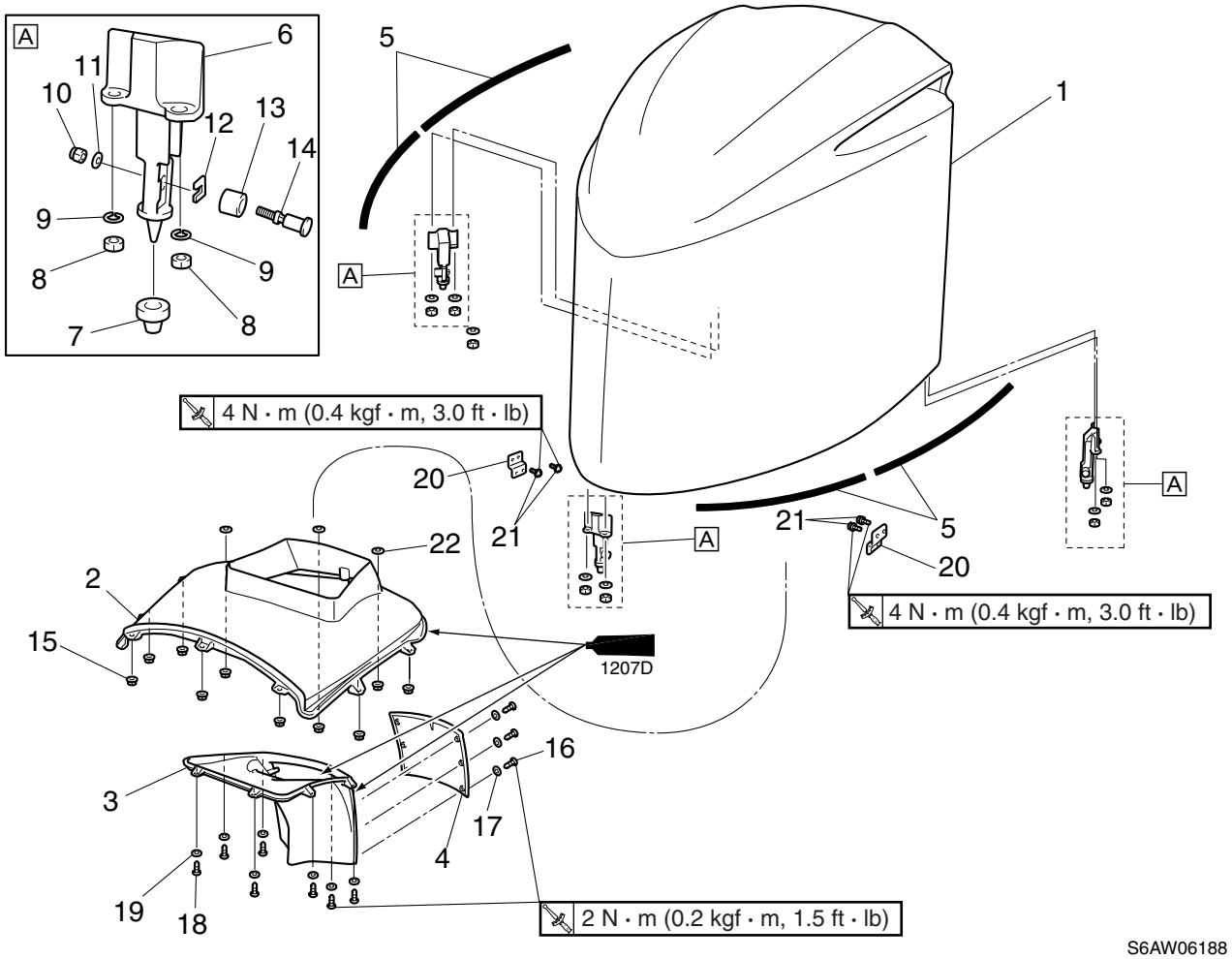
NOTE:
It is recommended to check the thermostat cover anodes before installing the thermostat covers.

11. Connect the thermoswitch connectors, quick connectors, and OCV couplers.

12. Route and fasten the wiring harness in its original position. To route and fasten the wiring harness, see “Wiring harness routing” (5-7).

13. Install the flywheel magnet cover.

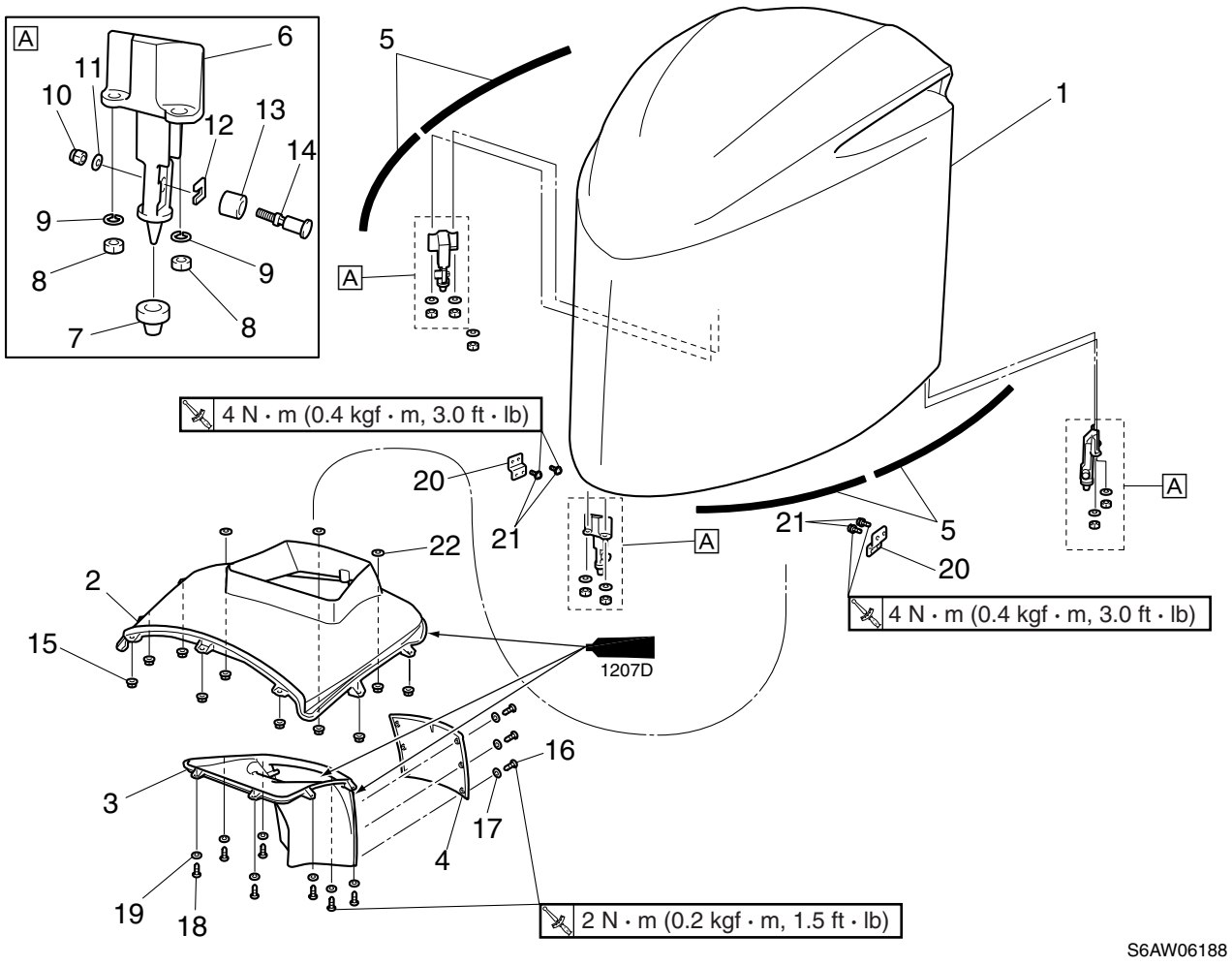
Top cowling



S6AW06188

No.	Part name	Q'ty	Remarks
1	Top cowling	1	
2	Air duct molding	1	
3	Water-separator duct	2	
4	Cover	6	
5	Rubber seal	4	
6	Holder	3	
7	Damper	3	
8	Nut	6	
9	Washer	6	
10	Nut	3	
11	Washer	3	
12	Plate	3	
13	Hook	3	
14	Shaft	3	
15	Nut	10	
16	Screw	6	ø5 × 15 mm
17	Washer	6	

7



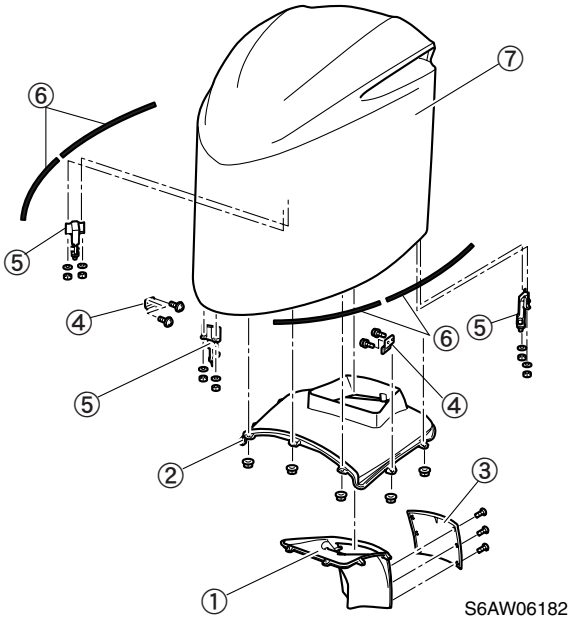
S6AW06188

No.	Part name	Q'ty	Remarks
18	Screw	7	ø5 × 15 mm
19	Washer	7	
20	Lock plate	2	
21	Screw	4	ø5 × 10 mm
22	Washer	3	

Disassembling the top cowling

1. Remove the water-separator duct ① from the air duct molding ②, and remove the cover ③ from the water-separator duct ①.

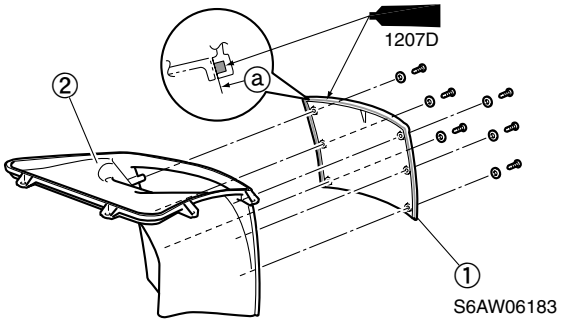
2. Remove the air duct molding ②, the rock plate ④, the holder ⑤, and the rubber seal ⑥ from the cowling ⑦.



S6AW06182

Assembling the top cowling

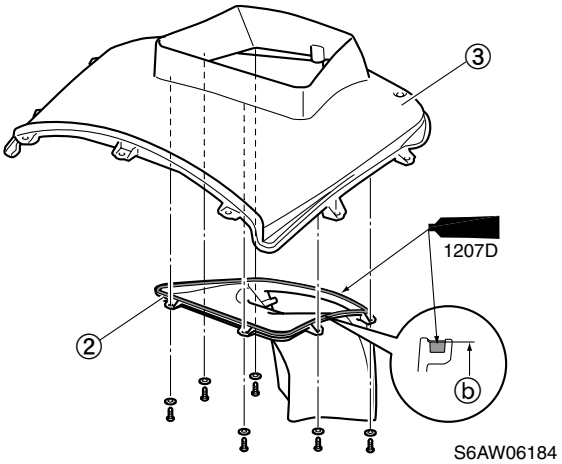
1. Fill up the groove with sealant to the level ⓐ, and install the cover ① to the water-separator duct ②.



S6AW06183

	Cover screw: 2.0 N·m (0.2 kgf·m, 1.5 ft·lb)

2. Fill the groove with sealant above the level ⓑ, but not to the extent that the sealant surface swells out of the groove. Then, install the water-separator duct ② in the air duct molding ③.



S6AW06184

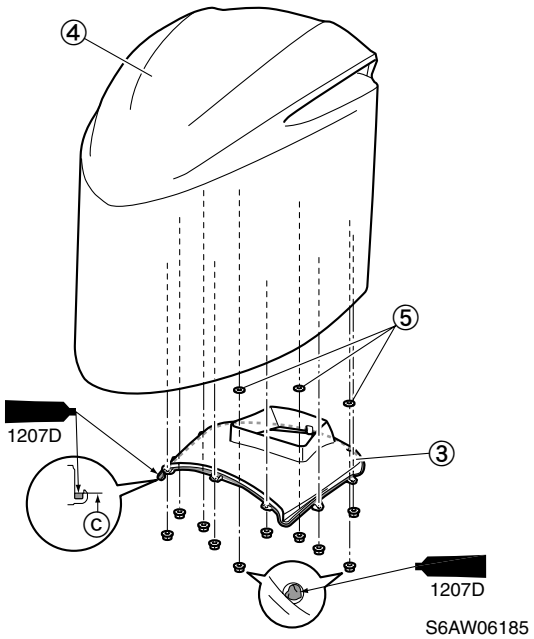
	Water-separator duct screw: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

3. Fill the groove with sealant above the level ⓒ, but not to the extent that the sealant surface swells out of the groove. Then, install the air duct molding ③ to the top cowling ④.

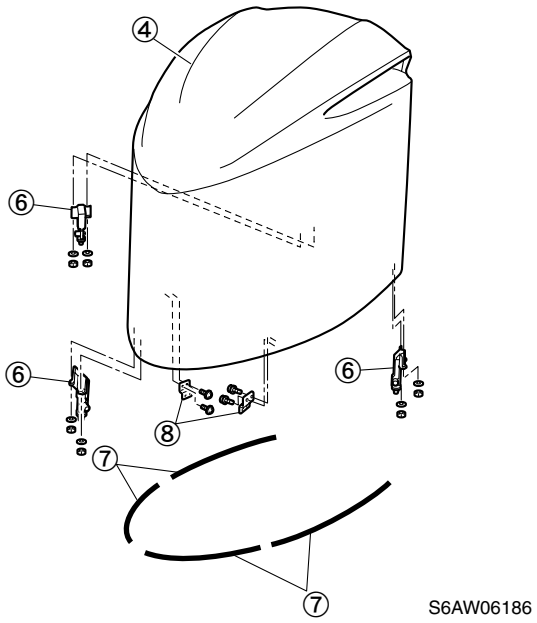
4. Apply the sealant so it will cover the air duct molding mounting nuts as shown.

7

5. Insert plain washers ⑤ between the bosses on the top cowling ④ and the air duct molding ③.



6. Install the holder ⑥ to the top cowling ④.



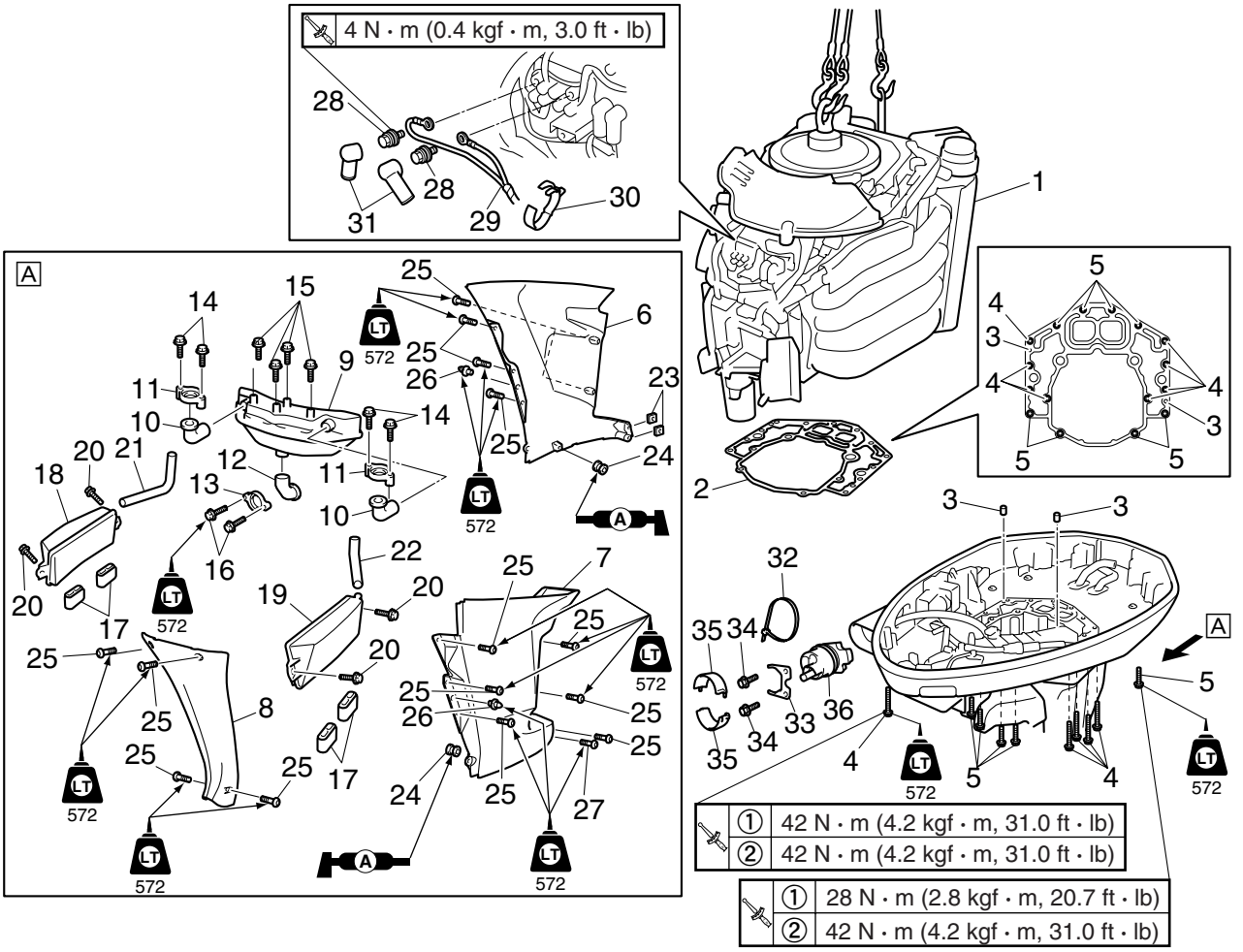
NOTE:
Always perform a mount position adjustment when the holder is removed. To adjust the mounting position, see "Checking the top cowling" (10-26).

7. Install the rubber seal ⑦.

8. Install the rock plate ⑧.

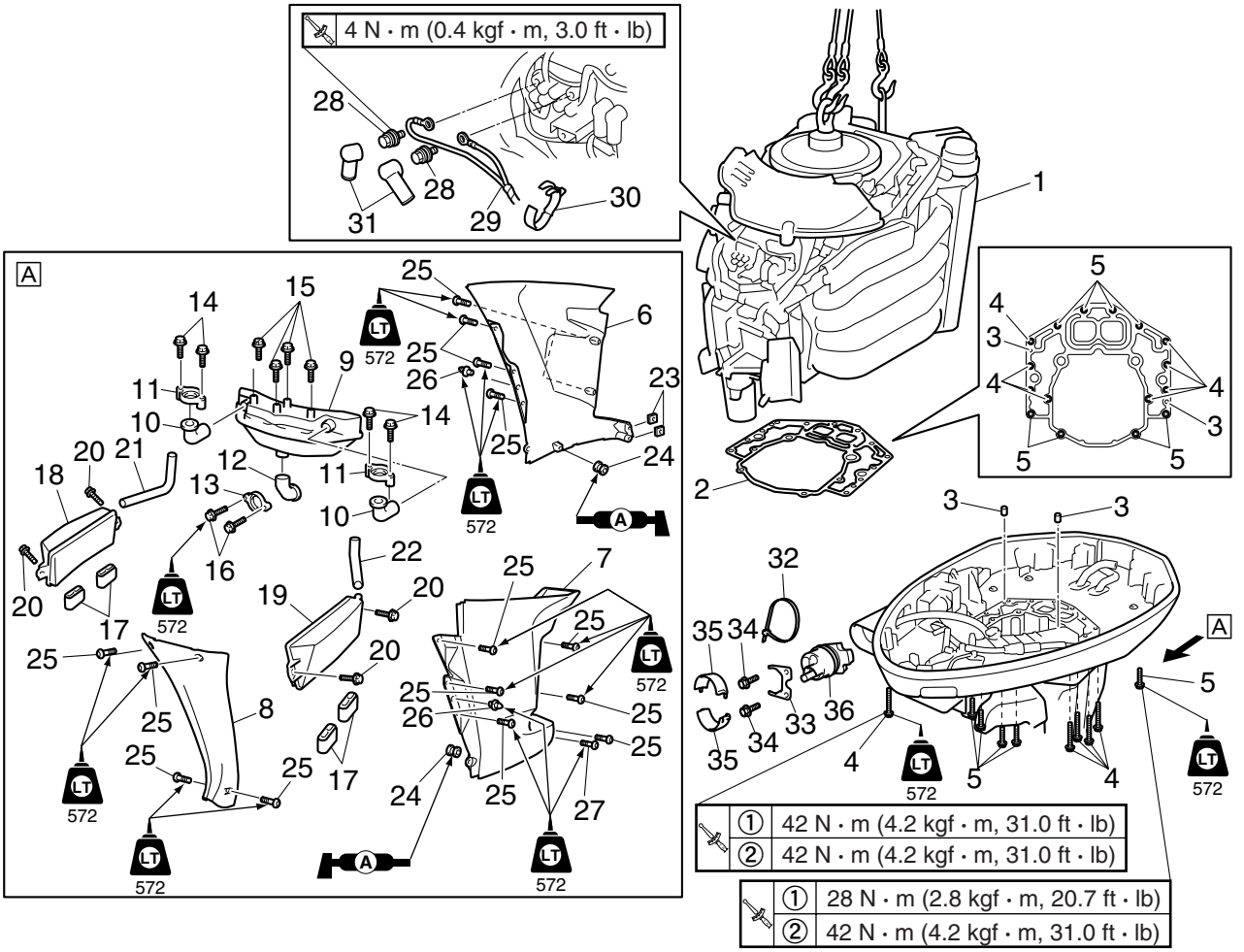
	Lock plate screw: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

Power unit assembly



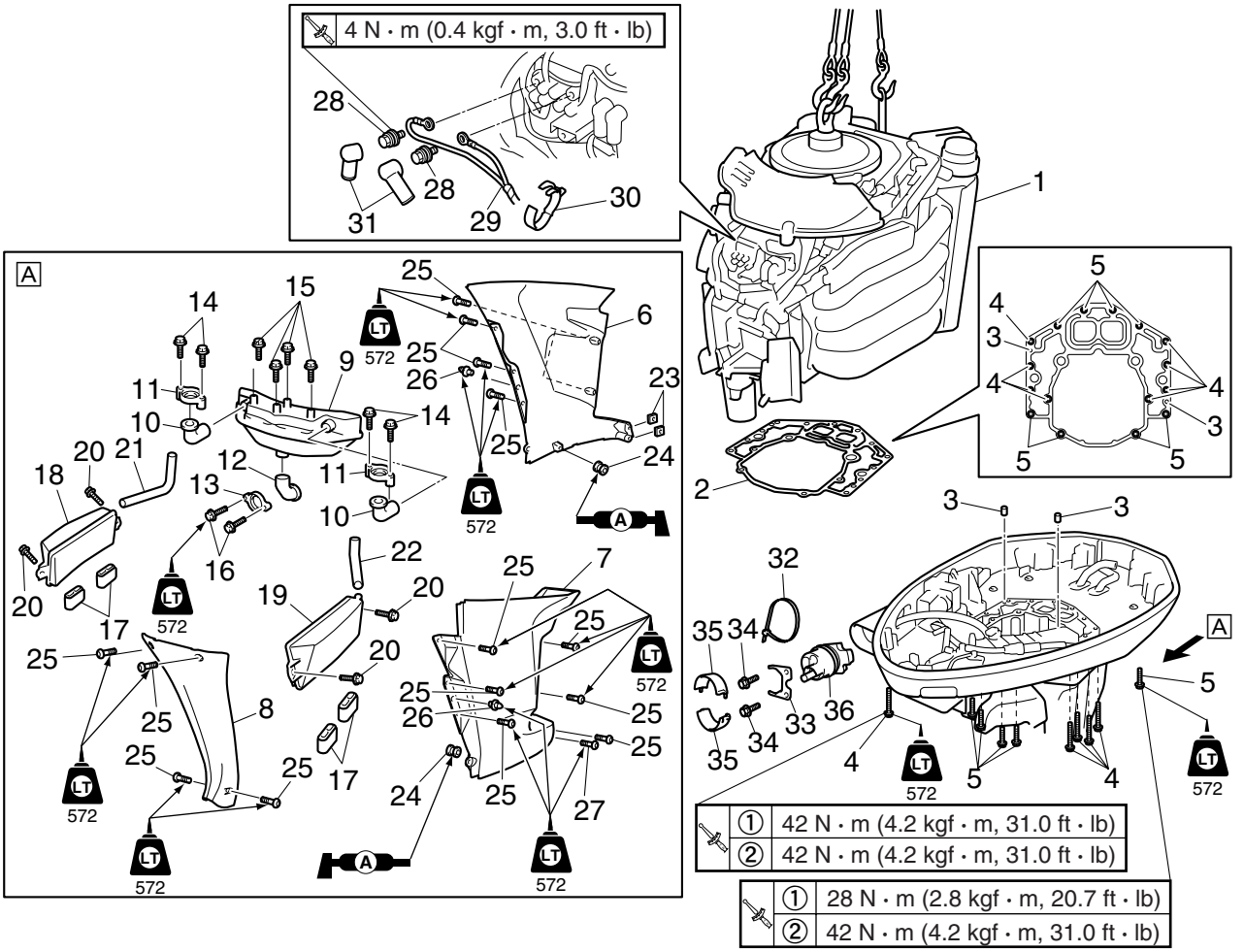
S6AW06189

No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Gasket	1	**Not reusable**
3	Dowel	2	
4	Bolt	8	M10 × 140 mm
5	Bolt	8	M10 × 35 mm
6	Apron (PORT)	1	
7	Apron (STBD)	1	
8	Apron (AFT)	1	
9	Silencer	1	
10	Pipe	2	
11	Spacer	2	
12	Pipe	1	
13	Spacer	1	
14	Bolt	4	M6 × 14 mm
15	Bolt	4	M6 × 14 mm
16	Bolt	2	M6 × 25 mm
17	Rubber seal	4	



S6AW06189

No.	Part name	Q'ty	Remarks
18	Drain box (PORT)	1	
19	Drain box (STBD)	1	
20	Bolt	4	M6 × 16 mm
21	Pipe (PORT)	1	
22	Pipe (STBD)	1	
23	Nut	2	
24	Grommet	2	
25	Bolt	15	M6 × 14 mm
26	Apron stay	4	
27	Bolt	1	M6 × 30 mm
28	Bolt	2	M6 × 10 mm
29	PTT motor lead	1	
30	Clamp	1	
31	Terminal cap	2	
32	Plastic tie	1	
33	Stopper	1	
34	Bolt	2	M6 × 20 mm



S6AW06189

No.	Part name	Q'ty	Remarks
35	Tube retainer	1	
36	Grommet	1	

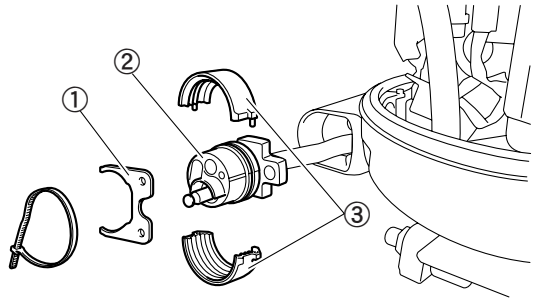
7

Removing the power unit

NOTE:

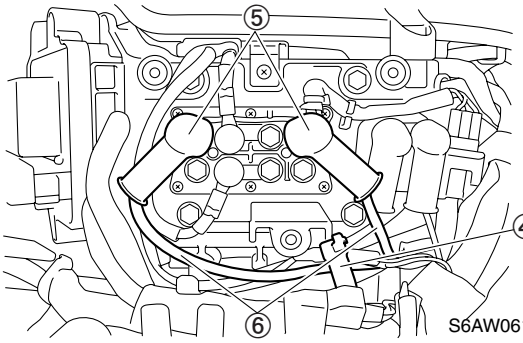
- Be sure to reduce the fuel pressure before removing the power unit. To reduce the fuel pressure, see “Reducing the fuel pressure” (6-27).
- It is recommended to loosen the flywheel magnet bolts before removing the power unit to improve working efficiency.

1. Remove the flywheel magnet cover.
2. Disconnect the fuel hose joint.
3. Remove the stopper ①, rigging grommet ②, and rigging tube retainer ③, and then disconnect the battery cable and extension wire harness.



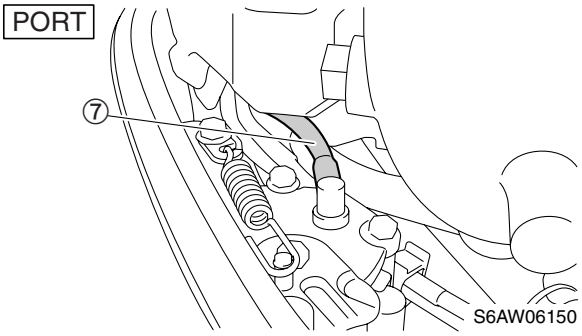
S6AW06148

4. Remove the clamp ④ and caps ⑤, and then disconnect the PTT motor leads ⑥.



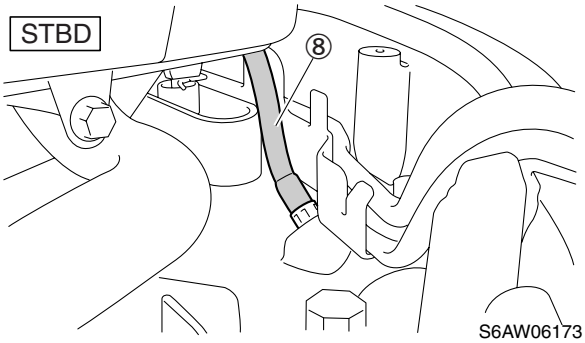
S6AW06149

5. Disconnect the vapor gas hose ⑦ from the bottom cowling.



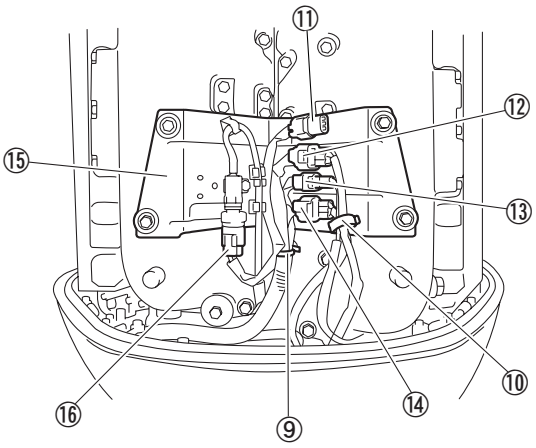
S6AW06150

6. Disconnect the cooling water pilot hose ⑧.



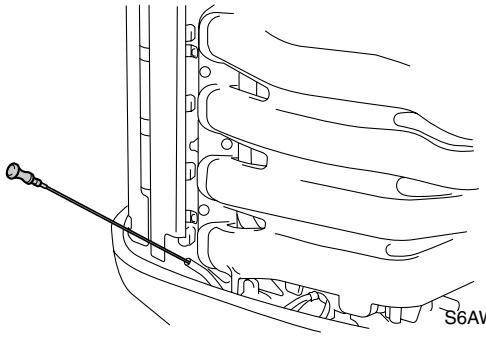
S6AW06173

7. Remove the plastic tie ⑨ and the clamp ⑩, and lift the harness. Remove the speed sensor coupler ⑪, the SPS coupler ⑫, the shift-actuator coupler ⑬, and PTT switch coupler ⑭ from the bracket ⑮. Disconnect the water pressure sensor coupler ⑯, the speed sensor coupler ⑪, the SPS coupler ⑫, the shift-actuator coupler ⑬, and the PTT switch coupler ⑭.



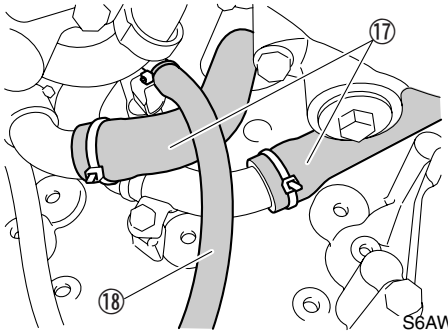
S6AW06174

8. Remove the oil dipstick.


S6AW06151

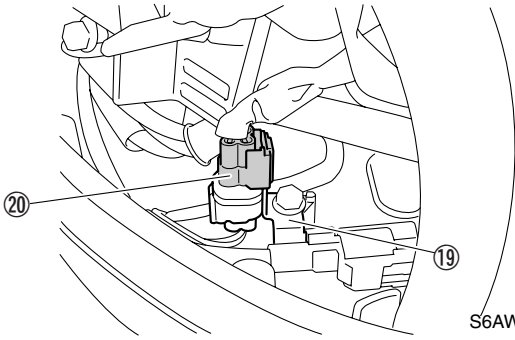
9. Disconnect the fuel hose from the fuel filter.

10. Remove the water hoses ⑰ and the flushing hose ⑱.



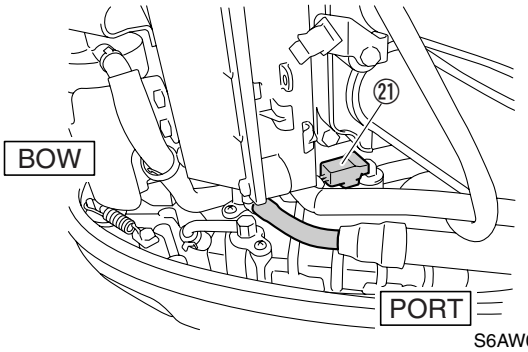
S6AW06152

11. Remove the bracket ⑲ from the bottom cowling, and then disconnect the PTT sensor coupler ⑳.



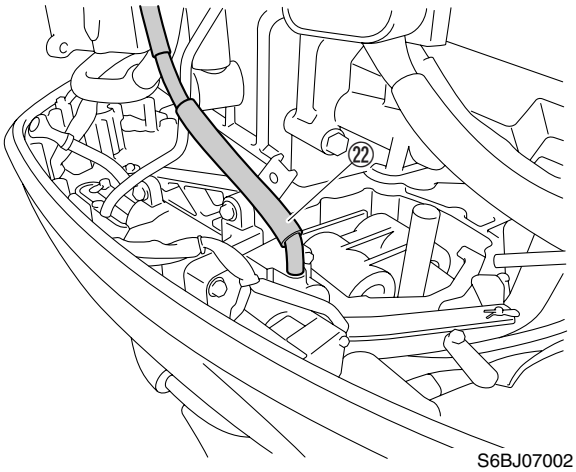
S6AW06175

12. Disconnect the low pressure fuel pump coupler ㉑ and the fuel hose.



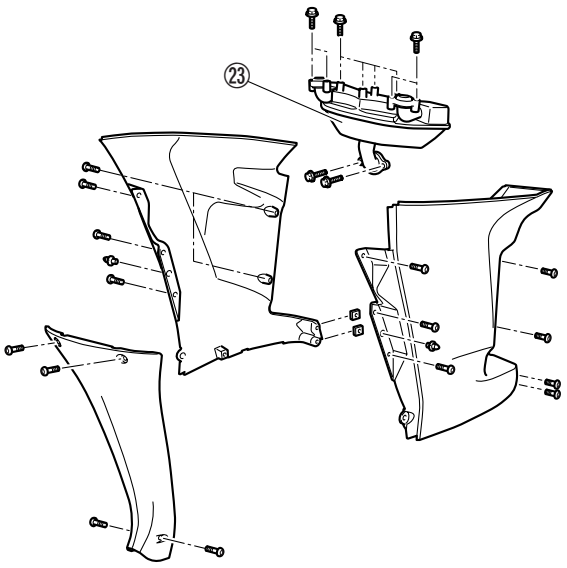
S6AW06153

13. Disconnect the shift-actuator hose ㉒.



S6BJ07002

14. Remove the aprons and silencer ㉓.



S6AW06154-a

7

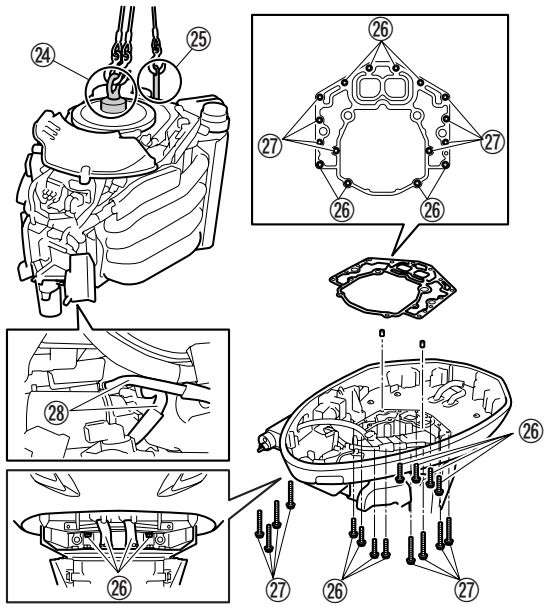
15. Install the engine lifting eye ㉔ and the balance hanger ㉕ to the power unit, and lift the power unit.

NOTE:
Eye mounting bolts M10. Use the general tightening torque for installation.

Engine lifting eye ㉔: 90890-06820
Balance hangar ㉕: 90890-06822

16. Remove the bolts ㉖ and ㉗, and remove the power unit.

17. Lift the power unit slightly and remove the water hose ㉘ make sure that there are not any hose or leads connected to the power unit. Then remove the power unit.



S6AW06156

CAUTION:
Always use the engine lifting eye ㉔ and balance hangar ㉕ among the special service tool to lift up the power unit.

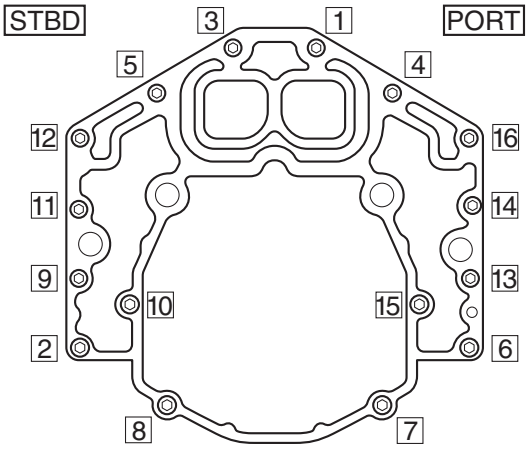
Installing the power unit

1. Be sure to install the shift rod assembly onto the upper exhaust guide before installing the power unit.

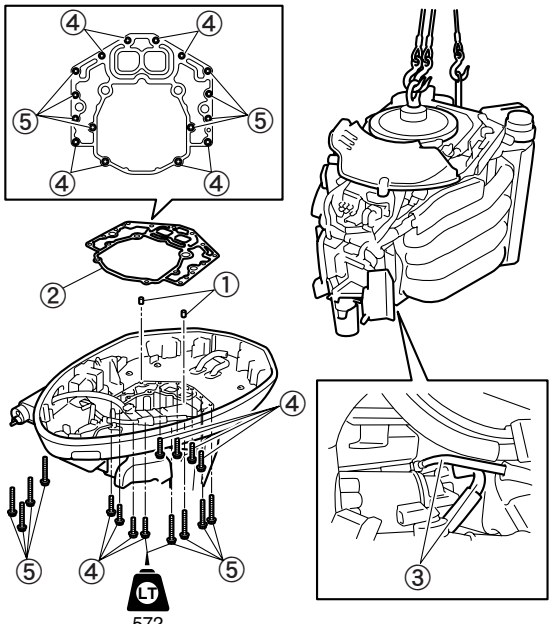
2. Apply WR-No2 to the drive shaft spline.

3. Clean the power unit mating surface, and install the dowels ① and then a new gasket ②.

4. Connect the water hoses ③ to the crankcase cover while the power unit is lifted, and then mount the power unit with bolts ④ and ⑤, and then tighten the bolts to the specified torque in sequence shown.



S6BJ07006

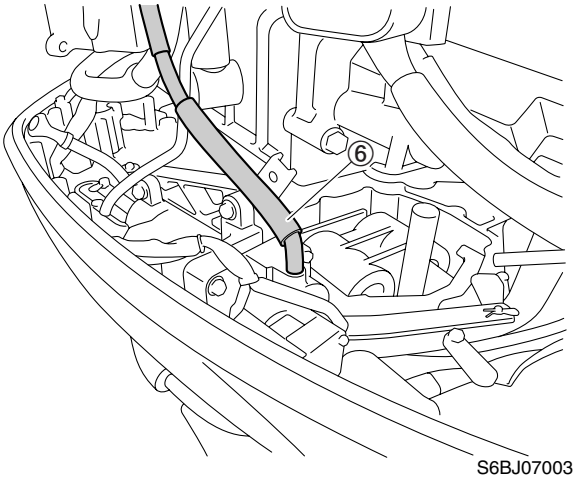


S6AW06159

NOTE:
Assembling of the drive shaft to the spline can be performed smoothly by trimming the drive unit angle.

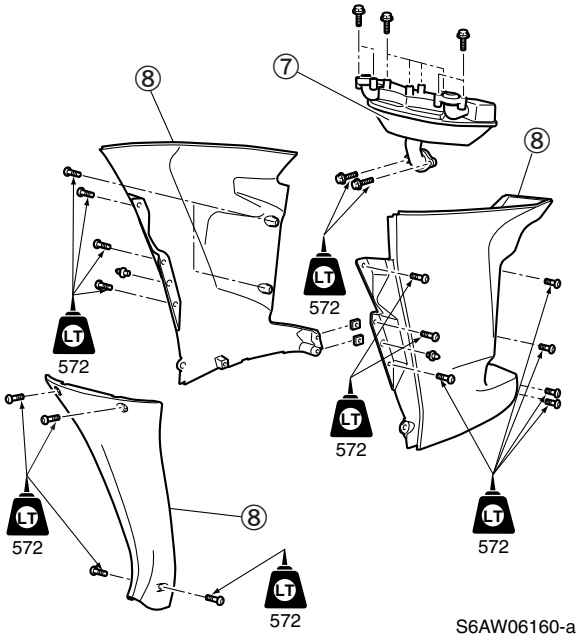
Power unit mounting bolt ④:
1st: 28 N·m (2.8 kgf·m, 20.7 ft·lb)
2nd: 42 N·m (4.2 kgf·m, 31.0 ft·lb)
Power unit mounting bolt ⑤:
1st: 42 N·m (4.2 kgf·m, 31.0 ft·lb)
2nd: 42 N·m (4.2 kgf·m, 31.0 ft·lb)

5. Connect the shift-actuator hose ⑥.



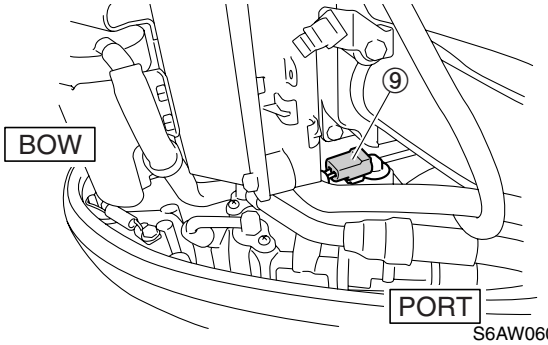
S6BJ07003

6. Install the silencer ⑦ and aprons ⑧.



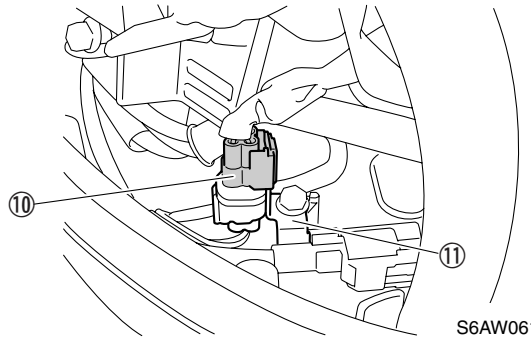
S6AW06160-a

7. Connect the low-pressure fuel pump coupler ⑨.



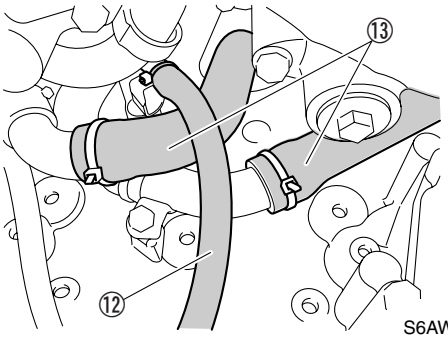
S6AW06020

8. Connect the PTT sensor coupler ⑩, and then install the bracket ⑪ to the bottom cowling.



S6AW06161-a

9. Install the flushing hose ⑫ and the water hoses ⑬.

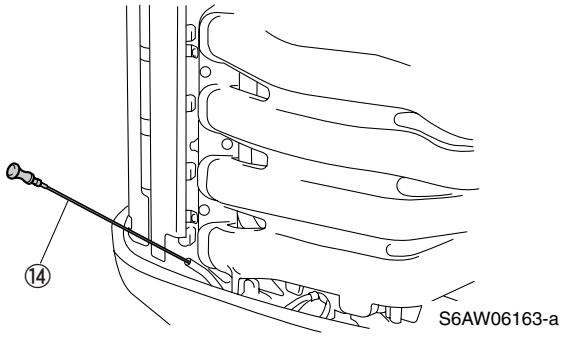


S6AW06162-a

10. Install the fuel hose to the fuel filter. To install the fuel hose, see “Fuel filter” (6-5).

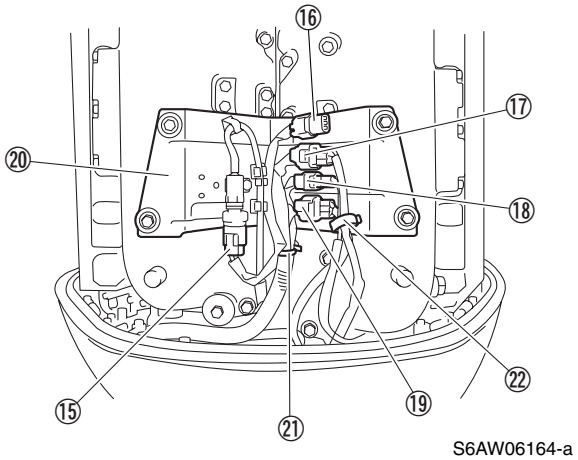
7

11. Install the oil dipstick ⑭.

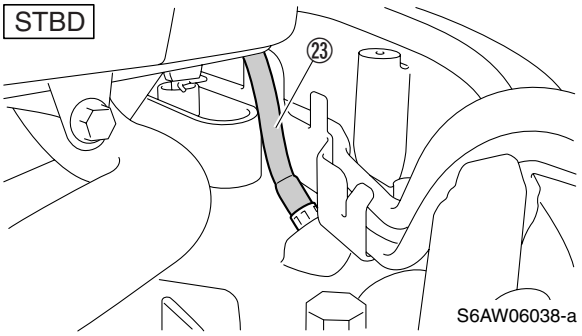


NOTE:
Apply engine oil to the O-ring before installing the dipstick guide.

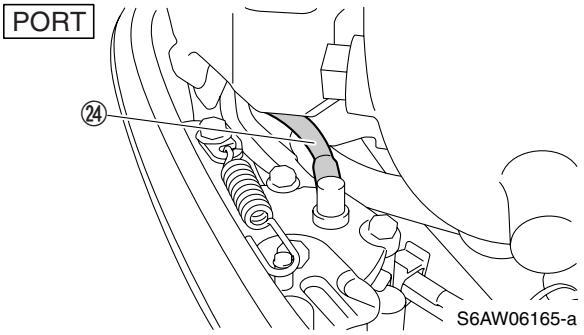
12. Connect the water pressure sensor coupler ⑮, the speed sensor coupler ⑯, SPS coupler ⑰, the shift-actuator coupler ⑱, and the PTT switch coupler ⑲.
    Install the speed sensor coupler ⑯, the SPS coupler ⑰, the shift-actuator coupler ⑱, and the PTT switch coupler ⑲ to the bracket ⑳.
    Install the plastic tie ㉑ and the clamp ㉒, and then install the harness.



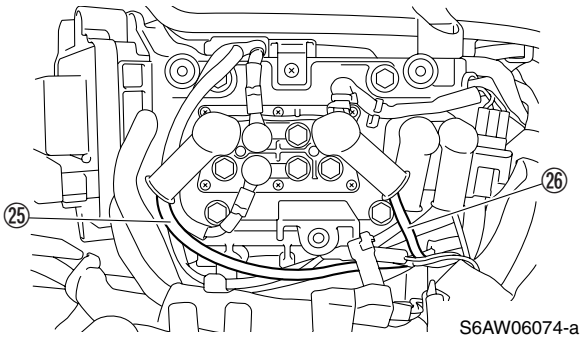
13. Connect the cooling water pilot hose ㉓.



14. Connect the vapor gas hose ㉔ to the bottom cowling.



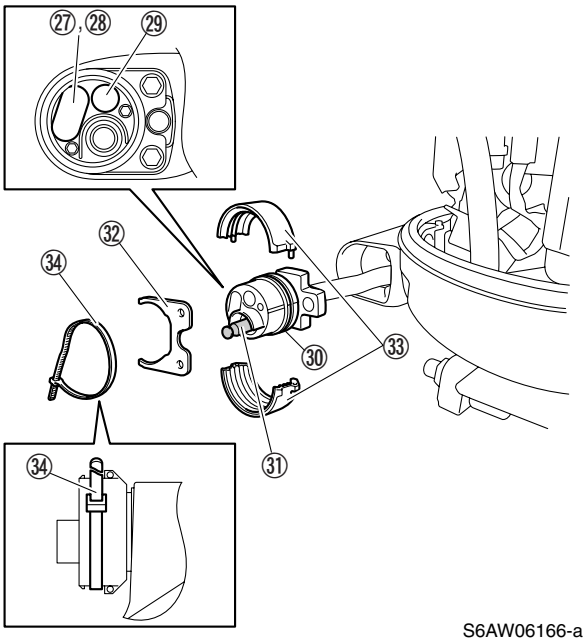
15. Connect the PTT motor leads ㉕ (red) and ㉖ (black), and then fasten them. To wire the PTT motor leads, see “Wiring harness routing” (5-7).



16. Fit the positive battery cable ㉗, the negative battery cable ㉘ and the extension wire harness ㉙ into the grommet ㉚.

17. Connect the fuel joint ㉛.

18. Install the stopper ㉜ and the tube retainer ㉝, and then install it with the plastic tie ㉞.



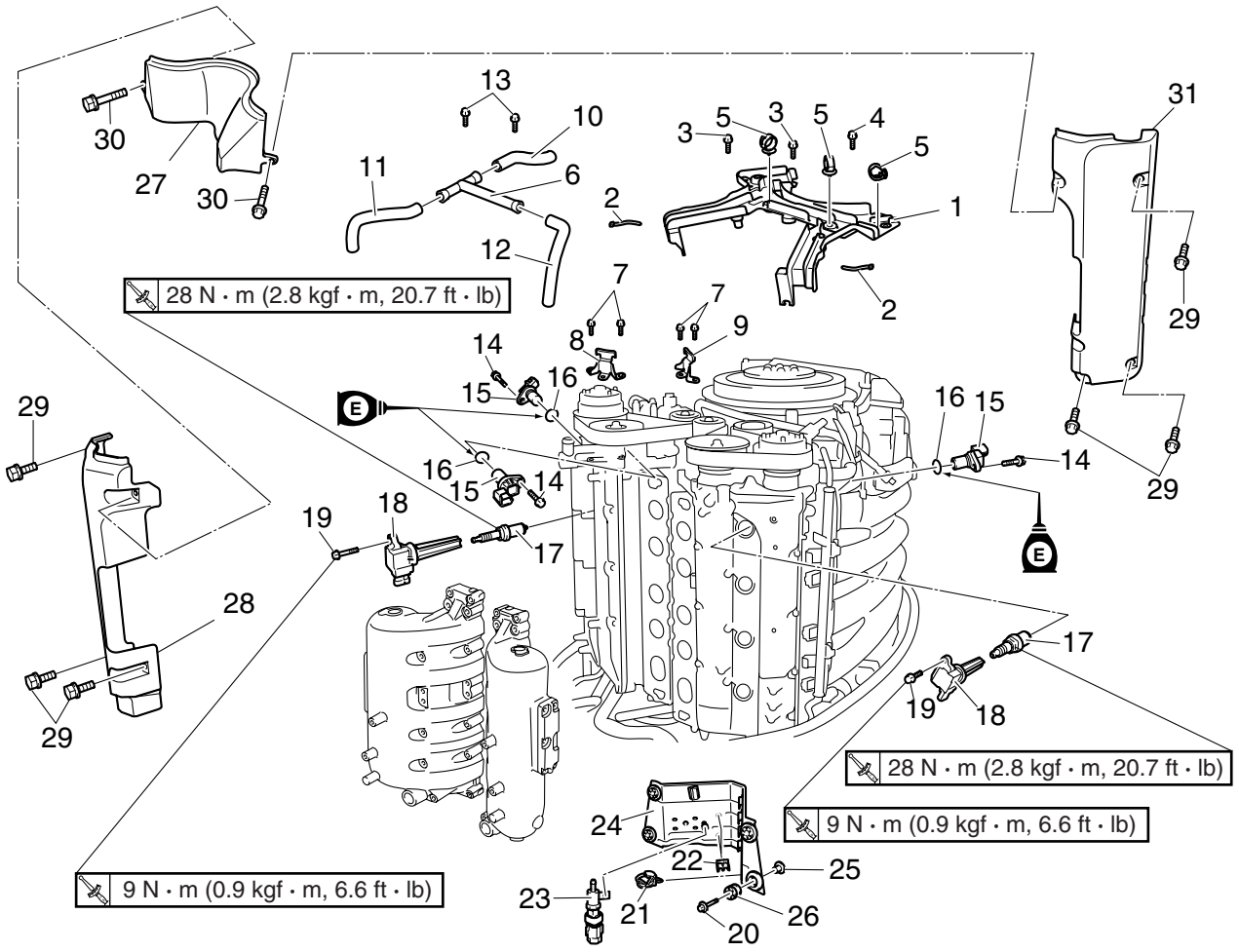
S6AW06166-a

NOTE:

- Tighten the plastic tie in the position as shown.
- To wire the extension wire harness and battery cables, see “Mounting the rigging grommet” (3-9).

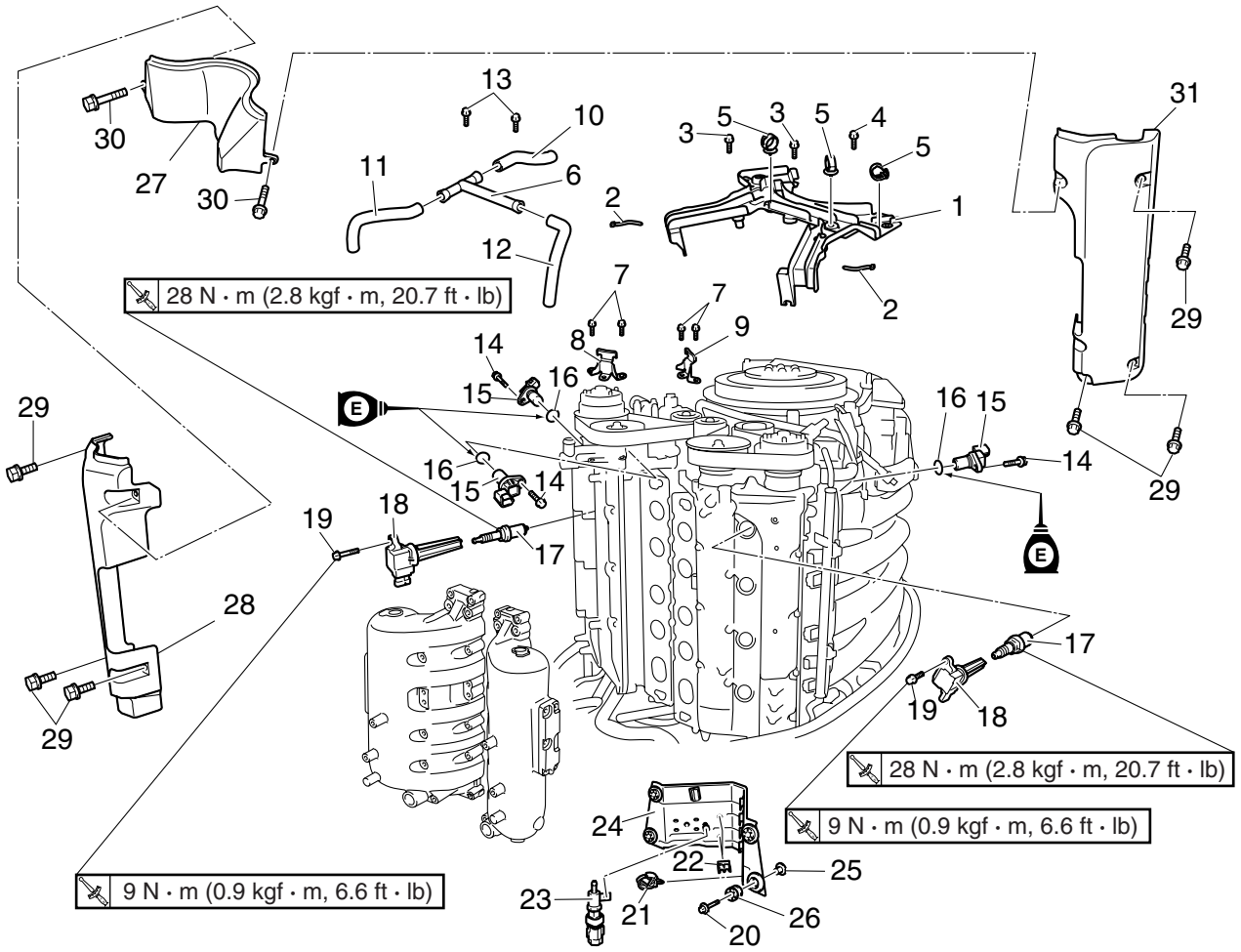
19. Install all the parts that were removed.

Wiring harness and flywheel magnet



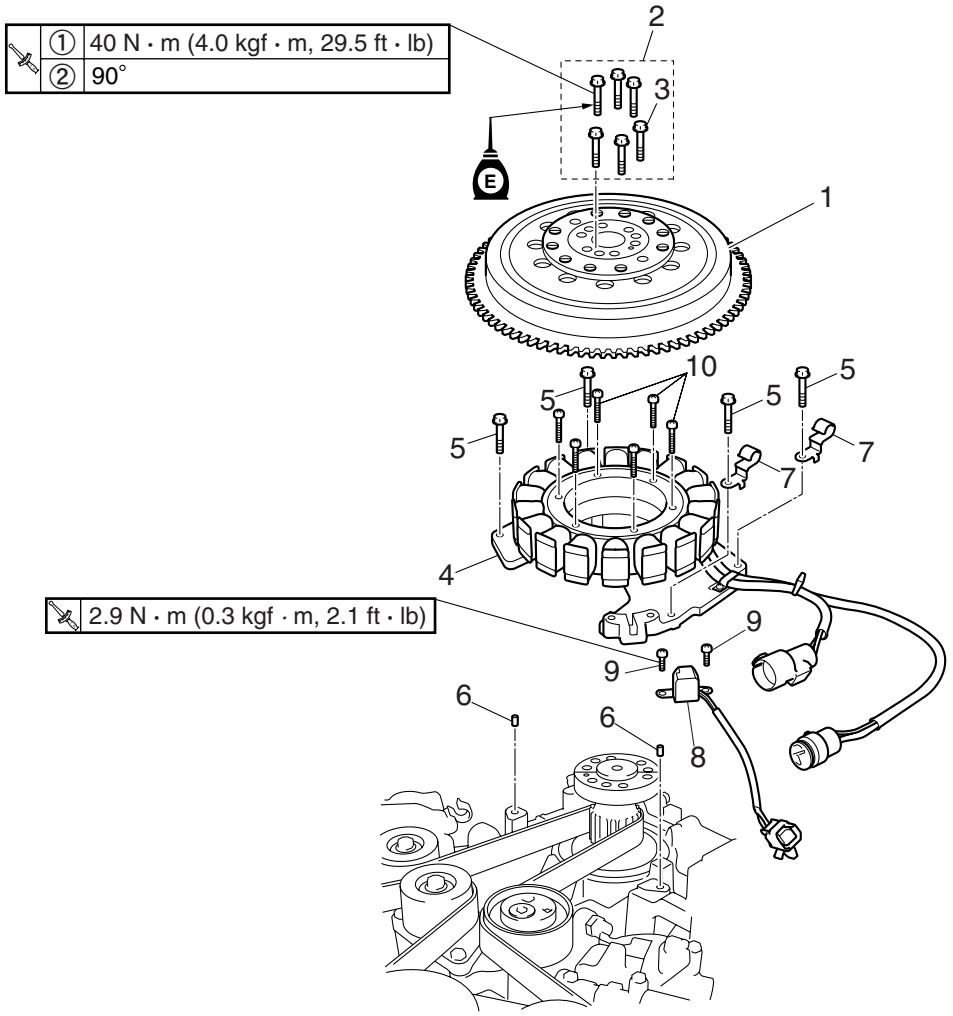
S6AW06190

No.	Part name	Q'ty	Remarks
1	Wiring harness guide	1	
2	Plastic tie	2	**Not reusable**
3	Bolt	2	M6 × 35 mm
4	Bolt	1	M6 × 25 mm
5	Clamp	3	
6	Pipe	1	
7	Bolt	4	M6 × 14 mm
8	Timing belt guide (PORT)	1	
9	Timing belt guide (STBD)	1	
10	Hose	1	
11	Hose	1	
12	Hose	1	
13	Bolt	2	M6 × 14 mm
14	Bolt	3	M6 × 20 mm
15	Cam position sensor (STBD IN, PORT IN, PORT EX)	3	
16	O-ring	3	**Not reusable**



S6AW06190

No.	Part name	Q'ty	Remarks
17	Spark plug	8	
18	Ignition coil	8	
19	Bolt	8	M6 × 25 mm
20	Bolt	4	M6 × 25 mm
21	Clamp	2	
22	Holder	1	
23	Adapter	1	
24	Bracket	1	
25	Collar	4	
26	Grommet	4	
27	Rear cover	1	
28	Side cover (PORT)	1	
29	Bolt	6	M6 × 20 mm
30	Bolt	2	M6 × 30 mm
31	Side cover (STBD)	1	



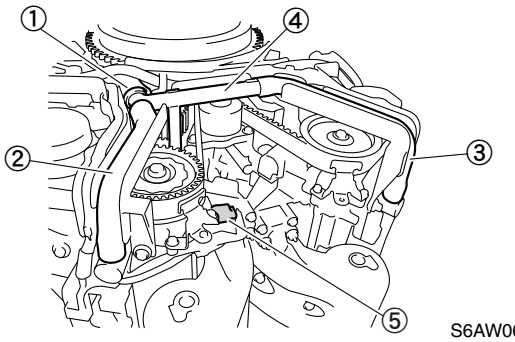
S6AW06191

No.	Part name	Q'ty	Remarks
1	Flywheel magnet	1	
2	Bolt set	1	**Not reusable**
3	Bolt	6	**Not reusable** M10 × 50 mm
4	Stator assembly	1	
5	Bolt	4	M6 × 30 mm
6	Dowel	2	
7	Holder	2	
8	Pulser coil	1	
9	Screw	2	ø5 × 12 mm
10	Screw	6	ø6 × 34 mm

Removing the wiring harness, the wiring harness guide and the flywheel magnet

1. When remove the wiring harness and wiring harness guide, the fuel line must be disconnected, so be sure to reduce the fuel pressure before performing the disassembly procedure. To reduce the fuel pressure, see “Reducing the fuel pressure” (6-27).

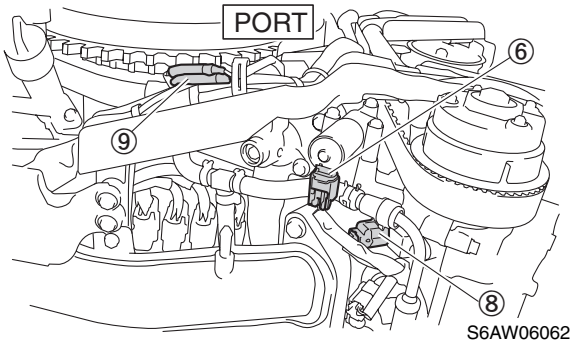
2. Remove the breather hoses ①, ②, ③, and the breather pipe ④.



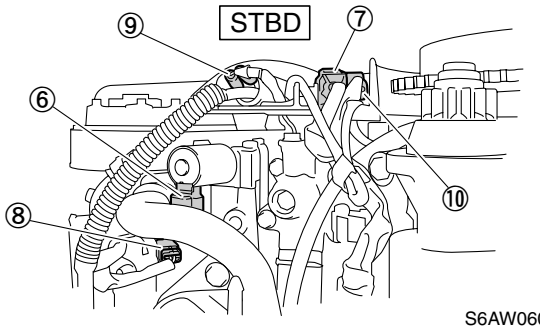
S6AW06061

3. Disconnect the OCV coupler ⑥, the engine temperature sensor coupler ⑦, the exhaust cam position sensor coupler ⑤, the intake cam position sensor couplers ⑧, and the thermoswitch connector ⑨.

4. Remove the engine temperature sensor coupler ⑦ and the pulser coil coupler ⑩ from the wiring harness guide.

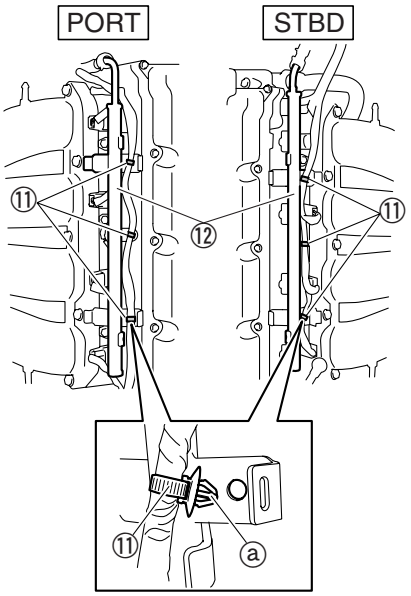


S6AW06062



S6AW06063

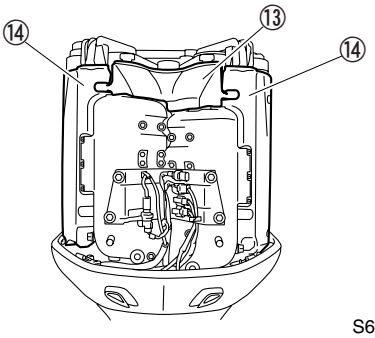
5. Remove the projections ⓐ on the holders ⑪ from fuel rails ⑫ (PORT and STBD), and then pull up the wiring harness.



S6BJ07007

6. Disconnect all ignition coil couplers.

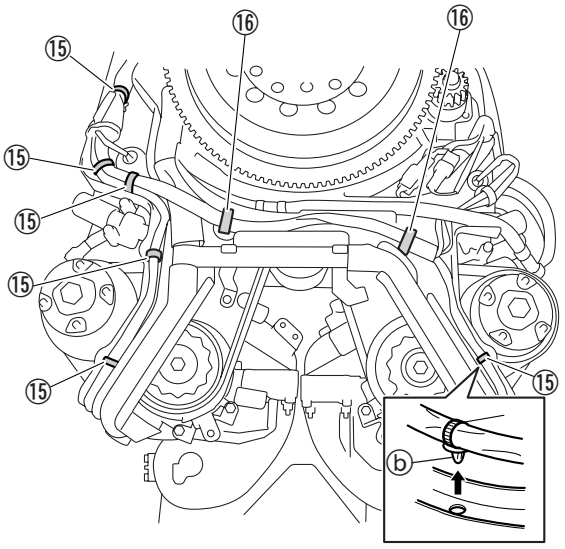
7. Remove the rear cover ⑬ and the side covers ⑭, and then disconnect all the fuel injector couplers and ground read (STBD).



S6AW06012-1

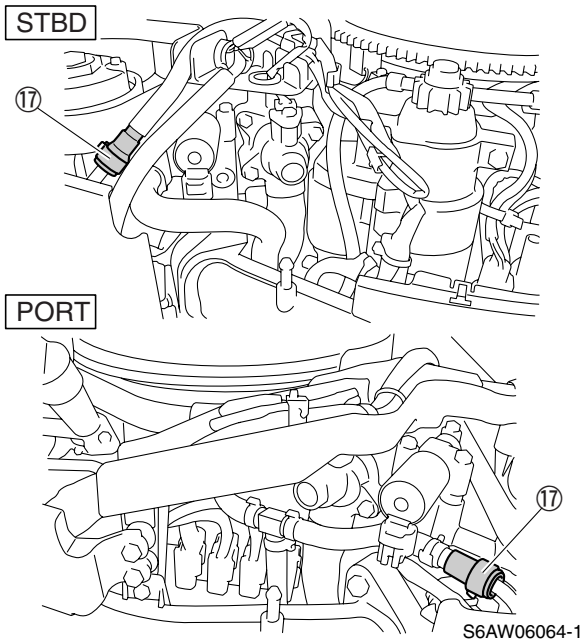
7

8. Remove the plastic ties ⑮ from the wiring harness and the projections ⓑ on the clamps ⑯ from the wiring harness guide, and then pull up the wiring harness.



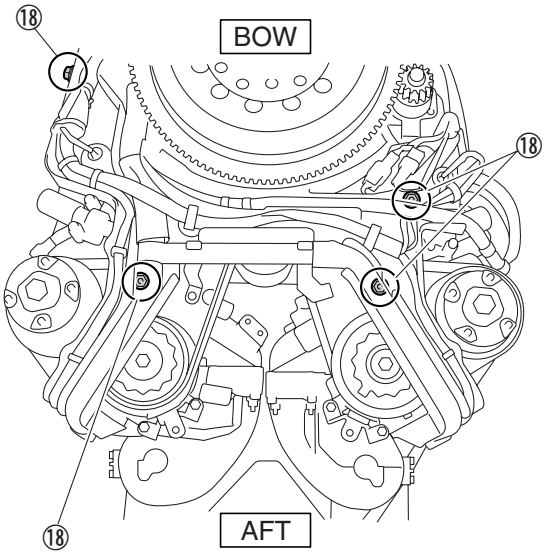
S6AW06066-1

9. Disconnect the quick connectors ⑰. See “Disconnecting the quick connector” (6-27).



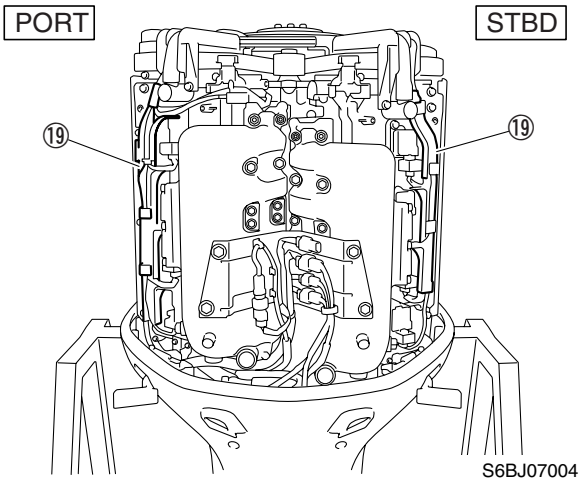
S6AW06064-1

10. Remove the wiring harness guide bolts ⑱.



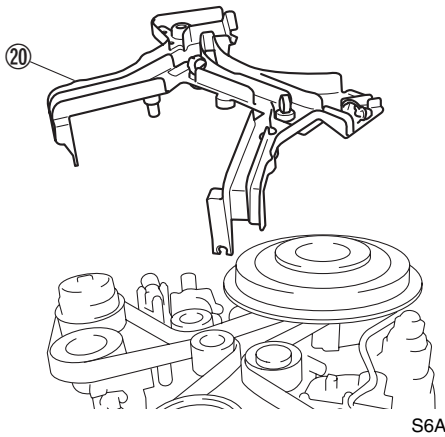
S6AW06065-1

11. Remove the guide plates ⑲.



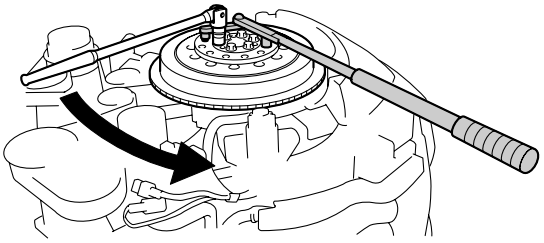
S6BJ07004

12. Remove the wiring harness guide ⑳.



S6AW06067-a

13. Loosen the flywheel magnet bolts.



S6AW06018

CAUTION:

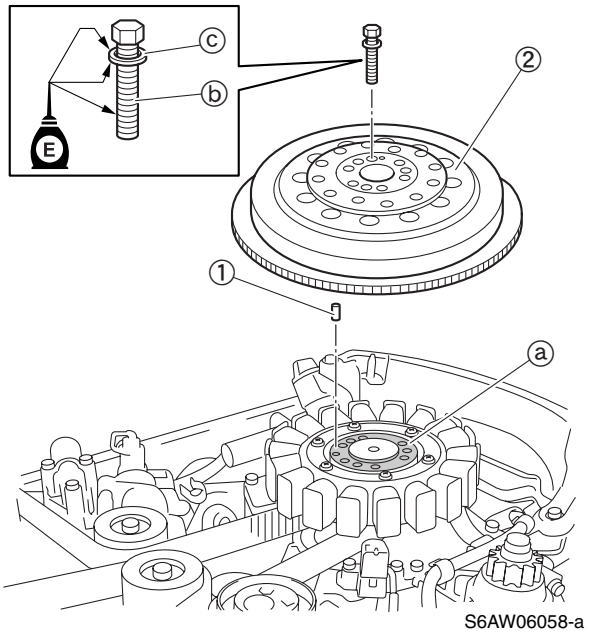
- **Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.**
- **Do not turn the flywheel magnet counterclockwise, to prevent the possible damage to the water pump impeller.**

Flywheel holder: 90890-06522

Installing the wiring harness, the wiring harness guide and the flywheel magnet

1. Install the stator assembly.

2. Install the dowel ① and the flywheel magnet ②. Totally the crankshaft flange seating ⓐ and the flywheel magnet seating must be cleaned and degrease before installation. Apply some engine oil to the threads of the flywheel magnet bolts ⓑ and the washers ⓒ.

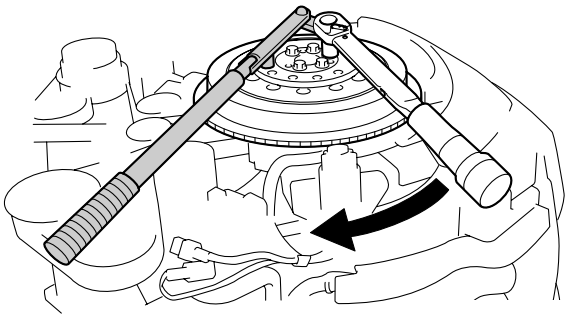


S6AW06058-a

CAUTION:

Do not reuse the flywheel magnet bolts, always replace them with new ones.

3. Tighten the flywheel magnet bolts to the specified torque.



S6AW06059

7

CAUTION:

Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

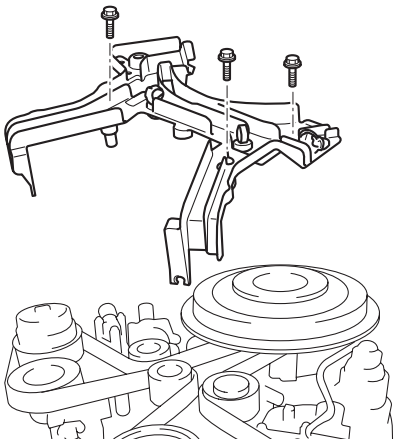
NOTE:

- To install all of the wiring harnesses, see "Wiring harness routing" (5-7).
- Perform this procedure after assembling the power unit.

Flywheel holder: 90890-06522

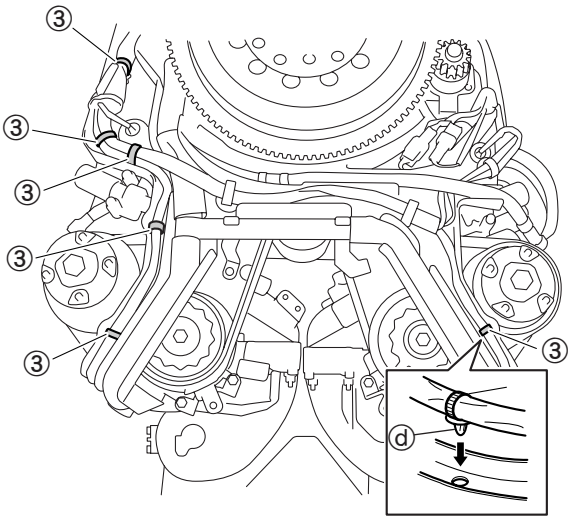
Flywheel magnet bolts:
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°

4. Install the wiring harness guide.



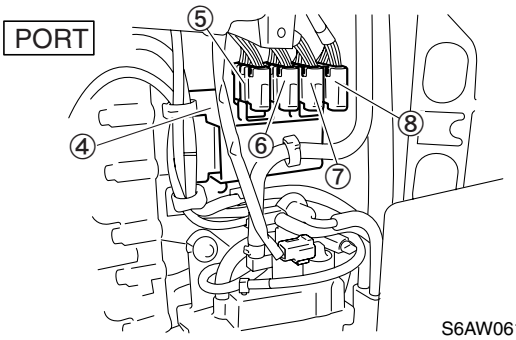
S6AW06207-1

5. Install the wiring harness in place using the plastic ties ③, and then fit the projections ⓓ into the hole in the wiring harness guide.



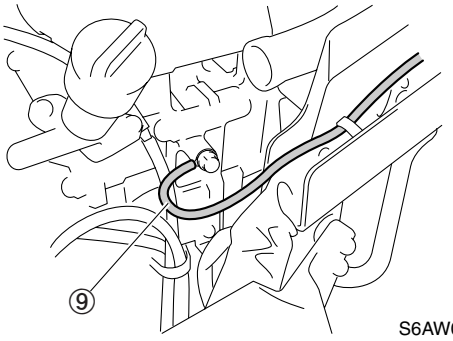
S6AW06168-1

6. Install the joint connectors onto the plate ④, starting from the left with the joint connector with no identification tape ⑤, white tape ⑥, yellow tape ⑦ and brown tape ⑧.



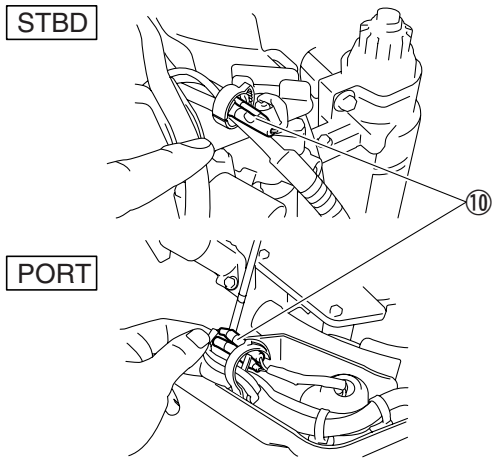
S6AW06169-1

7. Install the ground wire ⑨ as shown in the illustration.



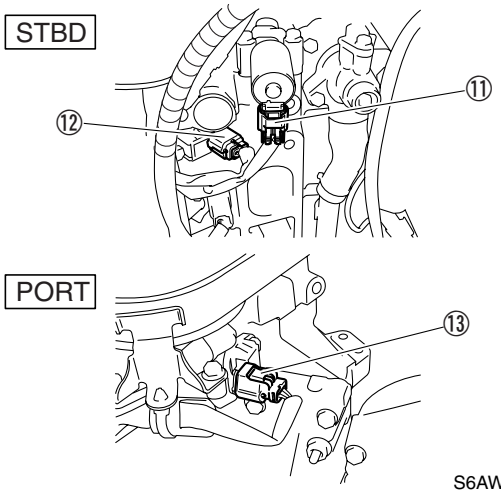
S6AW06170

8. Connect the starboard side and the port side thermoswitch connectors ⑩.



S6AW06178

9. Connect the OCV coupler (STBD) ⑪, the intake cam position sensor coupler (STBD) ⑫, and the exhaust cam position sensor coupler (PORT) ⑬.



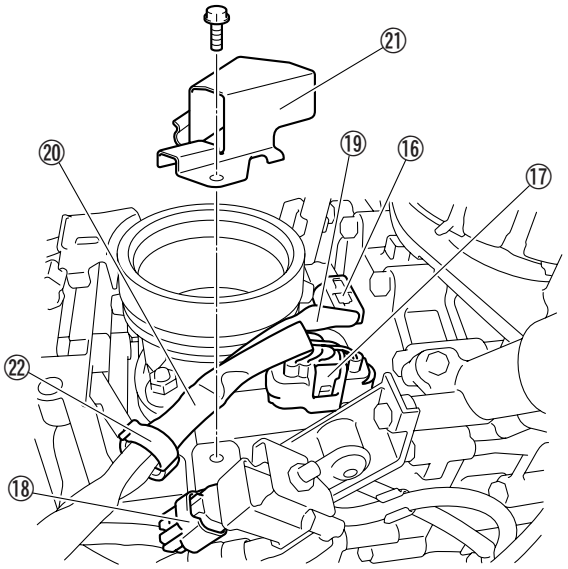
S6AW06171

10. Connect all ignition coil couplers and the fuel injector couplers. Tighten the ground lead ⑭ in the orientation as shown.

11. Install the wiring harness by fitting the projection ⓔ of the holders ⑮ into the fuel rail stay.

S6AW06172

12. Connect the air pressure sensor coupler ⑯, the TPS coupler ⑰, and the vapor shut-off valve coupler ⑱, and install the air pressure sensor lead ⑲ and the TPS lead ⑳ using the plate ㉑ and clamp ㉒.



S6AW06080-1

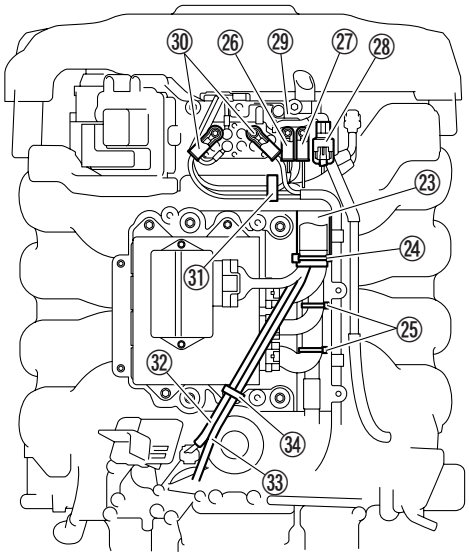
13. Install the wiring harness at the position of white tape to the bracket ㉓ using the plastic tie ㉔.

14. Connect the engine ECM couplers and the IDM coupler, and then install it on the engine ECM bracket using the plastic ties ㉕ at the position shown.

7

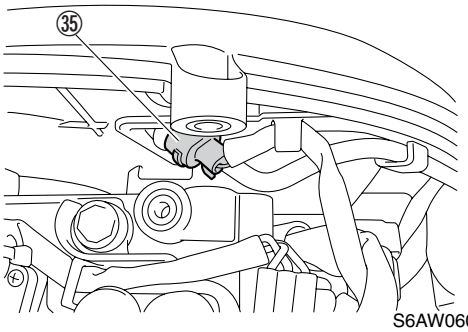
15. Connect the starter relay lead ㉖, the starter relay lead ㉗, and the PTT relay coupler ㉘, install the PTT relay coupler ㉘ to the junction box ㉙, and install the starter relay lead ㉗ and the PTT motor leads ㉚ using the clamp ㉛ as shown.

16. Connect the oil pressure sensor lead ㉜, and install the oil pressure sensor lead ㉜ and the water detection switch lead ㉝ at the position shown using the clamp ㉞.



S6AW06082-1

17. Connect the air temperature sensor lead ㉟, and then install the air temperature sensor lead ㉟ at the position shown.



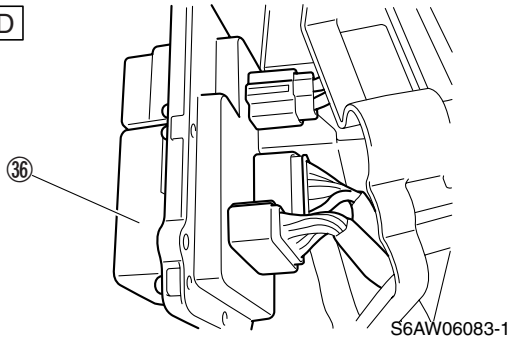
S6AW06091-1

18. Connect the wiring harness to the fuse box ㊱, and then install the fuse box ㊱.

NOTE:

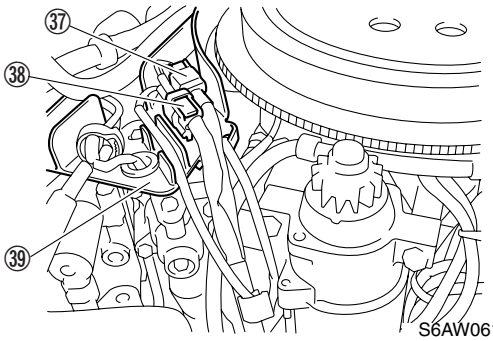
See “Fuse box” for mounting the fuse box ㊱. (7-38)

STBD



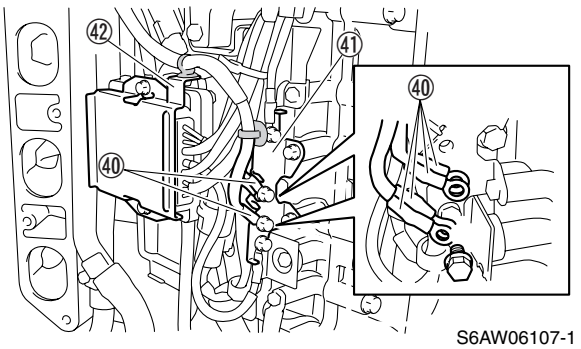
S6AW06083-1

19. Connect the pulser coil coupler ㊲ and the engine temperature sensor coupler ㊳, install them in the slit on the wiring harness guide ㊴.



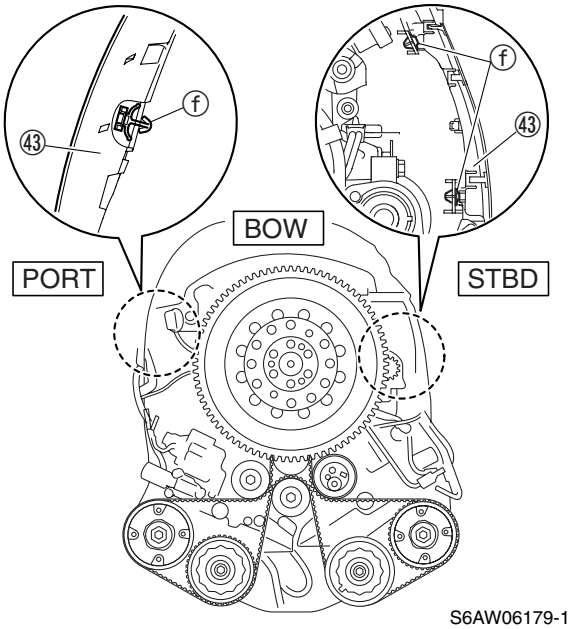
S6AW06106-1

20. Connect the ground leads ㊵ of the wiring harness as shown, and insert the projection of the plastic tie to the terminal plate ㊶ and the cord stay ㊷ as shown.



S6AW06107-1

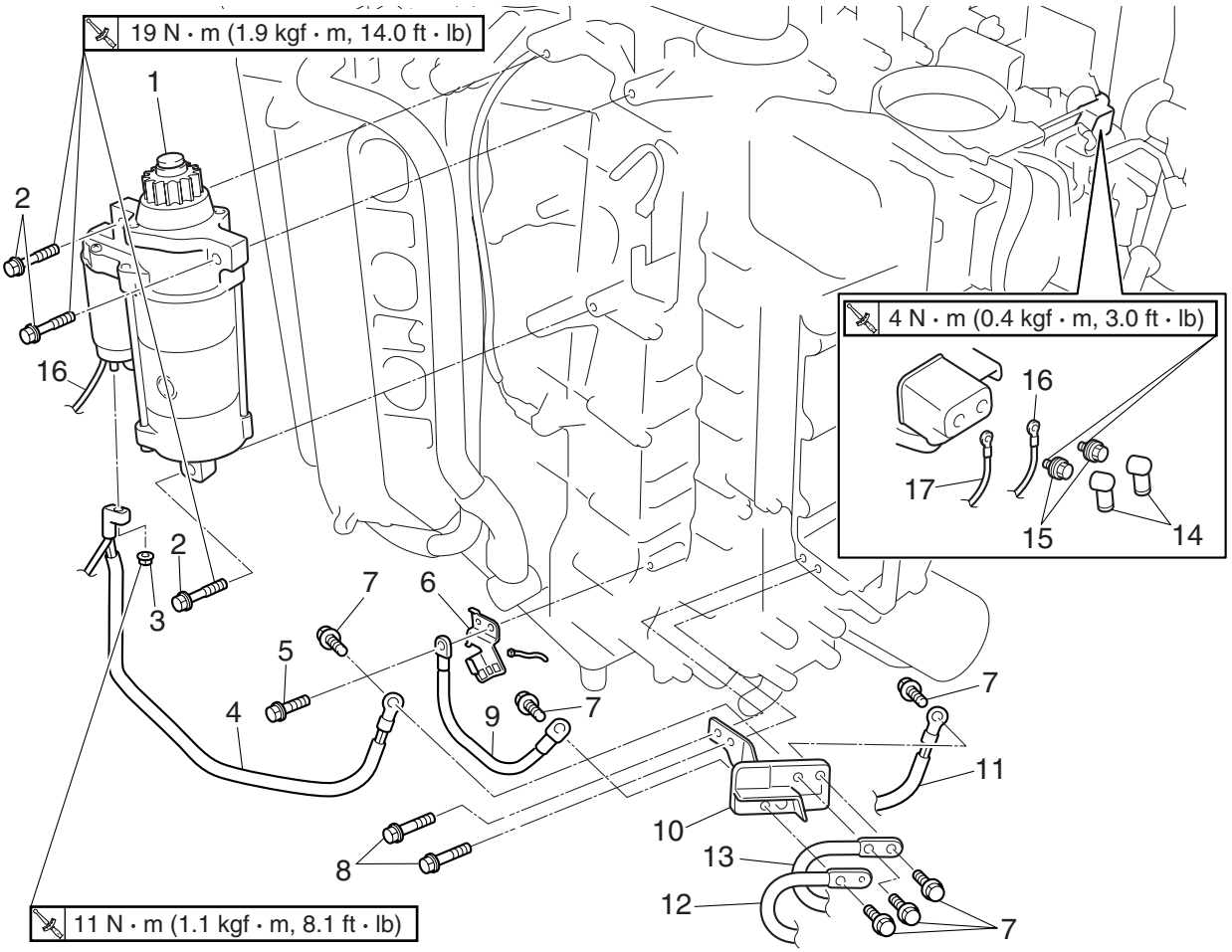
21. Install the projection ⓕ of the plastic tie integrated with the harness protector ㊸ into the mounting hole of the intake manifold.



S6AW06179-1

22. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

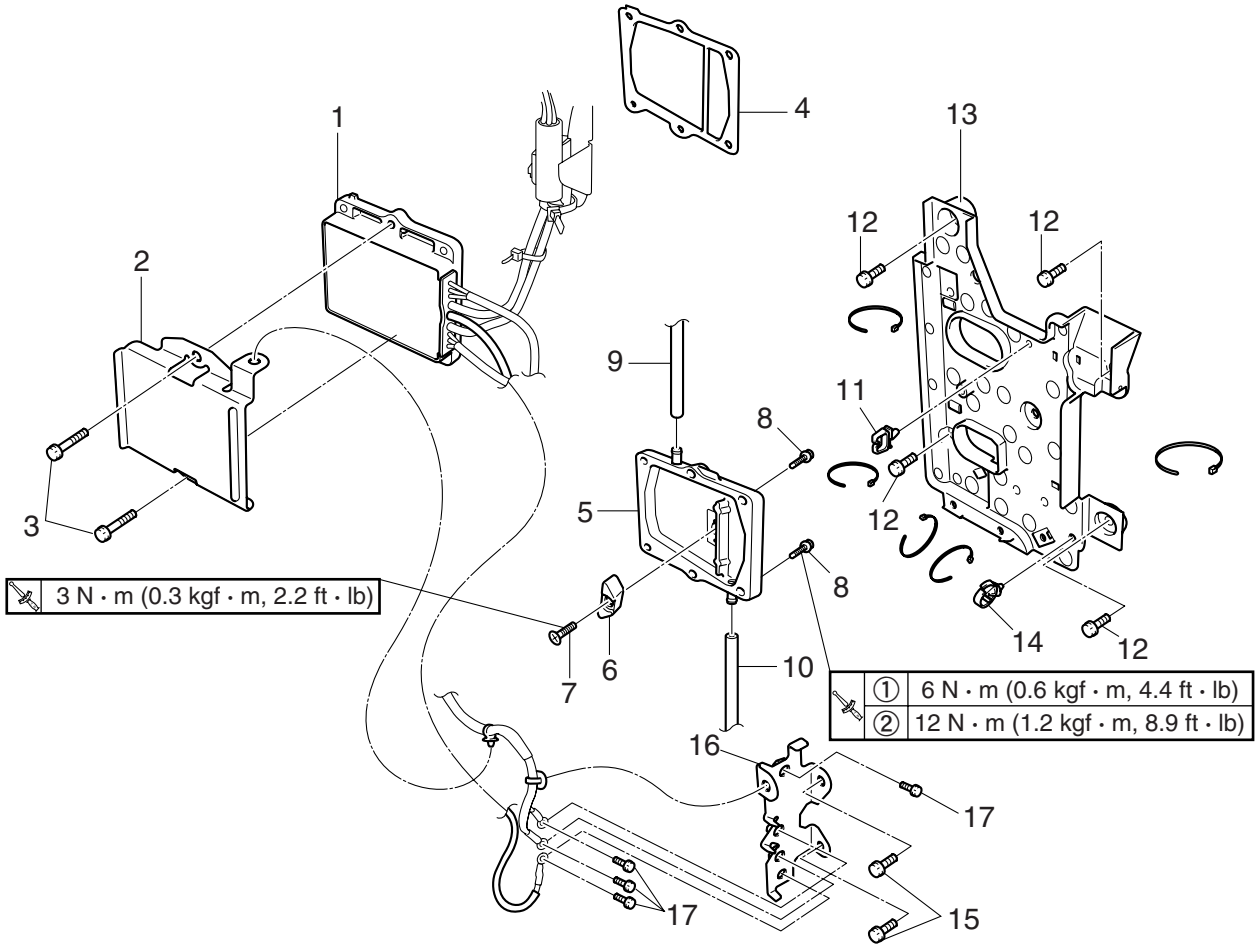
Starter motor



S6AW06192-1

No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Bolt	3	M8 × 45 mm
3	Nut	1	
4	Wiring harness	1	
5	Bolt	1	M6 × 20 mm
6	Clamp	1	
7	Bolt	6	M8 × 20 mm
8	Bolt	2	M8 × 20 mm
9	Ground read	1	
10	Terminal	1	
11	Wiring harness	1	
12	Negative battery cable	1	
13	Positive battery cable	1	
14	Cap	2	
15	Bolt	2	M6 × 10 mm
16	Starter motor lead	1	
17	Starter relay lead	1	

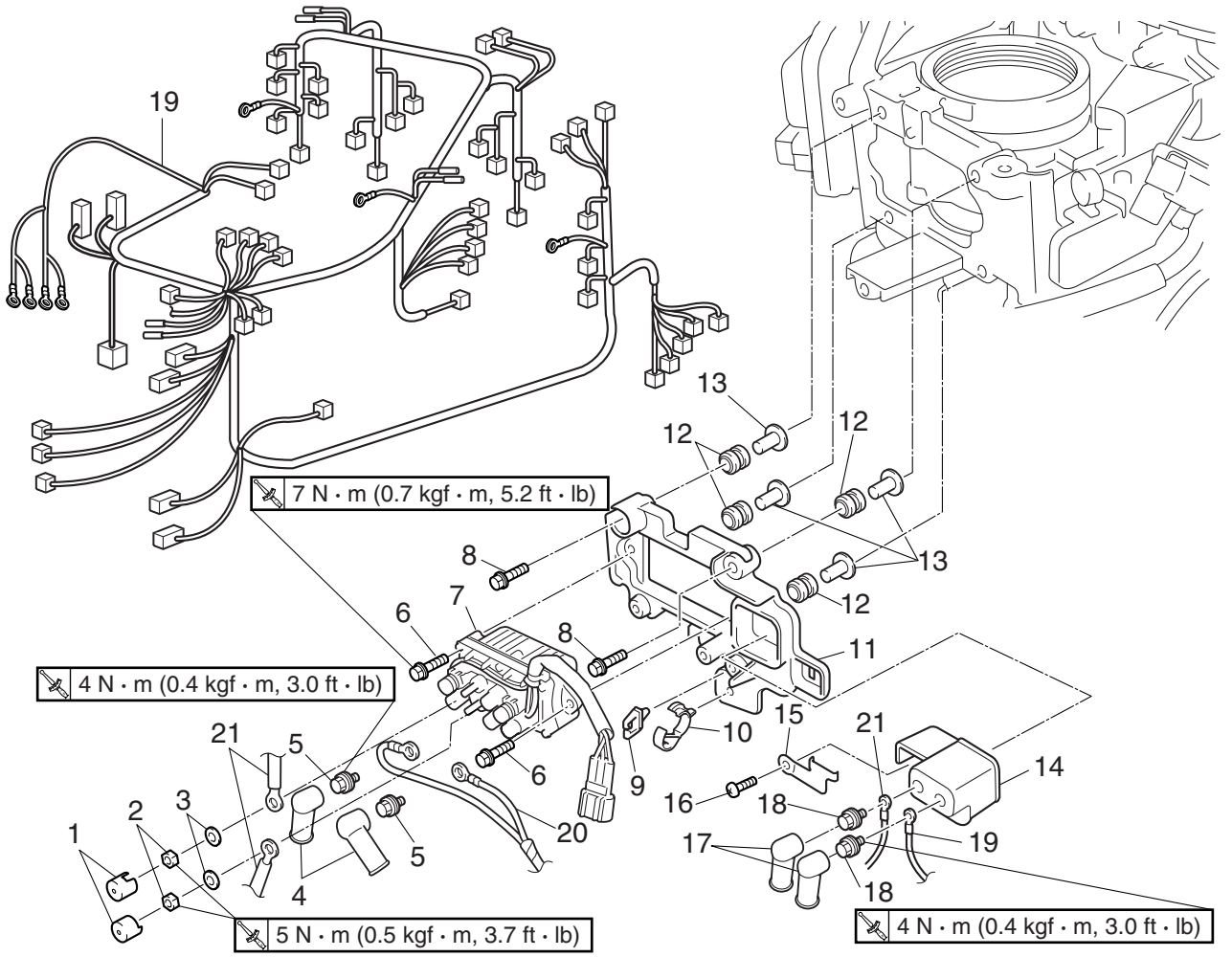
Rectifier Regulator



S6AW06193

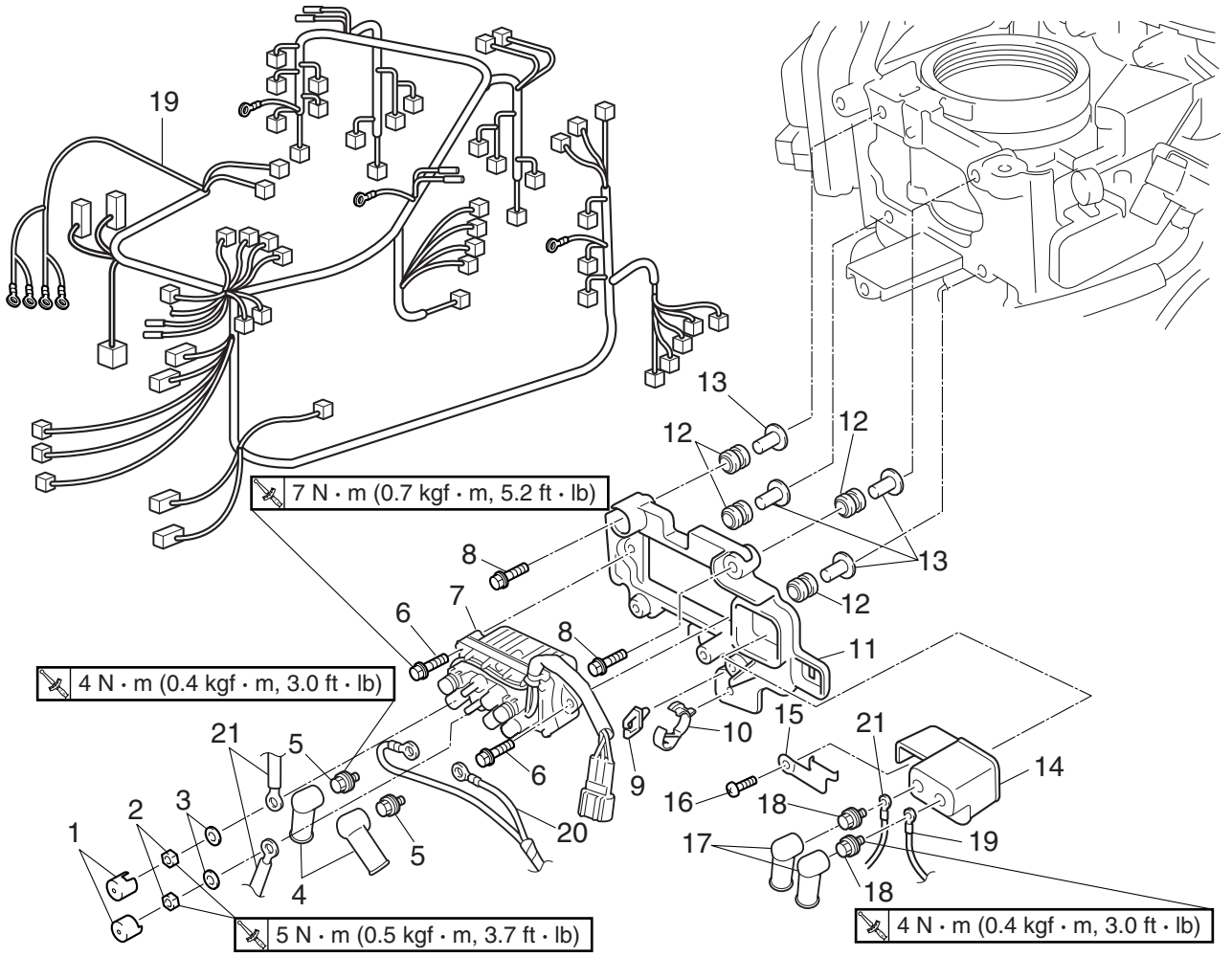
No.	Part name	Q'ty	Remarks
1	Rectifier Regulator	1	
2	Stay	1	
3	Bolt	2	M6 × 35 mm
4	Gasket	1	**Not reusable**
5	Cover	1	
6	Anode	1	
7	Screw	1	ø4 × 12 mm
8	Bolt	4	M6 × 25 mm
9	Cooling water hose	1	
10	Cooling water hose	1	
11	Clamp	1	
12	Bolt	4	M6 × 15 mm
13	Case	1	
14	Clamp	1	
15	Bolt	2	M6 × 16 mm
16	Terminal	1	
17	Bolt	4	M6 × 12 mm

PTT relay



S6AW06202

No.	Part name	Q'ty	Remarks
1	Cap	2	
2	Nut	2	
3	Washer	2	
4	Terminal cap	2	
5	Bolt	2	M6 × 10 mm
6	Bolt	2	M6 × 20 mm
7	PTT relay	1	
8	Bolt	4	M6 × 28 mm
9	Clamp	1	
10	Clamp	1	
11	Relay holder	1	
12	Grommet	4	
13	Collar	4	
14	Starter relay	1	
15	Plate	1	
16	Screw	1	ø6 × 19 mm
17	Terminal cap	2	

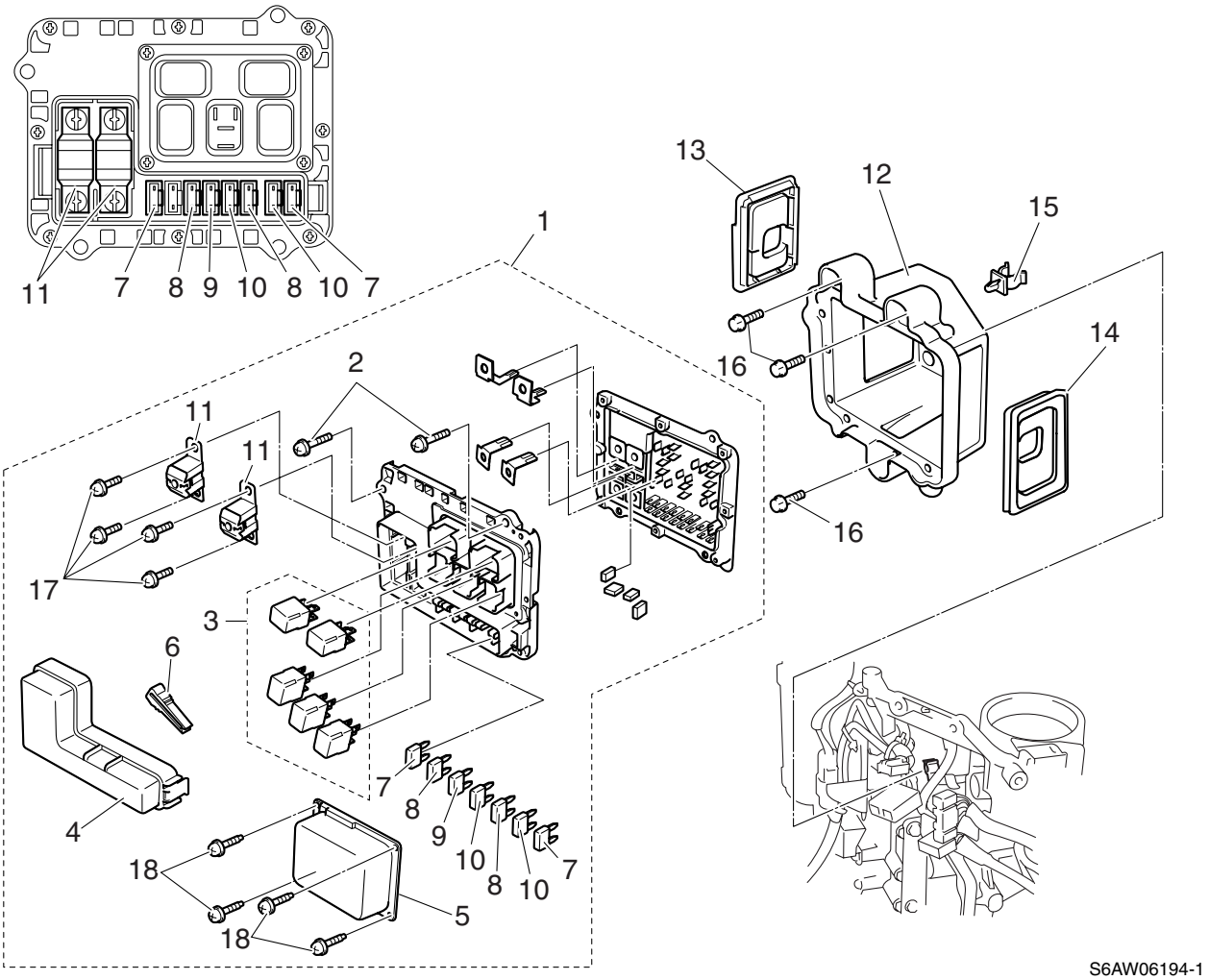


S6AW06202

No.	Part name	Q'ty	Remarks
18	Bolt	2	M6 × 10 mm
19	Wiring harness	1	
20	PTT motor lead	1	
21	Wiring harness	1	

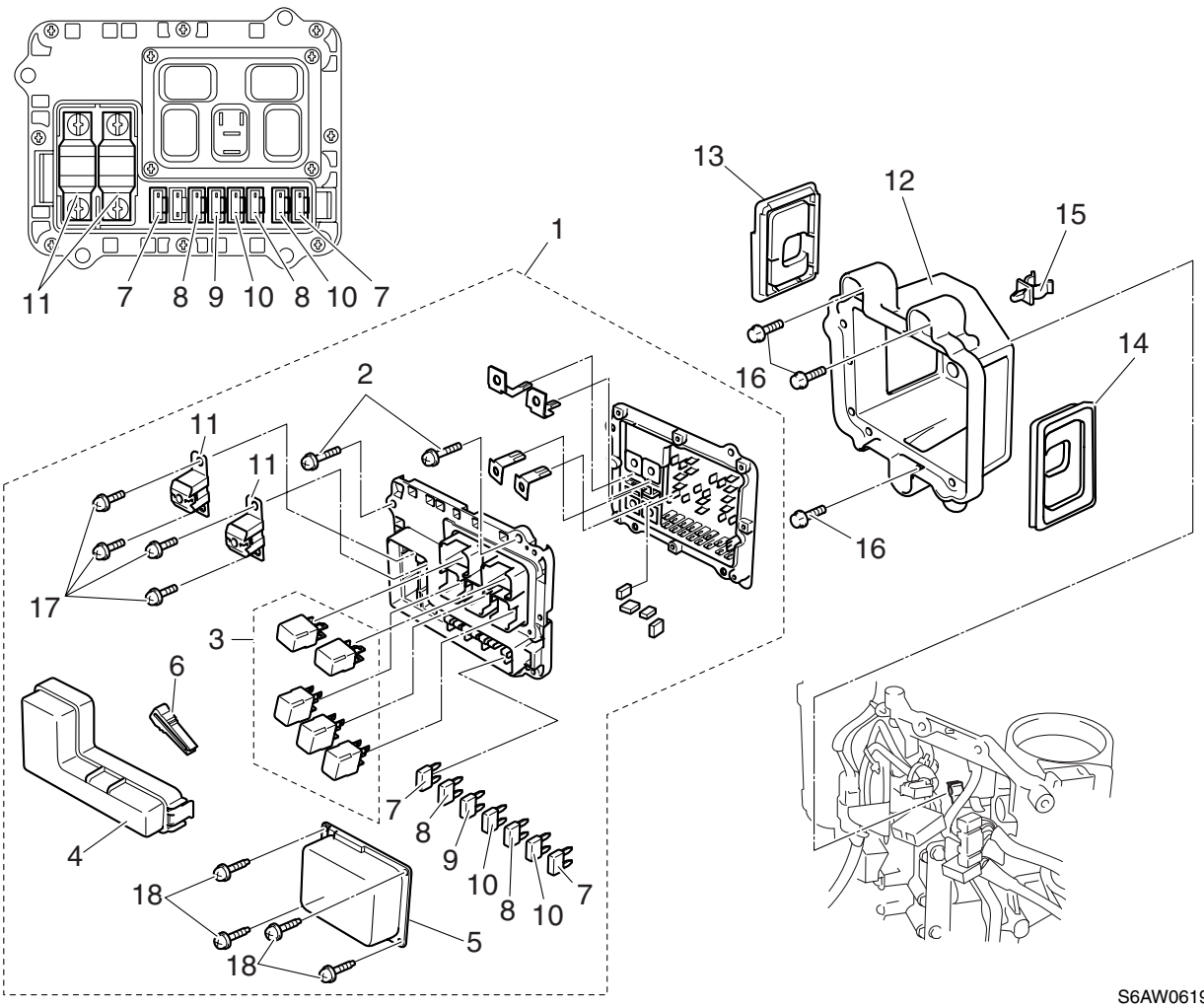
7

Fuse box



S6AW06194-1

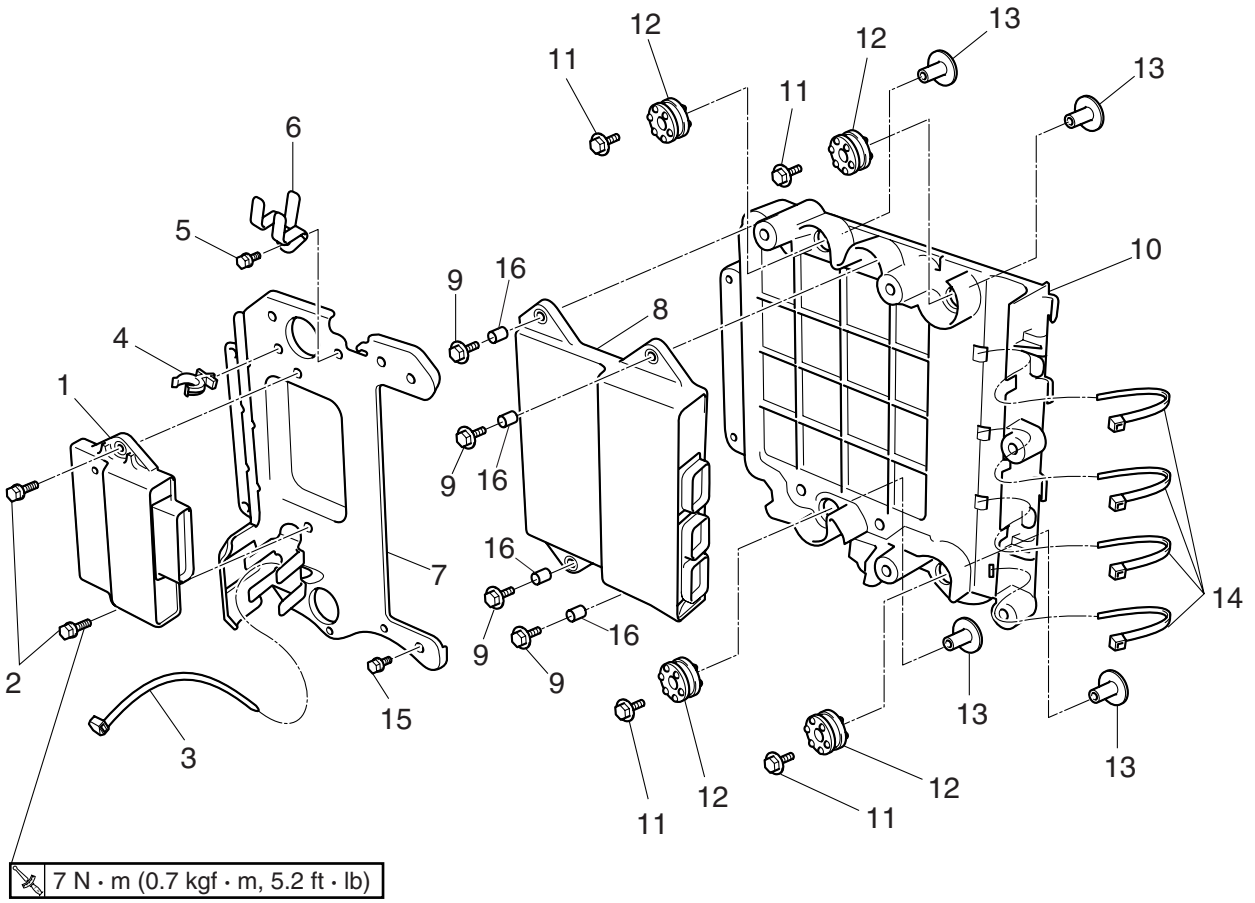
No.	Part name	Q'ty	Remarks
1	Fuse box	1	
2	Screw	4	ø5 × 20 mm
3	Relay assembly	1	
4	Cover	1	
5	Cover	1	
6	Fuse puller	1	
7	Fuse	3	10 A
8	Fuse	3	15 A
9	Fuse	2	20 A
10	Fuse	3	30 A
11	Fuse	3	60A (6AW 1001014–) (6AX 1000440–) (6BJ 1000001–) (6BK 1000001–) 80A (6AW 1000001–1001013) (6AX 1000001–1000439)
12	Fuse box case	1	



S6AW06194-1

No.	Part name	Q'ty	Remarks
13	Grommet	1	
14	Grommet	1	
15	Clamp	1	
16	Bolt	3	M6 × 28 mm
17	Screw	4	ø5 × 10 mm
18	Screw	12	ø3 × 18 mm

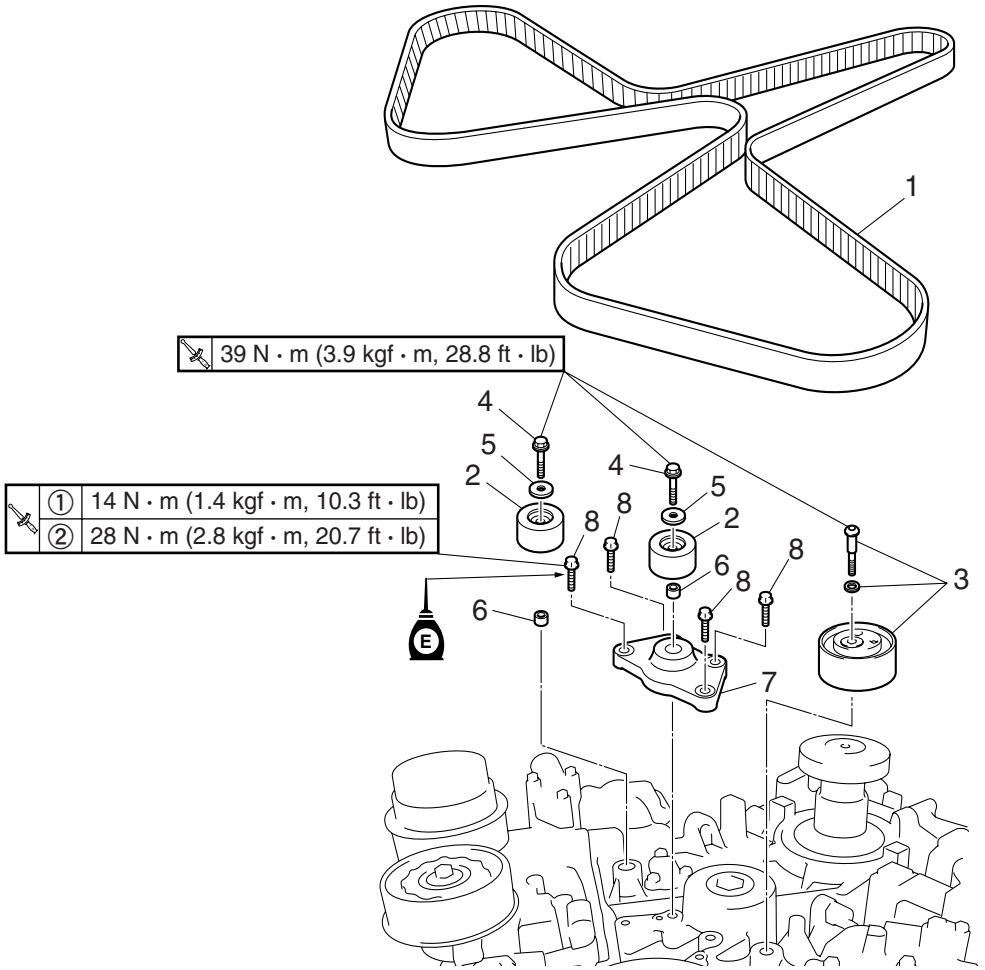
Engine ECM



S6AW06195

No.	Part name	Q'ty	Remarks
1	IDM	1	
2	Bolt	2	M6 × 20 mm
3	Plastic tie	1	
4	Clamp	1	
5	Bolt	1	M6 × 12 mm
6	Clamp	1	
7	Case	1	
8	Engine ECM	1	
9	Bolt	4	M6 × 20 mm
10	Engine ECM bracket	1	
11	Bolt	4	M6 × 35 mm
12	Grommet	4	
13	Collar	4	
14	Plastic tie	4	**Not reusable**
15	Bolt	5	M6 × 12 mm
16	Collar	4	

Timing belt



S6AW06196

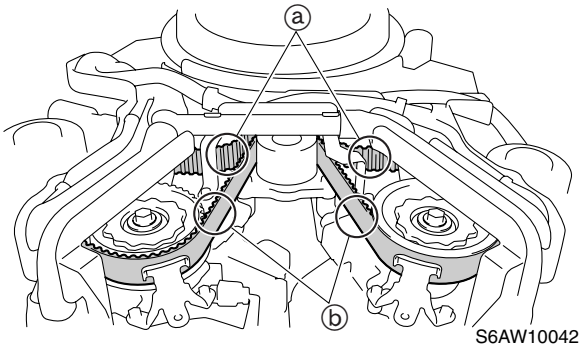
No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Pulley	2	
3	Timing belt tensioner	1	
4	Bolt	2	M10 × 55 mm
5	Washer	2	
6	Collar	2	
7	Stay	1	
8	Bolt	4	M8 × 30 mm

Checking the timing belt

CAUTION:

Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.

1. Remove the flywheel magnet cover.
2. While turning the flywheel magnet clockwise, check the interior ⓐ and the exterior ⓑ of the timing belt. Replace if cracked or worn. To replace the timing belt, see "Replacing the timing belt" (7-42).



S6AW10042

Replacing the timing belt

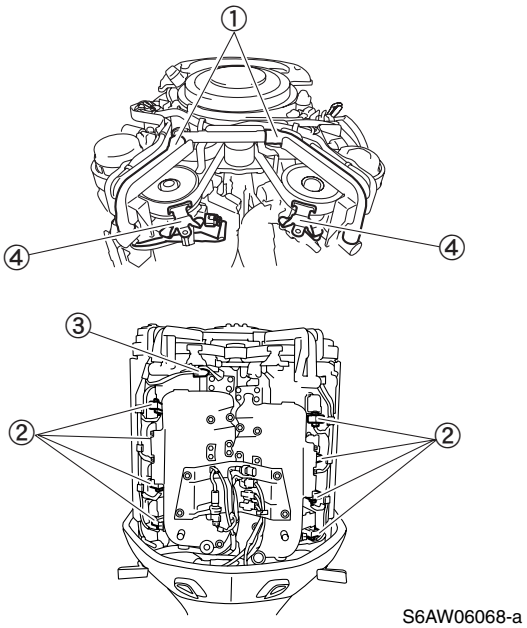
CAUTION:

- **Do not turn the flywheel magnet counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the flywheel magnet or the driven sprockets when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.**

NOTE:

To remove and install the timing belt without replacing it, see "Removing the timing belt, driven sprocket and camshaft" (7-54) and "Installing the camshaft, driven sprocket, and timing belt" (7-59).

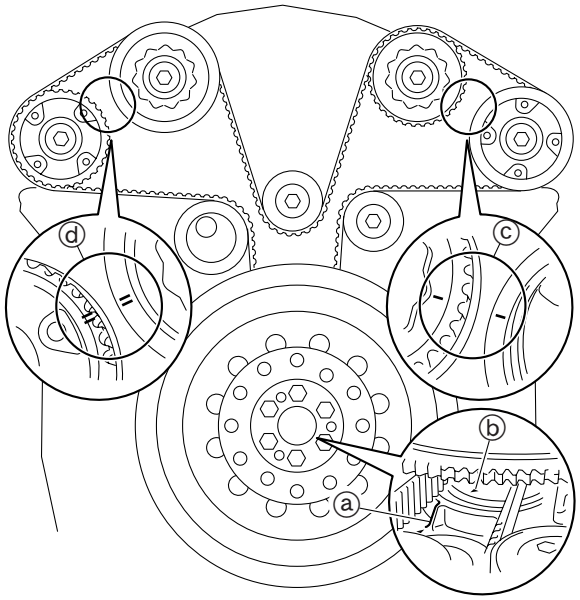
1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-27).
2. Remove the flywheel magnet cover, rear cover and side covers.
3. Remove the blowby hoses ①.
4. Disconnect the ignition coil couplers ②, condenser ③.
5. Remove the wiring harness. To remove the wiring harness, see "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).
6. Remove all ignition coils and spark plugs.
7. Remove the exhaust joints.
8. Remove the timing belt guides ④.



S6AW06068-a

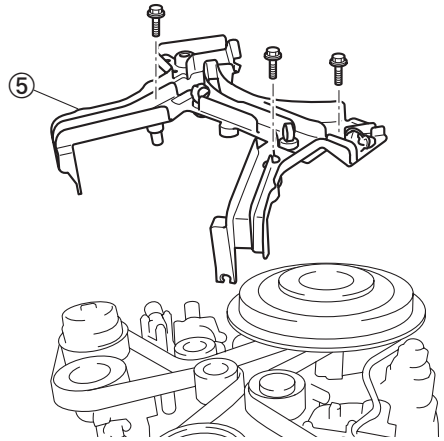
9. Align the "1TDC" mark ⓐ with the crank alignment mark ⓑ.

10. Check that the "I" marks ⓒ on the port driven sprockets are aligned, and check-that the "II" marks ⓓ on the starboard driven sprockets are aligned.



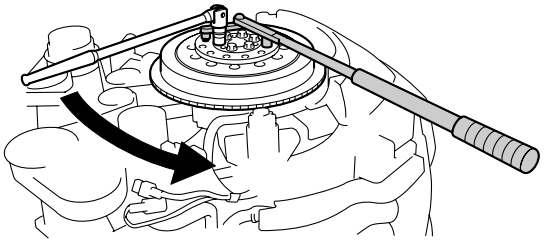
S6AW06014

11. Remove the wiring harness guide ⑤. To remove the wiring harness guide, see "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).



S6AW06209-a

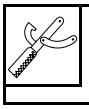
12. Loosen the flywheel magnet bolts.



S6AW06018

CAUTION:

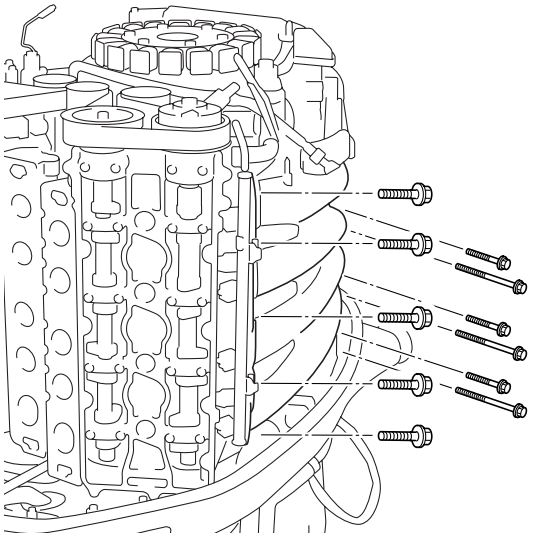
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.



Flywheel holder: 90890-06522

13. Remove the flywheel magnet and dowel.

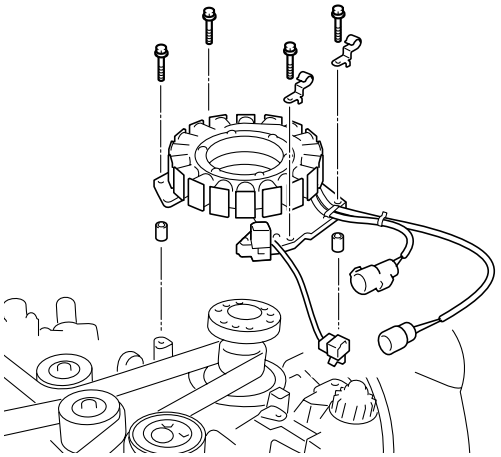
14. Remove the intake manifold (STBD).



S6AW06057

7

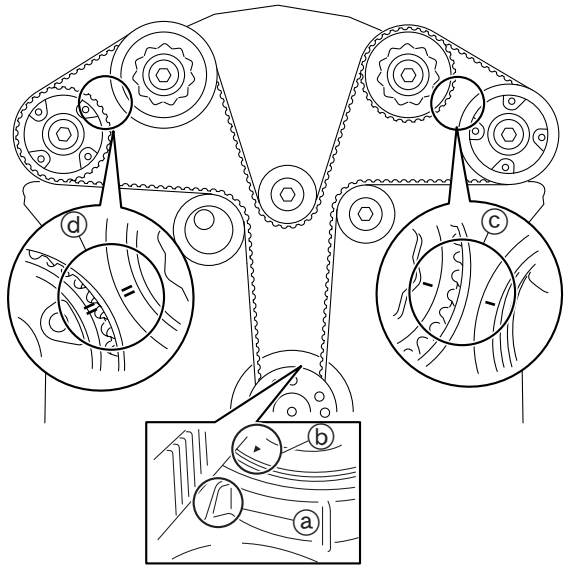
15. Remove the stator assembly bolts, and then move the stator assembly.



S6AW06054-1

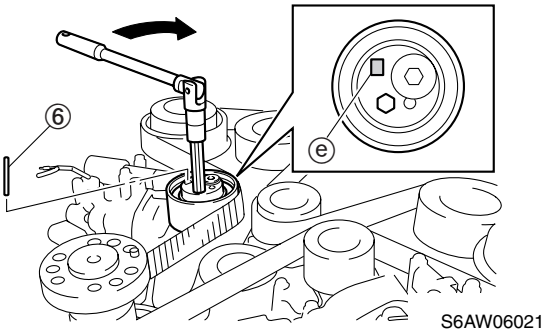
16. Check if the “1TDC” mark ⓐ and the crank alignment mark ⓑ are aligned.

17. Check that the “I” marks ⓒ on the port driven sprockets are aligned, and check that the “II” marks ⓓ on the starboard driven sprockets are aligned.



S6AW06211

18. Slowly turn the timing belt tensioner clockwise by applying torque of maximum 15 N·m (1.5 kgf·m, 11.1 ft·lb) with a hexagon wrench, and then insert the ø5 mm (0.2 in) pin ⑥ into the hole ⓔ.

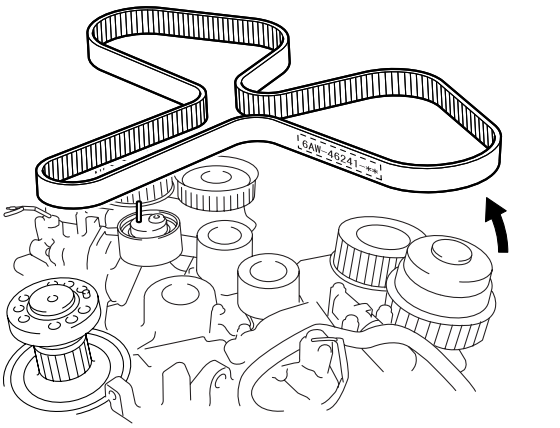


S6AW06021

NOTE:

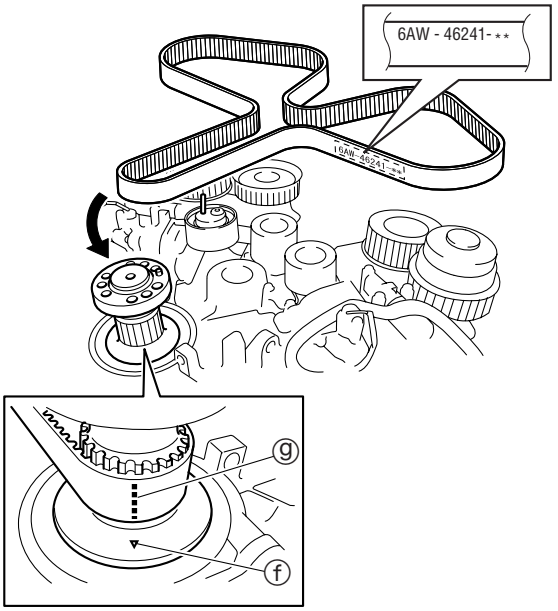
Leave the pin inserted into the hole ⓔ of the timing belt tensioner until the timing belt is installed again.

19. Remove the timing belt from the driven sprockets, and then from the drive sprocket.

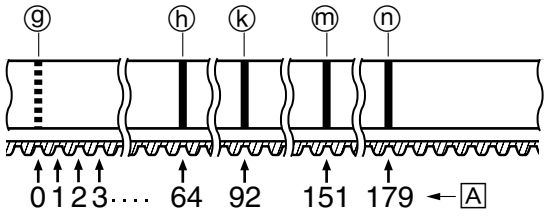


S6AW06022

20. Install a new timing belt to the drive sprocket so the part number comes upright, and then align the position mark ⓖ on the belt with the gear drive alignment mark ⓕ.



S6AW06023



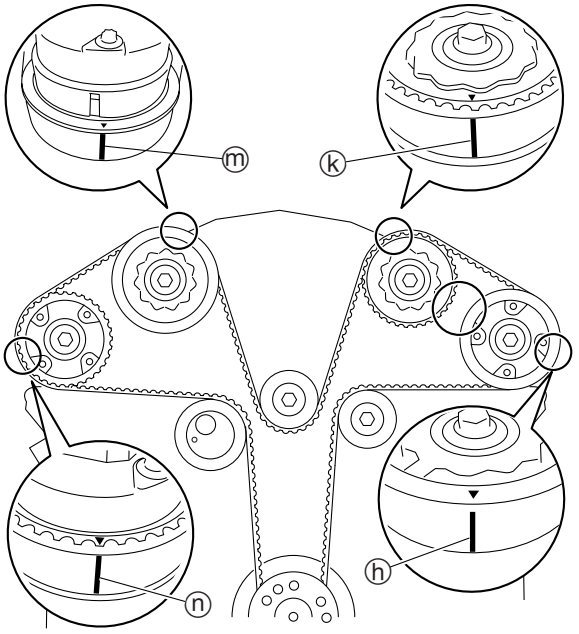
S6AW06070

A Belt teeth number

CAUTION:

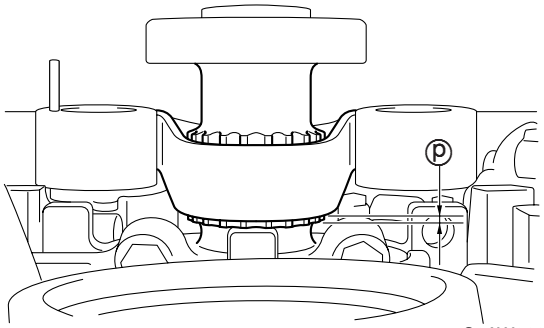
- **Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) otherwise it can be damaged.**
- **Do not get oil or grease on the timing belt.**

21. Install the timing belt onto the driven sprockets by aligning belt position marks ⓗ through ⓝ with the "▲" marks on the driven sprockets.



S6AW06024

22. Adjust the timing belt to the specified installation height ⓟ.

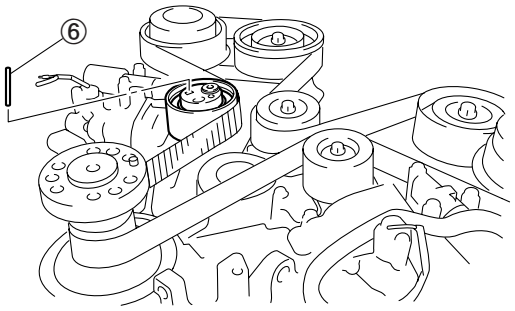


S6AW06072

Timing belt installation height ⓟ:
2.5 mm (0.098 in)

7

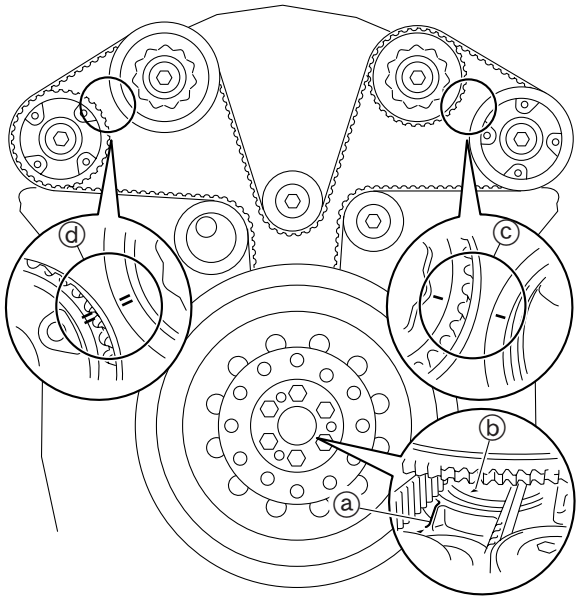
23. Check that belt position marks ⓖ through ⓝ are aligned with each alignment mark on the drive sprocket and driven sprockets, and then remove the pin ⑥.



S6AW06025-a

24. Temporarily assemble the flywheel magnet and the dowel.

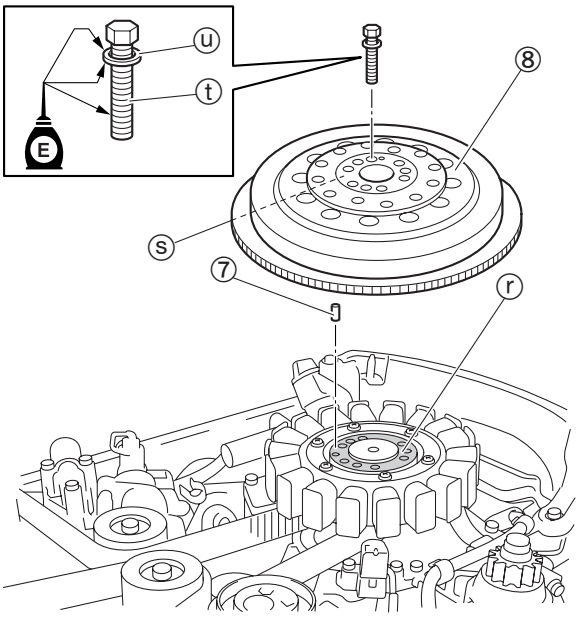
25. Turn the crankshaft clockwise 2 full turns, and then check that alignment marks ⓐ through ⓓ are aligned.



S6AW06014

26. Install the stator assembly.

27. Install the dowel ⑦ and the flywheel magnet ⑧. Totally the crankshaft flange seating ⓡ and the flywheel magnet seating ⓢ must be cleaned and degrease before installation. Apply some engine oil to the threads of the flywheel magnet bolts ⓣ and the washers ⓤ.

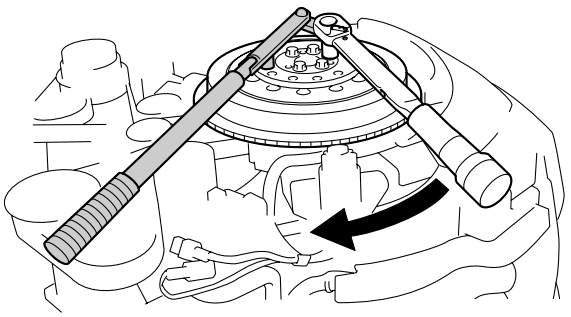


S6AW06079-a

CAUTION:

Do not reuse the flywheel magnet bolts, and always use a new one.

28. Tighten the flywheel magnet bolts to the specified torque.



S6AW06059

CAUTION:

Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

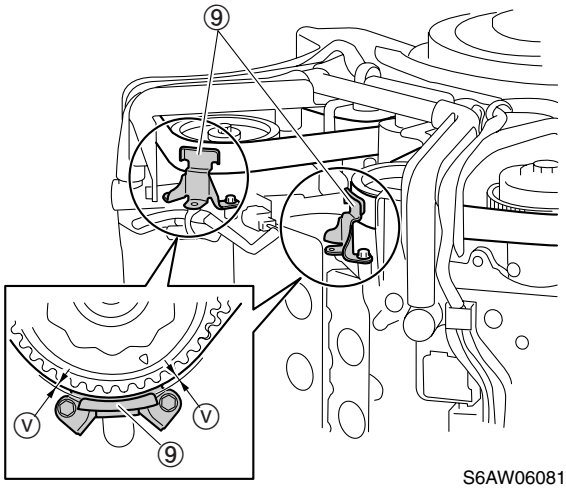

Flywheel holder: 90890-06522


Flywheel magnet bolts:
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°

29. Install the wiring harness guide. To install the wiring harness guide, see “Installing the wiring harness, the wiring harness guide and the flywheel magnet” (7-29).

30. Install all parts removed during disassembly.

31. Install the timing belt guides ⑨, and then adjust the timing belt guide clearance Ⓥ.



S6AW06081-a

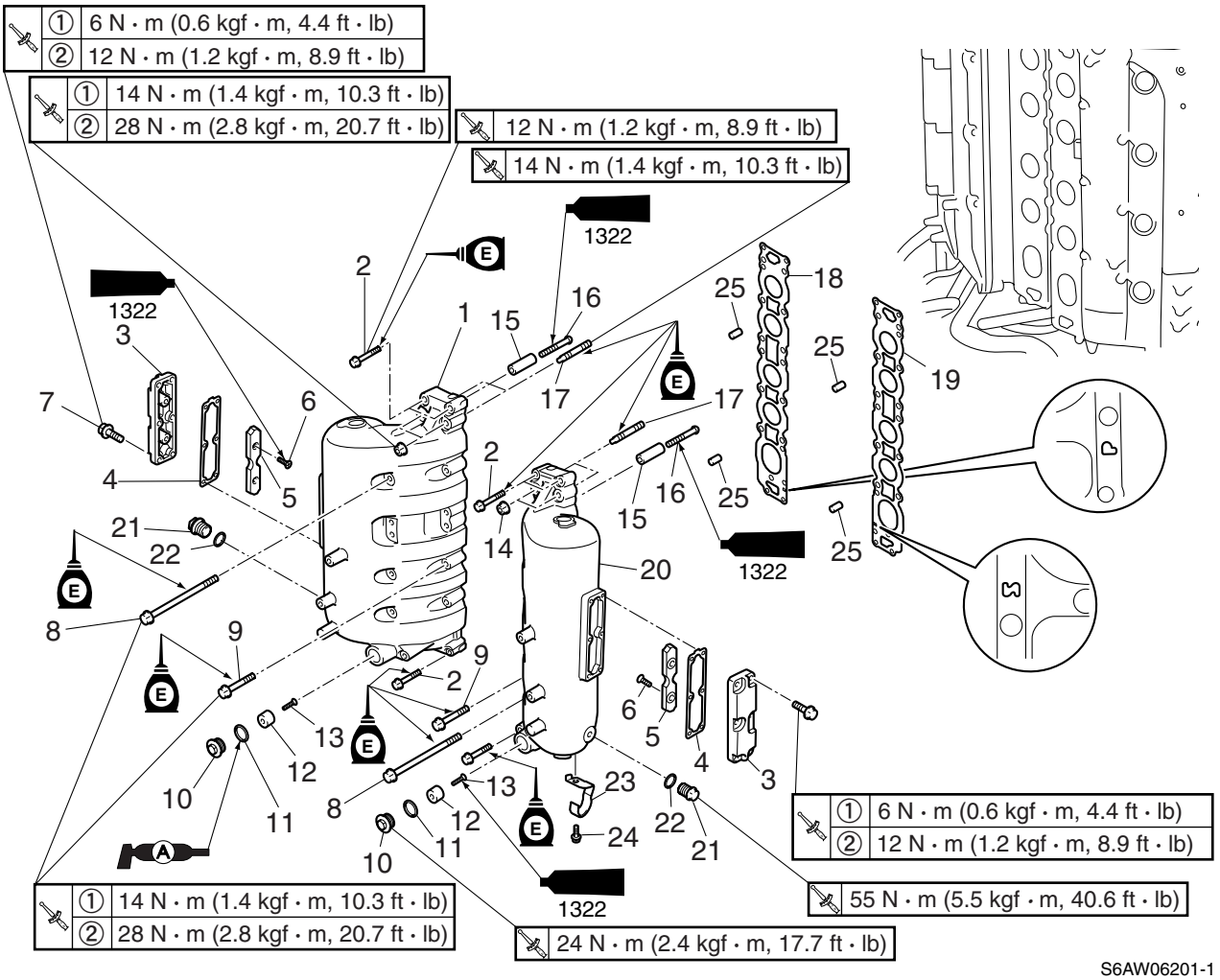

Timing belt guide clearance Ⓥ:
1.0 ± 0.5 mm (0.04 ± 0.02 in)

32. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

CAUTION:

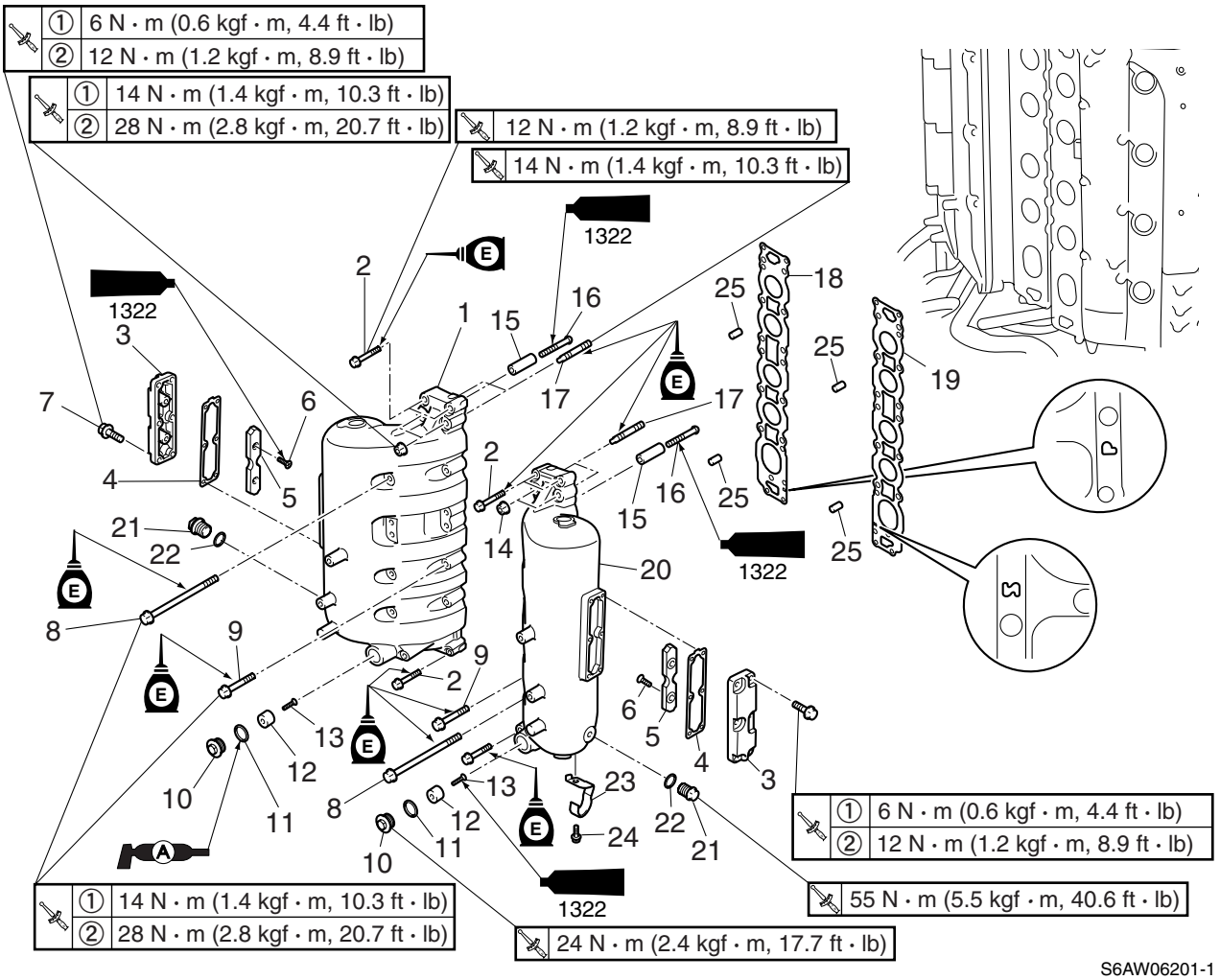
Incorrect assembly of the flywheel magnet cover may result in the interference with the timing belt.

Exhaust joint



S6AW06201-1

No.	Part name	Q'ty	Remarks
1	Exhaust joint (PORT)	1	
2	Bolt	8	M6 × 40 mm
3	Anode cover	2	
4	Gasket	2	**Not reusable**
5	Anode	2	
6	Screw	4	ø6 × 20 mm
7	Bolt	12	M6 × 20 mm
8	Bolt	12	M8 × 120 mm
9	Bolt	10	M8 × 50 mm
10	Plug	2	
11	O-ring	2	**Not reusable**
12	Anode	2	
13	Screw	2	ø5 × 20 mm
14	Nut	4	
15	Anode	10	
16	Screw	10	ø6 × 50 mm
17	Stud bolt	4	



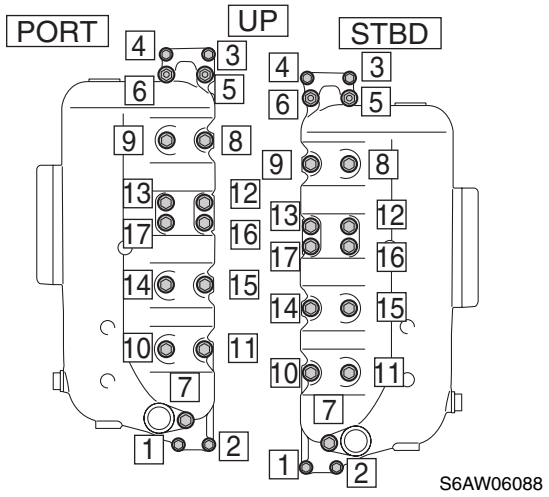
S6AW06201-1

No.	Part name	Q'ty	Remarks
18	Gasket	1	**Not reusable**
19	Gasket	1	**Not reusable**
20	Exhaust joint (STBD)	1	
21	Plug	2	
22	Gasket	2	**Not reusable**
23	Clamp	1	
24	Bolt	1	M6 × 14 mm
25	Dowel	4	

7

Removing the exhaust joint

1. Remove the exhaust joint bolts and nuts in the sequences shown.



Checking the exhaust joint anode

1. Check the anodes. Clean if there are scales, grease, or oil.

CAUTION:

Do not oil, grease, or paint the anodes, otherwise they will be ineffective.

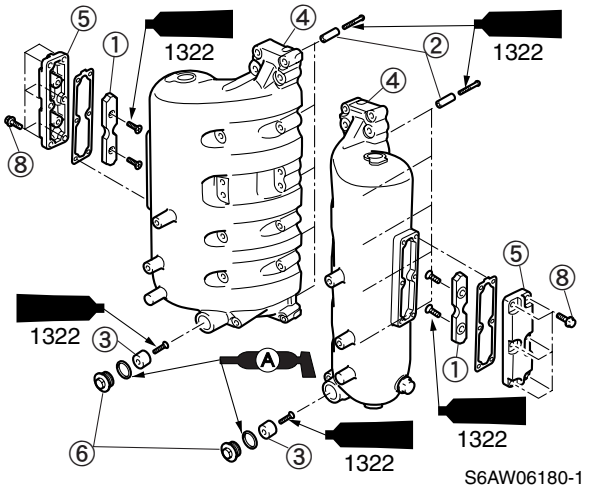
2. Replace the anodes if excessively eroded.

Installing the exhaust joint

1. Install the anodes ①, ②, and ③, to the exhaust joint ④.

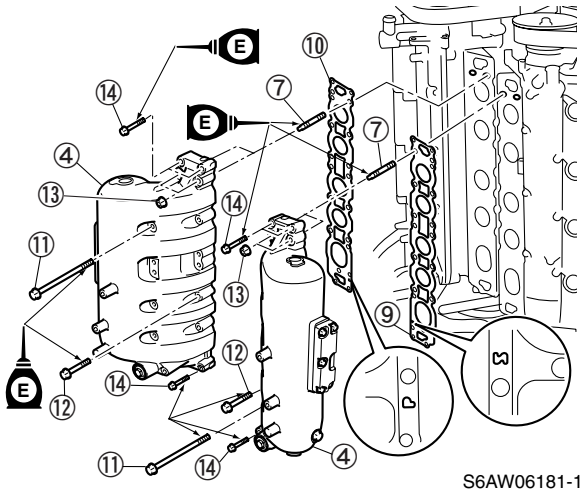
2. Install the anode covers ⑤, and anode plugs ⑥.

3. Install the stud bolts ⑦ to the cylinder head.

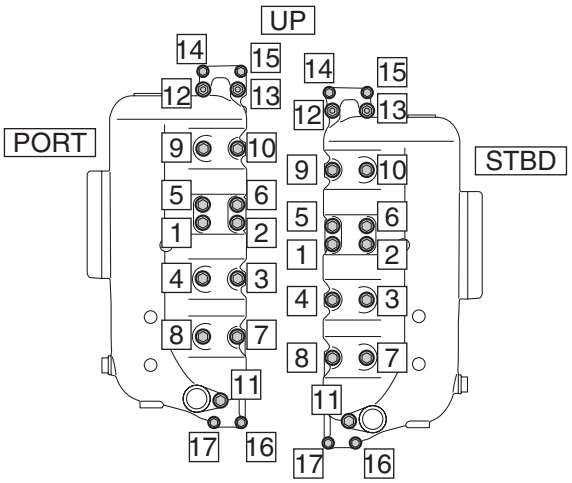


Anode plug ⑥:
24 N·m (2.4 kgf·m, 17.7 ft·lb)
Stud bolt ⑦:
14 N·m (1.4 kgf·m, 10.3 ft·lb)
Anode cover bolt ⑧:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

4. Install new exhaust joint gaskets ⑨ (STBD) and ⑩ (PORT), and the exhaust joints ④. Tighten the bolts ⑪, ⑫, ⑭ and nuts ⑬ to the specified torque in 2 stages and in the sequence shown. Apply some engine oil to the threads of the stud bolts ⑦ the exhaust joint bolts ⑪, ⑫ and ⑭ before tightening.



S6AW06181-1



S6AW06158-1

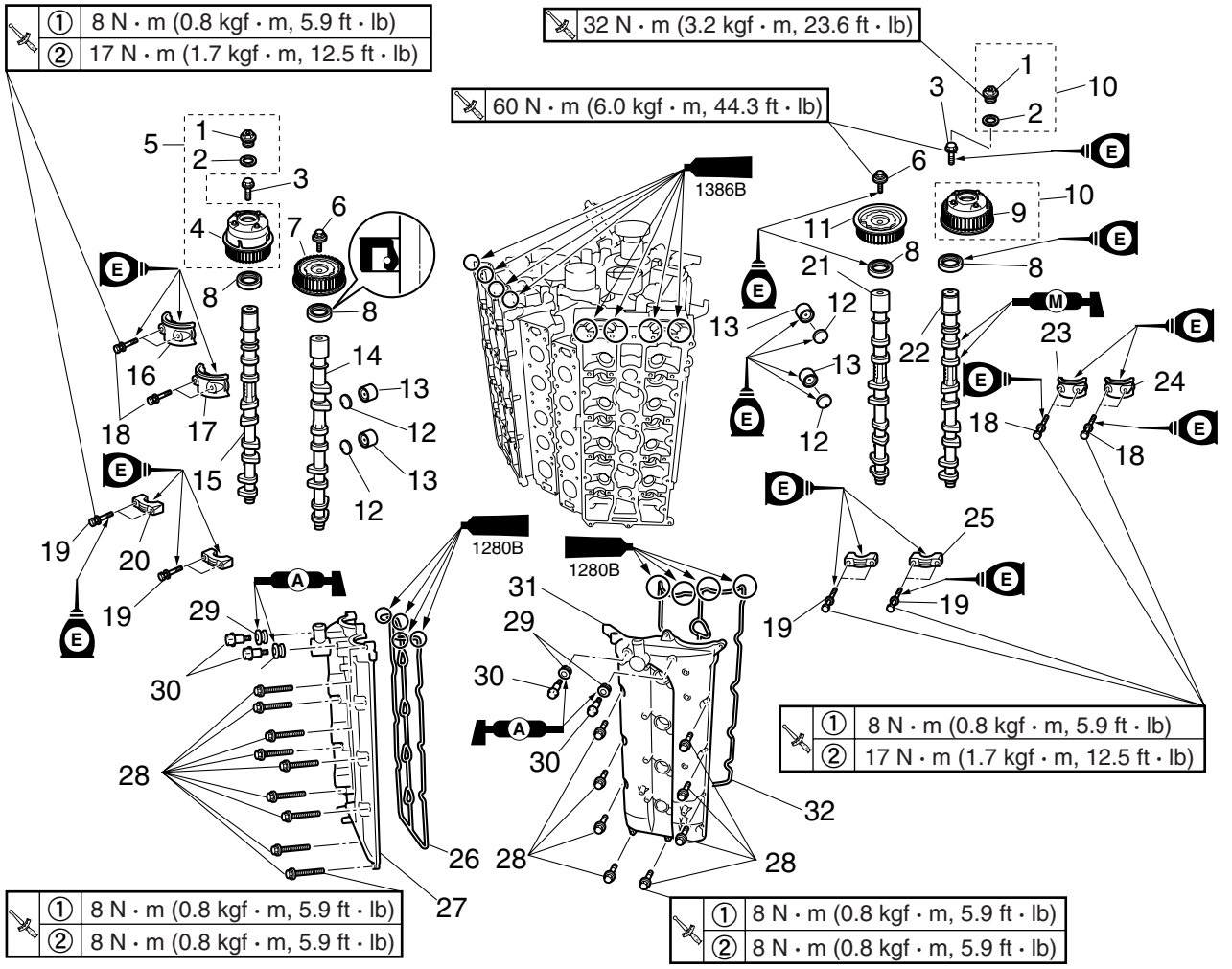
	Exhaust joint bolt ⑪, ⑫ 1–11 (M8): 1 st: 14 N·m (1.4 kgf·m, 10.3 ft·lb) 2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb) Exhaust joint nut ⑬ 12–13 (M8): 1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb) 2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb) Exhaust joint bolt ⑭ 14–17 (M6): 12 N·m (1.2 kgf·m, 8.9 ft·lb)

NOTE:

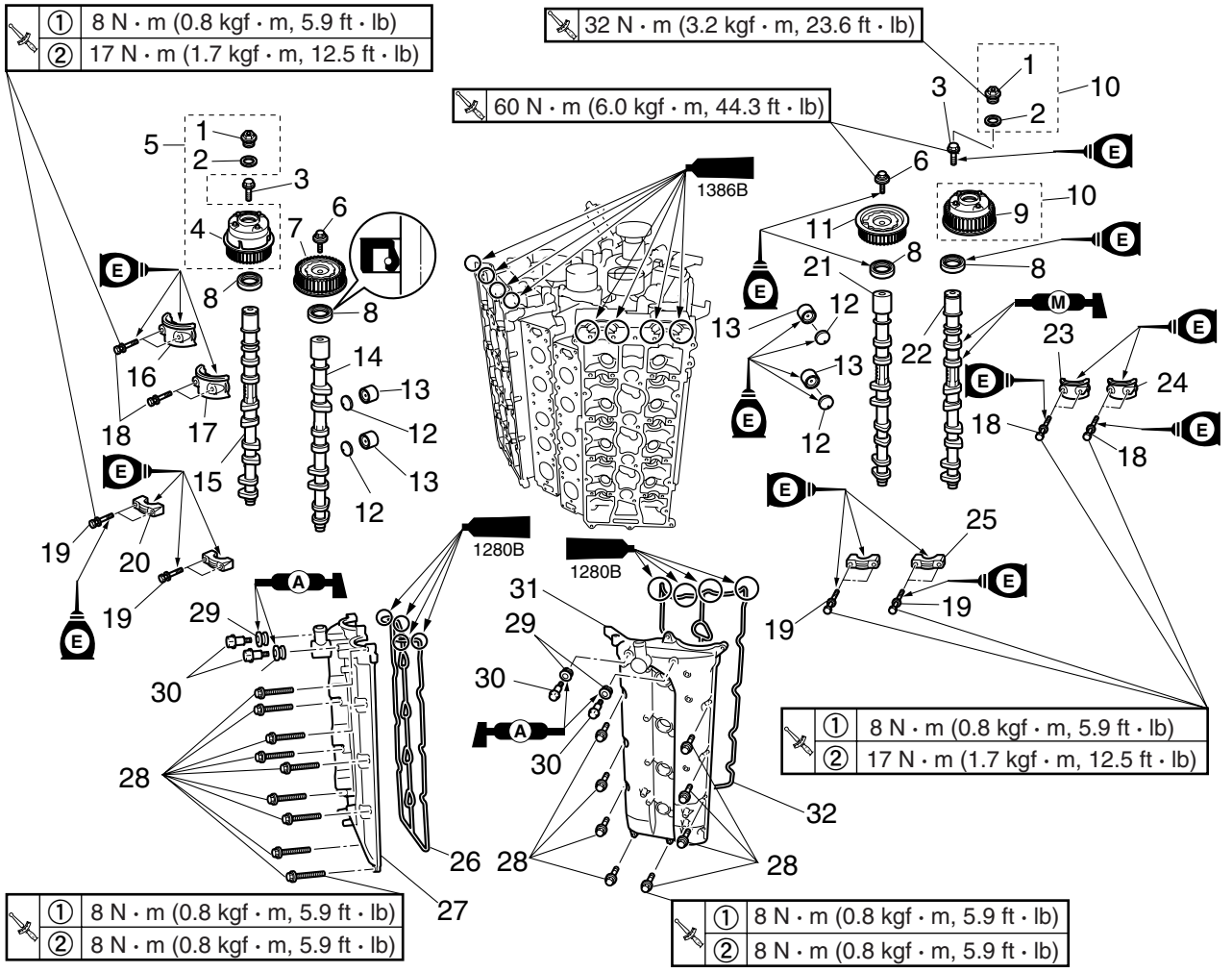
Due to the length of bolts 14–17 it is necessary to repeat the same torque a second time to ensure the desired torque value has been applied.

7

Driven sprocket and camshaft



No.	Part name	Q'ty	Remarks
1	Cap	2	
2	Gasket	2	**Not reusable**
3	Union bolt	2	M12 × 35 mm
4	Pulley	1	
5	VCT assembly (PORT)	1	
6	Bolt	2	M10 × 35 mm
7	Driven sprocket (PORT)	1	
8	Oil seal	4	**Not reusable**
9	Pulley	1	
10	VCT assembly (STBD)	1	
11	Driven sprocket (STBD)	1	
12	Valve shim	32	
13	Valve lifter	32	
14	Camshaft (PORT EX)	1	
15	Camshaft (PORT IN)	1	
16	Camshaft cap	1	
17	Camshaft cap	1	



No.	Part name	Q'ty	Remarks
18	Bolt	4	M7 × 48 mm
19	Bolt	32	M7 × 37 mm
20	Camshaft cap	8	
21	Camshaft (STBD EX)	1	
22	Camshaft (STBD IN)	1	
23	Camshaft cap	1	
24	Camshaft cap	1	
25	Camshaft cap	8	
26	Gasket	1	**Not reusable**
27	Cylinder head cover (PORT)	1	
28	Bolt	32	M6 × 30 mm
29	Grommet	4	
30	Bolt	4	M6 × 20 mm
31	Cylinder head cover (STBD)	1	
32	Gasket	1	**Not reusable**

Removing the timing belt, driven sprocket and camshaft

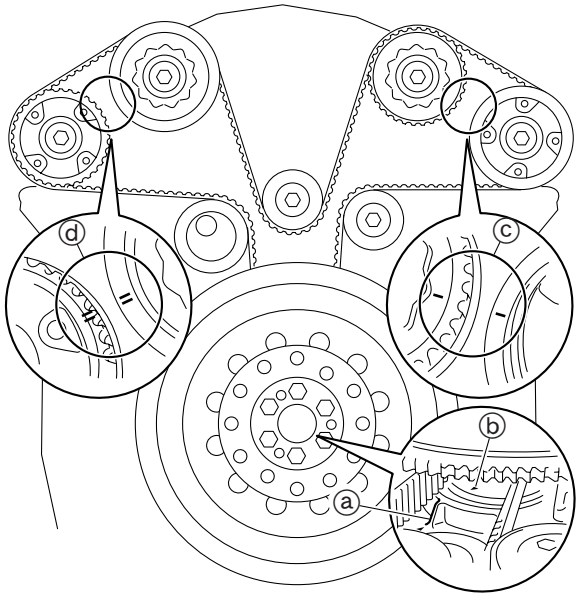
CAUTION:

- **Do not turn the crankshaft counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the crankshaft or the driven sprockets when the timing belt is not installed. Otherwise the piston and valves or intake and exhaust valves will collide with each other and be damaged.**
- **Do not turn the crankshaft and the camshafts unless instructions have been given.**

1. Check the valve clearances before removing the parts.

2. Check if the "1TDC" mark ⓐ and the crank alignment mark ⓑ are aligned.

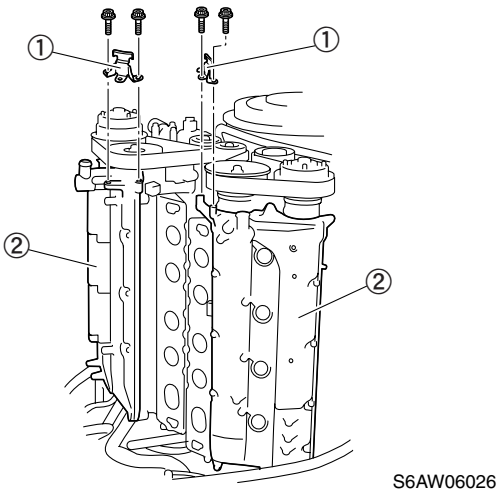
3. Check that the "II" marks ⓒ on the port driven sprockets are aligned, and check that the "I" marks ⓓ on the starboard driven sprockets are aligned.



S6AW06014

4. Remove the exhaust joints.

5. Remove the timing belt guides ① and cylinder head covers ②.

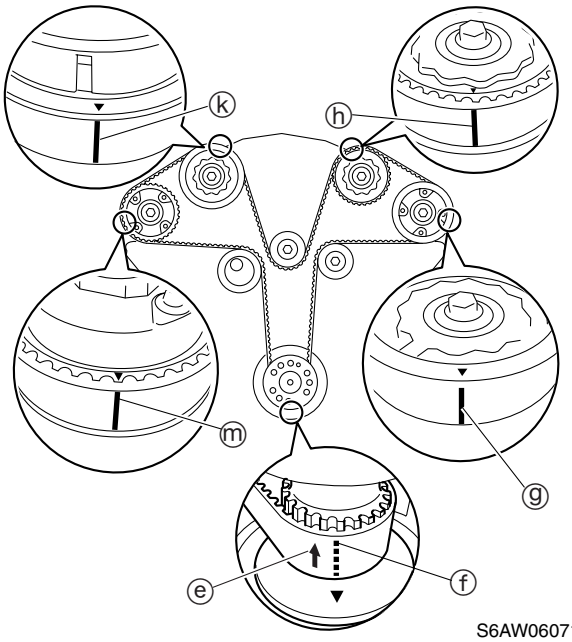


S6AW06026

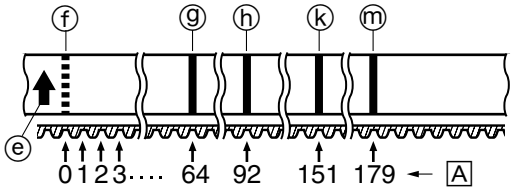
NOTE:

See the exploded diagram (7-24, 7-52).

6. Make marks ⓔ through ⓜ on the timing belt with aligning a each "▲" marks as shown.



S6AW06071



S6AW06167

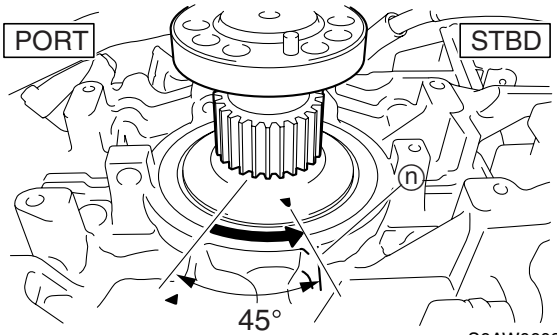
A Belt teeth number

NOTE:

It is not necessary to mark the timing belt when replacing it.

7. Remove the timing belt. To remove the timing belt, see "Replacing the timing belt" (7-42) steps 18–19.

8. Turn the crank shaft counterclockwise slowly up to 45°, and align it to the belt assemble alignment mark ⓝ.

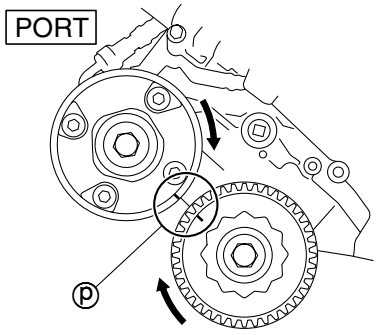


S6AW06028

CAUTION:

Do not turn the crankshaft counterclockwise more than 45°. Otherwise the piston and valves will collide with each other and be damaged.

9. Align the "I" marks ⓟ on the port driven sprockets by turning them clockwise 45° gradually.



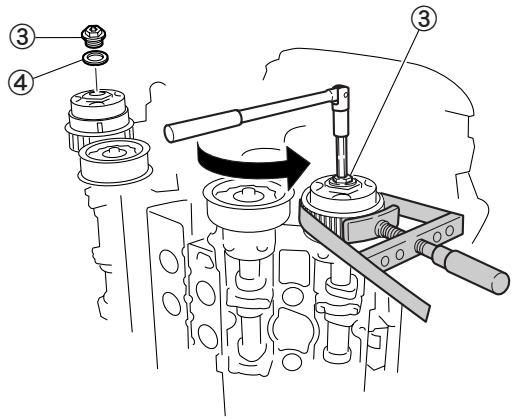
S6AW06029

CAUTION:

- **Do not turn the port driven sprockets clockwise more than 45°, and do not turn the starboard driven sprockets. Otherwise the intake and exhaust valves will collide with each other and be damaged.**
- **Be careful when turning the driven sprockets. Depending on the position of the camshafts, the force of the valve springs may cause the driven sprockets to be rotated too far.**

7

10. Hold the intake driven sprocket using the special service tool, and then remove the VCT caps ③.



S6AW06030

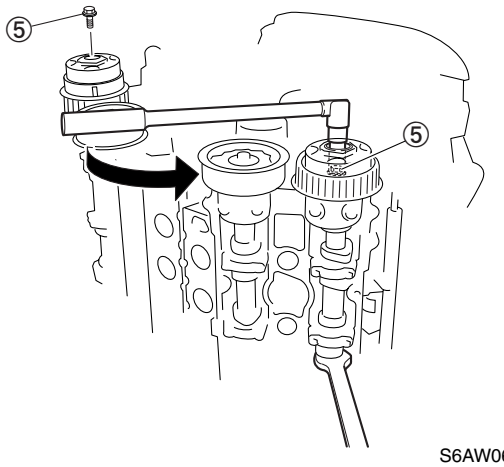
CAUTION:

- **Do not hold the camshaft when removing the VCT cap. Otherwise the VCT assembly can be damaged.**
- **Do not turn the driven sprocket when removing the VCT cap. Otherwise the intake and exhaust valves will collide with each other and be damaged.**
- **Do not reuse the gasket ④, always replace it with a new one.**

Sheave holder:
90890-01701

11. Hold the intake camshaft using a wrench, and then remove the VCT bolts ⑤.

12. Remove the VCT assembly with the driven sprockets.

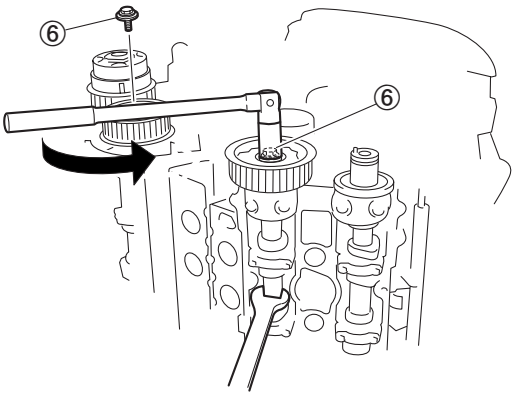


S6AW06031

CAUTION:

- **Do not hold the driven sprocket when removing the VCT bolt. Otherwise the VCT assembly can be damaged.**
- **Do not turn the intake camshaft when removing the VCT bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.**

13. Hold the exhaust camshaft using a wrench, and then remove the bolts ⑥.



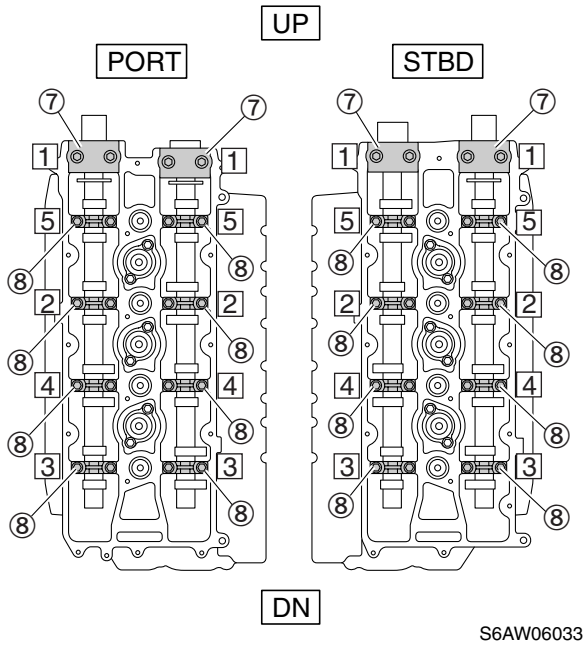
S6AW06032

14. Remove the exhaust driven sprockets.

CAUTION:

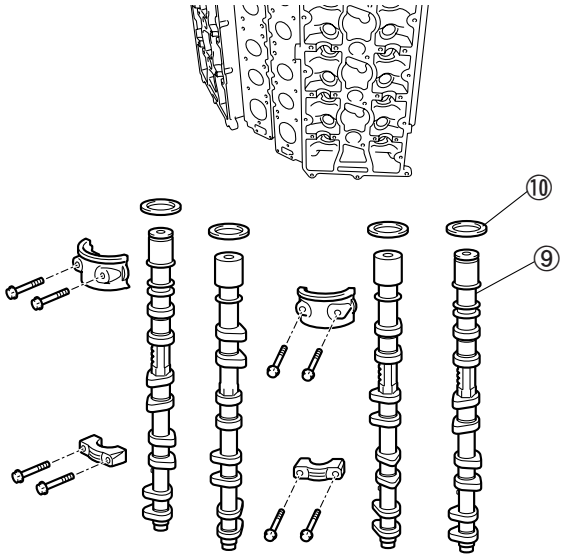
Do not turn the exhaust camshaft when removing the bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.

15. Gradually loosen the camshaft caps ⑦ and ⑧ in several stages and in the sequence shown. Take precaution not to tilt the camshafts.



S6AW06033

16. Remove the camshafts ⑨ and oil seals ⑩.



S6AW06034-1

NOTE:
See the exploded diagram (7-52).

17. Remove the valve lifters from the cylinder heads.

NOTE:
Do not mix the valve train parts. Keep them organized in their proper groups.

Checking the sprocket

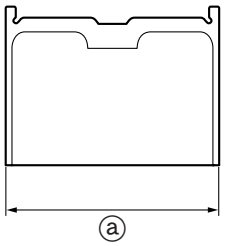
1. Check the drive sprocket. Replace if cracked, damaged, or worn.

2. Check the driven sprockets. Replace the VCT assembly or driven sprocket if cracked, damaged, or worn.

Checking the valve lifter

1. Check the valve lifters. Replace if damaged, scratched, or worn.

2. Measure the valve lifter outside diameter. Replace if out of specification.



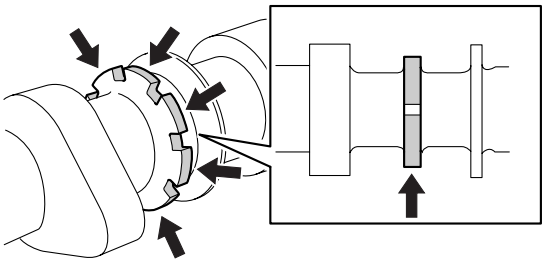
S6AW06084

Valve lifter outside diameter ⓐ:
32.982–32.997 mm
(1.2985–1.2991 in)

7

Checking the camshaft

1. Check the edge and face of the rotor on the port camshafts and starboard intake camshaft that is used for the cam position sensor. Replace if rough, damaged, or scratched.

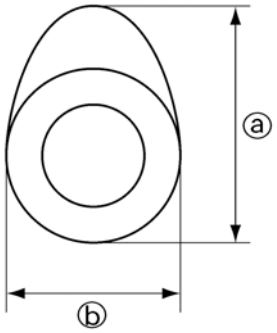


S6AW06035

NOTE:

- Do not scratch or damage the face of the rotor.
- If there is a scratch more than 0.2 mm (0.008 in) deep or more than 0.5 mm (0.020 in) wide on the surface of the brim, a malfunction may occur in the cam position sensor signal.

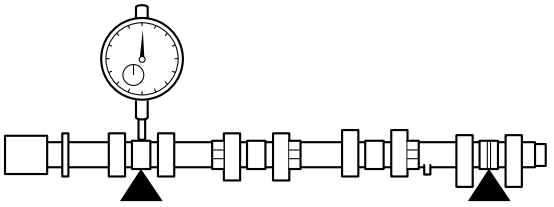
2. Measure the cam lobe. Replace if out of specification.



S69J5950

Cam lobe ⓐ:
  Intake:
    45.95–46.05 mm
    (1.809–1.813)
  Exhaust:
    45.35–45.45 mm
    (1.785–1.789 in)
Cam lobe ⓑ:
  Intake and exhaust:
    35.95–36.05 mm
    (1.415–1.419 in)

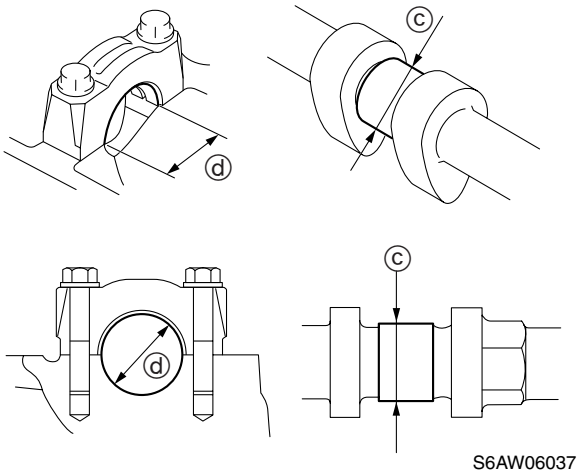
3. Measure the camshaft runout. Replace if above specification.



S6AW06036

Camshaft runout limit:
  0.03 mm (0.0012 in)

4. Measure the camshaft journal diameter ⓒ and cylinder head journal inside diameter ⓓ. Replace the camshaft or cylinder head assembly, or both if out of specifications.



S6AW06037

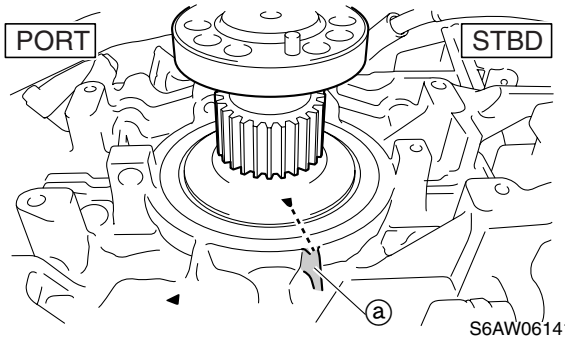
Camshaft journal diameter ⓒ:
  24.96–24.98 mm
  (0.9826–0.9834 in)
Camshaft cap inside diameter ⓓ:
  25.000–25.021 mm
  (0.9843–0.9851 in)

Installing the camshaft, driven sprocket, and timing belt

CAUTION:

- **Do not turn the crankshaft counterclockwise, otherwise the water pump impeller may be damaged.**
- **Do not turn the crankshafts when the timing belt is not installed. Otherwise the pistons and valves or intake and exhaust valves will collide with each other and be damaged.**
- **Do not turn the crankshaft and the camshafts unless otherwise instructed in this manual.**

1. Check that the mark "▲" on the flange below the dowel is aligned with the mark ⓐ.

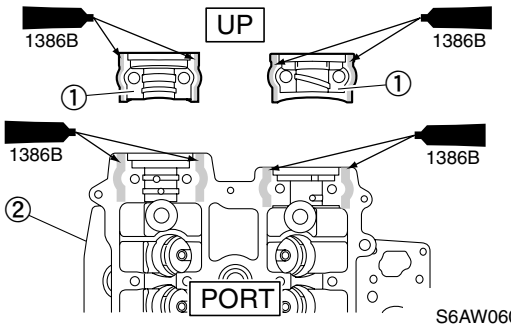


S6AW06141

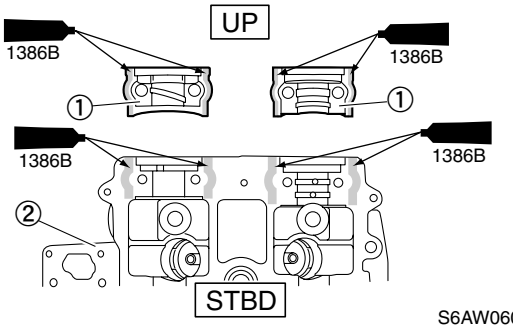
2. Apply engine oil to the valve shims and valve lifters before installation.

3. Install the valve lifters onto the cylinder heads. At this point, install the valve lifters and the valve shims to the original positions.

4. Apply a thin, even coat of sealant to the mating surface of the camshaft caps ① cylinder heads ② as shown.



S6AW06039



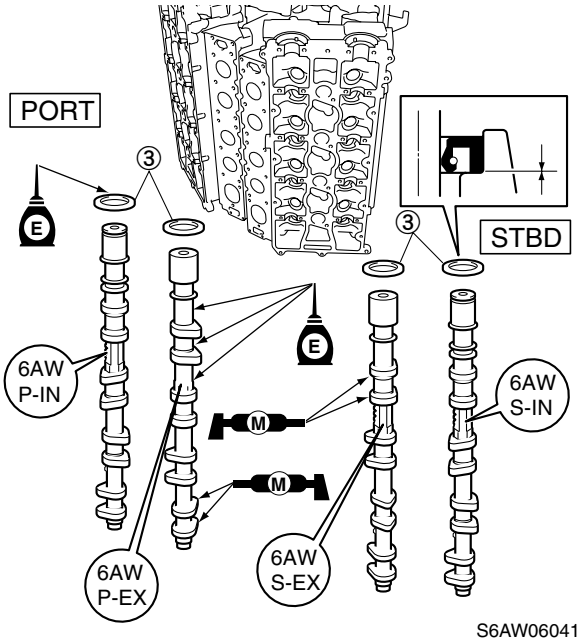
S6AW06040

NOTE:

When applying the sealant, be sure not to block the oil passages or oil holes and do not apply it to the cylinder head journals.

7

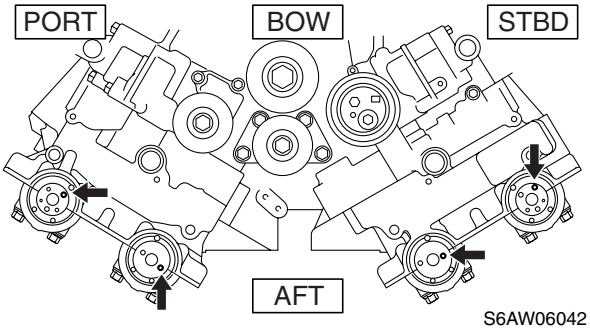
5. Install the cam shafts with the oil seals ③. Make sure the camshafts are installed to the original positions. Apply some molybdenum disulfide grease on the cam lobes.



S6AW06041

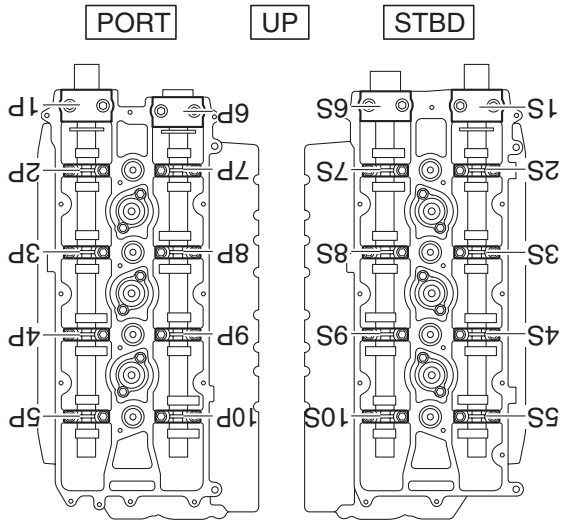
NOTE:
See the exploded diagram (7-52).

6. Check that the camshaft dowels are in the position shown in the illustration.



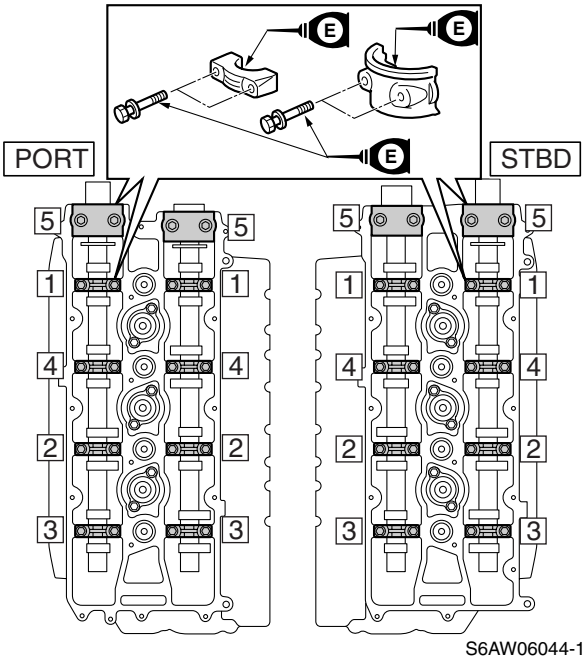
S6AW06042

7. Install the camshaft caps in their proper positions as shown and with the stamped numbers upside down.



S6AW06043

8. Tighten the camshaft cap bolts to the specified torques in 2 stages and in the sequence shown. Apply engine oil to the camshaft caps and camshaft cap bolts before installation.

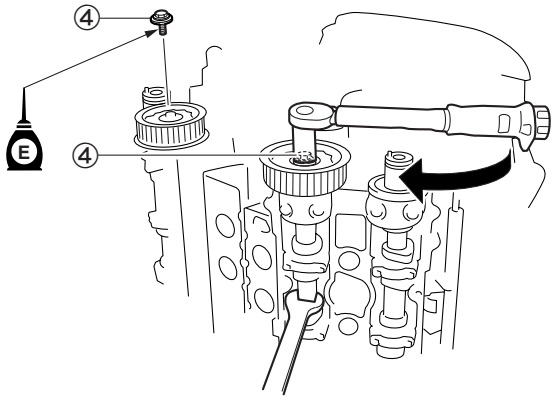


S6AW06044-1

Camshaft cap bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

9. Install the exhaust driven sprockets on the exhaust camshafts.

10. Hold the exhaust camshaft using a wrench, and tighten the driven sprocket bolts ④ to the specified torque.



S6AW06045-1

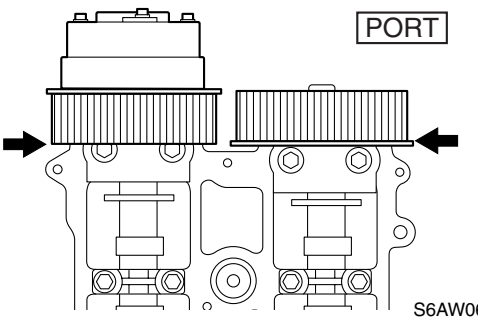
CAUTION:

Do not turn the exhaust camshaft when tightening the bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.

Driven sprocket bolt ④:
60 N·m (6.0 kgf·m, 44.3 ft·lb)

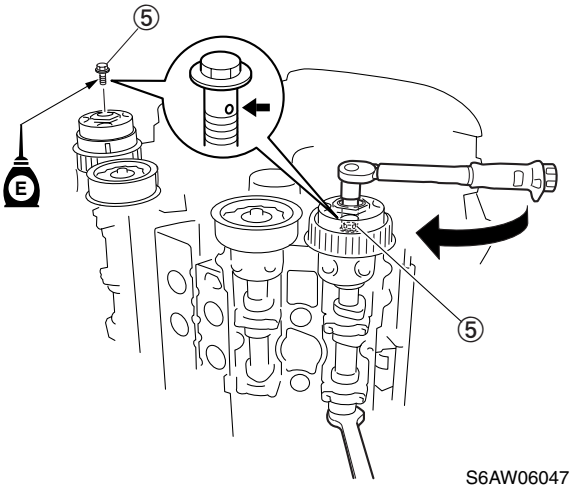
11. Install the VCT assemblies on the intake camshafts.

12. Check that the lower edge of the intake and exhaust driven sprockets are aligned.



S6AW06046

13. Hold the intake camshaft using a wrench, and then tighten the VCT bolts ⑤ (with oil hole) to the specified torque.



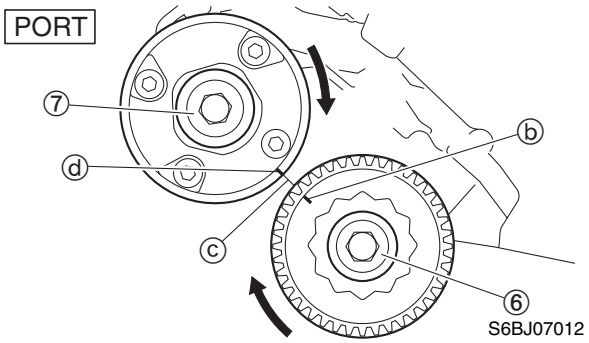
S6AW06047

CAUTION:

- **Do not hold the driven sprocket when tightening the VCT bolt. Otherwise the VCT assembly could be damaged.**
- **Do not turn the intake camshaft when tightening the VCT bolt. Otherwise the intake and exhaust valves will collide with each other and be damaged.**

VCT bolt ⑤:
60 N·m (6.0 kgf·m, 44.3 ft·lb)

14. Gradually turn the exhaust camshaft (PORT) ⑥ clockwise until "I" mark ⓑ is aligned with the cylinder head top surface ⓒ, and then gradually turn the intake camshaft (PORT) ⑦ clockwise until "I" mark ⓓ is aligned with the cylinder head top surface ⓒ.



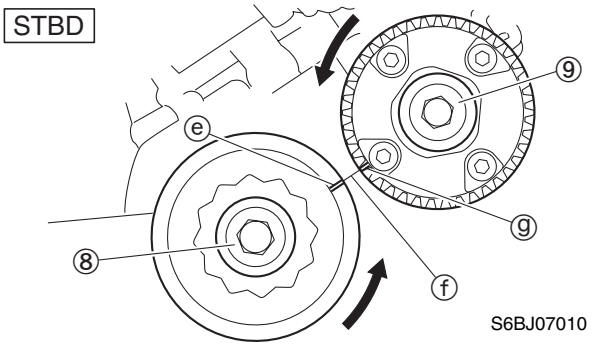
S6BJ07012

7

CAUTION:

- **Make sure to turn the exhaust camshaft (PORT) first, and then turn the intake camshaft (PORT). Otherwise, the intake and exhaust valves will contact each other causing valve damage. Do not turn the camshafts counterclockwise.**
- **Be careful when turning the camshafts. Compression of the valve springs may cause the camshafts to rotate too far.**

15. Gradually turn the exhaust camshaft (STBD) ⑧ counterclockwise until "II" mark ⓔ is aligned with the cylinder head top surface ⓕ, and then gradually turn the intake camshaft (STBD) ⑨ counterclockwise until "II" mark ⓖ is aligned with the cylinder head top surface ⓕ.

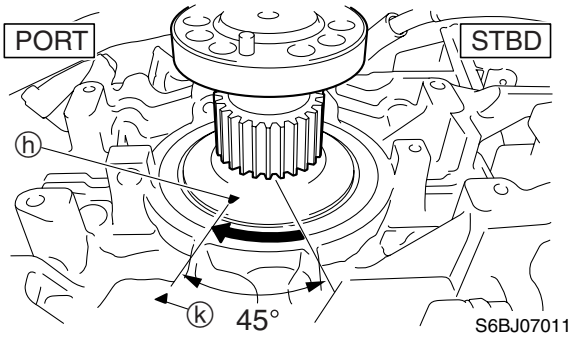


S6BJ07010

CAUTION:

- **Make sure to turn the exhaust camshaft (STBD) first, and then turn the intake camshaft (STBD). Otherwise, the intake and exhaust valves will contact each other causing valve damage. Do not turn the camshafts clockwise.**
- **Be careful when turning the camshafts. Compression of the valve springs may cause the camshafts to rotate too far.**

16. Gradually turn the crankshaft 45° clockwise to align the "▲" mark ⓗ on the flange below the dowel with the "1TDC" mark ⓚ.

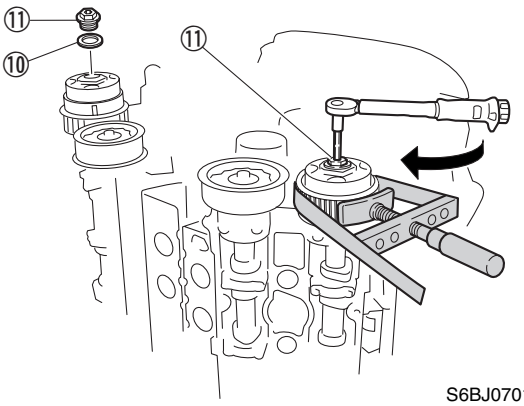


S6BJ07011

CAUTION:

Do not turn the crankshaft clockwise more than 45°. Otherwise, the pistons and valves will collide with each other causing damage.

17. Install new gaskets ⑩ and the VCT caps ⑪, and then tighten the caps to the specified torque while holding the driven sprocket using the special service tool.



S6BJ07016

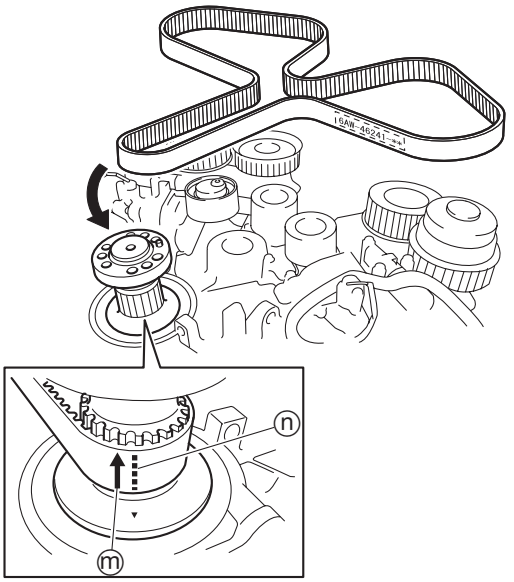
CAUTION:

- **Do not reuse the gaskets, always replace them with new ones.**
- **Do not hold the camshaft when tightening the VCT cap ⑪. Otherwise the VCT assembly could be damaged.**
- **Do not turn the driven sprocket when tightening the VCT cap ⑪. Otherwise the intake and exhaust valves will collide with each other and be damaged.**

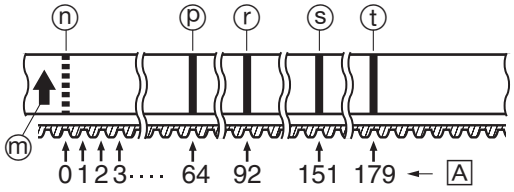
	Sheave holder: 90890-01701

	VCT cap ⑪: 32 N·m (3.2 kgf·m, 23.6 ft·lb)

18. Install the timing belt onto the drive sprocket with the arrow mark ⓜ facing upward and align the timing belt mark ⓝ with the "▲" mark on the drive sprocket. To install the timing belt, see "Replacing the timing belt" (7-42) steps 20–25.



S6BJ07013



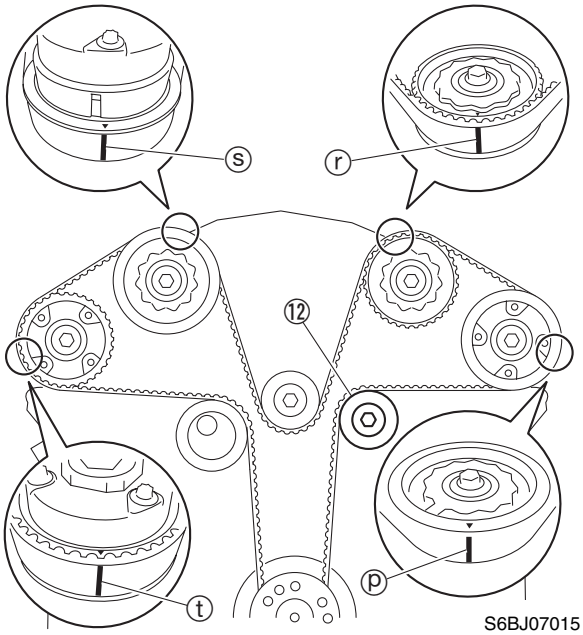
S6BJ07014

A Belt teeth number

CAUTION:

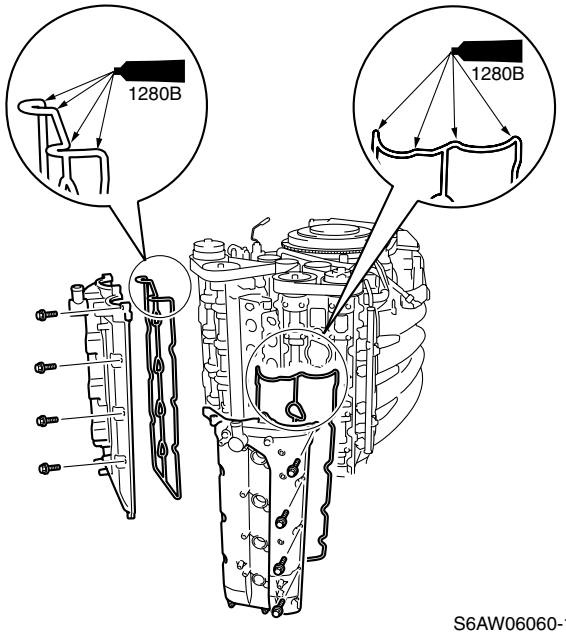
- **Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) otherwise it can be damaged.**
- **Do not get oil or grease on the timing belt.**

19. Align the timing belt position marks in the order of ⓝ, ⓣ, ⓢ, ⓡ, and ⓟ so the starboard side and the port side driven sprockets will not turn counterclockwise. Set the timing belt to the port side idler pulley ⑫ when the timing belt is installed to the driven sprocket.



S6BJ07015

20. Apply sealant on the cylinder head cover gasket at the positions shown in the illustration. Install the cylinder head cover, and tighten the bolts with the specified torque in 2 stages.



S6AW06060-1

7

NOTE:
See the exploded diagram (7-52).

Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

21. Install the wiring harness guide. To install the wiring harness guide, see “Installing the wiring harness, the wiring harness guide and the flywheel magnet” (7-29).

22. Install the exhaust joints. To install the exhaust joints, see “Installing the exhaust joint” (7-50).

23. Install all parts removed during disassembly.

24. Install the timing belt guides. To install the timing belt guides, see “Replacing the timing belt” (7-42) step 31.

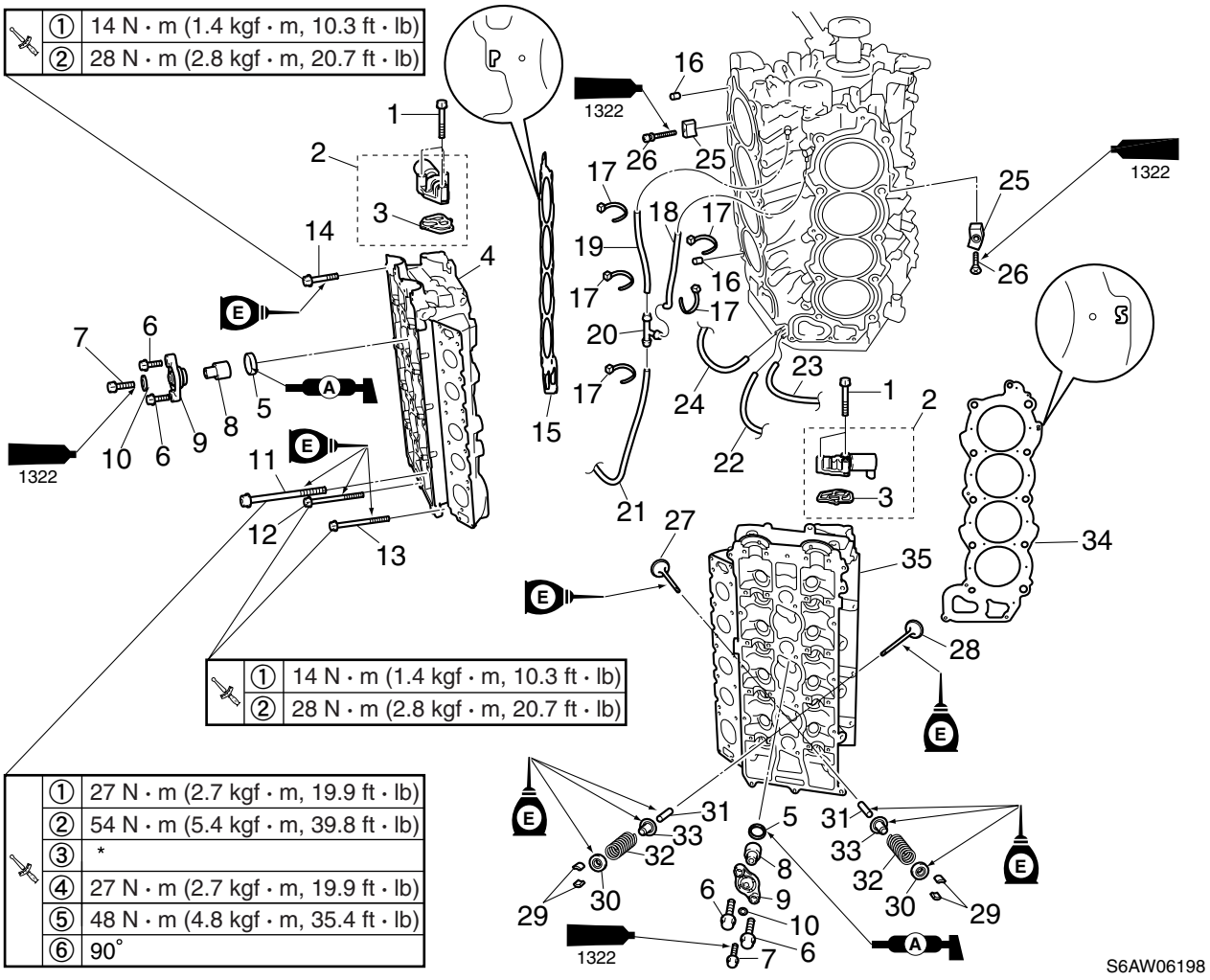
NOTE:
If the valve clearances are adjusted or any parts related to valve movement are replaced after installing the timing belt, check the valve clearances. To check the valve clearance, see “Checking the valve clearance” (7-3).

25. Check that the wiring harness, hoses, and other parts do not interfere with any moving parts.

CAUTION:
Incorrect assembly of the flywheel magnet cover may result in the interference with the timing belt.

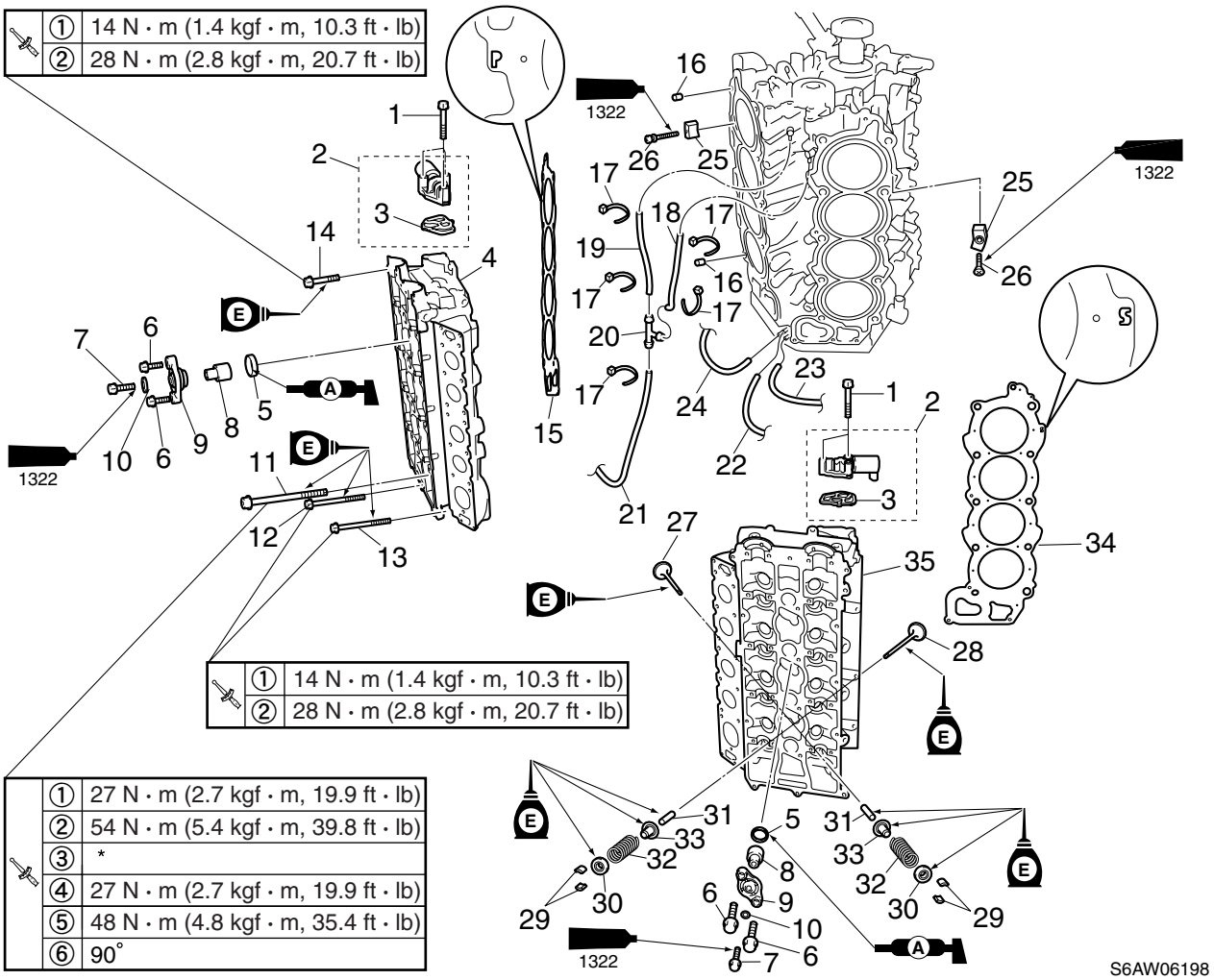
Cylinder head

Cylinder head



No.	Part name	Q'ty	Remarks
1	Bolt	6	M6 × 40 mm
2	OCV assembly	2	
3	Filter	2	**Not reusable**
4	Cylinder head (PORT)	1	
5	Grommet	6	
6	Bolt	12	M8 × 25 mm
7	Bolt	6	M6 × 20 mm
8	Anode	6	
9	Cover	6	
10	Gasket	6	**Not reusable**
11	Bolt	20	M11 × 120 mm/T55
12	Bolt	4	M8 × 70 mm
13	Bolt	2	M8 × 90 mm
14	Bolt	2	M8 × 30 mm
15	Gasket	1	**Not reusable**
16	Dowel	4	
17	Plastic tie	5	**Not reusable**

*: Loosen completely

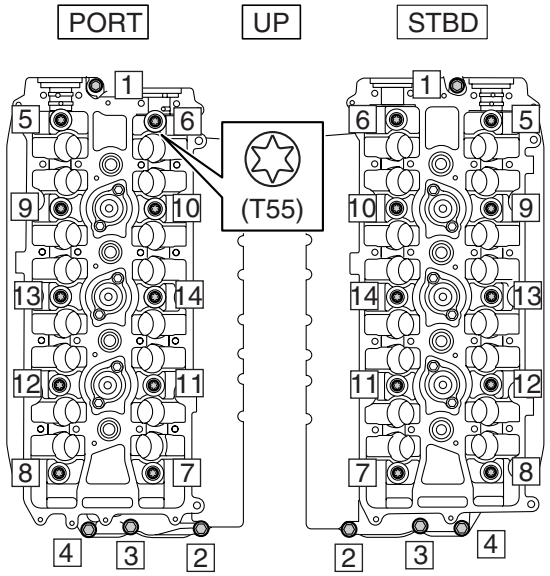


No.	Part name	Q'ty	Remarks
18	Flushing hose	1	
19	Flushing hose	1	
20	Joint	1	
21	Flushing hose	1	
22	Hose	1	
23	Hose	1	
24	Hose	1	
25	Anode	8	
26	Screw	8	ø6 × 25 mm
27	Intake valve	16	
28	Exhaust valve	16	
29	Valve cotter	64	
30	Valve spring retainer	32	
31	Valve guide	32	**Not reusable**
32	Valve spring	32	
33	Valve seal	32	**Not reusable**
34	Gasket	1	**Not reusable**
35	Cylinder head (STBD)	1	

*: Loosen completely

Removing the cylinder head

1. Remove the cylinder head bolts in the sequence shown.

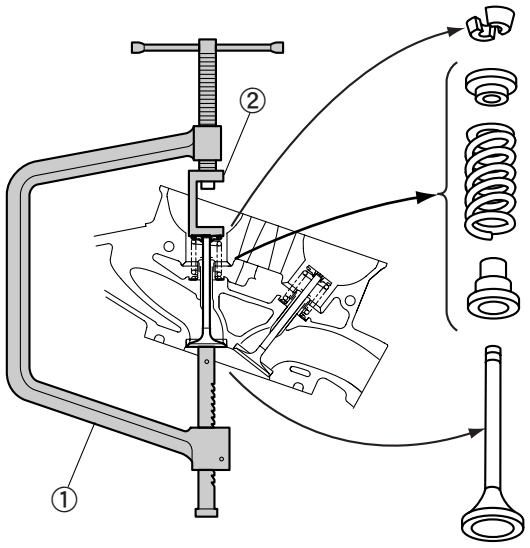


S6AW06076

CAUTION:

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

2. Remove the intake and exhaust valves.



S6AW06077

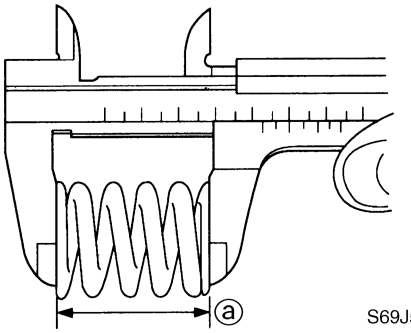
NOTE:

Be sure to keep the valves, springs, and other parts in the order as they were removed.

	Valve spring compressor ①: (commercially available) Valve spring compressor attachment ②: (commercially available)

Checking the valve spring

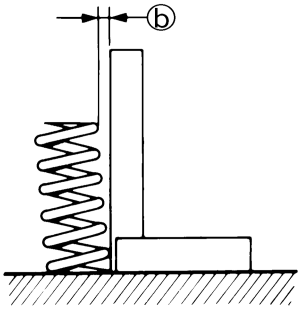
1. Measure the valve spring free length ⓐ. Replace if below specification.



S69J5720

	Valve spring free length ⓐ: 44.20 mm (1.740 in)

2. Measure the valve spring tilt ⓑ. Replace if above specification.



S69J5730

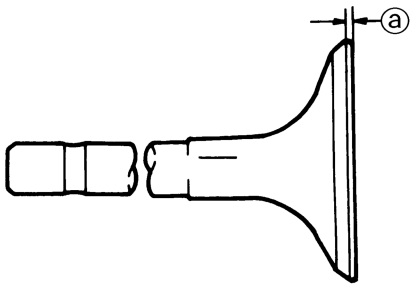
	Valve spring tilt limit ⓑ: 1.2 mm (0.05 in)

7

Checking the valve

1. Check the valve face. Replace if pitted or worn.

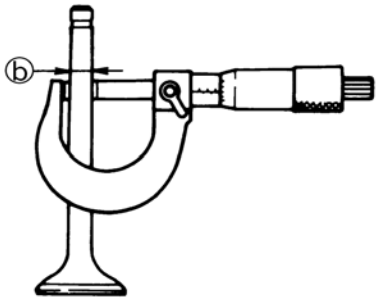
2. Measure the valve margin thickness ⓐ. Replace if out of specification.



S69J5740

Valve margin thickness ⓐ:
Intake:
0.50–0.90 mm (0.020–0.035 in)
Exhaust:
0.90–1.30 mm (0.035–0.051 in)

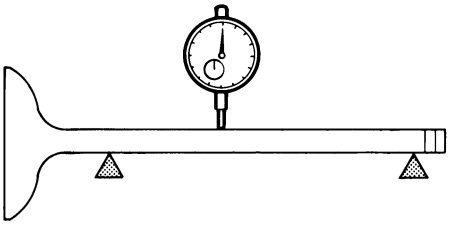
3. Measure the valve stem diameter ⓑ. Replace if out of specification.



S69J5750

Valve stem diameter ⓑ:
Intake:
5.477–5.492 mm
(0.2156–0.2162 in)
Exhaust:
5.464–5.479 mm
(0.2151–0.2157 in)

4. Measure the valve stem runout. Replace if above specification.



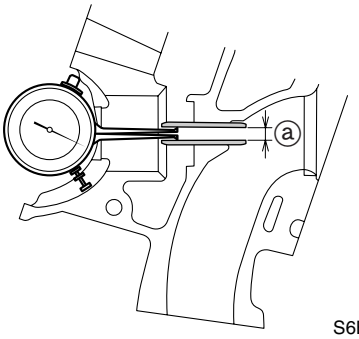
S69J5760

Valve stem runout limit:
0.01 mm (0.0004 in)

Checking the valve guide

1. Before checking the valve guides, make sure that the valve stem diameter is within specification.

2. Measure the valve guide inside diameter ⓐ.



S6BJ07005

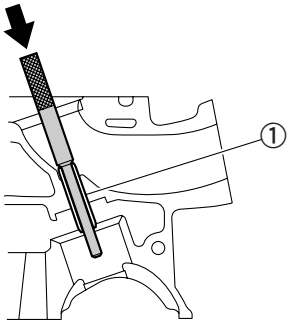
Valve guide inside diameter ⓐ:
Intake and exhaust:
5.504–5.522 mm
(0.2167–0.2174 in)

3. Calculate the valve stem-to-valve guide clearance as follows. Replace the valve guide if out of specification.

Valve stem-to-valve guide clearance = valve guide inside diameter – valve stem diameter:
Intake:
0.012–0.045 mm
(0.0005–0.0018 in)
Exhaust:
0.025–0.058 mm
(0.0010–0.0023 in)

Replacing the valve guide

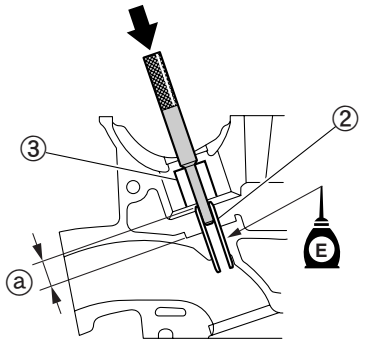
1. Remove the valve guide ① using the special service tool from the combustion chamber side.



S6AW06002

Valve guide remover:
90890-06801

2. Apply some engine oil to a new valve guide ②. Install it from the camshaft end to the position ⓐ where the valve guide installer ③ on the special service tool touches the cylinder head.

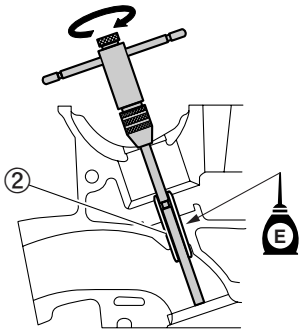


S6AW06003

Valve guide remover:
90890-06801
Valve guide installer ③:
90890-06810

Valve guide installation position:
Intake and exhaust ⓐ:
13.8 ± 0.2 mm (0.5 ± 0.01 in)

3. Apply some engine oil to the bore of the valve guide ②.
4. Process the bore of the valve guide by inserting the valve guide reamer to the valve guide ②, and turning it clockwise. Do not turn the valve guide reamer counterclockwise when removing it.



S6AW06004

5. Be sure to clean the valve guide after reaming it.

Valve guide reamer:
90890-06804

6. Measure the valve guide inside diameter.

Valve guide inside diameter:
Intake and exhaust:
5.504–5.522 mm
(0.2167–0.2174 in)

7. After replacing a valve guide, check the valve seat contact area. To check the valve seat contact area, see “Checking the valve seat” (7-70).

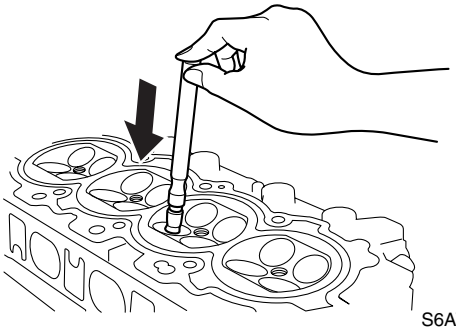
7

Checking the valve seat

1. Eliminate carbon deposits from the valves.

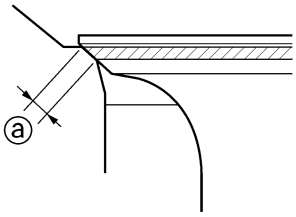
2. Apply a thin, even layer of Mechanic's blueing dye (Dykem) onto the valve seat.

3. Lap the valve slowly on the valve seat with a valve lapper (commercially available) as shown.

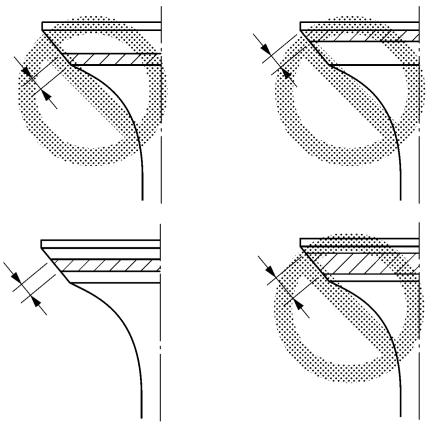


S6AW06092

4. Measure the valve seat contact width ⓐ where the blueing dye is adhered to the valve face. Reface the valve seat if the valve is not seated properly or if the valve seat contact width is out of specification. Replace the valve guide if the valve seat contact is uneven.



S69J5830

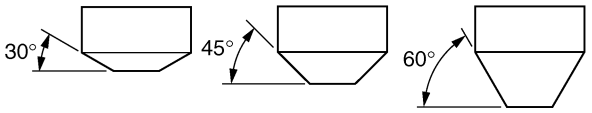


S69J5840

Valve seat contact width ⓐ:
Intake:
1.10–1.40 mm (0.043–0.055 in)
Exhaust:
1.40–1.70 mm (0.055–0.067 in)

Refacing the valve seat

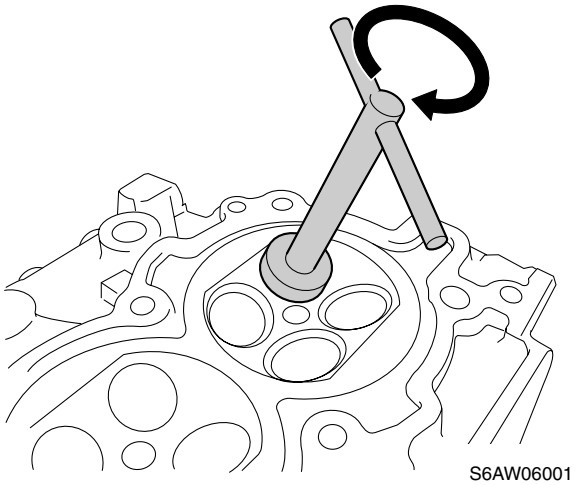
1. Reface the valve seat with the valve seat cutter.

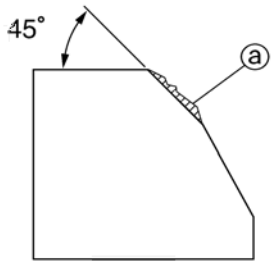


S69J585

Valve seat cutter holder:
90890-06316
Valve seat cutter:
30° (intake): 90890-06817
30° (exhaust): 90890-06326
45° (intake): 90890-06816
45° (exhaust): 90890-06325
60° (intake and exhaust):
90890-06324

2. Cut the surface of the valve seat with a 45° cutter by turning the cutter clockwise until the valve seat face has become smooth.


S6AW06001



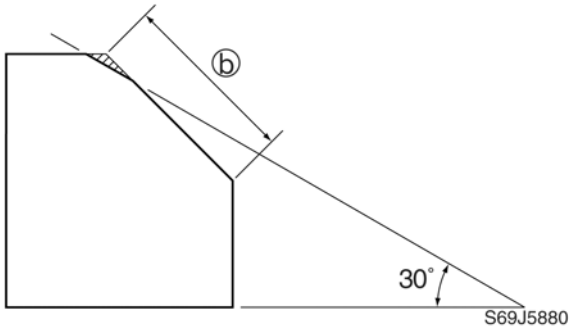
S69J5870

ⓐ Slag or rough surface

CAUTION:

Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.

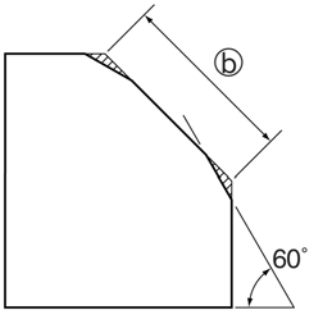
3. Use a 30° cutter to adjust the contact width of the top edge of the valve seat.



S69J5880

ⓑ Previous contact width

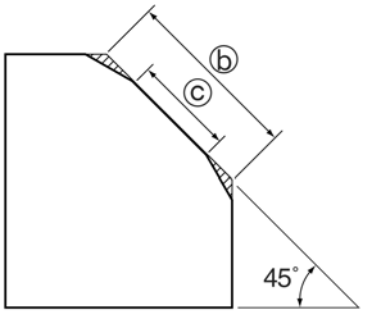
4. Use a 60° cutter to adjust the contact width of the bottom edge of the valve seat.



S69J5890

ⓑ Previous contact width

5. Use a 45° cutter to adjust the contact width of the valve seat to specification.



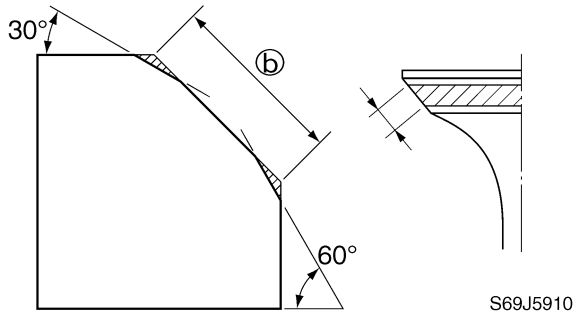
S69J5900

ⓑ Previous contact width
ⓒ Specified contact width

6. Check the valve seat contact area of the valve. To check the valve seat contact area, see “Checking the valve seat” (7-70).

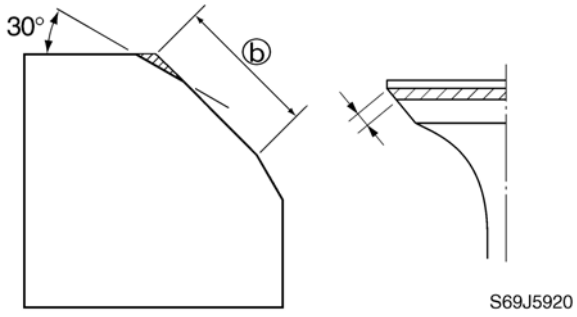
7

7. If the valve seat contact width is too wide and situated in the center of the valve face, use a 30° cutter to cut the top edge of the valve seat, a 60° cutter to cut the bottom edge to center the area and set its width.



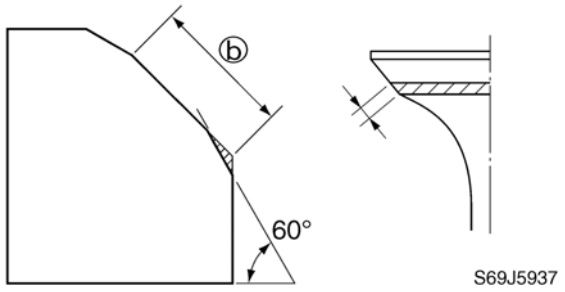
ⓑ Previous contact width

8. If the valve seat contact width is too narrow and situated near the top edge of the valve face, use a 30° cutter to cut the top edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



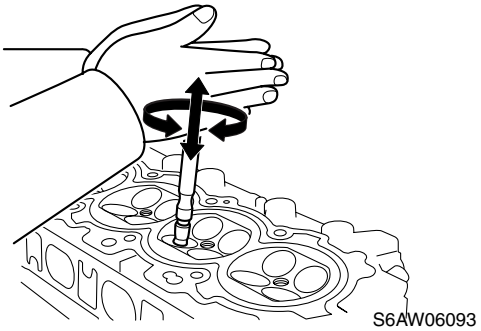
ⓑ Previous contact width

9. If the valve seat contact width is too narrow and situated near the bottom edge of the valve face, use a 60° cutter to cut the bottom edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



ⓑ Previous contact width

10. After refacing the valve seat to the specified contact width, apply a thin, even layer of lapping compound onto the valve seat, and then lap the valve using a valve lapper (commercially available).



CAUTION:

Do not get the lapping compound on the valve stem and valve guide.

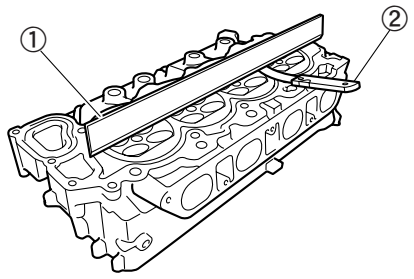
11. After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder heads and the valves.

12. Check the valve seat contact area of the valve again. To check the valve seat contact area, see “Checking the valve seat” (7-70).

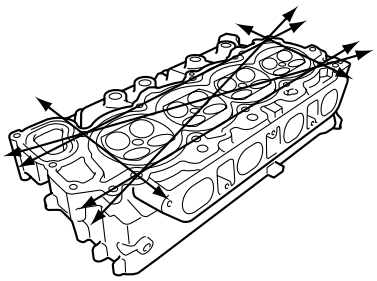
Checking the cylinder head

1. Eliminate carbon deposits from the combustion chambers and check for deterioration.

2. Check the cylinder head warpage using a straightedge ① and thickness gauge ② in the directions shown. Replace the cylinder head assembly if above specification.



S6AW06006

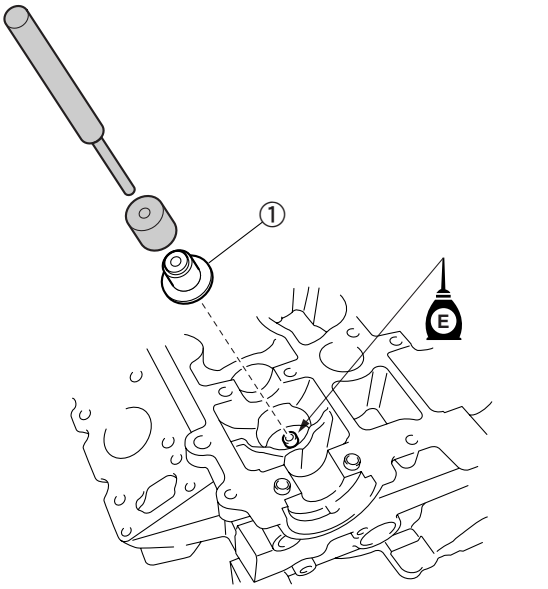


S6AW06007

Cylinder head warpage limit:
0.1 mm (0.0039 in)

Installing the valve

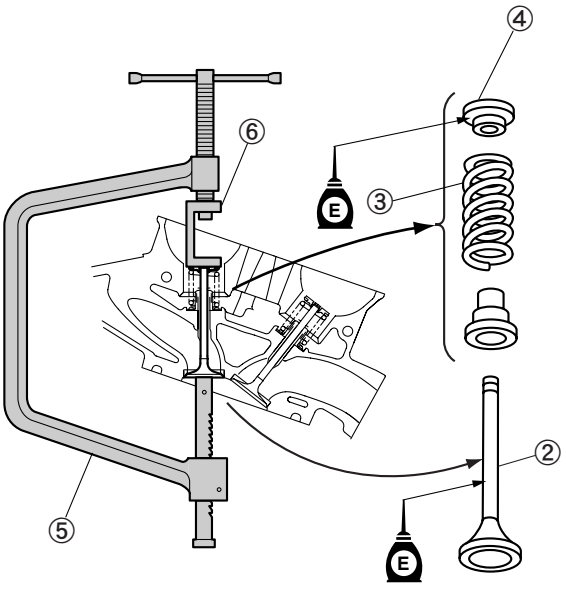
1. Install a new valve seal ① onto the valve guide.



S6AW06005

Valve guide remover:
90890-06801
Valve guide installer:
90890-06810

2. Install the valve ②, valve spring ③, and valve spring retainer ④ in the sequence shown, and then install the valve spring compressor ⑤ and valve spring compressor attachment ⑥.



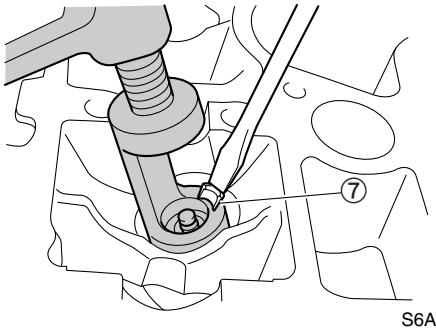
S6AW06094

7

NOTE:
The valve spring can be installed in any direction.

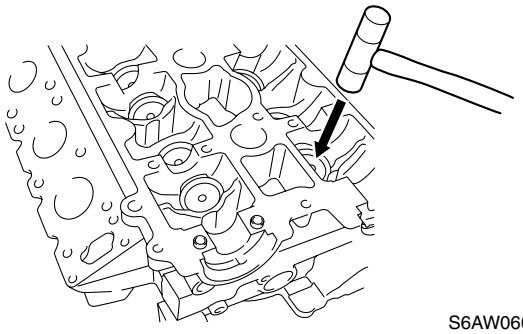
Valve spring compressor ⑤:
(commercially available)
Valve spring compressor attachment ⑥:
(commercially available)

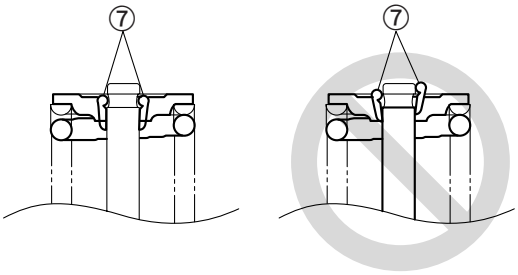
3. Compress the valve spring, and then install the valve cotters ⑦.



S6AW06095

4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotters ⑦ securely.


S6AW06008



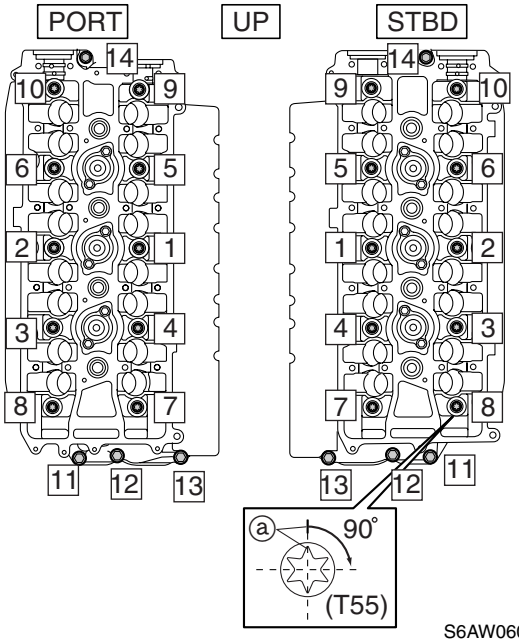
S6AL5430

Installing the cylinder head

1. Install the grommets and collars into the cylinder block.

NOTE:
See the exploded diagram (7-65, 7-78).

2. Install new gaskets and the cylinder heads, and then tighten the bolts to the specified torque in the sequence shown. When installing the cylinder heads, apply the engine oil to the cylinder head bolts.



S6AW06097

NOTE:
Be sure to install the port and starboard cylinder head gaskets onto the correct cylinder heads.

Cylinder head bolt 1–10 (M11):
1st: 27 N·m (2.7 kgf·m, 19.9 ft·lb)
2nd: 54 N·m (5.4 kgf·m, 39.8 ft·lb)
3rd: Loosen completely
4th: 27 N·m (2.7 kgf·m, 19.9 ft·lb)
5th: 48 N·m (4.8 kgf·m, 35.4 ft·lb)
6th: 90°
Cylinder head bolt 11–14 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

3. Install new filters and the OCV assemblies. At this time, beware that the filter does not move.

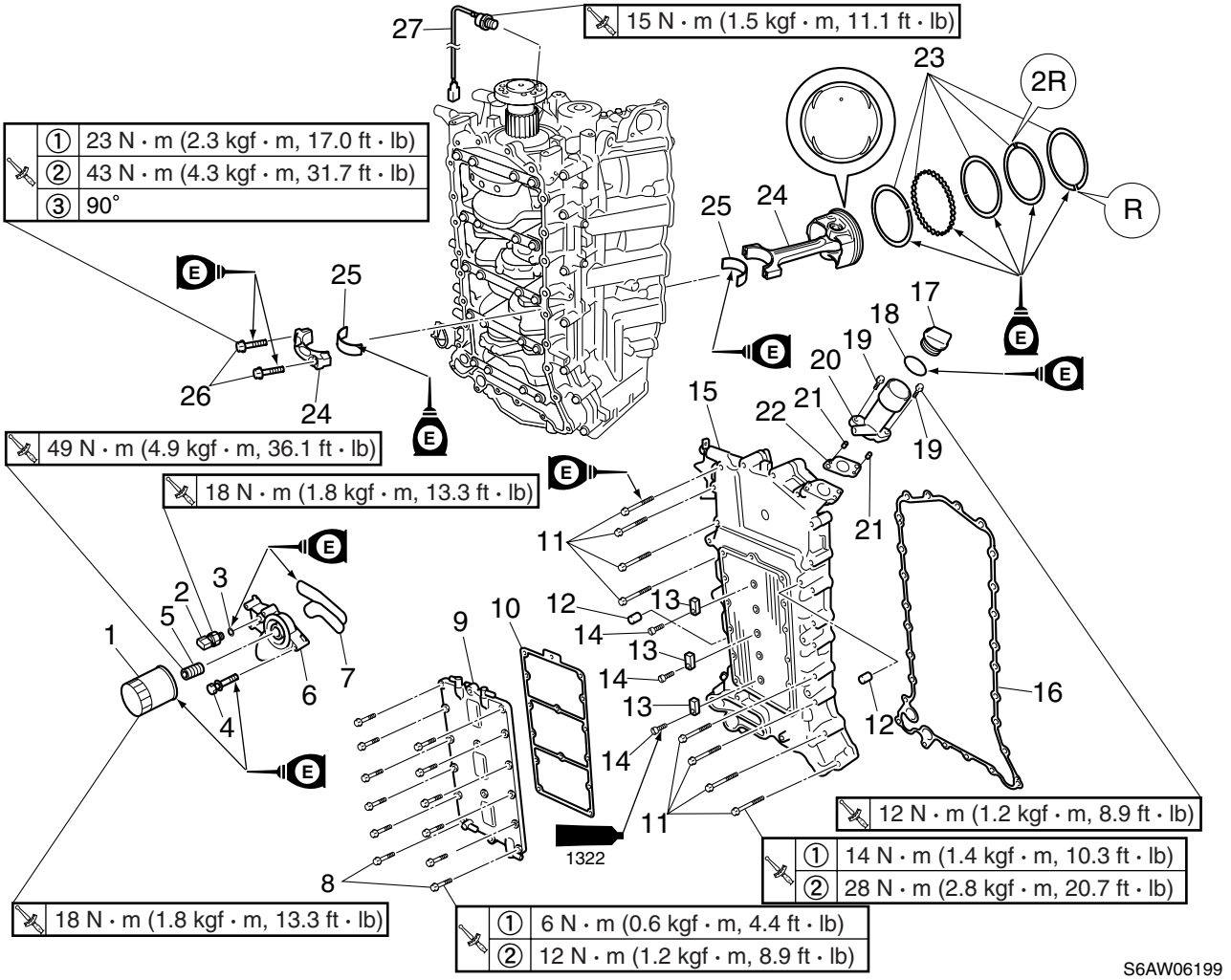
CAUTION:

Do not reuse the OCV filters, always replace them with new ones.

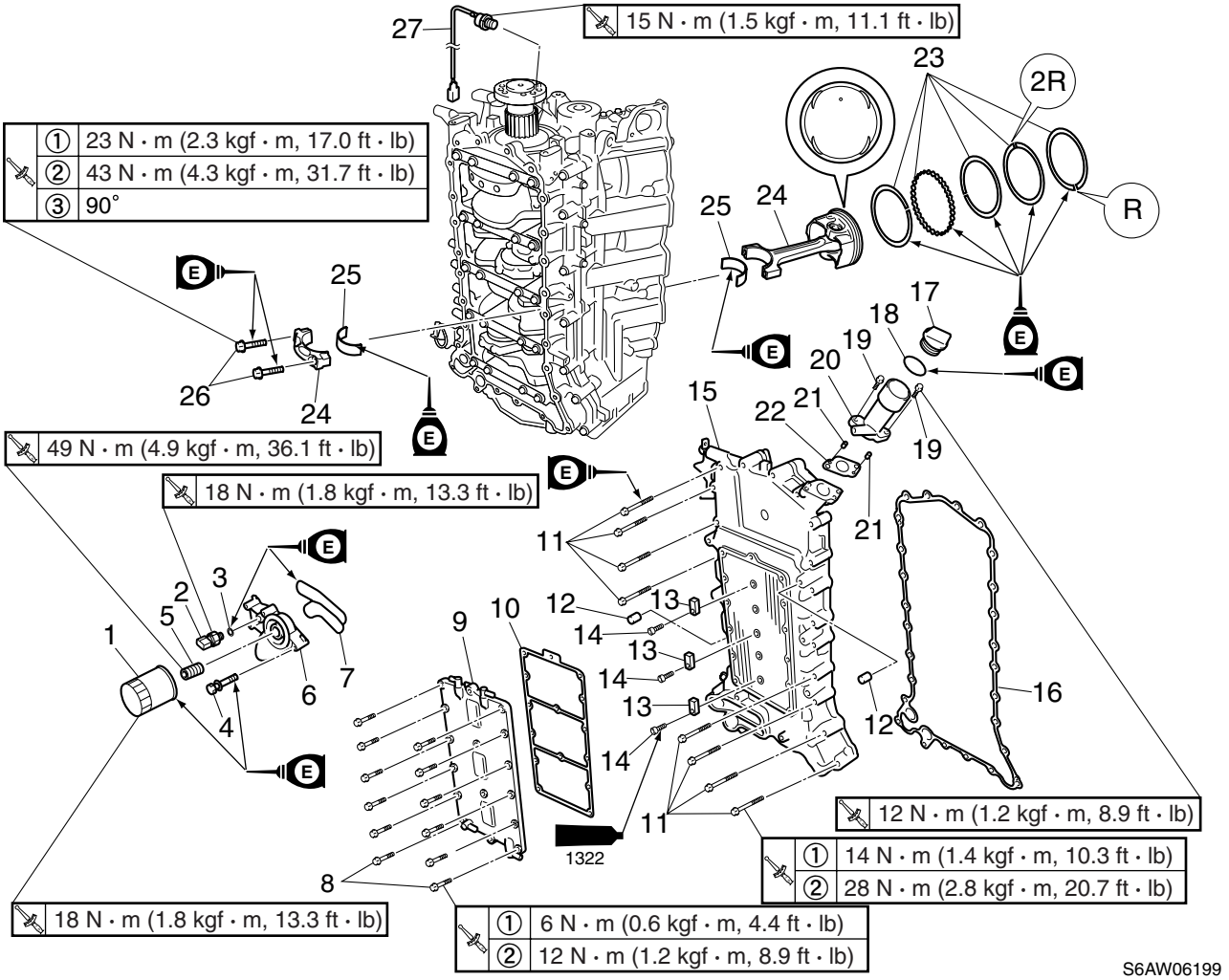
4. Install the camshafts, driven sprockets, and timing belt. To install the camshafts, driven sprockets, and timing belt, see “Installing the camshaft, driven sprocket, and timing belt” (7-59).

Cylinder block

Crankcase

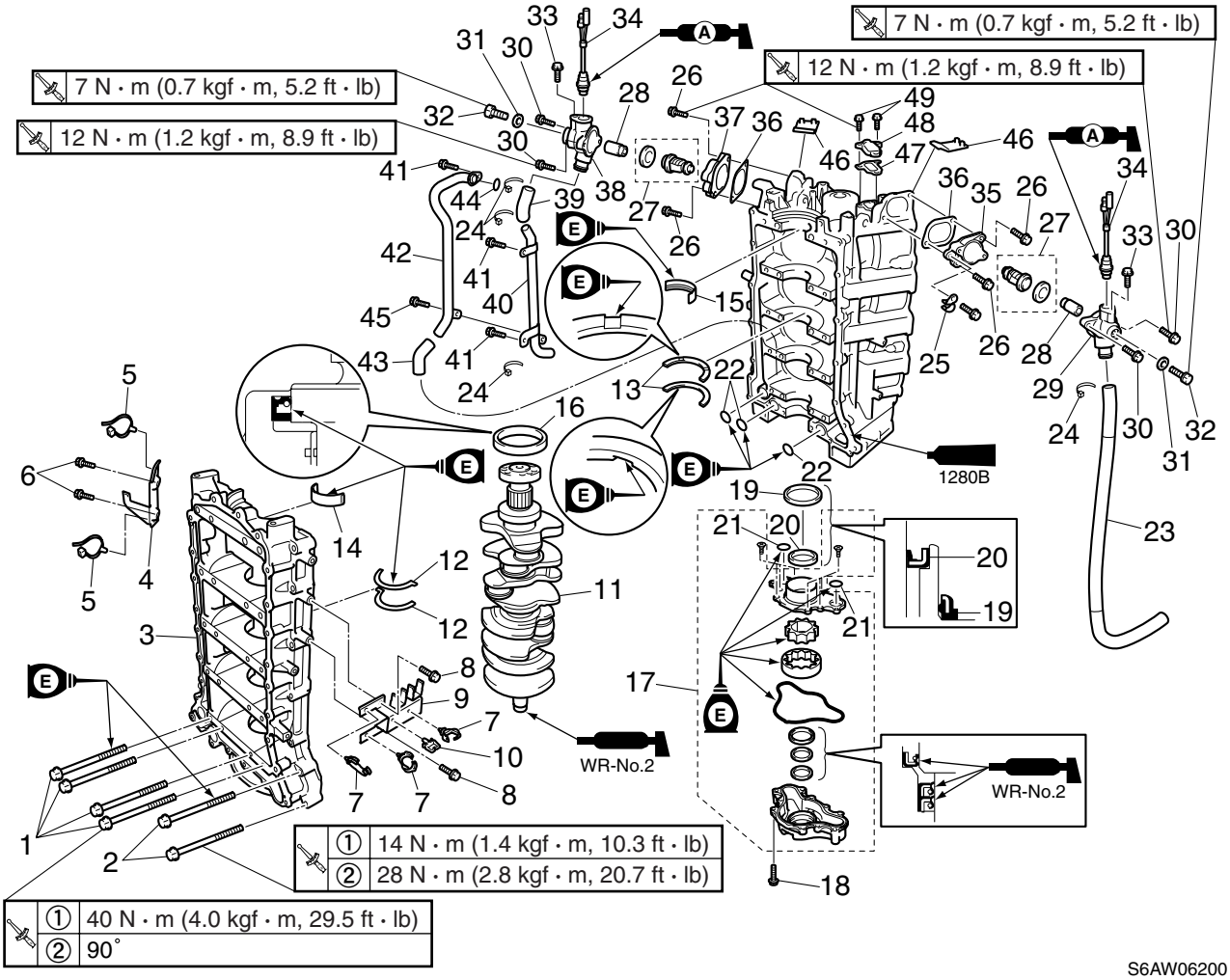


No.	Part name	Q'ty	Remarks
1	Oil filter	1	
2	Oil pressure sensor	1	
3	O-ring	1	**Not reusable**
4	Bolt	5	M6 × 14 mm
5	Joint	1	
6	Oil filter bracket	1	
7	Gasket	1	**Not reusable**
8	Bolt	16	M6 × 25 mm
9	Crankcase cover	1	
10	Gasket	1	**Not reusable**
11	Bolt	26	M8 × 50 mm
12	Dowel	2	
13	Anode	3	
14	Screw	3	ø6 × 16 mm
15	Crankcase cover	1	
16	Gasket	1	**Not reusable**
17	Oil filler cap	1	



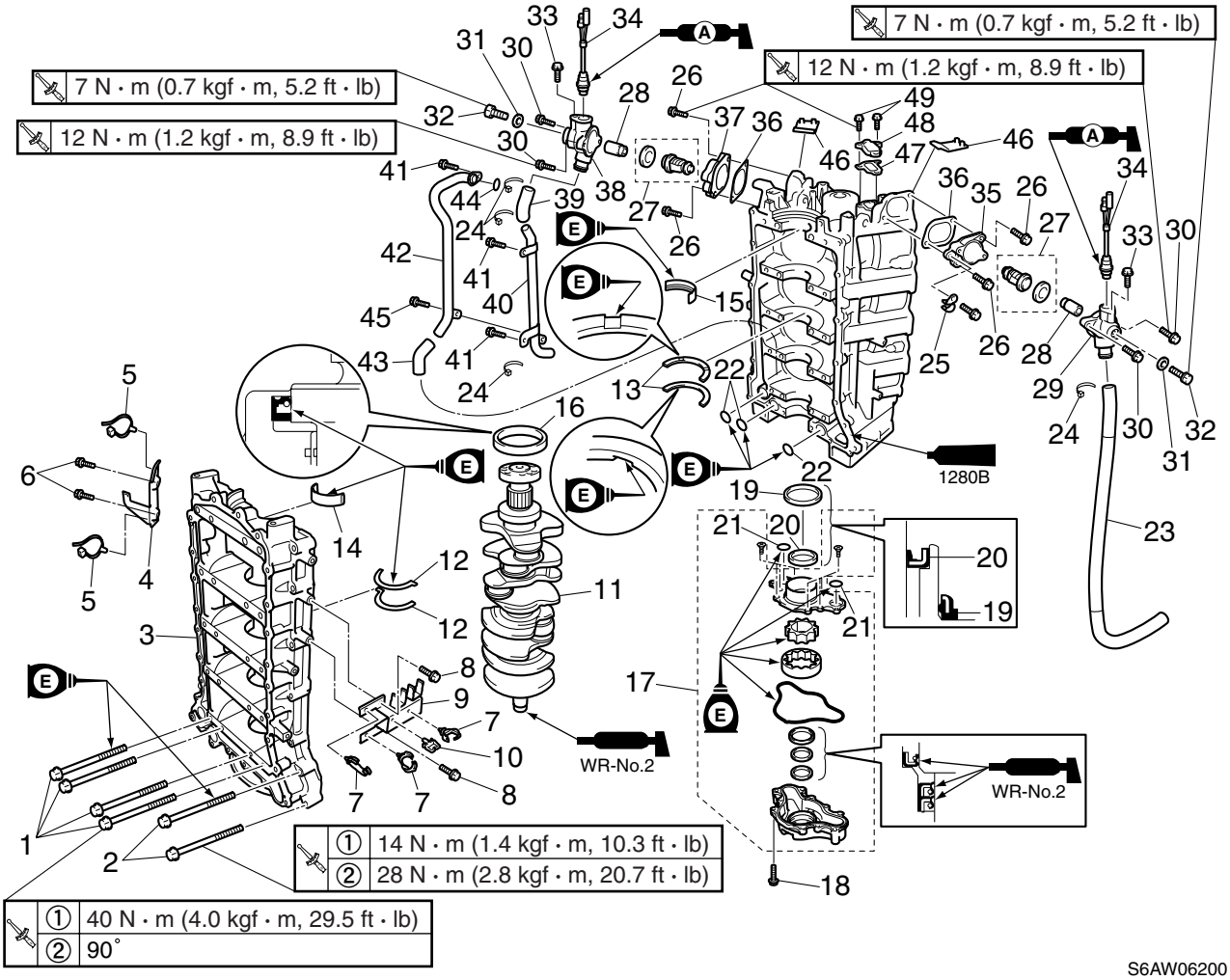
No.	Part name	Q'ty	Remarks
18	O-ring	1	
19	Bolt	2	M6 × 20 mm
20	Joint	1	
21	Dowel	2	
22	Gasket	1	**Not reusable**
23	Piston ring set	8	
24	Connecting rod assembly	8	
25	Connecting rod bearing	16	
26	Bolt	16	**Not reusable** M9 × 44 mm
27	Engine temperature sensor	1	

Cylinder block

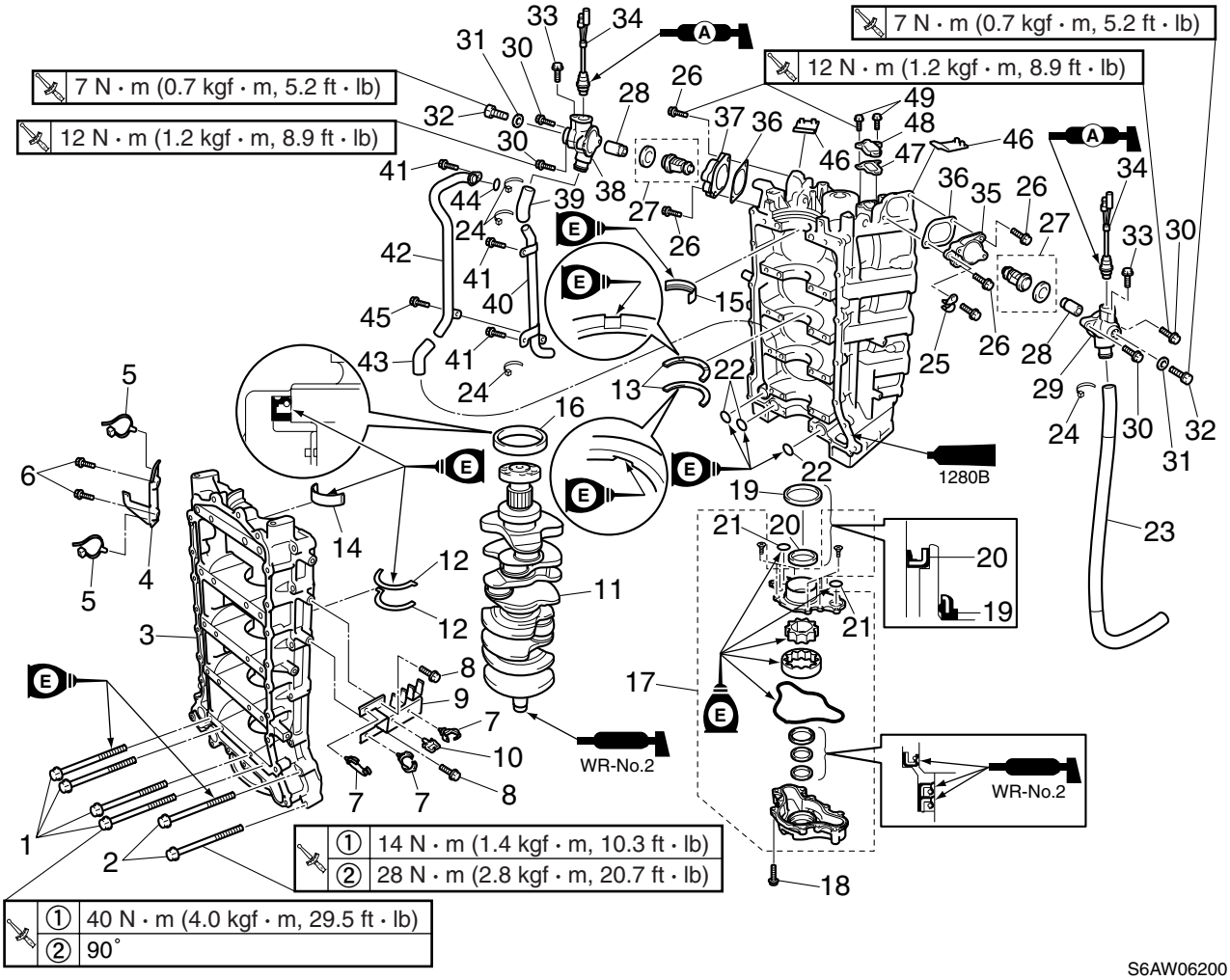


S6AW06200

No.	Part name	Q'ty	Remarks
1	Bolt	20	M10 × 105 mm
2	Bolt	18	M8 × 50 mm
3	Crankcase assembly	1	
4	Bracket	1	
5	Plastic tie	2	**Not reusable**
6	Bolt	2	M6 × 14 mm
7	Clamp	3	
8	Bolt	2	M6 × 15 mm
9	Plate	1	
10	Clamp	1	
11	Crankshaft	1	
12	Thrust bearing	2	
13	Thrust bearing	2	
14	Main bearing	5	
15	Main bearing	5	
16	Oil seal	1	**Not reusable**
17	Oil pump assembly	1	



No.	Part name	Q'ty	Remarks
18	Bolt	4	M6 × 50 mm
19	Oil seal	1	**Not reusable**
20	Oil seal	1	**Not reusable**
21	O-ring	2	**Not reusable**
22	O-ring	3	**Not reusable**
23	Cooling water hose	1	
24	Plastic tie	4	**Not reusable**
25	Clamp	1	
26	Bolt	4	M6 × 30 mm
27	Thermostat assembly	2	
28	Anode	2	
29	Thermostat cover (PORT)	1	
30	Bolt	4	M6 × 30 mm
31	Gasket	2	**Not reusable**
32	Bolt	2	M5 × 20 mm
33	Bolt	2	M6 × 30 mm
34	Thermoswitch	2	



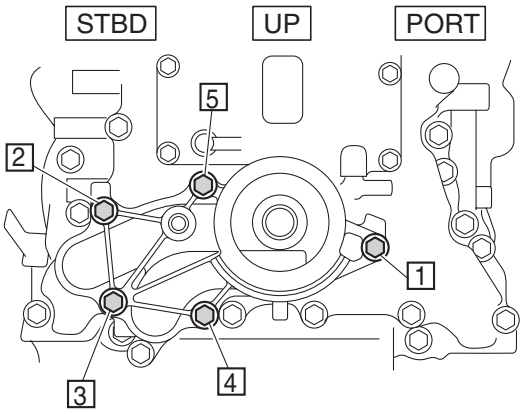
No.	Part name	Q'ty	Remarks
35	Thermostat cover housing (PORT)	1	
36	Gasket	2	**Not reusable**
37	Thermostat cover housing (STBD)	1	
38	Thermostat cover (STBD)	1	
39	Cooling water hose	1	
40	Cooling water pipe	1	
41	Bolt	3	M6 × 14 mm
42	Oil return pipe	1	
43	Oil return hose	1	
44	O-ring	2	**Not reusable**
45	Bolt	1	M6 × 10 mm
46	Grommet	2	
47	Gasket	1	**Not reusable**
48	Cover	1	
49	Bolt	3	M6 × 16 mm

Disassembling the cylinder block

1. Remove the oil filter using a 72.5 mm (2.9 in) oil filter wrench.

	Oil filter wrench: 90890-06830

2. Remove the oil filter bracket bolts in the sequence shown.

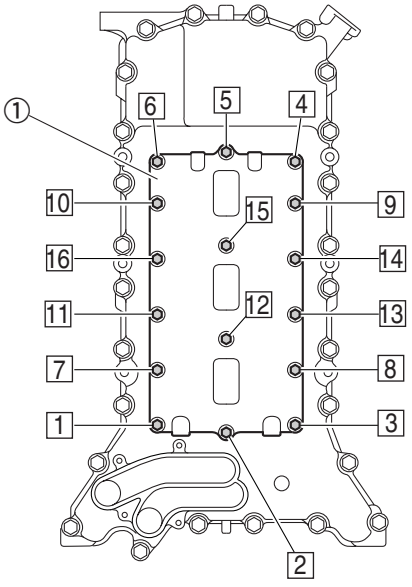


S6AW06098

3. Remove the oil pump.

NOTE:
See the exploded diagram (7-78).

4. Remove the crankcase cover ① bolts in the sequence shown.



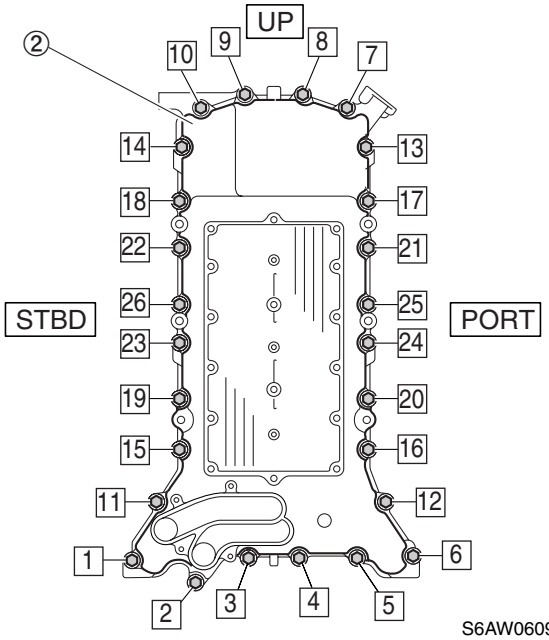
S6AW06096

5. Check the crankcase cover anodes. Clean if there are scales, grease, or oil.

CAUTION:
Do not oil, grease, or paint the anodes, otherwise they will be ineffective.

6. Replace the anodes if excessively eroded.

7. Remove the crankcase cover ② bolts in the sequence shown.



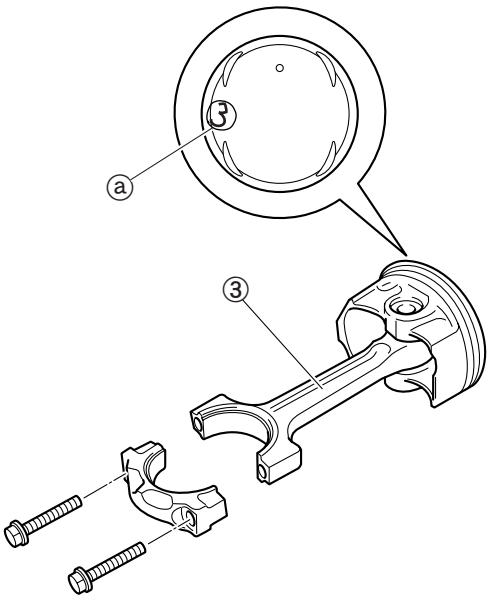
S6AW06099

8. Remove the connecting rod cap bolts and the connecting rod caps, and then remove the connecting rod assemblies.

NOTE:
See the exploded diagram (7-76).

7

9. Remove the connecting rod assembly ③. Keep connecting rods, connecting rod caps and bearings in order so that they will not get mixed up. Mark each piston with the corresponding cylinder number ⓐ.

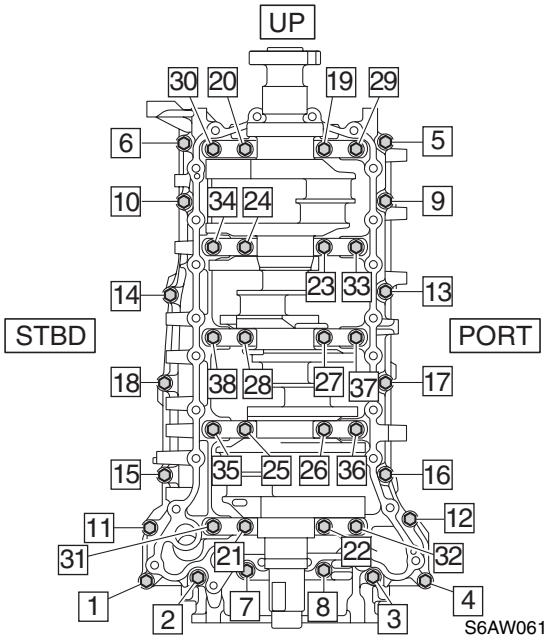


S6AW06100

NOTE:
See the exploded diagram (7-76).

10. Remove the piston rings and arrange them in order.

11. Remove the crankcase bolts in the sequence shown.

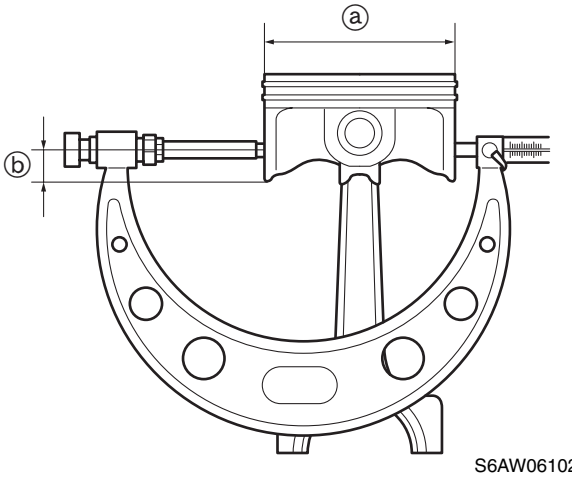


S6AW06101

12. Remove the crankshaft and the bearings. Keep the bearings in order so that they will not get mixed up.

Checking the piston diameter

1. Measure the piston outside diameter at the specified measuring point. Replace the piston if out of specification.

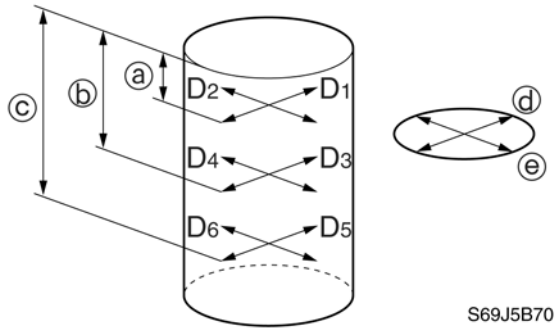


S6AW0610

Piston diameter ⓐ:
93.921–93.941 mm
(3.6977–3.6985 in)
Measuring point ⓑ:
11.5 mm (0.45 in) up from the bottom of the piston skirt

Checking the cylinder bore

1. Measure the cylinder bore (D_1–D_6) at measuring points ⓐ, ⓑ, and ⓒ, and in direction ⓓ (D_1, D_3, D_5), which is parallel to the crankshaft, and direction ⓔ (D_2, D_4, D_6), which is at a right angle to the crankshaft.

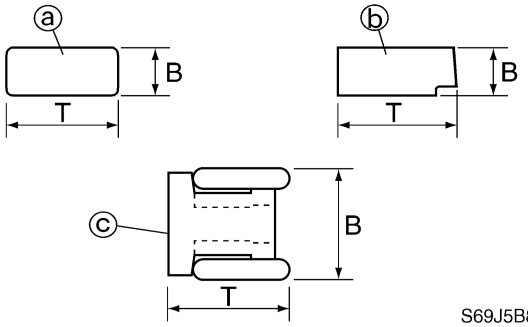


ⓐ 20 mm (0.8 in)
ⓑ 50 mm (2.0 in)
ⓒ 80 mm (3.1 in)

Cylinder bore (D_1–D_6):
94.000–94.017 mm
(3.7008–3.7014 in)

Checking the piston ring

1. Check the piston rings dimensions B and T. Replace the piston ring set if out of specification.



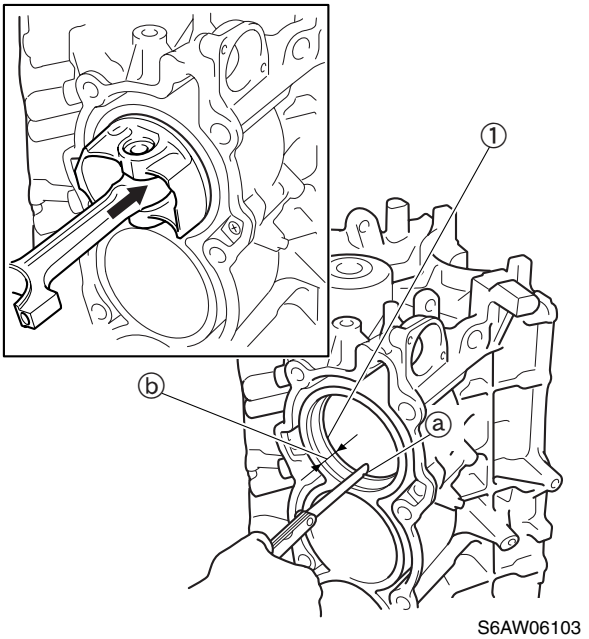
Piston ring dimensions:
Top ring ⓐ:
B: 1.170–1.185 mm
(0.046–0.047 in)
T: 2.80–3.00 mm
(0.110–0.118 in)
Second ring ⓑ:
B: 1.17–1.19 mm
(0.046–0.047 in)
T: 3.70–3.90 mm
(0.146–0.154 in)
Oil ring ⓒ:
B: 2.40–2.47 mm
(0.094–0.097 in)
T: 2.30–2.70 mm
(0.091–0.106 in)

7

Checking the piston ring end gap (reference)

1. Level the piston ring ① in the cylinder with a piston crown.

2. Check the piston ring end gap ⓐ at the specified measuring point ⓑ.



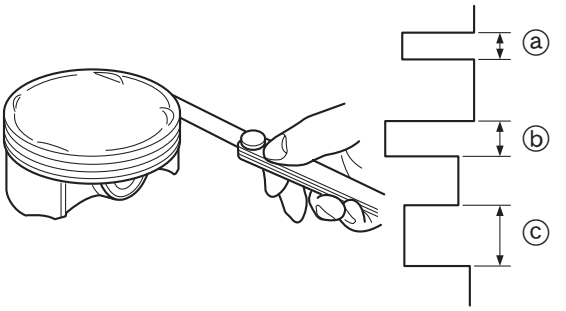
S6AW06103

Piston ring end gap ⓐ (reference data):
- Top ring:
  0.20–0.30 mm (0.008–0.012 in)
- Second ring:
  0.30–0.45 mm (0.012–0.018 in)
- Oil ring:
  0.15–0.60 mm (0.006–0.024 in)

Measuring point ⓑ (reference data):
20 mm (0.8 in)

Checking the piston ring groove

1. Measure the piston ring grooves. Replace the piston if out of specification.

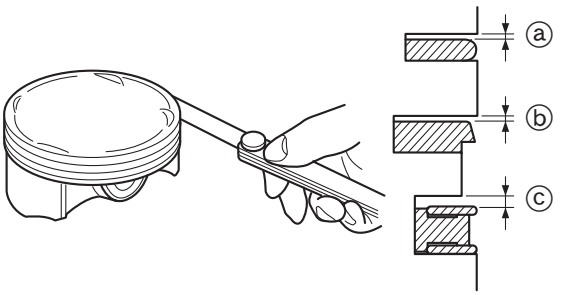


S6AW06104

Piston ring groove:
- Top ring ⓐ:
  1.22–1.25 mm (0.048–0.049 in)
- Second ring ⓑ:
  1.22–1.24 mm (0.048–0.049 in)
- Oil ring ⓒ:
  2.51–2.53 mm (0.099–0.100 in)

Checking the piston ring side clearance

1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if out of specification.

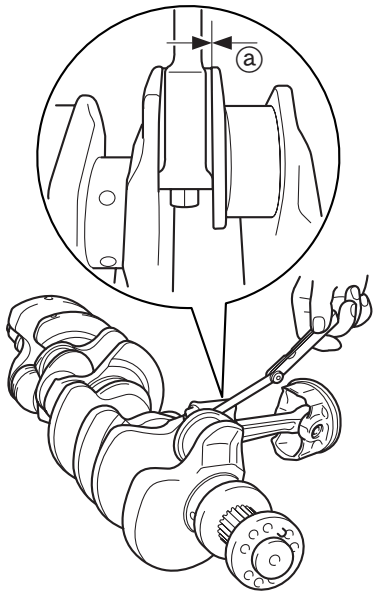


S6AW06105

Piston ring side clearance:
- Top ring ⓐ:
  0.03–0.08 mm (0.001–0.003 in)
- Second ring ⓑ:
  0.03–0.07 mm (0.001–0.003 in)
- Oil ring ⓒ:
  0.04–0.13 mm (0.002–0.005 in)

Checking the connecting rod big end side clearance

1. Measure the connecting rod big end side clearance ⓐ.

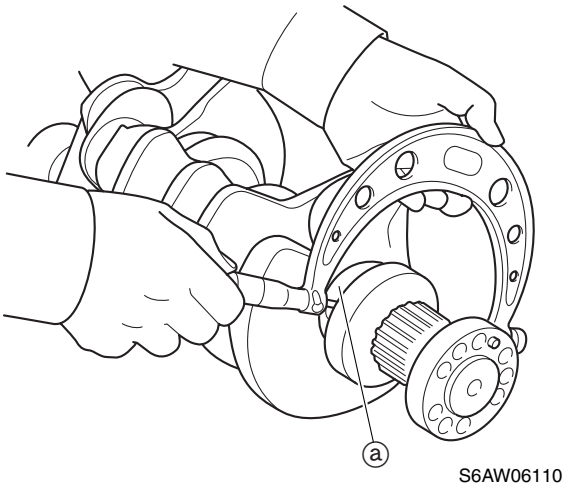


S6AW06109

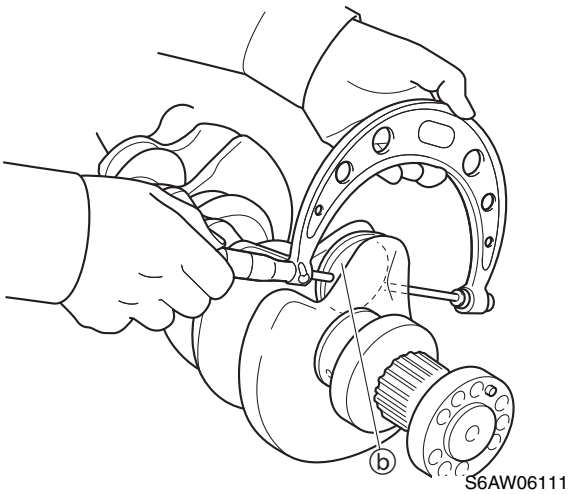
Connecting rod big end side clearance ⓐ (reference data):
0.14–0.31 mm (0.006–0.012 in)

Checking the crankshaft

1. Measure the crankshaft journal diameter ⓐ and crankpin diameter ⓑ. Replace the crankshaft if out of specification.



S6AW06110

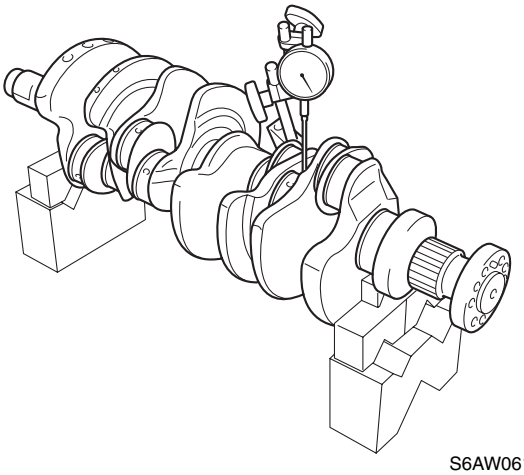


S6AW06111

Crankshaft journal diameter ⓐ:
62.972–62.992 mm
(2.4792–2.4800 in)
Crankpin diameter ⓑ:
49.980–50.000 mm
(1.9677–1.9685 in)

7

2. Measure the crankshaft runout. Replace the crankshaft if above specification.



S6AW06112

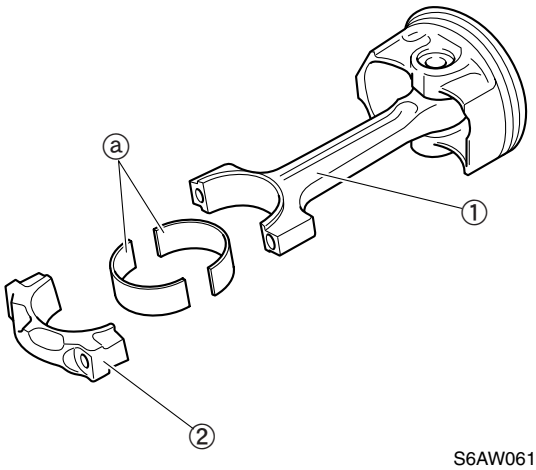
Crankshaft runout limit:
0.03 mm (0.0012 in)

Checking the crankpin oil clearance

NOTE:
Use the original connecting rod cap bolts for the oil clearance measurement.
In contrast, always replace them with new ones when installing the connecting rod assembly into the engine.

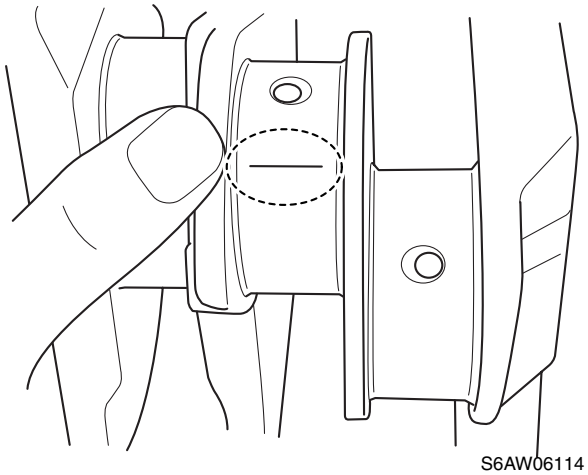
1. Clean the bearings ⓐ and the Connecting rod assembly.

2. Install the upper bearing into the connecting rod assembly ① and the lower bearing into the connecting rod cap ②.



S6AW06113

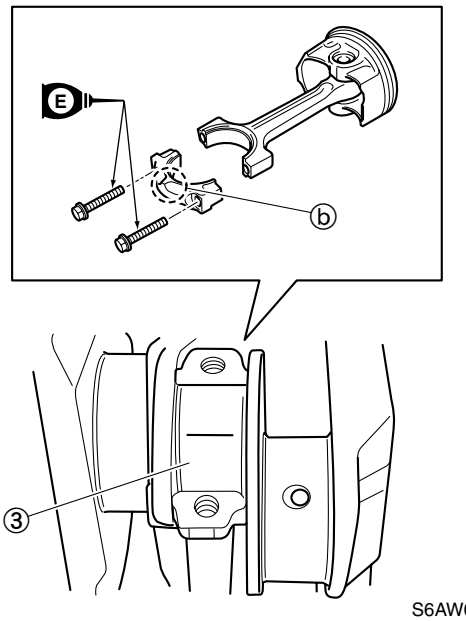
3. Put a piece of Plastigauge (PG-1) onto the crankpin, parallel to the crankshaft.



S6AW06114

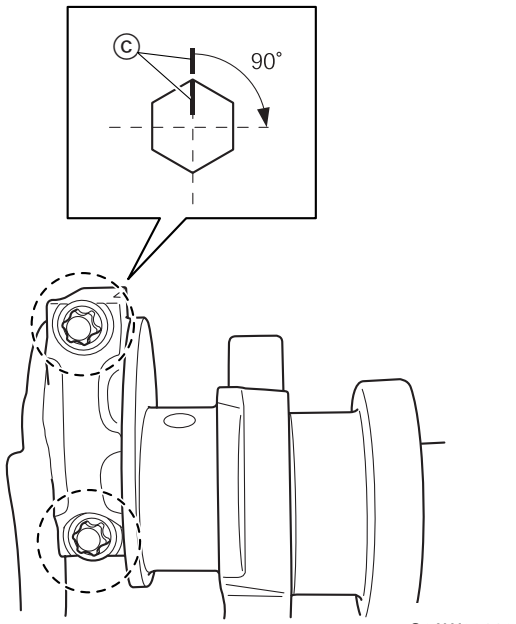
NOTE:
Be sure not to put the Plastigauge (PG-1) over the oil hole in the crankpin of the crankshaft.

4. Install the connecting rod cap to the crank pin ③ with its front mark ⓑ facing the flywheel.



S6AW06115

5. Tighten the connecting rod cap bolts to the specified torque in 2 stages. Then, put a mark ⓒ over the connecting rod cap bolts and the connecting rod cap, and retighten the bolt by additional 90°.

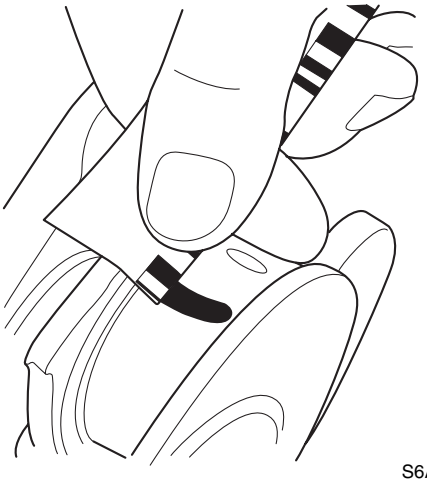


S6AW06116

NOTE:
- Reuse the removed connecting rod cap bolts when checking the oil clearance.
- Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.

Connecting rod cap bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

6. Remove the connecting rod cap and measure the width of the compressed Plastigauge (PG-1) on each crankpin. Replace the connecting rod bearing if out of specification.



S6AW06117

Crankpin oil clearance:
0.025–0.055 mm
(0.0010–0.0022 in)

7. After the measurement, thoroughly remove the plastigauge adhered to the crank pins and the connecting rod bearings, taking care not to scratch these parts.

Selecting the connecting rod bearing

1. When replacing the connecting rod bearings, select the suitable bearings as follows.

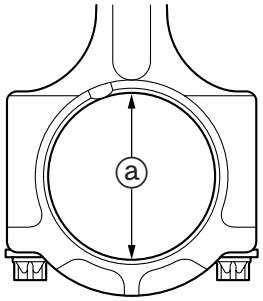
2. Assembling the connecting rod assembly, and then tighten the connecting rod assembly bolts to the specfied torque.

NOTE:
Reuse the connecting rod assembly bolts.

Connecting rod cap bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

7

3. Measure the connecting rod big end inside diameter ⓐ.

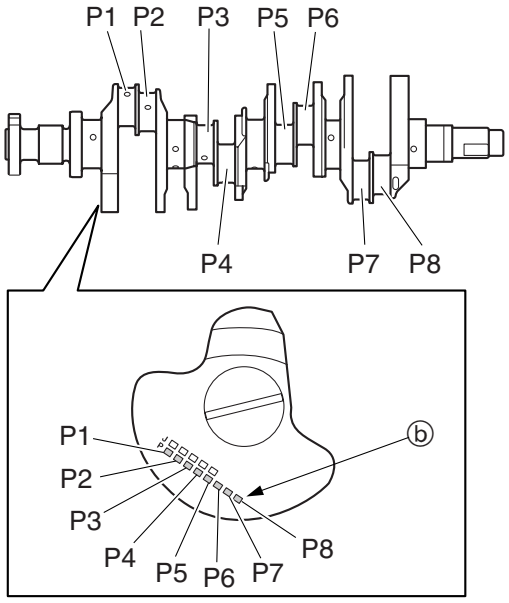


S6BJ07008

Example:

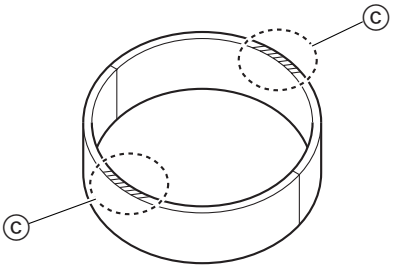
Connecting rod big end inside diameter ⓐ	Numerical value in table
53.025 mm	25

4. Check the crankpin mark ⓑ on the crankshaft.

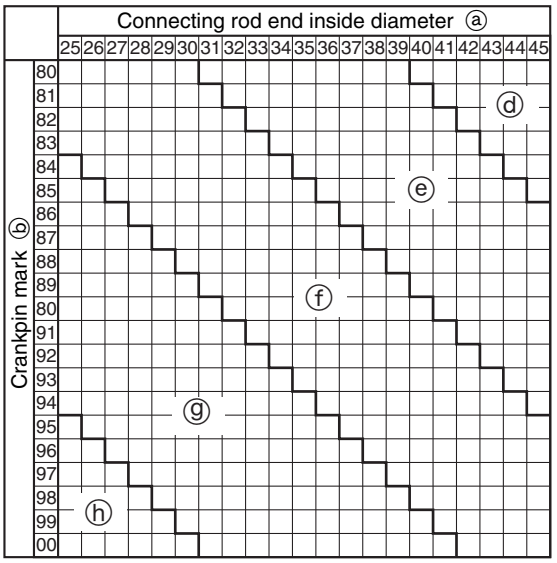


S6AW06118

5. Select the suitable color ⓒ for the connecting rod bearing from the table.



S6AW06119



S6AW06155

	Upper bearing color	Lower bearing color
ⓓ	Red	Red
ⓔ	Blue	Red
ⓕ	Blue	Blue
ⓖ	Green	Blue
ⓗ	Green	Green

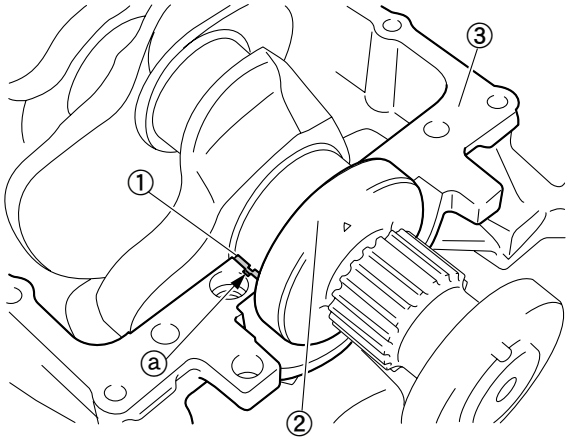
Example:
If the connecting rod big end inside diameter ⓐ is “35” and the crankpin mark ⓑ is “81,” and then select the bearing colors in “ⓔ.”

Checking the crankshaft journal oil clearance

1. Clean the bearings, crankshaft journals, and bearing portions of the crankcase and cylinder block.

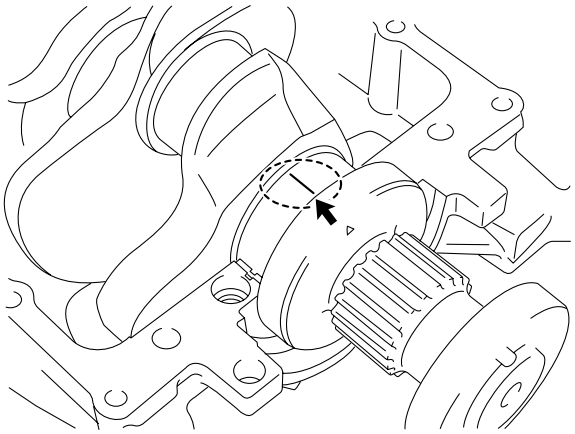
2. Place the cylinder block upside down on a bench.

3. Install the upper bearing ① and the crank shaft ② in the cylinder block ③. At this point, be sure to install the bearing in its original position, with the projection ⓐ fitted in the cylinder block groove.



S6AW06120

4. Put a piece of Plastigauge (PG-1) on each crankshaft journal parallel to the crankshaft.



S6AW06121

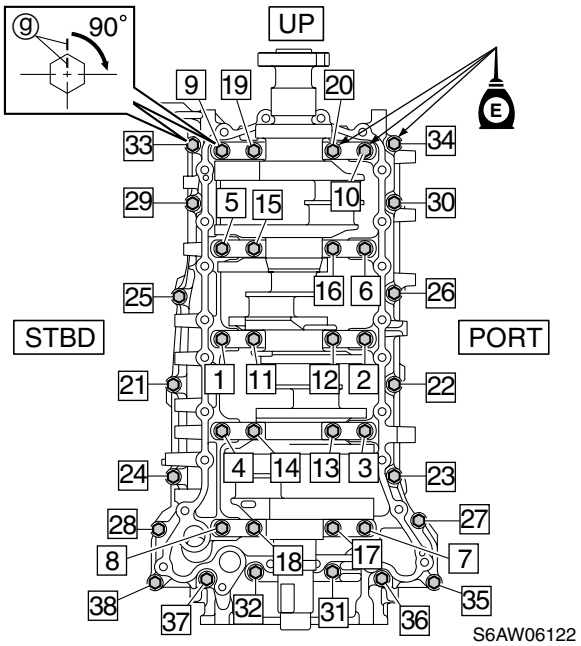
NOTE:

Do not put the Plastigauge (PG-1) over the oil hole in the main journals of the crankshaft.

5. Install the crankcase half of the main bearing in the crankcase. At this point, be sure to install the bearing in its original position, with the projection ⓐ fitted in the crankcase groove.

6. Install the crankcase onto the cylinder block and apply engine oil to the threads of the crankcase bolts.

7. Tighten the crankcase bolts to the specified torques in 2 stages and in the sequence shown.



S6AW06122

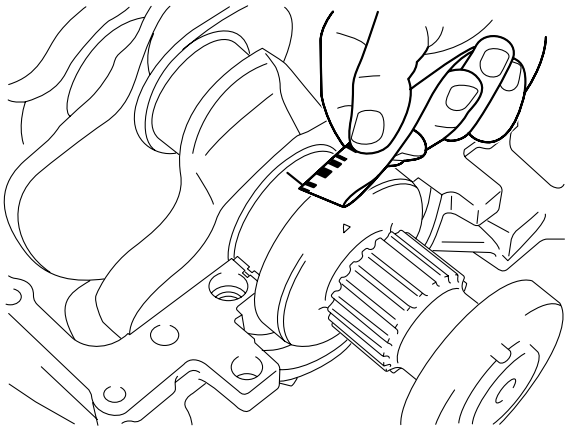
NOTE:

- Crankcase bolts 1–20 can be reused 5 times.
- Do not turn the crankshaft until the crankshaft journal oil clearance measurement has been completed.
- Make a mark ⓖ on the crankcase and crankcase bolts, and then tighten crankcase bolts 1–20 90° from the mark.

Crankcase bolt 1–20 (M10):
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°
Crankcase bolt 21–38 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

7

8. Gently remove the crankcase, and then measure the width of the compressed Plastigauge (PG-1) on each crankshaft journal. Replace the main bearing if out of specification.



S6AW06123

NOTE:
When loosening the crankcase bolts, loosen them in the opposite order used for tightening.

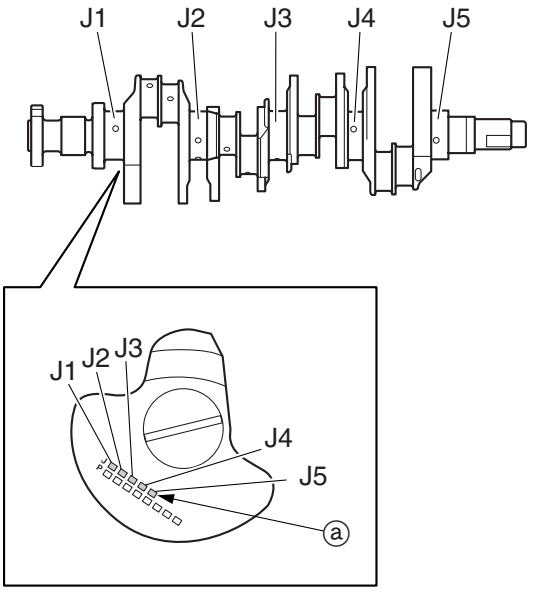
Crankshaft journal oil clearance:
J1, J3: 0.026–0.051 mm
(0.0010–0.0020 in)
J2, J4: 0.038–0.063 mm
(0.0015–0.0025 in)
J5: 0.032–0.057 mm
(0.0013–0.0022 in)

9. After the measurement, thoroughly remove the plastigauge adhered to the crankshaft journals and the main bearings, taking care not to scratch these parts.

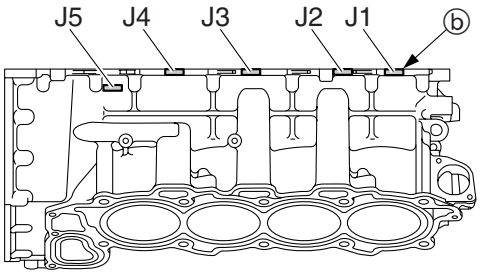
Selecting the main bearing

1. When replacing the main bearing, select the suitable bearing as follows.

2. Check the crankshaft journal mark ⓐ on the crankshaft and the cylinder block mark ⓑ on the cylinder block.

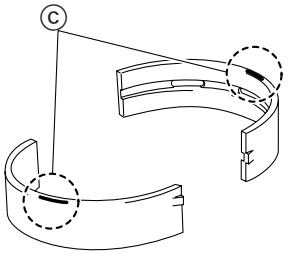


S6AW06124

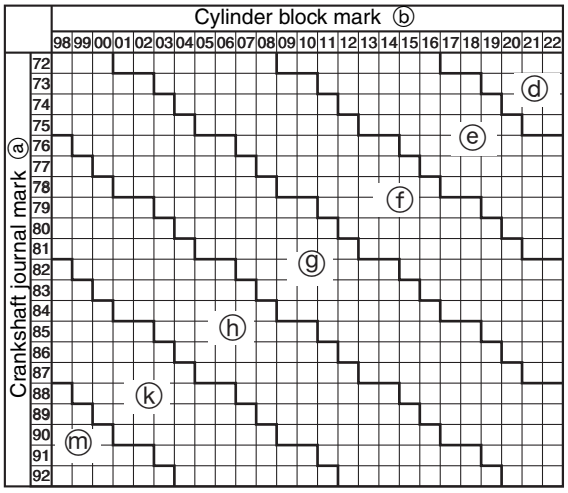


S6AW06125

3. Select the suitable color ⓒ for the main bearing from the table.



S6AW06126



S6AW06108

J1/J3	Upper bearing color	Lower bearing color
ⓓ	Blue	Blue
ⓔ	Blue	Black
ⓕ	Black	Black
ⓖ	Black	Brown
ⓗ	Brown	Brown
ⓚ	Brown	Green
ⓜ	Green	Green

J2/J4	Upper bearing color	Lower bearing color
ⓓ	Black	Black
ⓔ	Black	Brown
ⓕ	Brown	Brown
ⓖ	Brown	Green
ⓗ	Green	Green
ⓚ	Green	Yellow
ⓜ	Yellow	Yellow

J5	Upper bearing color	Lower bearing color
ⓓ	Blue	Black
ⓔ	Black	Black
ⓕ	Black	Brown
ⓖ	Brown	Brown
ⓗ	Brown	Green
ⓚ	Green	Green
ⓜ	Green	Yellow

Example:
If the crankshaft journal mark ⓐ is “80” and the cylinder block mark ⓑ is “10,” and then select the bearing colors in “ⓖ.”

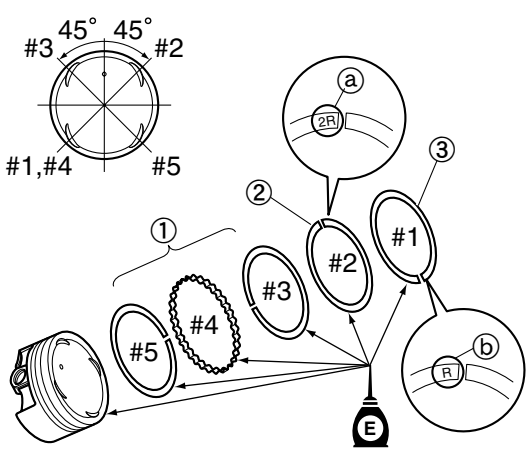
7

Assembling the power unit

NOTE:
See the exploded diagram (7-76).

1. Install the oil rings ①, second ring ②, and top ring ③ to the piston with the "2R" mark ⓐ of the second ring and the "R" mark ⓑ of the top ring facing upward.

2. Offset the piston ring end gaps as shown.

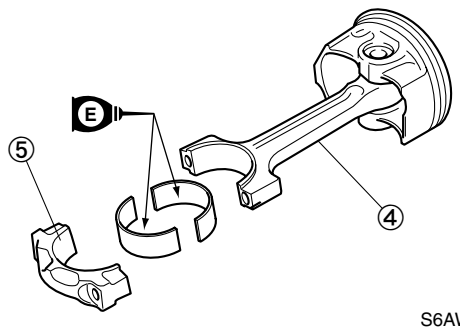


S6AW06128-1

CAUTION:
Do not scratch the pistons or break the piston rings.

NOTE:
After installing the piston rings, check that they move smoothly.

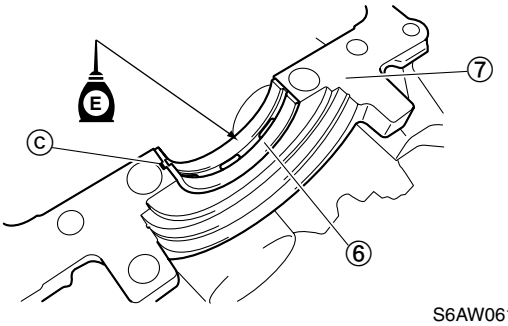
3. Install the upper bearing into the connecting rod assembly ④ and the lower bearing into the connecting rod cap ⑤.



S6AW06129

NOTE:
- Install the connecting rod bearings in their original positions.
- Install the selected bearing to the appropriate cylinder when replacing the bearing.

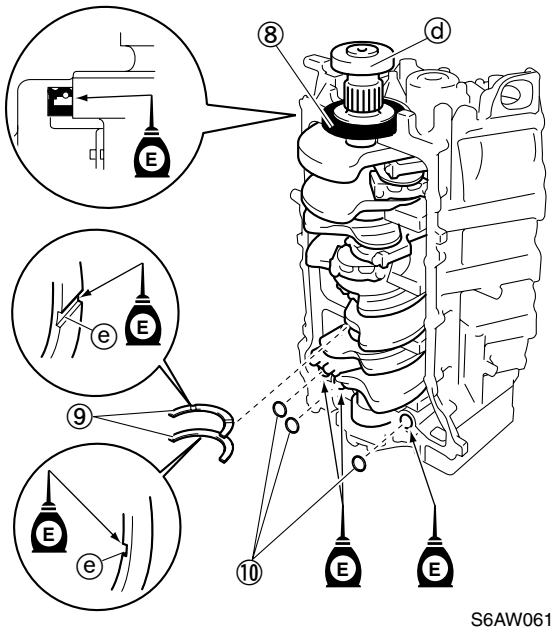
4. Install the upper bearings ⑥ into the cylinder block ⑦.



S6AW06130

NOTE:
- Install the bearings in their original positions.
- Install the selected bearing to the appropriate cylinder when replacing the bearing.
- Insert the projection ⓒ of each bearing into the slots in the cylinder block.

5. Set the crankshaft, a new oil seal ⑧, thrust bearings ⑨, and new O-rings ⑩ into the cylinder block as shown.
   Apply some engine oil to the oil seal lip ⑧, the thrust bearings ⑨, and the O-rings ⑩.



S6AW06131

CAUTION:

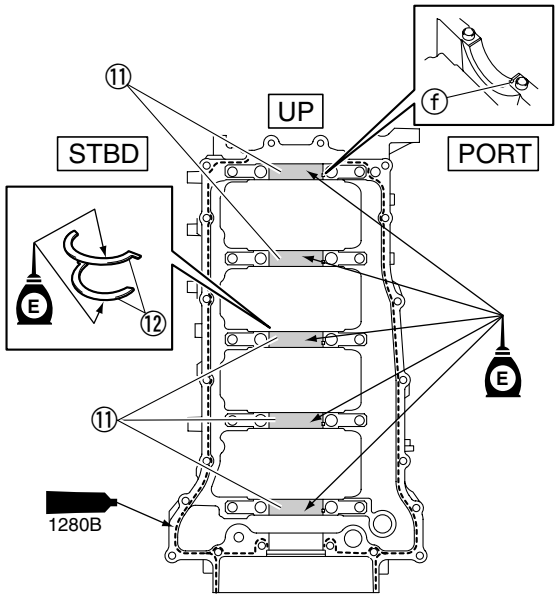
Do not damage the oil seal when installing it by contacting the edge ⓓ of the drive sprocket.

NOTE:

- Do not get any engine oil on the drive sprocket.
- Install each thrust bearing with its grooves ⓔ facing outward as shown.

6. Install the lower bearings ⑪ and the thrust bearings ⑫ to their original positions in the crankcase. Fit the protrusion ⓕ of the bearing in the groove on the crankcase.

7. Apply sealant to the mating surface of the crankcase. Make sure that no sealant comes in touch with the main bearings.

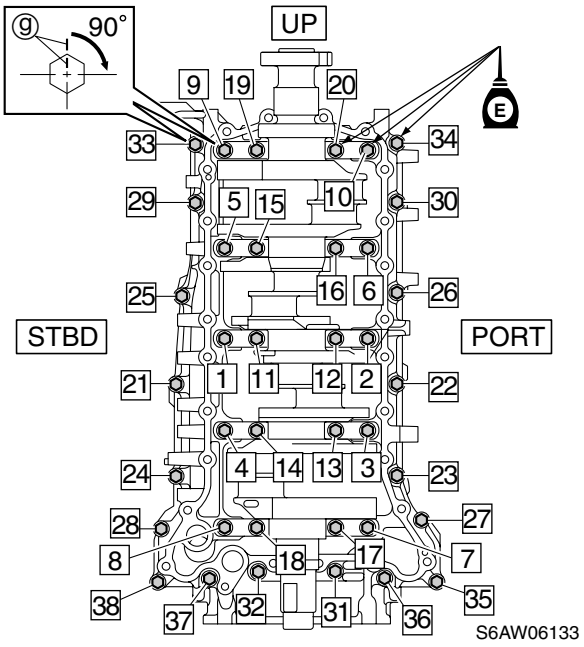


S6AW06132

NOTE:

Application of the sealant and tightening of the crank casing bolts should be completed in 3 minutes or less. If this process takes more than 3 minutes, remove the crankcase, clean off the sealant, and apply new sealant.

8. Install the crankcase onto the cylinder block, and tighten the crankcase bolts to the specified torques in 2 stages and in the sequence shown. Apply some engine oil to the crankcase bolts before use.



S6AW06133

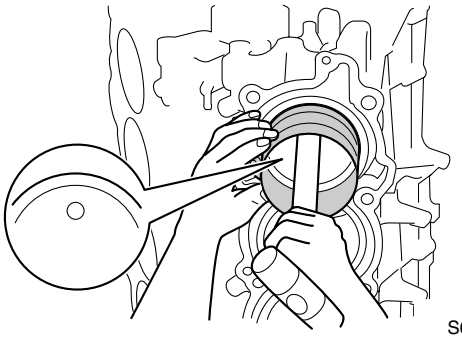
NOTE:

- Crankcase bolts 1–20 can be reused 5 times.
- After tightening the crankcase bolts, check that the crankshaft rotates smoothly.
- Make a mark ⓖ on the crankcase and crankcase bolts, and then tighten crankcase bolts 1–20 90° from the mark.

Crankcase bolt 1–20 (M10):
1st: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
2nd: 90°
Crankcase bolt 21–38 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

7

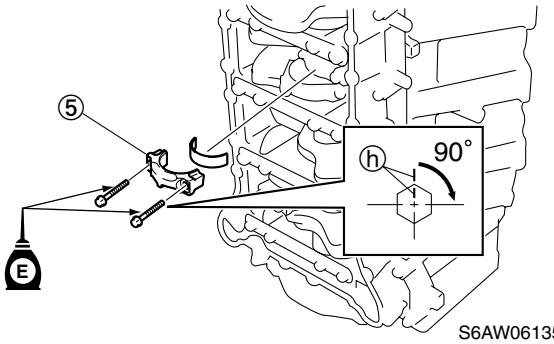
9. Install the pistons with “UP” mark on the piston crown facing the flywheel magnet. Apply some engine oil to the outer surface of the pistons and the piston rings.



S6AW06134

Piston ring compressor:
90890-05158

10. Install the connecting rod cap ⑤ to the connecting rod, and then tighten new connecting rod cap bolts to the specified torque in 3 stages. Apply some engine oil to the connecting rod cap and connecting rod cap bolts.



S6AW06135

CAUTION:

Do not reuse the connecting rod cap bolts, always replace them with new ones.

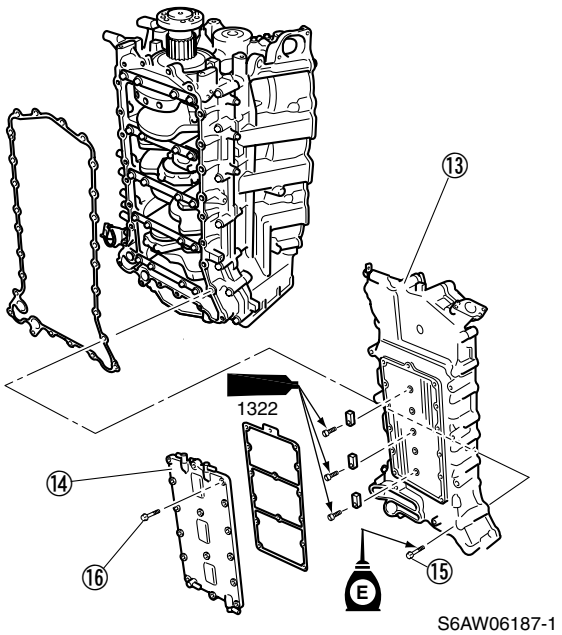
NOTE:

- After tightening the connecting rod cap bolts, check that the crankshaft rotates smoothly.
- Make a mark ⓗ on the connecting rod cap bolts, connecting rod caps, and then tighten the bolts 90° from the mark.

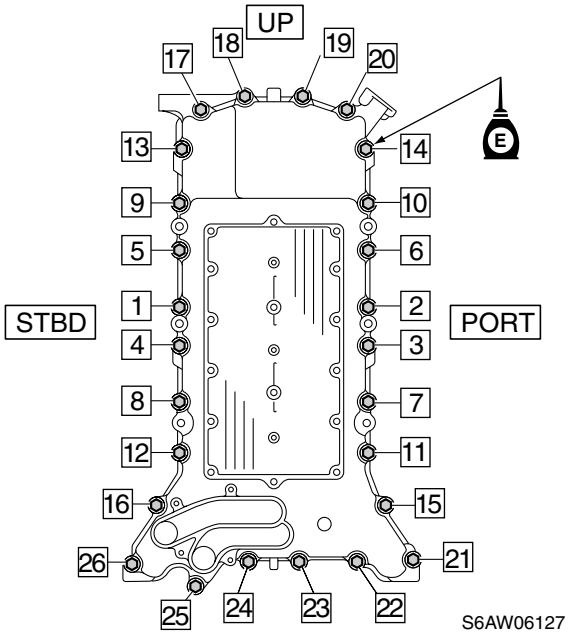
Connecting rod cap bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

11. Install the anodes to the crankcase cover ⑬.

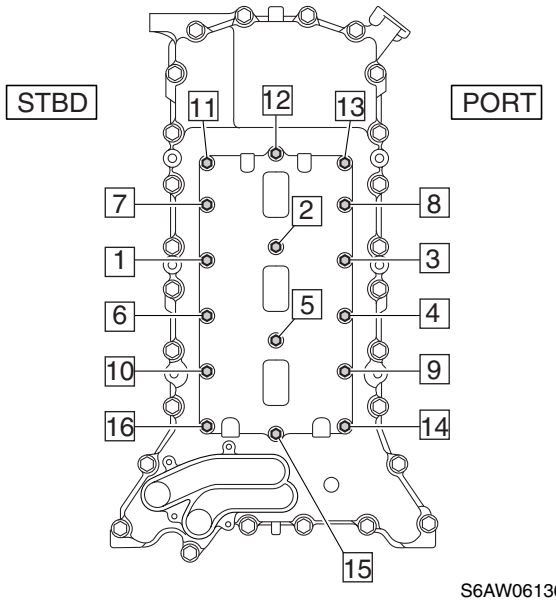
12. Install a new gasket and the crankcase covers ⑬ and ⑭, and then tighten the bolts to the specified torque in 2 stages and in the sequence shown. Apply some engine oil to the crankcase cover mounting bolt ⑮ (M8).



S6AW06187-1



S6AW06127



S6AW06136

CAUTION:

Do not reuse the gasket, always replace them with new ones.

Crankcase cover bolt ⑮ 1–26 (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)
Crankcase cover bolt ⑯ 1–16 (M6):
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8,9 ft·lb)

Checking the cylinder block anode

1. Check the anodes. Clean if there are scales, grease, or oil.

CAUTION:

Do not oil, grease, or paint the anodes, otherwise they will be ineffective.

2. Replace the anodes if excessively eroded.

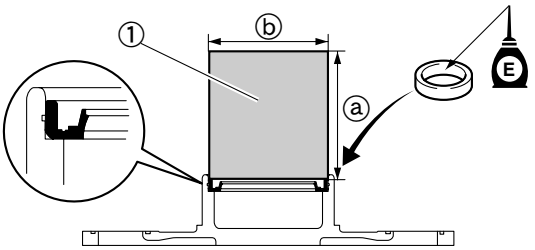
Checking the oil pump assembly

1. Check the oil pump case. Replace if damaged or deformed.

2. Check the oil seal lip. Replace the oil seal if the lip is damaged or deformed.

Assembling the oil pump assembly

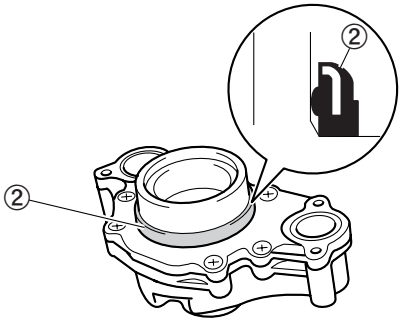
1. Install a new oil seal into the oil pump assembly.



S6AW06138

Pipe ① (commercially available):
ⓐ=50 mm (1.97 in)
ⓑ=61 mm (2.40 in)

2. Install a new oil seal ② into the oil pump assembly.



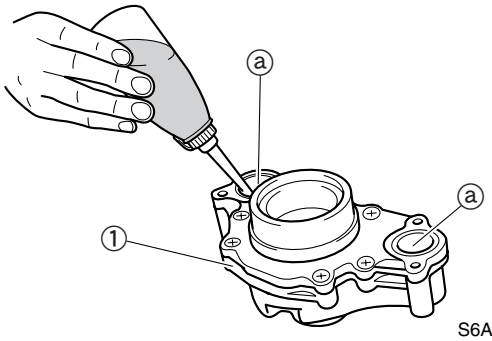
S6AW06204

7

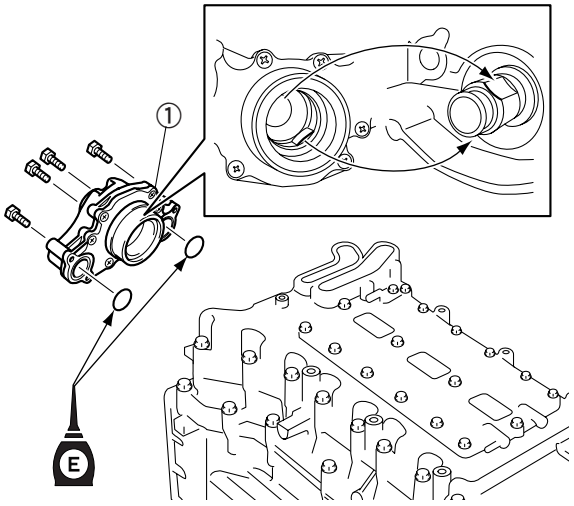
Installing the oil pump assembly

1. Before installing the oil pump assembly ①, be sure to fill it with engine oil through the oil passage ⓐ.

2. Install the oil pump assembly ① by aligning the oil pump gear with the crankshaft.



S6AW06142-1

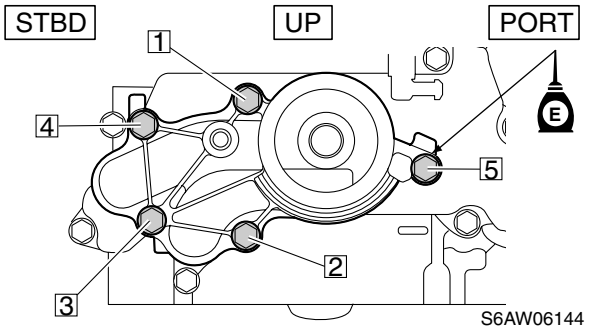


S6AW06143-1

NOTE:

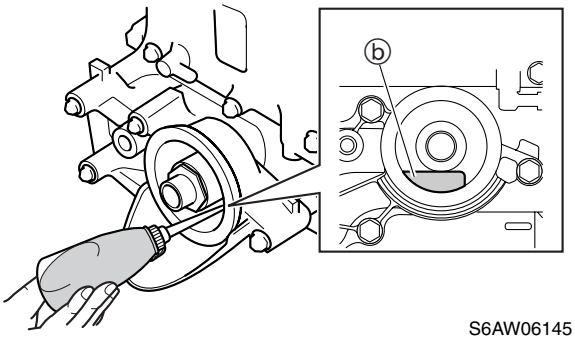
When installing the oil pump assembly ①, take care not to damage oil seal.

3. Install a new gasket and the oil filter bracket, and then tighten the bolts in the sequence shown. Apply some engine oil to the filter bracket bolt.



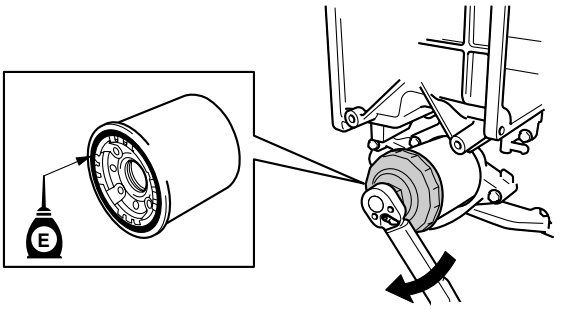
S6AW06144

4. Supply engine oil to the oil passage ⓑ of the oil filter bracket.



S6AW06145

5. Apply a thin coat of engine oil to the O-ring, and tighten the oil filter to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



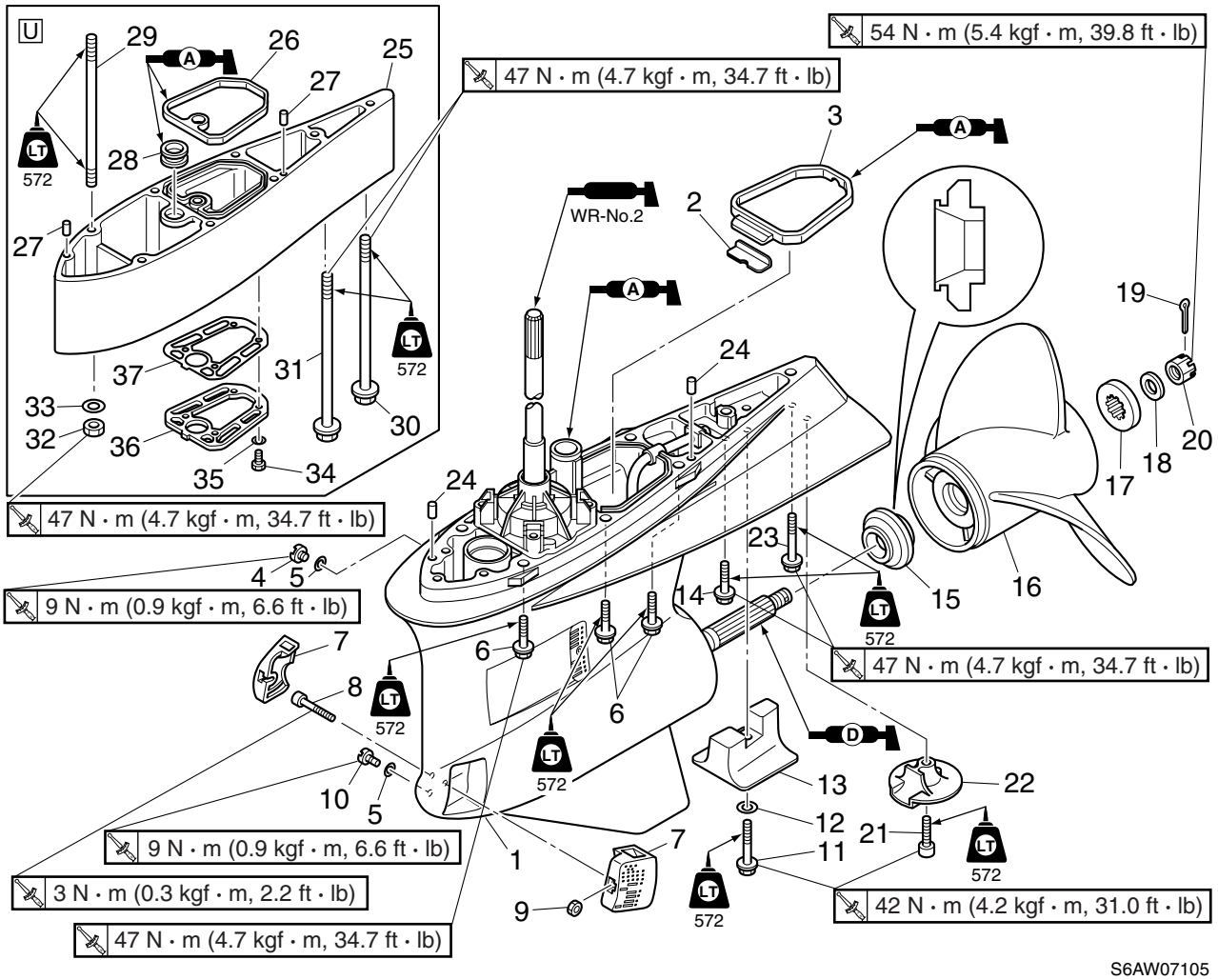
S6AW06146

	Oil filter wrench: 90890-06830

	Oil filter: 18 N·m (1.8 kgf·m, 13.3 ft·lb)

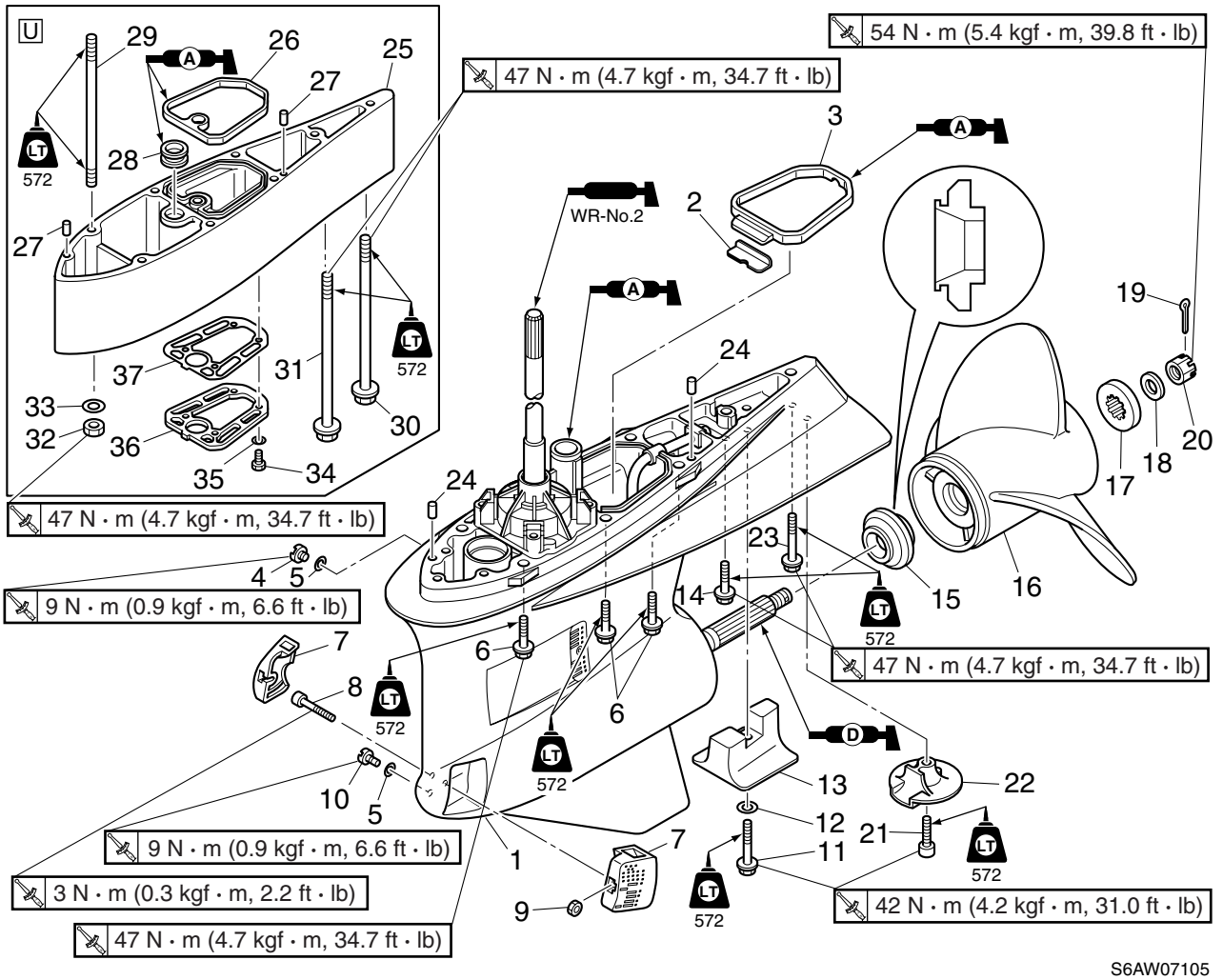
Lower unit

Lower unit (regular rotation model)

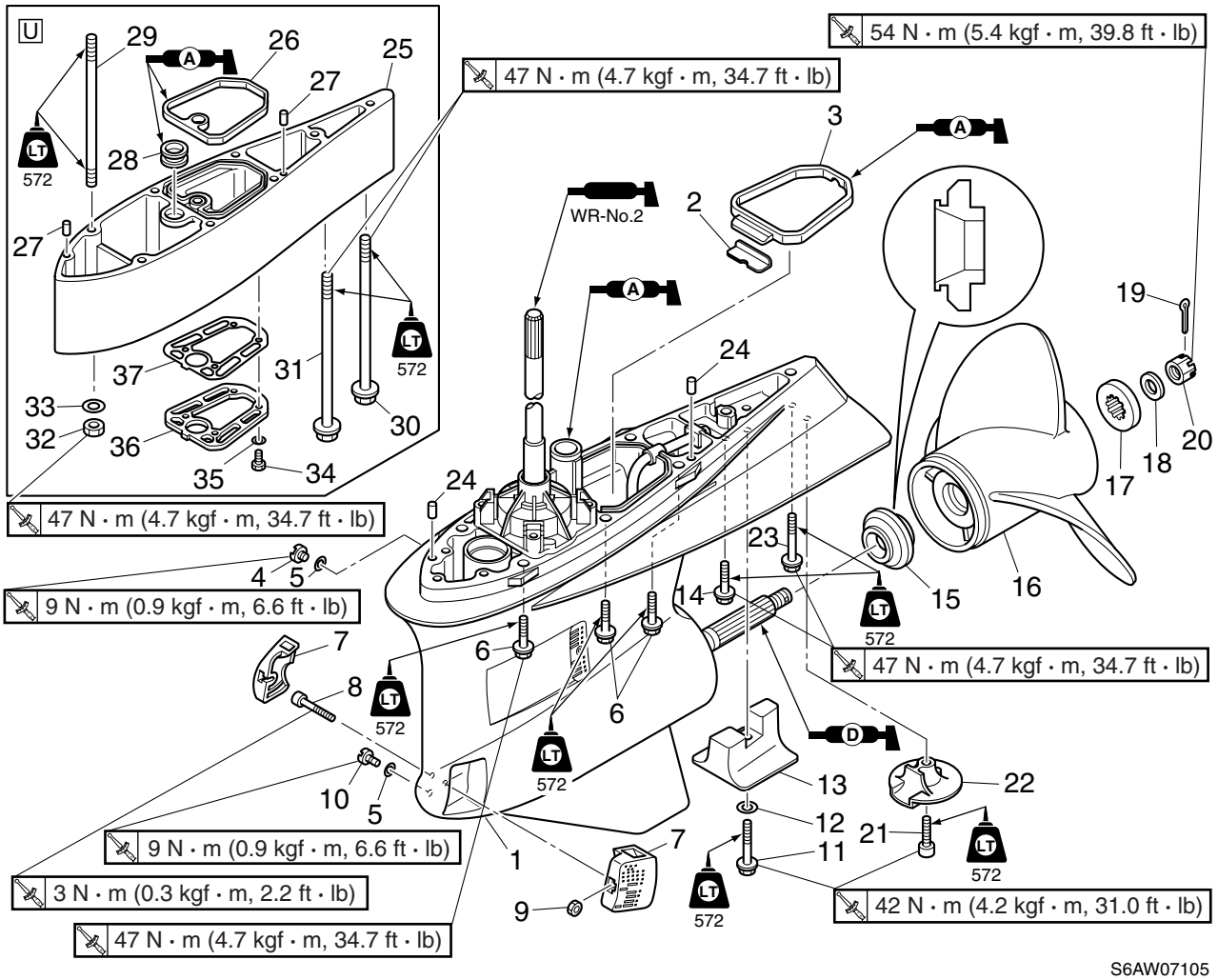


S6AW07105

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	**Not reusable**
6	Bolt	6	M10 × 45 mm/X-transom model
7	Water inlet cover	2	
8	Bolt	1	M5 × 42 mm
9	Self-locking nut	1	
10	Drain screw	1	
11	Bolt	1	M10 × 60 mm
12	Washer	1	
13	Anode	1	
14	Bolt	1	M10 × 45 mm/X-transom model
15	Spacer	1	
16	Propeller	1	
17	Spacer	1	



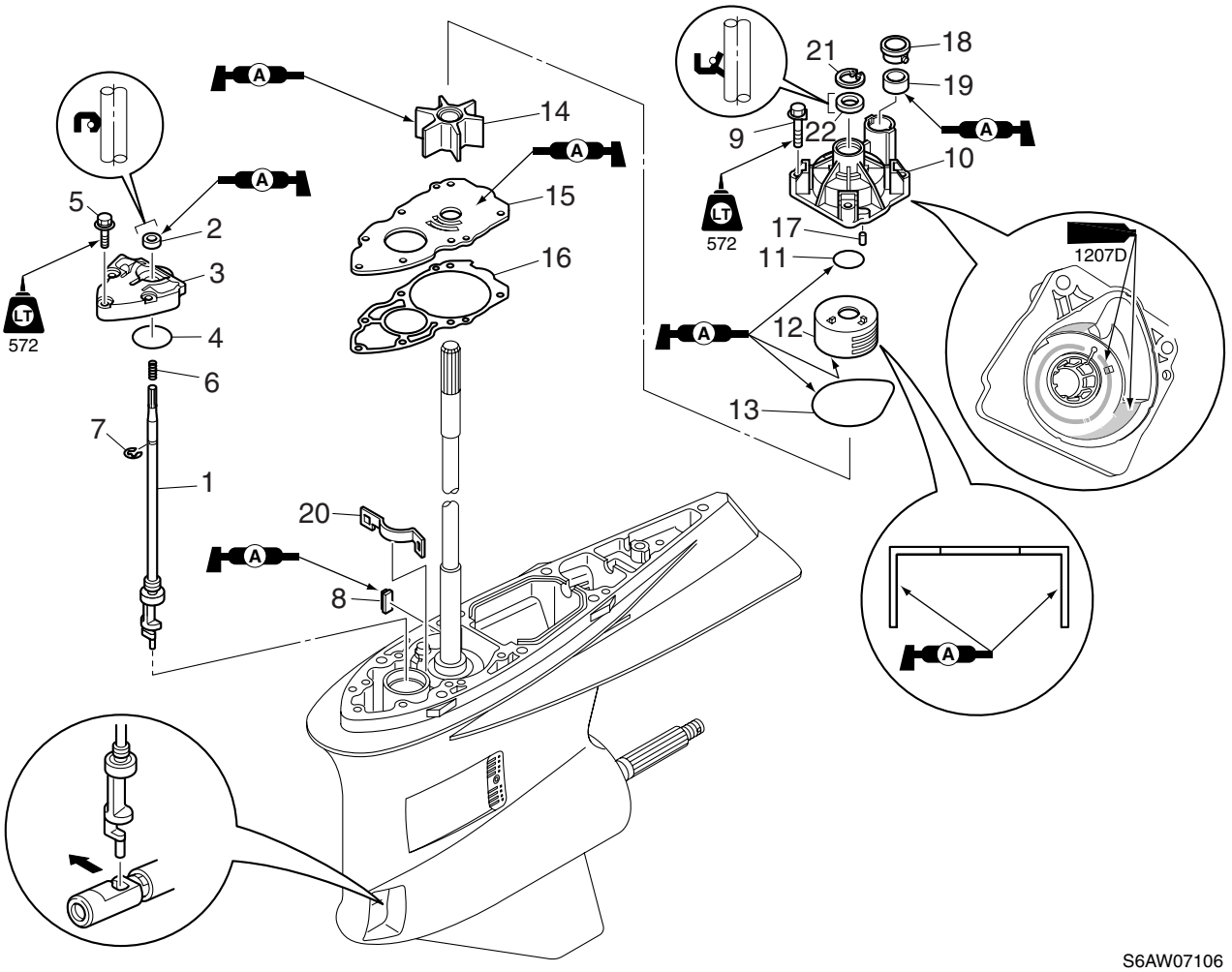
No.	Part name	Q'ty	Remarks
18	Washer	1	
19	Cotter pin	1	**Not reusable**
20	Propeller nut	1	
21	Bolt	1	M10 × 35 mm
22	Cap	1	
23	Bolt	1	M10 × 70 mm/X-transom model
24	Dowel	2	
25	Extension	1	U-transom model
26	Rubber seal	1	U-transom model
27	Dowel	2	U-transom model
28	Rubber seal	1	U-transom model
29	Stud bolt	6	U-transom model
30	Bolt	1	M10 × 200 mm/U-transom model
31	Bolt	1	M10 × 174 mm/U-transom model
32	Nut	6	U-transom model
33	Washer	6	U-transom model
34	Bolt	4	M6 × 20 mm



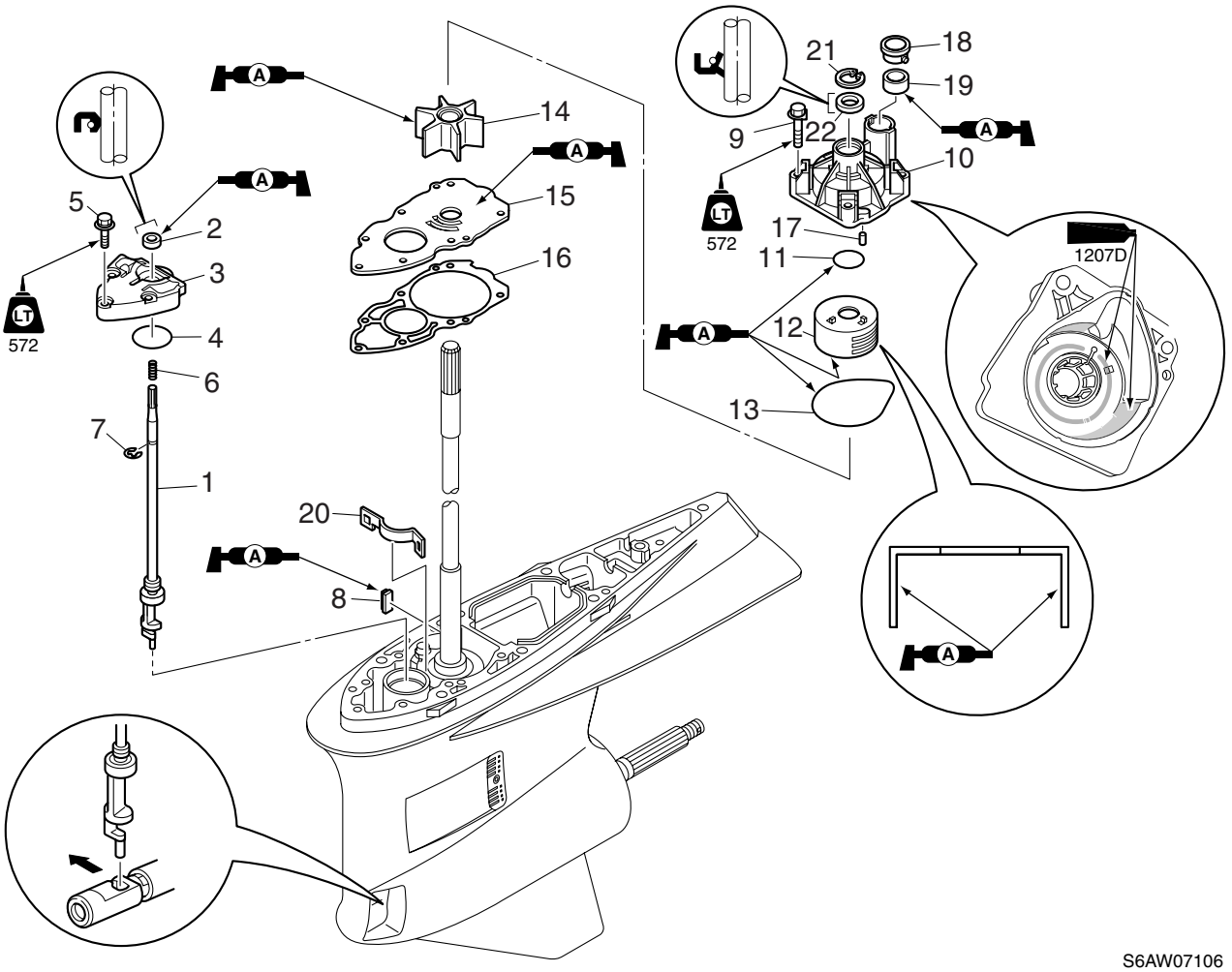
S6AW07105

No.	Part name	Q'ty	Remarks
35	Washer	4	U-transom model
36	Cover	1	U-transom model
37	Gasket	1	U-transom model **Not reusable**

8



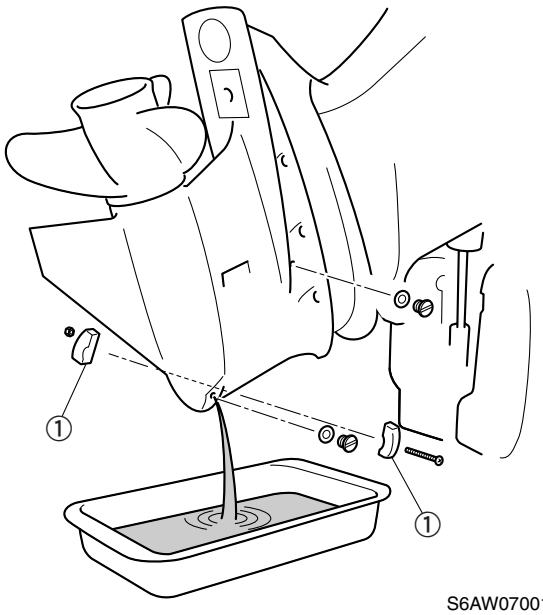
No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	**Not reusable**
3	Oil seal housing	1	
4	O-ring	1	**Not reusable**
5	Bolt	3	M8 × 35 mm
6	Spring	1	
7	E-clip	1	
8	Flat key	1	
9	Bolt	4	M8 × 45 mm
10	Water pump housing	1	
11	O-ring	1	**Not reusable**
12	Insert cartridge	1	
13	O-ring	1	**Not reusable**
14	Impeller	1	
15	Outer plate cartridge	1	
16	Gasket	1	**Not reusable**
17	Dowel	2	



No.	Part name	Q'ty	Remarks
18	Cover	1	
19	Seal	1	**Not reusable**
20	Seal plate	1	
21	Circlip	1	
22	Oil seal	1	**Not reusable**

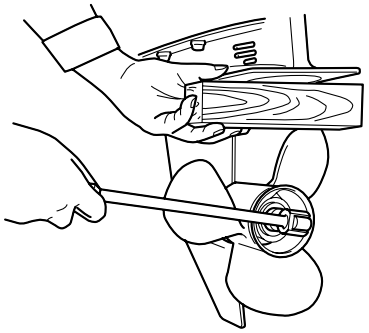
Removing the lower unit

1. Remove the water inlet covers ①, and drain the gear oil.



S6AW07001

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



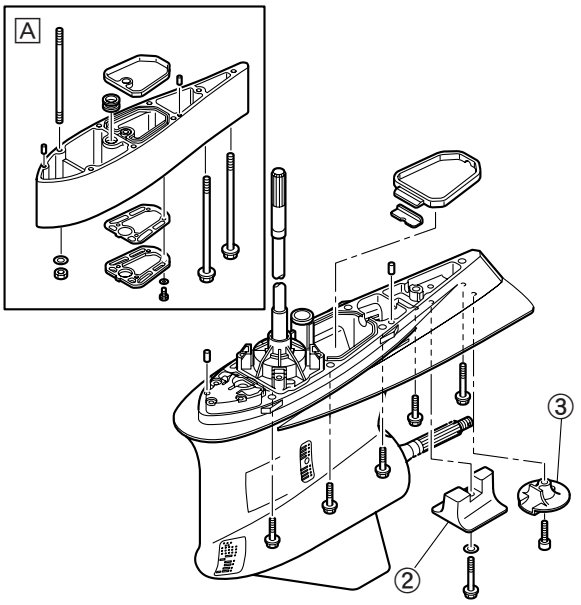
S6AW07002

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery cables from the battery and the clip from the engine shut-off switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**
- **When removing the lower unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.**

3. Remove the anode ② and cap ③.

4. Remove the bolts (nuts), and then remove the lower unit from the upper case.

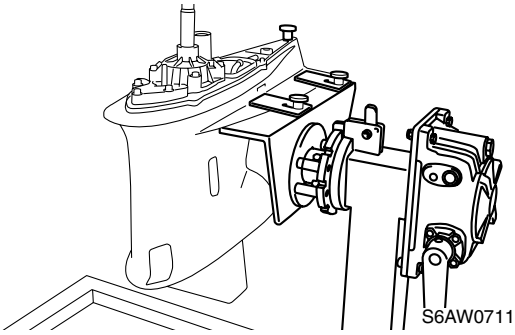


S6AW07003

A U-transom model

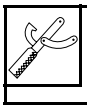
Removing the water pump and shift rod

1. Install the lower unit on the work table.



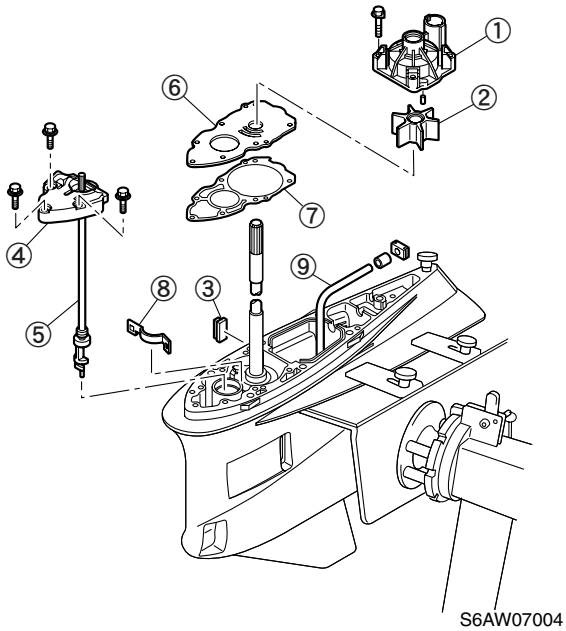
2. Remove the water pump housing ①, impeller ②, and flat key ③.

3. Remove the oil seal housing ④ and the shift rod assembly ⑤ after setting it in the neutral position using the shift rod push arm.



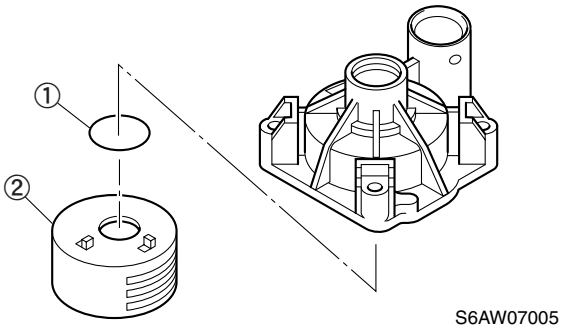
Shift rod push arm: 90890-06052

4. Remove the outer plate cartridge ⑥, gasket ⑦, seal plate ⑧ and water pipe ⑨.

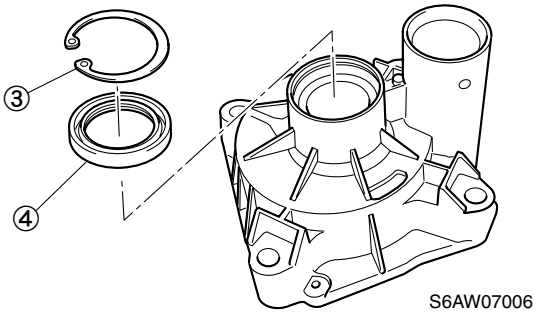


Disassembling the water pump housing

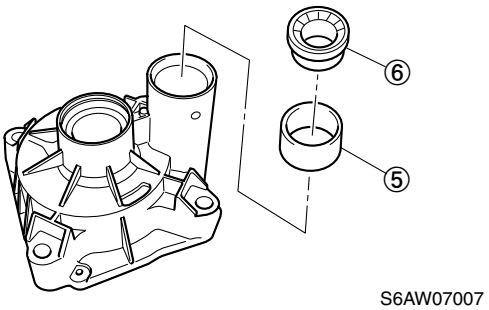
1. Remove the O-ring ① and insert cartridge ②.



2. Remove the circlip ③ and oil seal ④.



3. Remove the cover ⑤ and seal ⑥.



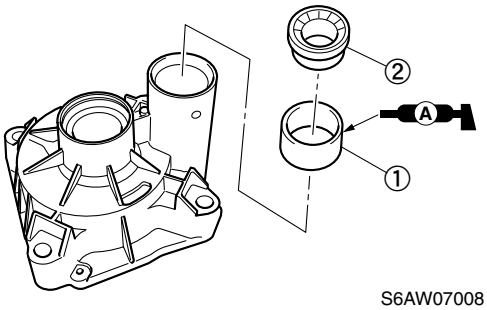
8

Checking the water pump and shift rod

1. Check the water pump housing. Replace if there is deformation.
2. Check the oil seal, cover, seal, impeller, insert cartridge and outer plate cartridge. Replace if cracked or worn.
3. Check the water pipe. Replace if corrosion, deformation or cracked.
4. Check the flat key. Replace if worn.
5. Check the shift rod. Replace if cracked or worn.

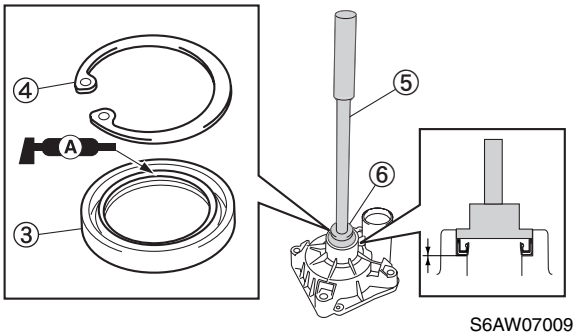
Assembling the water pump housing

1. Install the seal ① and cover ②.



S6AW07008

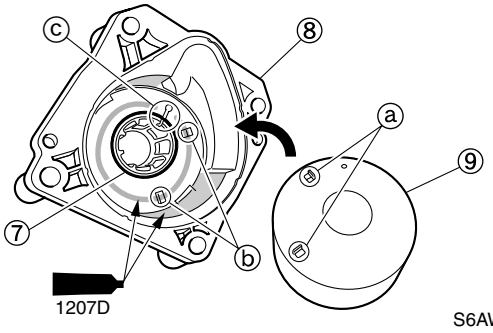
2. Install the oil seal ③ and circlip ④.



S6AW07009

Driver rod L3 ⑤: 90890-06652
Needle bearing attachment ⑥: 90890-06653

3. Install a new O-ring ⑦ into the water pump housing ⑧.
4. Install the insert cartridge ⑨ aligning ⓐ on the insert cartridge with ⓑ on the water pump housing ⑧.

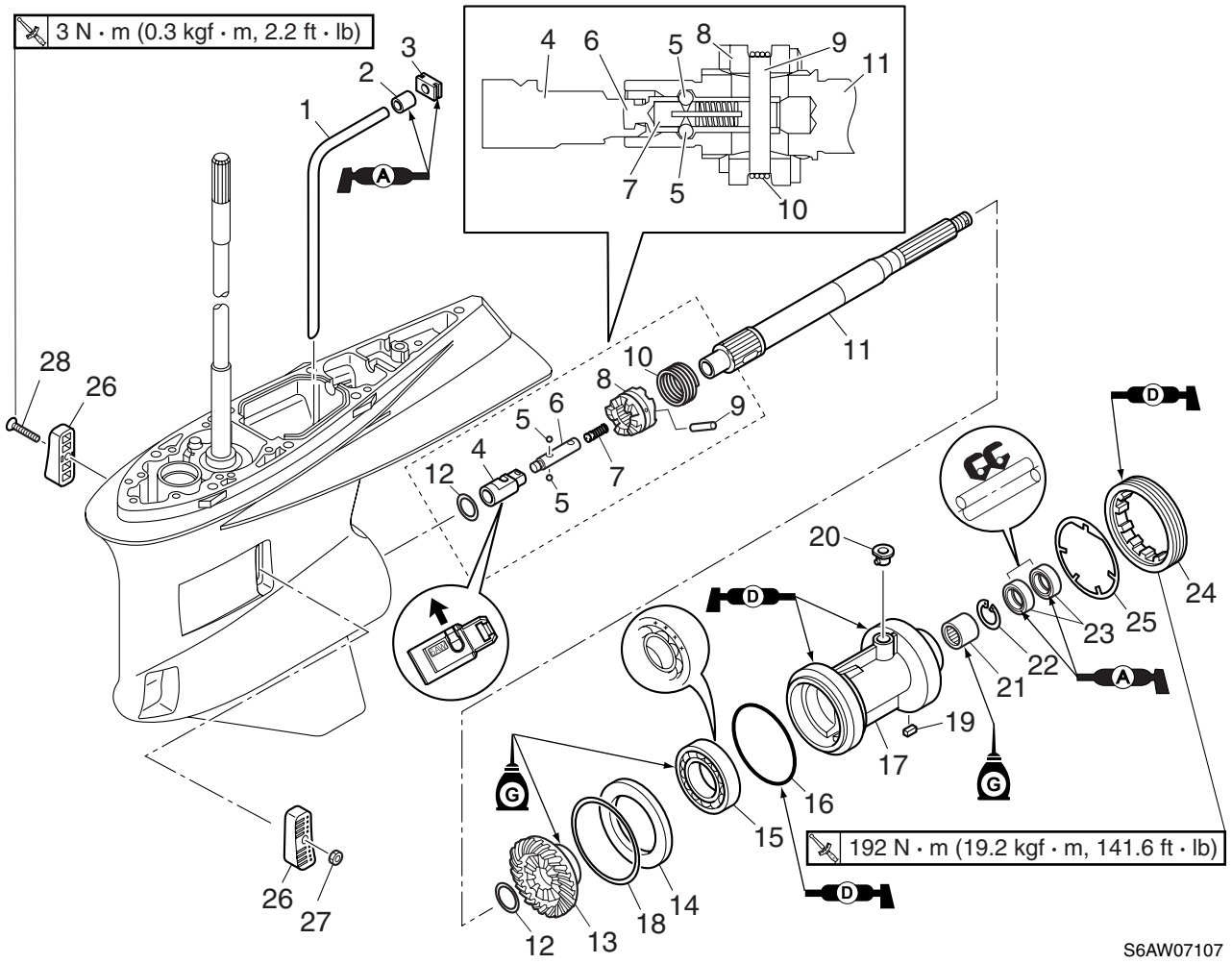


S6AW07010

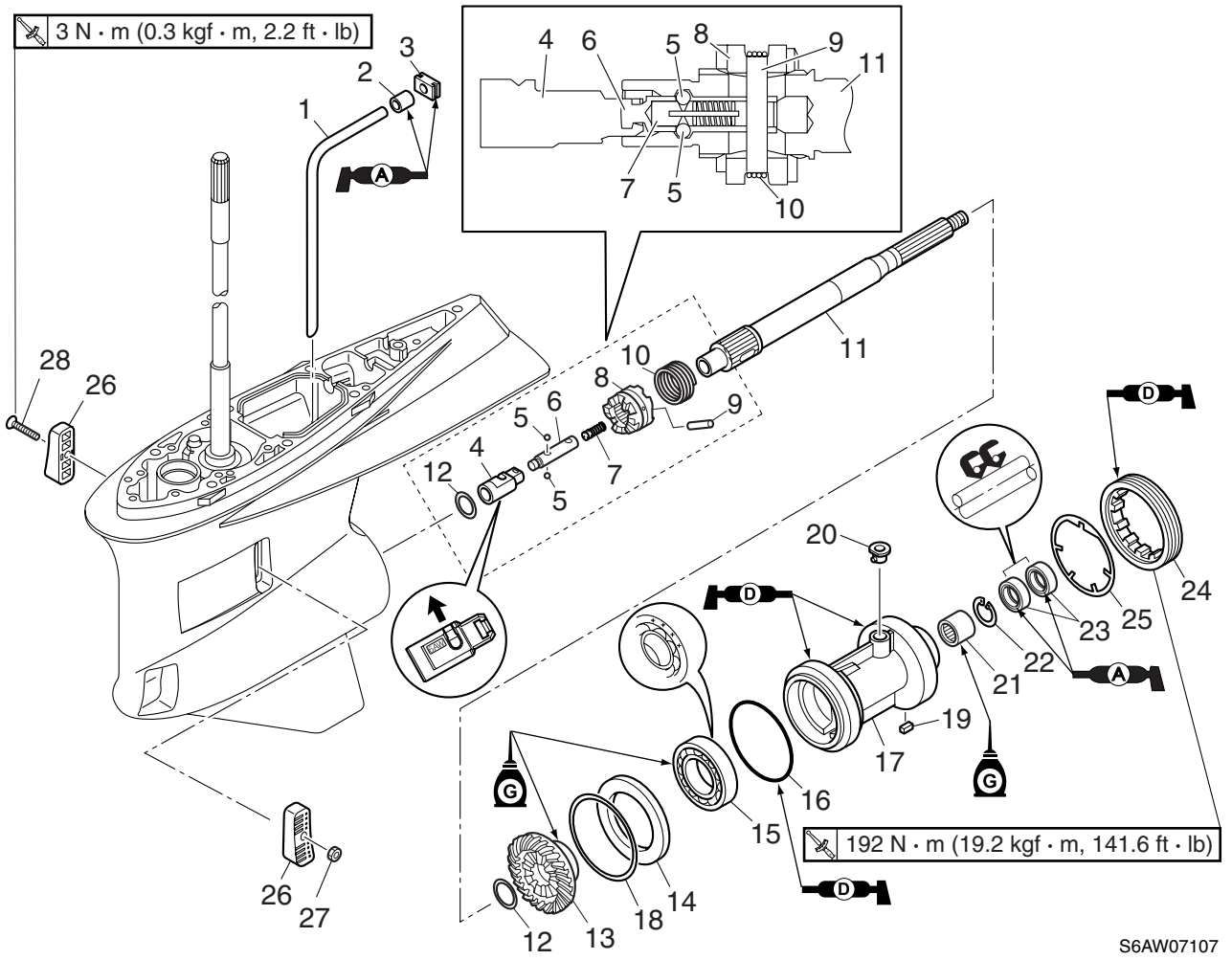
CAUTION:

Avoid the area ⓒ when applying ThreeBond 1207D on the water pump housing.

Propeller shaft housing (regular rotation model)



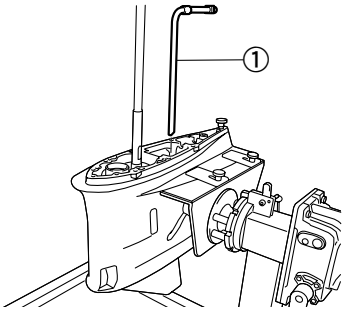
No.	Part name	Q'ty	Remarks
1	Water pipe	1	
2	Rubber seal	1	
3	Rubber seal	1	
4	Shift rod joint	1	
5	Ball	2	
6	Slider	1	
7	Shift plunger	1	
8	Dog clutch	1	
9	Cross pin	1	
10	Spring	1	
11	Propeller shaft	1	
12	Washer	2	
13	Reverse gear	1	
14	Thrust washer	1	
15	Ball bearing	1	**Not reusable**
16	O-ring	1	**Not reusable**
17	Propeller shaft housing	1	



No.	Part name	Q'ty	Remarks
18	Shim T2	—	
19	Key	1	
20	Rubber seal	1	
21	Needle bearing	1	**Not reusable**
22	Circlip	1	
23	Oil seal	2	**Not reusable**
24	Ring nut	1	
25	Claw washer	1	
26	Water inlet cover	2	
27	Self-locking nut	1	
28	Screw	1	ø5 × 54 mm

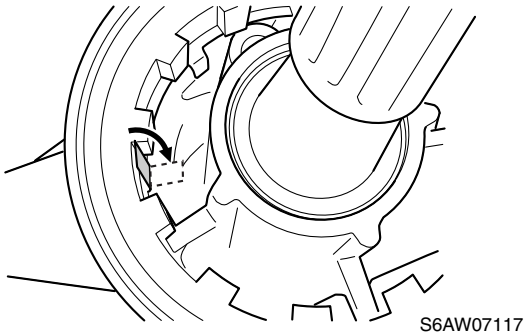
Removing the propeller shaft housing assembly

1. Remove the water pipe ①.

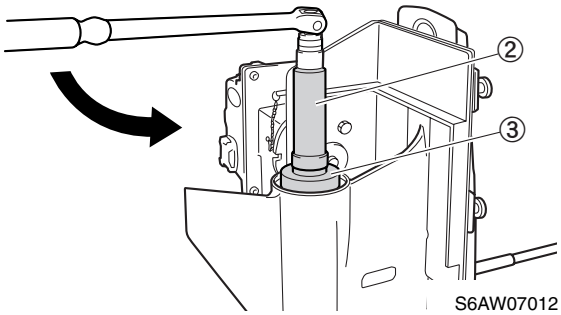


S6AW07011

2. Fold one tooth of the claw washer that is bent toward the propeller.


S6AW07117

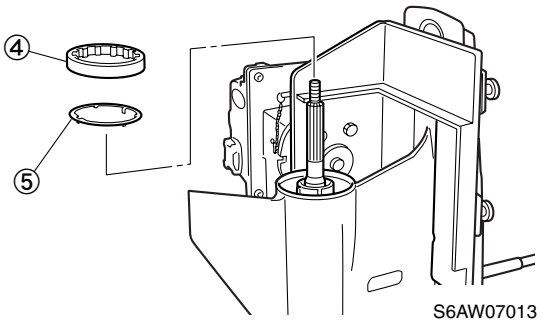
3. Loosen the ring nut.



S6AW07012

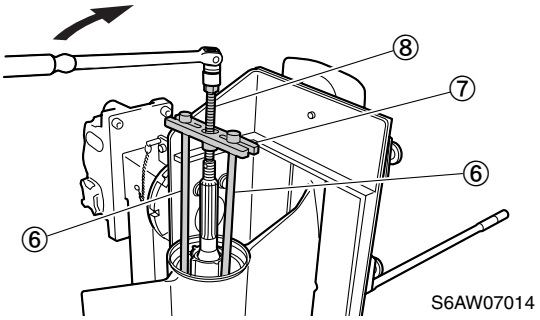
	Ring nut wrench extension 2 ②: 90890-06784 Ring nut wrench 2 ③: 90890-06823

4. Remove the ring nut ④ and claw washer ⑤.



S6AW07013

5. Remove the propeller shaft housing assembly, the propeller shaft, washers, and the shim T2. Be careful not to lose the key.
   See the exploded diagram (8-9) for each components.



S6AW07014

	Bearing housing puller claw L ⑥: 90890-06502 Stopper guide plate ⑦: 90890-06501 Center bolt ⑧: 90890-06504

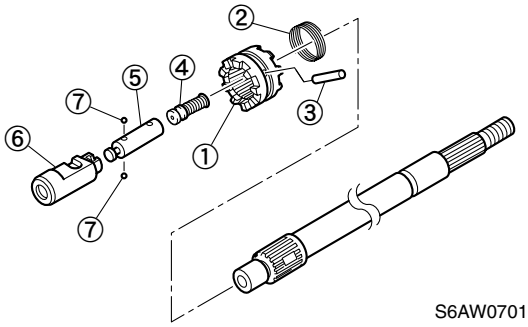
8

Disassembling the propeller shaft assembly

1. Place a marking on the dog clutch ①, so it can be installed in the original orientation (forward side or reverse side) before disassembling.

2. Remove the spring ②, and then remove the cross pin ③, and dog clutch ①.

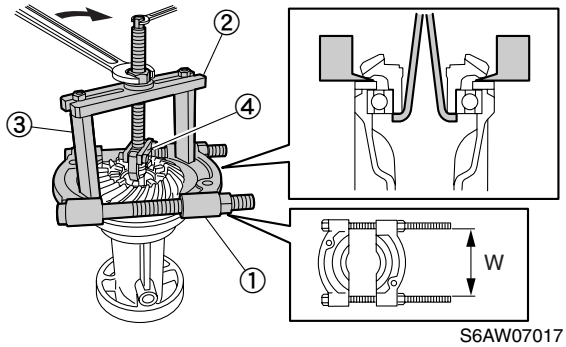
3. Remove the shift plunger ④, slider ⑤, shift rod joint ⑥, and the balls ⑦. Be careful not to lose the balls ⑦.



S6AW07016

Disassembling the propeller shaft housing

1. Remove the reverse gear and the thrust washer.

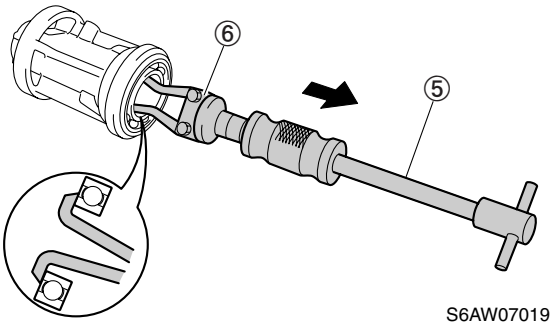


S6AW07017

Dimension "W": 110 mm (4.3 in) is recommended.

Bearing separator ①:
(commercially available)
Stopper guide plate ②: 90890-06501
Stopper guide stand ③:
90890-06538
Bearing puller assembly ④:
90890-06535

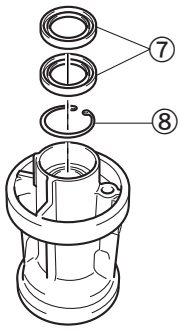
2. Remove the ball bearing.



S6AW07019

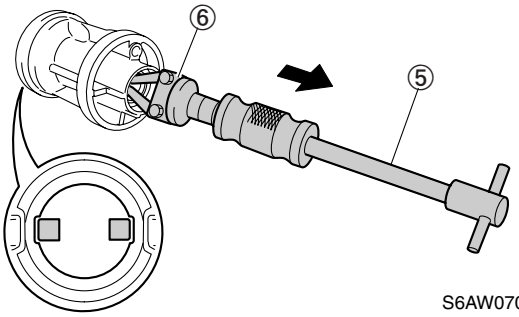
Slide hammer ⑤:
90890-06531
Bearing outer race puller assembly ⑥:
90890-06523

3. Remove the oil seals ⑦ and circlip ⑧.



S6AW07021

4. Remove the needle bearing.



S6AW07023

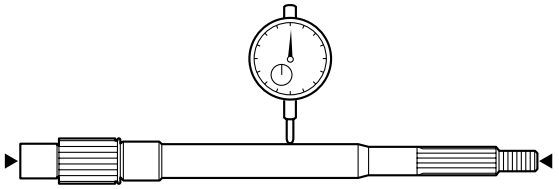
Slide hammer ⑤: 90890-06531
Bearing outer race puller assembly ⑥:
90890-06523

Checking the propeller shaft housing

1. Check the water pipe. Replace the water pipe if corrosion, deformation or cracked.
2. Clean the propeller shaft housing, and then check it. Replace the propeller shaft housing if cracked or damaged.
3. Check the teeth and dogs of the reverse gear. Replace the reverse gear if cracked or worn.
4. Check the bearings. Replace the bearings if pitted or if there is rumbling.

Checking the propeller shaft

1. Check the propeller shaft. Replace the propeller shaft if bent or worn.
2. Measure the propeller shaft runout. Replace the propeller shaft if above specification.



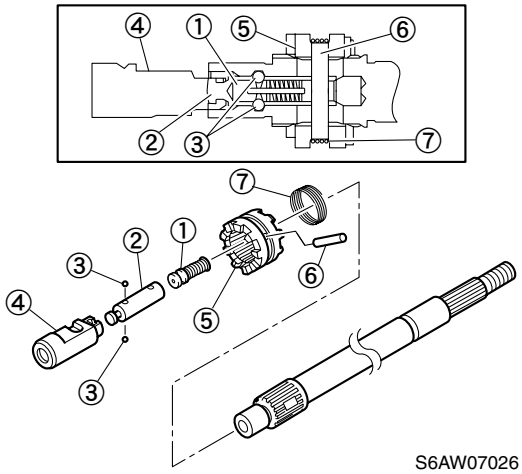
S6AW07025

Propeller shaft runout limit:
0.02 mm (0.0008 in)

3. Check the dog clutch, shift rod joint, and slider. Replace the dog clutch, shift rod joint, or slider if cracked or worn.

Assembling the propeller shaft assembly

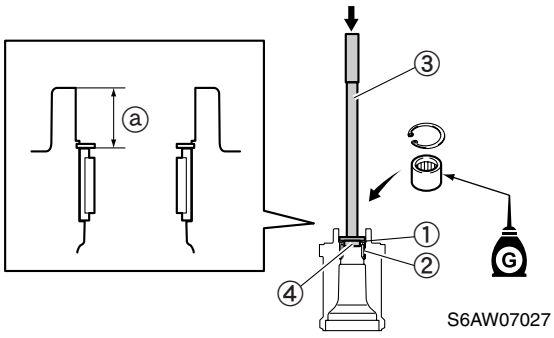
1. Install the shift plunger ①, slider ②, balls ③, shift rod joint ④.
2. Install the dog clutch ⑤ aligning the marking placed before disassembling.
3. Install the cross pin ⑥.
4. Install the spring ⑦.



S6AW07026

Assembling the propeller shaft housing

1. Install the needle bearing ① to the propeller shaft housing until it is set at the specified depth ⓐ, and install the circlip ②.



S6AW07027

CAUTION:

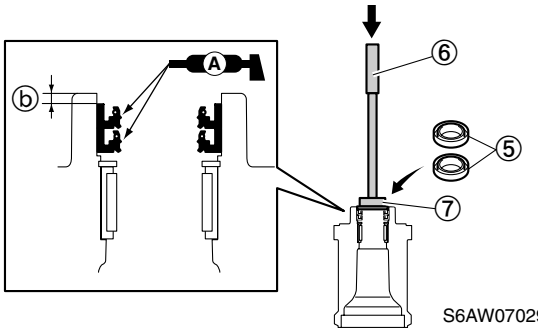
Do not reuse the bearing, always replace it with a new one.

Driver rod LL ③: 90890-06605
Ball bearing attachment ④:
90890-06632

8

Depth ⓐ:
26.75–27.25 mm (1.05–1.07 in)

2. Apply some grease to new oil seals ⑤, and install them into the propeller shaft housing until they are set at the specified depth ⓑ.



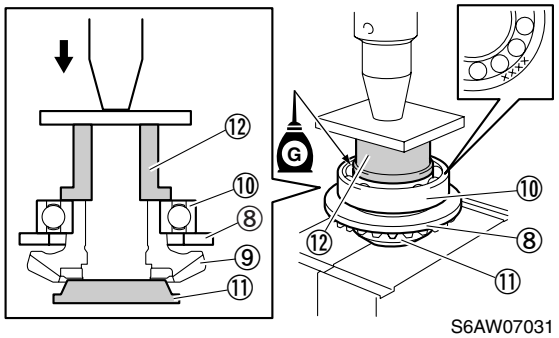
S6AW07029

NOTE:
Install an oil seal halfway into the propeller shaft housing, and then install the other oil seal.

Driver rod L3 ⑥: 90890-06652
Needle bearing attachment ⑦:
90890-06607

Depth ⓑ:
4.75–5.25 mm (0.19–0.21 in)

3. Install the thrust washer ⑧ to the reverse gear ⑨, and install a new ball bearing ⑩.



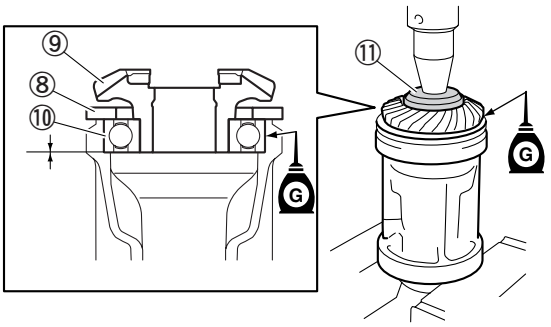
S6AW07031

CAUTION:
Do not reuse the bearing, always replace it with a new one.

NOTE:
Install the bearing with the manufacture identification mark facing toward the propeller shaft housing (propeller side).

Bearing outer race attachment ⑪:
90890-06622
Bearing inner race attachment ⑫:
90890-06659

4. Install the reverse gear ⑨, the thrust washer ⑧, and the ball bearing ⑩ installed in step 3 to the propeller shaft housing.

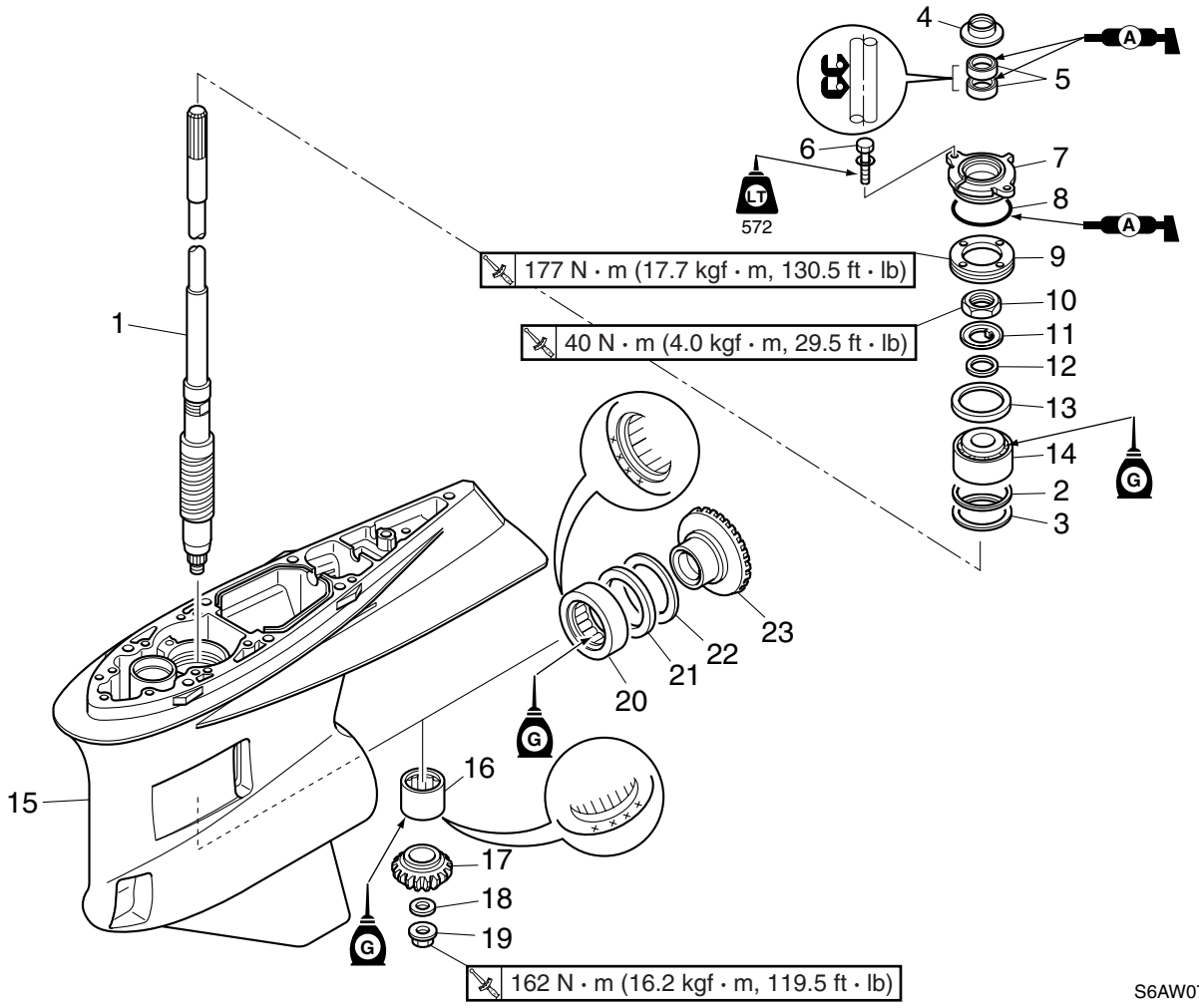


S6AW07033

Bearing outer race attachment ⑪:
90890-06622

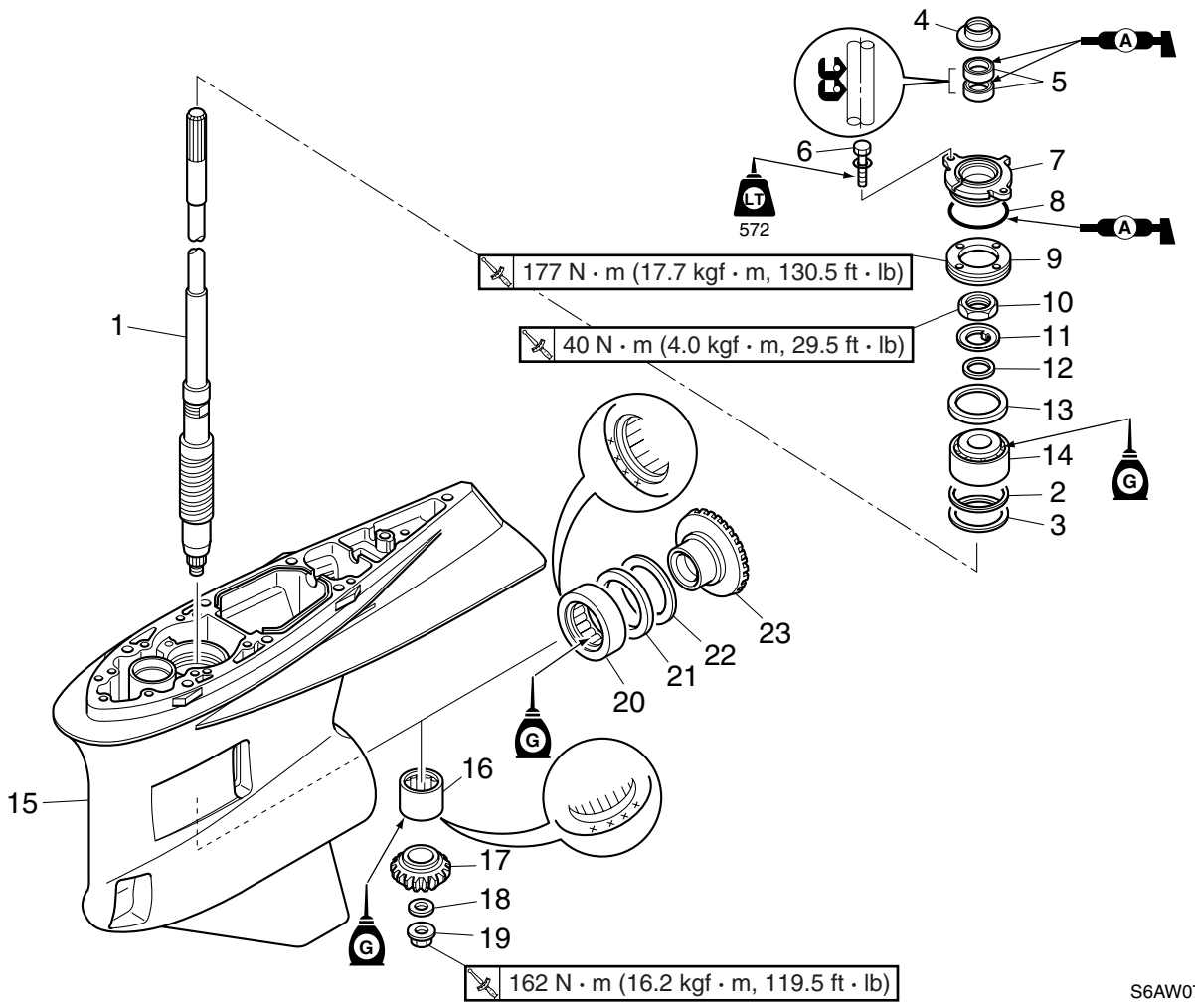
5. Make sure that the reverse gear rotates smoothly.

Drive shaft and lower case (regular rotation model)



S6AW07108

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Shim T3	—	
3	Washer	1	
4	Cover	1	
5	Oil seal	2	**Not reusable**
6	Bolt	2	M8 × 20 mm
7	Oil seal housing	1	
8	O-ring	1	**Not reusable**
9	Ring nut	1	
10	Nut	1	
11	Claw washer	1	
12	Washer	1	
13	Spacer	1	
14	Taper roller bearing	1	**Not reusable**
15	Lower case	1	
16	Needle bearing	1	
17	Pinion	1	

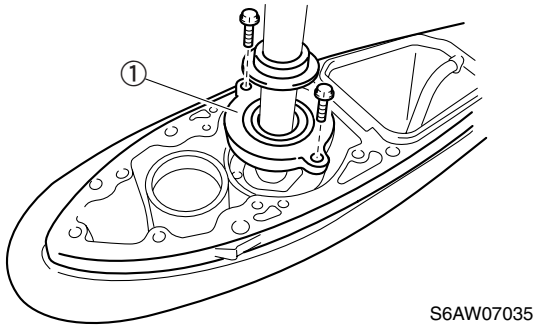


S6AW07108

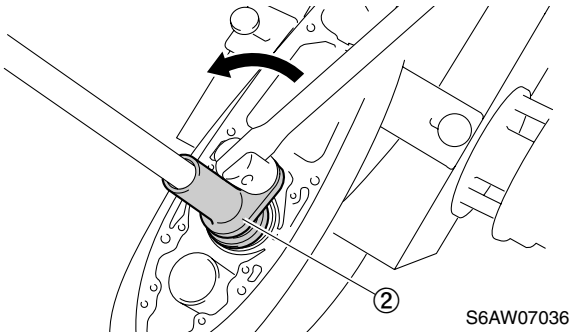
No.	Part name	Q'ty	Remarks
18	Washer	1	
19	Nut	1	
20	Roller bearing	1	**Not reusable**
21	Thrust bearing	1	
22	Shim T1	—	
23	Forward gear	1	

Removing the drive shaft

1. Remove the oil seal housing ①.

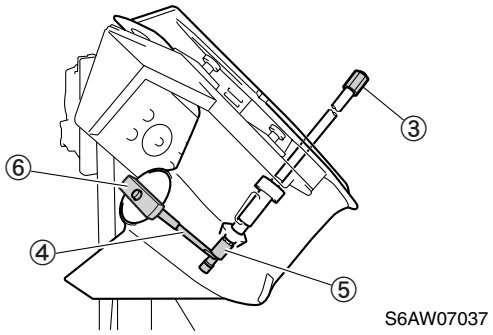


2. Remove the ring nut.



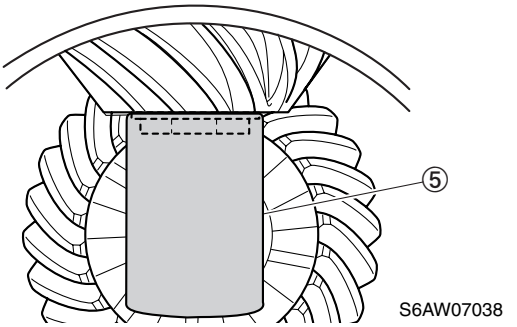
Ring nut wrench ②: 90890-06833

3. Install the special service tools ③, ④, ⑤, and ⑥ as shown.



Drive shaft holder 8 ③: 90890-06832
Pinion nut holder ④: 90890-06715
Socket adapter ⑤: 90890-06831
Holder guide ⑥: 90890-06834

4. Make sure that special service tool ⑤ is secure on the pinion nut as shown, and loosen the pinion nut.



Socket adapter ⑤: 90890-06831

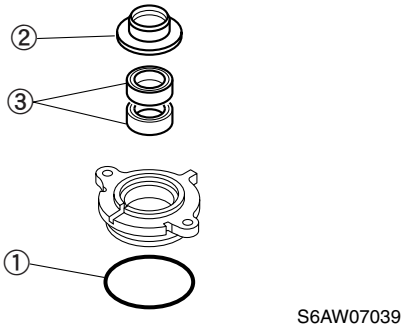
5. Remove the pinion nut and washer.
   See the exploded diagram (8-15).

6. Remove the drive shaft, pinion gear, shim T3, and washer.
   See the exploded diagram (8-15).

7. Pull out the forward gear, shim T1 and thrust bearing.
   See the exploded diagram (8-15).

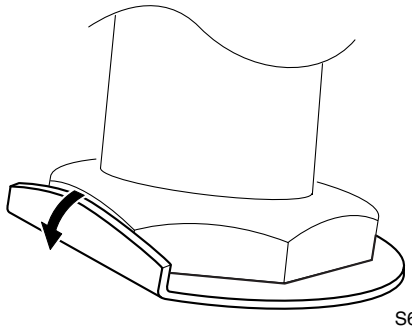
Disassembling the oil seal housing

1. Remove the O-ring ①, oil seal cover ②, and oil seals ③.

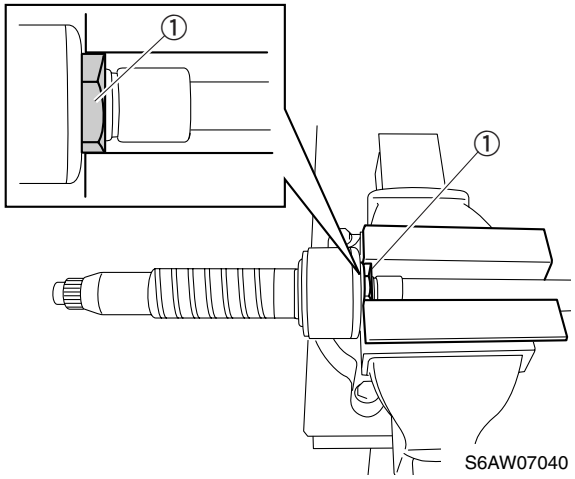


Disassembling the drive shaft

1. Fold out the claw washer as shown.


S6AW07118

2. Clamp the nut ① on the drive shaft with the aluminum plates, and fix them to the vise.

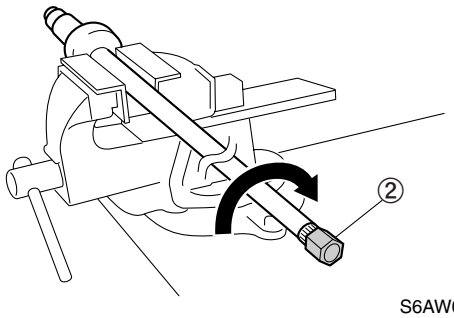


S6AW07040

CAUTION:

The nut will deform when the vise is tighten too much.

3. Loosen the nut ①.

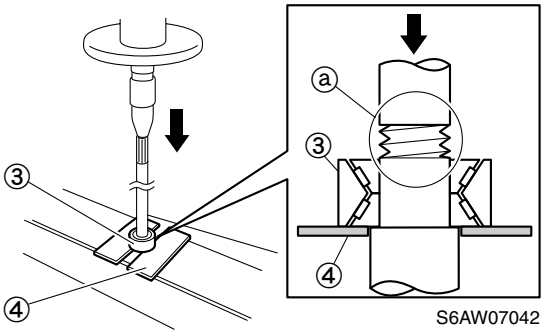


S6AW07041

Drive shaft holder 8 ②: 90890-06832

4. Remove the nut, claw washer, and spacer.
   See the exploded diagram (8-15).

5. Remove the taper roller bearing ③ using the press.



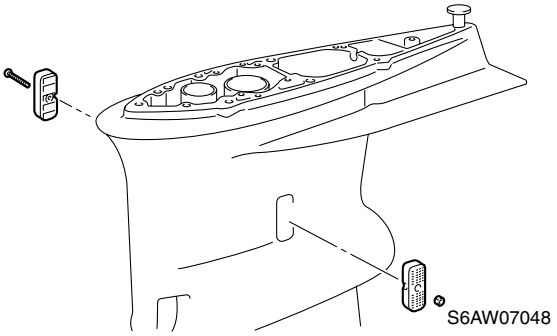
S6AW07042

CAUTION:

Make sure that the base ④ does not interfere with the screw ⓐ of the drive shaft.

Disassembling the lower case

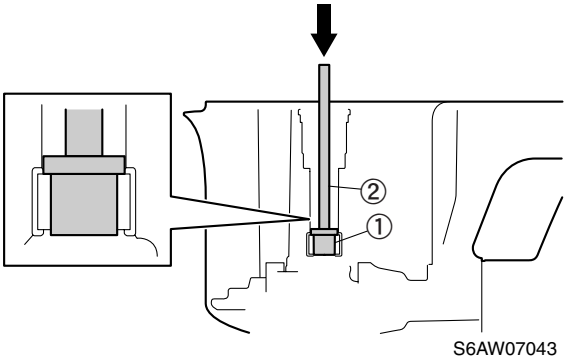
1. Remove the water inlet covers.


S6AW07048

CAUTION:

Remove all the plastic parts because you need to heat the lower unit later.

2. Remove the needle bearing from the lower case.

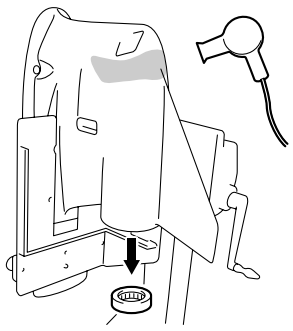


S6AW07043

NOTE:
Be sure to remove the forward gear before removing the needle bearing.

Needle bearing attachment ①: 90890-06665
Driver rod LL ②: 90890-06605

3. Turn the lower unit upside down as shown, and remove the roller bearing by heating all areas of the roller bearing on the lower case to approximately 80 °C (176 °F), using a heat gun or a burner.



S6AW07044

⚠ WARNING
- **Use a heat-resistant glove, since it may cause a burn.**
- **Keep away any flammable materials such as gasoline and oil in the work area to prevent possible fire.**
- **Work with a good ventilation.**

NOTE:
- Roller bearing will fall off suddenly, so place something to cushion beneath it.
- Tap lightly on the torpedo of the lower case using a plastic hammer if the roller bearing does not come off.

Checking the pinion and forward gear

1. Check the teeth of the pinion, and the teeth and dogs of the forward gear. Replace the pinion or forward gear if cracked or worn.

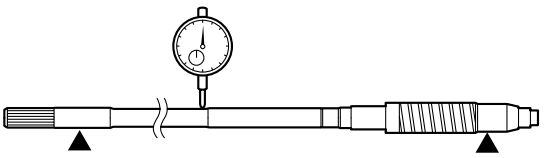
Checking the bearing

1. Check the bearings. Replace the bearing if pitted or if there is rumbling.

Checking the drive shaft

1. Check the drive shaft. Replace the drive shaft if bent or worn.

2. Measure the drive shaft runout. Replace the drive shaft if above specification.



S6AW07045

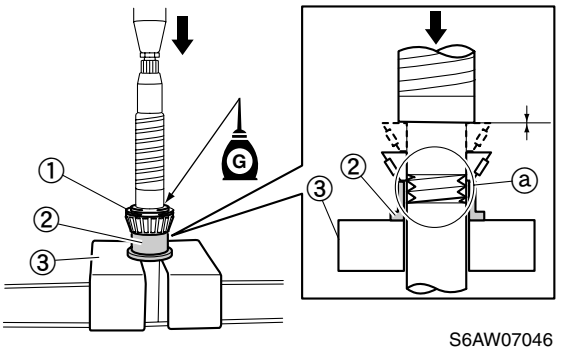
Drive shaft runout limit: 1.0 mm (0.04 in)

Checking the lower case

1. Check the skeg, torpedo, and anti cavitation plate. Replace the lower case if cracked or damaged.

Assembling the drive shaft

1. Install the bearing ① to the drive shaft.



S6AW07046

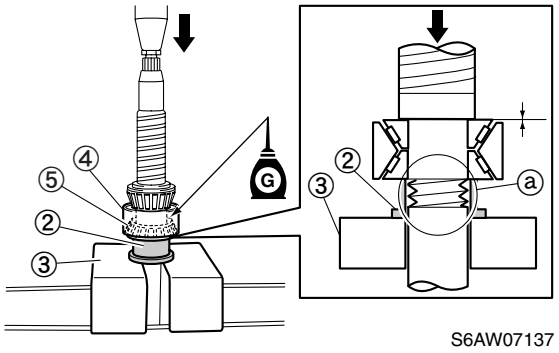
CAUTION:
- **Make sure that the special service tool ② or the base ③ does not interfere with the screw ⓐ of the drive shaft.**
- **Do not reuse the bearing, always replace it with a new one.**

Bearing inner race attachment ②: 90890-06640

8

Press load (bearing):
5×10^4 N (5000 kgf)

2. Install the outer race ④, and bearing ⑤ into the drive shaft.



S6AW07137

CAUTION:
- **Make sure that the special service tool ② or the base ③ does not interfere with the screw ⓐ of the drive shaft.**
- **Do not reuse the bearing, always replace it with a new one.**

Bearing inner race attachment ②:
90890-06640

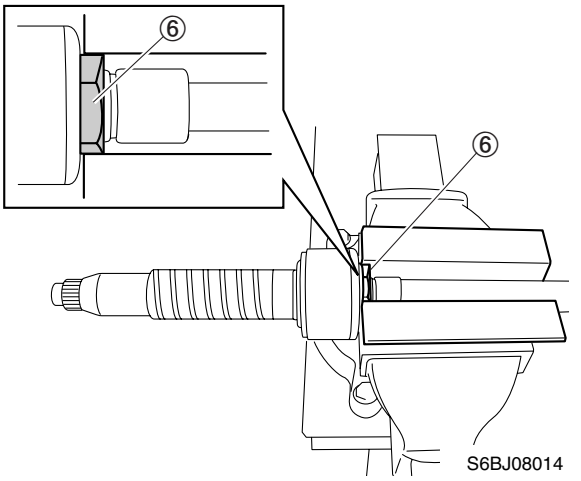
Press load (bearing):
5×10^4 N (5000 kgf)

3. Rotate the bearing by 5 turns or so to assure the proper fitting, and press it with the specified load again.

Press load (bearing):
5×10^4 N (5000 kgf)

4. Install the nut, claw washer, and spacer to the drive shaft.

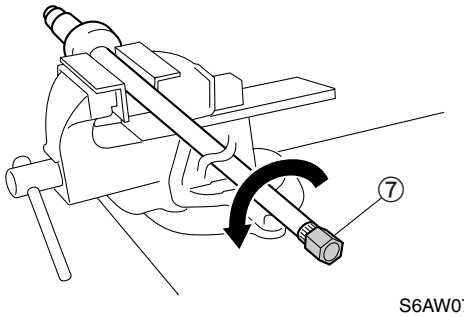
5. Clamp the nut ⑥ on the drive shaft with the aluminum plates, and fix them to the vise.



S6BJ08014

CAUTION:
The nut will deform when the vise is tighten too much.

6. Tighten the nut ⑥ to the specified torque.



S6AW07047

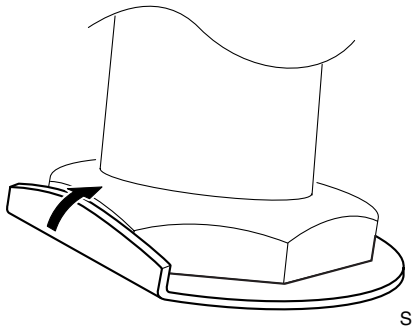
Drive shaft holder 8 ⑦: 90890-06832

Drive shaft nut:
40 N·m (4.0 kgf·m, 29.5 ft·lb)

7. Hold the outer race in a vise using the aluminum plates, and then measure the motive torque of the drive shaft.

Drive shaft motive torque:
0.78–4.00 N·m (0.08–0.40 kgf·m, 0.6–3.0 ft·lb)

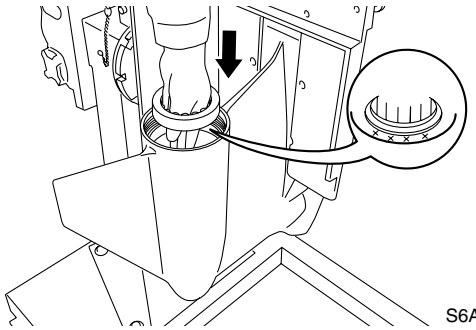
8. Fix the nut by bending the tooth of the claw washer.


S6AW07125

Assembling the lower case

1. Heat all the area of the roller bearing install of the lower case to approximately 80 °C (176 °F) using a heat gun or a burner.

2. Insert it straight with your hands. Make sure that the stamped mark on the roller bearing faces to the torpedo of the outboard motor.


S6AW07119

⚠ WARNING

- **Use a heat-resistant glove, since it may cause a burn.**
- **Keep away any flammable materials such as gasoline and oil in the work area to prevent possible fire.**
- **Work with a good ventilation.**

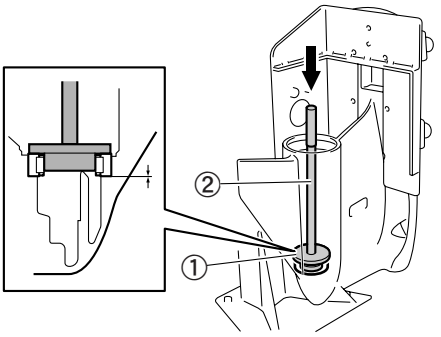
CAUTION:

Do not reuse the bearing, always replace it with a new one.

NOTE:

Repeat the steps 1–2, if the roller bearing does not fit-in correctly.

3. Make sure that the roller bearing is installed correctly by the hammering sound, using the special service tools ① and ②.



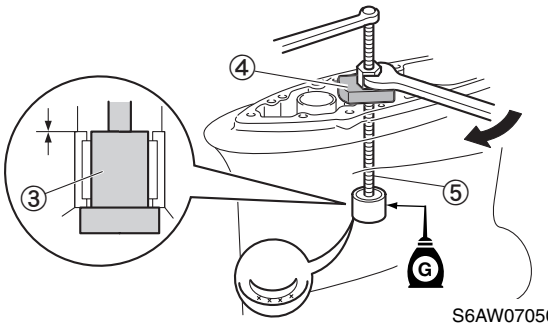
S6AW07049

NOTE:

Make sure that the bearing is inserted properly.

Needle bearing attachment ①: 90890-06839
Driver rod LL ②: 90890-06605

4. Install the needle bearing with the stamped mark facing to the propeller shaft. Pull up the needle bearing using the special service tools ③ and ④, along with a double-ended bolt ⑤. Make sure the needle bearing is set upright while pulling it up.



S6AW07050

CAUTION:

Do not reuse the bearing, always replace it with a new one.

NOTE:

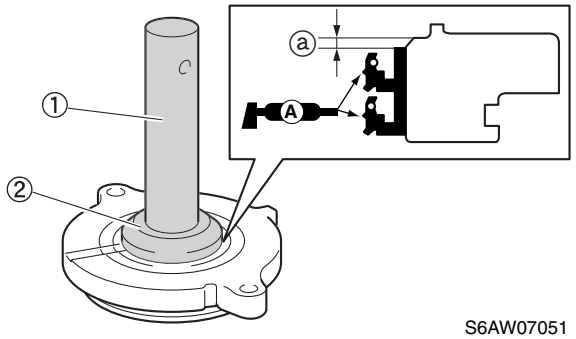
- The needle bearing contains 18 rollers.
- Make sure that the bearing is inserted properly.

8

Needle bearing attachment ③:
90890-06664
Stopper guide plate ④:
90890-06667
Double-ended bolt ⑤ (commercially available):
M10 × 1.25, 350 mm

Assembling the oil seal housing

1. Insert the inner oil seal partway into the oil seal housing, and then install it with the outer oil seal to the specified depth ⓐ.



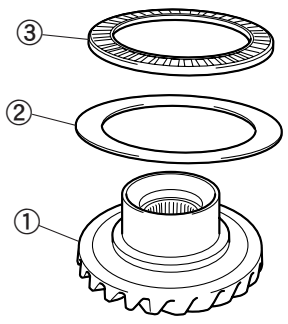
S6AW07051

Driver rod LS ①: 90890-06606
Bearing outer race attachment ②:
90890-06628

Depth ⓐ:
0.25–0.75 mm (0.01–0.03 in)

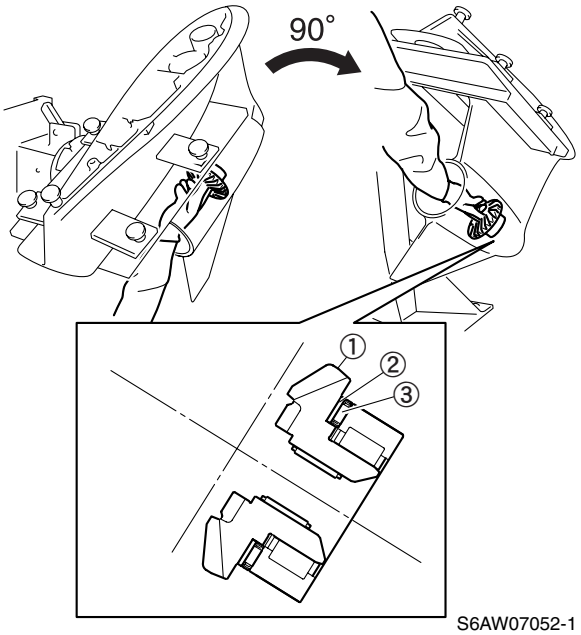
Installing the forward gear

1. Install the assembled shim T1 ② and the thrust bearing ③ to the forward gear ①. If you are not aware of the shim thickness that has been originally installed, use the one with 2.09 mm thickness.
   To select the shims, see "Shimming (regular rotation model)" (8-28).



S6AW07120

2. Tilt the lower case and set the forward gear ①. Take precautions against the possible dislocation of the shim T1 ② and the thrust bearing ③ while tilting the lower case. Then, turn the lower case by 90° holding the forward gear in place with your hand.

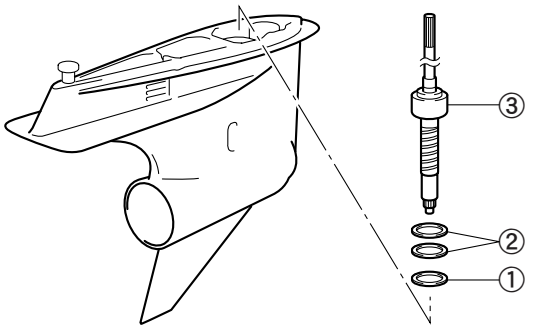


S6AW07052-1

NOTE:
Turn the gear after the assembly to assure the correct installation.

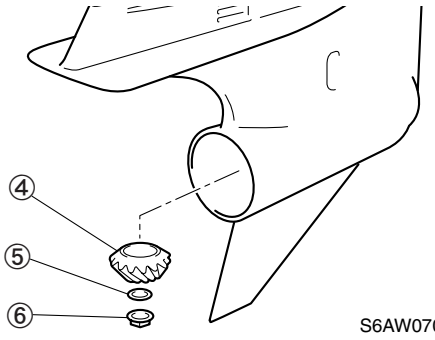
Installing the drive shaft

1. Install the washer ① and the assembled shim(s) T3 ② and the drive shaft ③ to the lower case. If you are not aware of the shim thickness that has been originally installed, combine the shims to obtain 0.98 mm thickness.
   To select the shims, see "Shimming (regular rotation model)" (8-28).



S6AW07053

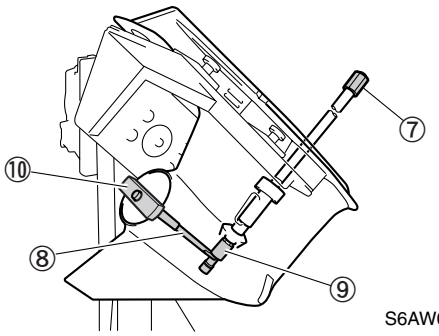
2. Install the pinion ④, washer ⑤, and pinion nut ⑥ temporarily.



S6AW07055

NOTE:
Hold up the drive shaft a little, determine the correct position of the pinion, and install it while rotating the drive shaft. Check the spline alignment.

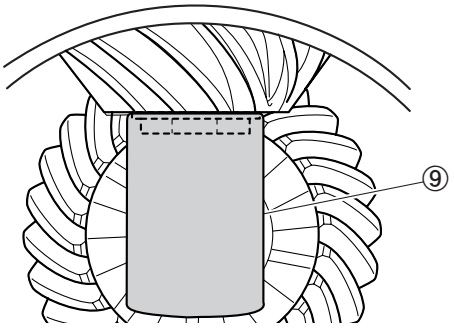
3. Install the special service tools ⑦, ⑧, ⑨, and ⑩ as shown.



S6AW07054

Drive shaft holder 8 ⑦: 90890-06832
Pinion nut holder ⑧: 90890-06715
Socket adapter ⑨: 90890-06831
Holder guide ⑩: 90890-06834

4. Make sure that the special service tool ⑨ is secure on the pinion nut as shown, and tighten the pinion nut to the specified torque.

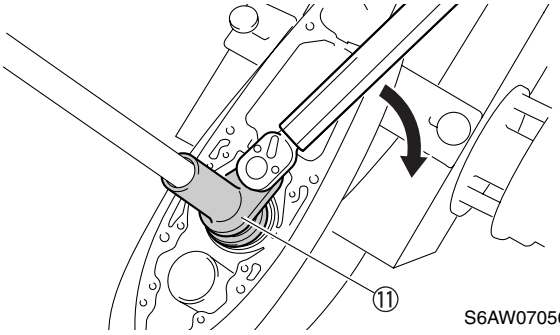


S6AW07135

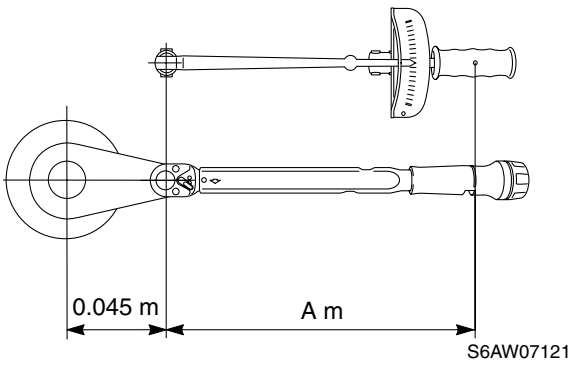
Socket adapter ⑨: 90890-06831

Pinion nut:
162 N·m (16.2 kgf·m, 119.5 ft·lb)

5. Install the ring nut.



S6AW07056



S6AW07121

CAUTION:
When tightening the ring nut to the specified torque, the correct torque wrench reading (setting value) varies depending on the torque wrench length. Please refer to the following calculation formula.

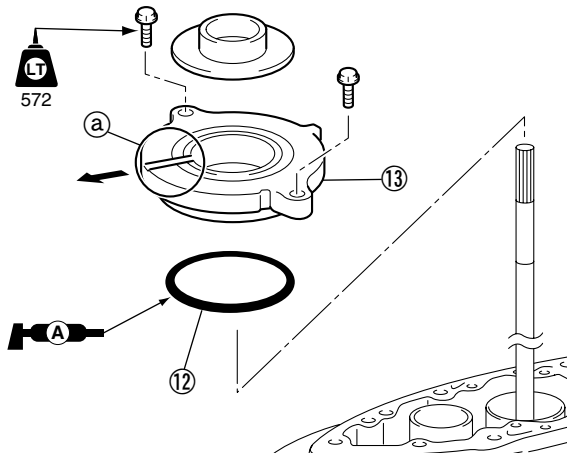
Ring nut wrench ⑪: 90890-06833

The reading (setting value) on the torque wrench used = 177 ÷ (A + 0.045) × A
- 177 N·m (17.7 kgf·m, 130.5 ft·lb): specified tightening torque for the ring nut
- 0.045 m: the ring nut wrench length
- A m: the torque wrench length

8

6. Install a new O-ring ⑫ to the oil seal housing ⑬.

7. Install the oil seal housing ⑬ with the cut-out ⓐ to face toward the bow as shown.



S6AW07057

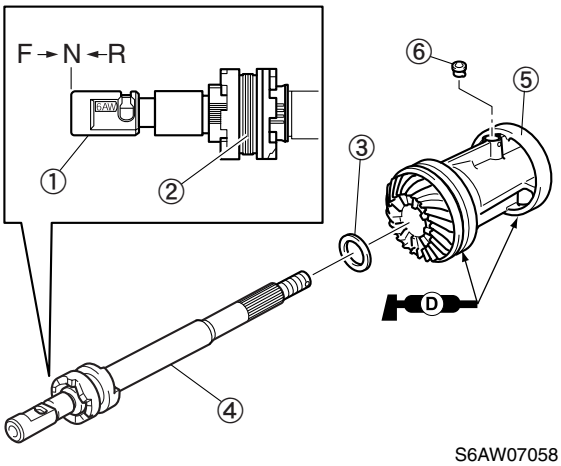
Installing the propeller shaft housing

1. Install the shift rod joint ① and dog clutch ② to the neutral position as shown.

2. Install the washer ③ and propeller shaft assembly ④ into the propeller shaft housing assembly ⑤.

3. Install the rubber seal ⑥.

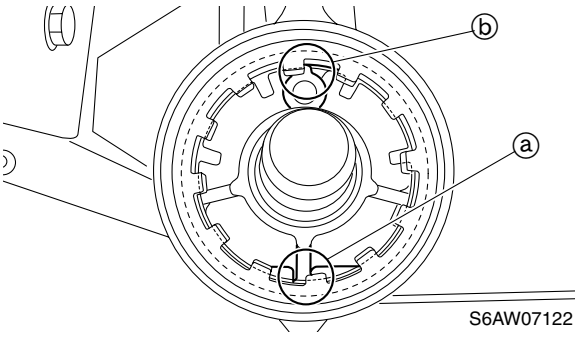
4. Apply grease to new O-ring and propeller shaft housing assembly ⑤.



S6AW07058

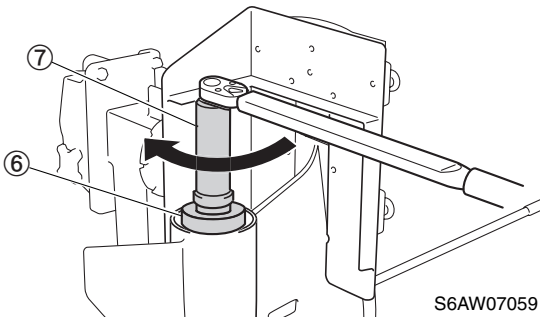
5. Install the shim(s) T2, the propeller shaft housing assembly, and the key to the lower case.
   See the exploded diagram (8-9).
   If you are not sure of the thickness of the assembled shim, combine the shims so the thickness becomes 0.92 mm.
   To select the shims, see “Shimming (regular rotation model)” (8-28).

6. Assemble the claw washer and the ring nut to the lower case. Check that the positions ⓐ and ⓑ are set in place properly.



S6AW07122

7. Tighten the ring nut to the specified torque.

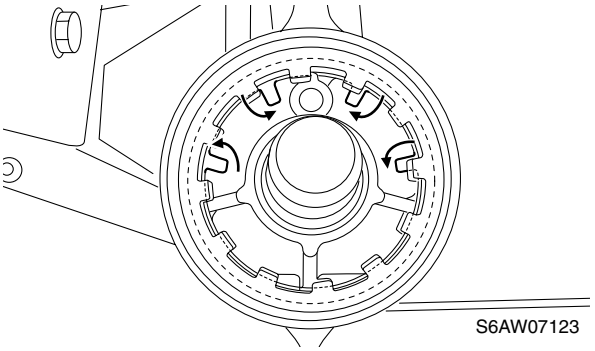


S6AW07059

	Ring nut wrench 2 ⑥: 90890-06823 Ring nut wrench extension 2 ⑦: 90890-06784

	Ring nut: 192 N·m (19.2 kgf·m, 141.6 ft·lb)

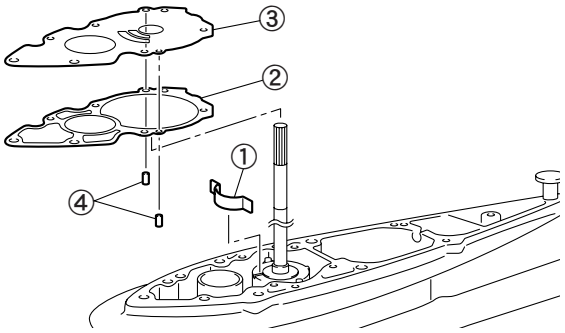
8. Bend one of the 4 teeth on the claw washer toward the propeller, and the other 3 toward the gear.


S6AW07123

9. Install the water pipe and rubber seals.

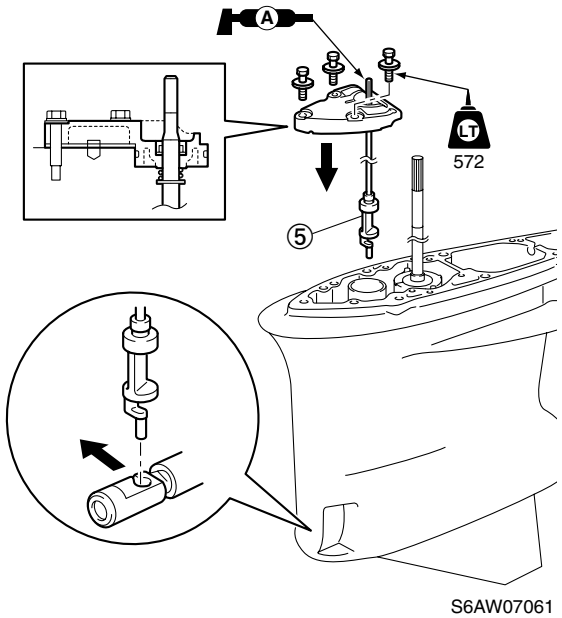
Installing the shift rod

1. Install the seal plate ①, a new gasket ②, outer plate cartridge ③ and dowels ④.



S6AW07060

2. Make sure that the gear shift is in the neutral position, and install the shift rod assembly ⑤.



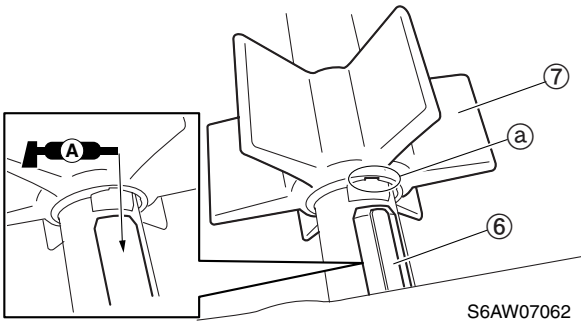
S6AW07061

3. Make sure that the drive shaft and the propeller shaft are moving properly when the gear is shifted into forward position and into reverse position.

Installing the water pump

1. Apply small amount of grease to the flat key ⑥, and affix it to the drive shaft.

2. Align the groove ⓐ on the impeller ⑦ and the projection of the flat key ⑥, and install the impeller ⑦ to the drive shaft.



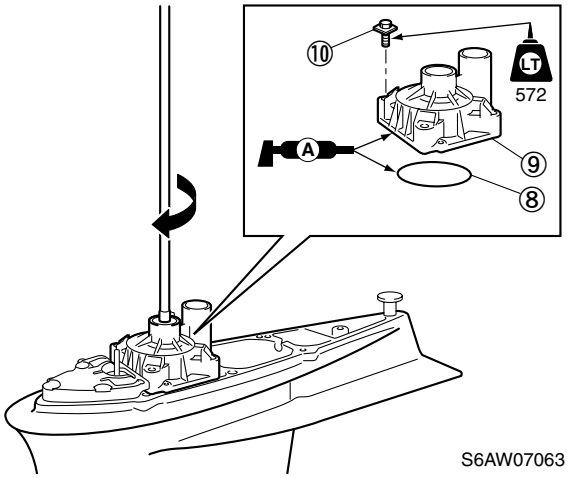
S6AW07062

3. When installing the pump housing and O-ring ⑧, apply grease to the inside of the insert cartridge, and then turn the drive shaft clockwise while pushing down the pump housing assembly ⑨.

CAUTION:

Do not turn the drive shaft counterclockwise, otherwise the water pump impeller may be damaged.

4. Install the bolts ⑩.



S6AW07063

8

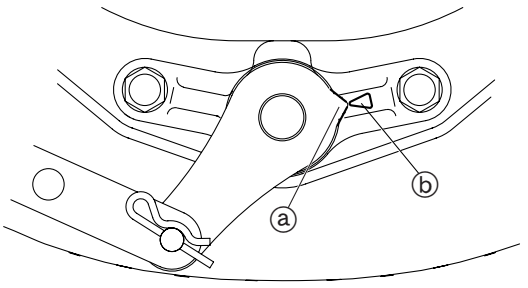
5. Apply 68.6 kPa (0.7 kgf/cm^2, 9.9 psi) of air to the lower unit and make sure that there is no leak.
   See “Checking the lower unit for air leakage” (10-24) for description.

Installing the lower unit

⚠ WARNING

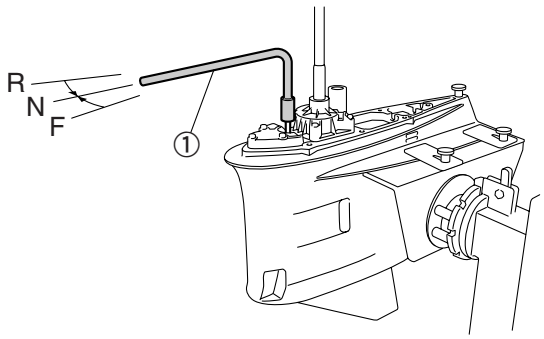
When installing the lower unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.

1. Align ⓐ of shift rod with the alignment mark ⓑ.



S6AW07066

2. Set the gear shift to the neutral position at the lower unit.



S6AW07067

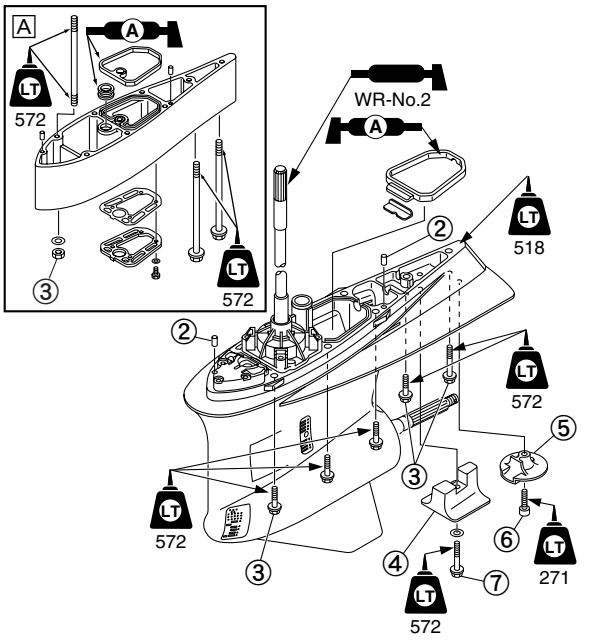
Shift rod push arm ①: 90890-06052

3. Install the dowels ② into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts (nuts) ③ to the specified torque.

5. Apply LOCTITE 518 to the mating surface of the lower unit.

6. Install the anode ④ and the cap ⑤, and tighten it to the specified torque.

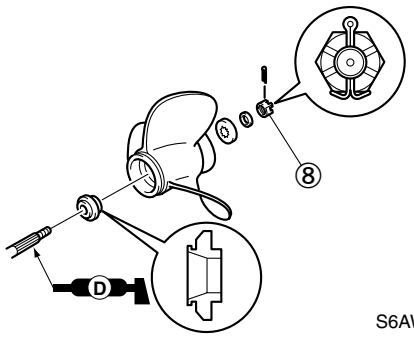


S6AW07069

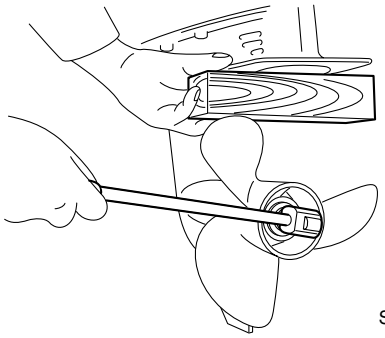
A U-transom model

Lower case mounting bolt (nut) ③:
47 N·m (4.7 kgf·m, 34.7 ft·lb)
Cap bolt ⑥:
42 N·m (4.2 kgf·m, 31.0 ft·lb)
Anode bolt ⑦:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

7. Install the propeller and propeller nut ⑧, and then tighten the nut temporarily. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



S6AW07070


S6AW07071

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery cables from the battery and the clip from the engine shut-off switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

NOTE:

If the grooves in the propeller nut ⑧ do not align with the cotter pin hole, tighten the nut until they are aligned.

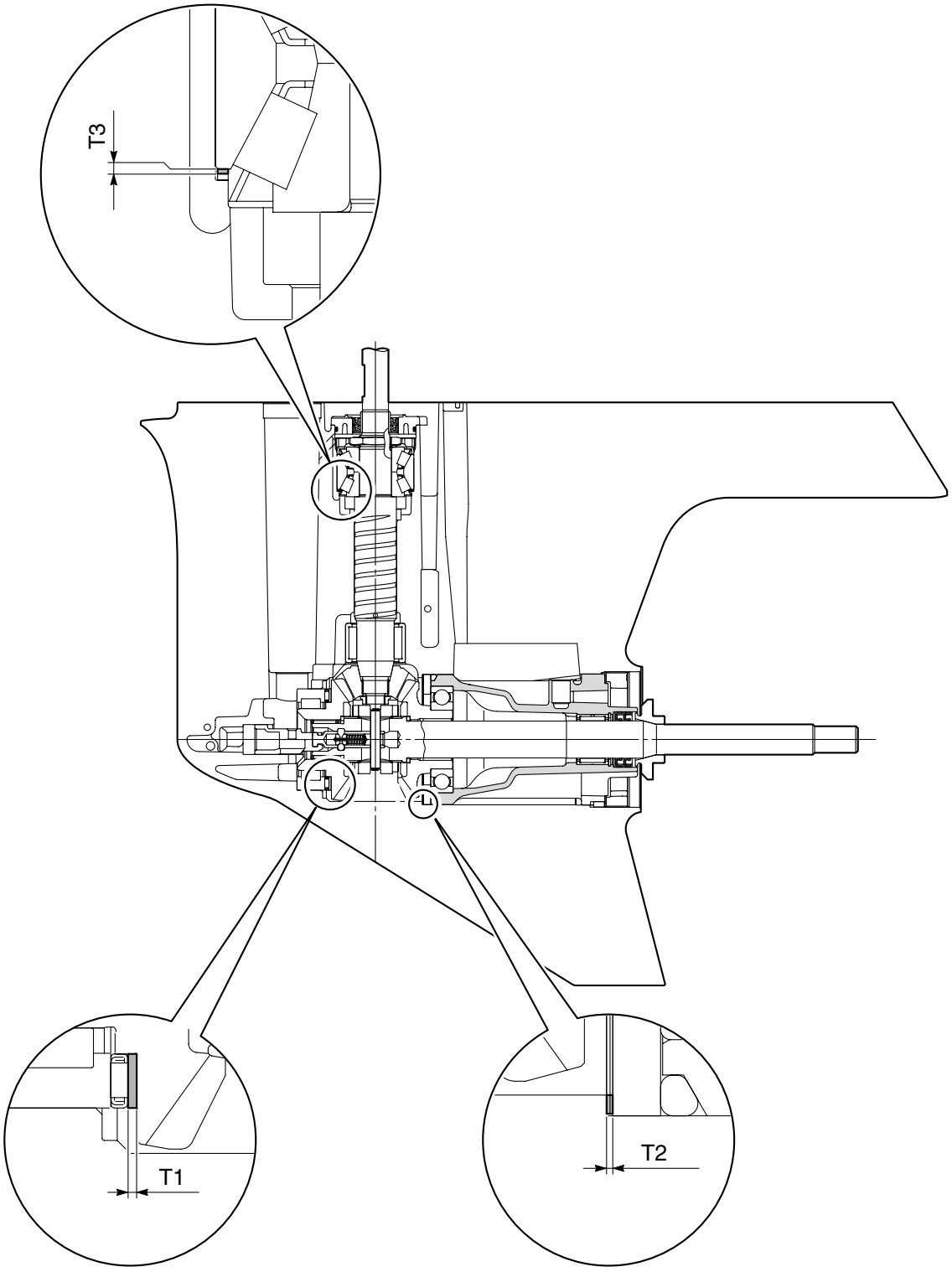
Propeller nut ⑧:
54 N·m (5.4 kgf·m, 39.8 ft·lb)

8. Fill the gear oil to the correct level.

Recommended gear oil:
Hypoid gear oil
API: GL-5
SAE: 90, 80W-90
Gear oil quantity:
Regular rotation model:
1,520 cm^3
(51.4 US oz, 53.5 Imp oz)

8

Shimming (regular rotation model)



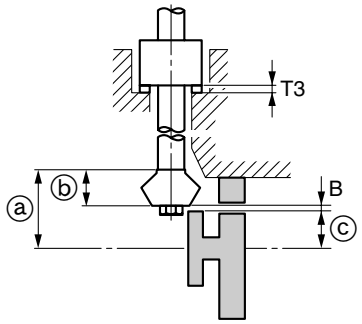
S6AW07072-1

Shimming

Shimming is not required when assembling the original lower case and inner parts.
Shimming is required when assembling the original inner parts and a new lower case.
Shimming is required when replacing the inner part(s).
Position of the pinion is the base for the selection of shim T1 and the shim T2, so always select the shim T3 before selecting the shim T1 and the shim T2.

Selecting the pinion shim T3

Install the shim T3 using the "compensation measurement of pinion MD" and the "tooth contact compensation."



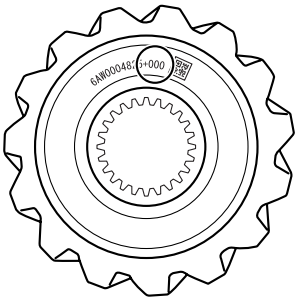
S6AW07111

ⓐ : MD (69 mm)
ⓑ : Pinion height (32 mm)
ⓒ : Special service tool measurement (36.5 mm)
Tooth contact compensation value "Z":
0.14 mm

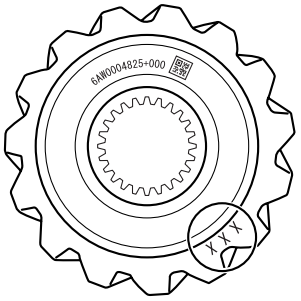
B = (MD) ⓐ + (MD compensation "measurement P") + (Tooth contact compensation "Z") – (Pinion height) ⓑ – (Pinion height compensation "measurement H") – (Special service tool measurement) ⓒ
= 69 + (MD compensation "measurement P") + 0.14 – 32 – (Pinion height compensation "measurement H") – 36.5
= 0.64 – (MD compensation "measurement P") – (Pinion height compensation "measurement H")

When the difference between the calculated value B and the measurement M is larger than ± 0.07 mm, adjust the difference by the shims.

1. Check the last 3 digits of the manufacturer's stamped mark at the left of the QR code on the pinion gear, and use the 1/1,000 of the value as the measurement P.


S6AW07089

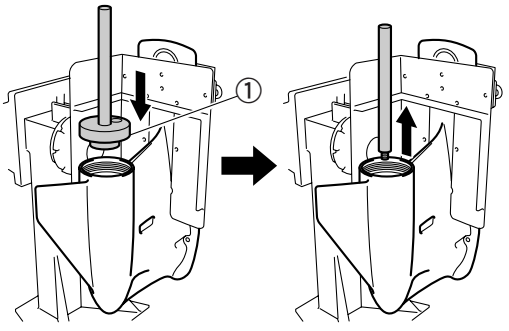
2. Check the hand written engraving on the pinion gear, and use the 1/1,000 of the value as the measurement H.


S6AW07090

3. Obtain the calculated value B based on P and H measurements on the pinion gear, see "Pinion 'Calculated value B' table" (8-34).

Example:
When measurement P is 0.00 mm and measurement H is 0.03 mm, the calculated value B is 0.61 mm.

4. Install the special service tool ① inside the lower case, and remove the rod.

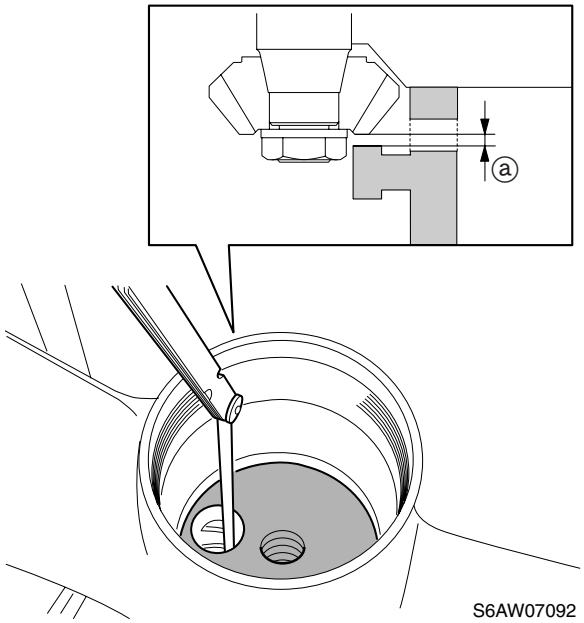


S6AW07091

8

Pinion shimming gauge ①:
90890-06835

5. Measure the gap between the special service tool and the pinion gear, and use the value as measurement M ⓐ.



6. Identify the need for increasing or decreasing the shim T3 thickness based on the calculated value B and the measurement M, and see “Pinion shim T3 increase or decrease table” (8-35). If the shim adjustment is required, check the “Pinion shim T3 increase or decrease table” (8-35) to obtain the appropriate thickness.

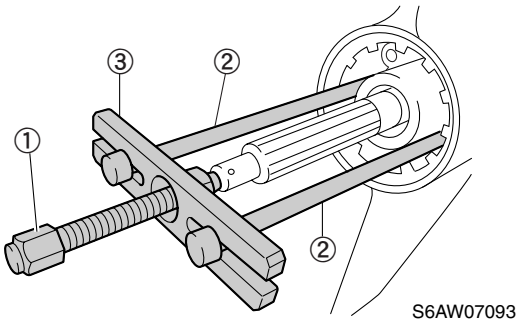
Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Use up to 3 shims listed above to make appropriate combination for the shim T3. If the pinion shim T3 comes in with 4 shims from the factory, use up to 4 shims to make appropriate combination.
Example:
When the measurement M is 0.46 mm and the calculated value B is 0.61 mm, the need for decreasing or increasing the shim is 0.15 mm. This means 0.15 mm thickness must be added to the present shim thickness.

Measuring the forward gear backlash and selecting the forward gear shim T1

1. Remove the water pump assembly if it is installed, and make sure that the gear position is in neutral.

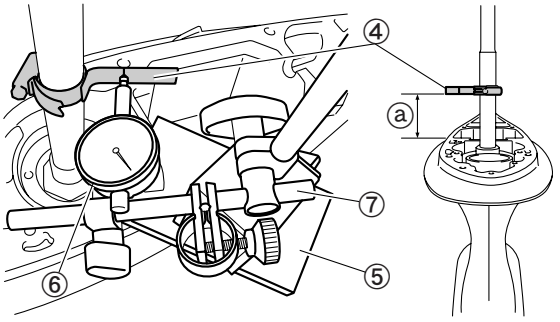
2. Install the special service tools and tighten the center bolt ① to the specified torque.



Center bolt ①: 90890-06504
Bearing housing puller claw L ②:
90890-06502
Stopper guide plate ③: 90890-06501

Center bolt ①:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

3. Install the backlash indicator ④ to the drive shaft, and then install the dial gauge to the lower unit.



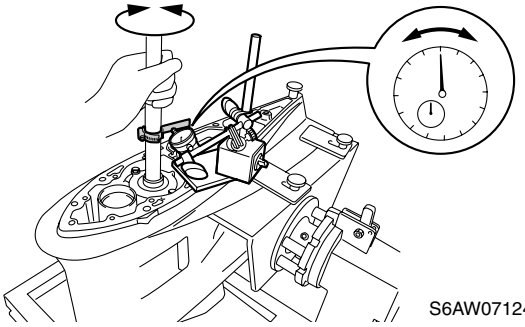
S6AW07095

NOTE:
Install the dial gauge so that the plunger contacts the mark on the backlash indicator.

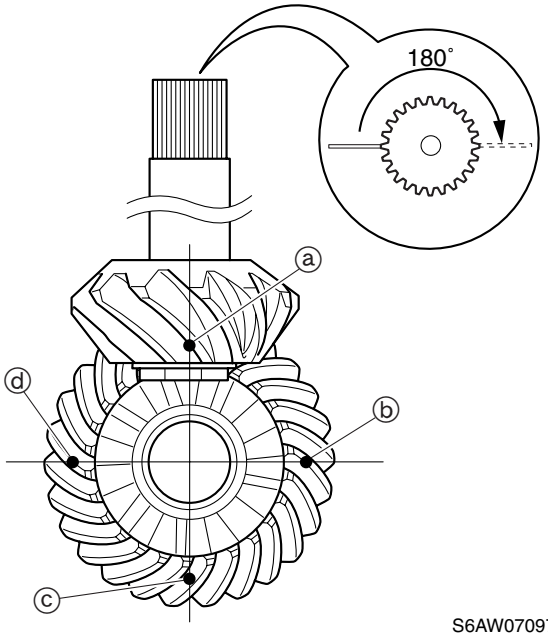
Backlash indicator ④: 90890-06836
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

Backlash indicator mounting height ⓐ: 90 mm (3.54 in)

4. Rotate the drive shaft slowly to clockwise and counterclockwise. Measure the backlash at the position it stops rotating for each direction.


S6AW07124

5. Measure the backlash 4 times by rotating the drive shaft by 180° each time, measuring at the points ⓐ, ⓑ, ⓒ, and ⓓ. Loosen the center bolt ① of the special service tool before rotating the drive shaft, and then rotate the drive shaft by 180°, and tighten it again to the specified torque. Make sure the drive shaft does not rotate at that time.



S6AW07097

Center bolt ①:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

6. Calculate the average of the 4 measurements values, and use that value as BL1. Shim adjustment is not necessary if the BL1 is within the range of the recommended backlash value.

Recommended backlash:
0.20–0.63 mm (0.0079–0.0248 in)

7. Shim adjustment is necessary if it is out of recommended backlash. Increase or decrease the shim T1 according to the relevant value in the “Forward gear shim T1 increase or decrease chart” (8-42).
Adjust the shim so it will be at the recommended medium value when the backlash measurement BL1 is out of the recommended backlash value.

Available shim thicknesses:
2.00, 2.03, 2.06, 2.09, 2.12, and 2.15 mm

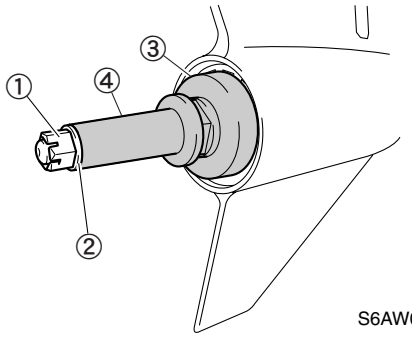
Use only single shim for the shim T1.
Example:
When the backlash measurement BL1 is 0.70 mm, the need for decreasing or increasing the shim is approximately 0.28 mm. This means to obtain a value by adding 0.28 mm to the present shim thickness, and select the shim having the thickness nearest to the obtained value.

8. Check the backlash again when the shim is increased or decreased.

Measuring the reverse gear backlash and selecting the reverse gear shim T2

1. Remove the water pump assembly if it is installed, and make sure that the gear position is in neutral.

2. Install the special service tools ③, ④, washer ②, and tighten the propeller nut ① to the specified torque.

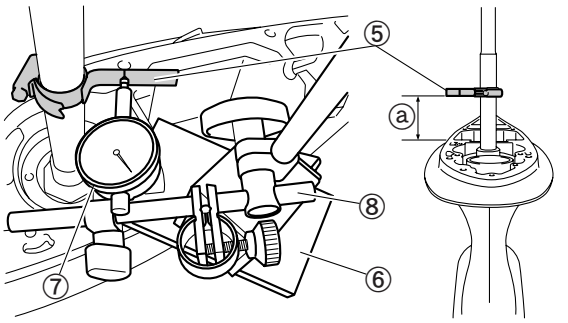


S6AW07098

Ring nut wrench 2 ③: 90890-06823
Ring nut extension ④: 90890-06666

Propeller nut ①:
15 N·m (1.5 kgf·m, 11.1 ft·lb)

3. Install the backlash indicator ⑤ to the drive shaft, and then install the dial gauge to the lower unit.



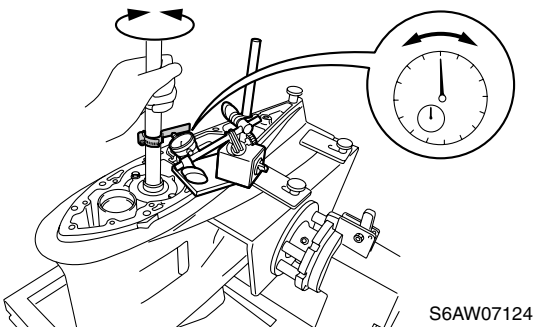
S6AW07095-2

NOTE:
Install the dial gauge so that the plunger contacts the mark on the backlash indicator.

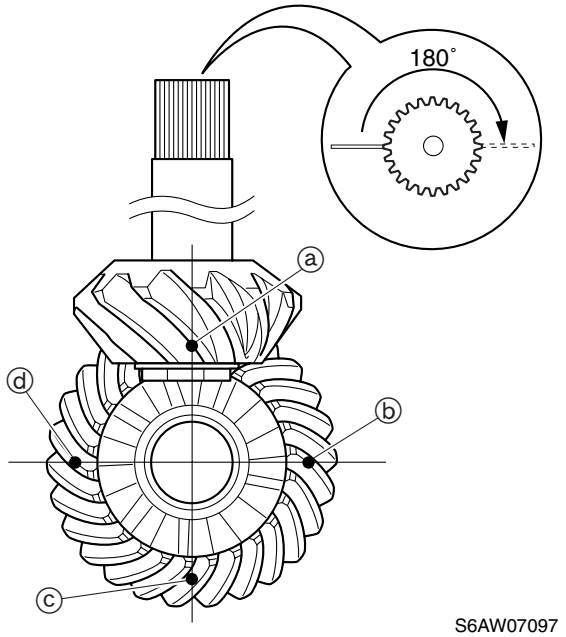
Backlash indicator ⑤: 90890-06836
Magnet base plate ⑥: 90890-07003
Dial gauge set ⑦: 90890-01252
Magnet base B ⑧: 90890-06844

Backlash indicator mounting height ⓐ: 90 mm (3.54 in)

4. Rotate the drive shaft slowly to clockwise and counterclockwise. Measure the backlash at the position it stops rotating for each direction.


S6AW07124

5. Measure the backlash 4 times by rotating the drive shaft by 180° each time, measuring at the points ⓐ, ⓑ, ⓒ, and ⓓ. Loosen the propeller nut ① of the special service tool before rotating the drive shaft, and then rotate the drive shaft by 180°, and tighten it again to the specified torque. Make sure the drive shaft does not rotate at that time.



S6AW07097

Propeller nut ①:
15 N·m (1.5 kgf·m, 11.1 ft·lb)

6. Calculate the average of the 4 measurements values, and use that value as BL2. Shim adjustment is not necessary if the BL2 is within the range of the recommended backlash value.

Recommended backlash:
0.42–1.01 mm (0.0165–0.0398 in)

7. Shim adjustment is necessary if it is out of recommended backlash. Increase or decrease the shim T2 according to the relevant value in the “Reverse gear shim T2 increase or decrease chart” (8-44).
Adjust the shim so it will be at the recommended medium value when the backlash measurement BL2 is out of the recommended backlash value.

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Use up to 3 shims listed above to make appropriate combination for the shim T2.
Example:
When the backlash measurement BL2 is 1.05 mm, the need for decreasing or increasing the shim is approximately –0.33 mm. This means 0.33 mm thickness must be subtracted from the present shim thickness.

8. Check the backlash again when the shim is increased or decreased.

8

Shim selection table (regular rotation model)

Pinion 'Calculated value B' table

(mm)

Pinion height compensation measurement: H \ Pinion MD compensation measurement: P	-0.11	-0.10	-0.09	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0.00
0.00	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64
0.01	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63
0.02	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62
0.03	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61
0.04	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60
0.05	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59
0.06	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58

Pinion height compensation measurement: H \ Pinion MD compensation measurement: P	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11
0.00	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.74	0.75
0.01	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.74
0.02	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73
0.03	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72
0.04	0.61	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71
0.05	0.60	0.61	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70
0.06	0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69

Pinion shim T3 increase or decrease table

* Shim adjustment is not necessary where is no number.

(mm)

Calculated value: B	Measurement: M												
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
0.47	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35
0.48	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38
0.49	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38
0.50	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38
0.51	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40
0.52	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40
0.53	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42
0.54	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42
0.55	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45
0.56	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45
0.57	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45
0.58	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48
0.59	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48
0.60	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48
0.61	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50
0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50
0.63	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52
0.64	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52
0.65	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55
0.66	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55
0.67	0.68	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55
0.68	0.68	0.68	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58
0.69	0.70	0.68	0.68	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58
0.70	0.70	0.70	0.68	0.68	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58
0.71	0.72	0.70	0.70	0.68	0.68	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60
0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.68	0.65	0.65	0.65	0.62	0.62	0.60
0.73	0.75	0.72	0.72	0.70	0.70	0.68	0.68	0.68	0.65	0.65	0.65	0.62	0.62
0.74	0.75	0.75	0.72	0.72	0.70	0.70	0.68	0.68	0.68	0.65	0.65	0.65	0.62
0.75	0.75	0.75	0.75	0.72	0.72	0.70	0.70	0.68	0.68	0.68	0.65	0.65	0.65

(mm)

Calculated value: B \ Measurement: M	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25
0.47	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22
0.48	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25
0.49	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25
0.50	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25
0.51	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28
0.52	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28
0.53	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28
0.54	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30
0.55	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30
0.56	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32
0.57	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32
0.58	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35
0.59	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35
0.60	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35
0.61	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38
0.62	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38
0.63	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38
0.64	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40
0.65	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40
0.66	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42
0.67	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42
0.68	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45
0.69	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45
0.70	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45
0.71	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48
0.72	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48
0.73	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48
0.74	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50
0.75	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50

(mm)

Calculated value: B \ Measurement: M	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38
0.47	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10
0.48	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10
0.49	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12
0.50	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12
0.51	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15
0.52	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15
0.53	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15
0.54	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18
0.55	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18
0.56	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18
0.57	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20
0.58	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20
0.59	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22
0.60	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22
0.61	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25
0.62	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25
0.63	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25
0.64	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28
0.65	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28
0.66	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28
0.67	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30
0.68	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30
0.69	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32
0.70	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32
0.71	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35
0.72	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35
0.73	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35
0.74	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38
0.75	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38

(mm)

Calculated value: B \ Measurement: M	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51
0.47	0.10	0.10	*	*	*	*	*	*	*	*	*	*	*
0.48	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*	*
0.49	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*
0.50	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*
0.51	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*
0.52	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*
0.53	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*
0.54	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*
0.55	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*
0.56	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*
0.57	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*
0.58	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10
0.59	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10
0.60	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10
0.61	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10
0.62	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12
0.63	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12
0.64	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15
0.65	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15
0.66	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15
0.67	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18
0.68	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18
0.69	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18
0.70	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20
0.71	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20
0.72	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22
0.73	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22
0.74	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25
0.75	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25

(mm)

Calculated value: B \ Measurement: M	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64
0.47	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18
0.48	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18
0.49	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15
0.50	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15
0.51	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15
0.52	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12
0.53	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12
0.54	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10
0.55	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10
0.56	*	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10
0.57	*	*	*	*	*	*	*	*	*	*	*	*	-0.10
0.58	*	*	*	*	*	*	*	*	*	*	*	*	*
0.59	0.10	*	*	*	*	*	*	*	*	*	*	*	*
0.60	0.10	0.10	*	*	*	*	*	*	*	*	*	*	*
0.61	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*	*
0.62	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*
0.63	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*
0.64	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*
0.65	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*
0.66	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*
0.67	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*
0.68	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*
0.69	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*
0.70	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*
0.71	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10
0.72	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10
0.73	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10
0.74	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10
0.75	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12

(mm)

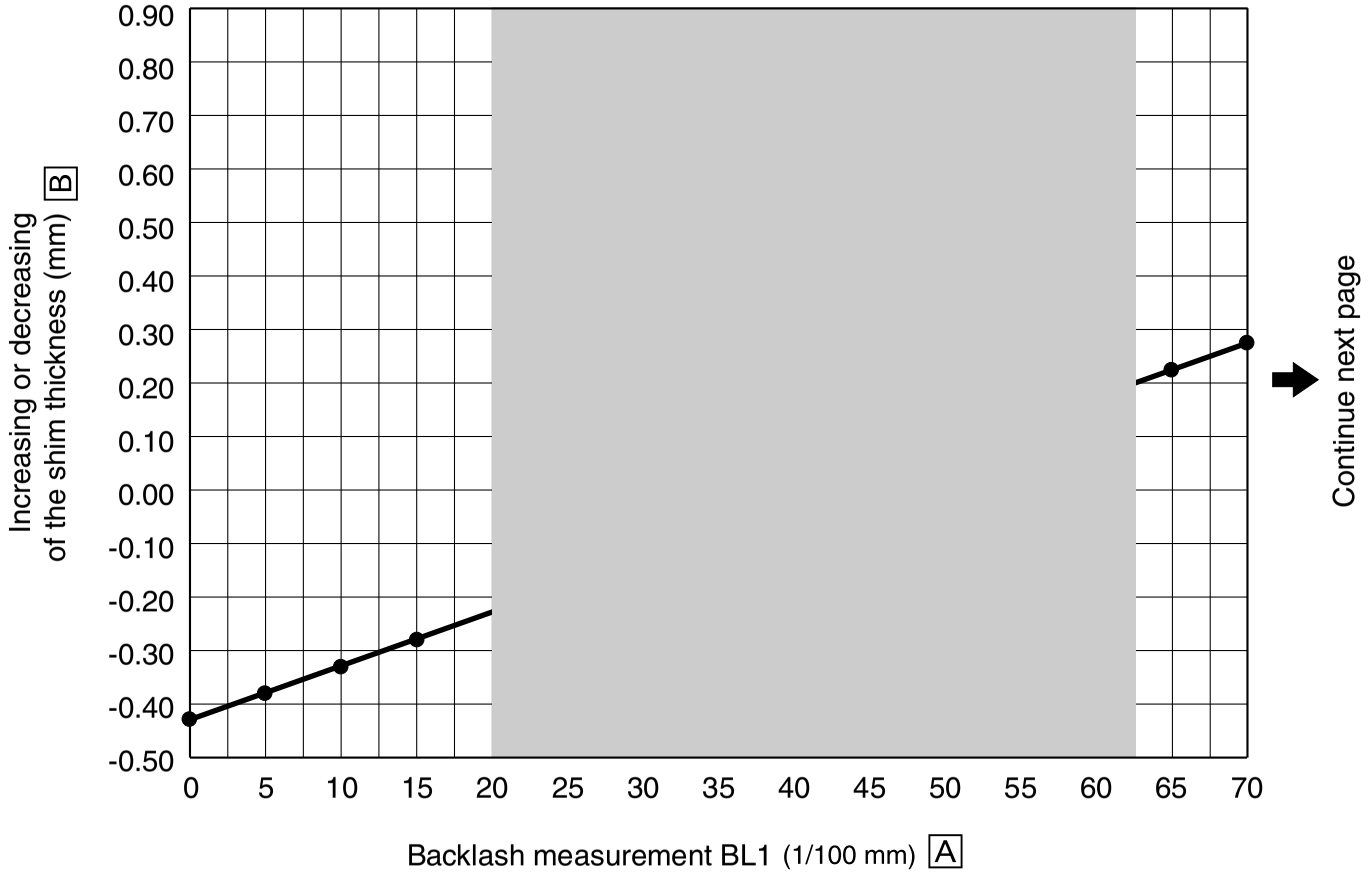
Calculated value: B \ Measurement: M	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.74	0.75	0.76	0.77
0.47	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30
0.48	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30
0.49	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28
0.50	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28
0.51	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28
0.52	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25
0.53	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25
0.54	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25
0.55	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22
0.56	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22
0.57	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20
0.58	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20
0.59	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18
0.60	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18
0.61	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18
0.62	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15
0.63	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15
0.64	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15
0.65	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12
0.66	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12
0.67	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10
0.68	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10
0.69	*	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10
0.70	*	*	*	*	*	*	*	*	*	*	*	*	-0.10
0.71	*	*	*	*	*	*	*	*	*	*	*	*	*
0.72	0.10	*	*	*	*	*	*	*	*	*	*	*	*
0.73	0.10	0.10	*	*	*	*	*	*	*	*	*	*	*
0.74	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*	*
0.75	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*

(mm)

Calculated value: B \ Measurement: M	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.84	0.85
0.47	-0.32	-0.32	-0.35	-0.35	-0.35	-0.38	-0.38	-0.38	-0.38	-0.38
0.48	-0.30	-0.32	-0.32	-0.35	-0.35	-0.35	-0.38	-0.38	-0.38	-0.38
0.49	-0.29	-0.30	-0.31	-0.32	-0.33	-0.34	-0.35	-0.36	-0.35	-0.36
0.50	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35	-0.35	-0.35	-0.35	-0.35
0.51	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35	-0.35	-0.35	-0.35
0.52	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35	-0.32	-0.35
0.53	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.32	-0.32
0.54	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.30	-0.32
0.55	-0.25	-0.25	-0.25	-0.26	-0.27	-0.28	-0.29	-0.30	-0.29	-0.30
0.56	-0.22	-0.25	-0.25	-0.25	-0.26	-0.28	-0.28	-0.30	-0.28	-0.30
0.57	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.28	-0.28
0.58	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.26	-0.28	-0.26	-0.28
0.59	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.25	-0.28
0.60	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.25	-0.25
0.61	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.25
0.62	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.22	-0.25
0.63	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.22	-0.22
0.64	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.20	-0.22
0.65	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.20	-0.20
0.66	-0.12	-0.15	-0.15	-0.15	-0.16	-0.18	-0.18	-0.20	-0.18	-0.20
0.67	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.18	-0.18
0.68	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.18
0.69	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.15	-0.18
0.70	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.15	-0.15
0.71	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.15
0.72	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.12	-0.15
0.73	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.12	-0.12
0.74	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.10	-0.12
0.75	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10

Forward gear shim T1 increase or decrease chart

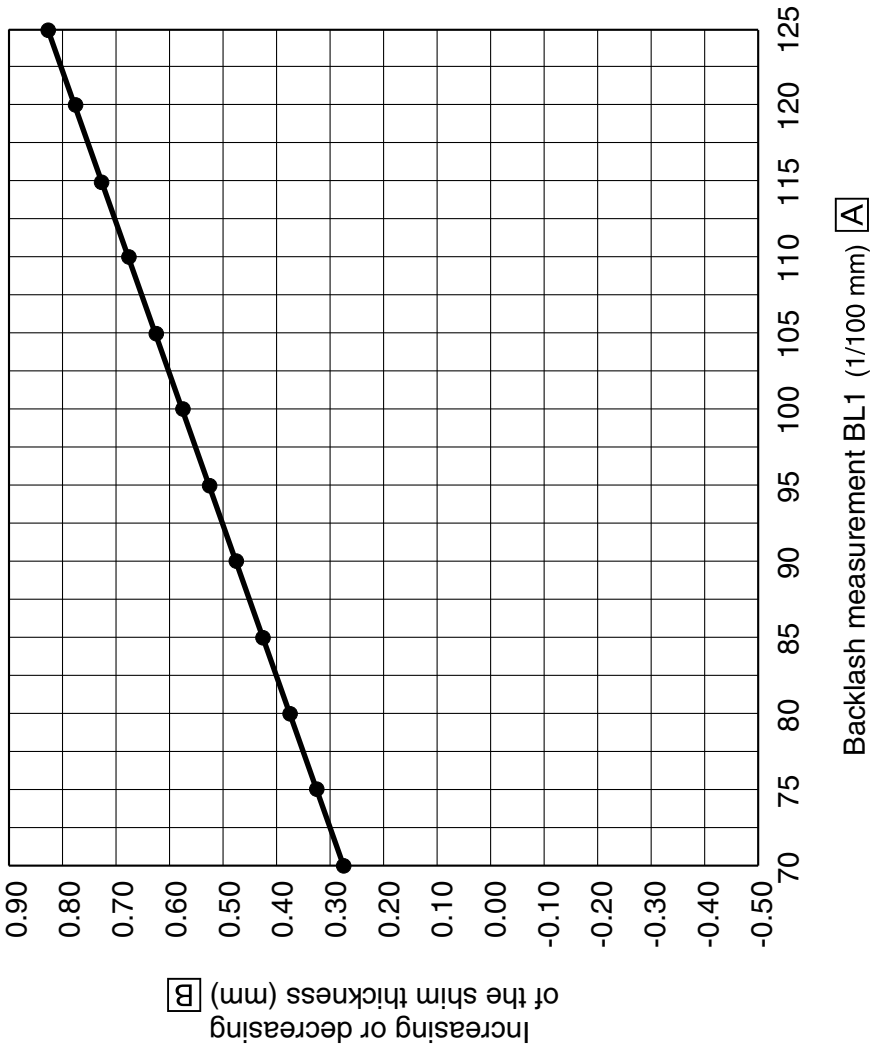
- The gray zone on the selection chart represents the specified range of the backlash. No shim adjustment is required if the measured backlash falls within the gray zone.
- In the “increasing or decreasing of the shim thickness B” column a positive number means to increase the shim, and negative number means to decrease the shim.



A (1/100 mm)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70
B (mm)	-0.42	-0.37	-0.32	-0.27										0.23	0.28

S6BJ08005

S6BJ08006

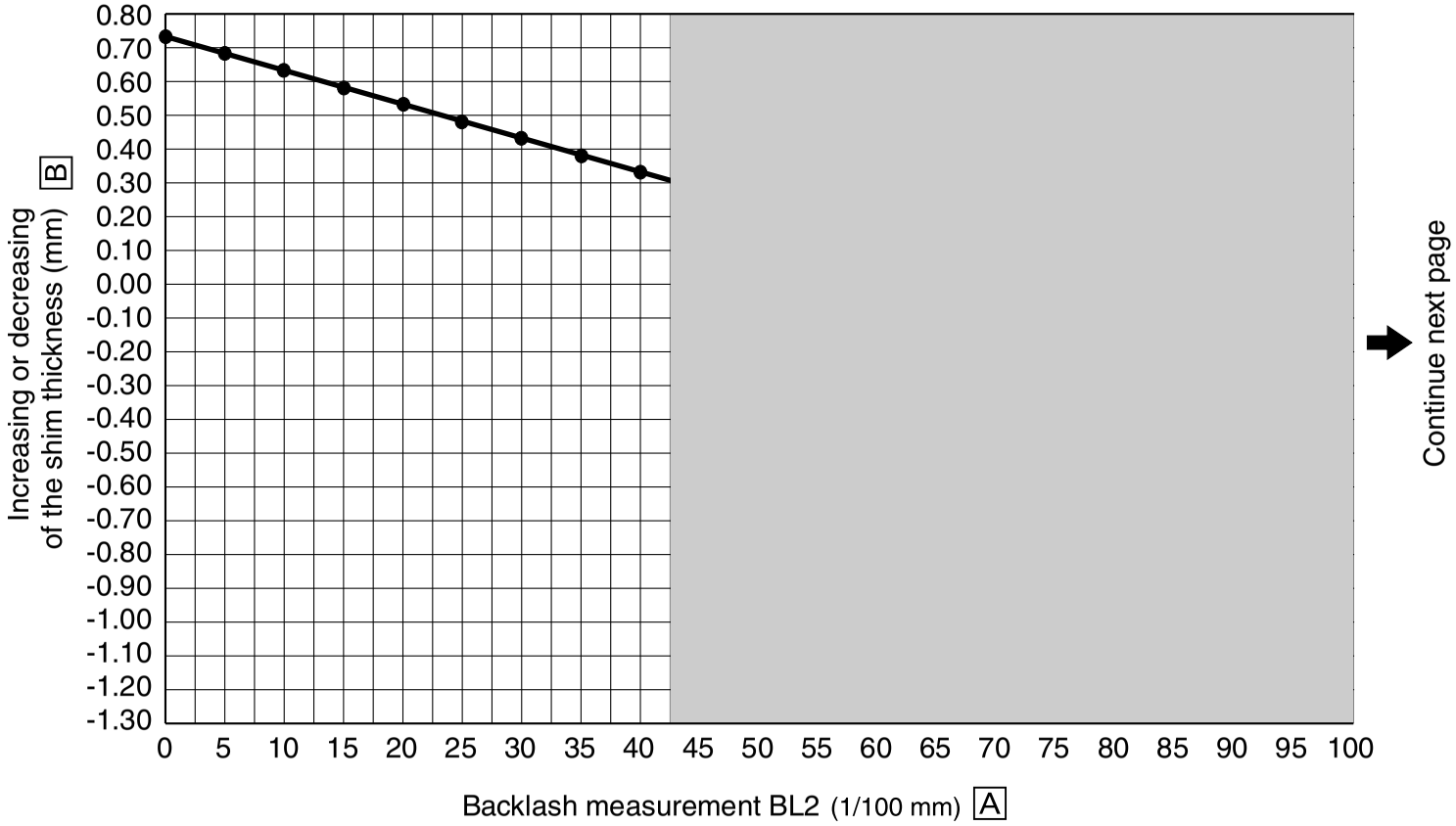


A (1/100 mm)	70	75	80	85	90	95	100	105	110	115	120	125
B (mm)	0.28	0.33	0.38	0.43	0.48	0.53	0.58	0.63	0.68	0.73	0.78	0.83

8

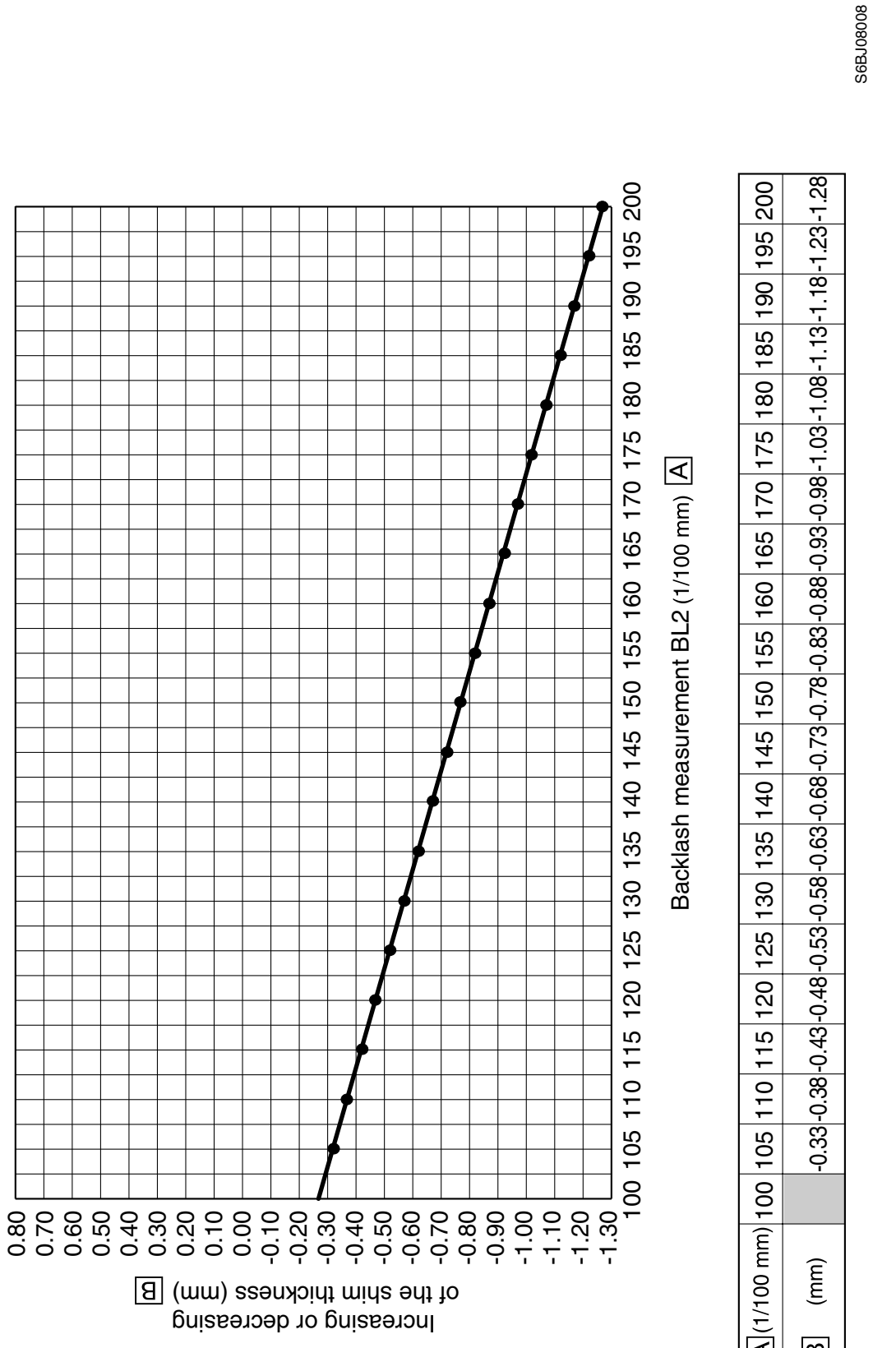
Reverse gear shim T2 increase or decrease chart

- The gray zone on the selection chart represents the specified range of the backlash. No shim adjustment is required if the measured backlash falls within the gray zone.
- In the “increasing or decreasing of the shim thickness B” column a positive number means to increase the shim, and negative number means to decrease the shim.



A (1/100 mm)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
B (mm)	0.72	0.67	0.62	0.57	0.52	0.47	0.42	0.37	0.32												

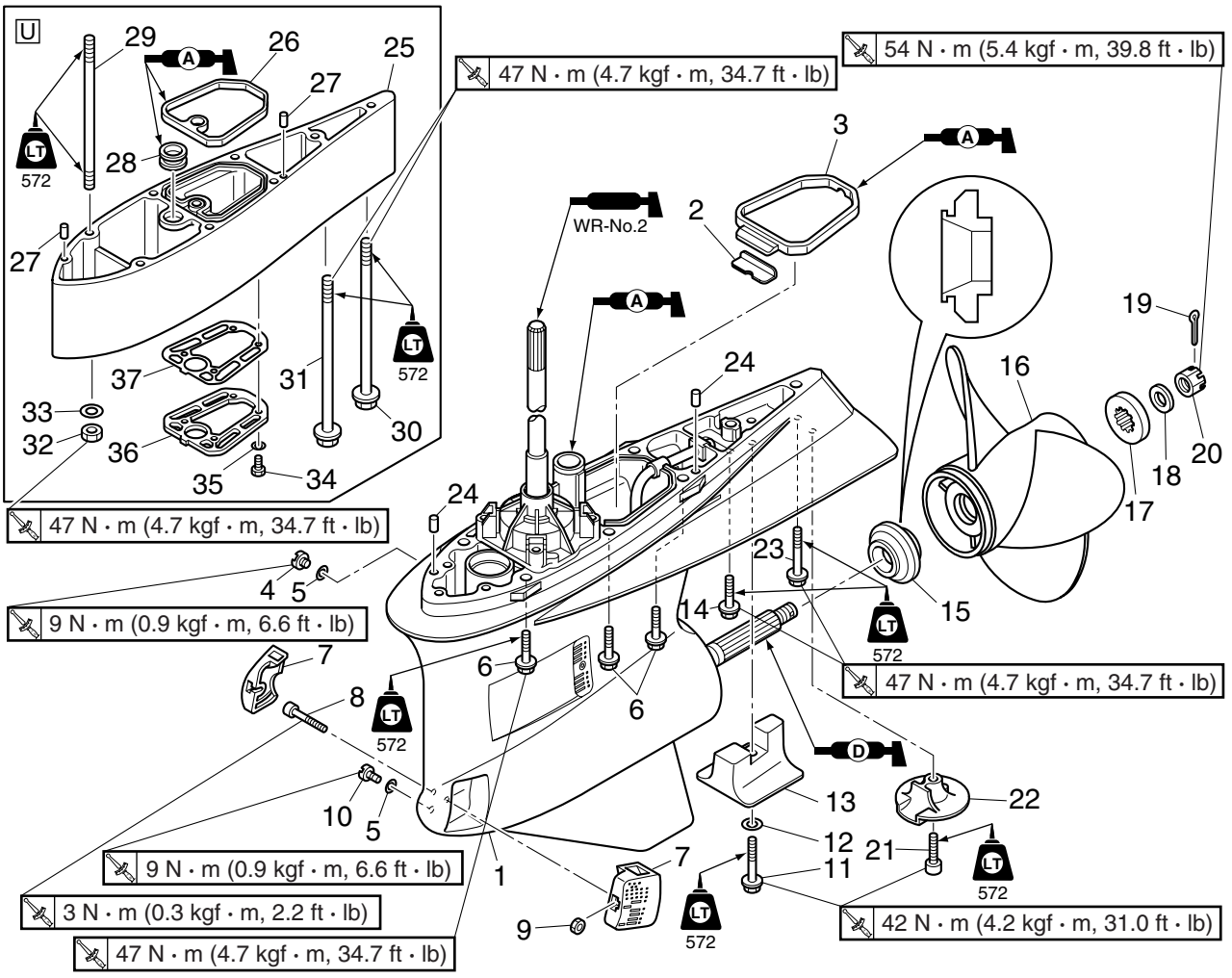
S6BJ08007



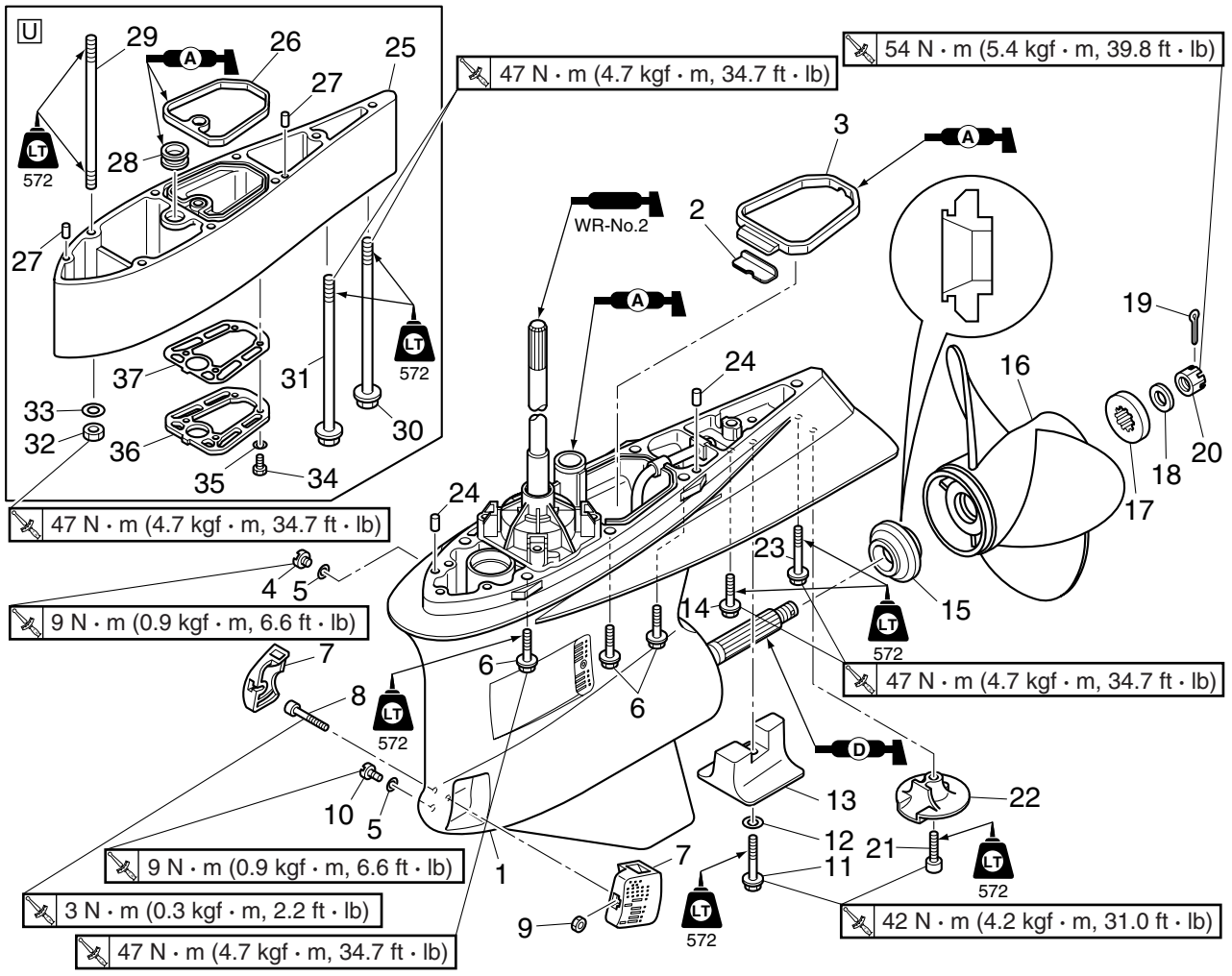
A (1/100 mm)	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
B (mm)		-0.33	-0.38	-0.43	-0.48	-0.53	-0.58	-0.63	-0.68	-0.73	-0.78	-0.83	-0.88	-0.93	-0.98	-1.03	-1.08	-1.13	-1.18	-1.23	-1.28

8

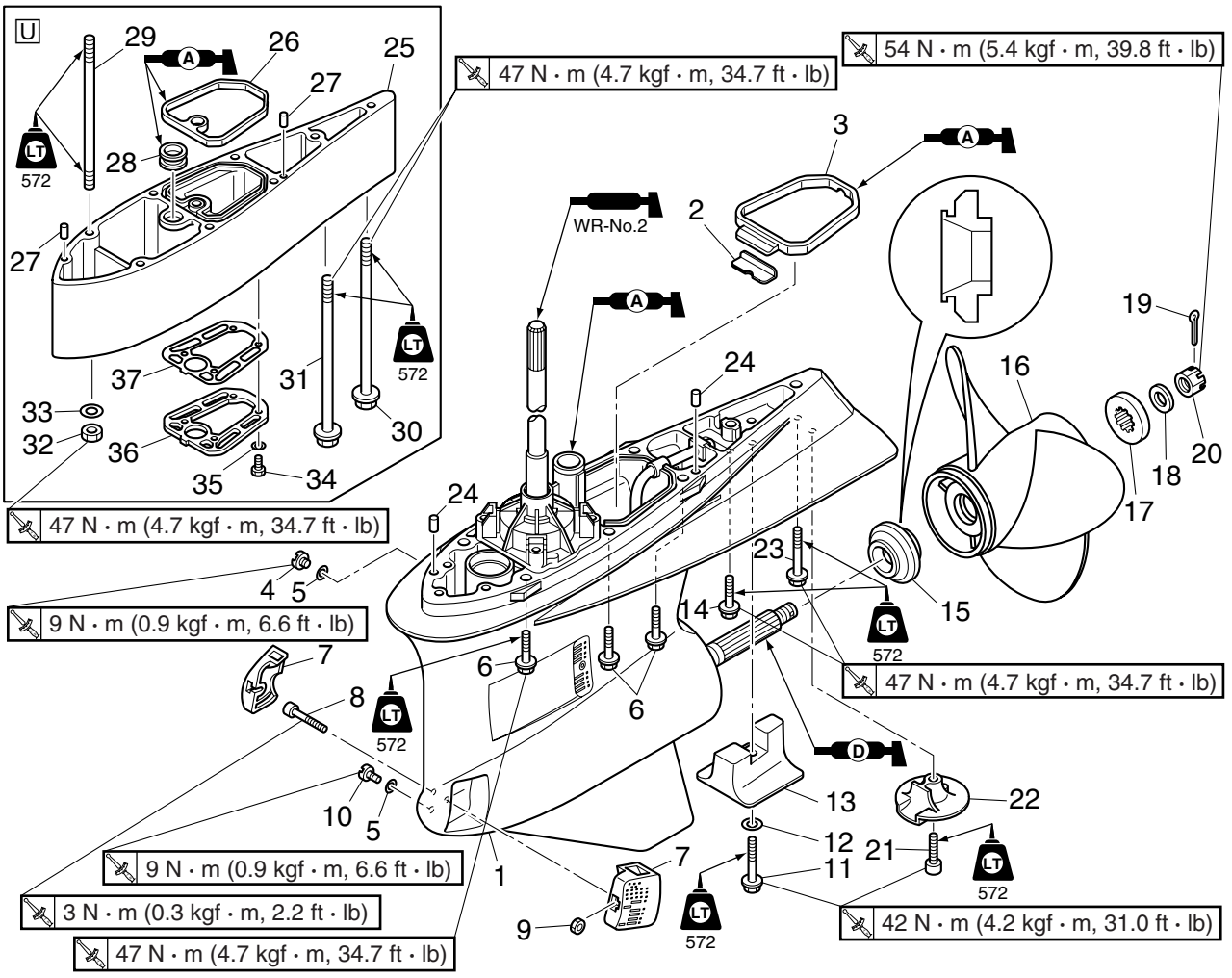
Lower unit (counter rotation model)



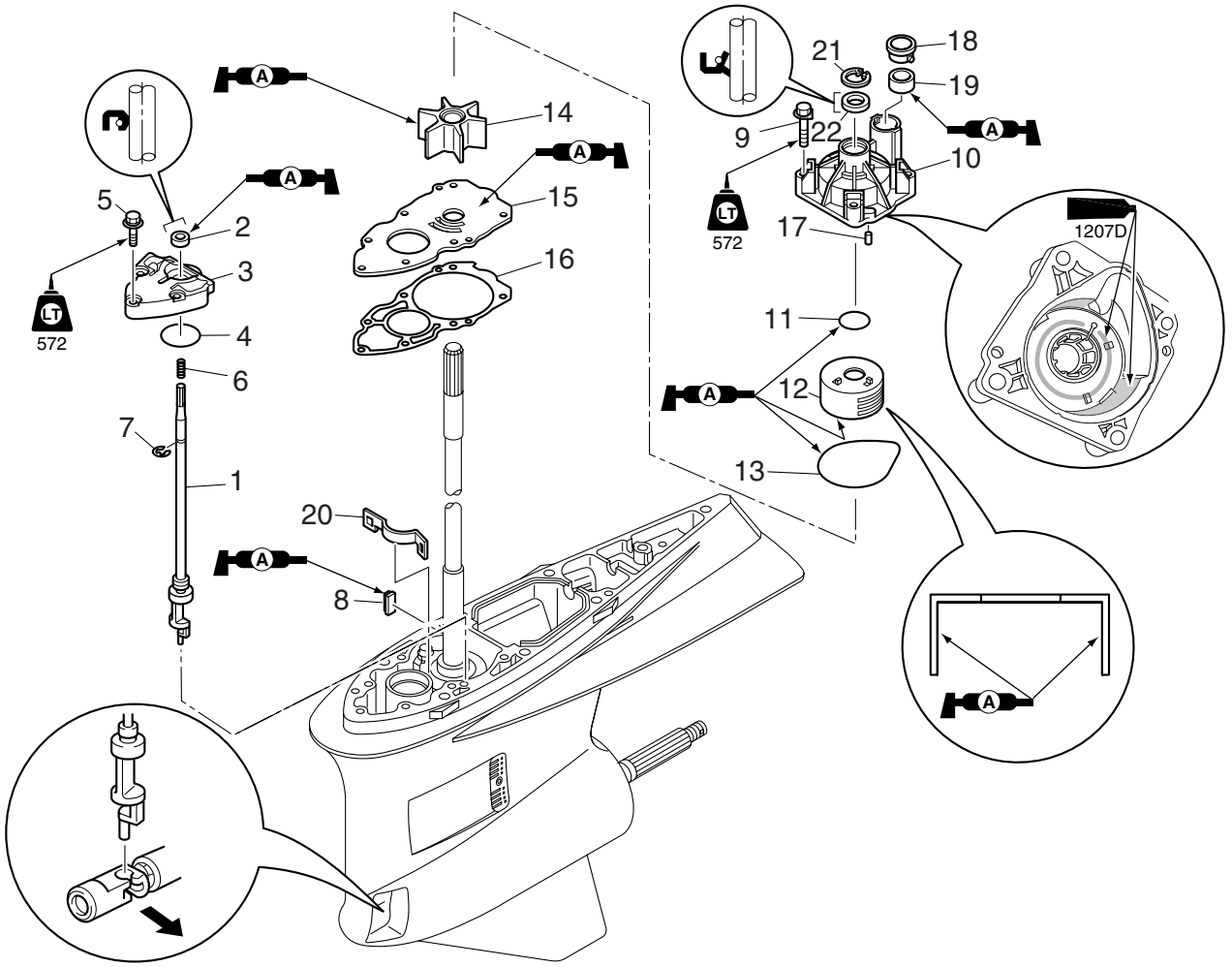
No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	**Not reusable**
6	Bolt	6	M10 × 45 mm
7	Water inlet cover	2	
8	Bolt	1	M5 × 42 mm
9	Self-locking nut	1	
10	Drain screw	1	
11	Bolt	1	M10 × 60 mm
12	Washer	1	
13	Anode	1	
14	Bolt	1	M10 × 45 mm/X-transom model
15	Spacer	1	
16	Propeller	1	
17	Spacer	1	



No.	Part name	Q'ty	Remarks
18	Washer	1	
19	Cotter pin	1	**Not reusable**
20	Propeller nut	1	
21	Bolt	1	M10 × 35 mm
22	Cap	1	
23	Bolt	1	M10 × 70 mm/X-transom model
24	Dowel	2	
25	Extension	1	U-transom model
26	Rubber seal	1	U-transom model
27	Dowel	2	U-transom model
28	Rubber seal	1	U-transom model
29	Stud bolt	6	U-transom model
30	Bolt	1	M10 × 200 mm/U-transom model
31	Bolt	1	M10 × 174 mm/U-transom model
32	Nut	6	U-transom model
33	Washer	6	U-transom model
34	Bolt	4	M6 × 20 mm

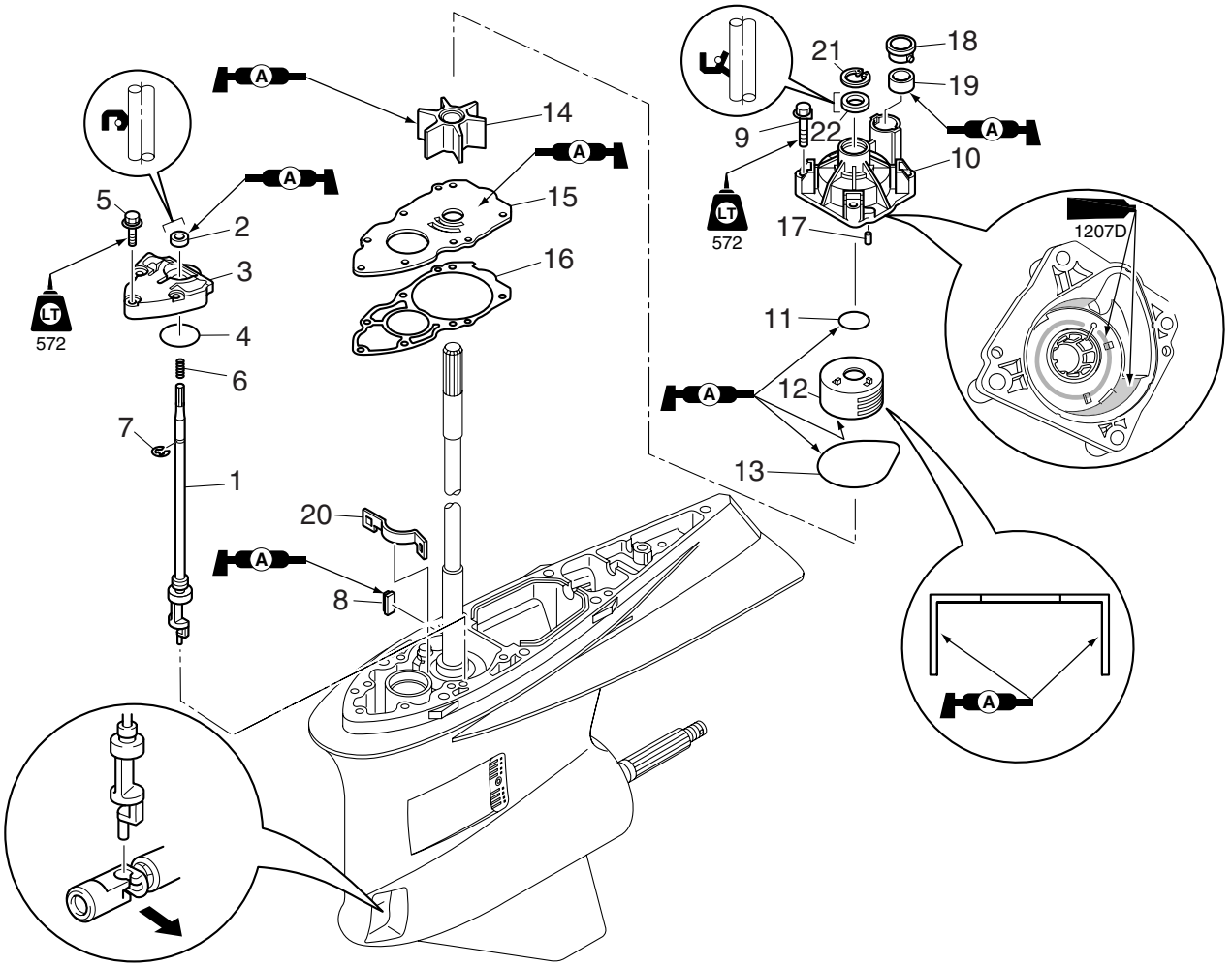


No.	Part name	Q'ty	Remarks
35	Washer	4	U-transom model
36	Cover	1	U-transom model
37	Gasket	1	U-transom model **Not reusable**



S6BJ08013

No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	**Not reusable**
3	Oil seal housing	1	
4	O-ring	1	**Not reusable**
5	Bolt	3	M8 × 35 mm
6	Spring	1	
7	E-clip	1	
8	Flat key	1	
9	Bolt	4	M8 × 45 mm
10	Water pump housing	1	
11	O-ring	1	**Not reusable**
12	Insert cartridge	1	
13	O-ring	1	**Not reusable**
14	Impeller	1	
15	Outer plate cartridge	1	
16	Gasket	1	**Not reusable**
17	Dowel	2	



S6BJ08013

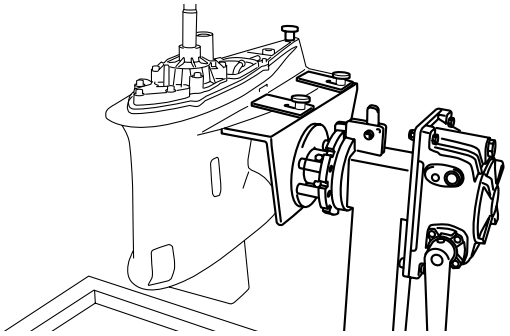
No.	Part name	Q'ty	Remarks
18	Cover	1	
19	Seal	1	**Not reusable**
20	Seal plate	1	
21	Circlip	1	
22	Oil seal	1	**Not reusable**

Removing the lower unit

See “Removing the lower unit” (8-6) of the lower unit (regular rotation model) for the procedure to remove the lower unit.

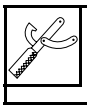
Removing the water pump and shift rod

1. Install the lower unit on the work table.

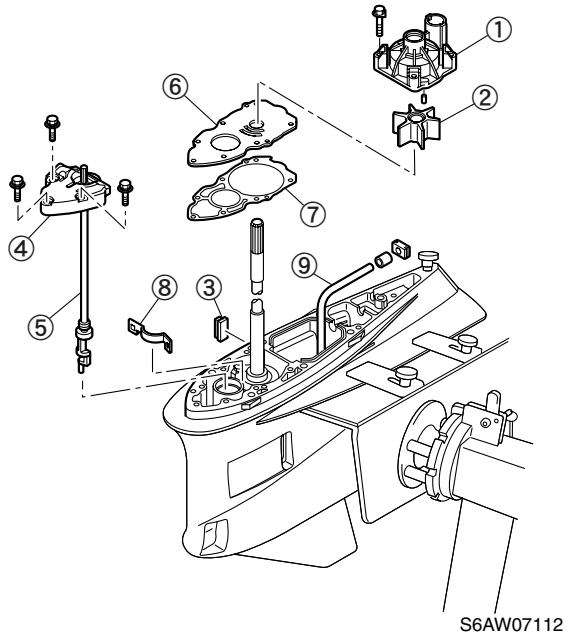

S6AW07116

2. Remove the water pump housing ①, impeller ②, and flat key ③.

3. Remove the oil seal housing ④ and the shift rod assembly ⑤ after setting it in the neutral position using the shift rod push arm.


Shift rod push arm: 90890-06052

4. Remove the outer plate cartridge ⑥, gasket ⑦, seal plate ⑧ and water pipe ⑨.



S6AW07112

Disassembling the water pump housing

See “Disassembling the water pump housing” (8-7) of the lower unit (regular rotation model) for the procedure to disassemble the water pump housing.

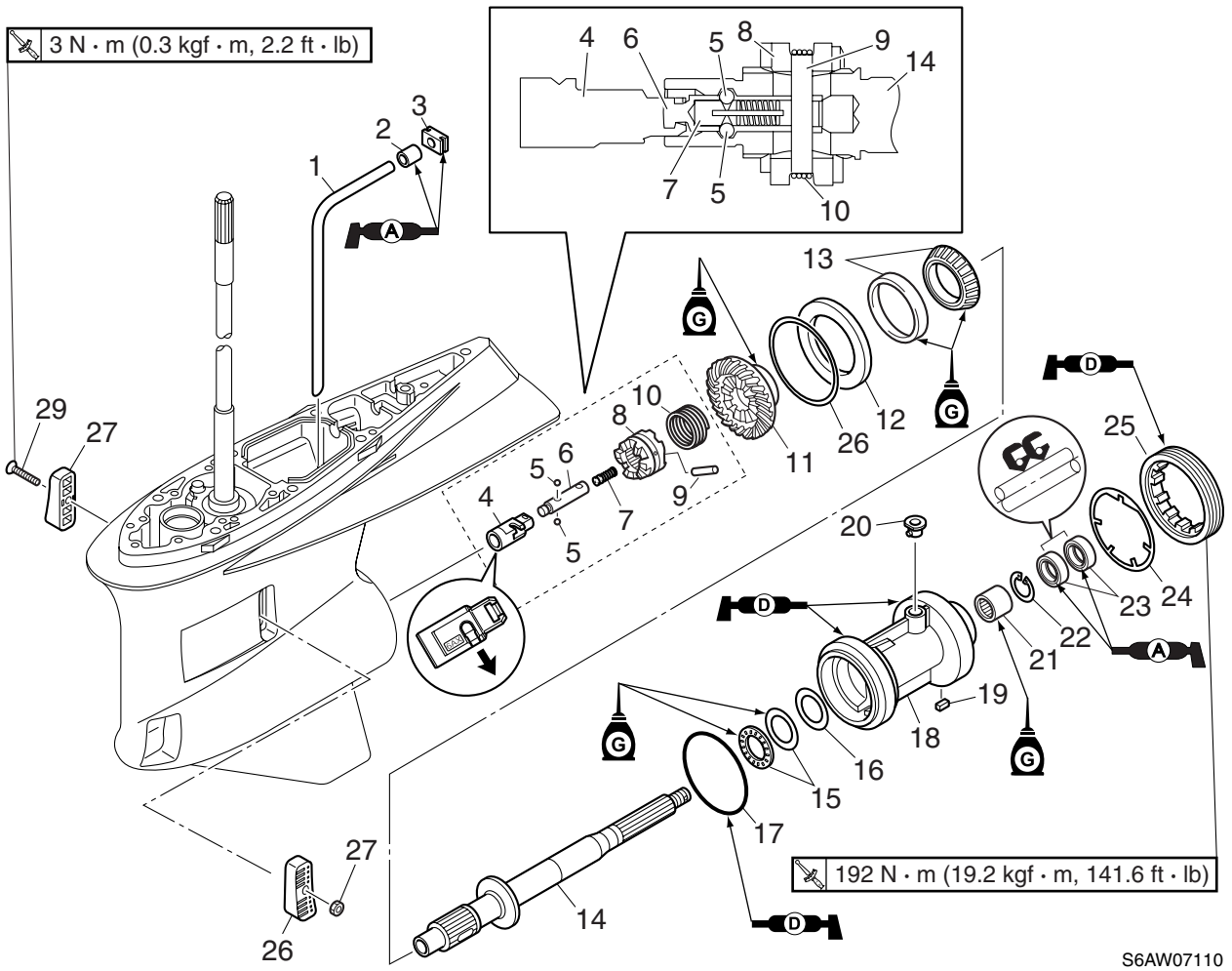
Checking the water pump and shift rod

See “Checking the water pump and shift rod” (8-8) of the lower unit (regular rotation model) to check the water pump and shift rod.

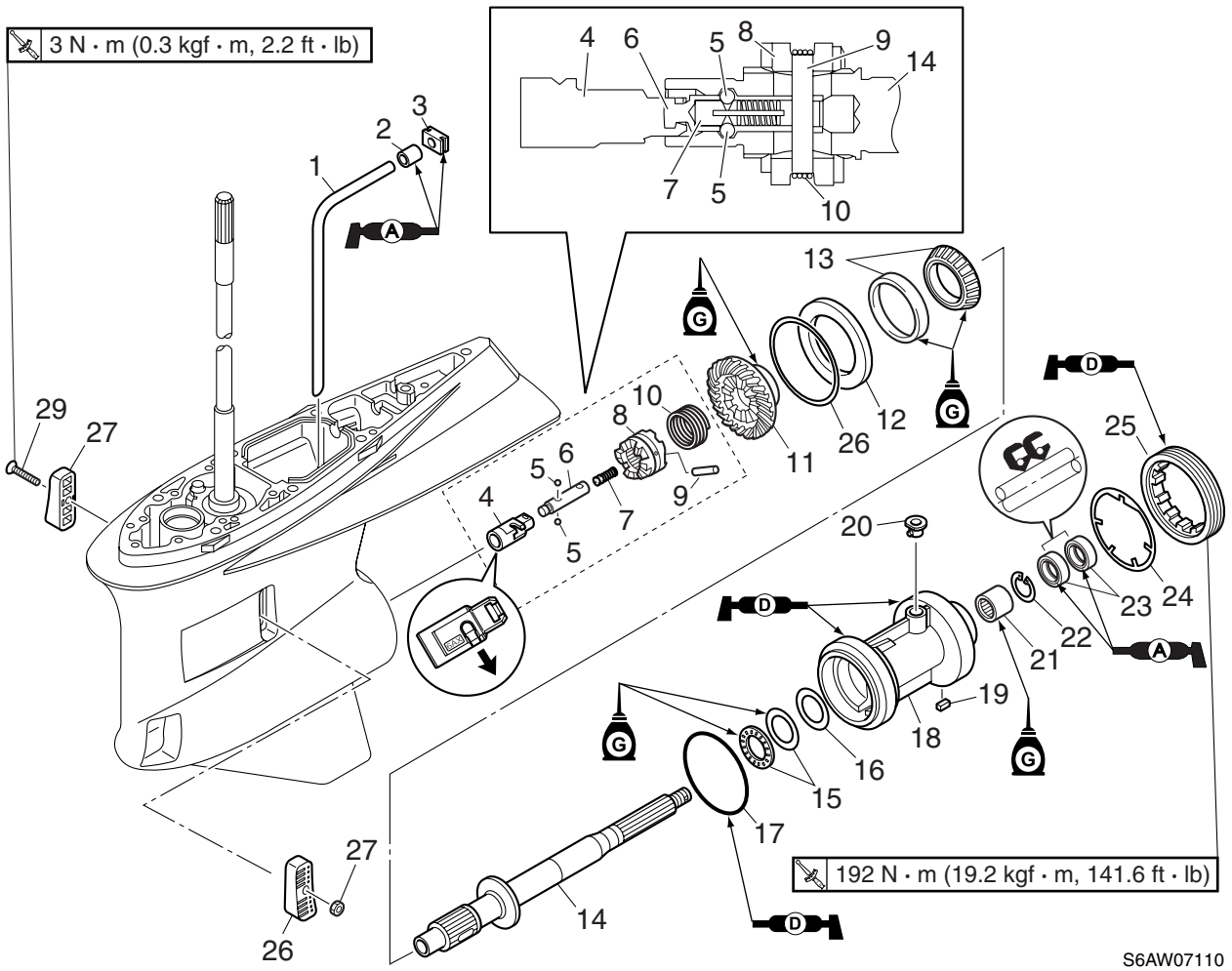
Assembling the water pump housing

See “Assembling the water pump housing” (8-8) of the lower unit (regular rotation model) for the procedure to assemble the water pump housing.

Propeller shaft housing (counter rotation model)



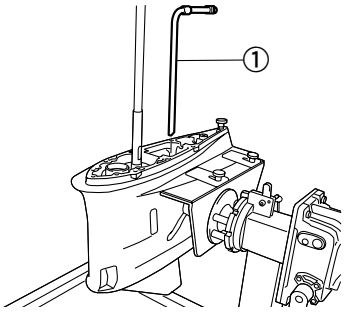
No.	Part name	Q'ty	Remarks
1	Water pipe	1	
2	Rubber seal	1	
3	Rubber seal	1	
4	Shift rod joint	1	
5	Ball	2	
6	Slider	1	
7	Shift plunger	1	
8	Dog clutch	1	
9	Cross pin	1	
10	Spring	1	
11	Forward gear	1	
12	Thrust washer	1	
13	Taper roller bearing	1	**Not reusable**
14	Propeller shaft	1	
15	Thrust bearing	1	
16	Shim T4	—	
17	O-ring	1	**Not reusable**



No.	Part name	Q'ty	Remarks
18	Propeller shaft housing	1	
19	Key	1	
20	Rubber seal	1	
21	Needle bearing	1	**Not reusable**
22	Circlip	1	
23	Oil seal	2	**Not reusable**
24	Claw washer	1	
25	Ring nut	1	
26	Shim T2	—	
27	Water inlet cover	2	
28	Self-locking nut	1	
29	Screw	1	ø5 × 54 mm

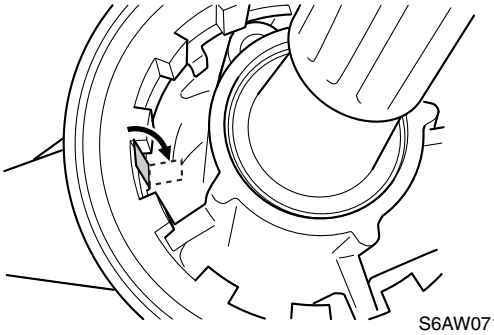
Removing the propeller shaft housing assembly

1. Remove the water pipe ①.

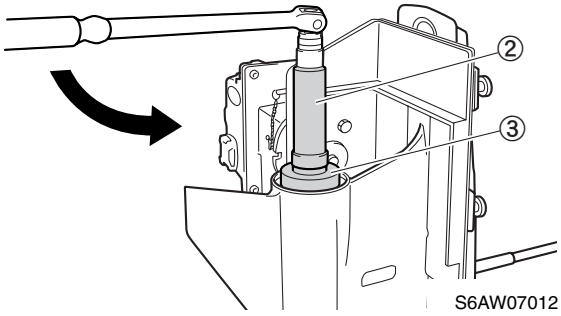


S6AW07011

2. Fold one tooth of the claw washer that is bent toward the propeller.


S6AW07117

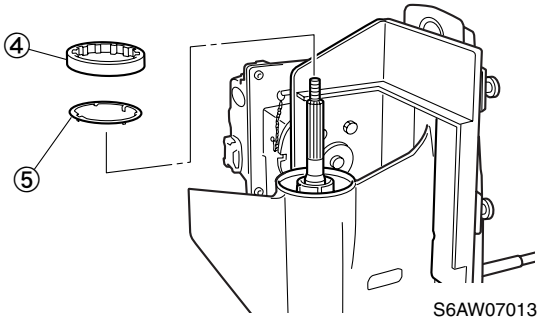
3. Loosen the ring nut.



S6AW07012

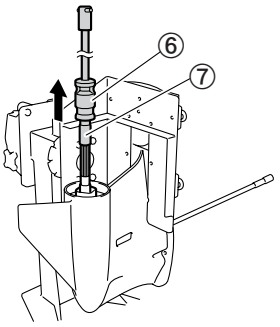
Ring nut wrench extension 2 ②: 90890-06784
Ring nut wrench 2 ③: 90890-06823

4. Remove the ring nut ④ and claw washer ⑤.



S6AW07013

5. Remove the propeller shaft housing assembly, the propeller shaft, washers, and the shim T2. Be careful not to lose the key.
   See the exploded diagram (8-52).



S6AW07074

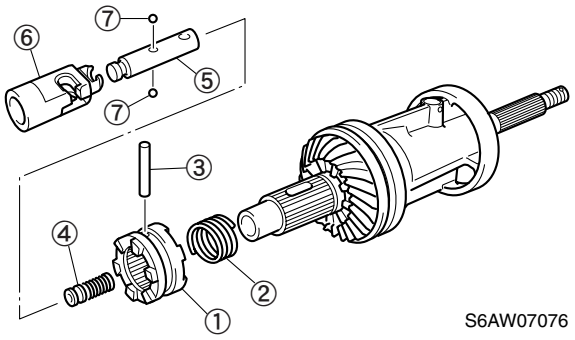
Slide hammer ⑥: 90890-06531
Puller head ⑦: 90890-06514

Disassembling the propeller shaft housing

1. Place a marking on the dog clutch ①, so it can be installed in the original orientation (forward side or reverse side) before disassembling.

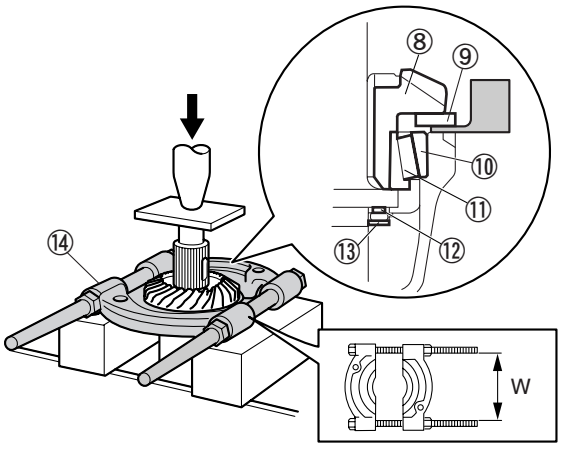
2. Remove the spring ②, and then remove the cross pin ③ and dog clutch ①.

3. Remove the shift plunger ④, slider ⑤, shift rod joint ⑥, and the balls ⑦. Be careful not to lose the balls ⑦.



S6AW07076

4. Remove the forward gear ⑧, thrust washer ⑨, bearing outer race ⑩, taper roller bearing ⑪, thrust bearing ⑫ and shim T4 ⑬ from the propeller shaft housing using a press.
   See the exploded diagram (8-52) for each components.

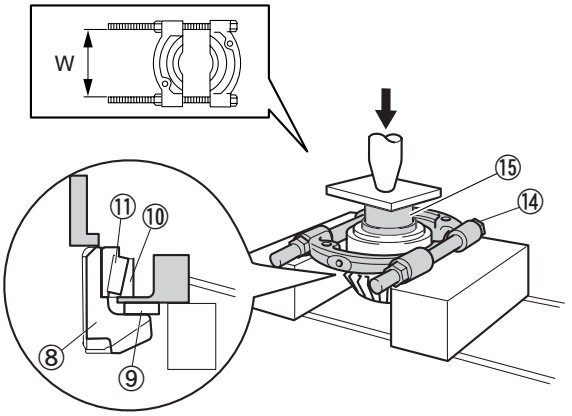


S6AW07077

Dimension “W”: 110 mm (4.3 in) is recommended.

	Bearing separator ⑭: (commercially available)

5. Remove the outer race ⑩, the tapered roller bearing ⑪, and the thrust washer ⑨ from the forward gear ⑧ using the press.

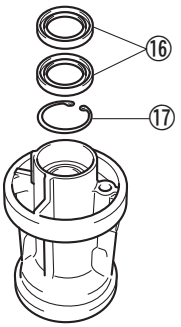


S6AW07078

Dimension “W”: 110 mm (4.3 in) is recommended.

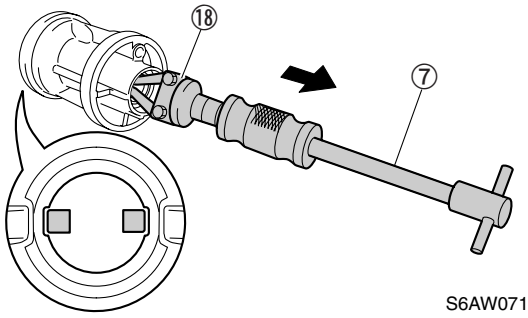
	Bearing separator ⑭: (commercially available) Bearing inner race attachment ⑮: 90890-06662

6. Remove the oil seals ⑯ and circlip ⑰.



S6AW07079

7. Remove the needle bearing.



S6AW07127

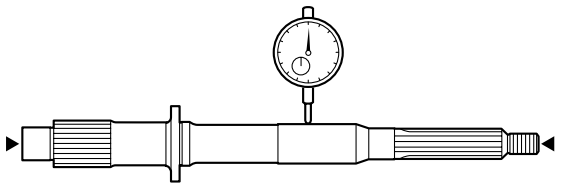
Slide hammer ⑦: 90890-06531
Bearing outer race puller assembly ⑱: 90890-06523

Checking the propeller shaft housing

1. Clean the propeller shaft housing, and then check it. Replace the propeller shaft housing if cracked or damaged.
2. Check the teeth and dogs of the forward gear. Replace the forward gear if cracked or worn.
3. Check the bearings. Replace the bearings if pitted or if there is rumbling.

Checking the propeller shaft

1. Check the propeller shaft. Replace the propeller shaft if bent or worn.
2. Measure the propeller shaft runout. Replace the propeller shaft if above specification.

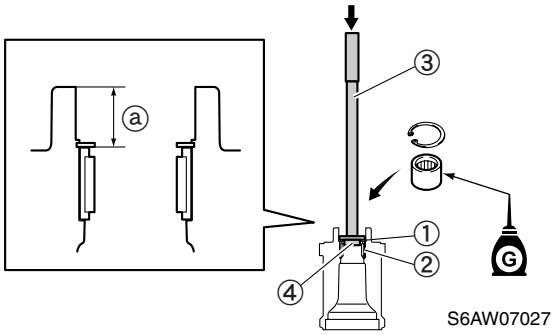

S6AW07080

Propeller shaft runout limit:
0.02 mm (0.0008 in)

3. Check the dog clutch, shift rod joint, and slider. Replace the dog clutch, shift rod joint, or slider if cracked or worn.

Assembling the propeller shaft housing

1. Install the needle bearing ① to the propeller shaft housing until it is set at the specified depth ⓐ, and install the circlip ②.



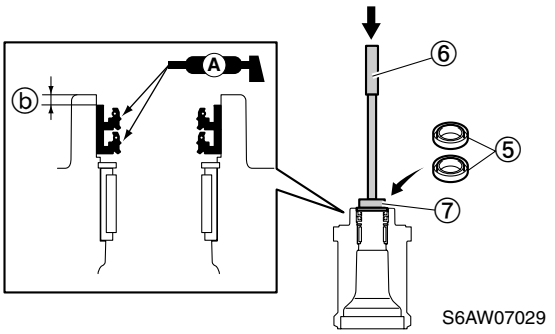
S6AW07027

CAUTION:
Do not reuse the bearing, always replace it with a new one.

Driver rod LL ③: 90890-06605
Ball bearing attachment ④: 90890-06632

Depth ⓐ:
26.8–27.3 mm (1.06–1.07 in)

2. Apply some grease to new oil seals ⑤, and drive them into the propeller shaft housing until they are install at the specified depth ⓑ.



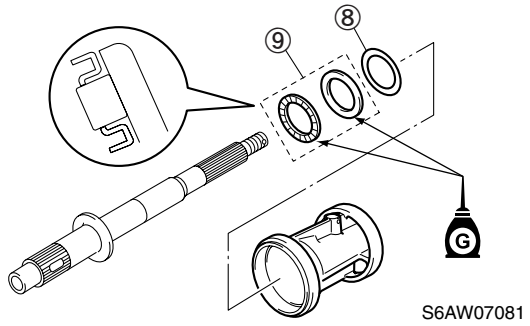
S6AW07029

NOTE:
Install an oil seal halfway into the propeller shaft housing, and then install the other oil seal.

Driver rod L3 ⑥: 90890-06652
Needle bearing attachment ⑦: 90890-06607

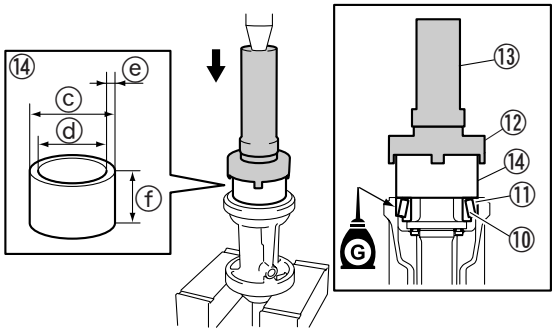
Depth ⓑ: 4.8–5.3 mm (0.19–0.21 in)

3. Install the original shim(s) T4 ⑧ and thrust bearing ⑨ with the propeller shaft into the propeller shaft housing.
   Be sure to select the propeller shaft shim(s) if replacing the propeller shaft, propeller shaft housing, and thrust bearing or taper roller bearing.
   To select the shims, see "Shimming (counter rotation model)" (8-65).



S6AW07081

4. Install a new taper roller bearing ⑩ and the bearing outer race ⑪ into the propeller shaft housing using a press.



S6AW07082

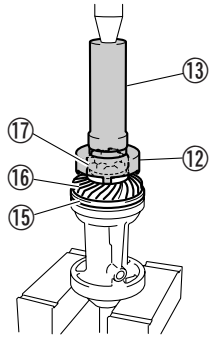
CAUTION:
Do not reuse the bearing, always replace it with a new one.

Ring nut wrench 2 ⑫: 90890-06823
Ring nut wrench extension 2 ⑬: 90890-06784
Pipe ⑭ (commercially available):
ⓒ = 95 mm (3.74 in)
ⓓ = 83 mm (3.27 in)
ⓔ = 6 mm (0.24 in)
ⓕ = 40 mm (1.57 in)

5. After installing the taper roller bearing and bearing outer race, check that the propeller shaft rotates smoothly.

6. Set the thrust washer ⑮ and the forward gear ⑯ with using the dog clutch ⑰ toward the orientation marked before disassembling.

7. Install the special service tools ⑫ and ⑬, and then install the thrust washer and the forward gear with using the press.



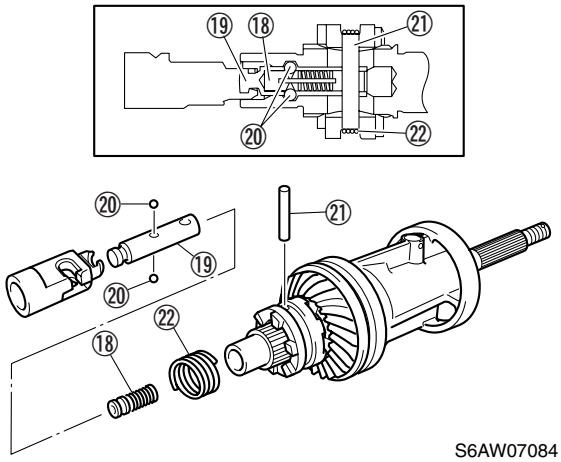
S6AW07083

Ring nut wrench 2 ⑫: 90890-06823
Ring nut wrench extension 2 ⑬: 90890-06784

8. After installing the forward gear, check that the propeller shaft and forward gear rotates smoothly.

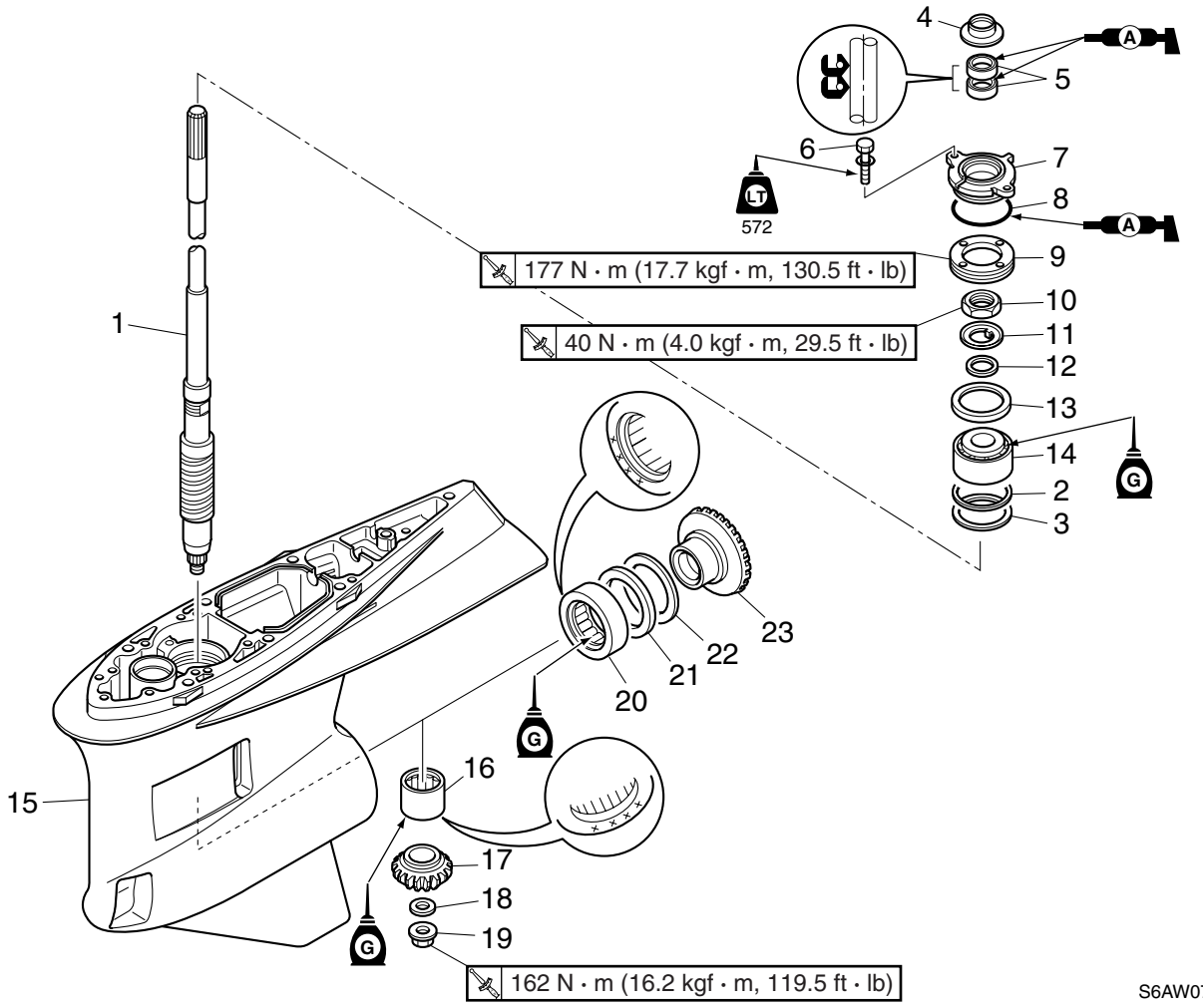
8

9. Install the shift plunger ⑱, slider ⑲, and balls ⑳ into the propeller shaft, and then install the cross pin ㉑ and spring ㉒.



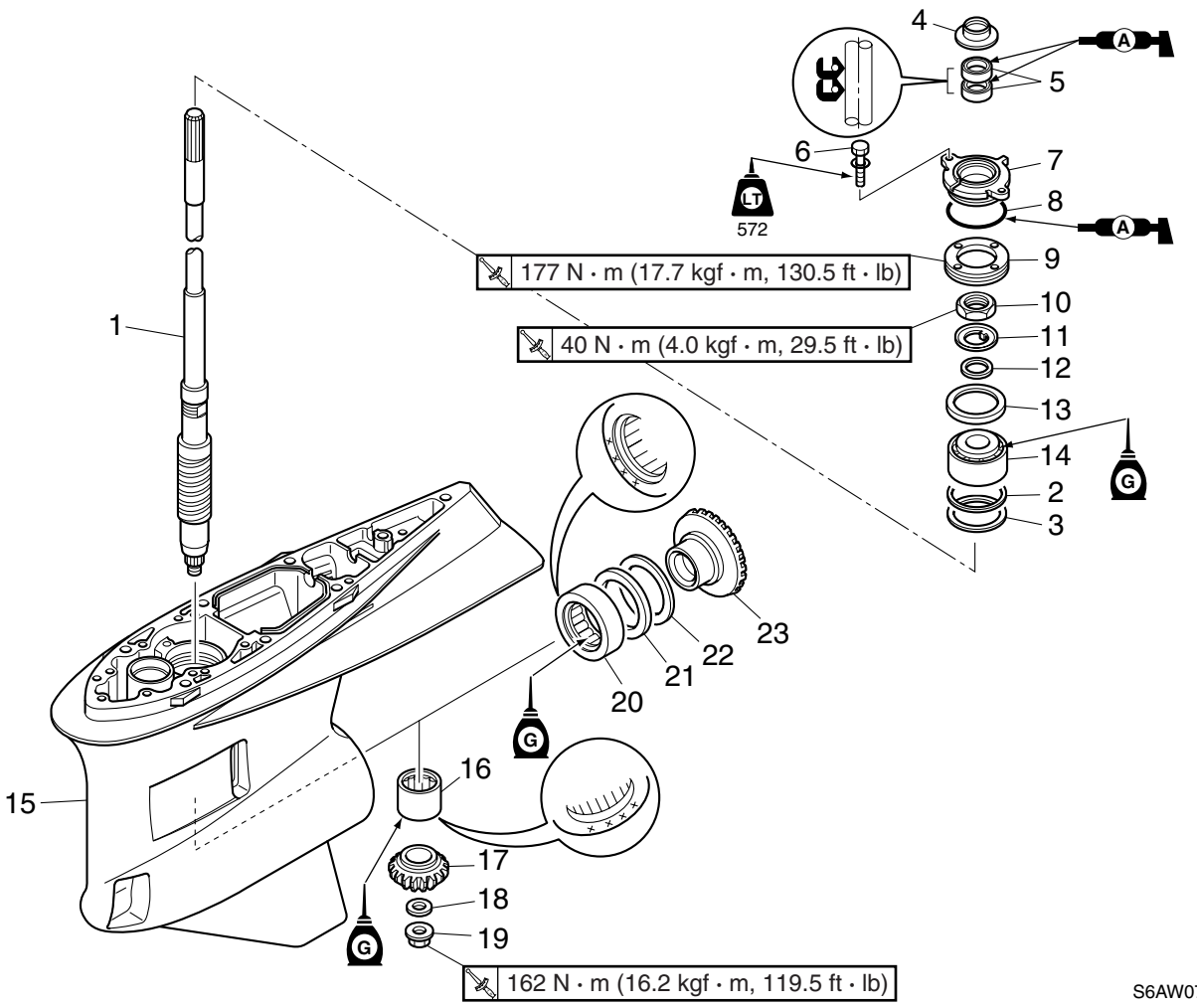
S6AW07084

Drive shaft and lower case (counter rotation model)



S6AW07108

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Shim T3	—	
3	Washer	1	
4	Cover	1	
5	Oil seal	2	**Not reusable**
6	Bolt	2	M8 × 20 mm
7	Oil seal housing	1	
8	O-ring	1	**Not reusable**
9	Ring nut	1	
10	Nut	1	
11	Claw washer	1	
12	Washer	1	
13	Spacer	1	
14	Taper roller bearing	1	**Not reusable**
15	Lower case	1	
16	Needle bearing	1	
17	Pinion	1	

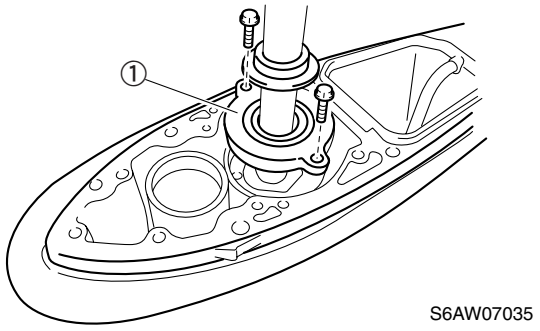


S6AW07108

No.	Part name	Q'ty	Remarks
18	Washer	1	
19	Nut	1	
20	Roller bearing	1	
21	Thrust bearing	1	
22	Shim T1	—	
23	Reverse gear	1	

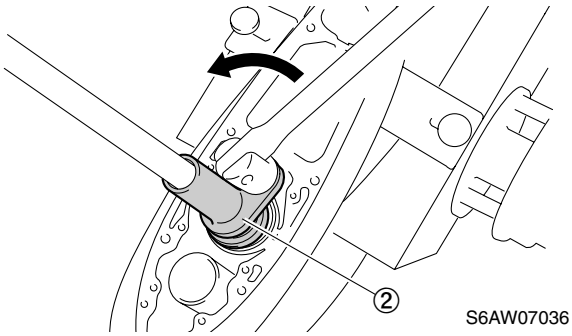
Removing the drive shaft

1. Remove the oil seal housing ①.



S6AW07035

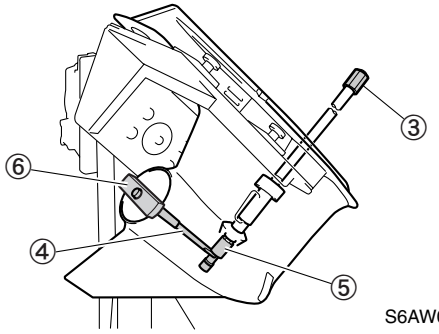
2. Remove the ring nut.



S6AW07036

Ring nut wrench ②: 90890-06833

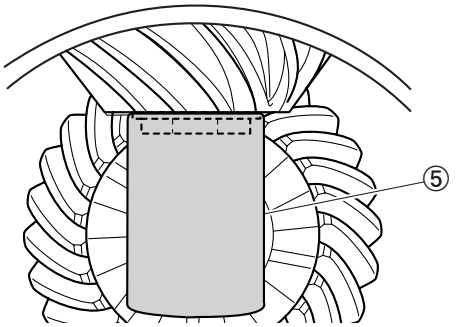
3. Install the special service tools ③, ④, ⑤, and ⑥ as shown.



S6AW07037

Drive shaft holder 8 ③: 90890-06832
Pinion nut holder ④: 90890-06715
Socket adapter ⑤: 90890-06831
Holder guide ⑥: 90890-06834

4. Make sure that special service tool ⑤ is secure on the pinion nut as shown, and loosen the pinion nut.



S6AW07038

Socket adapter ⑤: 90890-06831

5. Remove the pinion nut and washer.
   See the exploded diagram (8-59).

6. Remove the drive shaft, the pinion gear, the shim T3, and the washer.
   See the exploded diagram (8-59).

7. Remove the reverse gear, shim T1 and thrust bearing.
   See the exploded diagram (8-59).

Disassembling the oil seal housing

See “Disassembling the oil seal housing” (8-17) of the lower unit (regular rotation model) for the procedure to disassemble the oil seal housing.

Disassembling the drive shaft

See “Disassembling the drive shaft” (8-18) of the lower unit (regular rotation model) for the procedure to disassemble the drive shaft.

Disassembling the lower case

See “Disassembling the lower case” (8-18) of the lower unit (regular rotation model) for the procedure to disassemble the lower case.

Checking the pinion and reverse gear

1. Check the teeth of the pinion, and the teeth and dogs of the reverse gear. Replace the pinion or reverse gear if cracked or worn.

8

Checking the bearing
1. Check the bearings. Replace the bearings if pitted or if there is rumbling.

Checking the drive shaft
See “Checking the drive shaft” (8-19) of the lower unit (regular rotation model) to check the drive shaft.

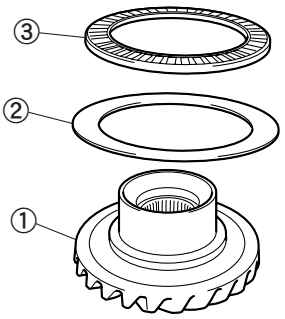
Checking the lower case
See “Checking the lower case” (8-19) of the lower unit (regular rotation model) to check the lower case.

Assembling the drive shaft
See “Assembling the drive shaft” (8-19) of the lower unit (regular rotation model) for the procedure to assemble the drive shaft.

Assembling the lower case
See “Assembling the lower case” (8-21) of the lower unit (regular rotation model) for the procedure to assemble the lower case.

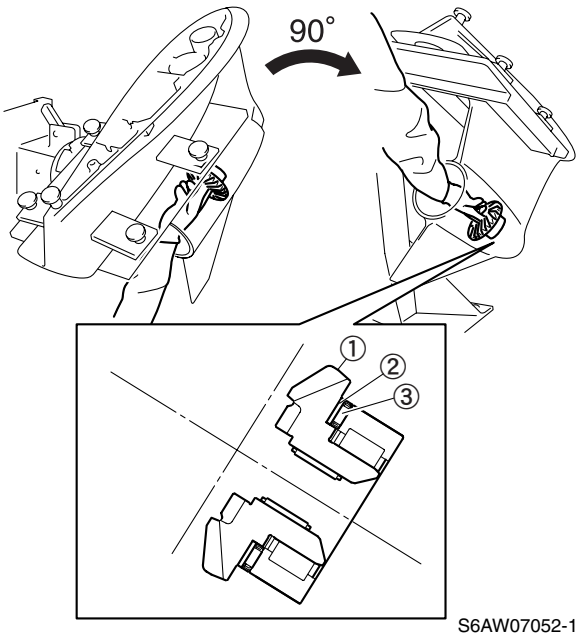
Assembling the oil seal housing
See “Assembling the oil seal housing” (8-22) of the lower unit (regular rotation model) for the procedure to assemble the oil seal housing.

Installing the reverse gear
1. Install the assembled shim T1 ② and the thrust bearing ③ to the reverse gear ①. If you are not aware of the shim thickness that has been originally installed, use the one with 2.09 mm thickness.
   To select the shims, see “Shimming (counter rotation model)” (8-65).



S6AW07120

2. Tilt the lower case and then install the reverse gear ①. Take precautions against the possible dislocation of the shim T1 ② and the thrust bearing ③ while tilting the lower case. Then, turn the lower case by 90° holding the reverse gear in place with your hand.

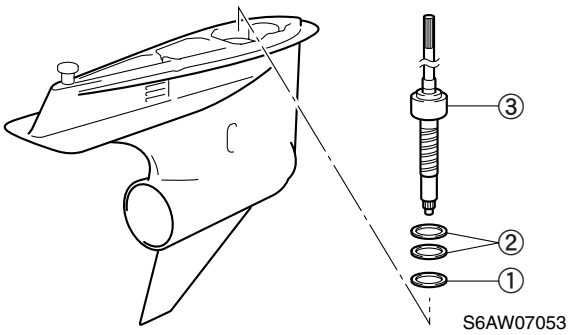


S6AW07052-1

NOTE:
Turn the gear after the assembly to assure the correct installation.

Installing the drive shaft

1. Install the washer ① and assembled shim(s) T3 ② and the drive shaft ③ to the lower case. If you are not aware of the shim thickness that has been originally installed, combine the shims to obtain 0.9 mm thickness.
   To select the shims, see “Shimming (counter rotation model)” (8-65).



2. For the step 2 and the subsequent steps, see “Installing the drive shaft” in lower unit (regular rotation model) section (8-22), step 2 onward.

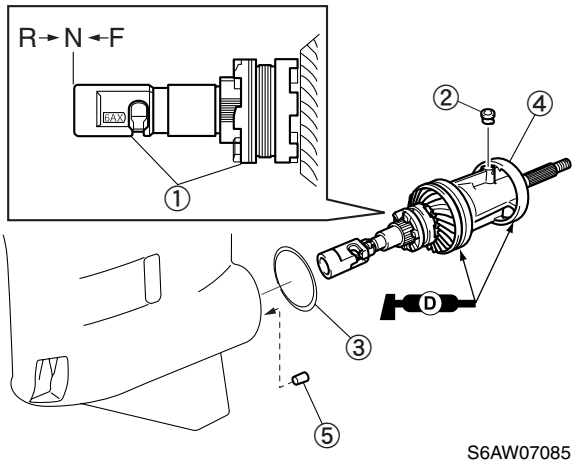
Installing the propeller shaft housing

1. Install the shift rod joint and dog clutch ① to the neutral position as shown.

2. Apply grease to new O-rings and propeller shaft housing.

3. Install the rubber seal ②.

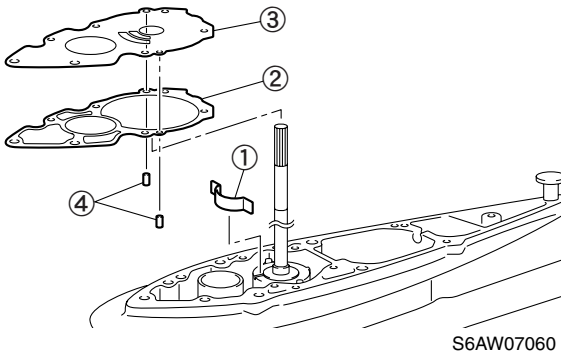
4. Install the assembled shim(s) T2 ③, the propeller shaft housing assembly ④, and the key ⑤ to the lower case. See the exploded diagram (8-52).
   If you are not sure of the thickness of the assembled shim, combine the shims so the thickness becomes 0.72 mm.
   To select the shims, see “Shimming (counter rotation model)” (8-65).



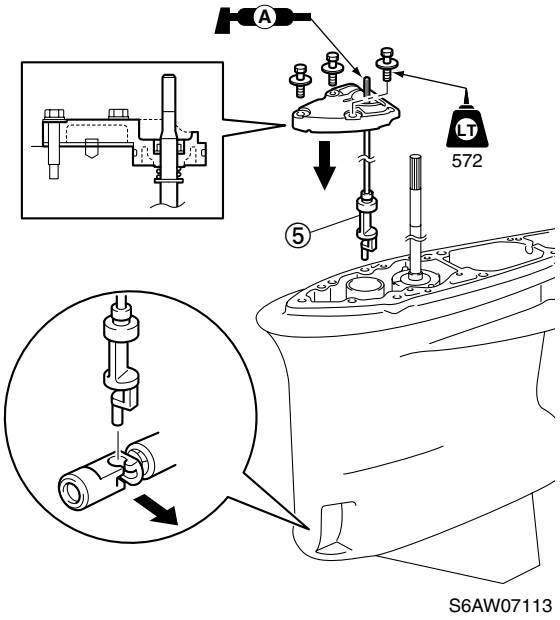
5. For the step 5 and the subsequent steps, see “Installing the propeller shaft housing” in lower unit (regular rotation model) section (8-24), step 6 onward.

Installing the shift rod

1. Install the seal plate ①, a new gasket ②, outer plate cartridge ③ and dowels ④.



2. Make sure that the gear shift is in the neutral position, and then install the shift rod assembly ⑤.



S6AW07113

3. Make sure that the drive shaft and the propeller shaft are moving properly when the gear is shifted into forward position and into reverse position.

Installing the water pump

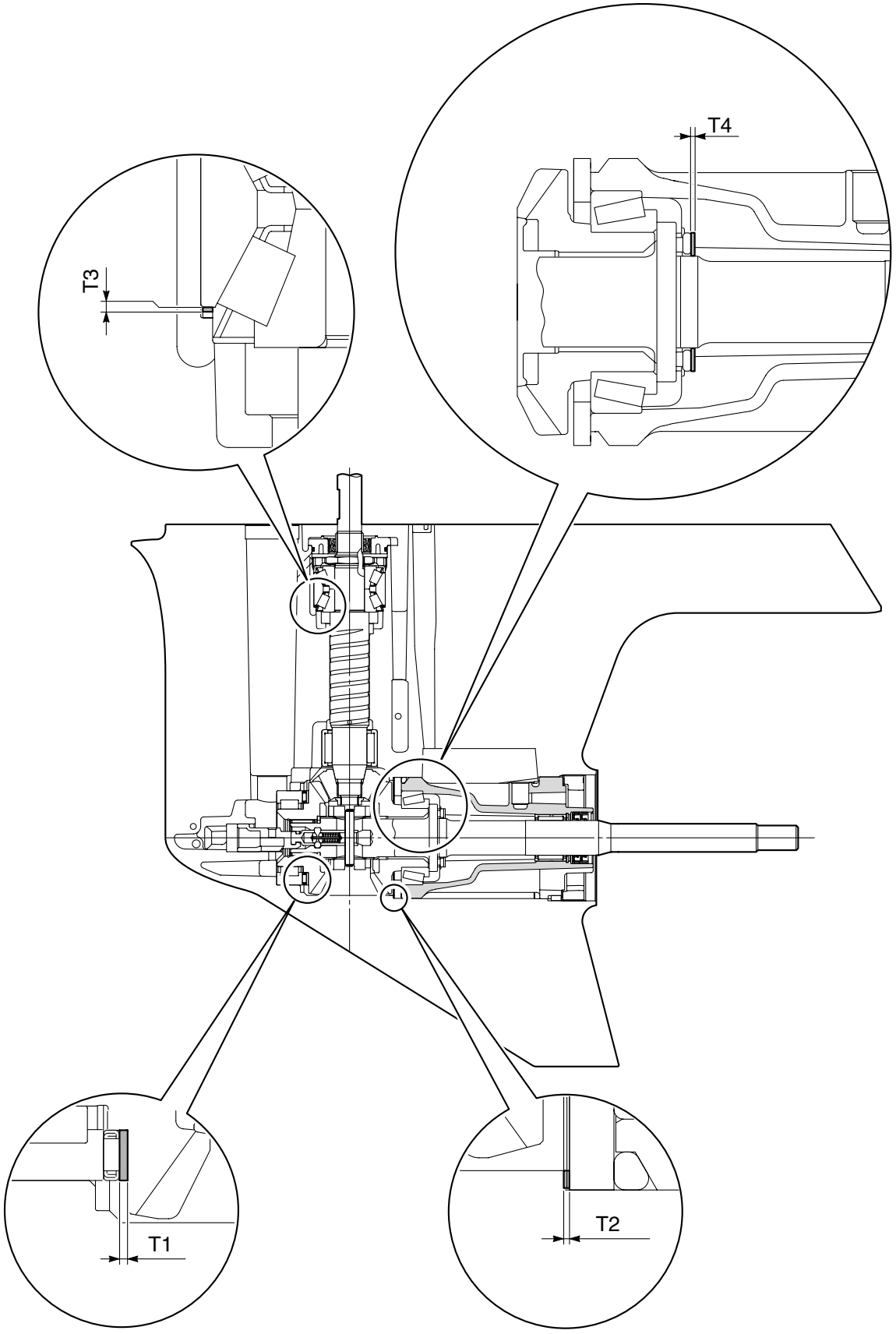
See “Installing the water pump” (8-25) of the lower unit (regular rotation model) for the procedure to install the water pump.

Installing the lower unit

See “Installing the lower unit” (8-26) of the lower unit (regular rotation model) for the procedure to install the lower case. However, install the propeller for the counter rotation model.

Recommended gear oil:
Hypoid gear oil
API: GL-5
SAE: 90, 80W-90
Gear oil quantity:
Counter rotation model:
1,310 cm^3
(44.3 US oz, 46.1 Imp oz)

Shimming (counter rotation model)



S6AW07088-1

Shimming

Shimming is not required when assembling the original lower case and inner parts.
Shimming is required when assembling the original inner parts and a new lower case.
Shimming is required when replacing the inner part(s).
Position of the pinion is the base for the selection of shim T1 and the shim T2, so always select the shim T3 before selecting the shim T1 and the shim T2.
Two pieces of washers (90201-35015) are required to measure the reverse gear backlash for the shim adjustment on the counter rotation model. Please prepare the washers before starting the shimming procedure. The washers are installed at both ends of the dog clutch on the regular rotation model.

Selecting the pinion shim T3

See “Selecting the pinion shim T3” (8-29) for the regular rotation model for the description of the shim T3.
However, the formula for “B” will be as follows for counter rotation model, because the tooth contact compensation value “Z” will be 0.05 mm.

B = 69 + (MD compensation “measurement P”) + 0.05 – 32 – (Pinion height compensation “measurement H”) – 36.5
= 0.55 – (MD compensation “measurement P”) – (Pinion height compensation “measurement H”)

When the difference between the calculated value B and the measurement M is larger than ± 0.07 mm, adjust the difference by the shims.

1. Make sure the measurement P and measurement H from the pinion gear.
   See “Selecting the pinion shim T3” (8-29) for the regular rotation model.

2. Obtain the calculated value B based on measurements P and H on the pinion gear. See “Pinion ‘Calculated value B’ table” (8-72).

Example:
When measurement P is 0.00 mm and measurement H is 0.03 mm, the calculated value B is 0.52 mm.

3. Make sure the actual value of the measurement M. See “Selecting the pinion shim T3” (8-29) for the regular rotation model for measuring method.

4. Based on the calculated value B and the measurement M, determine the shim thickness using the “Pinion shim T3 increase or decrease table” (8-73). If the shim adjustment is required, check the “Pinion shim T3 increase or decrease table” (8-73) to obtain the appropriate thickness.

Available shim thick nesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

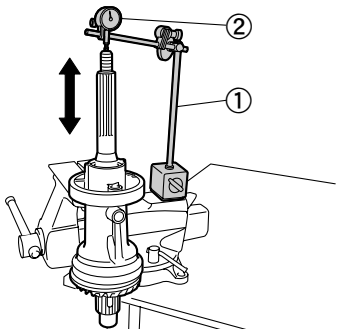
Use up to 3 shims listed above to make appropriate combination for the shim T3. If the shim T3 comes in with 4 shims from the factory, use up to 4 shims to make appropriate combination.
Example:
When the measurement M is 0.42 mm and the calculated value B is 0.52 mm, the need for decreasing or increasing the shim is 0.10 mm. This means 0.10 mm thickness must be added to the present shim thickness.

Selecting the propeller shaft shim T4

1. Install the original shim(s) T4, and measure the free play of the propeller shaft.

NOTE:
If the original shim(s) cannot be identified, measure the free play without any shim.

2. No shim T4 adjustment is required if the measurement M falls within the specified range. When the measurement M is out of the specified propeller shaft free play, select the shim(s) using “Propeller shaft shim T4 increase or decrease table” (8-79).



S6BJ08001

NOTE:
Make sure the propeller shaft does not sway during the measurement.

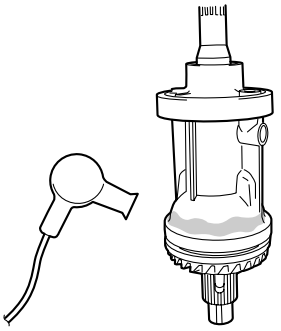
Magnet base B ①: 90890-06844
Dial gauge set ②: 90890-01252

Propeller shaft free play:
0.25–0.35 mm (0.0098–0.0138 in)

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

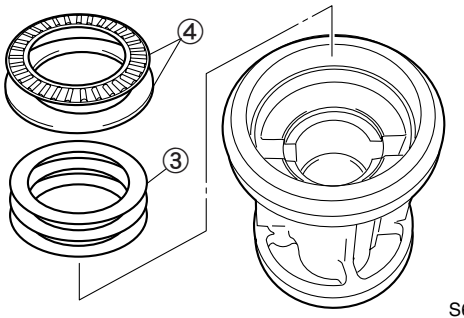
Use up to 3 shims listed to make appropriate combination for the shim T4.
Example:
When the measurement M is 0.72 mm, the need for increasing or decreasing the shim is 0.40 mm. This means 0.40 mm thickness must be added to the present shim thickness.

3. Heat all the area of the taper roller bearing install of the propeller shaft housing to approximately 80 °C (176 °F) using a heat gun or a burner. Then, disassemble the propeller shaft housing assembly.


S6BJ08002

⚠ WARNING
- **Use a heat-resistant glove, since it may cause a burn.**
- **Keep away any flammable materials such as gasoline and oil in the work area to prevent possible fire.**
- **Work with a good ventilation.**

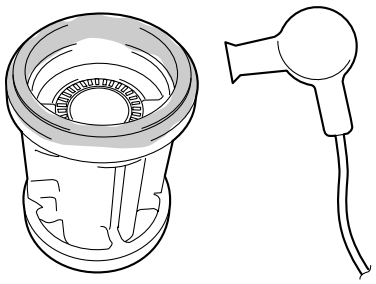
4. Install the shim(s) T4 ③ selected in process 3 above and the thrust bearing ④ in the propeller shaft housing.



S6BJ08003

8

5. Heat all the area of the taper roller bearing install of the propeller shaft housing to approximately 80 °C (176 °F) using a heat gun or a burner. Then, install the propeller shaft, tapered roller bearing and the forward gear into the propeller shaft housing.

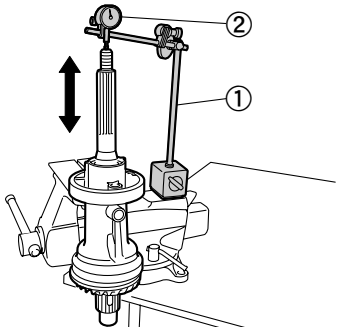


S6BJ08004

⚠ WARNING

- **Use a heat-resistant glove, since it may cause a burn.**
- **Keep away any flammable materials such as gasoline and oil in the work area to prevent possible fire.**
- **Work with a good ventilation.**

6. Measure the propeller shaft free play again to make sure that the measurement of play falls within the specified range.



S6BJ08001

NOTE:

If the measurement of play falls outside of the specified range, it is suspected that the forward gear tapered roller bearing is not installed properly in the propeller shaft housing.

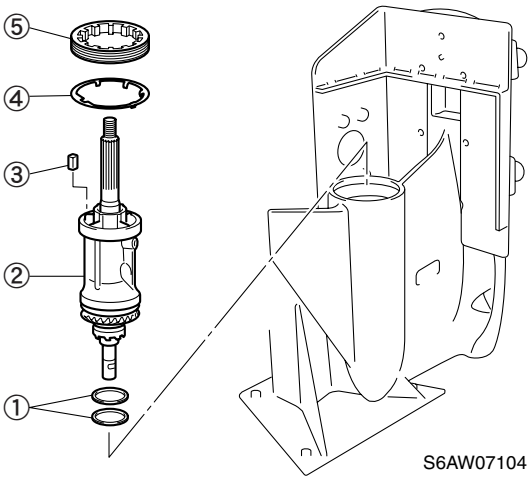
Magnet base B ①: 90890-06844
Dial gauge set ②: 90890-01252

Propeller shaft free play:
0.25–0.35 mm (0.0098–0.0138 in)

Measuring the reverse gear backlash and selecting the reverse gear shim T1

1. Remove the water pump assembly if it is installed, and make sure that the gear position is in neutral.

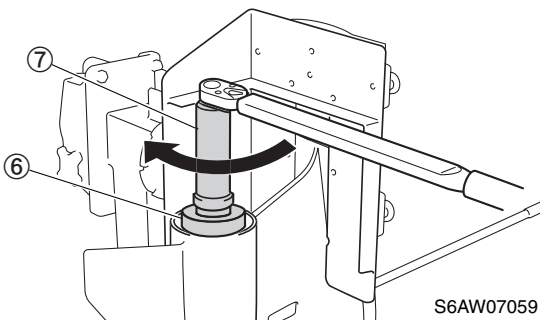
2. Insert 2 washers ① for the regular rotation model in front of the dog clutch, and install the propeller shaft housing ②, the key ③, the claw washer ④, and the ring nut ⑤.



S6AW07104

Washer ①: 90201-35015

3. Tighten the ring nut to the specified torque.

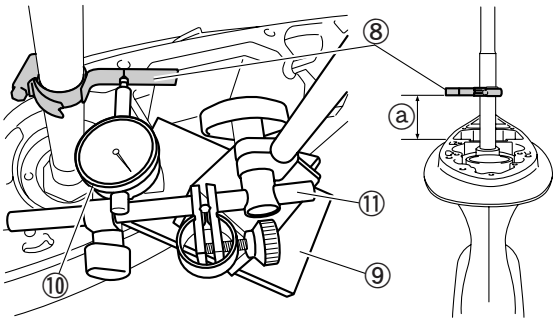


S6AW07059

Ring nut wrench 2 ⑥: 90890-06823
Ring nut wrench extension 2 ⑦: 90890-06784

Ring nut:
120 N·m (12.0 kgf·m, 88.5 ft·lb)

4. Install the backlash indicator ⑧ to the drive shaft, and then install the dial gauge to the lower unit.



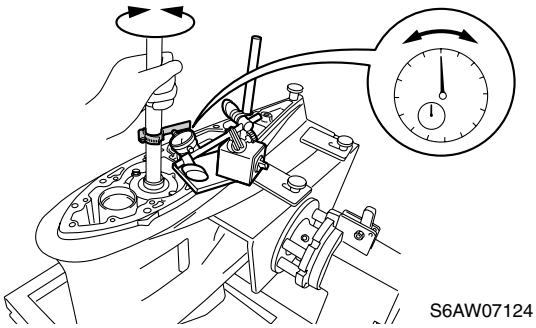
S6AW07128

NOTE:
Install the dial gauge so that the plunger contacts the mark on the backlash indicator.

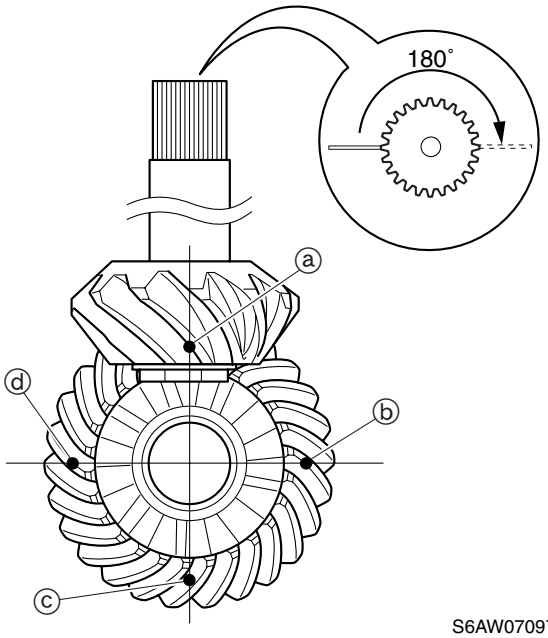
Backlash indicator ⑧: 90890-06836
Magnet base plate ⑨: 90890-07003
Dial gauge set ⑩: 90890-01252
Magnet base B ⑪: 90890-06844

Backlash indicator mounting height ⓐ: 90 mm (3.54 in)

5. Rotate the drive shaft slowly to clockwise and counterclockwise. Measure the backlash at the position it stops rotating for each direction.


S6AW07124

6. Measure the backlash 4 times by rotating the drive shaft by 180°, measuring at the points ⓐ, ⓑ, ⓒ, and ⓓ.



S6AW07097

7. Calculate the average of the 4 measurements values, and use that value as BL1. Shim adjustment is not necessary if the BL1 is within the range of the recommended backlash value.

Recommended backlash:
0.40–0.94 mm (0.0157–0.0370 in)

8. Shim adjustment is necessary if it is out of recommended backlash. Increase or decrease the shim T1 according to the relevant value in the “Reverse gear shim T1 increase or decrease chart” (8-80).
Adjust the shim so it will be at the recommended medium value when the backlash measurement BL1 is out of the recommended backlash value.

Available shim thicknesses:
2.00, 2.03, 2.06, 2.09, 2.12, and 2.15 mm

Use only single shim for the shim T1.

8

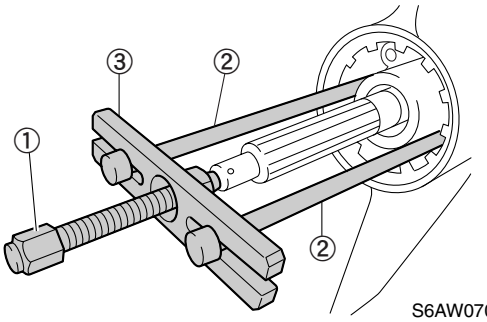
Example:
When the backlash measurement BL1 is 0.95 mm, the need for decreasing or increasing the shim is approximately 0.28 mm. This means to obtain a value by adding 0.28 mm to the present shim thickness, and select the shim having the thickness nearest to the obtained value.

9. Check the backlash again when the shim is increased or decreased.

Measuring the forward gear backlash and selecting the forward gear shim T2

1. Remove the water pump assembly if it is installed, and make sure that the gear position is in neutral.

2. Install the special service tools and then tighten the center bolt ① to the specified torque.

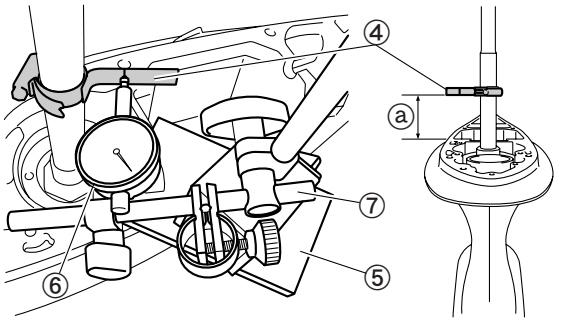


S6AW07093

Center bolt ①: 90890-06504
Bearing housing puller claw L ②: 90890-06502
Stopper guide plate ③: 90890-06501

Center bolt ①:
30 N·m (3.0 kgf·m, 22.1 ft·lb)

3. Install the backlash indicator ④ to the drive shaft, and then install the dial gauge to the lower unit.



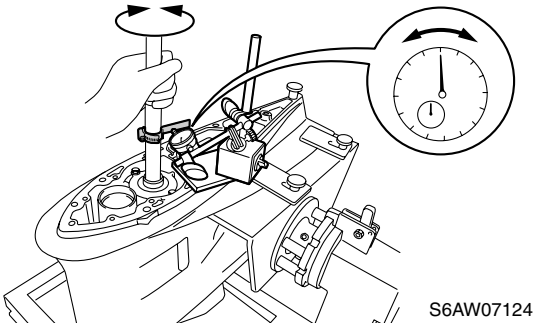
S6AW07095

NOTE:
Install the dial gauge so that the plunger contacts the mark on the backlash indicator.

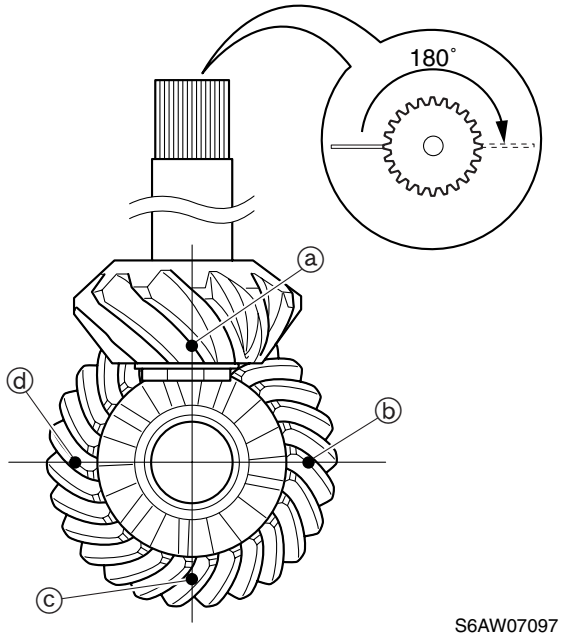
Backlash indicator ④: 90890-06836
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

Backlash indicator mounting height ⓐ: 90 mm (3.54 in)

4. Rotate the drive shaft slowly to clockwise and counterclockwise. Measure the backlash at the position it stops rotating for each direction.


S6AW07124

5. Measure the backlash 4 times by rotating the drive shaft by 180° each time, measuring at the points ⓐ, ⓑ, ⓒ, and ⓓ. Loosen the center bolt ① of the special service tool before rotating the drive shaft, then rotate the drive shaft by 180°, and tighten it again to the specified torque. Make sure the drive shaft does not rotate at that time.



S6AW07097

Center bolt ①:
30 N·m (3.0 kgf·m, 22.1 ft·lb)

6. Calculate the average of the 4 measurements values, and use that value as BL2. Shim adjustment is not necessary if the BL2 is within the range of the recommended backlash value.

Recommended backlash:
0.13–0.61 mm (0.0051–0.0240 in)

7. Shim adjustment is necessary if it is out of recommended backlash. Increase or decrease the shim T2 according to the relevant value in the “Forward gear shim T2 increase or decrease chart” (8-82).
Adjust the shim so it will be at the recommended medium value when the backlash measurement BL2 is out of the recommended backlash value.

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Use up to 3 shims listed above to make appropriate combination for the shim T2.
Example:
When the backlash measurement BL2 is 0.65 mm, the need for decreasing or increasing the shim is approximately –0.28 mm. This means 0.28 mm thickness must be subtracted from the present shim thickness.

8. Check the backlash again when the shim is increased or decreased.

Shim selection table (counter rotation model)

Pinion 'Calculated value B' table

(mm)

Pinion height compensation measurement: H \ Pinion MD compensation measurement: P	-0.11	-0.10	-0.09	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0.00
0.00	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55
0.01	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54
0.02	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52	0.53
0.03	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52
0.04	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51
0.05	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50
0.06	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49

Pinion height compensation measurement: H \ Pinion MD compensation measurement: P	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11
0.00	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.66
0.01	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.65
0.02	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64
0.03	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63
0.04	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62
0.05	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61
0.06	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60

Pinion shim T3 increase or decrease table

* Shim adjustment is not necessary where is no number.

(mm)

Calculated value: B	Measurement: M												
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
0.38	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28
0.39	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28
0.40	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28
0.41	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30
0.42	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30
0.43	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32
0.44	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32
0.45	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35
0.46	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35
0.47	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35
0.48	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38
0.49	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38
0.50	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38
0.51	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40
0.52	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40
0.53	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42
0.54	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42
0.55	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45
0.56	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45
0.57	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45
0.58	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48
0.59	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48	0.48
0.60	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50	0.48
0.61	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50	0.50
0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.50
0.63	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52	0.52
0.64	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55	0.52
0.65	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55	0.55
0.66	0.68	0.65	0.65	0.65	0.62	0.62	0.60	0.60	0.58	0.58	0.58	0.55	0.55

(mm)

Calculated value: B \ Measurement: M	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25
0.38	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15
0.39	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15
0.40	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15
0.41	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18
0.42	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18
0.43	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18
0.44	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20
0.45	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20
0.46	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22
0.47	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22
0.48	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25
0.49	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25
0.50	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25
0.51	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28
0.52	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28
0.53	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28
0.54	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30
0.55	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30
0.56	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32
0.57	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32
0.58	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35
0.59	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35	0.35
0.60	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38	0.35
0.61	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38	0.38
0.62	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38	0.38
0.63	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40	0.38
0.64	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40	0.40
0.65	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42	0.40
0.66	0.55	0.52	0.52	0.50	0.50	0.48	0.48	0.48	0.45	0.45	0.45	0.42	0.42

(mm)

Calculated value: B \ Measurement: M	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38
0.38	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*
0.39	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*
0.40	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*
0.41	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*
0.42	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*
0.43	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*
0.44	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*
0.45	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10
0.46	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10
0.47	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10
0.48	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10
0.49	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12
0.50	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12
0.51	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15
0.52	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15
0.53	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15
0.54	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18
0.55	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18
0.56	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18
0.57	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20
0.58	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20
0.59	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22	0.22
0.60	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25	0.22
0.61	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25	0.25
0.62	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25	0.25
0.63	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28	0.25
0.64	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28	0.28
0.65	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28	0.28
0.66	0.40	0.40	0.38	0.38	0.38	0.35	0.35	0.35	0.32	0.32	0.30	0.30	0.28

(mm)

Calculated value: B \ Measurement: M	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51
0.38	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15
0.39	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12
0.40	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12
0.41	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10
0.42	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10
0.43	*	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10
0.44	*	*	*	*	*	*	*	*	*	*	*	*	-0.10
0.45	*	*	*	*	*	*	*	*	*	*	*	*	*
0.46	0.10	*	*	*	*	*	*	*	*	*	*	*	*
0.47	0.10	0.10	*	*	*	*	*	*	*	*	*	*	*
0.48	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*	*
0.49	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*
0.50	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*
0.51	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*
0.52	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*
0.53	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*
0.54	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*
0.55	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*
0.56	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*
0.57	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*
0.58	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10
0.59	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10	0.10
0.60	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10	0.10
0.61	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.10
0.62	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12
0.63	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15	0.12
0.64	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15	0.15
0.65	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15	0.15
0.66	0.28	0.28	0.25	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.18	0.15

(mm)

Calculated value: B \ Measurement: M	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64
0.38	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28
0.39	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25
0.40	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25
0.41	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25
0.42	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22
0.43	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22
0.44	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20
0.45	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20
0.46	*	-0.10	-0.10	-0.10	-0.12	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18
0.47	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18
0.48	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18
0.49	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15
0.50	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15
0.51	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15
0.52	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12
0.53	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12
0.54	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10
0.55	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10	-0.10
0.56	*	*	*	*	*	*	*	*	*	*	*	-0.10	-0.10
0.57	*	*	*	*	*	*	*	*	*	*	*	*	-0.10
0.58	*	*	*	*	*	*	*	*	*	*	*	*	*
0.59	0.10	*	*	*	*	*	*	*	*	*	*	*	*
0.60	0.10	0.10	*	*	*	*	*	*	*	*	*	*	*
0.61	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*	*
0.62	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*	*
0.63	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*	*
0.64	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*	*
0.65	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*	*
0.66	0.15	0.15	0.12	0.12	0.10	0.10	0.10	0.10	*	*	*	*	*

(mm)

Calculated value: B \ Measurement: M	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.74
0.38	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35	-0.35	-0.35	-0.38
0.39	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35	-0.35	-0.35
0.40	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35	-0.35
0.41	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32	-0.35
0.42	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32	-0.32
0.43	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30	-0.32
0.44	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30	-0.30
0.45	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28	-0.30
0.46	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28	-0.28
0.47	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28	-0.28
0.48	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25	-0.28
0.49	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25	-0.25
0.50	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25	-0.25
0.51	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22	-0.25
0.52	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22	-0.22
0.53	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20	-0.22
0.54	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20	-0.20
0.55	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18	-0.20
0.56	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18	-0.18
0.57	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18	-0.18
0.58	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15	-0.18
0.59	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15	-0.15
0.60	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15	-0.15
0.61	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12	-0.15
0.62	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12	-0.12
0.63	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10	-0.12
0.64	*	*	*	*	*	*	-0.10	-0.10	-0.10	-0.10
0.65	*	*	*	*	*	*	*	-0.10	-0.10	-0.10
0.66	*	*	*	*	*	*	*	*	-0.10	-0.10

Propeller shaft shim T4 increase or decrease table

* Shim adjustment is not necessary where is no number.

(mm)

Measurement M	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16
Increasing or decreasing of shim thickness	-0.28	-0.25	-0.25	-0.22	-0.20	-0.18	-0.15	-0.15	-0.12

Measurement M	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34
Increasing or decreasing of shim thickness	-0.10	-0.10	-0.10	-0.10	*	*	*	*	*

Measurement M	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52
Increasing or decreasing of shim thickness	0.10	0.10	0.10	0.10	0.12	0.15	0.15	0.18	0.20

Measurement M	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70
Increasing or decreasing of shim thickness	0.22	0.25	0.25	0.28	0.30	0.32	0.35	0.35	0.38

Measurement M	0.72	0.74	0.76	0.78	0.80	0.82	0.84	0.86	0.88
Increasing or decreasing of shim thickness	0.40	0.42	0.45	0.45	0.48	0.50	0.52	0.55	0.55

Measurement M	0.90	0.92	0.94	0.96	0.98	1.00	1.02	1.04	1.06
Increasing or decreasing of shim thickness	0.58	0.60	0.62	0.65	0.65	0.68	0.72	0.72	0.75

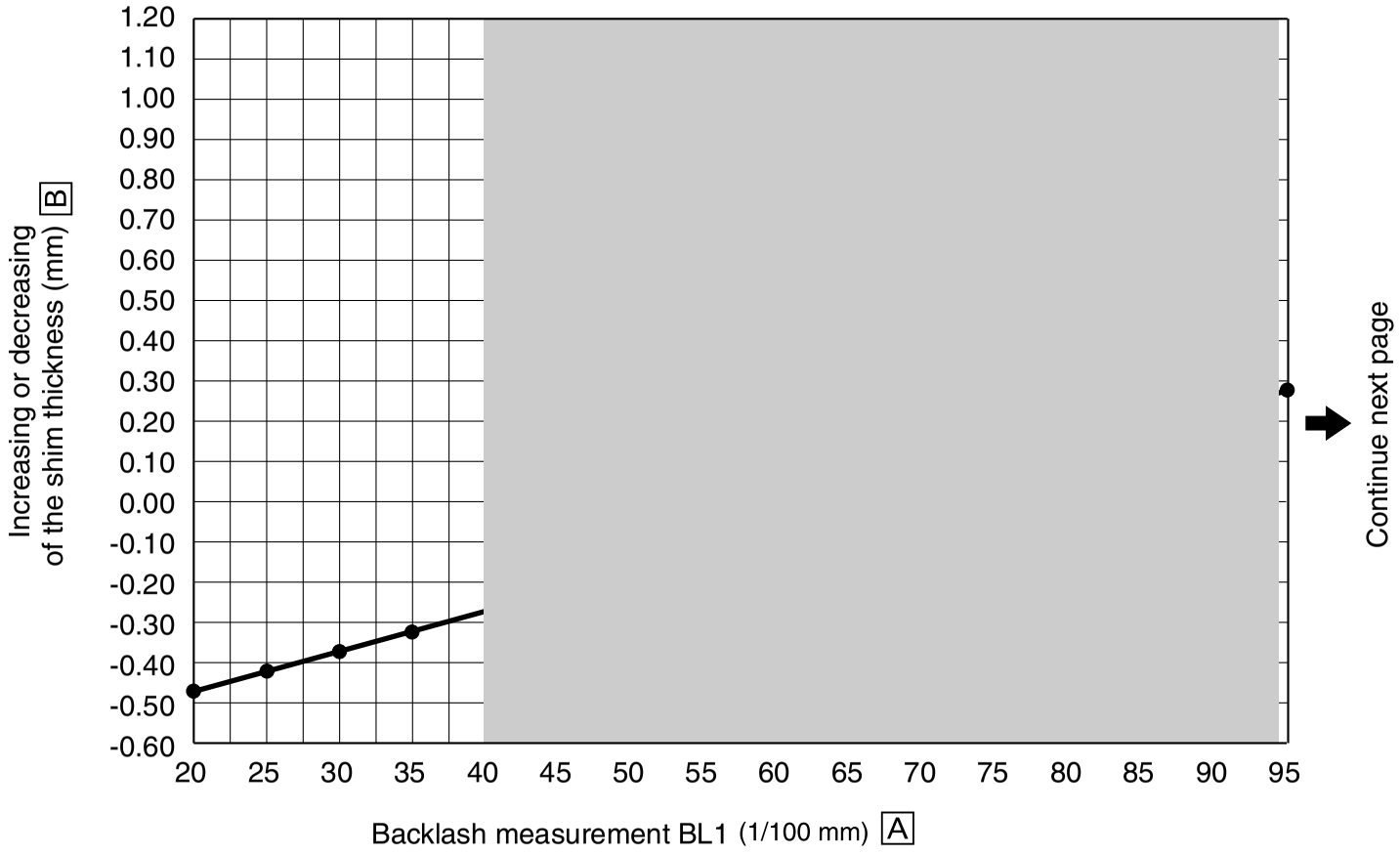
Measurement M	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24
Increasing or decreasing of shim thickness	0.75	0.78	0.80	0.82	0.85	0.85	0.88	0.90	0.92

Measurement M	1.26	1.28	1.30	1.32	1.34	1.36	1.38	1.40	1.42
Increasing or decreasing of shim thickness	0.95	0.95	0.98	1.00	1.02	1.05	1.05	1.08	1.10

Measurement M	1.44	1.46	1.48	1.50	1.52
Increasing or decreasing of shim thickness	1.12	1.15	1.15	1.18	1.20

Reverse gear shim T1 increase or decrease chart

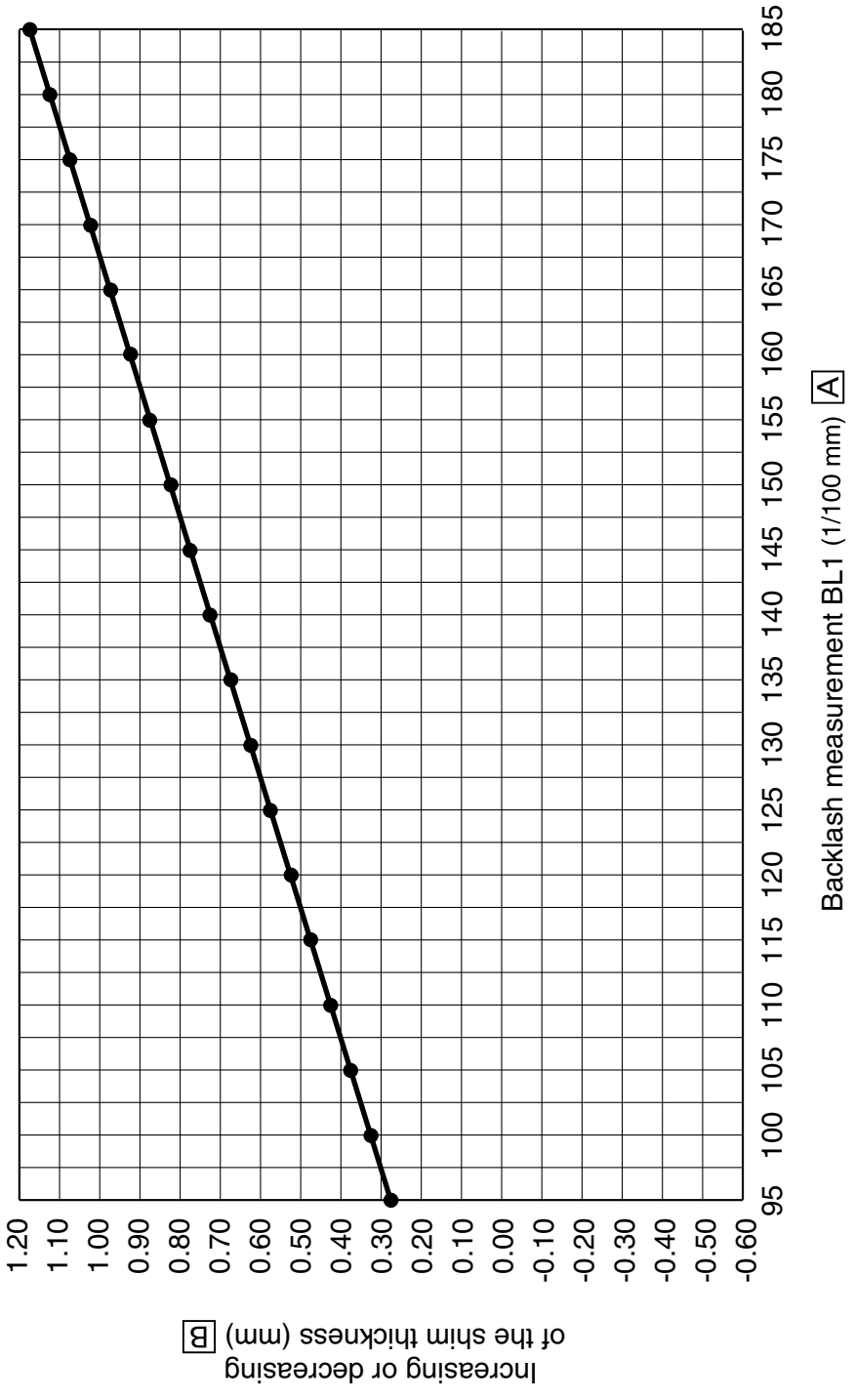
- The gray zone on the selection chart represents the specified range of the backlash. No shim adjustment is required if the measured backlash falls within the gray zone.
- In the “increasing or decreasing of the shim thickness B” column a positive number means to increase the shim, and negative number means to decrease the shim.



A (1/100 mm)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
B (mm)	-0.47	-0.42	-0.37	-0.32												0.28

S6BJ08009

S6BJ08010

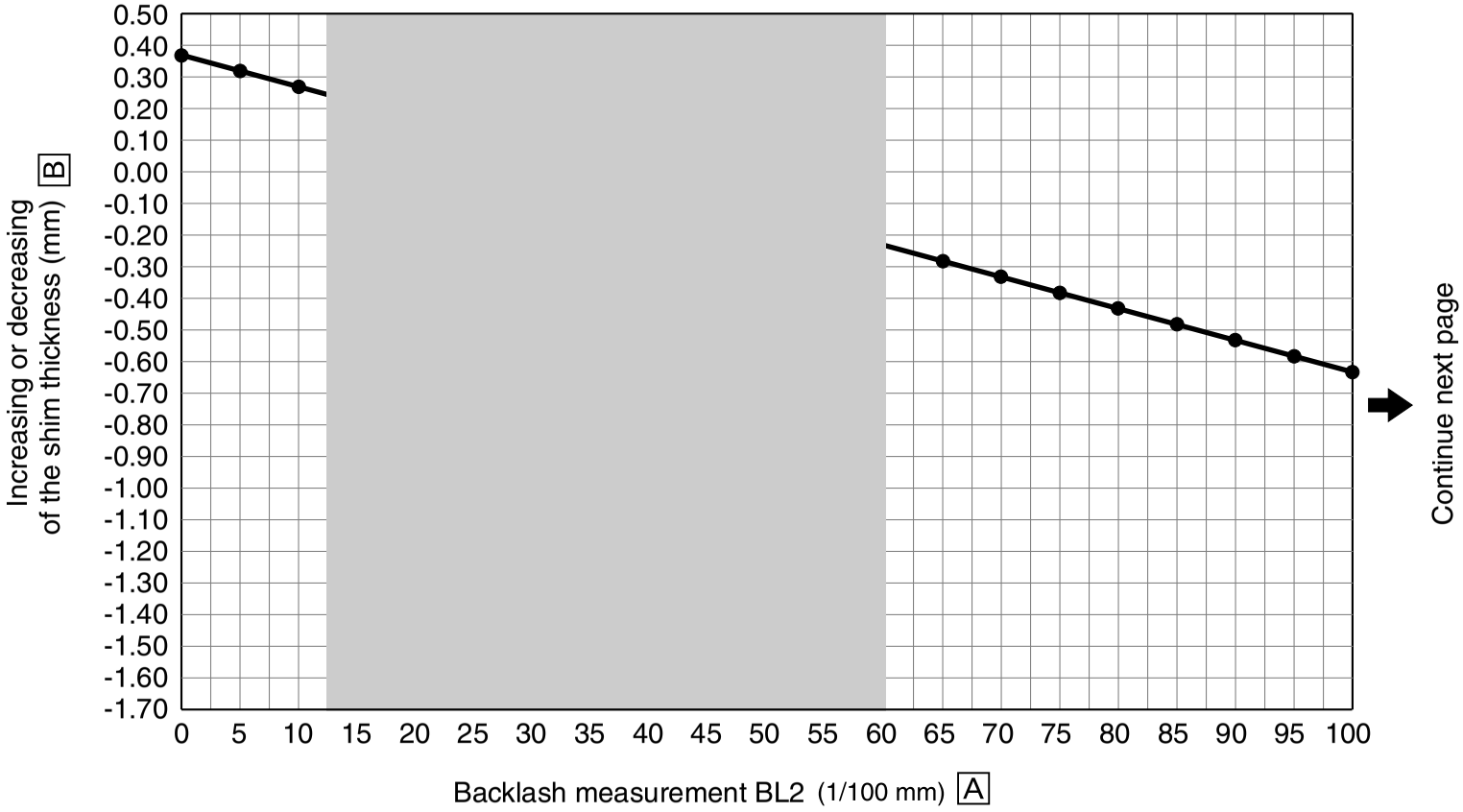


A (1/100 mm)	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185
B (mm)	0.28	0.33	0.38	0.43	0.48	0.53	0.58	0.63	0.68	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18

8

Forward gear shim T2 increase or decrease chart

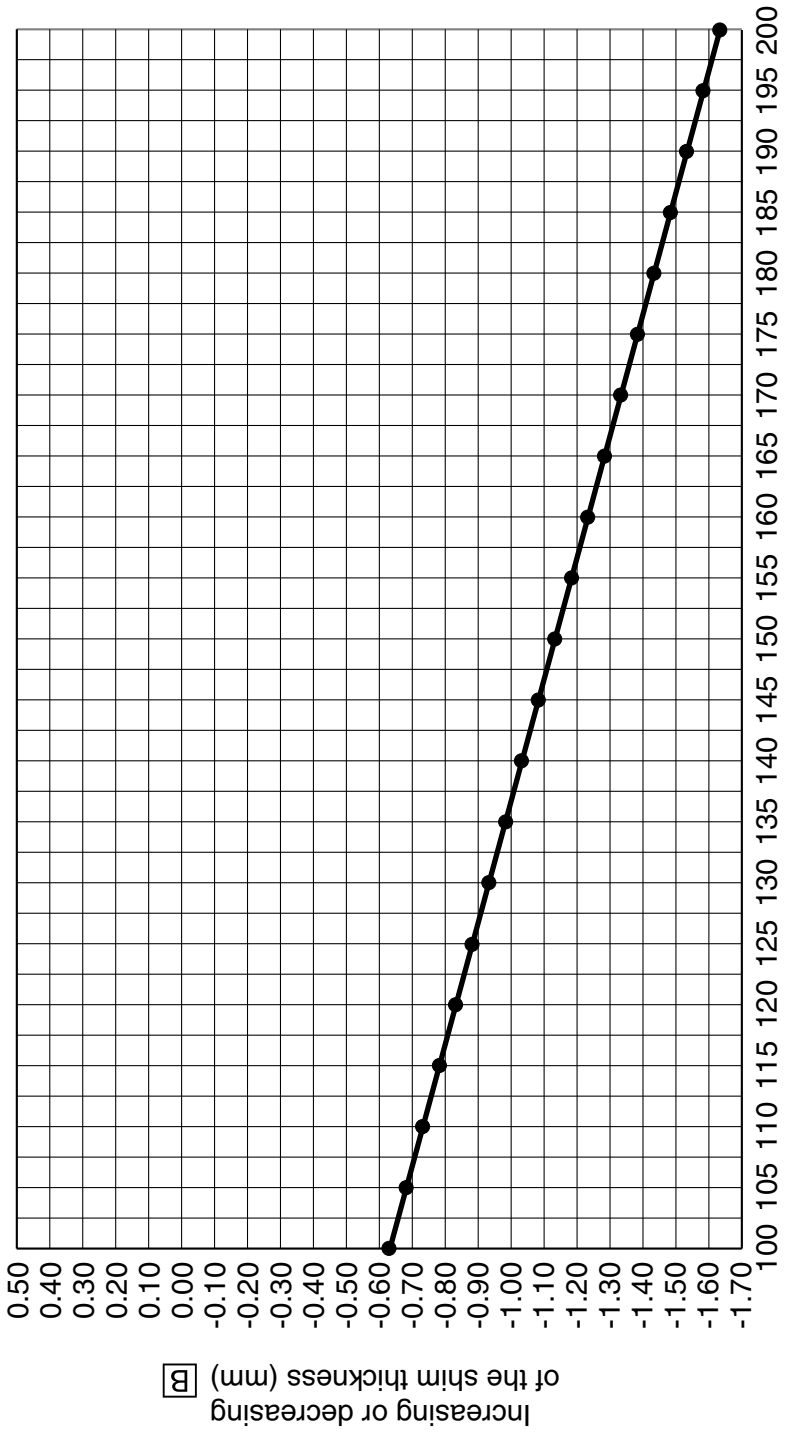
- The gray zone on the selection chart represents the specified range of the backlash. No shim adjustment is required if the measured backlash falls within the gray zone.
- In the “increasing or decreasing of the shim thickness B” column a positive number means to increase the shim, and negative number means to decrease the shim.



A (1/100 mm)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
B (mm)	0.37	0.32	0.27											-0.28	-0.33	-0.38	-0.43	-0.48	-0.53	-0.58	-0.63

S6BJ08011

S6BJ08012

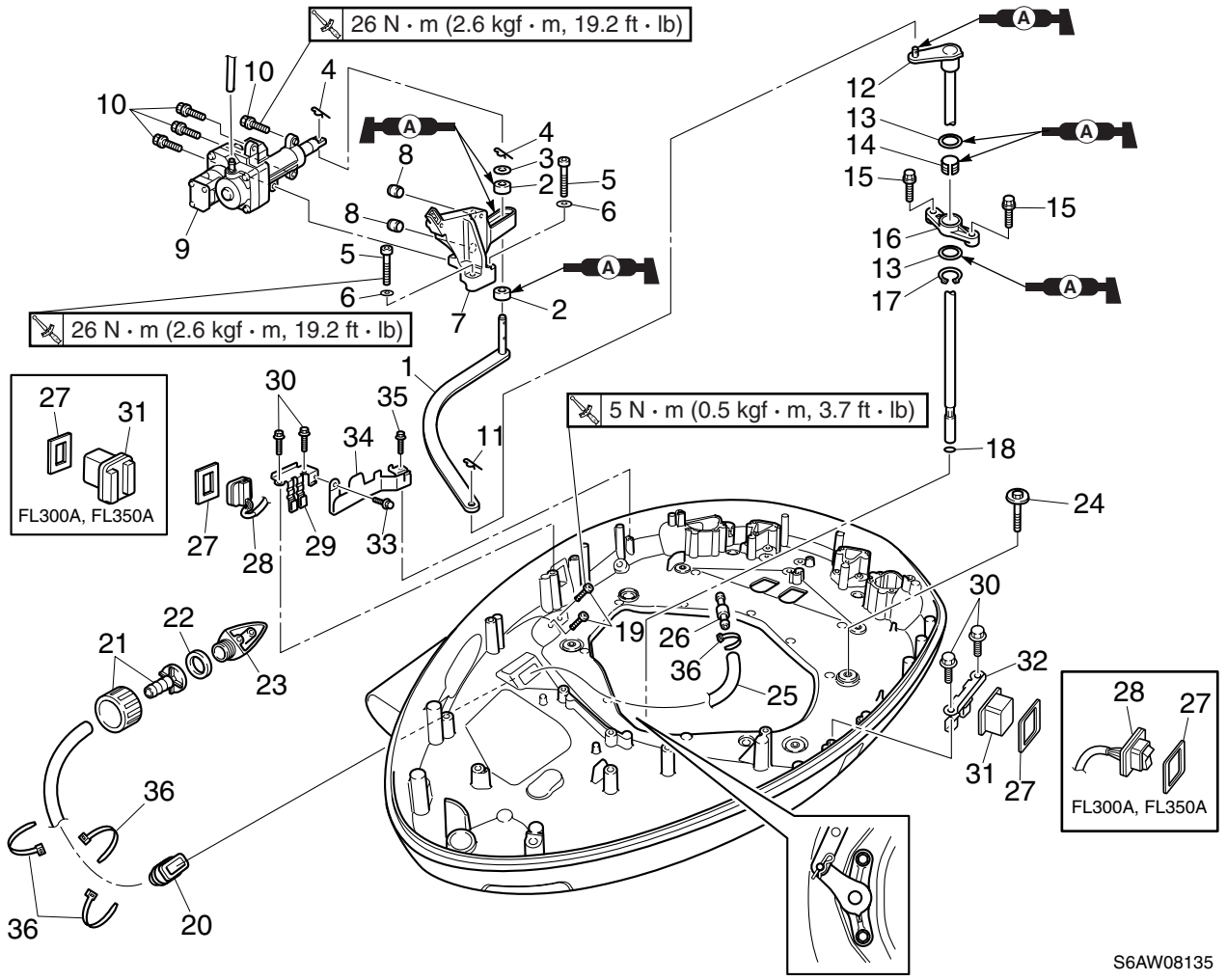


A (1/100 mm)	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
B (mm)	-0.63	-0.68	-0.73	-0.78	-0.83	-0.88	-0.93	-0.98	-1.03	-1.08	-1.13	-1.18	-1.23	-1.28	-1.33	-1.38	-1.43	-1.48	-1.53	-1.58	-1.63

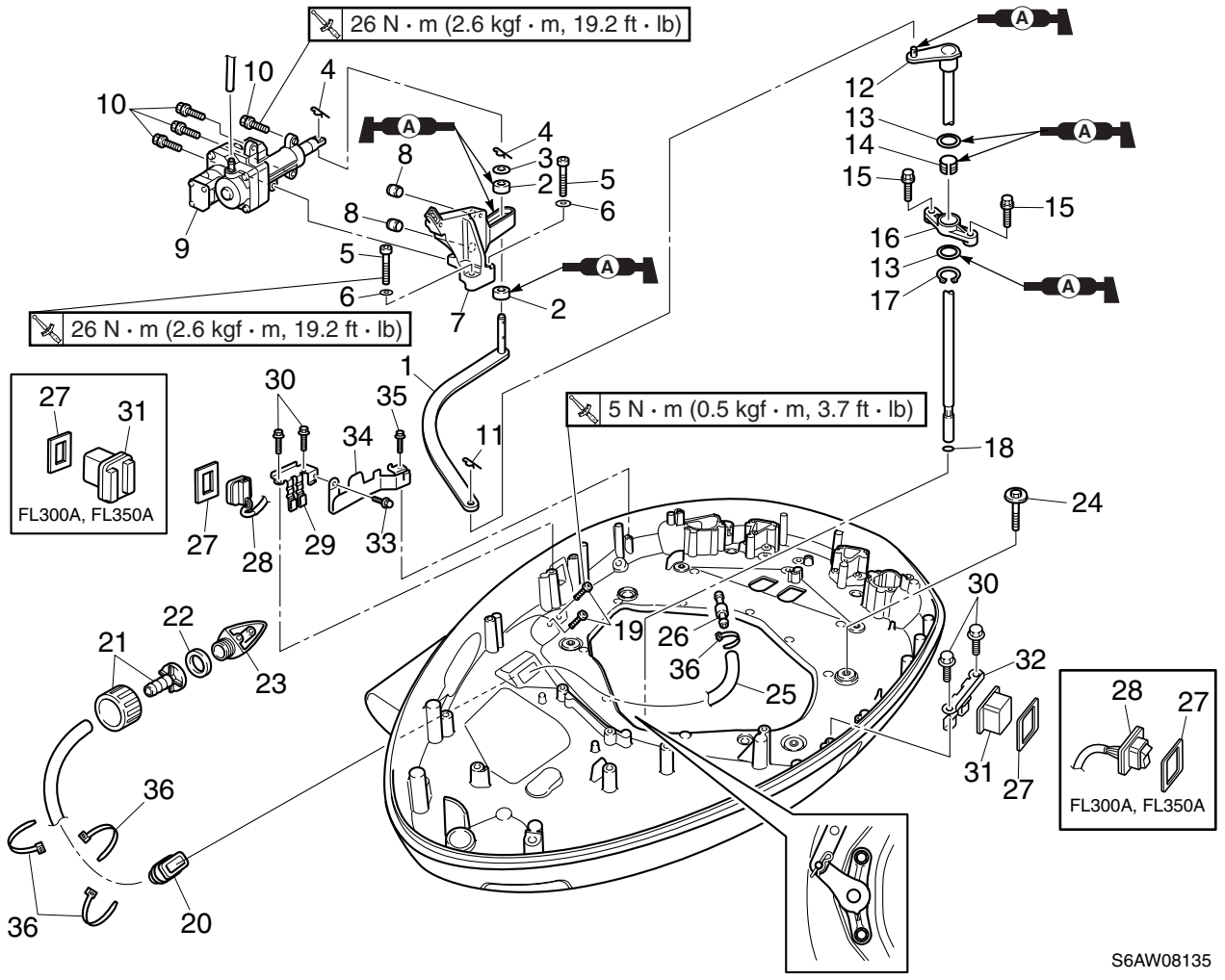
8

Bracket unit

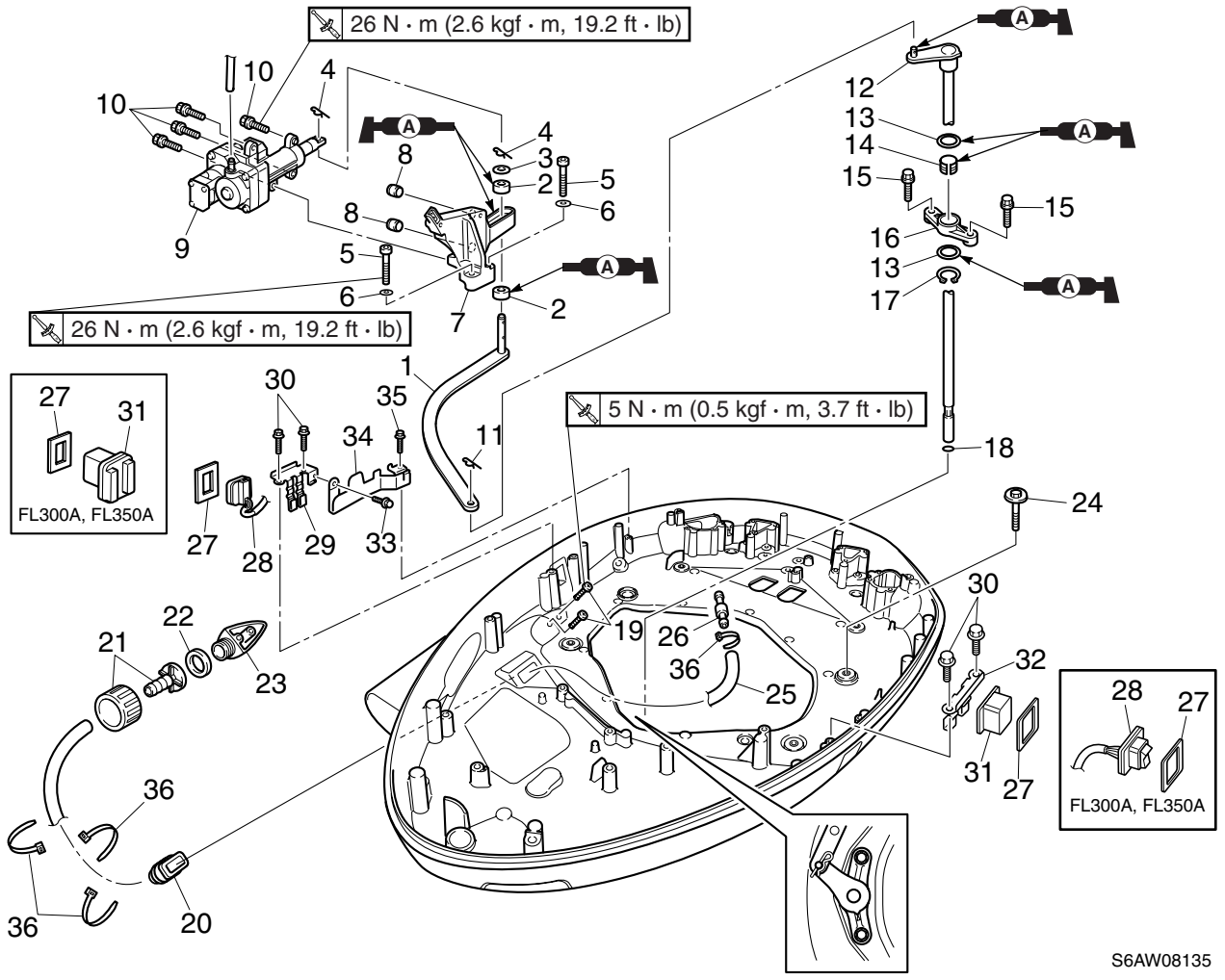
Bottom cowling



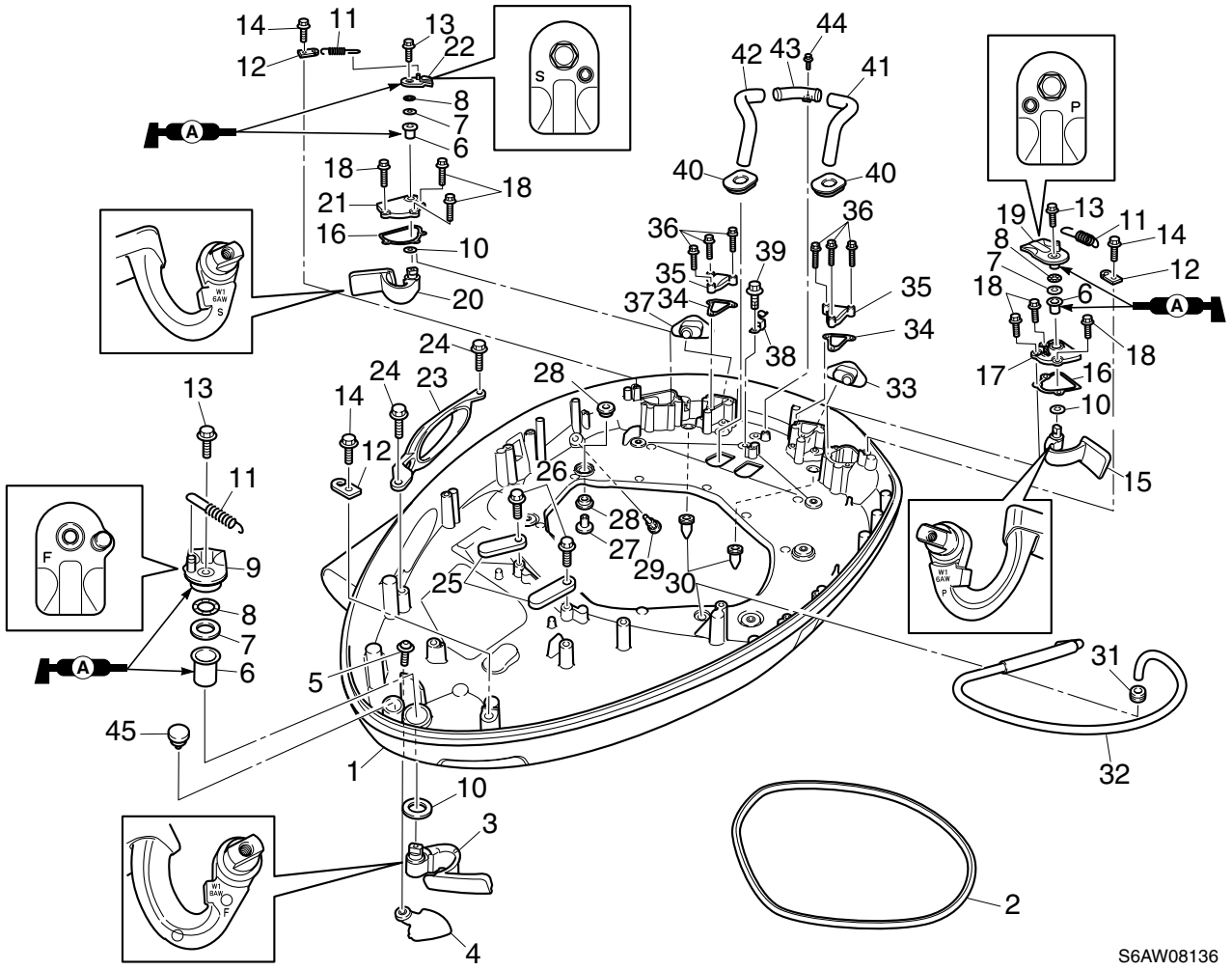
No.	Part name	Q'ty	Remarks
1	Shift lever	1	
2	Bush	2	
3	Washer	1	
4	Clip	2	
5	Bolt	2	M8 × 45 mm
6	Washer	2	
7	Bracket	1	
8	Collar	2	
9	Shift actuator	1	
10	Bolt	4	M8 × 30 mm
11	Clip	1	
12	Shift rod	1	
13	Washer	2	
14	Bush	1	
15	Bolt	2	M6 × 25 mm
16	Bracket	1	
17	Circlip	1	



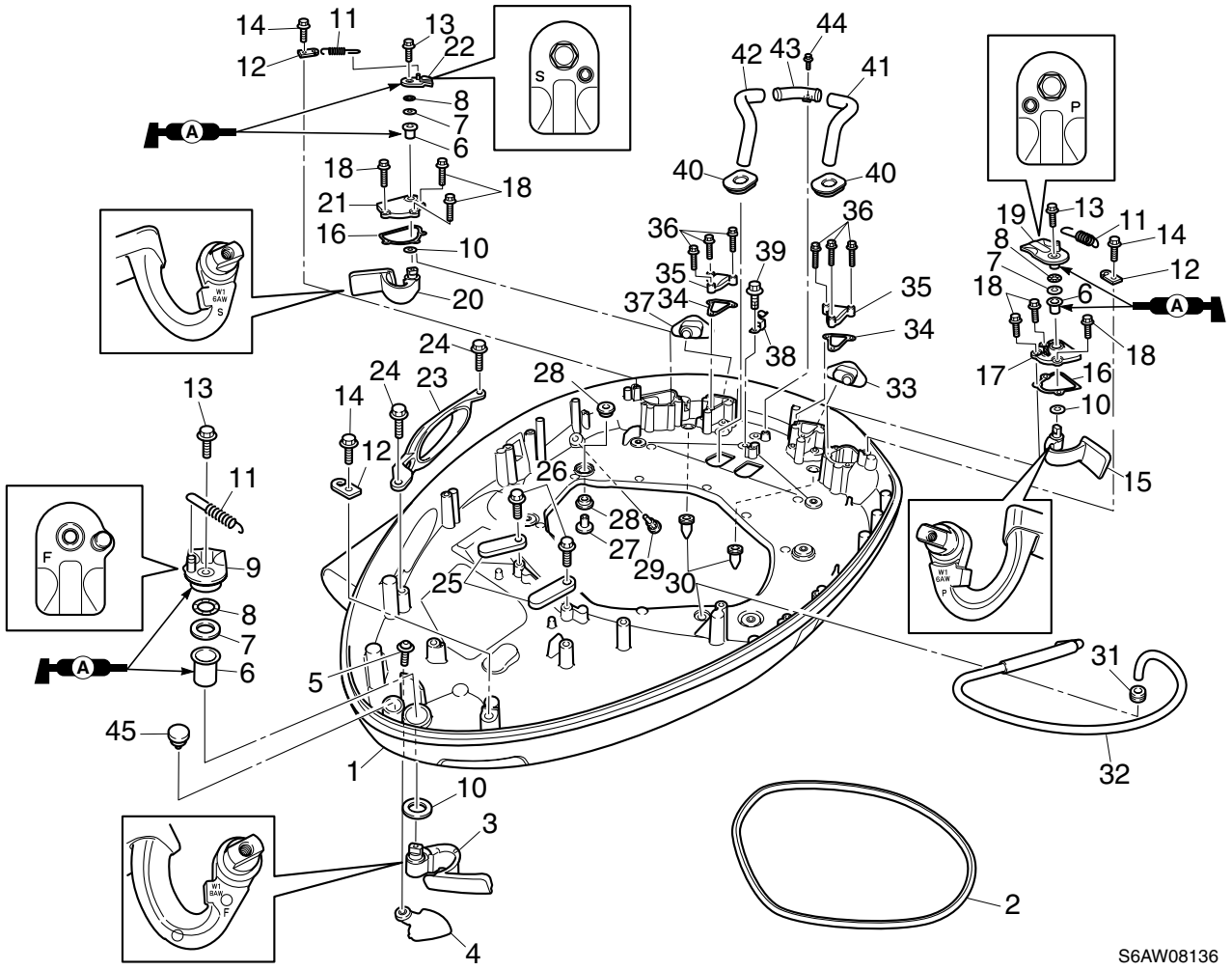
No.	Part name	Q'ty	Remarks
18	O-ring	1	**Not reusable**
19	Screw	2	ø6 × 19 mm
20	Grommet	1	
21	Hose joint	1	
22	Hose joint gasket	1	**Not reusable**
23	Hose joint adapter	1	
24	Bolt	6	M8 × 35 mm
25	Hose	1	
26	Hose joint	1	
27	Gasket	2	**Not reusable**
28	PTT switch	1	
29	Holder	1	
30	Bolt	4	M6 × 20 mm
31	Cover	1	
32	Holder	1	
33	Bolt	1	M6 × 12 mm
34	Clamp	1	



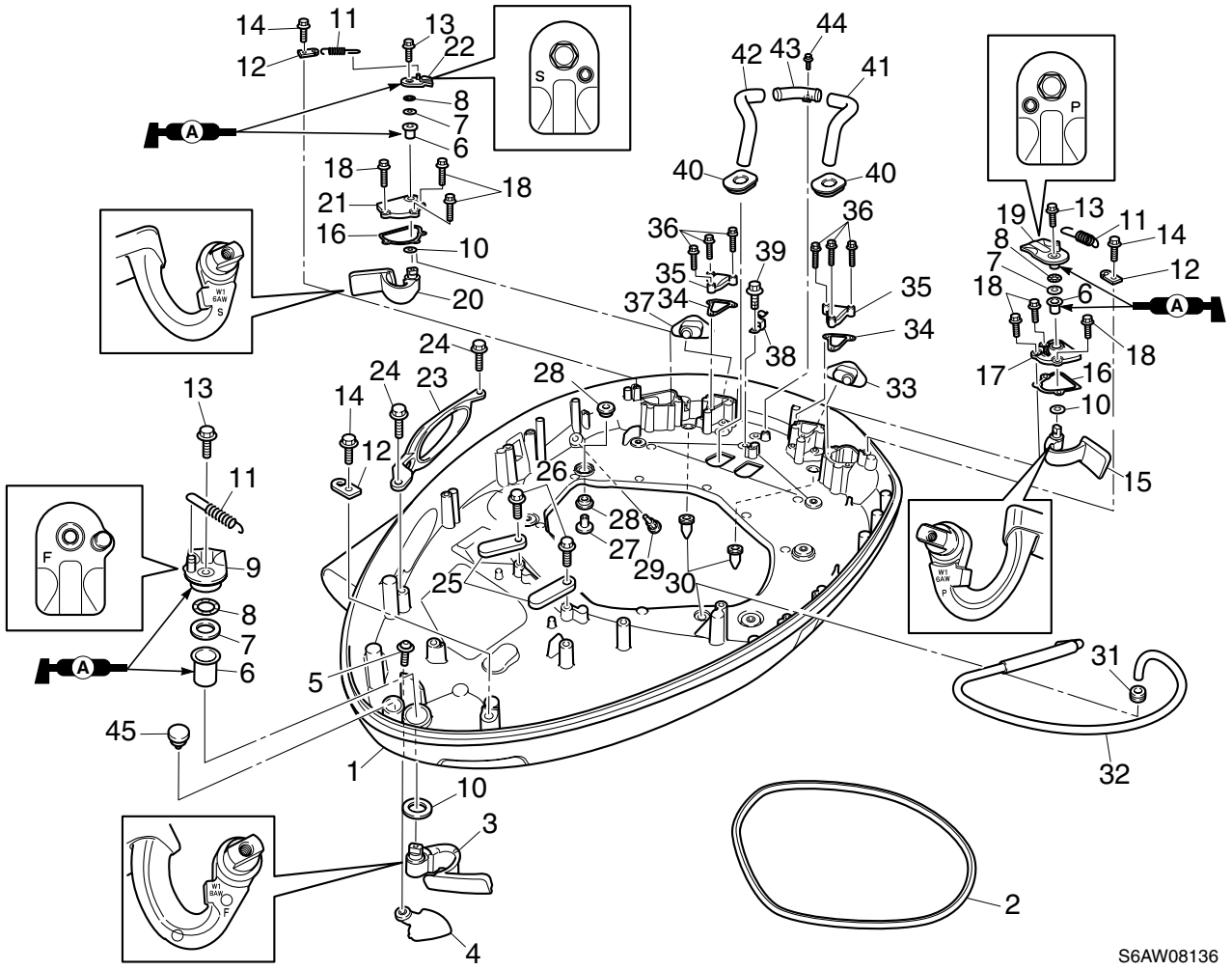
No.	Part name	Q'ty	Remarks
35	Bolt	1	M6 × 20 mm
36	Plastic tie	4	**Not reusable**



No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Cowling lock lever	1	
4	Cover	1	
5	Bolt	1	M6 × 12 mm
6	Bush	3	
7	Washer	3	
8	Wave washer	3	
9	Lever	3	
10	Washer	3	
11	Spring	3	
12	Hook	3	
13	Bolt	3	M6 × 20 mm
14	Bolt	3	M6 × 20 mm
15	Cowling lock lever	1	
16	Gasket	2	**Not reusable**
17	Plate	1	



No.	Part name	Q'ty	Remarks
18	Bolt	6	M6 × 25 mm
19	Lever clamp	1	
20	Cowling lock lever	1	
21	Plate	1	
22	Lever clamp	1	
23	Protector	1	
24	Bolt	2	M6 × 20 mm
25	Plate	2	
26	Bolt	2	M6 × 20 mm
27	Collar	6	
28	Grommet	12	
29	Hose nipple	1	
30	Rubber seal	2	
31	Grommet	1	
32	Hose	1	
33	Rubber seal	1	
34	Gasket	2	**Not reusable**

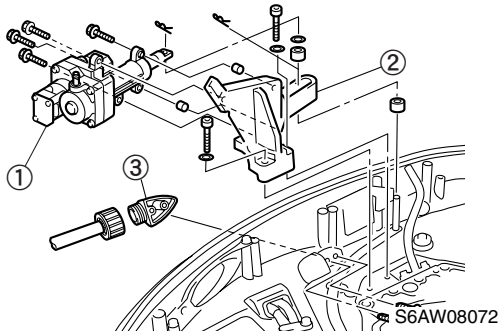


No.	Part name	Q'ty	Remarks
35	Cover	2	
36	Bolt	6	M6 × 25 mm
37	Rubber seal	1	
38	Stay	1	
39	Bolt	1	M6 × 20 mm
40	Grommet	2	
41	Hose	1	
42	Hose	1	
43	Pipe	1	
44	Bolt	1	M6 × 20 mm
45	Grommet	1	

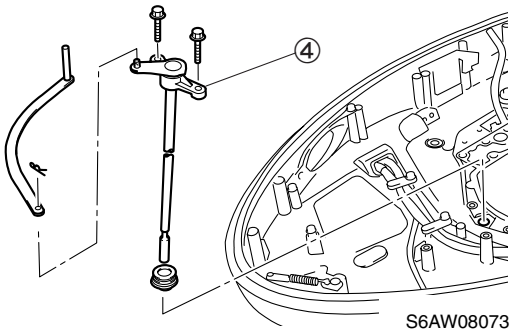
Removing the shift actuator and shift rod

Remove the power unit before carrying out this operation. See “Removing the power unit” (7-18).

1. Remove the shift actuator ① and shift bracket ②, and then remove the flushing hose joint adapter ③.
   To check the shift actuator ①, see “Checking the shift actuator” (5-31).

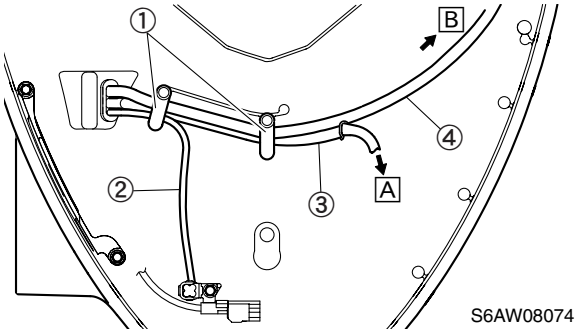


2. Remove the shift rod assembly ④.



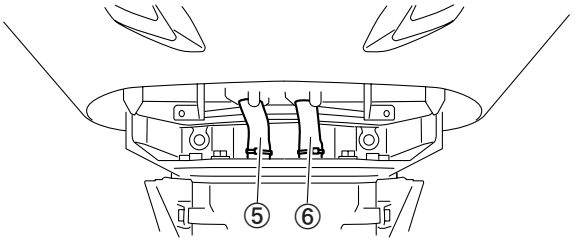
Removing the bottom cowling

1. Remove the plates ①, and then pull out the PTT sensor lead ②, PTT motor lead ③, and flushing hose ④.

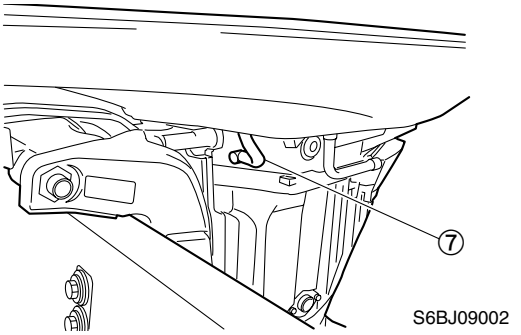


A To the PTT relay
B To the cooling water passage cover (via the joint)

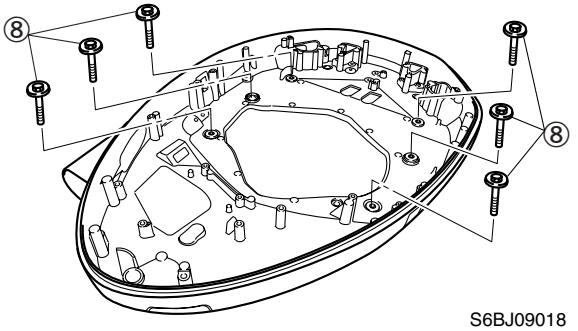
2. Disconnect the cooling water hoses ⑤ and ⑥.



3. Disconnect the cooling water hose ⑦.

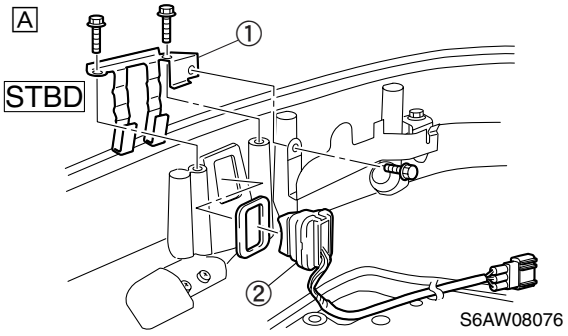


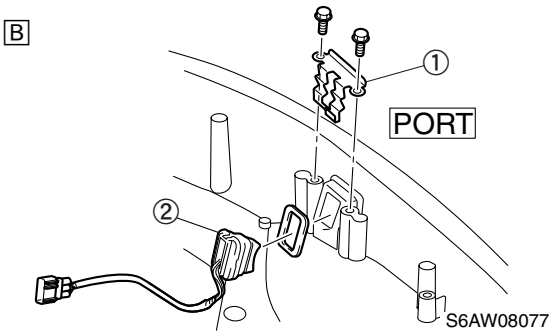
4. Remove the bolt ⑧, and remove the bottom cowling.



Disassembling the bottom cowling

1. Remove the holder ①, and then remove the PTT switch ②.
   To check the PTT switch, see “Checking the PTT switch (on bottom cowling)” (9-56).

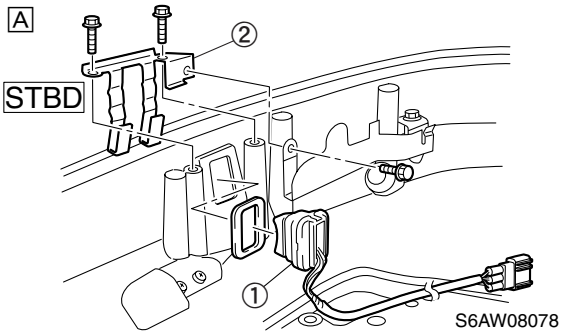


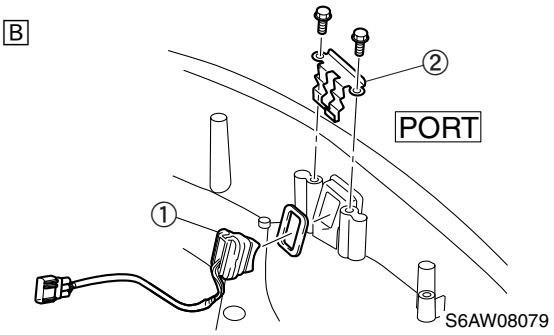


A Regular rotation model
B Counter rotation model

Assembling the bottom cowling

1. Install the PTT switch ① and holder ②.





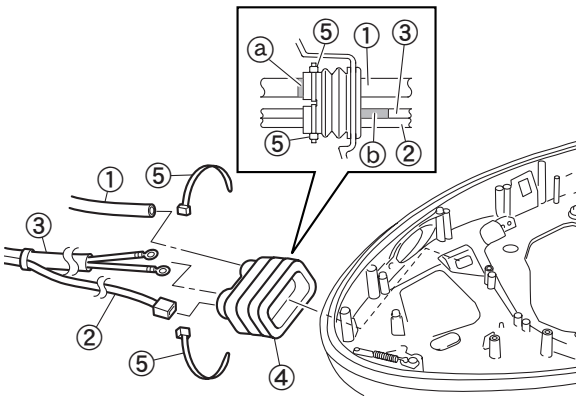
A Regular rotation model
B Counter rotation model

Installing the bottom cowling

1. Install the bottom cowling on the upper case assembly, and then tighten the bolts.

2. Put the flushing hose ①, PTT sensor lead ②, and PTT motor leads ③ through the grommet ④, and then secure them by fastening the plastic ties ⑤ around the grommet as shown.

3. Install the grommet ④ to the bottom cowling.



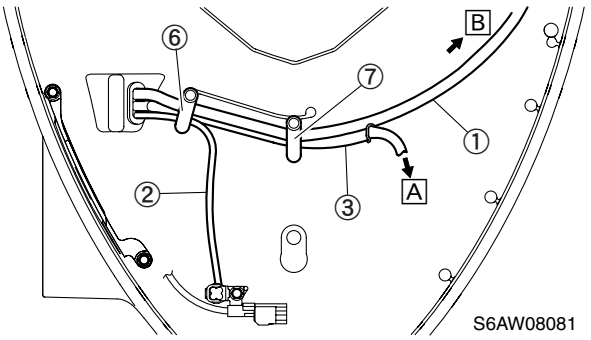
S6AW08080

NOTE:

Make sure that the white paint mark ⓐ on the flushing hose ① and the white tape ⓑ on the PTT motor leads ③ are positioned as shown.

4. Install the flushing hose ①, PTT motor lead ③, and PTT sensor lead ② with the plate ⑥.

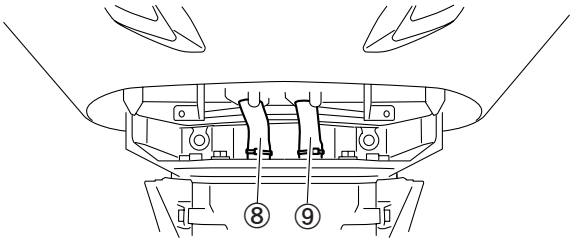
5. Install the flushing hose ① and PTT motor lead ③ with the plate ⑦.



S6AW08081

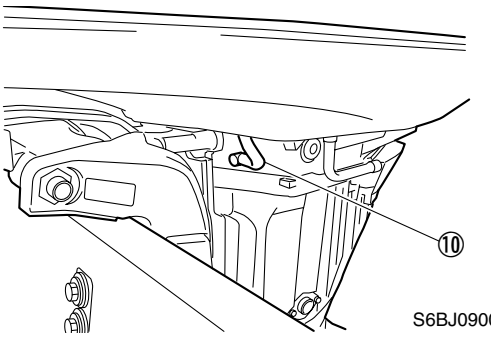
A To the PTT relay
B To the cooling water passage cover (via the joint)

6. Connect the cooling water hoses ⑧ and ⑨.



S6BJ09003

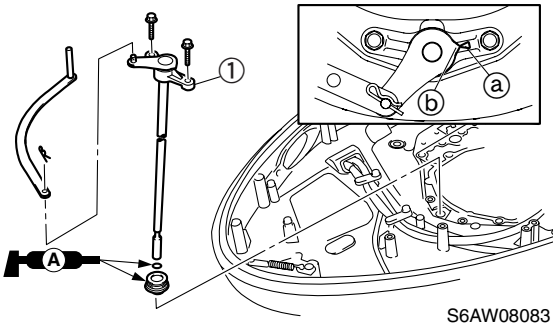
7. Connect the cooling water hose ⑩.



S6BJ09004

Installing the shift actuator and shift rod

1. Install the shift rod assembly ①, and then align the mark ⓐ with the mark ⓑ on the bottom cowling.

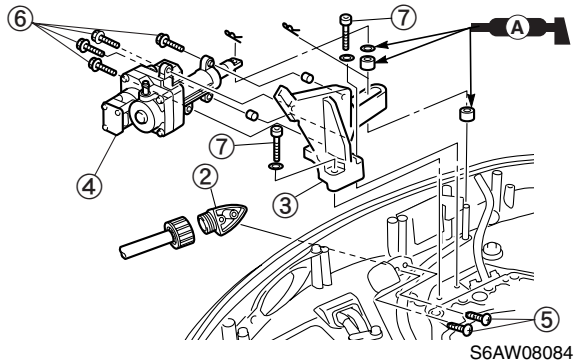


S6AW08083

NOTE:

Be sure to install the shift rod assembly onto the bottom cowling before installing the power unit.

2. Install the flushing hose joint adapter ②, and then install the shift bracket ③ and the shift actuator ④.



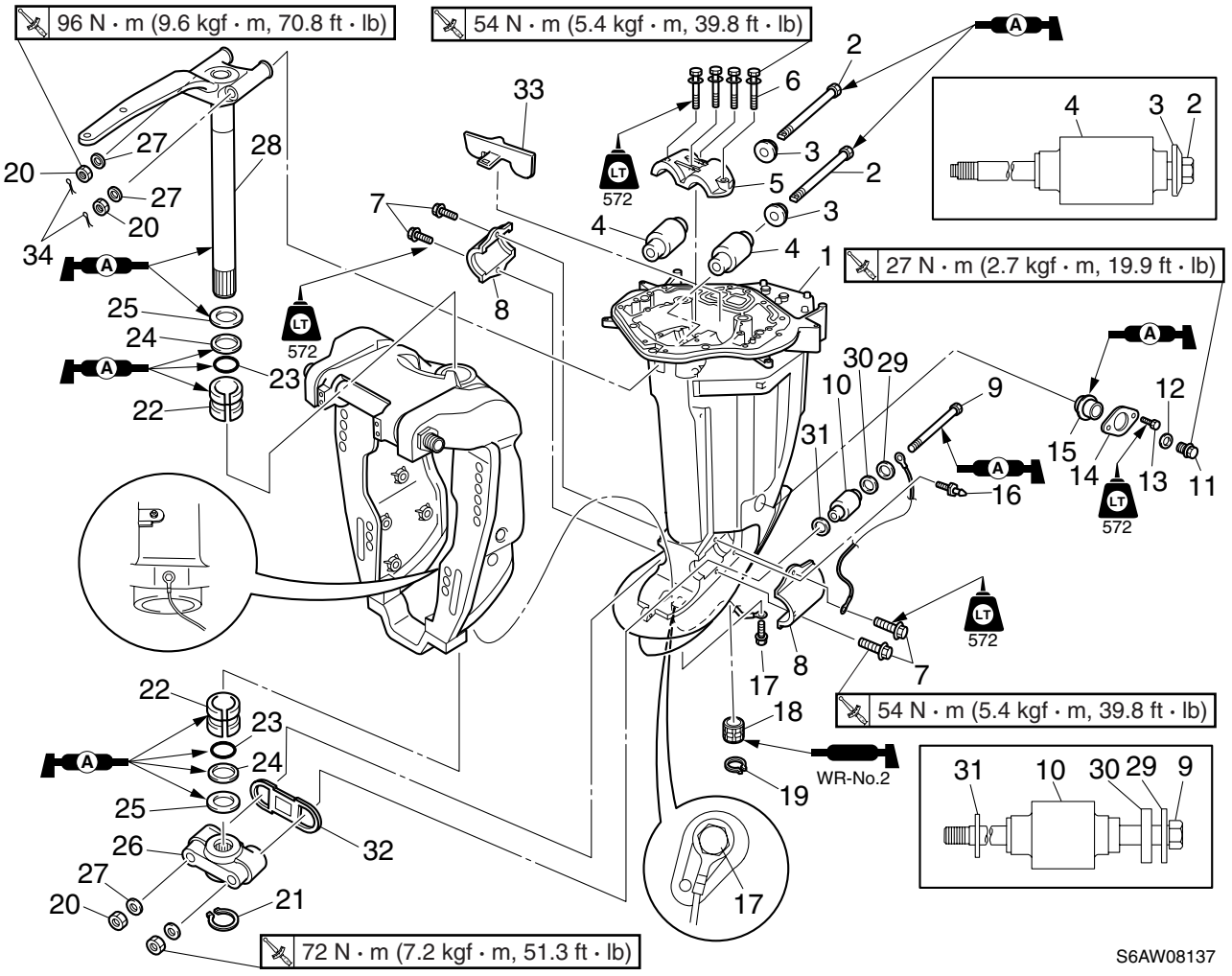
S6AW08084

NOTE:

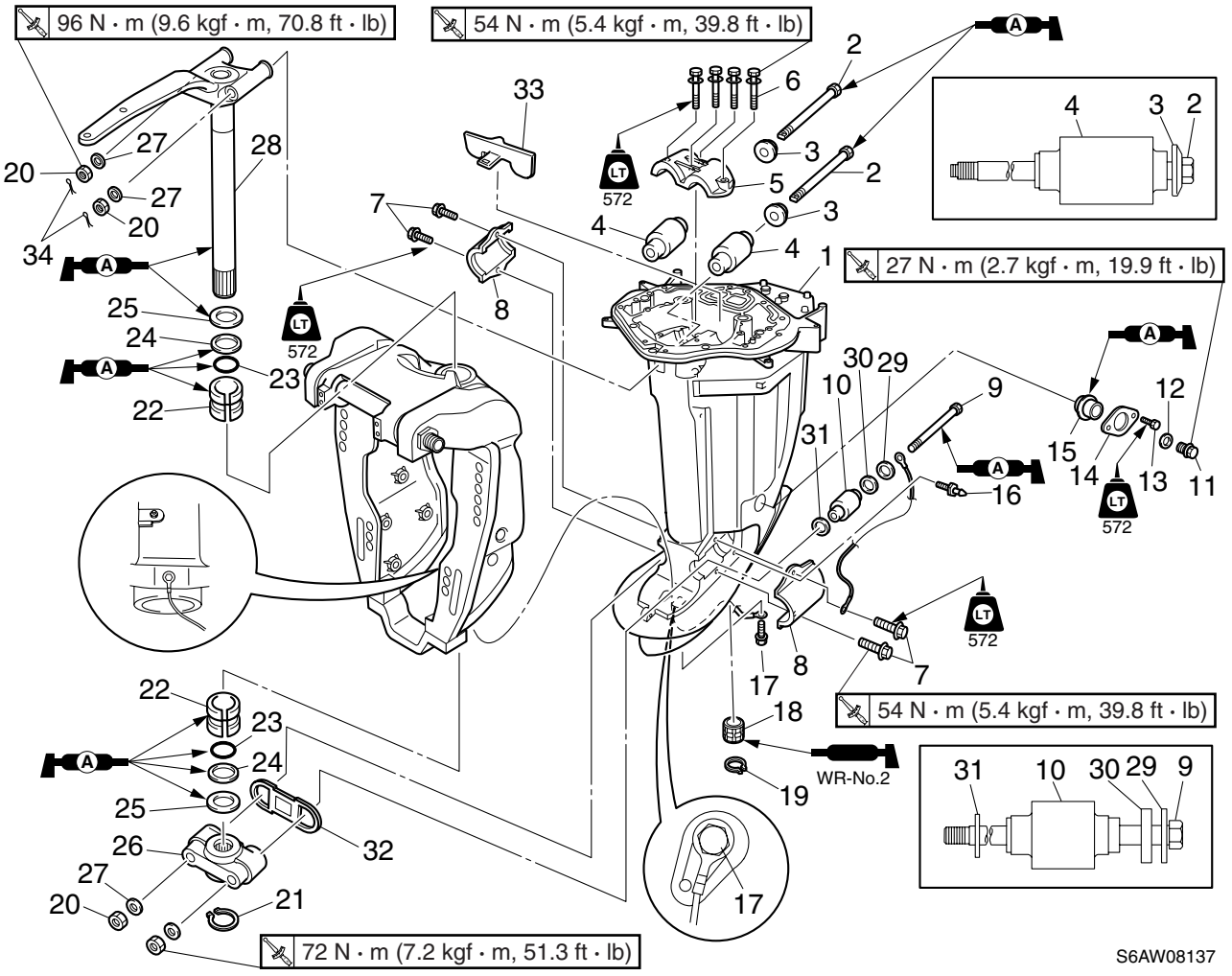
Be sure to install the shift actuator ④ onto the bottom cowling before installing the power unit.

	Hose joint adapter screw ⑤: 5 N·m (0.5 kgf·m, 3.7 ft·lb) Shift-actuator bolt ⑥: 26 N·m (2.6 kgf·m, 19.2 ft·lb) Shift bracket bolt ⑦: 26 N·m (2.6 kgf·m, 19.2 ft·lb)

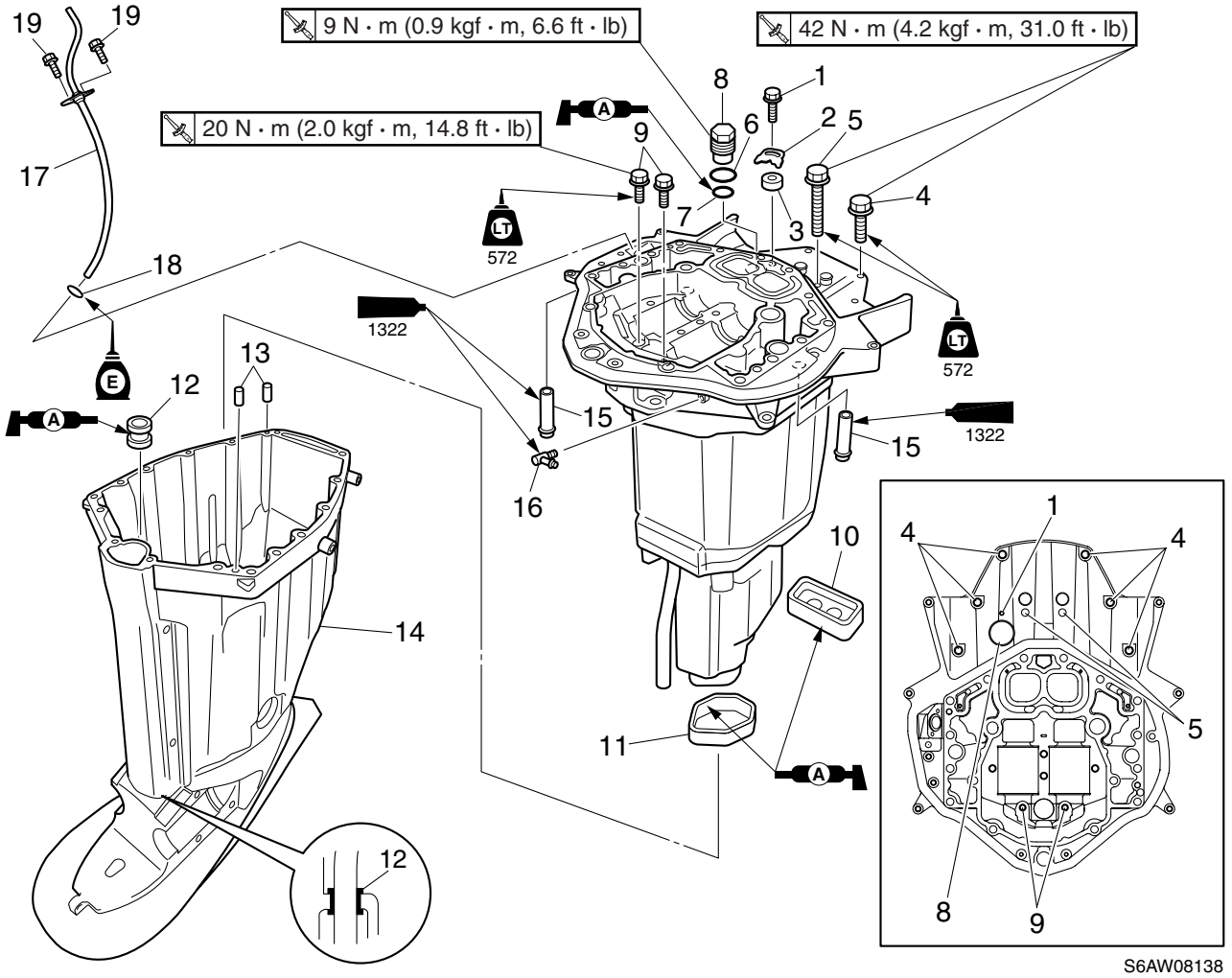
Upper case and steering arm



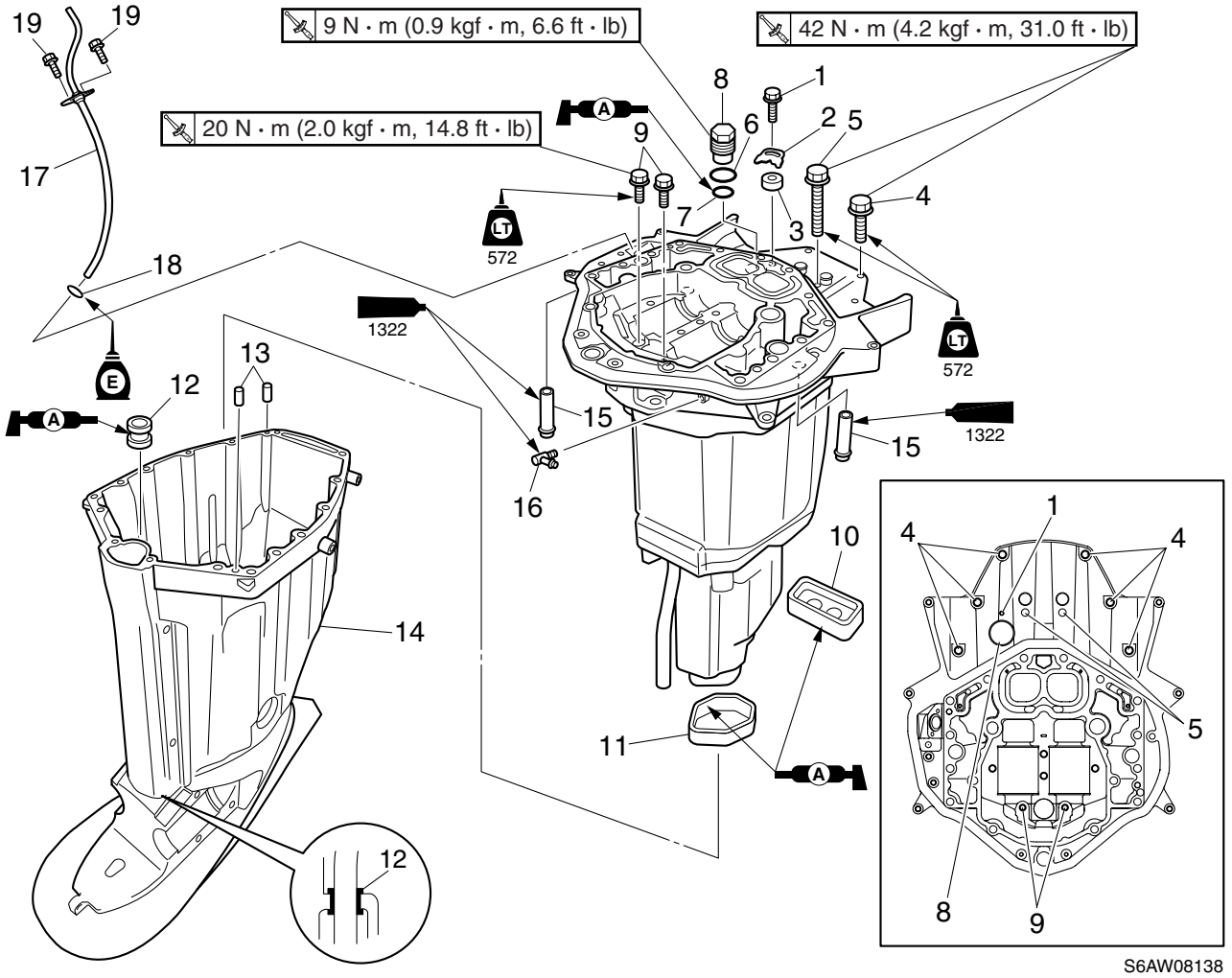
No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Bolt	2	M14 × 225 mm
3	Washer	2	
4	Upper mount	2	
5	Bracket	1	
6	Bolt	4	M10 × 45 mm
7	Bolt	4	M10 × 45 mm
8	Bracket	2	
9	Bolt	2	M14 × 225 mm
10	Lower mount	2	
11	Drain bolt	1	M14 × 12 mm
12	Gasket	1	**Not reusable**
13	Bolt	2	M6 × 14 mm
14	Cover	1	
15	Damper	1	
16	Apron stay	2	
17	Bolt	1	M6 × 10 mm



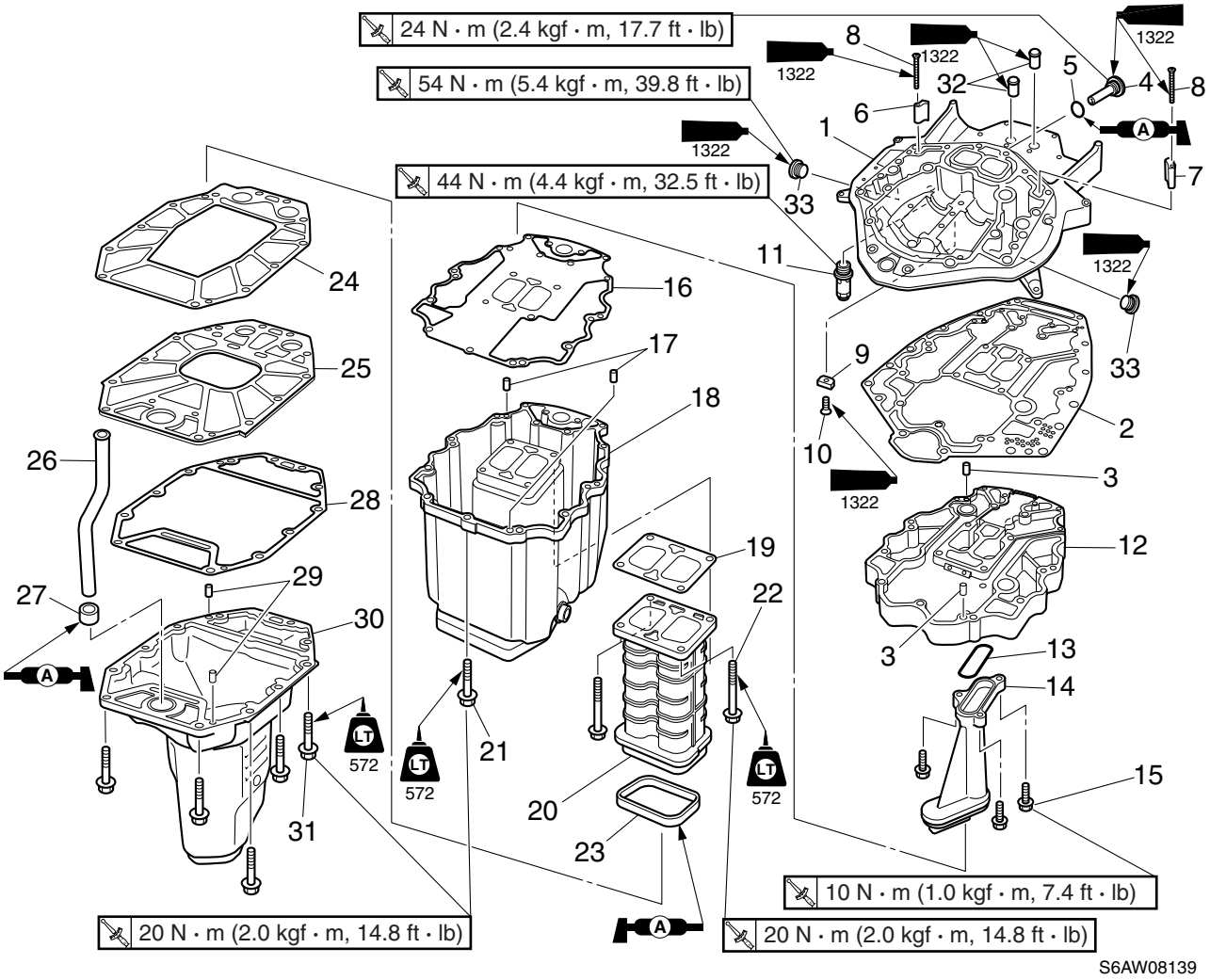
No.	Part name	Q'ty	Remarks
18	Bushing	1	
19	Circlip	1	
20	Self-locking nut	4	
21	Circlip	1	
22	Bushing	2	
23	O-ring	2	**Not reusable**
24	Bushing	2	
25	Washer	2	
26	Steering yoke	1	
27	Washer	4	
28	Steering arm	1	
29	Washer	2	
30	Washer	2	
31	Washer	2	
32	Damper rubber	1	
33	Damper rubber	1	
34	Cotter pin	2	**Not reusable**



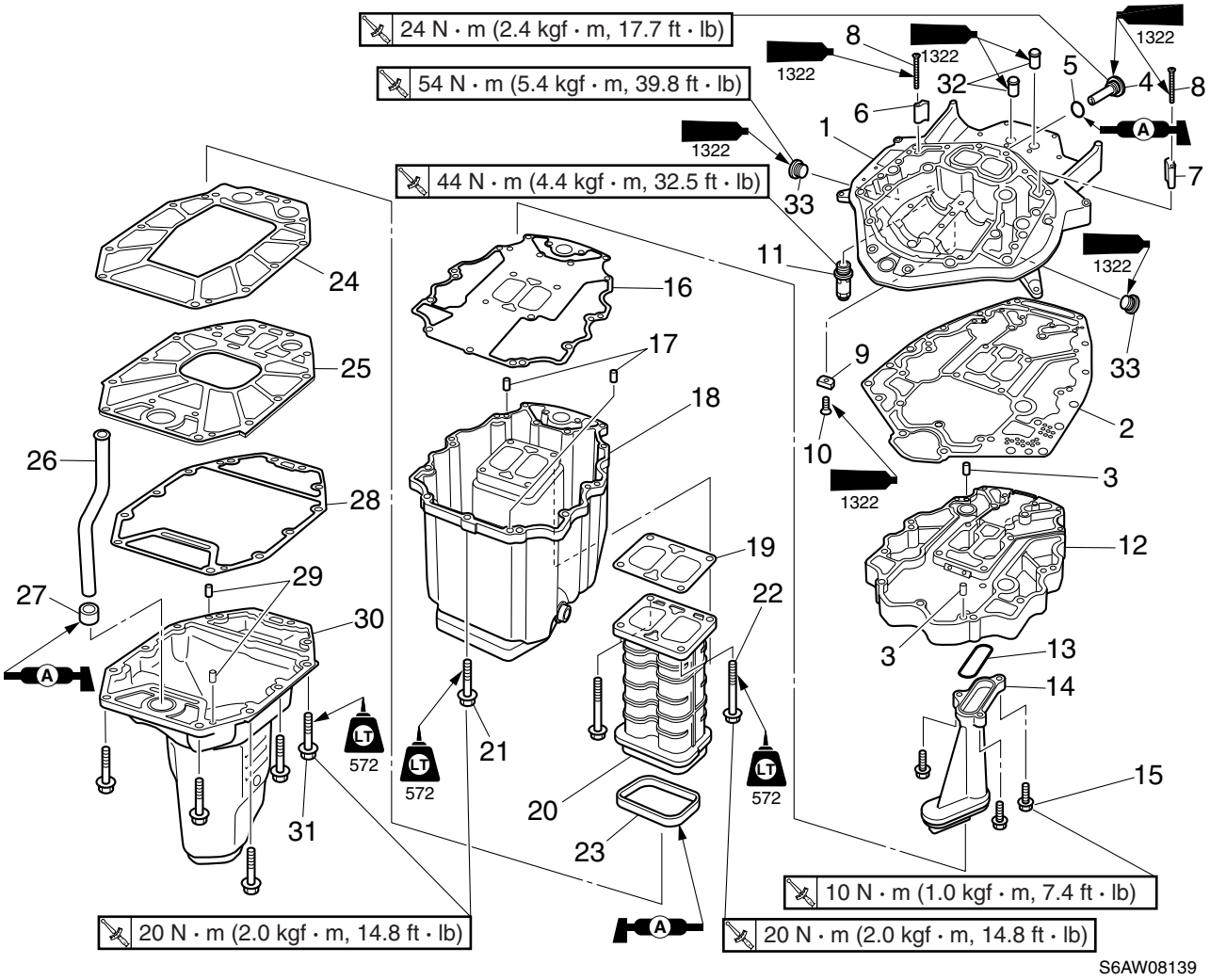
No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 20 mm
2	Plate	1	
3	Collar	1	
4	Bolt	6	M10 × 45 mm
5	Bolt	2	M10 × 85 mm
6	O-ring	1	**Not reusable**
7	O-ring	1	**Not reusable**
8	PCV	1	
9	Bolt	2	M8 × 30 mm
10	Rubber seal	1	
11	Rubber seal	1	
12	Rubber seal	1	
13	Dowel	2	
14	Upper case	1	
15	Pipe	2	
16	Hose nipple	1	
17	Dipstick guide	1	



No.	Part name	Q'ty	Remarks
18	O-ring	1	**Not reusable**
19	Bolt	2	M6 × 16 mm



No.	Part name	Q'ty	Remarks
1	Upper exhaust guide	1	
2	Gasket	1	**Not reusable**
3	Dowel	2	
4	Anode	1	
5	O-ring	1	**Not reusable**
6	Anode	1	
7	Anode	1	
8	Screw	2	ø5 × 50 mm
9	Anode	1	
10	Screw	1	ø5 × 10 mm
11	Relief valve	1	
12	Lower exhaust guide	1	
13	Gasket	1	**Not reusable**
14	Oil strainer	1	
15	Bolt	3	M6 × 25 mm
16	Gasket	1	**Not reusable**
17	Dowel	2	

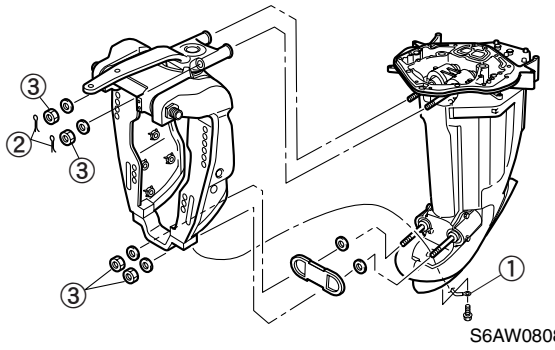


No.	Part name	Q'ty	Remarks
18	Oil pan	1	
19	Gasket	1	**Not reusable**
20	Exhaust manifold	1	
21	Bolt	13	M8 × 70 mm
22	Bolt	4	M8 × 95 mm
23	Rubber seal	1	
24	Gasket	1	**Not reusable**
25	Plate	1	
26	Pipe	1	
27	Rubber seal	1	
28	Gasket	1	**Not reusable**
29	Dowel	2	
30	Muffler	1	
31	Bolt	12	M8 × 35 mm
32	Pipe	2	
33	Plug	2	

Removing the upper case

It is recommended to drain the engine oil before removing the upper case.
Be sure to remove the shift rod assembly before removing the upper case assembly from the clamp bracket.

1. Disconnect the ground lead ①.
2. Remove the cotter pins ②.
3. Loosen the upper and lower mount bracket bolts.
4. Remove the upper and lower mounting nuts ③, and then remove the upper case assembly.



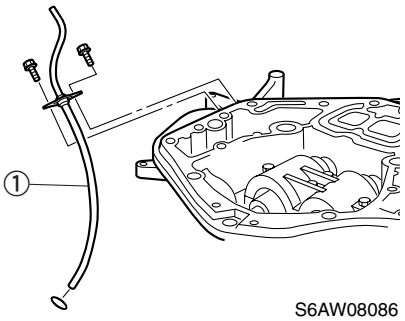
S6AW08085

Checking the ground lead

1. Check the ground lead. Replace if damaged.

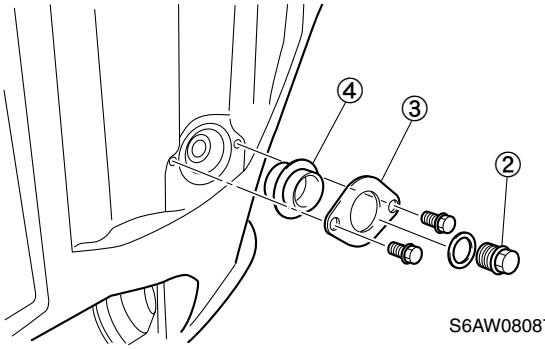
Disassembling the upper case

1. Remove the dipstick guide ①.



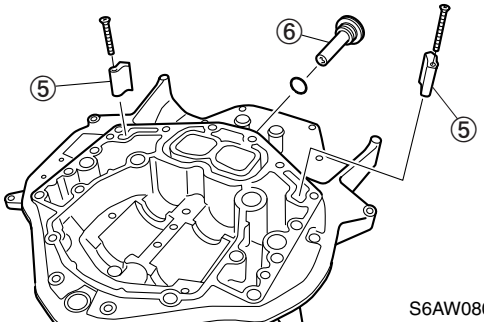
S6AW08086

2. Remove the engine oil drain bolt ②, cover ③, and damper ④.



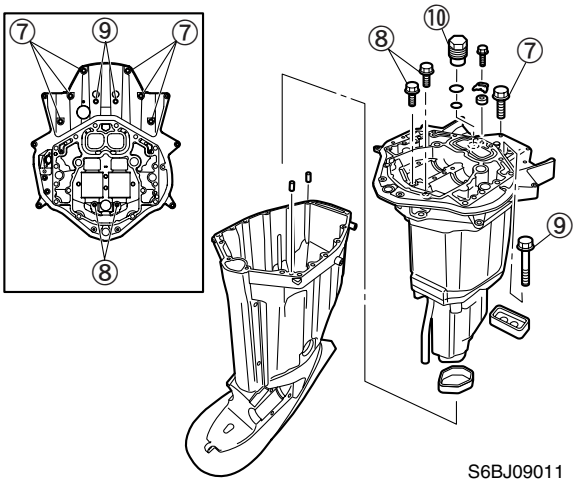
S6AW08087

3. Remove the upper mounts and lower mounts.
4. Remove the anodes ⑤ and ⑥.



S6AW08088

5. Remove the upper case bolts ⑦, ⑧ and ⑨, PCV ⑩, and then remove the oil pan assembly.

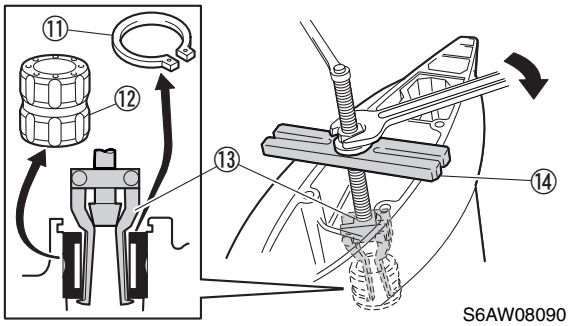


S6BJ09011

NOTE:

The bolts ⑨ is used to install the lower exhaust guide onto the upper exhaust guide.

6. Remove the circlip ⑪, and then remove the bushing ⑫.



S6AW08090

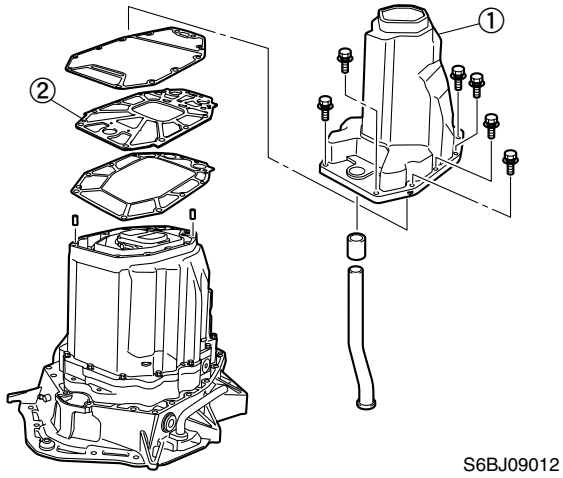
Bearing puller assembly ⑬: 90890-06535
Stopper guide plate ⑭: 90890-06501

Checking the drive shaft bushing

1. Check the bushing. Replace if cracked or worn.

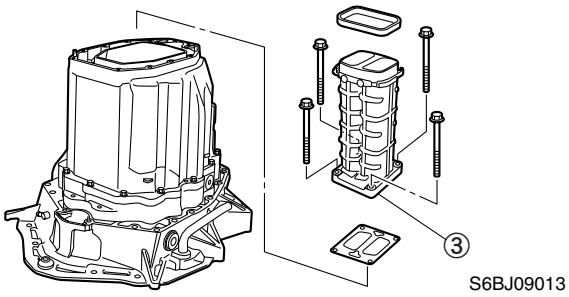
Disassembling the oil pan and exhaust manifold

1. Remove the muffler ① and plate ②.



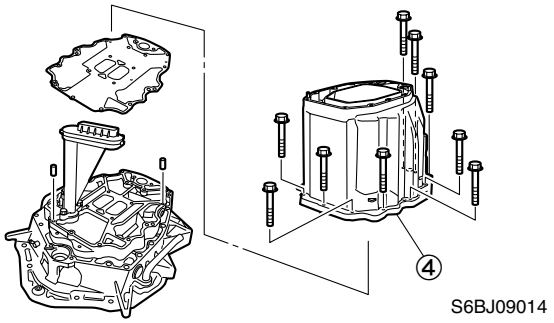
S6BJ09012

2. Remove the exhaust manifold ③.



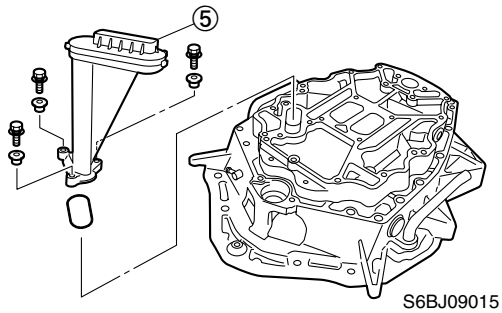
S6BJ09013

3. Remove the oil pan ④.



S6BJ09014

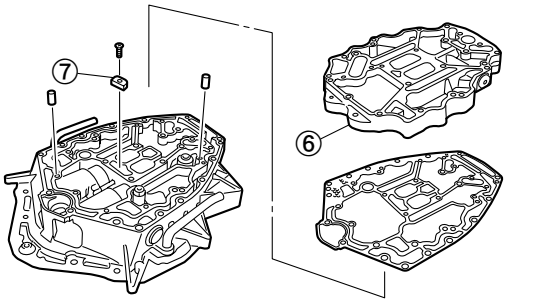
4. Remove the oil strainer ⑤.



S6BJ09015

5. Remove the lower exhaust guide ⑥.

6. Remove the anode ⑦.



S6BJ09016

9

Checking the oil pan and exhaust manifold

1. Clean the removed parts.
2. Check the exhaust guides, exhaust manifold, and muffler. Replace the exhaust guides, exhaust manifold, and muffler if cracked or if there is corrosion.
3. Check the oil pan. Replace the oil pan if cracked or if there is corrosion.

Checking the oil strainer

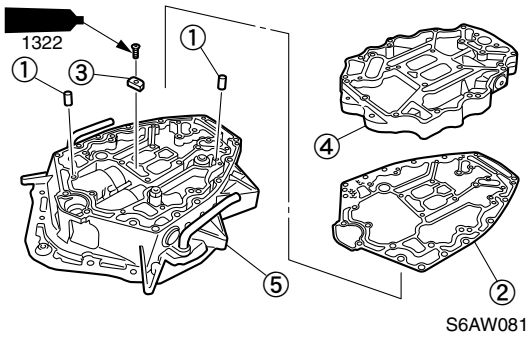
1. Check the oil strainer. Clean the oil strainer if there is dirt and residue.

Checking the anodes

1. Check the anodes. Replace if excessive wear.

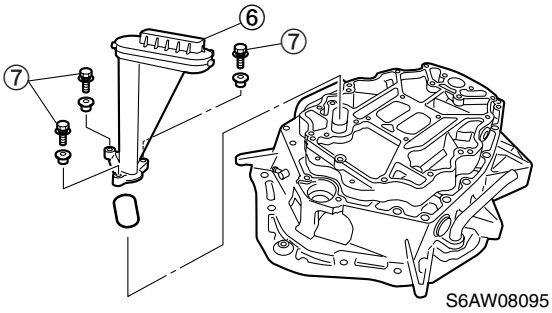
Assembling the oil pan and exhaust manifold

1. Install the dowels ①, a new gasket ②, anode ③, and the lower exhaust guide ④ onto the upper exhaust guide ⑤.



S6AW08146

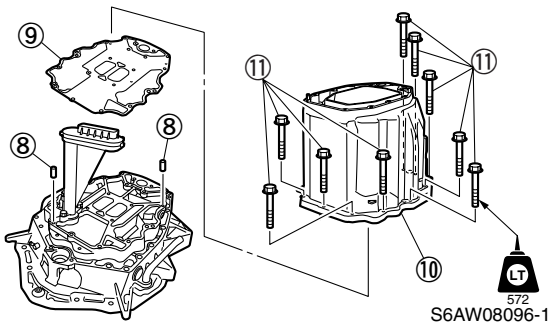
2. Install a new gasket, the oil strainer ⑥ and bolts ⑦, and then tighten the bolts to the specified torque.



S6AW08095

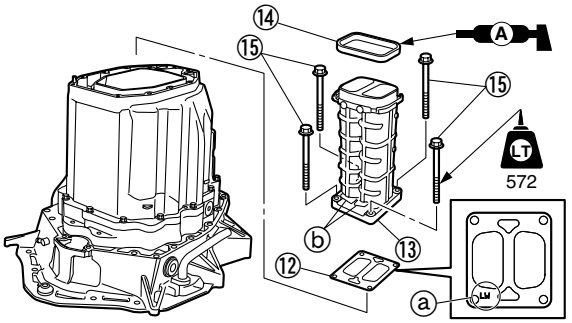
Oil strainer bolt ⑦:
10 N·m (1.0 kgf·m, 7.4 ft·lb)

3. Install the dowels ⑧, a new gasket ⑨ and the oil pan ⑩, and then tighten the oil pan bolts ⑪ temporarily.



S6AW08096-1

4. Install a new gasket ⑫ with the "LW" mark ⓐ facing the lower case.
5. Install the exhaust manifold ⑬ with the projection ⓑ facing the drive shaft. Then, install the rubber seal ⑭.
6. Tighten the exhaust manifold bolts ⑮ first, and then tighten the oil pan bolts ⑪ to the specified torques.

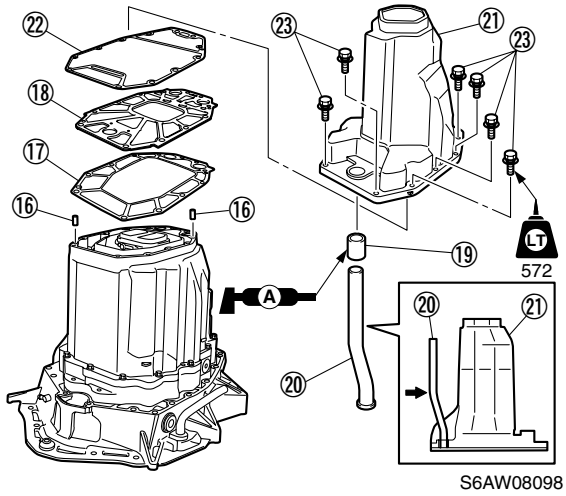


S6AW08097

Exhaust manifold bolt ⑮:
20 N·m (2.0 kgf·m, 14.8 ft·lb)
Oil pan bolt ⑪:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

7. Install the dowels ⑯, a new gasket ⑰, and the plate ⑱.
8. Install the rubber seal ⑲ and cooling water pipe ⑳ into the muffler ㉑ as shown.

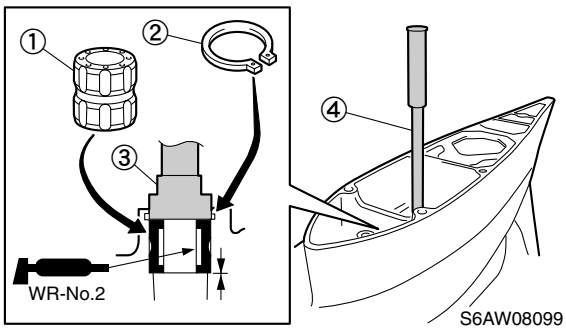
9. Install a new gasket ㉒, the muffler ㉑ and bolts ㉓ onto the oil pan, and then tighten the bolts ㉓ to the specified torque.



Muffler bolt ㉓:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

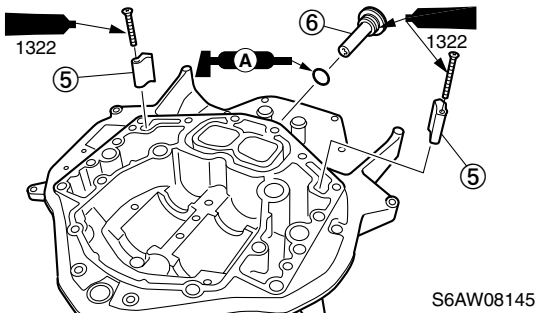
Assembling the upper case

1. Install the drive shaft bushing ① into the upper case, and then install the circlip ②.



Needle bearing attachment ③:
90890-06653
Driver rod L3 ④: 90890-06652

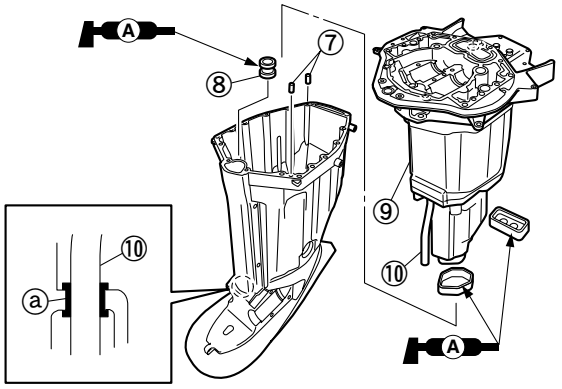
2. Install the anodes ⑤ and ⑥.



3. Install the dowels ⑦ onto the upper case.

4. Install the rubber seal ⑧ into the joint hole ⓐ of the upper case.

5. Install the oil pan assembly ⑨.

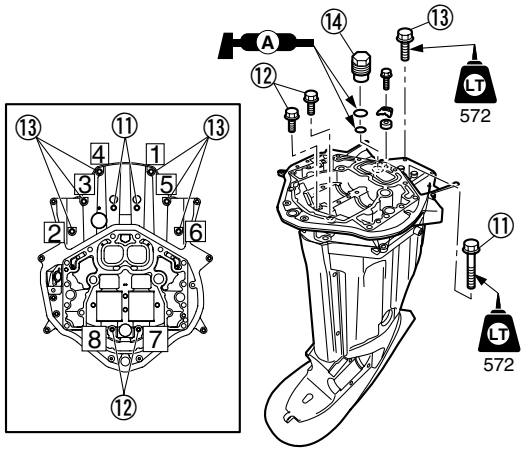


NOTE:
Be sure to insert the tip of the cooling water pipe ⑩ into the joint hole ⓐ of the upper case.

6. Install the oil pan assembly bolts ⑪, and then tighten them to the specified torque.

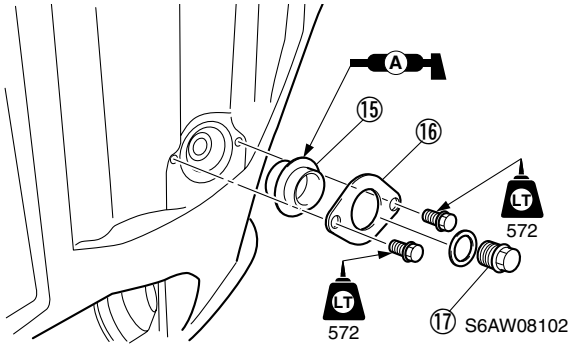
7. Install the upper case bolts ⑫ and ⑬, and then tighten them to the specified torque as shown in the illustration.

8. Install the PCV ⑭, and then tighten it to the specified torque.



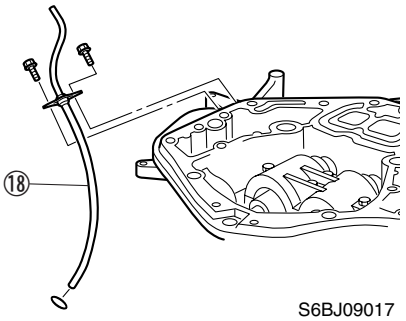
Oil pan assembly bolt (M10) ⑪:
42 N·m (4.2 kgf·m, 31.0 ft·lb)
Upper case bolt (M8) ⑫:
20 N·m (2.0 kgf·m, 14.8 ft·lb)
Upper case bolt (M10) ⑬:
42 N·m (4.2 kgf·m, 31.0 ft·lb)
PCV ⑭: 9 N·m (0.9 kgf·m, 6.6 ft·lb)

9. Install the damper ⑮, cover ⑯, and engine oil drain bolt ⑰, and then tighten the drain bolt to the specified torque.



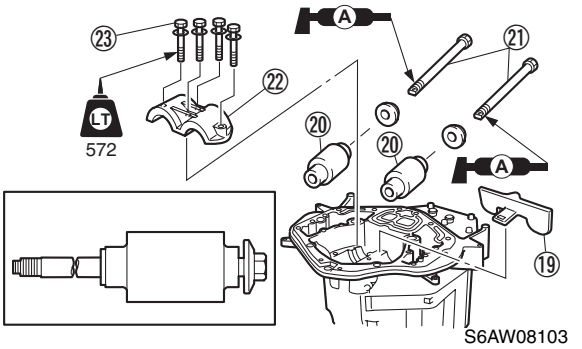
Drain bolt ⑰:
27 N·m (2.7 kgf·m, 19.9 ft·lb)

10. Install the dipstick guide ⑱.



11. Install the upper mount rubber ⑲, upper mounts ⑳, and upper mount bolts ㉑ into the upper case.

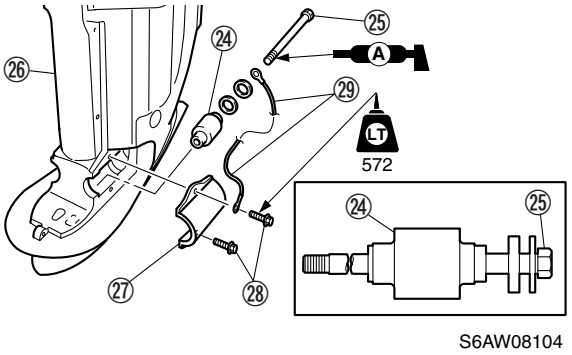
12. Install the bracket ㉒, and temporarily tighten the bracket bolts ㉓.



NOTE:
Temporarily tighten the bracket bolts ㉓ and ㉘.

13. Install the lower mounts ㉔, lower mount bolts ㉕ into the upper case ㉖.

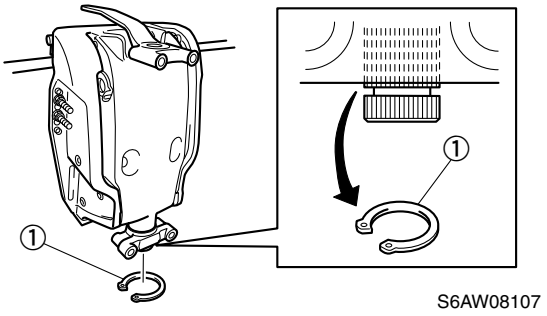
14. Install the bracket ㉗, and temporarily tighten the bracket bolts ㉘.



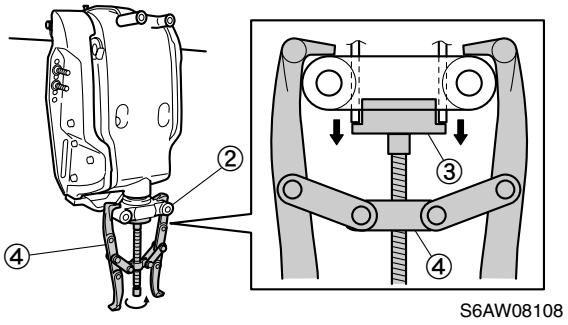
NOTE:
Ground lead ㉙ should be fitted on the port side.

Removing the steering arm

1. Remove the circlip ①.



2. Remove the steering yoke ② as shown.



S6AW08108

	Needle bearing attachment ③: 90890-06654 Gear puller ④: (commercially available)

3. Remove the steering arm.

Checking the steering arm

1. Check the steering arm. Replace the steering arm if cracked or if there is corrosion.

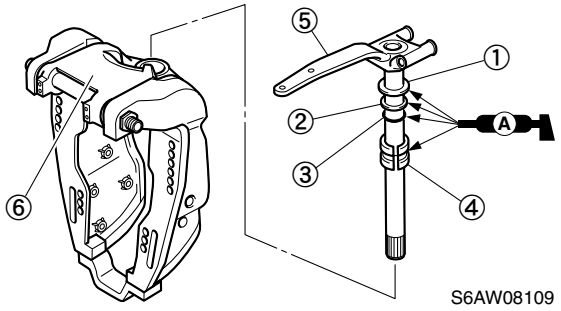
Checking the steering arm bushing

1. Check the steering arm bushing. Replace if cracked or worn.

Installing the steering arm

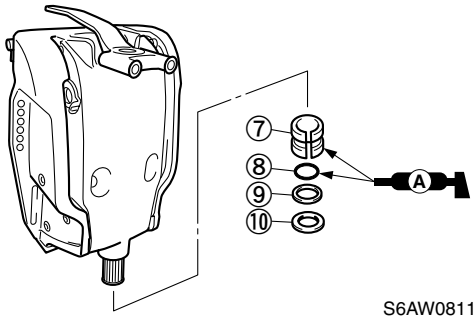
1. Install the washer ①, the bushing ② a new O-ring ③, and the bushing ④ onto the steering arm ⑤.

2. Place the swivel bracket ⑥ in an upright position, and then install the steering arm ⑤ onto the swivel bracket ⑥.



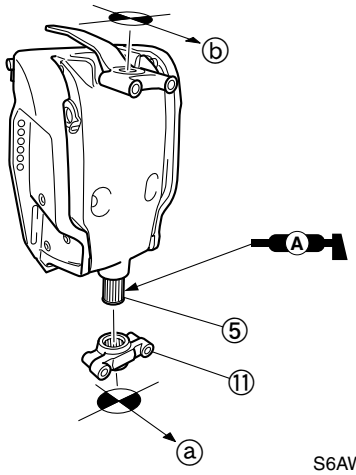
S6AW08109

3. Install the bushing ⑦, a new O-ring ⑧, the bushing ⑨, and the washer ⑩ onto the swivel bracket.



S6AW08110

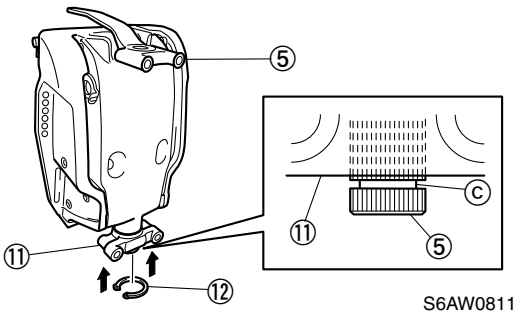
4. Install the steering yoke ⑪ onto the steering arm ⑤, making sure that they are both facing the same direction (ⓐ and ⓑ are aligned).



S6AW08111

5. Hold the steering arm ⑤, and then strike the steering yoke ⑪ until the slot ⓒ for installing the circlip is visible.

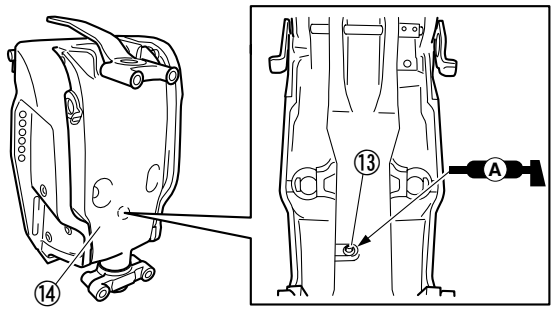
6. Install the circlip ⑫.



S6AW08112

9

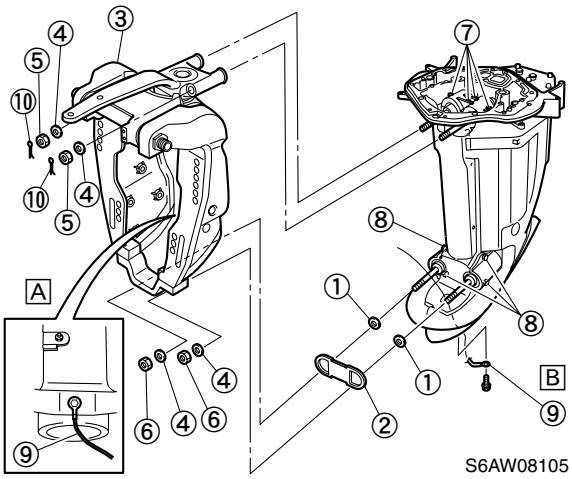
7. Apply grease into the grease nipple ⑬ on the swivel bracket ⑭ until grease comes out of both the upper and lower bushings.



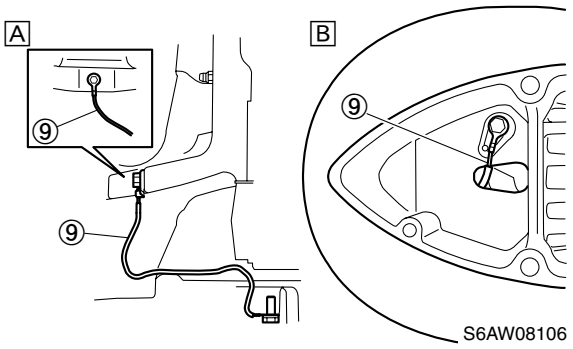
S6AW08113

Installing the upper case

1. Install the washers ① and damper rubber ② onto the lower mounting bolts.
2. Install the upper and lower mounting bolts into the bracket assembly ③ simultaneously.
3. Install the washers ④, upper mounting nuts ⑤, and lower mounting nuts ⑥, and then tighten them to the specified torques.
4. Starting with the center bolt, tighten the bracket bolts ⑦ to the specified torque.
5. Tighten the bracket bolts ⑧ to the specified torque.
6. Connect the ground lead ⑨.
7. Install the cotter pins ⑩.



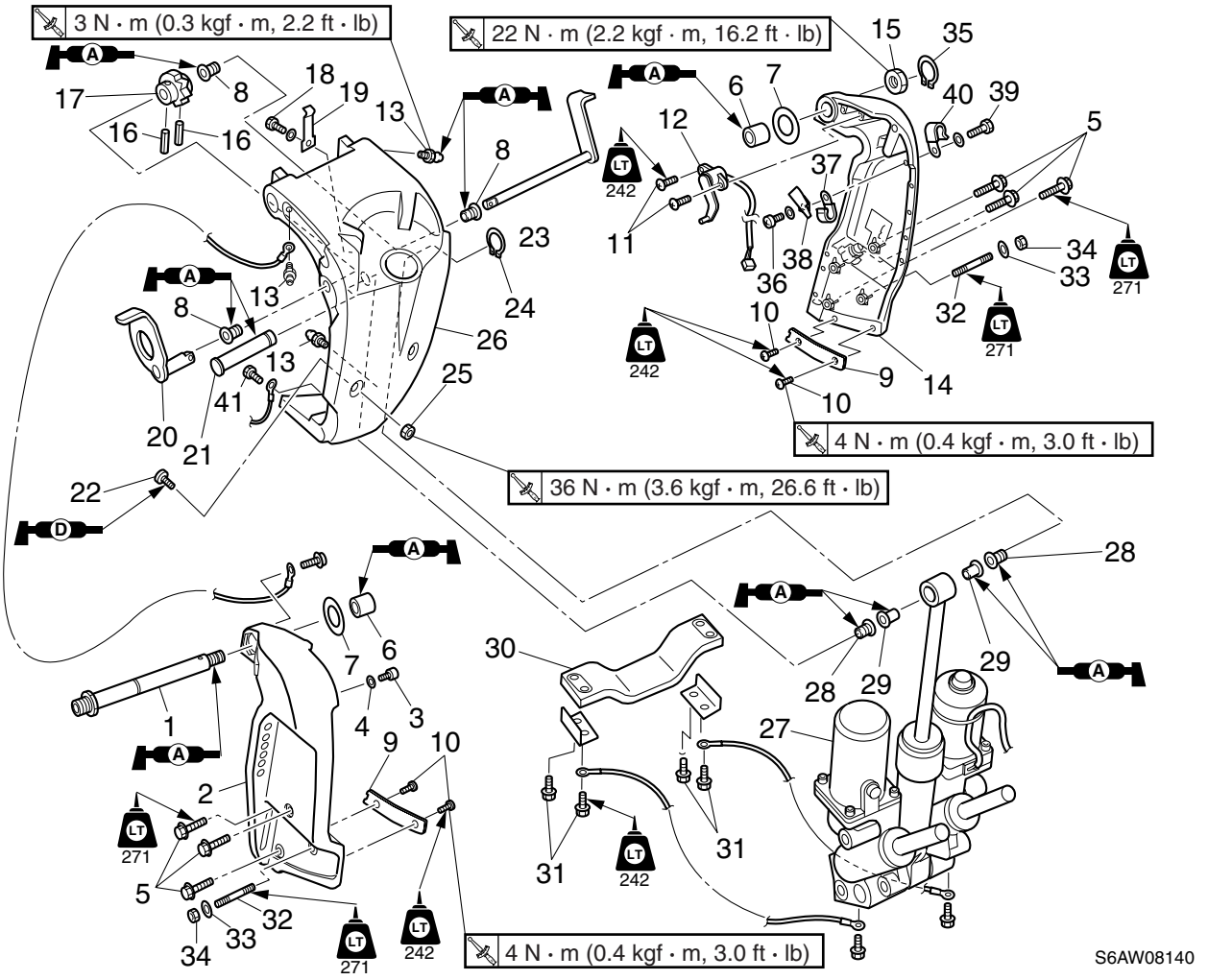
S6AW08105



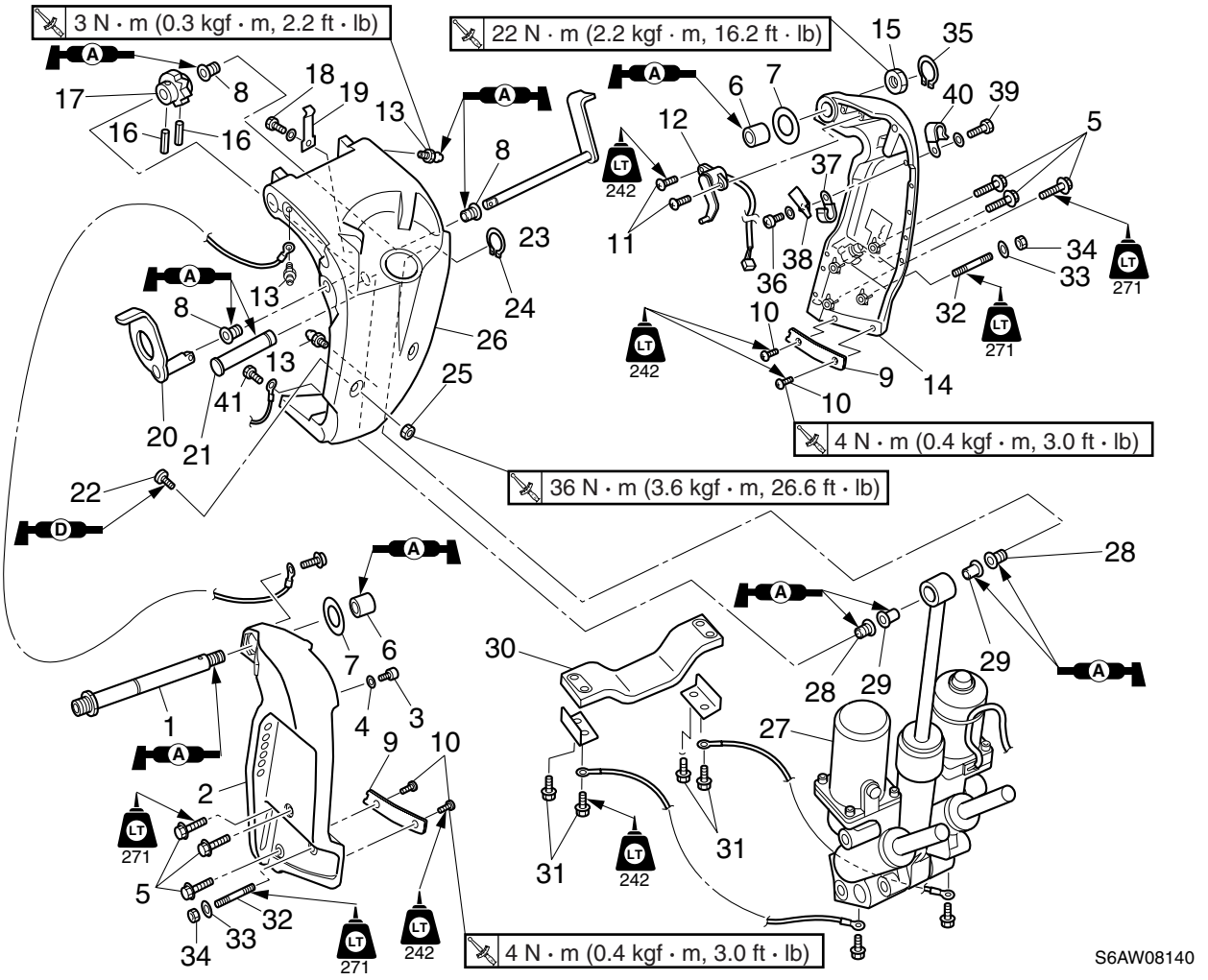
S6AW08106

	Upper mounting nut ⑤: 96 N·m (9.6 kgf·m, 70.8 ft·lb) Lower mounting nut ⑥: 72 N·m (7.2 kgf·m, 53.1 ft·lb) Bracket bolt ⑦: 54 N·m (5.4 kgf·m, 39.8 ft·lb) Bracket bolt ⑧: 54 N·m (5.4 kgf·m, 39.8 ft·lb)

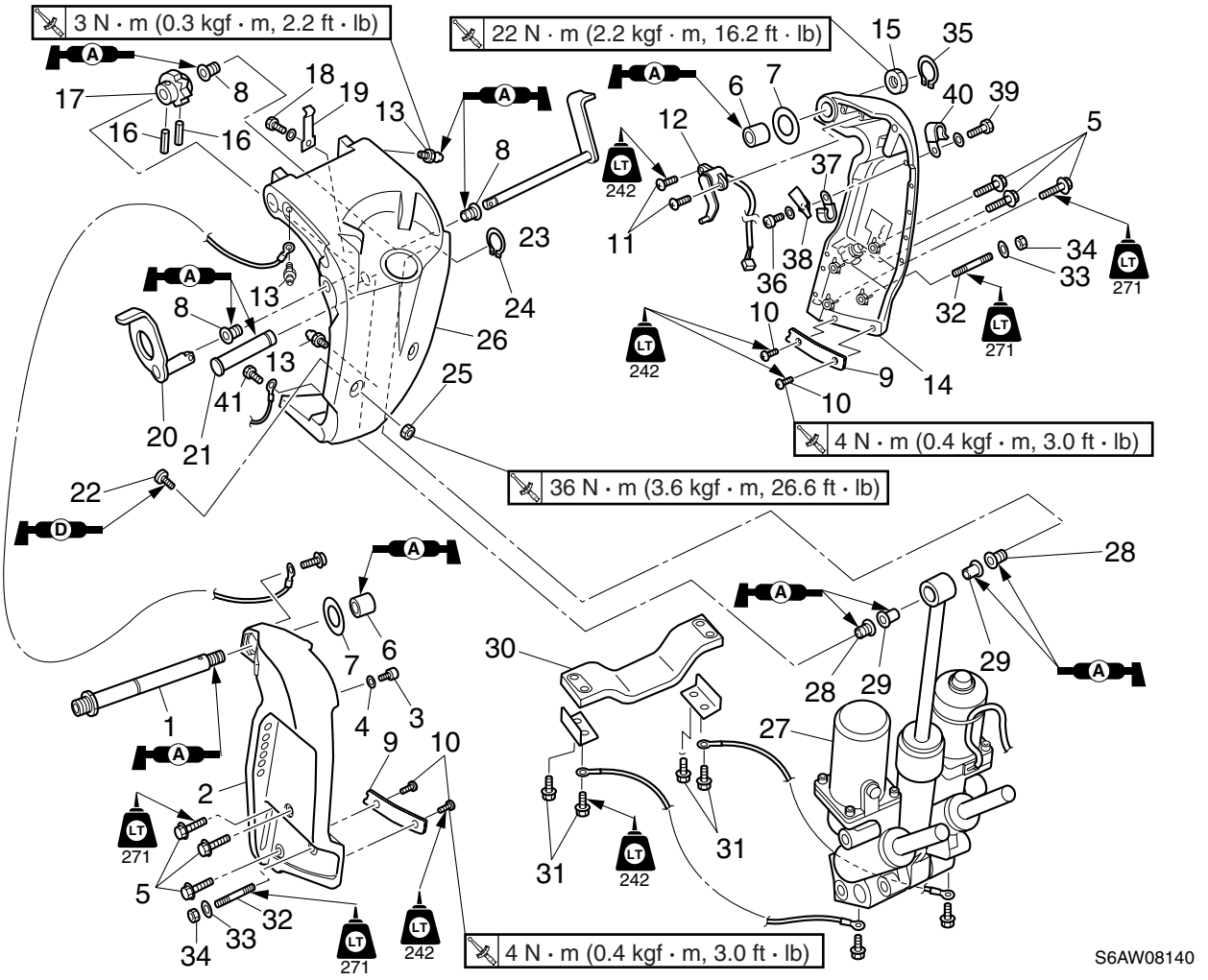
Clamp bracket and swivel bracket



No.	Part name	Q'ty	Remarks
1	Through tube	1	
2	Clamp bracket (PORT)	1	
3	Bolt	2	M10 × 20 mm
4	Washer	2	
5	Bolt	6	M10 × 45 mm
6	Bushing	2	
7	Washer	2	
8	Bushing	4	
9	Friction plate	2	
10	Screw	4	ø6 × 10 mm
11	Screw	2	ø6 × 15 mm
12	PTT sensor	1	
13	Grease nipple	3	
14	Clamp bracket (STBD)	1	
15	Self-locking nut	1	
16	Pin	2	
17	Distance collar	2	



No.	Part name	Q'ty	Remarks
18	Bolt	1	M6 × 10 mm
19	Spring holder	1	
20	Support lever (PORT)	1	
21	Shaft	1	
22	Trim stopper	2	
23	Support lever (STBD)	1	
24	Circlip	1	
25	Self-locking nut	2	
26	Swivel bracket	1	
27	PTT unit	1	
28	Bushing	2	
29	Bushing	2	
30	Anode	1	
31	Bolt	4	M6 × 30 mm
32	Stud bolt	2	
33	Washer	2	
34	Self-locking nut	2	**Not reusable**



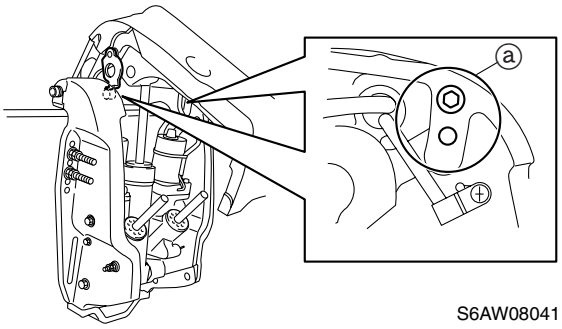
No.	Part name	Q'ty	Remarks
35	Circlip	1	
36	Screw	1	ø6 × 12 mm
37	Clamp	1	
38	Plate	1	
39	Bolt	1	M6 × 14 mm
40	Clamp	1	
41	Bolt	1	M6 × 10 mm

Removing the PTT unit

You need 2 nuts of 8 mm height, 14 mm width across flat, and pitch 1.25 for removing the PTT mounting stud bolt. Prepare the nuts in advance.

1. Make sure that the stopper bolts on port and starboard are both installed on the upper side, as indicated by ⓐ in the illustration.

2. Tilt up the outboard motor and apply the stopper bolt to the support lever.



S6AW08041

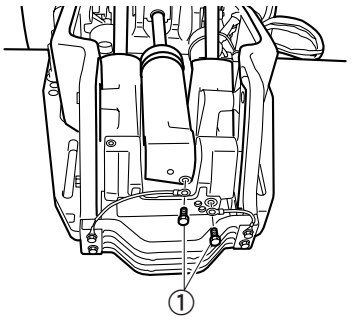
⚠ WARNING

- **After tilting up the outboard motor, be sure to support it with the support lever. Otherwise, the out board motor could suddenly lower if the PTT unit should lose fluid pressure.**
- **When removing the PTT unit with the power unit installed, be sure to suspend the outboard motor. If the outboard motor is not suspended it can fall suddenly and result in severe injury.**

NOTE:

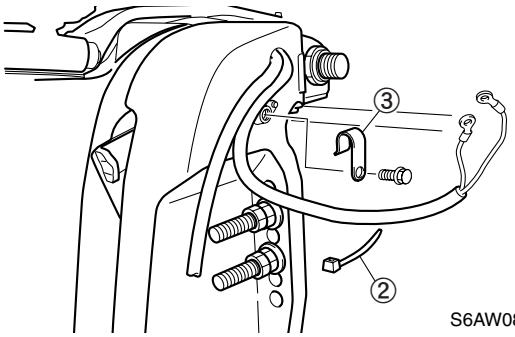
If the PTT does not operate, open the manual valve by turning it counterclockwise, and then tilt the outboard motor up.

3. Remove the bolts ① and disconnect the ground lead at the bottom of the PTT unit.



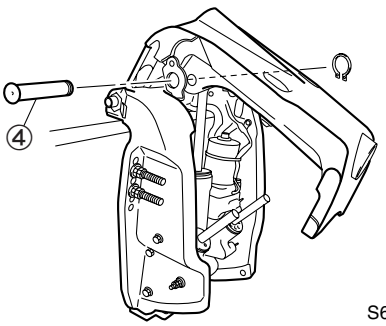
S6AW08042

4. Remove the plastic tie ② and the clamp ③ and pull the PTT motor lead to the inner side of the bracket.



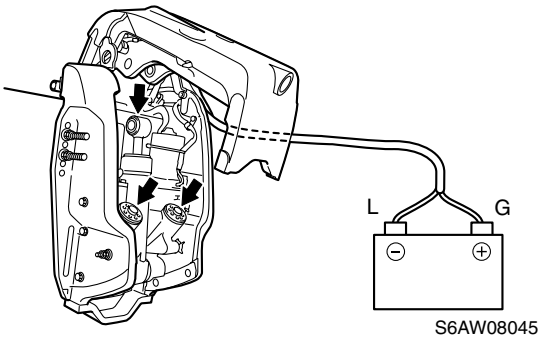
S6AW08043

5. Remove the circlip and the upper mounting shaft ④.



S6AW08044

6. Push down the PTT rod to the end of its stroke.

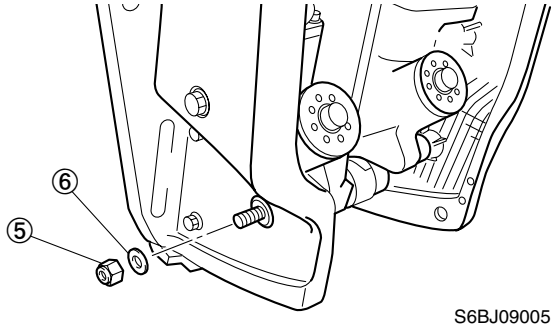


S6AW08045

Ram	PTT motor lead	Battery terminal
Down	Blue (L)	⊖
	Green (G)	⊕

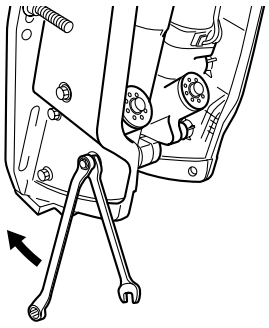
NOTE:
Fully retract the PTT rams to remove the PTT unit.

7. Remove the self-locking nut ⑤ and the washer ⑥. Do not reuse the self-locking nut.

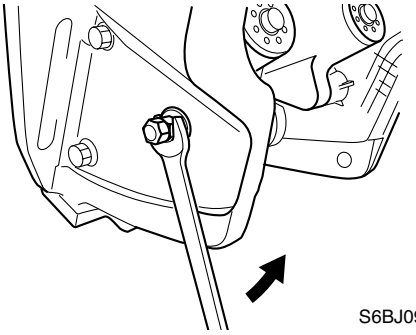


S6BJ09005

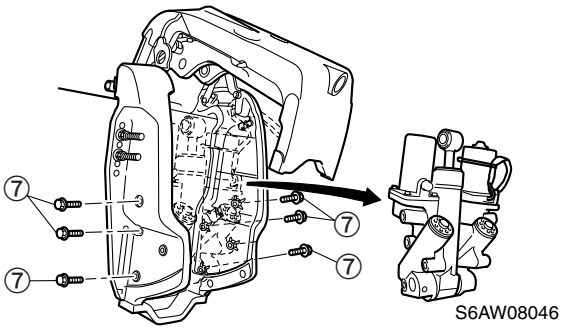
8. Install the two nuts that you prepared in advance a little away from the clamp bracket, so that they make a double-nut arrangement.


S6BJ09006

9. Install the tool to the inner nut and remove the stud bolt.


S6BJ09007

10. Remove the PTT attachment bolts ⑦, and then detach the PTT unit.



S6AW08046

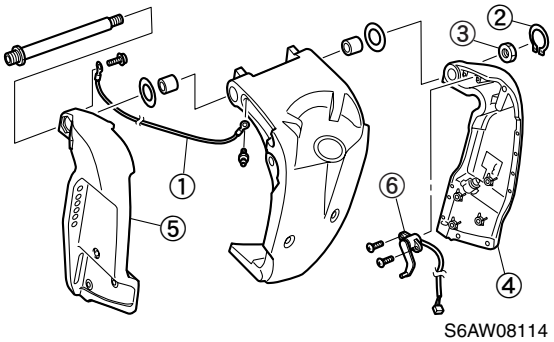
CAUTION:
Tilting down the outboard motor without mounting the PTT unit may result in the damage on the PTT sensor.

Removing the clamp bracket

1. Remove the ground lead ①.

2. Remove the circrip ② and self-locking nut ③ of the through tube, then clamp brackets ④ and ⑤.

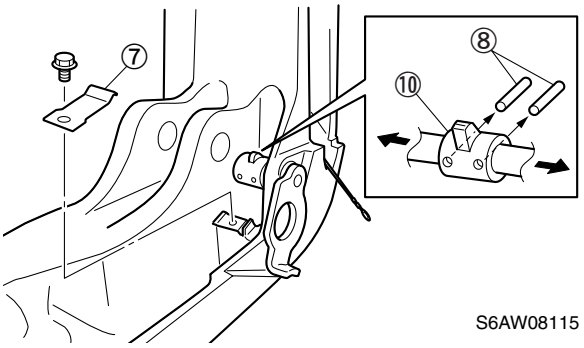
3. Remove the PTT sensor ⑥.



S6AW08114

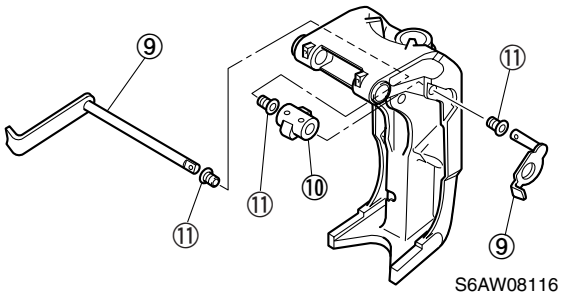
9

4. Remove the spring ⑦ and pins ⑧.



S6AW08115

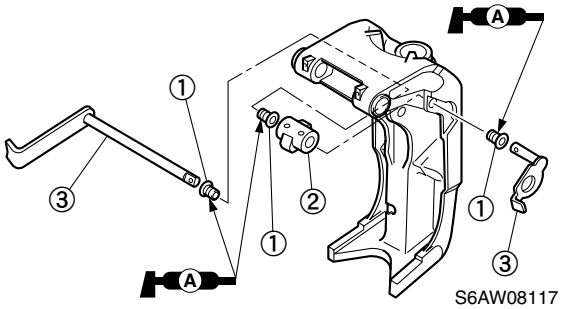
5. Remove the support levers ⑨, distance collar ⑩, and bushings ⑪.



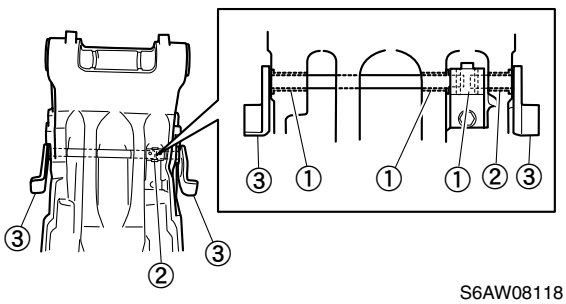
S6AW08116

Installing the clamp bracket

1. Install the bushings ①, distance collar ②, and support levers ③.



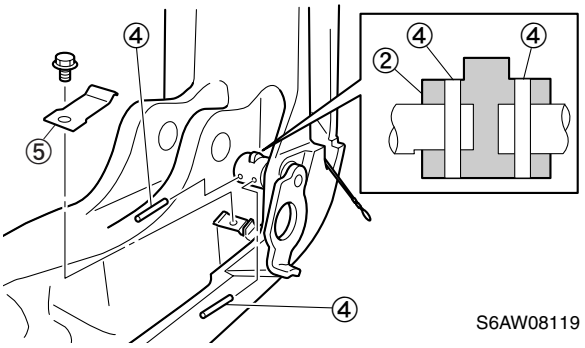
S6AW08117



S6AW08118

2. Insert the pins ④ to the extent that they do not protrude.

3. Install the spring ⑤.



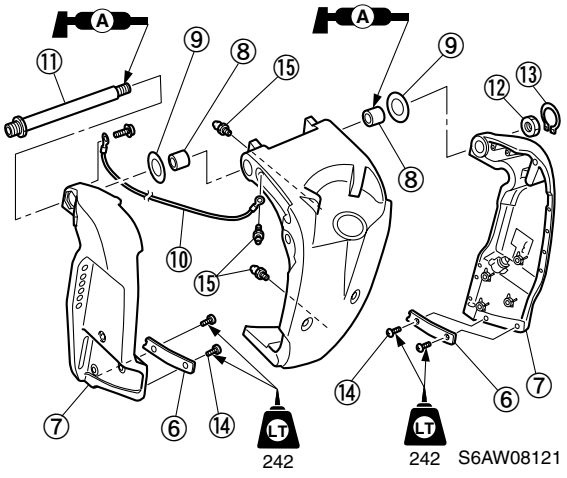
S6AW08119

4. Install the friction plates ⑥ onto the clamp brackets ⑦, and then install the bushings ⑧ and washers ⑨.

5. Assemble the clamp brackets and the swivel bracket.

6. Connect the ground lead ⑩, install the through tube ⑪, and then tighten the self-locking nut ⑫ temporarily.

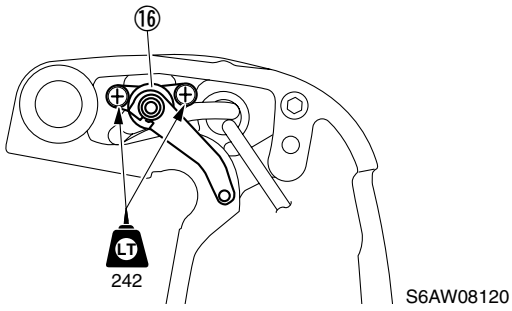
7. Install the circlip ⑬.



S6AW08121

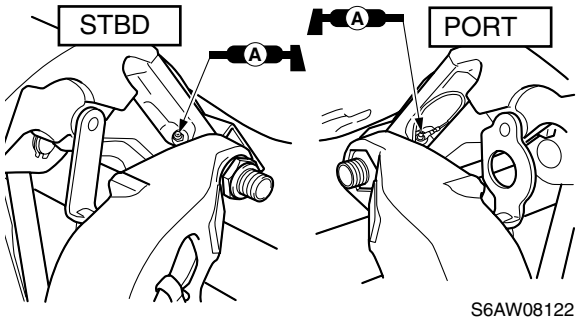
	Friction plate screw ⑭: 4 N·m (0.4 kgf·m, 3.0 ft·lb) Grease nipple ⑮: 3 N·m (0.3 kgf·m, 2.2 ft·lb)

8. Install the PTT sensor ⑯ onto the starboard clamp bracket.



S6AW08120

9. Apply grease into all grease nipples until grease comes out of the bushings.

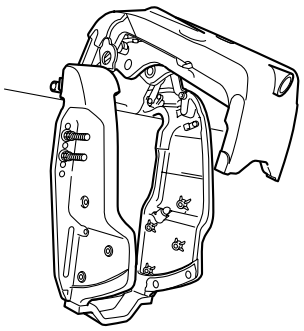


S6AW08122

Installing the PTT unit

You need 2 nuts of 8 mm height, 14 mm width across flat, and pitch 1.25 for installing the PTT mounting stud bolt. Prepare the nuts in advance.

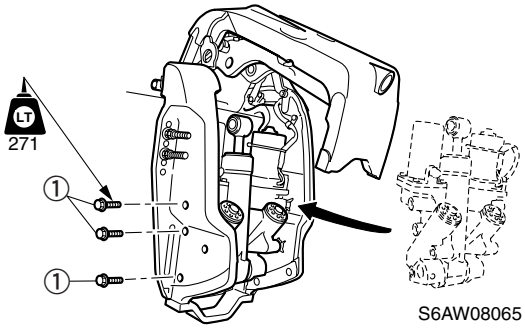
1. Tilt up the outboard motor and apply the stopper bolt to the support lever.


S6AW08064

⚠ WARNING

- **When installing the PTT unit with the power unit installed, be sure to support the outboard motor. If the outboard motor is not supported it can fall suddenly and result in severe injury.**
- **After tilting up the outboard motor, be sure to support it with the support lever.**

2. Install the PTT unit with the PTT rams pushed down to the end of their stroke, and temporarily tighten the bolts ①.

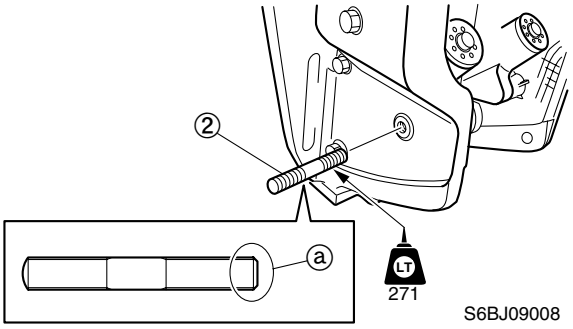


S6AW08065

NOTE:

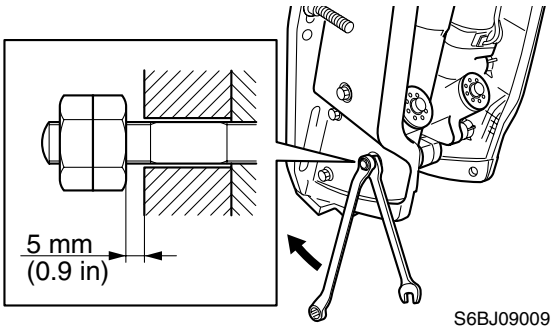
PTT rams must be retracted when installing the PTT unit.

3. Install the stud bolt ② by hands with its flat end ⓐ facing the PTT body.



S6BJ09008

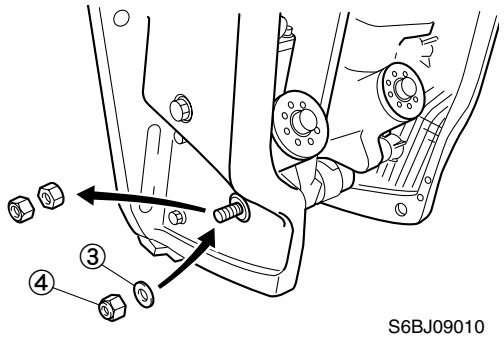
4. Install the two nuts that you prepared in advance at 5 mm (0.9 in) away from the clamp bracket, so that they make a double-nut arrangement.



S6BJ09009

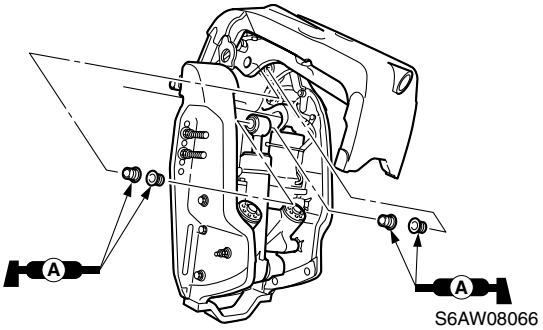
5. Install the tool to the outer nut and tighten the stud bolt.

6. Remove the 2 nuts from the stud bolt, and install the washer ③ and a new self-locking nut ④ temporarily.



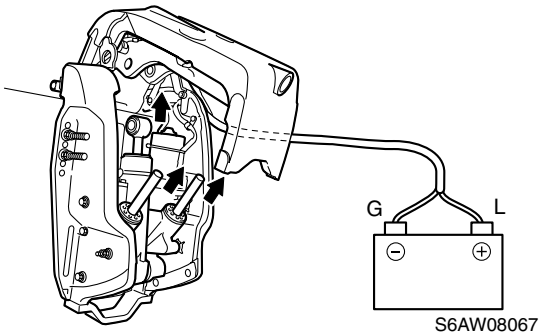
S6BJ09010

7. Install the bushings.



S6AW08066

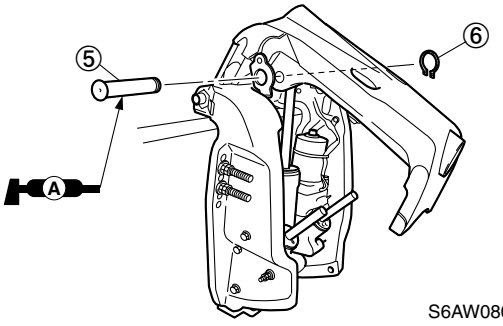
8. Extend the PTT rams until it is possible to insert the upper mounting shaft.



S6AW08067

Ram	PTT motor lead	Battery terminal
Up	Blue (L)	⊕
	Green (G)	⊖

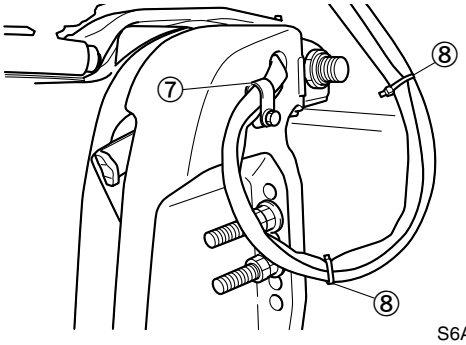
9. Insert the upper mounting shaft ⑤ from the port side and install the circlip ⑥.



S6AW08068

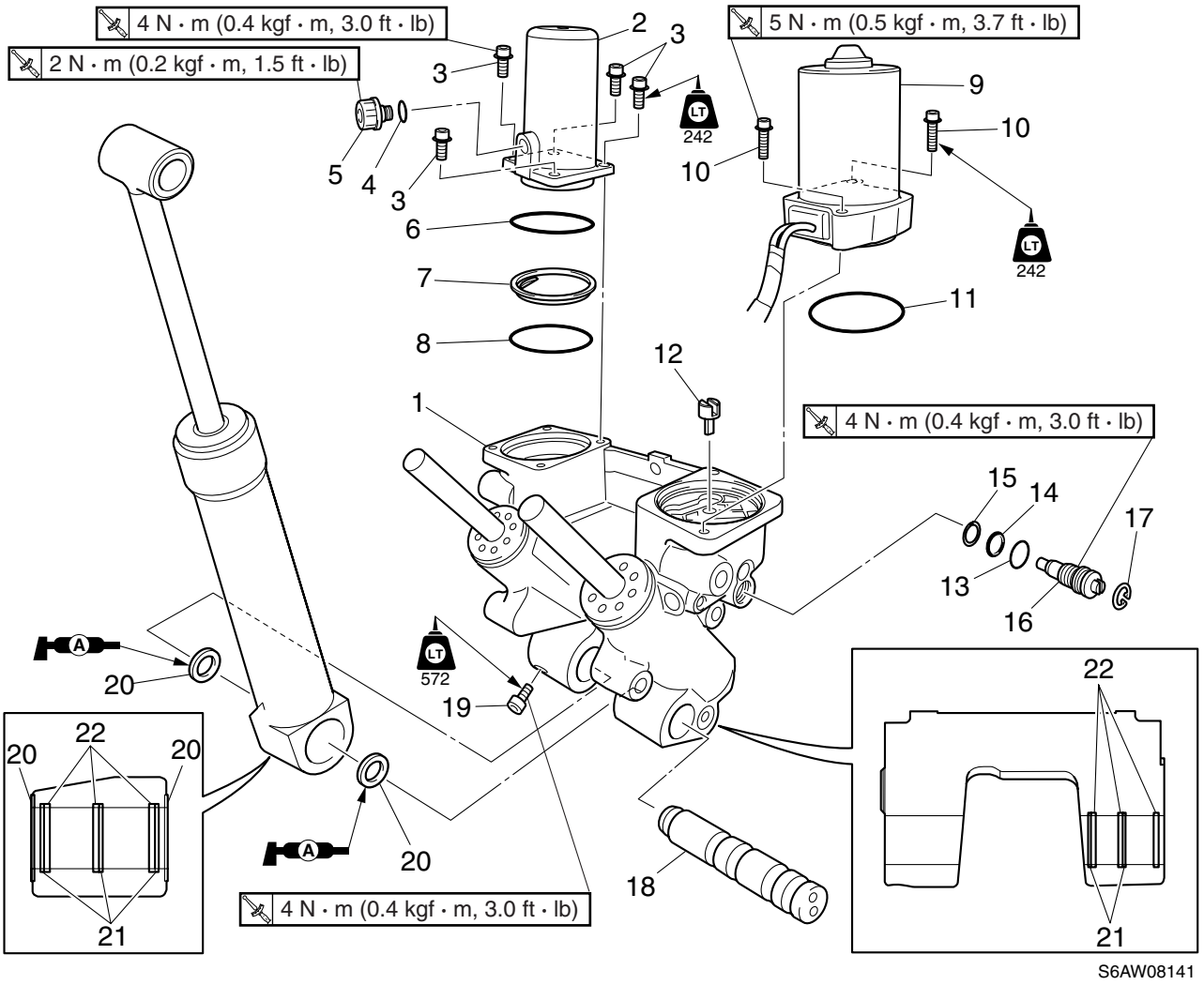
10. Properly tighten the bolts ① and self-locking nut ④ while holding the PTT unit in place.

11. Install the clamp ⑦ and the plastic ties ⑧.

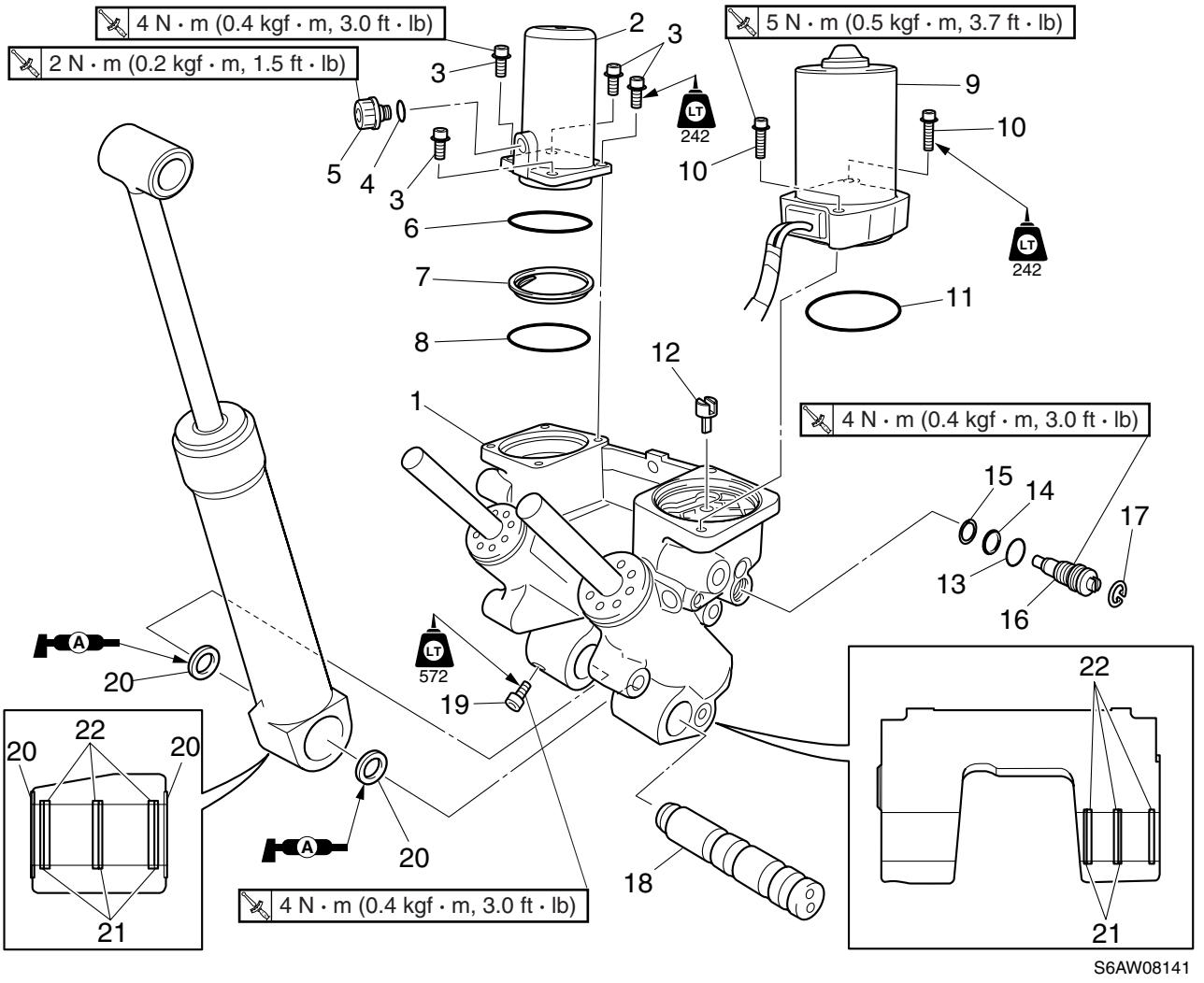


S6AW08069

PTT unit



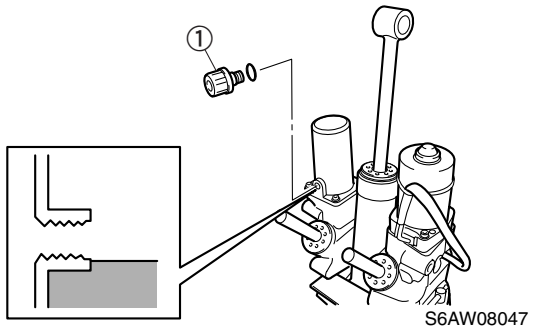
No.	Part name	Q'ty	Remarks
1	PTT body	1	
2	Reservoir	1	
3	Bolt	4	M5 × 20 mm
4	O-ring	1	**Not reusable**
5	Reservoir cap	1	
6	O-ring	1	**Not reusable**
7	Plate	1	
8	O-ring	1	**Not reusable**
9	PTT motor assembly	1	
10	Bolt	2	M6 × 37 mm
11	O-ring	1	**Not reusable**
12	Joint	1	
13	O-ring	1	**Not reusable**
14	D-ring	1	**Not reusable**
15	Backup ring	1	**Not reusable**
16	Manual valve	1	
17	Circlip	1	



No.	Part name	Q'ty	Remarks
18	Shaft	1	
19	Bolt	1	M6 × 10 mm
20	Spacer	2	
21	Backup ring	5	**Not reusable**
22	O-ring	6	**Not reusable**

Checking the hydraulic pressure

1. Full extend the PTT rams.
2. Remove the reservoir cap ①, and then check the fluid level in the reservoir.



⚠ WARNING

Make sure that the PTT rams are fully extended when removing the reservoir cap, otherwise fluid can spurt out from the unit due to internal pressure.

NOTE:

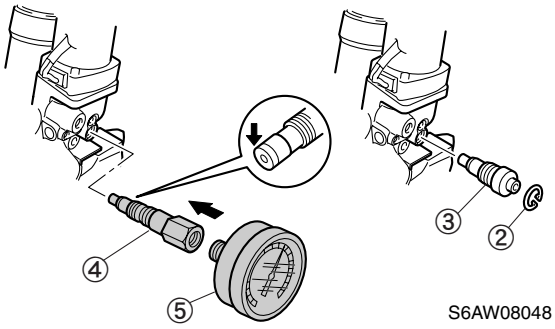
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

Recommended PTT fluid:
ATF Dexron II

3. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

4. Remove the circlip ② and the manual valve ③.
5. Install the up-relief fitting ④ and the hydraulic pressure gauge ⑤.

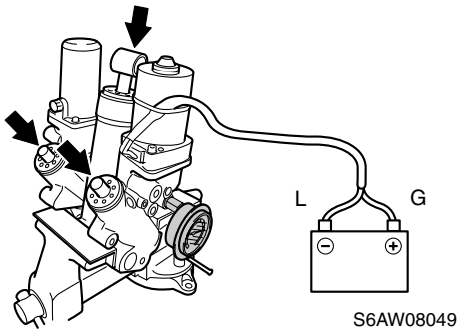


NOTE:

Quickly install the special service tools before any fluid flows out of the hole.

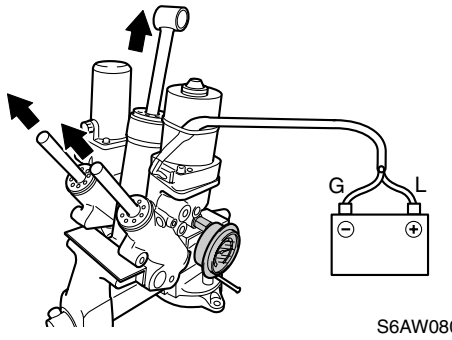
Up-relief fitting ④:
90890-06838
Hydraulic pressure gauge ⑤:
90890-06800

6. Connect the PTT motor leads to the battery terminals to fully retract the PTT rams.



Ram	PTT motor lead	Battery terminal
Down	Blue (L)	⊖
	Green (G)	⊕

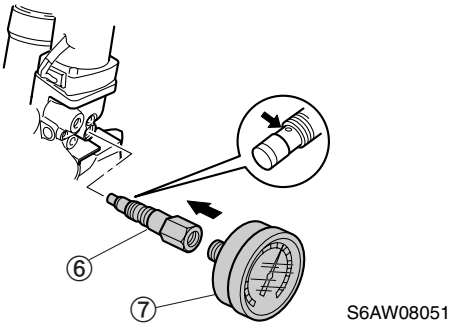
7. Reverse the PTT motor leads between the battery terminals to fully extend the PTT rams, and then measure the hydraulic pressure (Up). Check the inner components if out of specification.



Ram	PTT motor lead	Battery terminal
Up	Blue (L)	⊕
	Green (G)	⊖

Hydraulic pressure (Up):
14.6–19.0 MPa (149–194 kgf/cm²)

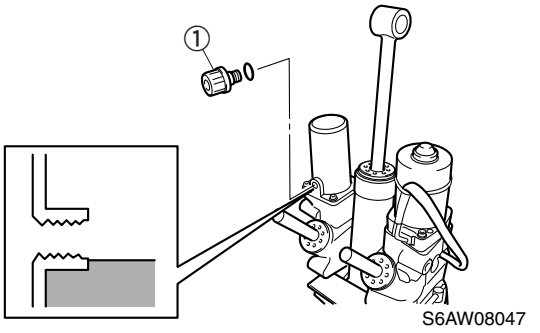
8. Remove the up-relief fitting ④ and the hydraulic pressure gauge ⑤ and then install down-relief fitting ⑥ and the hydraulic pressure gauge ⑦.



NOTE:
Quickly install the special service tools before any fluid flows out of the hole.

Down-relief fitting ⑥:
90890-06774
Hydraulic pressure gauge ⑦:
90890-06776

9. Remove the reservoir cap ①, and check the fluid level.



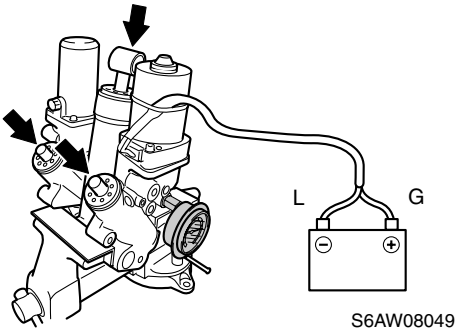
NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

Recommended PTT fluid:
ATF Dexron II

10. Install the reservoir cap ①, and then tighten it to the specified torque.

Reservoir cap ①:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

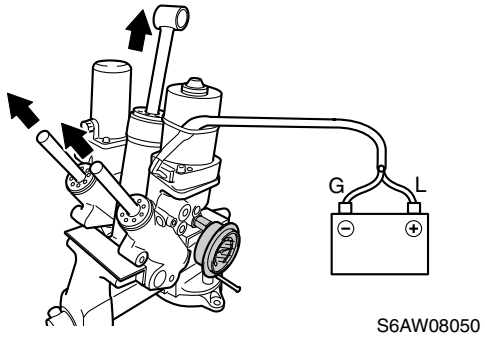
11. Connect the PTT motor leads to the battery terminals to fully retract the PTT rams. Then, measure the hydraulic pressure (Down). Check the inner components if out of specification.



Ram	PTT motor lead	Battery terminal
Down	Blue (L)	⊖
	Green (G)	⊕

Hydraulic pressure (Down):
10.6–14.0 MPa (108–143 kgf/cm²)

12. Reverse the PTT motor leads between the battery terminals to fully extend the PTT rams.



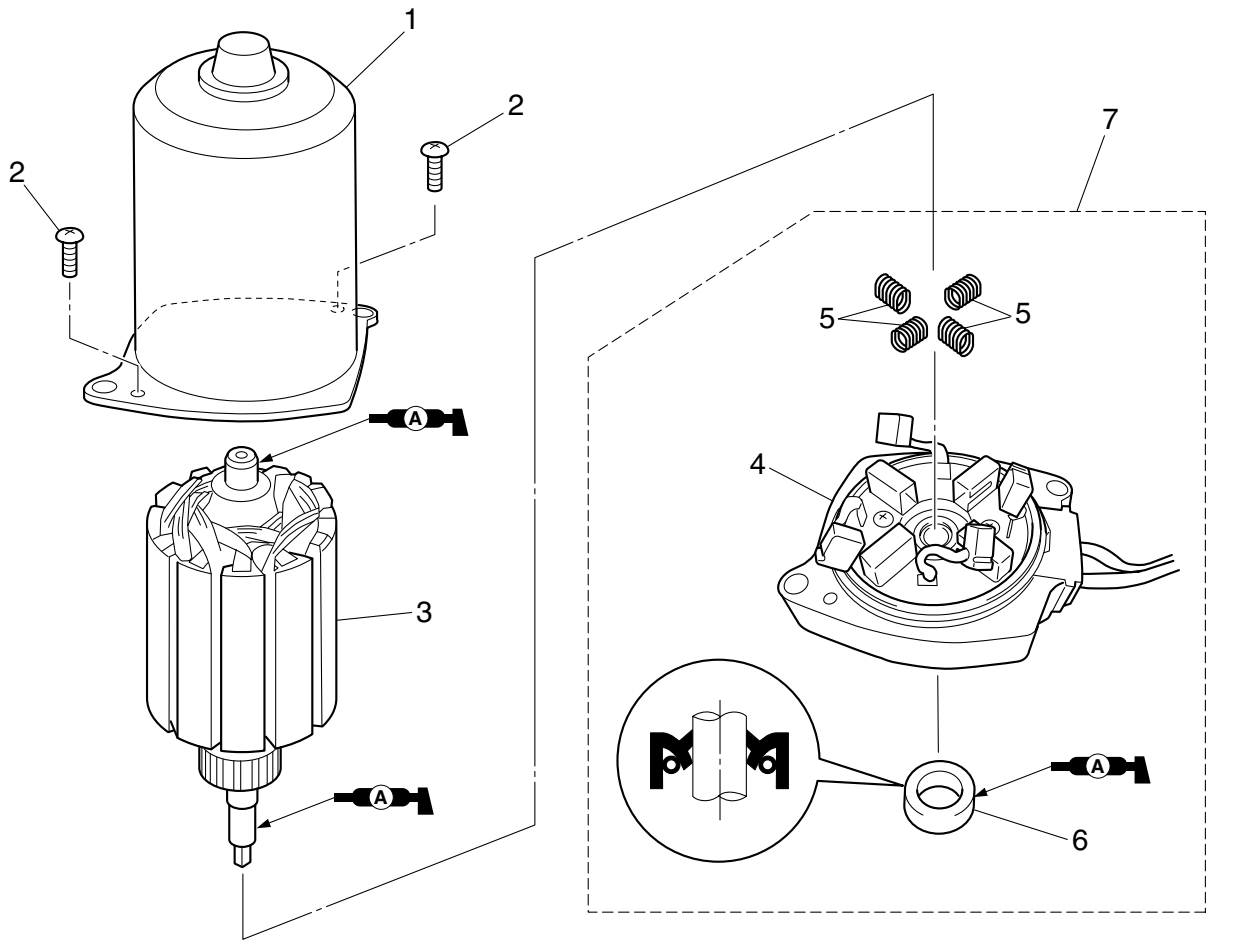
Ram	PTT motor lead	Battery terminal
Up	Blue (L)	⊕
	Green (G)	⊖

13. Remove the special service tools, and then install the manual valve and circlip.

NOTE:
Quickly install the manual valve before any fluid flows out of the hole.

	Manual valve: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

PTT motor

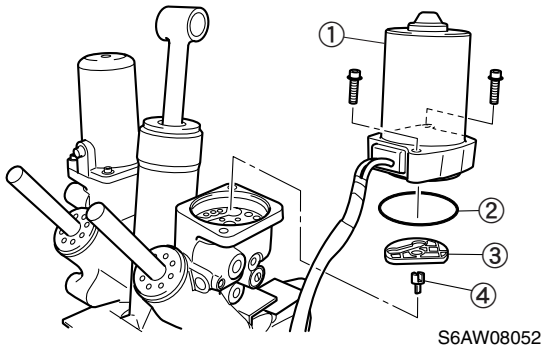


S6AW08142

No.	Part name	Q'ty	Remarks
1	Stator	1	
2	Screw	2	ø6 × 30 mm
3	Armature	1	
4	Base	1	
5	Spring	4	
6	Oil seal	1	**Not reusable**
7	Base assembly	1	

Disassembling the PTT motor

1. Remove the PTT motor assembly ①, O-ring ②, gear pump filter ③, and joint ④.

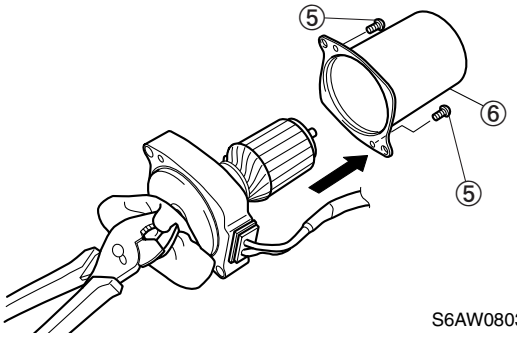


S6AW08052

⚠ WARNING

Do not push down the rams while the PTT motor is removed from the PTT unit, otherwise fluid can spurt out.

2. Remove the PTT motor screws ⑤, and then remove the stator ⑥.

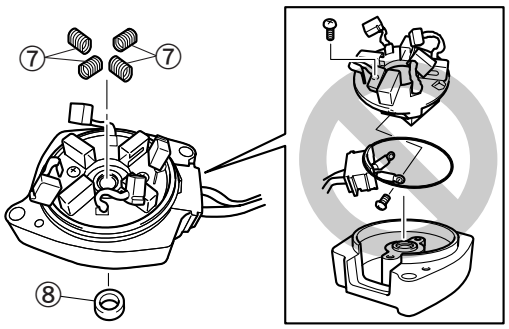


S6AW08030

CAUTION:

Hold the end of the armature shaft with a pair of pliers as shown, and then remove the armature together with the PTT motor base assembly, otherwise the armature could separate from the base assembly due to the magnetic force of the stator ⑥ and damage the brushes.

3. Remove the springs ⑦ and the oil seal ⑧.



S6AW08031

CAUTION:

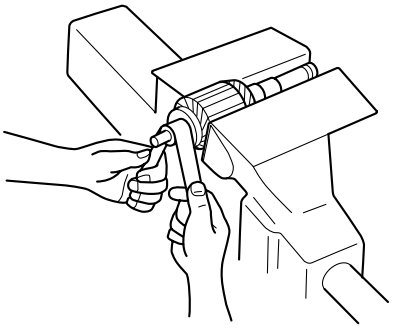
Do not disassemble the PTT motor assembly, otherwise the electrical circuit may be damage.

Checking the gear pump filter

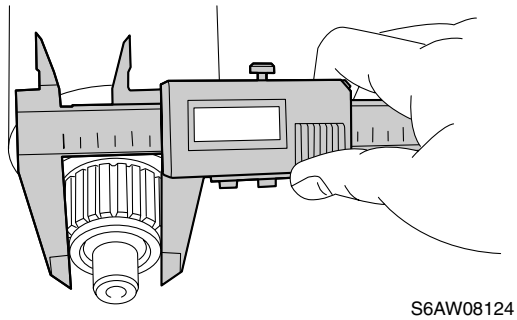
1. Check the gear pump filter for dirt or residue. Clean or replace if necessary.

Checking the PTT motor

1. Check the commutator. Clean with 600 grit sandpaper and compressed air if dirty.


S6AW08123

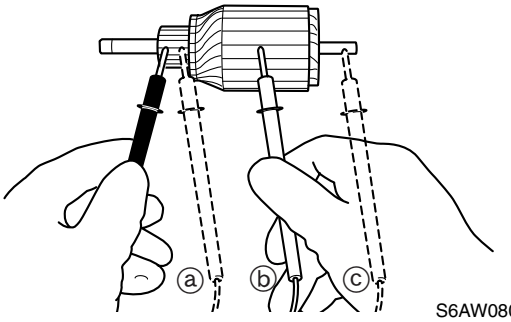
2. Measure the commutator diameter. Replace the armature if below specification.



S6AW08124

Motor commutator standard diameter: 23.65 mm (0.93 in) Wear limit: 21.00 mm (0.83 in)	

3. Check the armature for continuity. Replace the armature if out of specifications.

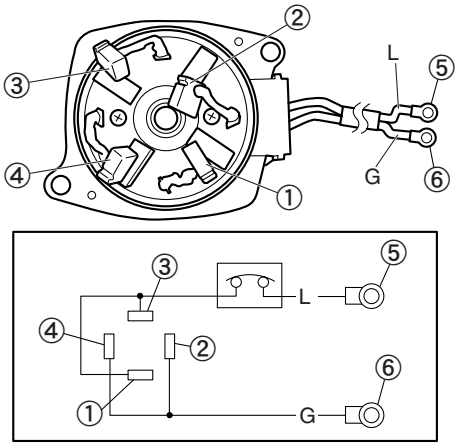


S6AW08032

Armature continuity:	
Commutator segments ⓐ	Continuity
Segment–Armature core ⓑ	No continuity
Segment–Armature shaft ⓒ	No continuity

Checking the brush

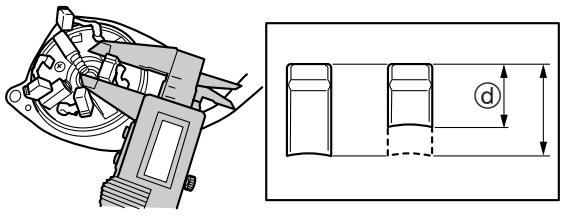
1. Check the PTT motor base assembly for continuity. Replace the PTT motor base assembly if out of specification.



S6AW08033

PTT motor base assembly continuity:	
Terminal ④–② Terminal ③–① Terminal ④–⑥ (G) Terminal ②–⑥ (G) Terminal ③–⑤ (L) Terminal ①–⑤ (L)	Continuity
For all terminal combinations not listed above.	No continuity

2. Measure the length of each brush. Replace the PTT motor base assembly if below specification.



S6AW08034

Motor brush standard length: 11.9 mm (0.47 in) Wear limit ⓓ: 7.5 mm (0.30 in)	

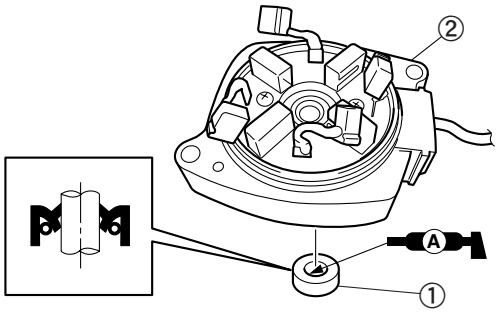
3. Check the PTT motor base. Replace the PTT motor base assembly if cracked or damaged.

Assembling the PTT motor

CAUTION:

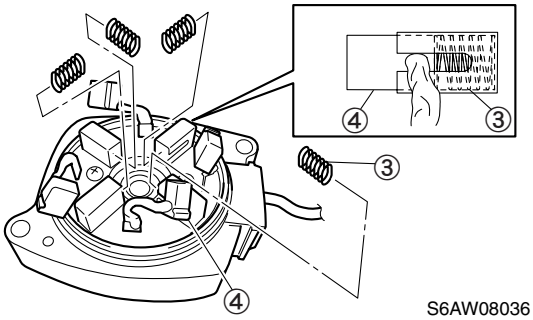
Do not allow grease or oil to come in contact with the commutator of the armature.

1. Install a new oil seal ① into the PTT motor base assembly ② as shown.



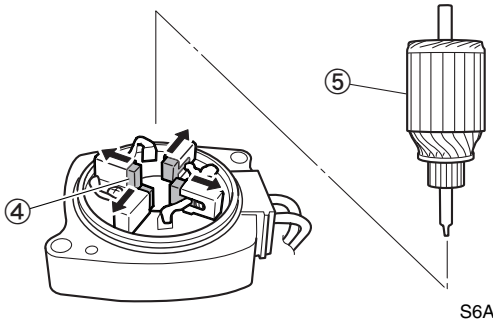
S6AW08035

2. Install the springs ③ and brushes ④ to the PTT motor base assembly as shown.



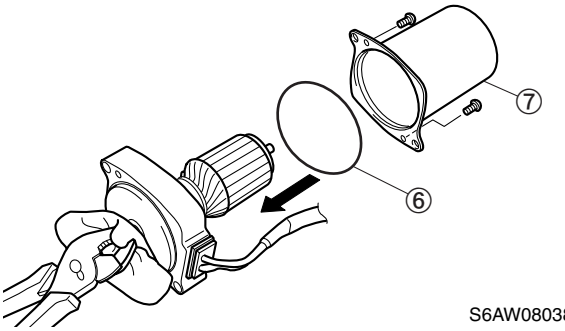
S6AW08036

3. Push the brushes ④ into the holders, and then install the armature ⑤.



S6AW08037

4. Install a new O-ring ⑥ and the stator ⑦ to the motor base.

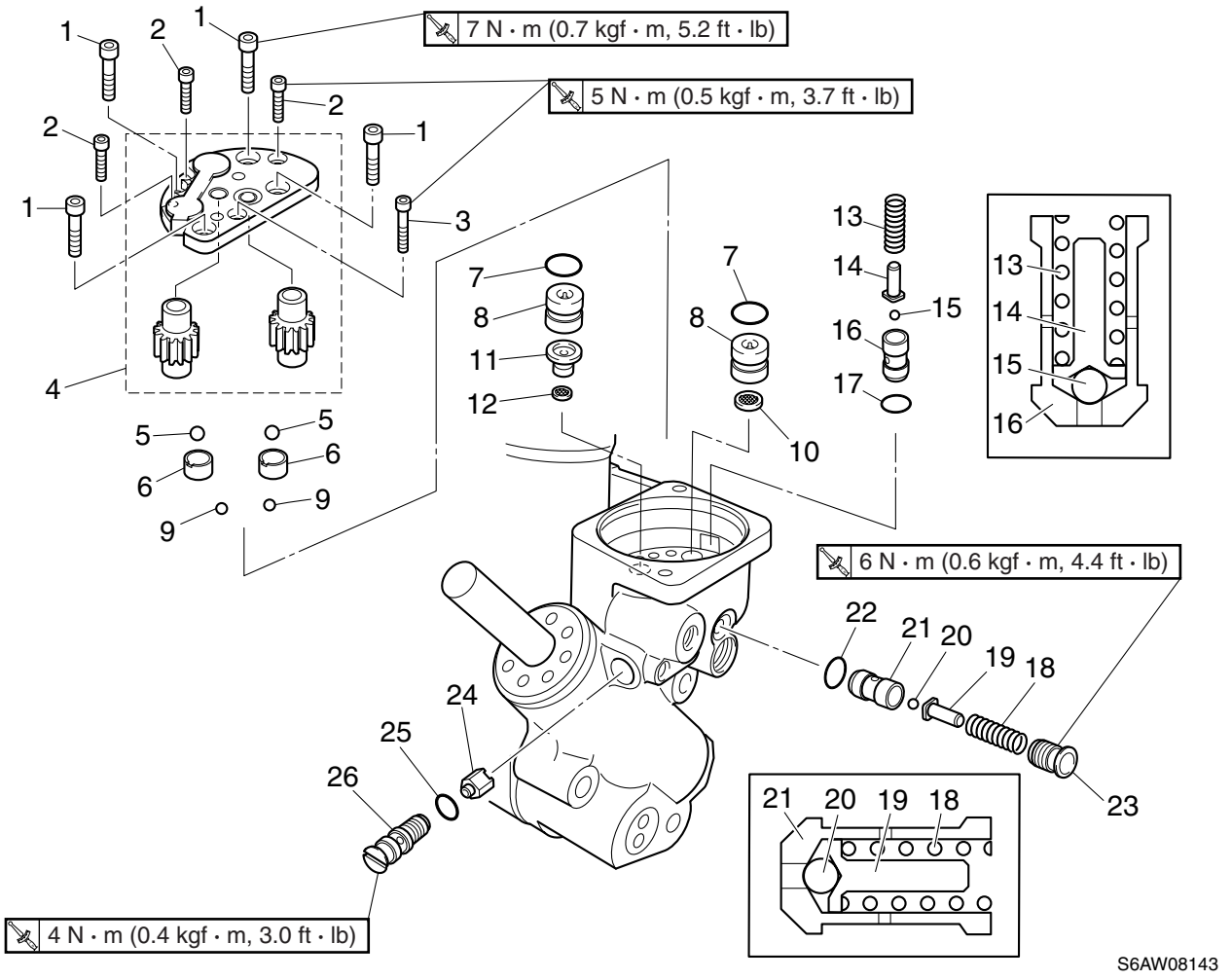


S6AW08038

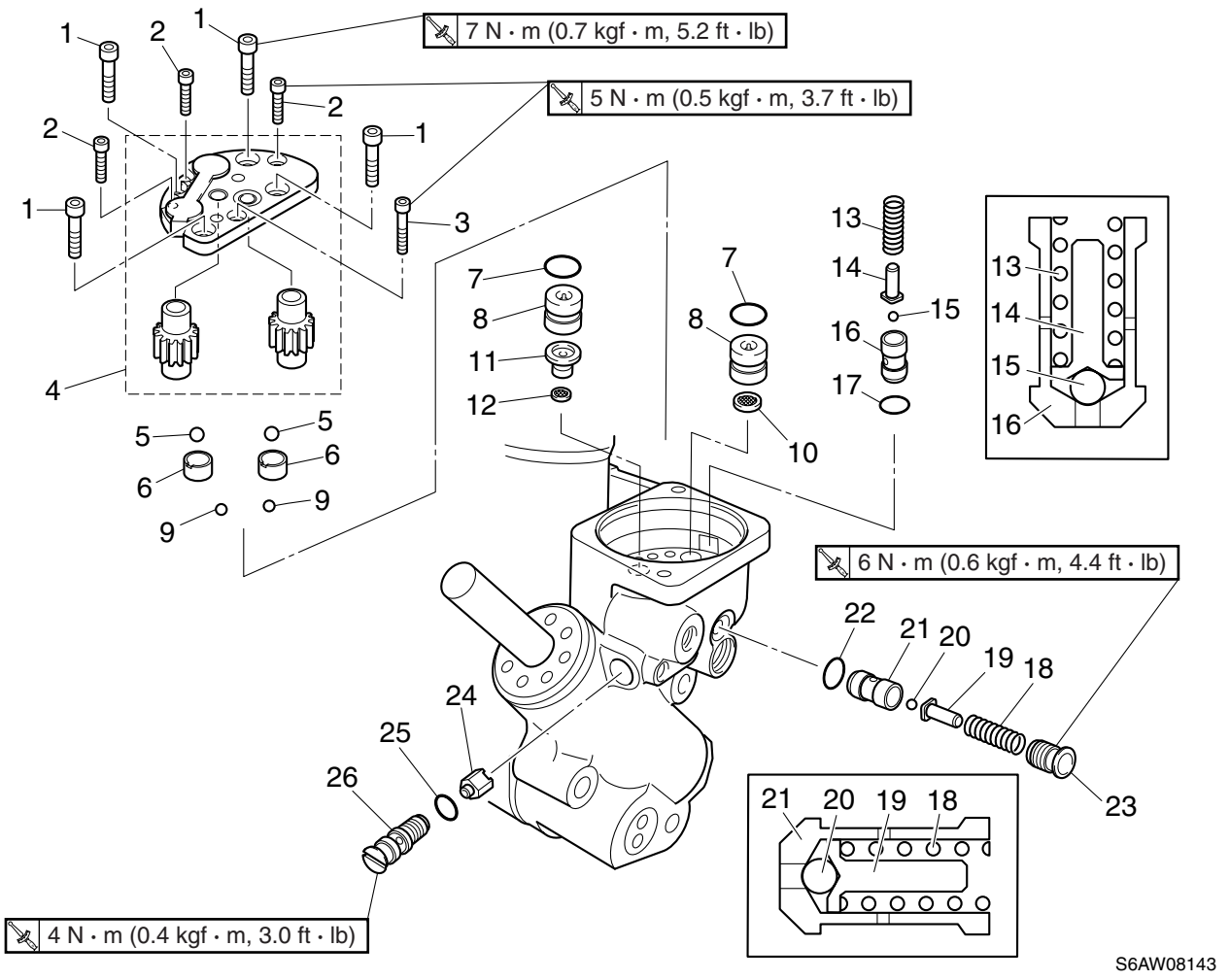
CAUTION:

Hold the end of the armature shaft with a pair of pliers as shown, and then install the armature together with the PTT motor base assembly, otherwise the armature could separate from the base assembly due to the magnetic force of the stator ⑦ and damage the brushes.

Gear pump



No.	Part name	Q'ty	Remarks
1	Bolt	4	M5 × 24 mm
2	Bolt	3	M4 × 20 mm
3	Bolt	1	M4 × 25 mm
4	Gear pump assembly	1	
5	Ball	2	
6	Shuttle piston	2	
7	O-ring	2	**Not reusable**
8	Main valve	2	
9	Ball	2	
10	Filter	1	
11	Valve seat	1	
12	Filter	1	
13	Spring	1	
14	Absorber valve pin	1	
15	Ball	1	
16	Down-relief valve seat	1	
17	O-ring	1	**Not reusable**

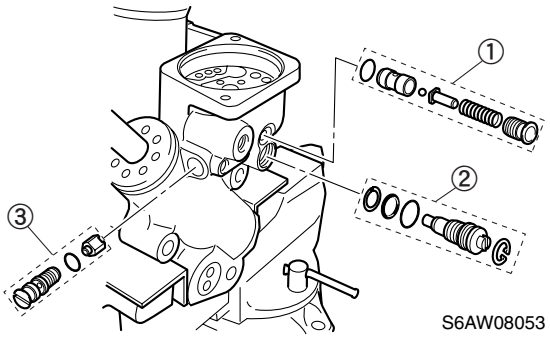


No.	Part name	Q'ty	Remarks
18	Spring	1	
19	Absorber valve pin	1	
20	Ball	1	
21	Up-relief valve seat	1	
22	O-ring	1	**Not reusable**
23	Plug	1	
24	Port plug	1	
25	O-ring	1	**Not reusable**
26	Cap	1	

Disassembling the gear pump housing

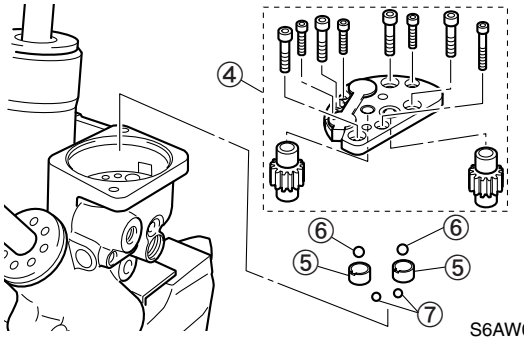
NOTE:
Do not mix the each components. Keep them organized in their proper groups.

1. Remove the up-relief valve assembly ①, manual valve assembly ②, and port plug assembly ③.



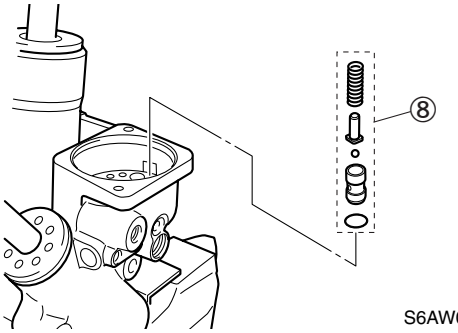
S6AW08053

2. Remove the gear pump assembly ④, shuttle pistons ⑤, and balls ⑥, ⑦.



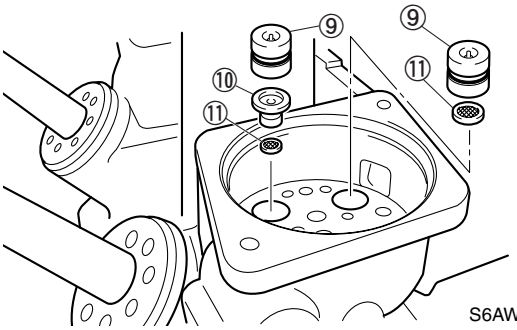
S6AW08054

3. Remove the up-relief valve assembly ⑧.



S6AW08055

4. Remove the main valves ⑨, the valve seat ⑩, and the filters ⑪.



S6AW08056

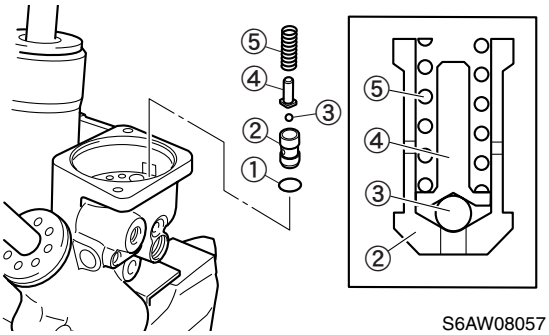
Checking the gear pump assembly

1. Clean all the valves, pistons, and balls, and then check them for damage or wear. Check the filters for damage or clogs. Replace if necessary.

2. Check the drive gears for damage or wear. Replace the gear pump assembly if necessary.

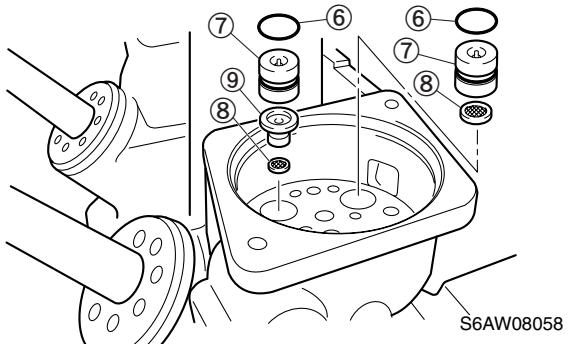
Assembling the gear pump housing

1. Install a new O-ring ①, the down-relief valve seat ②, ball ③, absorber valve pin ④, and spring ⑤ into the gear pump housing.

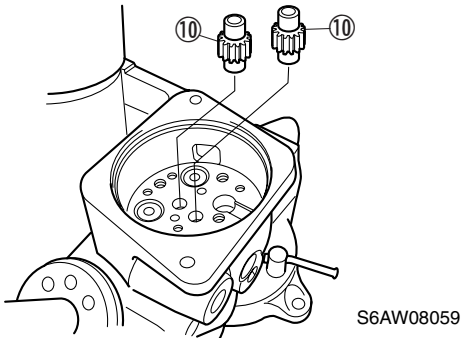


S6AW08057

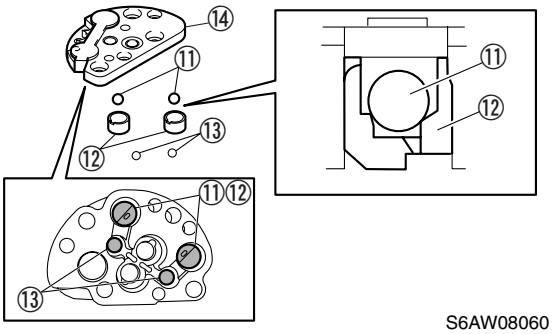
2. Install new O-rings ⑥ onto the main valves ⑦, and then install the filters ⑧, valve seat ⑨, the main valves ⑦ into the gear pump housing.



3. Install the drive gears ⑩ into the gear pump housing.



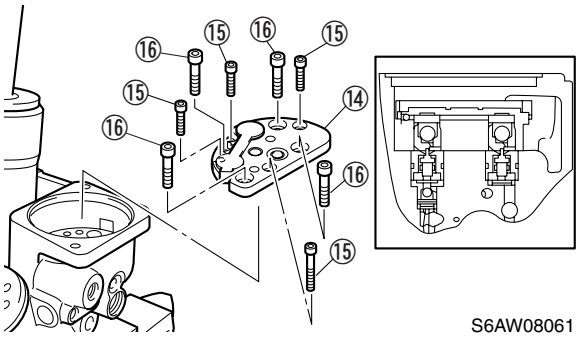
4. Install the balls ⑪, shuttle pistons ⑫, and balls ⑬ into the gear pump assembly ⑭.



NOTE:

Apply grease to the balls to prevent them from falling out of the gear pump assembly.

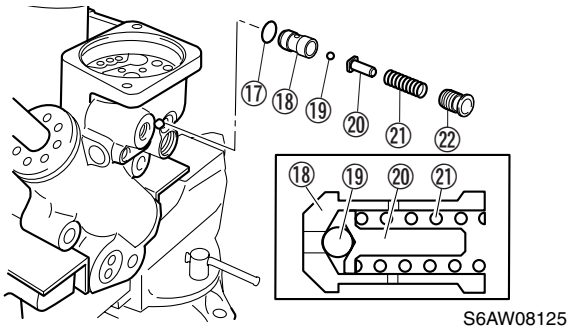
5. Install the gear pump assembly ⑭ into the gear pump housing, and then tighten the bolts ⑮ and ⑯ temporarily.



6. Check that the gear pump turns smoothly, and then tighten the gear pump assembly bolts ⑮ and ⑯ to the specified torque.

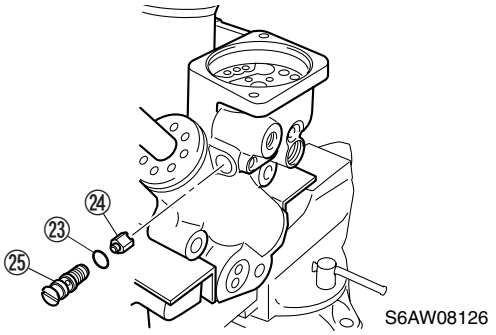
Gear pump bolt (M4) ⑮:
5 N·m (0.5 kgf·m, 3.7 ft·lb)
Gear pump bolt (M5) ⑯:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

7. Install a new O-ring ⑰, the up-relief valve seat ⑱, ball ⑲, absorber valve pin ⑳, and spring ㉑ into the gear pump housing. And then tighten up-relief valve plug ㉒ to the specified torque.



Up-relief valve plug ㉒:
6 N·m (0.6 kgf·m, 4.4 ft·lb)

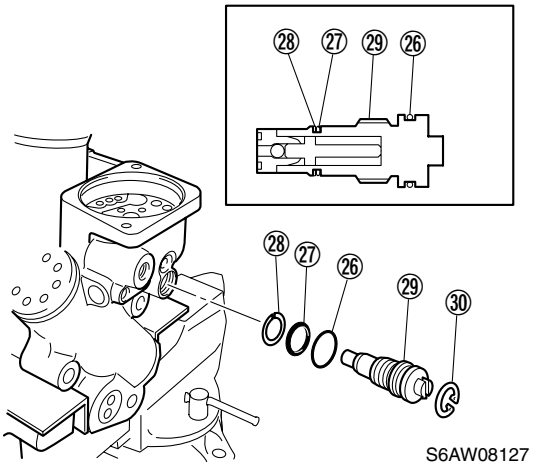
8. Install the new O-ring ㉓ and the port plug ㉔. Tighten the cap ㉕ to the specified torque.



Cap ㉕:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

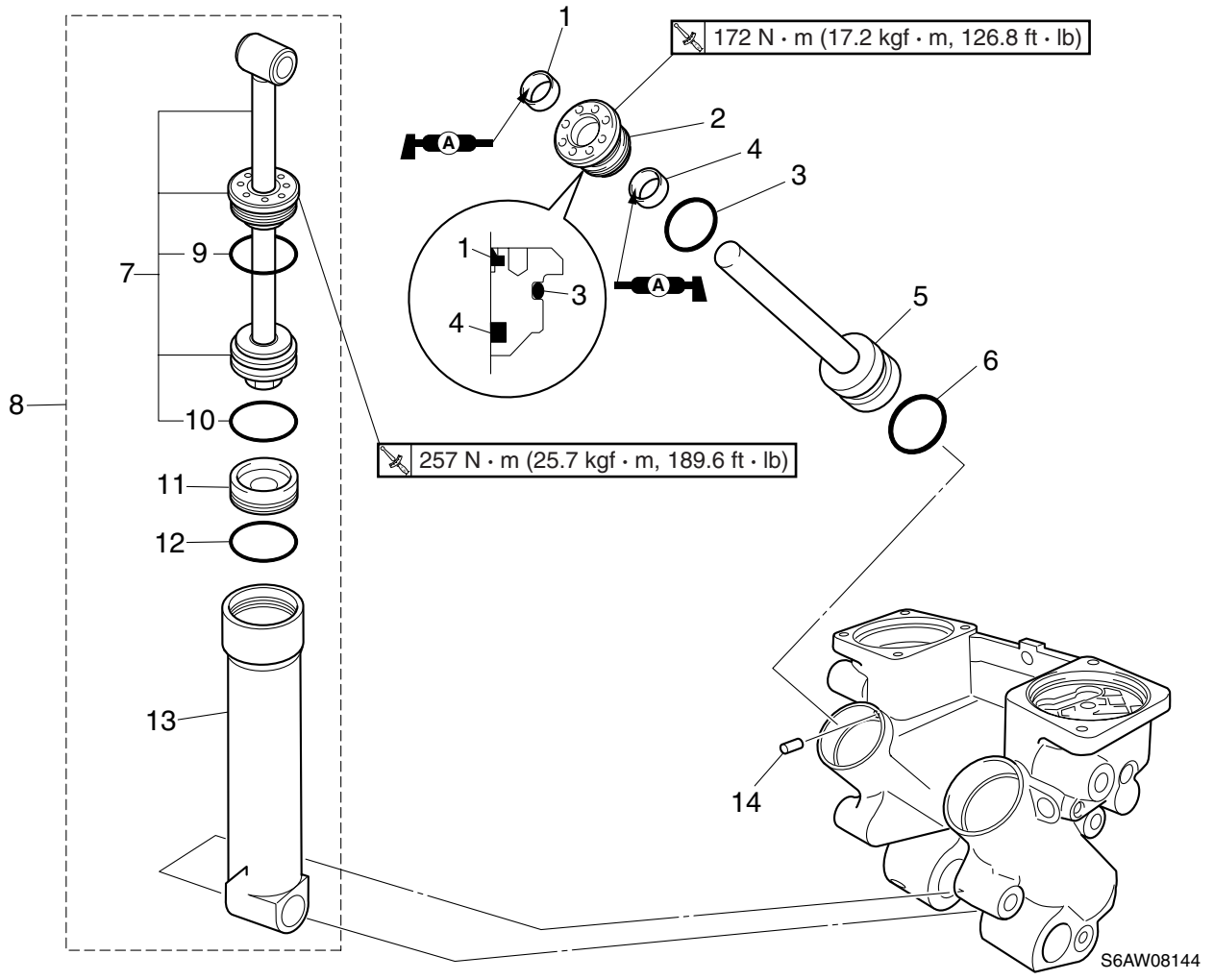
9. Install a new O-ring ㉖, a new D-ring ㉗, and a new back upper ring ㉘ onto the manual valve ㉙.

10. Tighten the manual valve ㉙ and the circlip ㉚ into the gear pump housing.



Manual valve ㉙:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

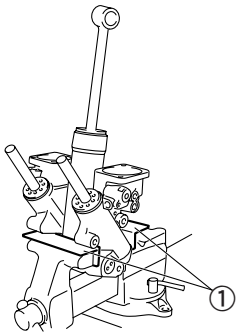
Tilt cylinder and trim cylinder



No.	Part name	Q'ty	Remarks
1	Dust seal	2	**Not reusable**
2	Cylinder end screw	2	
3	O-ring	2	**Not reusable**
4	Down seal	2	**Not reusable**
5	Trim ram assembly	2	
6	O-ring	2	**Not reusable**
7	Tilt ram assembly	1	
8	Power tilt assembly	1	
9	O-ring	1	**Not reusable**
10	O-ring	1	**Not reusable**
11	Free piston	1	
12	O-ring	1	**Not reusable**
13	Tilt cylinder	1	
14	Pin	1	

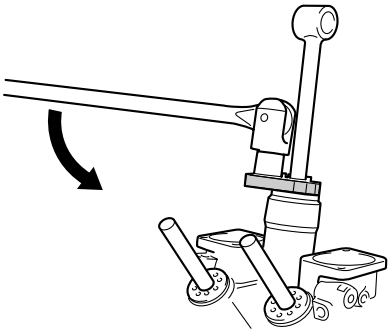
Disassembling the tilt cylinder and trim cylinder

1. Hold the PTT body in a vise using the aluminum plates ① on both sides.



S6AW08001

2. Loosen the tilt cylinder end screws, and then remove the tilt ram assembly.


S6AW08002

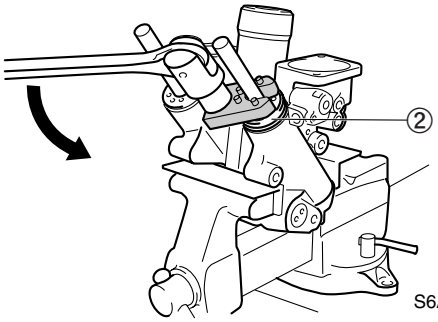
⚠ WARNING

Make sure that the PTT rams are fully extended before removing the end screw.

Cylinder-end screw wrench:
90890-06837

3. Drain the PTT fluid.

4. Loosen the trim cylinder end screw ② on the starboard side (or port side), and remove the trim ram assembly.

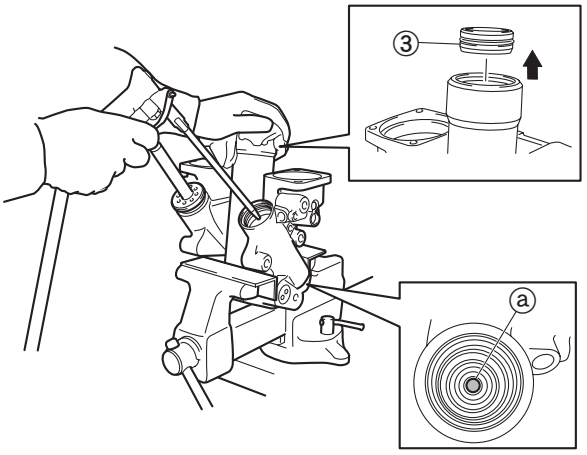


S6AW08003

Cylinder-end screw wrench:
90890-06837

5. Drain the PTT fluid.

6. Remove the free piston ③ by blowing compressed air into the hole ⓐ while covering on the opening of the tilt cylinder with a rag.



S6AW08004

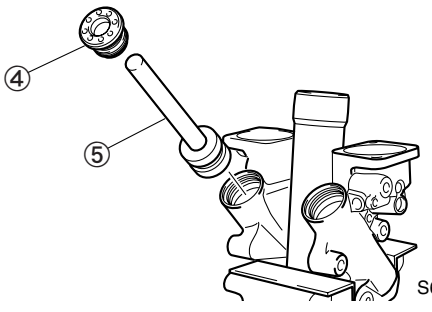
⚠ WARNING

Never look into the tilt cylinder opening when removing the free piston. The free piston and PTT fluid can be forcefully expelled out.

NOTE:

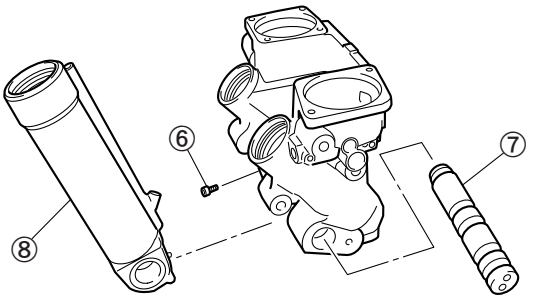
Either port side trim cylinder end screw or starboard side trim cylinder end screw must be tightened before removing the free piston.

7. Loosen the trim cylinder end screw ④ on the port side (or starboard side), and remove the trim ram assembly ⑤.



S6AW08005

8. After removing the shaft stopper bolt ⑥, remove the shaft ⑦ and the tilt cylinder ⑧.



S6AW08009

Checking the tilt cylinder and trim cylinder

1. Check the PTT body and the tilt cylinder. Replace the PTT body or tilt cylinder if cracked or if there is corrosion.

2. Check the inner surface of the PTT body and tilt cylinder. Replace the PTT body or tilt cylinder if scratched.

3. Check the outer surface of the tilt ram assembly, trim ram assembly, free piston, and dust seal of end screw. Replace the tilt ram assembly, trim ram assembly, free piston or dust seal if scratched.

4. Check the trim rams and the tilt ram. Polish them with 400–600 grit sandpaper if there is light rust, or replace them if bent or if there is excessive corrosion.

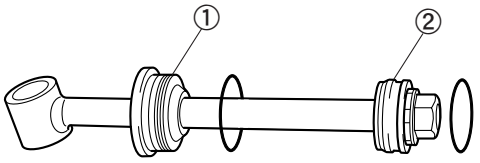
5. Check the shaft. Replace the shaft if cracked.

Assembling the tilt ram and trim ram

CAUTION:

Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

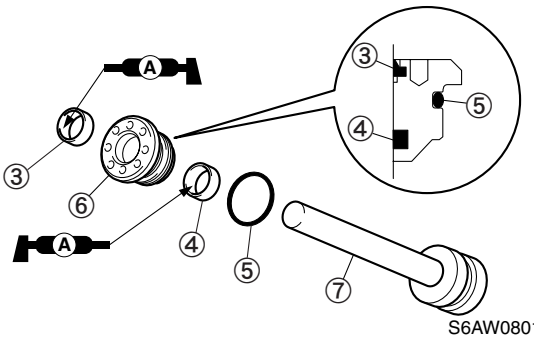
1. Install new O-rings into the tilt cylinder end screw ① and tilt piston ②.



S6AW08010

2. Install a new dust seal ③, a new down seal ④, and a new O-ring ⑤ to the trim cylinder end screw ⑥.

3. Install the trim cylinder end screw ⑥ onto the trim ram assembly ⑦.



S6AW08013

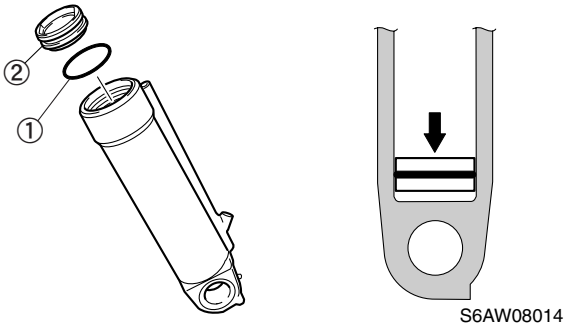
Installing the tilt cylinder

CAUTION:

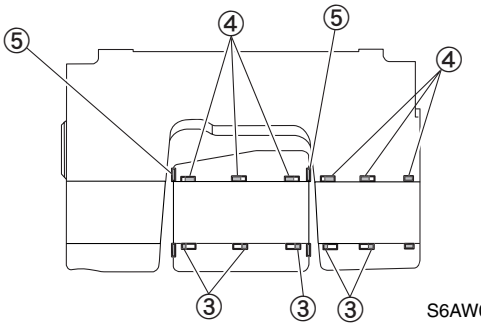
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install a new O-ring ① to the free piston ②.

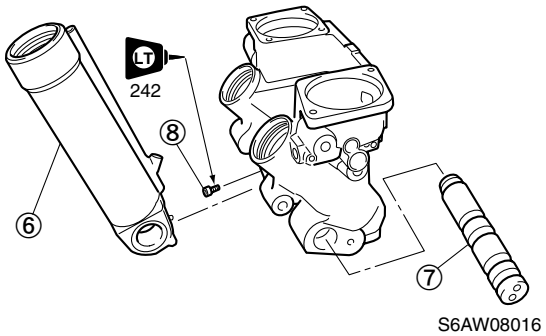
2. Push the free piston ② into the tilt cylinder until it bottoms out.

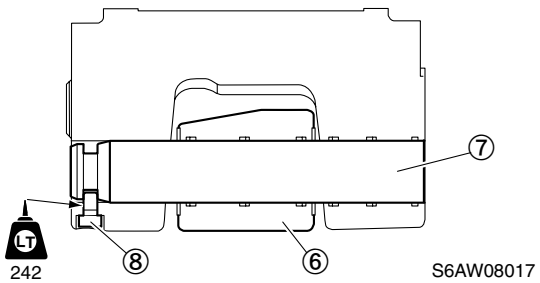


3. Install the back up rings ③, the new O-rings ④, and the spacers ⑤ in the tilt cylinder and the PTT body.



4. Install the tilt cylinder ⑥ and the shaft ⑦ into the PTT body and then tighten the shaft stopper bolt ⑧.





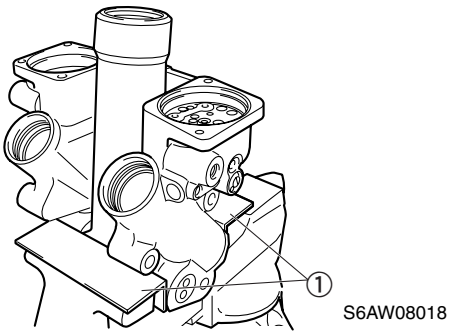
Shaft stopper bolt ⑧:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

Installing the trim ram

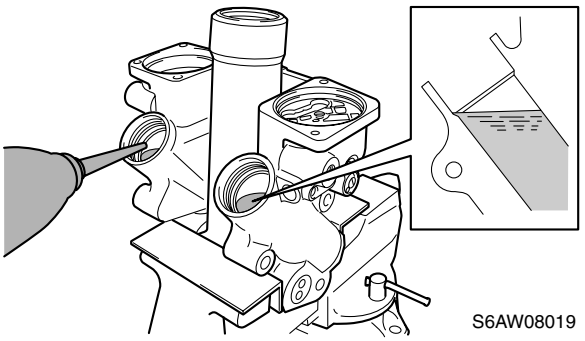
CAUTION:

Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Hold the PTT body in a vise using the aluminum plates ① on both sides.

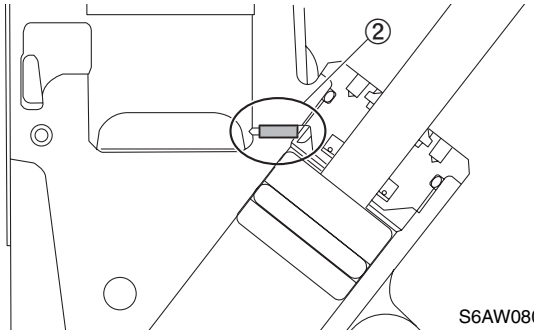


2. Fill the trim cylinders with the recommended fluid to the correct level as shown.

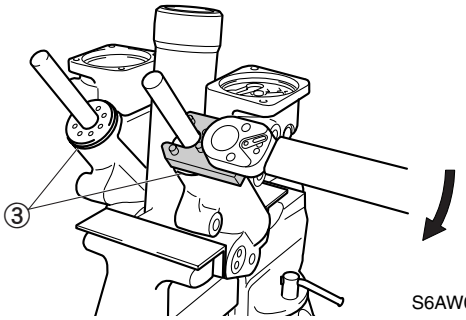


Recommended PTT fluid:
ATF Dexron II

3. Install the pin ② and trim ram assemblies ③ into the trim cylinders, and then tighten the trim cylinder end screws to the specified torque.



S6AW08039



S6AW08020

⚠ WARNING

Do not push down the trim rams while installing them into the trim cylinders. Otherwise, the PTT fluid may spurt out from the unit.

NOTE:

Make sure that the pin ② is installed, since it is only on the reservoir side.

Cylinder-end screw wrench:
90890-06837

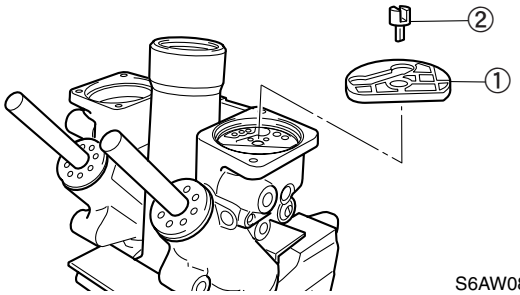
Trim cylinder end screw:
172 N·m (17.2 kgf·m, 126.9 ft·lb)

Installing the PTT motor

CAUTION:

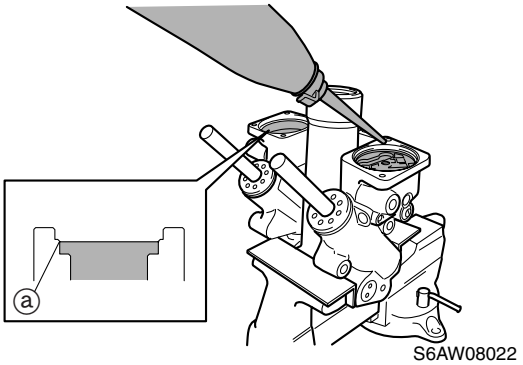
Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Install the gear pump filter ①, joint ② and into the PTT unit.



S6AW08021

2. Continue to add the recommended fluid from the gear pump side until it reaches level ⓐ on the reservoir side, as shown.



S6AW08022

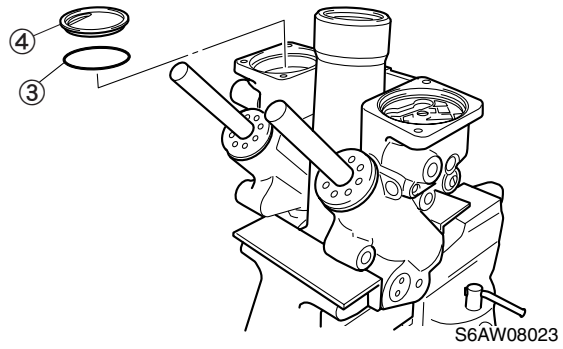
Recommended PTT fluid:
ATF Dexron II

3. Remove all of the air bubbles with a syringe or a suitable tool.

NOTE:

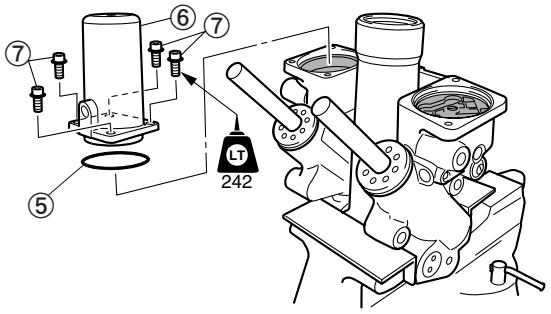
Turn the joint with a screw driver, and then remove any air between the pump gear teeth.

4. Install a new O-ring ③ and the plate ④ securely on the PTT body as shown.



S6AW08023

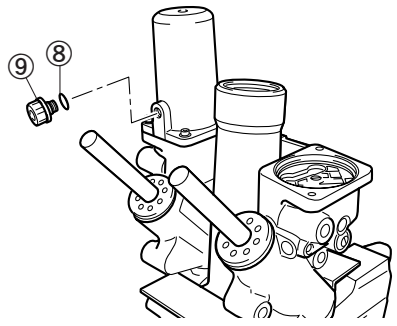
5. Install a new O-ring ⑤ and the reservoir ⑥, and then tighten the bolts ⑦ to the specified torque.



S6AW08024

Reservoir bolt ⑦:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

6. Install a new O-ring ⑧ the reservoir cap ⑨, and then tighten the reservoir cap ⑨ to the specified torque.

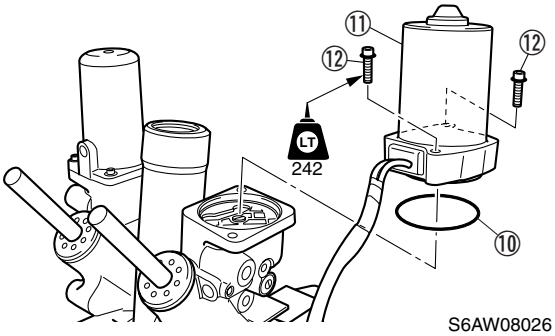


S6AW08025

Reservoir cap ⑨:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

7. Install a new O-ring ⑩ in the PTT motor assembly ⑪.

8. Install the PTT motor assembly ⑪ to the PTT unit, fitting the armature shaft into the joint groove.



S6AW08026

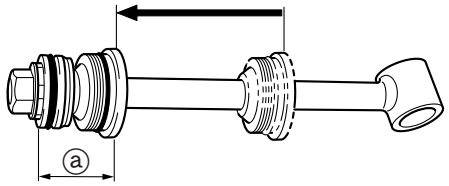
PTT motor bolt ⑫:
5 N·m (0.5 kgf·m, 3.7 ft·lb)

Installing the tilt ram

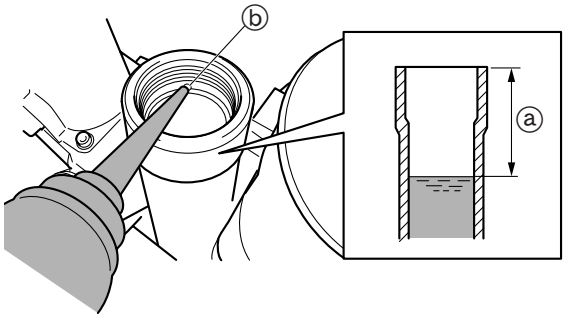
CAUTION:

Do not use a rag when assembling the PTT unit as dust and particles on the PTT unit components can lead to poor performance.

1. Fill the tilt cylinder with the recommended fluid to the correct level ⓐ as shown.
2. Add a small amount of the recommended fluid through the PTT body hole ⓑ as shown.

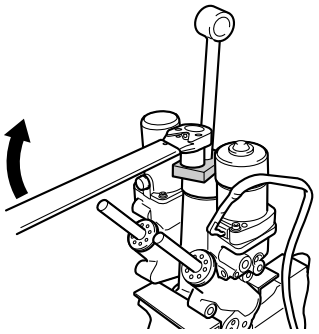


S6AW08027



S6AW08028

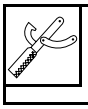
3. Install the tilt piston assembly into the tilt cylinder, and then tighten the tilt cylinder end screw to the specified torque.

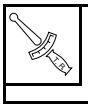


S6AW08029

NOTE:

Place the tilt cylinder end screw at the bottom ⓐ of the tilt ram and install the tilt piston assembly into the tilt cylinder.

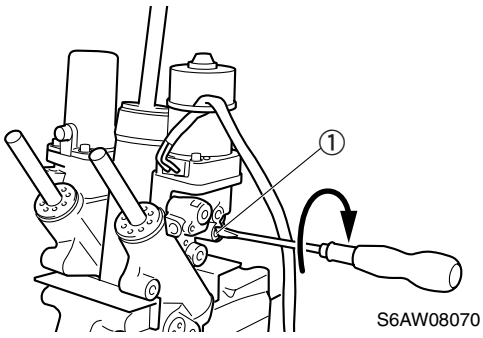
	Cylinder-end screw wrench: 90890-06837

	Tilt cylinder end screw: 257 N·m (25.7 kgf·m, 189.6 ft·lb)

9

Bleeding the PTT unit

1. Close the manual valve ① by turning it clockwise.



Manual valve ①:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

2. Remove the reservoir cap, and then check the fluid level in the reservoir.

⚠ WARNING

Make sure that the PTT rams are fully extended when removing the reservoir cap, otherwise fluid can spurt out from the unit due to internal pressure.

NOTE:

If the fluid is at the correct level, a small amount of fluid should overflow out of the filler hole.

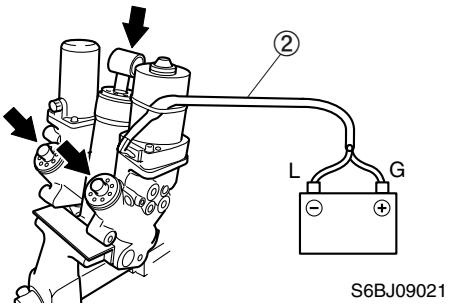
3. If fluid is below the correct level, add recommended fluid.

Recommended PTT fluid:
ATF Dexron II

4. Install the reservoir cap, and then tighten it to the specified torque.

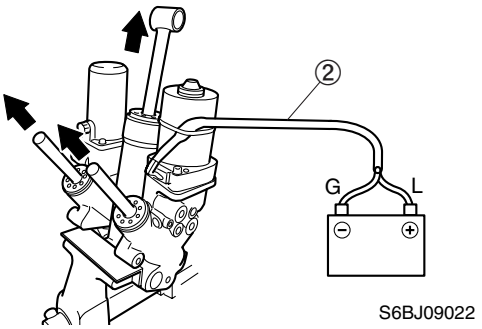
Reservoir cap:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

5. Connect the PTT motor leads ② to the battery terminals to fully retract the PTT rams.



Ram	PTT motor lead	Battery terminal
Down	Blue (L)	⊖
	Green (G)	⊕

6. Reverse the PTT motor leads ② between the battery terminals to fully extend the PTT rams.



Ram	PTT motor lead	Battery terminal
Up	Blue (L)	⊕
	Green (G)	⊖

NOTE:

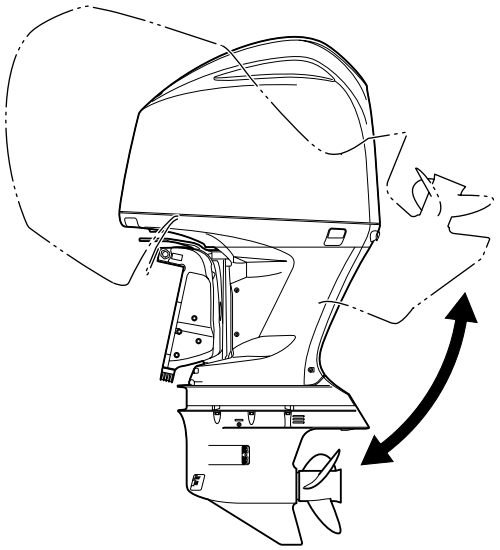
If the rams do not move up and down easily, push and pull the rams to assist operation.

7. Check the fluid level when the PTT rams are fully extended. Also check the presence of air bubbles in the fluid. Replenish the fluid if the fluid level is lower than the specified height. If air bubble remains in the fluid, repeat the steps 5–6 until no more air bubble comes out.

Bleeding the PTT unit (built-in)

Clear the tilt limiter setting before starting the procedure.

1. Push the PTT switch to fully tilt up and fully trim down the outboard motor for several times.



S6AW08129

2. Let the fluid settle for 5 minutes with the outboard motor trimmed down.

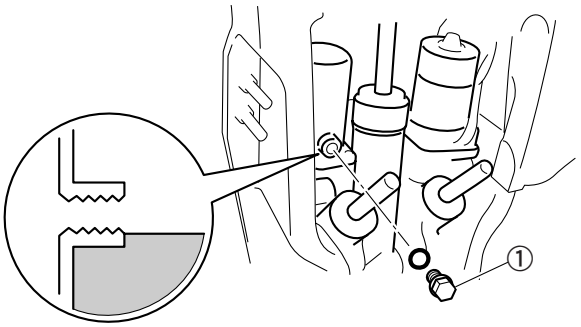
3. Push the PTT switch to fully tilt up the outboard motor.

4. Support the outboard motor with the support lever, and then let the fluid settle for 5 minutes.

⚠ WARNING

- **Make sure that the PTT rams are fully extended when removing the reservoir cap, otherwise fluid can spurt out from the unit due to internal pressure.**
- **After tilting up the outboard motor, be sure to support it with the support lever. Otherwise, the outboard motor could suddenly lower if the PTT unit should lose fluid pressure.**

5. Remove the reservoir cap ① to check the fluid level and the presence of air bubble in the fluid.



S6AW08128

NOTE:

If the fluid is at the correct level, a small amount of fluid should overflow out of the filler hole when the reservoir cap is removed.

Recommended PTT fluid:
ATF Dexron II

6. Install a new O-ring and the reservoir cap ①, and then tighten the reservoir cap to the specified torque.

Reservoir cap ①:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

7. Replenish the fluid if the fluid level is lower than the specified height. If air bubble remains in the fluid, repeat the steps 1–6 until no more air bubble comes out.

9

PTT electrical system

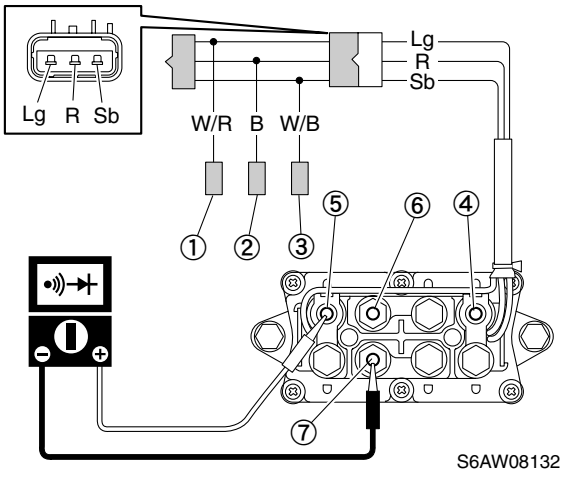
Checking the fuse

1. Check the fuse for continuity. Replace the fuse if there is no continuity. For the location of the fuse, see “Fuse holder” (5-3).

Checking the PTT relay

1. Disconnect the PTT relay coupler, battery power source, ground read, and PTT motor leads.

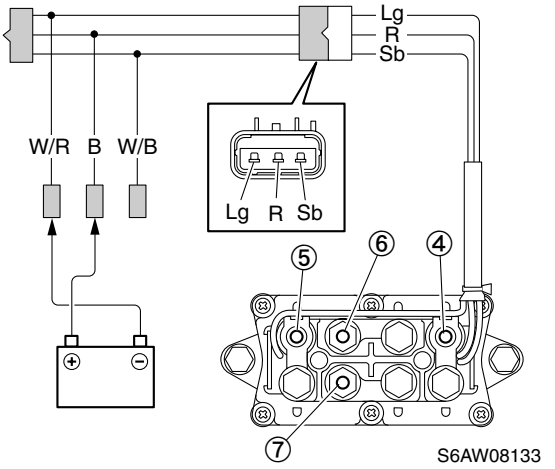
2. Using the test harness (3 pins) check the PTT relay for continuity. Replace the PTT relay if out of specification.



Test harness (3 pins): 90890-06791	

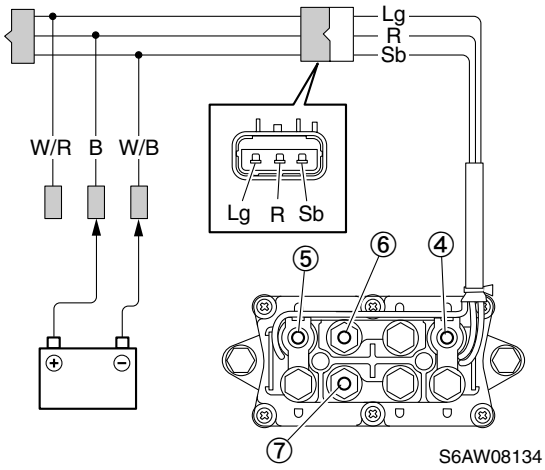
PTT relay continuity:	
Light green (Lg) ①– Red (R) ② Sky blue (Sb) ③–Red (R) ②	Continuity
Terminal ④–Terminal ⑦ Terminal ⑤–Terminal ⑦	Continuity
Terminal ④–Terminal ⑥ Terminal ⑤–Terminal ⑥	No continuity

3. Connect the positive battery lead to the Red (R) lead, and the negative battery lead to the Light green (Lg) lead as shown, and then check the PTT relay for continuity. Replace the PTT relay if out of specification.



PTT relay continuity:	
Terminal ④–Terminal ⑥ Terminal ⑤–Terminal ⑦	Continuity
Terminal ④–Terminal ⑤ Terminal ④–Terminal ⑦ Terminal ⑤–Terminal ⑥	No continuity

4. Connect the positive battery lead to the Red (R) lead, and the negative battery lead to the Sky blue (Sb) lead as shown, and then check the PTT relay for continuity.Replace the PTT relay if out of specification.

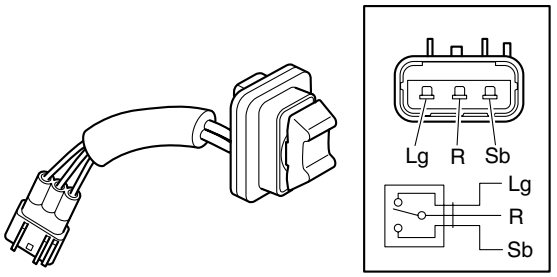


PTT relay continuity:

Terminal ④–Terminal ⑦ Terminal ⑤–Terminal ⑥	Continuity
Terminal ④–Terminal ⑤ Terminal ④–Terminal ⑥ Terminal ⑤–Terminal ⑦	No continuity

Checking the PTT switch (on bottom cowling)

1. Check the PTT switch for continuity. Replace the PTT switch if out of specification.



Lead color:

Switch position	Unloaded		
	Sky blue (Sb)	Red (R)	Light green (Lg)
Up	○	○	
Free			
Down		○	○

Maintenance

Outline

- To ensure long product life, Yamaha strongly recommends the specified periodic check and maintenance to be performed according to the maintenance interval chart.
- If replacement parts are necessary, use only genuine Yamaha parts of equivalent design and quality. Any parts of inferior quality may cause malfunction, and the resulting loss of control could endanger the operator and passengers. Yamaha genuine parts and accessories are available from Yamaha dealers.
- The service intervals provided in the Maintenance Chart are based upon “typical” operating conditions that include speed variations, sufficient time for engine warm up and cool-down, medium to light load, and an average cruising speed in 3,000 to 4,000 r/min range. If your normal operating conditions are more intensive, more frequent servicing will be required, especially the engine oil and gear oil changes. Examples of the intensive operation will be; wide-open-throttle, trolling or idling operations for extended period of time, carrying heavy loads, or frequent starting and stopping or shifting. In most cases, the frequent maintenance pays off in increased engine life and greater owner satisfaction. Consult Yamaha dealer for additional recommendations.
- The maintenance cycle on these charts assume usage of 100 hours per year and regular flushing of the cooling water passages. Maintenance frequency should be adjusted when operating the engine under adverse conditions such as extended trolling.
- Disassembly or repairs may be necessary depending on the outcome of maintenance checks.
- Expendable or consumable parts and lubricants will lose their effectiveness over time and through normal usage regardless of the warranty period.
- When operating in salt water, muddy, turbid (cloudy), or acidic water, the engine should be flushed with clean water after each use.

Maintenance interval chart 1

Item	Actions	Initial	Every			Refer to page
		20 hours (3 months)	100 hours (1 years)	300 hours (3 years)	500 hours (5 years)	
Anode(s) (external)	Check/replace		○			10-12
Anode(s) (cylinder head, thermo-stat cover)	Check/replace		○			10-12
Anodes(s) (exhaust joint, cylinder block, crankcase cover, Rectifier Regulator cover)	Replace				○	10-12
Anode(s) (upper case)	Replace				○	10-12
Battery	Check/charge/replace		○			10-13
Cooling water leakage	Check/replace	○	○			10-14
Cowling clamp	Check		○			10-26
Engine starting condition/ Noise	Check	○	○			10-19
Engine idle speed/Noise	Check	○	○			1-1, 10-9
Engine oil	Replace	○	○			10-16
Engine oil filter	Replace		○			10-17
Engine start switch/ engine shut-off switch	Check/replace	○	○			10-19
Fuel filter (can be disassembled)	Check/replace	○	○			10-20
Fuel filter (disposal type)	Replace		○			10-20
Fuel filter (vapor separator tank)	Check/replace				○	10-21
Fuel pump	Check/replace			○		6-19
Fuel/oil leakage	Check	○	○			10-20
Fuel hoses (high pressure)	Check/replace	○	○			6-1, 6-16
Fuel hoses (low pressure)	Check/replace	○	○			6-1, 6-16
Gear oil	Replace	○	○			10-22
Greasing points	Grease	○	○			10-15
Impeller/ water pump housing	Check/replace		○			10-23
Impeller/ water pump housing	Replace			○		10-23
OCV filter	Replace				○	10-24
PTT unit	Check/replace	○	○			10-25
Propeller/Propeller nut/ Cotter pin	Check/replace	○	○			10-25
PCV	Check/replace		○			9-13
Pilot water	Check	○	○			10-14

Item	Actions	Initial	Every			Refer to page
		20 hours (3 months)	100 hours (1 years)	300 hours (3 years)	500 hours (5 years)	
Spark plug(s)	Check/replace		○			10-25
Steering/Mount system	Check/retighten	○	○			—
Thermostat	Check/replace		○			10-26
Timing belt	Check/replace		○			10-26
Valve clearance	Check/adjust				○	7-3, 7-5
Water inlet	Check	○	○			10-14
Wire harness connections/ Wire coupler connections	Check/replace	○	○			—
Yamaha Meter/gauge	Check	○	○			*1

— : Not applicable
*1 : See “6Y8 Multifunction Meter set up manual” for the check of 6Y8 Multifunction Meter.

Maintenance interval chart 2

Item	Actions	Every	Refer to page
		1,000 hours	
Guide exhaust/ exhaust manifold	Check/replace	○	9-19
Timing belt	Replace	○	7-42

CAUTION:

Checking of the gears and pinion in the lower unit is recommended after 150 hours of operation at 5,000 r/min.

Predelivery check

To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the active and alert indicator

1. When the engine start switch is turned to "ON," check the active indicator and the alert indicator behavior. The active indicator comes on in the normal condition.

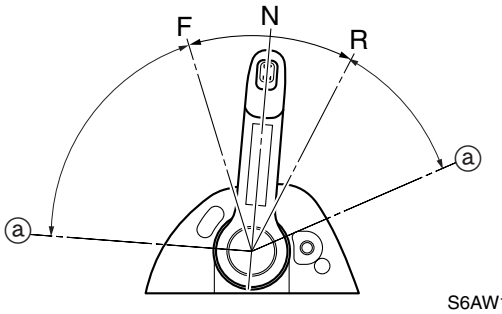
2. If both the active indicator and the alert indicator come one, check the Digital Electronic Control connection. For details of the Digital Electronic Control connections, see Chapter 4, "Troubleshooting," see Chapter 3, "Rigging information" and see "Digital Electronic Control service manual."

3. If only the alert indicator comes on, perform re-authentication between the Digital Control ECM and the engine ECM. For details of the re-authentication, see "Digital Electronic Control system reset" (3-23).

Checking the gear shift and throttle operation

1. After turning the engine start switch to "ON," check the smooth gearshift by moving the control lever from the neutral to reverse or to forward.

2. Check that the throttle operates smoothly when the control lever is shifted from forward or reverse to the fully open position ⓐ.

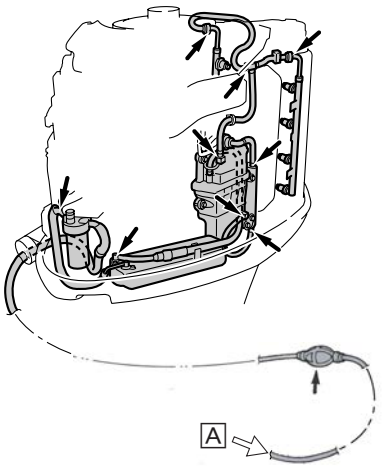


S6AW10005

If there is too much control lever friction, or too little, please make adjustments. To adjust the control lever friction, see the "Digital Electronic Control service manual."

Checking the fuel system

1. Check that the fuel hoses are securely connected and that the fuel tank is full with fuel.



S6AW10001

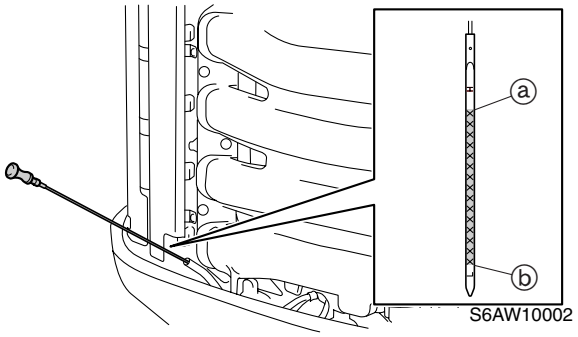
A : From the fuel tank

CAUTION:

This is a 4-stroke engine. Never use premixed fuel or 2-stroke outboard motor oil.

Checking the engine oil level

1. Put the outboard motor in an upright position (not tilted).
2. Remove oil dipstick and wipe it clean.
3. Insert the dipstick completely for accurate measurement and remove it again.
4. Check the oil level using the dipstick to be sure the level falls between the upper level mark ⓐ and lower level mark ⓑ. If the oil level is out of specified level or if it appears milky or dirty, check the power unit and the fuel system.



S6AW10002

Checking the gear oil level

1. Check the gear oil level. To check the gear oil level, see “Checking the gear oil level” (10-22).

Checking the battery

1. Check the battery capacity and specific gravity of the electrolyte.

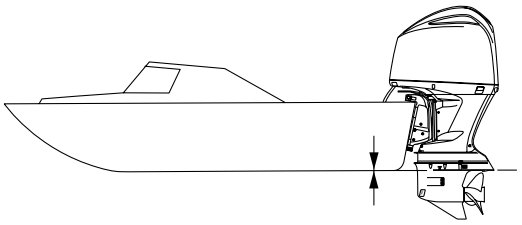
Representative Examples
Recommended battery capacity:
CCA/EN: 670 A at 0 °C (32.0 °F)
20 HR/IEC: 110 Ah at 0 °C (32.0 °F)
Electrolyte specified gravity:
1.280 at 20 °C (68 °F)

NOTE:
For other types of batteries, see Chapter 3, “Rigging information.”

2. Check the electrolyte level. Fill to the manufacturer’s recommended level when necessary. Top up only with distilled water (or pure deionized water suitable to use in batteries).
3. Check that the battery wiring is properly connected. For information about connecting the battery, see “Installing the battery” (3-13).

Checking the outboard motor mounting height

1. Check that the anti-cavitation plate is aligned with the bottom of the boat. If the mounting height is too high, cavitation will occur and propulsion will be reduced. Also, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase and reduce engine efficiency.

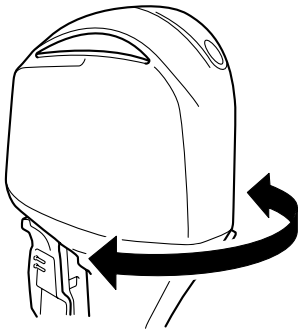

S6AW10073

NOTE:
The proper mounting height is depends on the combination of the boat and the outboard motor. To determine the optimum mounting height, test run the outboard motor at different heights.

2. Check that the clamp brackets are secured with the clamp bolts.

Checking the steering system

1. Check that the steering system operates smoothly.


S6AW10004

2. Check that there is no interference with wires or hoses when the outboard motor is steered.

Checking the PTT system

1. Check that the outboard motor tilts up and down smoothly when operating the PTT unit. If the outboard motor interferes with the motor well, change the set up of the tilt limiter. To change the tilt limiter setting, see "Setting the tilt limiter" (10-7).
2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.
4. Check that the trim meter points down when the outboard motor is tilted all the way down.

Checking the propeller nut

1. Check that the propeller nut is tightened to the specified torque.

Propeller nut:
54 N·m (5.4 kgf·m, 39.8 ft·lb)

Check and adjustment using the YDIS

Use YDIS for checking sensors and other components. When a connector must be disconnected for checking the voltages and resistance of sensors and components the engine ECM interprets this operation as a failure of the part and sets a trouble code. Therefore, be sure to delete the diagnosis record after checking the input voltage. Since the main relay stays on for approximately 10 seconds after the engine start switch is turned to "OFF," the power of the engine ECM cannot be turned off. Therefore, if the engine start switch is turned to "ON" within 10 seconds after it was turned to "OFF," the trouble codes cannot be deleted.

NOTE:
- Before checking the electrical components, make sure that the battery is fully charged.
- The YDIS requires that you use an exclusive communication cable and CD-ROM to connect to a computer. For a description of the communication cable and CD-ROM to be used, see "YDIS" (4-1). Also, be sure to check the CD-ROM version before using it.
- To connect the YDIS, see "YDIS" (4-1) or the YDIS (Ver. 1.30 or later) Instruction manual.

YDIS (CD-ROM, Ver. 1.30):
60V-WS853-04
YDIS (KIT):
60V-85300-04

Digital Electronic Control system reset

1. Reset the Digital Electronic Control system if the Digital Electronic Control ECM and the engine ECM cannot communicate with each other. For details of the reset procedure, see "Digital Electronic Control system reset" (3-23).

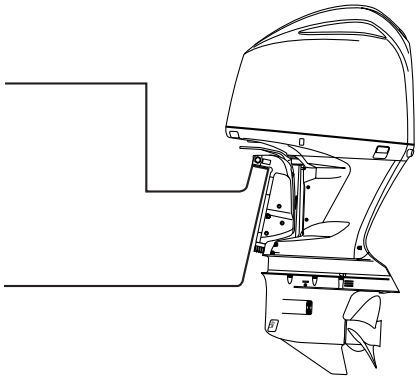
Setting the tilt limiter

CAUTION:

When the fully tilted up outboard motor could be pushing the motor well, use the tilt limiter to adjust the fully tilted up outboard motor position.

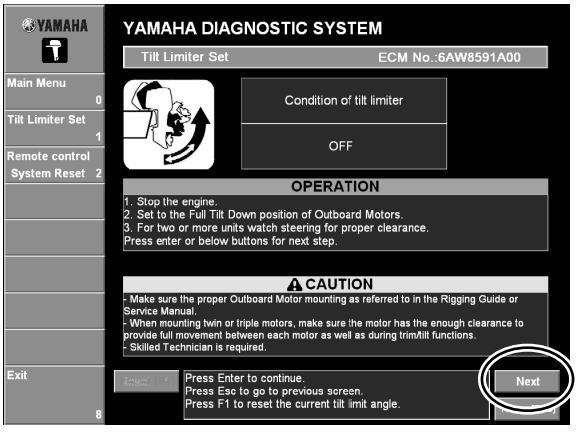
1. Make sure that the engine is stopped, and the engine start switch is turned to "ON."

2. Set the outboard motor at the fully tilted down position.



S6AW10076

3. Click the "Next" button or press the Enter key on your keyboard.



S6X604008

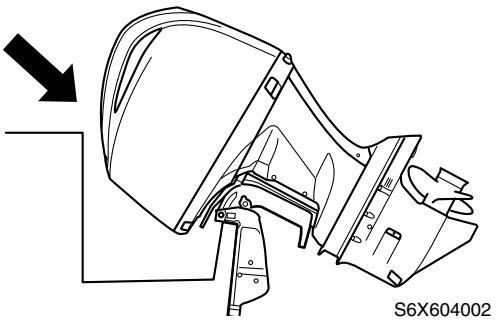
4. Tilt up the outboard motor by using the PTT switch on the bottom cowling to decide the position where the tilt limiter is activated.

CAUTION:

To prevent contact of motor well and cowling, do not use the PTT switch on the Digital Electronic Control.

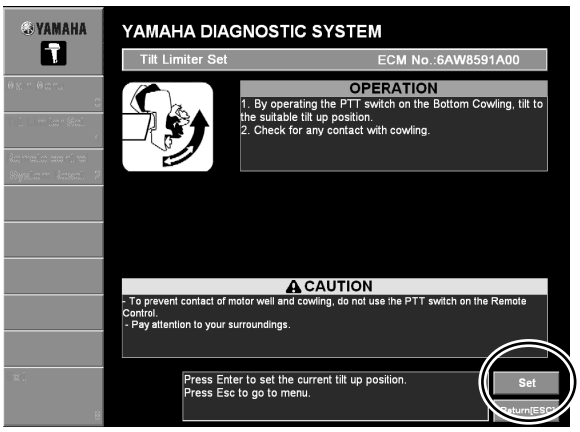
NOTE:

- Be sure to keep at least 50.8 mm (2 in) of clearance between the outboard motor and the motor well.
- The outboard motor actually stops at the position slightly lower than the corresponding tilt limiter setting angle. Chose the setting angle so that adequate clearance is ensured for the tilt support lever engagement.
- Always disengage the tilt support lever before setting the tilt limiter. The tilt support lever cannot be released after setting at certain angles.



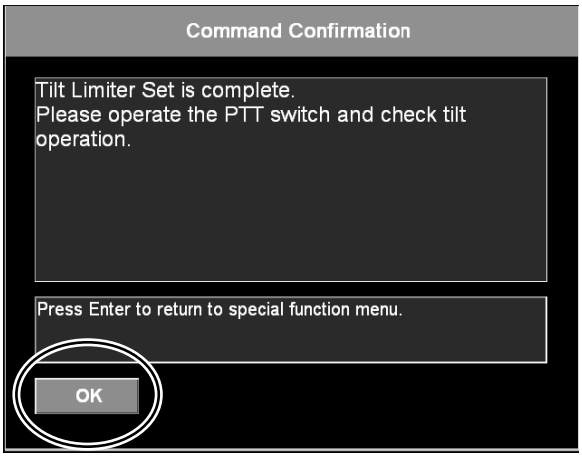
S6X604002

5. Click the "Set" button or press the Enter key on your keyboard.

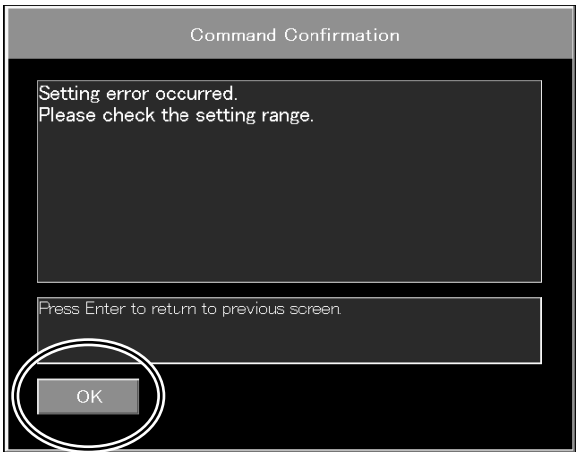


S6X604009

6. Click the “OK” button or press the Enter key on your keyboard. If an error occurs, an error message is displayed. Follow the instructions that appear in the error message.

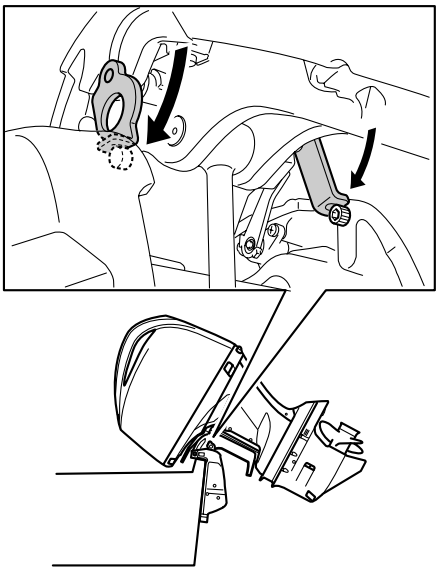


S6X604010



S6X604011

7. Check the proper operation of the tilt limiter and the effective engagement of the tilt support lever.



S6X604003

NOTE:

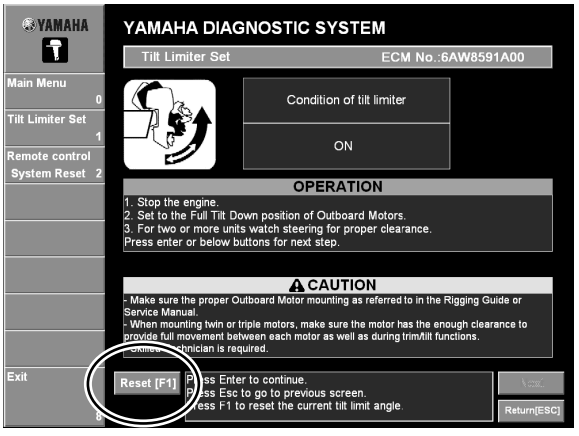
Clear the tilt limiter setting and then reset it, if the proper operation cannot be obtained, or the tilt limiter position is to be changed again.

Clear the tilt limiter

1. Make sure that the engine is stopped, and the engine start switch is turned to “ON.”

2. Set the outboard motor at the fully tilted down position.

3. Click the “Reset” button or press the F1 key on your keyboard.

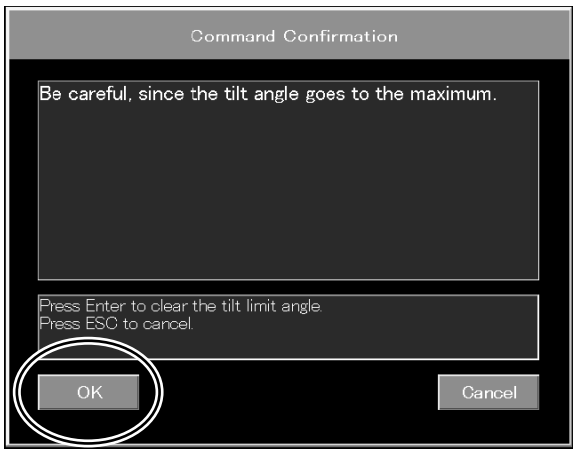


S6X604012

4. Click the “OK” button or press the Enter key on your keyboard.

S6X604013

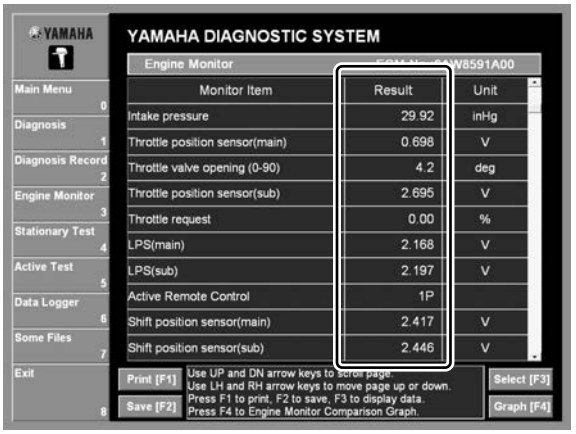
5. Click the “OK” button or press the Enter key on your keyboard.



S6X604014

Checking the engine - Digital Electronic Control communication

1. Check that the input and output values from each sensor are displayed properly on the YDIS engine monitor.



S6X604015

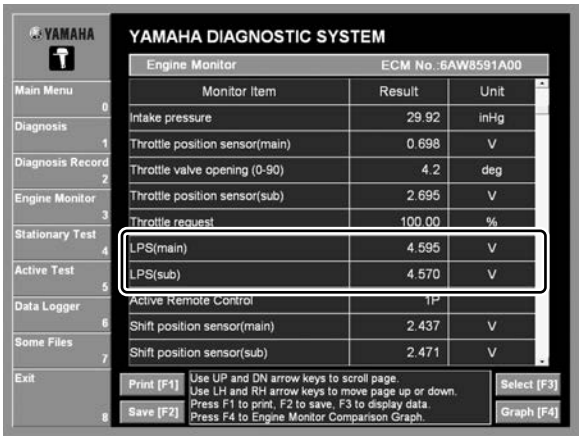
2. If any of the sensor output values on the display are out of specification, identify the problem see Chapter 4, “Trouble-shooting.”

Checking the LPS output voltage

1. Check the output voltage of the Lever Position Sensor on the YDIS engine monitor.

2. Operating the control lever, check the output voltages corresponding to forward and reverse positions, fully open forward and reverse position, and the neutral position.

3. For twin engine installation, pay attention to “P” (PORT) or “S” (STBD) display on the engine monitor, and operate the control lever for the engine to be checked (example: the engine to which the YDIS coupler is connected).



S6X604016

LPS output voltage:
Fully open forward position:
4.41–4.71 V
Forward position: 2.66–2.92 V
Neutral position: 2.07–2.33 V
Reverse position: 1.47–1.74 V
Fully open reverse position:
0.29–0.59 V

Throttle request:
Fully open forward position: 100%
Forward, Neutral, Reverse: 0%
Fully open reverse position: 100%
Fail: Over 4.8 V and Less than 0.2 V

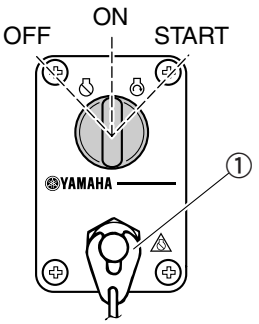
SPS output voltage:
Fully close to open forward position:
0.21–1.31 V
Fully close forward to reverse position:
2.26–2.61 V
Fully close to open reverse position:
3.56–4.79 V

Shift request:
Forward: 100%
Neutral: 0%
Reverse: -100%

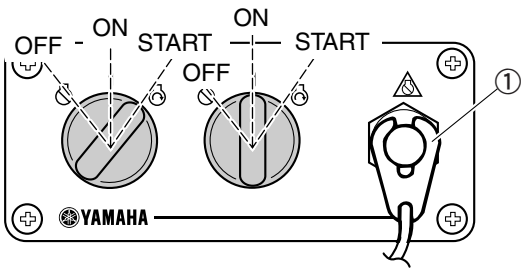
Checking the engine start switch and engine shut-off switch

1. Check that the engine starts when the engine start switch is turned to “START.”

2. Check that the engine turns off when the engine start switch is turned to “OFF.”



S6AW10006

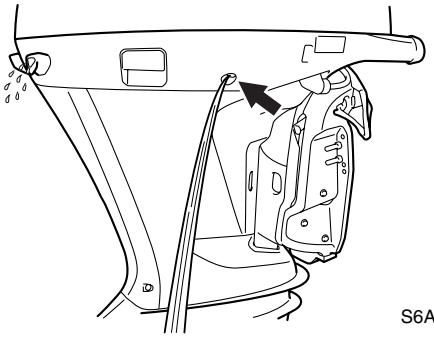


S6AW10062

3. Check that the engine turns off when the engine shut-off switch clip ① is pulled from the engine shut-off switch.

Checking the cooling water pilot hole

1. Start the engine, check that cooling water is discharged from the cooling water pilot hole.



S6AW10008

Test run

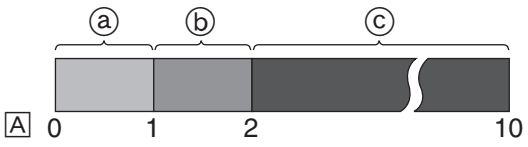
1. Turn the engine start switch to “ON,” and check that the control lever operates smoothly. And then, start the engine.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Check that the trolling speed control works.
5. Run the outboard motor according to the break-in procedure.
6. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.
7. Check that the PTT operates smoothly while the outboard motor is running.
8. Before doing a test run, check that the cooling water is being discharged from the pilot hole. Also, make sure the coolant pressure is over 75.8 kPa when test running the engine at full throttle.

NOTE:
The test run is part of the break-in operation.

Break-in

During the test run, perform the break-in operation in the following stages.

1. For the first hour of operation ⓐ:
   Run the engine at varying speeds up to 2,000 r/min or approximately half throttle.
2. For the second hour of operation ⓑ:
   Increase engine speed as much as necessary to put the boat on plane (but avoid full-throttle operation), and then back off on the throttle while keeping the boat at a planing speed.
3. Remaining eight hours ⓒ:
   Run the engine at any speed. However, avoid operating at full throttle for more than 5 minutes at a time.
4. After the first 10 hours:
   Operate the engine normally.



S6AW10074

A : Hour

After test run

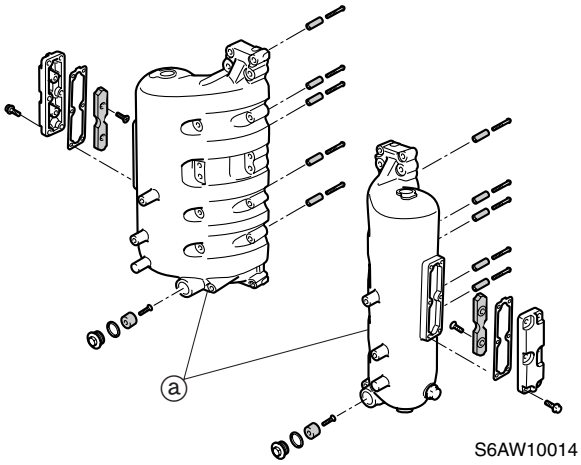
1. Check for water in the gear oil.
2. Check for fuel, water and oil leakage in the cowling.
3. Flush the cooling water passage with fresh water.

CAUTION:
Do not perform this procedure on land while the engine is running. The water pump may be damaged and severe engine damage from overheating can take place.

General Periodic Maintenance

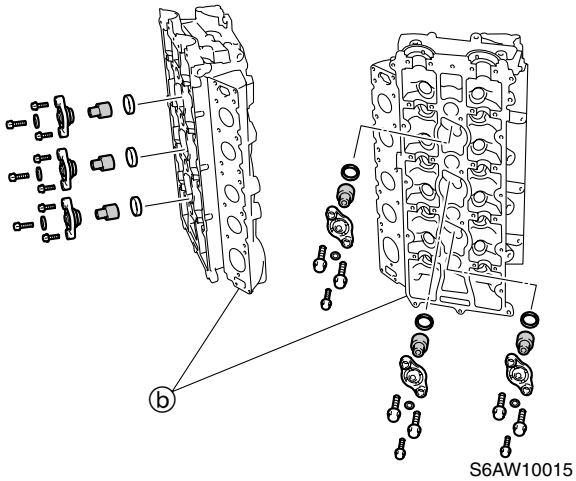
Checking the anode

1. Check the anodes. Clean if there are scales, grease, or oil. If it is necessary to disassemble the outboard motor to check an anode, refer to the applicable disassembly procedure in this manual.



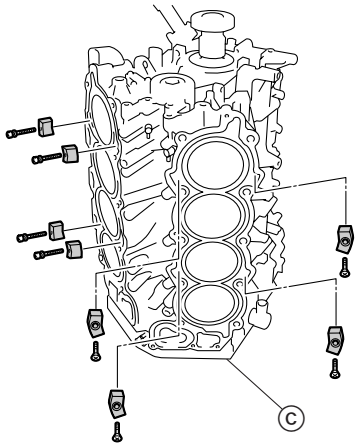
S6AW10014

ⓐ : Exhaust joint



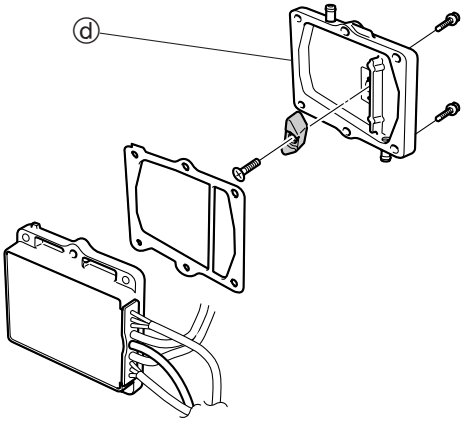
S6AW10015

ⓑ : Cylinder head



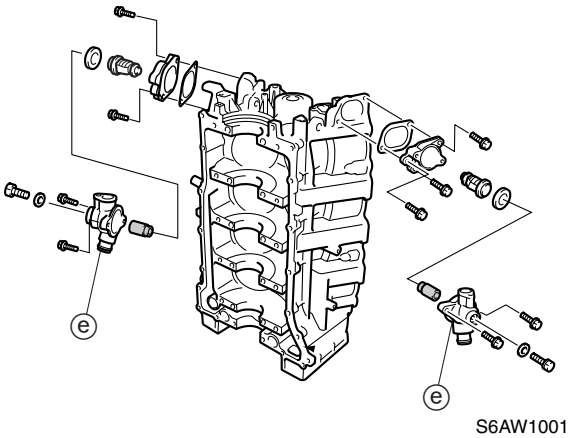
S6AW10072

ⓒ : Cylinder block



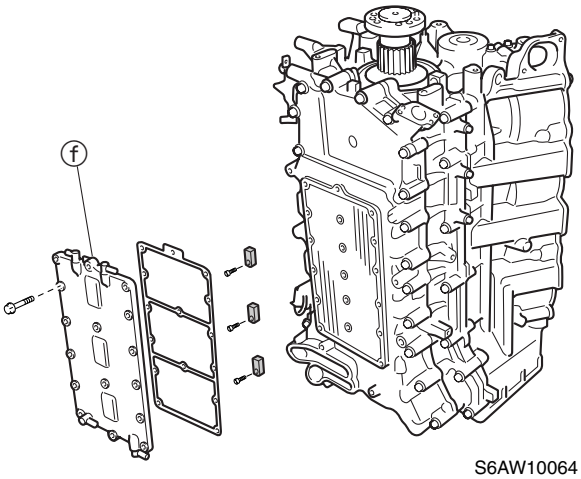
S6AW10016

ⓓ : Rectifier Regulator cover



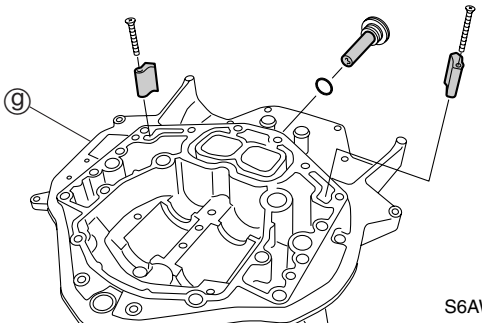
S6AW10017

ⓔ : Thermostat cover



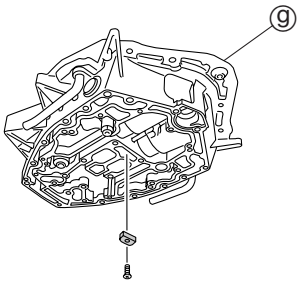
S6AW10064

ⓕ : Crankcase cover



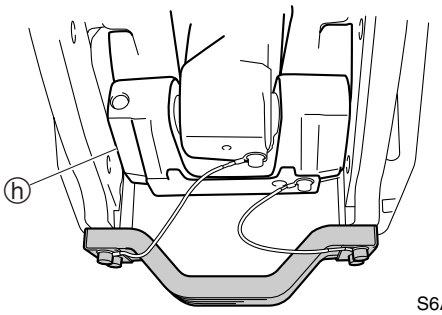
S6AW10063

ⓖ : Upper exhaust guide



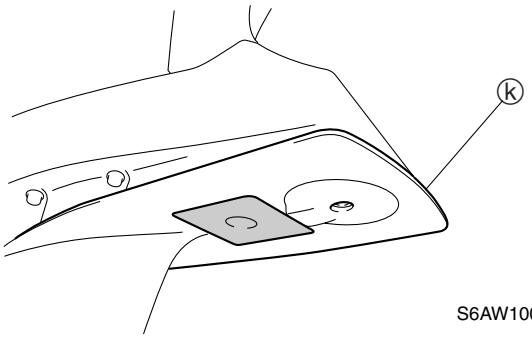
S6AW10071

ⓖ : Upper exhaust guide



S6AW10018

ⓗ : PTT unit



S6AW10019

ⓚ : Anti-cavitation plate

CAUTION:

Do not oil, grease, or paint the anodes or the trim tab, otherwise they will be ineffective.

2. Replace the anodes if excessively eroded. In addition, check the ground lead.

Checking the battery

1. Check the electrolyte level. Fill to the manufacturer's recommended level when necessary. Top up only with distilled water (or pure deionized water suitable to use in batteries).

2. Check the specific gravity of the electrolyte. Fully charge the battery if below specification.

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.

Always follow these preventive measures:

- **Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.**
- **Wear protective eye gear when handling or working near batteries.**

Antidote (EXTERNAL):

- **SKIN - Wash with water.**
- **EYES - Flush with water for 15 minutes and get immediate medical attention.**

Antidote (INTERNAL):

- **Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.**

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:

- **Charge batteries in a well-ventilated area.**
- **Keep batteries away from fire, sparks or open flames (example: welding equipment, lighted cigarettes).**
- **Do not smoke when charging or handling batteries.**

Keep batteries and electrolyte out of reach of children.

NOTE:

- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the negative battery cable first, and then disconnect the positive battery cable.

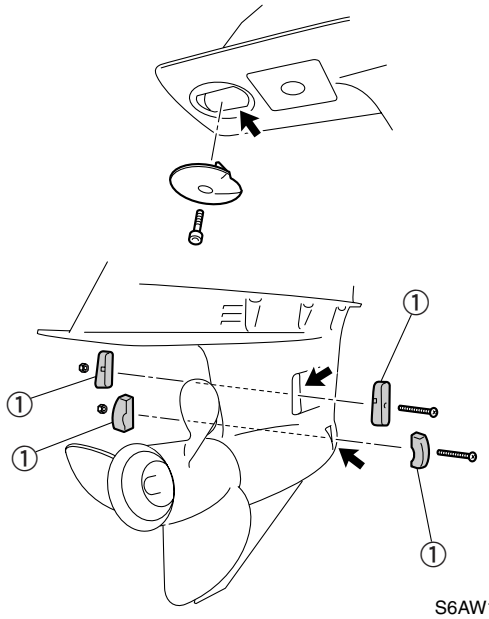
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Checking the cooling water leakage

1. Start the engine and check that no water leaks from the joints between the exhaust joint, cylinder head, cylinder body and so on.

Checking the cooling water passage

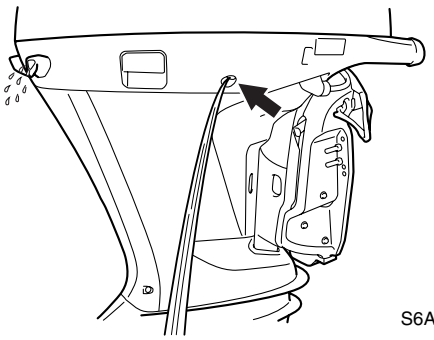
1. Check the cooling water inlet covers ① and cooling water inlet. Clean if clogged.



S6AW10051

2. Place the lower unit in water, and then start the engine.

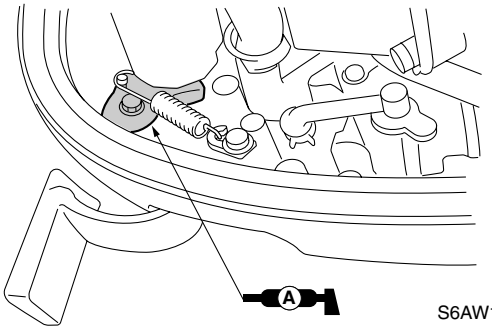
3. Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the outboard motor.



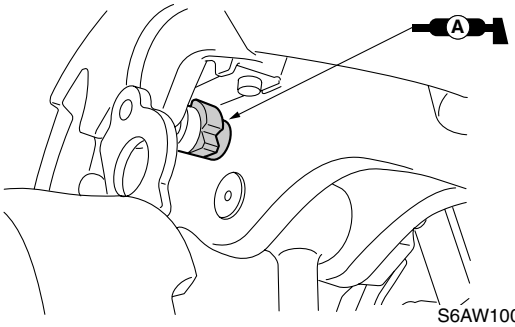
S6AW10008

Lubricating the outboard motor

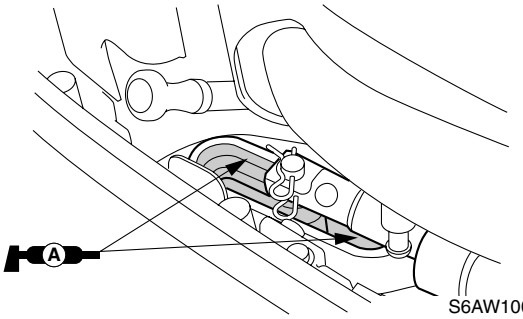
1. Apply water resistant grease to the areas shown.



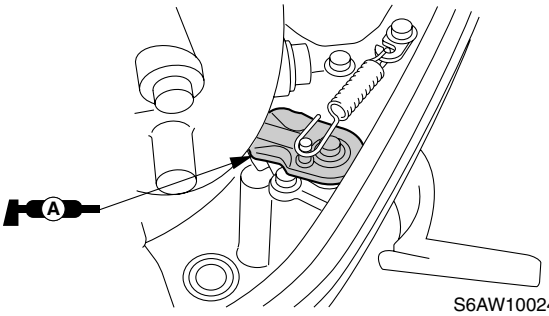
S6AW10021



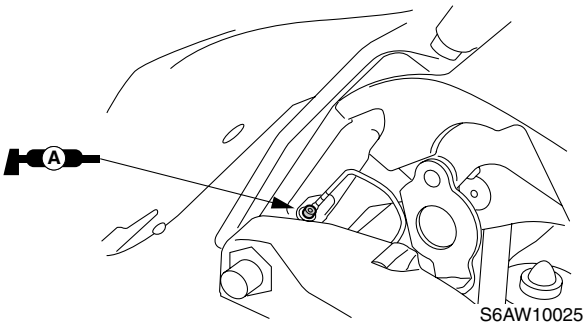
S6AW10022



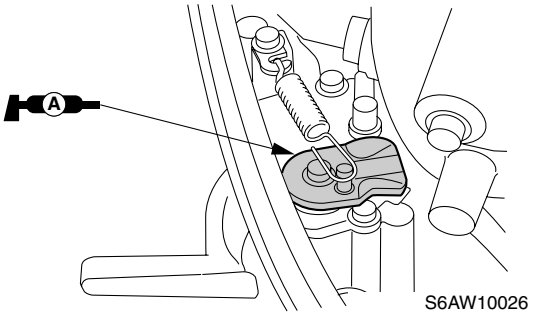
S6AW10023



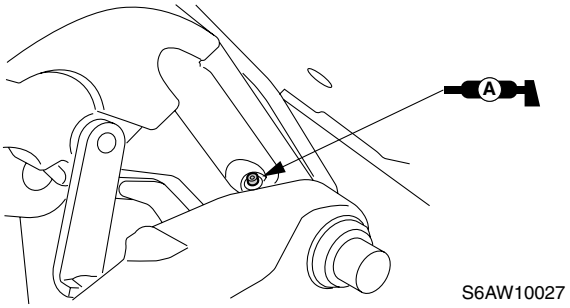
S6AW10024



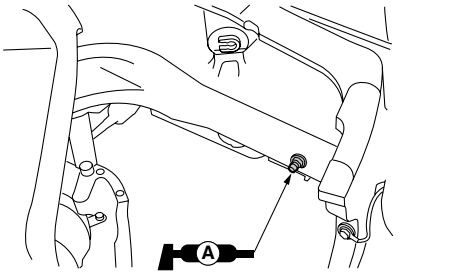
S6AW10025



S6AW10026

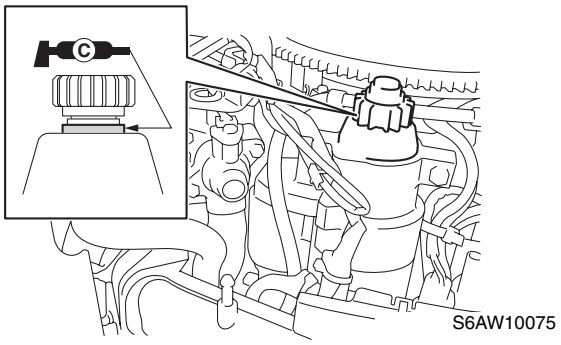


S6AW10027



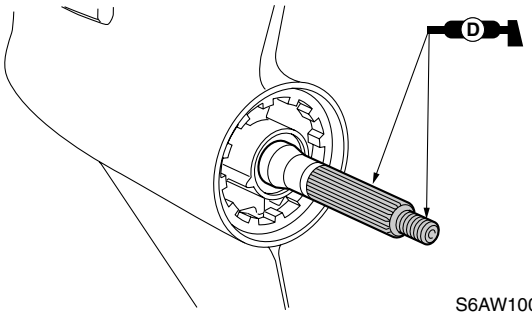
S6AW10028

2. Apply low temperature resistant grease to the area shown.



S6AW10075

3. Apply corrosion resistant grease to the area shown.



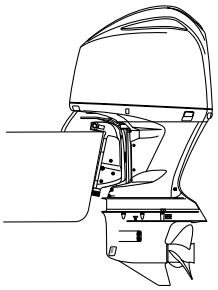
S6AW10029

Checking the engine oil level

1. Check the engine oil level. To check the engine oil level, See “Checking the engine oil level” (10-5).

Changing the engine oil

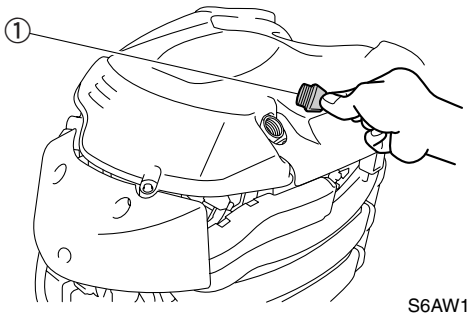
1. Put the outboard motor in an upright position (not tilted).


S6BJ10007

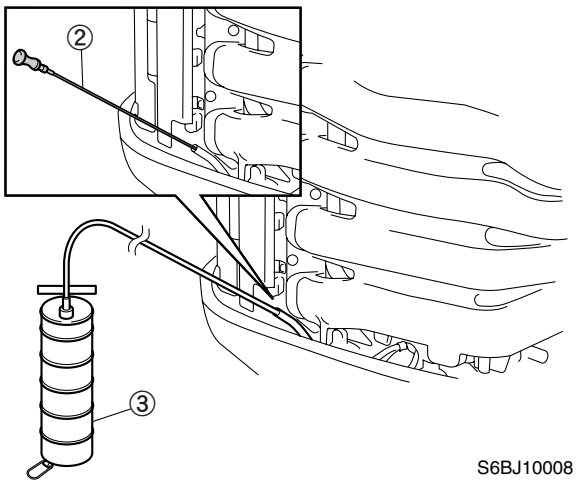
2. Start the engine. Warm it up and keep the idle speed for 5–10 minutes.

3. Stop the engine and leave it for 5–10 minutes.

4. Remove the oil filler cap ①. Pull out the dipstick ② and use the oil changer ③ to extract the oil completely.



S6AW10035



S6BJ10008

5. Add the correct amount of oil through the filler hole. Put back the filler cap ① and the dipstick ②.

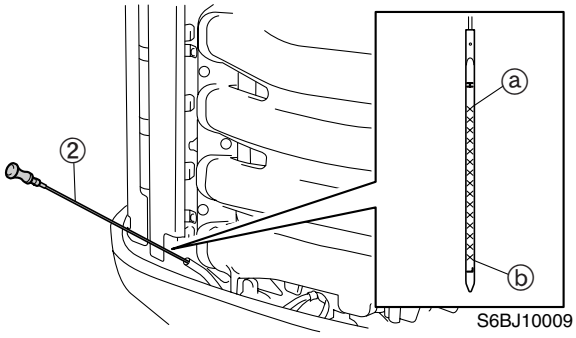
Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, SJ, or SL
SAE: 5W-30, 10W-30, 10W-40 and 20W-40
Amount of adding engine oil (at periodic maintenance):
Without oil filter:
6.3 L (6.66 US qt, 5.54 Imp qt)

6. Leave the outboard motor for 5–10 minutes.

7. Remove the dipstick ② and wipe it clean.

8. Insert the dipstick ② completely and remove it again.

9. Check the oil level using the dipstick ② to be sure the level falls between the upper level mark ⓐ and lower level mark ⓑ.



S6BJ10009

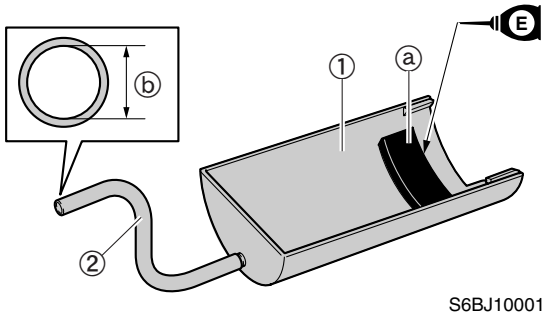
10. Start the engine and make sure that the low oil pressure alert indicator remains off. Also, make sure that there are no oil leaks.

Replacing the oil filter

CAUTION:

Do not damage the oil pressure sensor and its lead when replacing the oil filter.

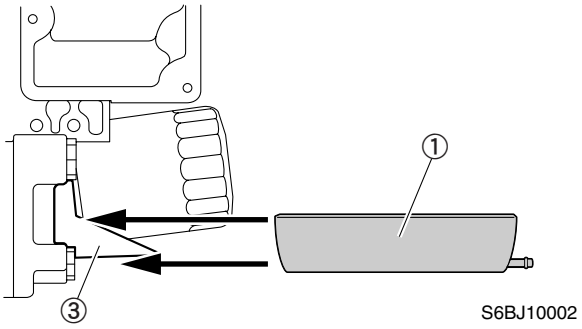
1. Check that the engine has cooled down sufficiently.
2. Remove the fuel filter assembly.
3. Place a rag under the oil filter.
4. Install the hose ② to the oil filter tray ①, and then apply a thin coat of engine oil to the foam rubber area ⓐ of the oil filter tray ①.



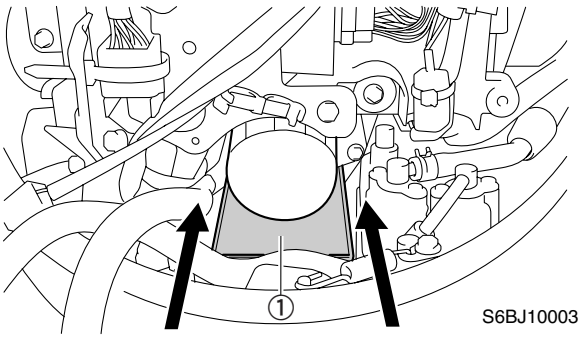
S6BJ10001

Oil filter tray ①: 90890-06845
Hose ②: (commercially available)
ⓑ=8 mm (0.32 in)

5. Install the oil filter tray ① on the oil filter bracket ③ in a horizontal position.

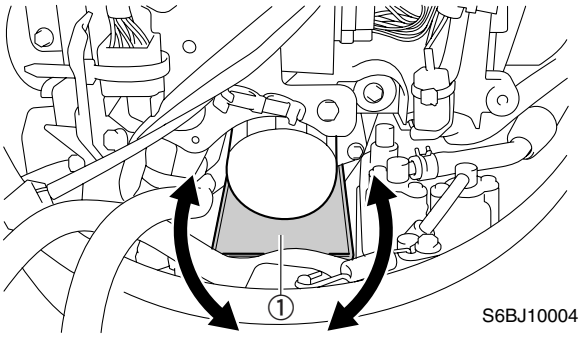


S6BJ10002



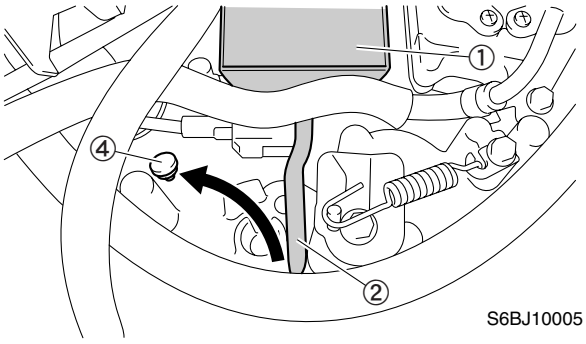
S6BJ10003

6. Check that the oil filter tray ① is installed without any free play or looseness.

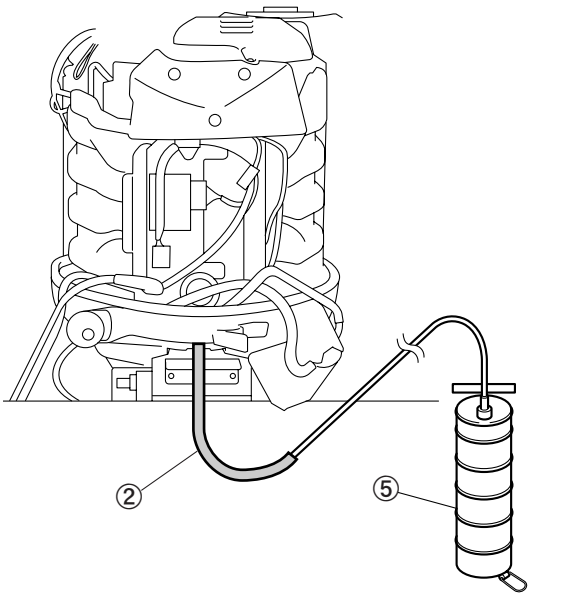


S6BJ10004

7. Remove the grommet ④ and put though the hose ②. Then, connect oil changer ⑤ to the hose ②.

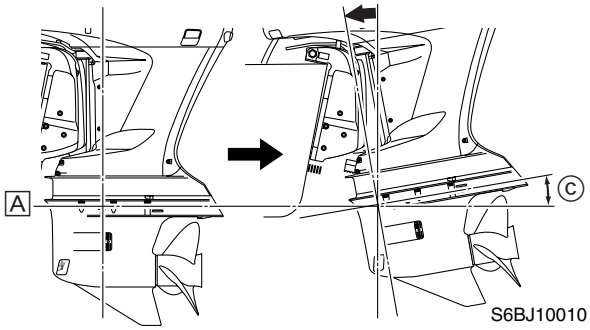


S6BJ10005



S6BJ10011

8. Slightly tilt up the outboard motor about 5–10 degree from horizontal line (water line).



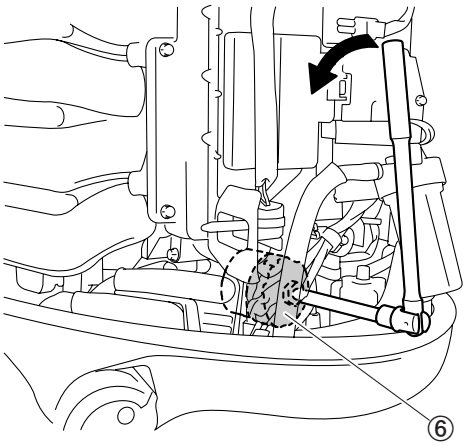
S6BJ10010

A Horizontal line
ⓒ 5–10 degree

NOTE:

Oil may spill out of the oil filter tray ① if the outboard motor is tilted up excessively.

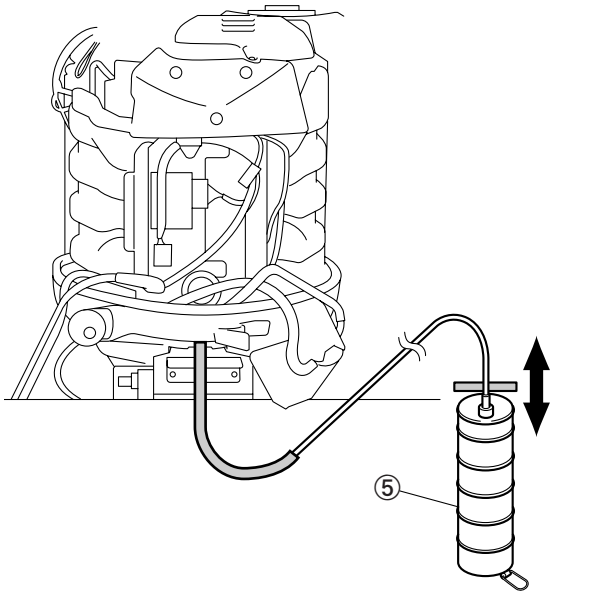
9. Slightly remove the oil filter using a 72.5 mm (2.9 in) oil filter wrench ⑥.



S6AW10040-1

Oil filter wrench ⑥: 90890-06830

10. Receive the spilled oil from the oil filter by the oil filter tray ① and pump out it using the oil changer ⑤.

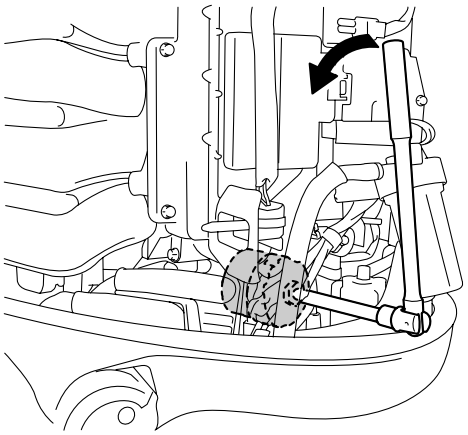


S6BJ10012

NOTE:

Pay attention to the possible oil spill while tilting up the outboard motor.

11. Let the engine oil drain completely, and then remove the oil filter.



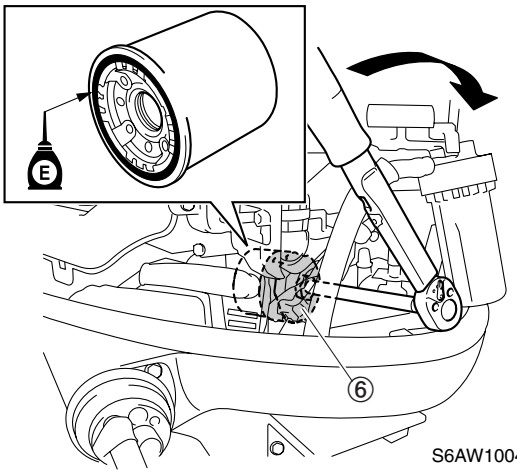
S6AW10040-2

NOTE:

Wipe off any spilled oil using the oil absorbent pads or shop towels. Spilled and leaking oil must not be allowed to leak onto the ground or water. Do not change the oil filter while the boat is in the water.

12. Apply a thin coat of engine oil to the O-ring of the new oil filter.

13. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench ⑥.



S6AW10041-1

Oil filter wrench ⑥: 90890-06830

Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

14. Remove the Oil filter tray ①.

15. Install the grommet ④.

16. Pour the specified amount of recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, SJ, or SL
SAE: 5W-30, 10W-30, 10W-40 and 20W-40
Amount of adding engine oil (at periodic maintenance):
With oil filter:
6.5 L (6.87 US qt, 5.72 Imp qt)

17. Install the fuel filter assembly.

Checking the engine start switch and engine shut-off switch

1. Check the engine start switch and engine shut-off switch. See “Checking the engine start switch and engine shut-off switch” (10-10).

Checking the exhaust manifold and exhaust guide

1. Remove the power unit. To remove the power unit, see “Removing the power unit” (7-18).

2. Remove the exhaust manifold and exhaust guide. To remove the exhaust manifold and exhaust guide, see “Upper case and steering arm” (9-11).

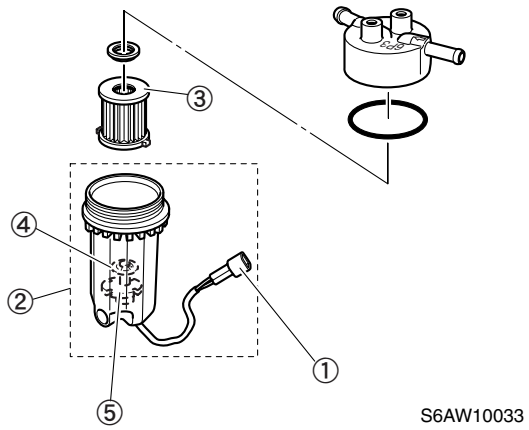
3. Checking the exhaust manifold and exhaust guide. Replace the exhaust manifold and exhaust guide if cracked or damaged.

4. Install the exhaust manifold and exhaust guide.

5. Install the power unit. To install the power unit, see “Installing the power unit” (7-20).

Checking the fuel filter

1. Remove the fuel filter cover.
2. Disconnect the water detection switch coupler (blue) ①.
3. Remove the filter cup assembly ②.
4. Check the filter element ③. Replace the filter element if there is dirt or residue.
5. Check the filter cup assembly ②. Clean with straight gasoline if there are foreign substance or replace if cracked.



S6AW10033

NOTE:

- When cleaning the filter cup assembly, be sure not to remove the clip ④ and float ⑤, otherwise the water detection switch may be damaged.
- To check the fuel cup for leaks, see “Checking the fuel filter assembly” (6-6).
- Check the water detection switch each time the fuel filter is checked.
- To check the water detection switch, see “Checking the water detection switch” (5-36).

6. Install the filter cup assembly ②.
7. Install the fuel filter cover.

NOTE:

Be sure to leave a little slack in the water detection switch lead.

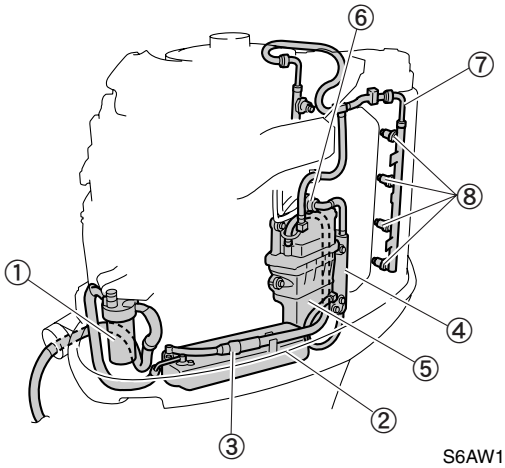
Checking the fuel joint and fuel hose (fuel joint-to-fuel injector)

1. Remove the flywheel magnet cover, intake manifold (PORT), and fuel rail covers.

NOTE:

See the exploded diagram (6-7), (6-32).

2. Check the low-pressure fuel hose connections. Also, check the fuel filter ①, low-pressure fuel pump assembly ②, filter ③, and fuel cooler ④. Replace the low-pressure fuel hose connections if there is leakage or deterioration.
3. Check the high-pressure fuel hose connections. Also, check the vapor separator tank ⑤, pressure regulator ⑥, fuel rails ⑦, and fuel injectors ⑧. Replace the high-pressure fuel hose connections if there is leakage or deterioration.

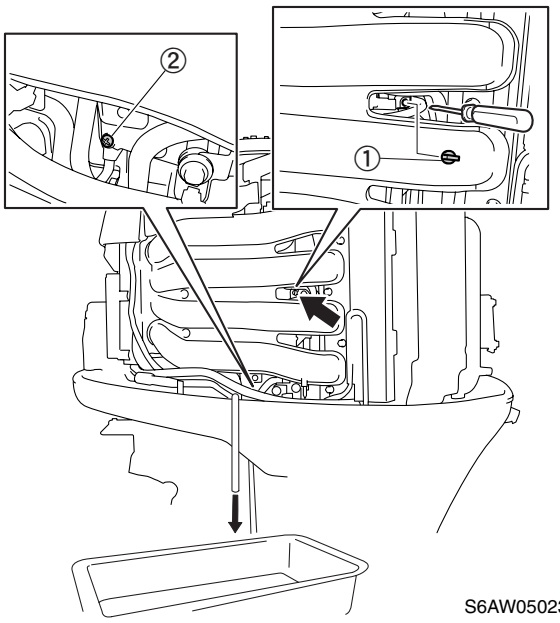


S6AW10032

4. Install the intake manifold (PORT), fuel rail covers, and flywheel magnet cover. To install the intake manifold, see “Installing the intake manifold” (6-9).

Draining the fuel

1. Reduce the fuel pressure. To reduce the fuel pressure, see “Reducing the fuel pressure” (6-27).
2. Remove the cap ①.
3. Place a drain pan under the vapor separator drain hose, and then loosen the vapor separator tank drain screw ②.
4. Drain the fuel from the vapor separator tank drain hose by pressing the pressure check valve using a thin screwdriver.



S6AW05023

⚠ WARNING

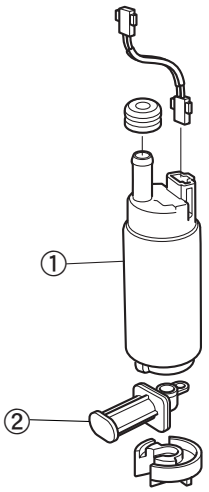
Reduce the fuel pressure before loosening the vapor separator tank drain screw, or pressurized fuel will spray out and may result in serious injury.

5. Tighten the vapor separator tank drain screw ②.

	Vapor separator tank drain screw ②: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

Replacing the fuel filter (vapor separator tank)

1. Reduce the fuel pressure. To reduce the fuel pressure, see “Reducing the fuel pressure” (6-27).
2. Remove the intake manifold (PORT).
3. Remove the vapor separator tank.
4. Disassemble the vapor separator tank. To disassemble the vapor separator tank, see “Vapor separator” (6-22) exploded diagram.
5. Remove the fuel filter ② from the high pressure fuel pump ①, and replace.



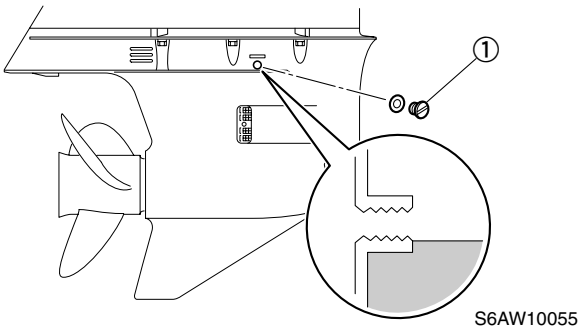
S6AW10077

6. Assemble the vapor separator tank.
7. Install the vapor separator tank.
8. Install the intake manifold (PORT). To install the intake manifold (PORT), see “Installing the intake manifold” (6-9).

Checking the gear oil level

1. Tilt down the outboard motor upside position.

2. Remove the gear oil check screw ①, and then check the gear oil level in the lower-case.



S6AW10055

NOTE:

If the oil is at the correct level, a small amount of oil should overflow out of the check hole when the check screw is removed.

3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.

Recommended gear oil:
Hypoid gear oil
API: GL-5
SAE: 90, 80W-90

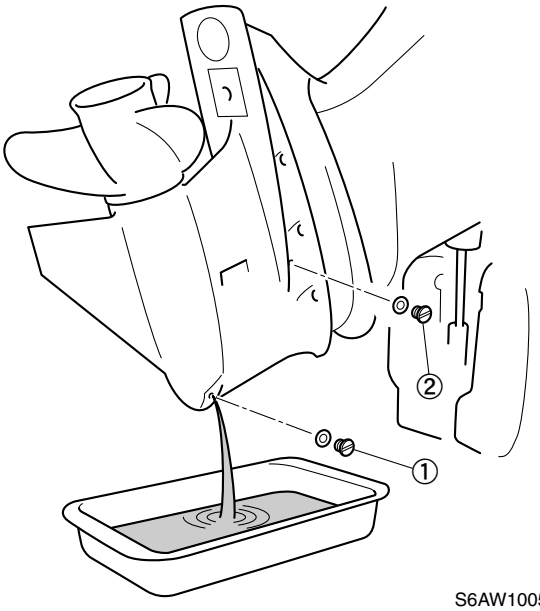
4. Install a new gasket and the gear oil check screw ①, and then tighten the gear oil check screw to the specified torque.

Gear oil check screw ①:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Changing the gear oil

1. Tilt up the outboard motor so that the gear hole is at the lowest point on the drive unit.

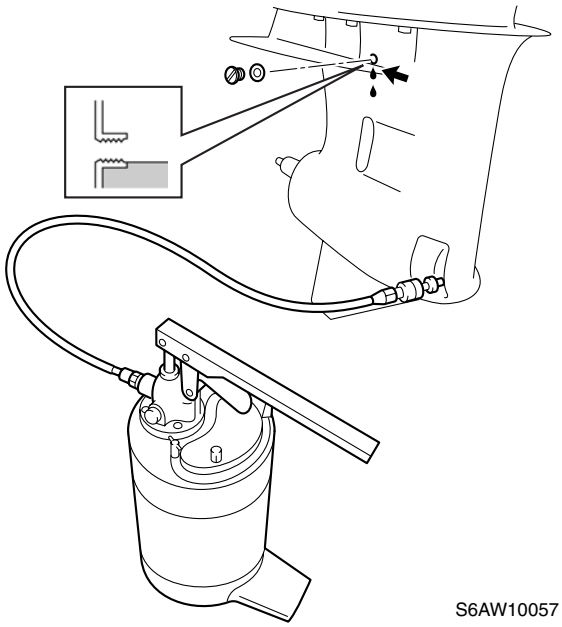
2. Place a drain pan under the gear oil drain hole, remove the gear oil drain screw ①, and then the gear oil check screw ② and let the oil drain completely.



S6AW10056

3. Check the oil for metal and discoloration, and check its viscosity. Check the internal parts of the lower case if necessary.

4. Insert a gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible. For recommended gear oils see “Checking the gear oil level” (10-22).


S6AW10057

5. Install new gaskets and the gear oil check screw ②, and quickly install the gear oil drain screw ①, and then tighten them to the specified torque.

Recommended gear oil:
Hypoid gear oil
API: GL-5
SAE: 90, 80W-90
Gear oil quantity:
Regular rotation model:
1520 cm^3
(51.4 US oz, 53.5 Imp oz)
Counter rotation model:
1310 cm^3
(44.3 US oz, 46.1 Imp oz)

Gear oil drain screw ① and check screw ②:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Checking the gear shift operation

1. Check that the gear shift operate smoothly when shifting it from the neutral position to forward or reverse.

2. Check the input and output voltages of SPS 1 and 2. To check the input and output voltages, see “Checking the SPS” (5-29).

Checking the impeller

1. Remove the lower unit. To remove the lower unit, see “Lower unit (regular rotation model)” (8-1) or “Lower unit (counter rotation model)” (8-46).

2. Remove the water pump housing.

3. Remove the impeller.

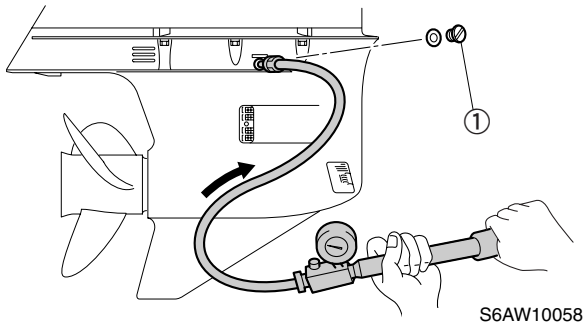
4. Check the impeller. Replace the impeller if deformed or damaged.

5. Check the water pump housing. Replace the water pump housing if cracked or damaged.

6. Install the lower unit.

Checking the lower unit for air leakage

1. Remove the gear oil check screw ①, and then install the special service tool.



S6AW10058

Leakage tester: 90890-06840

2. Apply the specified pressure to check that the pressure is maintained in the lower unit for at least 10 second.

Lower unit holding pressure:
68.6 kPa (0.7 kgf/cm^2, 9.9 psi)

CAUTION:

Do not over pressurize the lower unit, otherwise the oil seals may be damaged.

NOTE:

Cover the check hole with a rag when removing the tester from the lower unit.

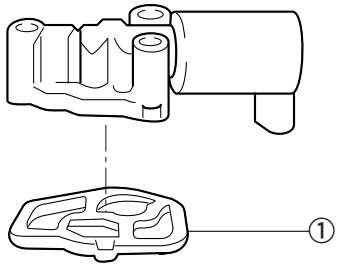
3. If the specified pressure cannot be maintained, check the drive shaft, propeller shaft and shift rod oil seals for damage. If necessary, check the each shaft for bends and damage.

Replacing the OCV filter

1. Remove the wiring harness guide. To remove the wiring harness guide, see "Removing the wiring harness, the wiring harness guide and the flywheel magnet" (7-27).

2. Remove the OCV assemblies (PORT and STBD).

3. Replace the OCV filter ①.



S6AW10078

4. Install the OCV assemblies (PORT and STBD).

5. Install the wiring harness guide. To install the wiring harness guide, see "Installing the wiring harness, the wiring harness guide and the flywheel magnet" (7-29).

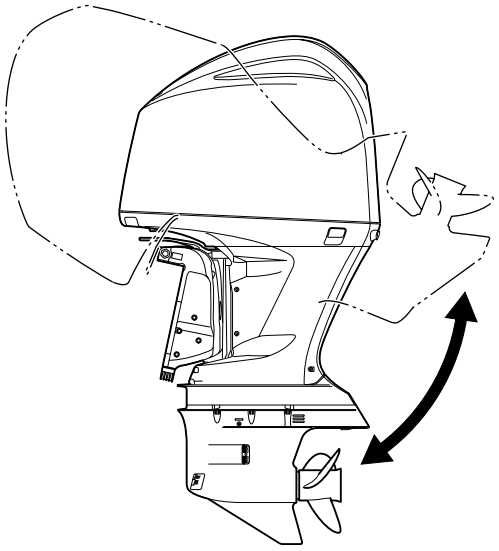
CAUTION:

Do not reuse the OCV filters ①, always replace them with new ones.

Checking the PTT operation

Clear the tilt limiter setting before starting the procedure.

1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the PTT fluid level if necessary.

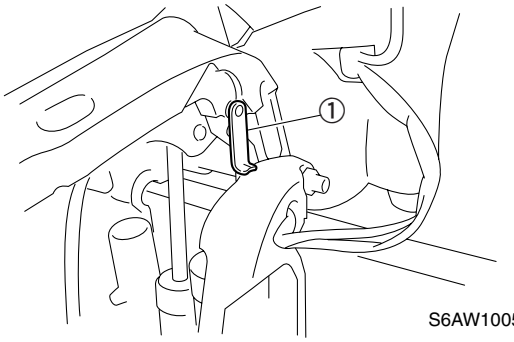


S6AW10052

NOTE:

Be sure to listen to the winding sound of the PTT motor for smooth operation.

2. Fully tilt the outboard motor up, and then support it with the tilt support lever ① to check the lock mechanism of the lever.



S6AW10053

Checking the PTT fluid level

1. Check the PTT fluid level. To check the PTT fluid level, see “Bleeding the PTT unit (built-in)” (9-54).

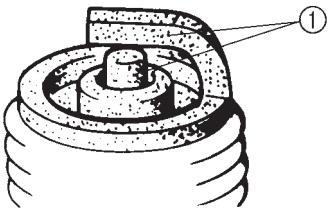
Checking the propeller

Check the propeller blades and splines. Replace the propeller if cracked, damaged, or worn. To replace the propeller, see “Lower unit (regular rotation model)” (8-1) or “Lower unit (counter rotation model)” (8-46).

Checking the spark plug

1. Remove the rear cover, side covers (PORT and STBD), all ignition coils and all spark plugs. See “Wiring harness and flywheel magnet” (7-24).

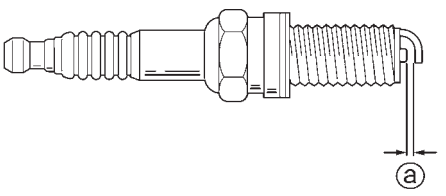
2. Clean the electrodes ① with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



S6AW10044

3. Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.

4. Check the spark plug gap ⓐ. Adjust if out of specification.



S6AW10045

Specified spark plug:
LFR6A-11 (NGK)
Spark plug gap ⓐ:
1.0–1.1 mm (0.039–0.043 in)

5. Install the all spark plugs, all ignition coils, side covers (PORT and STBD) and rear cover. See “Wiring harness and flywheel magnet” (7-24).

Checking the timing belt

1. Check the timing belt. To check the timing belt, see “Checking the timing belt” (7-42).

Checking the thermostat

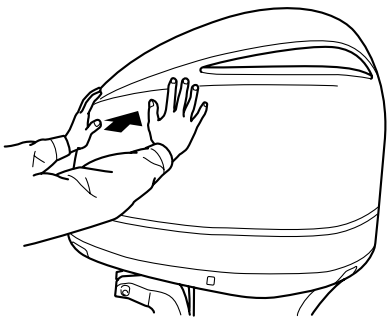
1. Check the thermostat. To check the thermostat, see “Checking the thermostat” (7-9).

Replacing the timing belt

1. Replace the timing belt. To replace the timing belt, see “Replacing the timing belt” (7-42).

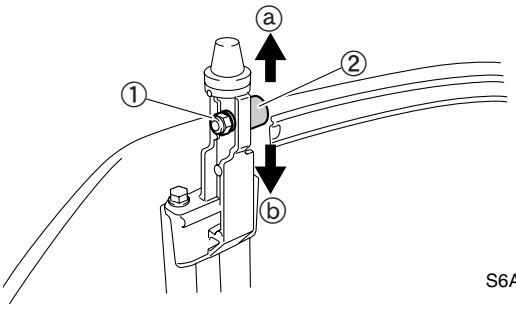
Checking the top cowling

1. Check the fitting by pushing the cowling with both hands. Adjust if necessary.



S6AW10010

2. Loosen the nut ①.
3. Move the hook ② up or down slightly to adjust its position.

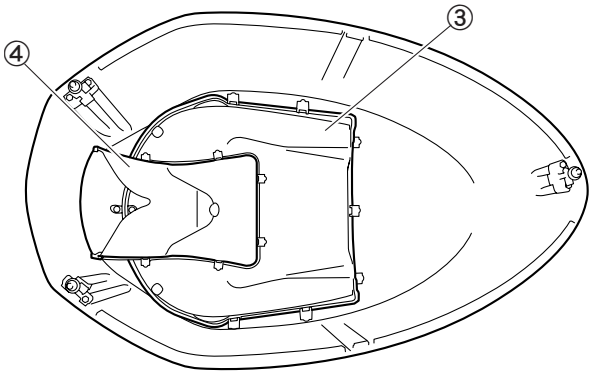


S6AW10011

NOTE:

To loosen the fitting, move the hook in direction ⓐ.
To tighten the fitting, move the hook in direction ⓑ.

4. Tighten the nut ①.
5. Check the fitting again and, if necessary, repeat steps 2–4.
6. Check the air duct molding ③ and the water-separator duct ④. Replace if cracks or other damage was found. To disassemble the air duct molding ③ and water-separator duct ④, see “Disassembling the top cowling” (7-13).



S6AW10012

Checking the valve clearance

1. Check the valve clearance. To check the valve clearance, see “Checking the valve clearance” (7-3).

A.

B.

C.

D.

E.

F.

G.

H.

I.

L.

M.

N.

O.

P.

R.

S.

T.

U.

V.

W.

Y.

Appendix

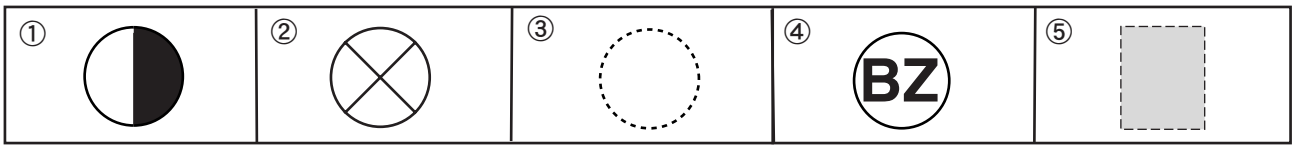
Wiring diagram

How to use the wiring diagram

Composition of the wiring diagrams

The wiring diagram consists of five categories. Engine control unit, Fuel unit, Ignition unit, Charging and starting unit, and PTT unit.

Legend symbols in the wiring diagrams



① Double colors wire.
② No wire connector.
③ A wire is not included in the selected wiring unit.
④ Alert buzzer
⑤ Option parts

Color Code

B : Black
Br : Brown
G : Green
L : Blue
Lg : Light green
O : Orange
P : Pink
Pu : Purple
R : Red
Sb : Sky blue
W : White
Y : Yellow
B/Br : Black/Brown
B/G : Black/Green
B/L : Black/Blue
B/O : Black/Orange
B/W : Black/White
B/Y : Black/Yellow
Br/W : Brown/White
G/R : Green/Red
L/B : Blue/Black
L/R : Blue/Red
L/W : Blue/White
P/G : Pink/Green
P/W : Pink/White
Pu/B : Purple/Black
Pu/G : Purple/Green
Pu/L : Purple/Blue
Pu/W : Purple/White
Pu/Y : Purple/Yellow
R/G : Red/Green
R/L : Red/Blue
R/W : Red/White
R/Y : Red/Yellow
W/B : White/Black
W/G : White/Green
W/L : White/Blue
W/R : White/Red

Engine control unit

① Engine start switch
② Engine ECM
③ SPS
④ Shift actuator
⑤ Oil pressure sensor
⑥ YDIS coupler
⑦ TPS
⑧ Cam position sensor (STBD IN)
⑨ OCV (STBD)
⑩ Joint connector 3 (yellow tape)
⑪ Cam position sensor (PORT IN)
⑫ OCV (PORT)
⑬ Cam position sensor (PORT EX)
⑭ Water pressure sensor
⑮ Speed sensor (option)
⑯ Air pressure sensor
⑰ PTT sensor
⑱ Joint connector 1 (white tape)
⑲ Joint connector 6 (brown tape)
⑳ Fuse box

ⓐ Fuse (60A) (house battery)(*1)
ⓑ Fuse (60A) (engine battery)(*1)
ⓒ Fuse (30A) (ignition coil, VCT, fuel injector, engine ECM)
ⓓ Fuse (10A) (low-pressure fuel pump)
ⓔ Fuse (15A) (high-pressure fuel pump)
ⓕ Fuse (15A) (shift actuator)
ⓖ Fuse (20A) (engine start switch, PTT switch, Digital Electronic Control ECM)
ⓗ Fuse (30A) (starter relay)
ⓚ Fuse (10A) (ETV)
ⓜ Main relay
ⓝ Fuel pump relay (low-pressure)
ⓟ Fuel pump relay (high-pressure)
ⓡ Shift-actuator relay
ⓢ ETV motor relay
ⓣ Diode (connect to the engine ECM)
ⓤ Condenser (connect to the cam position sensor) STBD IN, PORT IN, PORT EX
ⓥ Condenser (connect to the cam position sensor) PORT EX
ⓦ Condenser (connect to the air pressure sensor)

Ⓐ To Digital Electronic Control
Ⓑ To 6Y8 Multifunction Meter hub

(*1) 60A (6AW 1001014–)
(6AX 1000440–)
(6BJ 1000001–)
(6BK 1000001–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

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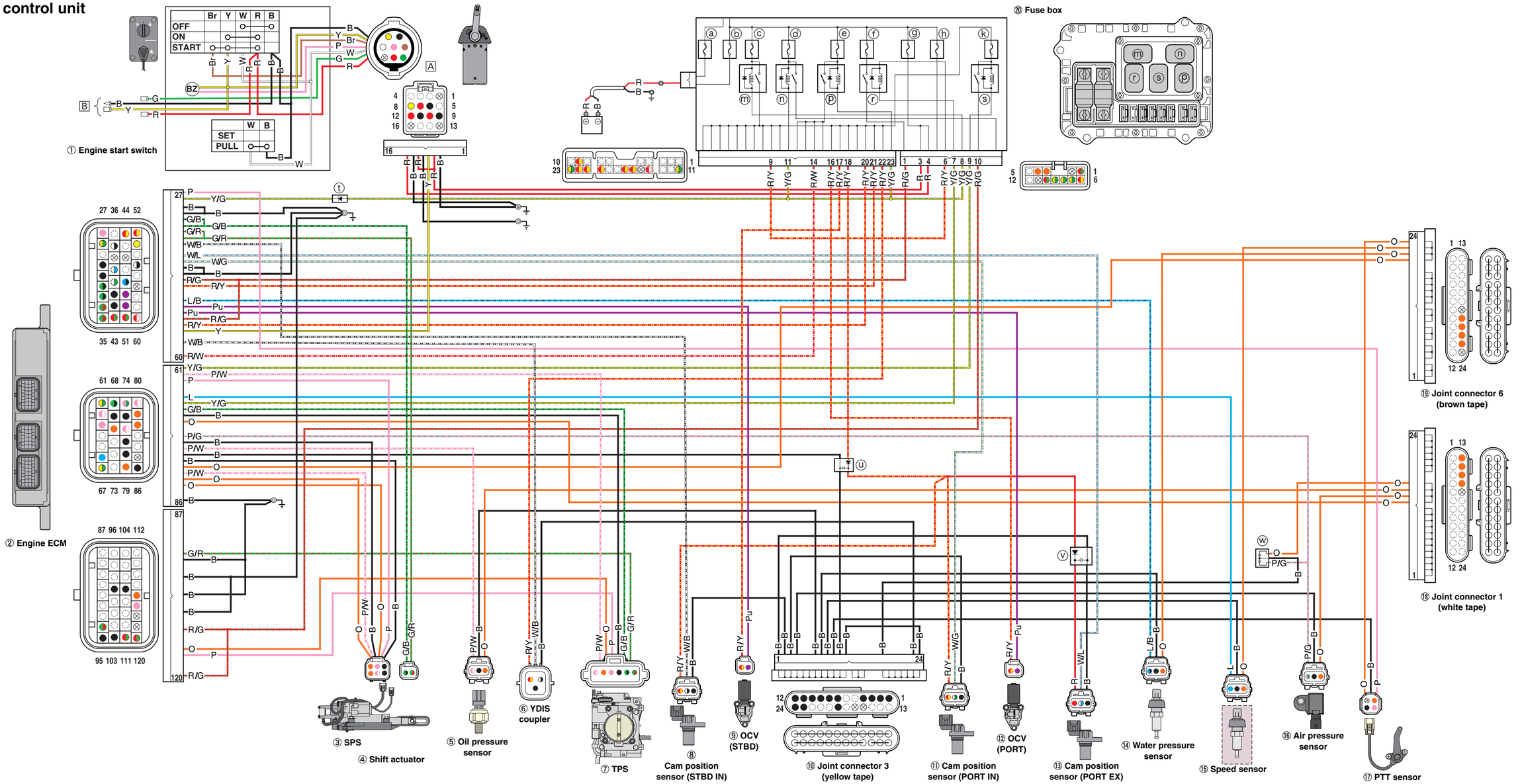
(E_7)

Engine control unit



Fuel unit

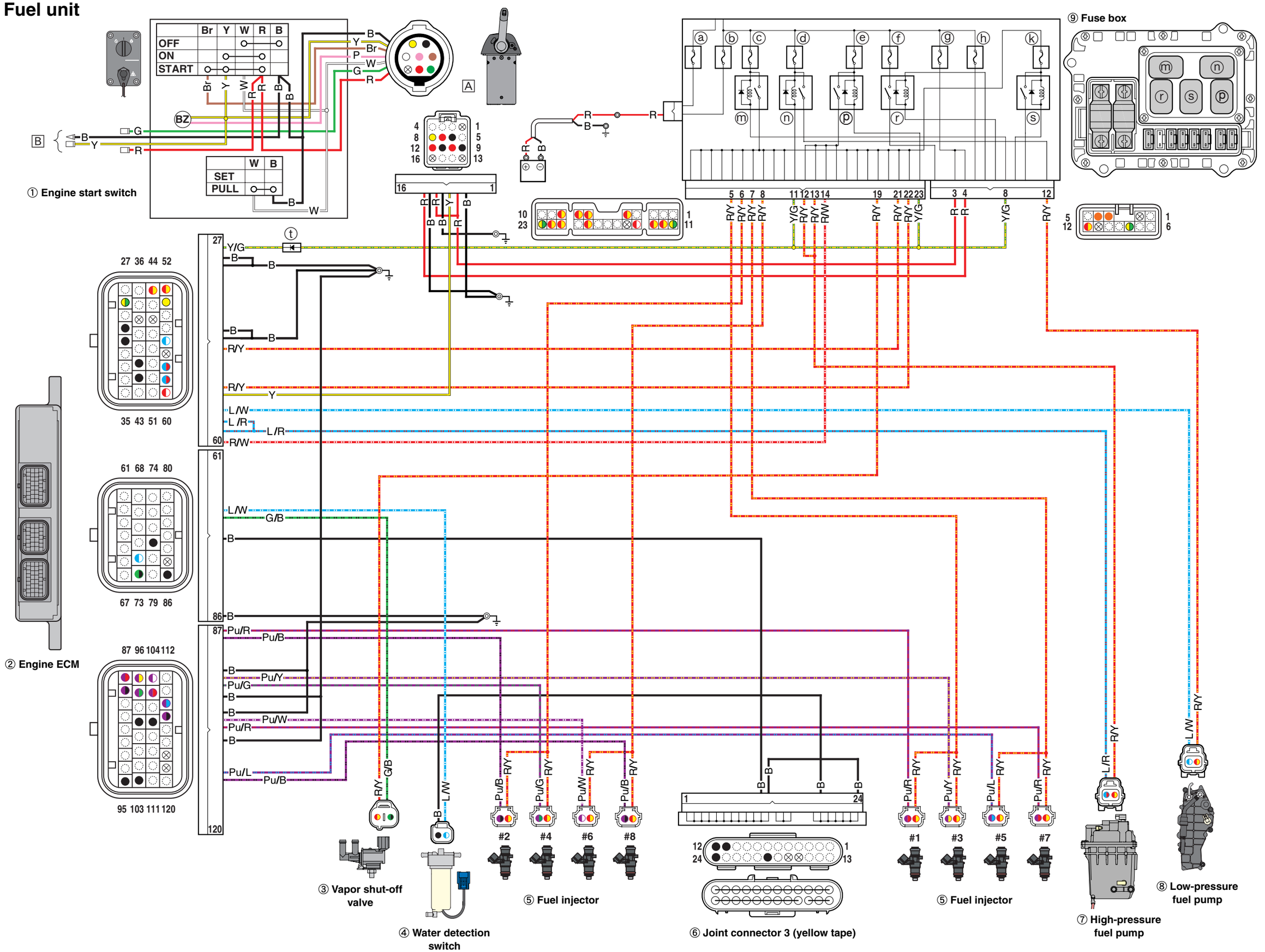
① Engine start switch
② Engine ECM
③ Vapor shut-off valve
④ Water detection switch
⑤ Fuel injector
⑥ Joint connector 3 (yellow tape)
⑦ High-pressure fuel pump
⑧ Low-pressure fuel pump
⑨ Fuse box

ⓐ Fuse (60A) (house battery)(*1)
ⓑ Fuse (60A) (engine battery)(*1)
ⓒ Fuse (30A) (ignition coil, VCT, fuel injector, engine ECM)
ⓓ Fuse (10A) (low-pressure fuel pump)
ⓔ Fuse (15A) (high-pressure fuel pump)
ⓕ Fuse (15A) (shift actuator)
ⓖ Fuse (20A) (engine start switch, PTT switch, Digital Electronic Control ECM)
ⓗ Fuse (30A) (starter relay)
ⓚ Fuse (10A) (ETV)
ⓜ Main relay
ⓝ Fuel pump relay (low-pressure)
ⓟ Fuel pump relay (high-pressure)
ⓡ Shift-actuator relay
ⓢ ETV motor relay
ⓣ Diode (connect to the engine ECM)

Ⓐ To Digital Electronic Control
Ⓑ To 6Y8 Multifunction Meter hub

(*1) 60A (6AW 1001014–)
(6AX 1000440–)
(6BJ 1000001–)
(6BK 1000001–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

Fuel unit


① Engine start switch
② Engine ECM
③ Vapor shut-off valve
④ Water detection switch
⑤ Fuel injector
⑥ Joint connector 3 (yellow tape)
⑦ High-pressure fuel pump
⑧ Low-pressure fuel pump
⑨ Fuse box
OFF
ON
START
SET
PULL
BZ
27 36 44 52
35 43 51 60
61 68 74 80
67 73 79 86
87 96 104 112
95 103 111 120

Ignition unit

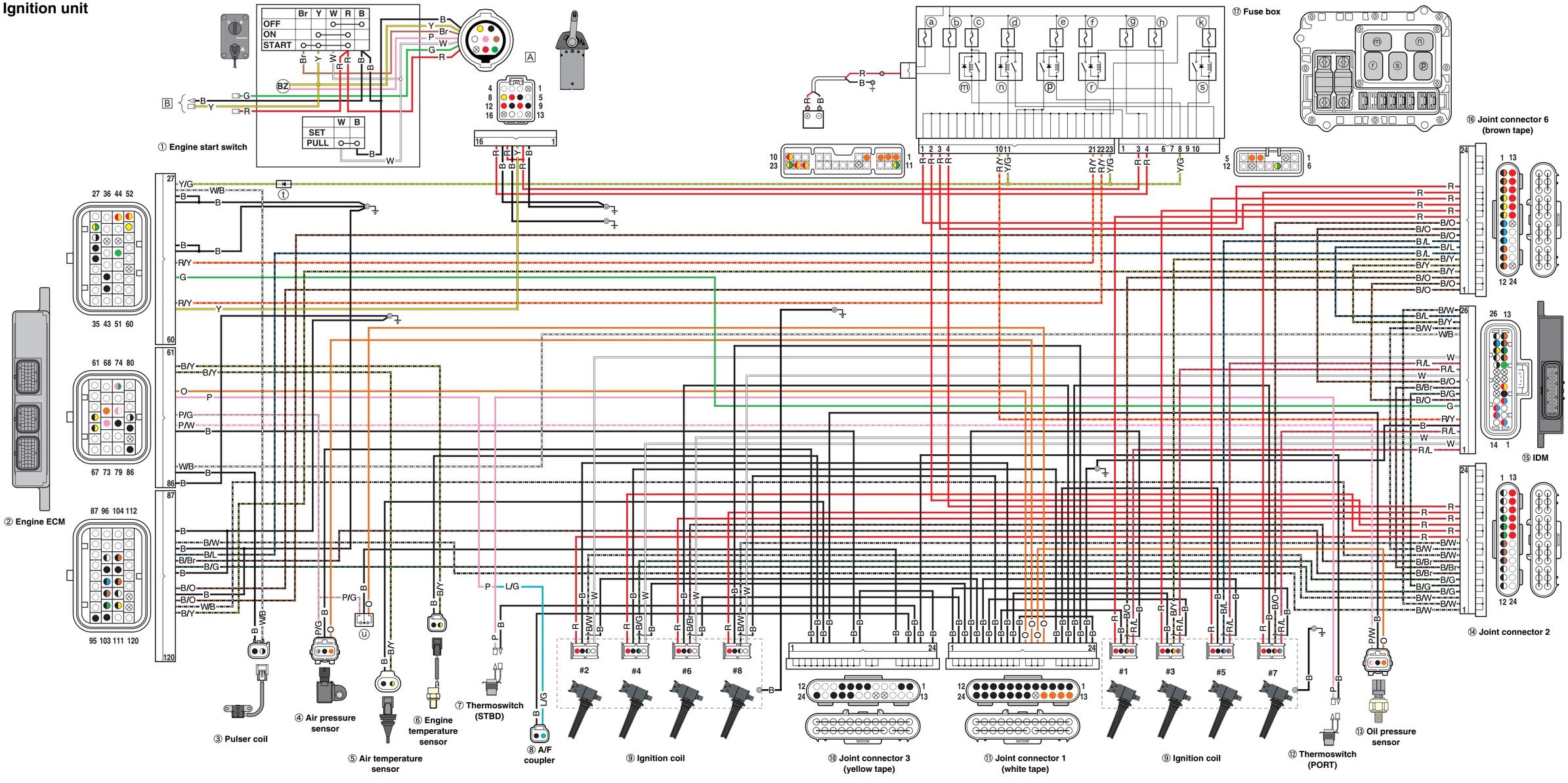
① Engine start switch
② Engine ECM
③ Pulser coil
④ Air pressure sensor
⑤ Air temperature sensor
⑥ Engine temperature sensor
⑦ Thermoswitch (STBD)
⑧ A/F coupler
⑨ Ignition coil
⑩ Joint connector 3 (yellow tape)
⑪ Joint connector 1 (white tape)
⑫ Thermoswitch (PORT)
⑬ Oil pressure sensor
⑭ Joint connector 2
⑮ IDM
⑯ Joint connector 6 (brown tape)
⑰ Fuse box

ⓐ Fuse (60A) (house battery)(*1)
ⓑ Fuse (60A) (engine battery)(*1)
ⓒ Fuse (30A) (ignition coil, VCT, fuel injector, engine ECM)
ⓓ Fuse (10A) (low-pressure fuel pump)
ⓔ Fuse (15A) (high-pressure fuel pump)
ⓕ Fuse (15A) (shift actuator)
ⓖ Fuse (20A) (engine start switch, PTT switch, Digital Electronic Control ECM)
ⓗ Fuse (30A) (starter relay)
ⓚ Fuse (10A) (ETV)
ⓜ Main relay
ⓝ Fuel pump relay (low-pressure)
ⓟ Fuel pump relay (high-pressure)
ⓡ Shift-actuator relay
ⓢ ETV motor relay
ⓣ Diode (connect to the engine ECM)
ⓤ Condenser (connect to the air pressure sensor)

Ⓐ To Digital Electronic Control
Ⓑ To 6Y8 Multifunction Meter hub

(*1) 60A (6AW 1001014–)
(6AX 1000440–)
(6BJ 1000001–)
(6BK 1000001–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

Ignition unit



Charging unit and starting unit

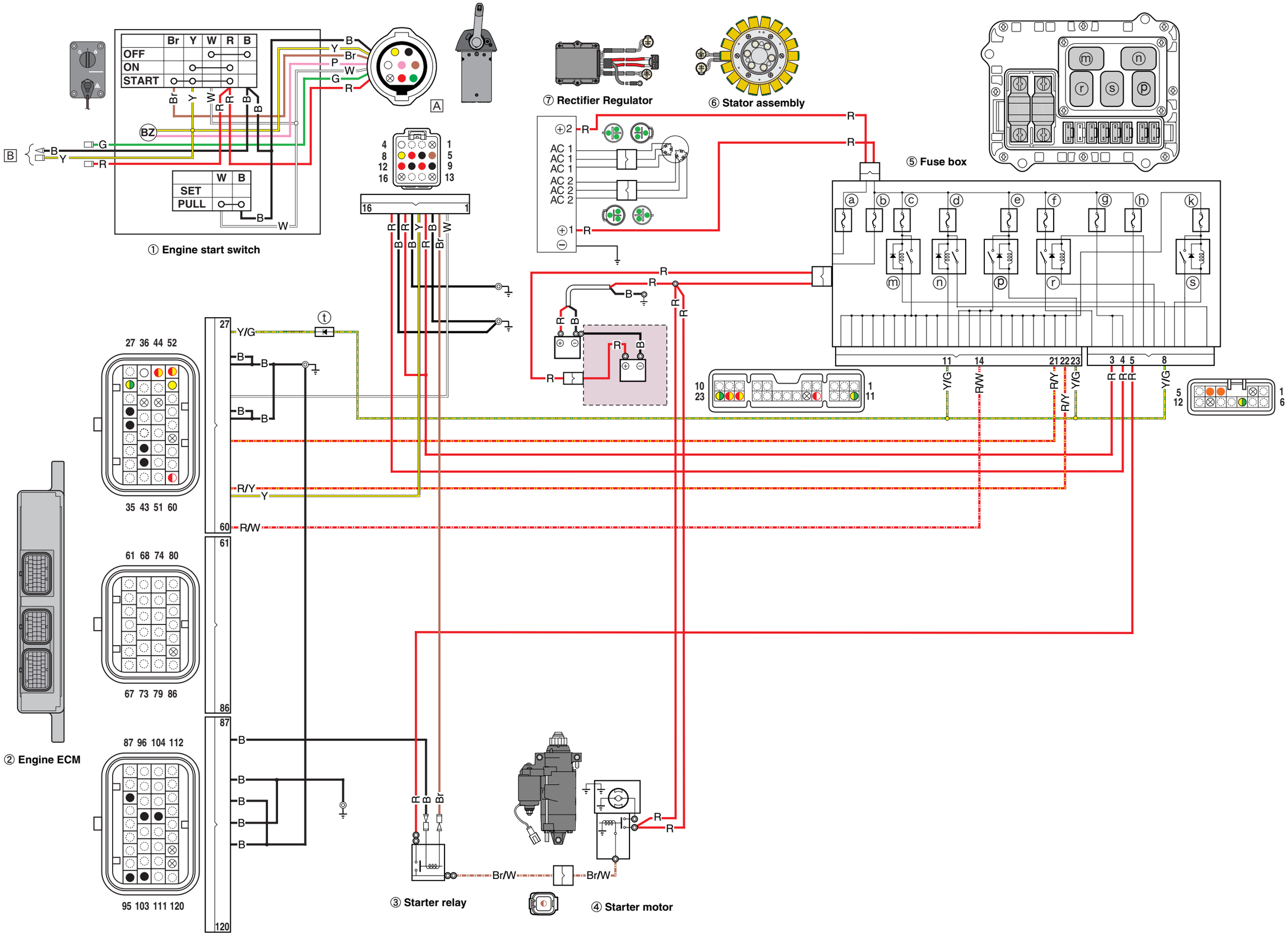
① Engine start switch
② Engine ECM
③ Starter relay
④ Starter motor
⑤ Fuse box
⑥ Stator assembly
⑦ Rectifier Regulator

ⓐ Fuse (60A) (house battery)(*1)
ⓑ Fuse (60A) (engine battery)(*1)
ⓒ Fuse (30A) (ignition coil, VCT, fuel injector, engine ECM)
ⓓ Fuse (10A) (low-pressure fuel pump)
ⓔ Fuse (15A) (high-pressure fuel pump)
ⓕ Fuse (15A) (shift actuator)
ⓖ Fuse (20A) (engine start switch, PTT switch, Digital Electronic Control ECM)
ⓗ Fuse (30A) (starter relay)
ⓚ Fuse (10A) (ETV)
ⓜ Main relay
ⓝ Fuse pump relay (low-pressure)
ⓟ Fuse pump relay (high-pressure)
ⓡ Shift-actuator relay
ⓢ ETV motor relay
ⓣ Diode (connect to the engine ECM)

Ⓐ To Digital Electronic Control
Ⓑ To 6Y8 Multifunction Meter hub

(*1) 60A (6AW 1001014–)
(6AX 1000440–)
(6BJ 1000001–)
(6BK 1000001–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

Charging unit and starting unit



PTT unit

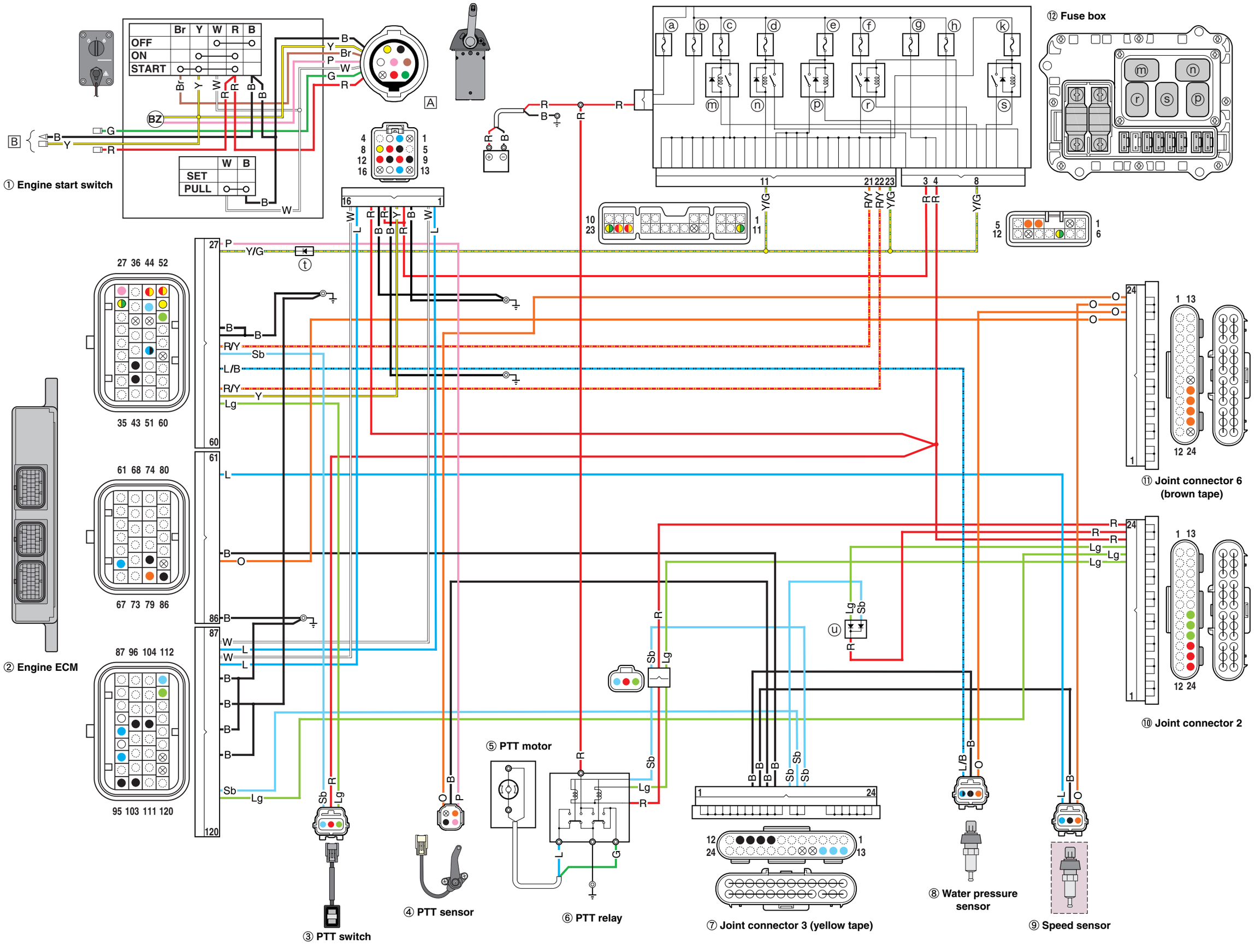
① Engine start switch
② Engine ECM
③ PTT switch
④ PTT sensor
⑤ PTT motor
⑥ PTT relay
⑦ Joint connector 3 (yellow tape)
⑧ Water pressure sensor
⑨ Speed sensor (option)
⑩ Joint connector 2
⑪ Joint connector 6 (brown tape)
⑫ Fuse box

ⓐ Fuse (60A) (house battery)(*1)
ⓑ Fuse (60A) (engine battery)(*1)
ⓒ Fuse (30A) (ignition coil, VCT, fuel injector, engine ECM)
ⓓ Fuse (10A) (low-pressure fuel pump)
ⓔ Fuse (15A) (high-pressure fuel pump)
ⓕ Fuse (15A) (shift actuator)
ⓖ Fuse (20A) (engine start switch, PTT switch, Digital Electronic Control ECM)
ⓗ Fuse (30A) (starter relay)
ⓚ Fuse (10A) (ETV)
ⓜ Main relay
ⓝ Fuel pump relay (low-pressure)
ⓟ Fuel pump relay (high-pressure)
ⓡ Shift-actuator relay
ⓢ ETV motor relay
ⓣ Diode (connect to the engine ECM)
ⓤ Condenser (connect to the PTT)

Ⓐ To Digital Electronic Control
Ⓑ To 6Y8 Multifunction Meter hub

(*1) 60A (6AW 1001014–)
(6AX 1000440–)
(6BJ 1000001–)
(6BK 1000001–)
80A (6AW 1000001–1001013)
(6AX 1000001–1000439)

PTT unit


① Engine start switch
② Engine ECM
③ PTT switch
④ PTT sensor
⑤ PTT motor
⑥ PTT relay
⑦ Joint connector 3 (yellow tape)
⑧ Water pressure sensor
⑨ Speed sensor
⑩ Joint connector 2
⑪ Joint connector 6 (brown tape)
⑫ Fuse box
OFF
ON
START
SET
PULL
BZ
A
B
27 36 44 52
35 43 51 60
61 68 74 80
67 73 79 86
87 96 104 112
95 103 111 120