HIDEA

Outboards

F130/F115

SERVICE MANUAL

Preface

This manual has been prepared by HiDea primarily for use by HiDea dealers and their trained mechanics when performing maintenance procedures and repairs to HiDea equipment. It has been written to suit the needs of persons who have the Bronze Technical Certificate of the HTA (HiDea 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 HiDea 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 HiDea dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual. Also, up-to-date parts information is available on HMBS (HiDea Marine Business System, USA only) or HPEC-web (except USA). Additional information and up-to-date information on HiDea products and services are available on HMBS, HMPE (HiDea Multimedia Product Ency- clopedia, Canada only), or HiDea Service Portal (except USA and Canada).

Important information

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

⚠ : This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ WAENING

A WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE

A NOTICE indicates special precautions that must be taken to avoid damage to the outboard motor or other property.

TIP:

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

F130/F115
SERVICE MANUAL
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Contents

General information	0
Specification	1
Technical feature and description	2
Rigging information	3
Troubleshooting	4
Electrical system	5
Fuel system	6
Power unit	7
Lower unit	8
Bracket unit	9
Maintenance	10
Appendix	A

General information

0

Important safety and service information……0-1

Rotating parts ……0-1
Hot parts……0-1
Electric shock……0-1
Propeller……0-1
Handling of gasoline ……0-1
Ventilation ……0-1
Self-protection…… 0-2
Lifting outboard motors……0-2
Handling of gas torch ……0-2
Parts, lubricants, and sealants……0-2
Handling of lubricants and sealants ……0-3
Special service tools……0-3
Tightening torque…… 0-3
Non-reusable parts……0-3
Disassembly and assembly ……0-3
Disposal of used components and chemicals…… 0-4

How to use this manual……0-5

Manual format. ……0-5
Conditions when testing and adjusting……0-6
Abbreviation…… 0-6
Color code ……0-8

Lubricant, sealant, and thread locking agent……0-9

Symbol …… 0-9

Special service tool……0-11

Important safety and service information

To prevent an accident or injury and to provide quality service, observe the following information.

Rotating parts

- Hands, feet, hair, jewelry, clothing, personal flotation device straps, and so on, can become entangled with internal rotating parts of the engine, resulting in serious injury or death.
- Keep the top cowling installed whenever possible. Do not remove or install the top cowling when the engine is running.
- Only operate the engine with the top cowling removed according to the specific instructions in the manual. Keep hands, feet, hair, jewelry, clothing, personal flotation device straps, and so on, away from any exposed moving parts.

Hot parts

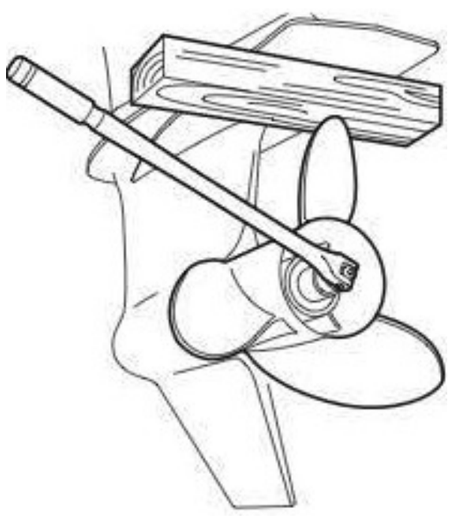
During and after operation, engine parts are hot enough to cause burns. Do not touch any parts under the top cowling until the engine has cooled.

Electric shock

Do not touch any electrical parts while starting or operating the engine. Otherwise, shock or electrocution could result.

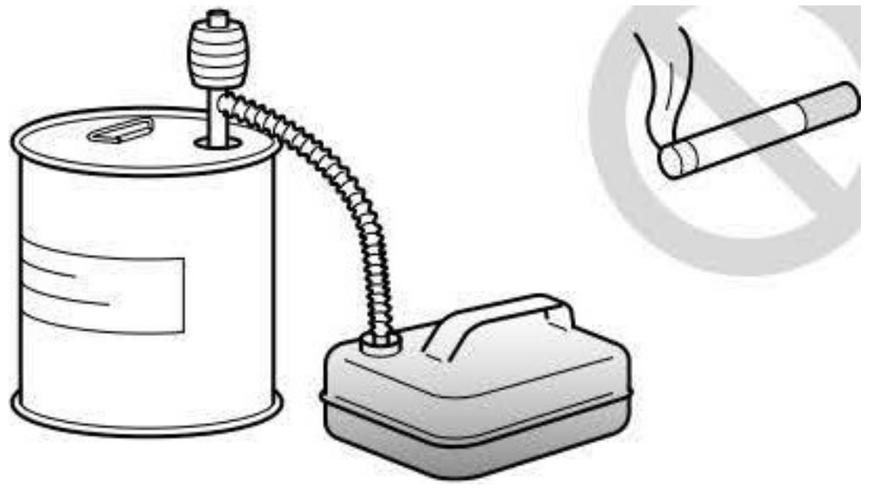
Propeller

Do not hold the propeller with your hands when loosening or tightening the propeller nut. Sharp propeller edges can cause injury. Place a wood block between gear case and propeller to hold the propeller for removal and installation.



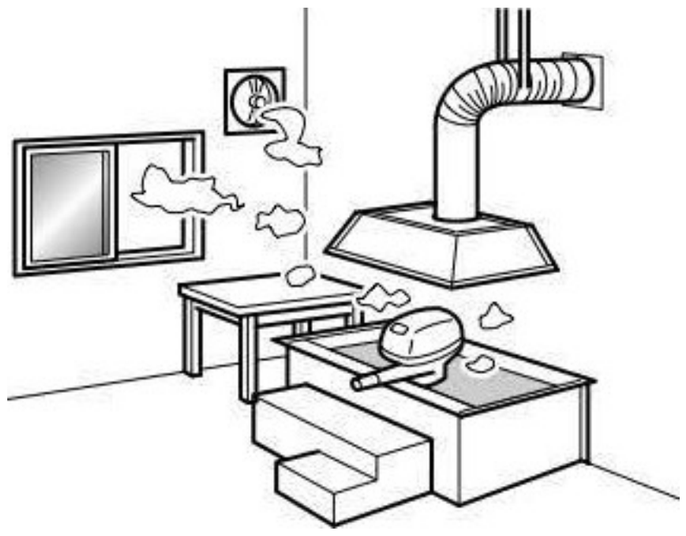
Handling of gasoline

- Gasoline is highly flammable. Keep gaso- line and all flammable products away from heat, sparks, and open flames.
- Gasoline is poisonous and can cause injury or death. Handle gasoline with care. Never siphon gasoline by mouth. If you swallow some gasoline, inhale a lot of gasoline vapor, or get some gasoline in your eyes, see your doctor immediately. If gasoline spills on your skin, wash with soap and water. If gasoline spills on your clothing, change your clothes.



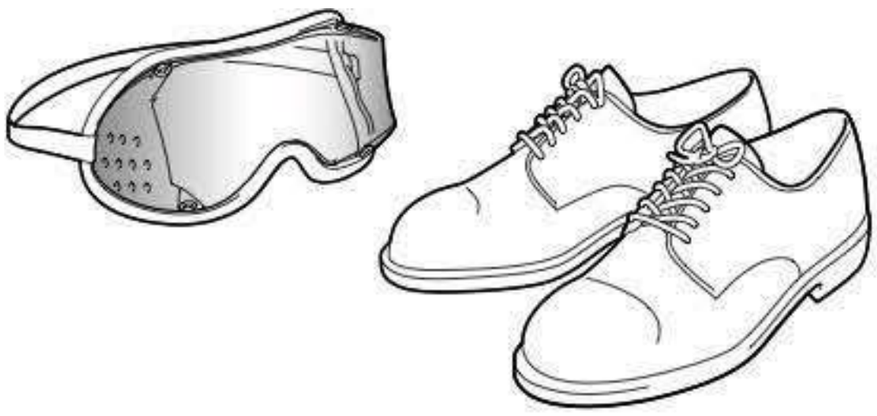
Ventilation

- Gasoline vapor and exhaust gases are heavier than air and extremely poisonous. If gasoline vapor orexhaust gases are inhaled in large quantities, it may cause loss of consciousness and death within a short time.
- When test running an engine indoors (for example, in a water tank) make sure to do so where adequate ventilation can be maintained.



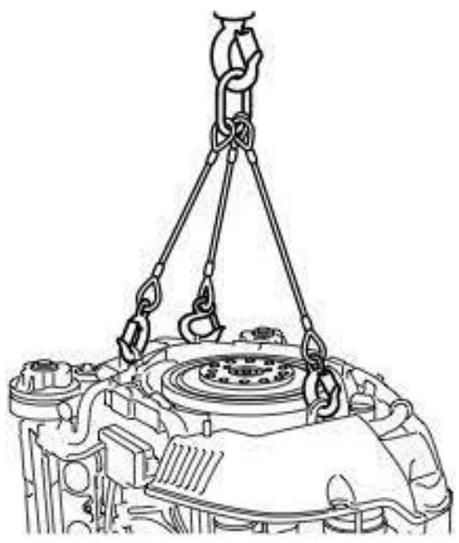
Self-protection

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



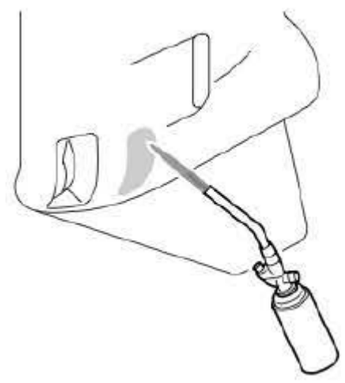
Lifting outboard motors

- Outboard motors weighing 18kg(40 lb) and over must be carried by a crane or equivalent.
- Use a wire cable lifting harness of adequate strength to lift up the outboard motor in a stable manner.
- Lift and suspend the outboard motor in a stable manner using the designated lifting attachment points.
- Do not work on or under an outboard motor while it is suspended from a lifting device. Securely mount the motor on a suitable work stand or place it on a stable work surface as soon as possible.



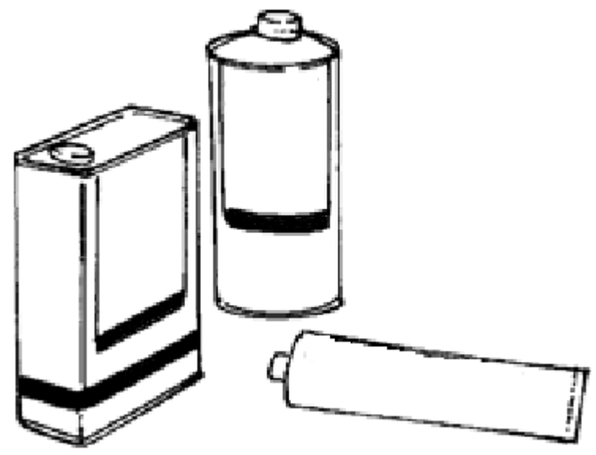
Handling of gas torch

- Improper handling of a gas torch may result in burns. For information on the proper handling of the gas torch, see the operation manual issued by the manufacturer.
- When using a gas torch, keep it away from the gasoline and oil, to prevent a fire.
- Components become hot enough to cause burns. Do not touch any hot components directly.



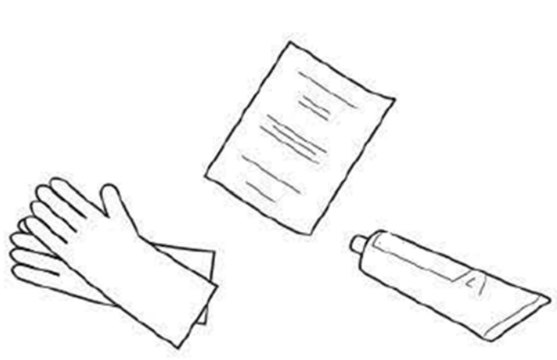
Parts, lubricants, and sealants

Use only genuine HiDea parts, lubricants, and sealants, or those recommended by HiDea, when servicing or repairing the out- board motor. Failures caused by the use of parts, lubricants, or sealants that are not equivalent in design and quality to genuine HiDea parts, lubricants, or sealants will not be covered by warranty.



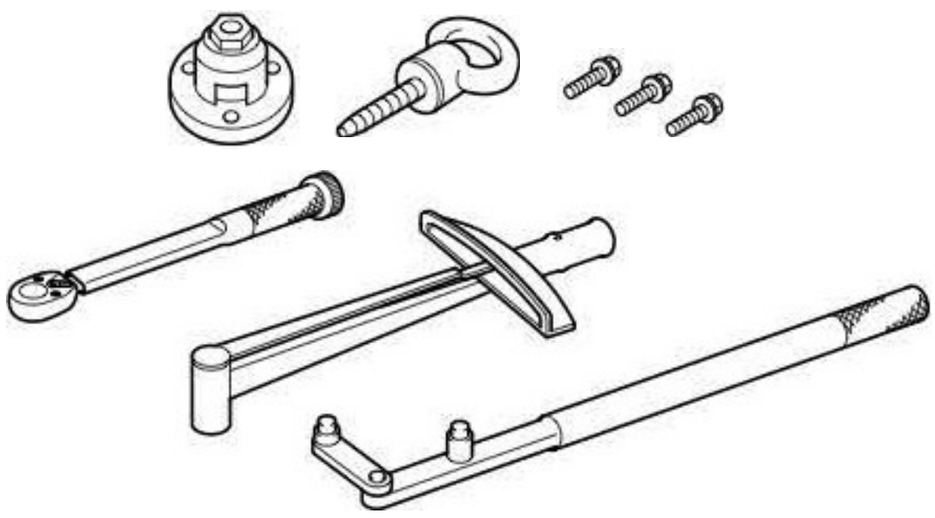
Handling of lubricants and sealants

- Follow all instructions and safety precau- tions provided on the product label and the material safety data sheet (MSDS/SDS) for lubricants, sealants, and other shop chemi- cals.
- Wear impervious gloves, eye protection, or other protective apparel when required.
- Wash skin thoroughly after contact with lubricants, sealants, and other shop chemi- cals, and change clothing if contaminated with them.



Special service tools

For safety and to help protect parts from damage, use the recommended special service tools.

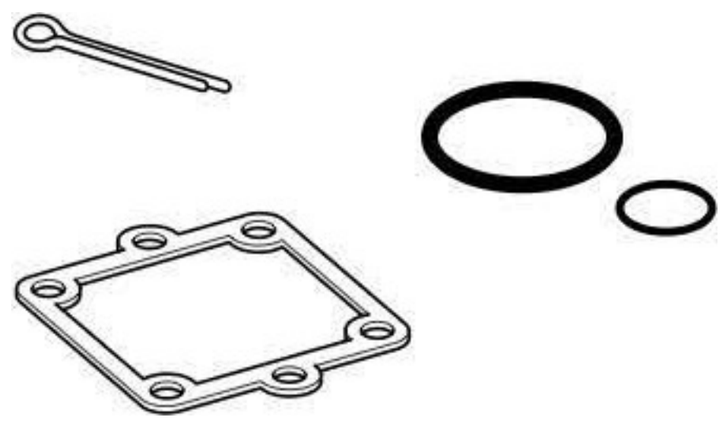


Tightening torque

When tightening nuts, bolts, and screws, follow the tightening instructions provided throughout the manual. If the tightening order is not specified, tighten the large sizes first, and then tighten the small sizes, starting from the center and moving outward.

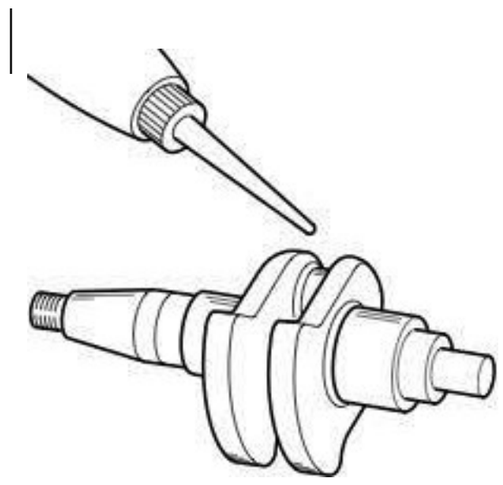
Non-reusable parts

Always use new gaskets, seals, 0-rings, cotter pins, and so on, when installing or assembling parts.



Disassembly and assembly

- Use compressed air to remove dust and dirt during disassembly.
- Apply engine oil to the contact surfaces of moving parts before assembly.
- During disassembly, cover all openings, such as intake and exhaust ports, to prevent foreign materials from entering the engine.Foreign materials could cause severe internal damage when the engine is started.



- Install bearings so that the bearing identification mark is facing in the direction indicated in the installation procedure. In addition, make sure to lubricate the bearings liberally.
- Apply a thin coat of water resistant grease to the lip and periphery of an oil seal before installation.
- Check that moving parts operate normally after assembly.
- When starting the engine after reassembly, check for fuel and water leaks from hoses and pipes that were disconnected or removed while servicing.

Disposal of used components and chemicals

Obey all federal, state and local regulations when disposing of used components and/or chemicals such as crate frames, replaced parts, gaskets, oil, and so on.

How to use this manual

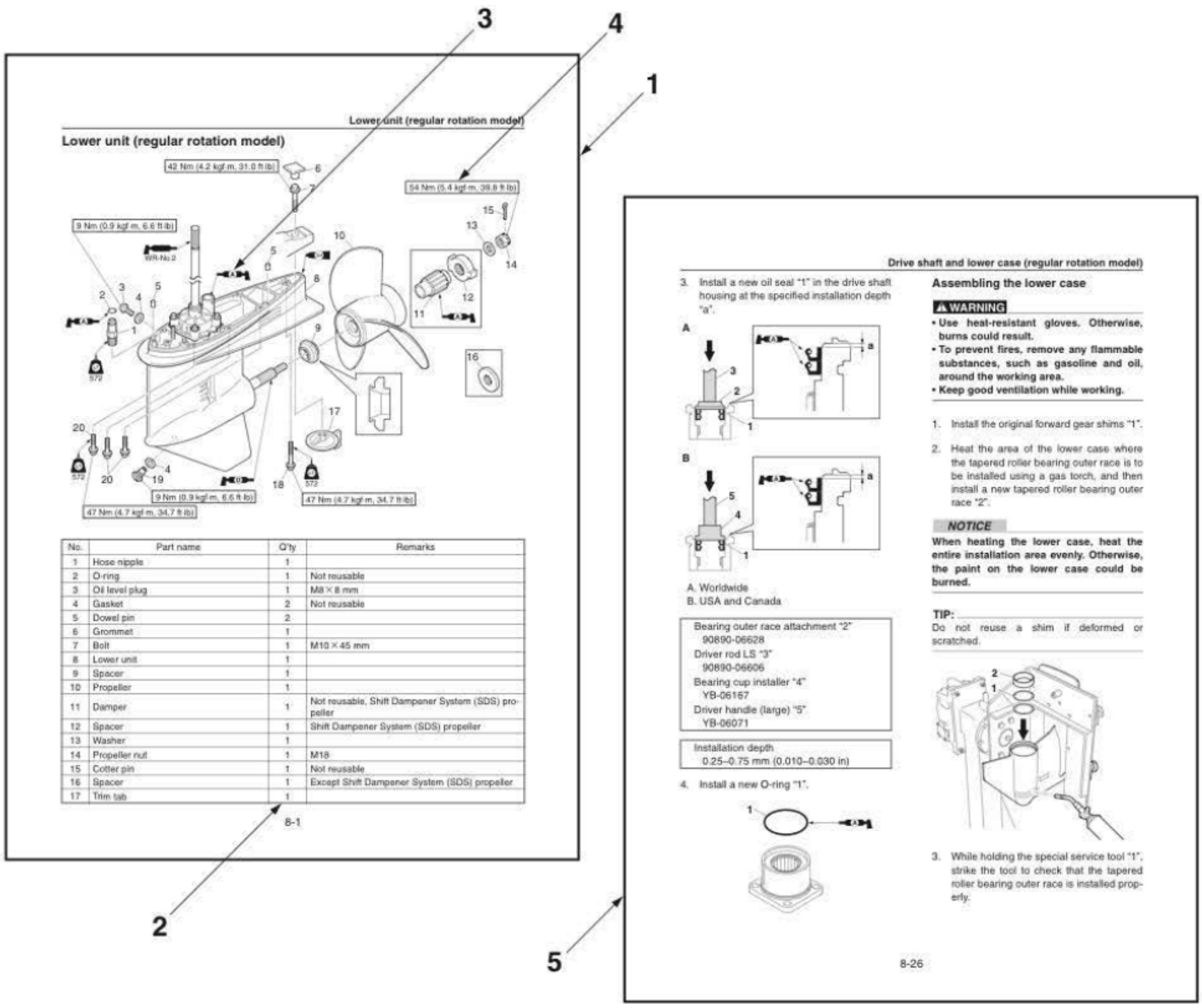
Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the following information 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 following figure for an example page).
- The component list consists of part names and quantities, as well as bolt and screw dimensions (see "2" in the following figure).
- Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and the lubrication points (see "3" in the following figure).
- Tightening torque specifications are provided in the exploded diagrams (see "4" in the following figure), 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 following figure for an example page).

TIP

For troubleshooting procedures, see Chapter 4, "Troubleshooting".



Conditions when testing and adjusting

Conditions can affect specifications when checking, measuring and making some adjustments. Service data in this manual was determined under the following conditions:

- Electrical resistance for components such as ignition coils and sensors was measured at 20 oc (68 °F).
- Engine compression was measured at:
  - Sea level
  - 20℃ (68 °F)
  - All spark plugs removed
  - Throttle valve at WOT (depending on model specification)
- Trim/tilt angles shown are when the transom angle is 12 degrees.

Abbreviation

The following abbreviations are used in this service manual.

Abbreviation	Description
ABYC	American Boat and Yacht Council
API	American Petroleum Institute
APS	Accelerator Position Sensor
ATF	Automatic Transmission Fluid
AWG	American Wire Gauge
CAN	Controller Area Network
CARS	California Air Resources Board
CCA	Cold Cranking Ampere
CDI	Capacitor Discharge Ignition
DN	Down side
DOHC	Double Overhead Camshaft
ECM	Electronic Control Module
EN	European Norm (European standard)
EPA	Environmental Protection Agency
ETV	Electronic Throttle Valve
EX	Exhaust
F	Forward
ID	Identification
IEC	International Electrotechnical Commission
IN	Intake
ISC	Idle Speed Control
ISO	International Organization for Standardization
LPS	Lever Position Sensor
MCA	Marine Cranking Ampere
N	Neutral
NMMA	National Marine Manufacturers Association

Abbreviation	Description
OCV	Oil Control Valve
OHC	Overhead Camshaft
PCV	Pressure Control Valve
PON	Pump Octane Number
PORT	Port side
PT	Power Tilt
PTT	Power Trim and Tilt
R	Reverse
RC	Reserve Capacity
RON	Research Octane Number
SAE	Society of Automotive Engineers
SPS	Shift Position Sensor
STBD	Starboard side
TCI	Transistor-Controlled Ignition
TDC	Top Dead Center
TPS	Throttle Position Sensor
UP	Up side
VCT	Variable Camshaft Timing
VST	Vapor Separator Tank
WOT	Wide Open Throttle
H-COP	HiDea Customer Outboard Protection
HDIS	HiDea Diagnostic System

Color code

The following color codes are used in this service manual.

Color code	Color
B	Black
Br	Brown
G	Green
Gy	Gray
L	Blue
Lg	Light green
Or	Orange
P	Pink
Pu	Purple
R	Red
Sb	Sky blue
W	White
Y	Yellow

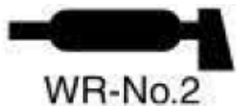
TIP:

For example, "R/Y" stands for a Red with Yellow tracer stripe wire.

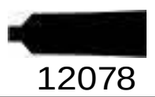
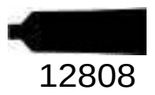
Lubricant, sealant, and thread locking agent

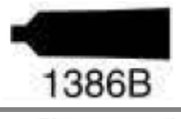
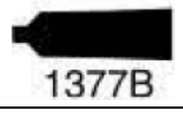
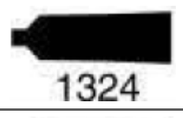
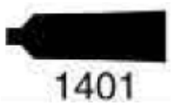
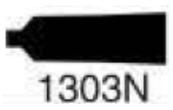
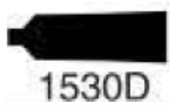
Symbol

Symbols in an exploded diagram or illustration indicate the grade of lubricant and the lubrication points.

Symbol	Name	Application
	HiDea grease SL/10W-40	Lubricant
	HiDea outboard gear oil or HiDea Marine Gearcase Lube	Lubricant
	ME-1	Lubricant
	Water resistant grease (HiDea grease A)	Lubricant
	Molybdenum disulfide grease (HiDea Molybdenum Disulfide grease)	Lubricant
	Corrosion resistant grease (HiDea greaseD)	Lubricant
	Low temperature resistant grease (HiDea grease)	Lubricant
	Injector grease	Lubricant
	WR-No.2 grease	Lubricant
	ThreeBond 1901	Lubricant

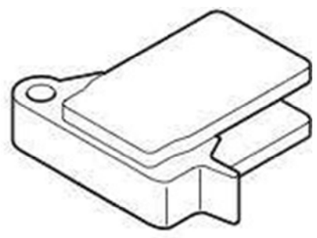
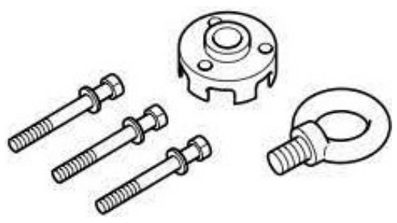
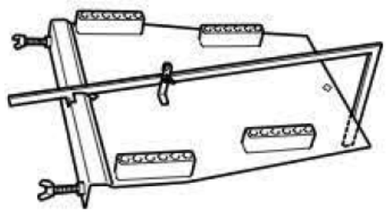
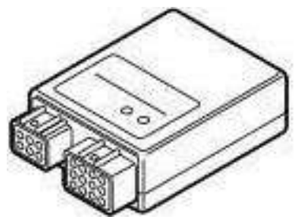
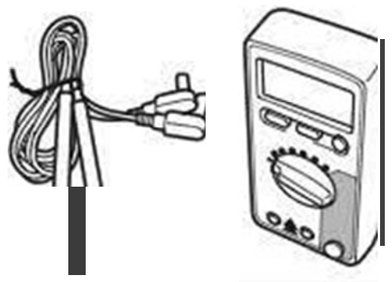
Symbols in an exploded diagram or illustration indicate the type of sealant or thread locking agent and the application points.

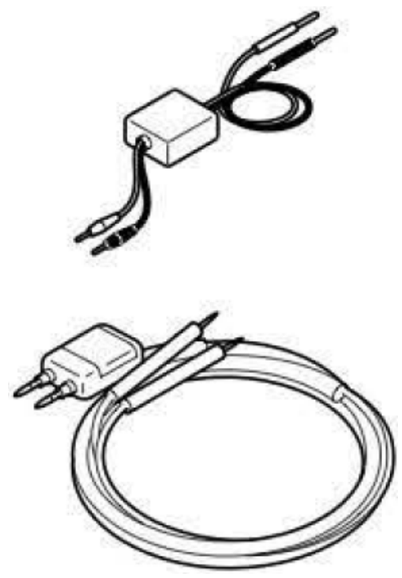
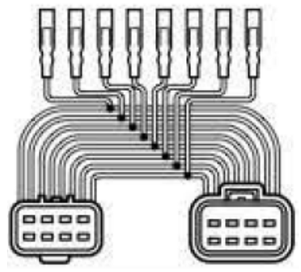
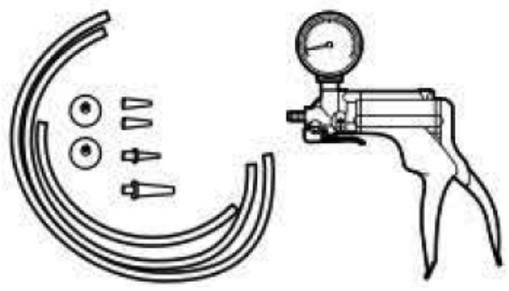
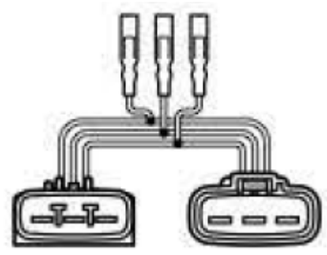
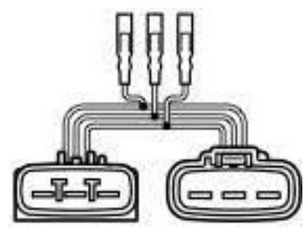
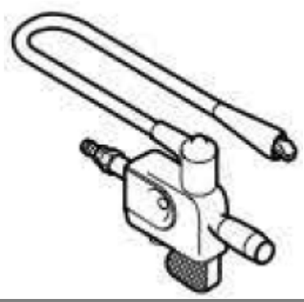
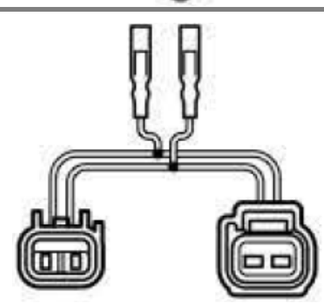
Symbol	Name	Application
	Gasket Maker	Sealant
	ThreeBond 1104J	Sealant
	ThreeBond 1207B	Sealant
	ThreeBond 1280B	Sealant
	ThreeBond 1322	Thread locking agent

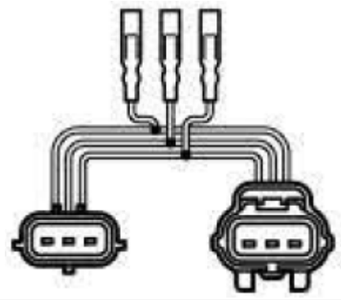
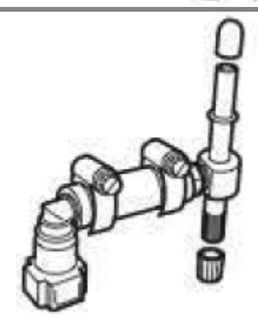
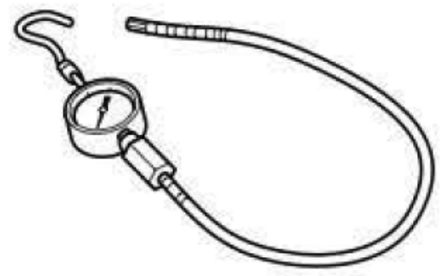
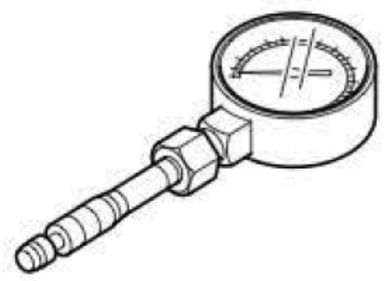
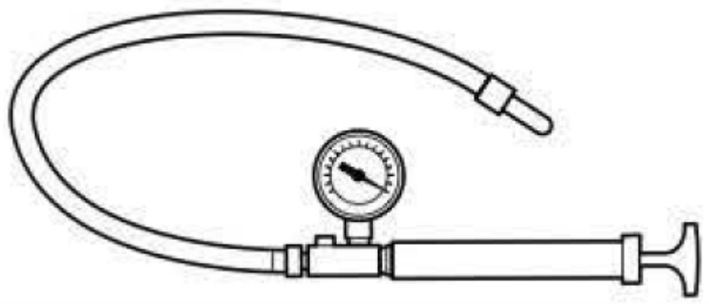
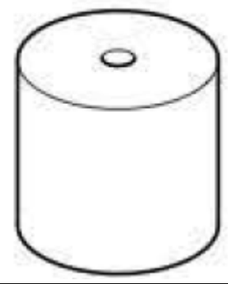
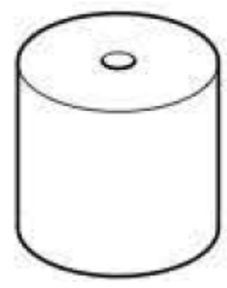
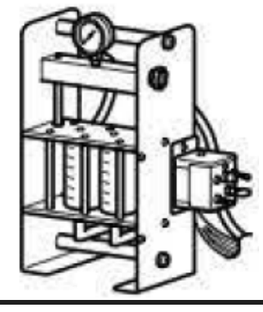
Symbol	Name	Application
 1386B	Three8ond 13868	Sealant
 1377B	Three8ond 13778	Thread locking agent
 1324	Three8ond 1324	Thread locking agent
 1401	Three8ond 1401	Thread locking agent
 1303N	Three8ond 1303N	Thread locking agent
 1530D	Three8ond 15300	Sealant
 1303	Three8ond 1303	Thread locking agent
 271	LOCTITE 271 (red)	Thread locking agent
 242	LOCTITE 242 (blue)	Thread locking agent
 572	LOCTITE 572 (white)	Sealant
 SS	Silicone sealant	Sealant
 648	LOCTITE 648 (green)	Thread locking agent
 210	LOCTITE 210 (red)	Thread locking agent

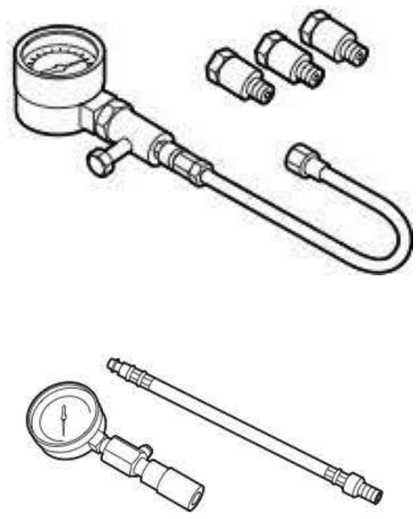
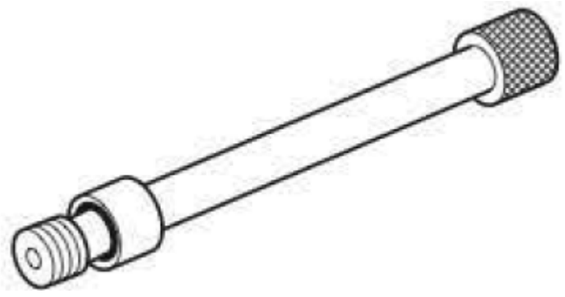
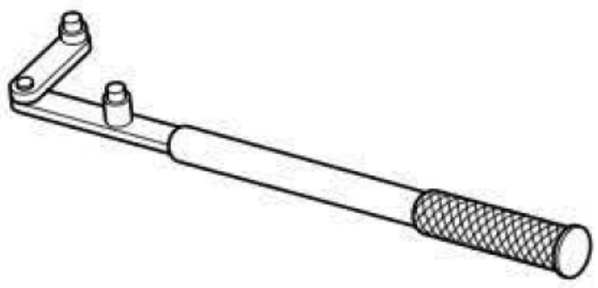
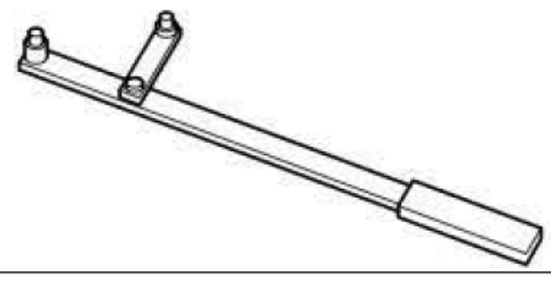
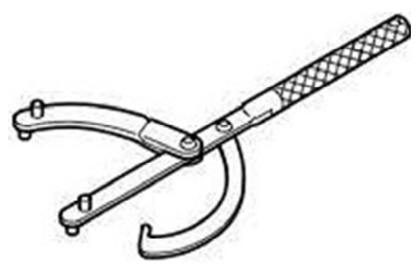
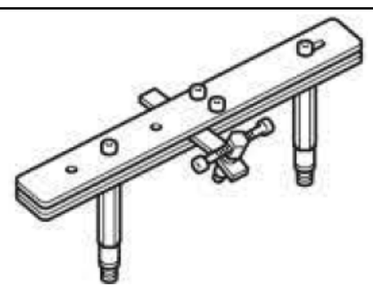
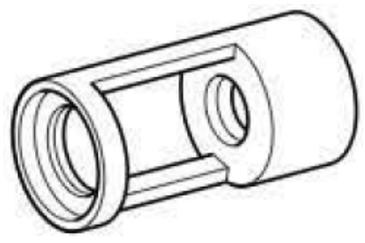
Special service tool

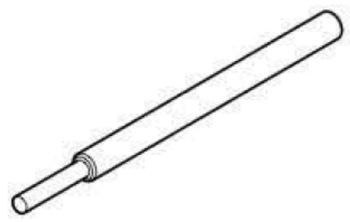
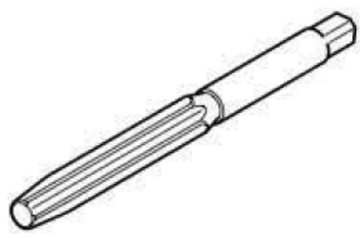
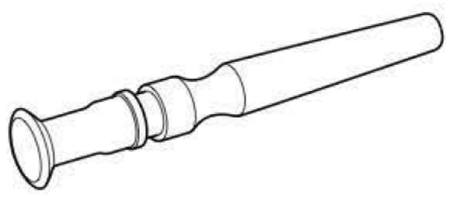
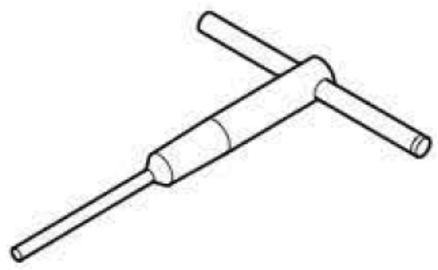
Special service tools with HiDea part numbers are distributed by the Parts Division.
Special service tools with USA and Canada part numbers are distributed by K&L Supply Co.
Special service tool with part number FIM20000ME, or LIT-HDIS2-01-KT is distrib-
uted by the Marine Service Division.

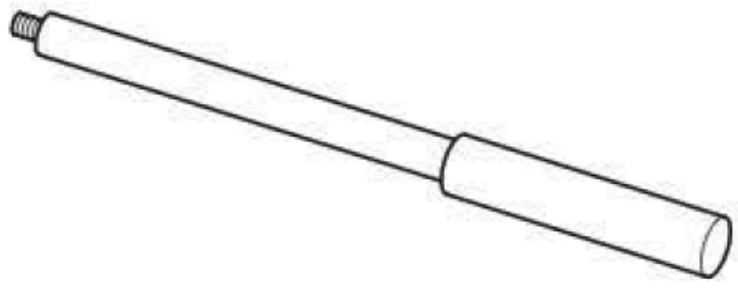
Tool name/Tool No.	Illustration	Reference pages
Flywheel stopper B Flywheel stopper B		3-3, 7-16,7-16 7-21 7-23
Engine lifting eye Engine lifting eye		3-3, 7-16, 7-16
Drilling plate Drilling plate		3-6
HDIS2 Hardware Kit HDIS2 Hardware Kit		4-1, 5-16
Digital circuit tester		5-17, 5-17, 9-41, 9-48
Digital multimeter		5-17, 5-17 9-41, 9-48

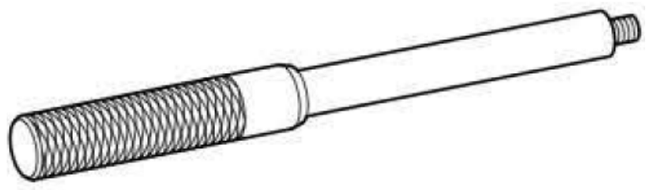
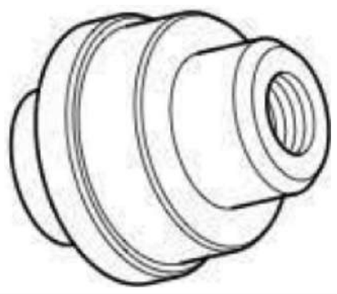
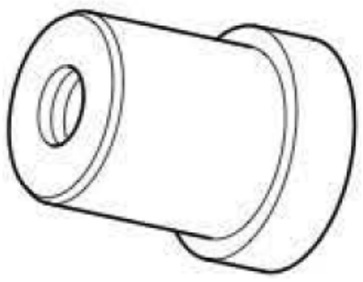
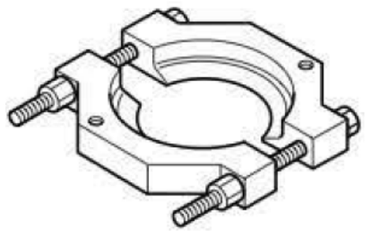
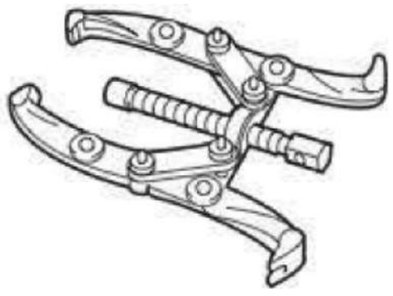
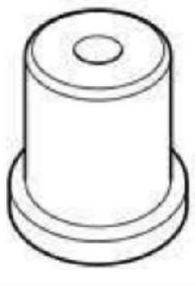
Tool name/Tool No.	Illustration	Reference pages
Peak voltage adapter B Peak volt adapter		5-17
Test harness (8 pins) Test harness (8 pins)		5-18
Vacuum/pressure pump gauge set Pressure/vacuum tester		5-21, 5-24, 6-3, 6-7, 6-11, 6-31, 6-37
Test harness (3 pins) Test harness (3 pins)		5-25
Test harness (3 pins) Test harness (3 pins)		5-26
Ignition checker (Spark gap tester) Spark checker		5-27
Test harness (2 pins) Test harness (2 pins)		5-29 , 5-45

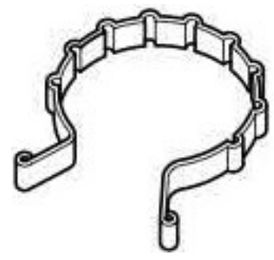
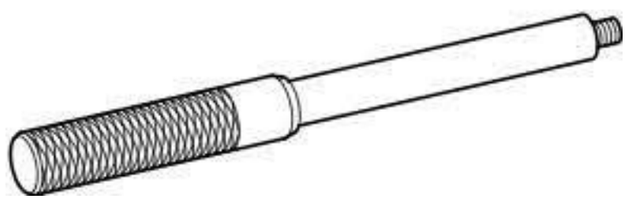
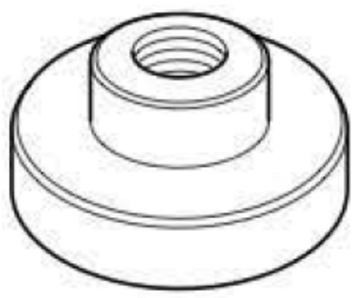
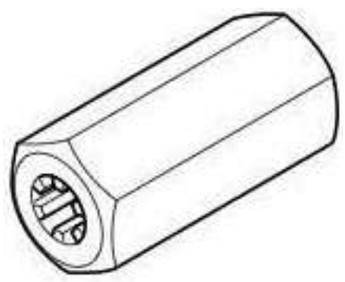
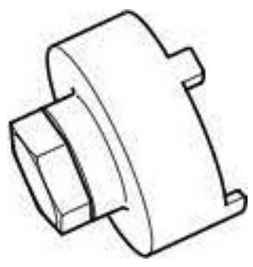
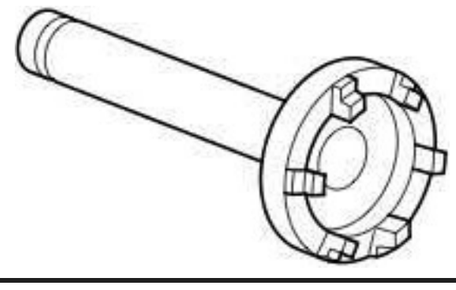
Tool name/Tool No.	Illustration	Reference pages
Test harness (3 pins) Test harness (3 pins)		5-44，5-45
Fuel pressure gauge adapter Fuel pressure gauge adapter		6-1，6-3
Fuel pressure gauge Fuel pressure gauge	 	6-2，6-3
Leakage tester		6-6，6-7，6-10， 8-29
Small end bearing installer		6-12，6-13
Connecting rod small end bearing installer		6-12，6-13
Fuel injection meter		6-17

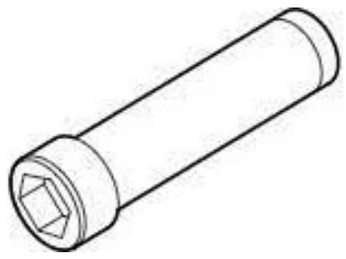
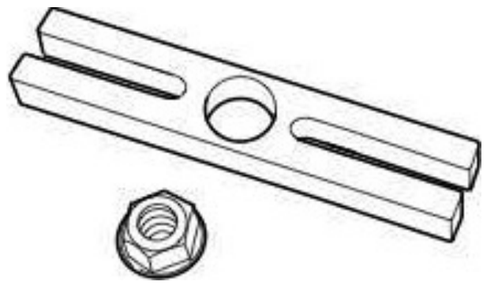
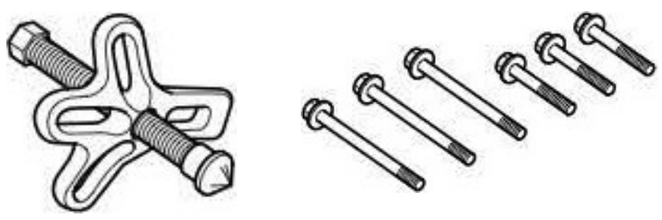
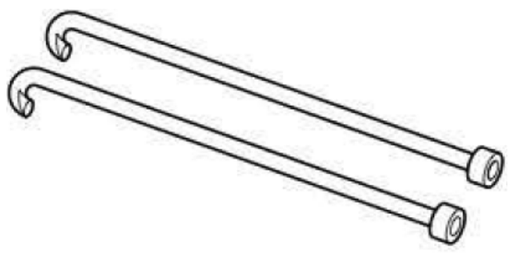
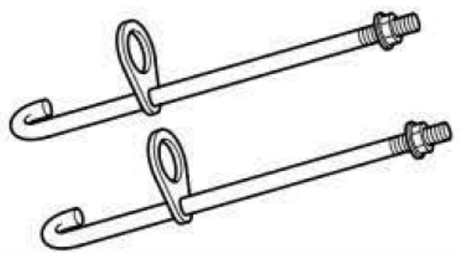
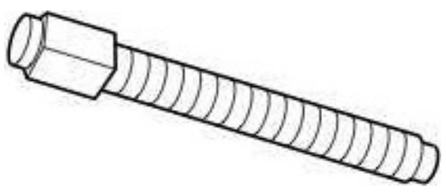
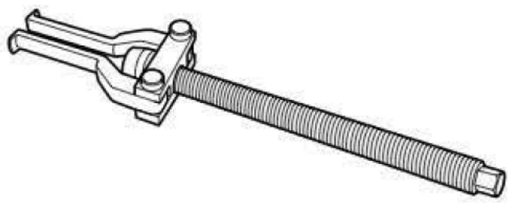
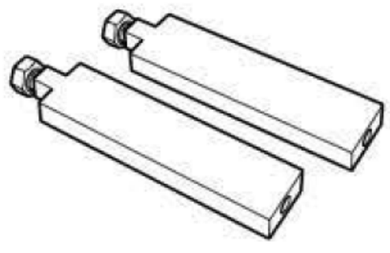
Tool name/Tool No.	Illustration	Reference pages
Compression gauge Combination compression gauge and cylinder leakdown test kit		7-1
Compression gauge extension M12		7-1
Flywheel holder Flywheel magneto holder	 	7-4,7-4,7-7, 7-7,7-48,7-53
Rotor holding tool Universal magneto & rotor holder		7-21 , 7-23
Valve spring compressor Valve spring compressor		7-67, 7-74
Valve spring compressor attachment Valve spring compressor adaptor		7-67 , 7-74

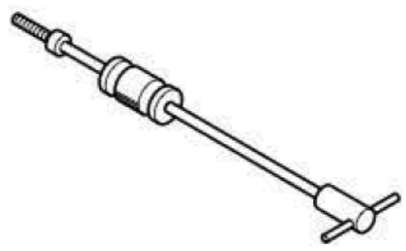
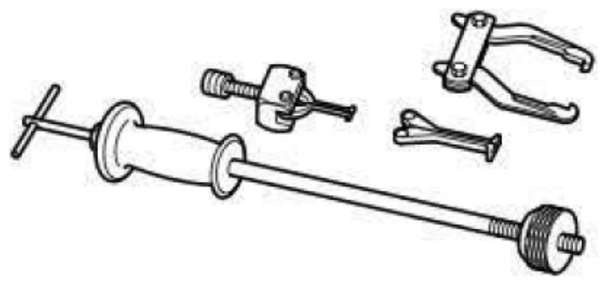
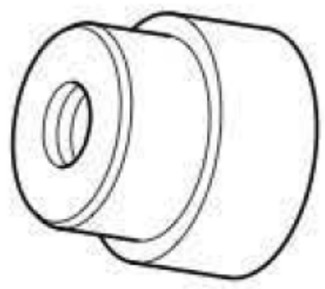
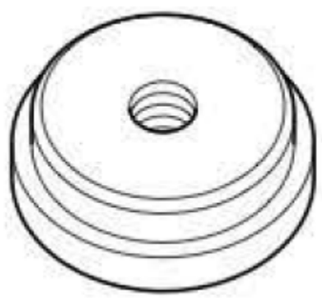
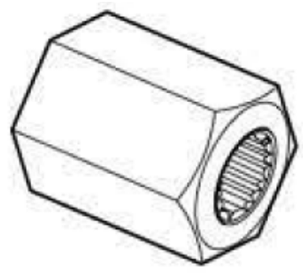
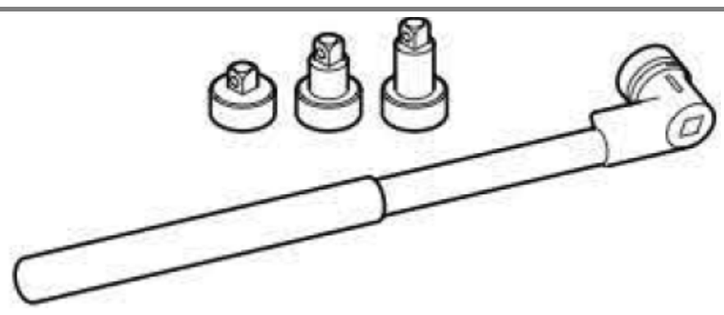
Tool name/Tool No.	Illustration	Reference pages
Valve guide remover/installer Valve guide remover		7-69 , 7-70
Valve guide installer Valve guide installer		7-70
Valve guide reamer Valve guide reamer		7-70
Valve lapper Valve lapping tool		7-70, 7-73
Valve seat cutter holder 5.5		7-71
Valve seat cutter 30-32.5		7-71
Valve seat cutter 45°		7-71

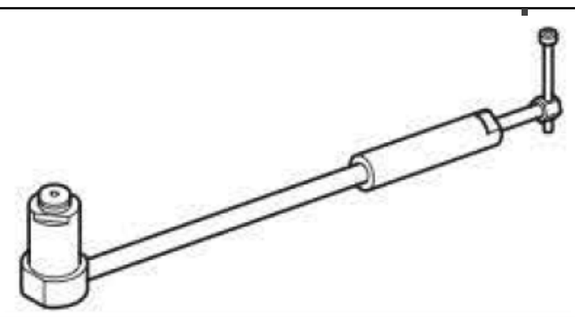
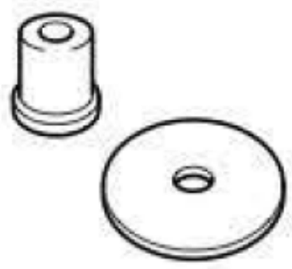
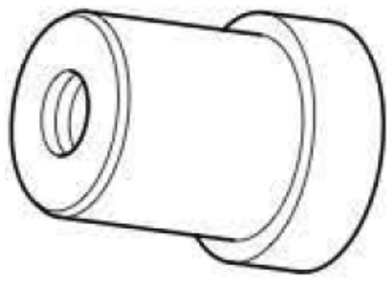
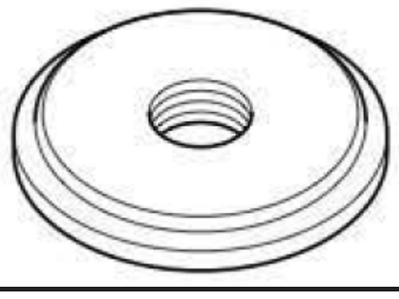
Tool name/Tool No.	Illustration	Reference pages
Valve seat cutter 60°		7-71
Valve seat cutter 30-27		7-71
Valve seat cutter 45°		7-71
Valve seat cutter 60°		7-71
Neway valve seat kit		7-71
Oil filter wrench Oil filter wrench		7-79, 7-82, 10-13
Driver rod L3		7-80, 7-80, 8-4, 8-14, 8-15, 8-20, 8-21, 8-22, 8-23, 8-25, 8-63, 8-63, 8-64, 9-27
Needle bearing attachment		7-80, 9-27

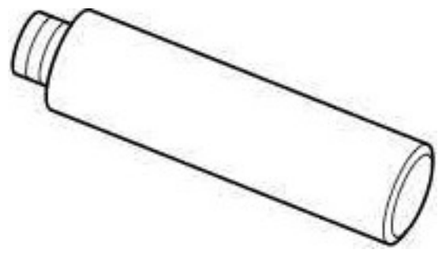
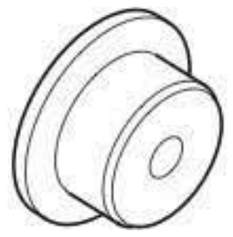
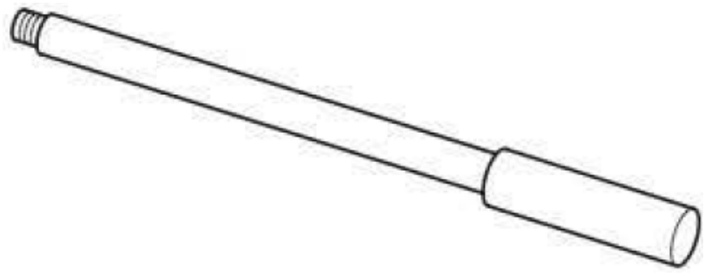
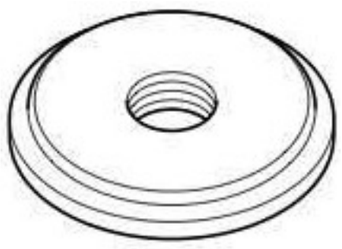
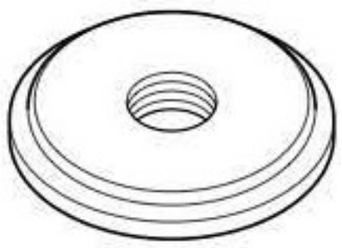
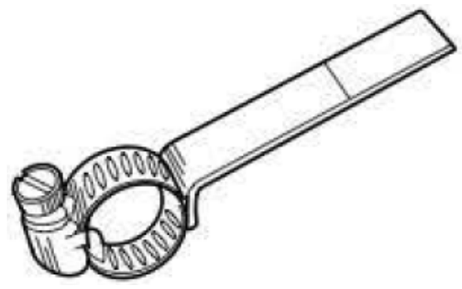
Tool name/Tool No.	Illustration	Reference pages
Driver handle(large) 1		7-80,8-14,8-15, 8-16,8-20,8-21, 8-24,8-25,8-63, 8-63,8-64,8-65
Oil seal installer		7-80
Needle bearing attachment		7-80, 8-16, 8-16, 8-22,8-63,8-64
Driveshaft bearing installer		7-80
Bearing separator		7-86, 8-12, 8-20,8-56
Gear puller		7-86
Needle bearing attachment Needle bearing remover and installer	 	7-86

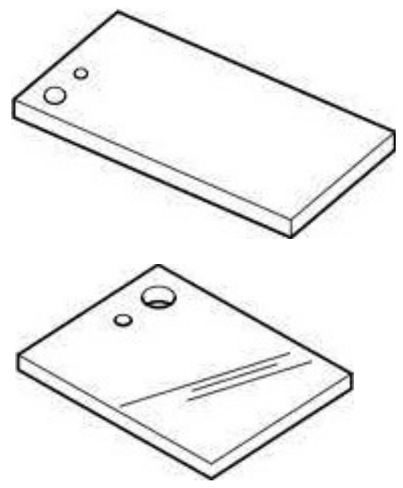
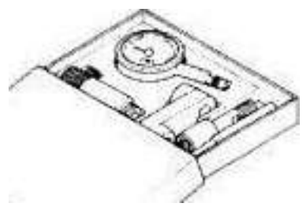
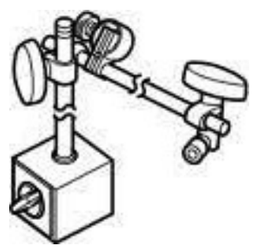
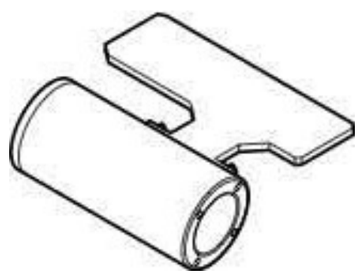
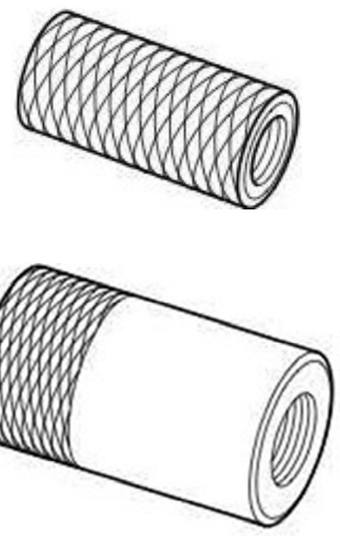
Tool name/Tool No.	Illustration	Reference pages
Piston slider 85		7-100
Piston ring compressor		7-100
Needle bearing attachment		8-4, 8-22
Driver handle (small)		8-4, 9-27
Crankshaft seal installer		8-4
Shift rod socket Shift rod socket		8-7, 8-30, 8-35, 8-70
Ring nut wrench 3 Gland nut wrench	 	8-11, 8-27

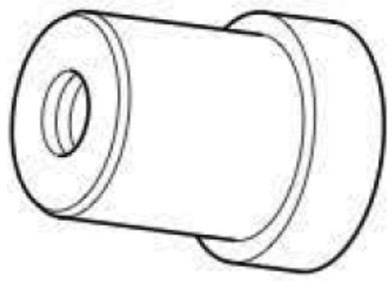
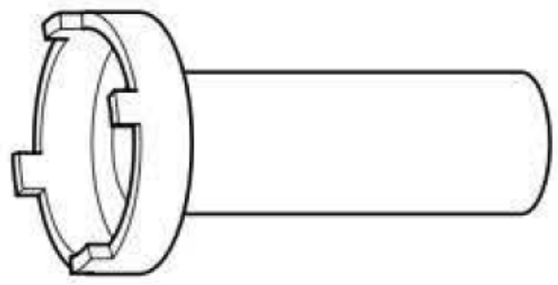
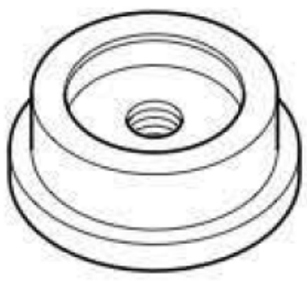
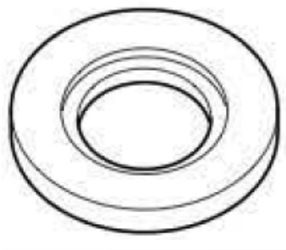
Tool name/Tool No.	Illustration	Reference pages
Ring nut wrench extension		8-11, 8-27
Stopper guide plate Universal puller	 	8-11, 8-12, 8-13, 8-35, 8-70, 9-26
Bearing housing puller claw L Bearing housing puller	 	8-11, 8-35, 8-70
Center bolt		8-11, 8-35, 8-70
Bearing puller assembly		8-12, 8-13, 9-26
Stopper guide stand		8-12, 8-13 9-26

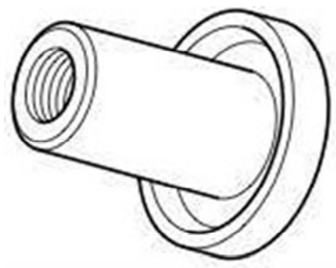
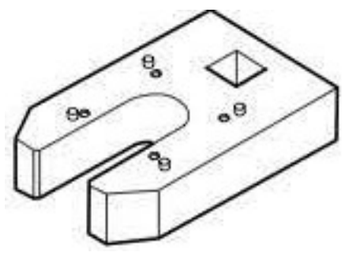
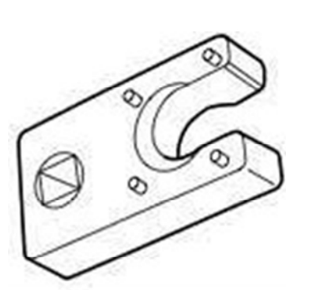
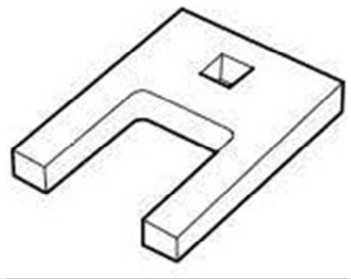
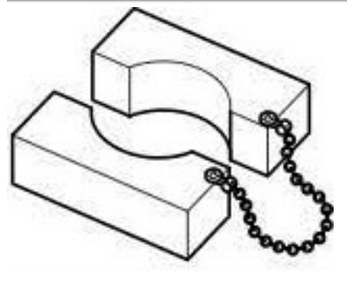
Tool name/Tool No.	Illustration	Reference pages
Slide hammer handle		8-55
Slide hammer		8-12, 8-13, 8-55, 9-26
Needle bearing attachment		8-14,8-15
Driveshaft needle bearing installer and remover		8-14, 8-15, 8-20, 8-23
Bearing inner race attachment		8-16
Forward gear outer race installer		8-16, 8-16, 8-22
Drive shaft holder 5 Driveshaft holder		8-19, 8-26, 8-41
Pinion nut holder Pinion nut holder		8-19, 8-26

Tool name/Tool No.	Illustration	Reference pages
Hydraulic drive shaft pusher Hydraulic drive shaft pusher		8-19
Needle bearing attachment		8-20 , 8-23
Bearing inner race attachment		8-20
Roller bearing installer/remover		8-20
Needle bearing attachment		8-21,8-25
Driveshaft needle bearing installer and remover		8-21, 8-25
Propshaft needle bearing attachment		8-22
Bearing outer race attachment		8-23

Tool name/Tool No.	Illustration	Reference pages
Driver rod LS		8-23
Bearing cup installer		8-23
Driver rod LL		8-24, 8-65
Bearing outer race attachment		8-24
Forward gear outer race installer		8-24
Drivershaft Bearing Depth Plate		8-25
Backlash indicator Backlash indicator rod		8-37 , 8-72

Tool name/Tool No.	Illustration	Reference pages
Magnet base plate Backlash adjustment plate		8-37, 8-72
Dial gauge set		8-37, 8-72, 8-75
Dial indicator gauge		8-37, 8-72, 8-75
Magnet base B Magnetic base stand		8-37, 8-72, 8-75
Pinion height gauge Pinion height gauge		8-40
Puller head Propeller shaft and bearing housing remover		8-55

Tool name/Tool No.	Illustration	Reference pages
Needle bearing attachment		8-56
Needle bearing attachment		8-56
Ring nut wrench Ring nut wrench		8-58, 8-58
Needle bearing installer		8-63, 8-64, 8-65
Needle bearing attachment		8-63
Reverse/forward gear bearing installer		8-63
Ball bearing attachment		8-65
Reverse gear bearing retainer/installer		8-65

Tool name/Tool No.	Illustration	Reference pages
Forward gear bearing installer		9-27
Cylinder end screw wrench Trim Cylinder Wrench	 	9-60 , 9-60 9-64, 9-65
Tilt rod wrench Tilt rod wrench		9-61,9-63
PTT piston vice attachment PTT piston vice attachment		9-61, 9-63

— MEMO-

Specification

Model feature.....**1-1**

General feature.....1-1
Model name designation.....1-2
Serial number.....1-4

Model data.....**1-5**

Electrical system technical data.....**1-8**

Ignition timing control system.....1-8
Fuel injection control system.....1-8
Engine speed control system.....1-9
PTT system.....1-9
Charging system.....1-9
Starting system.....1-10
H-COP.....1-10
Gauge/sensor.....1-10

Fuel system technical data.....**1-11**

Fuel system.....1-11

Power unit technical data.....**1-12**

Power unit.....1-12
Cylinder head assembly.....1-12
Crankcase assembly.....1-13

Lower unit technical data.....**1-15**

Lower unit assembly (regular rotation model).....1-15
Lower unit assembly (counter rotation model).....1-15

Bracket unit technical data.....**1-16**

PTT system.....1-16

External dimensions.....**1-17**

Specification

Clamp bracket dimensions.....1-19

Specified tightening torque.....1-20

General tightening torque.....1-20

Model feature

General feature

- External designs of V6 and V8 engines preserved.
- Electronic fuel injected, 4-stroke, L4, DOHC, 16-valve, 1832 cm^3 (111.8 cu. in) engine
- Low exhaust emissions conform to EU1, US EPA, GARB 3-STAR, and JBIA regulations.
- Low fuel evaporative/permeation emissions conform to US EPA regulation.

a. Power unit

- Shimless valve lifter
- Spiny cylinder sleeve
- Offset cylinder
- Damperless flywheel
- Large diameter intake and exhaust valve heads
- Single big bore throttle body
- Long intake manifold
- Center taking out exhaust manifold
- Low noise exhaust system

b. Electrical

- Electronic fuel injection control
- Digital ignition control
- ISC (Idle Speed Control)
- Knock control
- Over-revolution control
- Fail-safe
- Self-diagnosis system with HDIS (New version 2.12)
- Alert systems including low oil pressure, overheat, and water detection
- High generator output (maximum 35 A)
- Water-cooled rectifier/regulator
- Tilt limiter (optional)
- H-COP acceptable (standard for European market and optional for other markets)
- Variable troll speed control (600-1000 r/min)
- Conventional gauge or Multifunction Meters acceptable
- Speed sensor (standard for European and the Middle East markets and optional for other markets)
- Water pressure sensor (optional)

c. Bracket unit

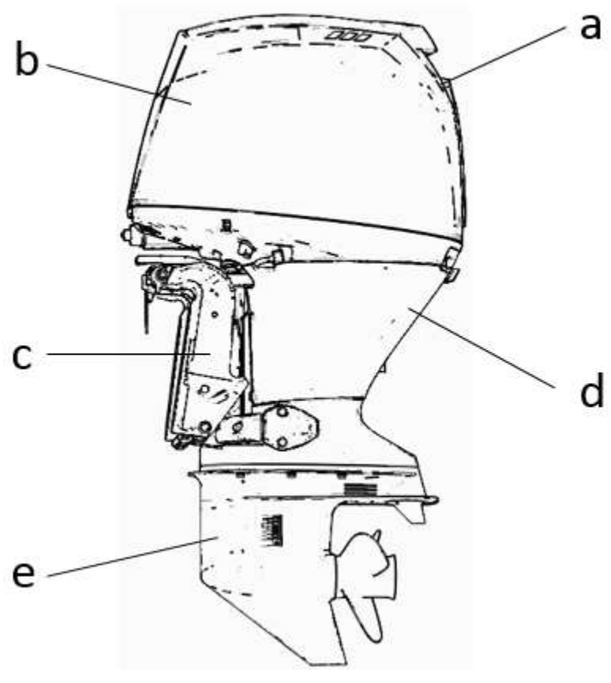
- Single ram PTT unit
- Long span mount

d. Upper case

- 2-piece upper casing
- Labyrinth idle exhaust system

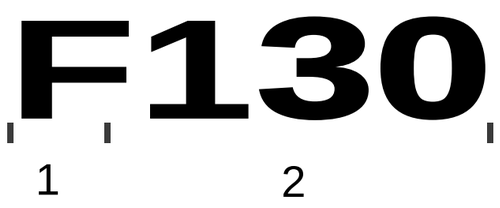
e. Lower unit

- Patented shift damper system (Shift Dampener System [SDS] aluminum propeller)
- Lower unit, shared with F/FL115A (68V/68W).



Model name designation

Worldwide



1	Model category	None: 2-stroke E: Enduro F: 4-stroke L: Counter rotating propeller T: High thrust (4-stroke) D: Twin rotating propeller K: Kerosene Z: HPDI
2	Output horsepower	Example: 6/9.9/75/150/250/300

USA, CAN, AUS, and NZL

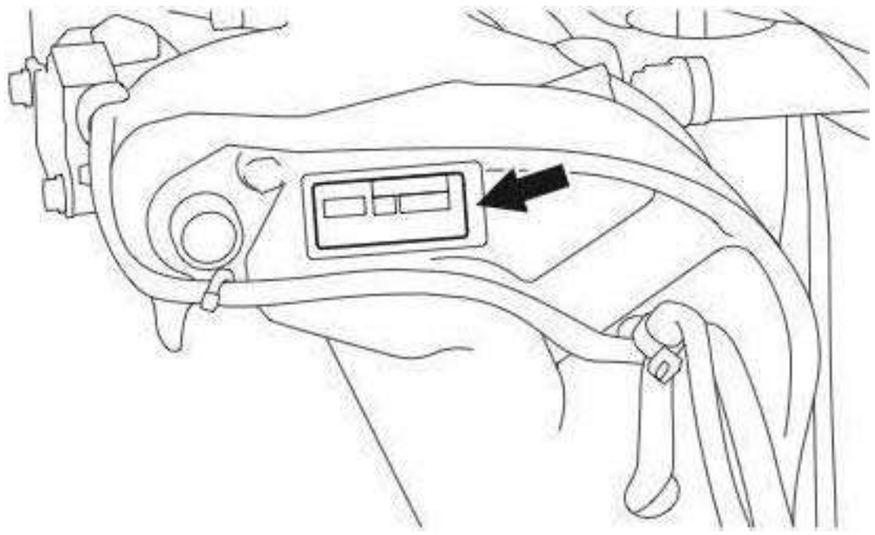
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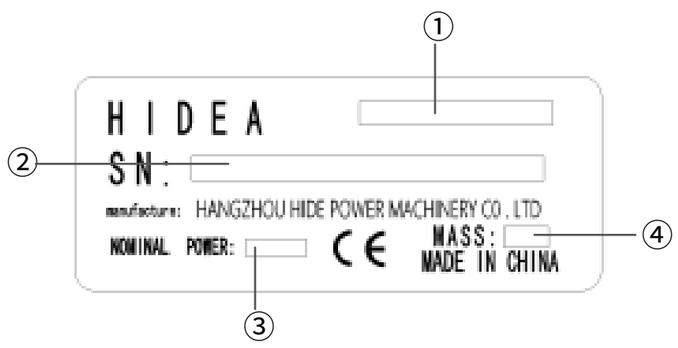
1 2

1	Model category	**F:** 4-stroke L: Counter rotation V: VMAX series T: High-thrust
2	Horsepower	Example: 6/9.9/75/150/250/300

Serial number

The outboard motor serial number is indicated on a label affixed to the port clamp bracket.





1.Model name
2.Serial number
3.Naximum power
4.Weight

Model data

Dimension and weight

Overall length	Remote control model: 826 mm (32.5 in)
Overall width	Remote control model: 522 mm (20.6 in)
Overall height L	516 mm (20.3 in)
Overall height X	643 mm 25.3 in)
Motor transom height L	
Motor transom height X	
Dry weight (SUS) L	175 kg (3861b))
Dry weight (SUS) X	Remote control model: 184 kg (406 lb)

* Dry weight: With SUS (stainless steel) propeller

Performance

Rated power	95.6 kW (130 HP)
Full throttle operating range	5300-6300 r/min
Maximum fuel consumption (reference data)	38.9 Uh@ 5800 r/min (10.3 US gal/h@ 5800 r/min, 8.61mp.gal/h@5800 r/min)
Idle speed (in neutral)	700-800 r/min

Power unit

Type	4-stroke DOHC L4 16 valves
Total displacement	1832 cm^3 (111.8 c.i.)
Bore×stroke	81.0×88.9 mm (3.19×3.50 in)
Compression ratio	10.0: 1
Throttle & shift control system	Remote control model: Remote control Tiller handle model: Handle gear shift & grip han-dle
Starting system	Electric starter
Fuel system	Fuel injection
Starting carburetion system	Fuel injection
Ignition system	TCI
Advance type	Microcomputer
Maximum generator output	35A
Maximum charging capacity	27 A
Spark plug (NGK)	LKR6E
Firing order	1-3-4-2
Steering system	Remote control model: Remote steering Tiller handle model: Tiller handle
Cooling system	Water
Exhaust system	Through propeller boss
Lubrication system	Wet sump

Lower unit	
Gear shift positions	Forward-neutral-reverse
Gear ratio	2.15 (28/13)
Gear type	Spiral bevel gear
Clutch type	Dog clutch
Propeller fitting mechanism	Spline
Propeller direction (rear view)	Regular rotation model: Clockwise Counter rotation model: Counter clockwise
Propeller mark	Regular rotation model: K Counter rotation model: KL
Bracket unit	
Trim angle	-4° to+18°
Tilt-up angle	70°
Tilt support angle	61°
Steering angle	35° (P), 35° (S)
Trim and tilt system	Power trim and tilt
Fuel and oil	
Recommended fuel	Regular unleaded gasoline
Min. research octane number (RON)	90
Min. pump octane number (PON)	86
Recommended engine oil	SAE 10W-30/10W-40/5W-40 API SL/SM/SN
Engine oil quantity (total amount)	3.8 L (4.02 US qt, 3.34 Imp.qt)
Engine oil quantity (without oil filter replacement)	3.0 L (3.17 US qt, 2.64 Imp.qt)
Engine oil quantity (with oil filter replacement)	3.2 L (3.38 US qt, 2.82 Imp.qt)
Recommended gear oil	Hypoid gearoilSAE#90
Recommended gear oil grade	GL-4
Gear oil quantity	Regular rotation model: 0.760 L (0.803 US qt, 0.669 lmp.qt) Counter rotation model: 0.715 L (0.756 US qt, 0.629 lmp.qt)
Battery requirement	
Cold cranking amps (CCNEN)	430-1080 A
Min. rated capacity (20HR/IEC)	70 Ah
Cold cranking amps (CCNSAE)	380-1150 A
Marine cranking amps (MCN ABYC)	502-1370 A
Min. reserve capacity (RC SAE)	124 minutes

* Recommended engine oil and gear oil grade: Meeting both APl and SAE requirements.

PTI system	
Fluid type	ATF Dexron II

Electrical system technical data

Ignition timing control system

Spark plug	
Spark plug gap	0.8-0.9 mm (0.031-0.035 in)
Ignition coil	
Primary coil resistance	1.53-2.07 Ω
Secondary coil resistance	12.5-16.9 kΩ
Pulser coil	
Air gap	0.36-1.14 mm (0.014.045 in)
Resistance	396.0-594.0 Ω
Output peak voltage at cranking (unloaded) (reference data)	3.9 V
Output peak voltage at cranking (loaded) (reference data)	3.4 V
Output peak voltage at 1500 r/min (loaded) (reference data)	12.3 V
Output peak voltage at 3500 r/min (loaded) (reference data)	15.5 V
Intake air pressure/temperature sensor	
Input voltage	4.75-5.25 V
Thermo sensor	
Resistance at 20℃(68 °F)	2.44 kΩ
Resistance at 100 ℃ (212 °F)	0.193 kΩ

Fuel injection control system

Water detection switch	
Input voltage	4.75-5.25 V
Fuel injector	
Input voltage	12 V (battery voltage)
Resistance (reference data)	11.50-12.50 Ω
High-pressure fuel pump	
Input voltage	12 V (battery voltage)
Resistance (reference data)	0.2-3.0 Ω

ISC valve	
Resistance	27.0-33.0 Ω
Vapor shut-off valve	
Input voltage	12 V (battery voltage)
Resistance	30.0-34.0 Ω

Engine speed control system

TPS	
Output voltage at throttle valve fully closed	1.00 V
Throttle valve opening angle at throttle valve fully closed (reference data)	6.00°
Input voltage	5.00 V
Oil pressure switch	
Working pressure	127.50-166.70 kPa (1.275-1.667 kgf/cm², 18.49-24.17 psi)
Shift position switch	
Input voltage	4.75-5.25 V

PTT system

Trim sensor	
Free position resistance	239-379 Ω
Setting resistance	9-11 Ω

Charging system

Lighting coil	
Output peak voltage at cranking (unloaded) (reference data)	7.1 V
Output peak voltage at 1500 r/min (unloaded) (reference data)	27.9 V
Output peak voltage at 3500 r/min (unloaded) (reference data)	82.8 V
Resistance (reference data)	0.1664-0.2496 Ω
Rectifier/Regulator	
Output voltage at 1500 r/min (loaded) (reference data)	13 V
Output voltage at 3500 r/min (loaded) (reference data)	13 V

Starting system

Starter motor	
Type	Sliding gear
Output	1.40 kW
Cranking time limit	30 sec
Standard brush length	15.5 mm (0.61 in)
Wear limit	9.5 mm (0.37 in)
Standard commutator diameter	29.0 mm (1.14 in)
Wear limit	28.0 mm (1.10 in)
Standard commutator undercut	0.8 mm (0.03 in)
Wear limit	0.2 mm (0.01 in)

H-COP

Receiver	
Input voltage	12 V (battery voltage)
Buzzer	
Input voltage	12 V (battery voltage)
Button cell battery - CR2016	
Battery voltage (reference data)	3 V

Gauge/sensor

Water pressure sensor	
Input voltage	4.75-5.25 V
Output voltage at 392.0 kPa (3.92 kgf/cm2, 56.8 psi) (reference data)	2.5 V
Output voltage at 784.0 kPa (7.84 kgf/cm2, 113.7 psi) (reference data)	4.5 V
Speed sensor	
Input voltage	4.75-5.25 V
Output voltage at 392.0 kPa (3.92 kgf/cm2, 56.8 psi) (reference data)	2.5 V
Output voltage at 784.0 kPa (7.84 kgf/cm2, 113.7 psi) (reference data)	4.5 V

Fuel system technical data

Fuel system

Fuel line	
Fuel pressure at engine start switch to "ON" within 5 seconds	300 kPa (3.0 kgf/cm^2, 43.5 psi)
Fuel pressure at engine idle speed	260 kPa (2.6 kgf/cm^2, 37.7 psi)
Fuel filter assembly	
Fuel inlet holding pressure (positive pressure)	200 kPa (2.0 kgf/cm^2, 29.0 psi)
Fuel outlet holding pressure (negative pressure)	80 kPa (0.8 kgf/cm^2 , 11.6 psi)
Fuel strainer	
Holding pressure (positive pressure)	200.0 kPa (2.0 kgf/cm^2, 29.00 psi)
Primer pump	
Positive pressure	166.7 kPa (1.67 kgf/cm^2 , 24.2 psi)
Vapor separator tank	
Float height	67.5 mm (2.66 in)
Canister	
Holding pressure (positive pressure)	19.6 kPa (0.20 kgf/cm^2, 2.8 psi)
Fuel pump	
Fuel inlet holding pressure (positive pressure)	196.0 kPa (1.96 kgf/cm^2, 28.4 psi)
Fuel outlet holding pressure (positive pressure)	196.0 kPa (1.96 kgf/cm^2, 28.4 psi)

Power unit technical data

Power unit

Compression pressure	
Minimum (reference data)	945.0 kPa (9.45 kgf/cm^2, 137.0 psi)
Engine oil	
Engine oil pressure at idle speed (reference data)	440.0 kPa (4.40 kgf/cm^2, 63.8 psi)
Engine oil pressure at 3000 r/min (reference data)	660.0 kPa (6.60 kgf/cm^2, 95.7 psi)

* For the checking method, see "Checking the oil pressure" (7-1). The figures are for reference only.

Thermostat	
Valve opening temperature	58-62 ℃ (136-144 °F)
Fully open temperature	72 ℃ (158 °F)
Fully open stroke	4 mm (0.17 in)
Timing belt	
Installation height	1.0 mm (0.04 in)

Cylinder head assembly

Cylinder head	
Warpage limit	0.10 mm (0.0039 in)
Journal inside diameter	25.000-25.021 mm (0.9843-0.9851 in)
Camshaft journal oil clearance	0.020-0.061 mm (0.0008-0.0024 in)
Limit	0.080 mm (0.0032 in)
Camshaft	
Cam lobe height IN	41.011-41.111 mm (1.6146–1.6185 in)
Limit	40.961 mm (1.6126 in)
Cam lobe height EX	41.260-41.360 mm (1.6244-1.6283 in)
Limit	41.210 mm (1.6224 in)
Cam lobe width IN	32.950-33.050 mm (1.2972-1.3012 in)
Cam lobe width EX	32.950-33.050 mm (1.2972-1.3012 in)
Journal diameter	24.960-24.980 mm (0.9827–0.9835 in)
Runout	0.030 mm (0.0012 in)
Valve clearance	
Valve clearance IN (cold engine)	0.17–0.24 mm (0.0067-0.0094 in)
Valve clearance EX (cold engine)	0.31-0.38 mm (0.0122-0.0150 in)
Valve	
Margin thickness IN	0.80- 1.20 mm (0.0315-0.0472 in)
Margin thickness EX	1.00-1.40 mm (0.0394-0.0551 in)
Seat contact width IN	1.10-1.50 mm (0.0433-0.0591 in)
Limit	1.950 mm (0.0768 in)
Seat contact width EX	1.10-1.50 mm (0.0433-0.0591 in)
Limit	1.950 mm (0.0768 in)

Valve lifter	
Outside diameter	27.965-27.975 mm (1.1010–1.1014 in)
Clearance IN (reference data)	0.025-0.056 mm (0.0010-0.0022 in)
Clearance EX (reference data)	0.025-0.056 mm (0.0010-0.0022 in)
Valve stem	
Diameter IN	5.475-5.490 mm (0.2156-0.2161 in)
Limit	5.445 mm (0.2144 in)
Diameter EX	5.460–5.475 mm (0.2150-0.2156 in)
Limit	5.430 mm (0.2138 in)
Runout limit IN	0.01 mm (0.0004 in)
Runout limit EX	0.01 mm (0.0004 in)
Valve guide	
Inside diameter IN	5.504–5.522 mm (0.2167-0.2174 in)
Clearance IN	0.014–0.047 mm (0.0006–0.0019 in)
Limit	0.070 mm (0.0028 in)
Inside diameter EX	5.504–5.522 mm (0.2167-0.2174 in)
Clearance EX	0.029–0.062 mm (0.0011-0.0024 in)
Limit	0.080 mm (0.0032 in)
Installation height	11.30-11.70 mm (0.4449-0.4606 in)
Valve spring	
Free length IN	41.20 mm (1.62 in)
Limit	39.14 mm (1.54 in)
Tilt limit IN	1.8 mm (0.07 in)
Free length EX	41.20 mm (1.62 in)
Limit	39.14 mm (1.54 in)
Tilt limit EX	1.8 mm (0.07 in)

Crankcase assembly

Cylinder	
Bore	81.000-81.012 mm (3.1890-3.1894 in)
Limit	81.061 mm (3.1914 in)
Piston	
Diameter	80.938–80.950 mm (3.1865-3.1870 in)
Limit	80.898 mm (3.1850 in)
1st oversize diameter	81.188–81.200 mm (3.1964–3.1968 in)
Measuring point	14.0 mm (0.55 in)
Piston clearance	0.050–0.074 mm (0.0020-0.0030 in)
Limit	0.163 mm (0.0064 in)
Ring groove (Top)	1.23–1.25 mm (0.0484-0.0492 in)
Ring groove (2nd)	1.22–1.24 mm (0.0480-0.0488 in)
Ring groove (Oil)	2.51–2.53 mm (0.0988-0.0996 in)
Pin boss inside diameter	18.004–18.015 mm (0.7202-0.7206 in)
Limit	18.035 mm (0.7214 in)
Pin outside diameter	17.991–18.000 mm (0.7083-0.7087 in)
Limit	17.981 mm (0.7079 in)

Piston ring (Top)	
Type	Barrel
Height (B)	1.170-1.190 mm (0.0461-0.0469 in)
Width(T)	2.350-2.650 mm (0.0925-0.1044 in)
End gap	0.15-0.30 mm (0.0059-0.0118 in)
Limit	0.470 mm (0.0185 in)
Side clearance	0.04-0.08 mm (0.0016-0.0032 in)
Limit	0.130 mm (0.0051 in)
Piston ring (2nd)	
Type	Taper
Height (B)	1.170-1.190 mm (0.0461-0.0469 in)
Width (T)	2.600-2.800 mm (0.1024-0.1102 in)
End gap	0.70-0.90 mm (0.0276-0.0354 in)
Limit	1.050 mm (0.0413 in)
Side clearance	0.03-0.07 mm (0.0012-0.0028 in)
Limit	0.110 mm (0.0043 in)
Piston ring (Oil)	
Height (B)	2.380-2.480 mm (0.0937-0.0976 in)
Width (T)	2.400 mm (0.0945 in)
End gap	0.20-0.70 mm (0.0079-0.0276 in)
Side clearance	0.03-0.15 mm (0.0012-0.0059 in)
Connecting rod	
Small end inside diameter	18.005-18.015 mm (0.7089-0.7094 in)
Big end inside diameter	50.000-50.018 mm (1.9695-1.9703 in)
Big end side clearance	0.150-0.300 mm (0.0059-0.0118 in)
Limit	0.35 mm (0.0138 in)
Big end oil clearance	0.022-0.040 mm (0.0007-0.0016 in)
Limit	0.070 mm (0.0028 in)
Crankshaft	
Journal diameter	51.982-52.000 mm (2.0465–2.0472 in)
Crankshaft pin diameter	46.982-47.000 mm (1.8496-1.8504 in)
Runout	0.03 mm (0.0012 in)
Limit	0.04 mm (0.0016 in)
Crankshaft pin width	21.00-21.10 mm (0.8268-0.8307 in)
Journal oil clearance	0.032-0.050 mm (0.0010-0.0020 in)
Limit	0.070 mm (0.0028 in)

Lower unit technical data

Lower unit assembly (regular rotation model)

Lower unit	
Holding pressure	68.6 kPa (0.69 kgf/cm^2, 9.9 psi)
Gear backlash	
Forward gear backlash	0.15-0.87 mm (0.0059-0.0343 in)
Reverse gear backlash	0.74-1.56 mm (0.0291-0.0614 in)

* Figures obtained using the special service tools.

Available shim thicknesses	
Pinion shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Forward shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Reverse shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Propeller shaft	
Runout	0.02 mm (0.0008 in)
Drive shaft	
Runout	1.0 mm (0.039 in)

Lower unit assembly (counter rotation model)

Lower unit	
Holding pressure	68.6 kPa (0.69 kgf/cm^2, 9.95 psi)
Gear backlash	
Forward gear backlash	0.13-0.87 mm (0.0051-0.0343 in)
Reverse gear backlash	0.75-1.56 mm (0.0295-0.0614 in)

* Figures obtained using the special service tools.

Available shim thicknesses	
Pinion shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Forward shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Reverse shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Propeller shaft shims	0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm
Propeller shaft	
Runout	0.02 mm (0.0008 in)
Drive shaft	
Runout	1.0 mm (0.039 in)

Bracket unit technical data

PTT system

Hydraulic pressure	
Down	3.00 MPa (30.0 kgf/cm^2, 435.0 psi)
Up	16.00 MPa (160.0 kgf/cm^2, 2320.0 psi)
Motor	
Standard commutator diameter	22.00 mm (0.8661 in)
Wear limit	21.00 mm (0.8268 in)
Standard commutator undercut	1.50 mm (0.0591 in)
Wear limit	1.00 mm (0.0394 in)
Standard brush length	10.00 mm (0.3937 in)
Wear limit	3.5 mm (0.14 in)

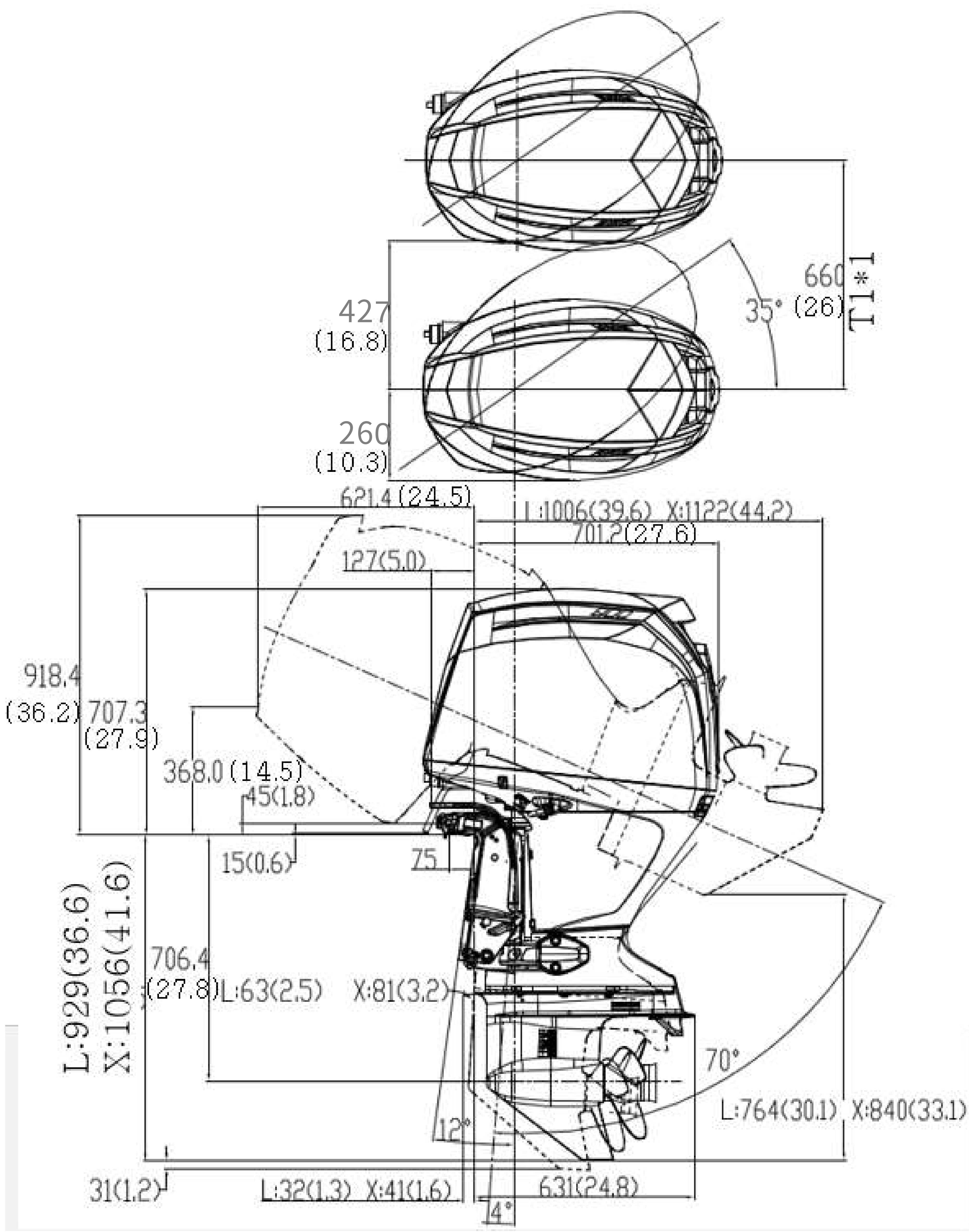
External dimensions

TIP:

The dimension values may include reference values.

F115BET, LF115BET,F130BET,FL130BET

mm (in)



*1. Minimum distance between the outboard motors in twin or triple engine application

*2. Motor transom height

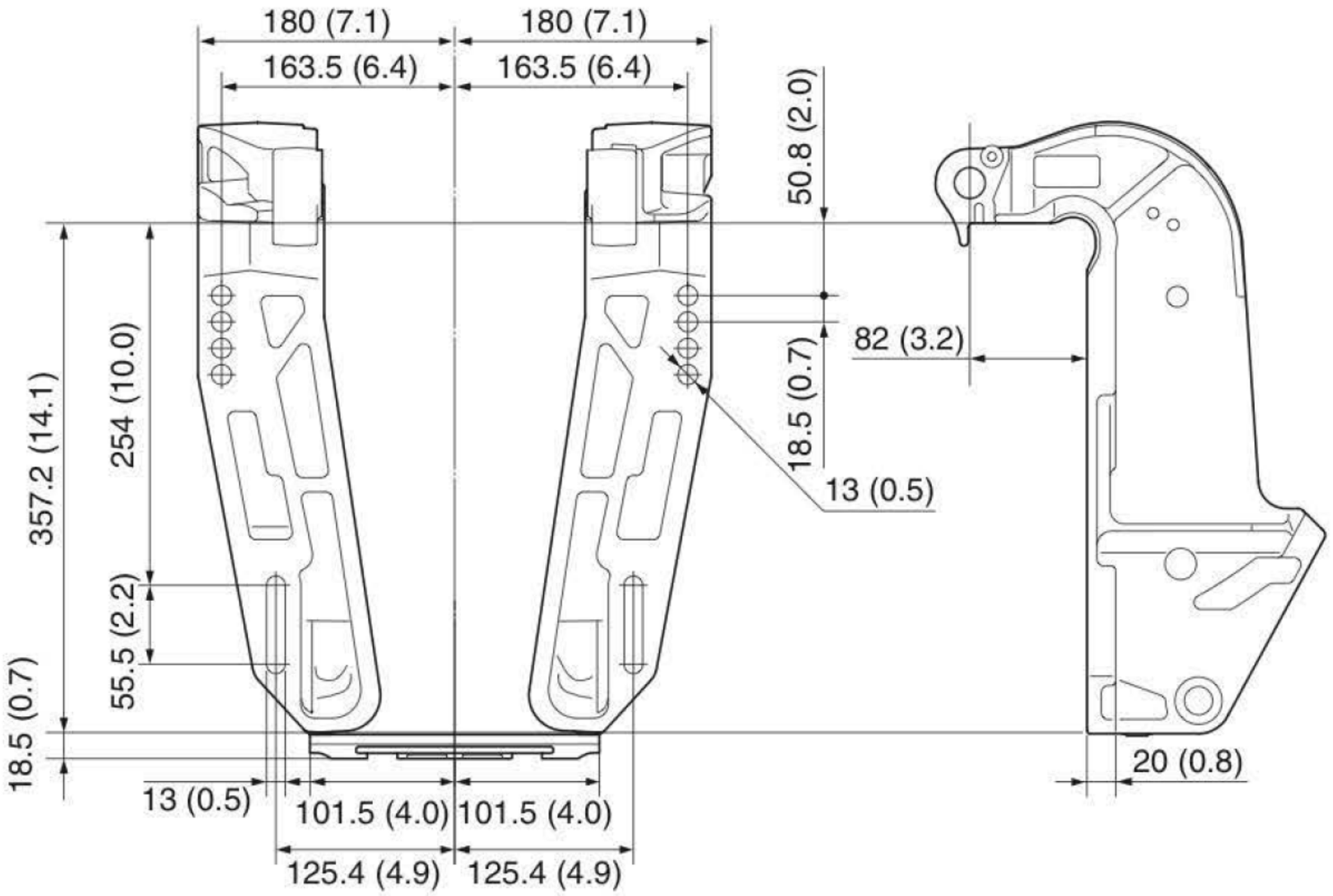
*3. Fully tilt-up angle (Not tilt support angle)

Clamp bracket dimensions

TIP:

The dimension values may include reference values.

mm (in)



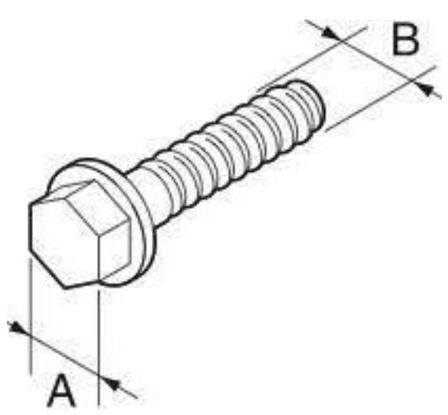
Specified tightening torque

Specified tightening torques are provided for specific nuts, bolts, and screws. When tightening these fasteners, follow the tightening torque specifications indicated throughout the manual to meet the design aims of the outboard motor.

General tightening torque

This chart indicates the tightening torques for standard fasteners with a standard ISO thread pitch.

Width across flats (A)	Thread size (B)	General torque specifications		
		Nm	kgf·m	ft·lb
8mm	M5	5	0.5	3.7
10mm	M6	9	0.8	5.9
12mm	M8	18	1.8	13.3
14mm	M10	36	3.6	26.6
17mm	M12	43	5.2	38.4



Technical feature and description

Electronic control system.....2-1

Electrical components.....2-3
Electronic fuel injection control.....2-5
Ignition timing control.....2-7
Engine speed control.....2-9
JSC valve control.....2-10
Knock control.....2-10
Battery removal control.....2-10
Warning control.....2-10
Water detection warning.....2-11
Fail-safe.....2-11

Serviceability 2-13

Lifting up.....2-13
Oil dipstick.....2-13
Oil catch tray.....2-13
Fuel filter.....2-13
Anode.....2-14
Rigging grommet.....2-15
Cable clamp.....2-15

Power unit system.....2-15

Overview.....2-15
Top cowling.....2-15
Cylinder block.....2-16
Flywheel and crankshaft.....2-17
Oil cooler.....2-17
Intake manifold.....2-17
Exhaust manifold exhaust joint.....2-17
Blowby gas passage.....2-18

Lower unit 2-19

Overview.....2-19
Shift Dampener System (SDS).....2-19

Bracket unit **2-20**

Upper case 2-20
Oil pan 2-20
Idle exhaust hole 2-20
Upper mount, lower mount 2-20
PTT, bracket 2-20

Fuel system **2-21**

High-pressure fuel pump control 2-21
Fuel diagram 2-21

Lubrication system **2-23**

Lubrication diagram 2-23

Cooling system **2-25**

Cooling diagram 2-25

Intake and exhaust system **2-27**

Intake and exhaust diagram 2-27

PPT unit **2-28**

Trim-up and tilt-up function 2-28
Trim-down and tilt-down function 2-29
Stationary condition 2-30
Shock-absorbing function 2-30

Additional features **2-31**

H-COP 2-31
Tilt limiter (optional) 2-32

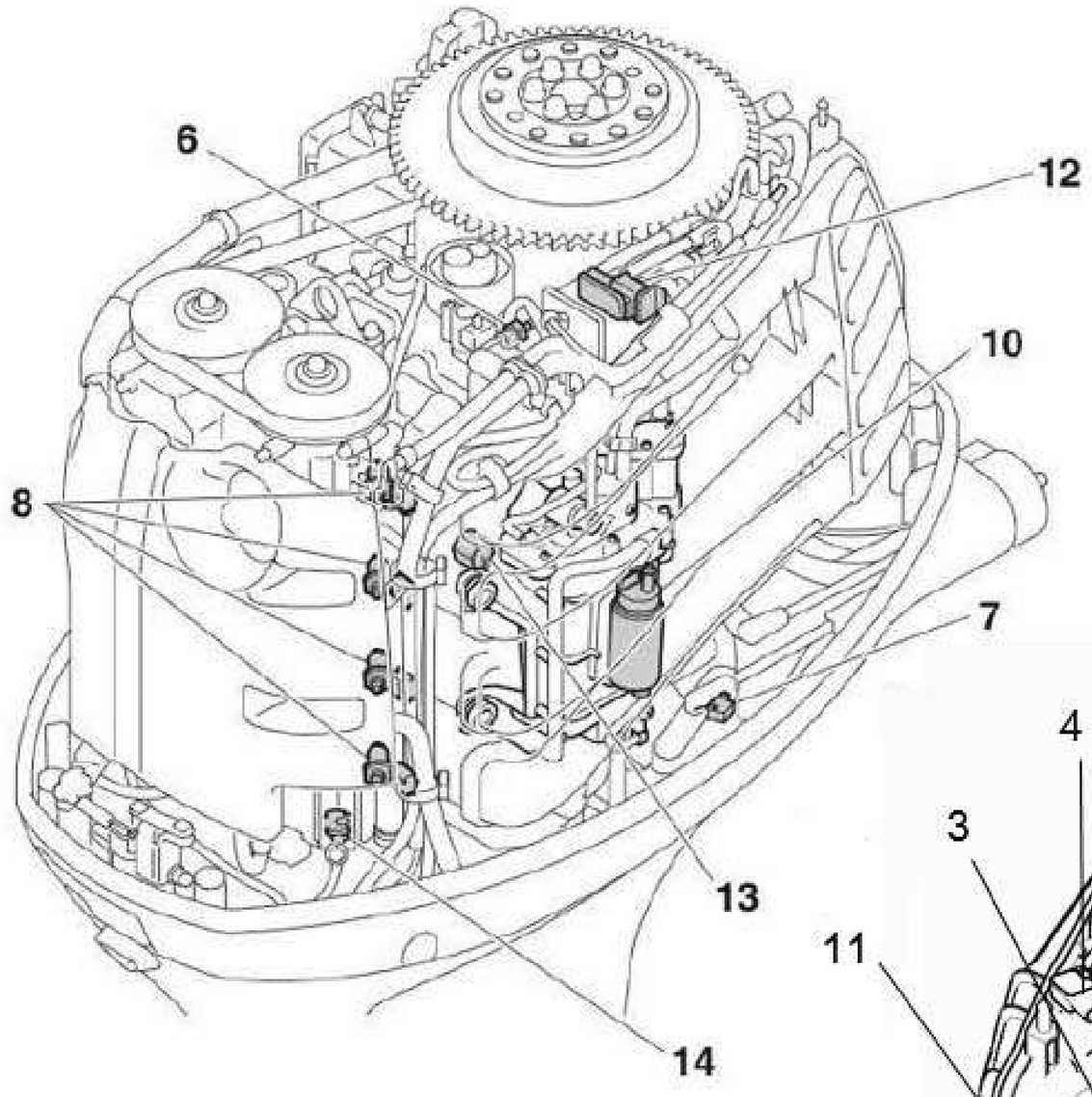
Hose routing **2-33**

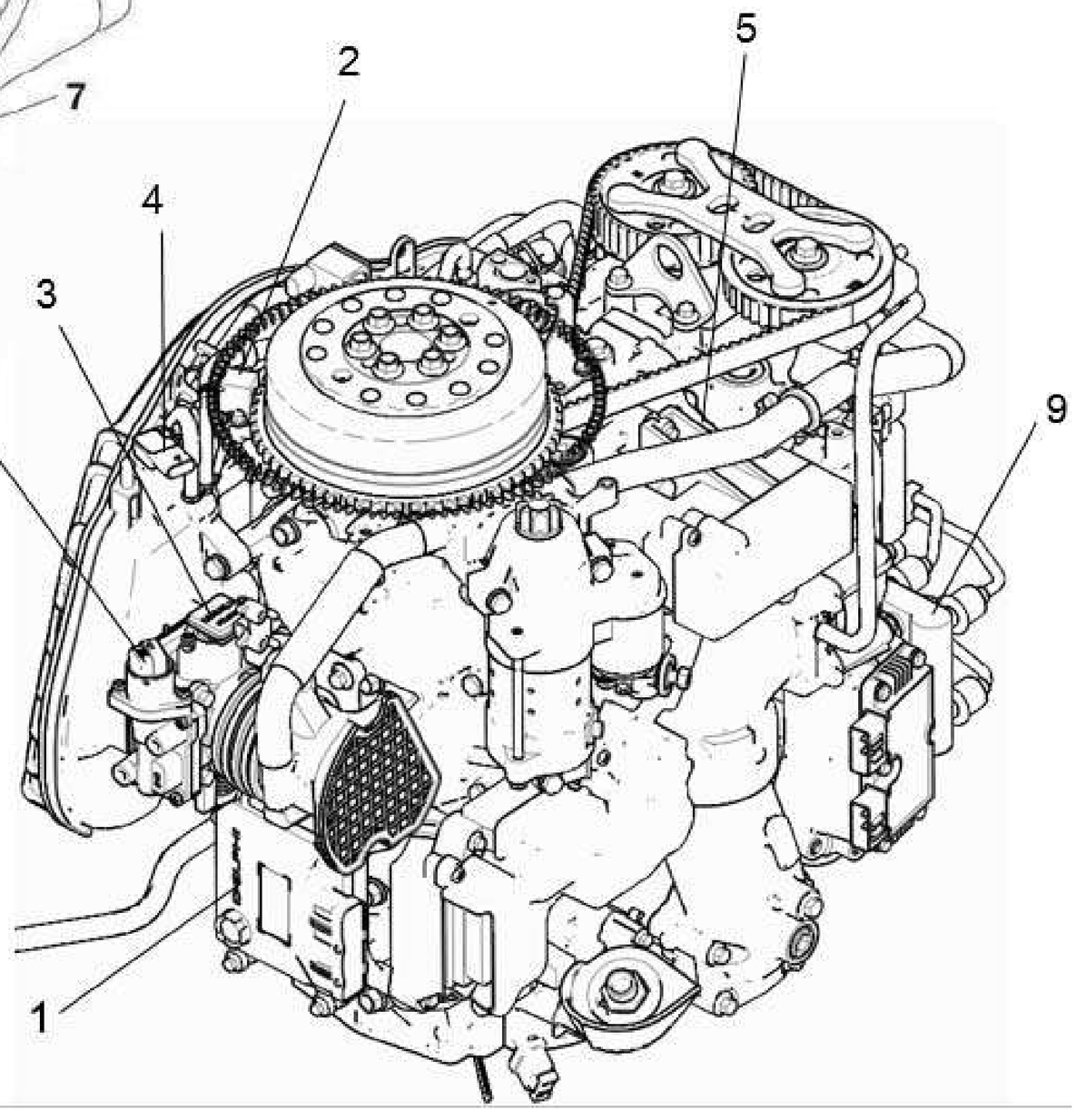
Fuel hose 2-33
Pressure regulator hose, vapor gas hose, and blowby hose 2-34
Cooling water hose 2-36

1. Pulser coil
2. TPS
3. Intake air pressure/temperature sensor
4. Oil pressure switch
5. Thermo sensor
6. Knock sensor
7. Shift position switch
8. Water detection switch
9. Water pressure sensor *2
10. Speed sensor *3
11. Ignition coil
12. Fuel injector
13. Vapor shut-off valve
14. High-pressure fuel pump
15. ISC valve
16. Engine ECM
17. HDIS
18. 6Y8 Multifunction Meters
19. H-COP *1
20. Multi-hub
21. Battery
22. Fuel injection control
23. Digital ignition control
24. Idle Speed Control

*1. Standard for European market and optional for other markets.
*2. Optional
*3. Standard for European and the Middle East markets and optional for other markets.

Electrical components



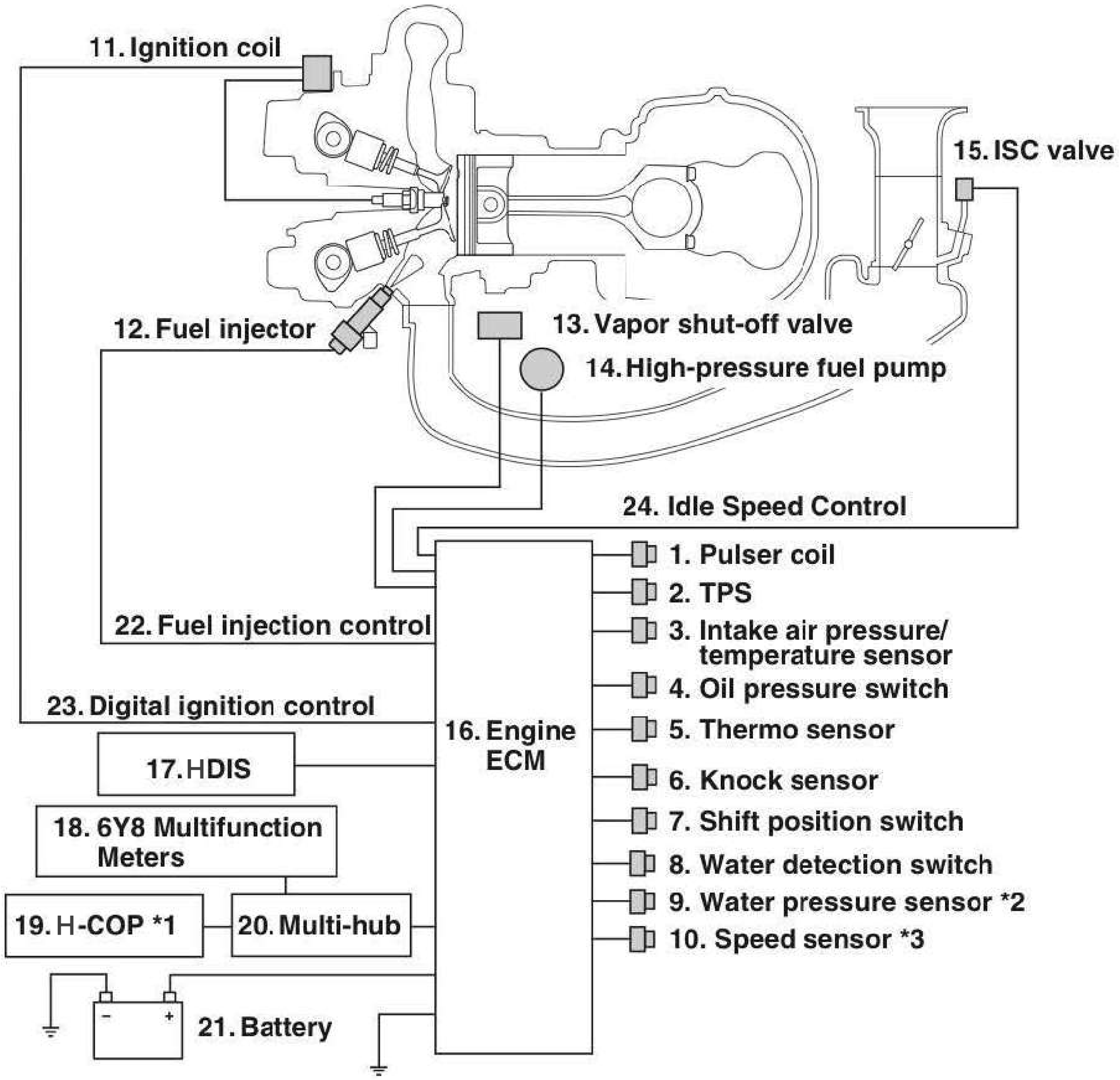


Electronic control system

This model uses an electronic fuel injection control, digital ignition control, ISC (Idle Speed Control), knock control, over-rev control, alert control, and fail-safe control.

The engine ECM performs these controls based on data received from each sensor and switch. The engine ECM is equipped with a self-diagnosis function. This function can be used to check trou- ble codes on the HDIS.

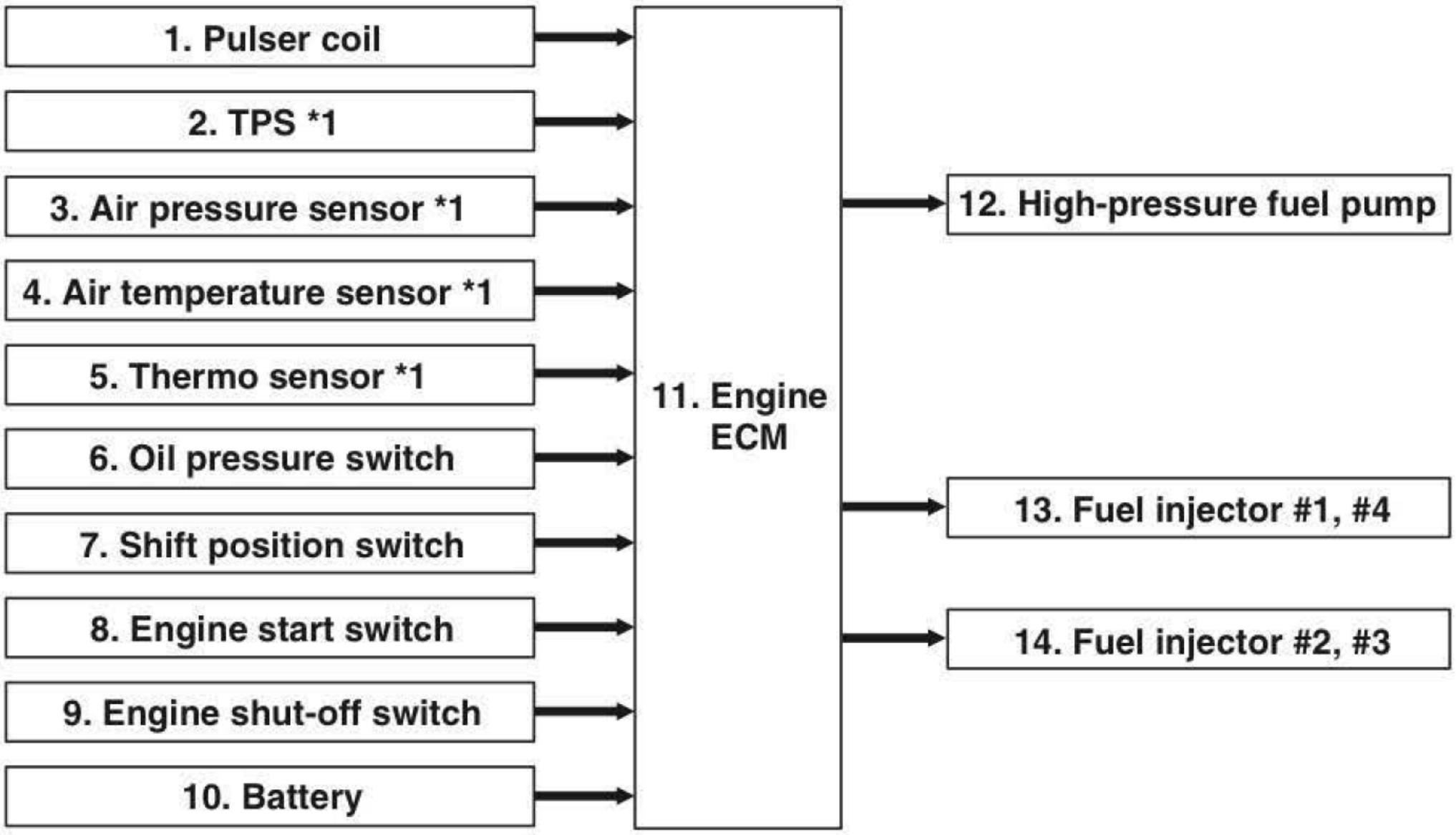
This model is designed to be compatible withH-COP *1 as an anti-theft measure.



Part name		Function
1	Engine ECM	Determines the engine operating conditions based on the input signals from the sensors which are installed at various locations on the engine, and transmits control signals to each actuator.
2	Pulser coil	Detects the engine speed and crankshaft angle.
3	TPS	Detects the throttle valve opening angle.
4	Intake air pressure/tern-perature sensor	Detects the intake air temperature and pressure.
5	Oil pressure switch	Detects oil pressure decrease.
6	Thermo sensor	Detects engine temperature.
7	Shift position switch	Detects the neutral position.
8	Fuel injector	Injects fuel.
9	Ignition coil	Produces high voltage to ignite a spark plug.
10	High-pressure fuel pump	Pressurizes and feeds the fuel to the fuel rails for injection.
11	ISC valve	Adjusts the intake air distribution to the engine when the throt- tie valve is fully closed.
12	Vapor shut-off valve	Controls the amount of vapor gas that is sent from the VST to the intake system to be reburned.
13	Knock sensor	Detects engine knocking.
14	Water detection switch	Detects water accumulated in the fuel filter.

Electronic fuel injection control

The engine ECM switches the control mode between the start-up mode, normal operating mode, and fuel injection cutoff mode according to the signals from the sensors. In addition, various com- pensations are made to determine the actual fuel injection timing and fuel injection amount. Addi- tionally, when the engine start switch is turned to ON, the engine ECM moves the injectors once before activating the high-pressure pump relay to prevent them from sticking.



1. Pulser coil
2. TPS
3. Air pressure sensor
4. Air temperature sensor
5. Thermo sensor
6. Oil pressure switch
7. Shift position switch
8. Engine start switch
9. Engine shut-off switch
10. Battery
11. Engine ECM
12. High-pressure fuel pump
13. Fuel injector #1, #4
14. Fuel injector #2, #3

*1. Sensors used for compensations.

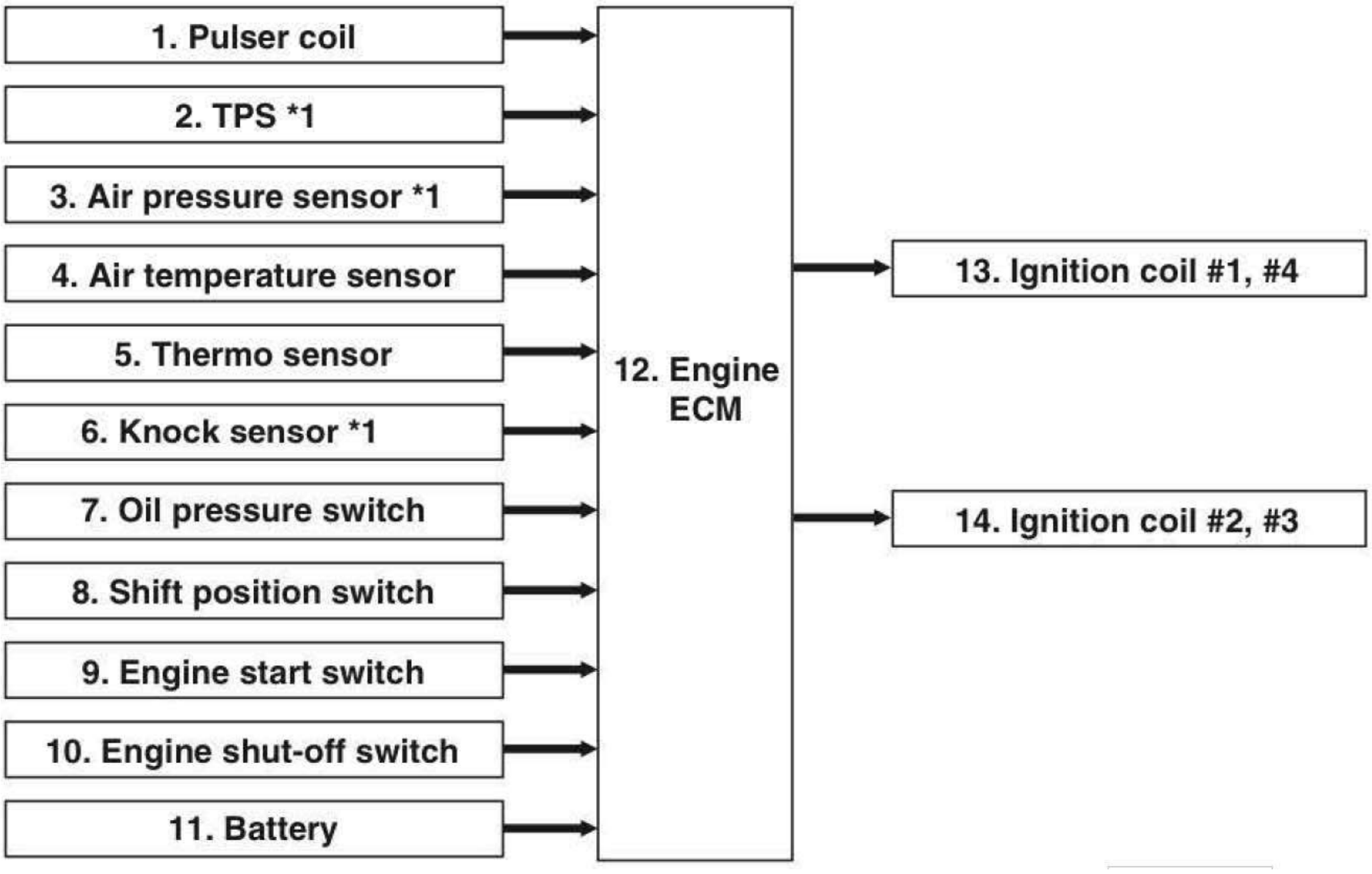
Mode	Controls performed by engine ECM	
Start-up mode	For quick engine start (to shorten cranking time), fuel is injected into all cylinders until the cylinders have been identified.	
Normal operating mode	Fuel is injected into cylinders in groups, to #1 and #4, and to #2 and #3 (to all cylinders during acceleration).	
Fuel injection cut off mode	Cutoff when engine shut-off switch is on	Fuel injection is cut when the clip is removed (engine shut-off switch: ON).
	Cutoff when over-rev-v1ng	To protect the engine, fuel injection is skipped when the engine speed is more than 5700 r/min at the neutral position, and more than 6450 r/min at shift-in positions.
	Cutoff due to activation of H-COP	Fuel is not injected when the engine is locked by H-COP. When a communication error occurs, fuel flow is cut to control engine speed.

Ignition timing control

This model uses group ignition in cylinders #1 and #4, and in cylinders #2 and #3.

The engine ECM switches the control mode between the start-up mode, normal operating mode, and ignition cutoff mode according to the signals from the sensors.

In addition, various compensations are made to determine the actual ignition timing and the energization time of current to the ignition coil.

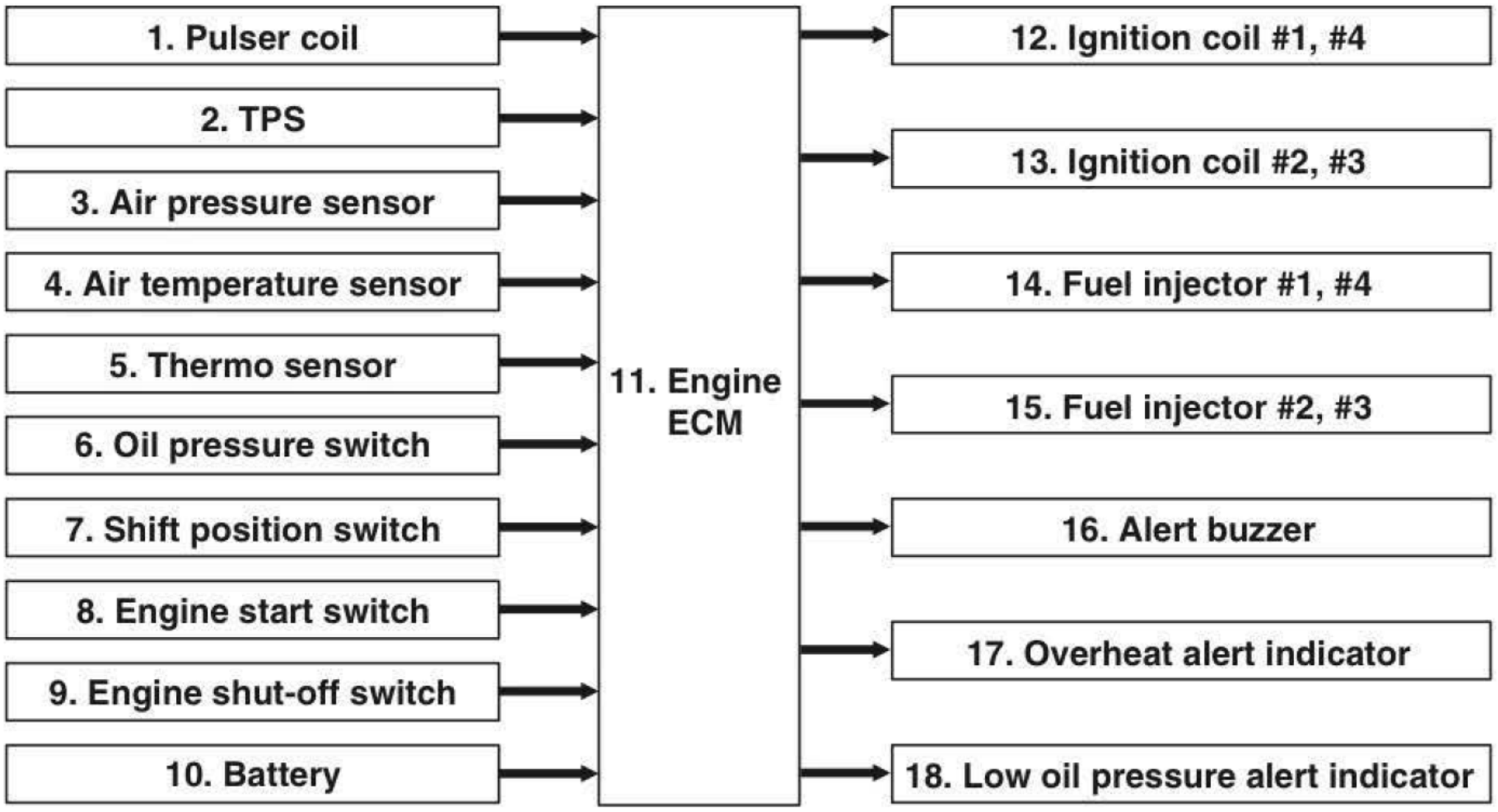


1. Pulser coil
2. TPS
3. Air pressure sensor
4. Air temperature sensor
5. Thermo sensor
6. Knock sensor
7. Oil pressure switch
8. Shift position switch
9. Engine start switch
10. Engine shut-off switch
11. Battery
12. Engine ECM
13. Ignition coil #1, #4
14. Ignition coil #2, #3

*1. Sensors used for compensations.

Mode	Control items	Controls performed by engine ECM
Start-up mode	Ignition timing when starting	Ignition takes place in all cylinders at BTDC 10° during cranking.
Normal operating mode	Normal ignition timing	Ignition timing is set based on signals from the pulser coil and the TPS, and all necessary compensations are made.
Ignition cut-off mode	Ignition cutoff when engine shut-off switch	Ignition is cut when the clip is removed (engine shut-off switch: ON).
	Ignition cutoff when over-revv1ng	To protect the engine, ignition is skipped when the engine speed is more than 5700 r/min at the neu- tral position, and more than 6450 r/min at shift-in positions.
	Ignition cutoff due to activation of H-COP	Ignition does not take place when the engine is locked by H-COP. When a communication error occurs, ignition is cut to control engine speed.

The engine ECM controls ignition and fuel injection as necessary to prevent damage to the engine when engine speed is more than a predetermined level, when the engine overheats, or if oil pres-sure decrease is detected. Fuel injection is cut together when ignition in the grouped cylinders has been cut completely.



1. Pulser coil
2. TPS
3. Air pressure sensor
4. Air temperature sensor
5. Thermo sensor
6. Oil pressure switch
7. Shift position switch
8. Engine start switch
9. Engine shut-off switch
10. Battery
11. Engine ECM
12. Ignition coil #1, #4
13. Ignition coil #2, #3
14. Fuel injector #1, #4
15. Fuel injector #2, #3
16. Alert buzzer
17. Alert indicator
18. Low oil pressure alert indicator

Control name	Condition	Description
Over-rev control	Neutral position	When the engine speed exceeds 5700 r/min, igni-tion or fuel injection is skipped to prevent increase in engine speed.
	In-gear position	When the engine speed exceeds 6450 r/min, igni-tion or fuel injection is skipped to prevent increase in engine speed.

ISC valve control

The engine ECM adjusts the opening of the ISC valve so that engine speed is maintained at a target value when the throttle valve is fully closed.

The ISC valve control also has a learning function and trolling speed control function.

Trolling speed can be adjusted in the range of 600-1000 r/min by opening and closing the ISC valve using the 6Y8 Multifunction meters or the tiller handle (with trolling switch). However, when the engine is stopped or when the engine speed exceeds 3000 r/min, the trolling speed control function is deactivated.

Knock control

The engine ECM receives a knock signal from the knock sensor that is installed to the cylinder block. To protect the engine from damage, the engine ECM retards the ignition timing and decreases the engine speed according to the amount of knocking.

If the knocking occurs frequently, the ignition timing is retarded until knocking is no longer detected, and the retarded ignition timing is maintained, using the learning function.

Regardless of the preceding conditions, the knock control also activates when the thermo sensor is malfunctioning.

	Water temperature	
Engine speed	52℃(125.6 °F) or less	53℃ (127.4 °F) or more
More than 500 r/min	Knock control does not	Knock control activates

Battery removal control

If the battery terminal has been removed, the fuel injection and ignition for all cylinders are shut-off to stop the engine and protect the rectifier/regulator.

Warning control

If the engine overheats or the oil pressure has dropped, ignition and fuel injection is controlled to limit the engine speed to less than 2600 r/min.

When the oil pressure switch is ON or the thermo sensor detects the specific value, the engine is controlled as shown in the table.

Detector	Thermo sensor	Oil pressure switch
Criterion	Cooling water temperature is 80 oc (176 °F) or more after 120 sec. have elapsed since the engine was started or after engine speed is 2000 r/min or more for more than 45 seconds.	The oil pressure switch is ON after 5 seconds have elapsed since the engine was started, and the engine speed
Activation	Overheat alert indicator lights and buzzer sounds.	Low oil pressure alert indicator lights and buzzer sounds.

Water detection warning

If water is present in the fuel and the water detection switch in the fuel filter turns on, the warning indicator on the meter will be activated as shown in the table.

Water detection switch state		Turning from ON to OFF	Always ON	Remarks
Neutral	Indicator (symbol)	Displayed for 30 sec.	Always displayed	—
	Buzzer	Sounds for 30 sec.	Sounds constantly	Starts sounding 3 seconds after shifting into neutral.
In-gear	Indicator (symbol)	Displayed for 30 sec.	Always displayed	—
	Buzzer	No sound	No sound	—

Fail-safe

In the fail-safe control, the engine ECM enters the fail-safe control mode when an electrical component malfunctions.

The fail-safe control system records the trouble codes according to the engine trouble conditions.

Trouble code	Item	Trouble conditions to be detected	Control and operation
15	Thermo sensor	Open or short circuit in the thermo sensor circuit. Output voltage is less than0.1 V or more than 4.5 V.	Control is performed based on the intake air tempera-ture when starting. Set to 40 ℃(104 °F) when runm• ng. High engine idle speed.
17	Knock sensor	Short or open circuit in the knock sensor circuit. Output voltage is less than 0.9 V or more than 4.0 V.	Ignition timing is retarded.
18	TPS	Open or short circuit in the TPS circuit. Output voltage is less than 0.3 V or more than 4.7 V.	Control is performed based on the intake air pressure.
19	Battery voltage	Voltage is 12 V or less for 2 minutes, even when engine speed is 2000 r/min or more.	High engine idle speed.
23	Air temperature sen-sor	Open or short circuit in the air temperature sensor circuit. Output voltage is less than 0.1 V or more than 4.6 V.	Set to 40℃ (104 °F). High engine idle speed.
27	Water in fuel filter	The shift position switch is on and the water detection switch 1s on.	The alert buzzer sounds.

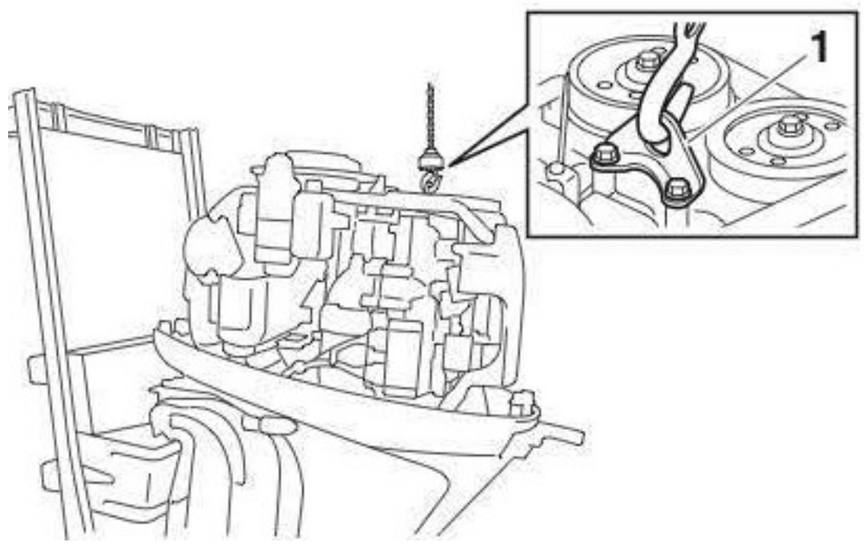
Trouble code	item	Trouble conditions to be detected	Control and operation
28	Shift position switch	Cranking while in gear. Cranking while the shift posi-tion switch circu it is open-circuited.	ECM does not control.
29	air pressure sensor	Open or short circuit in air pressure sensor circuit. Output voltage is less than0.2 V or more than 4.5 V.	Control is performed based High engine idle speed.
37	Intake air passage	The shift position switch is off,the throttle is fully closed, the ISC valve is fully closed, and the engine speed is more than1200r/min.	Ignition timing is retarded to control the engine speed. Ignition will be skipped if The engine speed does not decrease to the specified speed even after the igni- tion timing has been fully retarded.
44	Fuel injection is cut. switch	Cranking when the clip is removed.	Fuel injection is cut.
86	H-COP	Open or short circuit in the H -COP circuit. Communication error continues for more than 3 seconds.	The engine starts, but the engine speed is limited to less than 2600 r/min.

Serviceability

Lifting up

The outboard motor can be suspended using the special service tool (lifting eye) or by attaching lifting harnesses to the designated lifting points "1".

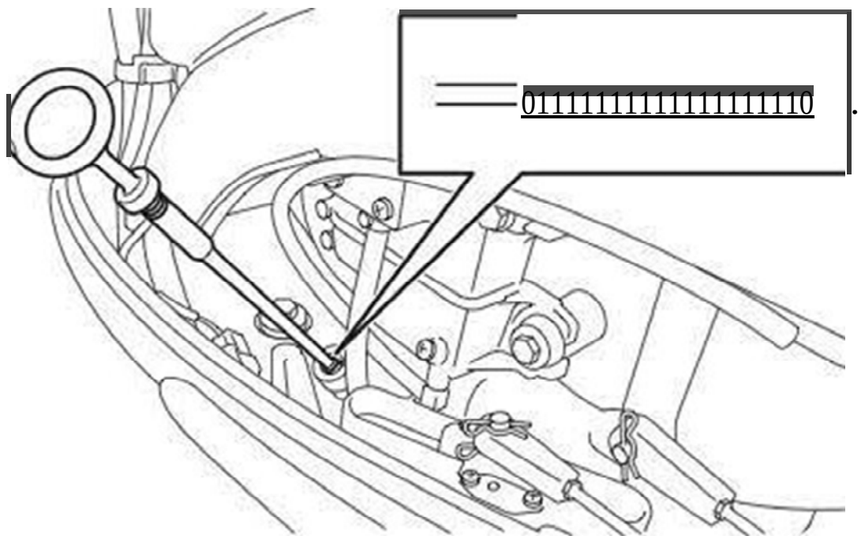
However, use the special service tool when removing the engine from the outboard motor.



Oil dipstick

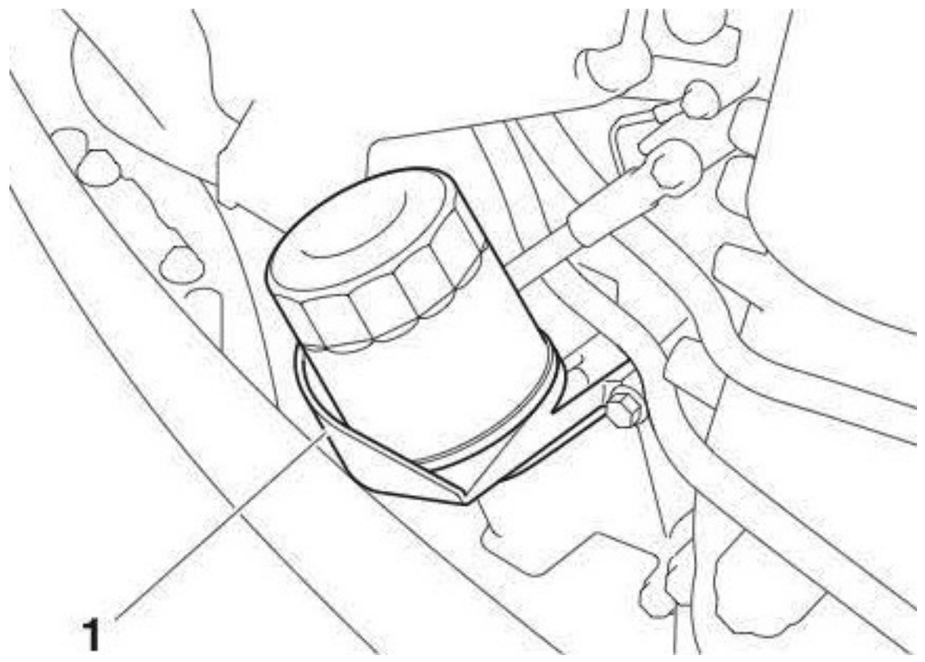
A yellow resin oil dipstick is used for easier checking.

The textured zone at the tip allows better oil adhesion, thus, it is easier to see the oil level.



Oil catch tray

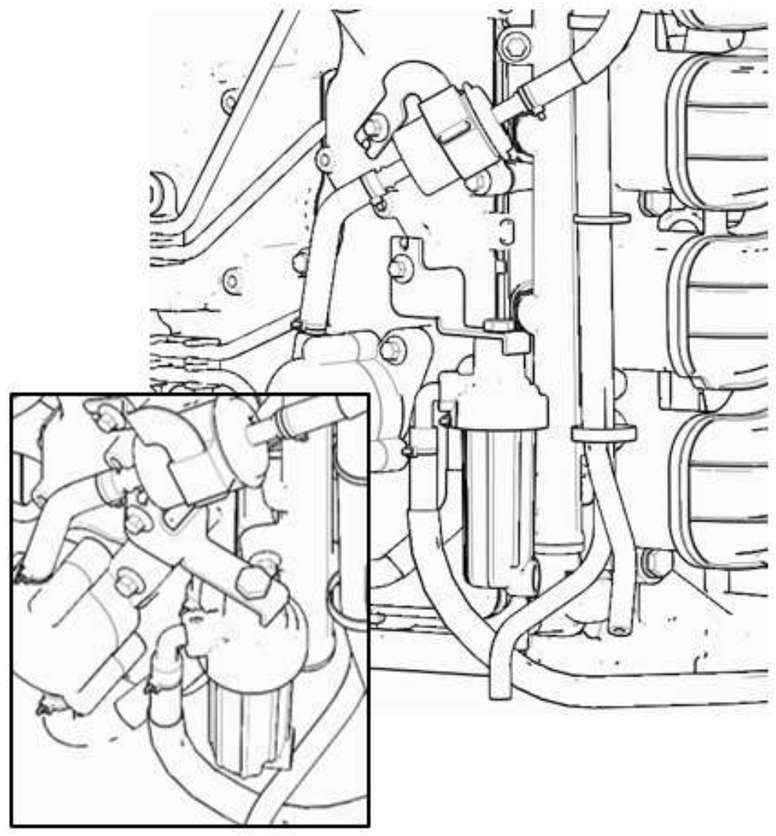
The oil filter is mounted on the oil catch tray "1" to prevent oil from dripping during oil filter replacement.



Fuel filter

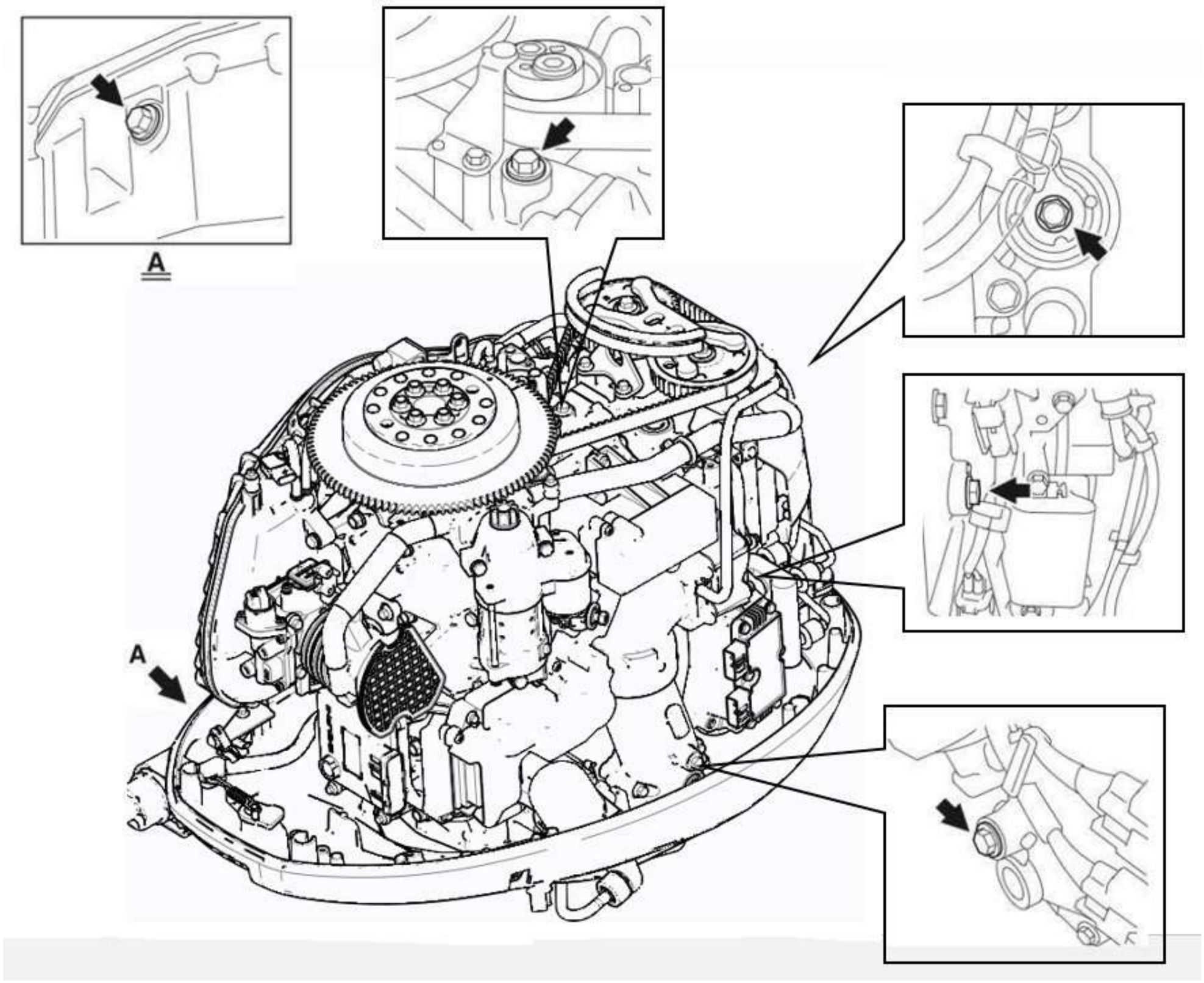
The mounting method of the fuel filter has been changed to a rubber holder type.

This allows fuel filter removal without the use of a special service tool, improving service- ability.



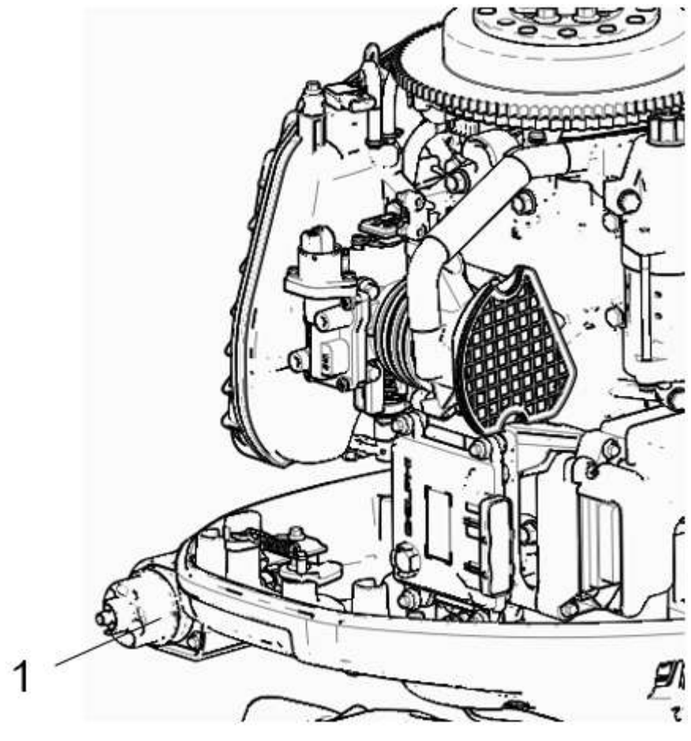
Anode

The locations of the anodes in the cooling water passages have been optimized, making the anode replacement easier, for better serviceability.



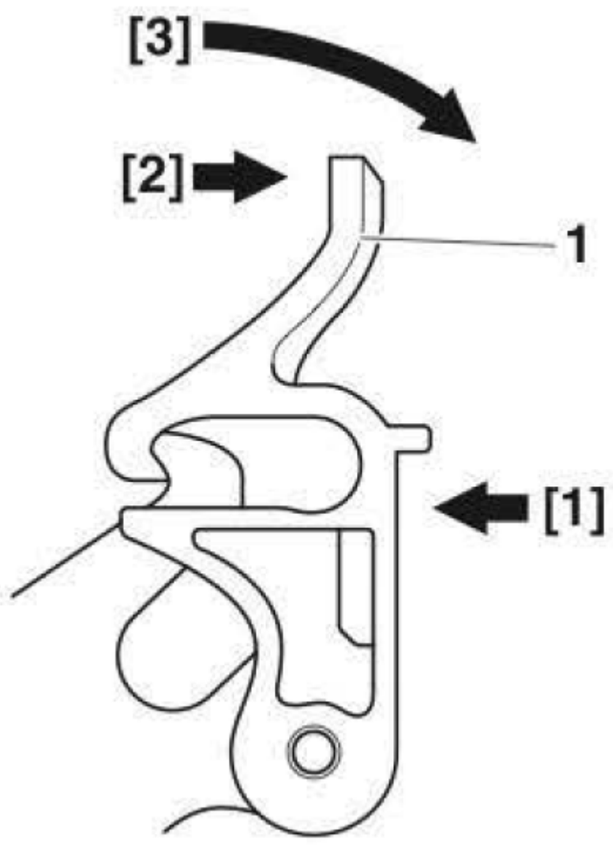
Rigging grommet

The rigging grommet "1" is located on the STBD side for easier rigging.



Cable clamp

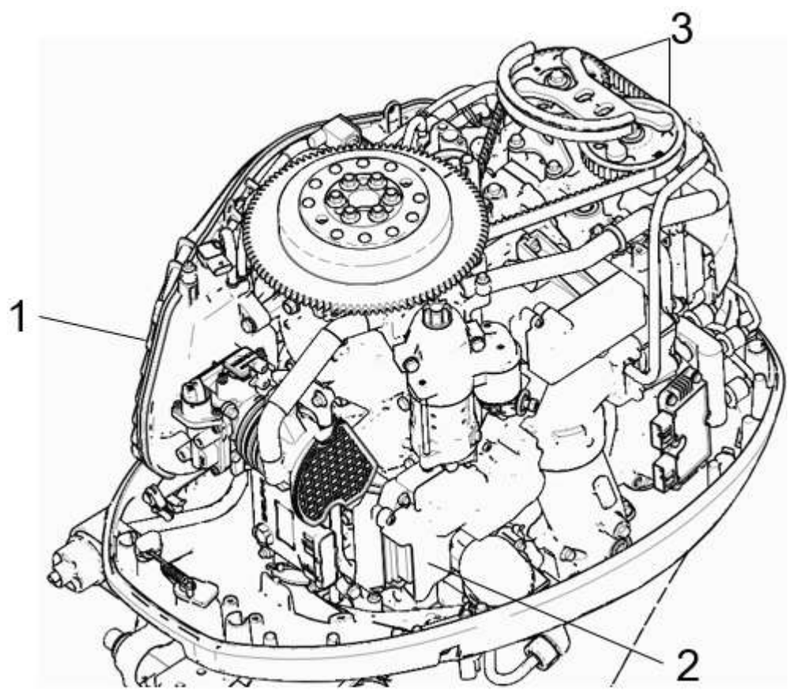
The shape of cable clamp "1" has been changed to improve the cable holding perfor- mance and reliability. To remove it, while pressing and holding [1] and [2], turn the cable clamp "1" in direction [3].



Power unit system

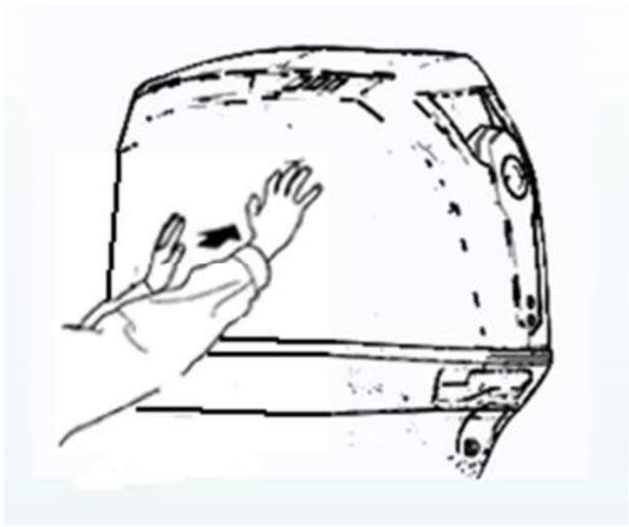
Overview

This model uses the newly developed 4- stroke L4 engine. Reduction of weight has been achieved because of a composite intake manifold "1" and electric bracket "2", aluminum driven gear "3", and the thin spiny cylinder sleeve.



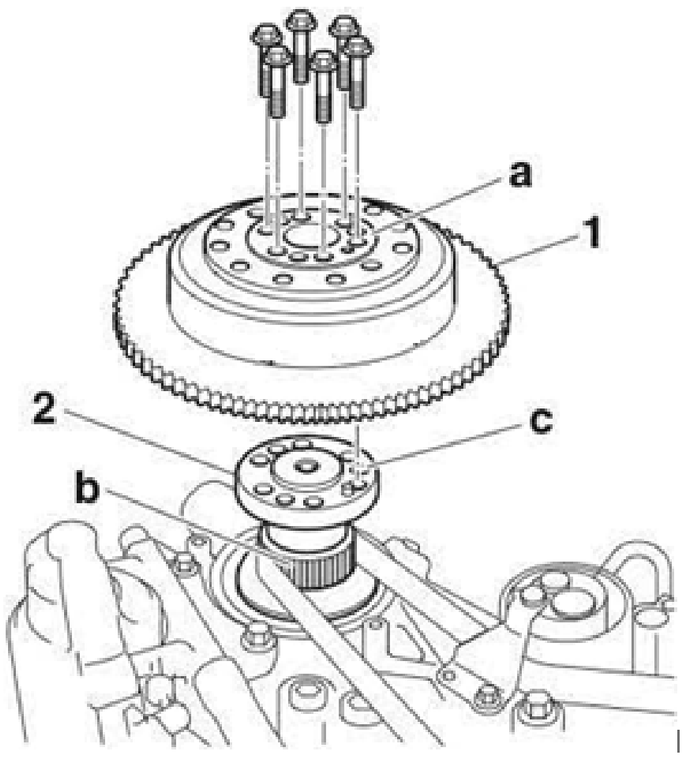
Top cowling

Check the fitting by pushing the cowling with both hands. Adjust if necessary.



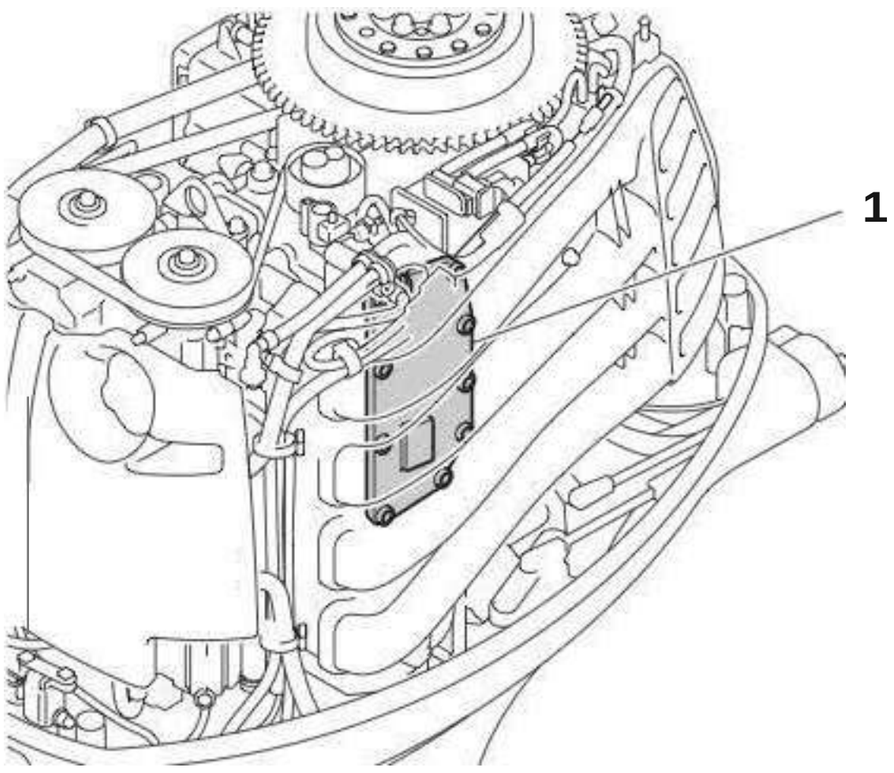
Flywheel and crankshaft

This model uses the flange mount "a" type flywheel "1".
The crankshaft "2" is formed as a one-piece casting with integrated drive sprocket "b" and the flywheel mounting flange "c", improving serviceability and reliability of the valve train.



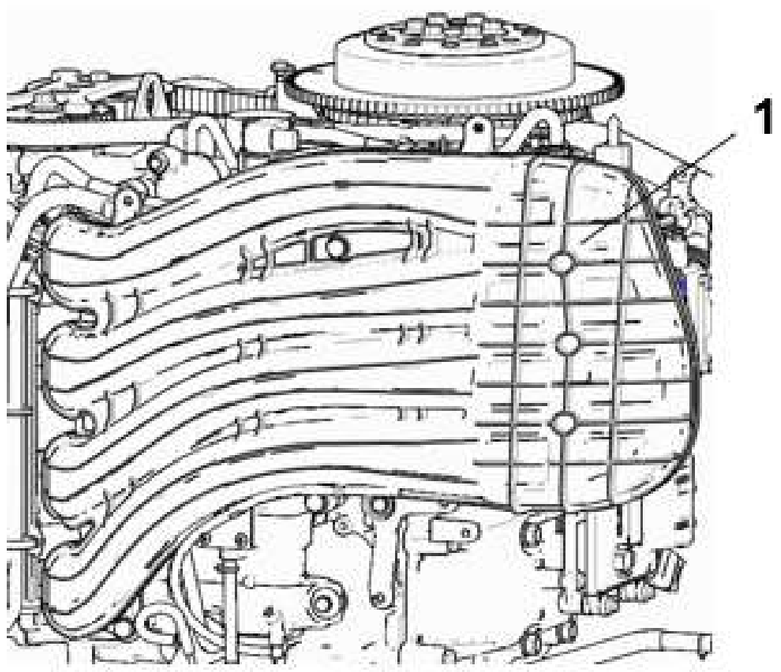
Oil cooler

A large-size oil cooler "1" is incorporated into the cylinder block to improve engine cooling performance.



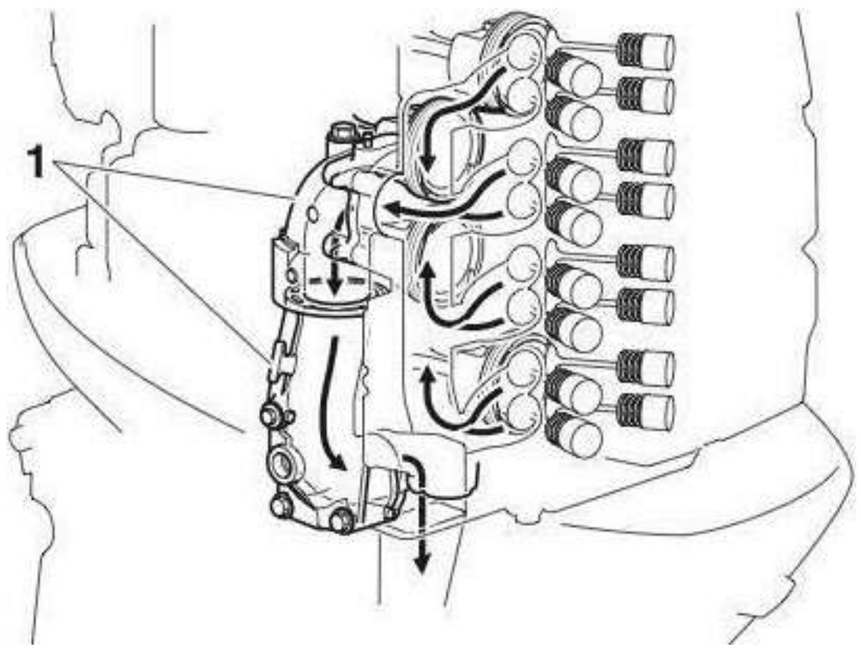
Intake manifold

The pipe length and pipe diameter of the intake manifold "1" have been increased to reduce air flow resistance, improving power output.



Exhaust manifold, exhaust joint

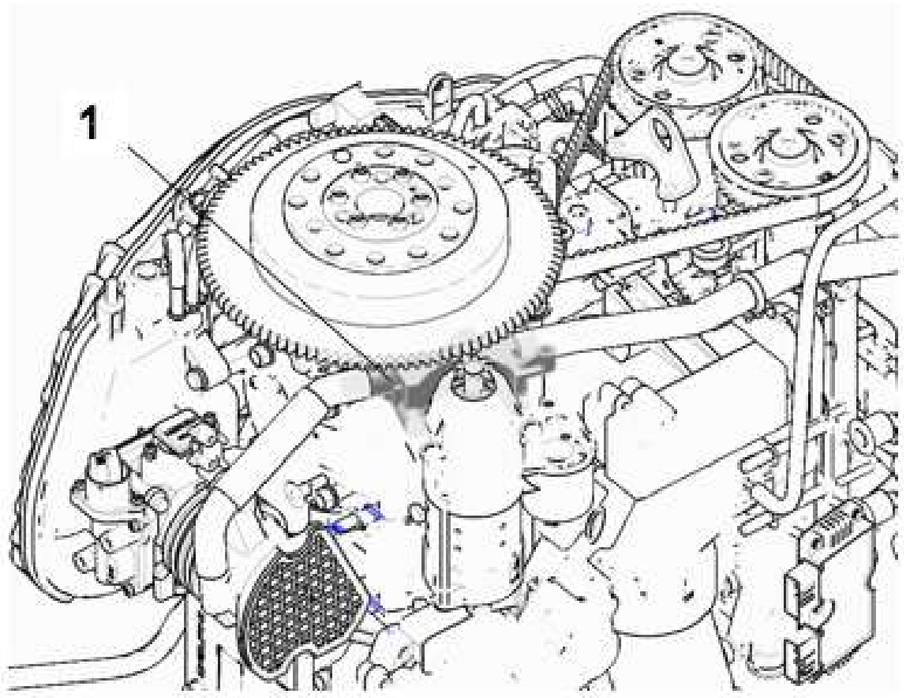
This model is fitted with a large-size exhaust manifold with a center exhaust system.
To improve resistance against corrosion, an alumite treatment is applied to the water jacket of the exhaust joint "1".



A. Exhaust gas flow

Blowby gas passage

The blowby gas passage is incorporated into the starter motor bracket "1", allowing for the compact arrangement of components.



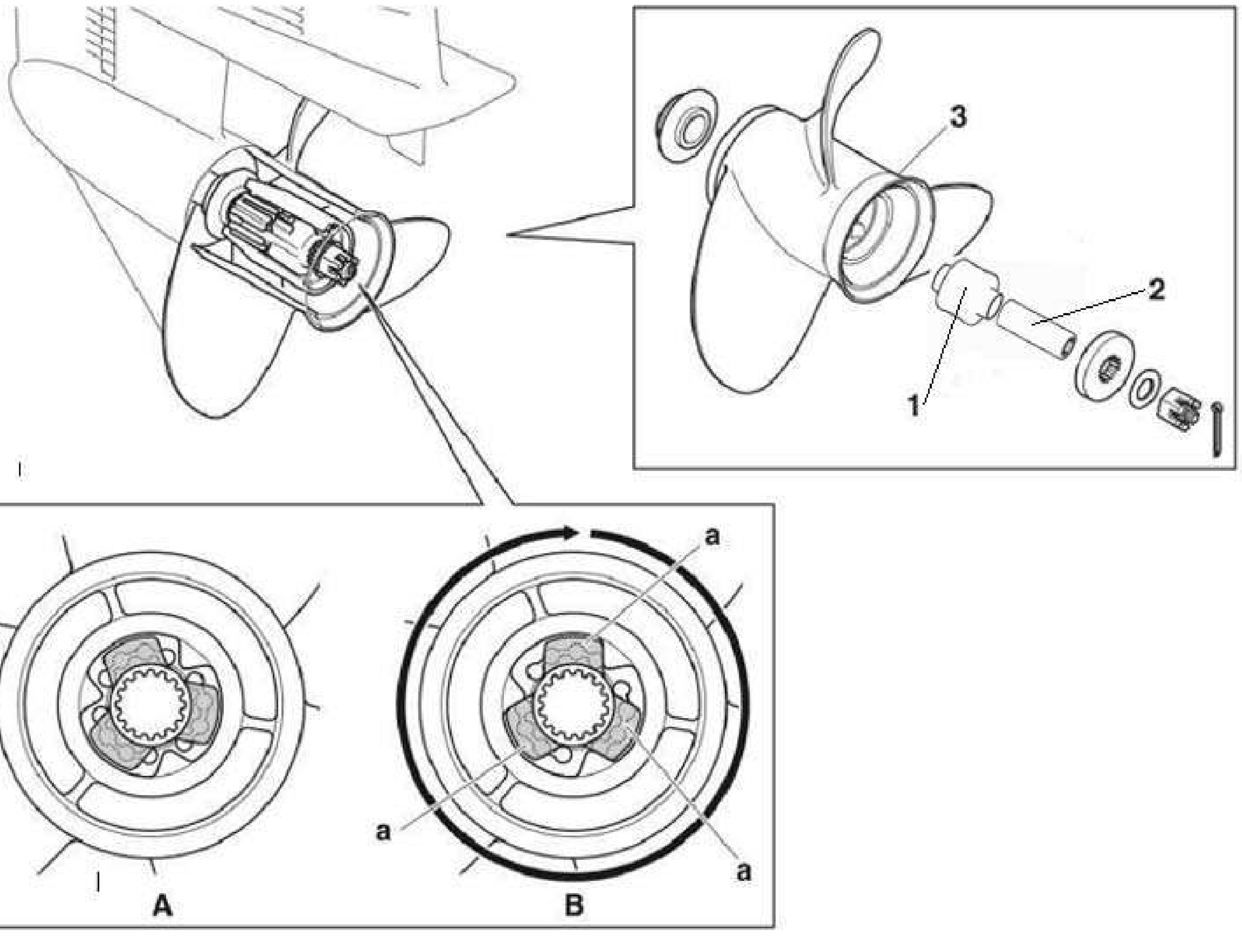
Lower unit

Overview

This model uses the proven 68V-type lower unit that is used on F130 (68V). Therefore, required special service tools and service procedures for F130 (68V) apply to this model also.

Shift Dampener System (SDS)

The Shift Dampener System (SDS) uses a damper "1" to reduce the shock when the outboard motor is shifted into gear and to improve quietness.
The damper "1" is replaceable.
When shifting gears, the damper compresses to absorb shock, and the protrusions "a" on the dedicated bushing "2" transmit the rotational force of the propeller shaft directly to the propeller "3".

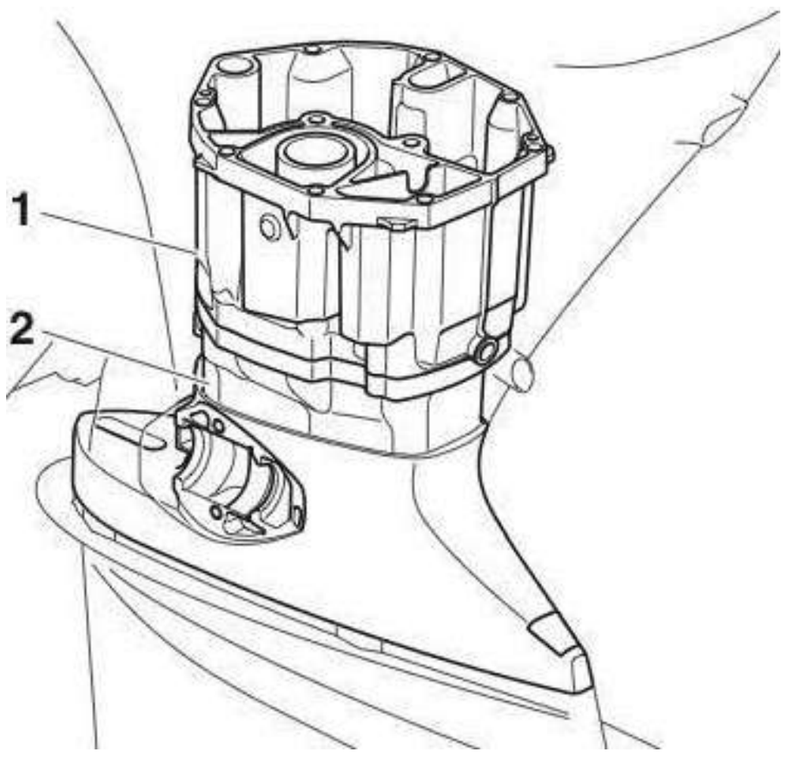


A. Neutral
B. Shift-in

Bracket unit

Upper case

The upper case with oil pan is used to reduce the weight. Therefore, the upper case "1", "2" has been separated into 2 pieces, upper part and lower part. Alumite treatment has also been applied to improve the resistance against corrosion.

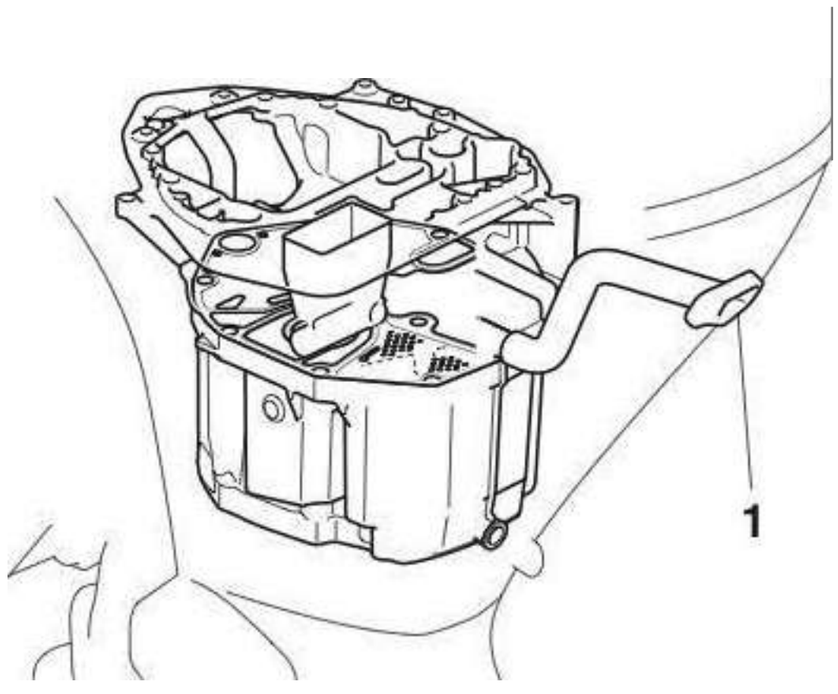


Oil pan

The cooling water passages and the engine oil passages returning to the oil pan have been optimized. This improvement resulted in a reduction in engine oil capacity of 0.7 L compared to F130 (68V).

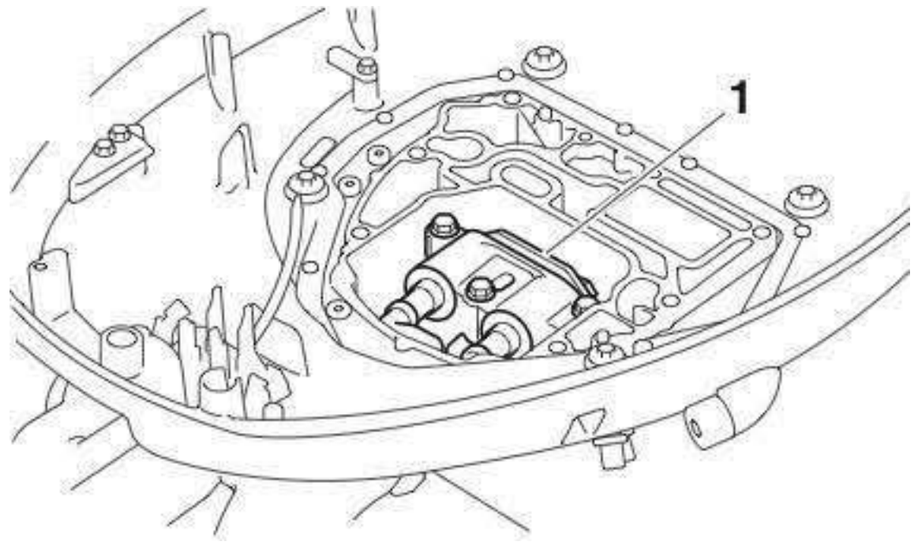
Idle exhaust hole

The idle exhaust hole "1" is located at a position 71 mm (2.8 in) higher than F130 (68V).



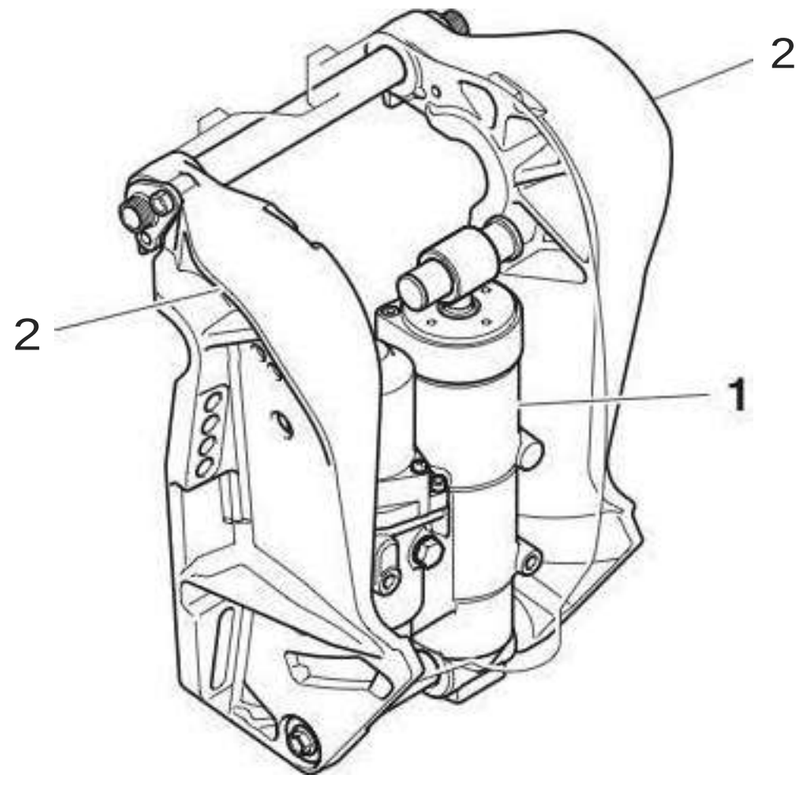
Upper mount, lower mount

The large-size upper mount piece "1" and lower mount that are equipped on F150-class models are used on this model. As a result, vibrations that occur at low engine speeds have been reduced.



PTT, bracket

Newly designed single rod PTT "1", clamp brackets "2", and swivel bracket are used on this model, consequently reducing the weight by 3 kg compared to F130 (68V). The steering angle of the swivel bracket has been changed from 30° to 35° to improve the turning performance.

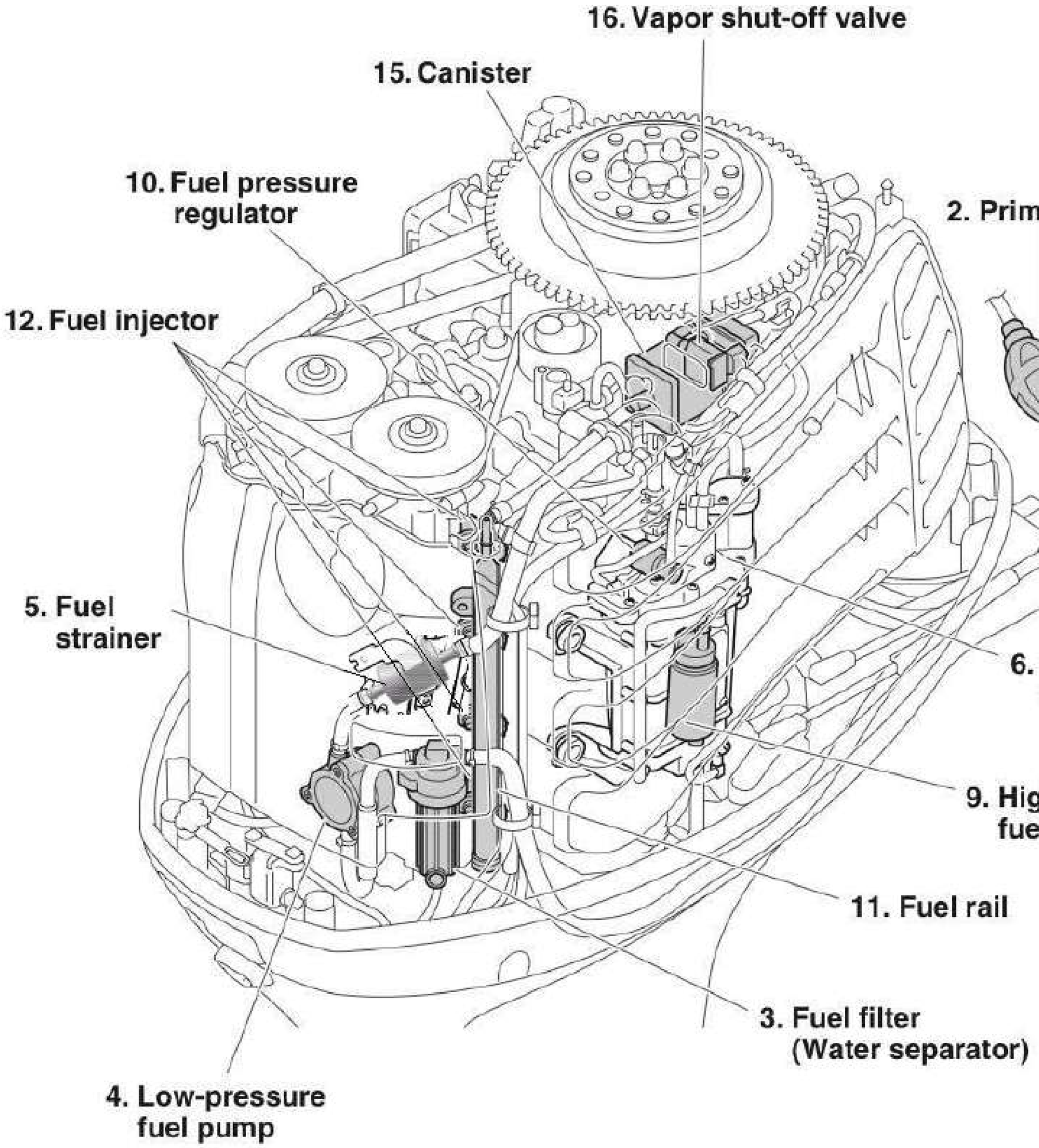


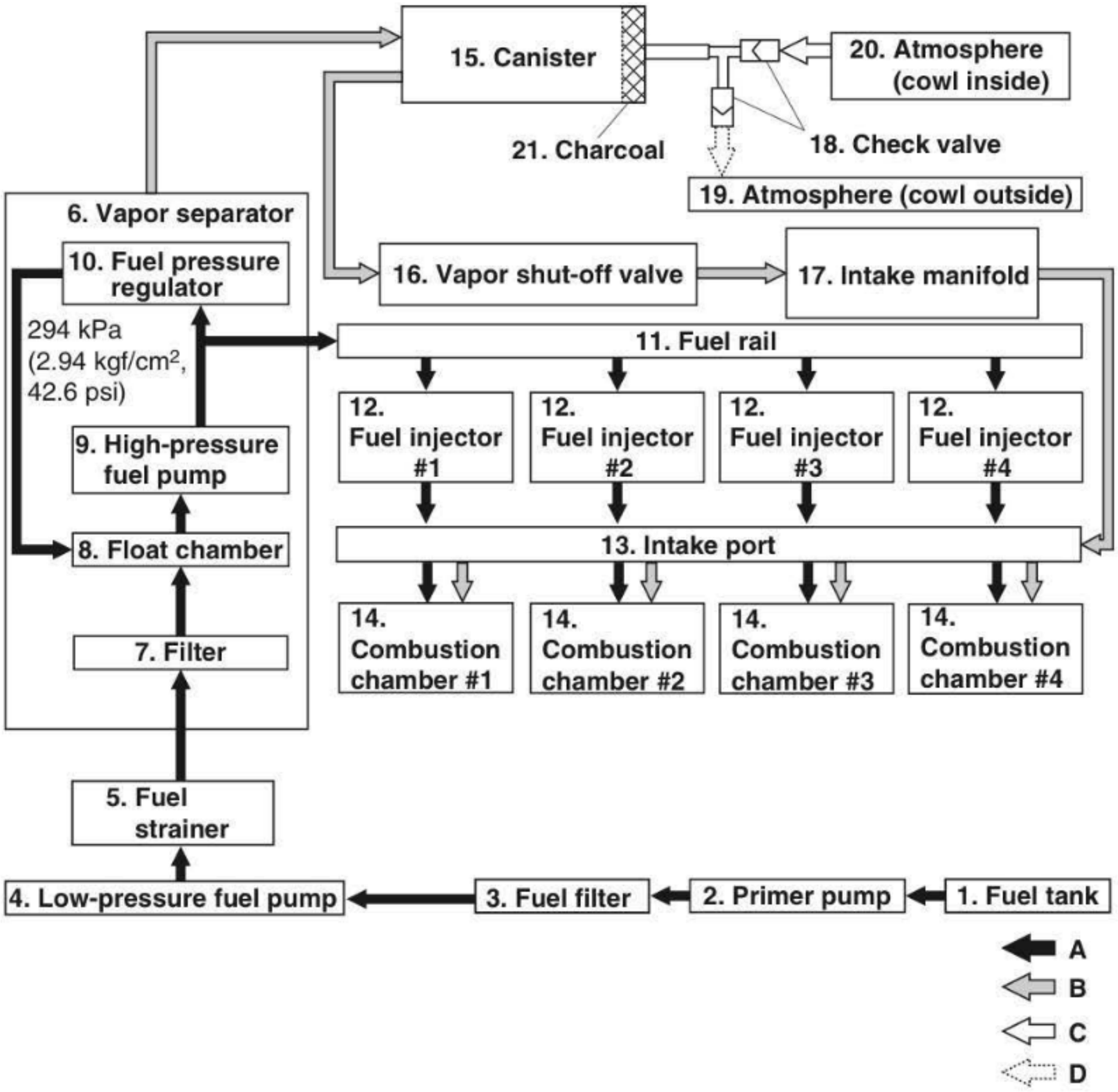
Fuel system

High-pressure fuelpump control

The high pressure fuel pump operates for 5 seconds after the engine start switch is turned to **ON**, and always operates while the engine is running.
The pump stops 1 second later after the engine stops.

Fuel diagram



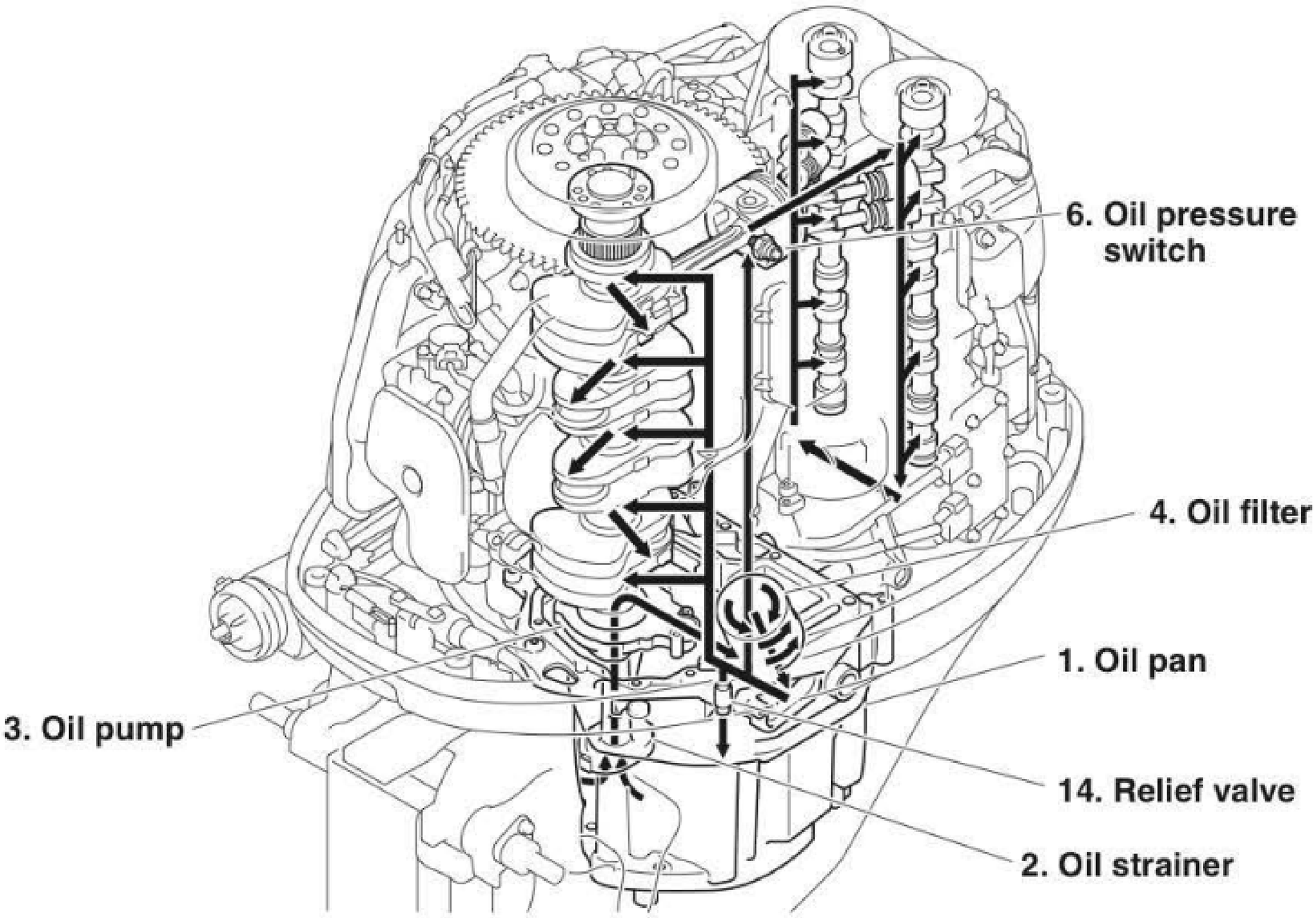


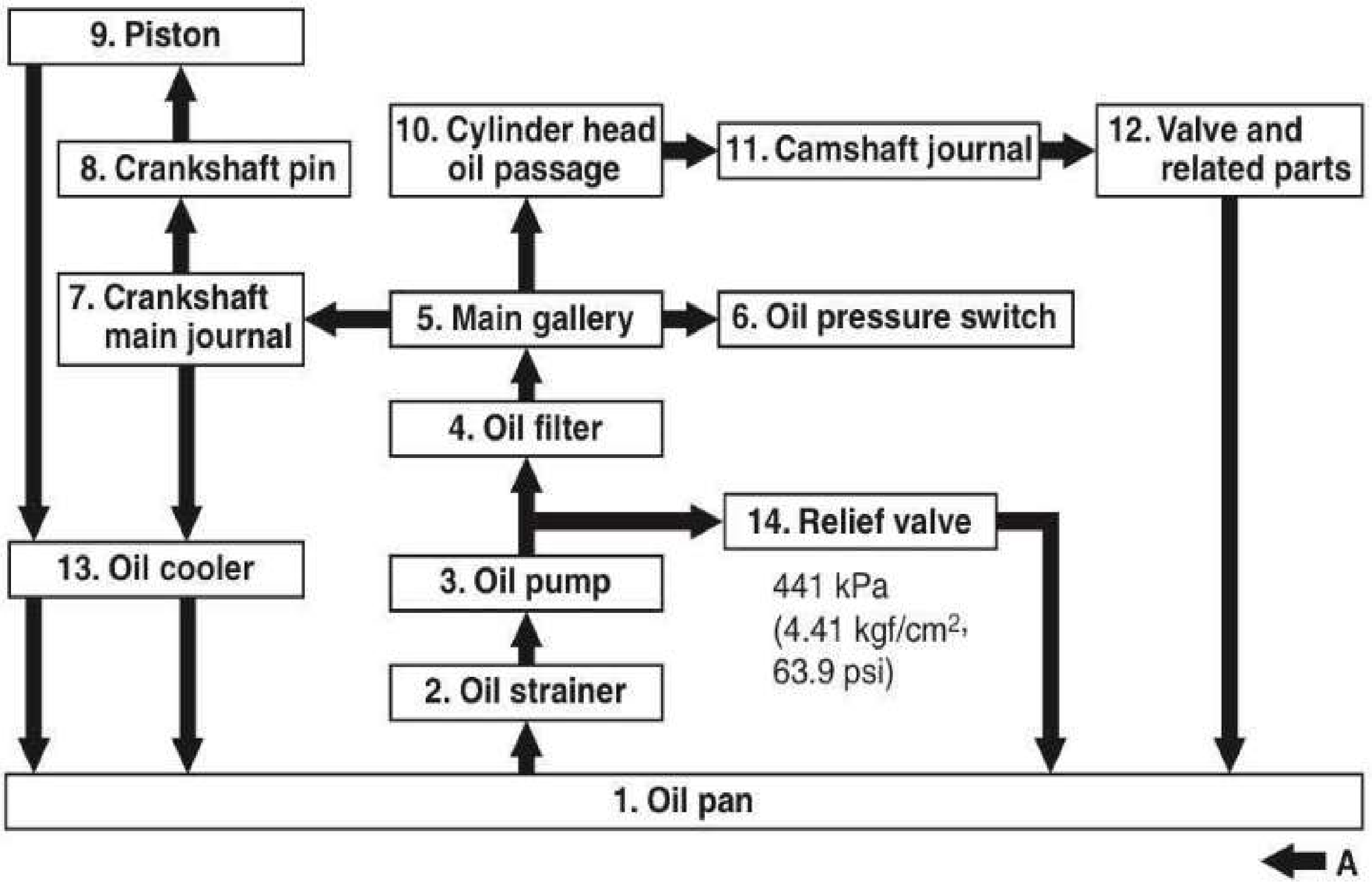
1. Fuel tank
2. Primer pump
3. Fuel filter (Water separator)
4. Low-pressure fuel pump
5. Fuel strainer
6. Vapor separator
7. Filter
8. Float chamber
9. High-pressure fuel pump
10. Fuel pressure regulator
11. Fuel rail
12. Fuel injector
13. Intake port
14. Combustion chamber
15. Canister
16. Vapor shut-off valve
17. Intake manifold
18. Check valve
19. Atmosphere (cowl outside)
20. Atmosphere (cowl inside)
21. Charcoal

A. Fuel flow
B. Vapor gas flow
C. Air flow
D. Purified gas flow

Lubrication system

Lubrication diagram



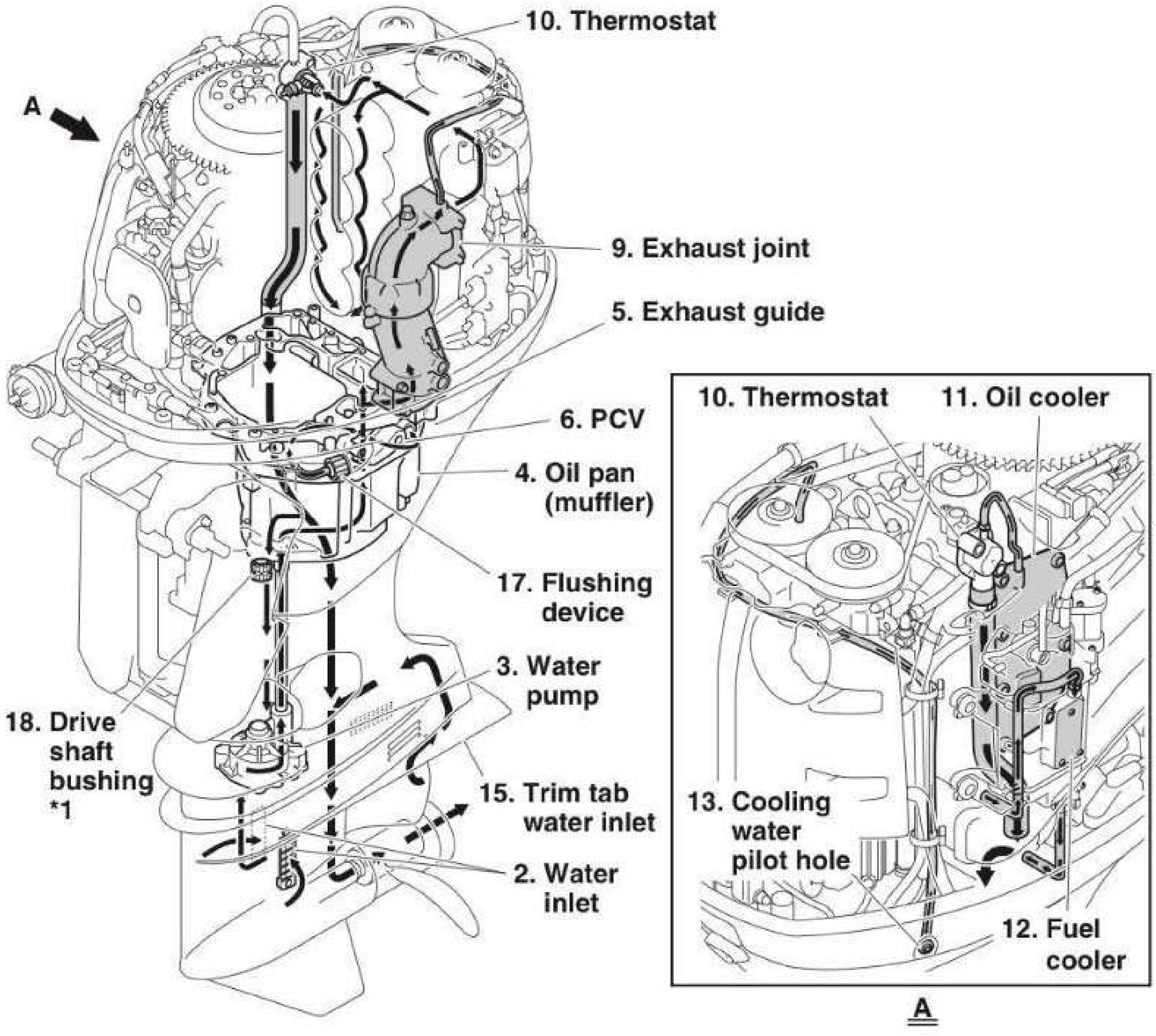


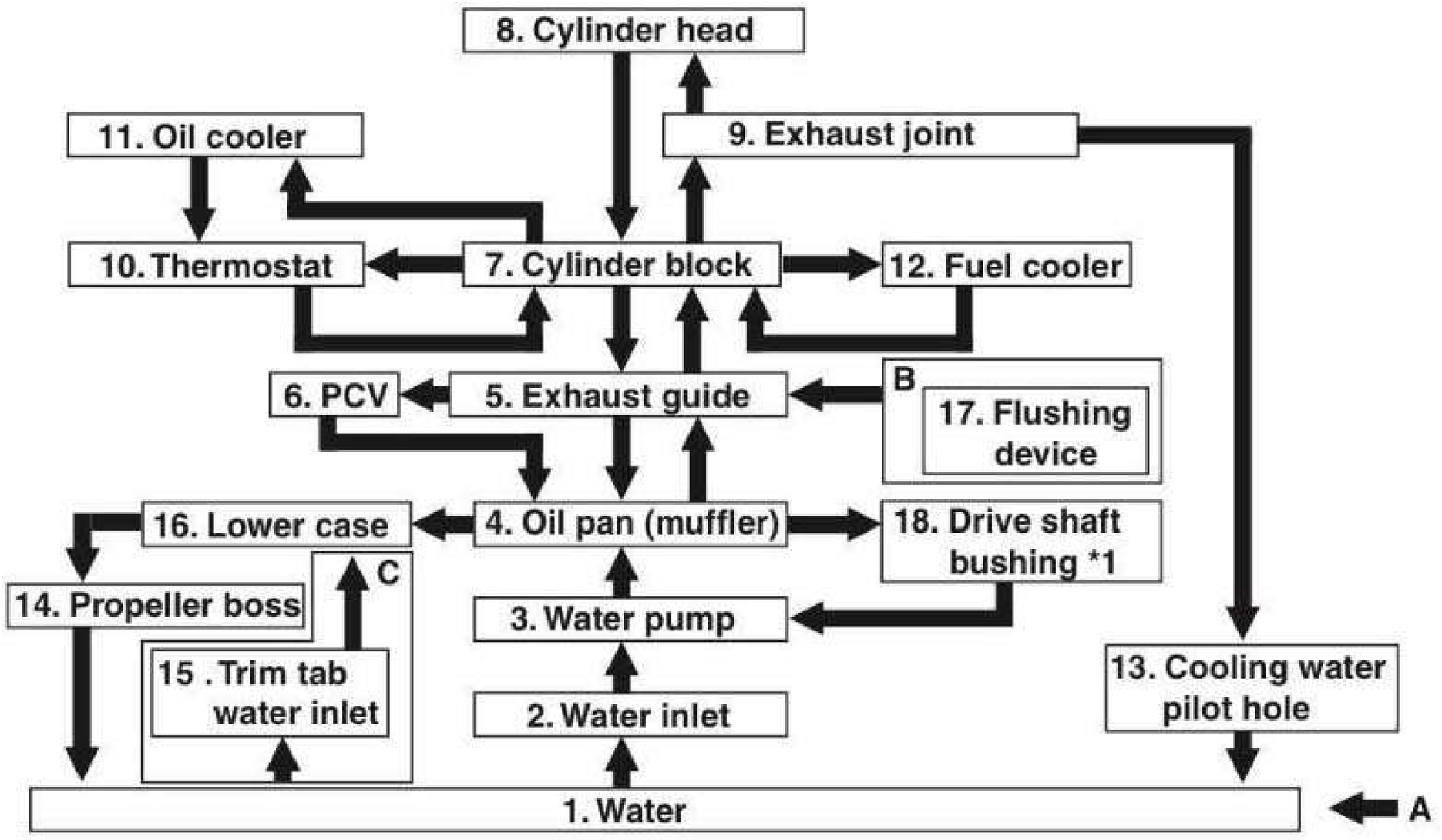
1. Oil pan
2. Oil strainer
3. Oil pump
4. Oil filter
5. Main gallery
6. Oil pressure switch
7. Crankshaft main journal
8. Crankshaft pin
9. Piston
10. Cylinder head oil passage
11. Camshaft journal
12. Valve and related parts
13. Oil cooler
14. Relief valve

A. Engine oil flow

Cooling system

Cooling diagram





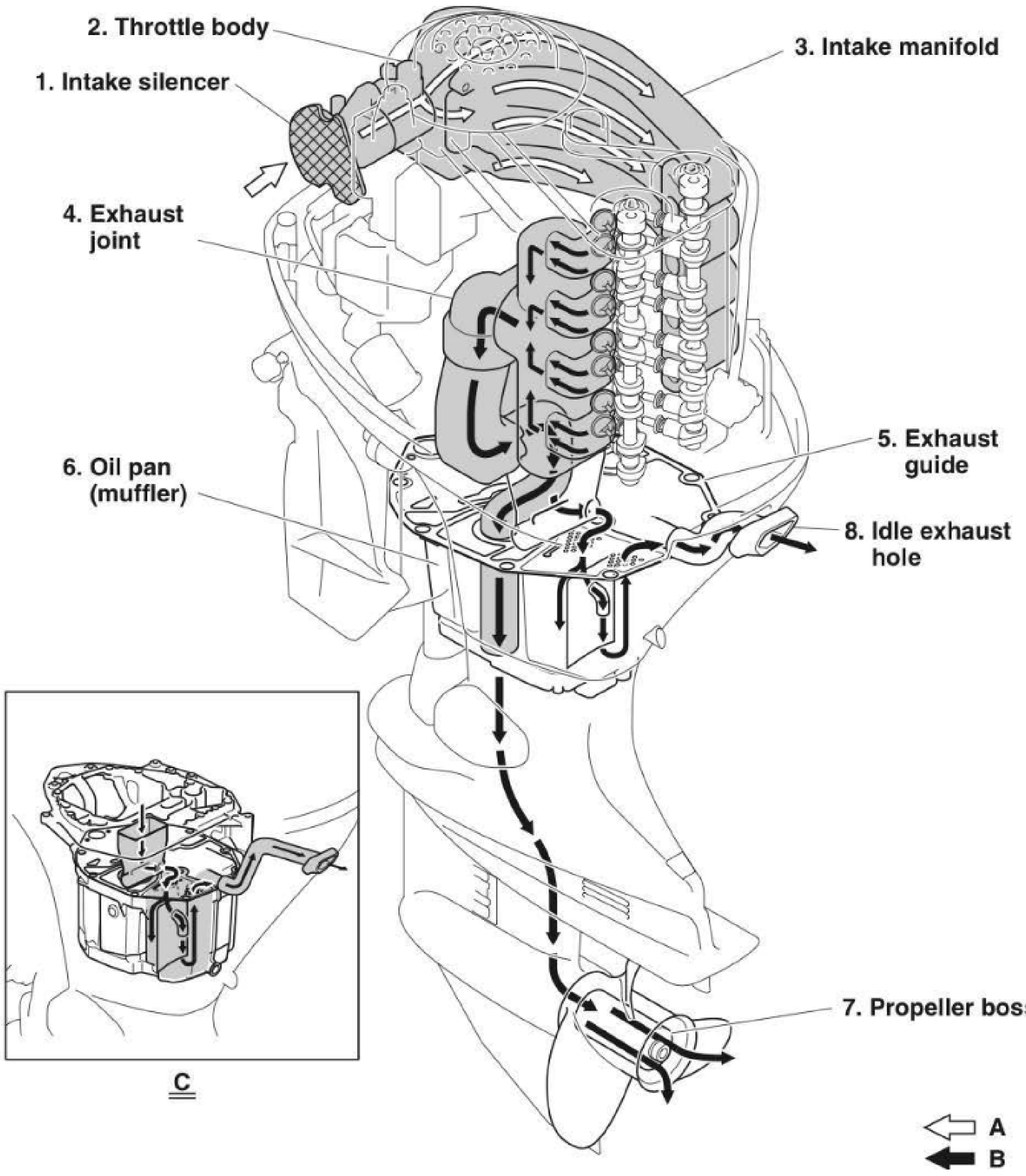
1. Water
2. Water inlet
3. Water pump
4. Oil pan (muffler)
5. Exhaust guide
6. PCV
7. Cylinder block
8. Cylinder head
9. Exhaust joint
10. Thermostat
11. Oil cooler
12. Fuel cooler
13. Cooling water pilot hole
14. Propeller boss
15. Trim tab water inlet
16. Lower case
17. Flushing device
18. Drive shaft bushing

A. Cooling water flow
B. When flushing the cooling water passages
C. Hydrodynamic water pressure for cooling the propeller boss damper

*1. X-transom model

Intake and exhaust system

Intake and exhaust diagram



1. Intake silencer
2. Throttle body
3. Intake manifold
4. Exhaust joint
5. Exhaust guide
6. Oil pan (muffler)
7. Propeller boss
8. Idle exhaust hole

A. Intake air flow
B. Exhaust gas flow
C. Labyrinth idle exhaust system

PTT unit

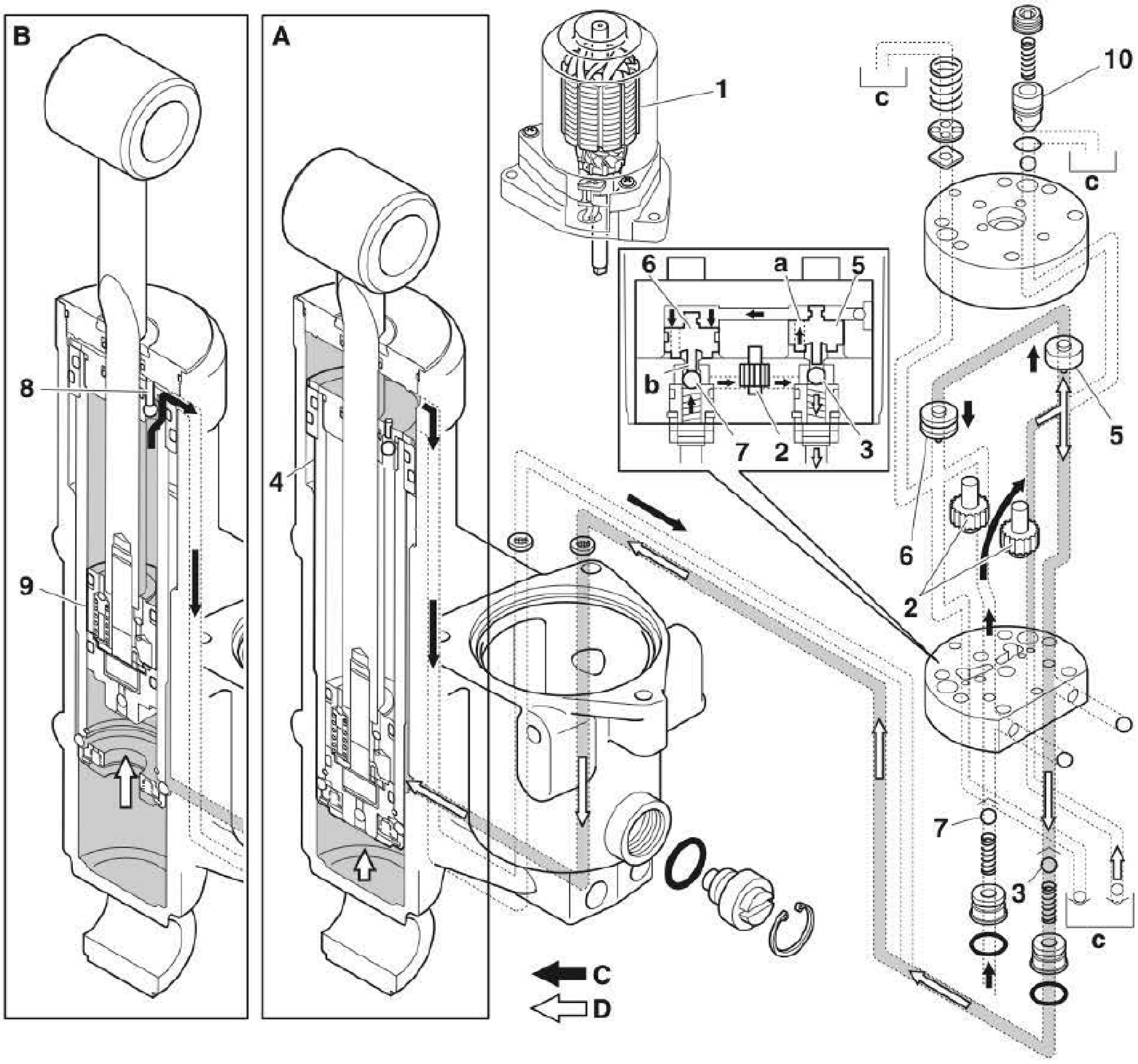
Trim-up and tilt-up function

Pushing the UP button on the PTT switch causes the PTT motor "1" to activate the gear pump "2", generating the PTT fluid pressure.

The PTT fluid passes through the check ball "3" within the send passage and flows into the lower chamber of the trim cylinder "4", and then the PTT fluid pressure pushes up the trim cylinder "4". This time, the PTT fluid passes through the one-way valve "a" within the up-main valve "5" and pushes the down-main valve "6". This causes the protrusion " b" on the down-main valve "6" to push the check ball "7" to open the return passage. As a result, the PTT fluid in the upper chamber of the trim cylinder passes through the down passage, returning to the gear pump.

The valve "8" opens when the trim cylinder is pushed to its upper extreme.

The PTT fluid pressure pushes up the tilt piston "9", and the PTT fluid in the upper chamber of the tilt cylinder passes through the return passage, returning to the gear pump "2". When the tilt-up operation is complete, the PTT fluid pressure increases causing the up-relief valve "10" to open, and the PTT fluid returns to the reservoir "c".



A. Trim range
B. Tilt range
C. Return passage
D. Send passage

Trim-down and tilt-down function

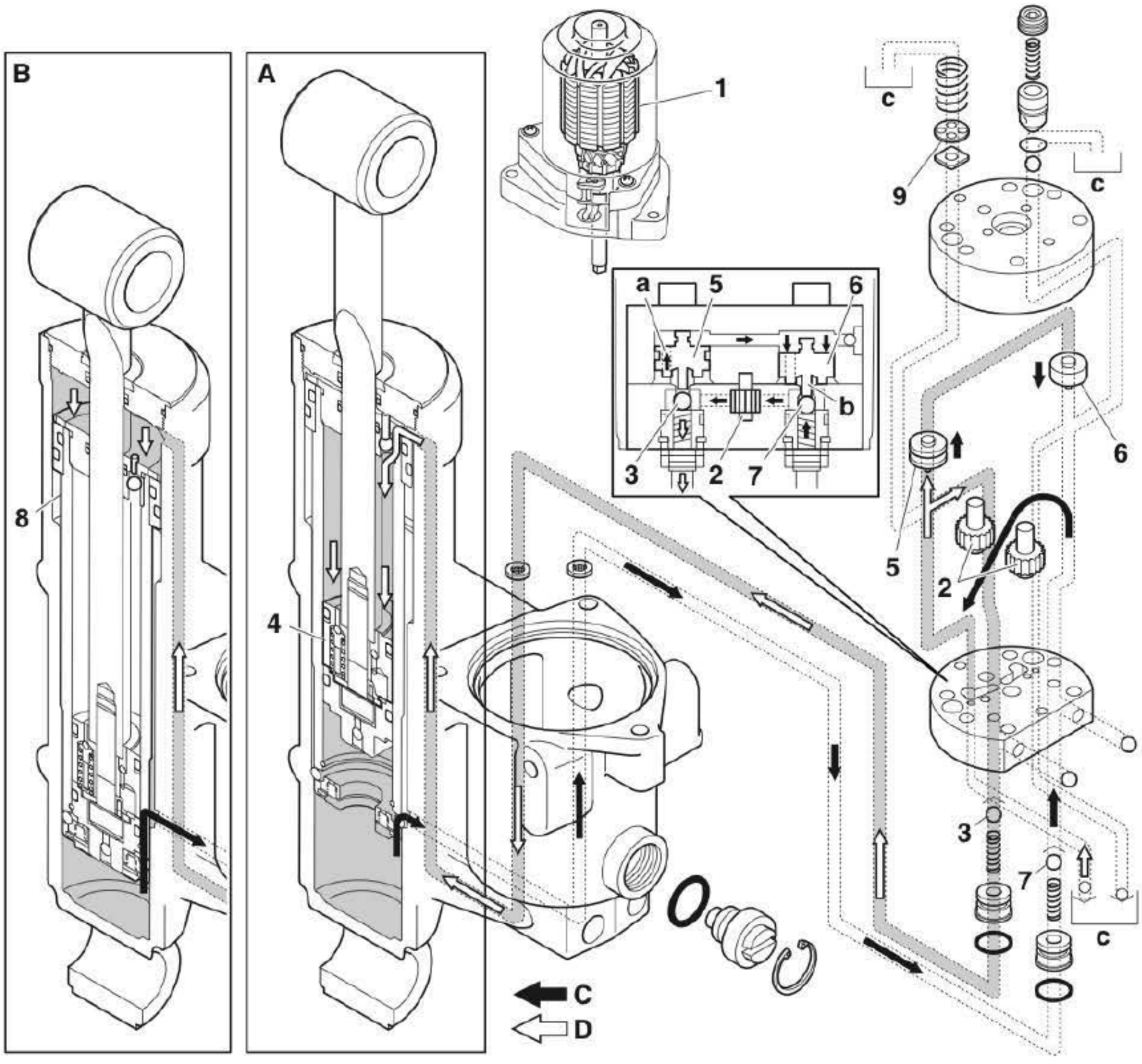
Pushing the ON button on the PTT switch causes the PTT motor "1" to activate the gear pump "2", (in the opposite direction to the trim/tilt up) generating the PTT fluid pressure.

The PTT fluid passes through the check ball "3" within the send passage and flows into the tilt cylinder, pushing down the tilt piston "4". This time, the PTT fluid passes through the one-way valve "a" within the down-main valve "5" and pushes the up-main valve "6". This causes the protrusion " b" on the up-main valve "6" to push the check ball "7" to open the return passage. As a result, the PTT fluid in the lower chamber of the tilt cylinder passes through the up passage, returning to the gear pump.

The trim cylinder "8" is pushed down when the tilt cylinder is filled with the PTT fluid.

The PTT fluid in the lower chamber of the trim cylinder passes through the return passage and returns to the gear pump "2".

When the tilt-down operation is complete, the PTT fluid pressure increases causing the down-relief valve "9" to open. The PTT fluid returns to the reservoir "c".



A. Tilt range
B. Trim range
C. Return passage
D. Send passage

Stationary condition

When the PTT operation is halted, the gear pump will not pump the PTT fluid, the up-main valve and down-main valve close due to the spring force, and thus the PTT fluid passage will be closed. As a result, the tilt piston stays in its current position.

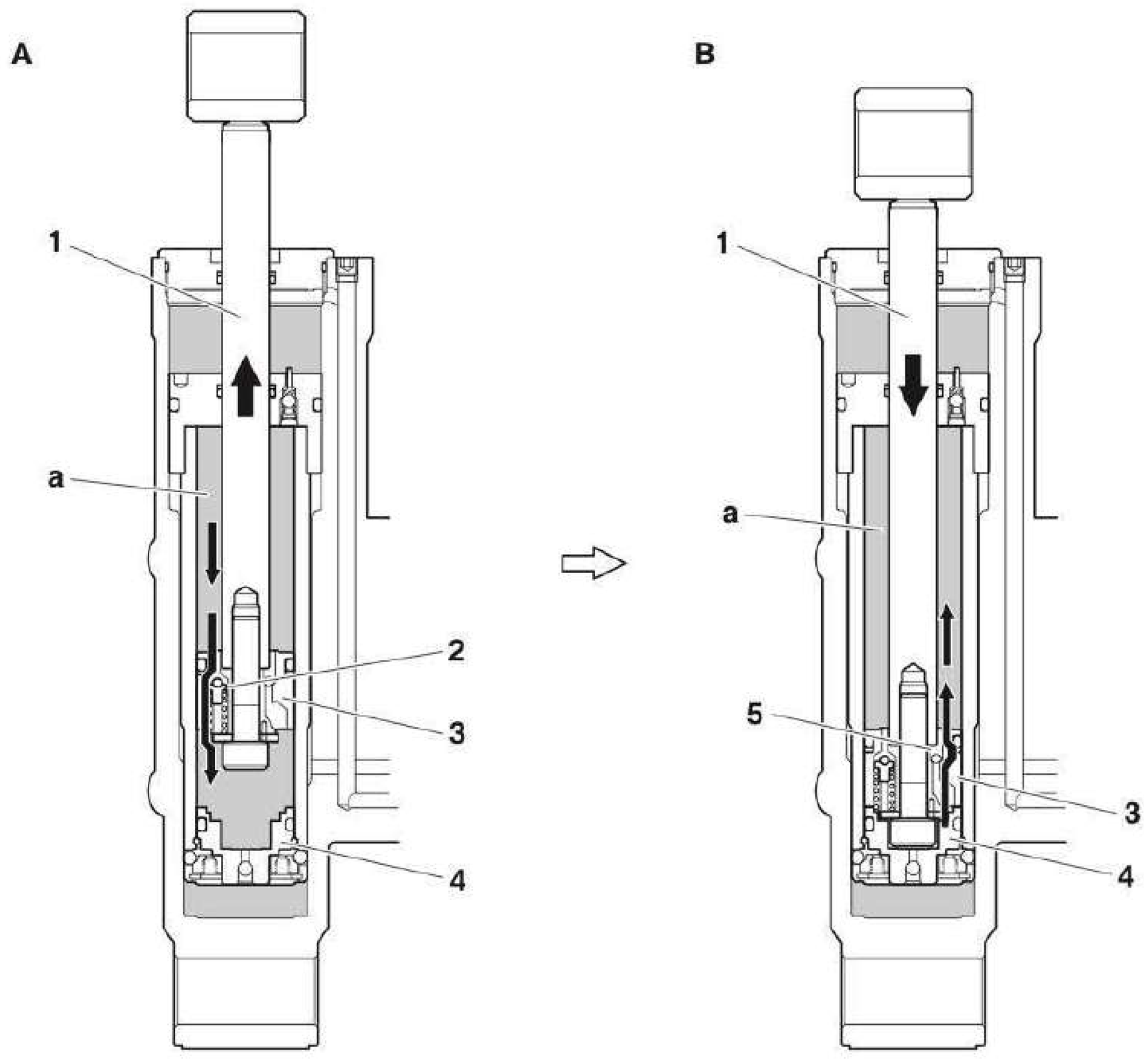
Shock-absorbing function

If the lower case strikes an obstacle while the boat is moving, a force causing the tilt rod "1" to extend will be applied. Because this force will cause the PTT fluid pressure in the tilt cylinder upper chamber "a" to increase, the tilt piston absorber valve "2" will open.

The PTT fluid enters the space between the tilt piston "3" and the free piston "4" extending the tilt rod "1".

The damping effect of the absorber valve stops the tilt piston before it reaches the top of the tilt cylinder.

After the collision with an obstacle, a force that directs the outboard motor to its original position is generated due to the weight of the outboard motor and the thrust of the propeller. The PTT fluid enters the tilt cylinder upper chamber "a" through the shock return valve "5" in the tilt piston "3". As the free piston "4" is not moving, the tilt rod "1" stops when it contacts the free piston "4" and returns to its original tilted position.



A. Fluid flow when the outboard motor strikes an obstacle.

B. Fluid flow when the outboard motor returns to the original position.

Additional features

H-COP

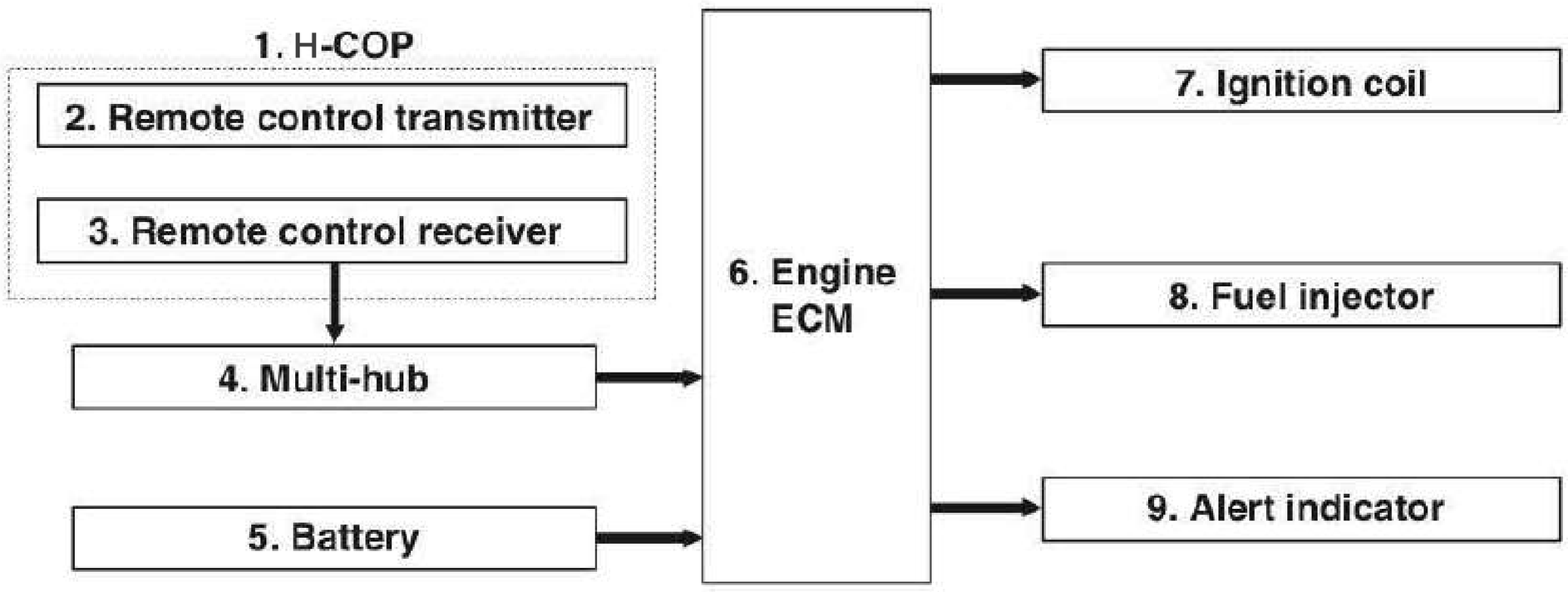
H-COP consists of a remote control transmitter and a remote control receiver. The remote control receiver transmits an authorization 10 to the engine ECM. Pushing the lock and unlock buttons on the remote control transmitter causes the remote control receiver to recognize the lock and unlock state, and to send data to the engine ECM. The locked or unlocked state is maintained even when the battery switch is turned to OFF. If an authorization 10 is not received or if the transmitted authorization 10 does not match the registered 10 in the engine ECM, the remote control receiver cannot perform data communication with the engine ECM.

NOTICE

Installation location requires special attention to avoid electrical interference, obstructions, or water exposure.

TIP:

- The receiver can register up to 5 transmitters.
- Additional transmitters cannot be registered if none of the transmitters is functioning properly.
- The transmitter and receiver function within a distance of approximately 3 m (10ft).



1. H-COP
2. Remote control transmitter
3. Remote control receiver
4. Multi-hub
5. Battery
6. Engine ECM
7. Ignition coil
8. Fuel injector
9. Alert indicator

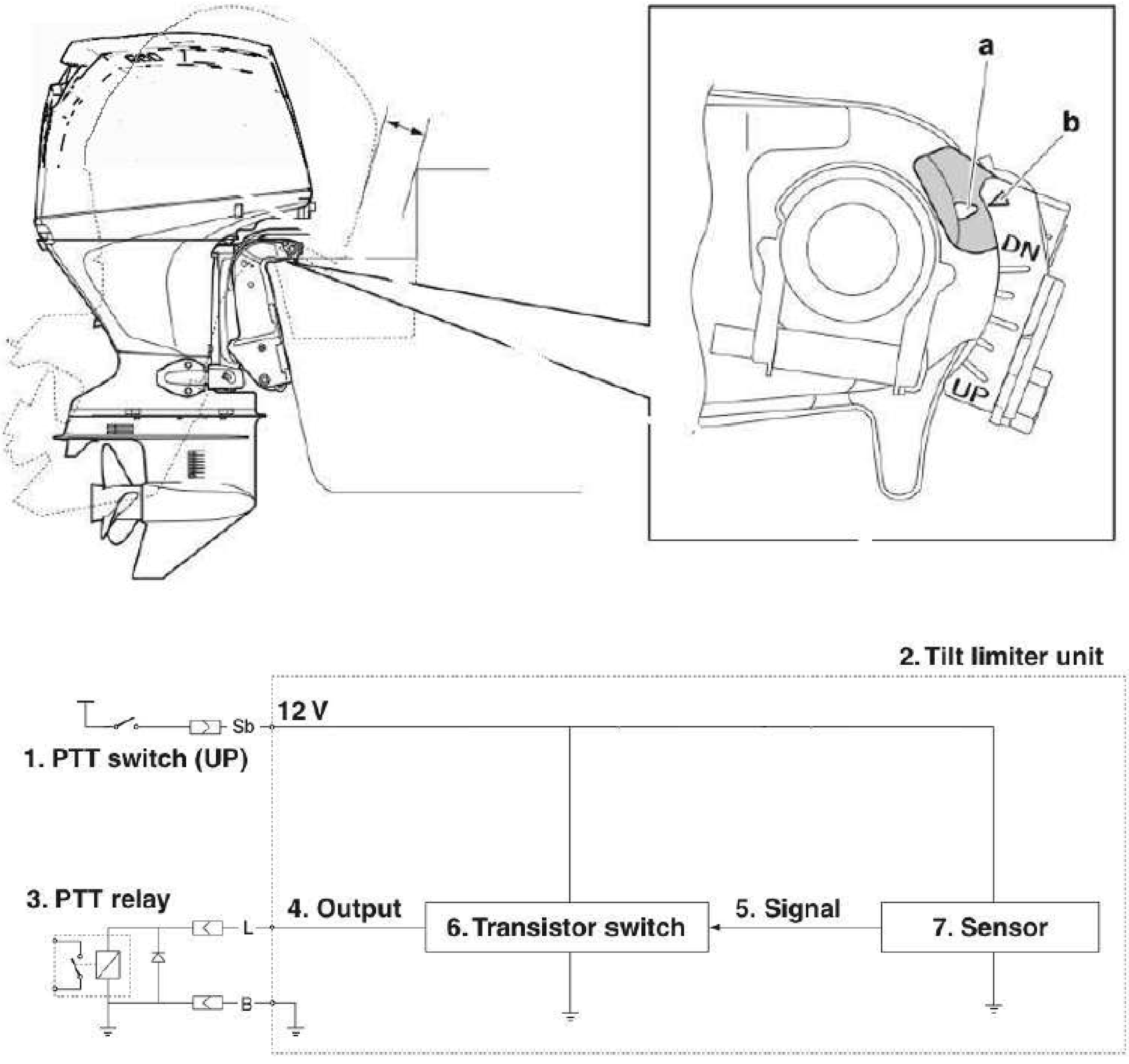
State	Operation
Unlocked	Normal
Locked	Stops fuel injection and ignition, and prevents the engine from starting.
Communication error, improper wiring connection	The engine will start, but engine speed is limited to 2000-3500 r/min. Outputs a trouble code 86.

Tilt limiter (optional)

The optional tilt limiter allows the tilt-up action to be halted at a set angle, preventing the outboard motor from coming into contact with the motor well when tilted up.
This tilt limiter consists of a magneto affixed to a through tube, and a sensor on a swivel bracket.
The movement of the swivel bracket when tilting the outboard motor up will move the sensor position. When the mark "a" on the magneto is aligned with the mark " b" on the sensor, power to the PTT for tilting the outboard motor up will be cut off.

TIP:

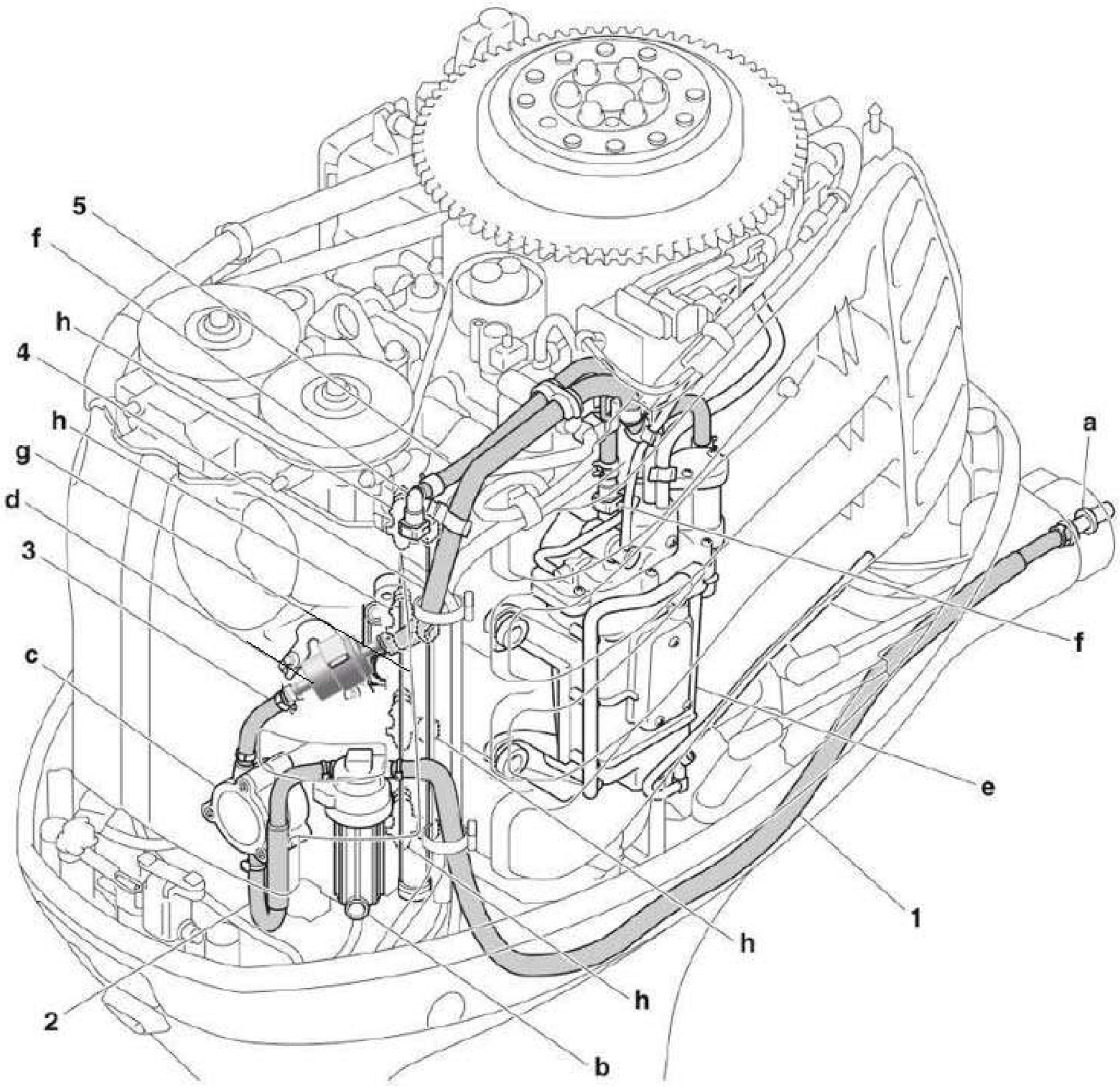
The set angle can be exceeded if the motor hits an obstruction in the water or when manually raising the motor by opening the PTT manual release valve.



1. PTT switch (UP)
2. Tilt limiter unit
3. PTT relay
4. Output
5. Signal
6. Transistor switch
7. Sensor

Hose routing

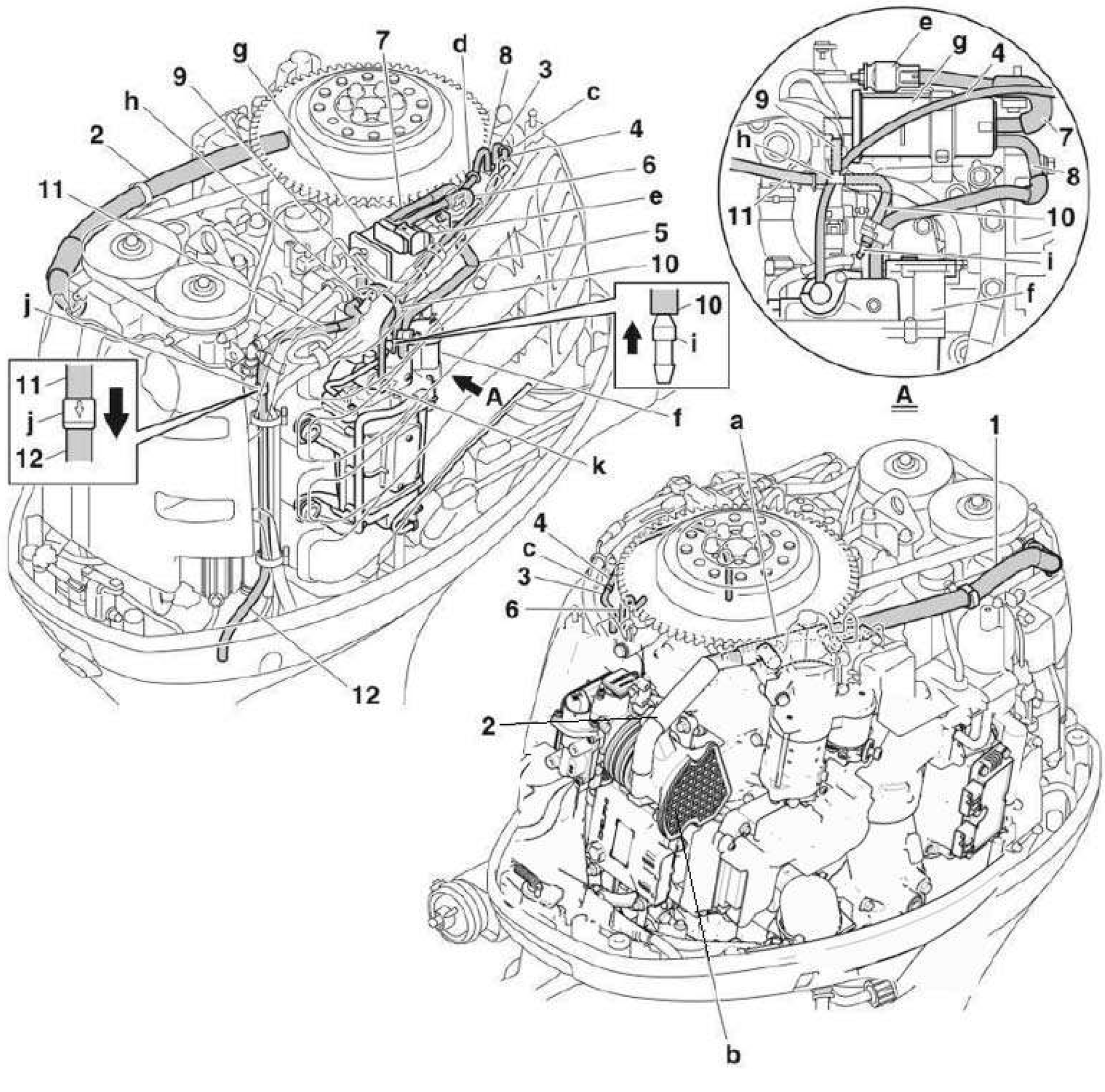
Fuel hose



1. Fuel hose (joint to fuel filter assembly)
2. Fuel hose (fuel filter assembly to fuel pump)
3. Fuel hose (low-pressure fuel pump to fuel strainer)
4. Fuel hose (fuel strainer to vapor separator)
5. Fuel hose (vapor separator to fuel rail)

a. Joint
b. Fuel filter assembly
c. Low-pressure fuel pump
d. Fuel strainer
e. Vapor separator
f. Quick connector
g. Fuel rail
h. Fuel injector

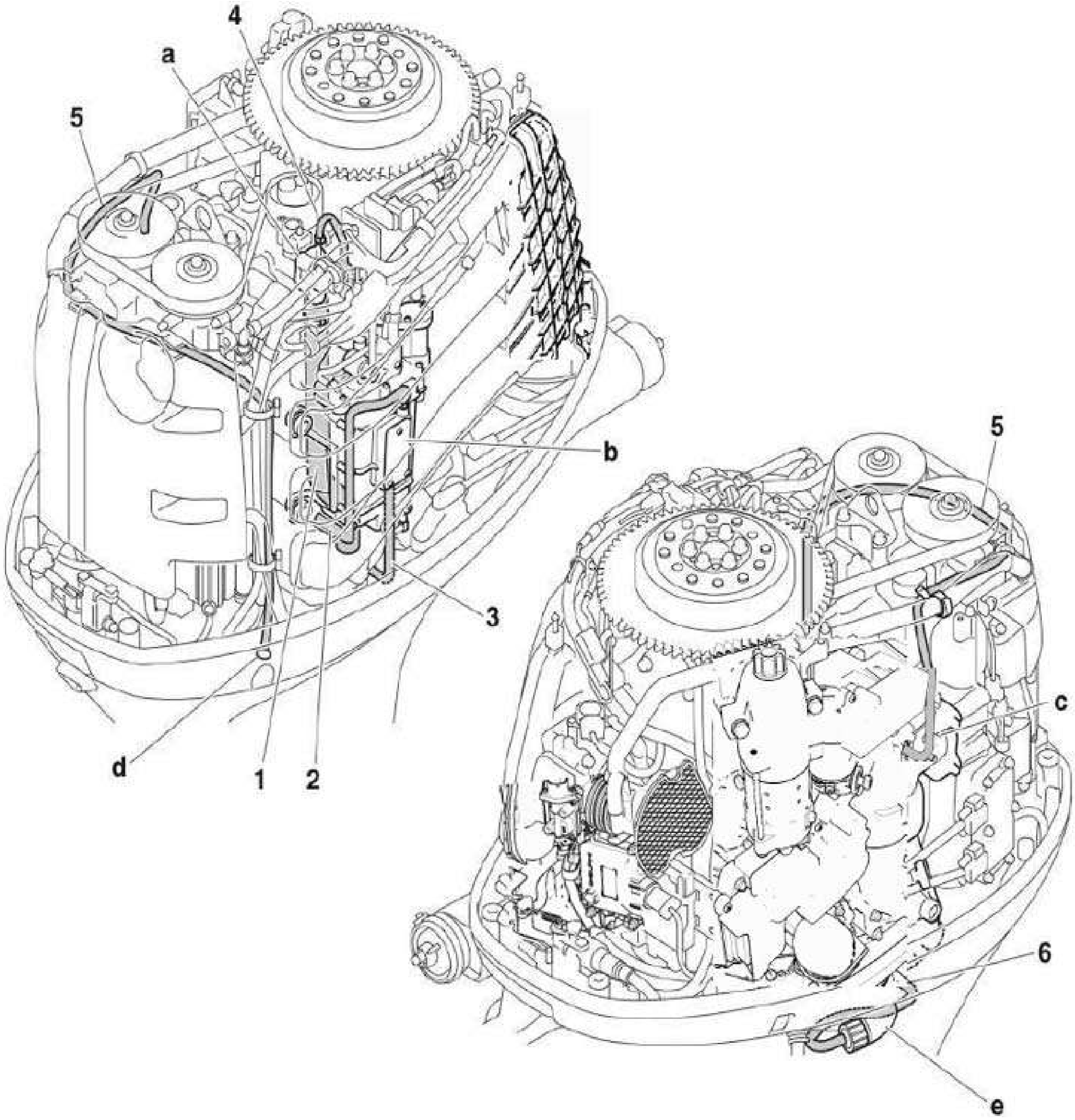
Pressure regulator hose, vapor gas hose, and blowby hose



1. Blowby hose (cylinder head cover to starter motor bracket)
2. Blowby hose (starter motor bracket to intake silencer)
3. Pressure regulator hose (intake manifold to joint)
4. Pressure regulator hose (joint to pressure regulator)
5. Vapor gas hose (vapor separator to canister tank port)
6. Vapor gas hose (canister purge port to vapor shut-off valve)
7. Vapor gas hose (vapor shut-off valve to joint)
8. Vapor gas hose (joint to intake manifold)
9. Vapor gas hose (canister to joint)
10. Vapor gas hose (joint to check valve)
11. Vapor gas hose (joint to check valve)
12. Vapor gas hose (check valve to bottom cowling)

a. Starter motor bracket
b. Intake silencer
c. Joint
d. Joint
e. Vapor shut-off valve
f. Vapor separator
g. Canister
h. Joint
i. Check valve
j. Check valve
k. Pressure regulator

Cooling water hose



1. Cooling water hose (thermostat cover to cylinder block)
2. Cooling water hose (cylinder block to fuel cooler)
3. Cooling water hose (fuel cooler to cylinder block)
4. Cooling water hose (oil cooler to thermostat cover)
5. Cooling water hose (exhaust joint to cooling water pilot hole)
6. Cooling water hose (flushing hose adapter to exhaust guide)

a. Thermostat cover
b. Fuel cooler
c. Exhaust Joint
d. Cooling water pilot hole (on the bottom cowling)
e. Flushing hose adapter

Rigging information

Important reminder on rigging 3-1

Outboard motor mounting instructions 3-1

Crate handling 3-2

Crate top cover pictograph description 3-2

Uncrating 3-3

Uncrating procedure **3-3**

Outboard motor mounting 3-4

Installing the outboard motor 3-4
Outboard motor mounting height 3-7
Adjusting the twin engine positions 3-7

Rigging grommet mounting 3-8

Rigging grommet description 3-8
Installing the main wire harness 3-8
Installing the battery cable 3-8
Installing the shift cable 3-9
Installing the throttle cable 3-10
Installing the 6Y8 multifunction meter harness (pigtail bus wire) **3-11**
Installing the conventional gauge (6Y5/6Y7) harness 3-12
Installing the rigging grommet 3-13

Tiller handle 3-13

Installing the tiller handle 3-13
Installing the friction plate 3-15

Optional equipment 3-16

Installing the water pressure sensor (6Y8 Multifunction Meters) 3-16
Installing the speed sensor (6Y8 Multifunction Meters) 3-17
Installing the tilt limiter 3-19
Setting the tilt limiter 3-20
Deactivating the tilt limiter 3-22
Installing the twin engine tie-bar with steering cable 3-22

Rigging information

H-COP 3-23

Installing H-COP **3-23**
Registering the remote control receiver ID to the ECM..... 3-23

Battery installation 3-25

Battery wiring **3-25**

System diagram..... 3-29

Single engine application (6Y8 Multifunction Meters) 3-29
Single engine application (conventional gauge) 3-31
Twin engine application (6Y8 Multifunction Meters) 3-33
Twin engine application (conventional gauge) 3-37

Rigging recommendation..... 3-39

Battery cable length..... 3-39
Extension length recommendation for battery cable 3-39

Propeller selection 3-41

Propeller size..... **3-41**
Selection..... **3-41**

Important reminder on rigging

Outboard motor mounting instructions

⚠ 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.

⚠ WARNING

Too much weight on the transom can change the center of gravity, buoyancy, operating balance, or performance of the boat, 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 an outboard motor that is too heavy could also damage the hull, transom, deck, or helm area, as well as the outboard motor and other equipment.

⚠ WARNING

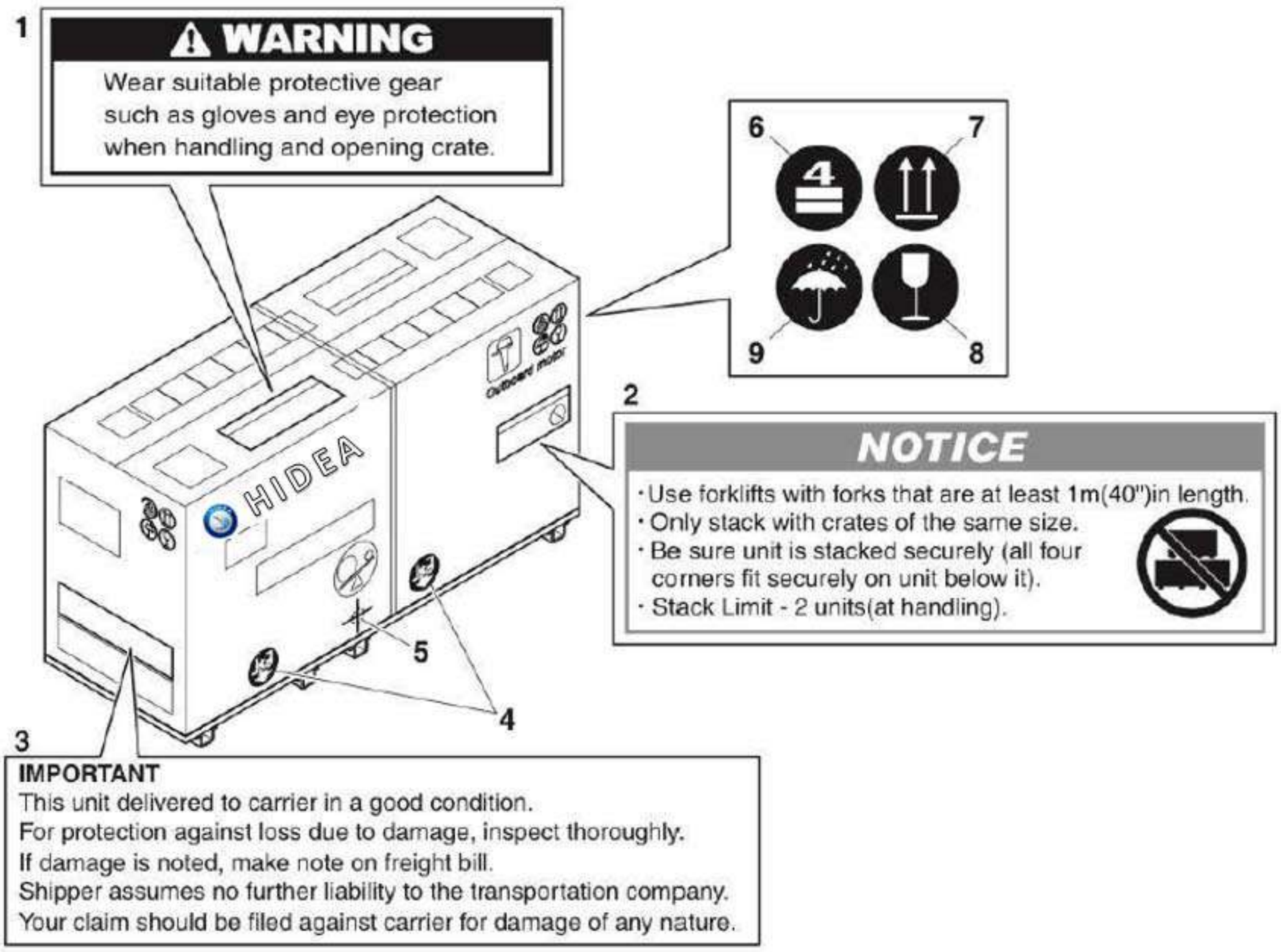
Before mounting the outboard motor, consult the manufacturer of the engine jack plates or brackets. Excessive loads could damage the engine jack plates, brackets, boat transom, steering system, or engine. These damages could cause loss of control.

Crate handling

Crate top cover pictograph description

The following pictographs are important when handling the crate.

Read the notice and understand what each pictograph means to prevent damage to the outboard motor when handling, transporting, and storing the crate.



1. ⚠ WARNING

Wear suitable protective gear such as gloves and eye protection when handling and opening crate.

2. NOTICE

- Use forklifts with forks that are at least 1 m (40 in) in length.
- Only stack with crate of the same size.
- Be sure unit is stacked securely (all four corners fit securely on unit below it).
- Stack Limit- 2 units (at handling).

3. IMPORTANT

This unit delivered to carrier in a good condition.

For protection against loss due to damage, inspect thoroughy.

If damage is noted, make note on freight bill.

Shipper assumes no further liability to the transportation company.

Your claim should be filed against carrier for damage of any nature.

4. Lifting fork insert position
5. Crate barycentric position
6. Stack limit: Maximum 4 units for storage
7. Upward indication
8. Care handling indication
9. Water avoidance indication

Uncrating

Uncrating procedure

⚠ WARNING

Wear gloves to avoid injury from sharp steel edges while uncrating.

1. Check the crate for shipping damage. If any damage is found, consult your Hidea agency.

2. Cut the strap, and then remove the top cover.

3. Remove all of the bolts from the bottom plate, and then remove the frame.

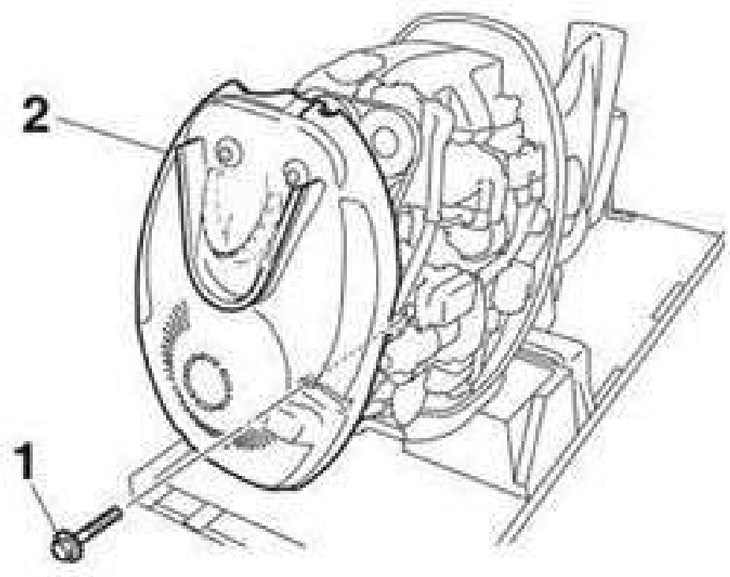
NOTICE

Be careful not to damage the outboard motor.

4. Remove the wrapping, and then check the outboard motor for concealed damage. If any damage is found, consult your Hidea agency.

5. Remove the top cowling.

6. Remove the bolt "1", and then remove the flywheel magneto cover "2".



7. Attach the special service tool "1" to prevent the flywheel magneto from turning.

TIP:

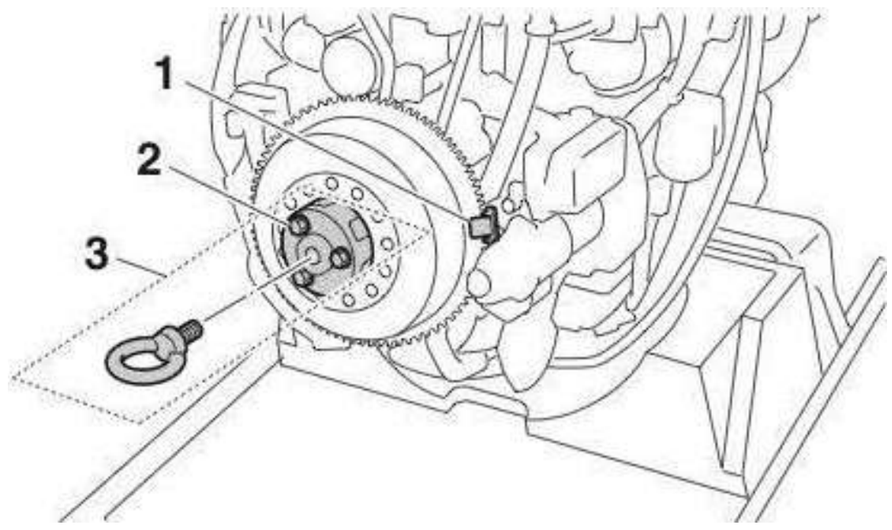
The special service tool "1" is installed to tighten the lifting eye bolt "2" to the specified torque.

8. Install the special service tool "3" to the flywheel magneto, and then tighten the lifting eye bolts "2" to the specified torque.

NOTICE

When lifting the outboard motor, make sure to use the specified special service tool. Other bolts and hanging jigs could bend or break, causing the outboard motor to fall.

9. Remove the special service tool "1" from the flywheel magneto.

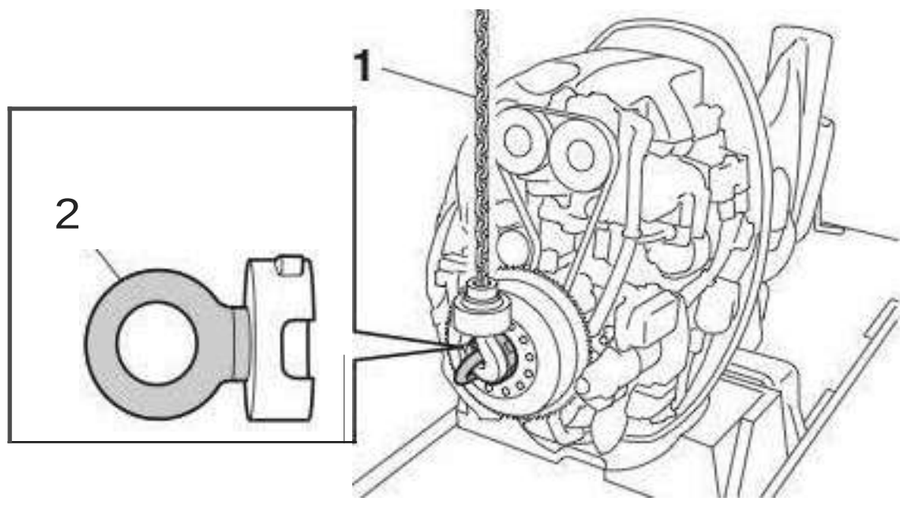


Flywheel stopper B "1"
Flywheel stopper B "1"
Engine lifting eye "3"
Engine lifting eye "3"

Lifting eye bolt "2" 36 Nm (3.6 kgf·m, 26.6 ft·lb)

10. Install the lifting harness "1" to the eye bolt "2".

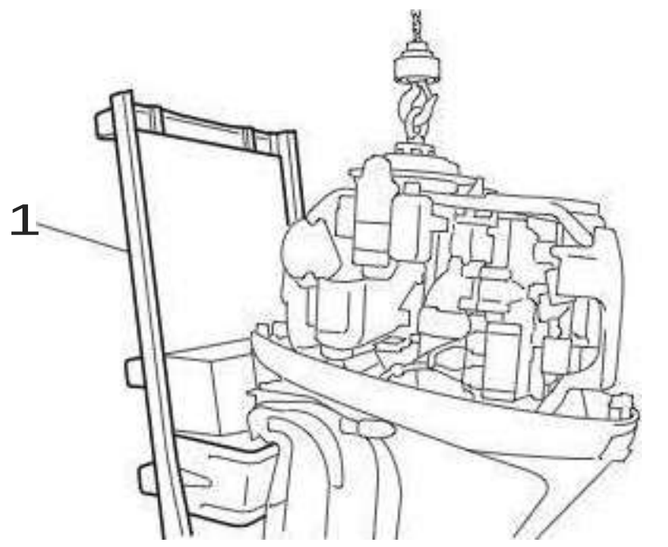
11. Apply tension to the lifting harness.



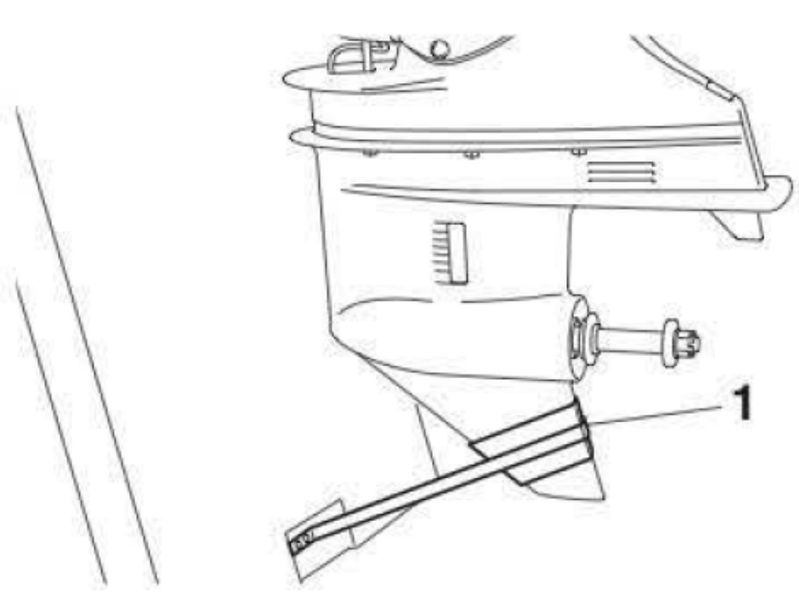
12. Lift up the outboard motor carefully along with the bottom frame "1".

NOTICE

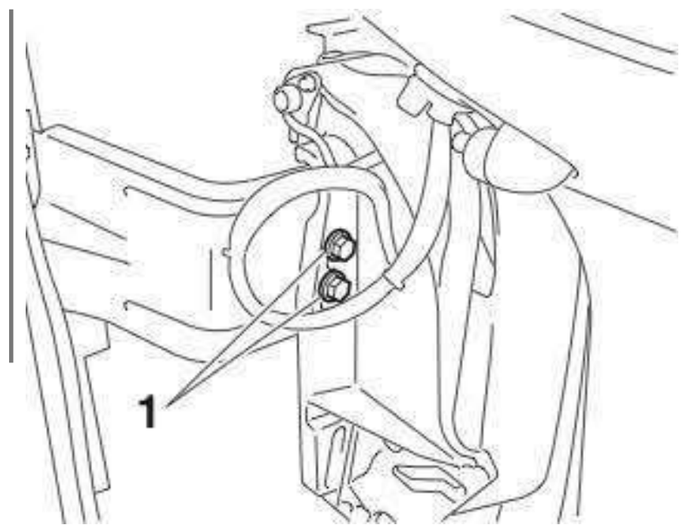
Make sure that the lifting harnesses do not damage any parts of the outboard motor.



13. Remove the skeg holder "1".



14. Remove the bolts "1".



15. Remove the steering retainer, and then install a hydraulic steering cylinder or steering cable following the recommendation of the manufacturer.

16. For the procedure of outboard motor

board motor" (3-4).

17. Remove the lifting harness and special service tool, and then install the flywheel magneto cover and top cowling.

Outboard motor mounting

Installing the outboard motor

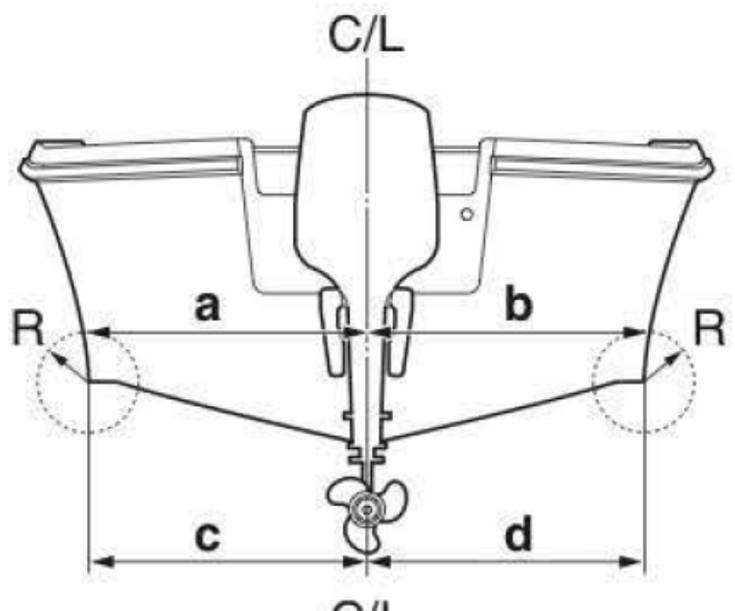
Proper mounting of the outboard motor provides better performance, maximum reliability, and the highest customer satisfaction. This chapter contains the specifications necessary to mount the outboard motor, and may vary slightly depending on the applications. When mounting the outboard motor, make sure that there is sufficient clearance for the outboard motor to fully tilt up, and to fully move to port and starboard. See "External dimensions" (1-17).

1. For single engine application, place the outboard motor on the vertical centerline of the boat transom.

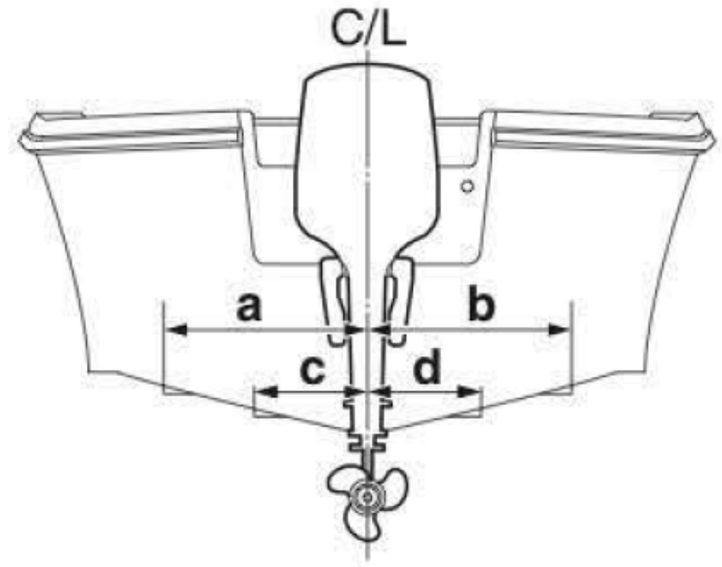
TIP:

Make sure that distance "a" is equal to distance "b", and distance "c" is equal to distance "d".

A



B



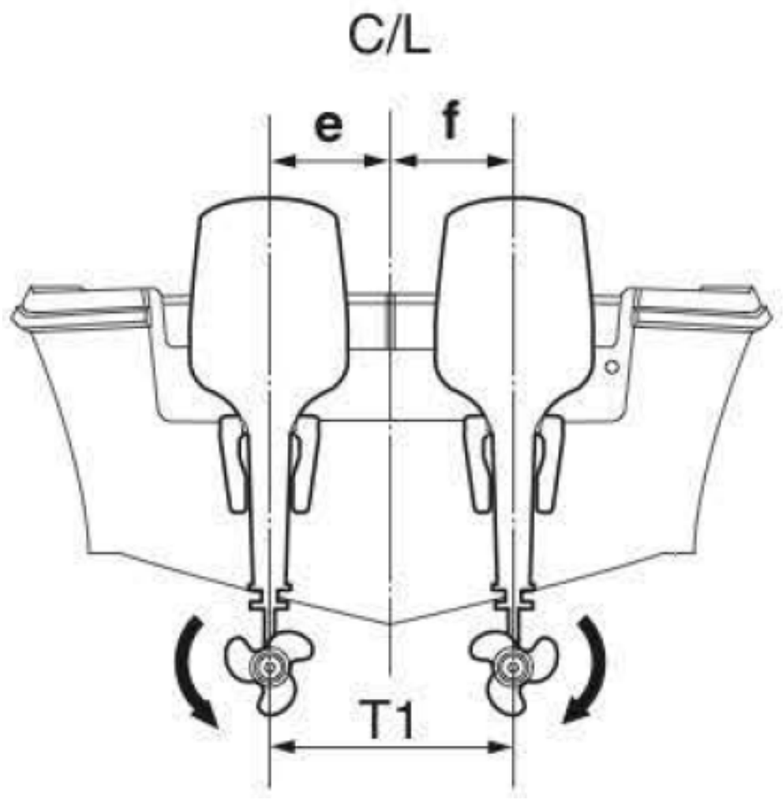
A. Hull without strakes
B. Hull with strakes

C/L: Centerline of the transom
R: Radius

For twin engine application, place the outboard motors so that the distance from the C/L of each outboard motor to the C/L of the boat transom are equal on both sides.

TIP:

- Make sure that distance "e" is equal to distance "f".
- For the distance (T1), see "External dimensions" (1-17).



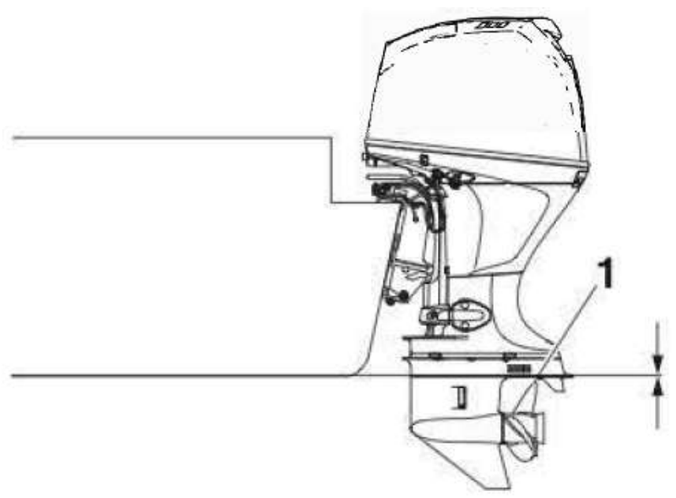
C/L: Centerline of the transom

2. Adjust the position of the outboard motor so that the height of the anti-cavitation plate "1" is equal to or slightly above the bottom of the boat transom.

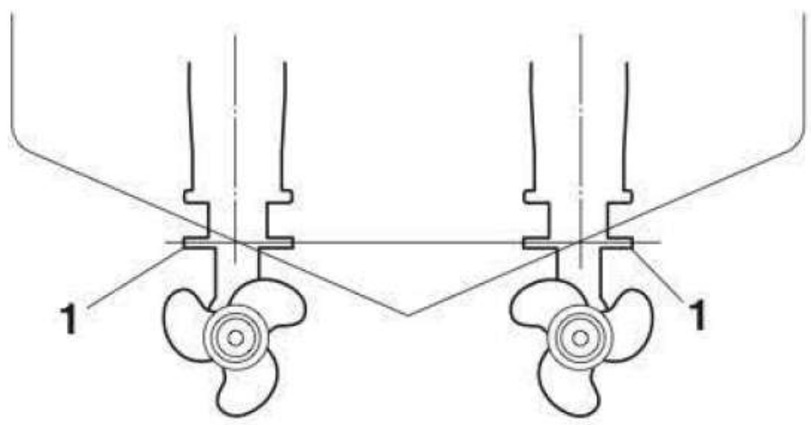
TIP:

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

A



B



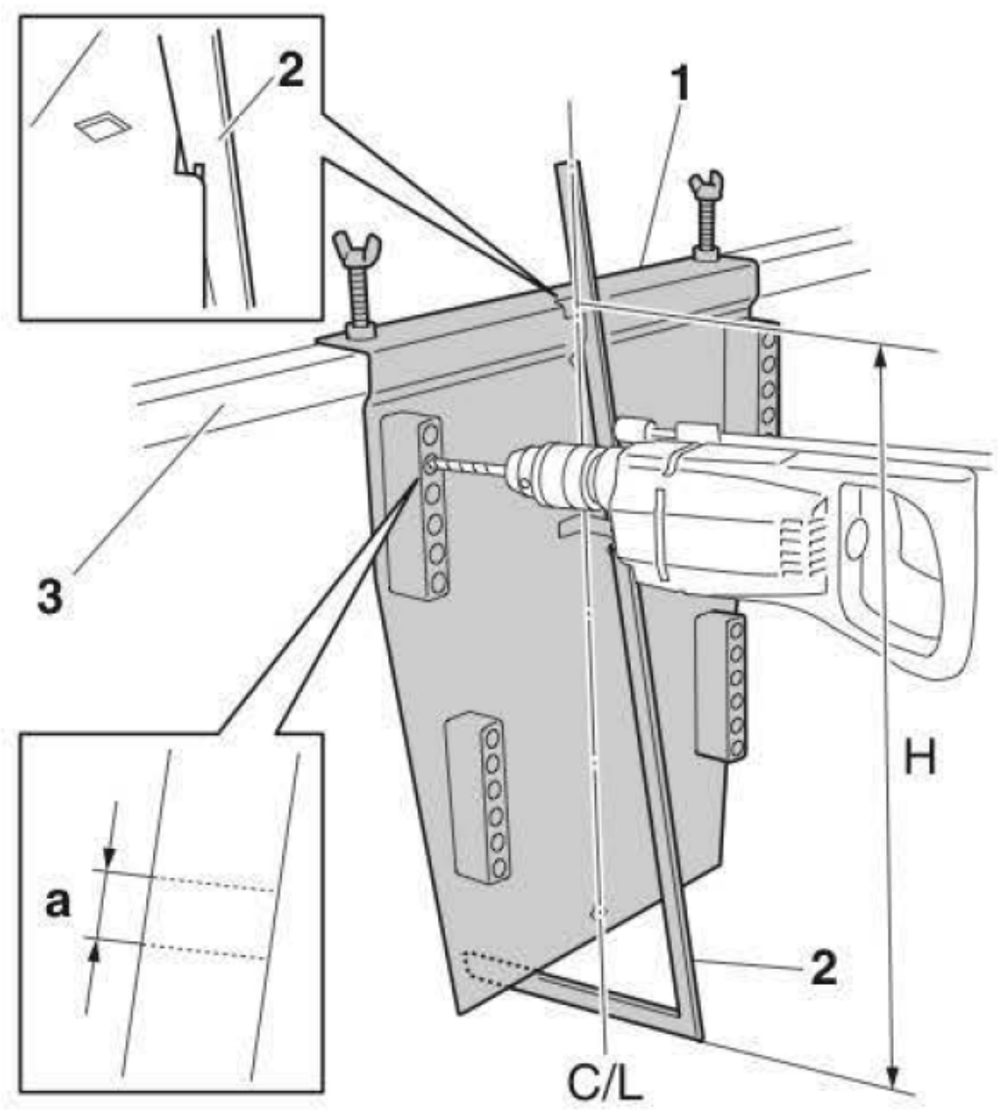
A. Single engine application
B. Twin engine application

3. Install the special service tool "1".

4. Adjust the height of the scale "2" to the transom height (H), and place it on the special service tool "1". Secure the special service tool "1" to the boat transom using screws or vises.

TIP:
For the transom height (H), see "External dimensions" (1-17).

5. When the outboard motor mounting position has been determined, mark the best suited 4 symmetrical mounting holes on the boat transom "3". Drill the mounting holes perpendicular to the surface of the boat transom using a 13.0 mm (0.5 in) "a" Drill bit.



C/L: Centerline of the transom

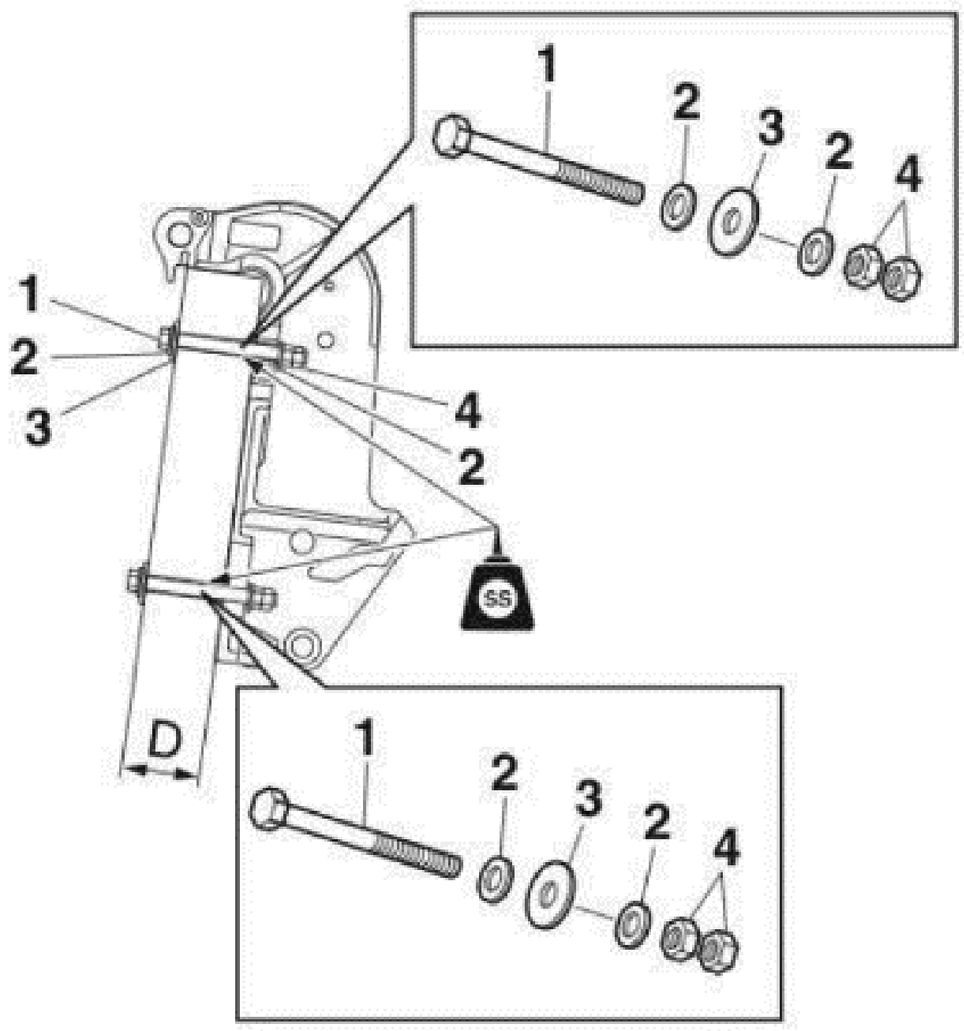
Drilling plate "1"
Drilling plate "1"

6. Apply sealant to the mounting holes, and then secure the outboard motor using the included mounting bolts "1", small washers "2", large washers "3", and nuts "4".

NOTICE

Make sure that there is no clearance between the surfaces of the boat transom and the clamp brackets. Otherwise, the clamp brackets or boat transom may be damaged.

TIP:
The second hole from the top of each clamp bracket is recommended for the upper mounting bolt.



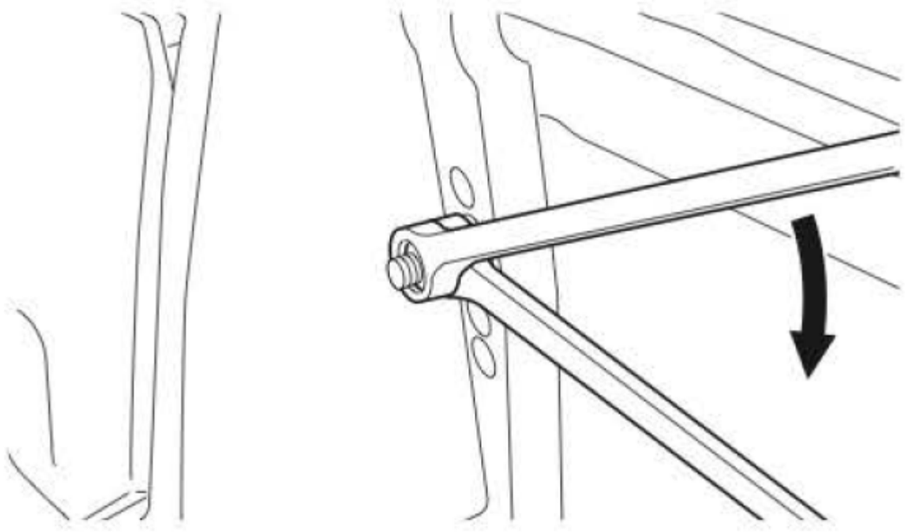
Boat transom thickness (D)	Mounting bolt
55-65 mm (2.17-2.56 in)	M12x115mm (4.53 in)
65-75 mm (2.56-2.95 in)	M12 x 130 mm (5.12 in)
75-95 mm (2.95-3.74 in)	M12 x 150 mm (5.91 in)

7. Install the mounting bolts, and then tighten the nuts firmly.

NOTICE

Make sure that the clamp brackets do not bite into the boat transom.

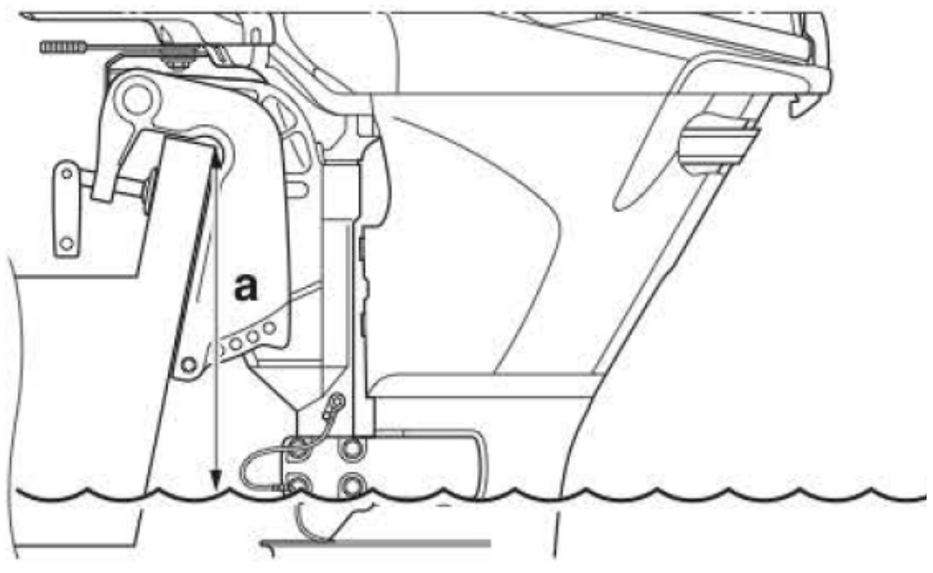
8. Tighten the locknuts firmly.



Outboard motor mounting height

If the water line is too close to the power head, poor engine performance could result, and water could enter the cylinders and damage the engine.

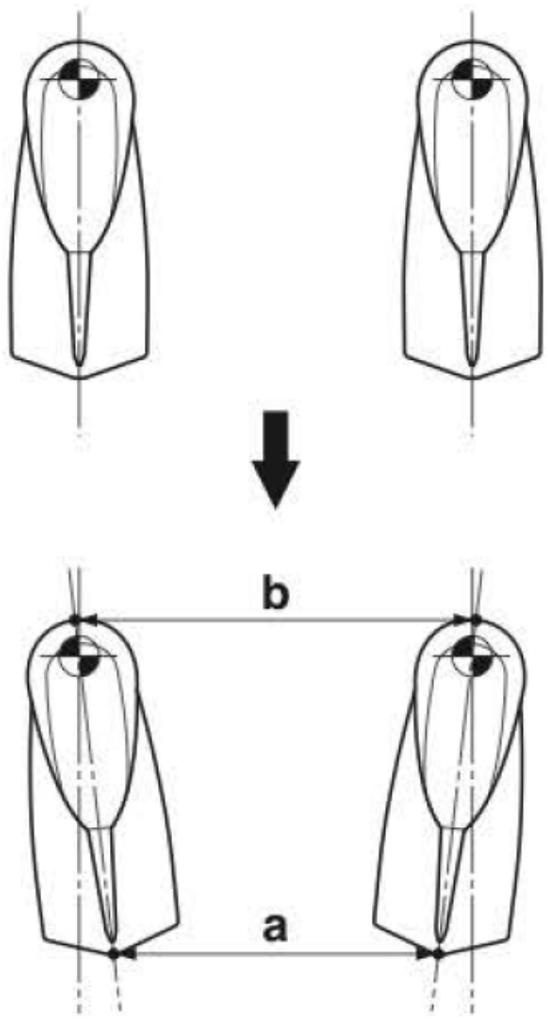
When mounting a 4-stroke outboard motor to a boat, make sure that the mounting height between the water surface and the clamp bracket seating point is not less than the specified minimum mounting height "a". Measure the mounting height when the boat is moored and carrying the maximum load.



Minimum mounting height
100 mm (3.9 in)

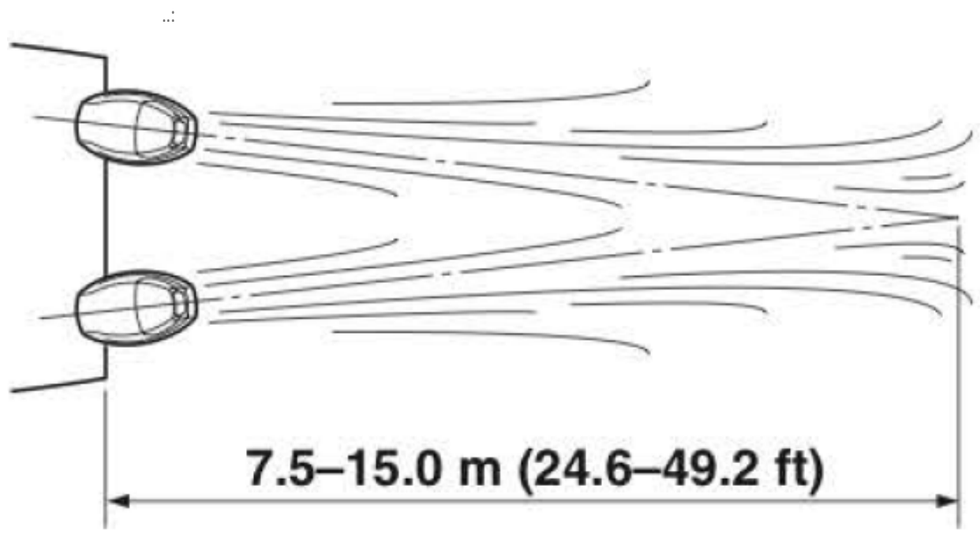
Adjusting the twin engine positions

Set the engines in the toe-out position, and measure the distances between the two engines at the center point of the rear "a" and front "b" of the lower case. The difference between measurement "a" and measurement "b" should not exceed 25 mm (1 in).



Adjustment: "b"- "a" = Within 25 mm (1 in)

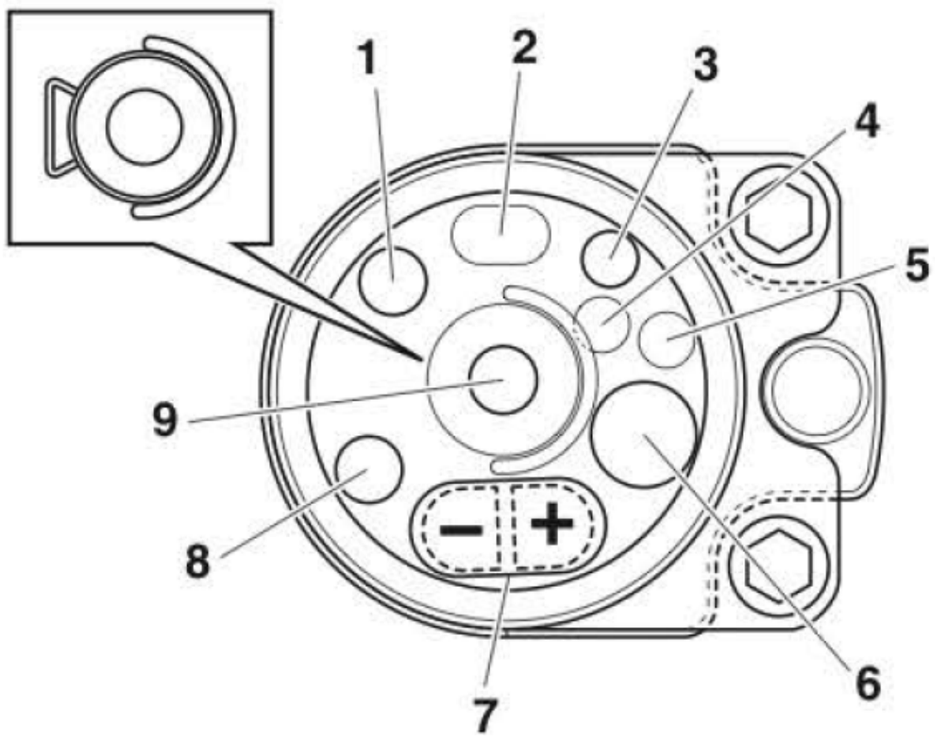
For best result, the toe-out distance should be set so that the twin engines wake meets approximately 7.5-15.0 m (24.6-49.2 ft) past the stern of the boat.



Rigging grommet mounting

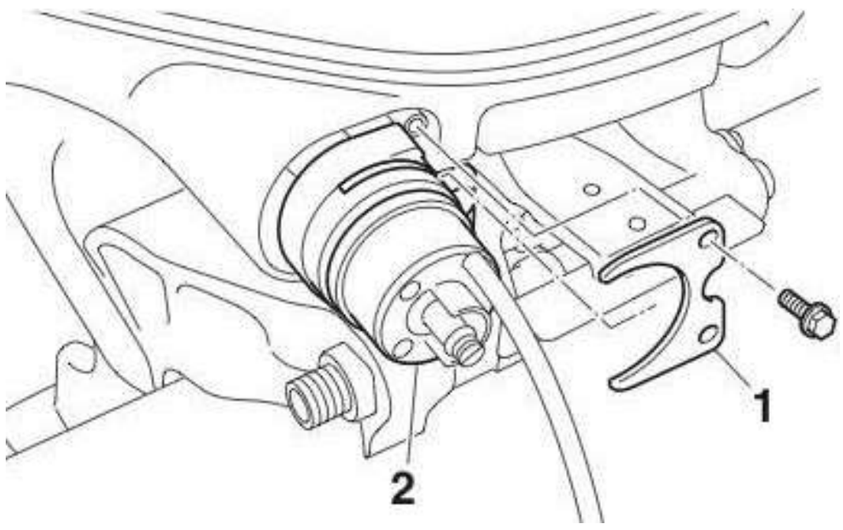
Rigging grommet description

Pass all the rigging components through the proper holes in the rigging grommet.



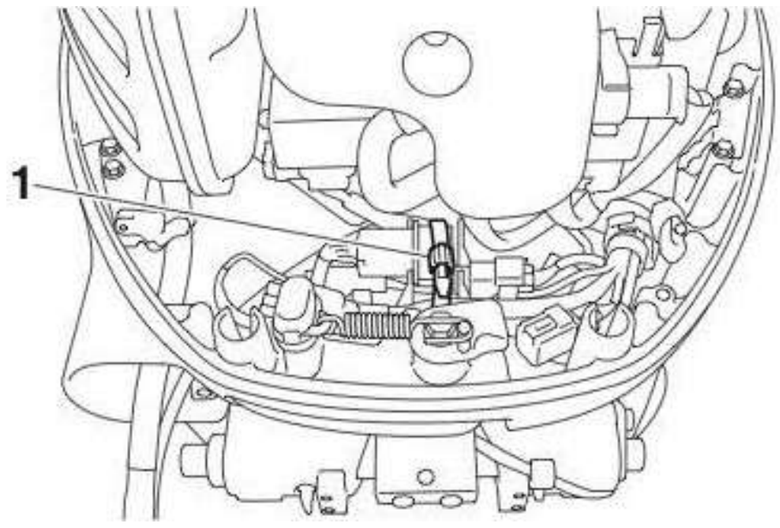
1. Throttle cable
2. 6Y8 multifunction meter harness (pigtail bus wire)
3. Speedometer hose
4. Trolling switch harness
5. Gauge harness
6. Main wire harness
7. Battery cable
8. Shift cable
9. Fuel hose

1. Remove the grommet holder "1" from the rigging grommet "2", and then remove the rigging grommet "2".



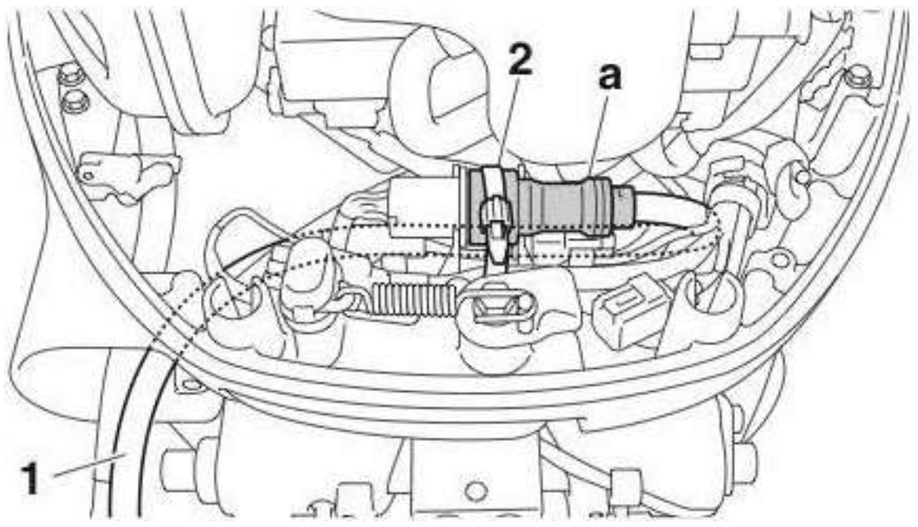
Installing the main wire harness

1. Release the holder "1".



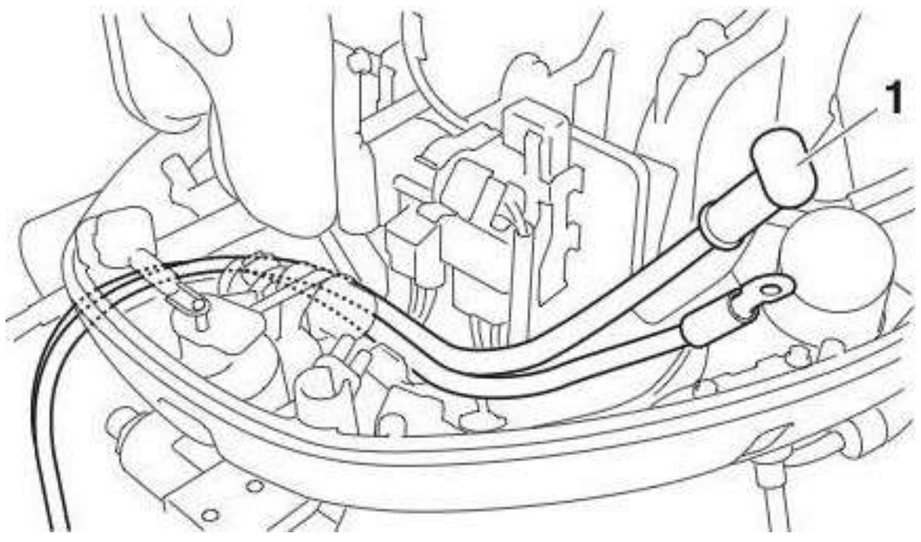
2. Route the main wire harness "1" through the bottom cowling.

3. Connect the main wire harness coupler (10-pin) "a", and then secure it using the holder "2". See "Bottom cowling" (5-9).



Installing the battery cable

1. Route the battery cable "1" through the bottom cowling.

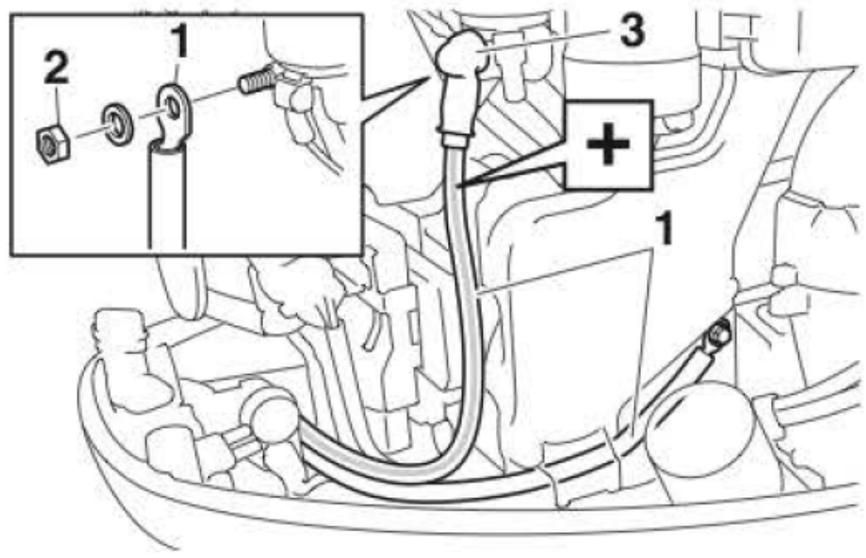


2. Connect the positive and negative terminals of the battery cable "1", and then tighten the positive battery cable nut "2" to the specified torque.

TIP:

The positive battery cable is marked with red tape and "+" marks.

3. Install the rubber cap "3".



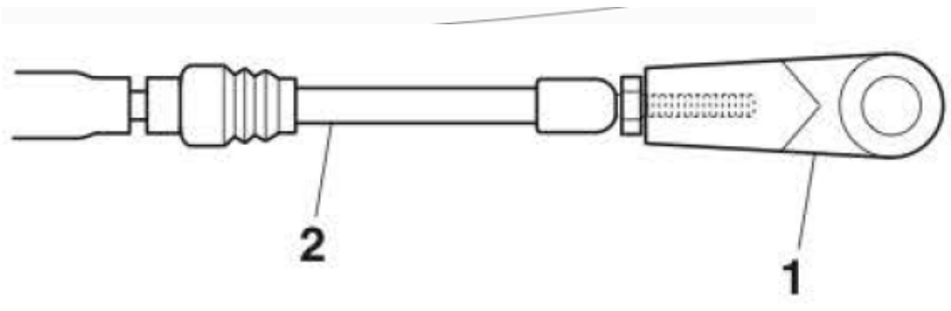
Positive battery cable nut "2"
9 Nm (0.9 kgf·m, 6.6 ft·lb)

Installing the shift cable

⚠WAENING

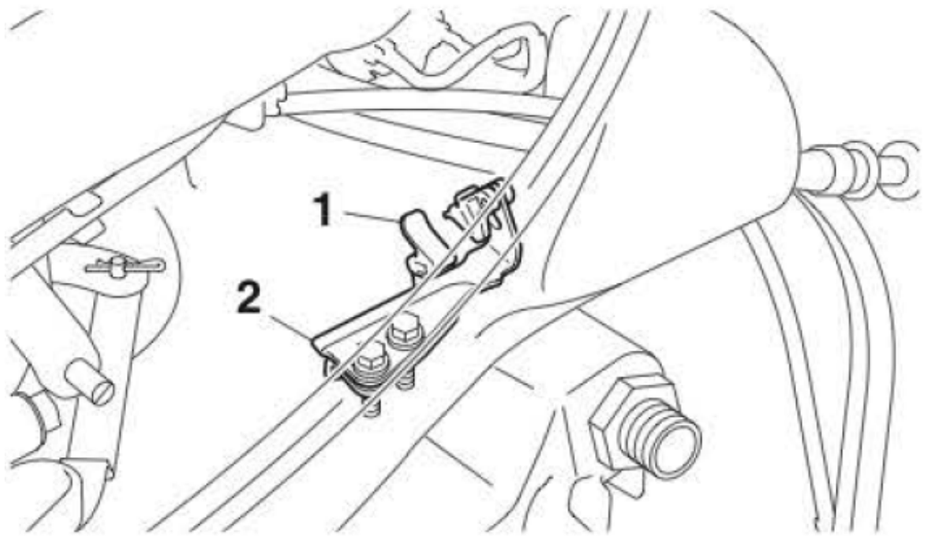
Always perform the cable adjustment in advance, following the procedures in the instruction accompanied with remote control box.

1. Install the shift cable joint "1" to the shift cable "2".

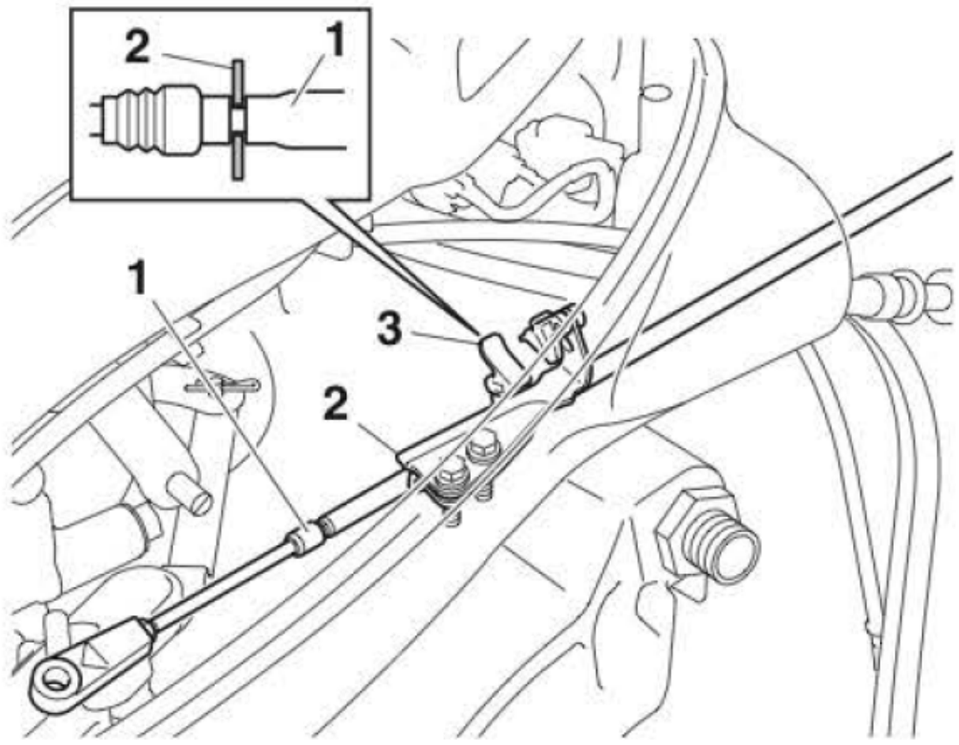


2. Move the remote control lever to the N position.

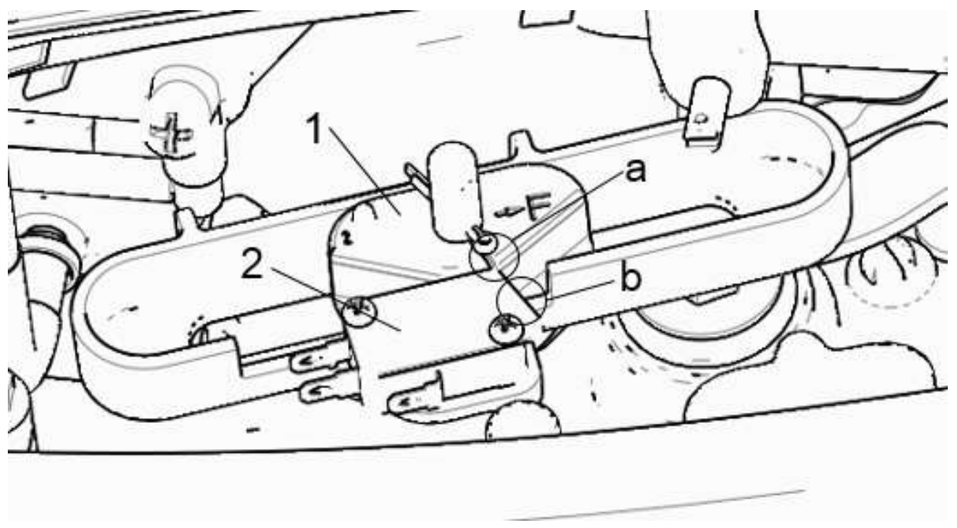
3. Disengage the cable clamp "1" from the bracket "2". See "Cable clamp" (2-15).



4. Install the shift cable "1" to the bracket "2", and then fasten it using the cable clamp "3".



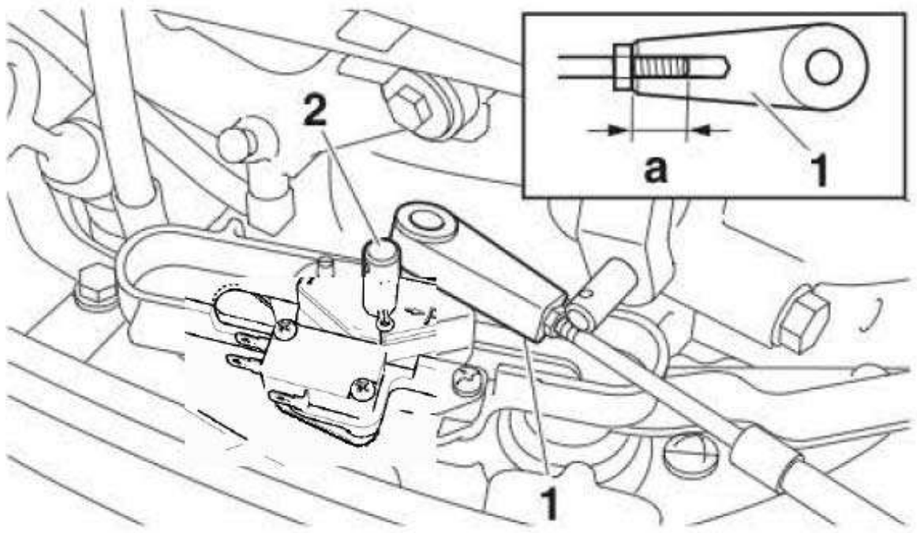
5. Align the mark "a" on the bushing "1" with the side "b" on the plate "2"



6. Adjust the shift cable joint "1", and then install it to the pin "2".

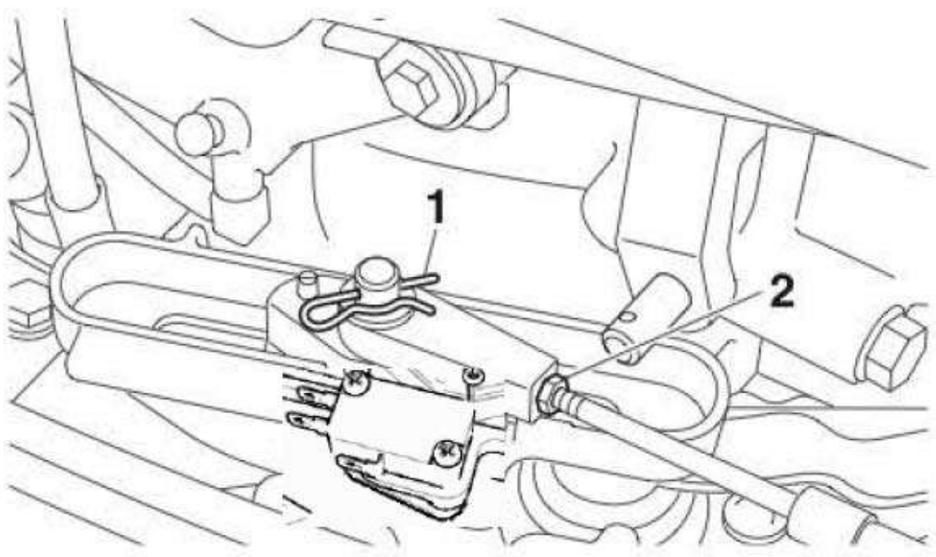
⚠WAENING

The shift cable joint must be screwed in 8.0 mm (0.31 in) or more.



Dimension "a"
8.0 mm (0.31 in) or more

7. Install the clip "1", and then tighten the shift cable locknut "2" to the specified torque.

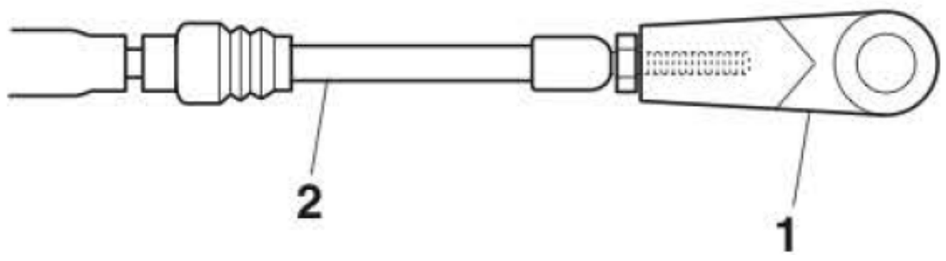


Shift cable locknut "2"
5 Nm (0.5 kgf·m, 3.7 ft·lb)

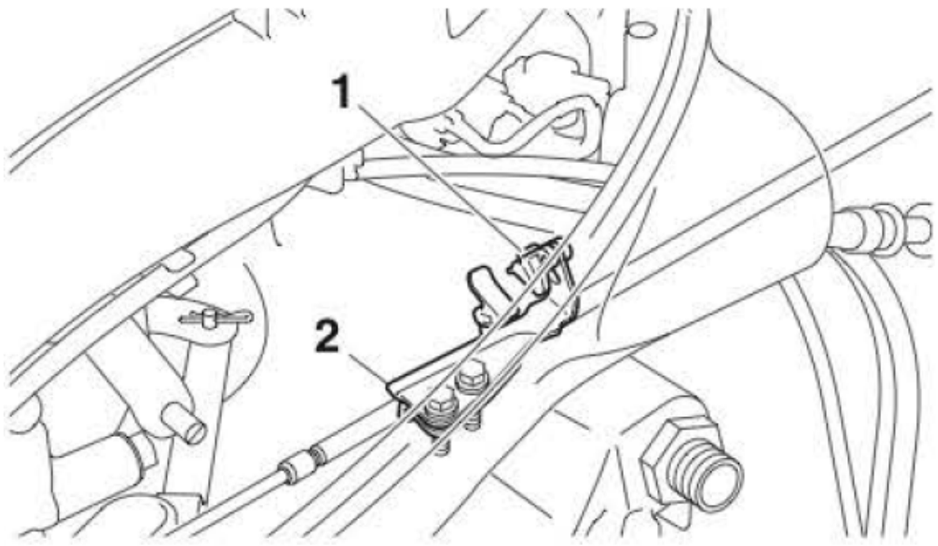
8. Check the shift cable for proper operation.

Installing the throttle cable

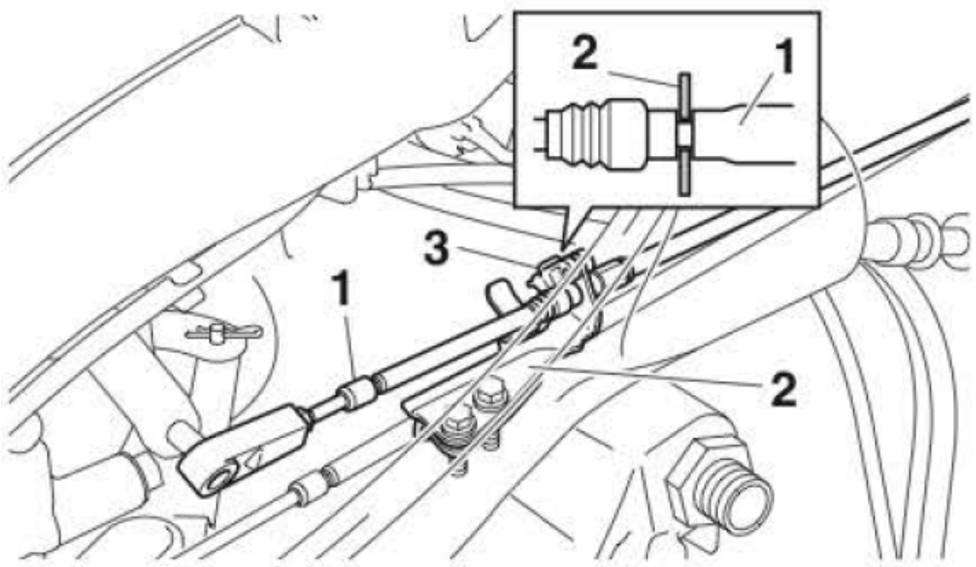
1. Install the throttle cable joint "1" to the throttle cable "2".



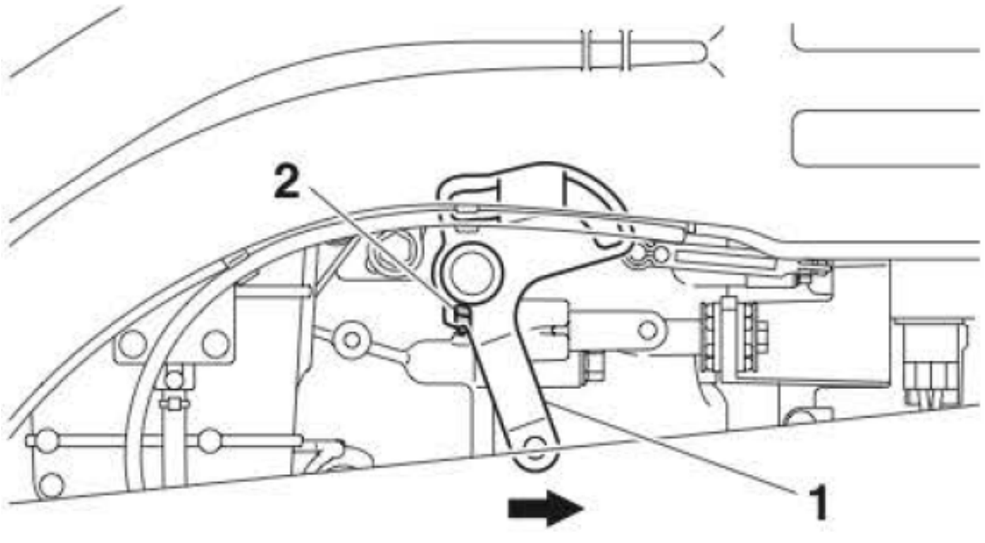
2. Disengage the cable clamp "1" from the bracket "2". See "Cable clamp" (2-15).



3. Install the throttle cable "1" to the bracket "2", and then fasten it using the cable clamp "3".



4. Move the accelerator cam "1" so that it contacts the cylinder block "2".

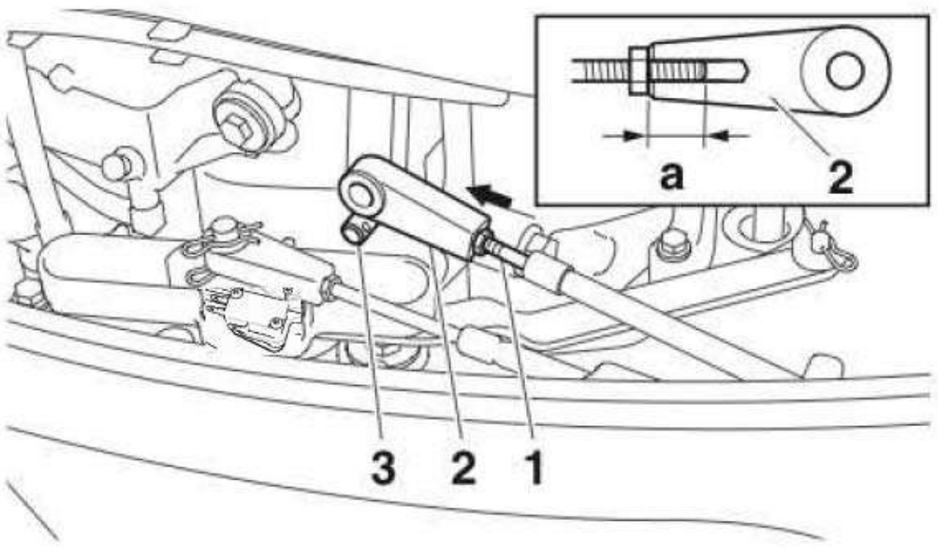


5. Pull the inner cable "1" using the force of 15 N (1.5 kgf, 3.4 lbf) to remove any free play in the cable.

6. Adjust the throttle cable joint "2", and then install it to the pin "3" of the accelerator cam.

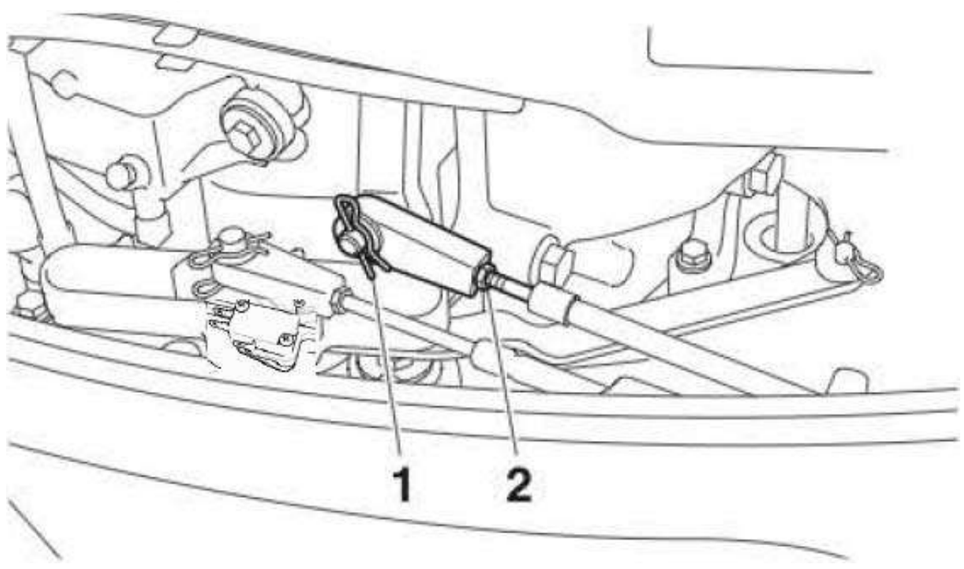
⚠ WARNING

The throttle cable joint must be screwed in 8.0 mm (0.31 in) or more.



Dimension "a"
8.0 mm (0.31 in) or more

7. Install the clip "1", and then tighten the throttle cable locknut "2" to the specified torque.

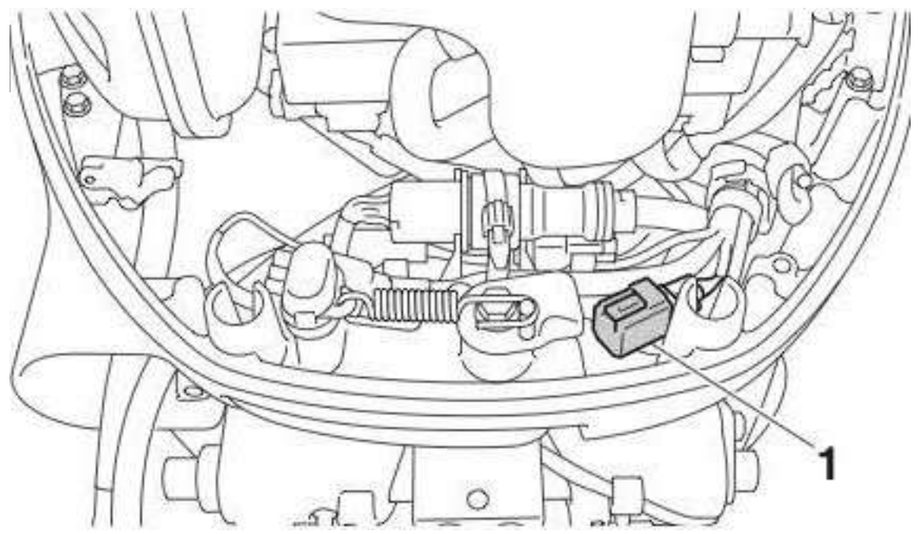


Throttle cable locknut "2"
5 Nm (0.5 kgf·m, 3.7 ft·lb)

8. Check the throttle cable for proper operation.

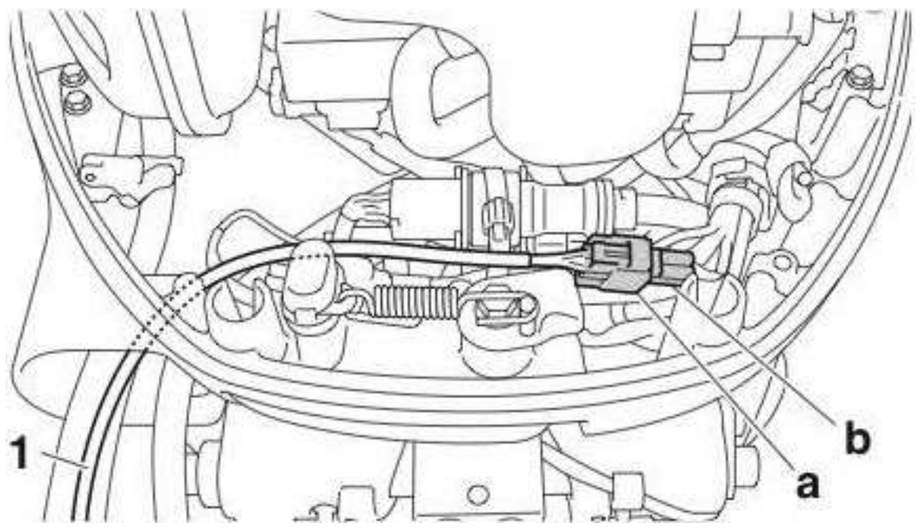
Installing the 6Y8 multifunction meter harness (pigtail bus wire)

1. Removethecap "1".

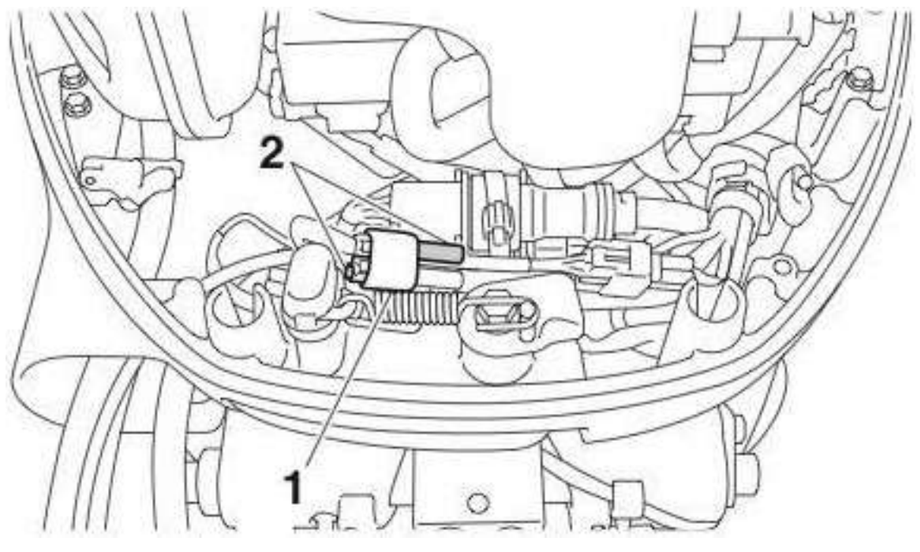


2. Route the pigtail bus wire "1" through the bottom cowling.

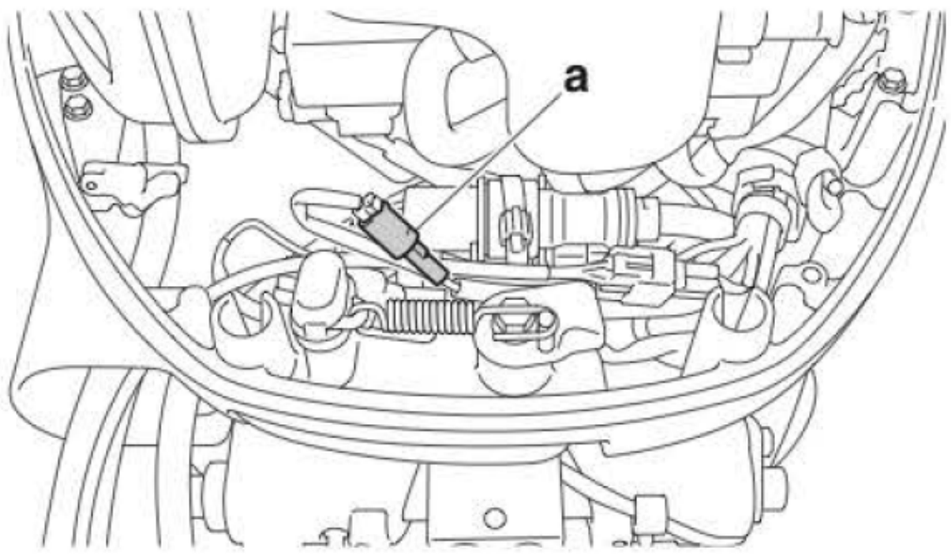
3. Connect the coupler "a" to the coupler "b".



4. Remove the yellow tape "1" and caps "2".

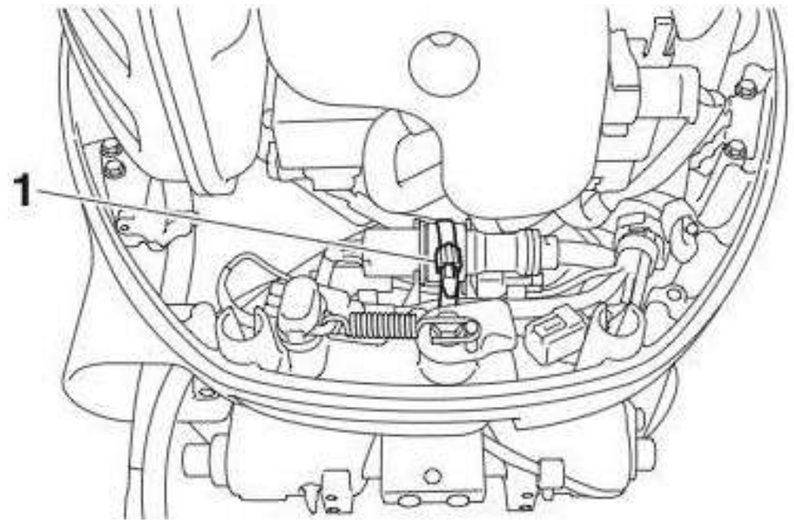


5. Connect the trim sensor coupler "a".

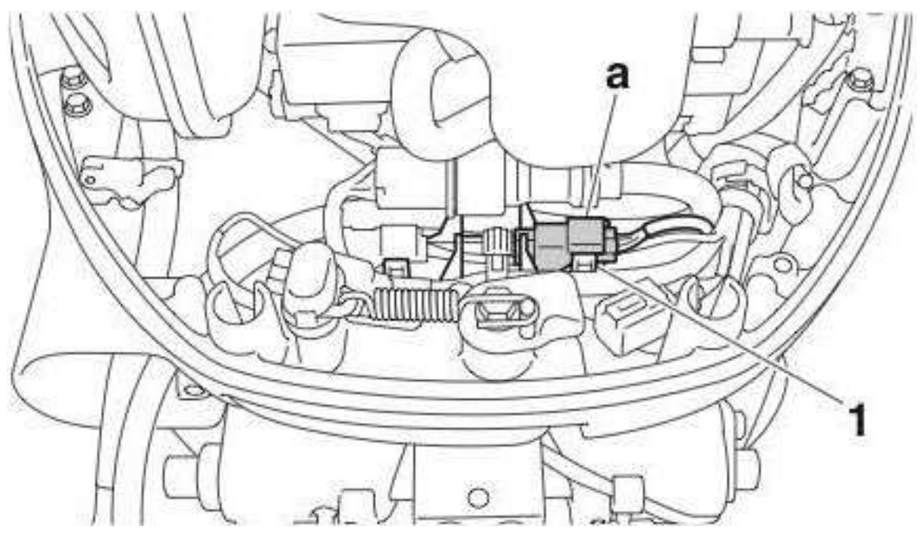


Installing the conventional gauge (6Y5/6Y7) harness

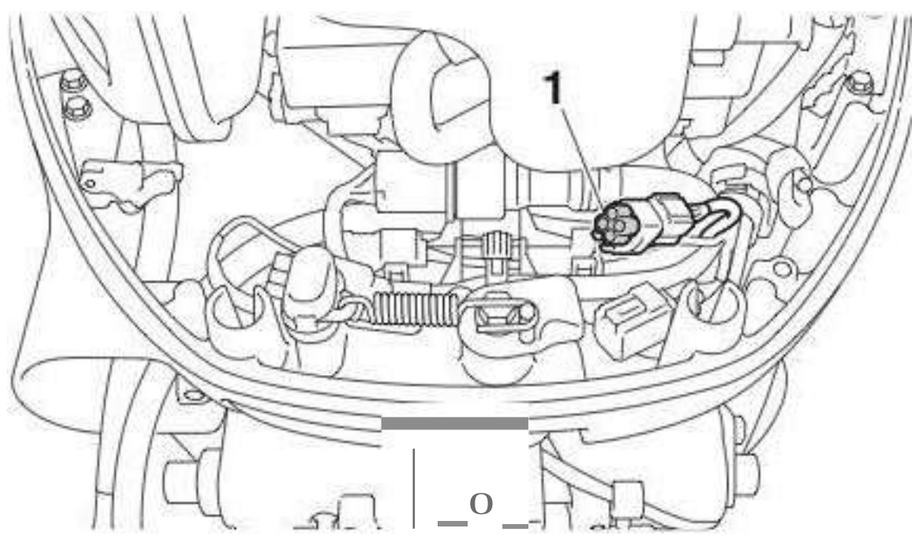
1. Release the holder "1".



2. Remove the gauge harness coupler "a" from the holder "1".

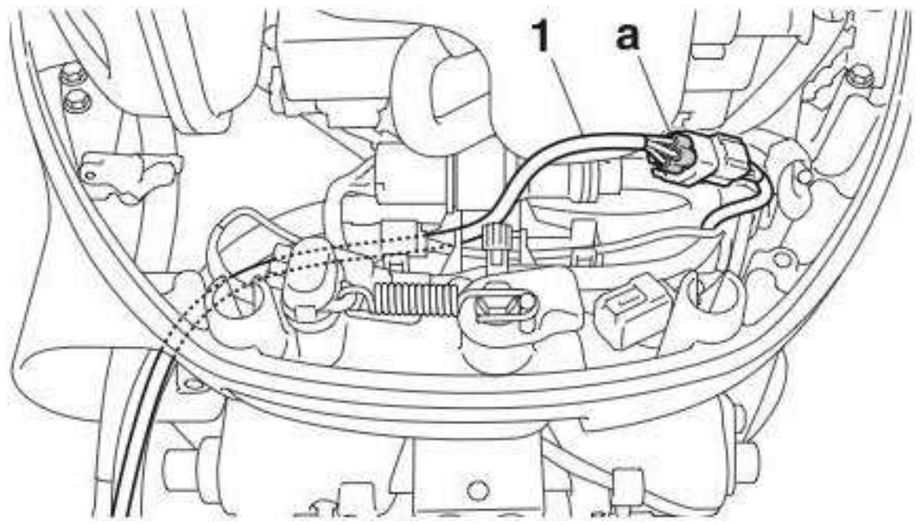


3. Remove the cap "1".

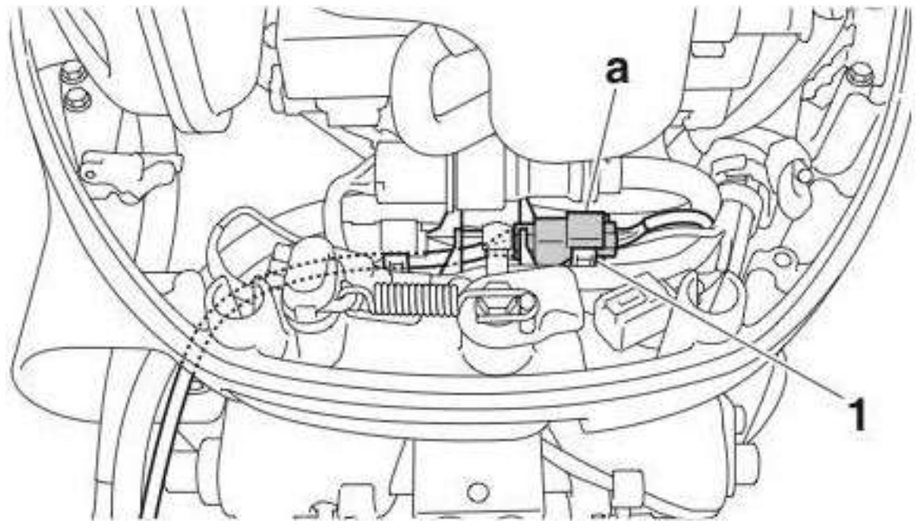


4. Route the gauge harness "1" through the bottom cowling.

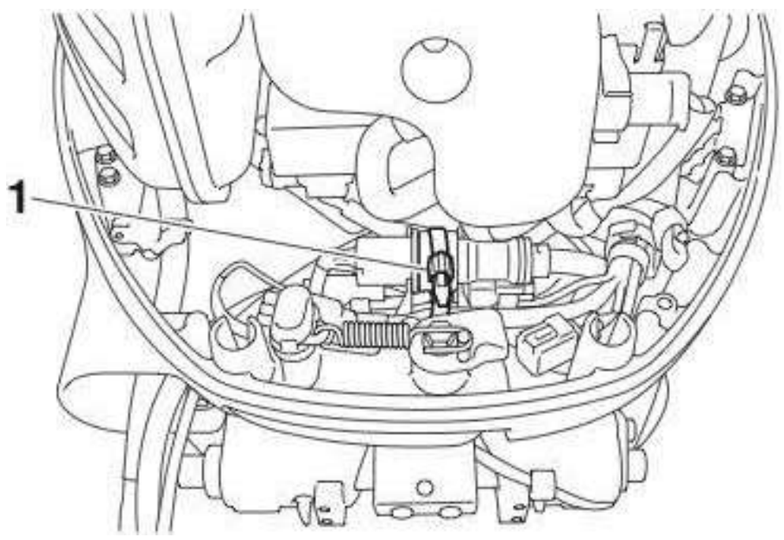
5. Connect the gauge harness coupler "a". See "Bottom cowling" (5-9).



6. Install the gauge harness coupler "a" to the holder "1".



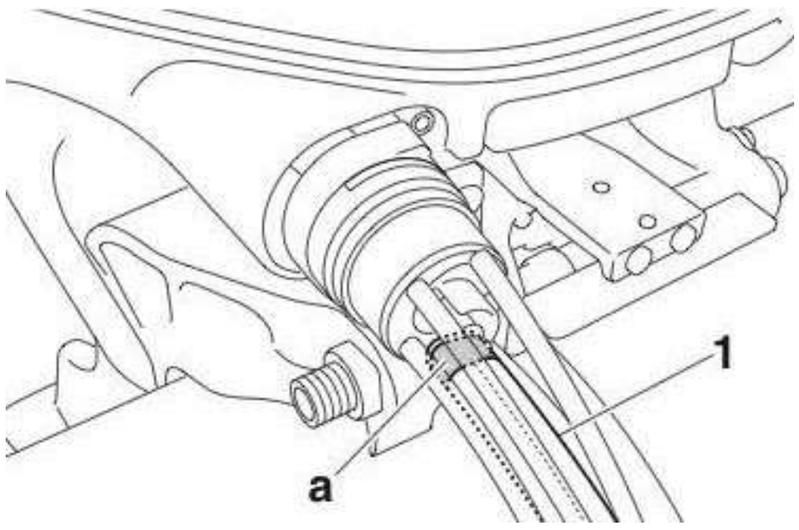
7. Secure the harnesses using the holder "1".



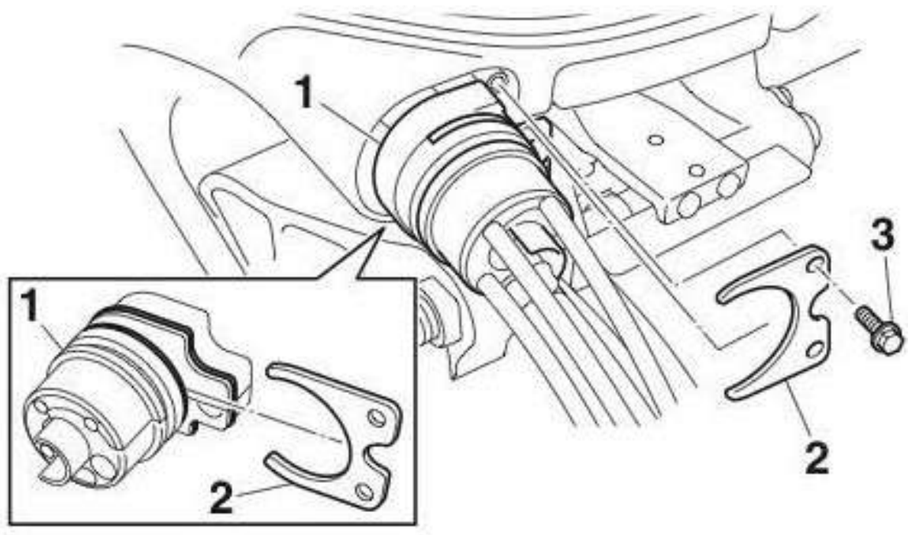
Installing the rigging grommet

1. Route each cable, harness, and hose through the proper holes in the rigging grommet. See "Rigging grommet description" (3-8).

2. Align the white tape "a" on the battery cable "1" with the outer end of the rigging grommet.

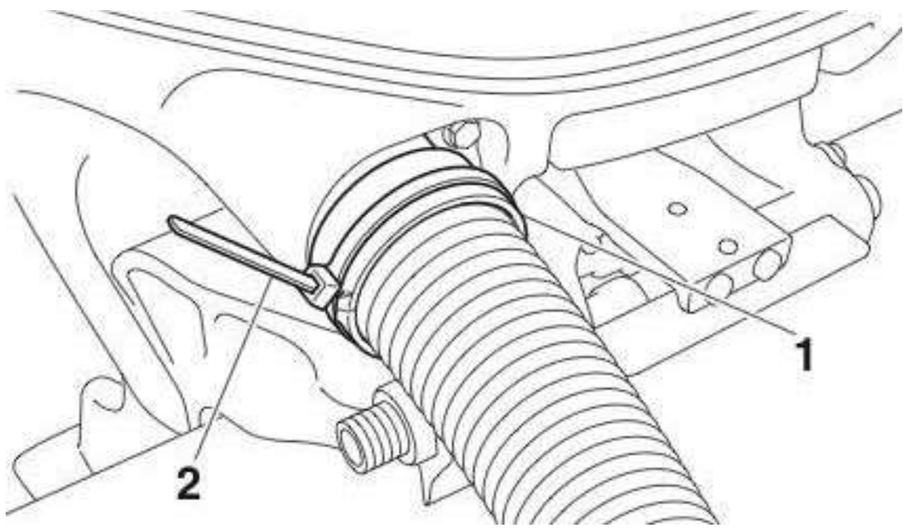


3. Install the rigging grommet "1" along with the grommet holder "2", and then tighten the grommet holder bolts "3" to the specified torque.



Grommet holder bolt "3"
10 Nm (1.0 kgf·m, 7.4 ft·lb)

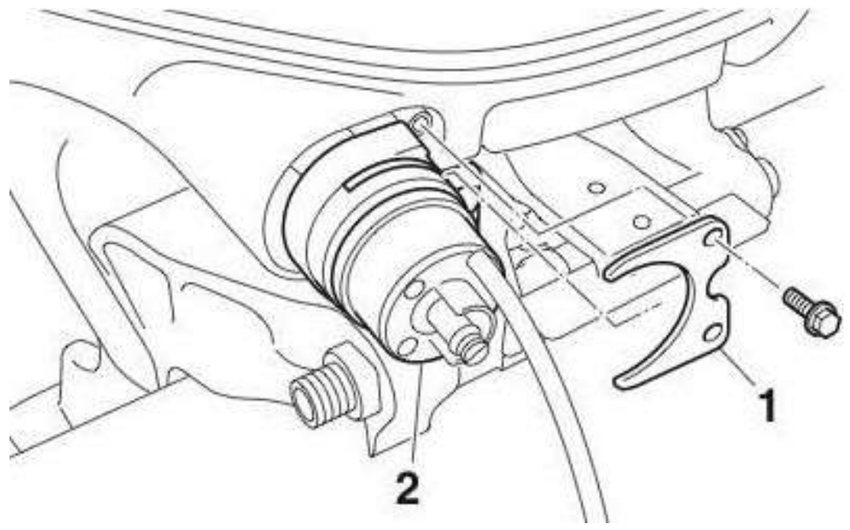
4. Install the rigging tube retainer "1", and then fasten it using the plastic tie "2".



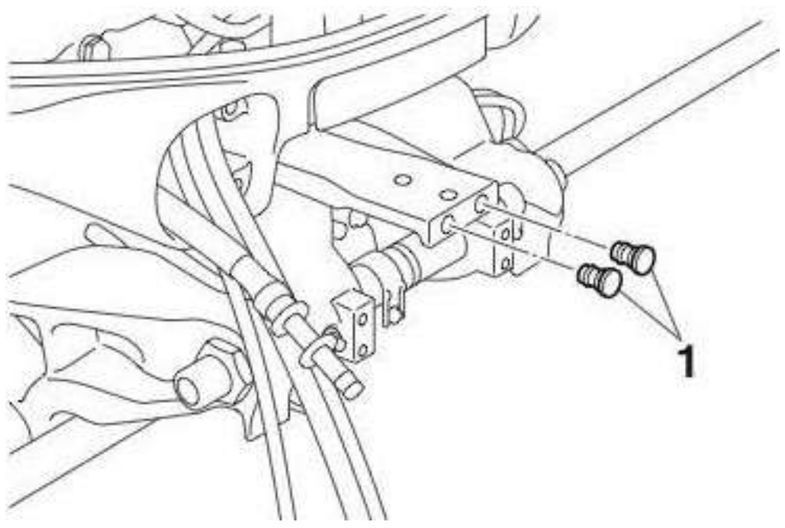
Tiller handle

Installing the tiller handle

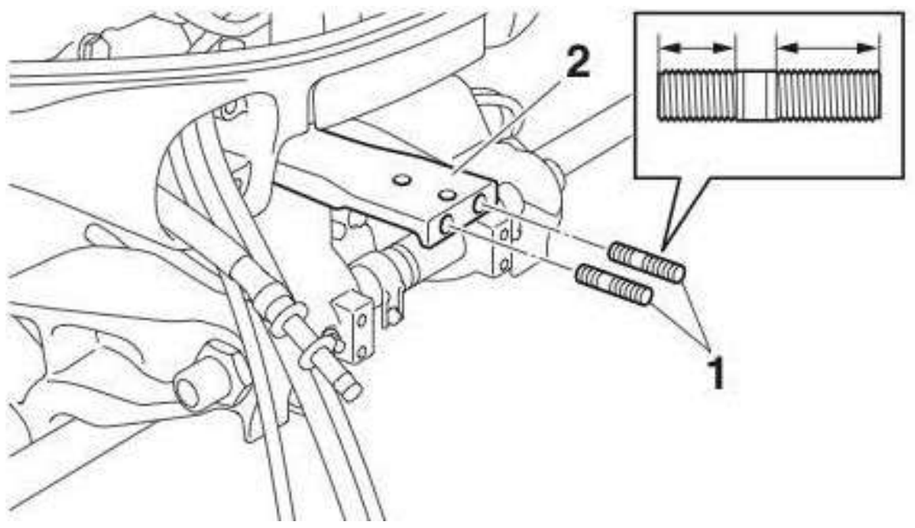
1. Remove the grommet holder "1" from the rigging grommet "2", and then remove the rigging grommet "2".



2. Remove the plugs "1".



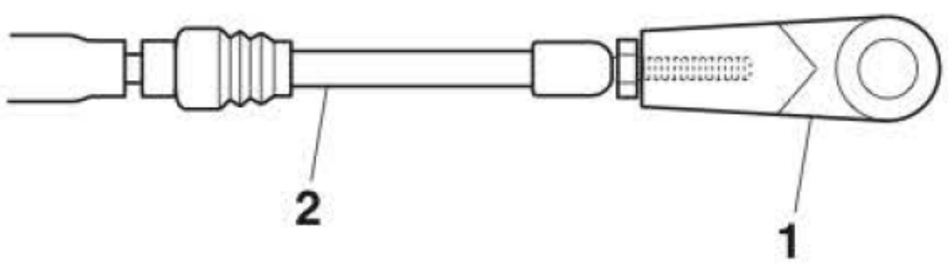
3. Install the stud bolts "1" to the steering arm "2", and then tighten them to the specified torque.



Stud bolt "1"
20 Nm (2.0 kgf·m, 14.8 ft·lb)

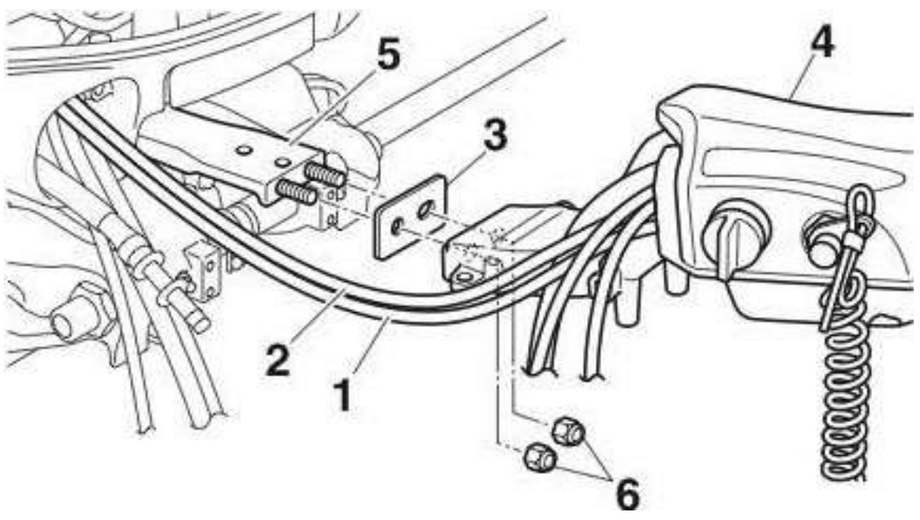
4. Move the shift lever to the N position.

5. Install the shift cable joint "1" and throttle cable joint "1" to the shift cable "2" and throttle cable "2".



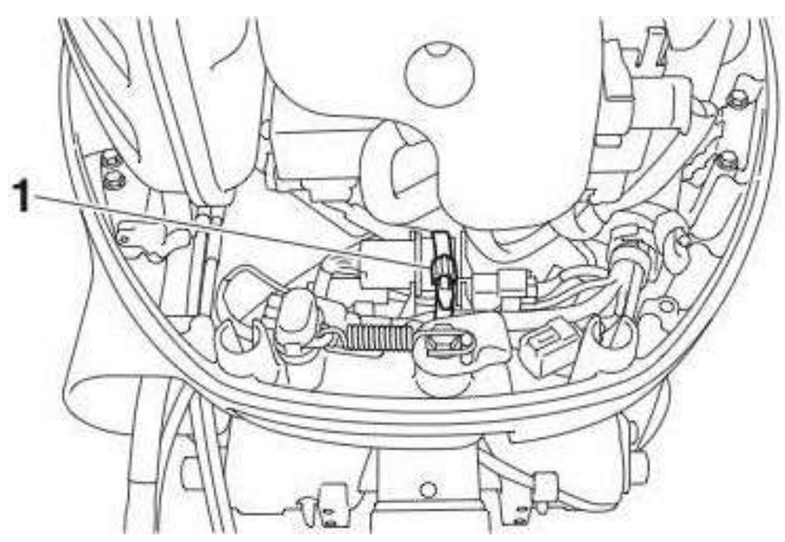
6. Route the shift cable "1" and throttle cable "2" through the bottom cowling.

7. Install the plate "3" and tiller handle assembly "4" to the steering arm "5", and then tighten the tiller handle nuts "6" to the specified torque.

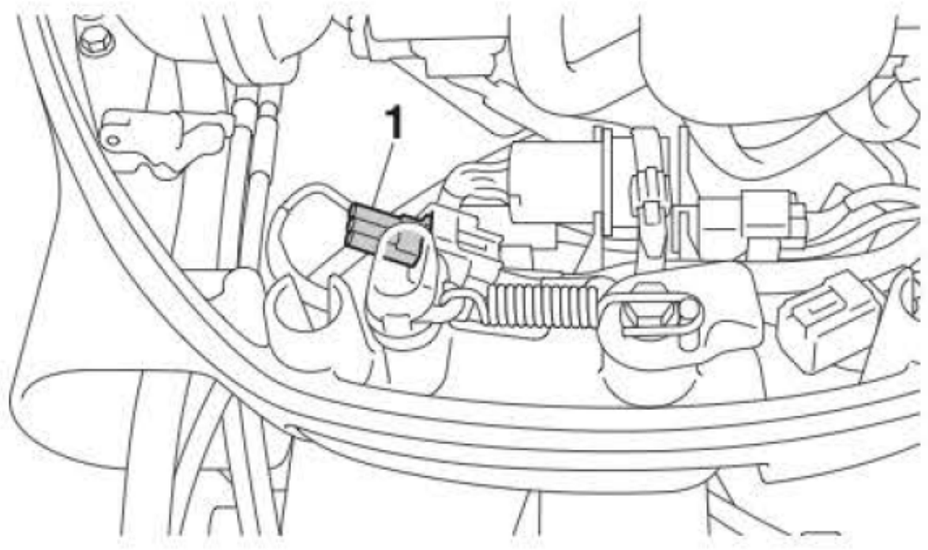


Tiller handle nut "6"
40 Nm (4.0 kgf·m, 29.5 ft·lb)

8. Release the holder "1".

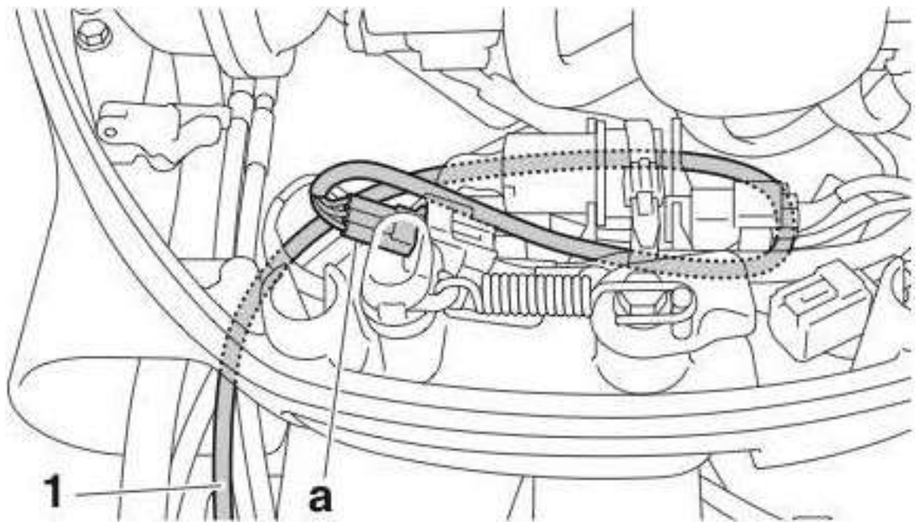


9. Remove the cap "1".



10. Route the trolling switch harness "1" through the bottom cowling.

11. Connect the trolling switch harness coupler "a". See "Bottom cowling" (5-9).



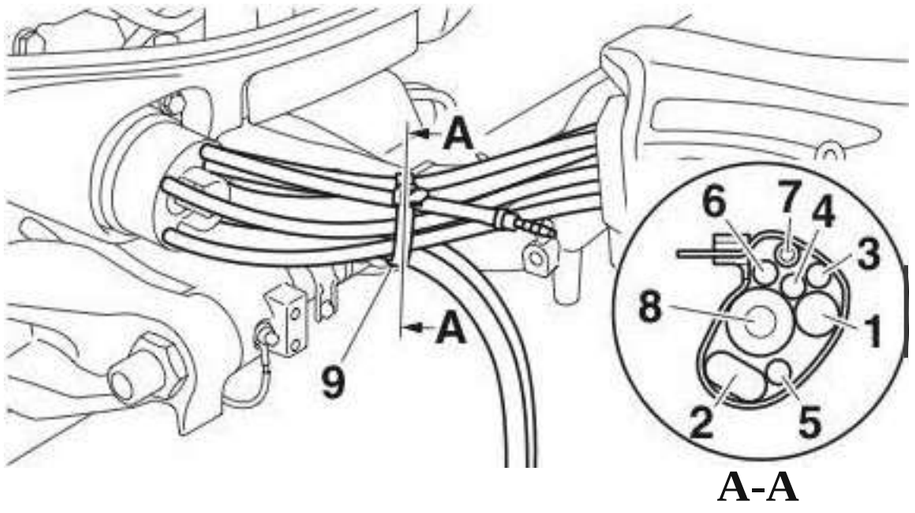
12. Install the gauge harness, main wire harness, and battery cable. See "Installing the conventional gauge (6Y5/6Y7) harness" (3-12), "Installing the main wire harness" (3-8), and "Installing the battery cable" (3-8).

13. Install the shift cable. See steps 2-8 in "Installing the shift cable" (3-9).

14. Install the throttle cable. See steps 2-8 in "Installing the thrattle cable" (3-10).

15. Install the rigging grommet. See "Installing the rigging grommet" (3-13).

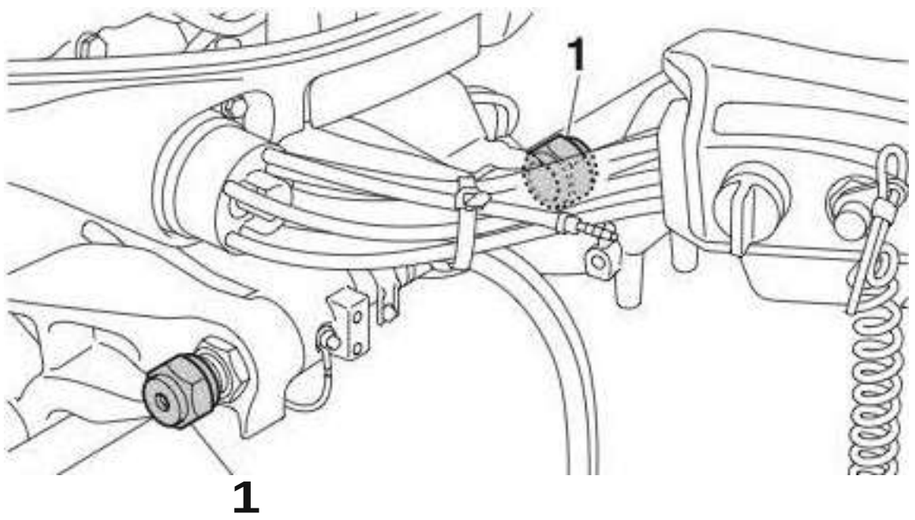
16. Fasten the main wire harness "1", battery cable "2", gauge harness "3", trolling switch harness "4", shift cable "5", throttle cable "6", speedometer hose "7", and fuel hose "8" using the plastic tie "9".



A-A

Installing the friction plate

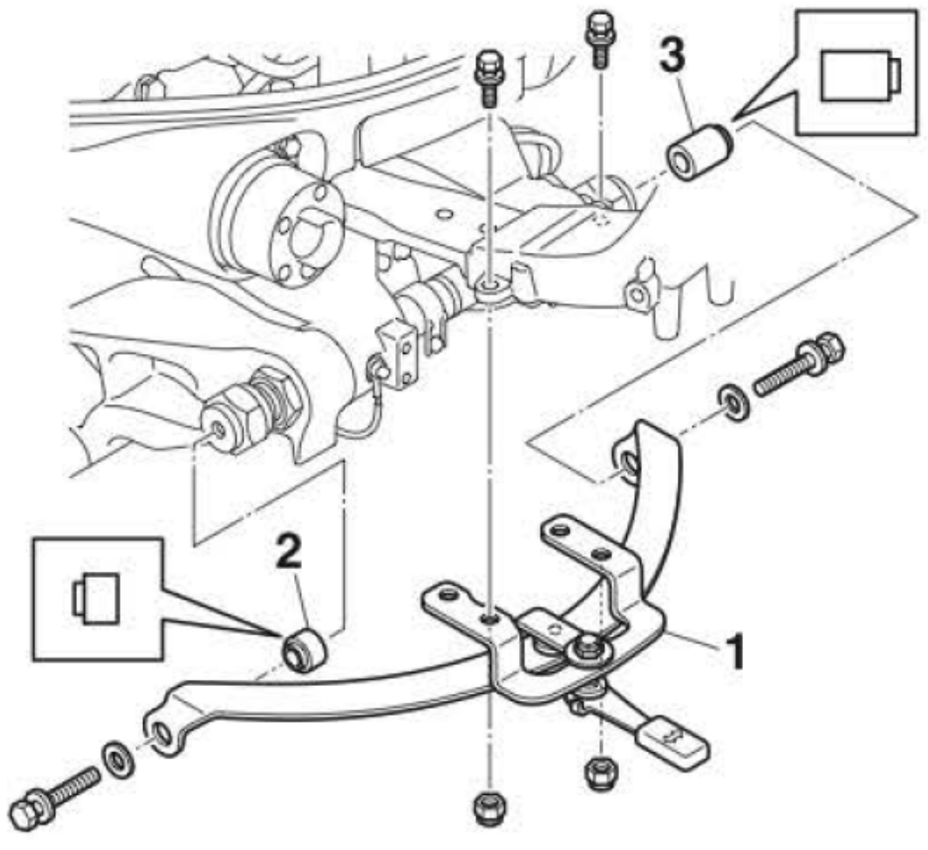
1. Install the friction plate nuts "1" onto both through tube ends, and then tighten them to the specified torque.



1

Friction plate nut "1"
20 Nm (2.0 kgf·m, 14.8 ft·lb)

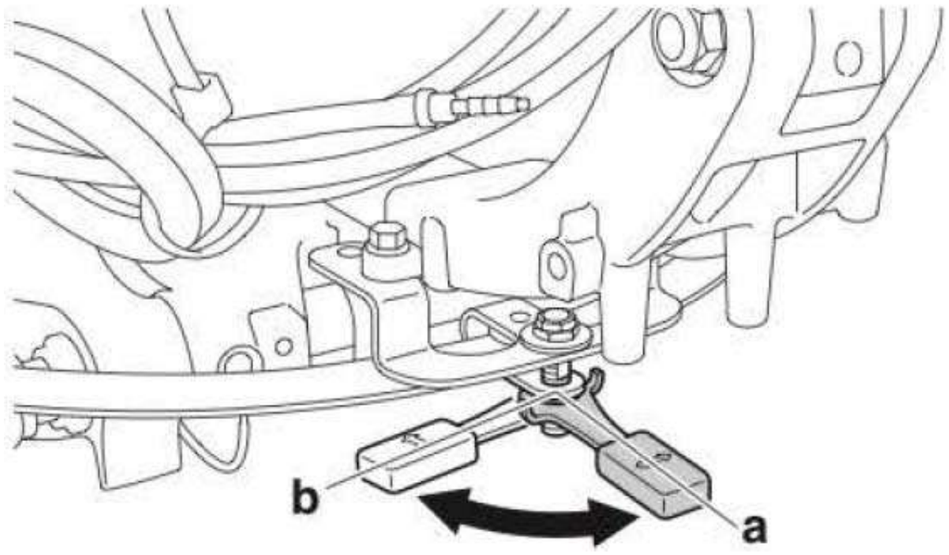
2. Install the friction plate assembly "1" and collars "2" and "3".



3. Check the friction plate assembly for the amount of friction.

TIP:

Make sure that the hoses, harnesses, leads, and cables do not interfere with the friction plate assembly.



a. Increase the friction
b. Decrease the friction

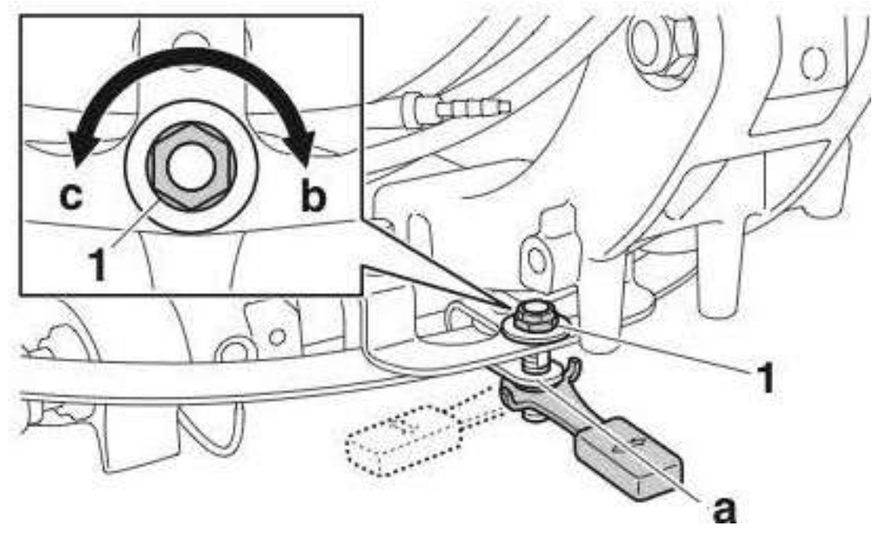
4. Adjust the friction adjusting nut "1" so that the steering operates properly.

⚠ WARNING

Do not overtighten the friction adjuster. If there is too much resistance, it could be difficult to steer, which could result in an accident.

TIP:

- Tighten or loosen the friction adjusting nut "1" at the steering lock lever in the position "a".
- To increase the friction, tighten the friction adjusting nut "1" in direction "b".
- To decrease the friction, loosen the friction adjusting nut "1" in direction "c".

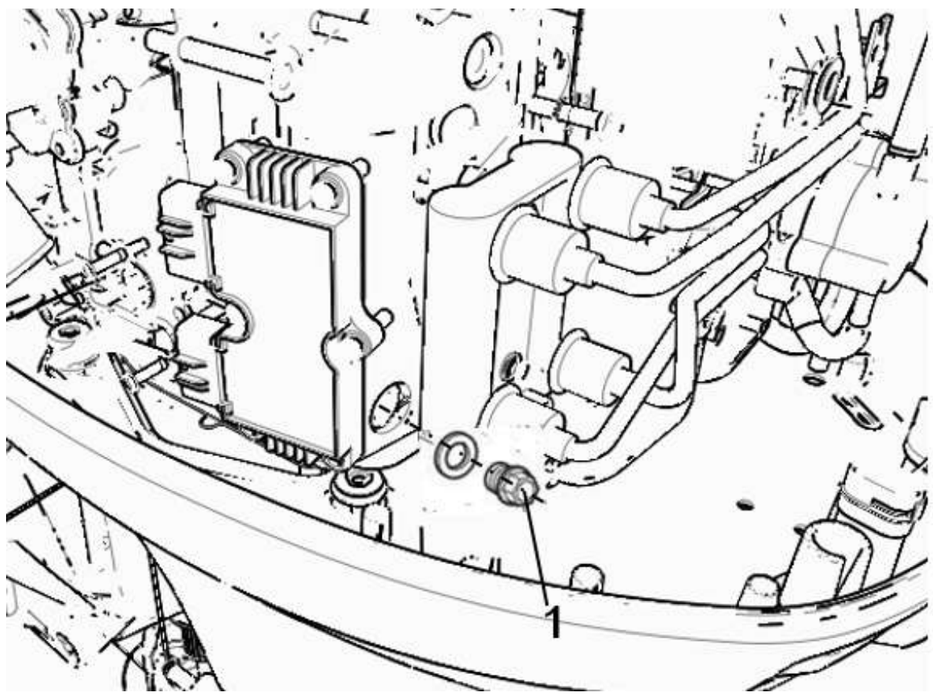


Optional equipment

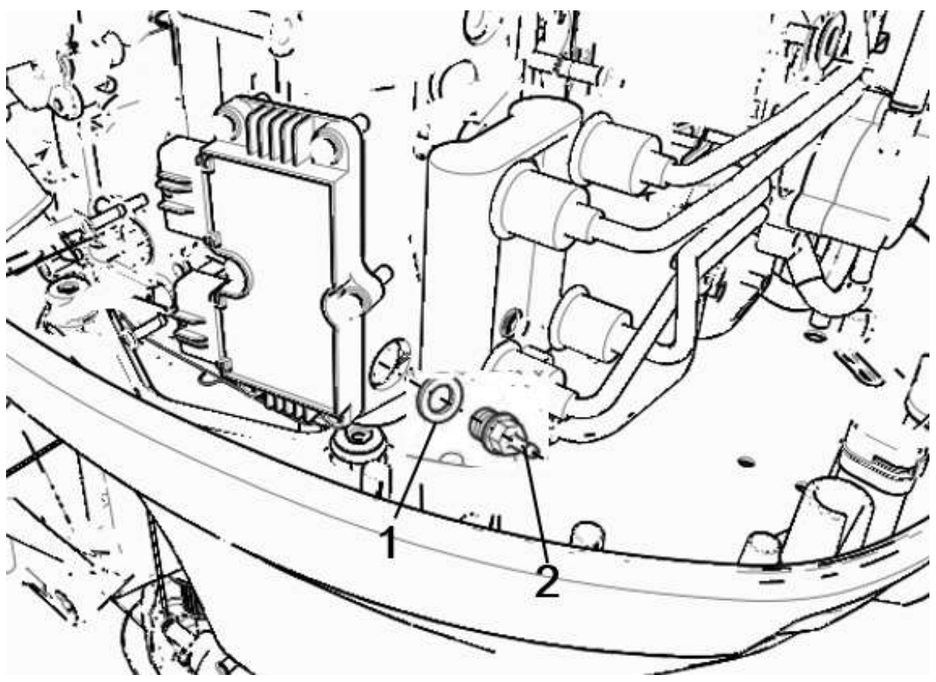
Installing the water pressure sensor (6Y8 Multifunction Meters)

See COMMAND LINK MULTIFUNCTION METER SET UP MANUAL (LIT-18514-00-05) or 6Y8 MULTIFUNCTION METER SET UP MANUAL (6Y8-2819K-3K-XX) for details of the components. "XX" (2-digit suffix) varies depending on the language.

1. Remove the plug "1".

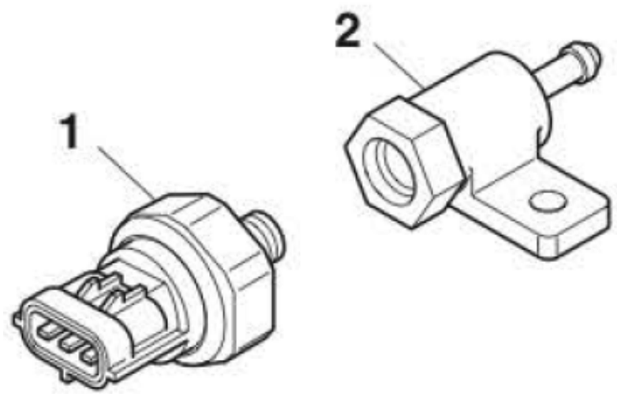


2. Install a new gasket "1", and then tighten the water pressure sensor nipple "2" to the specified torque.



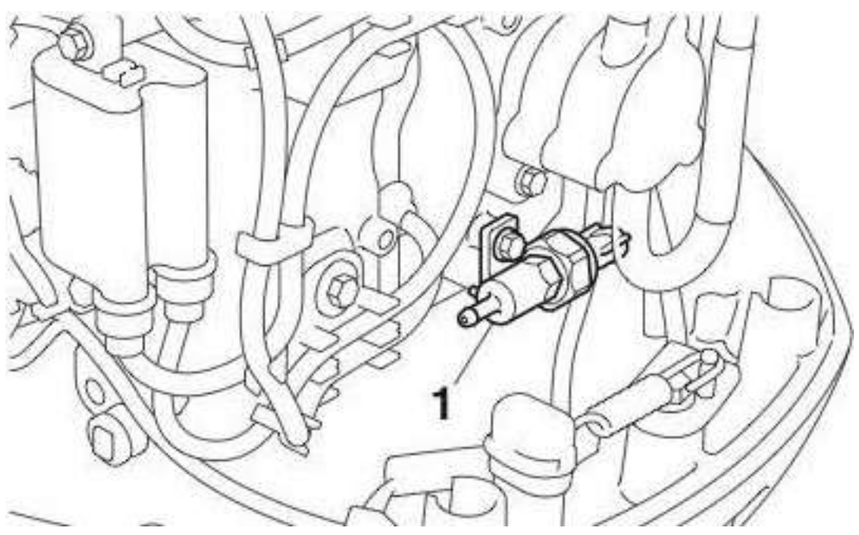
Water pressure sensor nipple "2"
23 Nm (2.3 kgf·m, 17.0 ft·lb)

3. Install the water pressure sensor "1" to the water pressure sensor adapter "2", and then tighten the water pressure sensor "1" to the specified torque.



Water pressure sensor "1"
19 Nm (1.9 kgf·m, 14.0 ft·lb)

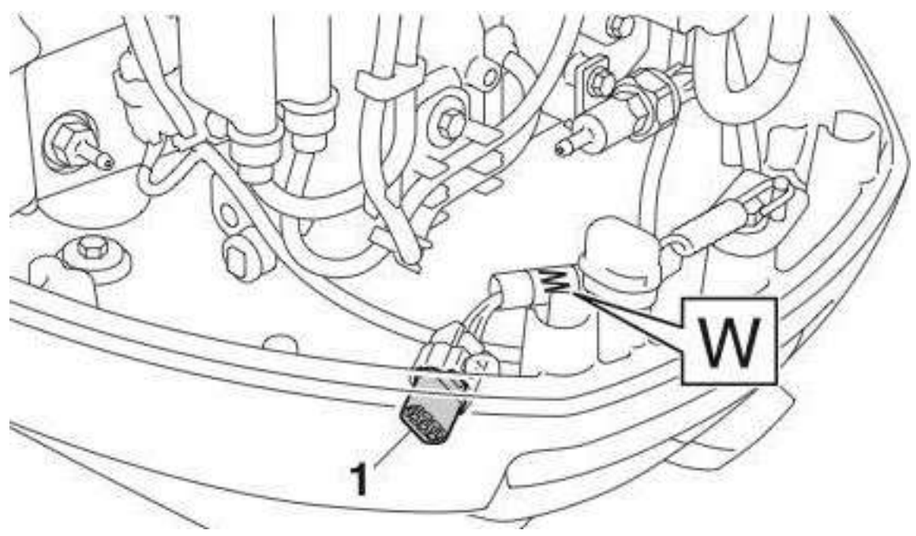
4. Install the water pressure sensor adapter "1".



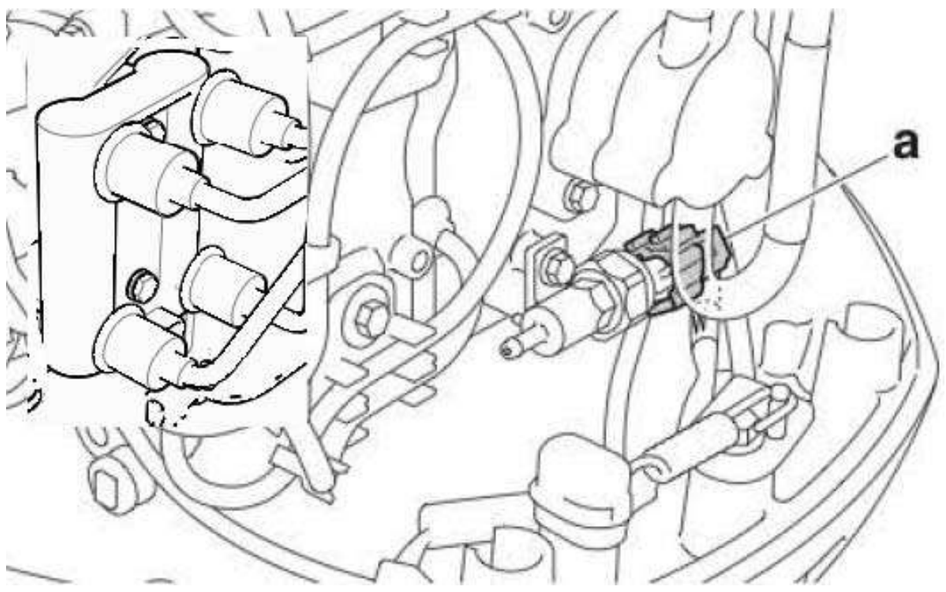
5. Remove the cap "1".

TIP:

The water pressure sensor lead is marked with "W".



6. Connect the water pressure sensor coupler "a".



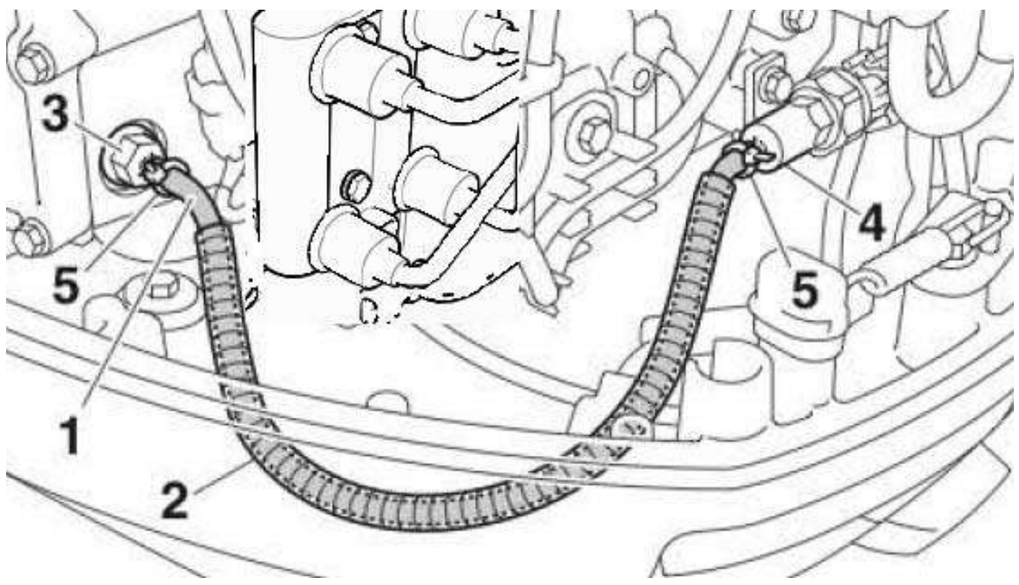
7. Cut the extension hose "1" to 340 mm (13.4 in).

8. Cut the corrugated tube "2" to 290 mm (11.4 in).

9. Pass the extension hose "1" through the corrugated tube "2".

10. Connect the extension hose "1" to the water pressure sensor nipple "3" and water pressure sensor adapter "4".

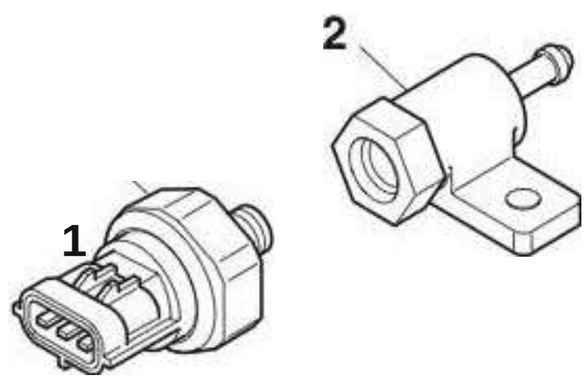
11. Fasten the ends of the extension hose "1" using the plastic ties "5".



Installing the speed sensor (6Y8 Multifunction Meters)

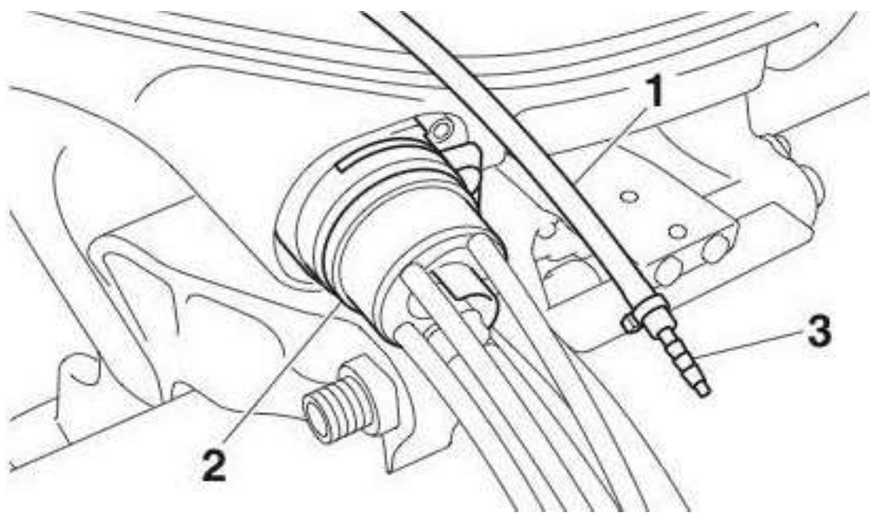
See COMMAND LINK MULTIFUNCTION METER SET UP MANUAL (LIT-18514-00-05) or 6Y8 MULTIFUNCTION METER SET UP MANUAL (6Y8-2819K-3K-XX) for details of the components. "XX" (2-digit suffix) varies depending on the language.

1. Install the speed sensor "1" to the speed sensor adapter "2", and then tighten the speed sensor "1" to the specified torque.

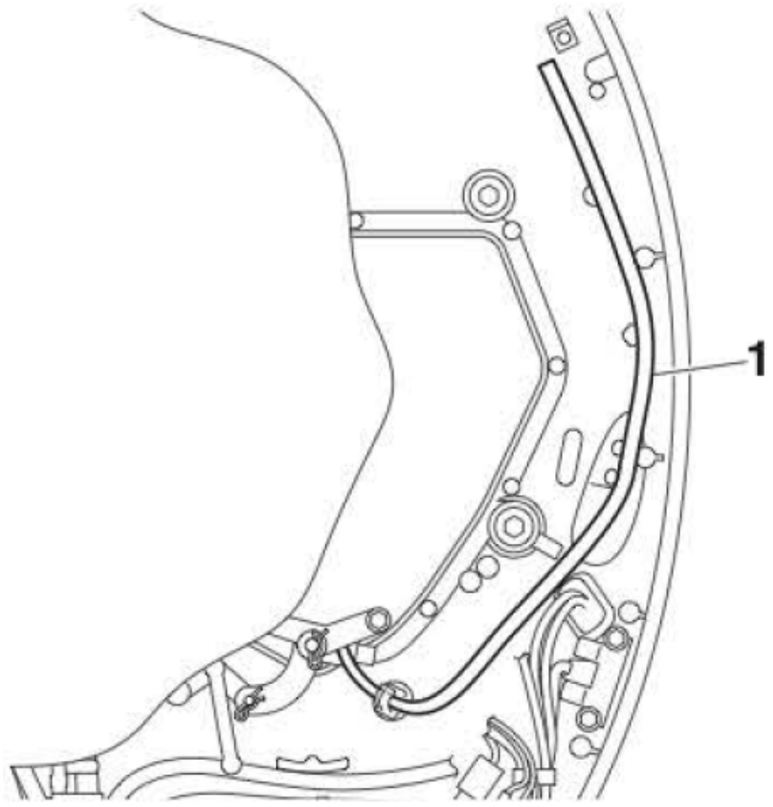


Speed sensor "1"
19 Nm (1.9 kgf·m, 14.0 ft·lb)

2. Remove the speedometer hose "1" from the rigging grommet "2", and then remove the nipple "3".



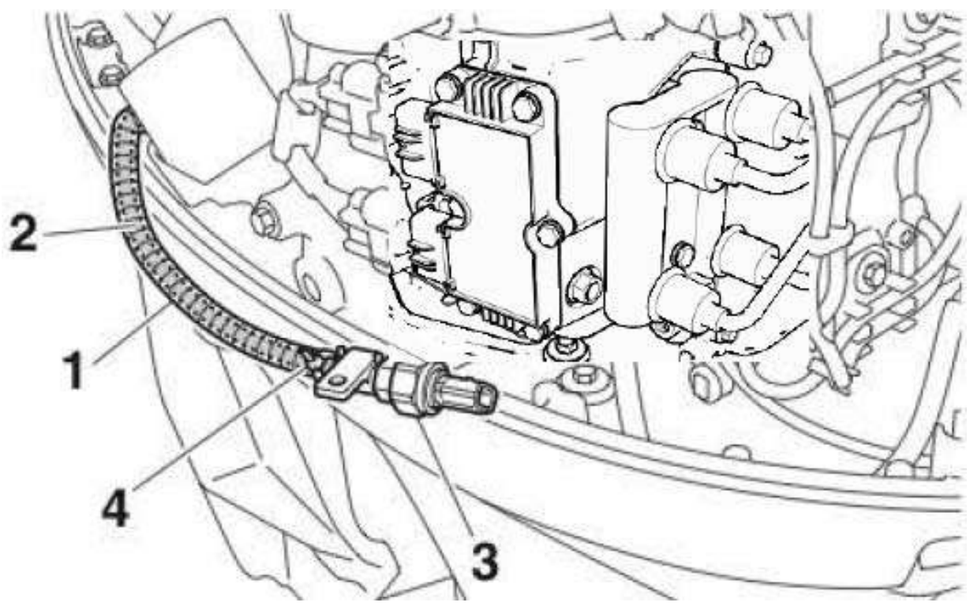
3. Route the speedometer hose "1" from the PORT side.



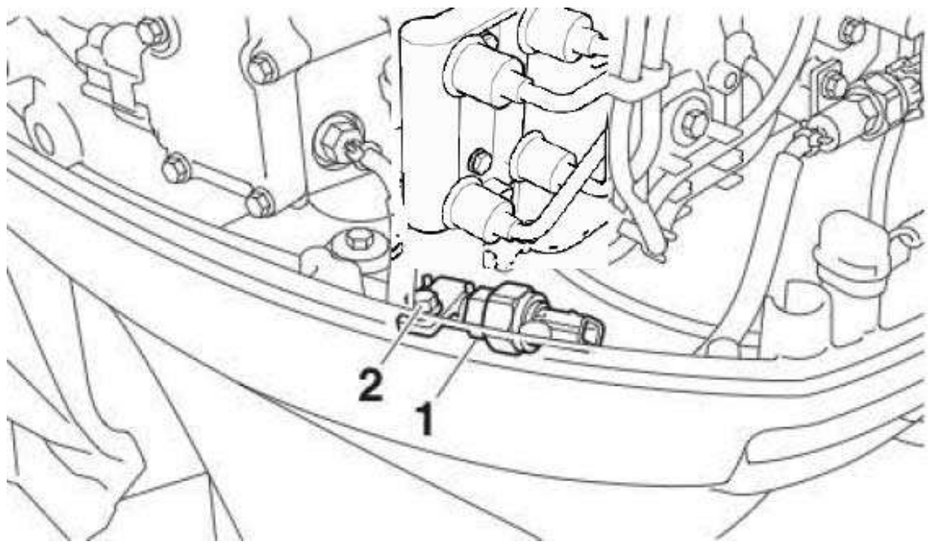
4. Cut the corrugated tube "1" to 520 mm (20.5 in).

5. Pass the speedometer hose "2" through the corrugated tube "1".

6. Connect the speedometer hose "2" to the speed sensor adapter "3", and then fasten it using the plastic tie "4".



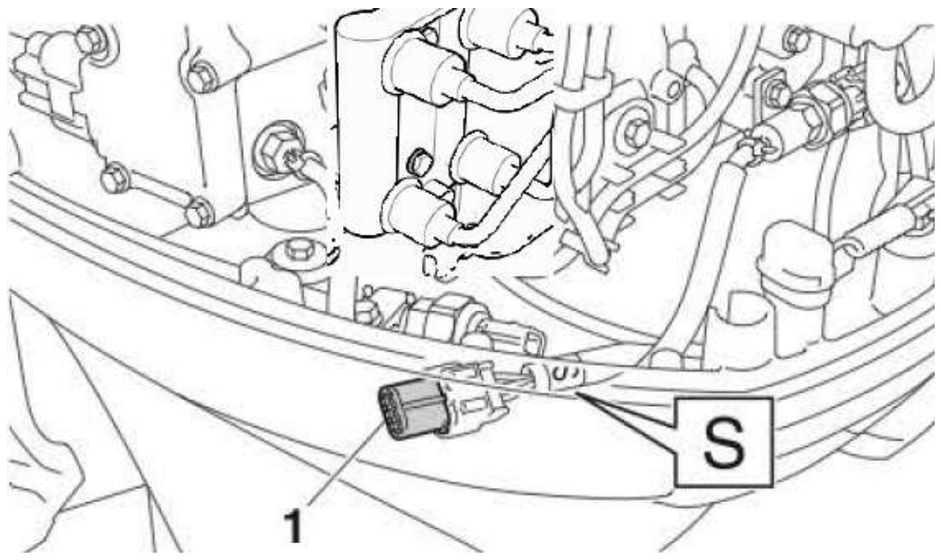
7. Install the speed sensor adapter "1" to the bottom cowling, and then tighten the speed sensor adapter bolt "2" to the specified torque.



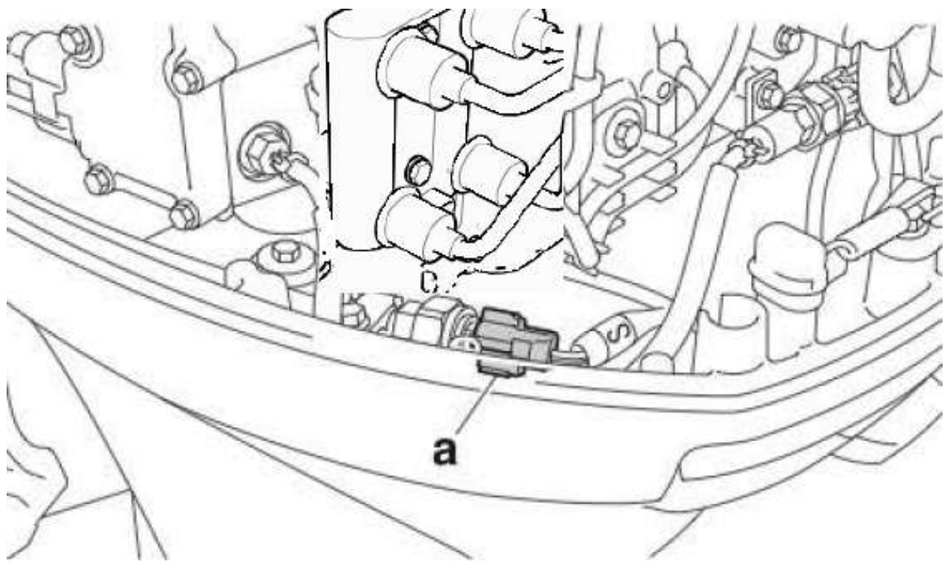
Speed sensor adapter bolt "2"
10 Nm (1.0 kgf·m, 7.4 ft·lb)

8. Remove the cap "1".

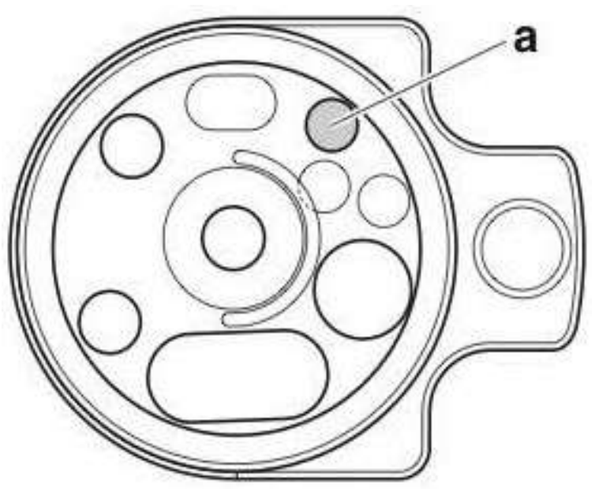
TIP:
The speed sensor lead is marked with "S".



9. Connect the speed sensor coupler "a".



10. Seal the hole "a" for the speedometer hose with the rubber seal included in the kit.



Installing the tilt limiter

The models with a dual steering cable cannot be fitted with a tilt limiter.

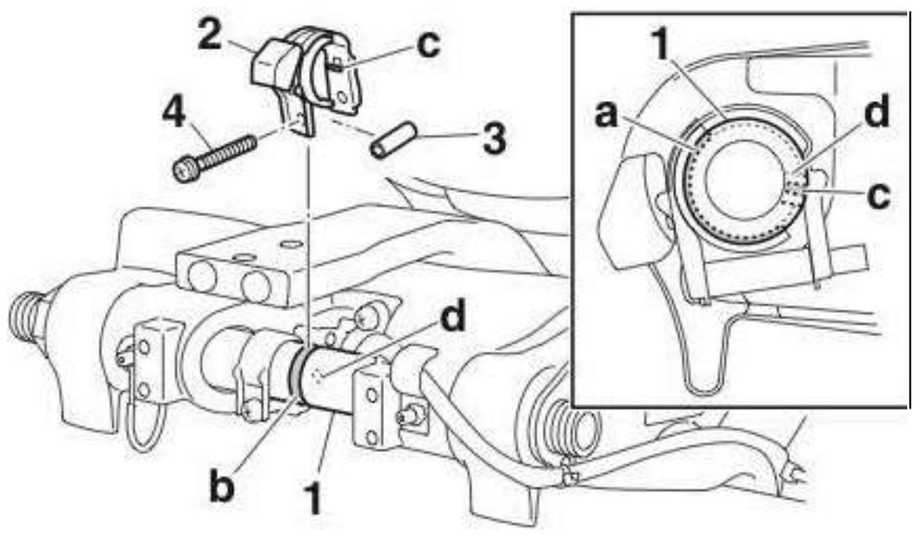
1. Disconnect the battery cable from the battery.

2. If there is any grease, clean the surface of through tube "1" to which the holder is to be installed.

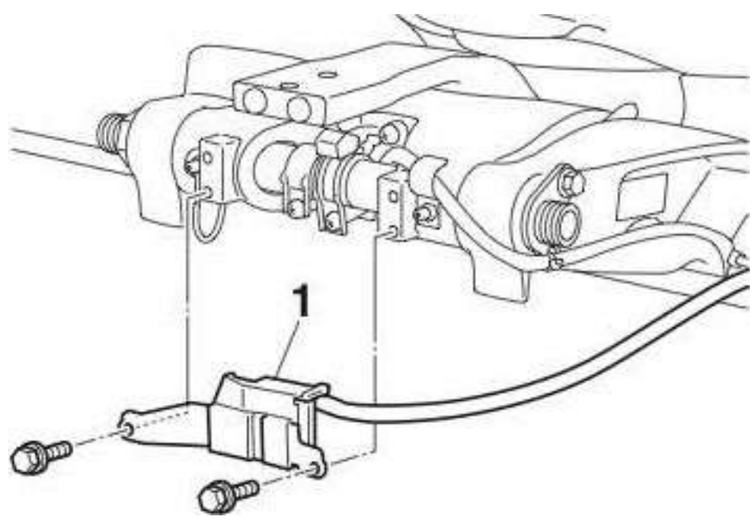
3. Install the holder "2" so that the protrusion "a" on the magnet lever is aligned with the groove "b" in the through tube "1", and the protrusion "c" on the holder is aligned with the hole "d" in the through tube "1".

4. Install the collar "3" and tighten the clamp screw "4" temporarily.

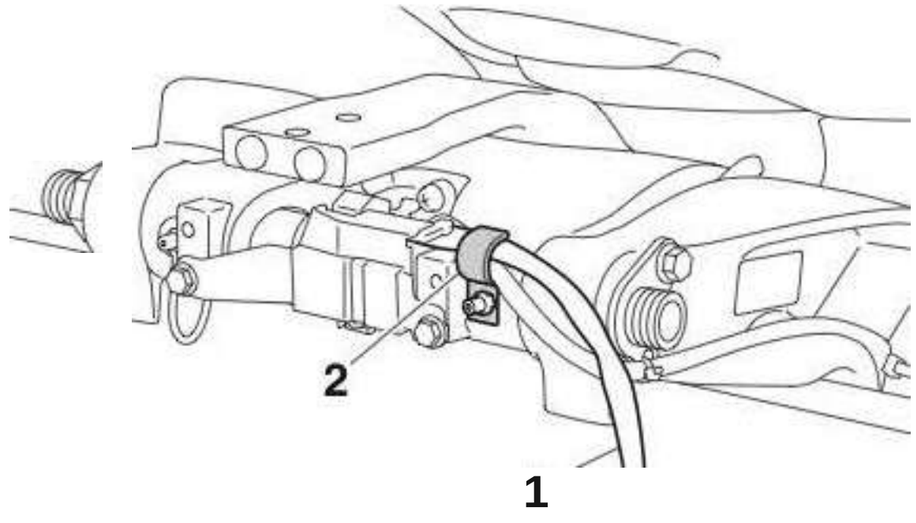
TIP:
Tighten the clamp screw "4" to the extent that the magnet lever can be moved manually to adjust the tilt limiter.



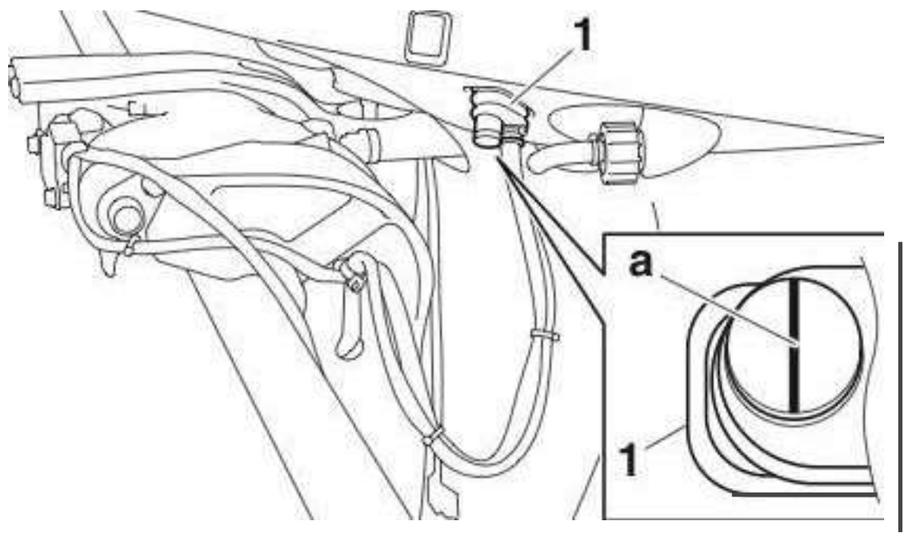
5. Install the sensor "1" on the swivel bracket.



6. Fasten the tilt limiter lead "1" using the holder "2".

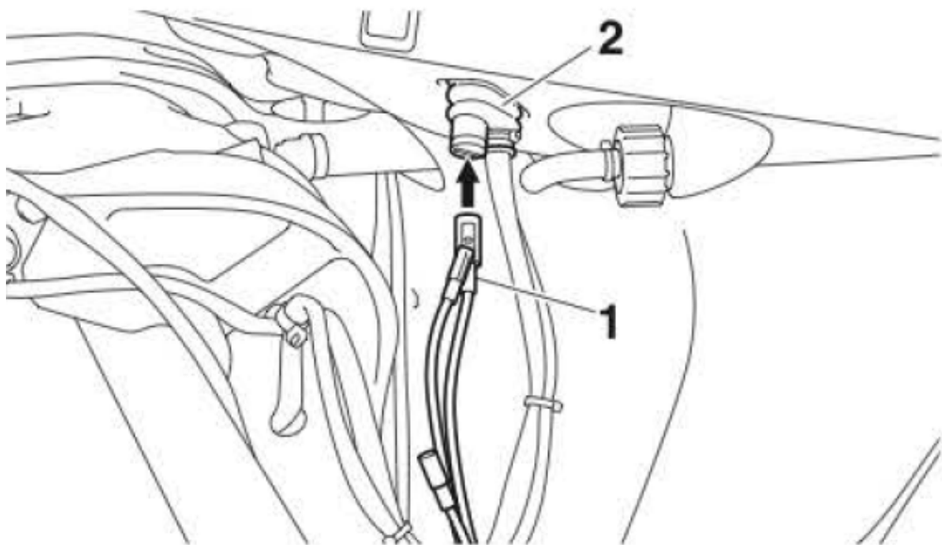


7. Make a slit "a" in the end of the grommet "1".



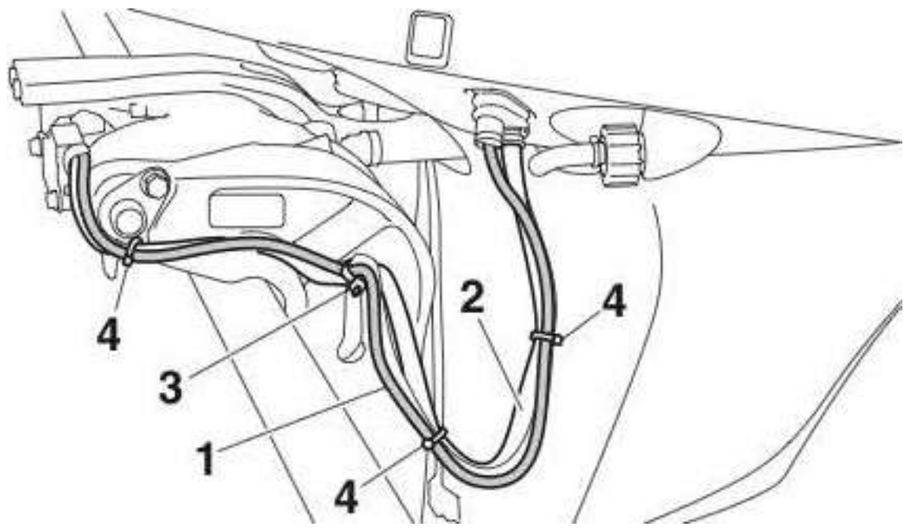
8. Route the tilt limiter leads "1" through the slit in the grommet "2" and into the bottom cowling.

TIP:
Pass the tilt limiter leads "1" one by one through the slit in the grommet "2".



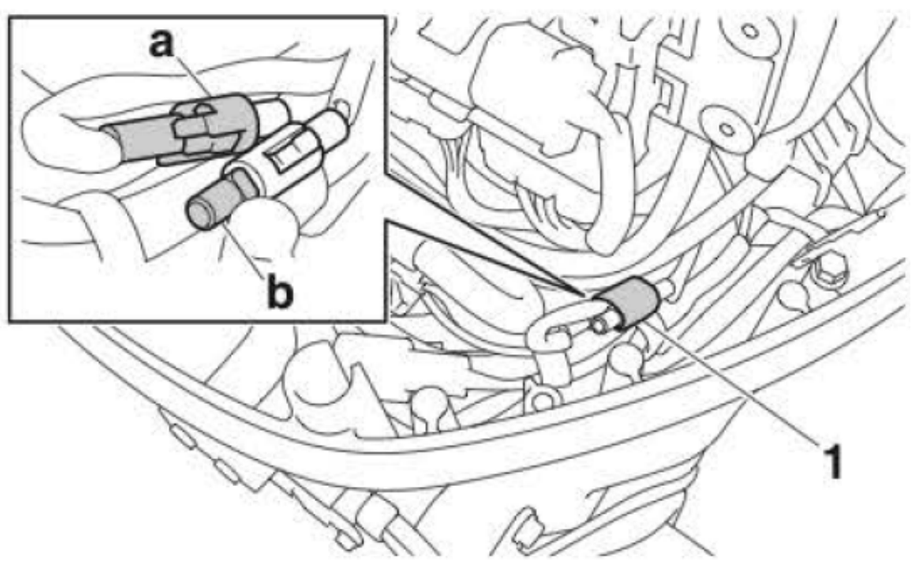
9. Remove the plastic ties that hold the trim sensor lead.

10. Route the tilt limiter lead "1" in the same manner as the trim sensor lead "2", and then fasten them using the plastic tie "3" and new plastic ties "4" at the positions where original plastic ties were installed.

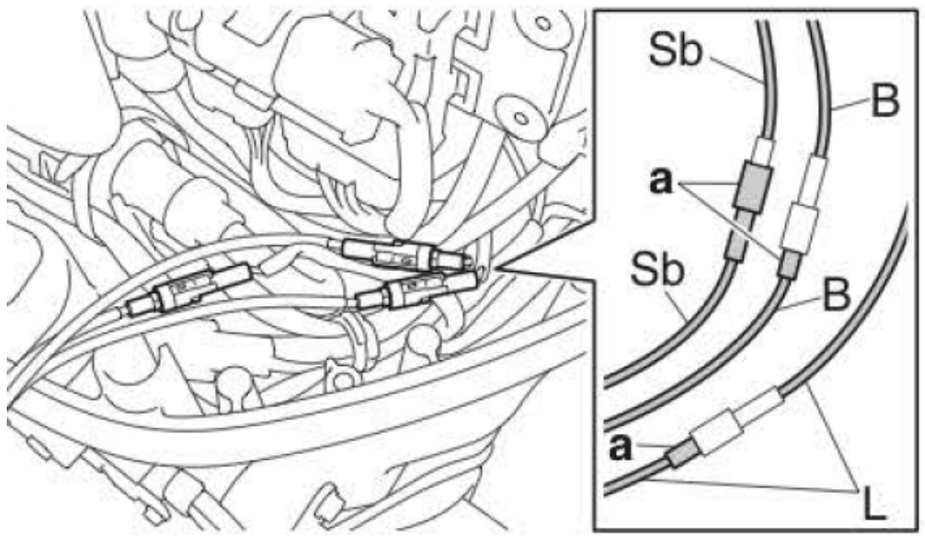


11. Remove the yellow tape "1".

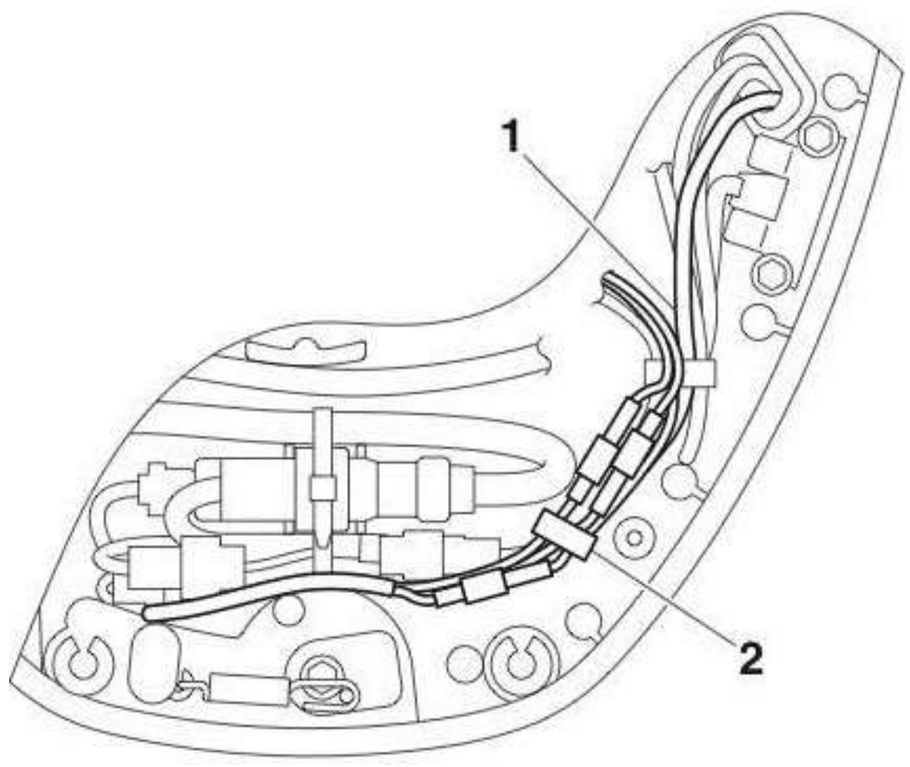
12. Disconnect the tilt limiter coupler "a" and remove the cap "b".



13. Connect the tilt limiter couplers at the main harness side with the tilt limiter couplers "a" at the tilt limiter side to the same colored wires.



14. Route the tilt limiter lead "1", and then fasten it using the clamp "2".



Setting the tilt limiter

⚠ WARNING

- **Check that the outboard motor is mounted securely.**
- **Never get under the outboard motor while it is tilted.**

NOTICE

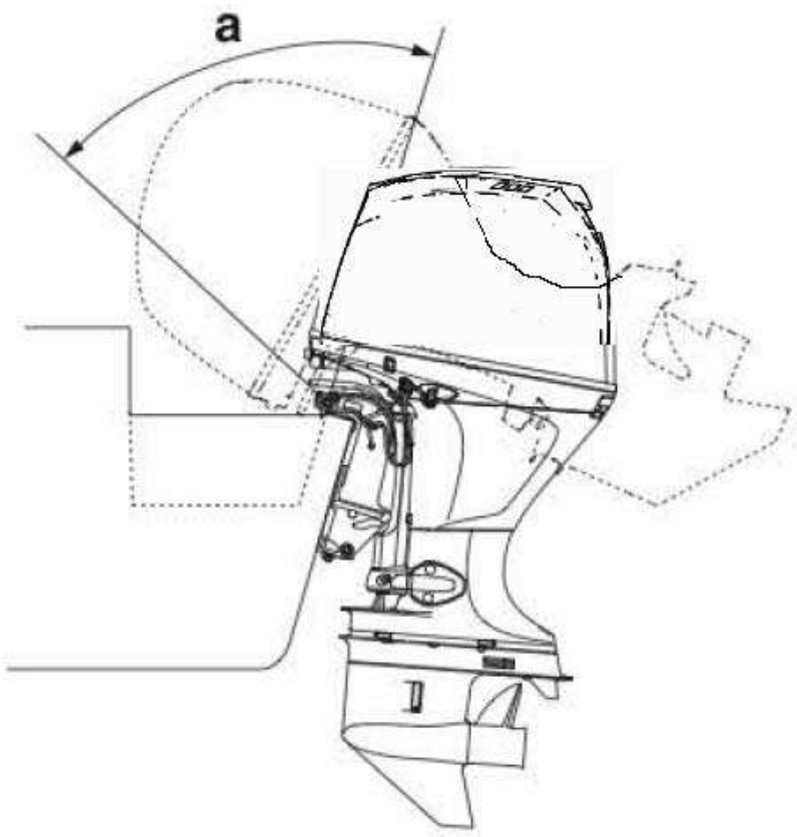
Make sure to keep the clearance of 50.8 mm (2.0 in) or more between the outboard motor and the motor well.

1. Check that there is no interference between the steering system and the tilt limiter when the outboard motor is steered to the left and right.

2. Connect the battery cables.

3. Decide the tilt up angle "a".

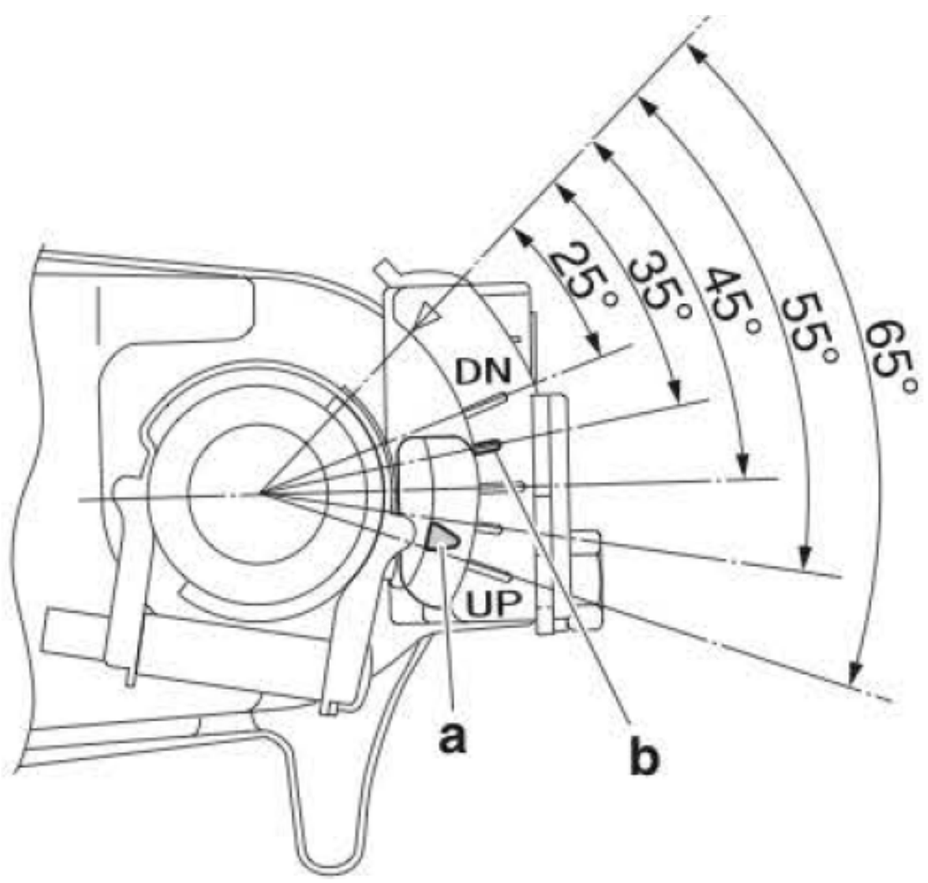
TIP:
The tilt up angle can be set at any tilt setting range.



4. Align the mark "a" on the magnet with the desired angle indicated on the sensor.

TIP:
The scales on the sensor indicate the approximate angles from the full trim down position.

Example:
If the desired tilt up angle is 35°, align the mark "a" on the magnet with the scale mark "b" on the sensor.

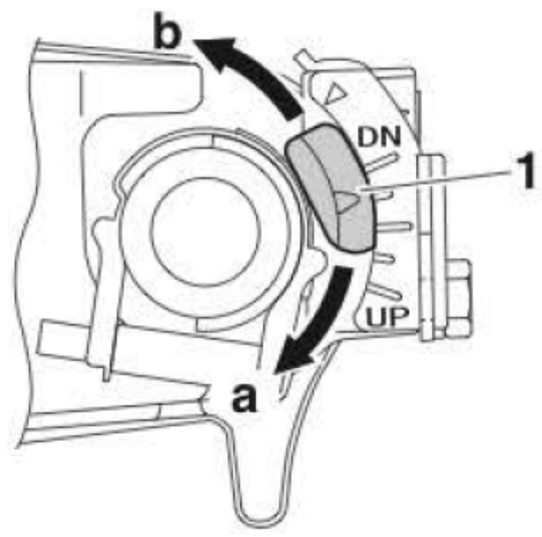


5. Operate the PTT switch on the bottom cowling to tilt the outboard motor up.

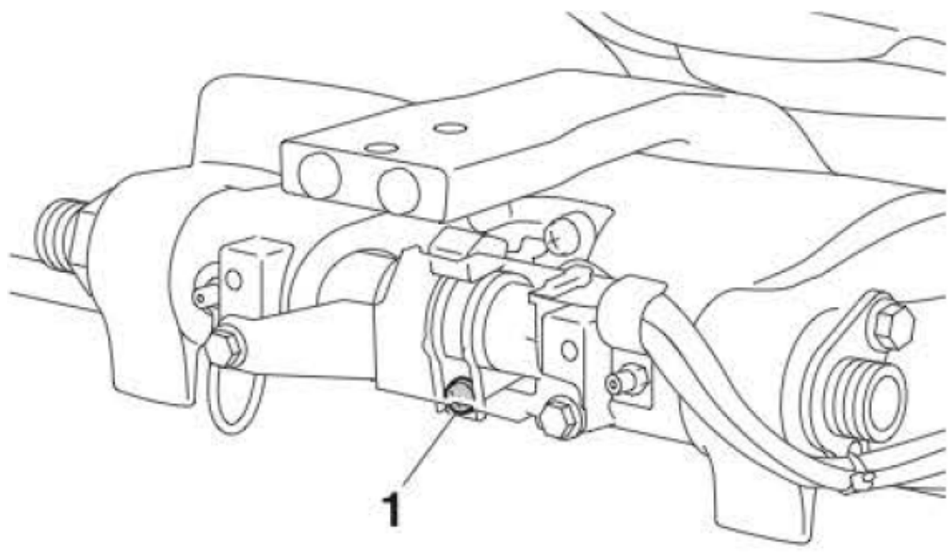
6. Check that the outboard motor stops at the set position.

7. Tilt the outboard motor down to adjust the position of the magnet "1" if the setting angle needs to be adjusted.

TIP:
- To adjust the tilt up angle higher: "a"
- To adjust the tilt up angle lower: "b"



8. Tighten the clamp screw "1" to the specified torque, and then recheck the tilt up angle.

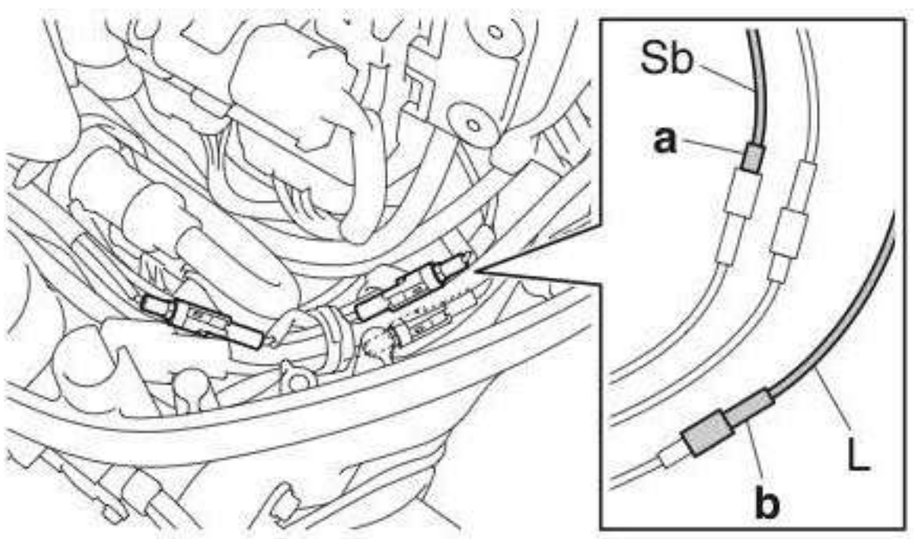


Clamp screw "1"
2 Nm (0.2 kgf·m, 1.5 ft·lb)

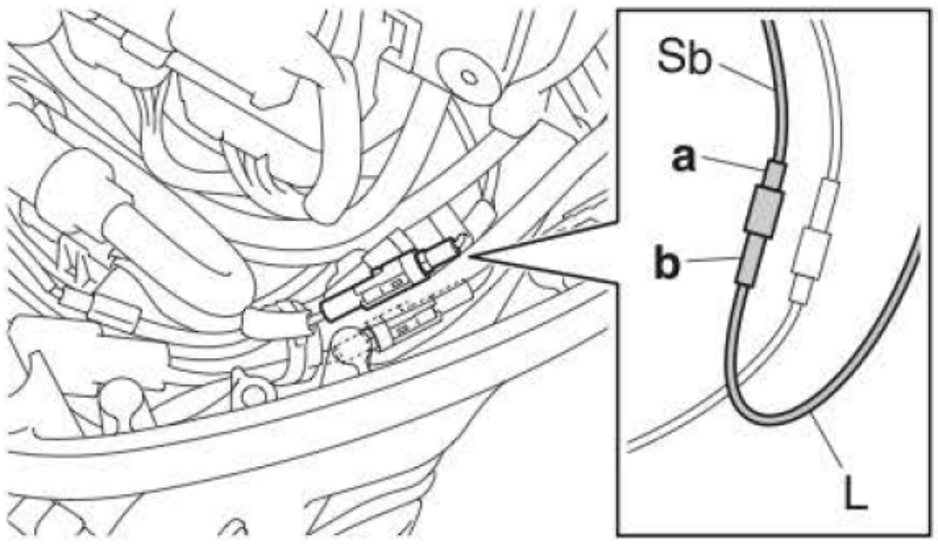
Deactivating the tilt limiter

To fully tilt the outboard motor up, deactivate the tilt limiter according to the following procedure.

1. Disconnect the tilt limiter couplers "a" and "b".

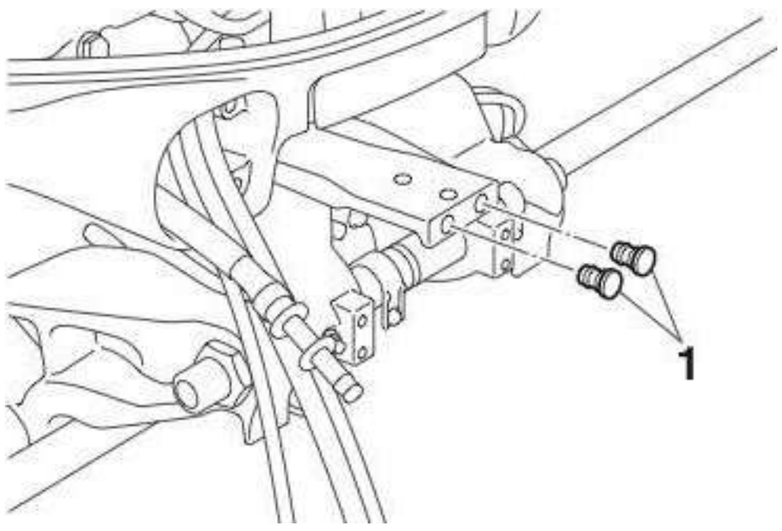


2. Connect the tilt limiter couplers "a" and "b".

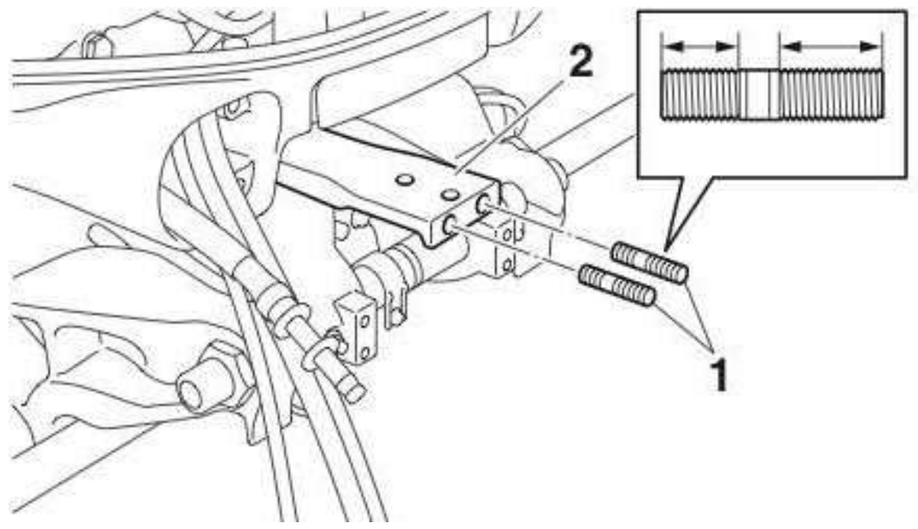


Installing the twin engine tie-bar with steering cable

1. Remove the plugs "1".



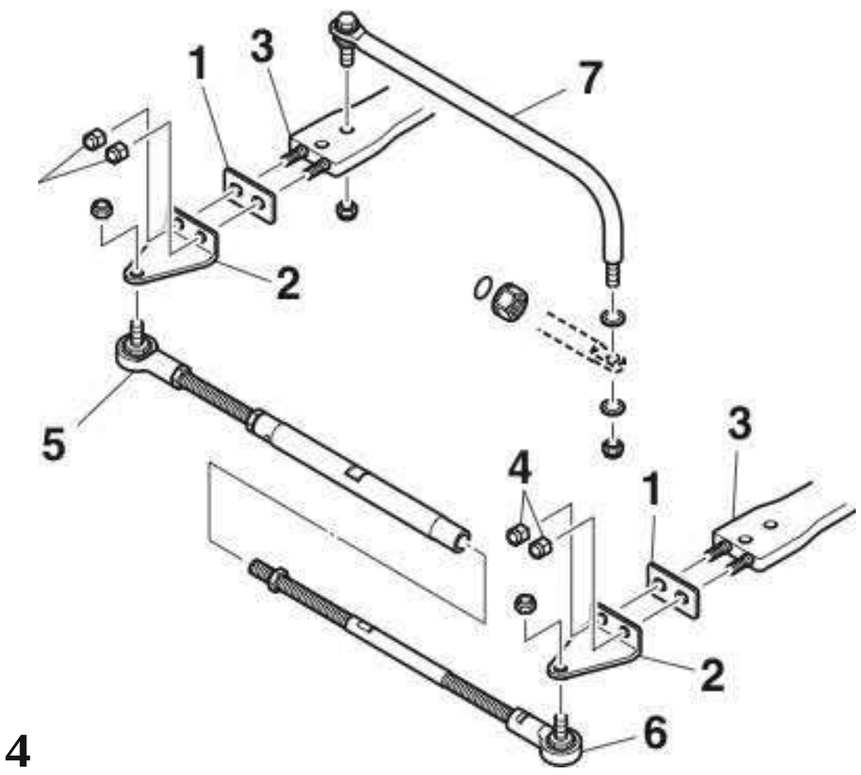
2. Install the stud bolts "1" to the steering arm "2", and then tighten them to the specified torque.



Stud bolt "1"
20 Nm (2.0 kgf·m, 14.8 ft·lb)

3. Install the plates "1" and steering hooks "2" to the steering arms "3", and then tighten the steering hook nuts "4" to the specified torque.

4. Install the tie-bars "5" and "6" and steering guide "7".



Steering hook nut "4"
40 Nm (4.0 kgf·m, 29.5 ft·lb)

5. Adjust the twin engine tie-bar. See "Adjusting the twin engine positions" (3-7).

H-COP

Installing H-COP

For further information, see the HIDEA SECURITY SYSTEM INSTALLATION MANUAL .

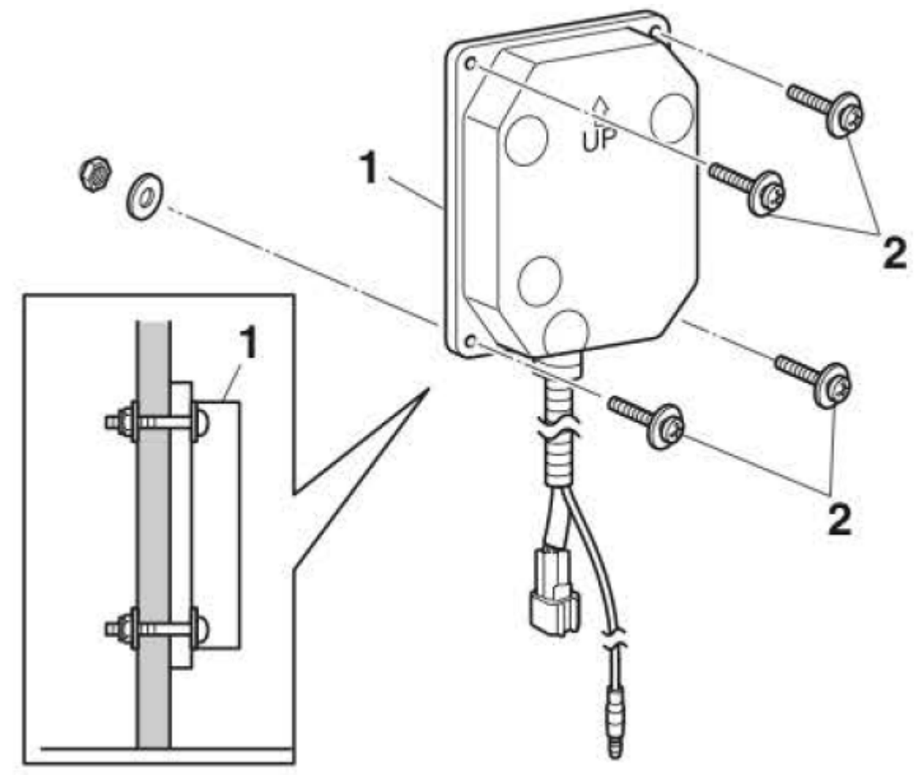
NOTICE

- **Install the remote control receiver so that the "UP" mark is facing up.**
- **Do not install the remote control receiver in a location where it will be exposed to water.**
- **Do not cover the remote control receiver with metal objects. Otherwise, signals may not be received.**

1. Install the remote control receiver "1", and then tighten the remote control receiver screws "2" to the specified torque.

TIP:

Mount the remote control receiver within 3 m (10 ft) from the helm.



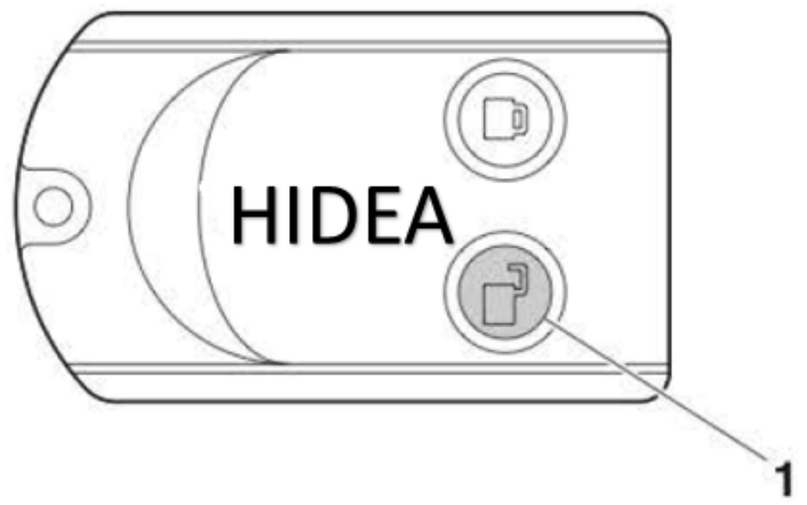
Remote control receiver screw "2"
4 Nm (0.4 kgf·m, 3.0 ft-lb)

2. Connect the H-COP wires. See "System diagram" (3-29).

Registering the remote control receiver ID to the ECM

1. Check that the engine start switch is OFF.

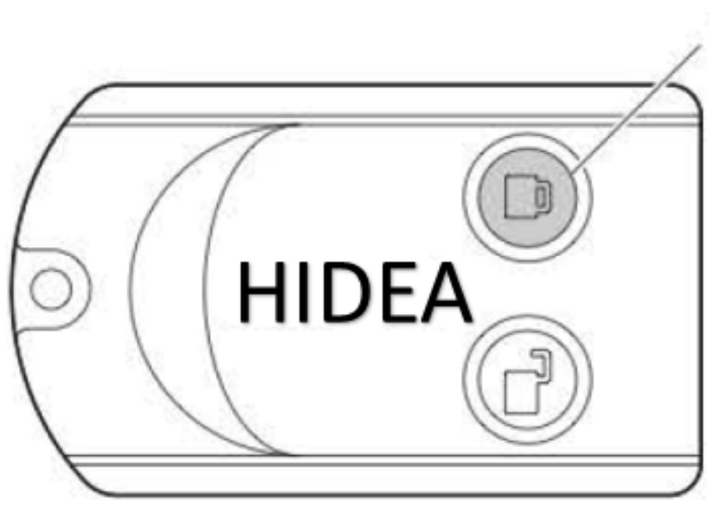
2. Push the unlock button "1" of the remote control transmitter. The buzzer of the remote control receiver sounds 2 short beeps.



3. Turn the engine start switch to ON. The buzzer of the remote control rece1ver sounds 1 medium beep.

4. Turn the engine start switch to OFF. Initial registration is complete. H-COP is unlocked.

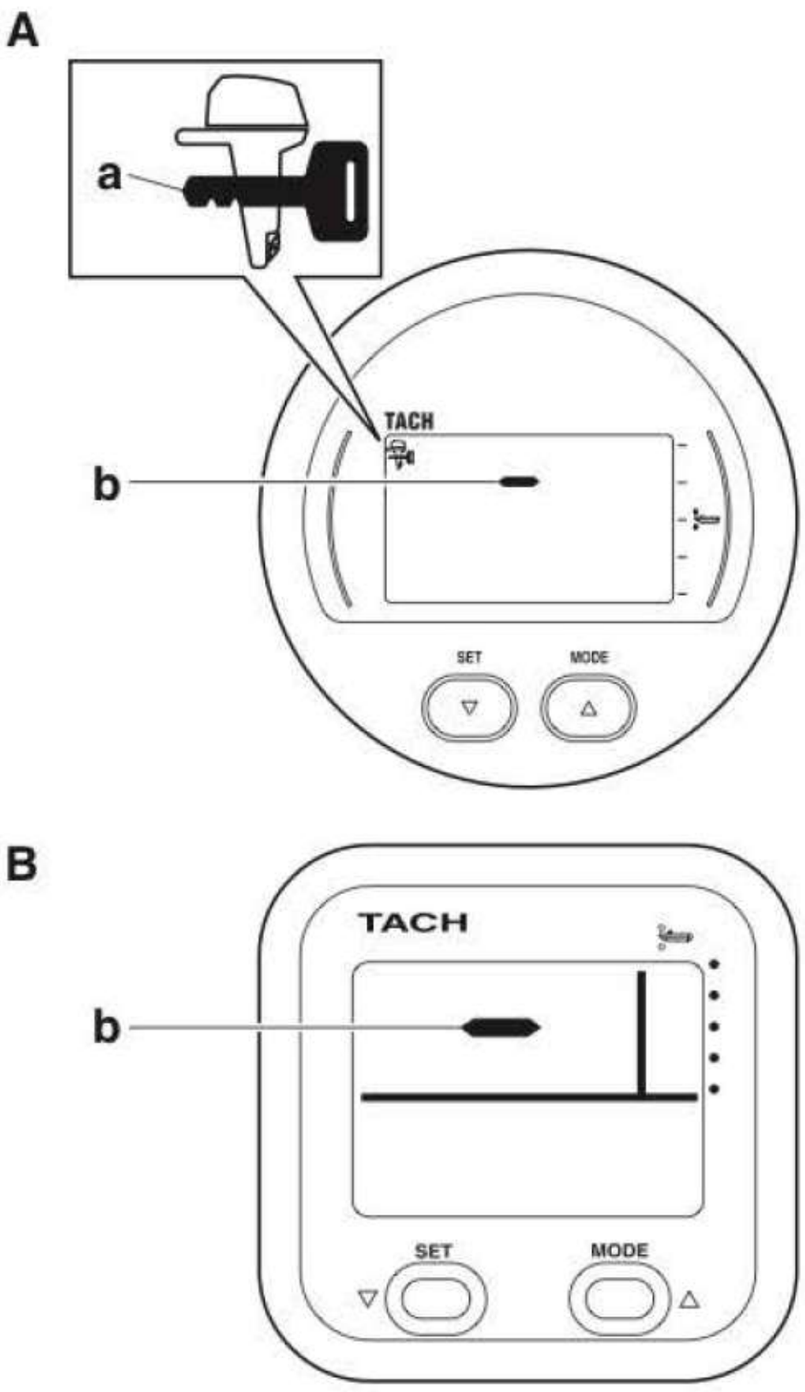
5. Push the lock button "1" of the remote control transmitter. Check that the buzzer of the remote control receiver sounds 1 short beep.



6. Turn the engine start switch to ON.

TIP:

- If the outboard motor is equipped with the 6Y8 multifunction meter (round style), H-COP icon "a" and "-" mark "b" are displayed on the tachometer when the engine start switch is turned to ON.
- If the outboard motor is equipped with the 6Y8 multifunction meter (square style), "-" mark "b" is displayed on the tachometer when the engine start switch is turned to ON.

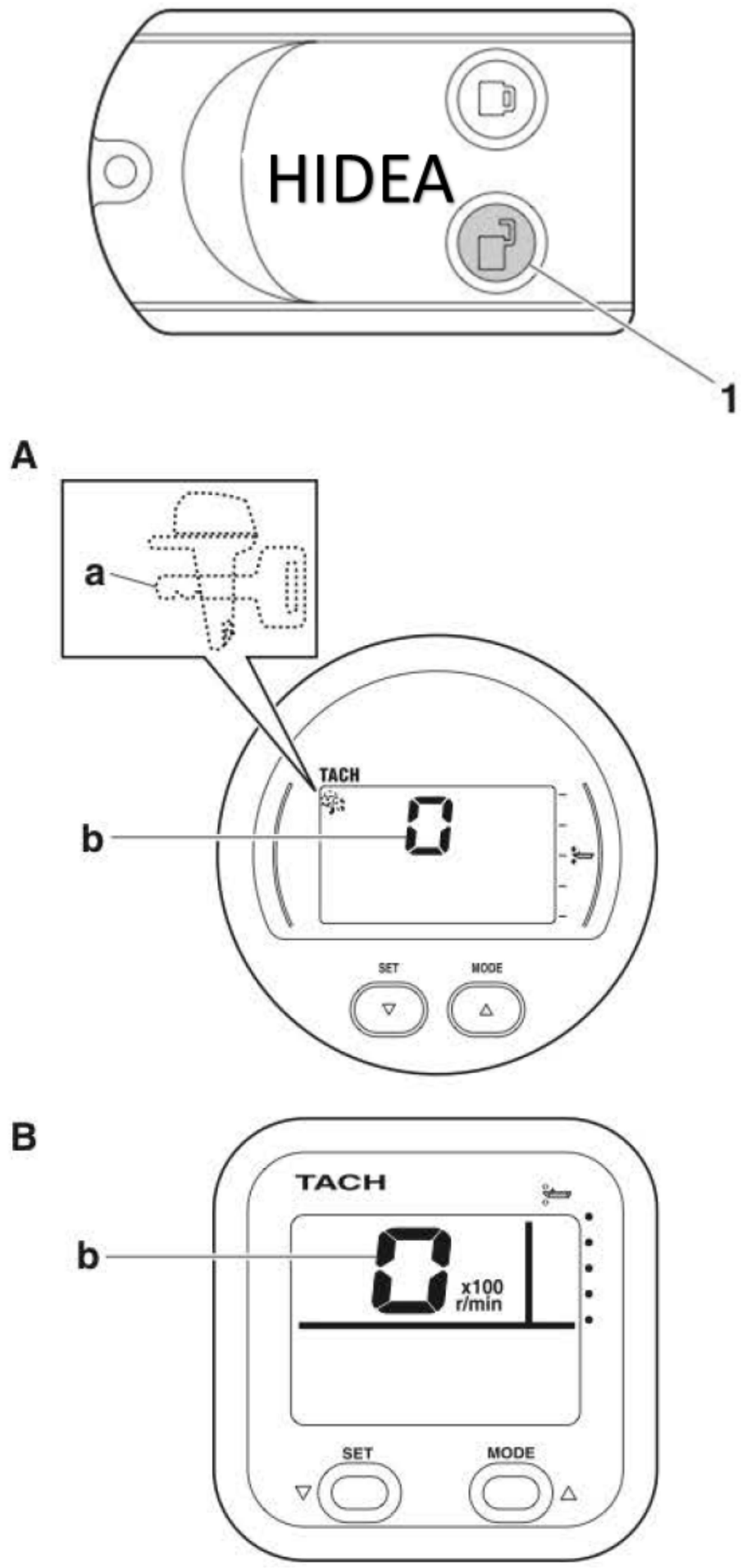


A. 6Y8 multifunction meter (round style)
B. 6Y8 multifunction meter (square style)

7. Push the unlock button "1" of the remote control transmitter. Check that the buzzer of the remote control receiver sounds 2 short beeps.

TIP:

- If the outboard motor is equipped with the 6Y8 multifunction meter (round style), H-COP icon "a" will disappear and "0" mark "b" will be displayed on the tachometer when the engine start switch is turned to ON.
- If the outboard motor is equipped with the 6Y8 multifunction meter (square style), "0" mark "b" is displayed on the tachometer when the engine start switch is turned to ON.



A. 6Y8 multifunction meter (round style)
B. 6Y8 multifunction meter (square style)

8. Turn the engine start switch to OFF.

Battery installation

⚠ WARNING

Make sure to connect the battery properly and select the proper cable sizes. Otherwise, a fire could result.

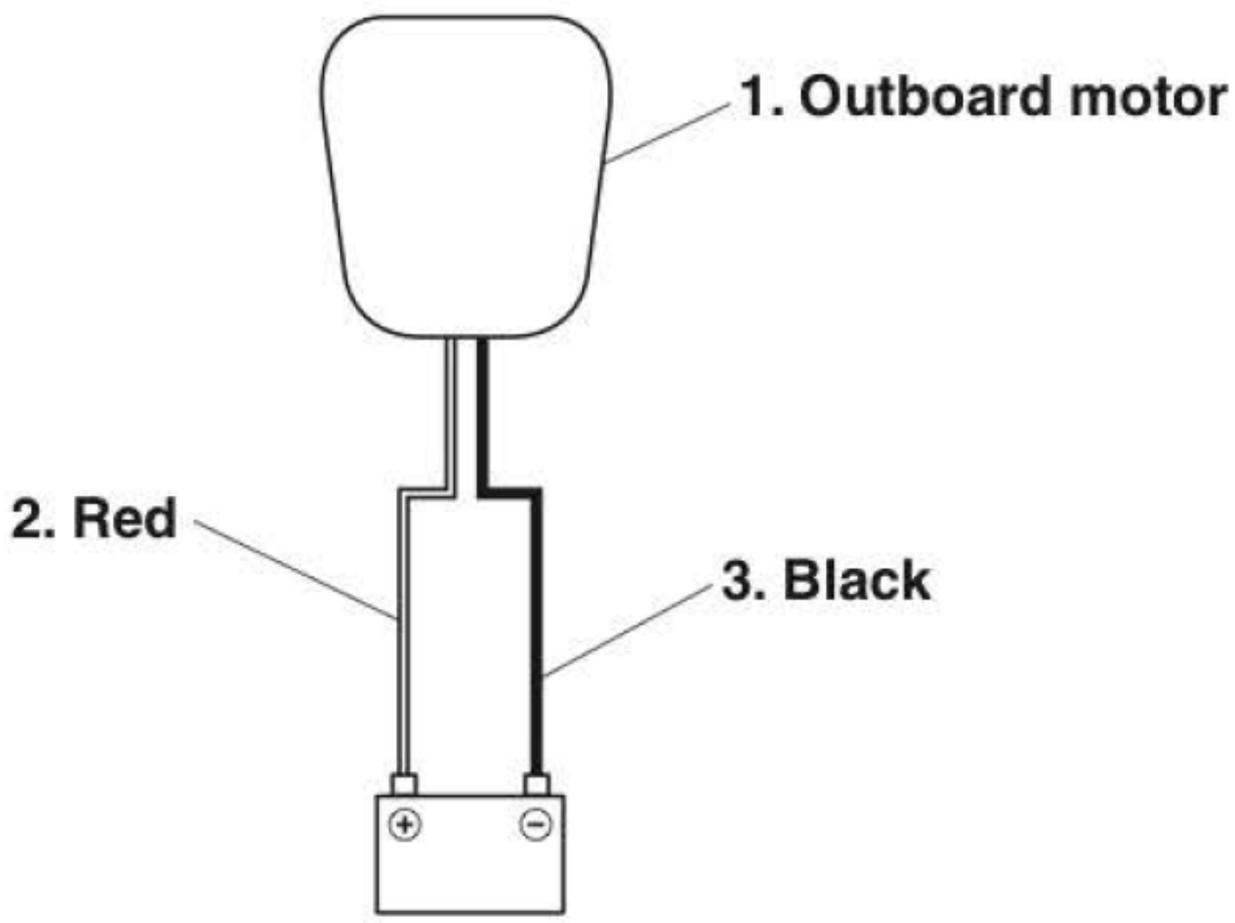
NOTICE

Do not reverse the battery connections. Otherwise, the charging system could be damaged.

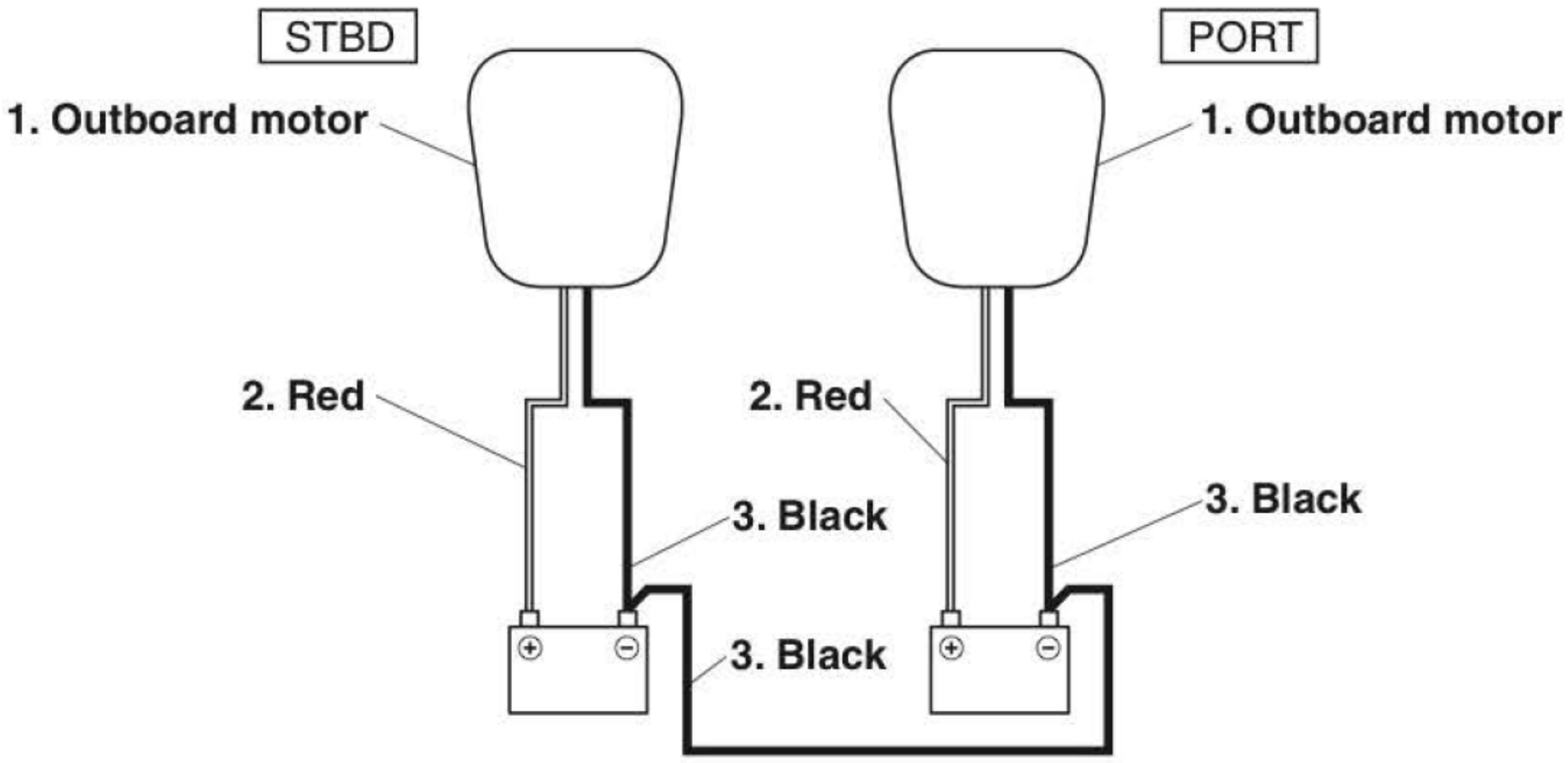
Battery wiring

⚠ WARNING

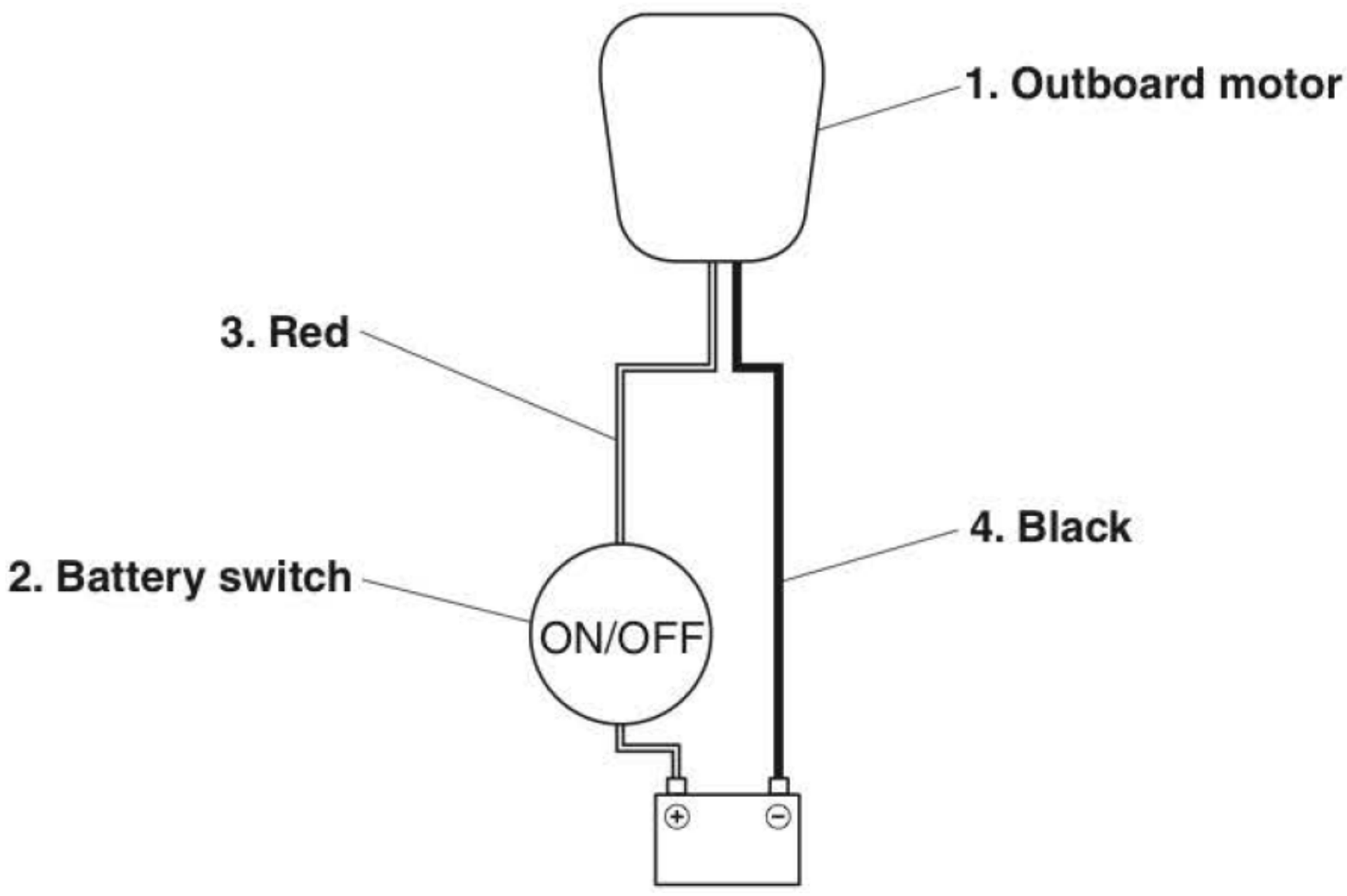
When using a dual battery installation, a negative battery cable must be installed between both engine batteries. This cable must be sized equivalent to the engine battery cables or larger AWG cable size in accordance with ABYC specifications.



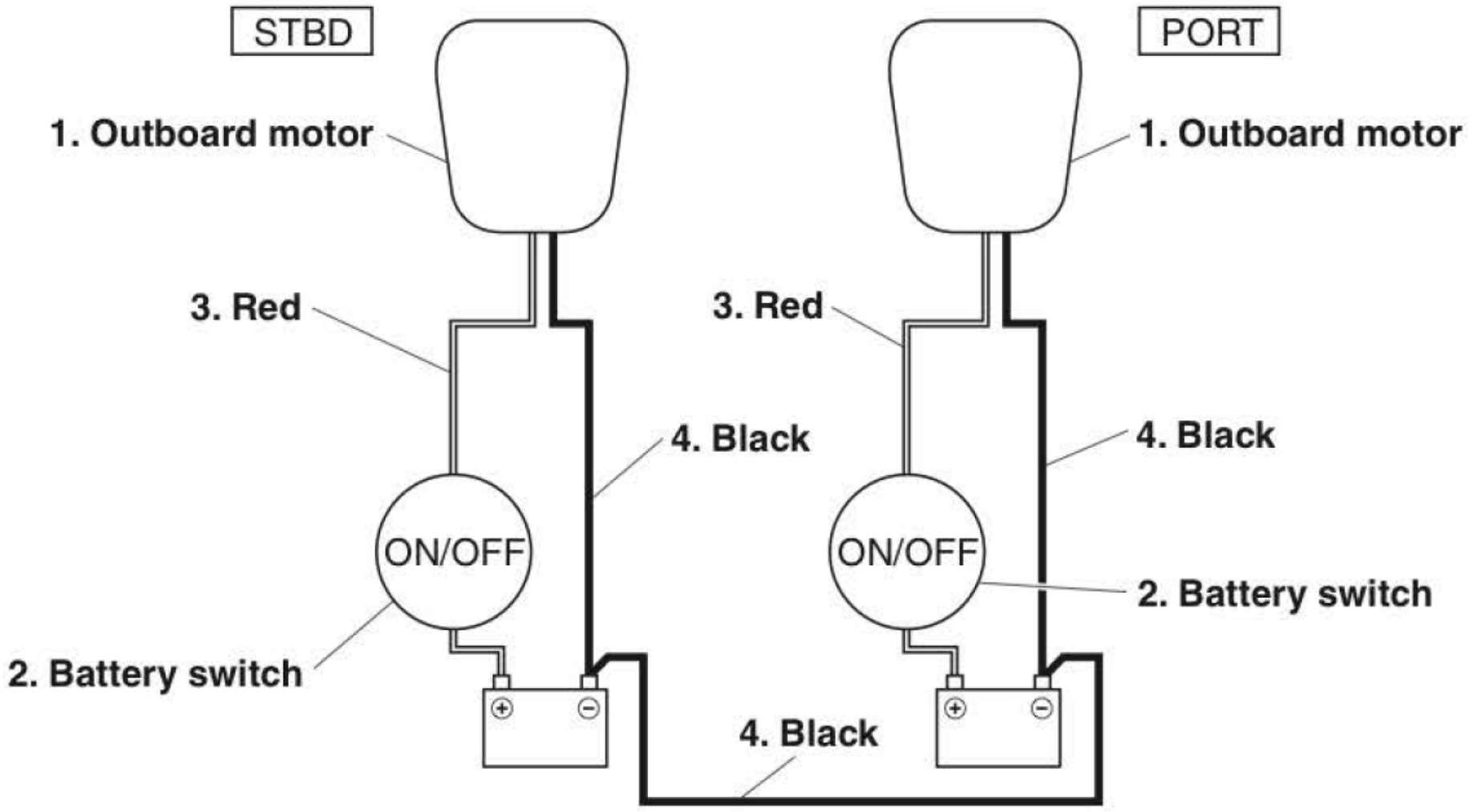
1. Outboard motor
2. Red
3. Black



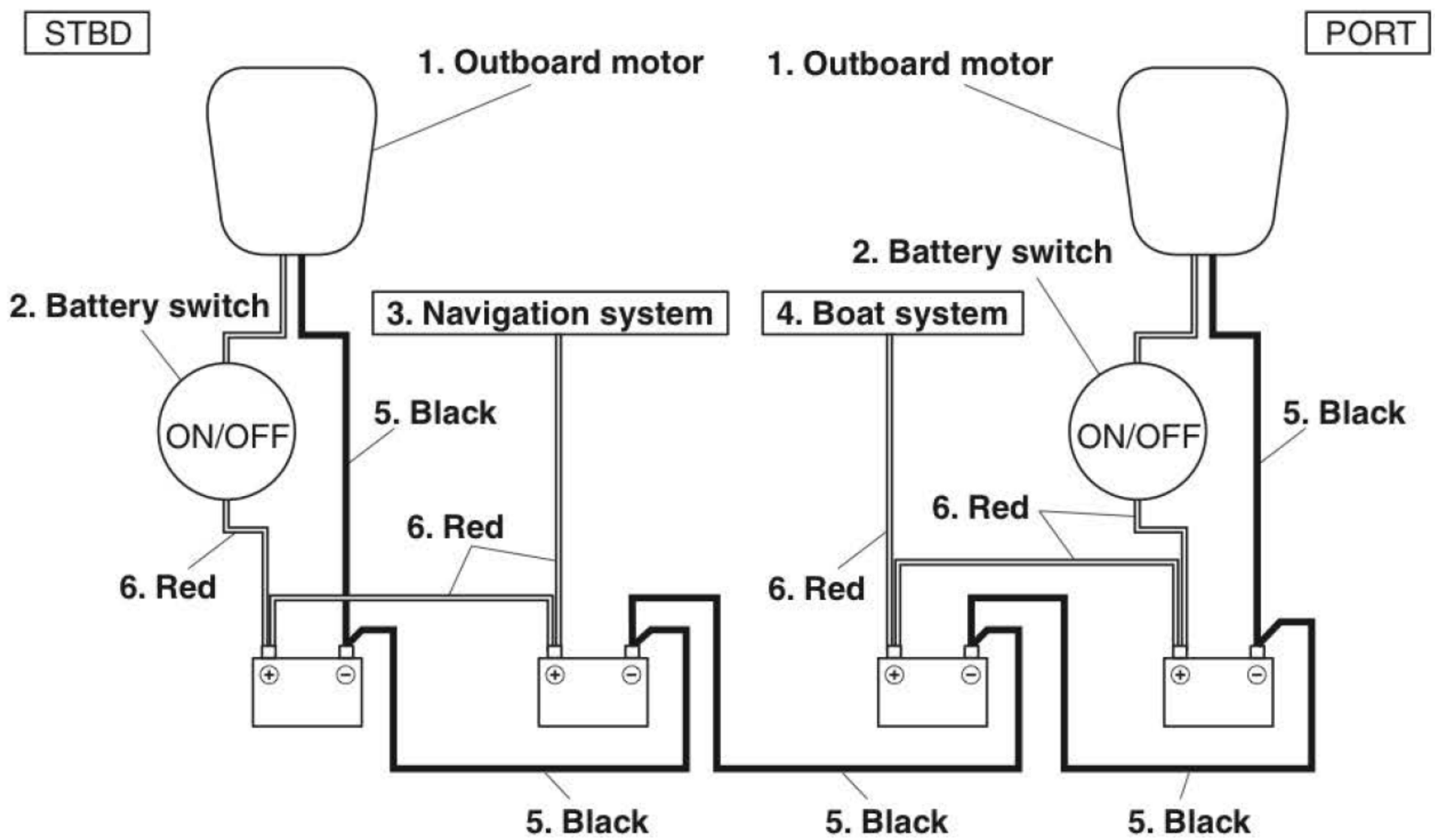
1. Outboard motor
2. Red
3. Black



1. Outboard motor
2. Battery switch
3. Red
4. Black



1. Outboard motor
2. Battery switch
3. Red
4. Black

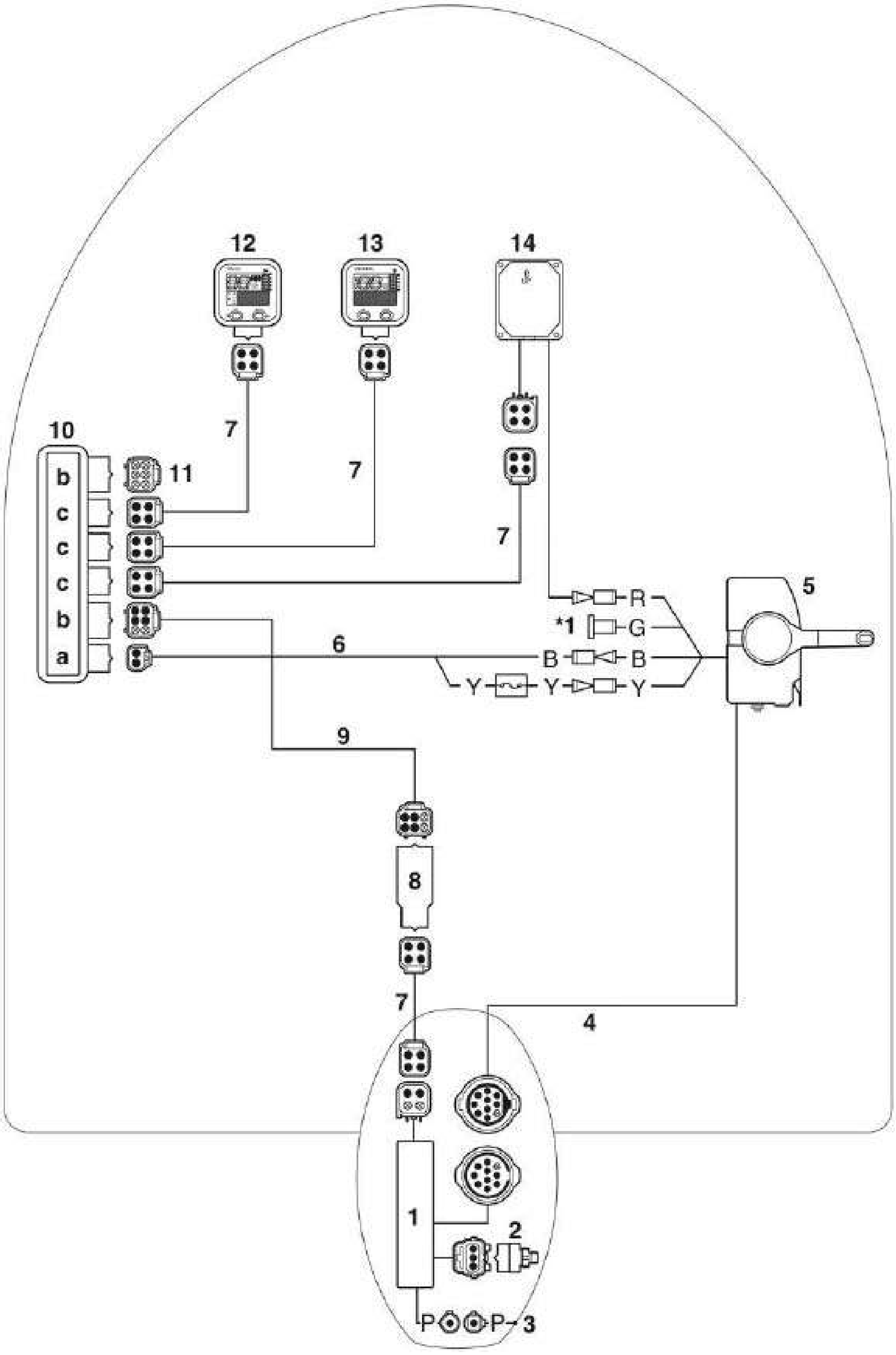


1. Outboard motor
2. Battery switch
3. Navigation system
4. Boat system
5. Black
6. Red

— MEMO-

System diagram

Single engine application (6Y8 Multifunction Meters)

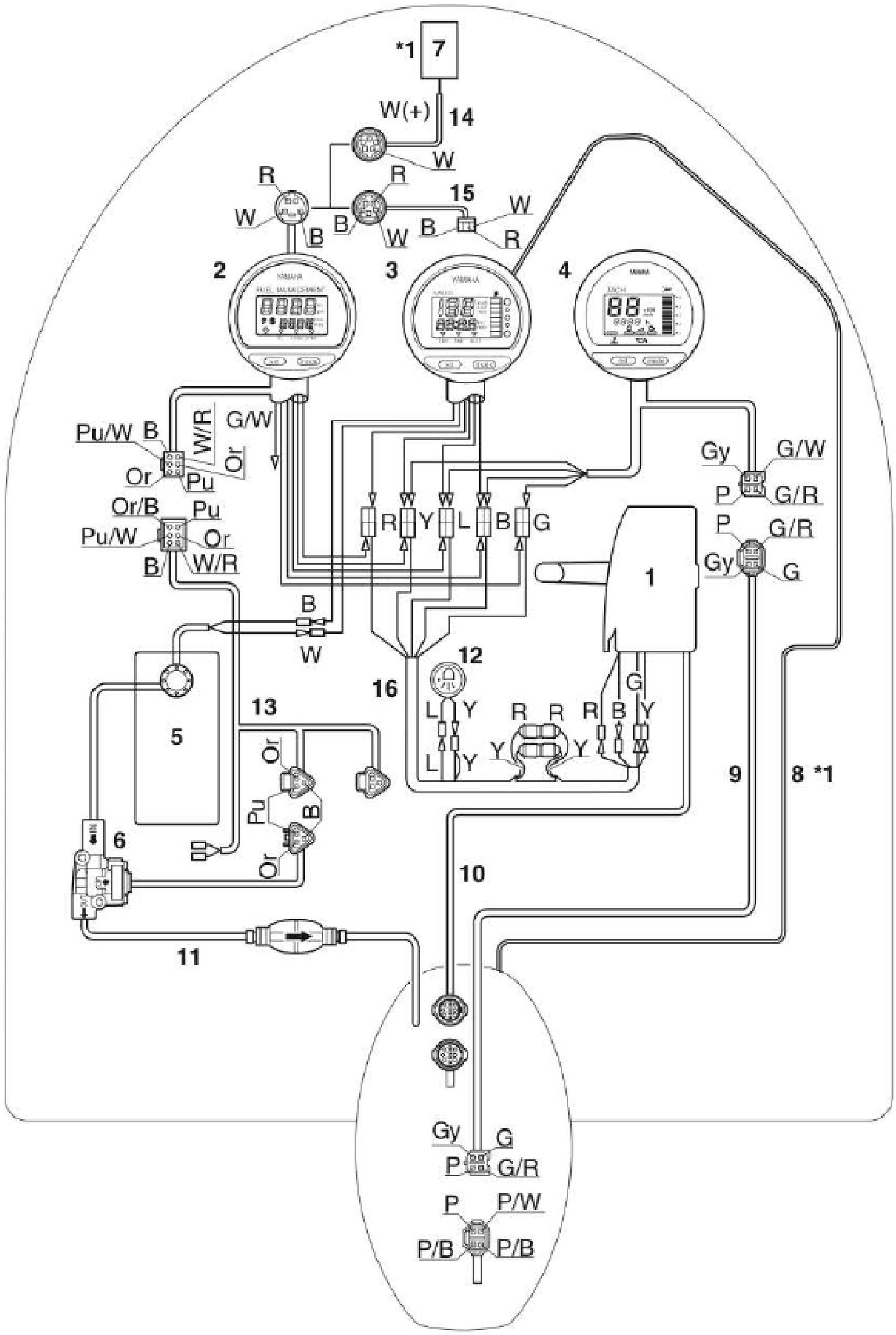


Ref. No.	Part name	Part No.	Remarks
1	Engine ECM	—	
2	Speed sensor kit	—	
3	Trim sensor	—	
4	Main wire harness	—	
5	Remote control box	—	
		—	w/ tilt switch
		—	For additional trim switch
6	Power supply wire	—	w/ 10 A fuse, 2.4 m (8ft)
7	Pigtail bus wire	—	0.3 m (1 ft)
		—	0.6 m (2ft)
		—	0.9 m (3ft)
		—	1.8 m (6 ft)
		—	2.7 m (9ft)
		—	3.6 m (12ft)
8	Single hub	—	w/ resistor, 4-6P, White
9	Main bus wire	—	0.3 m (1 ft)
		—	3.0 m (10ft)
		—	4.6 m (15ft)
		—	6.1 m (20ft)
		—	7.6 m (25ft)
		—	9.1 m (30ft)
10	Multi-hub	—	w/ resistor cap, Black
11	Resistor cap	—	6P, Gray
12	Tachometer	—	
13	Speedometer	—	
14	Immobilizer (H-COP)	—	
		—	

a. Power port
b. Bus port
c. Device port

*1. Attach the waterproof cap to the open terminal.

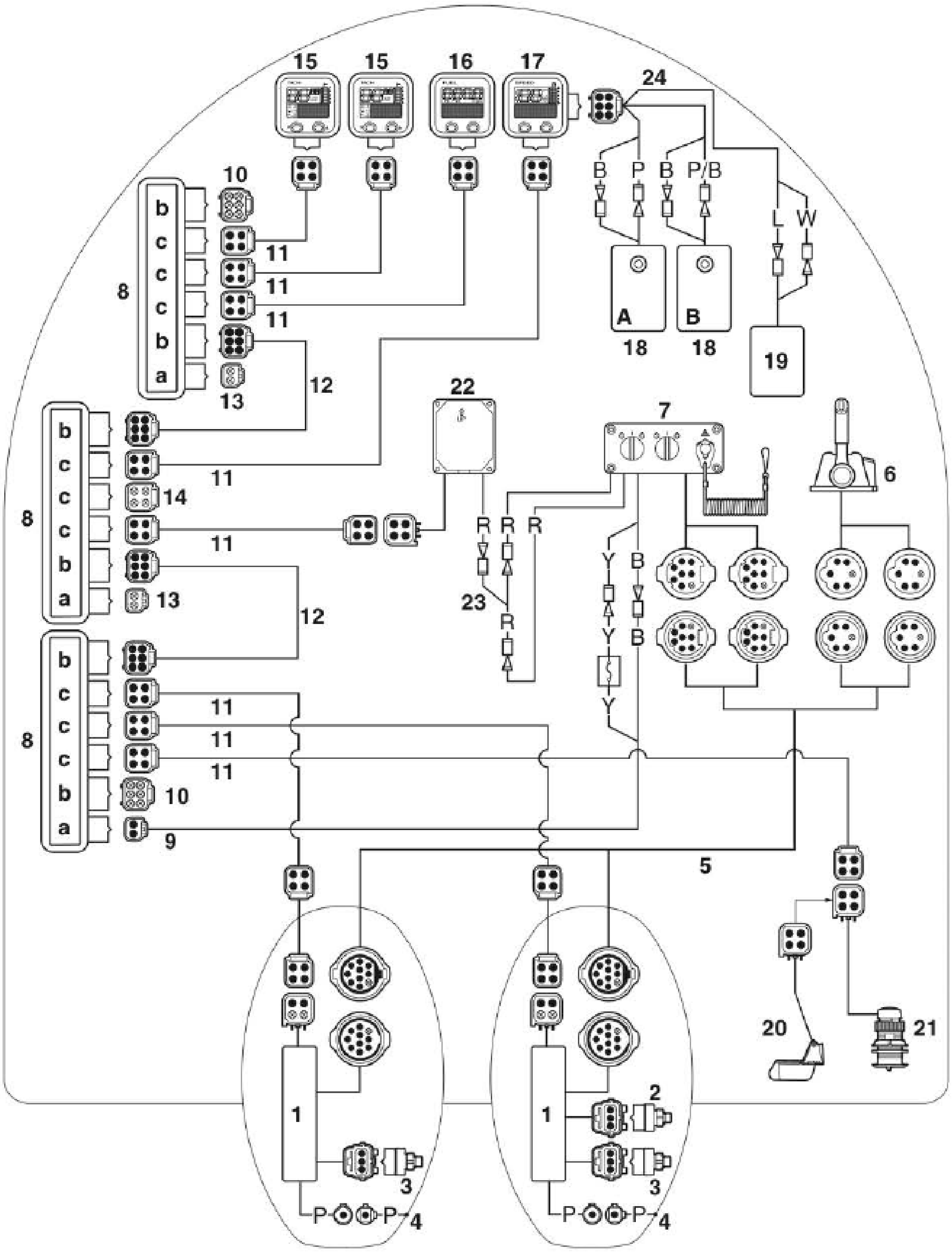
Single engine application (conventional gauge)



Ref. No.	Part name	Part No.	Remarks
1	Remote control box		
			w/ tilt switch
			For additional trim switch
2	Fuel management gauge		
3	Speedometer		
4	Tachometer		
5	Fuel tank (fuel level sensor)	—	
6	Fuel flow sensor		
7	GPS	—	NMEA0183
8	Speedometer hose		6 m (20ft)
9	Conventional gauge harness		5m(16ft)
			6 m (20ft)
			7 m (23ft)
			8 m (26ft)
			9 m (30ft)
			10.5 m (34 ft)
10	Main wire harness	—	
11	Fuel hose	—	
12	Lamp switch		0.1 m (0.33 ft)
			0.1 m (0.33 ft)
13	Fuel management gauge harness		8.0 m (26ft)
14	GPS wire		NMEA0183
15	Wire lead for speedometer		
16	Wire lead for digital meter		2.5 m (8ft)

*1. When a GPS (NMEA0183) is used, a speedometer hose is not required.

Twin engine application (6Y8 Multifunction Meters)



Ref. No.	Part name	Part No.	Remarks
1	Engine ECM	—	
2	Speed sensor kit		
3	Water pressure sensor kit		
4	Trim sensor	—	
5	Main wire harness		5 m (16ft)
			6 m (20ft)
			7 m (23ft)
			8 m (26ft)
			9.5 m (31 ft)
6	Remote control box		
7	Main switch		
8	Multi-hub		w/ resistor cap, Black
9	Power supply wire		w/ 10 A fuse, 2.4 m (8ft)
10	Resistor cap		6P, Gray
11	Pigtail bus wire		0.3 m (1 ft)
			0.6 m (2ft)
			0.9 m (3ft)
			1.8 m (6 ft)
			2.7 m (9ft)
			3.6 m (12ft)
12	Main bus wire		0.3 m (1 ft)
			3.0 m (10ft)
			4.6 m (15ft)
			6.1 m (20ft)
			7.6 m (25ft)
			9.1 m (30ft)
13	Waterproof cap		2P, Red
14	Waterproof cap		4P, White
15	Tachometer		
16	Fuel management gauge		
17	Speedometer		
18	Fuel tank (fuel level sensor)	—	
19	GPS	—	NMEA0183
20	Transom multi-sensor		
21	Thru-hull multi-sensor 1		Plastic body
	Thru-hull multi-sensor 2		Bronze body

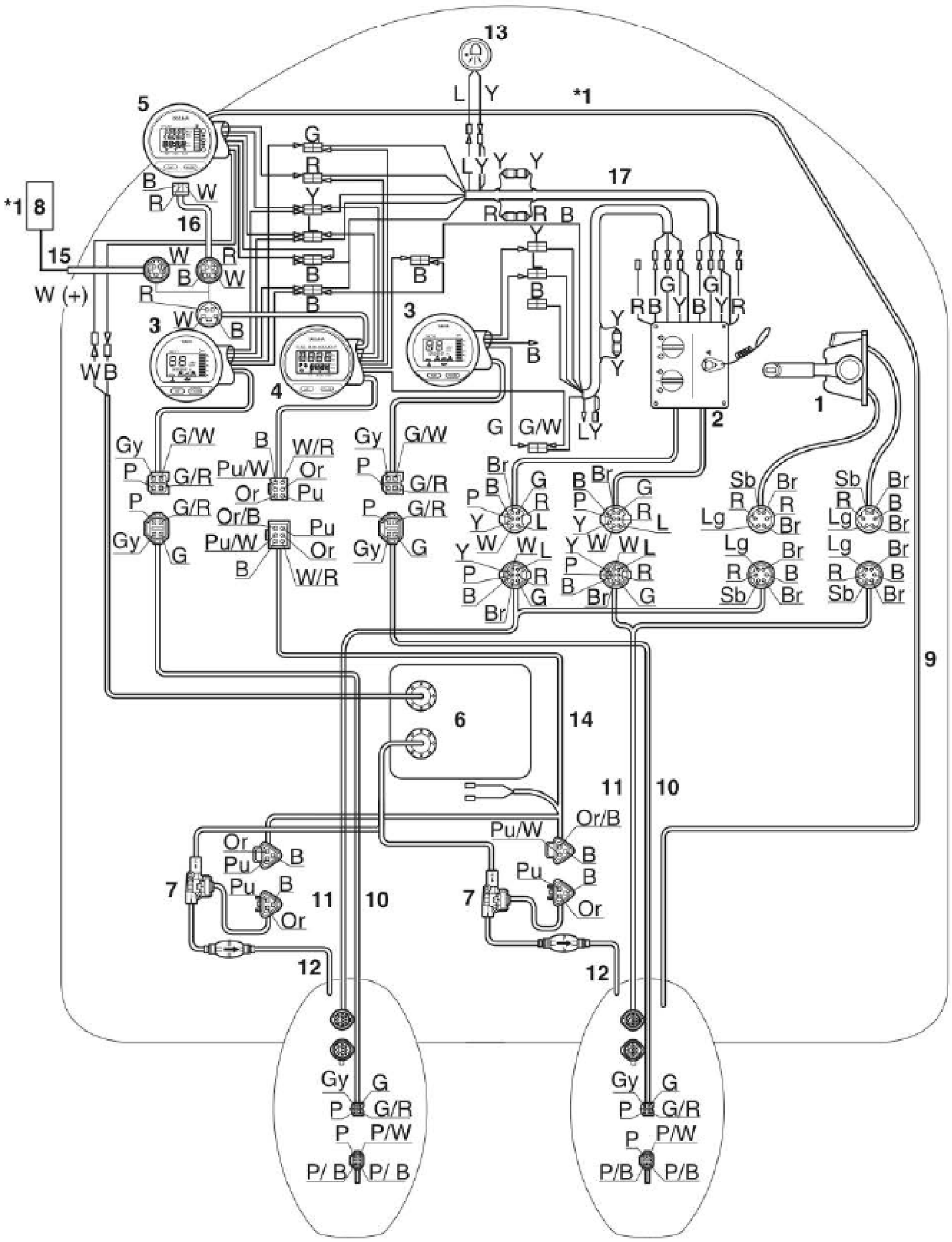
Ref. No.	Part name	Part No.	Remarks
22	Immobilizer (H-COP)		
23	Immobilizer power distribution wire 1		
24	Fuel tank/GPS wire		NMEA0183

a. Power port
b. Bus port
c. Device port

A. PORT
B. STBD

— MEMO-

Twin engine application (conventional gauge)



Ref. No.	Part name	Part No.	Remarks
1	Remote control box		
2	Main switch		
3	Tachometer		
4	Fuel management gauge		
5	Speedometer		
6	Fuel tank (fuel level sensor)	—	
7	Fuel flow sensor		
8	GPS	—	NMEA0183
9	Speedometer hose		6 m (20ft)
10	Conventional gauge harness		5 m (16ft)
			6 m (20ft)
			7 m (23ft)
			8 m (26ft)
			9 m (30ft)
			10.5 m (34ft)
11	Main wire harness		5 m (16ft)
			6 m (20ft)
			7 m (23ft)
			8 m (26ft)
			9.5 m (31 ft)
12	Fuel hose	—	
13	Lamp switch		0.1 m (0.33 ft)
			0.1 m (0.33 ft)
14	Fuel management gauge harness		8.0 m (26ft)
15	GPS wire		NMEA0183
16	Wire lead for speedometer		
17	Wire lead for digital meter		2.5 m (8ft)

*1. When a GPS (NMEA0183) is used, a speedometer hose is not required.

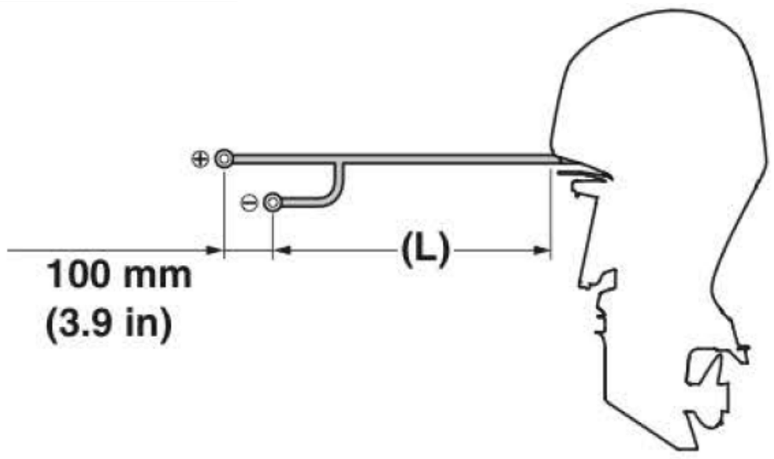
Rigging recommendation

Battery cable length

The table below shows the battery cable length from the negative terminal of the battery cable to the rigging grommet.

The positive battery cable is 100 mm (3.9 in) longer than the negative battery cable.

Length(L)
2.83m(9 ft)



Extension length recommendation for battery cable

NOTICE

Do not exceed the recommended extension length for the battery cable. Otherwise, the electrical system could be damaged or operate improperly.

To extend the length of battery cables, follow the requirements in the tables for battery capacity, cable size, and ambient temperature.

The maximum total extension length is the total combined length of the positive and negative battery cables.

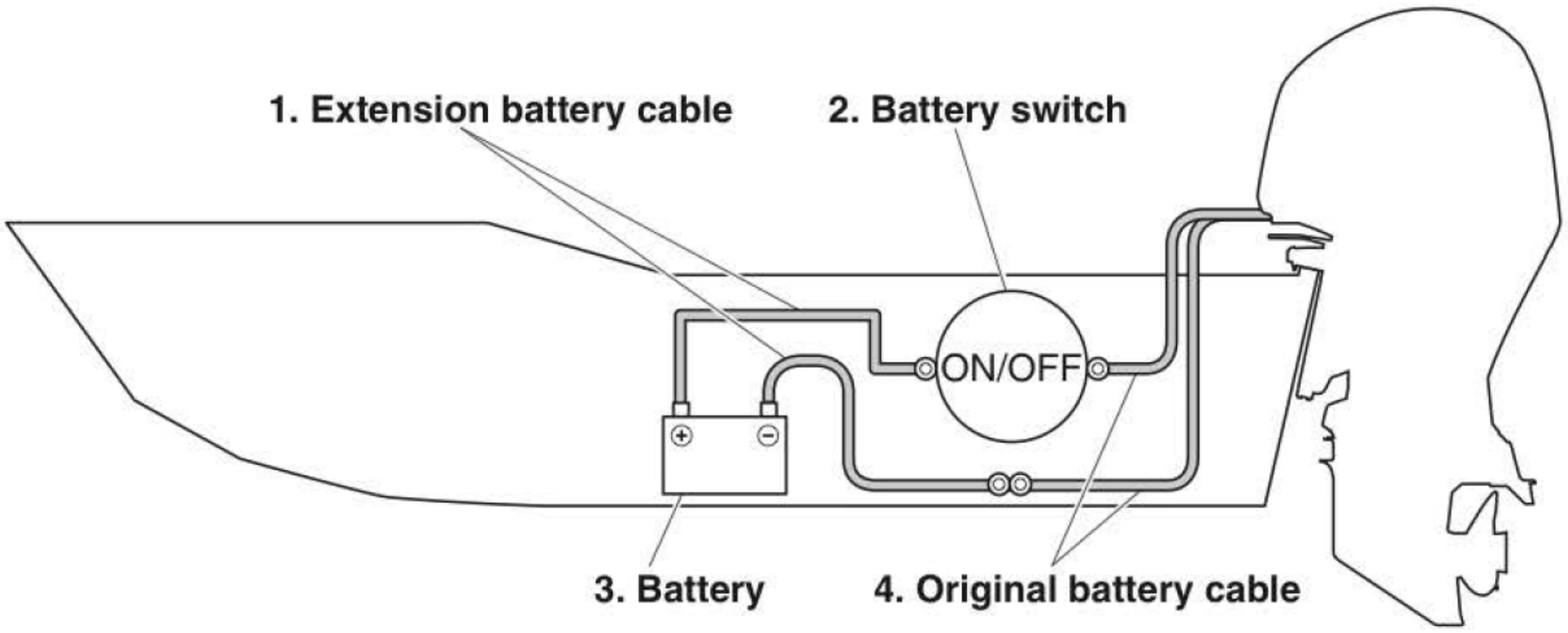
Select an extension battery cable and terminal that meet ABYC requirements or the equivalent.

Select the battery stud that is best-suited to the terminal size.

Solder the cable and terminal connections to prevent them from corroding.

Ambient temperature is 0 ℃(32 °F) and above					
Battery requirements		Cable specifications			
Unit	Rating	Maximum total extension length (Positive battery cable + Negative battery cable)			
		20 mm^2 (AWG4)	30 mm^2 (AWG2)	50 mm^2 (AWG1/0)	60 mm^2 (AWG2/0)
CCAISAE	380A	3.9 m (12.8ft)	6.7 m (22.0 ft)	10.3 m (33.8 ft)	—
MCAIABYC	502 A				
RC/SAE	124 minutes				
CCAIEN	430A				
20HR/IEC	70 Ah				
JIS	65031				

Ambient temperature is below 0 ℃ (32 °F)					
Battery requirements		Cable specifications			
Unit	Rating	Maximum total extension length (Positive battery cable+ Negative battery cable)			
		20mm² (AWG4)	30 mm² (AWG2)	50mm² (AWG1/0)	60 mm² (AWG2/0)
—	—	Cannot be extended			—



1. Extension battery cable
2. Battery switch
3. Battery
4. Original battery cable

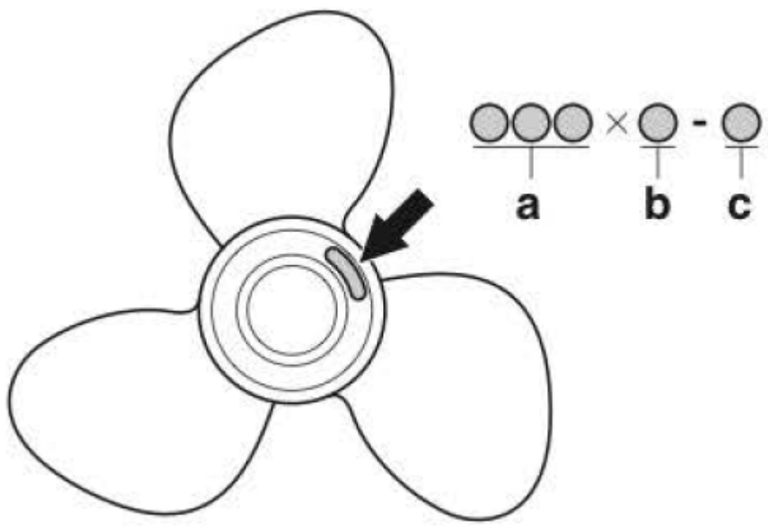
Propeller selection

The size and type of propeller that is used will affect the performance of a boat and outboard motor critically. 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 damage the engine seriously.

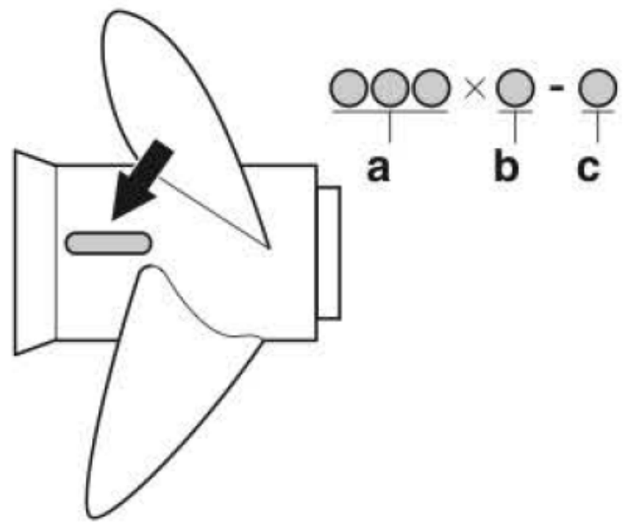
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and outboard motor.

Propeller size

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



a. Propeller diameter (in inches)



b. Propeller Pitch (in inches)
c. Propeller type (propeller mark)

Selection

With the engine speed at full throttle operating range and under a maximum boat load, the engine speed should be within the upper half of the full throttle operating speed range.

Full throttle operating range
5300-6300 r/min

Regular rotation model

Blade	Dia. (in)	Pitch (in)	Mark	Material	Part number	Remarks
3	14	11	K	Aluminum		
3	13 5/8	13	K	Aluminum		
3	13 5/8	14	K	Aluminum		
3	13 1/2	15	K	Aluminum		
3	13 1/4	17	K	Aluminum		
3	13	19	K	Aluminum		
3	12 5/8	21	K	Aluminum		
3	13	23	K	Aluminum		
3	13	25	K	Aluminum		
3	13 1/2	9	K	Aluminum		*1
3	13 1/2	10 1/2	K	Aluminum		*1
3	13 1/2	12	K	Aluminum		*1

Blade	Dia. (in)	Pitch (in)	Mark	Material	Part number	Remarks
3	13 1/2	14	K	Aluminum		*1
3	13 1/2	16	K	Aluminum		*1
3	13 1/2	14	K	Stainless steel		
3	13 1/2	16	K	Stainless steel		
3	13	17	K	Stainless steel		
3	13	19	K	Stainless steel		
3	13	21	K	Stainless steel		
3	13	23	K	Stainless steel		
3	13	25	K	Stainless steel		
3	13 1/2	17	K	Stainless steel		
3	13 1/2	19	K	Stainless steel		
3	13 1/2	21	K	Stainless steel		
3	13 1/2	23	K	Stainless steel		

*1. Shift Dampener System (SDS) propellers

Counter rotation model

Blade	Dia. (in)	Pitch (in)	Mark	Material	Part number	Remarks
3	13	17	KL	Stainless steel		
3	13	19	KL	Stainless steel		
3	13	21	KL	Stainless steel		

— MEMO-

Troubleshooting

HDIS.....4-1

Basic components 4-1
Function 4-2
Connecting the communication cable.....4-6

Outboard motor troubleshooting.....4-7

Troubleshooting procedure 4-7
Troubleshooting the power unit using the HDIS.....4-8
Trouble code and checking step 4-9
Troubleshooting the power unit (trouble code not detected).....4-11
Troubleshooting the PTT unit.....4-17
Troubleshooting the lower unit.....4-18

HDIS

The Hidea Diagnostic System uses precision fault diagnosis to offer better serviceability at a time when there is increasing demand for service tools for electronically controlled products. It provides quick, reliable, safe, and reasonable service, and is intended to obtain customer satisfaction. The Hidea Diagnostic System features updated software and expanded tool functions that allow it to respond to new models and technologies, maintaining compatibility with regulations. This manual contains the model-specific information. See HDIS (Ver. 2.12 or later) instruction manual for detailed information.

Basic components

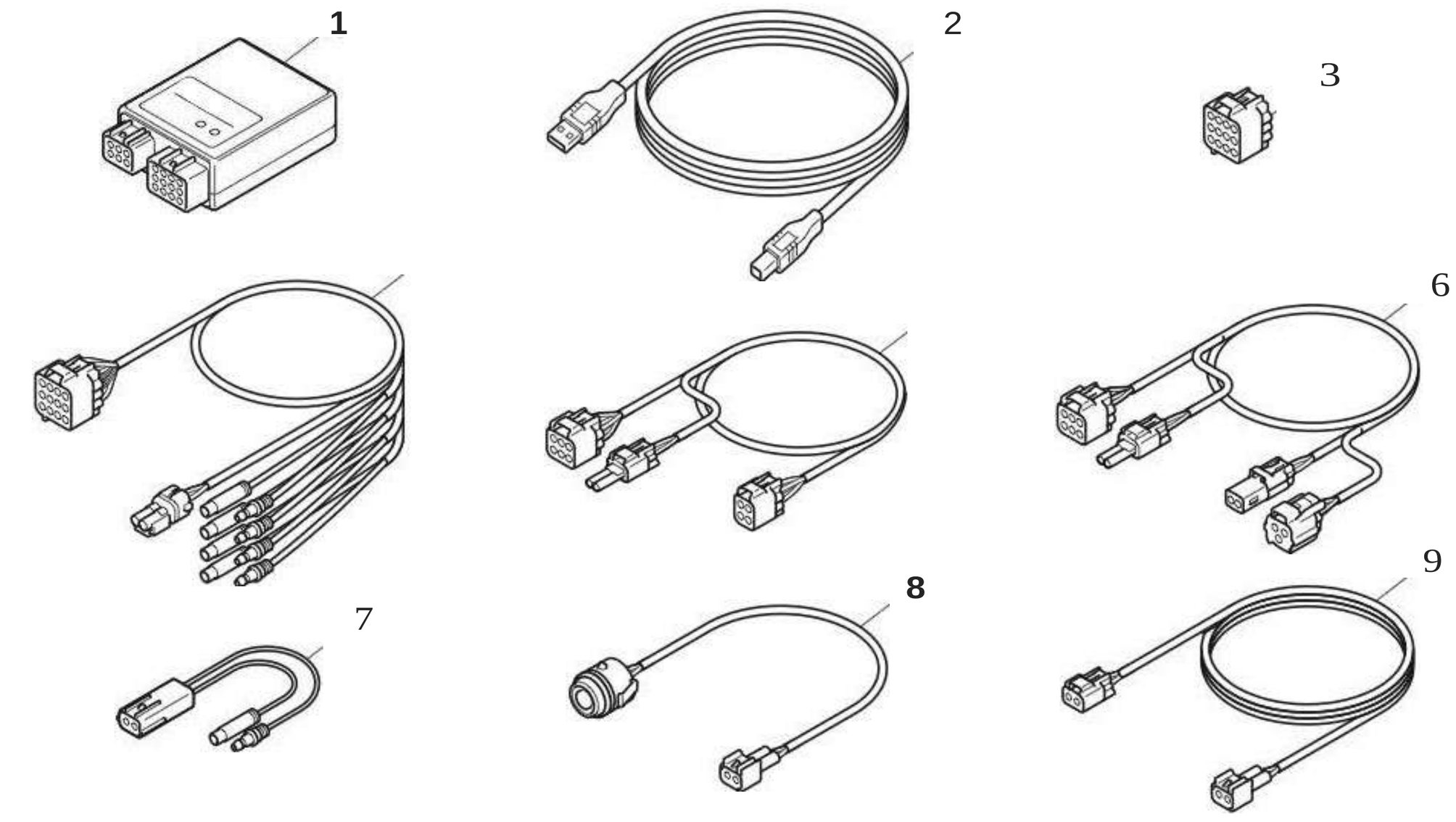
HDIS2 Hardware Kit

HDIS2 Hardware Kit

TIP:

The software is available through HMAN (Hidea Marine Associate Network)

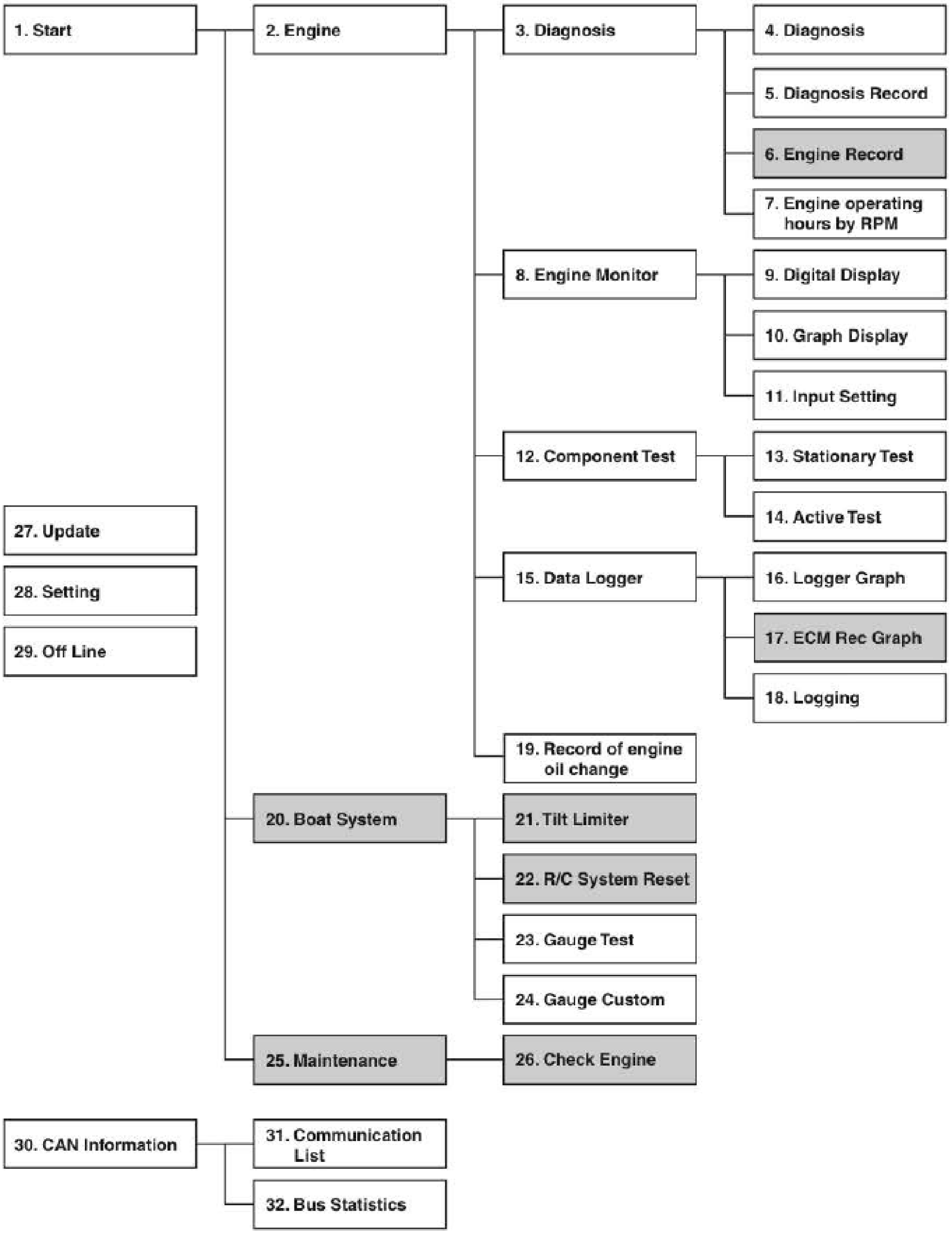
.



No.	Part name	Q'ty	Remarks
1	Adapter interface	1	
2	USB cable	1	5 m (16.4 ft)
3	Adapter cap	1	
4	AD harness	1	For external input
5	CAN-Line harness	1	
6	K-Line harness	1	
7	Power supply harness	1	
8	Trigger switch harness	1	
9	Trigger switch extension harness	1	

Function

HDIS version 2.12 comprises the following items.



1. Start
2. Engine
3. Diagnosis
4. Diagnosis
5. Diagnosis Record
6. Engine Record
7. Engine operating hours by RPM
8. Engine Monitor
9. Digital Display
10. Graph Display
11. Input Setting
12. Component Test
13. Stationary Test
14. Active Test
15. Data Logger
16. Logger Graph
17. ECM Rec Graph
18. Logging
19. Record of engine oil change
20. Boat System
21. Tilt Limiter
22. R/C System Reset
23. Gauge Test
24. Gauge Custom
25. Maintenance
26. Check Engine
27. Update
28. Setting
29. Off Line
30. CAN Information
31. Communication List
32. Bus Statistics

4. Diagnosis

Displays diagnosis codes recorded in the engine ECM, item names, and current item conditions. This enables detection of items with problems. The trouble codes displayed are the same as those described in this chapter. See "Trouble code and checking step" (4-9).

5. Diagnosis Record

Displays diagnosis codes recorded in the engine ECM, item names, and when problems are detected. The fault diagnosis history can be erased. The trouble codes displayed are the same as those described in this chapter. See "Trouble code and checking step" (4-9).

7. Engine operating hours by RPM

Displays both operating hours and total operating hours for different engine speeds.

8. Engine Monitor

Displays engine ECM conditions (sensor information) in real time. "9. Digital Display" displays these in digital form, and "10. Graph Display" displays these in graph form. Additionally, connecting a commercially available external device and configuring "11. Input Setting" enables display of the Engine Monitor.

Engine speed	Intake air pressure	TPS voltage
Throttle valve opening angle	ISC valve opening angle	Atmospheric pressure
Battery voltage	Fuel injection duration	Ignition timing
Cooling water temperature	Intake air temperature	Cooling water pressure
Speed	Trim Level	Fuel flow
Engine shut-off switch	Shift position switch	Oil pressure switch
Multi-engine system		

13. Stationary Test

When the engine is stopped and the shift is in the N position, operate the parts to check, and perform tests to check operating conditions and operating noise.

Activate ignition coil (#1, #4)	Activate ignition coil (#2, #3)	Activate electric fuel pump *1
Activate injector (#1, #4)	Activate injector (#2, #3)	Activate ISC valve

*1. Activate high-pressure fuel pump

14. Active test

While the engine is running and the shift is in the N position, operate the parts to check, and perform tests to check operating conditions and the engine condition.

Fully open ISC valve	Fix ISC valve opening angle

16. Logger Graph

Displays in graph form engine operation data stored in the ECM for the last 13 minutes in 1-minute intervals.

Engine speed	TPS voltage	Intake air pressure
Battery voltage	Cooling water temperature	Oil pressure switch

18. Logging

While the computer and the outboard motor are not connected, records "Engine Monitor" data using the adapter.

19. Record of engine oil change

It is possible to maintain oil change records using this function.

23. Gauge Test

It is possible to check if the 6Y8 Multifunction Meters function properly using this function.

24. Gauge Custom

It is possible to customize the screen settings of the 6Y8 Multifunction Meters using this function.

27. Update

It is possible to update the database when update information is provided.

28. Setting

Switches the language to use in the HDIS (English, French, Spanish, and Japanese).

It is possible to select units when connected via the CAN-Line.

29. Off Line

Displays graph data saved in the Engine Monitor (Graph Display) and Logging even when the computer is not connected to the outboard motor.

Record settings for logging, deleting data, and data playback are possible even when the computer is not connected to the outboard motor.

31. Communication List

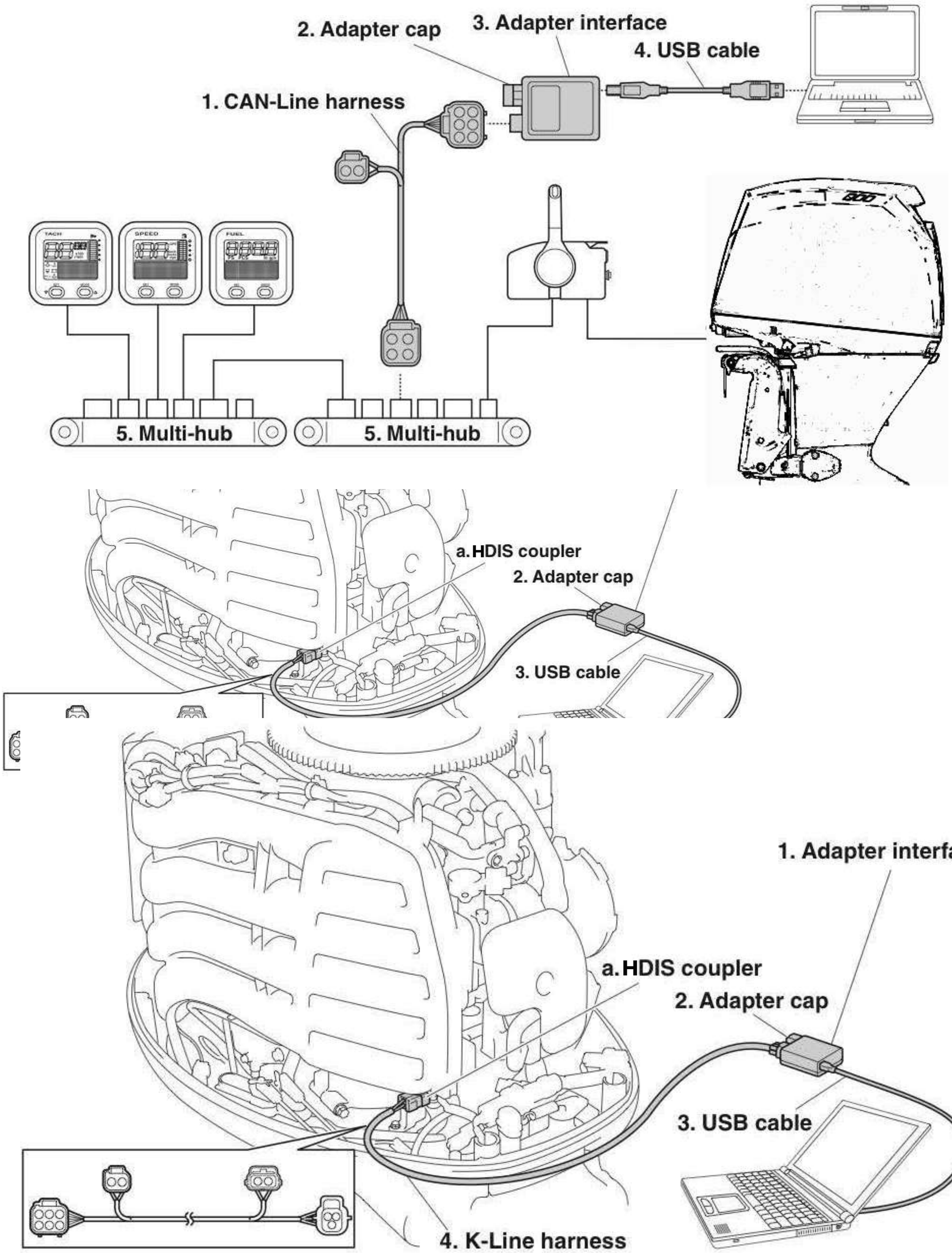
By connecting the HDIS to a multi-hub via a CAN-Line, displays the name of Hidea genuine parts connected to the Digital Network. This enables to check that the connections are correct.

32. Bus Statistics

By connecting the HDIS to a multi-hub via a CAN-Line, displays the bus load connected to the Digi -tal Network. If the bus load is higher than 40%, then check the connection status.

Connecting the communication cable

CAN-Line



1. Adapter interface
2. Adapter cap
3. USB cable
4. K-Line harness
   a. HDIS coupler (gray)

Outboard motor troubleshooting

Troubleshooting procedure

1. Before troubleshooting the outboard motor, check that fresh fuel of the specified type has been used.

2. Check that all electrical connections are secure and free from corrosion, and that the battery is fully charged.

3. Check the trouble code using the HDIS first, and then check the electronic control system following the trouble code chart.

4. If a trouble code is not detected, check the power unit according to "Troubleshooting the power unit (trouble code not detected)" (4-11).

5. Before using the HDIS to check the power unit, check the engine ECM circuit. See "Checking the engine ECM circuit" (5-19).

TIP:

- When deleting the diagnosis record on the HDIS, make 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, make sure to delete the diagnosis record after checking the input voltage.

Troubleshooting the power unit using the HDIS

1. Use the trouble codes displayed by the HDIS 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 of the items are in good condition, delete the trouble codes, and then check the trouble codes again. If the same trouble codes are detected again, the engine ECM is faulty.

Trouble code table

√: Indicated

－: Not indicated

Code No.	Item	HDIS diagnosis	HDIS diagnosis record
15	Thermo sensor	√	√
17	Knock sensor	√	√
18	TPS	√	√
19	Battery voltage	√	√
23	Air temperature sensor	√	√
28	Shift position switch	√	√
29	Air pressure sensor	√	√
37	Intake air passage	√	√
44	Engine shut-off switch	√	－
59	Memory data	－	√
86	Immobilizer	－	√

Trouble code and checking step

— : Not applicable

Trouble code	Item (Condition)	Symptom	Checking steps	See page
15	Thermo sensor (Out of specification)	"Check Engine" is displayed. High engine idle speed Degraded acceleration performance Declining maximum engine speed Overheat	Measure the thermo sensor input voltage.	5-30
			Measure the thermo sensor resistance.	5-30
			Check for wiring continuity between the thermo sensor and the engine ECM.	A-4
17	Knock sensor (Irregular signal)	"Check Engine" is displayed. High engine idle speed	Measure the knock sensor resistance.	5-30
			Check for wiring continuity between the knock sensor and the engine ECM.	A-4
18	TPS (Out of specification)	"Check Engine" is displayed. High engine idle speed Degraded acceleration performance	Measure the TPS output voltage and opening angle using the HDIS.	5-20
			Measure the TPS input voltage.	5-20
			Check for wiring continuity between the TPS and the engine ECM.	A-4
19	Battery voltage (Below specitied voltage)	Battery voltage and battery alert are displayed. Engine operates normally. Engine does not restart (depends on battery condition).	Check the battery cable and terminals for proper connection.	10-4
			Measure the lighting coil output peak voltage.	5-25
			Measure the lighting coil resistance.	5-25
			Measure the rectifier/regulator output peak voltage.	5-26
			Check the rectifier/regulator for continuity.	5-26
23	Air temperature sensor (Out of specification)	"Check Engine" is displayed. High engine idle speed	Check the intake air temperature using the HDIS.	5-29
			Check for wiring continuity between the intake air pressure/temperature sensor and the engine ECM.s	A-4

Trou-ble code	Item (Condition)	Symptom	Checking steps	See page
28	Shift position switch (Irregu-lar signal)	"Check Engine" is displayed. Engine operates normally.	Check the gear shift opera-tion.	10-7
			Measure the shift position switch input voltage.	5-31
			Check the shift position switch for continuity.	5-31
			Check for wiring continuity between the shift position switch and the engine ECM.	A-4
29	Air pressure sensor (Out of specification)	"Check Engine" is displayed. High engine idle speed Declining maximum engine speed	Measure the intake air pres-sure/temperature sensor input voltage.	5-29
			Check for wiring continuity between the intake air pres-sure sensor and the engine ECM.	A-4
37	Intake air pas-sage (Air leak)	"Check Engine" is displayed. High engine idle speed Impossible to shift-in (when the engine speed is more than 1500 r/min). Declining maximum engine speed	Check the gaskets of the intake manifold.	6-26
			Check the hose between the vapor shut-off valve and the intake manifold.	6-30
			Check the vacuum hoses.	6-33
			Check the O-ring of the intake air pressure/temperature sen-sor.	6-26
59	Memory data (Irregular sig-nal)	"Check Engine" is displayed. Engine stalls.	Replace the engine ECM.	6-25
86	Immobilizer (Communica-tion error)	"Check Engine" is displayed. Declining maximum engine speed	Check that H-COP is con-nected properly.	3-29
			Measure the remote control receiver input voltage.	5-34
			Check the H-COP circuit.	5-34

Troubleshooting the power unit (trouble code not detected)

Troubleshooting consists of the following 3 items:
Symptom 1: Specific trouble conditions
Symptom 2: Trouble conditions of an area or individual part
Cause: Trouble causes of symptom 2
— : Not applicable

Symptom 1: Engine does not crank.

Symptom 2	Cause	Checking steps	See page
Starter motor does not operate	Gear shift not in the N position	Set the gear shift to the N position.	10-7
	Blown fuse	Check the fuse.	5-5
	Starter relay malfunction	Check the starter relay.	5-31
	Engine start switch malfunction	Check the engine start switch.	5-32
	Neutral switch malfunction	Check the neutral switch.	—
	Short, open, or loose connection in starter motor circuit	Measure the starter relay input voltage.	5-31
		Check the wire harness for continuity.	A-5
	Starter motor malfunction	Disassemble and check the starter motor.	5-39
Starter motor operates, but the engine does not crank	Stuck piston or crankshaft	Disassemble and check the power unit.	7-83
	Stuck drive shaft	Check the drive shaft bushing.	9-26
		Disassemble and check the lower unit.	8-17 8-60

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

Symptom 2	Cause	Checking steps	See page
Engine ECM does not operate	Blown fuse	Check the fuse.	5-5
	Main relay malfunction	Check the main and fuel pump relay.	5-18
	Short, open, or loose connection in the engine ECM circuit	Check for wire harness continuity between the main and fuel pump relay and the engine ECM.	5-18
		Check for continuity between the engine ECM and ground.	5-19

Symptom 2	Cause	Checking steps	See page
Spark plug does not produce a spark (all cylinders)	Pulser coil malfunction	Measure the pulser coil output peak voltage.	5-28
		Checking the pulser coil air gap.	7-2
		Measure the pulser coil resistance.	5-28
	Short, open, or loose connection in the pulser coil circuit	Check for wire harness continuity between the pulser coil and the engine ECM.	A-4
	H-COP is locked.	Unlock H-COP.	3-23
Fuel not supplied (all cylinders)	—	Measure the fuel pressure.	6-1
	Pinched or kinked fuel hose	Check the fuel hose.	2-33
	Clogged fuel filter element	Check the fuel filter element for dirt and obstructions.	6-7
	Clogged fuel strainer	Check the fuel strainer for dirt and obstructions.	6-10
	Fuel leakage	Check the fuel line for leakage.	2-33
	High-pressure fuel pump malfunction	Check the high-pressure fuel pump operation using the HDIS.	5-24
		Measure the high-pressure fuel pump resistance.	5-24
	Main and fuel pump relay malfunction	Check the main and fuel pump relay.	5-18
	Short, open, or loose connection in high-pressure fuel pump circuit	Measure the high-pressure fuel pump input voltage.	5-24
		Check for continuity between the high-pressure fuel pump and the main and fuel pump relay.	A-4
		Check for continuity between the high-pressure fuel pump and ground.	A-4
	Fuel pump malfunction	Check the fuel pump for leakage.	6-11
		Check the diaphragm for tears.	6-12
		Check the cam shaft.	7-49
	H-COP is locked.	Unlock H-COP.	3-23

Symptom 2	Cause	Checking steps	See page
Compression pressure is low	—	Measure the compression pressure.	7-1
	Improper valve timing	Check the valve timing.	7-26
		Check the timing belt.	7-26
	Compression leakage	Check the valve for bends or sticking.	7-68
		Check the piston and piston rings for damage.	7-83
		Check the cylinder for scratches.	7-87
—	Intake air passage malfunction	Check the ISC valve for sticking.	5-20
		Check the intake manifold and throttle body for air leakage.	6-26 6-19

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

Symptom 2	Cause	Checking steps	See page
Throttle valve does not move properly	Throttle valve malfunction	Check the throttle valve for proper movement.	6-22
	Throttle link and the throttle cable are not installed properly	Adjust the throttle link and the throttle cable.	6-23
Spark plug does not produce a spark (some cylinders)	Spark plug malfunction	Check the ignition spark.	5-27
		Check the spark plugs.	7-33
	Short, open, or loose connection in ignition coil circuit	Check for wiring continuity between the ignition coil and the engine ECM.	A-4
		Check for wiring continuity between the ignition coil and the main and fuel pump relay.	A-4
	Ignition coil malfunction	Measure the ignition coil resistance.	5-28
	Engine ECM malfunction	Replace the engine ECM.	6-25
Fuel pressure is low	—	Measure the fuel pressure.	6-1
	Fuel leakage	Check for fuel leakage.	2-33
	Pressure regulator malfunction	Check the pressure regulator.	6-3
	Clogged fuel filter element	Check the fuel filter element for dirt and obstructions.	6-7
	Clogged fuel strainer	Check the fuel strainer for dirt and obstructions.	6-10
	High-pressure fuel line malfunction	Check the high-pressure fuel pump.	5-24

Symptom 2	Cause	Checking steps	See page
Fuel not supplied (some cylinders)	Fuel injector malfunction	Check the fuel injector operation using the HDIS.	5-23
		Measure the fuel injector resistance.	5-23
	Short, open, or loose connection in fuel injector circuit	Measure the fuel injector input voltage.	5-23
		Check for continuity between the fuel injector and the main and fuel pump relay.	A-4
		Check for continuity between the fuel injector and the engine ECM.	A-4
	Clogged fuel injector filter	Replace the fuel injector.	6-15
	Engine ECM malfunction	Replace the engine ECM.	6-25
Compression pressure is low	—	Measure the compression pressure.	7-1
	Improper valve timing	Check the timing belt.	7-26
	Compression leakage	Measure the valve clearance.	7-3
		Check the camshaft for damage.	7-49
		Check the valve and valve seat for wear.	7-68 7-70
		Check the piston and piston ring for damage.	7-83
		Check the cylinder for scratches.	7-87

Symptom 1: High engine idle speed.

Symptom 2	Cause	Checking steps	See page
—	Air leakage (throttle valve–cylinder head)	Check the gaskets of the intake manifolds and throttle body.	6-19 6-26
		Check the intake manifold for cracks.	6-28
	Throttle link and the throttle cable are not installed properly	Adjust the throttle link and the throttie cable.	6-23
	ISC valve malfunction	Check the ISC valve operation using the HDIS.	5-20
		Measure the ISC valve resistance.	5-20

Symptom 1: Limited engine speed (below 2000-3000 r/min).

Symptom 2	Cause	Checking steps	See page
Buzzer comes on, overheat alert indicator comes on	Clogged cooling water inlet	Check the pilot hole for cooling water discharge.	10-5
		Check the cooling water inlet.	10-10
	Water pump malfunction	Check the impeller.	8-8
		Check the impeller key.	8-8
		Check the insert cartridge.	8-8
	Water leakage from water pump housing	Check the water pump housing.	8-8
		Check the outer plate cartridge.	8-8
	Clogged cooling water passages	Check the cooling water passages.	8-8
	Open PCV	Check the PCV.	9-30
	Thermostat malfunction	Check the thermostat.	7-61
Buzzer comes on, oil pressure alert indicator comes on	Insufficient engine oil	Check the engine oil level.	10-4
		Check for engine oil leakage.	2-23
		Check the valve seals and valves.	7-64
		Check the piston rings.	7-87
	—	Measure the oil pressure.	7-1
	Engine oil pressure decrease	Check the oil pressure switch.	5-20
		Check the oil pump.	7-79
		Check the oil strainer.	9-30
		Check the relief valve.	7-77
		Check the oil passages (power unit and the oil pump).	2-23
		Replace the oil filter.	10-13

Symptom 1: Discharged battery

Symptom 2	Cause	Checking steps	See page
Low voltage indicator activates on the gauge	Battery performance decrease	Check the battery capacity and specific gravity.	10-4
		Check the battery cable and terminals for proper connections.	3-8
	Short, open, or loose connection in charging circuit	Check the charging circuit for wiring connection and damage.	A-5
	Lighting coil malfunction	Measure the lighting coil output peak voltage.	5-25
		Measure the lighting coil resistance.	5-25
	Rectifier/regulator malfunction	Measure the rectifier/regulator output peak voltage.	5-26
		Check the rectifier/regulator for continuity.	5-26

Symptom 1: H-COP lock and unlock do not function.

Symptom 2	Cause	Checking steps	See page
There is an answer-back (beep)	H-COP remote control transmitter malfunction	Check the button cell battery voltage.	5-35
		Replace with a spare remote control transmitter.	3-23
	Short, open, or loose connection of the wire harness	Check the H-COP circuit.	3-29

Symptom 1: H-COP lock and unlock function, but there is no answer-back (beep).

Symptom 2	Cause	Checking steps	See page
—	Buzzer malfunction	Check the buzzer.	5-34
	Short, open, or loose connection of the wire harness	Measure the buzzer input voltage.	5-34
		Check the H-COP circuit.	3-29

Troubleshooting the PTT unit

Troubleshooting consists of the following 3 items:
Symptom 1: Specific trouble conditions
Symptom 2: Trouble conditions of an area or individual part
Cause: Trouble causes of symptom 2
— : Not applicable

Symptom 1: PTT unit does not operate.

Symptom 2	Cause	Checking steps	See page
PTT relay does not operate	Blown fuse	Check the fuse.	5-5
	PTT switch malfunction	Check the PTT switch.	5-47
	PTT relay malfunction	Check the PTT relay.	5-45
	Short, open, or loose connection of the wire harness	Measure the PTT switch input voltage.	5-47
		Measure the PTT relay input voltage.	5-45
		Check for continuity between the PTT switch and the PTT relay.	A-5 A-6
PTT motor does not operate	PTT motor malfunction	Check the PTT motor.	9-46
	Bent trim and tilt ram	Check the trim and tilt ram.	9-58
	Stuck trim and tilt ram	Disassemble and check the PTT unit.	9-58
	Short, open, or loose connection in PTT motor circuit	Check for continuity between the PTT motor and the PTT relay terminal.	A-5
PTT fluid pressure does not increase	Manual valve open	Check the manual valve.	9-43
	Insufficient PTT fluid	Add sufficient PTT fluid.	10-16
	PTT fluid leakage	Check for PTT fluid leakage.	10-17
	Clogged fluid passage	Disassemble and check the PTT unit.	9-51 9-58
		Check the filter for dirt and obstructions.	9-55
		Check the valves for damage.	9-55
		Check the fluid passages for obstructions.	9-51 9-58
	PTT motor malfunction	Check the PTT motor.	9-46
	Gear pump malfunction	Check the gear pump operation.	9-43

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

Symptom 2	Cause	Checking steps	See page
PTT fluid pressure does not increase	Manual valve open	Check the manual valve.	9-43
	Insufficient PTT fluid	Add sufficient PTT fluid.	10-16
	PTT fluid leakage	Check for PTT fluid leakage.	10-17
	Clogged fluid passages	Disassemble and check the PTT unit.	9-51 9-58
		Check the valves for damage.	9-55
		Check the fluid passages for obstructions.	9-51 9-58

Troubleshooting the lower unit

Troubleshooting consists of the following 3 items:
Symptom 1: Specific trouble conditions
Symptom 2: Trouble conditions of an area or individual part
Cause: Trouble causes of symptom 2
— : Not applicable

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

Symptom 2	Cause	Checking steps	See page
—	Shift cable is not adjusted properly	Adjust the shift cable.	10-17
	Shift rod does not operate properly	Check the shift rod for wear.	9-14
		Check the detent mechanism.	9-14
—	Shift mechanism malfunction (in lower unit)	Check the shift rod connection.	8-27
		Check the dog clutch.	8-14
		Check the forward gear, reverse gear, and pinion for damage and wear.	8-21 8-14 8-21

Electrical system

Electrical component and wire harness routing 5-1

Port 5-1
Starboard..... 5-3
Front 5-5
Rear 5-6
Top..... 5-7
Bottom cowling 5-9
Tiller handle (F130BEHT)..... 5-11

ECM circuit diagram..... 5-13

ECM coupler layout..... 5-15

Checking the electrical component..... 5-16

Using the HDIS..... 5-16
Measuring the peak voltage 5-16
Using the digital tester 5-17

Engine control unit and component..... 5-18

Checking the main relay 5-18
Checking the engine ECM circuit 5-19
Checking the TPS 5-20
Checking the ISC valve 5-20
Checking the oil pressure switch..... 5-20
Checking the alert indicator (tiller handle model) 5-21
Checking the alert buzzer..... 5-22
Checking the trolling switch (tiller handle model) 5-22

Fuel control unit and component 5-22

Checking the water detection switch 5-22
Checking the fuel injector 5-23
Checking the high-pressure fuel pump..... 5-24
Checking the vapor shut-off valve 5-24

Charging unit and component 5-25

Checking the lighting coil (stator assembly) 5-25
Checking the rectifier/regulator..... 5-26

Electrical system

Ignition unit and component 5-27

Checking the ignition spark 5-27
Checking the ignition coil 5-28
Checking the pulser coil 5-28
Checking the intake air temperature sensor 5-29
Checking the intake air pressure sensor 5-30
Checking the thermo sensor 5-30
Checking the knock sensor 5-30
Checking the shift position switch 5-31
Checking the engine shut-off switch 5-31

Starting unit and component 5-31

Checking the starter relay 5-31
Checking the engine start switch 5-32

H-COP 5-33

Checking H-COP 5-34
Checking the buzzer 5-34
Checking the H-COP main wire harness 5-34
Checking the button cell battery 5-35

Starter motor 5-37

Removing the starter motor 5-39
Disassembling the starter motor 5-39
Checking the starter motor pinion 5-40
Checking the armature (starter motor) 5-41
Checking the brush holder 5-41
Assembling the starter motor 5-42
Installing the starter motor 5-44

6Y8 Multifunction Meters sensor 5-44

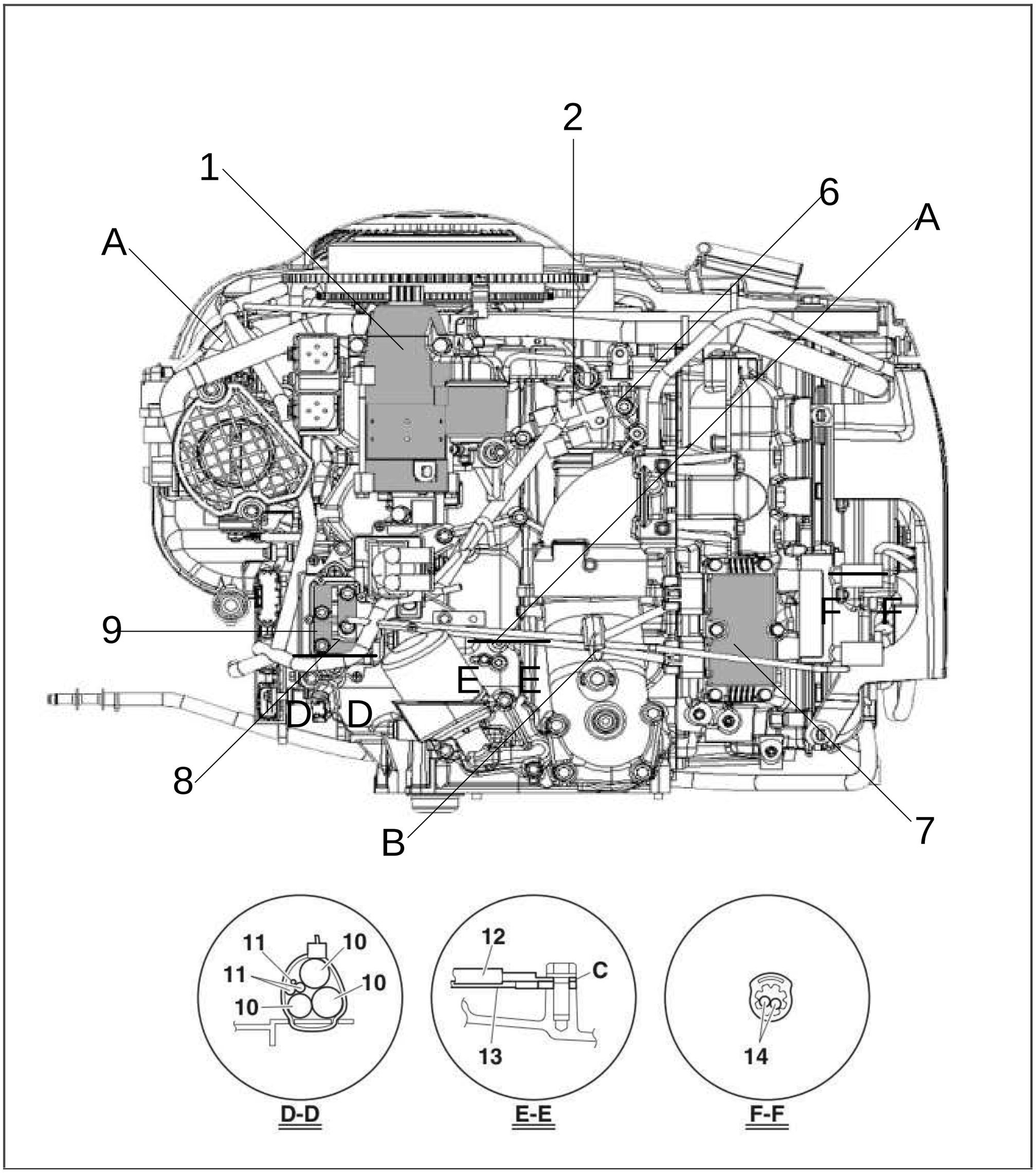
Checking the water pressure sensor 5-44
Checking the speed sensor 5-44

PTT system 5-45

Checking the PTT relay 5-45
Checking the PTT switch (on bottom cowling) 5-47
Checking the trim sensor 5-47
Checking the tilt limiter 5-48

Electrical component and wire harness routing

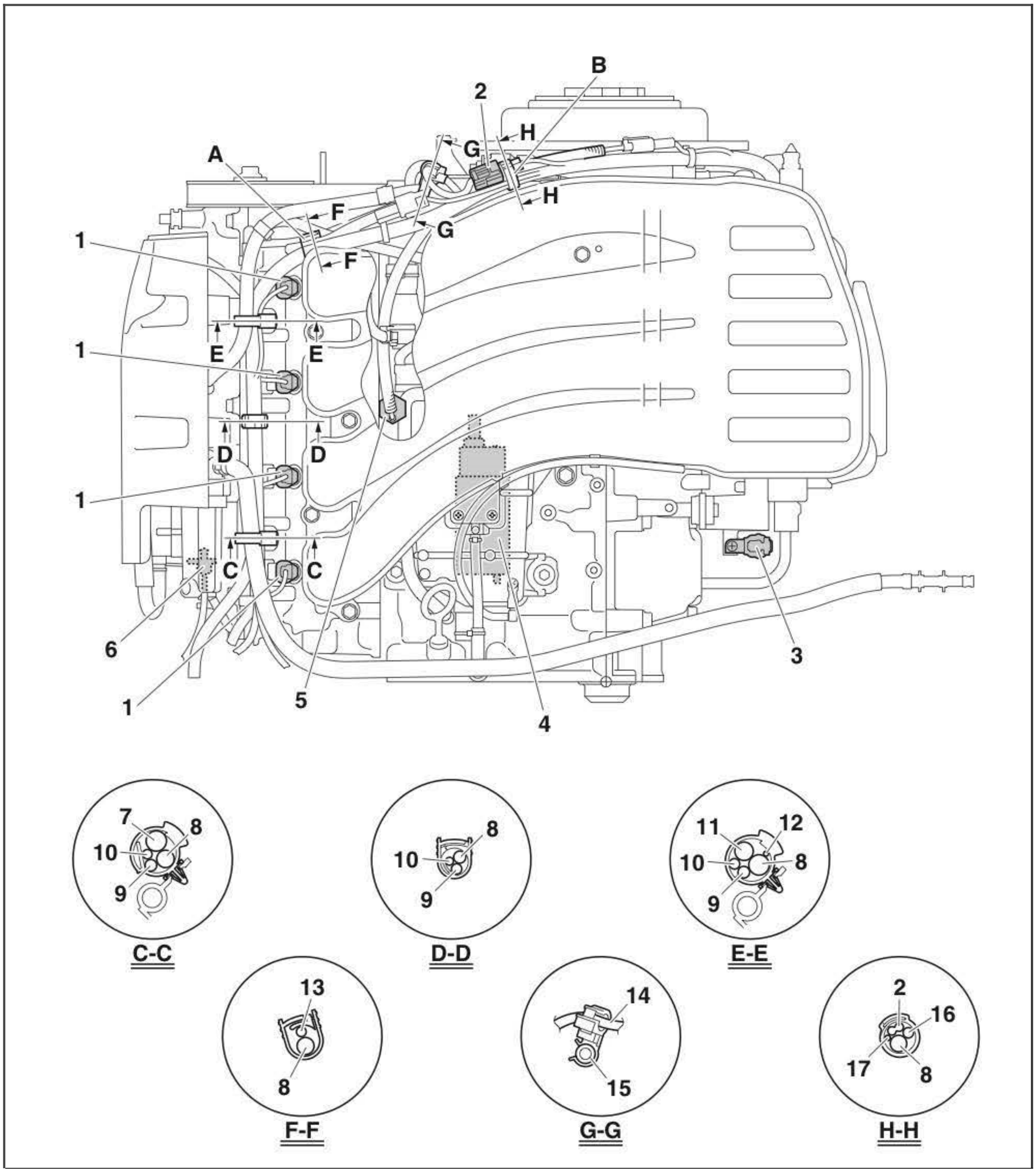
Port



1. Starter motor
2. Fuse (50 A) (battery)
3. Fuse (20 A) (engine start switch, PTT switch)
4. Fuse (20 A) (main and fuel pump relay)
5. Fuse (30 A) (starter relay)
6. Oil pressure switch
7. Rectifier/regulator
8. Starter relay
9. PTT relay
10. Wire harness
11. Starter relay lead
12. PTT relay lead
13. Rectifier/regulator lead
14. Ignition coil lead

A. Install the starter relay lead and PTT relay lead holding them against the stopper.
B. Fasten the lighting coil lead and rectifier/regulator lead to the exhaust joint using the plastic tie.
C. Install the ground terminals of the starter relay lead and PTT relay lead so that the crimped sides are facing out.

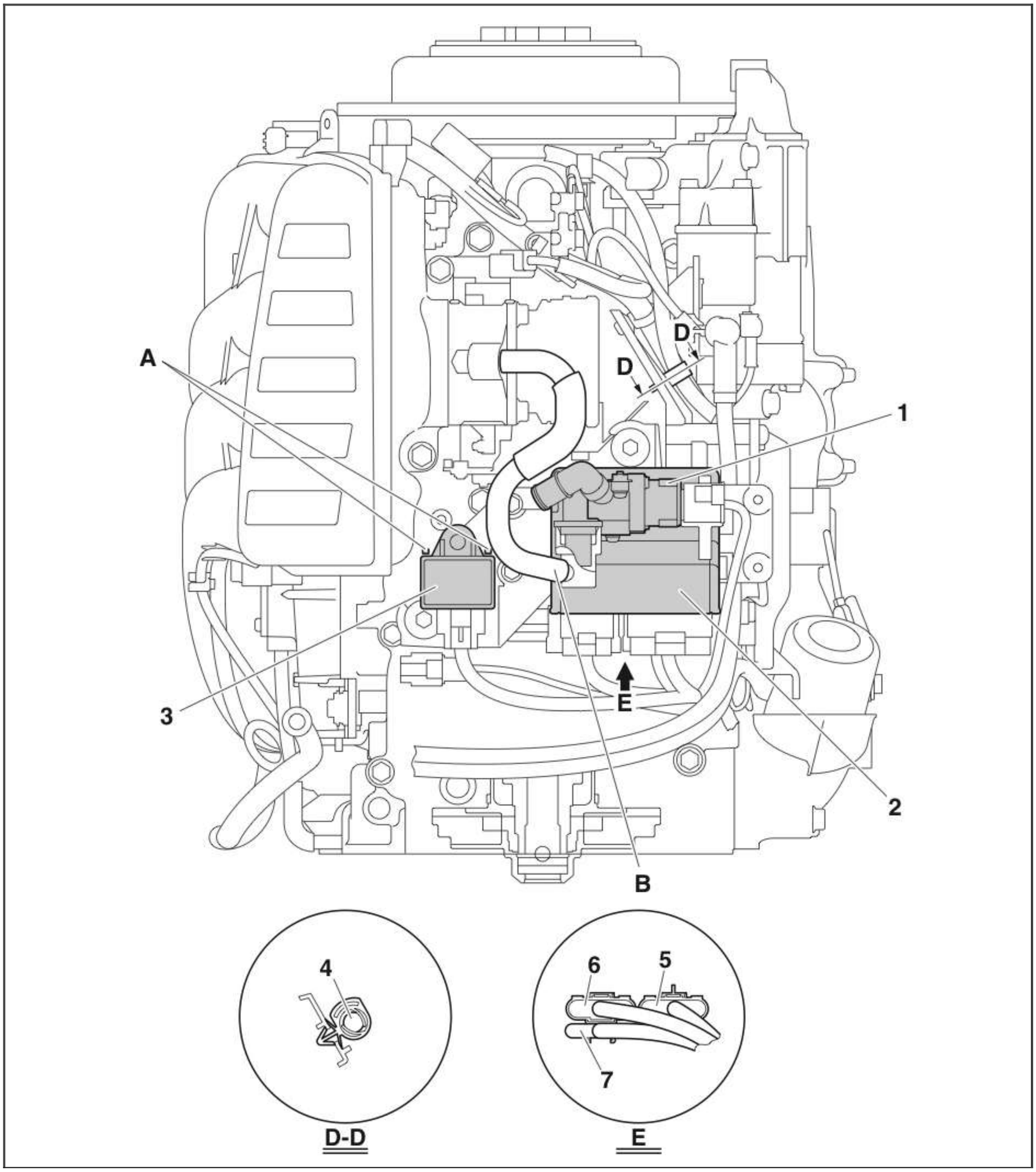
Starboard


B
2
H
G
A
H
F
G
1
F
E
E
1
D
D
1
C
C
6
1
5
4
3
7
8
10
9
C-C
8
10
9
D-D
11
12
10
8
9
E-E
13
8
F-F
14
15
G-G
2
16
17
8
H-H

1. Fuel injector
2. Thermo sensor coupler
3. HDIS coupler
4. High-pressure fuel pump
5. Knock sensor
6. Water detection switch
7. Fuel hose
8. Wire harness
9. Vapor gas hose
10. Cooling water pilot hole
11. Low-pressure fuel hose
12. Fuel injector lead
13. Extension wire harness
14. Thermo sensor lead
15. High-pressure fuel hose
16. Knock sensor lead
17. High-pressure fuel pump lead

A. Fasten the wire harness at the white tape using the clamp.
B. Secure the thermo sensor coupler along with the wire harness, knock sensor lead, and high-pressure fuel pump lead using the clamp.

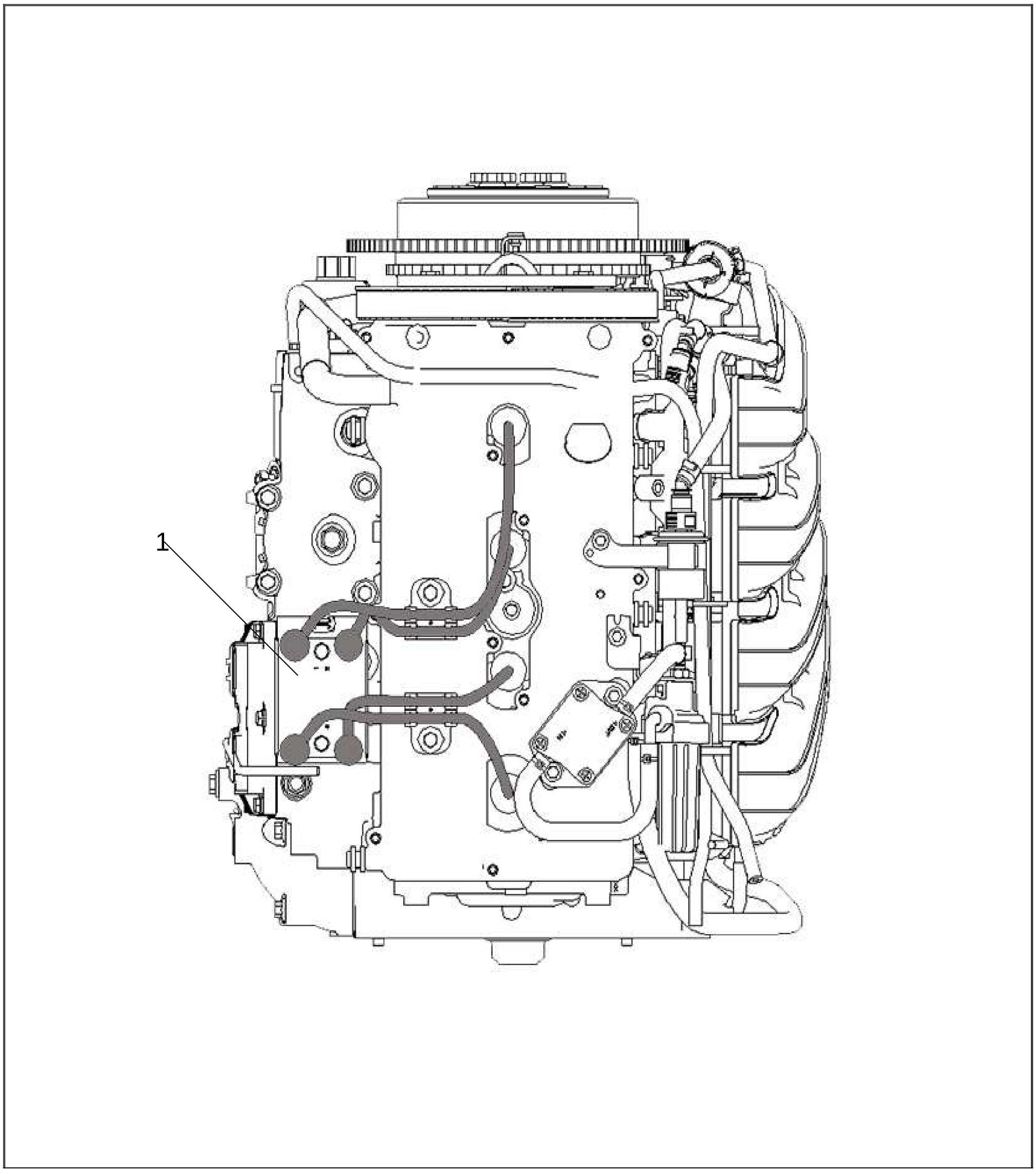
Front



1. ISC valve
2. Engine ECM
3. Main relay
4. Lighting coil lead
5. Joint connector 3
6. Joint connector 2
7. Joint connector 1

A. Push and hold the main and fuel pump relay installation boss against the stoppers.
B. Connect the hose toward front so that the paint on the hose is horizontal.

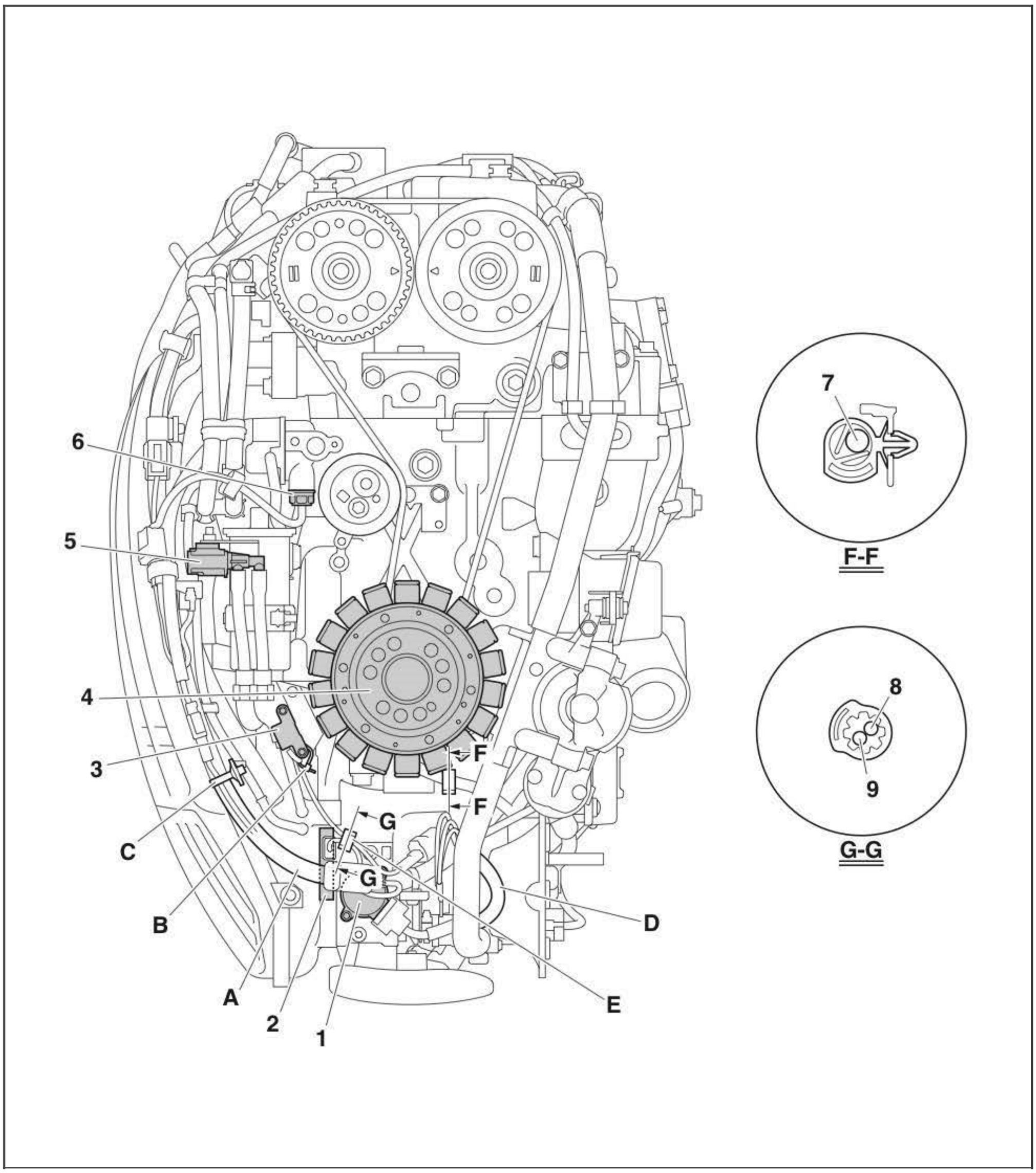
Rear



1. Ignition coil

A. Fit the spark plug wires into the holders so that the tape markings for cylinder identification are positioned at the center of the holders.

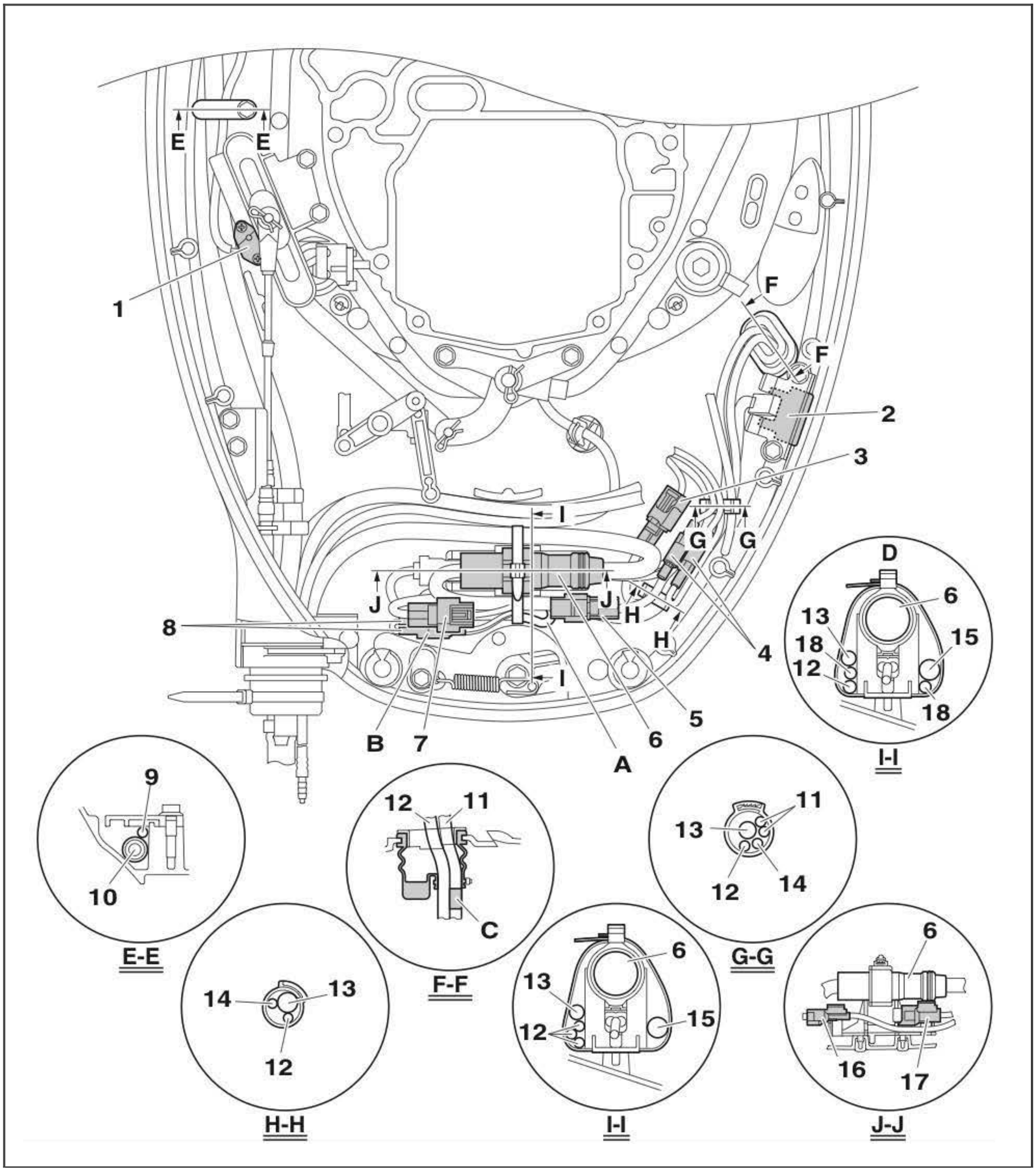
Top



1. TPS
2. Intake air pressure/temperature sensor
3. Pulser coil
4. Lighting coil (stator assembly)
5. Vapor shut-off valve
6. Thermo sensor
7. Lighting coil lead
8. Pulser coil lead
9. Intake air pressure/temperature sensor lead

A. Pass the wire harness between the intake air pressure/temperature sensor and the intake manifold rib.
B. Fasten the pulser coil lead to the base magnet boss using the clamp, and then cut the end of clamp so that it is less than 5 mm (0.2 in).
C. Install the holder on the wire harness to the intake manifold.
D. Route the TPS lead inside the blowby hose.
E. Fasten the lead using the clamp at the white tape on the pulser coil lead.

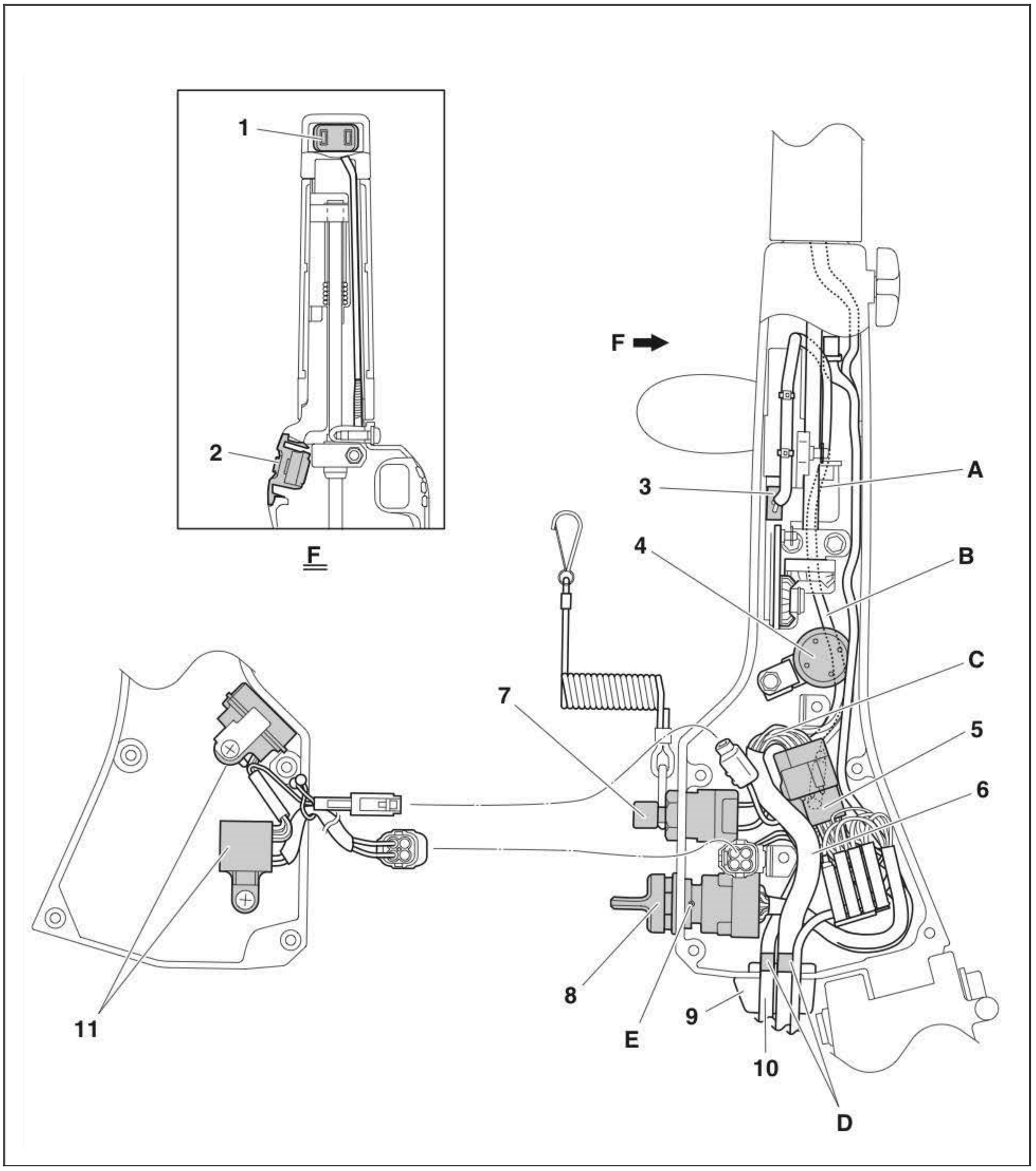
Bottom cowling



1. Shift position switch
2. PTT switch
3. PTT switch coupler
4. Tilt limiter coupler
5. multifunction meter communication coupler
6. Main wire harness coupler (10-pin)
7. Trolling switch coupler
8. Trim sensor coupler
9. Shift position switch lead
10. Fuel hose
11. PTT motor lead
12. Trim sensor lead
13. Wire harness
14. PTT switch lead
15. Main wire harness (10-pin)
16. Trim sensor coupler
17. Gauge harness coupler
18. Trolling switch harness

A. Fold the trim sensor lead to remove any slack, and then fasten it using the clamp.
B. If the multifunction meter is selected, connect the trim sensor coupler.
C. Align the end of gray tape on the PTT lead with the grommet end.
D. F130BEHT

Tiller handle (F130BEHT)



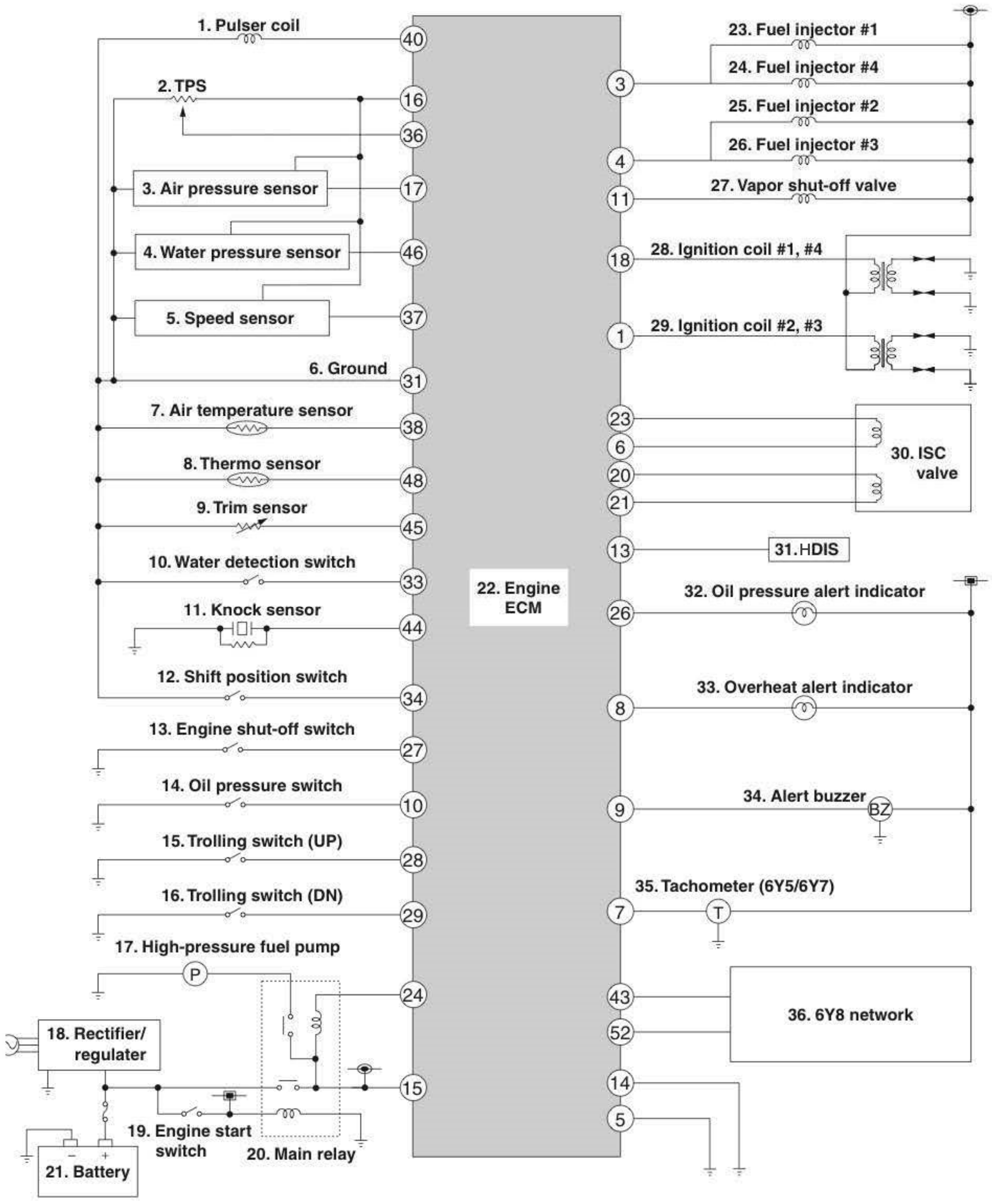
1. PTT switch
2. Trolling switch
3. Neutral switch
4. Alert buzzer
5. Engine start switch coupler
6. Extension wire harness
7. Engine shut-off switch
8. Engine start switch
9. Grommet
10. Alert indicator harness
11. Alert indicator

A. Route the neutral switch leads (blue and black) under the control link assembly.
B. Route the neutral switch leads (brown) under the buzzer.
C. Bend the extension wire harness "6", and then connect the harness coupler. The harness bending position must be 10.0 mm (0.39 in) or more away from the engine start switch coupler "5". The bend radius should be 10.0 mm (0.39 in) or more.
D. Align the tape ends of the extension wire harness "6" with the end of the grommet "9".
E. Install the engine start switch "8" so that the hole in the switch is facing up.

ECM circuit diagram

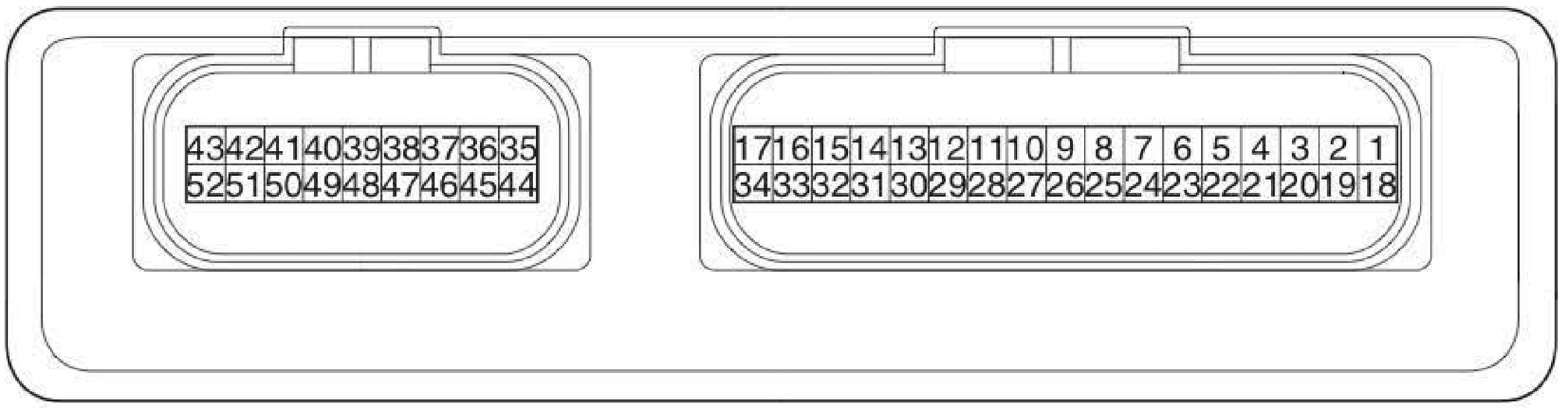
: Indicate a connection between the symbols.

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



1. Pulser coil
2. TPS
3. Air pressure sensor
4. Water pressure sensor
5. Speed sensor
6. Ground
7. Air temperature sensor
8. Thermo sensor
9. Trim sensor
10. Water detection switch
11. Knock sensor
12. Shift position switch
13. Engine shut-off switch
14. Oil pressure switch
15. Trolling switch (UP)
16. Trolling switch (DN)
17. High-pressure fuel pump
18. Rectifier/regulator
19. Engine start switch
20. Main relay
21. Battery
22. Engine ECM
23. Fuel injector #1
24. Fuel injector #4
25. Fuel injector #2
26. Fuel injector #3
27. Vapor shut-off valve
28. Ignition coil #1, #4
29. Ignition coil #2, #3
30. ISC valve
31. HDIS
32. Oil pressure alert indicator
33. Overheat alert indicator
34. Alert buzzer
35. Tachometer
36. network

ECM coupler layout



Connecting part		Color
1	Ignition coil #2, #3	Black/White
2	—	—
3	Fuel injector #1, #4	Purple/Red
4	Fuel injector #2, #3	Purple/Black
5	Ground	Black
6	ISC valve	Green/Blue
7	Main relay, tachometer (6Y5/6Y7)	Green
8	Overheat alert indicator	Pink/Black
9	Alert buzzer	Pink
10	Oil pressure switch	Pink/White
11	Vapor shut-off valve	Green/Black
12	—	—
13	HDIS	White/Black
14	Ground	Black
15	Main relay	Red/Yellow
16	Sensor power source	Orange
17	Air pressure sensor	Pink/Green
18	Ignition coil #1, #4	Black/Red
19	—	—
20	ISC valve	Green/Yellow
21	ISC valve	Green/ Orange
22	—	—
23	ISC valve	Green/Red
24	Main relay (high-pressure fuel pump	Blue

No.	Connecting part	Color
25	—	—
26	Oil pressure alert indicator	Green/White
27	Engine shut-off switch	White
28	Trolling switch (UP)	Orange/Blue
29	Trolling switch (ON)	White/Blue
30	—	—
31	Sensor ground	Black
32	—	—
33	Water detection switch	Blue/White
34	Shift position switch	Blue/Yellow
35	—	—
36	TPS	Pink/White
37	Speed sensor	Blue/Green
38	Air temperature sensor	Black/Yellow
39	—	—
40	Pulser coil	White/Black
41	—	—
42	—	—
43	6Y8 network	White
44	Knock sensor	Green
45	Trim sensor	Pink
46	Water pressure sensor	Blue/Black
47	—	—
48	Thermo sensor	Black/White

No.	Connecting part	Color
49	—	—
50	—	—
51	—	—
52	network	Blue

Checking the electrical component

Using the HDIS

When checking the TPS, ISC valve, high-pressure fuel pump, fuel injector, and related sensors, use the HDIS.

TIP:

- When deleting the diagnosis record in the HDIS, make 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, make sure to delete the diagnosis record after checking the input voltage.
- To connect and operate the HDIS, see the HDIS (Ver. 2.12 or later) instruction manual.
- The software is available through HMAN (Hidea Marine Associate Network).

HDIS2 Hardware Kit
HDIS2 Hardware Kit

Measuring the peak voltage

⚠ WARNING

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

NOTICE

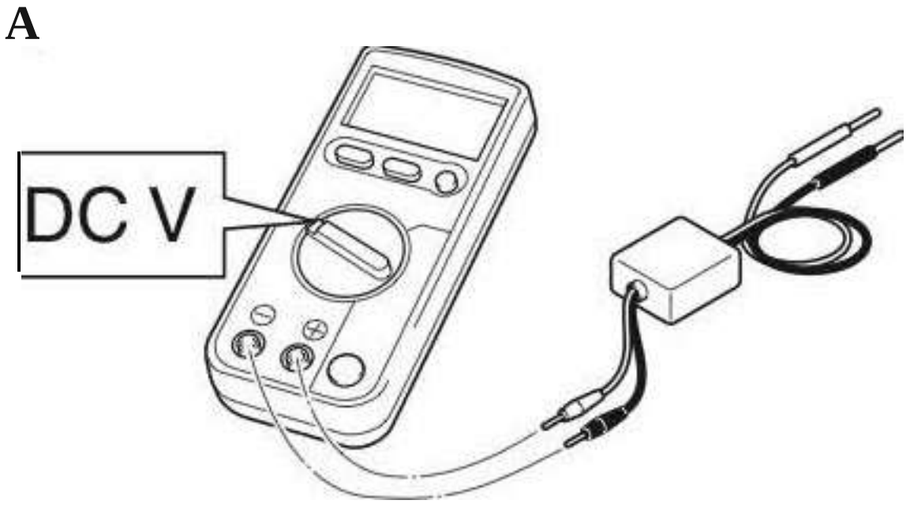
When measuring the peak voltage between the terminals of an electrical component using the digital tester, make sure that the leads do not contact any metal parts. Otherwise, the electrical component may short-circuit and be damaged.

To check the electrical components or measure the peak voltage, use the special service tools. A malfunctioning electrical component can be checked easily 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.

TIP:

- Before measuring the peak voltage, check all of the wire harnesses for corrosion. Also, make sure that the wire harnesses are connected properly and that the battery is fully charged.
- Use peak voltage adapter with the recommended digital circuit tester.
- Connect the positive pin of peak voltage adapter to the positive terminal of the digital tester, and the negative pin to the negative terminal.
- When measuring the peak voltage, set the digital circuit tester to the DC voltage mode.

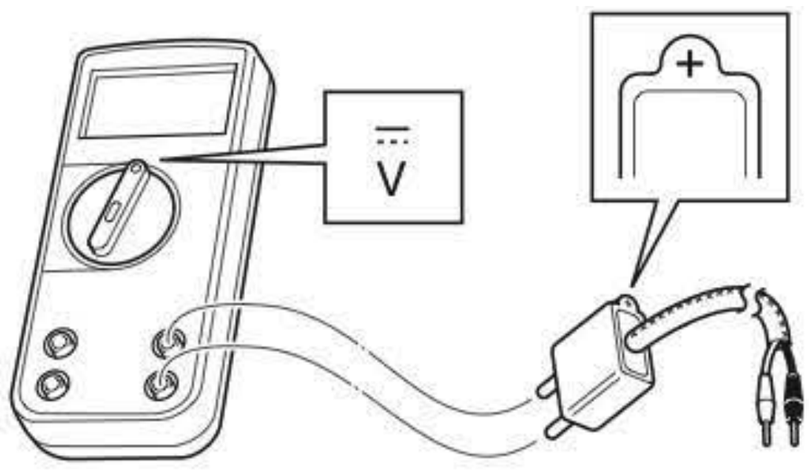
A





Digital circuit tester Digital multimeter Test lead Terminal，male"1" (commercially available) Terminal female "2" (commercially available)

B



A. Worldwide
B. USA and Canada

Digital circuit tester Digital multimeter Peak voltage adapter 8 Peak volt adapter

Using the digital tester

The electrical technical data applies to the measurements taken using the Hidea recommended tester.

The resistance values shown are the values taken before the engine is started. The actual resistance may vary depending on the environmental conditions and ambient temperature.

The input voltage changes depending on the battery voltage.

If the tester probe cannot be inserted into the coupler, prepare a test lead suitable for the measurement.

Engine control unit and component

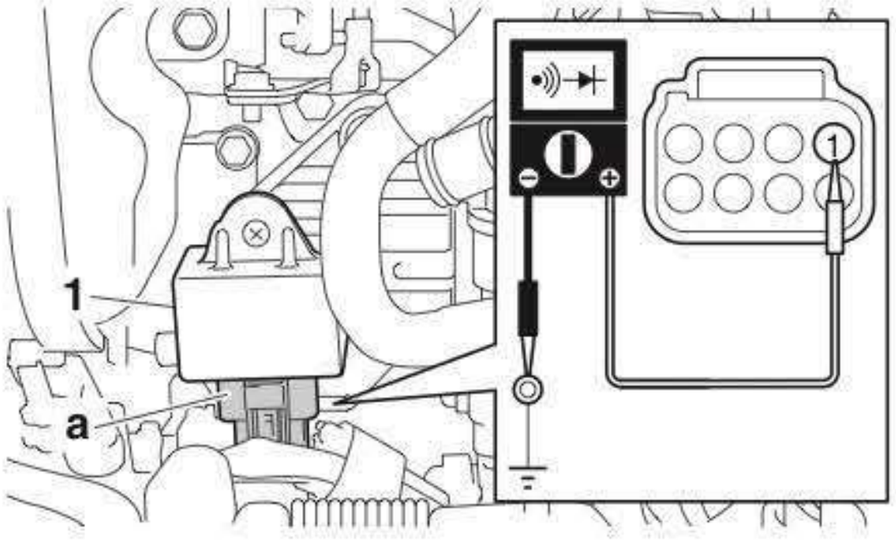
Checking the main relay

The main relay also has the function of fuel pump relay.

1. Remove the main and fuel pump relay "1".

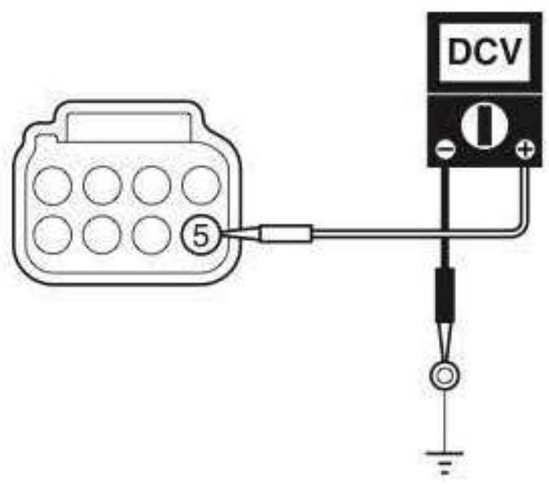
2. Disconnect the main and fuel pump relay coupler "a".

3. Check the wire harness for continuity.



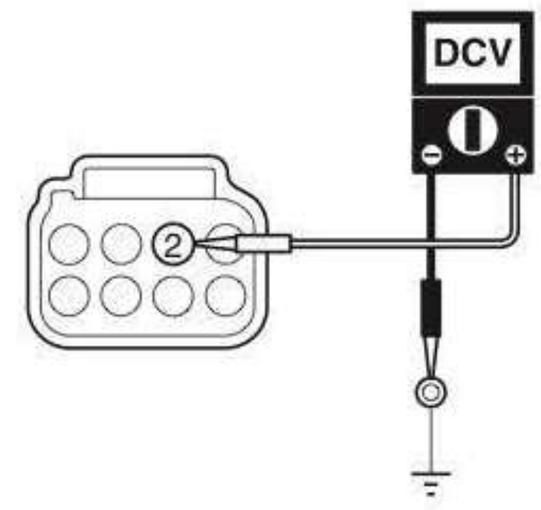
Wire harness continuity
Terminai1—Ground

4. Measure the input voltage between the terminal and ground.



Input voltage
12 V (battery voltage)
Terminal5-Ground

5. Turn the engine start switch to ON, and then measure the input voltage between the terminal and ground.



Input voltage
12 V (battery voltage)
Terminai2-Ground

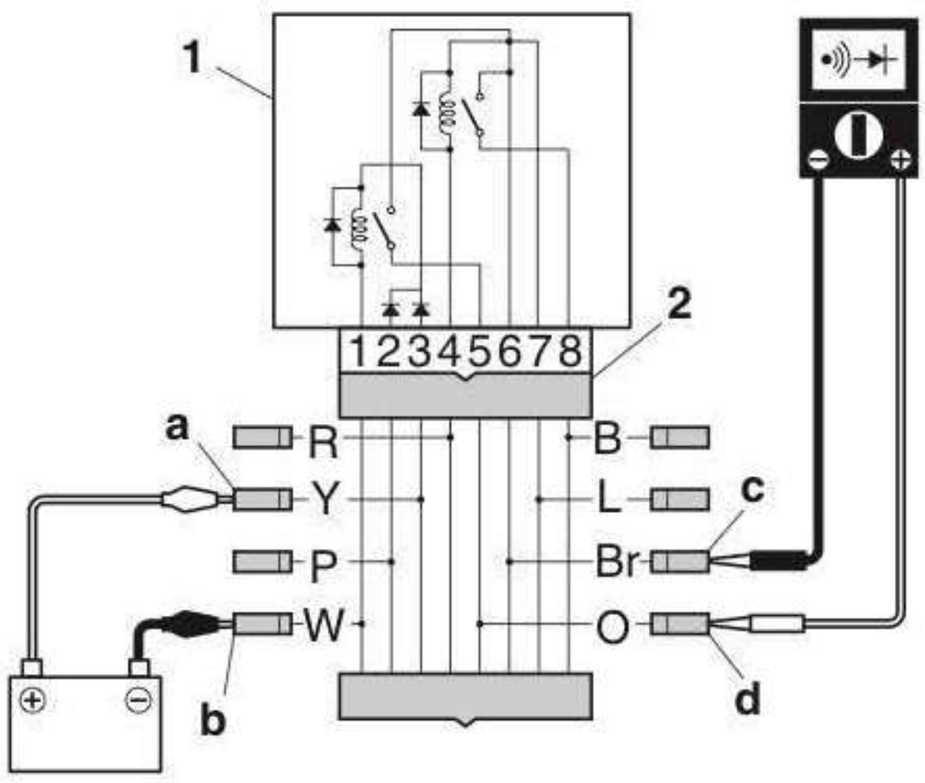
6. Turn the engine start switch to OFF.

7. Connect the special service tool "2" to the main and fuel pump relay "1".

8. Connect the positive battery lead to the connector "a", and the negative battery lead to the connector "b", and then check for continuity between the connectors "c" and "d". Replace the relay if out of specification.

NOTICE

Do not reverse the battery leads.



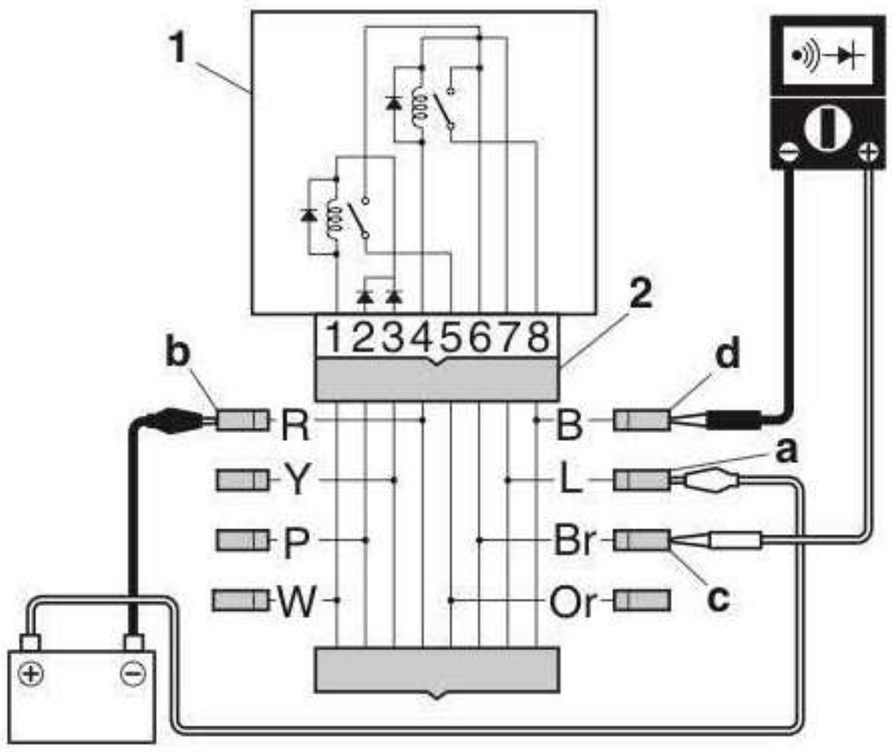
Test harness (8 pins) "2"
Test harness (8 pins) "2"

Relay terminals continuity
Terminal "c"–Terminal "d"

9. Connect the positive battery lead to the connector "a", and the negative battery lead to the connector "b", and then check for continuity between the connectors "c" and "d". Replace the relay if out of specification.

NOTICE

Do not reverse the battery leads.



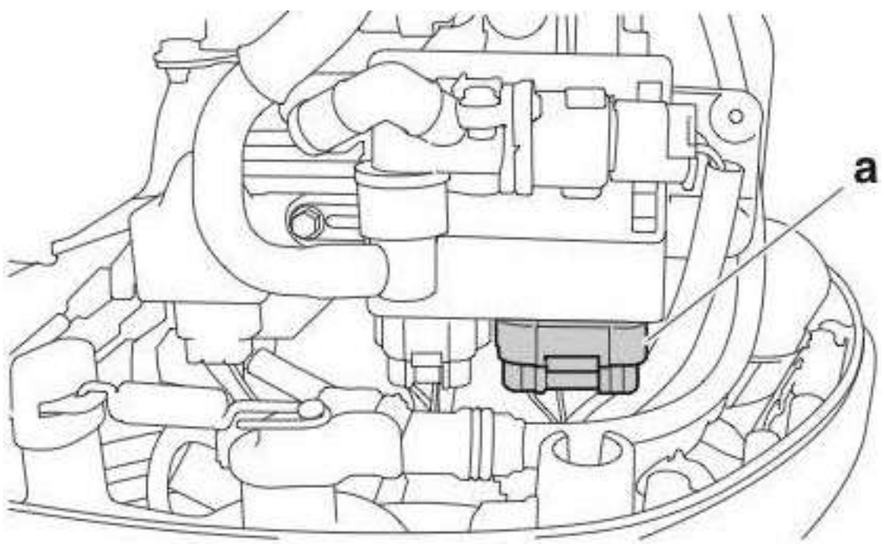
Relay terminals continuity
Terminal "c"-Terminal "d"

10. Disconnect the special service tool.

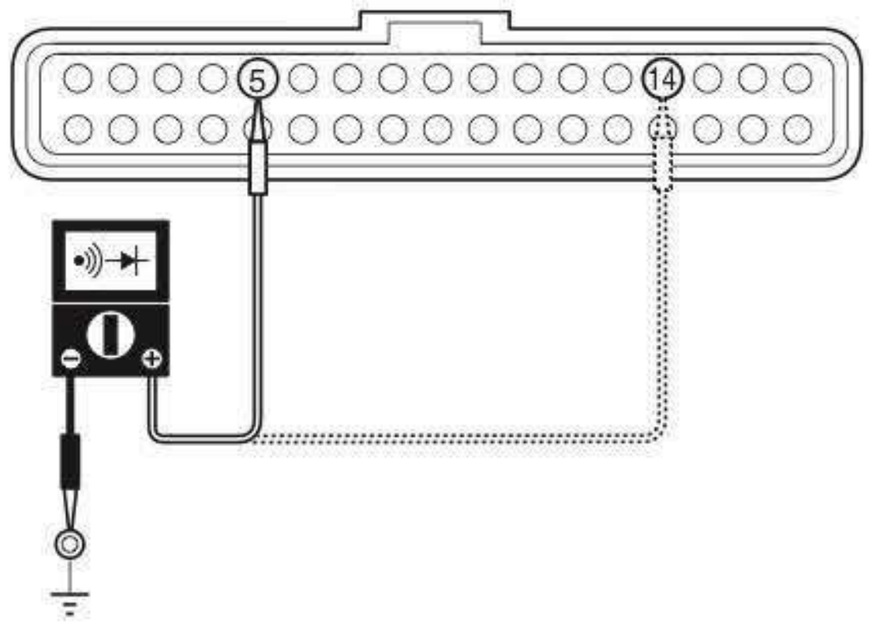
11. Install the main and fuel pump relay, and then connect the main and fuel pump relay coupler.

Checking the engine ECM circuit

1. Disconnect the engine ECM coupler "a".

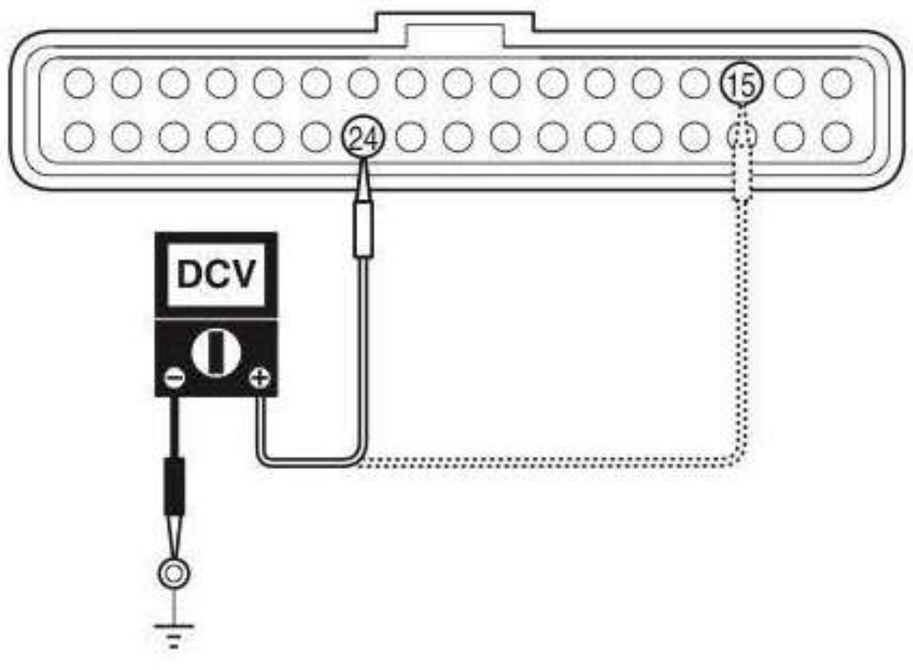


2. Check for continuity between the engine ECM coupler terminals and ground.



Wire harness continuity
Terminal 5-Ground
Terminal 14--Ground

3. Turn the engine start switch to ON, and then measure the input voltage at the eng1ne ECM coupler terminal and ground.



Input voltage
12 V (battery voltage)
Terminai15-Ground
Terminal 24-Ground

4. Turn the engine start switch to OFF.

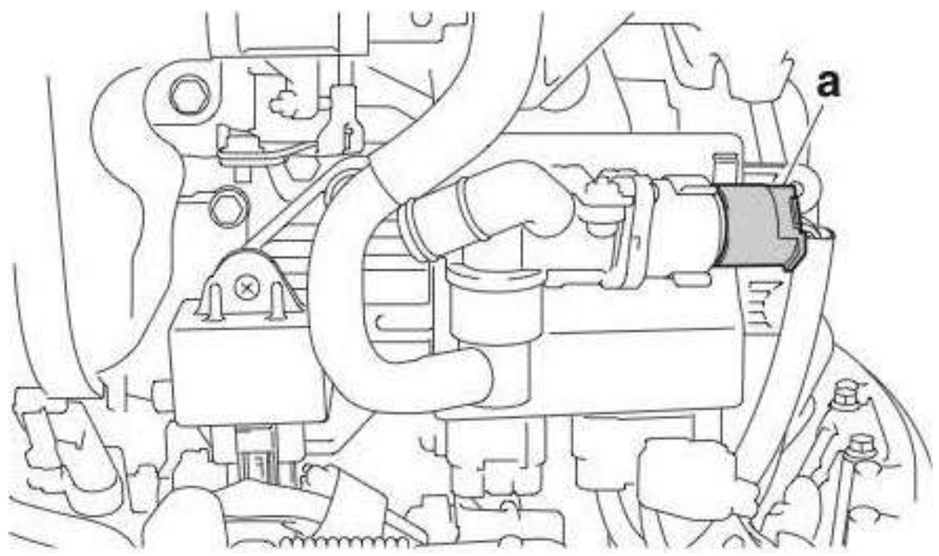
5. Connect the engine ECM coupler until it locks with a clicking sound.

Checking the TPS

1. Connect the HDIS to display "TPS".

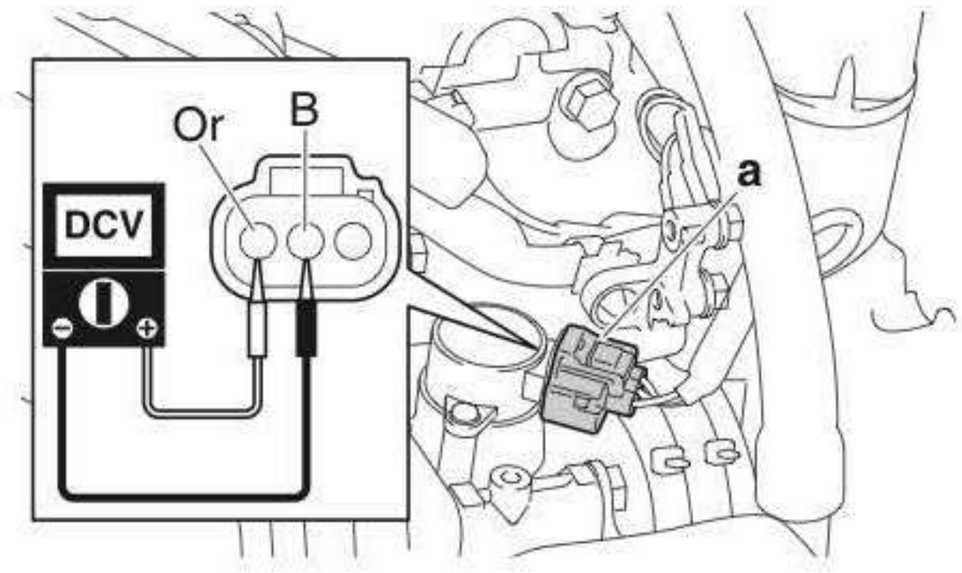
2. Start the engine and warm it up for 5-10 minutes, and then stop it.

3. Turn the engine start switch to ON, and then measure the TPS output voltage when the remote control lever is at the fully closed position.



Output voltage at throttle valve fully closed 1.00 V Throttle valve opening angle at throttle valve fully closed (reference data) 6.00°

4. Disconnect the TPS coupler "a", and then measure the TPS input voltage at the TPS coupler.



Input voltage 5.00 V Orange (Or)-Black (B)

5. Turn the engine start switch to OFF.

6. Connect the TPS coupler.

Checking the ISC valve

1. Check the operation of the ISC valve using the HDIS "Stationary test" and check the operating sound.

2. Start the engine, and then check that the engine speed increases using the HDIS "Active test".

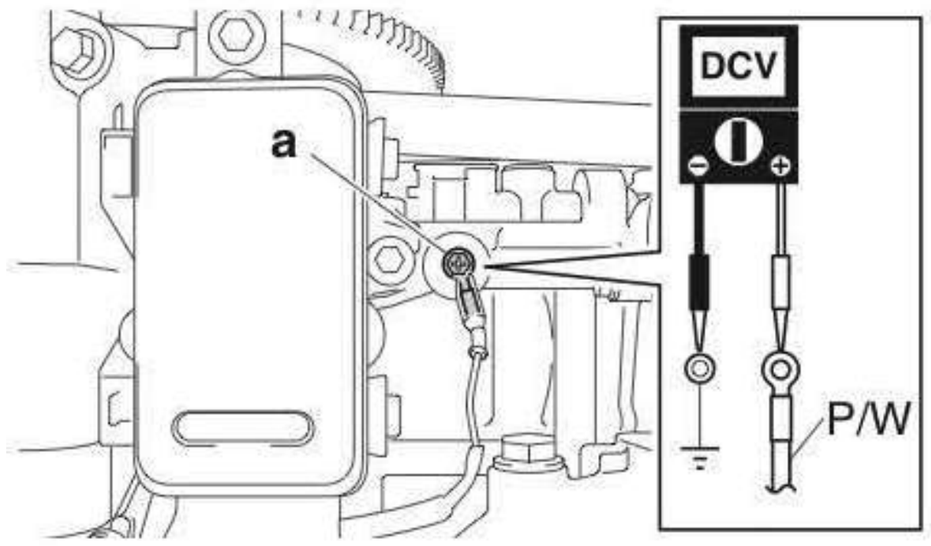
3. Disconnect the ISC valve coupler "a".

5. Connect the ISC valve coupler.

Checking the oil pressure switch

1. Disconnect the oil pressure switch lead "a".

2. Turn the engine start switch to ON, and then measure the oil pressure switch input voltage.



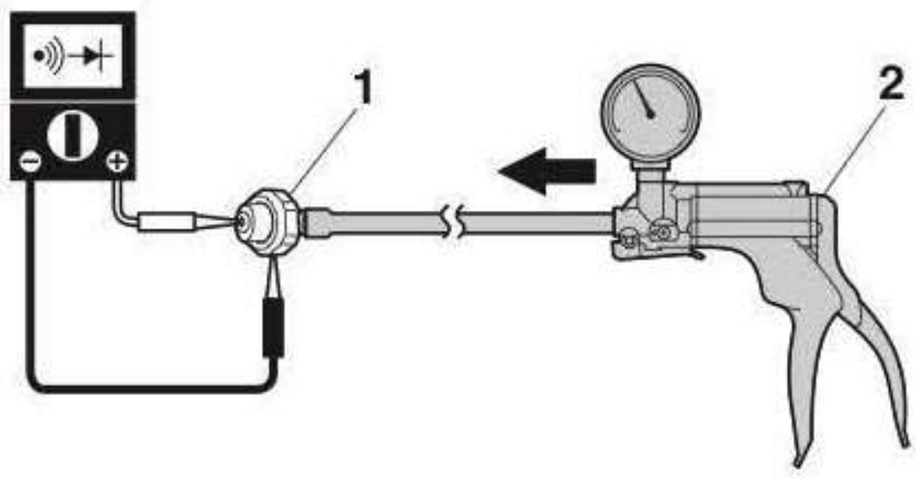
Input voltage 11.0-12.0 V Pink/White (P/W)-Ground

3. Turn the engine start switch to OFF.

4. Remove the oil pressure switch "1".

5. Connect the special service tool "2" to the oil pressure switch "1".

6. Apply positive pressure to the oil pressure switch "1" slowly, and then check that continuity is lost in the range of the working pressure. Replace the oil pressure switch if the continuity is not lost in the working pressure range.



Vacuum/pressure pump gauge set "2" Pressure/vacuum tester "2"

Working pressure 127.50-166.70 kPa (1.275-1.667 kgf/cm2, 18.49-24.17 psi)

7. Disconnect the special service tool.

8. Install the oil pressure switch, and then connect the oil pressure lead. See "Cylinder block" (7-77).

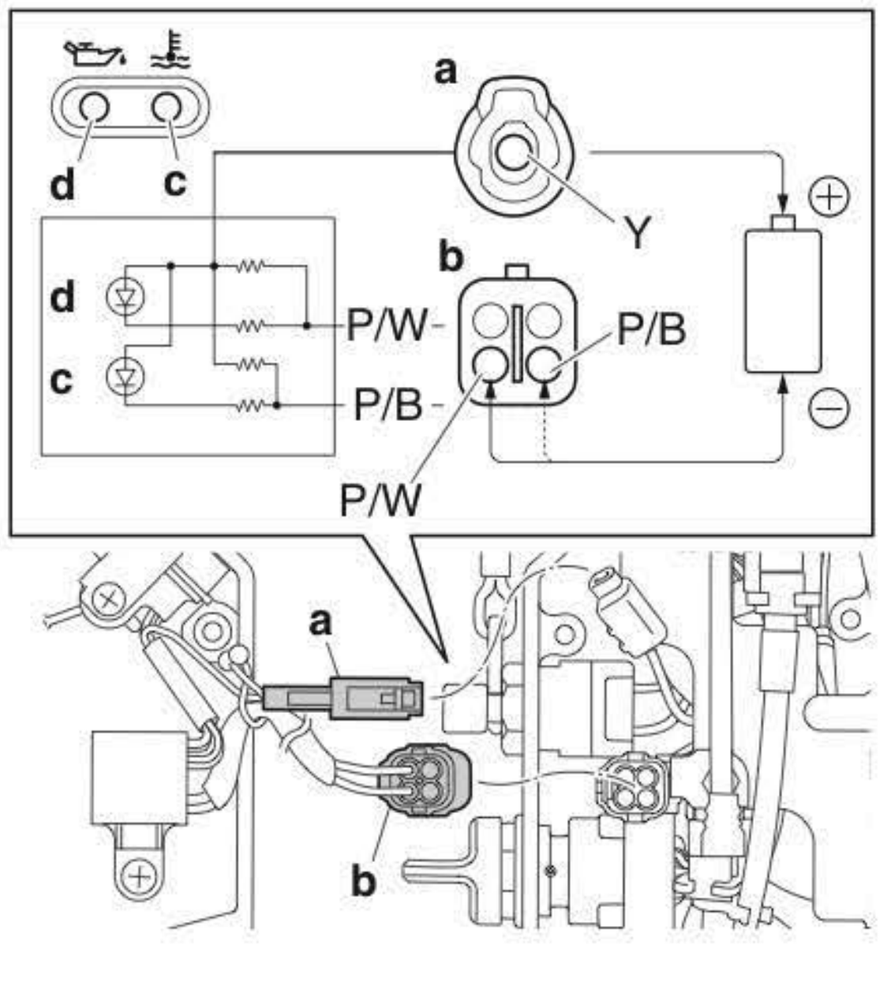
Checking the alert indicator (tiller handle model)

1. Remove the tiller handle cover, and then disconnect the alert indicator couplers "a" and "b".

2. Connect the battery (1.5 V) to the alert indicator couplers "a" and "b". Check that the overheat alert indicator "c" or the oil pressure alert indicator "d" comes on. Replace the alert indicator if it does not come on.

NOTICE

Do not apply a voltage higher than 1.7 V when checking the LED.



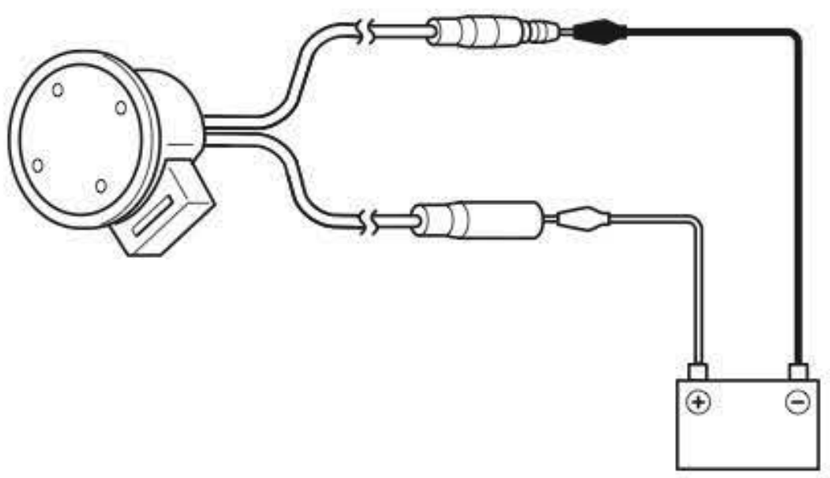
Lighting-up	Terminal	Battery
Overheat alert indicator "c"	Yellow (Y)	(+)
	Pink/Black (P/B)	(-)
Oil pressure alert indicator "d"	Yellow (Y)	(+)
	Pink/White (P/W)	(-)

3. Connect the alert indicator couplers and, and then install the tiller handle cover.

Checking the alert buzzer

1. Remove the alert buzzer.

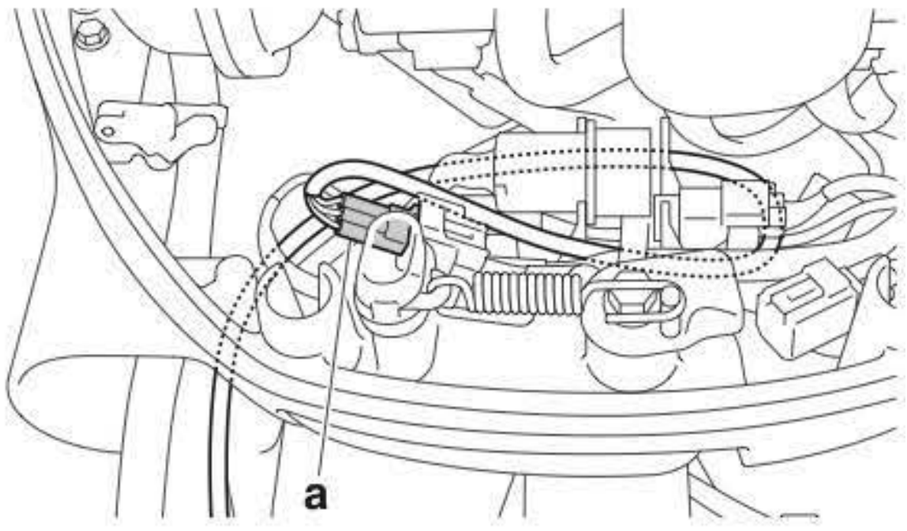
2. Connect the battery leads to the alert buzzer connectors, and check that the alert buzzer comes on. Replace the alert buzzer if it does not come on.



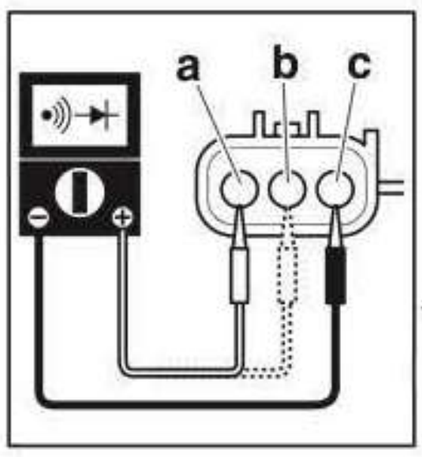
3. Install the alert buzzer.

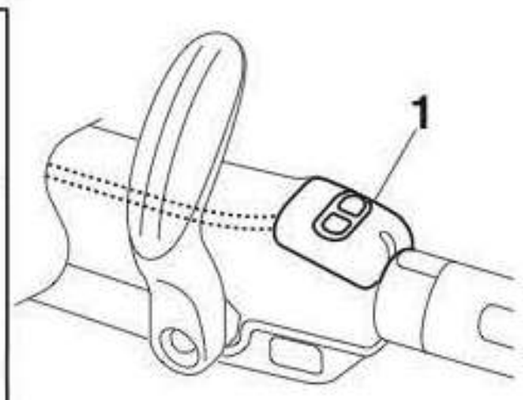
Checking the trolling switch (tiller handle model)

1. Disconnect the trolling switch coupler "a".



2. Check the trolling switch "1" for continuity. Replace the trolling switch if out of specification.





Trolling switch continuity
- Switch position UP
  - Terminal "b"–Terminal "c"
- Switch position DN
  - Terminal "a"–Terminal "c"

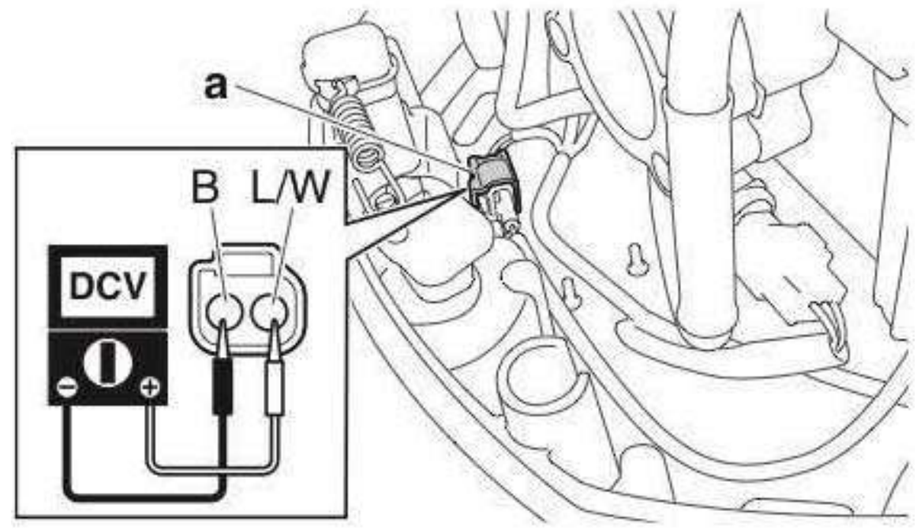
3. Connect the trolling switch coupler.

Fuel control unit and component

Checking the water detection switch

1. Disconnect the water detection switch coupler "a".

2. Turn the engine start switch to ON, and then measure the input voltage at the water detection switch coupler.



Input voltage
- 4.75-5.25 V
- Blue/White (L/W)–Black (B)

3. Turn the engine start switch to OFF, and then remove the fuel cup assembly.

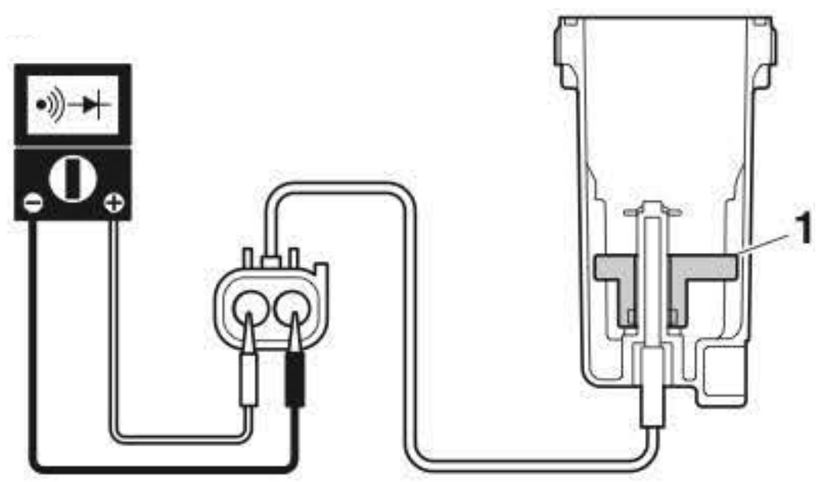
4. Check that the float "1" moves smoothly.

5. Check the water detection switch for continuity when the float "1" is in positions "A" and "B". Replace the fuel cup assembly if out of specification.

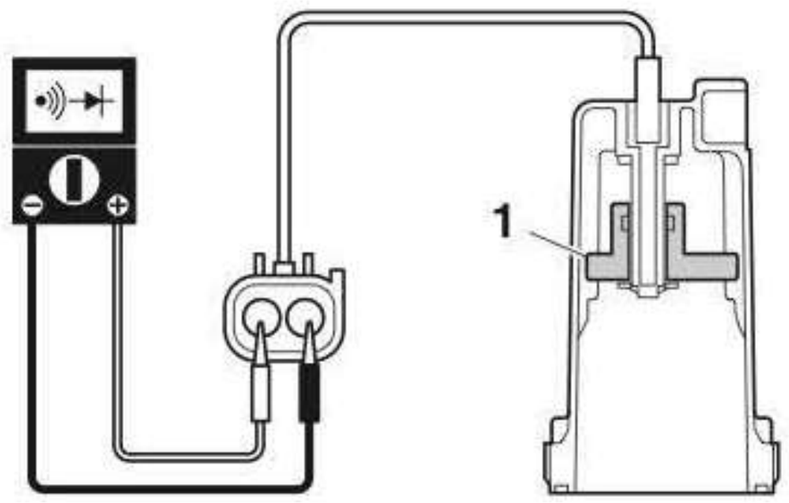
NOTICE

Do not remove the clip and float.

A



B



Water detection switch continuity
No continuity
Float position "A"
Continuity
Float position "B"

6. Install the fuel cup assembly. See "Installing the fuel filter assembly" (6-8).

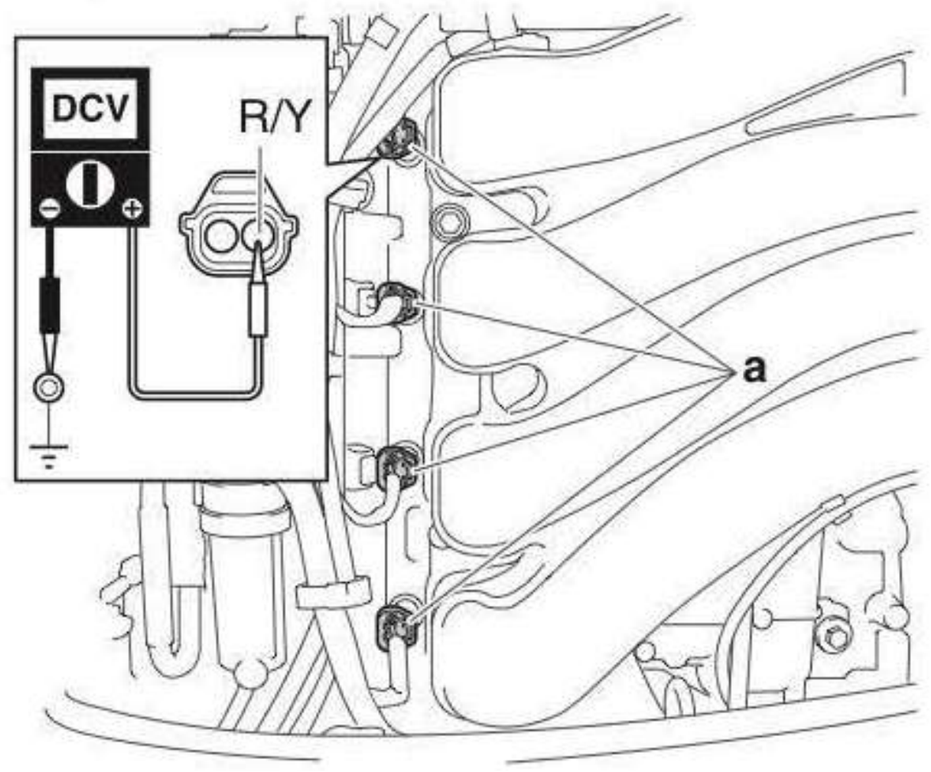
7. Connect the water detection switch coupler.

Checking the fuel injector

1. Check the operation of the fuel injectors using the HDIS "Stationary test" and check the operating sound.

2. Disconnect the fuel injector couplers "a".

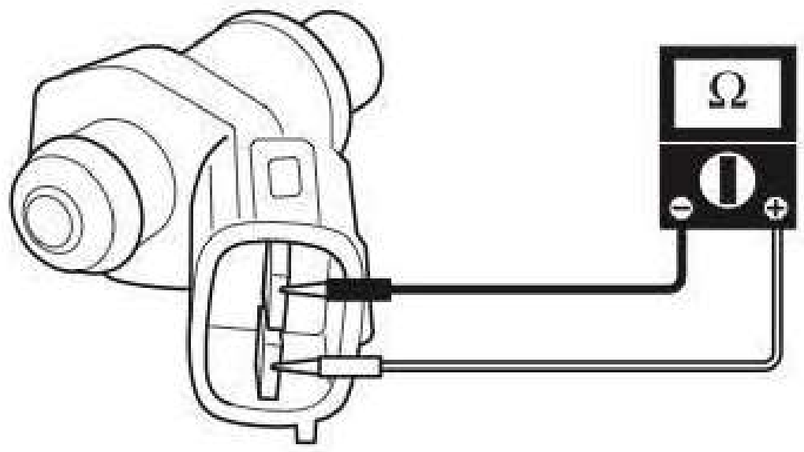
3. Turn the engine start switch to ON, and then measure the input voltage between the fuel injector coupler terminal and ground.



Input voltage
12 V (battery voltage)
Red/Yellow (R/Y)–Ground

4. Turn the engine start switch to OFF.

5. Measure the fuel injector resistance. Replace if out of specification.



Resistance (reference data)
11.50-12.50Ω

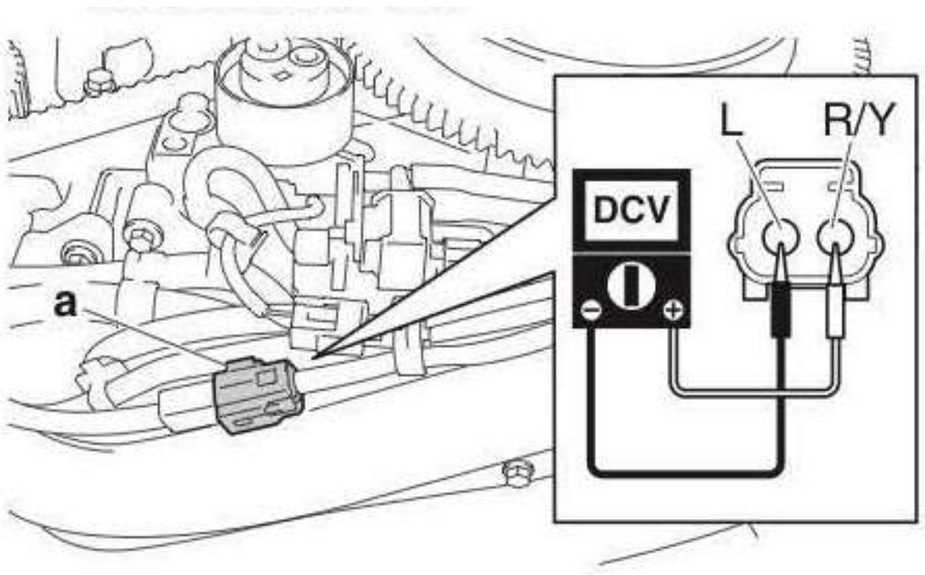
6. Connect the fuel injector couplers.

Checking the high-pressure fuel pump

1. Check the operation of the high-pressure fuel pump using the HDIS "Stationary test" and check the operating sound.

2. Disconnect the high-pressure fuel pump coupler "a".

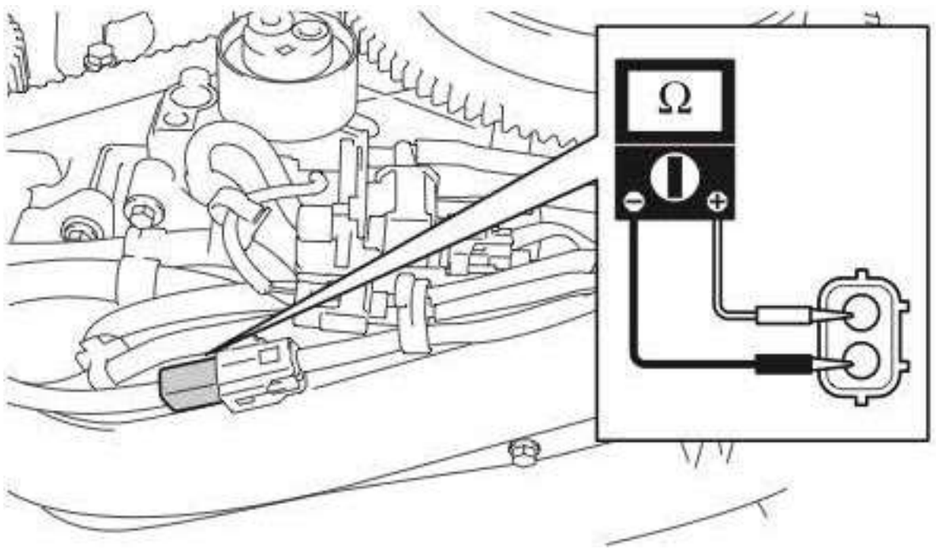
3. Connect the tester probes to the terminals of the high-pressure fuel pump coupler, and then measure the input voltage within 3 seconds after turning the engine start switch to ON.



Input voltage
12 V (battery voltage)
Red/Yellow (R/Y)-Blue (L)

4. Turn the engine start switch to OFF.

5. Measure the high-pressure fuel pump motor resistance.



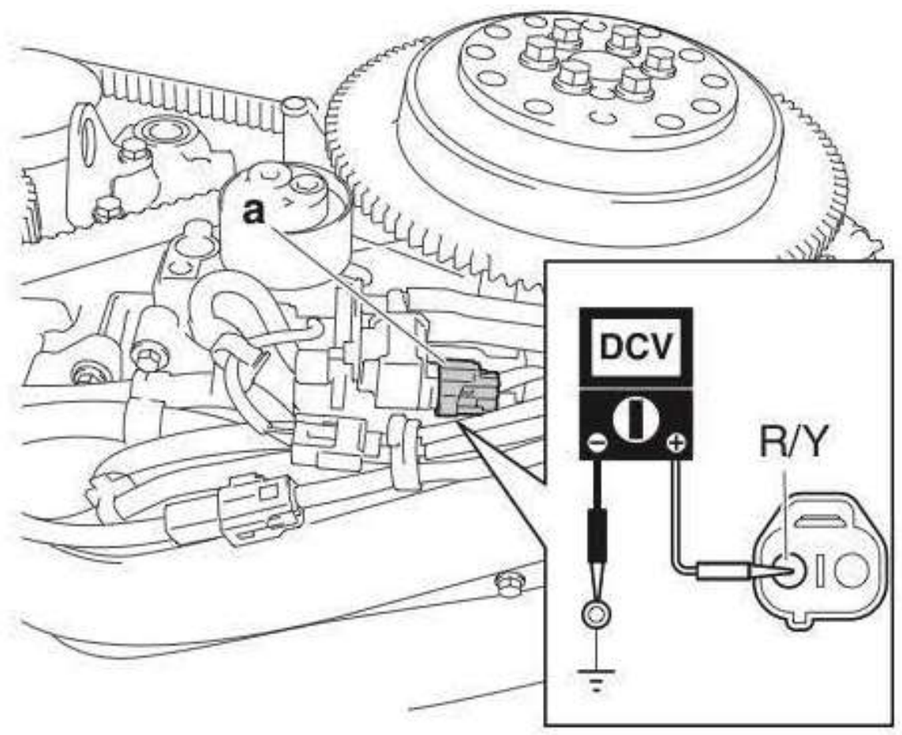
Resistance (reference data)
0.2-3.0Ω

6. Connect the high-pressure fuel pump coupler.

Checking the vapor shut-off valve

1. Disconnect the vapor shut-off valve coupler "a".

2. Turn the engine start switch to ON, and then measure the input voltage between the vapor shut-off valve coupler terminal and ground.



Input voltage
12 V (battery voltage)
Red/Yellow (R/Y)–Ground

3. Remove the vapor shut-off valve, and then connect the special service tool "1" to the vapor shut-off valve.

Vacuum/pressure pump gauge set "1"

Pressure/vacuum tester "1"

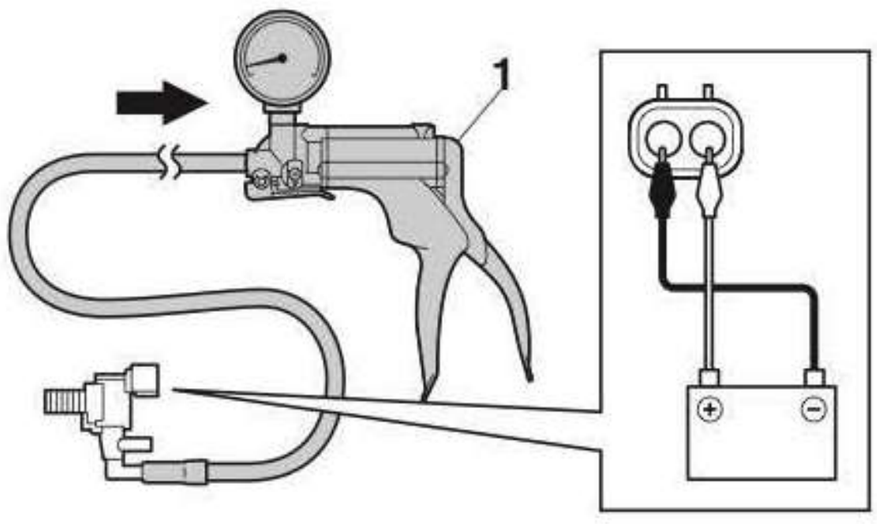
4. Apply the specified negative pressure to the vapor shut-off valve.

Specified negative pressure
67.0 kPa (0.67 kgf/cm^2, 9.7 psi)

5. Check that the vapor shut-off valve opens and the negative pressure is released when the battery leads are connected to the vapor shut-off valve terminals.

NOTICE

Connect the battery leads to the vapor shut-off valve terminals for only a few seconds.



6. Remove the special service tool.

7. Measure the resistance between the vapor shut-off valve terminals. Replace if out of specification.

Resistance
30.0-34.0Ω

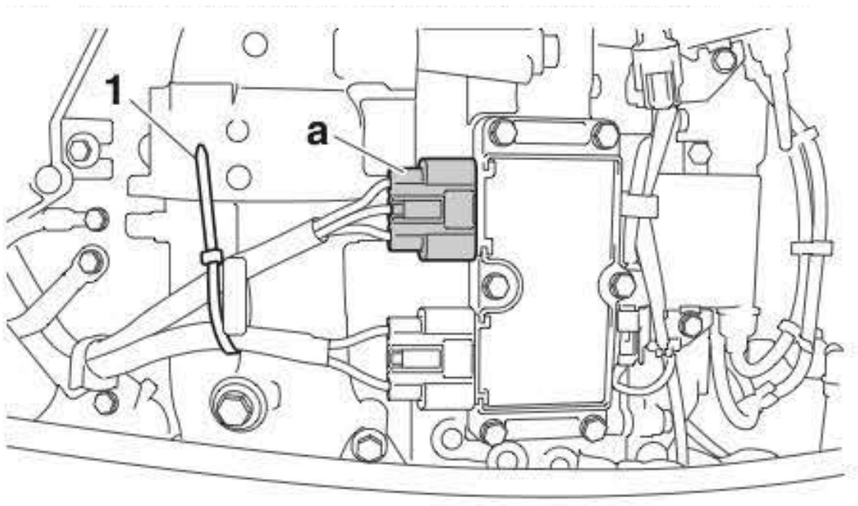
8. Install the vapor shut-off valve, and then connect the vapor shut-off valve coupler.

Charging unit and component

Checking the lighting coil (stator assembly)

1. Remove the plastic tie "1".

2. Disconnect the lighting coil coupler "a".



3. Connect the special service tool "1".

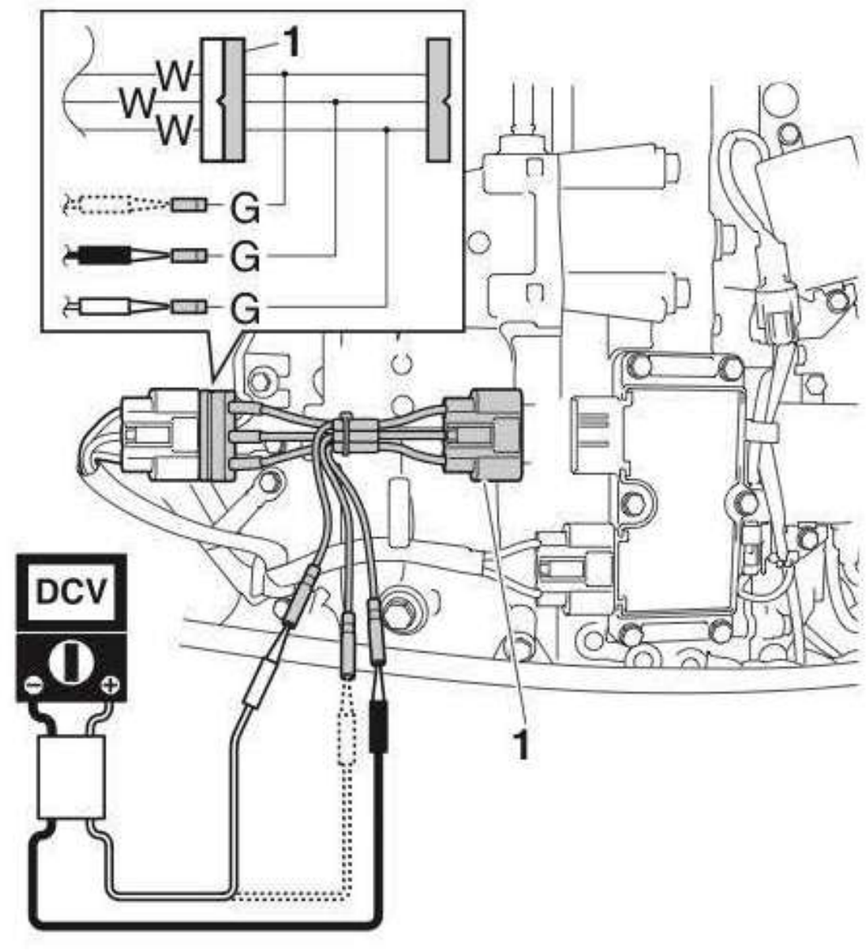
4. Remove the clip from the engine shut-off switch.

5. While cranking the engine, measure the peak voltage.

6. Insert the clip into the engine shut-off switch.

7. Start the engine, and then measure the peak voltage at the specified engine speed.

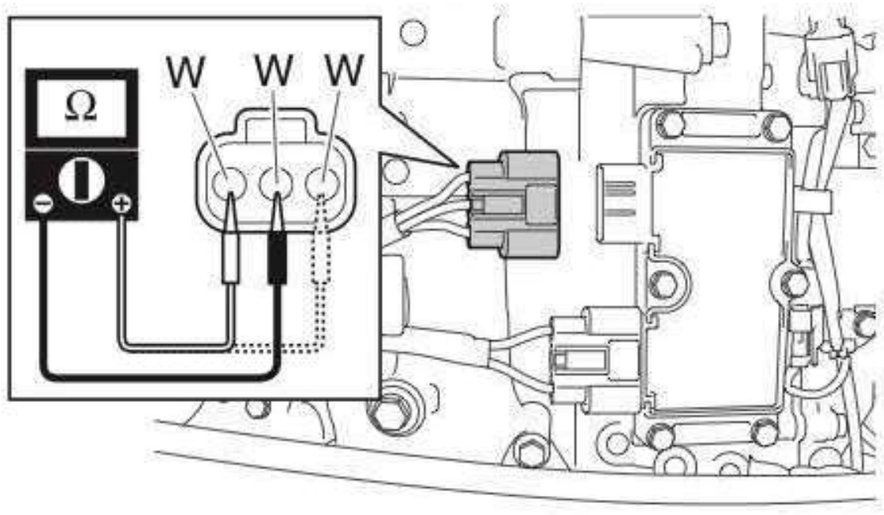
8. Measure the lighting coil output peak voltage between all combinations of the connectors.



Test harness (3 pins) "1"
Test harness (3 pins) "1"

Output peak voltage at cranking (unloaded) (reference data)
7.1 V
Output peak voltage at 1500 r/min (unloaded) (reference data)
27.9 V
Output peak voltage at 3500 r/min (unloaded) (reference data)
82.8 V
White (W)-White (W)

9. Disconnect the special service tool, and then measure the lighting coil resistance.



Resistance (reference data)
0.1664-0.2496Ω
White (W)-White (W)

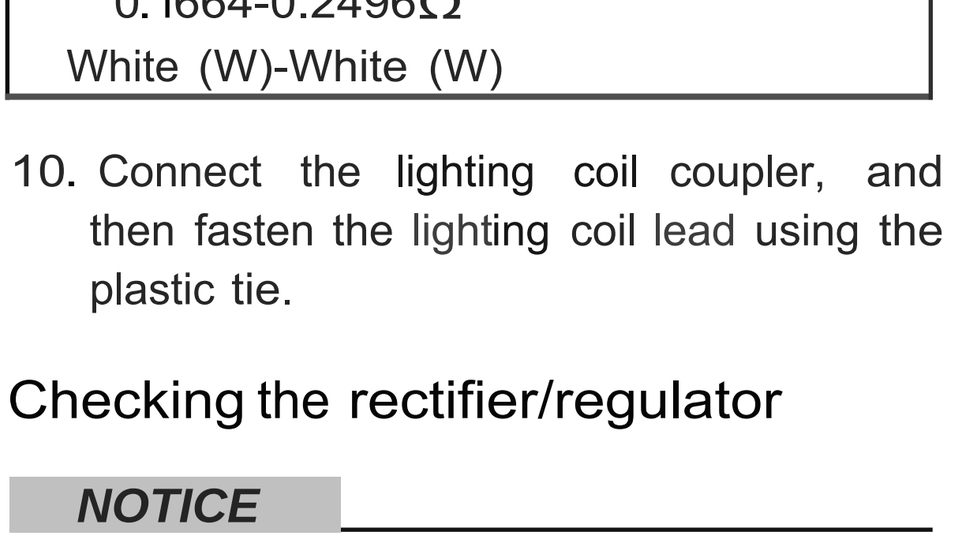
10. Connect the lighting coil coupler, and then fasten the lighting coil lead using the plastic tie.

Checking the rectifier/regulator

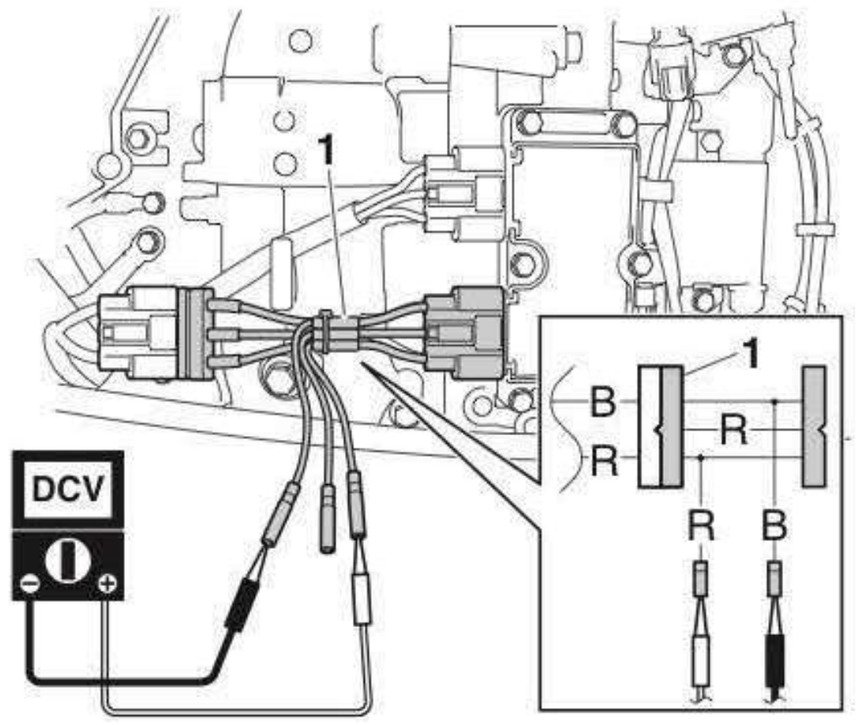
NOTICE

Do not connect the battery cables in reverse. Otherwise, the rectifier/regulator could be damaged.

1. Remove the plastic tie "1".
2. Disconnect the rectifier/regulator coupler "a".



3. Connect the special service tool "1", and then measure the rectifier/regulator output voltage at the specified engine speed.

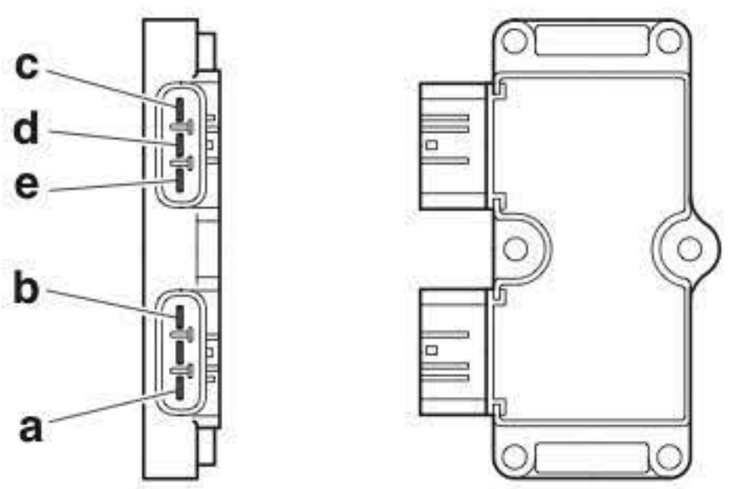


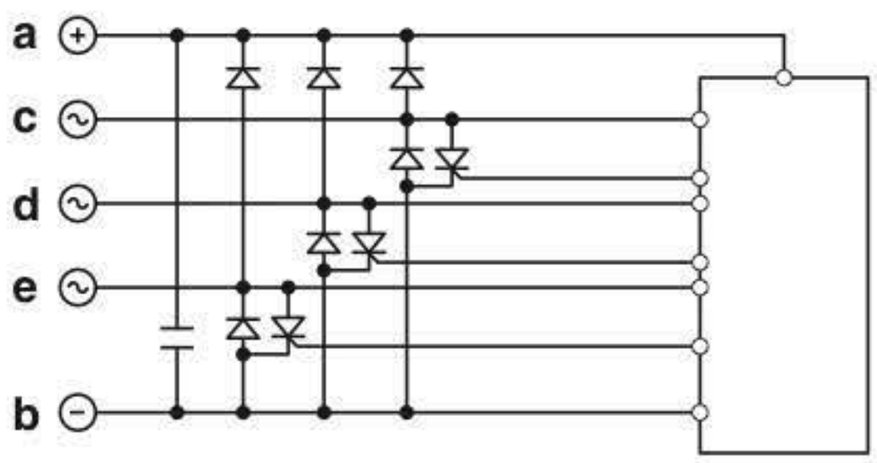
Test harness (3 pins)

Test harness (3 pins)

Output voltage at 1500 r/min (loaded) (reference data)
13 V
Output voltage at 3500 r/min (loaded) (reference data)
13 V
Red (R)-Black (B)

4. Set the digital circuit tester to the diode mode, and then check the rectifier/regulator for continuity.





Rectifier/regulator continuity (testing diode mode)		
Tester probe		Display value (reference data)
+)	(-)	
a	b	OL
	c	
	d	
	e	
b	a	0.7-0.8 V
	c	0.4-0.5 V
	d	
	e	
c	a	0.4-0.5 V
	b	OL
	d	
	e	
d	a	0.4-0.5V
	b	OL
	c	
	e	
e	a	0.4-0.5 V
	b	OL
	c	
	d	

OL: Indicates an overload

5. Connect the rectifier/regulator coupler, and then fasten the rectifier/regulator lead using the plastic tie.

Ignition unit and component

Checking the ignition spark

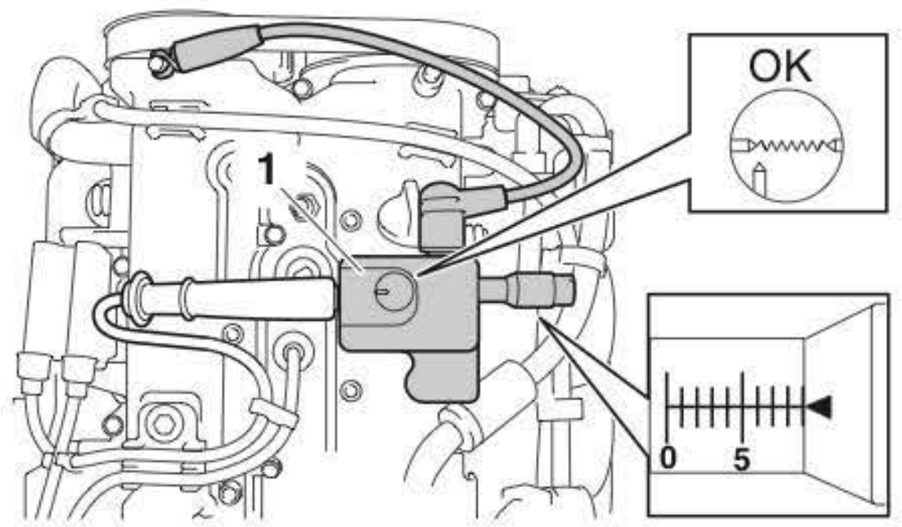
1. Disconnect the spark plug wire from the spark plug.

2. Connect the spark plug wire to the special service tool "1".

3. Check the ignition spark using the HDIS "Stationary test".

⚠ WARNING

Do not touch any of the connections of the special service tool.



Ignition checker (Spark gap tester) "1"

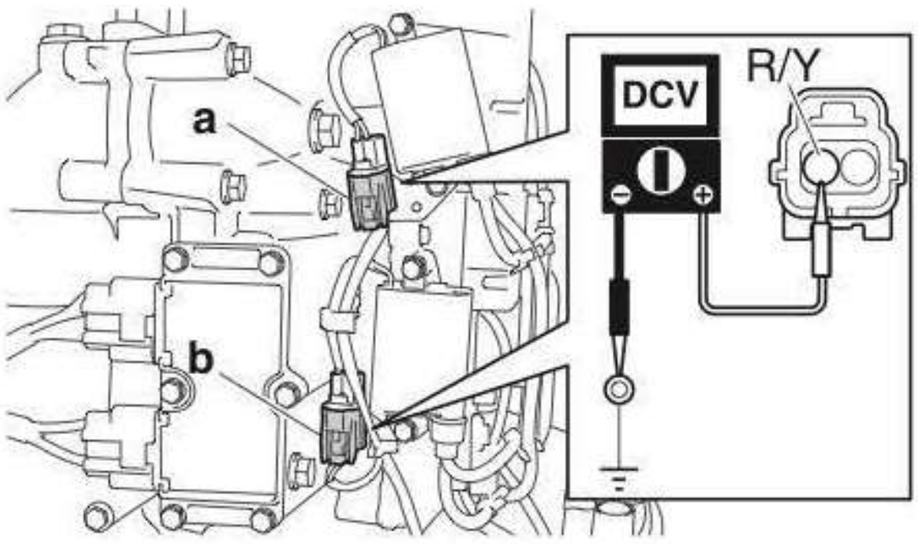
Spark checker "1"

4. Remove the special service tool, and then connect the spark plug wire.

Checking the ignition coil

1. Disconnect the ignition coil couplers "a" and "b".

2. Turn the engine start switch to ON, and then measure the input voltage at the ignition coil coupler terminal and ground.

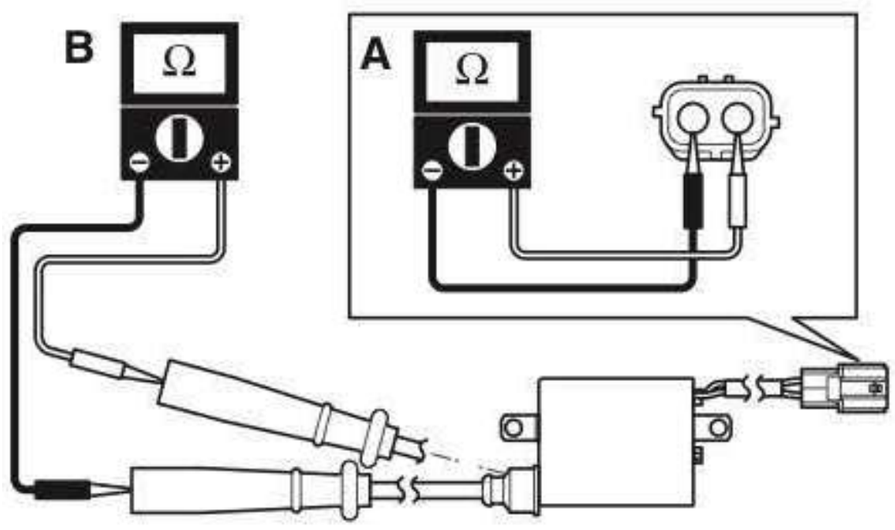


Input voltage
12 V (battery voltage)
Red/Yellow (R/Y)-Ground

3. Turn the engine start switch to OFF.

4. Disconnect the spark plug wires from the spark plugs.

5. Measure the ignition coil resistance. Replace if out of specification.



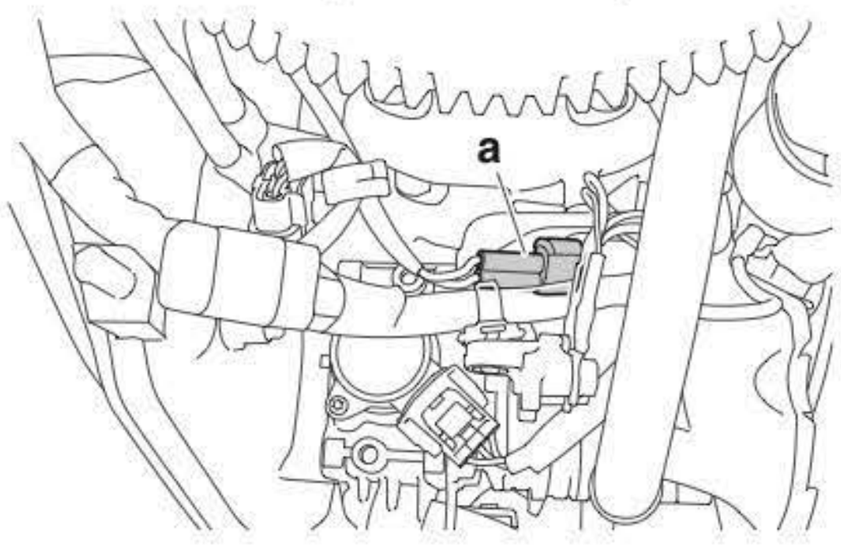
A. Primary coil
B. Secondary coil

Primary coil resistance
1.870-2.530Ω
Secondary coil resistance
18.97-35.23 kΩ
Spark plug wire number
#1 #4
Primary coil resistance
1.87-2.53Ω
Secondary coil resistance
18.55-34.45 kΩ
Spark plug wire number
#2 #3

6. Connect the spark plug wires and ignition coil couplers.

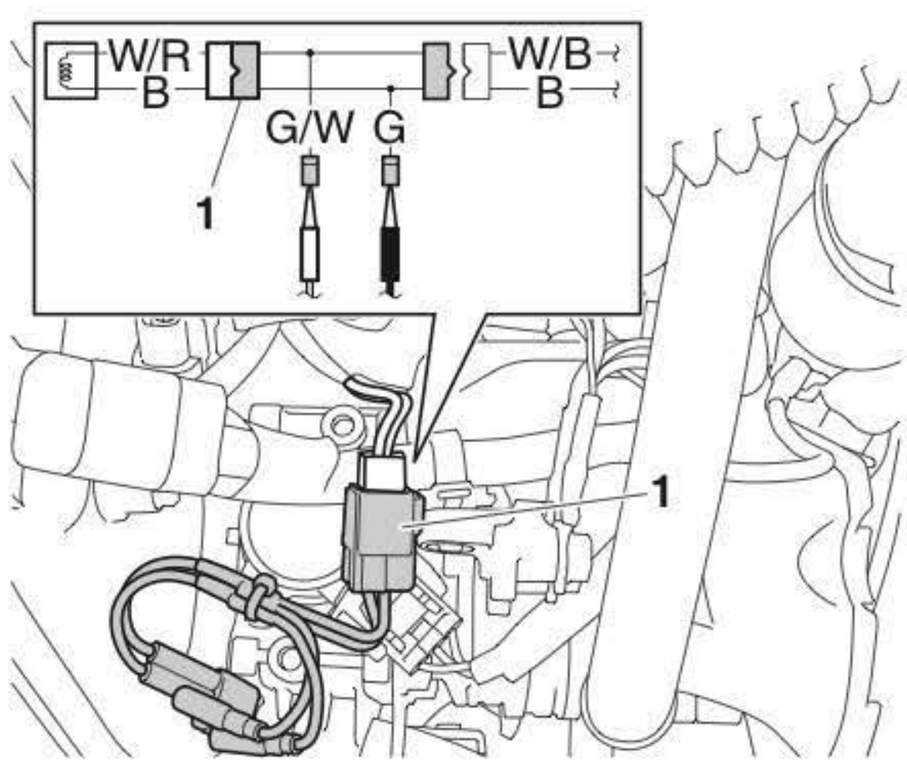
Checking the pulser coil

1. Disconnect the pulser coil coupler "a".



2. Connect the special service tool "1" to the pulser coil coupler (pulser coil end).

3. While cranking the engine, measure the peak voltage under unloaded condition.



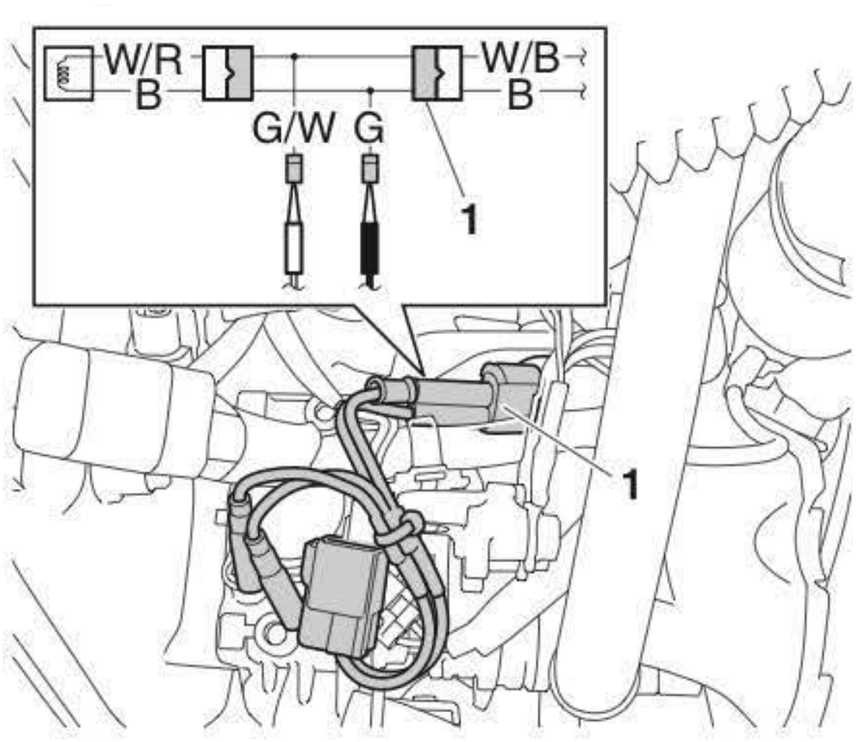
4. Connect the special service tool "1" to the pulser coil coupler (wire harness end).

5. Remove the clip from the engine shut-off switch.

6. While cranking the engine, measure the peak voltage under loaded condition.

7. Insert the clip into the engine shut-off switch.

8. Start the engine, and then measure the peak voltage at the specified engine speed.



Test harness (2 pins) "1"
Test harness (2 pins) "1"

Output peak voltage at cranking (unloaded) (reference data)
3.9 V
Output peak voltage at cranking (loaded) (reference data)
3.4 V
Output peak voltage at 1500 r/min (loaded) (reference data)
12.3 V
Output peak voltage at 3500 r/min (loaded) (reference data)
15.5 V
White/Red (W/R)-Black (B)

9. Disconnect the special service tool, and then measure the pulser coil resistance. Replace if out of specification.

Resistance
396.0-594.0Ω

10. Connect the pulser coil coupler.

Checking the intake air temperature sensor

The intake air pressure sensor is a component of the intake air pressure/temperature sensor.

1. Measure the ambient temperature.

2. Connect the HDIS to display "Intake air temperature".

3. Check that the difference between the ambient temperature and the displayed intake air temperature is within ± 5℃ (± 9 °F).

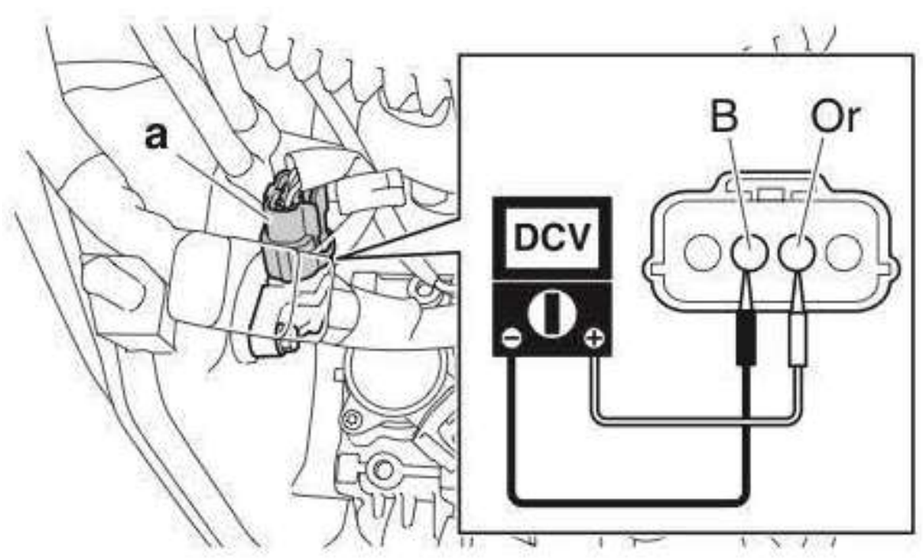
TIP:

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

Checking the intake air pressure sensor

The intake air pressure sensor is a component of the intake air pressure/temperature sensor.

1. Disconnect the intake air pressure/temperature sensor coupler "a".
2. Turn the engine start switch to ON, and then measure the input voltage at the intake air pressure sensor coupler.

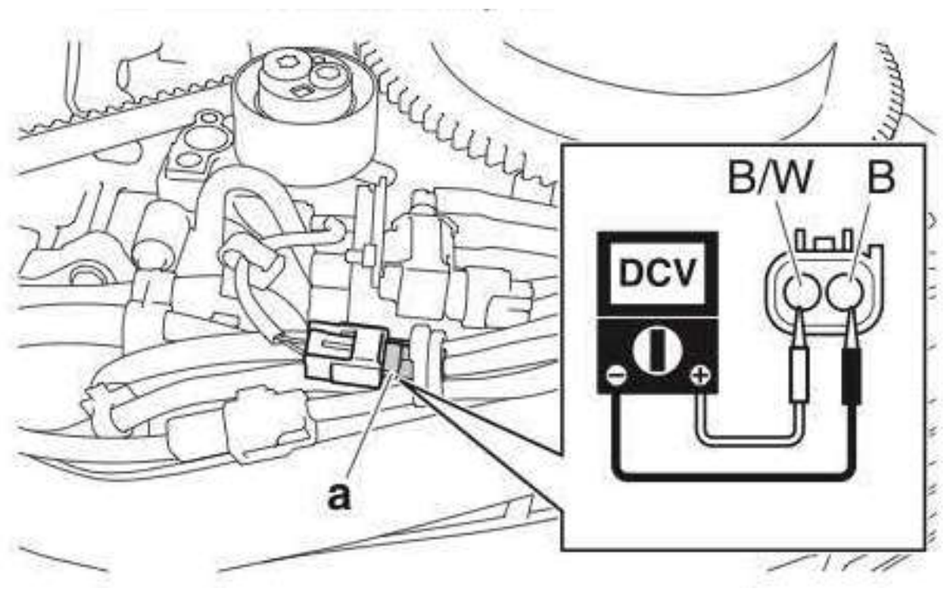


Input voltage
4.75-5.25 V
Orange (Or)-Black (B)

3. Turn the engine start switch to OFF.
4. Connect the intake air pressure/temperature sensor coupler.

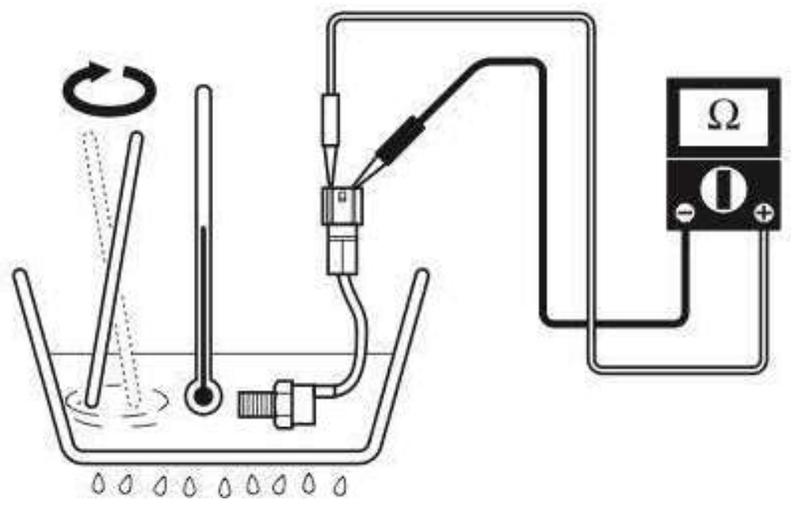
Checking the thermo sensor

1. Disconnect the thermo sensor coupler "a".
2. Turn the engine start switch to ON, and then measure the input voltage at the thermo sensor coupler.



Input voltage
4.75–5.25 V
Black/White (B/W)–Black (B)

3. Turn the engine start switch to OFF.
4. Remove the thermo sensor.
5. Place the thermo sensor in a container of water and heat the water slowly.
6. Measure the thermo sensor resistance.

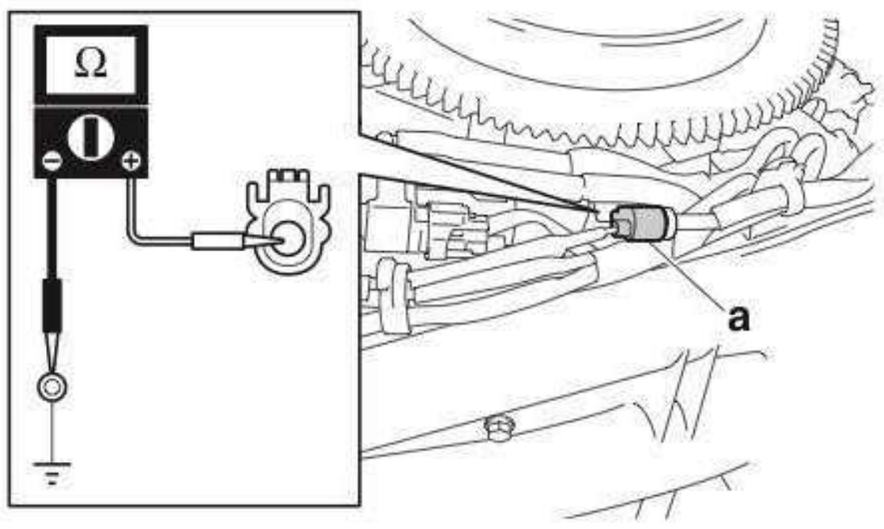


Resistance at 20℃ (68 °F)
2.44 kΩ
Resistance at 100℃ (212 °F)
0.193kΩ

7. Install the thermo sensor. See "Installing the crankcase cover" (7-62).
8. Connect the thermo sensor coupler.

Checking the knock sensor

1. Disconnect the knock sensor coupler "a".
2. Measure the knock sensor resistance. Replace if out of specification.



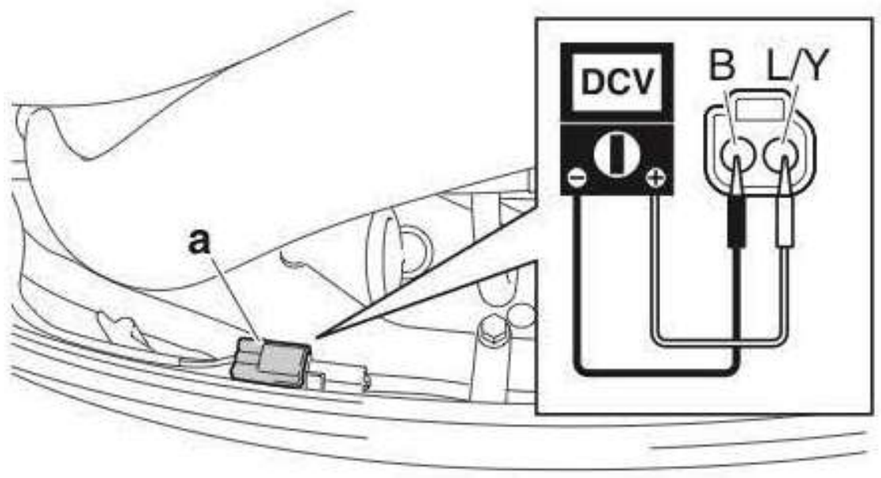
Resistance
504-616 kΩ

3. Connect the knock sensor coupler.

Checking the shift position switch

1. Disconnect the shift position switch coupler "a".

2. Turn the engine start switch to ON, and then measure the input voltage at the shift position switch coupler.

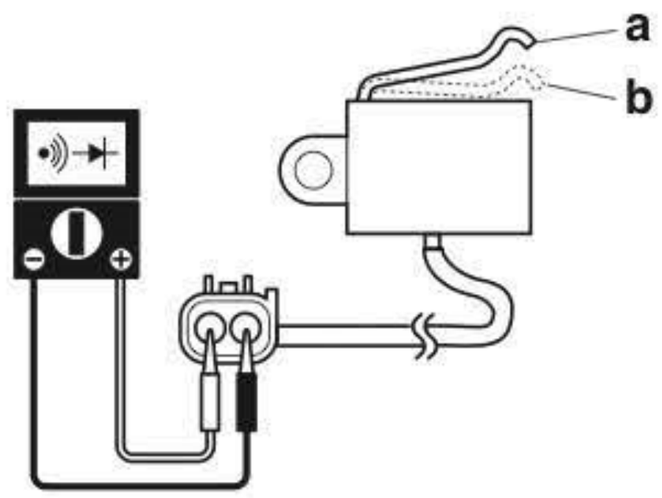


Input voltage
4.75- 5.25 V
Blue/Yellow (LY)-Black (B)

3. Turn the engine start switch to OFF.

4. Remove the shift position switch.

5. Check the shift position switch for continuity. Replace if out of specification.



Shift position switch continuity
No continuity
Switch position "a"
Continuity
Switch position "b"

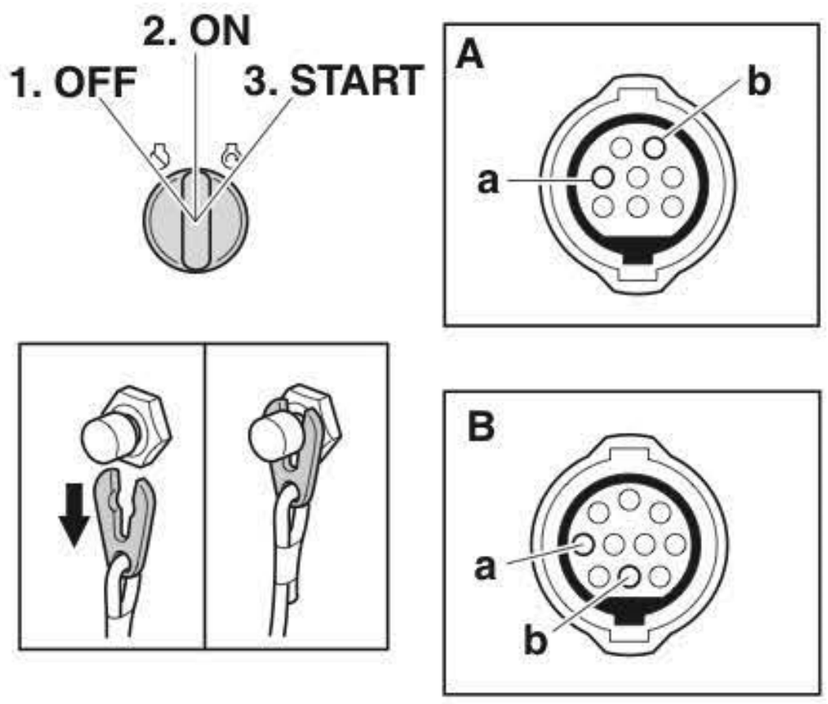
6. Install the shift position switch. See "Shift rod and shift bracket" (9-14).

7. Connect the shift position switch coupler.

Checking the engine shut-off switch

1. Disconnect the main wire harness coupler or engine start switch coupler.

2. Turn the engine start switch to ON, and then check the engine shut-off switch for continuity. Replace if out of specification.



1. OFF
2. ON
3. START

A. Engine start switch
B. 703 side mount remote control/tiller handle

Engine shut-off switch continuity
Clip removed
Terminal "a"–Terminal "b"

3. Turn the engine start switch to OFF.

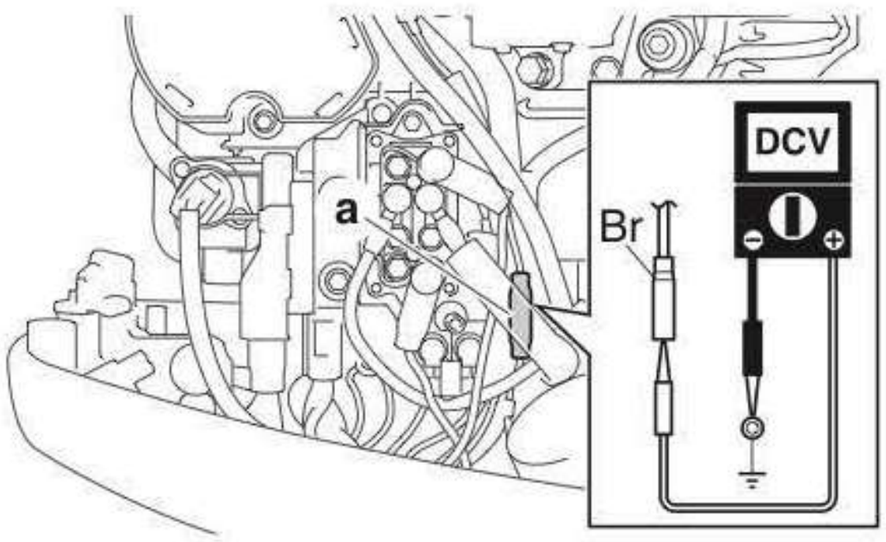
4. Connect the main wire harness coupler or engine start switch coupler.

Starting unit and component

Checking the starter relay

1. Disconnect the starter relay connector "a".

2. Turn the engine start switch to START position, and then measure the input voltage between the starter relay connector "a" and ground.



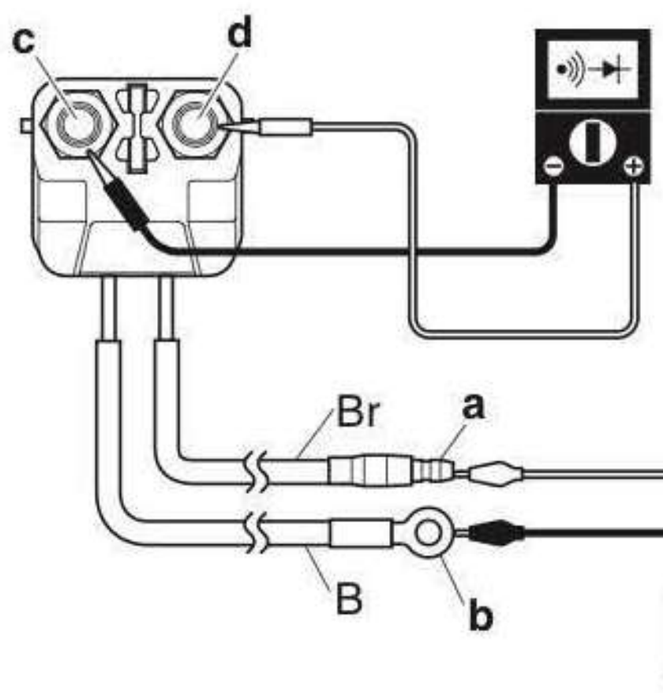
Input voltage
12 V (battery voltage)
Brown (Br)-Ground

3. Disconnect the starter relay leads, and then remove the starter relay.

NOTICE

Before disconnecting the starter relay terminals, make sure to disconnect the negative battery terminal.

4. Connect the positive battery lead to the relay connector "a", and the negative battery lead to the relay lead "b", and then check for continuity between terminals "c" and "d". Replace the starter relay if out of specification.



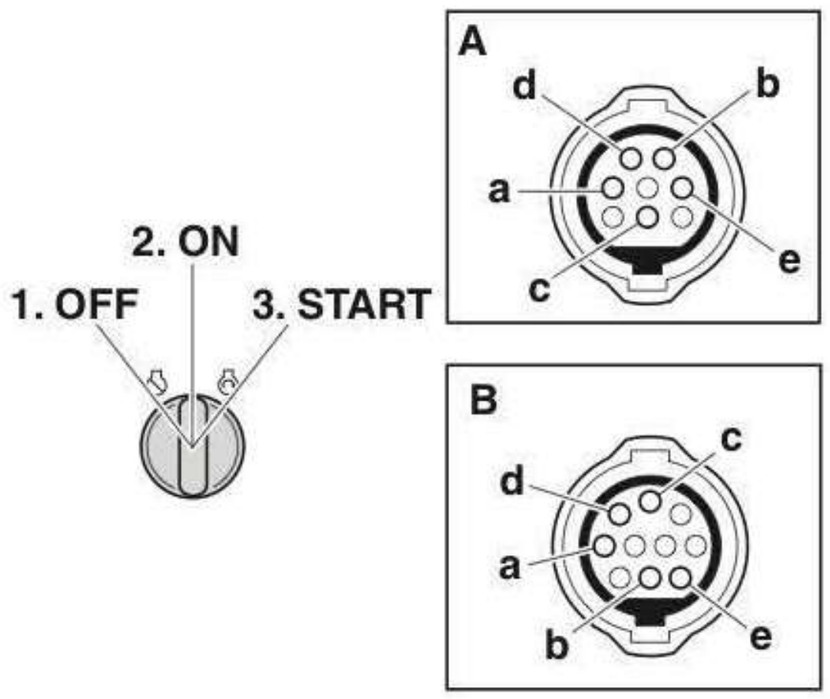
Relay terminals continuity
Battery lead connected
Terminal "c"–Terminal "d"

5. Install the starter relay, and then connect the starter relay leads.

Checking the engine start switch

1. Disconnect the main wire harness coupler or engine start switch coupler.

2. Check the engine start switch for continuity.



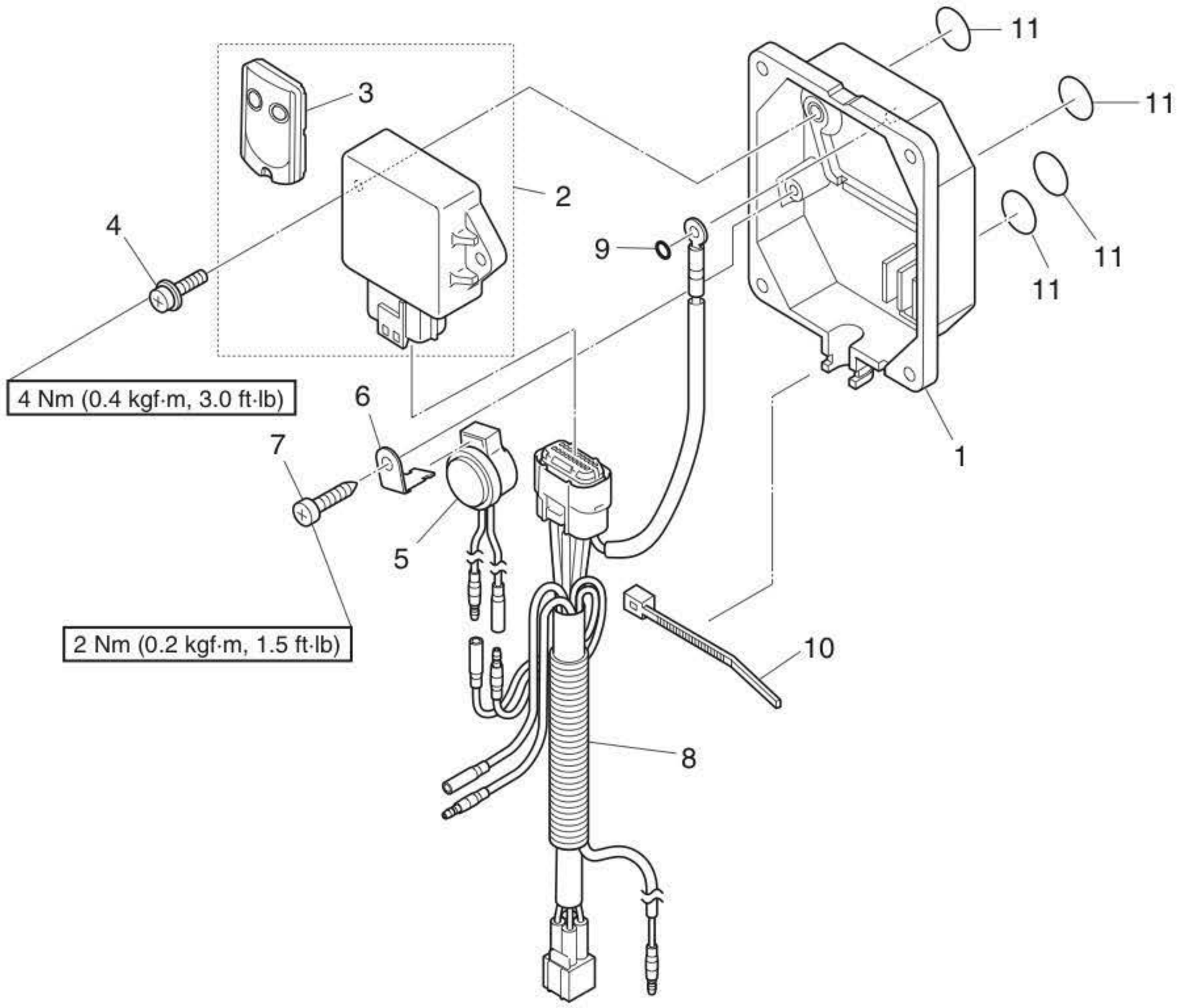
1. OFF
2. ON
3. START

A. Engine start switch
B. 703 side mount remote control/tiller handle

Engine start switch continuity
Switch position OFF
Terminal "a"–Terminal "b"
Switch position ON
Terminal "c"–Terminal "d"
Switch position START
Terminal "c"–Terminal "d"
Terminal "d"–Terminal "e"
Terminal "c"–Terminal "e"

3. Connect the main wire harness coupler or engine start switch coupler.

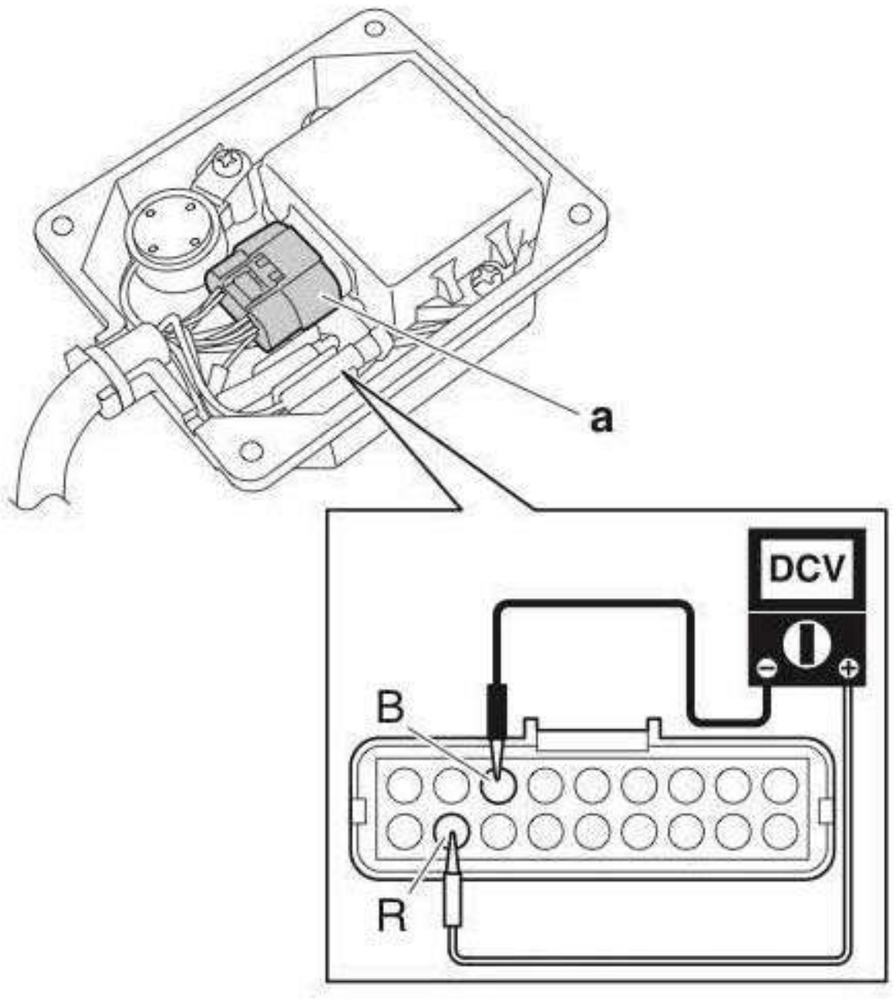
V-COP



No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Control unit assembly	1	
3	Remote control transmitter	2	
4	Screw	2	M6×15 mm
5	Buzzer	1	
6	Bracket	1	
7	Screw	1	M6×19 mm
8	Main wire harness	1	
9	O-ring	1	
10	Plastic tie	1	
11	Seal	4	

Checking H-COP

1. Disconnect the H-COP coupler "a", and then measure the H-COP input voltage.

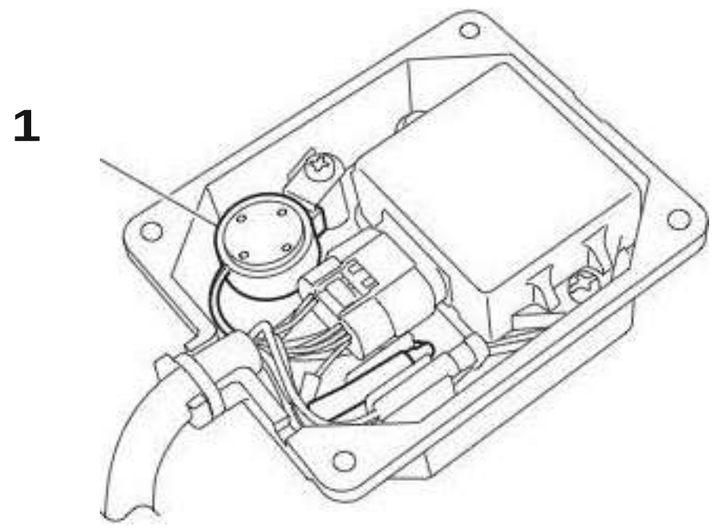


Input voltage
12 V (battery voltage)
Red (R)-Black (B)

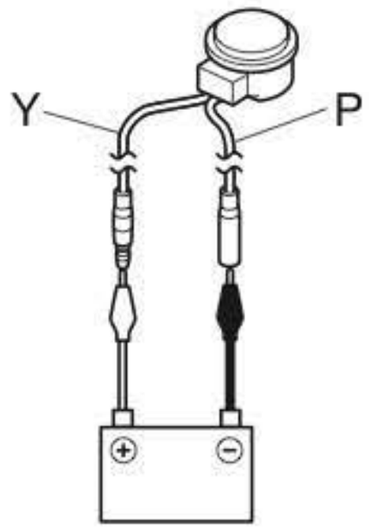
2. Connect the H-COP coupler.

Checking the buzzer

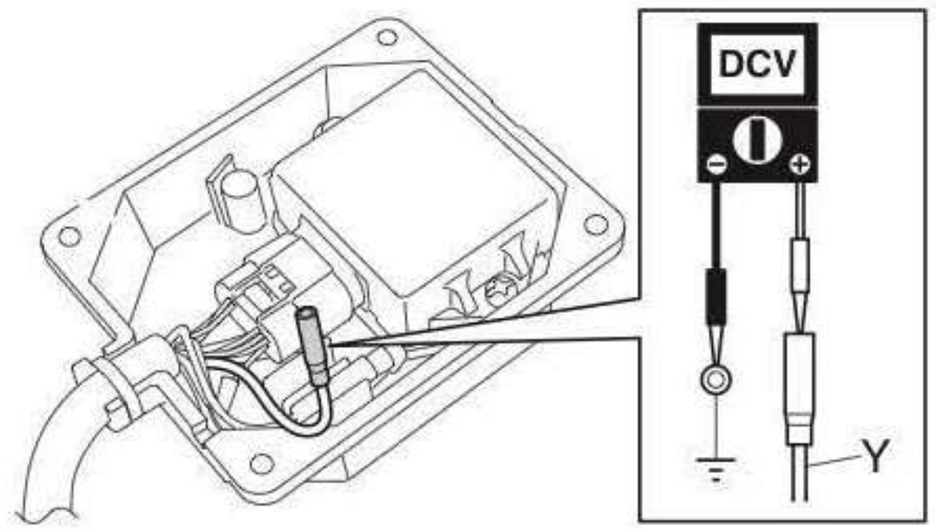
1. Remove theH-COP buzzer "1".



2. Connect the battery leads to the H-COP buzzer connectors, and then check that the H-COP buzzer comes on. Replace the H-COP buzzer if it does not come on.



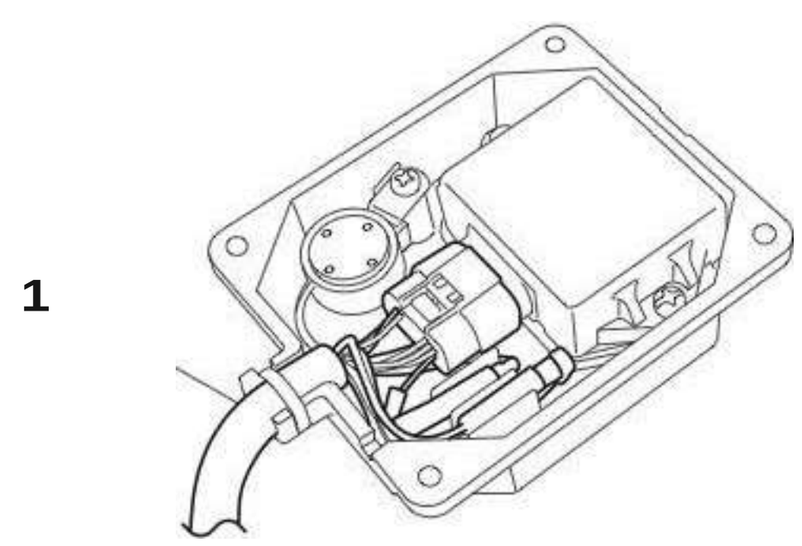
3. Measure the H-COP buzzer input voltage.



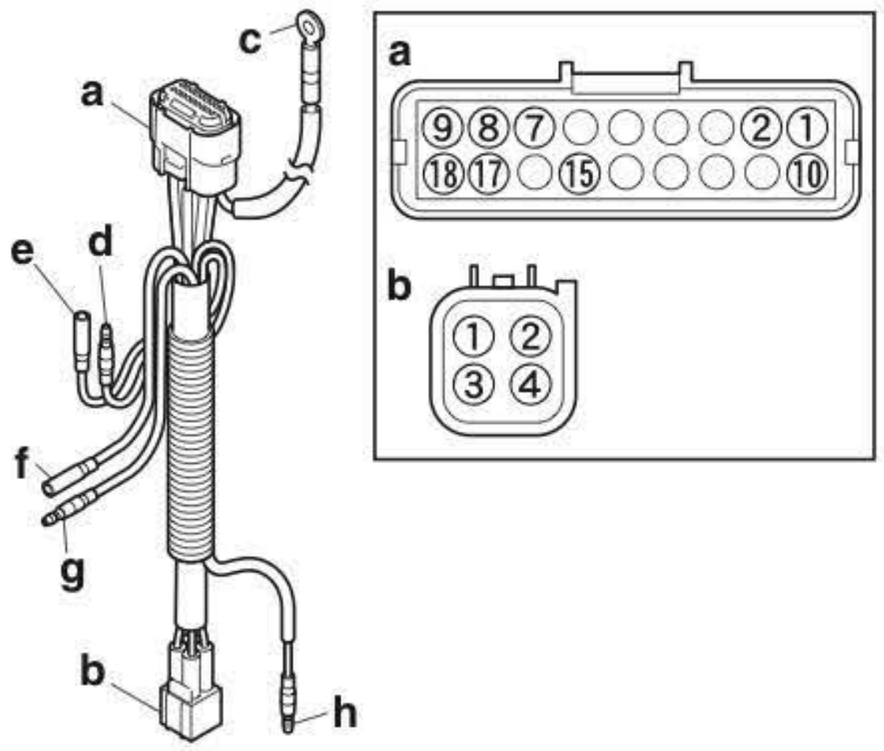
Input voltage
12 V (battery voltage)
Yellow (Y)-Ground

Checking theH-COP main wire harness

1. Remove the H-COP main wire harness “1”.



2. Check the wire harness for continuity. Replace if there is no continuity.

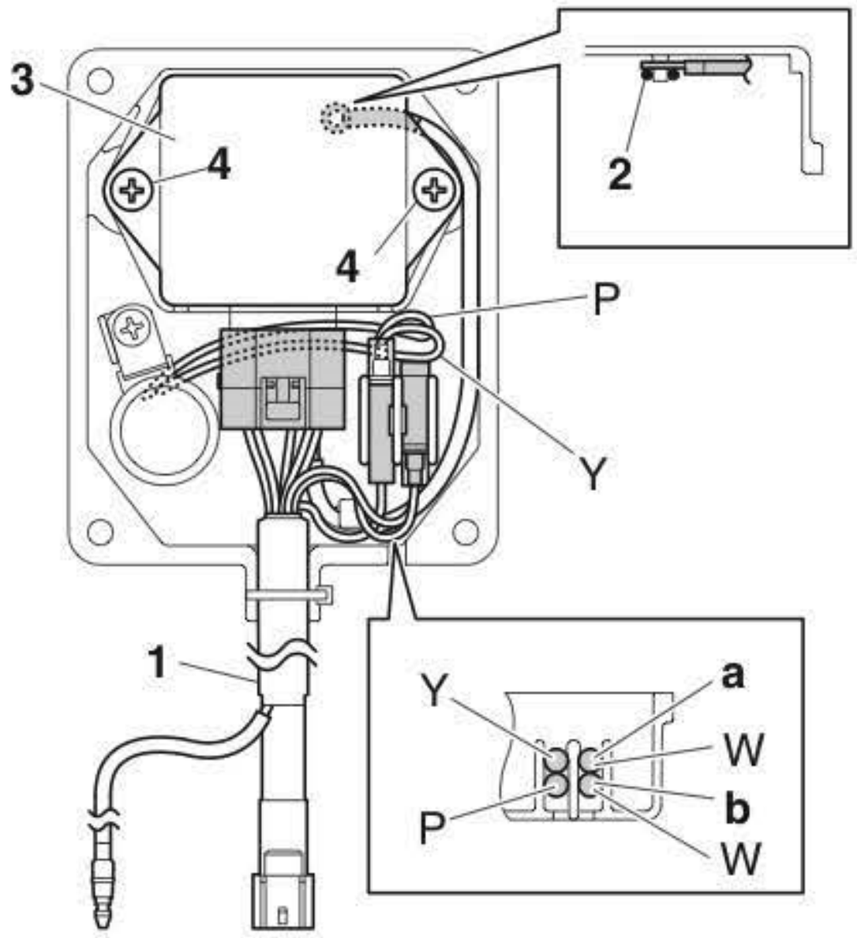


Wire harness continuity
- a. Terminal 1-b. Terminal 3 a.
- Terminal 2-d. Pink (P)
- a. Terminal 7-b. Terminal 2 a.
- Terminal 8-f. White (W) a.
- Terminal 9-g. White (W)
- a. Terminal 10-b. Terminal 4 a.
- Terminal 15-b. Terminal 1 a.
- Terminal 17-h. Red (R)
- a. Terminal 17-e. Yellow (Y)
- a. Terminal 18-c. White (W)

3. Install the H-COP main wire harness "1", 0-ring "2", and control unit "3", and then tighten the control unit screws "4" to the specified torque.

NOTICE

Do not connect the connectors "a" and "b". Otherwise, H-COP may not operate properly.

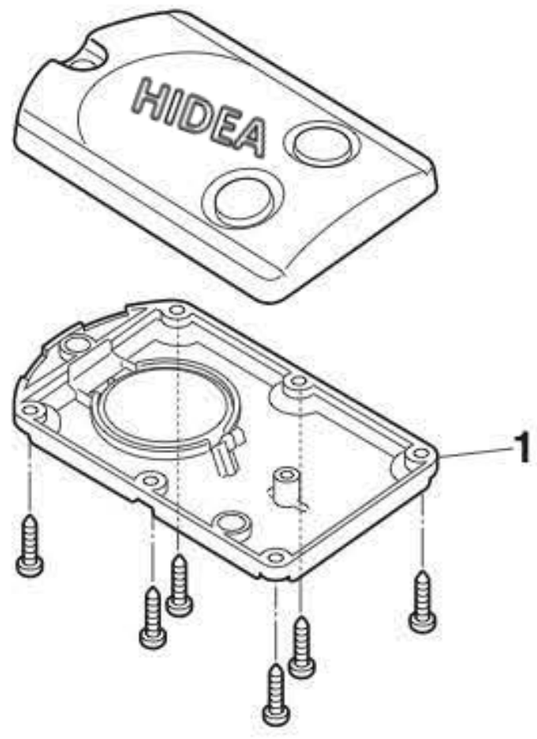


Control unit screw "4"
- 4 Nm (0.4 kgf·m, 3.0 ft·lb)

Checking the button cell battery

Replace the button cell battery in the remote control transmitter once in the first year, and once every two years thereafter.

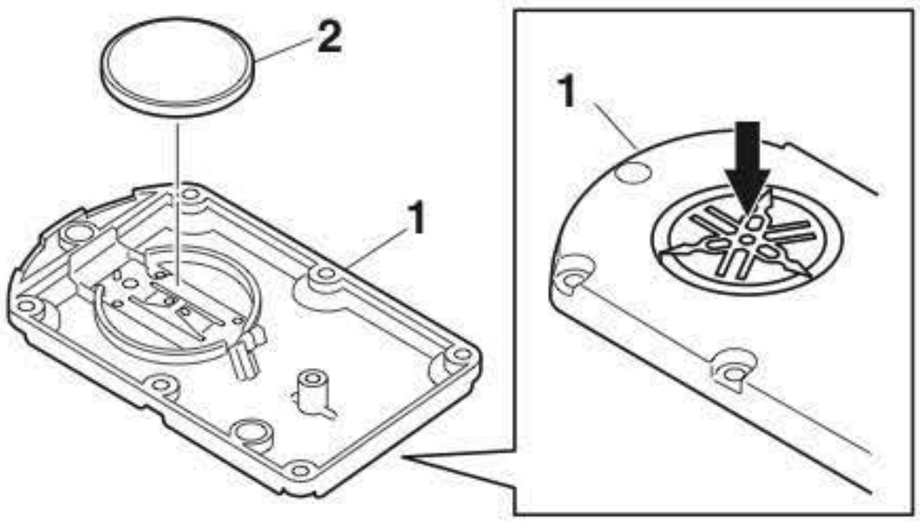
1. Remove the remote control transmitter cover "1".



2. Push the Hidea logo on the remote control transmitter cover "1" and remove the button cell battery "2".

NOTICE

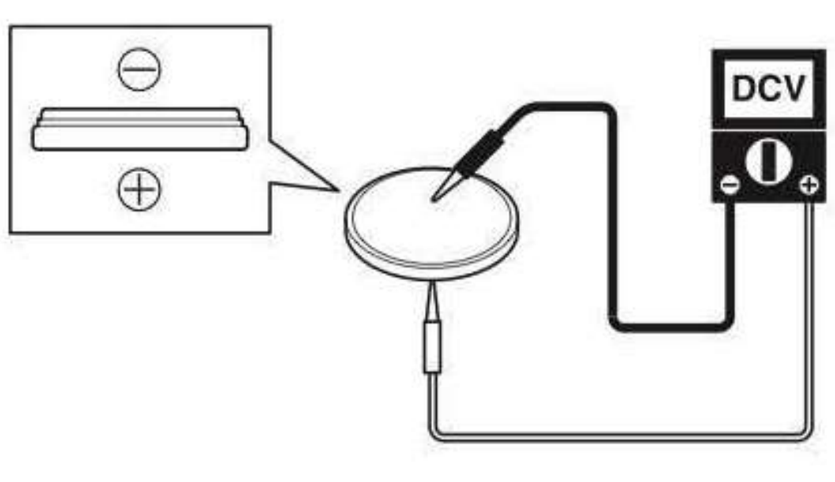
Do not touch the button cell battery directly. Otherwise, the button cell battery could get corroded.



3. Measure the button cell battery voltage. Replace if below specification.

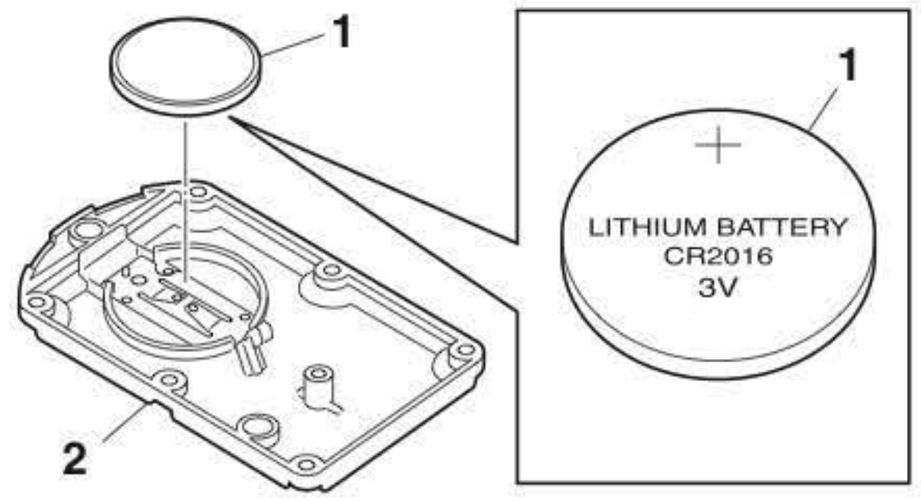
TIP:

When disposing of button cell batteries, make sure to follow local disposal regulations.

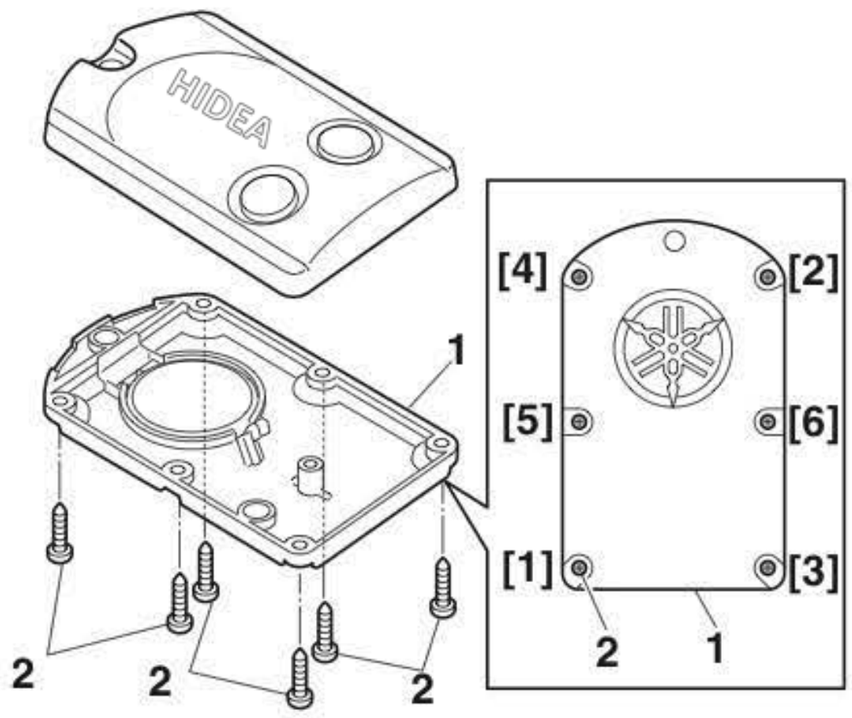


Button cell battery- CR2016 Battery voltage (reference data) 3V

4. Install the button cell battery "1" so that the positive side is facing the remote control transmitter cover "2".

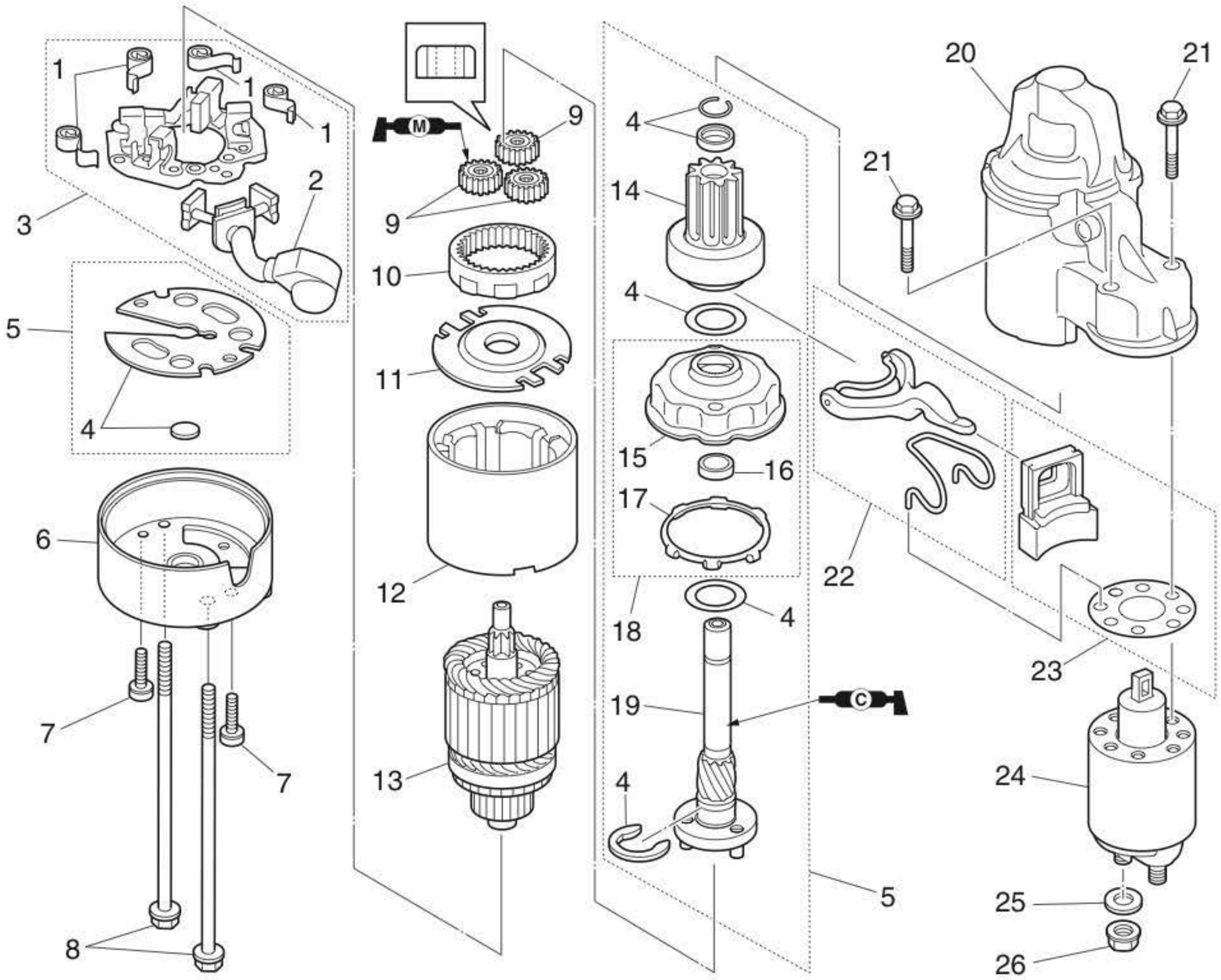


5. Install the remote control transmitter cover "1", and then tighten the remote control transmitter screws "2" to the specified torque in the order [1], [2], and so on.

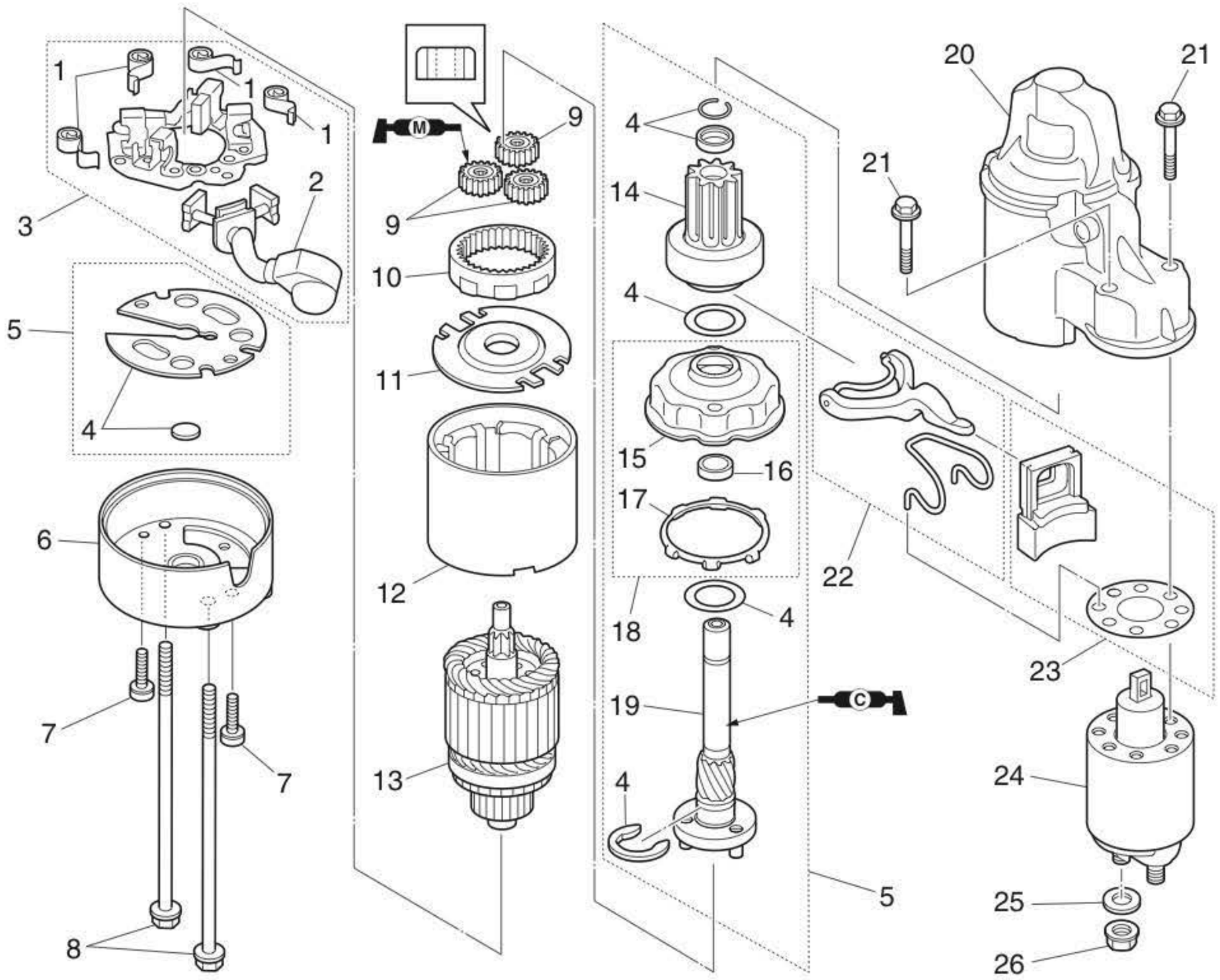


Remote control transmitter screw "2" 0.1 Nm (0.01 kgf·m, 0.07 ft·lb)

Starter motor



No.	Part name	Q'ty	Remarks
1	Brush spring	4	
2	Brush assembly	1	
3	Brush holder assembly	1	
4	Washer set	1	
5	Starting motor gear assembly	1	
6	Bracket	1	
7	Screw	2	M4×16 mm
8	Bolt	2	M5×127 mm
9	Planetary gear	3	
10	Outer gear	1	
11	Plate	1	
12	Stator	1	
13	Armature	1	
14	Pinion assembly	1	
15	Bracket	1	
16	Bearing	1	
17	Gasket	1	Not reusable



No.	Part name	Q'ty	Remarks
18	Bracket assembly	1	
19	Pinion shaft	1	
20	Cover	1	
21	Bolt	2	M6×35 mm
22	Lever assembly	1	
23	Seal set	1	Not reusable
24	Magnet switch	1	
25	Washer	1	
26	Nut	1	M8

Removing the starter motor

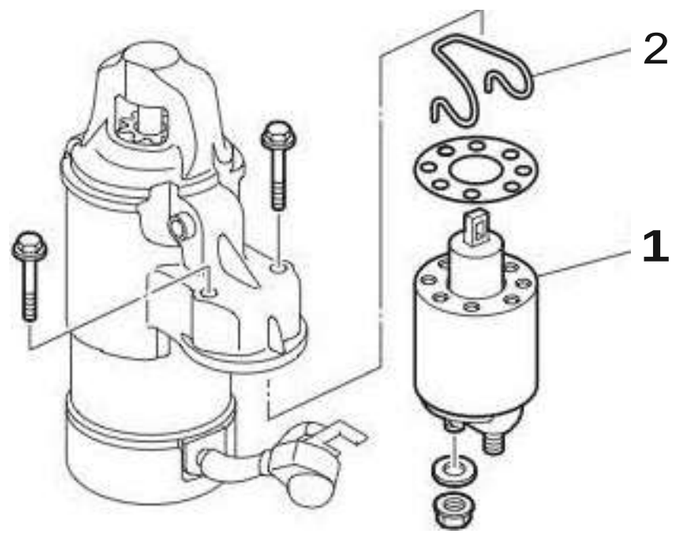
NOTICE

Before removing the starter motor, make sure to disconnect the negative battery terminal.

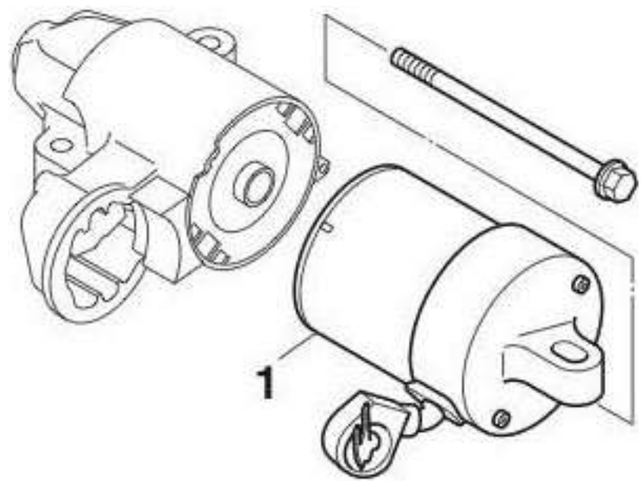
1. Remove the starter motor from the power unit. See "Removing the starter motor" (7-30).

Disassembling the starter motor

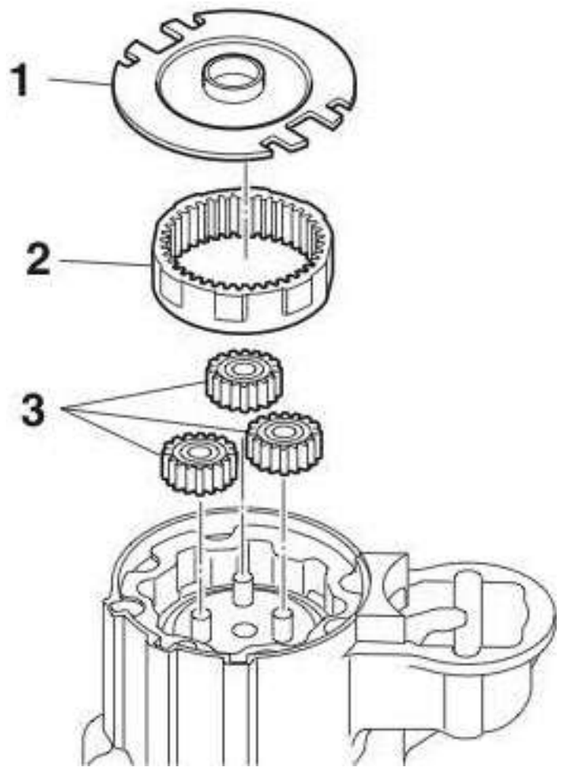
1. Remove the magnet switch "1" and spring "2".



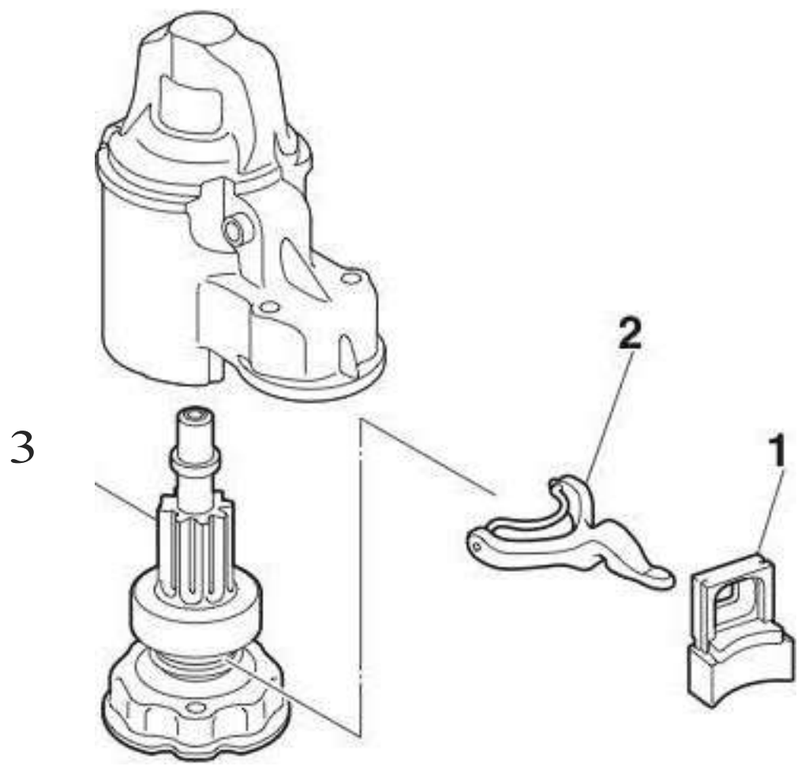
2. Remove the stator assembly "1".



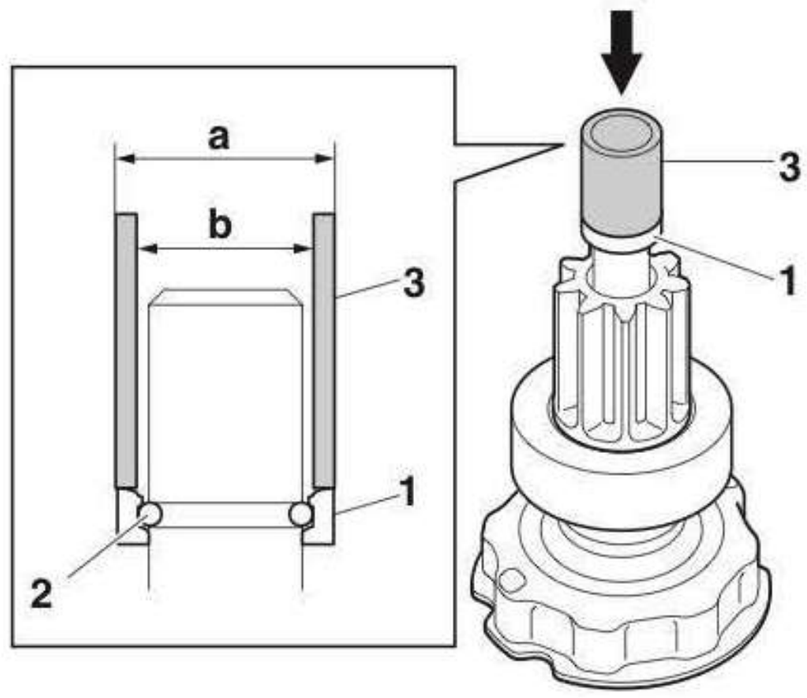
3. Remove the plate "1", outer gear "2", and planetary gears "3".



4. Remove the rubber seal "1", lever "2", and pinion shaft assembly "3".

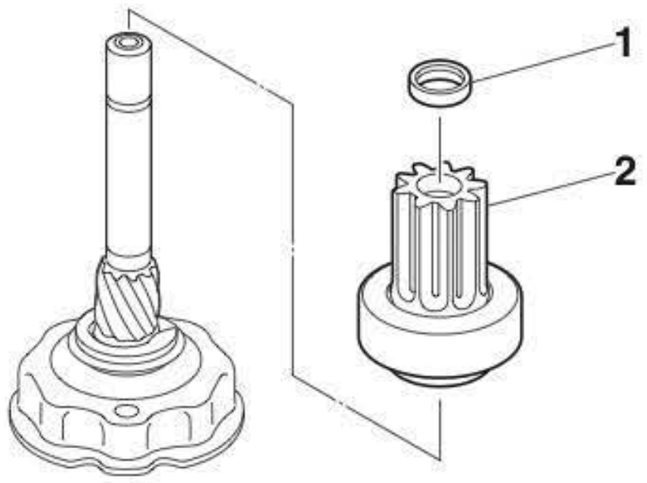


5. Push the pinion stopper "1" down, and then remove the clip "2".

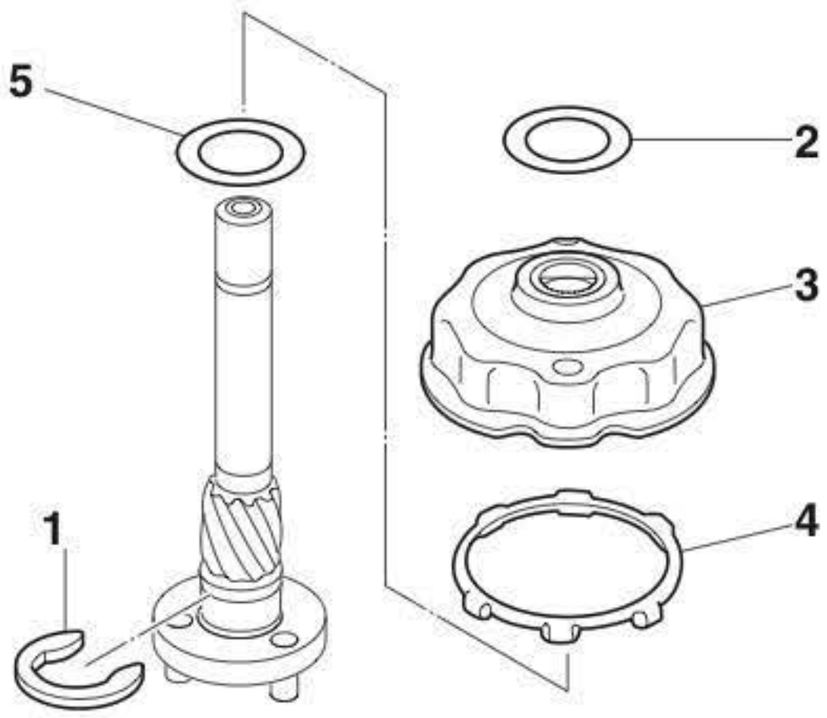


Pipe "3"
(commercially available)
"a": 18.0 mm (0.71 in)
"b": 13.0 mm (0.51 in)

6. Remove the pinion stopper "1" and pinion assembly "2".



7. Remove the E-clip "1", and then remove the shim "2", bracket "3", gasket "4", and shim "5".

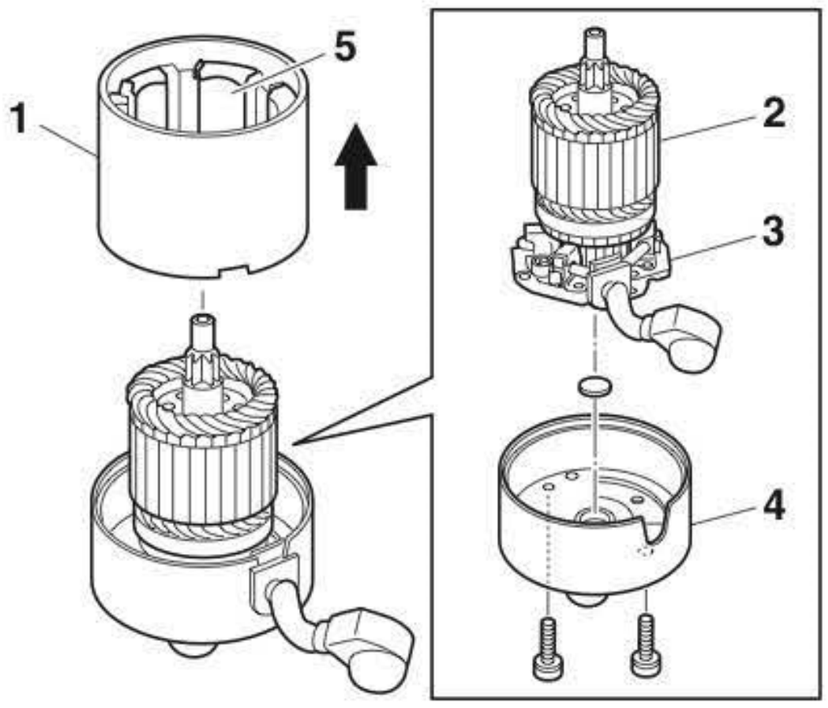


8. Remove the stator "1".

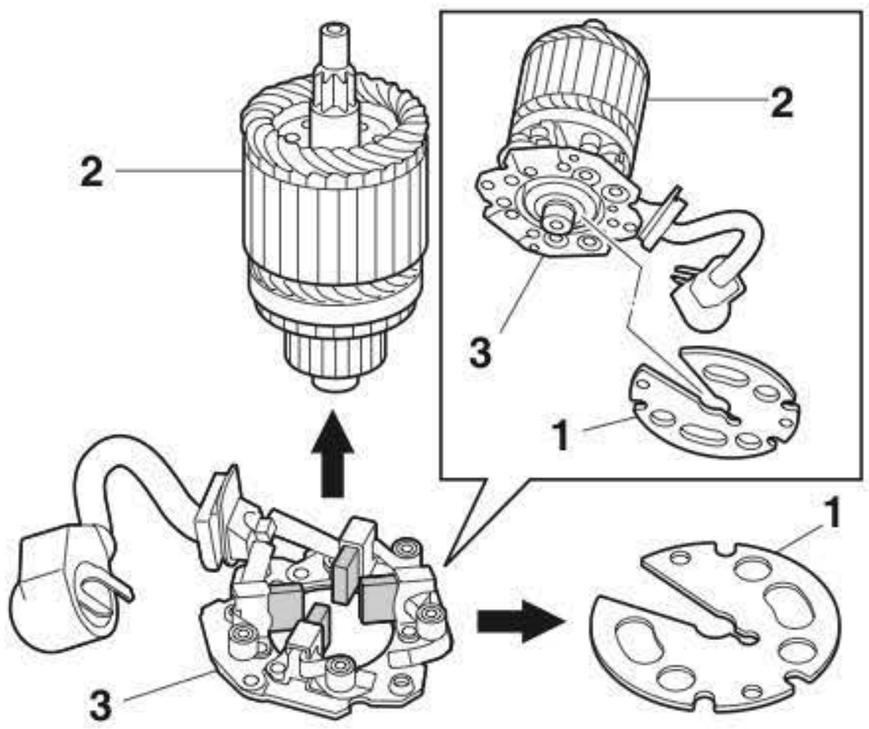
9. Remove the armature "2", along with the brush holder assembly "3", from the bracket "4".

NOTICE

Do not disassemble the stator. Do not remove the magnets "5" from it.



10. Remove the plate "1", and then remove the armature "2" from the brush holder assembly "3".



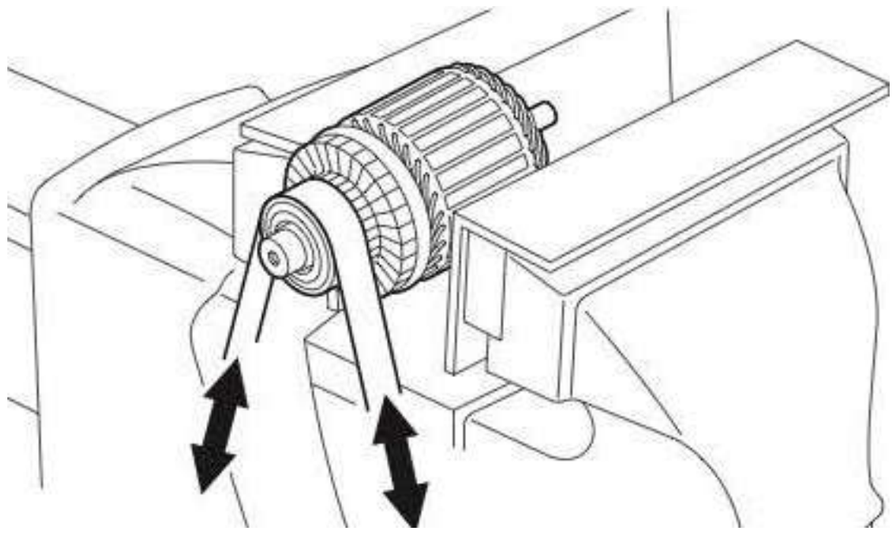
Checking the starter motor pinion

1. Check the pinion teeth. Replace the pinion if cracked or worn.

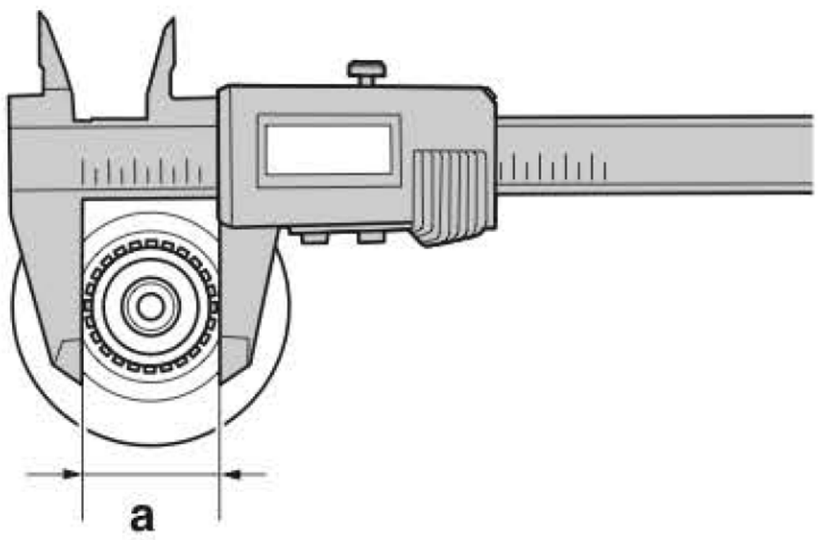
2. Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

Checking the armature (starter motor)

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

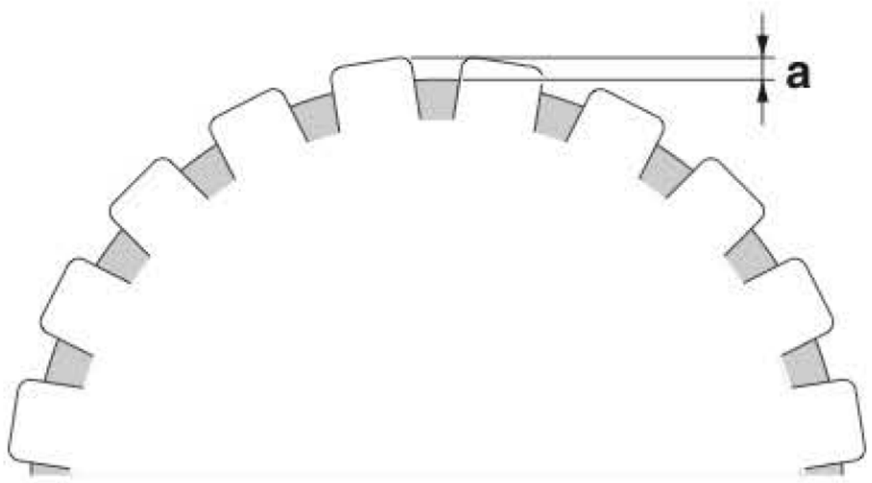


2. Measure the commutator diameter "a". Replace the armature if below specification.



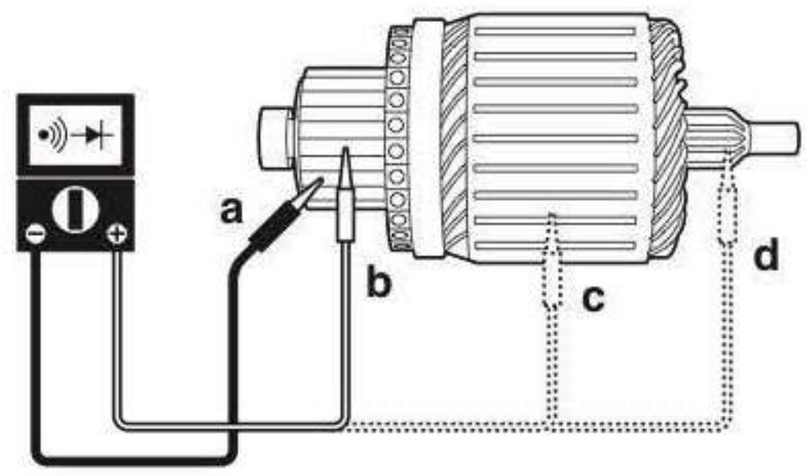
Commutator standard diameter	29.0 mm (1 .14 in)
Wear limit	28.0 mm (1 .10 in)

3. Measure the commutator undercut "a". Replace the armature if below specification.



Commutator standard undercut	0.8 mm (0.03 in)
Wear limit	0.2 mm (0.01 in)

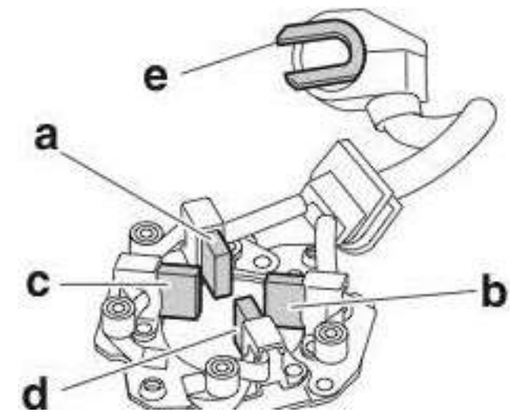
4. Check the armature for continuity. Replace if out of specification.

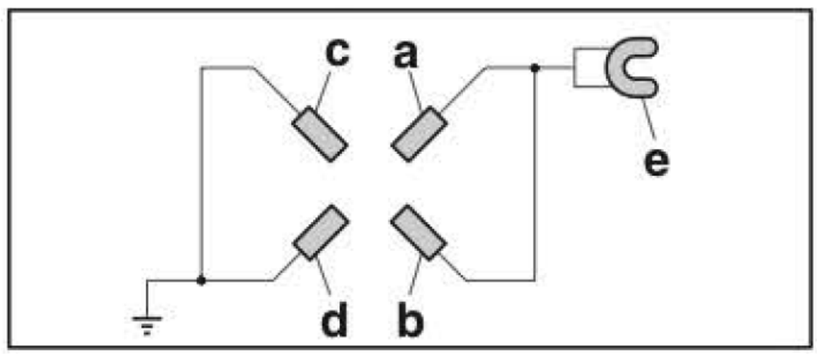


Armature continuity	
Continuity	
	"a"-"b"
No continuity	
	"a"-"c"
	"a"-"d"

Checking the brush holder

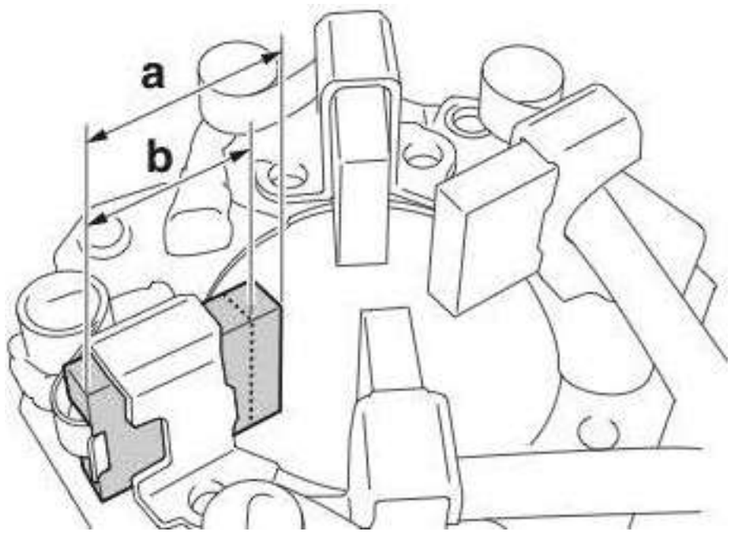
1. Check the brush holder assembly for continuity. Replace if out of specification.





Brush holder assembly continuity	
Brush "a"–Brush "b"	
Brush "a"–Terminal "e"	
Brush "b"–Terminal "e"	
Brush "c"-Brush "d"	

2. Measure the length "a" of each brush. Replace the brush assembly if below specification.



a. Standard brush length
b. Wear limit

Brush standard length 15.5 mm (0.61 in)
Wear limit 9.5 mm (0.37 in)

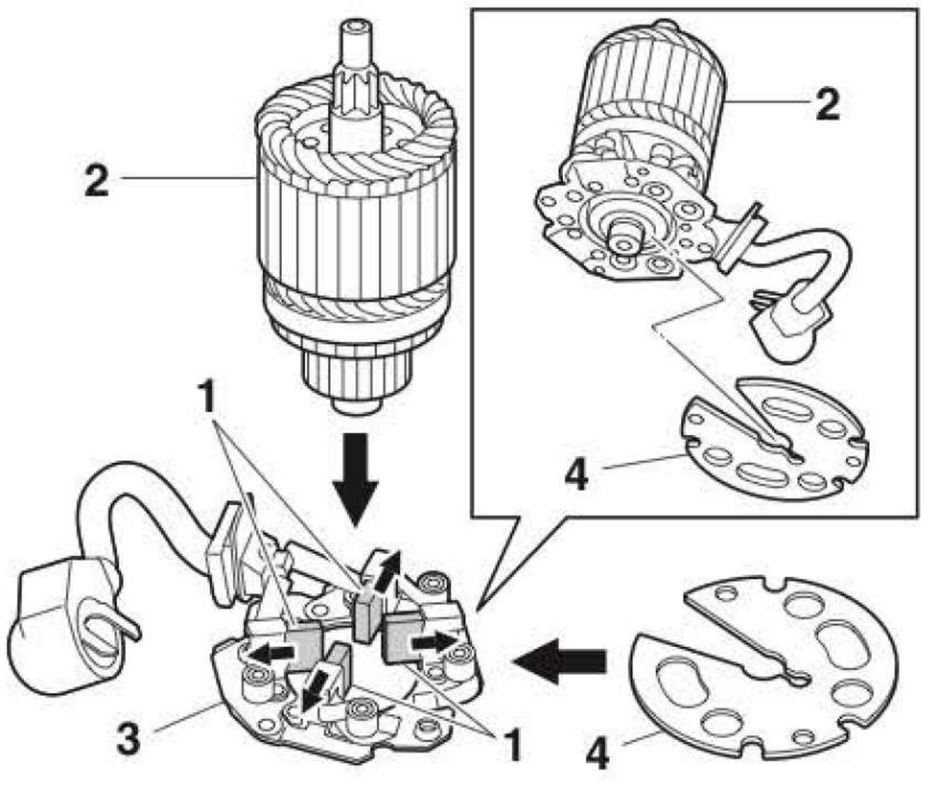
Assembling the starter motor

NOTICE

Do not apply grease or oil to the commutator of the armature.

1. Push the brushes "1" into the holders, and then install the armature "2" to the brush holder assembly "3".

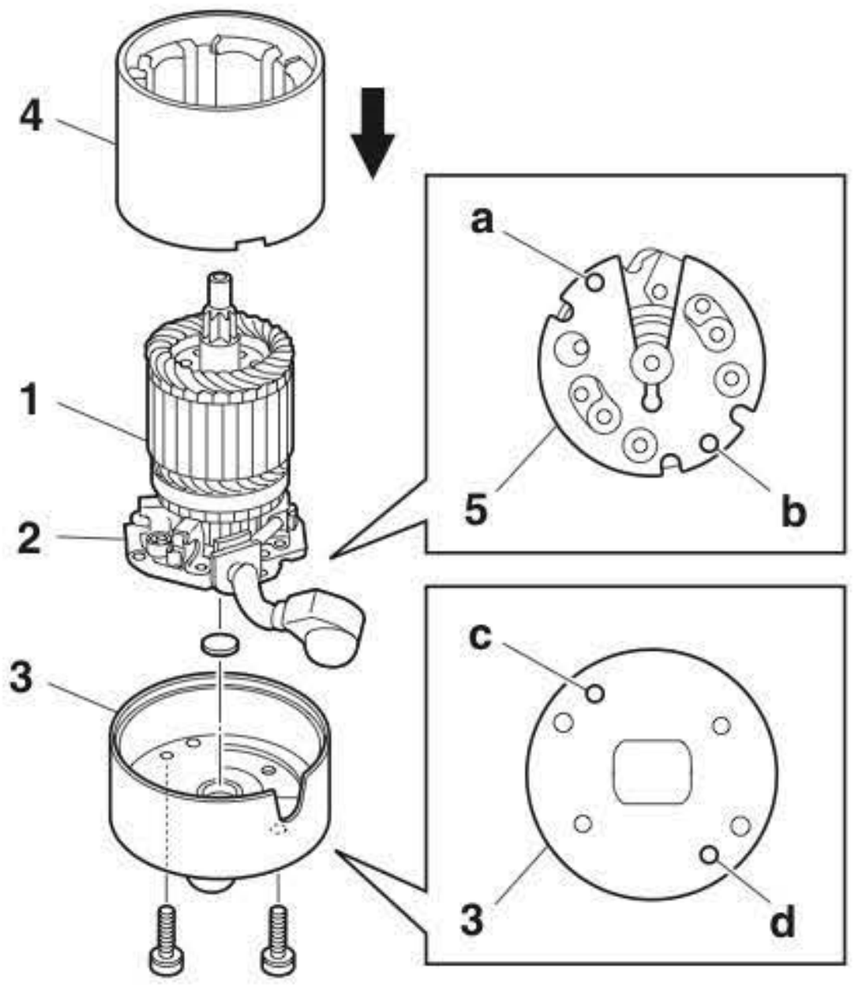
2. Install the plate "4".



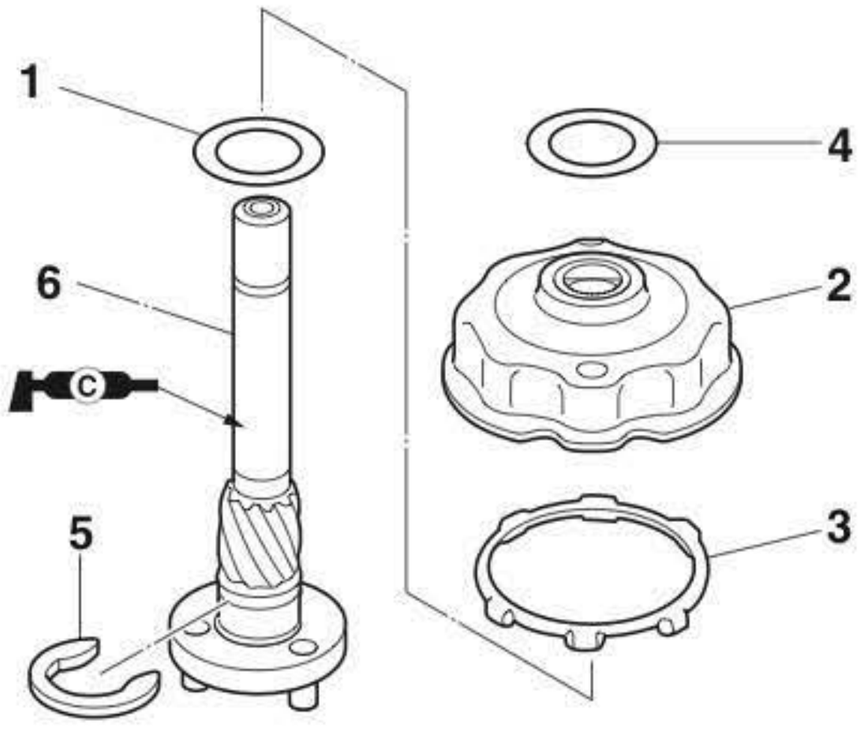
3. Install the armature "1", along with the brush holder assembly "2", to the bracket "3", and then install the stator "4".

TIP:

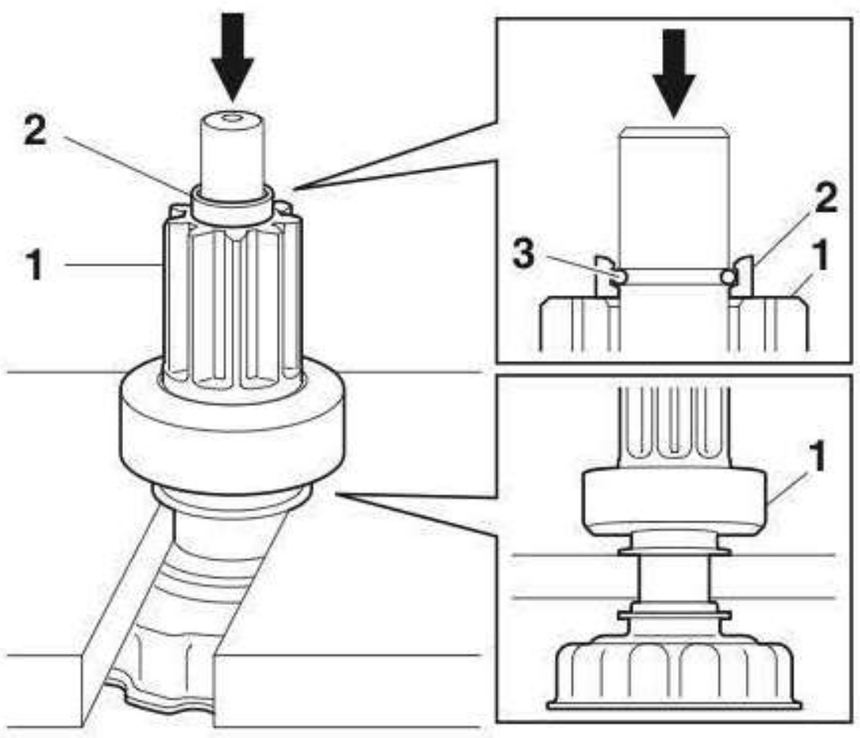
Align the holes "a" and "b" in the plate "5" with the holes "c" and "d" in the bracket "3".



4. Install the shim "1", the bracket "2", a new gasket "3", and the shim "4", and then install the E-clip "5" onto the pinion shaft "6".



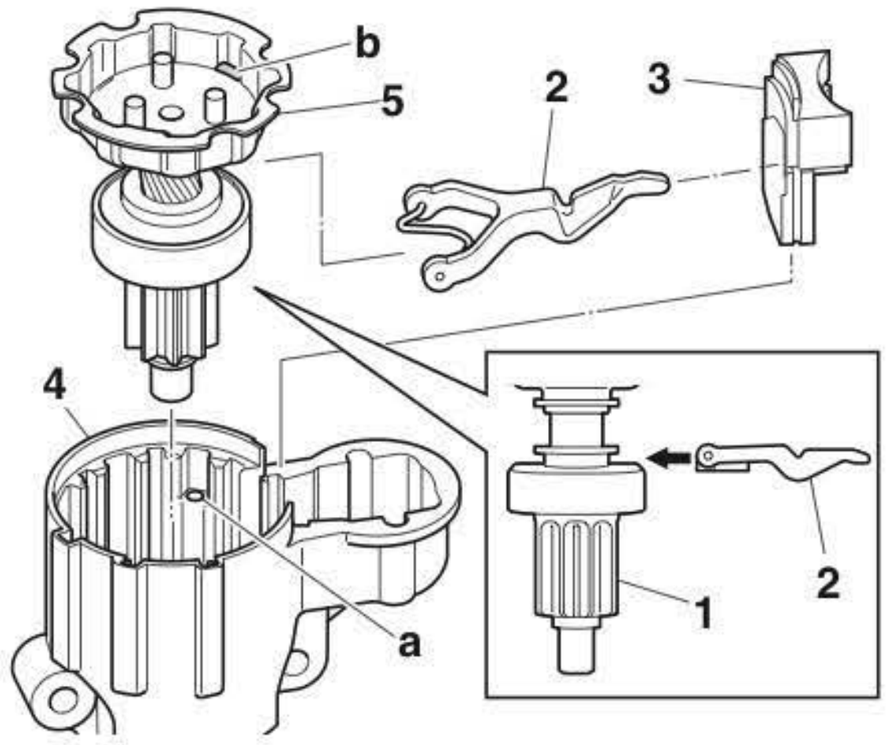
5. Install the pinion assembly "1", pinion stopper "2", and clip "3".



6. Install the pinion shaft assembly "1", the lever "2", and a new rubber seal "3".

TIP:

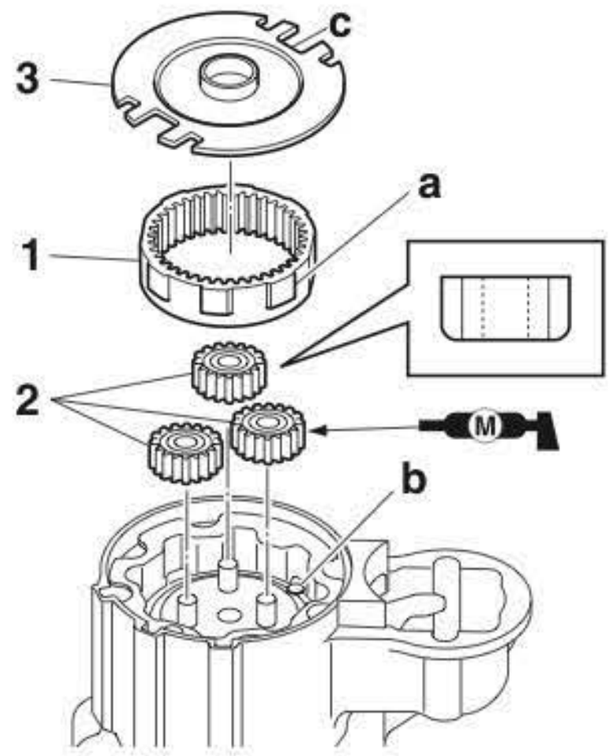
Align the holes "a" in the cover "4" with the holes "b" in the bracket "5".



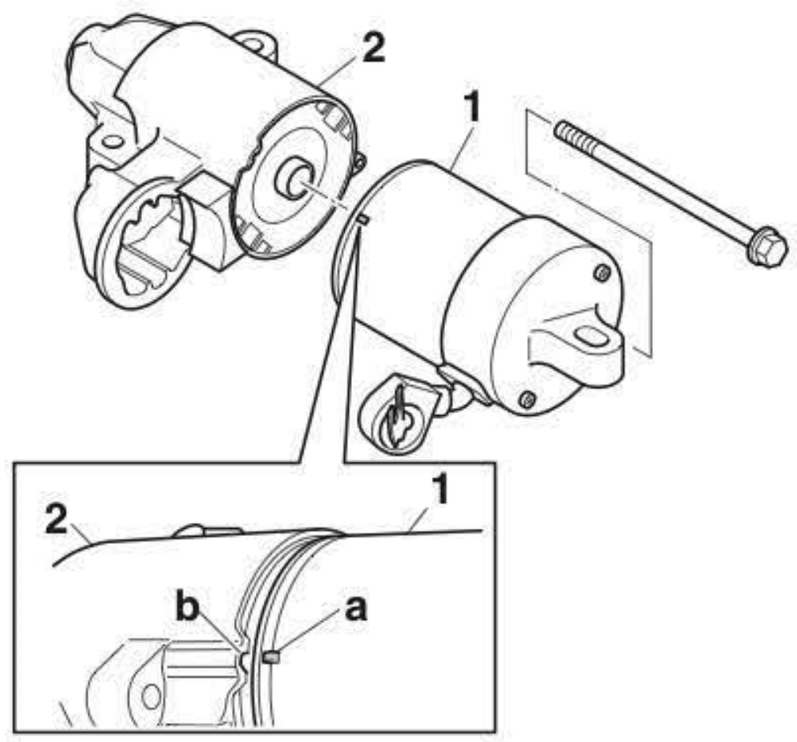
7. Install the outer gear "1", planetary gears "2", and plate "3".

TIP:

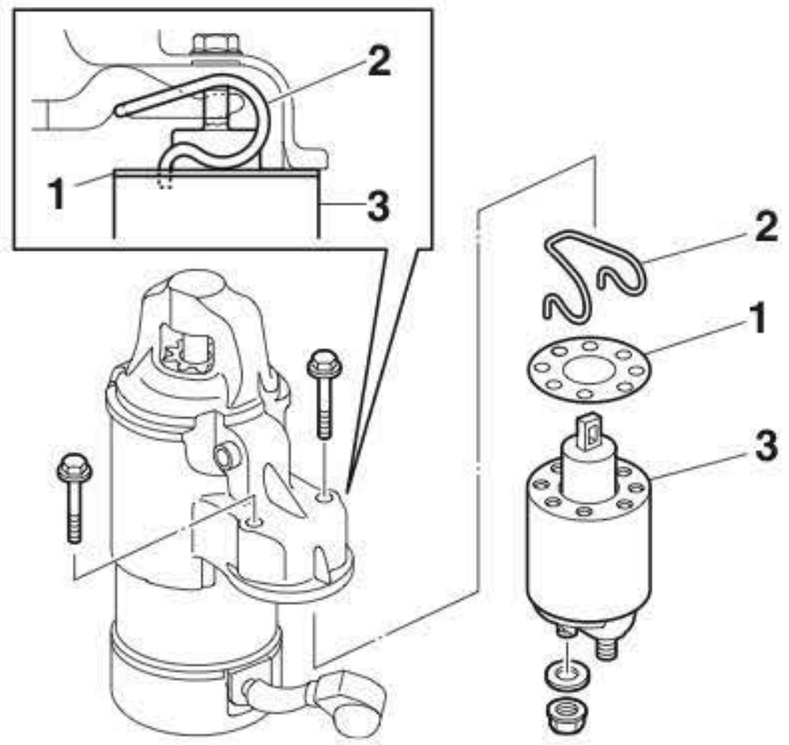
- Be careful not to align the protrusions "a" on the outer gear "1" with the holes "b" in the bracket.
- Align the notches "c" in the plate "3" with the holes "b" in the bracket.



8. Align the protrusion "a" on the stator "1" with the slot "b" in the cover assembly "2", and then assemble the starter motor.



9. Install a new gasket "1", the spring "2", and the magnet switch "3".



Installing the starter motor

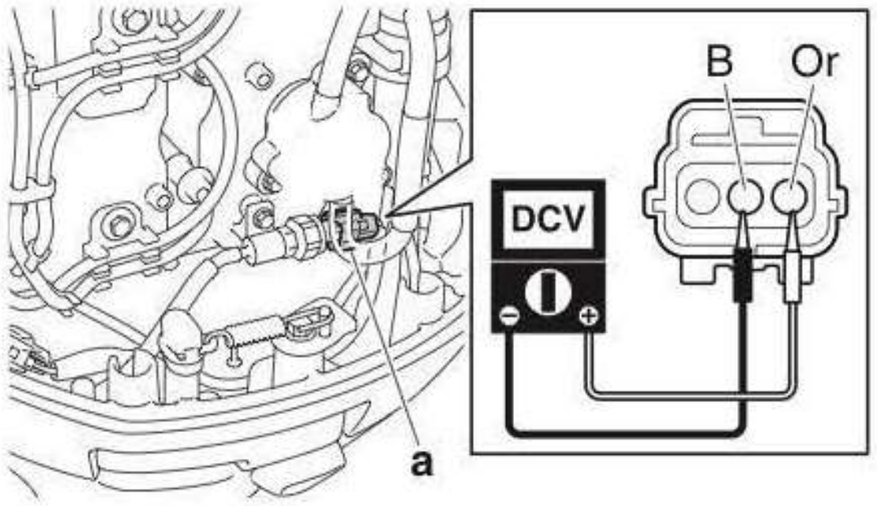
1. Install the starter motor to the power unit. See "Installing the starter motor" (7-30).

6Y8 Multifunction Meters sensor

Checking the water pressure sensor

1. Disconnect the water pressure sensor coupler "a".

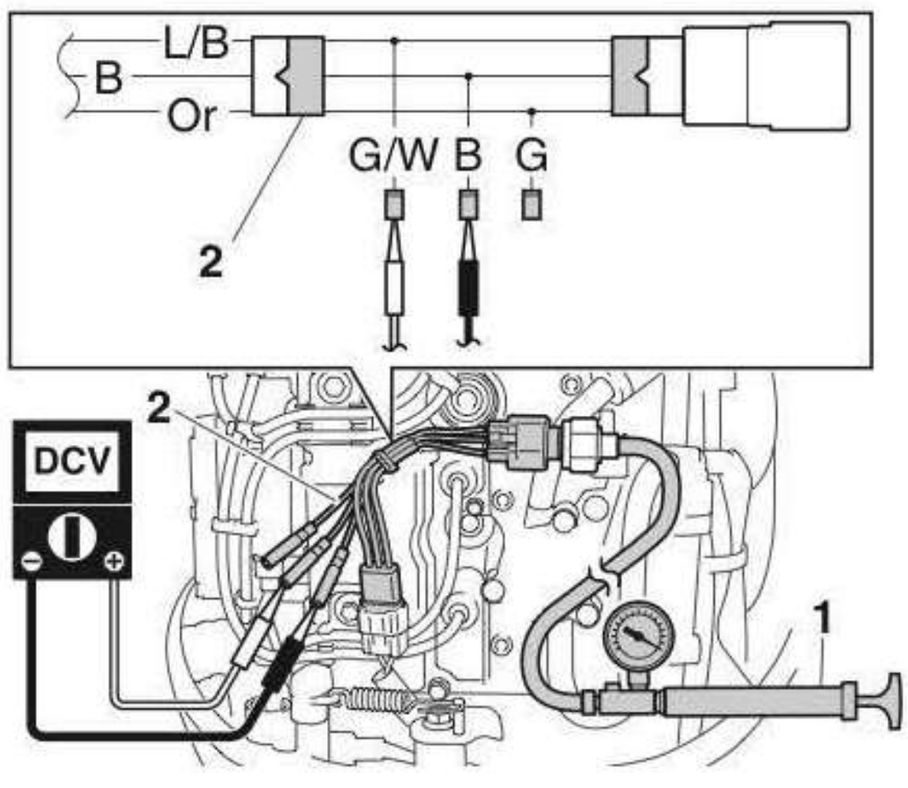
2. Turn the engine start switch to ON, and then measure the input voltage at the water pressure sensor coupler.



Input voltage
4.75-5.25 V
Orange (Or)-Black (B)

3. Remove the water pressure sensor, and then connect the pressure pump "1" and special service tool "2".

4. Apply positive pressure to the water pressure sensor slowly, and then measure the output voltage.



Pressure pump "1"
(commercially available)
Test harness (3 pins) "2"

Test harness (3 pins) "2"

Output voltage at 392.0 kPa
(3.92 kgf/cm^2 , 56.8 psi) (reference data)
2.5 V
Output voltage at 784.0 kPa
(7.84 kgf/cm^2, 113.7 psi) (reference data)
4.5 V
Blue/Black (L/B)-Black (B)

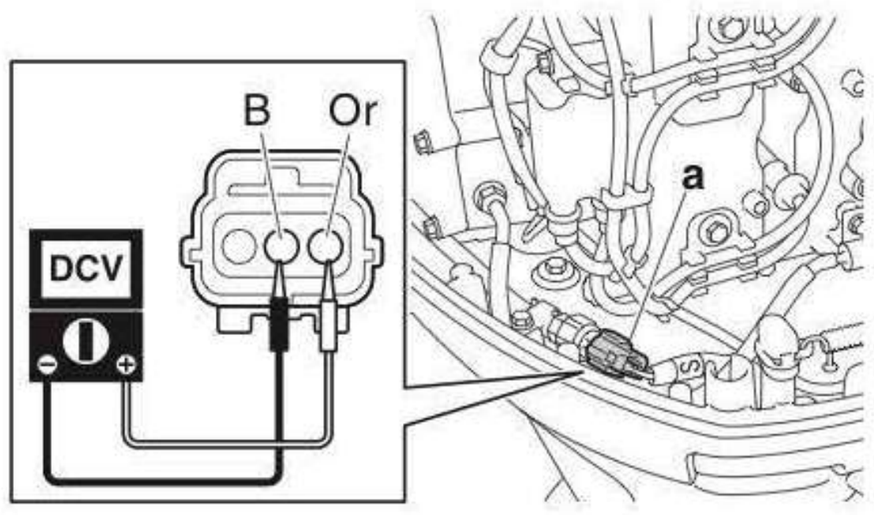
5. Turn the engine start switch to OFF, and then disconnect the special service tool and pressure pump.

6. Install the water pressure sensor, and then connect the water pressure sensor coupler. See "Installing the water pressure sensor (6Y8 Multifunction Meters)" (3-16).

Checking the speed sensor

1. Disconnect the speed sensor coupler "a".

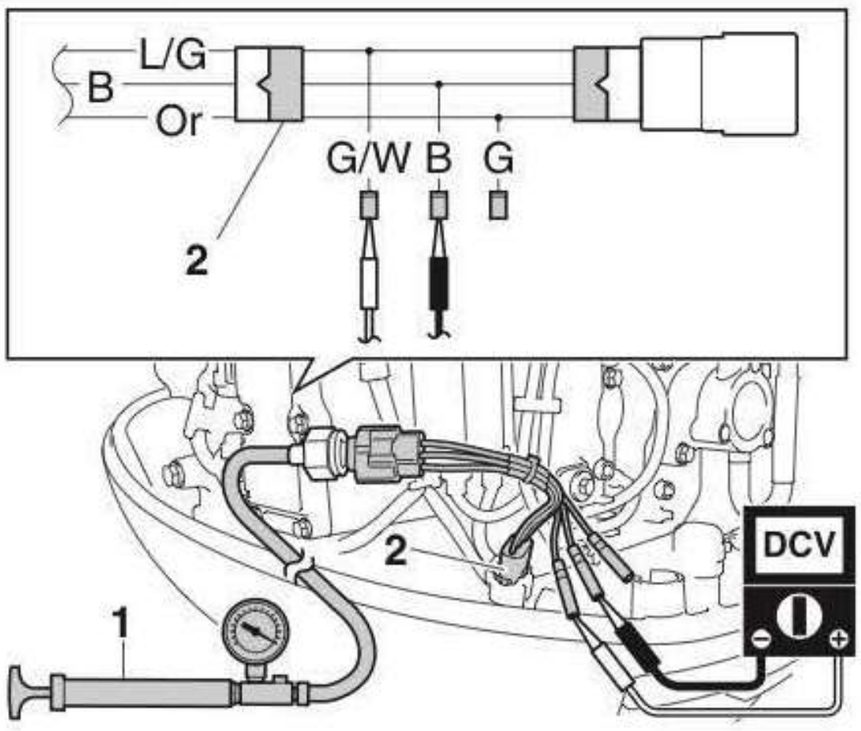
2. Turn the engine start switch to ON, and then measure the input voltage at the speed sensor coupler.



Input voltage
4.75-5.25V
Orange (Or)-Black (B)

3. Remove the speed sensor, and then connect the pressure pump "1" and special service tool "2".

4. Apply positive pressure to the speed sensor slowly, and then measure the output voltage.



Pressure pump "1" (commercially available) Test harness (3 pins) "2" Test harness (3 pins) "2"

Output voltage at 392.0 kPa (3.92 kgf/cm^2, 56.8 psi) (reference data) 2.5V Output voltage at 784.0 kPa (7.84 kgf/cm^2, 113.7 psi) (reference data) 4.5V Blue/Green (L/G)-Black (B)

5. Turn the engine start switch to OFF, and then disconnect the special service tool and pressure pump.

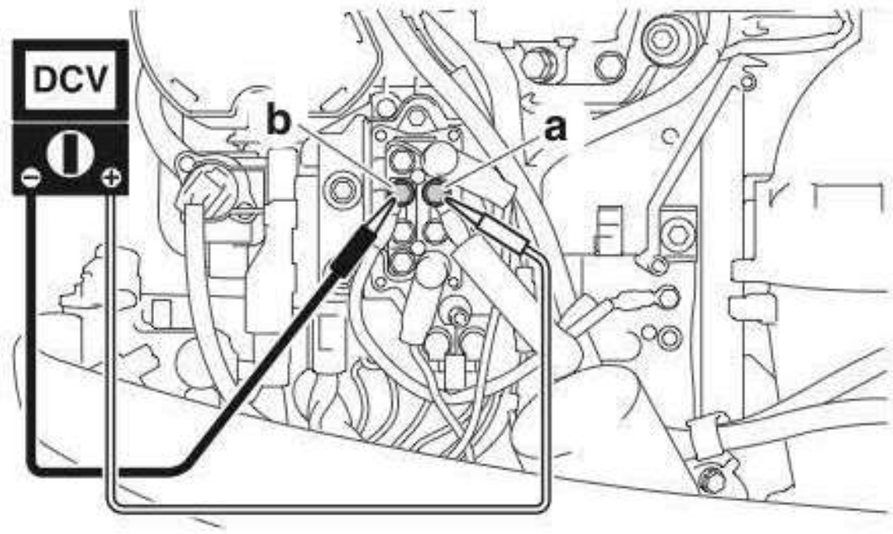
6. Install the speed sensor, and then connect the speed sensor coupler. See "Installing the speed sensor (6Y8 Multi-function Meters)" (3-17).

PTT system

Checking the PTT relay

1. Remove the caps.

2. Measure the input voltage between the PTT relay terminal "a" and terminal "b".



Input voltage 12 V (battery voltage) Terminal "a"-Terminal "b"

3. Disconnect the battery power source, ground lead, PTT motor leads, and PTT relay coupler.

4. Remove the PTT relay.

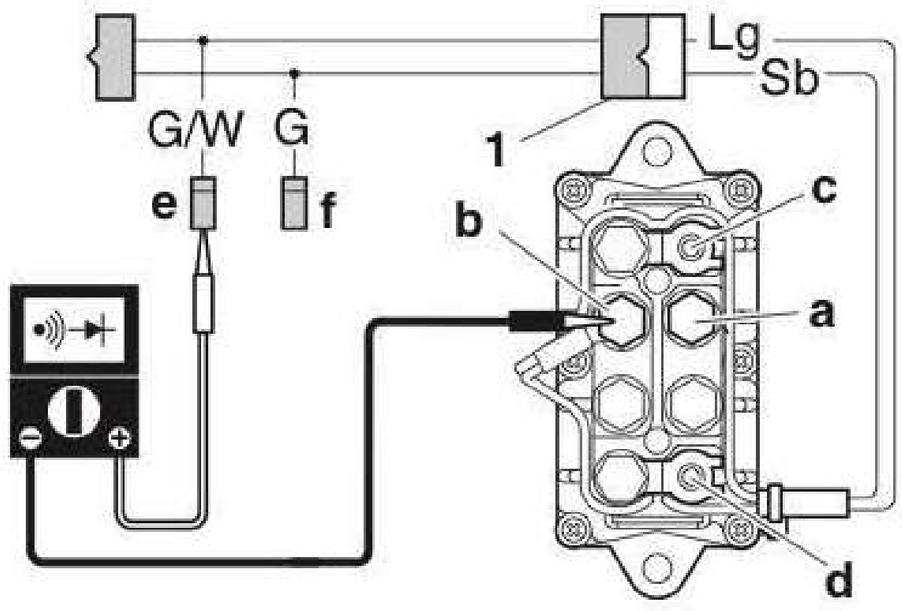
NOTICE

Before disconnecting the PTT relay terminals, make sure to disconnect the battery negative terminal.

5. Connect the special service tool "1".

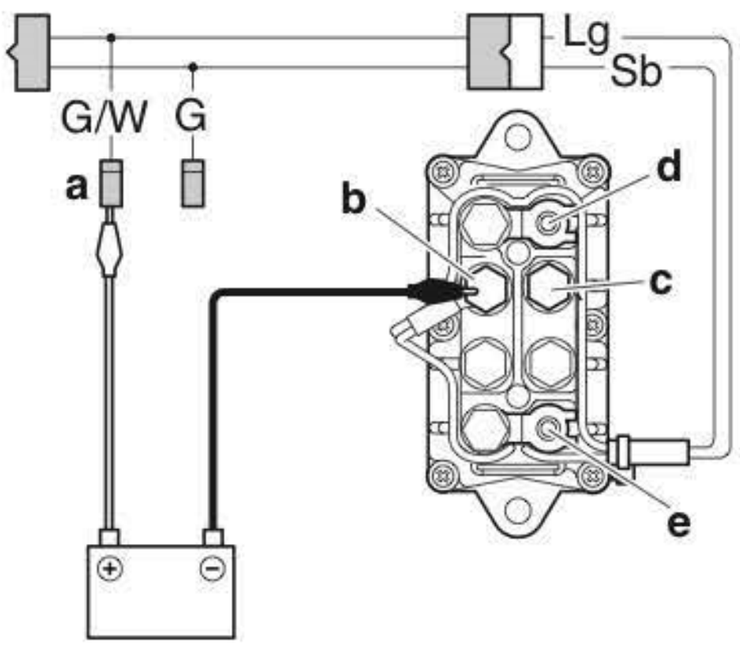
Test harness (2 pins) "1" Test harness (2 pins) "1"

6. Check the PTT relay for continuity. Replace if out of specification.



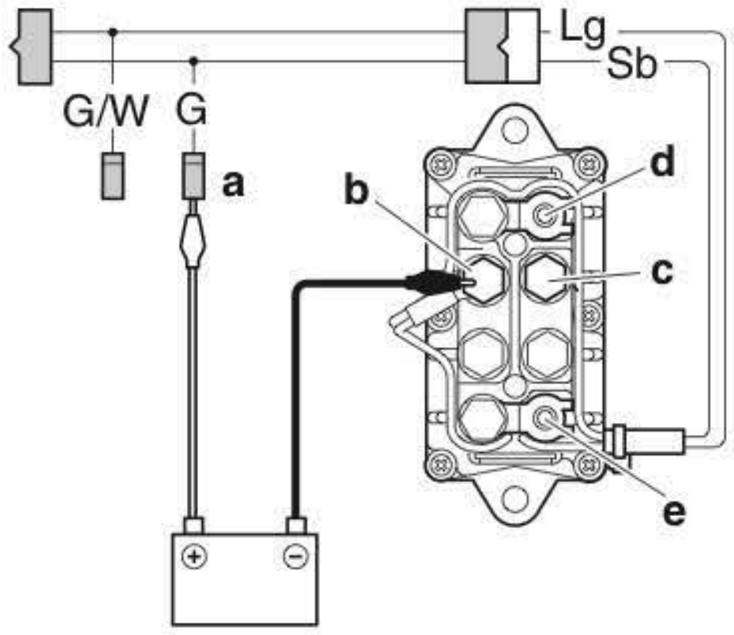
PTT relay continuity
- Terminal "b"–Terminal "c"
- Terminal "b"–Terminal "d"
- Terminal "b"–Terminal "e"
- Terminal "d"–Terminal "f"

7. Connect the positive battery lead to the terminal "a", and the negative battery lead to the terminal "b", and then check the PTT relay for continuity. Replace the PTT relay if out of specification.



PTT relay continuity
- Terminal "c"–Terminal "e"
- Terminal "b"–Terminal "d"

8. Connect the positive battery lead to the terminal "a", and the negative battery lead to the terminal "b", and then check the PTT relay for continuity. Replace the PTT relay if out of specification.



PTT relay continuity
- Terminal "c"–Terminal "d"
- Terminal "b"–Terminal "e"

9. Disconnect the special service tool.

10. Install the PTT relay.

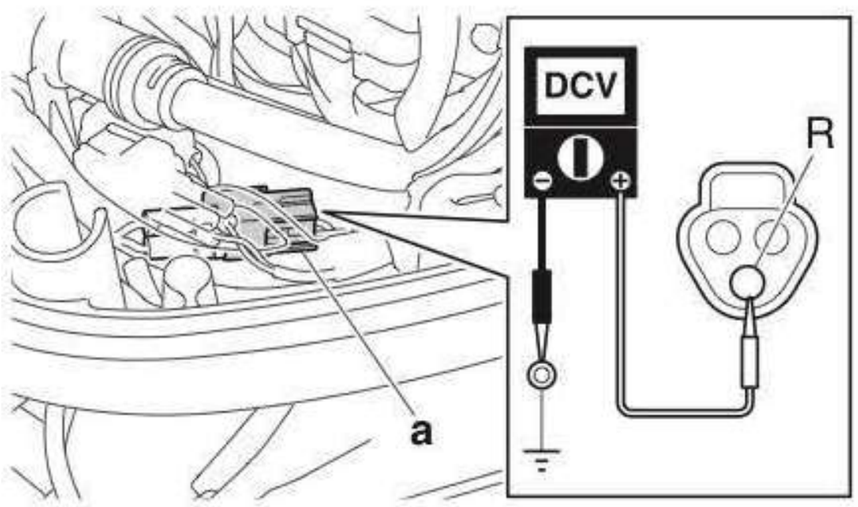
11. Connect the PTT relay coupler, battery power source, ground lead, and PTT motor leads.

12. Install the caps.

Checking the PTT switch (on bottom cowling)

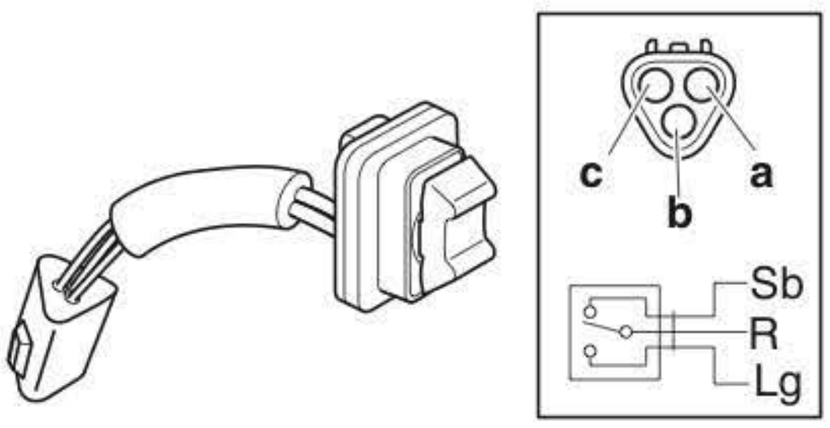
1. Disconnect the PTT switch coupler "a".

2. Measure the input voltage between the PTT switch coupler terminal and ground.



Input voltage
12 V (battery voltage)
Red (A)—Ground

3. Check the PTT switch for continuity. Replace the PTT switch if out of specification.

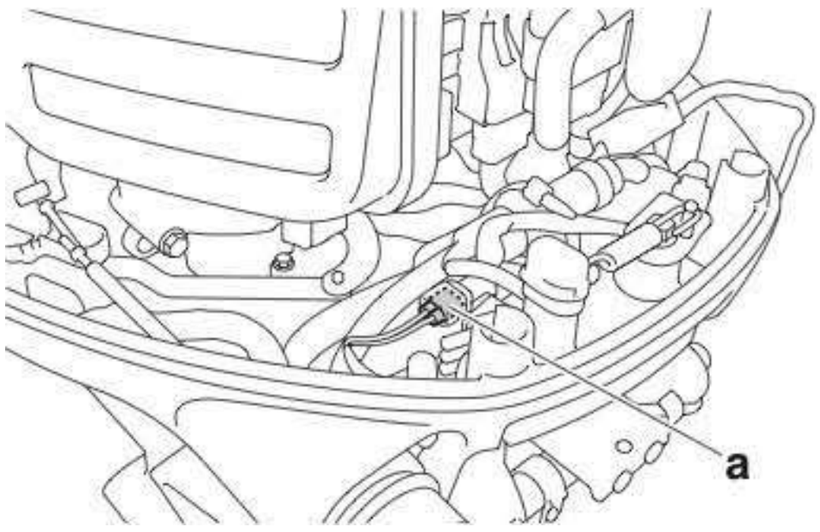


PTT switch continuity
Switch position UP
Terminal "a"—Terminal "b"
Switch position ON
Terminal "b"—Terminal "c"

4. Connect the PTT switch coupler.

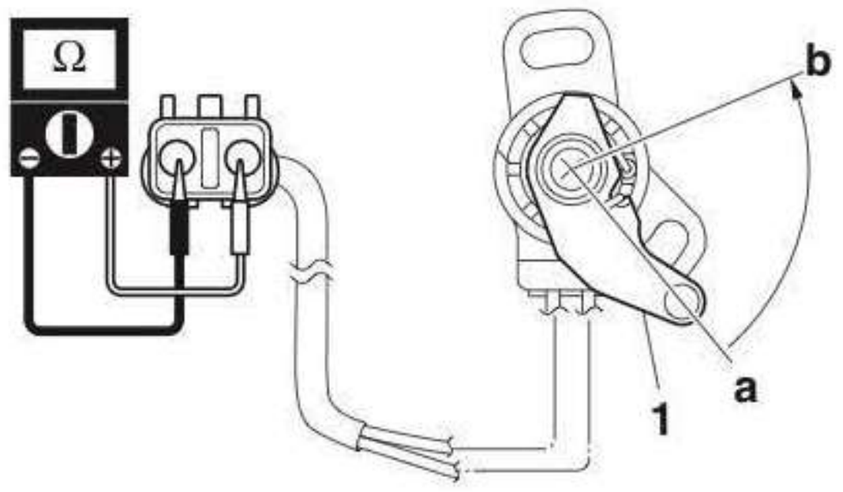
Checking the trim sensor

1. Disconnect the trim sensor coupler "a", and then remove the trim sensor.



2. Measure the trim sensor resistance.

3. Turn the trim sensor lever "1" from the position "a" to the position "b", and then measure the resistance as it gradually changes.



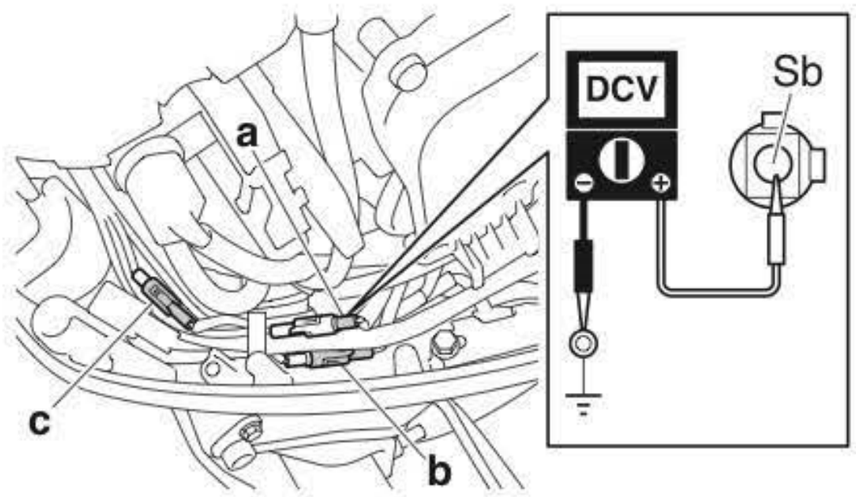
Free position resistance
239-379 Ω
Setting resistance
9.0-11.0 Ω

4. Install the trim sensor, and then connect the trim sensor coupler.

Checking the tilt limiter

1. Disconnect the tilt limiter couplers "a", "b", and "c".

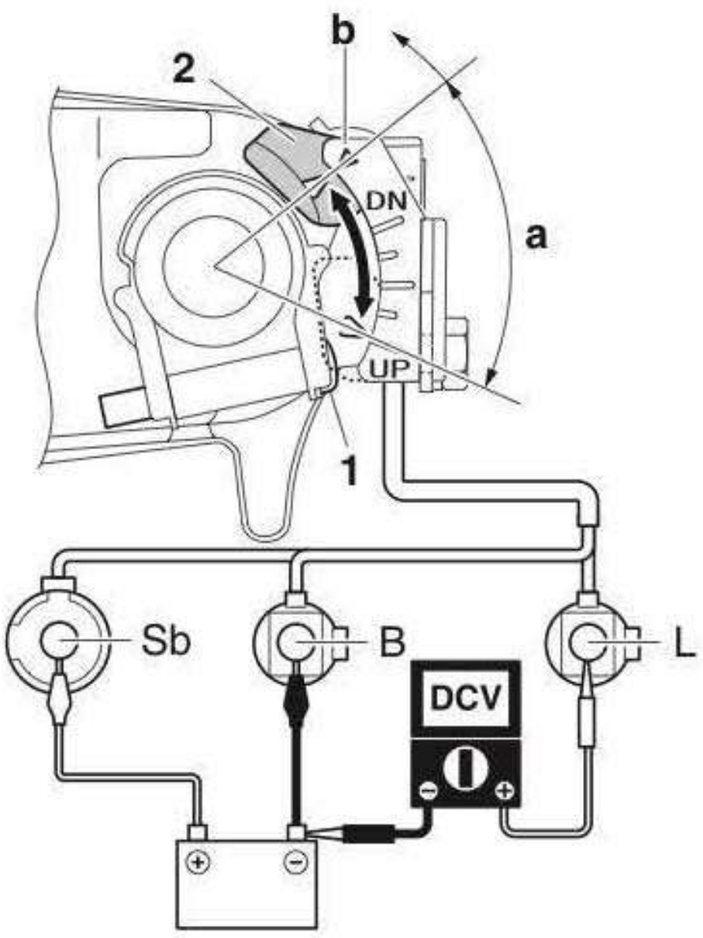
2. Measure the input voltage at the tilt limiter coupler "a" with the up side of the PTT switch pushed.



Input voltage
12 V (battery voltage)
Sky blue (Sb)-Ground

3. Connect the battery leads to the tilt limiter couplers.

4. Loosen the screw "1", and measure the output voltage at range "a". Slide the magnet "2" to mark "b". When the magnet passes mark "b", measure the output voltage again.



Output voltage
12 V (battery voltage) at "a"
0 V when passing "b"
Blue (L)-Ground

5. Connect the tilt limiter couplers.

6. Set the tilt limiter. See "Setting the tilt limiter" (3-20).

Fuel system **6-1**

Reducing the fuel pressure 6-1
Disconnecting the quick connector 6-1
Measuring the fuel pressure 6-1
Checking the pressure regulator 6-3

Fuel filter **6-5**

Removing the fuel filter assembly 6-6
Checking the fuel filter assembly 6-6
Disassembling the fuel filter assembly 6-7
Checking the fuel filter element 6-7
Checking the fuel cup assembly 6-7
Checking the primer pump 6-7
Assembling the fuel filter assembly 6-8
Installing the fuel filter assembly 6-8

Fuel pump assembly **6-9**

Removing the fuel pump assembly 6-10
Checking the fuel strainer 6-10
Checking the fuel pump assembly 6-11
Disassembling the fuel pump assembly 6-11
Checking the diaphragm and valve 6-12
Assembling the fuel pump assembly 6-12
Installing the fuel pump assembly 6-14

Fuel injector **6-15**

Removing the fuel injector 6-16
Checking the fuel rail and fuel injector (Worldwide) 6-17
Checking the fuel rail and fuel injector (USA and Canada) 6-17
Installing the fuel injector 6-17

Throttle body **6-19**

Removing the throttle body 6-21
Checking the throttle body 6-22
Installing the throttle body 6-22
Adjusting the throttle link 6-23

Fuel system

Engine ECM 6-25

Intake manifold 6-26

Removing the intake manifold 6-27
Checking the intake manifold 6-28
Checking the intake air pressure/temperature sensor 6-28
Installing the intake manifold 6-28

Canister and vapor shut-off valve 6-30

Removing the canister and vapor shut-off valve..... 6-31
Checking the canister 6-31
Checking the vapor shut-off valve 6-31
Installing the vapor shut-off valve and canister..... 6-32

Vapor separator 6-33

Draining the fuel 6-35
Removing the vapor separator 6-35
Checking the canister check valve 6-37
Installing the vapor separator 6-37

Vapor separator and high-pressure fuel pump 6-40

Disassembling the vapor separator 6-42
Checking the high-pressure fuel pump..... 6-43
Checking the vapor separator 6-43
Assembling the vapor separator 6-44

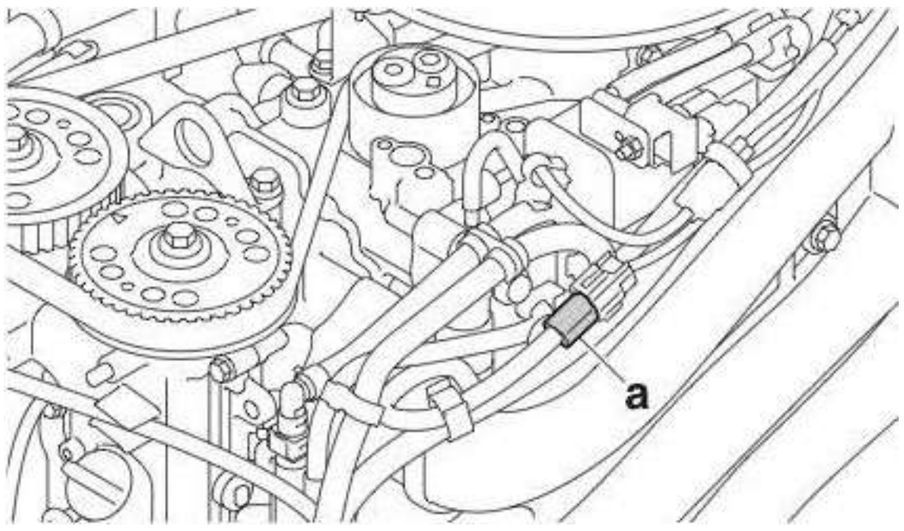
Fuel system

Reducing the fuel pressure

⚠ WARNING

Before servicing the high-pressure fuel line or vapor separator, make sure to reduce the fuel pressure in the fuel line. Otherwise, pressurized fuel could spray out.

1. Disconnect the high-pressure fuel pump coupler "a".



2. Start the engine.

TIP:

After disconnecting the high-pressure fuel pump coupler, wait until the engine stalls.

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

4. Turn the engine start switch to OFF.

5. Connect the high-pressure fuel pump coupler "a".

Disconnecting the quick connector

⚠ WARNING

Before disconnecting the quick connector, reduce the fuel pressure. Otherwise, pressurized fuel could spray out.

Cover the fuel components using a rag to prevent fuel from spilling out.

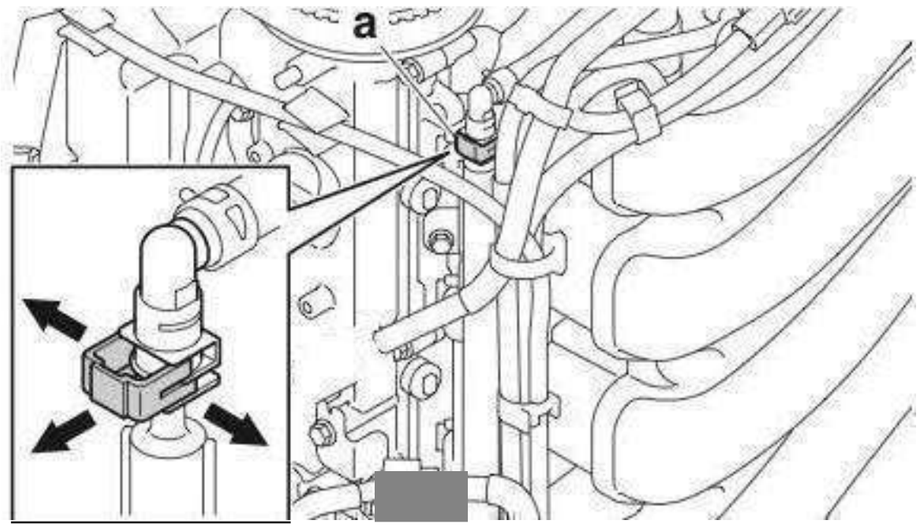
1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-1).

2. Wrap a rag around the quick connector "a".

3. Disconnect the quick connector "a" from the fuel rail.

TIP:

Cover the quick connector and fuel rail with a plastic bag to prevent damage and to protect them from dirt.



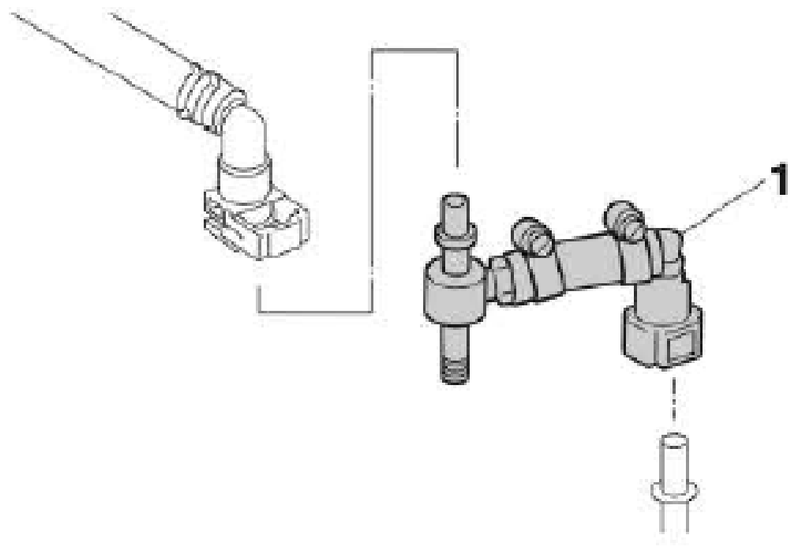
Measuring the fuel pressure

Cover then fuel components using a rag to prevent fuel from spilling out.

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

2. Disconnect the quick connector from the fuel rail. See step 3 in "Disconnecting the quick connector" (6-1).

3. Connect the special service tool "1" to the quick connector and the fuel rail.

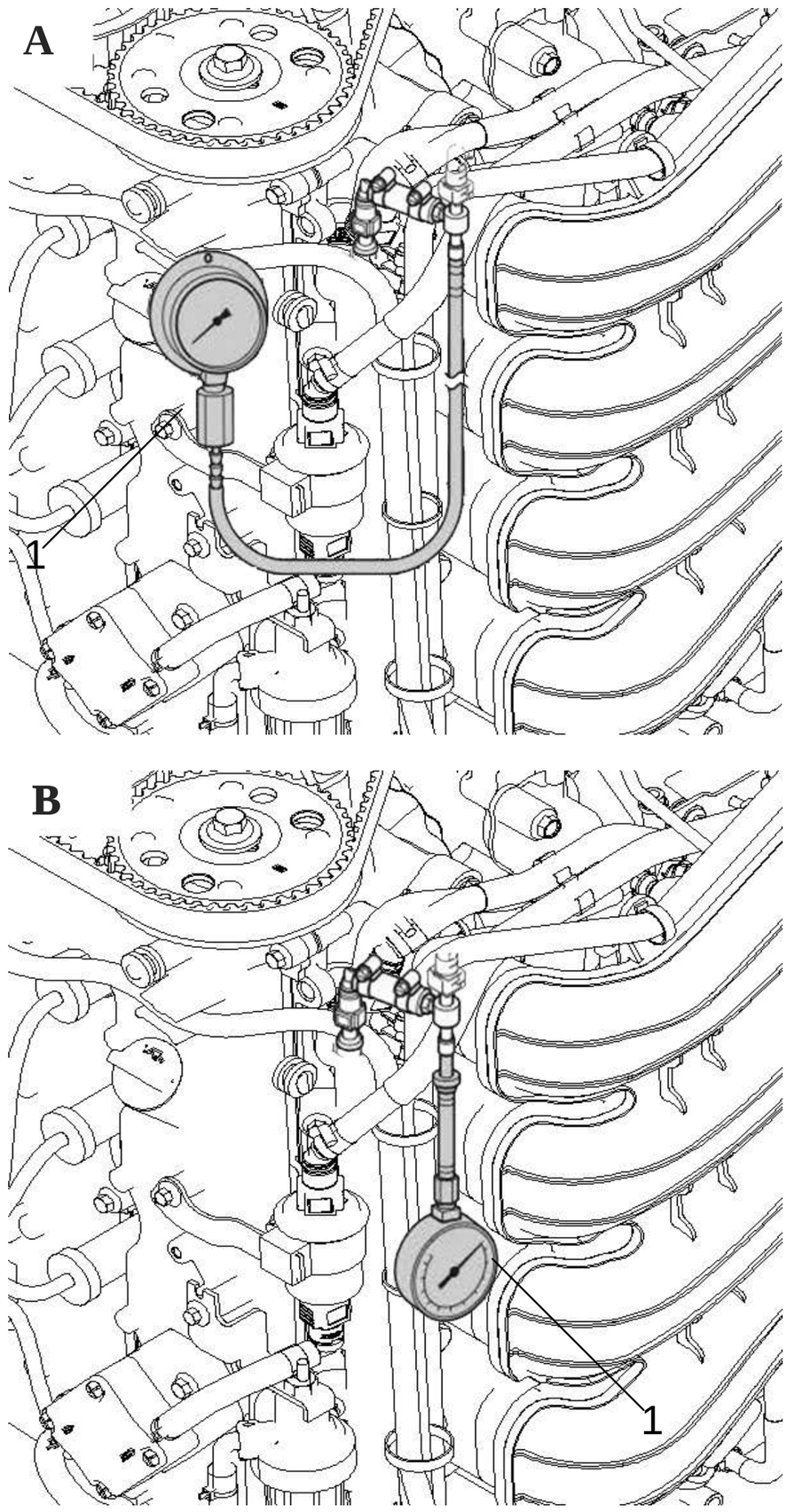


Fuel pressure gauge adapter "1"
Fuel pressure gauge adapter "1"

4. Connect the special service tool "1".

⚠ WARNING

To prevent fuel from leaking out, screw in the gauge gently until it is connected firmly.



A. Worldwide
B. USA and Canada

Fuel pressure gauge "1"
Fuel pressure gauge "1"

5. Install the flywheel magneto cover.

6. Turn the engine start switch to ON, and then measure the fuel pressure within 5 seconds.

TIP:

- The fuel pressure will decrease 5 seconds after the engine start switch is turned to ON.
- The high-pressure fuel pump does not operate when the engine start switch is turned to ON again within 10 seconds after turning the engine start switch to OFF.

Fuel pressure at engine start switch to "ON" within 5 seconds 300 kPa (3.0 kgf/cm2, 43.5psi)

7. Start the engine and warm it up until the engine idle speed stabilizes at 700–800 r/min.

8. Measure the fuel pressure.

Fuel pressure at engine idle speed 260 kPa (2.6 kgf/cm2, 37.7 psi)

9. Turn the engine start switch to OFF.

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

11. Disconnect the special service tool.

⚠ WARNING

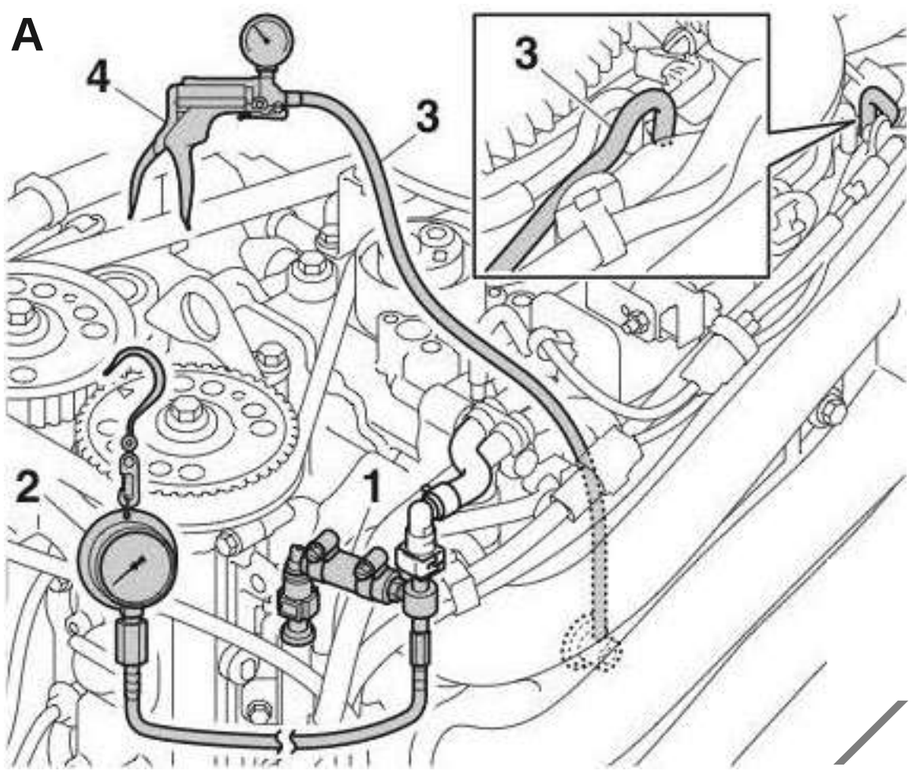
Before disconnecting the special service tools, cover the end of the hose using a clean and dry rag.

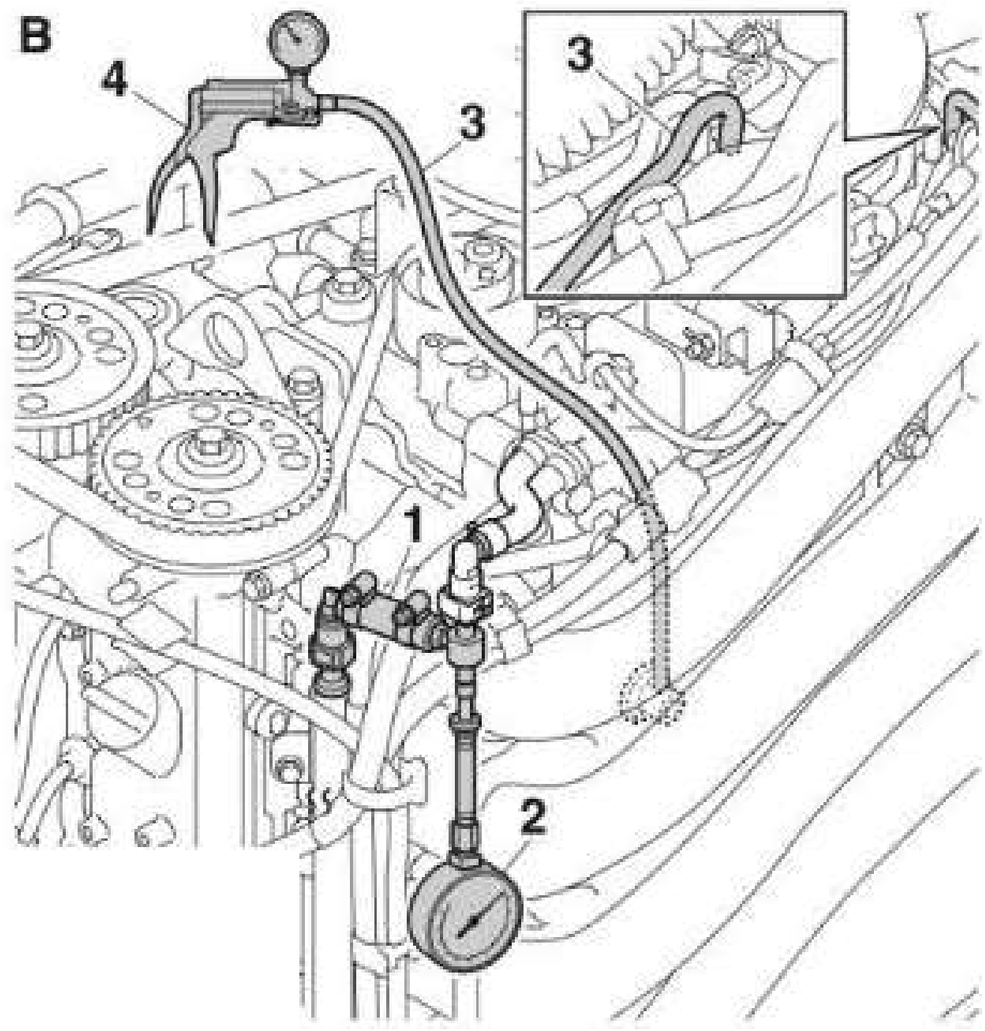
12. Connect the quick connector to the fuel rail.

Checking the pressure regulator

Cover the fuel components using a rag to prevent fuel from spilling out.

1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-1).
2. Disconnect the quick connector from the fuel rail. See step 3 in "Disconnecting the quick connector" (6-1).
3. Connect the special service tools "1" and "2". See steps 3 and 4 in "Measuring the fuel pressure" (6-1).
4. Disconnect the pressure regulator hose "3" from the intake manifold, and then connect the special service tool "4" to the pressure regulator hose"3".

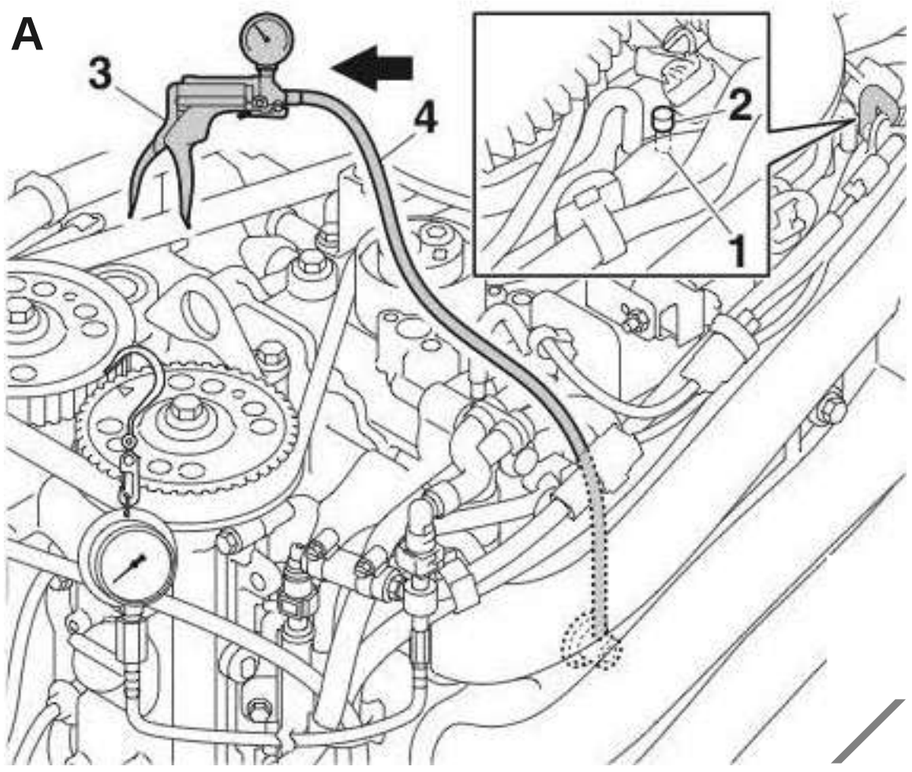


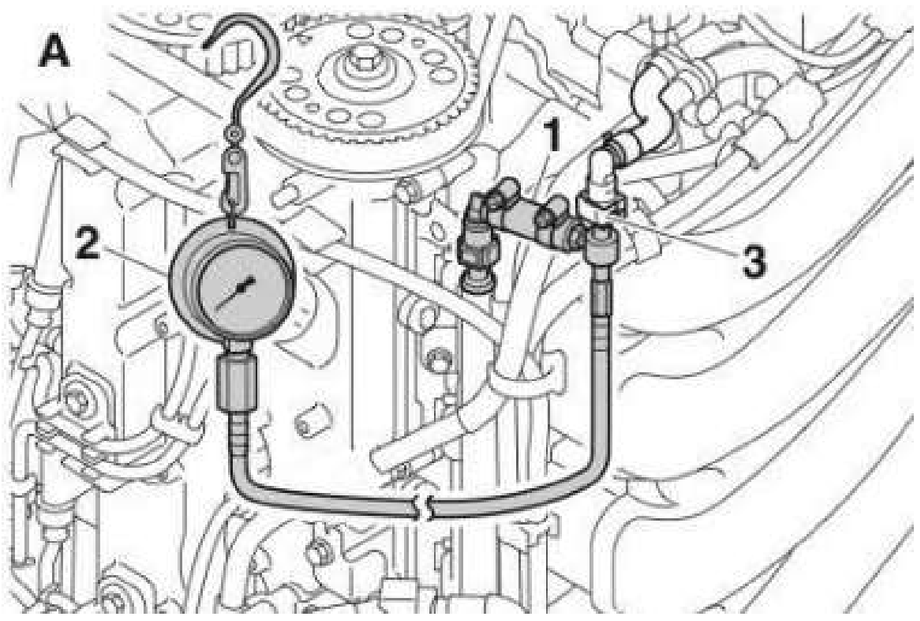


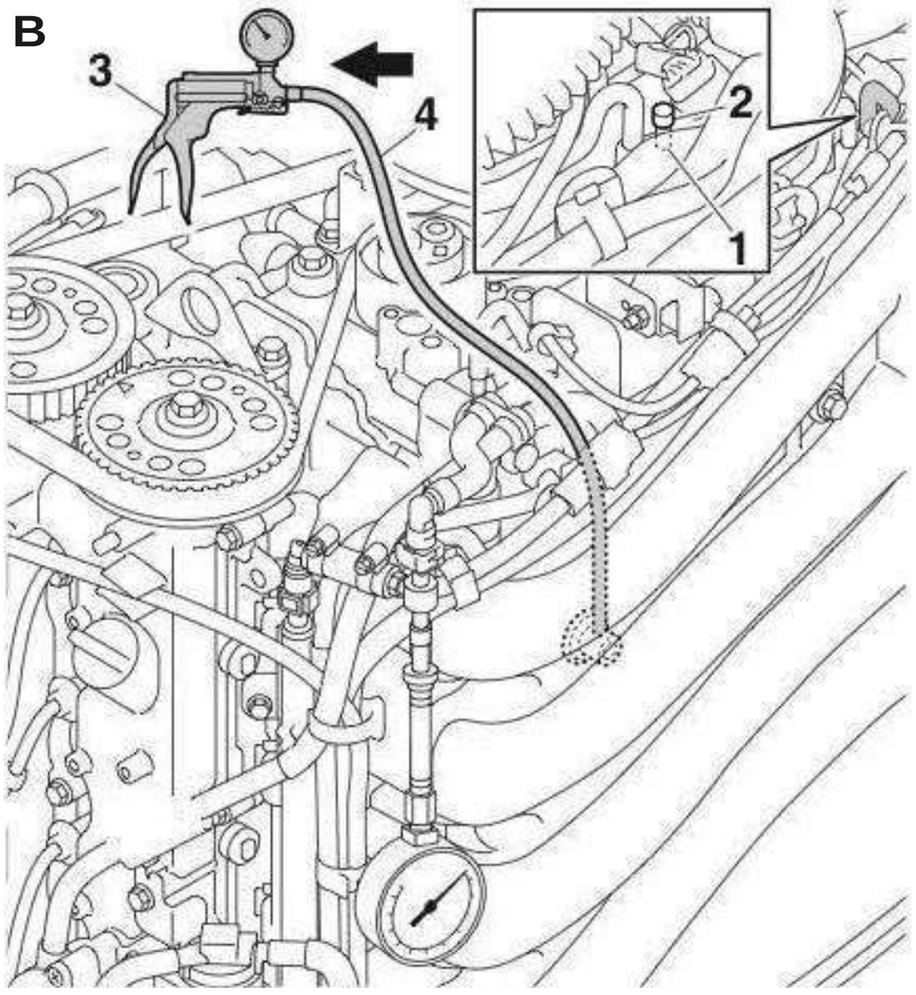
A. Worldwide
B. USA and Canada

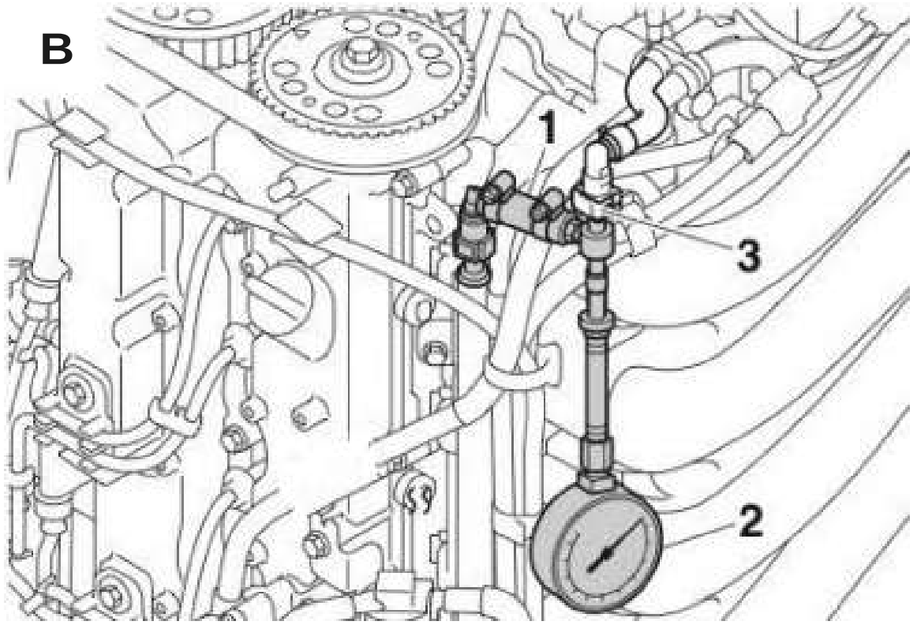
Fuel pressure gauge adapter "1"
Fuel pressure gauge adapter "1"
Fuel pressure gauge "2"
Fuel pressure gauge "2"
Vacuum/pressure pump gauge set "4"
Pressure/vacuum tester "4"

5. Block the end of the intake manifold "1" using a rubber plug "2".
6. Start the engine and let it idle.
7. Check that the fuel pressure is reduced when negative pressure is applied to the pressure regulator. If the fuel pressure is not reduced, replace the pressure regulator.
8. Turn the engine start switch to OFF.
9. Disconnect the special service tool "3", and then connect the pressure regulator hose "4" to the intake manifold.









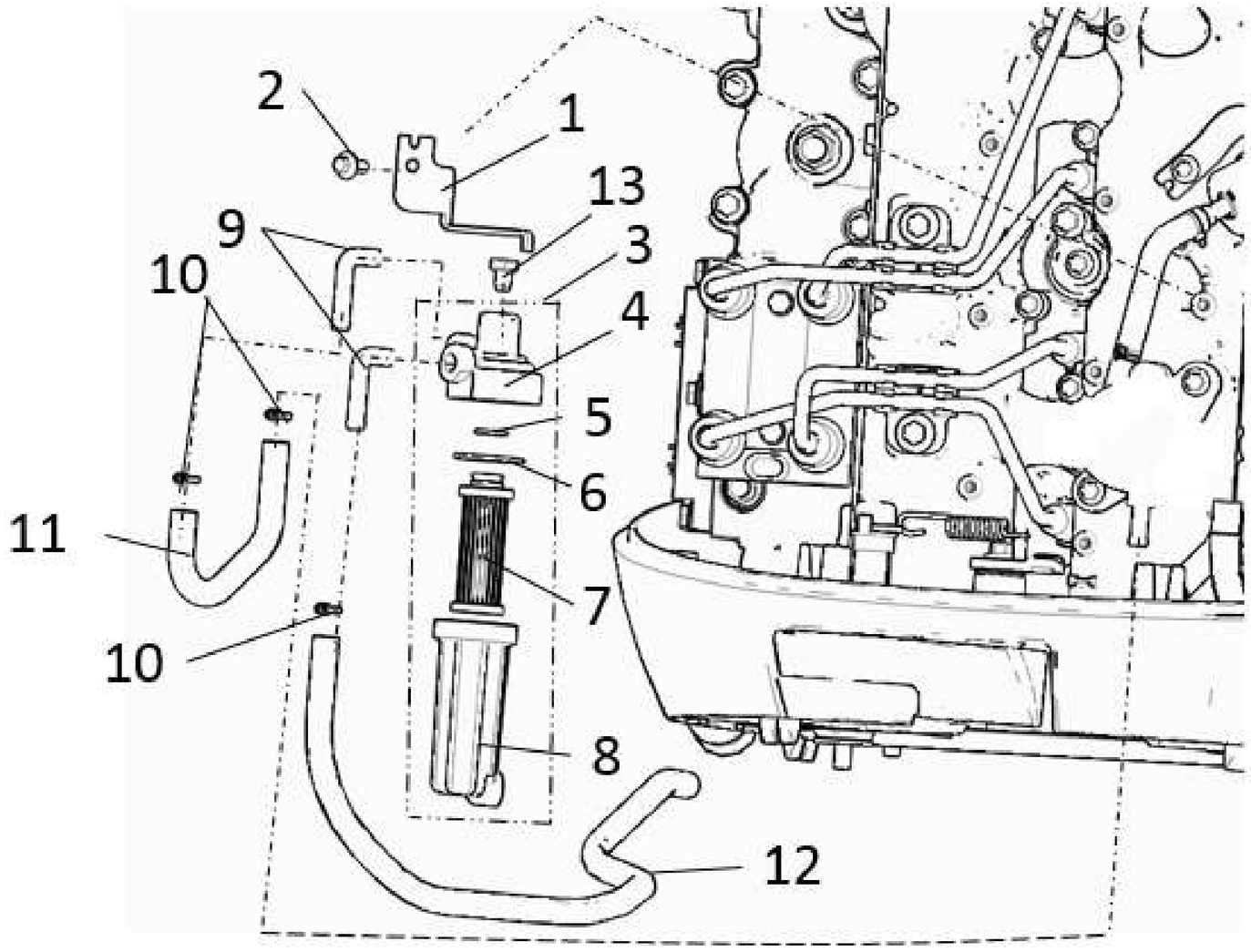
A. Worldwide
B. USA and Canada

A. Worldwide
B. USA and Canada

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

11. Disconnect the special service tools "1" and "2", and then connect the quick connector "3".

Fuel filter

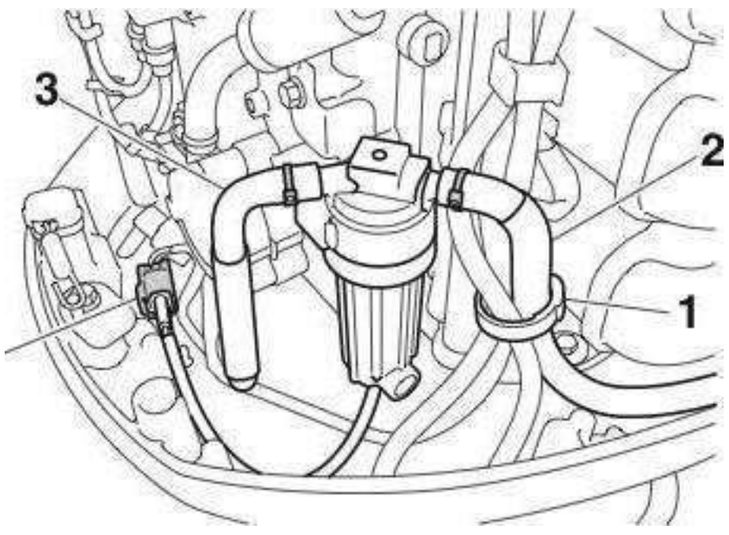


No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Bolt	1	M6 x 12 mm
3	Fuel filter assembly	1	
4	Holder	1	
5	0-ring	1	Not reusable
6	0-ring	1	Not reusable
7	Fuel filter element	1	
8	Fuel cup assembly	1	
9	Joint	2	
10	Plastic tie	3	
11	Hose	1	Fuel filter assembly to fuel pump assembly
12	Hose	1	
13	Bolt	1	M6 x8 mm

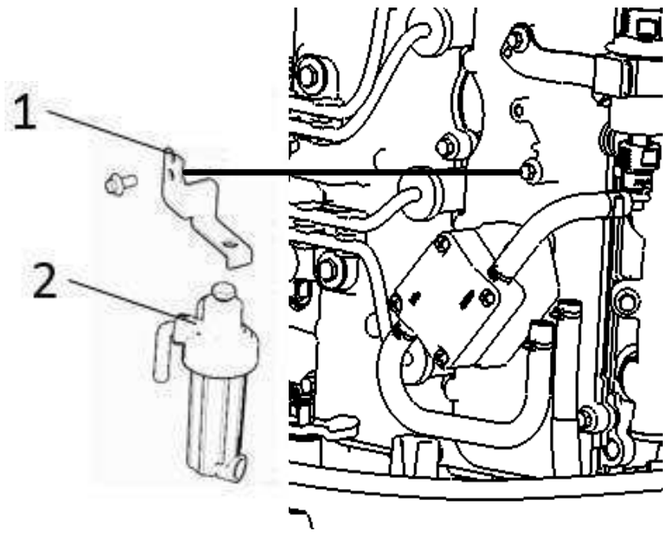
Removing the fuel filter assembly

Cover the fuel components using a rag to prevent fuel from spilling out.

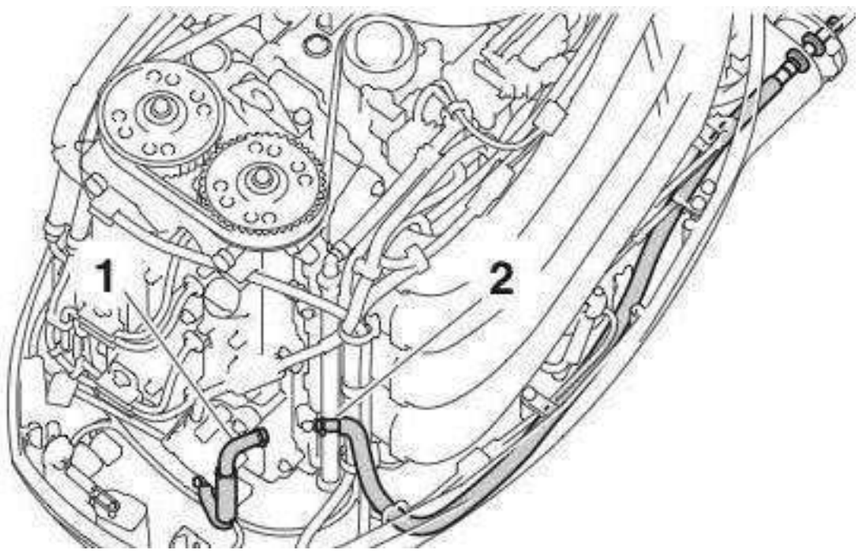
1. Disconnect the water detection switch coupler "a".
2. Remove the holder "1".
3. Disconnect the fuel hoses "2" and "3".



4. Remove the fuel filter assembly "1".
5. Remove the bracket "2".

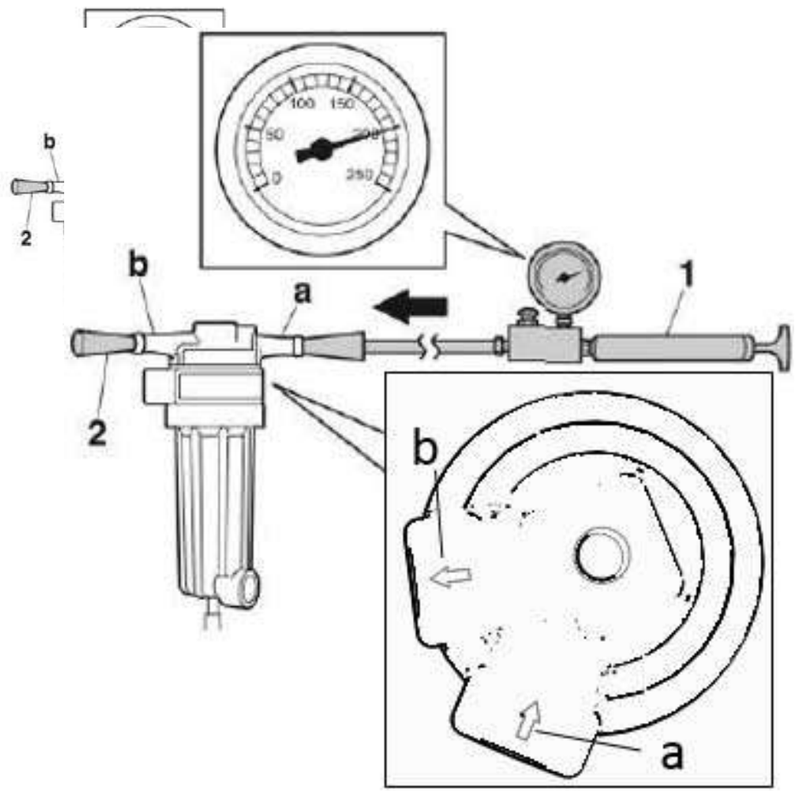


6. Remove the fuel hoses "1" and "2".



Checking the fuel filter assembly

1. Connect the leakage tester "1" to the fuel inlet "a".
2. Block the fuel outlet "b" using a rubber plug "2", and then apply the specified positive pressure. Replace the 0-ring, fuel cup assembly, or fuel filter assembly if the specified pressure cannot be maintained for 15 seconds or more.

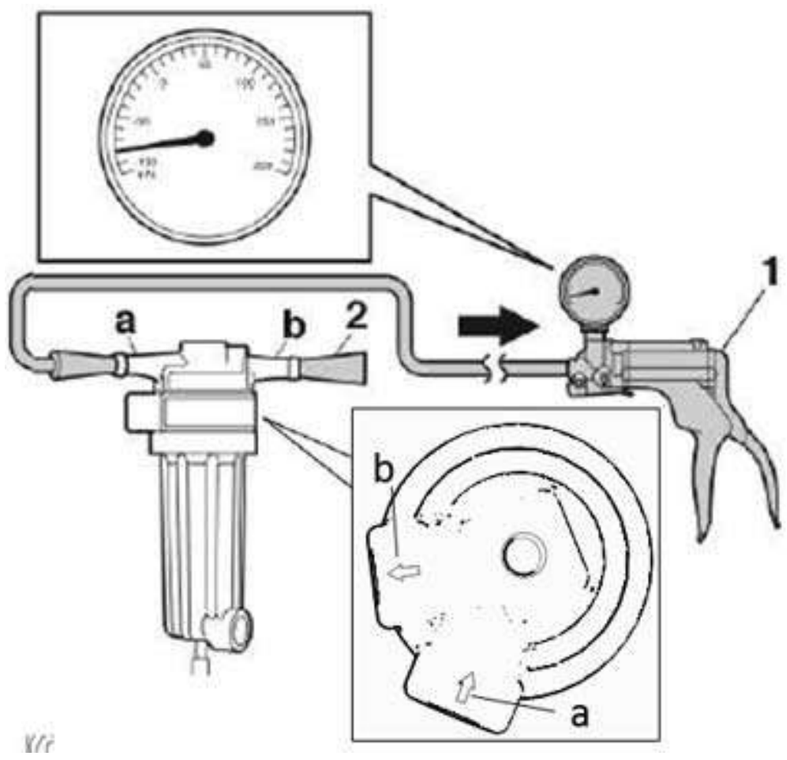


Leakage tester "1"
Leakage tester "1" (commercially available)

Fuel inlet holding pressure (positive pressure) 200 kPa (2.0 kgf/cm^2, 29.0 psi)

3. Connect the special service tool "1" to the fuel outlet "a".

4. Blockthe fuel inlet "b" using a rubber plug "2", and then apply the specified negative pressure. Replace the 0-ring, fuel cup assembly, or fuel filter assembly if the specified pressure cannot be maintained for 15 seconds or more.

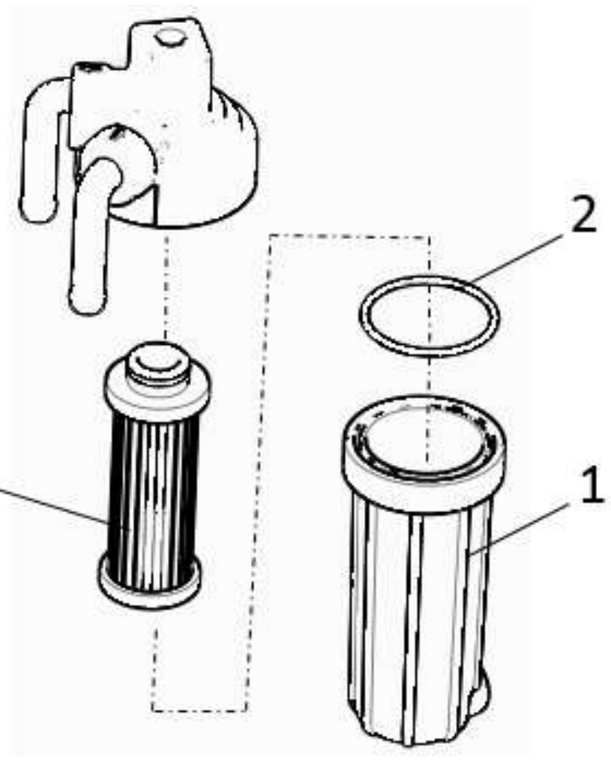


Vacuum/pressure pump gauge set "1"
Pressure/vacuum tester "1"

Fuel outlet holding pressure (negative pressure) 80 kPa (0.8 kgf/cm^2, 11.6 psi)

Disassembling the fuel filter assembly

1. Remove the fuel cup assembly "1", 0-ring "2", and fuel filter element "3".



Checking the fuel filter element

1. Check the fuel filter element. Replace the fuel filter element if there is dirt or residue.

Checking the fuel cup assembly

1. Check the fuel cup assembly. Clean using straight gasoline if there is foreign material or replace if cracked.

NOTICE

When cleaning the fuel cup assembly, do not remove the clip and float.

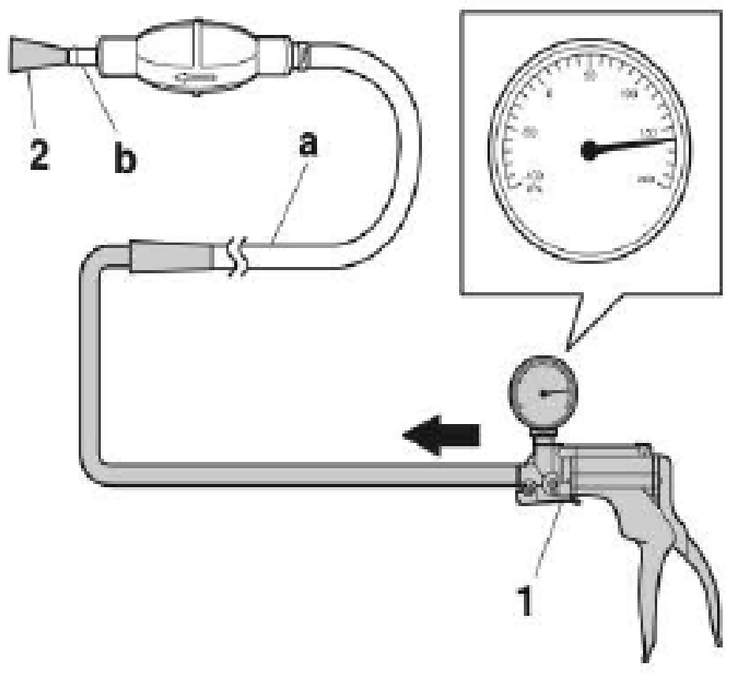
2. Check the water detection switch. See "Checking the water detection switch" (5-22).

Checking the primer pump

1. Connect the leakage tester "1" to the primer pump inlet "a".

2. Block the fuel outlet "b" using a rubber plug "2".

3. Apply the specified positive pressure. Replace the primer pump if the specified pressure cannot be maintained for 30 seconds or more.

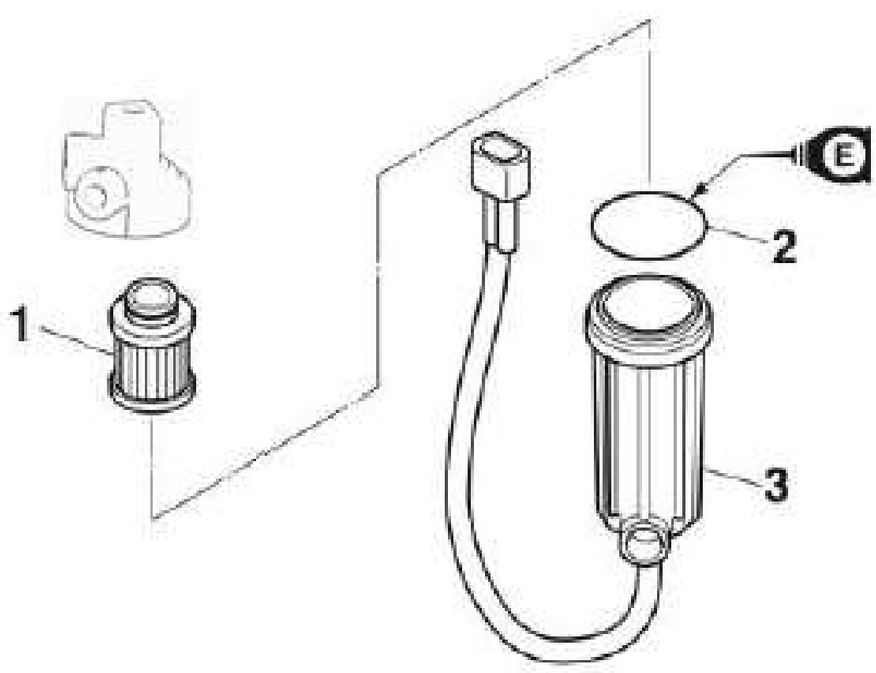


Leakage tester "1"
Leakage tester "1" (commercially available)

Positive pressure 166.7 kPa (1.67 kgf/cm^2, 24.2 psi)

Assembling the fuel filter assembly

1. Install the fuel filter element "1", a new O-ring "2", and the fuel cup assembly "3", and then tighten the fuel cup assembly "3" to the specified torque.

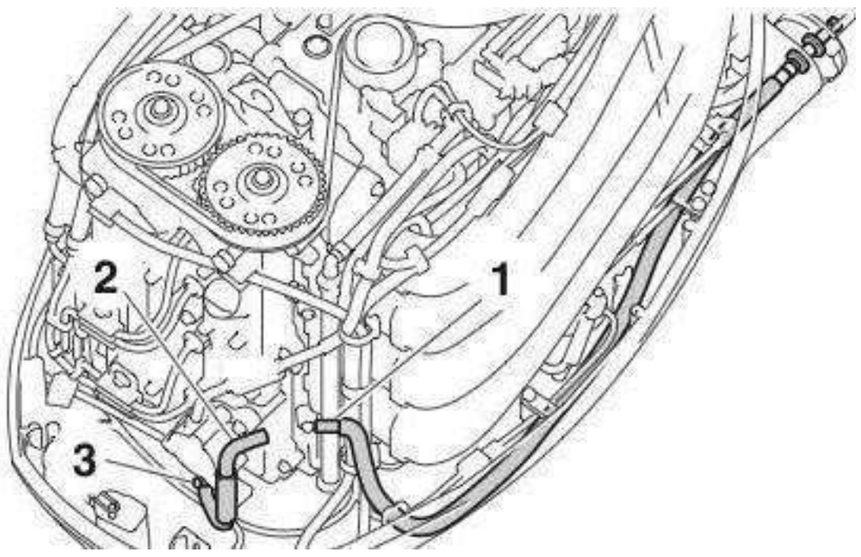


Fuel cup assembly "3" 5 Nm (0.5 kgf·m, 3.7 ft-lb)

Installing the fuel filter assembly

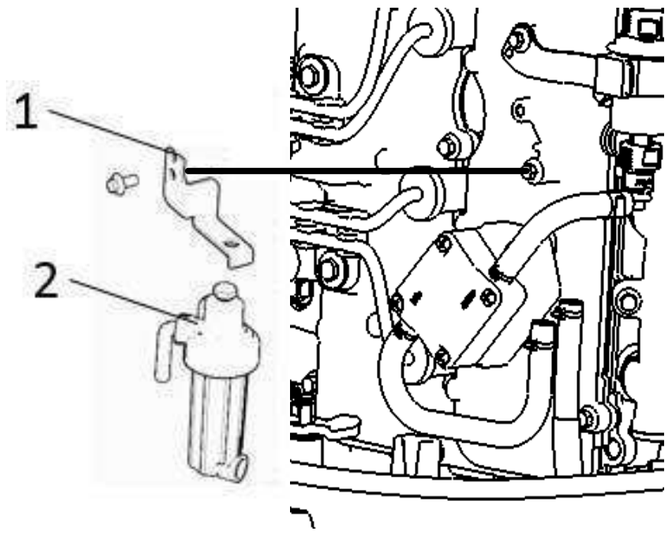
1. Install the fuel hose "1".

2. Connect the fuel hose "2" to the fuel pump, and then fasten it using the plastic tie "3".



3. Install the bracket "1" to the cylinder head cover.

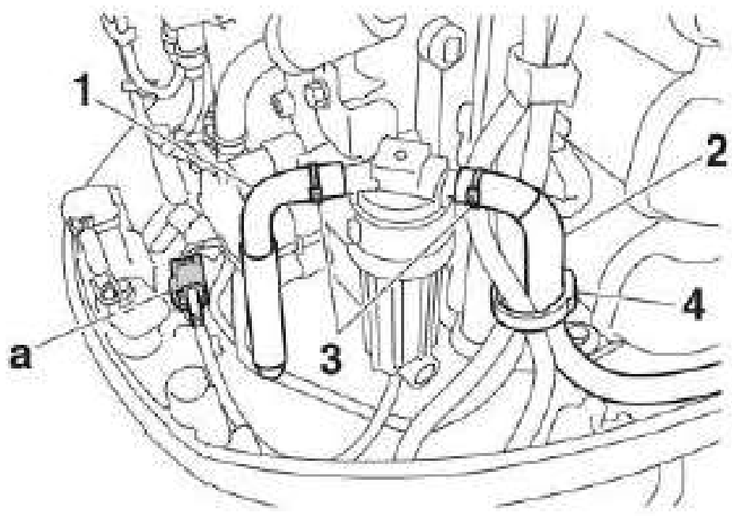
4. Install the fuel filter assembly "2" to the bracket "1".



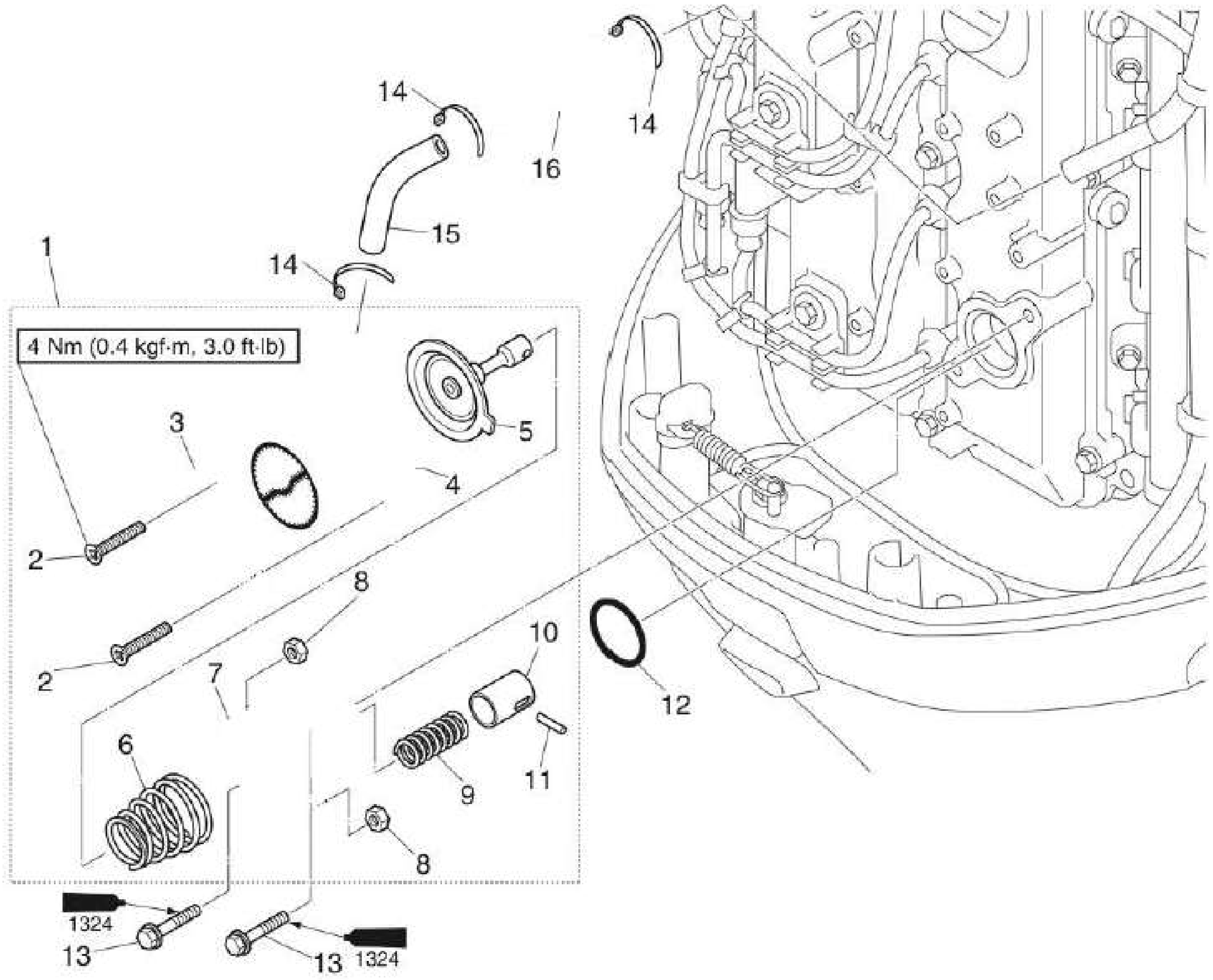
5. Connect the fuel hoses "1" and "2" to the fuel filter assembly, and then fasten them using the plastic ties "3".

6. Install the holder "4".

7. Connect the water detection switch coupler "a".



Fuel pump assembly



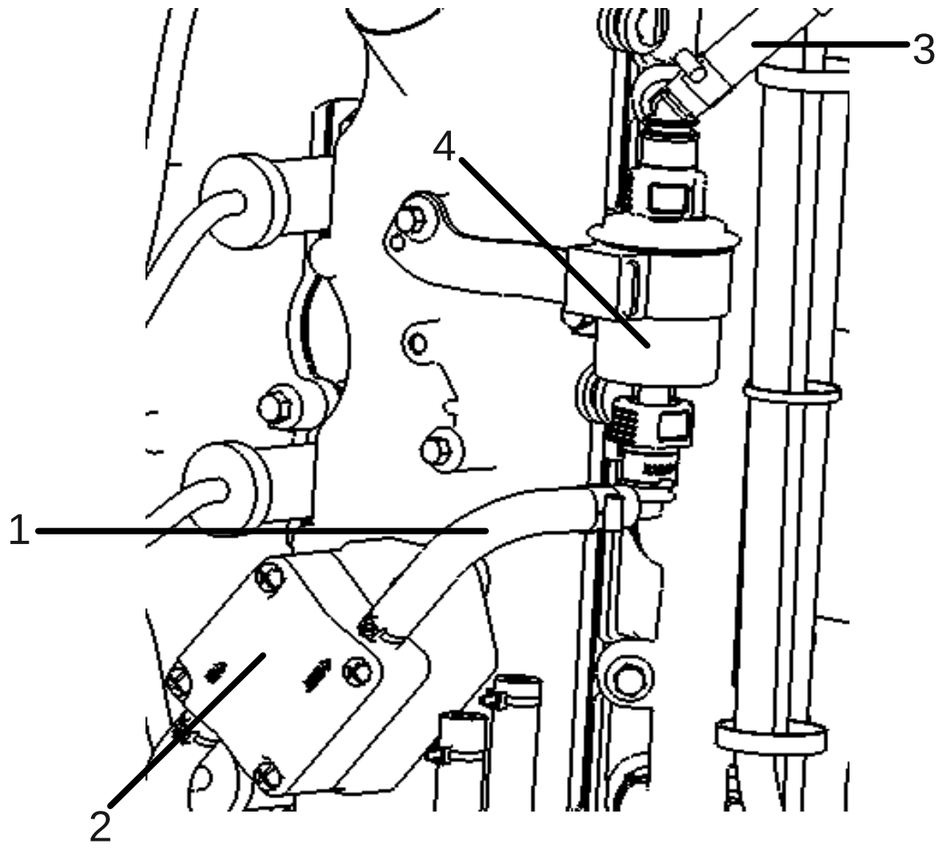
No.	Part name	Q'ty	Remarks
1	Fuel pump assembly	1	
2	Screw	3	M6 x 36 mm
3	Cover	1	
4	Fuel pump body	1	
5	Diaphragm	1	
6	Spring	1	
7	Fuel pump body	1	
8	Nut	3	M6
9	Spring	1	
10	Plunger	1	
11	Pin	1	
12	0-ring	1	Not reusable
13	Bolt	2	M6 x 30 mm
14	Plastic tie	3	
15	Hose	1	Fuel pump assembly to fuel strainer
16	Fuel strainer	1	

Removing the fuel pump assembly

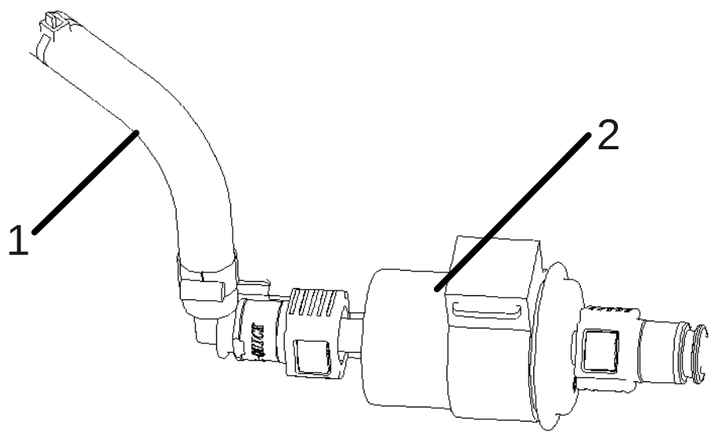
Cover the fuel components using a rag to prevent fuel from spilling out.

1. Disconnect the fuel hose "1" from the fuel pump "2".

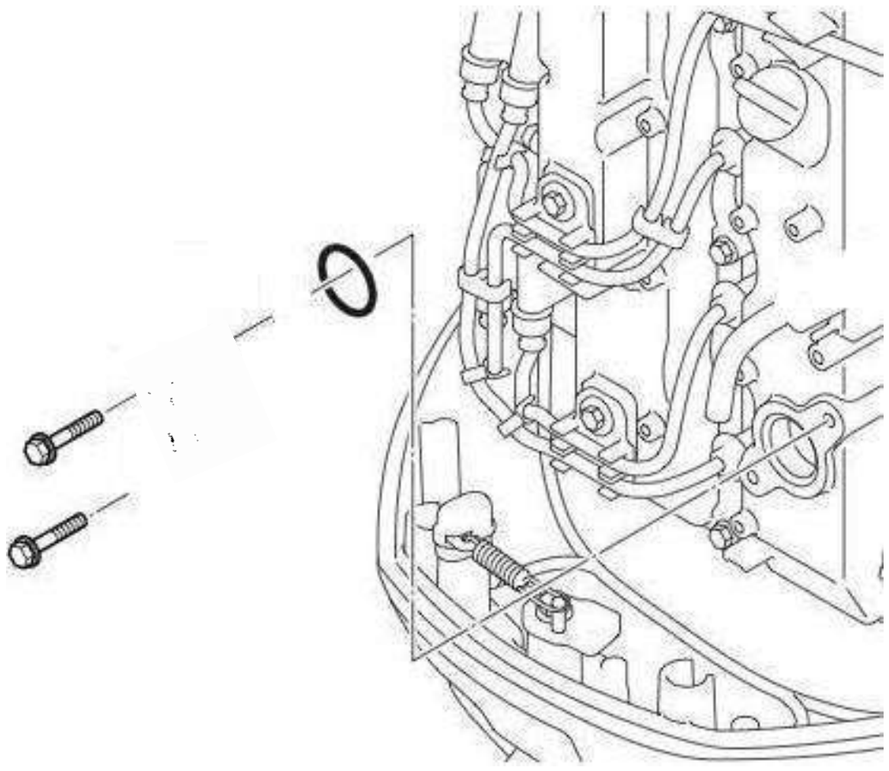
2. Disconnect the fuel hose "3" from the fuel strainer "4".



3. Disconnect the fuel hose "1" from the fuel strainer "2".



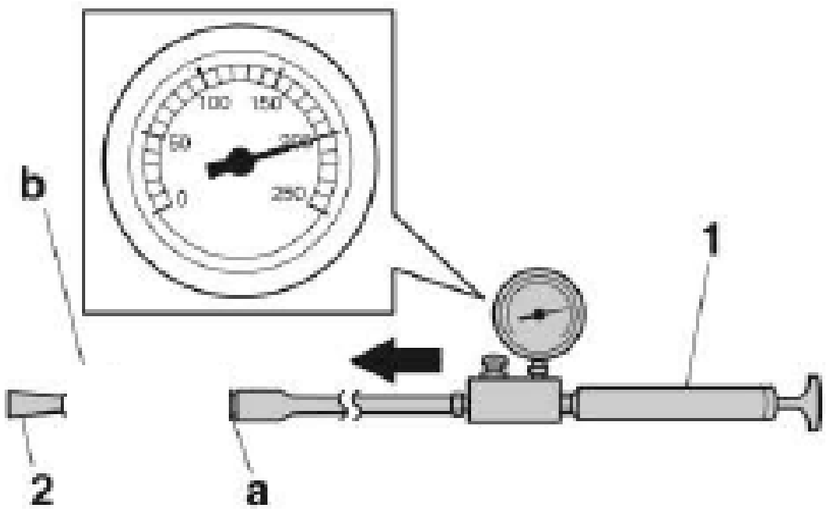
4. Remove the fuel pump assembly "1".



Checking the fuel strainer

1. Connect the leakage tester "1" to the fuel inlet "a".

2. Block the fuel outlet "b" using a rubber plug "2", and then apply the specified positive pressure. Replace the fuel strainer if the specified pressure cannot be maintained for 15 seconds or more.



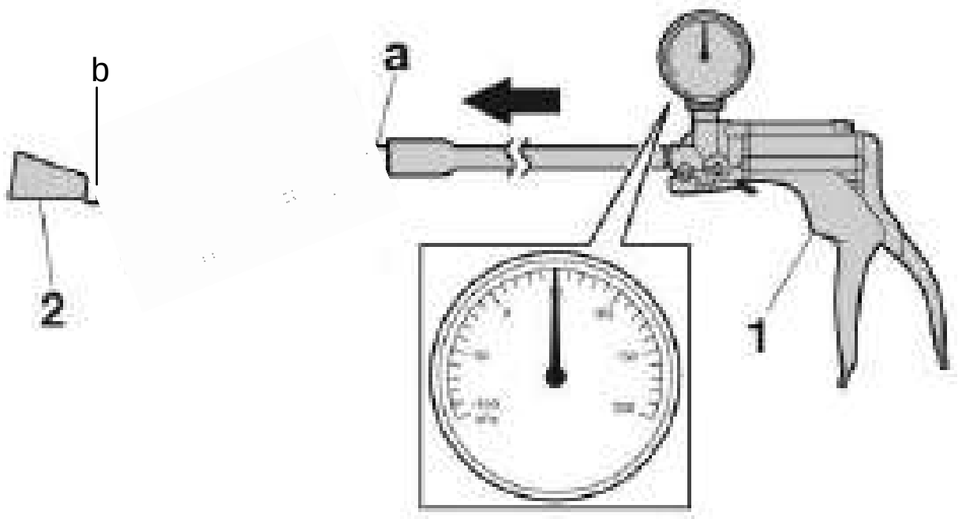
Leakage tester "1"
Leakage tester "1" (commercially available)

Specified positive pressure
200.0 kPa (2.00 kgf/cm^2, 29.0 psi)

Checking the fuel pump assembly

1. Connect the special service tool "1" to the fuel pump inlet "a".

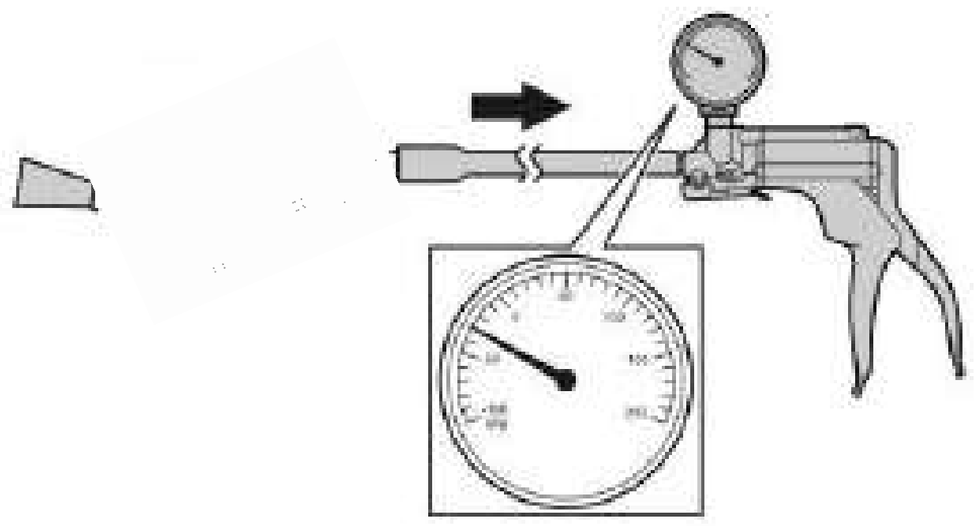
2. Block the fuel pump outlet "b" using a rubber plug "2", and then apply the specified positive pressure. Check that there is no air leakage. If there is air leakage, disassemble and check the fuel pump. See "Disassembling the fuel pump assembly" (6-11).



Vacuum/pressure pump gauge set "1" Pressure/vacuum tester "1"

Specified positive pressure 50.0 kPa (0.50 kgf/cm^2, 7.3 psi)

3. Apply the specified negative pressure, and then check that there is no air leakage. If there is air leakage, disassemble and check the fuel pump. See "Disassembling the fuel pump assembly" (6-11).

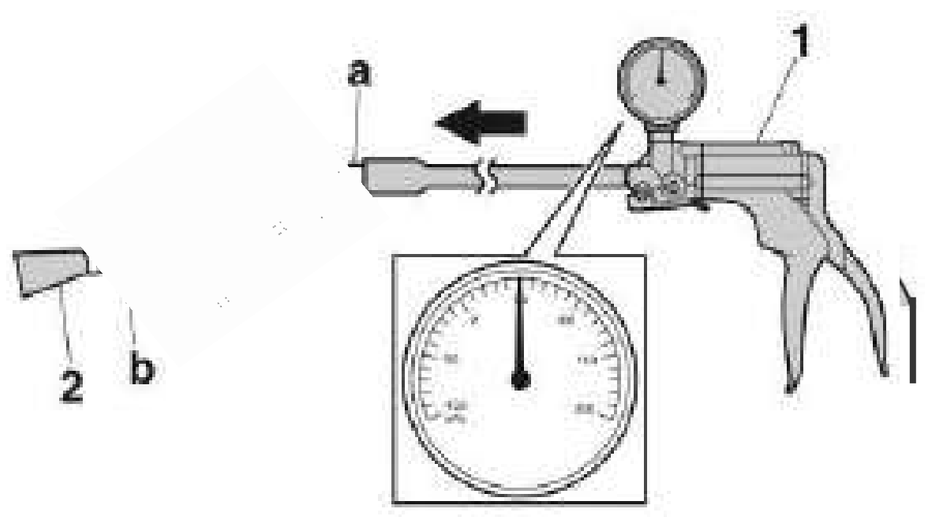


Specified negative pressure 30.0 kPa (0.30 kgf/cm^2, 4.4 psi)

4. Connect the special service tool "1" to the fuel pump outlet "a".

5. Block the fuel pump inlet "b" using a rubber plug "2".

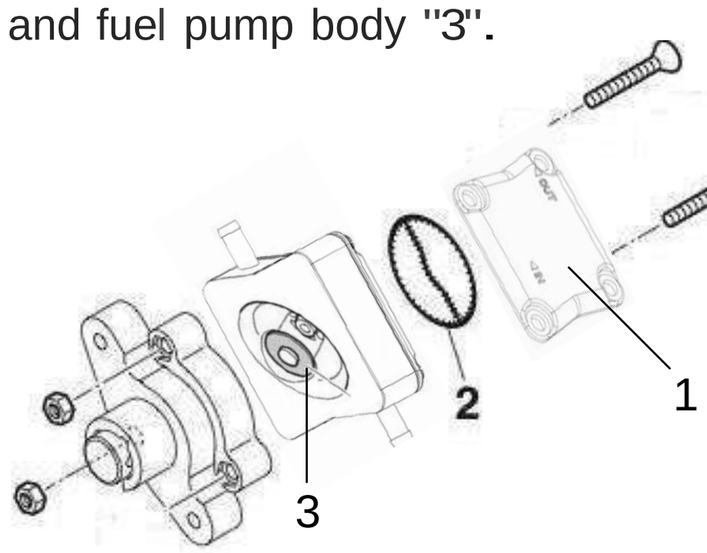
6. Apply the specified positive pressure, and then check that there is no air leakage. If there is air leakage, disassemble and check the fuel pump. See "Disassembling the fuel pump assembly" (6-11).



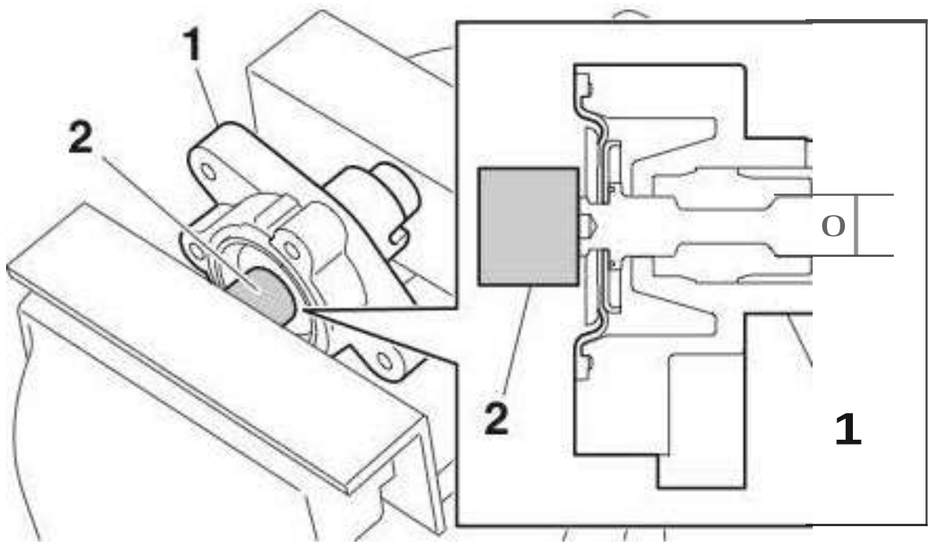
Specified positive pressure 50.0 kPa (0.50 kgf/cm^2, 7.3 psi)

Disassembling the fuel pump assembly

1. Remove the cover "1", diaphragm "2", and fuel pump body "3".



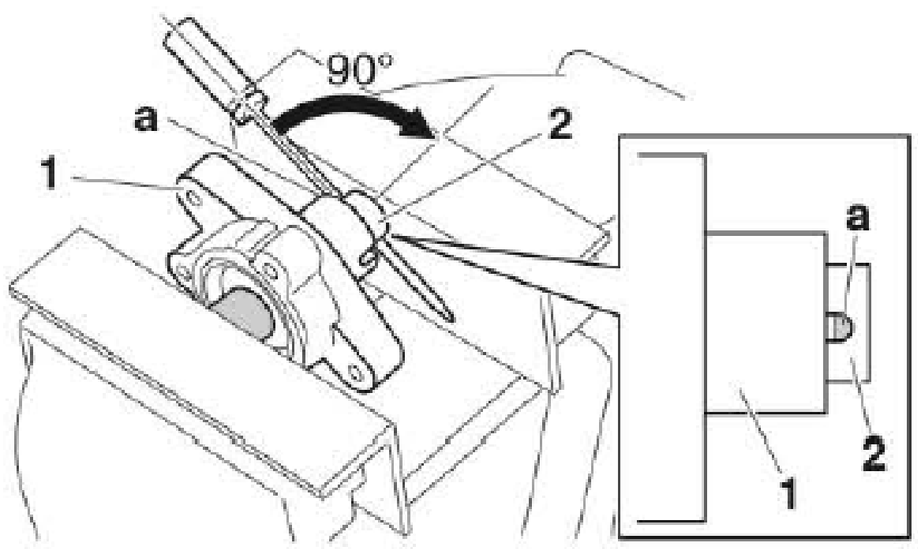
2. Compress the plunger spring using a vise to hold the fuel pump body "1".



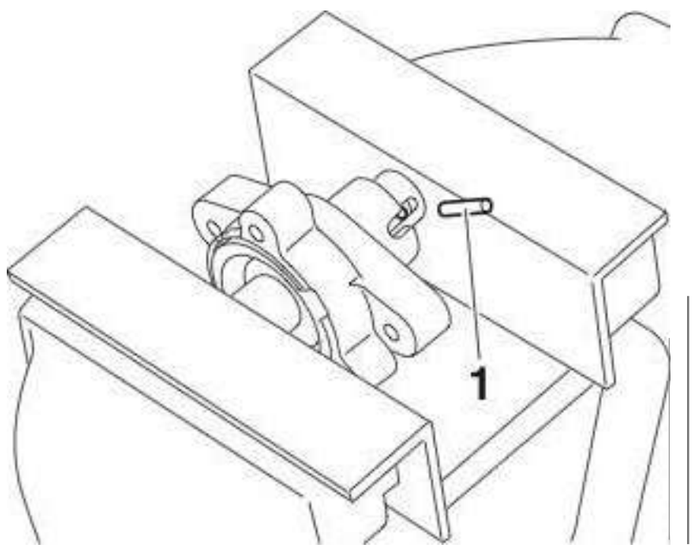
Small end bearing installer "2"

Connecting rod small end bearing installer "2"

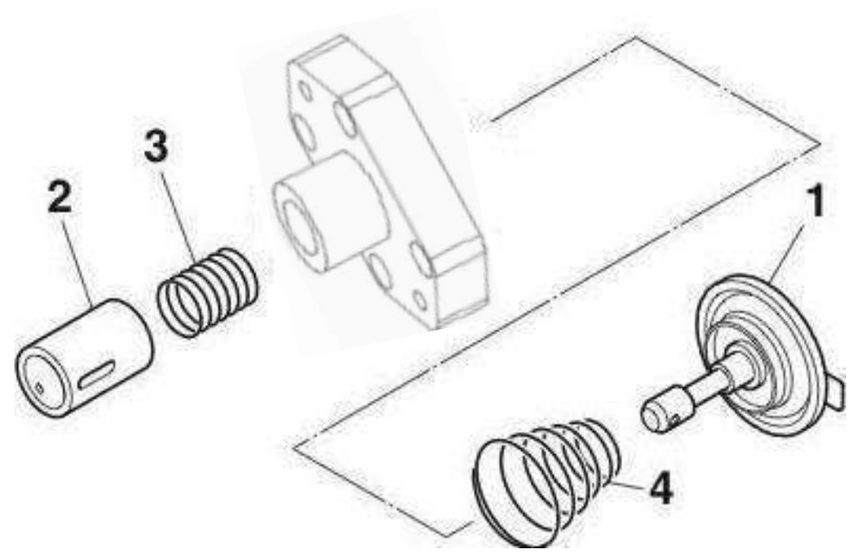
3. While holding fuel pump body "1" in place, insert a flathead screwdriver into the hole "a" in the plunger "2" and turn it 90°.



4. Remove the pin "1".



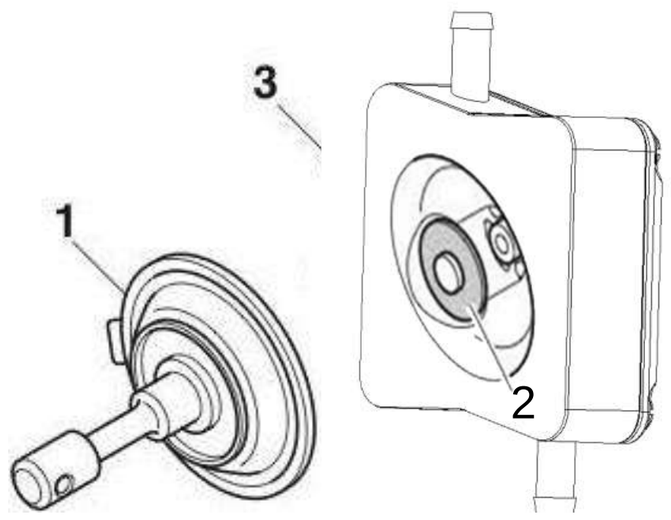
5. Remove the diaphragm "1", plunger "2", and springs "3" and "4".



Checking the diaphragm and valve

1. Check the diaphragm "1". Replace if torn.

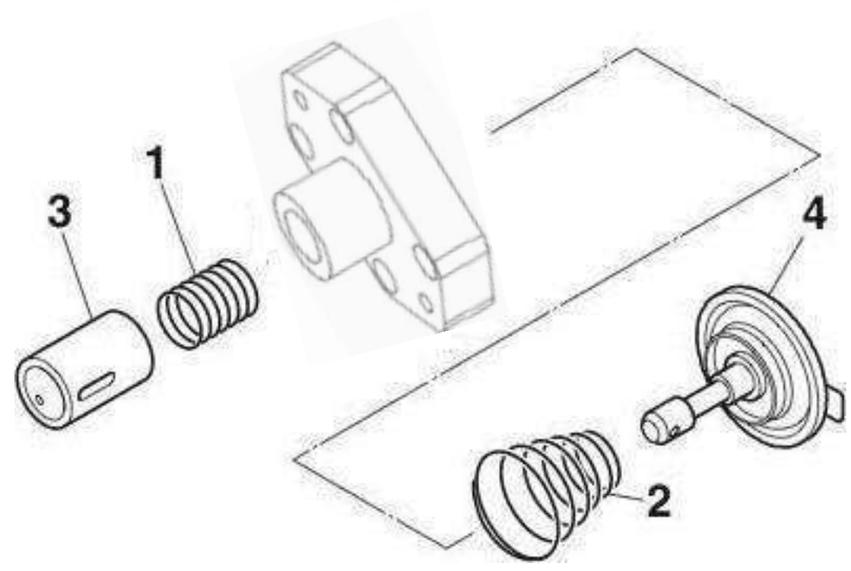
2. Check the diaphragm "1", valve "2". Replace the fuel pump body "3" if deformed or worn.



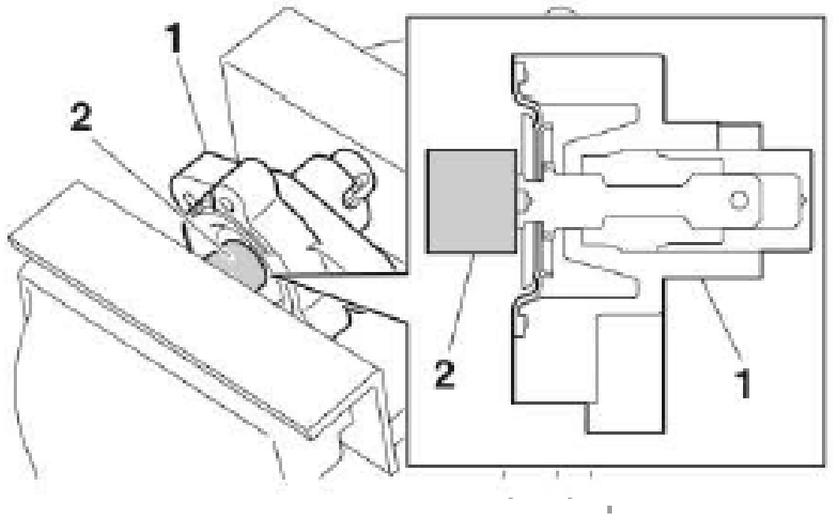
Assembling the fuel pump assembly

Before assembling the fuel pump assembly, clean the parts and soak the valves and diaphragm in gasoline to obtain prompt operation of the fuel pump assembly.

1. Install the springs "1" and "2", plunger "3", and diaphragm "4".

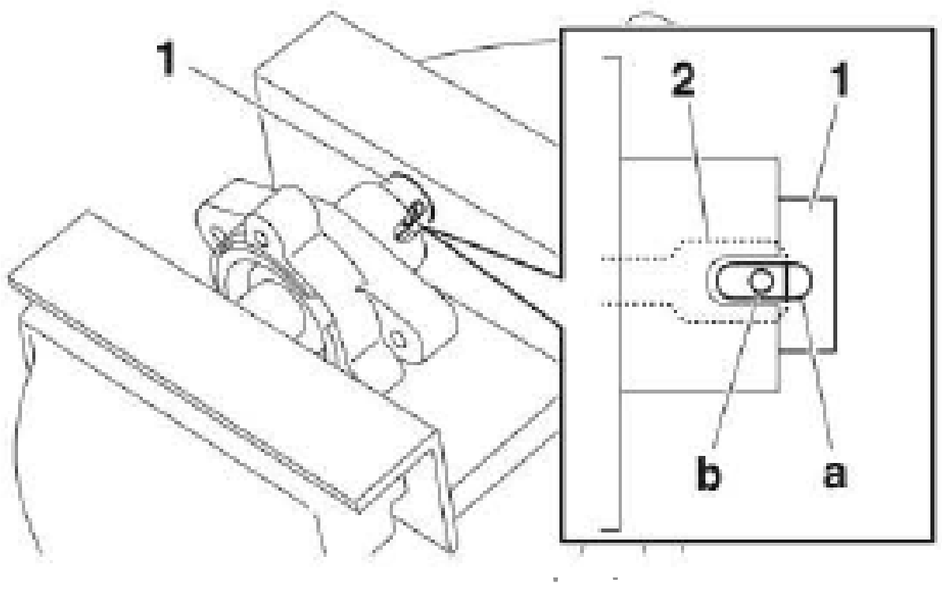


Compress the plunger spring using a vise to hold the fuel pump body "1".

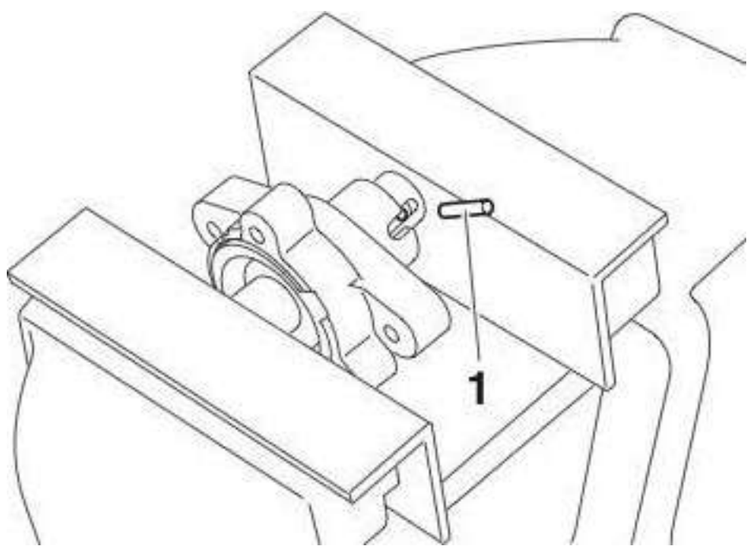


Small end bearing installer "2"
Connecting rod small end bearing installer "2"

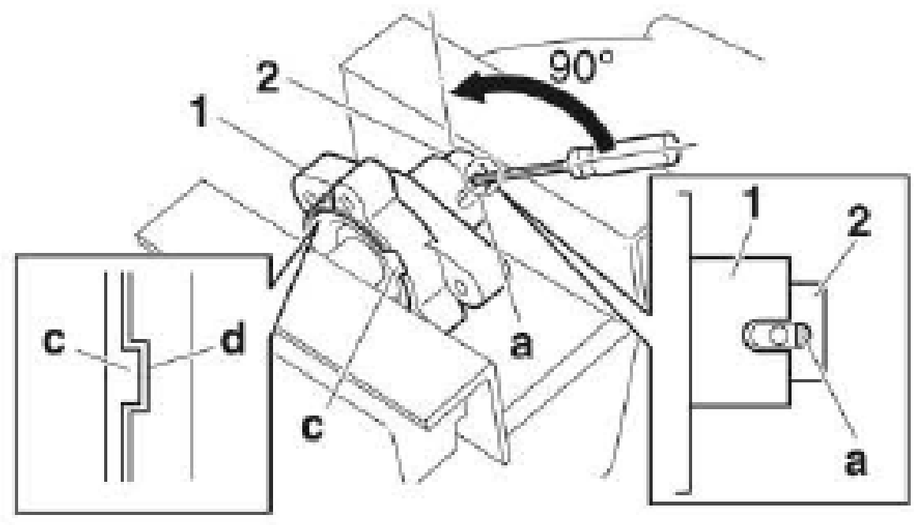
3. Align the hole "a" in the plunger "1" with the hole"b" in the diaphragm "2".



4. Install the pin "1".



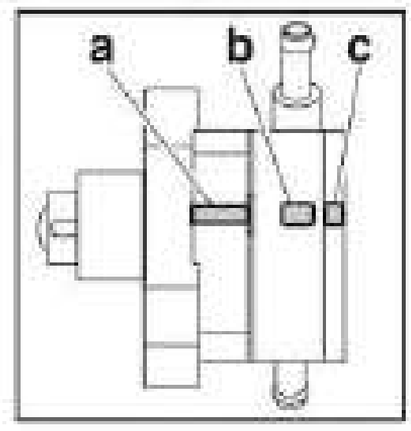
5. While holding fuel pump body "1" in place, insert a flathead screwdriver into the hole "a" in the plunger "2" and turn it 90° until the tab "c" on the diaphragm is aligned with the slot "d" in fuel pump body "1".



6. Install the fuel pump body "1", diaphragm "2", and cover "3", and then tighten the fuel pump screws "4" to the specified torque.

TIP:

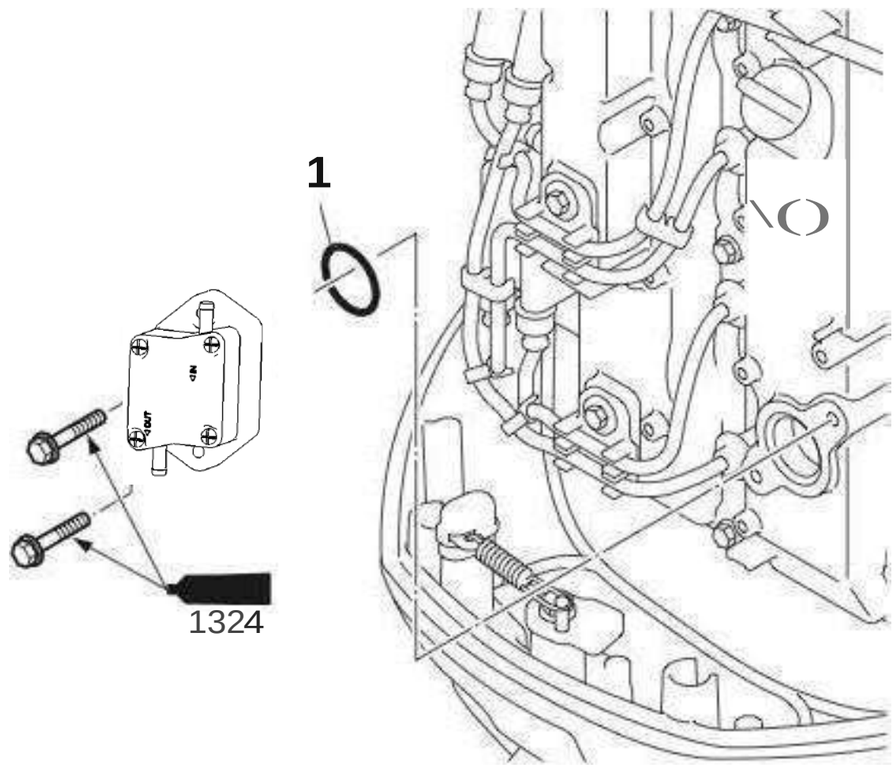
Make sure to align the protrusions "a", "b", and "c".



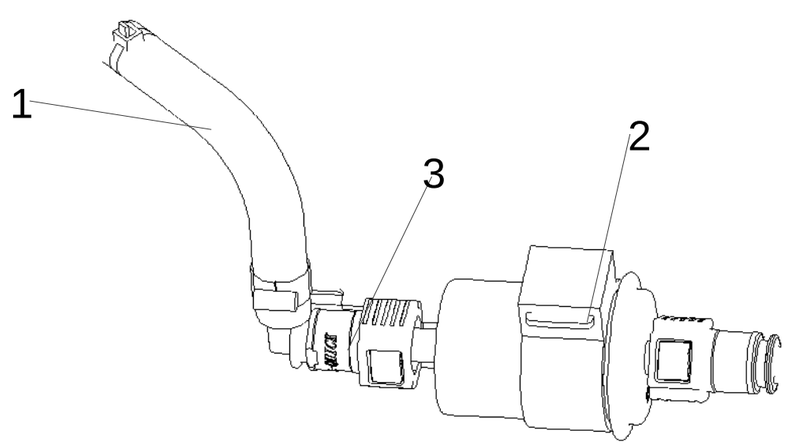
Fuel pump screw "4"
4 Nm (0.4 kgf·m, 3.0 ft·lb)

Installing the fuel pump assembly

1. Install a new 0-ring "1" and the fuel pump assembly "2".



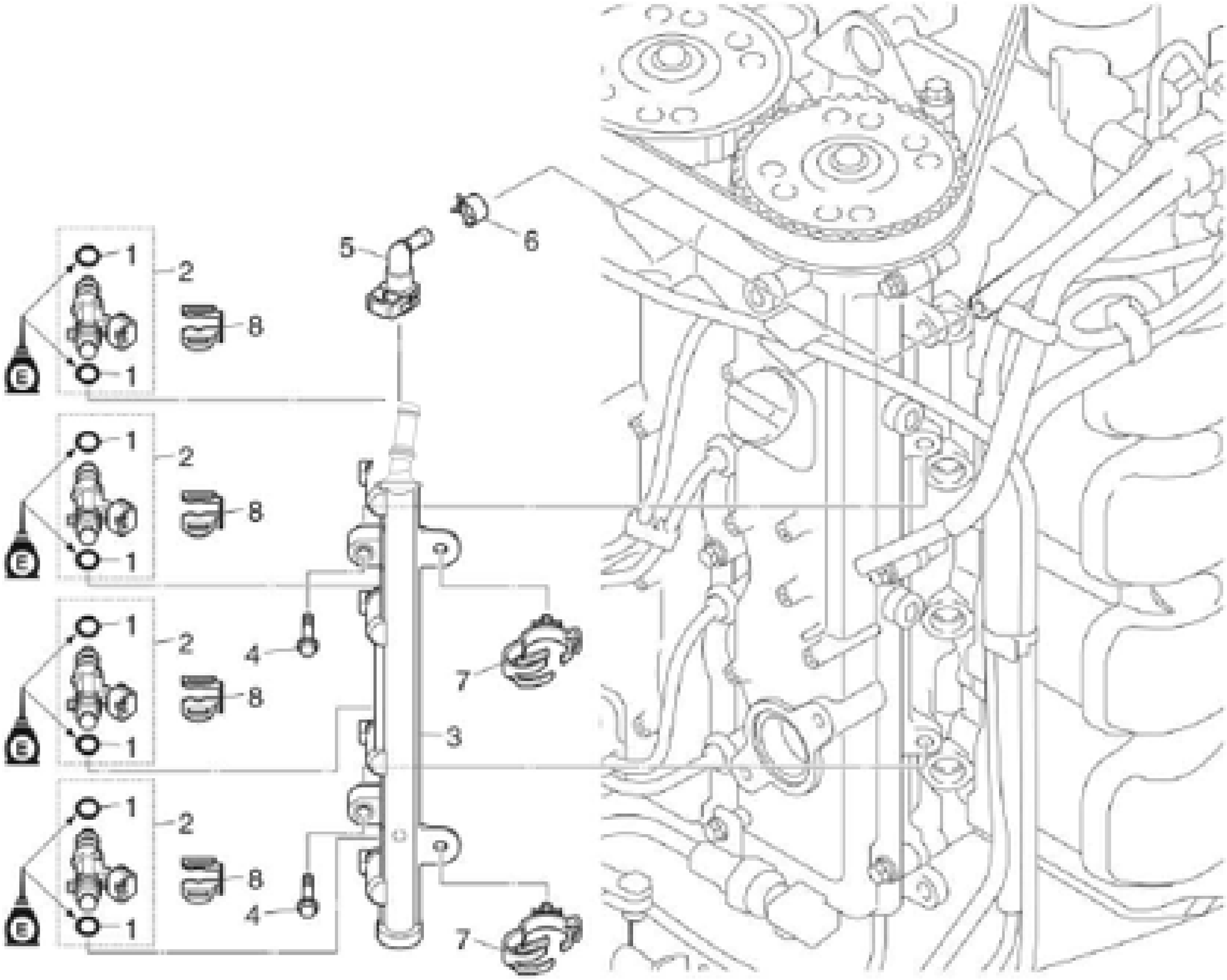
2. Connect the fuel hose "1" to the fuel strainer "2", and then fasten it using the plastic tie "3".



3. Connect the fuel hose "1" to the fuel strainer "2", and then fasten it using the plastic tie "3".

4. Connect the fuel hose "4" to the fuel pump "5", and then fasten it using the plastic tie "6".

Fuel injector



No.	Part name	Q'ty	Remarks
1	0-ring set	4	Not reusable, 2 pes/set
2	Fuel injector	4	
3	Fuel rail	1	
4	Bolt	2	M6 x 25 mm
5	Quick connector	1	
6	Clamp	1	
7	Holder	2	
8	Holder	4	

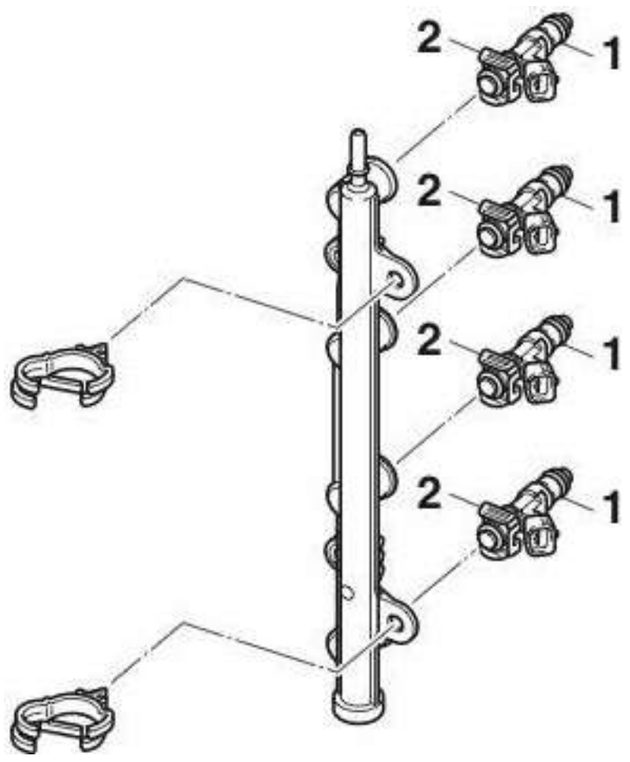
Removing the fuel injector

Cover the fuel components using a rag to prevent fuel from spilling out.

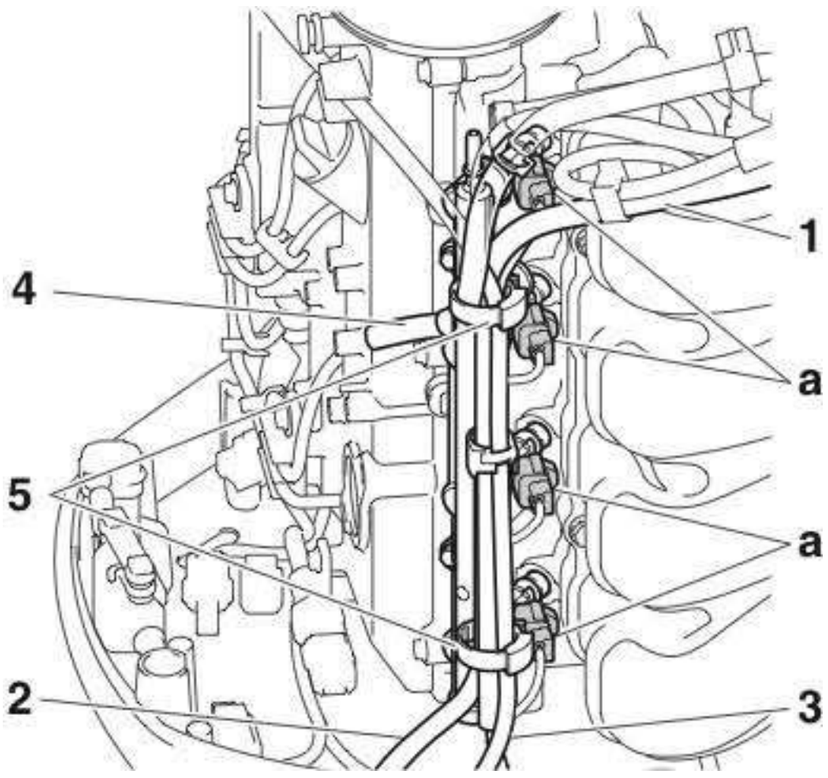
1. Reduce the fuel pressure. See "Reducing the fuel pressure" (6-1).

2. Disconnect the quick connector. See step 3 in "Disconnecting the quick connector" (6-1).

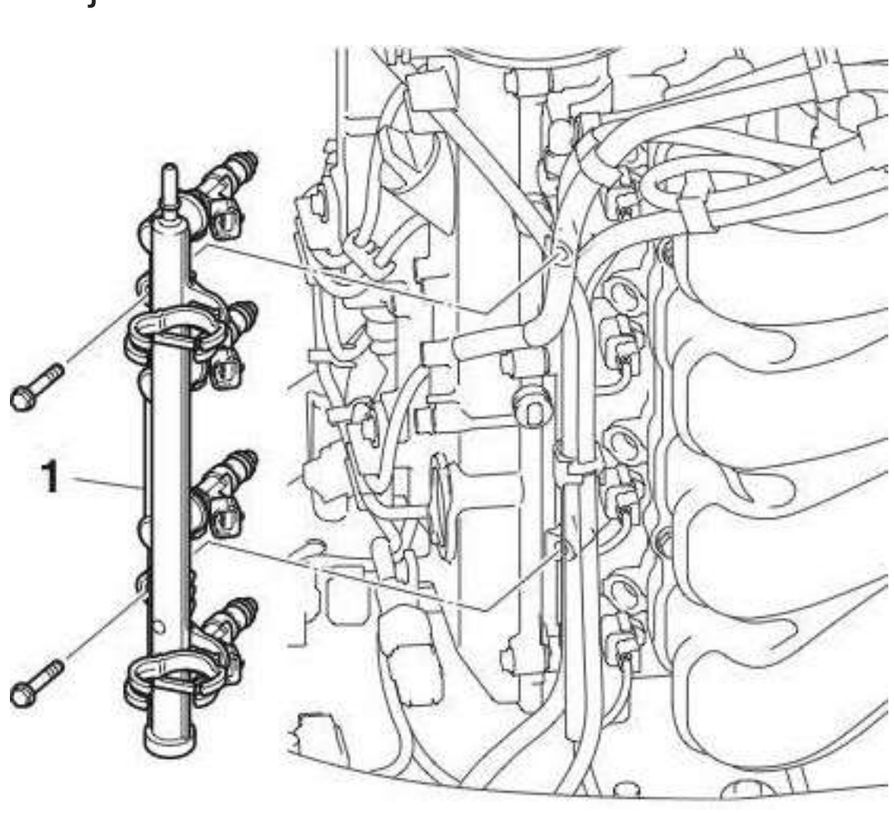
3. Remove the wire harness "1", vapor gas hose "2", cooling water hose "3", and fuel hose "4" from the holders "5".



4. Disconnect the fuel injector couplers "a".



5. Remove the fuel rail "1" along with the fuel injectors.



6. Remove the fuel injectors "1" along with the holders "2".

Checking the fuel rail and fuel injector (Worldwide)

1. Check the fuel rail. Replace if cracked or deformed.

2. Check the electrical performance of the fuel injector. See "Checking the fuel injector" (5-23).

3. Measure the volume injected by the injector. See the "Fuel Injection Meter Operation Manual".

⚠ WARNING

Do not use gasoline when measuring the fuel injection volume. Otherwise, the cylinder could be damaged, which can cause a gasoline leakage. Make sure to follow the instructions for operation of the fuel injection meter.

TIP:

- When measuring, obtain a result from the average of 4 measurements.
- It is not possible to obtain correct measurements under disparate test conditions.
- Make sure to fully charge the battery.
- The cylinder is graduated in increments of 2.5 cm^3 (2.5 cc).
- Make sure to comply with the laws and regulations of the region when disposing of the used test fuel.

Fuel injection meter

Fuel injection volume 138–147 cm^3 (138–147 cc)/30 sec Test fuel Dry sorbent (viscosity: 1.2 ± 0.03 mm^2/s, specific gravity: 0.774 [15 °C]) Test fuel temperature 22–24 °C (room temperature and test fuel temperature should be the same) Test fuel pressure 300 ± 1.5 kPa Measuring cylinder internal pressure (standard atmosphere pressure) 960–1060 hPa

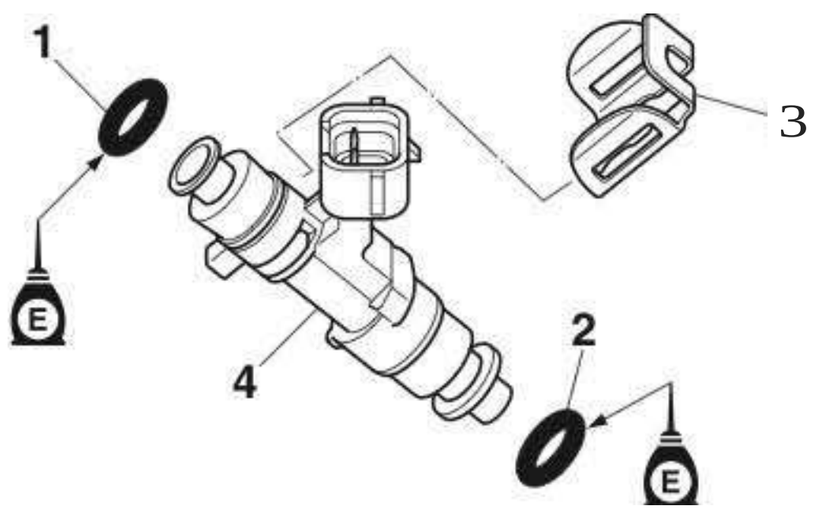
Checking the fuel rail and fuel injector (USA and Canada)

1. Check the fuel rail. Replace if cracked or deformed.

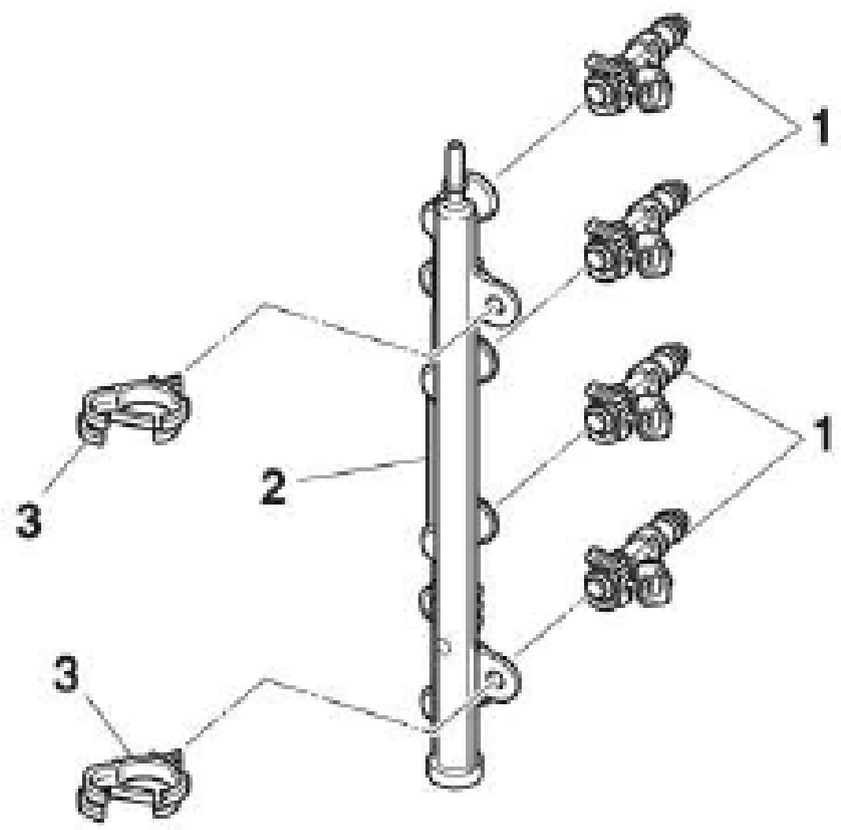
2. Check the electrical performance of the fuel injector. See "Checking the fuel injector" (5-23).

Installing the fuel injector

1. Install new 0-rings "1" and "2" and the holder "3" to the fuel injector "4".

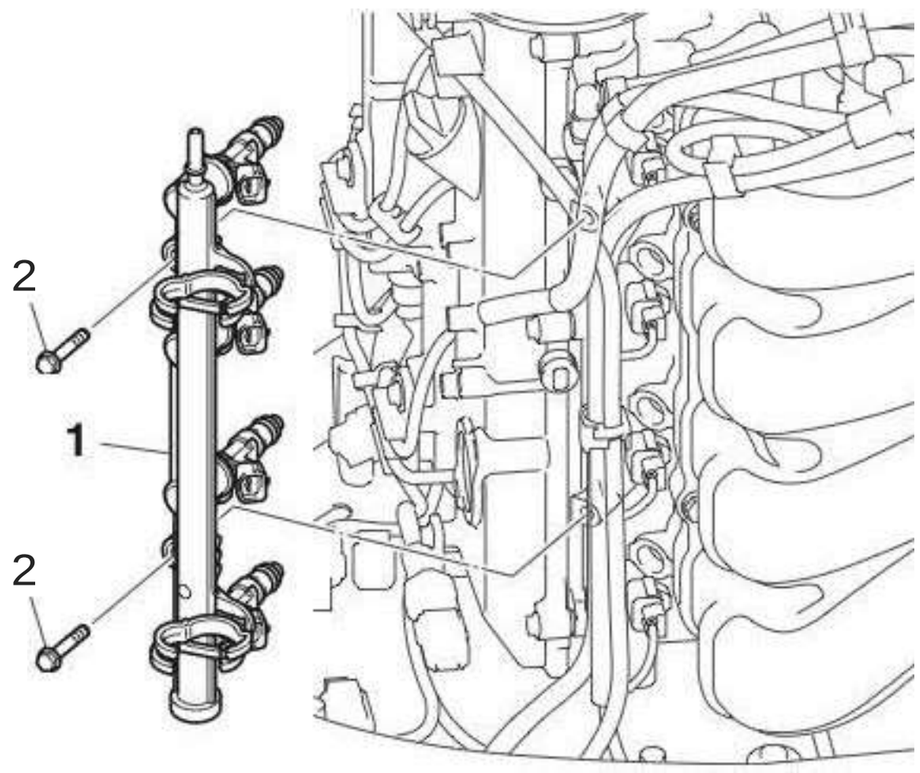


2. Install the fuel injectors "1" onto the fuel rail "2", and then install the holders "3".



3. Install the fuel rail "1" onto the cylinder head.

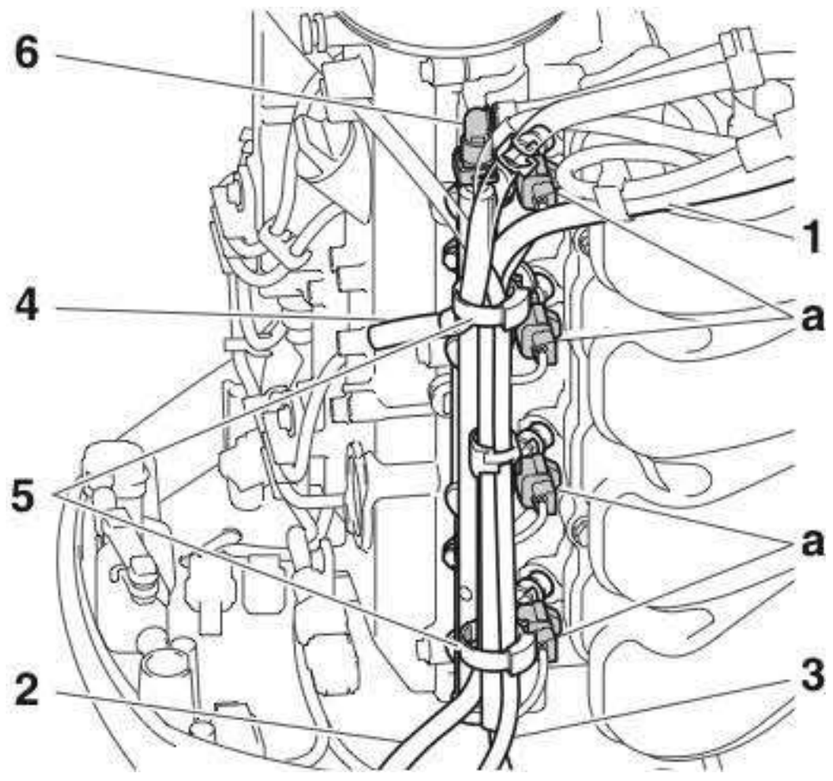
4. Tighten the fuel rail bolts "2" equally.



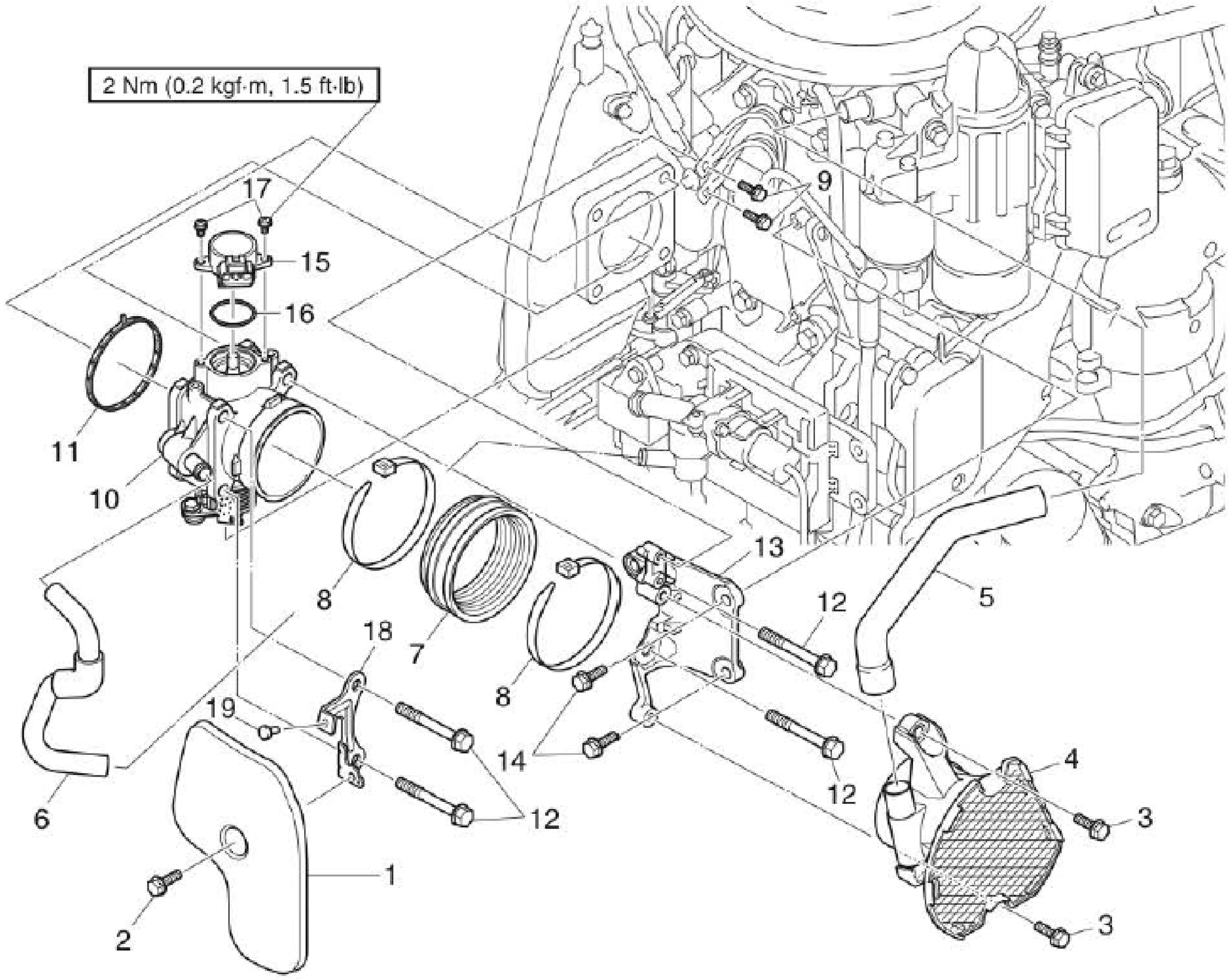
5. Connect the fuel injector couplers "a".

6. Fasten the wire harness "1", vapor gas hose "2", cooling water hose "3", and fuel hose "4" using the holders "5". See "Starboard" (5-3).

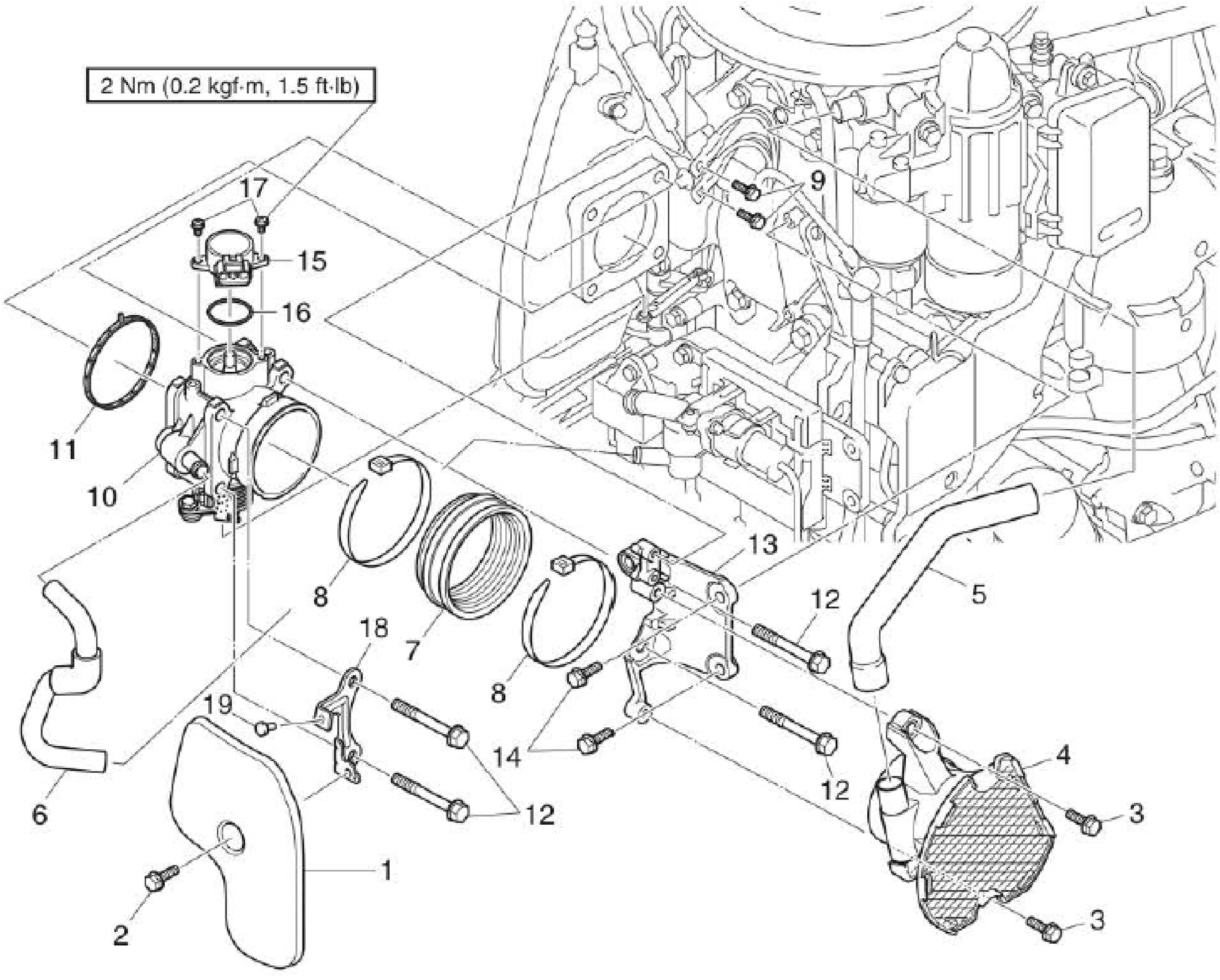
7. Connect the quick connector "6".



Throttle body



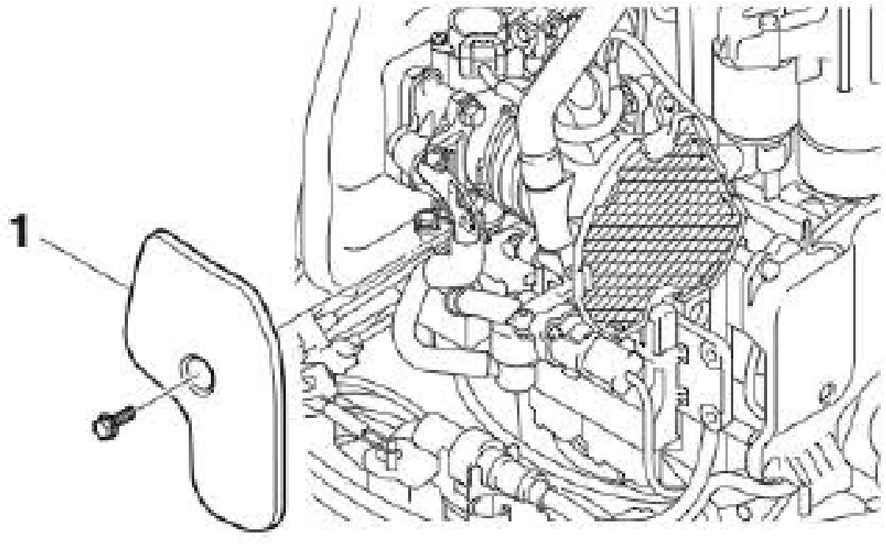
No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Bolt	1	M6 x 16 mm
3	Bolt	2	M6 x 25 mm
4	Intake silencer	1	
5	Hose	1	Intake silencer to starter motor bracket
6	Hose	1	Throttle body to ISC valve
7	Joint	1	
8	Plastic tie	2	
9	Bolt	2	M6 x 16 mm
10	Throttle body	1	
11	Gasket	1	Not reusable
12	Bolt	4	M8 x 60 mm
13	Bracket	1	
14	Bolt	2	M6 x 25 mm
15	TPS	1	
16	0-ring	1	Not reusable
17	Screw	2	M4 x 12 mm



No.	Part name	Q'ty	Remarks
18	Bracket	1	
19	Grommet	1	

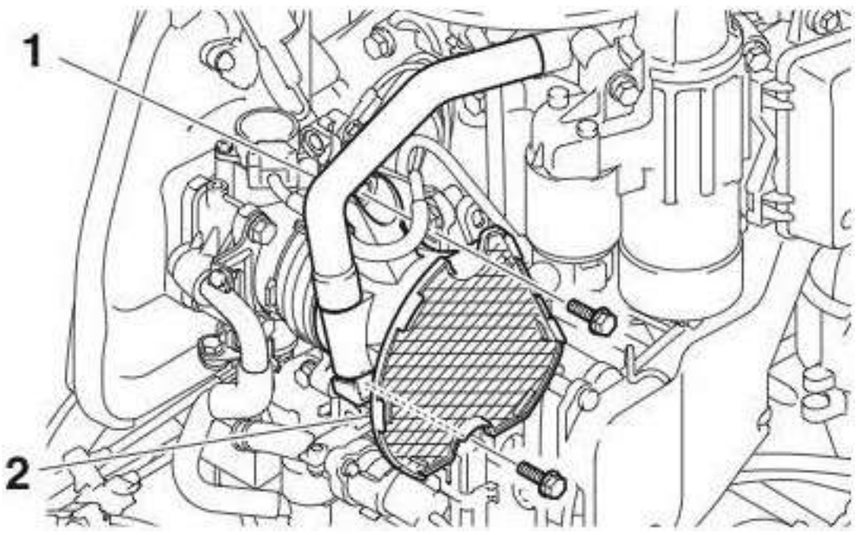
Removing the throttle body

1. Remove the throttle body cover "1".



2. Remove the blow by hose "1".

3. Remove the intake silencer "2".



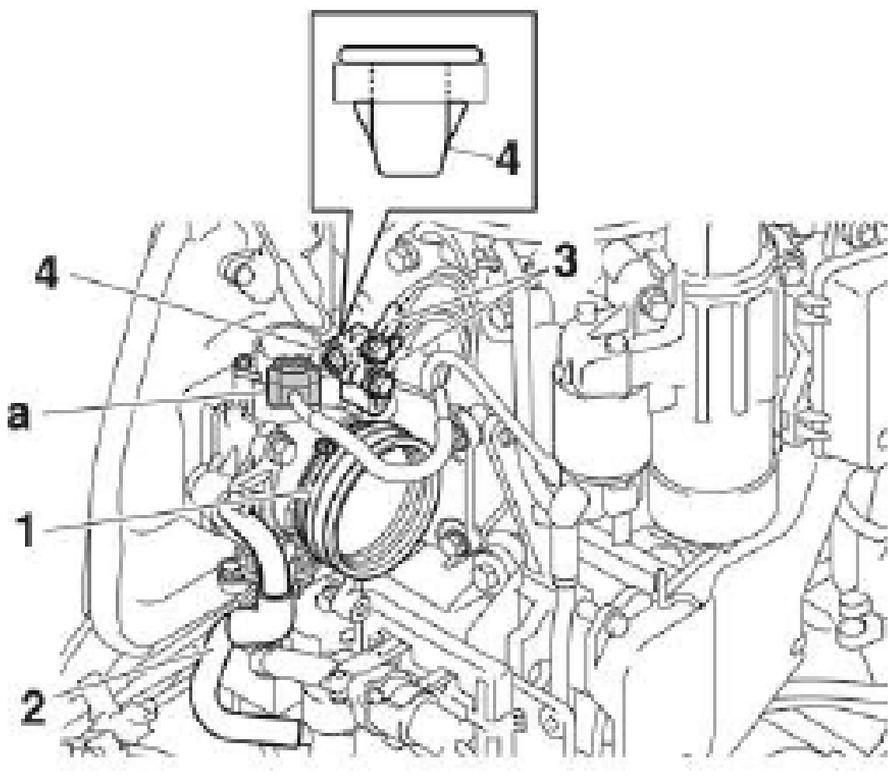
4. Disconnect the TPS coupler "a".

5. Remove the joint "1".

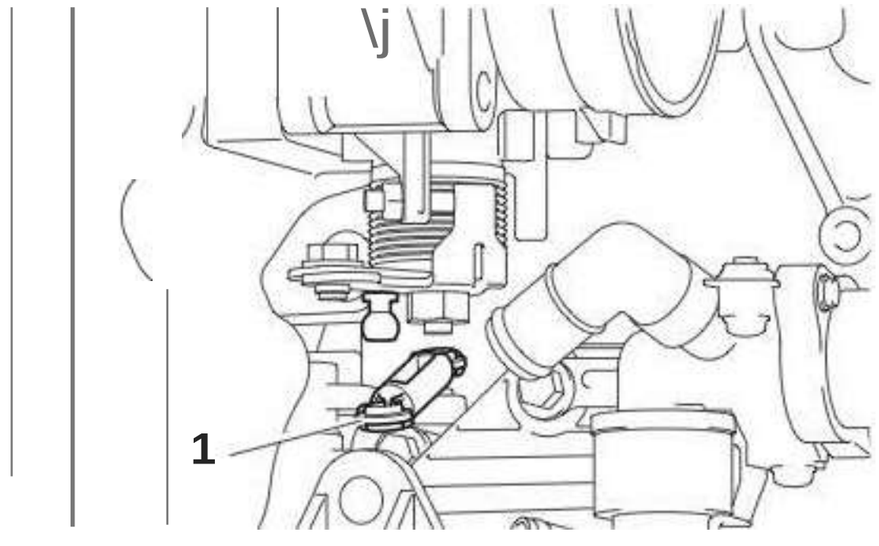
6. Remove the air hose "2".

7. Remove the ground leads "3".

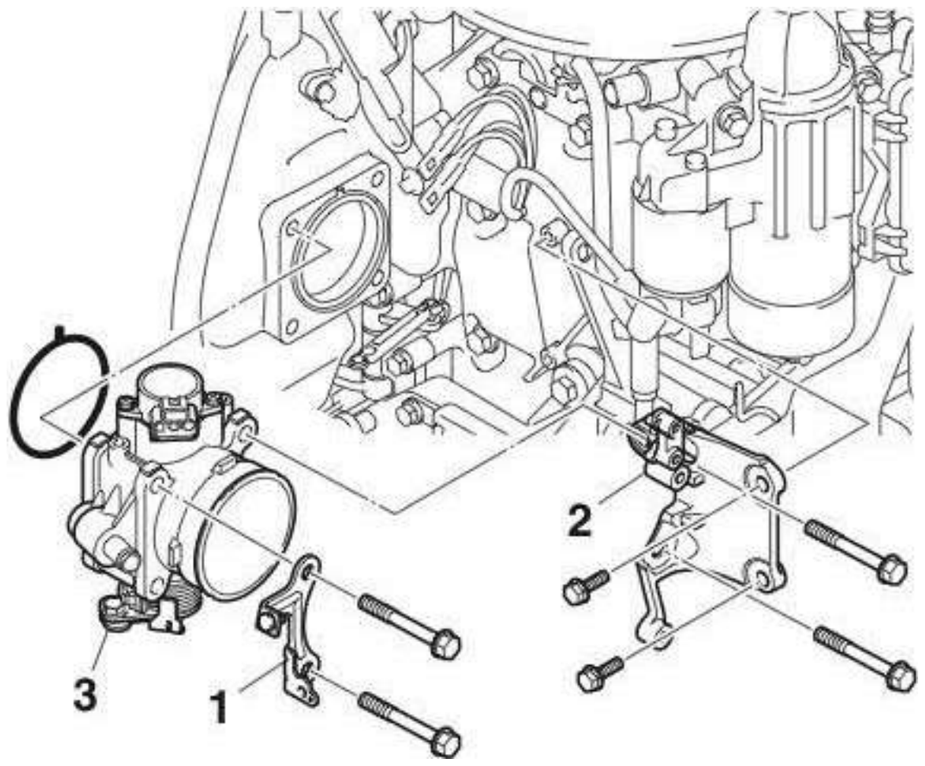
8. Remove the holder "4".



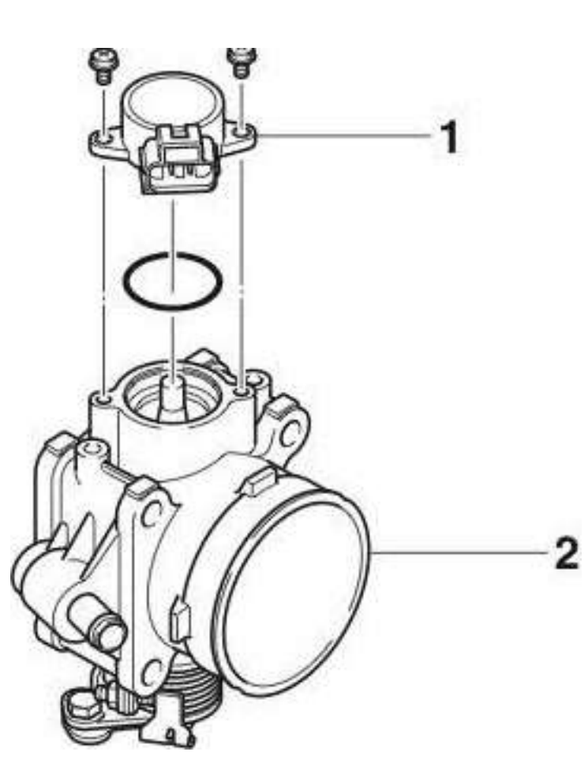
9. Disconnect the throttle link rod "1" from the throttle body side.



10. Remove the throttle body cover bracket "1", throttle body bracket "2", and throttle body "3".



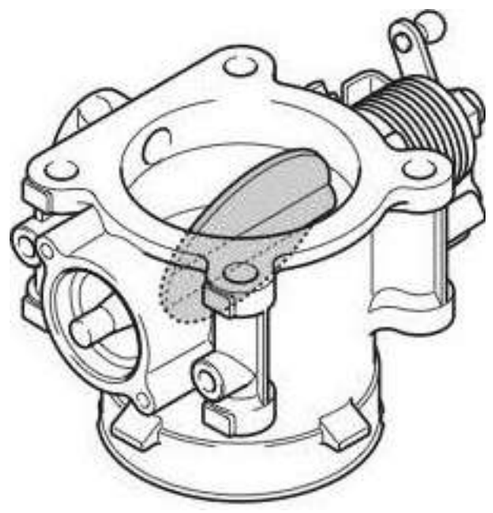
11. Remove the TPS "1" from the throttle body "2".



Checking the throttle body

1. Check the throttle body exterior. Replace if cracked.

2. Turn the throttle valve manually and check that it moves smoothly.



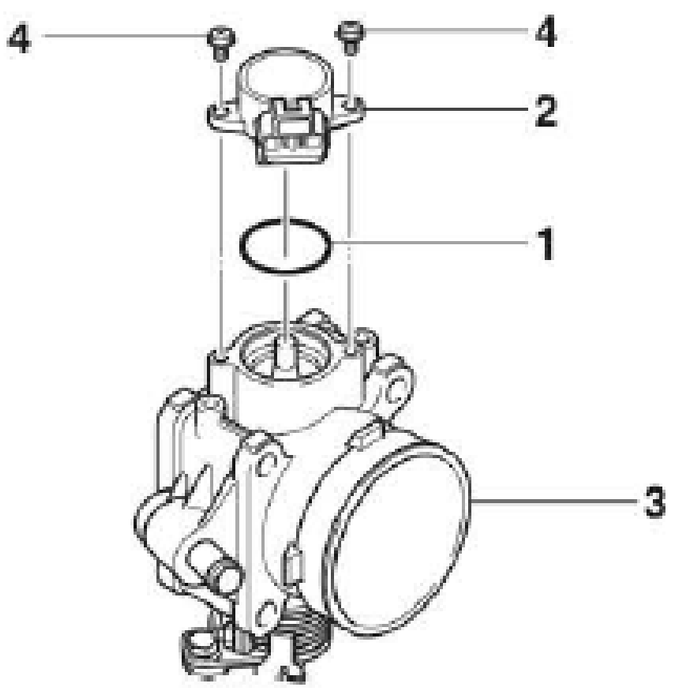
3. Check the electrical performance of the TPS. See "Checking the TPS" (5-20).

Installing the throttle body

1. Install a new 0-ring "1" to the TPS "2".

2. Install the TPS "2" to the throttle body "3".

3. Tighten the TPS screws "4" to the specified torque.



TPS screw "4"
2 Nm (0.2 kgf-m, 1 .5 ft- lb)

4. Install a new gasket "1".

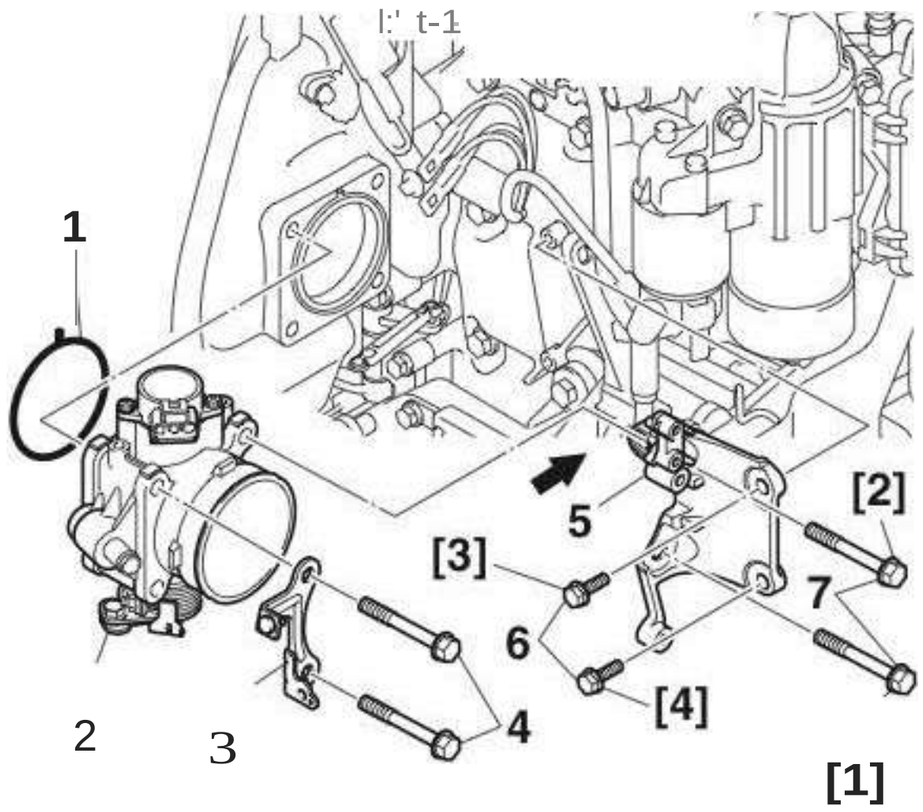
5. Install the throttle body "2" and throttle cover bracket "3".

6. Tighten the throttle body bolts "4".

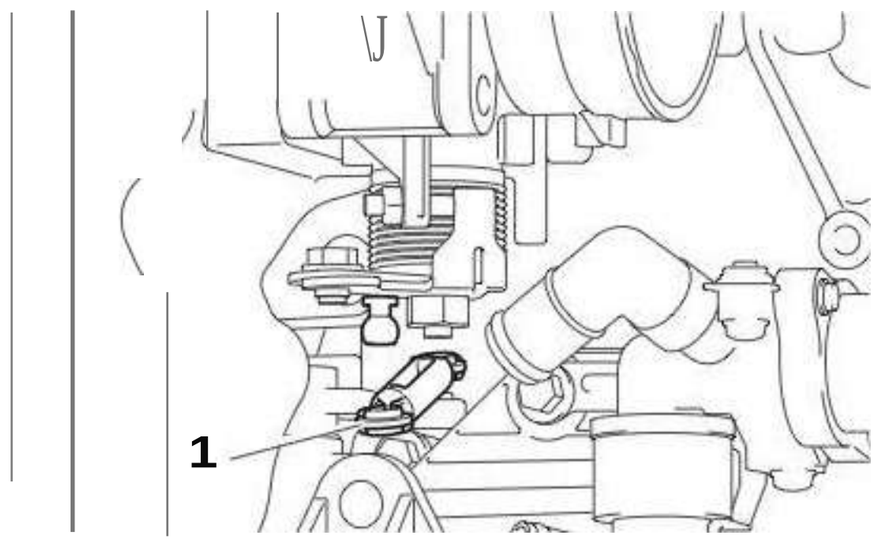
7. Install the throttle body bracket "5", and then tighten the throttle body bracket bolts "6" temporarily.

8. Tighten the throttle body bolts "7" temporarily.

9. While holding the throttle body in the direction of the arrow, tighten the throttle body bracket bolts "6" and throttle body bolts "7" in the order [1], [2] and so on.



10. Connect the throttle link rod "1" to the throttle body.



11. Install the holder "1".

12. Install the ground leads "2".

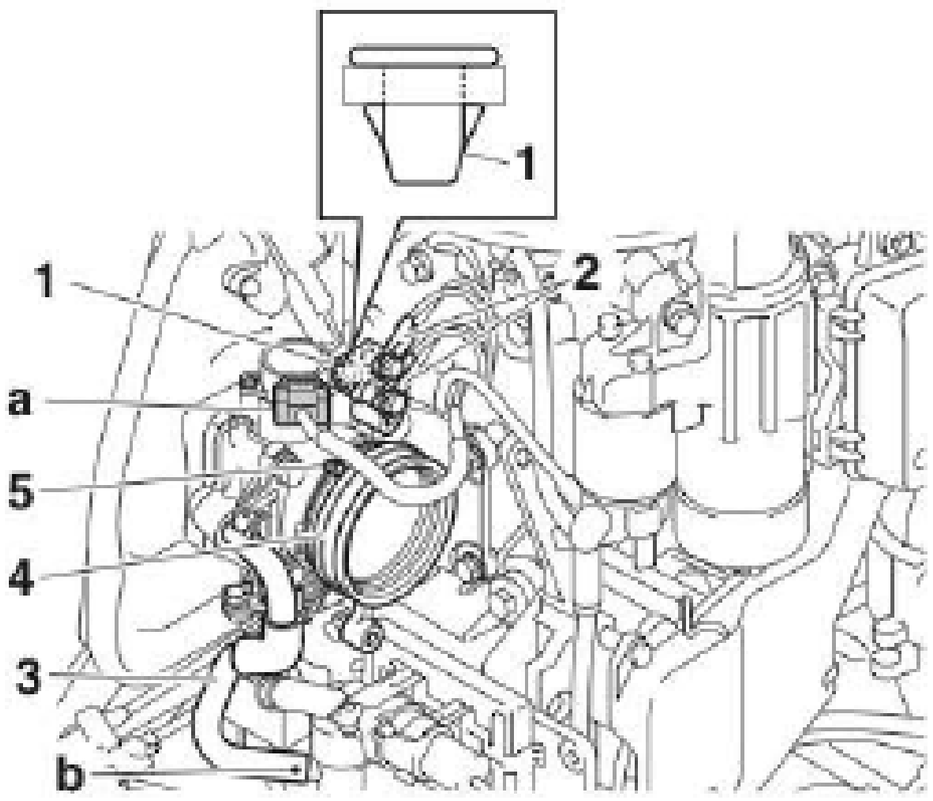
13. Connect the TPS coupler "a".

14. Install the air hose "3" to the ISC valve.

TIP:

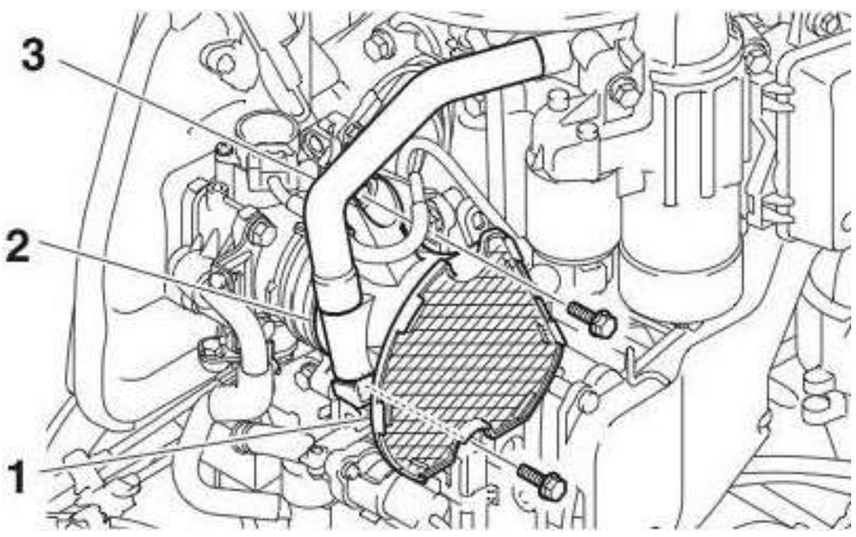
Connect the air hose "3" with the white paint mark "b" to the ISC valve.

15. Install the joint "4", and then fasten it using the plastic tie "5".

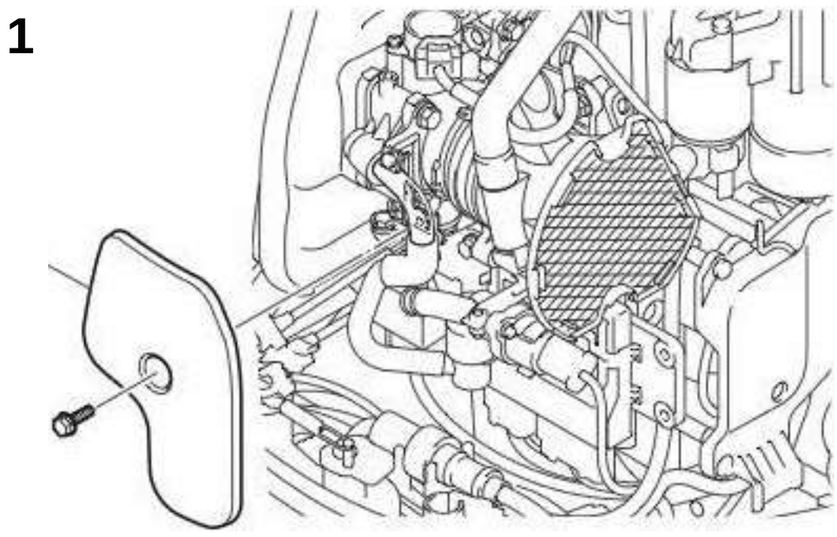


16. Install the intake silencer "1", and then fasten it using the plastic tie "2".

17. Install the blow by hose "3".

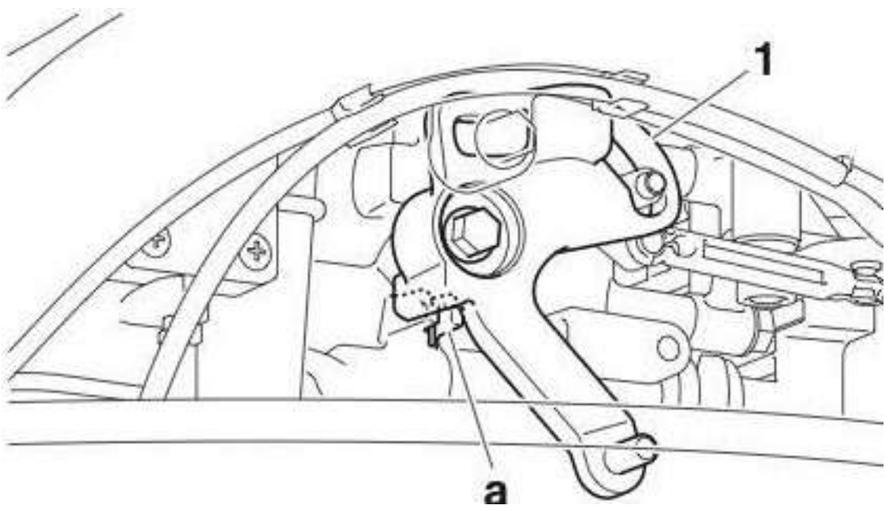


18. Install the throttle body cover "1".

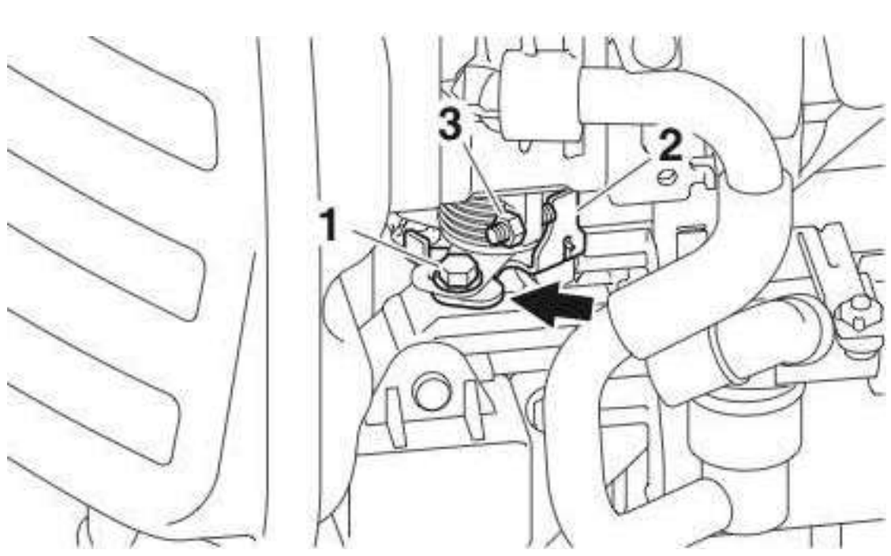


Adjusting the throttle link

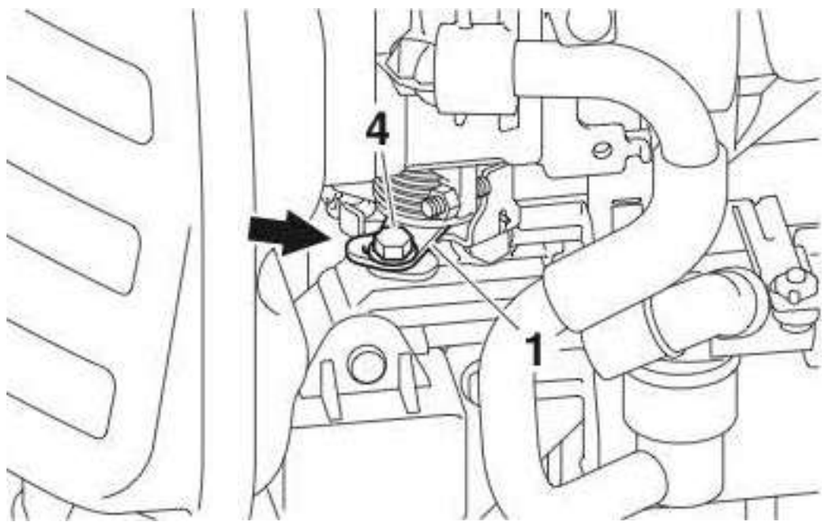
1. Turn the accelerator cam "1" until it contacts the stopper "a" of the cylinder block.

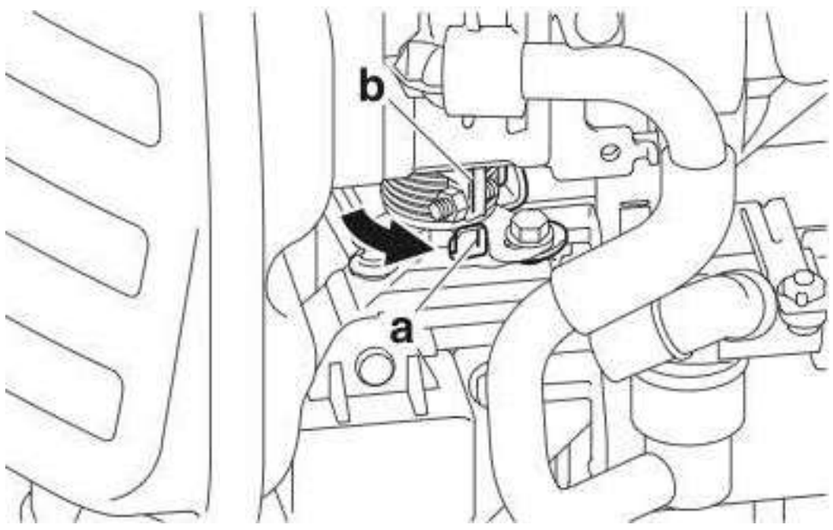


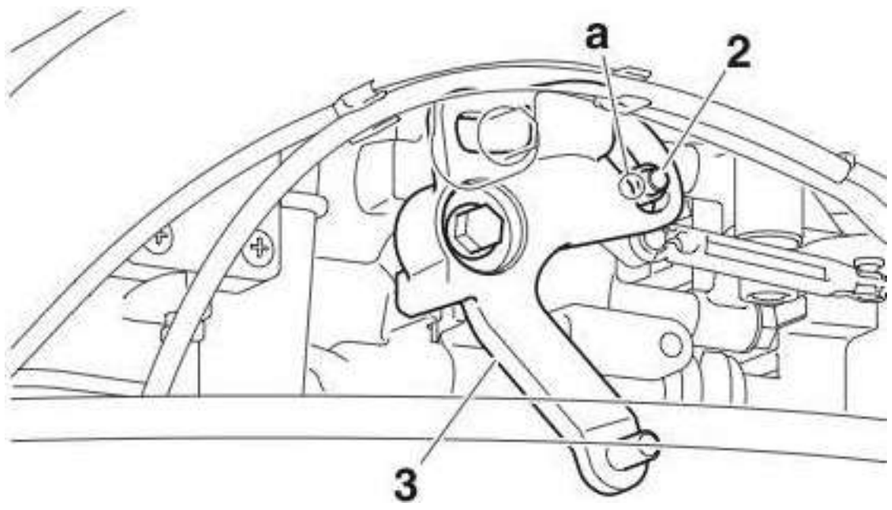
2. Loosen the throttle lever plate bolt "1", and then push the throttle lever plate "2" in the direction of the arrow so that it contacts the fully closed stopper "3" of the throttle body.



3. Push the throttle lever sub plate "1" in the direction of the arrow until the bushing "2" contacts the fully closed position "a" of the accelerator cam "3", and then tighten the throttle lever plate bolt "4".





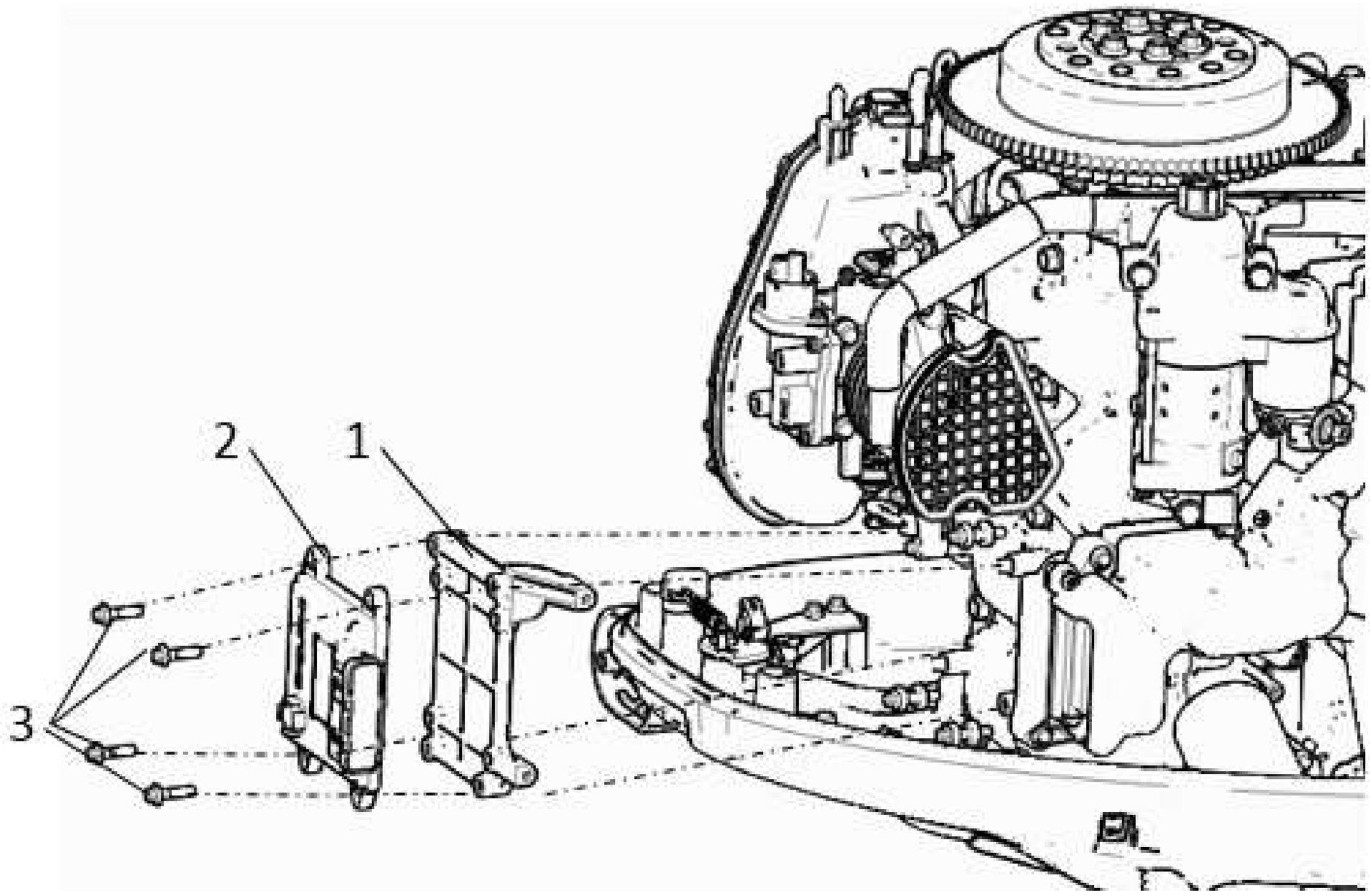


4. Turn the accelerator cam to the fully closed position and then fully open position. Repeat this operation 2 or 3 times to check that the accelerator cam returns to the fully closed position.

5. Check that the throttle lever plate is in contact with the fully closed stopper of the throttle body.

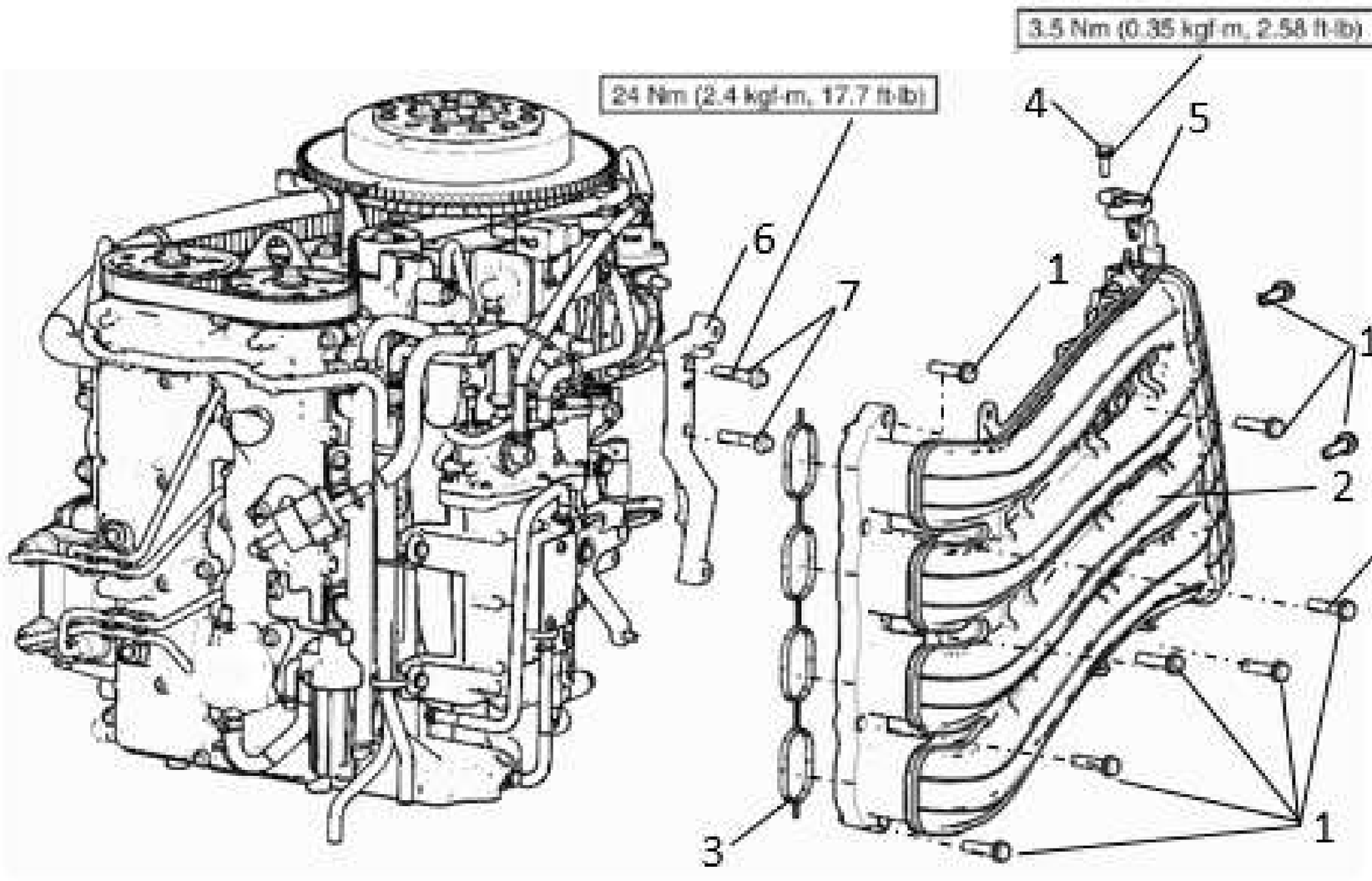
6. Turn the accelerator cam to the fully open position. Check that the mark "a" on the throttle lever plate has passed over the mark "b" on the throttle body. Repeat from step 1 if the mark "a" has not passed the mark "b".

Engine ECM



No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Engine ECM	1	
3	Bolt	4	M6 x 30 mm

Intake manifold



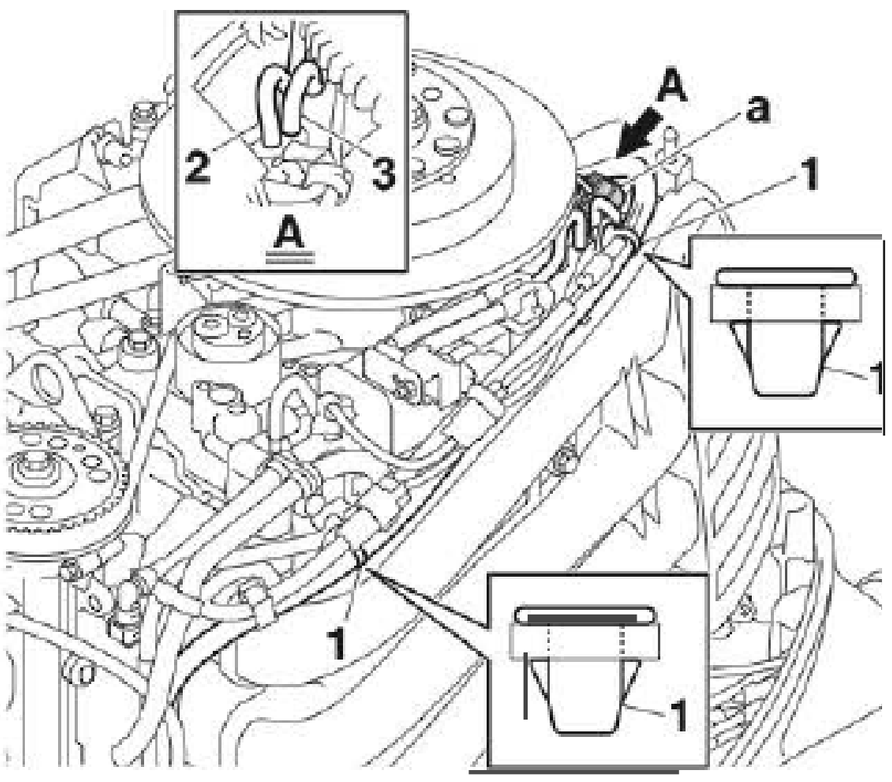
No.	Part name	Q'ty	Remarks
1	Bolt	9	M8 x 35 mm
2	Intake manifold	1	
3	Gasket	1	
4	Bolt	1	M6 x 10 mm
5	Intake air pressure/temperature sensor	1	
6	Bracket		
7	Bolt		M8 x 35 mm

Removing the intake manifold

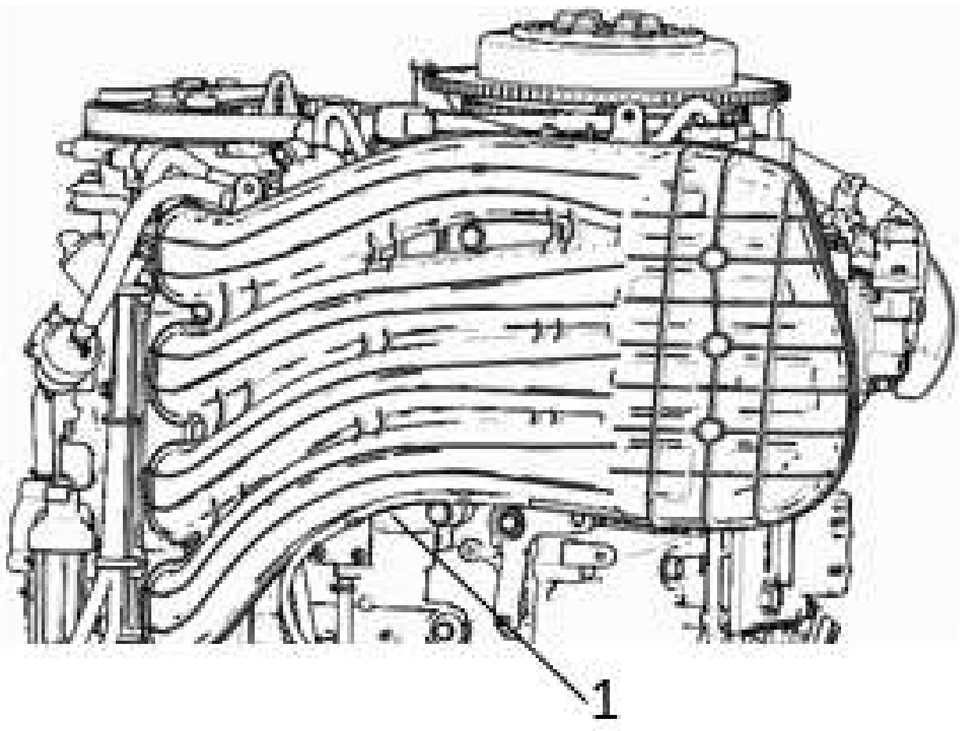
1. Remove the holders "1".

2. Disconnect the intake air pressure/temperature sensor coupler "a".

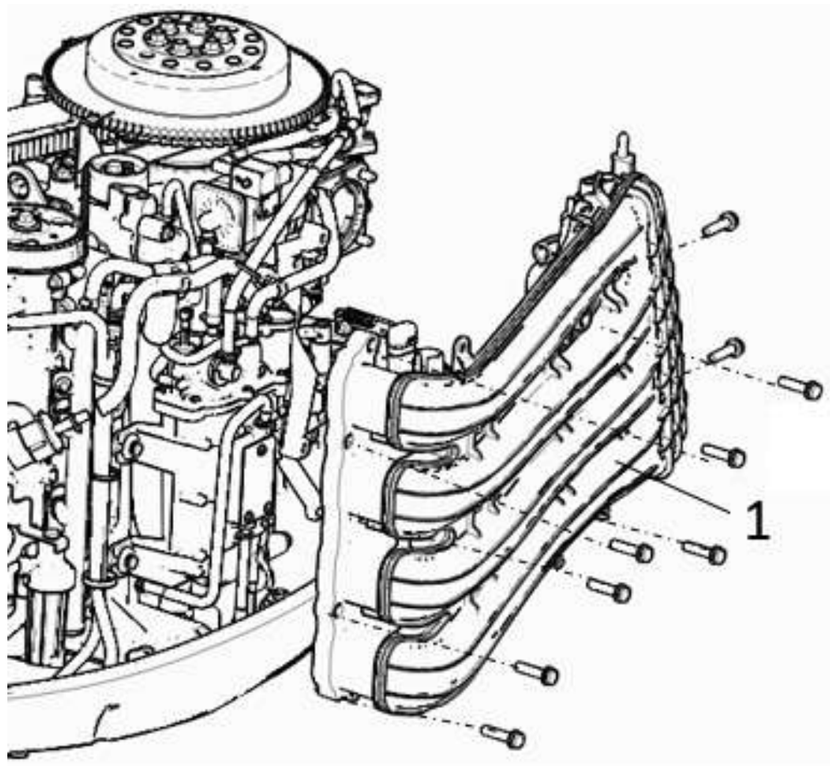
3. Disconnect the pressure regulator hose "2" and vapor gas hose "3" from the intake manifold.



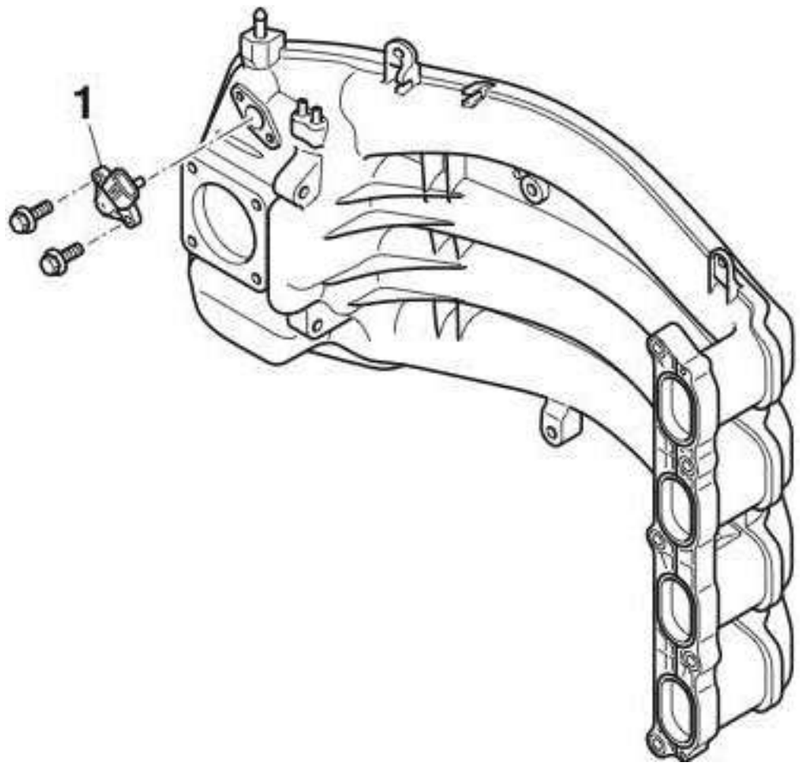
4. Remove the drain hose "1" from the intake manifold.



5. Remove the intake manifold "1".

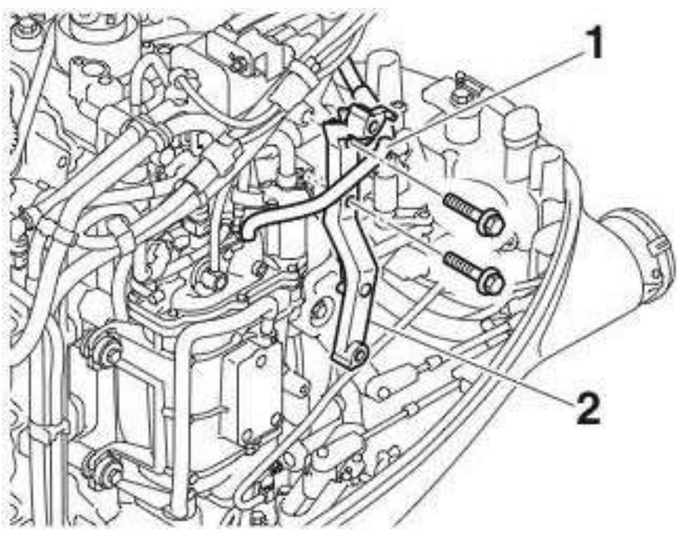


6. Remove the intake air pressure/temperature sensor "1".



7. Remove the vapor gas hose "1" from the intake manifold bracket "2".

8. Remove the intake manifold bracket "2".



Checking the intake manifold

1. Check the intake manifold. Replace if cracked or deformed.

Checking the intake air pressure/ temperature sensor

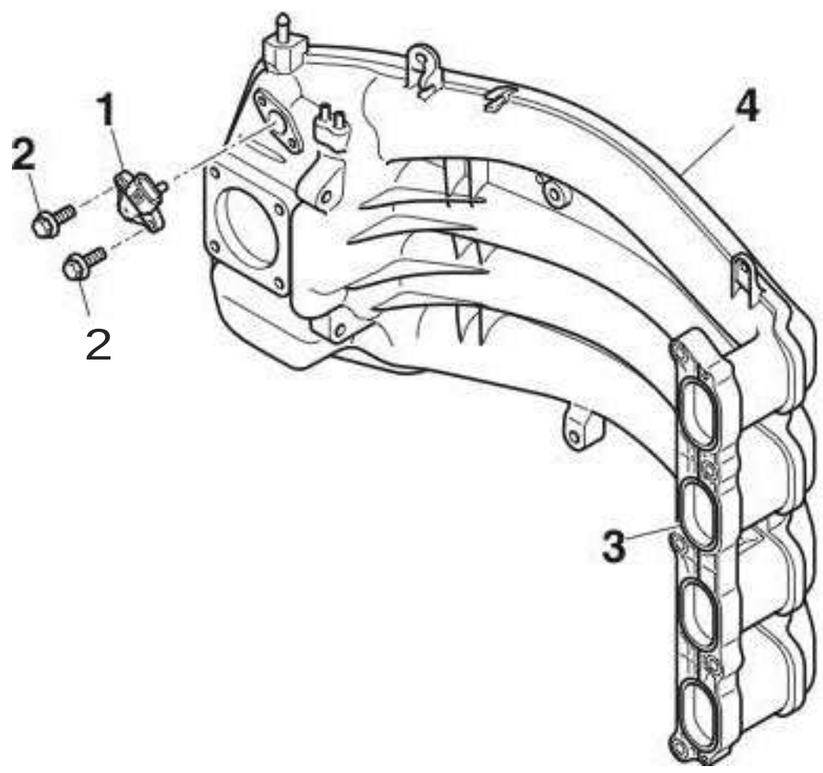
1. Check the intake air pressure/temperature sensor exterior. Replace if cracked.

2. Check the electrical performance of the intake air pressure/temperature sensor. See "Checking the intake air pressure sensor" (5-30) and "Checking the intake air temperature sensor" (5-29).

Installing the intake manifold

1. Install the intake air pressure/temperature sensor "1", and then tighten the ntake air pressure/temperature bolts "2" to the specified torque.

2. Install a new gasket "3" onto the intake manifold "4".



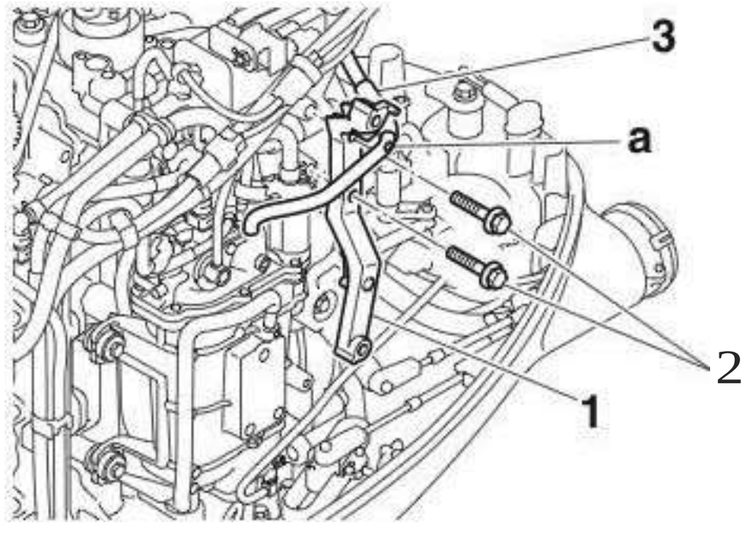
Intake air pressure/temperature bolt "2"
3.5 Nm (0.35 kgf-m, 2.58 ft·lb)

3. Install the intake manifold bracket "1", and then tighten the intake manifold bracket bolts "2" to the specified torque.

4. Install the vapor gas hose "3" to the intake manifold bracket "1".

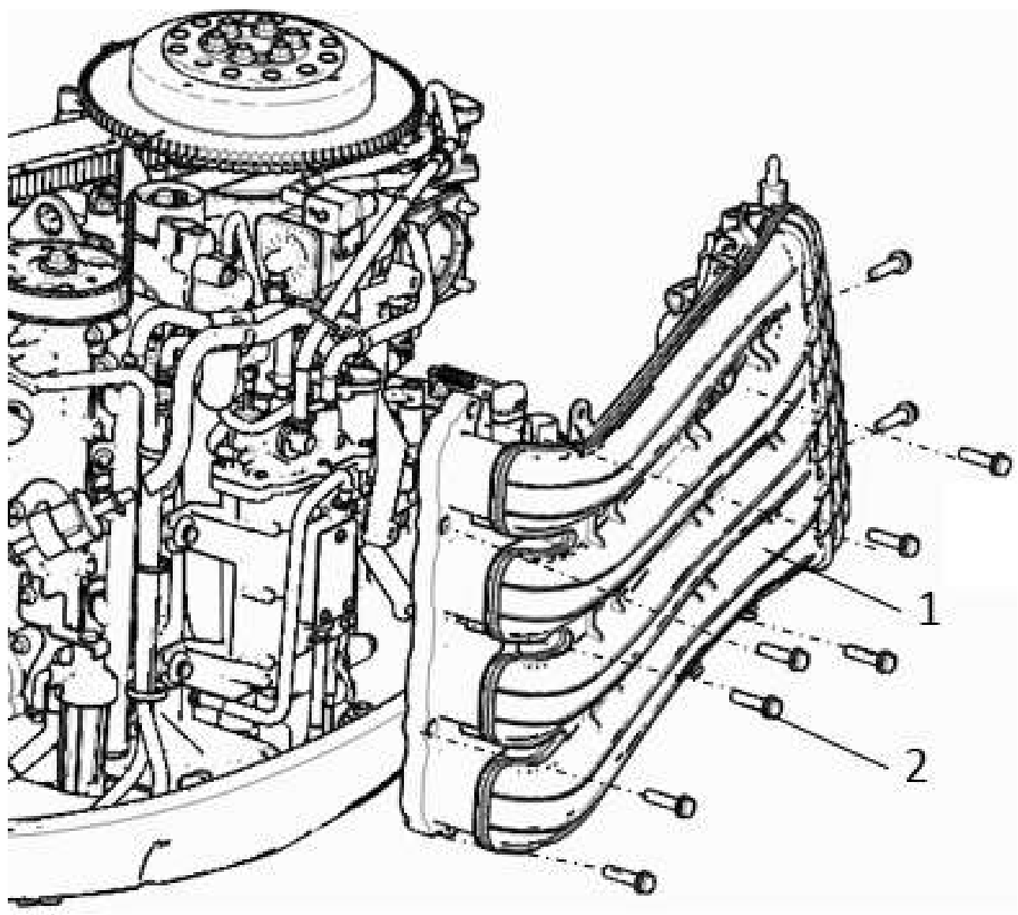
TIP:

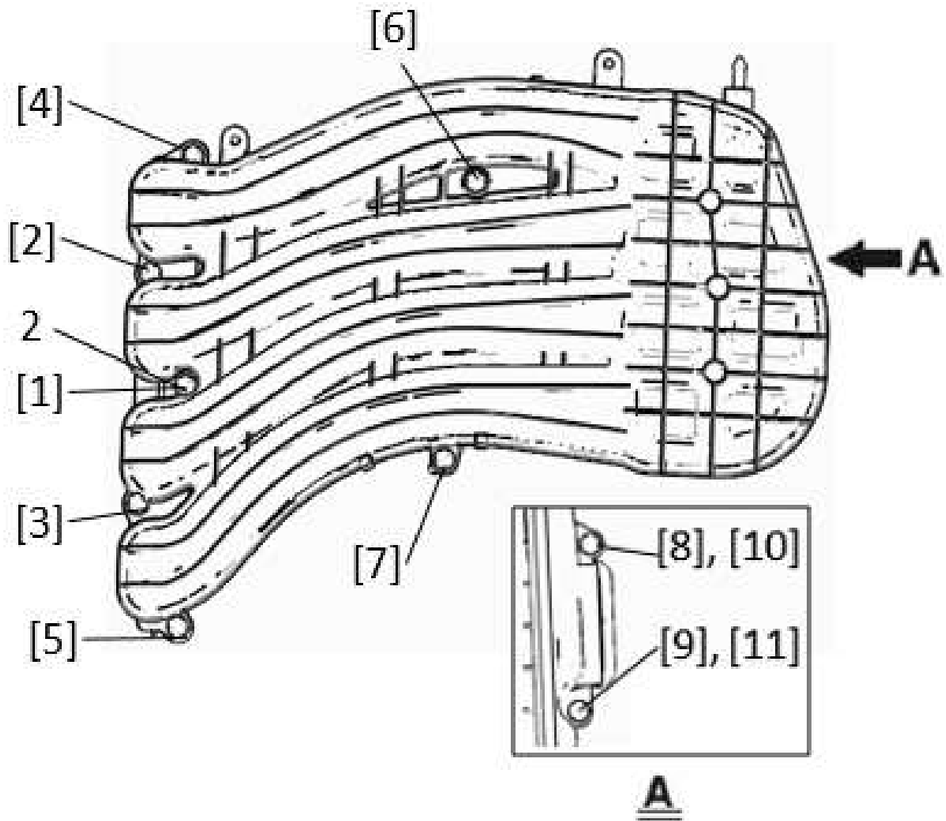
Install the vapor gas hose "3" at the white paint mark "a" to the intake manifold bracket "1"

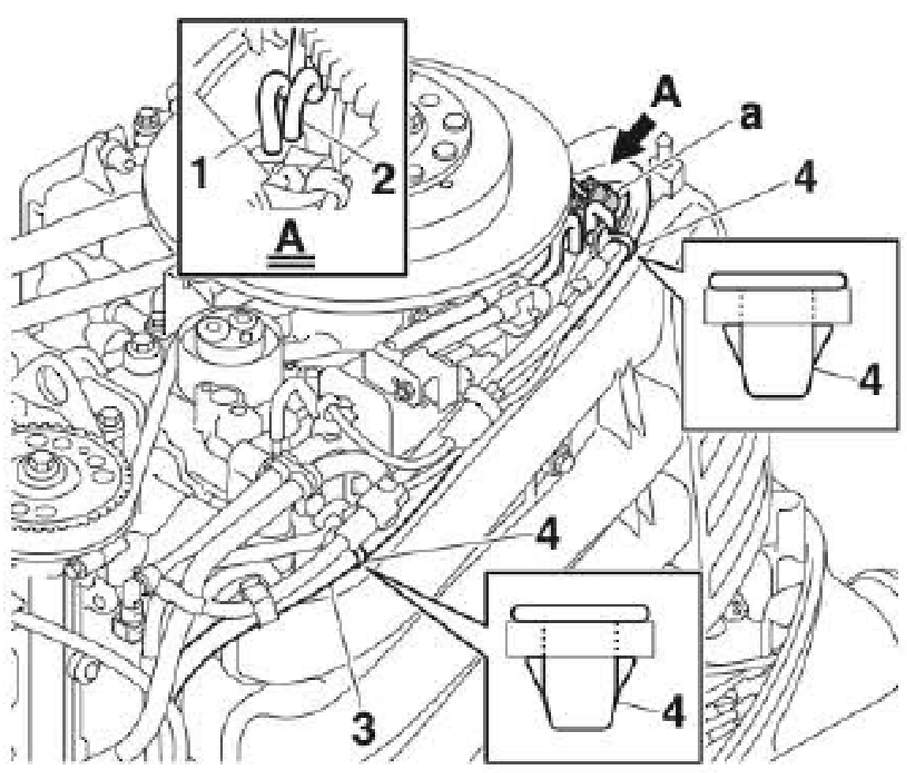


Intake manifold bracket bolt "2"
24 Nm (2.4 kgf·m, 17.7 ft·lb)

5. Install the intake manifold "1", and then tighten the intake manifold bolts "2" to the specified torque in the order [1], [2] and so on.

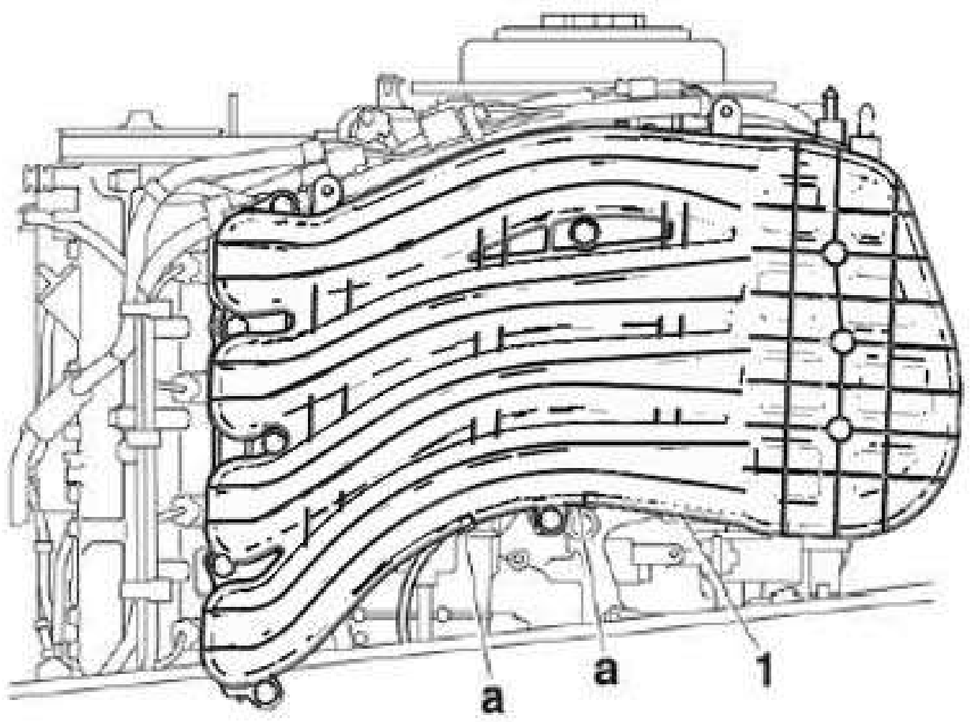






Intake manifold bolt "2"
32 Nm (3.2 kgf·m, 23.6 ft-lb)

6. Fit the drain hose "1" into the holders "a" on the intake manifold.

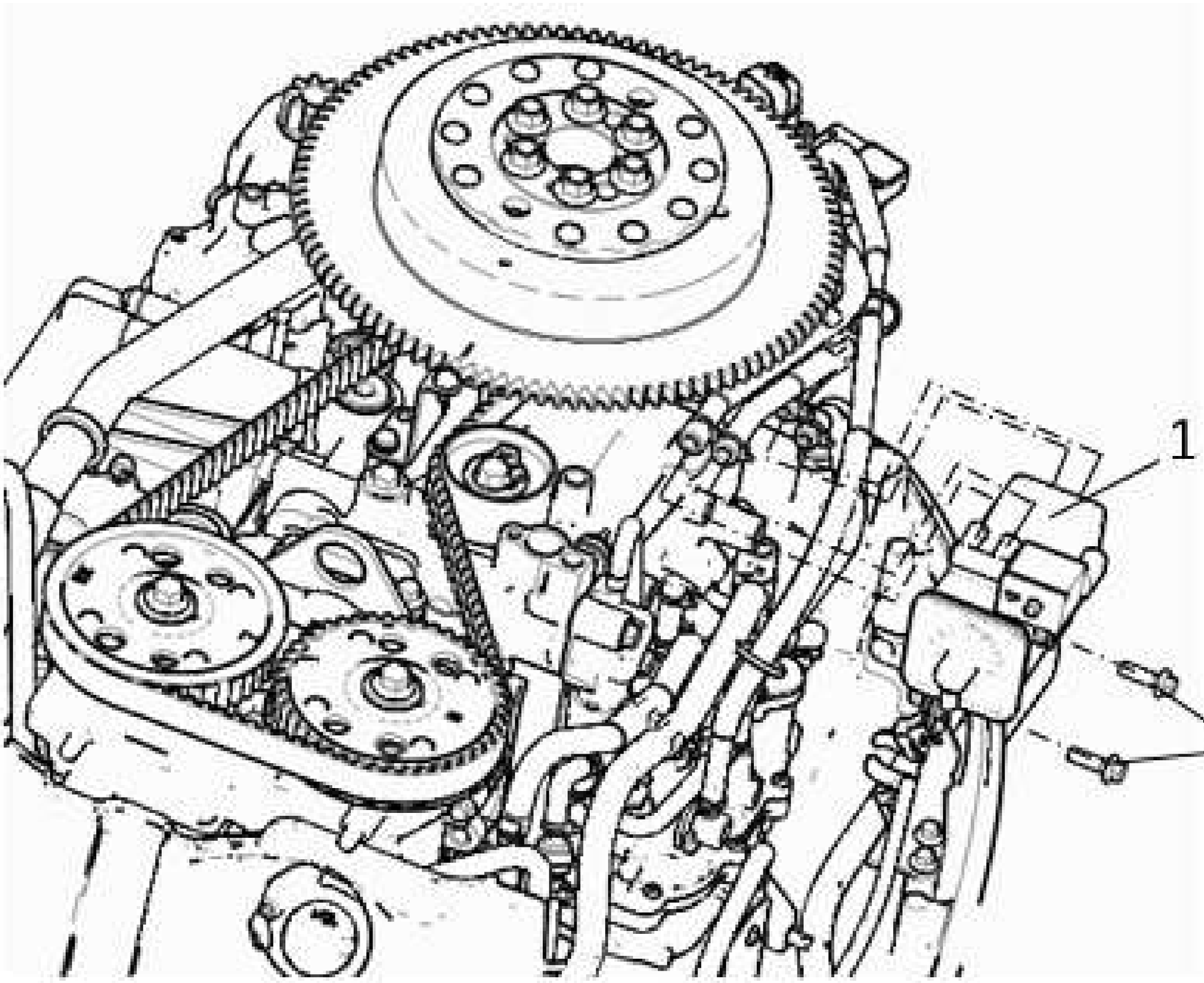


7. Connect the pressure regulator hose "1" and vapor gas hose "2" to the intake manifold.

8. Route the wire harness "3", and then install the holders "4" to the intake manifold.

9. Connect the intake air pressure/temperature sensor coupler "a".

Canister



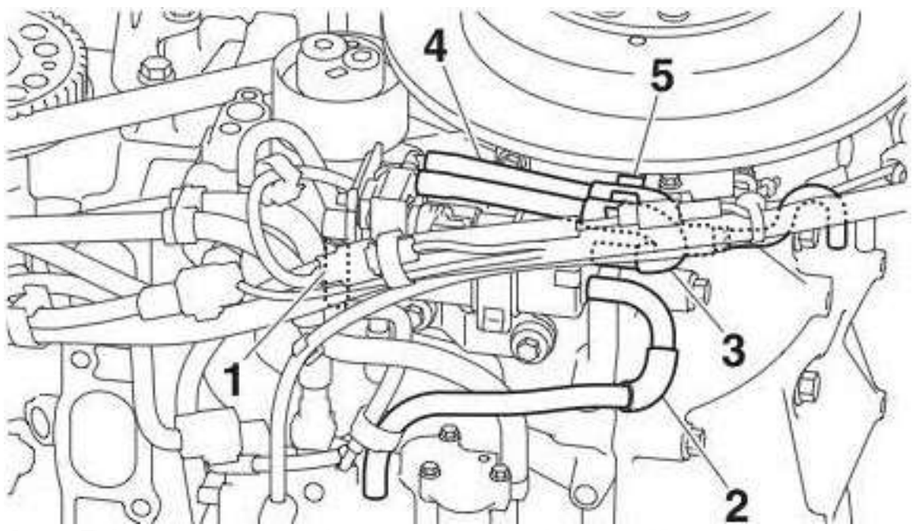
No.	Part name	Q'ty	Remarks
1	Canister	1	
2	Bolt	2	M6 x 20mm

Removing the canister and vapor shut-off valve

1. Disconnect the vapor gas hoses "1" and "2".

2. Remove the vapor gas hoses "3" and "4" from the holder "5".

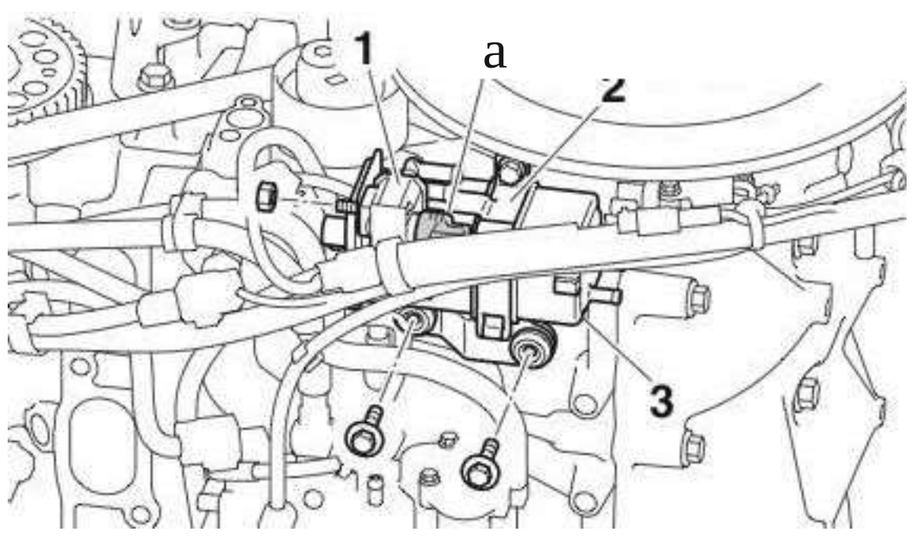
3. Remove the vapor gas hoses "3" and "4".



4. Disconnect the vapor shut-off valve coupler "a".

5. Remove the vapor shut-off valve "1".

6. Remove the bracket "2" along with the canister "3".

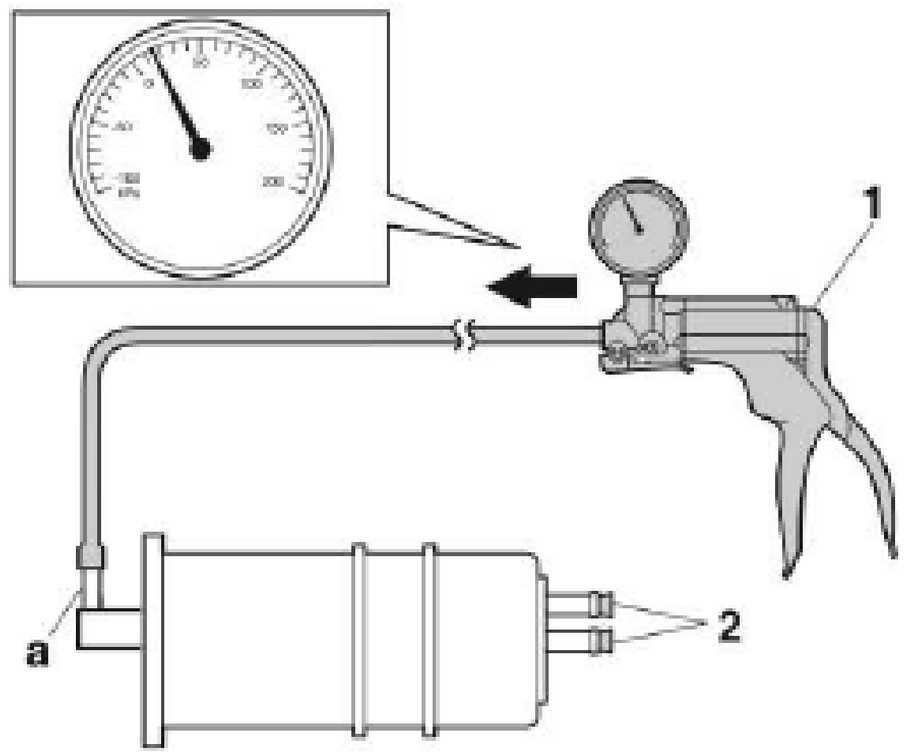


Checking the canister

1. Check the canister. Replace if cracked.

2. Connect the special service tool "1" to the atmospheric port "a" and block the other ports using rubber plugs "2".

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



Vacuum/pressure pump gauge set "1"
Pressure/vacuum tester "1"

Holding pressure (positive pressure) 19.6 kPa (0.20 kgf/cm^2, 2.8 psi)

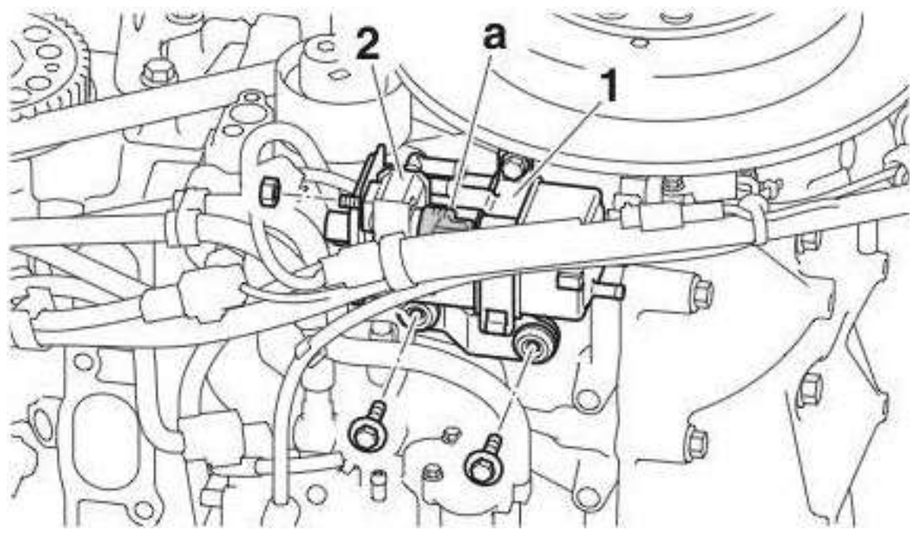
Checking the vapor shut-off valve

1. Check the vapor shut-off valve exterior. Replace if cracked.

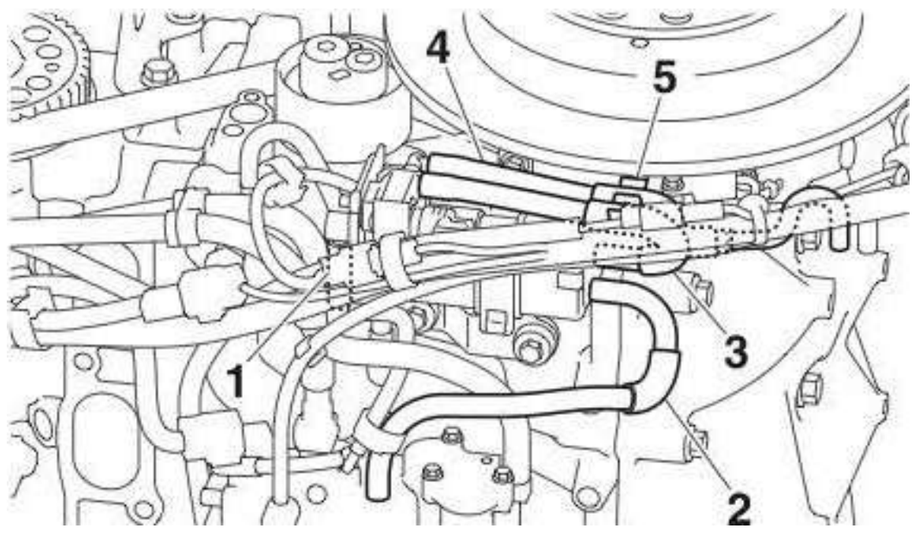
2. Check the functional performance of the vapor shut-off valve. See "Checking the vapor shut-off valve" (5-24).

Installing the vapor shut-off valve and canister

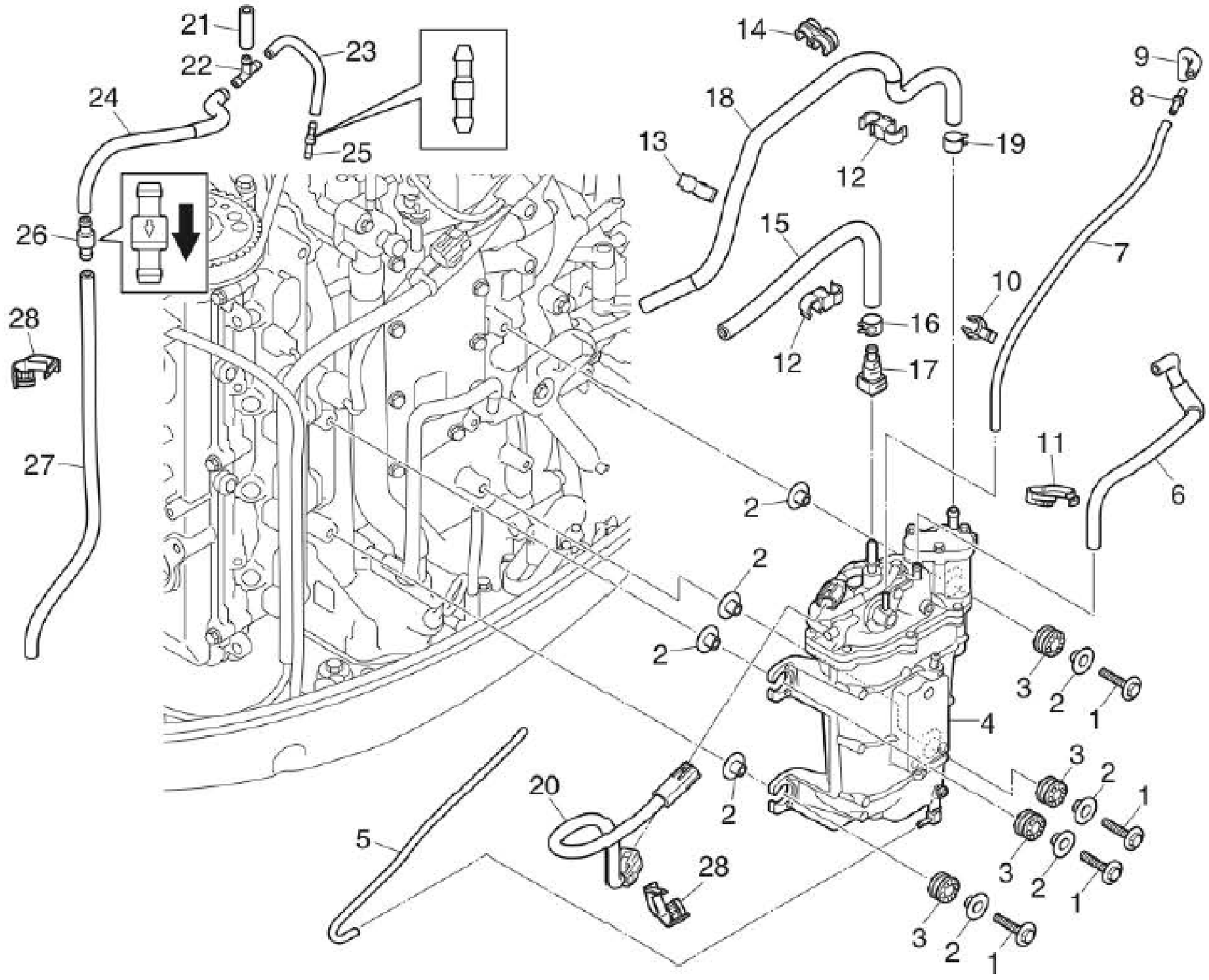
1. Connect the vapor shut-off valve coupler "a".



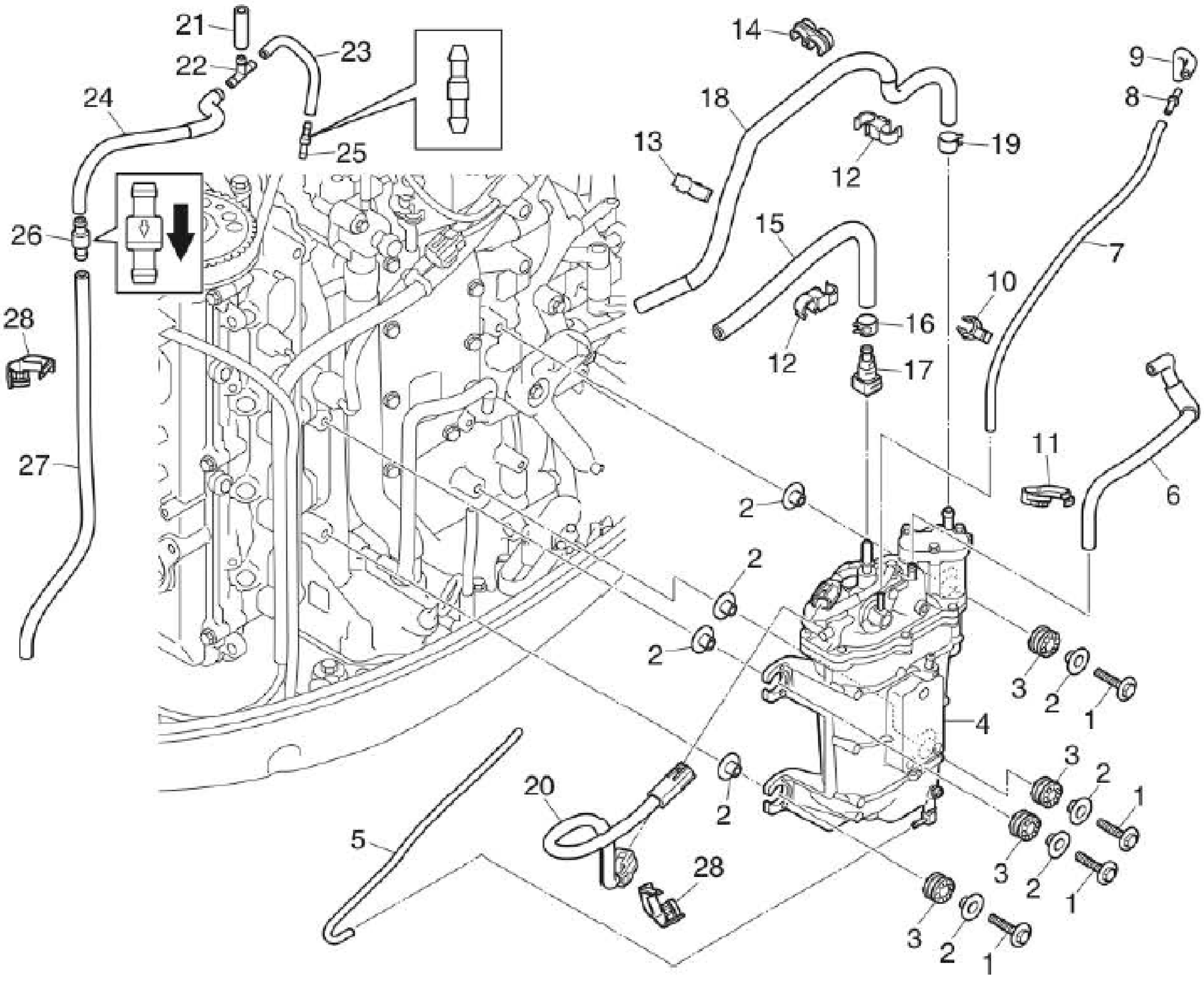
2. Connect the vapor gas hoses "1" and "2".
3. Install the vapor gas hose "3".
4. Install the vapor gas hose "4".
5. Install the vapor gas hoses "3" and "4" to the holder "5".



Vapor separator



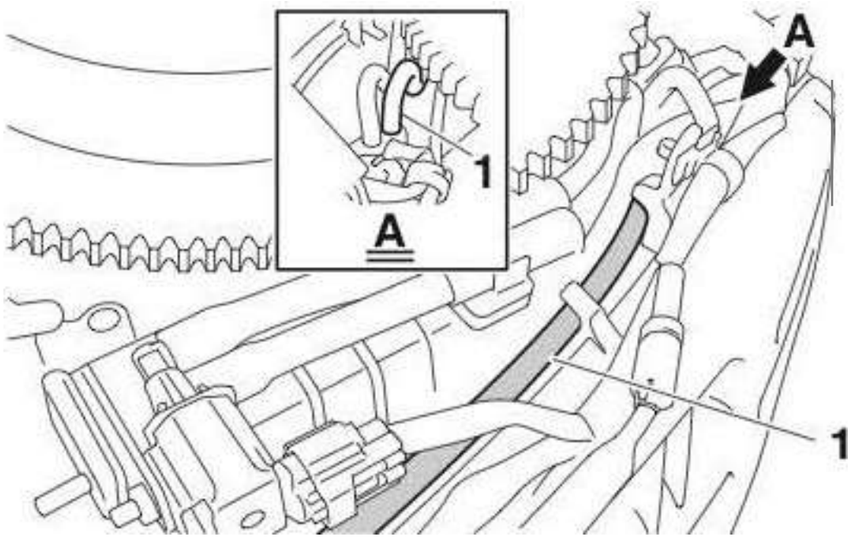
No.	Part name	Q'ty	Remarks
1	Bolt	4	M6 x 35 mm
2	Collar	8	
3	Grommet	4	
4	Vapor separator	1	
5	Drain hose	1	
6	Hose	1	Vapor separator to canister
7	Hose	1	Pressure regulator to joint
8	Joint	1	
9	Hose	1	Joint to intake manifold
10	Holder	1	
11	Clamp	1	
12	Holder	2	
13	Holder	1	
14	Holder	1	
15	Hose	1	Vapor separator to fuel rail
16	Clamp	1	
17	Quick connector	1	



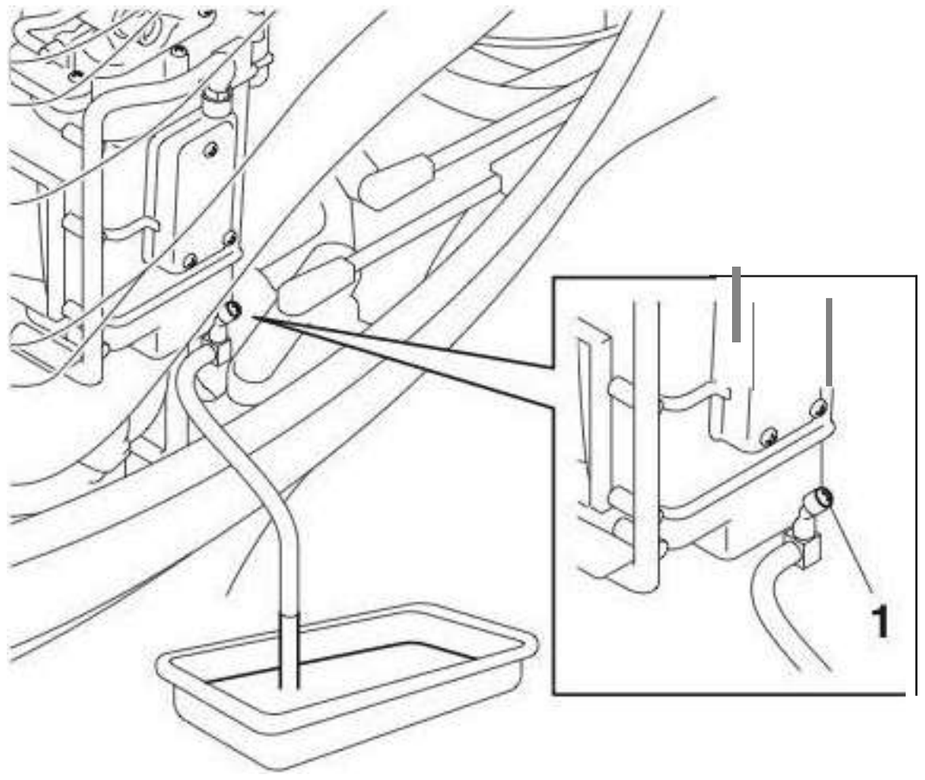
No.	Part name	Q'ty	Remarks
18	Hose	1	Low-pressure fuel pump to vapor separator
19	Clamp	1	
20	Wire harness	1	
21	Hose	1	Canister to joint
22	Joint	1	
23	Hose	1	Check valve to joint
24	Hose	1	Joint to check valve
25	Check valve	1	
26	Check valve	1	
27	Hose	1	Check valve to bottom cowling
28	Clamp	2	

Draining the fuel

1. Disconnect the vapor gas hose "1".



2. Loosen the drain screw "1".



3. Tighten the drain screw to the specified torque, and then connect the vapor gas hose.

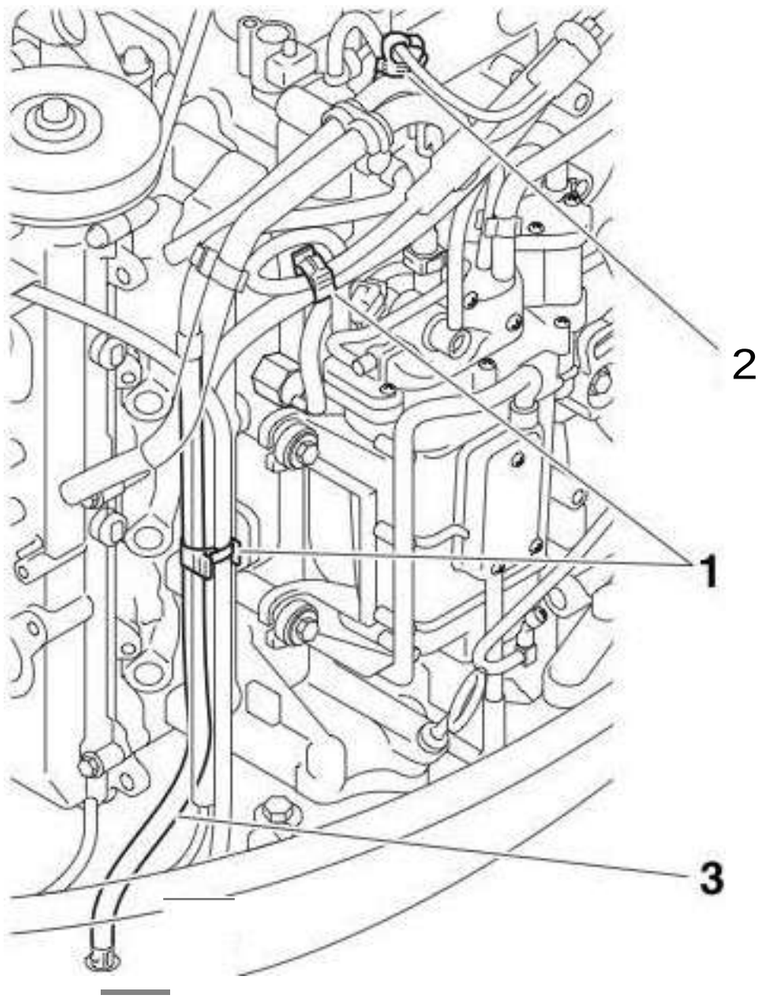
Drain screw
2 Nm (0.2 kgf-m, 1.5 ft-b)

Removing the vapor separator

Cover the fuel components using a rag to prevent fuel from spilling out.

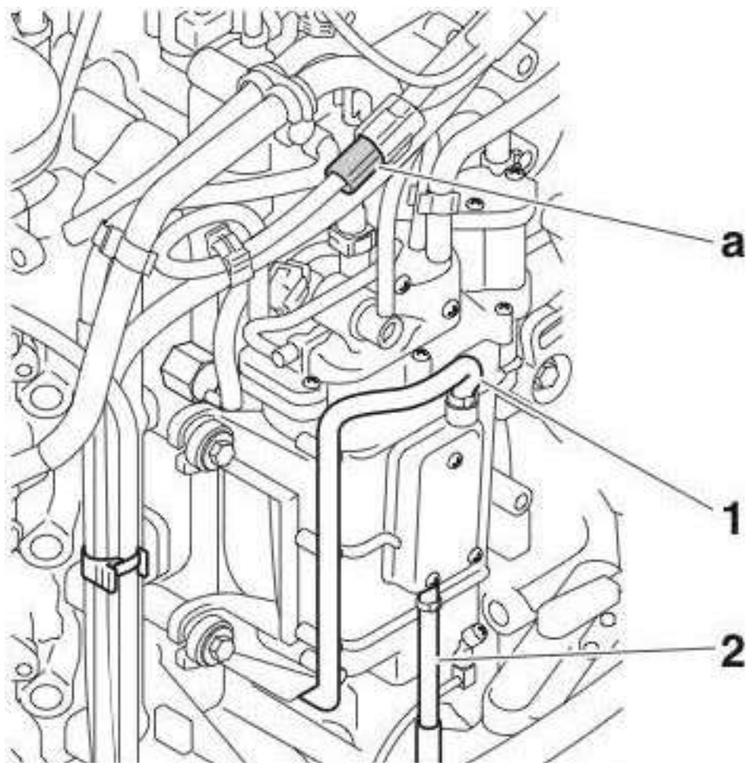
1. Drain the fuel. See "Draining the fuel" (6-35).

2. Remove the clamps "1" and holder "2", and then remove the vapor gas hoses "3" from the bottom cowling.

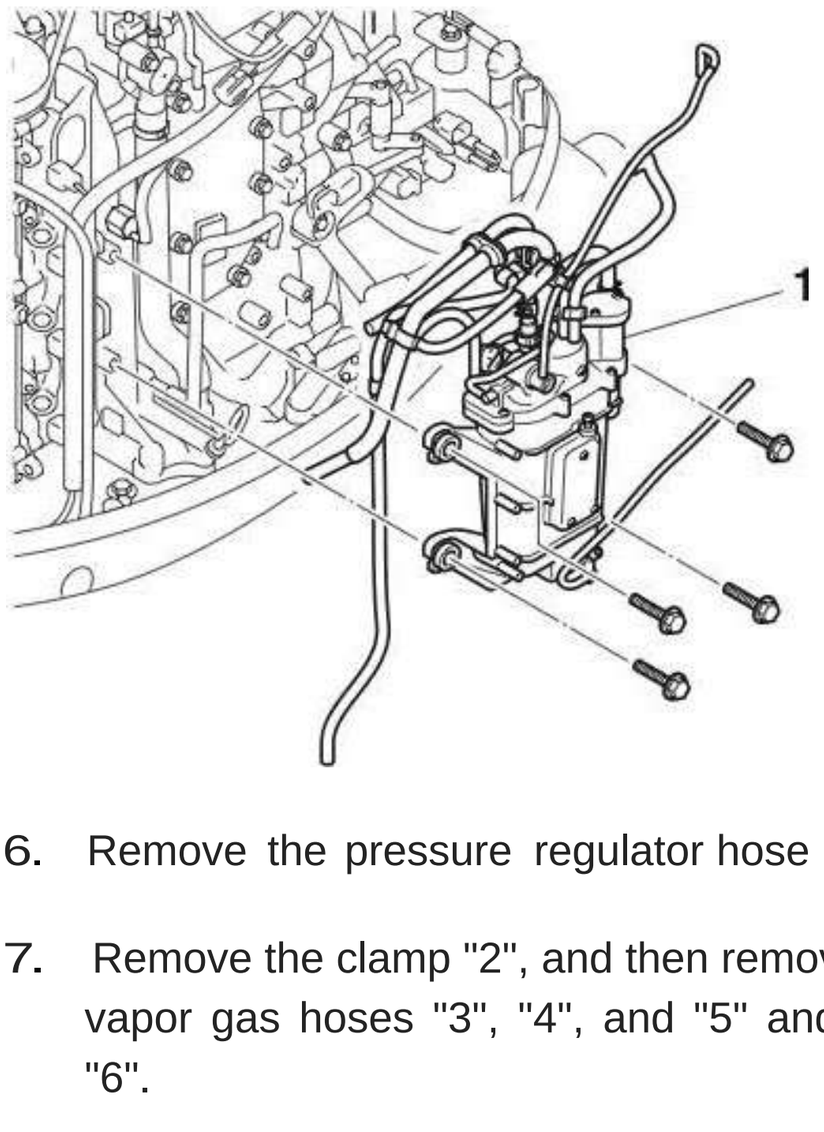


3. Disconnect the cooling water hoses "1" and "2" from the vapor separator assembly.

4. Disconnect the high-pressure fuel pump coupler "a".



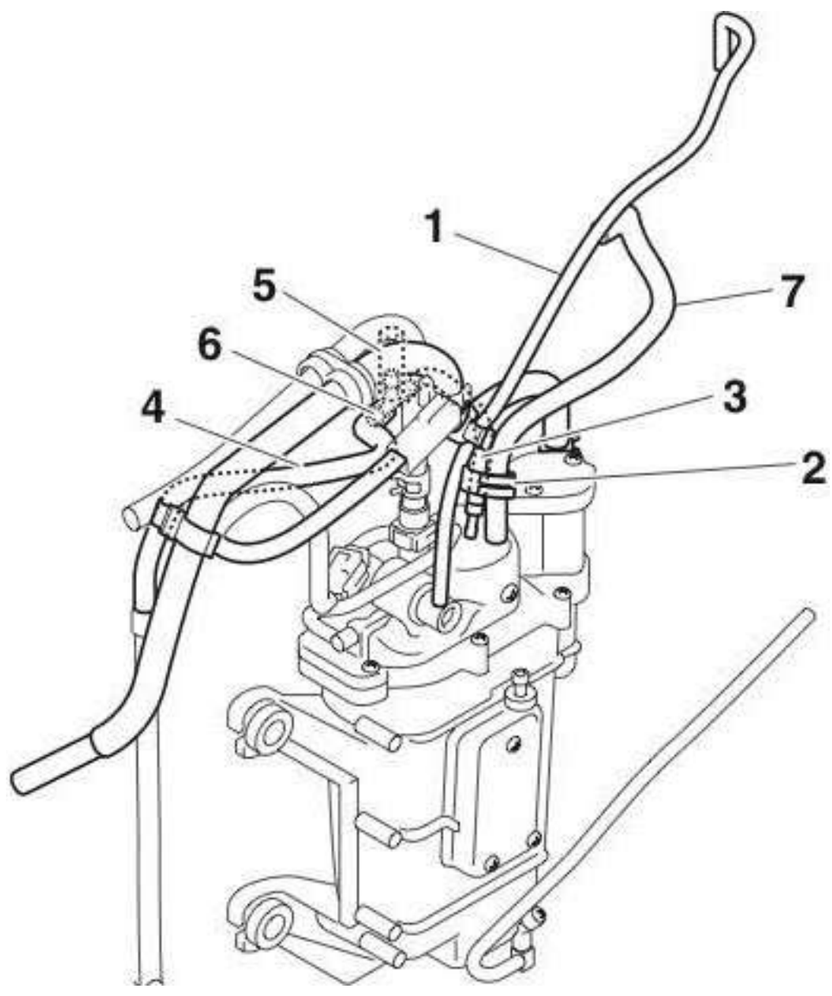
5. Remove the vapor separator assembly "1".



6. Remove the pressure regulator hose "1".

7. Remove the clamp "2", and then remove the vapor gas hoses "3", "4", and "5" and joint "6".

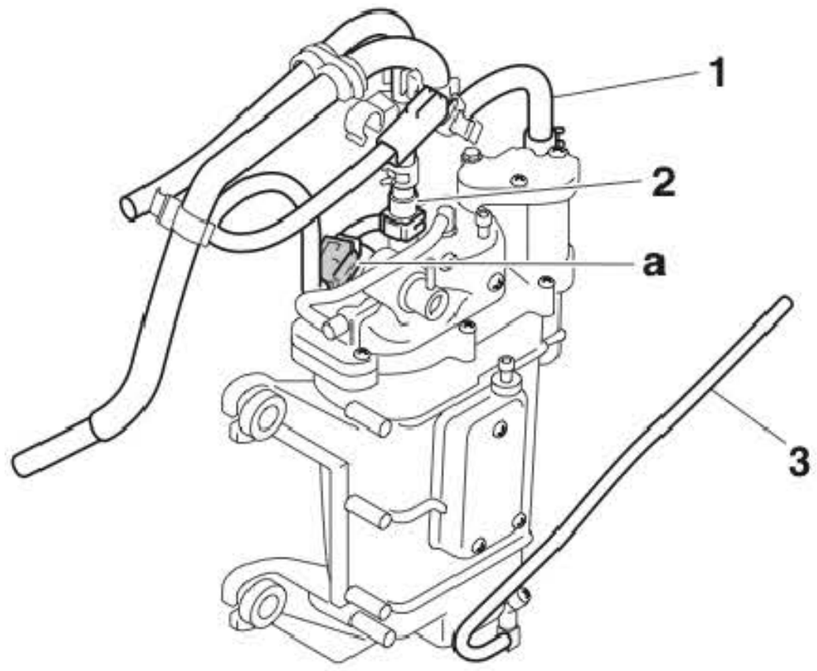
8. Remove the vapor gas hose "7".



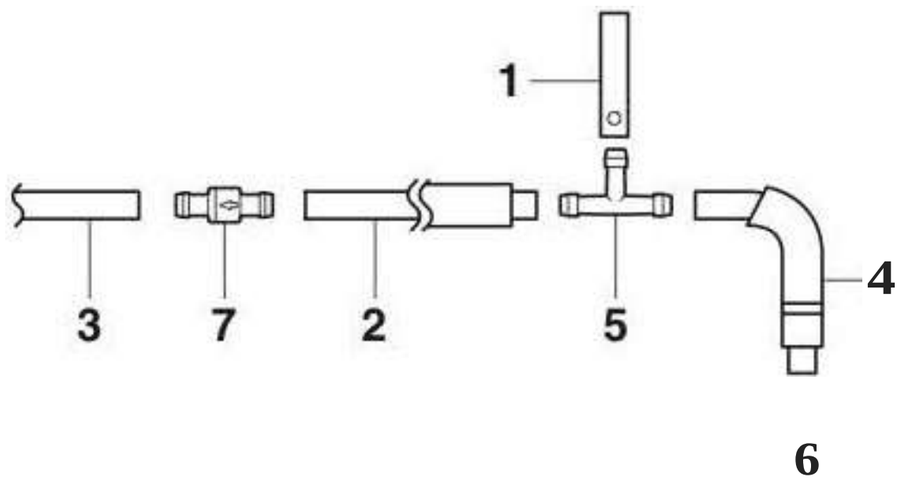
9. Remove the fuel hose "1" and quick connector "2". See step 3 in "Disconnecting the quick connector" (6-1).

10. Remove the drain hose "3".

11. Disconnect the high-pressure fuel pump coupler "a".



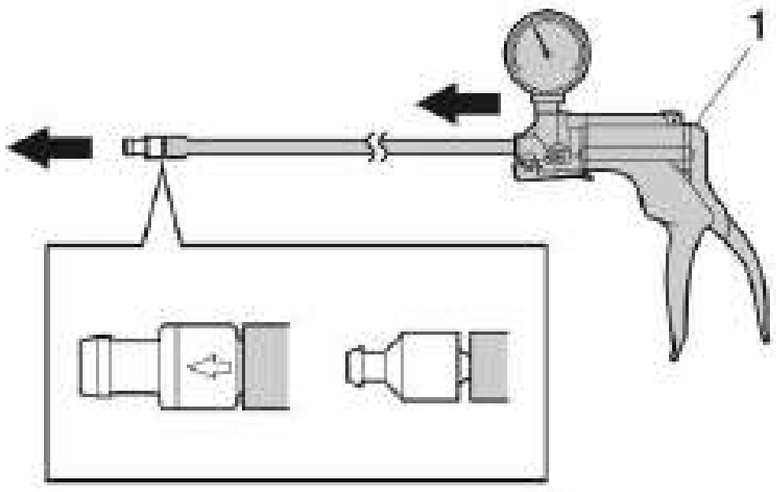
12. Disassemble the vapor gas hoses "1", "2", "3", and "4", joint "5", and check valves "6" and "7".



Checking the canister check valve

1. Connect the special service tool "1" to the canister check valve port.

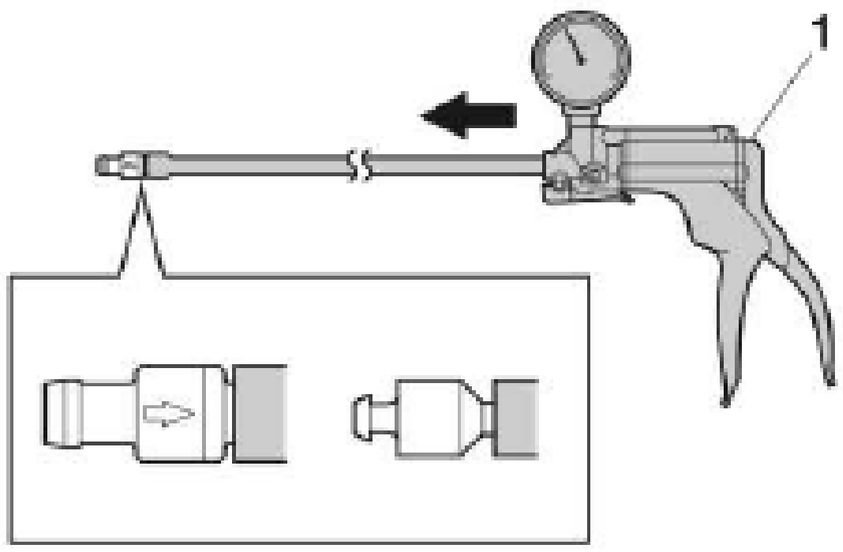
2. Apply positive pressure and check that air comes out of the opposite end of the canister check valve. Replace the canister check valve if no air comes out.



Vacuum/pressure pump gauge set "1"
Pressure/vacuum tester "1"

3. Connect the special service tool "1" to the opposite canister check valve port.

4. Apply positive pressure and check that no air comes out of the opposite end of the canister check valve. Replace the canister check valve if air comes out.

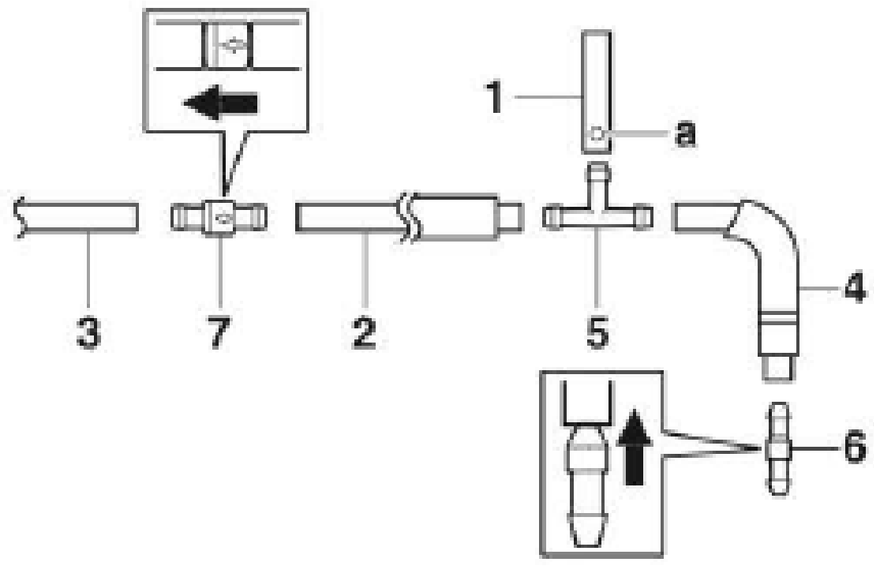


Installing the vapor separator

1. Connect the vapor gas hoses "1", "2", "3", and "4" to the joint "5" and check valves "6" and "7".

TIP:

Face the white mark "a" on the vapor gas hose "1" toward the check valve.



2. Connect the high-pressure fuel pump coupler "a".

3. Connect the drain hose "1".

4. Connect the quick connector "2".

5. Install the fuel hose "3", and then fasten it using the clamp "4".

6. Install the holder "5" to the fuel hose "3".

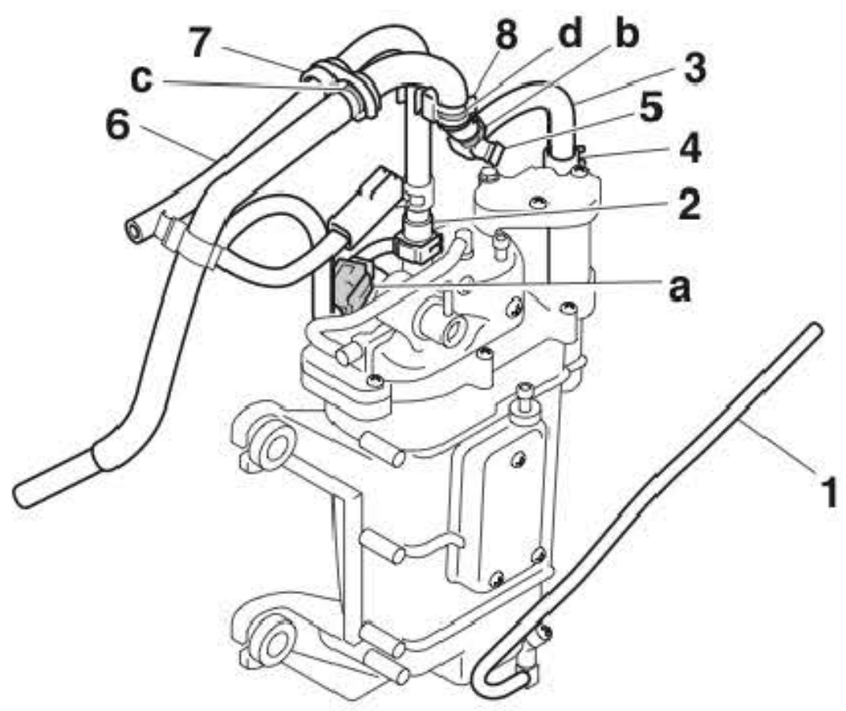
TIP:

Align the holder "5" with the white paint mark "b" on the fuel hose "3" .

7. Fasten the fuel hoses "3" and "6" using the holders "7" and "8"

TIP:

- Align the holder "7" with the white paint mark "c" on the fuel hose "3".
- Align the holder "8" with the white paint mark "d" on the fuel hose "3".



8. Connect the pressure regulator hose "1", and then fasten it using the holder "2".

9. Install the vapor gas hose "3".

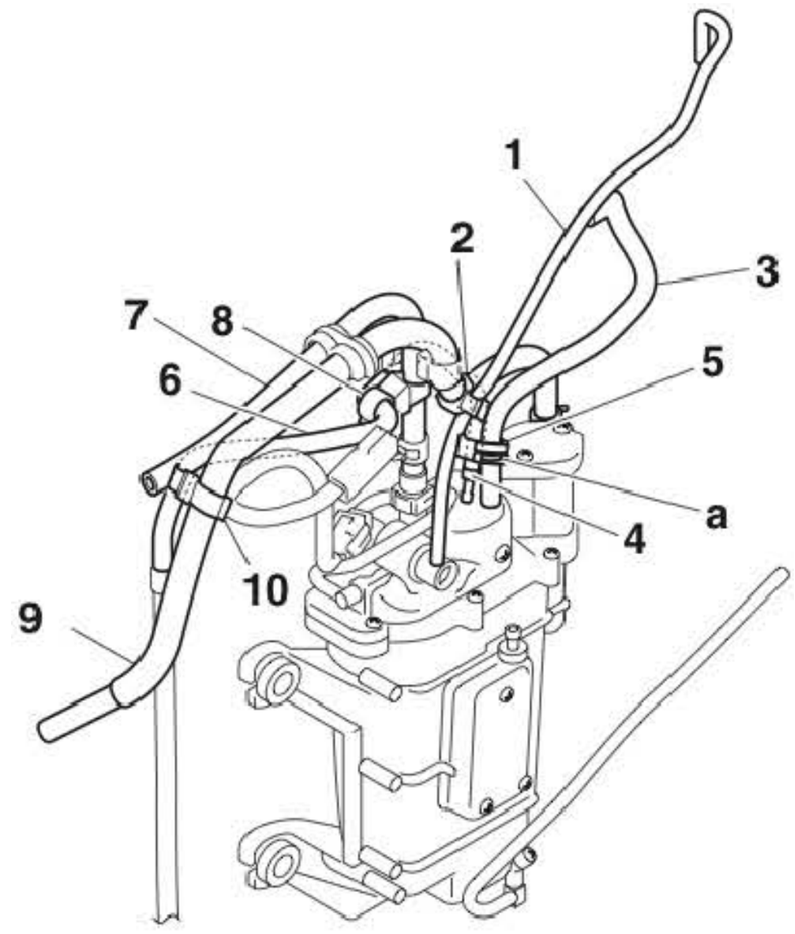
10. Fasten the vapor gas hoses "3" and "4" using the clamp "5".

TIP:

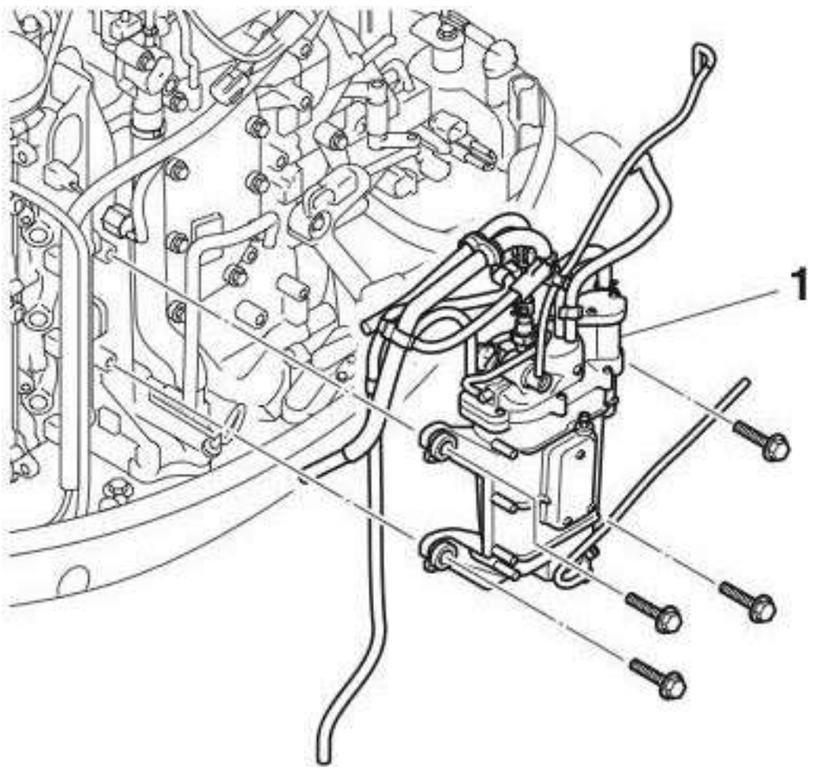
Align the clamp "5" with the white paint mark "a" on the vapor gas hose "3".

11. Fasten the vapor gas hose "6" and fuel hose "7" using the holder "8".

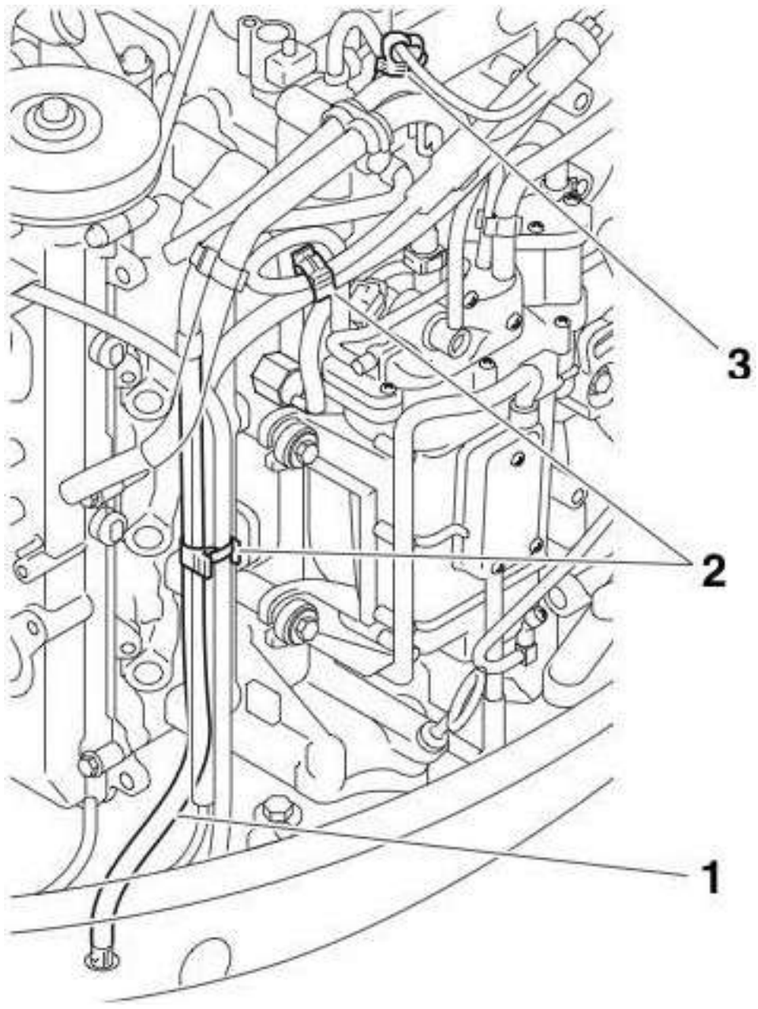
12. Fasten the vapor gas hose "6" and fuel hose "9" using the holder "10".



13. Install the vapor separator assembly "1".

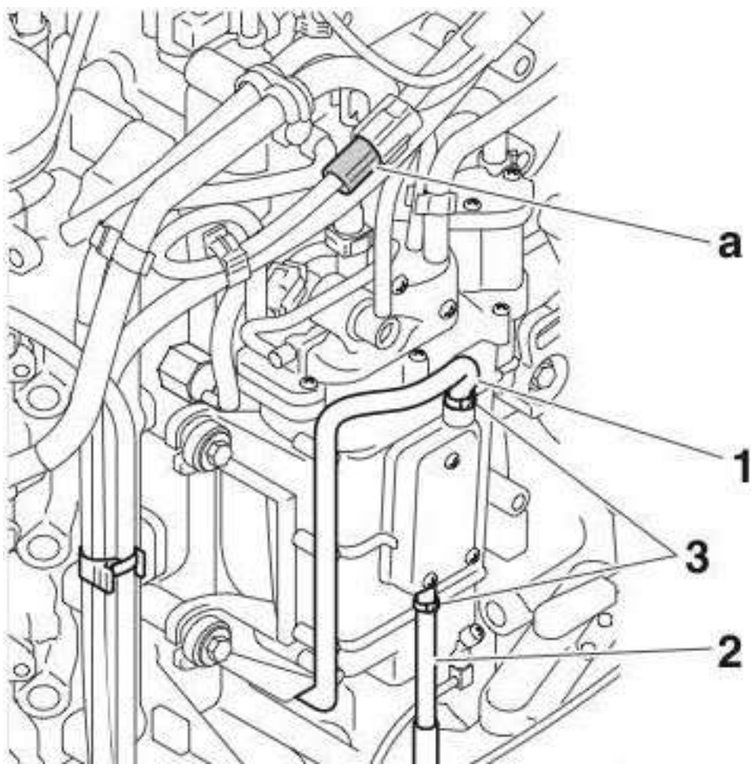


14. Install the vapor gas hose "1" to the bottom cowling, and then fasten it using the clamps "2" and holder "3".

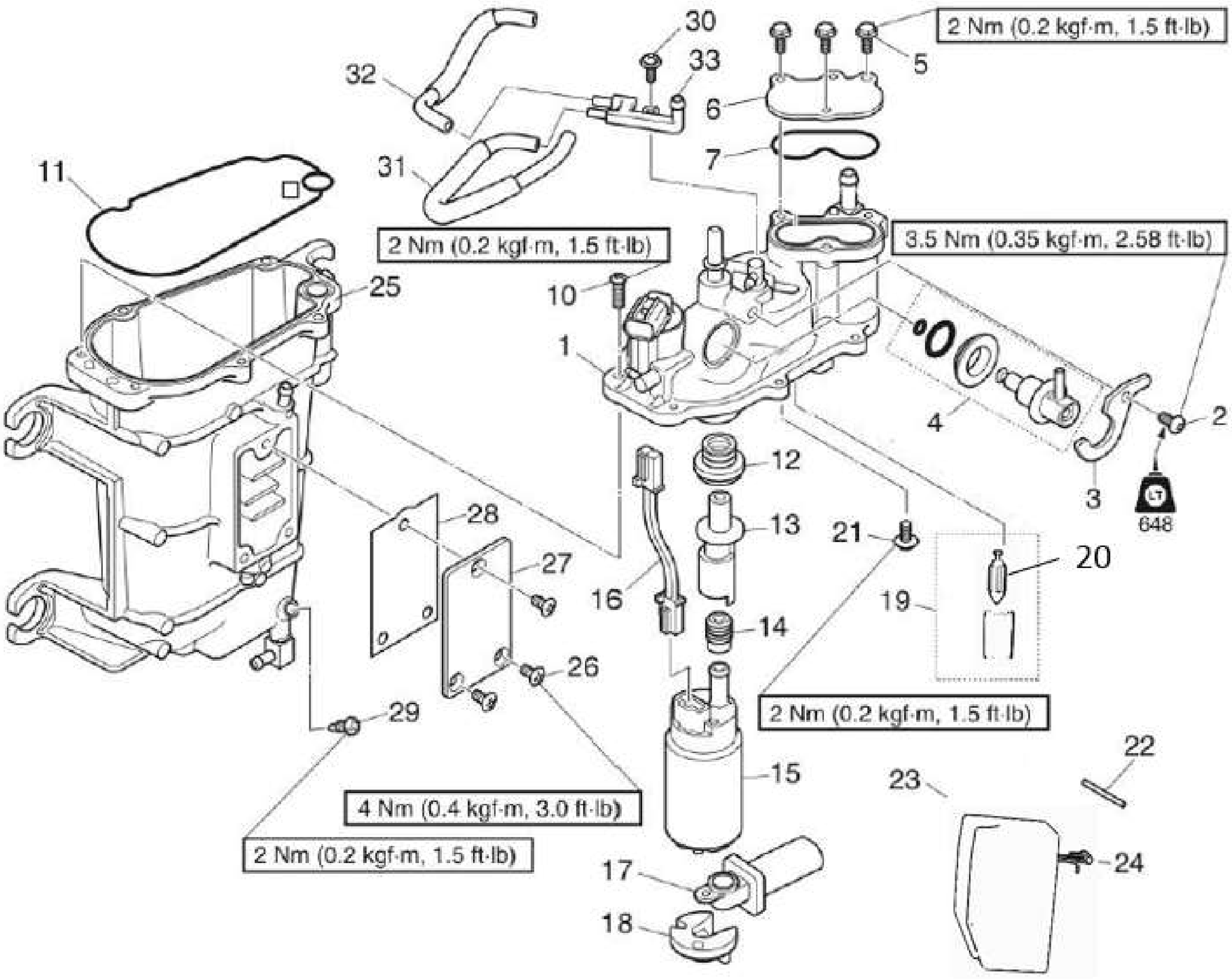


15. Connect the high-pressure fuel pump coupler "a".

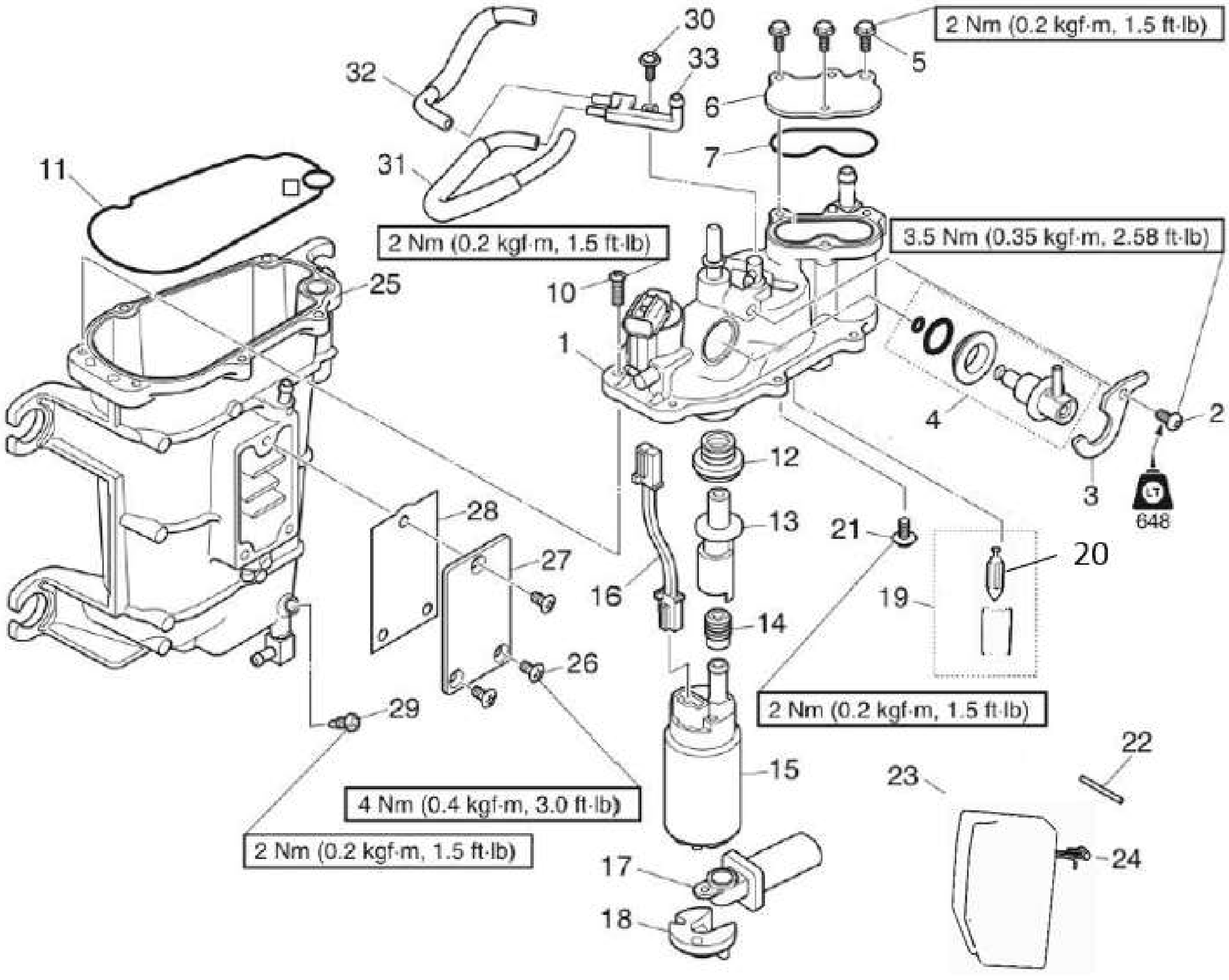
16. Connect the cooling water hoses "1" and "2" to the vapor separator, and then fasten them using the plastic tie "3".



Vapor separator and high-pressure fuel pump



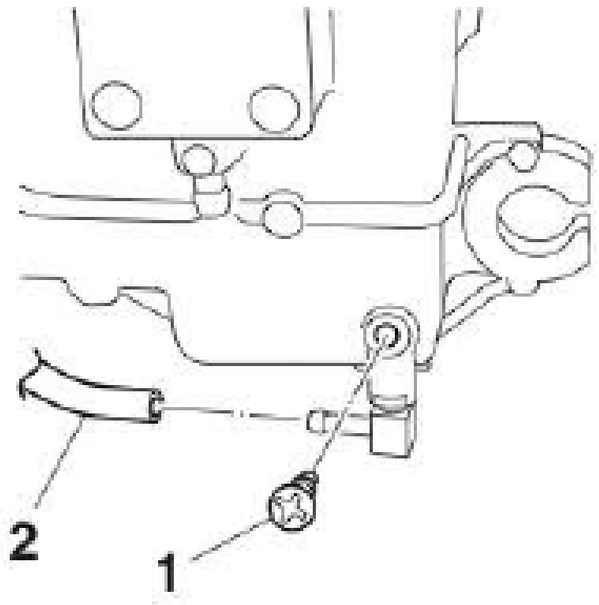
No.	Part name	Q'ty	Remarks
1	Vapor separator cover assembly	1	
2	Screw	1	M5 x 12 mm
3	Holder	1	
4	Pressure regulator	1	
5	Bolt	3	M4 x 12 mm
6	Cover	1	
7	Gasket	1	Not reusable
10	Screw	6	M4 x 16 mm
11	Gasket	1	Not reusable
12	Grommet	1	
13	Joint	1	
14	Damper	1	
15	High-pressure fuel pump	1	
16	Lead	1	
17	Filter	1	



No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Needle valve assembly	1	
20	Needle	1	Not reusable
21	Screw	1	M4x 8mm
22	Pin	1	
23	Float	1	
24	Holder	1	
25	Float chamber assembly	1	
26	Screw	3	M5x 12mm
27	Cover	1	
28	Gasket	1	Not reusable
29	Drain screw	1	
30	Screw	1	M4x 12mm
31	Hose	1	Vapor separator cover assembly to joint pipe
32	Hose	1	Vapor separator cover assembly to joint pipe
33	Joint pipe	1	

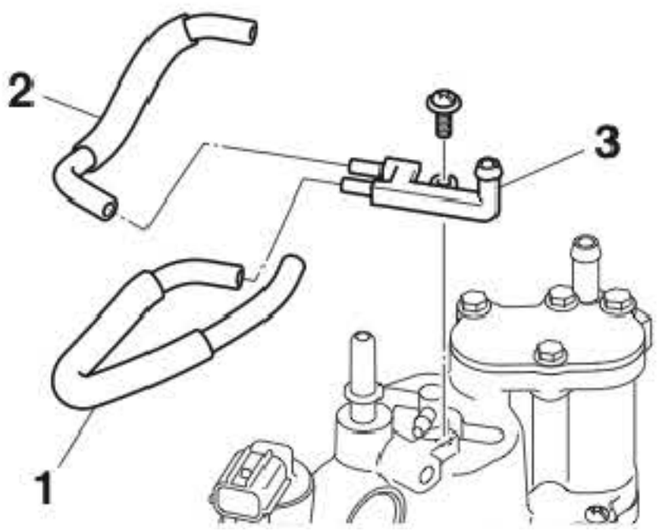
Disassembling the vapor separator

1. Remove the drain screw "1" and drain hose "2".



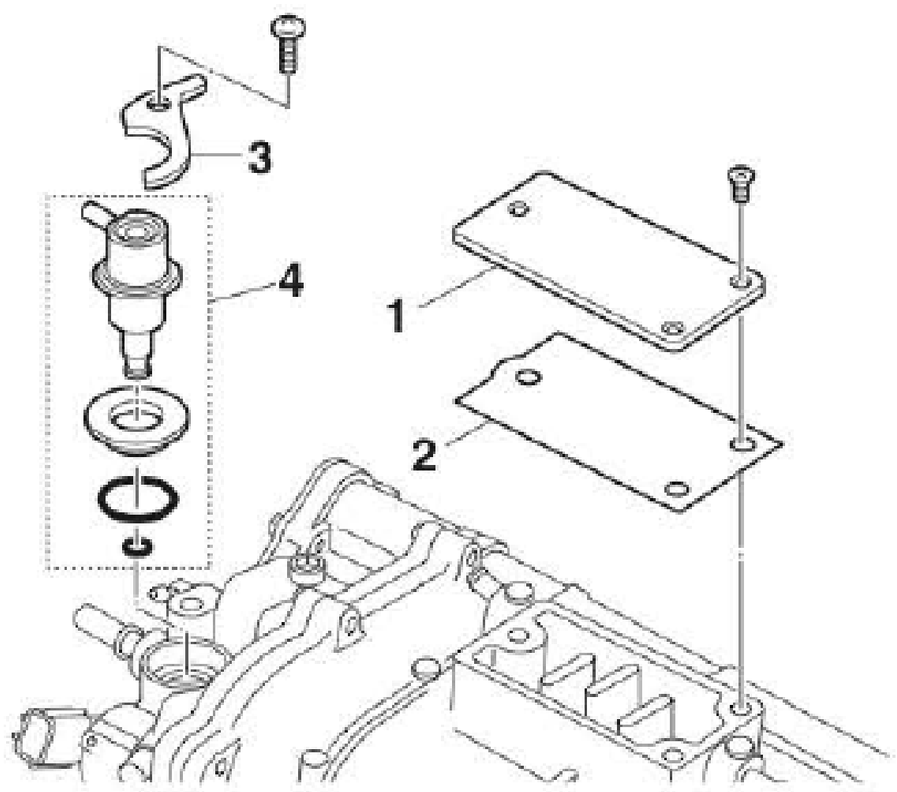
2. Remove the vapor gas hoses "1" and "2".

3. Remove the joint pipe "3".

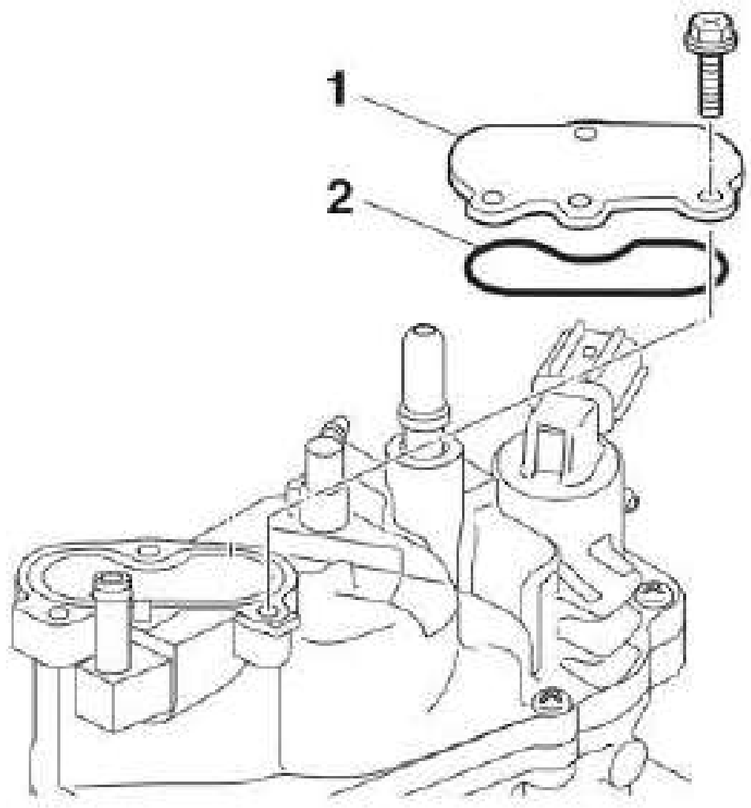


4. Remove the cover "1" and gasket "2".

5. Remove the holder "3", and then remove the pressure regulator "4".

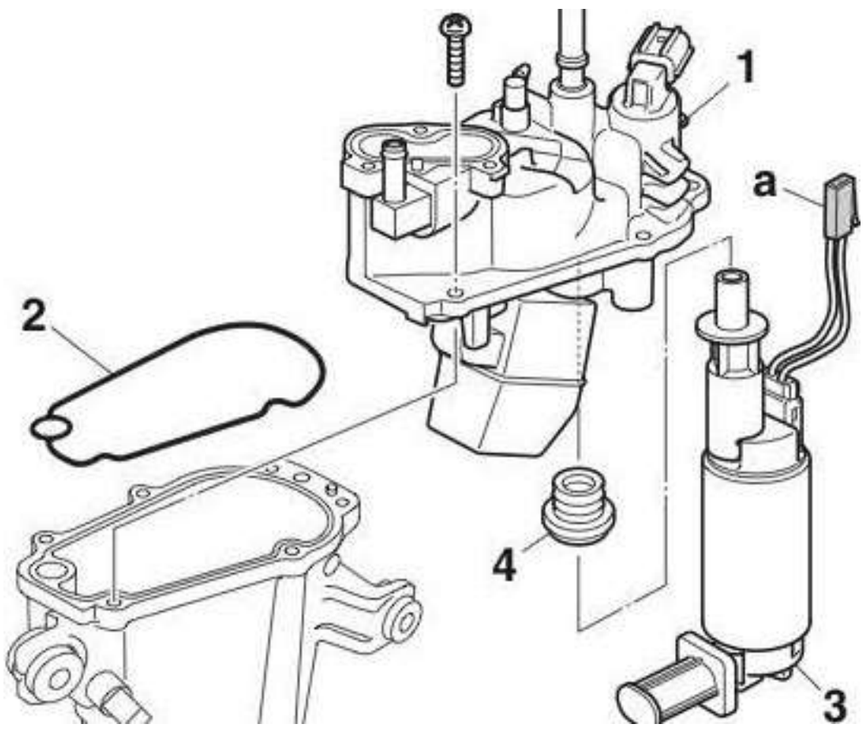


6. Remove the cover "1", gasket "2".



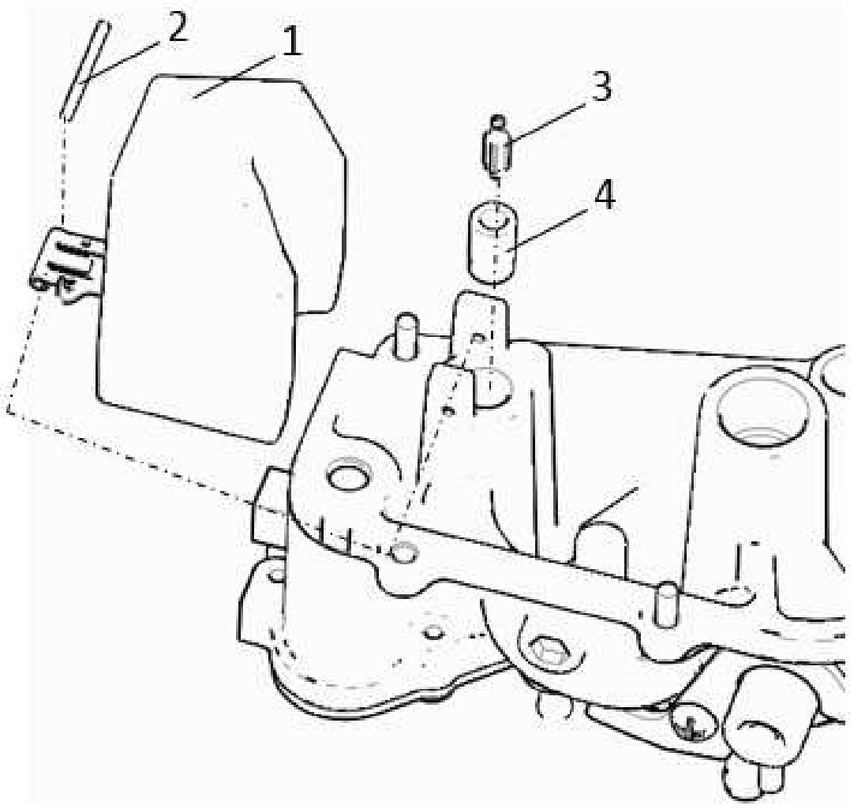
7. Remove the vapor separator cover assembly "1" and gasket "2".

8. Disconnect the fuel pump coupler "a", and then remove the high-pressure fuel pump "3" and grommet "4".

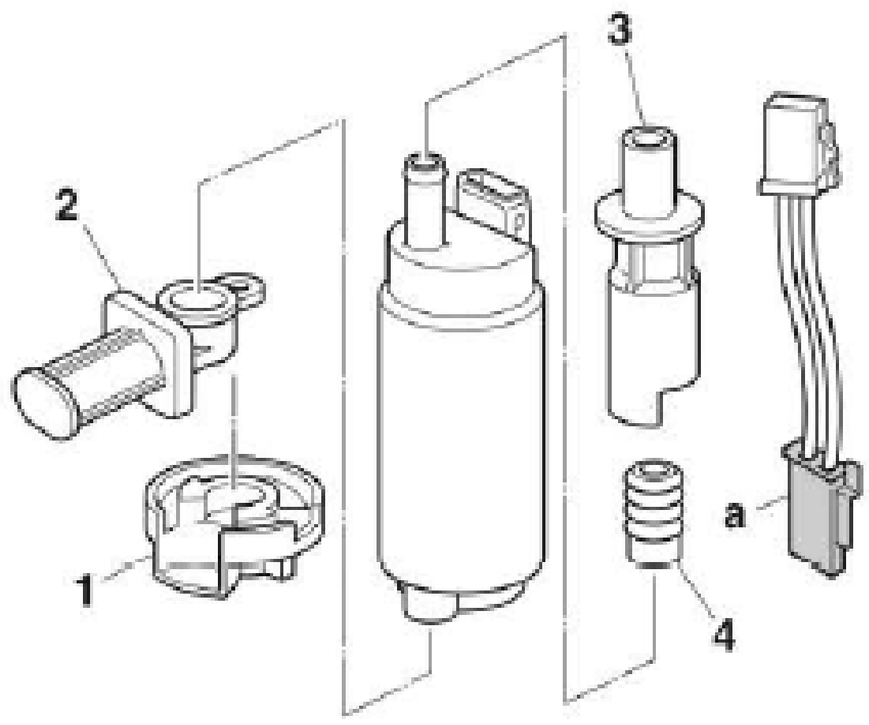


9. Remove the pin "1" and float "2".

10. Remove the screw "4", and then remove the needle valve assembly "5".



11. Disconnect the high-pressure fuel pump coupler "a", and then remove the filter holder "1", filter "2", jiont "3" , and damper "4".

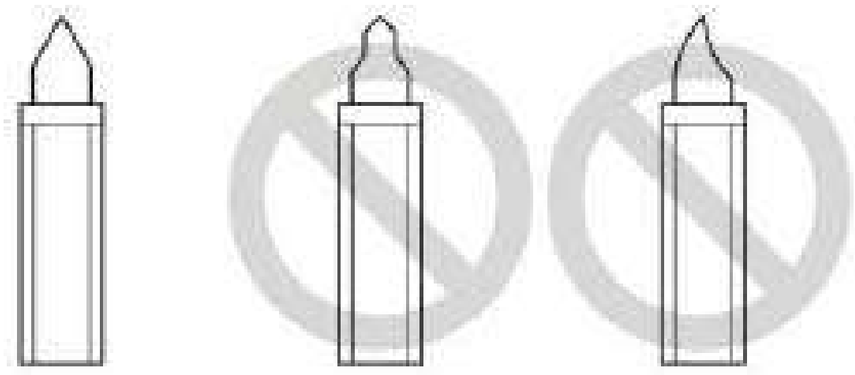


Checking the high-pressure fuel pump

1. Check the electrical performance of the high-pressure fuel pump. See "Checking the high-pressure fuel pump" (5-24).

Checking the vapor separator

1. Check the needle valve. Replace the needle valve assembly if bent or worn.



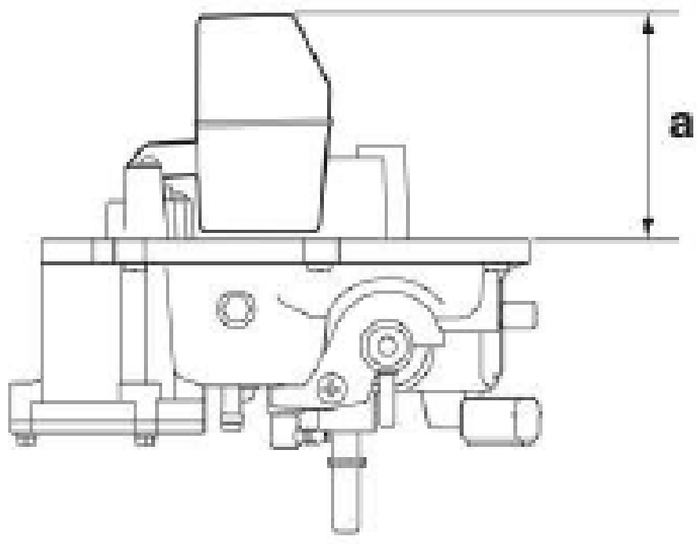
2. Check the float. Replace if deteriorated.

3. Check the filter. Clean if there is dirt or residue.

4. Place the cover assembly upside down, and then measure the float height "a".

TIP:

When measuring the float height, the float should be resting on the needle valve. Do not press the float.

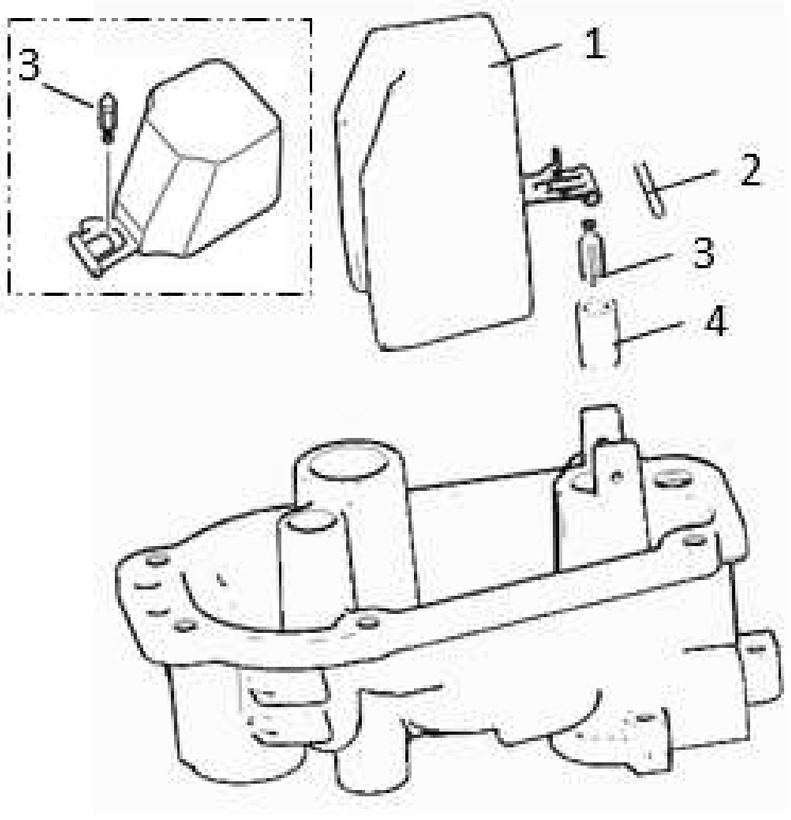


Float height
67.5 mm (2.66 in)

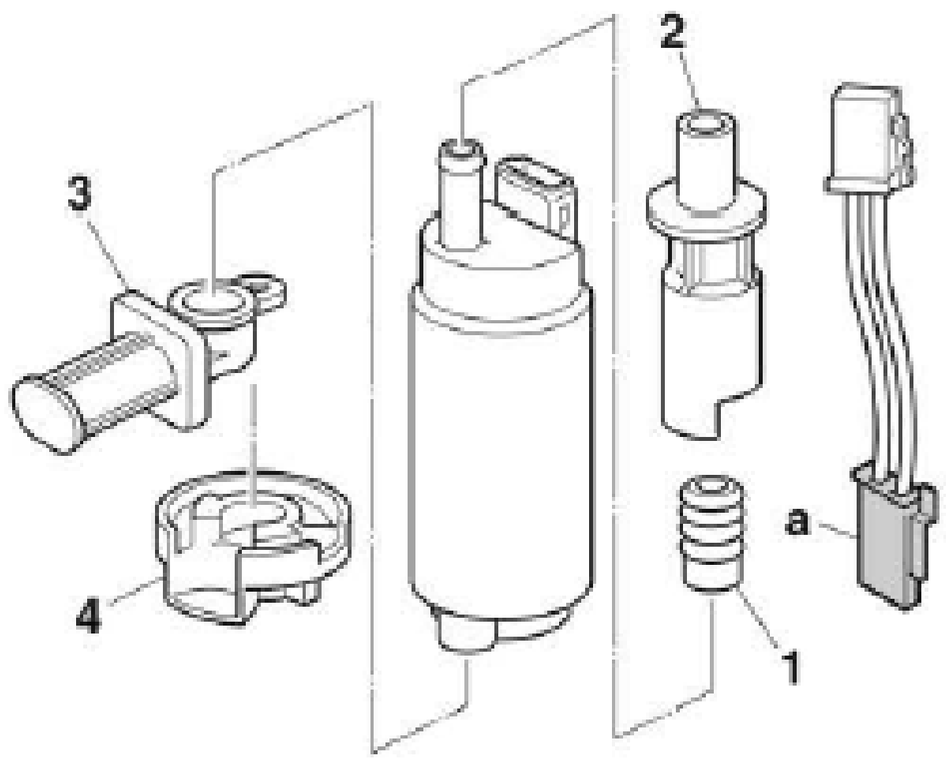
Assembling the vapor separator

1. Install the needle 3 and the pin 2 to the float 1.

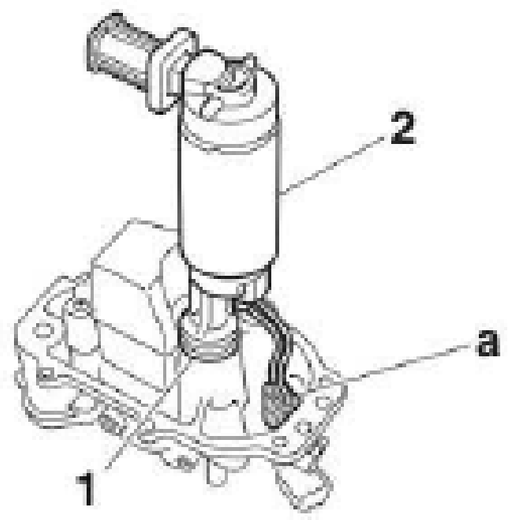
2. Install the base 4 to the cover.



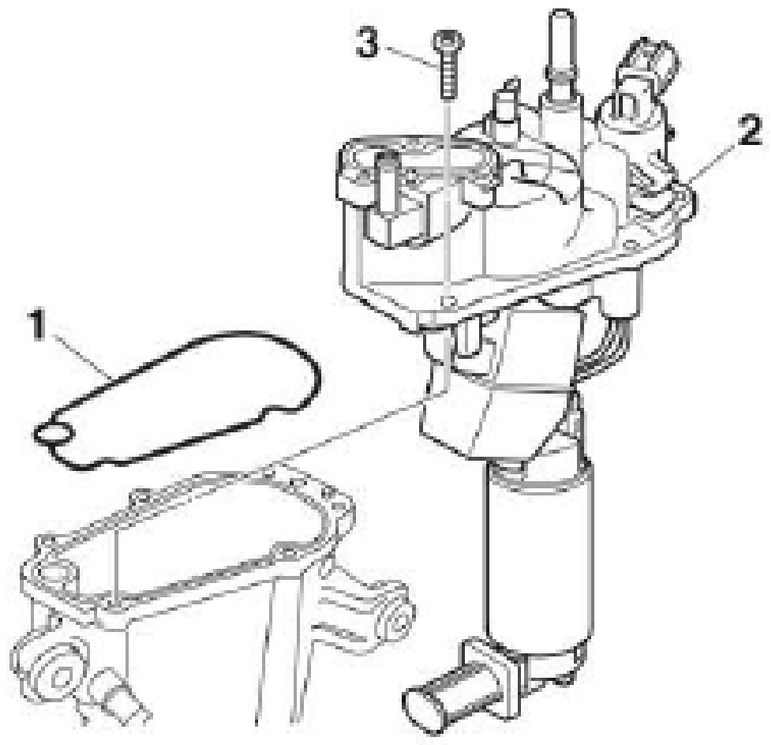
3. Install the damper "1", joint "2", filter "3", and filter holder "4", and then connect the high-pressure fuel pump coupler "a".



4. Install the grommet "1" and high-pressure fuel pump "2", and then connect the high-pressure fuel pump coupler "a".

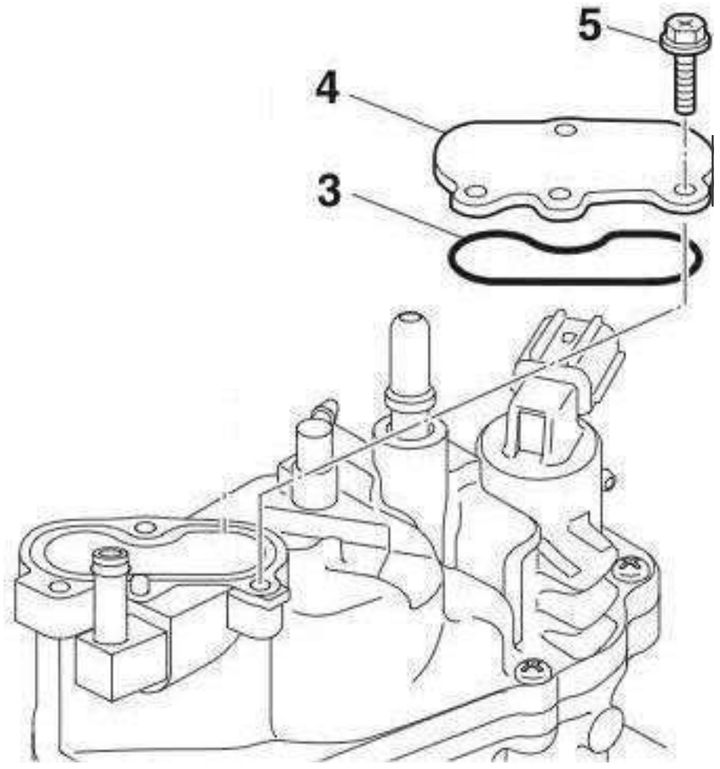


5. Install a new gasket "1" and the vapor separator cover assembly "2", and then tighten the float chamber cover screws "3" to the specified torque.



Float chamber cover screw "3"
2 Nm (0.2 kgf- m, 1.5 ft·lb)

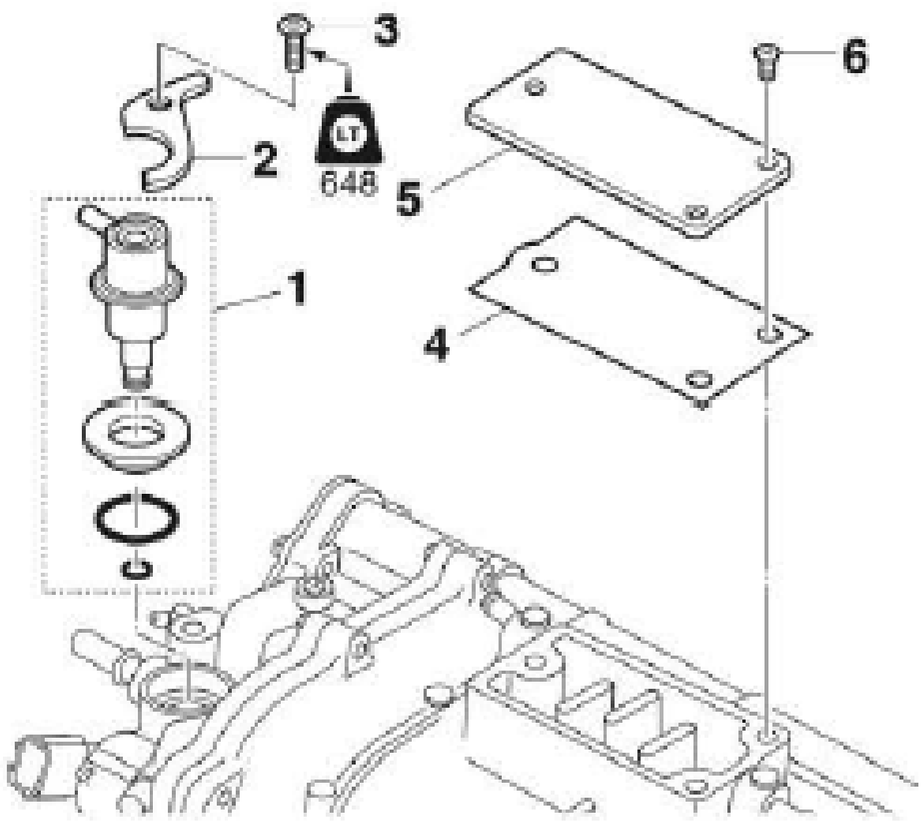
6. Install the gasket "3", and the cover "4", and then tighten the vapor separator cover bolts "5" to the specified torque.



Vapor separator cover bolt "5"
2 Nm (0.2 kgf·m, 1.5 ft-lb)

7. Install the pressure regulator "1"and holder "2", and then tighten the pressure regulator screw "3" to the specified torque.

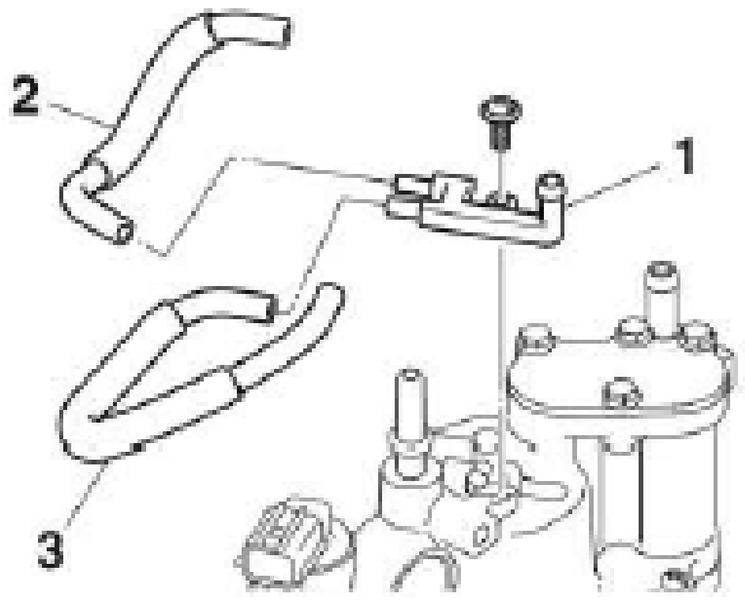
8. Install a new gasket "4" and the fuel cooler cover "5", and then tighten the fuel cooler cover screws "6" to the specified



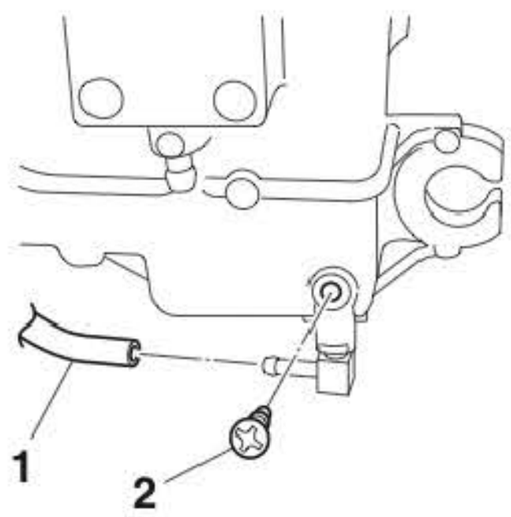
Pressure regulator screw "3"
3.5 Nm (0.35 kgf·m, 2.58 ft·lb)
Fuel cooler cover screw "6"
4 Nm (0.4 kgf·m, 3.0 ft·lb)

9. Install the joint pipe "1".

10. Install the vapor gas hoses "2" and "3".



11. Install the drain hose "1" and drain screw "2", and then tighten the drain screw "2" to the specified torque.



Drain screw "2"
2 Nm (0.2 kgf·m, 1.5 ft-lb)

Power unit

Power unit (check and adjustment) 7-1

Checking the compression pressure 7-1
Checking the oil pressure 7-1
Checking the pulser coil air gap 7-2
Checking the valve clearance 7-3
Adjusting the valve clearance 7-9

Power unit assembly 7-11

Removing the power unit 7-13
Installing the power unit 7-16

Flywheel magneto 7-20

Removing the flywheel magneto 7-21
Installing the flywheel magneto 7-22

Timing belt 7- 24

Removing the timing belt 7-25
Checking the timing belt 7-26
Installing the timing belt 7-26

Starter motor 7-28

Removing the starter motor 7-30
Installing the starter motor 7-30

Rectifier/regulator, ignition coil, and spark plug 7-32

Removing the rectifier/regulator, ignition coil, and spark piug 7-33
Checking the spark plug 7-33
Installing the ignition coil, rectifier/regulator, and spark piug 7-33

Wire harness 7-35

Removing the wire harness 7-38
Installing the wire harness 7-39

Irhrottle link rod 7-43

Removing the throttle link rod 7-44
Installing the throttle link rod 7-44

Power unit

Camshaft 7-46

Removing the driven sprocket and camshaft 7-48
Checking the sprocket 7-49
Checking the valve lifter 7-49
Checking the camshaft 7-49
Checking the camshaft journal oil clearance 7-50
Checking the camshaft journal outside diameter and camshaft journal inside diameter..... 7-51
Installing the camshaft and driven sprocket 7-51

Exhaust joint..... 7-55

Removing the exhaust joint 7-57
Checking the exhaust joint anode 7-57
Installing the exhaust joint 7-57

Oil cooler 7-59

Removing the crankcase cover 7-61
Checking the thermostat 7-61
Checking the crankcase cover anode 7-62
Installing the crankcase cover 7-62

Cylinder head 7-64

Removing the cylinder head 7-66
Disassembling the cylinder head..... 7-66
Checking the cylinder head 7-67
Checking the cylinder head bolt 7-67
Checking the valve spring 7-68
Checking the valve 7-68
Checking the valve guide 7-69
Replacing the valve guide 7-69
Checking the valve seat 7-70
Refacing the valve seat 7-71
Checking the cylinder head anode 7-74
Assembling the cylinder head..... 7-74
Installing the cylinder head..... 7-75

Power unit

Cylinder block 7-77

Removing the oil pump assembly 7-79
Removing the oil filter bracket 7-79
Disassembling the oil pump 7-79
Checking the oil pump 7-79
Assembling the oil pump 7-80
Installing the oil pump assembly 7-81
Checking the cylinder block anode 7-81
Installing the oil filter bracket 7-81

Crankcase 7-83

Disassembling the cylinder block 7-85
Checking the piston diameter 7-86
Checking the cylinder bore 7-87
Checking the piston clearance 7-87
Checking the piston ring 7-87
Checking the piston ring end gap 7-88
Checking the piston ring groove 7-88
Checking the piston ring side clearance 7-88
Checking the piston pin boss inside diameter 7-89
Checking the piston pin diameter 7-89
Checking the connecting rod small end inside diameter and big end inside diameter 7-89
Checking the connecting rod big end side clearance 7-90
Checking the crankshaft 7-90
Checking the big end oil clearance 7-91
Selecting the crankshaft pin bearing 7-92
Crankshaft pin bearing selection table 7-94
Checking the journal oil clearance 7-95
Selecting the crankshaft journal bearing 7-96
Crankshaft journal bearing selection table 7-98
Assembling the cylinder block 7-99

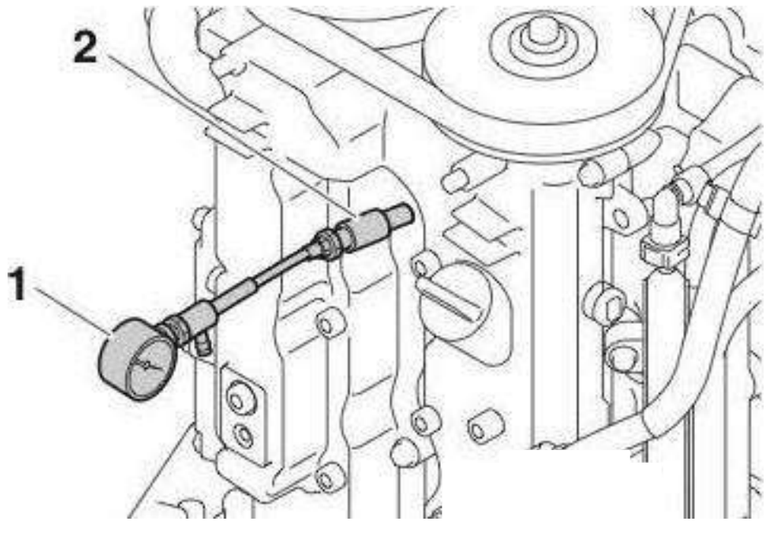
Power unit (check and adjustment)

Checking the compression pressure

1. Start the engine, warm it up for 5 minutes, and then stop it.
2. Remove the clip from the engine shut-off switch.
3. Disconnect the fuel injector couplers.
4. Disconnect the spark plug wires.
5. Remove all of the spark plugs.
6. Install the special service tools "1" and "2" into the spark plug hole.

NOTICE

Before removing the spark plugs, remove any dirt or dust in the spark plug wells that could fall into the cylinders.



Compression gauge "1"

Combination compression gauge and cylinder leak down test kit "1" and "2"

Compression gauge extension M12 "2"

7. Fully open the throttle.
8. Crank the engine until the reading on the compression gauge stabilizes, and then measure the compression pressure. Check the engine internal parts if the compression pressure is below specification.

Compression pressure
Minimum (reference data)
945.0 kPa (9.45 kgf/cm², 137.0 psi)

9. Remove the special service tools.
10. Install all of the spark plugs, and then tighten the spark plugs to the specified torque.

Spark plug
25 Nm (2.5 kgf·m, 18.4 ft·lb)

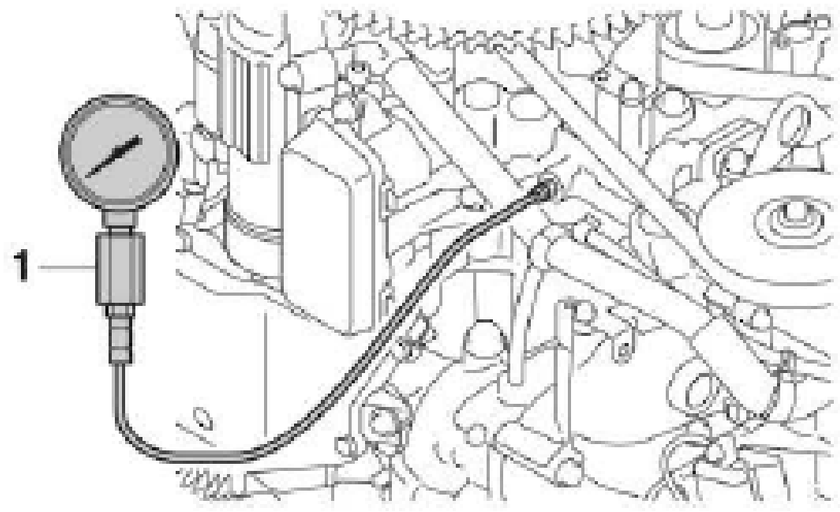
11. Connect the spark plug wires.
12. Connect the fuel injector couplers.

Checking the oil pressure

1. Remove the oil pressure switch lead from the oil pressure switch end.
2. Remove the oil pressure switch, and then install an oil pressure gauge "1" to the oil pressure switch installation hole.
3. Start the engine and warm it up until the engine idle speed stabilizes at 700-800 r/min.
4. Measure the oil pressure. Check the engine internal parts if the oil pressure is below specification.

TIP:

- Use a pressure gauge with an adapter that has a 118 pitch thread.
- The actual oil pressure may vary depending on the temperature and engine oil viscosity.



Oil pressure gauge "1"
(commercially available)

Engine oil pressure at idle speed (reference data)
440.0 kPa (4.40 kgf cm2, 63.8 psi)
I SL 1OW-30 engine oil
Engine oil pressure at 3000 rlmin (reference data)
660.0 kPa (6.60 kgf cm2, 95.7 psi)
I SL 1OW-30 engine oil

5. Remove the oil pressure gauge.

6. Install the oil pressure switch. See "Cylinder block" (7-77).

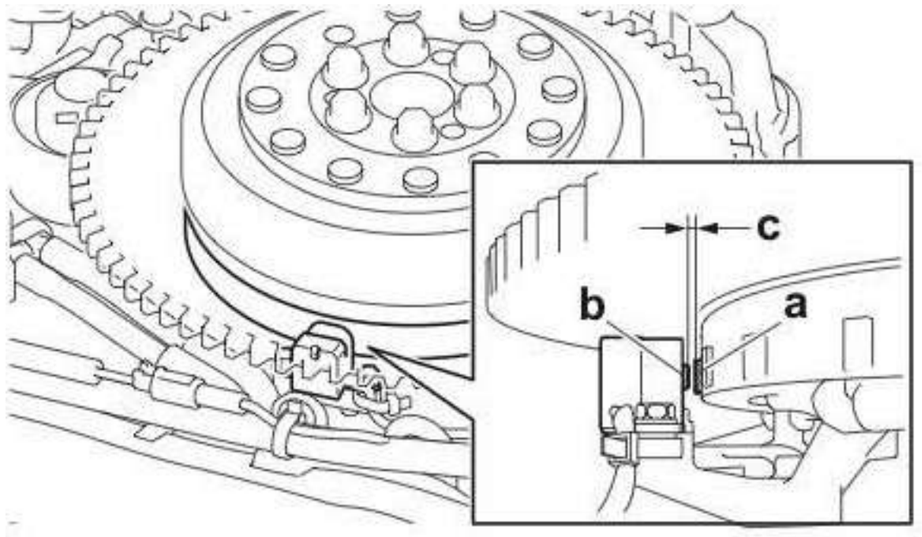
Checking the pulser coil air gap

NOTICE

Do not turn the flywheel magneto counter-clockwise. Otherwise, the water pump impeller could be damaged.

1. Turn the flywheel magneto clockwise to align the protrusion "a" on the flywheel magneto with the protrusion "b" on the pulser coil.

2. Measure the pulser coil air gap "c". Adjust the air gap if out of specification.



Pulser coil
Air gap
0.36-1.14 mm (0.014--0.045 in)

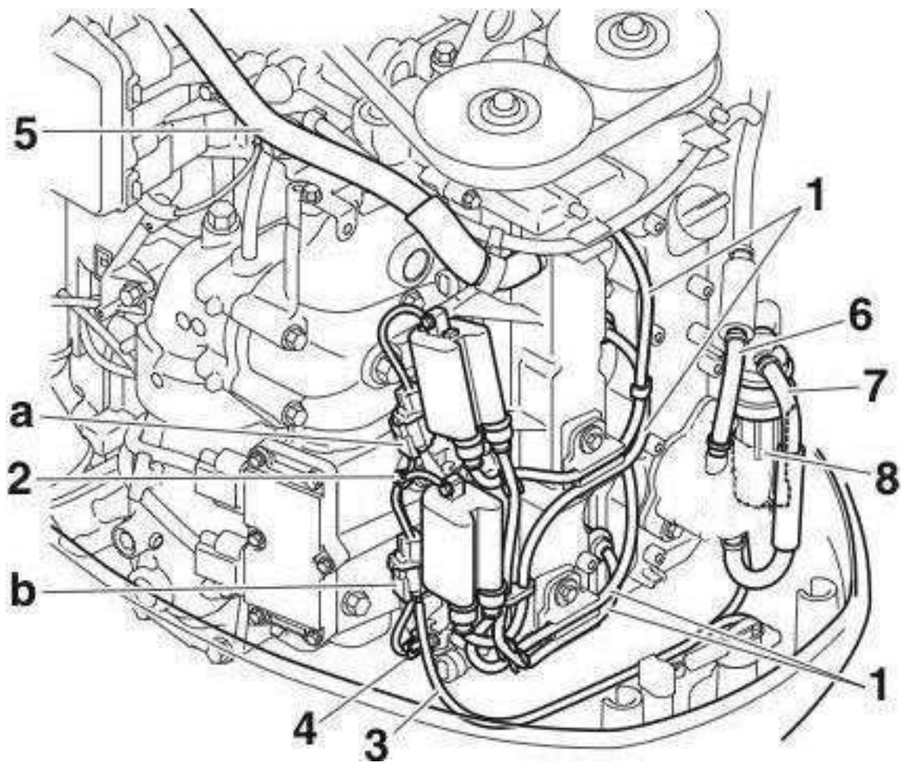
Checking the valve clearance

- Measure the valve clearances when the engine is cold.
- Cover the fuel components using a rag to prevent fuel from spilling out.

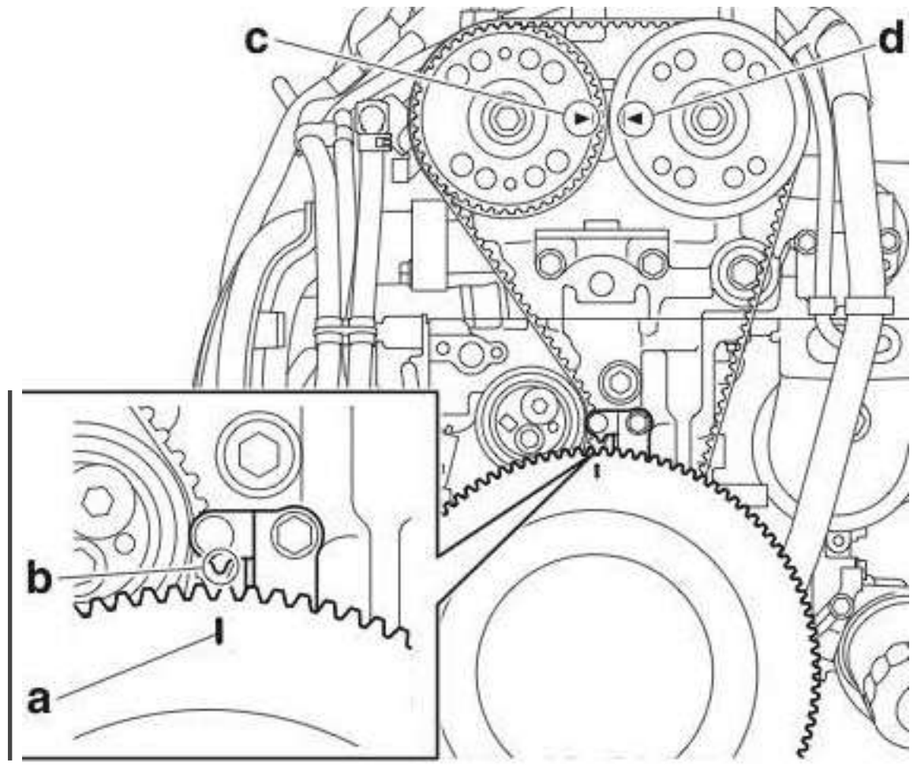
NOTICE

Do not turn the flywheel magneto counter-clockwise. Otherwise, the water pump impeller could be damaged.

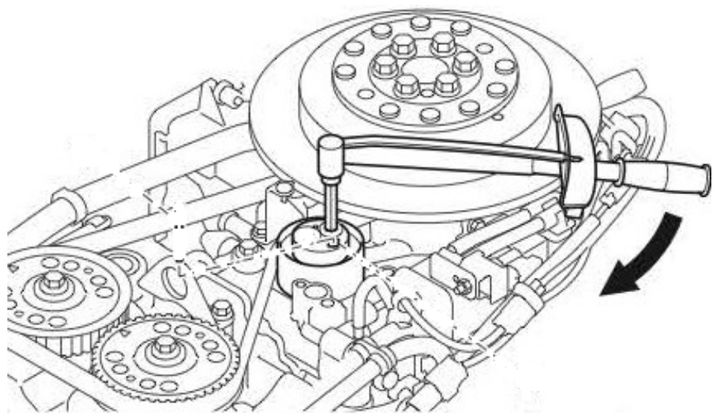
1. Disconnect the spark plug wires "1", and then remove the spark plugs.
2. Remove the clamp "2".
3. Remove the wire harness "3" from the holder "4".
4. Disconnect the ignition coil couplers "a" and "b".
5. Disconnect the blow by hose "5" and fuel hoses "6" and "7".
6. Remove the fuel filter "8".



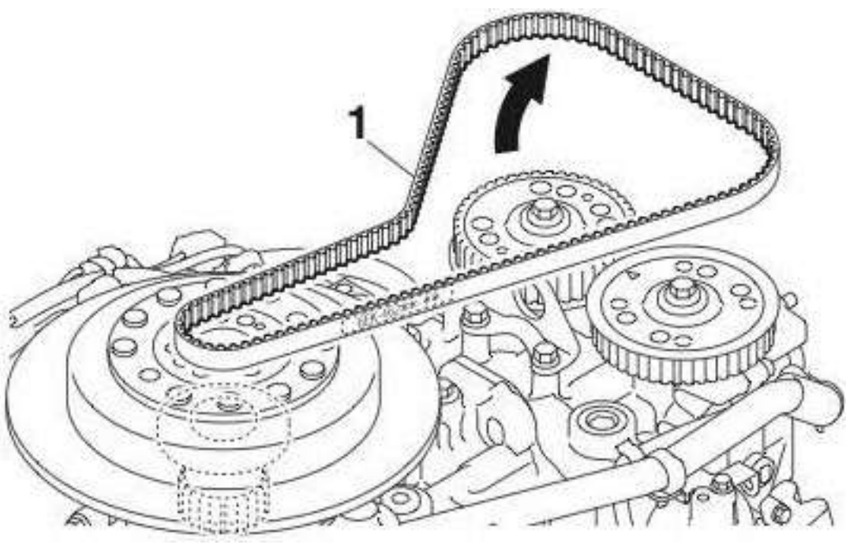
7. Turn the flywheel magneto clockwise to align the mark "a" on the flywheel magneto with the pointer "b". Check that the "▲" marks "c" and "d" on the driven sprockets are aligned.



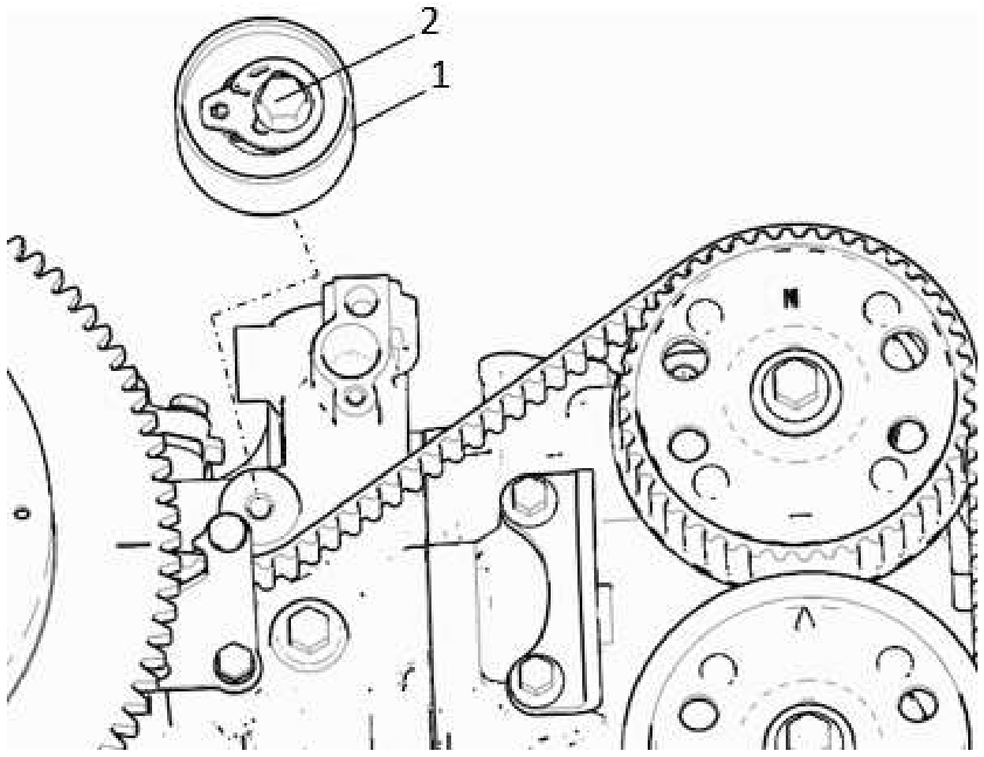
8. Loosen the bolt of the timing belt tensioner.



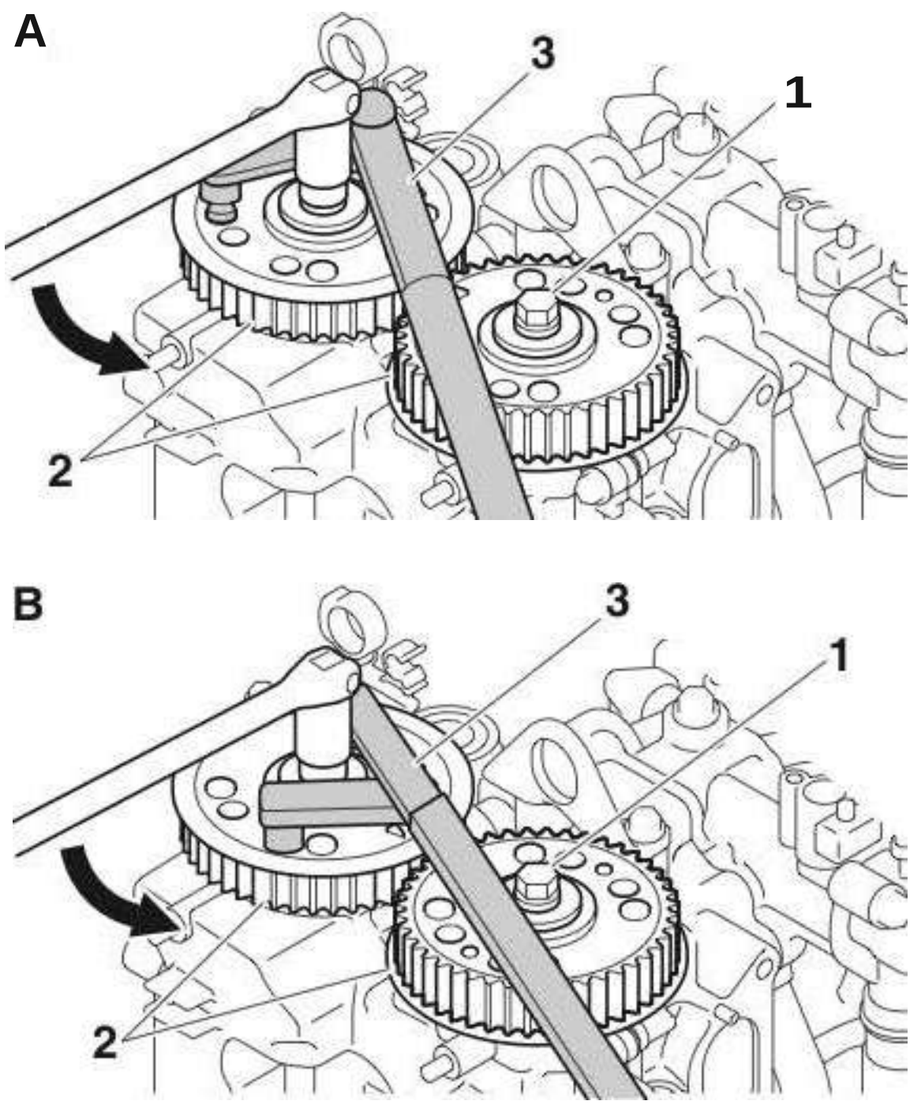
9. Remove the timing belt "1".



10. Remove the timing belt tensioner "1" along with the timing belt tensioner bolt "2".



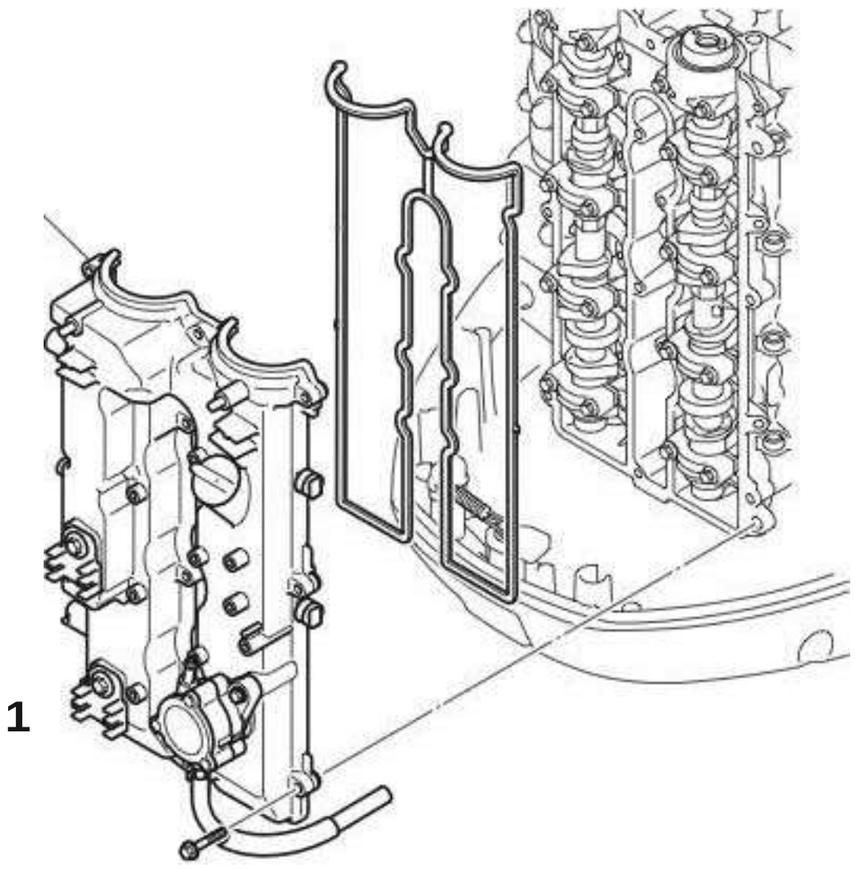
11. Loosen the driven sprocket bolts "1", and then remove the driven sprockets "2".



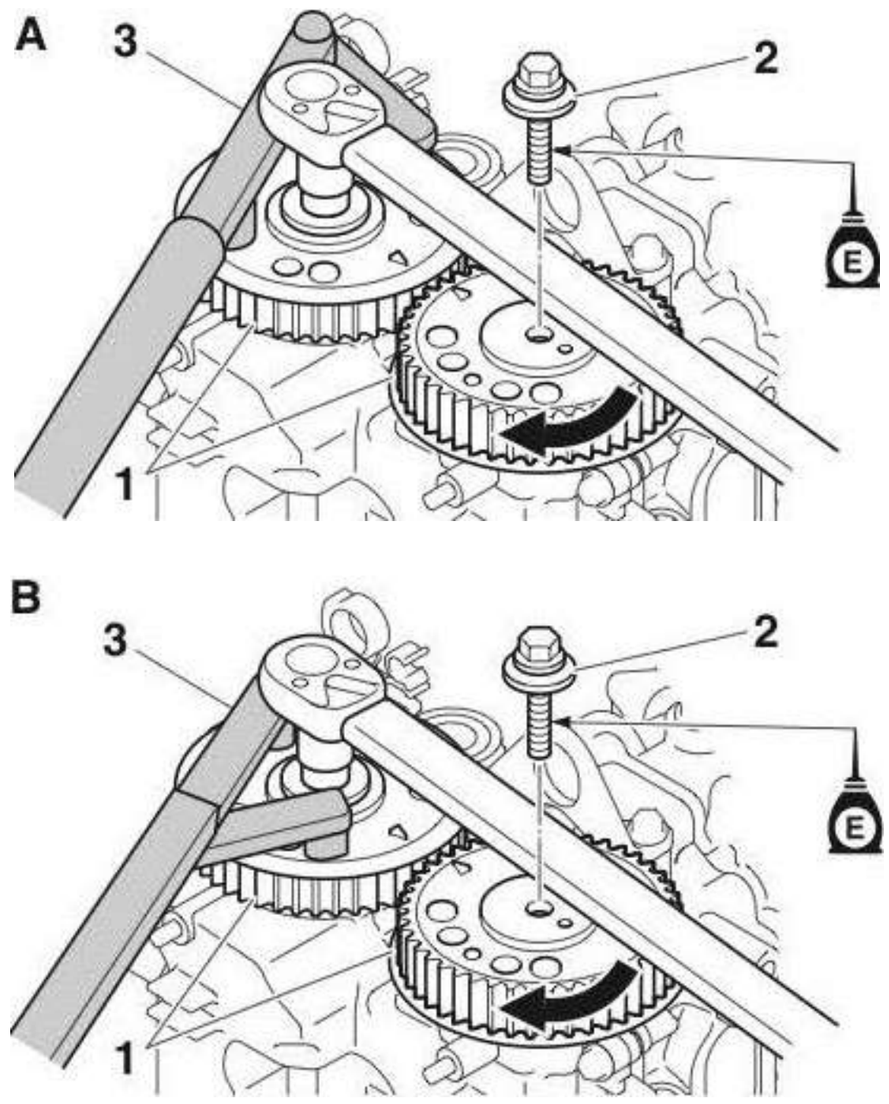
A. Worldwide
B. USA and Canada

Flywheel holder "3"
Flywheel magneto holder "3"

12. Remove the cylinder head cover "1".



13. Install the driven sprockets "1", and then tighten the driven sprocket bolts "2" temporarily.



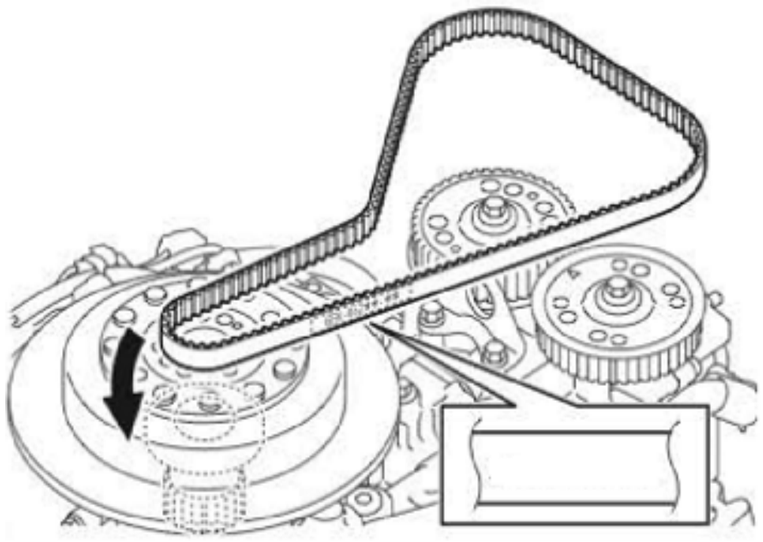
A. Worldwide
B. USA and Canada

Flywheel holder "3"
Flywheel magneto holder "3"

14. Install the timing belt tensioner, and tighten the bolt, keep the force less than 2 Nm.

NOTICE

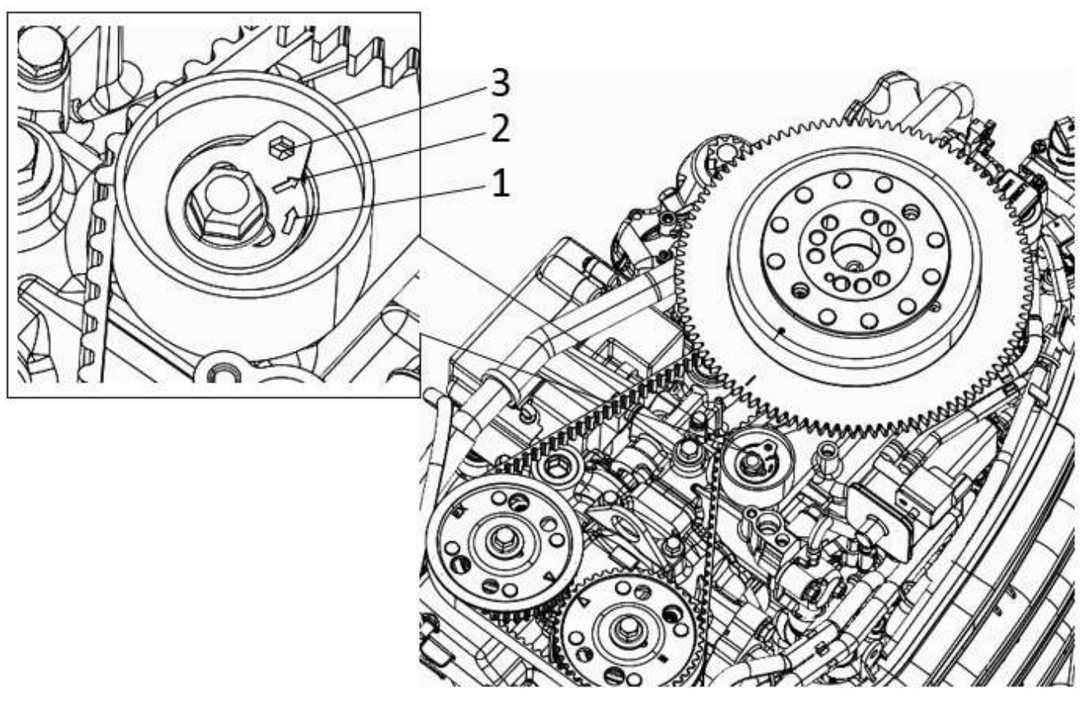
Do not apply grease or oil to the timing belt.

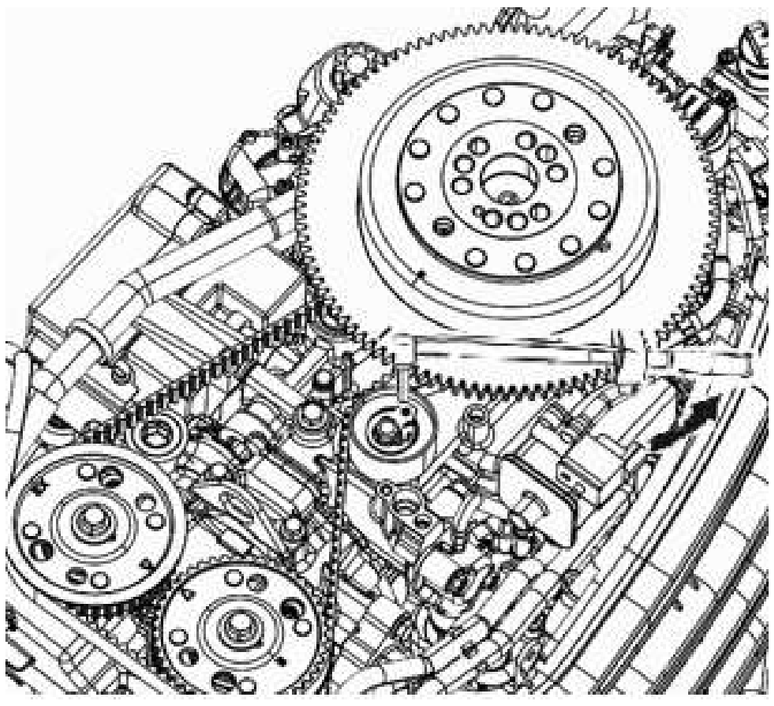


15. Turn the timing belt tensioner to limit position which keep the timing belt loosened. Then install the timing belt with its part number in the proper orientation, from the drive sprocket side to the port and starboard driven sprockets, in the counterclockwise direction.

16. Using a hexagon wrench to turn the timing belt tensioner along the arrow "1" to make the arrow "2" align to the slot "3". Check the timing belt if be tensioned.

17. Tighten the timing belt tensioner bolt.

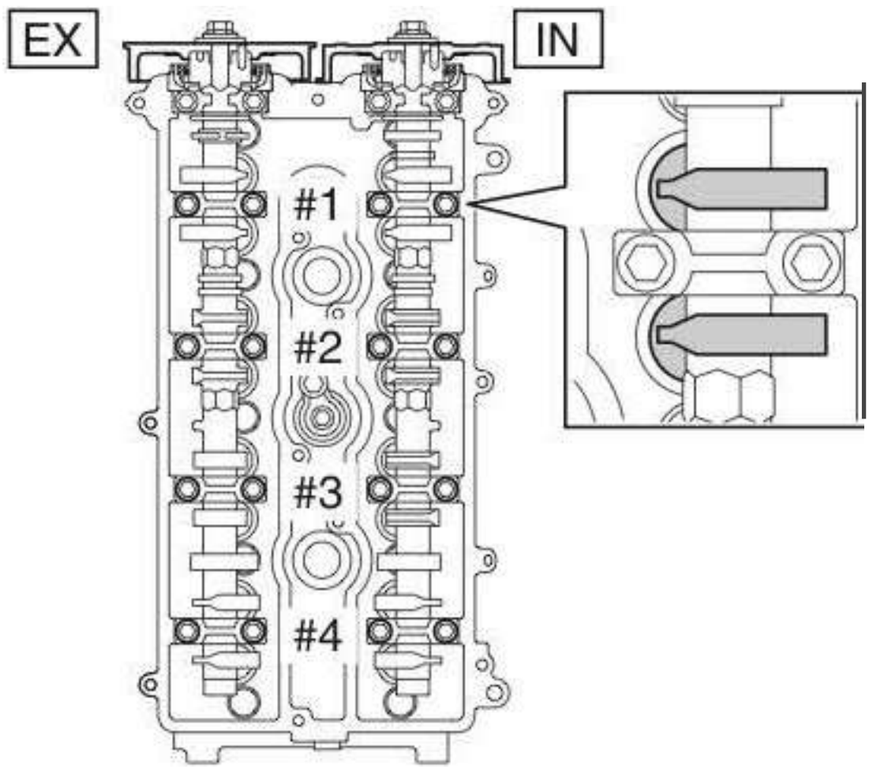


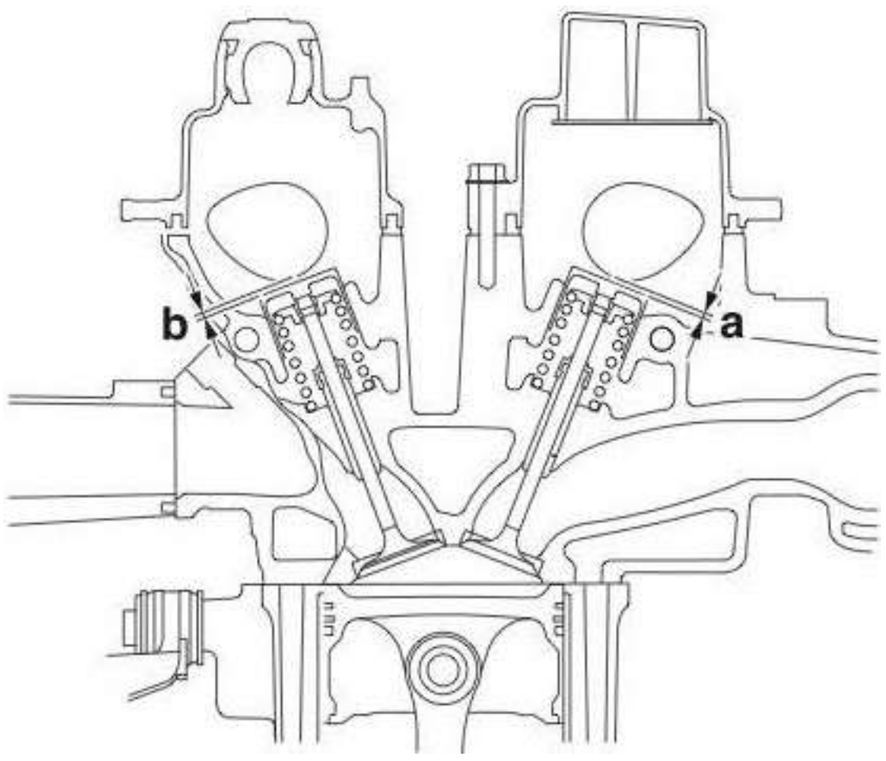


20. Measure the valve clearances "a" and "b" according to steps 20-22.

TIP:

Write down the measurement data.





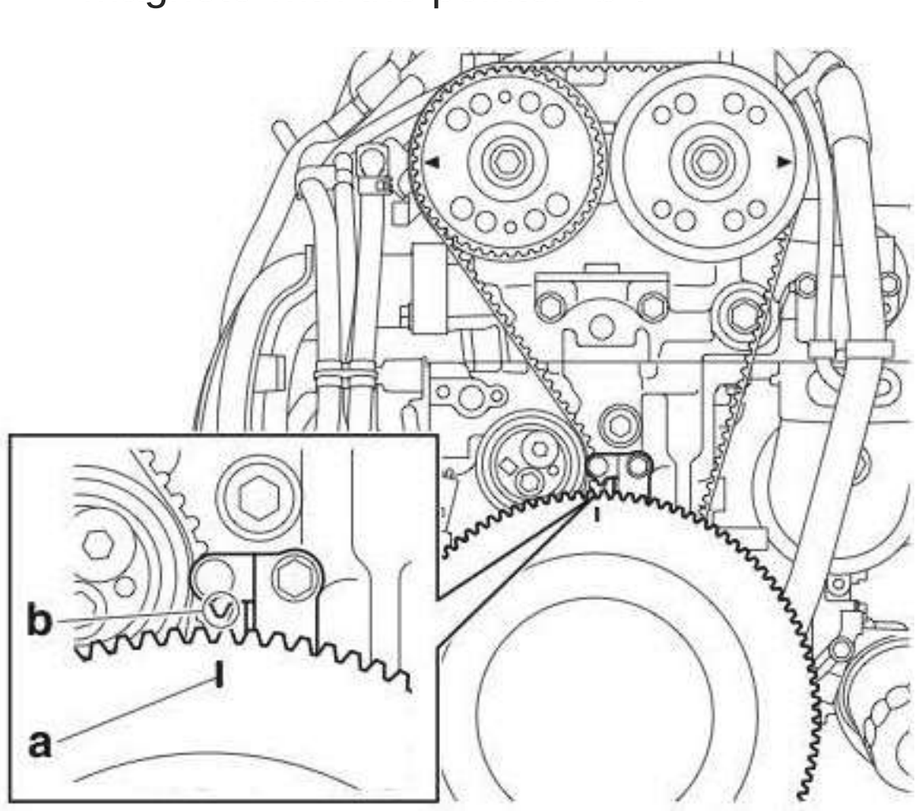
Valve clearance IN (cold engine)
0.17-0.24 mm (0.0067-0.0094 in)
Valve clearance EX (cold engine)
0.31-0.38 mm (0.0122-0.0150 in)

21. Measure the intake and exhaust valve clearances of the specified cylinders. Adjust if out of specification.

	#1	#2	#3	#4
IN	✓	✓	—	—
EX	✓	—	✓	—

—: Not applicable
✓: Specified cylinder

22. Turn the flywheel magneto clockwise 360° to align the mark "a" on the flywheel magneto with the pointer "b".

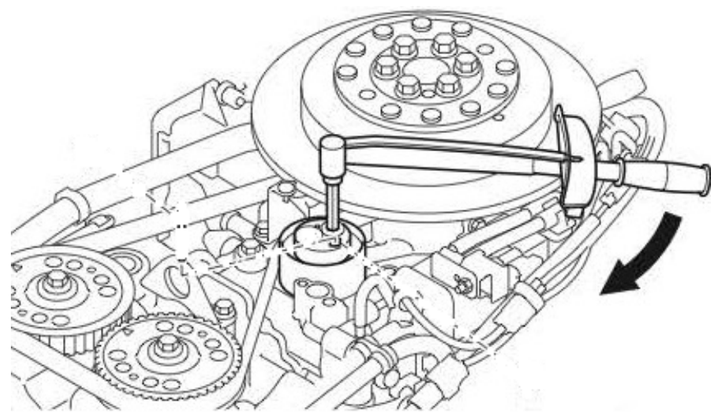


23. Measure the intake and exhaust valve clearances of the specified cylinders. Adjust if out of specification. See "Adjusting the valve clearance" (7-9).

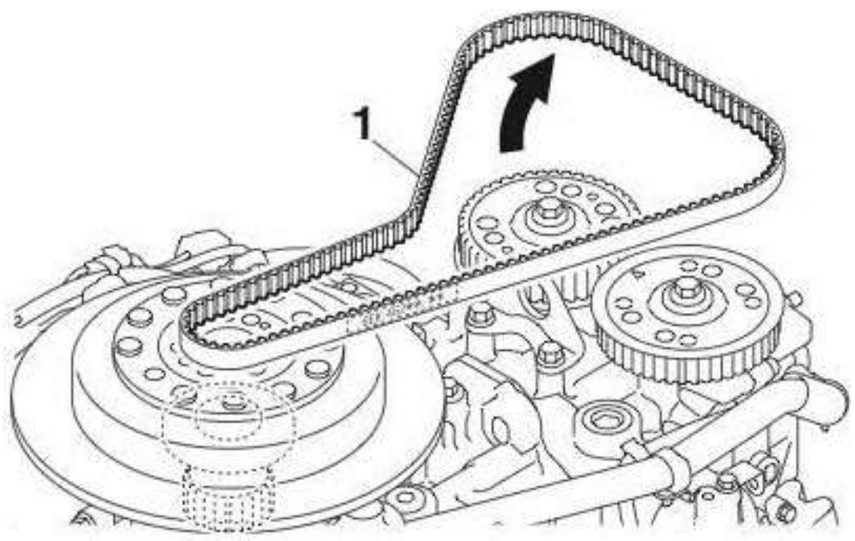
	#1	#2	#3	#4
IN	—	—	✓	✓
EX	—	✓	—	✓

—: Not applicable
✓: Specified cylinder

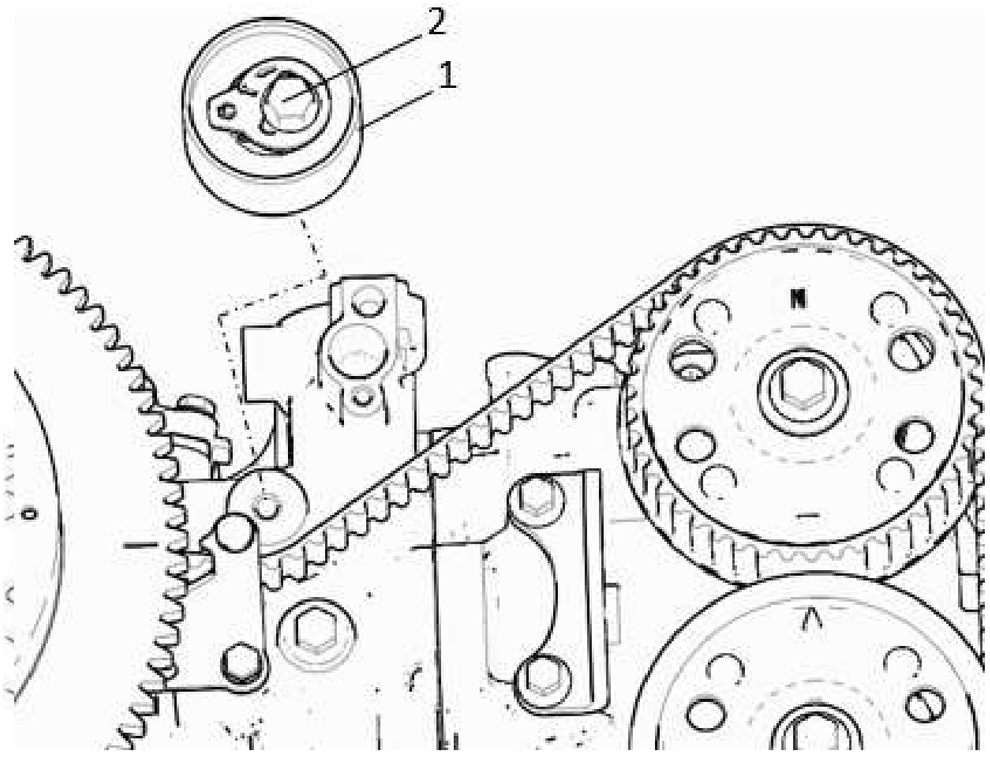
24. Loosen the bolt of the timing belt tensioner.



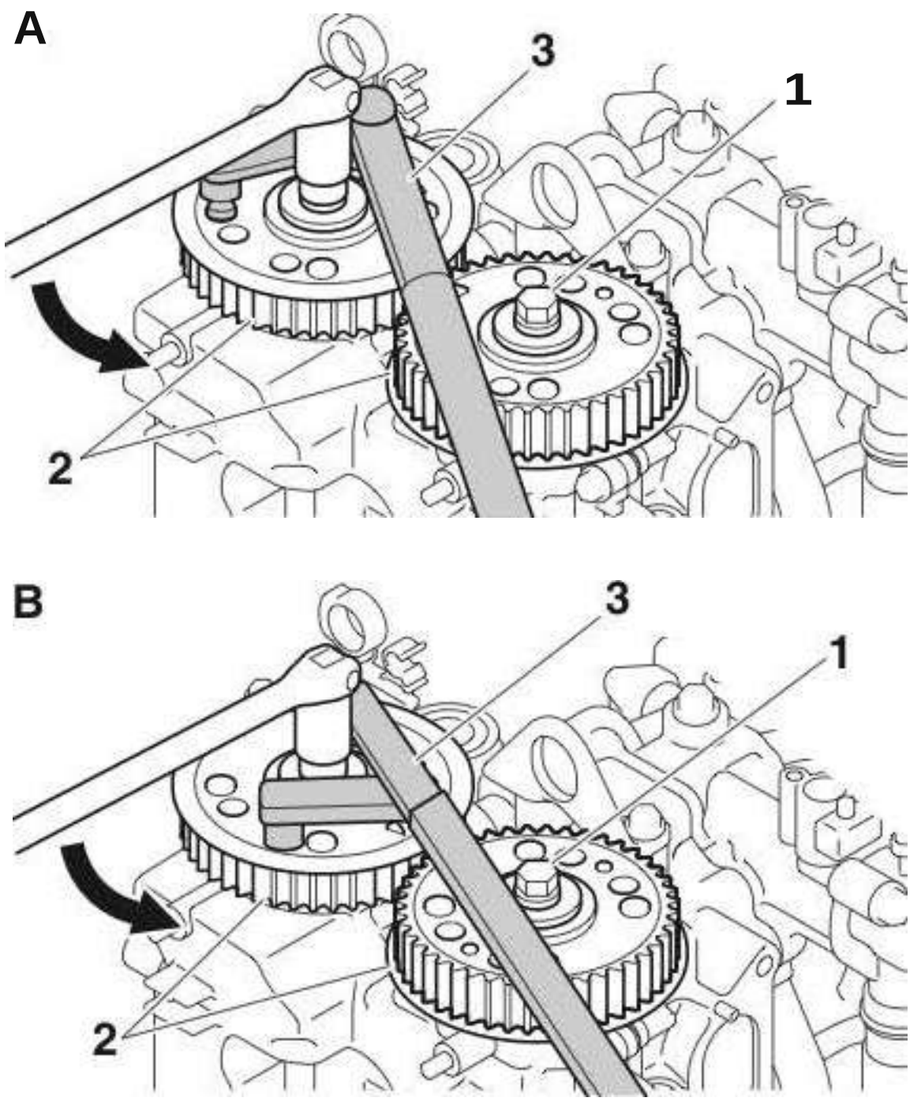
25. Remove the timing belt "1".



26. Remove the timing belt tensioner "1" along with the timing belt tensioner bolt "2".



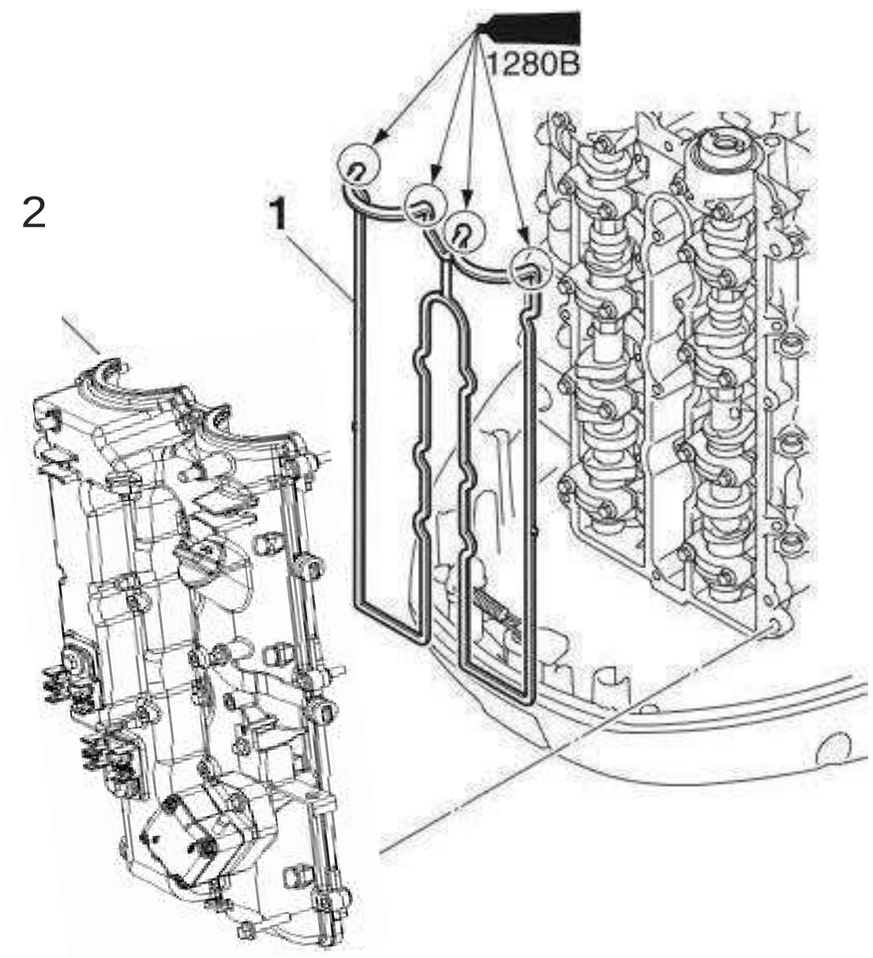
27. Loosen the driven sprocket bolts "1", and then remove the driven sprockets "2".



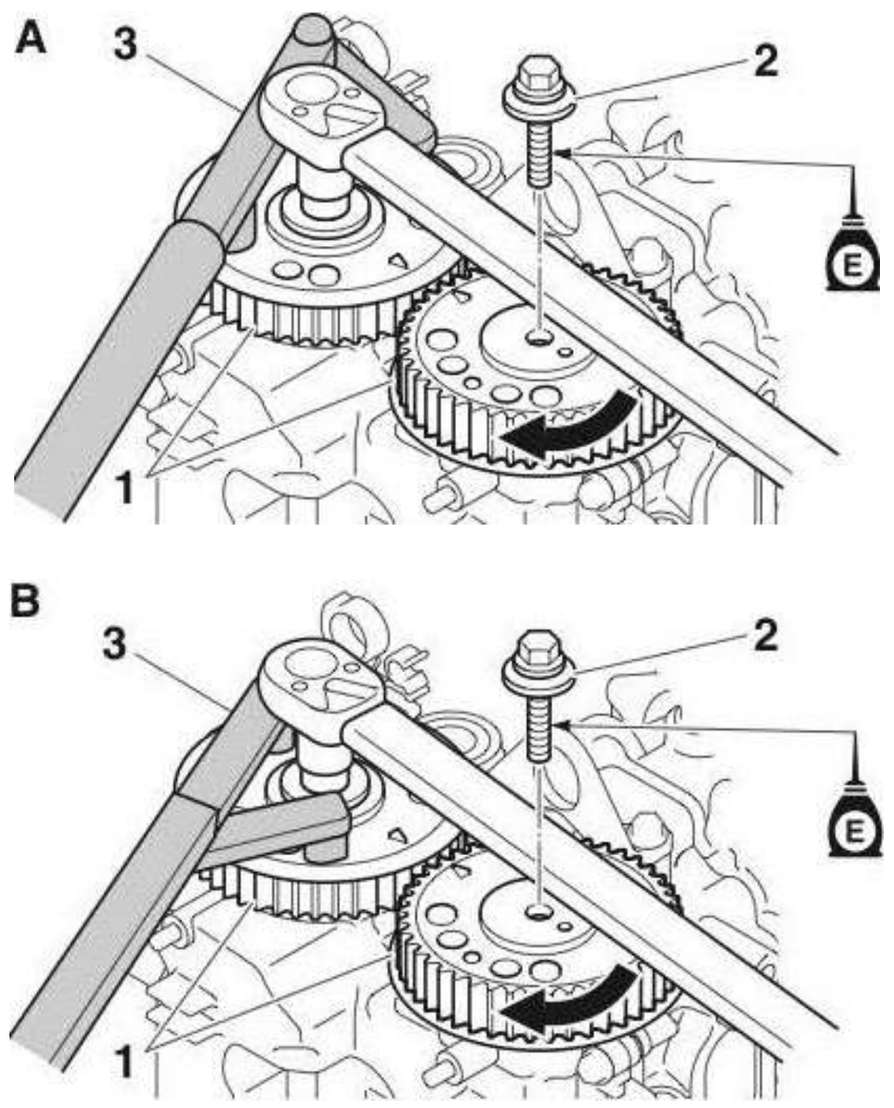
A. Worldwide
B. USA and Canada

Flywheel holder "3"
Flywheel magneto holder "3"

28. Install a new gasket "1" and the cylinder head cover "2".



29. Install the driven sprockets "1", and then tighten the driven sprocket bolts "2" to the specified torque.



A. Worldwide
B. USA and Canada

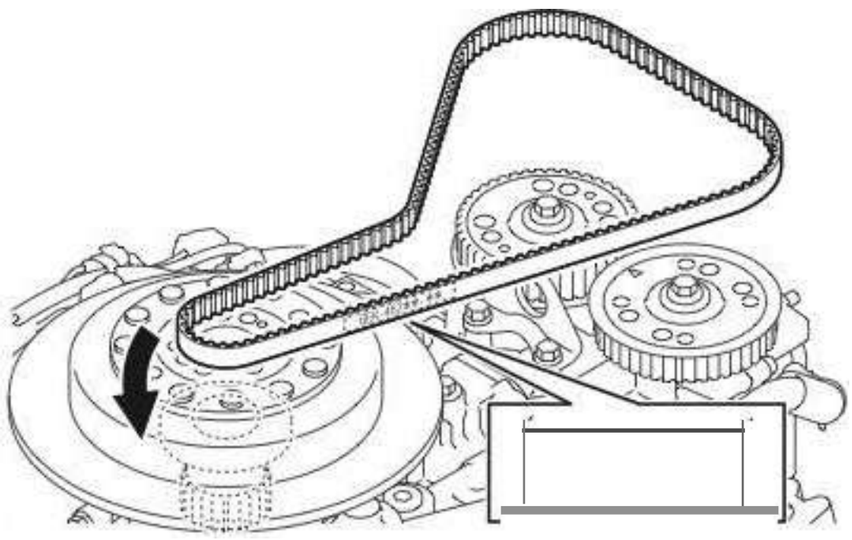
Flywheel holder "3"
Flywheel magneto holder "3"

Driven sprocket bolt "2"
60 Nm {6.0 kgf·m, 44.3 ft-lb)

30. Install the timing belt tensioner, and tighten the bolt, keep the force less than 2Nm.

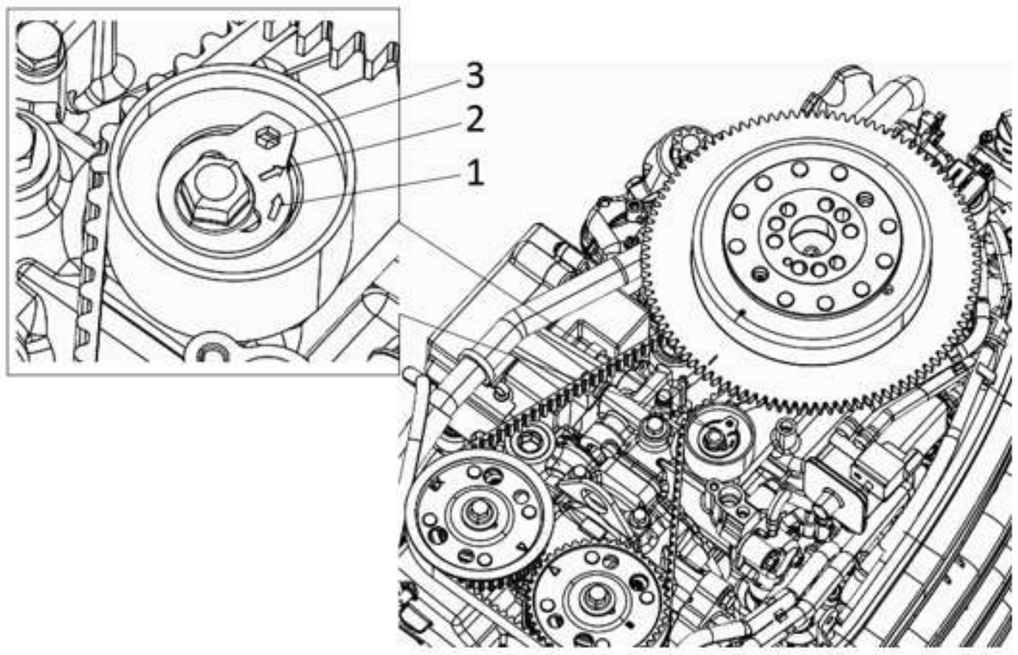
NOTICE

Do not apply grease or oil to the timing belt.



31. Turn the timing belt tensioner to limit position which keep the timing belt loosened. Then install the timing belt with its part number in the proper orientation, from the drive sprocket side to the port and starboard driven sprockets, in the counterclockwise direction.

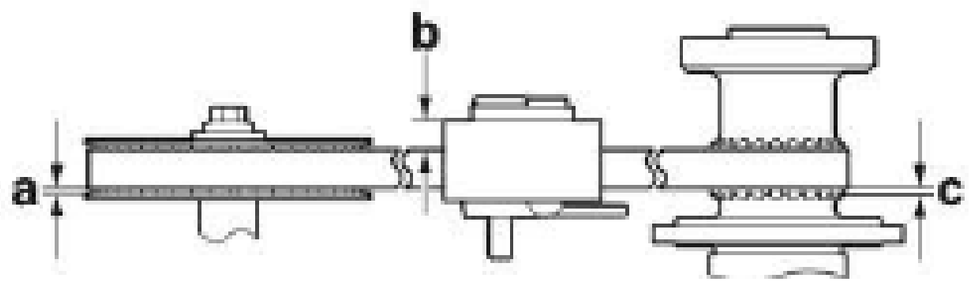
32. Using a hexagon wrench to turn the timing belt tensioner along the arrow 1 to make the arrow 2 align to the slot 3. Check the timing belt if be tensioned.



Timing belt tensioner bolt
35 Nm {3.5 kgf·m, 25.8 ft-lb)

33. Tighten the timing belt tensioner bolt.

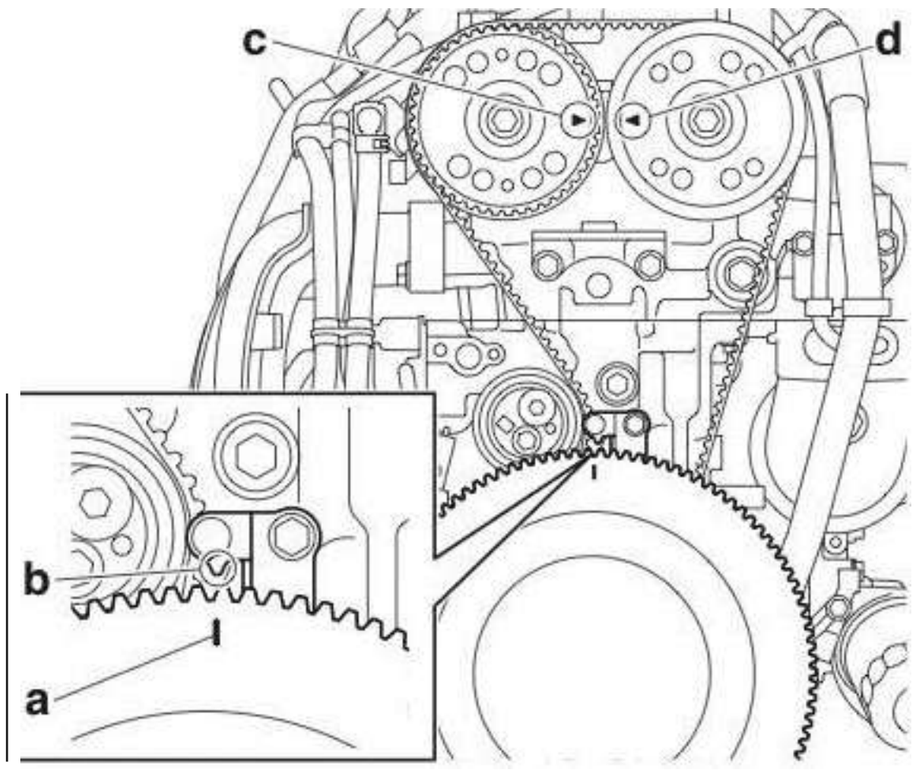
34. Adjust the timing belt to the specified installation height "a", "b", and "c".



Timing belt installation height
"a": 0.75 mm {0.03 in)
"b": 4.75 mm {0.2 in)
"c":0.75 mm {0.03 in)

35. Make sure that the mark "a" on the flywheel magneto is aligned with the pointer "b", and that the "▲" marks "c" and "d" on the driven sprockets are aligned.

36. Turn the flywheel magneto clockwise 2 full turns, and then check that the marks are aligned.



37. Install the spark plugs, and then tighten them to the specified torque.

Spark plug
25 Nm (2.5 kgf·m, 18.4 ft·lb)

38. Connect the spark plug wires "1".

39. Connect the ignition coil couplers "a" and"b".

40. Fasten the main wire harness using the clamp "2".

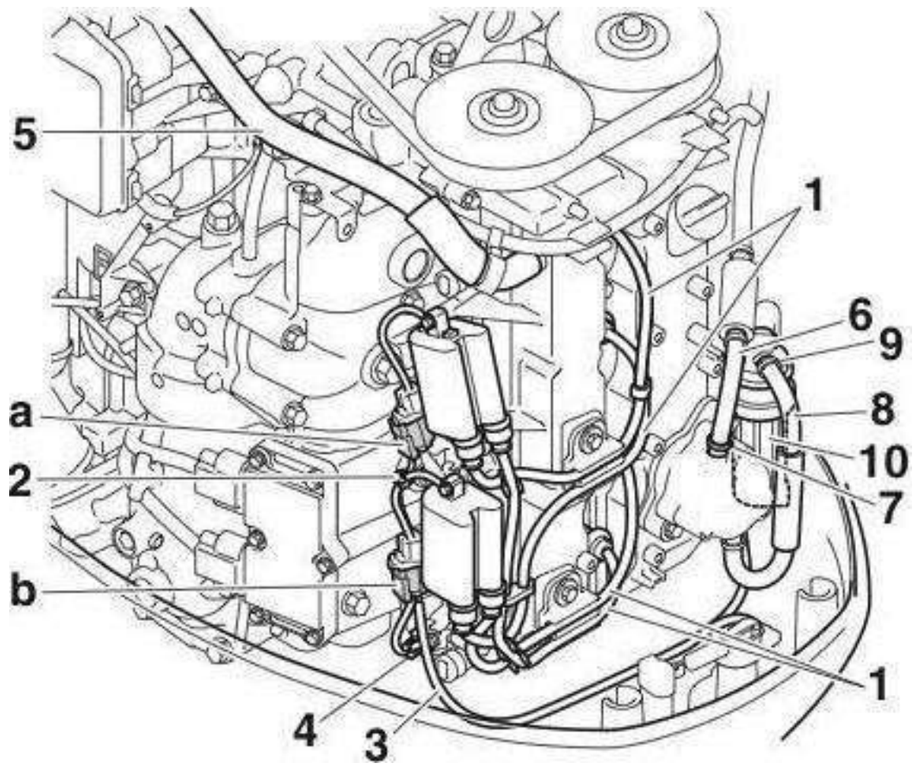
41. Install the main wire harness "3" to the holder "4".

42. Connect the blow by hose "5".

43. Connect the fuel hose "6" to the fuel pump, and then fasten it using the plastic tie "7".

44. Connect the fuel hose "8" to the fuel filter, and then fasten it using the plastic tie "9".

45. Install the fuel filter "10".



Adjusting the valve clearance

Adjust the valve clearances when the engine is cold.

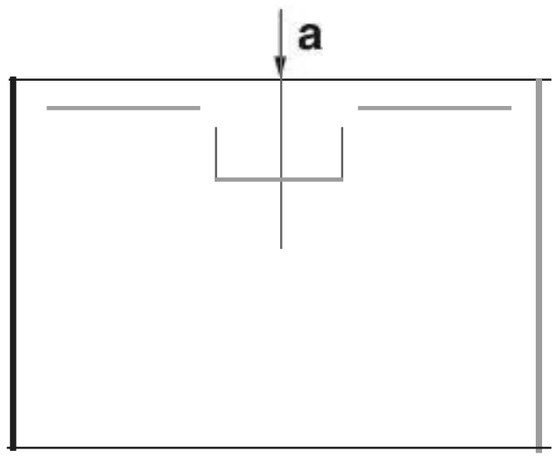
NOTICE

Do not turn the flywheel magneto counter-clockwise. Otherwise, the water pump impeller could be damaged.

1. Remove the cylinder head cover. See steps 1-12 in "Checking the valve clear- ance" (7-3).

2. Remove the camshaft caps, camshafts and valve lifters. See step 4 in "Removing the driven sprocket and camshaft" (7-48).

3. Measure the valve lifter thickness "a", and then write down the measurement data.



4. Select the necessary valve lifter by calculating its thickness using the following formula.

Calculation formula:
Necessary valve lifter thickness= Removed valve lifter thickness + Measured valve clearance – Specified valve clearance

Example:
Remove valve lifter thickness =
3.000 mm
Measured valve clearance= 0.30 mm
Specified valve clearance = 0.20 mm
Necessary valve lifter thickness
= 3.000 mm + 0.30 mm - 0.20 mm
= 3.100 mm

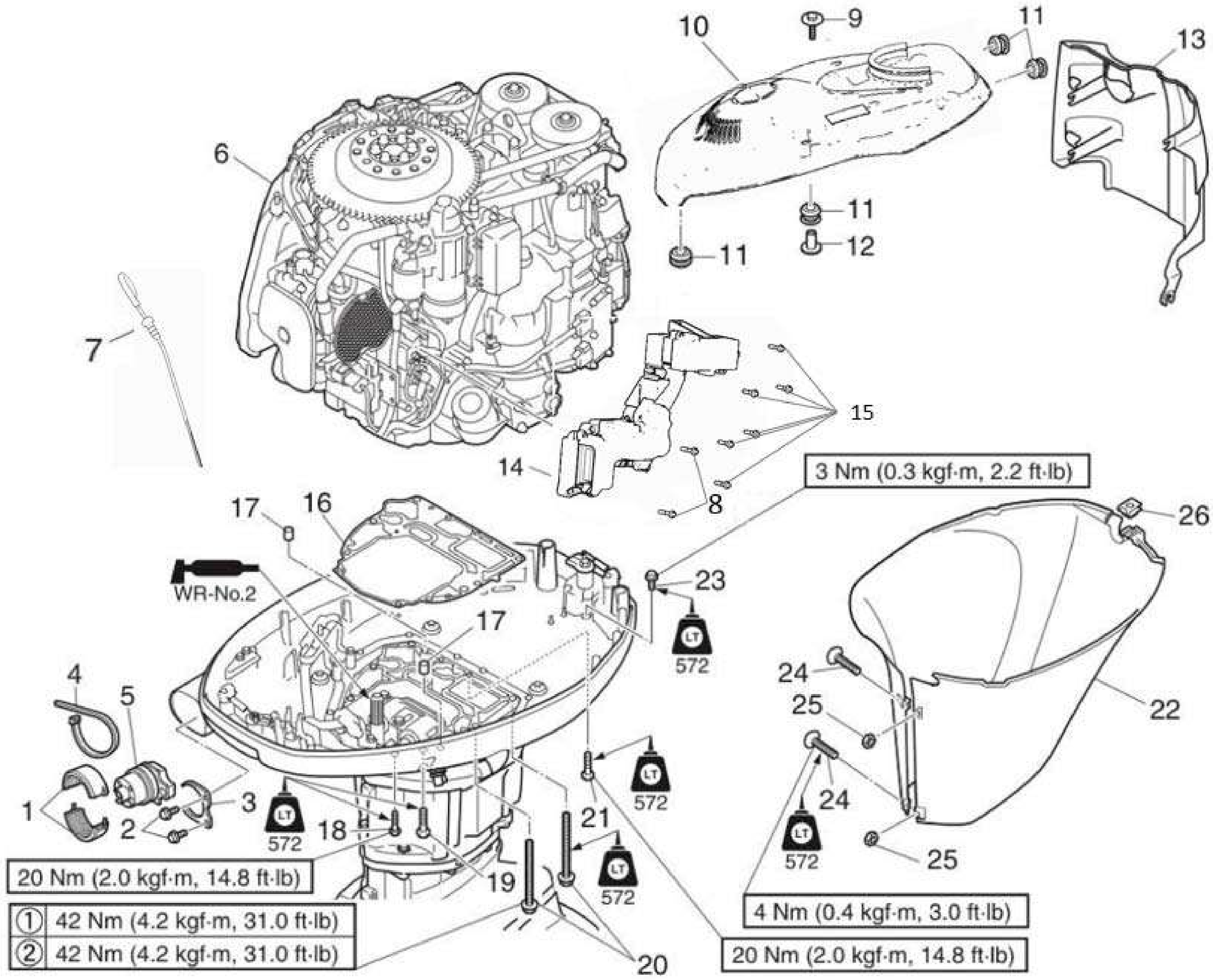
5. Install the necessary valve lifter into the cylinder head, and then install the camshafts and camshaft caps. See steps 2-8 in "Installing the camshaft and driven sprocket" (7-51).

6. Install the driven sprockets and timing belt. See steps 13-18 in "Checking the valve clearance" (7-3).

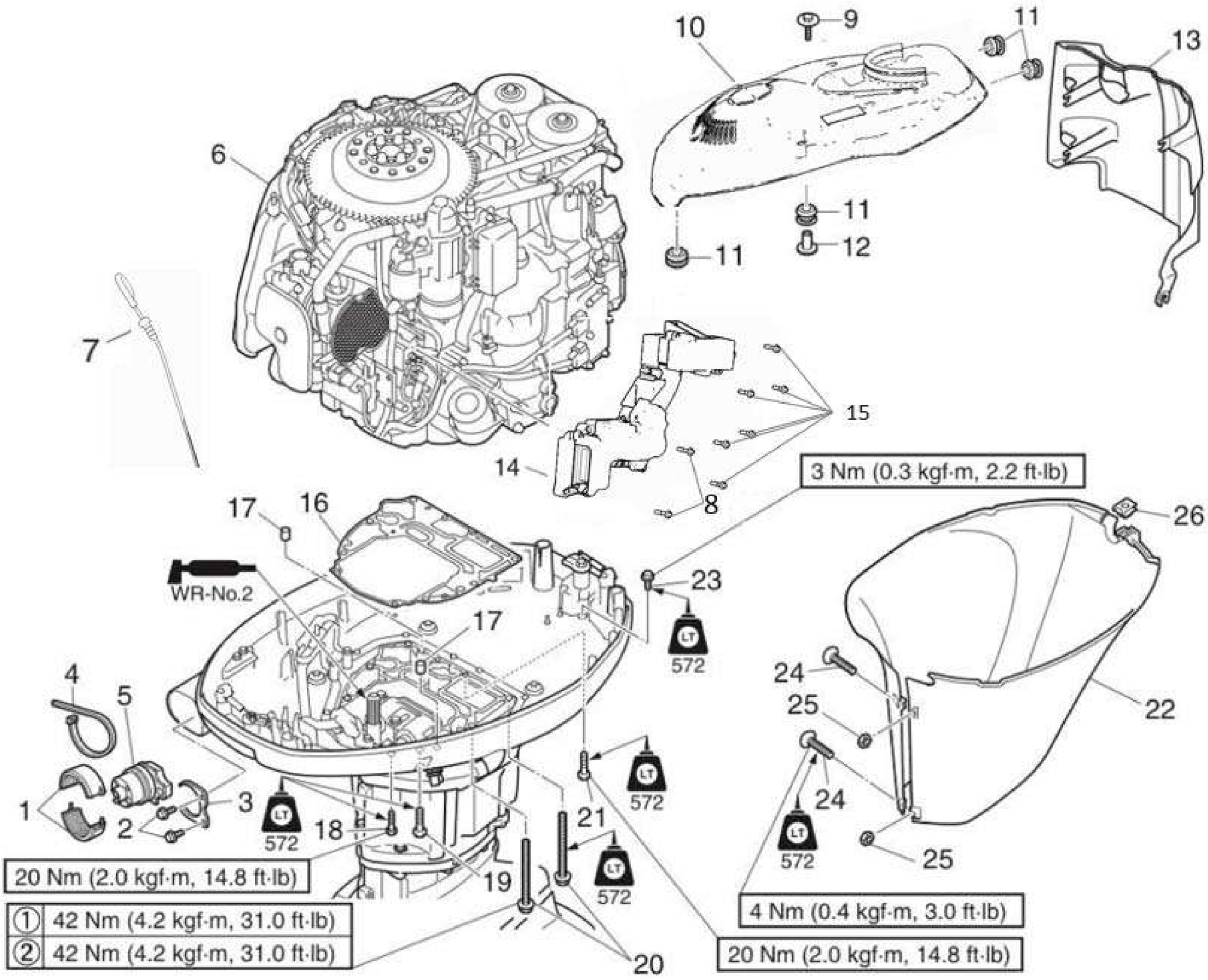
7. Measure the valve clearances. See steps 19-22 in "Checking the valve clearance" (7-3).

8. Install the cylinder head cover. See steps 23-45 in "Checking the valve clearance" (7-3).

Power unit assembly



No.	Part name	Q'ty	Remarks
1	Rigging tube retainer	1	
2	Bolt	2	M6 x 20 mm
3	Grommet holder	1	
4	Plastic tie	1	
5	Rigging grommet	1	
6	Power unit assembly	1	
7	Dipstick	1	
8	Bolt	3	M6 x 35 mm
9	Bolt	1	M6 x 30 mm
10	Cover	1	
11	Grommet	4	
12	Collar	1	
13	Cover	1	
14	Cover	1	
15	Bolt	4	M6 x 30 mm
16	Gasket	1	Not reusable
17	Dowel pin	2	

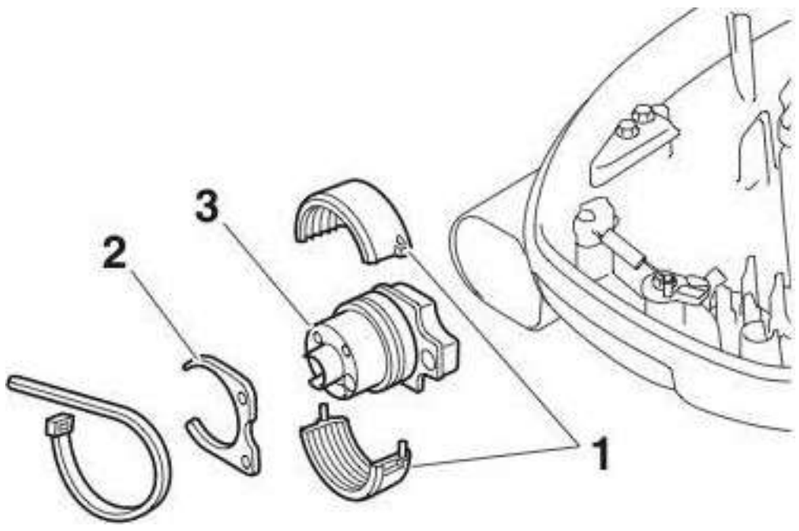


No.	Part name	Q'ty	Remarks
18	Bolt	2	M8 x 35 mm
19	Bolt	2	M10 x 45 mm
20	Bolt	4	M10 x 140 mm
21	Bolt	2	M8 x 35 mm
22	Apron	1	
23	Screw	1	M6 x 20 mm
24	Screw	2	M6 x 40 mm
25	Nut	2	M6
26	Nut	1	

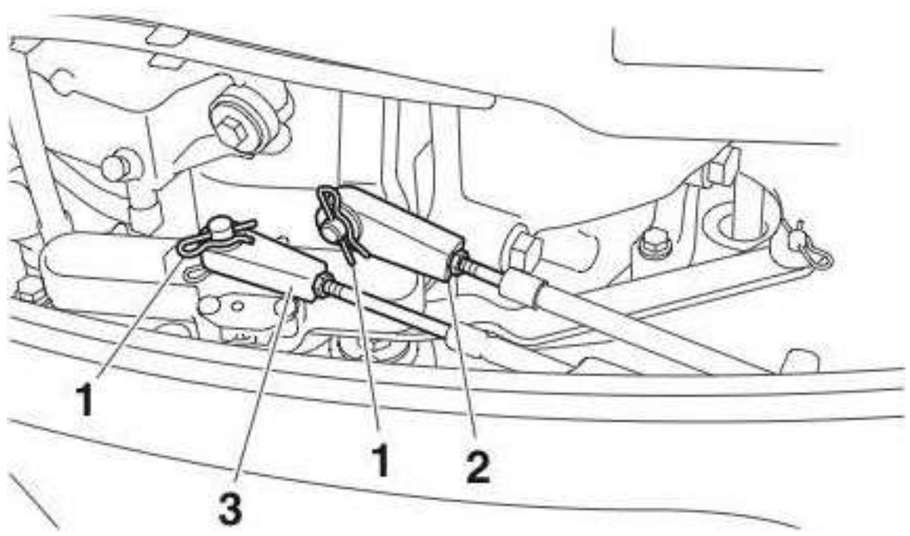
Removing the power unit

Cover the fuel components using a rag to prevent fuel from spilling out.

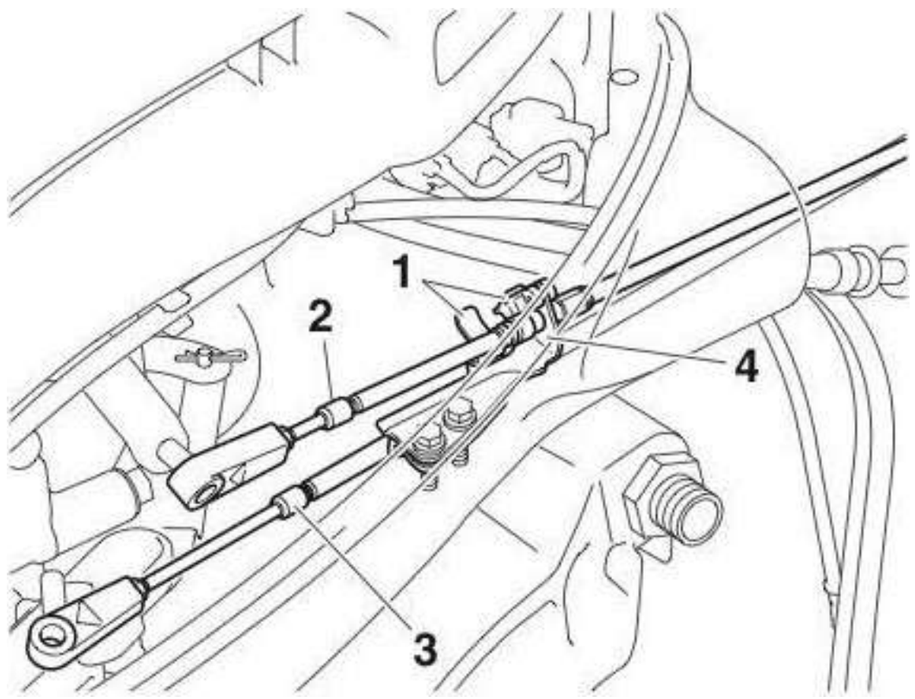
1. Remove the rigging tube retainer "1", grommet holder "2", and rigging grommet "3".



2. Remove the clips "1", throttle cable "2", and shift cable "3".

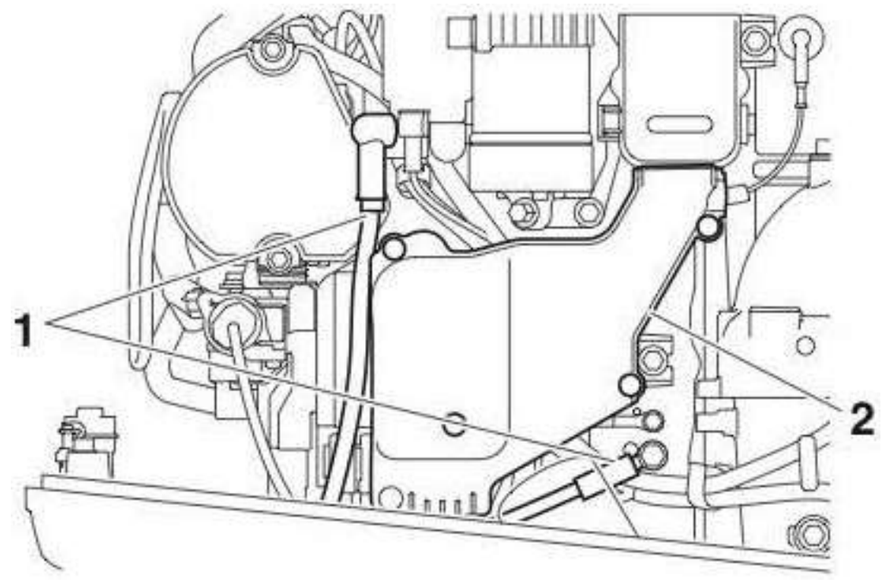


3. Release the holders "1" and then remove the throttle cable "2" and shift cable "3" from the cable holder "4".

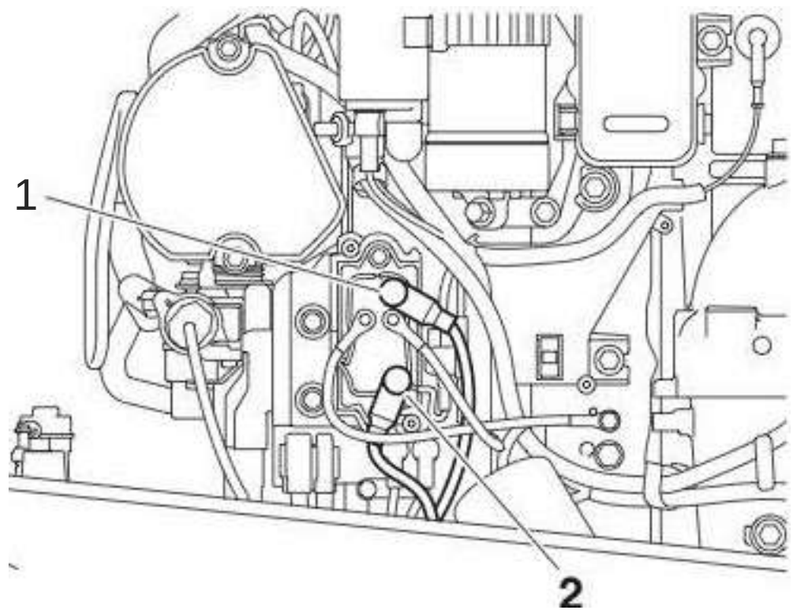


4. Disconnect the battery cables "1".

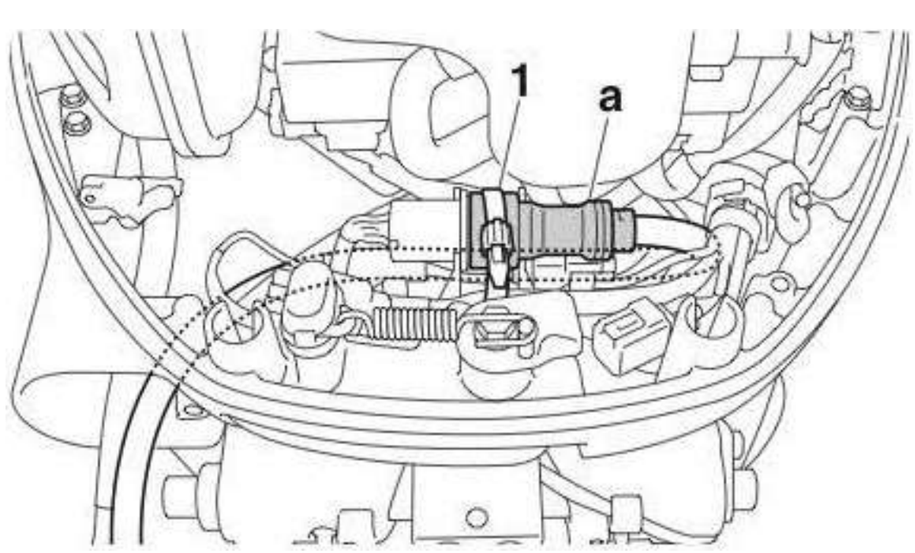
5. Remove the PIT relay cover "2".



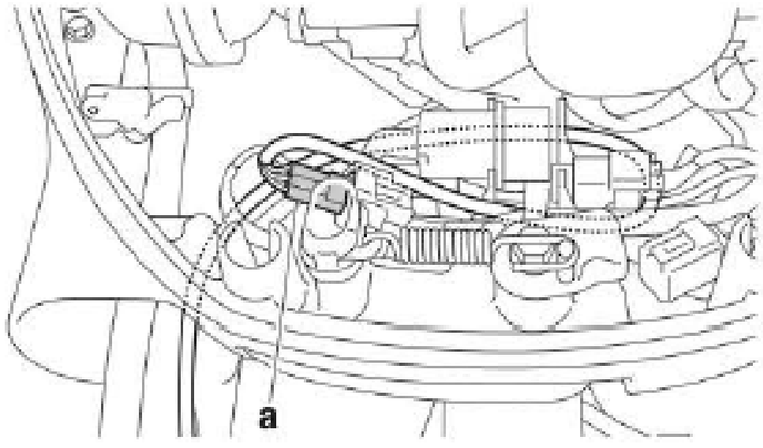
6. Disconnect the PIT motor leads "1" and "2".



7. Remove the holder "1", and then disconnect the main wire harness coupler "a".

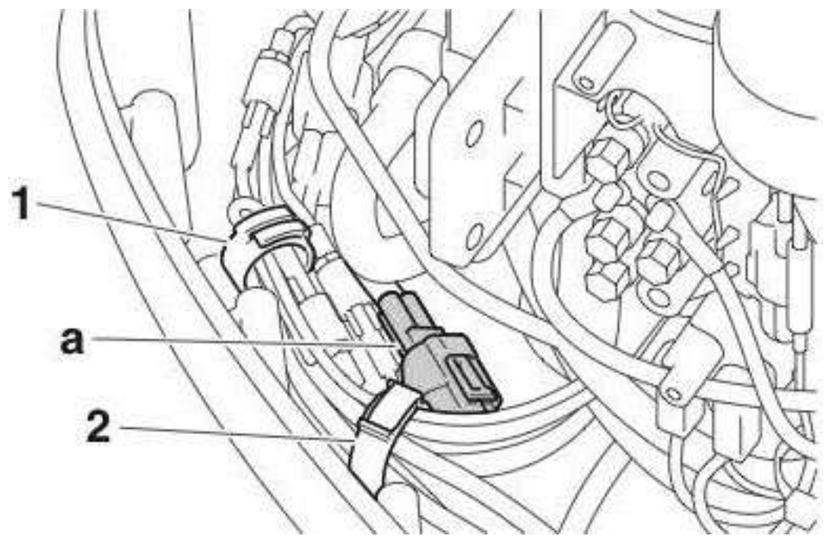


8. Disconnect the trolling switch harness coupler "a" (if equipped).



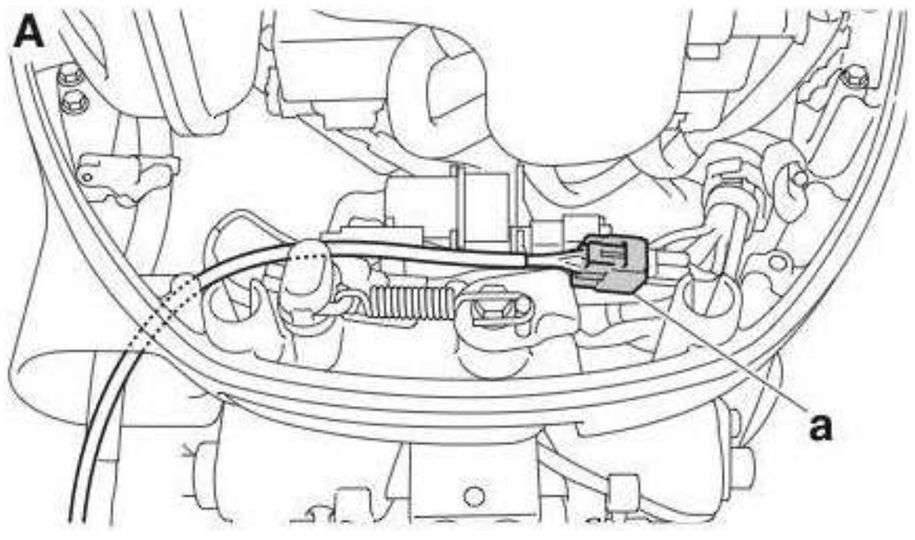
9. Remove the wire harness from the clamps "1" and "2".

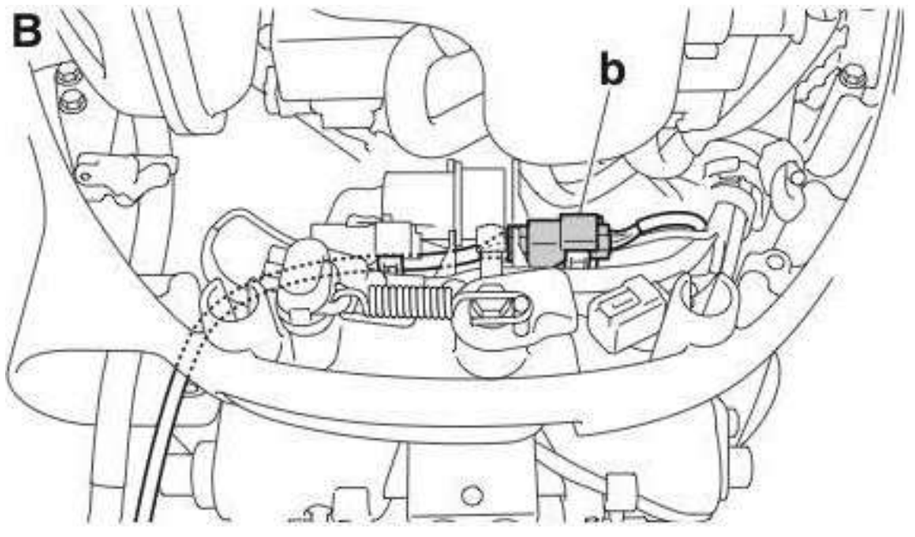
10. Disconnect the PTT switch coupler "a".



11. Remove the 6Y8 multifunction meter harness coupler "a" or gauge harness coupler "b" from the bracket.

12. Disconnect the multifunction meter harness coupler "a" or gauge harness coupler "b".

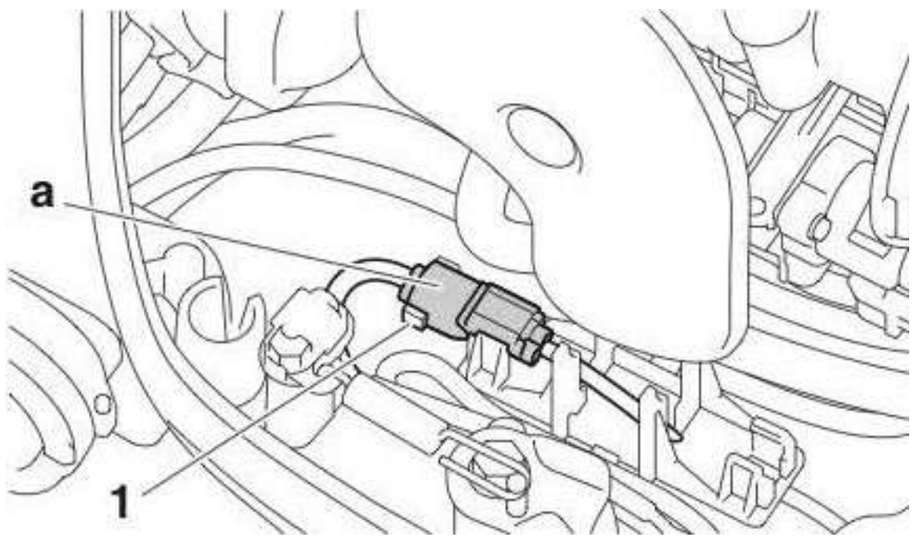




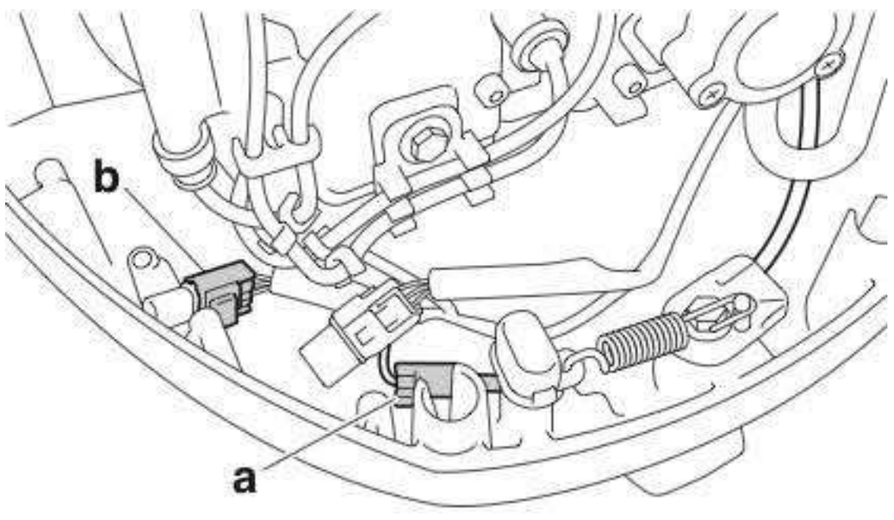
A. 6Y8 multifunction meter
B. Conventional gauge (tiller handle)

13. Remove the trim sensor coupler "a" from the bracket "1".

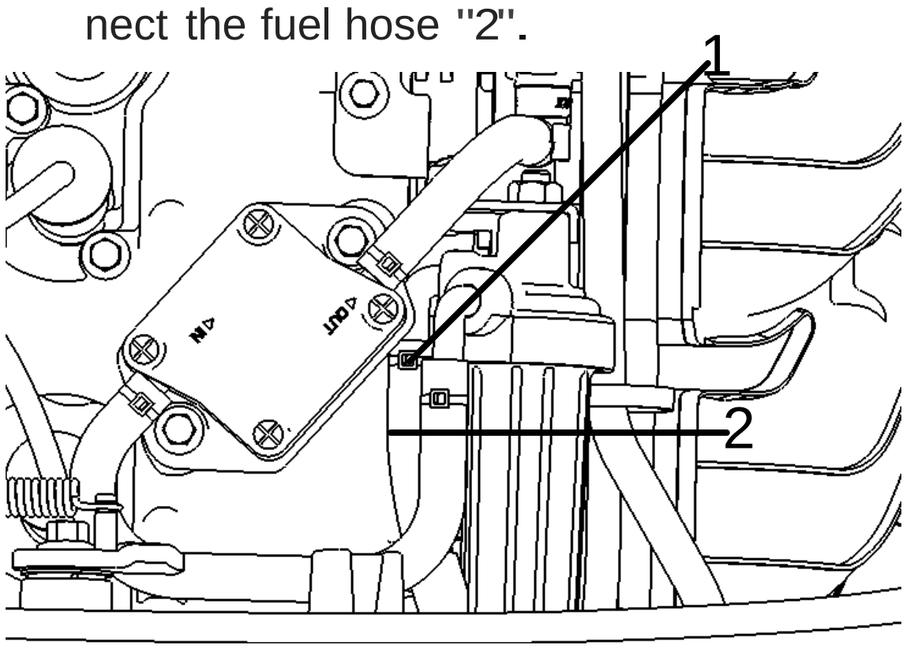
14. Disconnect the trim sensor coupler "a".



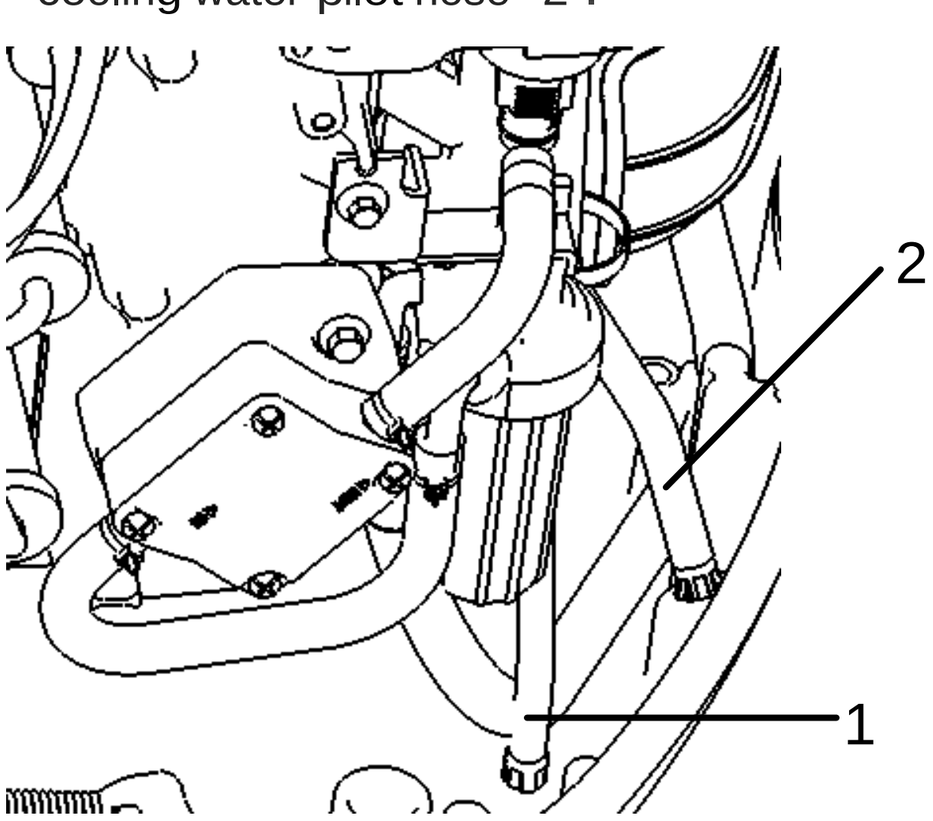
15. Disconnect the water detection switch coupler "a" and speed sensor coupler "b".



16. Remove the holder "1", and then disconnect the fuel hose "2".

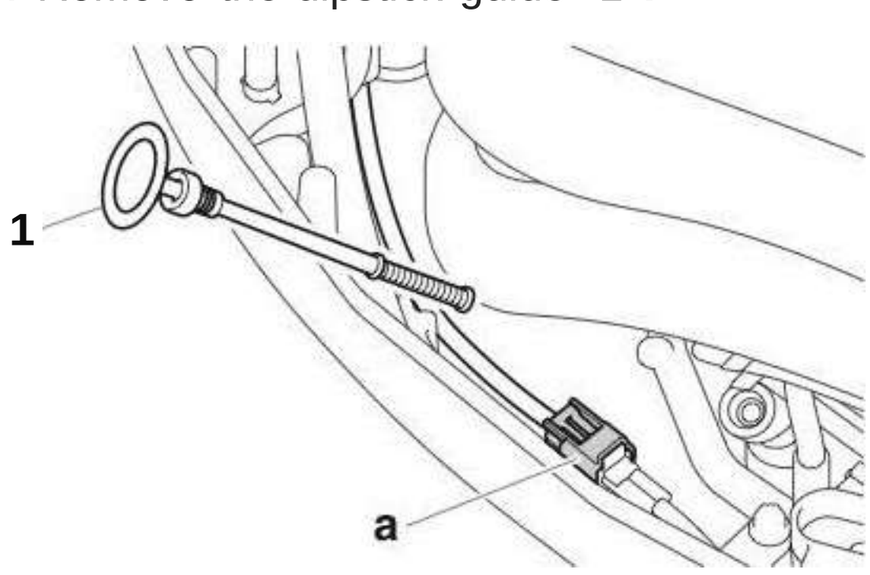


17. Disconnect the vapor gas hose "1" and cooling water pilot hose "2".

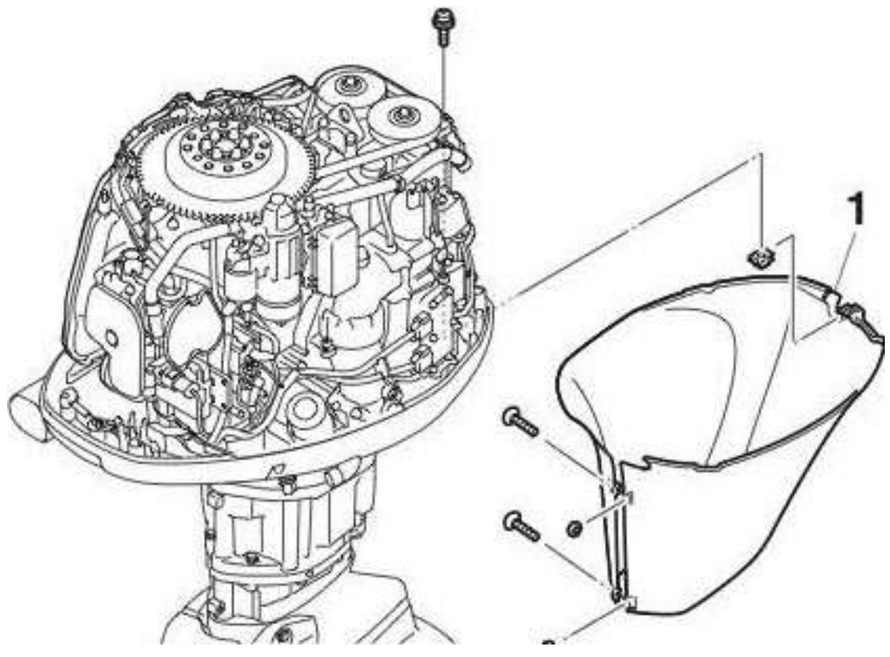


18. Disconnect the shift position switch coupler "a".

19. Remove the dipstick guide "1".



20. Remove the apron "1".



21. Attach the special service tool "1" to prevent the flywheel magneto from turning.

TIP:

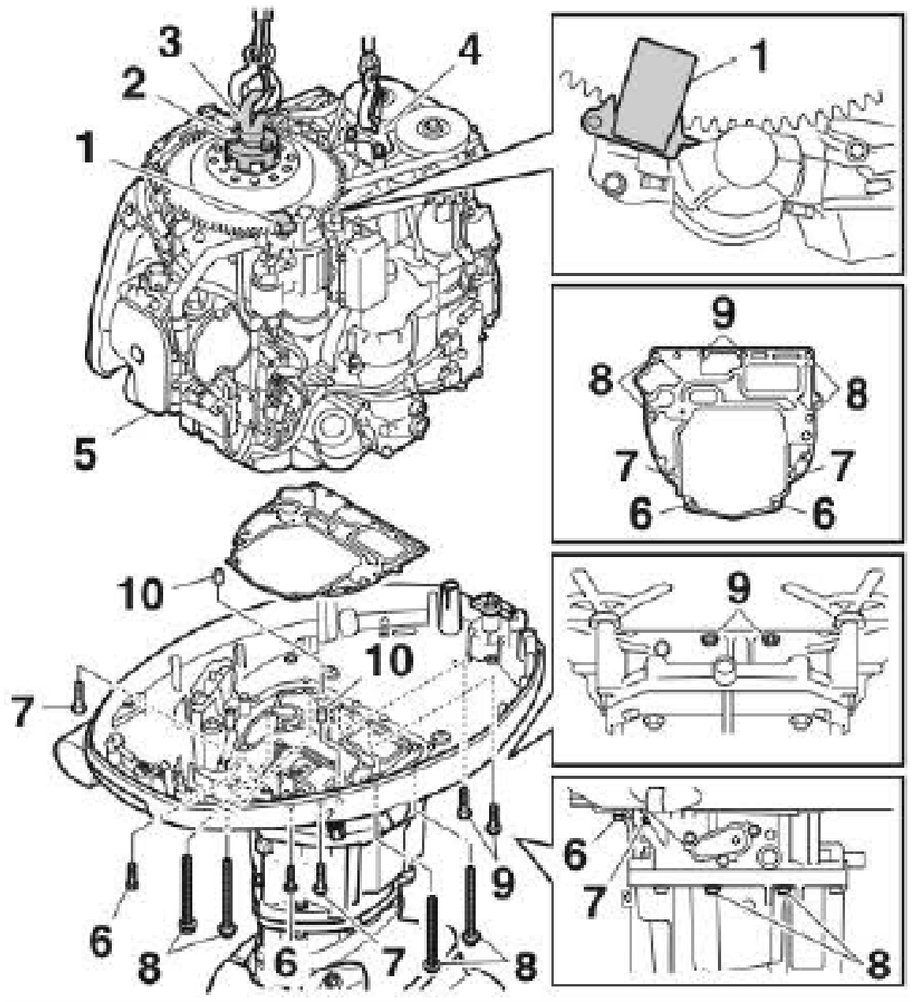
The special service tool "1" is installed to tighten the lifting eye bolts "2" to the specified torque.

22. Install the special service tool "3" to the flywheel magneto, and then tighten the lifting eye bolts "2" to the specified torque.

23. Remove the special service tool "1" from the flywheel magneto.

24. Hook a lifting harness onto the special service tool "3" and engine hanger "4", and then suspend the power unit "5".

25. Remove the power unit mounting bolts "6", "7", "8", and "9", and then remove the power unit "5" and dowel pins "10".



Flywheel stopper B "1"

Flywheel stopper B "1"

Engine lifting eye "3"

Engine lifting eye "3"

Lifting eye bolt "2"
36 Nm (3.6 kgf·m, 26.6 ft·lb)

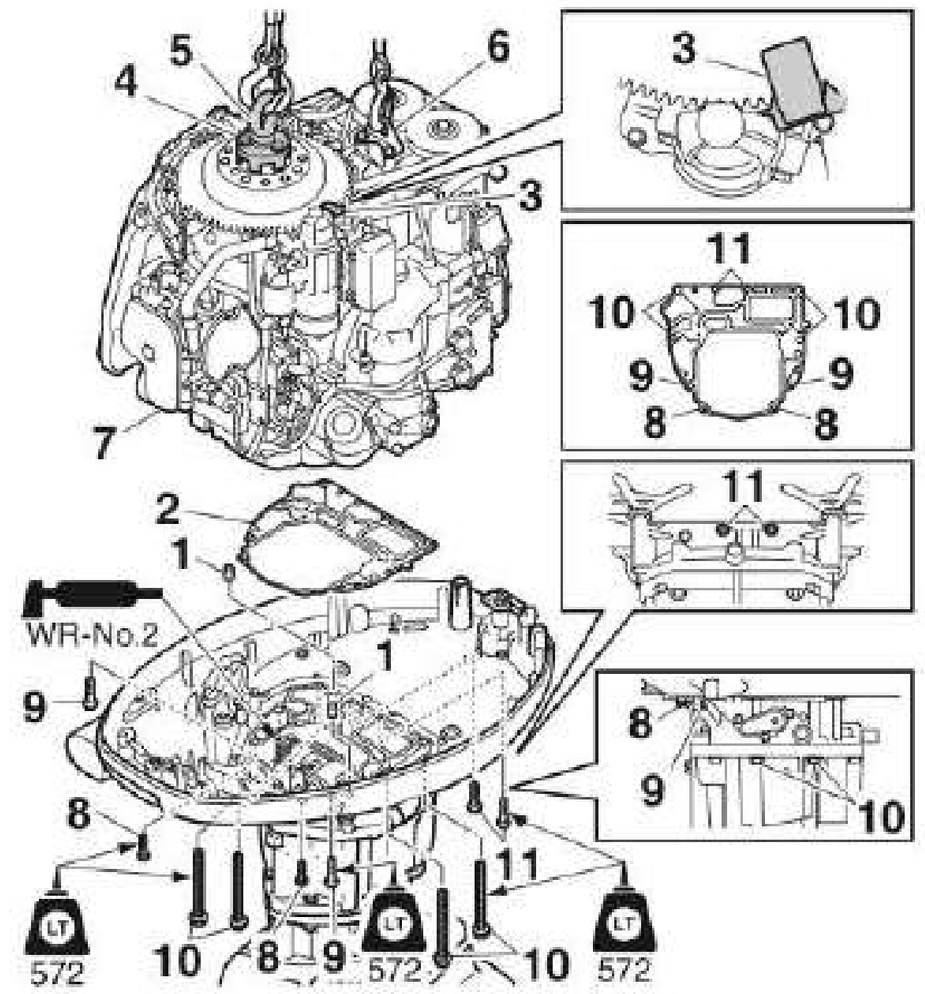
Installing the power unit

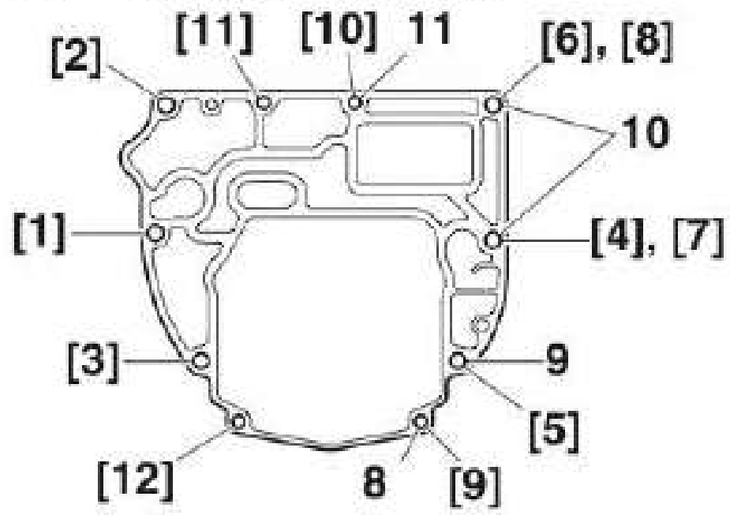
1. Clean the power unit mating surface, and then install the dowel pins "1" and a new gasket "2".
2. Attach the special service tool "3" to prevent the flywheel magneto from turning.

TIP:
The special service tool "3" is installed to tighten the lifting eye bolts "4" to the specified torque.

3. Install the special service tool "5" to the flywheel magneto, and then tighten the lifting eye bolts "4" to the specified torque.
4. Remove the special service tool "3" from the flywheel magneto.

5. Hook a lifting harness onto the special service tool "5" and engine hanger"6", and then suspend the power unit "7".
6. Install the power unit "7", and then tighten he power unit mounting bolts "8", "9", "10", and "11" to the specified torque in the order [1], [2], and so on.





Flywheel stopper B "3"

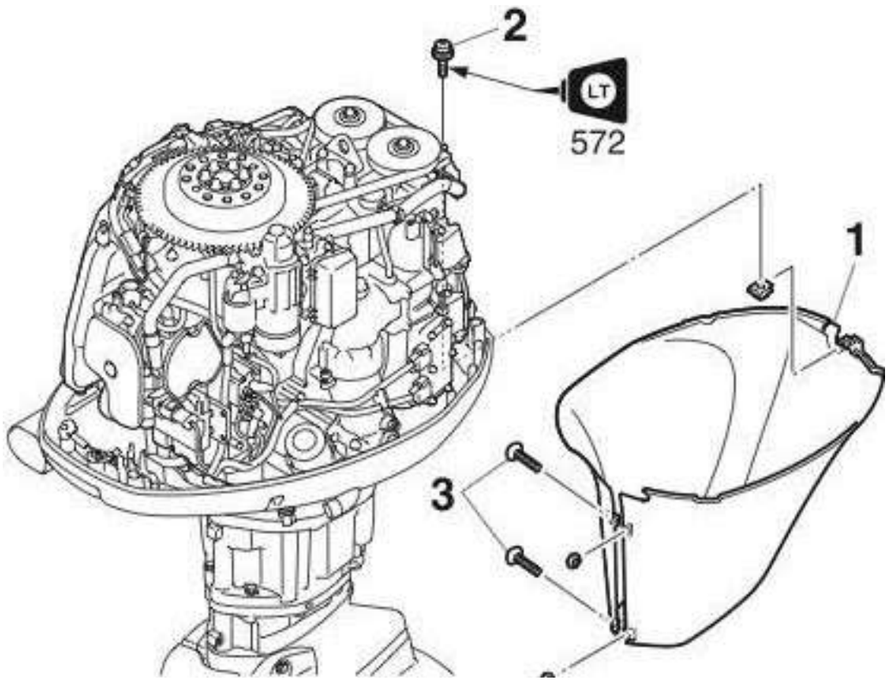
Flywheel stopper B "3"

Engine lifting eye "5"

Engine lifting eye "5"

Lifting eye bolt "4" 36 Nm (3.6 kgf·m, 26.6 ft-lb) Power unit mounting bolt (M8) "8" and "11" 20 Nm (2.0 kgf·m, 14.8 ft·lb) Power unit mounting bolt (M10) "9" and "10" 1st: 42 Nm (4.2 kgf·m, 31.0 ft-lb) 2nd: 42 Nm (4.2 kgf·m, 31.0 ft-lb)

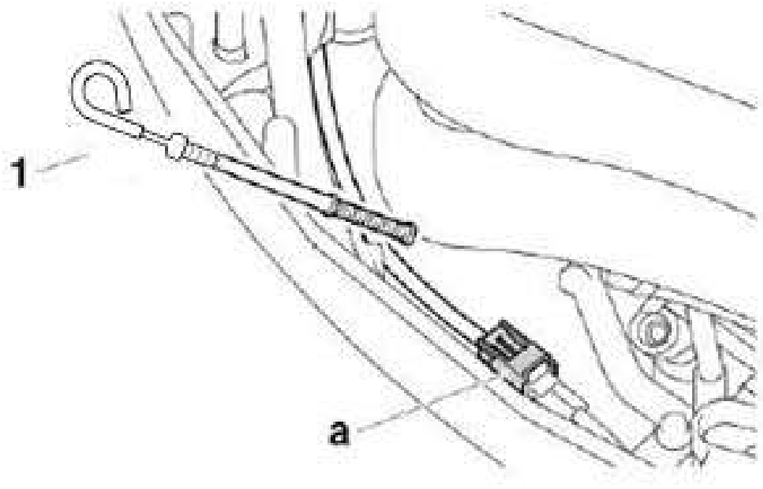
7. Install the apron "1", and then tighten the apron screws "2" and "3" to the specified torque.



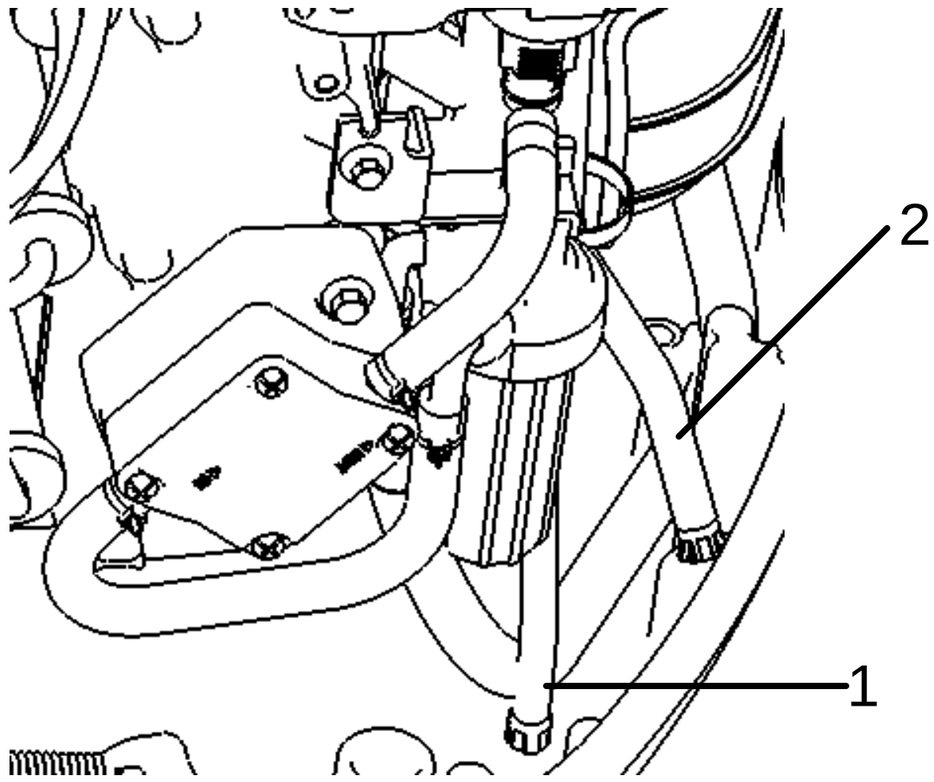
Apron screw "2" 3 Nm (0.3 kgf·m, 2.2 ft-b) Apron screw "3" 4 Nm (0.4 kgf·m, 3.0 ft·lb)

8. Install the dipstick "1".

9. Connect the shift position switch coupler "a".



10. Connect the vapor gas hose "1" and cooling water pilot hose "2".

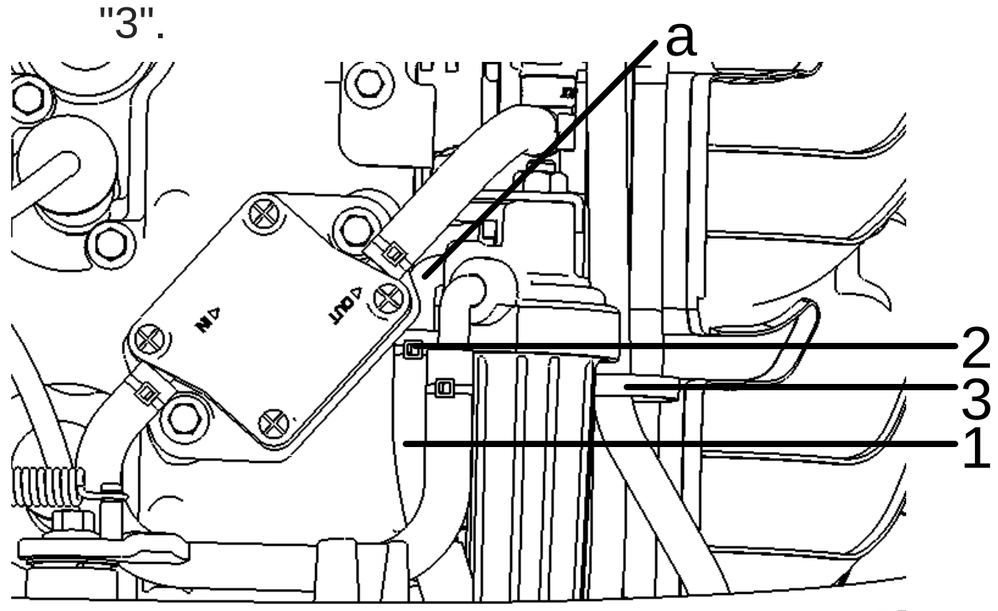


11. Connect the fuel hose "1", and then fasten it using the plastic tie "2".

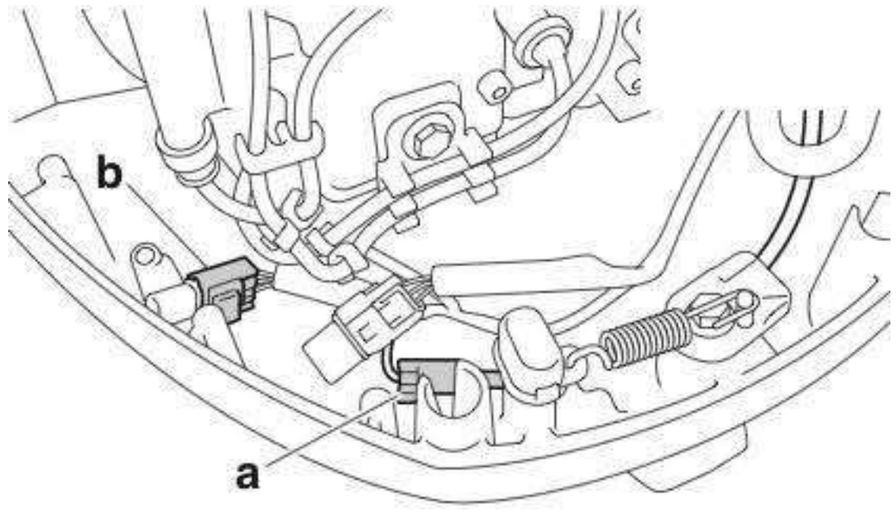
TIP:

Connect the fuel hose "1" to the fuel filter so that the yellow paint mark "a" on the fuel hose is engine side.

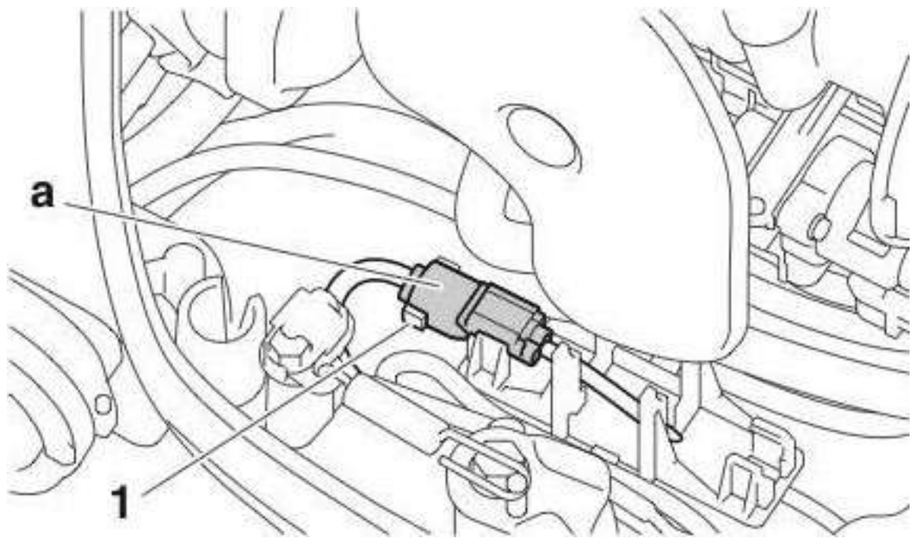
12. Fasten the fuel hose "1" using the holder "3".



13. Connect the water detection switch coupler "a" and speed sensor coupler "b".

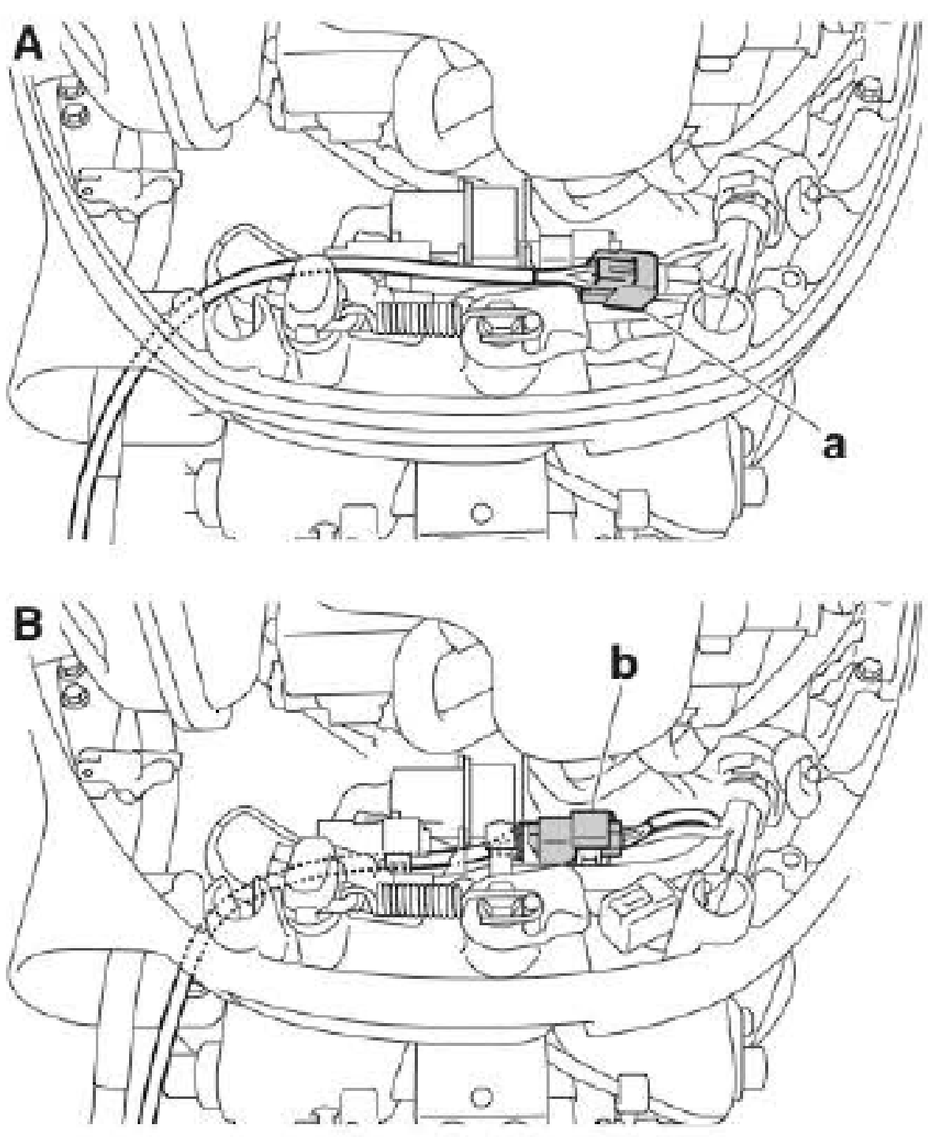


14. Connect the trim sensor coupler "a", and then install the trim sensor coupler "a" to the bracket "1".



15. Connect the 6Y8 multifunction meter harness coupler "a" or gauge harness coupler "b".

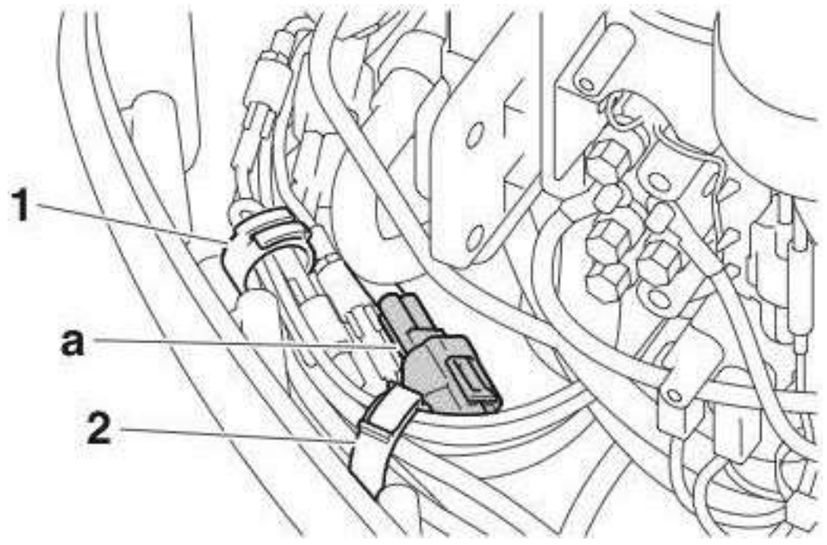
16. Install the 6Y8 multifunction meter harness coupler "a" or gauge harness coupler "b".



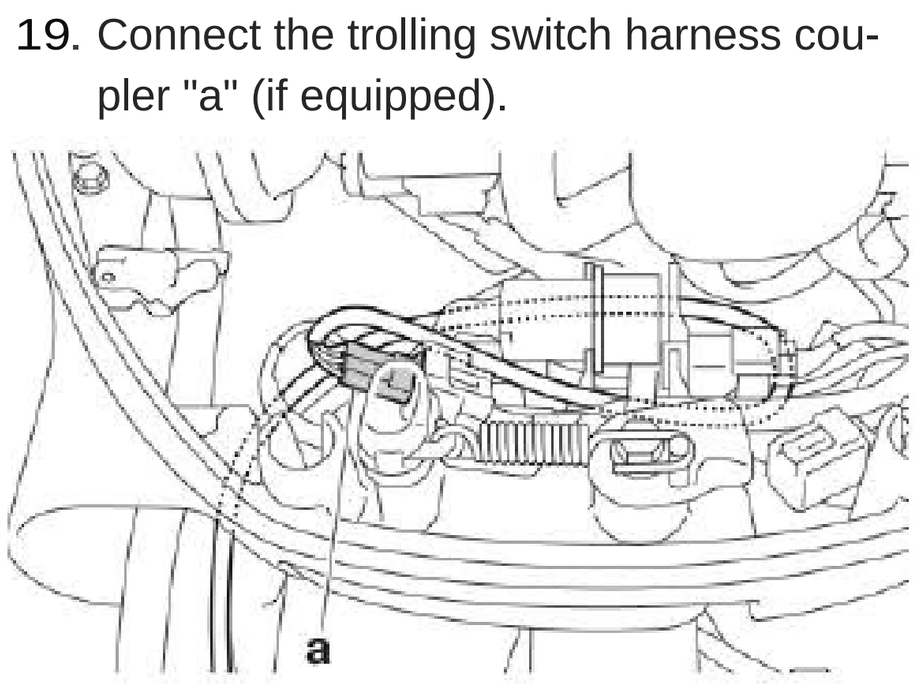
A. 6Y8 multifunction meter
B. Conventional gauge (tiller handle)

17. Connect the PTT switch coupler "a".

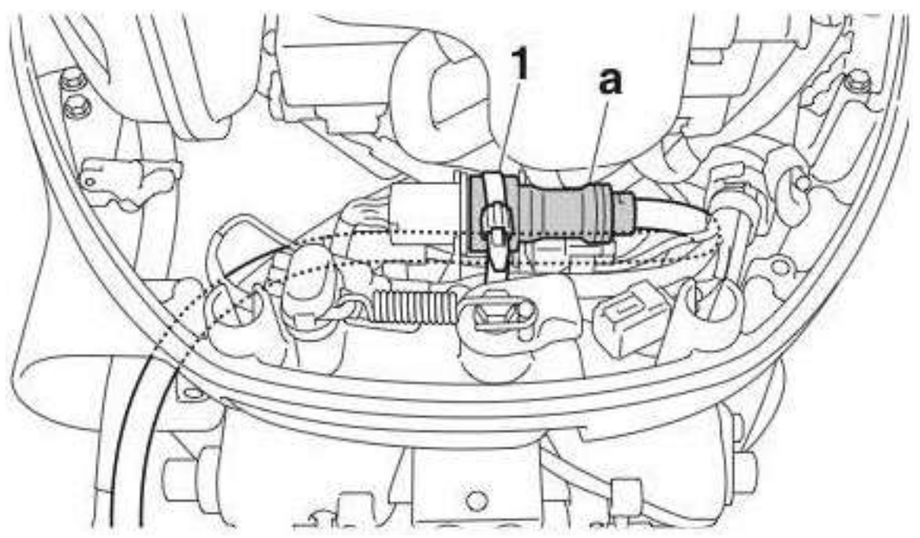
18. Fasten the wire harness using the holder "1" and clamp "2".



19. Connect the trolling switch harness coupler "a" (if equipped).

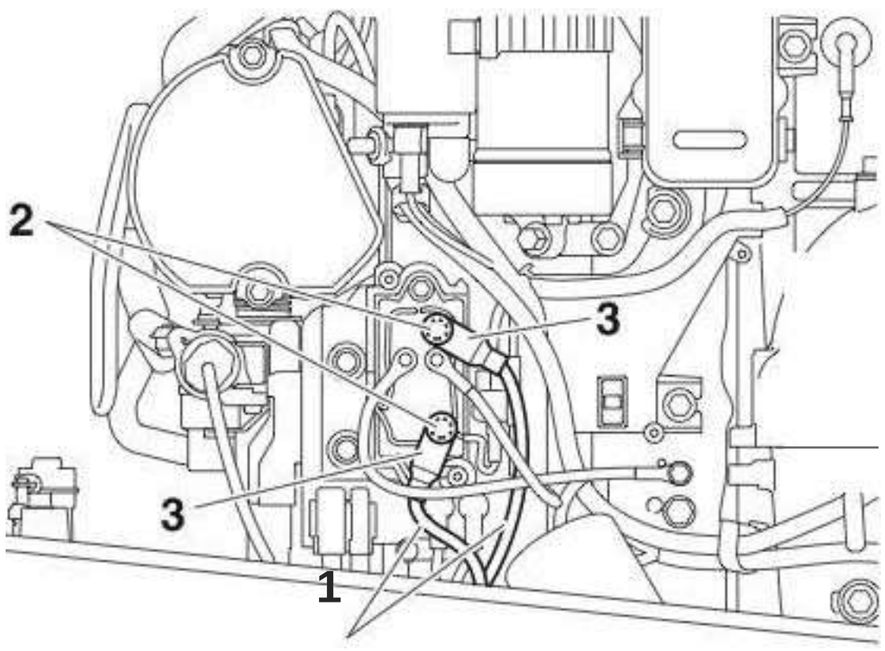


20. Connect the main wire harness coupler "a", and then fasten it using the holder "1".



21. Connect the PTT motor leads "1", and then tighten the PTT motor lead bolts "2" to the specified torque.

22. Install the caps "3".



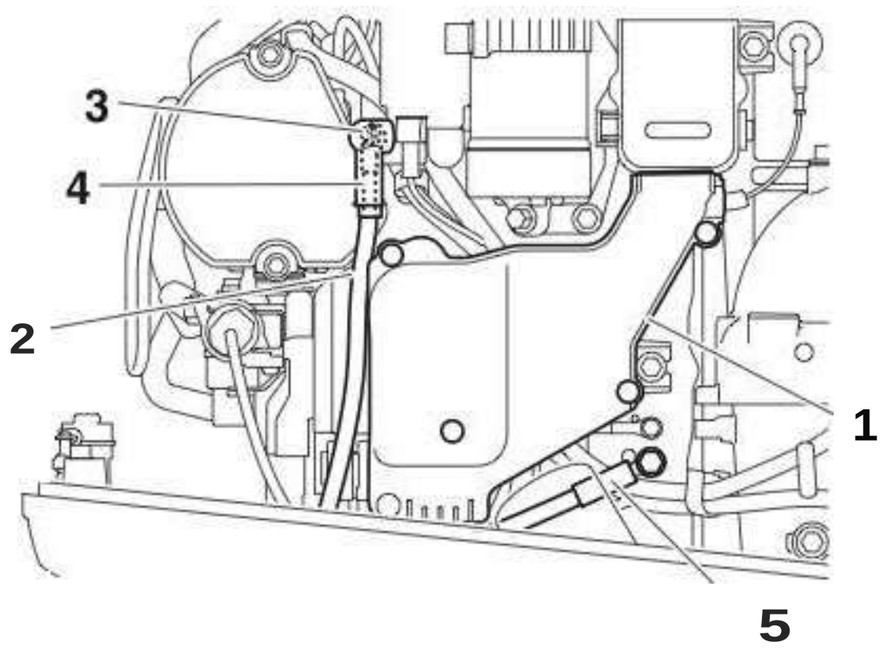
PTT motor lead bolt "2"
3.5 Nm (0.35 kgf·m, 2.58 ft·lb)

23. Install the PTT relay cover "1".

24. Connect the positive battery cable "2", and then tighten the positive battery cable nut "3" to the specified torque.

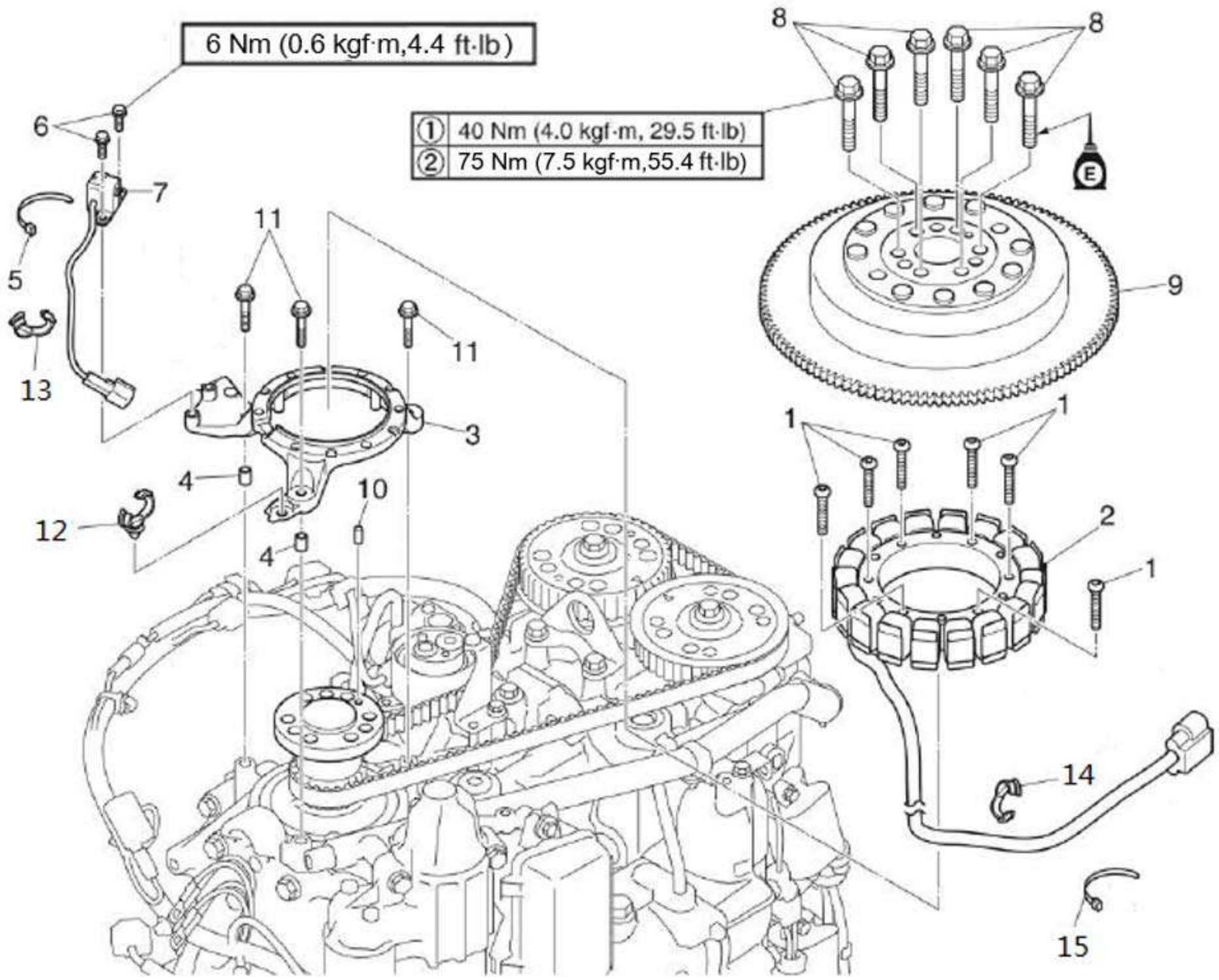
25. Install the rubber cap "4".

26. Install the negative battery cable "5".



Positive battery cable nut "3"
9 Nm (0.9 kgf·m, 6.6 ft·lb)

27. Install the throttle cable. See "Installing the throttle cable" (3-10).



Flywheel magneto

No.	Part name	Q'ty	Remarks
1	Bolt	6	M6 × 35 mm
2	Stator assembly	1	
3	Base assembly	1	
4	Dowel pin	2	
5	Plastic tie	1	
6	Bolt	2	M5 × 14 mm
7	Pulser coil	1	
8	Bolt	6	Not reusable, M10 × 50 mm
9	Flywheel magneto	1	
10	Dowel pin	1	
11	Bolt	3	M6 × 35 mm
12	Holder	1	
13	Clamp	1	
14	Clamp	1	
15	Plastic tie	1	

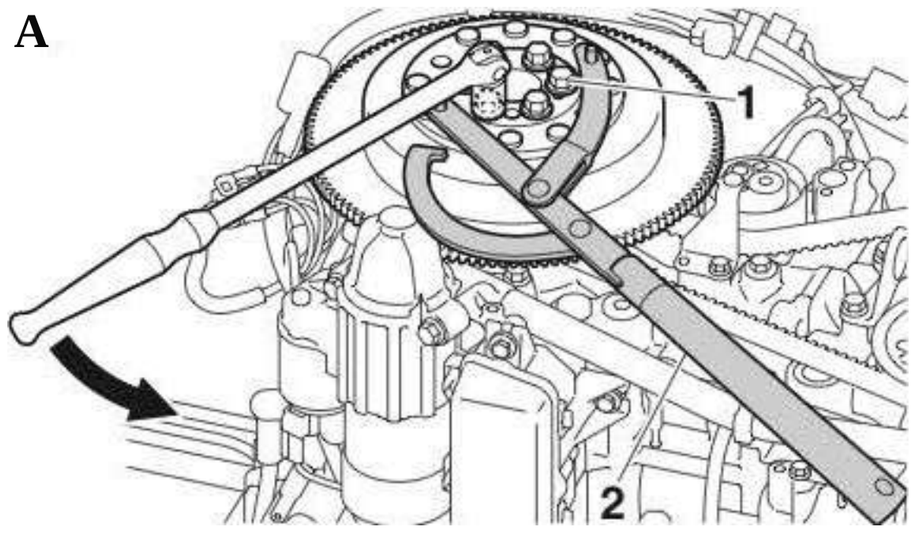
Removing the flywheel magneto

1. Loosen the flywheel magneto bolts "1".

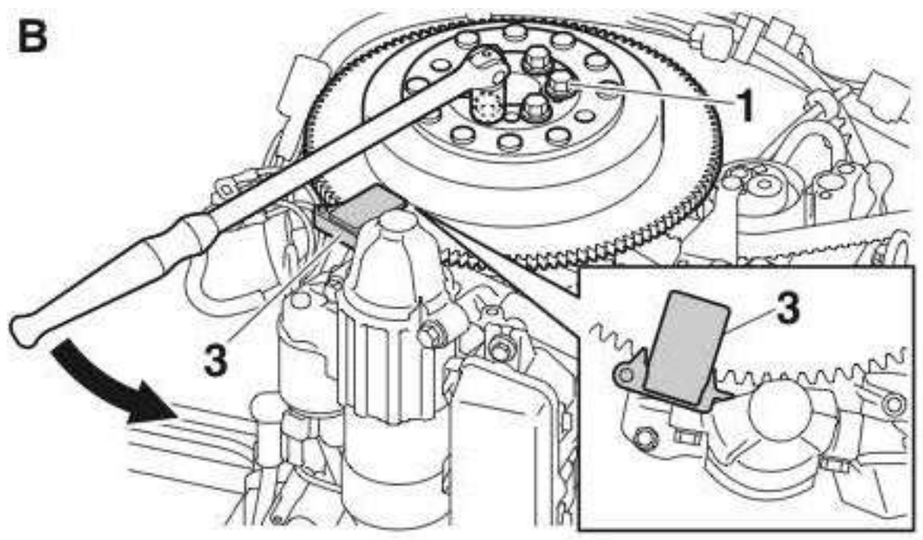
NOTICE

Apply force in the direction of the arrow to prevent the special service tool "2" from slipping off easily.

A



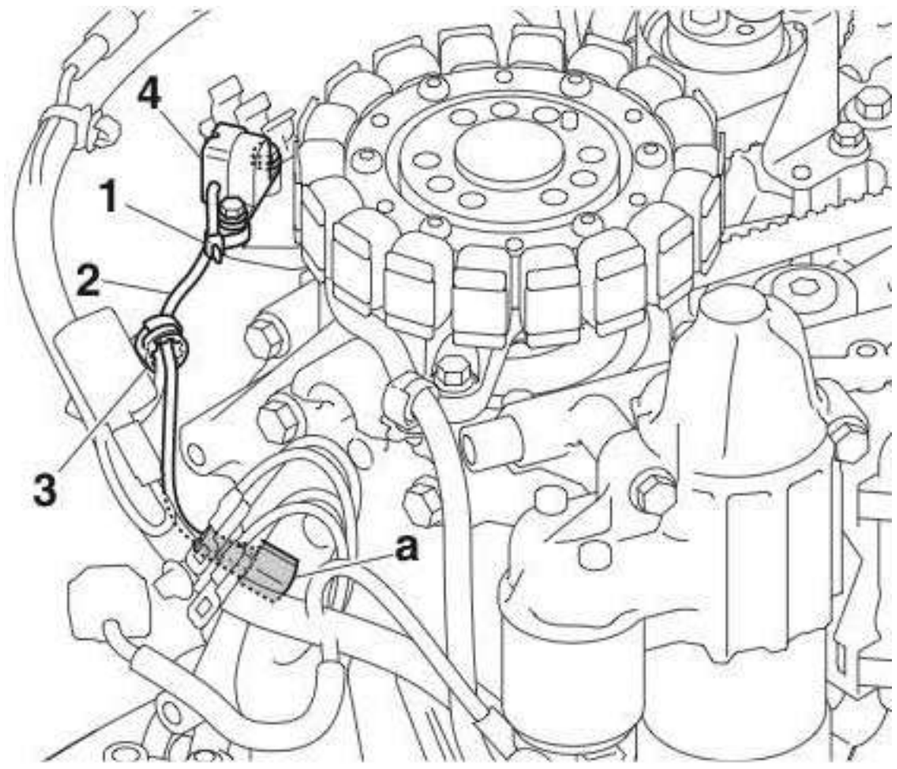
B



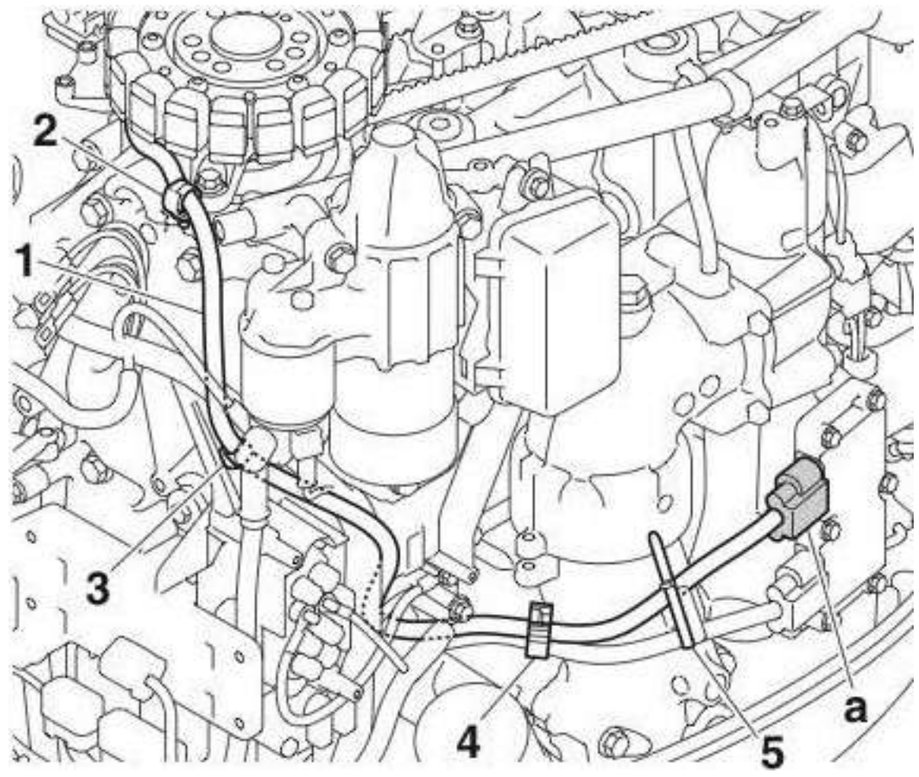
A. Conventional special service tool
B. New special service tool

Rotor holding tool "2"
Universal magneto & rotor holder "2"
Flywheel stopper B "3"
Flywheel stopper B "3"

2. Remove the flywheel magneto.
3. Disconnect the pulser coil coupler "a".
4. Remove the plastic tie "1".
5. Remove the pulser coil lead "2" from the holder "3".
6. Remove the pulser coil "4".

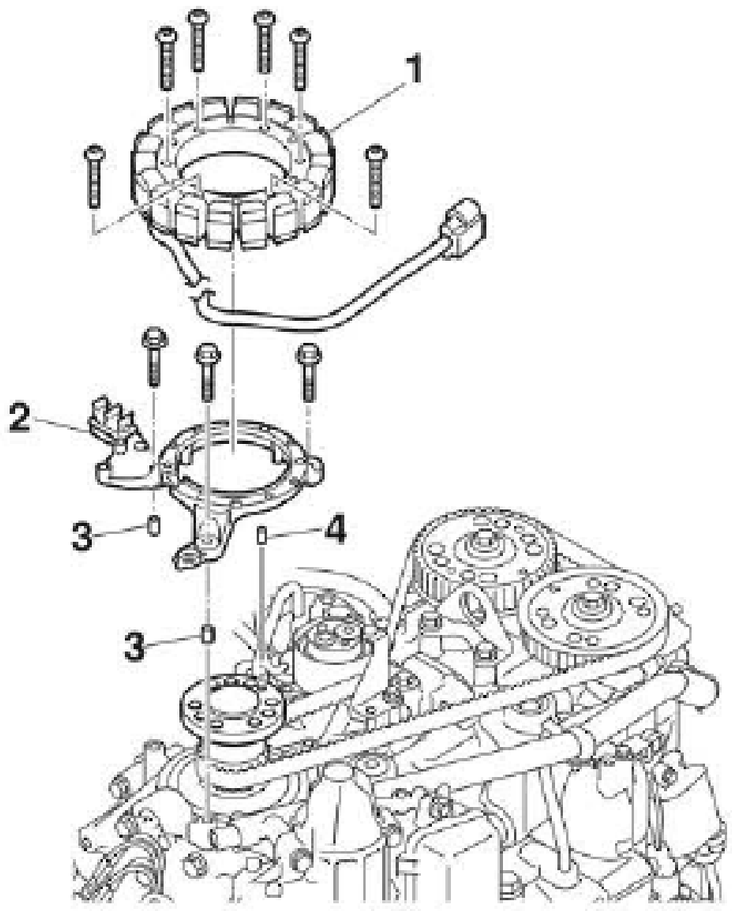


7. Remove the stator assembly lead "1" from the holders "2" and "3", and clamp "4".
8. Remove the plastic tie "5".
9. Disconnect the stator assembly coupler "a".



10. Remove the stator assembly "1", base assembly "2",and dowel pins "3".

11. Remove the dowel



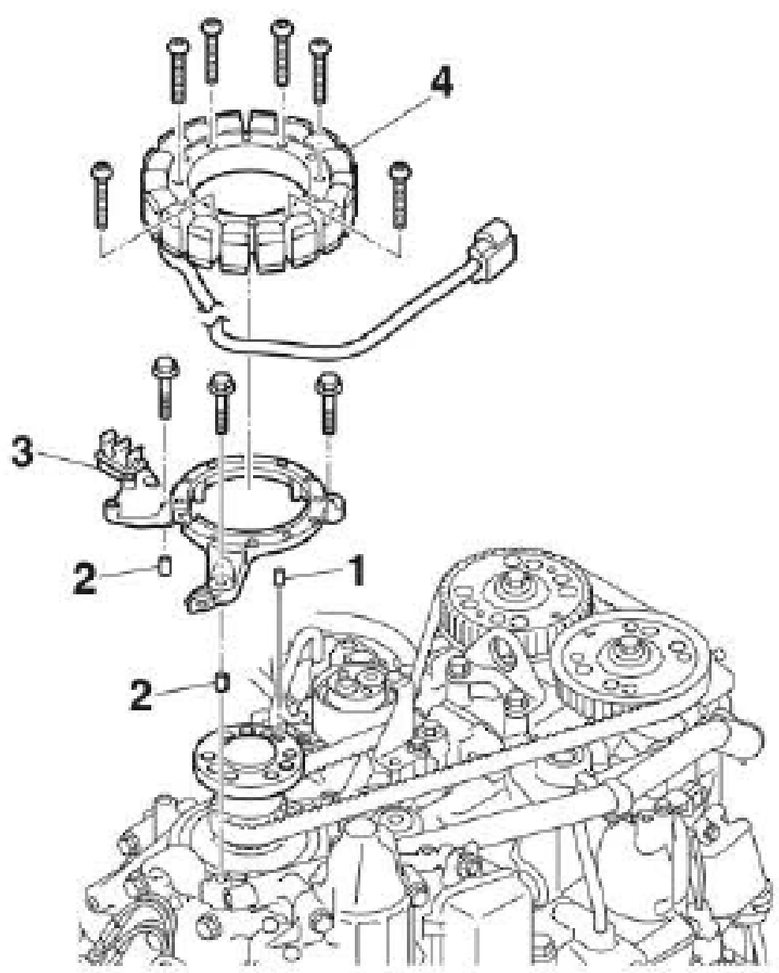
Installing the flywheel magneto

1. Install the dowel pin "1" to the crankshaft.

2. Install the dowel pins "2" to the base assembly "3".

3. Install the base assembly "3".

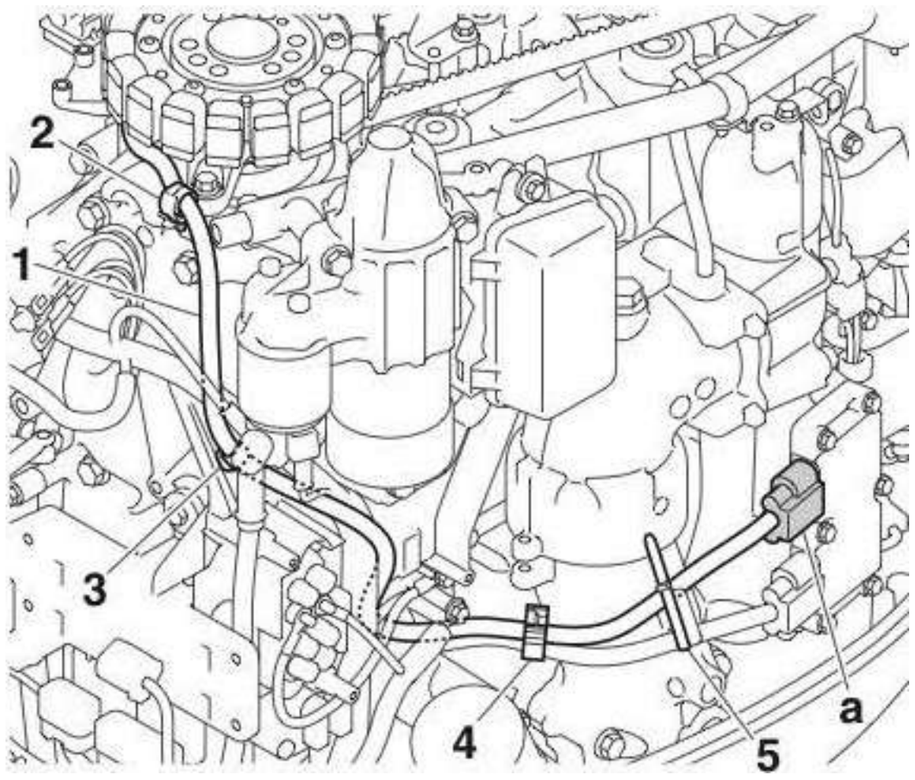
4. Install the stator assembly "4".



5. Fasten the stator assembly leads "1" using the holders "2" and "3", and clamp "4".

6. Connect the stator assembly coupler "a".

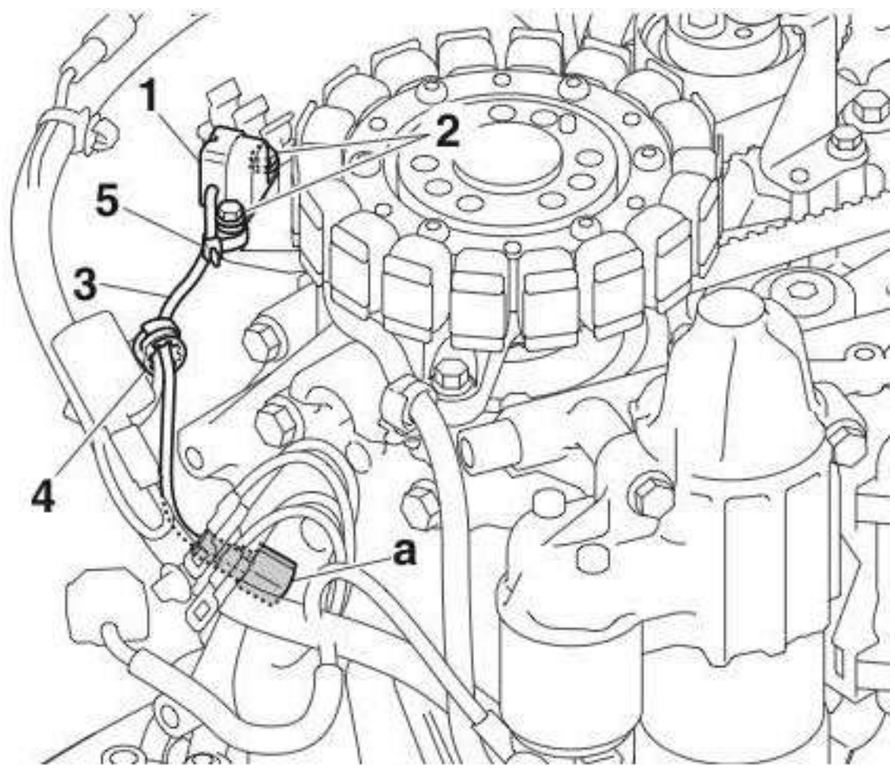
7. Install the plastic tie "5".



8. Install the pulser coil "1", adjust the air gap, and then tighten the pulser coil bolts "2" to the specified torque. See "Checking the pulser coil air gap" (7-2).

9. Connect the pulser coil coupler "a".

10. Fasten the pulser coil lead "3" using the holder "4" and plastic tie "5".

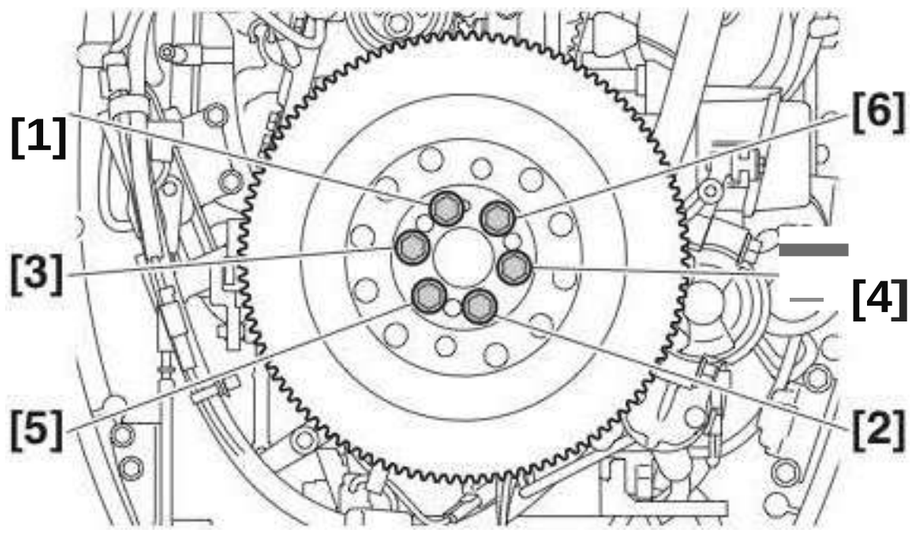


Pulser coil bolt "2"
6 Nm (0.6 kgf·m, 4.4 ft·lb)

11. Install the flywheel magneto, and then tighten new flywheel magneto bolts "1" to the specified torques in 2 stages and in the order [1], [2], and so on.

NOTICE

Apply force in the direction of the arrow to prevent the special service tool "2" from slipping off easily.

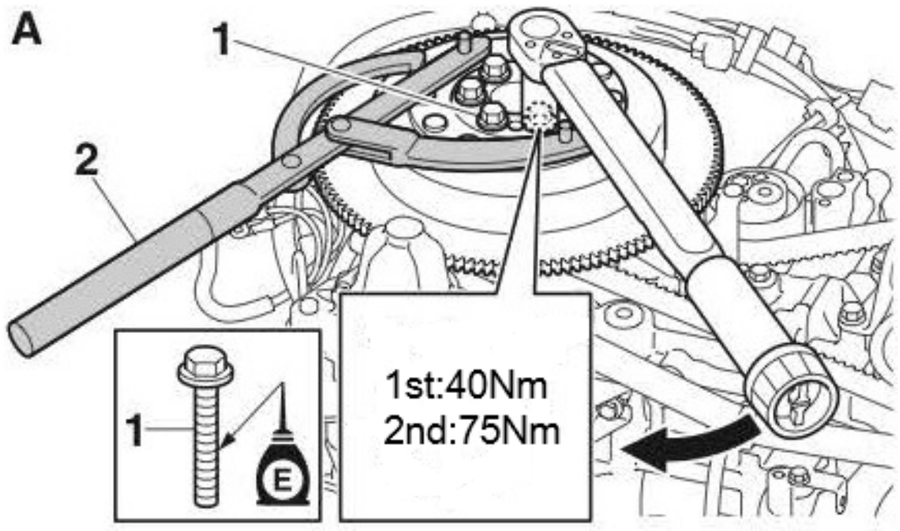


A. Conventional special service tool
B. New special service tool

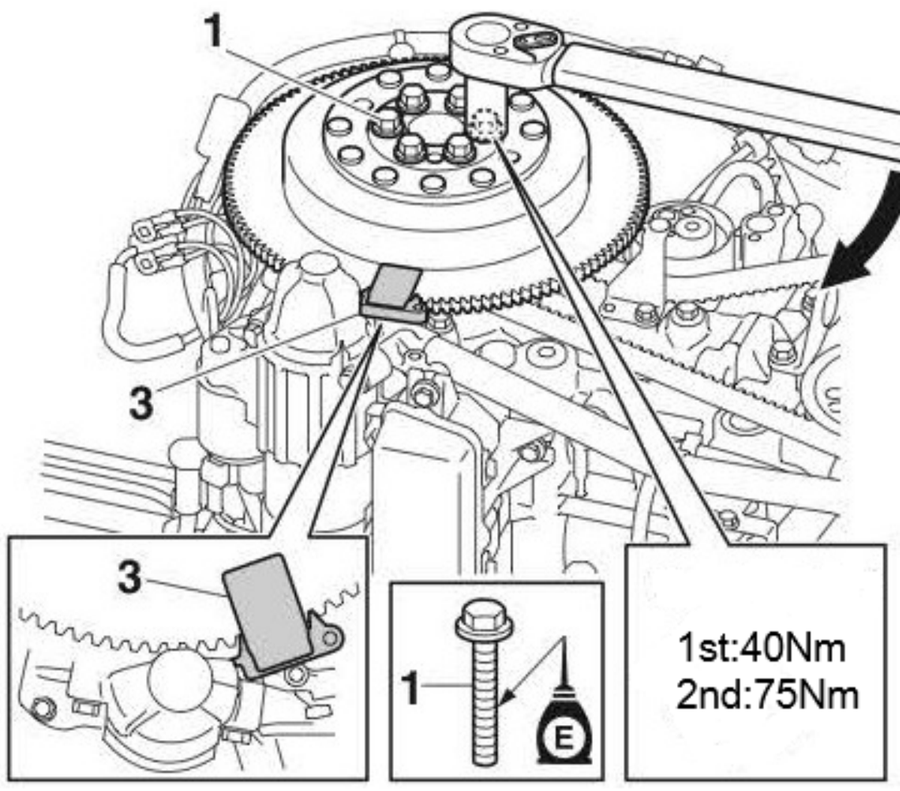
Rotor holding tool "2"
Universal magneto & rotor holder "2"
Flywheel stopper B "3"
Flywheel stopper B

Flywheel magneto bolt "1"
1st: 40 Nm (4.0 kgf·m, 29.5 ft·lb)
2nd: 75 Nm (7.5 kgf·m, 55.4 ft·lb)

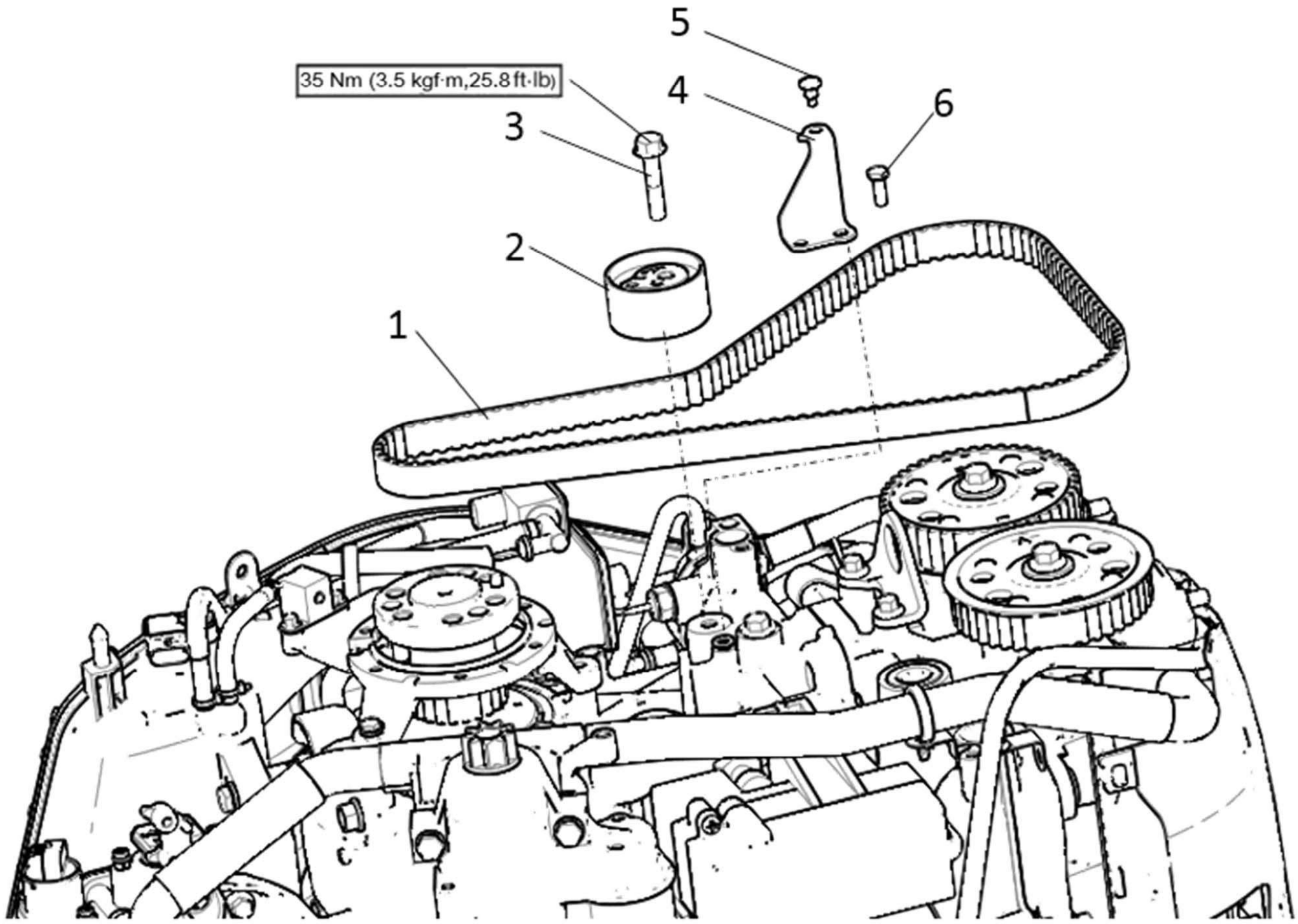
A



B



Timing belt



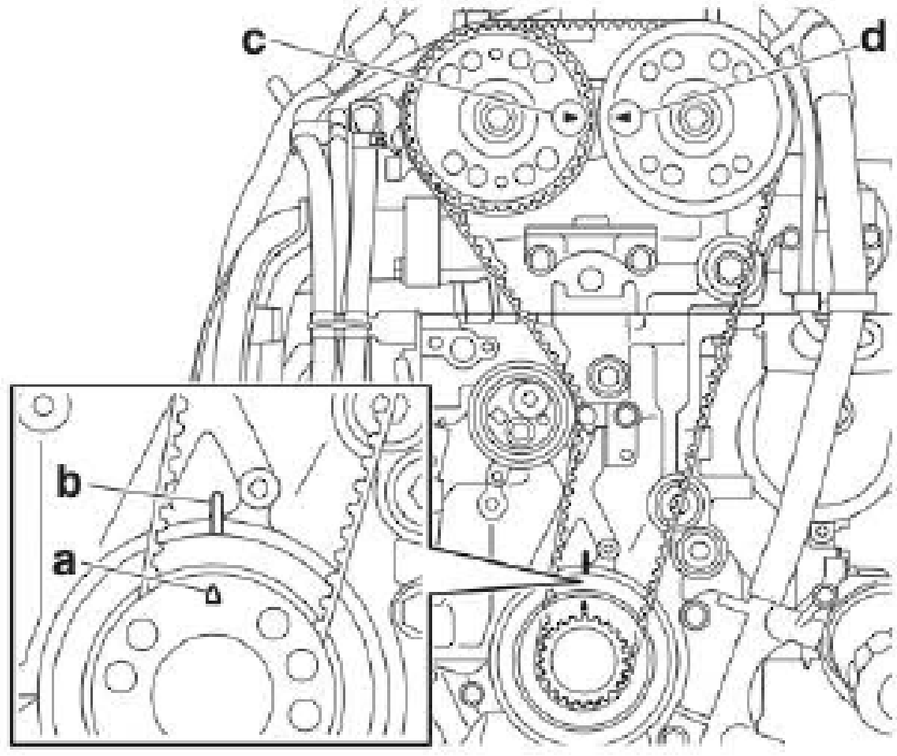
No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Timing belt tensioner	1	
3	Bolt	1	M8 x 40 mm
4	Plate	1	
5	Bolt	1	M6 x 16 mm
6	Grommet	1	

Removing the timing belt

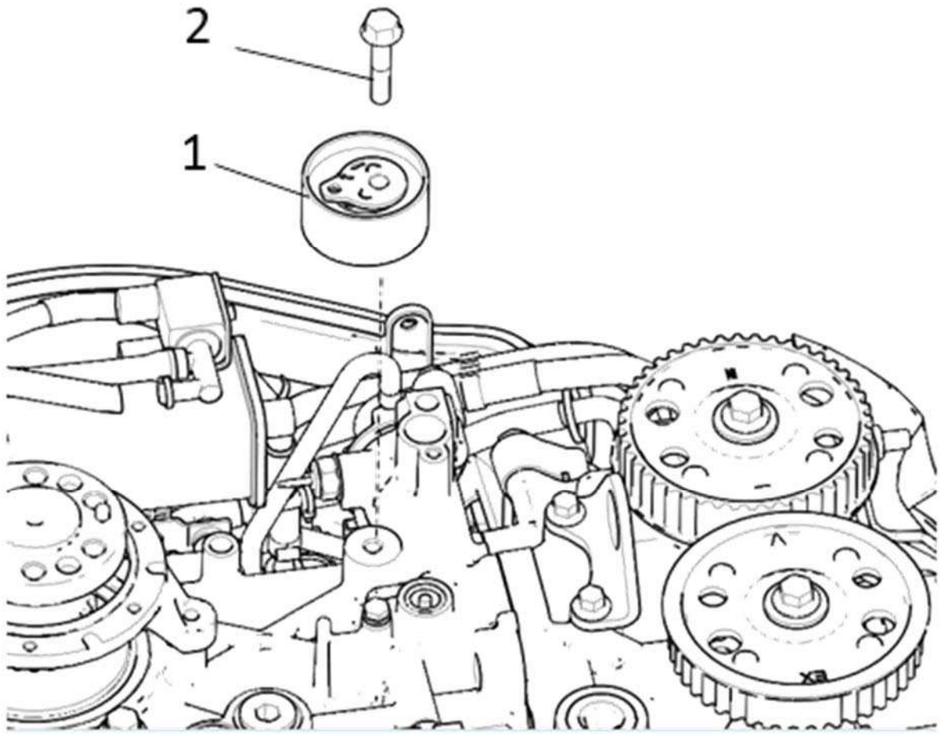
NOTICE

When the timing belt is not installed, do not turn the crankshaft or driven sprocket. Otherwise, the pistons and valves could collide with each other and be damaged.

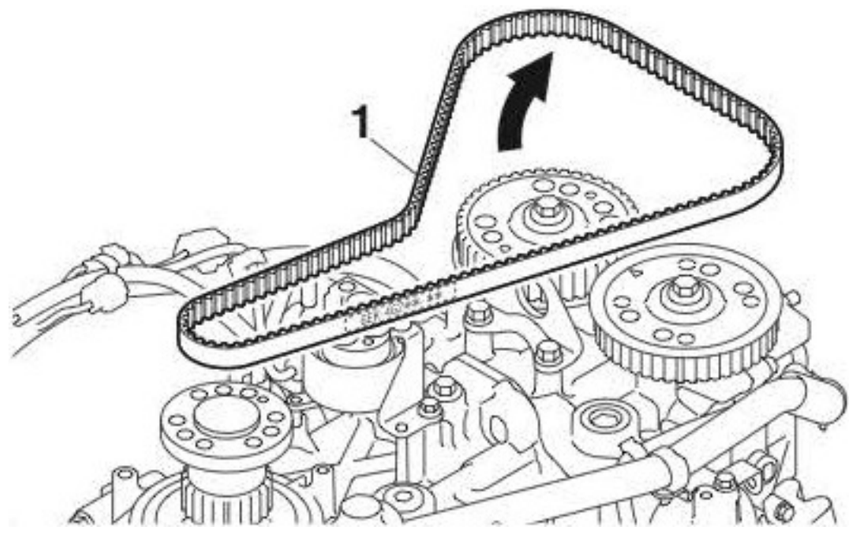
1. Turn the crankshaft clockwise to align the "△" mark "a" in the crankshaft and the protrusion "b" on the cylinder block. Check that the "▲" marks "c" and "d" on the driven sprockets are aligned.



2. Remove the timing belt tensioner "1" along with the timing belt tensioner bolt "2".



3. Remove the timing belt "1" from the driven sprocket side.



Checking the timing belt

1. Check the interior and exterior of the timing belt. Replace if cracked, damaged, or worn.

Installing the timing belt

NOTICE

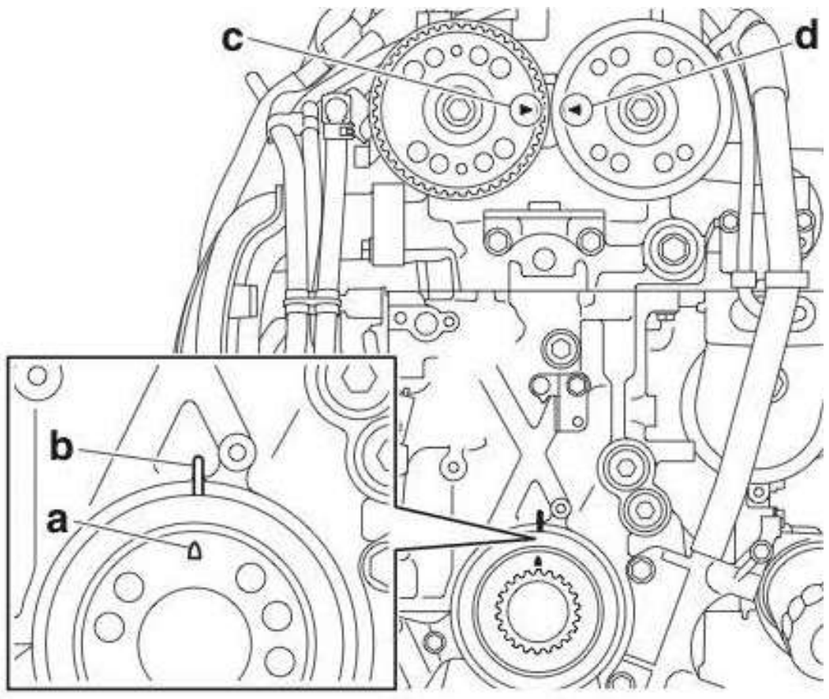
When the timing belt is not installed, do not turn the crankshaft or driven sprocket. Otherwise, the pistons and valves could collide with each other and be damaged.

1. Remove all of the spark plugs.

TIP:

Before installing the timing belt, remove all spark plugs to remove compression and prevent the crankshaft from turning.

2. Check that the "6" mark "a" in the crankshaft and the protrusion "b" on the cylinder block are aligned. Check that the ".&" marks "c" and "d" on the driven sprockets are aligned.



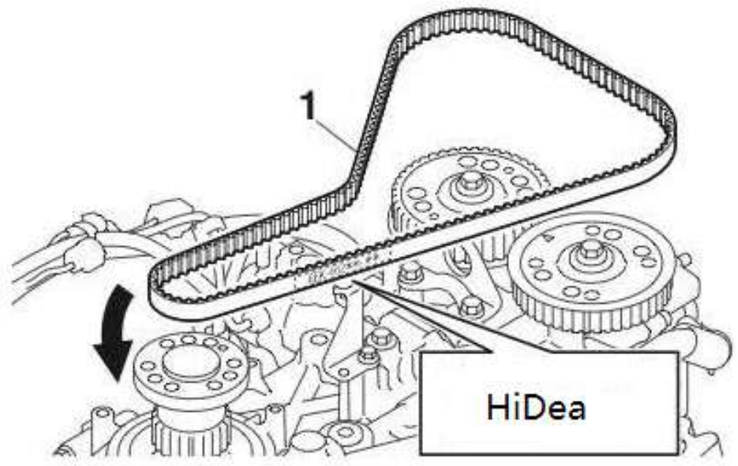
3.Install a new timing belt tensioner, and tighten the bolt, keep the force less than 2Nm.

NOTICE

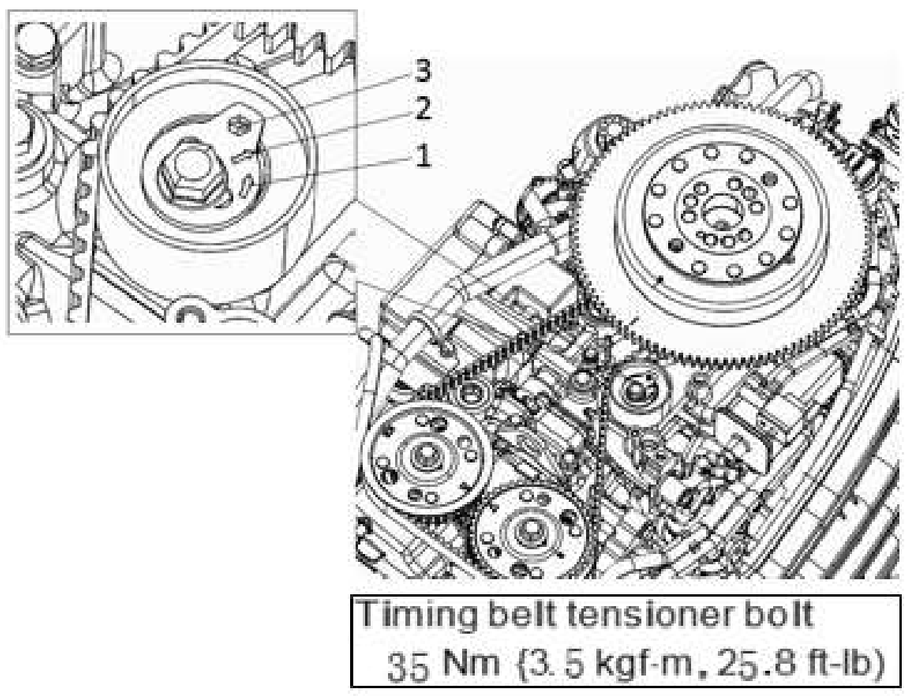
Do not apply grease or oil to the timing belt.

4. Turn the timing belt tensioner to limit position which keep the timing belt loosened. Then install the timing belt with its part number in the proper orientation, from the drive sprocket side to the port and starboard driven sprockets, in the counterclockwise direction.

5.Install a new timing belt "1" with its part number in the proper orientation, from the drive sprocket side to the port and starboard driven sprockets in the counterclockwise direction.



6. Using a hexagon wrench to turn the timing belt tensioner along the arrow 1 to make the arrow 2 align to the slot 3. Check the timing belt if be tensioned.

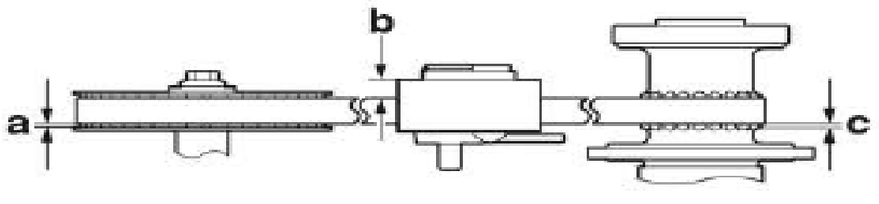


Timing belt tensioner bolt
35 Nm {3.5 kgf-m, 25.8 ft-lb}

7. Tighten the timing belt tensioner bolt.

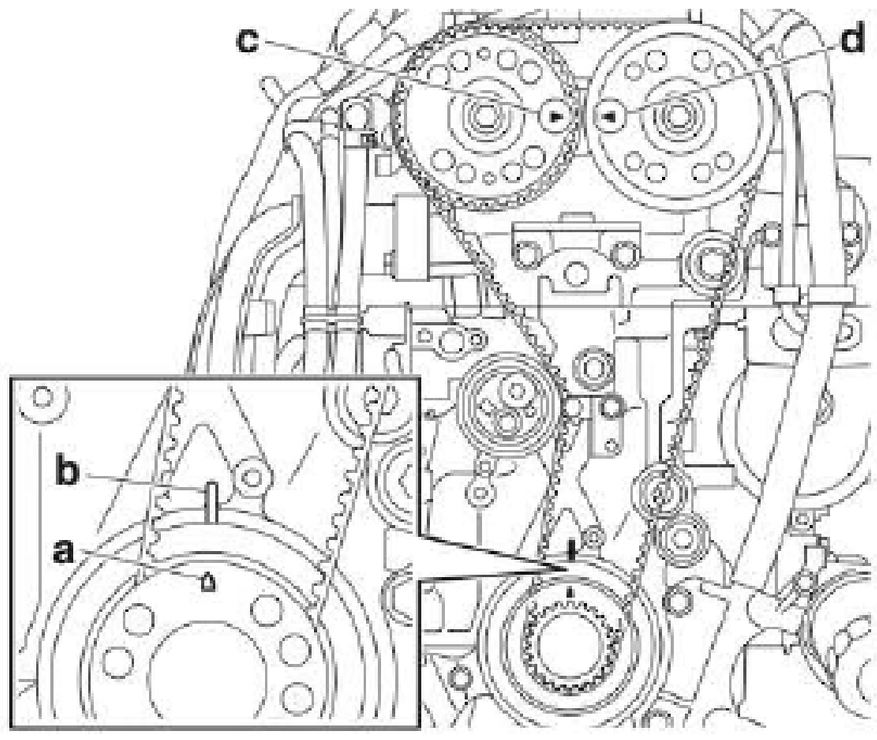
8. Turn the timing belt tensioner gradually counterclockwise until the timing belt is taut.

9. Adjust the timing belt to the specified installation height "a", "b", and "c".



Timing belt installation height
"a": 0.75 mm (0.03 in)
"b": 4.75 mm (0.2 in)
"c": 0.75 mm (0.03 in)

10. Turn the crankshaft clockwise 2 full turns, and then check that the "△"mark "a" in the crankshaft and the protrusion "b" on the cylinder block are aligned. Also, check that the "▲" marks "c" and "d" on the driven sprockets are aligned.

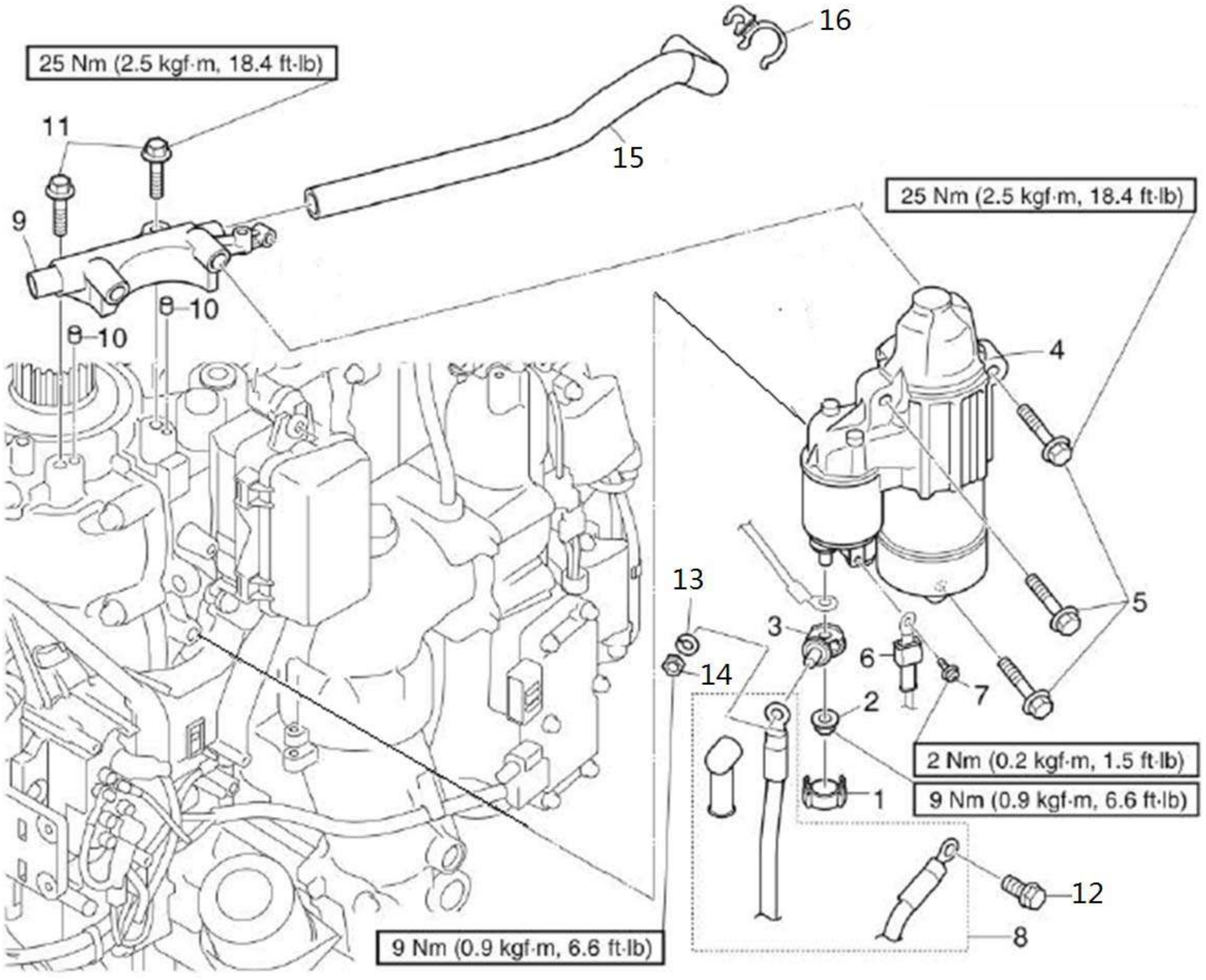


11. Install all of the spark plugs, and then tighten them to the specified torque.

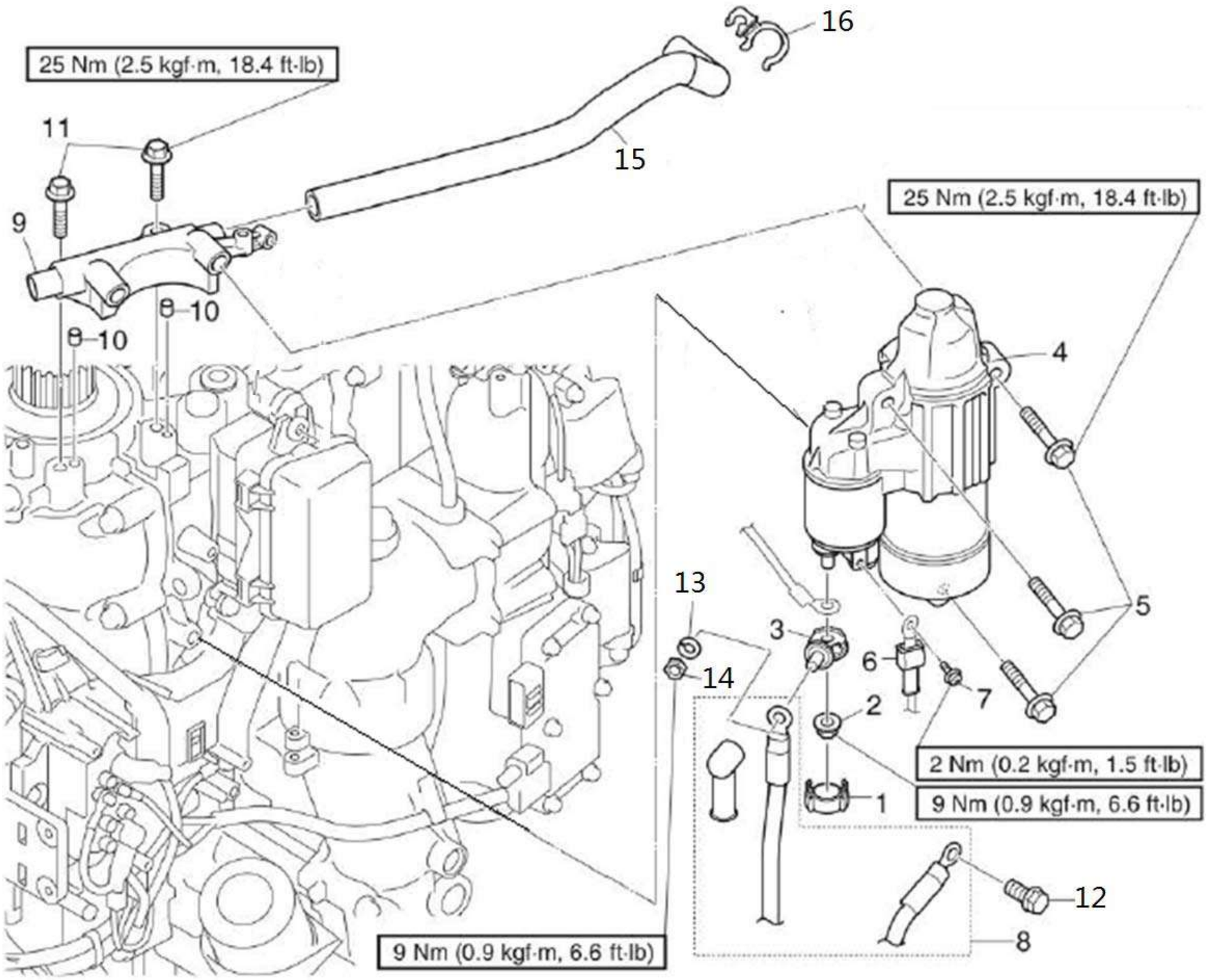
Spark plug
25 Nm (2.5 kgf·m, 18.4 ft·lb)

12. Connect the spark plug wires.

Starter motor



No.	Part name	Q'ty	Remarks
1	Cap	1	
2	Nut	1	M8
3	Terminal	1	
4	Starter motor	1	
5	Bolt	3	M8 x 45 mm
6	Cap	1	
7	Screw	1	M4 x 8 mm
8	Battery cable	1	
9	Bracket	1	
10	Dowel pin	2	
11	Bolt	2	M8 x 30 mm
12	Bolt	1	M6 x 16 mm
13	Washer	1	
14	Nut	1	M8

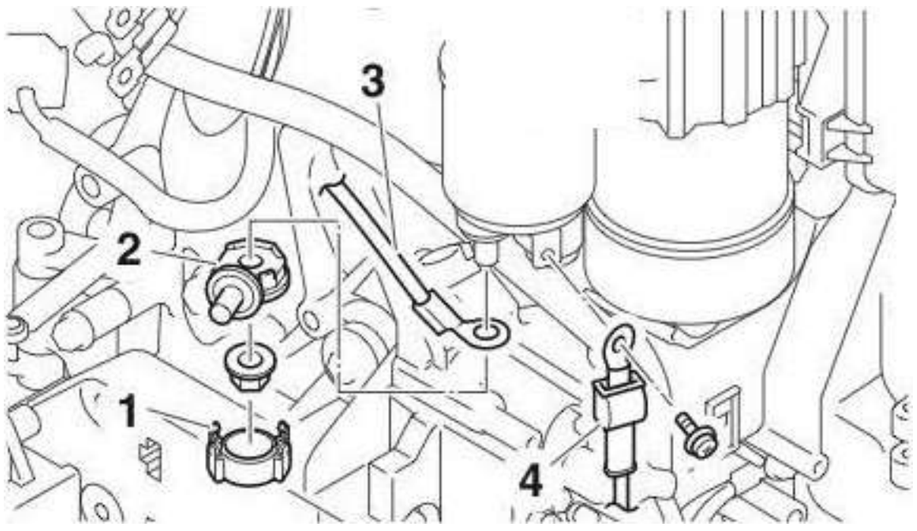


No.	Part name	Q'ty	Remarks
15	Blowby hose	1	Cylinder head cover to starter motor upper bracket
16	Holder	1	

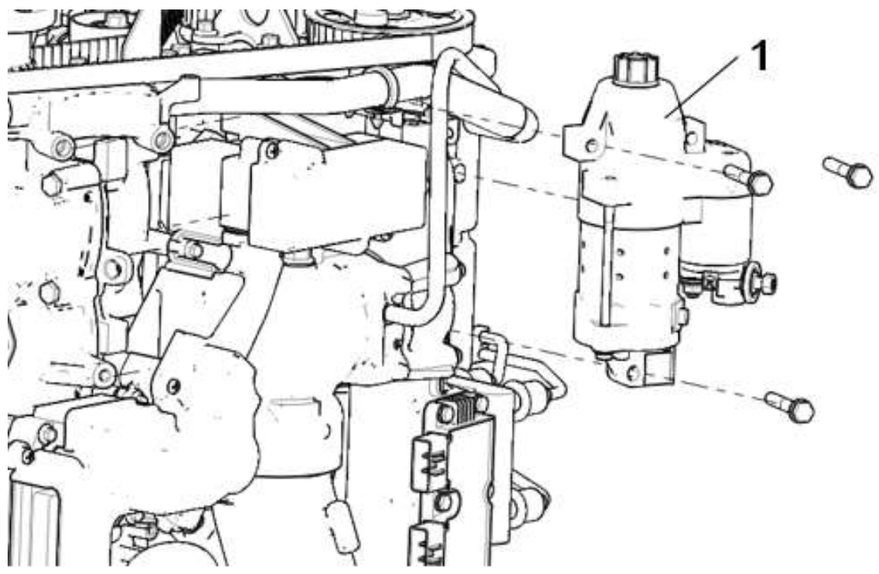
Removing the starter motor

1. Remove the cap "1" and terminal "2", and then disconnect the positive lead "3".

2. Disconnect the starter motor lead "4".

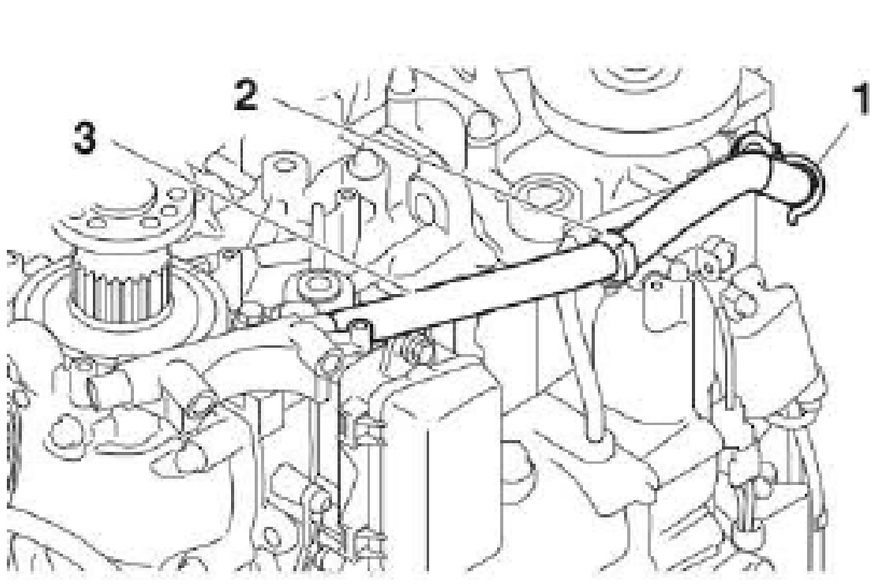


3. Remove the starter motor "1".

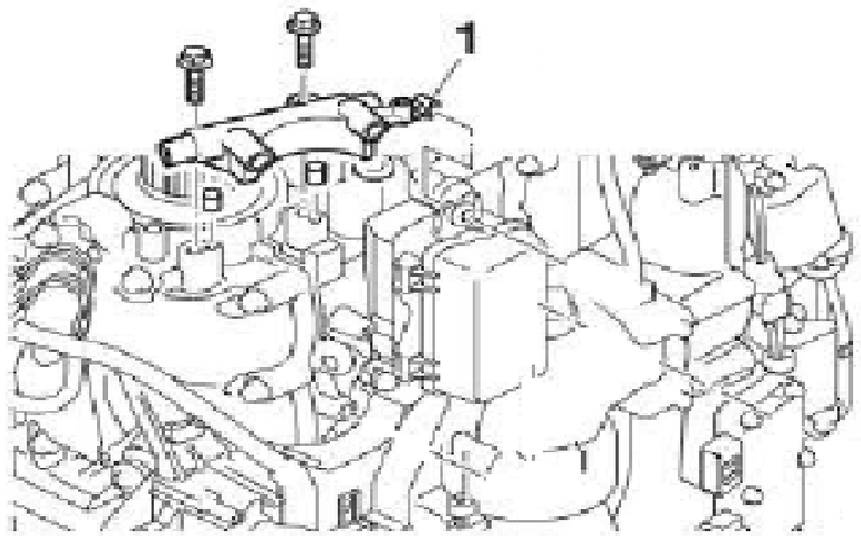


4. Remove the holders "1" and "2" from the blowby hose "3".

5. Remove the blowby hose "3".



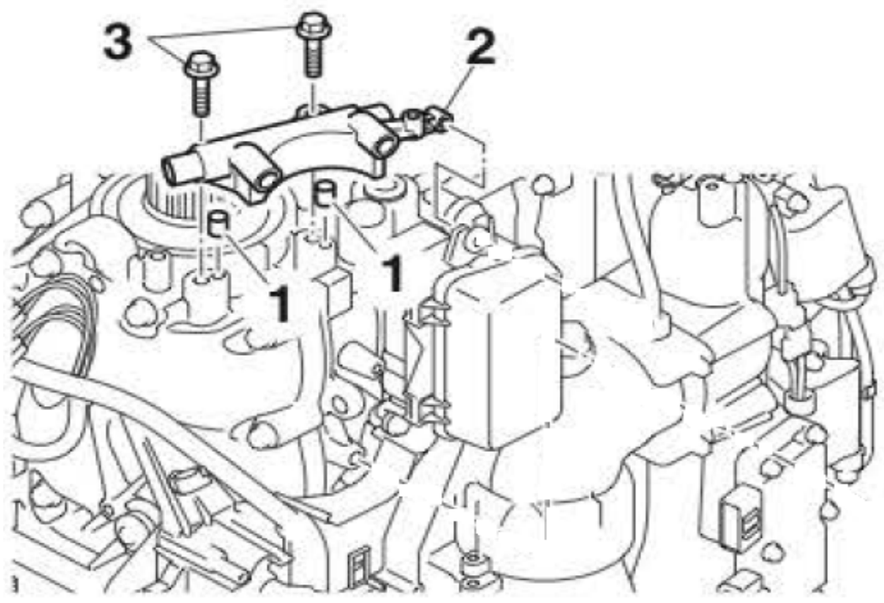
6. Remove the starter motor upper bracket "1".



Installing the starter motor

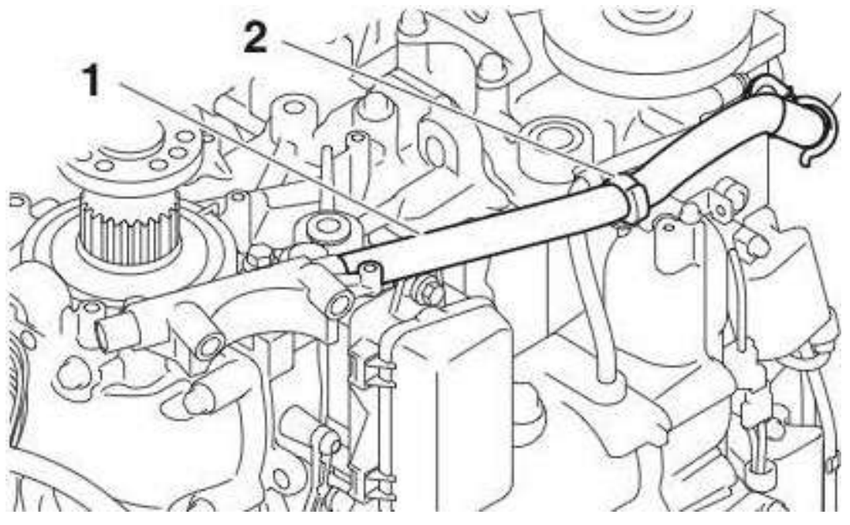
1. Install the dowel pins "1" to the starter motor upper bracket "2".

2. Install the starter motor upper bracket "2", and then tighten the starter motor upper bracket bolts "3" to the specified torque.



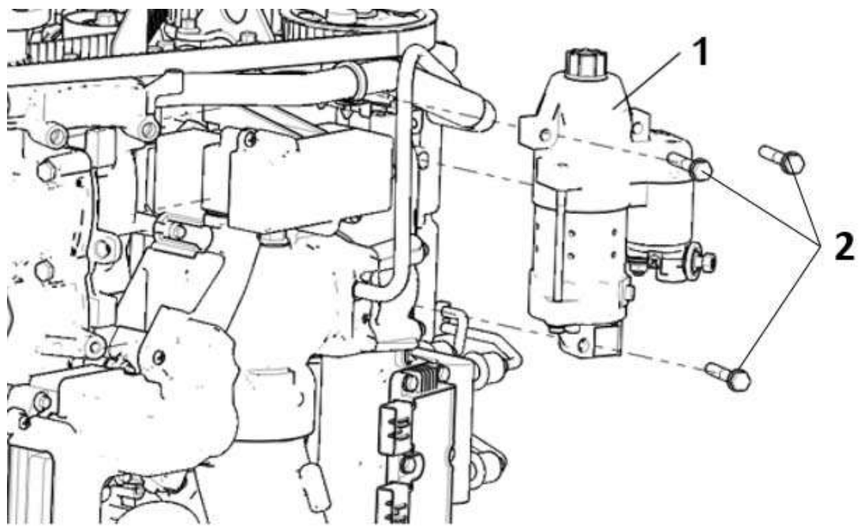
Starter motor upper bracket bolt "3" 25 Nm (2.5 kgf·m, 18.4 ft-lb) Starter motor lower bracket bolt "5" 25 Nm (2.5 kgf·m, 18.4 ft·lb)

4. Install the blowby hose "1", and then fasten it using the holders "2" and "3".



3

5. Install the starter motor "1", and then tighten the starter motor bolts "2" to the specified torque.



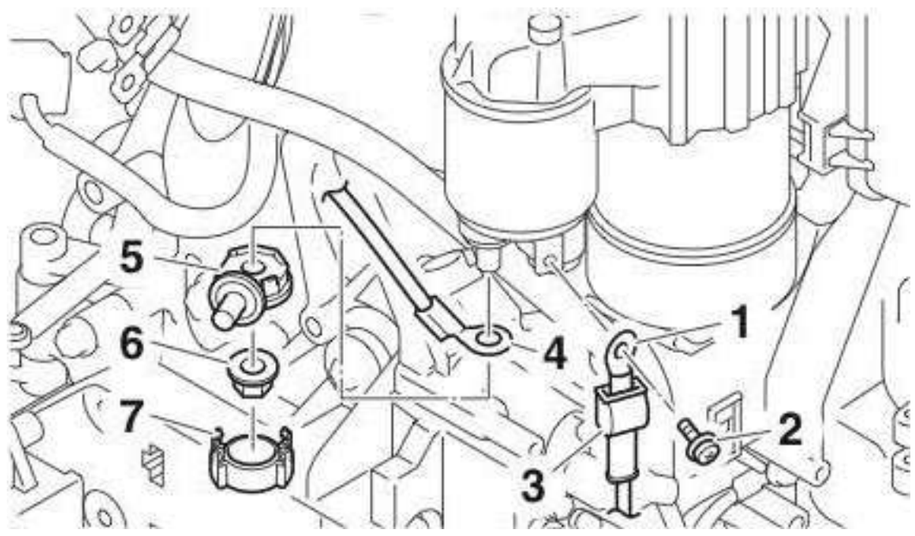
Starter motor bolt "2"
33 Nm (3.3 kgf.m, 24.3 ft·lb)

6. Connect the starter motor lead "1", and then tighten the starter motor lead screw "2" to the specified torque.

7. Cover with the cap "3".

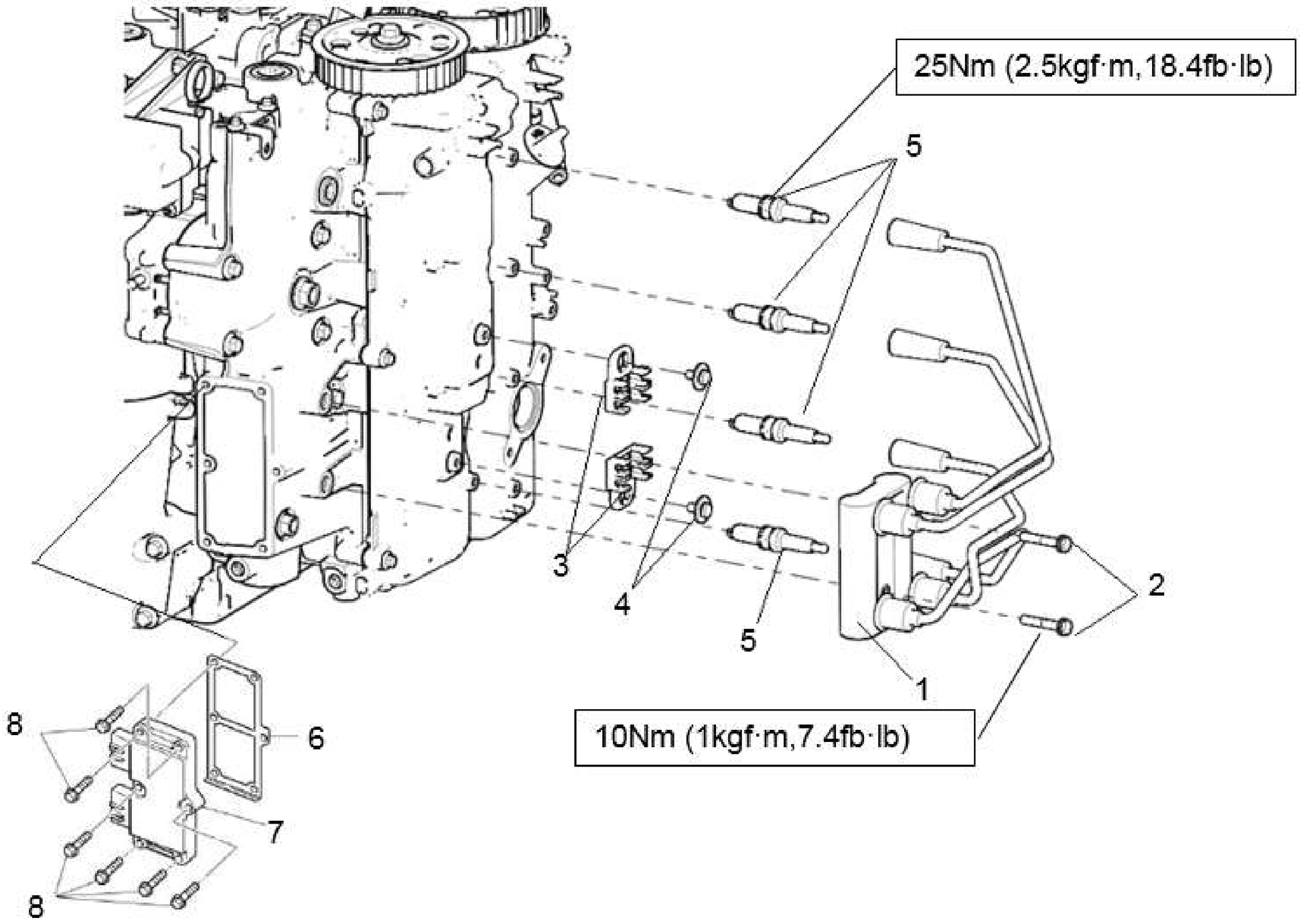
8. Install the positive lead "4" and terminal "5", and then tighten the terminal nut "6" to the specified torque.

9. Install the cap "7".



Starter motor lead screw "2"
2 Nm (0.2 kgf·m, 1.5 ft·lb)
Terminal nut "6"
9 Nm (0.9 kgf·m, 6.6 ft·lb)

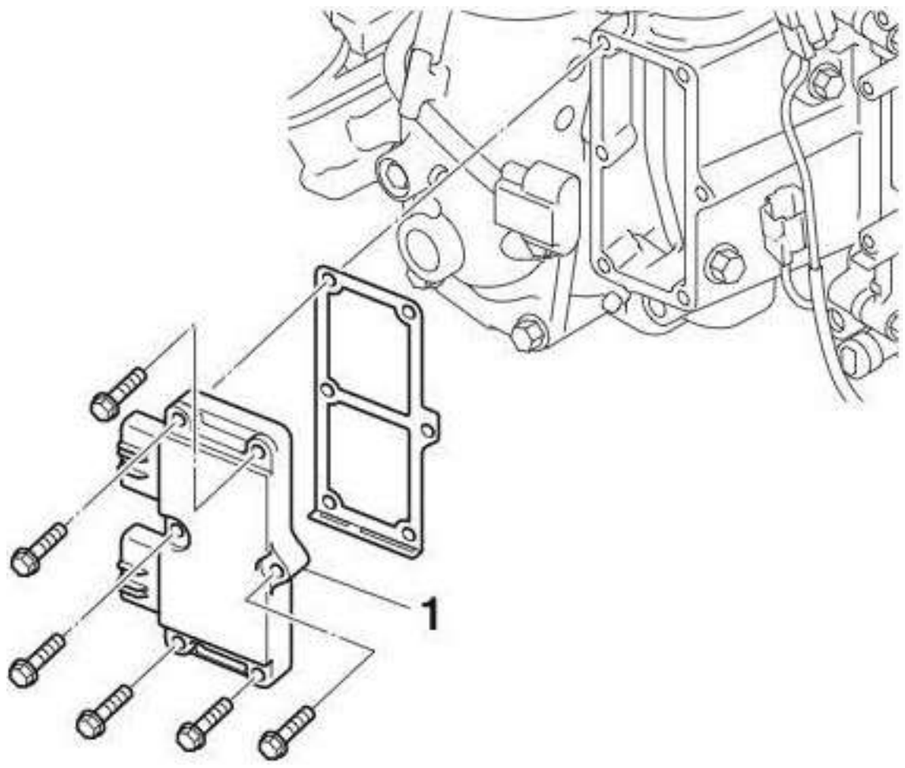
Rectifier/regulator, ignition coil, and spark plug



No.	Part name	Q'ty	Remarks
1	Ignition coil	1	
2	Bolt	2	M6 x 35 mm
3	Holder	2	
4	Bolt	2	M6 x 12 mm
5	Spark plug	4	M12
6	Gasket	1	Not reusable
7	Rectifier/regulator	1	
8	Bolt	6	M6 x 25mm

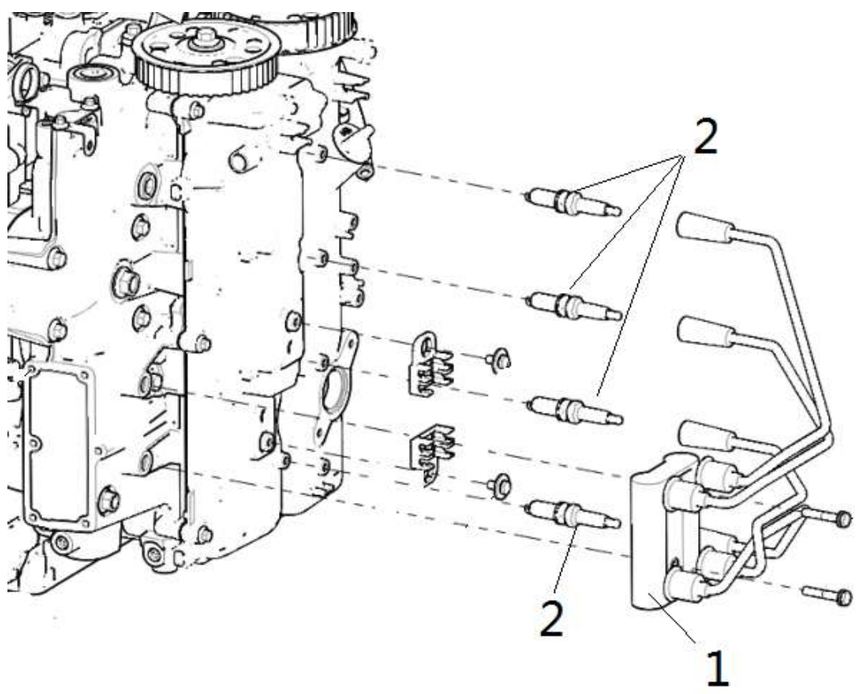
Removing the rectifier/regulator, ignition coil, and spark plug

1. Remove the rectifier/regulator "1".



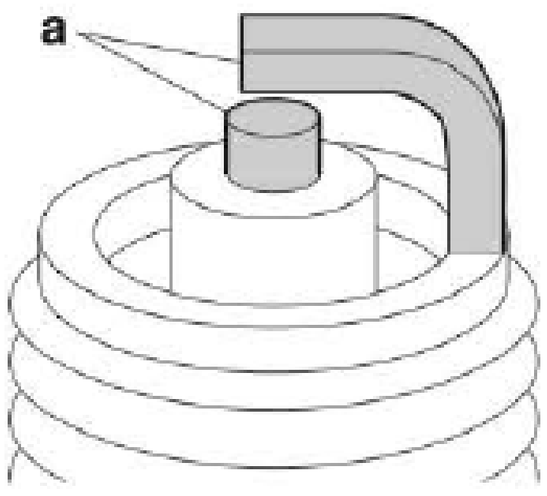
2. Remove the ignition coils "1".

3. Remove the spark plugs "2".



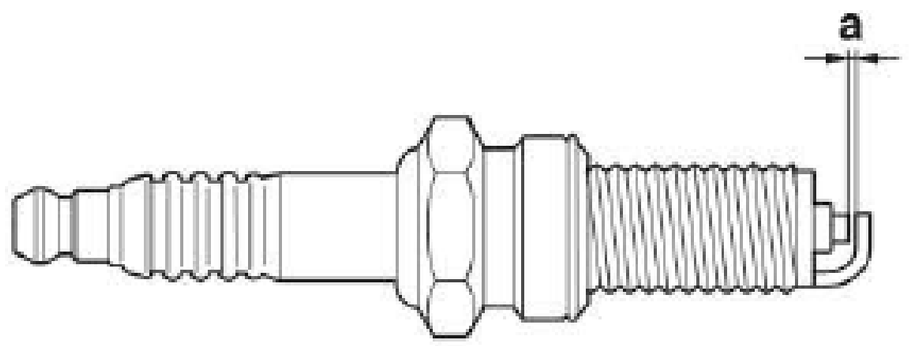
Checking the spark plug

1. Clean the electrodes "a" using a spark plug cleaner.



2. Check the spark plug. Replace if the electrodes are eroded, edges of electrodes are rounded, insulator is damaged, or there is carbon or other deposits.

3. Check the spark plug gap "a". Adjust if out of specification.



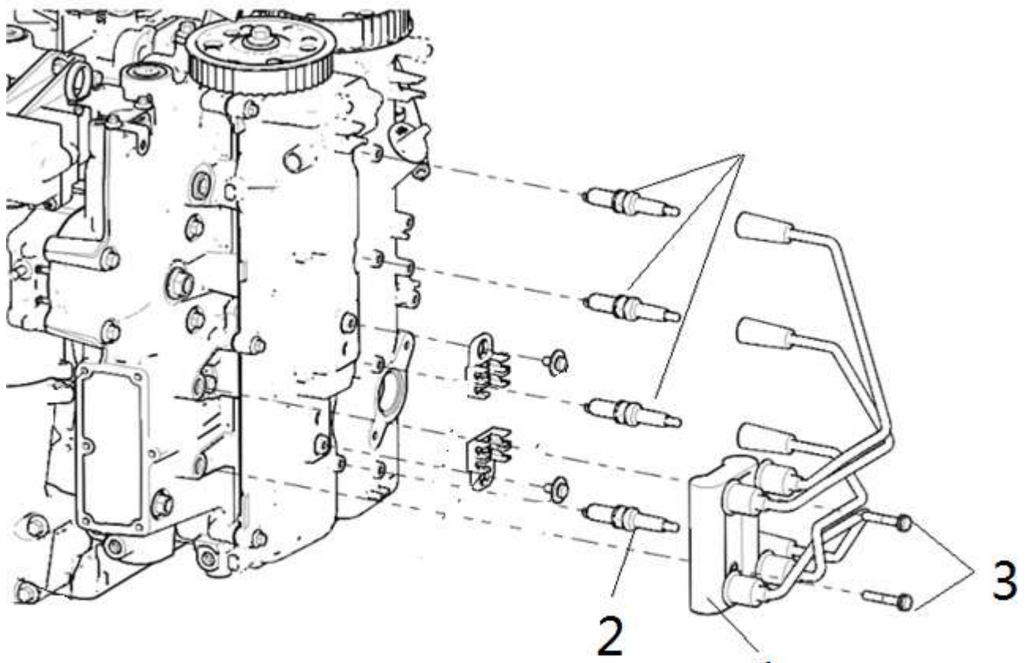
Spark plug (NGK)	LKR6C
Spark plug gap	0.85-0.95 mm (0.033-0.037 in)

Installing the ignition coil, rectifier/ regulator, and spark plug

1. Install the spark plugs "1", and then tighten them to the specified torque.

2. Install the ignition coils "2", and then tighten the ignition coil bolts "3" to the specified torque.

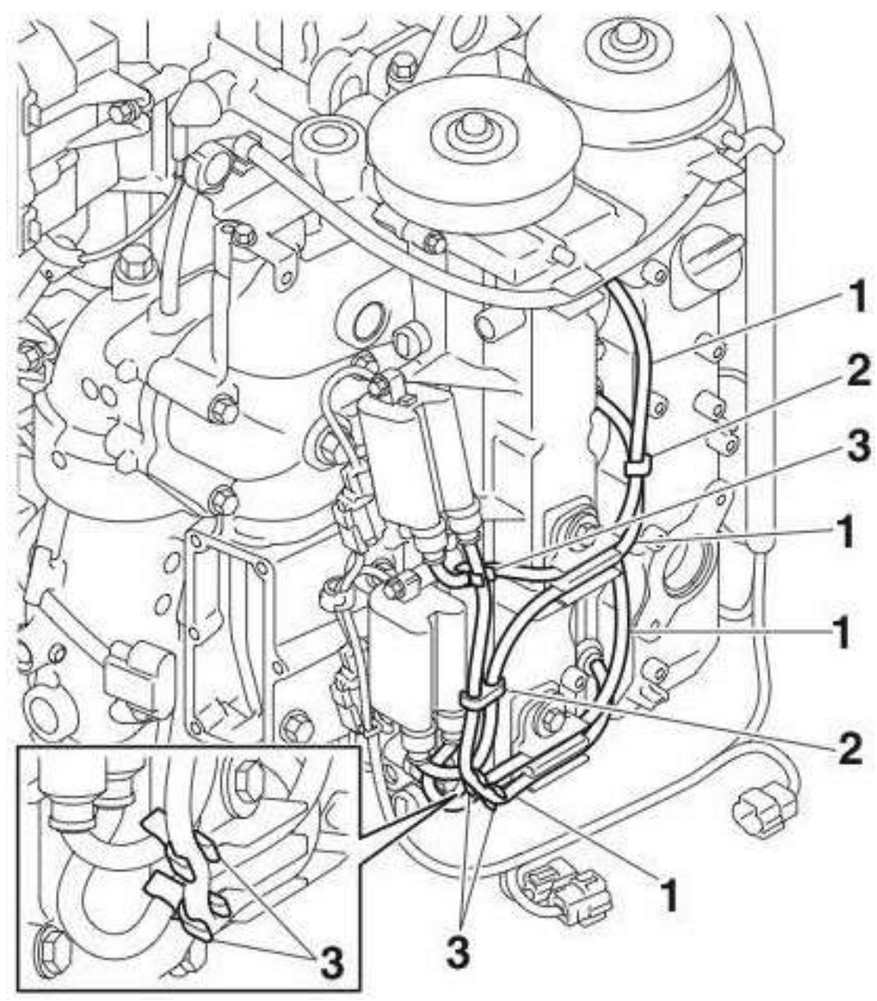
3. Pass the harnesses of the ignition coils "1", and then connect the couplers.



:

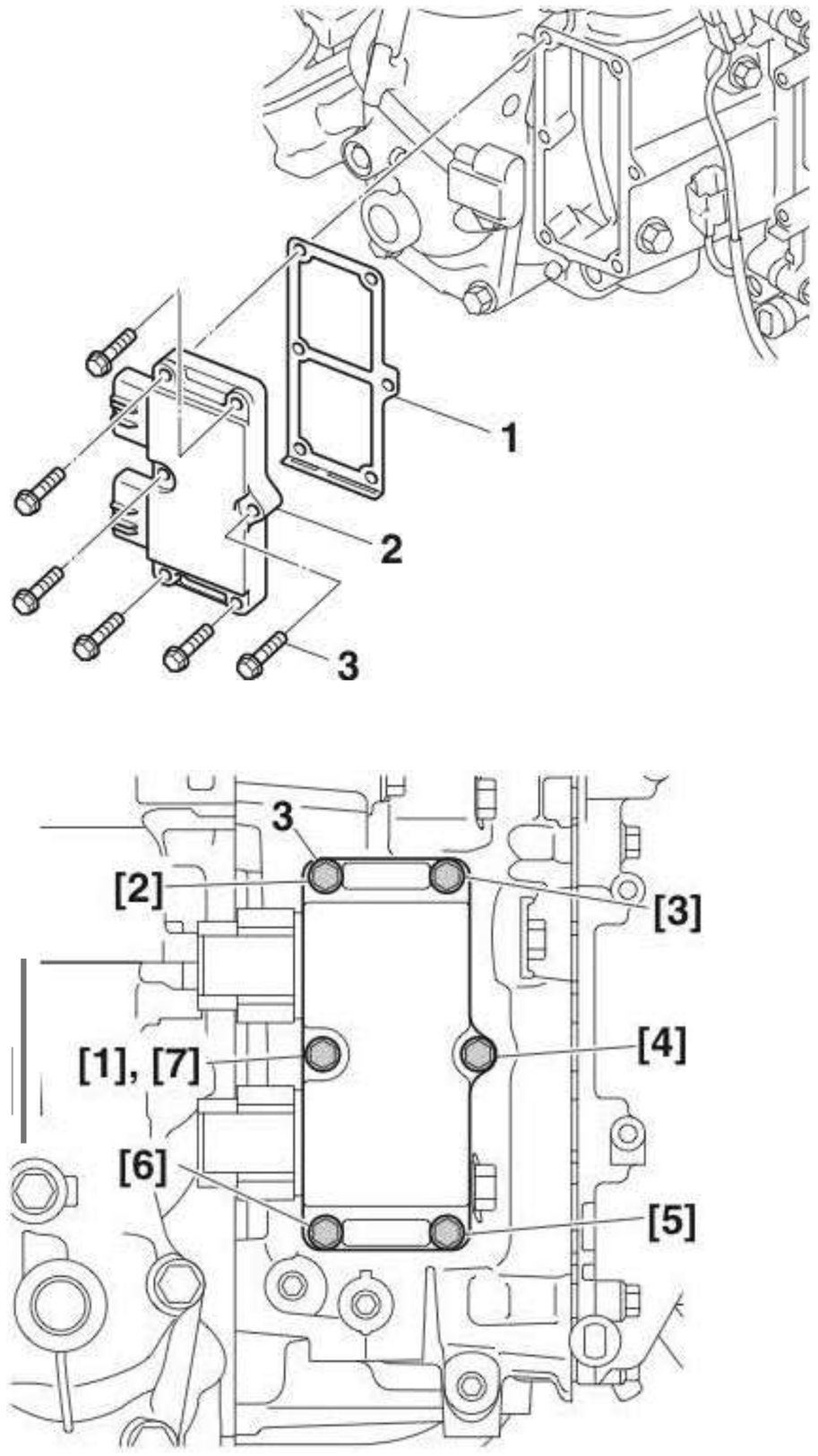
Spark plug "1" 25 Nm (2.5 kgf·m, 18.4 ft·lb)

4. Install the spark plug wires "1" and holders "2" and "3".

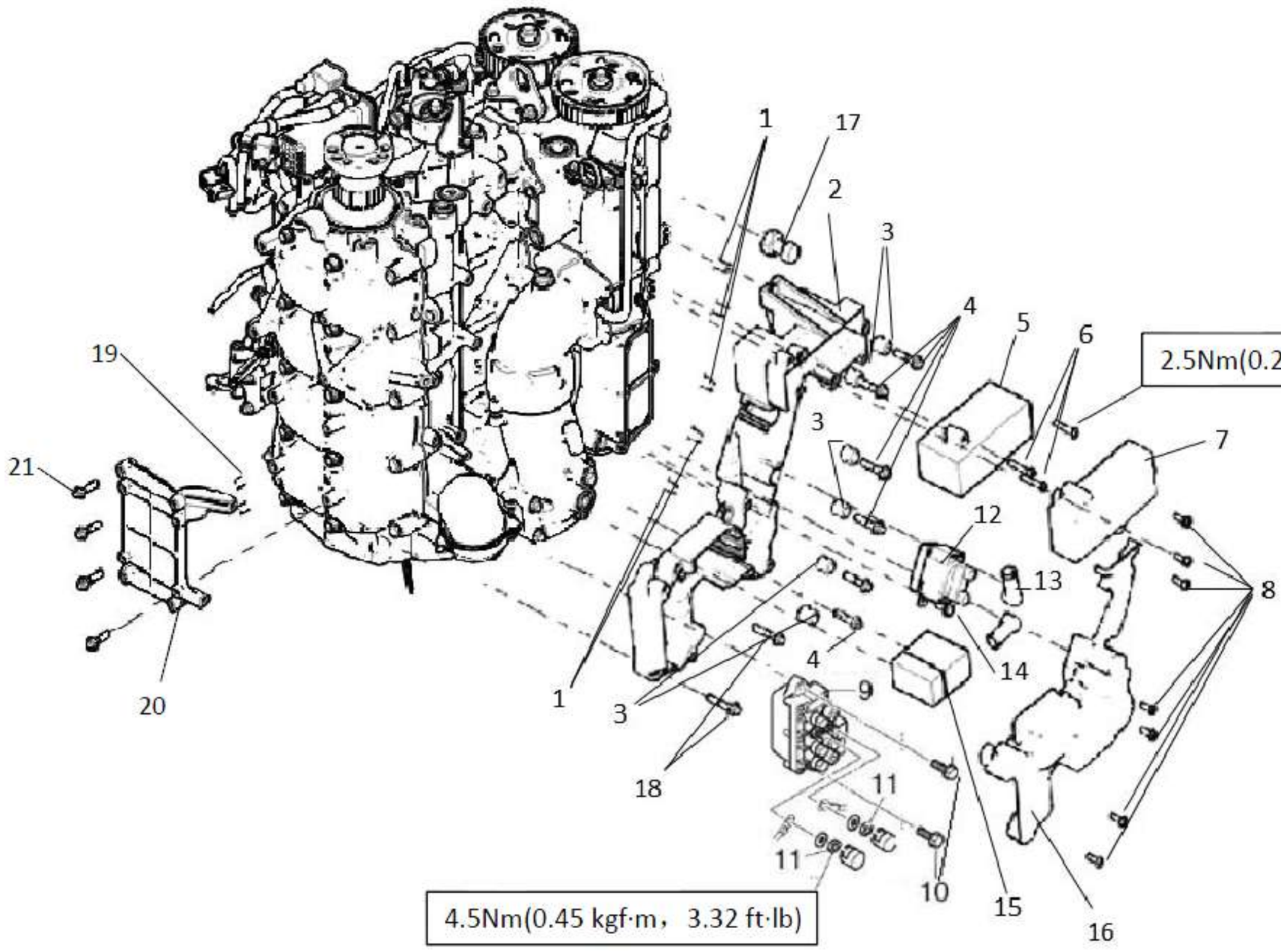


5. Install a new gasket "1" and the rectifier/regulator "2".

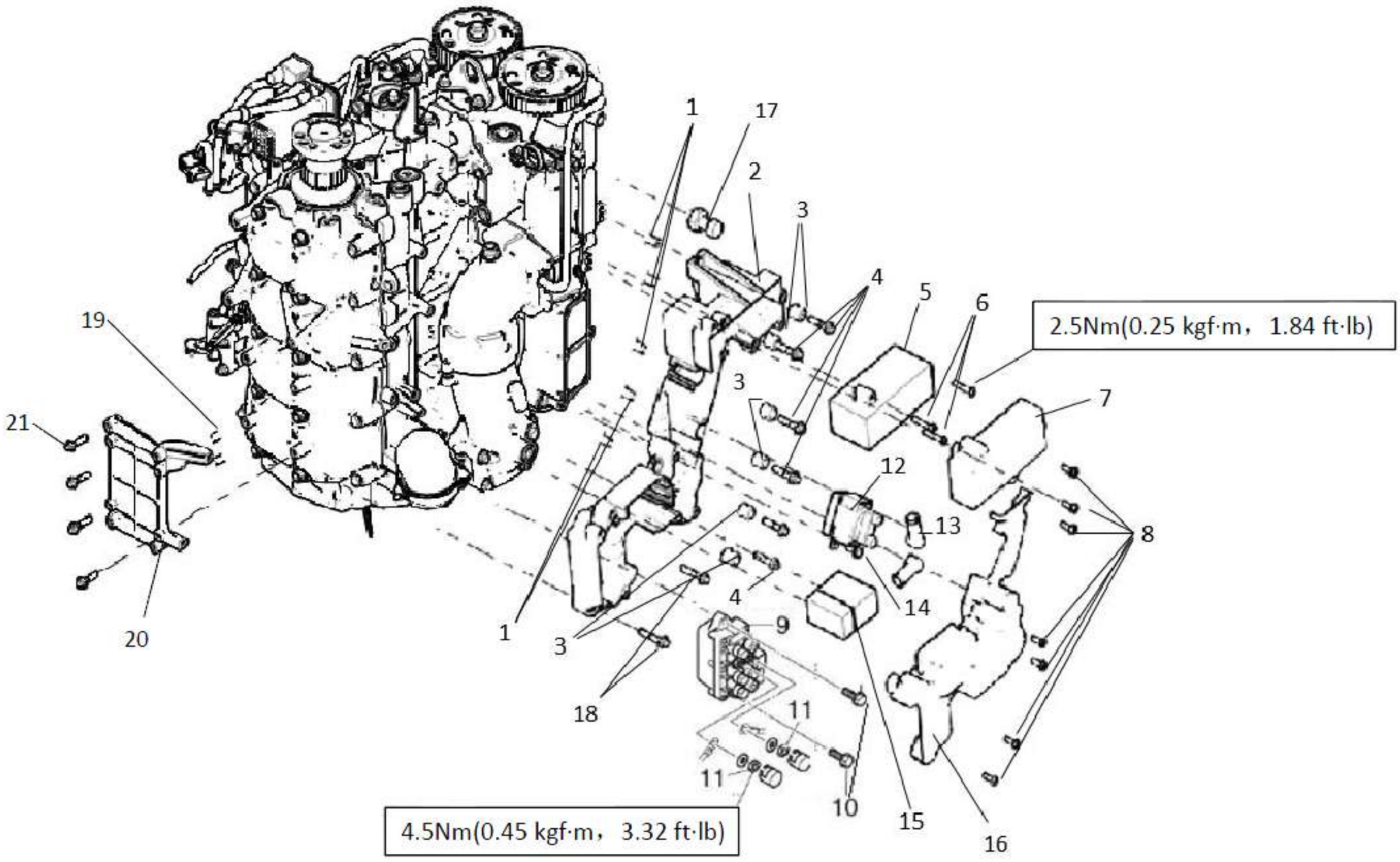
6. Tighten the rectifier/regulator bolts "3" in the order [1], [2], and so on.



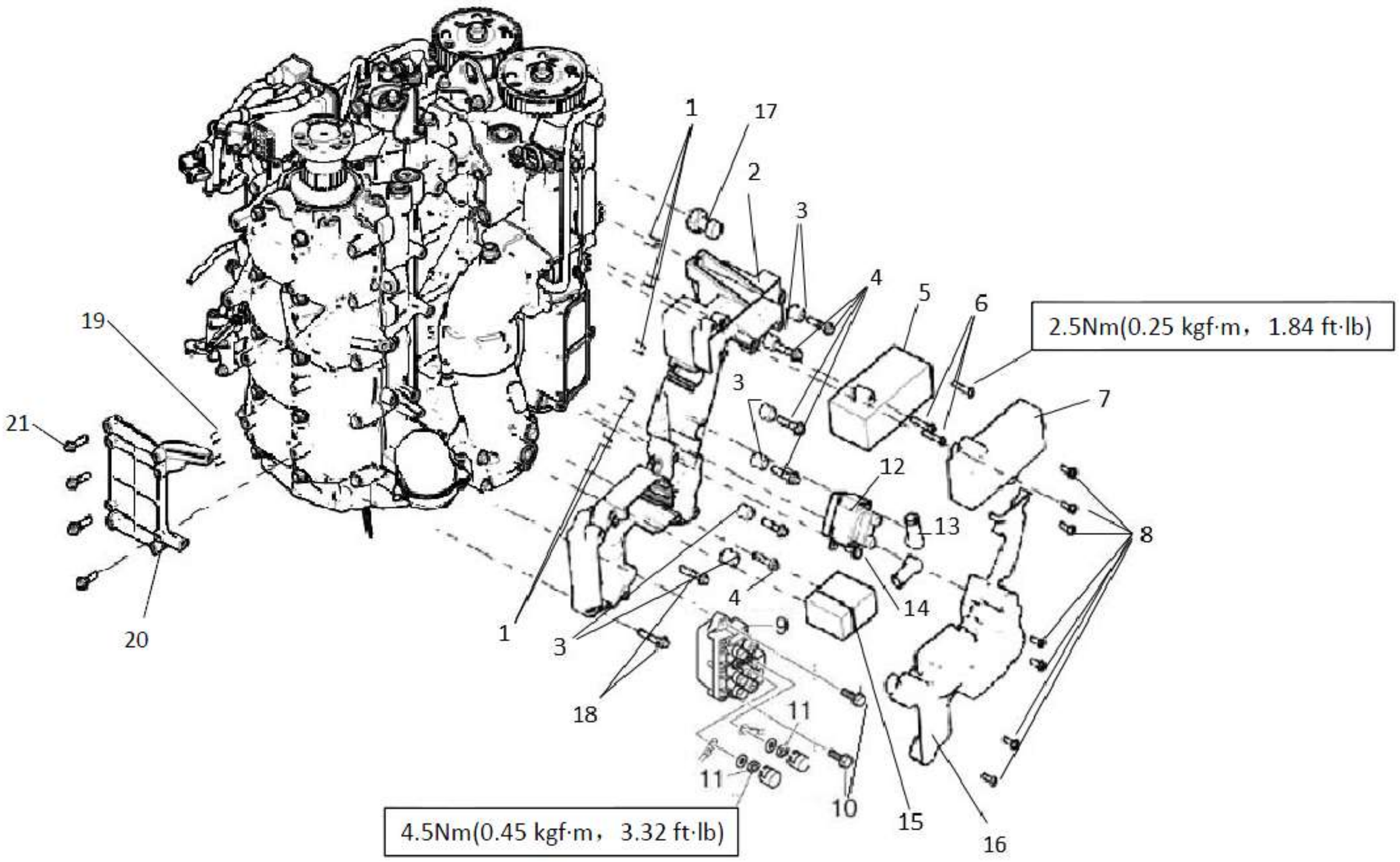
Wire harness



No.	Part name	Q'ty	Remarks
1	Collar	5	
2	Junction box	1	
3	Grommet	1	
4	Bolt	6	M6 x 30 mm
5	Fuse box	1	
6	Bolt	3	M5 x 30 mm
7	Cover	1	



No.	Part name	Q'ty	Remarks
8	Bolt	7	ST4.8 x 16
9	PTT relay	1	
10	Bolt	2	M6 x 20 mm
11	Nut	2	M6
12	Relay assembly	1	
13	Insulating bush	2	
14	Bolt	1	M6 x 16 mm
15	Main and fuel pump relay	1	
16	Cover	1	

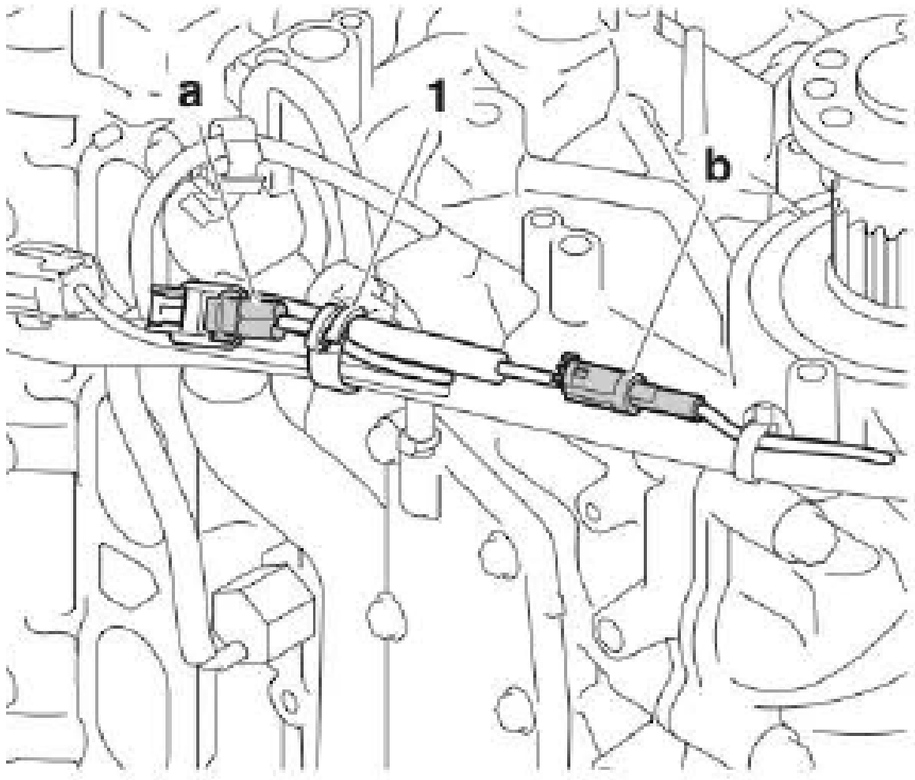


No.	Part name	Q'ty	Remarks
17	Oil pressure sensor	1	
18	Bolt	2	M6 x 35 mm
19	Dowel pin	2	
20	Bracket	1	
21	Bolt	4	M6 x 25 mm

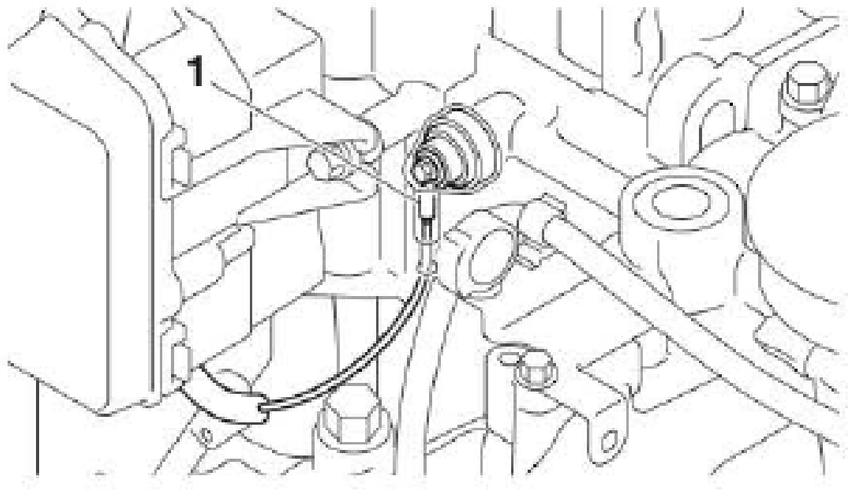
Removing the wire harness

1. Disconnect the thermo sensor coupler "a" and knock sensor coupler "b".

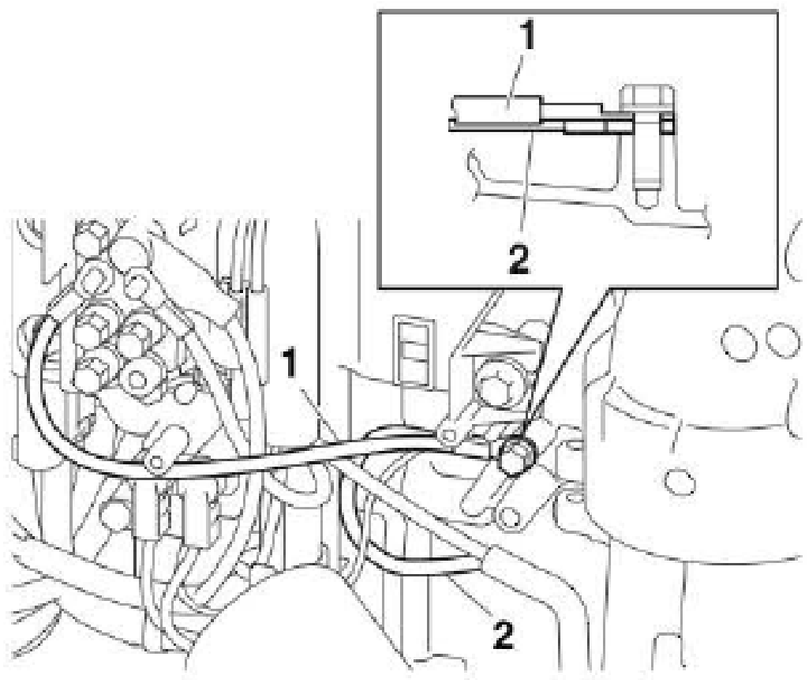
2. Remove the clamp "1".



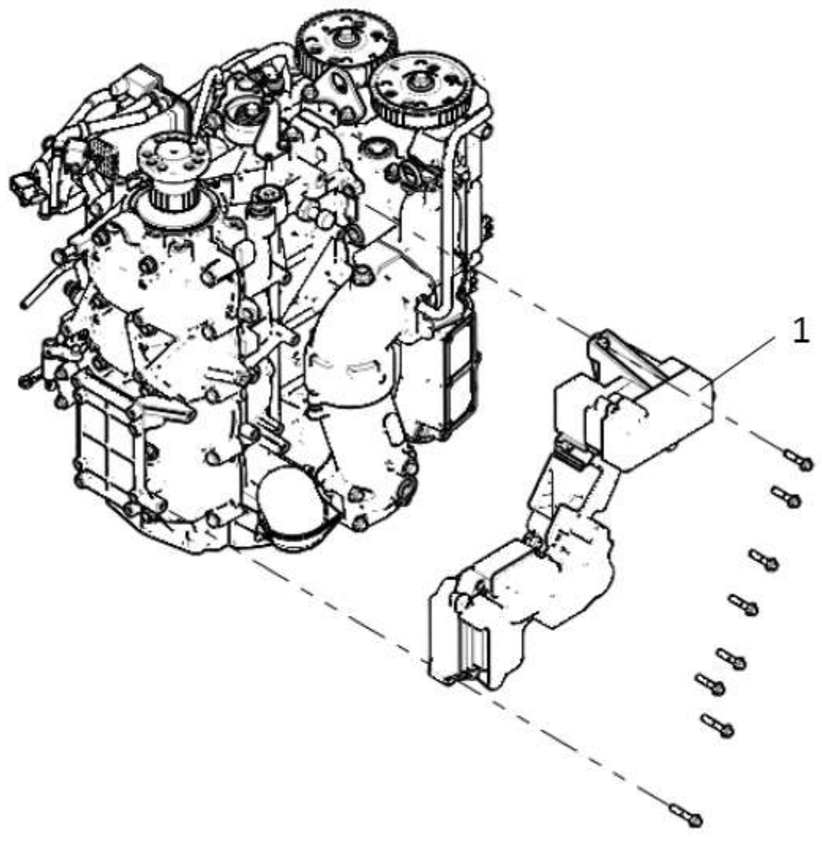
3. Remove the oil pressure switch lead "1".



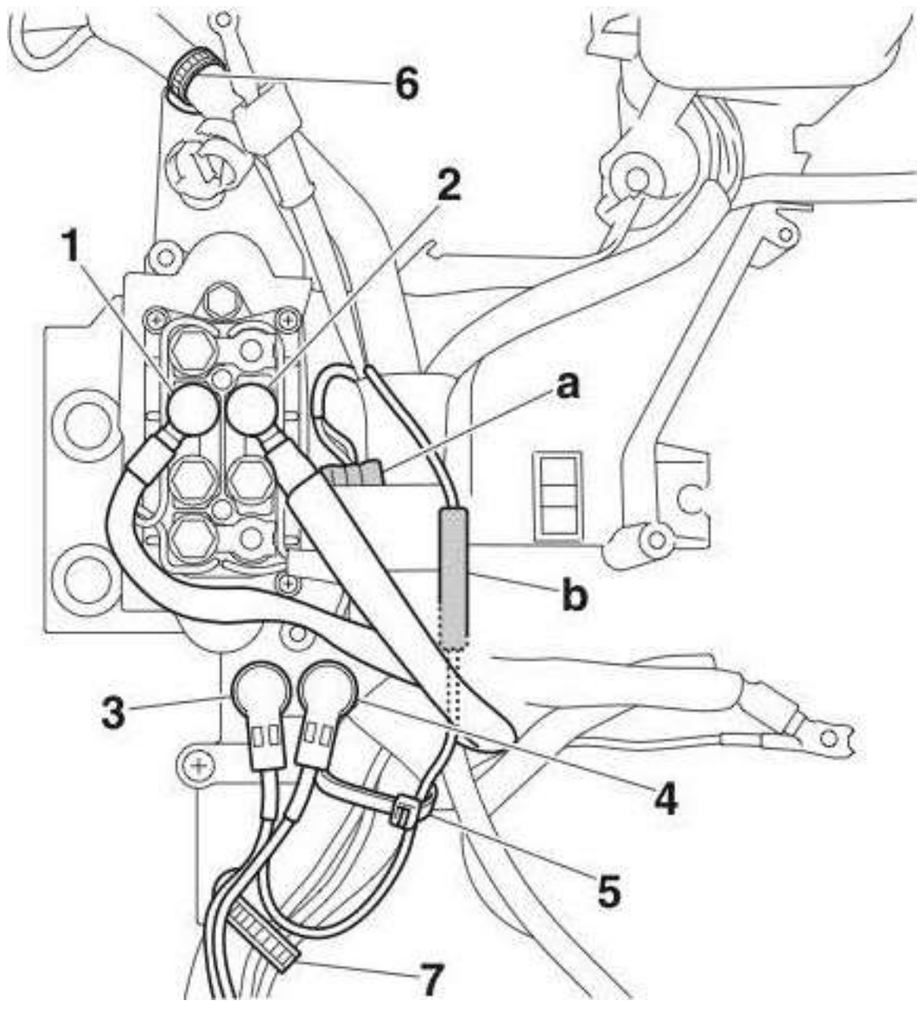
4. Remove the PTT relay lead "1" and rectifier/regulator lead "2".



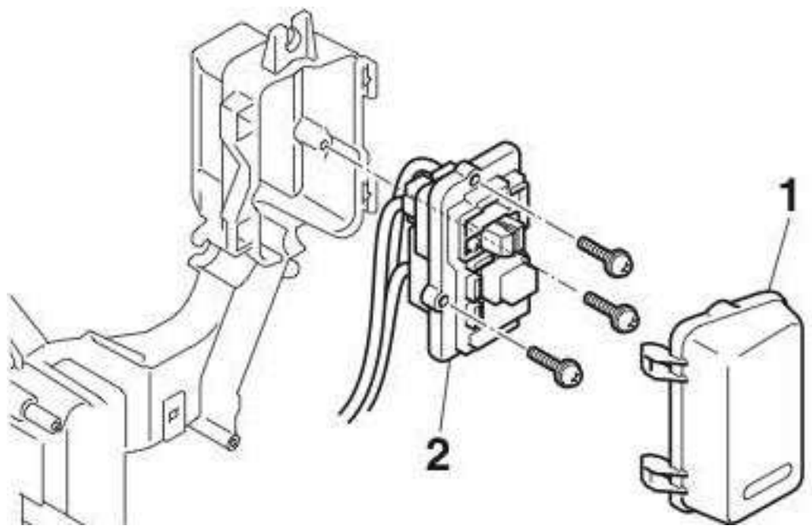
5. Remove the junction box "1" .



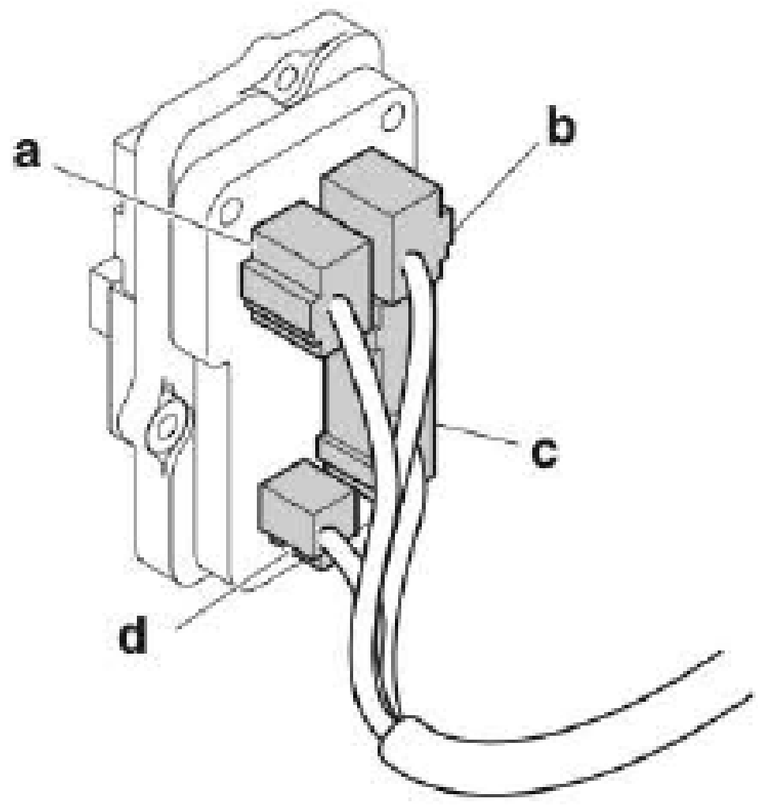
9. Remove the PTT relay leads "1" and "2".
10. Disconnect the PTT relay coupler "a".
11. Remove the starter relay leads "3" and "4".
12. Disconnect the starter relay connector "b".
13. Remove the plastic tie "5".
14. Remove the holders "6" and "7".



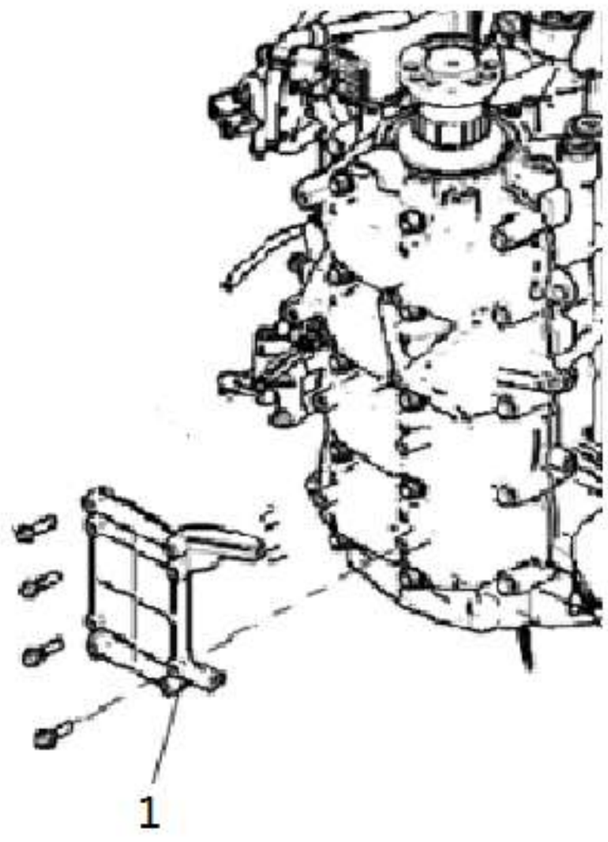
15. Remove fuse box cover "1", and then remove the fuse box "2".



16. Disconnect the couplers "a", "b", "c", and "d".



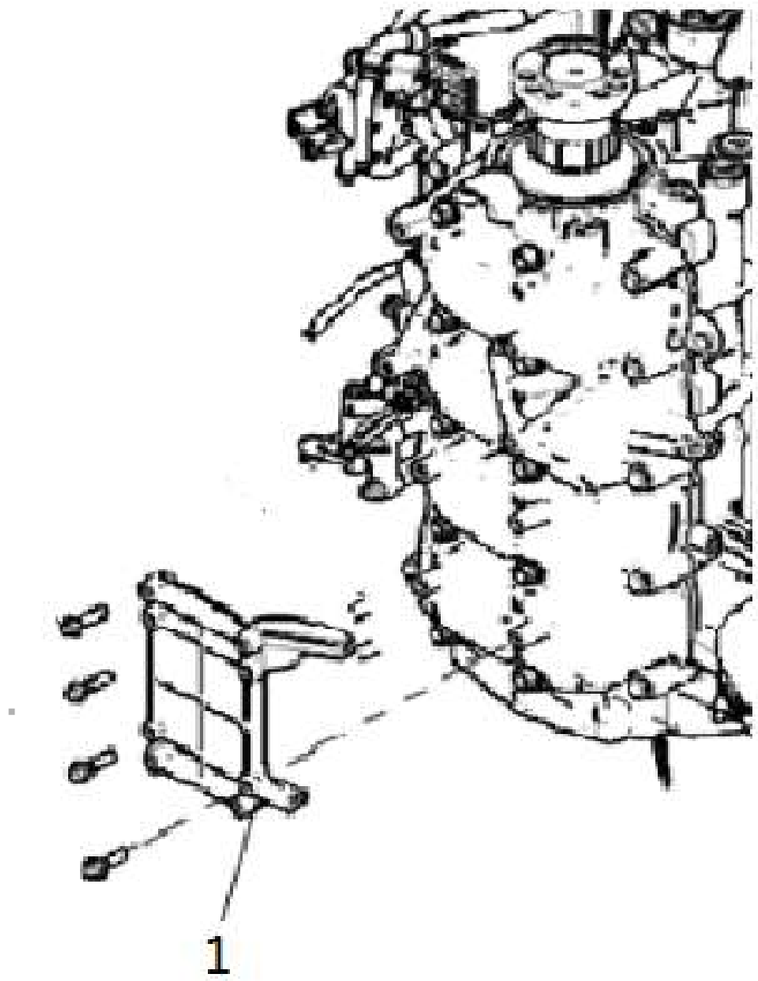
17. Remove the enging ECM bracket “1”.



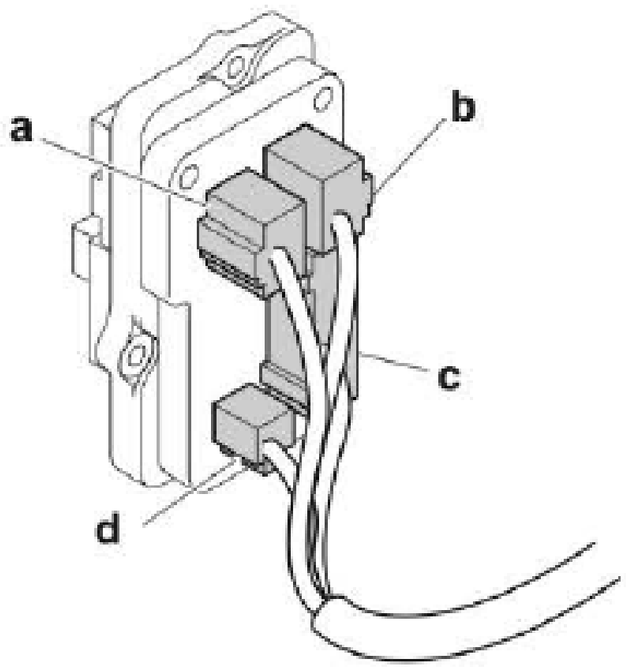
Installing the wire harness

See "Electrical component and wire harness routing" (5-1).

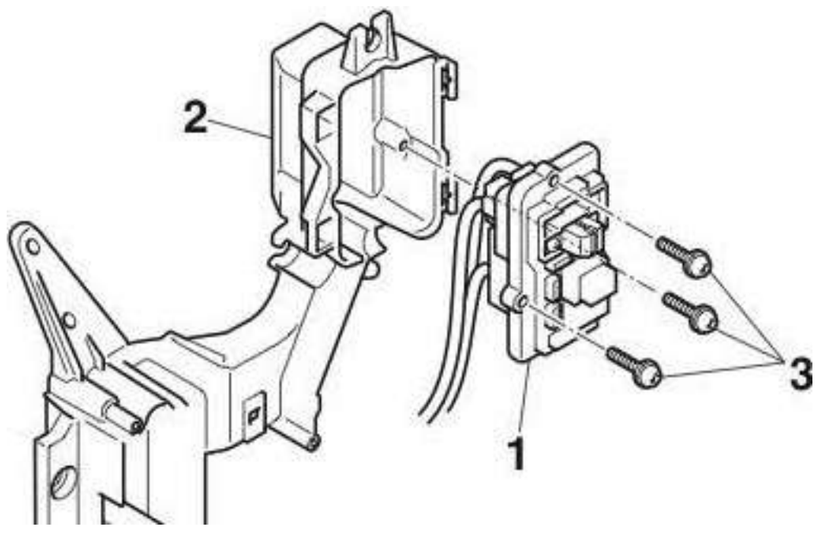
1. Install the engine ECM bracket “1”.



2. Connect the couplers "a", "b" "c" and "d".



3. Install the fuse box "1" to the junction box "2", and then tighten the fuse box screws "3" to the specified torque.



Fuse box screw "3"
2.5 Nm (0.25 kgf·m, 1.84 ft·lb)

4. Connect the PTT relay coupler "a", and then fasten the PTT relay coupler "a" to the wire harness "1" using the tape "2".

5. Install the PTT relay leads "3" and "4", and then tighten the PTT relay lead nuts "5" to the specified torque.

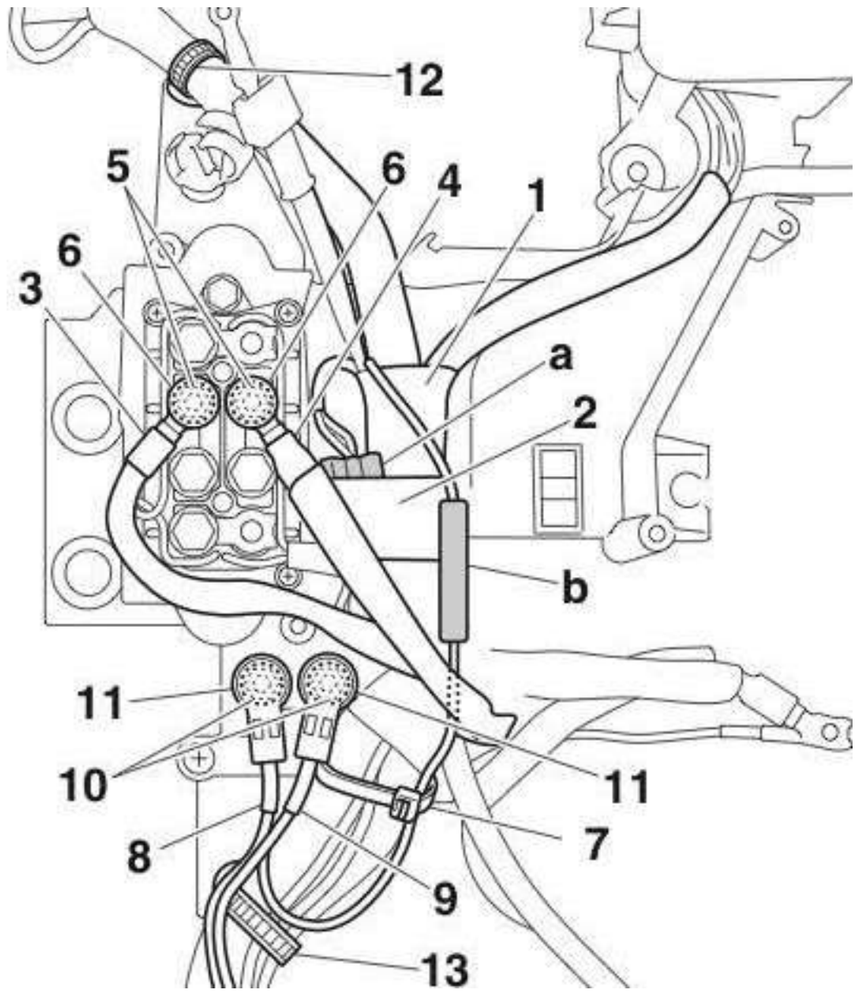
6. Install the caps "6".

7. Connect the starter relay connector "b", and then fasten it using the plastic tie "7".

8. Install the starter relay leads "8" and "9", and then tighten the starter relay lead nuts "10" to the specified torque.

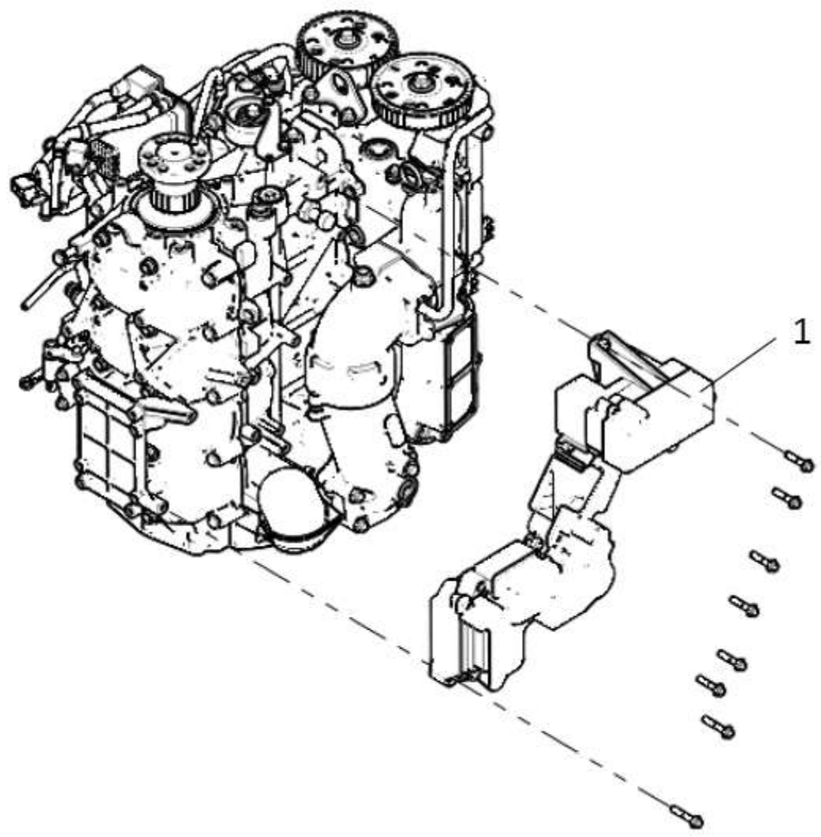
9. Install the caps "11".

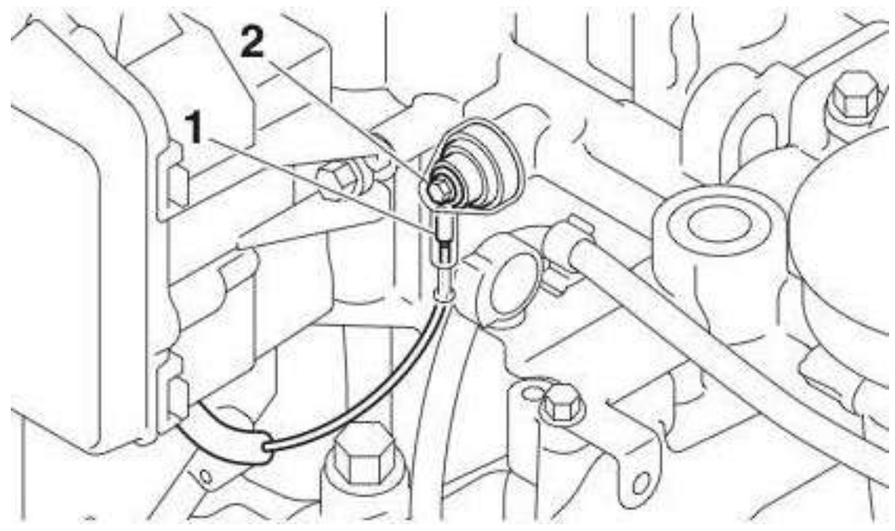
10. Fasten the wire harness "1" using the holders "12" and "13".



PTT relay lead nut "5"
4.5 Nm (0.45 kgf·m, 3.32 ft·lb)
Starter relay lead nut "10"
3.5 Nm (0.35 kgf·m, 2.58 ft-lb)

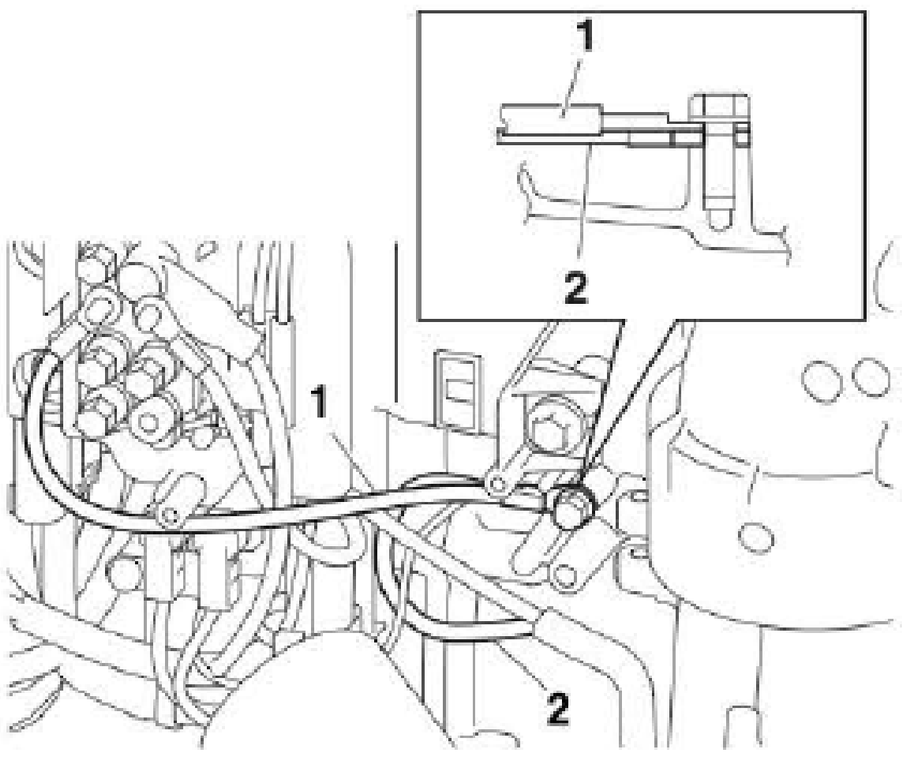
11. Install the junction box "1" .





Oil pressure switch lead bolt "2"
2 Nm (0.2 kgf·m, 1.5 ft·lb)

12. Install the PTT relay lead "1" and rectifier/ regulator lead "2".



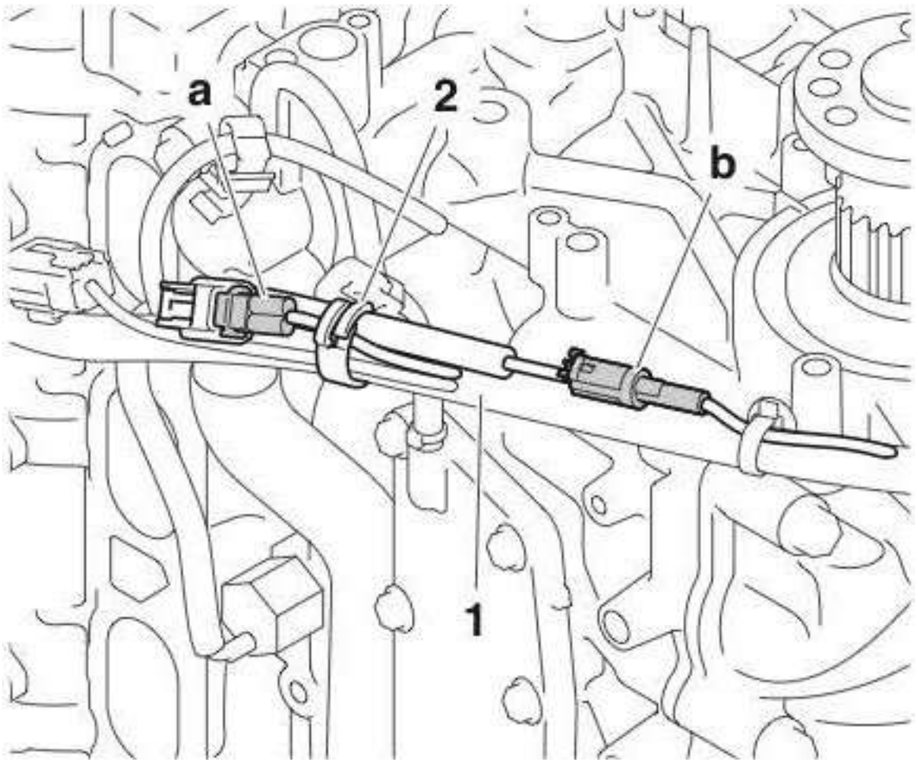
13. Install the oil pressure switch lead "1", and then tighten the oil pressure switch lead bolt "2" to the specified torque.

TIP:

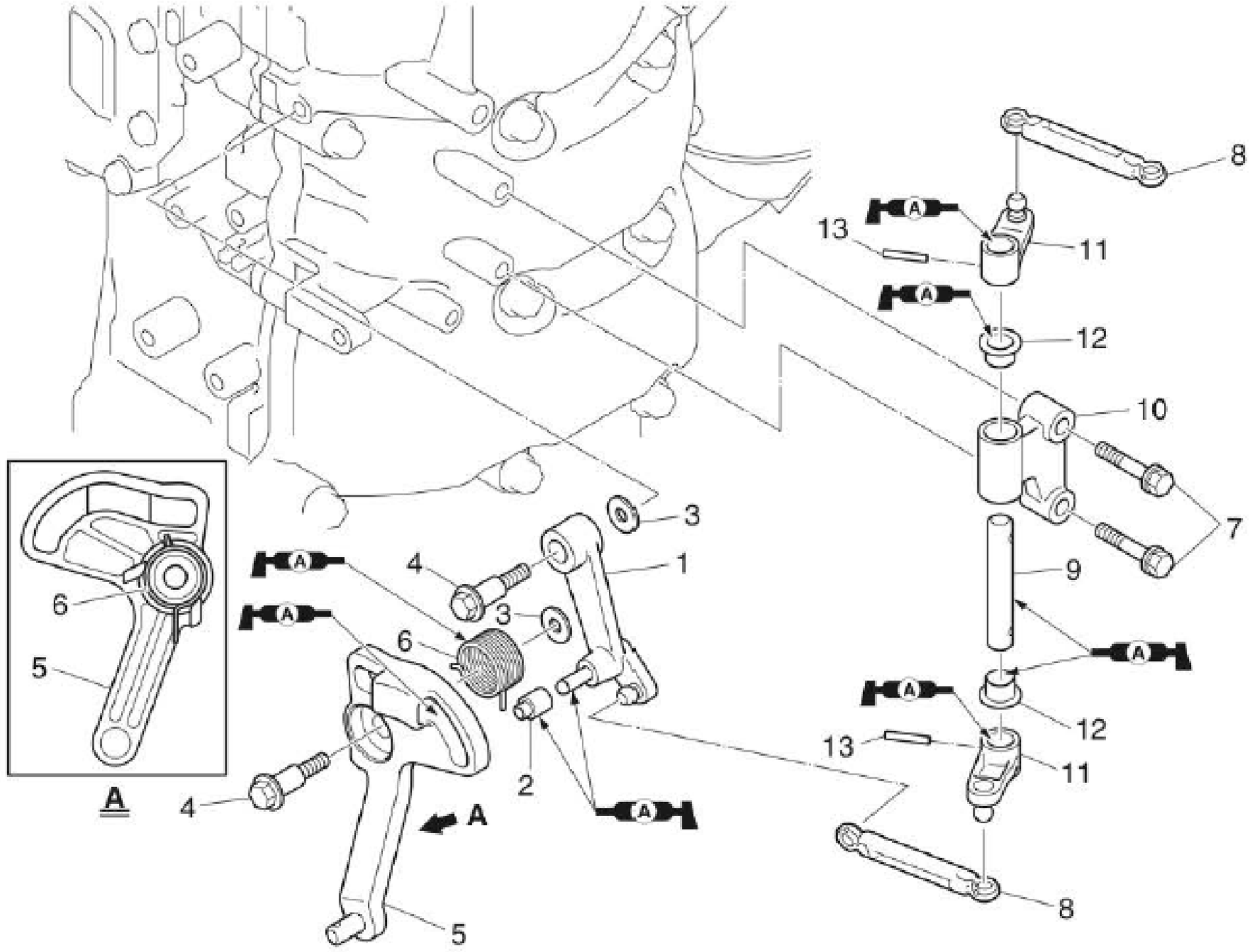
Install the oil pressure switch lead "1" in the direction shown in the illustration.

14. Connect the thermo sensor coupler "a" and knock sensor coupler "b".

15. Fasten the main wire harness "1" using the clamp "2".



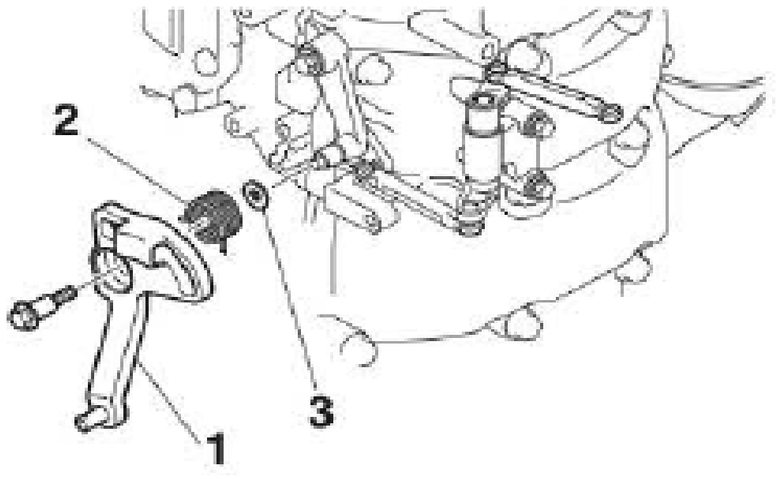
Throttle link rod



No.	Part name	Q'ty	Remarks
1	Throttle control lever	1	
2	Bushing	1	
3	Washer	2	
4	Bolt	2	M6 x 35 mm
5	Accelerator cam	1	
6	Spring	1	
7	Bolt	2	M6 x 30 mm
8	Link joint	2	
9	Link connecting shaft	1	
10	Bracket	1	
11	Throttle lever	2	
12	Bushing	2	
13	Pin	2	

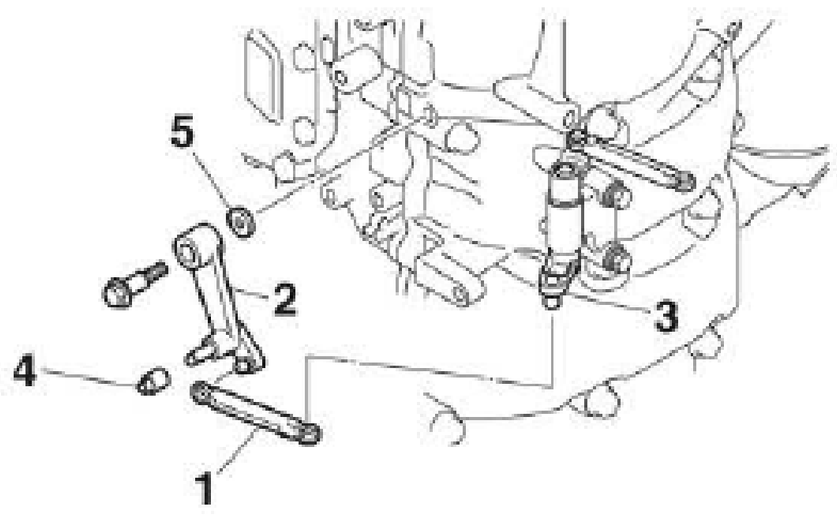
Removing the throttle link rod

1. Remove the accelerator cam "1", spring "2", and washer "3".

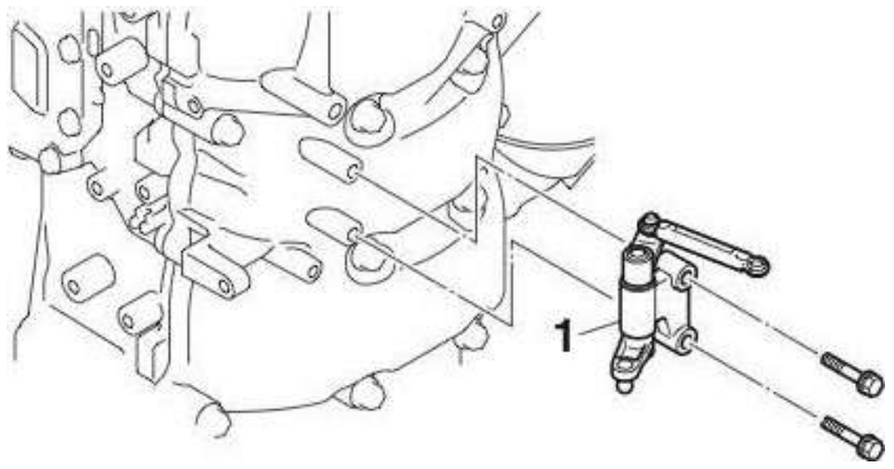


2. Remove the link joint "1" from the throttle control lever "2" and throttle lever "3".

3. Remove the bushing "4", throttle control lever "2", and washer "5".

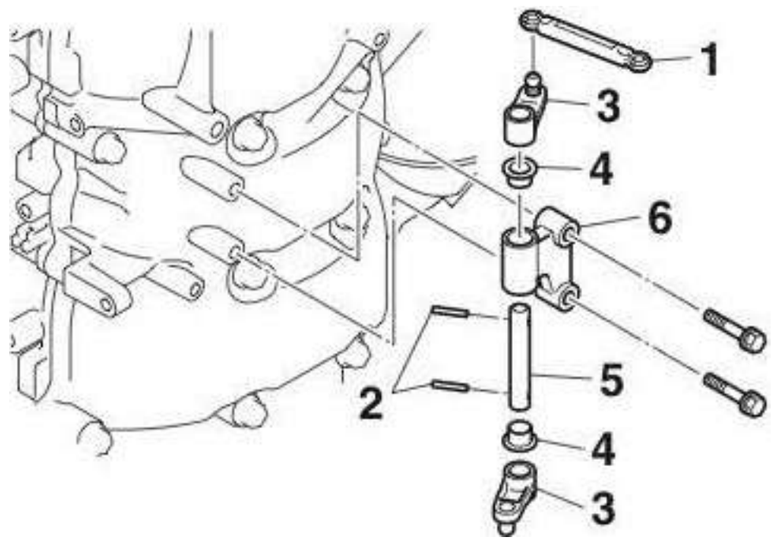


4. Remove the throttle lever assembly "1".



5. Remove the link joint "1".

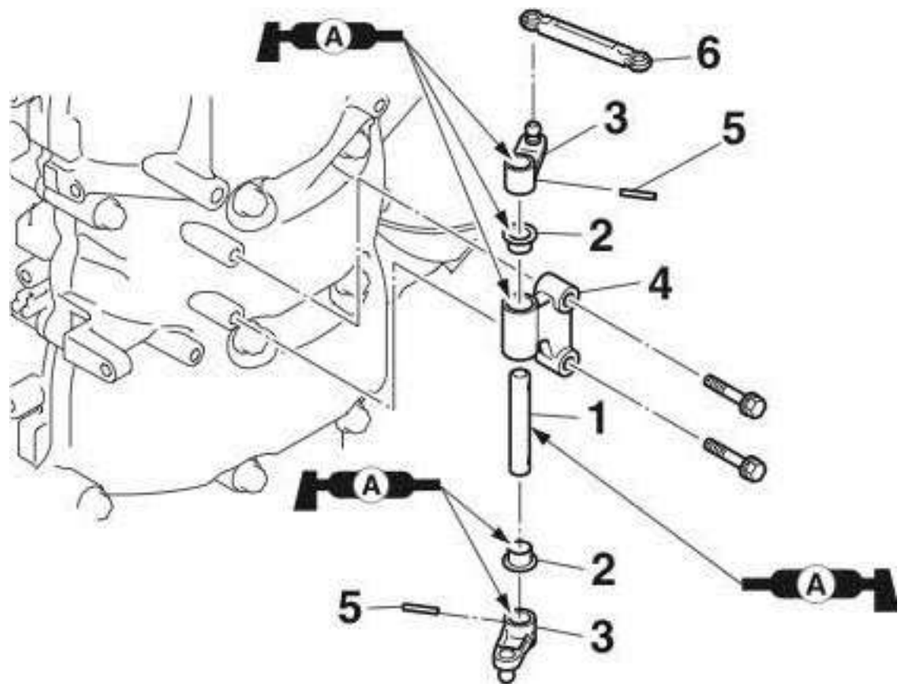
6. Remove the pins "2", and then remove the throttle levers "3", bushings "4", and link connecting shaft "5" from the bracket "6".



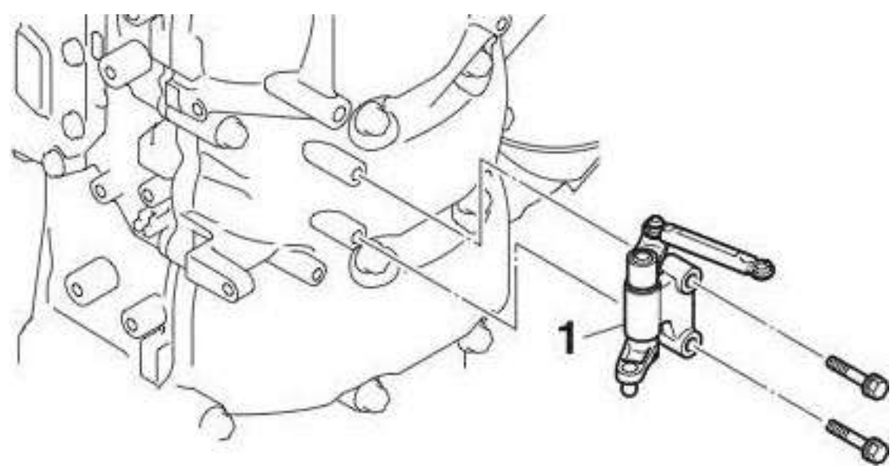
Installing the throttle link rod

1. Install the link connecting shaft "1", bushings "2", and throttle levers "3" to the bracket "4", and then secure them using the pins "5".

2. Install the link joint "6".



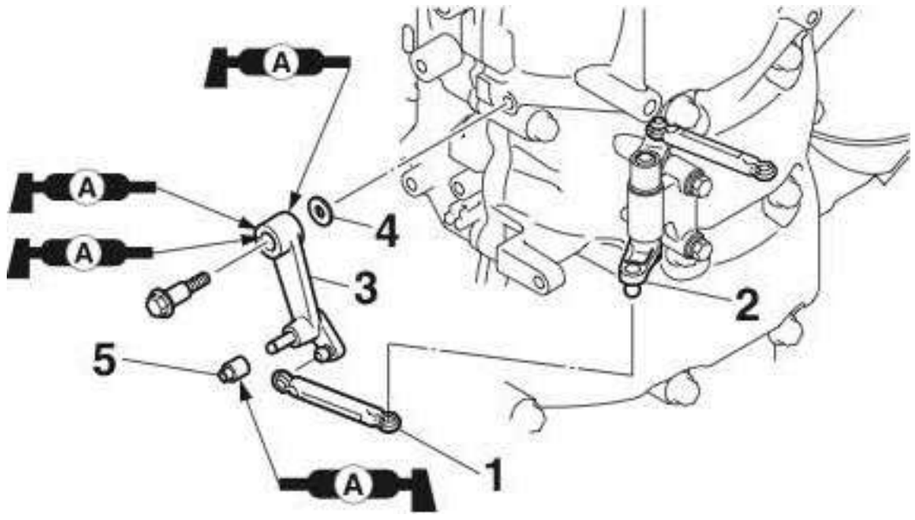
3. Install the throttle lever assembly "1".



4. Install the link joint "1" to the throttle lever "2".

5. Install the link joint "1" to the throttle control lever "3".

6. Install the washer "4", throttle control lever "3", and bushing "5".



7. Install the spring "1" to the accelerator cam "2".

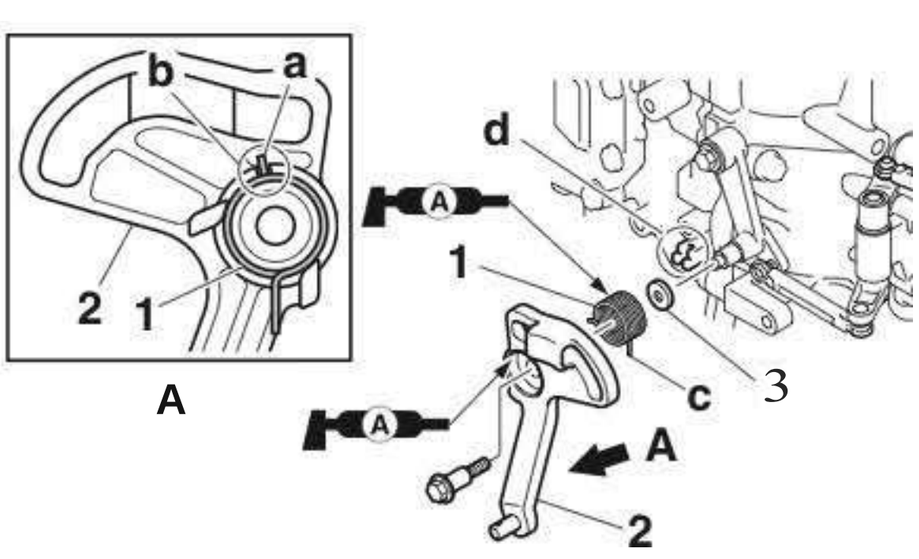
TIP:

Fit the end "a" of the spring "1" into the slit "b" in the accelerator cam "2".

8. Install the washer "3", spring "1", and accelerator cam "2".

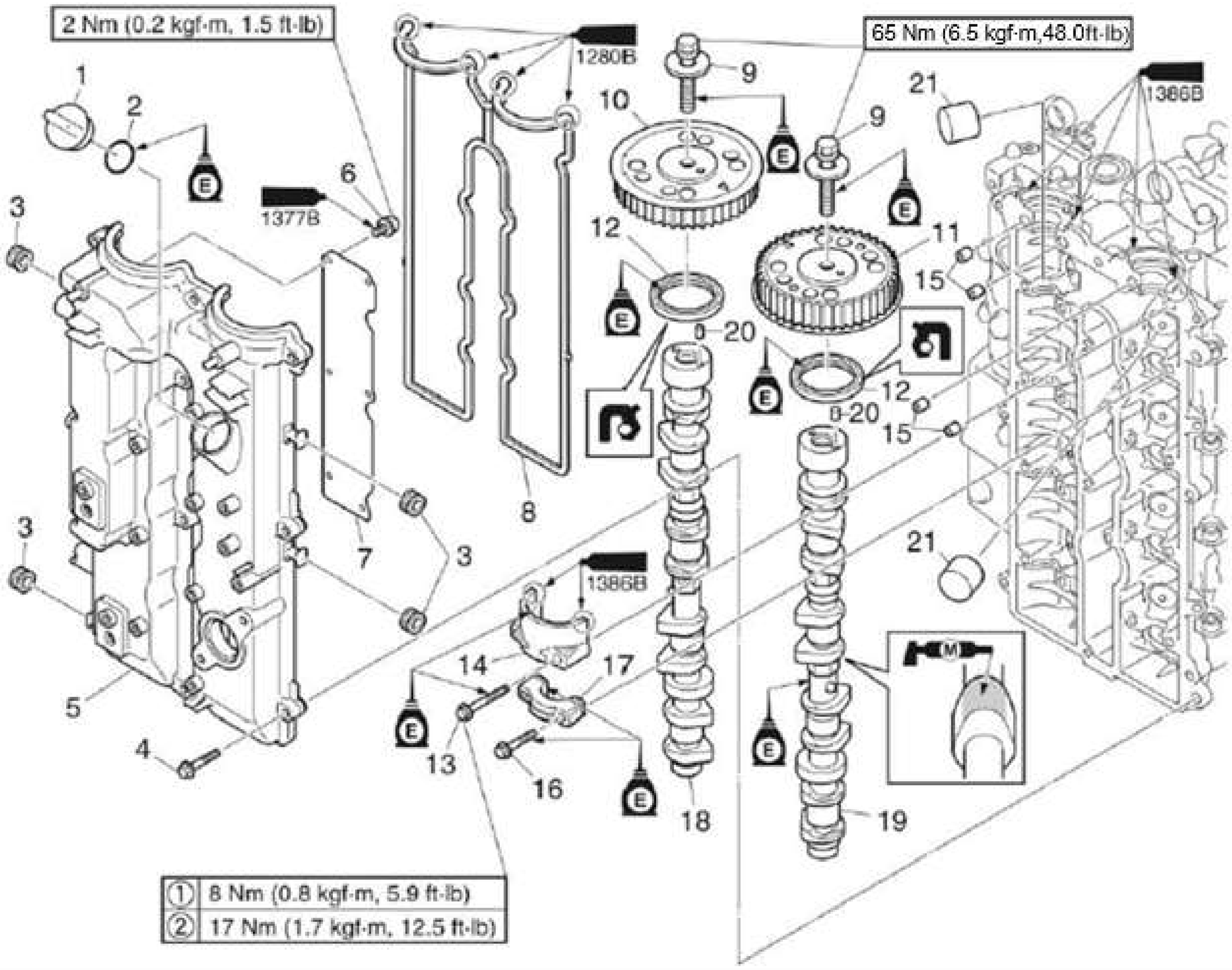
TIP:

Fit the end "c" of the spring "1" between the bosses "d" on the cylinder block.

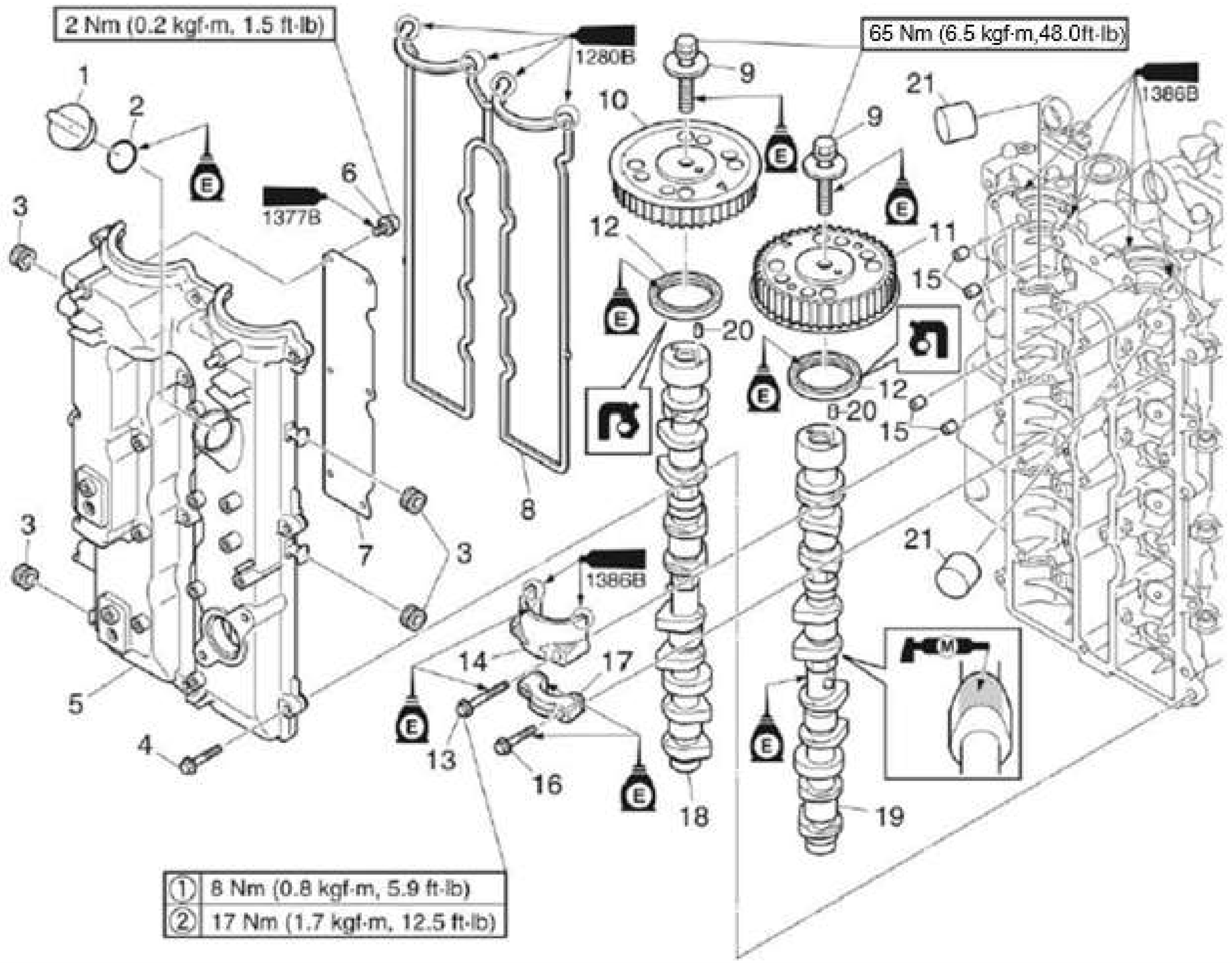


9. Adjust the throttle link. See "Adjusting the throttle link" (6-23).

Camshaft



No.	Part name	Q'ty	Remarks
1	Oil filler cap	1	
2	O-ring	1	Not reusable
3	Grommet	4	
4	Bolt	12	M6 x 30 mm
5	Cylinder head cover	1	
6	Screw	6	M4 x 8 mm
7	Plate	1	
8	Gasket	1	Not reusable
9	Bolt	2	M10 x 35 mm
10	Driven sprocket	2	EX
11	Driven sprocket	1	IN
12	Oil seal	2	Not reusable
13	Bolt	4	M6 x 45 mm
14	Camshaft cap	2	
15	Dowel pin	4	
16	Bolt	16	M6 x 35 mm
17	Camshaft cap	8	



No.	Part name	Q'ty	Remarks
18	Camshaft	1	EX
19	Camshaft	1	IN
20	Dowel pin	2	
21	Valve lifter	16	

Removing the driven sprocket and camshaft

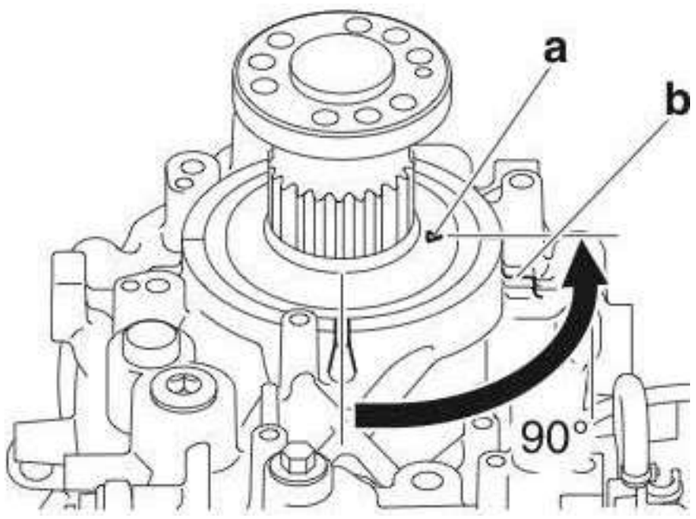
NOTICE

When the timing belt is not installed, do not turn the crankshaft or camshafts. Otherwise, the intake and exhaust valves could collide with each other or with the pistons and be damaged.

1. Turn the crankshaft counterclockwise 90° gradually until the "6" mark "a" in the crankshaft is aligned with the protrusion "b" on the cylinder block.

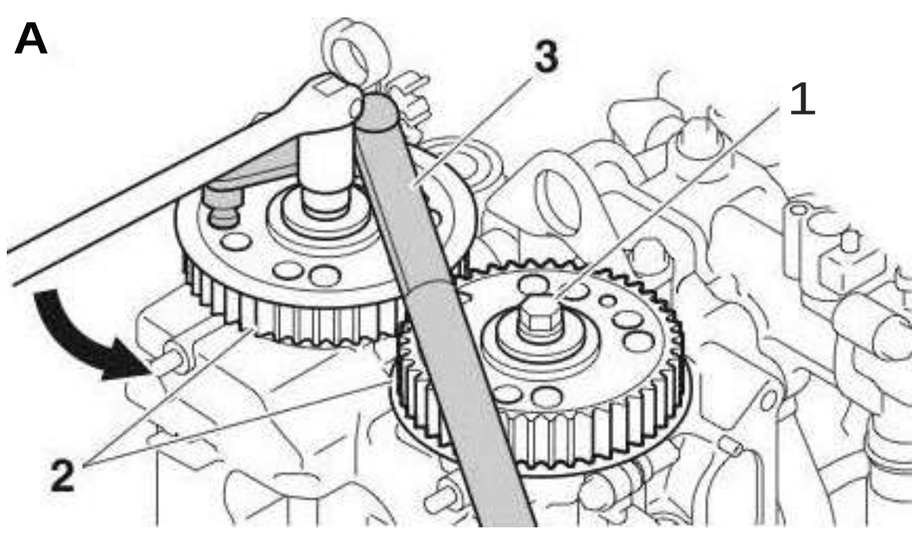
NOTICE

Do not turn the crankshaft counterclockwise more than 90°. Otherwise, the pistons and valves could collide with each other and be damaged.

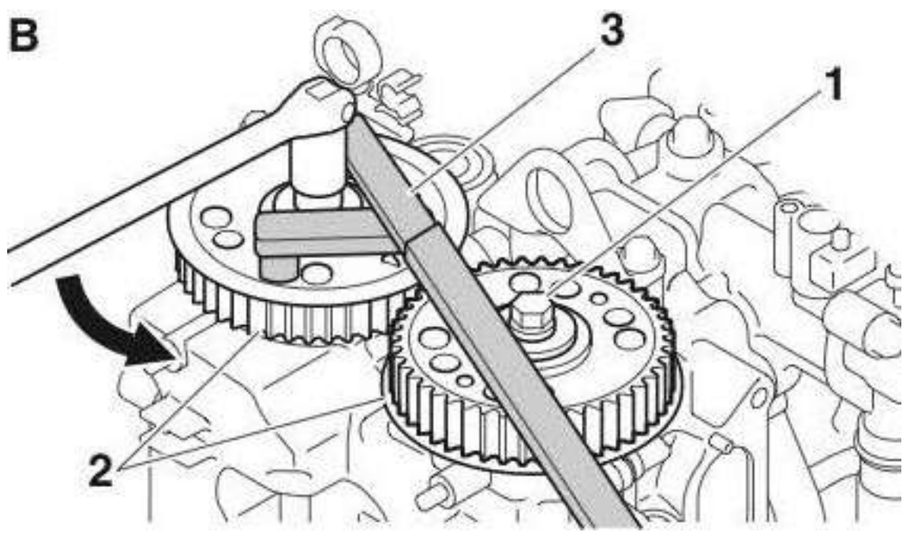


2. Loosen the driven sprocket bolts "1", and then remove the driven sprockets "2".

A



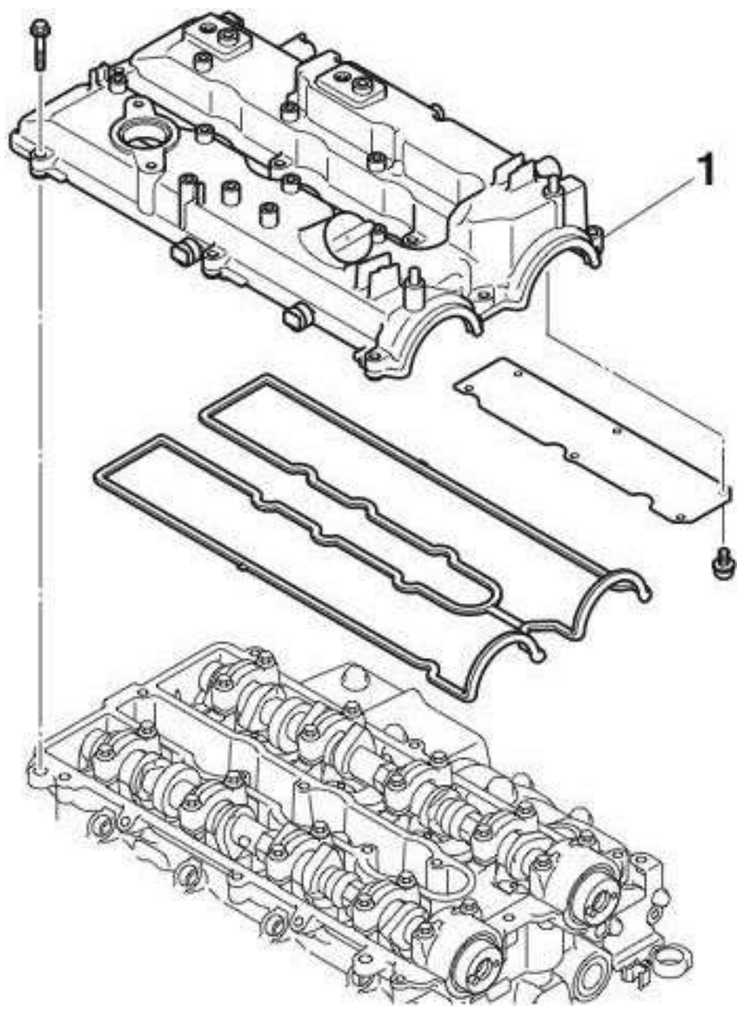
B



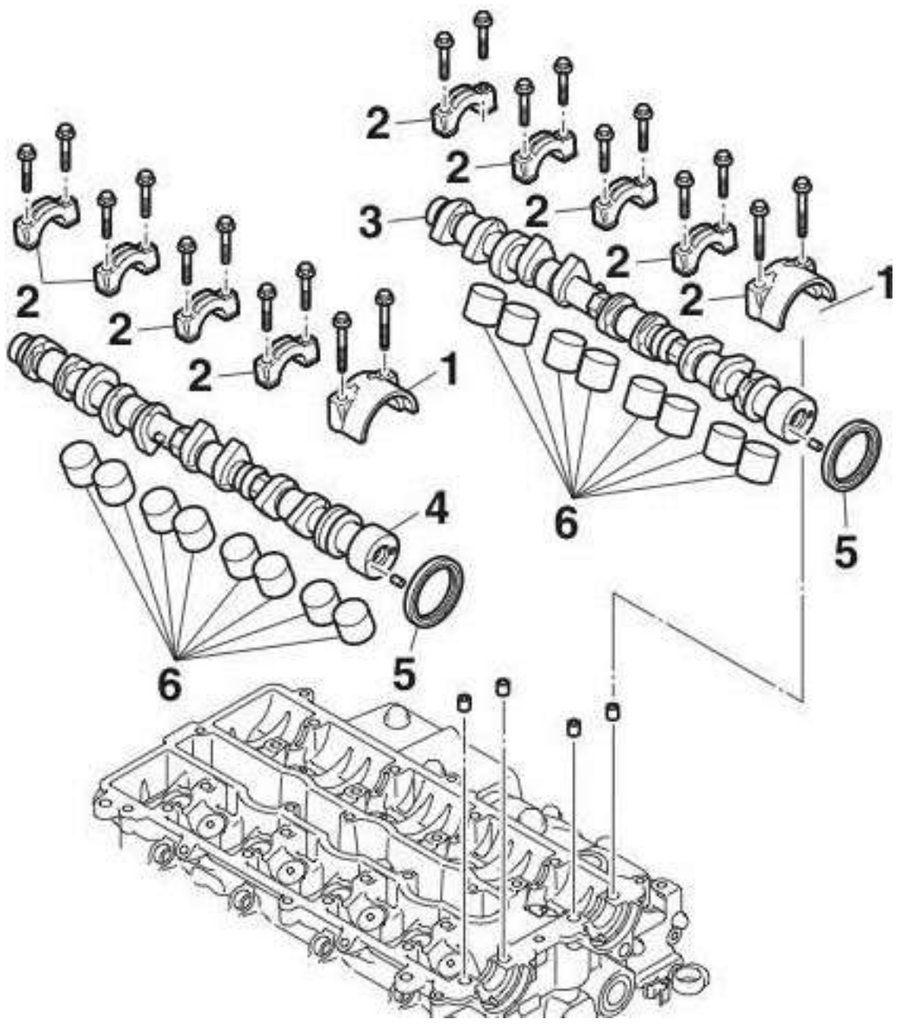
A. Worldwide
B. USA and Canada

Flywheel holder "3"
Flywheel magneto holder "3"

3. Remove the cylinder head cover "1".



4. Remove the camshaft caps "1" and "2", camshafts "3" and "4", and oil seals "5", and then remove the valve lifters "6".



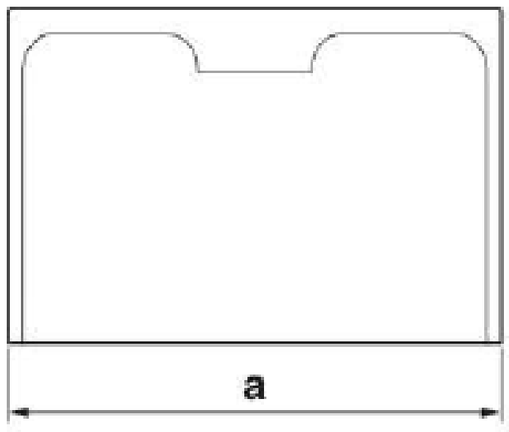
Checking the sprocket

1. Check the driven sprockets. Replace the driven sprocket if cracked, damaged, or worn.

Checking the valve lifter

1. Check the valve lifters. Replace if damaged, scratched, or worn.

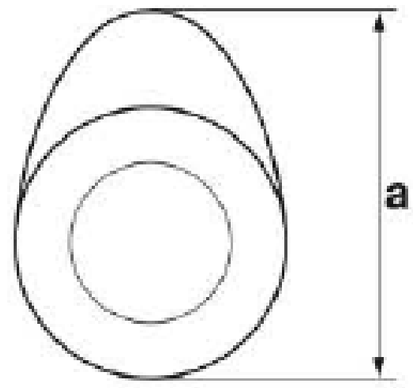
2. Measure the valve lifter outside diameter "a".



Outside diameter
27.967-27.980 mm (1 .1011-1.1015 in)

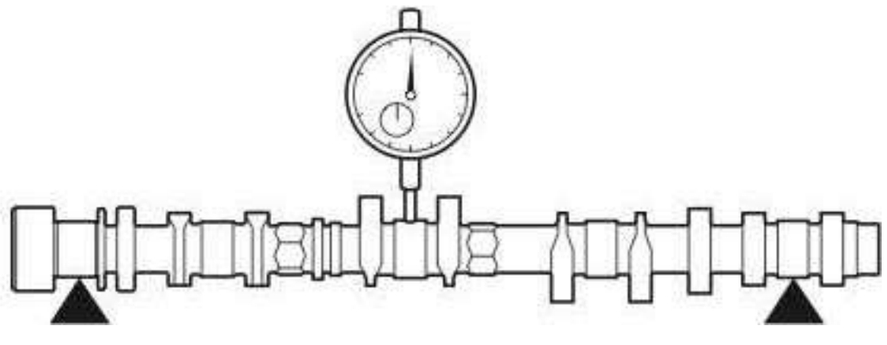
Checking the camshaft

1. Measure the camshaft lobe height "a". Replace if below specification.



Cam lobe height IN
42.464-42.544 mm (1.6718-1.6750 in)
Lift
4 2 . 4 1 4 mm (1.6698in)
Cam lobe height EX
41 .464-41.544 mm (1.6324-1.6356 in)
Lift
4 1 . 4 1 4 mm (1.6305in)

2. Measure the camshaft runout. Replace if above specification.



Runout
0.030 mm (0.0012 in)

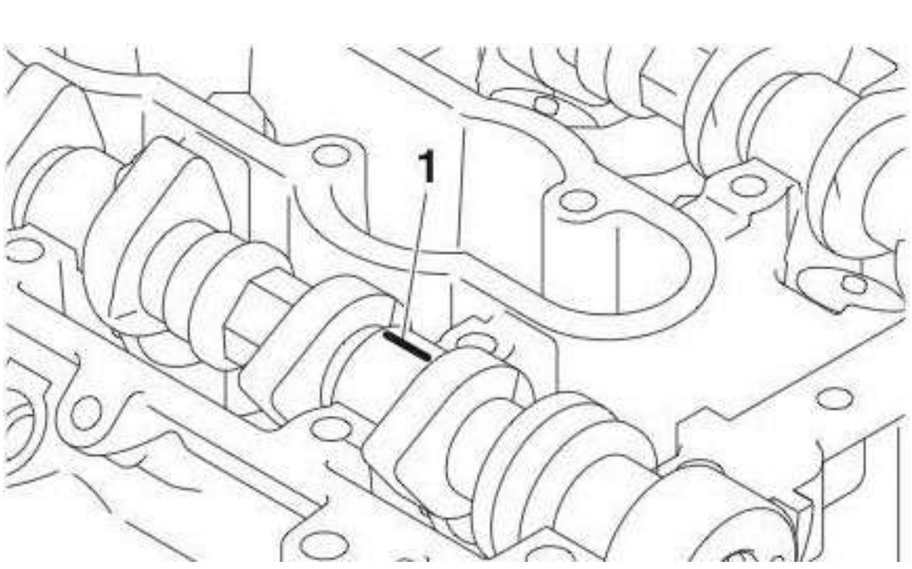
Checking the camshaft journal oil clearance

1. Place the camshafts on the cylinder head.

2. Place a piece of Plastigauge (PG-1) "1" on each camshaft journal, parallel to the camshaft.

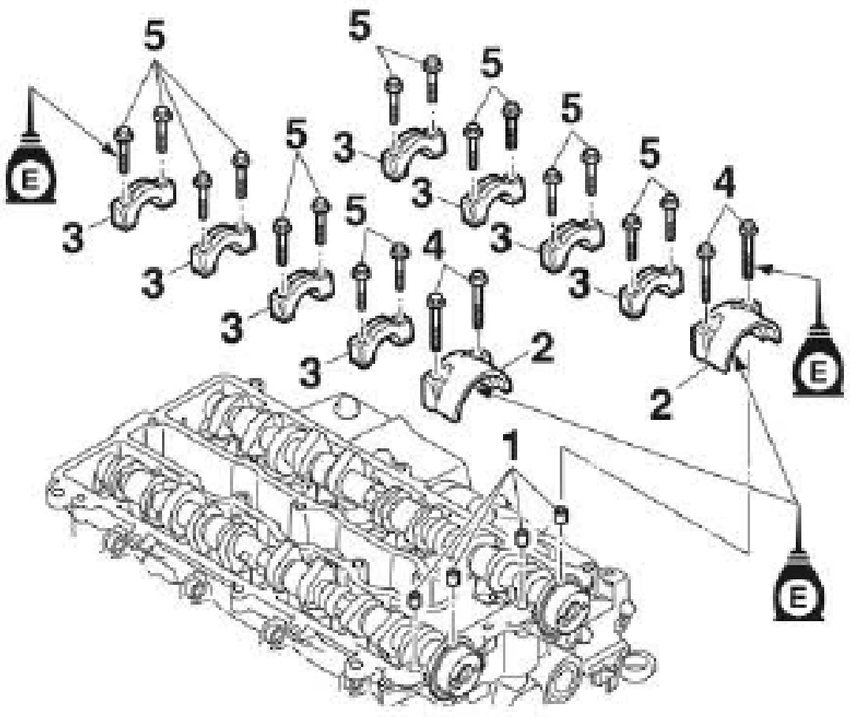
NOTICE

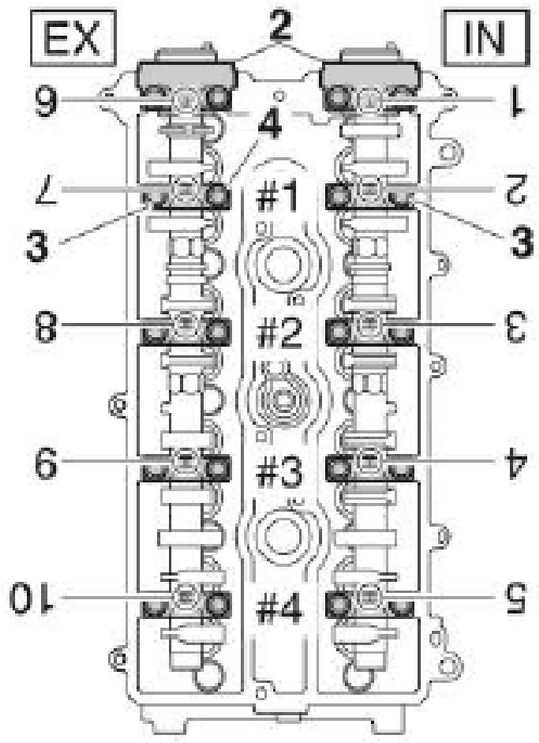
Do not place the Plastigauge (PG-1) over the oil hole in each camshaft journal.



3. Install the dowel pins "1" and camshaft caps "2" and "3" in their proper positions so that the stamped numbers are upside down.

4. Install the camshaft cap bolts “4” and “5”.

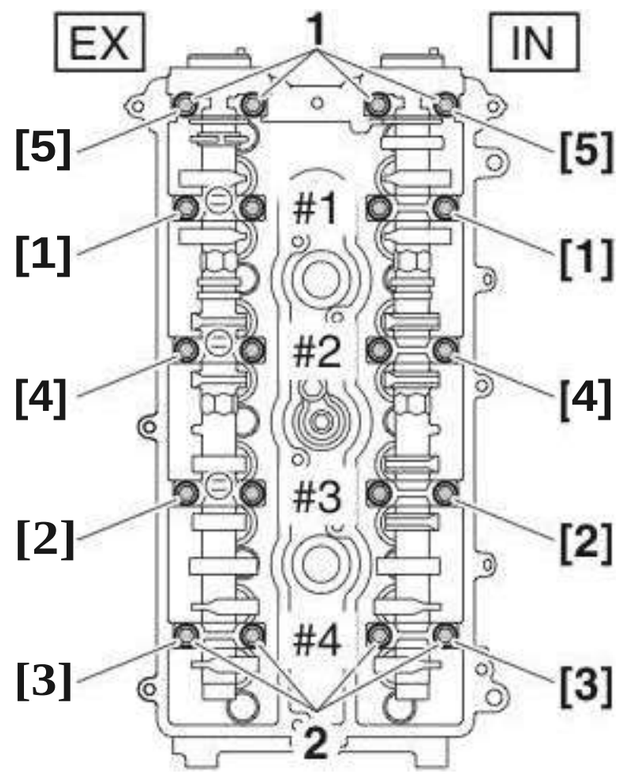




5. Tighten the camshaft cap bolts "1" to the specified torques, and the camshaft cap bolts "2" in 2 stages and in the order [1], [2], and so on.

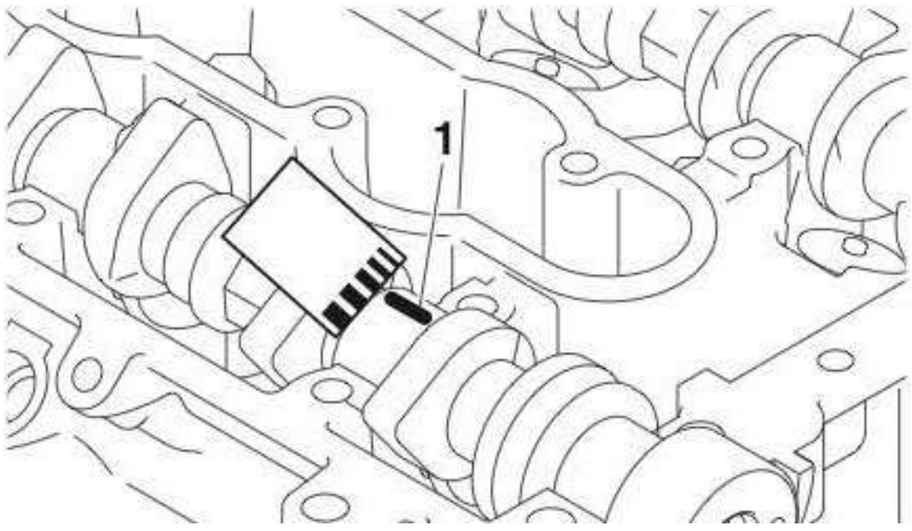
TIP:

Do not turn the camshafts when measuring the camshaft journal oil clearance using the Plastigauge.



Camshaft cap bolt "1"
1st: 8 Nm (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 Nm (1.7 kgf·m, 12.5 ft·lb)

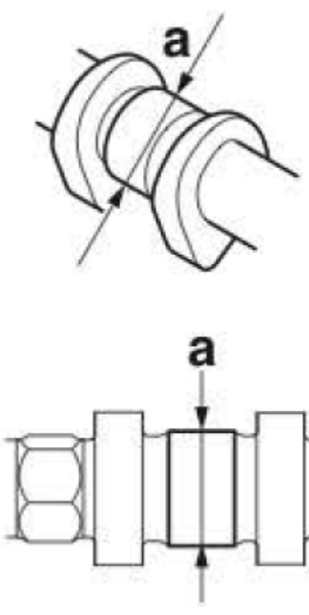
6. Remove the camshaft caps, and then measure the width of the Plastigauge "1". Check the camshaft journal outside diameter and cylinder head journal inside diameter if the oil clearance is above specification. See "Checking the cam- shaft journal outside diameter and cam- shaft journal inside diameter" (7-51).



Camshaft journal oil clearance
0.04-0.076 mm (0.0016-0.0030 in)
Limit
0.080 mm (0.0032 in)

Checking the camshaft journal outside diameter and camshaft journal inside diameter

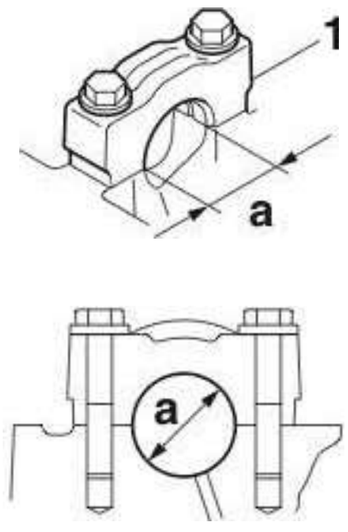
1. Measure the camshaft journal outside diameter "a". Replace the camshaft if the camshaft journal outside diameter is below specification.



Journal diameter
24.960-24.980 mm (0.9827-0.9834in)

2. Install the camshaft caps "1". See steps 3- 5 in "Checking the camshaft journal oil clearance" (7-50).

3. Measure the camshaft journal inside diameter "a". Replace the cylinder head and camshaft cap as a set if the cylinder head journal inside diameter is above specification.



Journal inside diameter
25.000-25.021 mm (0.9843-0.9851 in)

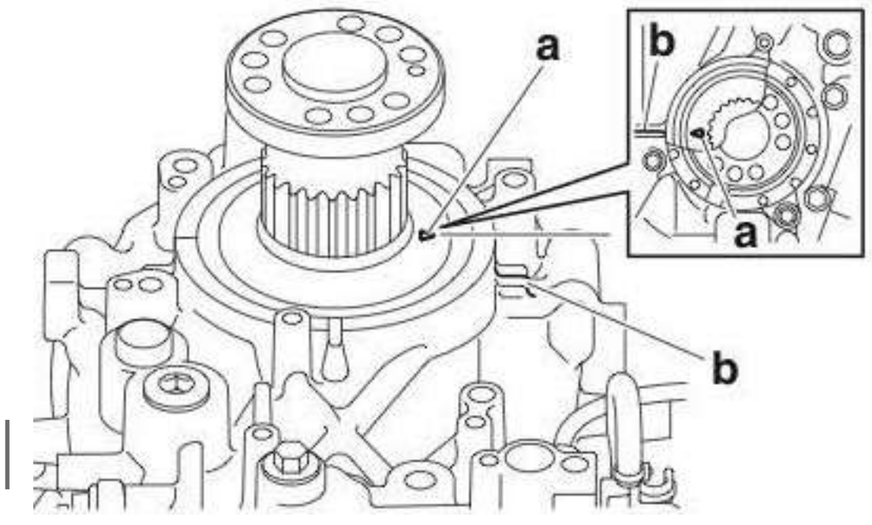
Installing the camshaft and driven sprocket

If the valve clearances are adjusted or any parts related to valve movement are replaced after installing the timing belt, check the valve clearances. See "Checking the valve clearance" (7-3).

NOTICE

- **When the timing belt is not installed, do not turn the crankshaft or camshafts. Otherwise, the pistons and valves or intake and exhaust valves could collide with each other and be damaged.**
- **Be careful when turning the camshafts. Compression of the valve spring may cause the camshafts to rotate too far.**

1. Check that the "△" mark "a" in the crankshaft is aligned with the protrusion “b”.

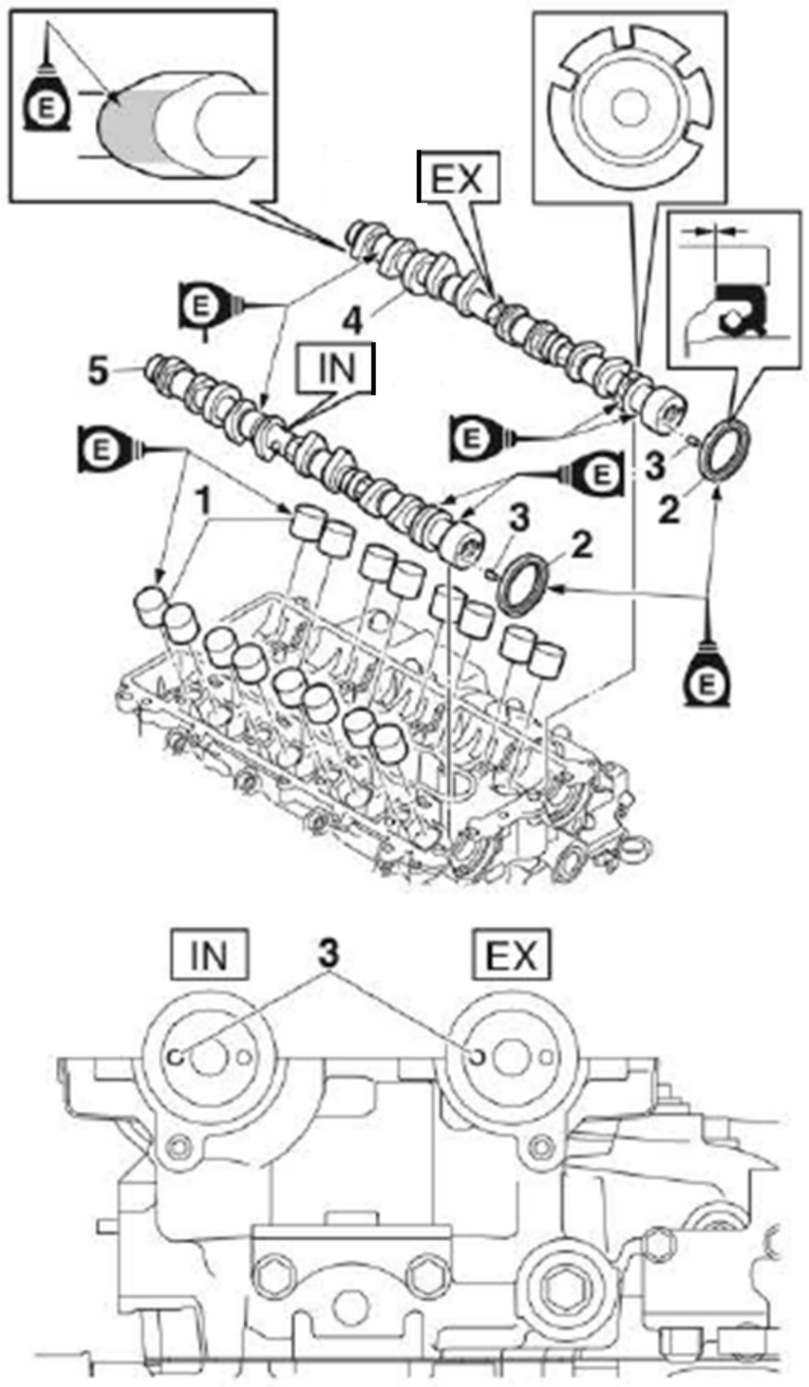


2. Install the valve lifters "1".

TIP:
Install the valve lifters in their original positions.

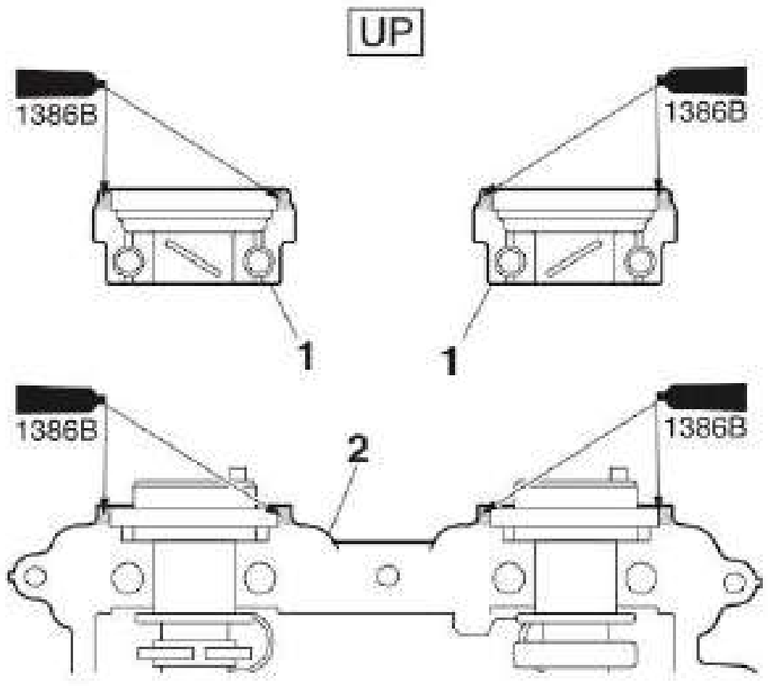
3. Install new oil seals "2" and the dowel pins "3" onto the camshafts "4" and "5".

4. Install the camshafts so that the dowel pins "3" are facing toward the intake manifold and that they are aligned with the mating surface of the cylinder head.



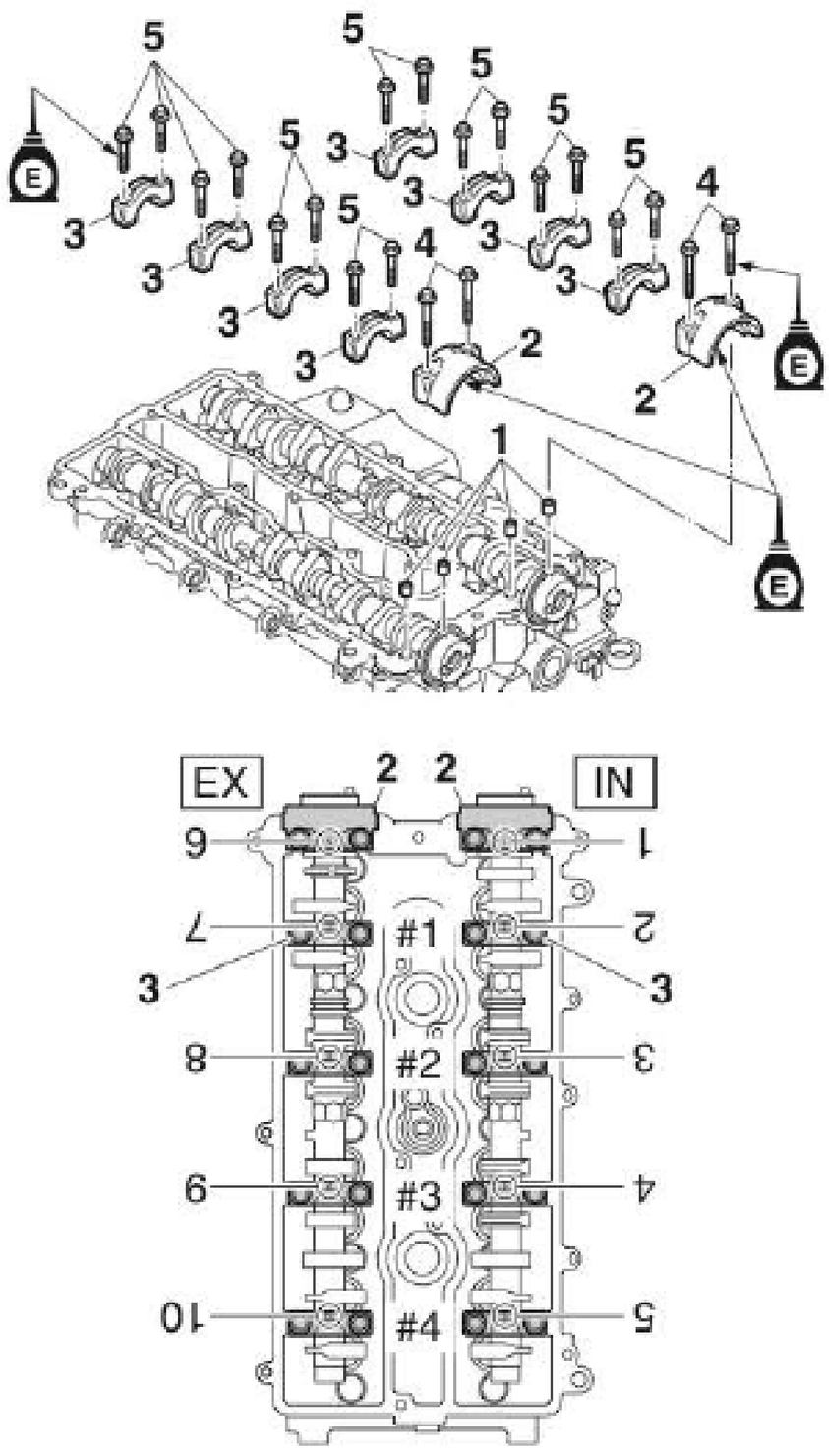
5. Apply a thin, even coat of sealant to the mating surfaces of the camshaft caps "1" and cylinder head "2".

TIP:
Do not block the oil passages or oil holes with the sealant.

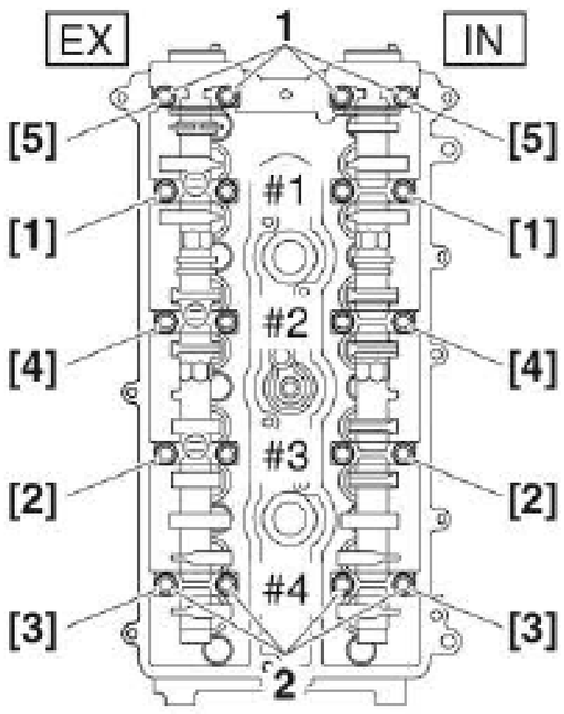


6. Install the dowel pins "1" and camshaft caps "2" and "3" in their proper positions so that the stamped numbers are upside down.

7. Install the camshaft cap bolts "4" and "5".



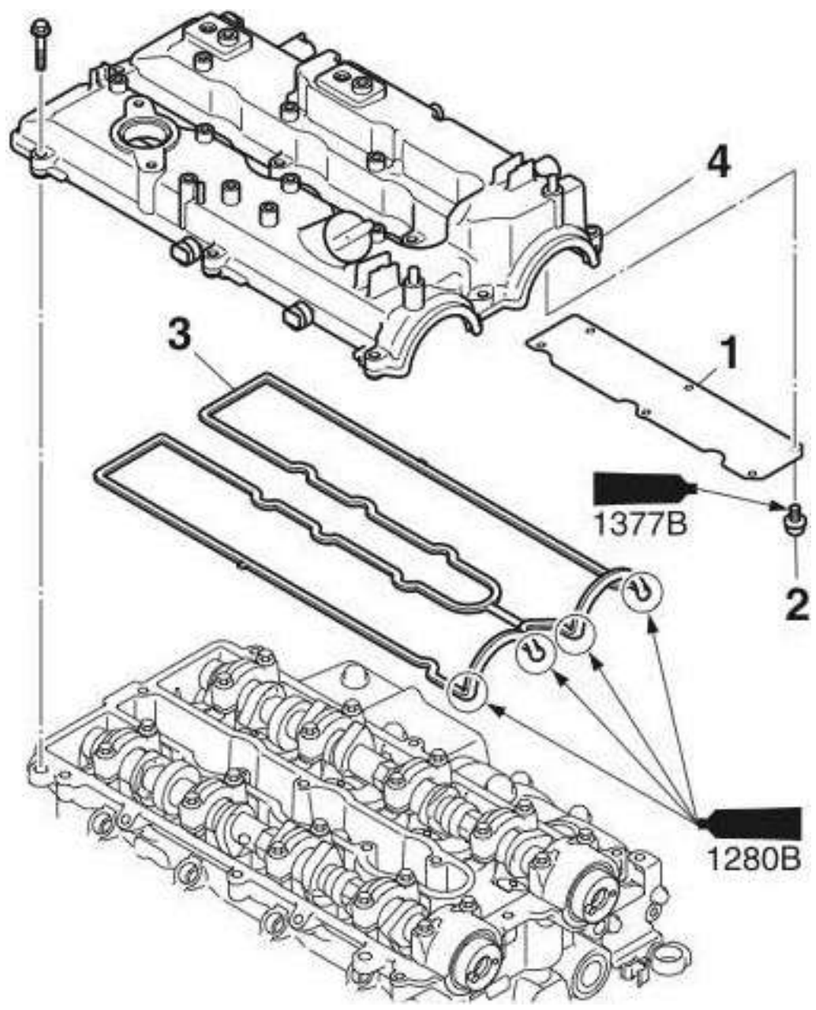
8. Tighten the camshaft cap bolts "1" to the specified torques and the camshaft cap bolt "2" in 2 stages and in the order [1], [2], and so on.



Camshaft cap bolt "1"
1st: 8 Nm (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 Nm (1.7 kgf·m, 12.5 ft·lb)

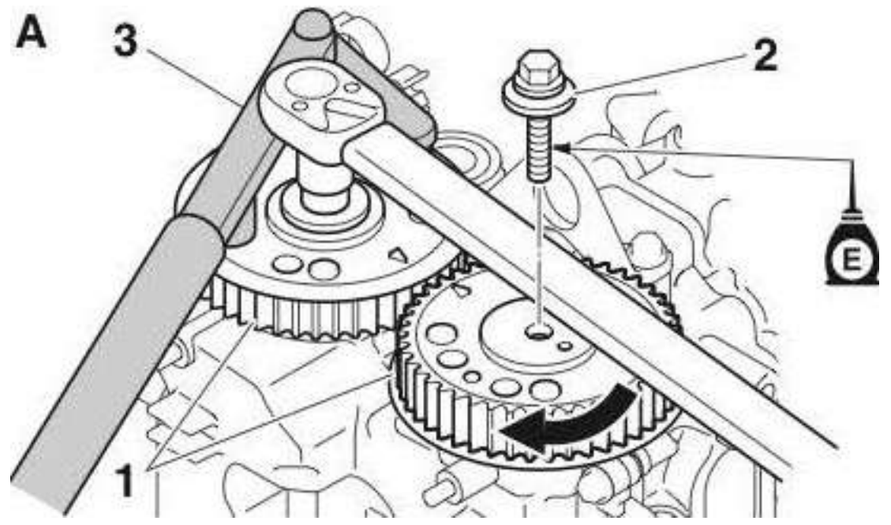
9. Install the plate "1", and then tighten the cylinder head plate screws "2" to the specified torque.

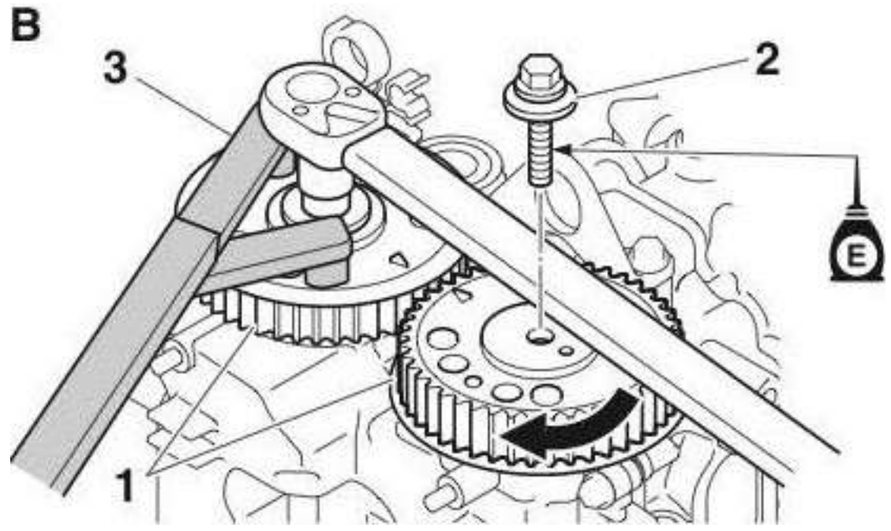
10. Install a new gasket "3" and the cylinder head cover "4".



Cylinder head plate screw "2"
2 Nm (0.2 kgf·m, 1.5 ft·b)

11. Install the driven sprockets "1", and then tighten the driven sprocket bolts "2" to the specified torque.





A. Worldwide
B. USA and Canada

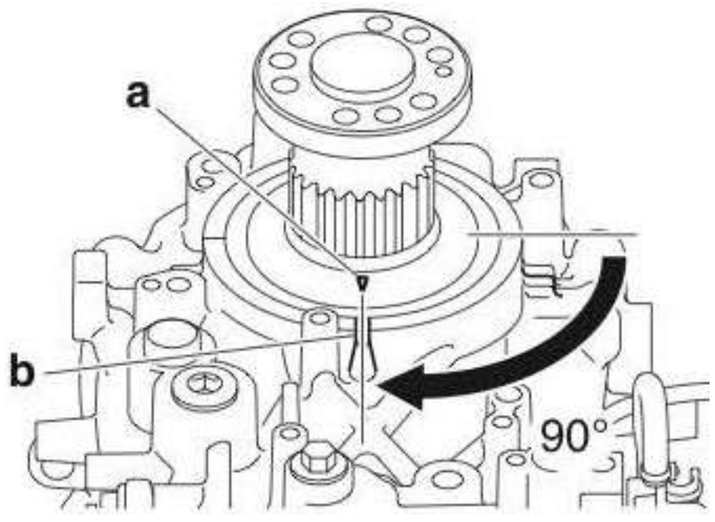
Flywheel holder "3"
Flywheel magneto holder "3"

Driven sprocket bolt "2"
65 Nm (6.5 kgf·m, 48 ft·lb)

12. Turn the crankshaft clockwise 90° gradually until the large "D." mark "a" on the crankshaft is aligned with the protrusion "b" on the cylinder block.

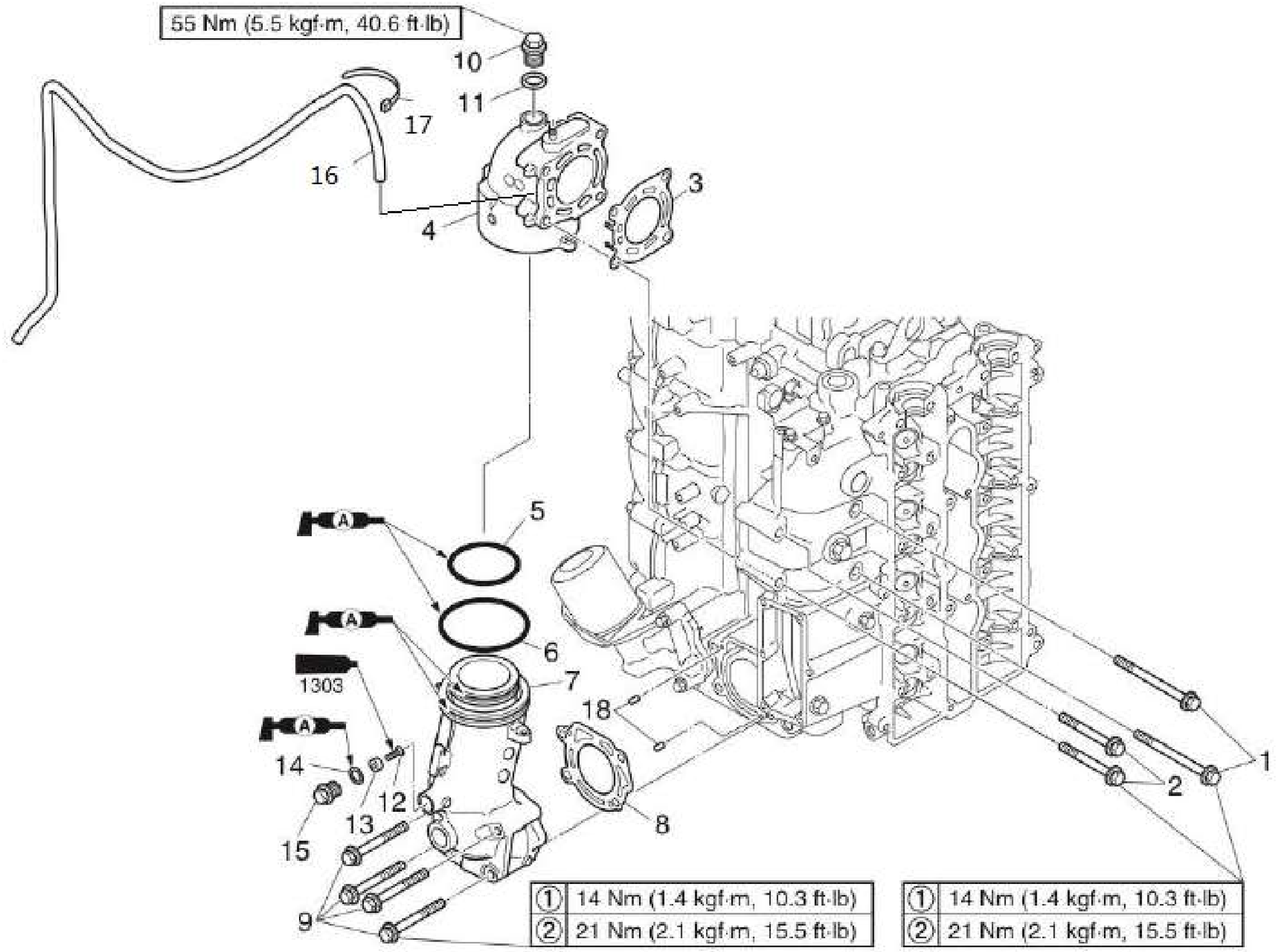
NOTICE

Do not turn the crankshaft clockwise more than 90°. Otherwise, the pistons and valves could collide with each other and be damaged.

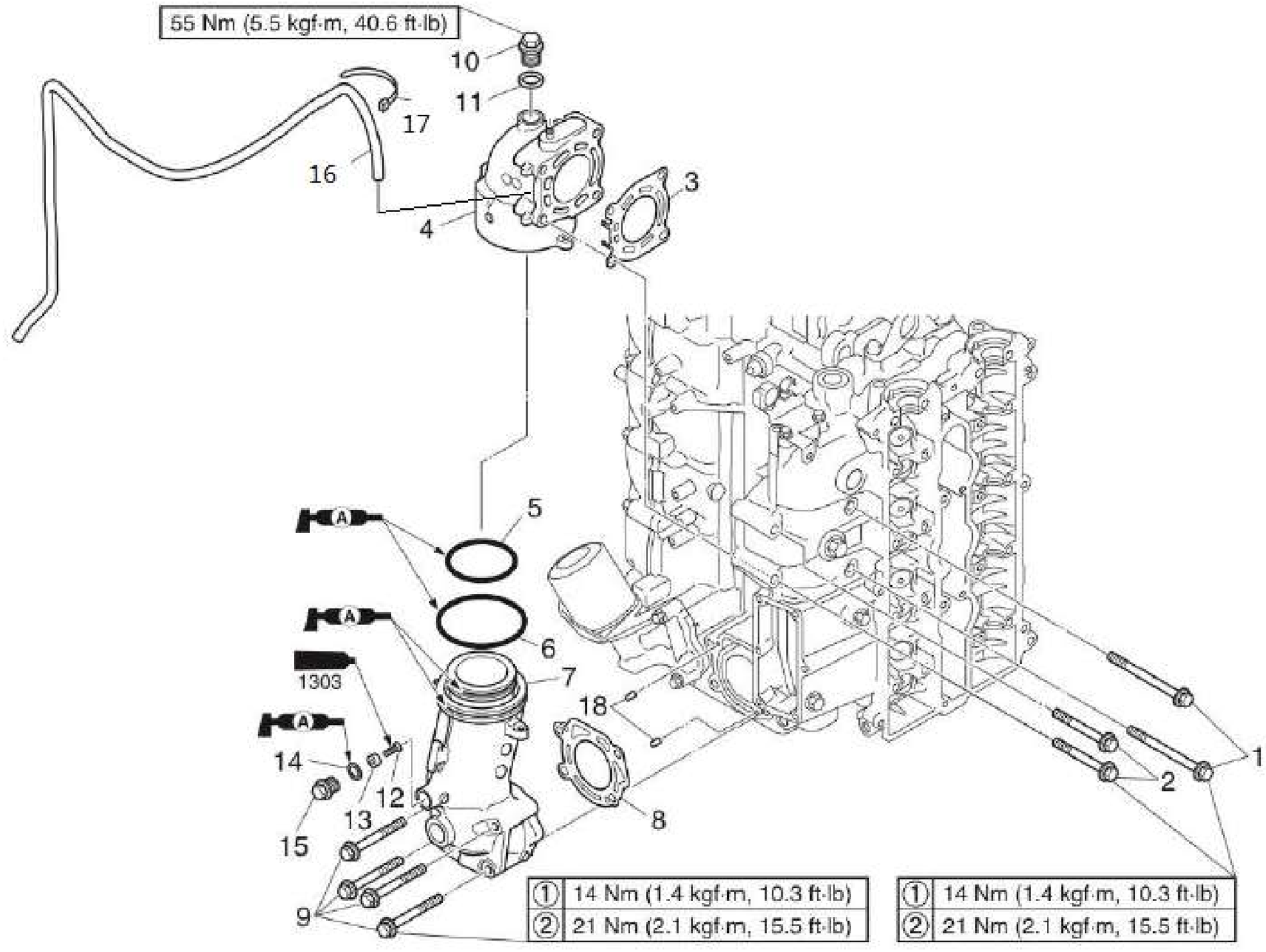


13. Install the cylinder head cover. See step 13 in "Checking the valve clearance" (7-3).

Exhaust joint



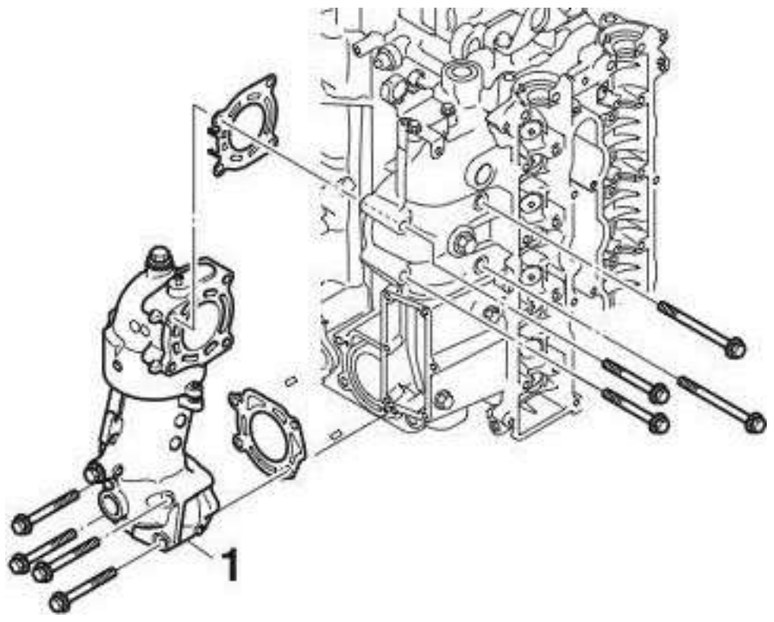
No.	Part name	Q'ty	Remarks
1	Bolt	2	M8 x100mm
2	Bolt	2	M8 x 70 mm
3	Gasket	1	Not reusable
4	Exhaust upper joint	1	
5	0-ring	1	Not reusable
6	0-ring	1	Not reusable
7	Exhaust lower joint	1	
8	Gasket	1	Not reusable
9	Bolt	4	M8 x 70 mm
10	Plug	1	
11	Gasket	1	Not reusable
12	Screw	1	M5 x 25 mm
13	Anode	1	
14	0-ring	1	Not reusable
15	Plug	1	
16	Hose	1	Exhaust upper joint to cooling water pilot hole
17	Plastic tie	1	



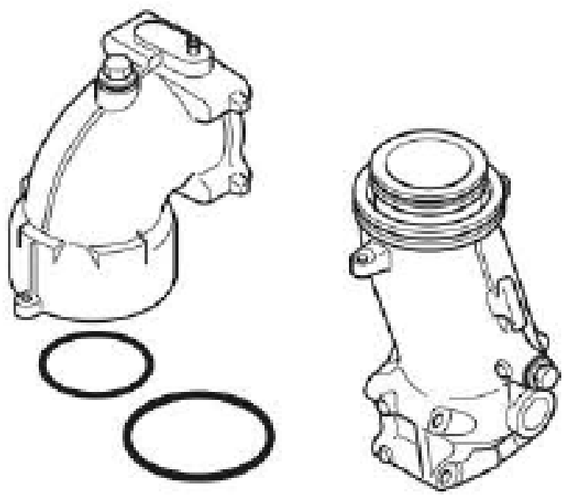
No.	Part name	Q'ty	Remarks
18	Dowel pin	2	

Removing the exhaust joint

1. Remove the exhaust joint assembly "1".



2. Disassemble the exhaust joint assembly.



Checking the exhaust joint anode

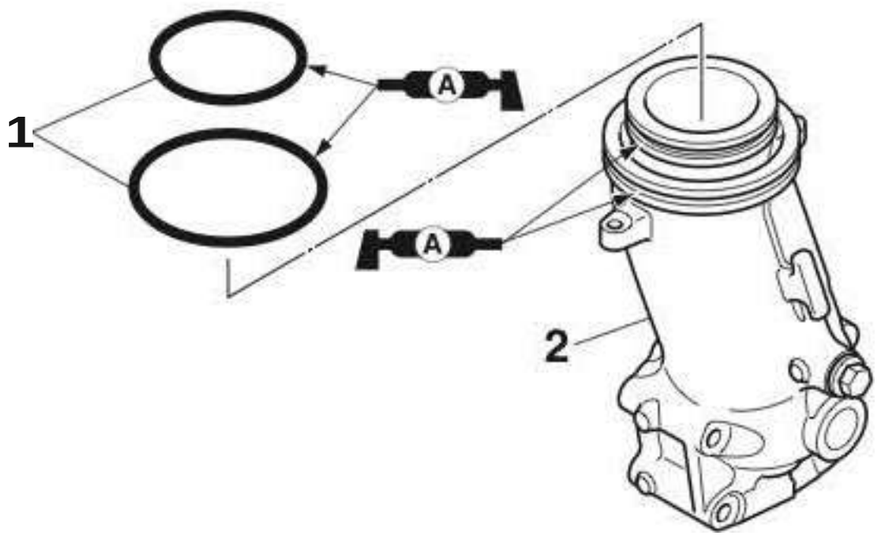
1. Check the anode. Replace the anode if half of it has eroded. Clean if there is grease, oil, or scales.

NOTICE

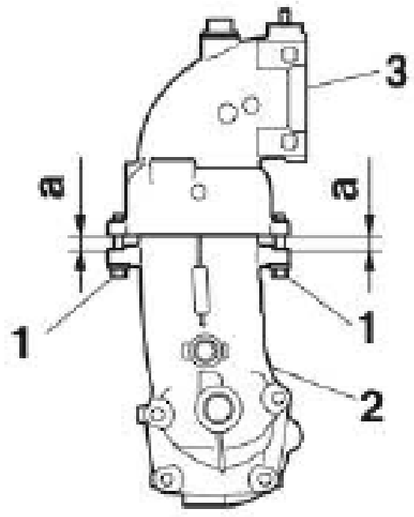
Do not apply grease, oil, or paint to the anode.

Installing the exhaust joint

1. Install new O-rings "1" to the exhaust lower joint "2".



2. Tighten the bolts (M6 x 30 mm) "1" alternately to assemble the exhaust lower joint "2" and exhaust upper joint "3" so that the clearance "a" is the specified distance.



Distance "a"
9.5 mm (0.37 in)

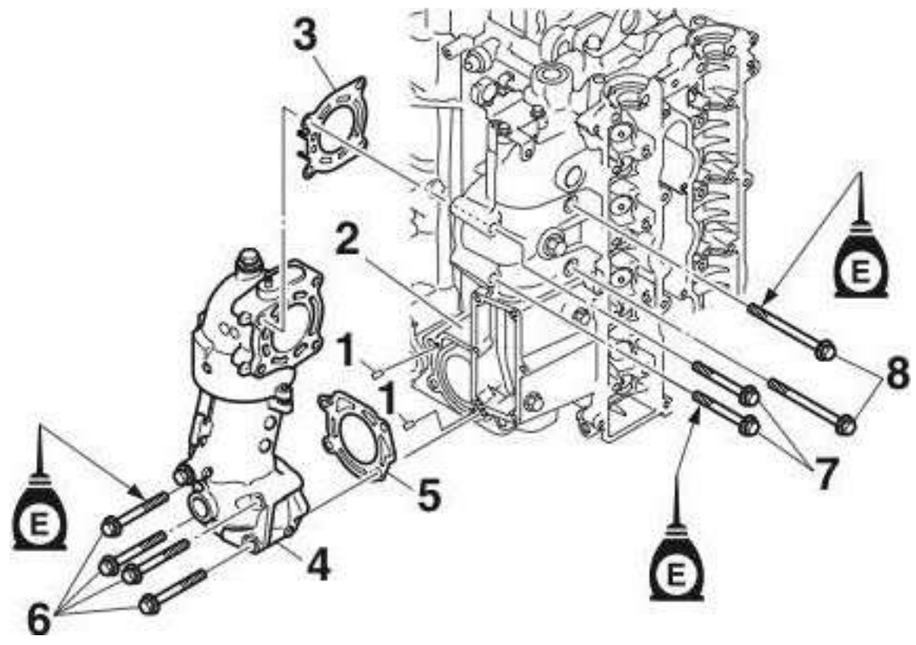
3. Remove the bolts (M6 x 30 mm).

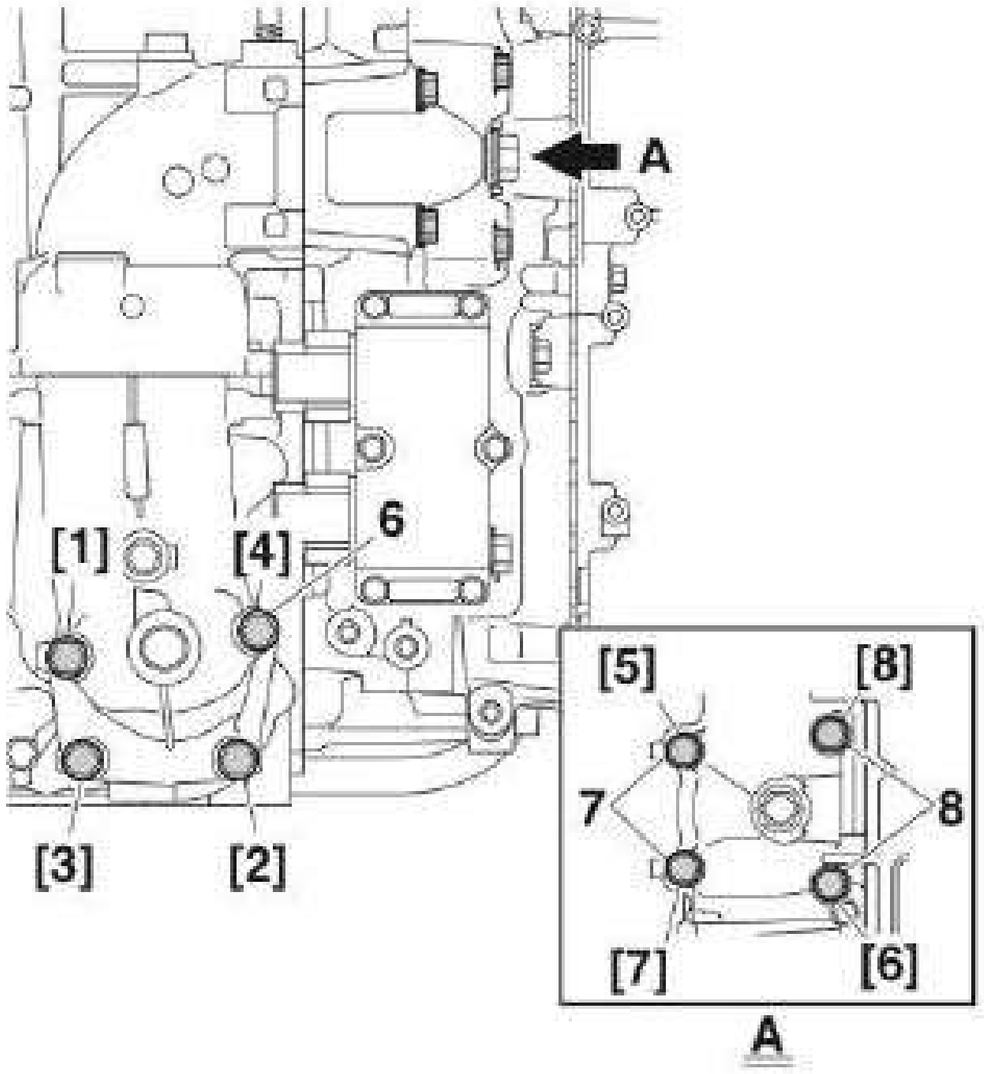
4. Install the dowel pins "1" to the cylinder block "2".

5. Install a new gasket "3" to the exhaust joint assembly "4".

6. Install a new gasket "5" to the cylinder block "2".

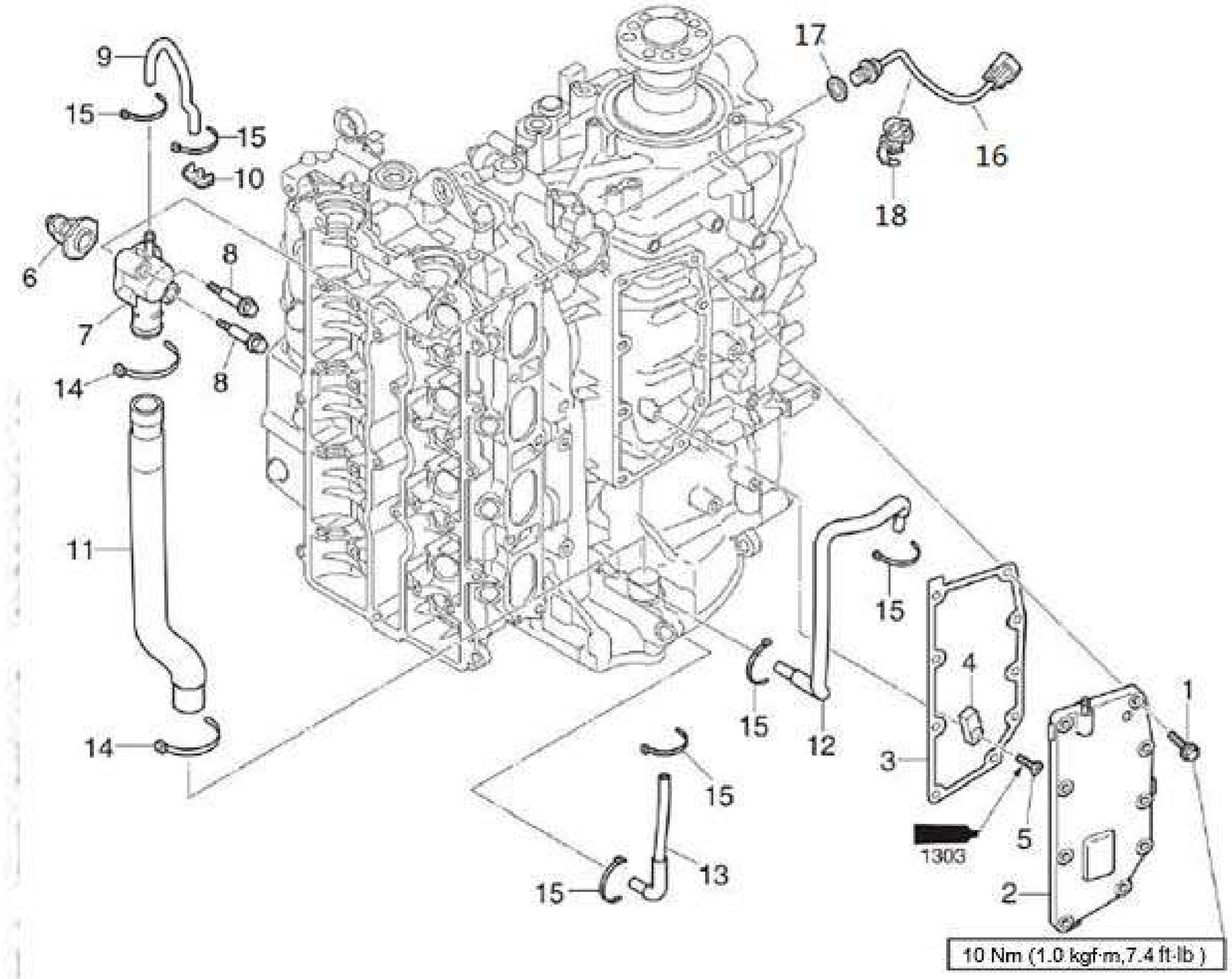
7. Install the exhaust joint assembly "4", and then tighten the exhaust joint bolts "6", "7", and "8" to the specified torque in 2 stages and in the order [1], [2], and so on.



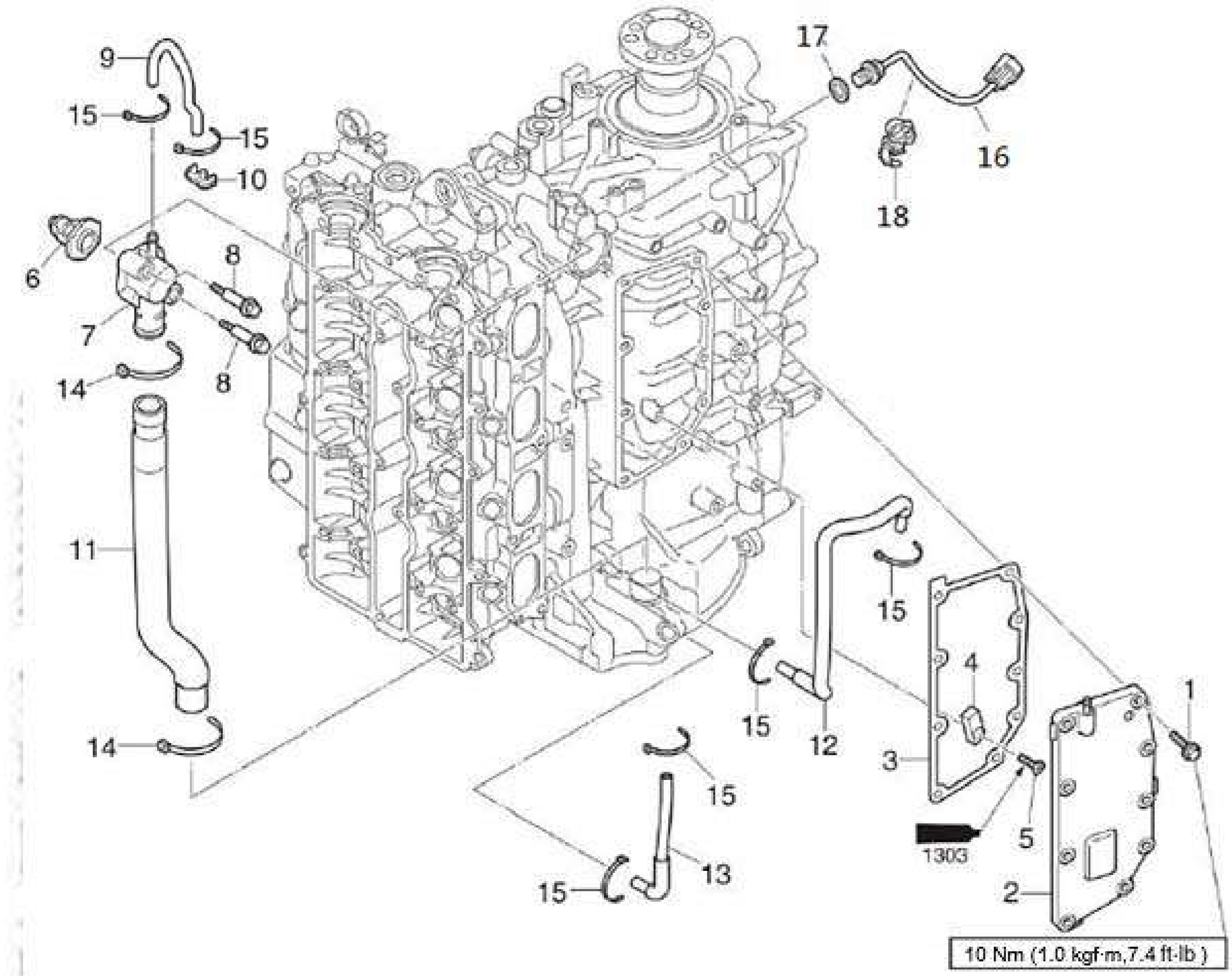


Exhaust joint bolts “6”,”7”,and “8”
1st: 14Nm(1.4 kgf·m,10.3 lb·ft)
2nd: 21Nm(2.1 kgf·m,15.5 lb·ft)

Oil cooler



No.	Part name	Q'ty	Remarks
1	Bolt	9	M6 x 25 mm
2	Crankcase cover	1	
3	Gasket	1	Not reusable
4	Anode	1	
5	Screw	1	M6 x 20 mm
6	Thermostat	1	
7	Thermostat cover	1	
8	Bolt	2	M6 x 40 mm
9	Hose	1	Thermostat case to crankcase cover
10	Holder	1	
11	Hose	1	Thermostat case to cylinder block
12	Hose	1	VST to cylinder block
13	Hose	1	Cylinder block to VST
14	Plastic tie	2	
15	Plastic tie	6	
16	Thermo sensor	1	
17	Gasket	1	

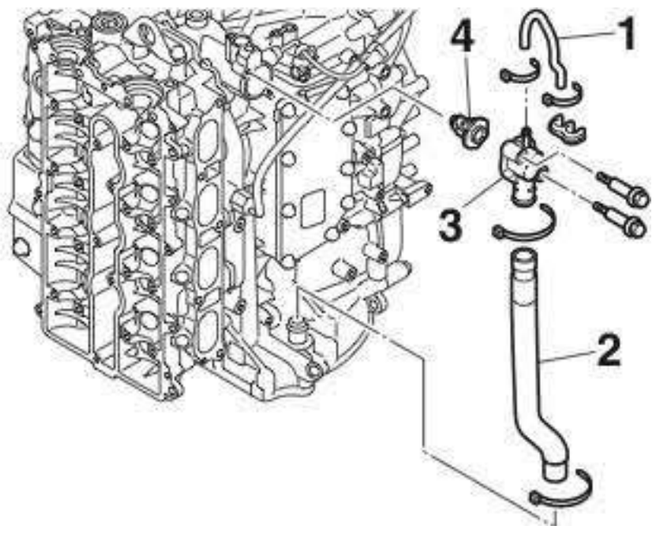


No.	Part name	Q'ty	Remarks
18	Holder	1	Not reusable

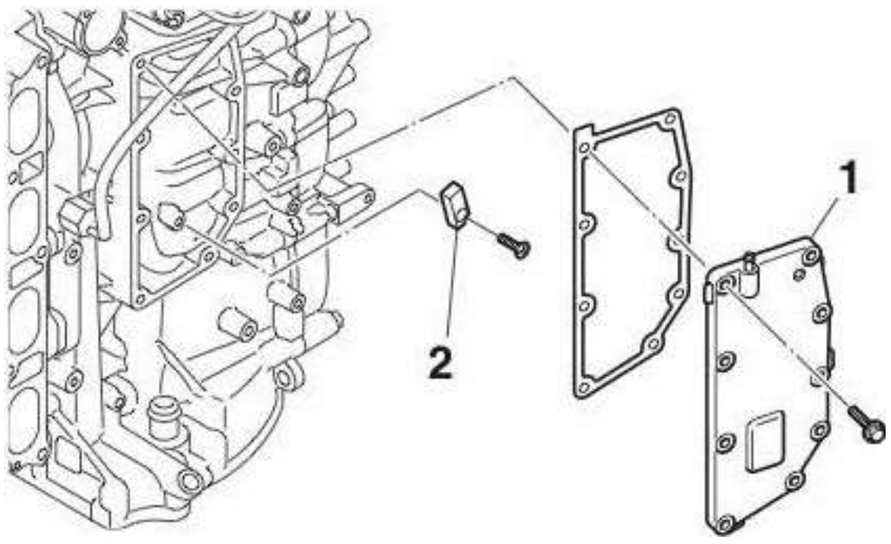
Removing the crankcase cover

1. Remove the cooling water hoses "1" and "2".

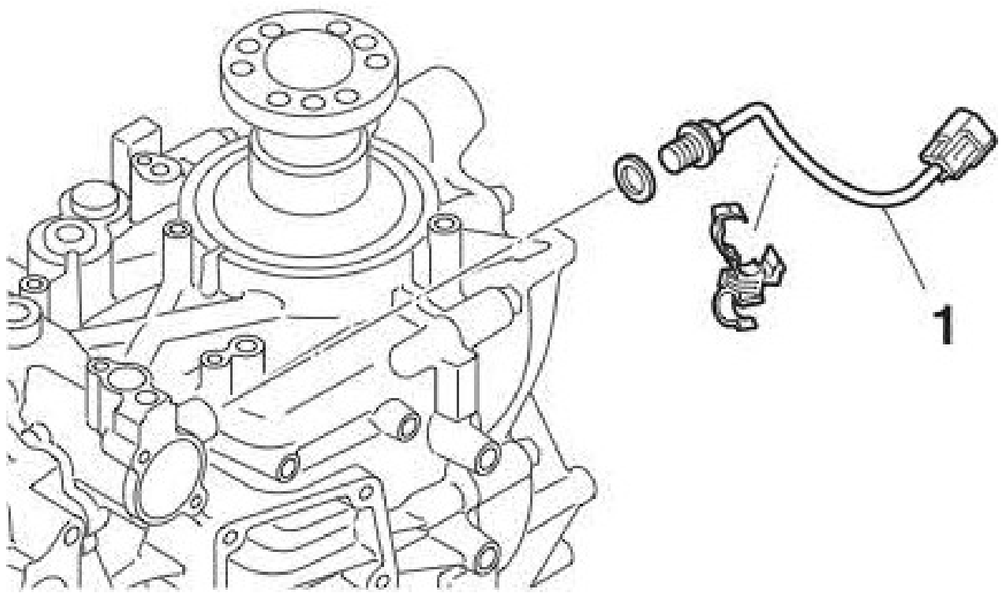
2. Remove the thermostat cover "3", and then remove the thermostat "4".



3. Remove the crankcase cover "1", and then remove the crankcase cover anode "2".



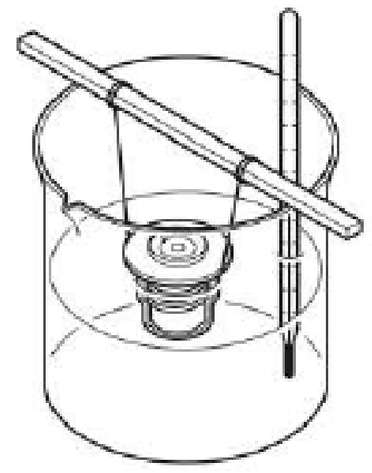
4. Remove the thermo sensor "1".



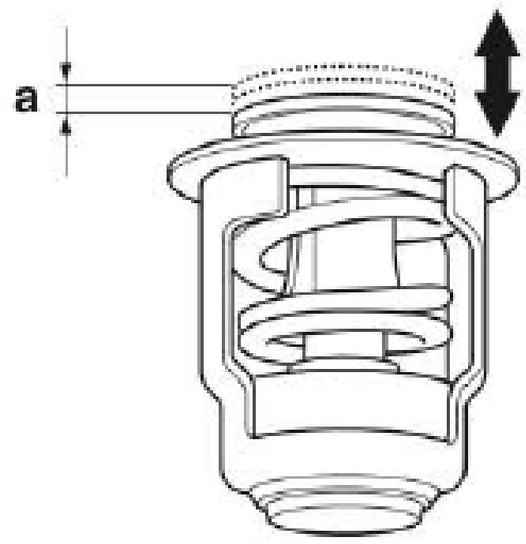
Checking the thermostat

1. Suspend the thermostat in a container of water.

2. Place a thermo meter in the water, and then heat the water slowly.



3. Measure the thermostat valve opemng "a" at the specified water temperatures. Replace if out of specification.



Water tempera-ture	Valve opening "a"
58-62 ℃ (136-144 °F)	Sarts opening
above 72 ℃ (162 °F)	4.0 mm (0.16 in) or above

Checking the crankcase cover anode

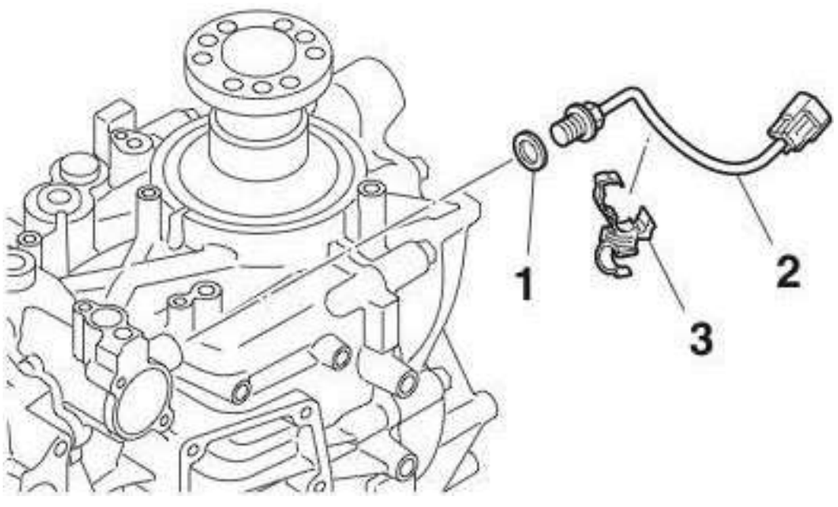
1. Check the anode. Replace the anode if half of it has eroded. Clean if there is grease, oil, or scales.

NOTICE

Do not apply grease, oil, or paint to the anode.

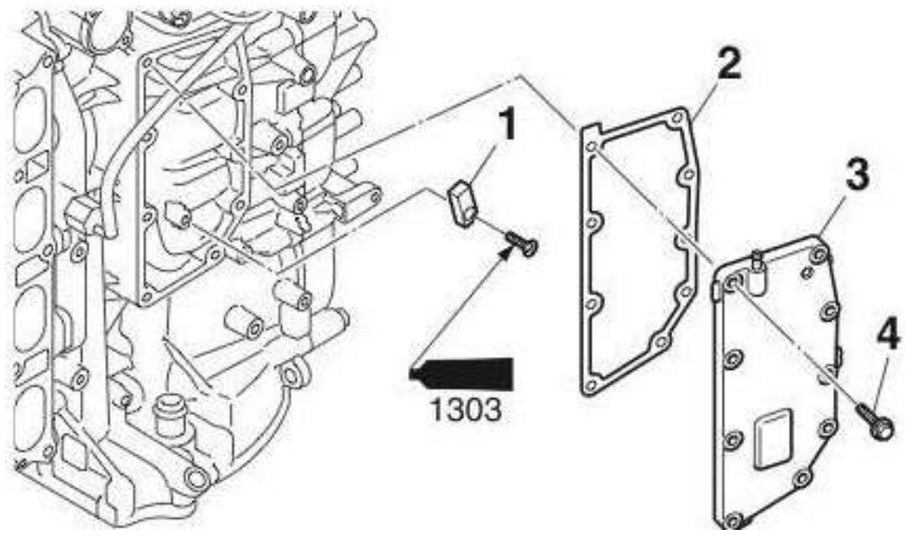
Installing the crankcase cover

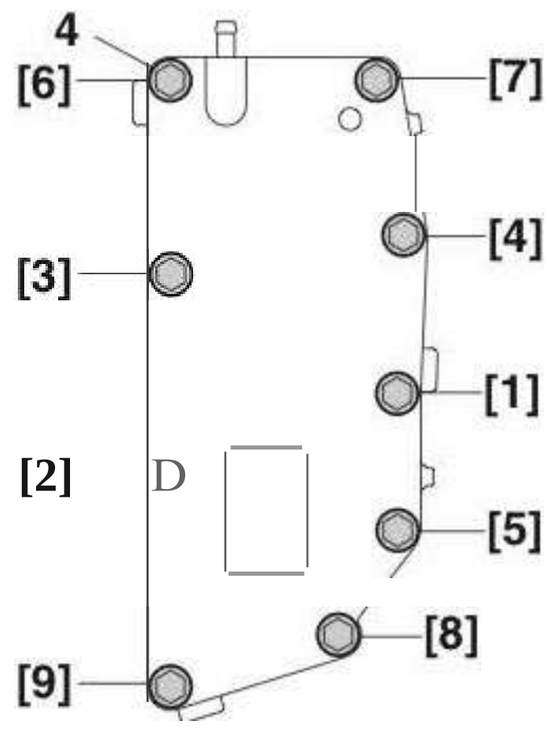
1. Install a new gasket "1" and the thermo sensor "2", and then tighten the thermo sensor to the specified torque.
2. Install the clamp "3" to the thermo sensor "2".



Thermo sensor "2"
23 Nm (2.3 kgf·m, 17.0 ft·lb)

3. Install the crankcase cover anode "1"
4. Install the new gasket "2" and the crankcase cover "3", and then tighten the crankcase cover bolts "4" to the specified torque in the order [1], [2], and so on.





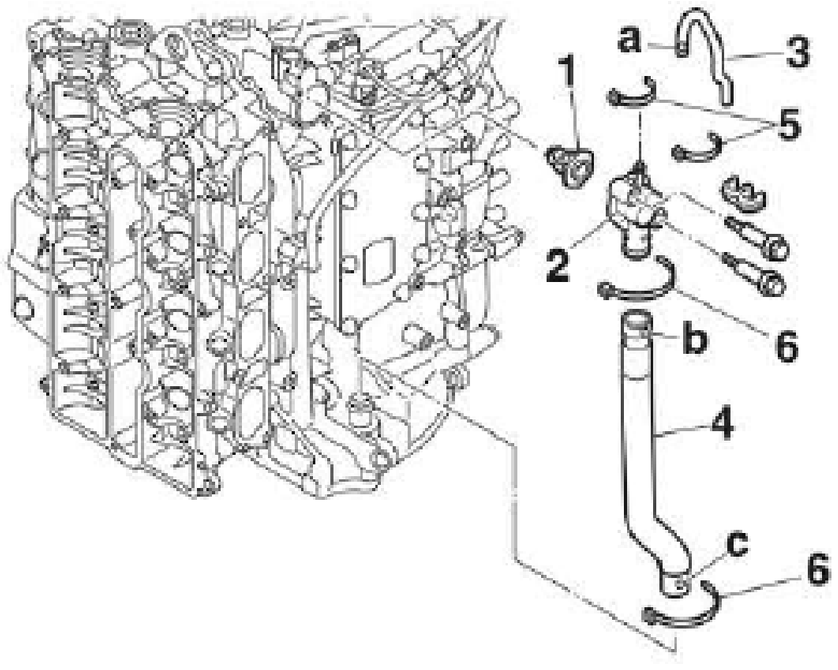
Crankcase cover bolt "4"
10 Nm (1.0 kgf·m, 7.4 ft·lb)

5. Install the thermostat "1" and thermostat cover "2".

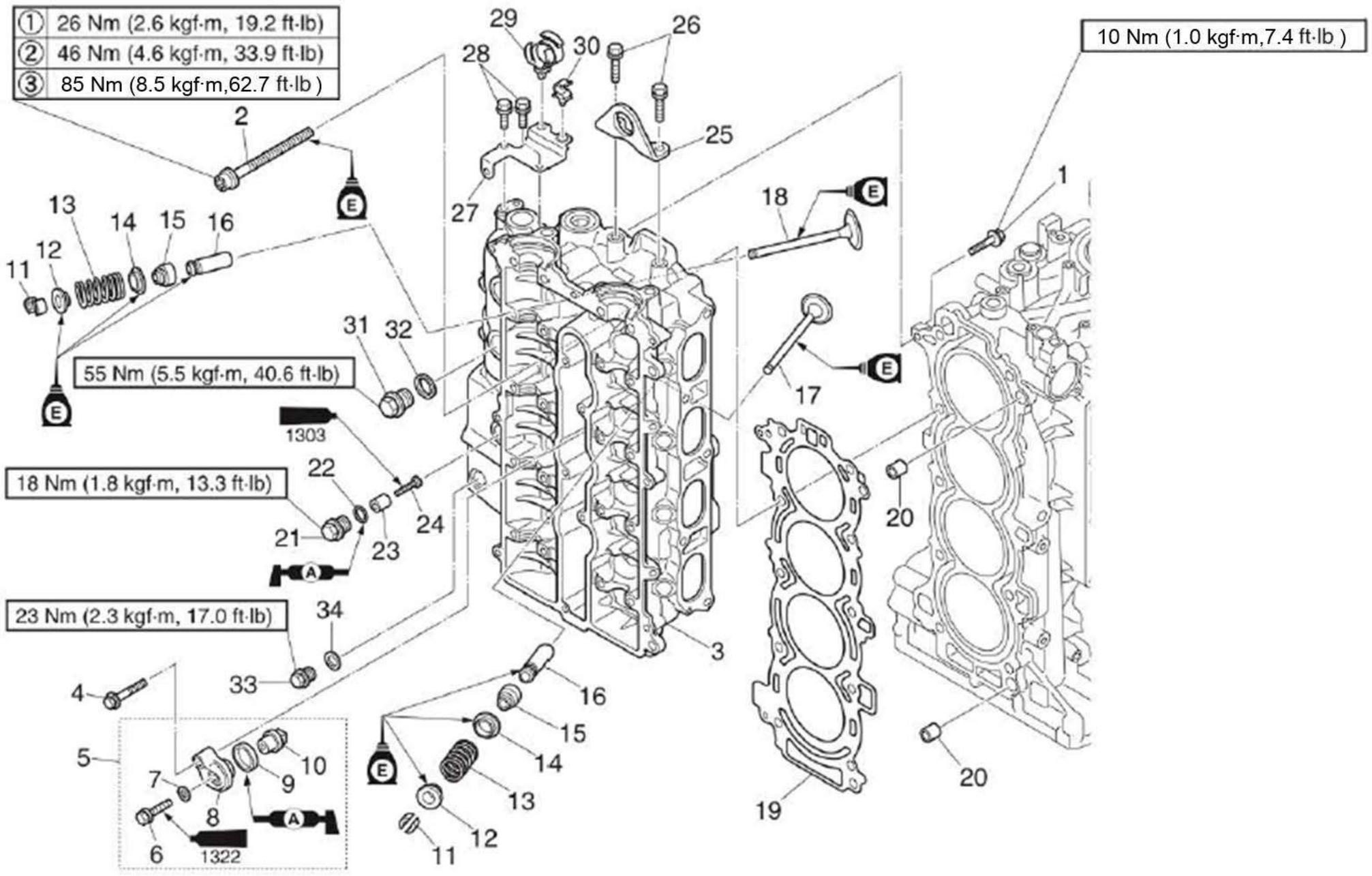
6. Install the cooling water hoses "3" and "4", and then fasten them using the plastic ties "5" and "6".

TIP:

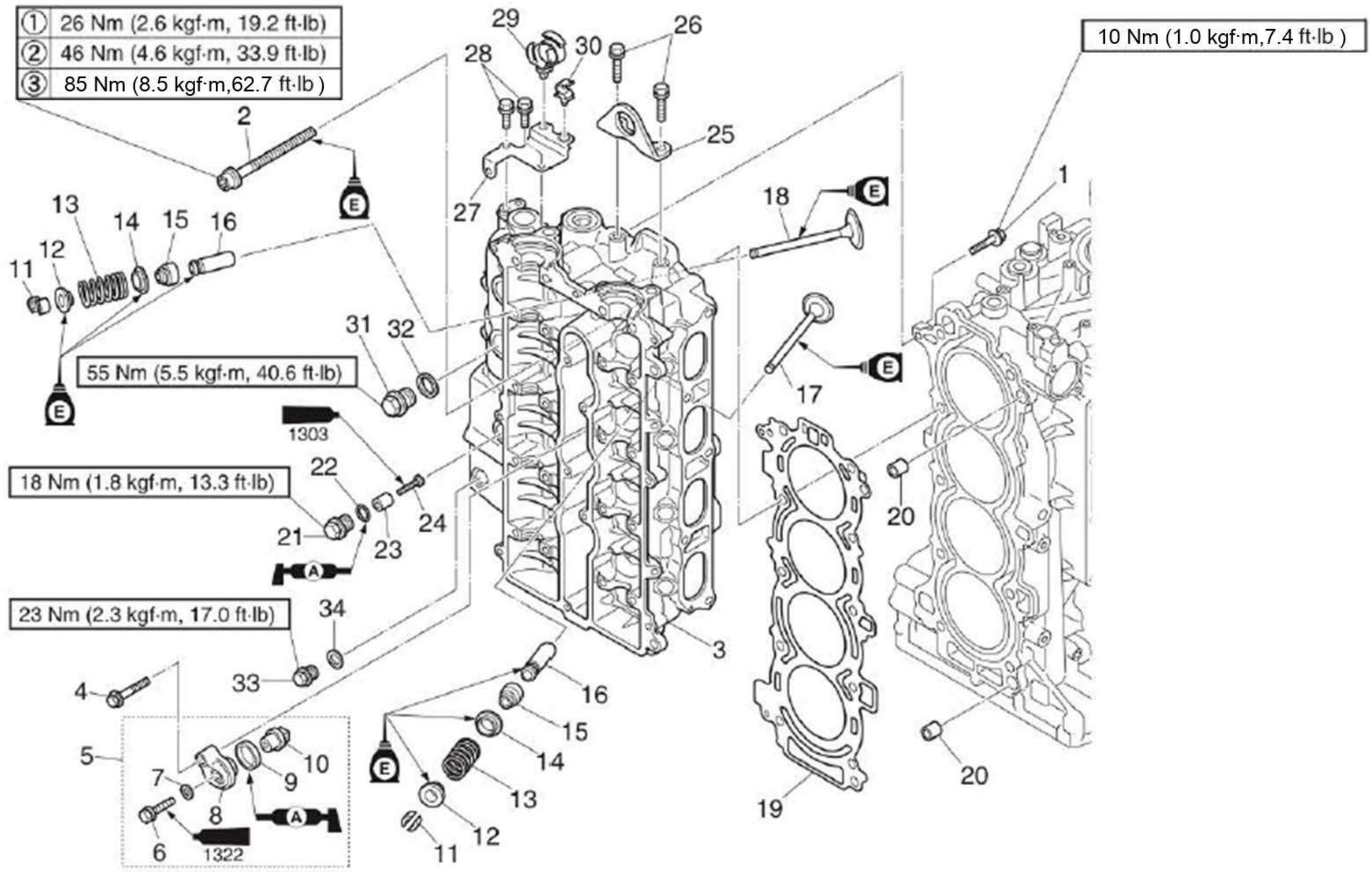
- Face the paint mark "a" on the cooling water hose "3" outward.
- Place the red paint mark "c" on the cooling water hose "4" at the bottom, and face the mark "b" and "c" outward.



Cylinder head



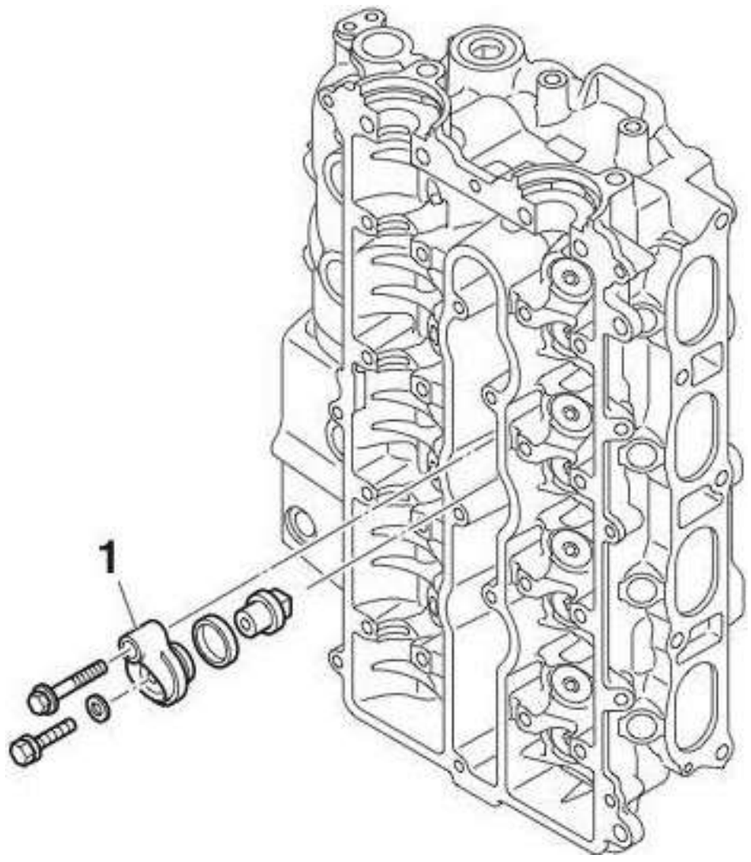
No.	Part name	Q'ty	Remarks
1	Cylinder head bolt	1	M6 x 25 mm
2	Cylinder head bolt	10	M10 x 110 mm
3	Cylinder head	1	
4	Bolt	1	M8 x 40 mm
5	Anode assembly	1	
6	Bolt	1	M6 x 20 mm
7	Gasket	1	Not reusable
8	Cover	1	
9	Grommet	1	
10	Anode	1	
11	Valve cotter	32	
12	Valve spring retainer	16	
13	Valve spring	16	
14	Valve spring seat	16	
15	Valve seal	16	Not reusable
16	Valve guide	16	Not reusable
17	Intake valve	8	



No.	Part name	Q'ty	Remarks
18	Exhaust valve	8	
19	Gasket	1	Not reusable
20	Dowel pin	2	
21	Plug	1	
22	O-ring	1	Not reusable
23	Anode	1	
24	Screw	1	M5 x 25 mm
25	Engine hanger	1	
26	Bolt	2	M8 x 20 mm
27	Bracket	1	
28	Bolt	2	M6 x 12 mm
29	Holder	1	
30	Holder	1	
31	Plug	1	M18 x 16 mm
32	Gasket	1	Not reusable
33	Plug	1	M14 x 12mm
34	Gasket	1	Not reusable

Removing the cylinder head

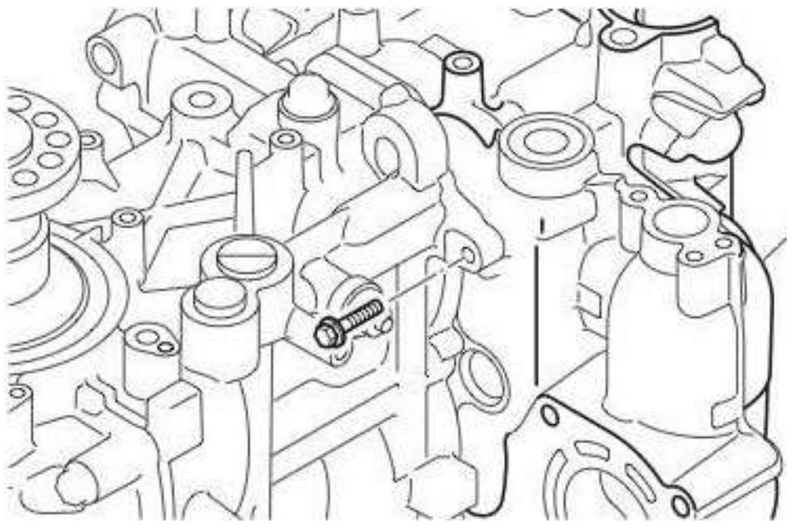
1. Remove the anode assembly "1".



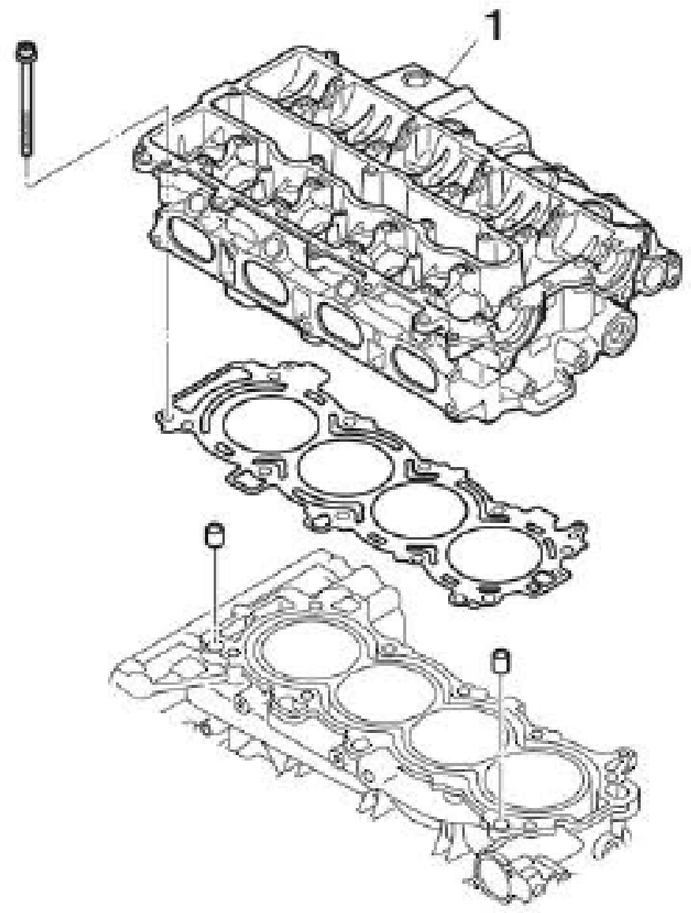
2. Remove the cylinder head "1".

NOTICE

Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.



1

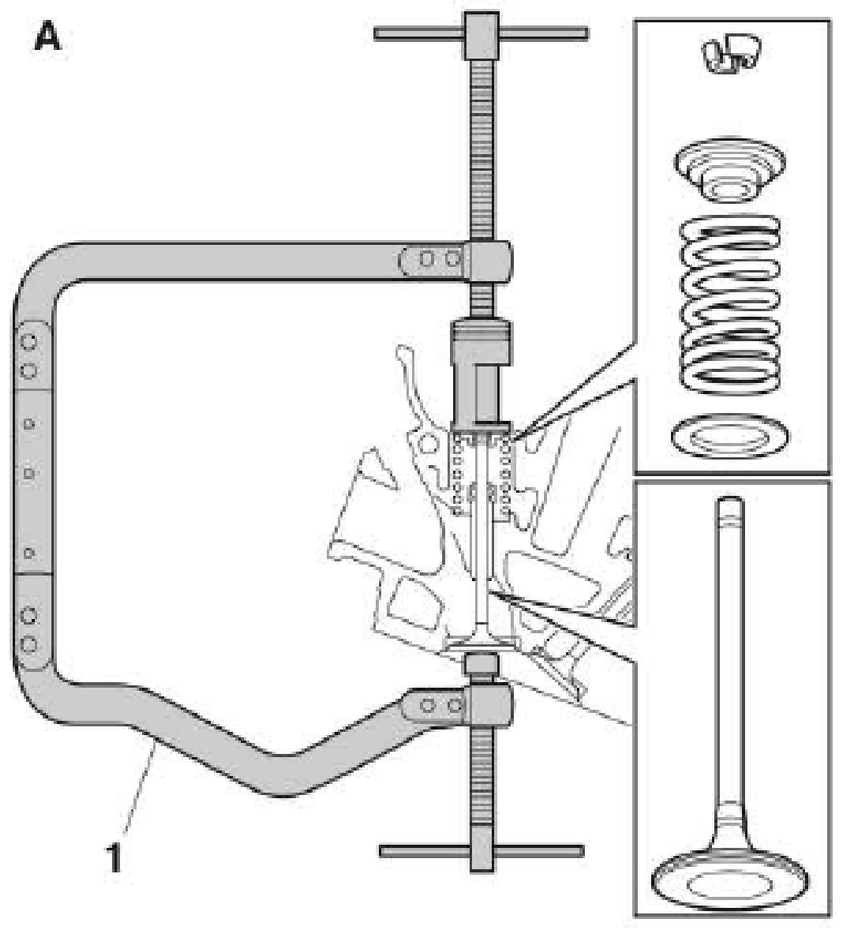


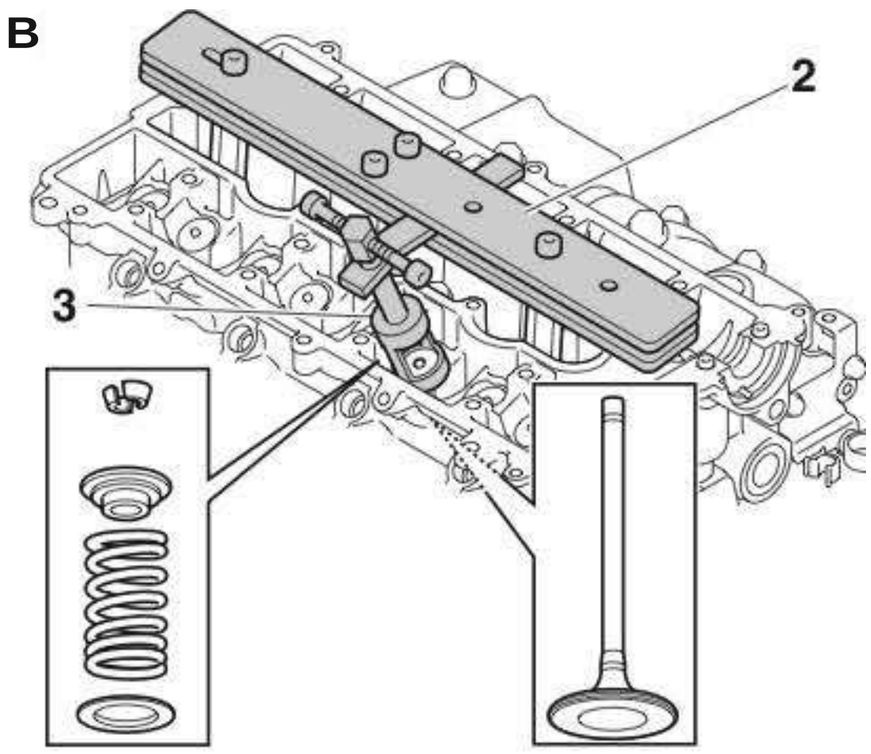
Disassembling the cylinder head

1. Remove the intake and exhaust valves.

TIP:

Make sure to keep the parts in the order of removal.





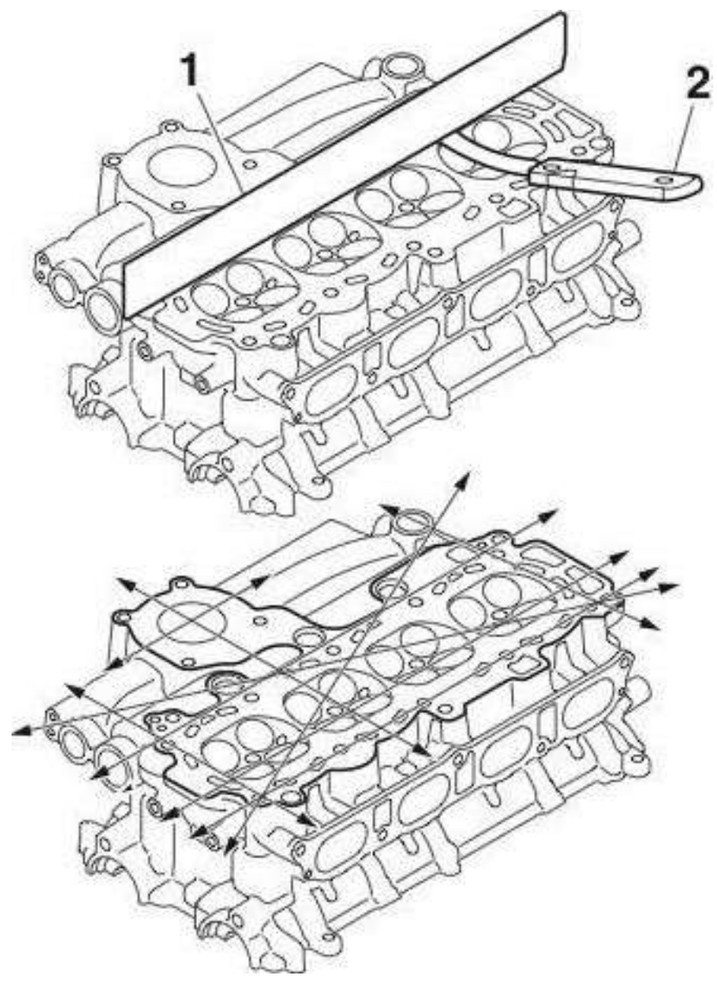
A. Commercially available tool
B. New special service tool

Valve spring compressor "1" (commercially available)
Valve spring compressor "2"
Valve spring compressor "2"
Valve spring compressor attachment "3"
Valve spring compressor adaptor "3"

Checking the cylinder head

1. Remove carbon deposits from the combustion chambers, and then check the cylinder head for damage and scratches.

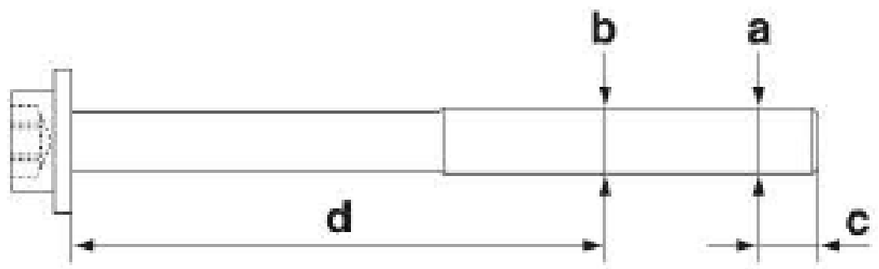
2. Check the cylinder head warpage using a straightedge "1" and a thickness gauge "2" in 9 directions. Replace the cylinder head if above specification.



Warpage limit 0.10 mm (0.0039 in)

Checking the cylinder head bolt

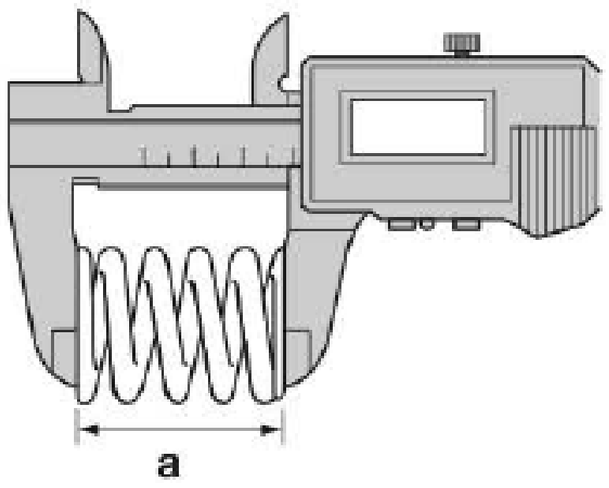
1. Measure the diameters "a" and "b" of the cylinder head bolt (M10) at the specified measuring points "c" and "d". Replace the cylinder head bolt if the difference between the diameters is above specification.



Cylinder head bolt (M10) diameter difference limit "a"- "b" = Less than 0.17 mm (0.01 in) Measuring point "c": 10.0 mm (0.39 in) Measuring point "d": 68.0 mm (2.68 in)

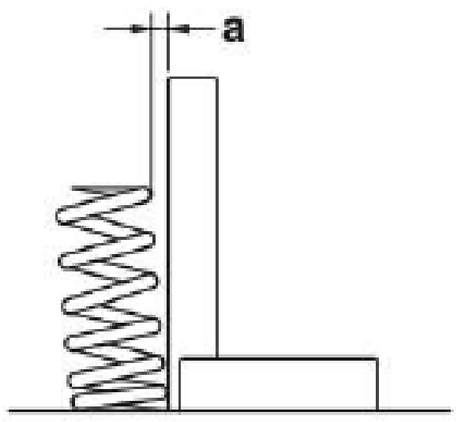
Checking the valve spring

1. Measure the valve spring free length "a". Replace if below specification.



Free length IN
41.20 mm (1.62 in)
Limit
39.14 mm (1.54 in)
Free length EX
41.20 mm (1.62 in)
Limit
39.14 mm (1.54 in)

2. Measure the valve spring tilt "a". Replace if above specification.

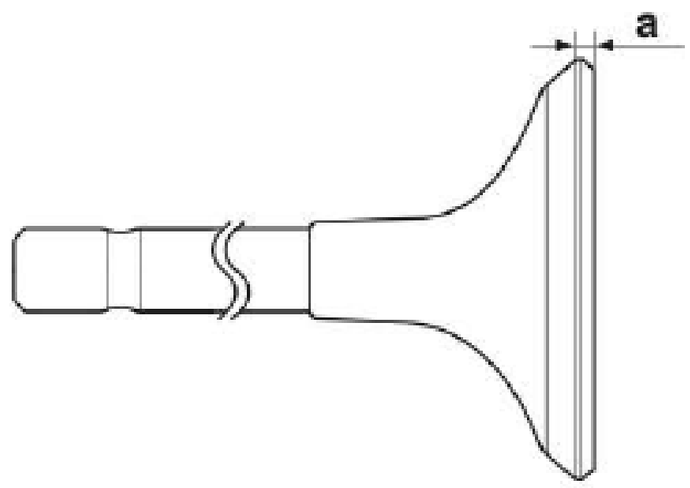


Tilt limit IN
1.8 mm (0.07 in)
Tilt limit EX
1.8 mm (0.07 in)

Checking the valve

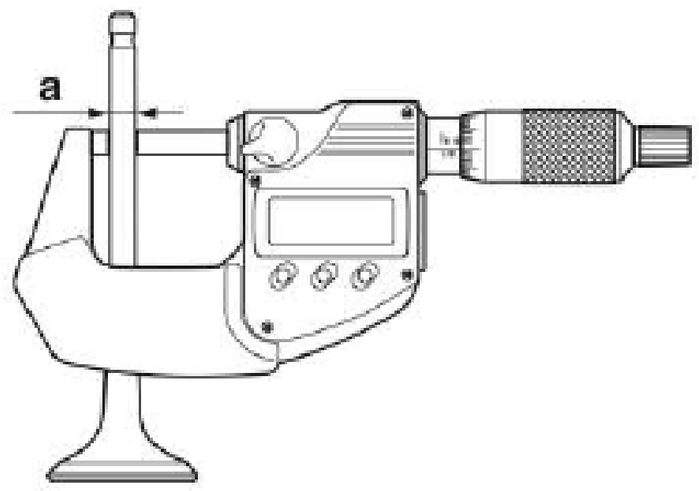
1. Check the valve face. Replace if pitted or worn.

2. Measure the valve margin thickness "a". Replace if above specification.



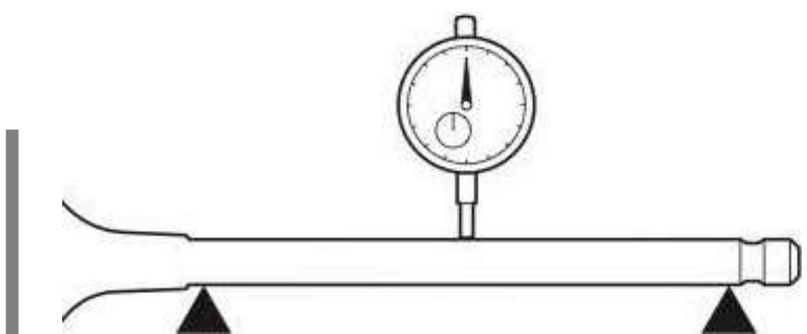
Margin thickness IN
1.34-1.3 6 mm (0. 0528-0.0535in)
Margin thickness EX
1.40-1.60 mm (0.0551-0.0630 in)

3. Measure the valve stem diameter "a". Replace if below specification.



Diameter IN
5.465-5.480 mm (0.2156-0.2161 in)
Limit
5.445 mm (0.2144 in)
Diameter EX
5.460-5.475 mm (0.2150-0.2156 in)
Limit
5.430 mm (0.2138 in)

4. Measure the valve stem runout. Replace if above specification.

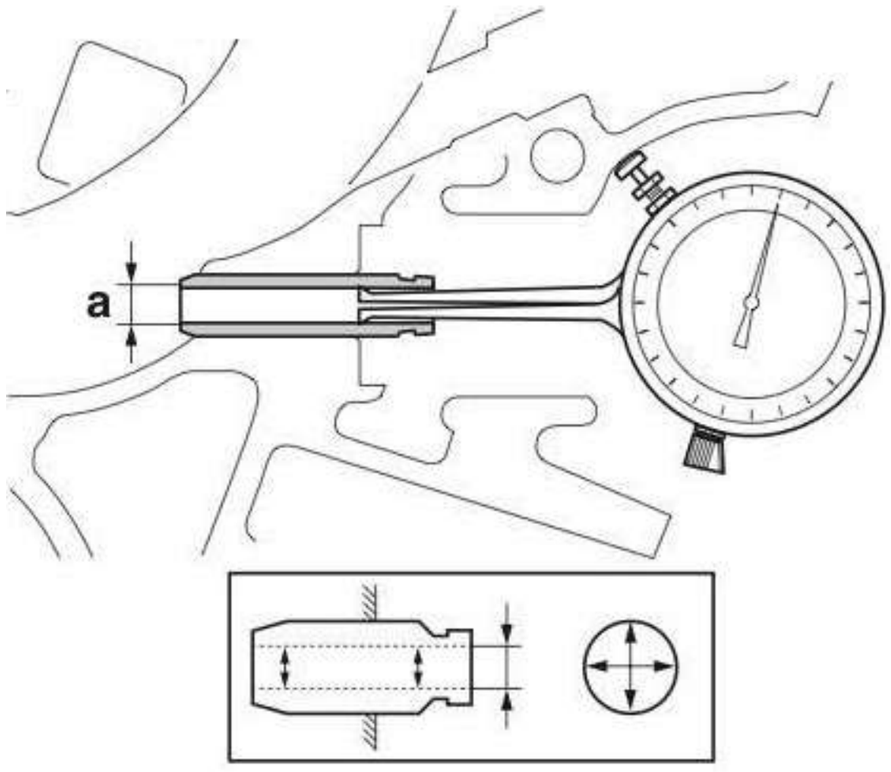


Runout limit EX 0.005 mm (0.0002 in) Runout limit IN 0.005 mm (0.0002 in)

Checking the valve guide

Before checking the valve guides, make sure that the valve stem diameter is within specification.

1. Measure the valve guide inside diameter "a". Replace if above specification.



Inside diameter IN 5.504-5.522 mm (0.2167-0.2174 in) Inside diameter EX 5.504-5.522 mm (0.2167-0.2174 in)

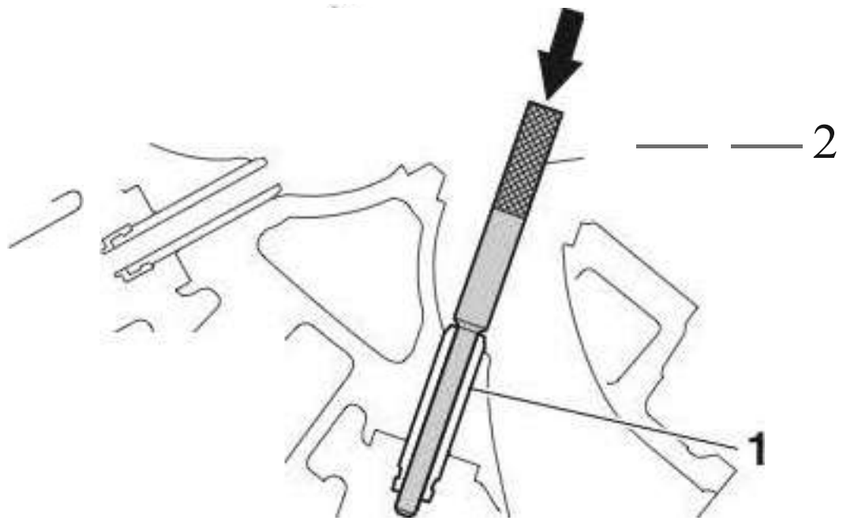
2. Calculate the valve stem to valve guide clearance. Replace the valve and valve guide if out of specification.

Valve stem to valve guide clearance = valve guide inside diameter – valve stem diameter Clearance IN 0.014-0.047 mm (0.0006-0.0019 in) Limit 0.070 mm (0.0028 in) Clearance EX 0.029-0.062 mm (0.0011-0.0024 in) Limit 0.080 mm (0.0032 in)

Replacing the valve guide

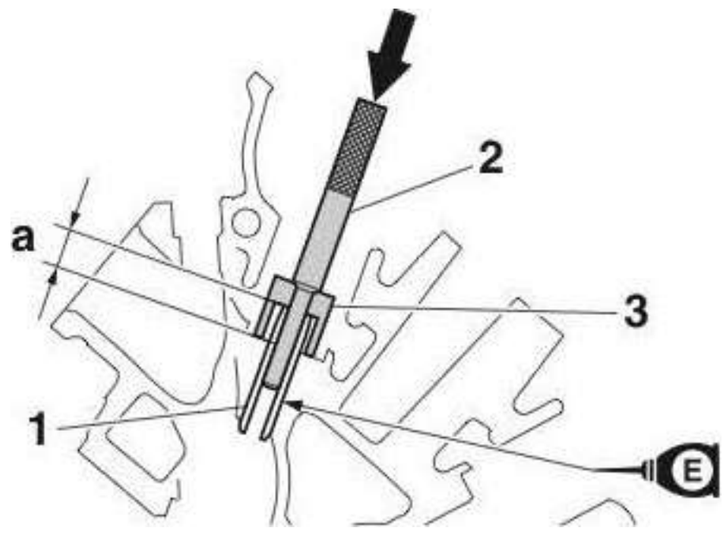
After replacing a valve guide, check the valve seat contact area.

1. Remove the valve guide "1" from the combustion chamber side.



Valve guide remover/installer "2" Valve guide remover "2"

2. Install a new valve guide "1" from the camshaft side to the specified installation height "a".



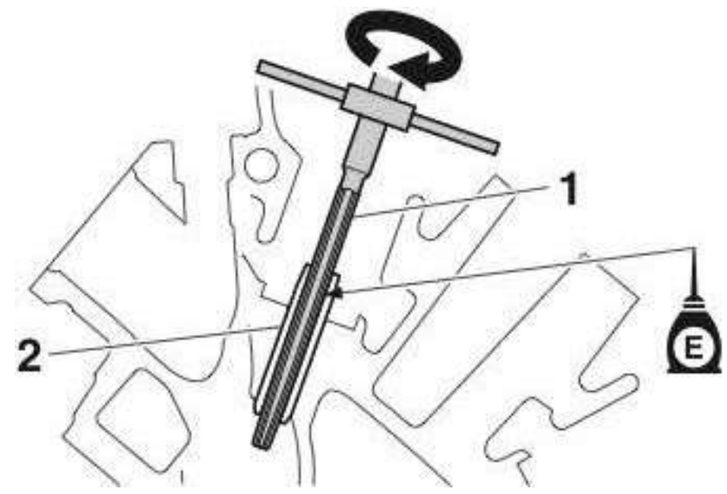
Valve guide remover/installer "2"
Valve guide remover "2"
Valve guide installer "3"
Valve guide installer "3"

Installation height
11.3–11.7 mm (0.44-0.46 in)

3. Insert the special service tool "1" into the valve guide "2", and then ream the valve guide.

TIP:

- To ream the valve guide, turn the valve guide reamer clockwise.
- When removing the valve guide reamer, do not turn it counterclockwise.
- After reaming the valve guide, make sure to clean it.



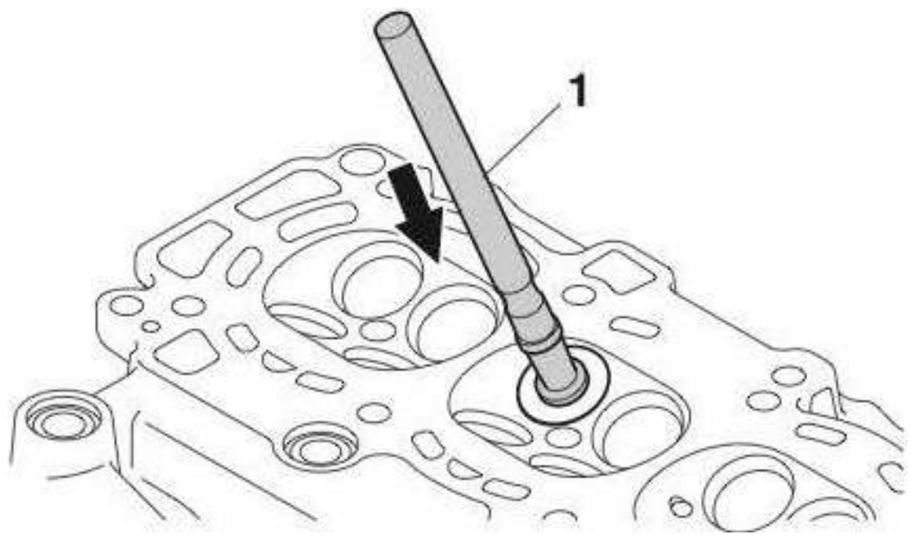
Valve guide reamer "1"
Valve guide reamer "1"

4. Measure the valve guide inside diameter.

Inside diameter EX
5.504-5.522 mm (0.2167-0.2174 in)
Inside diameter IN
5.504-5.522 mm (0.2167-0.2174 in)

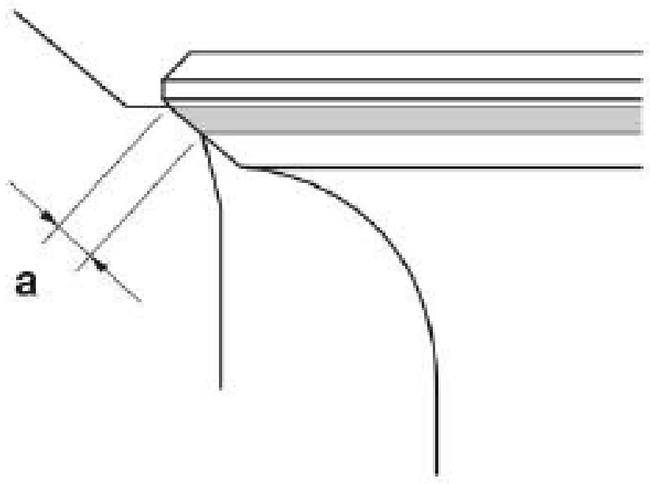
Checking the valve seat

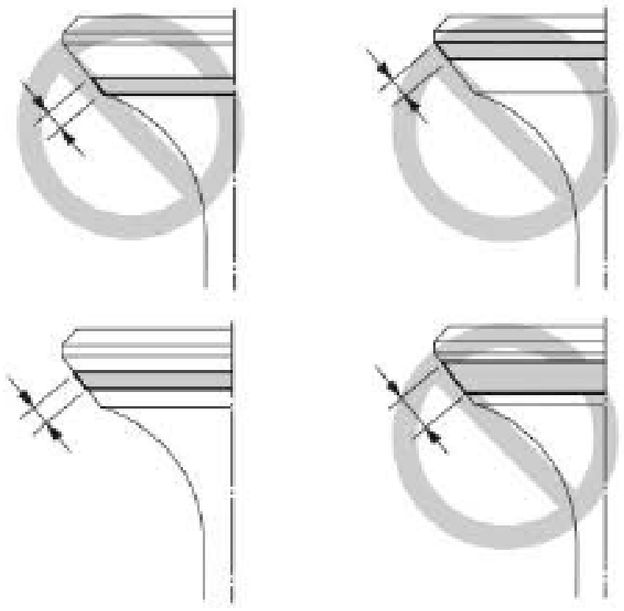
1. Remove carbon deposits from the valve.
2. Apply a thin, even layer of blue layout fluid (Dykem) onto the valve seat.
3. Push the valve lightly against the valve seat using the special service tool "1".



Valve lapper "1"
Valve lapping tool "1"

4. Measure the valve seat contact width "a" where the blue layout fluid 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. Check the valve guide if the valve seat contact width is uneven.





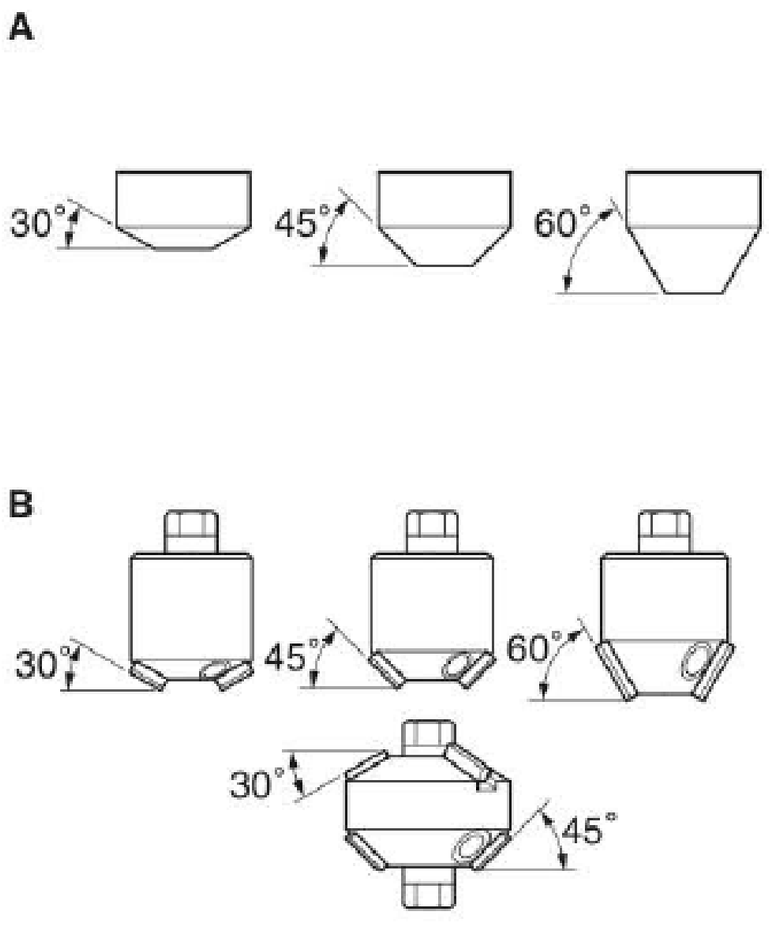
Seat contact width IN
1.10-1.50 mm (0.0433-0.0591 in)
Limit
1.950 mm (0.0768 in)
Seat contact width EX
1.10-1.50 mm (0.0433-0.0591 in)
Limit
1.950 mm (0.0768 in)

Refacing the valve seat

NOTICE

After every lapping procedure, make sure to clean off any remaining lapping compound from the cylinder head and valves.

1. Reface the valve seat using the valve seat cutters.



A. Worldwide
B. USA and Canada

Valve seat cutter holder 5.5

Intake:
Valve seat cutter 30-32.5

Valve seat cutter 45°

Valve seat cutter 60°

Exhaust:
Valve seat cutter 30-27

Valve seat cutter 45°

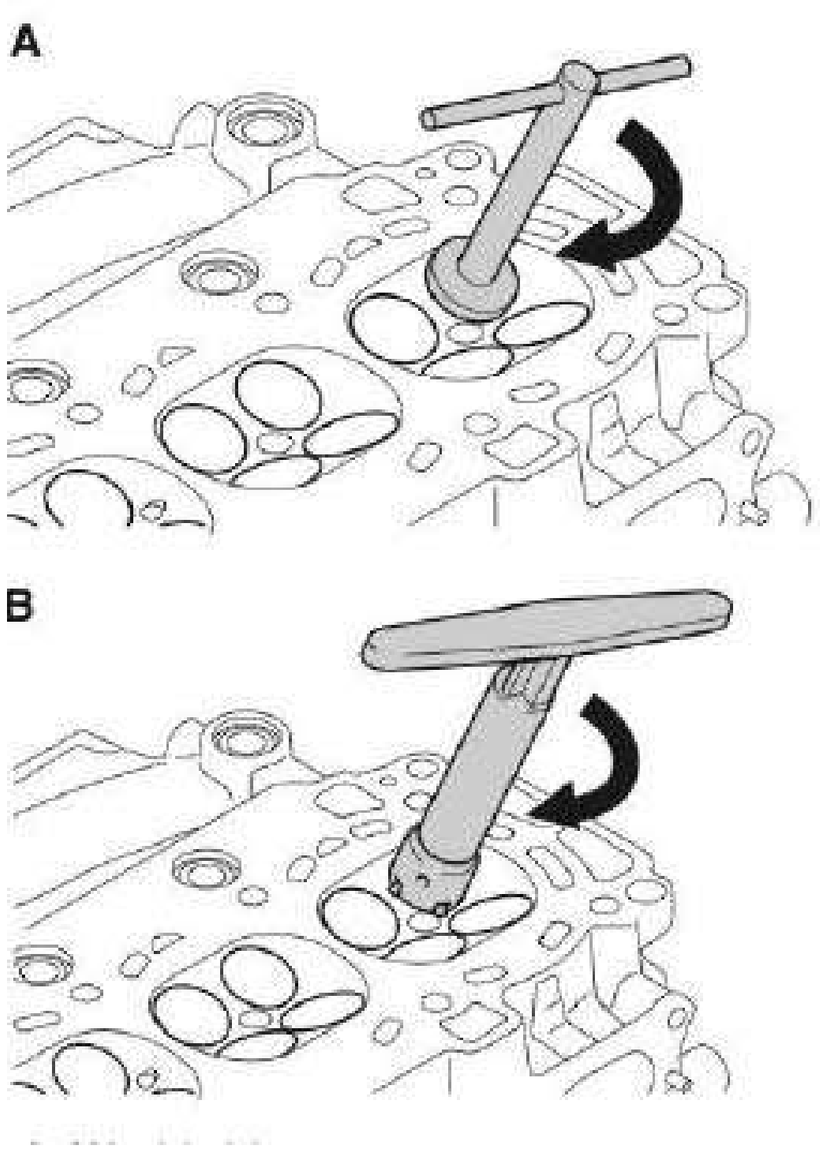
Valve seat cutter 60°

Neway valve seat kit

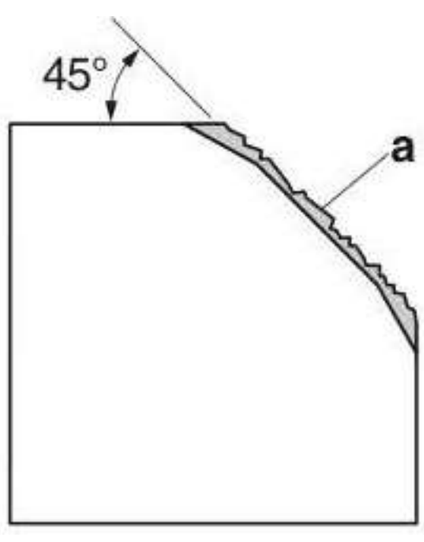
2. Cut the surface of the valve seat using a 45° cutter by turning the cutter clockwise until the valve seat face has become smooth.

NOTICE

Do not overcut the valve seat. To prevent chatter marks, make sure to turn the cutter evenly using a downward force of 40-50 N (4.0-5.0 kgf, 8.8-11.0 lbf).

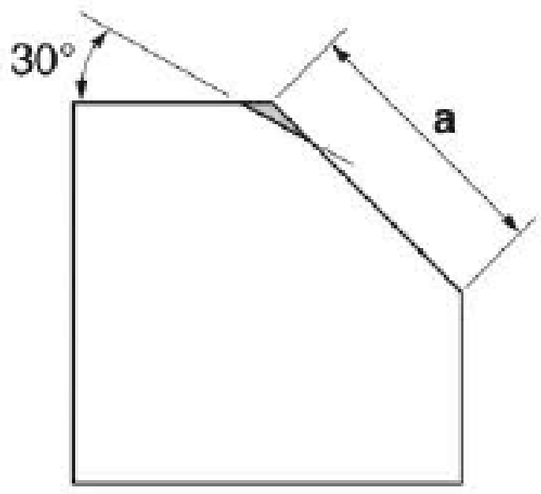


A. Worldwide
B. USA and Canada



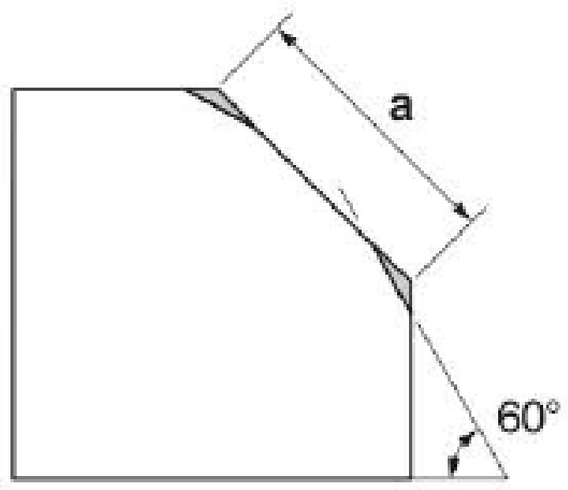
a. Slag or rough surface

3. Adjust the top edge of the valve seat contact width using a 30° cutter.



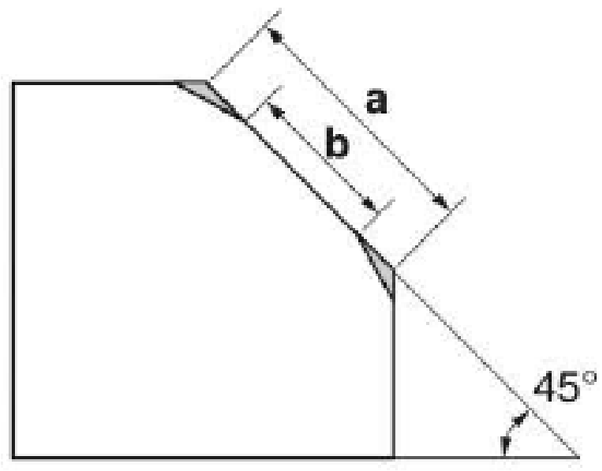
a. Previous contact width

4. Adjust the bottom edge of the valve seat contact width using a 60° cutter.



a. Previous contact width

5. Adjust the valve seat contact width to specification using a 45° cutter.

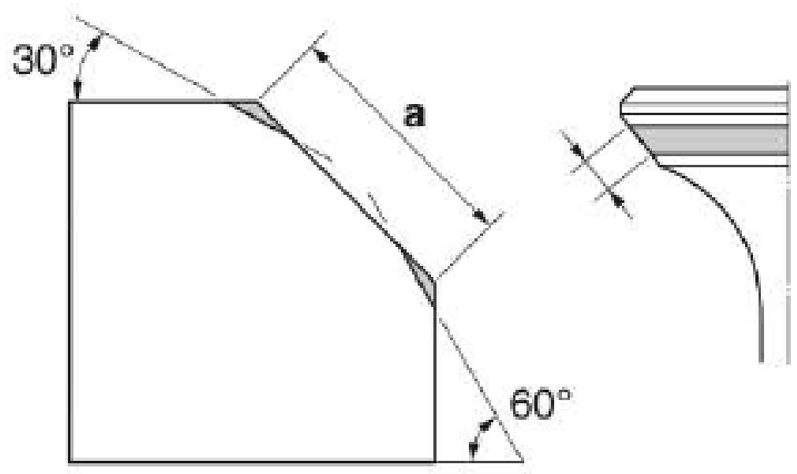


a. Previous contact width
b. Specified contact width

6. Check the valve seat contact area of the valve. See "Checking the valve seat" (7-70).

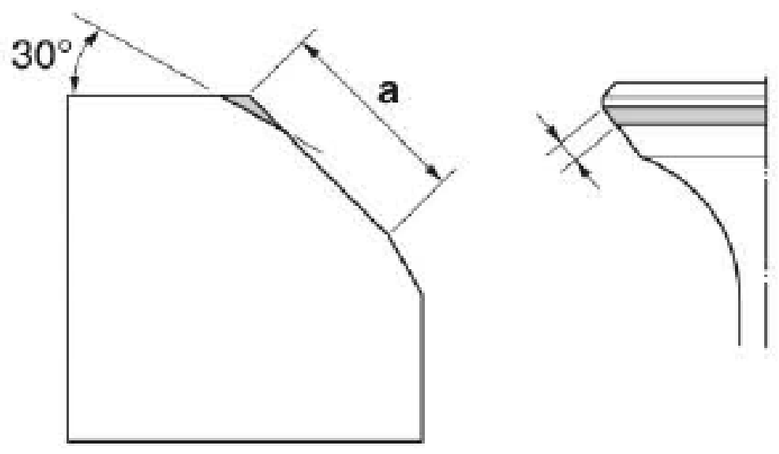
Example:

- If the valve seat contact area is too wide and situated in the center of the valve face, cut the top edge of the valve seat using a 30° cutter. Cut the bottom edge using a 60° cutter to center the area and set its width.



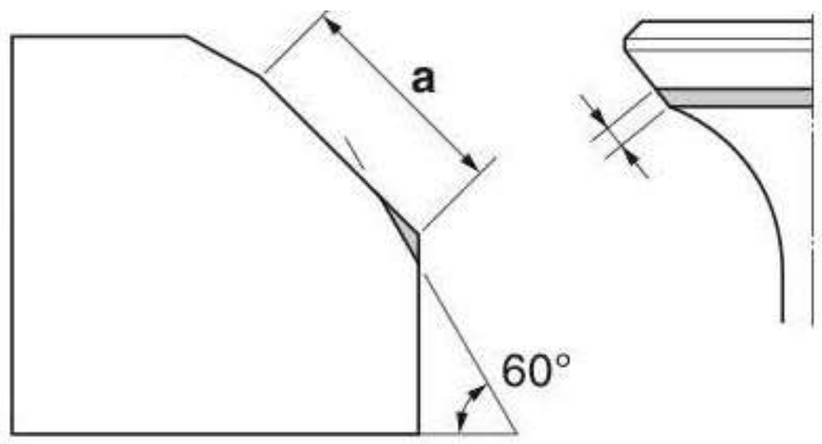
a. Previous contact width

- If the valve seat contact area is too narrow and situated near the top edge of the valve face, cut the top edge of the valve seat using a 30° cutter to center the area. Set its width using a 45° cut-



a. Previous contact width

- If the valve seat contact area is too narrow and situated near the bottom edge of the valve face, cut the bottom edge of the valve seat using a 60° cutter. Set its width using a 45° cutter.

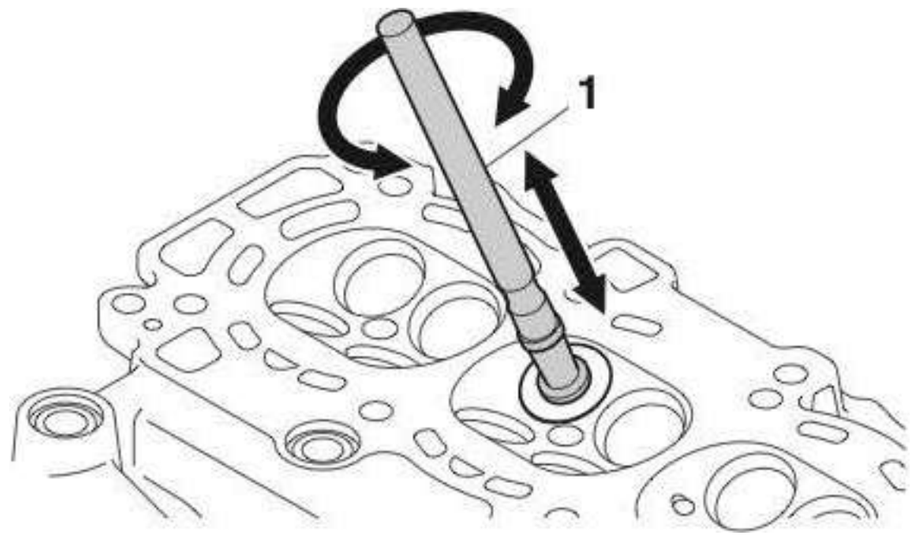


a. Previous contact width

7. 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 the special service tool "1".

NOTICE

Do not get the lapping compound on the valve stem and valve guide.



Valve lapper "1"
Valve lapping tool "1"

8. Recheck the valve seat contact area of the valve. See "Checking the valve seat" (7-70).

Checking the cylinder head anode

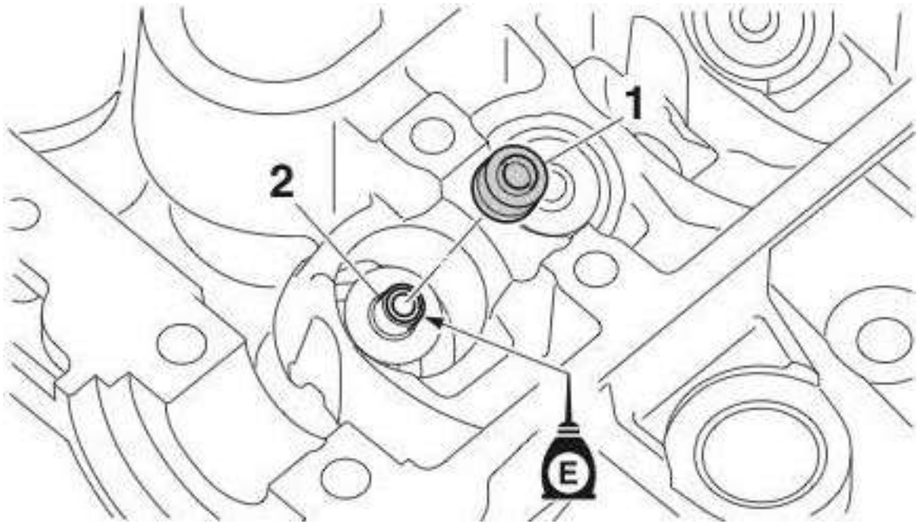
1. Check the anode. Replace the anode if half of it has eroded. Clean if there is grease, oil, or scales.

NOTICE

Do not apply grease, oil, or paint to the anodes.

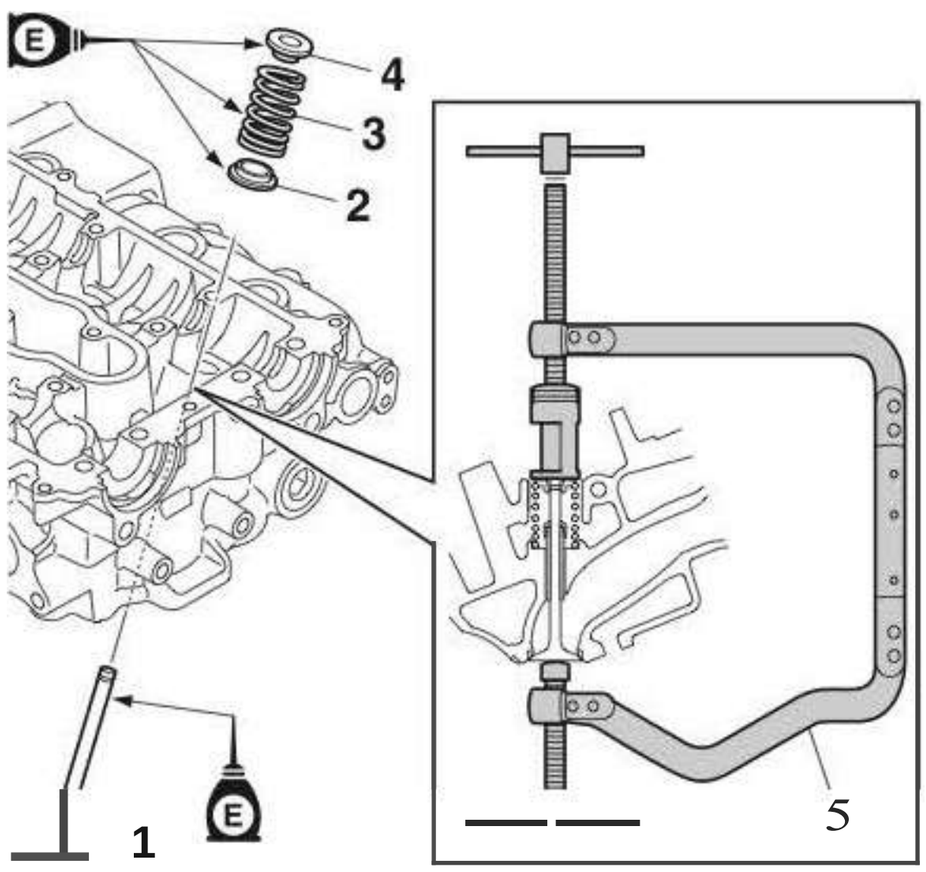
Assembling the cylinder head

1. Install a new valve seal "1" onto the valve guide "2".

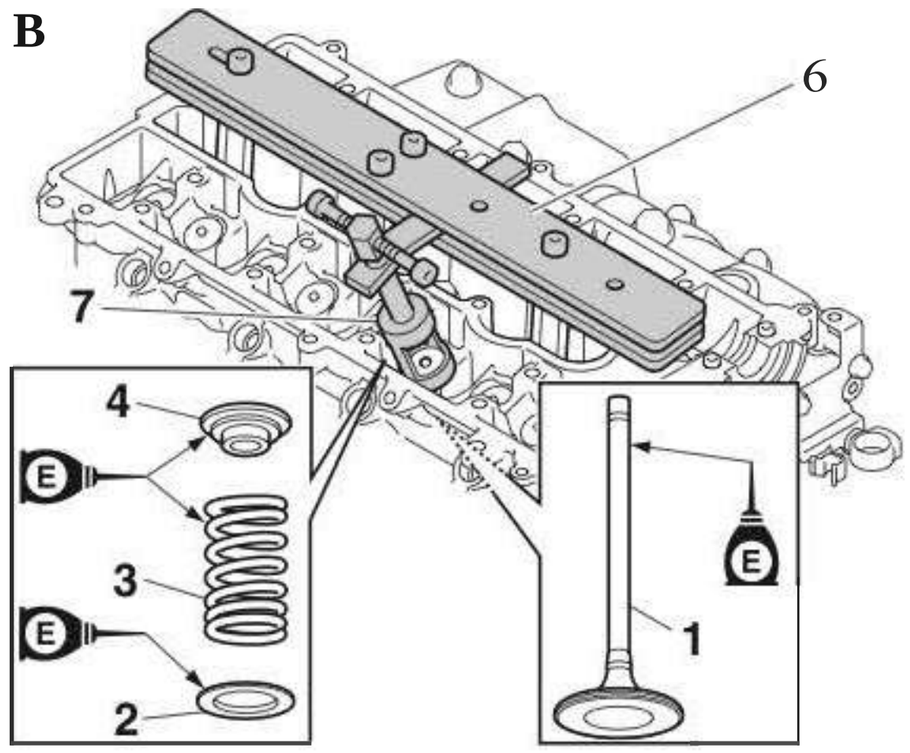


2. Install the valve "1", valve spring seat "2", valve spring "3", and valve spring retainer "4" in this order, and then install the tools "5" or "6" and "7".

A



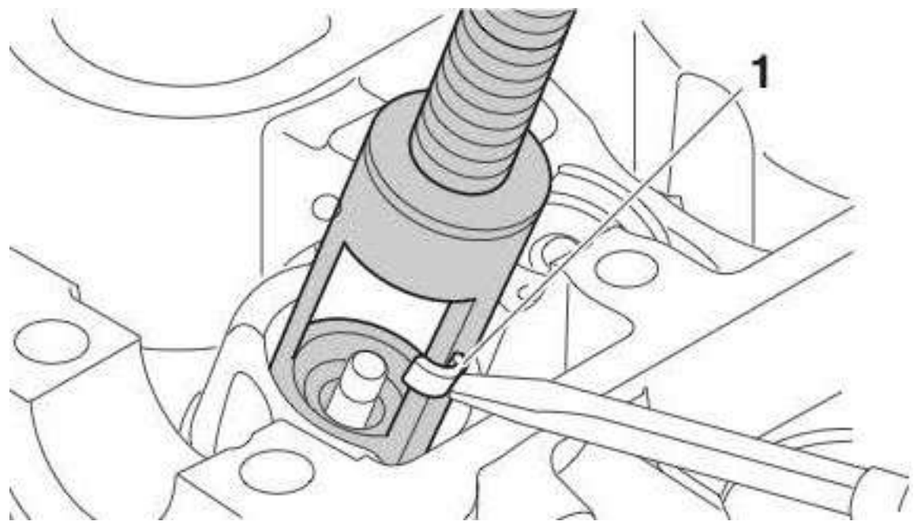
B



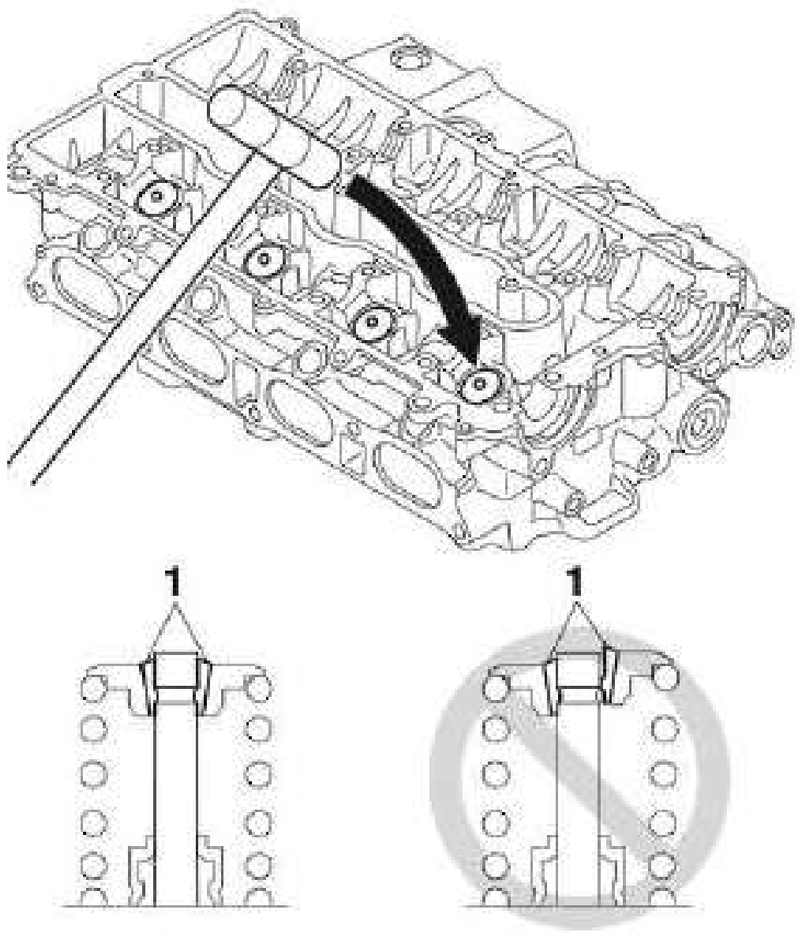
A. Commercially available tool
B. New special service tool

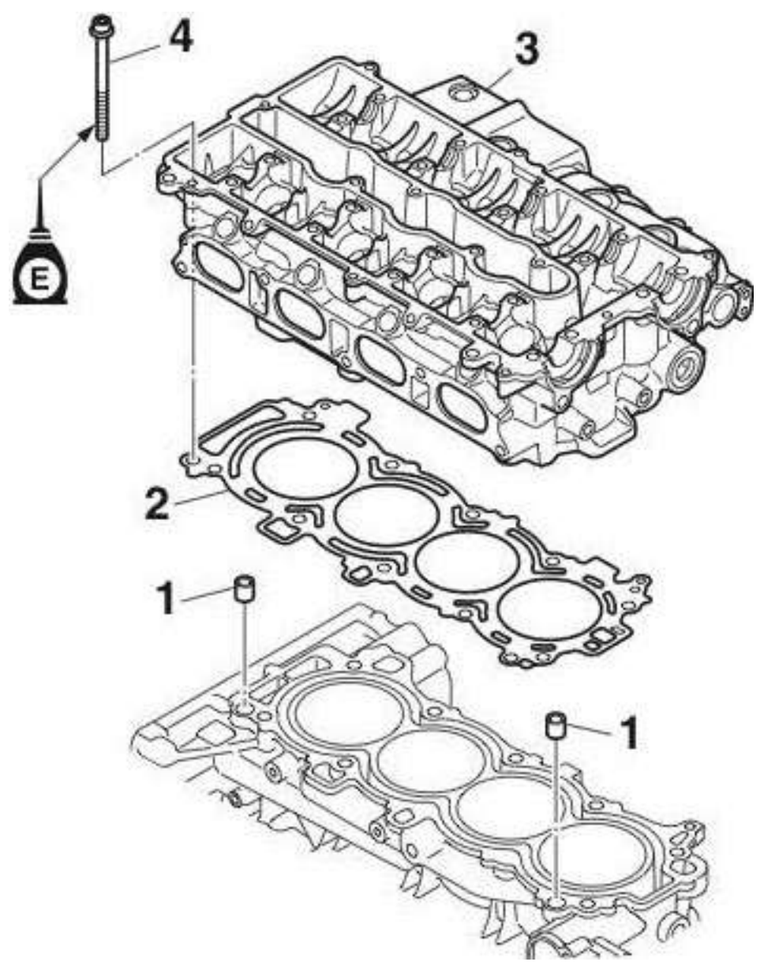
Valve spring compressor "5" (commercially available)	
Valve spring compressor "6"	
Valve spring compressor "6"	
Valve spring compressor attachment "7"	
Valve spring compressor adaptor "7"	

3. Compress the valve spring, and then install the valve cotters "1".



4. Tap the valve spring retainer lightly using a plastic hammer to seat the valve cotters "1" securely.



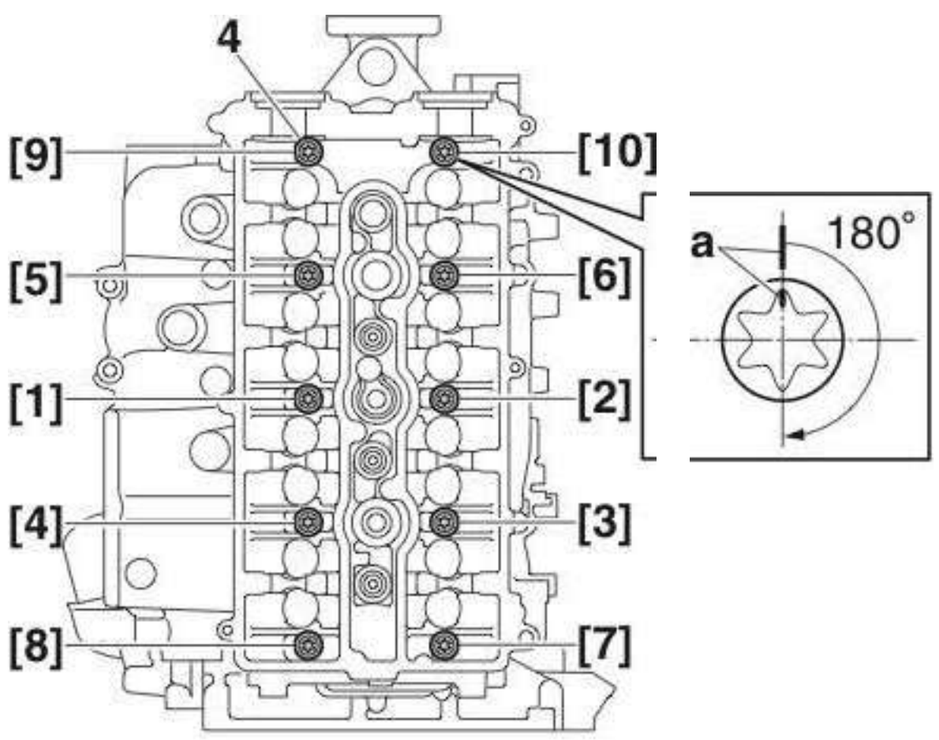


Installing the cylinder head

Before assembling the cylinder head, check the cylinder head bolts. See "Checking the cylinder head" (7-67).

1. Install the dowel pins "1", a new gasket "2", the cylinder head "3", and the cylinder head bolts "4".

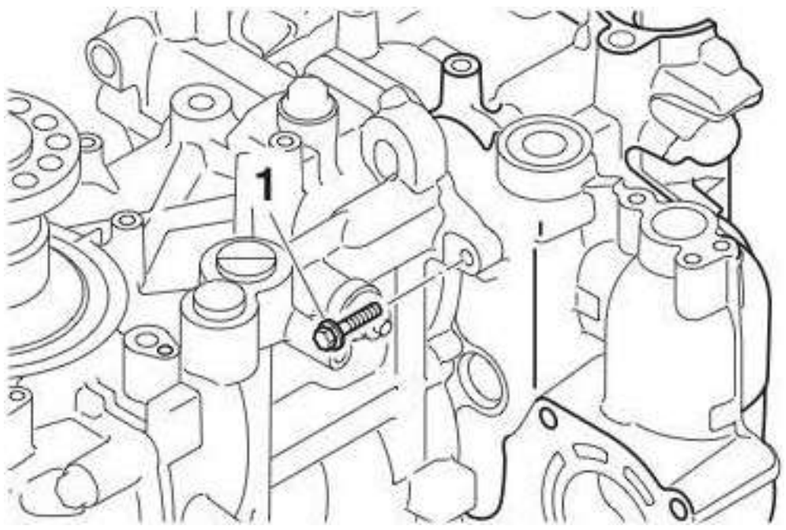
2. Tighten the cylinder head bolts "4" to the specified torques in 3 stages and in the order [1], [2], and so on.



3. Mark the cylinder head bolts (M10) and cylinder head with paint marks "a", and then tighten the cylinder head bolts (M10) 180° from the marks on the cylinder head.

Cylinder head bolt (M10) "4" [1]–[10]
1st: 26 Nm (2.6 kgf·m, 19.2 ft·lb)
2nd: 46 Nm (4.6 kgf·m, 33.9 ft·lb)
3rd: 180°

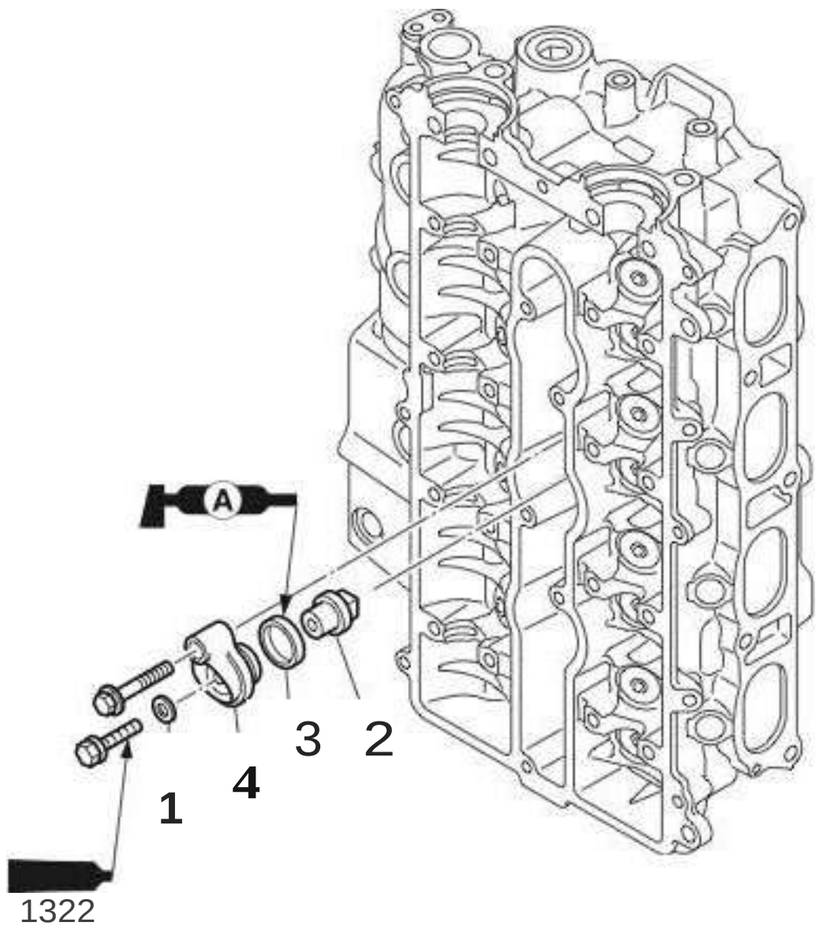
4. Tighten the cylinder head bolt (M6) “1” to The specified torque.



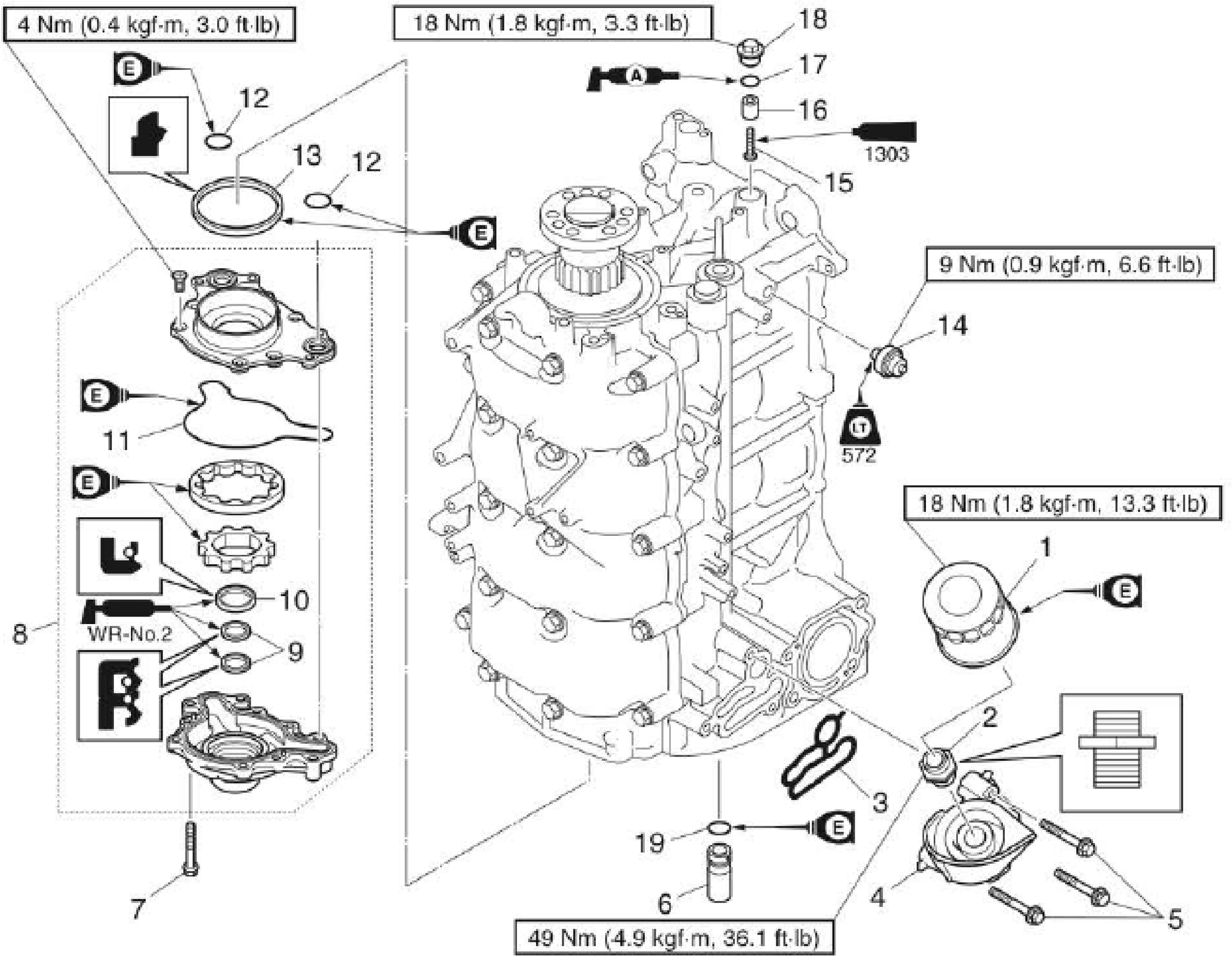
Cylinder head bolt (M6) "1"
12 Nm (1.2 kgf·m, 8.9 ft·lb)

5. Install a new gasket "1", the anode "2", and the grommet "3" to the cover "4".

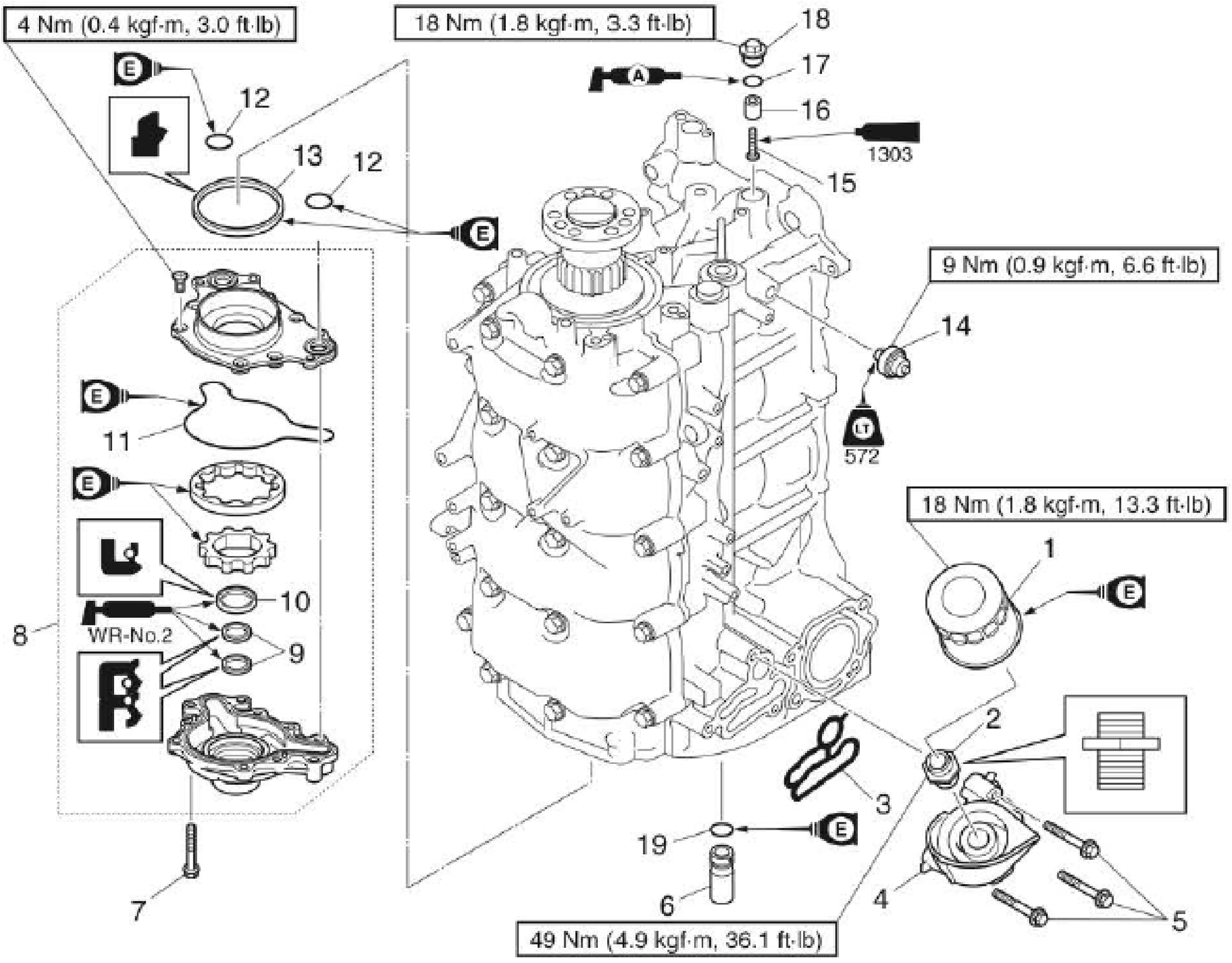
6. Install the anode assembly to the cylinder head.



Cylinder block



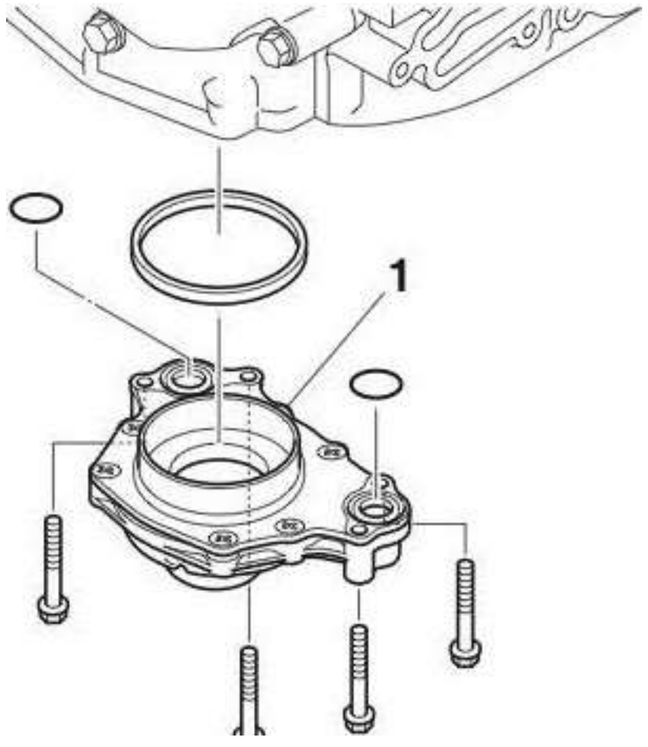
No.	Part name	Q'ty	Remarks
1	Oil filter	1	
2	Union bolt	1	M20
3	Gasket	1	Not reusable
4	Oil filter bracket	1	
5	Bolt	3	M6 x 40 mm
6	Relief valve	1	
7	Bolt	4	M6 x 40 mm
8	Oil pump assembly	1	
9	Oil seal	2	Not reusable
10	Oil seal	1	Not reusable
11	Gasket	1	Not reusable
12	O-ring	2	Not reusable
13	Oil seal	1	Not reusable
14	Oil pressure sensor	1	
15	Screw	1	M5 x 26 mm
16	Anode	1	
17	O-ring	1	Not reusable



No.	Part name	Q'ty	Remarks
18	Plug	1	M5 x 10 mm
19	O-ring	1	Not reusable

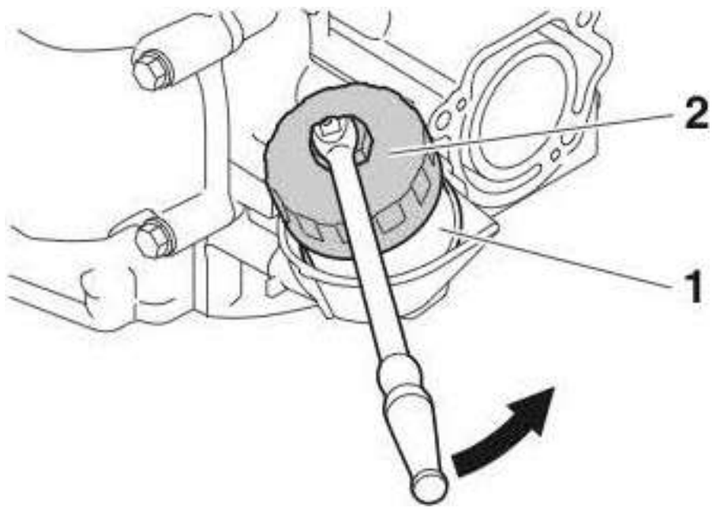
Removing the oil pump assembly

1. Remove the oil pump assembly "1".



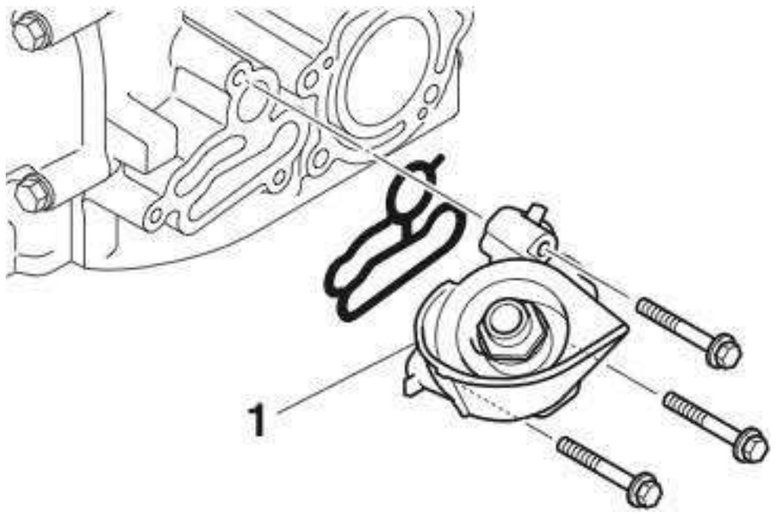
Removing the oil filter bracket

1. Remove the oil filter "1".



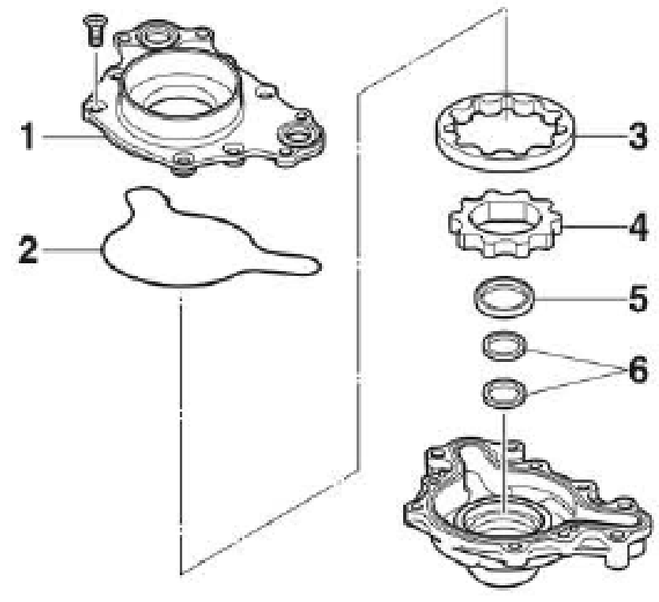
Oil filter wrench "2"
Oil filter wrench "2"

2. Remove the oil filter bracket "1".



Disassembling the oil pump

1. Remove the oil pump cover "1", gasket "2", outer rotor "3", inner rotor "4", and oil seals "5" and "6".

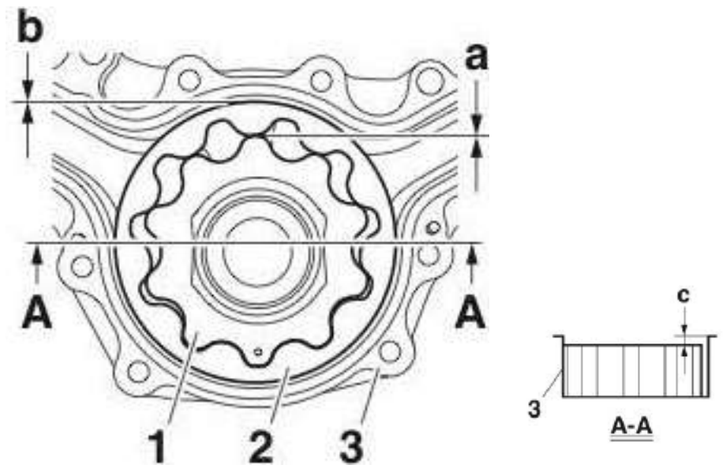


Checking the oil pump

1. Check the inner surface of the oil pump housing. Replace the oil pump assembly if scratched.

2. Check the gear teeth of the inner rotor and outer rotor. Replace the oil pump assembly if the gear teeth are cracked or worn.

3. Measure the inner rotor to outer rotor tip clearance "a", outer rotor to oil pump housing clearance "b", and oil pump housing to inner rotor and outer rotor clearance "c". Replace the oil pump rotor if out of specification.



1. Inner rotor
2. Outer rotor
3. Oil pump housing

Inner rotor to outer rotor tip clearance
0.12 mm (0.0047 in)
Limit
0.16 mm (0.0063 in)

Outer rotor to oil pump housing clearance 0.1 mm (0.0040 in) Limit 0.20 mm (0.0079 in)

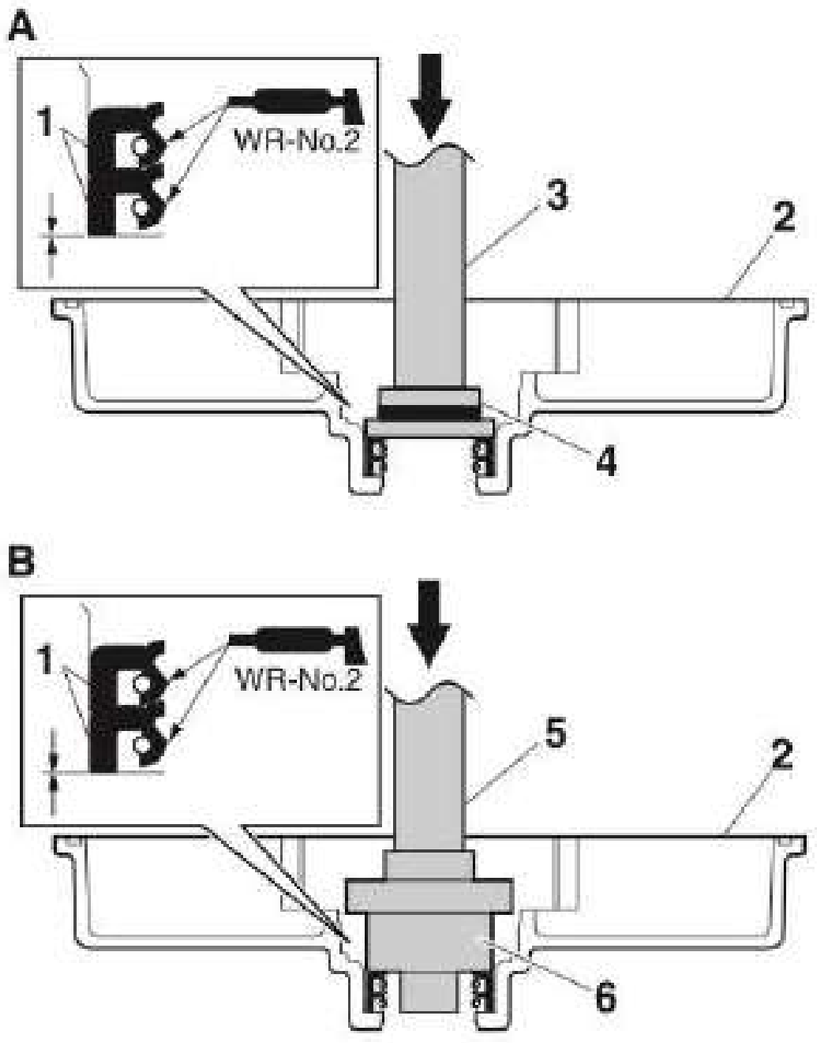
Oil pump housing to inner rotor and outer rotor clearance 0.03 mm (0.0012 in) Limit 0.12 mm (0.0047 in)

Assembling the oil pump

1. Install new oil seals "1" into the oil pump housing "2".

TIP:

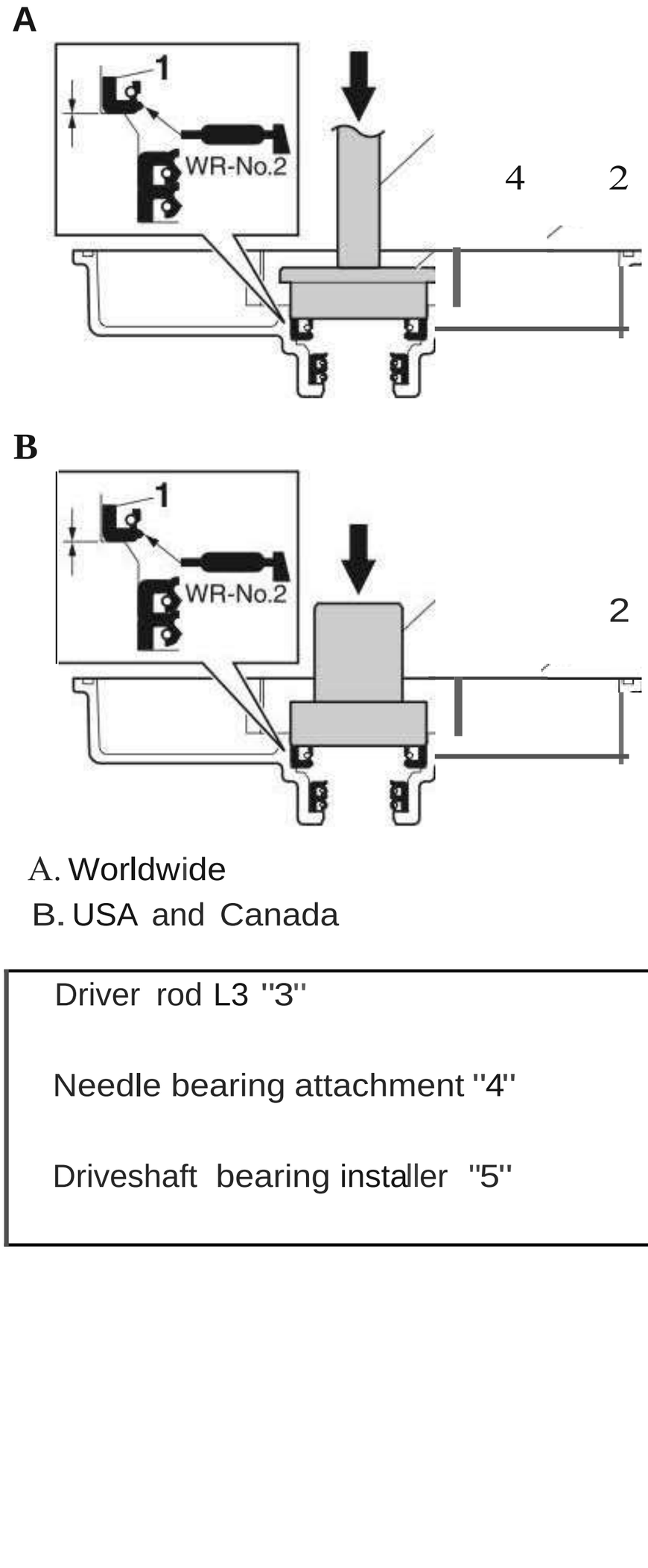
Install an oil seal halfway into the oil pump housing, and then install the other oil seal.



A. Worldwide
B. USA and Canada

Driver rod L3 "3" Needle bearing attachment "4" Driver handle (large) "5" Oil seal installer "6"

2. Install a new oil seal "1" into the oil pump housing "2".

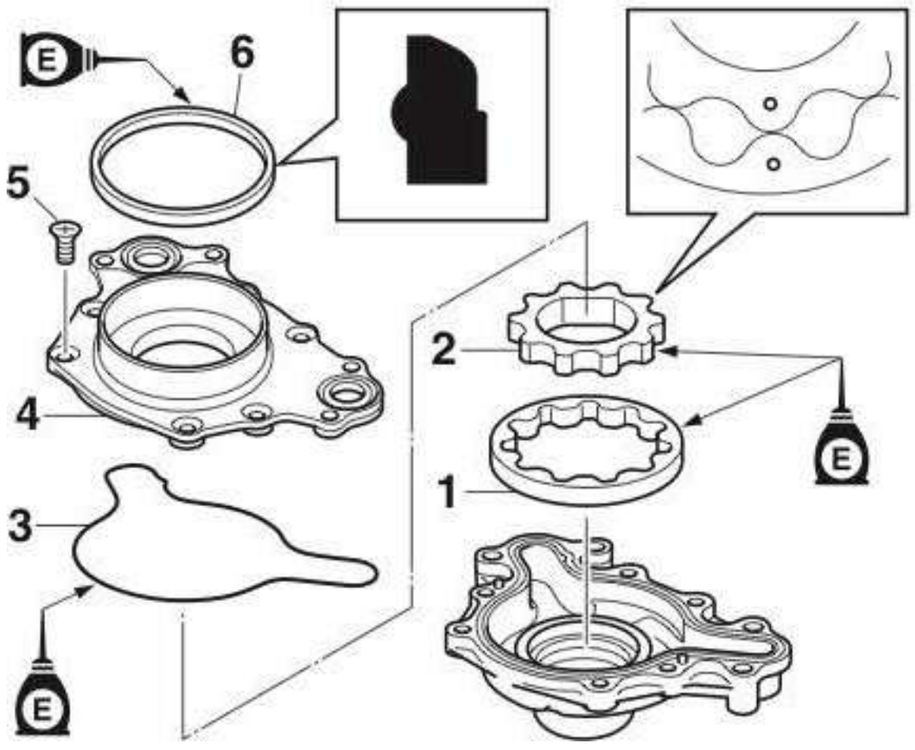


A. Worldwide
B. USA and Canada

Driver rod L3 "3" Needle bearing attachment "4" Driveshaft bearing installer "5"

3. Install the outer rotor "1", the inner rotor "2", a new gasket "3", and the oil pump cover "4", and then tighten the oil pump cover screws "5" to the specified torque.

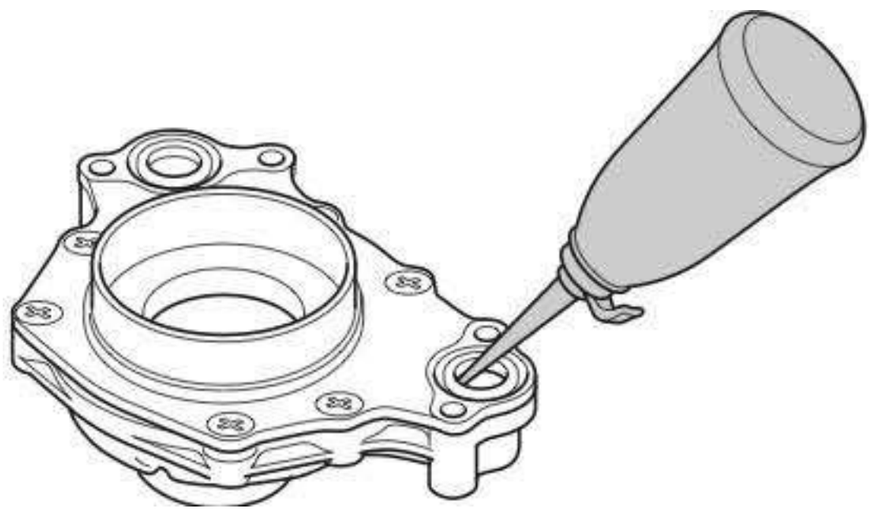
4. Install a new oil seal "6" so that it is facing in the proper direction.



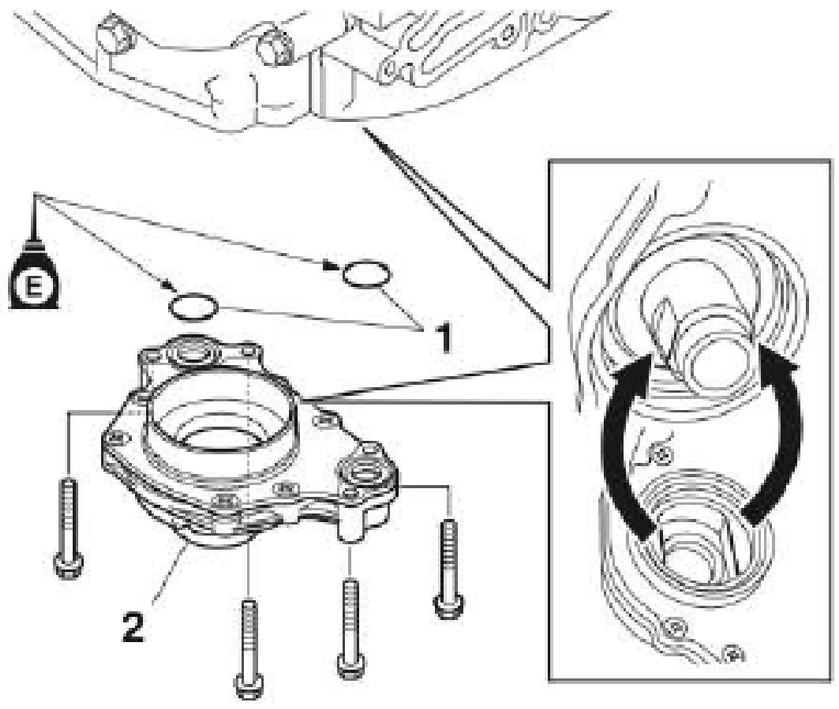
Oil pump cover screw "5"
4 Nm (0.4 kgf • m, 3.0 ft • lb)

Installing the oil pump assembly

1. Fill the oil pump assembly with engine oil through the oil passage.



2. Install new O-rings "1" and the oil pump assembly "2" by aligning the oil pump gear with the crankshaft.



Checking the cylinder block anode

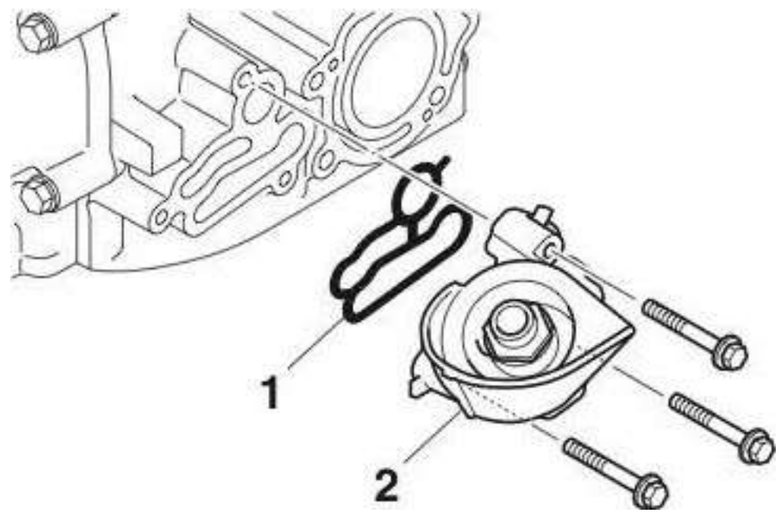
1. Check the anode. Replace the anode if half of it has eroded. Clean if there is grease, oil, or scales.

NOTICE

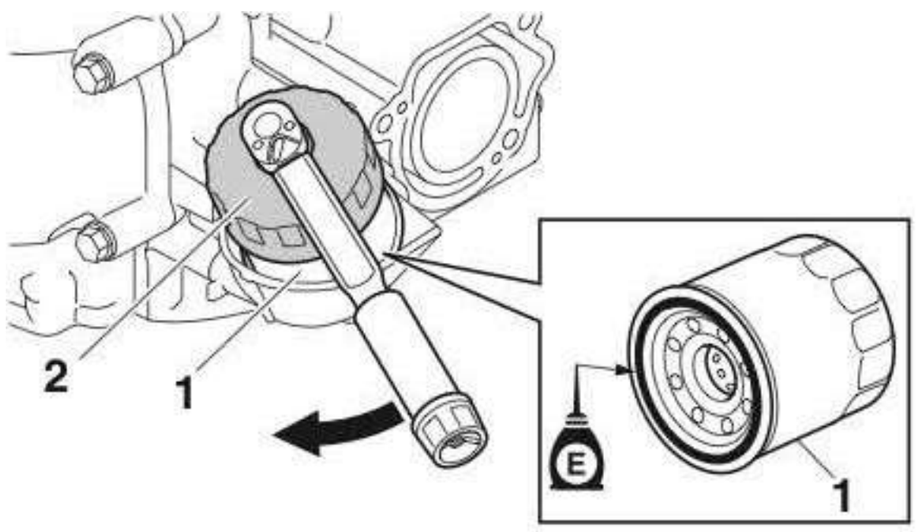
Do not apply grease, oil, or paint to the anode.

Installing the oil filter bracket

1. Install a new gasket "1" and the oil filter bracket "2".



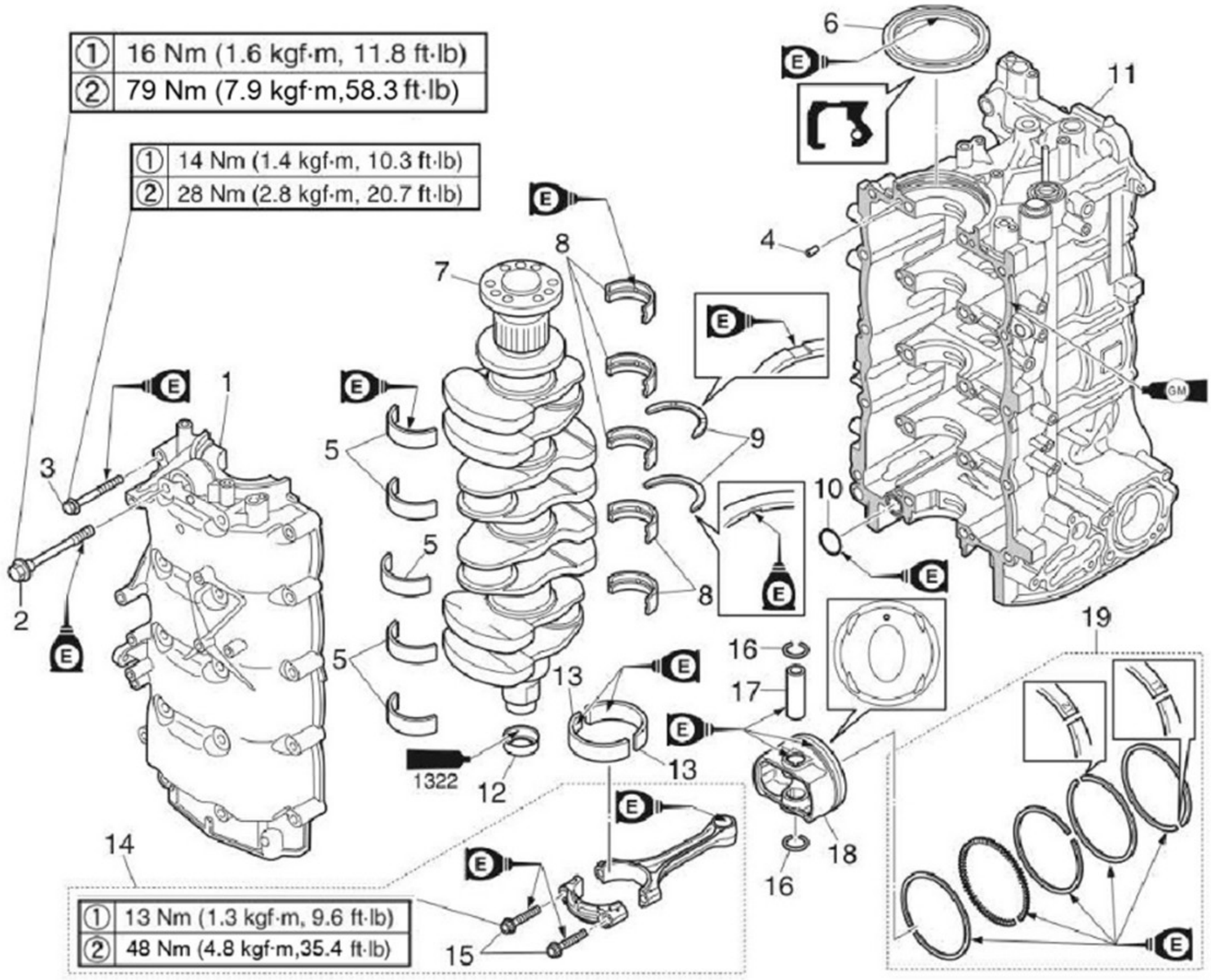
2. Install the oil filter "1", and then tighten it to the specified torque.



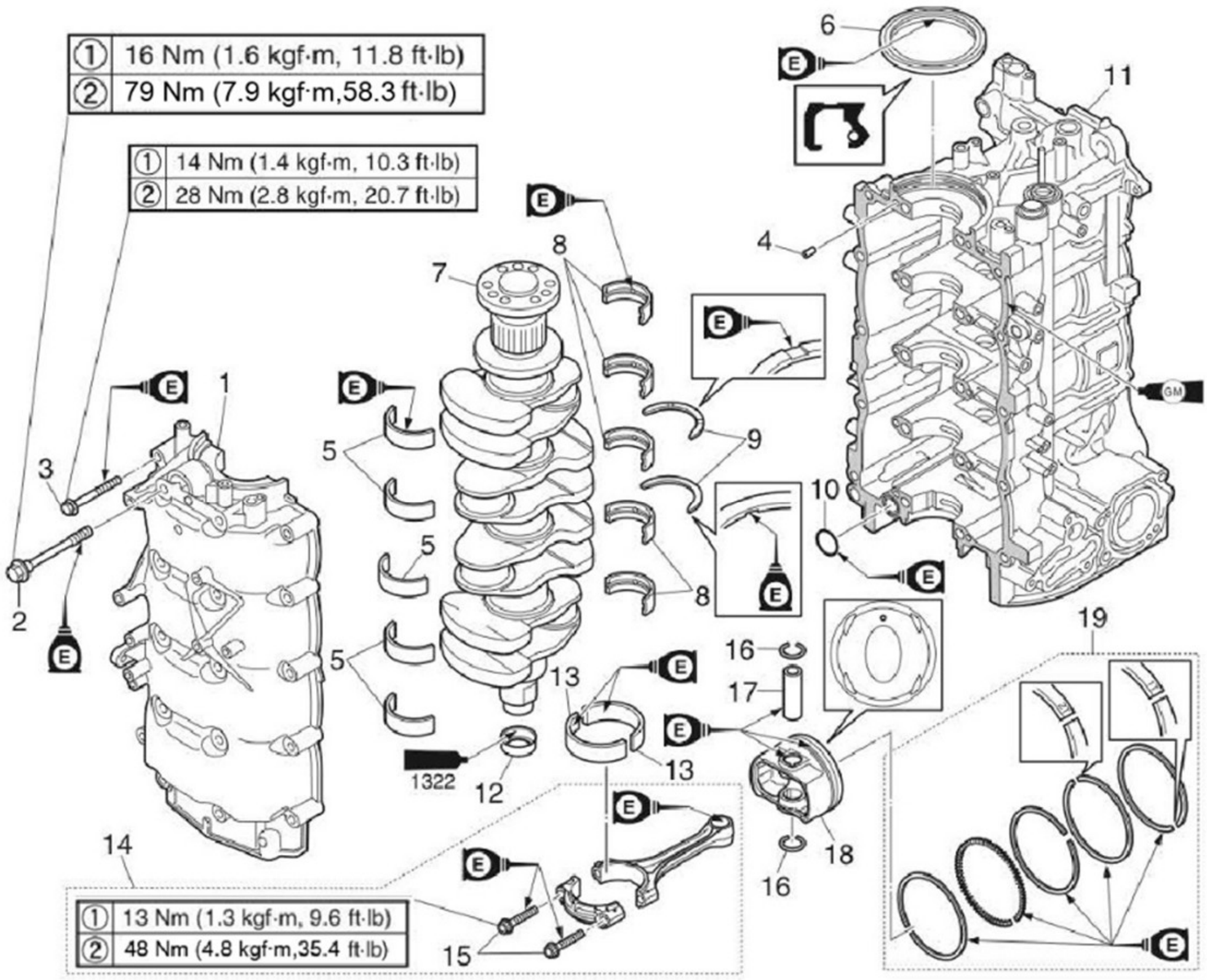
Oil filter wrench "2"
Oil filter wrench "2"

Oil filter "1"
20 Nm (2 kgf·m, 14.7ft·lb)

Crankcase



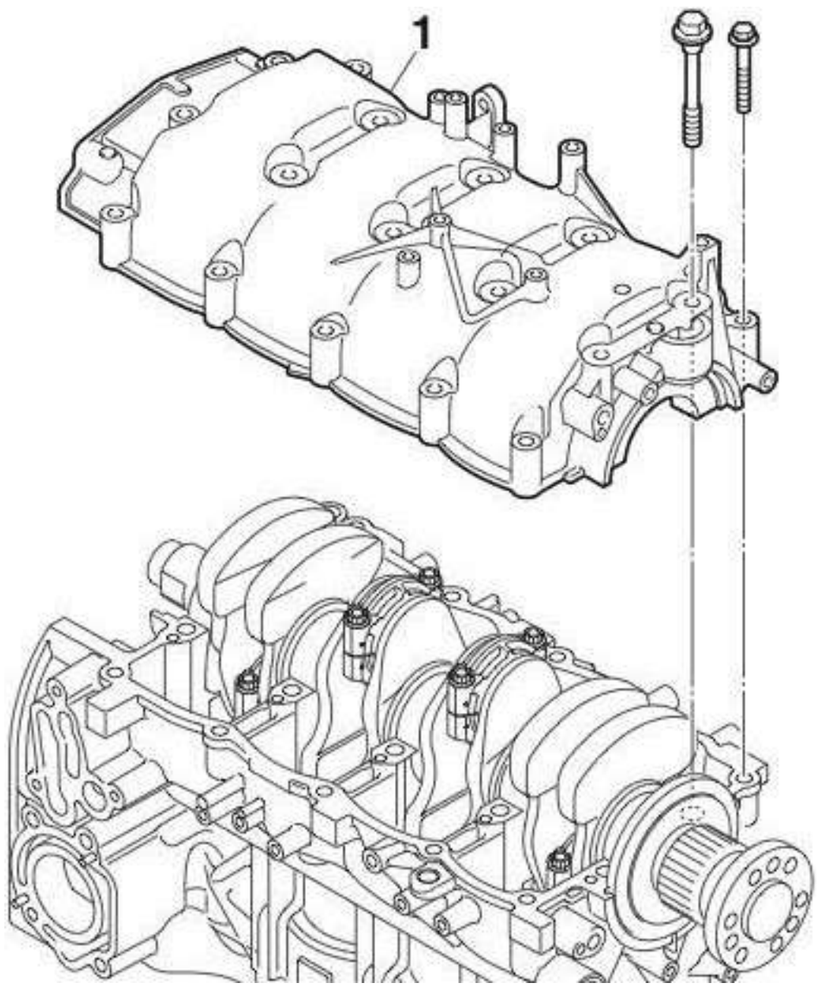
No.	Part name	Q'ty	Remarks
1	Crankcase	1	
2	Bolt	10	M10 x 105 mm
3	Bolt	10	M8 x 55 mm
4	Dowel pin	10	
5	Crankshaft journal bearing	5	
6	Oil seal	1	Not reusable
7	Crankshaft	1	
8	Crankshaft journal bearing	5	
9	Thrust bearing	2	
10	O-ring	1	Not reusable
11	Cylinder block	1	
12	Collar	1	Not reusable
13	Crankshaft pin bearing	8	
14	Connecting rod assembly	4	
15	Connecting rod bolt	8	Not reusable, M8 x 36 mm
16	Clip	8	Not reusable
17	Piston pin	4	



No.	Part name	Q'ty	Remarks
18	Piston	4	
19	Piston ring set	4	

Disassembling the cylinder block

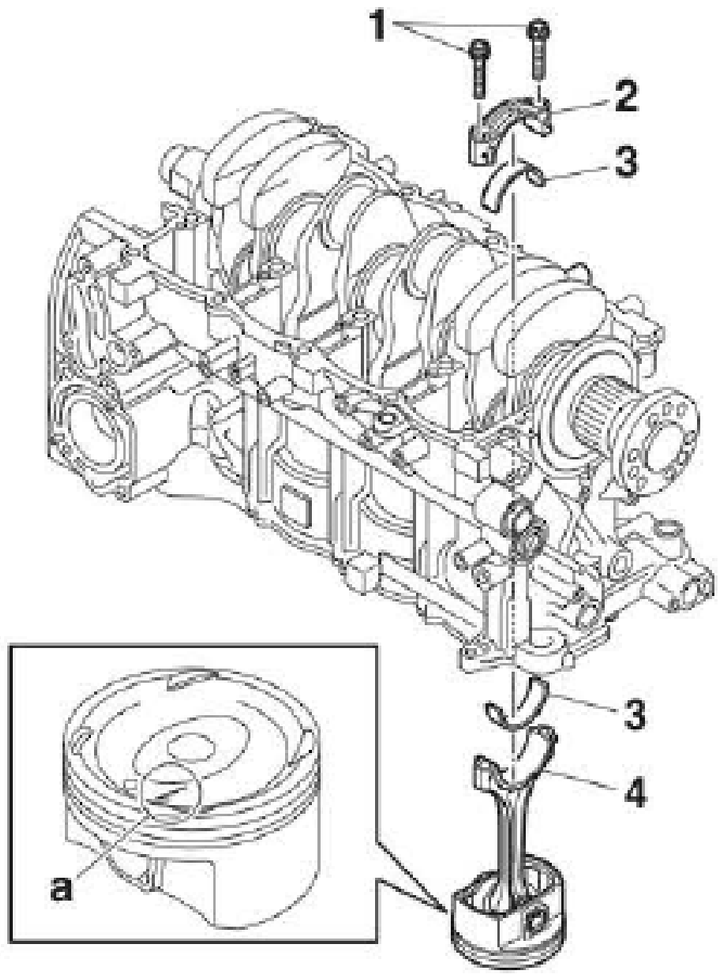
1. Remove the crankcase "1".



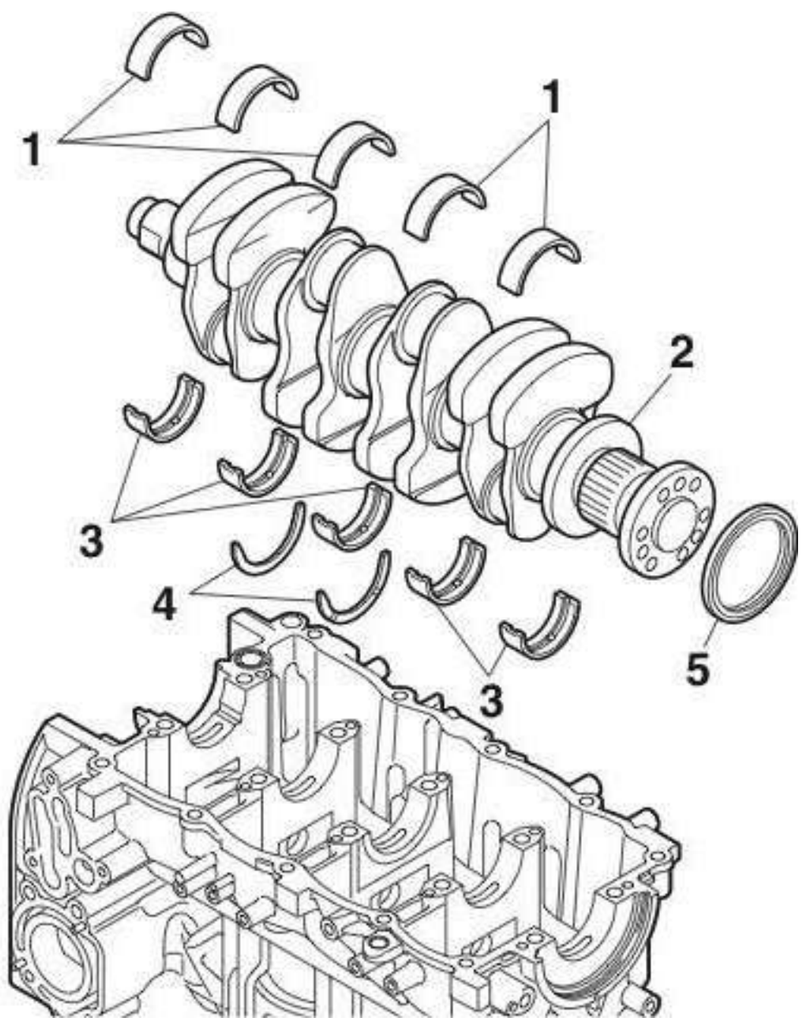
2. Remove the connecting rod bolts "1" and connecting rod caps "2", and then remove the crankshaft pin bearings "3" and piston and connecting rod assemblies "4".

TIP:

- To prevent mixing the piston and connecting rod assemblies "4" and connecting rod caps "2", mark each with an identification number "a" of the corresponding cylinder.
- Make sure to keep the parts in the order of removal.

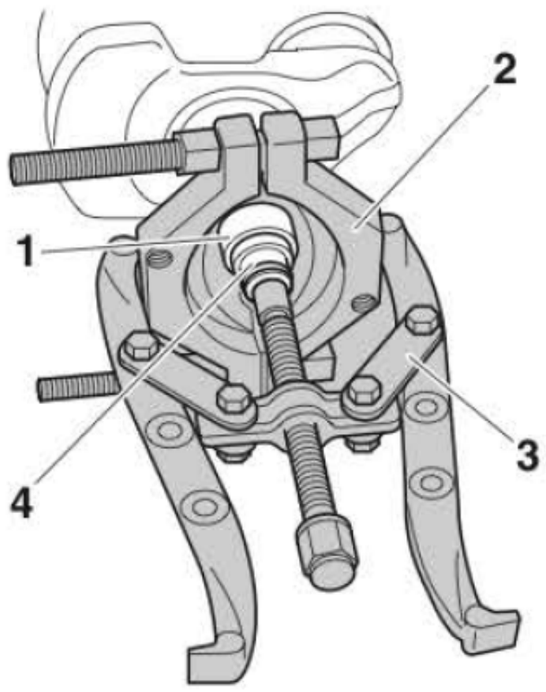


3. Remove the crankshaft journal bearings "1", crankshaft "2", crankshaft journal bearings "3", thrust bearings "4", and oil seal "5".

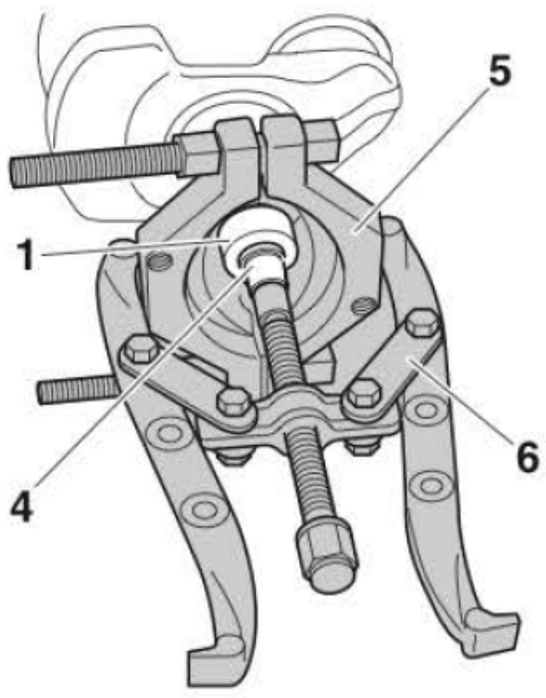


4. Remove the collar "1".

A



B



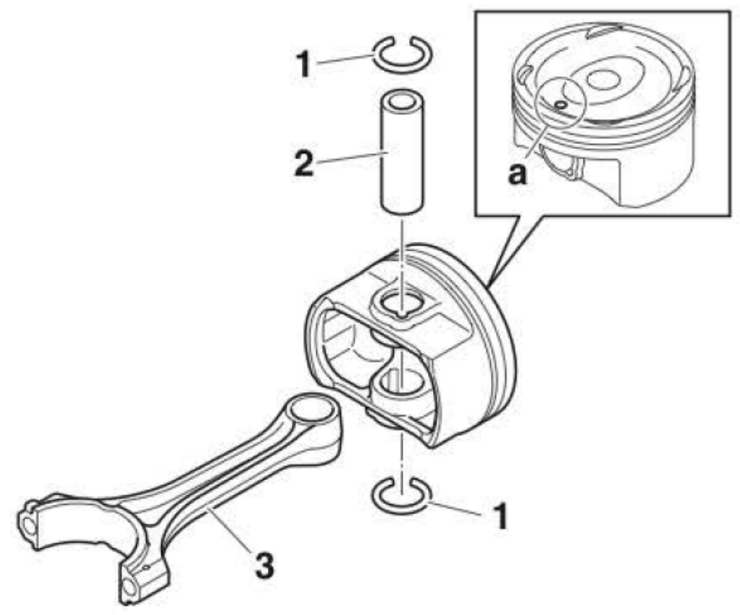
A. Worldwide
B. USA and Canada

Bearing separator "2"
Gear puller "3"
Needle bearing attachment "4"
Needle bearing remover and installer "4"
Bearing separator "5" (commercially available)
Gear puller "6" (commercially available)

5. Remove the clips "1" and piston pin "2", and then remove the connecting rod "3".

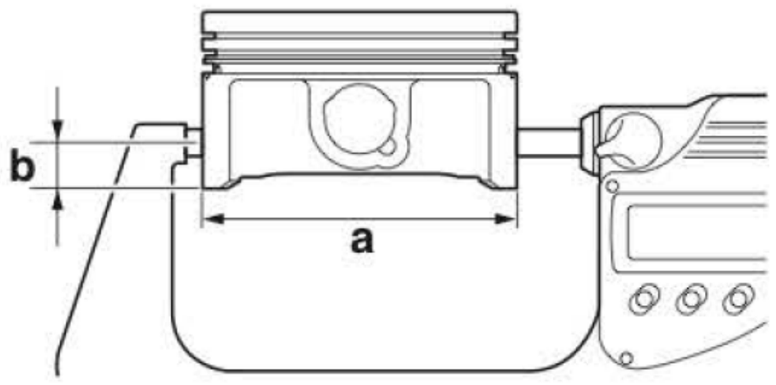
TIP:

- Remove the piston pin from the side marked with "a".
- Make sure to keep the parts in the order of removal.



Checking the piston diameter

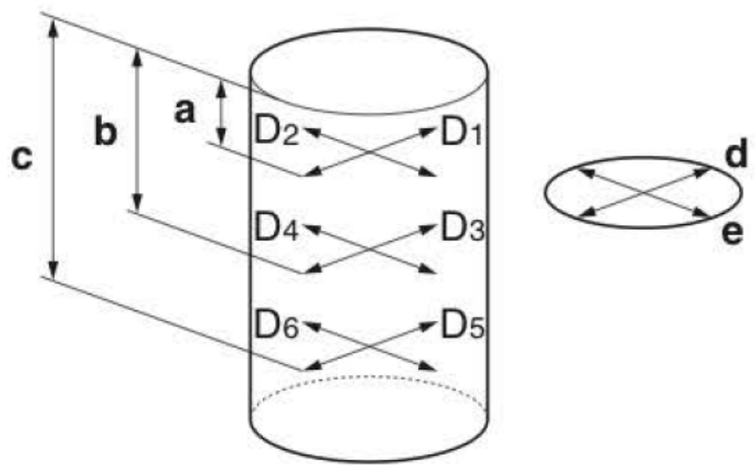
1. Measure the piston outside diameter "a" at the specified measuring point "b". Replace the piston if below specification.



Piston
Diameter
80.934- 80.950 mm (3.1864-3.1870 in)
Limit
80.898 mm (3.1850 in)
1st oversize diameter
81 .184- 81.200 mm (3.1962-3.1968 in
)Measuring point
10.0 mm (0.39 in)
above the bottom of the piston skirt

Checking the cylinder bore

1. Measure the cylinder bore (D1–D6) at measuring points "a" "b" and "c" and in direction "d" (D1, D3, D5) and "e" (D2, D4, D6). Replace the cylinder block if above specification.



a. 5.0 mm (0.20 in)
b. 35.0 mm (1.38 in)
c. 94.0 mm (3.70 in)
d. Parallel to the crankshaft
e. At a right angle to the crankshaft

Cylinder
Bore
81.000-81.016 mm (3.1890-3.1896 in)
Limit
81.061 mm(3.1914in)

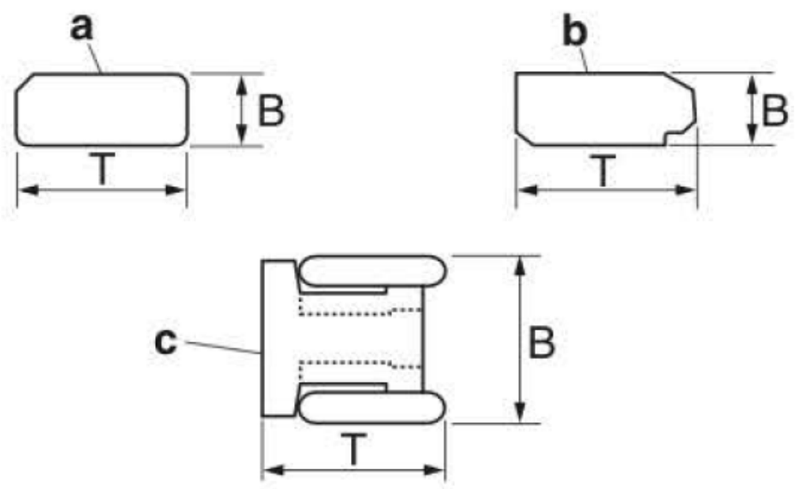
Checking the piston clearance

1. Measure the piston diameter. See "Checking the piston diameter" (7-86).
2. Measure the cylinder bore. See "Checking the cylinder bore" (7-87).
3. Calculate the piston clearance. Replace the piston or cylinder block if out of specification.

Piston clearance = maximum cylinder bore – piston outside diameter
Piston clearance
0.050–0.077 mm (0.0020-0.0030 in)
Limit
0.163 mm (0.0064 in)

Checking the piston ring

1. Measure piston ring dimensions B and T. Replace if below specification.



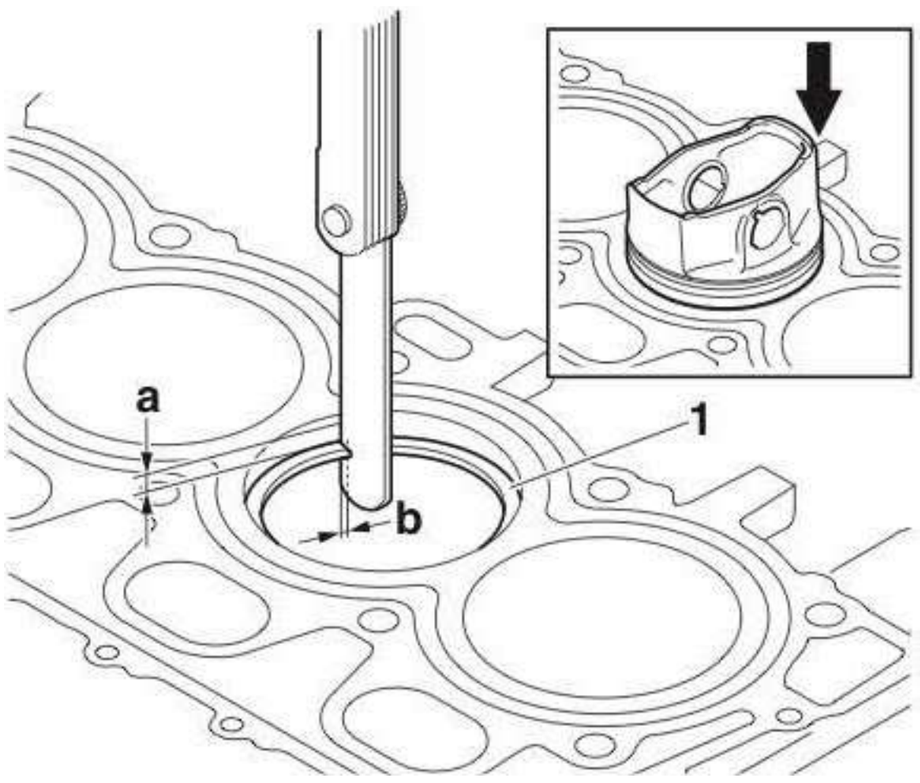
a. Top ring
b. 2nd ring
c. Oil ring

Piston ring dimensions
Top ring
Height (B)
1.170-1.190 mm (0.0461–0.0469 in)
Width (T)
2.350-2.650 mm (0.0926-0.1044 in)
2nd ring
Height (B)
1.170-1.190 mm (0.0461–0.0469 in)
Width (T)
2.600-2.800 mm (0.1024–0.1102 in)
Oil ring
Height (B)
2.360-2.480 mm (0.0930–0.0976 in)
Width (T)
2.450 mm (0.0965 in)

Checking the piston ring end gap

1. Level the piston ring "1" in the cylinder using a piston crown at the specified measuring point "a".

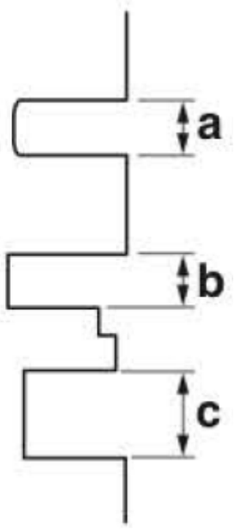
2. Measure the piston ring end gap "b". Replace if above specification.



Piston ring end gap	
Measuring point	
	10.0 mm (0.39 in)
Top ring	
End gap	
	0.15-0.30 mm (0.0059-0.0118 in)
Limit	
	0.470 mm (0.0185 in)
2nd ring	
End gap	
	0.40-0.60 mm (0.0158-0.0236 in)
Limit	
	1.050 mm (0.0413 in)
Oil ring	
End gap	
	0.20-0.70 mm (0.0079-0.0276 in)

Checking the piston ring groove

1. Measure the piston ring grooves. Replace if above specification.

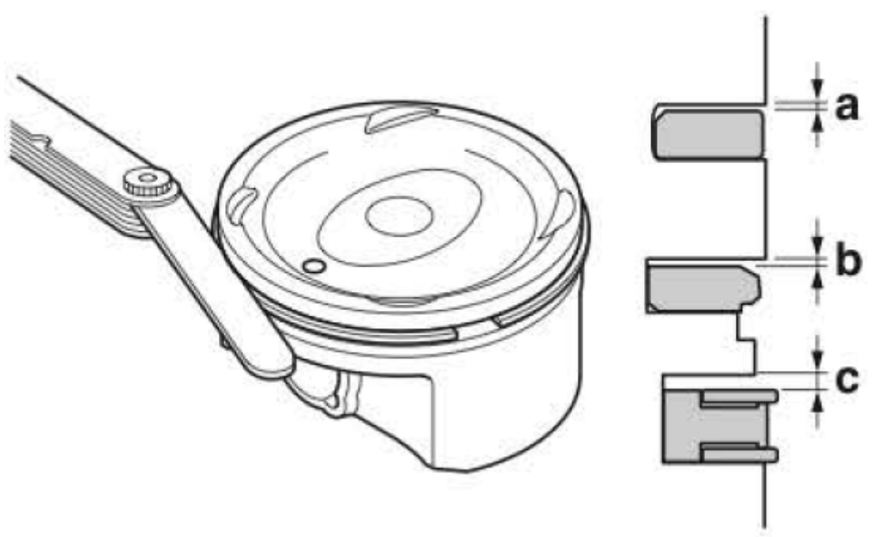


a. Ring groove (Top)
b. Ring groove (2nd)
c. Ring groove (Oil)

Piston ring groove	
Ring groove (Top)	
	1.23-1.25 mm (0.0484-0.0492 in)
Ring groove (2nd)	
	1.22-1.24 mm (0.0480-0.0488 in)
Ring groove (Oil)	
	2.51-2.53 mm (0.0988-0.0996 in)

Checking the piston ring side clearance

1. Measure the piston ring side clearance. Check the piston ring grooves and piston ring if below specification. See "Checking the piston ring groove" (7-88) and "Checking the piston ring" (7-87).



a. Top ring side clearance
b. 2nd ring side clearance
c. Oil ring side clearance

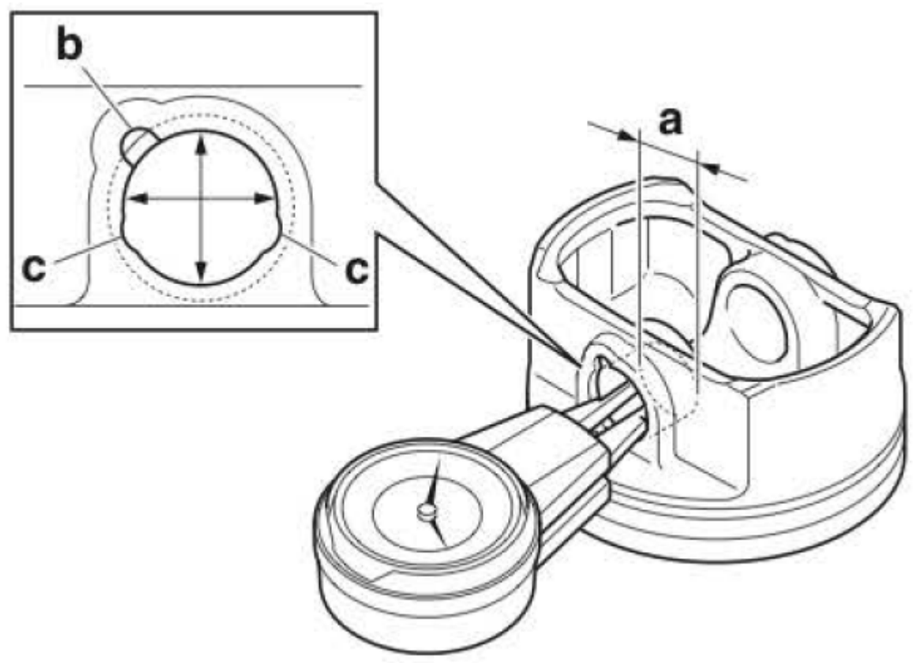
Piston ring side clearance
Top ring
Side clearance
0.04-0.08 mm (0.0016-0.0032 in)
Limit
0.130 mm (0.0051 in)
2nd ring
Side clearance
0.03-0.07 mm (0.0012-0.0028 in)
Limit
0.110 mm (0.0043 in)
Oil ring
Side clearance
0.03-0.17 mm (0.0012-0.0067 in)

Checking the piston pin boss inside diameter

1. Measure the piston pin boss inside diameter "a". Replace the piston if above specification.

TIP:

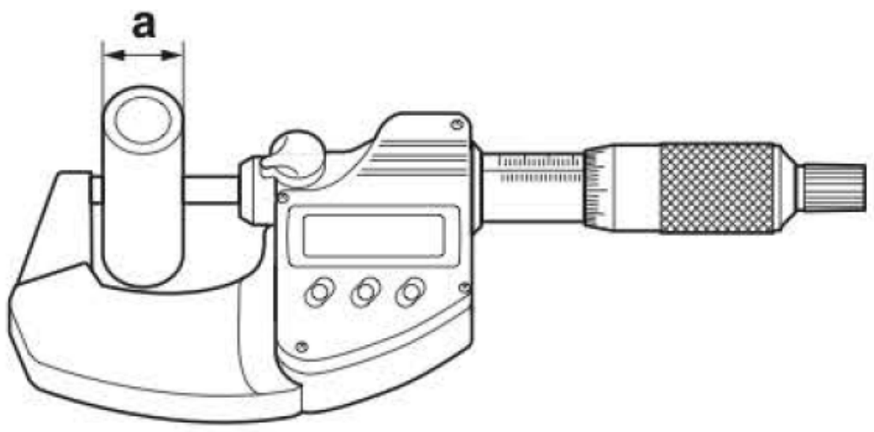
When measuring the piston pin boss inside diameter, do not measure it at the ring groove "b" or oil groove "c".

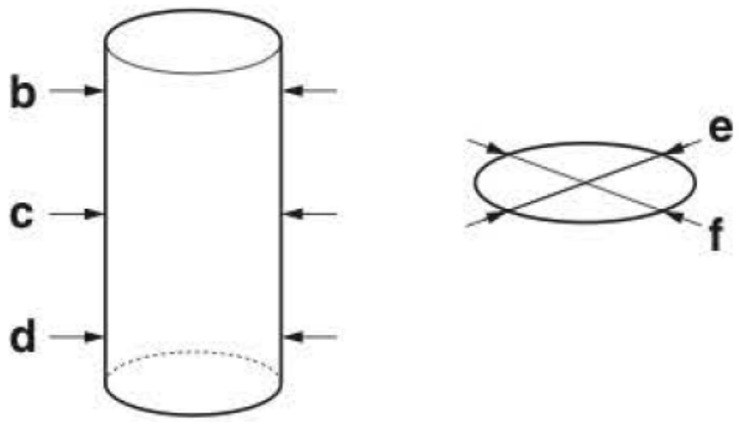


Pin boss inside diameter
18.004-18.010 mm (0.7202-0.7096 in)
Limit
18.035 mm (0.7214 in)

Checking the piston pin diameter

1. Measure the piston pin outside diameter "a" at measuring points "b", "c", and "d", and in directions "e" and "f". Replace if out of specification.





Pin outside diameter
17.997- 18.000 mm (0.7091-0.7087 in)
Limit
17.981 mm (0.7079 in)

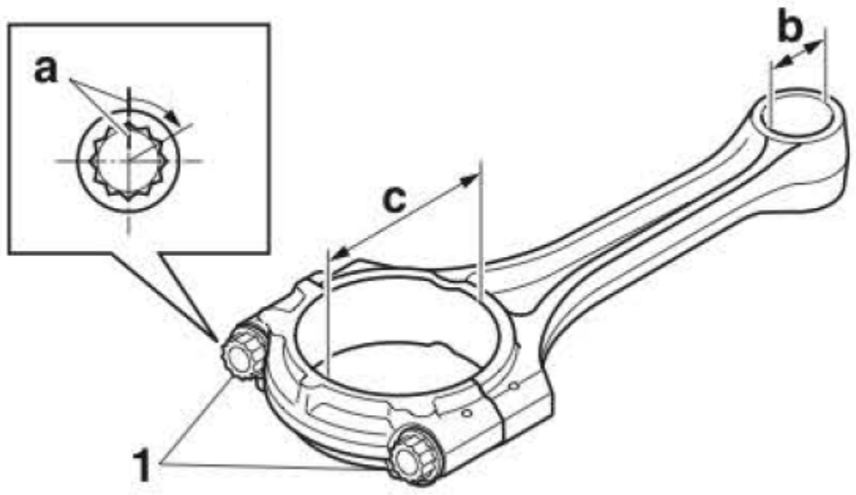
Checking the connecting rod small end inside diameter and big end inside diameter

1. Tighten the connecting rod bolts "1" to the specified torques in 2 stages.

TIP:

- When checking the big end inside diameter, reuse the removed connecting rod bolts.
- In the second tightening stage for the connecting rod bolts "1", mark the connecting rod bolts and the connecting rod cap with identification marks "a", and then tighten the bolts 60° from the marks on the connecting rod cap.

2. Measure the connecting rod small end inside diameter "b" and big end inside diameter "c". Replace the connecting rod if above specification.

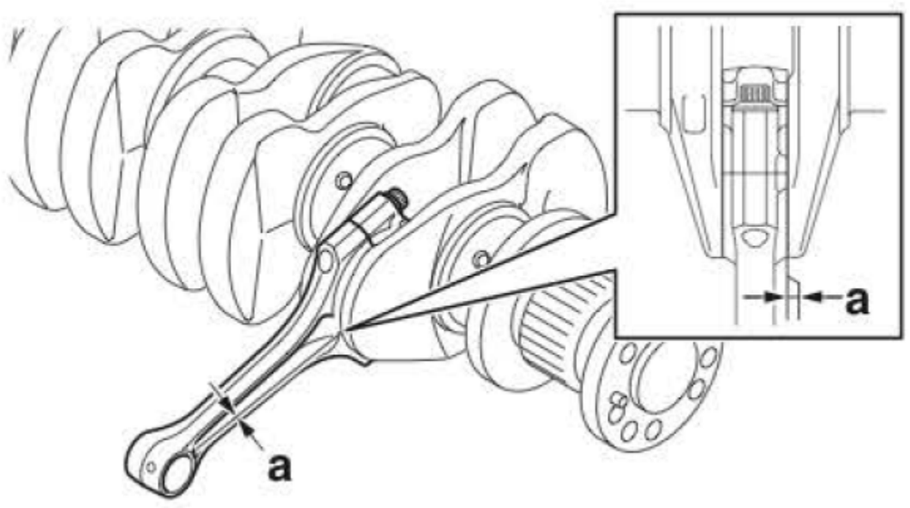


Connecting rod bolt "1"
1st: 13 Nm (1.3 kgf·m, 9.6 ft·lb)
2nd: 48 Nm (4.8 kgf·m, 35.4 ft·lb)

Small end inside diameter
18.005-18.015 mm (0.7089-0.7098in)
Big end inside diameter
50.000-50.024 mm (1.9700–1.9709 in)

Checking the connecting rod big end side clearance

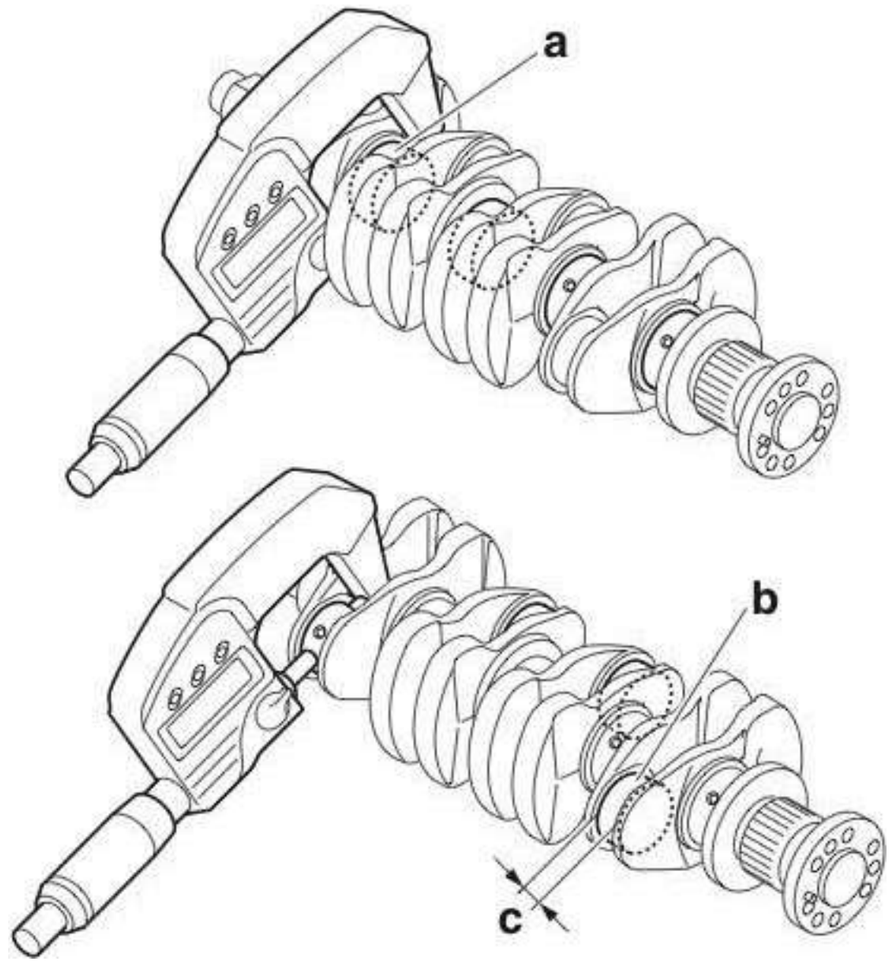
1. Measure the connecting rod big end side clearance "a". Check the crankshaft pin width if above specification. See "Checking the crankshaft" (7-90).



Big end side clearance
0.150-0.300 mm (0.0059-0.0118 in)
Limit
0.35 mm (0.0138 in)

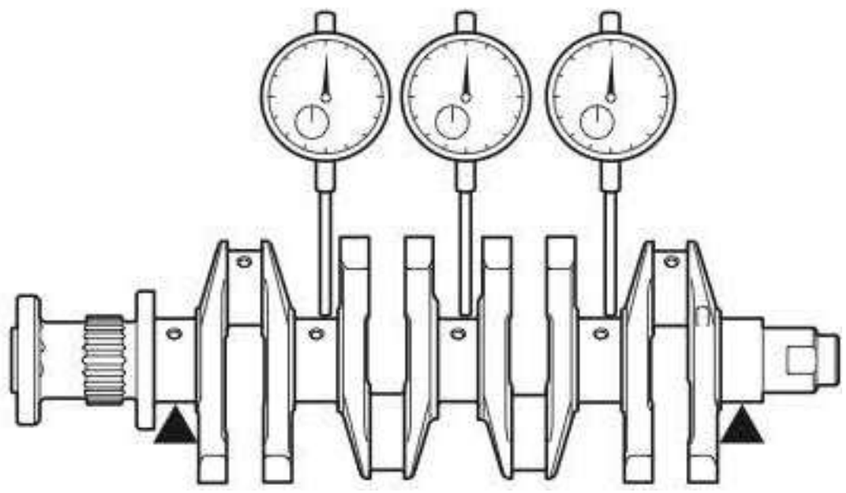
Checking the crankshaft

1. Measure the crankshaft journal diameters "a", crankshaft pin diameters "b", and crankshaft pin widths "c". Replace the crankshaft if below specification.



Journal diameter
51.982–52.000 mm (2.0481-2.0488 in)
Crankshaft pin diameter
46.984-47.000 mm (1.8512-1.8518 in)
Crankshaft pin width
21.00-21.10 mm (0.8268–0.8307 in)

2. Measure the crankshaft runout. Replace if above specification.



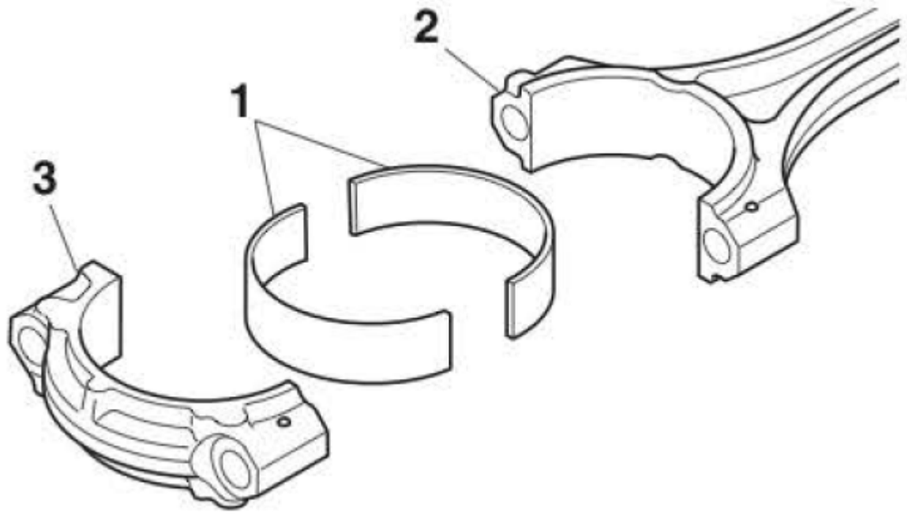
Crankshaft
Runout
0.05 mm (0.0020 in)
Limit
0.04 mm (0.0016 in)

Checking the big end oil clearance

1. Clean the crankshaft pin bearings, connecting rod, connecting rod cap, and crankshaft.

2. Install the crankshaft pin bearings "1" into the connecting rod "2" and connecting rod cap "3".

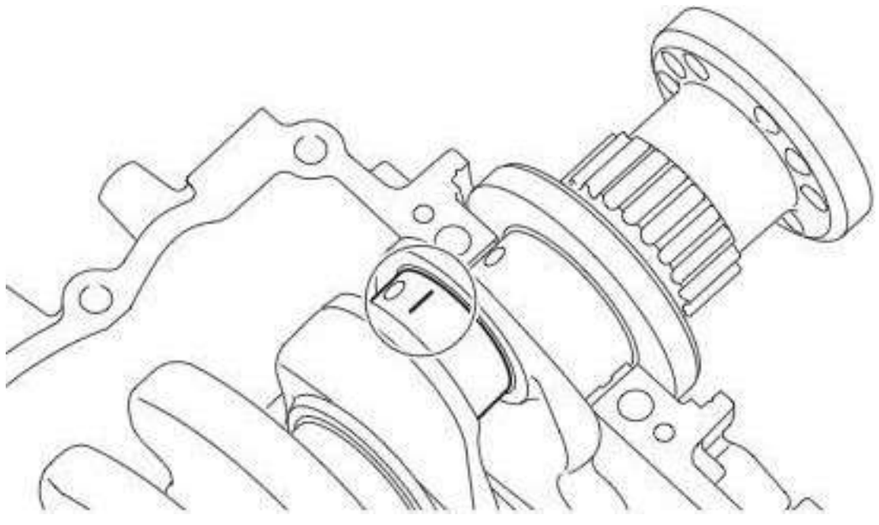
TIP:
Install the crankshaft pin bearings in their original positions.



3. Place a piece of Plastigauge (PG-1) on the crankshaft pin, parallel to the crankshaft.

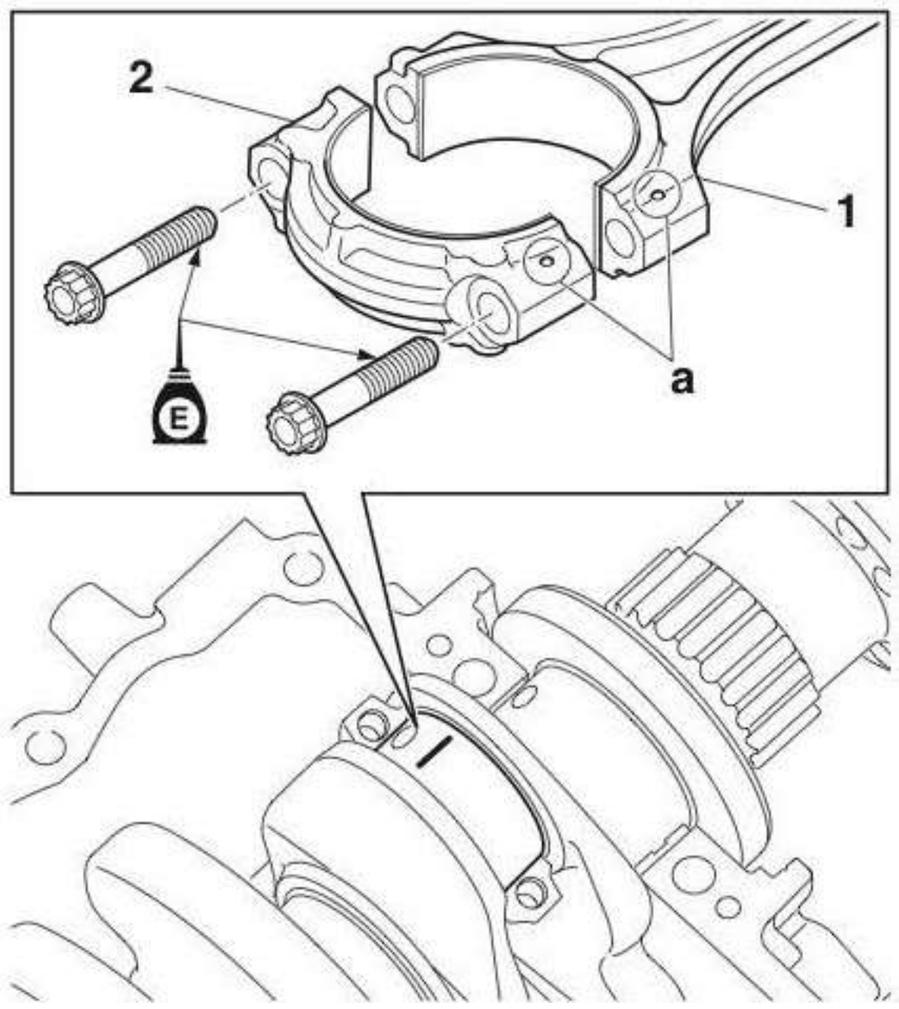
NOTICE

Do not place the Plastigauge (PG-1) over the oil hole in the crankshaft pin of the crankshaft.



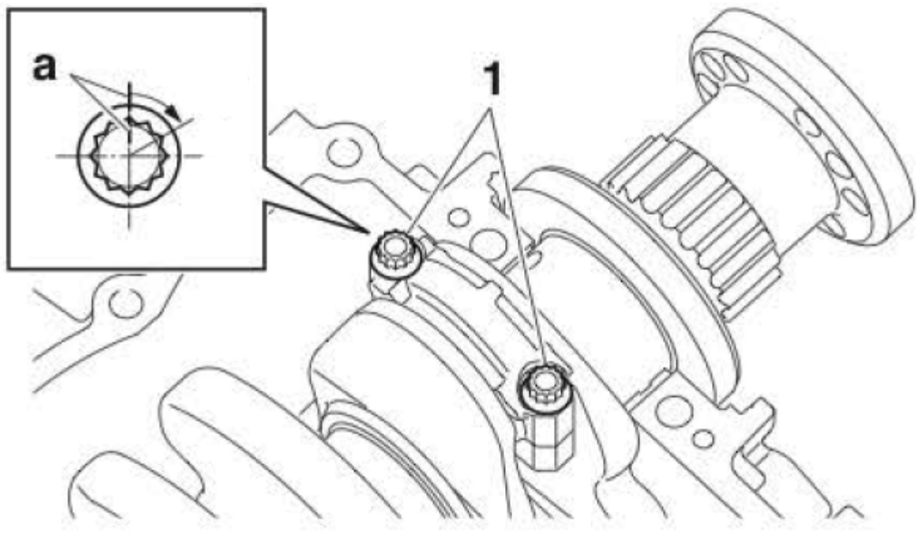
4. Install the connecting rod "1" and connecting rod cap "2" onto the crankshaft pin.

TIP:
- When checking the oil clearance, reuse the removed connecting rod bolts.
- Make sure that the protrusions "a" on the connecting rod "1" and connecting rod cap "2" face toward the flywheel magneto end of the crankshaft.
- Do not turn the connecting rod until the big end oil clearance measurement has been completed.



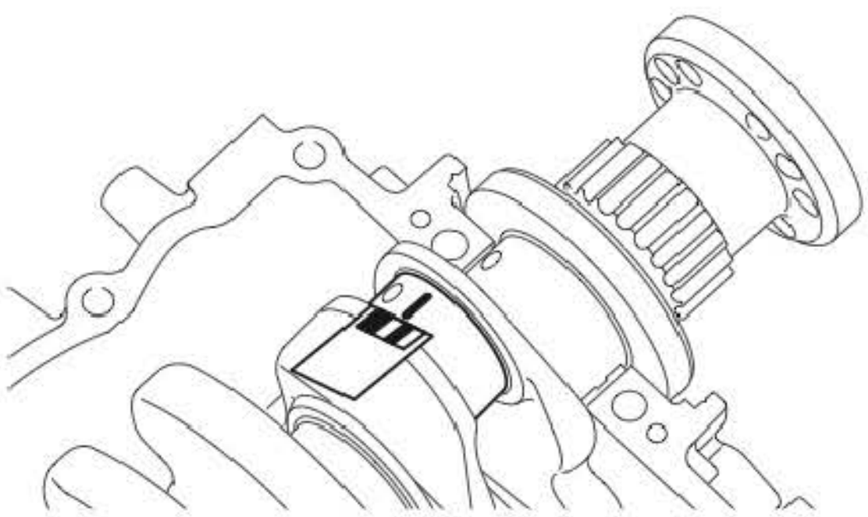
5. Tighten the connecting rod bolts "1" to the specified torques in 2 stages.

TIP:
In the second tightening stage for the connecting rod bolts "1", mark the connecting rod bolts and the connecting rod cap with identification marks "a", and then tighten the bolts 60° from the marks on the connecting rod cap.



Connecting rod bolt "1"
1st: 13 Nm (1.3 kgf·m, 9.6 ft·lb)
2nd: 48 Nm (4.8 kgf·m, 35.4 ft·lb)

6. Remove the connecting rod cap, and then measure the width of the compressed Plastigauge (PG-1) on the crankshaft pin. Check the journal diameter if above specification. See "Checking the crankshaft" (7-90).

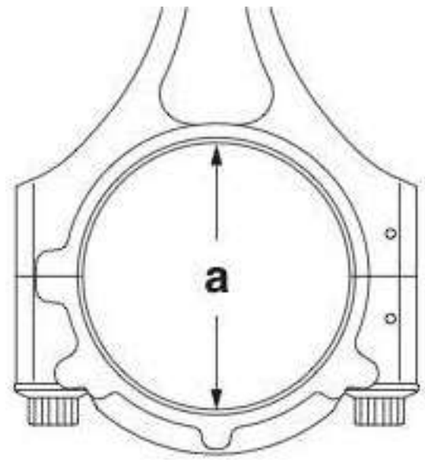


Big end oil clearance
0.016–0.040 mm (0.0006-0.0016 in)
Limit
0.070 mm (0.0028 in)

Selecting the crankshaft pin bearing

When replacing the crankshaft pin bearing, select the bearing as follows:

1. Measure the big end inside diameter "a".

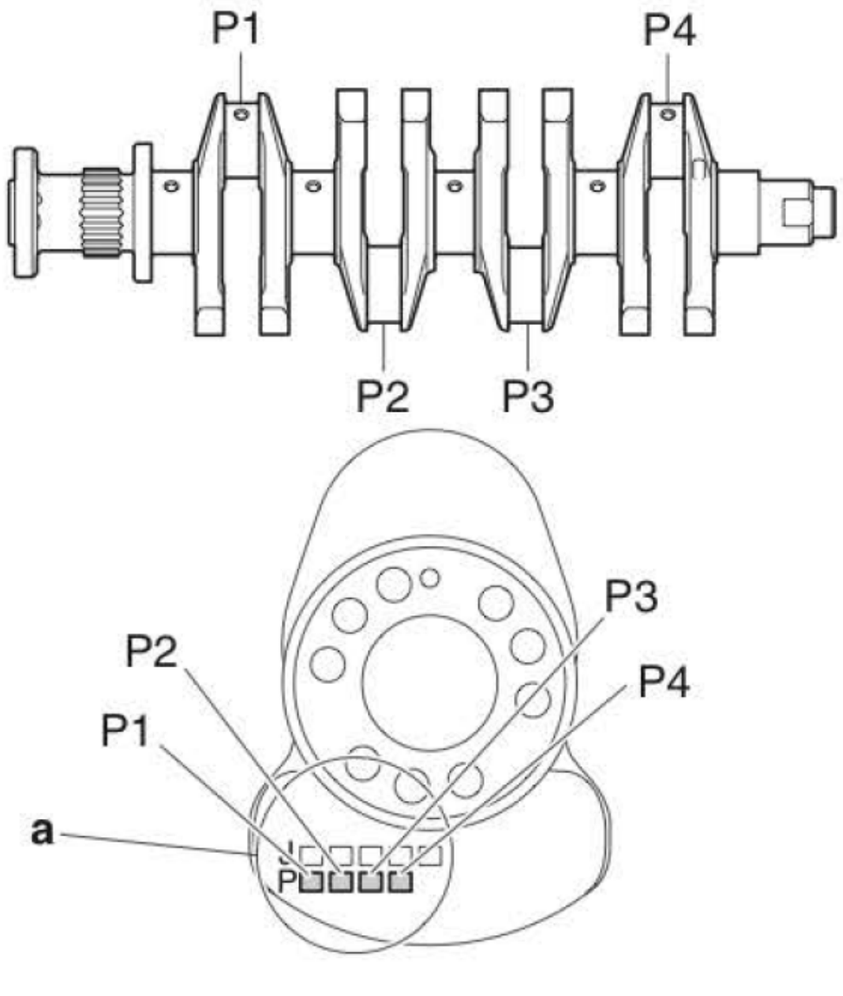


Big end inside diameter
50.000-50.024 mm (1.9700–1.9709 in)

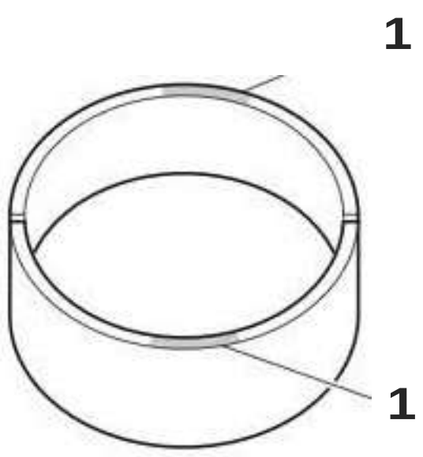
Example:

Connecting rod big end inside diameter "a"	Number in table
50.042 mm	42

2. Check the crankshaft pin mark "a" on the crankshaft.



3. Select the suitable colors "1" for the crankshaft pin bearing from the "Crankshaft pin bearing selection table" (7-94).



Crankshaft pin bearing selection table

Crankshaft pin bearing selection table							
Connecting rod hole(50-50.024)	group number	1		2		3	
	upper limit(≤)	50.008		50.016		50.024	
	lower limit(>)	50		50.008		50.016	
Crankshaft pin（46.984-47)	group number	1	2	1	2	1	2
	upper limit(≤)	47	46.992	47	46.992	47	46.992
	lower limit(>)	46.992	46.984	46.992	46.984	46.992	46.984
Connecting rod bearing	group number	green2	pink3	pink3	red4	red4	yellow5
	upper limit(≤)	1.492	1.496	1.496	1.5	1.5	1.504
	lower limit(>)	1.488	1.492	1.492	1.496	1.496	1.5
clearance	upper limit	0.04	0.04	0.04	0.04	0.04	0.04
	lower limit	0.016	0.016	0.016	0.016	0.016	0.016
oil clearance：0.016-0.04							

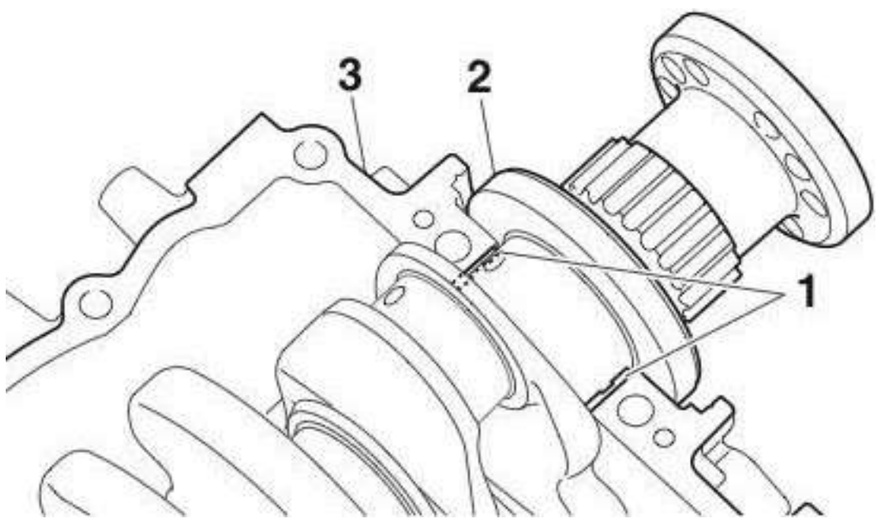
Checking the journal oil clearance

1. Clean the crankshaft journal bearings, crankshaft journals, and bearing portions of the crankcase and cylinder block.

2. Place the cylinder block with the crankcase mating surface facing down.

3. Install the crankshaft journal bearings "1" and crankshaft "2" into the cylinder block "3".

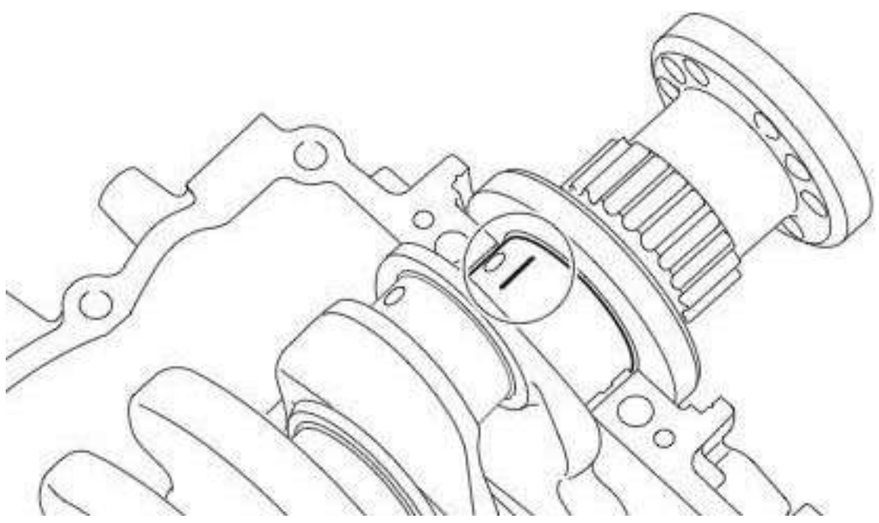
TIP:
Install the crankshaft journal bearings "1" in their original positions.



4. Place a piece of Plastigauge (PG-1) on each crankshaft journal, parallel to the crankshaft.

NOTICE

Do not place the Plastigauge (PG-1) over the oil hole in each crankshaft journal.



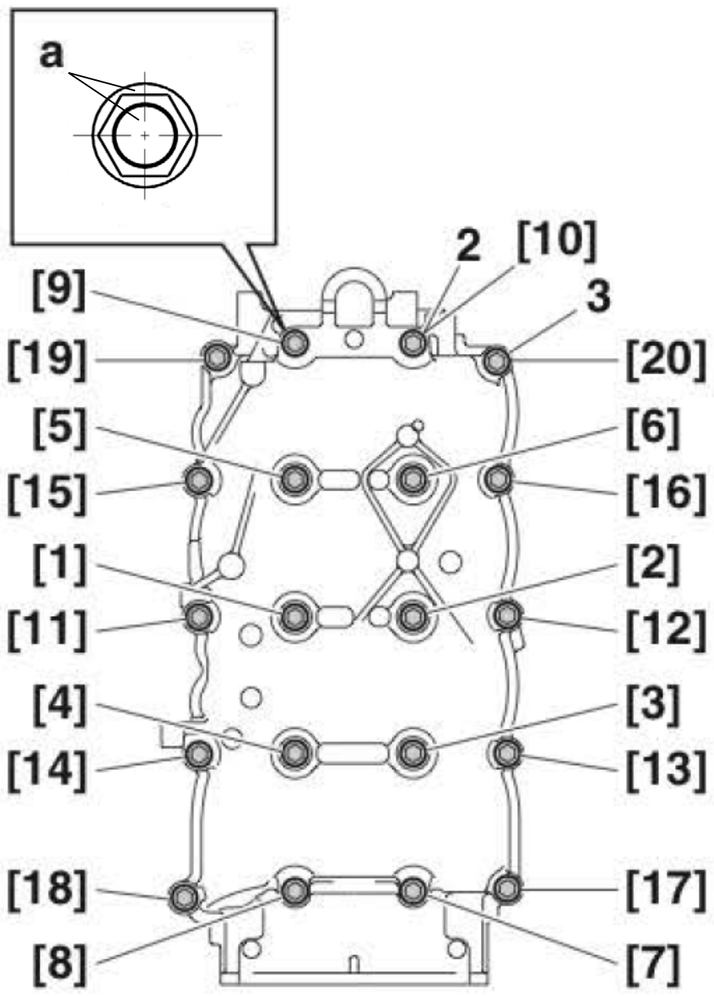
5. Install the crankshaft journal bearings into the crankcase.

TIP:
Install the crankshaft journal bearings in their original positions.

6. Install the crankcase "1", and then tighten the crankcase bolts (M10) "2" to the specified torques in 2 stages and in the order [1], [2], and so on.

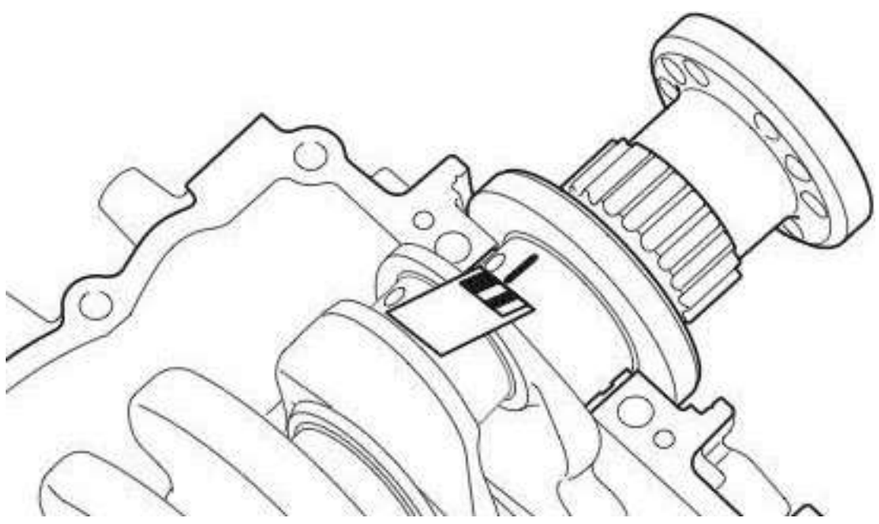
7. Tighten the crankcase bolts (M8) "3" to the specified torques in 2 stages and in the order [11], [12], and so on.

TIP:
- Do not turn the crankshaft until the journal oil clearance measurement has been completed.
- In the second tightening stage for the crankcase bolts (M10) "2", mark the crankcase bolts (M10) and the crankcase with identification marks "a", and then tighten the bolts 60° from the marks on the crankcase.



Crankcase bolt "2" [1]-[10] (M10) 1st: 16 Nm (1.6 kgf·m, 11.8 ft·lb) 2nd: 79 Nm (7.9 kgf·m, 58.2 ft·lb) 3rd: 60° Crankcase bolt "3" [11]-[20] (M8) 1st: 14 Nm (1.4 kgf·m, 10.3 ft·lb) 2nd: 28 Nm (2.8 kgf·m, 20.7 ft·lb)

8. Remove the crankcase, and then measure the width of the compressed Plastigauge (PG-1) on each crankshaft journal.



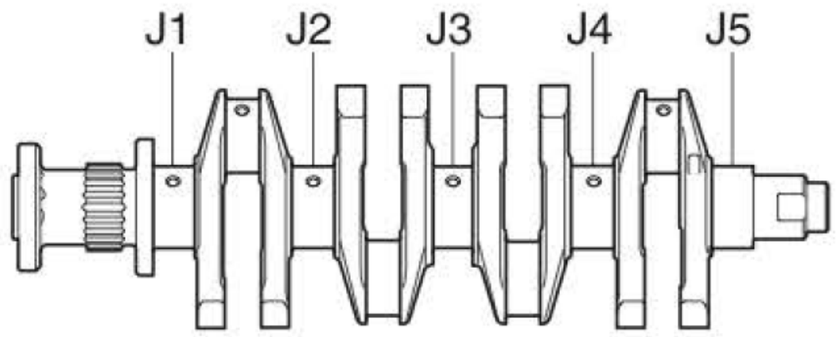
Journal oil clearance 0.032-0.050 mm (0.0013-0.0020 in) Limit 0.070 mm (0.0028 in)

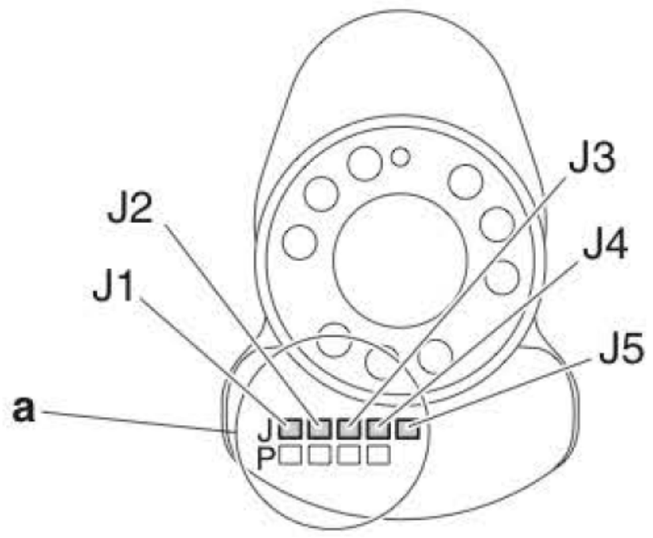
Selecting the crankshaft journal bearing

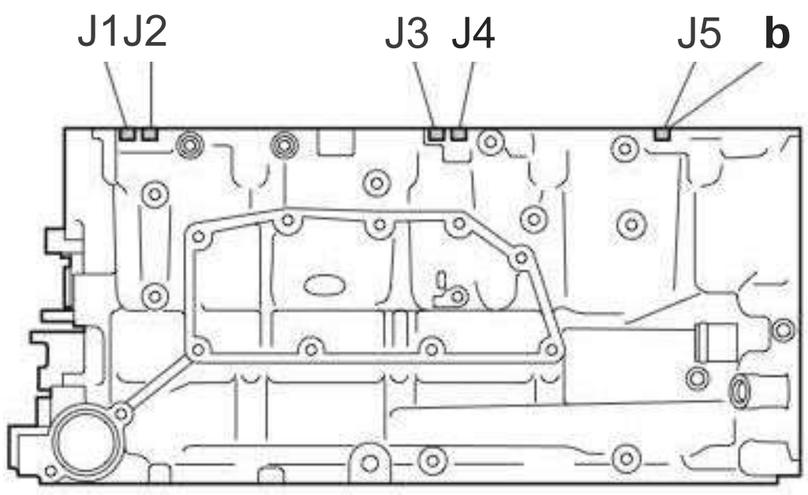
When replacing the crankshaft journal bearing, select the bearing as follows:

1. Remove the crankshaft journal bearings.

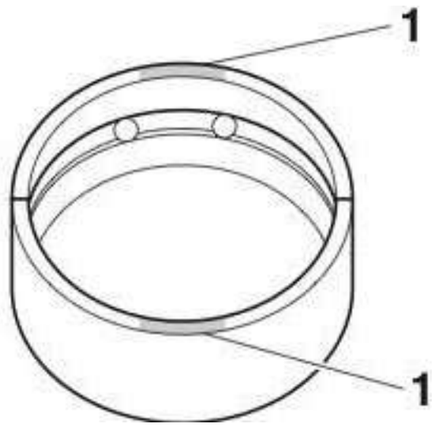
2. Check the mark "a" on the crank web and the mark "b" on the cylinder block.







3. Select the suitable colors "1" for the crankshaft journal bearing from the "Crankshaft journal bearing selection table" (7-98).

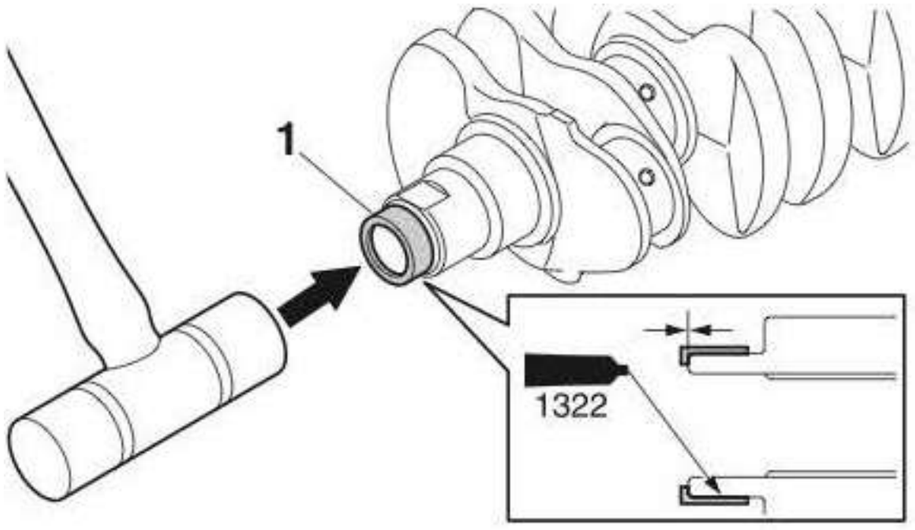


Crankshaft journal bearing selection table

Crankshaft journal bearing selection table							
Crankshaft hole（57-57.024)	group number	1		2		3	
	upper limit(≤)	57.008		57.016		57.024	
	lower limit(>)	57		57.008		57.016	
Crankshaft journal(51.984-52)	group number	1	2	1	2	1	2
	upper limit(≤)	52	51.992	52	51.992	52	51.992
	lower limit(>)	51.992	51.984	51.992	51.984	51.992	51.984
Crankshaft journal bearing	group number	green2	pink3		red4		yellow5
	upper limit(≤)	2.487	2.491	2.491	2.495	2.495	2.499
	lower limit(>)	2.483	2.487	2.487	2.491	2.491	2.495
clearance	upper limit	0.05	0.05	0.05	0.05	0.05	0.05
	lower limit	0.026	0.026	0.026	0.026	0.026	0.026
oil clearance：0.026-0.050							

Assembling the cylinder block

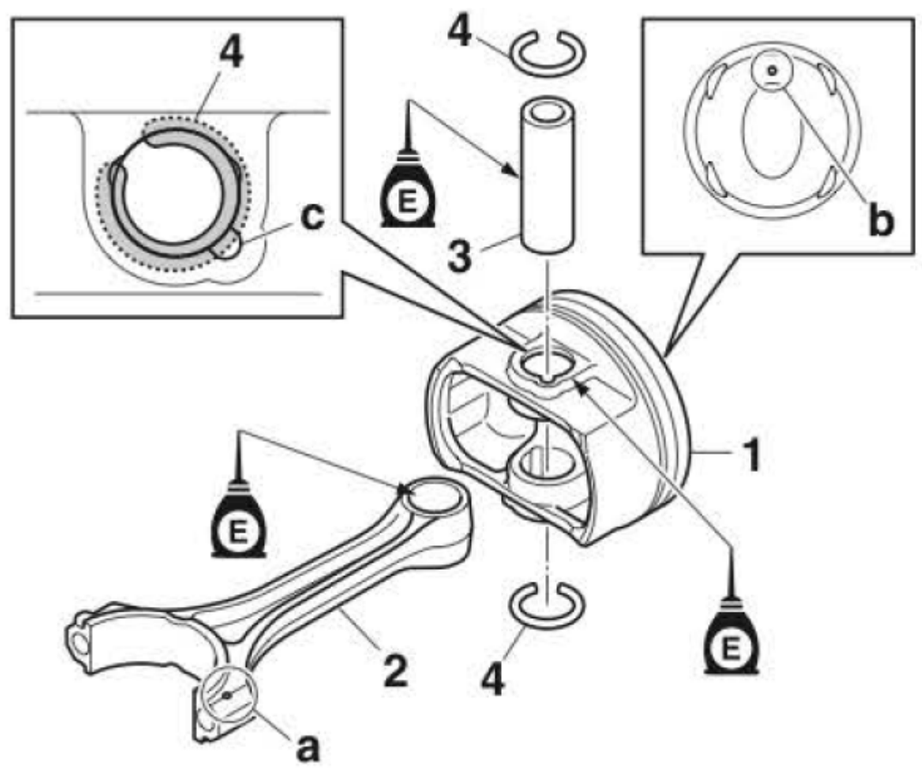
1. Install a new collar "1" by striking it using a plastic hammer.



2. Assemble the piston "1", the connecting rod "2", the piston pin "3", and new clips "4".

TIP:

- Face the protrusions "a" on the connecting rod "2" in the same direction as the mark "b" on the piston crown.
- Make sure that the clip "4" end is not aligned with the groove "c" in the piston pin boss.



3. Install the oil rings "1", 2nd ring "2", and top ring "3".

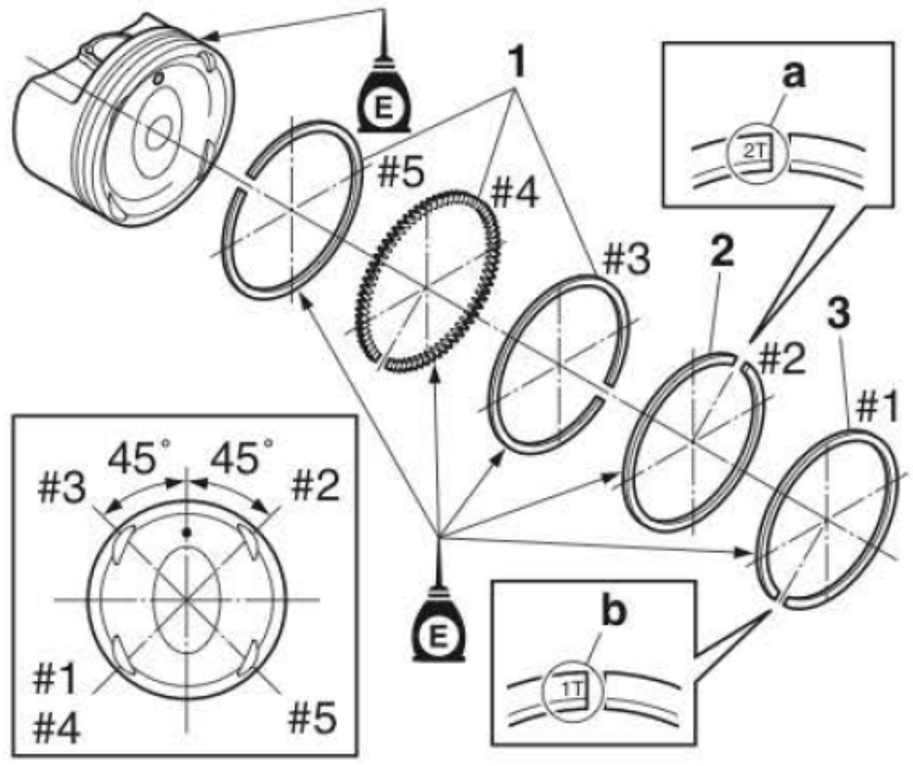
NOTICE

Do not scratch the pistons or break the piston rings.

TIP:

- Make sure that the "2T" mark "a" on the 2nd ring "2" and "1T" mark "b" on the top ring "3" are facing up.
- Make sure that the piston rings move smoothly.

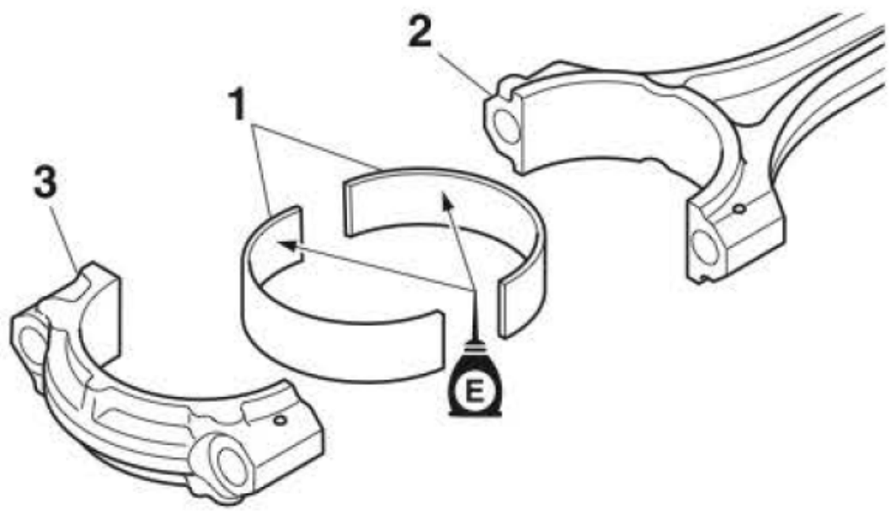
4. Offset the piston ring end gaps.



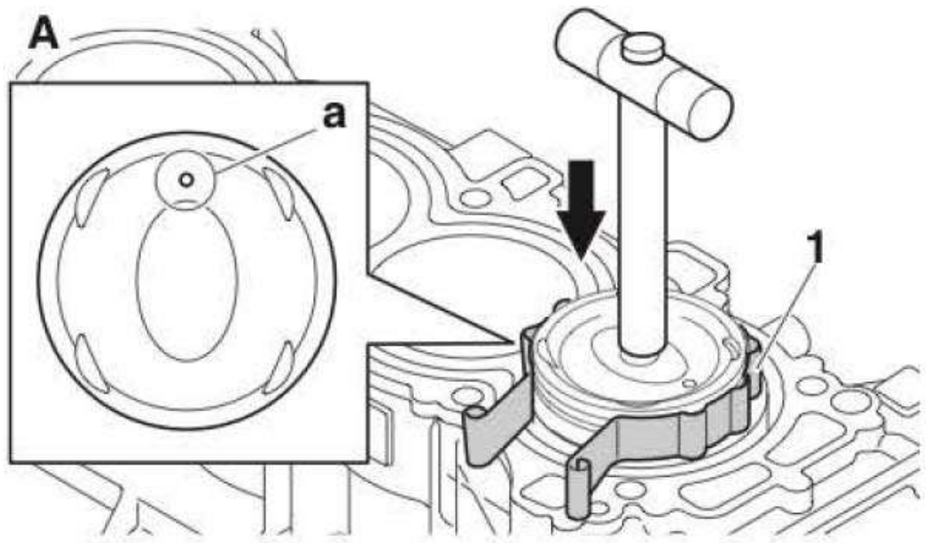
5. Install the crankshaft pin bearings "1" into the connecting rod "2" and connecting rod cap "3".

TIP:

Install the crankshaft pin bearings in the original positions.



6. Apply engine oil to the side of the piston, piston rings, and cylinder wall, and then install the piston so that the mark "a" on the piston crown is facing toward the flywheel magneto end of the crankshaft.



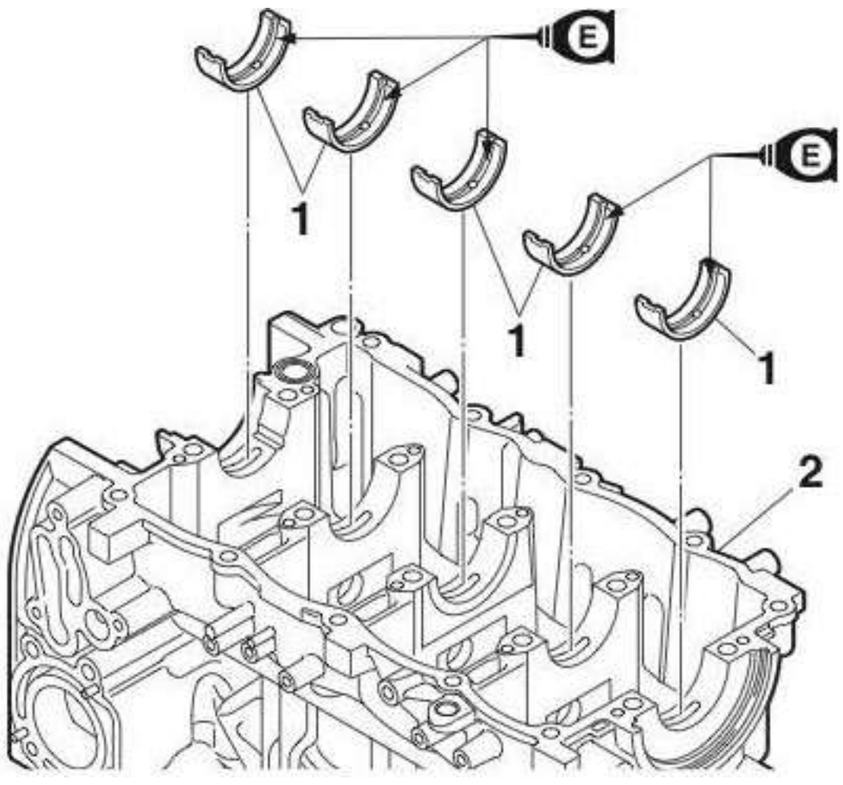
A. Worldwide
B. USA and Canada

Piston slider 85 "1"
Piston ring compressor "2"

7. Install the crankshaft journal bearings "1" into the cylinder block "2".

TIP:

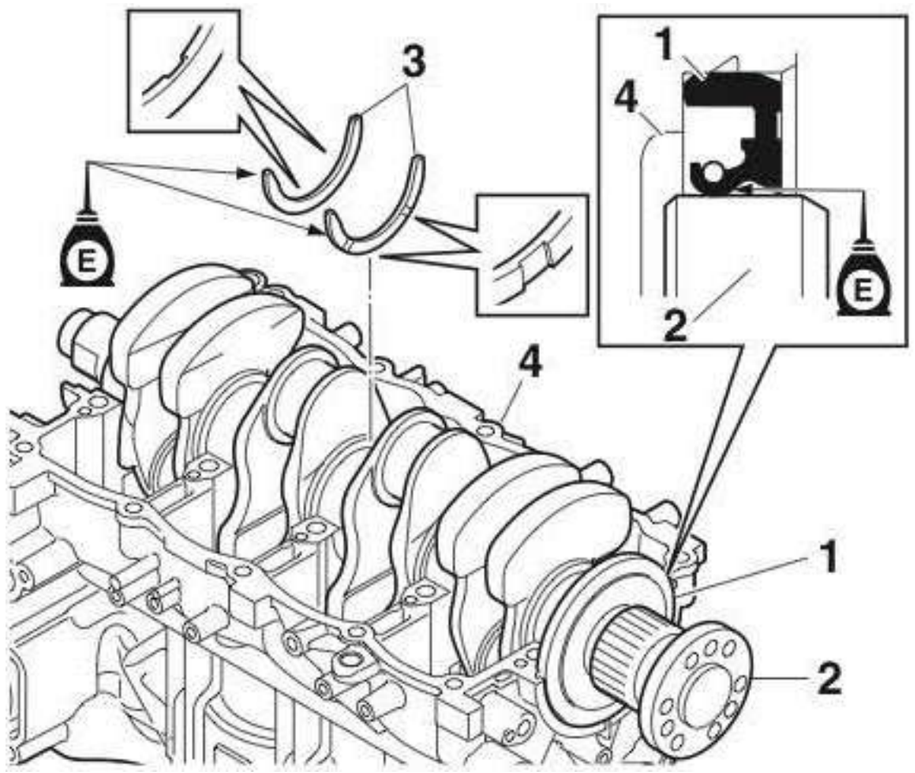
Install the crankshaft journal bearings "1" in their original positions.



8. Install a new oil seal "1" into the crankshaft "2", and then install the crankshaft and thrust bearings "3" into the cylinder block "4".

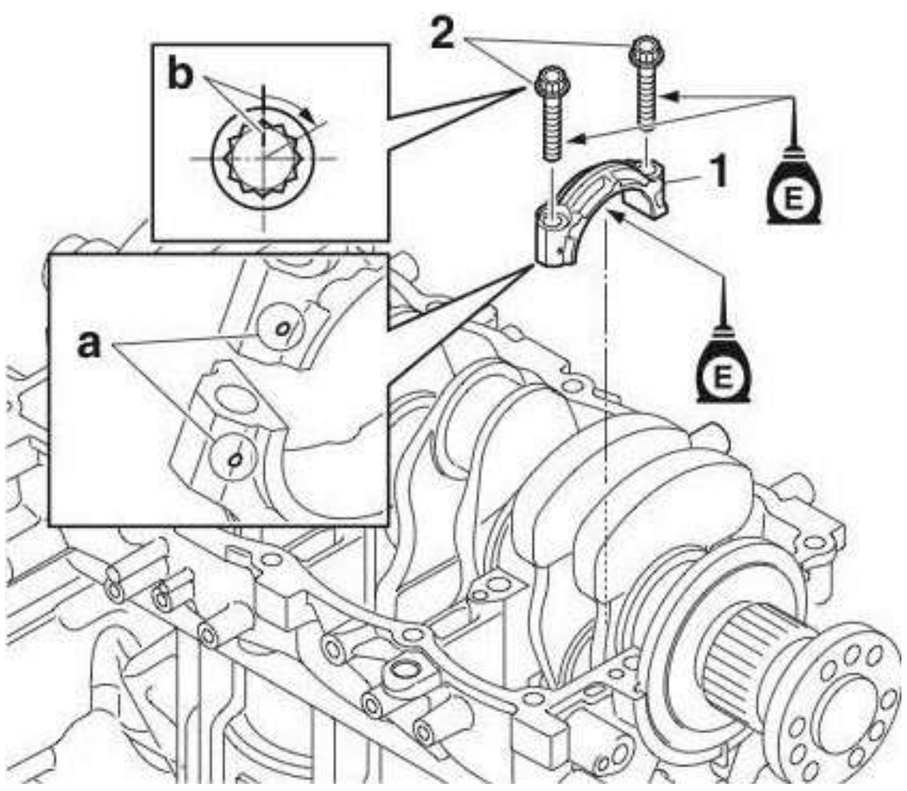
TIP:

- Make sure that each thrust bearing is installed with its notches facing outward.
- Slide the thrust bearing between the crankshaft and the cylinder block.



9. Install the connecting rod caps "1" to the piston and connecting rod assemblies, and then tighten new connecting rod bolts "2" to the specified torques in 2 stages.

TIP:
- Make sure that the protrusions "a" on the connecting rod and connecting rod caps "1" are facing toward the flywheel magneto end of the crankshaft.
- In the second tightening stage for the connecting rod bolts "2", mark the connecting rod bolts and connecting rod cap with paint marks "b", and then tighten the connecting rod bolts 60° from the marks on the connecting rod cap.
- After tightening the connecting rod bolts "2", make sure that the crankshaft turns smoothly.

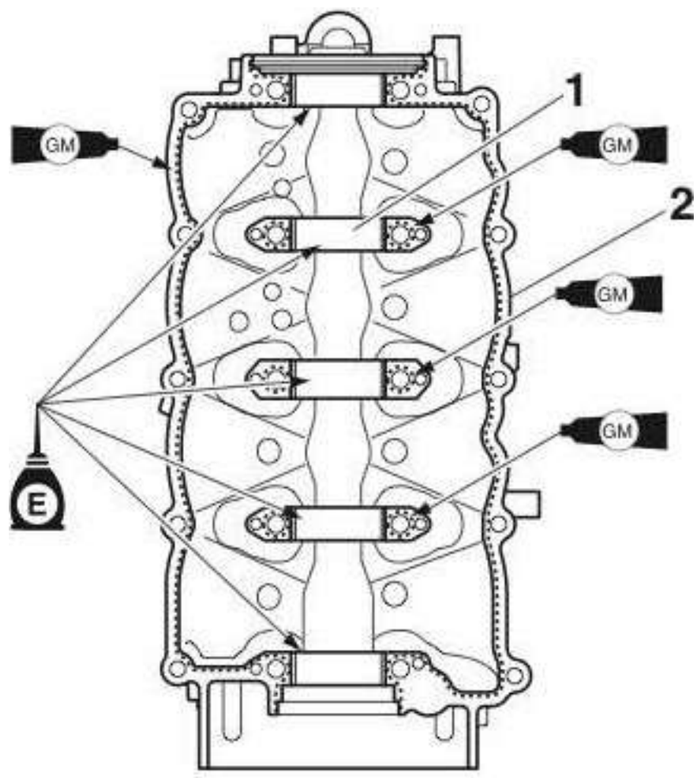


Connecting rod bolt "2"
1st: 13 Nm (1.3 kgf·m, 9.6 ft·lb)
2nd: 48 Nm (4.8 kgf·m, 35.4 ft·lb)

10. Install the crankshaft journal bearings "1" onto the crankcase "2".

11. Apply a thin, even layer of sealant onto the mating surface of the crankcase.

TIP:
- Install the crankshaft journal bearings "1" in their original positions.
- Do not apply any sealant to the crankshaft journal bearings "1".

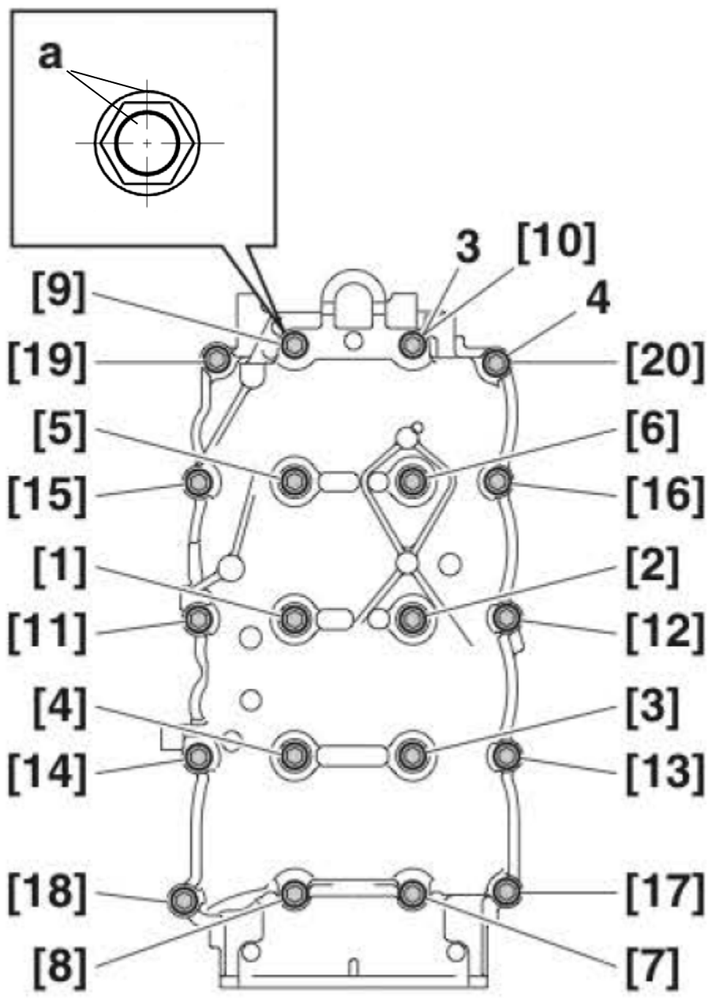


12. Install a new 0-ring "1" and the crankcase "2", and then tighten the crankcase bolts (M10) "3" to the specified torques in 2 stages and in the order [1], [2], and so on.

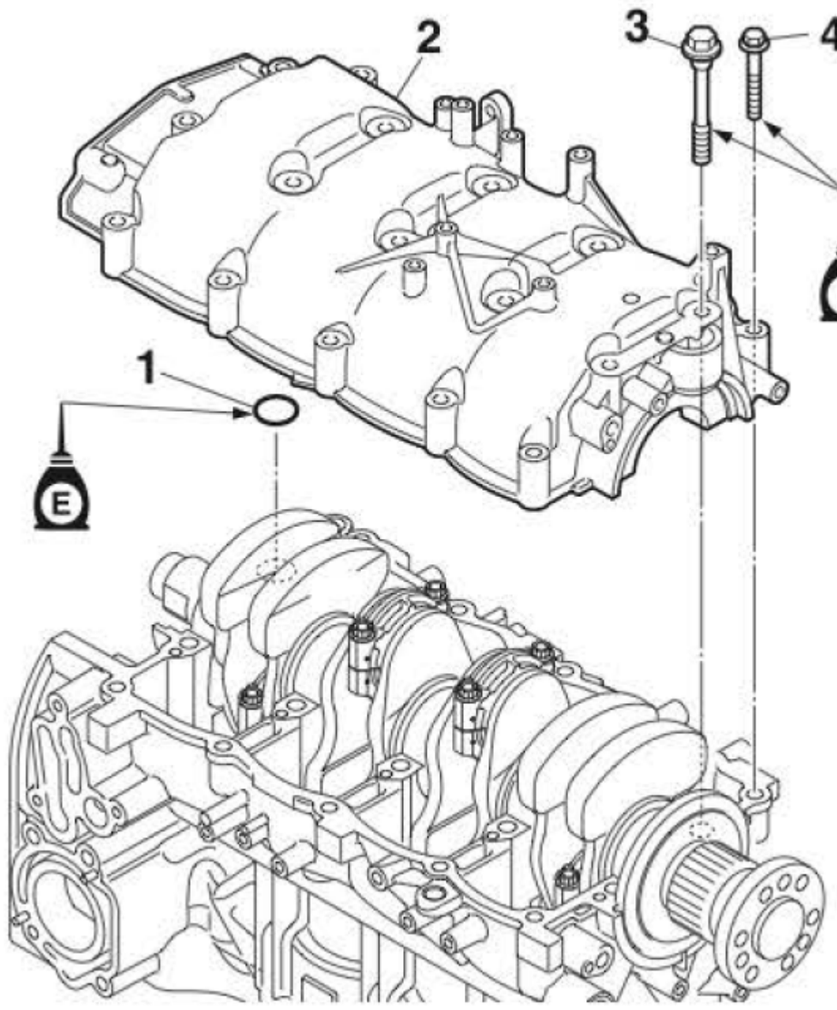
TIP:
In the second tightening stage for the crankcase bolts (M10) "3", mark the crankcase bolts (M10) and the crankcase "2" with identification marks "a", and then tighten the bolts 60° from the marks on the crankcase.

13. Tighten the crankcase bolts (M8) "4" to the specified torques in 2 stages and in the order [11], [12], and so on.

TIP:
After tightening the crankcase bolts "3" and "4", make sure that the crankshaft turns smoothly.



Crankcase bolt "3" [1]-[10] (M10)
1st: 16 Nm (1.6 kgf·m, 11.8 ft·lb)
2nd: 79 Nm (7.9 kgf·m, 58.2 ft·lb)
3rd: 60°
Crankcase bolt "4" [11]-[20] (M8)
1st: 14 Nm (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 Nm (2.8 kgf- m, 20.7 ft·lb)



— MEMO-

Lower unit

Lower unit (regular rotation model) 8-1

Removing the lower unit 8-3
Disassembling the propeller (Shift Dampener System [SDS] propeller)..... 8-3
Checking the propeller..... 8-4
Checking the lower unit anode 8-4
Assembling the propeller (Shift Dampener System [SDS] propeller)..... 8-4

Water pump and shift rod (regular rotation model) 8-5

Removing the water pump and shift rod..... 8-7
Disassembling the water pump housing..... 8-7
Checking the water pump and shift rod..... 8-8
Assembling the water pump housing..... 8-8

Propeller shaft housing (regular rotation model) 8-9

Removing the propeller shaft housing assembly..... 8-11
Disassembling the propeller shaft assembly 8-12
Disassembling the propeller shaft housing assembly..... 8-12
Checking the propeller shaft..... 8-14
Checking the dog clutch 8-14
Checking the propeller shaft housing 8-14
Checking the reverse gear..... 8-14
Assembling the propeller shaft assembly 8-14
Assembling the propeller shaft housing assembly 8-15

Drive shaft and lower case (regular rotation model) ...8-17

Removing the drive shaft..... 8-19
Disassembling the drive shaft housing 8-20
Disassembling the forward gear 8-20
Disassembling the lower case 8-21
Checking the pinion 8-21
Checking the forward gear 8-21
Checking the drive shaft 8-22
Checking the lower case 8-22
Assembling the forward gear 8-22
Assembling the drive shaft housing..... 8-23
Assembling the lower case..... 8-24
Installing the drive shaft..... 8-25
Installing the propeller shaft housing assembly..... 8-26
Installing the shift rod 8-27
Installing the water pump 8-28
Checking the lower unit for air leakage..... 8-29
Installing the lower unit 8-30

Shimming (regular rotation model) 8-32

Shimming workflow **8-32**
Shimming check sheet 8-33
Measuring the forward gear backlash and reverse gear backlash before disassembly 8-35
Shimming procedure **8-39**
Shim location **8-39**
Selecting the pinion shim (T3) 8-40
Measuring the forward gear backlash 8-43
Adjusting the forward gear shim thickness (T1) 8-43
Measuring the reverse gear backlash 8-44
Adjusting the reverse gear shim thickness (T2) 8-45

Lower unit (counter rotation model) 8-47

Removing the lower unit 8-49
Checking the propeller 8-49
Checking the lower unit anode 8-49

Water pump and shift rod (counter rotation model) 8-50

Removing the water pump and shift rod 8-52
Disassembling the water pump housing 8-52
Checking the water pump and shift rod 8-52
Assembling the water pump housing 8-52

Propeller shaft housing (counter rotation model) 8-53

Removing the propeller shaft housing assembly 8-55
Disassembling the propeller shaft housing assembly 8-55
Disassembling the forward gear 8-56
Checking the propeller shaft 8-57
Checking the dog clutch 8-57
Checking the propeller shaft housing 8-57
Checking the forward gear 8-57
Assembling the propeller shaft housing assembly and **forward gear** **8-57**

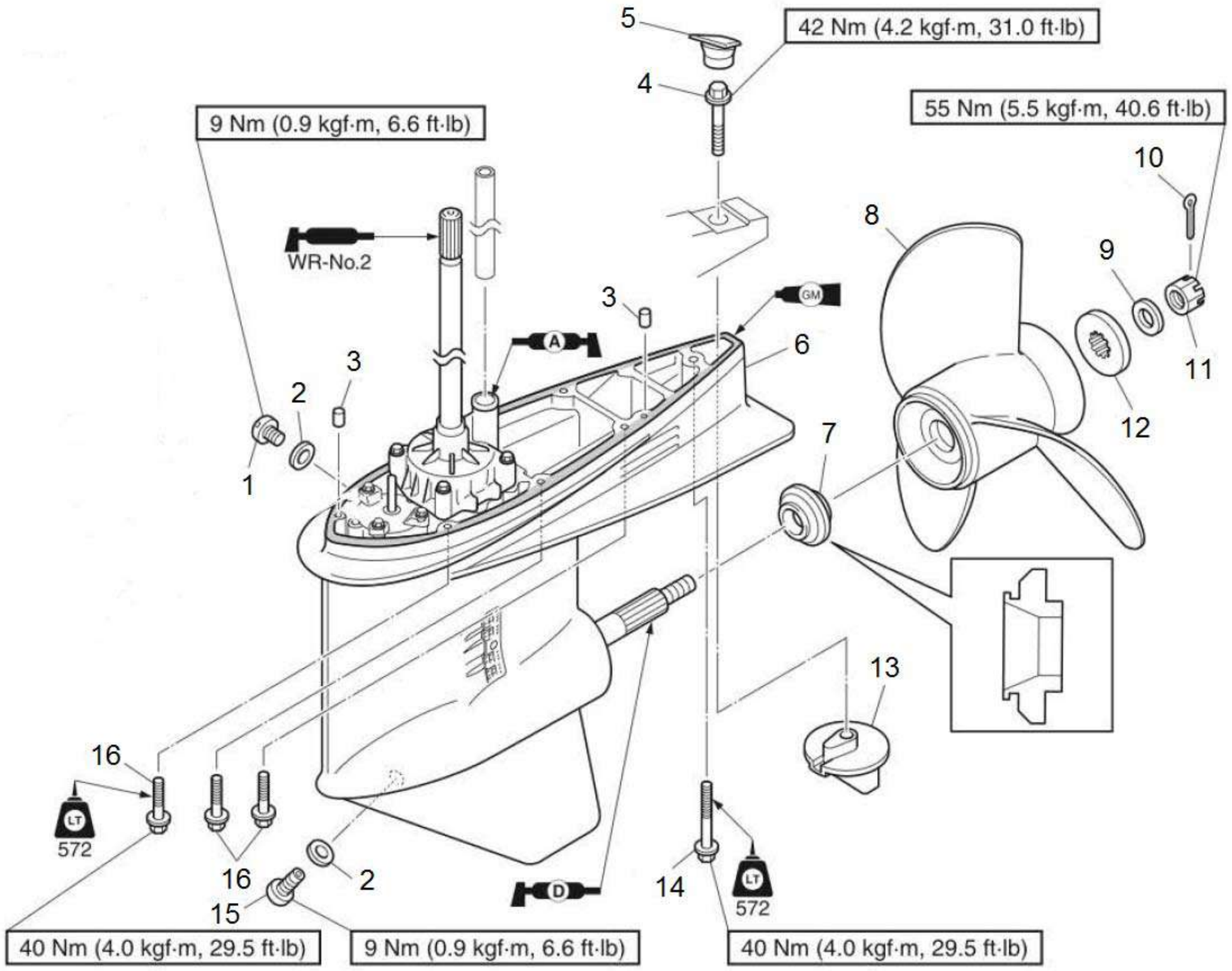
Drive shaft and lower case (counter rotation model) 8-60

Removing the drive shaft..... 8-62
Removing the reverse gear 8-62
Disassembling the drive shaft housing 8-62
Disassembling the reverse gear 8-62
Disassembling the lower case 8-62
Disassembling the retainer 8-63
Checking the pinion 8-63
Checking the reverse gear..... 8-63
Checking the drive shaft 8-63
Checking the lower case 8-63
Assembling the reverse gear 8-63
Assembling the retainer..... 8-64
Assembling the lower case..... 8-64
Assembling the drive shaft housing..... 8-65
Installing the reverse gear 8-65
Installing the drive shaft..... 8-65
Installing the propeller shaft housing assembly..... 8-66
Installing the shift rod 8-66
Installing the water pump 8-66
Checking the lower unit for air leakage..... 8-66
Installing the lower unit..... 8-66

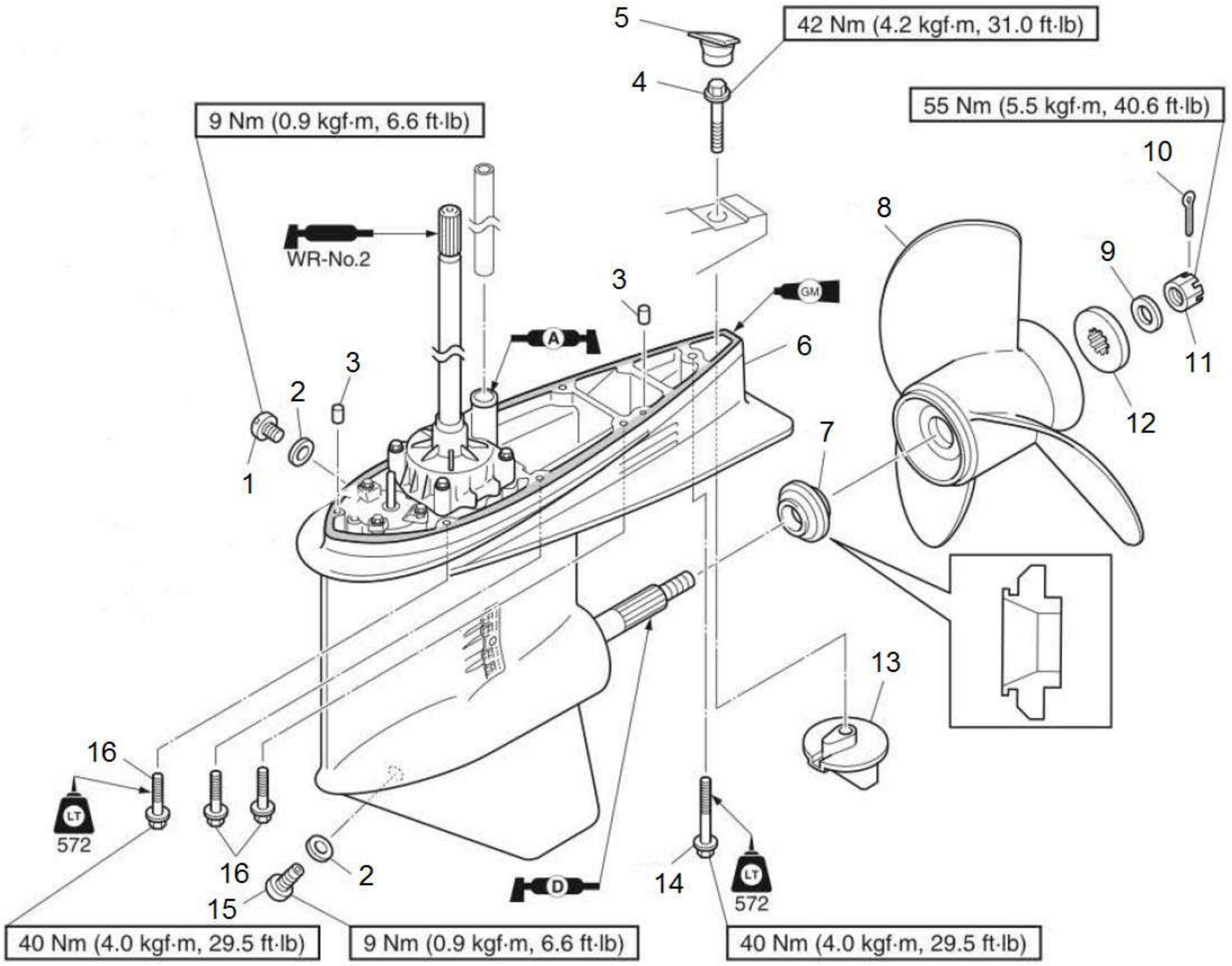
Shimming (counter rotation model) 8-67

Shimming workflow 8-67
Shimming check sheet 8-68
Measuring the forward gear backlash and reverse gear backlash before disassembly 8-70
Shimming procedure 8-74
Shim location..... 8-74
Selecting the pinion shim (T3) 8-75
Selecting the propeller shaft shim (T4)..... 8-75
Measuring the reverse gear backlash 8-76
Adjusting the reverse gear shim thickness (T1)..... 8-76
Measuring the forward gear backlash 8-78
Adjusting the forward gear shim thickness (T2) 8-78

Lower unit (regular rotation model)



No.	Part	Q'ty	Remark
1	Oil level plug	1	
2	Gasket	2	Not reusable
3	Dowel pin	2	
4	Bolt	1	M10 × 45 mm
5	Grommet	1	
6	Lower unit	1	
7	Spacer	1	
8	Propeller	1	
9	Washer	1	
10	Cotter pin	1	Not reusable
11	Propeller nut	1	
12	Spacer	1	
13	Trim tab	1	



No.	Part	Q'ty	Remark
14	Bolt	1	M10 × 70 mm
15	Drain screw	1	
16	Bolt	6	M10 × 45 mm

Removing the lower unit

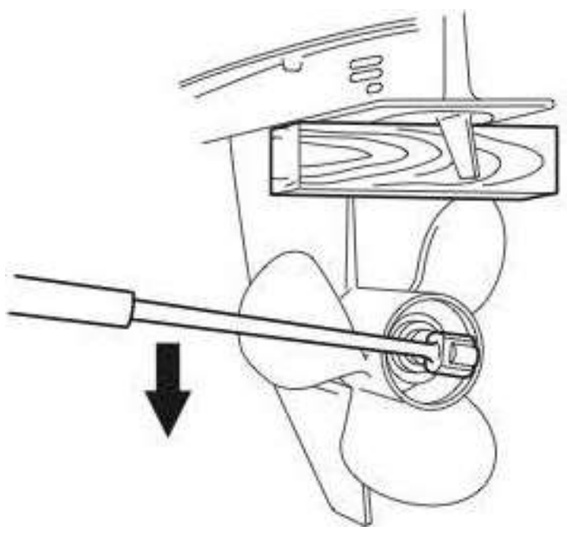
⚠ WARNING

- **Make sure to disconnect the battery cables from the battery, and remove the clip from the engine shut-off switch.**
- **When removing the lower unit with the power unit installed, make sure to suspend the outboard motor. Otherwise, the outboard motor could fall suddenly and result in severe injuries.**
- **When loosening or tightening the propeller nut, do not hold the propeller using your hands.**

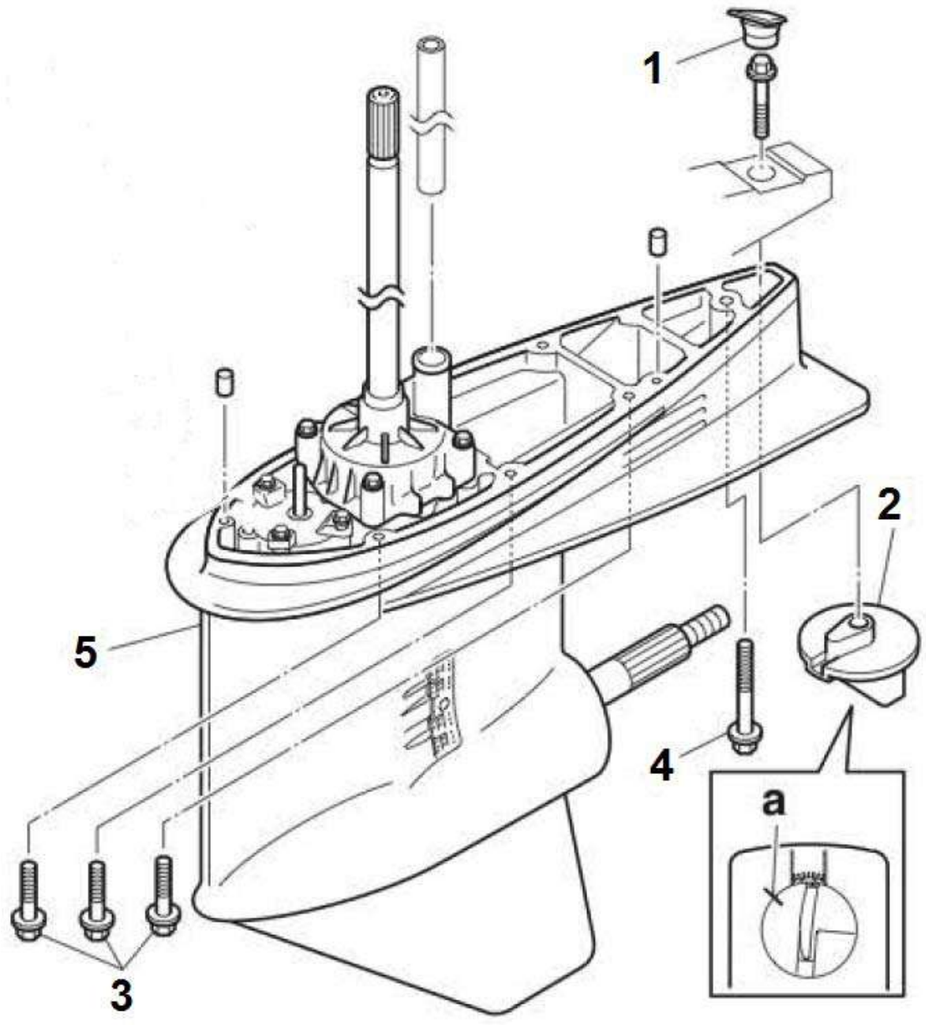
TIP:

When disassembling the lower unit, measure the backlash before disassembly. See "Measuring the forward gear backlash and reverse gear backlash before disassembly" (8-35).

1. Drain the gear oil. See steps 1-4 in "Changing the gear oil" (10-14).
2. Remove the cotter pin.
3. Set the gear shift to the N position.
4. Place a block of wood between the anti-cavitation plate and the propeller to prevent the propeller from turning, and then remove the propeller nut and propeller.

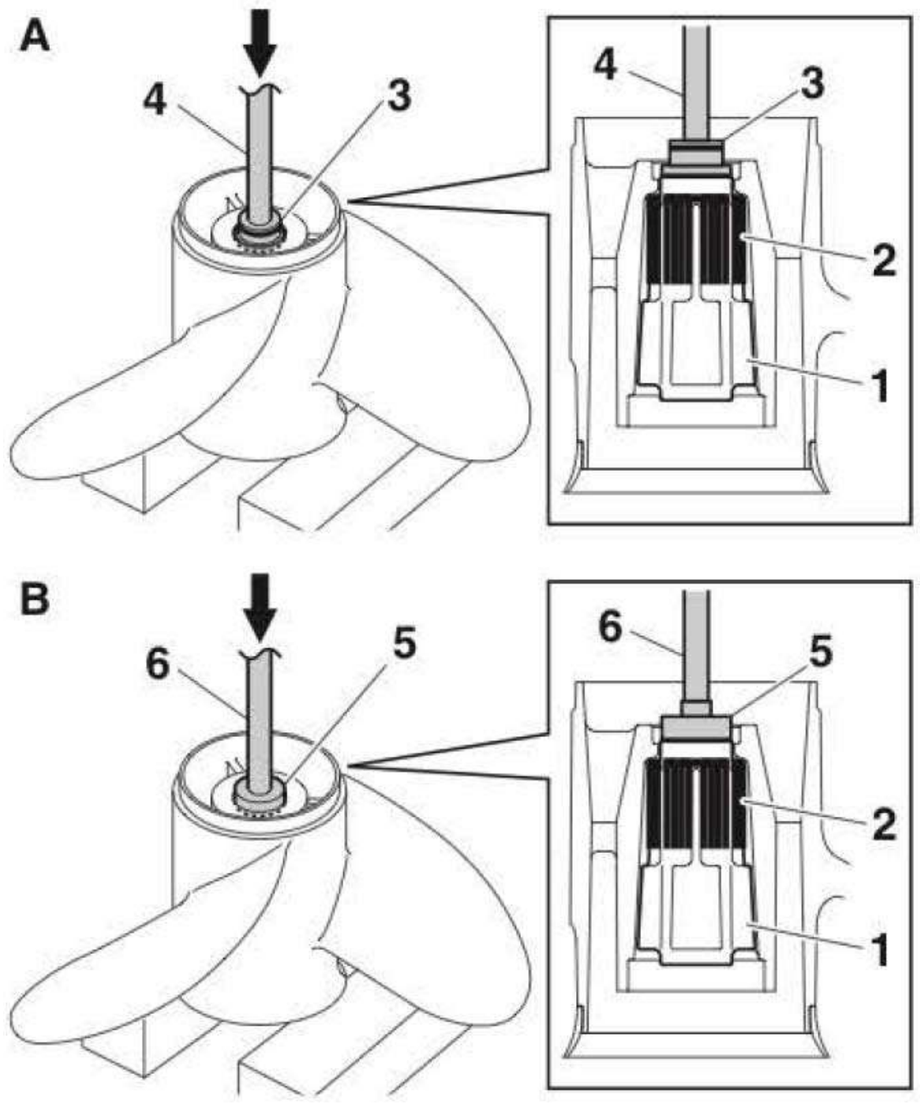


5. Remove the grommet "1".
6. Mark the trim tab "2" and lower case with an identification mark "a", and then remove the trim tab "2".
7. Remove the lower case mounting bolts "3" and "4", and then remove the lower unit "5".



Disassembling the propeller (Shift Dampener System [SDS] propeller)

1. Remove the bushing "1" and dampers "2".



A. Worldwide
B. USA and Canada

Needle bearing attachment "3"
Driver rod L3 "4"
Crankshaft seal installer "5"
Driver handle (small) "6"

Checking the propeller

1. Check the propeller blades, splines, and dampers. Replace the propeller or dampers if cracked, damaged, or worn.

Checking the lower unit anode

1. Check the trim tab. Replace the trim tab if half of it has eroded. Clean if there is grease, oil, or scales.

NOTICE

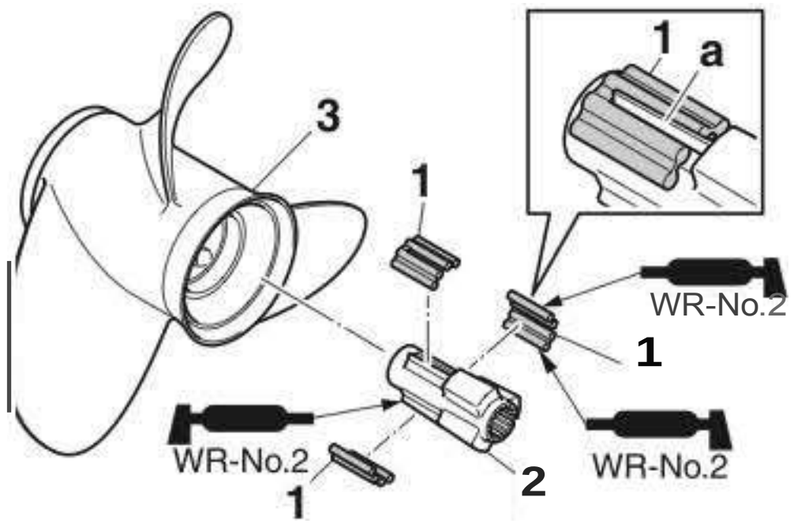
Do not apply grease, oil, or paint to the trim tab.

Assembling the propeller (Shift Dampener System [SDS] propeller)

1. Install new dampers "1" to the bushing "2", and then push them into the propeller "3" lightly.

NOTICE

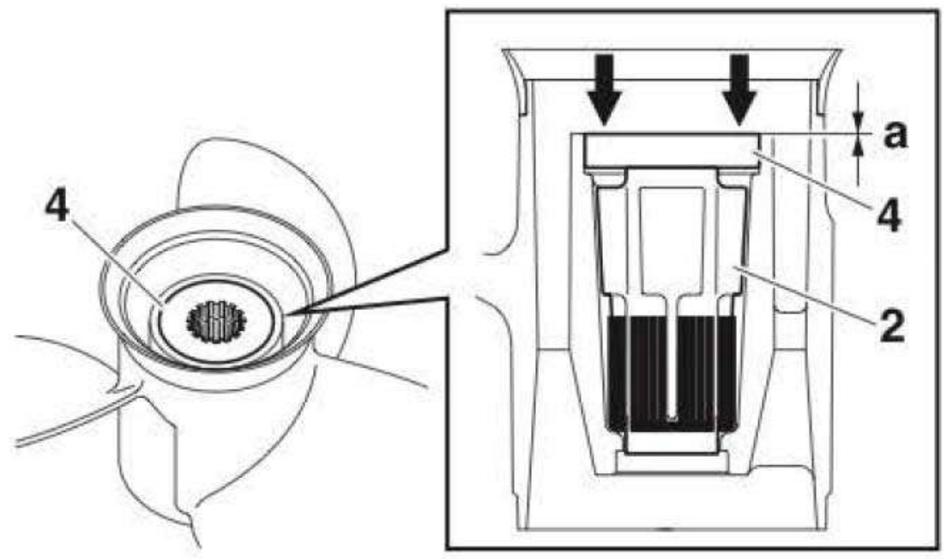
Make sure that the ridges "a" on the bushing "2" are engaged with the cutouts in the dampers "1". Otherwise, the dampers "1" may be damaged.



2. Install the bushing "2" using the spacer "4" to the specified installation height "a".

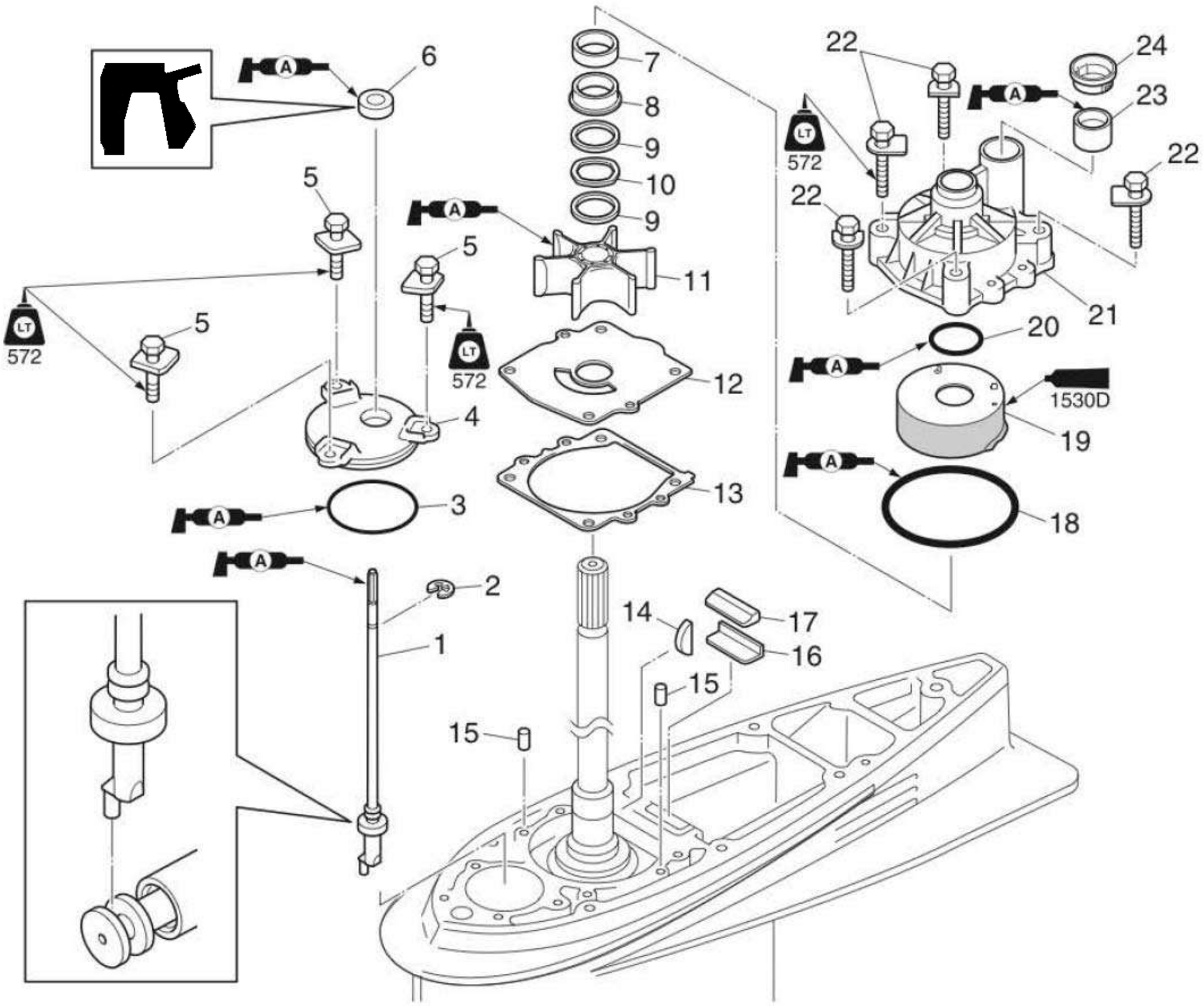
NOTICE

Make sure to use the spacer to push the bushing with damper. Otherwise, the damper cannot be installed in the specified position resulting in damage of the damper.

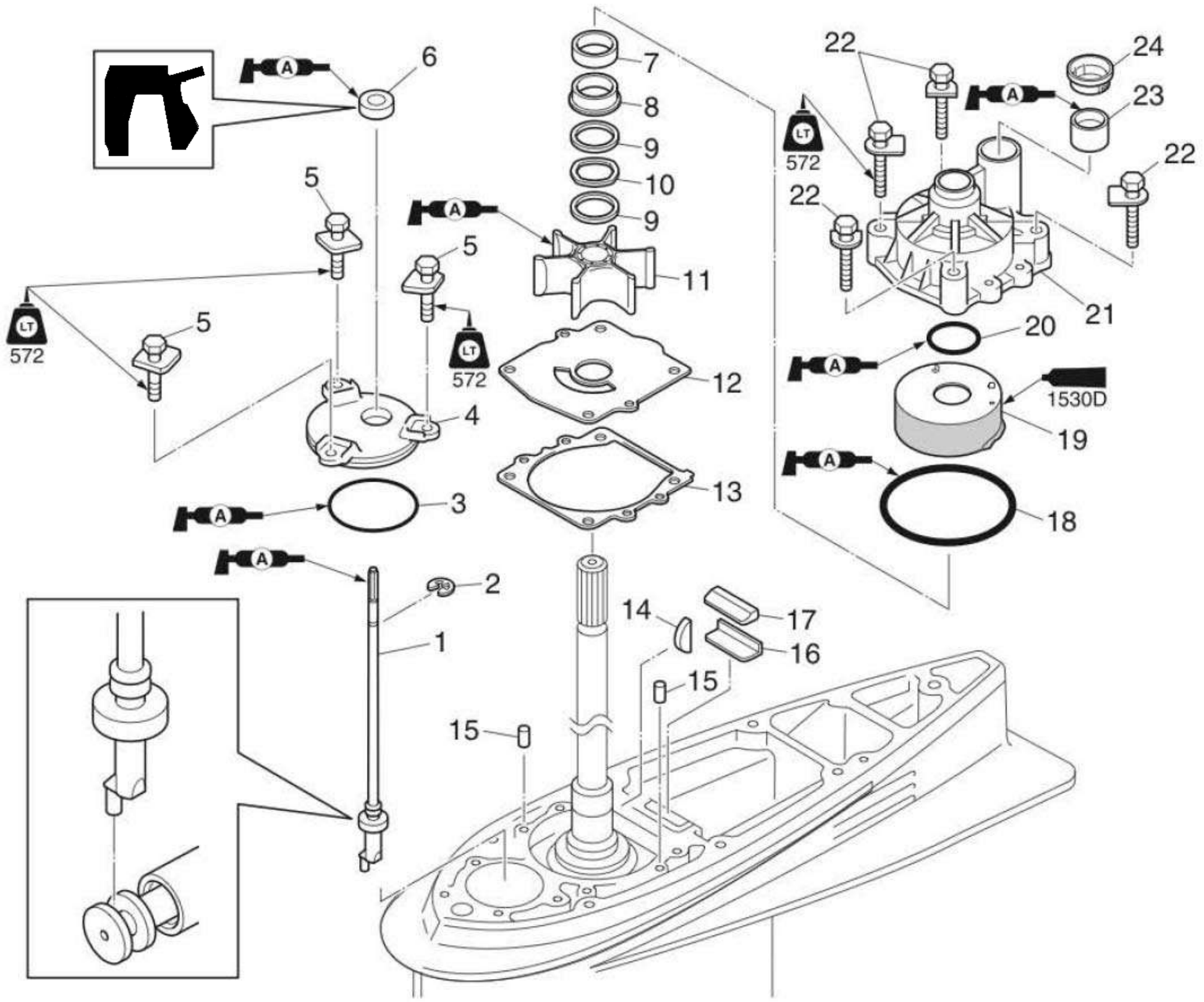


Installation height 0.0-2.6 mm (0.00-0.10 in)

Water pump and shift rod (regular rotation model)



No.	Part	Q'ty	Remark
1	Shift rod	1	
2	E-clip	1	
3	0-ring	1	Not reusable
4	Plate	1	
5	Bolt	3	M6 × 20 mm
6	Oil seal	1	Not reusable
7	Collar	1	
8	Spacer	1	
9	Washer	2	
10	Wave washer	1	
11	Impeller	1	
12	Outer plate cartridge	1	
13	Gasket	1	Not reusable
14	Impeller key	1	
15	Dowel pin	2	
16	Plate	1	
17	Rubber seal	1	

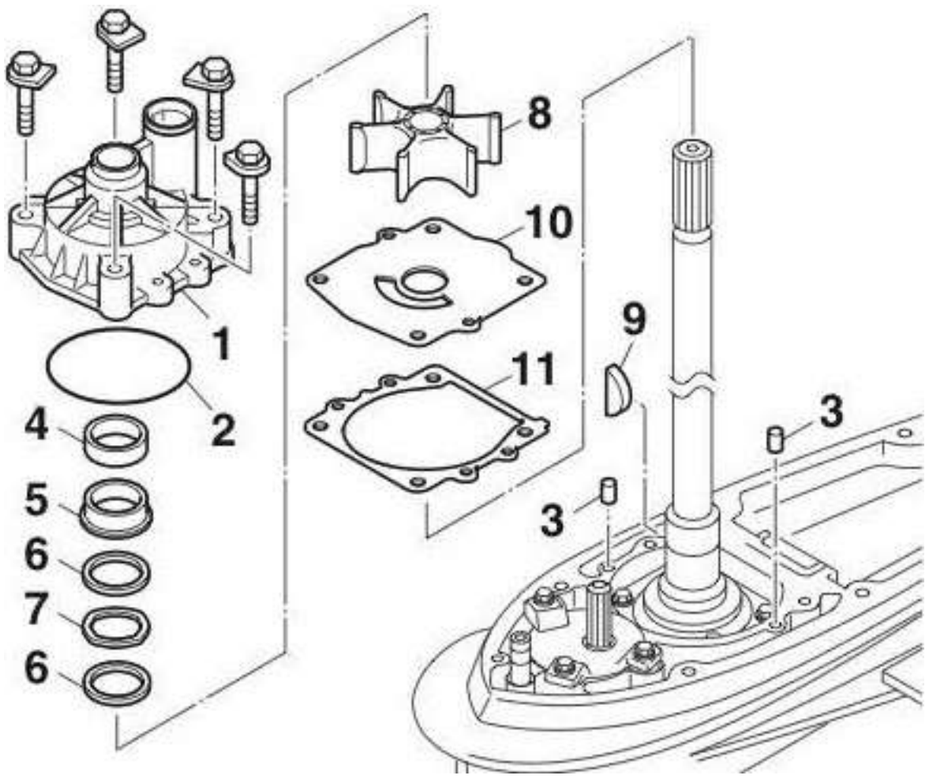


No.	Part	Q'ty	Remark
18	0-ring	1	Not reusable
19	Insert cartridge	1	
20	0-ring	1	Not reusable
21	Water pump housing	1	
22	Bolt	4	M8 × 45 mm
23	Seal	1	
24	Cover	1	

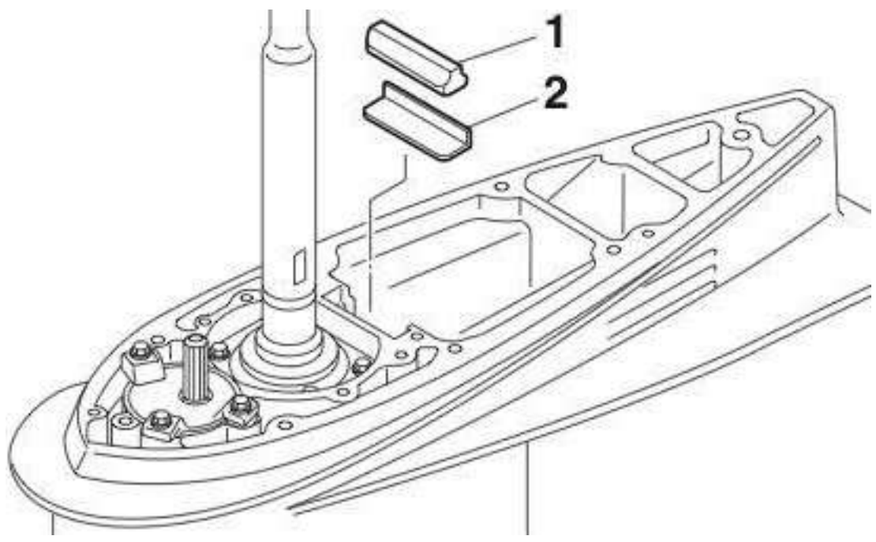
Removing the water pump and shift rod

1. Remove the water pump housing "1", 0-ring "2", dowel pins "3", collar "4", spacer "5", washers "6", wave washer "7", and impeller "8".

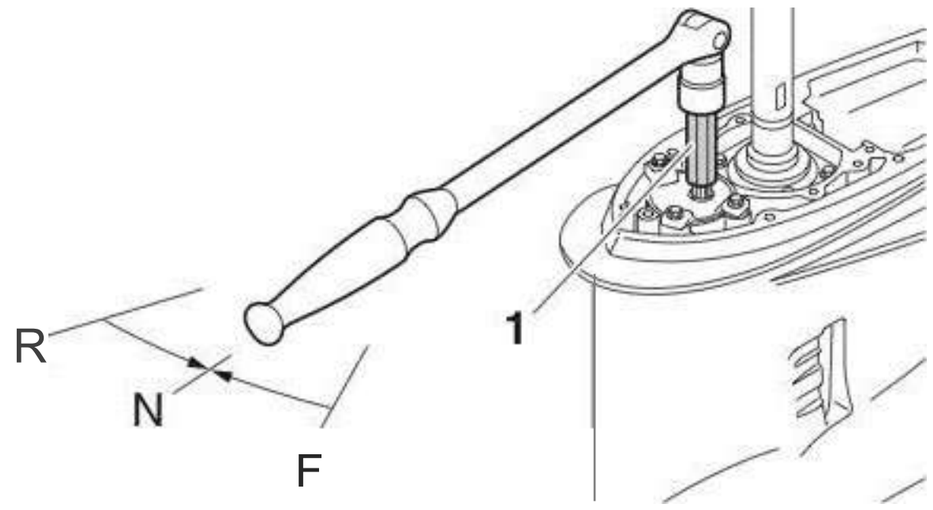
2. Remove the impeller key "9", outer plate cartridge "10", and gasket "11".



3. Remove the rubber seal "1" and plate "2".



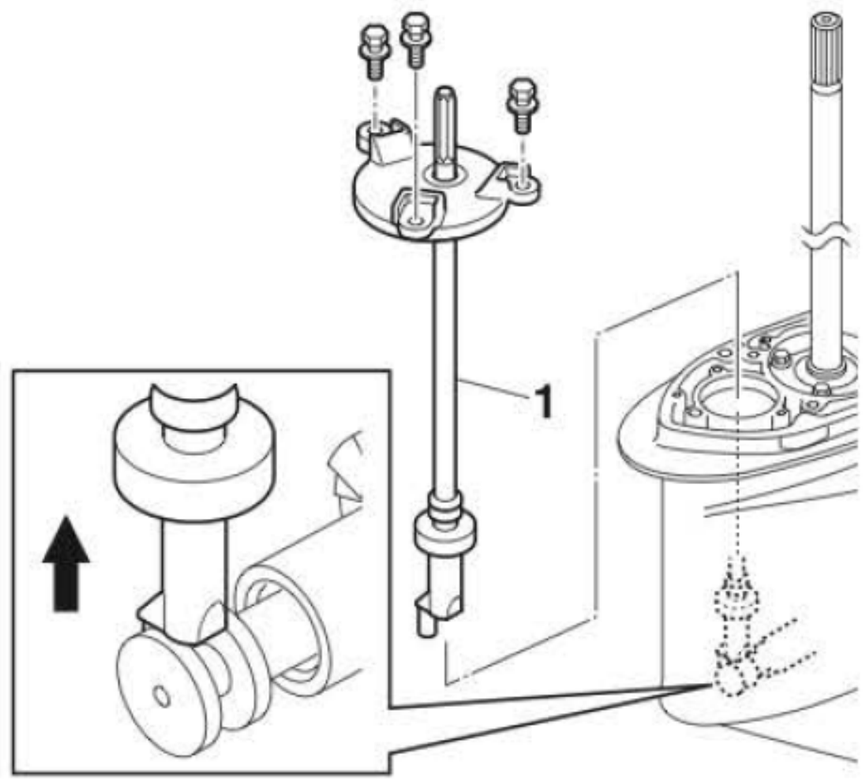
4. Set the gear shift to the N position.



Shift rod socket "1"

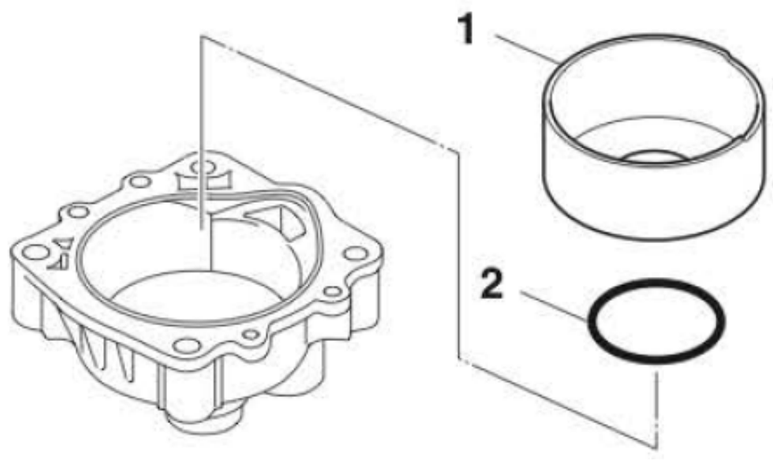
Shift rod socket "1"

5. Remove the shift rod "1".

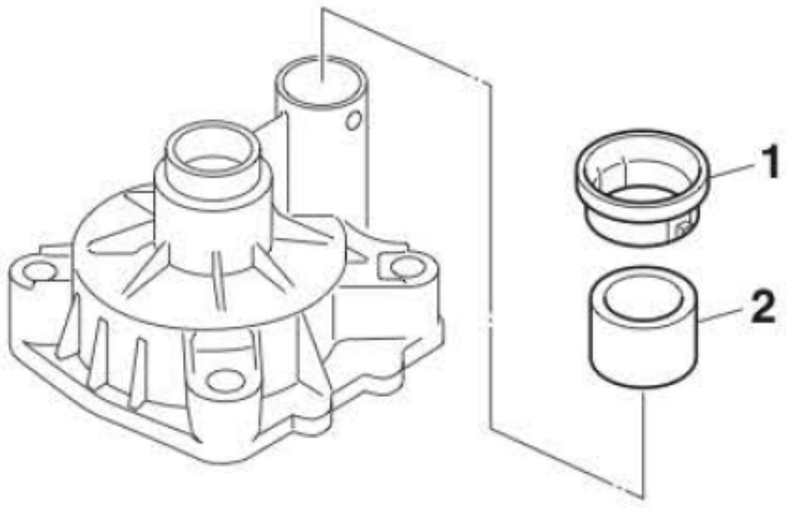


Disassembling the water pump housing

1. Remove the insert cartridge "1" and 0-ring "2".



2. Remove the cover "1" and seal "2".



Checking the water pump and shift rod

1. Check the water pump housing. Replace if deformed.

TIP:
If the engine overheats, the inside of the water pump housing may be deformed.
Therefore, make sure to remove the insert cartridge when checking the water pump housing.

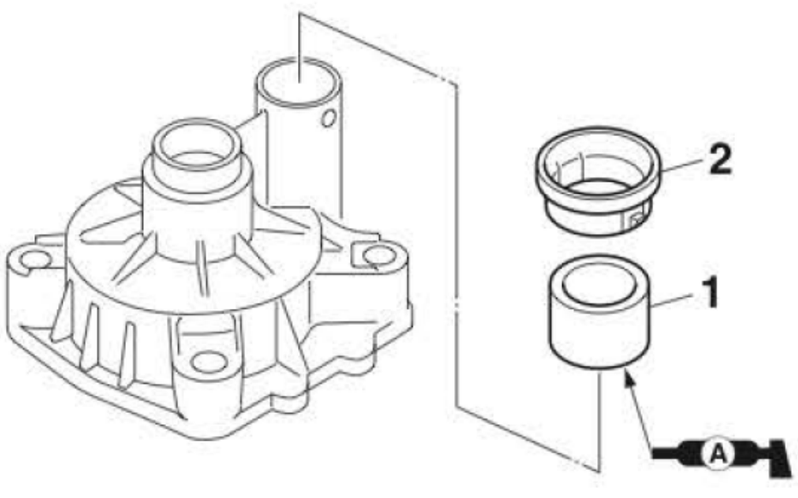
2. Check the impeller, insert cartridge, and outer plate cartridge. Replace if cracked or worn.

3. Check the impeller key and the keyway in the drive shaft. Replace if deformed or worn.

4. Check the shift rod. Replace if bent, cracked, or worn.

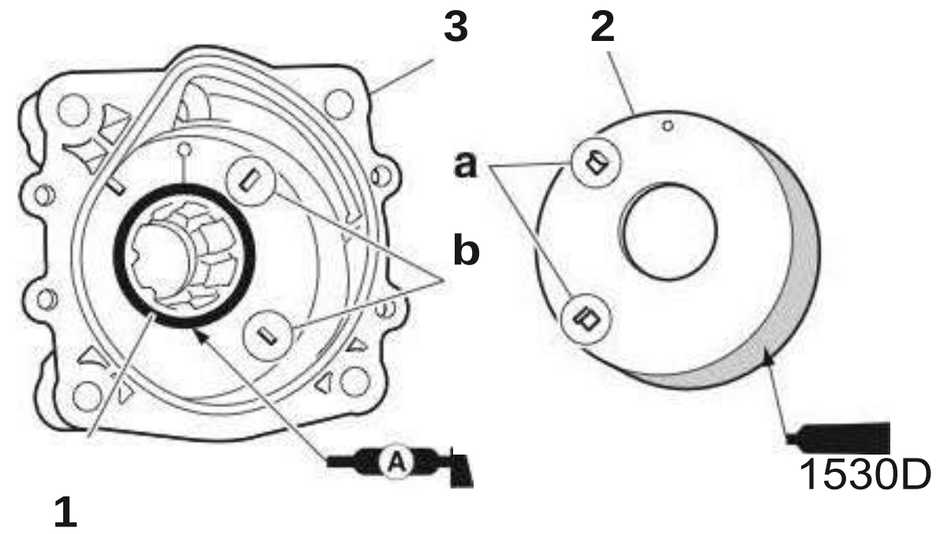
Assembling the water pump housing

1. Install the seal "1" and cover "2".



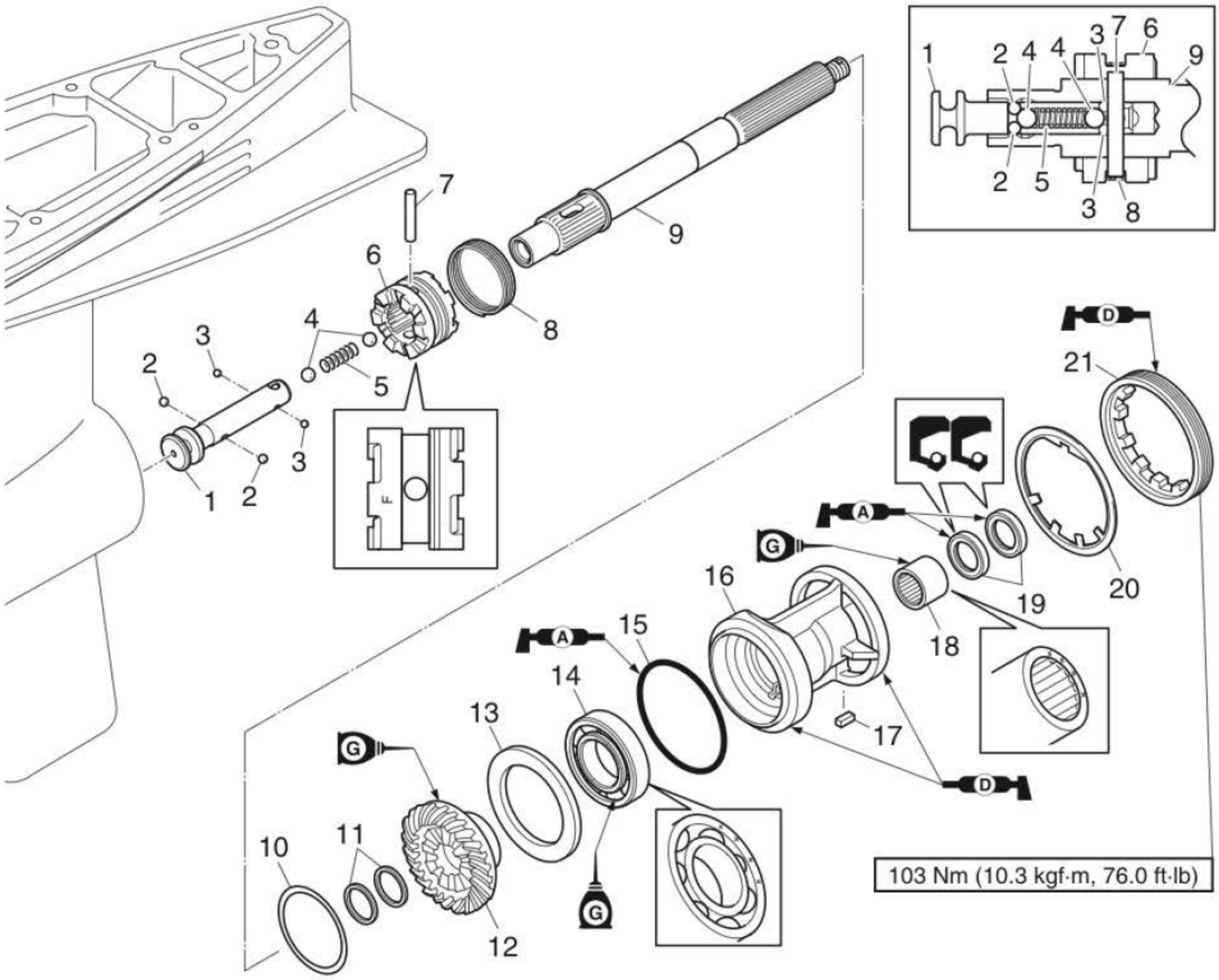
2. Install a new 0-ring "1" and the insert cartridge "2".

TIP:
Fit the protrusions "a" on the insert cartridge "2" into the slots "b" in the water pump housing "3".

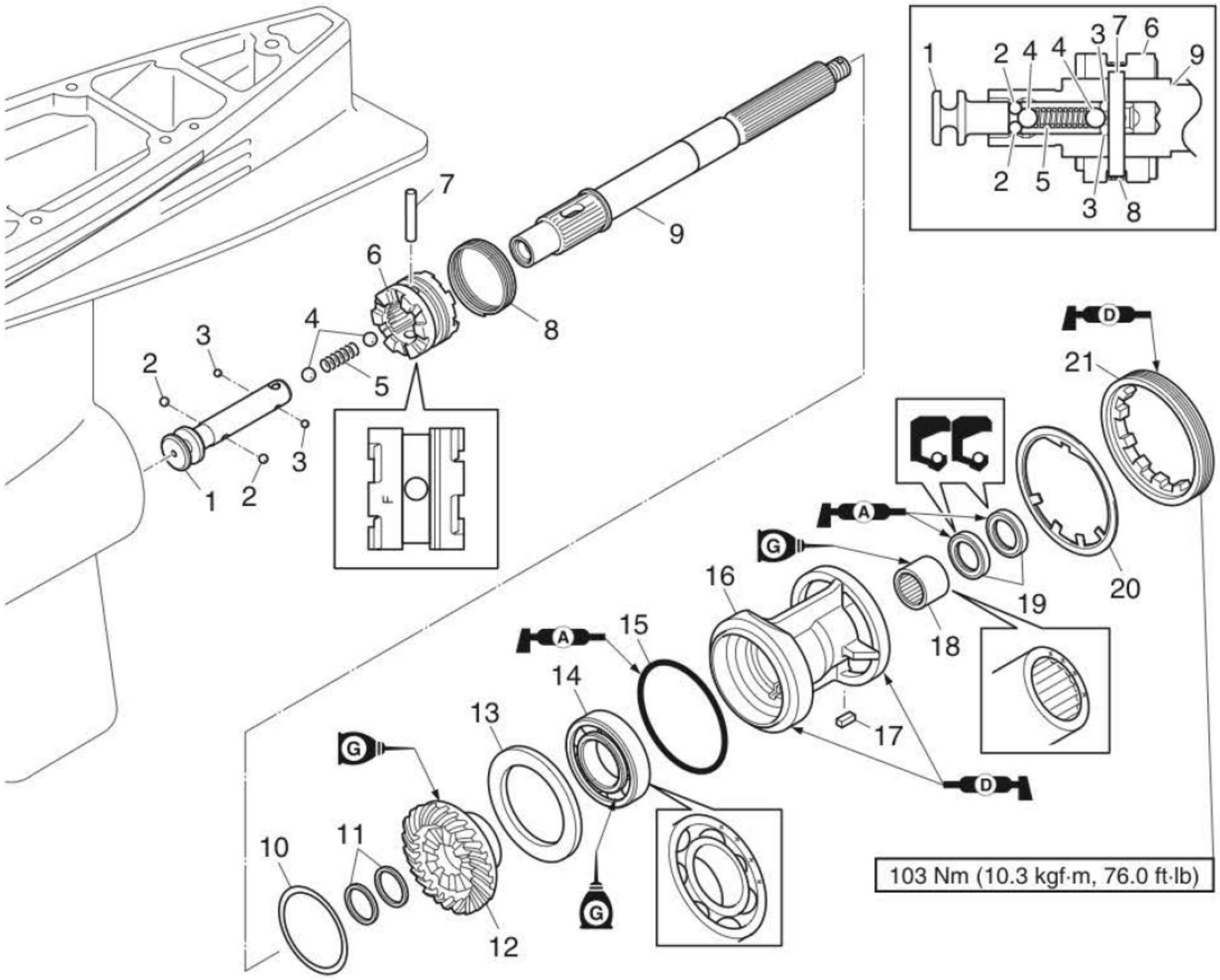


1

Propeller shaft housing (regular rotation model)



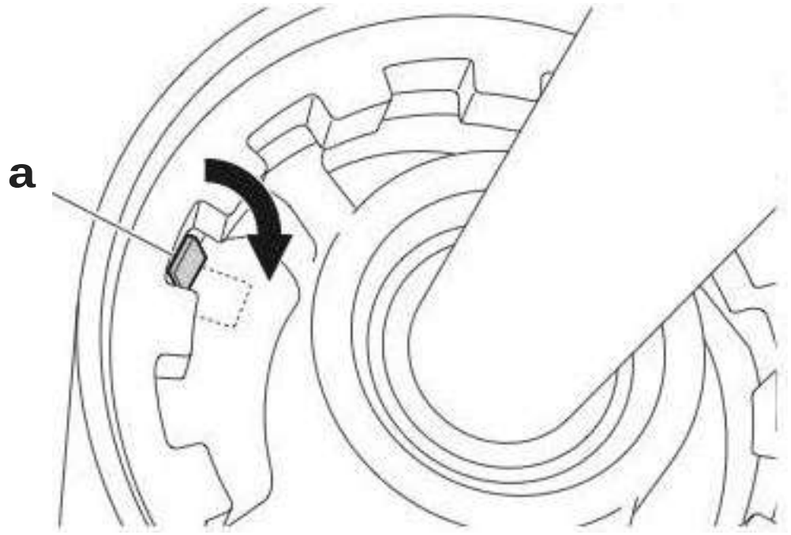
No.	Part	Q'ty	Remark
1	Slider	1	
2	Ball	2	5.56 mm (0.22 in)
3	Ball	2	4.76 mm (0.19 in)
4	Ball	2	8.73 mm (0.34 in)
5	Spring	1	
6	Dog clutch	1	
7	Cross pin	1	
8	Spring	1	
9	Propeller shaft	1	
10	Reverse gear shim (T2)	—	
11	Washer	2	
12	Reverse gear	1	
13	Thrust washer	1	
14	Ball bearing	1	Not reusable
15	0-ring	1	Not reusable
16	Propeller shaft housing	1	
17	Key	1	



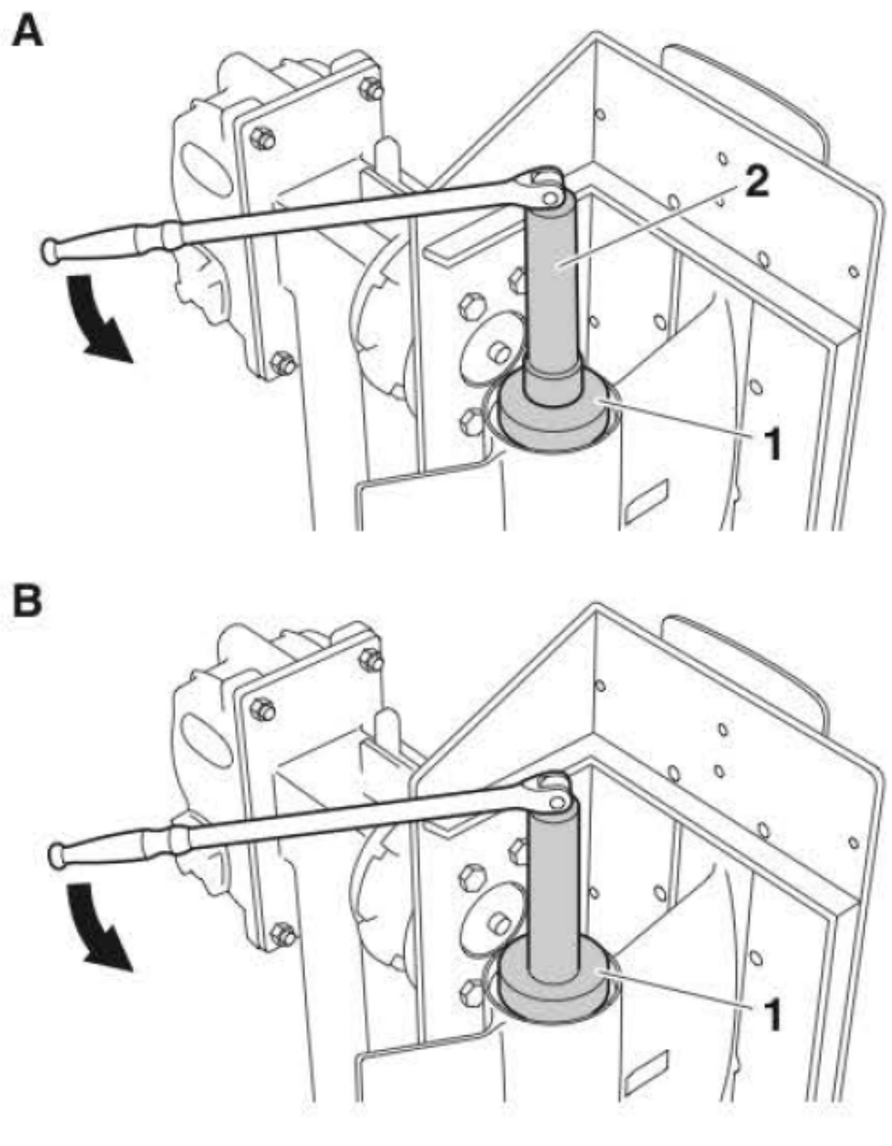
No.	Part	Q'ty	Remark
18	Needle bearing	1	Not reusable
19	Oil seal	2	Not reusable
20	Claw washer	1	
21	Ring nut	1	M101.5

Removing the propeller shaft housing assembly

1. Straighten the bent tab "a" on the claw washer.



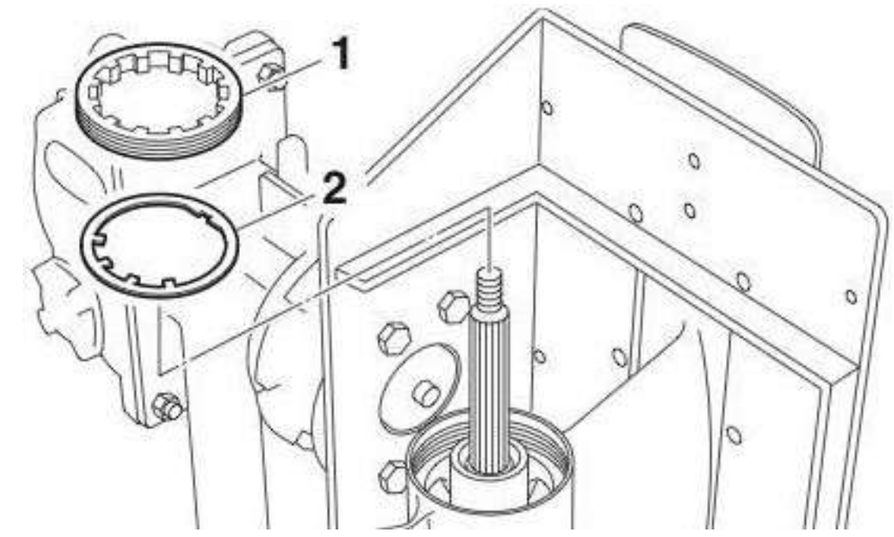
2. Loosen the ring nut.



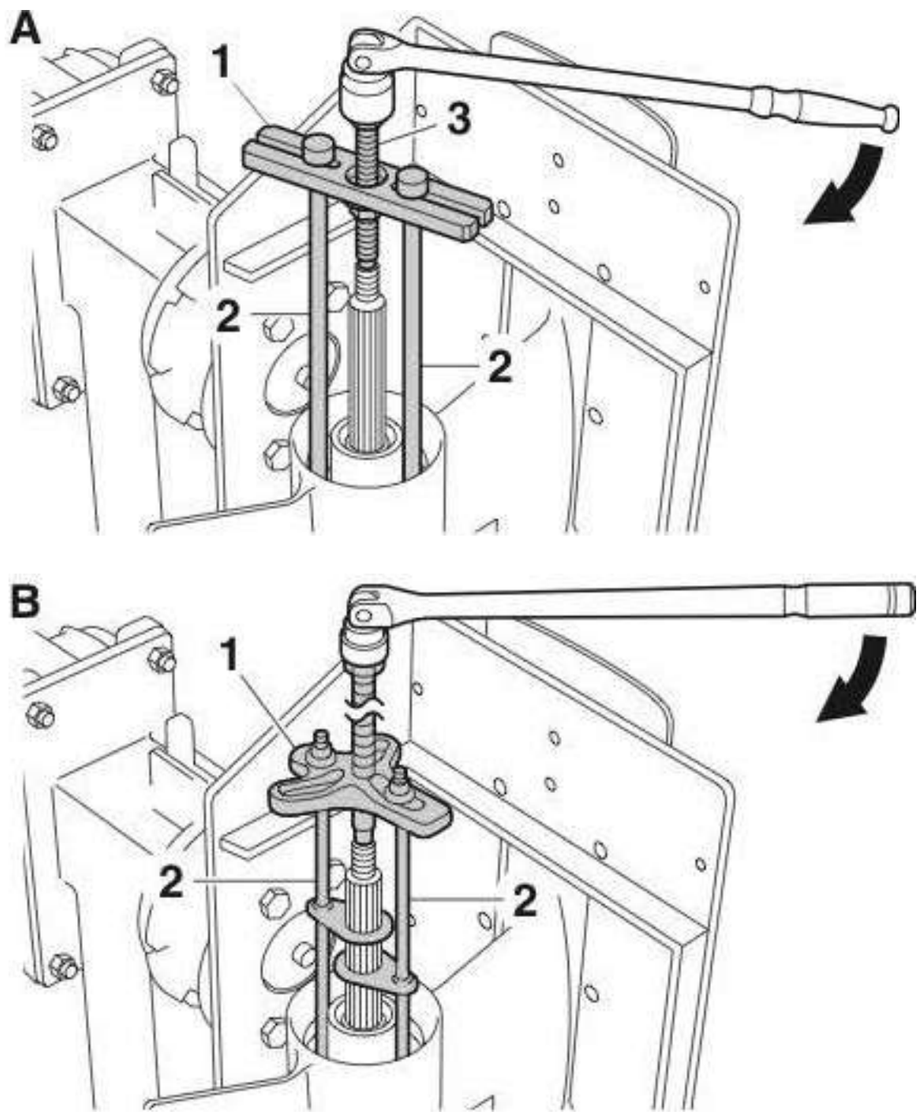
A. Worldwide
B. USA and Canada

Ring nut wrench 3 "1"
Gland nut wrench"1"
Ring nut wrench extension "2"

3. Remove the ring nut "1" and claw washer "2".



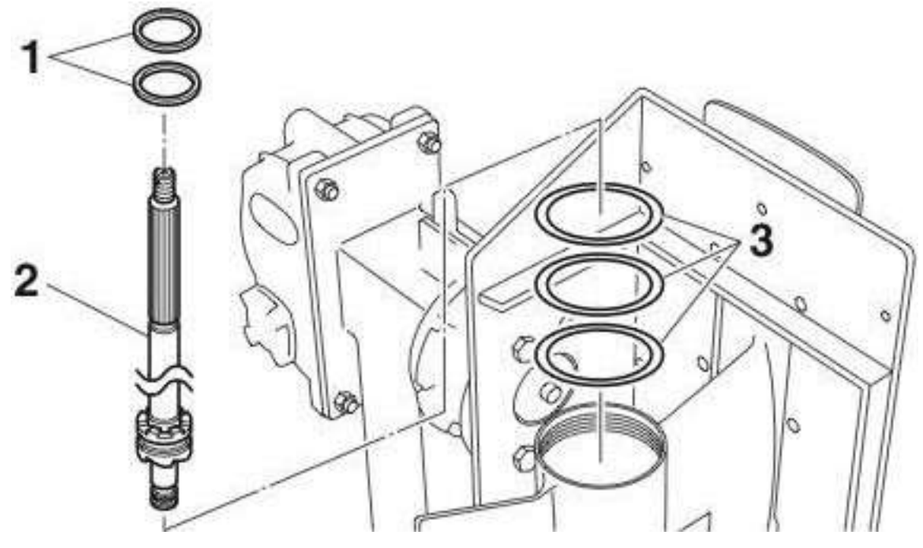
4. Remove the propeller shaft housing assembly and key.



A. Worldwide
B. USA and Canada

Stopper guide plate "1"
Universal puller "1"
Bearing housing puller claw L "2"
Bearing housing puller "2"
Center bolt "3"

5. Remove the washers "1", propeller shaft assembly "2", and reverse gear shims "3".

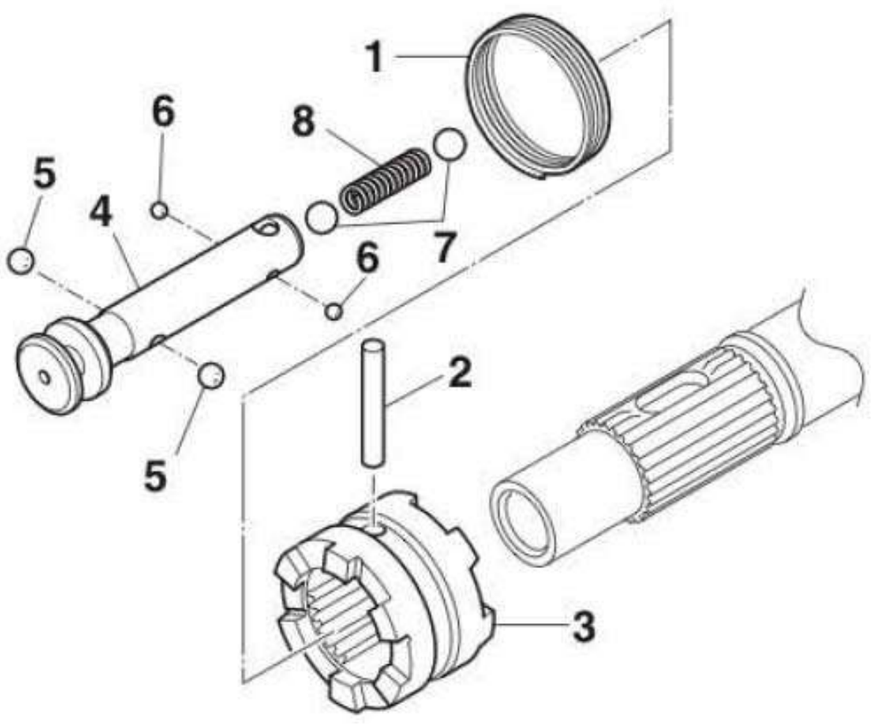


Disassembling the propeller shaft assembly

1. Remove the spring "1", and then remove the cross pin "2", dog clutch "3", slider "4", balls "5", "6", and "7", and spring "8".

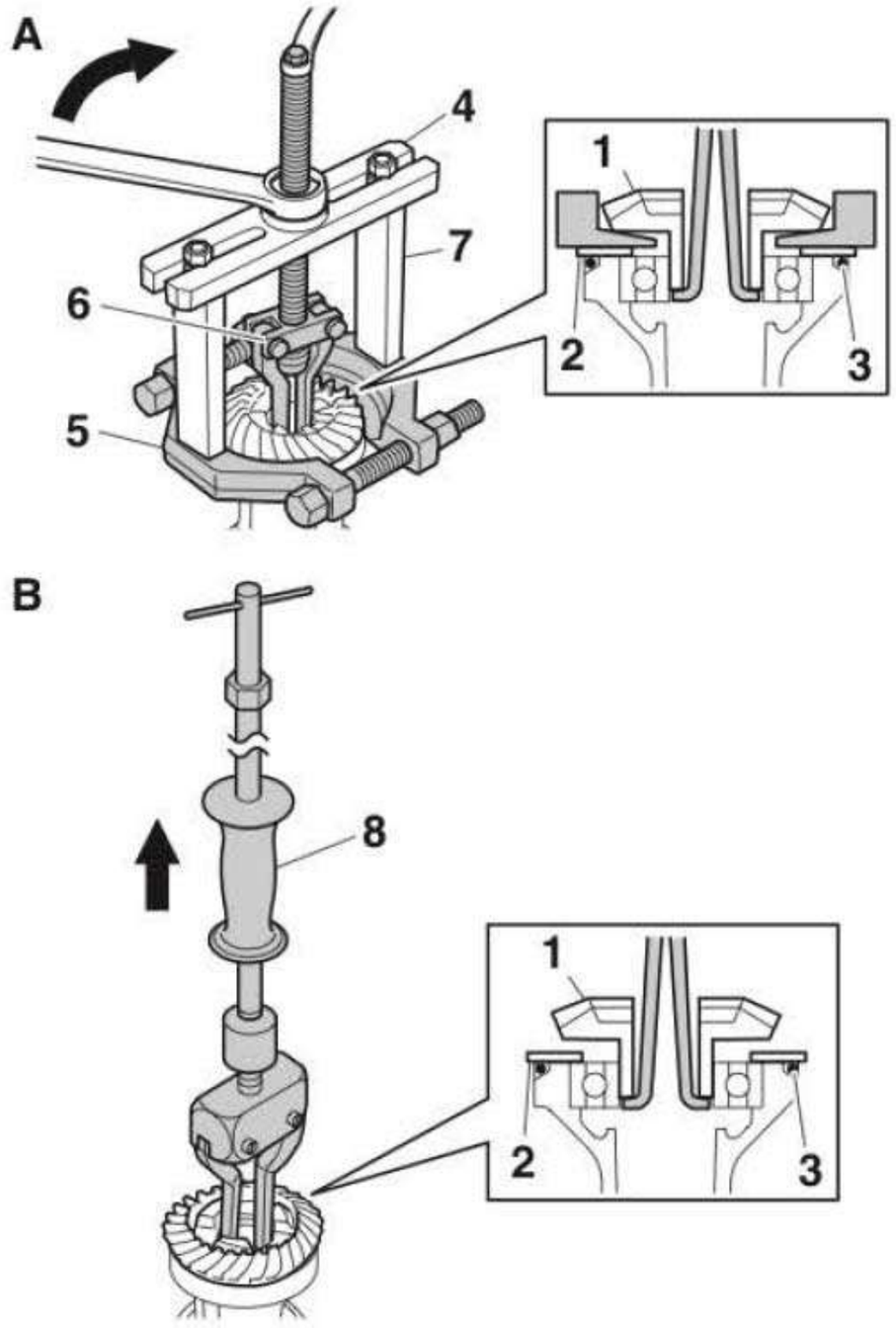
TIP:

When removing the slider "4", make sure that the balls do not fall out of position.



Disassembling the propeller shaft housing assembly

1. Remove the reverse gear "1", thrust washer "2", and 0-ring "3".



A. Worldwide
B. USA and Canada

Stopper guide plate "4"

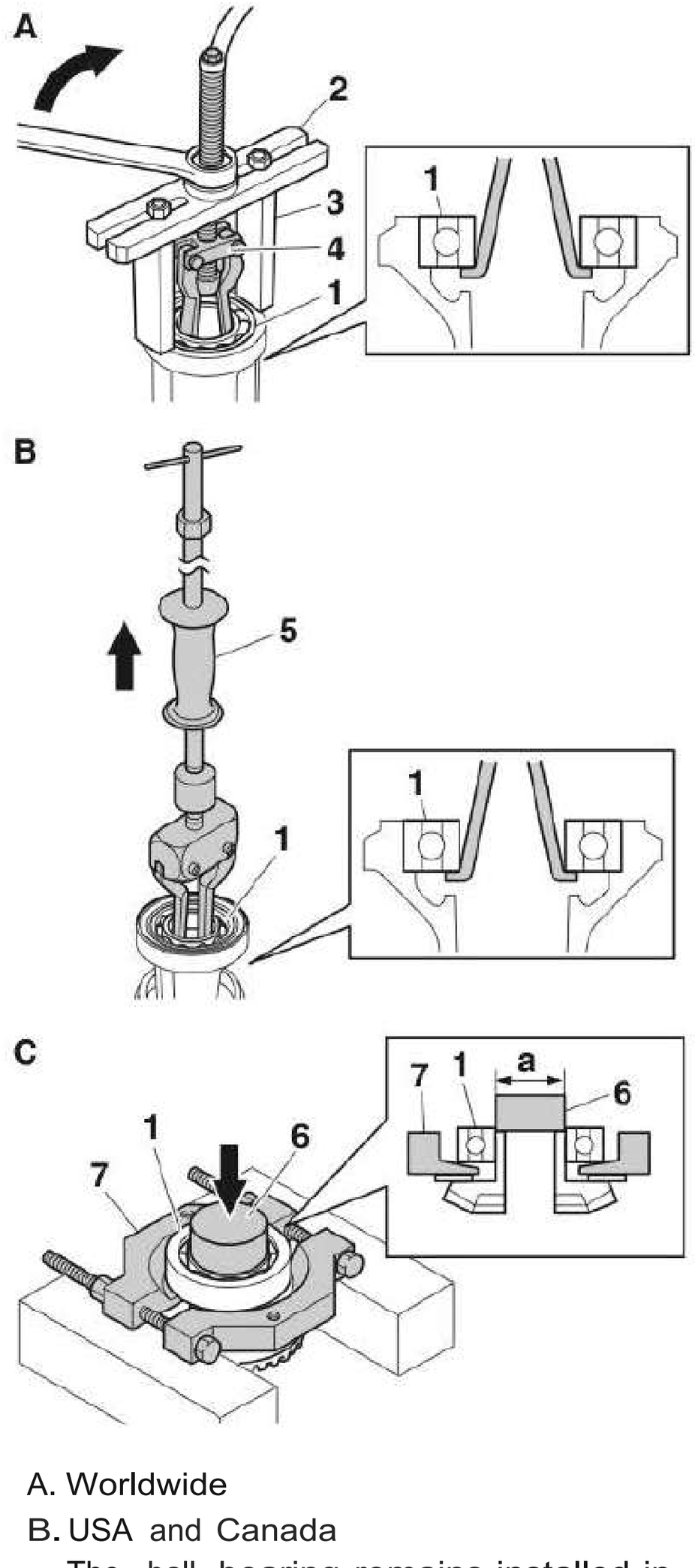
Bearing separator "5"

Bearing puller assembly "6"

Stopper guide stand "7"

Slide hammer "8"

2. Remove the ball bearing "1".



A. Worldwide
B. USA and Canada
The ball bearing remains installed in the propeller shaft housing
C. USA and Canada
The ball bearing and reverse gear are removed together

Stopper guide plate "2"

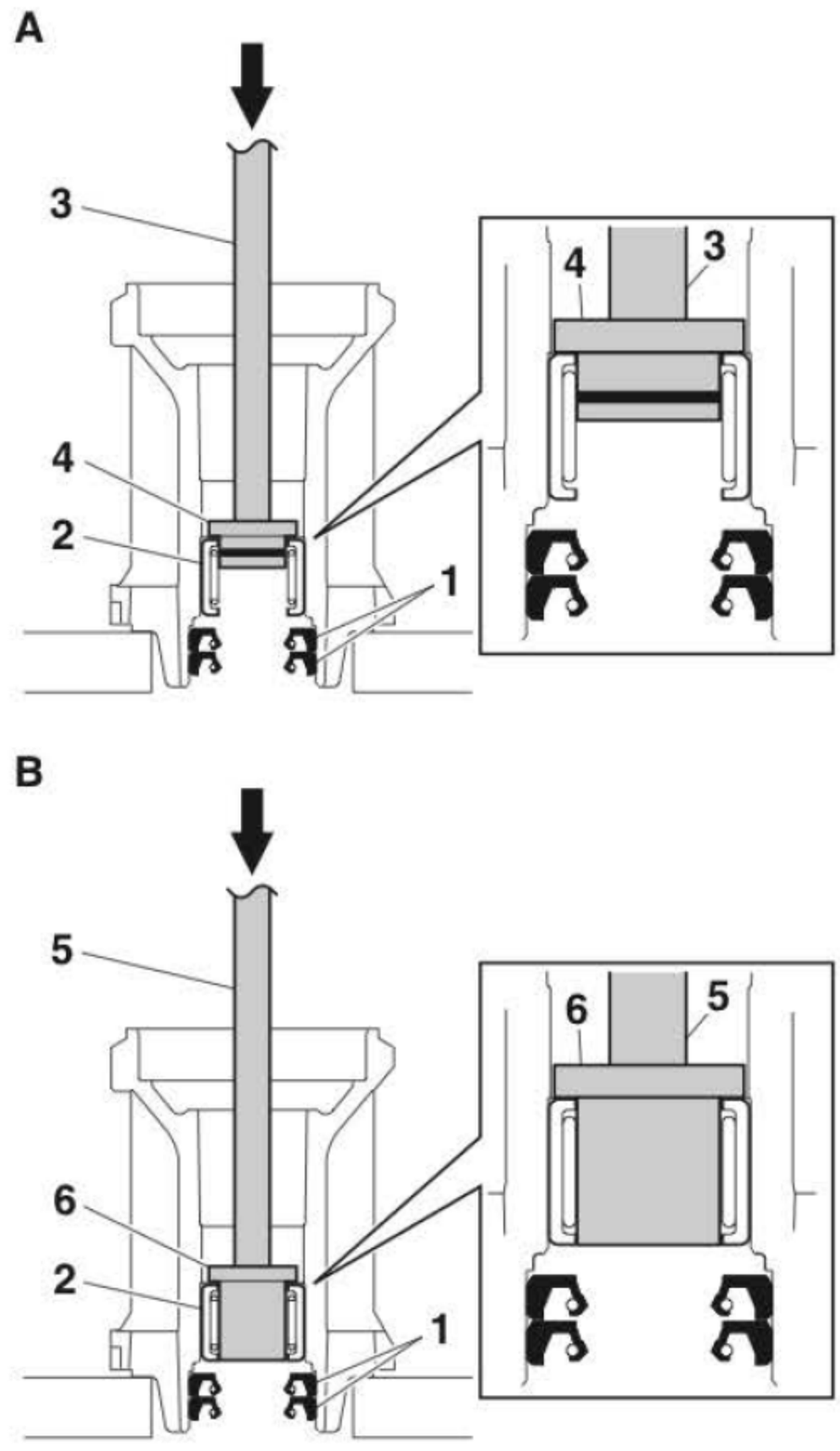
Stopper guide stand "3"

Bearing puller assembly "4"

Slide hammer "5"

Solid cylinder "6"
(commercially available)
"a": 38.0 mm (1.5 in)
Bearing separator "7"
(commercially available)

3. Remove the oil seals "1" along with the needle bearing "2".

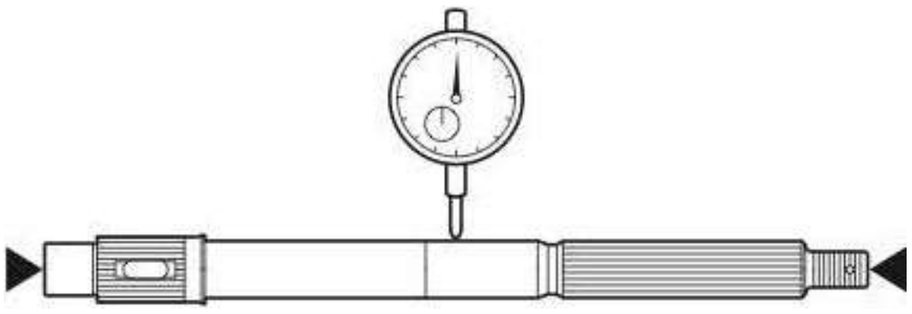


A. Worldwide
B. USA and Canada

Driver rod L3 "3"
Needle bearing attachment "4"
Driver handle (large) "5"
Driveshaft needle bearing installer and remover "6"

Checking the propeller shaft

1. Check the propeller shaft. Replace if damaged or worn.
2. Measure the propeller shaft runout.



Propeller shaft
Runout
0.02 mm (0.0008 in)

Checking the dog clutch

1. Check the dog clutch, cross pin, spring, balls, and slider. Replace if cracked or worn.

Checking the propeller shaft housing

1. Check the propeller shaft housing. Replace if cracked or damaged.

Checking the reverse gear

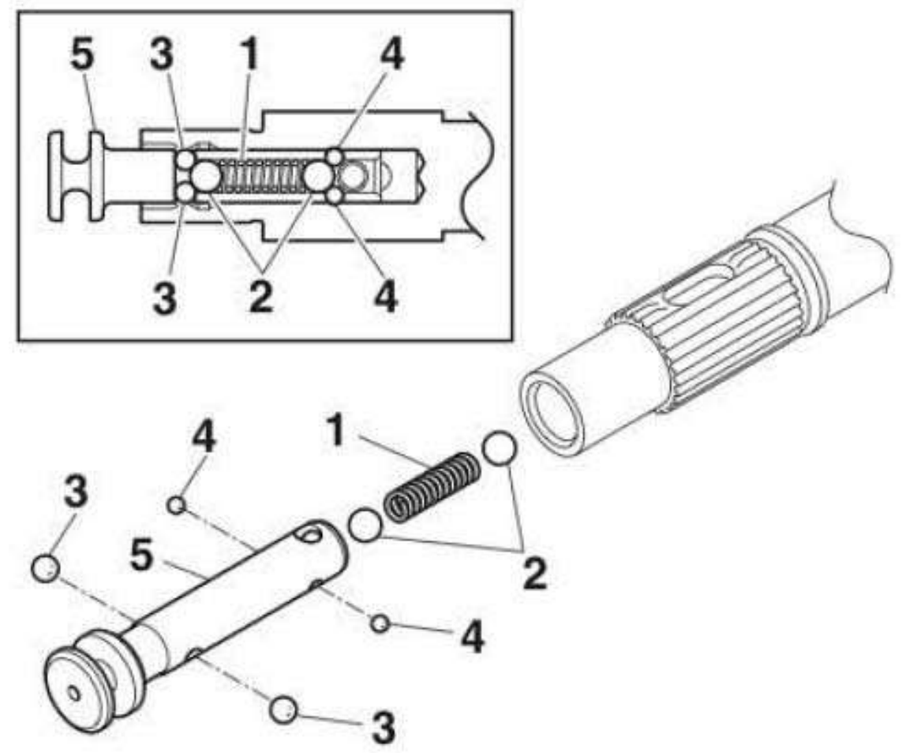
1. Check the teeth and dogs of the reverse gear. Replace if cracked or worn.

Assembling the propeller shaft assembly

1. Install the spring "1", balls "2", "3", and "4", and slider "5".

TIP:

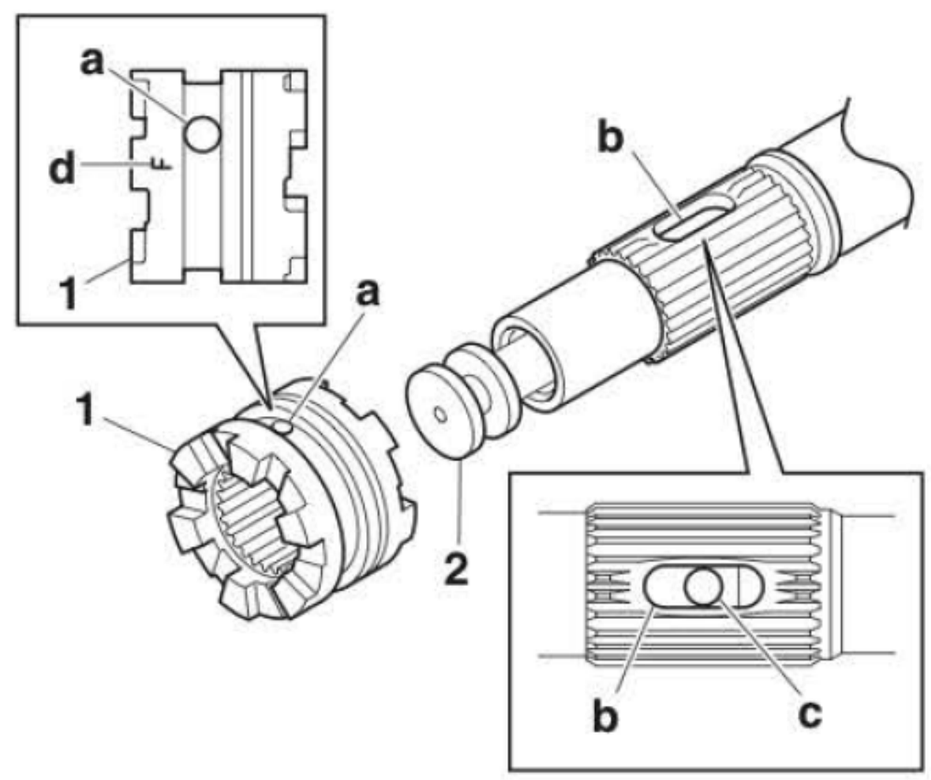
When installing the slider "5", make sure that the balls do not fall out of position.



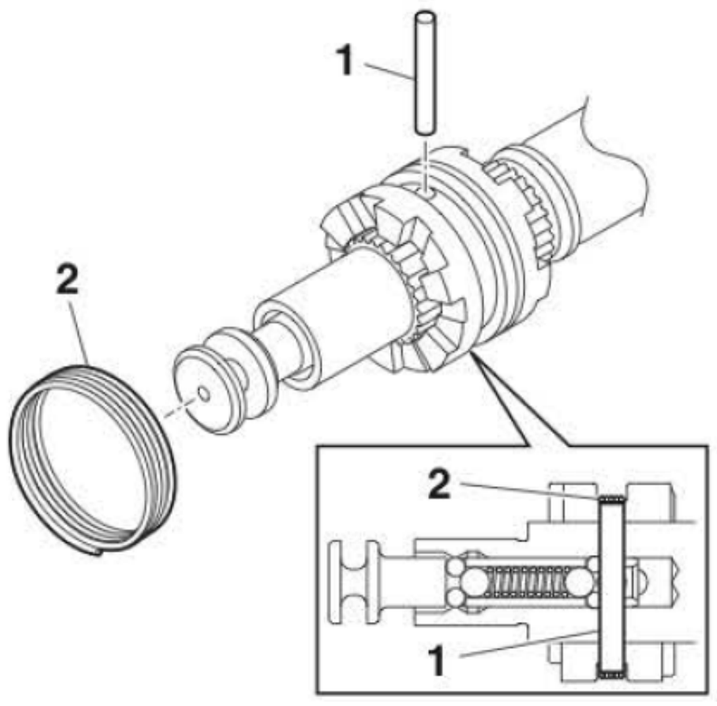
2. Install the dog clutch "1" so that the hole "a" in the dog clutch "1" and the hole "b" in the propeller shaft are aligned with the hole "c" in the slider "2".

TIP:

Face the "P" mark "d" on the dog clutch "1" toward the slider "2".



3. Install the cross pin "1", and then install the spring "2".



Driver rod L3 "2"

Needle bearing attachment "3"

Driver handle (large) "4"

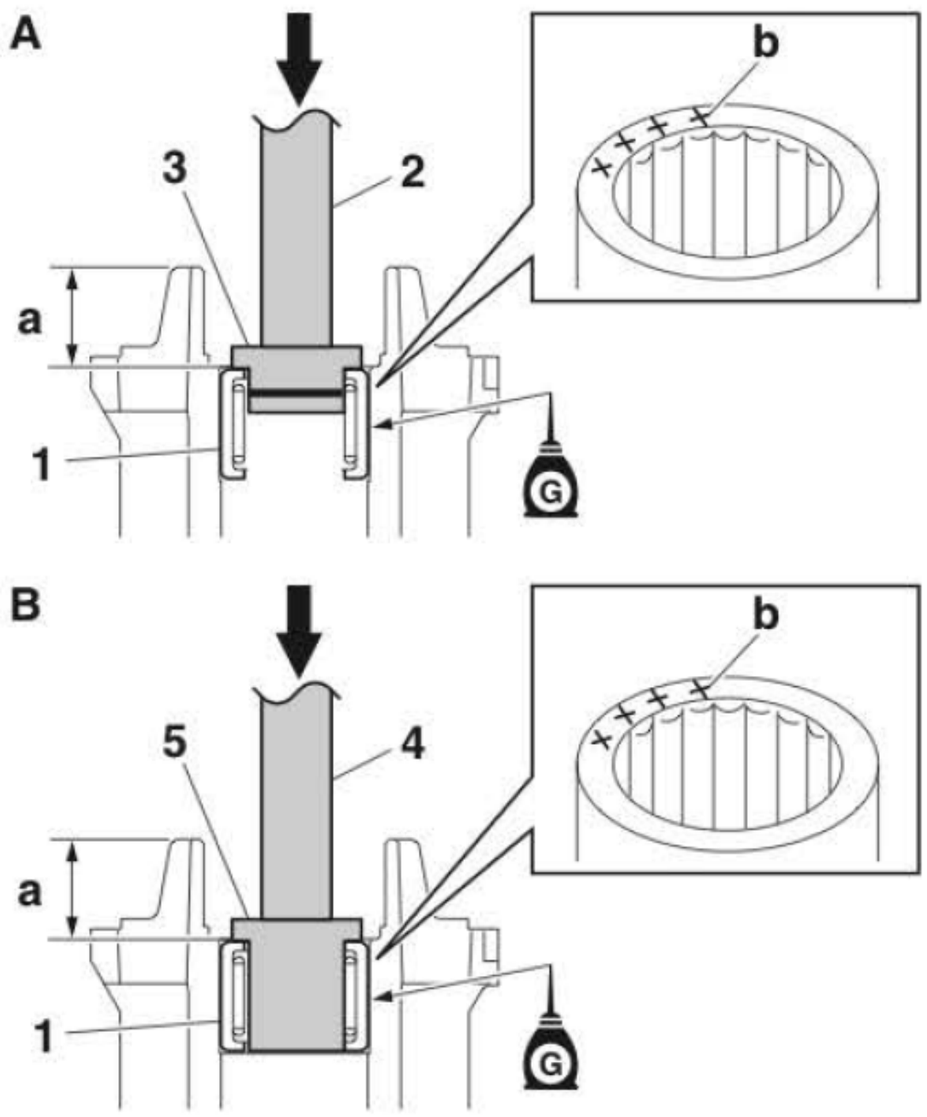
Driveshaft needle bearing installer and remover "5"

Installation depth
24.75-25.25 mm (0.974-0.994 in)

Assembling the propeller shaft housing assembly

1. Install a new needle bearing "1" in the propeller shaft housing at the specified installation depth "a".

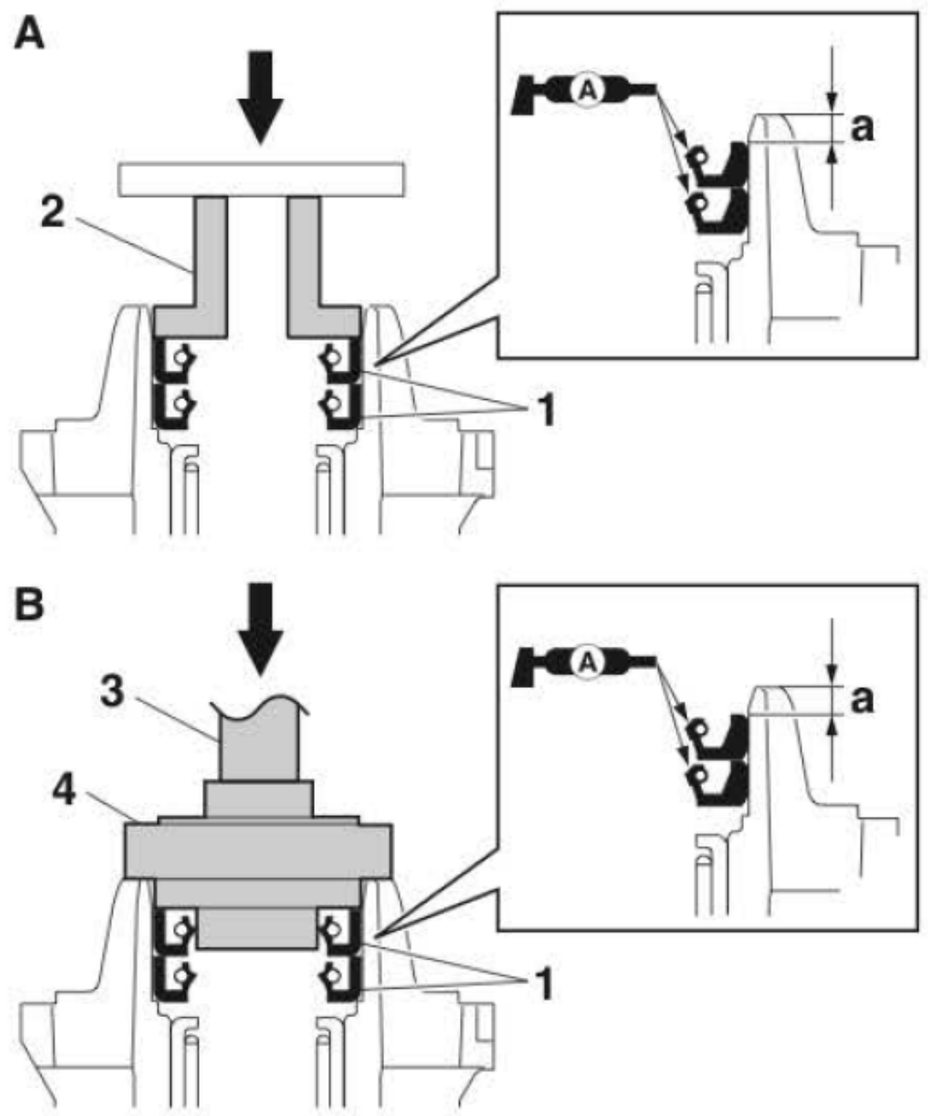
TIP:
Face the bearing identification mark "b" on the needle bearing toward the propeller.



A. Worldwide
B. USA and Canada

2. Install new oil seals "1" in the propeller shaft housing at the specified installation depth "a".

TIP:
Install an oil seal halfway into the propeller shaft housing, and then install the other oil seal.



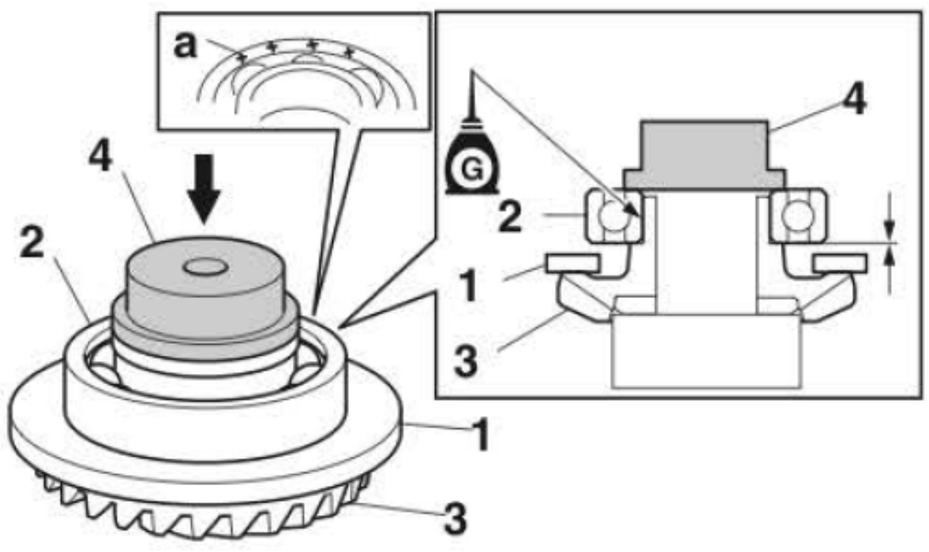
A. Worldwide
B. USA and Canada

Bearing inner race attachment "2" Driver handle (large) "3" Oil seal installer "4"

Installation depth 4.75-5.25 mm (0.187–0.207 in)

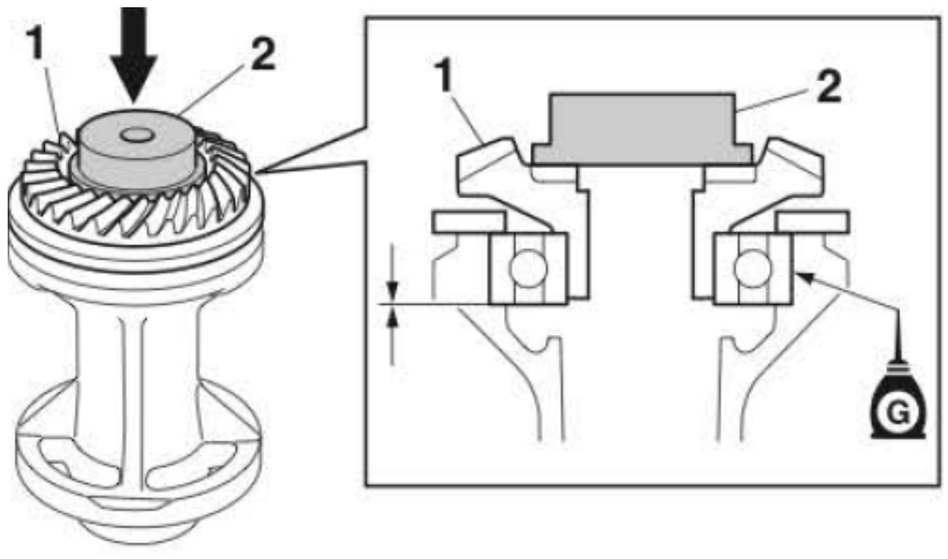
3. Install the thrust washer "1" and a new ball bearing "2" onto the reverse gear "3".

TIP:
Face the bearing identification mark "a" on the ball bearing toward the propeller.



Needle bearing attachment "4" Forward gear outer race installer "4"

4. Install the reverse gear assembly "1".

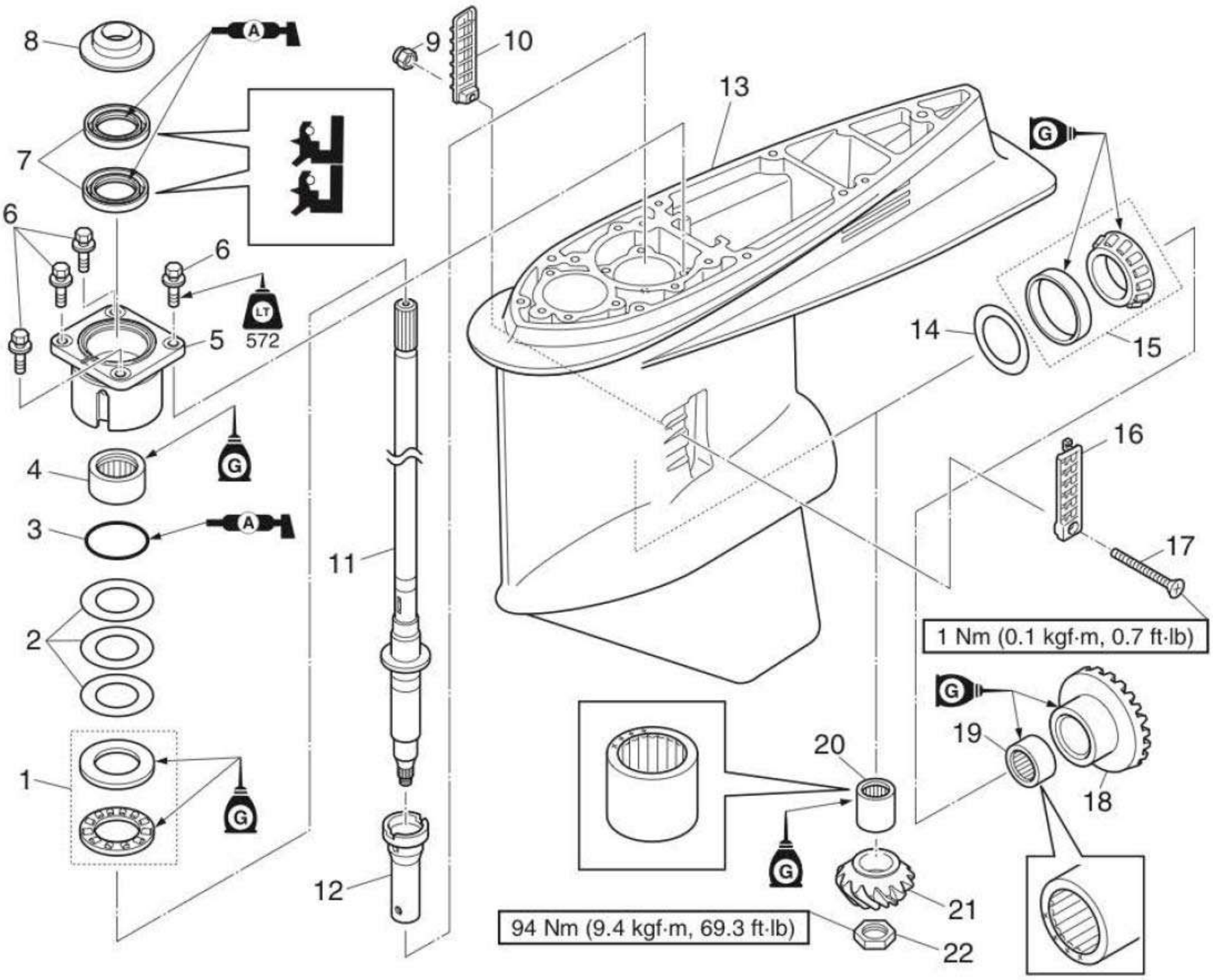


Needle bearing attachment "2" Forward gear outer race installer "2"

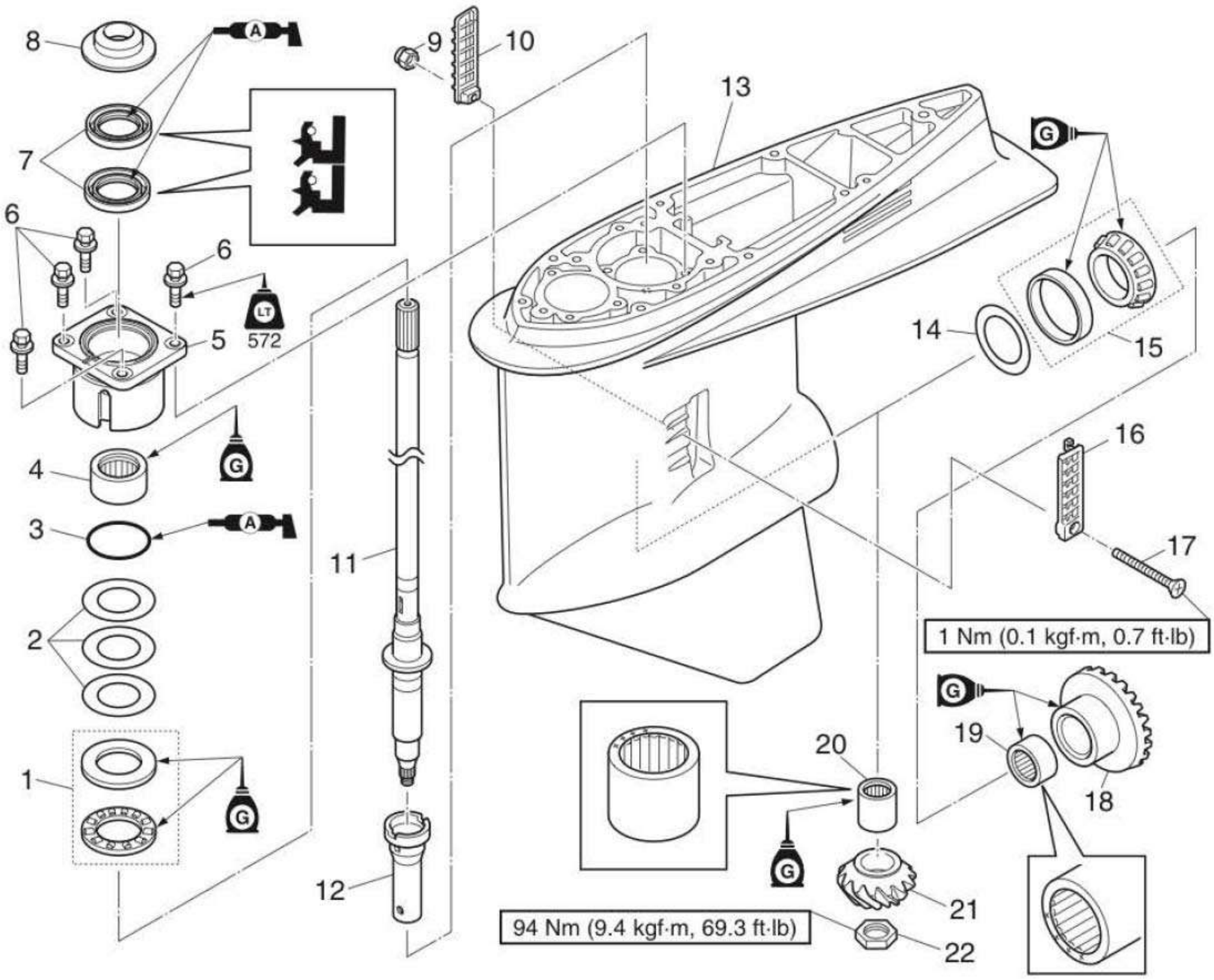
5. Check that the reverse gear turns smoothly.

6. Install a new 0-ring "1".

Drive shaft and lower case (regular rotation model)



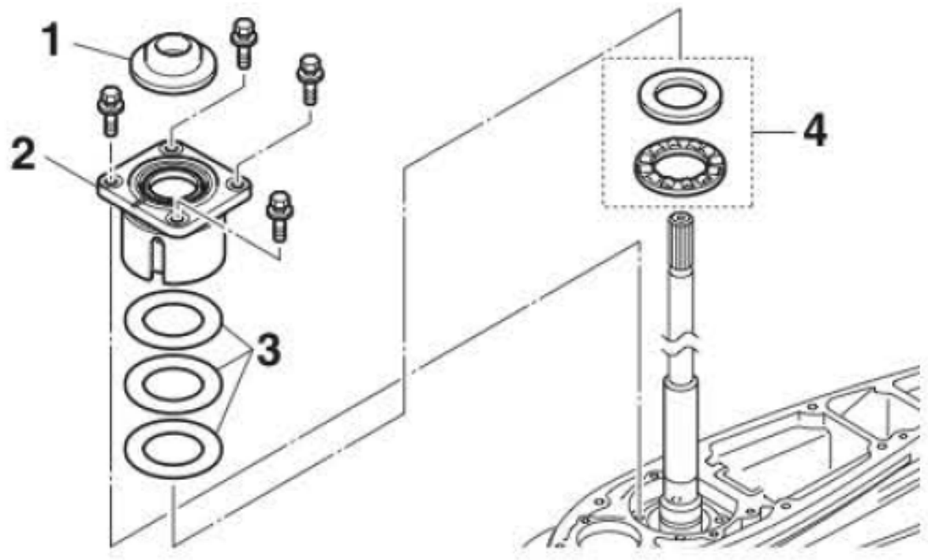
No.	Part	Q'ty	Remark
1	Thrust bearing	1	
2	Pinion shim (T3)	—	
3	0-ring	1	Not reusable
4	Needle bearing	1	Not reusable
5	Drive shaft housing	1	
6	Bolt	4	M8 × 25 mm
7	Oil seal	2	Not reusable
8	Cover	1	
9	Self-locking nut	1	
10	Water inlet cover (STBD)	1	
11	Drive shaft	1	
12	Sleeve	1	
13	Lower case	1	
14	Forward gear shim (T1)	—	
15	Tapered roller bearing	1	Not reusable
16	Water inlet cover (PORT)	1	
17	Screw	1	M5 × 48 mm



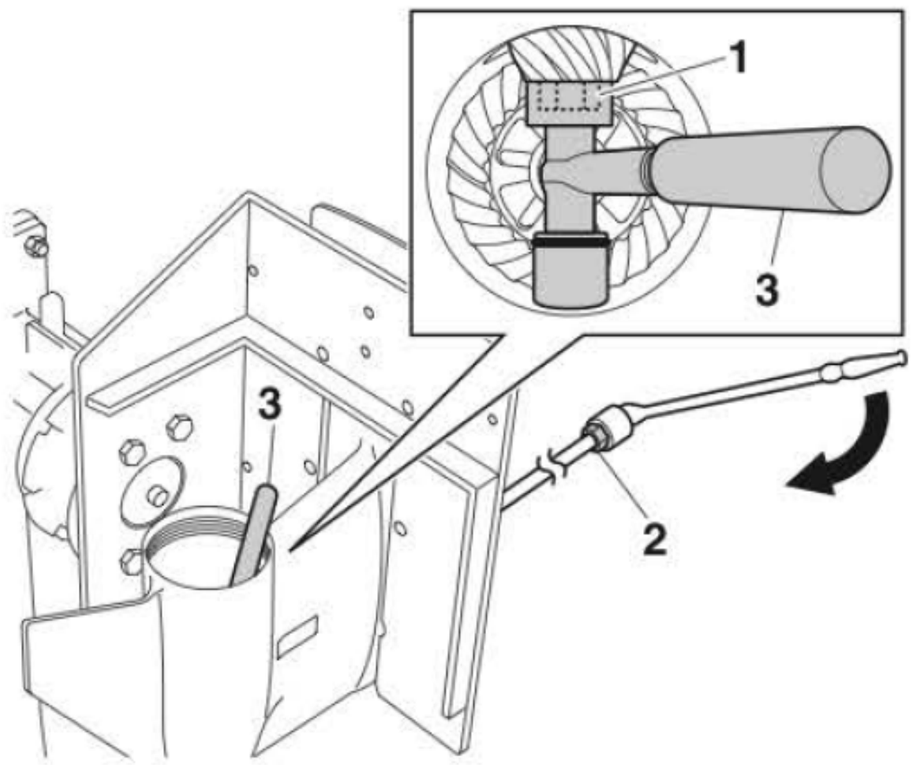
No.	Part	Q'ty	Remark
18	Forward gear	1	
19	Needle bearing	1	Not reusable
20	Needle bearing	1	Not reusable
21	Pinion	1	
22	Pinion nut	1	

Removing the drive shaft

1. Remove the cover "1", drive shaft housing "2", pinion shims "3", and thrust bearing "4".



2. Loosen the pinion nut "1".

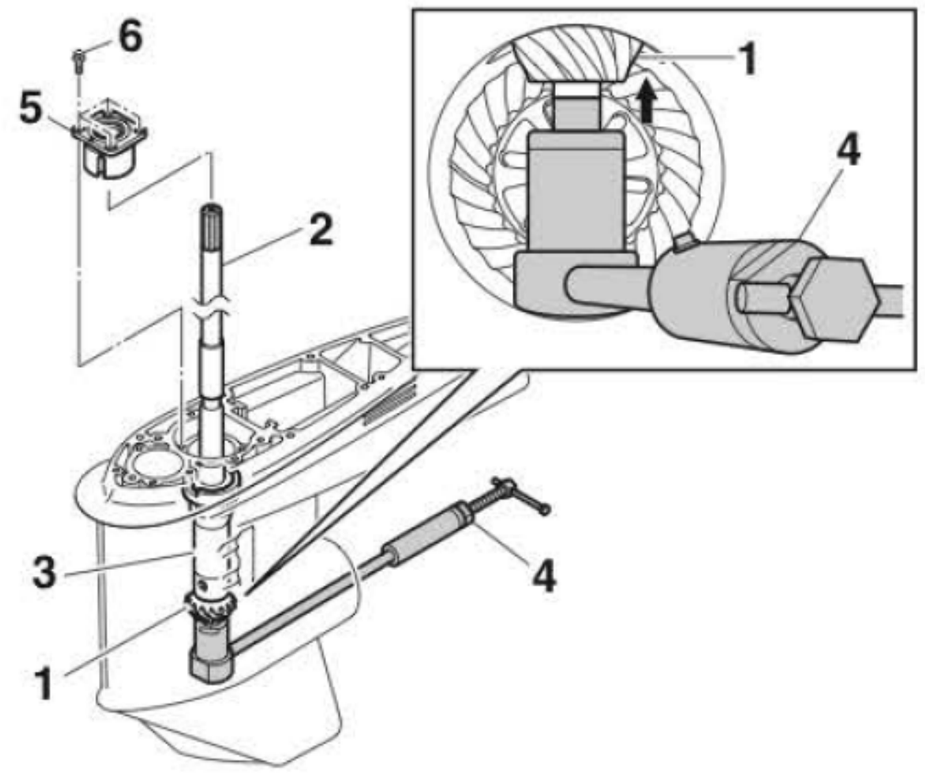


Drive shaft holder 5 "2" Driveshaft holder "2" Pinion nut holder "3" Pinion nut holder "3"

3. Remove the pinion "1", drive shaft "2", and sleeve "3".

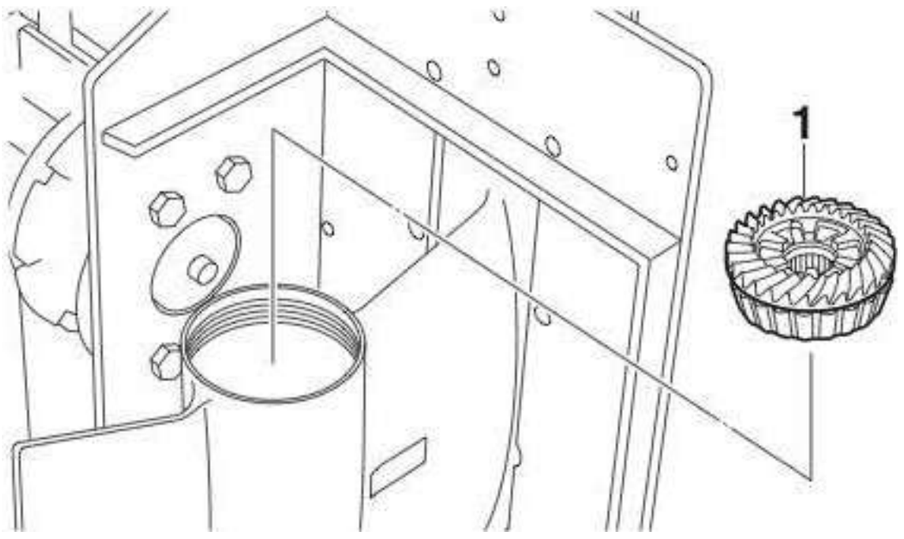
TIP:

- Use the special service tool "4" if the drive shaft "2" cannot be removed manually.
- When using the special service tool "4", install the drive shaft housing "5" temporarily using the bolt "6" to prevent the drive shaft "2" from popping out, and then apply force to the drive shaft "2" gradually.



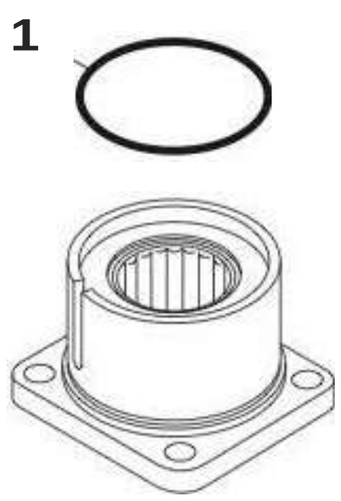
Hydraulic drive shaft pusher "4" Hydraulic drive shaft pusher "4"

4. Remove the forward gear assembly "1".

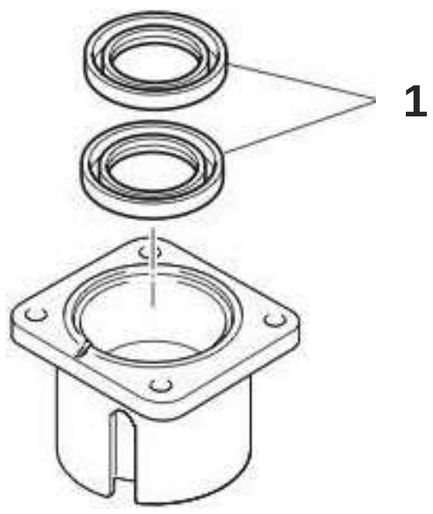


Disassembling the drive shaft housing

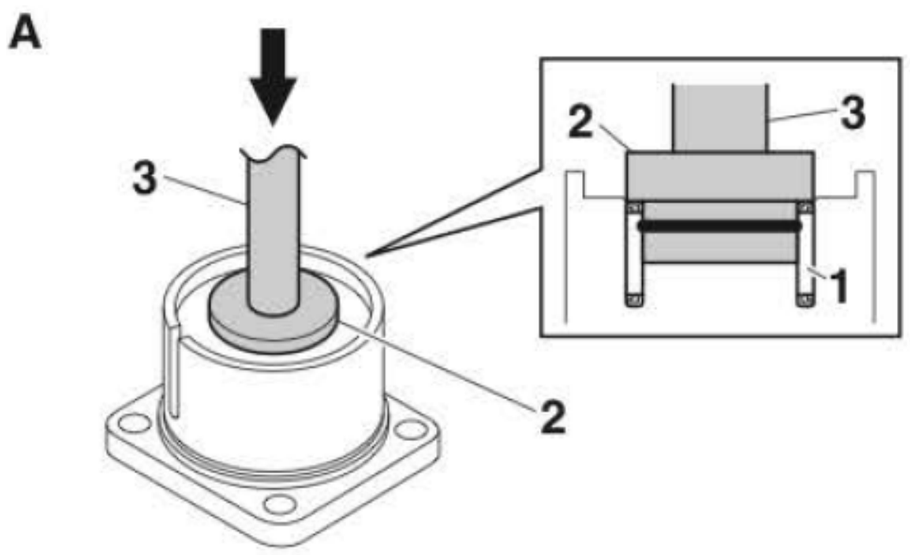
1. Remove the 0-ring "1".



2. Remove the oil seals "1".



3. Remove the needle bearing "1".

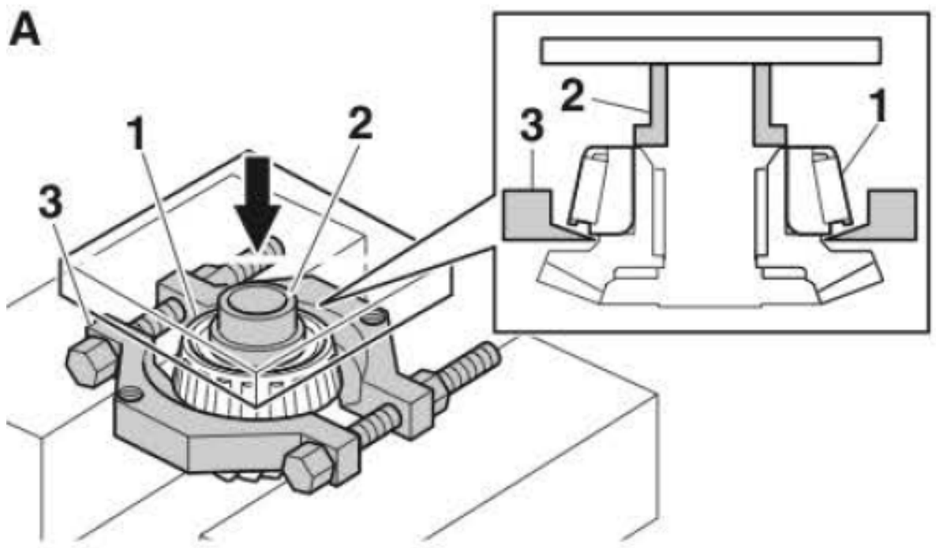


A. Worldwide
B. USA and Canada

Needle bearing attachment "2"
Driver rod L3 "3"
Driveshaft needle bearing installer and remover "4"
Driver handle (large) "5"

Disassembling the forward gear

1. Remove the tapered roller bearing inner race "1".



A. Worldwide
B. USA and Canada

Bearing inner race attachment "2"
Bearing separator "3"
Roller bearing installer/remover "4"
Bearing separator "5" (commercially available)

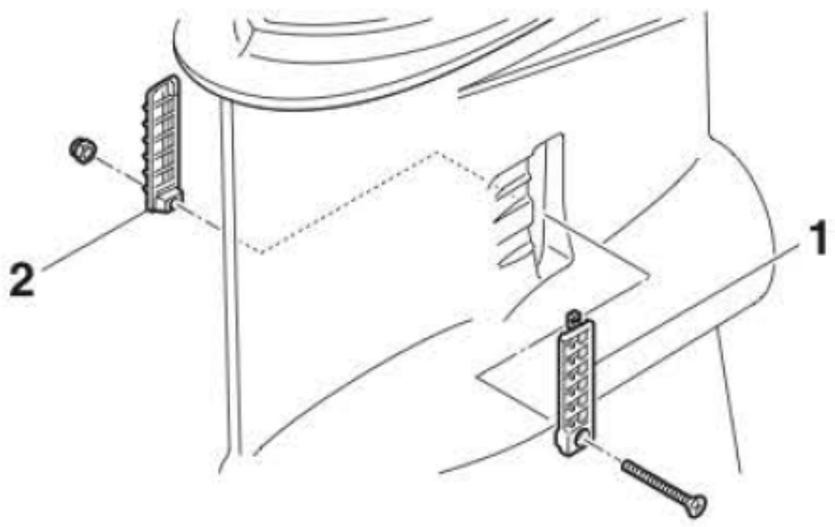
2. Remove the needle bearing from the forward gear.

Disassembling the lower case

⚠ WARNING

- **Use heat-resistant gloves. Otherwise, burns could result.**
- **To prevent fires, remove any flammable substances, such as gasoline and oil, around the working area.**
- **Keep good ventilation while working.**

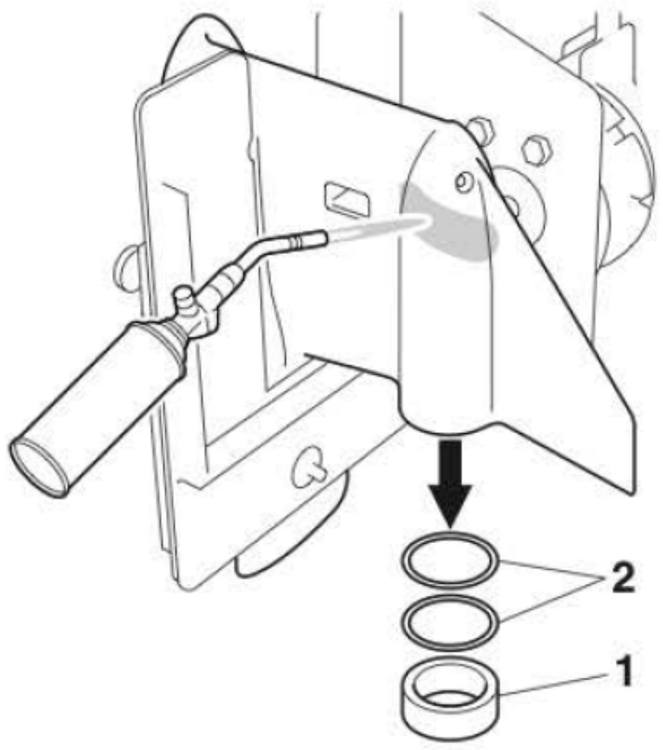
1. Remove the water inlet covers "1" and "2".



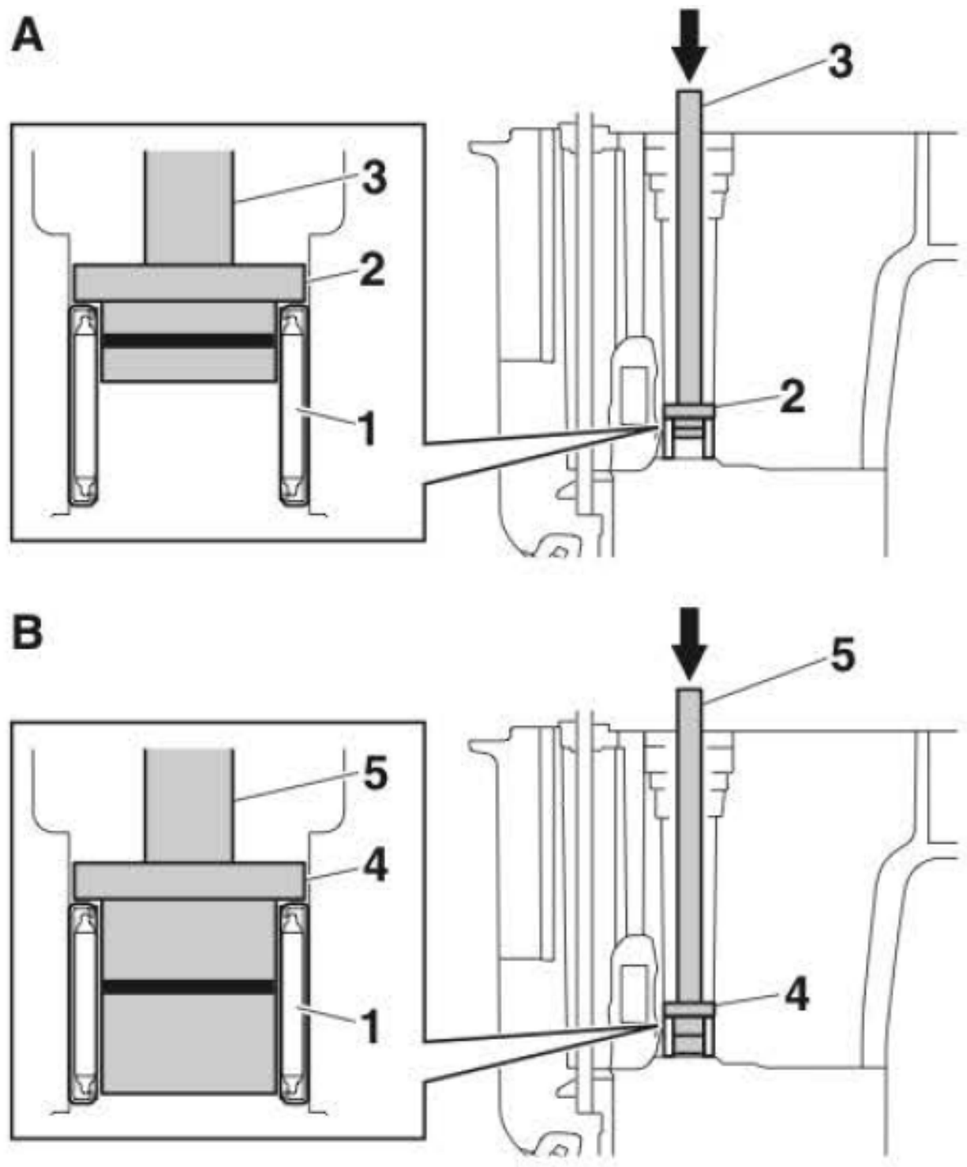
2. Heat the area of the lower case where the tapered roller bearing outer race is to be removed using a gas torch, and then remove the tapered roller bearing outer race "1" and forward gear shims "2".

NOTICE

When heating the lower case, heat the entire installation area evenly. Otherwise, the paint on the lower case could be burned.



3. Remove the needle bearing "1".



A. Worldwide
B. USA and Canada

Needle bearing attachment "2"
Driver rod L3 "3"
Driveshaft needle bearing installer and remover "4"
Driver handle (large) "5"

Checking the pinion

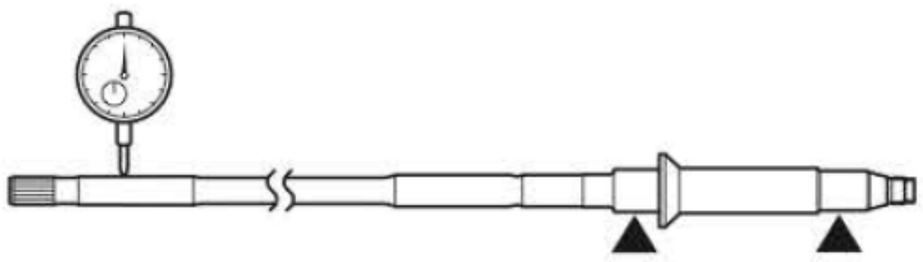
1. Check the teeth of the pinion. Replace if cracked or worn.

Checking the forward gear

1. Check the teeth and dogs of the forward gear. Replace if cracked or worn.

Checking the drive shaft

1. Check the drive shaft. Replace if damaged or worn.
2. Measure the drive shaft runout.



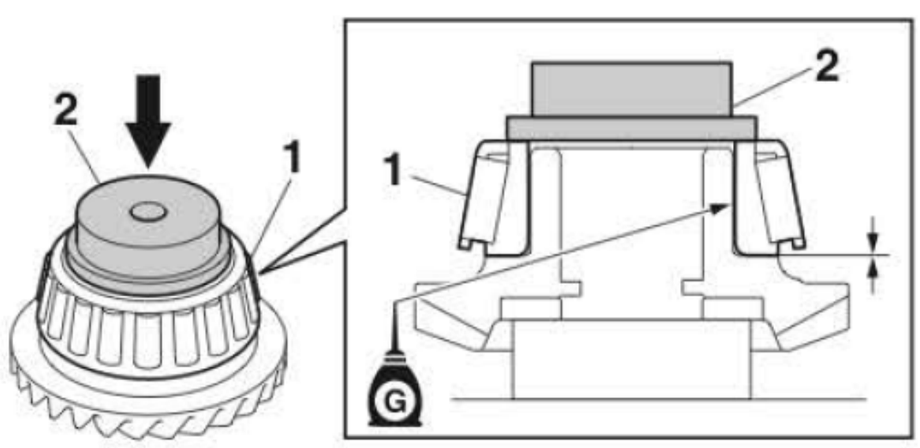
Drive shaft
Runout
0.03 mm (0.001 in)

Checking the lower case

1. Check the lower case. Replace if cracked or damaged.

Assembling the forward gear

1. Install a new tapered roller bearing inner race "1".

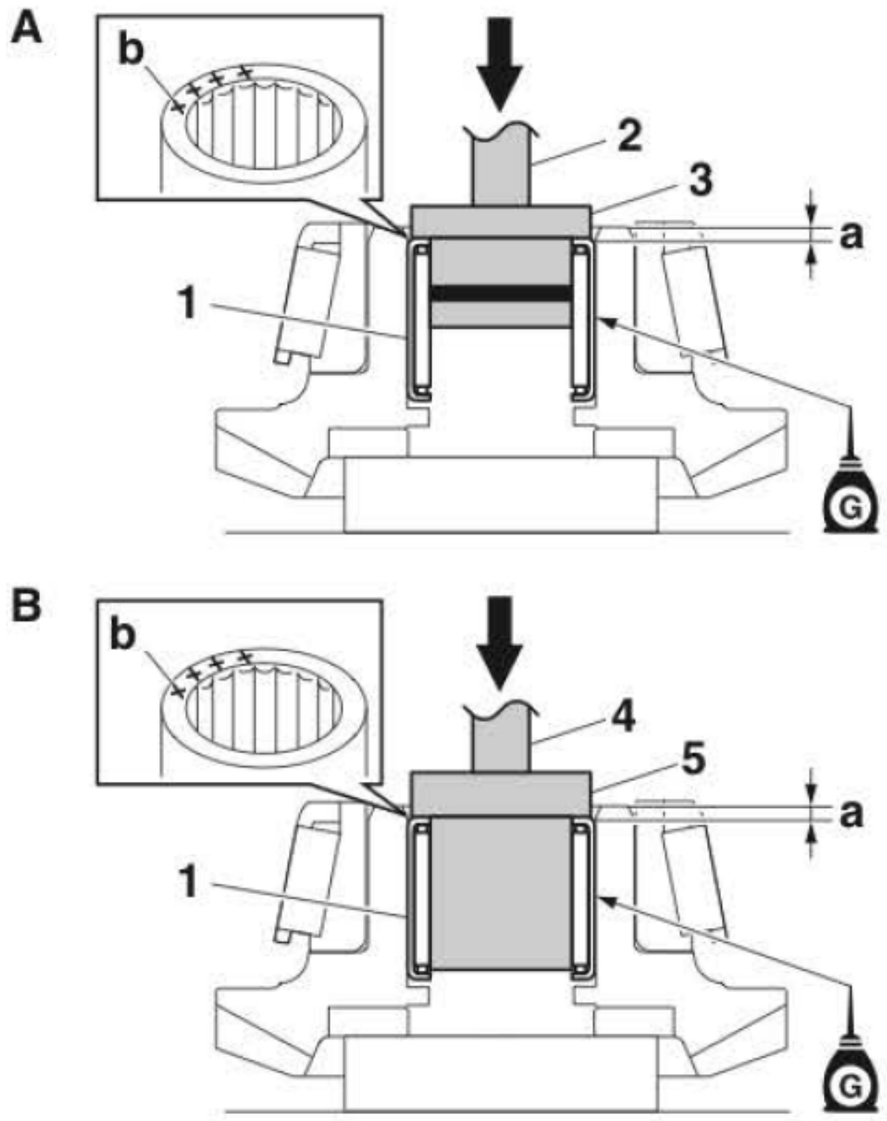


Needle bearing attachment "2"
Forward gear outer race installer "2"

2. Install a new needle bearing "1" at the specified installation depth "a".

TIP:

Face the bearing identification mark "b" on the needle bearing up.



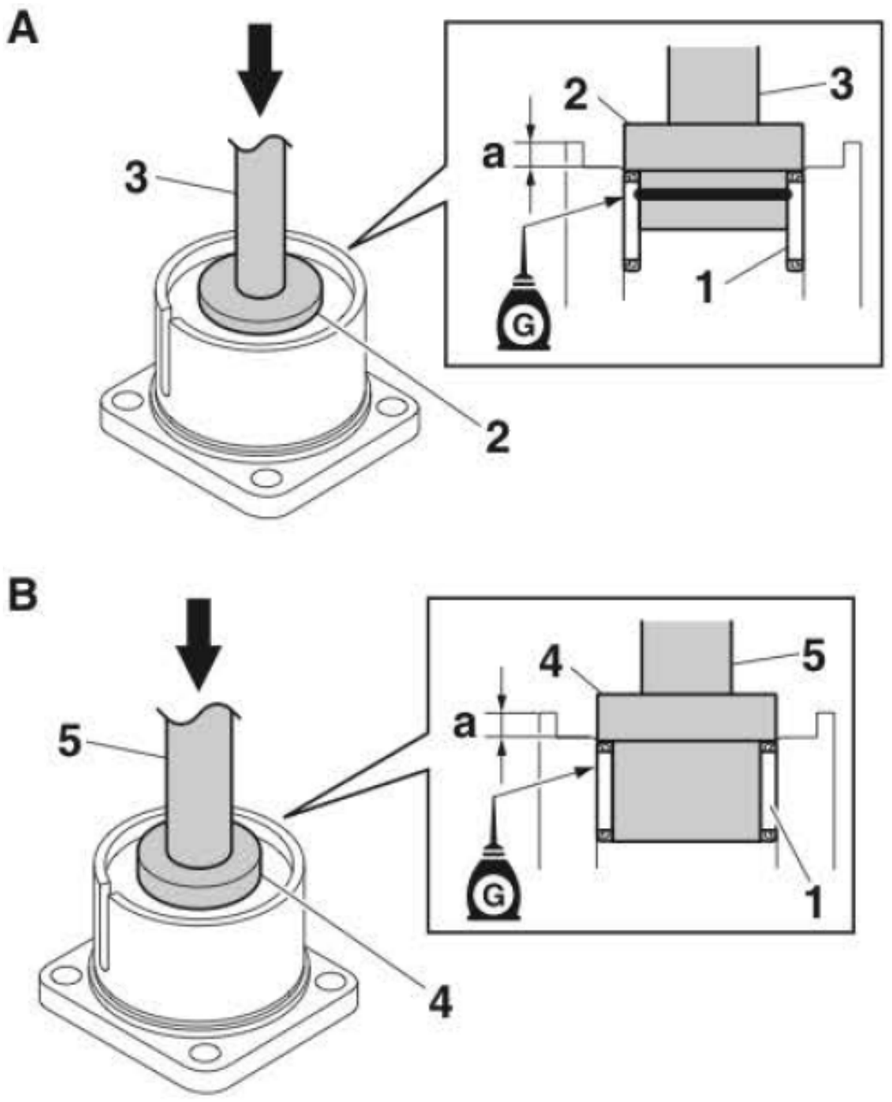
A. Worldwide
B. USA and Canada

Driver rod L3 "2"
Needle bearing attachment "3"
Driver handle (large) "4"
Propshaft needle bearing attachment "5"

Installation depth
2.50-3.50 mm (0.0984-0.1378 in)

Assembling the drive shaft housing

1. Install a new needle bearing "1" in the drive shaft housing at the specified installation depth "a".



A. Worldwide
B. USA and Canada

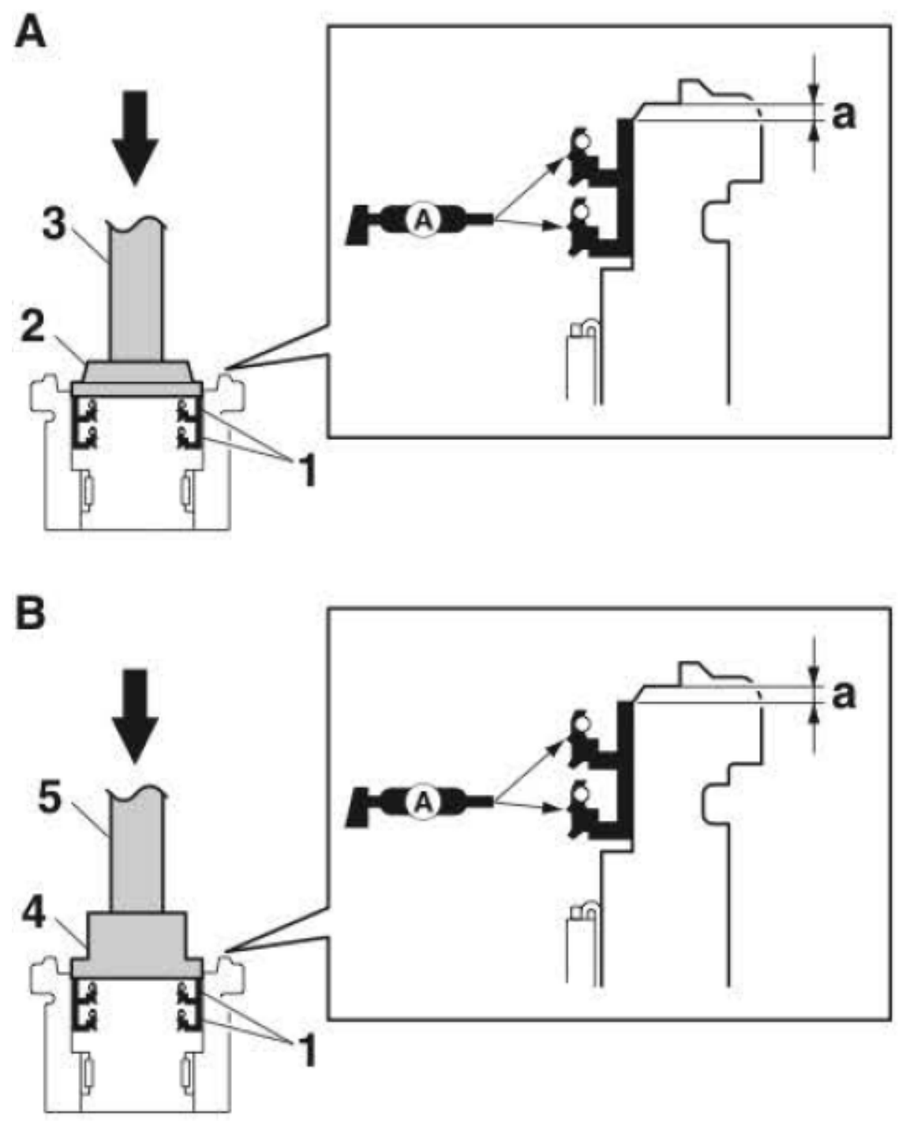
Needle bearing attachment "2"
Driver rod L3 "3"
Driveshaft needle bearing installer and remover "4"
Driver handle (large) "5"

Installation depth 5.75-6.25 mm (0.226-0.246 in)

2. Install new oil seals "1" in the drive shaft housing at the specified installation depth "a".

TIP:

Install an oil seal halfway into the drive shaft housing, and then install the other oil seal.

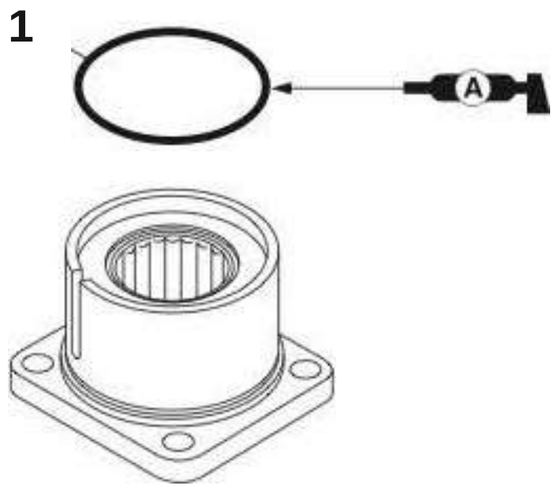


A. Worldwide
B. USA and Canada

Bearing outer race attachment "2"
Driver rod LS "3"
Bearing cup installer "4"
Driver handle (large) "5"

Installation depth 0.25-0.75 mm (0.010-0.030 in)

3. Install a new 0-ring "1".



Assembling the lower case

⚠ WARNING

- **Use heat-resistant gloves. Otherwise, burns could result.**
- **To prevent fires, remove any flammable substances, such as gasoline and oil, around the working area.**
- **Keep good ventilation while working.**

1. Install the original forward gear shims "1".

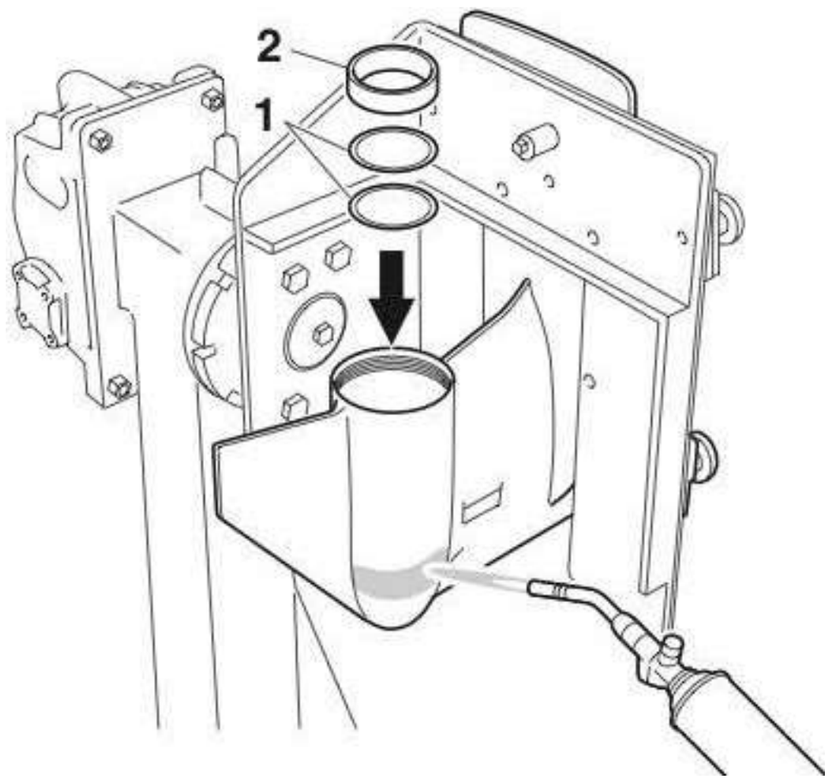
2. Heat the area of the lower case where the tapered roller bearing outer race is to be installed using a gas torch, and then install a new tapered roller bearing outer race "2".

NOTICE

When heating the lower case, heat the entire installation area evenly. Otherwise, the paint on the lower case could be burned.

TIP:

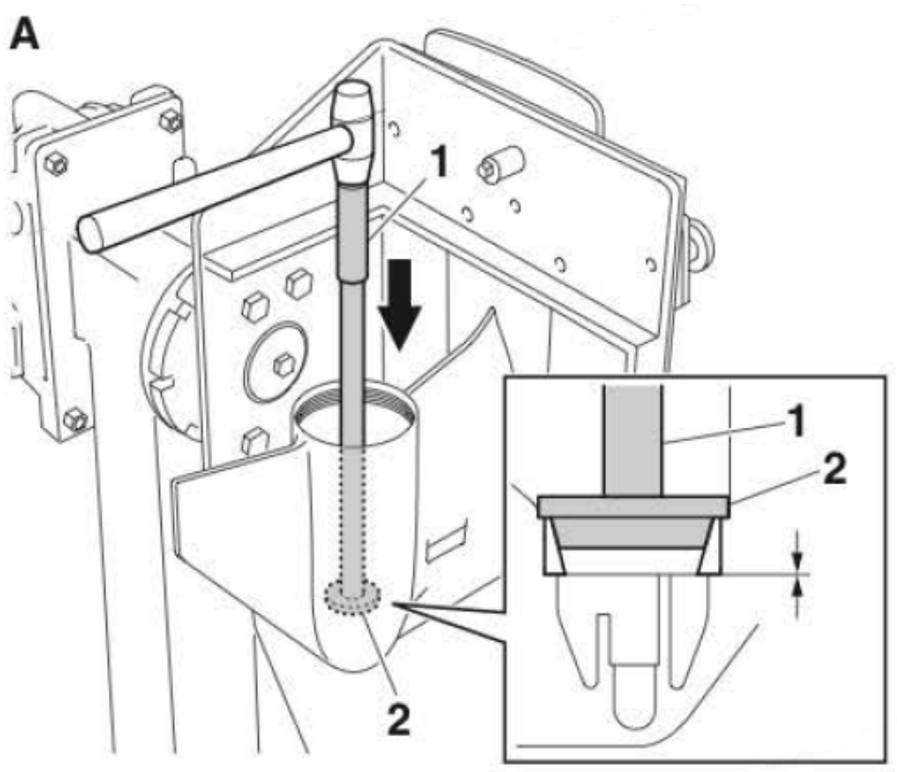
Do not reuse a shim if deformed or scratched.

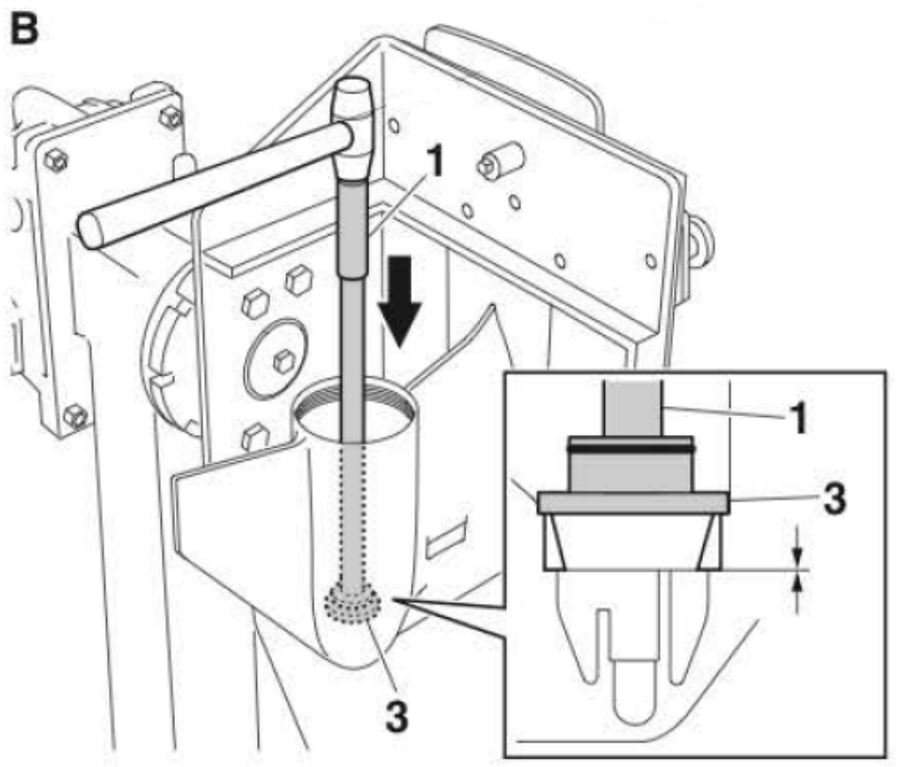


3. While holding the special service tool "1", strike the tool to check that the tapered roller bearing outer race is installed properly.

TIP:

If a high-pitched metallic sound is produced when the special service tool is struck, the outer race is installed properly.



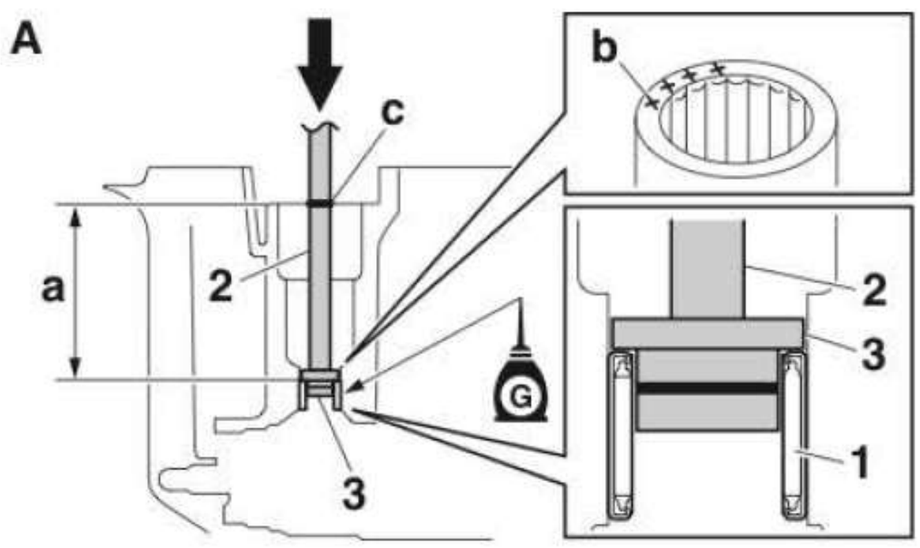


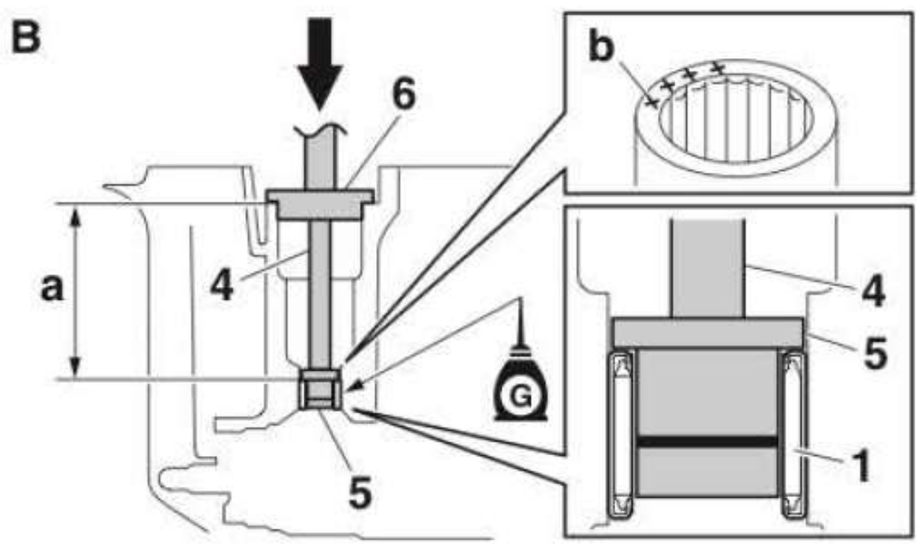
A. Worldwide
B. USA and Canada

Driver rod LL "1"
Driver handle (large) "1"
Bearing outer race attachment "2"
Forward gear outer race installer "3"

4. Install a new needle bearing "1" in the lower case at the specified installation depth "a".

TIP:
- Face the bearing identification mark "b" on the needle bearing up.
- Mark the driver handle at the specified installation depth "a" with an identification mark "c", and then install the needle bearing to the specified installation depth. Make sure to measure the depth on the driver handle from the flange bottom of the special service tool "2".





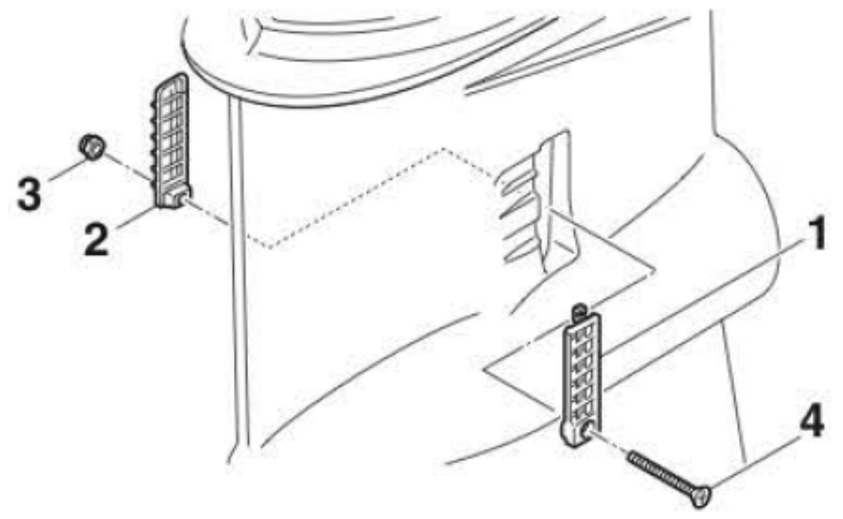
A. Worldwide
B. USA and Canada

Driver rod L3 "2"
Needle bearing attachment "3"
Driver handle (large) "4"
Driveshaft needle bearing installer and remover "5"
Drivershaft Bearing Depth Plate "6"

Installation depth 167.75–168.25 mm (6.604-6.624 in)

5. Install the water inlet covers "1" and "2", nut "3", and water inlet cover screw "4", and then tighten the water inlet cover screw "4" to the specified torque.

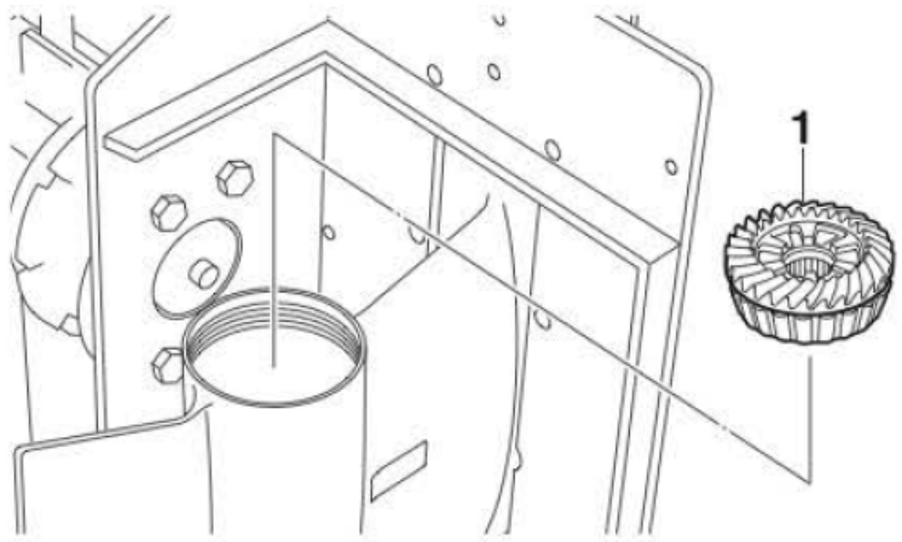
TIP:
After installing the water inlet covers, make sure that there is no rattling.



Water inlet cover screw "4" 1 Nm (0.1 kgf-m, 0.7 ft-lb)

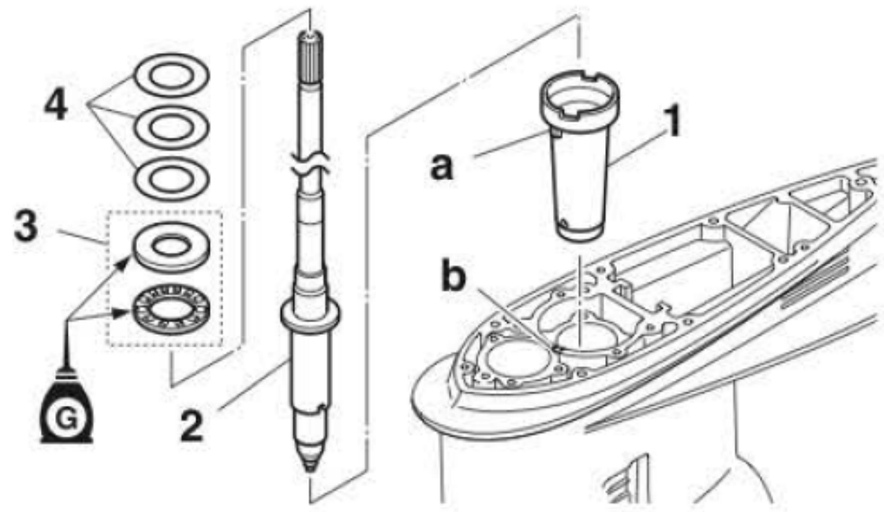
Installing the drive shaft

1. Install the forward gear assembly "1".



2. Install the sleeve "1", drive shaft "2", thrust bearing "3", and original pinion shims "4".

TIP:
Make sure that the protrusion "a" on the sleeve "1" is aligned with the slot "b" in the lower case.

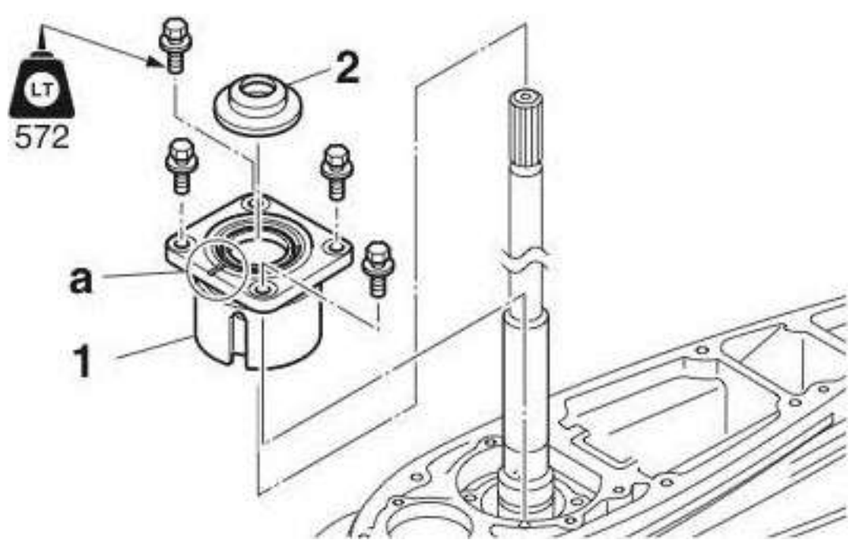


3. Install the pinion and pinion nut temporarily.

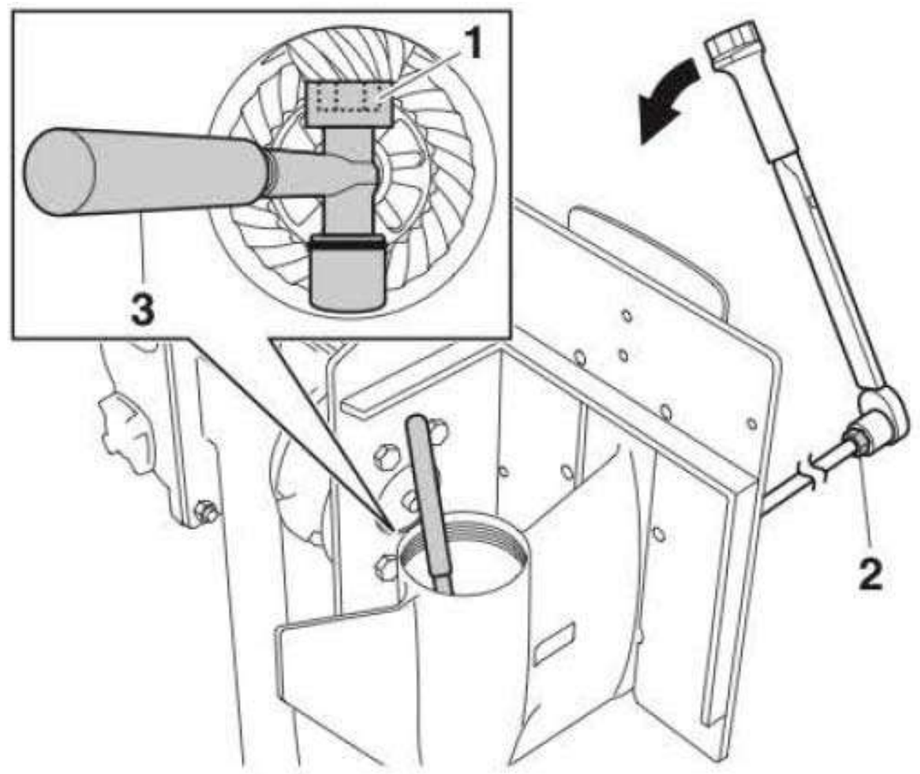
TIP:
When installing the pinion, lift up the drive shaft slightly and align the splines on the drive shaft with the splines on the pinion.

4. Install the drive shaft housing "1" and cover "2" into the lower case.

TIP:
Make sure to face the cutout "a" in the drive shaft housing "1" forward.



5. Tighten the pinion nut "1" to the specified torque.



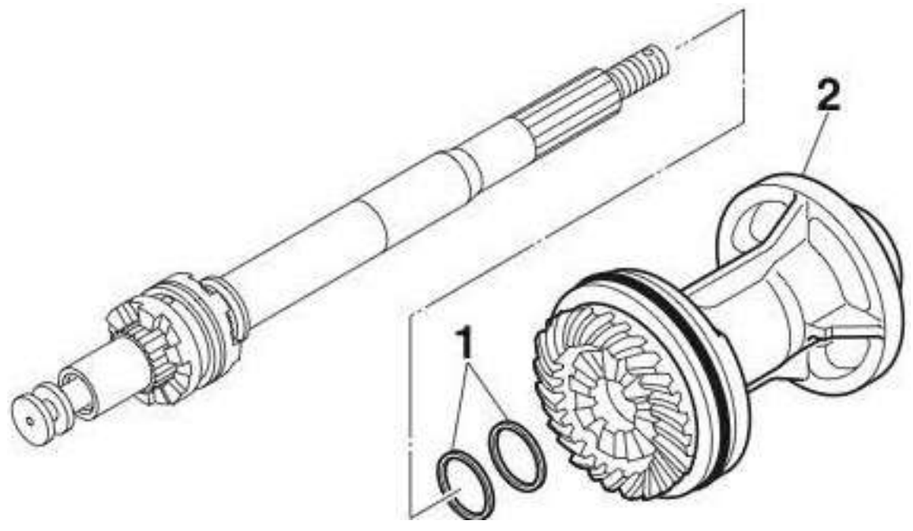
Drive shaft holder 5 "2"
Driveshaft holder "2"
Pinion nut holder "3"
Pinion nut holder "3"

Pinion nut "1"
94 Nm (9.4 kgf·m, 69.3 ft·lb)

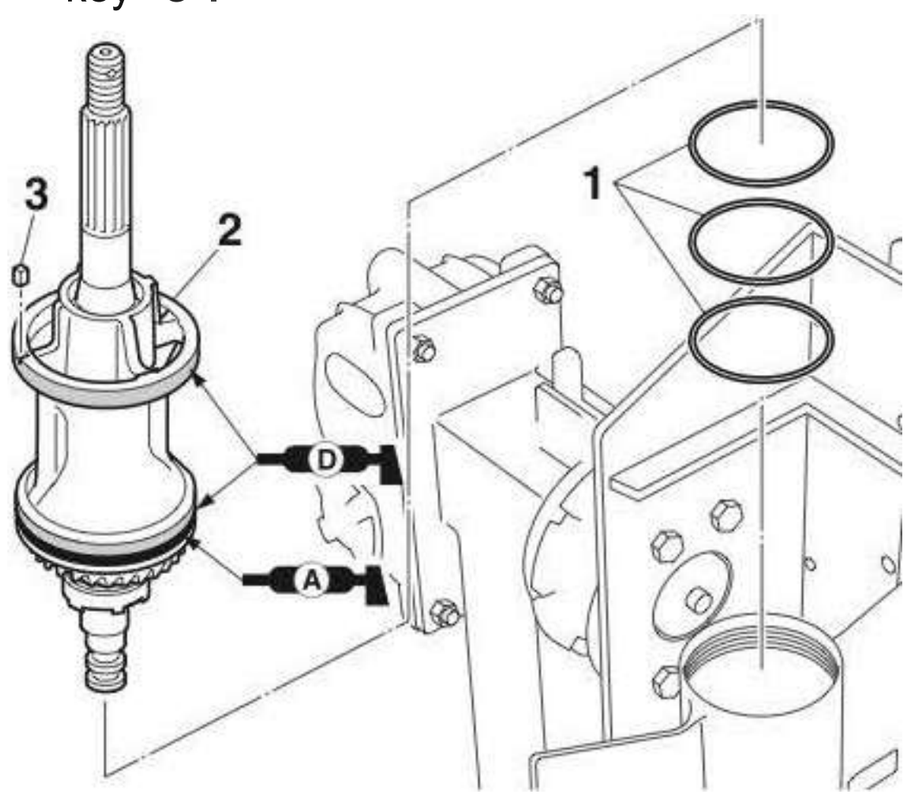
6. Check that the drive shaft turns smoothly.

Installing the propeller shaft housing assembly

1. Install the washers "1" and propeller shaft housing assembly "2".



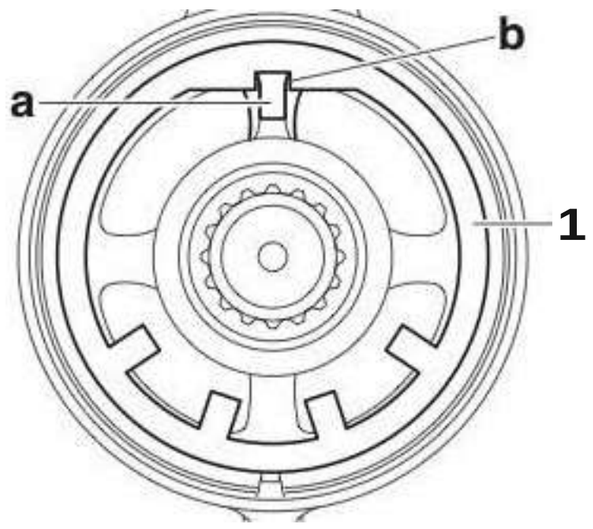
2. Install the original reverse gear shims "1", propeller shaft housing assembly “2”, and key "3".



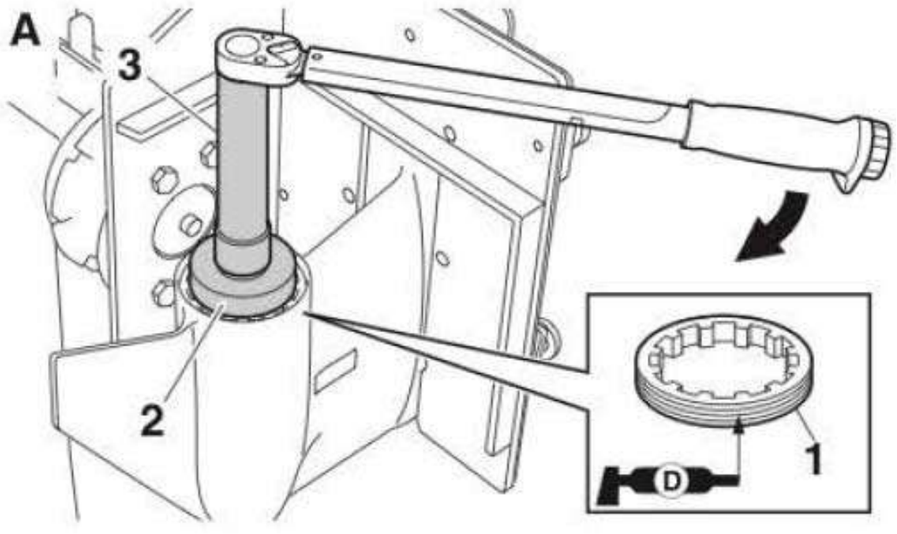
3. Install the claw washer "1".

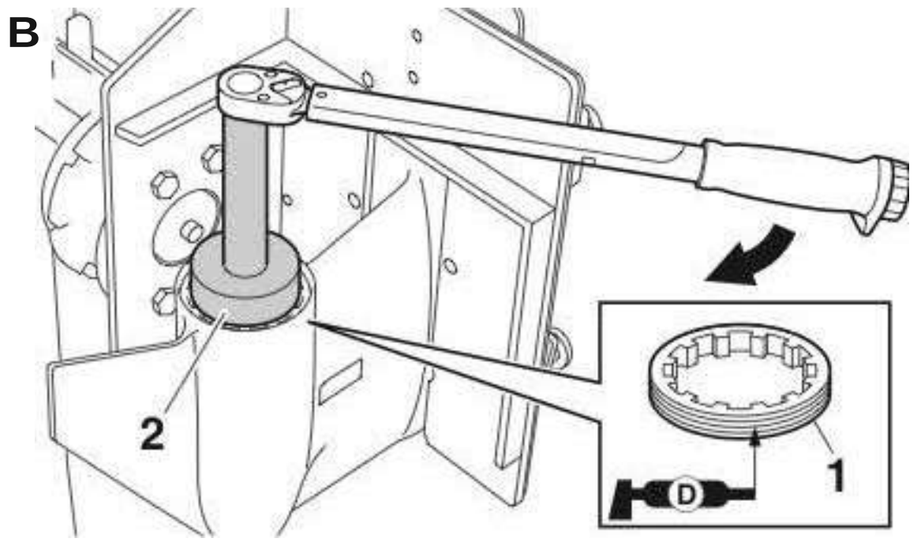
TIP:

Make sure to fit the protrusion "a" on the propeller shaft housing into the slot "b" in the claw washer "1".



4. Install the ring nut "1", and then tighten it to the specified torque.



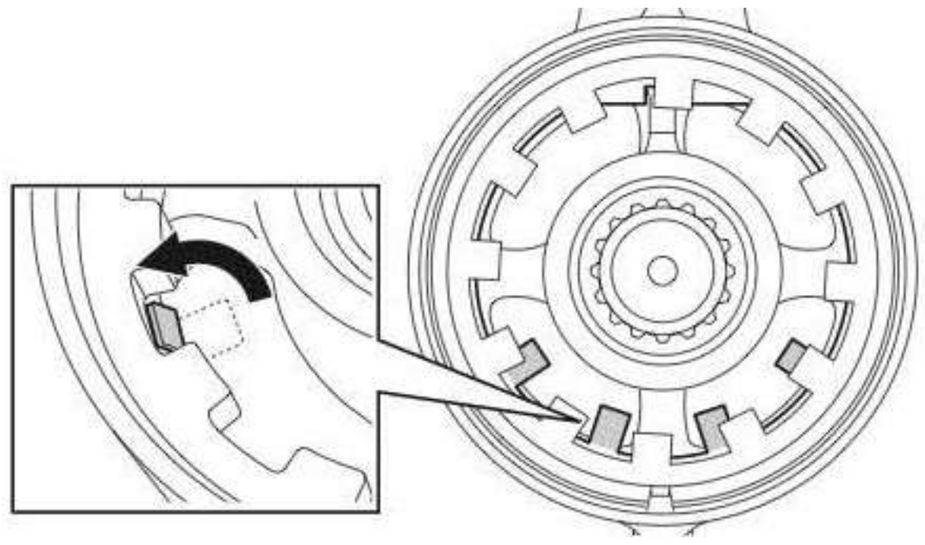


A. Worldwide
B. USA and Canada

Ring nut wrench 3 "2" Gland nut wrench "2" Ring nut wrench extension "3"

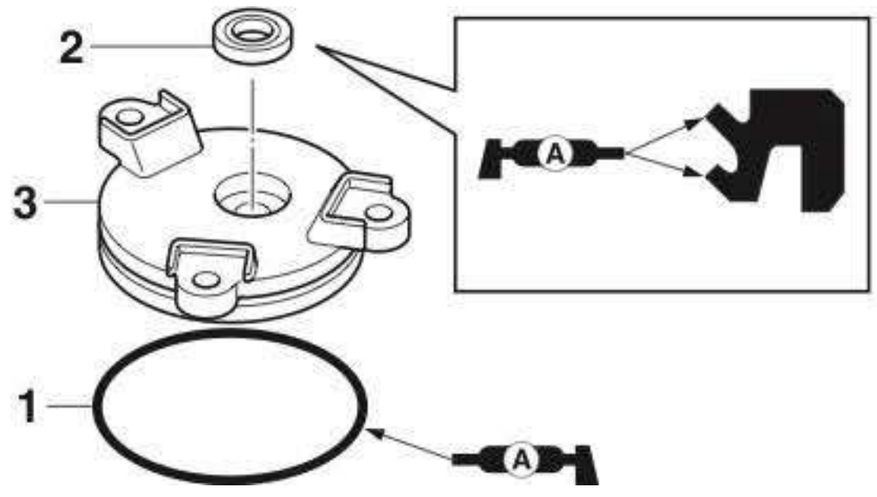
Ring nut "1" 103 Nm (10.3 kgf·m, 76.0 ft·lb)

5. Bend one of the 4 tabs on the claw washer outward, and then bend the other 3 tabs inward.

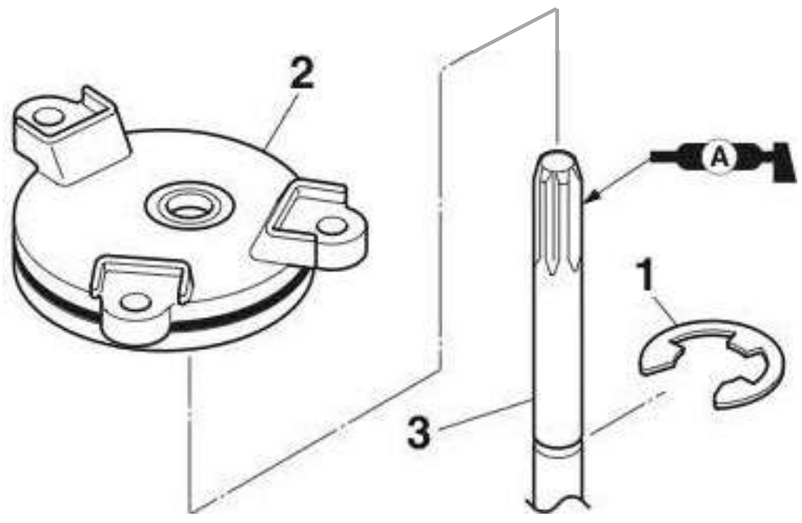


Installing the shift rod

1. Install a new 0-ring "1" and a new oil seal "2" to the plate "3".



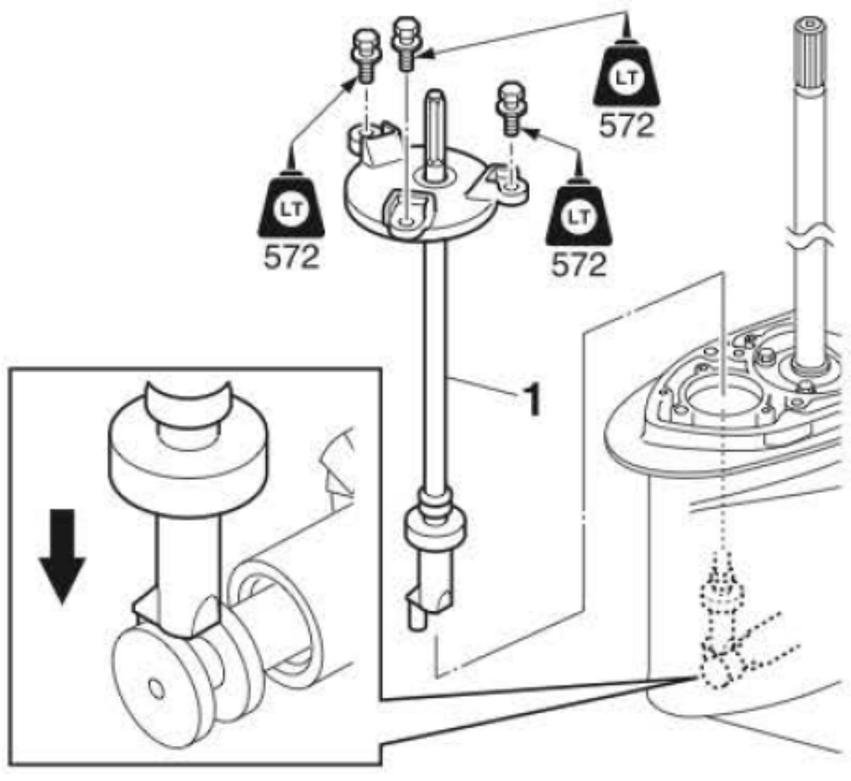
2. Install the E-clip "1" and plate "2" to the shift rod "3".



3. Install the shift rod "1".

TIP:

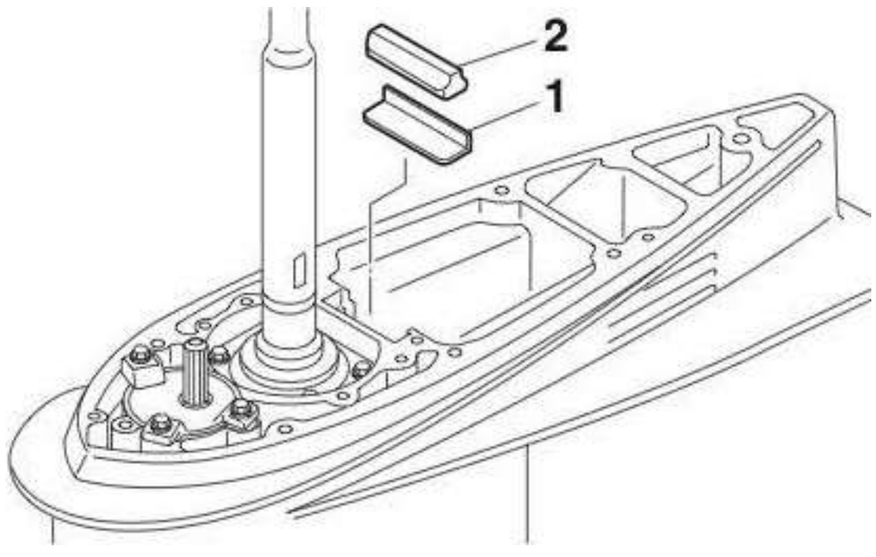
Make sure to install the shift rod "1" in the proper orientation. Installation orientation is different between the counter rotation model and the regular rotation model.



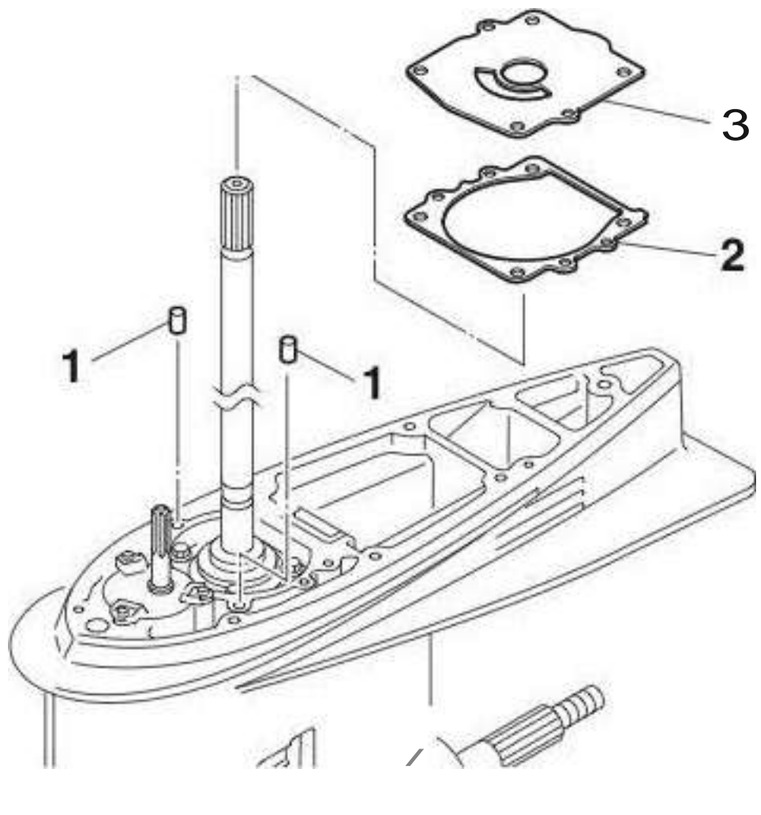
4. Check that the shift rod operates smoothly.

Installing the water pump

1. Install the plate "1" and rubber seal "2".

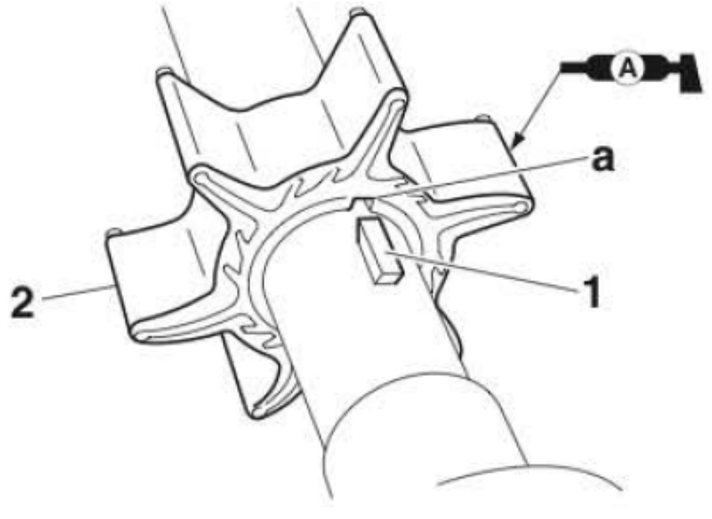


2. Install the dowel pins "1", a new gasket "2", and the outer plate cartridge "3".



3. Install the impeller key "1".

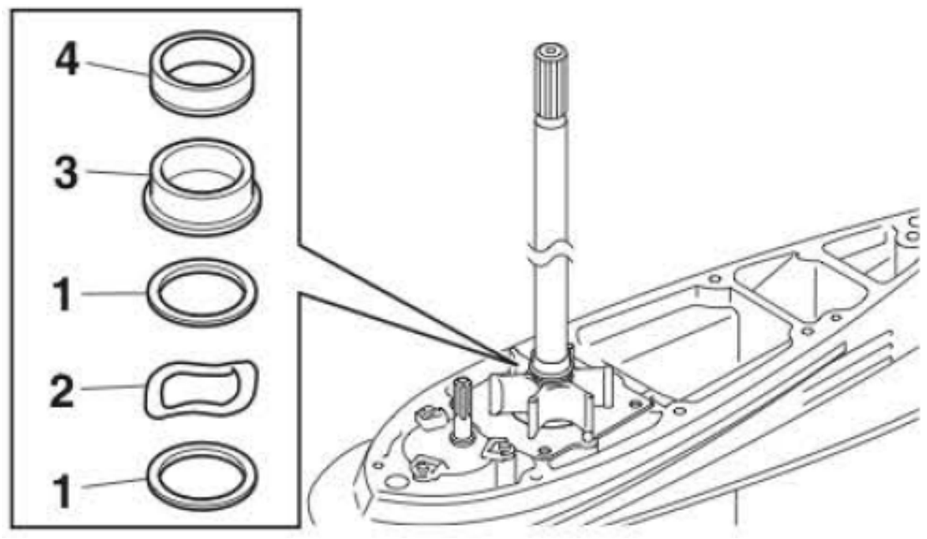
4. Align the slot "a" in the impeller "2" with the impeller key "1", and then install the impeller "2".



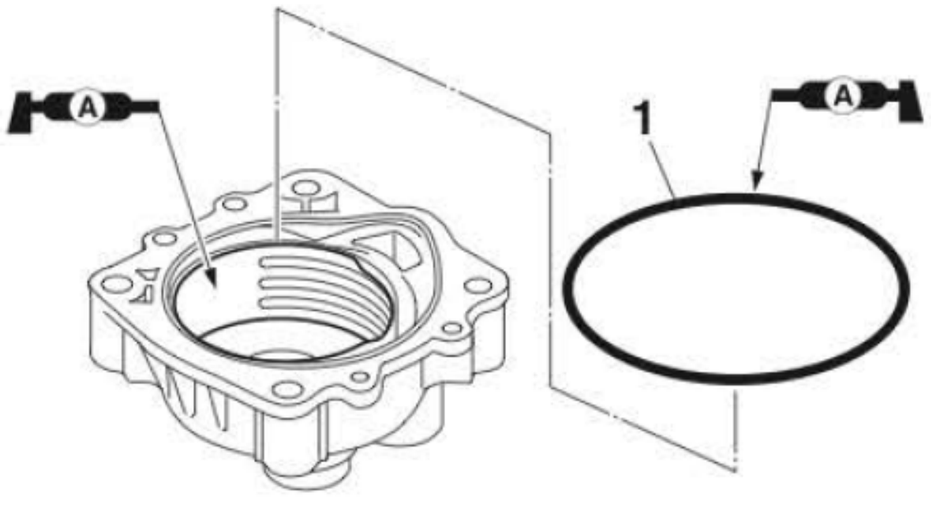
5. Install the washers "1", wave washer "2", spacer "3", and collar "4".

TIP:

The spacer "3" and collar "4" should fit together firmly.



6. Install a new O-ring "1".



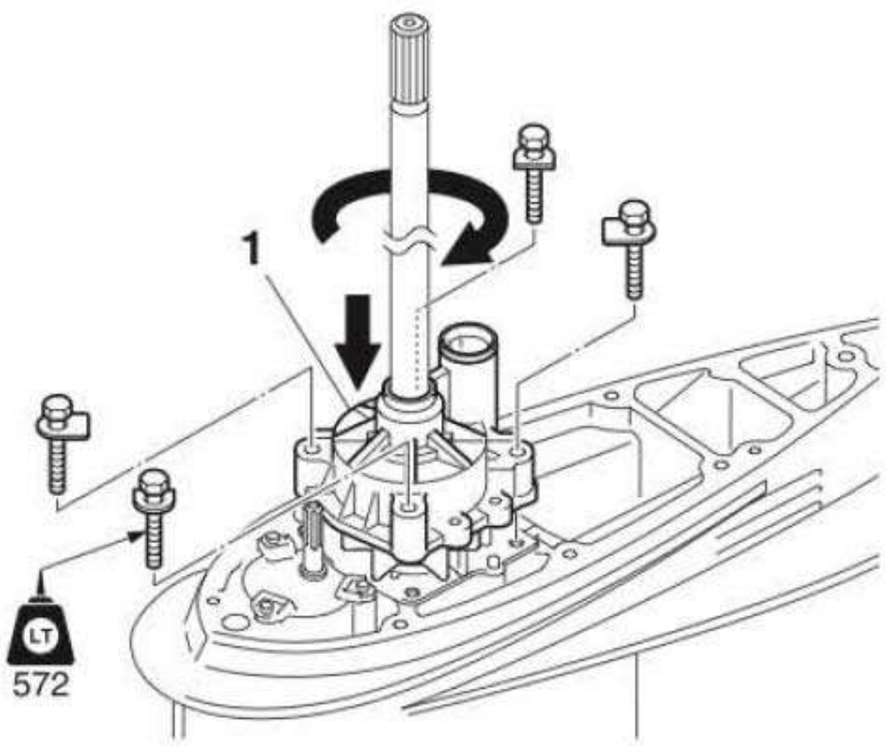
7. Install the water pump housing "1".

NOTICE

Do not turn the drive shaft counterclockwise. Otherwise, the water pump impeller could be damaged.

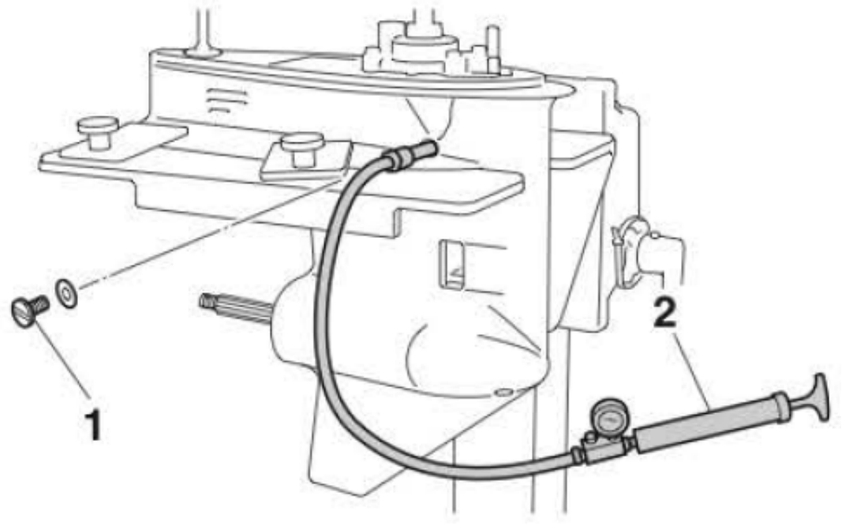
TIP:

While turning the drive shaft clockwise, push the water pump housing down to install it.



Checking the lower unit for air leakage

1. Remove the oil level plug "1", and then install the special service tool "2".



Leakage tester "2"
Leakage tester "2" (commercially available)

2. Apply the specified pressure. Check that the pressure is maintained in the lower unit for 10 seconds or more.

NOTICE

Do not overpressurize the lower unit. Otherwise, the oil seals could be damaged.

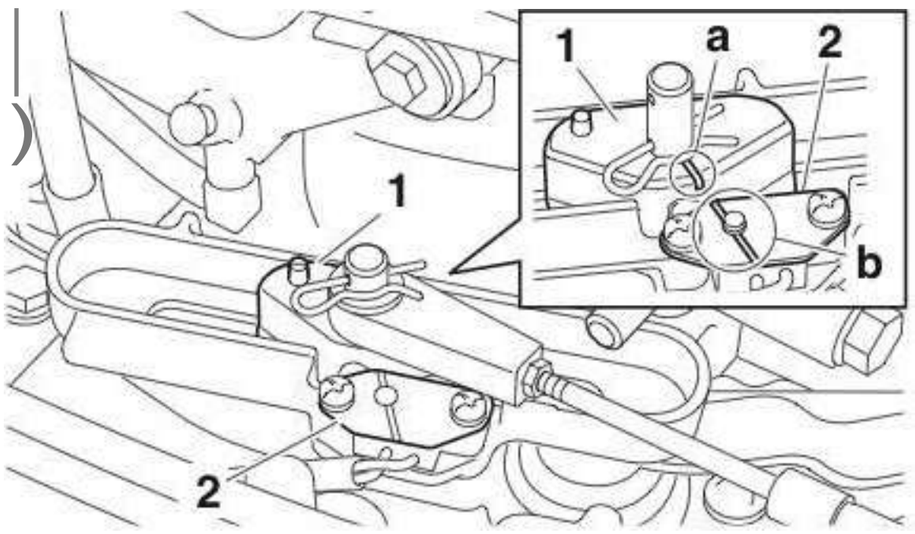
Lower unit Holding pressure 68.6 kPa (0.69 kgf/cm^2, 9.9 psi)

Installing the lower unit

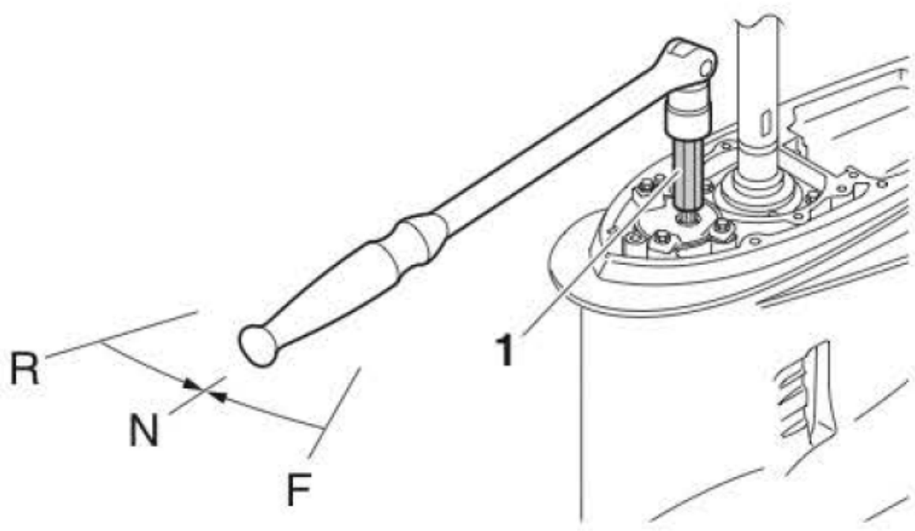
⚠ WARNING

- **Make sure to disconnect the battery cables from the battery, and remove the clip from the engine shut-off switch.**
- **When installing the lower unit with the power unit installed, make sure to suspend the outboard motor. Otherwise, the outboard motor could fall suddenly and result in severe injuries.**
- **When loosening or tightening the propeller nut, do not hold the propeller using your hands.**

1. Check that the mark "a" on the bushing "1" is aligned with the mark "b" on the plate "2".



2. Set the gear shift to the N position.

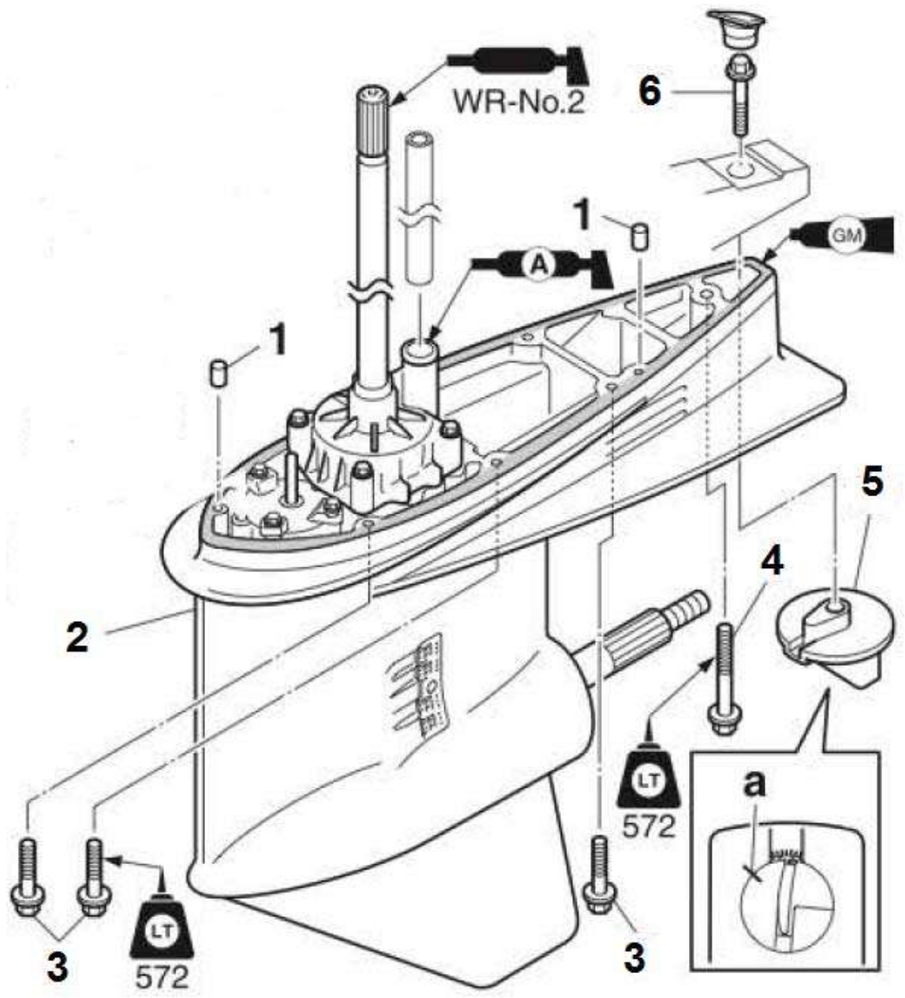


Shift rod socket "1"
Shift rod socket "1"

3. Install the dowel pins "1".

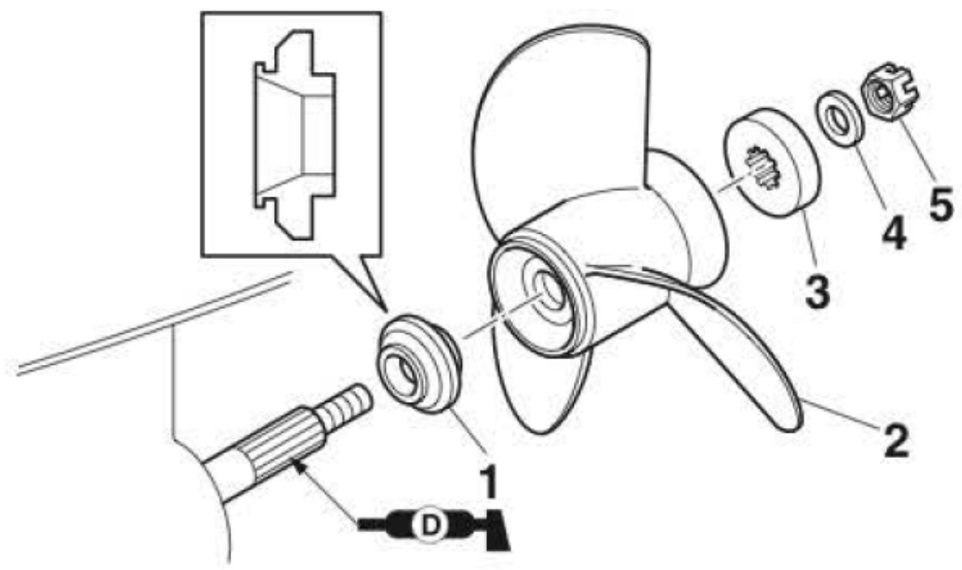
4. Install the lower unit "2", and then tighten the lower case mounting bolts "3" and "4" to the specified torque.

5. Install the trim tab "5" to its original position "a", and then tighten the trim tab bolt "6" to the specified torque.

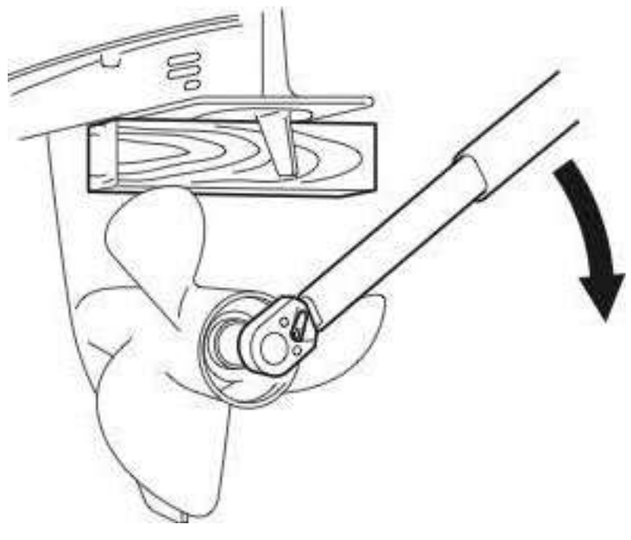


Lower case mounting bolts "8" and "9" 40 Nm (4.0 kgf·m, 29.5 ft·lb) Trim tab bolt "11" 42 Nm (4.2 kgf·m, 31.0 ft·lb)

6. Install the spacer "1", propeller "2" spacer "3", washer "4", and propeller nut "5".



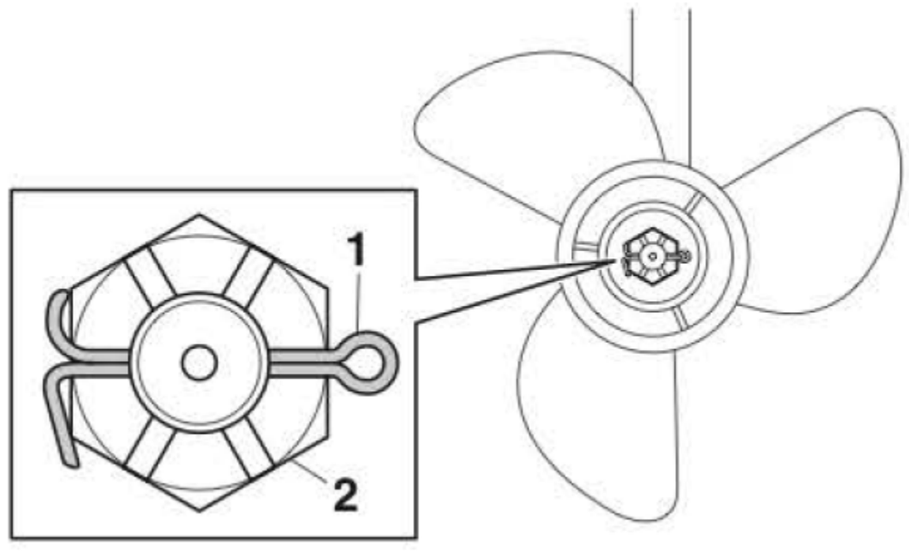
7. Place a block of wood between the anti-cavitation plate and the propeller to prevent the propeller from turning, and then tighten the propeller nut to the specified torque.



Propeller nut
55 Nm (5.5 kgf·m, 40.6 ft·lb)

8. Install a new cotter pin "1".

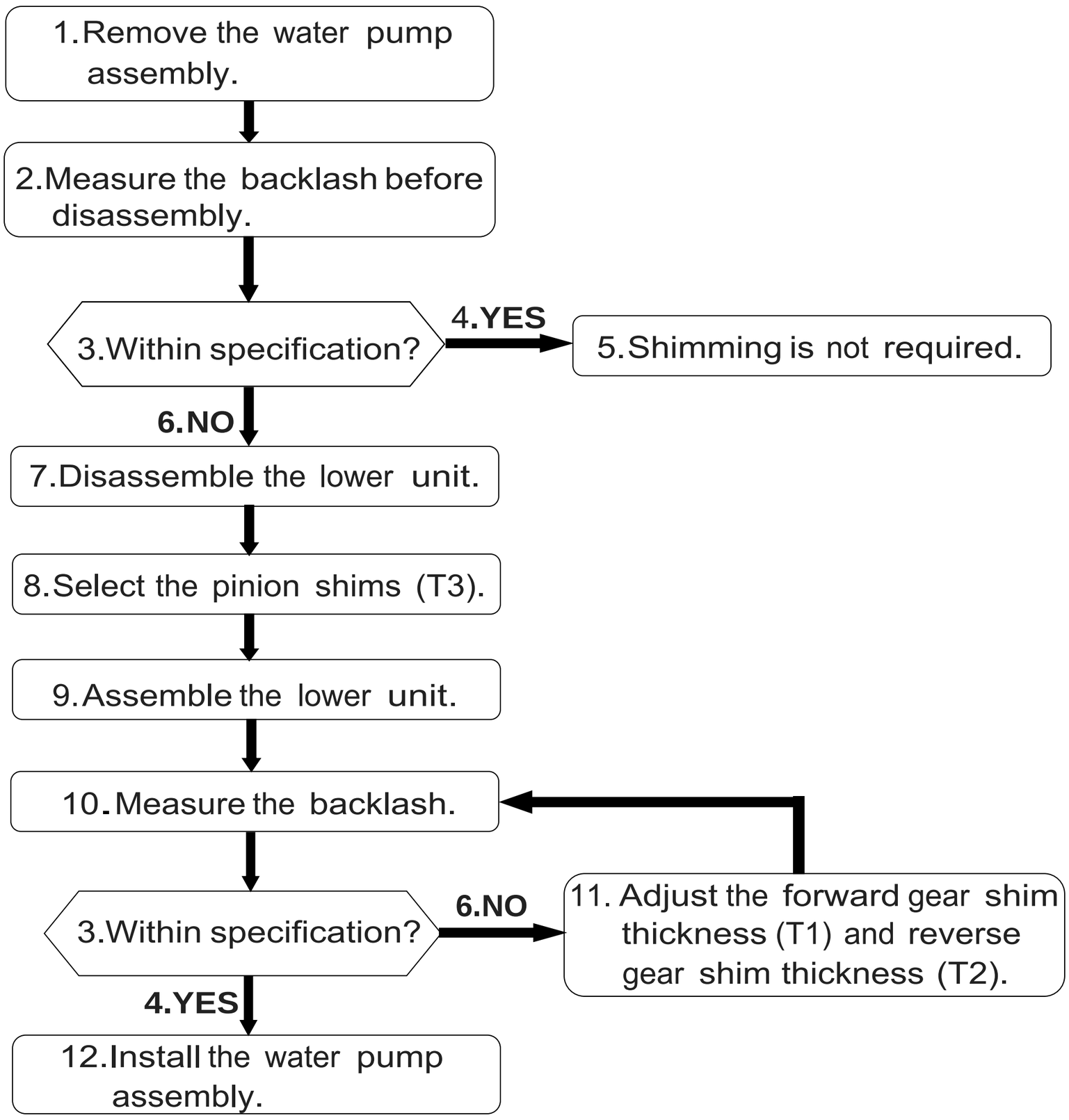
TIP:
If the slots in the propeller nut "2" are not aligned with the cotter pin hole, tighten the propeller nut until they are aligned.



9. Fill the lower unit with gear oil up to the proper level. See steps 4– 6 in "Changing the gear oil" (10-14).

Shimming (regular rotation model)

Shimming workflow



1. Remove the water pump assembly.
2. Measure the backlash before disassembly.
3. Within specification?
4. YES
5. Shimming is not required.
6. NO
7. Disassemble the lower unit.
8. Select the pinion shims (T3).
9. Assemble the lower unit.
10. Measure the backlash.
11. Adjust the forward gear shim thickness (T1) and reverse gear shim thickness (T2).
12. Install the water pump assembly.

TIP:

- Make sure to drain the gear oil before measuring the backlash.
- If the backlash is within specification, shimming is not required.
- When assembling the original inner parts and a new lower case, shimming is required.
- When replacing the pinion, forward gear, reverse gear, bearings, drive shaft, or propeller shaft housing, shimming is required.

Shimming check sheet

Lower case deviation

Serial number	p	F	R	Remarks

Pinion height

	Measurements (mm)		
Measuring point "a"			
Measuring point "b"			
Measuring point "c"			
Measuring point "d"			
Average			
Round-down average (M)			

Forward gear backlash

	Measurements (mm)					
	Before disassembly			After disassembly		
Measuring point "a"						
Measuring point "b"						
Measuring point "c"						
Measuring point "d"						
Average						
Round-down average						

Reverse gear backlash

	Measurements (mm)					
	Before disassembly			After disassembly		
Measuring point "a"						
Measuring point "b"						
Measuring point "c"						
Measuring point "d"						
Average						
Round-down average						

Forward gear shim (T1) thickness measurement in 2 places

(mm)	Number of shim(s)			Subtotal
0.10				
0.12				
0.15				
0.18				
0.30				
0.40				
0.50				
Total				

Reverse gear shim (T2) thickness measurement in 2 places

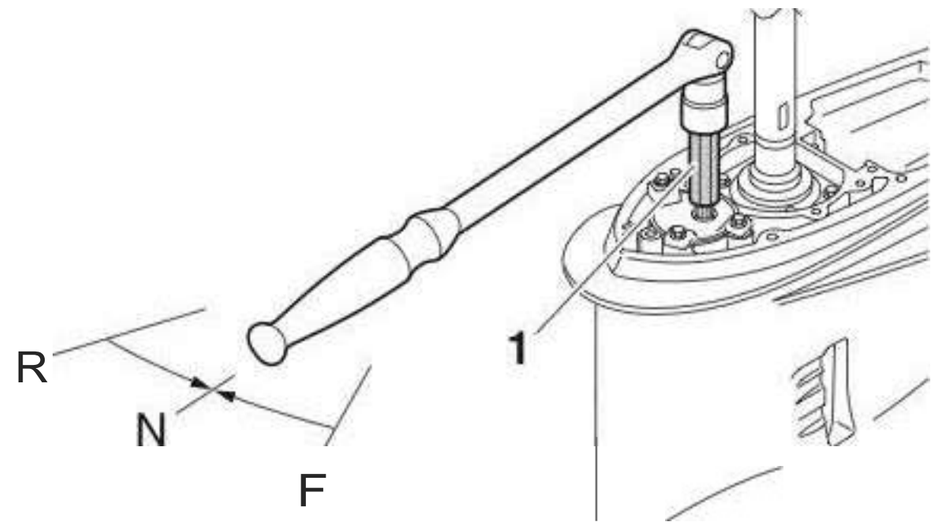
(mm)	Number of shim(s)			Subtotal
0.10				
0.12				
0.15				
0.18				
0.30				
0.40				
0.50				
Total				

Measuring the forward gear backlash and reverse gear backlash before disassembly

1. Install the lower unit onto a repair stand.

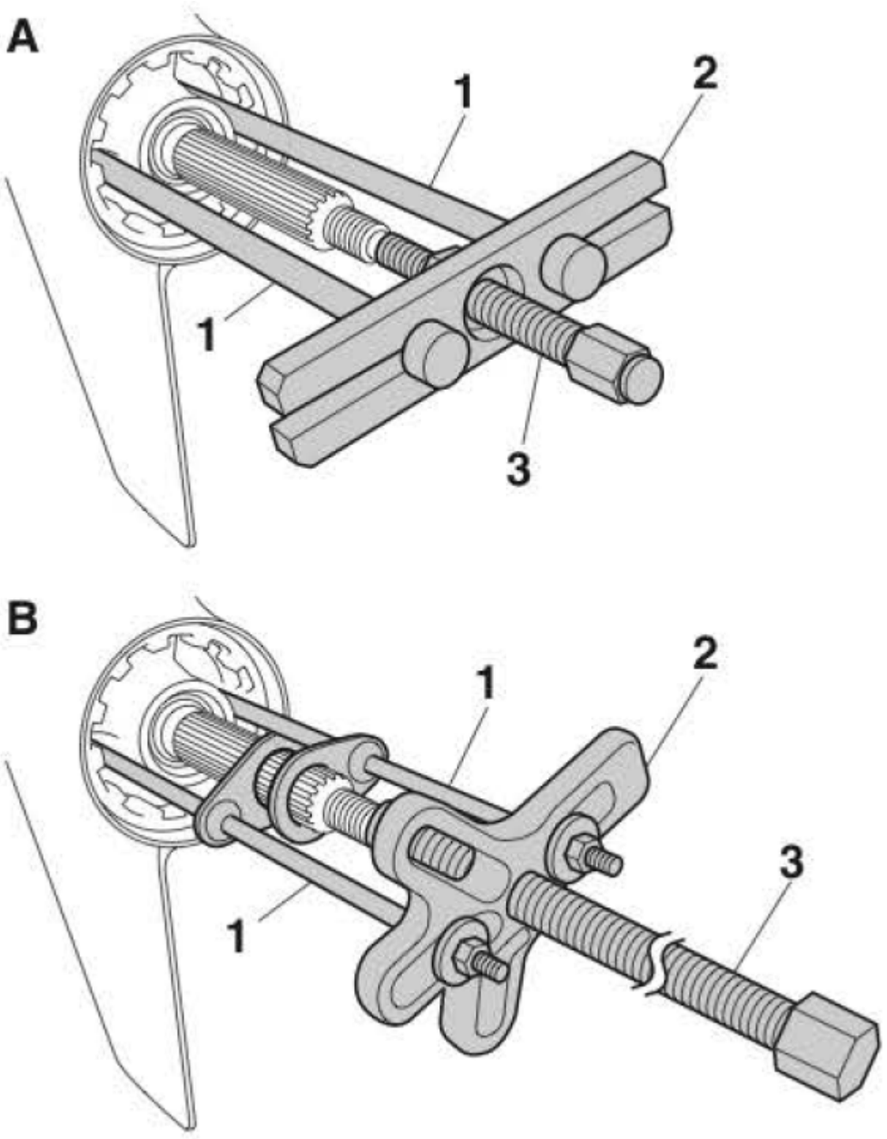
2. Remove the water pump assembly and outer plate cartridge. See steps 1 and 2 in "Removing the water pump and shift rod" {8-7).

3. Set the gear shift to the N position.



Shift rod socket "1"
Shift rod socket "1"

4. Set up the special service tools "1", "2", and "3", and then tighten the center bolt "3" temporarily.



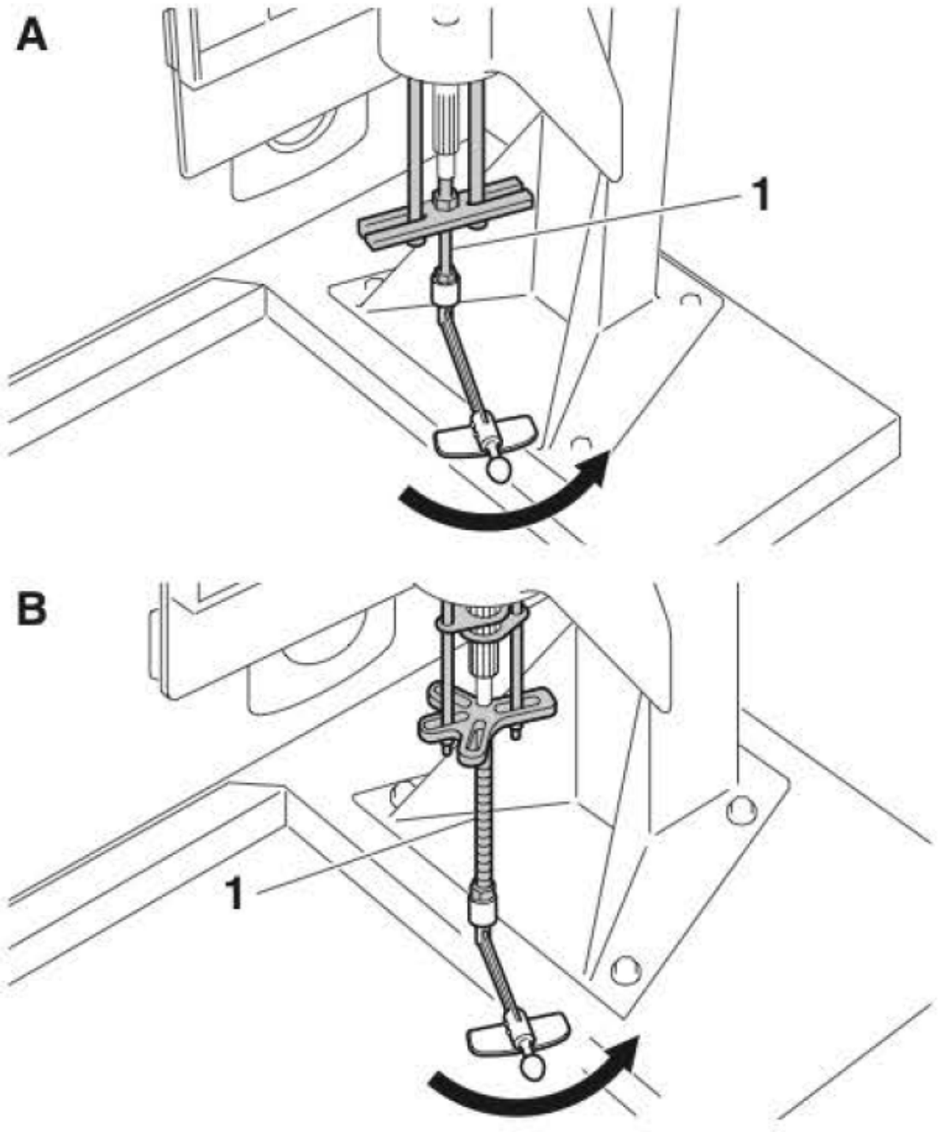
A. Worldwide
B. USA and Canada

Bearing housing puller claw L "1"
Bearing housing puller "1"
Stopper guide plate "2"
Universal puller "2"
Center bolt "3"

5. Turn the lower unit so that the propeller shaft is pointing down.

6. Turn the drive shaft 10 turns or more to seat the tapered roller bearing.

7. While holding the drive shaft to prevent it from turning, tighten the center bolt "1" to the specified torque.

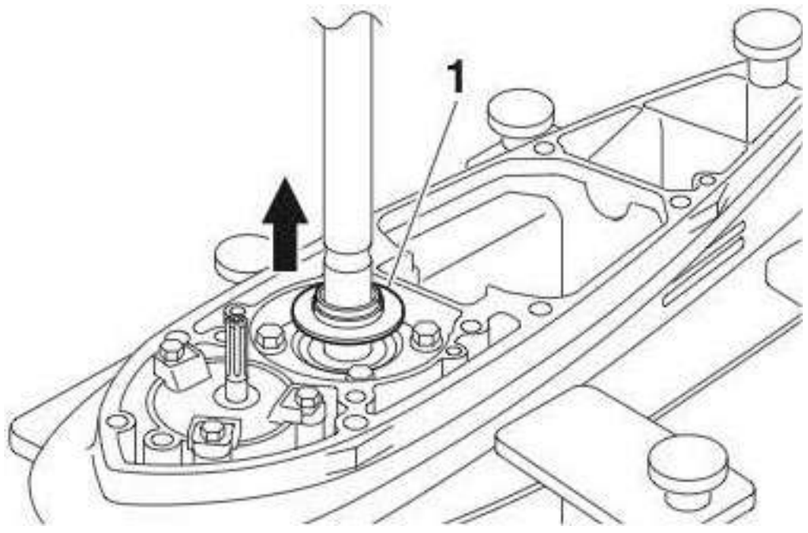


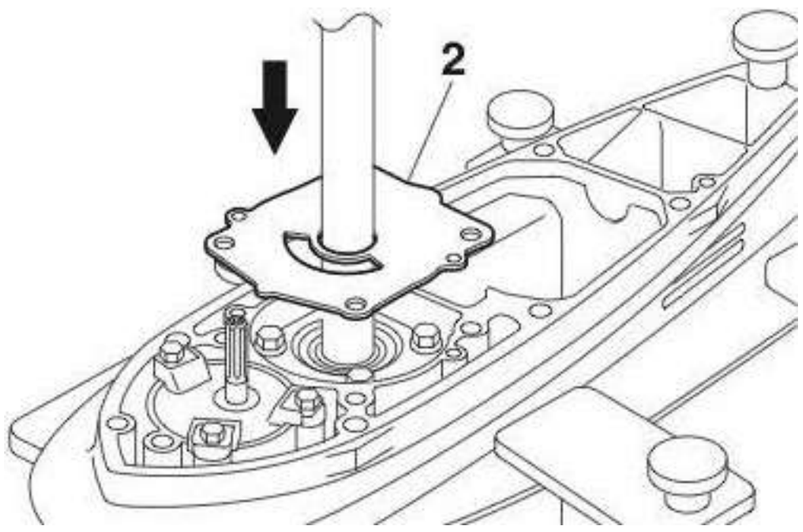
A. Worldwide
B. USA and Canada

Center bolt "1" (shimming) 5 Nm (0.5 kgf·m, 3.7 ft·lb)

8. Place the lower unit in an upright position.

9. Remove the cover “1”,and the install the outer plate cartridge "2".

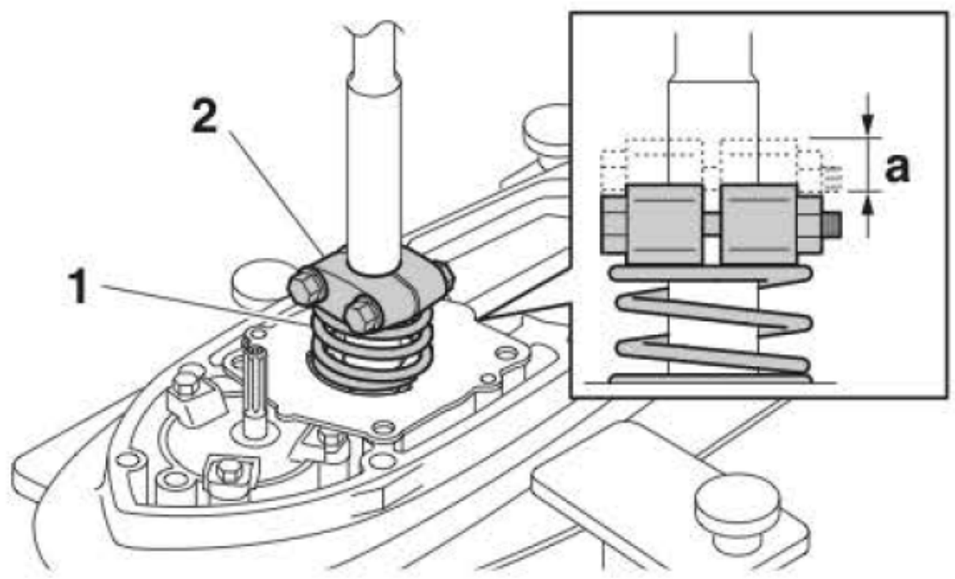




10. Set the spring "1" on the outer plate cartridge, and then install the handle holder "2" so that the spring is compressed to the specified setting height "a".

TIP:

- After installing the handle holder, pull the drive shaft upward to remove any free play.
- Do not press the spring more than 5.0 mm (0.197 in). Otherwise, too much torque will be required to turn the drive shaft, making it difficult to obtain correct measurements.

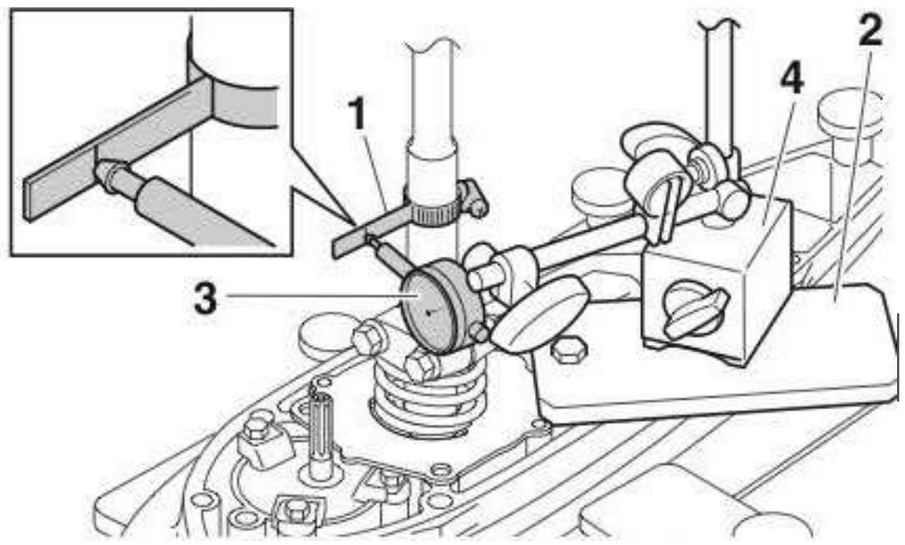


Spring "1" *1 Handle holder "2" (2 required) *1

*1. Order from Hidea Parts Distribution Center.

Setting height 3.0-5.0 mm (0.118–0.197 in)

11. Install the special service tool "1" onto the drive shaft at the lowest possible position where the shaft diameter is 22.4 mm (0.881 in), and then set up the special service tools "2", "3", and "4".



Backlash indicator "1"

Backlash indicator rod "1"

Magnet base plate "2"

Backlash adjustment plate "2"

Dial gauge set "3"

Dial indicator gauge "3"

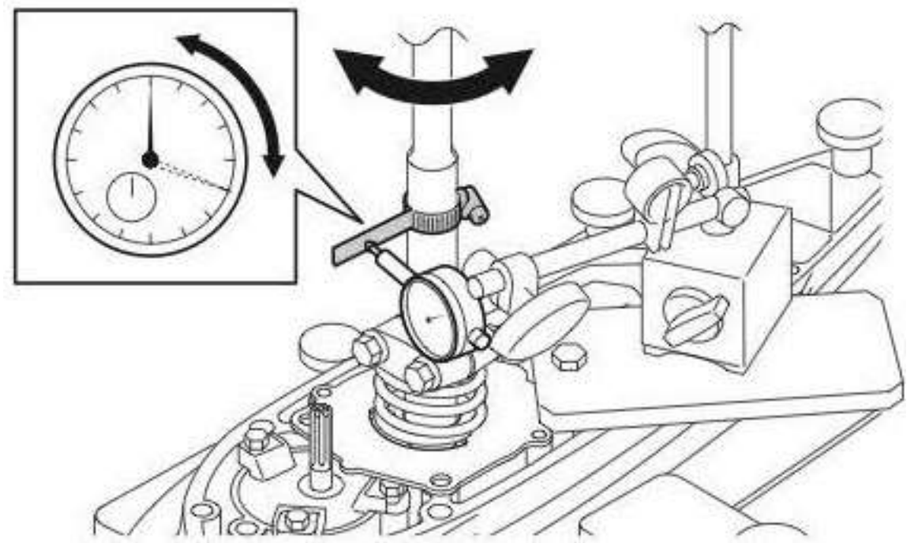
Magnet base B "4"

Magnetic base stand "4"

12. Turn the drive shaft slowly clockwise and counterclockwise, and then measure the backlash between where the drive shaft stops in each direction.

TIP:

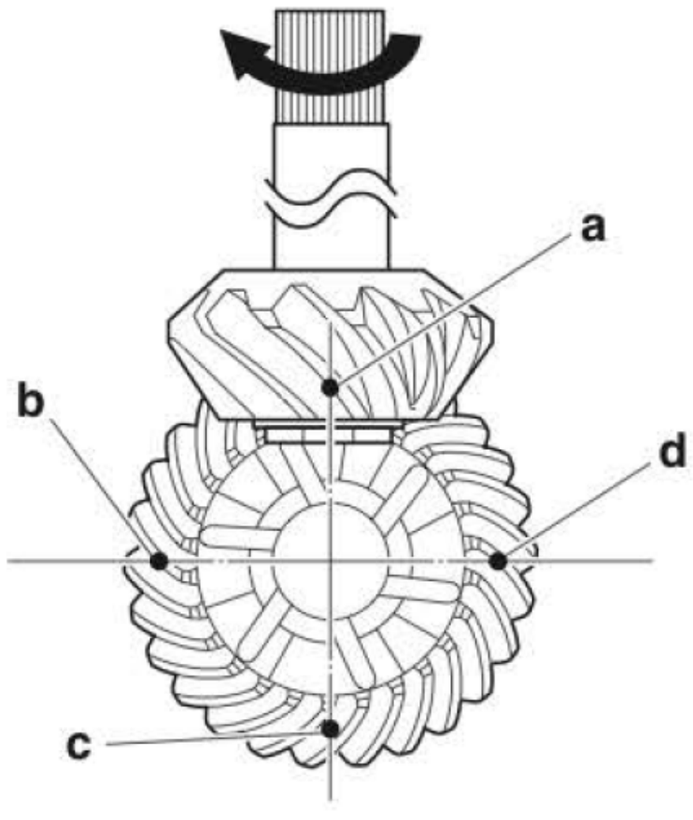
- The resistance of the spring increases the force required to turn the drive shaft. Therefore, to obtain correct measurements, consider the spring resistance force when turning the drive shaft.
- Do not turn the drive shaft using too much force. Otherwise, the forward gear will turn, leading to incorrect measurements.
- A knocking sound may be heard when the drive shaft is rotated, but this is the sound of the pinion contacting the reverse gear and does not affect the backlash measurement.



13. Turn the drive shaft 180° clockwise, and then measure the backlash again.

TIP:

- Measure the backlash at 4 points: "a", "b", "c", and "d", turning the drive shaft 180° clockwise after each measurement.
- Write down the measurement data in the shimming check sheet.



14. Determine the backlash average, and then round down the average to 2 decimal places.

Example:
(mm)

Measurement point "a"	0.30
Measurement point "b"	0.36
Measurement point "c"	0.34
Measurement point "d"	0.33
Average	0.3325
Round-down average	0.33

15. Check that the forward gear backlash average is within specification.

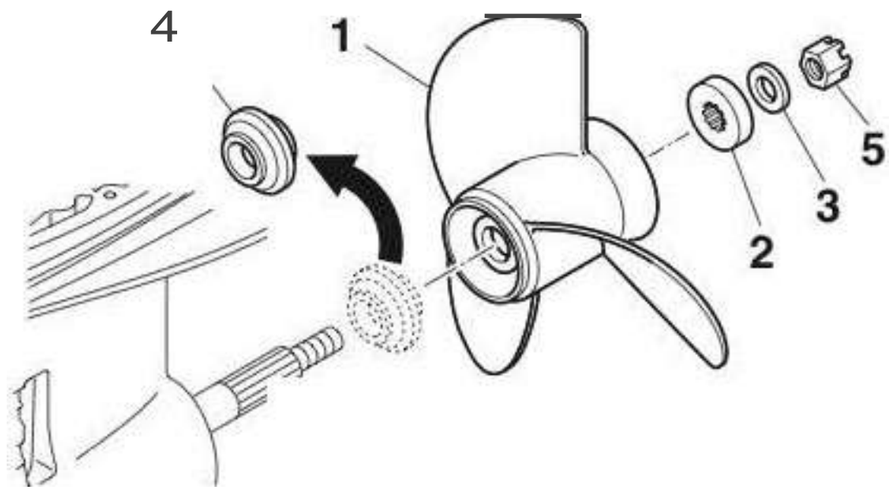
TIP:
Adjust the shim thicknesses if the forward gear backlash is out of specification.

Forward gear backlash
0.15-0.87 mm (0.0059-0.0343 in)

16. Remove the special service tools from the propeller shaft.

17. Apply a load to the reverse gear by installing the propeller "1", spacer "2", and washer "3" (without installing the spacer "4").

18. Tighten the propeller nut "5" to the specified torque.



Propeller nut "5" (shimming)
10 Nm (1.0 kgf•m, 7.4 ft•lb)

19. Repeat steps 12-14 to measure the reverse gear backlash.

20. Check that the reverse gear backlash average is within specification.

TIP:
Adjust the shim thicknesses if the reverse gear backlash is out of specification.

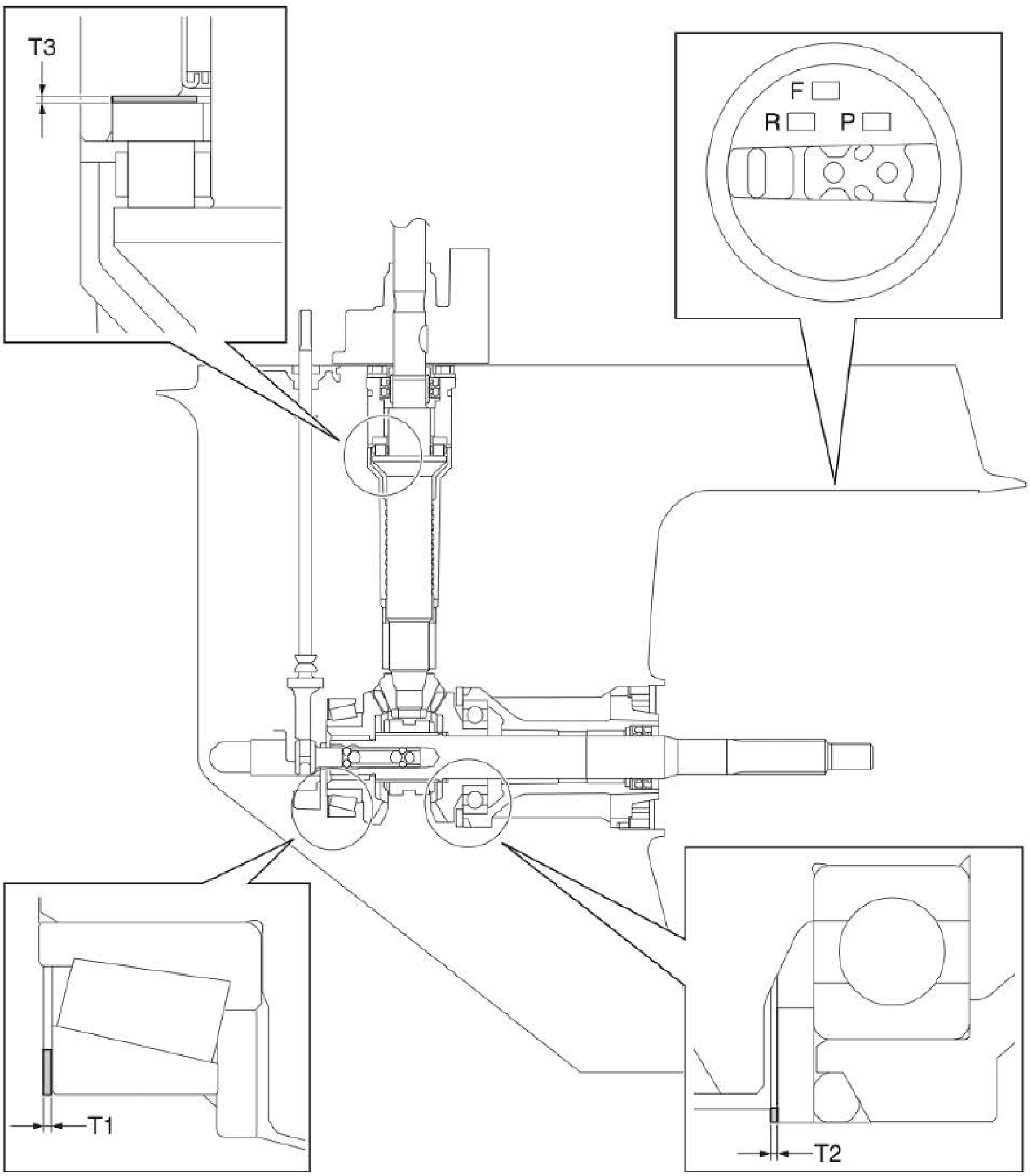
Reverse gear backlash
0.74-1 .56 mm (0.0291-0.0614 in)

21 . Remove the special service tools, and then install the water pump assembly.

Shimming procedure

- Before selecting the forward gear shim (T1) and reverse gear shims (T2), make sure to select the pinion shims (T3).
- When assembling the lower unit to measure the backlash after selecting the pinion shims (T3), do not apply gear oil, grease, or sealant to the parts.
- When assembling the lower unit after shimming is completed, make sure to apply gear oil, grease, and sealant to the specified areas.

Shim location



Selecting the pinion shim (T3)

- Spray anti-rust lubricant on the bearing before installation. Do not apply gear oil to the parts. Otherwise, correct measurements cannot be obtained.
- Keep the parts free of foreign material, such as dirt and lint.

NOTICE

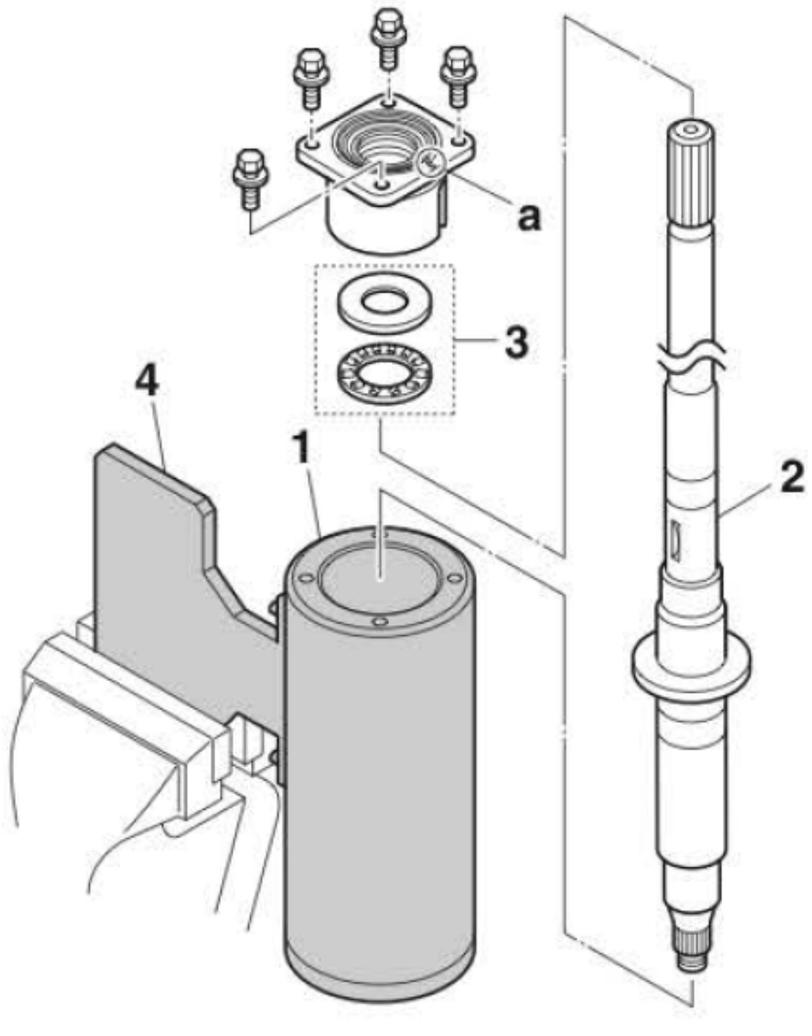
Be careful not to damage the measurement plane surface of the special service tool. Otherwise, correct measurements cannot be obtained.

1. Disassemble the lower unit.

2. Hold the special service tool "1", and then install the drive shaft "2", thrust bearing "3", and drive shaft housing assembly to the special service tool.

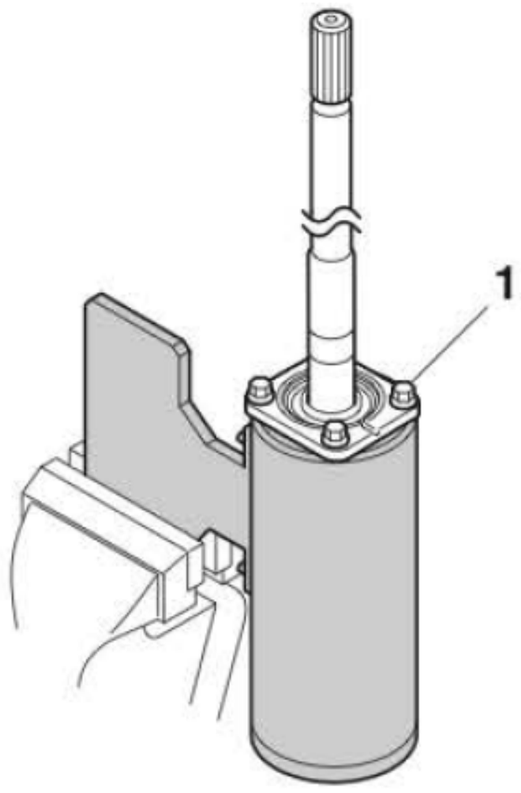
TIP:

- Do not install the pinion shims (T3) and O-ring. Make sure that the pinion shims (T3) are not affixed to the thrust bearing outer race.
- Make sure to install the thrust bearing outer race so that it is facing the same direction as when it was removed.
- Make sure that the cutout "a" in the drive shaft housing assembly is facing the opposite direction of the plate "4" of the special service tool.



Pinion height gauge "1"
Pinion height gauge "1"

3. Tighten the drive shaft housing bolts "1".



4. Install the pinion "1" and pinion nut "2", and then tighten the pinion nut "2" temporarily.

NOTICE

When tightening the pinion nut, check that the drive shaft turns smoothly.

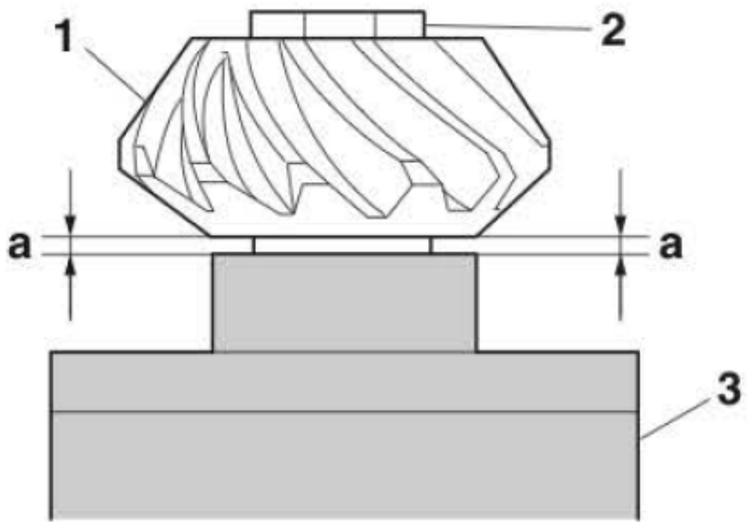
5. Check that there is a gap "a" between the pinion "1" and the special service tool "3".

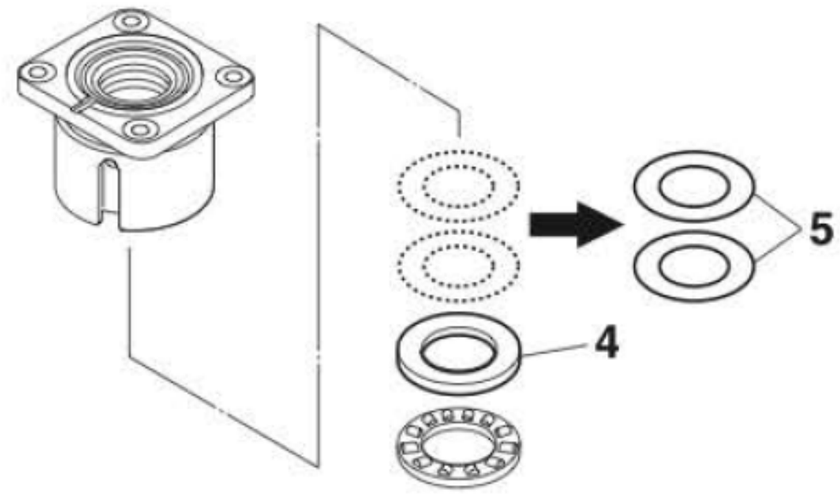
NOTICE

If there is no gap and the drive shaft does not turn, the special service tool could be damaged.

TIP:

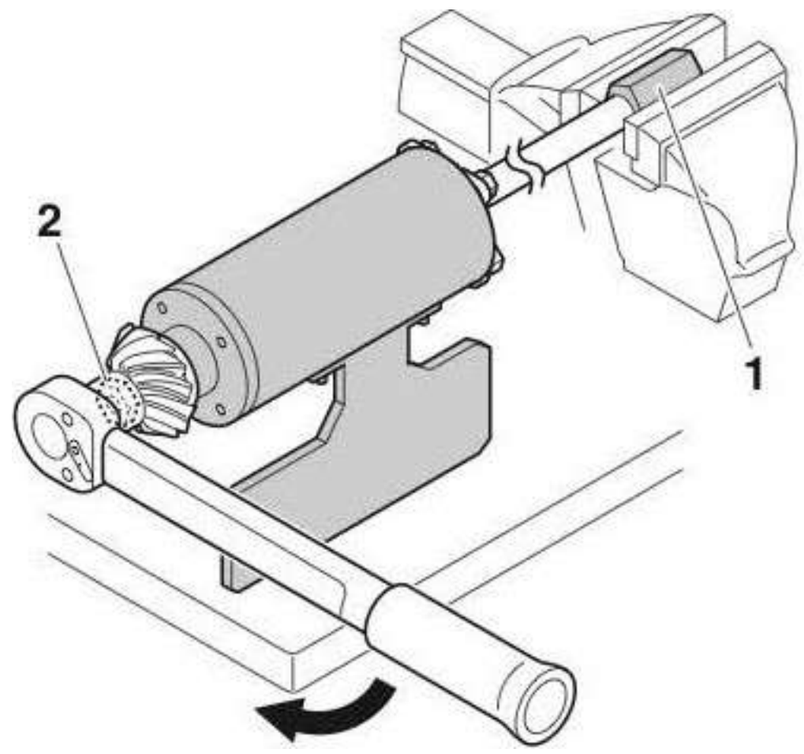
If there is no gap, the thrust bearing outer race "4" may not have been installed. If the gap is 1.0 mm (0.039 in) or more, the pinion shims (T3) "5" may not have been removed.





6. Install the special service tool "1" to the drive shaft spline and hold the special service tool "1".

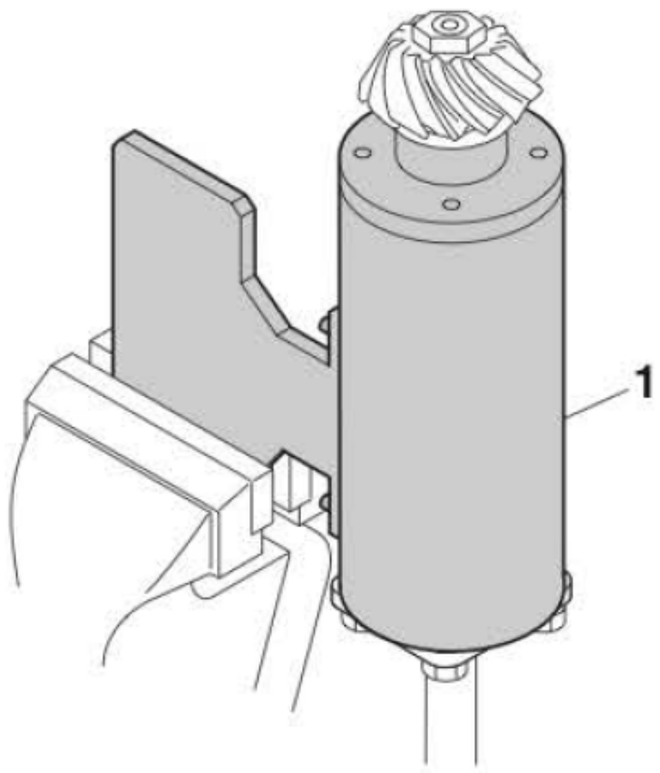
7. Tighten the pinion nut "2" to the specified torque.



Drive shaft holder 5 "1"
Driveshaft holder "1"

Pinion nut "2"
94 Nm (9.4 kgf·m, 69.3 ft·lb)

8. Hold the special service tool "1" so that the pinion is facing up.

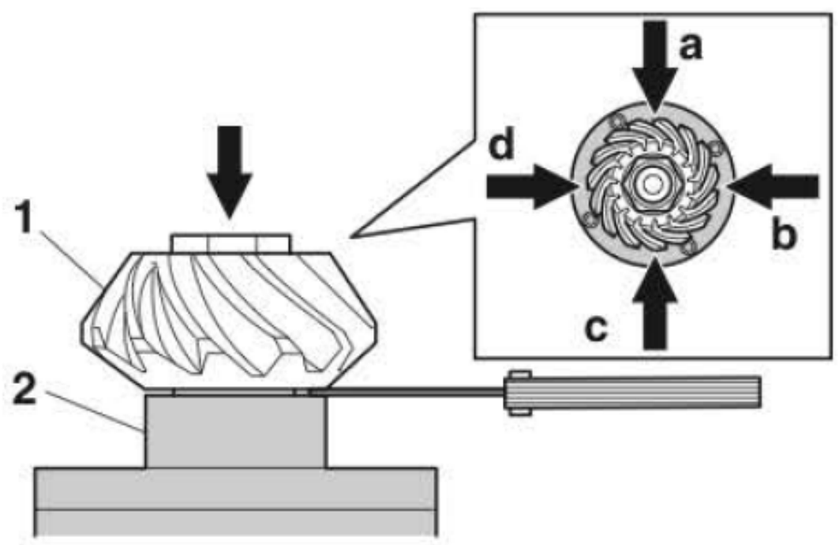


9. Turn the drive shaft 10 turns or more to seat the thrust bearing.

10. Push down on the pinion "1" so that it does not pop up, and then measure the distance between the pinion "1" and the special service tool "2".

TIP:

- When measuring the distance, insert the end of the thickness gauge straight into the gap at the measurement point. Do not insert the thickness gauge at an angle.
- Measure the distance at 4 points: "a", "b", "c", and "d".
- Write down the measurement data in the shimming check sheet.



11. Determine the distance average, and then round down the average to 2 decimal places.

Example:
(mm)

Measurement point "a"	0.24
Measurement point "b"	0.24
Measurement point "c"	0.25
Measurement point "d"	0.25
Average	0.2450
Round-down average (M)	0.24

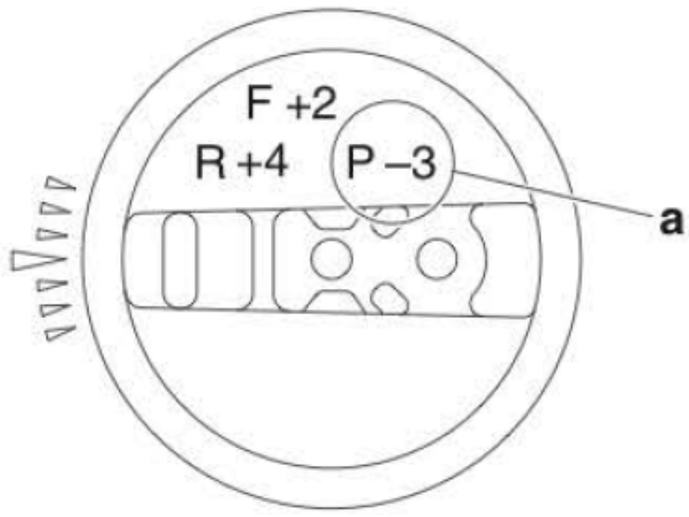
12. Determine the pinion shim (T3) thickness adjustment using the "Pinion shim (T3) selection table" according to the rounded average (M) and the deviation (P) stamped on the lower case. See "Pinion shim (T3) selection table" (A-7).

TIP:

The (P) mark "a" is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the (P) mark is unreadable, replace the lower case.

Available shim thicknesses
Pinion shims
0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm

Example:
(M) = 0.24
(P) = -3



(T3) = 0.95 mm from the "Pinion shim (T3) selection table".

		Pinion height measurement (M)		
		0.23	0.24	0.25
Stamped value on the lower case (P)	-2		↓	
	-3	→	0.95	
	-4			

13. Remove the special service tools, and then install the determined pinion shims (T3).

Measuring the forward gear backlash

- Spray anti-rust lubricant on the gear and bearings before installation. Do not apply gear oil to the parts. Otherwise, correct measurements cannot be obtained.
- Keep the parts free of foreign material, such as dirt and lint.
- When measuring the forward gear or reverse gear backlash, use the original bearings and shims.

1. Install the original forward gear shims (T1) and tapered roller bearing outer race.

TIP:

- If the original forward gear shims (T1) are missing, install new shims with a combined thickness of 0.72 mm.
- Do not reuse a shim if deformed or scratched.

2. Install the forward gear assembly, drive shaft, and pinion. See "Installing the drive shaft" (8-25).

3. Check that the drive shaft turns smoothly.

4. Install the propeller shaft housing assembly. See "Installing the propeller shaft housing assembly" (8-26).

5. Check that the drive shaft turns smoothly.

6. Measure the forward gear backlash. See steps 3-15 in "Measuring the forward gear backlash and reverse gear backlash before disassembly" (8-35).

Forward gear backlash
0.15-0.87 mm (0.0059-0.0343 in)

Adjusting the forward gear shim thickness (T1)

1. Remove the tapered roller bearing outer race and forward gear shims (T1).

2. Measure the thickness of original forward gear shim (T1) in 2 places.

TIP:

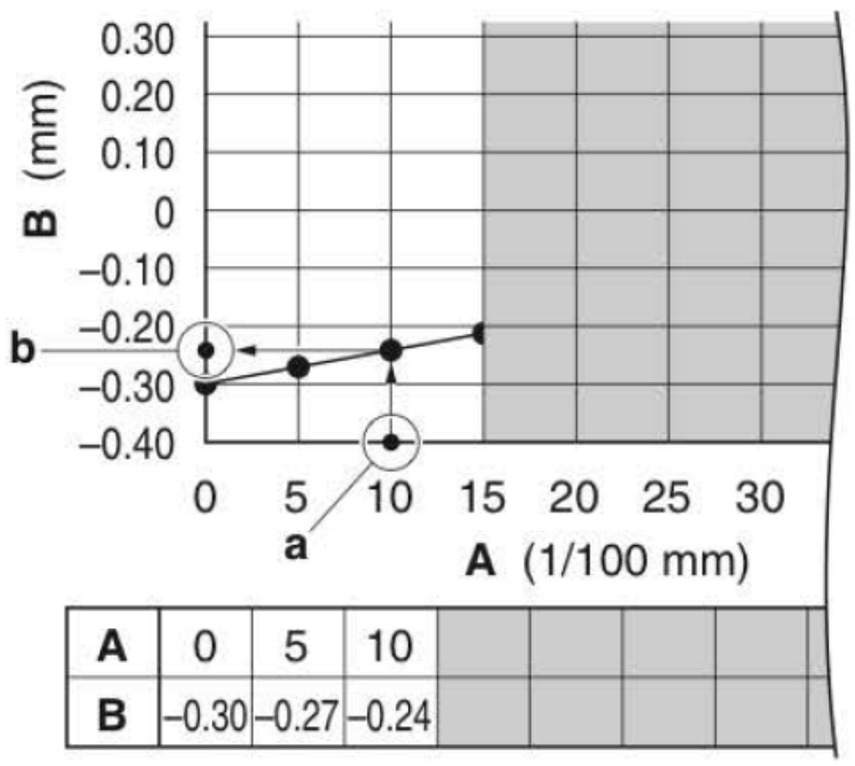
Do not reuse a shim if deformed or scratched.

3. Determine the forward gear shim (T1) thickness adjustment using the "Forward gear shim (T1) selection chart" according to the backlash measurement (BL1) from "Measuring the forward gear backlash". See "Forward gear shim (T1) selection chart (regular rotation model)" (A-8).

TIP:

- If the shim thickness adjustment value is positive, increase the current shim thickness by that amount and, if the value is negative, decrease the current shim thickness by that amount.
- The gray-colored area on the selection chart indicates the range of the specified backlash. Shimming is not required if the measured backlash is within the gray-colored area.
- The values for the shim thickness adjustments specified in the selection chart are intended to obtain the median value within the range for the specified forward gear or reverse gear backlash.
- The table that follows the selection chart shows the shim thickness adjustments for the points marked on the chart.

Example:
Backlash measurement (BL1) = 0.10 mm "a"
Forward gear shim (T1) thickness adjustment = –0.24 mm "b"
The current shim thickness must be decreased by 0.24 mm.



A	0	5	10				
B	–0.30	–0.27	–0.24				

A. Backlash measurement (BL1)
B. Shim thickness adjustment

4. Calculate the new forward gear shim (T1) thickness.

TIP:
- Use the lowest number of shims to obtain the required shim thickness.
- If the calculated shim thickness cannot be obtained with a combination of the available shims, increase or decrease the shim thickness by 0.01 mm.

Calculation formula:
New forward gear shim (T1) thickness = Current forward gear shim thickness + shim thickness adjustment

Example:
Use the following formula when the shim thickness adjustment value is positive.
Current forward gear shim thickness – 0.72 mm
Shim thickness adjustment = 0.22 mm
New forward gear shim (T1) thickness = 0.72 mm + 0.22 mm = 0.94 mm
Use the following formula when the shim thickness adjustment value is negative.
Current forward gear shim thickness = 0.72 mm
Shim thickness adjustment = –0.24 mm
New forward gear shim (T1) thickness = 0.72 mm + (-0.24 mm) = 0.48 mm

Available shim thicknesses
Forward shims
0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm

5. Install the determined forward gear shims (T1) and tapered roller bearing outer race.

Measuring the reverse gear backlash

- Spray anti-rust lubricant on the gears and bearings before installation. Do not apply gear oil to the parts. Otherwise, correct measurements cannot be obtained.
- Keep the parts free of foreign material, such as dirt and lint.
- When measuring the forward gear or reverse gear backlash, use the original bearings and shims.

1. Install the original reverse gear shims (T2) and propeller shaft housing assembly. See "Installing the propeller shaft housing assembly" (8-26).

TIP:
- If the original reverse gear shims (T2) are missing, install new shims with a combined thickness of 0.70 mm.
- Do not reuse a shim if deformed or scratched.

2. Measure the reverse gear backlash. See steps 17-19 in "Measuring the forward gear backlash and reverse gear backlash before disassembly" (8-35).

Reverse gear backlash
0.74-1.56 mm (0.0291-0.0614 in)

Adjusting the reverse gear shim thickness (T2)

1. Remove the propeller shaft housing assembly and reverse gear shims (T2).

2. Measure the thickness of original reverse gear shim (T2) in 2 places.

TIP:

Do not reuse a shim if deformed or scratched.

3. Determine the reverse gear shim (T2) thickness adjustment using the "Reverse gear shim (T2) selection chart" according to the backlash measurement (BL2) from "Measuring the reverse gear backlash". See "Reverse gear shim (T2) selection chart (regular rotation model)" (A-8).

TIP:

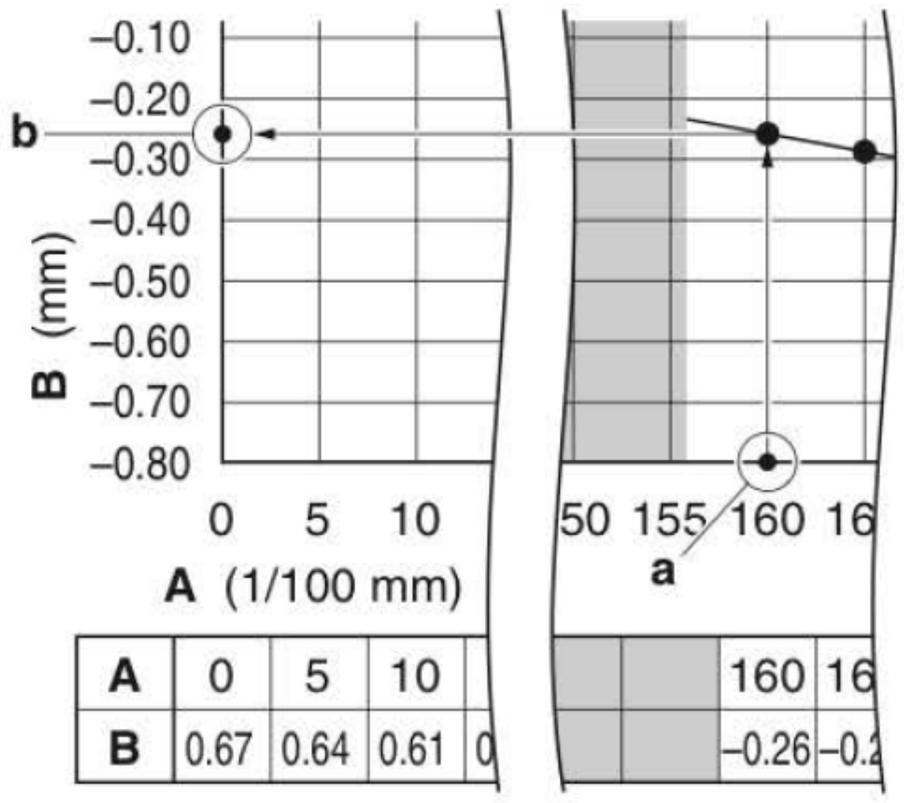
- If the shim thickness adjustment value is positive, increase the current shim thickness by that amount and, if the value is negative, decrease the current shim thickness by that amount.
- The gray-colored area on the selection chart indicates the range of the specified backlash. Shimming is not required if the measured backlash is within the gray-colored area.
- The values for the shim thickness adjustments specified in the selection chart are intended to obtain the median value within the range for the specified forward gear or reverse gear backlash.
- The table that follows the selection chart shows the shim thickness adjustments for the points marked on the chart.

Example:

Backlash measurement (BL2) = 1.60 mm "a"

Reverse gear shim (T2) thickness adjustment = -0.26 mm "b"

The current shim thickness must be decreased by 0.26 mm.



A. Backlash measurement (BL2)
B. Shim thickness adjustment

4. Calculate the new reverse gear shim (T2) thickness.

TIP:

- Use the lowest number of shims to obtain the required shim thickness.
- If the calculated shim thickness cannot be obtained with a combination of the available shims, increase or decrease the shim thickness by 0.01 mm.

Calculation formula:

New reverse gear shim (T2) thickness = Current reverse gear shim thickness + shim thickness adjustment

Example:

Use the following formula when the shim thickness adjustment value is positive.

Current reverse gear shim thickness – 0.70 mm

Shim thickness adjustment = 0.26 mm

New reverse gear shim (T2) thickness = 0.70 mm + 0.26 mm = 0.96 mm

Use the following formula when the shim thickness adjustment value is negative.

Current reverse gear shim thickness = 0.70 mm

Shim thickness adjustment= -0.26 mm

New reverse gear shim (T2) thickness = 0.70 mm + (-0.26 mm) = 0.44 mm

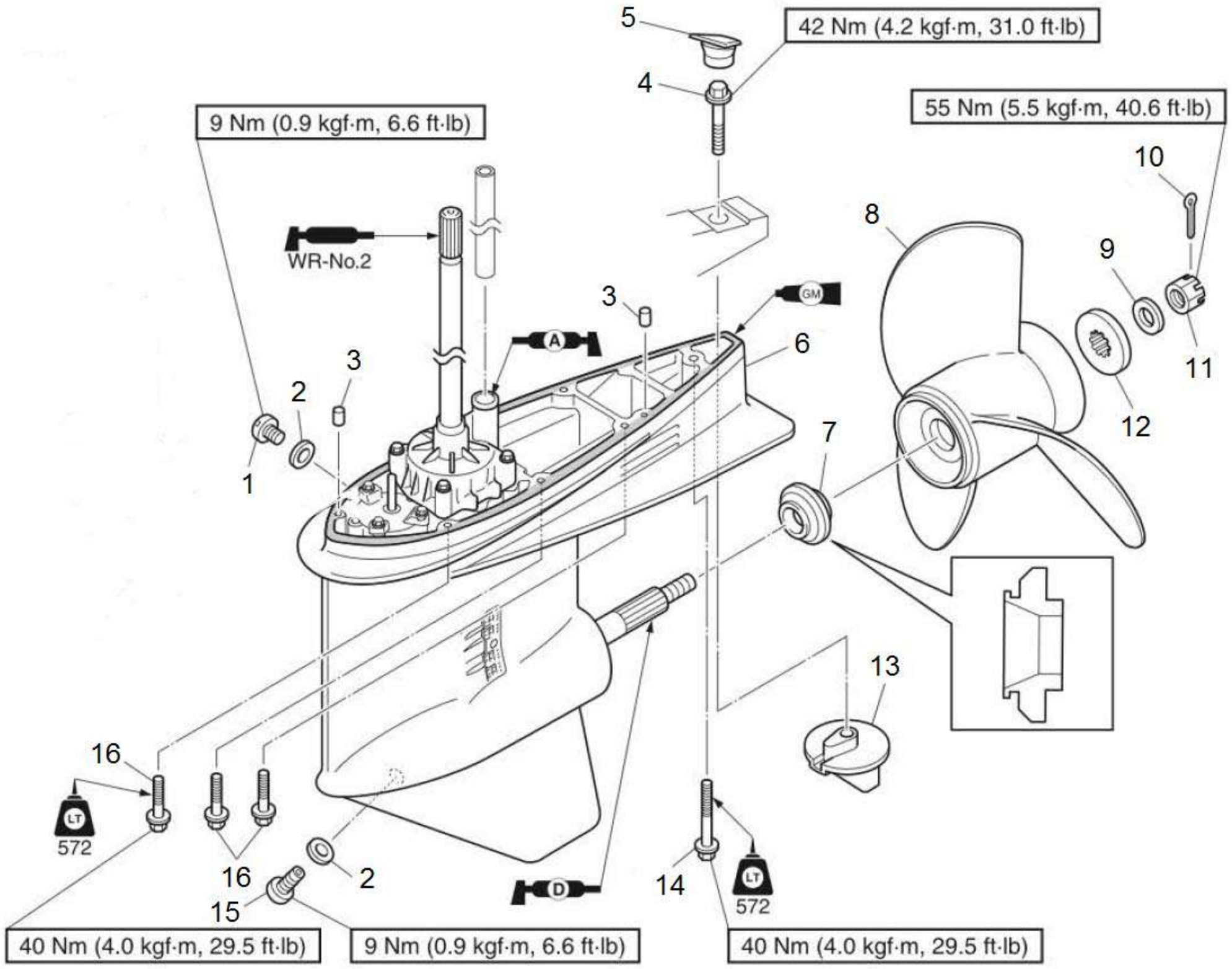
Available shim thicknesses

Reverse shims

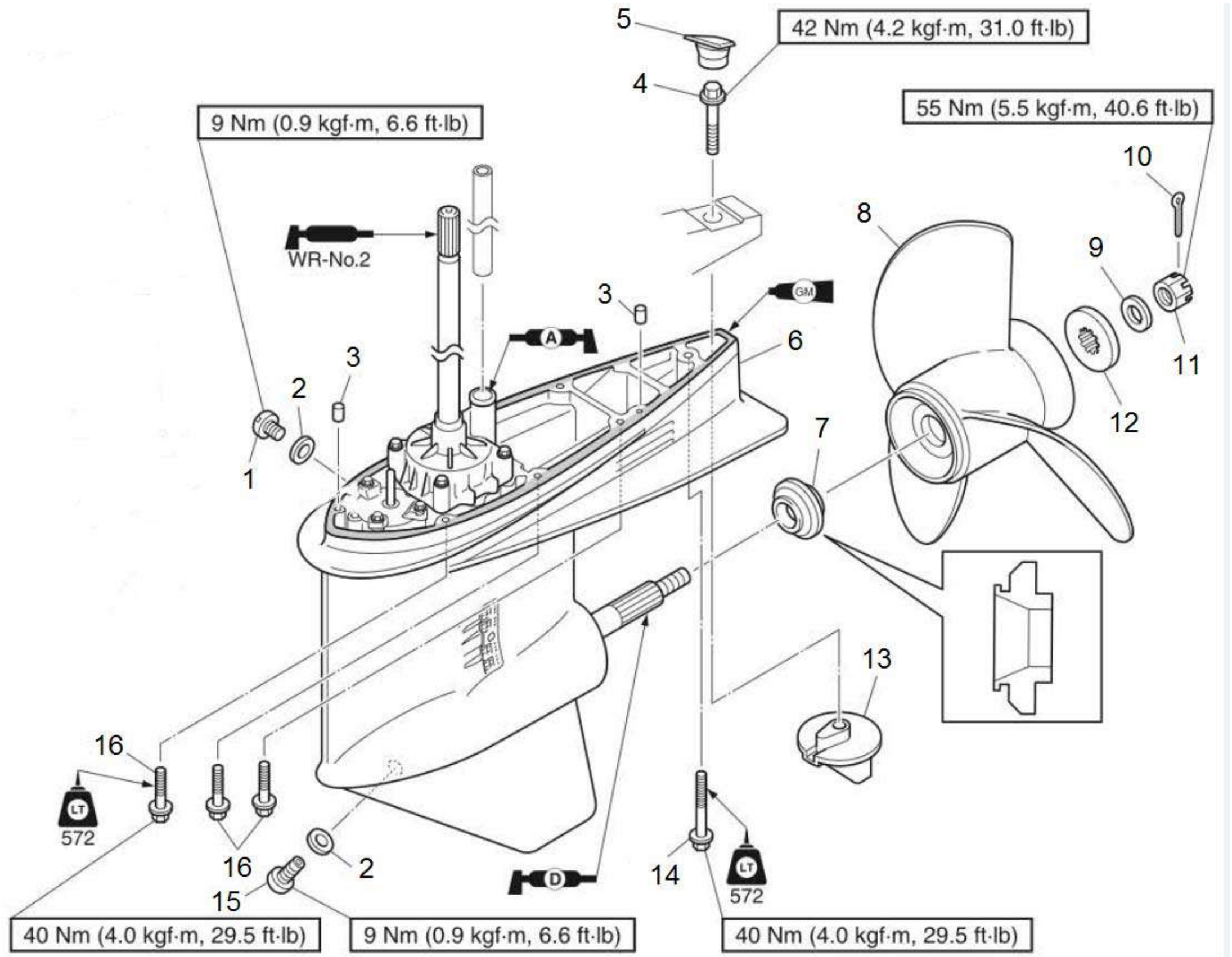
0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm

5. Install the determined reverse gear shims (T2) and propeller shaft housing assembly.

Lower unit (counter rotation model)



No.	Part name	Q'ty	Remarks
1	Oil level plug	1	
2	Gasket	2	Not reusable
3	Dowel pin	2	
4	Bolt	1	M10 × 45 mm
5	Grommet	1	
6	Lower unit	1	
7	Spacer	1	
8	Propeller	1	
9	Washer	1	
10	Cotter pin	1	Not reusable
11	Propeller nut	1	
12	Spacer	1	
13	Trim tab	1	



No.	Part name	Q'ty	Remarks
14	Bolt	1	M10 x 70 mm
15	Drain screw	1	
16	Bolt	6	M10 x 45 mm

Removing the lower unit

See "Removing the lower unit" (8-3).

TIP:

When disassembling the lower unit, measure the backlash before disassembly. See "Mea-suring the forward gear backlash and reverse gear backlash before disassembly" (8-70).

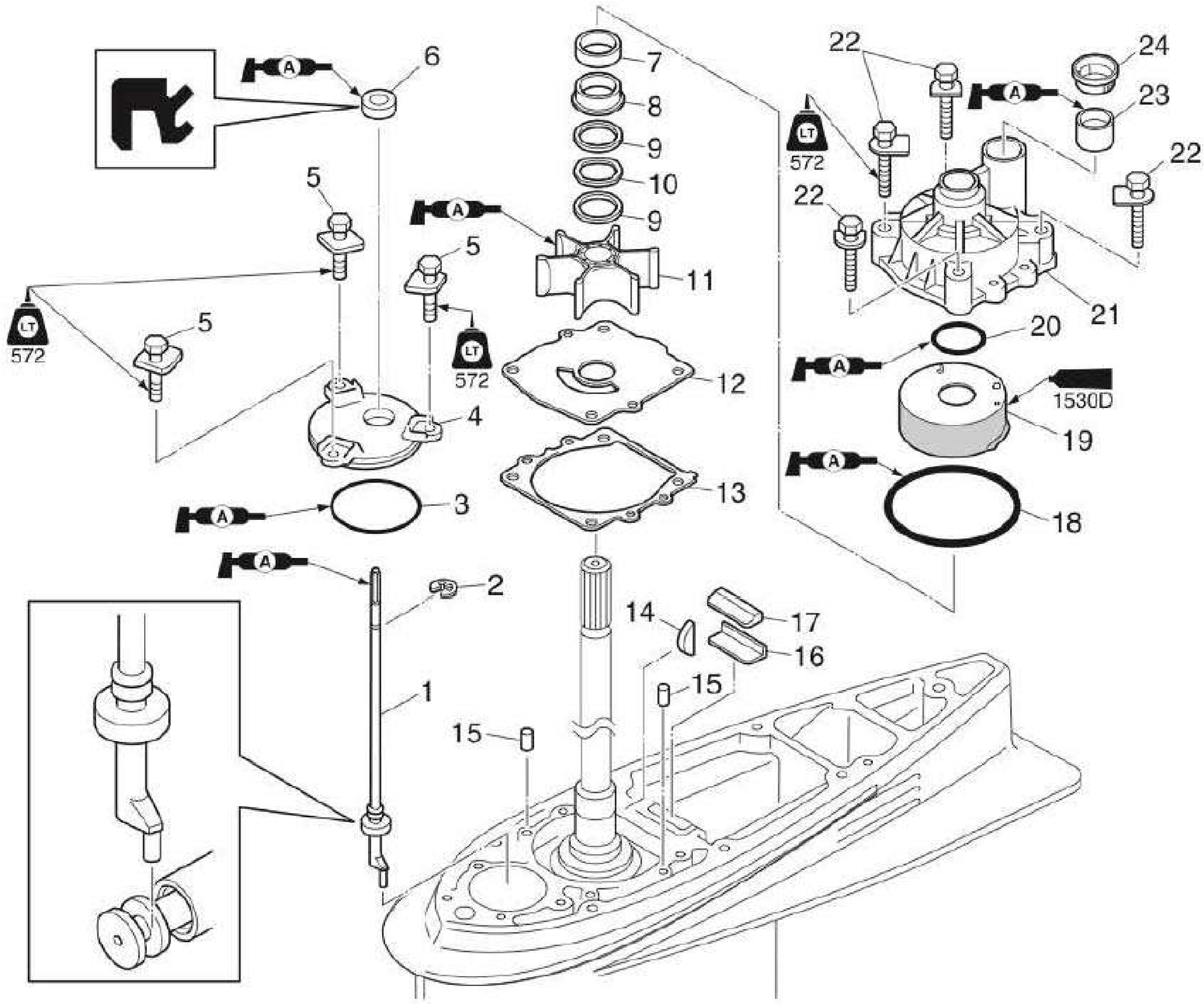
Checking the propeller

See "Checking the propeller" (8-4).

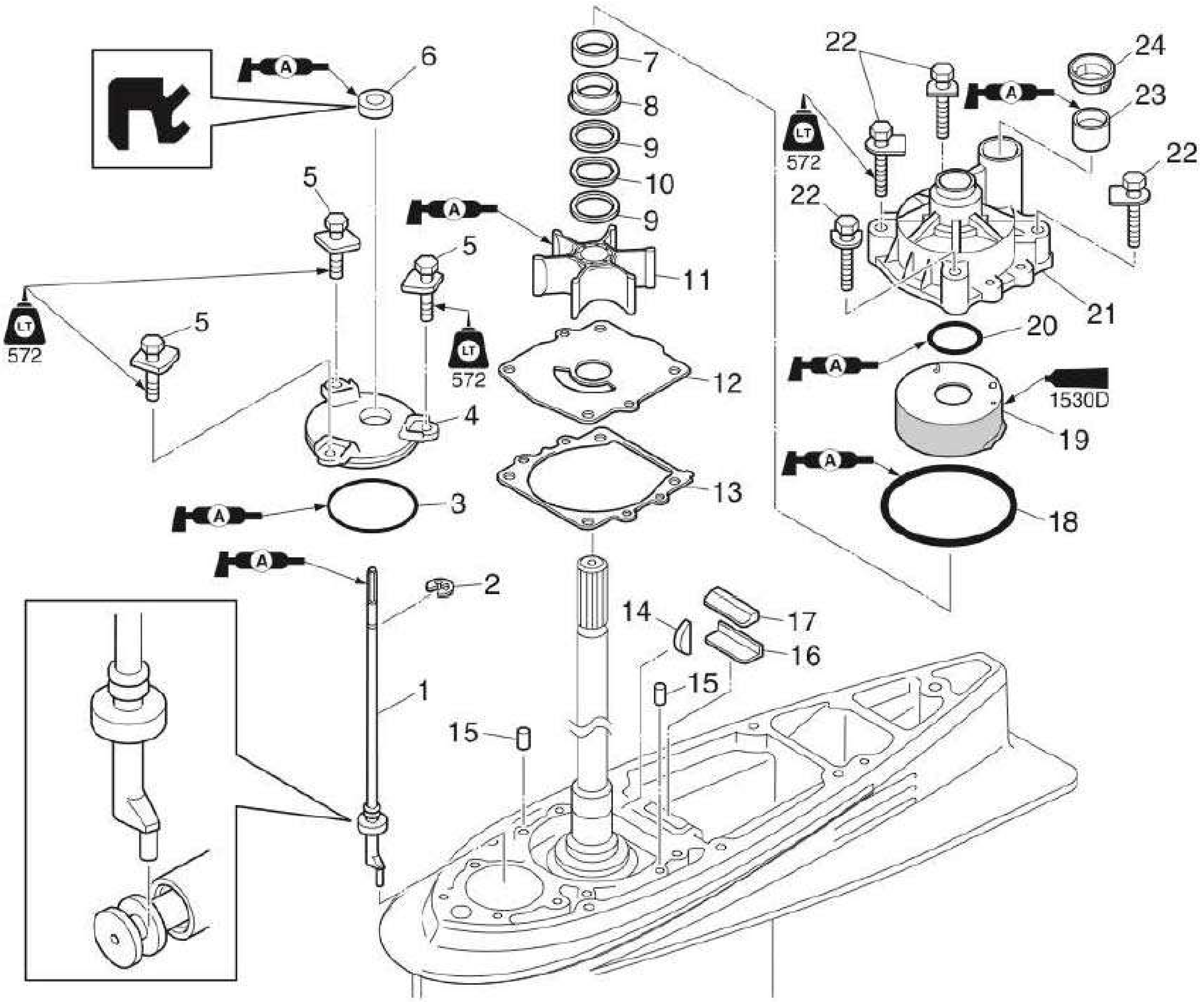
Checking the lower unit anode

See "Checking the lower unit anode" (8-4).

Water pump and shift rod (counter rotation model)



No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	E-clip	1	
3	O-ring	1	Not reusable
4	Plate	1	
5	Bolt	3	M6 x 20 mm
6	Oil seal	1	Not reusable
7	Collar	1	
8	Spacer	1	
9	Washer	2	
10	Wave washer	1	
11	Impeller	1	
12	Outer plate cartridge	1	
13	Gasket	1	Not reusable
14	Impeller key	1	
15	Dowel pin	2	
16	Plate	1	
17	Rubber seal	1	

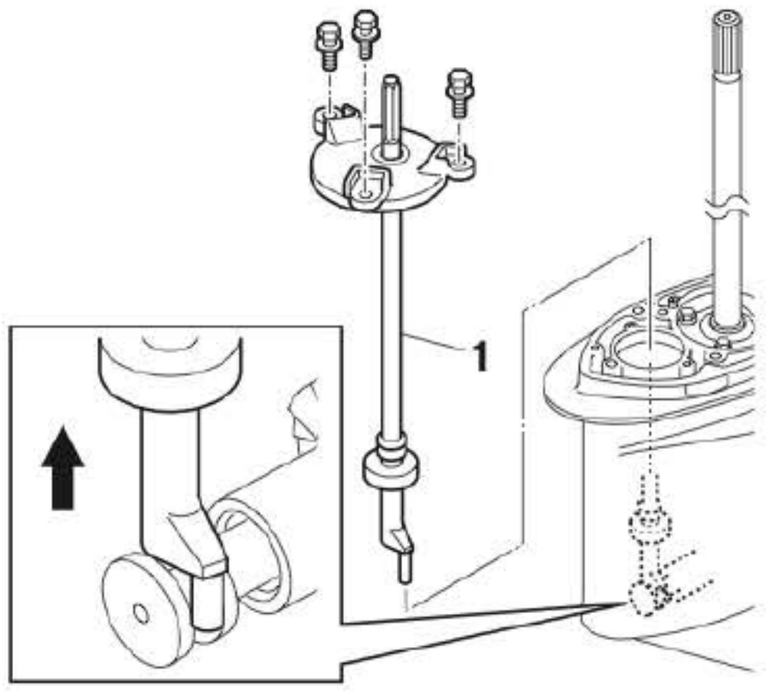


No.	Part	Q'ty	Remarks
18	O-ring	1	Not reusable
19	Insert cartridge	1	
20	O-ring	1	Not reusable
21	Water pump housing	1	
22	Bolt	4	M8 x 45mm
23	Seal	1	
24	Cover	1	

Removing the water pump and shift rod

1. Remove the water pump. See steps 1–4 in "Removing the water pump and shift rod" (8-7)

2. Remove the shift rod "1".



Disassembling the water pump housing

See "Disassembling the water pump housing" (8-7).

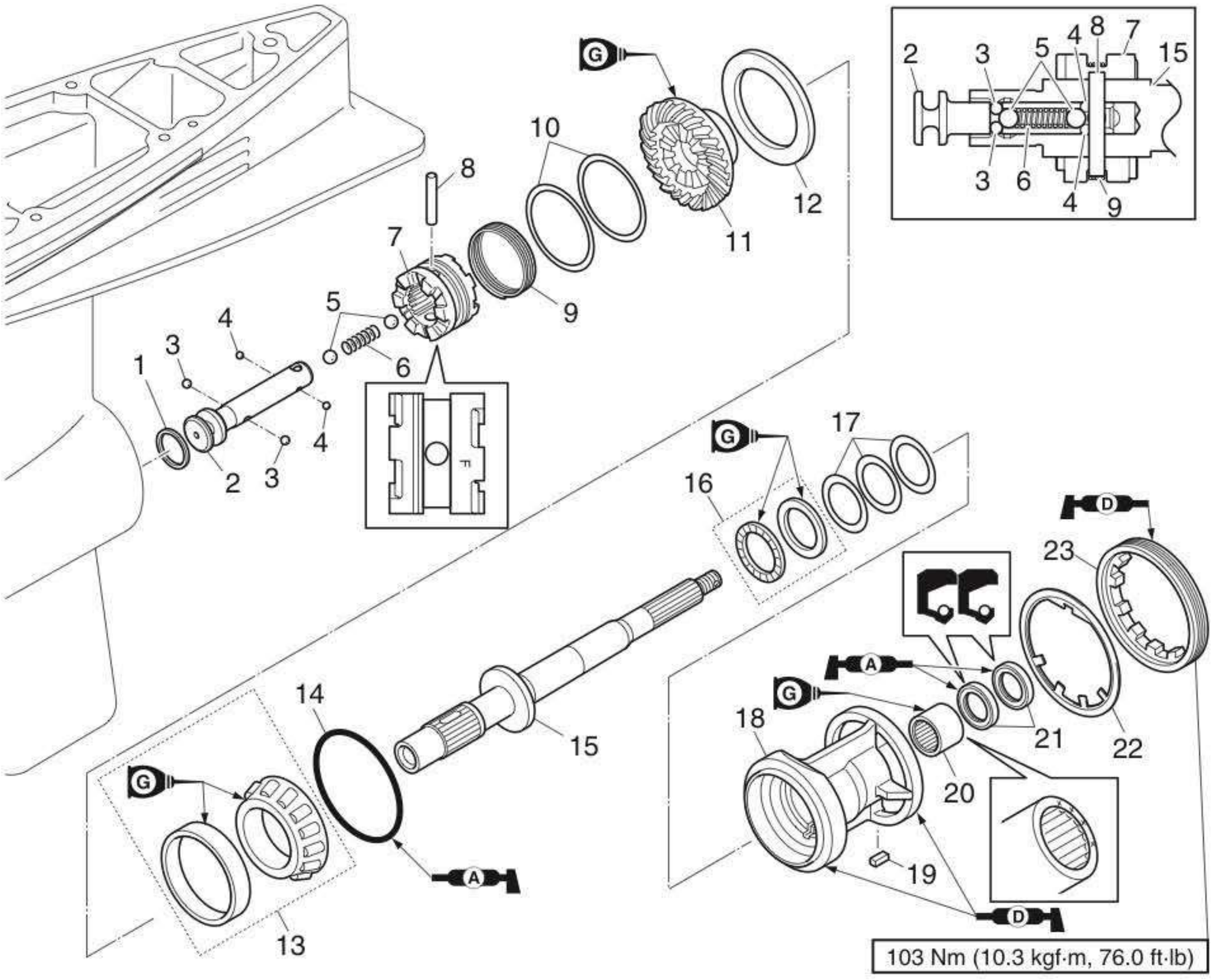
Checking the water pump and shift rod

See "Checking the water pump and shift rod" (8-8).

Assembling the water pump housing

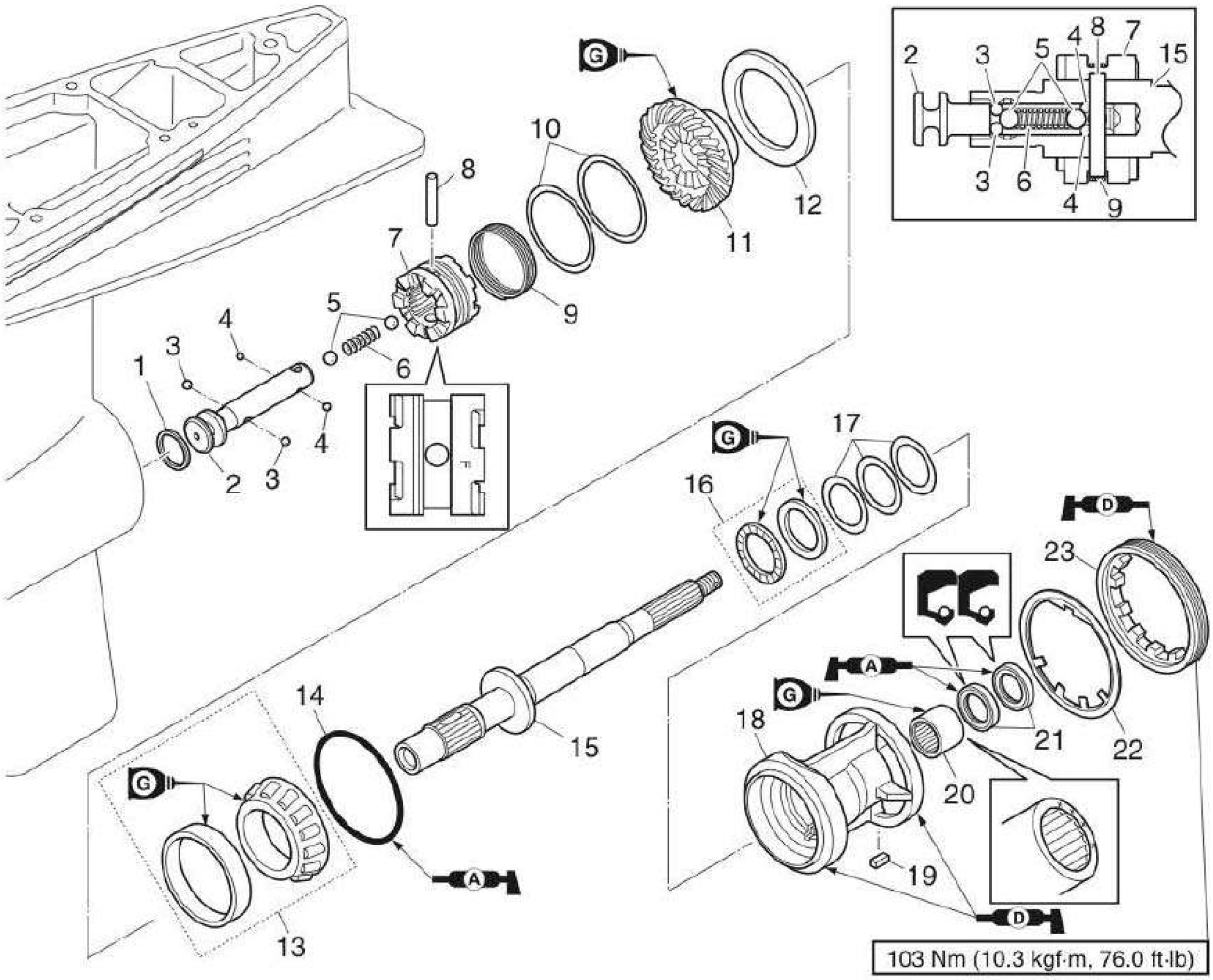
See "Assembling the water pump housing" (8-8).

Propeller shaft housing (counter rotation model)



No.	Part name	Q'ty	Remarks
1	Washer	1	
2	Slider	1	
3	Ball	2	5.56 mm (0.22 in)
4	Ball	2	4.76 mm (0.19 in)
5	Ball	2	8.73 mm (0.34 in)
6	Spring	1	
7	Dog clutch	1	
8	Cross pin	1	
9	Spring	1	
10	Forward gear shim (T2)	—	
11	Forward gear	1	
12	Thrust washer	1	
13	Tapered roller bearing	1	Not reusable
14	O-ring	1	Not reusable
15	Propeller shaft	1	
16	Thrust bearing	1	
17	Propeller shaft shim (T4)	—	

Propeller shaft housing (counter rotation model)



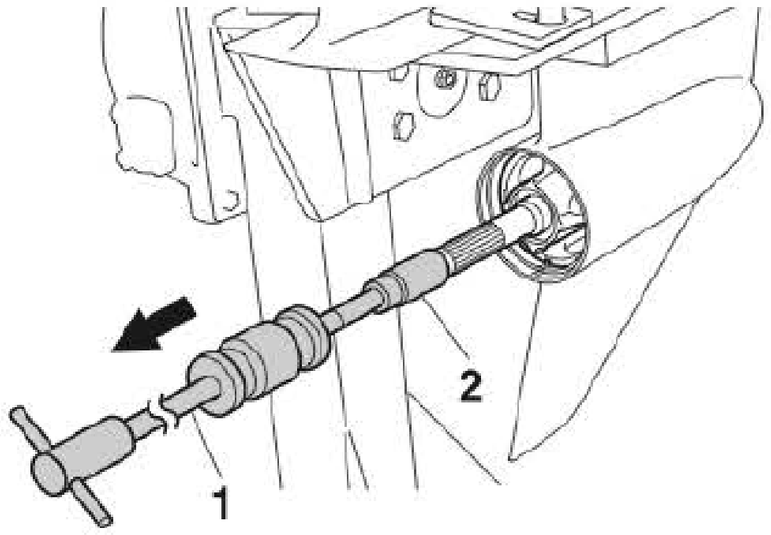
No.	Part name	Q'ty	Remarks
18	Propeller shaft housing	1	
19	Key	1	
20	Needle bearing	1	Not reusable
21	Oil seal	2	Not reusable
22	Claw washer	1	
23	Ring nut	1	M101.5

Removing the propeller shaft housing assembly

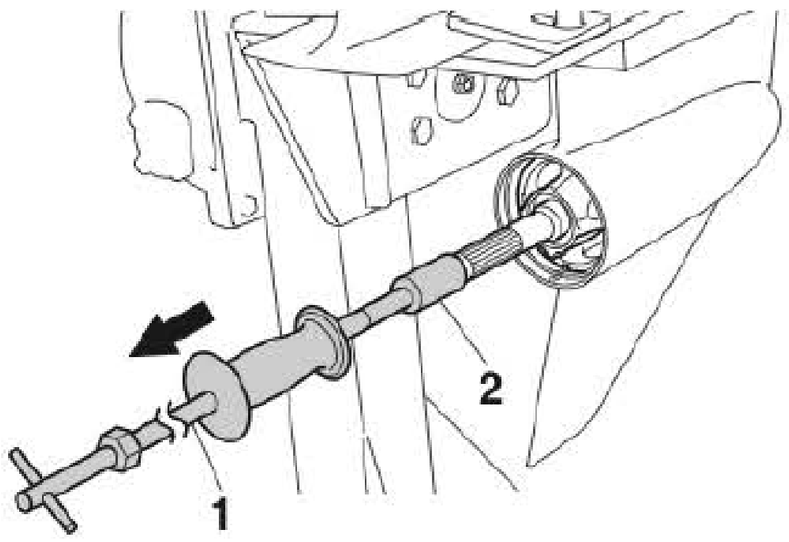
1. Remove the ring nut and claw washer. See steps 1–3 in "Removing the propeller shaft housing assembly" (8-11).

2. Remove the propeller shaft housing assembly, key, and forward gear shims.

A



B



A. Worldwide
B. USA and Canada

Slide hammer handle "1"
Slide hammer "1"
Puller head "2"
Propeller shaft and bearing housing remover "2"

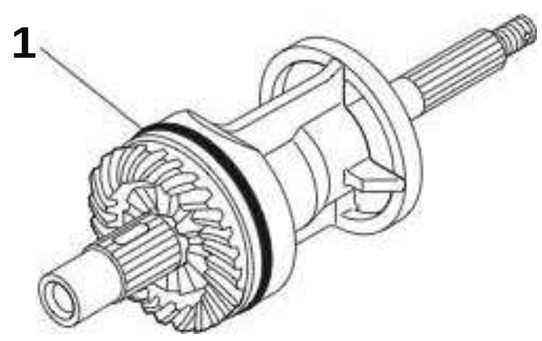
Disassembling the propeller shaft housing assembly

⚠ WARNING

- **Use heat-resistant gloves. Otherwise, burns could result.**
- **To prevent fires, remove any flammable substances, such as gasoline and oil, around the working area.**
- **Keep good ventilation while working.**

1. Remove the dog clutch. See "Disassembling the propeller shaft assembly" (8-12).

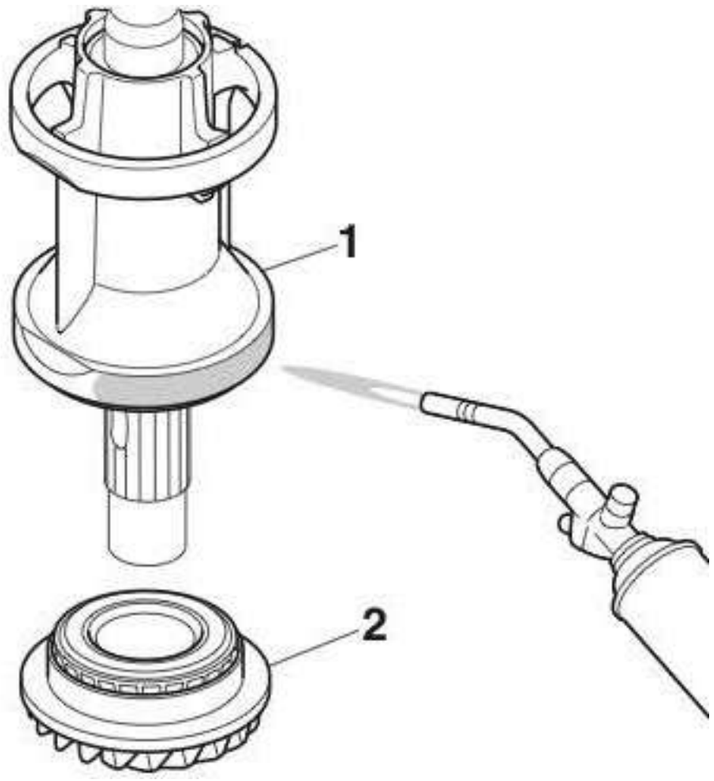
2. Remove the O-ring "1".



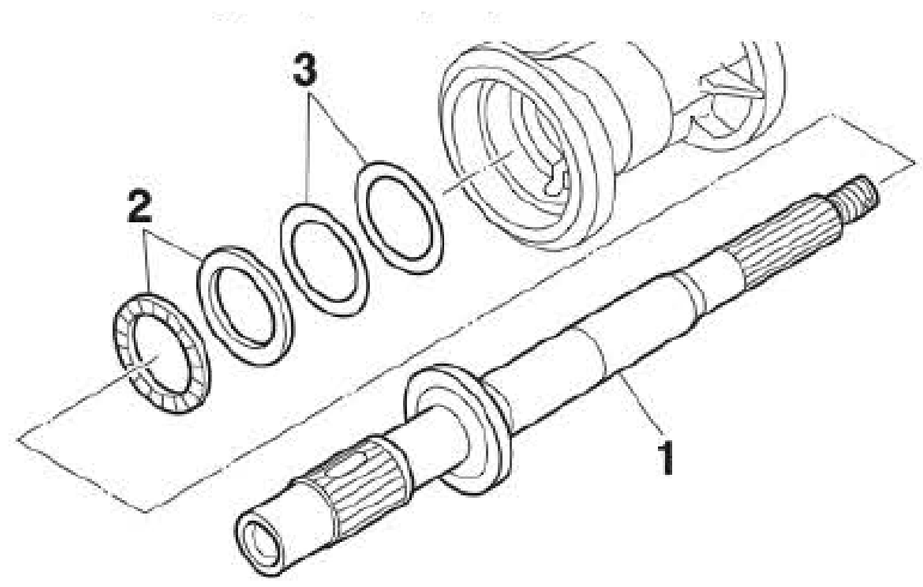
3. Heat the area of the propeller shaft housing "1" where the tapered roller bearing outer race is to be installed using a gas torch, and then remove the forward gear assembly "2".

NOTICE

When heating the propeller shaft housing, heat the entire installation area evenly. Otherwise, the propeller shaft housing could be damaged.



4. Remove the propeller shaft "1", thrust bearing "2", and propeller shaft shims "3".

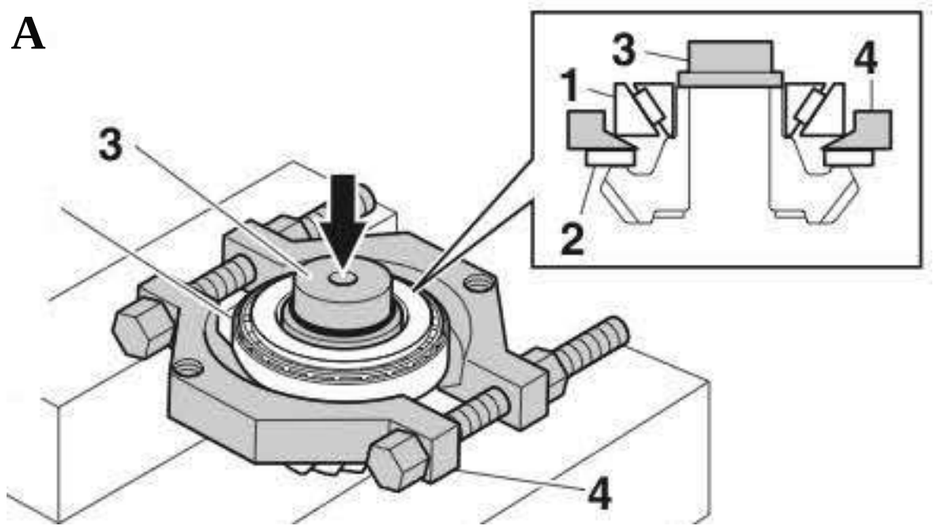


5. Remove the oil seals and needle bearing. See step 3 in "Disassembling the propeller shaft housing assembly" (8-12).

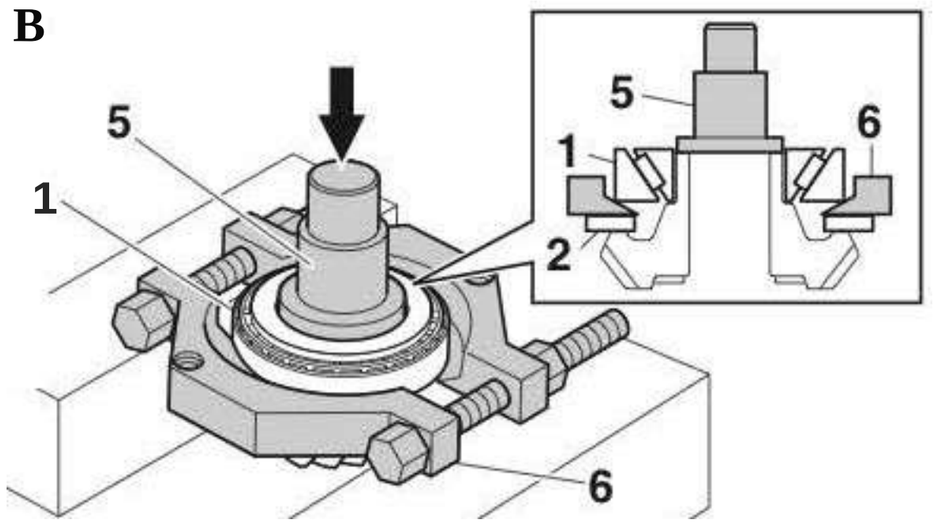
Disassembling the forward gear

1. Remove the tapered roller bearing "1" and thrust washer "2".

A



B



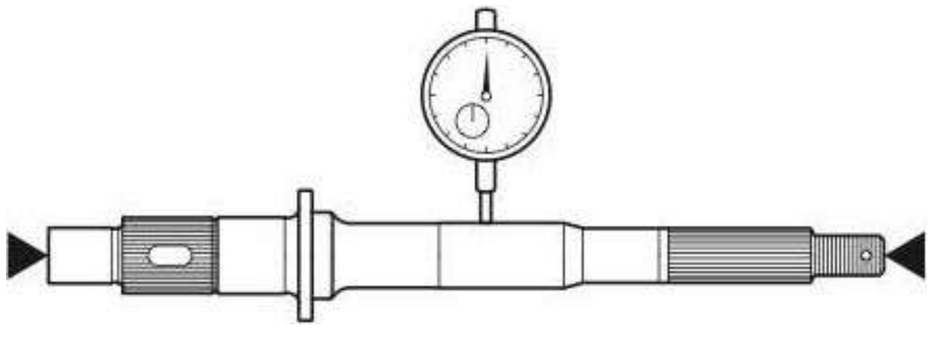
A. Worldwide
B. USA and Canada

Needle bearing attachment "3"
Bearing separator "4"
Needle bearing attachment "5"
Bearing separator "6" (commercially available)

Checking the propeller shaft

1. Check the propeller shaft. Replace if damaged or worn.

2. Measure the propeller shaft runout.



Propeller shaft
Runout
0.02 mm (0.0008 in)

Checking the dog clutch

See "Checking the dog clutch" (8-14).

Checking the propeller shaft housing

See "Checking the propeller shaft housing" (8-14).

Checking the forward gear

1. Check the teeth and dogs of the forward gear. Replace if cracked or worn.

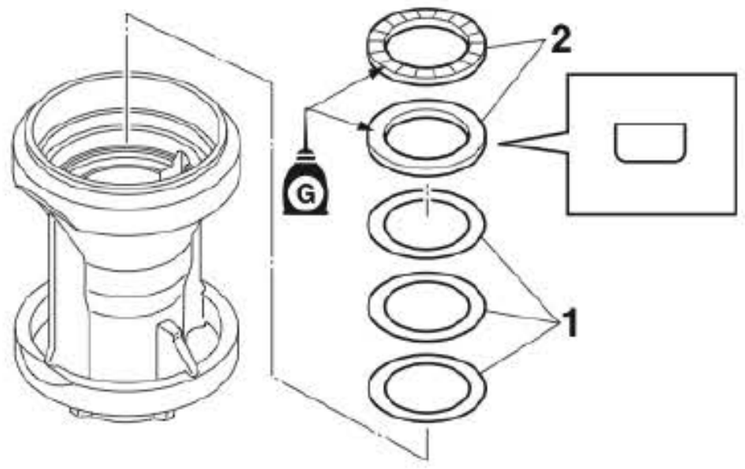
Assembling the propeller shaft housing assembly and forward gear

⚠ WARNING

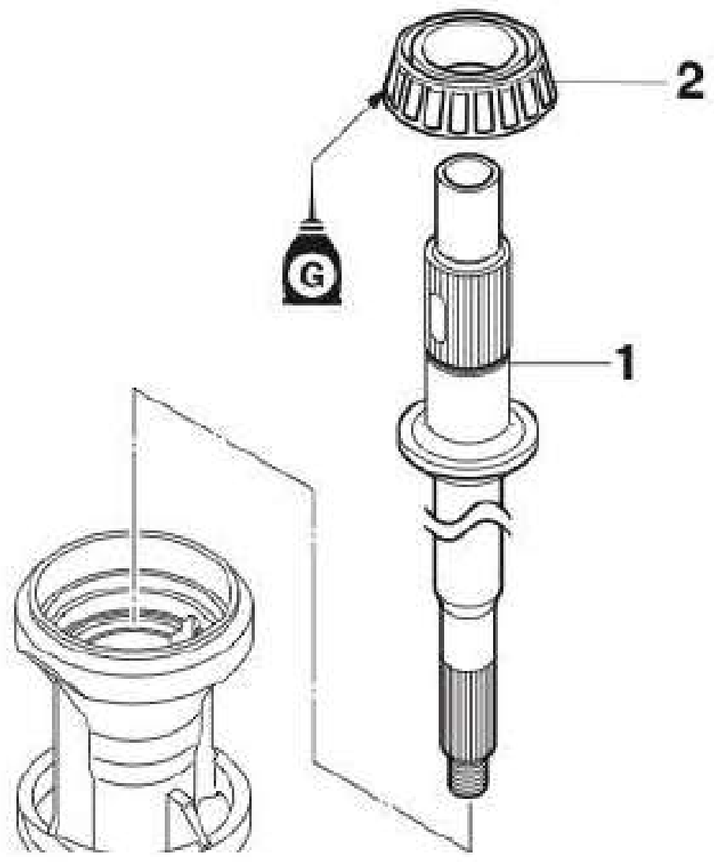
- **Use heat-resistant gloves. Otherwise, burns could result.**
- **To prevent fires, remove any flammable substances, such as gasoline and oil, around the working area.**
- **Keep good ventilation while working.**

1. Install the needle bearing and oil seals. See steps 1 and 2 in "Assembling the propeller shaft housing assembly" (8-15).

2. Install the original propeller shaft shims "1" and a new thrust bearing "2".



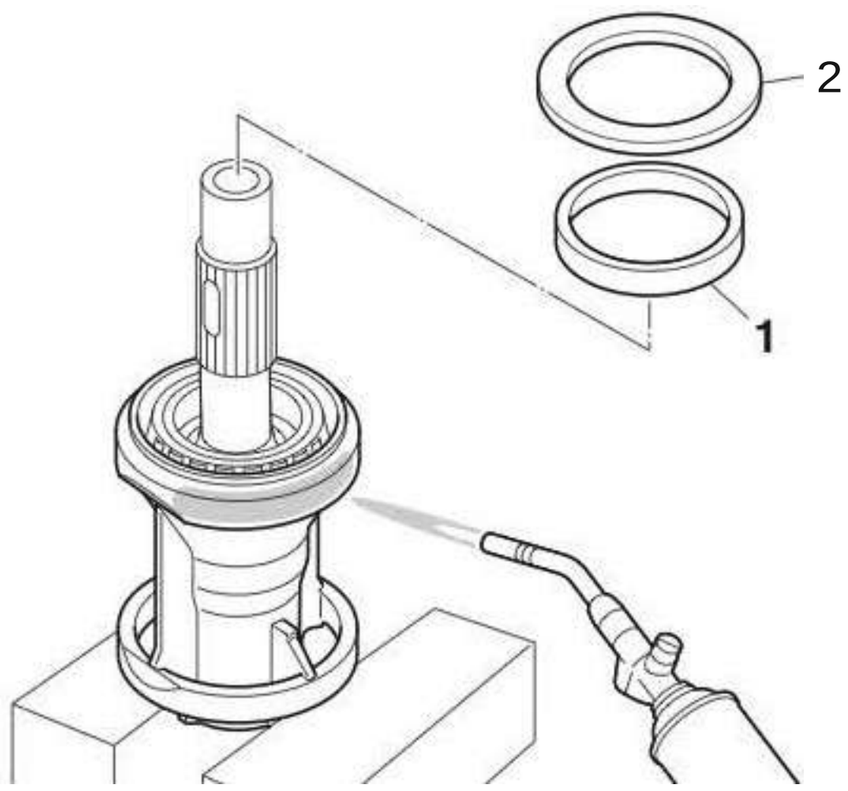
3. Install the propeller shaft "1" and tapered roller bearing inner race "2".



4. Heat the area of the propeller shaft housing where the tapered roller bearing outer race "1" is to be installed using a gas torch, and then install the tapered roller bearing outer race "1" and thrust washer "2".

NOTICE

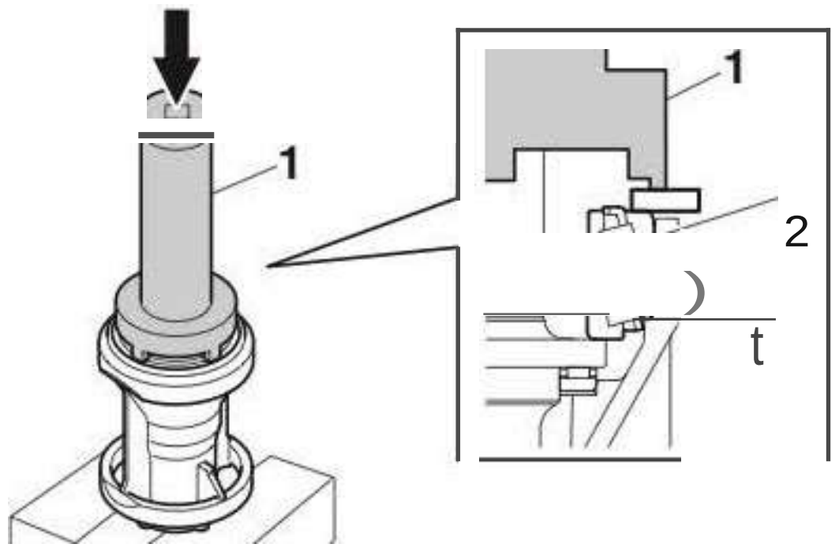
When heating the propeller shaft housing, heat the entire installation area evenly. Otherwise, the propeller shaft housing could be damaged.



5. While holding the special service tool "1", strike the tool to check that the tapered roller bearing "2" is installed properly.

TIP:

If a high-pitched metallic sound is produced when the special service tool is struck, the tapered roller bearing outer race is installed properly.



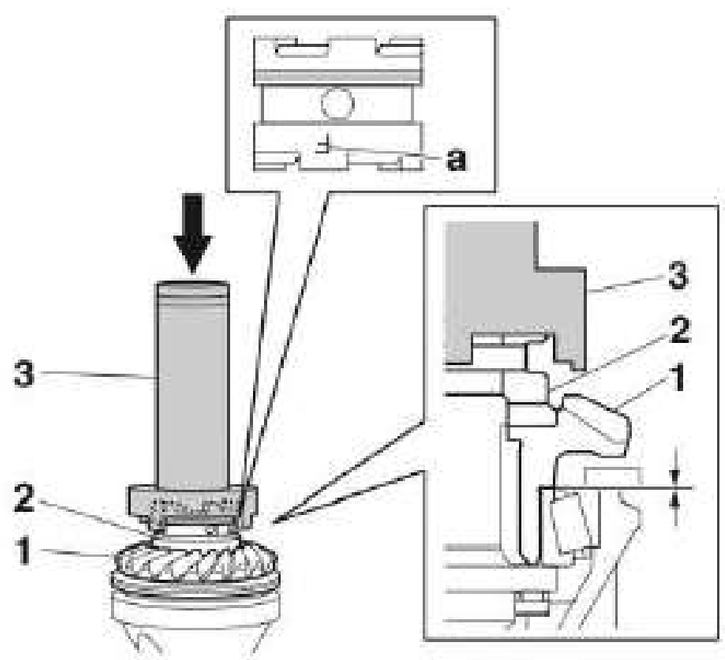
Ring nut wrench "1"

Ring nut wrench "1"

6. Install the forward gear "1" using the dog clutch "2" and special service tool "3".

TIP:

Face the "P" mark "a" on the dog clutch "2" toward the forward gear.

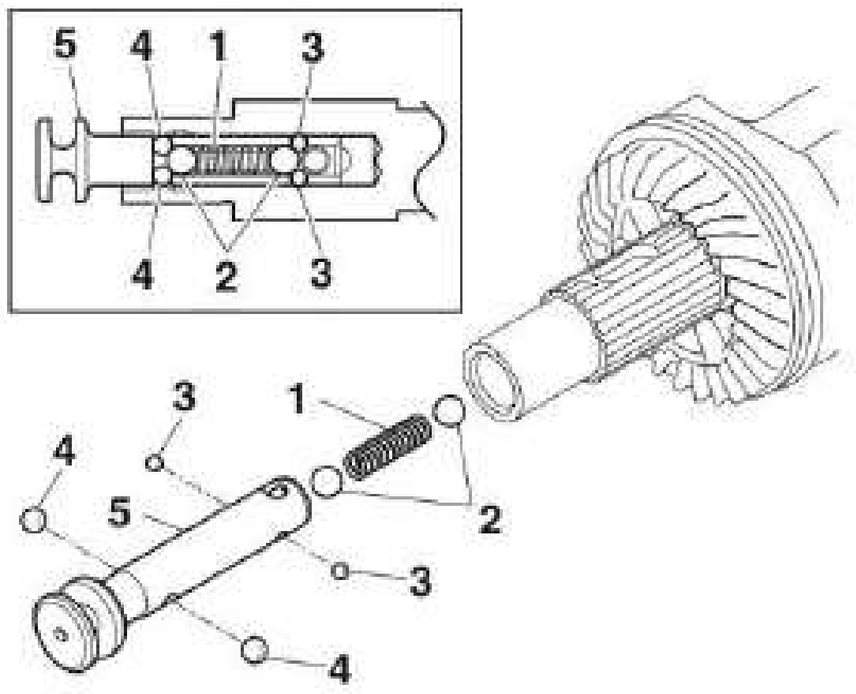


Ring nut wrench "3"

Ring nut wrench "3"

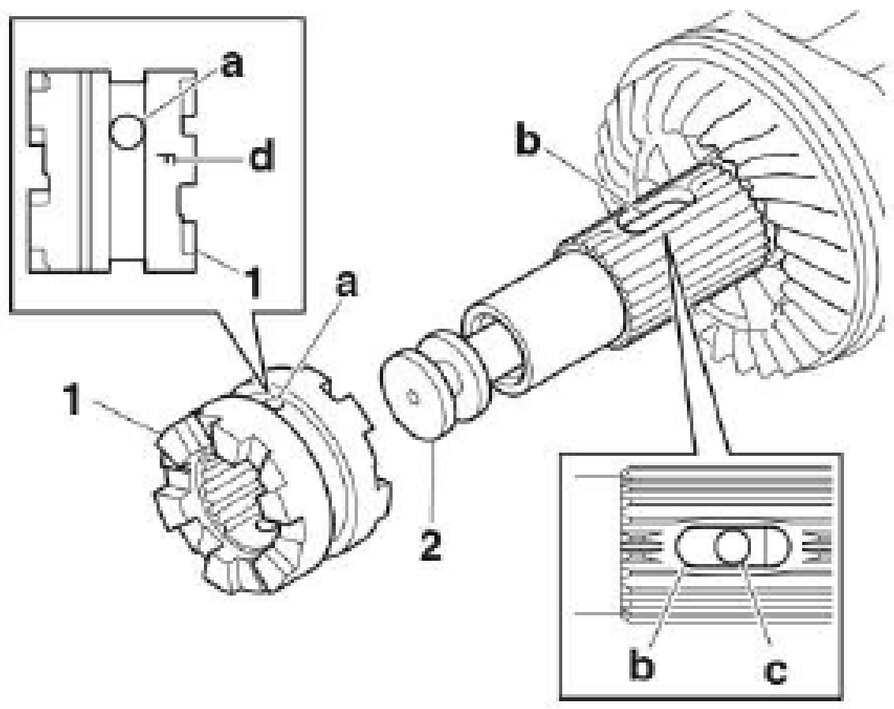
7. Install the spring "1", balls "2", "3", and "4", and slider "5".

TIP:
When installing the slider "5", make sure that the balls do not fall out of position.

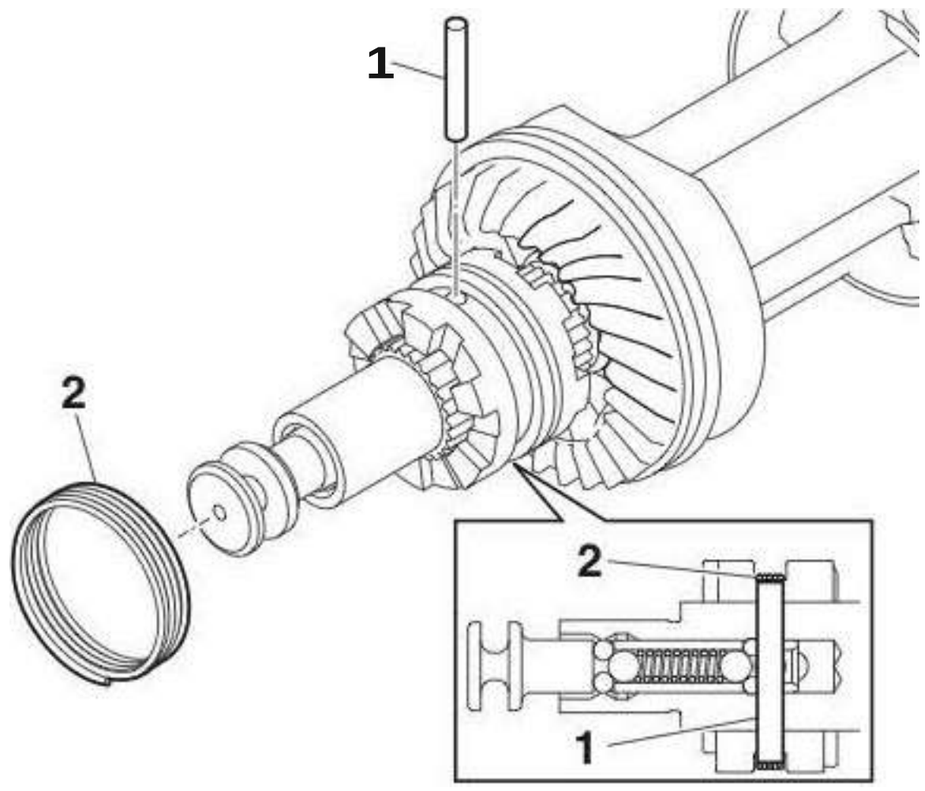


8. Install the dog clutch "1" so that the hole "a" in the dog clutch "1" and the hole "b" in the propeller shaft are aligned with the hole "c" in the slider "2".

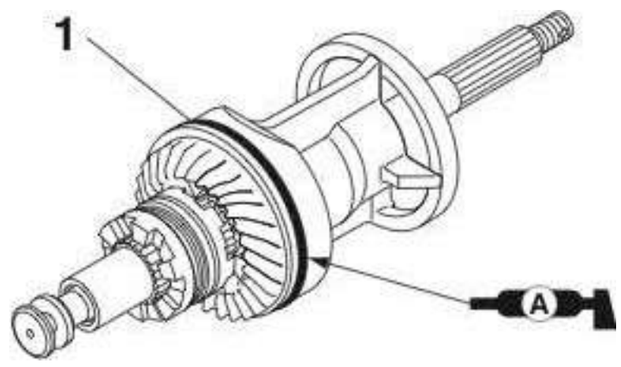
TIP:
Face the "F" mark "d" on the dog clutch "1" toward the forward gear.



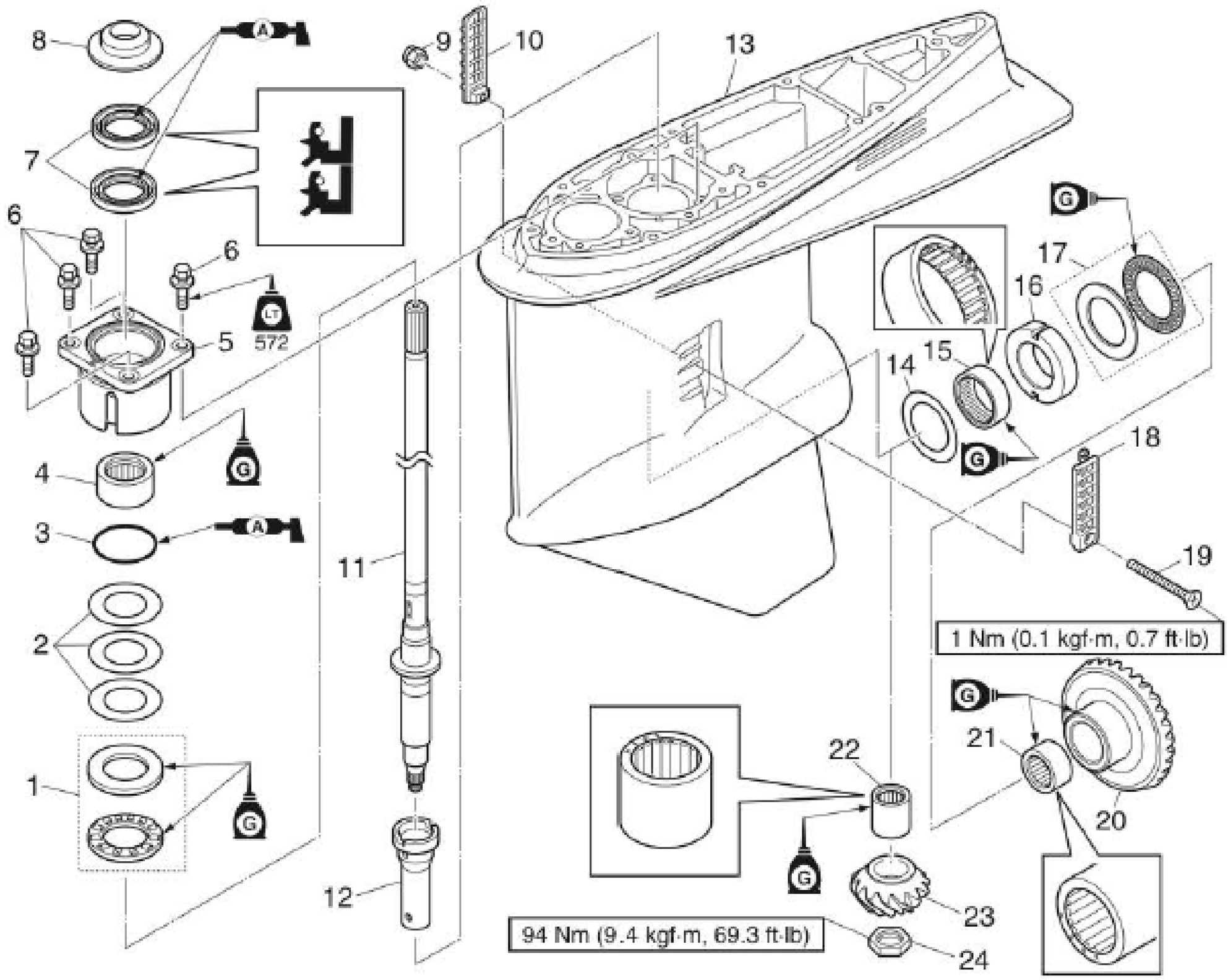
9. Install the cross pin "1", and then install the spring "2".



10. Install a new O-ring "1".

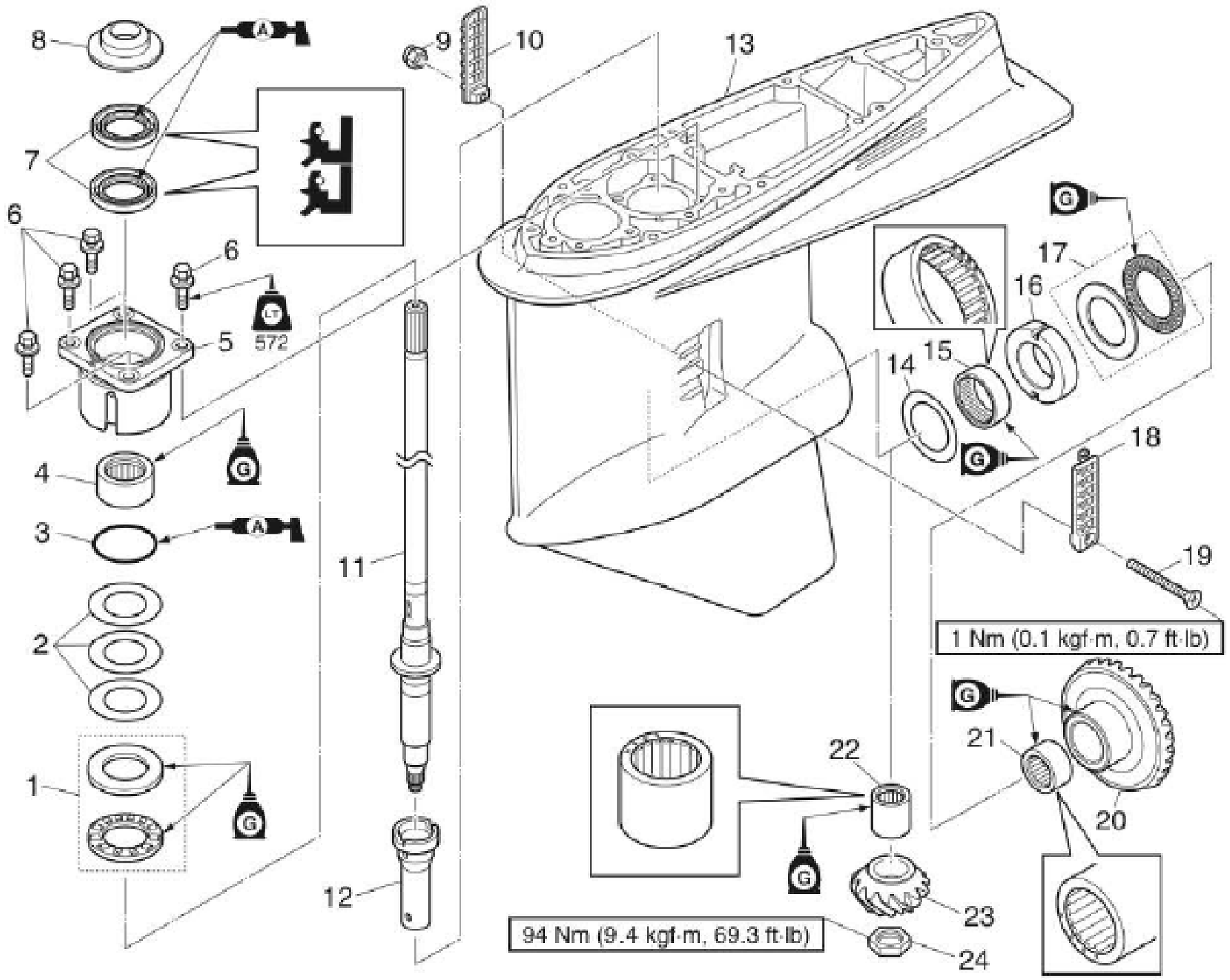


Drive shaft and lower case (counter rotation model)



No.	Part name	Q'ty	Remarks
1	Thrust bearing	1	
2	Pinion shim (T3)	—	
3	O-ring	1	Not reusable
4	Needle bearing	1	Not reusable
5	Drive shaft housing	1	
6	Bolt	4	M8 x 25 mm
7	Oil seal	2	Not reusable
8	Cover	1	
9	Self-locking nut	1	
10	Water inlet cover (STBD)	1	
11	Drive shaft	1	
12	Sleeve	1	
13	Lower case	1	
14	Reverse gear shim (T1)	—	
15	Needle bearing	1	Not reusable
16	Retainer	1	
17	Thrust bearing	1	

Drive shaft and lower case (counter rotation model)



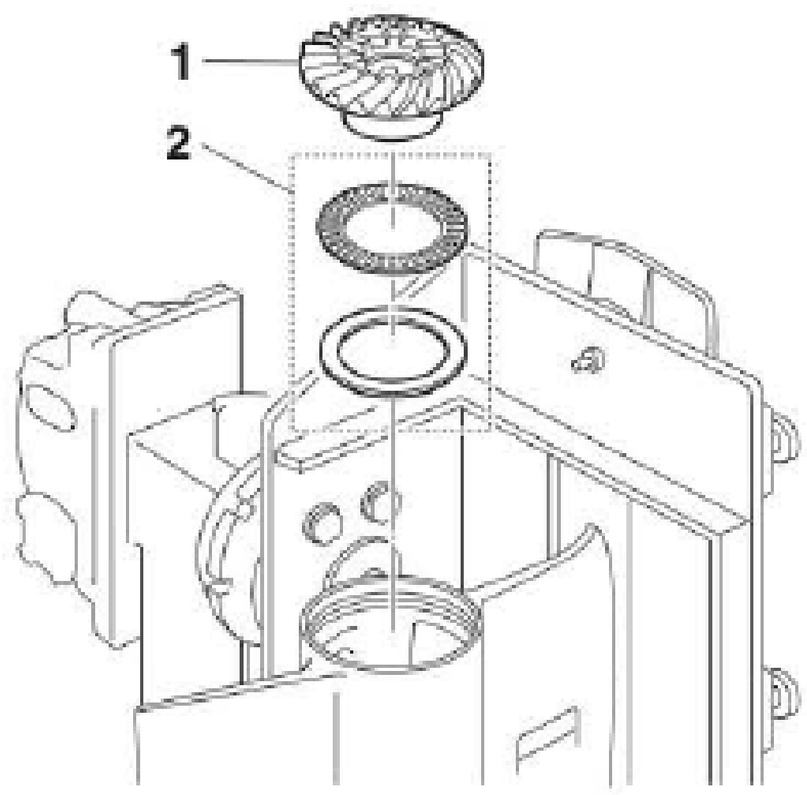
No.	Part name	Q'ty	Remarks
18	Water inlet cover (PORT)	1	
19	Screw	1	M5 x 48 mm
20	Reverse gear	1	
21	Needle bearing	1	Not reusable
22	Needle bearing	1	Not reusable
23	Pinion	1	
24	Pinion nut	1	

Removing the drive shaft

See steps 1–3 in "Removing the drive shaft" (8-19).

Removing the reverse gear

1. Remove the reverse gear "1" and thrust bearing "2".



Disassembling the drive shaft housing

See "Disassembling the drive shaft housing" (8-20).

Disassembling the reverse gear

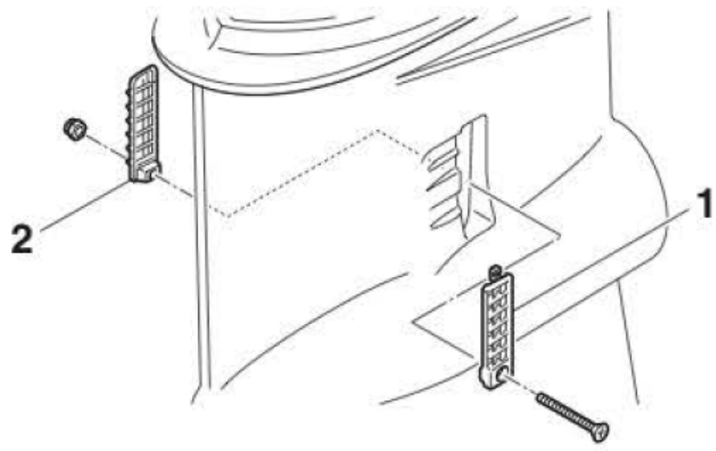
1. Remove the needle bearing from the reverse gear.

Disassembling the lower case

⚠ WARNING

- **Use heat-resistant gloves. Otherwise, burns could result.**
- **To prevent fires, remove any flammable substances, such as gasoline and oil, around the working area.**
- **Keep good ventilation while working.**

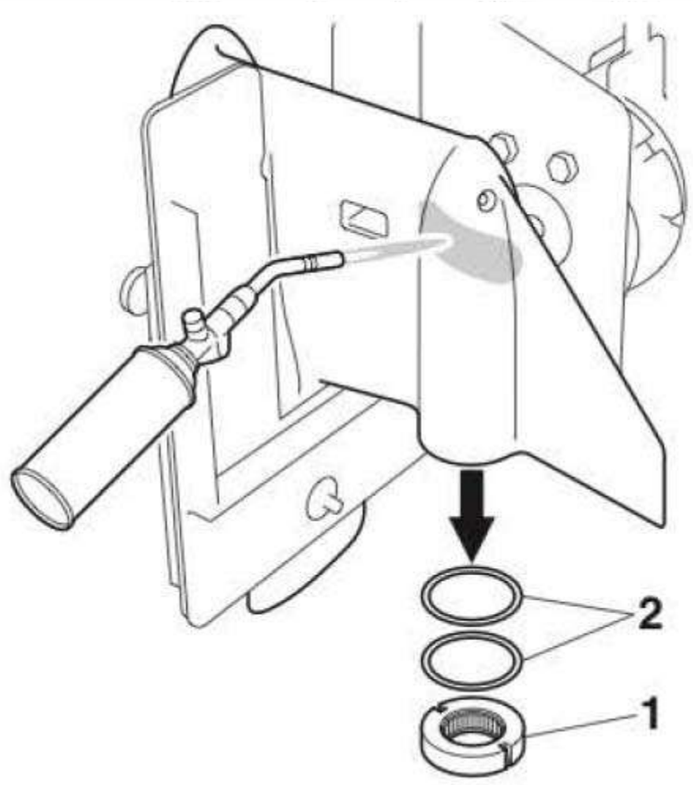
1. Remove the water inlet covers "1" and "2".



2. Heat the area of the lower case where the retainer is to be installed using a gas torch, and then remove the retainer "1" and reverse gear shims "2".

NOTICE

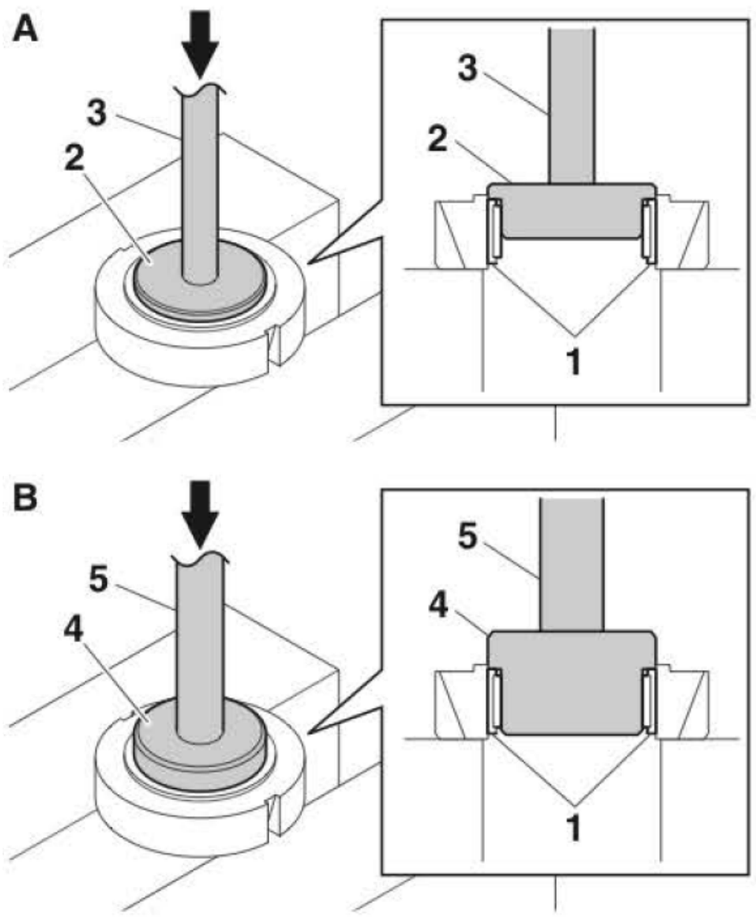
When heating the lower case, heat the entire installation area evenly. Otherwise, the paint on the lower case could be burned.



3. Remove the needle bearing. See step 3 in "Disassembling the lower case" (8-21).

Disassembling the retainer

1. Remove the needle bearing "1".



A. Worldwide
B. USA and Canada

Needle bearing attachment "2"
Driver rod L3 "3"
Needle bearing installer "4"
Driver handle (large) "5"

Checking the pinion

See "Checking the pinion" (8-21).

Checking the reverse gear

1. Check the teeth and dogs of the reverse gear. Replace if cracked or worn.

Checking the drive shaft

See "Checking the drive shaft" (8-22).

Checking the lower case

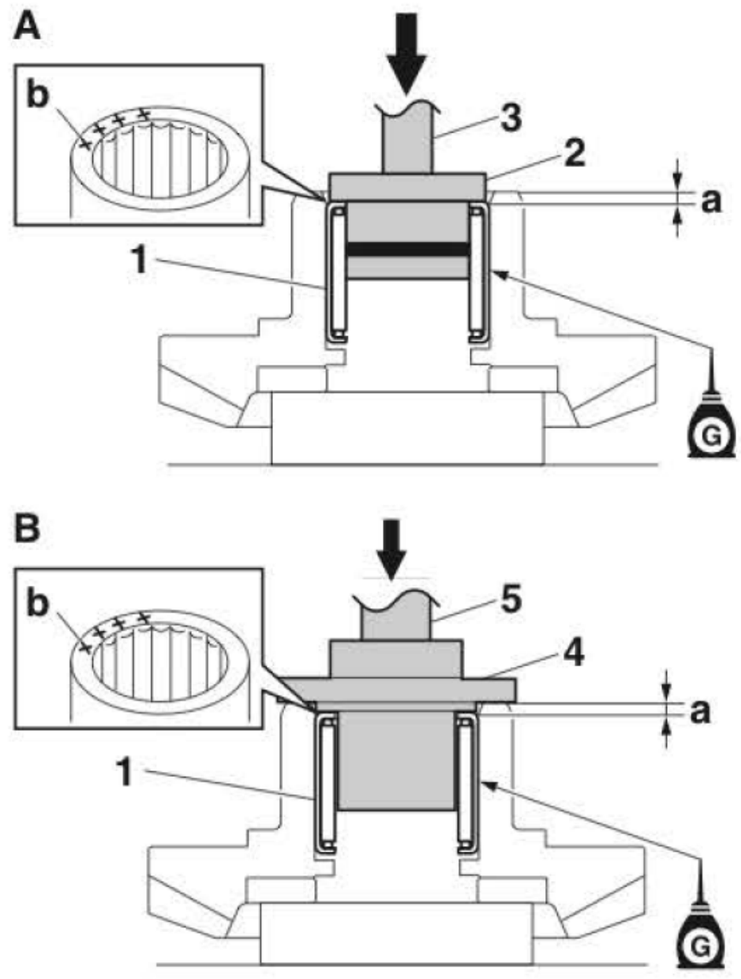
See "Checking the lower case" (8-22).

Assembling the reverse gear

1. Install a new needle bearing "1" at the specified installation depth "a".

TIP:

Face the bearing identification mark "b" on the needle bearing inner race "1" up.



A. Worldwide
B. USA and Canada

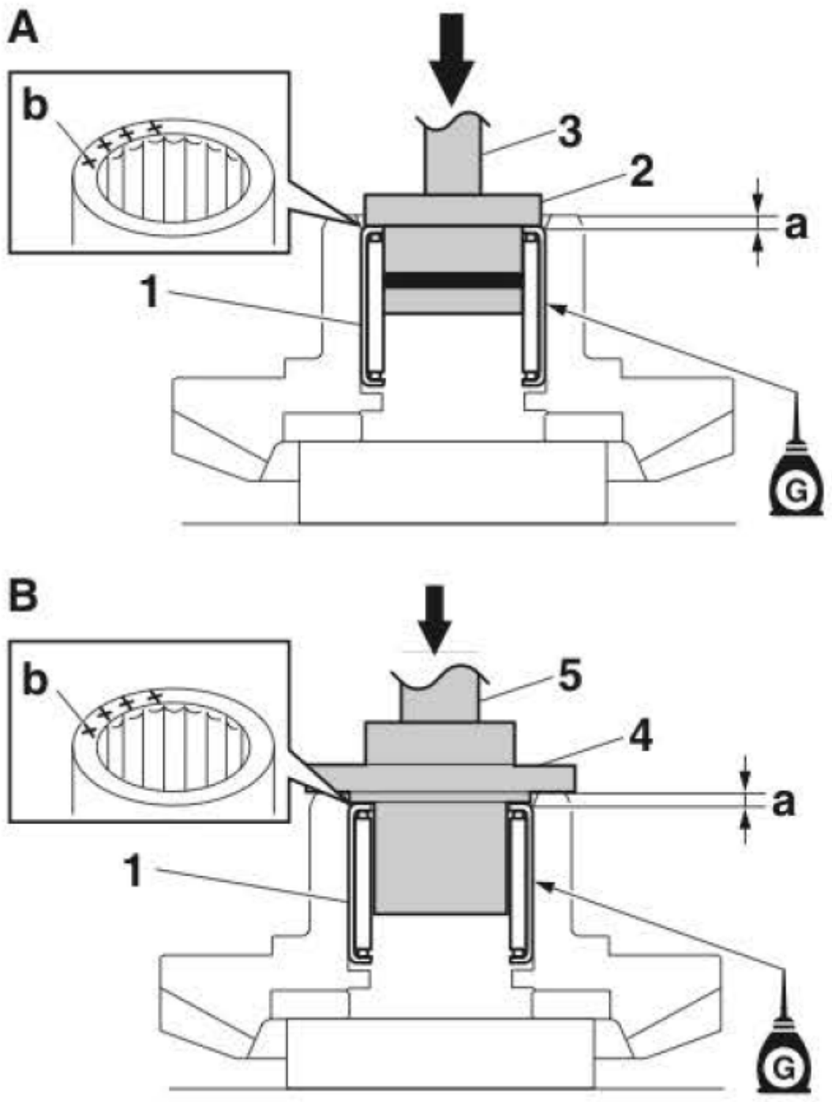
Needle bearing attachment "2"
Driver rod L3 "3"
Reverse/forward gear bearing installer "4"
Driver handle (large) "5"

Installation depth 2.50-3.50 mm (0.098-0.138 in)

Assembling the retainer

1. Install a new needle bearing "1" at the specified installation depth "a".

TIP:
Face the bearing identification mark "b" on the needle bearing "1" up.



A. Worldwide
B. USA and Canada

Needle bearing attachment "2"
Driver rod L3 "3"
Needle bearing installer "4"
Driver handle (large) "5"

Installation depth 0.75-1.25 mm (0.030-0.049 in)

Assembling the lower case

⚠WAENING

- Use heat-resistant gloves. Otherwise, burns could result.
- To prevent fires, remove any flammable substances, such as gasoline and oil, around the working area.
- Keep good ventilation while working.

1. Install the original reverse gear shims "1".

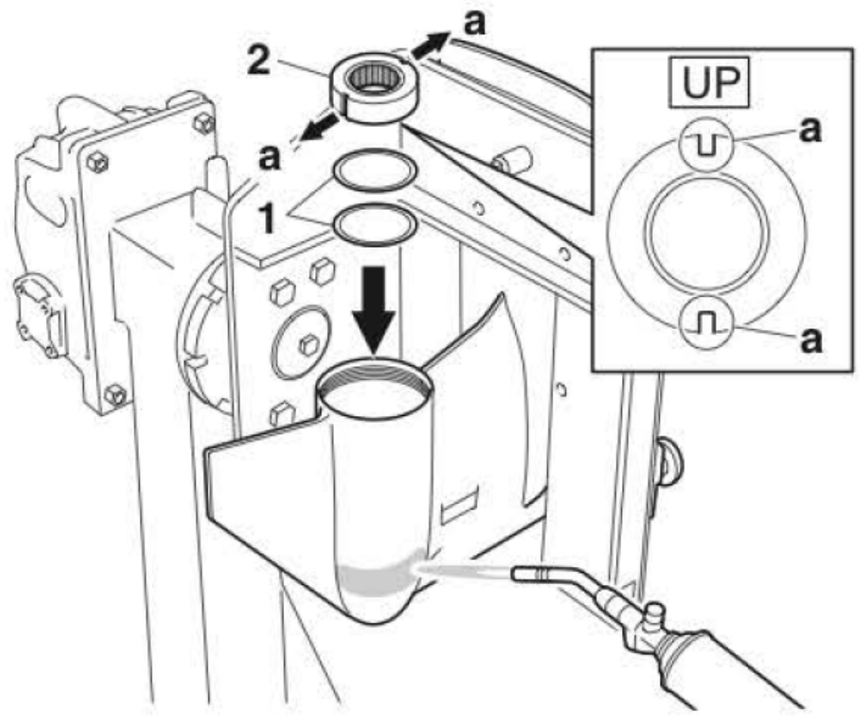
TIP:
Do not reuse a shim if deformed or scratched.

2. Heat the area of the lower case where the retainer is to be installed using a gas torch,and then install the retainer "2".

NOTICE

When heating the lower case, heat the entire installation area evenly. Otherwise, the paint on the lower case could be burned.

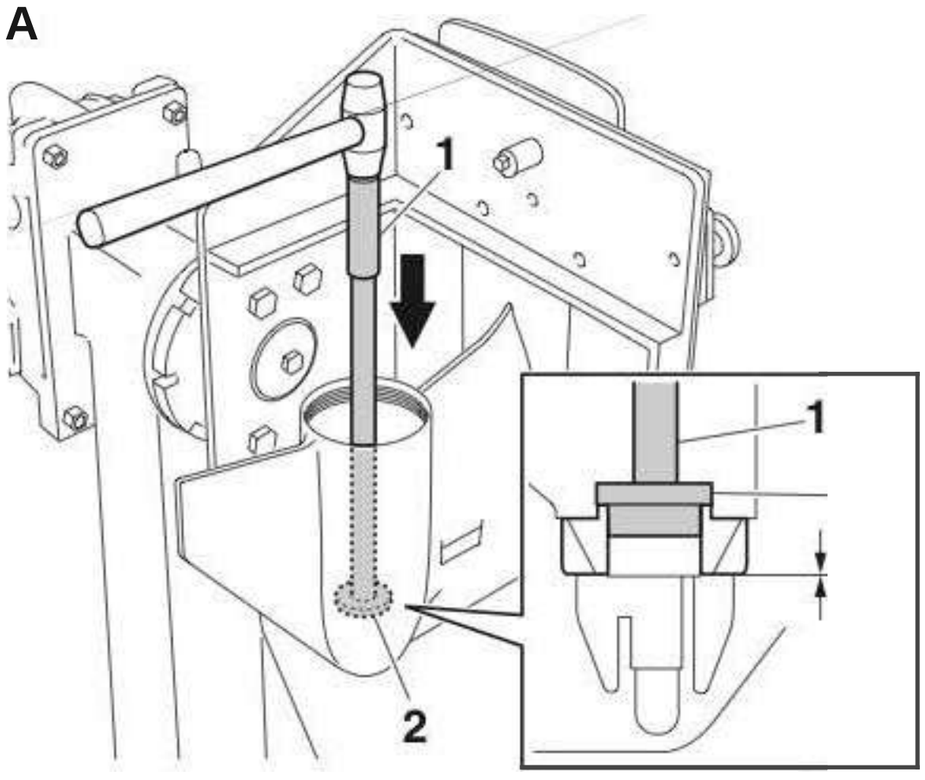
TIP:
Make sure that the slots "a" in the retainer are aligned vertically.



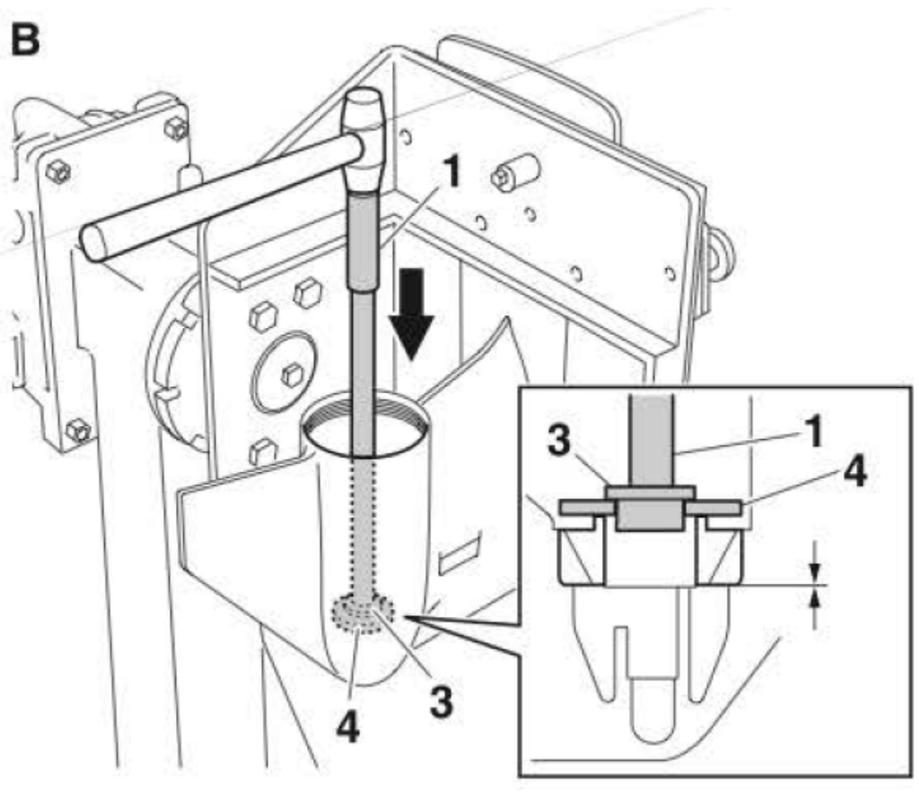
3. While holding the special service tool "1", strike the tool to check that the retainer is installed properly.

TIP:
If a high-pitched metallic sound is produced when the special service tool is struck, the retainer is installed properly.

A



B



A. Worldwide
B. USA and Canada

Driver rod LL "1"

Driver handle (large) "1"

Ball bearing attachment "2"

Reverse gear bearing retainer/installer "3"

Needle bearing installer "4"

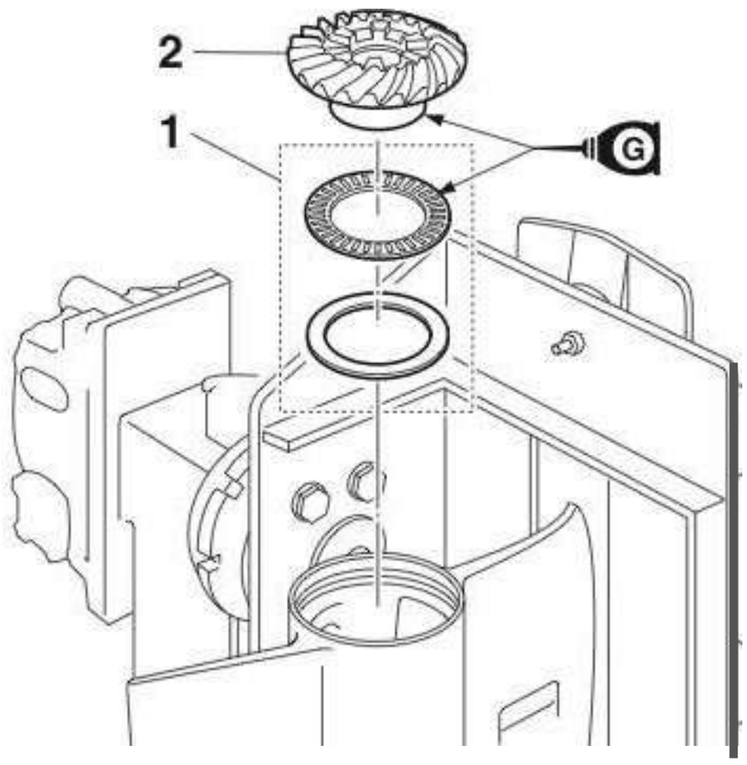
4. Install the needle bearing and water inlet covers. See steps 4 and 5 in "Assembling the lower case" (8-24).

Assembling the drive shaft housing

See "Assembling the drive shaft housing" (8-23).

Installing the reverse gear

1. Install a new thrust bearing "1" and the reverse gear "2".



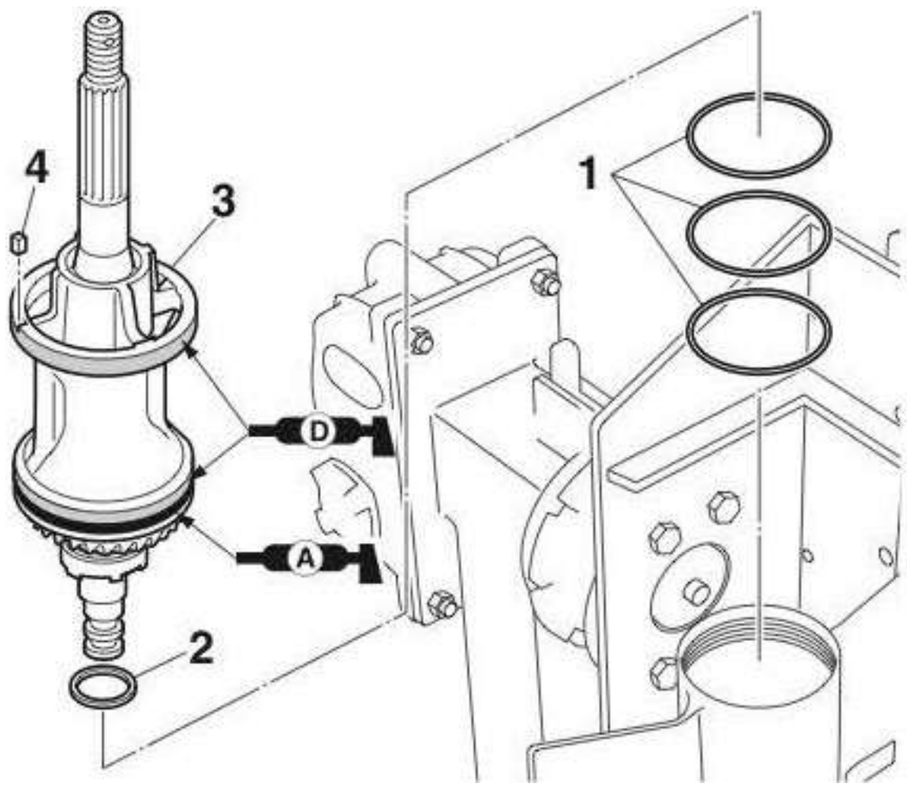
Installing the drive shaft

See "Installing the drive shaft" (8-25).

Installing the propeller shaft housing assembly

1. Install the original forward gear shims "1", washer "2", propeller shaft housing assembly "3", and key "4".

2. Turn the drive shaft and check that the propeller shaft housing assembly "3" is installed securely.



3. Install the claw washer and ring nut. See steps 3-5 in "Installing the propeller shaft housing assembly" (8-26).

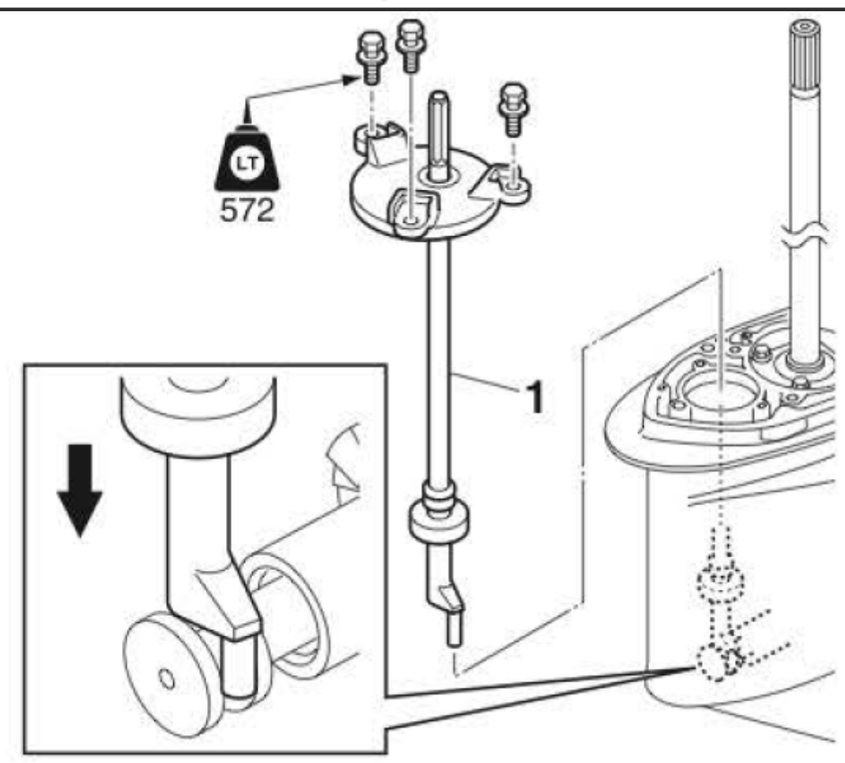
Installing the shift rod

1. Install the plate to the shift rod. See steps 1 and 2 in "Installing the shift rod" (8-27).

2. Install the shift rod "1".

TIP:

Make sure to install the shift rod "1" in the proper orientation. Installation orientation is different between the counter rotation model and the regular rotation model.



Installing the water pump

See "Installing the water pump" (8-28).

Checking the lower unit for air leakage

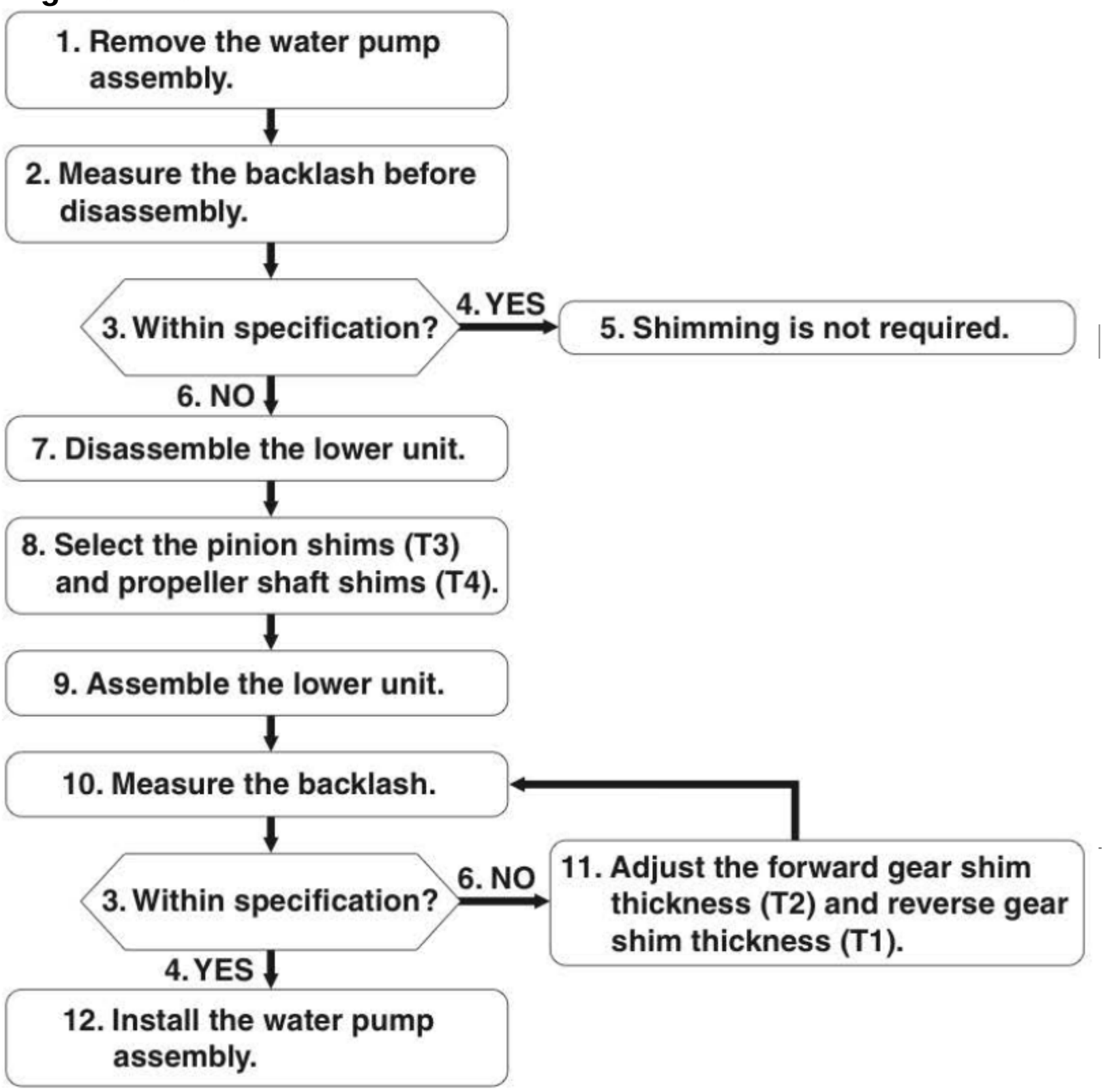
See "Checking the lower unit for air leakage" (8-29).

Installing the lower unit

See "Installing the lower unit" (8-30).

Shimming (counter rotation model)

Shimming workflow



1. Remove the water pump assembly.
2. Measure the backlash before disassembly.
3. Within specification?
4. YES
5. Shimming is not required.
6. NO
7. Disassemble the lower unit.
8. Select the pinion shims (T3) and propeller shaft shims (T4).
9. Assemble the lower unit.
10. Measure the backlash.
11. Adjust the forward gear shim thickness (T2) and reverse gear shim thickness (T1).
12. Install the water pump assembly.

TIP:

- Make sure to drain the gear oil before measuring the backlash.
- If the backlash is within specification, shimming is not required.
- When assembling the original inner parts and a new lower case, shimming is required.
- When replacing the pinion, forward gear, reverse gear, bearings, drive shaft, or propeller shaft housing, shimming is required.

Shimming check sheet

Lower case deviation

Serial number	P	F	R	Remarks

Pinion height

	Measurements (mm)		
Measuring point "a"			
Measuring point "b"			
Measuring point "c"			
Measuring point "d"			
Average			
Round-down average (M)			

Forward gear backlash

	Measurements (mm)					
	Before disassembly			After disassembly		
Measuring point "a"						
Measuring point "b"						
Measuring point "c"						
Measuring point "d"						
Average						
Round-down average						

Reverse gear backlash

	Measurements (mm)					
	Before disassembly			After disassembly		
Measuring point "a"						
Measuring point "b"						
Measuring point "c"						
Measuring point "d"						
Average						
Round-down average						

Forward gear shim (T2) thickness measurement in 2 places

(mm)	Number of shim(s)			Subtotal
0.10				
0.12				
0.15				
0.18				
0.30				
0.40				
0.50				
Total				

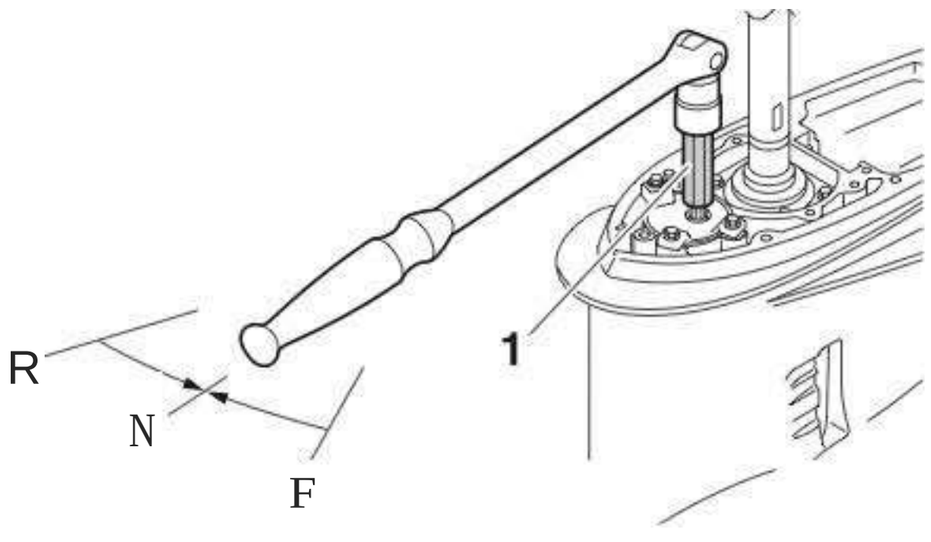
Reverse gear shim (T1) thickness measurement in 2 places

(mm)	Number of shim(s)			Subtotal
0.10				
0.12				
0.15				
0.18				
0.30				
0.40				
0.50				
Total				

Measuring the forward gear backlash and reverse gear backlash before disassembly

Two washers {90201-26MOO) are required for the reverse gear backlash measurement in the counter rotation model. One washer is pre-installed between the reverse gear and the propeller shaft as a standard component. Make sure to prepare an additional washer prior to measuring the backlash.

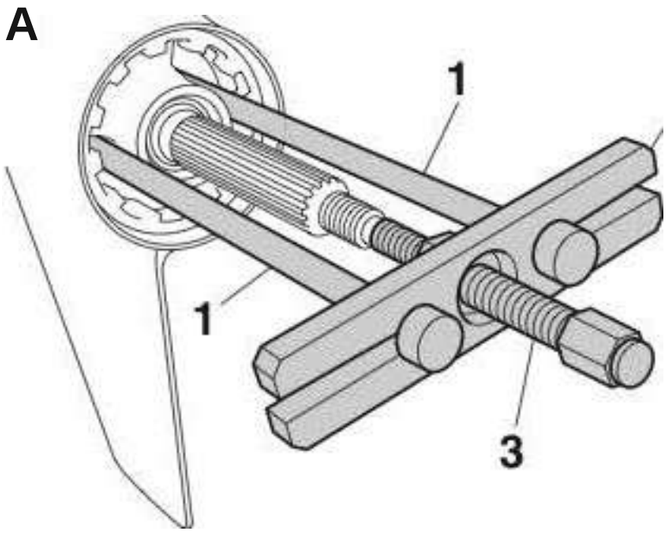
1. Install the lower unit onto a repair stand.
2. Remove the water pump assembly and outer plate cartridge. See steps 1 and 2 in "Removing the water pump and shift rod" {8-7).
3. Set the gear shift to the N position.



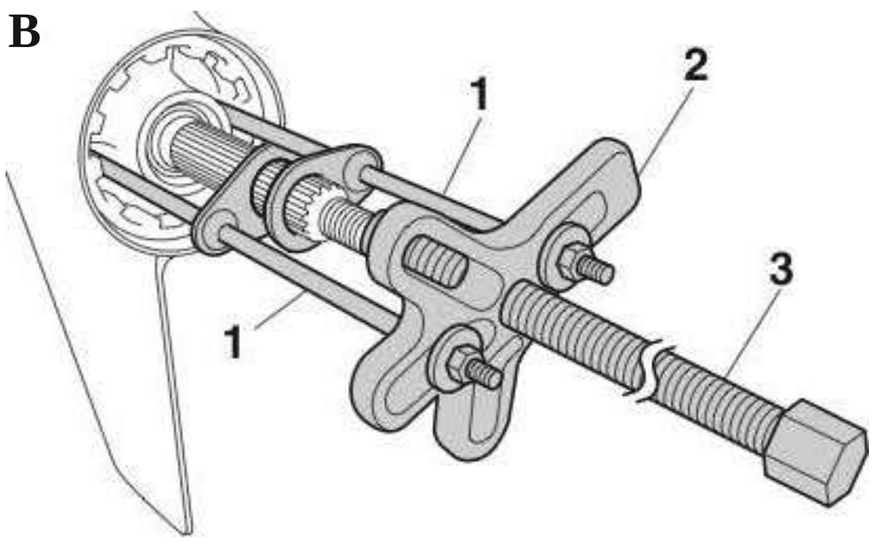
Shift rod socket "1"
Shift rod socket "1"

4. Set up the special service tools "1", "2", and "3", and then tighten the center bolt "3" temporarily.

A



B



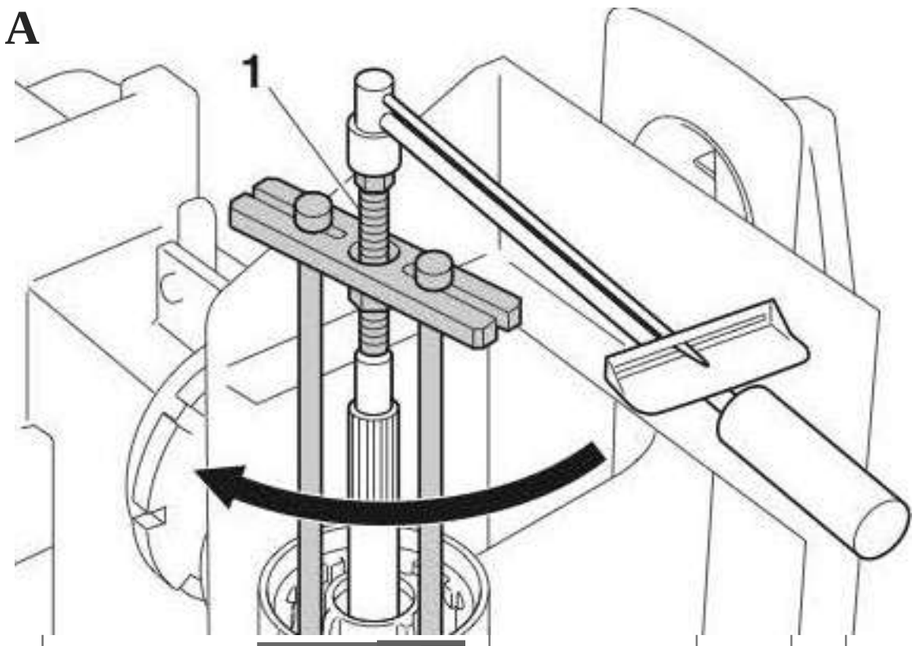
A. Worldwide
B. USA and Canada

Bearing housing puller claw L "1"
Bearing housing puller "1"
Stopper guide plate "2"
Universal puller "2"
Center bolt "3"

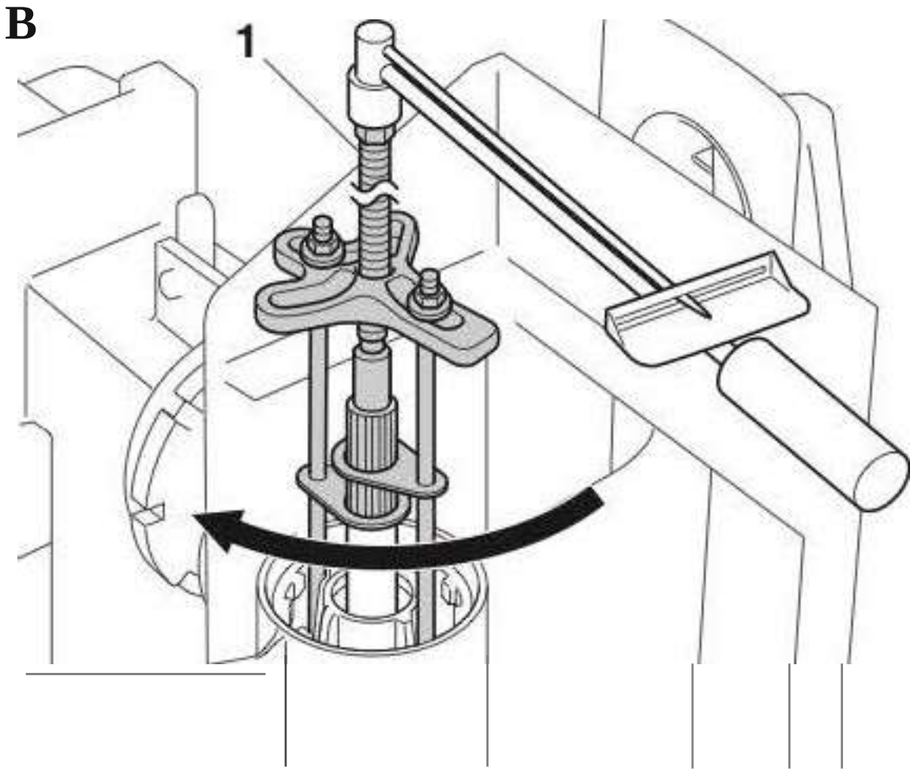
5. Turn the lower unit so that the propeller shaft is pointing up.
6. Turn the drive shaft 10 turns or more.

7. While holding the drive shaft to prevent it from turning, tighten the center bolt "1" to the specified torque.

A



B

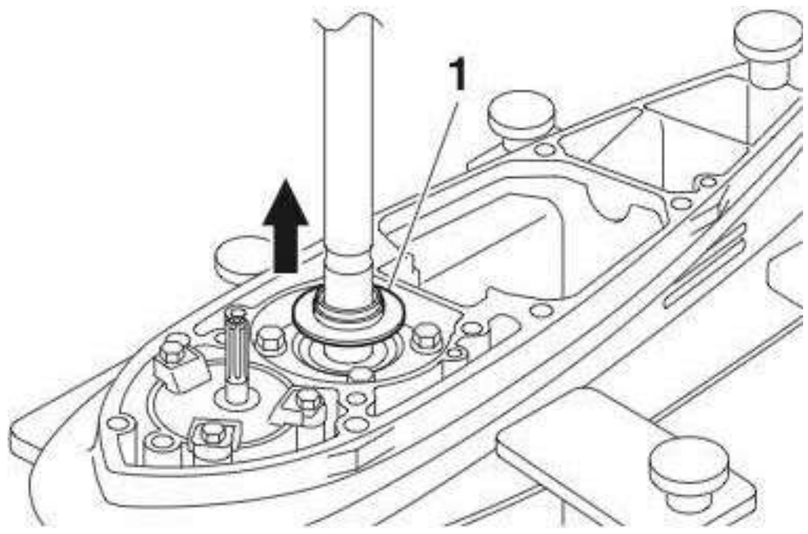


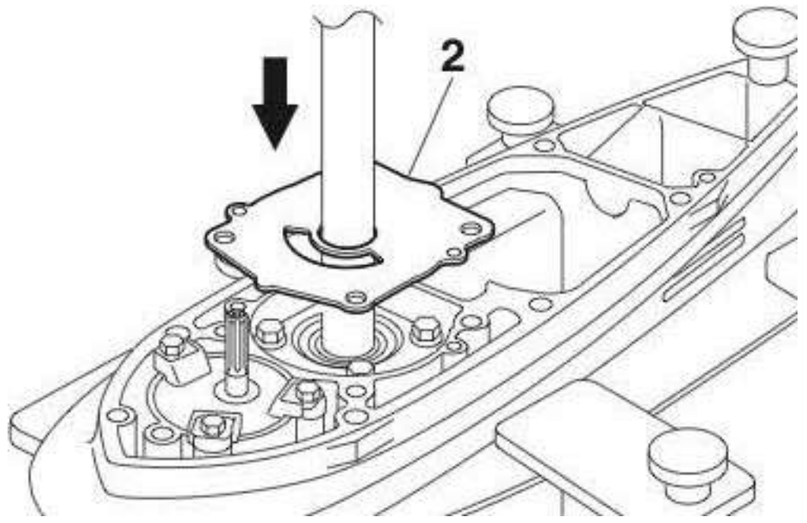
A. Worldwide
B. USA and Canada

Center bolt "1" (shimming)
20 Nm (2.0 kgf·m, 14.8 ft·lb)

8. Place the lower unit in an upright position.

9. Remove the cover "1", and then install the outer plate cartridge "2".

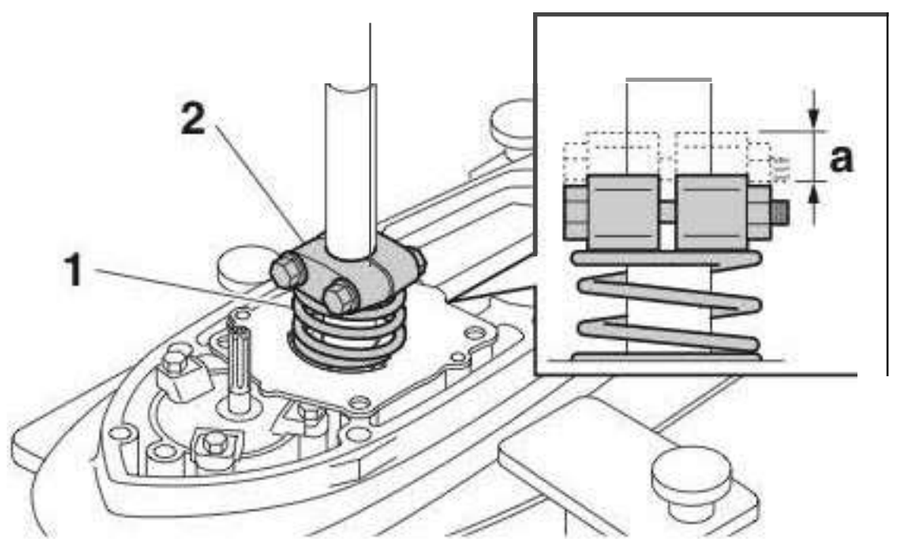




10. Set the spring "1" on the outer plate cartridge, and then install the handle holder "2" so that the spring is compressed to the specified setting height "a".

TIP:

- After installing the handle holder, pull the drive shaft upward to remove any free play.
- Do not press the spring more than 5.0 mm (0.197 in). Otherwise, too much torque will be required to turn the drive shaft, making it difficult to obtain correct measurements.

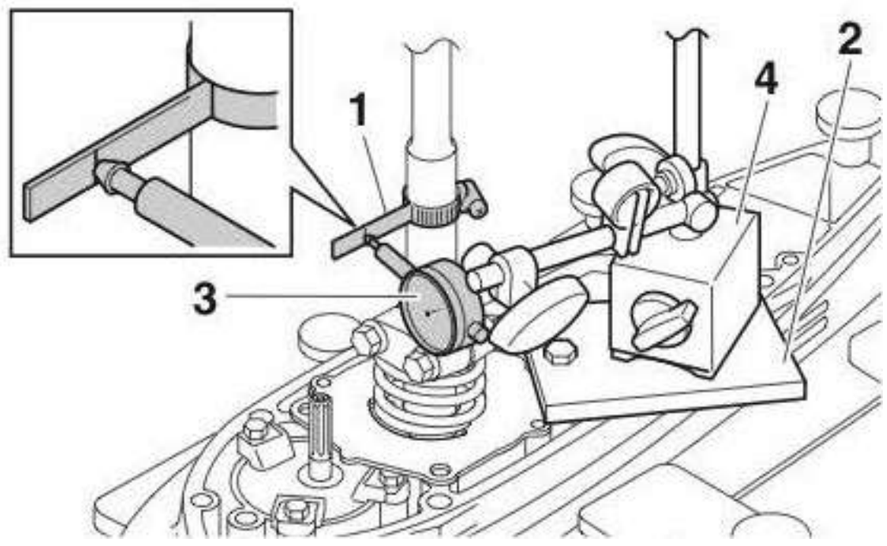


Spring "1" *1
Handle holder "2" (2 required) *1

*1. Order from Hidea Parts Distribution Center.

Setting height
3.0–5.0 mm (0.118-0.197 in)

11. Install the special service tool "1" onto the drive shaft at the lowest possible position where the shaft diameter is 22.4 mm (0.881 in), and then set up the special service tools "2", "3", and "4".

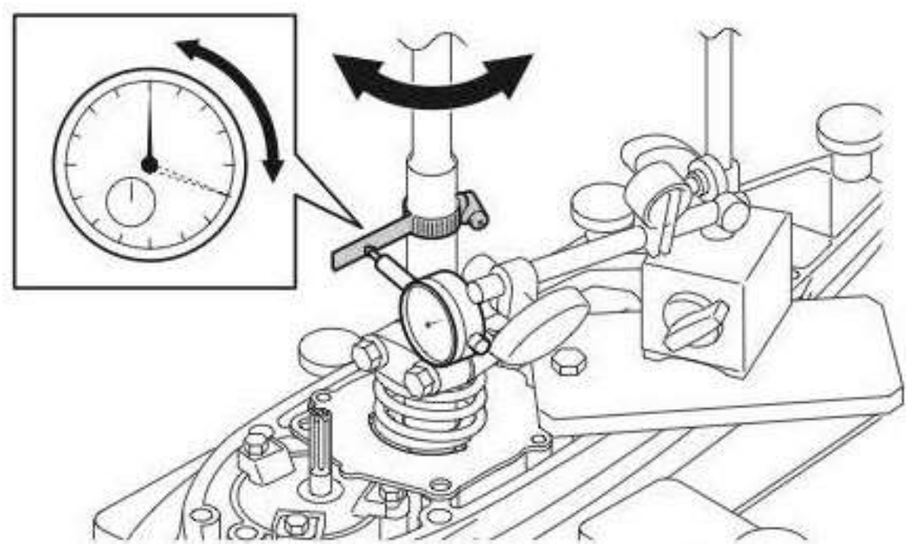


Backlash indicator "1"
Backlash indicator rod "1"
Magnet base plate "2"
Backlash adjustment plate "2"
Dial gauge set "3"
Dial indicator gauge "3"
Magnet base B "4"
Magnetic base stand "4"

12. Turn the drive shaft slowly clockwise and counterclockwise, and then measure the backlash between where the drive shaft stops in each direction.

TIP:

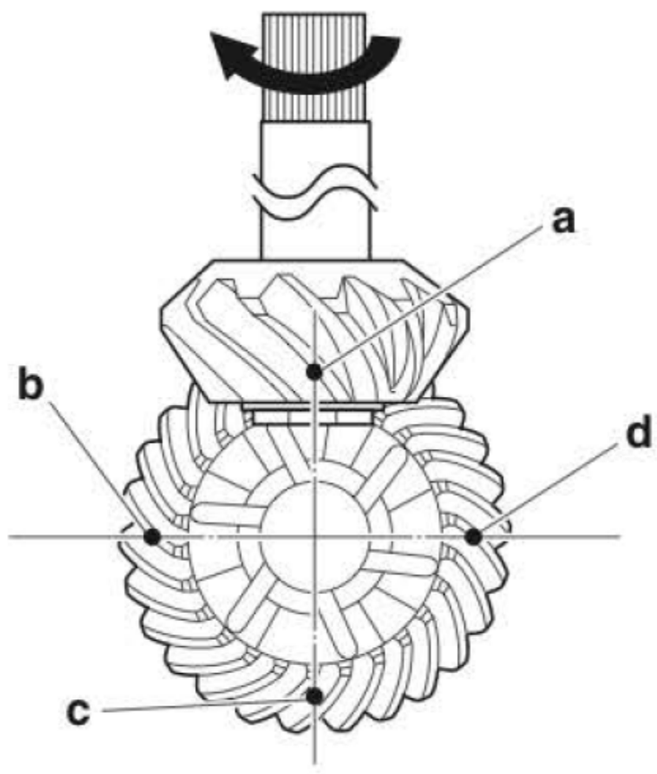
- The resistance of the spring increases the force required to turn the drive shaft. Therefore, to obtain correct measurements, consider the spring resistance force when turning the drive shaft.
- Do not turn the drive shaft using too much force. Otherwise, the forward gear will turn, leading to incorrect measurements.
- A knocking sound may be heard when the drive shaft is rotated, but this is the sound of the pinion contacting the reverse gear and does not affect the backlash measurement.



13. Turn the drive shaft 180° clockwise, and then measure the backlash again.

TIP:

- Measure the backlash at 4 points: "a", "b", "c", and "d", turning the drive shaft 180° clockwise after each measurement.
- Write down the measurement data in the shimming check sheet.



14. Determine the backlash average, and then round down the average to 2 decimal places.

Example:
(mm)

Measurement point "a"	0.30
Measurement point "b"	0.36
Measurement point "c"	0.34
Measurement point "d"	0.33
Average	0.3325
Round-down average	0.33

15. Check that the forward gear backlash average is within specification.

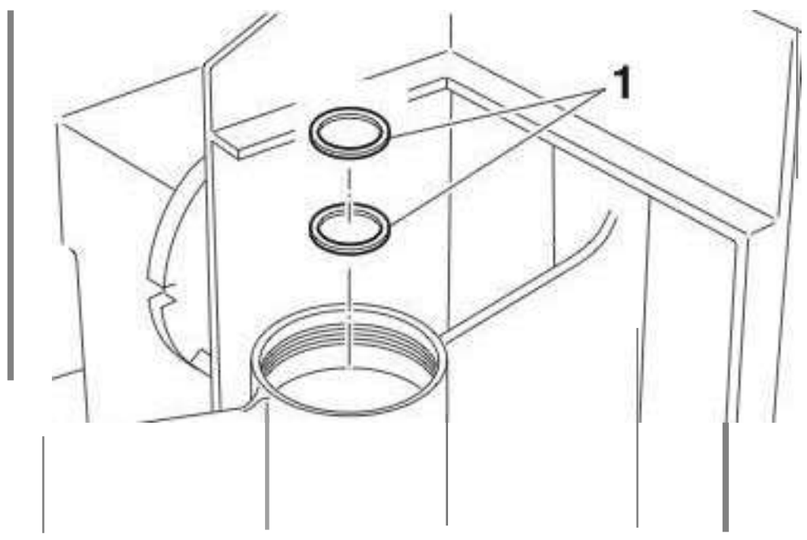
TIP:
Adjust the shim thicknesses if the forward gear backlash is out of specification.

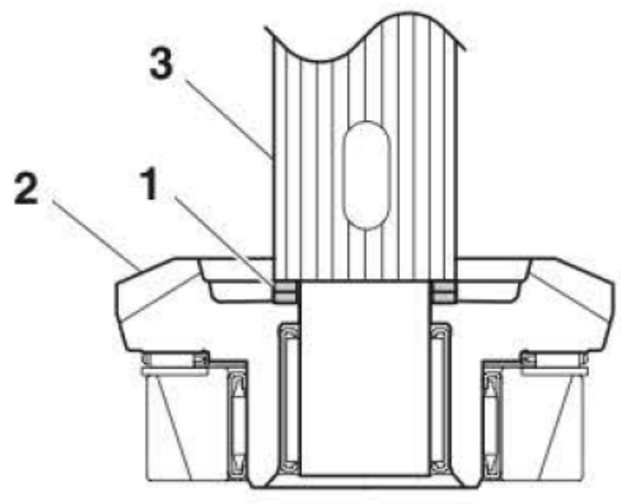
Forward gear backlash
0.13-0.87 mm (0.0051-0.0343 in)

16. Remove the special service tools from the propeller shaft.

17. Remove the shift rod and propeller shaft housing assembly.

18. Install the washers "1" between the reverse gear "2" and the propeller shaft "3".





Washer "1"

*1. Order from Hidea Parts Distribution Center.

19. Install the original forward gear shims (T2) and propeller shaft housing assembly, and then tighten the ring nut to the specified torque.

Ring nut (shimming)
50 Nm (5.0 kgf-m, 36.9 ft-lb)

20. Repeat steps 11-13 to measure the reverse gear backlash.

21. Check that the reverse gear backlash average is within specification.

TIP:
Adjust the shim thicknesses if the reverse gear backlash is out of specification.

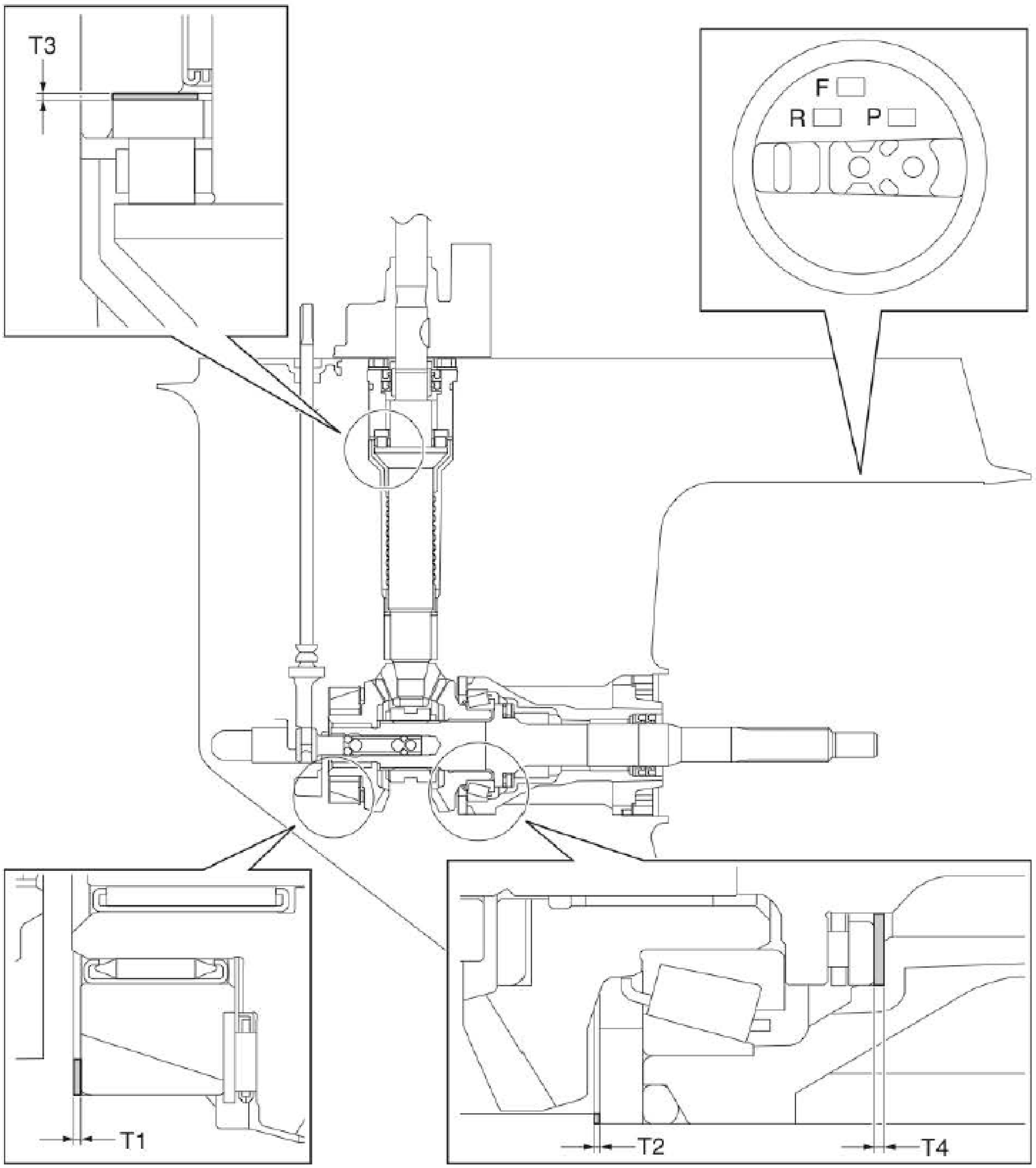
Reverse gear backlash
0.75-1.56 mm (0.0295-0.0614 in)

22. Remove the special service tools, and then install the water pump assembly and shift rod.

Shimming procedure

- Before selecting the forward gear shims (T2) and reverse gear shims (T1), make sure to select the pinion shims (T3) and propeller shaft shims (T4).
- When assembling the lower unit to measure the backlash after selecting the pinion shims (T3), do not apply gear oil, grease, or sealant to the parts.
- When assembling the lower unit after shimming is completed, make sure to apply gear oil, grease, and sealant to the specified areas.

Shim location



Selecting the pinion shim (T3)

See "Selecting the pinion shim (T3)" (8-40).

Selecting the propeller shaft shim (T4)

1. Install the original propeller shaft shims (T4).

TIP:

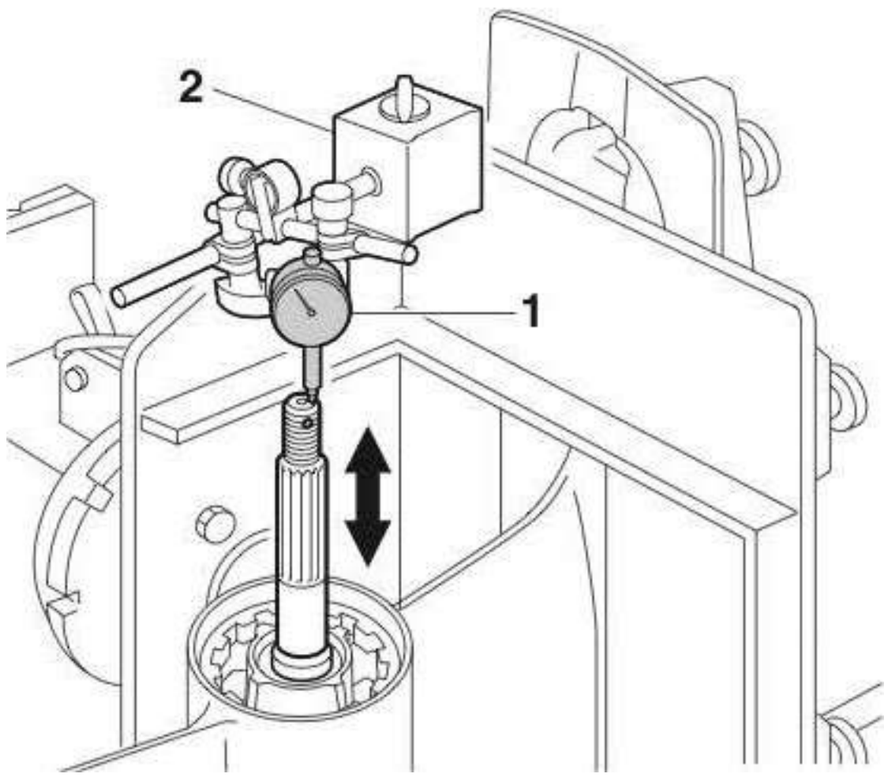
- If the original shims are missing, measure the free play without any shims.
- Do not reuse a shim if deformed or scratched.

2. Install the propeller shaft housing assembly. See "Installing the propeller shaft housing assembly" (8-66).

3. Turn the propeller shaft 10 turns or more.

4. Set up the special service tools "1" and "2".

5. Measure the propeller shaft free play.



Dial gauge set "1"
Dial indicator gauge "1"
Magnet base B "2"
Magnetic base stand "2"

Propeller shaft free play 0.25-0.35 mm (0.0098-0.0138 in)

6. Round the measurement value to the 1/10 place if out of specification.

TIP:

In the "Propeller shaft shim (T4) selection table", use the rounded measurement value for the free play measurement.

7. Determine the value of propeller shaft shim (T4) thickness adjustment using the "Propeller shaft shim (T4) selection table" according to the free play measurement. See "Propeller shaft shim (T4) selection table" (A-9).

TIP:

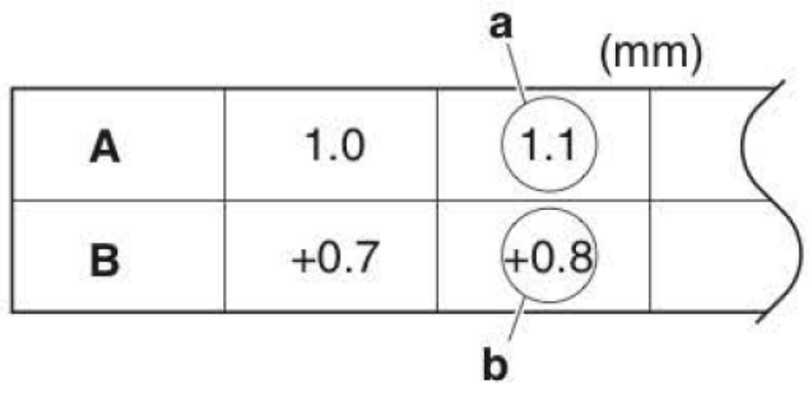
- If the shim thickness adjustment value is positive, the current shim thickness must be increased by that amount and, if the value is negative, the current shim thickness must be decreased by that amount.
- The gray-colored cell on the selection table indicates the specified propeller shaft free play. Shimming is not required if the measured propeller shaft free play is 0.25–0.35 mm.
- The values for the shim thickness adjustments specified in the selection table are intended to obtain the specified propeller shaft free play of 0.3 mm.

Example:

Free play measurement = 1.1 mm "a"

Propeller shaft shim (T4) thickness adjustment = 0.8 mm "b"

The current shim thickness must be increased by 0.8 mm.



A. Free play measurement
B. Shim thickness adjustment

8. Calculate the new propeller shaft shim (T4) thickness.

TIP:
Use up to 3 shims to obtain the required shim thickness.

Calculation formula:
New propeller shaft shim (T4) thickness = Current propeller shaft shim thickness + Shim thickness adjustment

Example:
Use the following formula when the shim thickness adjustment value is positive.
Current propeller shaft shim thickness = 0.8 mm
Shim thickness adjustment = 0.2 mm
New propeller shaft shim (T4) thickness = 0.8 mm + 0.2 mm = 1.0 mm
Use the following formula when the shim thickness adjustment value is negative.
Current propeller shaft shim thickness = 0.8 mm
Shim thickness adjustment =-0.1 mm
New propeller shaft shim (T4) thickness = 0.8 mm + (-0.1 mm) = 0.7 mm

Available shim thicknesses
Propeller shaft shims
0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm

9. Remove the special service tools, and then install the determined propeller shaft shims.

Measuring the reverse gear backlash

- Spray anti-rust lubricant on the gear and bearings before installation. Do not apply gear oil to the parts. Otherwise, correct measurements cannot be obtained.
- Keep the parts free of foreign material, such as dirt and lint.
- When measuring the forward gear or reverse gear backlash, use the original bearings and shims.

1. Install the original reverse gear shims (T1) and retainer.

TIP:
- If the original reverse gear shims (T1) are missing, install new shims with a combined thickness of 0.95 mm.
- Do not reuse a shim if deformed or scratched.

2. Install the reverse gear assembly, drive shaft, and pinion. See "Installing the reverse gear" (8-65) and "Installing the drive shaft" (8-25).

3. Check that the drive shaft turns smoothly.

4. Install the thrust bearing, pinion shims (T3), and drive shaft housing.

5. Install the propeller shaft housing assembly. See "Installing the propeller shaft housing assembly" (8-66).

6. Check that the drive shaft turns smoothly.

7. Measure the reverse gear backlash. See steps 17-20 in "Measuring the forward gear backlash and reverse gear backlash before disassembly" (8-70).

Reverse gear backlash
0.75-1.56 mm (0.0295-0.0614 in)

Adjusting the reverse gear shim thickness (T1)

1. Remove the retainer and reverse gear shims (T1).

2. Measure the thickness of original reverse gear shim (T1) in 2 places.

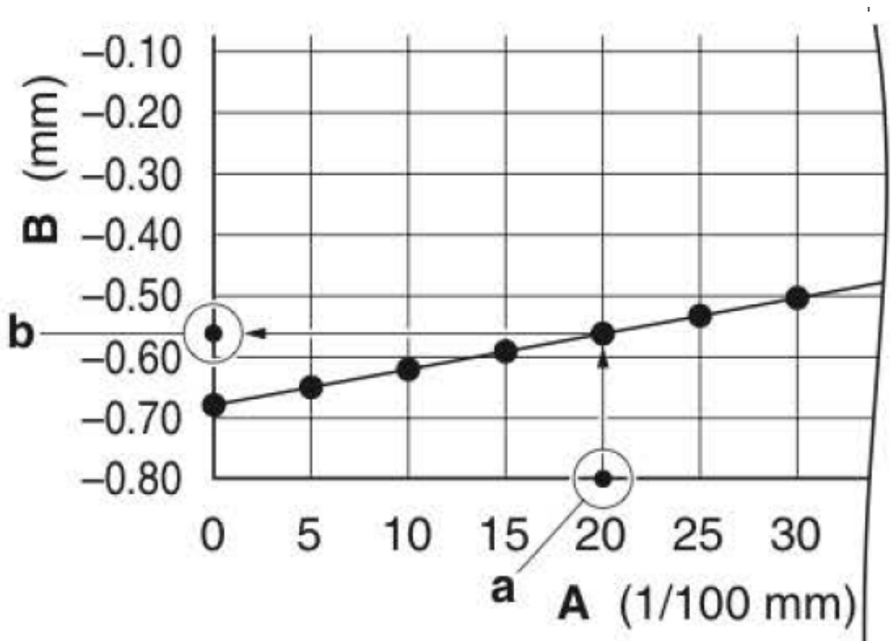
TIP:
Do not reuse a shim if deformed or scratched.

3. Determine the reverse gear shim (T1) thickness adjustment using the "Reverse gear shim (T1) selection chart" according to the backlash measurement (BL1) from "Measuring the reverse gear backlash". See "Reverse gear shim (T1) selection chart (counter rotation model)" (A-10).

TIP:

- If the shim thickness adjustment value is positive, increase the current shim thickness by that amount and, if the value is negative, decrease the current shim thickness by that amount.
- The gray-colored area on the selection chart indicates the range of the specified backlash. Shimming is not required if the measured backlash is within the gray-colored area.
- The values for the shim thickness adjustments specified in the selection chart are intended to obtain the median value within the range for the specified forward gear or reverse gear backlash.
- The table that follows the selection chart shows the shim thickness adjustments for the points marked on the chart.

Example:
Backlash measurement (BL1) = 0.20 mm "a"
Reverse gear shim (T1) thickness adjustment = -0.56 mm "b"
The current shim thickness must be decreased by 0.56 mm.



A	0	5	10	15	20	25	30
B	–0.68	–0.65	–0.62	–0.59	–0.56	–0.53	–0.50

A. Backlash measurement (BL1)
B. Shim thickness adjustment

4. Calculate the new reverse gear shim (T1) thickness.

TIP:

- Use the lowest number of shims to obtain the required shim thickness.
- If the calculated shim thickness cannot be obtained with a combination of the available shims, increase or decrease the shim thickness by 0.01 mm.

Calculation formula:
New reverse gear shim (T1) thickness = Current reverse gear shim thickness + shim thickness adjustment

Example:
Use the following formula when the shim thickness adjustment value is positive.
Current reverse gear shim thickness – 0.95 mm
Shim thickness adjustment = 0.25 mm
New reverse gear shim (T1) thickness = 0.95 mm + 0.25 mm = 1.20 mm
Use the following formula when the shim thickness adjustment value is negative.
Current reverse gear shim thickness = 0.95 mm
Shim thickness adjustment = –0.27 mm
New reverse gear shim (T1) thickness = 0.95 mm + (-0.27 mm) = 0.68mm

Available shim thicknesses
Reverse shims
0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm

5. Install the determined reverse gear shims (T1) and retainer.

Measuring the forward gear backlash

- Spray anti-rust lubricant on the gears and bearings before installation. Do not apply gear oil to the parts. Otherwise, correct measurements cannot be obtained.
- Keep the parts free of foreign material, such as dirt and lint.
- When measuring the forward gear or reverse gear backlash, use the original bearings and shims.

1. Install the original forward gear shims (T2) and propeller shaft housing assembly. See "Installing the propeller shaft housing assembly" (8-66).

TIP:

- If the original forward gear shims (T2) are missing, install new shims with a combined thickness of 0.62 mm.
- Do not reuse a shim if deformed or scratched.

2. Measure the forward gear backlash. See steps 3-14 in "Measuring the forward gear backlash and reverse gear backlash before disassembly" (8-70).

Forward gear backlash
0.13-Q.87 mm (0.0051-0.0343 in)

Adjusting the forward gear shim thickness (T2)

1. Remove the propeller shaft housing assembly and forward gear shims (T2).

2. Measure the thickness of original forward gear shim (T2) in 2 places.

TIP:

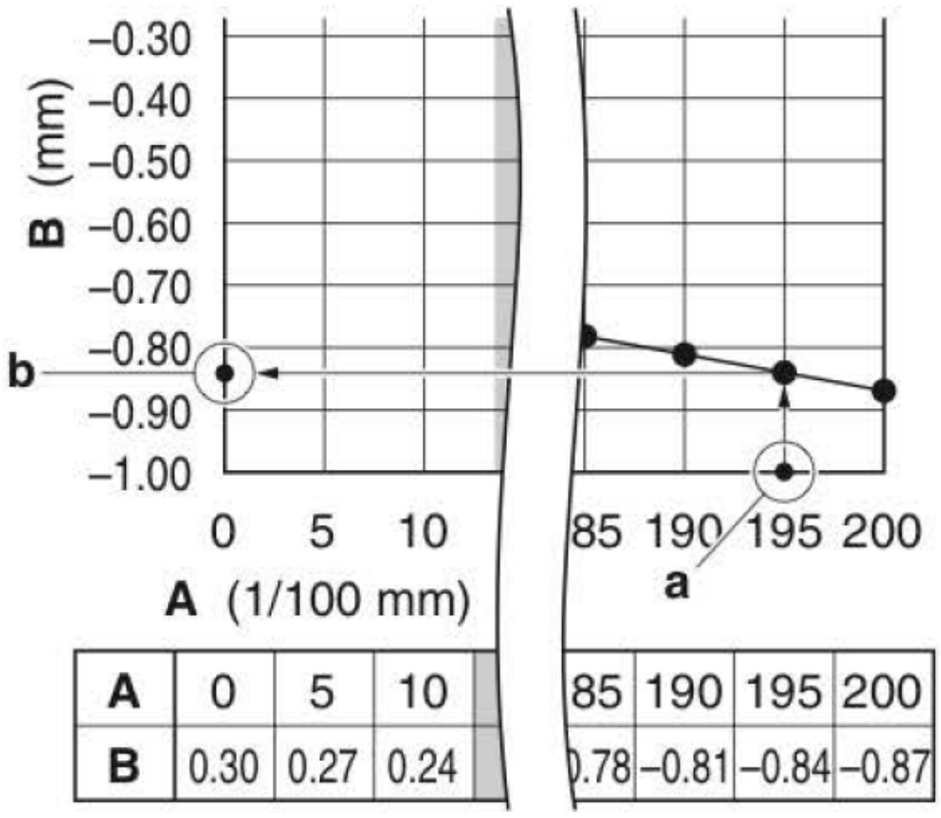
Do not reuse a shim if deformed or scratched.

3. Determine the forward gear shim (T2) thickness adjustment using the "Forward gear shim (T2) selection chart" according to the backlash measurement (BL2) from "Measuring the forward gear backlash". See "Forward gear shim (T2) selection chart (counter rotation model)" (A-10).

TIP:

- If the shim thickness adjustment value is positive, increase the current shim thickness by that amount and, if the value is negative, decrease the current shim thickness by that amount.
- The gray-colored area on the selection chart indicates the range of the specified backlash. Shimming is not required if the measured backlash is within the gray-colored area.
- The values for the shim thickness adjustments specified in the selection chart are intended to obtain the median value within the range for the specified forward gear or reverse gear backlash.
- The table that follows the selection chart shows the shim thickness adjustments for the points marked on the chart.

Example:
Backlash measurement (BL2) = 1.95 mm "a"
Forward gear shim (T2) thickness adjustment = –0.84 mm "b"
The current shim thickness must be increased by 0.84 mm.



A	0	5	10	85	190	195	200
B	0.30	0.27	0.24	0.78	–0.81	–0.84	–0.87

A. Backlash measurement (BL2)
B. Shim thickness adjustment

4. Calculate new forward gear shim (T2) thickness.

TIP:

- Use the lowest number of shims to obtain the required shim thickness.
- If the calculated shim thickness cannot be obtained with a combination of the available shims, increase or decrease the shim thickness by 0.01 mm.

Calculation formula:
New forward gear shim (T2) thickness = Current forward gear shim thickness + shim thickness adjustment

Example:
Use the following formula when the shim thickness adjustment value is positive.
Current forward gear shim thickness - 0.62 mm
Shim thickness adjustment = 0.24 mm
New forward gear shim (T2) thickness = 0.62 mm + 0.24 mm = 0.86 mm
Use the following formula when the shim thickness adjustment value is negative.
Current forward gear shim thickness = 0.62 mm
Shim thickness adjustment = –0.23 mm
New forward gear shim (T2) thickness = 0.62 mm + (–0.23 mm) = 0.39 mm

Available shim thicknesses
Forward shims
0.10/0.12/0.15/0.18/0.30/0.40/0.50 mm

5. Install the determined forward gear shims (T2)and propeller shaft housing assembly.

Bracket unit

Shift rod and shift bracket..... 9-1

PTT switch and cowling lock lever 9-3

Bottom cowling 9-4

Upper case assembly and mount 9-6

Removing the upper case 9-7
Installing the upper case 9-7

Upper case (L-transom model) 9-9

Disassembling the upper case 9-10
Assembling the upper case 9-10

Upper case (X-transom model) 9-12

Disassembling the upper case 9-13
Checking the drive shaft bushing 9-13
Assembling the upper case 9-13

Oil pan and exhaust guide..... 9-15

Disassembling the oil pan and exhaust guide 9-17
Checking the oil pan and exhaust guide..... 9-17
Checking the oil strainer 9-17
Checking the PCV 9-17
Checking the exhaust guide anode 9-17
Assembling the oil pan and exhaust guide 9-18

Bracket unit

Steering arm 9-20

Removing the steering arm 9-21
Installing the steering arm 9-21

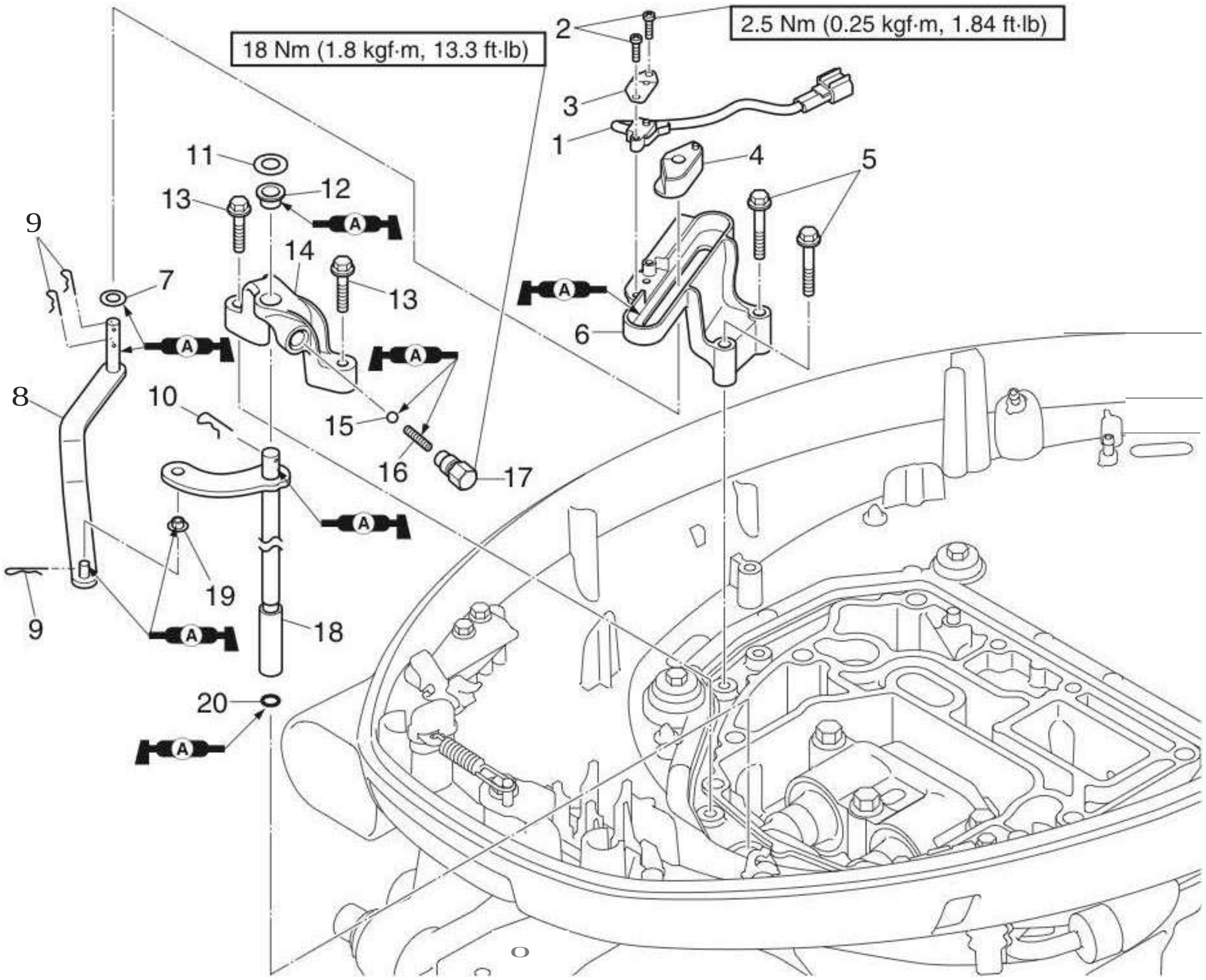
Clamp bracket and swivel bracket..... 9-23

Removing the clamp bracket 9-25
Checking the clamp bracket anode 9-25
Installing the clamp bracket 9-26
Adjusting the trim sensor cam 9-28

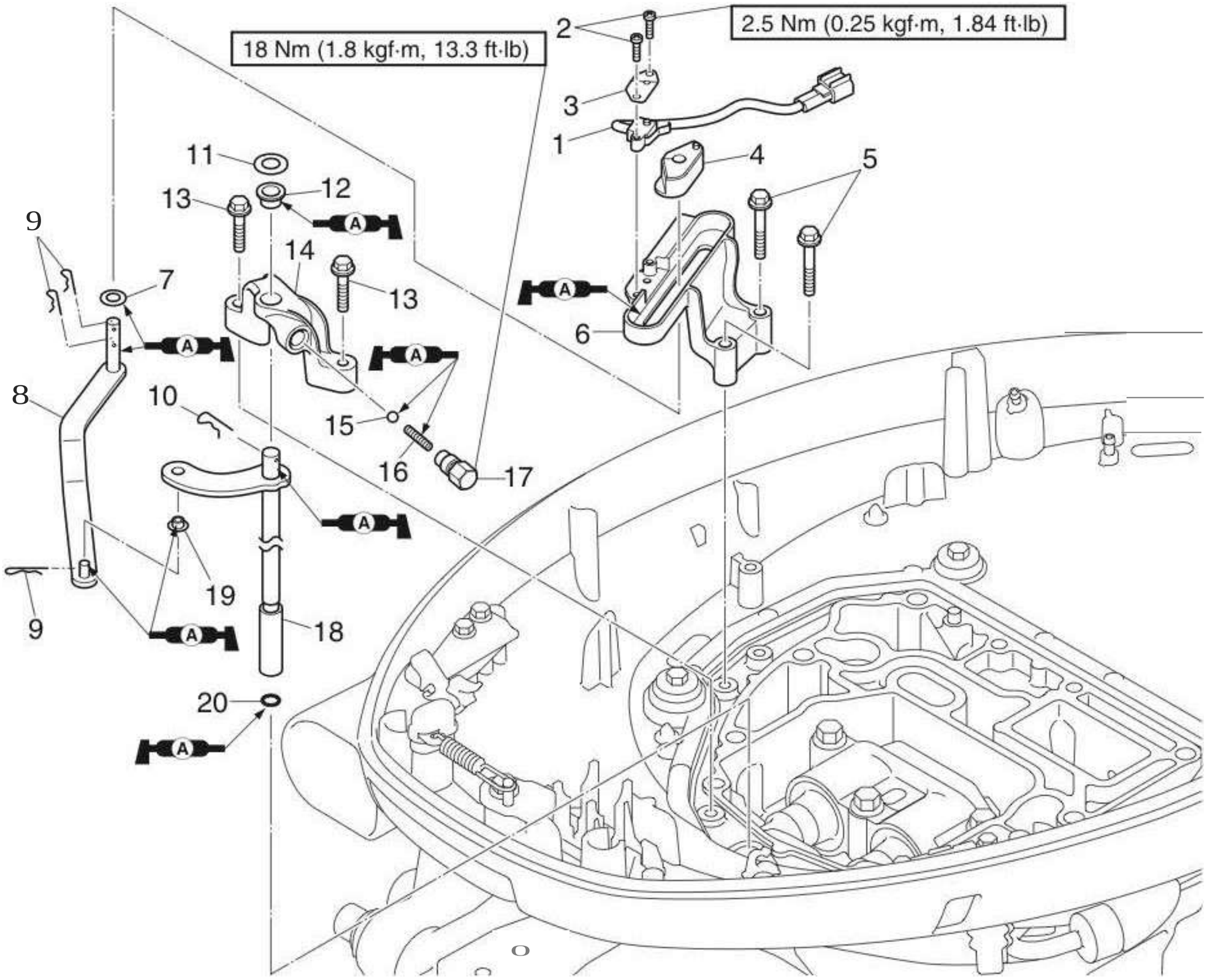
PTT unit 9-29

Removing the PTT unit..... 9-30
Bleeding the PTT unit..... 9-30
Installing the PTT unit..... 9-32

Shift rod and shift bracket

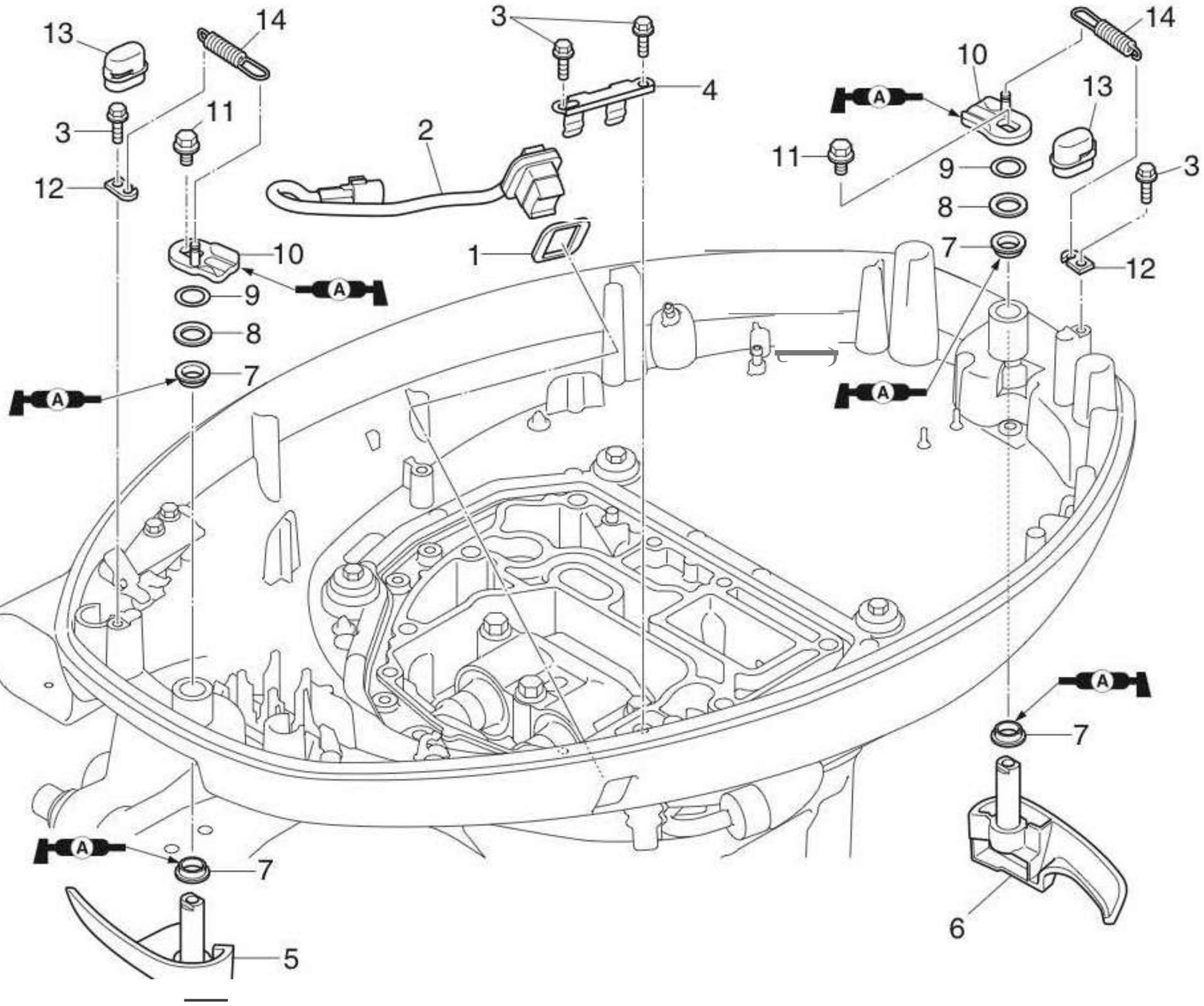


No.	Part name	Q'ty	Remarks
1	Shift position switch	1	
2	Screw	2	M4 x 16 mm
3	Plate	1	
4	Bushing	1	
5	Bolt	2	M6 x 40 mm
6	Bracket	1	
7	Washer	1	
8	Shift lever	1	
9	Clip	3	
10	Clip	1	
11	Washer	1	
12	Bushing	1	
13	Bolt	2	M6 x 30 mm
14	Bracket	1	
15	Ball	1	6.32 mm (0.25 in) (reference data)
16	Spring	1	
17	Shift rod detent bolt	1	M12 x 16 mm



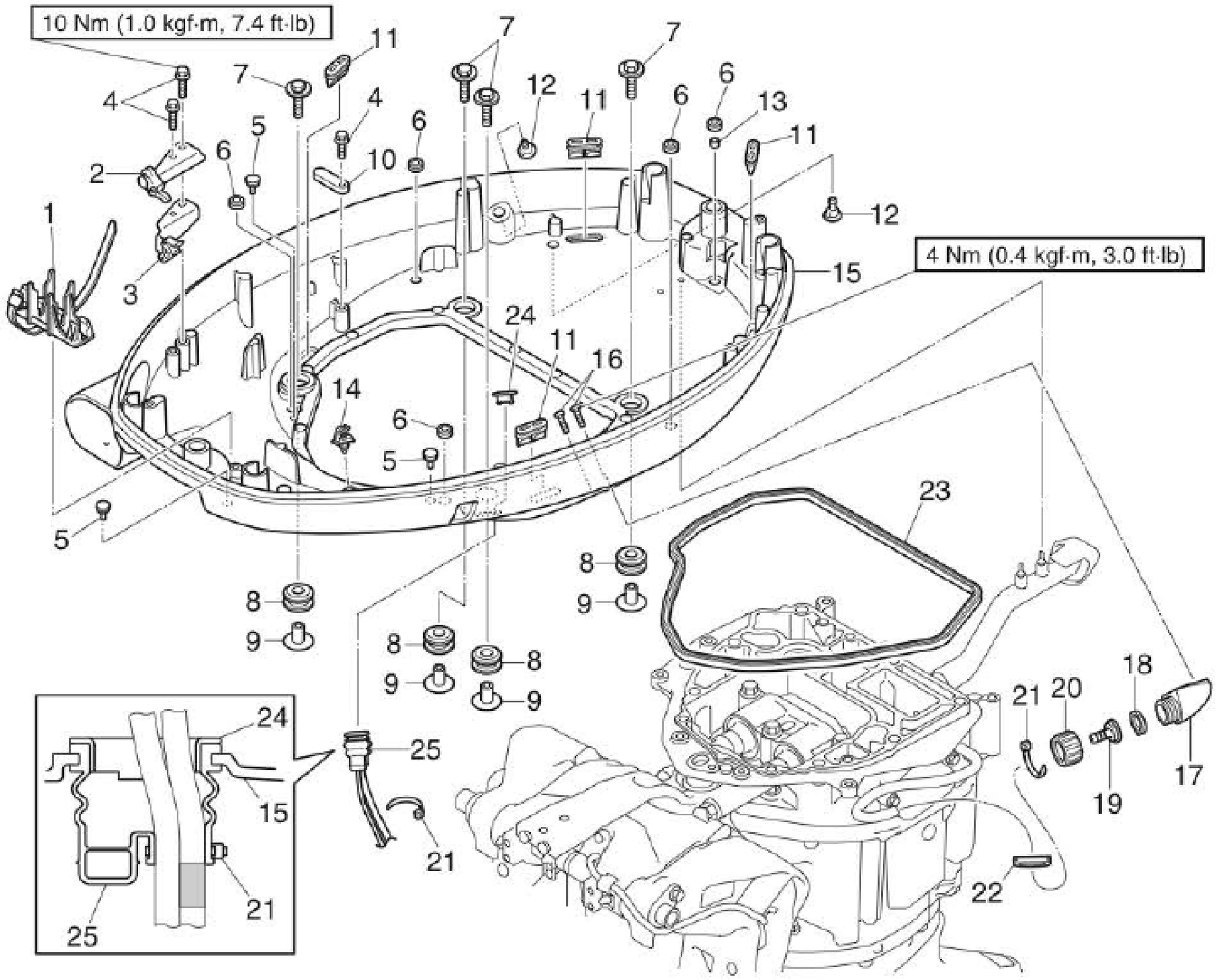
No.	Part name	Q'ty	Remarks
18	Shift rod	1	
19	Bushing	1	
20	O-ring	1	Not reusable

PTT switch and cowling lock lever

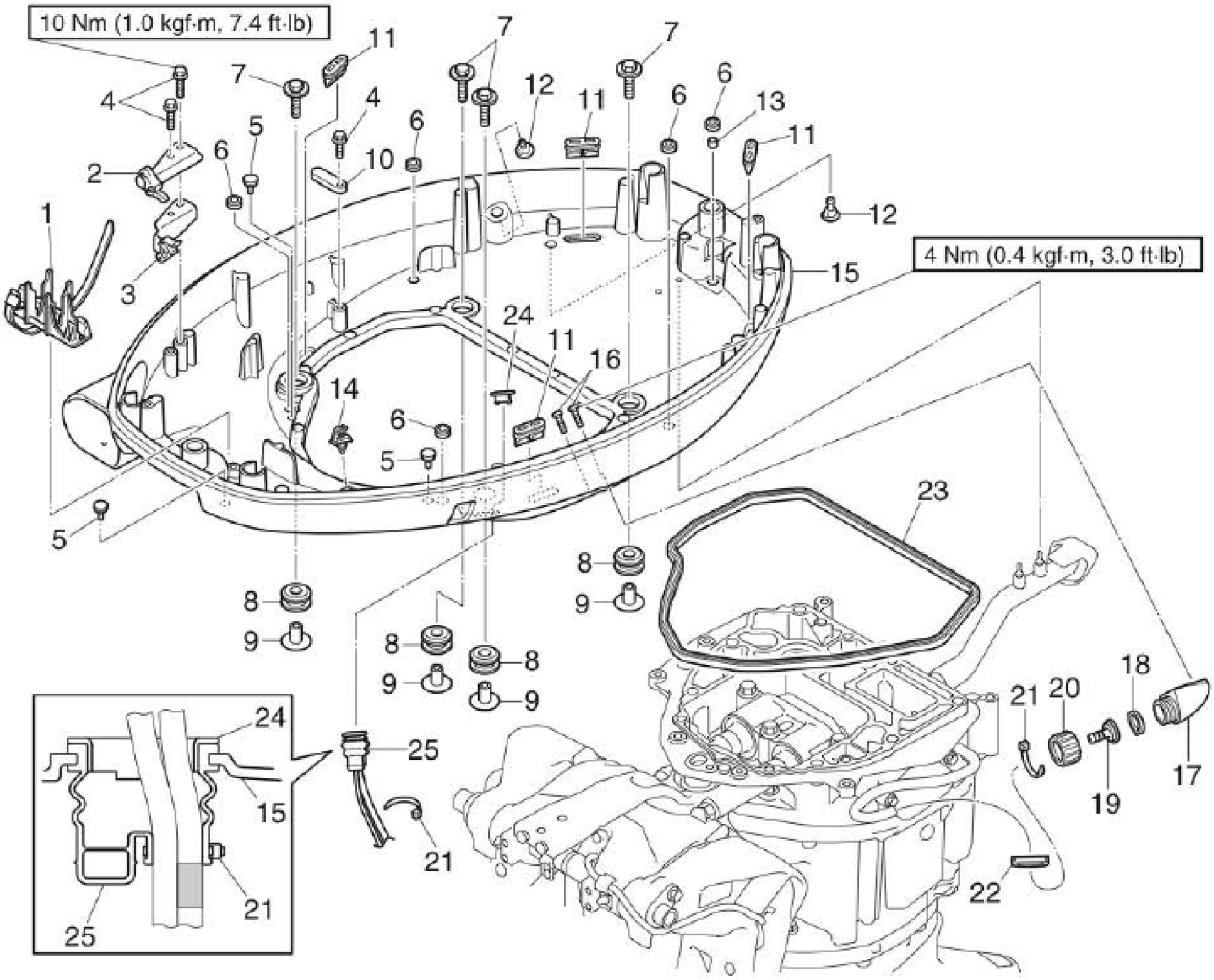


No.	Part name	Q'ty	Remarks
1	Gasket	1	
2	PTT switch	1	
3	Bolt	4	M6 x 20 mm
4	Holder	1	
5	Cowling lock lever (front)	1	
6	Cowling lock lever (rear)	1	
7	Bushing	4	
8	Washer	2	
9	Wave washer	2	
10	Lever	2	
11	Bolt	2	M8 x 12 mm
12	Hook	2	
13	Cap	2	
14	Spring	2	

Bottom cowling

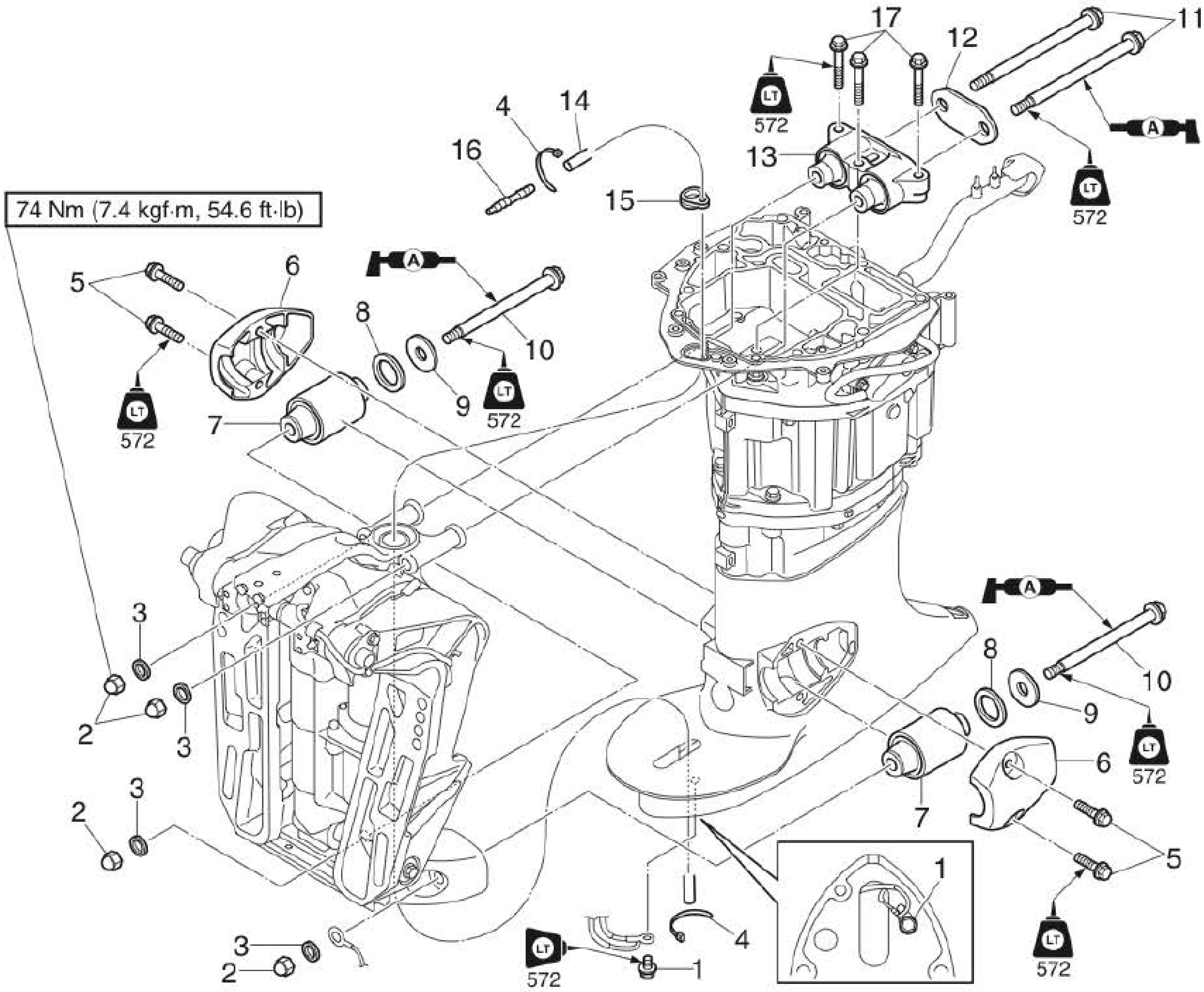


No.	Part name	Q'ty	Remarks
1	Holder	1	
2	Bracket	1	
3	Bracket	1	
4	Bolt	3	M6 x 25 mm
5	Grommet	3	
6	Grommet	5	
7	Bolt	4	M8 x 35 mm
8	Grommet	4	
9	Collar	4	
10	Plate	1	
11	Rubber seal	4	
12	Water outlet	2	
13	Collar	1	
14	Holder	1	
15	Bottom cowling	1	
16	Screw	2	M6 x 19 mm
17	Adapter	1	



No.	Part name	Q'ty	Remarks
18	Gasket	1	
19	Hose joint	1	
20	Hose joint	1	
21	Plastic tie	2	
22	Grommet	1	
23	Rubber seal	1	
24	Cap	1	
25	Grommet	1	

Upper case assembly and mount



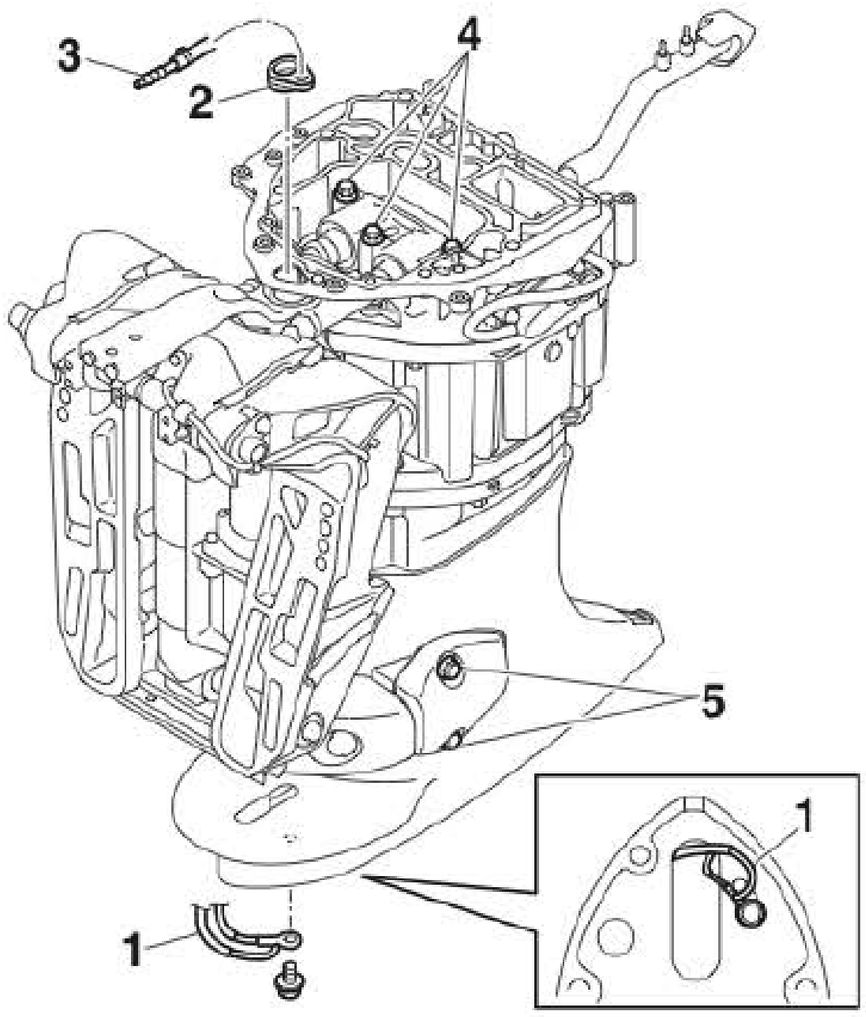
No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 x 10 mm
2	Nut	4	M14
3	Washer	4	
4	Plastic tie	2	
5	Bolt	4	M10 x 40 mm
6	Cover	2	
7	Lower mount	2	
8	Washer	2	
9	Washer	2	
10	Bolt	2	M14 x 178 mm
11	Bolt	2	M14 x 195 mm
12	Plate	1	
13	Upper mount	1	
14	Speedometer hose	1	Adapter to nipple
15	Grommet	1	
16	Nipple	1	
17	Bolt	3	M10x60mm

Removing the upper case

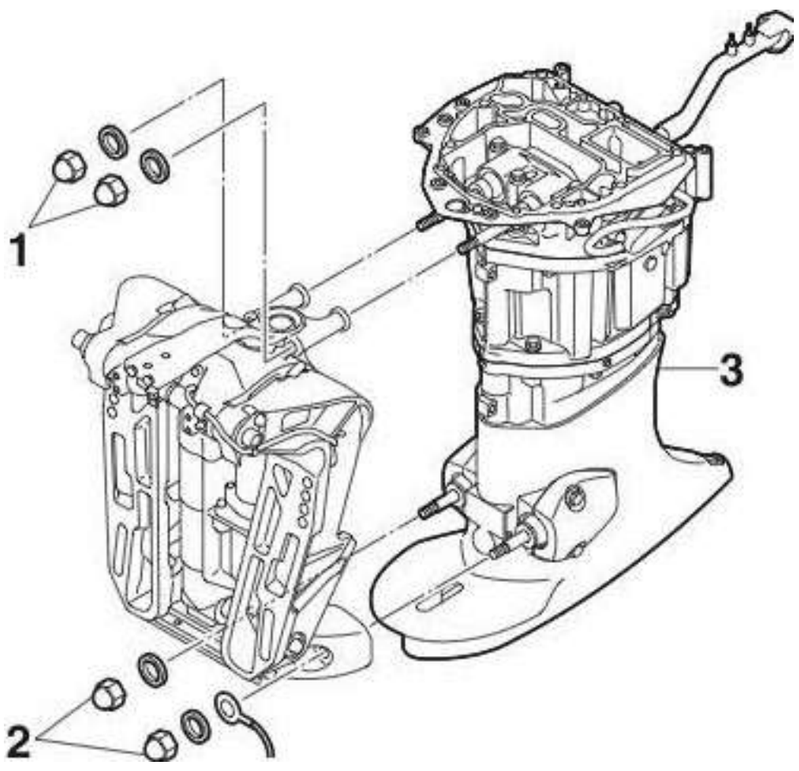
1. Drain the remaining engine oil.

2. Remove the ground lead "1", grommet "2", and speedometer hose "3".

3. Loosen the upper mount bolts “4” and Lower mount cover bolts (PORT and STBD)“5”.



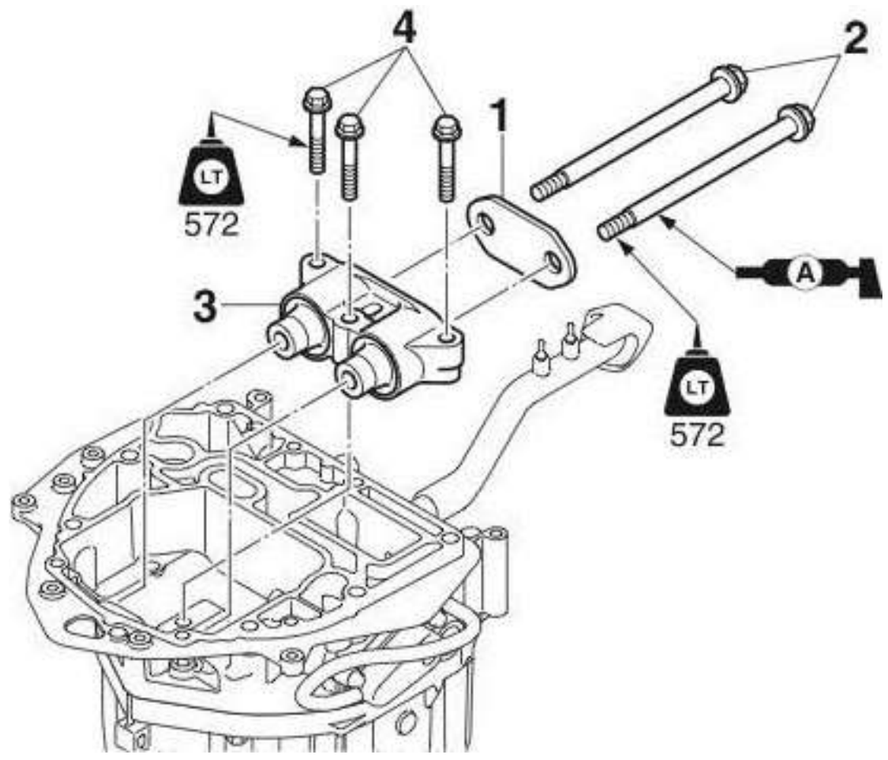
4. Remove the upper mount nuts "1" and lower mount nuts "2", and then remove the upper case assembly "3".



Installing the upper case

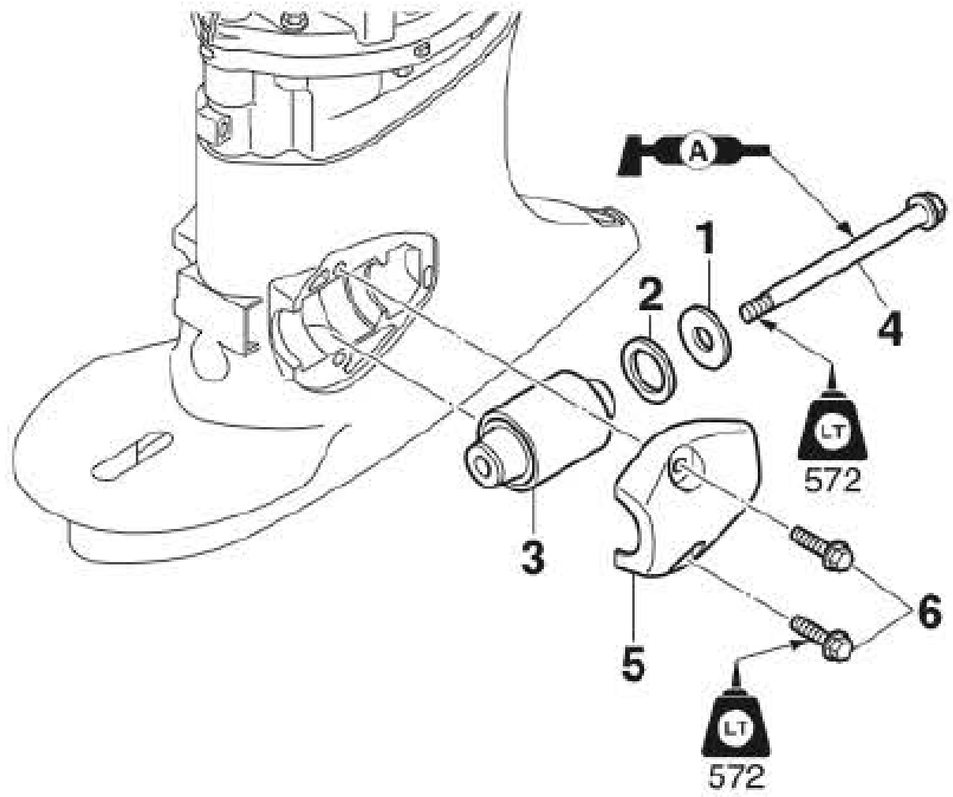
1. Install the plate "1" and upper mount bolts "2" to the upper mount "3", and then install the upper mount.

2. Tighten the upper mount bolts "4" temporarily.

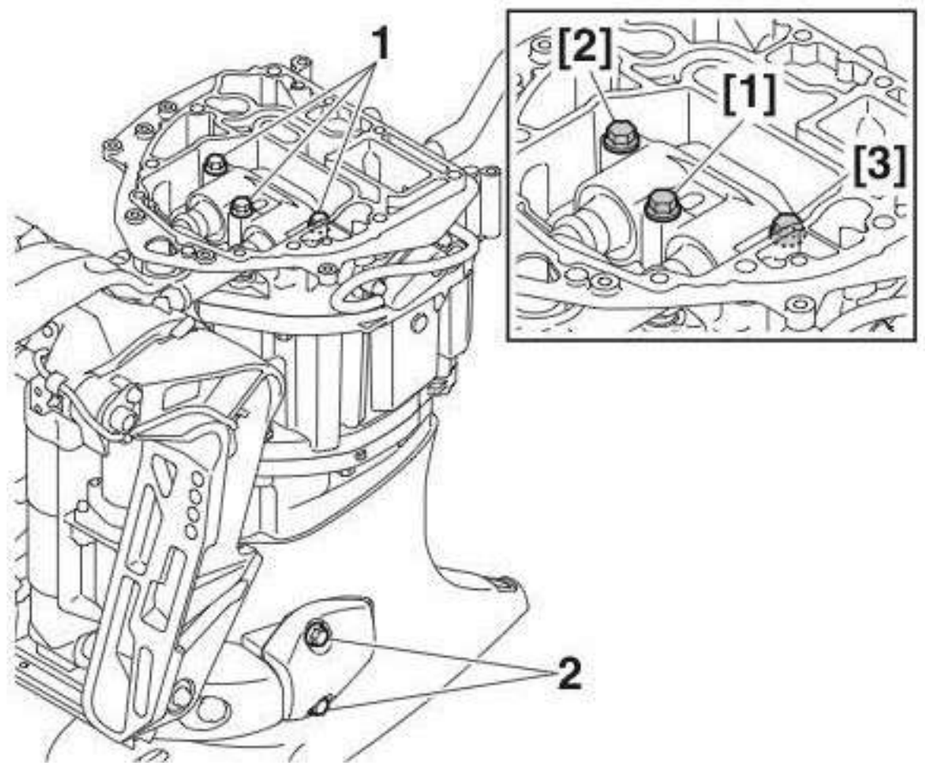


3. Install the washers "1" and "2" and lower mounts "3" to the lower mount bolts "4".

4. Install the lower mounts "3" and lower mount covers "5", and then tighten the lower mount cover bolts "6" temporarily.

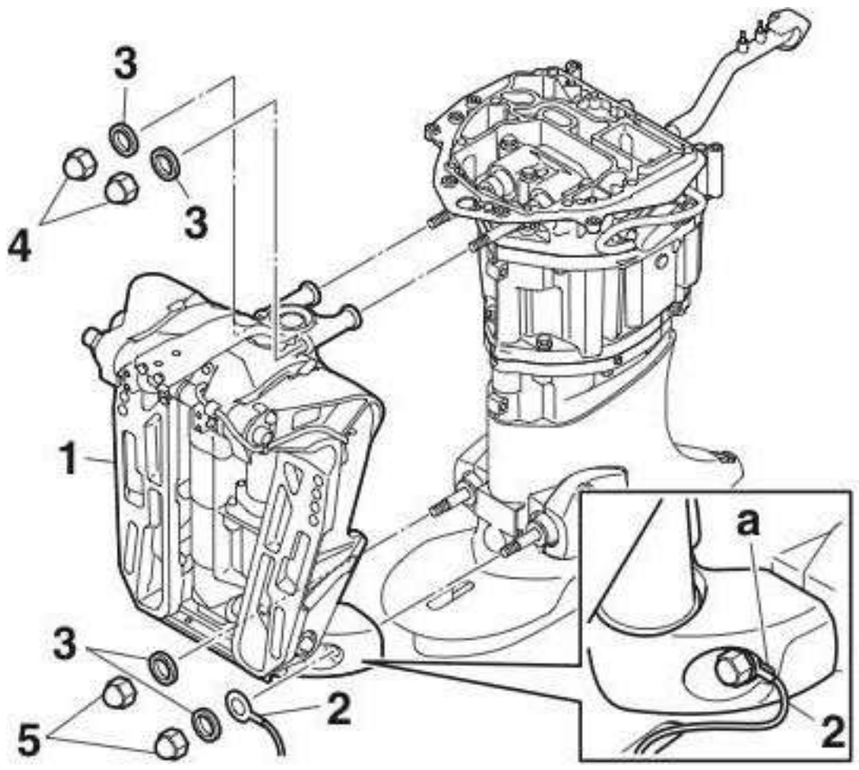


5. Align the upper and lower mount bolts with the holes in the bracket assembly "1" and then insert the bolts into the bracket holes.



6. Install the ground lead (PORT) "2" and washers "3", and then tighten the upper mount nuts "4" and lower mount nuts "5" to the specified torque.

TIP:
Fit the ground lead "2" into the groove "a" in the steering yoke.



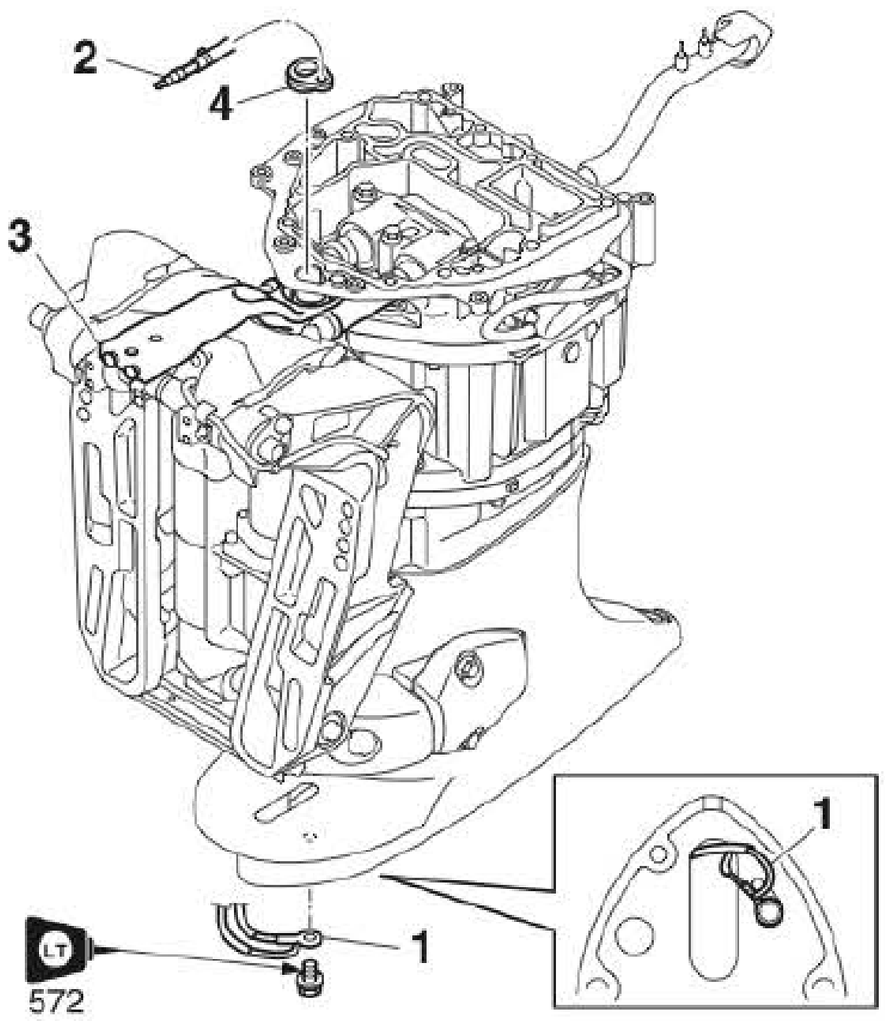
Upper mount nut "4" 74 Nm (7.4 kgf·m, 54.6 ft·lb)
Lower mount nut "5" 74 Nm (7.4 kgf·m, 54.6 ft·lb)

7. Tighten the upper mount bolts "1" in the order [1], [2], and so on.

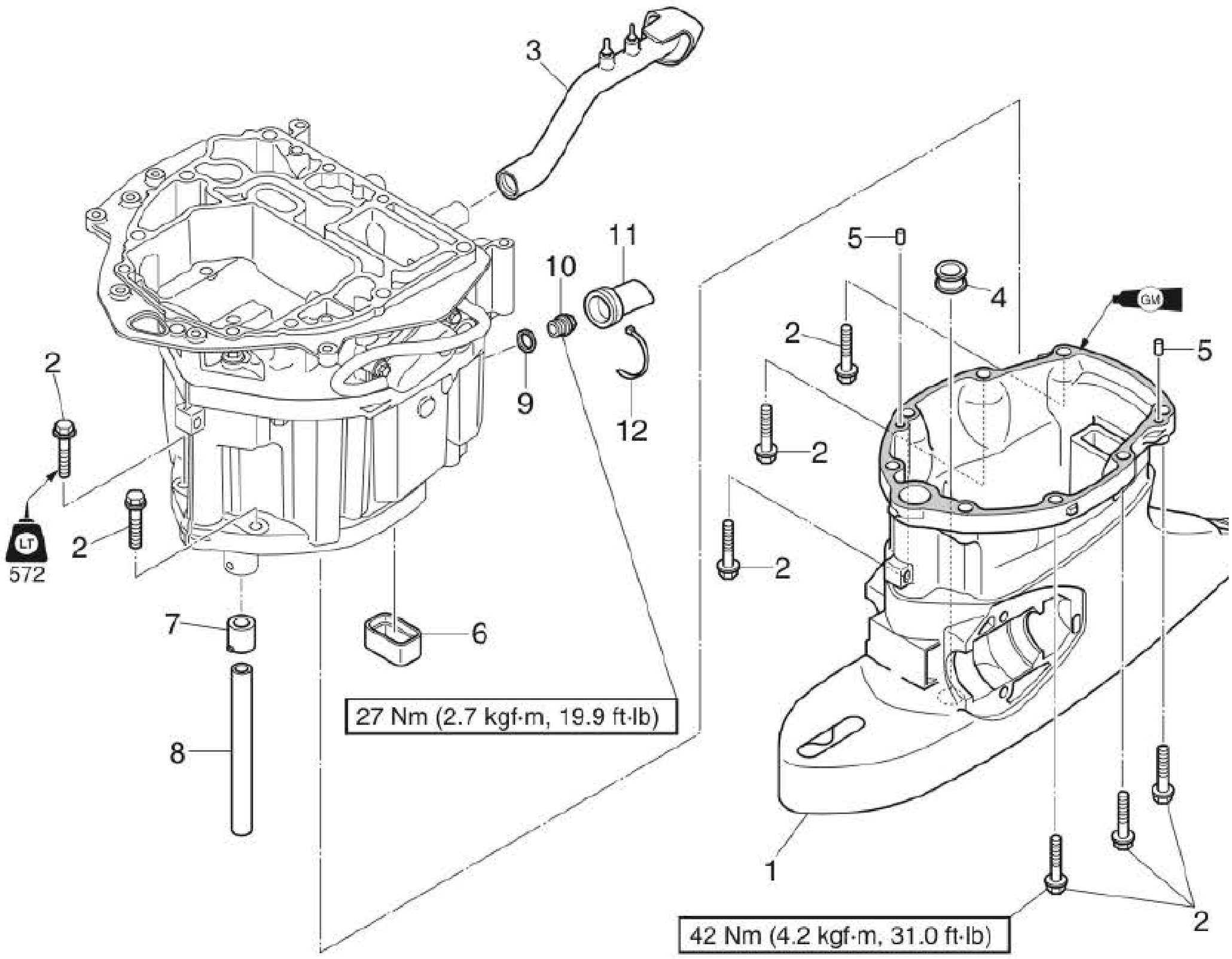
8. Tighten the lower mount cover bolts (PORT and STBD) "2".

9. Connect the ground lead "1".

10. Pass the speedometer hose "2" through the steering arm "3", and then install the grommet "4".



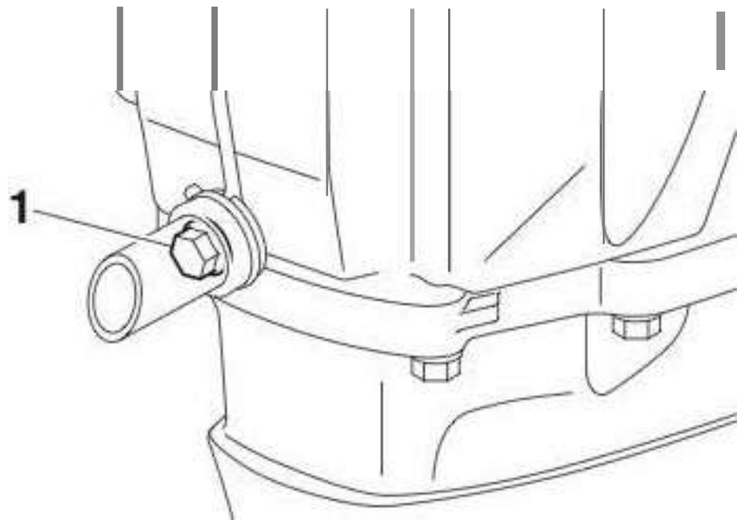
Upper case (L-transom model)



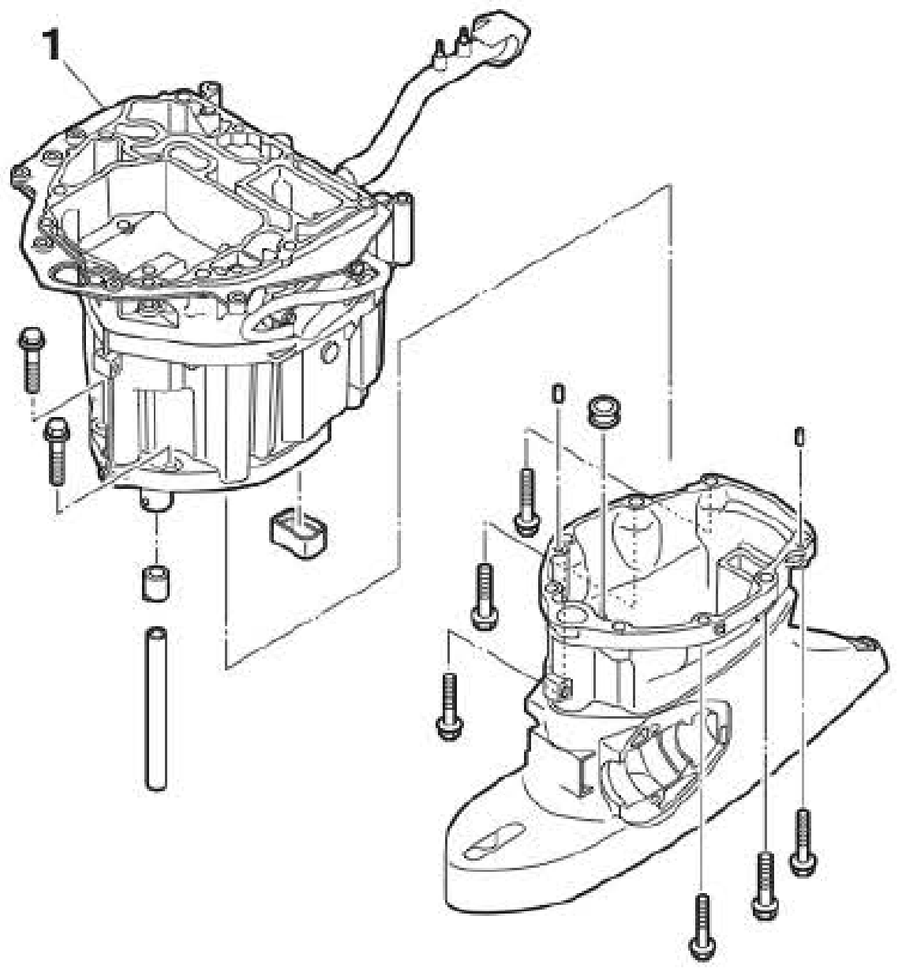
No.	Part name	Q'ty	Remarks
1	Upper case	1	
2	Bolt	8	M10 x 45 mm
3	Rubber seal	1	
4	Rubber seal	1	
5	Dowel pin	2	
6	Rubber seal	1	
7	Rubber seal	1	
8	Water pipe	1	
9	Gasket	1	Not reusable
10	Drain bolt	1	M14
11	Damper	1	
12	Plastic tie	1	

Disassembling the upper case

1. Remove the drain bolt "1".



2. Remove the oil pan assembly "1".

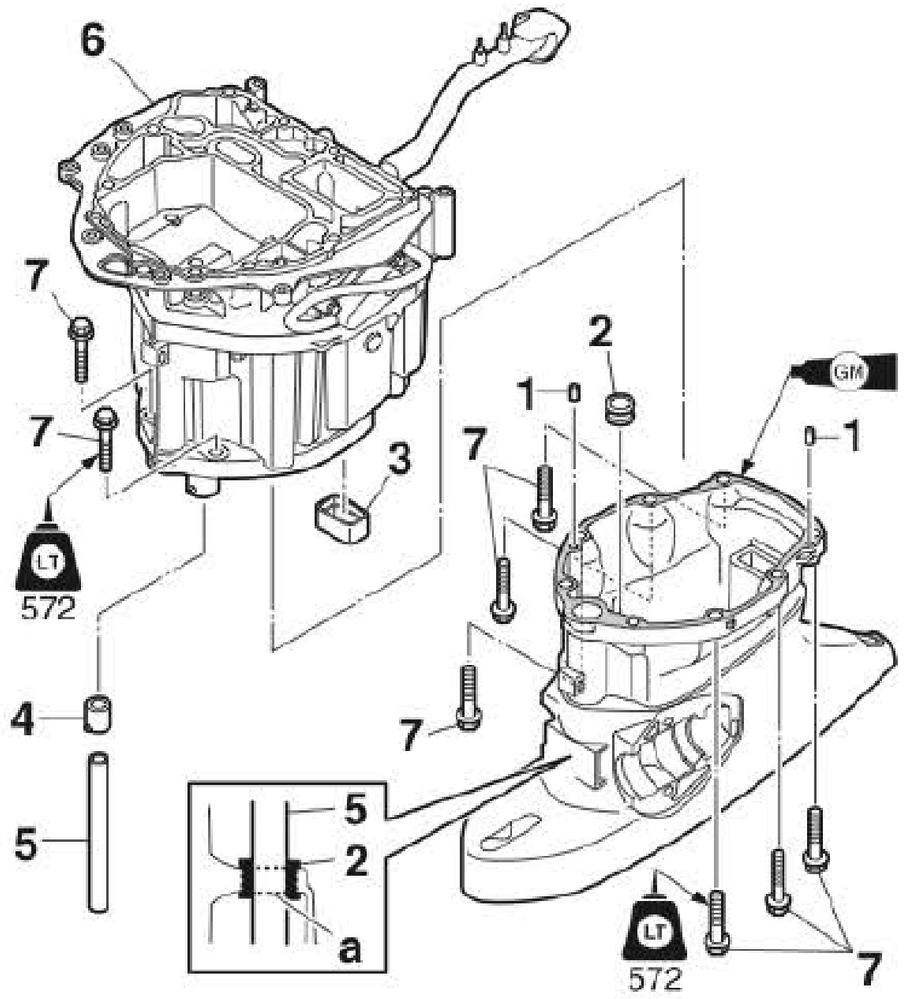


Assembling the upper case

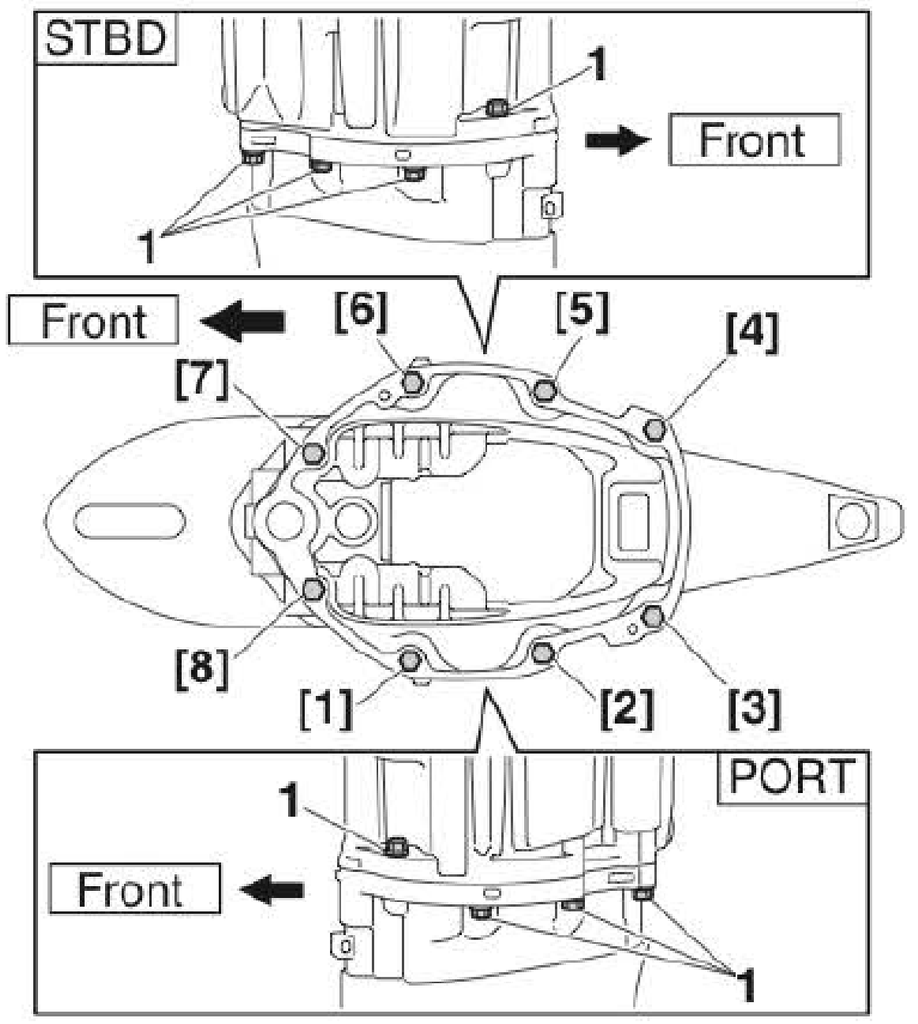
1. Install the dowel pins "1".

2. Install the rubber seal "2" to the joint hole "a" in the upper case.

3. Install the rubber seals "3" and "4", cooling water pipe "5", oil pan assembly "6", and upper case bolts "7".

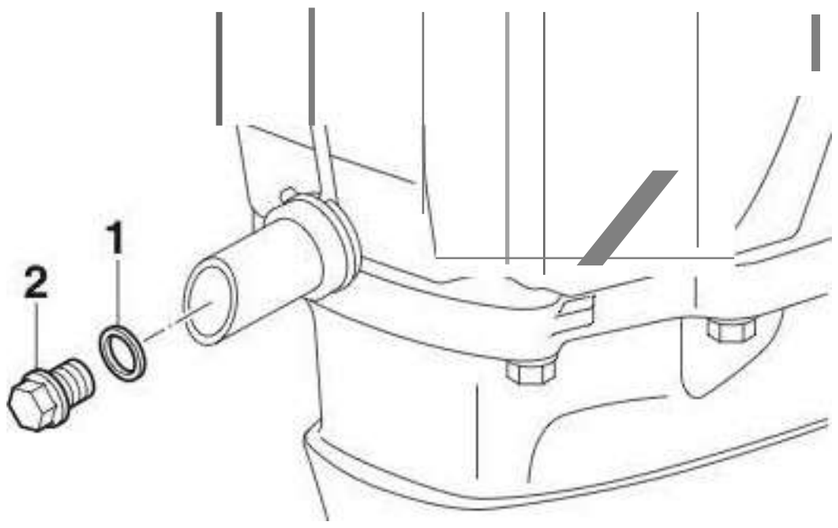


4. Tighten the upper case bolts "1" to the specified torque in the order [1], [2], and so on.



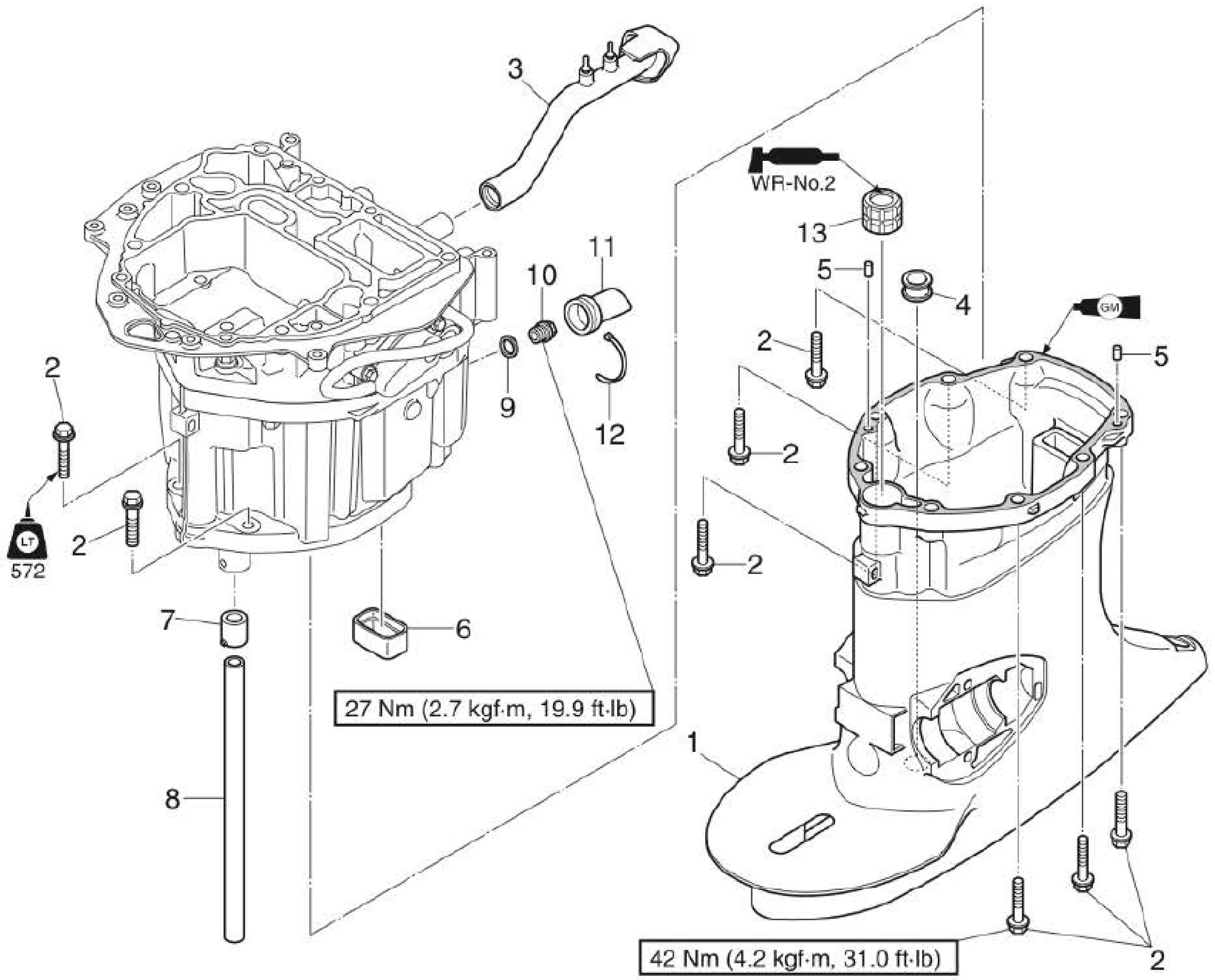
Upper case bolt "1"
42 Nm (4.2 kgf·m, 31.0 ft·lb)

5. Install a new gasket "1", and then tighten the drain bolt "2" to the specified torque.



Drain bolt "2"
27 Nm (2.7 kgf·m, 19.9 ft·lb)

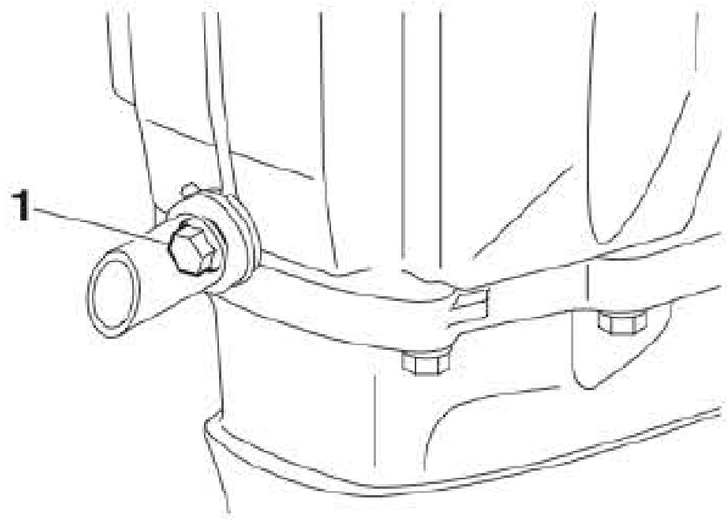
Upper case (X-transom model)



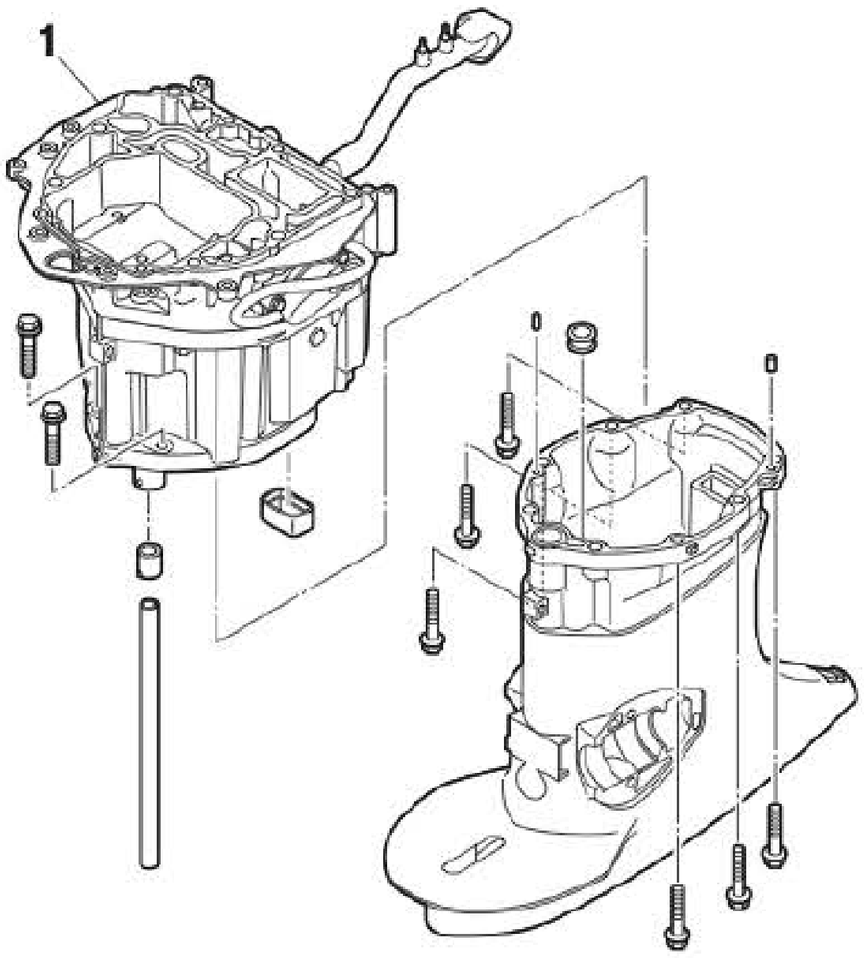
No.	Part name	Q'ty	Remarks
1	Upper case	1	
2	Bolt	8	M10 x 45 mm
3	Rubber seal	1	
4	Rubber seal	1	
5	Dowel pin	2	
6	Rubber seal	1	
7	Rubber seal	1	
8	Water pipe	1	
9	Gasket	1	Not reusable
10	Drain bolt	1	M14
11	Damper	1	
12	Plastic tie	1	
13	Bushing	1	

Disassembling the upper case

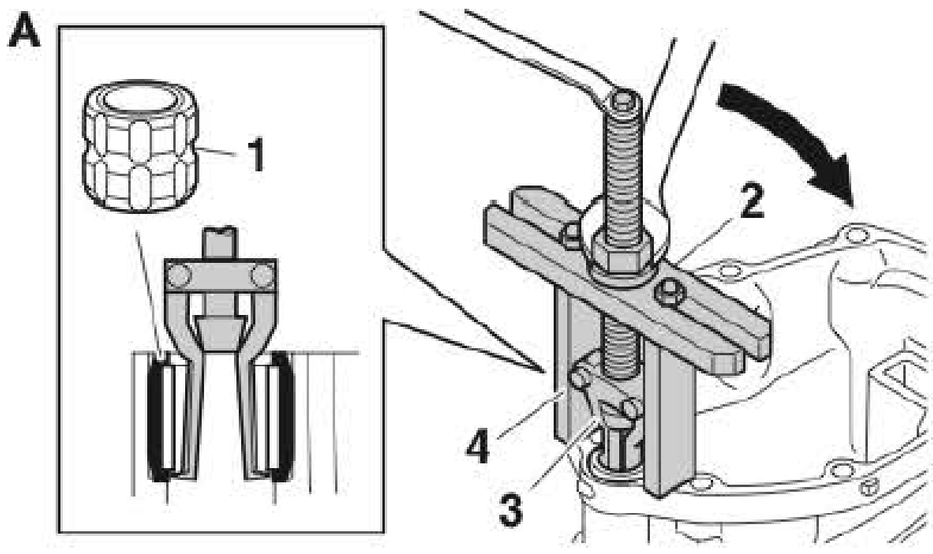
1. Remove the drain bolt "1".

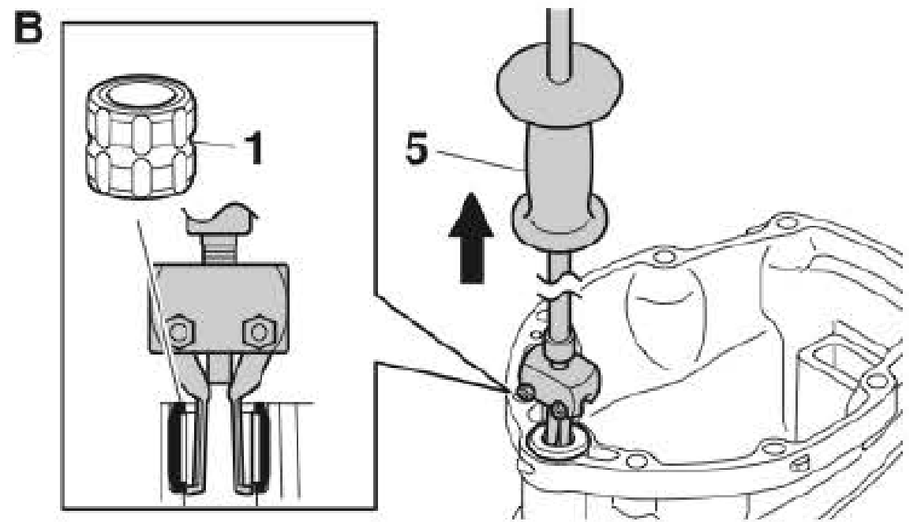


2. Remove the oil pan assembly "1".



3. Remove the drive shaft bushing "1".





A. Worldwide
B. USA and Canada

Stopper guide plate "2"

Bearing puller assembly "3"

Stopper guide stand "4"

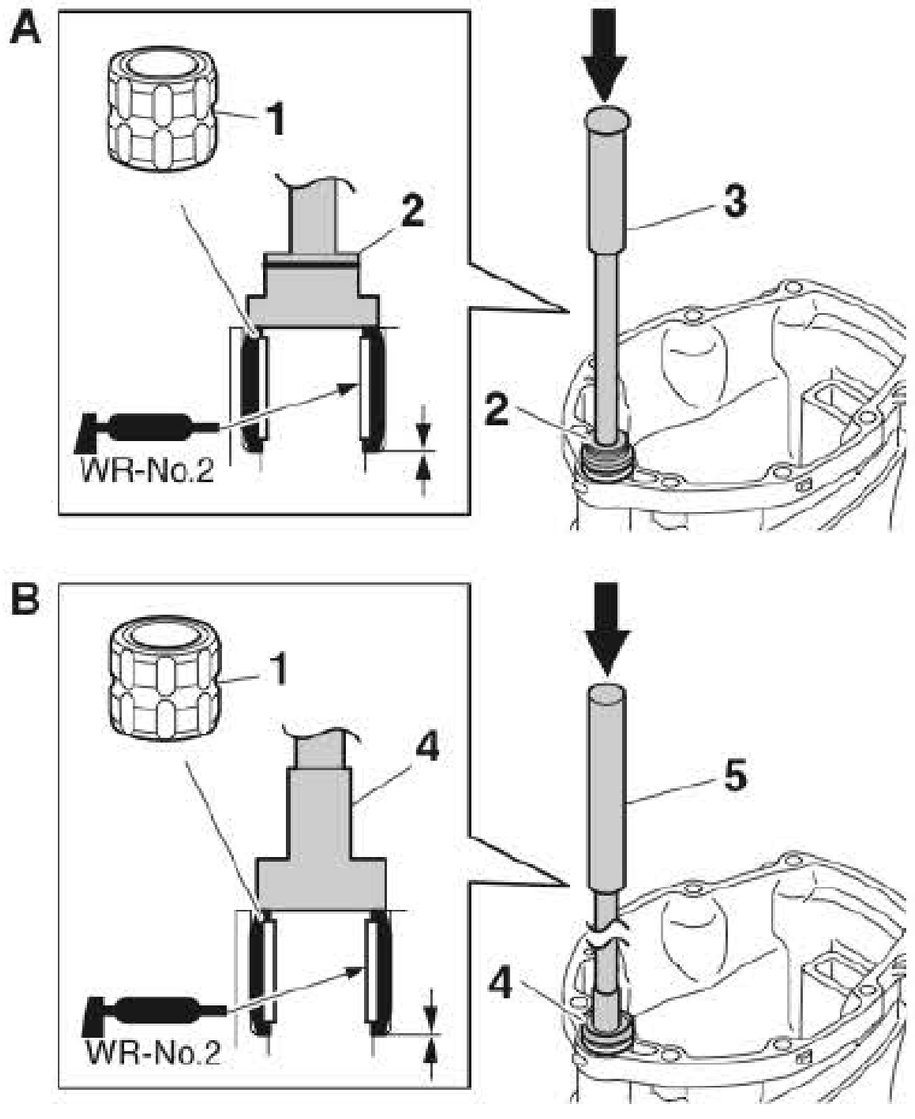
Slide hammer "5"

Checking the drive shaft bushing

1. Check the bushing. Replace if cracked or worn.

Assembling the upper case

1. Install the drive shaft bushing "1".



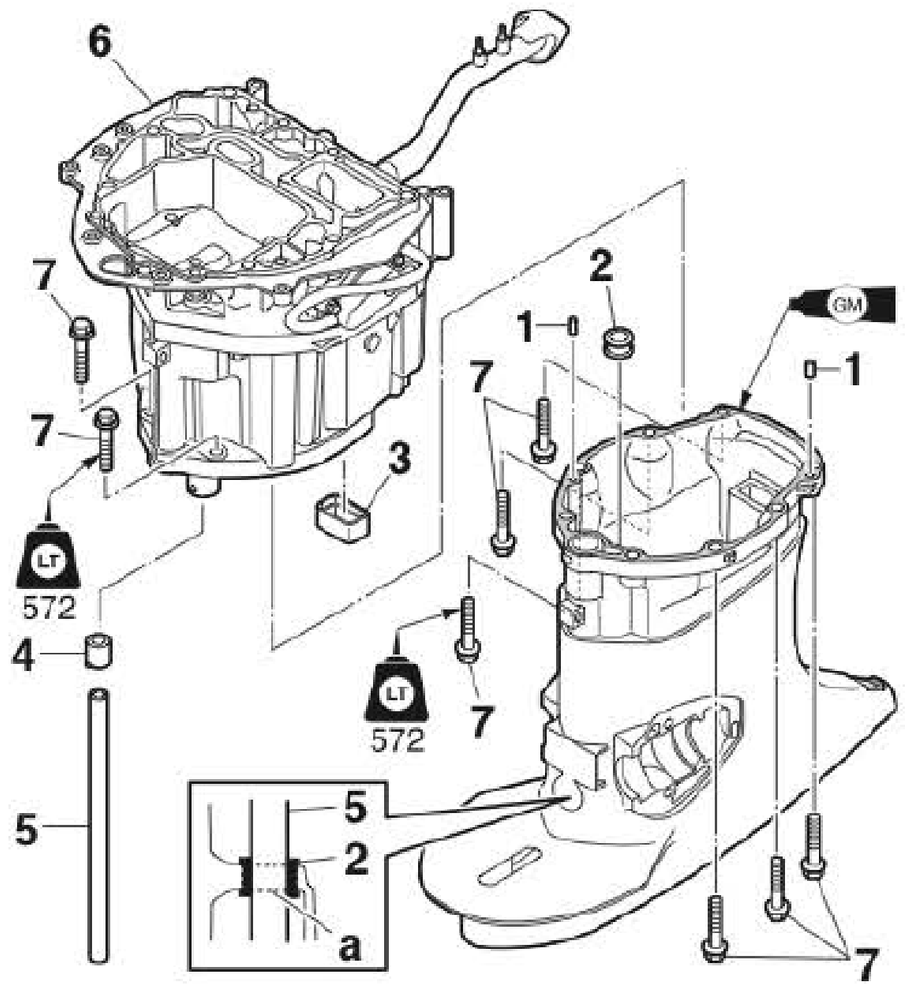
A. Worldwide
B. USA and Canada

Needle bearing attachment "2"
Driver rod L3 "3"
Forward gear bearing installer "4"
Driver handle (small) "5"

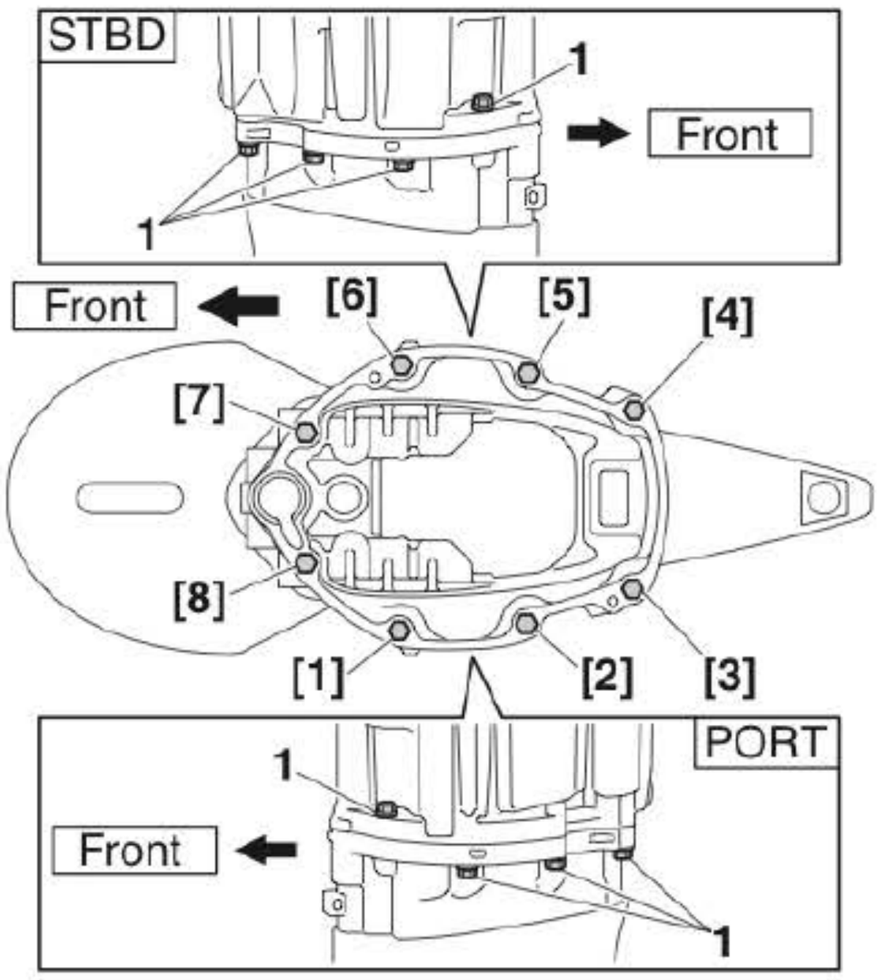
2. Install the dowel pins "1".

3. Install the rubber seal "2" to the joint hole "a" in the upper case.

4. Install the rubber seals "3" and "4", cooling water pipe "5", oil pan assembly "6", and upper case bolts "7".

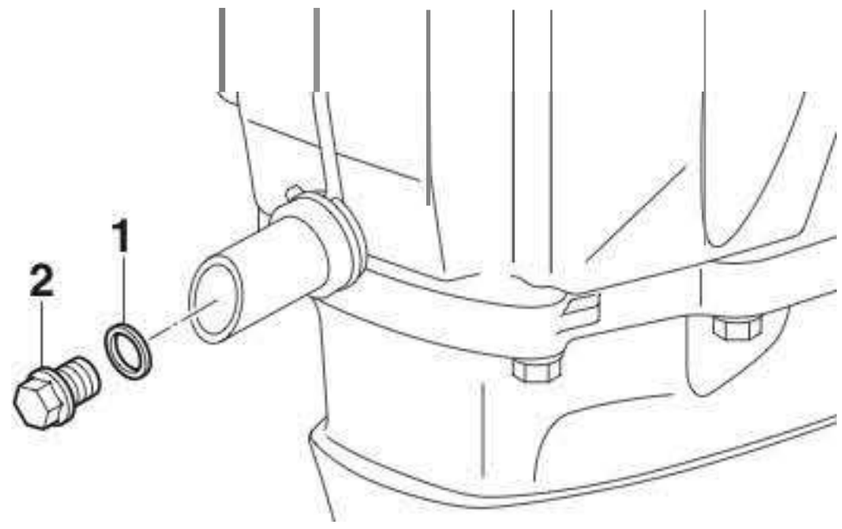


5. Tighten the upper case bolts "1" to the specified torque in the order [1], [2], and so on.



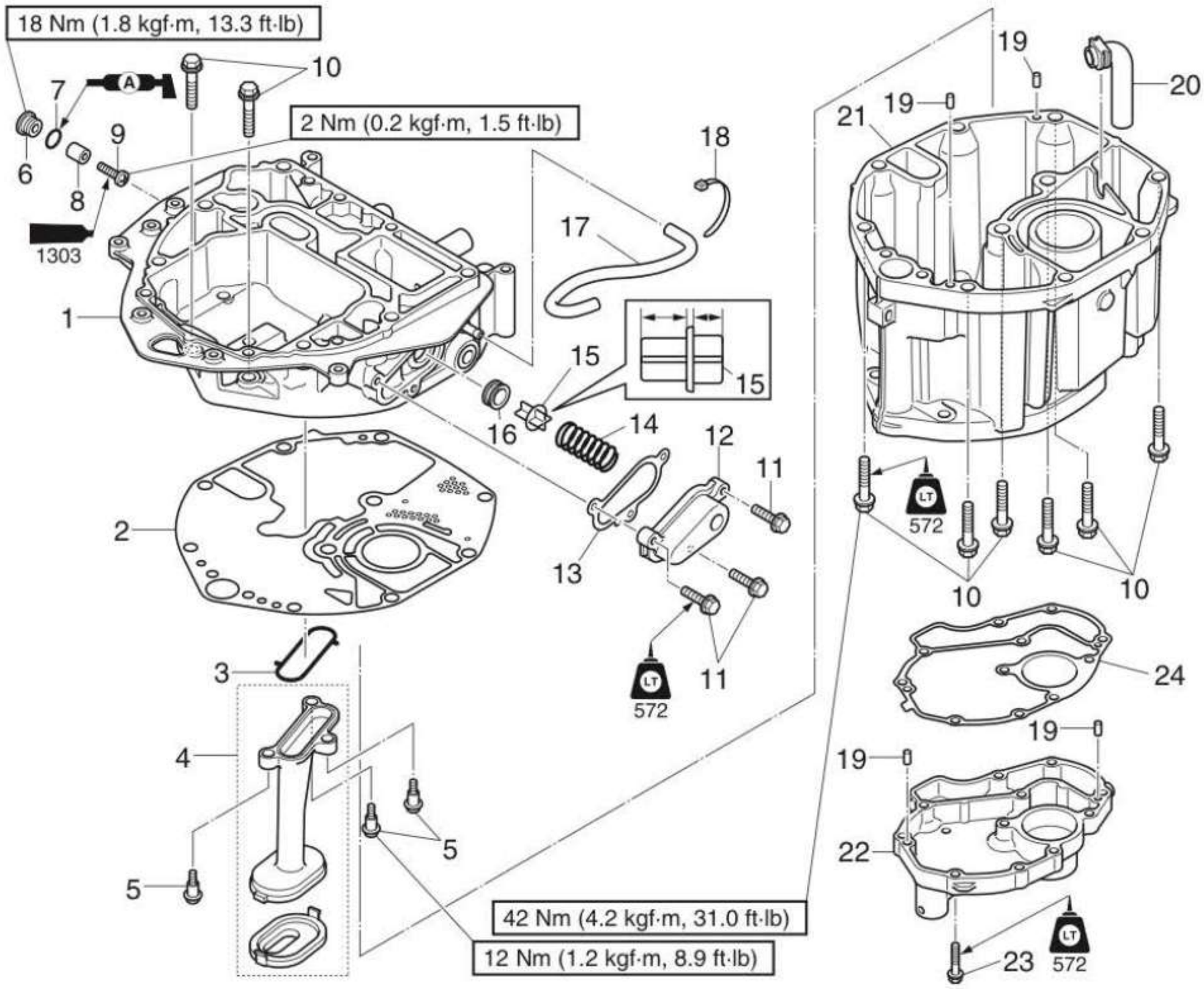
Upper case bolt "1" 42 Nm (4.2 kgf·m, 31.0 ft-b)

6. Install a new gasket "1", and then tighten the drain bolt "2" to the specified torque.

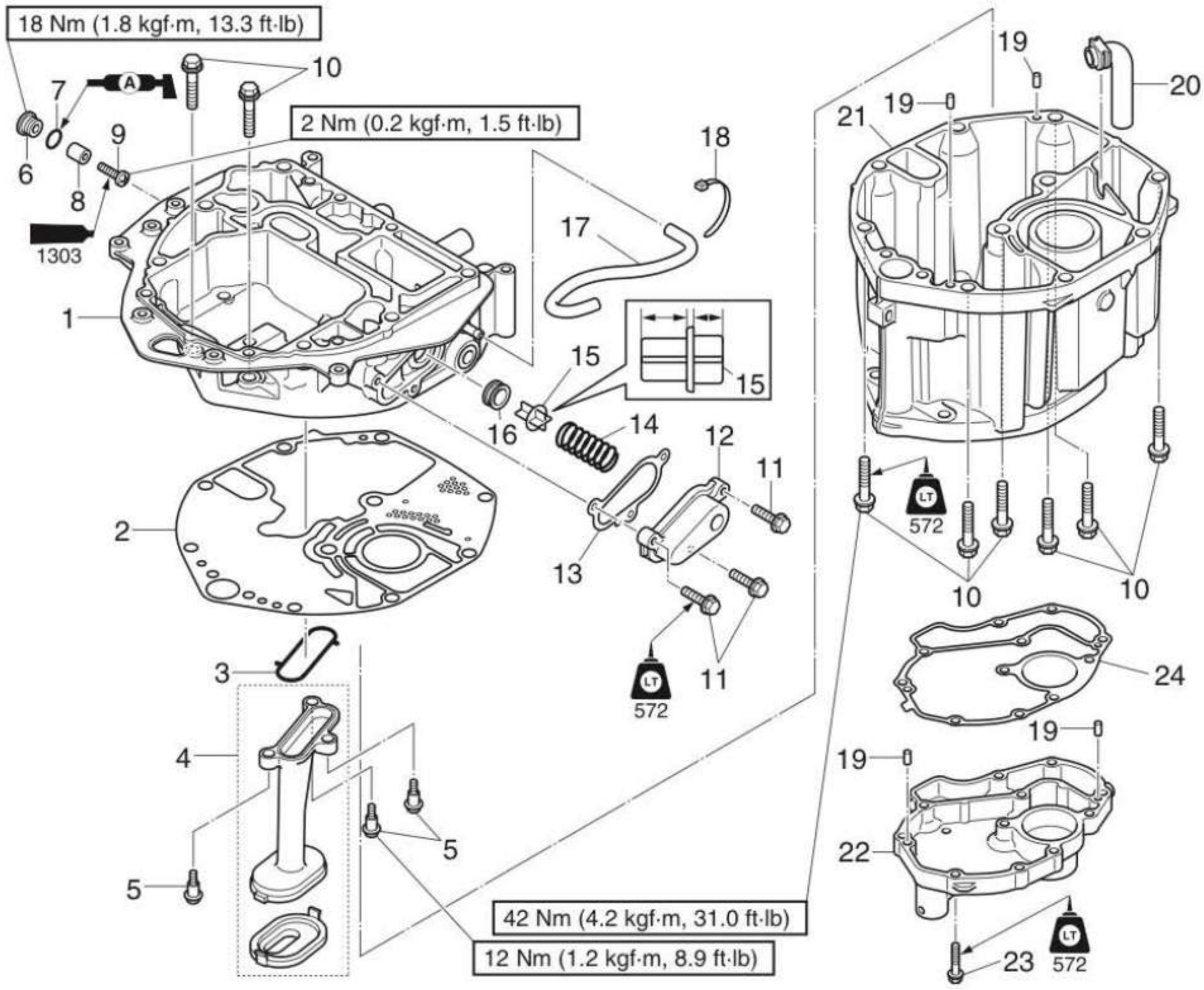


Drain bolt "2" 27 Nm (2.7 kgf·m, 19.9 ft·lb)

Oil pan and exhaust guide



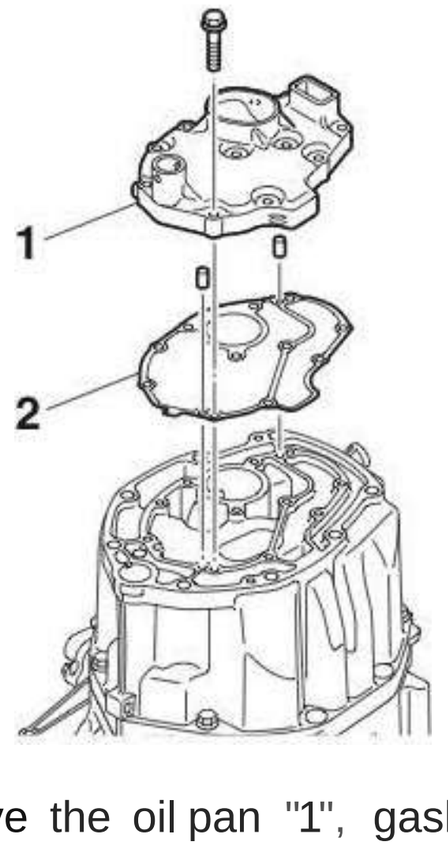
No.	Part name	Q'ty	Remarks
1	Exhaust guide	1	
2	Gasket	1	Not reusable
3	Gasket	1	Not reusable
4	Oil strainer	1	
5	Bolt	3	M6 x 24 mm
6	Plug	1	
7	O-ring	1	Not reusable
8	Anode	1	
9	Screw	1	M5 x 24 mm
10	Bolt	8	M10 x 45mm
11	Bolt	3	M6 x 25 mm
12	Cover	1	
13	Gasket	1	Not reusable
14	Spring	1	
15	PCV	1	
16	Grommet	1	
17	Hose	1	Joint to exhaust guide



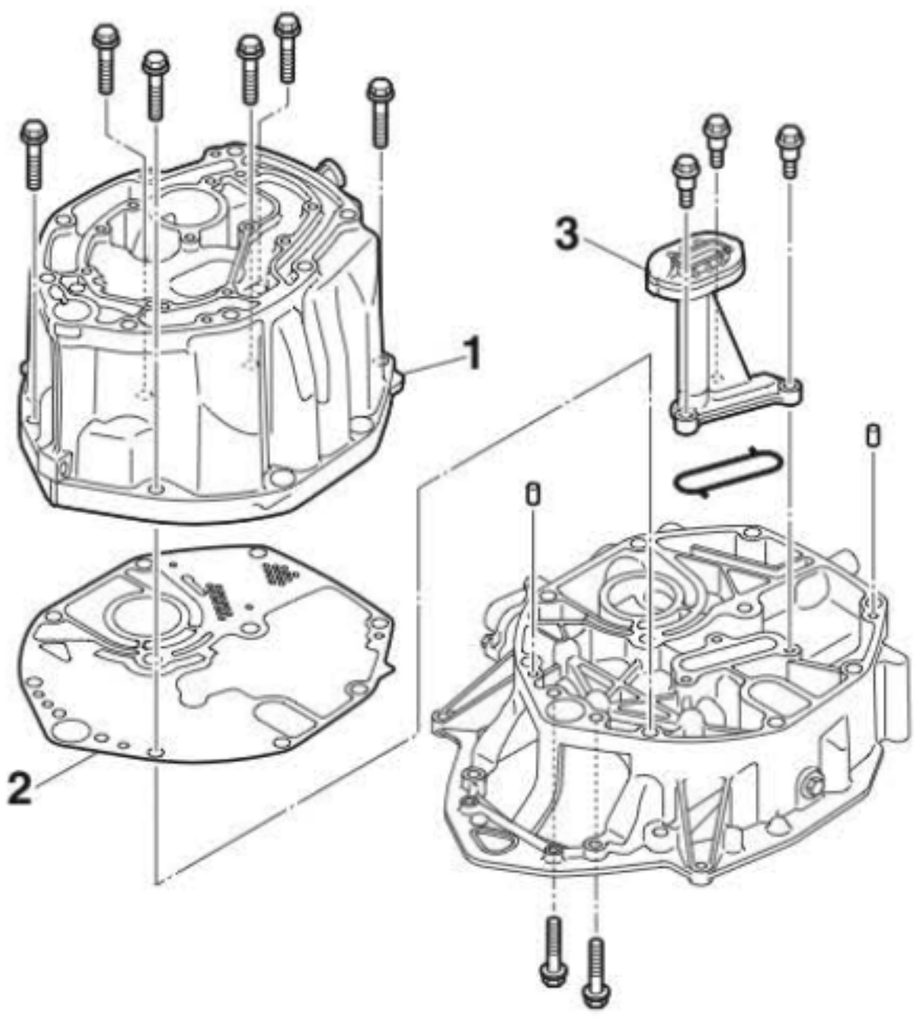
No.	Part name	Q'ty	Remarks
18	Plastic tie	1	
19	Dowel pin	4	
20	Pipe	1	
21	Oil pan	1	
22	Plate	1	
23	Bolt	11	M6 x 30 mm
24	Gasket	1	Not reusable

Disassembling the oil pan and exhaust guide

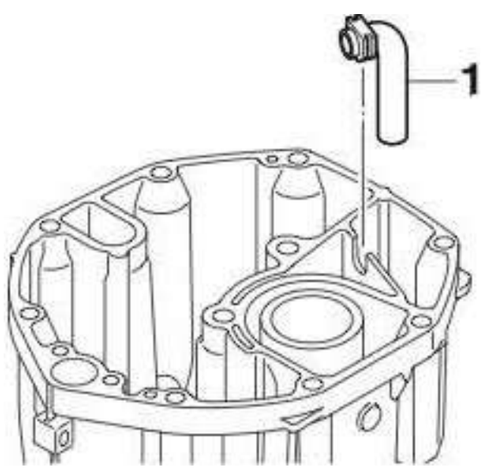
1. Remove the plate "1" and gasket "2".



2. Remove the oil pan "1", gasket "2", and oil strainer "3".



3. Remove the pipe "1".



Checking the oil pan and exhaust guide

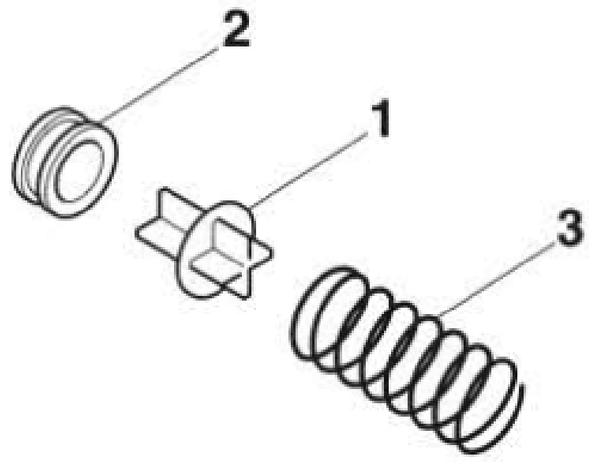
1. Clean the removed parts.
2. Check the exhaust guide. Replace if corroded or cracked.
3. Check the oil pan. Replace if corroded or cracked.

Checking the oil strainer

1. Check the oil strainer. Clean if there is dirt or residue.

Checking the PCV

1. Check the PCV "1". Replace if damaged or worn.
2. Check the grommet "2". Replace if deformed.
3. Check the spring "3". Replace if deformed or fatigued.



Checking the exhaust guide anode

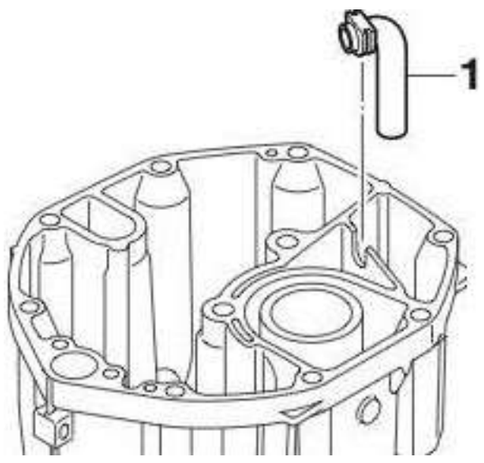
1. Check the anode. Replace the anode if half of it has eroded. Clean if there is grease, oil, or scales.

NOTICE

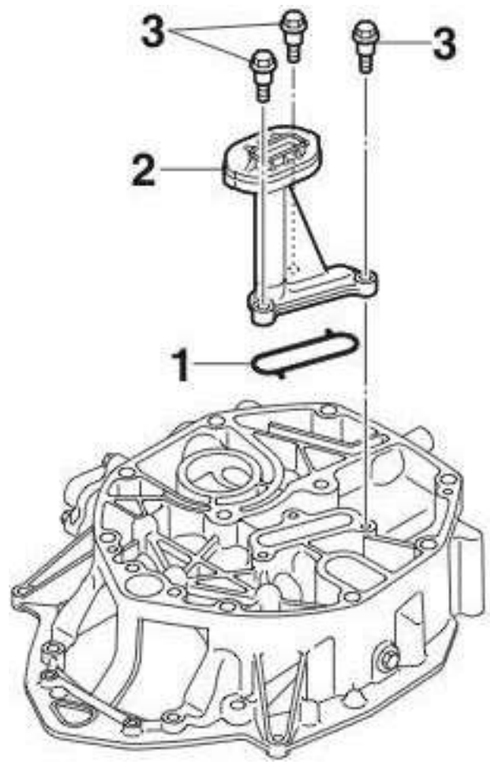
Do not apply grease, oil, or paint to the anode.

Assembling the oil pan and exhaust guide

1. Install the pipe "1".

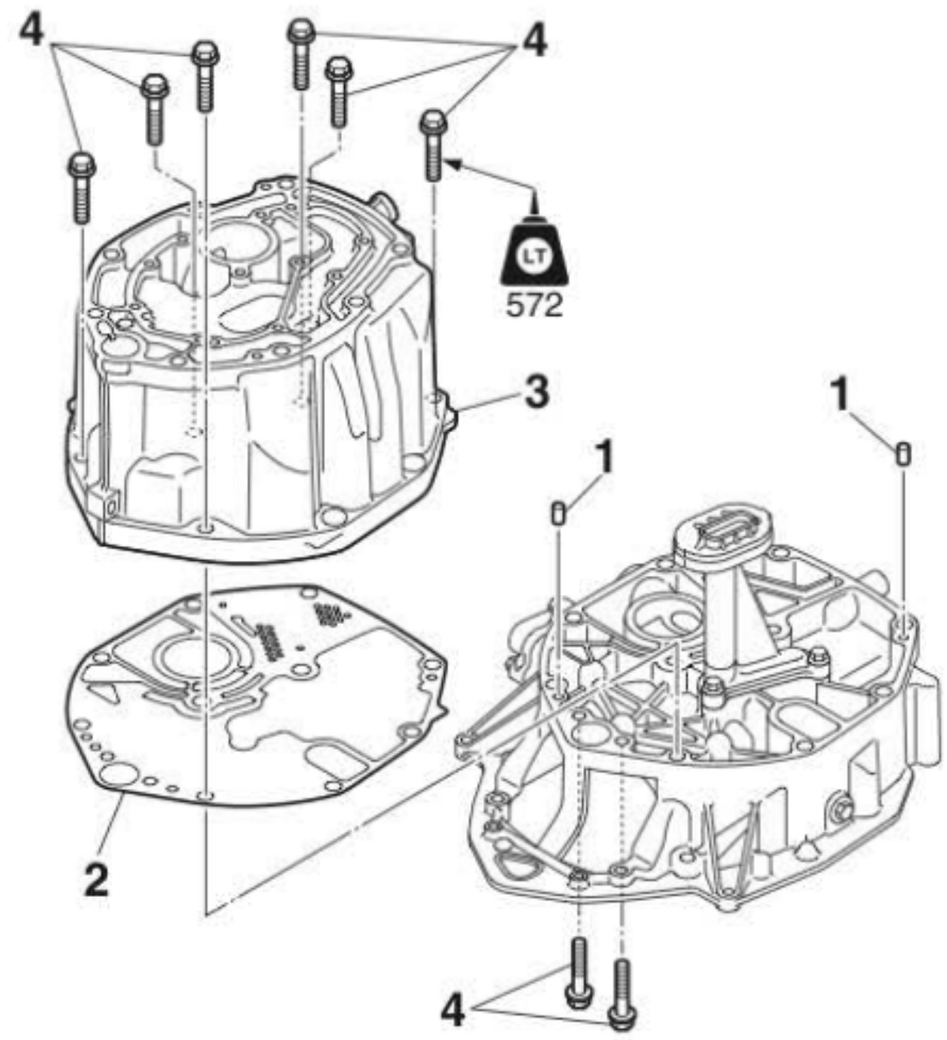


2. Install a new gasket "1" and the oil strainer "2", and then tighten the oil strainer bolts "3" to the specified torque.

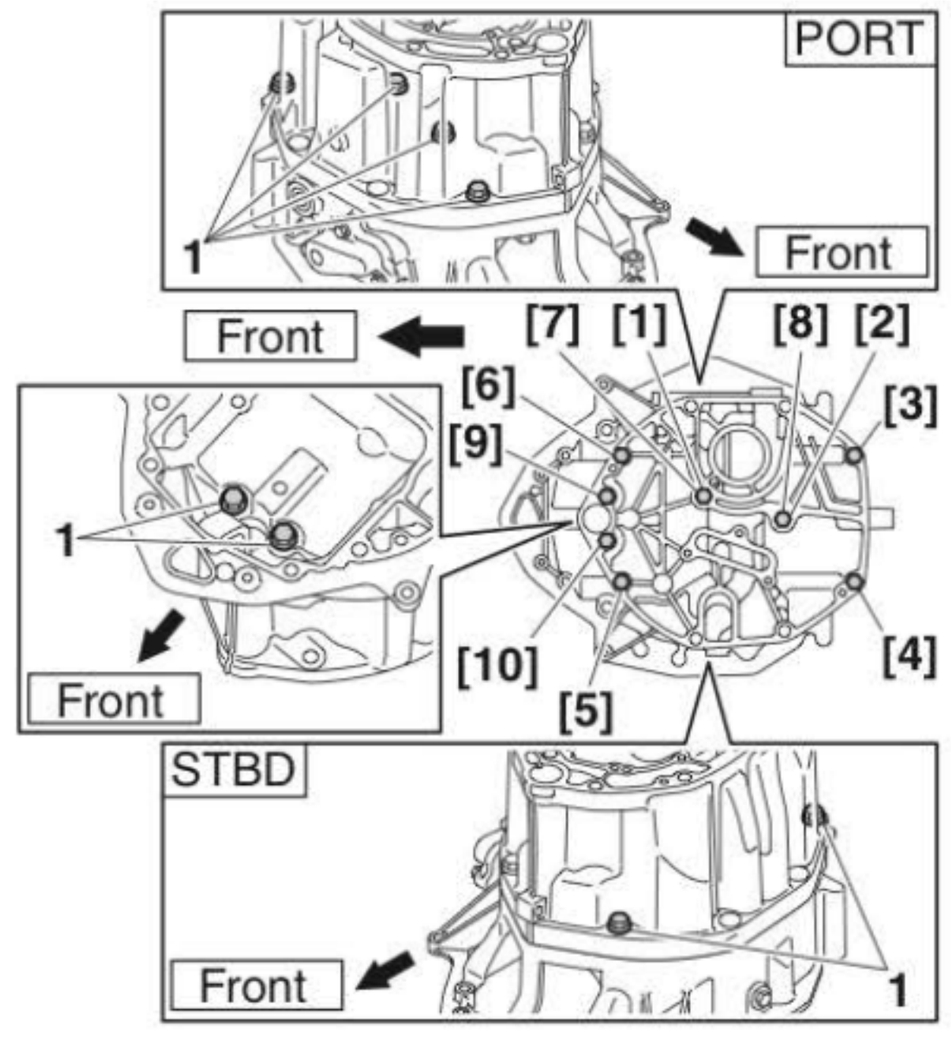


Oil strainer bolt "3"
12 Nm (1.2 kgf·m, 8.9 ft·lb)

3. Install the dowel pins "1", a new gasket "2", the oil pan "3", and the oil pan bolts "4".

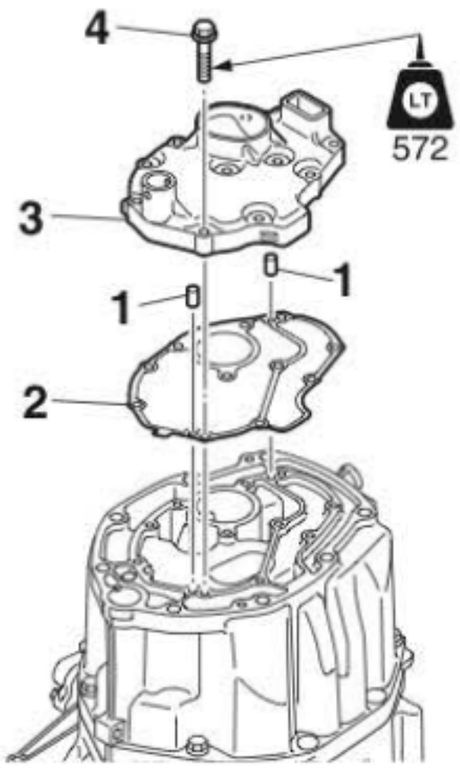


4. Tighten the oil pan bolts "1" to the specified torque in 2 stages and in the order [1], [2], and so on.

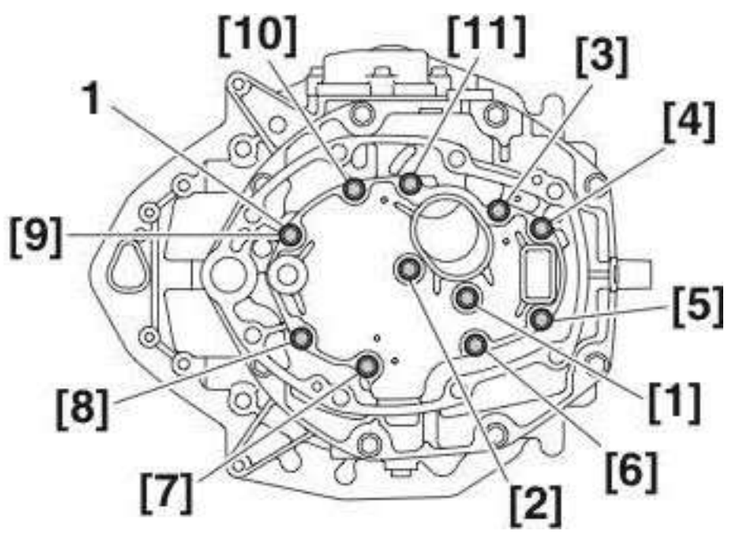


Oil pan bolt "1"
1st: 42 Nm (4.2 kgf·m, 31.0 ft·lb)
2nd: 42 Nm (4.2 kgf·m, 31.0 ft·lb)

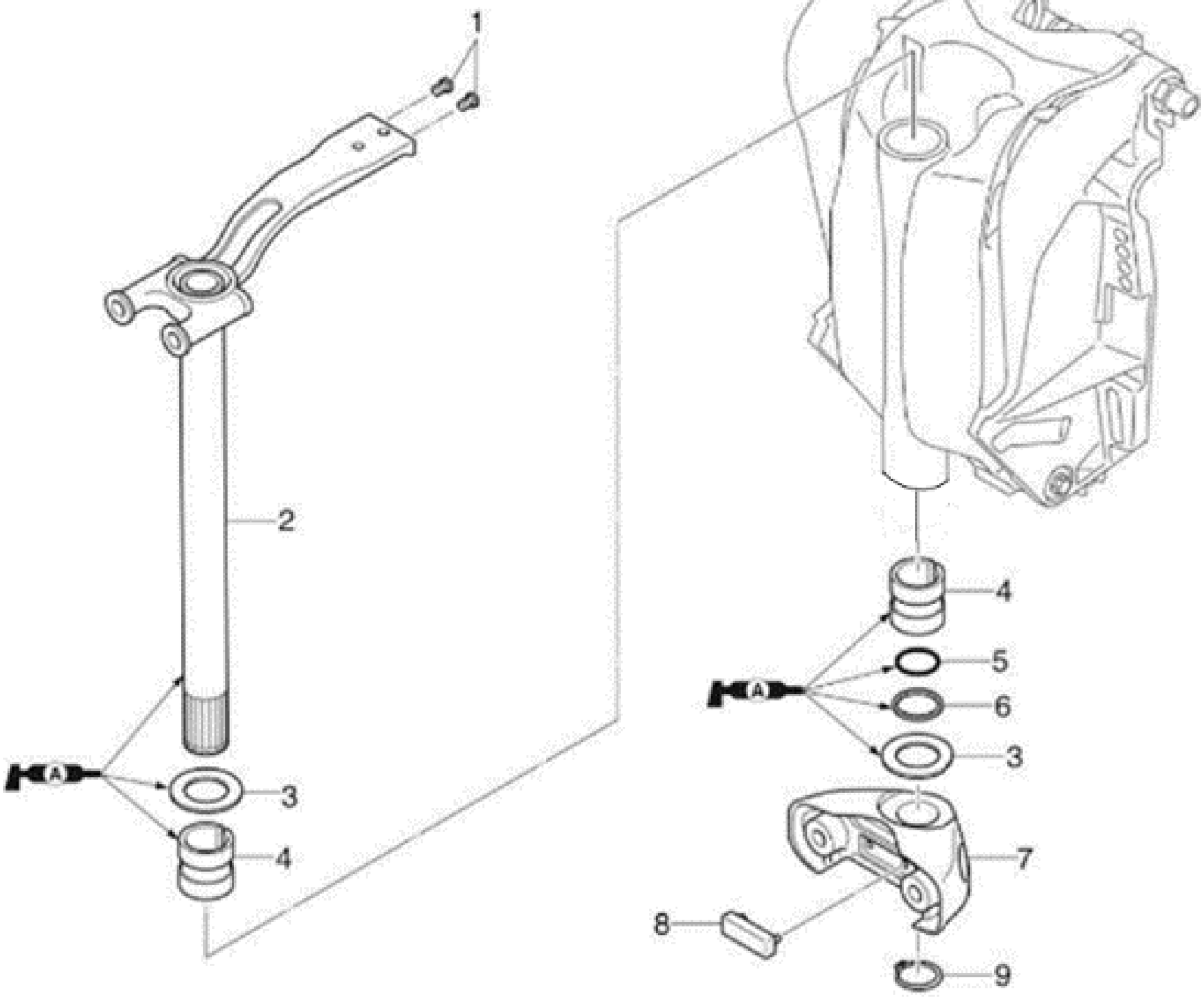
5. Install the dowel pins "1", a new gasket "2", the plate "3", and the plate bolts "4".



6. Tighten the plate bolts "1" in the order [1], [2], and so on.



Steering arm



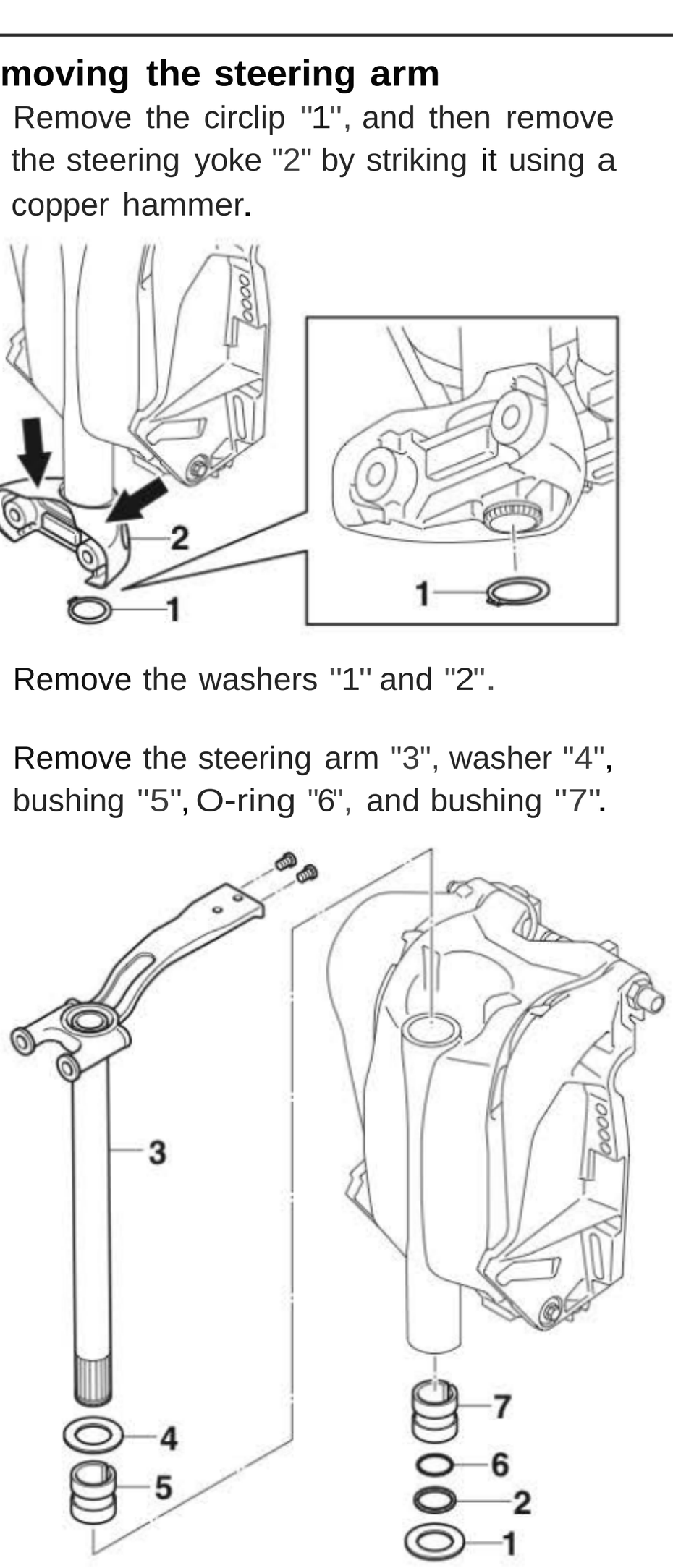
No.	Part name	Q'ty	Remarks
1	Plug	2	
2	Steering arm	1	
3	Washer	2	
4	Bushing	2	
5	O-ring	1	Not reusable
6	Washer	1	
7	Steering yoke	1	
8	Damper	1	
9	Circlip	1	

Removing the steering arm

1. Remove the circlip "1", and then remove the steering yoke "2" by striking it using a copper hammer.

2. Remove the washers "1" and "2".

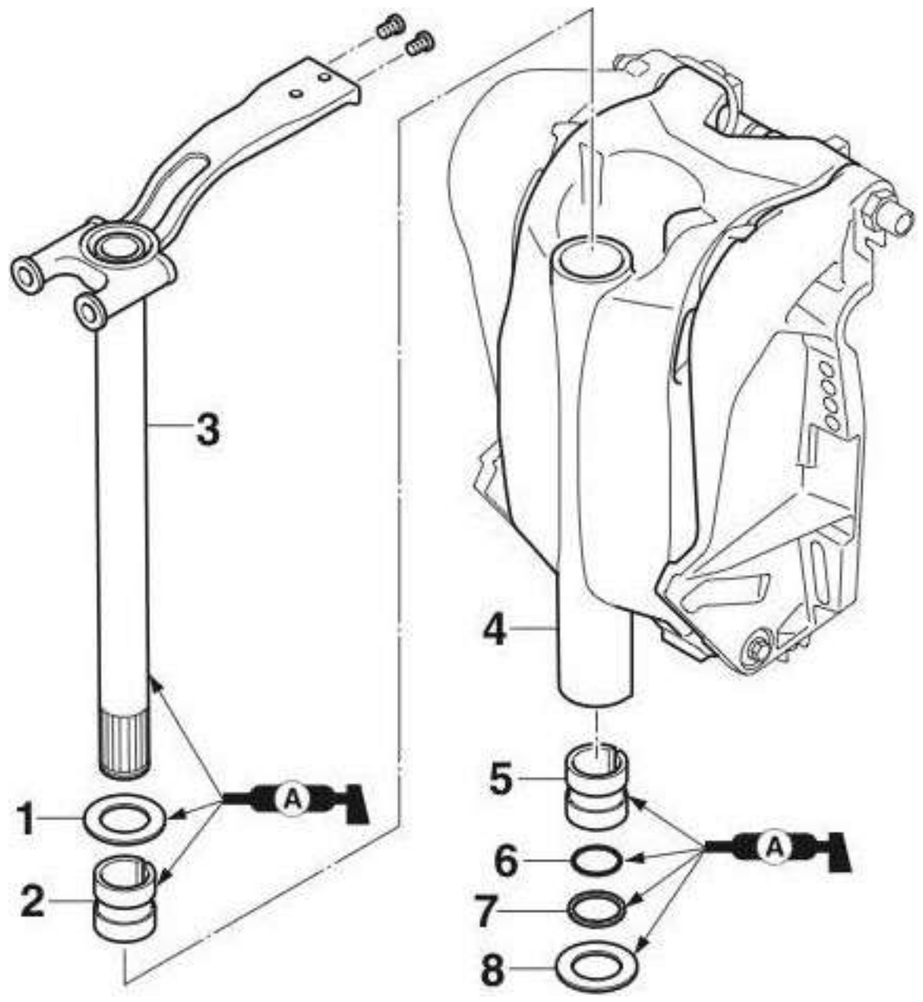
3. Remove the steering arm "3", washer "4", bushing "5", O-ring "6", and bushing "7".



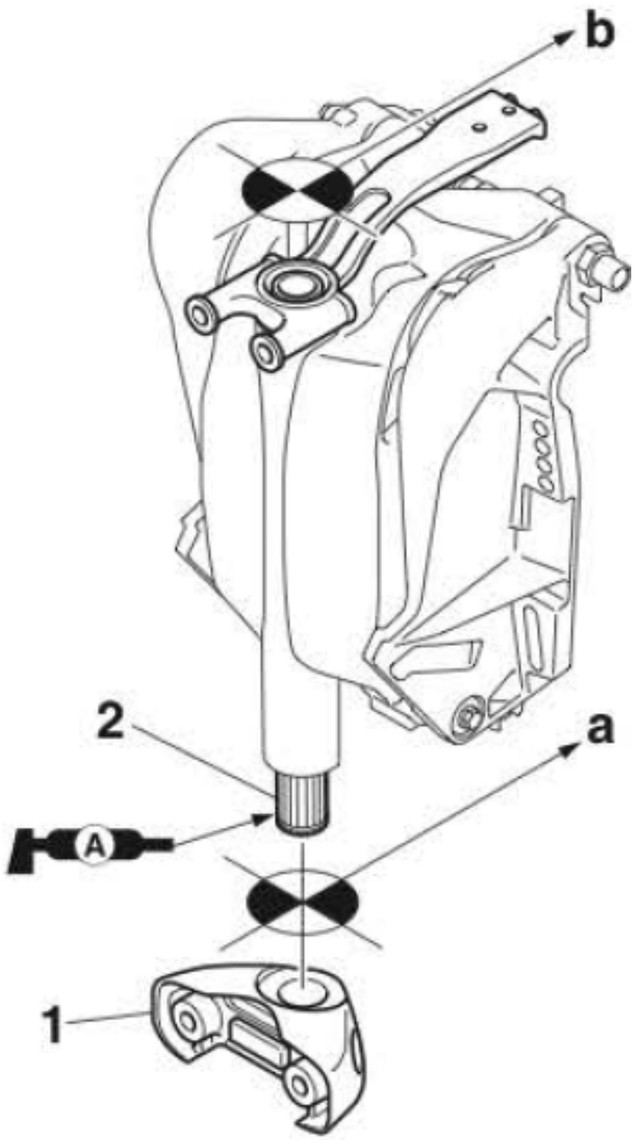
Installing the steering arm

1. Install the washer "1" and bushing "2" onto the steering arm "3", and then install the steering arm "3" to the swivel bracket "4".

2. Install the bushing "5", a new O-ring "6", and the washers "7" and "8".

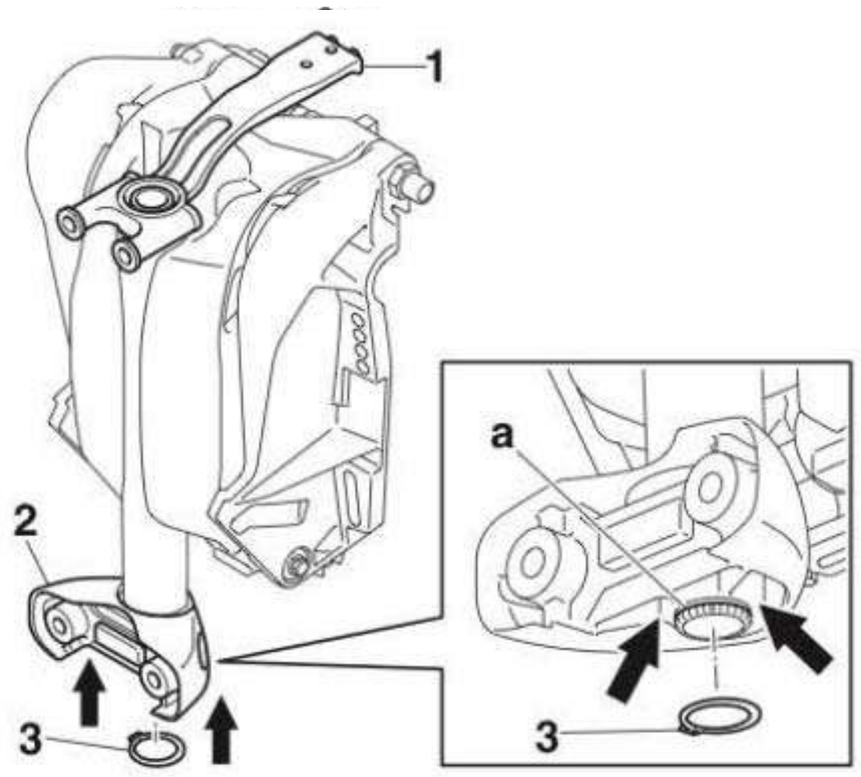


3. Install the steering yoke "1" so that the steering arm "2" and the steering yoke "1" are facing in the same direction ("a" and "b" are aligned).

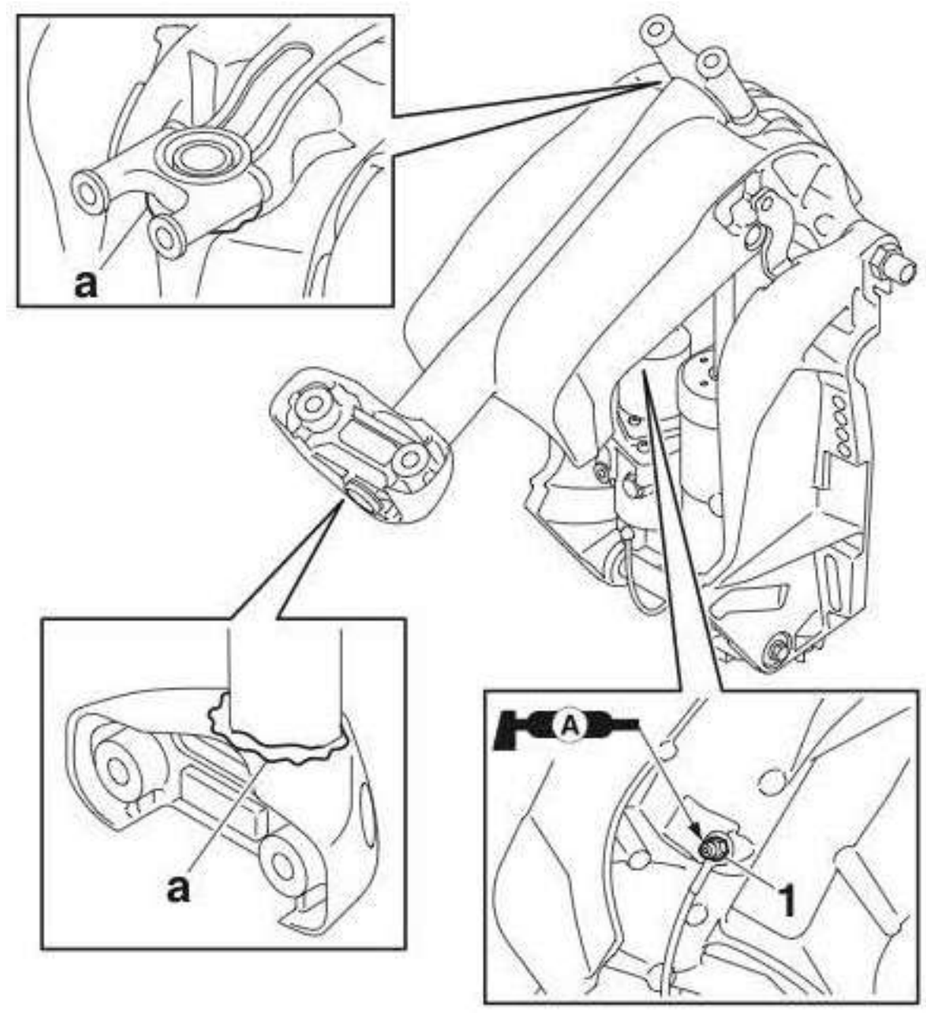


4. Hold the steering arm "1", and then strike the steering yoke "2" using a copper hammer until the groove "a" for installing the circlip is visible.

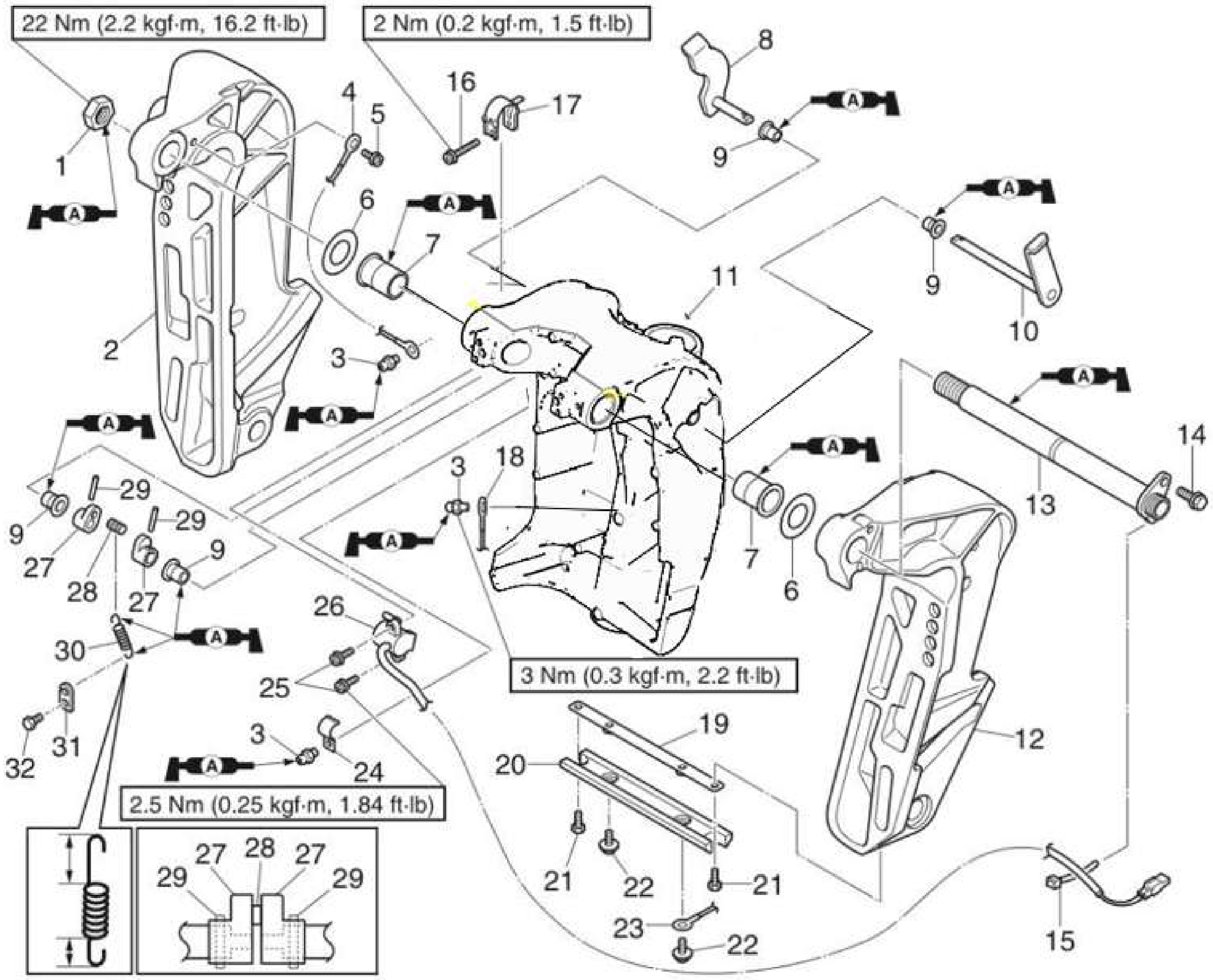
5. Install the circlip "3".



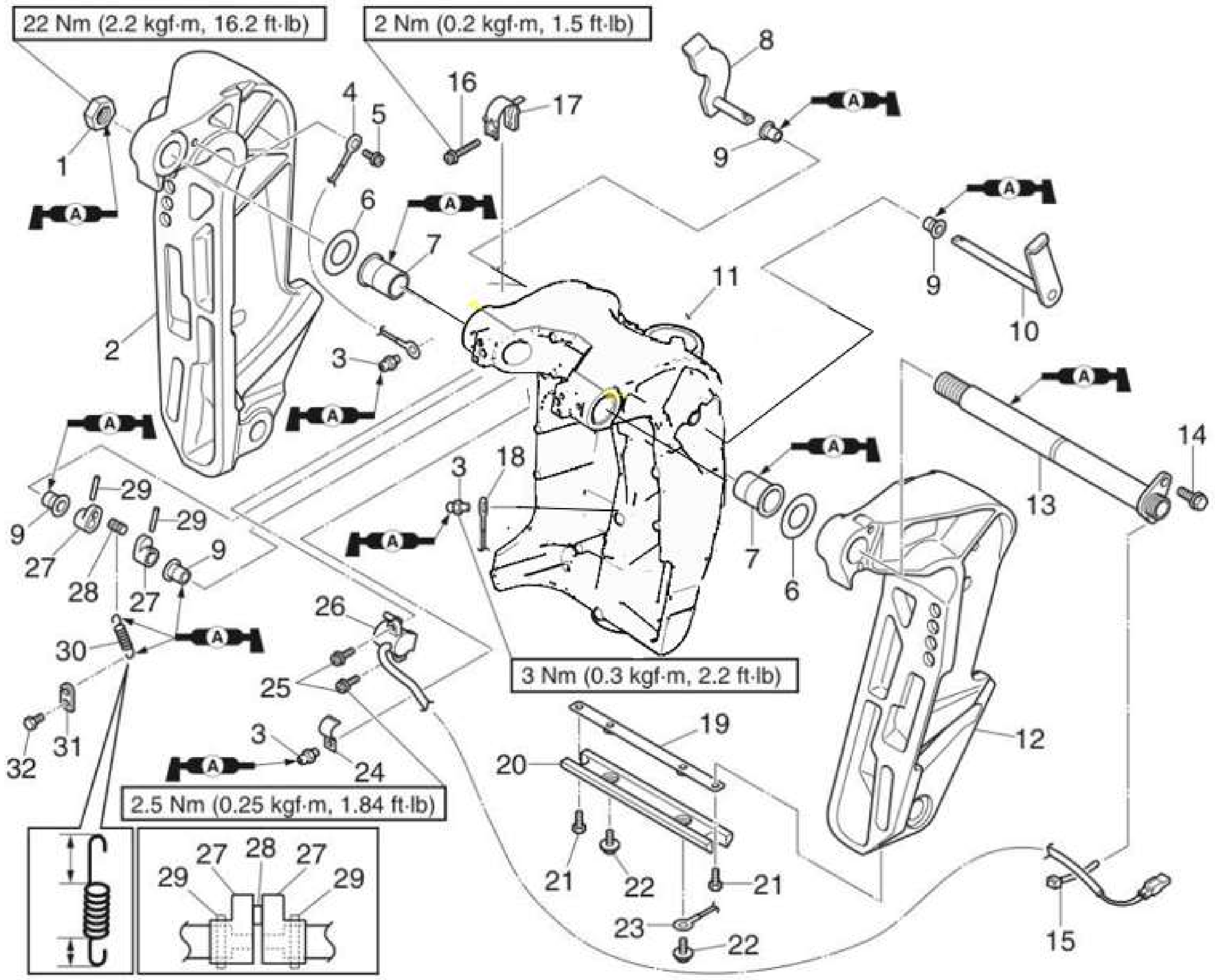
6. Inject grease into the grease nipple "1" until it comes out from both the upper and lower bushings "a".



Clamp bracket and swivel bracket



No.	Part name	Q'ty	Remarks
1	Self-locking nut	1	M22
2	Clamp bracket (STBD)	1	
3	Grease nipple	3	M6
4	Ground lead	1	
5	Screw	1	M6 x 11 mm
6	Washer	2	
7	Bushing	2	
8	Tilt stop lever	1	
9	Bushing	4	
10	Tilt stop lever	1	
11	Swivel bracket	1	
12	Clamp bracket (PORT)	1	
13	Through tube	1	
14	Bolt	1	M8 x 20 mm
15	Plastic tie	1	
16	Screw	1	M5 x 35 mm
17	Trim sensor cam	1	

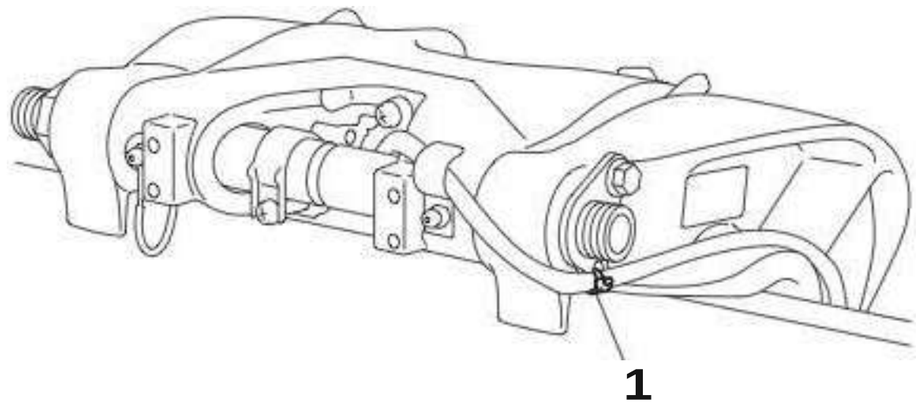


No.	Part name	Q'ty	Remarks
18	Ground lead	1	
19	Plate	1	
20	Anode	1	
21	Bolt	2	M6 x 16 mm
22	Bolt	2	M6 x 14 mm
23	Ground lead	1	
24	Clamp	1	
25	Screw	2	M6 x 16 mm
26	Trim sensor	1	
27	Distance collar	2	
28	Pin	1	
29	Pin	2	
30	Spring	1	
31	Hook	1	
32	Bolt	1	M6 x 10 mm

Removing the clamp bracket

1. Remove the PTT unit. See "Removing the PTT unit" (9-43).

2. Remove the plastic tie "1".



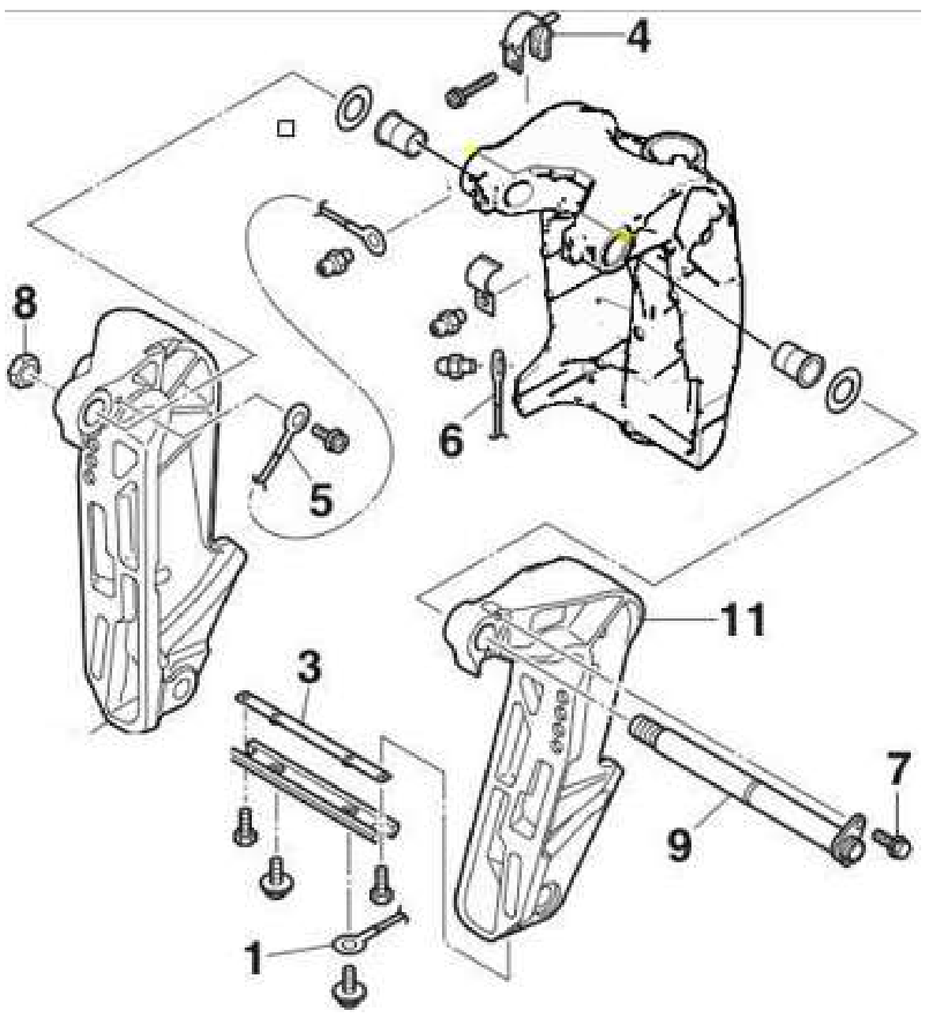
3. Remove the ground lead "1", anode "2", and plate "3".

4. Remove the trim sensor cam "4".

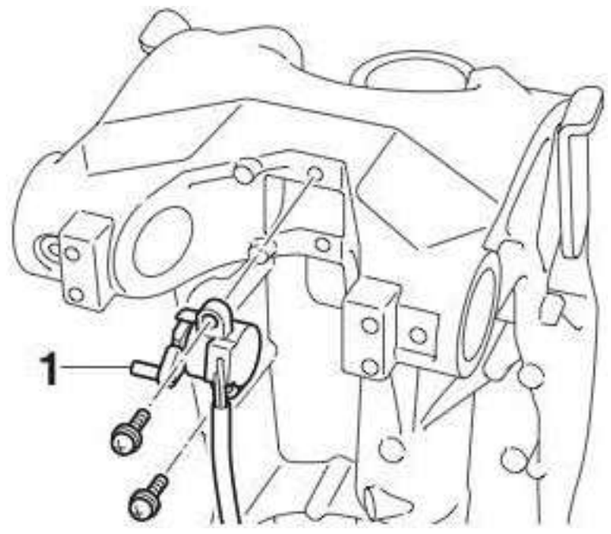
5. Remove the ground leads "5" and "6".

6. Remove the bolt "7" and self-locking nut "8".

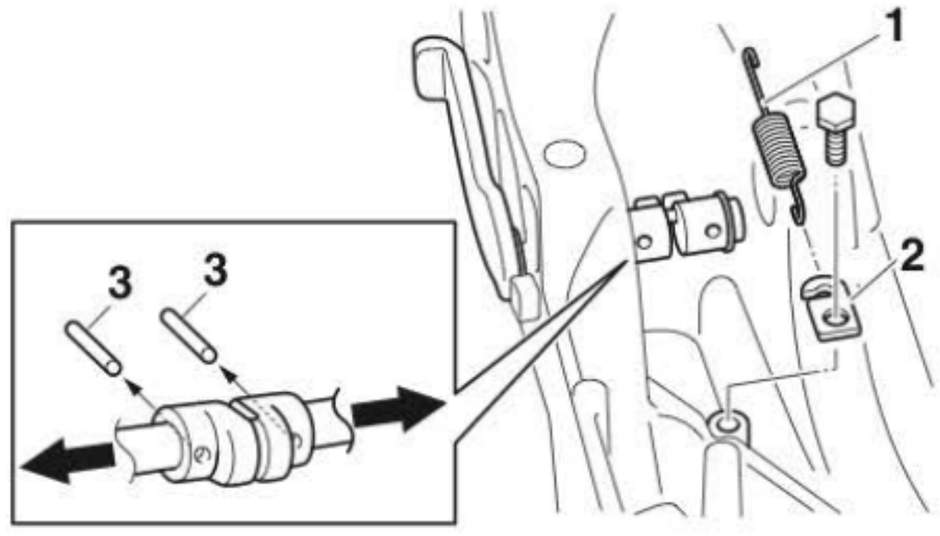
7. Remove the through tube "9", and then disassemble the clamp brackets "10" and "11".



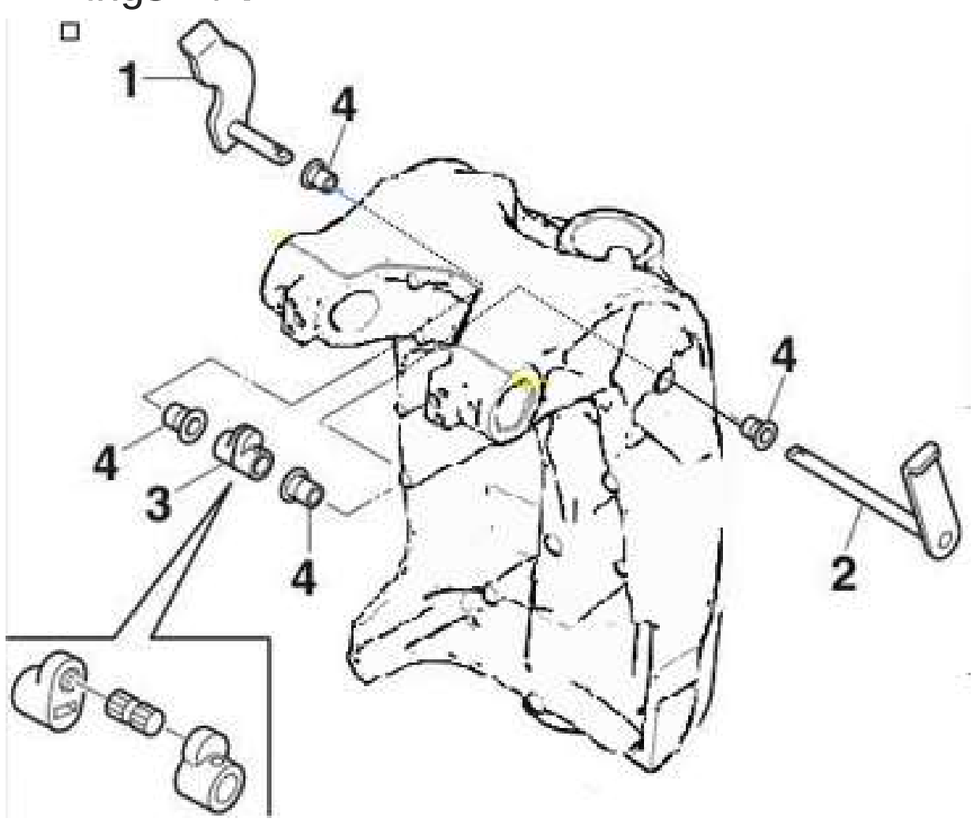
8. Remove the trim sensor "1".



9. Remove the spnng "1" hook "2", and pins "3".



10. Remove the tilt stop levers "1" and "2", distance collar assembly "3", and bushings "4".



Checking the clamp bracket anode

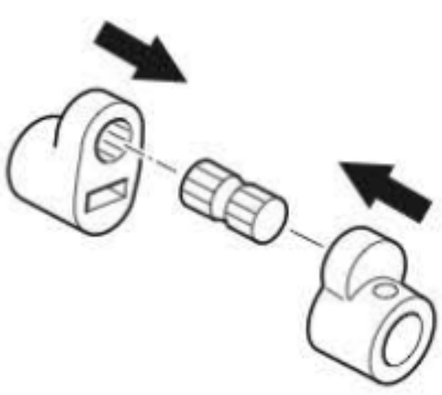
1. Check the anode. Replace the anode if half of it has eroded. Clean if there is grease, oil, or scales.

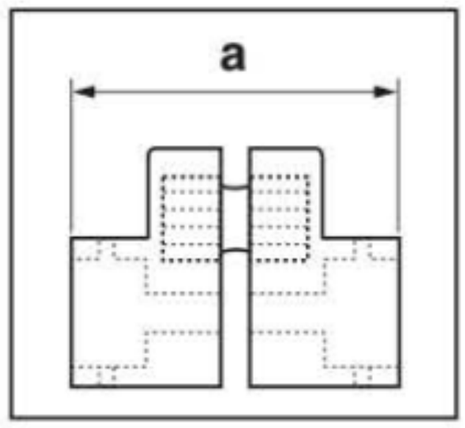
NOTICE

Do not apply grease, oil, or paint to the anode.

Installing the clamp bracket

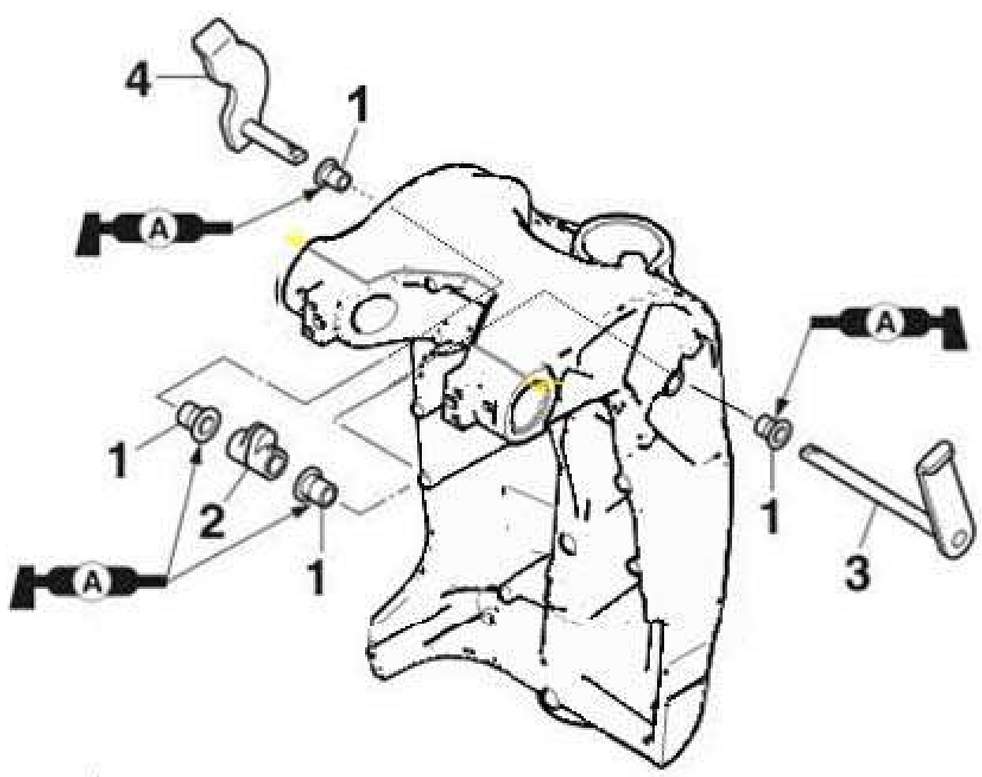
1. Assemble the distance collar assembly.



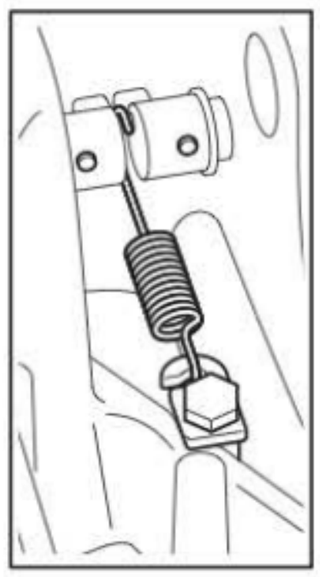


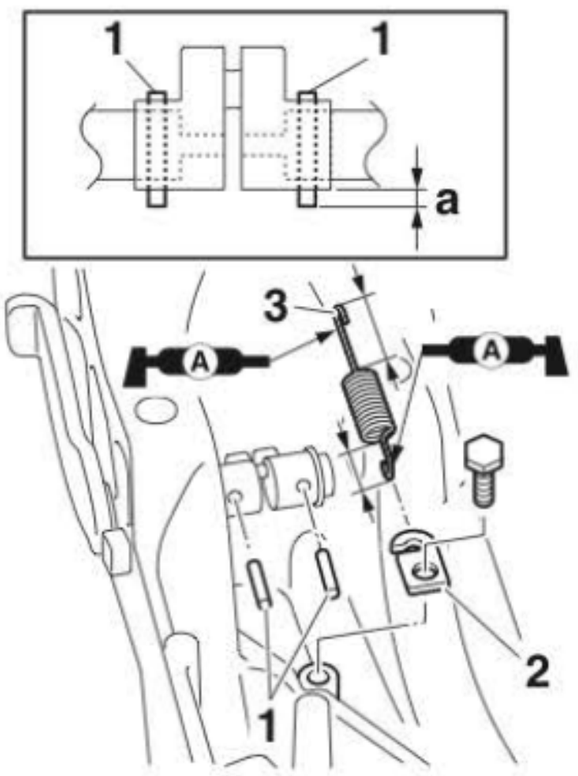
Distance "a"
30.3–30.6 mm (1.19–1.20 in)

2. Install the bushings "1", distance collar assembly "2", and tilt stop levers "3" and "4".



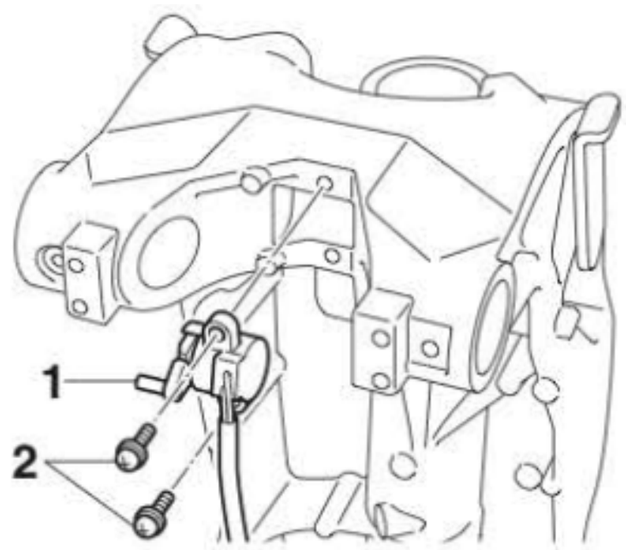
3. Install the pins "1", hook "2", and spring "3".





Distance "a"
2.5-3.5 mm (0.10-0.14 in)

4. Install the trim sensor "1", and then tighten the trim sensor screws "2" to the specified torque.



Trim sensor screw "2"
2.5 Nm (0.25 kgf·m, 1.84 ft·lb)

5. Install the bushings "1", washers "2", clamp brackets "3" and "4", and through tube "5" to the swivel bracket "6", and then install the bolt "7".

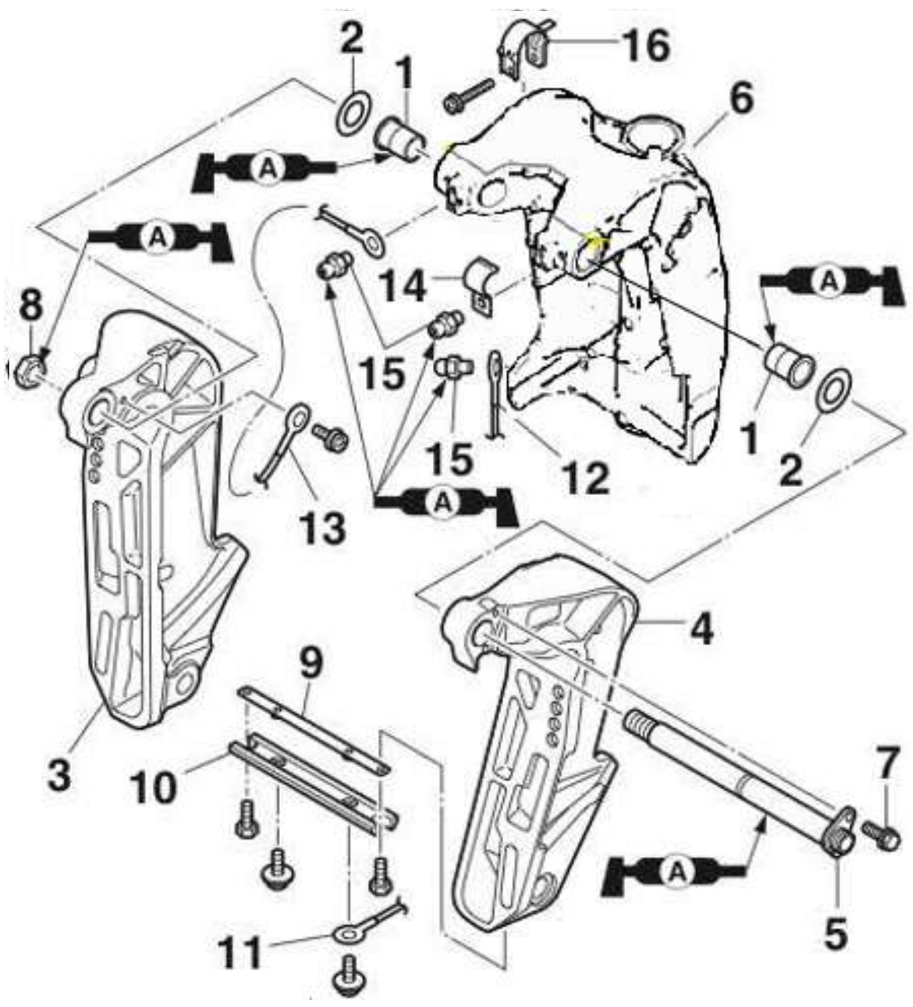
6. Install the self-locking nut "8" to the through tube "5", and then tighten it temporarily.

7. Install the plate "9", anode "10", and ground lead "11".

8. Tighten the self-locking nut "8" to the specified torque.

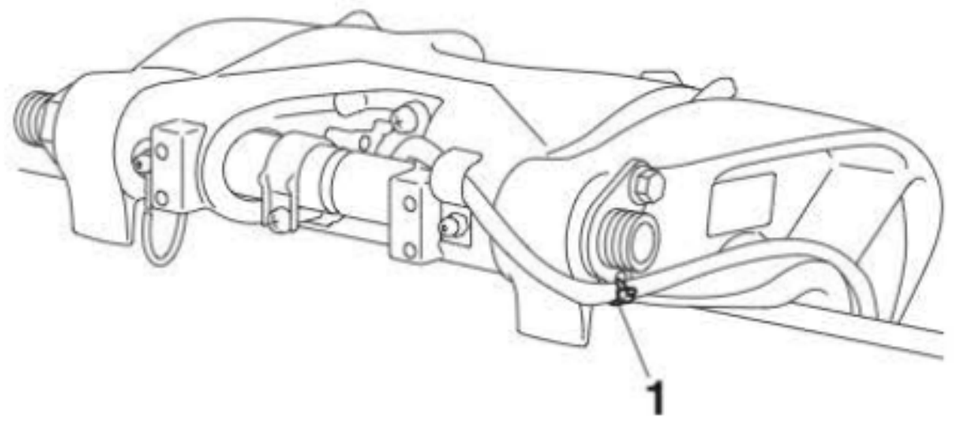
9. Install the ground leads "12" and "13" and clamp "14", and then tighten the grease nipples "15" to the specified torque.

10. Install the trim sensor cam "16".

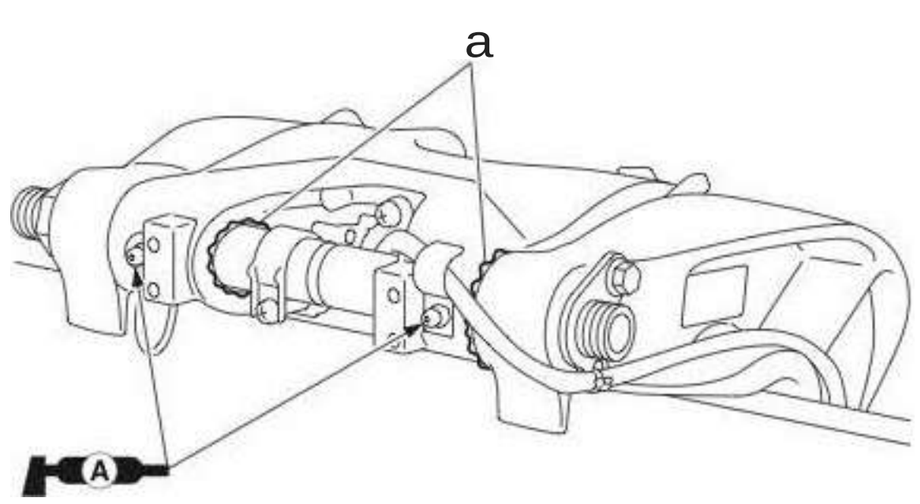


Self-locking nut "8"
22 Nm (2.2 kgf·m, 16.2 ft·lb)
Grease nipple "15"
3 Nm (0.3 kgf·m, 2.2 ft·lb)

11. Install the plastic tie "1".



12. Inject grease into the grease nipples until grease comes out from the bushings "a".



13. Install the PTT unit. See "Installing the PTT unit" (9-45).

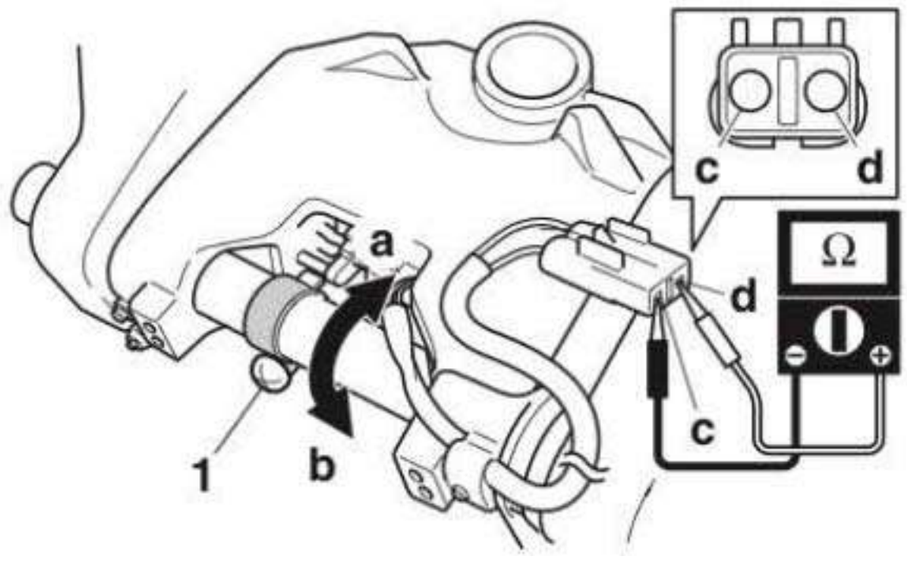
Adjusting the trim sensor cam

1. Fully tilt the swivel bracket down.

2. Loosen the trim sensor cam screw "1".

3. Measure the trim sensor setting resistance. Adjust if out of specification.

TIP:
- To decrease the resistance, turn the trim sensor cam in direction "a".
- To increase the resistance, turn the trim sensor cam in direction "b".



Digital circuit tester

Digital multimeter

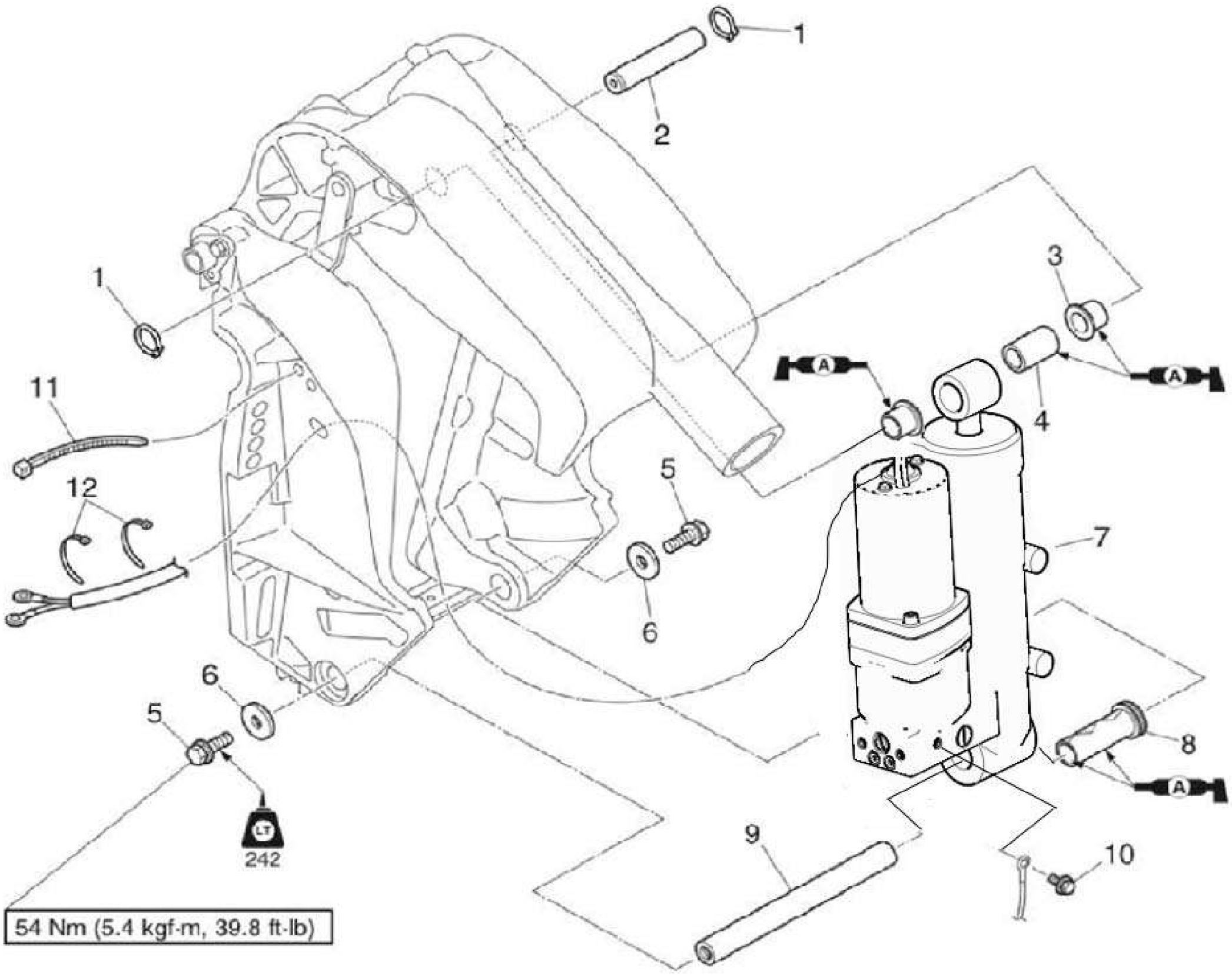
Trim sensor
Setting resistance
9-11 Ω
Terminal "c" – Terminal "d"

4. Tighten the trim sensor cam screw to the specified torque.

Trim sensor cam screw
2 Nm (0.2 kgf-m, 1.5 ft·lb)

5. Check that the trim sensor setting resistance is within specification.

PTT unit



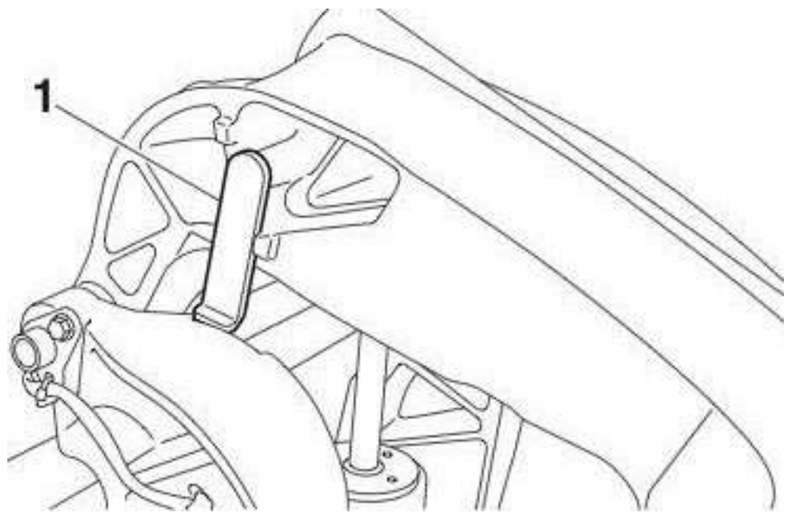
No.	Part name	Q'ty	Remarks
1	Circlip	2	
2	Shaft	1	
3	Bushing	2	
4	Bushing	1	
5	Bolt	2	M10 x 30 mm
6	Washer	2	
7	PTT unit	1	
8	Bushing	1	
9	Shaft	1	
10	Bolt	1	M6 x 10 mm
11	Plastic tie	1	
12	Plastic tie	2	

Removing the PTT unit

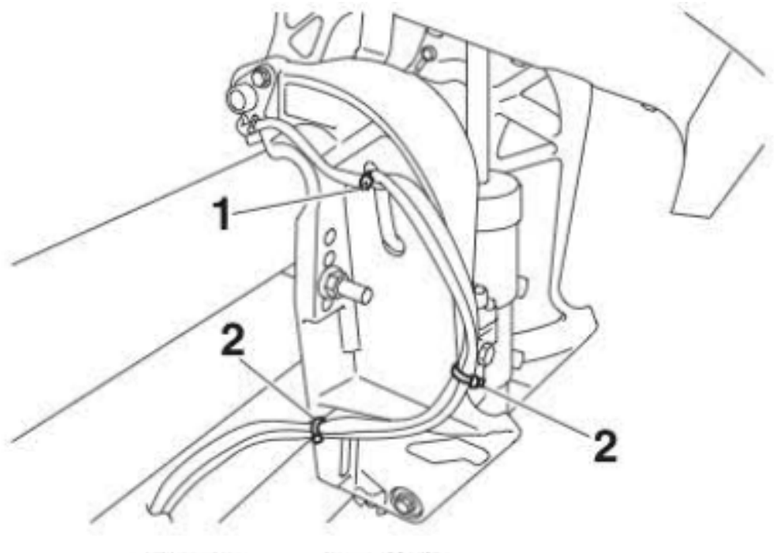
⚠ WARNING

When removing the PTT unit with the power unit installed, make sure to suspend the outboard motor.

1. Fully tilt the swivel bracket up, and then support it using the tilt stop lever "1".



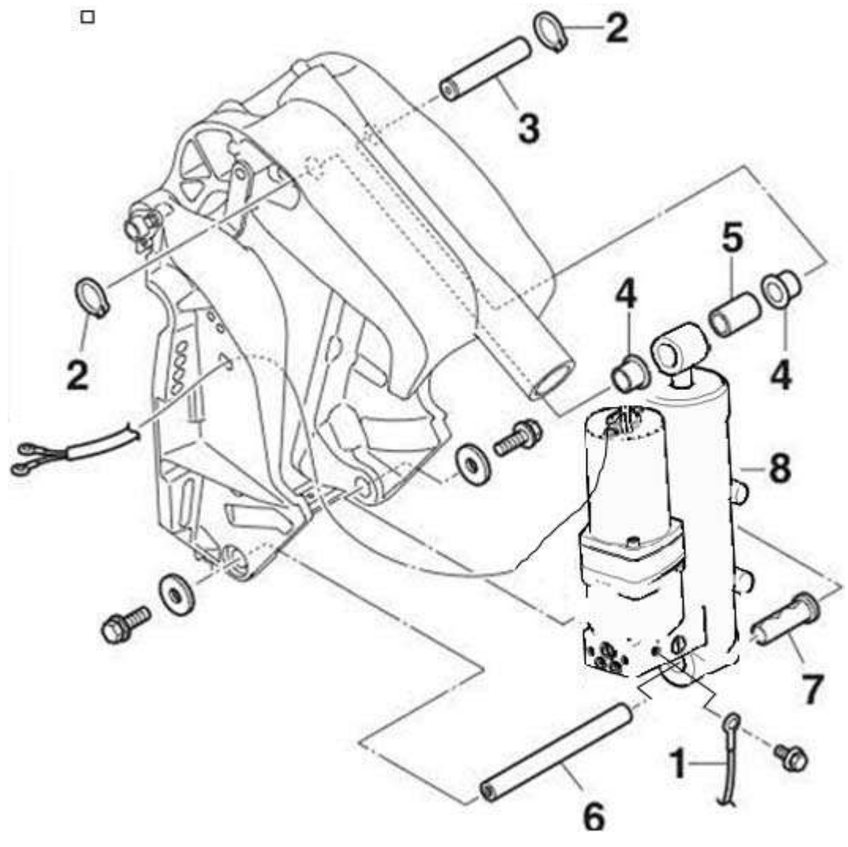
2. Remove the plastic ties "1" and "2".



3. Disconnect the ground lead "1".

4. Remove the circlips "2", upper mount shaft "3", and bushings "4" and "5".

5. Remove the lower mount shaft "6", bushing "7", and PTT unit "8".



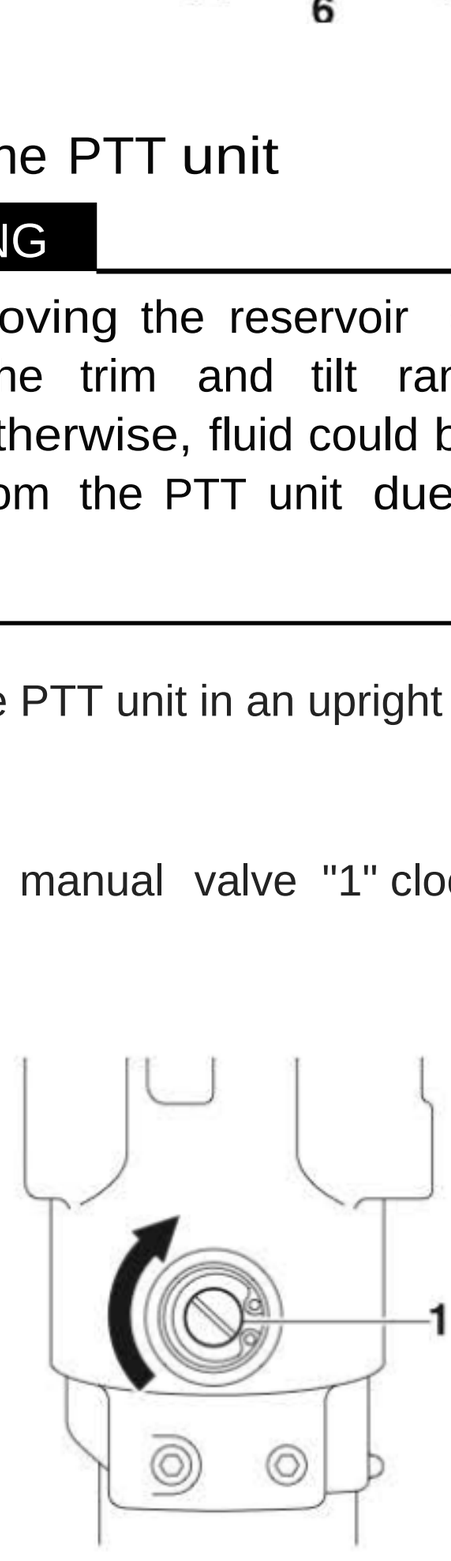
Bleeding the PTT unit

⚠ WARNING

Before removing the reservoir cap, make sure that the trim and tilt ram is fully extended. Otherwise, fluid could be expelled forcefully from the PTT unit due to internal pressure.

1. Place the PTT unit in an upright position.

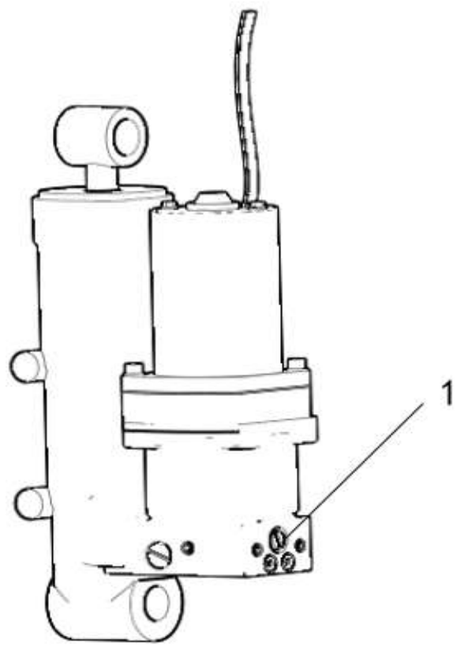
2. Turn the manual valve "1" clockwise to close it.



Manual valve "1"
2 Nm (0.2 kgf·m, 1.5 ft·lb)

3. Remove the reservoir cap "1", and then check the fluid level.

TIP:
If the fluid is at the proper level, a small amount of fluid should flow out of the filler hole.



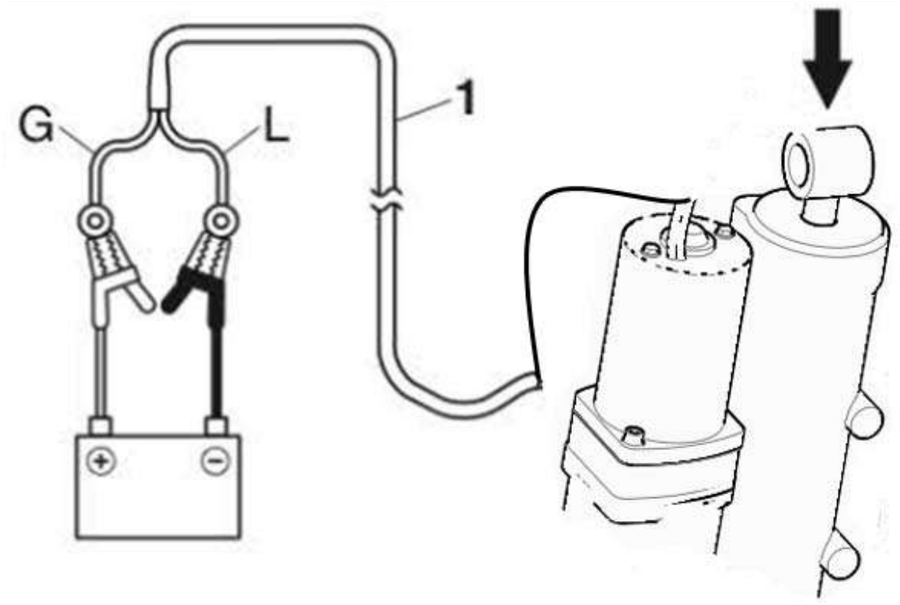
4. If the fluid is below the proper level, add the recommended fluid.

5. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap
7 Nm (0.7 kgf-m, 5.2 ft- lb)

6. Connect the battery jumper leads to the PTT motor lead "1" to fully retract the trim and tilt ram.

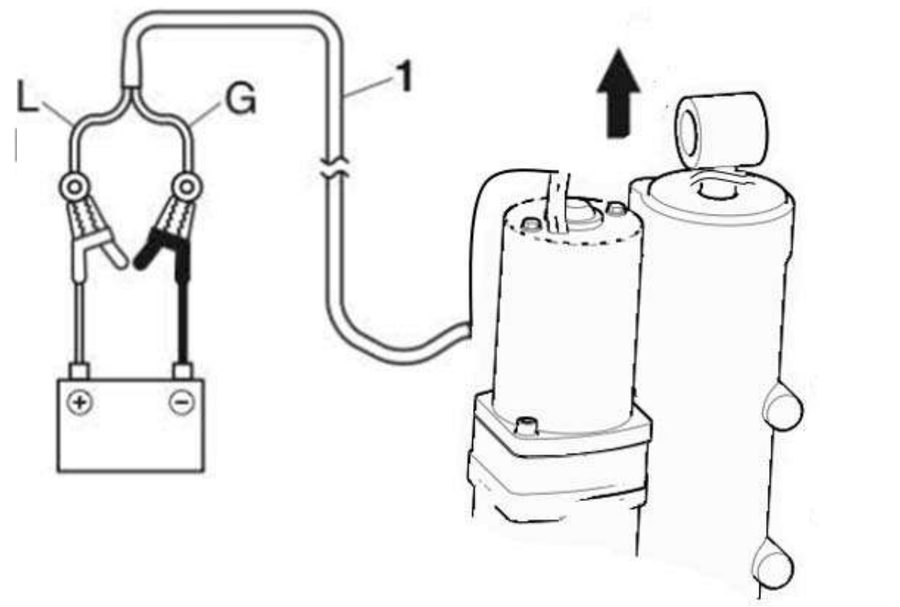
TIP:
If the trim and tilt ram does not move down easily, push on the trim and tilt ram to assist operation.



Ram	PTT motor lead	Battery
Retract	Green (G)	(+)
	Blue (L)	(-)

7. Reverse the connection between the battery jumper leads and the PTT motor lead "1" to fully extend the trim and tilt ram.

TIP:
If the trim and tilt ram does not move up easily, pull on the trim and tilt ram to assist operation.



Ram	PTT motor lead	Battery
Extend	Blue (L)	(+)
	Green (G)	(–)

8. Repeat steps 6 and 7 to fully extend and retract the trim and tilt ram 4 or 5 times.

9. Fully extend the trim and tilt ram.

10. Remove the reservoir cap, and then check the fluid level.

TIP:
If the fluid is below the proper level, add the recommended PTT fluid. Repeat steps 3-9 until the fluid is at the proper level.

11. Install a new O-ring and the reservoir cap, and then tighten the reservoir cap to the specified torque.

Reservoir cap
7 Nm (0.7 kgf·m, 5.2 ft·lb)

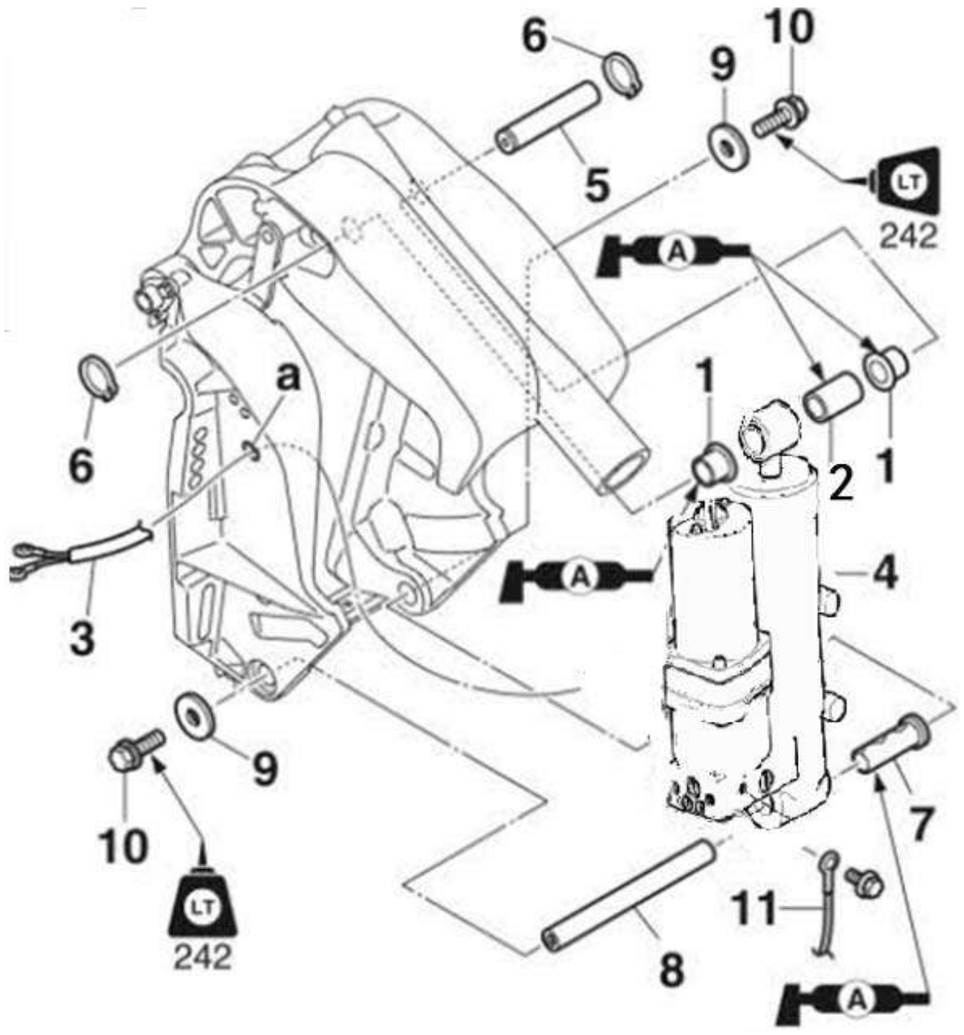
Installing the PTT unit

1. Install the bushings "1" and "2".

2. Route the PTT motor lead "3" through the hole "a" in the clamp bracket (PORT), and then install the PTT unit "4", upper mount shaft "5", and circlips "6".

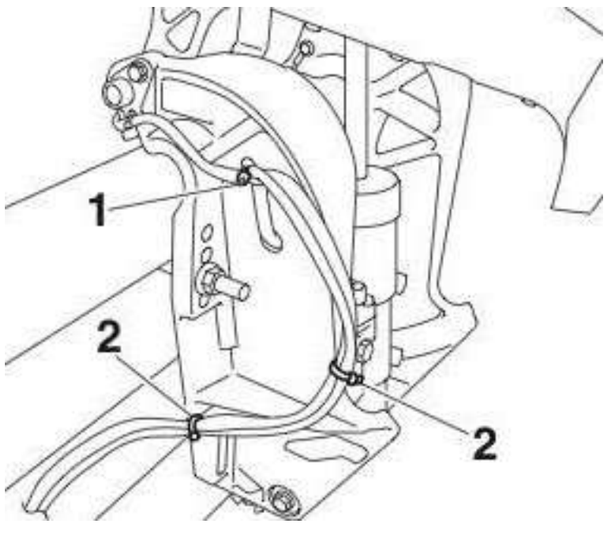
3. Install the bushing "7", lower mount shaft "8", and washers "9", and then tighten the lower mount shaft bolts "10" to the specified torque.

4. Connect the ground lead "11".



Lower mount shaft bolt "10"
54 Nm (5.4 kgf-m, 39.8 ft-lb)

5. Fasten the PTT motor lead and trim sensor lead using the plastic ties "1" and "2".



Maintenance

Outline 10-1

Maintenance interval chart 1..... 10-1
Maintenance interval chart 2 10-3

Predelivery check 10-4

Checking the engine oil level 10-4
Checking the battery..... 10-4
Checking the cooling water pilot hole..... 10-5
Checking the main switch/stop switch..... 10-5
Checking the fuel line..... 10-6
Checking the gear oil level 10-6
Checking the gear shift and throttle operation
(remote control model) 10-7
Checking the gear shift and throttle operation
(tiller handle model)..... 10-7
Checking the outboard motor mounting height..... 10-7
Checking the power trim and tilt unit 10-7
Checking the steering system..... 10-8
Checking the throttle cable and shift cable
(remote control model) 10-8
Checking the throttle cable and shift cable
(tiller handle model) 10-8
Test run..... 10-9
Break-in 10-9
After test run..... 10-9

Maintenance

General periodic maintenance 10-10

Checking the anode..... 10-10
Checking the battery..... 10-10
Checking the cooling water inlet..... 10-10
Checking the cooling water pilot hole..... 10-10
Checking the engine idle speed/noise..... 10-10
Changing the engine oil using an oil changer..... 10-11
Changing the engine oil by removing the drain bolt..... 10-12
Checking the engine oil level..... 10-13
Replacing the oil filter..... 10-13
Checking the exhaust guide/exhaust manifold..... 10-14
Checking the main switch/stop switch..... 10-14
Checking the fuel filter..... 10-14
Checking the fuel pump..... 10-14
Checking for fuel/engine oil leakage..... 10-14
Changing the gear oil..... 10-14
Checking the gear oil level..... 10-15
Greasing points..... 10-15
Greasing the clamp bracket bolt (through tube)..... 10-16
Checking the propeller/propeller nut/cotter pin..... 10-16
Checking the PCV..... 10-16
Checking the PTT fluid level..... 10-16
Checking the power trim and tilt unit operation..... 10-17
Adjusting the shift link/shift cable..... 10-17
Checking the spark plug..... 10-17
Checking the timing belt..... 10-17
Replacing the timing belt..... 10-17
Checking the thermostat..... 10-17
Adjusting the throttle link/throttle cable..... 10-17
Checking the cowling lock lever..... 10-18
Checking the valve clearance..... 10-18
Checking the impeller/water pump housing..... 10-18

Outline

- To obtain long product life, HiDea strongly recommends that the specified periodic checks and maintenance be performed according to the maintenance interval charts.
- If replacement parts are necessary, use only genuine HiDea parts of equivalent design and quality. Any parts of inferior quality may cause a malfunction, and the resulting loss of control could endanger the operator and passengers. HiDea genuine parts and accessories are available from HiDea dealers.
- The service intervals provided in the maintenance interval charts are based upon "typical" operat-ing conditions that include speed variations, sufficient time for engine warm up and cool-down, medium to light load, and an average cruising speed in the 3000-4000 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 operation for extended periods of time, carrying heavy loads, and frequent start-ing and stopping or shifting. In most cases, the frequent maintenance pays off in increased engine life and greater owner satisfaction.
- The maintenance cycle on these charts is based on usage of 100 hours per year and regular flushing of the cooling water passages. Adjust the maintenance frequency 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 the outboard motor in salt water, or in muddy, turbid (cloudy), or acidic water, flush the engine using clean water after each use.

Maintenance interval chart 1

The "●" symbol indicates the check-ups which the owners or operators may carry out themselves.
The "○" symbol indicates work to be carried out by a HiDea dealer.

Item	Actions	Initial	Every		
		20 hours (3 months)	100 hours (1 year)	300 hours (3 years)	500 hours (5 years)
Anode(s) (external)	Inspection or replace-ment as necessary		●/○		
Anode(s) (cylinder head)	Inspection or replace-ment as necessary		○		
Anodes (cylinder block, cooling water passage, exhaust joint, exhaust manifold, exhaust guide)	Replacement				○
Battery (electrolyte level, terminal)	Inspection	●/○	●/○		
Battery (electrolyte level, terminal)	Fill, charging or replac-ing as necessary		○		
Cooling water leakage	Inspection or replace-ment as necessary	○	○		
Cowling lock lever	Inspection		●/○		

Item	Actions	Initial	Every		
		20 hours (3 months)	100 hours (1 year)	300 hours (3 years)	500 hours (5 years)
Engine starting condition/noise	Inspection	●/○	●/○		
Engine idle speed/noise	Inspection	●/○	●/○		
Engine oil	Replacement	●/○	●/○		
Engine oil filter (cartridge)	Replacement		●/○		
Fuel filter (can be disassembled)	Inspection or replacement as necessary	●/○	●/○		
Fuel line (High pressure)	Inspection	●	●		
Fuel line (High pressure)	Inspection or replacement as necessary	○	○		
Fuel line (Low pressure)	Inspection	●	●		
Fuel line (Low pressure)	Inspection or replacement as necessary	○	○		
Fuel pump	Inspection or replacement as necessary			○	
Fuel/engine oil leakage	Inspection	○	○		
Gear oil	Replacement	●/○	●/○		
Greasing points	Greasing	●/○	●/○		
Clamp bracket bolt (through tube)	Inspection and greasing		○		
Impeller/water pump housing	Inspection or replacement as necessary		○		
Impeller/water pump housing	Replacement			○	
Power trim and tilt unit	Inspection	●/○	●/○		
Propeller/propeller nut/cotter pin	Inspection or replacement as necessary	●/○	●/○		
PCV (Pressure Control Valve)	Inspection or replacement as necessary		○		
Shift link/shift cable	Inspection, adjustment or replacement as neeessary	○	○		
Spark plug(s)	Inspection or replacement as necessary		●/○		
Spark plug caps/spark plug wires	Inspection or replacement as necessary	○	○		
Water from the cooling water pilot hole	Inspection	●/○	●/○		

Item	Actions	Initial	Every		
		20 hours (3 months)	100 hours (1 year)	300 hours (3 years)	500 hours (5 years)
Throttle link/throttle cable	Inspection, adjustment or replacement as nee-essary	○	○		
Thermostat	Inspection or replace-ment as necessary		○		
Timing belt	Inspection or replace-ment as necessary		○		
Valve clearance	Inspection and adjust-ment				○
Cooling water inlet	Inspection	●/○	●/○		
Main switch/stop switch	Inspection or replace-ment as necessary	○	○		
Wire harness connec-tions/wire coupler con-nections	Inspection or replace-ment as necessary	○	○		
(HiDea) Meter/gauge	Inspection	○	○		

Maintenance interval chart 2

Item	Actions	Every
		1000 hours
Exhaust guide/exhaust manifold	Inspection or replace-ment as necessary	○
Timing belt	Replacement	○

Predelivery check

To make the delivery process smooth and efficient, complete the predelivery checks as explained in the following procedures.

Checking the engine oil level

NOTICE

Make sure that the engine is filled with engine oil before operating the outboard motor for the first time. Otherwise, the engine could be damaged severely.

TIP:

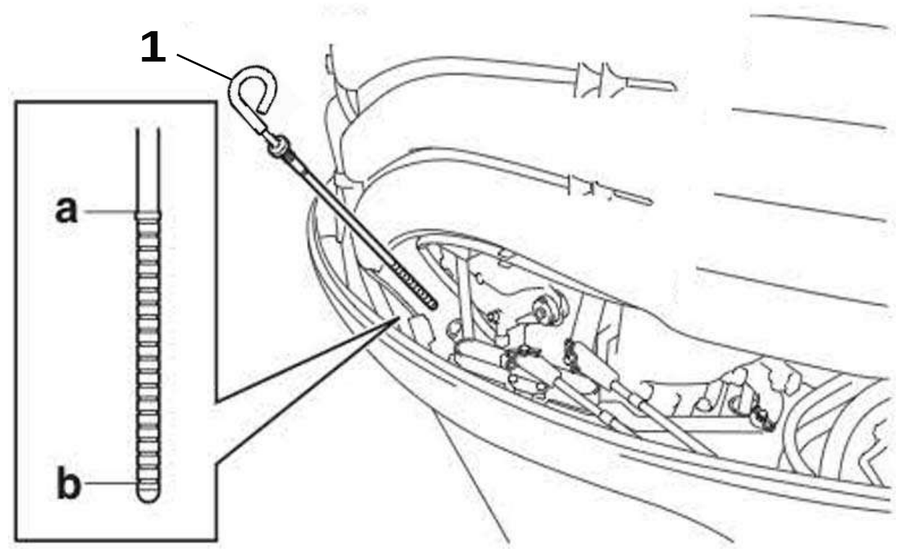
The outboard motor is shipped from the factory without engine oil.

1. Place the outboard motor in an upright position.

NOTICE

If the outboard motor is not level, the oil level indicated on the dipstick may not be correct.

2. Start the engine and warm it up for 5—10 minutes.
3. Stop the engine and leave it off for 5—10 minutes.
4. Remove the top cowling.
5. Remove the dipstick "1" and wipe it clean.
6. Insert the dipstick "1" completely for a correct measurement and remove it again.
7. Check that the oil level indicated on the dipstick "1" is between the upper mark "a" and the lower mark "b". If the engine oil is not at the proper level, add or extract engine oil.



Checking the battery

⚠ 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):

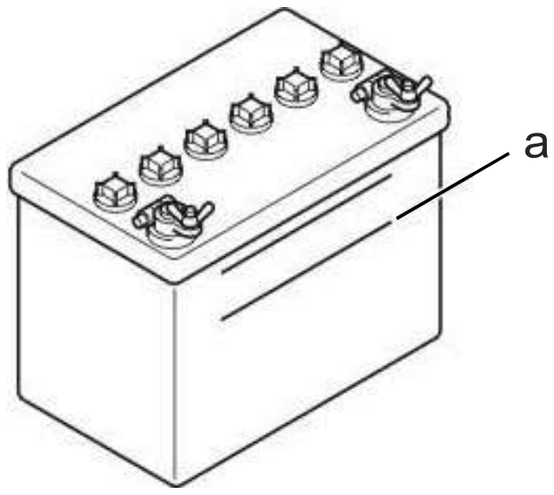
- **Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medicalattention.**

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 (for example, welding equipment and lighted cigarettes).**
- **DO NOT SMOKE when charging or handling batteries.**

KEEP BATIERIES AND ELECTROLYTE OUT OF REACH OF CHILDREn.

1. Check the battery electrolyte level. If the level is at or below the minimum level mark "a", add distilled water until the level is between the maximum and minimum level marks.



2. Check the specific gravity of the electrolyte. Fully charge the battery if below specification.

TIP:

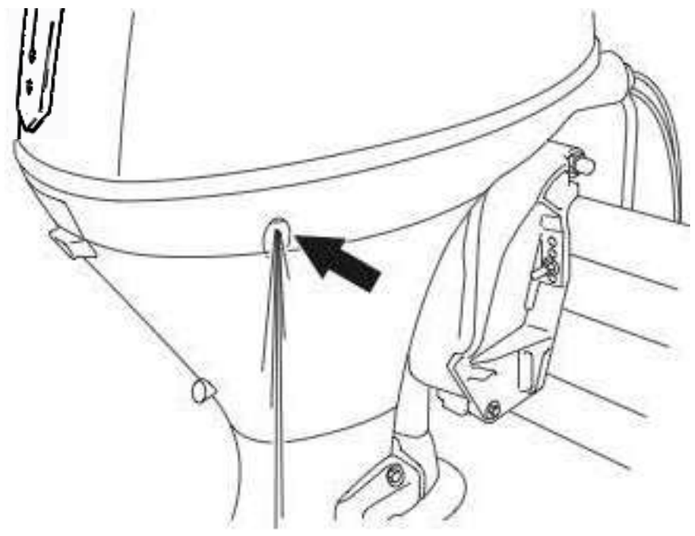
- Batteries vary depending on the manufacturer. The procedures mentioned in this manual may not always apply. Therefore, see the instruction manual of the battery.
- Disconnect the negative battery cable first, and then disconnect the positive battery cable.

Representative examples
Recommended battery capacity
Cold cranking amps (CCA/SAE)
380–1150 A
Marine cranking amps (MCA/ABYC)
502–1370 A
Min. reserve capacity (RC/SAE)
124 minutes
Cold cranking amps (CCA/EN)
430–1080 A
Min. rated capacity (20HR/IEC)
70 Ah
Electrolyte specific gravity
1.280 at 20 °C (68 °F)

Checking the cooling water pilot hole

1. Place the lower unit in water, and then start the engine.

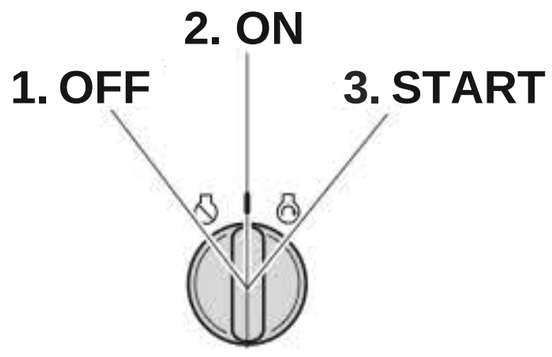
2. Check that cooling water is discharged from the cooling water pilot hole. If there is no water flow, check the cooling water passages for clog. See "Cooling diagram" (2-25).



Checking the main switch/stop switch

1. Check that the engine starts when the engine start switch is turned to START. Check the engine start switch if the engine does not start. See "Checking the engine start switch" (5-32).

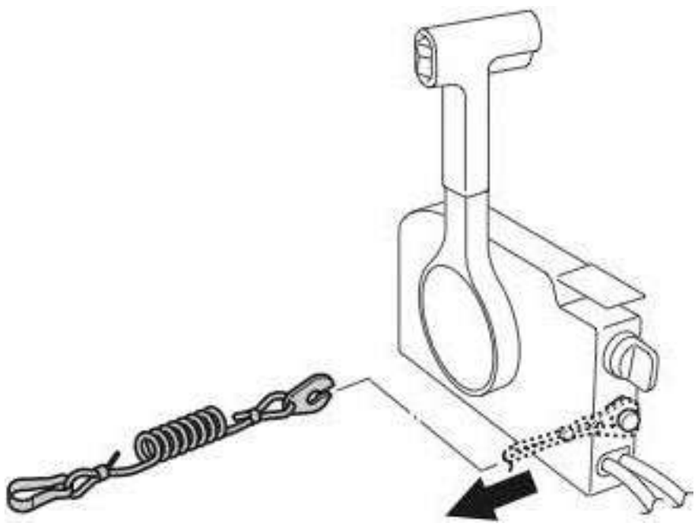
2. Check that the engine stops when the engine start switch is turned to OFF. Check the engine start switch if the engine does not stop. See "Checking the engine start switch" (5-32).



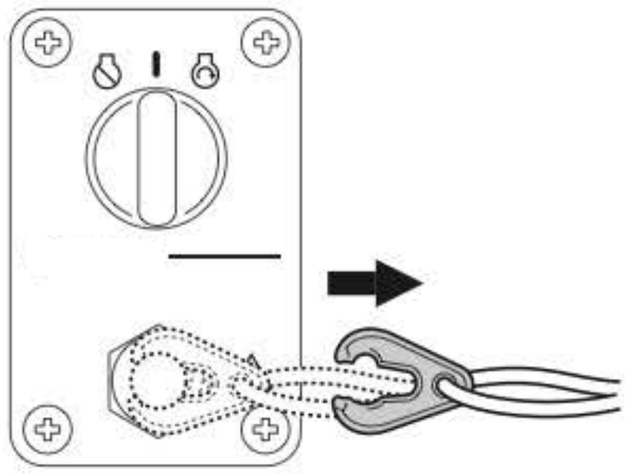
1. OFF
2. ON
3. START

3. Check that the engine stops when the clip is removed from the engine shut-off switch or the engine shut-off switch is pushed. Check the engine shut-off switch if the engine does not stop. See "Checking the engine shut-off switch" (5-31).

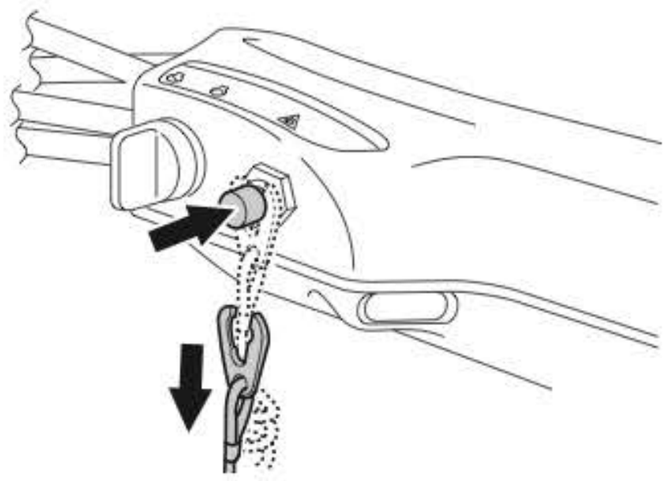
A



B



C



A. 703 side mount remote control model
B. 704 binnacle mount remote control model
C. Tiller handle model

Checking the fuel line

1. Check that the fuel hoses are connected securely. See "Fuel hose" (2-33).

NOTICE

This outboard motor is equipped with a 4-stroke engine. Never use premixed fuel or 2-stroke outboard motor oil.

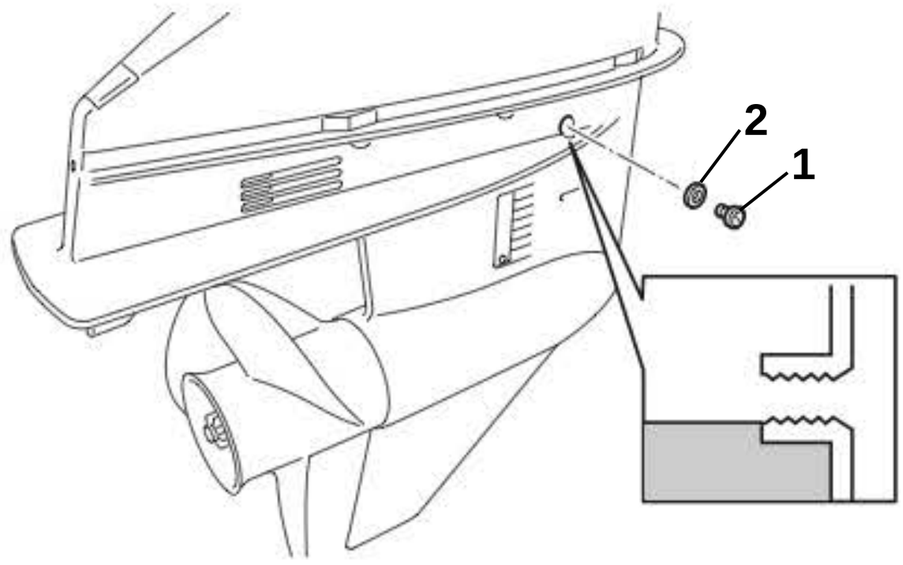
Checking the gear oil level

1. Place the outboard motor in an upright position.

2. Remove the oil level plug "1" and gasket "2", and then check the gear oil level. If the gear oil is below the proper level, add the recommended gear oil.

TIP:

If the oil is at the proper level, a small amount of oil should flow out of the check hole.



3. Install a new gasket and the oil level plug, and then tighten the oil level plug to the specified torque.

Oil level plug
9 Nm (0.9 kgf·m, 6.6 ft·lb)

Checking the gear shift and throttle operation (remote control model)

⚠ WARNING

Do not overtighten the friction adjuster. If there is too much resistance, it could be difficult to operate the remote control lever, which could result in an accident.

1. Check that the gear shift operates smoothly when the remote control lever is moved from the N position to the F or R position. Adjust the shift cable joints or check the related parts if the shift operation is not smooth. See "Installing the shift cable" (3-9).

2. Check that the throttle operates smoothly when the remote control lever is moved repeatedly from the F or R position to the fully open or fully closed position. Adjust the throttle cable joints or check the related parts if the throttle operation is not smooth. See "Installing the throttle cable" (3-10).

Checking the gear shift and throttle operation (tiller handle model)

⚠ WARNING

Do not overtighten the friction adjuster. If there is too much resistance, it could be difficult to operate the throttle grip, which could result in an accident.

1. Check that the gear shift operates smoothly when the shift lever is moved from the N position to the F or R position. Adjust the shift cable joint or check the related parts if the shift operation is not smooth. See "Installing the shift cable" (3-9).

TIP:

The shift lever can be operated only when the throttle grip is in the fully closed position.

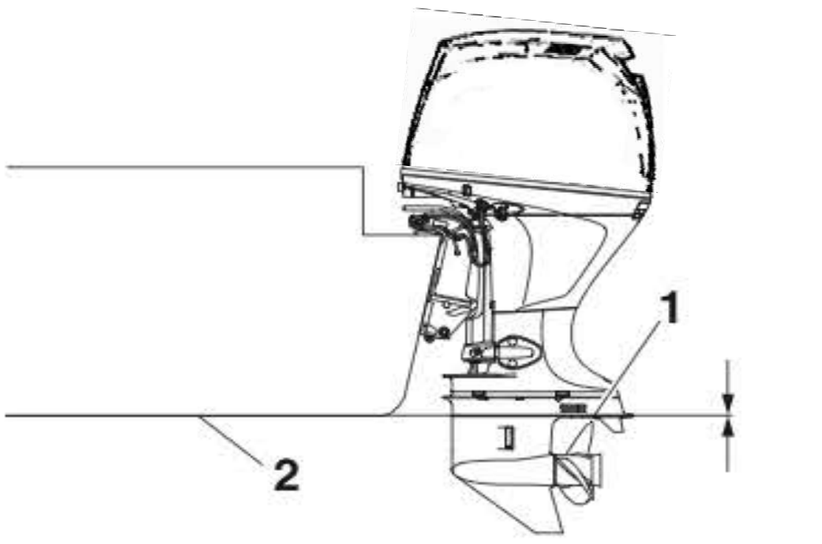
2. Check that the throttle operates smoothly when the throttle grip is moved from the fully closed position to the fully open position. Adjust the throttle cable joint or check the related parts if the throttle operation is not smooth. See "Installing the thrattle cable" (3-10).

Checking the outboard motor mounting height

1. Check that the anti-cavitation plate "1" is aligned with the bottom of the boat "2". If the mounting height is too high, cavitation will occur and propulsion will decrease. Besides, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase, which will decrease engine efficiency and performance.

TIP:

The appropriate mounting height depends on the combination of the boat and outboard motor. To determine the appropriate mounting height, test run the outboard motor at different heights.



2. Check that the clamp brackets are secured using the clamp bolts.

Checking the power trim and tilt unit

1. Check the power trim and tilt unit operation. See "Checking the power trim and tilt unit operation" (10-17).

2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down. Check the PTT if any abnormal noise is heard.

3. Check that there is no interference with cables, hoses, leads, or the boat when the tilted-up outboard motor is steered.

4. Check that the trim meter points down when the outboard motor is fully tilted down. Adjust the trim sensor cam if the trim meter does not point down. See "Adjusting the trim sensor cam" (9-41).

Checking the steering system

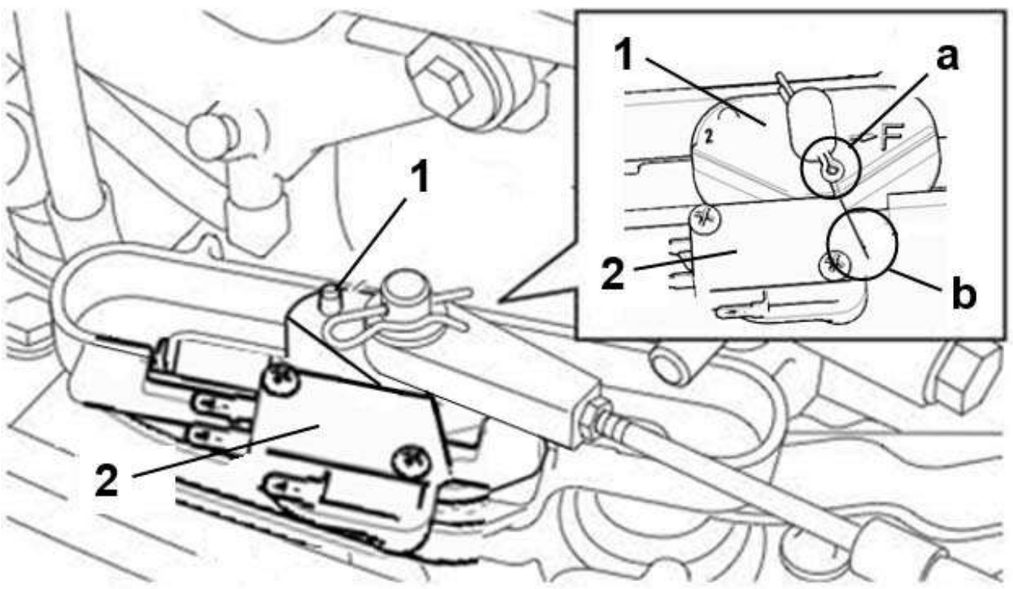
1. Check that the steering operates smoothly.

2. Check that there is no interference with cables, hoses, or lead when the outboard motor is steered.

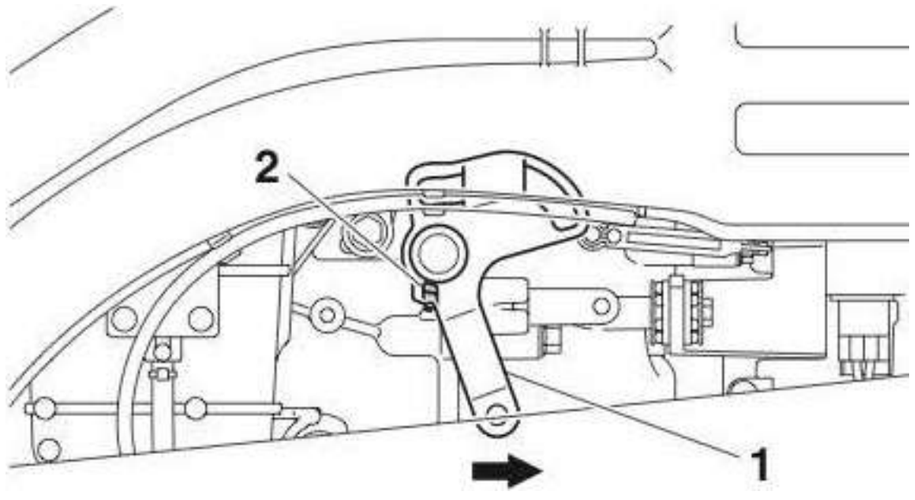
Checking the throttle cable and shift cable (remote control model)

1. Move the remote control lever to the N position.

2. Check that the mark "a" on the bushing "1" and the mark "b" on the plate "2" are aligned. Adjust the shift cable joints or check the related parts if the marks are not aligned. See "Installing the shift cable" (3-9).



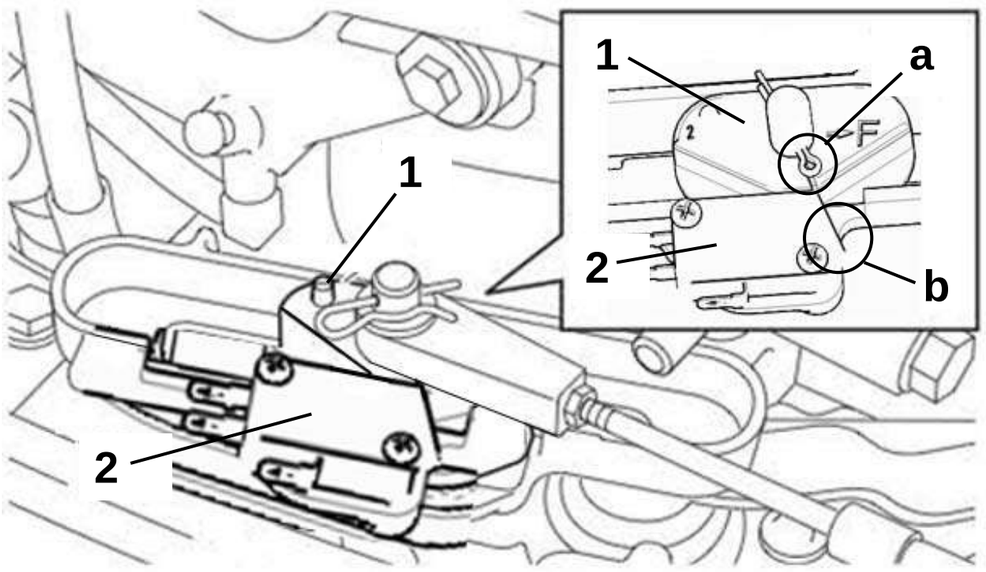
3. Check that the accelerator cam "1" contacts the cylinder block "2". Adjust the throttle cable joints or throttle link, or check the related parts if the accelerator cam does not contact the cylinder block. See "Installing the throttle cable" (3-10) or "Adjusting the throttle link" (6-23).



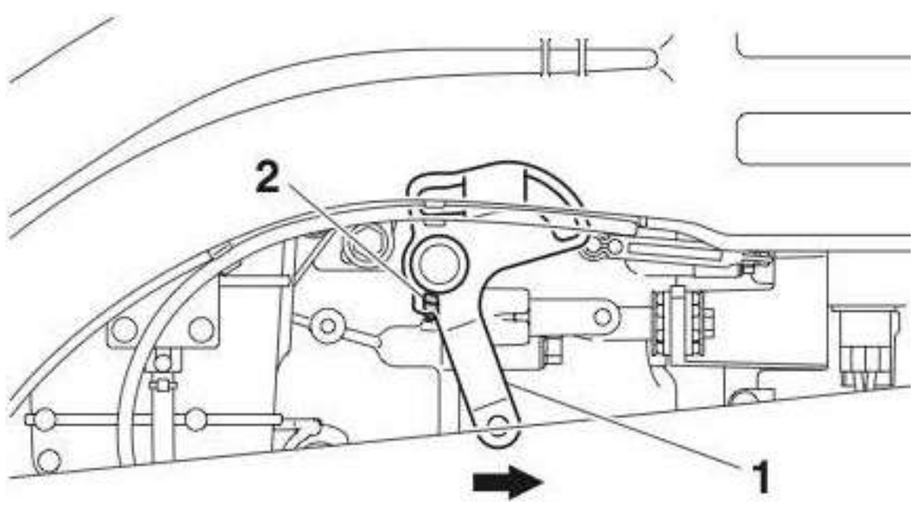
Checking the throttle cable and shift cable (tiller handle model)

1. Move the shift lever to the N position and turn the throttle grip to the fully closed position.

2. Check that the mark "a" on the bushing "1" and the mark "b" on the plate "2" are aligned. Adjust the shift cable joint or check the related parts if the marks are not aligned. See "Installing the shift cable" (3-9).



3. Check that the accelerator cam "1" contacts the cylinder block "2". Adjust the throttle cable joint or throttle link, or check the related parts if the accelerator cam does not contact the cylinder block. See "Installing the throttle cable" (3-10) or "Adjusting the throttle link" (6-23).



Test run

1. Start the engine, and then check that the gear shift operates smoothly.

2. Warm up the engine, and then check the engine idle speed. See "Checking the engine idle speed/noise" (10-10).

3. Operate the boat at trolling speed.

4. Operate the outboard motor according to the break-in procedure.

5. Check that the outboard motor does not tilt up when reverse operation.

6. Check that the power trim operates smoothly while cruising. Check the PTT if the power trim operation is not smooth.

Break-in

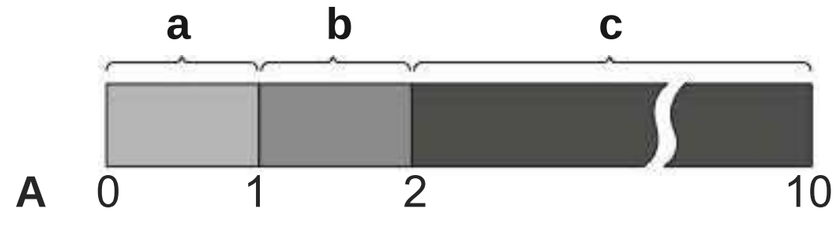
Operate the engine under load (in gear with a propeller installed) for 10 hours as follows:

1. For the first hour "a" of operation:
   Operate the engine at varying speeds up to 2000 r/min or approximately 1/2 throttle.

2. For the second hour "b" of operation:
   Increase the engine speed until the boat is on plane (but do not fully open the throttle), and then back off on the throttle while keeping the boat at a planning speed.

3. For the remaining 8 hours "c" of operation:
   Operate the engine at any engine speed. However, do not operate the engine at full throttle for more than 5 minutes at a time.

4. After the first 10 hours of operation:
   Operate the engine normally.



A. Hour

After test run

1. Check for water in the gear oil. Check the lower case for airtightness and oil seal damage if the oil is milky. See "Checking the lower unit for air leakage" (8-29).

2. Check all the fuel lines for leakage. See "Fuel hose" (2-33).

3. Flush the cooling water passages using fresh water.

NOTICE

When flushing the cooling water passages, do not start the engine. Otherwise, the water pump could be damaged and the engine could be severely damaged due to overheating.

TIP:

When using the flushing device (flushing hose joint adapter), flush the cooling water passages without starting the engine.

General periodic maintenance

Checking the anode

NOTICE

Do not apply grease, oil, or paint to the anodes or the trim tab.

1. Check the anodes and trim tab. See "Checking the exhaust joint anode" (7-57), "Checking the crankcase cover anode" (7-62), "Checking the cylinder head anode" (7-74), "Checking the cylinder block anode" (7-81), "Checking the lower unit anode" (8-4), "Checking the exhaust guide anode" (9-30), and "Checking the clamp bracket anode" (9-38).

TIP:

Replace the anodes or trim tab if eroded. Also, check the ground lead.

Checking the battery

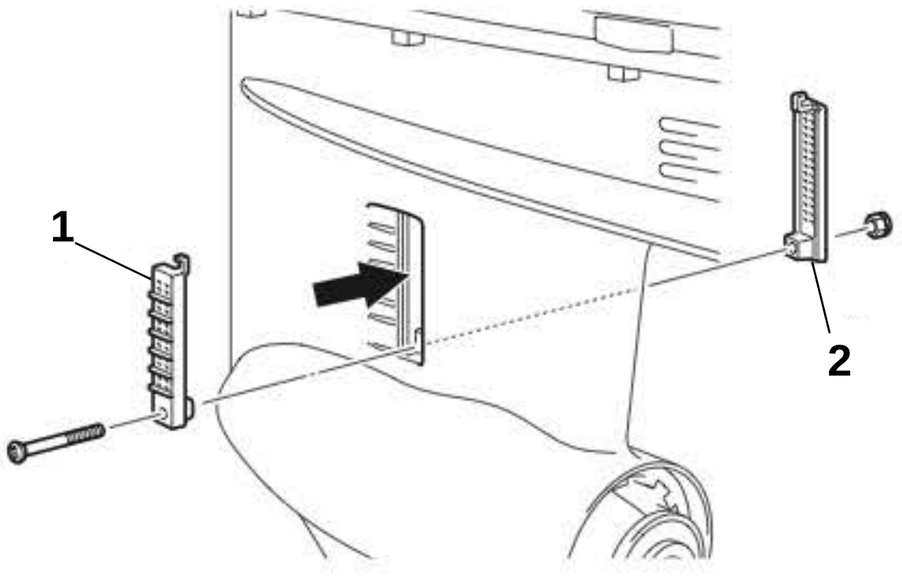
1. Check the battery. See "Checking the battery" (10-4).

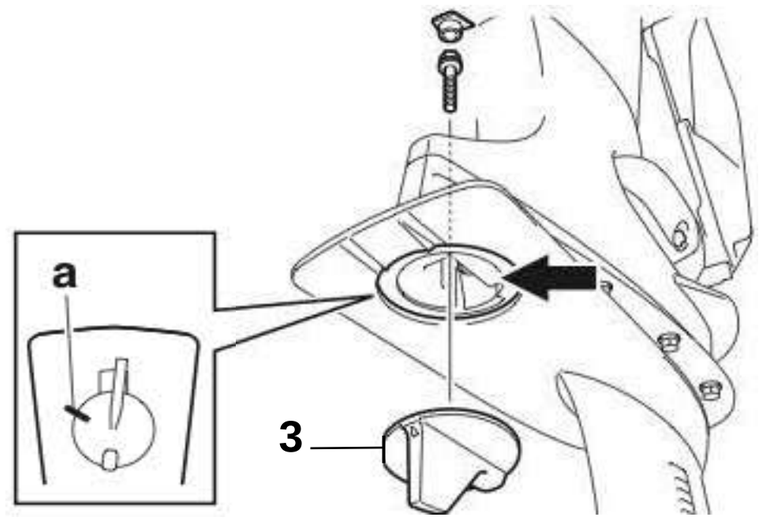
Checking the cooling water inlet

1. Remove the water inlet covers "1" and "2".

2. Mark the trim tab "3" with an identification mark "a", and then remove the trim tab "3".

3. Check the water inlet covers and water inlets. Clean if clogged.





4. Install the water inlet covers and trim tab, and then tighten the water inlet cover screw and trim tab bolt to the specified torque.

TIP:

After installing the water inlet covers, make sure that there is no rattling.

Water inlet cover screw
1 Nm (0.1 kgf·m, 0.7 ft·lb)
Trim tab bolt
42 Nm (4.2 kgf·m, 31.0 ft·lb)

Checking the cooling water pilot hole

1. Check that cooling water is discharged from the cooling water pilot hole. See "Checking the cooling water pilot hole" (10-5).

Checking the engine idle speed/ noise

1. Start the engine and warm it up for 5-10 minutes.

2. Check the engine idle speed using the HiDea genuine tachometer (on-board meter) or the HDIS. See the HDIS (Ver. 2.12 or later) instruction manual. Perform the troubleshooting procedures if out of specification. See "Troubleshooting procedure" (4-7).

Idle speed (in neutral)
700-800 r/min

Changing the engine oil using an oil changer

NOTICE

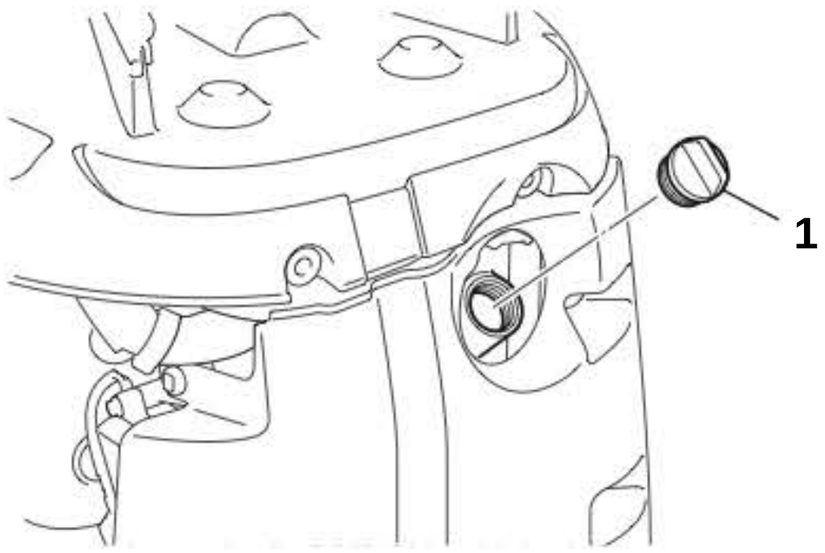
Change the engine oil after the first 20 hours of operation or 3 months, and every 100 hours or at 1-year intervals thereafter.

1. Place the outboard motor in an upright position.

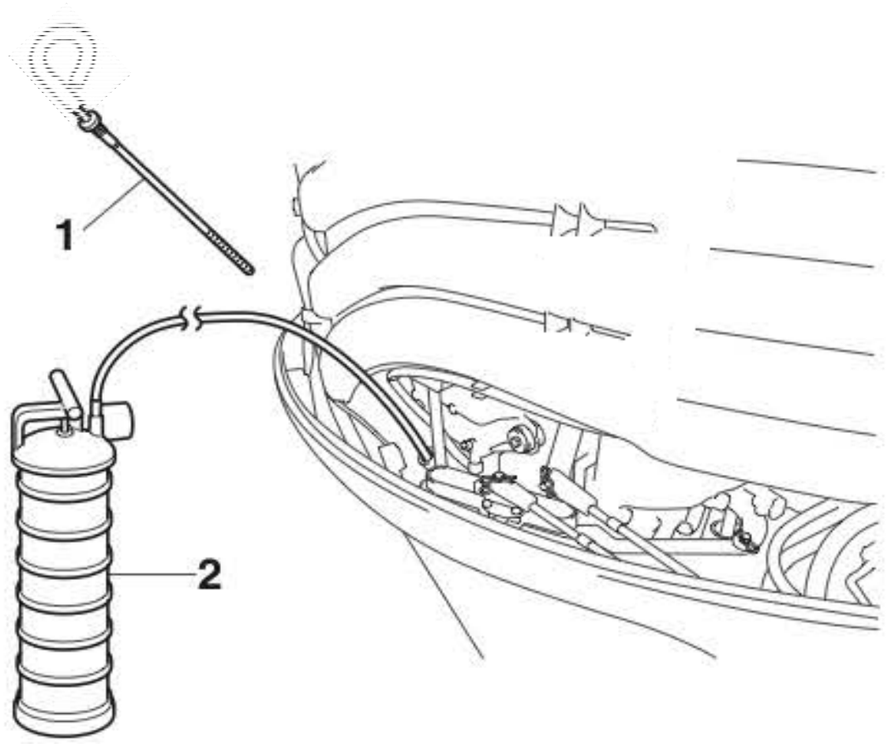
NOTICE

If the outboard motor is not level, the oil level indicated on the dipstick may not be correct.

2. Start the engine and warm it up for 5- 10 minutes.
3. Stop the engine and leave it off for 5- 10 minutes.
4. Remove the top cowling.
5. Remove the oil filler cap “1”.



6. Remove the dipstick "1" and extract the engine oil using the oil changer "2".



7. Fill the engine with the specified amount of the recommended engine oil through the oil filler hole. Install the oil filler cap and dipstick.

NOTICE

Do not overfill the engine with engine oil. Otherwise, the engine could be damaged or oil could leak. If the engine oil is above the upper level, extract the excess engine oil until the oil is at the proper level.

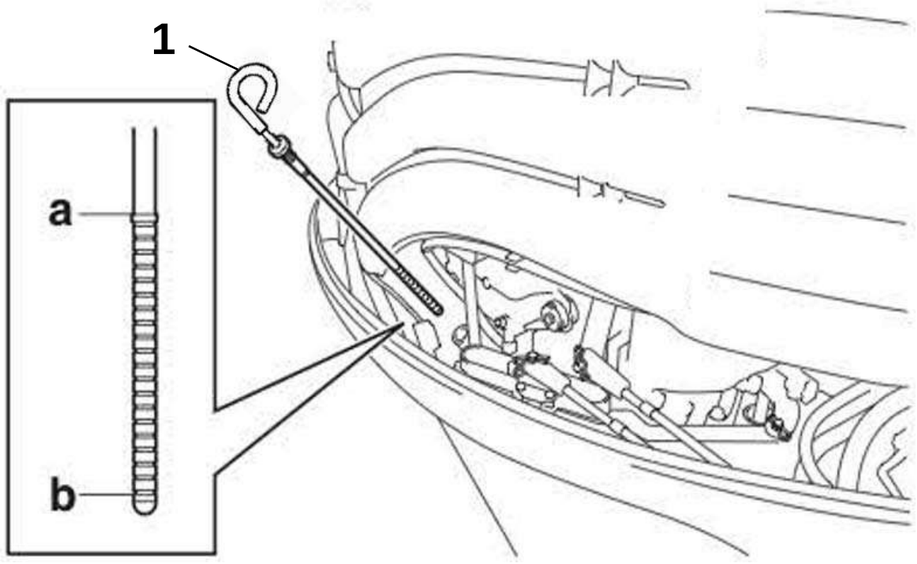
Engine oil quantity (without oil filter replacement)
3.0 L (3.17 US qt, 2.64 Imp.qt)

8. Leave the outboard motor off for 5-10 minutes.

9. Remove the dipstick "1" and wrpe it clean.

10. Insert the dipstick "1" completely for a correct measurement and remove it again.

11. Check that the oil level indicated on the dipstick "1" is between the upper mark "a" and the lower mark "b".



12. Start the engine and check that the oil pressure alert indicator does not come on. Also, check that there is no oil leakage.

NOTICE

If the oil pressure alert indicator comes on or if there is oil leakage, stop the engine and find the cause. Continued operation with a problem could cause severe engine damage.

Changing the engine oil by removing the drain bolt

NOTICE

Change the engine oil after the first 20 hours of operation or 3 months, and every 100 hours or at 1-year intervals thereafter.

1. Place the outboard motor in an upright position.

NOTICE

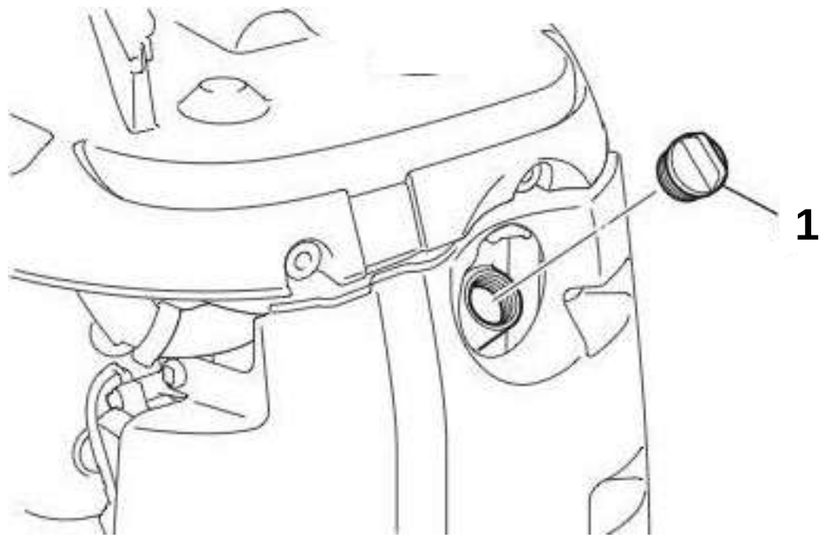
If the outboard motor is not level, the oil level indicated on the dipstick may not be correct.

2. Start the engine and warm it up for 5-10 minutes.

3. Stop the engine and leave it off for 5-10 minutes.

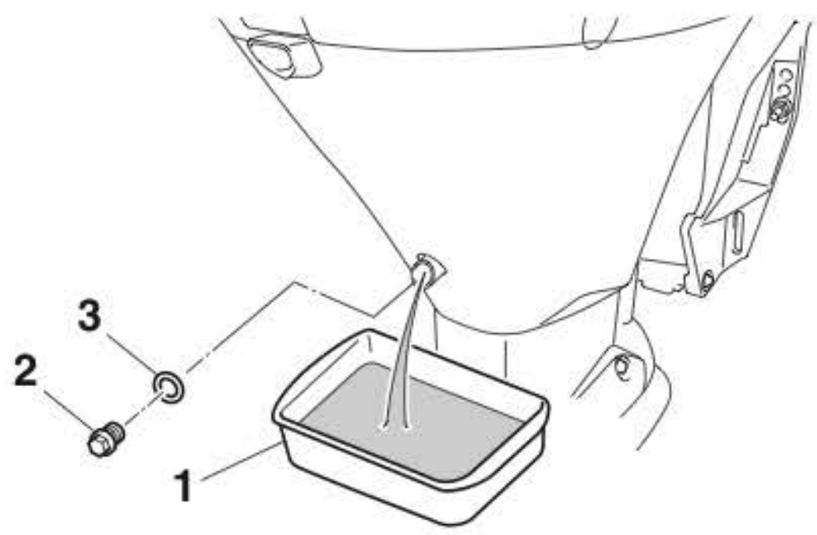
4. Remove the top cowling.

5. Remove the oil filler cap "1".

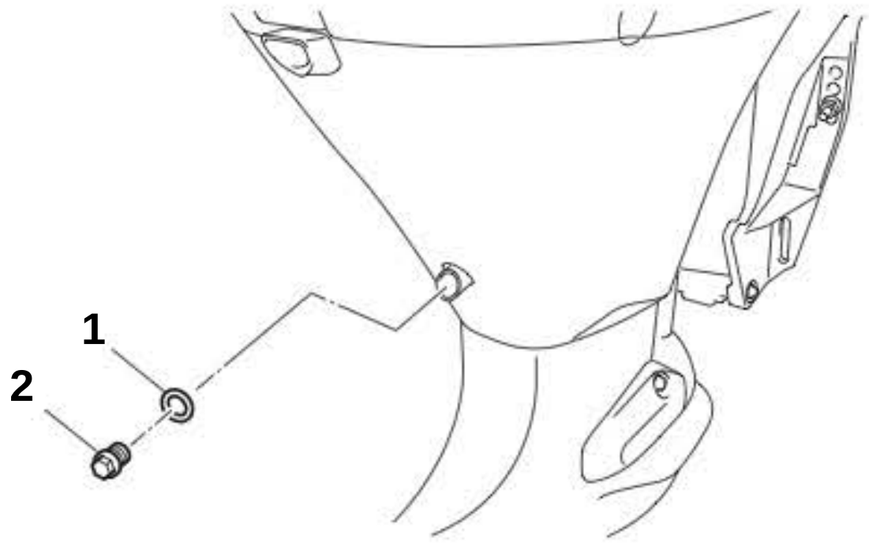


6. Place a drain pan "1" under the engine oil drain hole.

7. Remove the drain bolt "2" and gasket "3" and let the oil drain completely.



8. Install a new gasket "1" and the drain bolt "2", and then tighten the drain bolt "2" to the specified torque.



Drain bolt "2"
27 Nm (2.7 kgf·m, 19.9 ft·lb)

9. Fill the engine with the specified amount of the recommended engine oil through the oil filler hole. Install the oil filler cap.

NOTICE

Do not overfill the engine with engine oil. Otherwise, the engine could be damaged or oil could leak. If the engine oil is above the upper level, extract the excess engine oil until the oil is at the proper level.

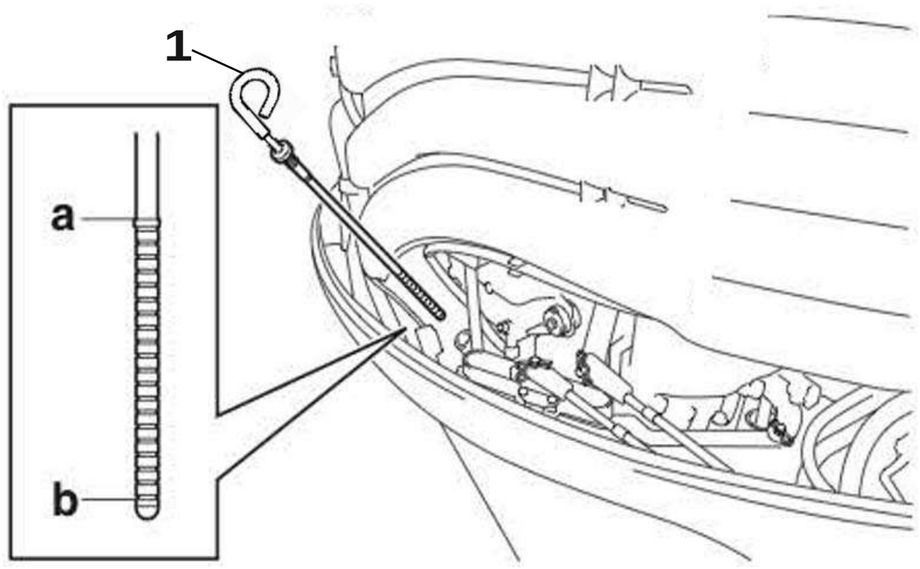
Engine oil quantity (without oil filter replacement) 3.0 L (3.17 US qt, 2.64 Imp.qt)

10. Leave the outboard motor off for 5–10 minutes.

11. Remove the dipstick "1" and wipe it clean.

12. Insert the dipstick "1" completely for a correct measurement and remove it agam.

13. Check that the oil level indicated on the dipstick "1" is between the upper mark "a" and the lower mark "b".



14. Start the engine and check that the oil pressure alert indicator does not come on. Also, check that there is no oil leakage.

NOTICE

If the oil pressure alert indicator comes on or if there is oil leakage, stop the engine and find the cause. Continued operation with a problem could cause severe engine damage.

Checking the engine oil level

1. Check the oil level. See "Checking the engine oil level" (10-4).

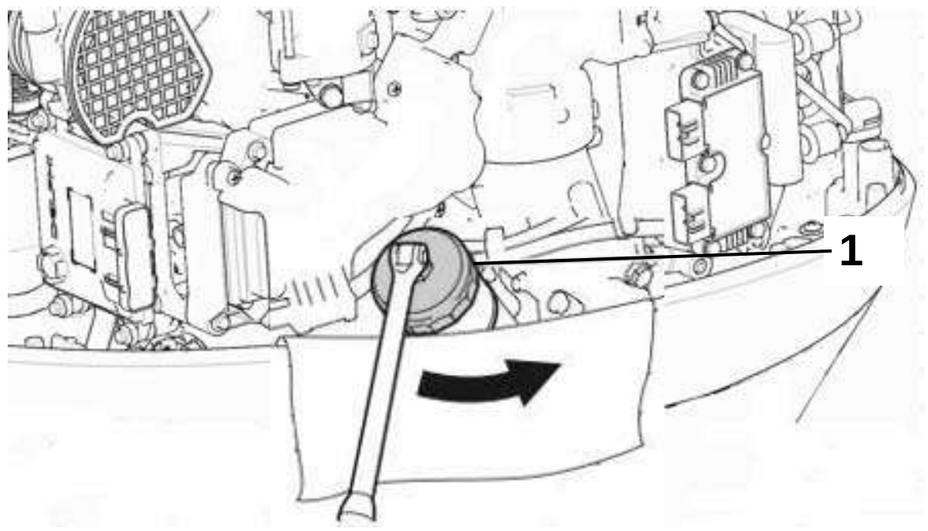
Replacing the oil filter

1. Extract the engine oil. See steps 1-6 in "Changing the engine oil using an oil changer" (10-11) or steps 1-8 in "Changing the engine oil by removing the drain bolt" (10-12).

2. Place a rag under the oil filter, and then remove the oil filter.

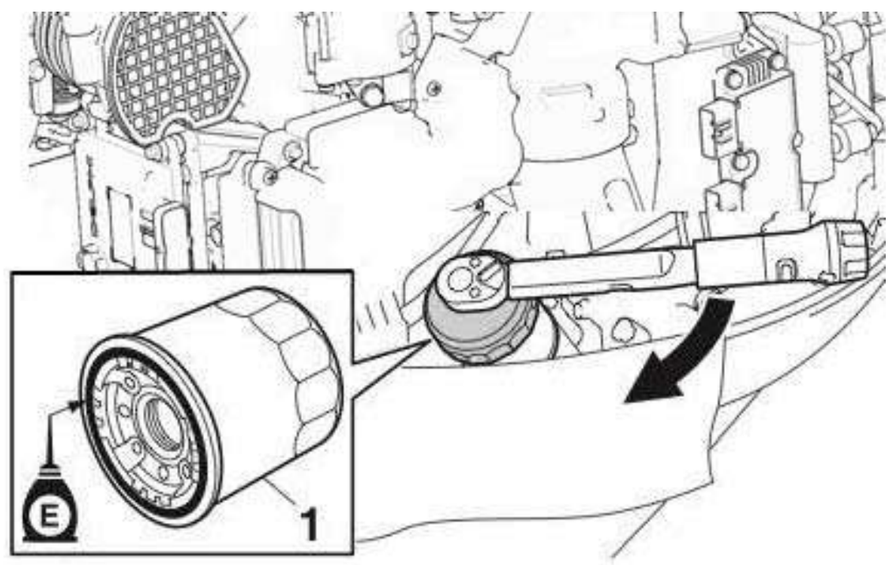
TIP:

Make sure to clean up any oil spills.



Oil filter wrench "1"
Oil filter wrench "1"

3. Install a new oil filter "1", and then tighten it to the specified torque.



Oil filter "1" 18 Nm (1.8 kgf·m, 13.3 ft·lb)

4. Fill the engine with the specified amount of the recommended engine oil through the oil filler hole.

Engine oil quantity (with oil filter replacement)
3.2 L (3.38 US qt, 2.82 Imp.qt)

5. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5-10 minutes.

6. Stop the engine, and then leave if off for 5-10 minutes.

7. Check the oil level.

Checking the exhaust guide/exhaust manifold

1. Check the exhaust guide and exhaust manifold. See "Checking the oil pan and exhaust guide" (9-30).

Checking the main switch/stop switch

1. Check the engine start switch and engine shut-off switch. See "Checking the main switch/stop switch" (10-5).

Checking the fuel filter

1. Check the fuel filter. See "Checking the fuel filter assembly" (6-6), "Checking the fuel filter element" (6-7), and "Checking the fuel cup assembly" (6-7).

Checking the fuel pump

1. Check the fuel pump. See "Checking the high-pressure fuel pump" (5-24).

Checking for fuel/engine oil leakage

1. Check the fuel joint and fuel hose connections. See "Fuel hose" (2-33).

2. Check for oil leakage.

Changing the gear oil

⚠ WARNING

Never get under the lower unit while it is tilted.

1. Tilt the outboard motor so that the drain screw is at the lowest point.

2. Place a drain pan "1" under the gear oil drain hole.

3. Remove the drain screw "2" and gasket "3".

NOTICE

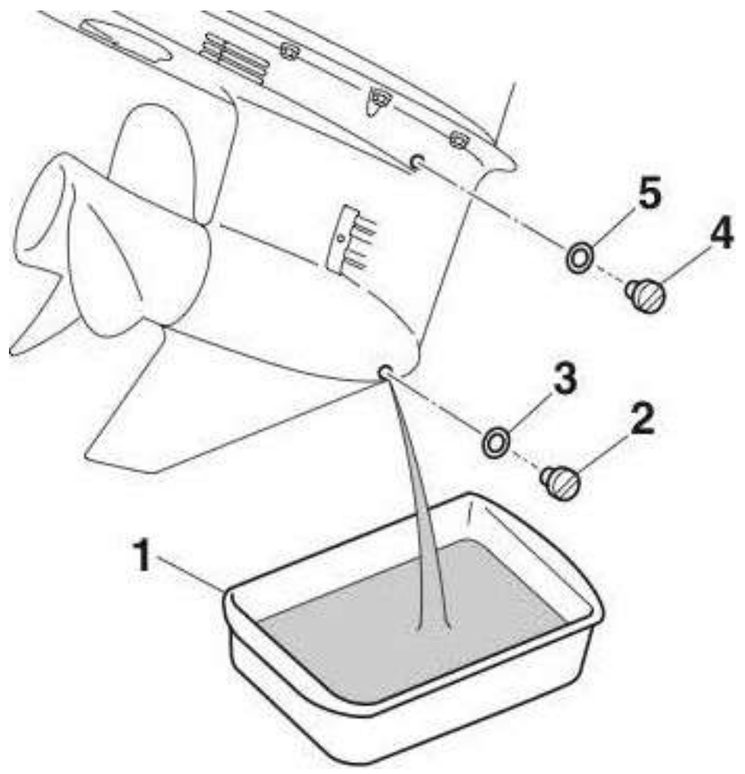
If there is a significant amount of metal particles on the magnetic drain screw, the lower unit may have a problem.

4. Remove the oil level plug "4" and gasket "5" and let the oil drain completely.

5. After the gear oil has been drained, check the used oil. Check the lower case for airtightness and oil seal damage if the oil is milky. See "Checking the lower unit for air leakage" (8-29).

NOTICE

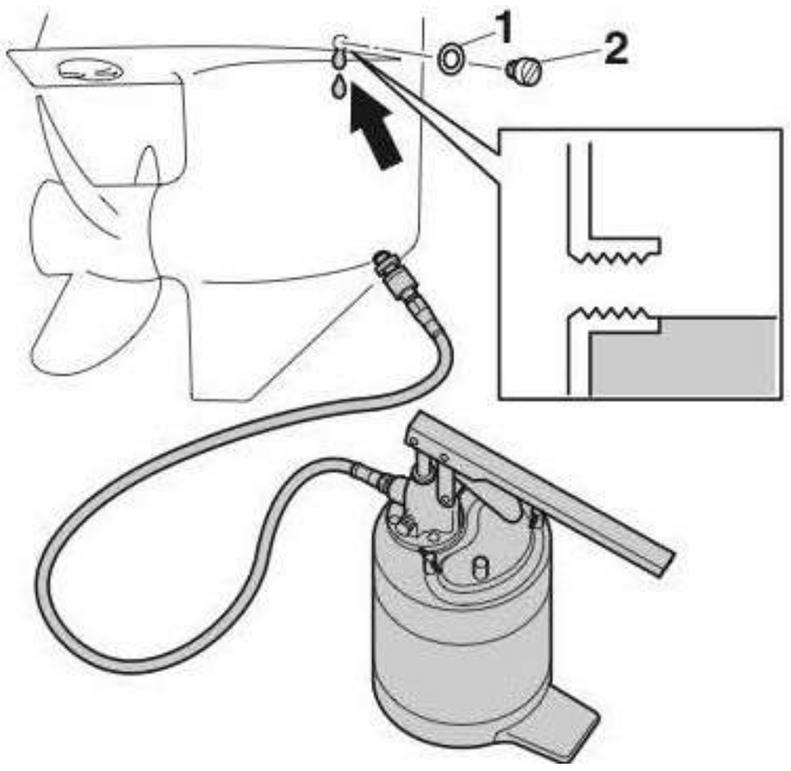
If the oil is milky, water is getting into the lower case, which can cause gear damage.



6. Place the outboard motor in an upright position.

7. Insert the gear oil pump into the drain hole, and then fill the lower unit slowly with gear oil until oil flows out of the check hole and no air bubbles are visible.

8. Install a new gasket "1" and the oil level plug "2".



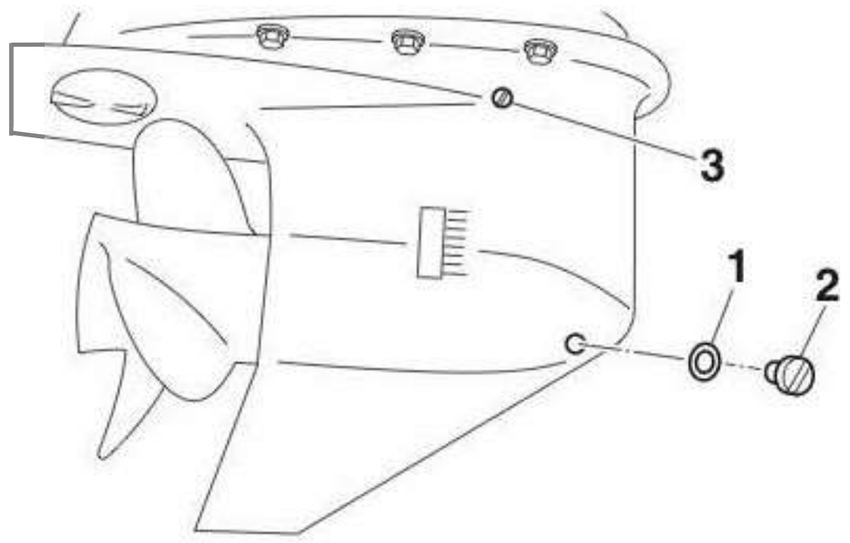
Gear oil quantity
Regular rotation model
0.760 L (0.803 US qt, 0.669 Imp.qt)
Counter rotation model
0.715 L (0.756 US qt, 0.629 Imp.qt)

9. Remove the gear oil pump, and then install a new gasket "1" and the drain screw "2".

TIP:

Before installing the magnetic drain screw, make sure to remove all metal particles.

10. Tighten the oil level plug "3" and drain screw "2" to the specified torque.



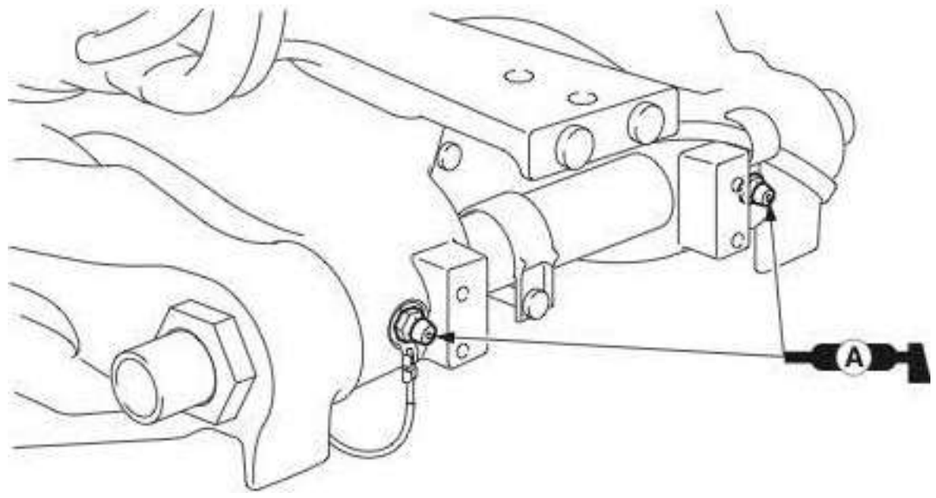
Drain screw "2"
9 Nm (0.9 kgf·m, 6.6 ft·lb)
Oil level plug "3"
9 Nm (0.9 kgf·m, 6.6 ft·lb)

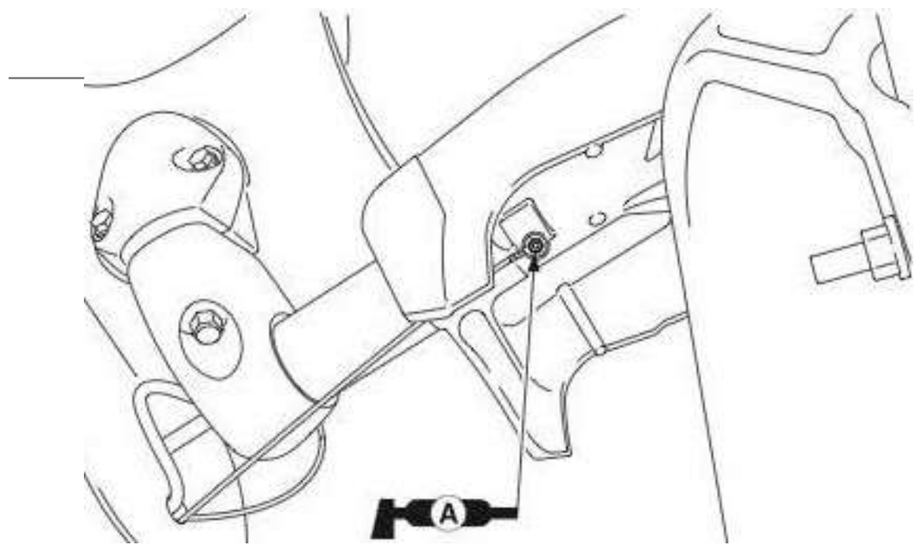
Checking the gear oil level

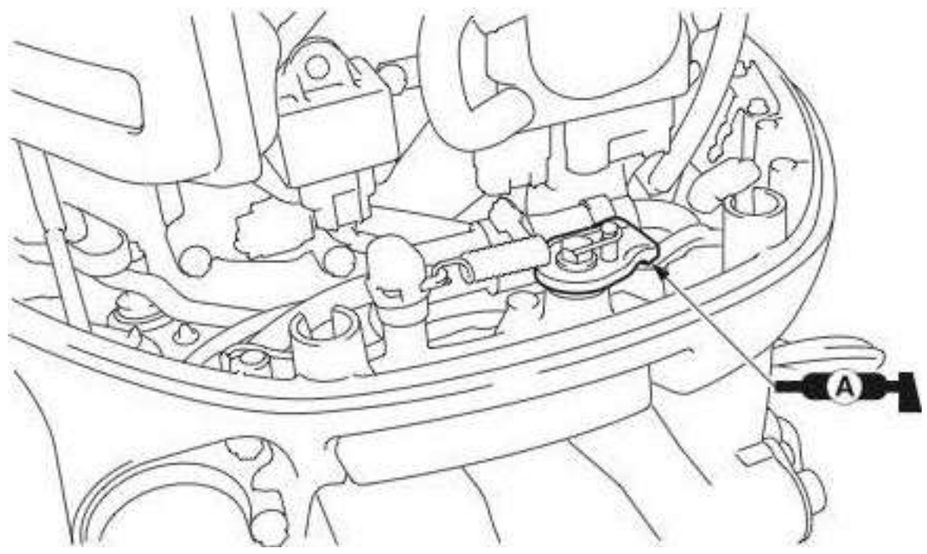
1. Check the gear oil level. See "Checking the gear oil level" (10-6).

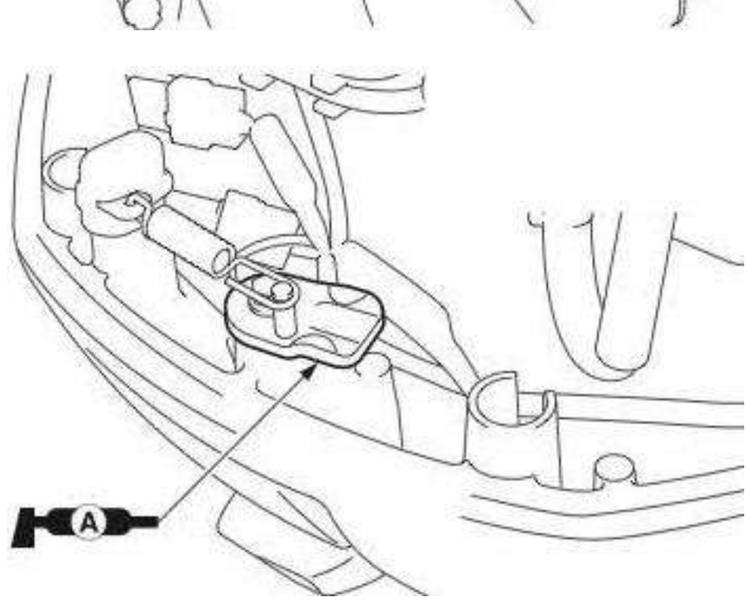
Greasing points

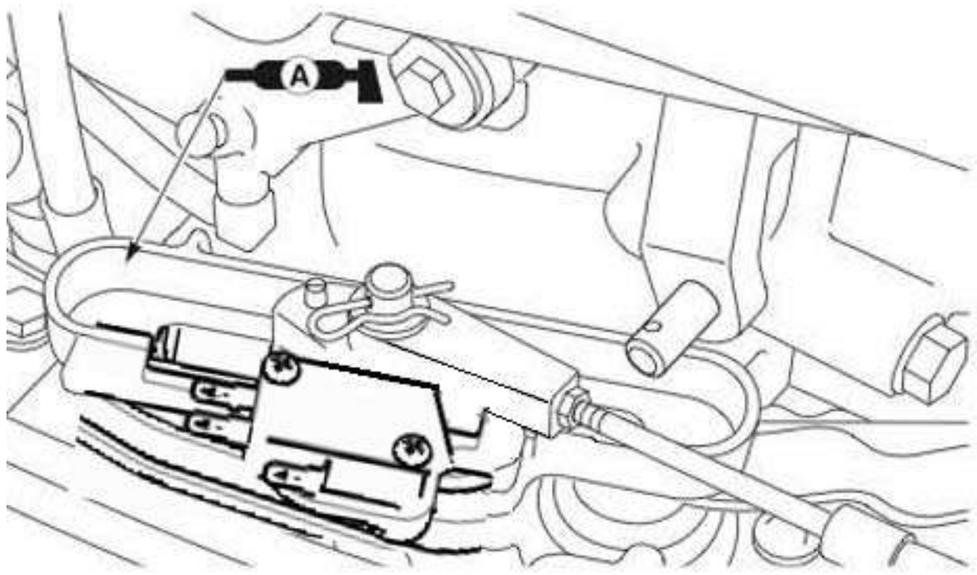
1. Apply water resistant grease to the specified lubrication points.

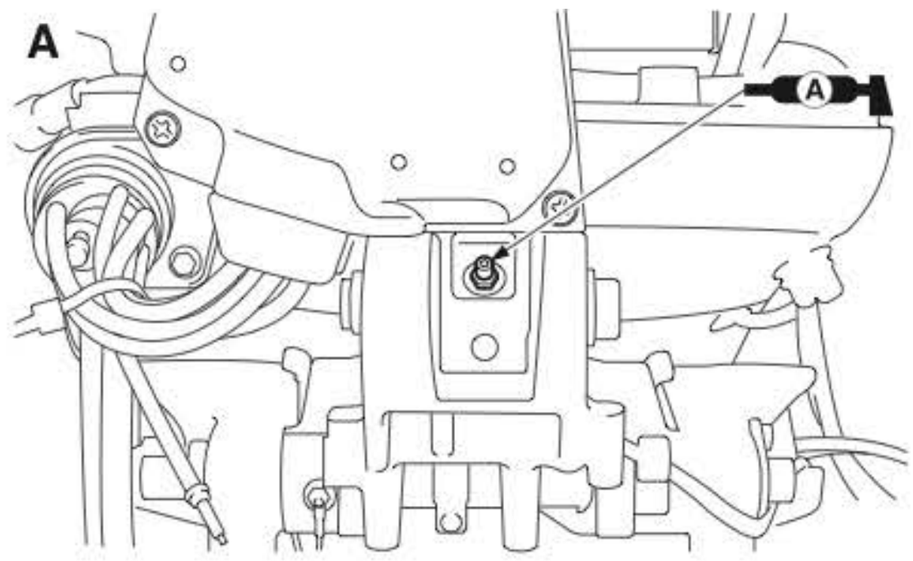






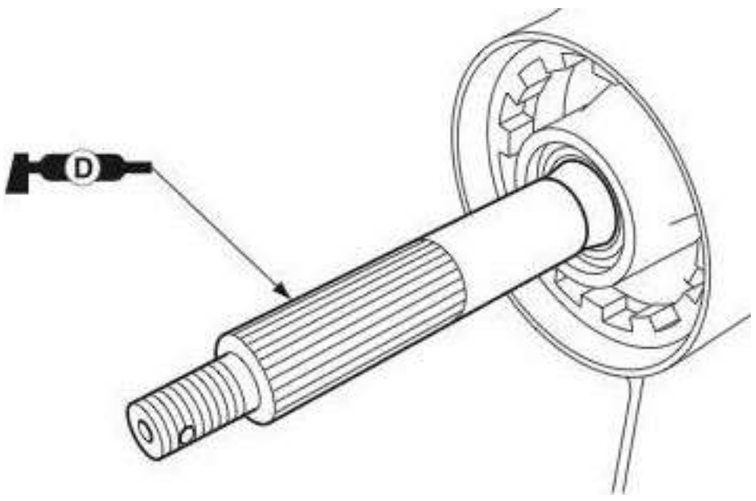






A. Tiller handle model

2. Apply corrosion resistant grease to the specified lubrication points.

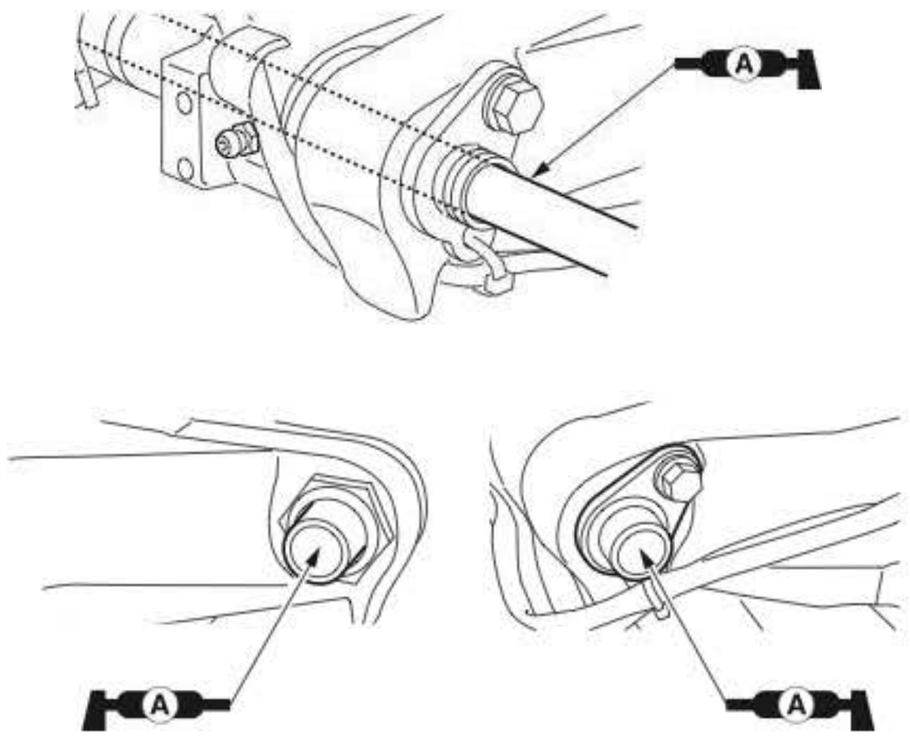


Greasing the clamp bracket bolt (through tube)

1. Remove the hydraulic steering cylinder or steering cable from the through tube.

2. Clean inside of the through tube and the hydraulic steering cylinder rod or steering cable.

3. Apply a sufficient amount of grease to the inside of the through tube and to the hydraulic steering cylinder rod or steering cable.



4. Assemble the hydraulic steering cylinder or steering cable to the through tube.

Checking the propeller/propeller nut/ cotter pin

1. Check the propeller. See "Checking the propeller" (8-4).

2. Check the propeller nut and cotter pin. See "Installing the lower unit" (8-30).

Checking the PCV

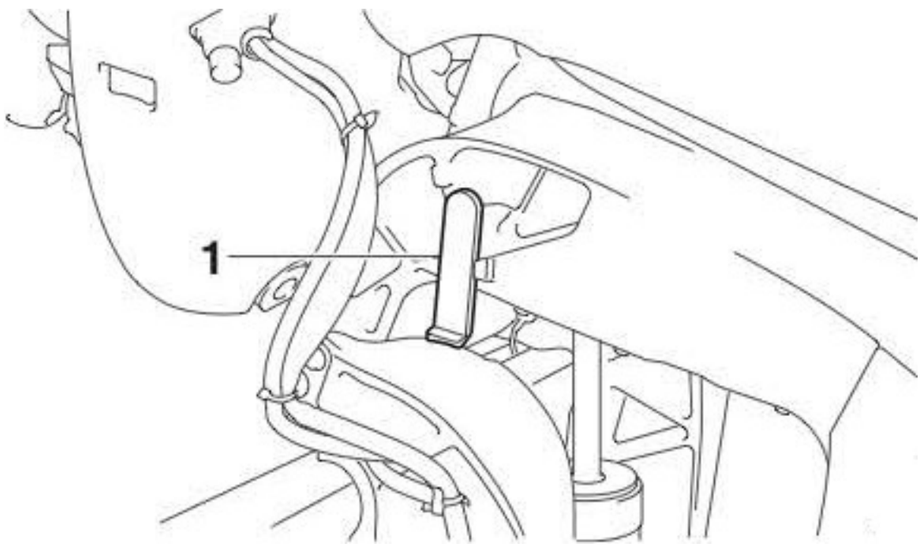
1. Check the PCV. See "Checking the PCV" (9-30).

Checking the PTT fluid level

⚠ WARNING

Never get under the outboard motor while it is tilted.

1. Fully tilt the outboard motor up, and then support it using the tilt stop lever "1".



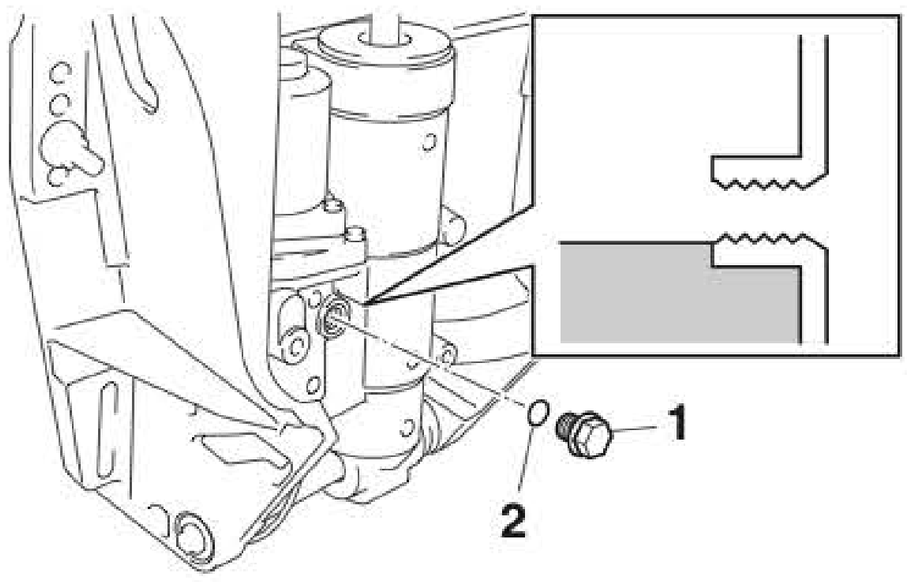
2. Remove the reservoir cap "1" and 0-ring "2", and then check the fluid level in the reservoir.

⚠ WARNING

Before removing the reservoir cap, make sure that the PTT ram is fully extended. Otherwise, fluid could be expelled forcefully from the unit due to internal pressure.

TIP:

If the fluid is at the proper level, a small amount of fluid should flow out of the filler hole when the reservoir cap is removed.



3. If the fluid is below the proper level, add the recommended fluid.

4. Install a new O-ring and the reservoir cap, and then tighten the reservoir cap to the specified torque.

Reservoir cap
7 Nm (0.7 kgf·m, 5.2 ft·lb)

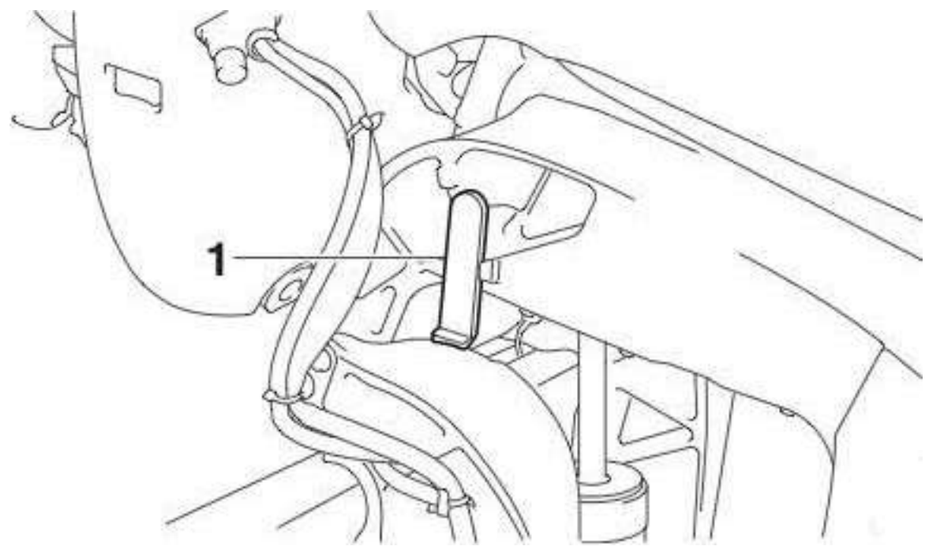
Checking the power trim and tilt unit operation

1. Fully tilt the outboard motor up and down a few times and check that it tilts up and down smoothly. Check the PTI fluid level if the tilt operation is not smooth.

TIP:

The motor will have a consistent sound when operating properly and there is no air in the system.

2. Fully tilt the outboard motor up, and then support it using the tilt stop lever "1". Check that the tilt stop lever locks in place properly.



3. Check the PTT unit for fluid leakage.

Adjusting the shift link/shift cable

1. Disconnect the shift cable, and then adjust it. See "Installing the shift cable" (3-9).

Checking the spark plug

1. Check the spark plugs. See "Checking the spark plug" (7-33).

Checking the timing belt

1. Check the timing belt. See "Checking the timing belt" (7-26).

Replacing the timing belt

1. Replace the timing belt. See "Timing belt" (7-24).

Checking the thermostat

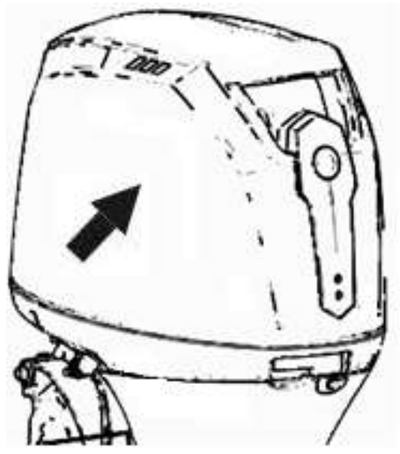
1. Check the thermostat. See "Checking the thermostat" (7-61).

Adjusting the throttle link/throttle cable

1. Install the throttle cable. See "Installing the throttle cable" (3-10).

Checking the cowling lock lever

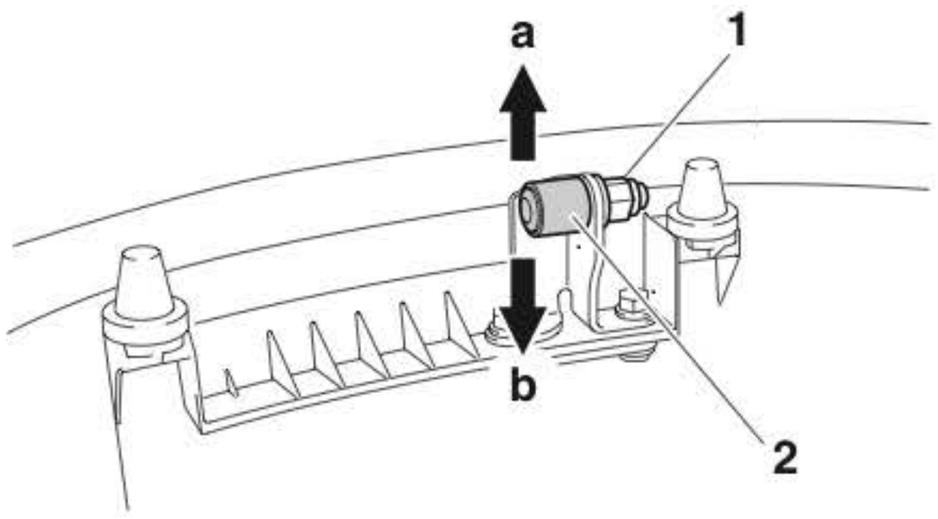
1. Check the fitting by pushing the top cowling. Adjust if there is looseness or rattling.



2. Loosen the nuts "1".
3. Move the stopper "2" up or down slightly to adjust its position.

TIP:

- To loosen the fitting, move the stopper in direction "a".
- To tighten the fitting, move the stopper in direction "b".



4. Tighten the nut.
5. Recheck the fitting. Replace the cowling seal if the looseness or rattling cannot be adjusted.

Checking the valve clearance

1. Check the valve clearance. See "Checking the valve clearance" (7-3).

Checking the impeller/water pump housing

2. Check the water pump housing and impeller. See "Checking the water pump and shift rod" (8-8).

—MEMO—

Appendix

Wiring diagram A-1

How to use the wiring diagram.....A-1
Engine control unit, Fuel unit, and ignition unit.....A-4
Charging unit, starting unit, and PTT unit.....A-5
Control unit.....A-6

Shim selection table and chart

(regular rotation modei).....A-7

Pinion shim (T3) selection table.....A-7
Forward gear shim (T1) selection chart
(regular rotation model).....A-8
Reverse gear shim (T2) selection chart
(regular rotation model).....A-8

Shim selection table and chart

(counter rotation model).....A-9

Pinion shim (T3) selection table.....A-9
Propeller shaft shim (T4) selection table.....A-9
Forward gear shim (T2) selection chart
(counter rotation model).....A-10
Reverse gear shim (T1) selection chart
(counter rotation model).....A-10

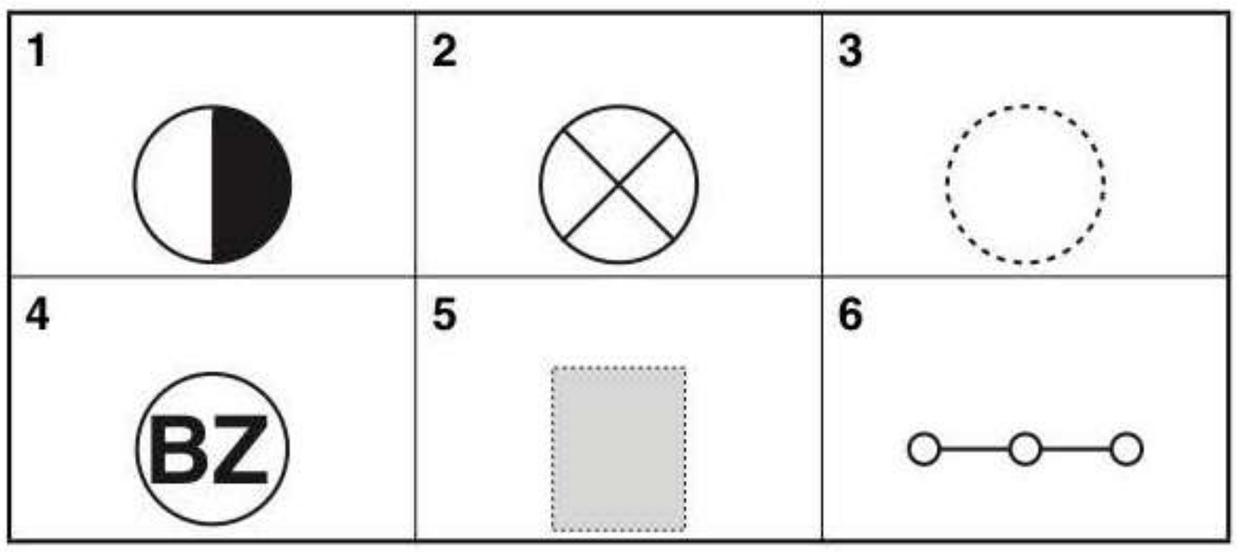
Wiring diagram

How to use the wiring diagram

Composition of the wiring diagrams

The wiring diagram consists of three categories; "Engine control, fuel unit, and Ignition unit", "Charging unit, Starting unit, and PTT unit", and "Control unit".

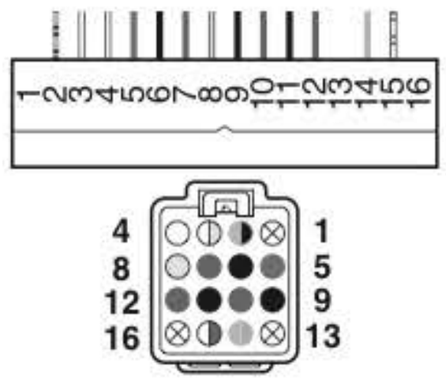
Legend symbols in the wiring diagrams



1. Double colors wire
2. Not used (vacant)
3. A wire is not included in the selected wiring unit.
4. Alert buzzer
5. Optional parts
6. Continuity

Terminal numbers

- Terminal numbers are indicated for cases where terminal locations of wires are unclear.
- In the coupler illustrations, only the rightmost and leftmost terminal numbers are indicated, and terminal numbers between them are omitted.



Color code

B	: Black
Br	:Brown
G	:Green
Gy	:Gray
L	: Blue
Lg	: Light green
Or	:Orange
P	: Pink
R	: Red
Sb	: Sky blue
W	:White
Y	: Yellow
B/R	: Black/Red
B/W	: Black/White
B/Y	: Black/Yellow
G/B	: Green/Black
G/L	: Green/Blue
G/Or	: Green/Orange
G/R	:Green/Red
G/W	: Green/White
G/Y	: Green/Yellow
L/B	: Blue/Black
L/G	: Blue/Green
L/W	: Blue/White
L/Y	: Blue/Yellow
Or/W	: Orange/White
P/B	: Pink/Black
P/G	: Pink/Green
P/W	: Pink/White
Pu/B	: Purple/Black
Pu/G	: Purple/Green
Pu/R	: Purple/Red
Pu/Y	: Purple/Yellow
R/Y	: Red/Yellow
W/B	: White/Black
WIG	: White/Green
W/L	: White/Blue
Y/G	: Yellow/Green

Example:

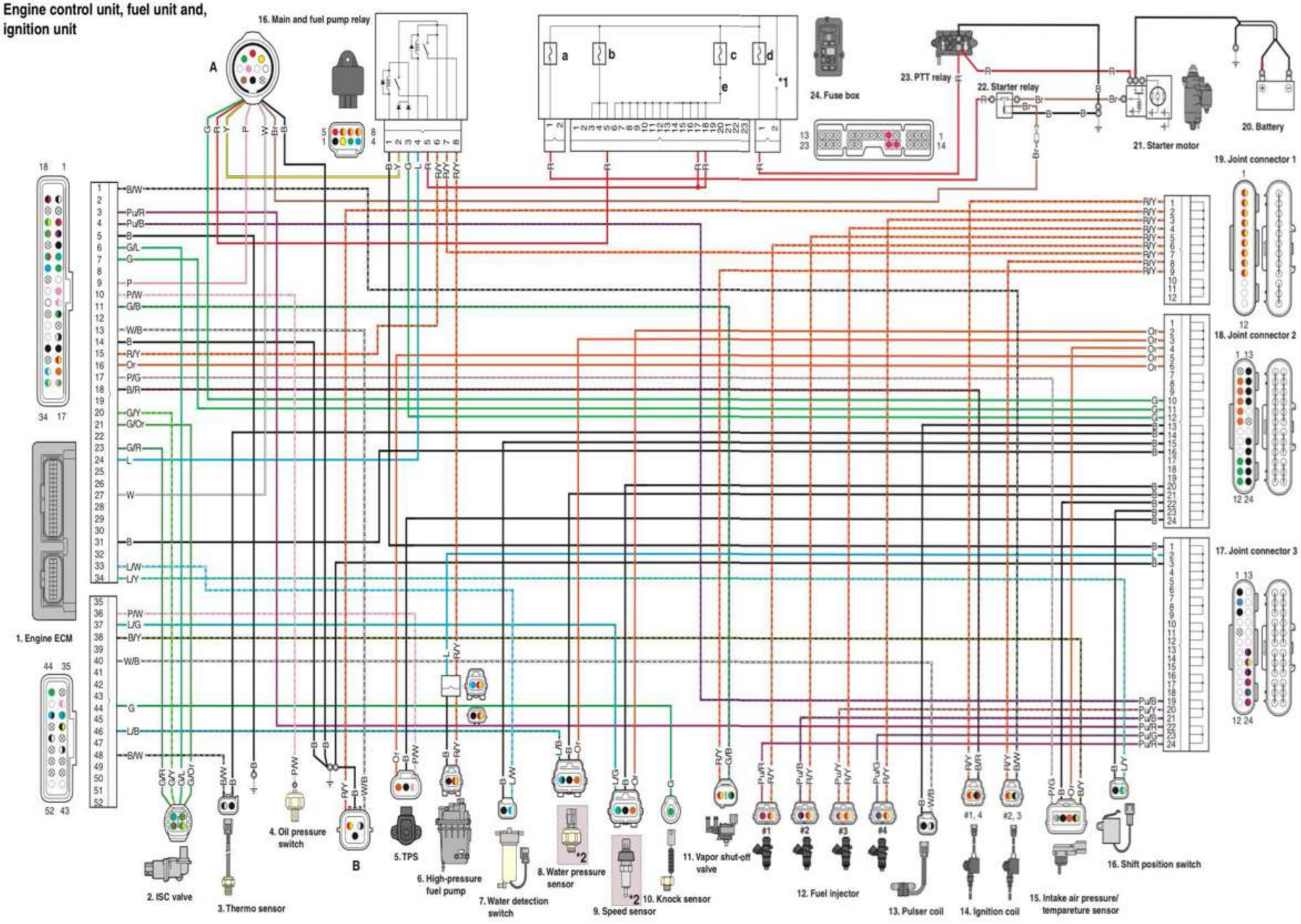
R/Y: Red with Yellow tracer stripe wire

—MEMO—

HIDEA

HIDEA
Outboards

Engine control unit, fuel unit and, ignition unit



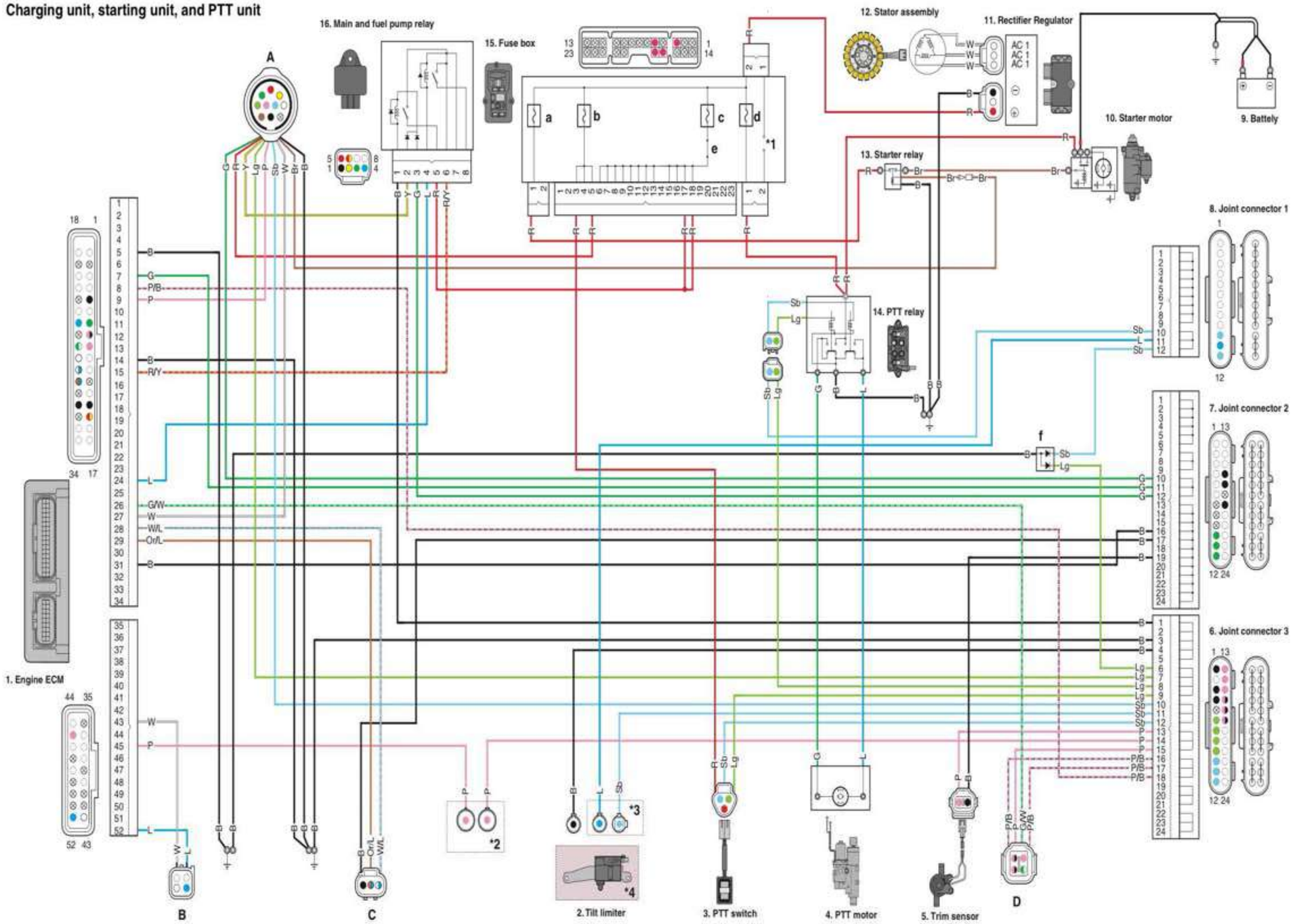
1. Engine ECM
2. ISC valve
3. Thermo sensor
4. Oil pressure switch
5. TPS
6. High-pressure fuel pump
7. Water detection switch
8. Water pressure sensor
9. Speed sensor
10. Knock sensor
11. Vapor shut-off valve
12. Fuel injector
13. Pulser coil
14. Ignition coil
15. Intake air pressure/temperature sensor
16. Shift position switch
17. Joint connector 3
18. Joint connector 2
19. Joint connector 1
20. Battery
21. Starter motor
22. Starter relay
23. PTT relay
24. Fuse box
25. Main and fuel pump relay

a. Fuse (30 A) (starter relay)
b. Fuse (20 A) (engine start switch, PTT switch)
c. Fuse (20 A) (main and fuel pump relay)
d. Fuse (50 A) (battery)
e. Short pin

A. To remote control/tiller handle
B. To YDIS

*1. Not used (vacant)
*2. Optional settings depend on the destination

Charging unit, starting unit, and PTT unit



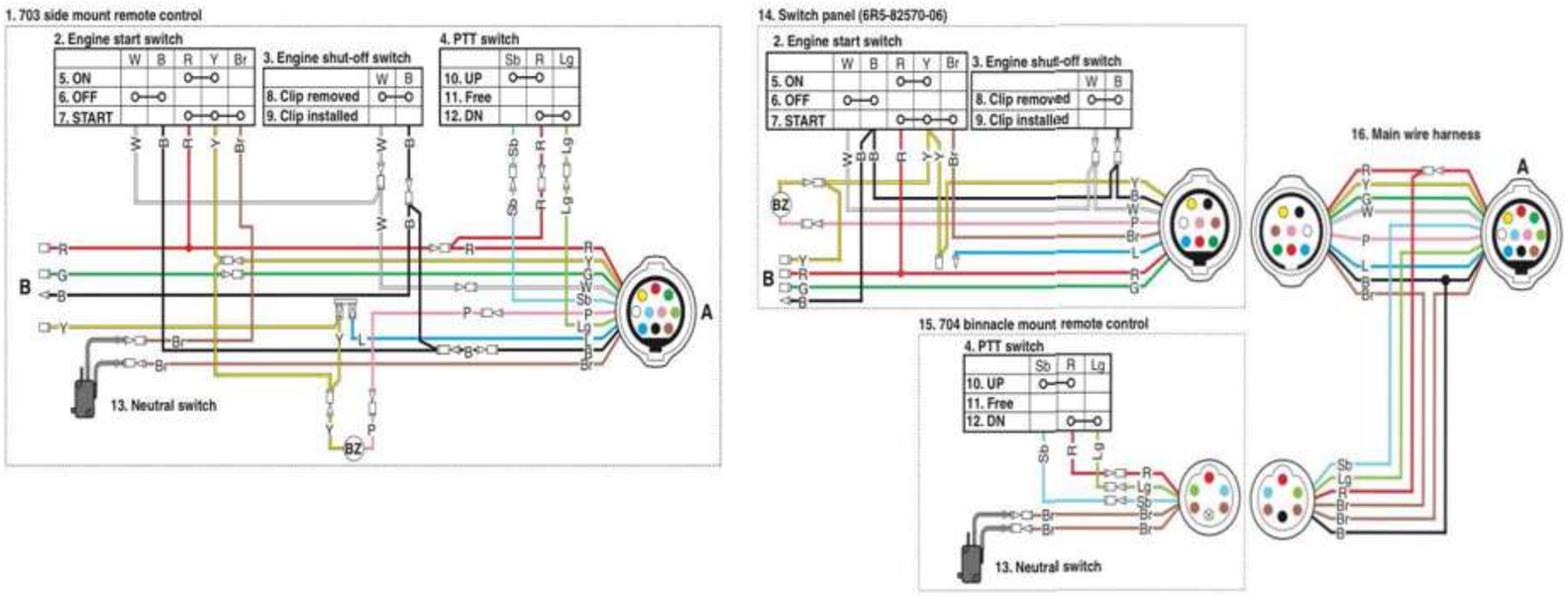
1. Engine ECM
2. Tilt limiter
3. PTT switch
4. PTT motor
5. Trim sensor
6. Joint connector 3
7. Joint connector 2
8. Joint connector 1
9. Battery
10. Starter motor
11. Rectifier/regulator
12. Stator assembly
13. Starter relay
14. PTT relay
15. Fuse box
16. Main and fuel pump relay

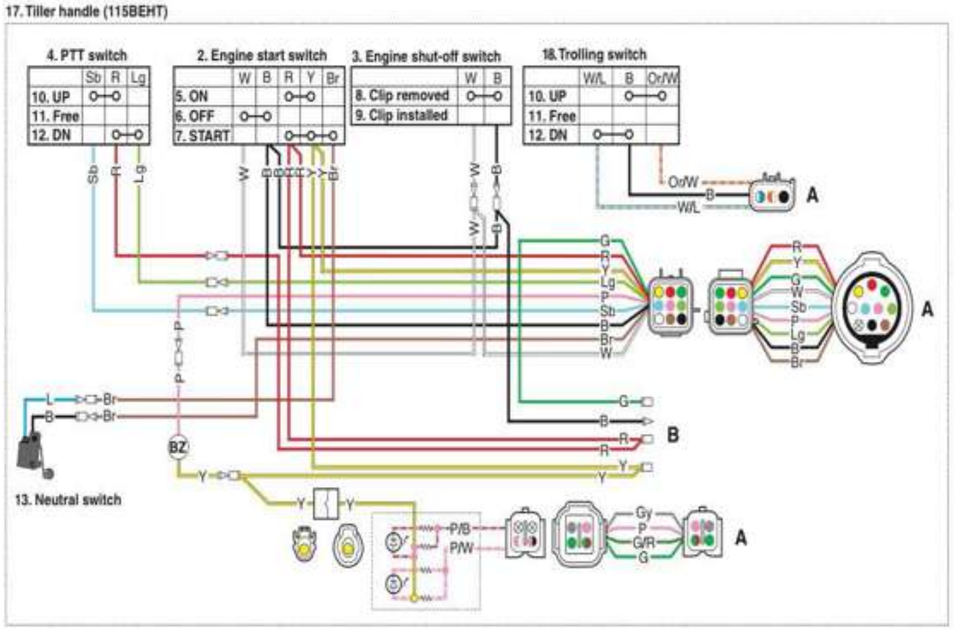
a. Fuse (30 A) (starter relay)
b. Fuse (20 A) (engine start switch, PTT switch)
c. Fuse (20 A) (main relay)
d. Fuse (50 A) (battery)
e. Short pin
f. Condenser

A. To remote control/tiller handle
B. To 6Y8 network
C. To trolling switch
D. To conventional gauge (6Y5/6Y7)/tiller handle

*1. Not used (vacant)
*2. If the 6Y8 multifunction meter is selected, connect the coupler.
*3. If the outboard motor is not fitted with a tilt limiter (optional), connect the coupler.
*4. Optional settings depend on the destination

Control unit





1. 703 side mount remote control
2. Engine start switch
3. Engine shut-off switch
4. PTT switch
5. ON
6. OFF
7. START
8. Clip removed
9. Clip installed
10. UP
11. Free
12. DN
13. Neutral switch
14. Switch panel (6R5-82570-06)
15. 704 binnacle mount remote control
16. Main wire harness
17. Tiller handle (F115BEHT)
18. Trolling switch

A. To power unit
B. To gauge

Shim selection table and chart (regular rotation model)
Pinion shim (T3) selection table

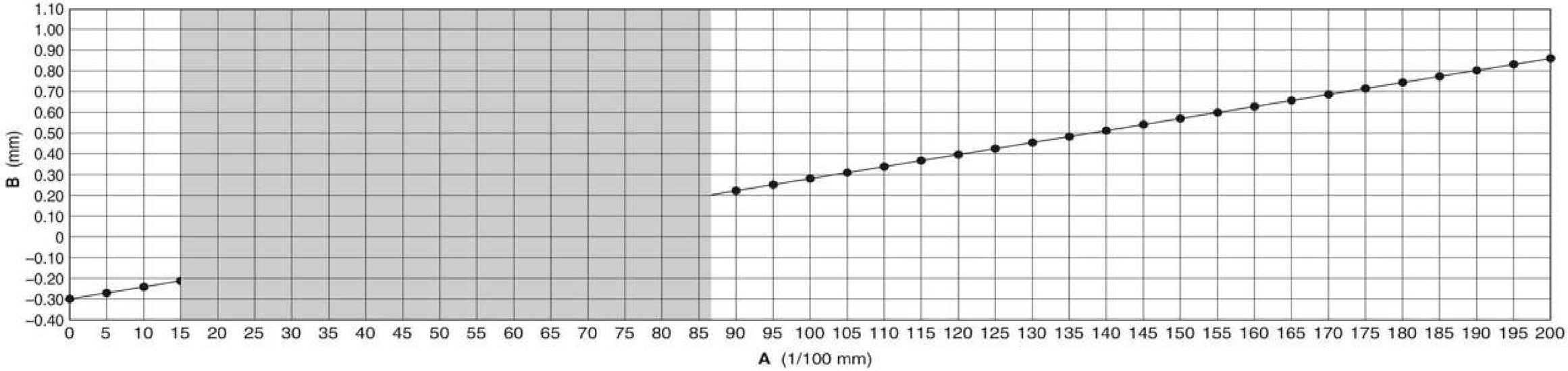
(mm)

B \ A	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.30
13	1.32	1.32	1.32	1.30	1.30	1.28	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05
12	1.32	1.32	1.30	1.30	1.28	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02
11	1.32	1.30	1.30	1.28	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02
10	1.30	1.30	1.28	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02
9	1.30	1.28	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00
8	1.28	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00
7	1.28	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98
6	1.25	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98
5	1.25	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95
4	1.25	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95
3	1.22	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95
2	1.22	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92
1	1.22	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92
0	1.20	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92
−1	1.20	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90
−2	1.18	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90
−3	1.18	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88
−4	1.15	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88
−5	1.15	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85
−6	1.15	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85
−7	1.12	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85
−8	1.12	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82
−9	1.12	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82
−10	1.10	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82
−11	1.10	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80
−12	1.08	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80
−13	1.08	1.05	1.05	1.05	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78

B \ A	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	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	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60
13	1.02	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75
12	1.02	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.72
11	1.02	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72
10	1.00	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72
9	1.00	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70
8	0.98	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70
7	0.98	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68
6	0.95	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68
5	0.95	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65
4	0.95	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65
3	0.92	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62
2	0.92	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62
1	0.92	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62
0	0.90	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60
−1	0.90	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60
−2	0.88	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58
−3	0.88	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58
−4	0.85	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55
−5	0.85	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55
−6	0.85	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55
−7	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52
−8	0.82	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52	0.52
−9	0.82	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.52
−10	0.80	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.52	0.50
−11	0.80	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.52	0.50	0.50
−12	0.78	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.52	0.50	0.50	0.48
−13	0.78	0.75	0.75	0.75	0.72	0.72	0.72	0.70	0.70	0.68	0.68	0.65	0.65	0.62	0.62	0.62	0.60	0.60	0.58	0.58	0.55	0.55	0.55	0.52	0.52	0.52	0.50	0.50	0.48	0.48

A. Pinion height measurement (M)
B. Stamped value on the lower case (P)

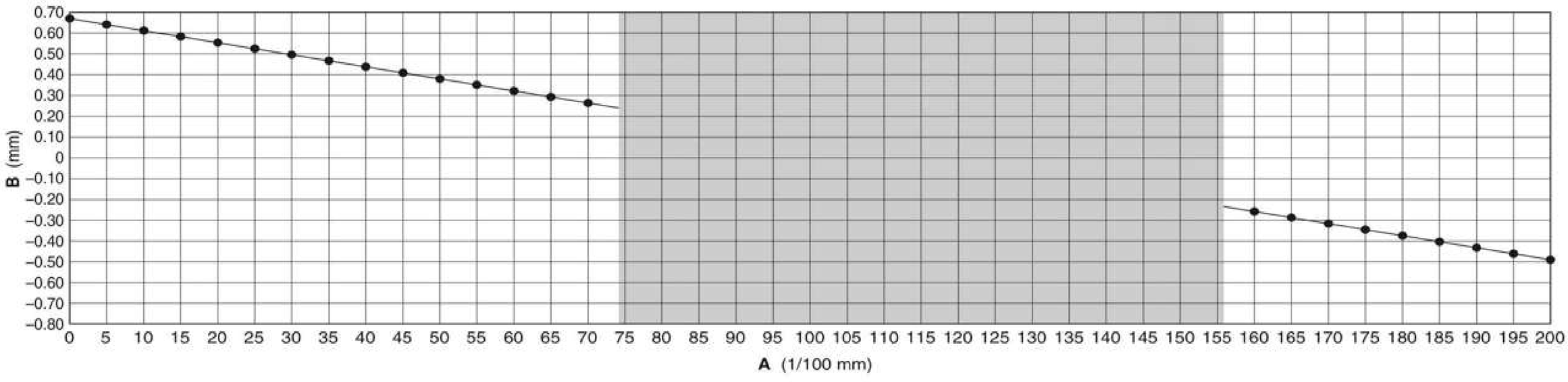
Forward gear shim (T1) selection chart (regular rotation model)



A	0	5	10	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
B	−0.30	−0.27	−0.24	0.22	0.25	0.28	0.31	0.34	0.37	0.40	0.43	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.74	0.77	0.80	0.83	0.86

A. Backlash measurement (BL1)
B. Shim thickness adjustment

Reverse gear shim (T2) selection chart (regular rotation model)



A	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	160	165	170	175	180	185	190	195	200
B	0.67	0.64	0.61	0.58	0.55	0.52	0.50	0.47	0.44	0.41	0.38	0.35	0.32	0.29	0.26	−0.26	−0.29	−0.32	−0.35	−0.37	−0.40	−0.43	−0.46	−0.49

A. Backlash measurement (BL2)
B. Shim thickness adjustment

Shim selection table and chart (counter rotation model)

Pinion shim (T3) selection table

See "Pinion shim (T3) selection table" (A-7).

Propeller shaft shim (T4) selection table

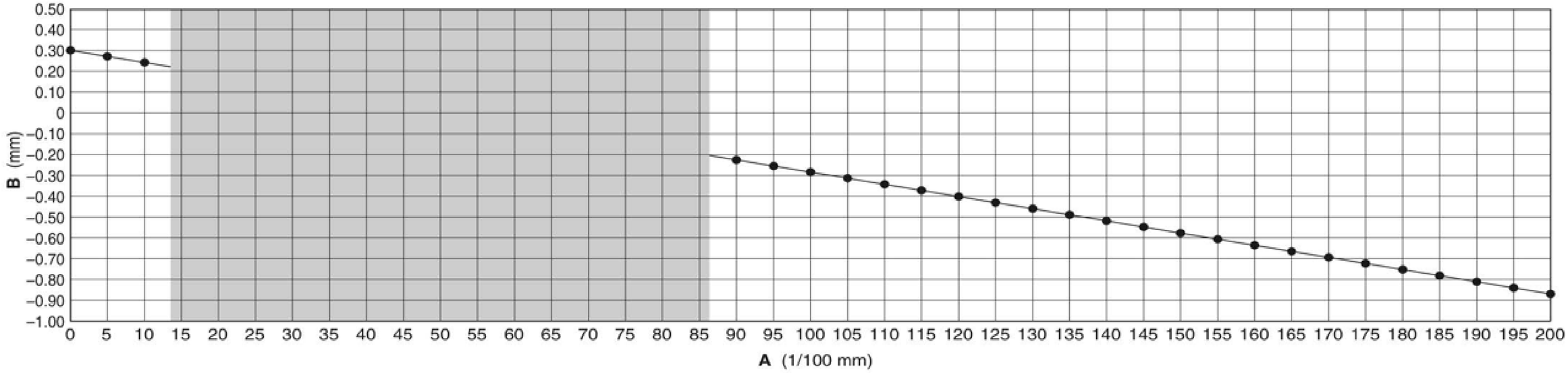
The shim thickness does not have to be adjusted for the gray-colored cell.

(mm)

A	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9
B	–0.3	–0.2	–0.1		+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	+1.1	+1.2	+1.3	+1.4	+1.5	+1.6	+1.7	+1.8	+1.9	+2.0	+2.1	+2.2	+2.3	+2.4	+2.5	+2.6

A. Free play measurement
B. Shim thickness adjustment

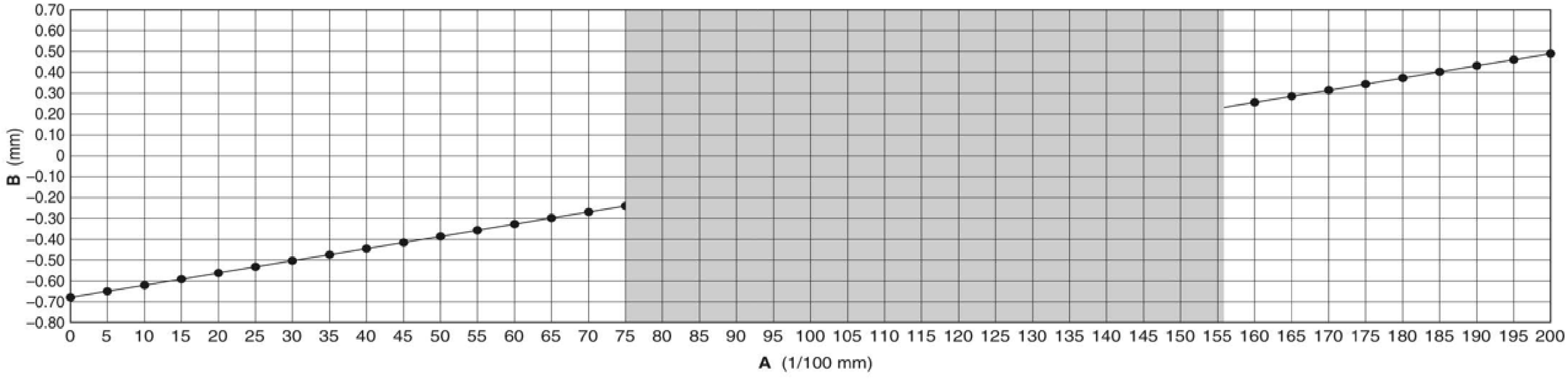
Forward gear shim (T2) selection chart (counter rotation model)



A	0	5	10														90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
B	0.30	0.27	0.24														−0.23	−0.26	−0.29	−0.31	−0.34	−0.37	−0.40	−0.43	−0.46	−0.49	−0.52	−0.55	−0.58	−0.60	−0.63	−0.66	−0.69	−0.72	−0.75	−0.78	−0.81	−0.84	−0.87

A. Backlash measurement (BL2)
B. Shim thickness adjustment

Reverse gear shim (T1) selection chart (counter rotation model)



A	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70															160	165	170	175	180	185	190	195	200
B	−0.68	−0.65	−0.62	−0.59	−0.56	−0.53	−0.50	−0.47	−0.44	−0.41	−0.38	−0.36	−0.33	−0.30	−0.27															0.25	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49

A. Backlash measurement (BL1)
B. Shim thickness adjustment